# AGENDA

**TOWN OF NAGS HEAD BOARD OF COMMISSIONERS**
**NAGS HEAD MUNICIPAL COMPLEX - BOARD ROOM**
***WEDNESDAY, OCTOBER 2, 2024, 9:00 A.M.***

---

**A. CALL TO ORDER / MOMENT OF SILENCE / PLEDGE OF ALLEGIANCE**

**B. ADOPTION OF AGENDA**

**C. RECOGNITION**

1. Recognition

   NEW EMPLOYEE - Facilities Maintenance Technician John Stewart - September 11, 2024

   NEW EMPLOYEE - Sanitation Equipment Operator Steve Farrow - September 16, 2024

   FIVE YEARS - Fire Chief Randy Wells - September 4, 2019

   PROCLAMATION - Fire Prevention Week - October 6 - 12, 2024

   Documents:

   10 C RECOG SUMMARY.PDF
   10 C RECOGNITION FIRE PREV WK PROC.PDF

**D. PUBLIC COMMENT**

**E. CONSENT AGENDA**

1. Consideration Of Budget Amendment #4 To FY 24/25 Budget

   Documents:

   10 E1 BUD AMEND TO FY 24-25 SUMMARY.PDF
   10 E1 BUD AMEND TO FY 24-25 WORKSHEET.PDF

2. Consideration Of Tax Adjustment Report

   Documents:

   10 E2 TAX ADJ REPORT SUMMARY.PDF
   10 E2 TAX ADJ MSD REPORT.PDF
   10 E2 TAX ADJ REPORT.PDF

3. Approval Of Minutes

Documents:

10 E3 MINUTES SUMMARY.PDF
10 E3 MINUTES SEP 4 2024 BOC MINS.PDF
10 E3 MINUTES SEP 18 2024 BOC MINS.PDF

4. Consideration Of Seventh Amendment To Verizon Lease Of Town Hall Monopole

Documents:

10 E4 VERIZON TOWN MONOPOLE AGREE AMEND 7 SUMMARY.PDF
10 E4 VERIZON TOWN MONOPOLE AGREEMENT AMEND 7.PDF
10 E4 VERIZON TOWN MONOPOLE STRUCTURAL ANALYSIS REPORT.PDF

5. Consideration Of Great Trails State Program Grant Application For Multi-Use Path Engineering

Documents:

10 E5 GREAT TRAILS STATE PGM APP SUMMARY.PDF
10 E5 GREAT TRAILS APPLICATION.PDF
10 E5 GREAT TRAILS APP - BOARD APPROVAL FORM.PDF

6. Consideration Of Resolution Authorizing Execution Of NC-DEQ Grant Contract For The June St Beach Access

Documents:

10 E6 NCDEQ JUNE ST BCH ACCESS GRANT SUMMARY.PDF
10 E6 NCDEQ JUNE ST BCH ACCESS GRANT RES.PDF

7. Consideration Of Capital Project Fund Ordinance Amendments:
   - Amendment #5 to Capital Project Fund (General) for Public Services Complex
   - Amendment #3 to Capital Project Fund (Water) for AMI and Public Services Complex

Documents:

10 E7 CAP PROJ ORDINANCES SUMMARY.PDF
10 E7 CAP PROJ FUND AMEND 5 ORD.PDF
10 E7 CAP PROJ WATER FUND AMEND 3 ORD.PDF

8. Consideration Of Modification To Rules Of Procedure Re: Time Allotted For Speakers

Documents:

10 E8 MOD TO RULES OF PROCEDURE SUMMARY.PDF
10 E8 MOD TO RULES OF PROCEDURE.PDF

9. Request For Public Hearing To Consider A Special Use/Site Plan Review for the construction of a 2-story, 8-bedroom dormitory.

Documents:

10 E10 RPH DORMITORY AT CCC SUMMARY.PDF

10. Request For Public Hearing To Consider Various Amendments To The UDO Within SPD-C,
    Village Commercial-1 Zoning District to accommodate a new use, EMS Station

    Documents:

    10 E11 RPH UDO EMS STATION SUMMARY.PDF

## F. PUBLIC HEARINGS

1. Public Hearing To Consider A Map Amendment Request
   submitted by Chris Greening of Coastal Bluewater Capital, LLC, as authorized by property owner Mazzi, LLC
   to rezone the property located at 0 W. Satterfield Landing Road, Lot 2a-1r of the Charles Sineath Subdivision,
   (Parcel # 005618002) from C-3, Commercial Services to C-2, General Commercial.
   This is the vacant property
   west of TW's Bait and Tackle

   Documents:

   10 F1 PH ZONING MAP AMEND SUMMARY.PDF
   10 F1 PH ZONING MAP AMEND MEMO.PDF
   10 F1 PH ZONING MAP AMEND PN.PDF

## G. REPORTS AND RECOMMENDATIONS FROM THE PLANNING BOARD AND THE PLANNING AND DEVELOPMENT DIRECTOR

1. Update From Planning Director

   Documents:

   10 G1 PLANNING DIRECTOR SUMMARY.PDF
   10 G1 PLANNING DIRECTOR REPORT.PDF

## H. OLD BUSINESS TABLED FROM PREVIOUS MEETINGS

1. From Sep 4th Board Meeting – Consideration Of Multi-Family Dwelling Ordinance -Workshop held on Sep 18th

   Documents:

   10 H1 MULTI-FAMILY SUMMARY.PDF
   10 H1 MULTI-FAMILY WORKSHOP PACKET.PDF

## I. NEW BUSINESS

1. Committee Reports

   Documents:

   10 I1 COMMITTEE REPORTS SUMMARY.PDF

2. Consideration Of Board/Committee Appointments/Reappointments
   - Personnel Grievance Panel / Board of Adjustment

   Documents:

10 I2 BOARDS-COMMITTEES SUMMARY.PDF
10 I2 CURRENT - PGP.PDF
10 I2 CANDIDATE - PGP.PDF
10 I2 CURRENT - BOA.PDF
10 I2 CANDIDATE -BOA.PDF

3. Estuarine Shoreline Management Project Areas 1 And 2 Engineering And Design:
   - Consideration of resolution authorizing the Town Manager to enter into a contract with NCDEQ
   - Request authorization for the Town Manager to enter into a contract with McAdams
   - Consideration of associated budget amendment

   Documents:

   10 I3 ESMP CONTRACT AUTH SUMMARY.PDF
   10 I3 ESMP CONTRACT AUTH RES.PDF
   10 I3 ESMP MCADAMS LIVING SHORELINE PROPOSAL.PDF
   10 I3 ESMP BUDGET AMENDMENT.PDF

4. Consideration Of Fire Truck Purchase Contract

   Documents:

   10 I4 FIRE TRUCK PURCHASE SUMMARY.PDF
   10 I4 FIRE TRUCK PURCHASE MEMO.PDF

5. Consideration Of Resolution Authorizing Application To NC-DEQ Division Of Water Infrastructure For Septic Health Project Grant;
   Consideration of revised Septic Health Loan Policy

   Documents:

   10 I5 NCDEQ SEPTIC HEALTH GRANT SUMMARY.PDF
   10 I5 NCDEQ SEPTIC HEALTH GRANT RES.PDF
   10 I5 NCDEQ SEPTIC HEALTH POLICY.PDF

6. Discussion Of Stormwater Master Plan Process/Public Engagement

   Documents:

   10 I6 STORMWATER MP SUMMARY.PDF
   10 I6 STORMWATER MP MEMO.PDF
   10 I6 STORMWATER MP NCDEQ FUNDS ACCEPTANCE.PDF
   10 I6 STORMWATER SNH SOOIR NCDEQ FUNDS ACCEPTANCE.PDF
   10 I6 STORMWATER MP MCADAMS PROPOSAL FINAL.PDF

**J. ITEMS REFERRED TO AND PRESENTATIONS FROM TOWN ATTORNEY**

**K. ITEMS REFERRED TO AND PRESENTATIONS FROM TOWN MANAGER**

1. Presentation - Annual Beach Condition Survey – Moffat & Nichol – Time Specific 11 Am

   Documents:

10 K1 TM ANNUAL BEACH COND SUMMARY.PDF
10 K1 TM ANNUAL BEACH COND SURVEY.PDF
10 K1 TM ANNUAL BEACH COND FALL SURVEY PROPOSAL.PDF
10 K1 TM ANNUAL BEACH COND FALL SURVEY SCOPE.PDF

2. Update On Construction Of The Public Services Facility

Documents:

10 K2 TM PUBLIC SVCS FACILITY UPDATE SUMMARY.PDF

**L. BOARD OF COMMISSIONERS AGENDA**

**M. MAYOR'S AGENDA**

**N. CLOSED SESSIONS**

**O. OTHER BUSINESS**

**P. ADJOURNMENT**

# Agenda Item Summary Sheet

Item No: **C**
Meeting Date: **October 2, 2024**

**Item Title**: Recognition

**Item Summary**:

Recognition at the October 2nd Board of Commissioners meeting includes the following:

NEW EMPLOYEE – Facilities Maintenance Technician John Stewart – September 11, 2024
NEW EMPLOYEE – Sanitation Equipment Operator Steve Farrow – September 16, 2024

FIVE YEARS – Fire Chief Randy Wells – September 4, 2019

PROCLAMATION – Fire Prevention Week – October 6 – 12, 2024

Number of Attachments: 1

**Specific Action Requested**:

Provided for Board recognition.

Submitted By: Administration Date: September 27, 2024

**Finance Officer Comment**:

N/A

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation:**

Welcome and congratulations to those with Years of Service!

Signature: Andy Garman Date: September 27, 2024

**PROCLAMATION DECLARING FIRE PREVENTION WEEK**
**OCTOBER 6 – 12, 2024**

**WHEREAS**, the Town of Nags Head is committed to ensuring the safety and security of all those living in and visiting our town; AND

**WHEREAS**, fire is a serious public safety concern both locally and nationally, and homes are the locations where people are at greatest risk from fire; AND

**WHEREAS**, in 2022 in the United States home fires killed more than 2,700 people and fire departments responded to 360,000 home fires; AND

**WHEREAS**, roughly three out of five fire deaths happen in homes with either no smoke alarms or with no working smoke alarms; AND

**WHEREAS**, working smoke alarms cut the risk of dying in reported home fires almost in half; AND

**WHEREAS**, smoke alarms detect smoke well before you can, alerting you to danger in the event of fire in which you may have as little as two minutes to escape safely; AND

**WHEREAS**, Nags Head residents should install smoke alarms in every sleeping room, outside each separate sleeping area, and on every level of the home; AND

**WHEREAS**, Nags Head residents should make sure their smoke alarms meet the needs of all their family members, including those with sensory or physical disabilities; AND

**WHEREAS**, Nags Head residents should test smoke alarms at least once a month; AND

**WHEREAS**, residents who have planned and practiced a home fire escape plan are more prepared and will therefore be more likely to survive a fire; AND

**WHEREAS,** Nags Head first responders are dedicated to reducing the occurrence of home fires and home fire injuries through prevention and protection education; and

**WHEREAS,** Nags Head residents are responsive to public education measures and are able to take personal steps to increase their safety from fire, especially in their homes; and

**WHEREAS**, the 2024 Fire Prevention Week theme, "Smoke alarms: Make them work for you" serves to remind us of the importance of having working smoke alarms in the home.

**NOW, THEREFORE, BE IT RESOLVED** that I, Ben Cahoon, Mayor of the Town of Nags Head, do hereby proclaim October 6 – 12, 2024, as Fire Prevention Week, and I urge all the people of the Town of Nags Head to make sure their homes have working smoke alarms and to support the many public safety activities and efforts of Nags Head Fire & Rescue. All Town residents and visitors are invited to attend the annual Nags Head Fire & Rescue Open House, held at the Douglas A Remaley Fire Station 16 on Thursday, October 10, 2024 from 5:00 to 7:30 pm.

This the 2nd day of October 2024.

_____
Ben Cahoon, Mayor
Town of Nags Head

ATTEST:

_____
Carolyn F. Morris, Town Clerk

# Agenda Item Summary Sheet

Item No: **E-1**
Meeting Date: **October 2, 2024**

**Item Title**: Consideration of Budget Amendment #4 to FY 24/25 Budget

**Item Summary**:

Attached please find Budget Amendment #4 to the FY 24/25 Budget which is provided for Board review and approval at the October 2nd Board of Commissioners meeting. Budget Amendment #4 is in accordance with the FY 24/25 Budget Ordinance, adopted at the June 5, 2024 meeting.

Number of Attachments: 1

**Specific Action Requested**:

Request Board approval of attached Budget Amendment #4.

Submitted By: Administrative Services Date: September 27, 2024

**Finance Officer Comment**:

Request Board approval of attached Budget Amendment #4.

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:

I concur with staff's request.

Signature: Andy Garman Date: September 27, 2024

TOWN OF NAGS HEAD

**BUDGET AMENDMENT REQUEST**
**FY 2024-2025**

**BUDGET AMENDMENT NO. 4**
**Amendment 4.1**

| SOURCE OF FUNDS | | | | USE OF FUNDS | | |
|---|---|---|---|---|---|---|
| CODE | ACCOUNT | AMOUNT | | CODE | ACCOUNT | AMOUNT |
| | **General Fund Revenues** | | | | **General Fund Expenditures** | |
| 10-499000 | Appropriated Fund Balance | 1,090,542.00 | | | **Town Manager** | |
| | | | | 420-544000 | Professional Fees | 18,989.00 |
| | | | | 420-544003 | Professional Fees CIF | 13,492.00 |
| | | | | | **Admin. Services** | |
| | | | | 440-544500 | Professional Fees | 4,148.00 |
| | | | | 440-544500 | Contracted Services | 5,512.00 |
| | | | | 440-577400 | Capital Outlay Equipment | 990.00 |
| | | | | | **Information Technology** | |
| | | | | 441-543600 | Maint/Repair Equipment | 13,996.00 |
| | | | | | **Planning and Development** | |
| | | | | 490-543405 | Other Supplies-Computer | 1,130.00 |
| | | | | 490-544003 | Professional Fees-CIF | 206.00 |
| | | | | 490-544500 | Contracted Services | 1,173.00 |
| | | | | 490-577350 | Capital Outlay Improvements | 14,839.00 |
| | | | | 490-577400 | Capital Outlay Equipment | 20,344.00 |
| | | | | | **Public Services-Admin.** | |
| | | | | 500-543700 | Vehicle Maintenance | 8,953.00 |
| | | | | 500-544800 | Purchases for Resale | 10,839.00 |
| | | | | | **Facilities Maintenance** | |
| | | | | 530-543500 | Maint/Repair Buildings | 13,200.00 |
| | | | | 530-543503 | Maint/Repair Buildings - CIF | 41,088.00 |
| | | | | 530-543700 | Vehicle Maintenance | 9,262.00 |
| | | | | 530-544500 | Contracted Services | 7,800.00 |
| | | | | 530-577350 | Capital Outlay Improvements | 145,257.00 |
| | | | | | **Sanitation** | |
| | | | | 580-543700 | Vehicle Maintenance | 16,533.00 |
| | | | | 580-577500 | Capital Outlay Vehicles | 242,686.00 |
| | | | | | **Police** | |
| | | | | 610-532100 | Building/Equipment Rental | 5,000.00 |
| | | | | 610-543300 | Department Supplies | 20,069.00 |
| | | | | 610-543605 | Maint/Repair Firing Range | 16,613.00 |
| | | | | 610-543700 | Vehicle Maintenance | 2,200.00 |
| | | | | 610-577500 | Capital Outlay Vehicles | 50,537.00 |
| | | | | | **Streets and Stormwater** | |
| | | | | 625-577407 | Capital Outlay Infrastructure | 98,611.00 |
| | | | | | **Fire** | |
| | | | | 730-543700 | Vehicle Maintenance | 7,100.00 |
| | | | | 730-543900 | Uniforms | 120.00 |
| | | | | 730-544000 | Professional Fees | 1,731.00 |
| | | | | 730-544500 | Contracted Services | 870.00 |
| | | | | 730-577500 | Capital Outlay Vehicles | 297,254.00 |
| TOTAL CHARGES | | $ 1,090,542.00 | | TOTAL CREDITS | | $ 1,090,542.00 |

**JUSTIFICATION**

FY 23/24 purchase orders carried over to FY 24/25 - General Fund

ADMINISTRATIVE SERVICES 9/27/2024
RECOMMENDED BY DATE

APPROVED BY BOC: DATE

POSTED TO GENERAL LEDGER:

INITIALS

TOWN OF NAGS HEAD

**BUDGET AMENDMENT REQUEST**
**FY 2024-2025**

**BUDGET AMENDMENT NO. 4**
**Amendment 4.2**

| SOURCE OF FUNDS | | | | USE OF FUNDS | | |
|---|---|---|---|---|---|---|
| CODE | ACCOUNT | AMOUNT | | CODE | ACCOUNT | AMOUNT |
| | **Water Fund** | | | | **Water Fund** | |
| | **Revenues** | | | | **Expenses** | |
| 61-499100 | Appropriated Net Position | 434,535.00 | | | **Septic Health** | |
| | | | | 725-577400 | Capital Outlay Equipment | 74,966.00 |
| | | | | | **Operations** | |
| | | | | 810-532500 | Postage | 1,652.00 |
| | | | | | **Distribution** | |
| | | | | 818-577300 | Capital Outlay Other | 277,917.00 |
| | | | | 818-577407 | Capital Outlay Infrastructure | 80,000.00 |
| TOTAL CHARGES | | $ 434,535.00 | | TOTAL CREDITS | | $ 434,535.00 |

**JUSTIFICATION**

FY 23/24 purchase orders carried over to FY 24/25 - Water Fund

ADMINISTRATIVE SERVICES 9/27/2024
RECOMMENDED BY DATE

APPROVED BY BOC: DATE

POSTED TO GENERAL LEDGER:

INITIALS

TOWN OF NAGS HEAD

**BUDGET AMENDMENT REQUEST**
**FY 2024-2025**

**BUDGET AMENDMENT NO. 4**
**Amendment 4.3**

SOURCE OF FUNDS | USE OF FUNDS

| CODE | ACCOUNT | AMOUNT | | CODE | ACCOUNT | AMOUNT |
|---|---|---|---|---|---|---|
| | **General Fund Revenues** | | | | **General Fund Streets and Stormwater** | |
| 10-432100 | NC DEQ grant | 269,000.00 | | 625-577407 | Capital Outlay Infrastructure | 269,000.00 |
| TOTAL CHARGES | | $ 269,000.00 | | TOTAL CREDITS | | $ 269,000.00 |

**JUSTIFICATION**

Project Area #4 grant-NCDEQ/DWI LASII
Engineering scope and report

ADMINISTRATIVE SERVICES 9/27/2024
RECOMMENDED BY DATE

APPROVED BY BOC: DATE

POSTED TO GENERAL LEDGER:

INITIALS

TOWN OF NAGS HEAD

**BUDGET AMENDMENT REQUEST**
**FY 2024-2025**

**BUDGET AMENDMENT NO. 4**
**Amendment 4.4**

| SOURCE OF FUNDS | | | | USE OF FUNDS | | |
|---|---|---|---|---|---|---|
| CODE | ACCOUNT | AMOUNT | | CODE | ACCOUNT | AMOUNT |
| 625-577407 | **General Fund**<br>**Streets and Stormwater**<br>Capital Outlay Infrastructure | 270,000.00 | | 10-430900 | **General Fund**<br>**Revenues**<br>Golden LEAF grant | 270,000.00 |
| TOTAL CHARGES | | $ 270,000.00 | | TOTAL CREDITS | | $ 270,000.00 |

**JUSTIFICATION**

Reduce Golden LEAF grant not received

ADMINISTRATIVE SERVICES 9/27/2024
RECOMMENDED BY DATE

APPROVED BY BOC: DATE

POSTED TO GENERAL LEDGER:

INITIALS

# Agenda Item Summary Sheet

Item No: **E-2**
Meeting Date: **October 2, 2024**

**Item Title**: Consideration of Tax Adjustment Reports

**Item Summary**:

Attached please find the list of adjustments to the 2024 Tax Levy (per information received from Dare County) for the monthly Property and MSD valuations.

These reports are submitted for your approval at the October 2nd Board of Commissioners meeting.

Number of Attachments: 2

**Specific Action Requested**:

Tax reports provided for Board review and approval.

Submitted By: Linda Bittner, Tax Collector Date: September 27, 2024

**Finance Officer Comment**:

No unbudgeted fiscal impact.

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:

I concur with staff.

Signature: Andy Garman Date: September 27, 2024

**Town of Nags Head, North Carolina**
**ANALYSIS OF CURRENT 2023-2024 MSD TAX LEVY**
**2024 Tax Levy As of September 25, 2024 for Oct 2, 2024 BOC Meeting**

| | BEACH NOURISHMENT DISTRICT | | | | | |
|---|---|---|---|---|---|---|
| | MSD Valuation | Rate | Total Levy | MSD Excluding Registered Motor Vehicles | Registered Motor Vehicles | |
| **Original MSD Levy:** | | | | | | |
| MSD Beach Nourishment at Current 2024 Dist 1 Rate | 581,289,973 | 0.00143 | 831,244.89 | 831,244.89 | | |
| MSD Beach Nourishment at current 2024 Dist 2 Rate | 475,161,197 | 0.00143 | 679,480.79 | 679,480.79 | | |
| MSD Beach Nourishment at Current 2024 Dist 3 Rate | 1,059,343,513 | 0.00005 | 52,968.57 | 52,968.57 | | |
| MSD Beach Nourishment at Current 2024 Dist 4 Rate | 667,823,999 | 0.00010 | 66,782.28 | 66,782.28 | | |
| MSD Beach Nourishment at Current 2024 Dist 6 Rate | 376,372,688 | 0.00005 | 18,819.49 | 18,819.49 | | |
| Registered Motor Vehicles at Current 2024 Dist 1 Rate | 94,287 | 0.00143 | 134.83 | | 134.83 | |
| Registered Motor Vehicles at Current 2024 Dist 2 Rate | 203,021 | 0.00143 | 290.32 | | 290.32 | |
| Registered Motor Vehicles at Current 2024 Dist 3 Rate | 574,000 | 0.00005 | 28.70 | | 28.70 | |
| Registered Motor Vehicles at Current 2024 Dist 4 Rate | 385,500 | 0.00010 | 38.55 | | 38.55 | |
| Registered Motor Vehicles at Current 2024 Dist 5 Rate | 0 | 0.00000 | 0.00 | | 0.00 | |
| Registered Motor Vehicles at Current 2024 Dist 6 Rate | 147,400 | 0.00005 | 7.37 | | 7.37 | |
| Registered Motor Vehicles at 2023 Dist 1 Rate | 183,100 | 0.00143 | 261.84 | | 261.84 | |
| Registered Motor Vehicles at 2023 Dist 2 Rate | 391,096 | 0.00143 | 559.30 | | 559.30 | |
| Registered Motor Vehicles at 2023 Dist 3 Rate | 1,141,302 | 0.00005 | 57.07 | | 57.07 | |
| Registered Motor Vehicles at 2023 Dist 4 Rate | 777,023 | 0.00010 | 77.72 | | 77.72 | |
| Registered Motor Vehicles at 2023 Dist 6 Rate | 696,750 | 0.00005 | 34.93 | | 34.93 | |
| Registered Motor Vehicles at 2022 Dist 3 Rate | 22,400 | 0.00005 | 1.12 | | 1.12 | |
| Penalties | | | 0.00 | | | |
| **Total** | **3,164,607,248** | | **1,650,787.77** | **1,649,296.02** | **1,491.75** | |
| **Discoveries & Adjustments:** | | | | | | |
| Current year discoveries & adjustments | 0 | | 0.00 | 0.00 | | |
| | | | 0.00 | 0.00 | | |
| **Total** | **0** | | **0.00** | **0.00** | | |
| **Releases & Adjustments:** | | | | | | |
| DMV Current year valuation adjustments | 0 | | 0.00 | 0.00 | 0.00 | |
| DMV Current year tax releases | 0 | | 0.00 | 0.00 | 0.00 | |
| Real/Personal Current year releases & adjustments | (12,413) | | (5.38) | (5.38) | | Dist 3 & 4 |
| **Total** | **(12,413)** | | **(5.38)** | **(5.38)** | **0.00** | |
| **Write-offs (under $1.00) or Adjustments:** | | | 0.00 | 0.00 | | |
| **Total MSD Valuation** | **3,164,594,835** | | | | | |
| **Net levy** | | **1,650,782.39** | | **1,649,290.64** | **1,491.75** | |
| **TOTAL UNCOLLECTED MSD AS OF 9/25/24:** | | **(1,002,362.65)** | | **(1,002,362.65)** | **0.00** | |
| **CURRENT YEAR MSD COLLECTED:** | | **648,419.74** | | **646,927.99** | **1,491.75** | |
| **CURRENT MSD COLLECTION PERCENTAGE:** | | **39.280%** | | **39.225%** | **0.000%** | |

**Town of Nags Head, North Carolina**
**ANALYSIS OF CURRENT 2023-2024 TOWN WIDE TAX LEVY**
**2024 Tax Levy As of September 25, 2024 for Oct 2, 2024 BOC Meeting**

| | Town-Wide Tax | | | Total Levy | |
|---|---|---|---|---|---|
| | Property Valuation | Rate | Total Levy | Property Excluding Registered Motor Vehicles | Registered Motor Vehicles |
| **Original levy:** | | | | | |
| Property taxed at current 2024 rate | 3,071,851,717 | 0.003300 | 10,137,252.77 | 10,137,252.77 | |
| Registered Motor Vehicles at current 2024 rate | 2,963,438 | 0.003300 | 9,553.18 | | 9,553.18 |
| Registered Motor Vehicles at 2023 year's rate | 9,204,633 | 0.003300 | 30,375.29 | | 30,375.29 |
| Registered Motor Vehicles at 2022 year's rate | 1,398 | 0.002875 | 4.02 | | 4.02 |
| Penalties | | | 8,387.61 | 8,387.61 | |
| **Total** | **3,084,021,186** | | **10,185,572.87** | **10,145,640.38** | **39,932.49** |
| **Discoveries & Adjustments:** | | | | | |
| Current year discoveries & adjustments tax | 0 | | 0.00 | 0.00 | |
| Town wide beach nourishment tax | | | 0.00 | 0.00 | |
| Corporate Utilities discoveries & tax | 15,551,166 | | 47,431.06 | 47,431.06 | |
| Corporate Utilities beach nourishment tax | | | 3,887.80 | 3,887.80 | |
| Penalty Discoveries | | | 0.00 | 0.00 | |
| **Total** | **15,551,166.00** | | **51,318.86** | **51,318.86** | |
| **Releases & Adjustments:** | | | | | |
| Current year releases & adjustments | (37,491) | | (530.37) | (114.33) | (416.04) |
| Town wide beach nourishment | | | (9.35) | (9.35) | |
| Penalty Releases | | | (11.62) | (11.62) | |
| **Total** | **(37,491)** | | **(551.34)** | **(135.30)** | **(416.04)** |
| **Write-offs (under $1.00) or Adjustments:** | | | 0.00 | 0.00 | |
| **Total Property Valuation** | **3,099,534,861** | | | | |
| **Net levy** | | **10,236,340.39** | | **10,196,823.94** | **39,516.45** |
| Uncollected Taxes & Penalties | | (5,989,484.31) | | (5,989,484.31) | 0.00 |
| Uncollected Town Wide Beach Nourishment | | (491,206.70) | | (491,206.70) | 0.00 |
| **TOTAL UNCOLLECTED TAXES AS OF 09/25/24:** | | **(6,480,691.01)** | | **(6,480,691.01)** | **0.00** |
| **CURRENT YEAR TAXES COLLECTED:** | | **3,755,649.38** | | **3,716,132.93** | **39,516.45** |
| **CURRENT LEVY COLLECTION PERCENTAGE:** | | **36.689%** | | **36.444%** | **0.000%** |

# Agenda Item Summary Sheet

Item No: **E-3**
Meeting Date: **October 2, 2024**

**Item Title**: Approval of minutes from Board of Commissioners meetings/workshops

**Item Summary**:

Attached for Board review and approval are the following DRAFT Board of Commissioners meeting minutes:

- September 4, 2024, Regular Board of Commissioners meeting
- September 18, 2024, Recessed Session Board of Commissioners Multi-Family Workshop

Number of Attachments: 2

**Specific Action Requested**:

Provided for Board review and approval.

Submitted By: Carolyn F. Morris, Town Clerk Date: September 27, 2024

**Finance Officer Comment**:

No unbudgeted costs associated with this agenda item.

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:

N/A

Signature: Andy Garman Date: September 27, 2024

*DRAFT* **MINUTES**
**TOWN OF NAGS HEAD**
**BOARD OF COMMISSIONERS**
**REGULAR MEETING**
**WEDNESDAY, SEPTEMBER 4, 2024**

The Nags Head Board of Commissioners met at the Board Room located at 5401 S Croatan Highway, Nags Head, North Carolina on Wednesday, September 4, 2024 at 9:00 a.m. for a Regular Meeting.

Board members Present: Mayor Ben Cahoon; Mayor Pro Tem Michael Siers; Comr. Kevin Brinkley; Comr. Bob Sanders; and Comr. Megan Lambert

Board members Absent: None

Others present: Town Manager Andy Garman; Attorney John Leidy; Amy Miller; Kelly Wyatt; David Ryan; Perry Hale; Randy Wells; Nancy Carawan; Joe Costello; Brittany Phillips; Roberta Thuman; Brandon Stallings; John McDowell; Linda Bittner; Kennetha Kathleen Morgan; David Roberts; Steve House; Katie Wilkins; Valerie Netsch; Bob Muller; John Donlan; Terry Brown; Duke Geraghty; Mary Ellon Ballance; Aida Havel; David Elder; Lauren Nelson; Jason James; Barbara Bell; Katie Morgan; Robin Morgan; Megan Vaughan; Peter Pinto; David Shufflebarger; David Thompson; Molly Harrison; Lee Nettles; Jeff Schwartzenberg; Town Clerk Carolyn F. Morris

## CALL TO ORDER

Mayor Cahoon called the meeting to order at 9 a.m. and recognized former Mayor Bob Muller in the audience. A moment of silence was followed by the Pledge of Allegiance.

## ADOPTION OF AGENDA

MOTION: Mayor Pro Tem Siers made a motion to approve the September 4th agenda as presented. The motion was seconded by Comr. Brinkley which passed unanimously.

## RECOGNITION

Fire Chief Randy Wells introduced Fire Engineer Brandon Stallings who was recognized by the Board for five years of service.

Public Services Director Nancy Carawan introduced Sanitation Equipment Operator II John McDowel who was recognized by the Board for five years of service.

Dep Town Manager/Finance Officer Amy Miller introduced Tax Collector Linda Bittner who was recognized by the Board for ten years of service.

PRESENTATION – Outer Banks Visitors Bureau presents "The Outer Banks Promise"

Outer Banks Visitors Bureau Executive Director, Lee Nettles, introduced the *Outer Banks Promise* initiative and Community Engagement Manager, Jeff Schwartzenberg.

Mr. Schwartzenberg presented a short video on the *Outer Banks Promise* initiative which encourages people to preserve the natural environment and cultural heritage of the Outer Banks by signing an online pledge. Signing the pledge shows support of the protection of the natural environment of the Outer Banks and shows interest in exploring responsible ways to protect this area. The online location to obtain additional information and sign the pledge is obxpromise.com.

PROCLAMATION – Septic Smart Week – September 16 - 20, 2024

Public Information Officer, Roberta Thuman, presented a *CCEDS Challenge at the Coast* powerpoint which was prepared by Coastal Community Environmental Data Scholars (CCEDS), East Carolina University PHD candidates in partnership with the Town, Coastal Studies Institute, and the National Science Foundation (NSF). The emphasis is on encouraging the protection of the Town's water quality via the Todd D Krafft Septic Health Initiative. Her presentation is attached to and made a part of these minutes as shown in Addendum "A".

Mayor Cahoon read the Proclamation for Septic Smart Week as follows:

"WHEREAS, proper septic system use and routine care are vital to protecting public health and preserving our highly valued groundwater and surface waters; AND

'WHEREAS, proper septic system maintenance will preserve the function, performance, and longevity of systems thereby avoiding costly repairs that can result from neglect; AND

'WHEREAS, nearly 85 percent of homes and most businesses in the Town of Nags Head rely on septic systems to treat wastewater; AND

'WHEREAS, the Todd D. Krafft Septic Health program established by the Town of Nags Head provides education to its property owners about the need for proper septic system use and routine maintenance; AND

'WHEREAS, the Todd D. Krafft Septic Health program encourages proper maintenance by offering free inspections of conventional septic systems and a $150 water bill credit each time the system tank is pumped; AND

'WHEREAS, if a conventional system is found in need of repair or replacement, the town offers low interest loans to assist in replacing all or a portion of the septic system; AND

'WHEREAS, residents and the environment of the Town of Nags Head benefit from properly designed, installed, operated, and maintained septic systems.

'NOW THEREFORE BE IT RESOLVED, that the Town of Nags Head Board of Commissioners does hereby proclaim the week of September 16 - 20, 2024 as Septic Smart Week in the Town of Nags Head and urges all citizens to join us in this special observance by considering what they can do to properly maintain their septic system."

MOTION: Mayor Pro Tem Siers made a motion to approve the Septic Smart Week Proclamation as presented. The motion was seconded by Comr. Brinkley which passed unanimously.

PROCLAMATION – National Night Out – October 1, 2024

Police Chief Perry Hale summarized the upcoming National Night Out activities scheduled for October 1st at Dowdy Park. He noted that many people visit Nags Head to attend National Night Out and enjoy the activities each year; he is looking forward to this year's event and appreciates the Board's support and participation.

Mayor Cahoon read the Proclamation for National Night Out as follows:

"WHEREAS, the National Association of Town Watch (NATW) is sponsoring a unique, nationwide crime, drug and violence prevention program called "National Night Out" which is celebrated by communities in August and in early October; AND

'WHEREAS, the Town of Nags Head, the Nags Head Community Watch Association, and the Nags Head Police Department are celebrating National Night Out on Tuesday, October 1st, 2024; AND

'WHEREAS, the Annual National Night Out provides a unique opportunity for the Town of Nags Head to join forces with thousands of other communities across the country in promoting cooperative, police-community crime prevention efforts; AND

'WHEREAS, the Nags Head Community Watch Association plays a vital role in assisting the Nags Head Police Department through joint crime, drug and violence prevention efforts in the Town of Nags Head and is supporting "National Night Out 2024" locally; AND

'WHEREAS, it is essential that all citizens of the Town of Nags Head be aware of the importance of crime programs and the impact that their participation can have on reducing crime, drug and violence in the Town of Nags Head; AND

'WHEREAS, police-community partnerships, neighborhood safety, awareness and cooperation are important themes of the "National Night Out" program.

'THEREFORE, I do hereby call upon all citizens of the Town of Nags Head to join the Nags Head Community Watch Association, the Town of Nags Head Police Department, and the National Association of Town Watch in supporting the 41st Annual National Night Out on October 1st, 2024.

'FURTHER, Let it be resolved that I, Ben Cahoon, do hereby proclaim Tuesday, October 1st, 2024 as "National Night Out" in the Town of Nags Head, Dare County, North Carolina."

MOTION: Mayor Pro Tem Siers made a motion to approve the National Night Out Proclamation as presented. The motion was seconded by Comr. Brinkley which passed unanimously.

PROCLAMATION – Diaper Need Awareness Week – September 23 – 29, 2024

Mayor Cahoon presented the proposed Children & Youth Partnership proclamation emphasizing the importance of providing diapers to those in need.

Mayor Cahoon read the Proclamation for Diaper Need Awareness Week as follows:

"WHEREAS, diaper need, the condition of not having a sufficient supply of clean diapers to keep babies and toddlers clean, dry, and healthy, can adversely affect the health and well-being of babies, toddlers, and their families; and

'WHEREAS, the latest study from the National Diaper Bank Network reports that one in two families struggles with diaper need, an increase from previous studies done in 2010 and 2017; and

'WHEREAS, purchasing enough diapers to keep a baby or toddler clean, dry, and healthy can consume 14 percent of a low-wage family's post-tax income, making it difficult to obtain a sufficient supply; and

'WHEREAS, a daily or weekly supply of diapers is generally an eligibility requirement for babies and toddlers to participate in child care programs and quality early-education programs; and

'WHEREAS, without enough diapers, babies and toddlers risk infections and health problems that may require medical attention, and may prevent parents from attending work or school, thereby hurting the family's economic prospects and well-being; and

'WHEREAS, the Nags Head community recognizes that diaper need is a public health issue, and addressing diaper need can lead to economic opportunity for our families and community and improved health for children, thus ensuring all children and families have access to the basic necessities required to thrive and reach their full potential; and

'WHEREAS, the Town of Nags Head is proud to be home to trusted community-based organizations including Children & Youth Partnership for Dare County, that recognize the importance of diapers in ensuring health and providing economic stability for families and thus distribute diapers to families through various channels.

'WE, THE TOWN OF NAGS HEAD, do hereby proclaim the week of September 23 through September 29, 2024 as DIAPER NEED AWARENESS WEEK.

'We thank Children & Youth Partnership, their staff and donors for their service through CYP's Diaper Bank, and encourage the citizens of our community to support CYP's Diaper Bank to help ensure that all Dare County children and families have what they need to thrive."

MOTION: Comr. Brinkley made a motion to approve the Diaper Need Awareness Week proclamation as presented. The motion was seconded by Mayor Pro Tem Siers which passed unanimously.

**PUBLIC COMMENT**

Town Attorney John Leidy introduced Public Comment at 9:32 a.m. He asked those interested in speaking concerning the upcoming Public Hearings to reserve their comments until that time.

Steve House, Dare County Comr. and president of the Outer Banks Jeep Invasion organization; he thanked the Town Board and the Town's Police Dept as well as the Dare County Tourism Board for supporting the Jeep Invasion events that took place in previous years without any issues; he looks forward to this year's event at the Soundside Event Site - September 20 – 22, 2024.

Aida Havel, Salvo; she is running for Dare County Commissioner in the upcoming election; she spoke of the Buxton beach environmental disaster which is now one year and three days old; she directed those interested

to view two online videos from the Buxton Civic Association; at yesterday's Dare County Commissioners meeting, Col Sturgeon provided an update and she and others were not impressed as he stated that a lot of testing is still needed to take place; she asked anyone with any strings to be pulled in Washington, DC to please help out; she noted the workforce housing issue later on today's agenda and she is looking for creative solutions – she is pleased to see the towns looking into this issue.

**CONSENT AGENDA**

The Consent Agenda consisted of the following items:

Consideration of Budget Amendment #3 to FY 24/25 Budget

Consideration of Tax Adjustment Report
- FY 24/25 Tax Adjustment Report (New Year and Year-to-date)

Approval of minutes

Consideration of policy for neighborhoods to request traffic calming devices
- presented at Aug 7th Board meeting

Request for Public Hearing to consider a map amendment request submitted by Chris Greening of Coastal Bluewater Capital, LLC, as authorized by property owner Mazzi, LLC to rezone the property located at 0 W. Satterfield Landing Road, Lot 2a-1r of the Charles Sineath Subdivision, (Parcel # 005618002) from C-3, Commercial Services to C-2, General Commercial. This is the vacant property west of TW's Bait and Tackle

MOTION: Comr. Brinkley made a motion to approve the Consent Agenda as presented. The motion was seconded by Mayor Pro Tem Siers which passed unanimously.

Budget Amendment #3, as approved, is attached to and made a part of these minutes as shown in Addendum "B".

Tax Adjustment Reports, as approved, are attached to and made a part of these minutes as shown in Addendum "C".

The Board of Commissioners minutes from August 7, 2024, as approved, are on file in the Town Clerk's Office.

The final Traffic Calming Device Policy, as approved, is attached to and made a part of these minutes as shown in Addendum "D".

The Request for Public Hearing, as approved, read in part as follows:

"Chris Greening of Coastal Bluewater Capital, LLC has submitted a zoning map amendment request with authorization from the current property owner, Mazzi, LLC. If adopted, this map amendment would rezone Lot 2a-1r of the Charles Sineath Subdivision, Parcel # 005618002 from C-3, Commercial Services to C-2, General Commercial. The intent of the C-3, Commercial Services District, is to provide for higher intensity land uses that are not compatible with other areas of the Town. The C-3 District accommodates utilities, light industrial uses, warehousing, bulk storage, municipal facilities, etc. The 2022 Comprehensive Land Use Plan states that the C-3 standards are to regulate and buffer uses so that their location or activities will not be detrimental to adjacent uses, the environment, and the sources of potable water. The Commercial Services District must be

at least 10 acres in size and must have direct access to a US highway or collector street improved to town standards. If adopted, the requested rezoning would reduce the overall acreage of C-3 by 0.8 acres, leaving upwards of 36 acres of C-3 Commercial Services remaining.

'The intent of the C-2, General Commercial District, is to provide for the proper grouping and development of commercial facilities to serve the entire community. The C-2 District allows the broadest range of commercial uses. All C-2 districts shall be at least 5 acres in area, the proposed zoning map amendment would result in an increase in the total acreage of C-2 zoning designation.

'Staff Recommendation/Planning Board Recommendation
Based upon the evaluation of the intent of each zoning district and goals listed in the 2022 Comprehensive Land Use Plan, staff recommends adoption of the proposed zoning map amendment as presented.

'At their August 20, 2024, meeting, the Planning Board voted unanimously to recommend approval of the proposed map amendment as requested."

**PUBLIC HEARINGS**

Public Hearing to consider various text amendments to the Unified Development Ordinance (UDO) as it pertains to the use of multi-family dwelling developments

Attorney John Leidy introduced the Public Hearing to consider text amendments to the Unified Development Ordinance as it pertains to the use of multi-family dwelling developments. The time was 9:40 a.m.

Notice of the Public Hearing was published in the *Coastland Times* on Wednesday, August 21, 2024 and on Wednesday, August 28, 2024, as required by law.

The staff memo prepared for this agenda item read in part as follows:

"At the Board's March regular meeting, the Board requested that the Town establish a working group to review and make recommendations on a draft Multi-Family Housing Ordinance. This ordinance was originally drafted by the Planning Board and a public hearing was held in February.

'The charge for the working group was as follows:

- To consider the draft multi-family ordinance written by the Planning Board.
- To preserve the intent of the ordinance, to protect the character of Nags Head, and to provide new alternatives for workforce/long-term housing without increasing the stock of short-term rentals.
- To evaluate conditions/standards which would render such projects unfeasible due to financing, construction, configuration, or management.
- To suggest additional measures that would achieve the aforementioned goals.

'Over the course of four meetings, the working group developed a recommendation for review by the Board of Commissioners. This included changes to the original ordinance drafted by the Planning Board as well as several other suggestions. Information about the working group including agendas and minutes from its meetings can be found here: https://www.nagsheadnc.gov/1108/Multi-Family-Working-Group. The Working Group's Final Recommended Ordinance is included as Attachment 1.

'The Planning Board has reviewed the Working Group's Ordinance over the course of three meetings. The primary focus of the Planning Board's discussion centered around the density and design of multi-family development, mostly pertaining to larger projects. The Planning Board also discussed parking standards.

The Planning Board's discussions resulted in three recommended changes to the Working Group's ordinance:

1) The Planning Board is recommending that large multi-family developments (greater than six units on one site) consist of townhouses only. The Working Group's version of the ordinance allowed townhouses and apartments in both the small and large categories.
2) The Planning Board is recommending increasing the parking requirement to 2.5 spaces per unit plus one additional space for every four units.
3) The Planning Board is recommending an additional density limitation of 25 bedrooms per acre applicable to both large and small multi-family sites. The Working Group's version of the ordinance controlled density through the use of a floor area ratio only. The recommended floor area ratio is 0.32 square feet of building area to one square foot of lot area.

'The Planning Board's recommended ordinance is included as Attachment 2. Staff's presentation from the June 5th Board of Commissioners meeting is included as Attachment 3. It may be useful for the Board of Commissioners to review the Planning Board staff reports and minutes from its June, July, and August meetings (see below).

'June 18th Planning Board – https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Agenda/_06182024-461?html=true

'Minutes: https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Minutes/_06182024-461

'July 16th Planning Board - https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Agenda/_07162024-464?html=true

'Minutes: https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Minutes/_07162024-464

'August 20th Planning Board - https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Agenda/_08202024-468?html=true

'Note: Minutes from the August 20th Planning Board Meeting are included in the agenda packet. The Planning Board was more comfortable with the small multi-family approach. This was viewed as better maintaining the town's desired vision for development. The Planning Board expressed an interest in capping the overall number of large multi-family developments that can be approved townwide. Staff and the town attorney are researching the feasibility of this approach but did not complete this prior to the August Planning Board meeting. The Planning Board would recommend that the Board of Commissioners consider a cap on multi-family development sites should it be deemed feasible.

'Staff Comments:
Staff would recommend the addition of a density limitation based on bedrooms per acre. The floor area ratio of 0.32 was developed based on the Town's current large residential dwelling ordinance which allows for a 5,000 square foot dwelling on a 16,000 square foot lot. In keeping with that approach, the large residential dwelling ordinance caps on-site wastewater systems at 9 bedrooms. Therefore, 9 bedrooms for every 16,000 square feet of lot area equates to roughly 25 bedrooms per acre.

'Staff and the Planning Board reviewed parking standards from other communities. Most ordinances do include additional parking for guests. However, 2.5 spaces per unit plus additional parking for guests was more parking than we saw in any other community. Staff would suggest 2 parking spaces per unit plus one additional space for every four units. This balances the need for sufficient parking with the Town's desire to limit paved surfaces and disturb less of the development site.

'Regarding townhouse vs. apartment style design: this is viewed as primarily an aesthetic preference. Part of the Working Group's approach was to reduce the cost of construction to improve the affordability of units. The Working Group lowered minimum square footage to 500 square feet for a one-bedroom unit. Staff believes it would create practical difficulties to construct townhouses of this size, given most townhouses are two stories. If the Board is interested in allowing smaller units, apartments would be more conducive to this.

'The Board of Commissioners has scheduled a public hearing on the multi-family ordinance for the upcoming meeting (September 4th). The Board may consider the two attached versions of the ordinance, as presented, or the Board can modify the standards contained within either ordinance. If the Board of Commissioners is inclined to adopt any version of the proposed text amendments, please reference Appendix A for the Statement of Consistency with the Town's adopted Comprehensive Land Use Plan requirements (attached)."

Town Manager Garman provided a series of slides detailing the background of the multi-family dwelling development item with a slide presentation which is attached to and made a part of these minutes as shown in Addendum "E". Highlights of his slide presentation follow:

Background
Late 2022 – the Town adopted a moratorium and subsequently eliminated Multi- Family (MF)
Goal was to review if and where MF should be allowed and under what standards
MF no longer allowed in the new C-5 district near Jockey's Ridge and Cottage Row
BOC and Planning Board held a joint workshop to provide guidance on a new ordinance
Consensus was to consider MF in C-2 (possibly limited to high activity areas) and not for more short-term rentals. Focus on workforce housing. Possible use of deed restrictions.

The Planning Board worked on the ordinance in 2023; a public hearing was held in February 2024
BOC wanted further review and established a working group
Working Group's ordinance was presented to the BOC in June of 2024
Planning Board reviewed the Working Group ordinance and has now submitted a recommendation

New Multi-Family Ordinance Goals
Multi-Family would be used to enhance opportunities for workforce/long-term housing but not for short-term or vacation rentals
More units per acre to reduce land cost per unit
Smaller units to reduce construction cost per unit
Maintain controls over density to preserve town values
Carefully consider where large and small projects can occur to increase compatibility with other uses
Consider other standards to enhance design/appearance and reduce scale while increasing flexibility

Working Group Ordinance Summary

Two Categories – Large and Small

*Large MF*
Deed restrictions – 60% workforce, all have to be long-term rentals (no short-term rentals)
Use Floor Area Ratio for large projects instead of units per acre
*Floor Area Ratio (FAR) means the quotient resulting from division of the gross floor area of all buildings on a lot by the area of the lot*
FAR of 0.32 is proposed. This is the effective FAR currently used for large residential dwellings.
Reduce Unit Size
Minimum Unit Sizes/Size Categories: Studio/One Bedroom 500 sq. ft.
Two Bedroom 700 sq. ft.; Three Bedroom 1,000 sq. ft.

Maximum unit size 1,750 sq. ft.
No more than 60% of the units shall be from any unit size category.
Individual building size would be limited to 10,000 sq. ft.
Apartments and Townhouses
Only fronting US 158; Special Use Permit required
Must have 26,000 sq. ft. lot

*Small MF*
All units deed restricted to workforce only
Continue to use units per acre (1 per 4,000 sq. ft. of land area)
Max six units in small category
Max building size is 5,000 sq. ft. (similar to large residential dwelling)
Allowed everywhere in C-2 (not just on US 158)
Must have 15,000 sq. ft. lot
Approved administratively by staff
Same architectural requirements as large residential
Reduced setbacks; design requirements similar to large residential dwellings

*Planning Board Recommendation*
Preference for the Small MF Category – best reflects desired development patterns for Nags Head
Increase parking to 2.5 spaces per unit + one space for every four units
For Large MF – only allow townhouse style units
Add in bedroom per acre limitation of 25 bedrooms per acre (this is consistent with the town's large residential dwelling ordinance)
Recommendation included no changes to other provisions of the Working Group Ordinance
Would like to see a townwide cap on the number of large multi-family projects that can be approved

Draft Planning Board Ordinance – Design

From Joint Workshop consensus that townhouse style development was preferred.
Townhouses generally have fewer shared walls; offer more privacy than apartments, more home-like environment.
Townhouse developments can offer more diverse architectural designs, maintaining the character of the surrounding areas.
Townhouse development is generally not as dense as apartment style development.
Townhouse development fosters a sense of community, residents have their own entrances, outdoor spaces, etc.
Ordinance precludes apartment style development for the Large Multi-Family.
Either is acceptable for Small Multi-Family category as both a principal and accessory use.

Attorney Leidy invited those present who wished to speak to come to the podium.

Mayor Cahoon directed the Town Clerk to include the comments that were emailed to Board members into today's minutes. These emails are attached to and made a part of these minutes as shown in Addendum "F".

Robin Morgan, Nags Head resident; she questioned if contractors can go in now and make changes if a lot size is increased; she also expressed her concern about stormwater runoff – she saw nothing addressing this.

Town Engineer David Ryan provided stormwater runoff scenarios and stated that the requirements are included in the Town Code; Town Manager Garman explained that a separate section of the Town Code addresses stormwater requirements.

David Shufflebarger, Nags Head resident; workforce housing did not work because of NIMBY (not in my backyard); he feels this is more of the same; he urged the Board to reconsider provisions recommended by the Planning Board re: townhomes, his primary concern is workforce housing.

Peter Pinto, owner of multiple units and one of the developers of The Landings at Sugar Creek; hard to believe if anyone were impacted by this proposed change if people bought by the previous rules that were changed; towns change rules when necessary; anything proposed on Kelly's property is met with resistance; he feels that the real goal of the working group was to prevent MF development on Kelly's site - passing these changes will accomplish that goal; if either ordinance is adopted, there will be no MF homes in Nags Head as no private developer will construct with the deed restrictions proposed; this ordinance is close to a "taking"; deed restrictions are difficult; proposed calculations are unnecessary; perception now is that Nags Head is closed for business when it comes to development; does not feel these proposed changes have been significantly researched.

Valerie Netsch, Soundside Road; she appreciates the opportunity to provide input; is in favor of MF housing and workforce housing; this needs to be a collective effort in Nags Head and in all towns; she wants the Board to pause before making a decision; how many units are allowed; there needs to be a compromise in the C-2 District; it's important to have a cap on the number of units allowed; she questioned how long it will remain as affordable housing.

David Thompson, Planning Board member; multi-family housing is not new and is very much needed; a lot of hours were put in to come up with an effective model for moving forward; what has been brought forward today includes a lot of details that need to be worked out; he suggested not voting on this today to make sure this is done correctly.

David Elder, Planning Board member; the former MF ordinance was abandoned and a new one put in place; at the time of the moratorium problems were mostly due to changes in development; the Planning Board addressed MF questions and considered the public survey where it was indicated that too much density was the main concern; parking and aesthetics are also a concern; acceptability by developers and density are issues; this doesn't refer to just Kelly's property; he's not sure this MF ordinance is what Nags Head wants; he is not in favor of the proposed policy.

Bob Muller, Nags Head resident and former Mayor; he saluted the Board of Commissioners, Planning Board, and the Working Group for addressing what the Town is looking for in MF housing; he supports the Working Group - two parking spaces and isn't sure how townhouses will support a 500 sq ft studio apt; people need to understand what a large MF structure looks like – it would be less than a third of the size of the homes that are being built – they are not the big block homes being built now; he also suggested in the listing of the standards large and small to include the style of development that is allowed in the ordinance; the manager of the development should be the one to provide reports; while he likes the proposal, he is not in favor of a vote today either; the request for public hearing should be on the Consent Agenda prior to the public hearing – per the UDO; he suggested holding a workshop to show the public what a large and a small development would look like; another way to approach this problem is to address mixed uses.

Duke Geraghty, Outer Banks Homebuilders Association Government Affairs rep; he was a member of the Working Group; he thanked Andy Garman and Kelly Wyatt for their leadership during the Working Group meetings; there are two versions before the Board; both versions he has a disagreement with – it has to be beneficial to a developer; highest and best use of the land is still a short-term rental so it may not ever be built; the Planning Board version increases parking and he feels that is too many parking spaces; townhome

style is more expensive and he is not in favor of it; he hopes that the Working Group recommendation is taken with the change of sq ft per unit to allow more units per lot; he emphasized that not everyone will get everything they wanted; he said that height may be an issue in the future.

Katie Morgan; she has friends in Nags Head; she feels there is still a lot that needs to be worked on and asked the Board to not vote today; a workshop in the evening would be great so more could attend.

Katie Wilkins; Outer Banks community leader for Air BNB's; she agrees with Ms. Morgan and requested that the Board delay a vote on the ordinance.

Mayor Pro Tem Siers questioned why the Planning Board changed their mind to move this ordinance forward when they were not in favor of moving it forward.

Planning Board Chair Megan Vaughan spoke and stated that the Planning Board did not change their mind but simply voted the way they voted.

Planning Board member David Elder stated that he would prefer to split the small and the large multi-family sections apart. Ms. Vaughan said that since the Board of Commissioners' Public Hearing was already scheduled, they made a decision.

Planning Board member Molly Harrison stated that she did not vote in favor of the ordinance because of the townhome vs apartment issue – she was not comfortable with allowing multi-family in the C-2 District where 76 lots were affected; she wanted some type of cap; a Public Hearing had already been scheduled and the Planning Board had to vote.

There being no one else present who wished to speak, Attorney Leidy concluded the Public Hearing at 10:48 a.m.

Mayor Cahoon addressed some of the comments made today:
Stormwater issue – same standards everywhere located in a separate portion of the code
Townhome provision – he shares these same concerns
Affordable housing – housing which allows smaller units that is deed restricted so no short term rental units
Deed restrictions – are perpetual – deed restricted as long as the structure stands
He agrees with Mayor Muller's comment that the association would be responsible for the management.
Mayro Cahoon also pointed out that the mixed-use provision is already in place and could be improved and utilized more.

Comr. Lambert said that she has worked on this issue while on the Planning Board, as a member of the Working Group, and as a Commissioner; this ordinance has taken a lot of twists and turns; she would like to take a pause, at least until the October Board meeting.

Mayor Pro Tem Siers said that he doesn't like either ordinance presented; he emphasized that this concerns workforce housing, not low-income housing; there is no perfect solution but if it was not ready for a public hearing, the ordinance should not have come forward today.

Comr. Brinkley stated that he agrees with the comments re: a cap on the large projects; he commented that if a developer doesn't like the regulations to adhere to, they don't need to develop in this area; he feels it is a good ordinance.

Comr. Sanders said that he appreciated and enjoyed those who came to today's meeting to provide comments on the proposal; feels there are some holes in the ordinance; it needs work and he supports a cap; he worries about density as results of the community survey indicate; he is especially concerned about

workforce housing as a business owner; he's also concerned about keeping the character of Nags Head and feels more work needs to be done before adoption.

Mayor Cahoon stated that the Board and staff have spent a couple of years with public meetings to include Planning Board and Board of Commissioners meetings where this issue was discussed; we will never make everyone happy; he feels caps on number of projects is a good idea; if there was a cap today, he would be ready to vote today.

MOTION: Mayor Pro Tem Siers made a motion to table the multi-family proposal and to return it to the Planning Board for consolidation into one ordinance, and to include a workshop (pursuant to a friendly amendment made by Comr. Lambert) that would include builders, and to return for Board consideration no later than 60 days. The motion was seconded by Comr. Sanders.

WITHDRAWAL OF MOTION: Mayor Pro Tem Siers withdrew his motion and Comr. Sanders withdrew his second.

MOTON: Comr. Brinkley made a motion to table consideration of the multi-family ordinance and to schedule a mid-month workshop on this issue for Wednesday, September 18th at 9 am with action tabled until the October 2nd Board of Commissioners meeting. The motion was seconded by Mayor Pro Tem Siers which passed 4 – 1 with Mayor Cahoon casting the NO vote.

Public Hearing to consider a text amendment to the Unified Development Ordinance submitted by Anlauf Engineering, PLLC on behalf of Ark Church, to modify the definition of "Religious Complex" to include an additional single-family residence for church staff, in addition to the existing allowance for an onsite parsonage

Town Attorney John Leidy introduced the Public Hearing to consider a text amendment to the UDO to modify the definition of "Religious Complex" to include an additional single-family residence for church staff, in addition to the existing allowance for an onsite parsonage. The time was 11:30 a.m.

Notice of the Public Hearing was published in the *Coastland Times* on Wednesday, August 21, 2024 and on Wednesday, August 28, 2024, as required by law.

Planning Director Kelly Wyatt summarized her report which read in part as follows:

"Joseph Anlauf, P.E., of Anlauf Engineering, PLLC has submitted the attached text amendment request on behalf of the Ark Church. If adopted, the text amendment would modify the definition of "Religious Complex" to allow for the construction of a single-family dwelling, in addition to the already permitted parsonage, as a residence for church staff.

'The current definition of "Religious Complex" within the Unified Development Ordinance is below:

*"Religious complex means a church (a building primarily used for public divine worship) or a church and any related structures including a parsonage, fellowship halls, educational buildings, youth centers, recreational facilities (which include playgrounds), day care centers, parochial schools or similar structures or areas located on a single site."*

'The applicant has noted in the application that the amendment is designed to allow religious complexes the ability to include additional affordable housing options for church staff and their families. More affordable housing options will allow the church to attract and retain additional much needed church staff.

'Staff believes that permitting religious complexes to build a single-family dwelling onsite for church staff can offer significant benefits to the church, its staff, and the community, provided all zoning and building regulations are met. Onsite residences could enhance community engagement, ensure staff availability for church-related events and activities, and provide a constant presence to quickly respond to any emergencies involving the church. As noted by the applicant, this capability could be particularly beneficial for attracting and retaining qualified and dedicated staff in an area with high living costs.

'It is important to note that nothing in this proposal would eliminate the need for any single-family dwelling associated with a religious complex to comply with all relevant zoning and building standards, such as compliance with principal structure setbacks, building separation, access, parking, lot coverage, stormwater management, and architectural design, if applicable.

'POLICY CONSIDERATIONS
LU-9, Encourage land uses that serve the needs of both year-round and seasonal residents in support of the town's overall vision for the community.

'LU-27, Promote and expand the types of housing and accommodations for varying income levels, aging populations, and the seasonal workforce within the town.

'STAFF ANALYSIS AND RECOMMENDATION
Planning staff finds the proposed text amendment to be consistent with the 2022 Comprehensive Land Use Plan and recommend adoption of the amendment as presented.

'PLANNING BOARD RECOMMENDATION
At their July 16, 2024, meeting, the Planning Board voted unanimously to recommend adoption of the text amendment as presented.

'If the Board of Commissioners is inclined to adopt this proposed text amendment, please reference Appendix A for the Statement of Consistency with the Town's adopted Comprehensive Land Use Plan requirements (attached)."

Bob Muller, Nags Head resident and former Mayor; stated that religious complexes as a use replaced churches in the late 1980's to allow the broadest possible uses on the property of a church; he strongly supports the amendment.

There being no one else present who wished to speak, Attorney Leidy concluded the Public Hearing at 11:32 a.m.

MOTION: Mayor Pro Tem Siers made a motion to adopt the ordinance modifying the definition of Religious Complex to include a single family residence for church staff as presented. The motion was seconded by Comr. Brinkley which passed unanimously.

The ordinance, as adopted, is attached to and made a part of these minutes as shown in Addendum "G".

Public Hearing to consider various amendments to the Unified Development Ordinance as it pertains to dormitory use in the SED-80, Special Environmental District

Town Attorney John Leidy introduced the Public Hearing to consider various amendments to the UDO as it pertains to dormitory use in the SED-80, Special Environmental District. The time was 11:34 a.m.

Notice of the Public Hearing was published in the *Coastland Times* on Wednesday, August 21, 2025 and on Wednesday, August 28, 2024, as required by law.

Planning Director Kelly Wyatt summarized her report which read in part as follows:

"In response to ongoing discussions and concerns regarding workforce housing availability within the County, the Town of Nags Head is actively exploring the potential construction of two residential duplexes. These structures would primarily serve as housing for the town's lifeguards.

'Town staff have been collaborating with Beacon Architecture and Design, PLLC, and Quible & Associates, PC to develop several potential layouts for these residential structures. The proposed site for this workforce housing is Town-owned property located at 425 W. Health Center Drive, formerly the Outer Banks Medical Center and now the Community Care Clinic. Specifically, the town is considering construction in the area of the old, non-functional helipad.

'This property is located within SED-80, Special Environmental District zoning designation. Section 6.6 of the Unified Development Ordinance (UDO) states that Nursing Homes and Medical Offices are permitted via the Special Use Permit process in the SED-80 District, with supplemental regulations outlined in Section 7.41 (see attached).

'Section 7.41.6 of the supplemental regulation states: *"A dormitory for temporary use by staff of nursing homes may be allowed only in conjunction with nursing home facilities already permitted in the SED-80 District."*

'In late 2017 the town adopted various text amendments requested by Jim Rose, resulting in the creation of a definition for "Dormitory" and permitting dormitory use via a Special Use Permit within the C-2, General Commercial Zoning District. This led to the establishment of supplemental regulations for dormitories now found in Section 7.10 of the Unified Development Ordinance (see attached). This context is relevant to highlight that the allowances for a dormitory for temporary use by staff of nursing home facilities within the SED-80 District in Section 7.41 pre-dated the 2017 standards established for dormitory use.

'The definition and standards adopted in 2017 are attached and included below.

'Appendix A of the UDO, Definitions, defines a dormitory *as a commercial facility used for monthly rental of housing for unrelated residents in a communal non-transient living arrangement, with separate sleeping, bathing, and common living areas*.
Section 7.10, Supplemental Regulations for Dormitory, includes the following requirements:

*1. A minimum lot area of 25,000 square feet and a minimum lot width of 100 feet.*
*2. Sleeping rooms with a minimum floor area of 70 square feet for the first occupant and 50 square feet for each additional occupant.*
*3. At least one restroom with a minimum of two water closets, two sinks, and two showers. Compliance with the North Carolina Plumbing Code is required for dormitory bathroom fixtures.*
*4. A minimum floor area of 20 square feet per occupant for common living areas (including kitchen and dining), but not less than 220 square feet per unit or floor. Circulation spaces less than six feet wide are excluded from this calculation.*
5. *No dormitory facility shall house more than 25 occupants*.

'Staff acknowledges that the dormitory use afforded to nursing home staff was not intended to meet the same supplemental regulations as those adopted in 2017. To preserve both dormitory use opportunities, staff has drafted an ordinance amendment that maintains the dormitory use for nursing home staff while also extending

the dormitory use, currently allowed in the C-2, General Commercial District, to the SED-80, Special Environmental District.

'POLICY CONSIDERATIONS
LU-9, Encourage land uses that serve the needs of both year-round and seasonal residents in support of the town's overall vision for the community.

'LU-27, Promote and expand the types of housing and accommodations for varying income levels, aging populations, and the seasonal workforce within the town.

'STAFF RECOMMENDATION
Planning staff finds the proposed text amendment to be consistent with the 2022 Comprehensive Land Use Plan and recommend adoption of the amendment as presented.

'PLANNING BOARD RECOMMENDATION
At their July 16, 2024 meeting the Planning Board voted unanimously to recommend adoption of the text amendment as presented.

'If the Board of Commissioners is inclined to adopt this proposed text amendment, please reference Appendix A for the Statement of Consistency with the Town's adopted Comprehensive Land Use Plan requirements (attached)."

Mayor Pro Tem Siers questioned if hospital/health care staff should be included in addition to nursing home staff; Town Manager stated that he can approve others in his capacity.

There being no one else who wished to speak, Attorney Leidy concluded the Public Hearing at 11:38 a.m.

MOTION: Comr. Brinkley made a motion to adopt the ordinance as it pertains to dormitory use in the SED-80, Special Environmental District as presented. The motion was seconded by Mayor Pro Tem Siers which passed unanimously.

The ordinance, as adopted, is attached to and made a part of these minutes as shown in Addendum "H".

**REPORTS AND RECOMMENDATIONS FROM THE PLANNING BOARD AND THE PLANNING AND DEVELOPMENT DIRECTOR**

Update from Planning Director

Planning Director Kelly Wyatt summarized her monthly report which read in part as follows:

"This memo provides an overview of selected Planning and Development Department activities, projects, and initiatives. If requested, Staff will be prepared to discuss any of this information in detail at the Board of Commissioners meeting on September 4, 2024.

'Monthly Activity Report
Attached for the Board's review is the *Planning and Development Monthly Report for July 2024.* In addition to permitting, inspections, code enforcement, and Todd D. Krafft Septic Health Initiative activities, Staff was involved in the following meetings or activities of note during the month of July:

- Tuesday, August 6th – Technical Review Committee Meeting
- Wednesday, August 7th - Board of Commissioners Meeting
- Thursday, August 8th – Board of Adjustment (no hearings scheduled)
- August 10th – August 14th – Planner Chris Trembly attend Certified Zoning Official Conference
- Wednesday, August 14th – Committee for Art and Culture Meeting
- Tuesday, August 20th – Planning Board Meeting
- Wednesday, August 21st – Board of Commissioners mid-month meeting
- Wednesday, August 28th – CRS Cycle Verification Visit
- Wednesday, August 28th – Outer Banks Hazard Mitigation Joint Committee Meeting (1pm)
- Dowdy Park Farmers Market – Thursday, August 1st, 8th, and final market on 15th
- Dowdy Park Summer Concert Series – Wednesday, August 7th, 14th, and 21st

'Planning Board - Pending Applications and Discussions
The Planning Board's most recent meeting was held on Tuesday, August 20, 2024. The following items were heard:

➢ Consideration of a map amendment request submitted by Chris Greening of Coastal Bluewater Capital, LLC as authorized by property owner Mazzi, LLC to rezone the property located at 0 W. Satterfield Landing Road, Lot 2a-1r of the Charles Sineath Subdivision, (Parcel # 005618002) from C-3, Commercial Services to C-2, General Commercial. This is the vacant property west of TW's Bait and Tackle. The Planning Board voted unanimously to recommend approval of the map amendment request as presented. This item is on the Board of Commissioners September 4th Consent Agenda requesting Public Hearing to be held on October 2, 2024.

➢ Consideration of various amendments to the Unified Development Ordinance as it pertains to the use of multi-family dwelling developments. The Planning Board discussed this item at length and voted 5 to 1 to recommend adoption of the Multi-Family Working Group's draft ordinance with several revisions. The Public Hearing for this item is scheduled for the Board of Commissioners September 4th, 2024 meeting.

➢ Discussion of minimum required parking standards for hotel use and restaurant use within the Town. Staff will provide the Planning Board with additional requested information at their September 17th meeting.

➢ Discussion and update on potential Accessory Dwelling Unit (ADU) ordinance and existing conditions within the town. Planning Board members emphasized the importance of hearing from Nags Head citizens, including both supporters of ADUs and those with concerns, before drafting new language. Staff requested that Planning Board members share any groups, organizations, or individuals who should be personally invited to an upcoming meeting. In addition to receiving public comments at their September 17th meeting, an evening session has been scheduled for Wednesday, September 18th, from 6:00 – 7:00 p.m. in the Board Room for residents unable to attend during work hours. This opportunity for public input has been and will continue to be widely advertised through various channels to encourage community participation.

'The Planning Board's next meeting is scheduled for Tuesday, September 17th, 2024. Currently, the agenda is expected to include consideration of a Special Use/Site Plan review for construction of a duplex for the purpose of Town of Nags Head lifeguard housing at 425 W. Health Center Drive, continued discussion on parking standards for hotel and restaurant uses, and continued discussion with community engagement regarding Accessory Dwelling Units (ADU's).

'Board of Adjustment – Recent and Pending Applications

There were no items for the Board of Adjustments consideration in August 2024.

'Additional Updates

- Estuarine Shoreline Management Plan – The Town was awarded a grant of $500,000 under the N.C. Resilient Coastal Communities Program to assist in completing the engineering and design work for the Villa Dunes and Soundside Road estuarine marsh restoration and marsh stabilization projects. It will be November before we know about the NC Land and Water Fund Grant that was applied for to assist with the Harvey Site/OBVB site. Additionally, staff are researching using a combination of Community Conservation Assistance Program (CCAP) funds and Coastal Federation cost share funds for a shoreline stabilization along the causeway.

- Electric Vehicle Action Plan – LoWire Technologies has completed the installation of two- Level II EV chargers at Town Hall. Shoshin is scheduled to install an outside access point for the charging stations. Once we finalize payment and the station management interface, these units will be available for public use. A DEQ representative will conduct an onsite inspection to ensure all grant requirements for reimbursement have been met

- Sand Relocation and Dune Management Cost Share Program – Following the Board of Commissioners' allocation of $400,000 for the FY 24-25 Sand Relocation and Dune Management Cost Share Program, staff is currently reviewing and updating educational materials and the sand relocation application. The application period is expected to open on November 1, 2024, for review purposes only. In preparation, staff will host an educational presentation and Q&A session in mid-October for equipment operators, property owners, and other interested parties interested in participating in this season's program.

'Public Beach and Coastal Waterfront Access Grant Program – Staff has submitted the final application for the improvements at the June Street Beach Access and anticipates receiving notification regarding the grant award by late September or early October.

- Dowdy Park Events/Farmers Market/Holiday Markets/Art & Culture – As summer winds down, so have some of our events. The Dowdy Park Farmers Markets have concluded for the season. The rescheduled evening market was a great success, with strong attendance and positive feedback from vendors on their sales. Family Fun Nights have also wrapped up, and Kids Night was a huge hit. Special thanks to the Nags Head Police and Fire Departments for their participation.

'The Summer Concert Series has ended as well, with Event Coordinator Paige Griffin noting that concert attendance significantly increased this season. There was a growing sense of excitement and community, with many familiar faces returning for each event.

'While Fitness Fridays have concluded, Tuesday morning Yoga sessions will continue through October 22nd.

'Movies in the Park will run over the next several months. The next movie night is scheduled for September 6th, featuring *Twister* starting around 8 p.m. Additional movie nights are planned for October 4th and November 1st.

'Event Coordinator Paige Griffin is currently finalizing the Holiday Market application process. Keep an eye on our website and social media for details!

'Upcoming Meetings and Other Dates

- Tuesday, September 3rd - Technical Review Committee Meeting
- Wednesday, September 4th - Board of Commissioners Meeting
- Thursday, September 11th – Committee for Art and Culture Meeting

- Thursday, September 12th – Board of Adjustment Meeting (no hearings scheduled)
- Thursday, September 12th – CRS Users Group Meeting
- Tuesday, September 17th – Planning Board Meeting
- Wednesday, September 18th – Board of Commissioners mid-month meeting
- Dowdy Park Movie Night, Friday, September 6th at 8pm – TWISTER"

**OLD BUSINESS/ITEMS TABLED FROM PREVIOUS MEETINGS**

From July 3rd Board meeting – Results of Board requested Vanasse Hangen Brustlin, Inc. (VHB) traffic study at the intersection of Lakeside St and Hwy 158

The agenda summary sheet was presented and read in part as follows:

"At the July 3rd Board of Commissioners meeting, the Board reviewed a modification to the site plan for the Whalebone Hotel pertaining to required improvements to W. Lakeside Street. As part of the discussion, the Board expressed concerns about traffic safety at this intersection once the hotel is constructed, not only associated with increased traffic, but also related to pedestrian crossings of US 158 as patrons of the hotel attempt to walk to the beach. The Board expressed a desire to have a signal installed at this intersection. Typically, NCDOT reviews signal requests based on a traffic study, which must demonstrate that certain conditions exist now or in the future that would warrant a signal. A traffic study was completed by the developer initially in 2022. This study showed that the existing and future conditions did not meet the warrants for a signal.

'At the July 2024 meeting, the Board requested that the traffic study be updated to reflect current seasonal traffic data. Staff initiated an update to the study with the original traffic engineer, VHB, Inc. This is now complete, and staff will discuss the results with the Board at the upcoming meeting (see attached)."

Town Engineer David Ryan reviewed the study results with the Board; the study results are attached to and made a part of these minutes as shown in Addendum "I".

Mayor Cahoon suggested putting all options forward to locate the necessary funds for the signal, to include the Mayor contacting someone in Raleigh. It was noted that the buildout date of 2026 is the date used in the analysis to have the traffic required to authorize a traffic signal.

**NEW BUSINESS**

Committee Reports

Comr. Brinkley – Jennette's Pier update was provided: the June and July visitation numbers exceeded last year's numbers and the expectations of pier management; it has been a busy summer with week-long camps and fishing programs; Wind turbines are being inspected by an engineer but there is no timeline yet on installation; Two EV charging stations have been installed.

Comr. Brinkley - Septic Loan Program – he has received requests to extend the time to repay a septic loan to five or seven years.

Consideration of resolution in support of AEC protections for Jockey's Ridge State Park

Mayor Cahoon presented the resolution, for Board consideration, in support of the re-establishment of Jockey's Ridge State Park as an Area of Environmental Concern which would allow it the special protections granted by the designation.

MOTION: Mayor Pro Tem Siers made a motion to adopt the resolution in support of Area of Environmental Control (AEC) protections for Jockey's Ridge State Park as presented. The motion was seconded by Comr. Brinkley which passed unanimously.

The resolution, as adopted, read in part as follows:

"WHEREAS, Jockey's Ridge State Park (JRSP) is the most visited State Park in the state of North Carolina and it is the only state park fully within the boundaries of a town – the Town of Nags Head; AND

'WHEREAS, the North Carolina Coastal Resources Commission (CRC) protects its beautiful and fragile coastal resources thanks in part to the Coastal Area Management Act and the rules and policies of the CRC; AND

'WHEREAS, JRSP is an existing State Park, a nature preserve, and contains unique geological formations as identified by the State Geologist, and therefore meets the criteria of AEC designation as established in G.S. 113A-113; AND

'WHEREAS, G.S. 113A-115 states that AECs should not be deleted unless it is found that the conditions upon which the original designation was based have been substantially altered; AND

'WHEREAS, at an August 6, 2024 Special Meeting, the North Carolina Coastal Resources Commission (CRC) voted unanimously to begin the process of reinstituting Area of Environmental Concern (AEC) protections for JRSP to include a prohibition on removing sand from the Park and restrictions on development immediately adjacent to the Park; AND

'WHEREAS, JRSP is an important educational, scientific, and scenic resource that would be jeopardized by uncontrolled or incompatible development; AND

'WHEREAS, the preservation of this valuable resource of more than local significance is the objective of this designation; AND

'WHEREAS, a Public Hearing regarding the AEC for JRSP is scheduled to be held at the JRSP Community Room in the Park's Visitor's Center, 300 W Carolista Dr, Nags Head, NC 27959, on Tuesday, October 15, 2024, at 1:00 P.M.

'NOW, THEREFORE, BE IT RESOLVED THAT THE BOARD OF COMMISSIONERS OF THE TOWN OF NAGS HEAD, NORTH CAROLINA, does hereby formally submit this resolution in support of the re-establishment of Jockey's Ridge State Park as an Area of Environmental Concern and allow it the special protections granted by the designation."

## ITEMS REFERRED TO AND PRESENTATIONS FROM TOWN MANAGER

Town Manager Garman - Update on construction of the Public Services Facility

Town Engineer David Ryan provided an update on the construction of the Public Services Facility. The Fleet and Sanitation building is partially occupied; two of the fleet maintenance bays are occupied; lift installation

delayed occupancy of the third bay but this should be done soon; the Equipment Bldg is several weeks away from occupancy; the Vehicle Storage Bldg has a mid-November construction completion timeframe.

**BOARD OF COMMISSIONERS AGENDA**

Comr. Brinkley – Multi-Family Workshop

Comr. Brinkley noted that there are two weeks to the date of the Multi-Family Workshop (on September 18th) and he encouraged staff to actively promote the workshop as much as possible to encourage participation.

Comr. Brinkley – Nags Head Lifesaving Station Marker

Comr. Brinkley spoke of the Nags Head Lifesaving Station Marker that Ralph Buxton brought forward in his presentation at last month's Board meeting. It was Board consensus to concur with the marker and Comr. Brinkley said that he would work with Mr. Buxton on finding the location.

Comr. Sanders – Water leak at his restaurant

Comr. Sanders spoke of a recent water leak at his restaurant that staff found via the new AMI Smart Meter water software and he was able to fix and repair the leak before major damage was done. He thanked staff for their assistance.

**MAYOR'S AGENDA**

Recognition of ten years of service - Town Manager Andy Garman

Mayor Cahoon recognized Town Manager Andy Garman for ten years of service, noting that he also worked for the Town from 2000 to 2005. He presented Manager Garman with a $40 gift card as ten year service employees receive.

**CLOSED SESSION**

MOTION: Mayor Cahoon made a motion to enter Closed Session to confer with the Board re: matters related to attorney/client privilege and to preserve that privilege, pursuant to GS 143-318.11(a)(3) and to discuss the possible acquisition of real property located at 4222 S Croatan Highway pursuant to GS 143-318.11(a)(5). The motion was seconded by Comr. Brinkley which passed unanimously. The time was 12:14 p.m.

**OPEN SESSION**

The Board re-entered Open Session at 12:30 p.m. Attorney Leidy reported that during Closed Session the Board did discuss matters within attorney/client privilege, did give direction to the Town Attorney and no actions were taken.

**ADJOURNMENT**

MOTION: Mayor Cahoon made a motion to recess to a mid-month Multi-Family Workshop on Wednesday, September 18th at 9 am in the Board Room. The motion was seconded by Comr. Brinkley which passed unanimously. The time was 12:31 p.m.

_____
Carolyn F. Morris, Town Clerk

Date Approved: _____

Mayor: _____
Benjamin Cahoon

***DRAFT* MINUTES**
**TOWN OF NAGS HEAD**
**BOARD OF COMMISSIONERS**

**MULTI-FAMILY/WORKFORCE HOUSING WORKSHOP**

**WEDNESDAY, SEPTEMBER 18, 2024**

The Nags Head Board of Commissioners met at the Board Room located at 5401 S Croatan Highway, Nags Head, North Carolina on Wednesday, September 18, 2024 at 9:00 a.m. for a Recessed Meeting/Workshop.

Board members Present: Mayor Ben Cahoon; Mayor Pro Tem Michael Siers; Comr. Kevin Brinkley; Comr. Bob Sanders; and Comr. Megan Lambert

Board members Absent: None

Others present: Town Manager Andy Garman; Kelly Wyatt; David Ryan; Joe Costello; Karen Snyder; Paula Houck; Gary Houck; Terry Brown; David Roberts; Donna Creef; Amanda Kornegay; Kenneth and Kathleen Morgan; Duke Geraghty; Bob Muller; Hilary McCubbins; David Shufflebarger; Wayne and Becky Varilek; Valerie Netsch; Megan Oaksmith; Sam Gonzales; Mark Dunlevy; David Elder; Dave Carawan; Bill Simmons; Susan Lee; Clara and Steve Smiley; Lauren Nelson; Meade Gwinn; and Town Clerk Carolyn F. Morris

## CALL TO ORDER

Mayor Cahoon called the meeting to order at 9 am. He expressed his appreciation of everyone coming out to listen to and speak on the important topic of multi-family dwellings.

Mayor Cahoon explained that the workshop will be less formal than regular meetings with a presentation followed by public comments and some exchange with Board members. The discussion concerns an ordinance that applies to the commercial district (C-2) – not about a specific piece of property. The ordinance would reintroduce multi-family housing into the town code. The Sugar Creek condominiums and other projects were built under the old multi-family ordinance which was struck from the Town Code by the Board two years ago over affordable housing concerns.

Multi-Family / Workforce Housing Workshop

Town Manager Andy Garman presented slides summarizing the background, process, and final draft ordinance on the Multi-Family/Workforce Housing issue. His slides are attached to and made a part of these minutes as shown in Addendum "A".

Manager Garman presented the Final Draft Ordinance that the Board will consider at their October 2nd Board meeting which does the following:

- Modifies the Planning Board recommendation as follows:
  - Allows apartments and townhouses in the large category
  - Parking is required at 2 spaces per dwelling unit + 1 space for every four units
  - A cap of no more than 3 multi-family developments can be approved under large category
- Maintains the 25 bedrooms per acre limitation
- Clarifies that the HOA is responsible for enforcing deed restrictions and reporting to the town

Town Manager Garman noted the extensive public notification of the ordinance and of today's workshop.

Mayor Cahoon invited those present to speak.

David Shufflebarger, Nags Head resident; he applauded the revisions presented to include the addition of apartments and suggested increasing the square footage limit to 11,000 to allow for a 3-story unit.

Donna Creef, Outer Banks Association of Realtors, Government Affairs rep, she served on the working group which was a good process - it was a good blend of what the Planning Board had done; the housing workforce language is a positive step; idea of the cap should be carefully considered as once it is in the ordinance, it is there; she is not sure the annual cap is needed here at the beginning of the ordinance and suggested an annual review; she thanked the Board for today's workshop.

Duke Geraghty, Outer Banks Homebuilders Association Government Affairs rep, he served on the working group; his concerns are square foot limit – it would be nice to lower that limit to get more units on a lot; the highest and best use are short term rentals; he suggested rethinking the cap and to consider a review of the ordinance in a year; no regulations on cost since it is multi-family and not an affordable housing ordinance.

Amanda Kornegay, Carolinian Circle resident; she questioned why go from 10 to 11 bedrooms per acre up to 25 bedrooms per acre; Town Manager Garman explained that it was units per acre and now it is bedrooms per acre; she expressed concern about the Kelly's site and how bad it looks; if a multi-family unit is built there, how would that affect their septic, traffic, etc; she stated that Carolinian Circle property owners are very concerned and she asked the Board to please consider these concerns. Mayor Cahoon confirmed with Manager Garman that large projects would be a conditional use and would have to be approved by the Planning Board and then the Board of Commissioners; all Town Code, wastewater, and stormwater regulations would have to be met in addition to the required vegetative buffers during the site plan process; it was noted that the C-2 district allows multiple types of uses.

David Elder, Planning Board member and Carolinian Circle resident; he expressed concern with not only what property is available presently but other properties that could be considered.

Lauren Nelson, Nags Head resident; she questioned the 60% workforce regulation definition; she also pointed out that the townhouse style is contradictory to the multi-family definition. Manager Garman read the Workforce Housing definition on the screen which includes that someone must be working in Dare County.

Dave Carawan, Nags Head Cove resident; workforce housing is the biggest problem that affects most communities – more than anything he is curious where people come from; he's astounded by how many travel from other counties to work here; this is just one piece of a bigger puzzle; this is our responsibility to solve; he suggested that we reach out to other communities and make sure they are passing ordinances and working together to help with this issue; he doesn't want to lose opportunities if there is not enough workforce here.

Sam Gonzales, relatively new resident; accessory dwelling units (ADU's) are also being discussed as a possible solution to the need for multi-family dwellings; he questioned what the Homeowner's Associations' perspective

would be on this. Mayor Cahoon said that at some point the Town has to make sure the appropriate documents are being recorded, are meeting the Town's needs, and are enforceable.

Hilary McCubbins, Nags Head resident; she felt that deed restrictions would be more valuable for enforcing the small multi-family regulations and expressed her concern with small developments having so few property owners with a stake in it.

Town Manager Garman stated that the deed restrictions will apply to any of the multi-family projects – the HOA enforcement would be the second layer. Mayor Cahoon noted that for the smaller units, 100% of the residents have to be workforce housing. Town Manager Garman also noted that each project will require a zoning permit – which is another layer of review.

Bill Simmons, Nags Head Pond resident; the HOA is good to have but he is aware that the Nags Head Pond HOA does not have the funds to hire a lawyer to enforce a covenant; he is also concerned about the C-2 District and the Kelly's site which is one of the busiest intersections in Nags Head; when you add 100 people to that area, this will be a large impact on that intersection. Mayor Cahoon pointed out that with conditional uses, the Town can impose certain restrictions to help with specific issues.

Valerie Netsch, Nags Head resident; she feels that this is great progress; she appreciates having a cap; everything should be in writing and she would like to see in writing that any unit cannot be turned into a short term rental or Air-BNB for a number of years. Mayor Cahoon explained that the HOA enforcement is one level but the deed restriction, that would have to be recorded before final BOC approval, it is perpetual and goes with the building.

Paula Houck, Nags Head property owner/MD resident; this community is head and shoulders above other communities; if the HOA is bankrupt and can't take people to court, it would fall to the county, what she sees as a problem is no impact fees and questions why no one requires developers to pay impact fees; she left a "Social Host" ordinance with Town staff for consideration.

Susan Lee, Nags Head resident; she has HOA concerns; those who were active in the HOA in her neighborhood are now gone; there are lots of cases in her neighborhood but they can't afford attorneys; she questioned what can communities do if the HOA is the first line of defense or one without an HOA. Mayor Cahoon addressed the HOA concern - the deed restrictions go with the property and the Town would impose, regardless of what the HOA does or does not do; Town Manager Garman said that the HOA would be required to be formed and each unit would be required to be a member to record who is living there and make sure they are meeting the workforce housing requirements; the Town would do the enforcement of what is in the ordinance. Mayor Cahoon said that the concern is how the units will be occupied and the Town has the tools to enforce that.

Wayne Varilek, Nags Head resident, over time there may not be compliance with no one qualifying in the home due to death, moving out, etc. Planning Director Kelly Wyatt said that it would be on a case-by-case scenario when those types of things happen with no intention to remove the family or the rest of the members if that qualifying person should no longer be in the unit.

Mark Dunlevy, Old Nags Head Cove resident; questioned if the Town has considered occupancy requirements for these units; at times they have seen neighbors renting their bedrooms to 14 people. Town Manager Garman said that the County Health Dept addresses occupancy requirements and the standard is 2 persons per bedroom.

Hilary McCubbins, Nags Head resident; she said that after yesterday's storm, she is worried about the large multi-family projects, and stormwater issues – there need to be more permeable surfaces. Mayor Cahoon stated that development standards for stormwater are not in this ordinance but are in another part of the ordinance. Town Manager Garman said that lot coverage for commercial uses in C-2 is 55% and parking lots have to be at least 20% permeable and stormwater management also has to be adhered to – the Town requires

almost three times what the state requires. Mayor Cahoon noted that flooding issues in a neighborhood are fixed on a case-by-case basis as was the case with Old Nags Head Place. Comr. Sanders asked about open space and Manager Garman explained the requirement for the amount of open space required for a commercial development.

Kenneth Morgan, Nags Head resident; he has not heard anyone mention any traffic surveys being done and if a traffic signal would be warranted coming out of the Kelly's neighborhood; Coordination of traffic flow is not easy and takes long-term study; he also questioned housing for the four-month rush of employees needed. Mayor Cahoon responded that this effort is to address one piece of the problem – the need for short-term employee housing on the Outer Banks is a separate problem with a separate solution.

Town Engineer David Ryan responded to Mr. Morgan that for large projects a traffic impact analysis can be required of the developer by the Town; that area is very congested and after analysis, staff would coordinate with NCDOT as they are the ultimate authority for installation of any type of traffic signal.

**NEXT STEPS**

Mayor Cahoon explained that the next step would be that the proposed ordinance, as outlined by Manager Garman, would come back to the Board of Commissioners at the October 2nd Board meeting. He mentioned the possibility for additional public comment at that time; the Board may vote on the proposed ordinance at that time.

Mayor Cahoon thanked everyone for coming to today's workshop as well as the Board for allowing this additional opportunity to hear comments and to staff for the new draft ordinance and for pushing notification of the workshop to the public.

Comr. Lambert stated how nice it was to walk in and see so many people at today's workshop and to see so much interest in the multi-family dwelling issue.

Mayor Pro Tem Siers thanked everyone for coming to today's workshop; he appreciated the community input.

Comr. Brinkley thanked everyone for coming to today's workshop and providing input.

Comr. Sanders felt like he received a lot of great information and feedback today and was very appreciative.

Mayor Cahoon said that he looks forward to getting the best ordinance possible back on the books.

Town Manager Garman expressed his appreciation of the work done by the Planning Board, the Working Group, and the Board of Commissioners on this issue.

**ADJOURNMENT**

It was Board consensus to adjourn the workshop; the time was 10:30 a.m.

_____
Carolyn F. Morris, Town Clerk

Date Approved: _____

Mayor: _____
Benjamin Cahoon

# Agenda Item Summary Sheet

Item No: **E-4**
Meeting Date: **October 2, 2024**

**Item Title**: Consideration of seventh amendment to Verizon lease of Town Hall monopole

**Item Summary**:

At the October 2nd Board of Commissioners meeting, Board members will consider the attached seventh amendment to the Ground and Water Tank Agreement between the Town and Cellco Partnership D/B/A Verizon Wireless. This amendment is being requested to reflect changes to the current Verizon Tower equipment.

Attached please find the Seventh Amendment agreement including an updated Exhibit D-7 – Description of Tower Equipment for Board approval. An updated Structural Analysis Report is provided for information.

TEP structural engineering has sealed the structural analysis. A building permit will be issued upon Board approval. TEP will conduct a post-construction inspection.

Number of Attachments: 2

**Specific Action Requested**:

Provided for Board review and approval.

Submitted By: Administration Date: September 27, 2024

**Finance Officer Comment**:

This is a zero-dollar amendment as the load is being reduced. Rent shall continue to escalate as set forth in the Agreement. Approval will be contingent upon attorney review/comment.

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:

I concur with the request.

Signature: Andy Garman Date: September 27, 2024

# SEVENTH AMENDMENT TO GROUND AND WATER TANK AGREEMENT

This Seventh Amendment to Ground and Water Tank Agreement ("Seventh **Amendment**") is made this __ day of _____, 20___, by and between **TOWN OF NAGS HEAD, NORTH CAROLINA** ("**Owner**") and **CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS** ("**Tenant**"). Owner and Tenant are at times collectively referred to hereinafter as the "**Parties**" or individually as the "**Party**".

**WHEREAS,** Owner and Tenant entered into a Ground and Water Tank Lease Agreement dated June 2, 2004, as amended by that certain First Amendment to Ground and Water Tank Lease Agreement dated July 14, 2010, as amended by that certain Second Amendment to Ground and Water Tank Lease Agreement dated March 8, 2012, as amended by that certain Third Amendment to Ground and Water Tank Agreement dated April 24, 2014, as amended by that certain Fourth Amendment to Ground and Water Tank Agreement dated January 29, 2015, as amended by that certain Fifth Amendment to Ground and Water Tank Agreement dated July 23, 2015, and as amended by that certain Sixth Amendment to Ground and Water Tank Agreement dated October 16, 2017, (collectively, the "**Agreement**") whereby Tenant leases from Owner certain space at 5401 South Croatan Highway, Town of Nags Head, North Carolina, as further described in the Agreement;

**WHEREAS,** Owner subsequently dismantled the Water Tank and constructed a communications tower (the "Tower") on the Property, and Tenant removed its antennas from the Water Tanks and installed its antennas and related equipment on the Tower.

**WHEREAS,** the Parties desire to amend the Agreement in order to amend Tenant's equipment on the premises.

**NOW, THEREFORE,** for good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the Parties hereto agree to be legally bound to this Seventh Amendment as follows:

1. The above recitals are incorporated herein by reference. Except as expressly set forth in this Seventh Amendment, all defined terms herein used shall have the same meaning as set forth in the Agreement.

2. Exhibit D-6 to the Agreement is hereby deleted in its entirety and replaced with **Exhibit D-7**, attached hereto and incorporated herein. In the event of any discrepancy between Exhibit D-6 and Exhibit D-7, **Exhibit D-7** shall control.

3. Rent shall continue to escalate as set forth in the Agreement.

4. All remaining provisions of the Agreement shall remain in full force and effect as to all other terms and conditions and shall remain binding on the Parties hereto. The Parties hereby ratify the Agreement, as amended by this Seventh Amendment.

5. The Agreement and this Seventh Amendment contain all agreements, promises or understandings between the Parties. No oral agreements, promises or understandings shall be binding upon either Party in any dispute, controversy or proceeding at law. Any addition, variation or modification to the Agreement and/or this Seventh Amendment shall be void and ineffective unless made in writing and signed by the Parties. In the event any provision of the Agreement and/or this Seventh Amendment is found to be invalid, or unenforceable, such a finding shall not affect the validity and enforceability of the remaining provisions of the Agreement and/or this Seventh Amendment. Each of the Parties hereto warrants to the other that the

person or persons executing this Seventh Amendment on behalf of such Party has the full right, power and authority to enter into and execute this Seventh Amendment on such Party's behalf and that no consent from any other person or entity is necessary as a condition precedent to the legal effect of this Seventh Amendment.

[REMAINDER OF PAGE LEFT BLANK]

**IN WITNESS WHEREOF,** the Parties have executed this Seventh Amendment as of the date first written above.

OWNER:

**TOWN OF NAGS HEAD,**
**NORTH CAROLINA**

_____
Witness

By:_____
Name: Benjamin Cahoon
Title: Mayor
Date:_____

TENANT:

**CELLCO PARTNERSHIP**
**d/b/a Verizon Wireless**

_____
Witness

By:_____
Name: _____
Title: _____
Date:_____

**EXHIBIT D-7**
**DESCRIPTION OF TOWER EQUIPMENT**

Tenant's Tower Equipment:

| | |
|---|---|
| Antennas: | Nine (9) total<br>Six (6) Commscope NHH-65C-R2B<br>Three (3) MT6413-77A |
| Lines: | Two (2) total<br>Two (2) Hybriflex lines |
| Distribution Boxes: | Two (2) RVZDC6627-PF-48 |
| Remote Radio Heads: | Six (6) total<br>Three (3) B2/B66A RRH ORAN (RF4439d-25A)<br>Three (3) RF4461d-13A |

**July 18, 2024**

**NC LIC# P-1403**

Susan Lankford
Dewberry Engineers Inc.
8401 Arlington Blvd.
Fairfax, VA 22031
(919) 424-3722

Tower Engineering Professionals
326 Tryon Road
Raleigh, NC 27603
(919) 661-6351
Structures@tepgroup.net

**Subject:** **Structural Analysis Report**

***Carrier Designation:*** ***Verizon Wireless*** **Reconfiguration**

***Client Designation:*** **Site Number:** N/A
**Site Name:** Nags Head

***Engineering Firm Designation:*** **TEP Project Number:** 73857.976701

***Site Data:*** **5401 South Croatan Hwy, Nags Head, Dare County, NC 27959**
**Latitude *35° 56' 2.23"*, Longitude *-75° 36' 43.00"***
**174.0± Foot - Monopole**

Dear Susan Lankford,

*Tower Engineering Professionals* is pleased to submit this **"Structural Analysis Report"** to determine the structural integrity of the above-mentioned tower.

The purpose of the analysis is to determine acceptability of the tower stress level. Based on our analysis we have determined the stress level for the tower and foundation structure, under the following load case, to be:

LC1: Existing + Proposed + Reserved Loading **Sufficient Capacity**
Note: See Table 1 for the existing, proposed, and reserved loading

| Structure Capacity | Foundation Capacity |
|---|---|
| 86.9% | - |

The analysis has been performed in accordance with the ANSI/TIA-222-G-2-2009 Structural Standard for Antenna Supporting Structures, Antennas, and Small Wind Turbine Support Structures and the 2018 North Carolina State Building Code.

All modifications and equipment proposed in this report shall be installed in accordance with the appurtenances listed in Table 1 for the determined available structural capacity to be effective.

We at *Tower Engineering Professionals* appreciate the opportunity of providing our continuing professional services to you and *Dewberry.* If you have any questions or need further assistance on this or any other projects please give us a call.

Respectfully submitted by:

Aaron T. Rucker, P.E.

NORTH CAROLINA PROFESSIONAL SEAL 042120 ENGINEER AARON T. RUCKER

07/19/2024

## TABLE OF CONTENTS

**1) INTRODUCTION**

**2) ANALYSIS CRITERIA**
Table 1 - Existing, Proposed, and Reserved Antenna and Cable Information

**3) ANALYSIS PROCEDURE**
Table 2 - Documents Provided
3.1) Analysis Method
3.2) Assumptions

**4) ANALYSIS RESULTS**
Table 3 - Section Capacity (Summary)
Table 4 - Tower Component Stresses vs. Capacity
Table 5 - Dish Twist/Sway Results for 60 mph Service Wind Speed
4.1) Recommendations

**5) APPENDIX A**
tnxTower Output

**5) APPENDIX B**
Additional Calculations

## 1) INTRODUCTION

This tower is a 174.0-ft monopole tower**.** The original design standard and wind speed were unavailable for review. TEP visited the site in October of 2023 to gather tower steel and appurtenance information. All information provided to TEP was assumed to be accurate and complete.

## 2) ANALYSIS CRITERIA

| | |
|---|---|
| **TIA-222 Revision:** | ANSI/TIA-222-G-2-2009 |
| **Type of Analysis:** | Feasibility |
| **Risk Category:** | II |
| **Wind Speed:** | 104 mph (Nominal) |
| **Exposure Category:** | D |
| **Topographic Procedure:** | Method 1 (Kzt = 1.0) |
| **Ice Thickness:** | 0.25 in |
| **Wind Speed with Ice:** | 30 mph |
| **Seismic Design Category:** | B |
| **Seismic Ss:** | 0.076 |
| **Seismic S1:** | 0.044 |
| **Service Wind Speed:** | 60 mph |

**Table 1 - Existing, Proposed, and Reserved Antenna and Cable Information**

| Existing/ Proposed/ Reserved | Mount Level (ft) | Ant CL (ft) | Qty | Antenna Model | Mount Type | Qty Coax | Coax Size | Coax Location | Owner/ Tenant |
|---|---|---|---|---|---|---|---|---|---|
| Existing | 170.0 | 170.0 | 6 | Commscope NNH4-65C-R6-V3 | Square Platform Mount | 12<br>4<br>2<br>1<br>2 | 1-5/8<br>3/4<br>3/8<br>5/16<br>2" Conduit | Inside | AT&T |
| | | | 3 | 72" X 12" X 7" Panel Antenna | | | | | |
| | | | 3 | Ericsson RADIO 4449 | | | | | |
| | | | 3 | Ericsson RADIO 4426 | | | | | |
| | | | 3 | Ericsson RADIO 4478 | | | | | |
| | | | 6 | Ericsson RRUS 32 | | | | | |
| | | | 4 | ANDREW E15S09P94 | | | | | |
| | | | 3 | Raycap DC6-48-60-18-8F | | | | | |
| ***Proposed*** | ***161.0*** | ***161.0*** | ***3*** | ***Commscope NHH-65C-R2B*** | (3)T-Arm Mount | ***-*** | ***-*** | ***-*** | ***Verizon*** |
| | | | ***3*** | ***Samsung MT6413-77A*** | | | | | |
| | | | ***3*** | ***Samsung B2/B66A RRH ORAN (RF4439d-25A)*** | | | | | |
| | | | ***3*** | ***Samsung RF4461d-13A*** | | | | | |
| | | | ***2*** | ***RVZDC-6627-PF-48 OVP*** | | | | | |
| Existing | 161.0 | 161.0 | 3 | Commscope NHH-65C-R2B | | 2 | 1-5/8 Hybrid | Inside | Verizon |
| *To Be Removed* | *161.0* | *161.0* | *3* | *Andrew HBXX-6517DS A2M* | *-* | *12* | *1-5/8* | *Inside* | *Verizon* |
| | | | *6* | *CSS X7C-FRO-860-VR0* | | | | | |
| | | | *3* | *Nokia B66A RRH 4x45* | | | | | |
| | | | *3* | *Alcatel Lucent B13 RRH4x30* | | | | | |
| | | | *3* | *Alcatel Lucent B25 RRH 4x30* | | | | | |
| | | | *3* | *Nokia 13.75" X 12.5" X7.5"* | | | | | |
| | | | *6* | *Commscope CBC78T-DS-43* | | | | | |
| | | | *2* | *Raycap RHSDC-3315-PF-48* | | | | | |

| Existing/ Proposed/ Reserved | Mount Level (ft) | Ant CL (ft) | Qty | Antenna Model | Mount Type | Qty Coax | Coax Size | Coax Location | Owner/ Tenant |
|---|---|---|---|---|---|---|---|---|---|
| Existing | 148.0 | 148.0 | 3 | Cellmax CMA-BDHH/6521/E0-6/RET | Circular Platform Mount | 3 | 1-3/4 Hybrid | Inside | T-Mobile |
| | | | 3 | 96” X 24” X 8” Panel Antenna | | | | | |
| | | | 3 | Ericsson AIR 6449 B41 | | | | | |
| | | | 3 | ERICSSON RADIO 4415 | | | | | |
| | | | 3 | ERICSSON RADIO 4449 | | | | | |
| | | | 3 | ERICSSON RADIO 2212 | | | | | |
| Existing | 120.0 | 129.0 | 1 | Amphenol 4220.09-445Txx | Standoff Mount | 1 | 7/8 | Inside | Nags Head |
| Existing | 114.5 | 117.0 | 1 | 5-FT OMNI | Sidearm Mount | 1<br>1 | 1-5/8<br>1/2 | Inside | County |

## 3) ANALYSIS PROCEDURE

**Table 2 - Documents Provided**

| Document | Remarks | Source |
|---|---|---|
| Tower Mapping Report | Tower Engineering Professionals, Inc., October 23, 2023<br>TEP No. 73857.860919 | TEP |
| Previous Structural Analysis | Tower Engineering Professionals, Inc., October 31, 2023<br>TEP No. 73857.860920 | TEP |
| Correspondence | Correspondence in reference to the existing, proposed, and reserved loading. | Dewberry |

### 3.1) Analysis Method

tnxTower (version 8.2.4.3), a commercially available analysis software package, was used to create a three-dimensional model of the tower and calculate member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

### 3.2) Analysis Assumptions

1) The tower and foundation were built and maintained in accordance with the manufacturer's specification.
2) The configuration of existing antennas, transmission cables, mounts and other appurtenances are as specified in the tower mapping report by TEP.
3) Unless specified by the client or tower mapping, the location of the existing and proposed coax is assumed by TEP and listed in Table 1.
4) All tower components are in sufficient condition to carry their full design capacity.
5) Serviceability with respect to antenna twist, tilt, roll, or lateral translation, is not checked and is left to the carrier or tower owner to ensure conformance.
6) All antenna mounts and mounting hardware are structurally sufficient to carry the full design capacity requirements of appurtenance wind area and weight as provided by the original manufacturer specifications. It is the carrier's responsibility to ensure compliance to the structural limitations of the existing and/or proposed antenna mounts. TEP did not analyze antenna supporting mounts as part of this structural analysis report.
7) The following material grade were assumed:
   a) Tower shaft grade: ASTM A572-65
   b) Anchor bolts: ASTM A615-75
   c) Base plate: ASTM A572-50

This analysis may be affected if any assumptions are not valid or have been made in error. Tower Engineering Professionals should be notified to determine the effect on the structural integrity of the tower.

## 4) ANALYSIS RESULTS

**Table 3 - Section Capacity (Summary)[1]**

| Section No. | Elevation (ft) | Component Type | Size | Critical Element | P (lb) | $\phi P_{allow}$ (lb) | % Capacity | Pass / Fail |
|---|---|---|---|---|---|---|---|---|
| L1 | 174 - 144.17 | Pole | TP27.89x19.125x0.1875 | 1 | -11032.50 | 1055210.00 | 67.8 | Pass |
| L2 | 144.17 - 94.4 | Pole | TP42.14x26.513x0.3125 | 2 | -20750.00 | 2755060.00 | 86.9 | Pass |
| L3 | 94.4 - 46.05 | Pole | TP55.72x39.9987x0.375 | 3 | -35140.10 | 4217740.00 | 83.8 | Pass |
| L4 | 46.05 - 0 | Pole | TP68.5x52.9604x0.4375 | 4 | -58297.30 | 6044450.00 | 76.4 | Pass |
| | | | | | | | Summary | |
| | | | | | | Pole (L2) | 86.9 | Pass |
| | | | | | | **RATING =** | **86.9** | **Pass** |

**Table 4 - Tower Component Stresses vs. Capacity**

| Notes | Component | Elevation (ft) | % Capacity | Pass / Fail |
|---|---|---|---|---|
| 1 | Anchor Rods | - | 80.7 | Pass |
| 1 | Base Plate | - | 58.0 | Pass |

| Structure Rating (max from all components)[1] = | 86.9% |
|---|---|

Notes:
1) See additional documentation in "Appendix B - Additional Calculations" for calculations supporting the % capacity listed.

**Table 5 - Dish Twist/Sway Results for 60 mph Service Wind Speed**

| Elevation (ft) | Dish Model | Beam Deflection | | |
|---|---|---|---|---|
| | | Deflection (in) | Tilt (deg) | Twist (deg) |
| - | - | - | - | - |

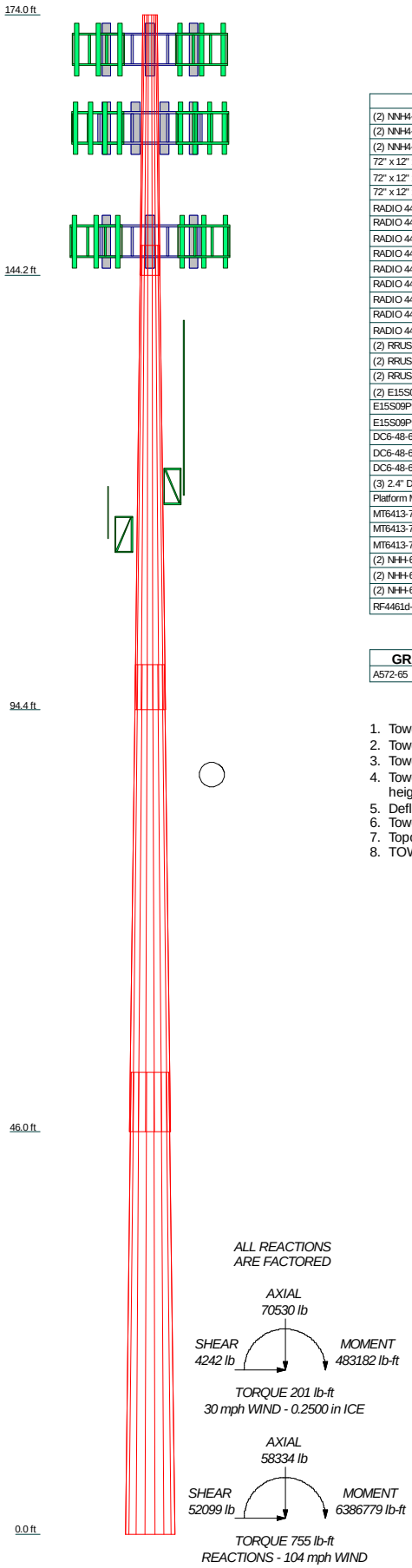
### 4.1 ) Recommendations

1) If the load differs from that described in Table 1 of this report or the provisions of this analysis are found to be invalid, another structural analysis should be performed.
2) The tower has sufficient capacity to carry the existing, proposed, and reserved loading. No modifications are required at this time.
3) TEP did not have sufficient information to perform a foundation analysis. Provide TEP with foundation drawings and/or a geotechnical report for this site in order to determine the substructure capacity. If this information is not available, TEP recommends a foundation mapping and/or geotechnical investigation.
4) Prior to acceptance of changed configuration a rigorous structural analysis shall be performed in order to determine the overall stability and the adequacy of the structural members, foundations and connections.

## APPENDIX A

## TNX TOWER OUTPUT

| Section | Length (ft) | Number of Sides | Thickness (in) | Socket Length (ft) | Top Dia (in) | Bot Dia (in) | Grade | Weight (lb) |
|---|---|---|---|---|---|---|---|---|
| 1 | 29.83 | 18 | 0.1875 | 3.41 | 19.1250 | 27.8900 | | 1408.7 |
| 2 | 53.18 | 18 | 0.3125 | 5.16 | 26.5130 | 42.1400 | | 6105.2 |
| 3 | 53.51 | 18 | 0.3750 | 6.84 | 39.9987 | 55.7200 | | 10291.0 |
| 4 | 52.89 | 18 | 0.4375 | | 52.9604 | 68.5000 | | 15068.1 |
| | | | | | | | A572-65 | 32873.0 |




## DESIGNED APPURTENANCE LOADING

| TYPE | ELEVATION | TYPE | ELEVATION |
|---|---|---|---|
| (2) NNH4-65C-R6-V3 w/ Mount Pipe | 170 | RF4461d-13A | 161 |
| (2) NNH4-65C-R6-V3 w/ Mount Pipe | 170 | RF4461d-13A | 161 |
| (2) NNH4-65C-R6-V3 w/ Mount Pipe | 170 | B2/B66A RRH-BR049 | 161 |
| 72" x 12" x 7" Panel w/ Mount Pipe | 170 | B2/B66A RRH-BR049 | 161 |
| 72" x 12" x 7" Panel w/ Mount Pipe | 170 | B2/B66A RRH-BR049 | 161 |
| 72" x 12" x 7" Panel w/ Mount Pipe | 170 | (2) RVZDC-6627-PF-48 | 161 |
| RADIO 4449 | 170 | T-Arm Mount [TA 701-3] | 161 |
| RADIO 4449 | 170 | CMA-BDHH/6521/E0-6 w/ mount pipe | 148 |
| RADIO 4449 | 170 | CMA-BDHH/6521/E0-6 w/ mount pipe | 148 |
| RADIO 4426 | 170 | CMA-BDHH/6521/E0-6 w/ mount pipe | 148 |
| RADIO 4426 | 170 | 96"x24"x5" w/ Mount Pipe | 148 |
| RADIO 4426 | 170 | 96"x24"x5" w/ Mount Pipe | 148 |
| RADIO 4478 | 170 | 96"x24"x5" w/ Mount Pipe | 148 |
| RADIO 4478 | 170 | AIR 6449 B41 w/ Mount Pipe | 148 |
| RADIO 4478 | 170 | AIR 6449 B41 w/ Mount Pipe | 148 |
| (2) RRUS 32 | 170 | AIR 6449 B41 w/ Mount Pipe | 148 |
| (2) RRUS 32 | 170 | RADIO 4415 | 148 |
| (2) RRUS 32 | 170 | RADIO 4415 | 148 |
| (2) E15S09P94 | 170 | RADIO 4415 | 148 |
| E15S09P94 | 170 | RADIO 4449 | 148 |
| E15S09P94 | 170 | RADIO 4449 | 148 |
| DC6-48-60-18-8F | 170 | RADIO 4449 | 148 |
| DC6-48-60-18-8F | 170 | RADIO 2212 | 148 |
| DC6-48-60-18-8F | 170 | RADIO 2212 | 148 |
| (3) 2.4" Dia. x 9-ft Pipe | 170 | RADIO 2212 | 148 |
| Platform Mount [LP 1304-1_HR-1] | 170 | 2L3x3x3/16 x 13ft | 148 |
| MT6413-77A w/ Mount Pipe | 161 | 2L3x3x3/16 x 13ft | 148 |
| MT6413-77A w/ Mount Pipe | 161 | 2L3x3x3/16 x 13ft | 148 |
| MT6413-77A w/ Mount Pipe | 161 | Miscellaneous [NA 506-1] | 148 |
| (2) NHH-65C-R2B w/ Mount Pipe | 161 | 4220.09-445-TXX | 120 |
| (2) NHH-65C-R2B w/ Mount Pipe | 161 | Side Arm Mount [SO 203-1] | 120 |
| (2) NHH-65C-R2B w/ Mount Pipe | 161 | 5' x 12" dia Omni | 114.5 |
| RF4461d-13A | 161 | Side Arm Mount [SO 302-1] | 114.5 |

## MATERIAL STRENGTH

| GRADE | Fy | Fu | GRADE | Fy | Fu |
|---|---|---|---|---|---|
| A572-65 | 65 ksi | 80 ksi | | | |

## TOWER DESIGN NOTES

1. Tower is located in Dare County, North Carolina.
2. Tower designed for Exposure D to the TIA-222-G Standard.
3. Tower designed for a 104 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 30 mph basic wind with 0.25 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Structure Class II.
7. Topographic Category 1 with Crest Height of 0.00 ft
8. TOWER RATING: 86.9%


Tower Engineering Professionals, Inc.

**Tower Engineering Professionals, Inc.**
326 Tryon Road
Raleigh, NC 27603
Phone: (919) 661-6351
FAX: (919) 661-6350


| | | | |
|---|---|---|---|
| Job: **Nags Head** | | | |
| Project: **TEP No. 73857.976701** | | | |
| Client: Dewberry | Drawn by: Ethan L. Gardner | App'd: | |
| Code: TIA-222-G | Date: 07/18/24 | Scale: NTS | |
| Path: | | Dwg No. E-1 | |

## Tower Input Data

The tower is a monopole.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

Tower is located in Dare County, North Carolina.
Basic wind speed of 104 mph.
Structure Class II.
Exposure Category D.
Topographic Category 1.
Crest Height 0.00 ft.
Nominal ice thickness of 0.2500 in.
Ice thickness is considered to increase with height.
Ice density of 56 pcf.
A wind speed of 30 mph is used in combination with ice.
Deflections calculated using a wind speed of 60 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

## Options

| | | |
|---|---|---|
| Consider Moments - Legs | Assume Legs Pinned | Calculate Redundant Bracing Forces |
| Consider Moments - Horizontals | √ Assume Rigid Index Plate | Ignore Redundant Members in FEA |
| Consider Moments - Diagonals | √ Use Clear Spans For Wind Area | SR Leg Bolts Resist Compression |
| Use Moment Magnification | Use Clear Spans For KL/r | All Leg Panels Have Same Allowable |
| √ Use Code Stress Ratios | Retension Guys To Initial Tension | Offset Girt At Foundation |
| √ Use Code Safety Factors - Guys | √ Bypass Mast Stability Checks | √ Consider Feed Line Torque |
| Escalate Ice | √ Use Azimuth Dish Coefficients | Include Angle Block Shear Check |
| Always Use Max Kz | √ Project Wind Area of Appurtenances | Use TIA-222-G Bracing Resist. Exemption |
| Use Special Wind Profile | √ Alternative Appurt. EPA Calculation | Use TIA-222-G Tension Splice Exemption |
| Include Bolts In Member Capacity | Autocalc Torque Arm Areas | Poles |
| Leg Bolts Are At Top Of Section | Add IBC .6D+W Combination | √ Include Shear-Torsion Interaction |
| Secondary Horizontal Braces Leg | √ Sort Capacity Reports By Component | Always Use Sub-Critical Flow |
| Use Diamond Inner Bracing (4 Sided) | Triangulate Diamond Inner Bracing | Use Top Mounted Sockets |
| SR Members Have Cut Ends | Treat Feed Line Bundles As Cylinder | √ Pole Without Linear Attachments |
| SR Members Are Concentric | Ignore KL/ry For 60 Deg. Angle Legs | Pole With Shroud Or No Appurtenances |
| Distribute Leg Loads As Uniform | Use ASCE 10 X-Brace Ly Rules | Outside and Inside Corner Radii Are Known |

## Tapered Pole Section Geometry

| Section | Elevation ft | Section Length ft | Splice Length ft | Number of Sides | Top Diameter in | Bottom Diameter in | Wall Thickness in | Bend Radius in | Pole Grade |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 174.00-144.17 | 29.83 | 3.4100 | 18 | 19.1250 | 27.8900 | 0.1875 | 0.7500 | A572-65 (65 ksi) |
| L2 | 144.17-94.40 | 53.18 | 5.1600 | 18 | 26.5130 | 42.1400 | 0.3125 | 1.2500 | A572-65 (65 ksi) |
| L3 | 94.40-46.05 | 53.51 | 6.8400 | 18 | 39.9987 | 55.7200 | 0.3750 | 1.5000 | A572-65 (65 ksi) |
| L4 | 46.05-0.00 | 52.89 | | 18 | 52.9604 | 68.5000 | 0.4375 | 1.7500 | A572-65 (65 ksi) |



| Section | Elevation ft | Section Length ft | Splice Length ft | Number of Sides | Top Diameter in | Bottom Diameter in | Wall Thickness in | Bend Radius in | Pole Grade |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | (65 ksi) |

## Tapered Pole Properties

| Section | Tip Dia. in | Area $in^2$ | I $in^4$ | r in | C in | I/C $in^3$ | J $in^4$ | It/Q $in^2$ | w in | w/t |
|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 19.3911 | 11.2702 | 510.6385 | 6.7228 | 9.7155 | 52.5592 | 1021.9490 | 5.6362 | 3.0360 | 16.192 |
| | 28.2913 | 16.4865 | 1598.4628 | 9.8344 | 14.1681 | 112.8211 | 3199.0289 | 8.2448 | 4.5786 | 24.419 |
| L2 | 27.8913 | 25.9877 | 2253.8490 | 9.3012 | 13.4686 | 167.3407 | 4510.6637 | 12.9963 | 4.1163 | 13.172 |
| | 42.7419 | 41.4877 | 9170.2277 | 14.8488 | 21.4071 | 428.3728 | 18352.5218 | 20.7478 | 6.8666 | 21.973 |
| L3 | 42.0973 | 47.1621 | 9354.9565 | 14.0664 | 20.3194 | 460.3963 | 18722.2225 | 23.5856 | 6.3798 | 17.013 |
| | 56.5217 | 65.8744 | 25492.4054 | 19.6475 | 28.3058 | 900.6084 | 51018.3543 | 32.9435 | 9.1467 | 24.391 |
| L4 | 55.7506 | 72.9346 | 25419.5947 | 18.6456 | 26.9039 | 944.8299 | 50872.6371 | 36.4742 | 8.5510 | 19.545 |
| | 69.4892 | 94.5133 | 55315.4082 | 24.1622 | 34.7980 | 1589.6146 | 110703.6018 | 47.2656 | 11.2860 | 25.797 |

| Tower Elevation ft | Gusset Area (per face) $ft^2$ | Gusset Thickness in | Gusset Grade | Adjust. Factor $A_f$ | Adjust. Factor $A_r$ | Weight Mult. | Double Angle Stitch Bolt Spacing Diagonals in | Double Angle Stitch Bolt Spacing Horizontals in | Double Angle Stitch Bolt Spacing Redundants in |
|---|---|---|---|---|---|---|---|---|---|
| L1 174.00-144.17 | | | | 1 | 1 | 1 | | | |
| L2 144.17-94.40 | | | | 1 | 1 | 1 | | | |
| L3 94.40-46.05 | | | | 1 | 1 | 1 | | | |
| L4 46.05-0.00 | | | | 1 | 1 | 1 | | | |

## Feed Line/Linear Appurtenances - Entered As Round Or Flat

| Description | Face or Leg | Allow Shield | Exclude From Torque Calculation | Component Type | Placement ft | Total Number | Number Per Row | Clear Spacing in | Width or Diameter in | Perimeter in | Weight plf |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *** | | | | | | | | | | | |

## Feed Line/Linear Appurtenances - Entered As Area

| Description | Face or Leg | Allow Shield | Exclude From Torque Calculation | Component Type | Placement ft | Face Offset in | Lateral Offset (Frac FW) | # | | $C_AA_A$ $ft^2/ft$ | Weight plf |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Safety Line 3/8 | A | No | No | CaAa (Out Of Face) | 174.00 - 0.00 | 6.0000 | 0 | 1 | No Ice<br>1/2" Ice | 0.04<br>0.14 | 0.22<br>0.75 |
| Step Pegs (5/8" SR) 7" w/ 16" Step | A | No | No | CaAa (Out Of Face) | 174.00 - 0.00 | 0.0000 | 0 | 1 | No Ice<br>1/2" | 0.03<br>0.13 | 0.46<br>0.93 |

| Description | Face or Leg | Allow Shield | Exclude From Torque Calculation | Component Type | Placement ft | Face Offset in | Lateral Offset (Frac FW) | # | | $C_AA_A$ $ft^2/ft$ | Weight plf |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Ice | | |
| ** | | | | | | | | | | | |
| LDF7-50A(1-5/8) | A | No | No | Inside Pole | 170.00 - 3.00 | 0.0000 | 0 | 12 | No | 0.00 | 0.82 |
| | | | | | | | | | Ice | 0.00 | 0.82 |
| | | | | | | | | | 1/2" Ice | | |
| 3/4" Coax | A | No | No | Inside Pole | 170.00 - 3.00 | 0.0000 | 0 | 4 | No | 0.00 | 3.00 |
| | | | | | | | | | Ice | 0.00 | 3.00 |
| | | | | | | | | | 1/2" Ice | | |
| 3/8" Coax | A | No | No | Inside Pole | 170.00 - 3.00 | 0.0000 | 0 | 2 | No | 0.00 | 0.07 |
| | | | | | | | | | Ice | 0.00 | 0.07 |
| | | | | | | | | | 1/2" Ice | | |
| 2" Flexible Conduit | A | No | No | Inside Pole | 170.00 - 3.00 | 0.0000 | 0 | 2 | No | 0.00 | 0.34 |
| | | | | | | | | | Ice | 0.00 | 0.34 |
| | | | | | | | | | 1/2" Ice | | |
| 5/16" Coax | A | No | No | Inside Pole | 170.00 - 3.00 | 0.0000 | 0 | 1 | No | 0.00 | 0.09 |
| | | | | | | | | | Ice | 0.00 | 0.09 |
| | | | | | | | | | 1/2" Ice | | |
| ** | | | | | | | | | | | |
| 1 5/8" Hybrid | C | No | No | Inside Pole | 161.00 - 6.96 | 0.0000 | 0 | 2 | No | 0.00 | 0.75 |
| | | | | | | | | | Ice | 0.00 | 0.75 |
| | | | | | | | | | 1/2" Ice | | |
| ** | | | | | | | | | | | |
| 1-3/4" Feedline | B | No | No | Inside Pole | 148.00 - 3.00 | 0.0000 | 0 | 3 | No | 0.00 | 1.68 |
| | | | | | | | | | Ice | 0.00 | 1.68 |
| | | | | | | | | | 1/2" Ice | | |
| ** | | | | | | | | | | | |
| 7/8" Coax | C | No | No | Inside Pole | 120.00 - 3.00 | 0.0000 | 0 | 1 | No | 0.00 | 0.26 |
| | | | | | | | | | Ice | 0.00 | 0.26 |
| | | | | | | | | | 1/2" Ice | | |
| **** | | | | | | | | | | | |
| LDF7-50A(1-5/8) | B | No | No | Inside Pole | 114.50 - 3.00 | 0.0000 | 0 | 1 | No | 0.00 | 0.82 |
| | | | | | | | | | Ice | 0.00 | 0.82 |
| | | | | | | | | | 1/2" Ice | | |
| LDF4-75A(1/2) | B | No | No | Inside Pole | 114.50 - 3.00 | 0.0000 | 0 | 1 | No | 0.00 | 0.16 |
| | | | | | | | | | Ice | 0.00 | 0.16 |
| | | | | | | | | | 1/2" Ice | | |
| *** | | | | | | | | | | | |

## Feed Line/Linear Appurtenances Section Areas

| Tower Section | Tower Elevation ft | Face | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|
| L1 | 174.00-144.17 | A | 0.000 | 0.000 | 0.000 | 1.933 | 608.03 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 19.29 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 25.25 |
| L2 | 144.17-94.40 | A | 0.000 | 0.000 | 0.000 | 3.225 | 1166.35 |



| Tower Section | Tower Elevation ft | Face | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 270.39 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 81.44 |
| L3 | 94.40-46.05 | A | 0.000 | 0.000 | 0.000 | 3.133 | 1133.08 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 290.92 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 85.33 |
| L4 | 46.05-0.00 | A | 0.000 | 0.000 | 0.000 | 2.984 | 1010.90 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 259.03 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 70.04 |

## Feed Line/Linear Appurtenances Section Areas - With Ice

| Tower Section | Tower Elevation ft | Face or Leg | Ice Thickness in | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|---|
| L1 | 174.00-144.17 | A | 0.585 | 0.000 | 0.000 | 0.000 | 8.911 | 646.09 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 19.29 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 25.25 |
| L2 | 144.17-94.40 | A | 0.568 | 0.000 | 0.000 | 0.000 | 14.868 | 1229.85 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 270.39 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 81.44 |
| L3 | 94.40-46.05 | A | 0.539 | 0.000 | 0.000 | 0.000 | 14.115 | 1192.11 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 290.92 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 85.33 |
| L4 | 46.05-0.00 | A | 0.482 | 0.000 | 0.000 | 0.000 | 12.905 | 1062.79 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 259.03 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 70.04 |

## Feed Line Center of Pressure

| Section | Elevation ft | $CP_X$ in | $CP_Z$ in | $CP_X$ Ice in | $CP_Z$ Ice in |
|---|---|---|---|---|---|
| L1 | 174.00-144.17 | 0.0000 | -0.5616 | 0.0000 | -1.2541 |
| L2 | 144.17-94.40 | 0.0000 | -0.5705 | 0.0000 | -1.3190 |
| L3 | 94.40-46.05 | 0.0000 | -0.5758 | 0.0000 | -1.3313 |
| L4 | 46.05-0.00 | 0.0000 | -0.5786 | 0.0000 | -1.3030 |

Note: For pole sections, center of pressure calculations do not consider feed line shielding.

## Discrete Tower Loads

| Description | Face or Leg | Offset Type | Offsets: Horz Lateral ft<br>Vert ft | Azimuth Adjustment ° | Placement ft | $C_AA_A$ Front $ft^2$ | $C_AA_A$ Side $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|---|

| Description | Face or Leg | Offset Type | Offsets: Horz Lateral ft<br>Vert ft<br>ft | Azimuth Adjustment ° | Placement ft | | $C_AA_A$ Front $ft^2$ | $C_AA_A$ Side $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|---|---|
| **170** | | | | | | | | | |
| (2) NNH4-65C-R6-V3 w/ Mount Pipe | A | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 17.31<br>18.04 | 10.34<br>11.86 | 134.95<br>252.88 |
| (2) NNH4-65C-R6-V3 w/ Mount Pipe | B | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 17.31<br>18.04 | 10.34<br>11.86 | 134.95<br>252.88 |
| (2) NNH4-65C-R6-V3 w/ Mount Pipe | C | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 17.31<br>18.04 | 10.34<br>11.86 | 134.95<br>252.88 |
| 72" x 12" x 7" Panel w/ Mount Pipe | A | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 8.71<br>9.37 | 7.58<br>8.87 | 96.32<br>171.23 |
| 72" x 12" x 7" Panel w/ Mount Pipe | B | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 8.71<br>9.37 | 7.58<br>8.87 | 96.32<br>171.23 |
| 72" x 12" x 7" Panel w/ Mount Pipe | C | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 8.71<br>9.37 | 7.58<br>8.87 | 96.32<br>171.23 |
| RADIO 4449 | A | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 1.98<br>2.16 | 1.41<br>1.57 | 85.00<br>103.55 |
| RADIO 4449 | B | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 1.98<br>2.16 | 1.41<br>1.57 | 85.00<br>103.55 |
| RADIO 4449 | C | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 1.98<br>2.16 | 1.41<br>1.57 | 85.00<br>103.55 |
| RADIO 4426 | A | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 1.64<br>1.80 | 0.73<br>0.84 | 48.50<br>61.32 |
| RADIO 4426 | B | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 1.64<br>1.80 | 0.73<br>0.84 | 48.50<br>61.32 |
| RADIO 4426 | C | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 1.64<br>1.80 | 0.73<br>0.84 | 48.50<br>61.32 |
| RADIO 4478 | A | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 1.62<br>1.78 | 1.00<br>1.13 | 60.00<br>74.78 |
| RADIO 4478 | B | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 1.62<br>1.78 | 1.00<br>1.13 | 60.00<br>74.78 |
| RADIO 4478 | C | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 1.62<br>1.78 | 1.00<br>1.13 | 60.00<br>74.78 |
| (2) RRUS 32 | A | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 2.86<br>3.08 | 1.78<br>1.97 | 55.12<br>77.39 |
| (2) RRUS 32 | B | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 2.86<br>3.08 | 1.78<br>1.97 | 55.12<br>77.39 |
| (2) RRUS 32 | C | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 2.86<br>3.08 | 1.78<br>1.97 | 55.12<br>77.39 |
| (2) E15S09P94 | A | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 0.57<br>0.67 | 0.32<br>0.40 | 14.80<br>19.74 |



| Description | Face or Leg | Offset Type | Offsets: Horz Lateral ft<br>Vert ft<br>ft | Azimuth Adjustment ° | Placement ft | | $C_AA_A$ Front $ft^2$ | $C_AA_A$ Side $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|---|---|
| | | g | 0.00 | | | | | | |
| E15S09P94 | B | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 0.57<br>0.67 | 0.32<br>0.40 | 14.80<br>19.74 |
| E15S09P94 | C | From Centroid-Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 0.57<br>0.67 | 0.32<br>0.40 | 14.80<br>19.74 |
| DC6-48-60-18-8F | A | From Centroid-Leg | 2.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 0.85<br>1.36 | 0.85<br>1.36 | 18.90<br>35.59 |
| DC6-48-60-18-8F | B | From Centroid-Leg | 2.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 0.85<br>1.36 | 0.85<br>1.36 | 18.90<br>35.59 |
| DC6-48-60-18-8F | C | From Centroid-Leg | 2.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 0.85<br>1.36 | 0.85<br>1.36 | 18.90<br>35.59 |
| (3) 2.4" Dia. x 9-ft Pipe | B | From Centroid-Face | 4.00<br>0.00<br>0.00 | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 2.16<br>3.09 | 2.16<br>3.09 | 32.94<br>49.18 |
| Platform Mount [LP 1304-1_HR-1] | C | None | | 0.0000 | 170.00 | No Ice<br>1/2" Ice | 26.70<br>32.69 | 26.70<br>32.69 | 2626.77<br>3571.43 |
| **160** | | | | | | | | | |
| MT6413-77A w/ Mount Pipe | A | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 4.00<br>4.31 | 2.15<br>2.55 | 69.74<br>103.26 |
| MT6413-77A w/ Mount Pipe | B | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 4.00<br>4.31 | 2.15<br>2.55 | 69.74<br>103.26 |
| MT6413-77A w/ Mount Pipe | C | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 4.00<br>4.31 | 2.15<br>2.55 | 69.74<br>103.26 |
| (2) NHH-65C-R2B w/ Mount Pipe | A | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 11.63<br>12.35 | 9.79<br>11.31 | 84.45<br>173.76 |
| (2) NHH-65C-R2B w/ Mount Pipe | B | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 11.63<br>12.35 | 9.79<br>11.31 | 84.45<br>173.76 |
| (2) NHH-65C-R2B w/ Mount Pipe | C | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 11.63<br>12.35 | 9.79<br>11.31 | 84.45<br>173.76 |
| RF4461d-13A | A | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 1.87<br>2.03 | 1.28<br>1.42 | 79.10<br>97.61 |
| RF4461d-13A | B | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 1.87<br>2.03 | 1.28<br>1.42 | 79.10<br>97.61 |
| RF4461d-13A | C | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 1.87<br>2.03 | 1.28<br>1.42 | 79.10<br>97.61 |
| B2/B66A RRH-BR049 | A | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 1.88<br>2.05 | 1.25<br>1.39 | 84.40<br>102.74 |
| B2/B66A RRH-BR049 | B | From Leg | 4.00<br>0.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 1.88<br>2.05 | 1.25<br>1.39 | 84.40<br>102.74 |
| B2/B66A RRH-BR049 | C | From Leg | 4.00<br>0.00 | 0.0000 | 161.00 | No Ice<br>1/2" Ice | 1.88<br>2.05 | 1.25<br>1.39 | 84.40<br>102.74 |

| Description | Face or Leg | Offset Type | Offsets: Horz Lateral ft / Vert ft / ft | Azimuth Adjustment ° | Placement ft | | $C_AA_A$ Front $ft^2$ | $C_AA_A$ Side $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|---|---|
| | | | 0.00 | | | | | | |
| (2) RVZDC-6627-PF-48 | C | From Leg | 2.00 | 0.0000 | 161.00 | No Ice | 3.79 | 2.51 | 32.00 |
| | | | 0.00 | | | 1/2" Ice | 4.04 | 2.73 | 63.48 |
| | | | 0.00 | | | | | | |
| T-Arm Mount [TA 701-3] | C | None | | 0.0000 | 161.00 | No Ice | 23.94 | 23.94 | 1092.00 |
| | | | | | | 1/2" Ice | 30.04 | 30.04 | 1475.58 |
| **148** | | | | | | | | | |
| CMA-BDHH/6521/E0-6 w/ mount pipe | A | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 11.78 | 6.23 | 96.90 |
| | | | 0.00 | | | 1/2" Ice | 12.31 | 7.23 | 173.63 |
| | | | 0.00 | | | | | | |
| CMA-BDHH/6521/E0-6 w/ mount pipe | B | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 11.78 | 6.23 | 96.90 |
| | | | 0.00 | | | 1/2" Ice | 12.31 | 7.23 | 173.63 |
| | | | 0.00 | | | | | | |
| CMA-BDHH/6521/E0-6 w/ mount pipe | C | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 11.78 | 6.23 | 96.90 |
| | | | 0.00 | | | 1/2" Ice | 12.31 | 7.23 | 173.63 |
| | | | 0.00 | | | | | | |
| 96"x24"x5" w/ Mount Pipe | A | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 20.27 | 7.92 | 69.20 |
| | | | 0.00 | | | 1/2" Ice | 20.91 | 9.33 | 188.49 |
| | | | 0.00 | | | | | | |
| 96"x24"x5" w/ Mount Pipe | B | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 20.27 | 7.92 | 69.20 |
| | | | 0.00 | | | 1/2" Ice | 20.91 | 9.33 | 188.49 |
| | | | 0.00 | | | | | | |
| 96"x24"x5" w/ Mount Pipe | C | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 20.27 | 7.92 | 69.20 |
| | | | 0.00 | | | 1/2" Ice | 20.91 | 9.33 | 188.49 |
| | | | 0.00 | | | | | | |
| AIR 6449 B41 w/ Mount Pipe | A | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 5.87 | 3.27 | 128.35 |
| | | | 0.00 | | | 1/2" Ice | 6.23 | 3.73 | 177.30 |
| | | | 0.00 | | | | | | |
| AIR 6449 B41 w/ Mount Pipe | B | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 5.87 | 3.27 | 128.35 |
| | | | 0.00 | | | 1/2" Ice | 6.23 | 3.73 | 177.30 |
| | | | 0.00 | | | | | | |
| AIR 6449 B41 w/ Mount Pipe | C | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 5.87 | 3.27 | 128.35 |
| | | | 0.00 | | | 1/2" Ice | 6.23 | 3.73 | 177.30 |
| | | | 0.00 | | | | | | |
| RADIO 4415 | A | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 1.86 | 0.87 | 49.60 |
| | | | 0.00 | | | 1/2" Ice | 2.03 | 1.00 | 64.16 |
| | | | 0.00 | | | | | | |
| RADIO 4415 | B | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 1.86 | 0.87 | 49.60 |
| | | | 0.00 | | | 1/2" Ice | 2.03 | 1.00 | 64.16 |
| | | | 0.00 | | | | | | |
| RADIO 4415 | C | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 1.86 | 0.87 | 49.60 |
| | | | 0.00 | | | 1/2" Ice | 2.03 | 1.00 | 64.16 |
| | | | 0.00 | | | | | | |
| RADIO 4449 | A | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 1.98 | 1.41 | 85.00 |
| | | | 0.00 | | | 1/2" Ice | 2.16 | 1.57 | 103.55 |
| | | | 0.00 | | | | | | |
| RADIO 4449 | B | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 1.98 | 1.41 | 85.00 |
| | | | 0.00 | | | 1/2" Ice | 2.16 | 1.57 | 103.55 |
| | | | 0.00 | | | | | | |
| RADIO 4449 | C | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 1.98 | 1.41 | 85.00 |
| | | | 0.00 | | | 1/2" Ice | 2.16 | 1.57 | 103.55 |
| | | | 0.00 | | | | | | |
| RADIO 2212 | A | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 1.64 | 0.64 | 35.27 |
| | | | 0.00 | | | 1/2" Ice | 1.80 | 0.75 | 47.41 |
| | | | 0.00 | | | | | | |
| RADIO 2212 | B | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 1.64 | 0.64 | 35.27 |
| | | | 0.00 | | | 1/2" Ice | 1.80 | 0.75 | 47.41 |



| Description | Face or Leg | Offset Type | Offsets: Horz Lateral ft / Vert ft / ft | Azimuth Adjustment ° | Placement ft | | $C_AA_A$ Front $ft^2$ | $C_AA_A$ Side $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|---|---|
| | | g | 0.00 | | | | | | |
| RADIO 2212 | C | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 1.64 | 0.64 | 35.27 |
| | | | 0.00 | | | 1/2" Ice | 1.80 | 0.75 | 47.41 |
| | | g | 0.00 | | | | | | |
| 2L3x3x3/16 x 13ft | A | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 3.90 | 3.90 | 97.00 |
| | | | 0.00 | | | 1/2" Ice | 4.83 | 4.83 | 171.00 |
| | | g | 0.00 | | | | | | |
| 2L3x3x3/16 x 13ft | B | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 3.90 | 3.90 | 97.00 |
| | | | 0.00 | | | 1/2" Ice | 4.83 | 4.83 | 171.00 |
| | | g | 0.00 | | | | | | |
| 2L3x3x3/16 x 13ft | C | From Centroid-Leg | 4.00 | 0.0000 | 148.00 | No Ice | 3.90 | 3.90 | 97.00 |
| | | | 0.00 | | | 1/2" Ice | 4.83 | 4.83 | 171.00 |
| | | g | 0.00 | | | | | | |
| Miscellaneous [NA 506-1] | C | None | | 0.0000 | 148.00 | No Ice | 27.49 | 27.49 | 1587.00 |
| | | | | | | 1/2" Ice | 33.96 | 33.96 | 2297.42 |
| **120** | | | | | | | | | |
| 4220.09-445-TXX | B | From Leg | 3.00 | 0.0000 | 120.00 | No Ice | 3.66 | 3.66 | 28.66 |
| | | | 0.00 | | | 1/2" Ice | 5.44 | 5.44 | 56.62 |
| | | | 9.00 | | | | | | |
| Side Arm Mount [SO 203-1] | B | From Leg | 1.50 | 0.0000 | 120.00 | No Ice | 1.78 | 3.79 | 125.00 |
| | | | 0.00 | | | 1/2" Ice | 2.24 | 4.47 | 152.76 |
| | | | 0.00 | | | | | | |
| **117** | | | | | | | | | |
| 5' x 12" dia Omni | C | From Leg | 4.00 | 0.0000 | 114.50 | No Ice | 2.78 | 2.78 | 25.00 |
| | | | 0.00 | | | 1/2" Ice | 4.12 | 4.12 | 67.48 |
| | | | 2.50 | | | | | | |
| Side Arm Mount [SO 302-1] | C | From Leg | 2.00 | 0.0000 | 114.50 | No Ice | 0.81 | 3.31 | 55.00 |
| | | | 0.00 | | | 1/2" Ice | 1.30 | 5.00 | 82.94 |
| | | | 0.00 | | | | | | |
| **** | | | | | | | | | |
| *** | | | | | | | | | |
| ** | | | | | | | | | |
| * | | | | | | | | | |

## Load Combinations

| Comb. No. | Description |
|---|---|
| 1 | Dead Only |
| 2 | 1.2 Dead+1.6 Wind 0 deg - No Ice |
| 3 | 0.9 Dead+1.6 Wind 0 deg - No Ice |
| 4 | 1.2 Dead+1.6 Wind 30 deg - No Ice |
| 5 | 0.9 Dead+1.6 Wind 30 deg - No Ice |
| 6 | 1.2 Dead+1.6 Wind 60 deg - No Ice |
| 7 | 0.9 Dead+1.6 Wind 60 deg - No Ice |
| 8 | 1.2 Dead+1.6 Wind 90 deg - No Ice |
| 9 | 0.9 Dead+1.6 Wind 90 deg - No Ice |
| 10 | 1.2 Dead+1.6 Wind 120 deg - No Ice |
| 11 | 0.9 Dead+1.6 Wind 120 deg - No Ice |
| 12 | 1.2 Dead+1.6 Wind 150 deg - No Ice |
| 13 | 0.9 Dead+1.6 Wind 150 deg - No Ice |

| Comb. No. | Description |
|---|---|
| 14 | 1.2 Dead+1.6 Wind 180 deg - No Ice |
| 15 | 0.9 Dead+1.6 Wind 180 deg - No Ice |
| 16 | 1.2 Dead+1.6 Wind 210 deg - No Ice |
| 17 | 0.9 Dead+1.6 Wind 210 deg - No Ice |
| 18 | 1.2 Dead+1.6 Wind 240 deg - No Ice |
| 19 | 0.9 Dead+1.6 Wind 240 deg - No Ice |
| 20 | 1.2 Dead+1.6 Wind 270 deg - No Ice |
| 21 | 0.9 Dead+1.6 Wind 270 deg - No Ice |
| 22 | 1.2 Dead+1.6 Wind 300 deg - No Ice |
| 23 | 0.9 Dead+1.6 Wind 300 deg - No Ice |
| 24 | 1.2 Dead+1.6 Wind 330 deg - No Ice |
| 25 | 0.9 Dead+1.6 Wind 330 deg - No Ice |
| 26 | 1.2 Dead+1.0 Ice |
| 27 | 1.2 Dead+1.0 Wind 0 deg+1.0 Ice |
| 28 | 1.2 Dead+1.0 Wind 30 deg+1.0 Ice |
| 29 | 1.2 Dead+1.0 Wind 60 deg+1.0 Ice |
| 30 | 1.2 Dead+1.0 Wind 90 deg+1.0 Ice |
| 31 | 1.2 Dead+1.0 Wind 120 deg+1.0 Ice |
| 32 | 1.2 Dead+1.0 Wind 150 deg+1.0 Ice |
| 33 | 1.2 Dead+1.0 Wind 180 deg+1.0 Ice |
| 34 | 1.2 Dead+1.0 Wind 210 deg+1.0 Ice |
| 35 | 1.2 Dead+1.0 Wind 240 deg+1.0 Ice |
| 36 | 1.2 Dead+1.0 Wind 270 deg+1.0 Ice |
| 37 | 1.2 Dead+1.0 Wind 300 deg+1.0 Ice |
| 38 | 1.2 Dead+1.0 Wind 330 deg+1.0 Ice |
| 39 | Dead+Wind 0 deg - Service |
| 40 | Dead+Wind 30 deg - Service |
| 41 | Dead+Wind 60 deg - Service |
| 42 | Dead+Wind 90 deg - Service |
| 43 | Dead+Wind 120 deg - Service |
| 44 | Dead+Wind 150 deg - Service |
| 45 | Dead+Wind 180 deg - Service |
| 46 | Dead+Wind 210 deg - Service |
| 47 | Dead+Wind 240 deg - Service |
| 48 | Dead+Wind 270 deg - Service |
| 49 | Dead+Wind 300 deg - Service |
| 50 | Dead+Wind 330 deg - Service |

## Maximum Tower Deflections - Service Wind

| Section No. | Elevation ft | Horz. Deflection in | Gov. Load Comb. | Tilt ° | Twist ° |
|---|---|---|---|---|---|
| L1 | 174 - 144.17 | 26.635 | 41 | 1.5422 | 0.0030 |
| L2 | 147.58 - 94.4 | 18.406 | 41 | 1.3605 | 0.0009 |
| L3 | 99.56 - 46.05 | 7.464 | 40 | 0.7825 | 0.0003 |
| L4 | 52.89 - 0 | 1.932 | 40 | 0.3431 | 0.0001 |

## Critical Deflections and Radius of Curvature - Service Wind

| Elevation ft | Appurtenance | Gov. Load Comb. | Deflection in | Tilt ° | Twist ° | Radius of Curvature ft |
|---|---|---|---|---|---|---|
| 170.00 | (2) NNH4-65C-R6-V3 w/ Mount Pipe | 41 | 25.344 | 1.5190 | 0.0026 | 24265 |
| 161.00 | MT6413-77A w/ Mount Pipe | 41 | 22.472 | 1.4637 | 0.0018 | 9332 |
| 148.00 | CMA-BDHH/6521/E0-6 w/ mount pipe | 41 | 18.527 | 1.3643 | 0.0009 | 4790 |
| 120.00 | 4220.09-445-TXX | 40 | 11.427 | 1.0424 | 0.0004 | 4898 |
| 114.50 | 5' x 12" dia Omni | 40 | 10.262 | 0.9709 | 0.0004 | 4965 |



## Maximum Tower Deflections - Design Wind

| Section No. | Elevation ft | Horz. Deflection in | Gov. Load Comb. | Tilt ° | Twist ° |
|---|---|---|---|---|---|
| L1 | 174 - 144.17 | 143.214 | 4 | 8.3073 | 0.0162 |
| L2 | 147.58 - 94.4 | 99.114 | 4 | 7.3374 | 0.0046 |
| L3 | 99.56 - 46.05 | 40.255 | 4 | 4.2236 | 0.0015 |
| L4 | 52.89 - 0 | 10.425 | 4 | 1.8518 | 0.0004 |

## Critical Deflections and Radius of Curvature - Design Wind

| Elevation ft | Appurtenance | Gov. Load Comb. | Deflection in | Tilt ° | Twist ° | Radius of Curvature ft |
|---|---|---|---|---|---|---|
| 170.00 | (2) NNH4-65C-R6-V3 w/ Mount Pipe | 4 | 136.299 | 8.1839 | 0.0141 | 4699 |
| 161.00 | MT6413-77A w/ Mount Pipe | 4 | 120.914 | 7.8893 | 0.0097 | 1805 |
| 148.00 | CMA-BDHH/6521/E0-6 w/ mount pipe | 4 | 99.765 | 7.3577 | 0.0050 | 923 |
| 120.00 | 4220.09-445-TXX | 4 | 61.604 | 5.6257 | 0.0022 | 928 |
| 114.50 | 5' x 12" dia Omni | 4 | 55.332 | 5.2401 | 0.0020 | 938 |

## *Compression Checks*

## Pole Design Data

| Section No. | Elevation ft | Size | L ft | $L_u$ ft | Kl/r | A $in^2$ | $P_u$ lb | $\phi P_n$ lb | Ratio $\frac{P_u}{\phi P_n}$ |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 174 - 144.17 (1) | TP27.89x19.125x0.1875 | 29.83 | 0.00 | 0.0 | 15.8902 | -11032.50 | 1055210.00 | 0.010 |
| L2 | 144.17 - 94.4 (2) | TP42.14x26.513x0.3125 | 53.18 | 0.00 | 0.0 | 39.9837 | -20750.00 | 2755060.00 | 0.008 |
| L3 | 94.4 - 46.05 (3) | TP55.72x39.9987x0.375 | 53.51 | 0.00 | 0.0 | 63.4825 | -35140.10 | 4217740.00 | 0.008 |
| L4 | 46.05 - 0 (4) | TP68.5x52.9604x0.4375 | 52.89 | 0.00 | 0.0 | 94.5133 | -58297.30 | 6044450.00 | 0.010 |

## Pole Bending Design Data

| Section No. | Elevation ft | Size | $M_{ux}$ lb-ft | $\phi M_{nx}$ lb-ft | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | $M_{uy}$ lb-ft | $\phi M_{ny}$ lb-ft | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ |
|---|---|---|---|---|---|---|---|---|
| L1 | 174 - 144.17 (1) | TP27.89x19.125x0.1875 | 385275.83 | 579848.33 | 0.664 | 0.00 | 579848.33 | 0.000 |
| L2 | 144.17 - 94.4 (2) | TP42.14x26.513x0.3125 | 1965200.00 | 2284000.00 | 0.860 | 0.00 | 2284000.00 | 0.000 |
| L3 | 94.4 - 46.05 (3) | TP55.72x39.9987x0.375 | 3840816.67 | 4629616.67 | 0.830 | 0.00 | 4629616.67 | 0.000 |
| L4 | 46.05 - 0 (4) | TP68.5x52.9604x0.4375 | 6386774.67 | 8471750.00 | 0.754 | 0.00 | 8471750.00 | 0.000 |

## Pole Shear Design Data

| Section No. | Elevation ft | Size | Actual $V_u$ lb | $\phi V_n$ lb | Ratio $\frac{V_u}{\phi V_n}$ | Actual $T_u$ lb-ft | $\phi T_n$ lb-ft | Ratio $\frac{T_u}{\phi T_n}$ |
|---|---|---|---|---|---|---|---|---|
| L1 | 174 - 144.17 (1) | TP27.89x19.125x0.1875 | 29539.00 | 527607.00 | 0.056 | 167.45 | 1162341.67 | 0.000 |
| L2 | 144.17 - 94.4 (2) | TP42.14x26.513x0.3125 | 36547.40 | 1377530.00 | 0.027 | 1207.63 | 4578933.33 | 0.000 |
| L3 | 94.4 - 46.05 (3) | TP55.72x39.9987x0.375 | 43884.30 | 2108870.00 | 0.021 | 945.85 | 9280416.67 | 0.000 |
| L4 | 46.05 - 0 (4) | TP68.5x52.9604x0.4375 | 52139.90 | 3022230.00 | 0.017 | 718.52 | 16980749.33 | 0.000 |

## Pole Interaction Design Data

| Section No. | Elevation ft | Ratio $\frac{P_u}{\phi P_n}$ | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ | Ratio $\frac{V_u}{\phi V_n}$ | Ratio $\frac{T_u}{\phi T_n}$ | Comb. Stress Ratio | Allow. Stress Ratio | Criteria |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 174 - 144.17 (1) | 0.010 | 0.664 | 0.000 | 0.056 | 0.000 | 0.678 | 1.000 | |
| L2 | 144.17 - 94.4 (2) | 0.008 | 0.860 | 0.000 | 0.027 | 0.000 | 0.869 | 1.000 | |
| L3 | 94.4 - 46.05 (3) | 0.008 | 0.830 | 0.000 | 0.021 | 0.000 | 0.838 | 1.000 | |
| L4 | 46.05 - 0 (4) | 0.010 | 0.754 | 0.000 | 0.017 | 0.000 | 0.764 | 1.000 | |

## Section Capacity Table

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $\phi P_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| L1 | 174 - 144.17 | Pole | TP27.89x19.125x0.1875 | 1 | -11032.50 | 1055210.00 | 67.8 | Pass |
| L2 | 144.17 - 94.4 | Pole | TP42.14x26.513x0.3125 | 2 | -20750.00 | 2755060.00 | 86.9 | Pass |
| L3 | 94.4 - 46.05 | Pole | TP55.72x39.9987x0.375 | 3 | -35140.10 | 4217740.00 | 83.8 | Pass |
| L4 | 46.05 - 0 | Pole | TP68.5x52.9604x0.4375 | 4 | -58297.30 | 6044450.00 | 76.4 | Pass |
| | | | | | | | Summary | |
| | | | | | | Pole (L2) | 86.9 | Pass |



| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $\phi P_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| | | | | | | **RATING =** | **86.9** | **Pass** |

# APPENDIX B

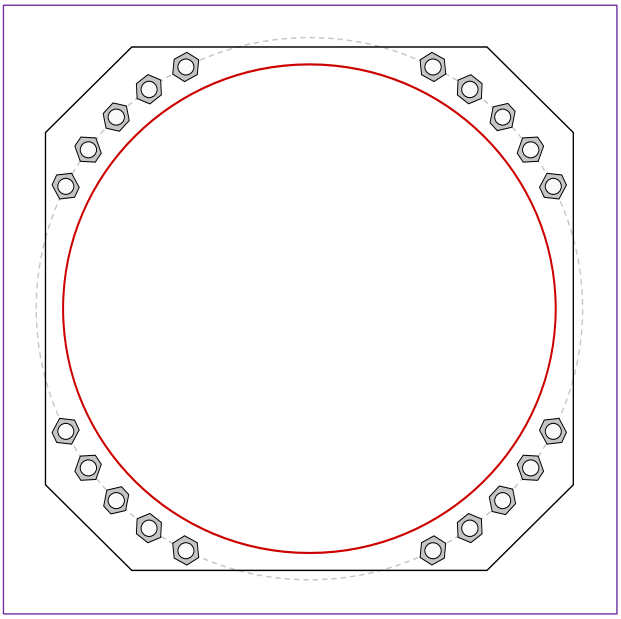
# ADDITIONAL CALCULATIONS

# Monopole Base Plate Connection

| Site Info | |
|---|---|
| Site # | N/A |
| Site Name | Nags Head Town Hall |
| TEP # | 73857.976701 |

| Analysis Considerations | |
|---|---|
| TIA-222 Revision | G |
| Grout Considered: | No |
| $l_{ar}$ (in) | 2.25 |
| Eta Factor, η | 0.5 |

| Applied Loads | |
|---|---|
| Moment (kip-ft) | 6386.78 |
| Axial Force (kips) | 58.30 |
| Shear Force (kips) | 52.14 |



## Connection Properties

**Anchor Rod Data**

(20) 2-1/4" ø bolts (A615-75 N; Fy=75 ksi, Fu=100 ksi) on 76" BC

*Anchor Spacing: 6 in*

**Base Plate Data**

73.375" W x 3.5" Plate (A572-50; Fy=50 ksi, Fu=65 ksi);  Clip: 12 in

**Stiffener Data**

N/A

**Pole Data**

68.5" x 0.4375" 18-sided pole (A572-65; Fy=65 ksi, Fu=80 ksi)

## Analysis Results

**Anchor Rod Summary** *(units of kips, kip-in)*

| | | |
|---|---|---|
| Pu_c = 204.53 | ϕPn_t = 260 | **Stress Rating** |
| Vu = 2.61 | ϕVn = n/a | **80.7%** |
| Mu = n/a | ϕMn = n/a | **Pass** |

**Base Plate Summary**

| | | |
|---|---|---|
| Max Stress (ksi): | 26.08 | (Flexural) |
| Allowable Stress (ksi): | 45 | |
| Stress Rating: | **58.0%** | **Pass** |

# Agenda Item Summary Sheet

Item No: **E-5**
Meeting Date: **October 2, 2024**

**Item Title**: Consideration of Great Trails State Program Grant application for multi-use path engineering

**Item Summary**:

Please find attached an application for the Great Trails State Program grant. The grant would be used for the design/engineering of the multi-use path extension on South Croatan Highway. Specific areas to be connected are between Carolista Drive and W Soundside Road; S Seachase Drive and W Baymeadow Drive; and Gull Street to Gray Eagle Street. These extensions would connect these areas to the existing multi-use path. As noted in the application, these connections were top ranked by the Town's Pedestrian Project Advisory Committee.

Strong community support for the project is reflected in the attached correspondence from the Superintendent of and the Friends of Jockey's Ridge State Park, Outer Banks Visitors Bureau, as well as the Pedestrian Project Advisory Committee.

Number of Attachments: 2

**Specific Action Requested**:

Request Board approval of the Great Trails State Program grant application.

Submitted By: Finance Officer Amy Miller Date: September 27, 2024

**Finance Officer Comment**:

This grant, in the amount of $100,000, would require a match of $50,000. The local funding is adopted in the FY 24/25 budget for design work, included as part of the CIP pedestrian projects.

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:

I concur with staff's request.

Signature: Andy Garman Date: September 27, 2024

# 1116 - Design for South Croatan Highway multi-use path extension

## Application Details

| | |
|---|---|
| **Funding Opportunity:** | 230-Great Trails State Program (GTSP) |
| **Funding Opportunity Due Date:** | Nov 12, 2024 5:00 PM |
| **Program Area:** | Great Trails State Program |
| **Status:** | Editing |
| **Stage:** | Final Application |
| **Initial Submit Date:** | |
| **Initially Submitted By:** | |
| **Last Submit Date:** | |
| **Last Submitted By:** | |

## Contact Information

### Primary Contact Information

| | |
|---|---|
| **Name*:** | Ms. (Salutation) AMY (First Name) MARIE (Middle Name) MILLER (Last Name) |
| **Title*:** | Finance Officer |
| **Email*:** | AMY.MILLER@NAGSHEADNC.GOV |
| **Address*:** | 5401 S. Croatan Highway |
| | Nags Head (City) North Carolina (State/Province) 27959 (Postal Code/Zip) |
| **Phone*:** | (252) 449-2020 Ext.<br>Phone<br>###-###-#### |
| **Fax:** | ###-###-#### |

### Organization Information

| | |
|---|---|
| **Name*:** | Nags Head, Town of |
| **Organization Type*:** | City Government |

**Tax Id:**

**County*:** Dare

**Organization Website:** https://www.nagsheadnc.gov/

**Address*:** 5401 S. Croatan Highway

Nags Head (City) North Carolina (State/Province) 27959- (Postal Code/Zip)

**Phone*:** (252) 449-2020 Ext.
###-###-####

**Fax:** ###-###-####

# GTSP Application Information

***Applicant Information***

## Contact Information

Is the person from the partner organization who will administer the grant contract, if awarded, the same as the Primary Contact listed on the application?

**Grant Administrator*:** Yes

Is the Project Manager the same as the Primary Contact listed on the application?

**Project Manager*:** Yes

If awarded, will the person who signs the grant contract be the same as the Primary Contact listed on the application?

**Person Signing Contract*:** No

Please list contact information.

**Contact Information:** Andy (First Name) Garman (Last Name)

**Title:** Town Manager
Title

**Email:** andy.garman@nagsheadnc.gov

***Project Overview***

**Project Name*:**

Design for South Croatan Highway multi-use path extension This project title will be used internally and externally.

Describe your project, including how this project would advance your trail network and state your project objectives.
This description will be used to determine your project's overall sustainability as compared to other projects submitted. This statement should be suitable for public review. The text provided in this box will be published internally and externally without editing by Division of Parks & Recreation (DPR) staff. Be concise and discerning with information, covering key components and background, if needed. Narratives are limited in word length as noted below the text box.

**Project Description*:**

These projects establish a missing link in our west side multi-use path network between Carolista Dr. and W. Soundside Rd., S. Seachase Dr. and W. Baymeadow Dr., and Gull St. to Gray Eagle St. These projects are top-ranked by our Pedestrian Project Advisory Committee at #1, #5, and #6, respectively. They would provide

connectivity to the existing multi-use path, constructed of 10' wide concrete, that begins on the west side of South Croatan Highway at the intersection of W. Eighth St., the northern Town limit. Currently, the multi-use path extends south to Carolisa Dr. The multi-use path begins again at W. Soundside Rd. and further extends south to Seachase Dr. The last segment completed was W. Baymeadow Dr. to West Gull St. This project would complete the three segments that are not constructed. The proposed northernmost portion would be constructed at the entrance of Jockey's Ridge State Park, which is also the eastern terminus for the NC Mountains-to-Sea trail, and run adjacent to the park, providing recreational opportunity for pedestrians and bicyclists to enjoy. This would also provide a connection to the Jockey's Ridge State Park sound access located on West Soundside Rd. Completing the path would provide countless benefits, including promoting healthier lifestyles through active transportation, providing enhanced safety through a continuous, dedicated space for pedestrians and cyclists where the current multi-use path abruptly ends, and supporting local businesses by creating a more connected and accessible community. A continuous pathway will provide convenient access to key destinations we visit daily, including parks, businesses, and schools. The Phase VIII extension of the multi-use path, completed in 2020, created new opportunities for connectivity between neighborhoods and areas of interest we can leverage through this grant. The construction documents will be used to bid out the project and construct the path, aligning with our CIP.

**What process will be used for selecting the person or the organization to complete the project? :**

For the engineering and survey work, we awarded an on-call contract to a local engineering firm for professional services. We have a Town Engineer that does engineering and construction administration that works with our contracted engineers. The RFQ was done in accordance with NC procurement statutes and was awarded on qualifications based on outcomes of prior engineering projects as well as their ability to be responsive and have a presence in performing construction administration. The Town Engineer is a P.E. and has designed, bid, and overseen numerous construction projects including beach nourishment, street paving and drainage, water line replacements, multi-use path construction, trail rehabilitation, sidewalks, beach access improvements, and building construction. He has also coordinated several grant projects as referenced in the previous grant/similar project experience section.

**Can this project be completed within 3 years of the contract? *:** Yes Please attach a detailed timeline below.

### *Previous Grant or Similar Project Experience*

| Previous Grant / Similar Project Name | Amount of Project | Project Objective | Was your grant or project successful? |
|---|---|---|---|
| Beach dune vegetation and beach nourishment project engineering/Coastal Storm Damage Mitigation | $1,202,000.00 | Vegetative dune sprigging/planting and engineering for our next beach nourishment project. | We have received two Coastal Storm Damage Mitigation grants. We are currently completing close out of our vegetative sprigging grant and are going under contract for our beach nourishment engineering grant. The Town Engineer was the project lead and the Finance Officer was the administrator on both these grants. We used our beach nourishment engineers to design both the planting project and to engineer our next beach nourishment project, which will take us to bid for a project in 2027. |

| Previous Grant / Similar Project Name | Amount of Project | Project Objective | Was your grant or project successful? |
|---|---|---|---|
| FEMA/NC DPS DR-4465-NC Hurricane Dorian beach re-nourishment (Category G) | $12,408,784.06 | Beach re-nourishment, including engineering, sand fencing and plants as a result of Hurricane Dorian. | Yes. This project was closed out on time and all reimbursements have been received. The Town was able to replace sand lost during Hurricane Dorian since we have an engineered beach. This was our second FEMA/NC DPS disaster recovery Category G grant (Hurricane Matthew DR-4285 for $16,233,837.14). For both of these projects, construction was over seen by the Town Engineer and the Finance Officer was the grant administrator. |
| Phase VIII west side multi-use path construction/Outer Banks Visitors Bureau | $1,658,664.74 | Extend the existing multi-use path to provider greater connectivity throughout town. | Yes, this project was closed out and completed on time. This included design, acquiring the necessary permits, bidding the project out, and final construction completion. It was so successful we are moving on to the next phase-engineering three unfinished segments. The project added 10,958 linear feet of 10' wide concrete multi-use pathway along S. Croatan Highway's western right-of-way. This included segments of 5' wide sidewalks, associative concrete curb/gutter and drainage improvements. |

### *Project Justification*

What are the expected outcomes and benefits from this project? Please include:
- How the trail provides or would provide connectivity to daily destinations?
- How the trail is designed or would be designed to increase access to trails (first trail in a community, fills a trail-type need, etc.)?
- How the proposed project would eliminate a gap in an existing trail or in funding?

**All acquisition applications should include urgency of acquisition.**
**- What is the approximate length, width, and surface type?**

**Maintenance applications should include when the trail was originally built and previous maintenance (what was done and when it was completed).**

**Project Justitication*:**

**This project will be designed to include 4,490 linear feet of 10' wide concrete multi-use pathway with associative concrete curb and gutter, drainage infrastructure improvements, and incidental work along U.S. Highway 158. The connection would provide an essential linkage within the Town of Nags Head. This missing portion of the U.S. 158 multi-use path would connect commercial development and neighborhoods along this corridor from the Nags Head Outlets all the way to Jockey's Ridge State Park. This State Park sees upwards of a million visits a day and is also the terminus of the Mountains to Sea Trail, a 1,200 mile trail from Clingmans Dome in the Smokey Mountains to Jockeys Ridge. Dare County as a whole has one of the highest pedestrian fatality rates within the U.S. Part of this issue is the difficulty of crossing the high speed, high volume U.S. 158 Highway from east side homes, rentals and businesses.**

**Another is an incomplete active transportation network. This project would be a major step towards having a cohesive active transportation network in Nags Head based around the U.S. 158 multi-use trail spine. Currently, the lack of continuation of the multi-use path forces pedestrians and bicyclists onto the highway to continue to the other side of the missing link where the path begins again. Adding these segments would connect major commercial areas with dense neighborhoods to the north. The project allows those who do not have a vehicle or are unable to drive have a much safer and direct way to access daily amenities by walking or biking. There are a multitude of commercial businesses and employment centers along the U.S. 158 corridor that construction of this missing link would provide improved access to. Schools, churches, municipal buildings, professional offices, grocery stores, and a variety of stand alone recreation destinations would be directly accessible from the multi-use path. The Soundside Event Site, a large outdoor gathering space hosting over 30,000 people a year, would have direct access from northern neighborhoods. This is the major commercial corridor in town and the west-side neighborhoods with the most full time residences would be directly served as a result of the construction of this new multi-use path segment. If awarded, additional money could be included in the CIP for the completion of this phase of the project and for future construction in line with the updated Town of Nags Head Pedestrian Plan.**

### *Certification and Approval by Governing Body*

A signed copy of the certification and approval by the governing board must be attached at the bottom of this section.

| | |
|---|---|
| **I hereby certify the information contained in this application is true and correct and the required matching funds will be available during the project period. This application has been approved by the governing body. *:** | **Yes** |

### *Applicant Attachments*

| Named Attachment | Required | Description | File Name | Type | Size | Upload Date |
|---|---|---|---|---|---|---|
| *If application has multiple sponsoring agencies, please attached a W-9 for each organization in a single combined file.* | | | | | | |
| Organization W-9 | ✓ | W9 Town of Nags Head wet ink | W9 wet ink.pdf | pdf | 119 KB | 08/14/2024 06:59 PM |
| *Please provide a detailed project timeline. Be sure to include when any pending or unsecured matches will be available.* | | | | | | |
| Detailed Project Timeline | ✓ | | | | | |
| *Please upload the signed certification and approval by the governing board. A template of this certification is included in the application guide. Electronic signatures are acceptable.* | | | | | | |
| Signed Certification & Approval by Governing Board | ✓ | | | | | |

# Project Information

### *Project Details*

| Named Attachment | Required | Description | File Name | Type | Size | Upload Date |
|---|---|---|---|---|---|---|

***In addition to the legal description, acquisition-only projects must submit a copy of a conceptual plan showing the property to be acquired and future development for public recreation. See Application Guide for an example***

**Conceptual Plan for Acquisition Only Applications**

### *Land Acquisition*

**Does your project involve land acquisition?*:** No

### *List of Properties to be Acquired (if applicable)*

| Description | Will the property be | Current Owner | Number | Acreage | Land | Improvements for Trail Purposes | Proposed Purchase Price |
|---|---|---|---|---|---|---|---|

No Data for Table

### *Legal Description of Property to be Acquired*

| Description | File Name | Type | Size | Upload Date |
|---|---|---|---|---|

No files attached.

## Budget

### *Project Type*

**Type of Project*:** Design + Engineering

### *Project Costs*

| Project Element | Unit Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|

No Data for Table

### *Planning, Feasibility, Design, and Engineering Costs*

| Project Element | Cost |
|---|---|
| Survey, engineering design, and permitting | $150,000.00 |
| | $150,000.00 |

### *Acquisition Costs*

| Parcel Number | Acres Acquired | Land Acquisition Cost |
|---|---|---|

No Data for Table

### *Non-State Match*

| Type of Match | Amount of Match | Source of Match | Availability |
|---|---|---|---|
| Cash | $50,000.00 | Town of Nags Head Fiscal Year 24/25 Adopted Budget | Yes - immediately |

### *Budget Summary*

**Total Project Cost:** **$0.00**

**Total Non-State Match:** **$50,000.00**

**Total Grant Request*:** **$100,000.00** May not exceed $500,000

### *Match Summary*

**What county or counties will the project be located in? *:** **Dare**

**What is the Tier designation of the county? If the project is in multiple counties, the match shall be based on the lowest wealth county. Tier designation can be verified here.*:** **Tier 2**

The Match Requirement is as follows:
- Tier 1 counties must match 1:4, or 25%
- Tier 2 counties must match 1:2, or 50%
- Tier 3 counties must match 1:1, or 100%

Incomplete or insufficient matches could result in an ineligible applicant.

**Match Percentage:** **0%**

## Partners & Community Support

### *Partnerships & Community Support Attachments*

| Description | File Name | Type | Size | Upload Date |
|---|---|---|---|---|
| Friends of Jockey's Ridge letter of support | Jockeys Ridge-letter-8-21-24-1.pdf | pdf | 72 KB | 08/21/2024 02:59 PM |
| Letter of support from Jockey's Ridge State Park Superintendent. | Town of Nags Head - Letter of suppiort.pdf | pdf | 67 KB | 08/19/2024 11:19 AM |
| Outer Banks Visitors Bureau Letter of Support | OBVB Letter of Support TNH.pdf | pdf | 757 KB | 08/20/2024 11:43 AM |
| Pedestrian Project Advisory Committee Summary including final prioritized project list. The west side multi-use path extensions raked 1, 5, and 6. The final report includes minutes of the committee meetings. | PAC summary and minutes.pdf | pdf | 8 MB | 08/15/2024 12:50 PM |

*Partnerships & Community Support*

**Is the trail supported by the community where it will be built?*:** **Yes**

**Please explain:*:**

**The Town's Comprehensive Plan, certified in 2022, engaged community meetings throughout the project, including an appointed Advisory Committee, representing a diverse cross section of the community. The Plan states the necessity to continue the 10' multi-use path to serve the growing demand for active transportation. Policy PR-4b: Continue construction of the multi-use trail along US 158 with safety as a priority. The Plan identified this project on its Pedestrian Project List, Table 3.7.3.**

**Has the applicant held a public meeting within the last 24 months to discuss the trail project and obtained comments? Is the public supportive of the project?*:** **Yes**

**Please explain:**

**The 2020 Phase VIII construction of the multi-use path established an enhanced network connection to the west side neighborhoods and created new opportunities for east/west connections with oceanfront access. Due to this change in dynamic, in 2022 the Board of Commissioners appointed citizens with relative interest areas and perspectives to update the 2014 Pedestrian Plan to take a more deliberate approach to pedestrian and bicycle improvements. Community input was identified as a critical component to survey potential users of improvement options. The Pedestrian Project Advisory Committee engaged citizen input to develop a multi-year master plan for pedestrian and bicycle transportation routes via sidewalks and multi-modal pathways throughout the Town. The mission of the Committee was to assist the Town with facilitating, enhancing, and encouraging safe travel by pedestrians and bicyclists alike and identify improvement options to correspond with relative needs and priorities. The Committee held 5 meetings between September 27, 2022, and January 10, 2023. The charge was to create a prioritized list of sidewalk and multi-use path projects to improve active transportation connections in Nags Head by developing safe access to community destinations. The committee presented the prioritized list at the Nags Head Board of Commissioners meeting on February 3, 2023 for consideration at the FY 24 CIP workshop. These connections ranked #1 and #5-6 on the list.**

**Is the trail supported by other organizations or partners?*:** **Yes**

**Please explain*:**

**Support of the west side multi-use path is evidenced by the Town securing $487,932 in funding towards Phase VIII construction, completed in the summer of 2020. Locally funded by the Dare County Tourism Board, this grant was approved by the Dare County Board of Commissioners. The competitive grant is designed to assist local governments with construction projects that support sustainable tourism through master planning objectives. Construction included 10,958 l.f. of a 10' wide concrete path.**

**Has the applicant used another way to gain & document support of the trail project?*:**

**The Town conducted a Community Survey in 2023. Providing sidewalks/paths was important to 85% of respondents, and 84% of respondents indicated Nags Head has performed successfully with respect to this. The survey indicated providing sidewalks and paths was essential/very important to 84% of**

## Certification & Approval by Governing Board

I hereby certify the information contained in the attached Great Trails State Program application is true and correct, and the required matching funds for the grant will be available within three years of submitting the application. This application has been approved by the governing board.

| |
|---|
| Chief Elected Official **Mayor Ben Cahoon** |
| (Print or Type Name and Title) |
| (Signature) |
| If two sponsors are applying together, this form must be completed and signed by each board. |

# Agenda Item Summary Sheet

Item No: **E-6**
Meeting Date: **October 2, 2024**

**Item Title**: Resolution to authorize a NC Public Beach and Coastal Waterfront Access grant contract

**Item Summary**:

The Town of Nags Head has been awarded a NC Public Beach and Coastal Waterfront Access grant for improvements to the June Street Public Beach Access in S Nags Head. Attached please find a resolution authorizing the execution of the grant contract.

Number of Attachments: 1

**Specific Action Requested**:

Provided for Board review and consideration of attached resolution.

Submitted By: Administration Date: September 27, 2024

**Finance Officer Comment**:

The total project cost is $277,259; the Town will pay a total local cash contribution of $60,790 and local in-kind contribution of $8,800 as its local share of the total project costs. This project is included in the FY 25/26 CIP and will be completed within the timeline of the grant requirement.

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:

I concur with the request.

Signature: Andy Garman Date: September 27, 2024

**RESOLUTION AUTHORIZING EXECUTION OF
PUBLIC BEACH AND COASTAL WATERFRONT ACCESS PROGRAM
GRANT CONTRACT**

**WHEREAS**, The Town of Nags Head (the "Town") has been awarded a public access grant for the June Street Public Beach Access improvements; and

**WHEREAS**, The Town is advised that a proposed contract between the Town and the North Carolina Department of Environmental Quality (DEQ) for Public Beach and Coastal Waterfront Access grant funds is being presented for the project known as June Street Beach Access, and discussed; and

**WHEREAS**, That, under the terms of the said contract, the total project cost is $277,259; and

**WHEREAS**, The Town will pay a total local cash contribution of $60,790 and local in-kind contribution of $8,800 as its local share of the total project costs; and

**WHEREAS**, The total grant assistance requested is $207,669.

**BE IT THEREFORE RESOLVED** as follows:

1. That a contract between the Town of Nags Head and the North Carolina Department of Environmental Quality be and the same is hereby approved.

2. That the Manager is hereby authorized to sign and execute the said contract for and on behalf of the Town of Nags Head and forward the same to the North Carolina Department of Environmental Quality.

3. That upon final execution, a copy of said contract be filed with the minutes.

ADOPTED this the 2nd day of October 2024.

_____
Ben Cahoon, Mayor
Town of Nags Head

ATTEST:

_____
Carolyn F. Morris, Town Clerk

# Agenda Item Summary Sheet

Item No: **E-7**
Meeting Date: **October 2, 2024**

**Item Title**: Consideration of Capital Project Fund ordinance amendments

**Item Summary**:

At the October 2nd Board of Commissioners meeting, staff is requesting Board consideration of the following Capital Project Ordinances:

- Consideration of Capital Project Ordinance amendment #5 for the Public Services Complex Project. This amendment increases interest income and building capital outlay by $62,150 each.

- Consideration of Water Capital Project Ordinance amendment #3 for the Public Services Complex Project and Advanced Metering Infrastructure Projects. This amendment increases interest income and building capital outlay for the Public Services Complex by $16,203 each.

Number of Attachments: 2

**Specific Action Requested**:

Provided for Board review and adoption.

Submitted By: Finance Director Amy Miller Date: September 27, 2024

**Finance Officer Comment**:

These ordinances budget for interest income received on LOBs escrow funds. The interest is required to be spent on the project the funds were borrowed for. These funds will account for change orders and other items associated with the Public Services Complex project. The Town is currently meeting the spending requirements of the Two-Year Spending Exception for arbitrage and is complying with US Treasury Regulations. No arbitrage is currently owed.

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:

I concur with staff's request.

Signature: Andy Garman Date: September 27, 2024

**CAPITAL PROJECT ORDINANCE**
**Public Works Complex**
(Amendment #5)

BE IT ORDAINED by the Governing Board of the Town of Nags Head, North Carolina, that, pursuant to Section 13.2 of Chapter 159 of the General Statutes of North Carolina, the following capital project ordinance as adopted January 5, 2022, amended August 3, 2022, amended March 1, 2023, amended April 3, 2024, amended August 7, 2024, is hereby further amended as follows:

Section 1. This ordinance is to establish a budget for the Public Works Complex.

Section 2. The following budget shall be conducted within the Capital Projects Fund (fund #41).

Section 3. The officers of this unit are hereby directed to proceed with the capital project within the terms of the budget contained herein.

Section 4. The following amounts are appropriated for the project:

| | |
|---|---|
| Construction design and oversight | $ 1,382,623 |
| Building | 12,088,607 |
| Equipment | 1,119,413 |
| Professional fees | 265,938 |
| Arbitrage liability | 261,185 |
| Contribution to Capital Investment Fund | 489,950 |
| Total Expenditures | $ 15,607,716 |

Section 5. The following revenues are anticipated to be available to complete this project:

| | |
|---|---|
| Contribution from General Fund | $ 489,950 |
| Interest Income | 745,512 |
| Bond Proceeds, Limited Obligation Bonds, Series 2023 | 14,372,254 |
| Total revenues | $ 15,607,716 |

Section 6. The Finance Officer is hereby directed to maintain within the Capital Project Fund sufficient detailed accounting records to satisfy federal, state, and local regulations.

Section 7. The Finance Officer is directed to report, on a quarterly basis, on the financial status of each project element.

Section 8. Copies of this project ordinance shall be furnished to the Clerk of the Governing Board, and to the Budget Officer and Finance Officer for direction in carrying out this project.

Adopted this 2nd day of October 2024.

_____
**Benjamin Cahoon, Mayor**

ATTEST:

_____
Carolyn F. Morris, Town Clerk

Ordinance No. 24-10-0xx
Capital Project Ordinance
Amendment #3
BOC Meeting October 2, 2024

**WATER CAPITAL PROJECT ORDINANCE for**
**APPROVED WATER CIP PROJECTS**
(Amendment #3)

BE IT ORDAINED by the Governing Board of the Town of Nags Head, North Carolina, that, pursuant to Section 13.2 of Chapter 159 of the General Statutes of North Carolina, the following capital project ordinance adopted March 1, 2023, amended April 3, 2024, amended August 7, 2024, is hereby further amended:

Section 1. The projects authorized are those approved by the Board of Commissioners.

Section 2. The following budget shall be conducted within the Water Capital Projects Fund (fund #65).

Section 3. The officers of this unit are hereby directed to proceed with the capital projects within the terms of the budget contained herein.

Section 4. The following amounts are appropriated for the project:

| | |
|---|---|
| Public Services Complex | $ 3,652,883 |
| Advanced Metering Infrastructure | 1,849,830 |
| Total Water Capital Reserve Fund Expenses | $ 5,502,713 |

Section 5. The following revenues are anticipated to be available to complete this project:

| | |
|---|---|
| Bond proceeds, Limited Obligation Bonds, Series 2023 | $ 5,316,615 |
| Interest Income | 186,098 |
| Total Water Capital Reserve Fund Revenues | $ 5,502,713 |

Section 6. The Finance Officer is hereby directed to maintain within the Capital Project Fund sufficient detailed accounting records to satisfy federal, state, and local regulations.

Section 7. The Finance Director is directed to report, on a quarterly basis, on the financial status of each project element.

Section 8. Copies of this project ordinance shall be furnished to the Clerk of the Governing Board, and to the Budget Officer and Finance Officer for direction in carrying out this project.

Adopted this 2nd day of October 2024.

_____
**Benjamin Cahoon, Mayor**

ATTEST:

_____
Carolyn F. Morris, Town Clerk

# Agenda Item Summary Sheet

Item No: **E-8**
Meeting Date: **October 2, 2024**

**Item Title**: Consideration of modification to Rules of Procedure re: time allotted for speakers

**Item Summary**:

Attached please find modifications to two Rules of the Town's Rules of Procedure:
- Rule #5 *Public Address to the Board of Commissioners*
- Rule #27 *Public Hearings*

As mentioned during a recent Board of Commissioners meeting, the modifications would provide for consistency in allotting the amount of time when the Board of Commissioners receives public comment during a Board meeting and during public hearings.

Number of Attachments: 1

**Specific Action Requested**:

Changes to the Rules of Procedure provided for Board review and consideration.

Submitted By: Administration Date: September 27, 2024

**Finance Officer Comment**:

No fiscal impact.

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:

I concur with staff's request.

Signature: Andy Garman Date: September 27, 2024

# RULES OF PROCEDURE

**Rule 5: Public Address to the Board of Commissioners ***

The Board of Commissioners shall provide a time at each meeting for anyone to address them. The Mayor may set and enforce appropriate time limits for such comments but under these rules that limit may not be ~~less than 5 minutes nor~~ more than ~~10~~ 5 minutes. Other boards shall provide access for the public as is appropriate to their charge and determined by each board.

**Rule 27: Public Hearings**

Public hearings required by law or deemed advisable by the Board of Commissioners shall be organized by a special order, adopted by a majority vote, that sets forth the subject, date, place, and time of the hearing as well as any rules regarding the length of time for each speaker, and other pertinent matters except that staff may schedule public hearings on matters required by statute or ordinance without a vote of the board provided the hearing is scheduled for the first meeting of the board as allowed by notice requirements. The rules may include, but are not limited to, rules fixing the maximum time allotted to each speaker which shall be no more than 5 minutes; (ii) providing for the designation of spokespersons for groups of persons supporting or opposing the same positions; (iii) providing for the selection of delegates from groups of persons supporting or opposing the same positions when the number of persons wishing to attend the hearing exceeds the capacity of the hall (so long as arrangements are made, in the case of hearings subject to the Open Meetings Law, for those excluded from the hall to listen to the hearing); and (iv) providing for the maintenance of order and decorum in the conduct of the hearing.

All notice and other requirements of the Open Meetings Law applicable to Board of Commissioners meetings shall also apply to public hearings at which a majority of the Board of Commissioners is present. A public hearing for which any required notices have been given may be continued to a time and place certain without further advertisement. The requirements of Rule 2(c) shall be followed in continuing a hearing at which a majority of the Board of Commissioners is present.

At the time appointed for the hearing, the mayor or his or her designee shall call the hearing to order and then preside over it. When the allotted time expires or when no one wishes to speak who has not done so, the presiding officer shall declare the hearing ended.

# Agenda Item Summary Sheet

Item No: **E-10**
Meeting Date: **October 2, 2024**

**Item Title**: Request for Public Hearing to consider a Special Use/Site Plan Review for construction of a two story, eight-bedroom dormitory

**Item Summary**:
Special Use Permit/Site Plan Review submitted by Quible & Associates, P.C. and Beacon Architecture and Design, PLLC on behalf of the Town of Nags Head for the construction of a 3,460 square foot, two story, eight-bedroom dormitory (duplex) and all associated site improvements. This dormitory is for use by Town of Nags Head workforce, specifically Ocean Rescue and others as approved by the Town Manager. The property is zoned SED-80, Special Environmental District and is located at 425 W. Health Center Drive.

Applying the parking standard for dormitory use would only require four spaces. However, since the structure will house up to 16 seasonal lifeguards as part of the Town of Nags Head's workforce, it's clear that actual parking needs will exceed this minimum. Currently, there are 37 spaces onsite, 25 of which are allocated to the Community Care Clinic, leaving 12 available for dormitory use. Ideally, 16 spaces—one per occupant—would be designated for the dormitory. Section 10.15.2.2 of the UDO provides a mechanism, through the Special Use Permit process, to consider shared parking when multiple uses on a site have staggered hours or differing peak parking demands. Staff are requesting that this shared parking provision be applied to account for the additional four spaces needed to meet the target of 16 dormitory spaces. The Community Care Clinic operates from 9 a.m. to 4 p.m., Monday through Friday, and is closed on weekends. In contrast, the Town's Ocean Rescue staff generally works from 9 a.m. to 6 p.m., with some early morning training sessions. Given these staggered schedules, the overlap in parking demand between the clinic and Ocean Rescue staff should be minimal.

**Staff Recommendation/Planning Board Recommendation**
Planning staff finds that the proposal is consistent with the applicable use and development standards, as well as relevant land use policies. Additionally, staff finds that the requirements necessary to offer a reduction in parking pursuant to Section 10.15.2.2. of the UDO, Shared Parking Associated with a Special use Plan, has been met given that it will not result in increased traffic congestion or negatively impact existing traffic flow or pedestrian and vehicular safety, will not create parking impacts for adjacent properties or within Town rights-of-way, will not be contrary to the objectives specified in the Comprehensive Plan, is necessary to permit the reasonable use of the subject property, and will not adversely impact adjacent property or the surrounding area. At their September 17, 2024 meeting the Planning Board voted unanimously to recommend approval of the Special Use Permit/Site Plan Review as presented, to include shared parking arrangements based upon the Community Care Clinic and the Town's Ocean Rescue personnel having staggered parking demands.

Number of Attachments: 0

**Specific Action Requested**:
Schedule the Public Hearing for the Board of Commissioners November 6, 2024 Board Meeting.

Submitted By: Planning and Development Date: September 25, 2024

**Finance Officer Comment**: N/A

Signature: Amy Miller Date: September 25, 2024

**Town Attorney Comment**: N/A

Signature: John Leidy Date: September 25, 2024

**Town Manager Comment and/or Recommendation**: N/A

Signature: Andy Garman Date: September 25, 2024

# Agenda Item Summary Sheet

Item No: **E-11**
Meeting Date: **October 2, 2024**

**Item Title**: Request for Public Hearing to consider various amendments to the UDO within SPD-C, Village at Nags Head Commercial-1 Zoning District to accommodate a new use, EMS Station

**Item Summary**:
Dare County has been working with Oakley Collier Architects on a proposed design for the county's emergency services project within the town. After reviewing the preliminary site development renderings and analyzing the existing SPD-C, Village at Nags Head, Commercial-1 district standards, three text amendments to the Unified Development Ordinance (UDO) would be necessary:

- Amend Section 9.36, Table of Uses and Activities to list "County EMS Station" as a permitted use within the district.
- Amend Section 9.21.8.2, Table of Development Standards to reduce the front yard setback requirement from 75 feet to 45 feet.
- Amend Section 10.16, Required Parking by Use, to establish a parking standard for the new use category of "County EMS Station".

**Planning Staff and Planning Board Recommendation**
Planning staff finds the proposed text amendments to be consistent with the 2022 Comprehensive Land Use Plan and recommends adoption of the amendment as presented.

At their September 17, 2024, meeting the Planning Board voted unanimously to recommend adoption of the text amendment as presented.

Number of Attachments: 0

**Specific Action Requested**:
Schedule the Public Hearing for the Board of Commissioners November 6, 2024, Board Meeting.

Submitted By: Planning and Development Date: September 25, 2024

**Finance Officer Comment**:

N/A

Signature: Amy Miller Date: September 25, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 25, 2024

**Town Manager Comment and/or Recommendation**:

N/A

Signature: Andy Garman Date: September 25, 2024

# Agenda Item Summary Sheet

Item No: **F-1**
Meeting Date: **October 2, 2024**

**Item Title**: Public Hearing for consideration of a zoning map amendment for the property located at 0 W. Satterfield Landing Road (Parcel # 005618002)

**Item Summary**:

Chris Greening of Coastal Bluewater Capital, LLC has submitted a zoning map amendment request with authorization from the current property owner, Mazzi, LLC. If adopted, this map amendment would rezone Lot 2a-1r of the Charles Sineath Subdivision, Parcel # 005618002 from C-3, Commercial Services to C-2, General Commercial. The intent of the C-3, Commercial Services District, is to provide for higher intensity land uses that are not compatible with other areas of the Town. The C-3 District accommodates utilities, light industrial uses, warehousing, bulk storage, municipal facilities, etc. The 2022 Comprehensive Land Use Plan states that the C-3 standards are to regulate and buffer uses so that their location or activities will not be detrimental to adjacent uses, the environment, and the sources of potable water. The Commercial Services District must be at least 10 acres in size and must have direct access to a US highway or collector street improved to town standards. If adopted, the requested rezoning would reduce the overall acreage of C-3 by 0.8 acres, leaving upwards of 36 acres of C-3 Commercial Services remaining.

The intent of the C-2, General Commercial District, is to provide for the proper grouping and development of commercial facilities to serve the entire community. The C-2 District allows the broadest range of commercial uses. All C-2 districts shall be at least 5 acres in area, the proposed zoning map amendment would result in an increase in the total acreage of C-2 zoning designation.

**Staff Recommendation/Planning Board Recommendation**
Based upon the evaluation of the intent of each zoning district and goals listed in the 2022 Comprehensive Land Use Plan, staff recommends adoption of the proposed zoning map amendment as presented.

At their August 20, 2024, meeting, the Planning Board voted unanimously to recommend approval of the proposed map amendment as requested.

Number of Attachments: 2

**Specific Action Requested**:
Conduct the Public Hearing for the requested map amendment.

Submitted By: Planning and Development Date: September 25, 2024

**Finance Officer Comment**:
No specific fiscal impact.

Signature: Amy Miller Date: September 25, 2024

**Town Attorney Comment**:

Signature: John Leidy Date: September 25, 2024

**Town Manager Comment and/or Recommendation**:
N/A

Signature: Andy Garman Date: September 25, 2024

# MEMORANDUM
# Town of Nags Head
# Planning & Development Department

To: Board of Commissioners

From: Kelly Wyatt, Planning Director
Joe Costello, Deputy Planning Director

Date: September 25, 2024

Subject: Consideration of a proposed zoning map amendment, Lot 2a-1r of the Charles Sineath Subdivision (Parcel # 005618002).

Chris Greening of Coastal Bluewater Capital, LLC, has submitted the attached zoning map amendment request with authorization from current property owner, Mazzi, LLC. If adopted, this map amendment would rezone the property located at 0 W. Satterfield Landing Road (Parcel # 005618002) from C-3, Commercial Services District to C-2, General Commercial District.

**Recent History of Property**

In late 2017, the property owner at the time, TLG Greenwater Investments, submitted a request to rezone the easternmost 50 feet of this lot from C-3, Commercial Services, to C-2, General Commercial Services. This rezoning was part of a planned transfer and recombination of the affected portion with Lot 1a-1 (TW's Bait and Tackle). After the map amendment was adopted, TW's Bait and Tackle constructed the accessory storage structure currently on the property.

In November 2022, the Board of Commissioners approved a Special Use Permit/Site Plan Review, submitted by Mazzi LLC, for the construction of an 11,200 square foot building that includes 8 units operating a "Trade Center", with parking and all associated improvements. When the November 2022 approval expired, the Board of Commissioners re-approved the same requested scope of work at their February 7, 2024, meeting. This new approval is valid

until February 7, 2025. However, it is important to note that if the requested rezoning is approved, changing the property's zoning designation to C-2, General Commercial, the Trade Center use would no longer be permitted in this zoning district.

## Analysis

When considering a possible re-zoning it is helpful to review the intent of both the giving and receiving zoning classification in conjunction with potential outcomes.

Section 6.2.4.3 of the UDO, Zoning Districts, notes that the intent of the C-3, Commercial Services District is to provide for higher intensity land uses that are not compatible with other areas of the Town. The C-3 District accommodates utilities, light industrial uses, warehousing, bulk storage, municipal facilities, etc. The 2017 Comprehensive Land Use Plan states that the C-3 standards are to regulate and buffer usus so that their location or activities will not be detrimental to adjacent uses, the environment, and the sources of potable water. The Commercial Services District must be at least 10 acres in size and must have direct access to a US highway or collector street improved to town standards. If adopted, the requested rezoning would reduce the overall acreage of C-3 by 0.8 acres, leaving approximately 36 acres of C-3 Commercial Services Remaining.

The intent of the C-2, General Commercial District, is to provide for the proper grouping and development of commercial facilities to serve the entire community. The C-2 District allows the broadest range of commercial uses. All C-2 districts shall be at least 5 acres in area and proposed zoning map amendment would result in an increase in the total acre of C-2 designation.

As information, the table of uses and activities allowed within the existing C-3, Commercial Services Zoning District and the C-2, Commercial Services Zoning District can be found in Section 6.6 of the Unified Development Ordinance and HERE.

## 2022 Comprehensive Land Use Plan Consideration

Pg. 3-20 (LU-10) Discourage high intensity land uses that produce significant noise, light, heavy vehicle traffic, noxious fumes or poor air quality, are unsightly, encourage unsafe behavior, or require large amounts of land for heavy industrial uses, processing, or storage of materials or equipment.

Pg. 3-20 (LU-10b) Maintain the current boundaries of the C-3 District and do not expand these uses to other parts of the Town.

Pg. 3-117 (EC-1) Develop and promote a sustainable economy that supports high quality of life for residents and visitors without compromising the integrity of the natural and cultural resources and sense of place.

Pg. 3-122 (EC-5) Direct new commercial growth into neighborhood commercial nodes, activity centers, or areas currently zoned for commercial development with emphasis on reuse of existing structures.

The property in question is located within the Northern Commercial Character Area and is currently zoned C-3, Commercial Services. It is bordered by C-2, General Commercial to the

east (TW's Bait and Tackle) and north (OBX Bowling Center), R-2, Medium Density Residential to the south (vacant property), and C-3, Commercial Services to the west (Village Real Estate Rental Management). If the rezoning is approved, it would extend the C-2 zoning designation from the north and east.

## Staff Recommendation

Based upon the evaluation of the intent of each district and the goals listed in the 2022 Comprehensive Land Use Plan, staff recommends adoption of the proposed zoning map amendment as presented.

Note that any future development of this property would require Site Plan Review and approval from both the Planning Board and Board of Commissioners.

## Planning Board Recommendation

At their August 20, 2024, meeting, the Planning Board voted unanimously to recommend approval of the proposed map amendment as requested.

Unified Development Ordinance (UDO) Text Amendment ☐ $750
Zoning Map Amendment ☑ $750 +
$500/acre or fraction thereof

UNIFIED DEVELOPMENT ORDINANCE TEXT/
ZONING MAP AMENDMENT APPLICATION
TOWN OF NAGS HEAD, NORTH CAROLINA

Applicant Coastal Bluewater Capital, LLC

Mailing address PO Box 969 Nags Head, NC 27959

Explanation of request

☐ Unified Development Ordinance (UDO) - Section(s) _____
Attach amendment in ordinance form.

☑ Zoning Map
Attach copy of current Zoning Map with affected property outlined in red.
Attach names and mailing addresses of the property owners of all parcels of land abutting the parcel in question.

Nature of request

Rezone an existing C3 parcel to C2.
Parcel ID 005618002 joins 2230 S. Croatan which is the lot of current business operation.

Reason for request

The rezoning of existing C3 to C2 would allow use for workforce housing and operations to support continued growth of business at 2230 S. Croatan Hwy.

Current limitations of C3 do not allow for best use of property under current zoning.

Coastal Bluewater Capital, LLC
Applicant

7/2/2024
Date

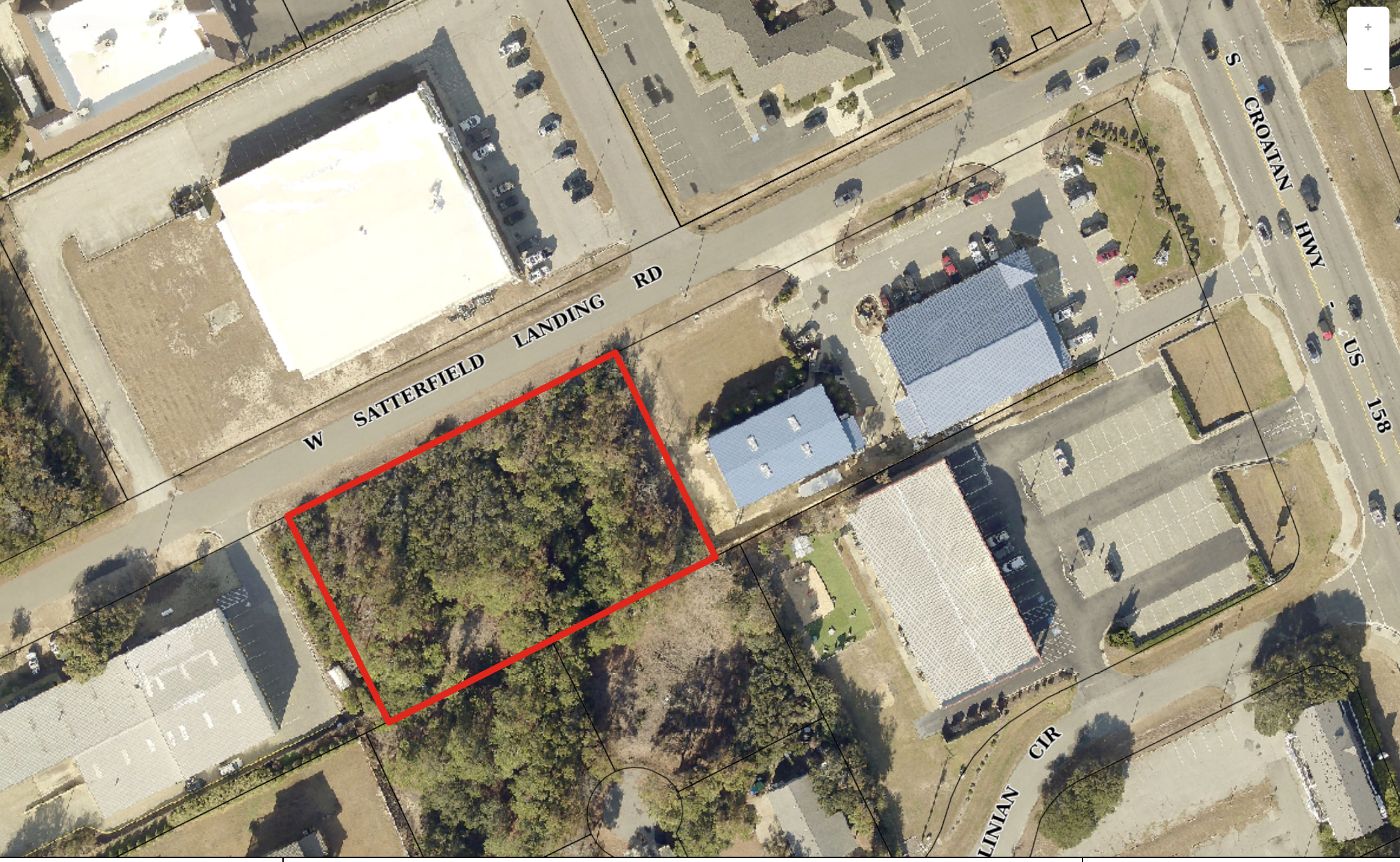
2005

**Legend**

- C2
- C3
- C4
- C5
- CR
- Rezone Parcel
- Street
- Parcel
- SPD-20
- R2
- R3

0.25 Miles

# Rezoning Request From C3 to C2
# Parcel 005618002




This map is prepared from data used for the inventory of the real property for tax purposes. Primary information sources such as recorded deeds, plats, wills, and other primary public records should be consulted for verification of the information contained in this map.

0 W Satterfield Landing RD
Nags Head NC, 27959
Parcel: 005618002
Pin: 989317113533

Owners: Mazzi Llc -Primary Owner

Building Value: $0
Land Value: $319,000
Misc Value: $0
Total Value: $319,000

Tax District: Nags Head
Subdivision: Charles L Sineath Division
Lot BLK-Sec: Lot: 2a-1r Blk: Sec:
Property Use: Vacant Land (Private)
Building Type:
Year Built:

**Benjamin Cahoon**
Mayor

**Michael Siers**
Mayor Pro Tem

**Andy Garman**
Town Manager

**Town of Nags Head**
Post Office Box 99
Nags Head, NC 27959
Telephone 252-441-5508
Fax 252-441-0776
www.nagsheadnc.gov

**Kevin Brinkley**
Commissioner

**Bob Sanders**
Commissioner

**Megan Lambert**
Commissioner

**PUBLIC NOTICE**

NOTICE IS HEREBY GIVEN that the Nags Head Board of Commissioners will conduct a public hearing on **Wednesday, October 2, 2024** beginning at 9:00 am in the Board Room of the Municipal Complex, 5401 S Croatan Highway, Nags Head, NC to consider and take action upon the following request:

> Public Hearing to consider a map amendment request submitted by Chris Greening of Coastal Bluewater Capital, LLC, as authorized by property owner Mazzi, LLC to rezone the property located at 0 W. Satterfield Landing Road, Lot 2a-1r of the Charles Sineath Subdivision, (Parcel # 005618002) from C-3, Commercial Services to C-2, General Commercial. This is the vacant property west of TW's Bait and Tackle.

A copy of the application request will be available for public inspection at the Nags Head Planning and Development Department and the Office of the Town Clerk, Town Municipal Complex, 5401 S. Croatan Hwy, Nags Head, NC 27959, telephone (252) 441-5508 during normal business hours.

As a result of this hearing, substantial changes may be made in the proposal as advertised to reflect objections, debate and discussion at the hearing. Any person desiring to be heard on the proposal as stated above should appear at the time and place specified above.

This is the 11th day of September 2024.

Kelly Wyatt
Planning Director

*For publication in the Coastland Times on Wednesday, September 18th and on Wednesday, September 25th, 2024. Please use Nags Head seal and legal print.*

# Agenda Item Summary Sheet

Item No: **G-1**
Meeting Date: **October 2, 2024**

**Item Title**: Update from Planning Director

**Item Summary**:

Please find attached a monthly update from Planning Director Kelly Wyatt.

Number of Attachments: 1

**Specific Action Requested**:

Provided for Board information and update.

Submitted By: Planning and Development Date: September 27, 2024

**Finance Officer Comment**:

N/A

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:

I will participate in the discussion as necessary.

Signature: Andy Garman Date: September 27, 2024

# MEMORANDUM
# Town of Nags Head
# Planning & Development Department

To: Board of Commissioners
Planning Board

From: Kelly Wyatt, Planning Director
Joe Costello, Deputy Planning Director

Date: September 26, 2024

Subject: Planning and Development Director's Report (G-1)

This memo provides an overview of selected Planning and Development Department activities, projects, and initiatives. If requested, Staff will be prepared to discuss any of this information in detail at the Board of Commissioners meeting on October 2nd, 2024.

**Monthly Activity Report**

Attached for the Board's review is the *Planning and Development Monthly Report for August 2024.* In addition to permitting, inspections, code enforcement, and Todd D. Krafft Septic Health Initiative activities, Staff was involved in the following meetings or activities of note during the month of September:

- Tuesday, September 3rd - Technical Review Committee Meeting
- Wednesday, September 4th - Board of Commissioners Meeting
- Thursday, September 11th – Committee for Art and Culture Meeting
- Thursday, September 12th – Board of Adjustment Meeting (no hearings scheduled)
- Thursday, September 12th – CRS Users Group Meeting
- Tuesday, September 17th – Planning Board Meeting
- Wednesday, September 18th – Board of Commissioners mid-month meeting
- Dowdy Park Movie Night, Friday, September 6th at 8pm – TWISTER

**Planning Board - Pending Applications and Discussions**

The Planning Board's most recent meeting was held on Tuesday, September 17, 2024. The following items were heard:

- Consideration of a Special Use/Site Plan Review submitted by Quible & Associates, P.C. and Beacon Architecture, PLLC on behalf of the Town of Nags Head, for the construction of a 2-story, 8-bedroom dormitory (duplex). The property is zoned SED-80, Special Environmental District and is located at 425 W. Health Center Drive. The Planning Board voted unanimously to recommend approval of the SUP/Site Plan Review as presented. This item is on the Board of Commissioners October 2nd Consent Agenda requesting Public Hearing to be held on November 6th, 2024.

- Consideration of text amendments within the SPD-C, Village at Nags Head Commercial-1 Zoning designation to accommodate future construction of a Dare County EMS Station. The Planning Board voted unanimously to recommend adoption of the proposed amendments as

presented. This item is on the Board of Commissioners October 2nd Consent Agenda requesting Public Hearing to be held on November 6th, 2024.

- Continued discussion of minimum required parking standards for hotel uses and restaurant uses. Based upon discussion staff will present a draft ordinance to the Planning Board at their October 15th meeting outlining a hotel parking standard of 1.2 parking spaces for each unit to be rented or one (1) parking space per bed, whichever is greater, plus one (1) parking space for every two employees on the largest shift. Staff will continue to discuss minimum required parking standards for restaurant uses with the Planning Board in the coming months.

- The Planning Board held two public input sessions, one at their regularly scheduled meeting on Tuesday, September 17th at 9am, the second on Wednesday, September 18th at 6pm. Between these two community engagement sessions the Planning Board received comments from approximately 16 individuals. The majority of attendees were generally supportive of ADU's if items such as parking, noise, and sanitation were properly addressed. Many felt as though attached ADU's (within the existing footprint of the home), were more acceptable than detached ADU's, especially with concerns of increased lot coverage, stormwater runoff, and density. There was support expressed for allowing both long-term and short-term rental of ADU's should they be permitted. Some individuals expressed a concern with having any type of ADU, attached or detached, on the west side of US 158.

The Planning Board's next meeting is scheduled for Tuesday, October 15th, 2024. Currently, the agenda is expected to include consideration of a Site Plan Review submitted by SRE Mustang, LLC and Timmons Group, on behalf of Outlets Nags Head for construction of a 2,400 square foot restaurant, consideration of Sketch Plan Review for construction of a 6,760 square foot EMS Station located at 105 W. Seachase Drive, continued discussion of parking standards for hotel and restaurant uses, and continued discussion related Accessory Dwelling Units (ADU's).

**Board of Adjustment – Recent and Pending Applications**

There were no items for the Board of Adjustments consideration in September 2024.

**Additional Updates**

- **DWMP/Septic Health Advisory Committee –** The Septic Health Advisory Committee is scheduled to meet on Monday, October 21st, 2024. The Planning Department is hosting an intern, Ella Trainor, a rising Junior at UNC-Chapel Hill through the Outer Banks Field Site at CSI, over the next few weeks. Ella's project while here is working along side Environmental Planner, Conner Twiddy and Deputy Planning Director, Joe Costello to geolocate existing conventional septic systems and drain fields and uploading data to create an interactive map of the towns septic infrastructure. We anticipate having Ella attend the upcoming SHAC meeting.

- **Estuarine Shoreline Management Plan** – The Town was awarded a grant of $500,000 under the N.C. Resilient Coastal Communities Program to assist in completing the engineering and design work for the Villa Dunes and Soundside Road estuarine marsh restoration and marsh stabilization projects. The town has received an initial scope from Biohabitats in anticipation of the receiving and executing the grant contract. It will be November before we know about the NC Land and Water Fund Grant that was applied for to assist with the Harvey Site/OBVB Site.

  Additionally, staff are researching using a combination of Community Conservation Assistance Program (CCAP) funds and Coastal Federation cost share funds for a shoreline stabilization project along the causeway.

- **Electric Vehicle Action Plan** – The two Level II EV Chargers have been installed and are available for use. We have submitted the reimbursement package and will be scheduling the final inspection from DEQ.

- **Sand Relocation and Dune Management Cost Share Program** – Staff are preparing for the upcoming Sand Relocation season which will begin on November 15th, 2024. We will begin accepting applications for sand relocation on November 1st for review purposes only. An educational presentation and Q&A session will be provided on Tuesday, October 15th for all equipment operators, property owners, and other interested parties wishing to participate in the sand relocation and dune management cost share program this year.

- **Public Beach and Coastal Waterfront Access Grant Program** – The town was awarded $207,669 through the NC Public Beach and Waterfront Access Program for improvements to the June Street Beach Access. Once the contract has been fully executed, we will put out a Request for Qualifications (RFQ). (Attachment E-6, Consent Agenda)

- **Dowdy Park Events/Farmers Market/Holiday Markets/Art & Culture** – The following events are coming up in October:

  - Free yoga sessions will continue through October, every Tuesday at 7:30am at Dowdy Park.
  - Friday Night Movie on October 4th, beginning around 6:45pm. This movie is being shown in partnership with Outer Banks Health – *The Goonies*.
  - Holiday Market application will be available online Wednesday, October 16th from 8am – 10am. After 10am the application will no longer be accessible. Market Rules have been updated regarding the required percentage of handmade or handcrafted items and the radius for vendors producing handcrafts, original artwork and perishables. You will also need to provide your NC sales tax number as part of the application process. For more information, please visit the Dowdy Park Events Facebook page.
  - Event Coordinator, Paige Griffin is collaborating with Nags Head Elementary School to host a Young Entrepreneur Market in conjunction with the Great Pumpkin Fair, held on Friday October 18th, 4pm – 7pm.

**Upcoming Meetings and Other Dates**

- Tuesday, October 1st - Technical Review Committee Meeting
- Wednesday, October 2nd - Board of Commissioners Meeting
- Wednesday, October 9th – Committee for Art and Culture Meeting
- Thursday, October 10th – Board of Adjustment Meeting (no hearings scheduled)
- Tuesday, October 15th – Planning Board Meeting
- Tuesday, October 15th – Sand Relocation and Dune Management Contractor Meeting
- Wednesday, October 16th – Board of Commissioners mid-month meeting
- Monday, October 21st – Septic Health Advisory Committee Meeting
- Dowdy Park Movie Night, Friday, October 4th at 6:45pm – The Goonies

Brought to you by - NHES pumpkin fair & the Town of Nags Head
PLEASE JOIN US FOR THE ....
YOUNG ENTREPRENEUR FALL MARKET
AT DOWDY PARK
3005 S. CROATAN HWY AT BONNETT ST.
FRIDAY
18TH OF OCTOBER
4 TO 7PM
HANDMADE ITEMS
ART • JEWELLERY • POTTERY
YOUNG VENDORS REGISTER NOW:
JOIN THIS ANNUAL EVENT AS WE CELEBRATE OVER FOOD, GAMES, AND FALL FESTIVITIES.

# Agenda Item Summary Sheet

Item No: **H-1**
Meeting Date: **October 2, 2024**

**Item Title**: From Sep 4th Board meeting – Consideration of Multi-Family Dwelling Ordinance Workshop held on Sep 18th *(Attachment H-1)*

**Item Summary**:
The Board of Commissioners conducted a public hearing on a draft multi-family ordinance at its September 4th meeting. Based on extensive public comments received at the public hearing, the Board of Commissioners scheduled a workshop which was held on September 18th. The purpose of the workshop was to provide the public with additional time to review and comment on the ordinance. The minutes from this workshop are included in the Board's packet.

During the Board's September 4th discussion, the Board suggested a modified version of the ordinance that represents a combination of draft ordinances developed by the Working Group and the Planning Board. This was presented at the September 18th workshop along with the original Working Group and Planning Board proposals. Attached is the packet from the workshop. This includes an explanation of the process used to develop the ordinance and a summary of the different versions of the ordinance.

Since the Public Hearing has already been held, the Board may deliberate and/or vote on the ordinance at the upcoming meeting.

Number of Attachments: 1

**Specific Action Requested**:

Discuss and/or vote on the proposed ordinance.

Submitted By: Planning and Development Date: September 25, 2024

**Finance Officer Comment**:
Insufficient information to determine fiscal impact.

Signature: Amy Miller Date: September 25, 2024

**Town Attorney Comment**:
I will participate in the discussion as necessary.

Signature: John Leidy Date: September 25, 2024

**Town Manager Comment and/or Recommendation**:
I will participate in the discussion.

Signature: Andy Garman Date: September 25, 2024

# AGENDA

**TOWN OF NAGS HEAD BOARD OF COMMISSIONERS**
**NAGS HEAD MUNICIPAL COMPLEX - BOARD ROOM**
***WEDNESDAY, SEPTEMBER 18, 2024, 9:00 A.M.***

---

**A. CALL TO ORDER**

1. Multi-Family/ Workforce Housing Workshop

   Documents:

   9WS MULTI-FAMILY MEMO.PDF
   MULTI-FAMILY ORD MFWG-ATTACHMENT1.PDF
   MULTI-FAMILY ORD PB-ATTACHMENT2.PDF
   MULTI-FAMILY STAFF PRESENTATION-ATTACHMENT3.PDF
   MULTI-FAMILY ORD BOC INPUT-ATTACHMENT4.PDF
   DRAFT AUG 20TH 2024 PLANNING BOARD MINUTES-ATTACHMENT5.PDF

**B. ADJOURNMENT**

---

**5401 S. Croatan Hwy, Nags Head, NC 27959**
**252-441-5508**

# MEMORANDUM
# Town of Nags Head
# Planning & Development Department

To: Board of Commissioners

From: Kelly Wyatt, Planning Director
Joe Costello, Deputy Planning Director
Andy Garman, Town Manager

Date: September 6, 2024

Subject: Workshop to receive public input on various amendments to the Unified Development Ordinance (UDO) pertaining to multi-family dwellings.

For two years, the Town has been working to review and consider new standards regulating multi-family development. A presentation was given at the Board's September 4th regular meeting outlining this process (see Attachment 3). To summarize, the Planning Board initially drafted an ordinance which was presented to the Board of Commissioners at a public hearing in February. Information on this can be found here: https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Item/5367?fileID=10753. After the public hearing, the Board requested that the Town establish a Working Group to review and make recommendations on the ordinance drafted by the Planning Board. The charge for the Working Group was as follows:

- To consider the draft multi-family ordinance written by the Planning Board.
- To preserve the intent of the ordinance, to protect the character of Nags Head, and to provide new alternatives for workforce/long-term housing without increasing the stock of short-term rentals.
- To evaluate conditions/standards which would render such projects unfeasible due to financing, construction, configuration, or management.
- To suggest additional measures that would achieve the aforementioned goals.

Over the course of four meetings, the Working Group developed a recommendation for review by the Board of Commissioners. This included changes to the original ordinance drafted by the Planning Board as well as several other suggestions. Information about the Working Group including agendas and minutes from its meetings can be found here: https://www.nagsheadnc.gov/1108/Multi-Family-Working-Group. The Working Group's Final Recommended Ordinance is included as Attachment 1.

The Planning Board reviewed the Working Group's Ordinance over the course of three meetings this past Summer. The primary focus of the Planning Board's discussion centered around the density and design of multi-family development, mostly pertaining to larger projects. The Planning Board also discussed parking standards. The Planning Board's discussions resulted in three recommended changes to the Working Group's ordinance:

1) The Planning Board is recommending that large multi-family developments (greater than six units on one site) consist of townhouses only. The Working Group's version of the ordinance allowed townhouses and apartments in both the small and large categories.

2) The Planning Board is recommending increasing the parking requirement to 2.5 spaces per unit plus one additional space for every four units.
3) The Planning Board is recommending an additional density limitation of 25 bedrooms per acre applicable to both large and small multi-family sites. The Working Group's version of the ordinance controlled density through the use of a floor area ratio only. The recommended floor area ratio is 0.32 square feet of building area to one square foot of lot area.

The Planning Board's recommended ordinance is included as Attachment 2. Below are the Planning Board staff reports and minutes from its June, July, and August meetings (see below).

June 18th Planning Board -
https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Agenda/_06182024-461?html=true

Minutes:
https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Minutes/_06182024-461

July 16th Planning Board -
https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Agenda/_07162024-464?html=true

Minutes:
https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Minutes/_07162024-464

August 20th Planning Board -
https://www.nagsheadnc.gov/AgendaCenter/ViewFile/Agenda/_08202024-468?html=true

Note: Minutes from the August 20th Planning Board Meeting are included in the agenda packet as Attachment 5.

The Planning Board stated that they were more comfortable with the small multi-family approach. They viewed this as better maintaining the town's desired vision for development. The Planning Board also expressed an interest in capping the overall number of large multi-family developments that can be approved townwide.

**Board of Commissioners Consideration**
The Board of Commissioners held a public hearing on the proposed ordinances (the drafts from the Working Group and the Planning Board) on September 4, 2024. The presentation from this meeting is included as Attachment 3. In light of significant public comment on the ordinance, the Board voted to delay consideration of the ordinance until its October meeting. The Board requested that a public workshop be held at 9 am on September 18th in the Board of Commissioners meeting room to receive feedback on the multi-family ordinance. The Board provided suggested changes to the ordinance for future consideration. These include:

- Allowing both apartment and townhouse style units in the large and small categories.
- Including a limit of 25 bedrooms per acre for all projects.
- Including a cap of no more than 3 project approvals in the large category.
- Parking would be required at 2 spaces per unit plus 1 space for every 4 units.

These changes have been incorporated into a revised ordinance which is included as Attachment 4. We welcome public feedback on the multi-family ordinance at the September 18th workshop. It is anticipated that the Board will consider the ordinance at its October 2nd, 2024 regular meeting.

**AN ORDINANCE AMENDING THE UNIFIED DEVELOPMENT ORDINANCE OF THE TOWN OF NAGS HEAD, NORTH CAROLINA AS IT RELATES TO MULTI-FAMILY DWELLING DEVELOPMENTS WITHIN THE TOWN.**

**ARTICLE I. Purpose(s) and Authority.**

**WHEREAS**, pursuant to N.C.G.S. § 160D-701, the Town of Nags Head (the "Town") may enact and amend ordinances regulating the zoning and development of land within its jurisdiction and specifically the location and use of buildings, structures and land; pursuant to this authority and the additional authority granted by N.C.G.S. Chap. 160D-702, the Town has adopted comprehensive zoning regulations and has codified the same within the Unified Development Ordinance, Part II of the Town Code, adopted pursuant to N.C.G.S. § 160D-103, which allows the Town to combine certain land development ordinances into a unified ordinance;

**WHEREAS**, Section 2.4.4.3 of the Unified Development Ordinance provides that the powers and duties of the Planning Board include developing and recommending policies, ordinances, development regulations, administrative procedures, and other means for carrying out plans in a coordinated and efficient manner;

**WHEREAS,** Section 3.5.1. of the Town Code makes clear that a zoning ordinance text amendment may be initiated by motion of the Board of Commissioners, by motion of the Planning Board, or by application by any person within the zoning jurisdiction of the Town;

**WHEREAS**, the Board of Commissioners requested a comprehensive review of the town's multi-family standards and recommendations on how to re-introduce this use into the Unified Development Ordinance, and

**WHEREAS,** Planning staff began working with the Planning Board at their May 2023 meeting to complete a thorough review of the multi-family standards and identify issues and/or inconsistencies with the existing multi-family language. Subsequently, the Board of Commissioners established a Multi-Family Working Group to review the Planning Board's ordinance. The Planning Board and Multi-Family Working Group have developed a comprehensive set of draft text amendments for the Board of Commissioner's review and consideration.

**WHEREAS,** the 2022 Comprehensive Land Use Plan provides the following policies and actions which should guide the Town's zoning and development actions:

> Table 2.2.2.A, pg. 2-12 lists "Multi-Family" as an appropriate land use in the Gallery Row – Community Center Character Area, Northern Commercial Node.
>
> Table 2.4.2.A, pg. 2-25 lists "Multi-Family" as an appropriate land use in the Village Municipal Service Character Area.
>
> Table 2.6.2.A, pg. 2-36 lists "Multi-Family" as an appropriate land use in the Whalebone Junction Character Area, Soundside Activity Node.
>
> Table 2.8.2.A, pg. 2-48 lists "Multi-Family Residential" as an appropriate land use in the Corridors Character Area, US 158/US 64 only.
>
> LU-1 – Ensure that the character of Nags Head is preserved as a single-family residential beach community with ties to its natural environment. This character is defined by:
>
> - Development that blends with the landscape, preserving natural vegetation, dunes, open spaces, and environmental quality.
> - Buildings with a residential scale and appearance with lot heights and small footprints that are designed to reflect the heritage of Nags Head.
> - Land uses that are compatible with the community and with adjacent properties that don't create excessive noise, light, unsafe conditions, or other nuisances.
> - Development of low density and intensity served primarily with on-site wastewater systems.
>
> LU-9 – Encourage land uses that serve the needs of both year-round and seasonal residents in support of the town's overall vision for the community.

LU-10 – Discourage high intensity land uses that produce significant noise, light, heavy vehicle traffic, noxious fumes, or poor air quality, are unsightly, encourage unsafe behavior, or require large amounts of lands for heavy industrial uses, processing, or storage of materials or equipment.

LU-15 – Promote architectural standards for commercial development in keeping with the Nags Head style architecture.

LU-27 – Promote and expand the types of housing and accommodations for varying income levels, aging populations, and the seasonal workforce within the town.4e – Develop regulations that prevent incompatible commercial development adjacent to areas with historical designations or significance.

**WHEREAS**, consistent with Section 3.5.4 of the UDO (and subparts to that section), the Board finds that the proposed text amendment advances the public health, safety, or welfare; will help preserve the residential and historic character of areas of Town where commercial and non-residential uses or increases in or expansions of such uses are not compatible or desirable; is reasonable and in the public interest; and is consistent with the Town of Nags Head Comprehensive Land Use Plan.

**ARTICLE II. Construction.**
For purposes of this ordinance amendment, underlined words (underline) shall be considered as additions to existing Town Code language and strikethrough words (strikethrough) shall be considered deletions to existing language. Any portions of the adopted Town Code which are not repeated herein but are instead replaced by an ellipsis ("...") shall remain as they currently exist within the Town Code.

**ARTICLE III. Amendment of the Unified Development Ordinance.**
PART I. That **Appendix A, Definitions,** be amended as follows:

~~*Dwelling, multi-family* means a dwelling containing three or more dwelling units, designed for or occupied by three or more families living independently of each other. Multifamily dwelling shall include a townhouse and any similar building, irrespective of the form of legal title~~.

**Dwelling, Multi-Family or Dwelling Unit, Multi-Family** means a single-family dwelling unit located within a multi-family development.

**Apartment or Apartment Style Design** means a residential architectural and planning design characterized by single-family attached dwelling units constructed on multiple floors and separated by shared vertical walls and shared horizontal ceilings, floors, planes, or surfaces. For the purposes of this chapter, a series or group of **Apartment** units shall be considered a multi-family development.

**Floor Area Ratio (FAR)** means the quotient resulting from division of the gross floor area of all buildings on a lot by the area of the lot.

~~**Townhouse** means a single-family dwelling on its own individual lot but connected on two sides, by means of a common wall for at least ten feet of its length, to two other single-family dwellings or an end dwelling of a row of such dwellings~~.

**Townhouse or Townhouse Style Design** means a residential architectural and planning design characterized by single-family attached dwelling units constructed in a series or group of units and separated by shared vertical walls. For the purposes of this chapter, a series or group of **Townhouse** units shall be considered a multi-family development.

**Multi-Family Development** means a development containing no less than three multi-family dwelling units and shall be characterized as either a large multi-family development or a small multi-family development.

**Large Multi-Family Development** means a development containing more than six multi-family dwelling units.

**Small Multi-Family Development** means a development containing no less than three multi-family dwelling units and no more than six multi-family dwelling units.

**Long-term occupancy/tenancy** means the occupancy of a single-family dwelling by an owner, tenant, or other lawful occupant for a period of ninety (90) consecutive calendar days or more.

**Principal Place of Residence** means the home or place in which one's habitation is fixed, and to which one has present intention of returning after a departure or absence therefrom.

**Qualified Person** means a person working/employed in Dare County, NC. A qualified person includes but is not limited to any person who has an internship with an employer if the employer's place of business is physically located in Dare County, NC, or a person who works remotely for an employer if the person's principal place of residence and the employer's place of business are both physically located in Dare County, NC.

**Workforce Housing** or **workforce housing unit** means the following:

a. A dwelling unit which is occupied by at least one qualified person under a long- term occupancy/tenancy, and

b. A dwelling unit which is the principal place of residence for at least one qualified person, and

c. A dwelling unit which has been encumbered by the owner of the dwelling unit with recorded restriction covenants to ensure compliance with this definition and Section 7.5 of the Town Code. The recorded restrictive covenant shall expressly identify the Town as the sole beneficiary of the recorded restrictive covenant, which shall include the express power and authority of the Town to enforce the recorded restrictive both in law and in equity, including the use of judicial injunctive relief. The Town staff shall provide the owner with the exact wording of the restrictive covenant to be recorded by the owner with the Dare County Register of Deeds in order to satisfy this requirement, and Town staff shall verify such recordation. The recorded restrictive covenant shall appear in the recorded chain of title of the dwelling unit and in the case of a multi-family development, the recorded restrictive covenant shall also be contained in the multi-family development's recorded declaration of covenants establishing the multi-family development.

Nothing in this definition shall preclude employers from purchasing workforce housing units to provide accommodation for their employees, provided the employees are qualified persons who occupy such workforce housing units within Dare County and the workforce housing unit is the employee's principal place of residence, even if owned by the employer.

**PART II.** That **Section 7.5 Dwellings, Multi-Family,** shall be replaced in its entirety by the following:

Multi-family dwelling units are permitted in accordance with Section 6.6, Table of Uses and Activities, provided that the following additional requirements and conditions are met:

| **TABLE 7-1: REQUIREMENTS FOR MULTI-FAMILY DWELLINGS** | | |
|---|---|---|
| | **Large Multi-Family C-2** | **Small Multi-Family C-2** |
| Min. Lot Width for Multi-Family Site | 150 feet | No minimum |
| Min. Site Area in Uplands | 26,000 square feet | 15,000 square feet |
| Location of Multi-Family Site | Properties with frontage on US Hwy 158 only. | On any lot meeting the minimum site area requirements. |
| Setbacks | All buildings shall be setback a minimum 35 feet to all property lines. | All buildings shall meet the minimum setbacks:<br>Front: 30 feet<br>Side: 12 feet or 15 feet for corner lots<br>Rear: 20% lot depth not to exceed 30 feet. |
| Townhome orientation | No townhome structure established as part of a multi-family development shall be situated on a site so as to face/front the rear of another townhome structure within the development or on an adjoining property. | |

| TABLE 7-1: REQUIREMENTS FOR MULTI-FAMILY DWELLINGS | | |
|---|---|---|
| | **Large Multi-Family C-2** | **Small Multi-Family C-2** |
| Density/ Building Size | Floor Area Ratio: 0.32 square feet of gross floor area for each 1 square foot of lot area.<br><br>Maximum gross floor area for a single building is 10,000 square feet. More than one building may be permitted on a site. | One (1) unit per every 4,000 square feet of lot area.<br><br>Maximum building gross floor area is 5,000 square feet. |
| Maximum number of units | 75 dwelling units | 6 dwelling units. |
| Number of dwelling units per townhome structure | Maximum 6 dwelling units per structure. | No maximum. |
| Height | Maximum of 35 feet, may be increased to 42 feet with the use of an 8:12 roof pitch or greater. Additionally, no building shall exceed three (3) habitable floors. | Maximum of 35 feet, may be increased to 42 feet with the use of an 8:12 roof pitch or greater. Additionally, no building shall exceed three (3) habitable floors. |
| Open Space | 50% of side yards to remain as open space. | 50% of side yards to remain as open space. |
| Lot Coverage | 55% | 55% |
| Parking | A minimum of 2 parking spaces for each dwelling unit plus 0.5 spaces for each additional bedroom over 2. | |
| Deed Restrictions | All multi-family dwelling units within a multi-family development shall be deed restricted for long- term occupancy/tenancy. No less than 60% of all units shall be deed restricted for workforce housing. | All multi-family dwelling units in a multi-family development shall be deed restricted for long term occupancy/tenancy and workforce housing. |
| Unit Sizes/ Categories | Minimum Unit Sizes/Size Categories:<br>• Studio/One Bedroom 500 sq. ft.<br>• Two Bedroom 700 sq. ft.<br>• Three Bedroom 1,000 sq. ft.<br>Maximum unit size 1,750 sq. ft. | |
| Mixture of Units | No more than 60% of the units shall be from any unit size category. | No requirement |
| Buffer | In addition to the buffering requirements included in the Commercial Design Standards, a minimum 10-foot-wide commercial transitional protective yard shall be provided consistent with Section 10.93.3.2 and 10.93.3.3 of the UDO. | In addition to the buffering requirements included in the Commercial Design Standards, a 10-foot-wide commercial transitional protective yard shall be provided consistent with Section 10.93.3.2 of the UDO. |
| Architectural Design Requirements | All multi-family dwelling buildings, regardless of size, shall go through the Sketch Plan process as outlined in Section 10.84 of the UDO.<br><br>Multi-family dwelling buildings shall meet the requirements of Article 10, Part VI, Commercial Design Standards. | Buildings shall meet the design requirements for a large residential dwelling.<br><br>Small multi-family structures shall be approved administratively. |

| TABLE 7-1: REQUIREMENTS FOR MULTI-FAMILY DWELLINGS | | |
|---|---|---|
| | **Large Multi-Family C-2** | **Small Multi-Family C-2** |
| Building Separation | 20 feet; a sidewalk or boardwalk constructed to provide a grade separation from vehicular traffic of at least six inches shall connect all principal buildings on the site. Separate buildings shall be connected with pedestrian passageways that are striped when crossing traffic lanes. | Buildings shall be separated from one another by a minimum of ten feet, including projections. Separate buildings shall be connected with pedestrian passageways that are striped when crossing traffic lanes. |
| Accessory Uses | Management/sales office, not including a trailer, provided that the management office shall be included as a permanent structure in the project's design or may occupy one of the dwelling units.<br><br>A management/sales office may include, within the particular project, spaces for maintaining supplies, service products and amenities to be used in connection with the units within the project. There shall be sanitary facilities available for customers and employees.<br><br>Shed.<br><br>Pool (only one pool per development),<br><br>Walls and Fences.<br><br>Private Park/Playgrounds. | Shed.<br><br>Pool (only one pool per development).<br><br>Walls and Fences. Private Park/Playgrounds |
| Outdoor Amenity Area/Common Area | An area designated on the site plan for multi-family development as "common area" or as an area to be held in separate ownership for the use and benefit of residents occupying the dwelling units shown on such plan provided that it is conveniently accessible to all residents of the development. | |

7.5.1 The multi-family development shall have a mandatory homeowners' or residents' association. At a minimum, the duties of such association are to ensure compliance with Section [7.5]. The obligation of an owner or lessee to join the association and to provide the information the owner or manager of a multi-family development must be expressed in a declaration of covenants that is recorded in the Dare County Registry and provided to the town prior to any residential occupancy. The developer of a multi-family development shall provide annually a certification to the town of the multi-family developments' compliance with the restrictive covenant and workforce housing occupancy requirements, using a required certificate of compliance form provided to the association by town staff upon request.

7.5.2 Any site improvements, including construction of additions of any size, accessory structures of any size, and landscaping and buffering projects, that occur following the original Board of Commissioners Special Use Approval of a Large Multi-family dwelling development or Administrative Approval of a Small Multi-family dwelling development shall be submitted for consideration by the UDO Administrator to determine whether additional stormwater management measures are necessary.

**PART III.** That **Section 10.93.3.3, High Impact Uses,** be amended as follows:

10.93.3.3. High Impact Uses**.** High impact uses are particular uses of land, which are considered as a whole because of their peculiar or operational and physical characteristics are expected to have an adverse effect on adjoining or adjacent properties. High impact uses include, but are not limited to:

10.93.3.3.27. Large Multi-Family Dwelling Development.

**PART IV.** That **Section 6.6, Table of Permitted Uses and Activities**, be amended as follows:

| | | | Residential Districts | | | Commercial Districts | | | | | | Special Districts | | | | Overlay Districts | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Use Category/Class** | **Use Type** | **R-1** | **R-2** | **R-3** | **CR** | **C-1*** | **C-2** | **C-3** | **C-4** | **C-5** | **SPD-20** | **SED-80** | **SPD-C*** | **O&S** | **CO** | **HO** | **SRO** |
| 1 | Residential | Dwelling, Large Residential | PR | PR | PR | PR | | PR | | | PR | PR | PR | | PR | | | PR |
| 1 | Residential | Dwelling, Multi-Family (Small) | | | | | | PR | | | | | | | | | | |
| 1 | Residential | Dwelling, Multi-Family (Large) | | | | | | SR | | | | | | | | | | |
| 1 | Residential | Dwelling, Single-Family (detached) | P | P | P | P | P | P | | P | P | P | P | | P | | | P |
| 1 | Residential | Dwelling, Two-Family | | P | P | P | P | P | | P | P | | | | | | | |
| ~~1~~ | ~~Residential~~ | ~~Townhouse~~ | | | | | | ~~SR~~ | | | | ~~SR~~ | | | | | | |

**ARTICLE IV**. All ordinances or parts of ordinances in conflict with this ordinance are hereby repealed. This ordinance shall be in full force and effect from and after the 4th day of September 2024.

_____
Benjamin Cahoon, Mayor

ATTEST:

_____
Carolyn F. Morris, Town Clerk

APPROVED AS TO FORM:

_____
John Leidy, Town Attorney

Date adopted: _____
Motion to adopt by Commissioner _____
Motion seconded by Commissioner _____
Vote: AYES _____ NAYS _____

**AN ORDINANCE AMENDING THE UNIFIED DEVELOPMENT ORDINANCE OF THE TOWN OF NAGS HEAD, NORTH CAROLINA AS IT RELATES TO MULTI-FAMILY DWELLING DEVELOPMENTS WITHIN THE TOWN.**

**ARTICLE I. Purpose(s) and Authority.**

**WHEREAS**, pursuant to N.C.G.S. § 160D-701, the Town of Nags Head (the "Town") may enact and amend ordinances regulating the zoning and development of land within its jurisdiction and specifically the location and use of buildings, structures and land; pursuant to this authority and the additional authority granted by N.C.G.S. Chap. 160D-702, the Town has adopted comprehensive zoning regulations and has codified the same within the Unified Development Ordinance, Part II of the Town Code, adopted pursuant to N.C.G.S. § 160D-103, which allows the Town to combine certain land development ordinances into a unified ordinance;

**WHEREAS**, Section 2.4.4.3 of the Unified Development Ordinance provides that the powers and duties of the Planning Board include developing and recommending policies, ordinances, development regulations, administrative procedures, and other means for carrying out plans in a coordinated and efficient manner;

**WHEREAS,** Section 3.5.1. of the Town Code makes clear that a zoning ordinance text amendment may be initiated by motion of the Board of Commissioners, by motion of the Planning Board, or by application by any person within the zoning jurisdiction of the Town;

**WHEREAS**, the Board of Commissioners requested a comprehensive review of the town's multi-family standards and recommendations on how to re-introduce this use into the Unified Development Ordinance, and

**WHEREAS,** Planning staff began working with the Planning Board at their May 2023 meeting to complete a thorough review of the multi-family standards and identify issues and/or inconsistencies with the existing multi-family language. Subsequently, the Board of Commissioners established a Multi-Family Working Group to review the Planning Board's ordinance. The Planning Board and Multi-Family Working Group have developed a comprehensive set of draft text amendments for the Board of Commissioner's review and consideration.

**WHEREAS,** the 2022 Comprehensive Land Use Plan provides the following policies and actions which should guide the Town's zoning and development actions:

> Table 2.2.2.A, pg. 2-12 lists "Multi-Family" as an appropriate land use in the Gallery Row – Community Center Character Area, Northern Commercial Node.
>
> Table 2.4.2.A, pg. 2-25 lists "Multi-Family" as an appropriate land use in the Village Municipal Service Character Area.
>
> Table 2.6.2.A, pg. 2-36 lists "Multi-Family" as an appropriate land use in the Whalebone Junction Character Area, Soundside Activity Node.
>
> Table 2.8.2.A, pg. 2-48 lists "Multi-Family Residential" as an appropriate land use in the Corridors Character Area, US 158/US 64 only.
>
> LU-1 – Ensure that the character of Nags Head is preserved as a single-family residential beach community with ties to its natural environment. This character is defined by:
>
> - Development that blends with the landscape, preserving natural vegetation, dunes, open spaces, and environmental quality.
> - Buildings with a residential scale and appearance with lot heights and small footprints that are designed to reflect the heritage of Nags Head.
> - Land uses that are compatible with the community and with adjacent properties that don't create excessive noise, light, unsafe conditions, or other nuisances.
> - Development of low density and intensity served primarily with on-site wastewater systems.
>
> LU-9 – Encourage land uses that serve the needs of both year-round and seasonal residents in support of the town's overall vision for the community.

LU-10 – Discourage high intensity land uses that produce significant noise, light, heavy vehicle traffic, noxious fumes, or poor air quality, are unsightly, encourage unsafe behavior, or require large amounts of lands for heavy industrial uses, processing, or storage of materials or equipment.

LU-15 – Promote architectural standards for commercial development in keeping with the Nags Head style architecture.

LU-27 – Promote and expand the types of housing and accommodations for varying income levels, aging populations, and the seasonal workforce within the town.4e – Develop regulations that prevent incompatible commercial development adjacent to areas with historical designations or significance.

**WHEREAS**, consistent with Section 3.5.4 of the UDO (and subparts to that section) the Board finds that the proposed text amendment advances the public health, safety, or welfare; will help preserve the residential and historic character of areas of Town where commercial and non-residential uses or increases in or expansions of such uses are not compatible or desirable; is reasonable and in the public interest; and is consistent with the Town of Nags Head Comprehensive Land Use Plan.

**ARTICLE II. Construction.**
For purposes of this ordinance amendment, underlined words (underline) shall be considered as additions to existing Town Code language and strikethrough words (strikethrough) shall be considered deletions to existing language. Any portions of the adopted Town Code which are not repeated herein but are instead replaced by an ellipsis ("...") shall remain as they currently exist within the Town Code.

**ARTICLE III. Amendment of the Unified Development Ordinance.**
PART I. That **Appendix A, Definitions,** be amended as follows:

~~*Dwelling, multi-family* means a dwelling containing three or more dwelling units, designed for or occupied by three or more families living independently of each other. Multifamily dwelling shall include a townhouse and any similar building, irrespective of the form of legal title~~.

**Dwelling, Multi-Family or Dwelling Unit, Multi-Family** means a single-family dwelling unit located within a multi-family development.

**Apartment or Apartment Style Design** means a residential architectural and planning design characterized by single-family attached dwelling units constructed on multiple floors and separated by shared vertical walls and shared horizontal ceilings, floors, planes, or surfaces. For the purposes of this chapter, a series or group of **Apartment** units shall be considered a multi-family development.

**Floor Area Ratio (FAR)** means the quotient resulting from division of the gross floor area of all buildings on a lot by the area of the lot.

~~**Townhouse** means a single-family dwelling on its own individual lot but connected on two sides, by means of a common wall for at least ten feet of its length, to two other single-family dwellings or an end dwelling of a row of such dwellings~~.

**Townhouse or Townhouse Style Design** means a residential architectural and planning design characterized by single-family attached dwelling units constructed in a series or group of units and separated by shared vertical walls. For the purposes of this chapter, a series or group of **Townhouse** units shall be considered a multi-family development.

**Multi-Family Development** means a development containing no less than three multi-family dwelling units and shall be characterized as either a large multi-family development or a small multi-family development.

**Large Multi-Family Development** means a development containing more than six multi-family dwelling units.

**Small Multi-Family Development** means a development containing no less than three multi-family dwelling units and no more than six multi-family dwelling units.

**Long-term occupancy/tenancy** means the occupancy of a single-family dwelling by an owner, tenant, or other lawful occupant for a period of ninety (90) consecutive calendar days or more.

**Principal Place of Residence** means the home or place in which one's habitation is fixed, and to which one has present intention of returning after a departure or absence therefrom.

**Qualified Person** means a person working/employed in Dare County, NC. A qualified person includes but is not limited to any person who has an internship with an employer if the employer's place of business is physically located in Dare County, NC, or a person who works remotely for an employer if the person's principal place of residence and the employer's place of business are both physically located in Dare County, NC.

**Workforce Housing** or **workforce housing unit** means the following:

a. A dwelling unit which is occupied by at least one qualified person under a long- term occupancy/tenancy, and

b. A dwelling unit which is the principal place of residence for at least one qualified person, and

c. A dwelling unit which has been encumbered by the owner of the dwelling unit with recorded restriction covenants to ensure compliance with this definition and Section 7.5 of the Town Code. The recorded restrictive covenant shall expressly identify the Town as the sole beneficiary of the recorded restrictive covenant, which shall include the express power and authority of the Town to enforce the recorded restrictive both in law and in equity, including the use of judicial injunctive relief. The Town staff shall provide the owner with the exact wording of the restrictive covenant to be recorded by the owner with the Dare County Register of Deeds in order to satisfy this requirement, and Town staff shall verify such recordation. The recorded restrictive covenant shall appear in the recorded chain of title of the dwelling unit and in the case of a multi-family development, the recorded restrictive covenant shall also be contained in the multi-family development's recorded declaration of covenants establishing the multi-family development.

Nothing in this definition shall preclude employers from purchasing workforce housing units to provide accommodation for their employees, provided the employees are qualified persons who occupy such workforce housing units within Dare County and the workforce housing unit is the employee's principal place of residence, even if owned by the employer.

**PART II.** That **Section 7.5 Dwellings, Multi-Family,** shall be replaced in its entirety by the following:

Multi-family dwelling units are permitted in accordance with Section 6.6, Table of Uses and Activities, provided that the following additional requirements and conditions are met:

| **TABLE 7-1: REQUIREMENTS FOR MULTI-FAMILY DWELLINGS** | | |
|---|---|---|
| | **Large Multi-Family C-2** | **Small Multi-Family C-2** |
| Min. Lot Width for Multi-Family Site | 150 feet | No minimum |
| Min. Site Area in Uplands | 26,000 square feet | 15,000 square feet |
| Location of Multi-Family Site | Properties with frontage on US Hwy 158 only. | On any lot meeting the minimum site area requirements. |
| Setbacks | All buildings shall be setback a minimum 35 feet to all property lines. | All buildings shall meet the minimum setbacks:<br>Front: 30 feet<br>Side: 12 feet or 15 feet for corner lots<br>Rear: 20% lot depth not to exceed 30 feet. |
| Townhome orientation | No townhome structure established as part of a multi-family development shall be situated on a site so as to face/front the rear of another townhome structure within the development or on an adjoining property. | |

| TABLE 7-1: REQUIREMENTS FOR MULTI-FAMILY DWELLINGS | | |
|---|---|---|
| | **Large Multi-Family C-2** | **Small Multi-Family C-2** |
| Density/ Building Size | Floor Area Ratio: 0.32 square feet of gross floor area for each 1 square foot of lot area.<br><br>Maximum gross floor area for a single building is 10,000 square feet. More than one building may be permitted on a site. | One (1) unit per every 4,000 square feet of lot area.<br><br>Maximum building gross floor area is 5,000 square feet. |
| Maximum Bedroom per Acre Standard | Total number of bedrooms within the development shall not exceed 25 per acre. | Total number of bedrooms within the development shall not exceed 25 per acre. |
| Maximum number of units | 75 dwelling units | 6 dwelling units. |
| Number of dwelling units per townhome structure | Maximum 6 dwelling units per structure. | No maximum. |
| Height | Maximum of 35 feet, may be increased to 42 feet with the use of an 8:12 roof pitch or greater. Additionally, no building shall exceed three (3) habitable floors. | Maximum of 35 feet, may be increased to 42 feet with the use of an 8:12 roof pitch or greater. Additionally, no building shall exceed three (3) habitable floors. |
| Open Space | 50% of side yards to remain as open space. | 50% of side yards to remain as open space. |
| Lot Coverage | 55% | 55% |
| Parking | A minimum of 2.5 parking spaces for each dwelling unit plus 1 space for every four units. | |
| Deed Restrictions | All multi-family dwelling units within a multi-family development shall be deed restricted for long- term occupancy/tenancy. No less than 60% of all units shall be deed restricted for workforce housing. | All multi-family dwelling units in a multi-family development shall be deed restricted for long term occupancy/tenancy and workforce housing. |
| Unit Sizes/ Categories | Minimum Unit Sizes/Size Categories:<br>• Studio/One Bedroom 500 sq. ft.<br>• Two Bedroom 700 sq. ft.<br>• Three Bedroom 1,000 sq. ft.<br>Maximum unit size 1,750 sq. ft. | |
| Mixture of Units | No more than 60% of the units shall be from any unit size category. | No requirement |
| Buffer | In addition to the buffering requirements included in the Commercial Design Standards, a minimum 10-foot-wide commercial transitional protective yard shall be provided consistent with Section 10.93.3.2 and 10.93.3.3 of the UDO. | In addition to the buffering requirements included in the Commercial Design Standards, a 10-foot-wide commercial transitional protective yard shall be provided consistent with Section 10.93.3.2 of the UDO. |
| Architectural Design Requirements | All multi-family dwelling buildings, regardless of size, shall go through the Sketch Plan process as outlined in Section 10.84 of the UDO.<br><br>Multi-family dwelling buildings shall meet the requirements of Article 10, Part VI, Commercial Design Standards. | Buildings shall meet the design requirements for a large residential dwelling.<br><br>Small multi-family structures shall be approved administratively. |

| TABLE 7-1: REQUIREMENTS FOR MULTI-FAMILY DWELLINGS | | |
|---|---|---|
| | **Large Multi-Family C-2** | **Small Multi-Family C-2** |
| Building Separation | 20 feet; a sidewalk or boardwalk constructed to provide a grade separation from vehicular traffic of at least six inches shall connect all principal buildings on the site. Separate buildings shall be connected with pedestrian passageways that are striped when crossing traffic lanes. | Buildings shall be separated from one another by a minimum of ten feet, including projections. Separate buildings shall be connected with pedestrian passageways that are striped when crossing traffic lanes. |
| Accessory Uses | Management/sales office, not including a trailer, provided that the management office shall be included as a permanent structure in the project's design or may occupy one of the dwelling units.<br><br>A management/sales office may include, within the particular project, spaces for maintaining supplies, service products and amenities to be used in connection with the units within the project. There shall be sanitary facilities available for customers and employees.<br><br>Shed.<br><br>Pool (only one pool per development),<br><br>Walls and Fences.<br><br>Private Park/Playgrounds. | Shed.<br><br>Pool (only one pool per development).<br><br>Walls and Fences. Private Park/Playgrounds |
| Outdoor Amenity Area/Common Area | An area designated on the site plan for multi-family development as "common area" or as an area to be held in separate ownership for the use and benefit of residents occupying the dwelling units shown on such plan provided that it is conveniently accessible to all residents of the development. | |

7.5.1 The multi-family development shall have a mandatory homeowners' or residents' association. At a minimum, the duties of such association are to ensure compliance with Section [7.5]. The obligation of an owner or lessee to join the association and to provide the information the owner or manager of a multi-family development must be expressed in a declaration of covenants that is recorded in the Dare County Registry and provided to the town prior to any residential occupancy. The developer of a multi-family development shall provide annually a certification to the town of the multi-family developments' compliance with the restrictive covenant and workforce housing occupancy requirements, using a required certificate of compliance form provided to the association by town staff upon request.

7.5.2 Any site improvements, including construction of additions of any size, accessory structures of any size, and landscaping and buffering projects, that occur following the original Board of Commissioners Special Use Approval of a Large Multi-family dwelling development or Administrative Approval of a Small Multi-family dwelling development shall be submitted for consideration by the UDO Administrator to determine whether additional stormwater management measures are necessary.

**PART III.** That **Section 10.93.3.3, High Impact Uses,** be amended as follows:

10.93.3.3. High Impact Uses**.** High impact uses are particular uses of land, which are considered as a whole because of their peculiar or operational and physical characteristics are expected to have an adverse effect on adjoining or adjacent properties. High impact uses include, but are not limited to:

10.93.3.3.27. Large Multi-Family Dwelling Development.

**PART IV.** That **Section 6.6, Table of Permitted Uses and Activities**, be amended as follows:

| | | | Residential Districts | | | Commercial Districts | | | | | | Special Districts | | | | Overlay Districts | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Use Category/Class** | **Use Type** | **R-1** | **R-2** | **R-3** | **CR** | **C-1*** | **C-2** | **C-3** | **C-4** | **C-5** | **SPD-20** | **SED-80** | **SPD-C*** | **O&S** | **CO** | **HO** | **SRO** |
| 1 | Residential | Dwelling, Large Residential | PR | PR | PR | PR | | PR | | | PR | PR | PR | | PR | | | PR |
| 1 | Residential | Dwelling, Multi-Family (Small) Townhouse & Apartment Style Design | | | | | | PR | | | | | | | | | | |
| 1 | Residential | Dwelling, Multi-Family (Large) Townhouse Style Design Only | | | | | | SR | | | | | | | | | | |
| 1 | Residential | Dwelling, Single-Family (detached) | P | P | P | P | P | P | | P | P | P | P | | P | | | P |
| 1 | Residential | Dwelling, Two-Family | | P | P | P | P | P | | P | P | | | | | | | |
| ~~1~~ | ~~Residential~~ | ~~Townhouse~~ | | | | | | ~~SR~~ | | | | ~~SR~~ | | | | | | |

**ARTICLE IV**. All ordinances or parts of ordinances in conflict with this ordinance are hereby repealed. This ordinance shall be in full force and effect from and after the 4th day of September 2024.

_____
Benjamin Cahoon, Mayor

ATTEST:

_____
Carolyn F. Morris, Town Clerk

APPROVED AS TO FORM:

_____
John Leidy, Town Attorney

Date adopted: _____
Motion to adopt by Commissioner _____
Motion seconded by Commissioner _____
Vote: AYES _____ NAYS _____

# Town of Nags Head

## Multi-Family Ordinance

Nags Head Board of Commissioners

Wednesday, September 4th, 2024

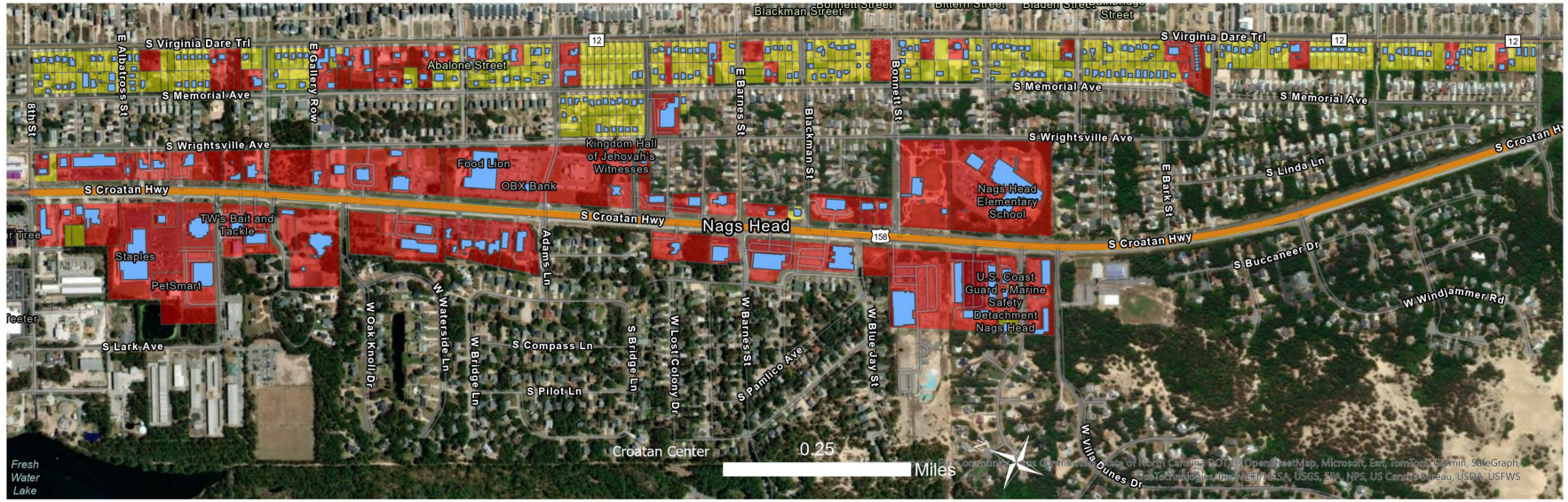
# Background

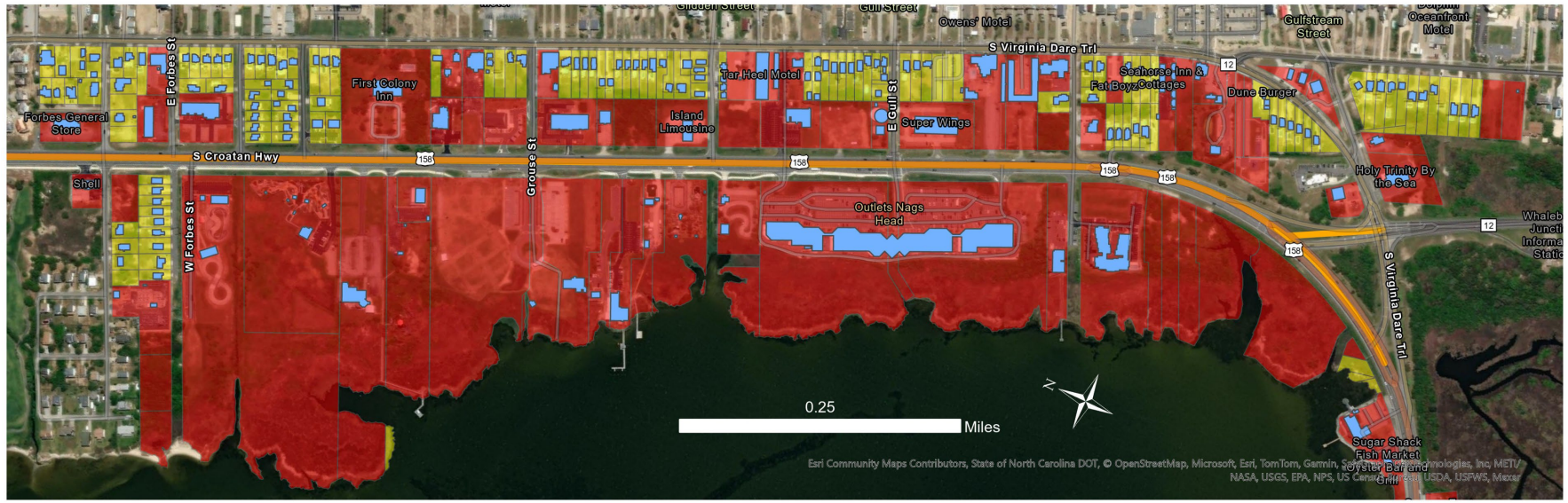
- Late 2022 – the Town adopted a moratorium and subsequently eliminated Multi-Family (MF)
- Goal was to review if and where MF should be allowed and under what standards
- MF no longer allowed in the new C-5 district near Jockey's Ridge and Cottage Row
- BOC and PB held a joint workshop to provide guidance on a new ordinance
- Consensus was to consider MF in C-2 (possibly limited to high activity areas) and not for more short-term rentals. Focus on workforce housing. Possible use of deed restrictions.

# Background

- The Planning Board worked on the ordinance in 2023; a public hearing was held in February 2024
- BOC wanted further review and established a working group
- Working group’s ordinance was presented to the BOC in June of 2024
- Planning Board reviewed the Working Group ordinance and has now submitted a recommendation

# Prior Multi-Family Ordinance




- Parcels Zoned C2
- 840 Unique Parcels
- 207 Parcels greater than 15,000 sq. ft.

**Legend**

< 15,000

> 15,000

S Croatan Hwy

# Prior Multi-Family Ordinance

- MF is three or more units on lot
- Allowed Multi-Family in the C-2 District Townwide
- No limitations related to long-term or workforce housing (i.e. could be used for short-term rentals)
- No maximum size for units; minimum unit size of 800 sq. ft.
- 20,000 sq. ft. building size limitation; could have multiple buildings
- Density controlled through units per acre (roughly 10-11 units per acre)
- Other standards apply (height, setbacks, lot coverage, lot width)
- No limit on bedrooms per acre (i.e. all units could have four bedrooms)
- Minimum lot size 26,000 sq. ft.
- Last MF project was the Sugar Creek Condos

# New Multi-Family Ordinance Goals

- Multi-Family would be used to enhance opportunities for workforce/long-term housing but not for short-term or vacation rentals
- More units per acre to reduce land cost per unit
- Smaller units to reduce construction cost per unit
- Maintain controls over density to preserve town values
- Carefully consider where large and small projects can occur to increase compatibility with other uses
- Consider other standards to enhance design and appearance and reduce scale while increasing flexibility

# Working Group Ordinance Summary

## Two Categories – Large and Small

## Large MF

- Deed restrictions – 60% workforce, all have to be long-term rentals (no short-term rentals)
- Use Floor Area Ratio for large projects instead of units per acre
- *Floor Area Ratio (FAR) means the quotient resulting from division of the gross floor area of all buildings on a lot by the area of the lot*
- FAR of 0.32 is proposed. This is the effective FAR we currently use for large residential dwellings.
- Reduce Unit Size:
  - ✓ Minimum Unit Sizes/Size Categories: Studio/One Bedroom 500 sq. ft.; Two Bedroom 700 sq. ft.; Three Bedroom 1,000 sq. ft.
  - ✓ Maximum unit size 1,750 sq. ft.
  - ✓ No more than 60% of the units shall be from any unit size category.
- Individual building size would be limited to 10,000 sq. ft.
- Apartments and Townhouses
- Only fronting US 158; Special Use Permit required
- Must have 26,000 sq. ft. lot

# Working Group Summary

## Small MF

- All units deed restricted to workforce only
- Continue to use units per acre (1 per 4,000 sq. ft. of land area)
- Max six units in small category
- Max building size is 5,000 sq. ft. (similar to large residential dwelling)
- Allowed everywhere in C-2 (not just on US 158)
- Must have 15,000 sq. ft. lot
- Approved administratively by staff
- Same architectural requirements as large residential
- Reduced setbacks; design requirements similar to large residential dwellings

# Planning Board Recommendation

- Preference for the Small MF Category – best reflects desired development patterns for Nags Head
- Increase parking to 2.5 spaces per unit + one space for every four units
- For Large MF – only allow townhouse style units
- Add in bedroom per acre limitation of 25 bedrooms per acre (this is consistent with the town's large residential dwelling ordinance)
- Recommendation included no changes to other provisions of the Working Group Ordinance
- Would like to see a townwide cap on the number of large multi-family projects that can be approved

# Discussion

# Draft Planning Board Ordinance – Design

- From Joint Workshop consensus that townhouse style development was preferred.
  - Townhouses generally have fewer shared walls and offer more privacy than apartments, more home-like environment.
  - Townhouse developments can offer more diverse architectural designs, maintaining the character of the surrounding areas.
  - Townhouse development is generally not as dense as apartment style development.
  - Townhouse development fosters a sense of community, residents have their own entrances, outdoor spaces, etc.
- Ordinance precludes apartment style development for the Large Multi-Family.
- Either is acceptable for Small Multi-Family category as both a principal and accessory use.

**AN ORDINANCE AMENDING THE UNIFIED DEVELOPMENT ORDINANCE OF THE TOWN OF NAGS HEAD, NORTH CAROLINA AS IT RELATES TO MULTI-FAMILY DWELLING DEVELOPMENTS WITHIN THE TOWN.**

**ARTICLE I. Purpose(s) and Authority.**

**WHEREAS**, pursuant to N.C.G.S. § 160D-701, the Town of Nags Head (the "Town") may enact and amend ordinances regulating the zoning and development of land within its jurisdiction and specifically the location and use of buildings, structures and land; pursuant to this authority and the additional authority granted by N.C.G.S. Chap. 160D-702, the Town has adopted comprehensive zoning regulations and has codified the same within the Unified Development Ordinance, Part II of the Town Code, adopted pursuant to N.C.G.S. § 160D-103, which allows the Town to combine certain land development ordinances into a unified ordinance;

**WHEREAS**, Section 2.4.4.3 of the Unified Development Ordinance provides that the powers and duties of the Planning Board include developing and recommending policies, ordinances, development regulations, administrative procedures, and other means for carrying out plans in a coordinated and efficient manner;

**WHEREAS,** Section 3.5.1. of the Town Code makes clear that a zoning ordinance text amendment may be initiated by motion of the Board of Commissioners, by motion of the Planning Board, or by application by any person within the zoning jurisdiction of the Town;

**WHEREAS**, the Board of Commissioners requested a comprehensive review of the town's multi-family standards and recommendations on how to re-introduce this use into the Unified Development Ordinance, and

**WHEREAS,** Planning staff began working with the Planning Board at their May 2023 meeting to complete a thorough review of the multi-family standards and identify issues and/or inconsistencies with the existing multi-family language. Subsequently, the Board of Commissioners established a Multi-Family Working Group to review the Planning Board's ordinance. The Planning Board and Multi-Family Working Group have developed a comprehensive set of draft text amendments for the Board of Commissioner's review and consideration.

**WHEREAS,** the 2022 Comprehensive Land Use Plan provides the following policies and actions which should guide the Town's zoning and development actions:

> Table 2.2.2.A, pg. 2-12 lists "Multi-Family" as an appropriate land use in the Gallery Row – Community Center Character Area, Northern Commercial Node.
>
> Table 2.4.2.A, pg. 2-25 lists "Multi-Family" as an appropriate land use in the Village Municipal Service Character Area.
>
> Table 2.6.2.A, pg. 2-36 lists "Multi-Family" as an appropriate land use in the Whalebone Junction Character Area, Soundside Activity Node.
>
> Table 2.8.2.A, pg. 2-48 lists "Multi-Family Residential" as an appropriate land use in the Corridors Character Area, US 158/US 64 only.
>
> LU-1 – Ensure that the character of Nags Head is preserved as a single-family residential beach community with ties to its natural environment. This character is defined by:
>
> - Development that blends with the landscape, preserving natural vegetation, dunes, open spaces, and environmental quality.
> - Buildings with a residential scale and appearance with lot heights and small footprints that are designed to reflect the heritage of Nags Head.
> - Land uses that are compatible with the community and with adjacent properties that don't create excessive noise, light, unsafe conditions, or other nuisances.
> - Development of low density and intensity served primarily with on-site wastewater systems.
>
> LU-9 – Encourage land uses that serve the needs of both year-round and seasonal residents in support of the town's overall vision for the community.

LU-10 – Discourage high intensity land uses that produce significant noise, light, heavy vehicle traffic, noxious fumes, or poor air quality, are unsightly, encourage unsafe behavior, or require large amounts of lands for heavy industrial uses, processing, or storage of materials or equipment.

LU-15 – Promote architectural standards for commercial development in keeping with the Nags Head style architecture.

LU-27 – Promote and expand the types of housing and accommodations for varying income levels, aging populations, and the seasonal workforce within the town.4e – Develop regulations that prevent incompatible commercial development adjacent to areas with historical designations or significance.

**WHEREAS**, consistent with Section 3.5.4 of the UDO (and subparts to that section), the Board finds that the proposed text amendment advances the public health, safety, or welfare; will help preserve the residential and historic character of areas of Town where commercial and non-residential uses or increases in or expansions of such uses are not compatible or desirable; is reasonable and in the public interest; and is consistent with the Town of Nags Head Comprehensive Land Use Plan.

**ARTICLE II. Construction.**
For purposes of this ordinance amendment, underlined words (underline) shall be considered as additions to existing Town Code language and strikethrough words (strikethrough) shall be considered deletions to existing language. Any portions of the adopted Town Code which are not repeated herein but are instead replaced by an ellipsis ("...") shall remain as they currently exist within the Town Code.

**ARTICLE III. Amendment of the Unified Development Ordinance.**
PART I. That **Appendix A, Definitions,** be amended as follows:

~~*Dwelling, multi-family* means a dwelling containing three or more dwelling units, designed for or occupied by three or more families living independently of each other. Multifamily dwelling shall include a townhouse and any similar building, irrespective of the form of legal title~~.

**Dwelling, Multi-Family or Dwelling Unit, Multi-Family** means a single-family dwelling unit located within a multi-family development.

**Apartment or Apartment Style Design** means a residential architectural and planning design characterized by single-family attached dwelling units constructed on multiple floors and separated by shared vertical walls and shared horizontal ceilings, floors, planes, or surfaces. For the purposes of this chapter, a series or group of **Apartment** units shall be considered a multi-family development.

**Floor Area Ratio (FAR)** means the quotient resulting from division of the gross floor area of all buildings on a lot by the area of the lot.

~~**Townhouse** means a single-family dwelling on its own individual lot but connected on two sides, by means of a common wall for at least ten feet of its length, to two other single-family dwellings or an end dwelling of a row of such dwellings~~.

**Townhouse or Townhouse Style Design** means a residential architectural and planning design characterized by single-family attached dwelling units constructed in a series or group of units and separated by shared vertical walls. For the purposes of this chapter, a series or group of **Townhouse** units shall be considered a multi-family development.

**Multi-Family Development** means a development containing no less than three multi-family dwelling units and shall be characterized as either a large multi-family development or a small multi-family development.

**Large Multi-Family Development** means a development containing more than six multi-family dwelling units.

**Small Multi-Family Development** means a development containing no less than three multi-family dwelling units and no more than six multi-family dwelling units.

**Long-term occupancy/tenancy** means the occupancy of a single-family dwelling by an owner, tenant, or other lawful occupant for a period of ninety (90) consecutive calendar days or more.

**Principal Place of Residence** means the home or place in which one's habitation is fixed, and to which one has present intention of returning after a departure or absence therefrom.

**Qualified Person** means a person working/employed in Dare County, NC. A qualified person includes but is not limited to any person who has an internship with an employer if the employer's place of business is physically located in Dare County, NC, or a person who works remotely for an employer if the person's principal place of residence and the employer's place of business are both physically located in Dare County, NC.

**Workforce Housing** or **workforce housing unit** means the following:

a. A dwelling unit which is occupied by at least one qualified person under a long- term occupancy/tenancy, and

b. A dwelling unit which is the principal place of residence for at least one qualified person, and

c. A dwelling unit which has been encumbered by the owner of the dwelling unit with recorded restriction covenants to ensure compliance with this definition and Section 7.5 of the Town Code. The recorded restrictive covenant shall expressly identify the Town as the sole beneficiary of the recorded restrictive covenant, which shall include the express power and authority of the Town to enforce the recorded restrictive both in law and in equity, including the use of judicial injunctive relief. The Town staff shall provide the owner with the exact wording of the restrictive covenant to be recorded by the owner with the Dare County Register of Deeds in order to satisfy this requirement, and Town staff shall verify such recordation. The recorded restrictive covenant shall appear in the recorded chain of title of the dwelling unit and in the case of a multi-family development, the recorded restrictive covenant shall also be contained in the multi-family development's recorded declaration of covenants establishing the multi-family development.

Nothing in this definition shall preclude employers from purchasing workforce housing units to provide accommodation for their employees, provided the employees are qualified persons who occupy such workforce housing units within Dare County and the workforce housing unit is the employee's principal place of residence, even if owned by the employer.

**PART II.** That **Section 7.5 Dwellings, Multi-Family,** shall be replaced in its entirety by the following:

Multi-family dwelling units are permitted in accordance with Section 6.6, Table of Uses and Activities, provided that the following additional requirements and conditions are met:

| **TABLE 7-1: REQUIREMENTS FOR MULTI-FAMILY DWELLINGS** | | |
|---|---|---|
| | **Large Multi-Family C-2** | **Small Multi-Family C-2** |
| Unit Design | Townhouse and Apartment Style Design shall be allowed for both large and small categories. | |
| Min. Lot Width for Multi-Family Site | 150 feet | No minimum |
| Min. Site Area in Uplands | 26,000 square feet | 15,000 square feet |
| Location of Multi-Family Site | Properties with frontage on US Hwy 158 only. | On any lot meeting the minimum site area requirements. |
| Setbacks | All buildings shall be setback a minimum 35 feet to all property lines. | All buildings shall meet the minimum setbacks:<br>Front: 30 feet<br>Side: 12 feet or 15 feet for corner lots<br>Rear: 20% lot depth not to exceed 30 feet. |
| Townhome orientation | No townhome structure established as part of a multi-family development shall be situated on a site so as to face/front the rear of another townhome structure within the development or on an adjoining property. | |

| TABLE 7-1: REQUIREMENTS FOR MULTI-FAMILY DWELLINGS | | |
|---|---|---|
| | **Large Multi-Family C-2** | **Small Multi-Family C-2** |
| Density/ Building Size | Floor Area Ratio: 0.32 square feet of gross floor area for each 1 square foot of lot area.<br><br>Maximum gross floor area for a single building is 10,000 square feet. More than one building may be permitted on a site. | One (1) unit per every 4,000 square feet of lot area.<br><br>Maximum building gross floor area is 5,000 square feet. |
| Maximum Bedroom per Acre Standard | Total number of bedrooms within the development shall not exceed 25 per acre. | |
| Maximum number of units | 75 dwelling units | 6 dwelling units. |
| Number of dwelling units per townhome structure | Maximum 6 dwelling units per structure. | No maximum. |
| Height | Maximum of 35 feet, may be increased to 42 feet with the use of an 8:12 roof pitch or greater. Additionally, no building shall exceed three (3) habitable floors. | |
| Open Space | 50% of side yards to remain as open space. | |
| Lot Coverage | 55% | |
| Parking | A minimum of 2 parking spaces shall be included for each dwelling unit plus 1 parking space for every 4 units. | |
| Deed Restrictions | All multi-family dwelling units within a multi-family development shall be deed restricted for long- term occupancy/tenancy. No less than 60% of all units shall be deed restricted for workforce housing. | All multi-family dwelling units in a multi-family development shall be deed restricted for long term occupancy/tenancy and workforce housing. |
| Unit Sizes/ Categories | Minimum Unit Sizes/Size Categories:<br>• Studio/One Bedroom 500 sq. ft.<br>• Two Bedroom 700 sq. ft.<br>• Three Bedroom 1,000 sq. ft.<br>Maximum unit size 1,750 sq. ft. | |
| Mixture of Units | No more than 60% of the units shall be from any unit size category. | No requirement |
| Buffer | In addition to the buffering requirements included in the Commercial Design Standards, a minimum 10-foot-wide commercial transitional protective yard shall be provided consistent with Section 10.93.3.2 and 10.93.3.3 of the UDO. | In addition to the buffering requirements included in the Commercial Design Standards, a 10-foot-wide commercial transitional protective yard shall be provided consistent with Section 10.93.3.2 of the UDO. |
| Architectural Design Requirements | All multi-family dwelling buildings, regardless of size, shall go through the Sketch Plan process as outlined in Section 10.84 of the UDO.<br><br>Multi-family dwelling buildings shall meet the requirements of Article 10, Part VI, Commercial Design Standards. | Buildings shall meet the design requirements for a large residential dwelling.<br><br>Small multi-family structures shall be approved administratively. |

| TABLE 7-1: REQUIREMENTS FOR MULTI-FAMILY DWELLINGS | | |
|---|---|---|
| | **Large Multi-Family C-2** | **Small Multi-Family C-2** |
| Building Separation | 20 feet; a sidewalk or boardwalk constructed to provide a grade separation from vehicular traffic of at least six inches shall connect all principal buildings on the site. Separate buildings shall be connected with pedestrian passageways that are striped when crossing traffic lanes. | Buildings shall be separated from one another by a minimum of ten feet, including projections. Separate buildings shall be connected with pedestrian passageways that are striped when crossing traffic lanes. |
| Accessory Uses | Management/sales office, not including a trailer, provided that the management office shall be included as a permanent structure in the project's design or may occupy one of the dwelling units.<br><br>A management/sales office may include, within the particular project, spaces for maintaining supplies, service products and amenities to be used in connection with the units within the project. There shall be sanitary facilities available for customers and employees.<br><br>Shed.<br><br>Pool (only one pool per development),<br><br>Walls and Fences.<br><br>Private Park/Playgrounds. | Shed.<br><br>Pool (only one pool per development).<br><br>Walls and Fences. Private Park/Playgrounds |
| Outdoor Amenity Area/Common Area | An area designated on the site plan for multi-family development as "common area" or as an area to be held in separate ownership for the use and benefit of residents occupying the dwelling units shown on such plan provided that it is conveniently accessible to all residents of the development. | No requirement. |
| Limit on Development Approvals | There shall be a limit of no more than 3 new large multi-family projects approved after the effective date of this ordinance. Existing multi-family development as of the effective date of this ordinance shall be governed by Article V – Nonconformities. | There is no limit on the number of small multi-family projects that can be approved under this ordinance. |

7.5.1 The multi-family development shall have a mandatory homeowners' or residents' association. At a minimum, the duties of such association are to ensure compliance with Section [7.5]. The obligation of an owner or lessee to join the association and to provide the information the owner or manager of a multi-family development must be expressed in a declaration of covenants that is recorded in the Dare County Registry and provided to the town prior to any residential occupancy. The homeowners' or residents' association shall provide annually a certification to the town of the multi-family developments' compliance with the restrictive covenant and workforce housing occupancy requirements, using a required certificate of compliance form provided to the association by town staff upon request.

7.5.2 Any site improvements, including construction of additions of any size, accessory structures of any size, and landscaping and buffering projects, that occur following the original Board of Commissioners Special Use Approval of a Large Multi-family dwelling development or Administrative Approval of a Small Multi-family dwelling development shall be submitted for consideration by the UDO Administrator to determine whether additional stormwater management measures are necessary.

**PART III.** That **Section 10.93.3.3, High Impact Uses,** be amended as follows:

10.93.3.3. High Impact Uses**.** High impact uses are particular uses of land, which are considered as a whole because of their peculiar or operational and physical characteristics are expected to have an adverse effect on adjoining or adjacent properties. High impact uses include, but are not limited to:

10.93.3.3.27. Large Multi-Family Dwelling Development.

**PART IV.** That **Section 6.6, Table of Permitted Uses and Activities**, be amended as follows:

| | | | Residential Districts | | | Commercial Districts | | | | | | Special Districts | | | | Overlay Districts | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Use Category/Class** | **Use Type** | **R-1** | **R-2** | **R-3** | **CR** | **C-1*** | **C-2** | **C-3** | **C-4** | **C-5** | **SPD-20** | **SED-80** | **SPD-C*** | **O&S** | **CO** | **HO** | **SRO** |
| 1 | Residential | Dwelling, Large Residential | PR | PR | PR | PR | | PR | | | PR | PR | PR | | PR | | | PR |
| 1 | Residential | Dwelling, Multi-Family (Small) | | | | | | PR | | | | | | | | | | |
| 1 | Residential | Dwelling, Multi-Family (Large) | | | | | | SR | | | | | | | | | | |
| 1 | Residential | Dwelling, Single-Family (detached) | P | P | P | P | P | P | | P | P | P | P | | P | | | P |
| 1 | Residential | Dwelling, Two-Family | | P | P | P | P | P | | P | P | | | | | | | |
| ~~1~~ | ~~Residential~~ | ~~Townhouse~~ | | | | | | ~~SR~~ | | | | ~~SR~~ | | | | | | |

**ARTICLE IV**. All ordinances or parts of ordinances in conflict with this ordinance are hereby repealed. This ordinance shall be in full force and effect from and after the _____ day of _____2024.

_____
Benjamin Cahoon, Mayor

ATTEST:

_____
Carolyn F. Morris, Town Clerk

APPROVED AS TO FORM:

_____
John Leidy, Town Attorney

Date adopted: _____
Motion to adopt by Commissioner _____
Motion seconded by Commissioner _____
Vote: AYES _____ NAYS _____

**Town of Nags Head**
**Planning Board**
**August 20th, 2024**
**- D R A F T -**

The Planning Board of the Town of Nags Head met on Tuesday, August 20th, 2024, in the Board Room at the Nags Head Municipal Complex.

Chair Vaughan called the meeting to order at 9:00 a.m. as a quorum was present.

## *Members Present*

Megan Vaughan, Meade Gwinn, Molly Harrison, David Thompson, Gary Ferguson, Kristi Wright,

## *Members Absent*

David Elder

## *Others Present*

Kelly Wyatt, Joe Costello, Andy Garman, Lily Nieberding

## *Approval of Agenda*

Meade Gwinn moved to approve the agenda as presented. Kristi Wright seconded, and the motion passed by unanimous vote.

## *Public Comment/Audience Response*

None

## *Approval of Minutes*

Chair Vaughan asked for a motion to approve the minutes of the July 16th, 2024, meeting. David Thompson moved to approve the minutes as corrected; Meade Gwinn seconded, and the motion passed unanimously.

## *Action Items*

*Consideration of a Map Amendment request submitted by Chris Greening of Coastal Bluewater Capital, LLC, as authorized by property owner Mazzi, LLC to rezone the property located at 0 W. Satterfield Landing Road from C-3, Commercial Services to C-2, General Commercial. This is the vacant property west of TW's Bait and Tackle.*

Planning Director Kelly Wyatt explained that Chris Greening of Coastal Bluewater Capital, LLC, owner of TW's, had submitted a zoning map amendment request with authorization from current property owner, Mazzi, LLC. If adopted, this map amendment would rezone the property located at 0 W. Satterfield Landing Road (Lot 2a-1r of the Charles Sineath Subdivision, Parcel # 005618002) from C-3, Commercial Services District to C-2, General Commercial District.

Ms. Wyatt noted that in late 2017, the property owner at the time, TLG Greenwater Investments, submitted a request to rezone the easternmost 50 feet of this lot from C-3, Commercial Services, to C-2, General Commercial Services. This rezoning was part of a planned transfer and recombination of the affected portion with Lot 1a-1 (TW's Bait and Tackle). After the map amendment was adopted, TW's Bait and Tackle constructed the accessory storage structure currently on the property.

In November 2022, the Board of Commissioners approved a Special Use Permit/Site Plan Review, submitted by Mazzi LLC, for the construction of a "Trade Center", with parking and all associated improvements. When the November 2022 approval expired, the Board of Commissioners re-approved the same requested scope of work at their February 7, 2024, meeting. This new approval is valid until February 7, 2025. Ms. Wyatt noted that if the requested rezoning is approved, the Trade Center use would no longer be permitted, as that use is not allowed in the C2 zoning district.

When considering a possible re-zoning it is helpful to review the intent of both the giving and receiving zoning classification in conjunction with potential outcomes. The intent of the C-3, Commercial Services District, is to provide for higher intensity land uses that are not compatible with other areas of the Town. The C-3 District accommodates utilities, light industrial uses, warehousing, bulk storage, dog agility, etc. It is in close proximity to the Fresh Pond, actually within that buffer area for the Fresh Pond.

The intent of the C-2, General Commercial District, is to provide for the proper grouping and development of commercial facilities to serve the entire community. The C-2 District allows the broadest range of commercial uses. All C-2 districts shall be at least 5 acres in area and proposed zoning map amendment would result in an increase in the total acre of C-2 designation.

The 2017 Comprehensive Land Use Plan states that the C-3 standards are to regulate and buffer uses so that their location or activities will not be detrimental to adjacent uses, the environment, and the sources of potable water. The Commercial Services District must be at least 10 acres in size and must have direct access to a US highway or collector street improved to town standards. If adopted, the requested rezoning would reduce the overall acreage of C-3 by 0.8 acres,
leaving approximately 36 acres of C-3 Commercial Services Remaining.

Ms. Wyatt noted that she had included a link to the table of uses and activities allowed within the existing C-3 and C-2 Zoning Districts, as well as some Land Use Plan considerations in her Staff Report.

Ms. Wyatt stated that based upon the evaluation of the intent of each district and the goals listed in the 2017 Comprehensive Land Use Plan, staff would recommend adoption of the proposed zoning map amendment as presented noting that any future development of this property would require Site Plan Review and approval from both the Planning Board and Board of Commissioners.

Ms. Wyatt stated that she, as well as the applicant Chris Greening, was available to answer any questions for the Board.

Ms. Wyatt confirmed for Mr. Ferguson that the Fresh Pond was still in the AEC noting that there re certain requirements that must be met within 500 ft and 1200 ft. A portion of the property in question is within the 1200 ft., which might affect septic capacity and would be looked at during site plan review.

Ms. Wyatt pulled up an aerial view to the C-3 zoning for the Board's consideration, noting that the parcel where the Town's water plant is located was recently rezoned into the C-3 district.

Mr. Gwinn inquired as to what the parcel would be used for. Applicant Chris Greening stepped to the podium and explained that part of would be used for workforce housing and some for retail. Mr. Greening noted that the proximity of the parcel to his business as well as being slightly off the main road make it an ideal location for workforce housing. Mr. Greening confirmed that the residential would be accessory to the retail use which is currently allowed in the C2.

Meade Gwinn moved to approve the rezoning request as presented. David Thompson seconded and the motion was approved unanimously

*Consideration Of Various Amendments to the Unified Development Ordinance as it pertains to the use of multi-family dwelling developments.*

Town Manager Andy Garman explained that at last month's meeting, Staff discussed the draft multi-family housing ordinance with the Planning Board.

The Planning Board mainly discussed two provisions of the draft ordinance. This included the parking standard and a provision that would limit the density of projects based on bedrooms per acre. The Planning Board requested that the parking standard be modified to 2.5 spaces per unit. The draft ordinance has been revised to include this proposed parking standard. It also includes a range of standards regulating bedrooms per acre.

Mr. Garman noted that the Planning Board also requested that staff propose a bedrooms per acre standard of between 25 to 30 bedrooms per acre. For discussion purposes, Staff has provided an analysis which compares the results of including an additional standard regulating bedrooms per acre at two different ranges vs. only regulating density using a floor area ratio. Mr. Garman noted that, a bedrooms per acre, standard would provide an additional regulation of density above and beyond just the floor area ratio. If the Planning Board is concerned about being able to control not just the mass of the building but the number of persons that may potentially be on the property, then the bedrooms per acre would be a thing to consider adding into the ordinance. Mr. Garman also reminded the Board that there is a proposed cap of 75 units in the Working Group's Ordinance so in most of the sample cases that provides a sort of artificial limit on the number of units you can have.

**5 Acres**
- 217,800 square feet x 0.32 = 69,696.
- Let's say 60% of the units are going to be 2 bedrooms with min. unit size of 700 sf = area of 41,817 = 59 units (118 bedrooms).
- Remaining 27,878 sf to be 1 bedroom at 500 sf = 55 units (55 bedrooms).
- This equates to 114 units and 173 bedrooms, however the Working Group proposed cap at 75 units would apply.
- A maximum of 25 bedrooms per acre would allow 125 bedrooms.
- A maximum of 30 bedrooms per acre would allow 150 bedrooms.

**4 Acres**
- 174,240 square feet x 0.32 = 55,756.
- Let's say 60% of the units are going to be 2 bedrooms with min. unit size of 700 sf = area of 33,454 = 47 units (94 bedrooms).
- Remaining 22,302 sf to be 1 bedroom at 500 sf = 44 units (44 bedrooms).
- This equates to 91 units and 138 bedrooms, however the Working Group cap of 75 units would apply.
- A maximum of 25 bedrooms per acre would allow 100 bedrooms.
- A maximum of 30 bedrooms per acre would allow 120 bedrooms.

**3 Acres**
• 130,680 square feet x 0.32 = 41,817.
• Let's say 60% of the units are going to be 2 bedrooms with min unit size of 700 sf = area of 25,090 = 35 units (70 bedrooms)..
• Remaining 16,727 sf to be 1 bedroom at 500 sf = 33 units (33 bedrooms)
• This equates to 68 units and 103 bedrooms. Would comply with the Working Group recommended cap of 75. Would not comply with the Planning Board recommended cap of 60 units.
• A maximum of 25 bedrooms per acre would allow 75 bedrooms.
• A maximum of 30 bedrooms per acre would allow 90 bedrooms.

**2 Acres**
• 87,120 square feet x 0.32 = 27,878.
• Let's say 60% of the units are going to be 2 bedrooms with minimum unit size of 700 sf = area of 16,727 = 23 units (46 bedrooms).
• Remaining 11,151 sf to be 1 bedroom at 500 sf = 22 units (22 bedrooms).
• This equates to 45 units and 68 bedrooms. Would comply with the Working Group and Planning Board cap on units.
• A maximum of 25 bedrooms per acre would allow 50 bedrooms.
• A maximum of 30 bedrooms per acre would allow 60 bedrooms.

Mr. Garman confirmed for Mr. Gwinn and the Board that the floor area ratio controls the size of the building whereas a maximum number of bedrooms per acre controls density. Mr. Garman then presented a plan view sketch developed by Staff, which showed a conceptual site plan on a 5.5-acre parcel based on the draft ordinance. The sketch included five separate buildings totaling 9,900 sq. ft. each, and 188 parking spaces. Mr. Garman noted that this sketch includes the 2.5 parking spaces per unit and was intended to assist the Planning Board with understanding how the ordinance would regulate density of a hypothetical multi-family project.

Mr. Garman explained that you want to have enough parking for all occupants but when you add additional parking you also add additional lot coverage, in this case it amounts to 6000 ft of lot coverage by having the 2.5 spaces per units vs. the other standard so it's something that should be considered. In this scenario, the less restrictive parking standard would likely result in more open space as they would have already maxed out the number of units.

The Board was concerned about building mass, but also the number of people on the property (density) and were in favor of the bedrooms per acre requirement. Mr. Thompson reminded the Board that if some of it is going to be workforce housing there was a big chance that even the one-bedroom apartments would be shared by multiple people.

Mr. Gwinn asked if it was possible to limit the number of multi-family dwellings in town. Mr. Garman stated that he had asked the Town Attorney but did not have an answer yet but reminded the Board that there are already several multi-family dwelling developments in town.

Deputy Planning Director Joe Costello gave a quick presentation showing parcels in the C2 zone. There are 840 unique parcels and there are 207 parcels that are greater than 15,000 SF that could fit a small multi-family dwelling development. 93% of the 840 are developed so any multi-family would more than likely be redevelopment.

Mr. Costello also noted that there are 145 parcels adjacent to US 158, 91 of which are greater than 26,000 SF which could be large multi-family but again most are developed so most would be redevelopment.

The Board discussed and agreed that they wanted to limit the maximum number of bedrooms per acre to 25. The Board were also in agreement that they were in support of the small multi-family development but wanted to include 25 bedroom per acre limitation as well as the parking standard of 2.5 parking spaces per unit plus 1 space per 4 units.

Mr. Garman confirmed for Mr. Ferguson that the restrictions placed by the Flood Ordinance would not be much of a limiting factor when it comes to construction of multi-family development.

As far as large multi-family development, the Board was in consensus that they were ok if it didn't front the bypass. Chair Vaughan stated and the Board agreed that they didn't like the apartment style building for the large family dwelling development, they prefer townhouse style development. The Board was in agreement that they do not want to see a large number of apartments all over town and would like to see the number of developments limited. The Board also would like to see the 25 bedroom per acre limitation as well as the parking standard of 2.5 parking spaces per unit plus 1 space per 4 units.

Meade Gwinn moved to recommend the Small Style Multi-Family Development Amendment as proposed by the Working Group with the following changes:

- Include the maximum 25 bedrooms per acre standard as well as the Parking Standard of 2.5 spaces per unit plus one space for every 4 units.

Mr. Gwinn also moved to recommend the Large Style Multi-Family Development amendment as proposed by the Working group with the following changes:

- Allow townhouse style only, include the 25 bedrooms per acre limitation and the Parking Standard of 2.5 spaces per unit plus one space for every 4 units.

Kristi Wright seconded the motion, and the motion passed with a vote of 5 to 1 with Molly Harrison casting the Nay vote.

Ms. Harrison would like to explore further the idea of putting a limitation on how many could be developed and the Board agreed to recommend that the Board of Commissioners look at a limitation on the number of developments that can be built in Town.

## *Report on Board of Commissioners Actions –*

Ms. Wyatt gave an update on the Board of Commissioner Actions, of note: Several items on Consent Agenda including Requests for Public Hearings for text amendments to the UDO on the use of multi-family dwelling developments, text amendments to the UDO for "Religious Complex" definition modification and text amendments to the UDO re: SED-80 dormitory use. The Board approved $400K Sand Relocation and Dune Management Cost Share Program which is a continuation of year three of a three-year program. Environmental Planner Conner Twiddy and Dep Planning Director Joe Costello reviewed with Board members a power point presentation summarizing the Septic Health Initiative Program and the long-range data collection and mapping efforts which was very well received. Comr. Lambert expressed her concern re: parking requirements vs parking needs at hotels. It was Board consensus to direct staff to look at hotel parking standards with consideration of existing properties and consultation with the industry and include restaurants in the review.

## *Town Updates*

None

## *Discussion Items*

*Discussion and Possible Amendment of minimum required parking standards for hotel use and restaurant use.*

Ms. Wyatt introduced a discussion on the parking standards for hotels and restaurants, emphasizing that no immediate recommendations were expected. The purpose of the discussion was to begin a conversation about potential changes to parking requirements, particularly in light of recent concerns following the approval of the hotel on Lakeside.

Ms. Wyatt gave a brief background:

- The Board of Commissioners requested a review of current parking standards for hotels.
- The current standard is one parking space per hotel unit, with additional spaces required for units with kitchens, conference rooms, restaurants, etc.
- Historically, parking standards were slightly stricter:
    - Just before the adoption of the UDO, the standard was 1.2 spaces per unit plus one space for every four employees.
    - In August 1989, the standard was 1.2 spaces per unit or one space per bedroom, whichever was greater, plus one space per employee on the largest shift.

Ms. Wyatt then discussed the relevance, comparing the historical standards to the current requirements and noted that the approved Inn at Whalebone would have required 105 parking spaces under the older standards for its 87 units.

Ms. Wyatt then reviewed an attachment (included in the Meeting Packet) which provided a comparison of hotel parking standards in other coastal communities:

- **Kill Devil Hills:** 1.2 spaces per unit plus one per employee.
- **Kitty Hawk:** 1.5 spaces per rented room plus one per employee.
- **Southern Shores:** 1.5 spaces per rented room plus one per employee.
- **Duck:** 1.5 spaces per rented room plus one for every three employees.
- **Sunset Beach, Wrightsville Beach, Carolina Beach, Emerald Isle, Oak Island, Atlantic Beach:** These were mentioned as additional points of interest for comparison.

Ms. Wyatt found the historical and comparative data on hotel parking standards interesting and suggested that addressing potential changes to hotel parking might be a more straightforward discussion compared to restaurant parking, which could require more in-depth conversations.

Mr. Gwinn asked whether there had been any discussions with counterparts in other towns (KDH, Kitty Hawk, Duck) to understand if their parking standards are working effectively or if they face any challenges. He inquired if feedback on the adequacy of these ordinances had been gathered.

Ms. Wyatt confirmed that she had not yet had those conversations but would do so for the next meeting.

DRAFT

Mr. Thompson shared his personal experience as a sales professional frequently pulling over into hotel parking lots, noting that even in summer, there are often empty spaces during the day. He observed that hotel parking lots are generally full only from 9:00 PM to 7:00 AM during peak season (June-August), and occupancy is lower during the other nine months of the year.

Chair Vaughan agreed, adding that it is probably uncommon for there to be more than one vehicle per hotel room, especially compared to year-round living or workforce housing. However, she emphasized the importance of considering employee parking, which might be underestimated.

Chair Vaughan also noted that most people are at work during the day, leaving parking spaces available, but it seemed that other towns generally have more parking for hotels than Nags Head.

Ms. Wyatt mentioned that the town used to have a standard of 1.2 parking spaces per hotel unit before reducing it to one, while other towns still have standards of 1.2 or 1.5, often with additional requirements for employee parking.

Chair Vaughan pointed out that it's challenging to meet parking demand when additional facilities like kitchens or meeting spaces are present, as these can create unusual levels of demand, especially during events or conferences.

Mr. Thompson asked about the definition of a hotel efficiency unit or kitchen facility, leading to a discussion on the specific criteria for hotel units, efficiency units, and suites.

Ms. Wyatt confirmed for Mr. Thompson that the parking standard does take into account if there is a restaurant associated with the hotel.

Ms. Wyatt concluded by stating that she would gather feedback from other local municipalities on their standards and return in September with more information, potentially leading to a proposed ordinance.

Moving on to restaurant parking, Ms. Wyatt noted that there are several aspects of restaurant parking that will require more detailed review and discussion, these include but are not limited to:

- The current parking standard has been applied to sit down restaurants for well over 10 years, any changes to the standard could result in site nonconformities for existing restaurants.

- Regulating restaurant parking by customer service area can become problematic if that area changes unbeknownst to staff. If a restaurant changes hands, the new tenant may wish to increase the amount of customer service area, thus making the existing parking count inadequate. In this scenario, a parking standard based upon gross floor may be more appropriate. What are the pros and cons of regulating based upon gross floor area? Kill Devil Hills, Sunset Beach, Carolina Beach, Oak Island, and Atlantic Beach regulate restaurant parking based upon gross floor area. Southern Shores and Duck regulates restaurant parking based upon customer seats. Wrightsville Beach regulates restaurant parking based upon the maximum occupancy allowed.

- The existing definition of "customer service area" states that it is the area designated for the purchase and/or consumption of food, drink, or other similar items. The definition further goes on to exclude outdoor seating areas not designated for the purchase of food, drink, or similar items and instead are used primarily as waiting areas for customers who are waiting to be seated in indoor customer service areas. Staff submits that these outdoor areas, while initially were primarily used for waiting, gradually transition into areas which may very well need to be included

in a parking standard (drinks served while waiting, in some instances appetizers being provided while "waiting", etc.).

- Should the town address outdoor entertainment areas associated with restaurants in the parking requirements? Should the town address outdoor entertainment areas generally?

- Should we include a parking requirement for employees/staff? Note that the Town of Duck, Southern Shores, and Wrightsville Beach regulate employee parking.

Chair Vaughan said that they need to look at parking differently, trying to encompass these other areas where people gather as they still have to park somewhere.

Mr. Gwinn believes that outdoor seating should be parked like indoor seating if customers are being served outdoors.

Mr. Thompson noted that something else to consider is that often times people drive separately and meet at a restaurant to eat so there are multiple vehicles per table.

Chair Vaughan stated that they have to strike a balance, because the town wants and needs restaurants, but they need to require enough parking to meet that peak demand so that it's safe and not overflowing into neighboring properties; so many restaurants are maxed out on parking during the season.

Ms. Wright noted that this is changing and more restaurants are busy year round. The Board agreed that coming up with an improved parking standard will be a challenge.

*Discussion of potential Accessory Dwelling Unit (ADU) ordinance and existing conditions within the Town.*

Ms. Wyatt stated that there has been a lot of discussion about ADUs and reminded the Board that Staff delivered a presentation to both the Board of Commissioners and the Planning Board at their meetings on July 3rd and July 16th, respectively. The presentation emphasized the similarities and interconnectedness among Accessory Dwelling Units (ADUs), Partial-Home Short-Term Rentals (STRs), and Duplexes.

Staff believe that recognizing these overlaps with existing uses in the town is a critical first step as they begin to explore options for allowing ADUs within the Town noting that many of the existing partial-home STRs share similar characteristics and functions with ADUs. Both types of housing provide additional living spaces that can be rented as separate, independent units with similar operational dynamics. Additionally, both partial-home STRs and, if permitted, attached ADUs, would resemble duplexes in terms of structure and use.

Currently, Short-Term Rentals are permitted in all zoning districts within the Town, except for the C-3, Commercial Services District. However, Accessory Dwelling Units are not allowed in any district. Duplexes, or two-family dwellings, are permitted in the R-2, R-3, CR, C-1, C-2, C-4, and C-5 Districts, with a minimum lot size of 22,500 square feet (30,000 square feet in the R-2 district).

Recognizing that many residents may not be familiar with the current codes and ordinances governing these uses, Staff would recommend that the Planning Board consider dedicating time at their upcoming September 17th meeting for an overview of these uses and their associated regulations. This session would allow for a discussion on areas of overlap and any aspects requiring

further clarification, while also providing an opportunity for citizens to offer their input on potential changes to existing language or proposed future language. Given the range of opinions within the community, particularly regarding ADUs and concerns about density, staff want to seek input from both supporters and those with reservations. Ms. Wyatt also asked that if there are specific groups, organizations, or individuals that the Planning Board believes should be personally invited to participate to please share that information with staff.

The Board was in consensus that they would like to have public input and were not opposed to having an evening workshop. Ms. Wyatt will send out a poll with some times and dates for the Board to choose.

*July 30th, 2024, Director's Report*

Ms. Wyatt briefly discussed her Director's Report with the Board which included various activities involving staff. Ms. Wyatt reminded the Board that one of the Farmer's Markets that was cancelled due to weather has been rescheduled to another date in the afternoon/evening.

## *Planning Board Members' Agenda*

None

## *Planning Board Chairman's Agenda*

None

## *Adjournment*

A motion to adjourn was made by Molly Harrison. The time was 11:03 AM.

Respectfully submitted,
Lily Campos Nieberding

DRAFT

# Agenda Item Summary Sheet

Item No: **I-1**
Meeting Date: **October 2, 2024**

**Item Title**: Committee Reports

**Item Summary**:

At the October 2nd Board of Commissioners meeting, Board members will provide reports from meetings they have attended on behalf of the Town.

Number of Attachments: 0

**Specific Action Requested**:

Provided for Board information and update.

Submitted By: Administration Date: September 27, 2024

**Finance Officer Comment**:

N/A

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:

N/A

Signature: Andy Garman Date: September 27, 2024

# Agenda Item Summary Sheet

Item No: **I-2**
Meeting Date: **October 2, 2024**

**Item Title**: Consideration of appointment/reappointment to Boards/Committees

**Item Summary**:
At the October 2nd Board of Commissioners meeting, request Board consideration of the following appointment/reappointment:

Personnel Grievance Panel:

- Tina Adderholdt's term expires October 6, 2024. She is interested in being reappointed.

Board of Adjustment:

- Alice Coffey's term expires November 3, 2024. She is interested in being reappointed.

Attached please find Current Rosters and Candidate Charts for each.

Number of Attachments: 4

**Specific Action Requested**:
Provided for Board appointment/reappointment.

Submitted By: Administration Date: September 27, 2024

**Finance Officer Comment**:
No unbudgeted fiscal impact.

Signature: Amy Miller Date: September 27, 2024

**Town Attorney Comment**:
N/A

Signature: John Leidy Date: September 27, 2024

**Town Manager Comment and/or Recommendation**:
N/A

Signature: Andy Garman Date: September 27, 2024

**Town of Nags Head *CURRENT* - Personnel Grievance Panel** **Meeting Date: October 2, 2024**

| *Name of Board/Committee* | *Current members* | *Contact Info* | *Last appointed date* | *Seat expires* | *Eligible for Re-appointment* | *Notes* |
|---|---|---|---|---|---|---|
| | | | | | | |
| Personnel Grievance Panel<br>Meets as necessary<br><br>3 Registered Voters<br>3 Alternates<br><br>3-year term | Jeanne Kramer | Phone/email on file | 11/1/23 | 11/1/26 | Term not expired | |
| | Tina Adderholdt | Phone/email on file | 10/6/21 | 10/6/24 | Term expiring | Interested in being reappointed |
| | Jean Flanigan | Phone/email on file | 06/7/23 | 06/7/26 | Term not expired | |
| | Vacant (ALT) | | | | | |
| | Vacant (ALT) | | | | | |
| | Vacant (ALT) | | | | | |
| | | | | | | |

***CANDIDATES*** Characteristic Chart – Personnel Grievance Panel Meeting Date: October 2, 2024

| Applicant Name | Bd/Comm Interested in Serving | Yrs of Residency | Location of Residency | Role in Community | Attributes to offer Bd/Comm | Special Interest in Bd/Comm | Currently serving on Town Bd/Comm |
|---|---|---|---|---|---|---|---|
| Robert T. Snyder (1/18/24) | Planning Bd./BOA/Arts & Culture/PGP | 14 yrs | Dune Lantern | Condo Assoc President 23 yrs. Served on Tourism Board, Board of Tourism and Maritime Museum Board of Governors in MD. | Previously served 12 yrs as Commissioner in St. Michaels, MD. | Would like serve community by participating in town government | Appointed to Dangerous Animal Appeal Board March 6, 2024 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Town of Nags Head *CURRENT* Board of Adjustment** **Meeting Date: October 2, 2024**

| *Name of Board/Committee* | *Current members* | *Contact Info* | *Last appointed date* | *Seat expires* | *Eligible for Re-appointment* | *Notes* |
|---|---|---|---|---|---|---|
| | | | | | | |
| Board of Adjustment<br>2nd Thursday at 9AM as necessary<br>5 Regular Members<br>3 Alternate Members<br>3-year term | Margaret Suppler<br>Chair | Phone/email on file | 1/5/22 | 1/5/25 | Term not expired | |
| | Bobby Gentry<br>Vice-Chair | Phone/email on file | 1/3/24 | 1/3/27 | Term not expired | |
| | Judy Burnette | Phone/email on file | 5/4/22 | 5/4/25 | Term not expired | |
| | Alice Coffey | Phone/email on file | 11/3/21 | 11/3/24 | Term expiring | Interested in being reappointed |
| | Tina Adderholdt | Phone/email on file | 5/4/22 | 5/4/25 | Term not expired | |
| | Angelina Lowe<br>(ALT) | Phone/email on file | 7/5/23 | 7/5/26 | Term not expired | |
| | Dru Ferrence<br>(ALT) | Phone/email on file | 1/3/24 | 1/3/27 | Term not expired | |
| | VACANT<br>(ALT) | | | | June 2019 Board determined to take no action to fill this third Alternate seat | |

***CANDIDATES*** Characteristic Chart Board of Adjustment Meeting Date: October 2, 2024

| Applicant Name | Bd/Comm Interested in Serving | Yrs of Residency | Location of Residency | Role in Community | Attributes to offer Bd/Comm | Special Interest in Bd/Comm | Currently serving on Town Bd/Comm |
|---|---|---|---|---|---|---|---|
| Barbara Ayars (12/1/22) | BOA/Arts & Culture/ Planning Bd | 11 yrs. | Gallery Row | Retired attorney | Knowledge of environmental law | Assist w/maintaining a balance between ecosystem protection and use | No |
| Robert T. Snyder (1/18/24) | Planning Bd./BOA/Arts & Culture/PGP | 14 yrs. | Dune Lantern | Condo Assoc President 23 yrs. Served on Tourism Board, Board of Tourism and Maritime Museum Board of Governors in MD. | Previously served 12 yrs as Commissioner in St. Michaels, MD. | Would like serve community by participating in town government | Appointed to Dangerous Animal Appeal Board March 6, 2024 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

***CANDIDATES*** Characteristic Chart Board of Adjustment Meeting Date: October 2, 2024

# Agenda Item Summary Sheet

Item No: **I-3**
Meeting Date: **October 2, 2024**

**Item Title**: Estuarine Shoreline Management Project Areas 1 and 2 Engineering and Design

**Item Summary**:

Nags Head was awarded a $500,000 grant under the N.C. Resilient Coastal Communities Program. This award is to assist the Town in completing the engineering and design work to assess, analyze, and design two estuarine marsh restoration and shoreline stabilization sites, identified in the Town's Estuarine Shoreline Management Plan (ESMP), to reduce erosion and increase shoreline stability. The McAdams scope includes Moffatt & Nichol and Biohabitats partnering on the project. These firms developed the Town's ESMP. The scope is on a one-year timeline with a possible extension. The project deliverable of 60% set of plans ready for permitting includes community engagement. These designs will allow the project to be close to shovel-ready to apply for permits. These approval requests are necessary requirements to meet grant contract requirements and milestones. This is a pipeline project directly resulting from the Town's ESMP.

Number of Attachments: 3

**Specific Action Requested**:

Authorization for Town Manager to enter into a Living Shoreline Design and Engineering contract with McAdams for Estuarine Shoreline Management Project Areas 1 and 2 located at Nags Head Woods Preserve & Villa Dunes Drive and West Soundside Road (the "Project"); Request for authorization for Town Manager to execute a contract between the Town of Nags Head and the NC Department of Environmental Quality for the Project; and approval of associated budget amendment.

Submitted By: Administration Date: September 26, 2024

**Finance Officer Comment**:

The $40,000 local portion of the grant is included in the Fiscal Year 24/25 adopted budget. The budget amendment is for the grant portion.

Signature: Amy Miller Date: September 26, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 26, 2024

**Town Manager Comment and/or Recommendation**:

Signature: Andy Garman Date: September 26, 2024

Resolution No. 24-10-xxx
N.C. Resilient Coastal Communities Program Grant Contract
BOC Meeting October 2, 2024

**Resolution Authorizing Execution of N.C. Resilient Coastal Communities Program Grant Contract**

WHEREAS: The Town of Nags Head (the "Town") has been awarded a coastal resiliency grant in completing the engineering and design work to assess, analyze, and design two estuarine marsh restoration and shoreline stabilization sites (Nags Head Woods Preserve & Villa Dunes Drive and West Soundside Road) to reduce erosion and increase shoreline stability; and

WHEREAS: The Town is advised that a proposed contract between the Town and the North Carolina Department of Environmental Quality (DEQ) for Resilient Coastal Communities Program grant funds is being presented for the project known as Designing Innovative Living Shorelines to Restore and Protect Coastal Community Infrastructure and discussed; and

WHEREAS: That, under the terms of the said contract, the total project cost is $540,000.00; and

WHEREAS: The Town will pay a total local cash contribution of $40,000 as its local share of the total project costs; and

WHEREAS: The total grant assistance requested is $500,000.00;

BE IT THEREFORE RESOLVED, as follows:

1. That a contract between the Town of Nags Head and the North Carolina Department of Environmental Quality be and the same is hereby approved.

2. That the Manager is hereby authorized to sign and execute the said contract for and on behalf of the Town of Nags Head and forward the same to the North Carolina Department of Environmental Quality.

3. That upon final execution, a copy of said contract be filed with the minutes.

ADOPTED this the 2nd day of October 2024.

_____
Ben Cahoon, Mayor
Town of Nags Head

ATTEST:

_____
Carolyn F. Morris, Town Clerk

McAdams
621 Hillsborough Street
Suite 500
Raleigh, NC 27603
919. 361. 5000

TNH22001.27

September 27, 2024

Amy Miller
Deputy Town Manager
Town of Nags Head
PO Box 99
Nags Head, NC 27959

**RE: Town of Nags Head Estuarine Shoreline Management Plan – Living Shoreline Design**
**Nags Head Woods Preserve & Villa Dunes Drive and West Soundside Road**
**Nags Head, North Carolina**
**TNH22001.27**

Dear Ms. Miller,

## Project Understanding

The proposed project will advance the design of two living shoreline projects identified as priority in the Town of Nags Head Estuarine Shoreline Management Plan. These two living shoreline projects will proactively support the Town's resiliency improvement process of reducing shoreline erosion and provide protection to community infrastructure. The services proposed will provide site analysis and engineering and design of two community-prioritized estuarine marsh restoration and shoreline stabilization sites, located at Nags Head Woods Preserve & Villa Dunes Drive and West Soundside Road. The alternatives evaluated will integrate nature-based solutions (NBS) and include the of restoration of brackish marshes and construction of offshore living breakwaters to deflect wave energy and encourage the formation of sub-aquatic habitats. The NBS will also consider anticipated climate change impacts including sea level rise and erosion that threatens the Town-owned neighborhood access roads at these locations.

The project team will consist of Biohabitats of North Carolina (BioNC) as the project manager, design lead, and community engagement lead. Moffatt and Nichol (M&N) will lead coastal hydrodynamic modeling, structural design, and state and federal regulatory permitting. M&N will provide support in field studies, basis of design report and community engagement. Coastal Engineering and Surveying (CES) will provide topographic and bathymetric surveying. Catlin Engineers and Scientist (CAT) will provide geotechnical services. McAdams will provide general grant reporting support, team coordination, and grant administration, and will work with the project team and Town to facilitate completion of the project.

## Assumptions

This proposal is based on the following assumptions:

- Any public notifications and public engagement will be coordinated through the Town of Nags Head.

# Proposed Services + Fees

We propose the following services (Alphanumeric task numbers are for internal coding purposes):

## Task 1 - General Project Administration

### PROJECT ADMINISTRATION:

Work under this task will be completed by McAdams and includes the following major tasks and components:

- Coordination and assistance to Town for duration of project;
- Periodic project updates and status reports;
- General project management and administration throughout duration of contract; and
- Participation in periodic virtual meetings and discussions with Town and project team.

### PROJECT COORDINATION + MANAGEMENT:

Work under this task will be completed by Biohabitats:

- Project kickoff meeting with Town and invited stakeholders;
  - BioNC will lead a kickoff team meeting with the Town of Nags Head (Town) and invited stakeholders to confirm overall project goals, desired outcomes, data sources, schedule, lines of communication, billing protocols and deliverables. Following the kick-off meeting, the project team will visit the sites with the Town to review opportunities, areas of concern, property access, boating access, critical habitat, aesthetics, etc. Photos of the site will be collected. BioNC will prepare and distribute meeting minutes.

- Progress Meetings:
  - BioNC will lead monthly progress meetings (virtual) with the Town and design team to review the project progress and schedule as well as discuss concerns or potential challenges associated with upcoming work. BioNC will prepare and distribute meeting minutes.

- Team Coordination Meetings:
  - BioNC will lead internal bi-weekly project team coordination meetings to review work progress, scheduling and deliverables. BioNC will maintain a SharePoint site to store documents and coordinate communication.

- Monthly Status Reports:
  - As part of monthly billing, BioNC will prepare a monthly status report outlining work accomplished during the billing period, schedule updates, issues-at-hand, and, if necessary, additional work efforts.

- Grant Funding Support:
  - In support of grant reporting requirements, BioNC will provide the Town quarterly updates on the project status and schedule. The Town will be responsible for the preparation of the grant reports and communicating directly with DEQ.

- Project Debrief and Next Steps:
  - At the conclusion of the project, BioNC will meet with the Town to debrief on our Team's performance and review next steps for preparing bidding documents, contractor procurement and construction.

- Task 1 Deliverables:
  - Meeting minutes (as needed);
  - Monthly status reports (twelve); and
  - Quarterly grant reporting updates (up to four updates, 1-2 pages each).

## Task 2 - Data Collection, Field Studies + Coastal Modeling

- Data Collection + Review:

The BioNC Team will collect and review readily accessible data relevant to supporting the design and permitting requirements. This review of assembled data will identify data gaps in coverage that may need to be collected during field surveys and modeling.

- Field Surveys:

The BioNC team will perform the following field surveys to collect data relevant to supporting the design and permitting requirements:

- M&N will conduct a survey of benthic habitats (submerged aquatic vegetation, shellfish and reefs) in compliance with regulatory requirements;
- BioNC will conduct a field characterization of the shoreline and nearshore conditions, visually identifying vegetation communities, shoreline infrastructure (bulkheads, piers, docks, storm drains, erosion control features, etc.) and nearshore and shoreline habitat. BioNC will also identify and collect biological benchmark data to be used in establishing elevations for design features;
- BioNC will perform a jurisdictional non-coastal wetland delineation of the study area. Jurisdictional non-coastal wetlands, if present, will be flagged, surveyed, and mapped. The delineation will be used to inform the placement of design features as well as comply with regulatory permits;

- Cultural and Historic Resources Assessment;

A desktop analysis will be conducted to evaluate potential historical resources within the project area. Early coordination will be conducted with the State Historic Preservation Office (SHPO) to ensure no impacts with cultural resources from project implementation.

- Property + Topographic/Bathymetric Survey:

Coastal Engineering and Surveying (CES) will perform the following:

- Boundary research of properties adjoining project area;
- Provide mailing lists/contact information for adjoining property owners;
- Obtain boundary evidence of adjoining properties to establish accurate boundary line locations;
- Perform topo and bathymetric survey of the areas outlined on email attachment provided on 8/16/202;
- Bathymetric survey information will be comprised of single beam high frequency transducer readings with RTK capabilities, at 100 ‘ transect spacing, and based on NAVD88 Datum. Topographic survey readings will utilize RTK and be based on NAVD88 vertical datum and NAD83 (2011) horizontal datum;
- Prepare a survey map which will include physical locations of docks, bulkheads, walls, or other structures within the project area, topographic and bathymetric survey information, and property lines/information for all adjoining properties; and
- Provide easement exhibits for any lots that will be affected by temporary construction accesses or staging.

### Geotechnical Investigation

Catlin Engineers & Scientists (CAT) will advance a total of five (5) Standard Penetration Tests (SPT) to depths of approximately 50 feet below bed of the Pamlico Sound at or near the seven (7) proposed wave attenuator sites. The SPT borings will be completed in general accordance with ASTM Method D1586, via a barge mounted CME 45-B drill rig.

Representative soil samples will be collected from these borings and submitted to CAT's soil lab in Wilmington, NC, for classification. CAT will locate all boring locations and elevations utilizing survey grade GPS technology.

CAT will prepare a Subsurface Exploration Report including, but not limited to, the following:

- General description of site and subsurface conditions.
- Summary of testing procedures and results.
- SPT logs.
- Site map with boring locations.
- Geologic setting.
- Soil properties including USCS classification, consistency/density, lateral earth pressure coefficients (at-rest/active/passive), and sliding friction coefficients (as applicable).
- Foundation type and design recommendations.
- Net allowable bearing capacity for shallow foundations.
- Allowable capacities for deep foundations (if deemed necessary).
- Anticipated total/differential settlement estimates for shallow foundations.
- Ground improvement considerations.

> **ALLOWANCE #1 - Based on recent observations of the project site's substrate conditions, BioNC is assuming that there will be minor inconsistencies in the penetration tests between sampling locations. If there proves to be sufficient inconsistency between penetration tests, then BioNC may direct Catlin to perform up to two (2) additional penetration tests, in accordance with the allowance fee, to further characterize the substrate.**

### Coastal Hydrodynamic Modeling

M&N will extract results from their existing hydrodynamic and wave model of the area to establish design criteria for the project elements. Additionally, sediment transport will be qualitatively modeled for typical wind events to determine / confirm transport directions / patterns in the immediate vicinity of the project elements. A brief memo for incorporation into the BOD will be prepared for both efforts.

### Task 2 Deliverables

- Benthic habitat, jurisdictional wetland delineation & cultural and historic resource assessment (included in regulatory permit application)
- Field characterization and biological benchmarks (included in the Basis of Design Report)
- Paper copies and pdf digital transfers of the survey map, signed and sealed by an NC licensed surveyor.
- Paper copies and pdf digital transfers of easement exhibits, signed and sealed by an NC licensed surveyor.
- .dwg file of survey map (if requested)
- Geotechnical investigation analysis (included in the Basis of Design Report)
- Coastal hydrodynamic modeling memorandum (to be included in the Basis of Design Report)

## Task 3 - Basis of Design

For the development of a DRAFT Basis of Design (BOD) Report, BioNC, with support from M&N, will compile the information from Task 2 to prepare a BOD report that will include both sites. The BOD will summarize the design decisions, assumptions, and specifications that will be used to develop the schematic design. Target level sill/reef and marsh elevations, design wave and wave attenuation criteria, and water level criteria will be presented in the BOD. The BOD will support the permit application process in Task 5 and will include the following:

- Coastal hydrodynamic modeling memorandum
- Compilation of local wind-wave data, as available
- Desktop analysis of wind-generated wave environment
- Estimation of boat wake
- Water level information
- Sea level change scenarios
- Estimated settlement of substrate
- Benthic habitat impacts
- Targeted elevations for NBS
- Construction access requirements
- Potential risks
- Information gaps

BioNC will submit a draft copy (PDF) of the BOD report to the Town for review.

- Milestone Review #1 (virtual) – BioNC and M&N will lead a meeting with the Town and invited stakeholders (to be selected by the Town) to review the draft BOD report, address questions, discuss risks and review information gaps. BioNC will prepare and distribute meeting minutes.

FINAL Basis of Design Report – BioNC, with the support of M&N, will make agreed upon revisions to the report and submit a final BOD report (PDF) to the Town, which will serve as the basis for Schematic Design.

- Task 3 Deliverables
  - Draft BOD report (PDF)
  - Milestone Review #1 meeting minutes
  - Final BOD report (PDF)

## Task 4 - Schematic Design (30%)

BioNC and M&N will develop draft schematic designs for each of the two sites; Nags Head Woods Preserve & Villa Dunes Drive and West Soundside Road. The schematic design will build off the concepts developed for the Estuarine Shoreline Management Plan, the BOD report, and integrate geotechnical and geophysical results and stakeholder input. Design features will focus on the use of NBS to reduce shoreline erosion while maintaining maritime access to private docks, piers and Sound access points. NBS may include the restoration of brackish marshes and various types of offshore intertidal and subtidal living breakwaters (oyster reefs, fish reefs, marsh plantings) to deflect wave energy and encourage the formation of sub-aquatic habitats. Layout considerations for the design features will include water quality and circulation, adaptation to sea level rise, wave energy impact and dampening, and focused shoreline stabilization. The coastal hydrodynamic modeling performed in Task 2 will be used to guide the schematic design. M&N will rerun the coastal hydrodynamic modeling to check that the proposed schematic design meets project engineering goals. The schematic design for each site will consist of

scaled illustrative drawings including general layout of design features, typical cross sections, select conceptual details, general notes, labels and legend. BioNC will prepare a preliminary opinion of probable construction costs for each site.

- Milestone Review #2 (virtual) – BioNC & M&N will lead a meeting with the Town and invited stakeholders to review and solicit feedback on the draft schematic design. Comments and revisions will be incorporated into the Final Schematic Design. BioNC will prepare and distribute meeting minutes.

Final Schematic Design (30%) – BioNC will prepare a final schematic design (30%) based on feedback from the Town, community workshop and field visits.. BioNC will update the preliminary opinion of probable construction costs for the final schematic design.

- Task 4 Deliverables
  - Draft and Final Schematic Design (PDF)
  - Preliminary estimation of probable construction costs for each site
  - Milestone Review #2 meeting minutes

## Task 5 - Regulatory Permitting & Agency Coordination

M&N will provide regulatory guidance on CAMA, 401 Water Quality Certification, and USACE regulatory processes, including the development and submittal of the appropriate permit applications and associated technical documents required for state and federal agency reviews and consultations.

Permit Application Preparation - M&N will compile available biological/ecological data and field assessment analyses performed by the team and other sources and integrate the data into the BOD report. The BOD report will be used to support the narrative to be included with state and federal agency permit applications, as required by the Joint CAMA/Corps review.

Pre-Application Meeting - M&N will facilitate one pre-application meeting with regulatory representatives of the North Carolina Division of Coastal Management, the North Carolina Division of Water Resources, and the USACE, as well as other interested resource agencies, to discuss the proposed shoreline features and identify any concerns the agencies may have prior to submittal of the final Joint Permit application.

Joint Permit Application – M&N will prepare and submit a joint permit application. Once the application is submitted, M&N will assist in responding to agency requests for additional information. Our team has significant experience in problem resolution during permit application review and will use that expertise and relationships with North Carolina regulatory and resource agencies to satisfy any agency concerns that may arise during project and permit development.

Regulatory Feedback -Comments received from regulatory agencies on the schematic design prior to the issuance of the final design documents will be addressed in the BOD report and incorporated into the final design. Completion of this task is not contingent on receiving approved permits.

- Task 5 Deliverables
  - Completed & Submitted Regulatory Applications
  - Draft & Final Essential Fish Habitat Assessment and Biological Assessment
  - Agency Meeting Minutes
  - Email Status Updates on permits

## Task 6 – Design Documents (60%)

BioNC, with support from M&N will complete the necessary design and engineering to produce 60% design documents, including drawings and an outline of specifications. The design drawings will include location and vicinity maps, standard note sheets, grading and site plans, breakwater and living shoreline design and installation, planting and revegetation plans, erosion and sediment control plans, and representative cross sections. Anticipated regulatory requirements will be incorporated into the design documents. BioNC will prepare a construction quantities list and update the opinion of probable construction costs. An electronic copy of the design documents will be provided to the Town for review and comment.

- Milestone Review #3 (virtual) – BioNC will lead a meeting with the Town and invited stakeholders to review and answer questions regarding the 60% design documents. Revisions will be addressed in a future phase/contract in which 90% design plans will be developed. BioNC will prepare and distribute meeting minutes.

Special Condition: It is anticipated that the Design Documents (60%) will be completed prior to the issuance of all state and federal permits to remain compliant with grant funding scheduling conditions. Design changes that result from regulatory review following the submittal of the Final Design Documents will be addressed in the 90% Design Documents under a separate contract.

60% Design Documents Submittals – BioNC will transmit to the Town digital copies of the 60% Design Documents, the topographic and bathymetric surveys, geotechnical results, technical documents and other material used to support the design and permit applications.

- Task 6 Deliverables
  - Agency Meeting Minutes
  - 60% Design Documents (AutoCAD and PDF)
  - Topographic and bathymetric surveys and other material used to support the design and permit applications.
  - Construction quantities schedule (PDF)
  - 60% design opinion of probable construction cost (PDF)
  - Milestone Review #3 meeting minutes

## Task 7 – Community Engagement

BioNC, with support from M&N, will support the Town in providing community engagement through Schematic and 60% design levels. M&N licenses PublicInput, a collaborative public engagement platform that streamlines the process of engaging with constituents and makes it easy for residents to participate on their own time. The platform centralizes engagement efforts across various modes of communication, collects and processes data from respondents, and streamlines the process of engaging and re-engaging a constituency throughout the span of the planning effort. PublicInput also has valuable tools for filtering and analyzing responses, allowing our team to filter by geography, demographics, and respondent preferences and quickly generate nuanced analyses more efficiently than with public surveys alone. The platform will be instrumental in supporting the Town with comment collection, analysis, and response from the community. The platform can host the virtual component of virtual or hybrid public meetings.

Task 7 - Support for Community Engagement

- M&N, with support from BioNC, will lead an interactive in-person community workshop (2-3 hours) to present and solicit feedback on the Draft Schematic Plan. The workshop will consist of a Power Point presentation followed by a listening session to gather feedback and address questions. Up to three (3) graphic boards depicting the schematic design along with conceptual details will be prepared for the workshop.
- Following the workshop, M&N +BioNC will participate in a half-day of in-person field meetings with property owners and stakeholders to review site conditions, discuss project elements, construction methodologies and project benefits.
- Take-aways from the community engagement session and in-person field meetings will be documented and summarized in a brief memorandum.
- BioNC + M&N will participate in one virtual public meeting to present and solicit feedback on the 60% design documents. Comments will be noted and discussed with the Town. Minor revisions will be addressed in a final 60% draft. More substantial revisions will be incorporated into the 90% design documents under a separate contract.
- BioNC + MN will participate in one Town Council meeting to present findings of the project at the 60% design level.
- M&N, with support from BioNC, will work with the Town to provide a portal on the Town's existing web site to serve as a public facing information page for the project. The portal will include information about the project, project schedule, public-facing documents, recordings of the community engagement & virtual public meetings and a comment form to solicit feedback. The Town will be responsible for programing , updating and maintaining the web site.

Special Condition: The Town will lead the organization and take responsibility for the logistics of the public engagement session, the field meetings and the virtual Town Council Meeting, including scheduling, arranging for the venue(s), site visits, advertising, food & drink, security, etc. M&N + BioNC will provide guidance and consultation to the Town.

- Task 7 Deliverables
  - Community workshop presentation materials, including a PowerPoint presentation & up to 3 project graphic boards.
  - Brief memorandum documenting the community workshop and field meetings.
  - Notes from the Town Council meeting
  - Web portal information as described above.

## Contingencies

This proposal includes a $6,500 allowance for project contingencies and additional tasks that will be identified during the course of the primary scope of work. Example tasks are included below for general information. Additional services may be completed using this contingency with written approval from the Town.

## Supplemental Services

Supplemental services are not included in the scope of work for this contract. These services may be performed at the Owner's request with compensation and potential schedule adjustments. Supplemental services that the Town may choose to add to the scope of work include, but are not limited to the following items:

- On-site meetings with local, State, or Federal agencies not included in the scope of work.
- Additional field studies to identify rare, threatened or endangered species; contaminated soils; or water quality sampling.
- Additional surveying or geotechnical investigations due to unforeseen changes in site conditions from weather events and natural and manmade disturbances.
- Additional regulatory coordination beyond the 12-month schedule proposed below, including permit application tracking, responding to requests for additional information and attending meetings requested by the regulatory agencies.
- Supplemental design and engineering work required to meet the requirements of regulatory or funding agencies that are identified after the completion of the 90% final design documents.
- Additions to an engineering report or other document to update or revise original recommendations.
- Revision of designs, drawings, and specifications to incorporate changes arising from Value Engineering review.
- Preparation of a Benefit-Cost-Analysis (BCA).
- Preparation technical specifications or bid documents (100% design documents) and bidding support.
- Securing temporary construction easements.
- Performing construction administration.
- Performing post construction monitoring.
- Producing or hosting a project web site.

## Assumptions

The following assumptions have been made in the generation of this proposal's scope and fee.

- Available background information helpful to the goals of this project will be provided to the BioNC team within 2 weeks of project award. Non-digital format documents will be scanned and sent, or copies will be provided to the team during the kick-off meeting.
- Unencumbered access to the project sites, shoreline and adjoining properties. The Town shall be responsible for notifying and obtaining permission from the property owners to access the shoreline if needed. Drone photos & videos may be collected when access to certain properties is not feasible. The Town will be notified at least 5 days prior to an anticipated site visit to determine availability of boat-site access.
- All fees and costs associated with the community workshop and permit application will be the responsibility of the Town and are not included within the proposed fee.
- To remain on schedule, the review period of deliverables by the Town has been assumed to be 1 week.

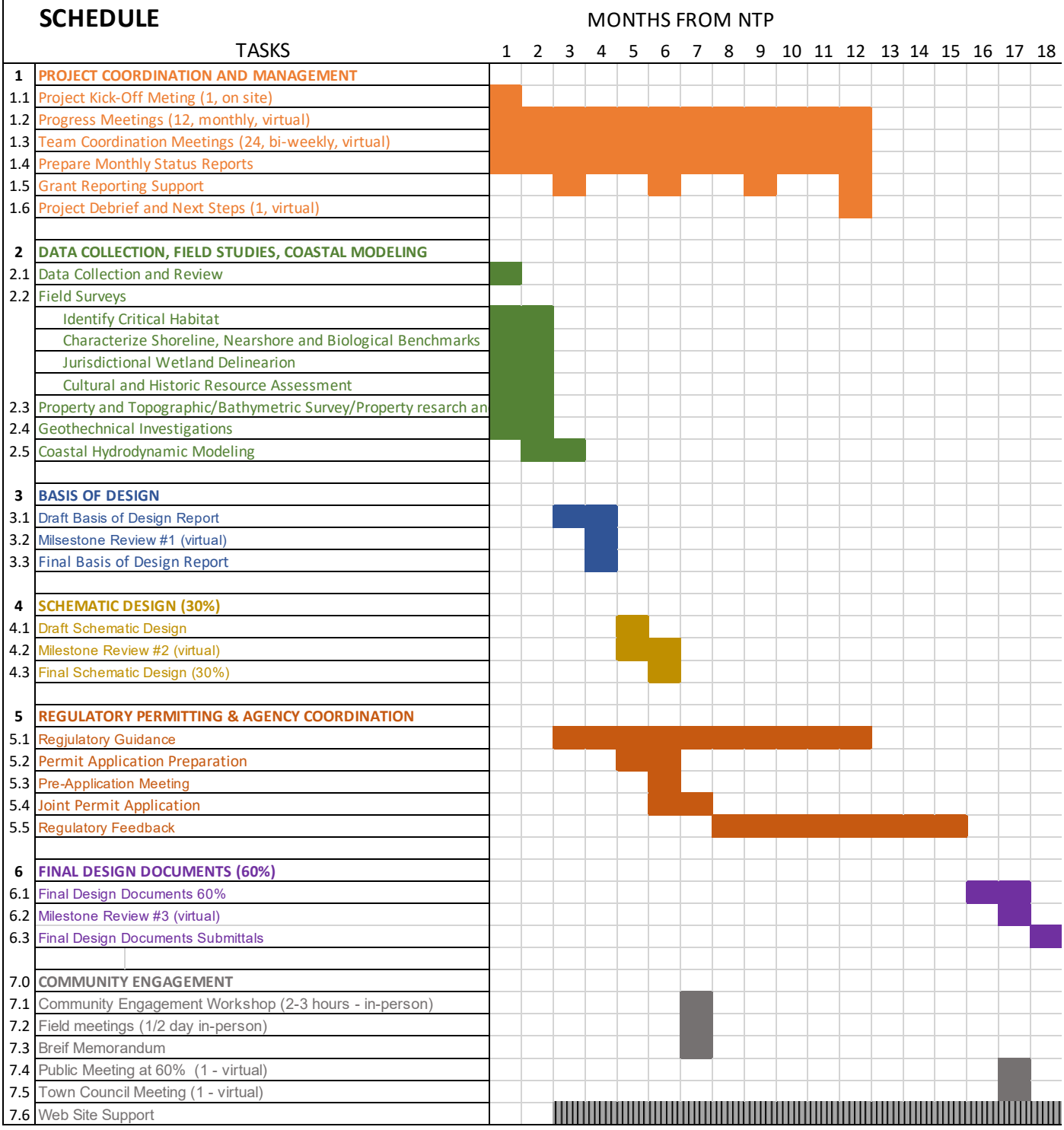
- Additional drilling requested or required in excess of proposed items may incur additional drilling charges, and may also incur additional labor charges for mobilization, field supervision, creation of boring logs, and additional engineering evaluation time.
- If unusual conditions are encountered or suspected, such as obstructions, unstable soils, existing drainage channels where unstable soils may occur, or any other conditions which may require changes to the depth or location of borings, CATLIN will immediately contact the Client for direction. Additional borings or drilling footage required in excess of proposed borings/footage may incur additional charges and/or a second phase of the geotechnical investigation to perform additional services.
- If contaminated material is encountered during drilling activities, field work will stop, and the client will immediately be notified. Costs associated with handling and disposal of contaminated materials are not included in this cost estimate.
- Inability to access the location may result in additional charges for mobilization and field crew travel time.

## Project Schedule

The following schedule outlines the anticipated time frames for performing each Task. In accordance with the grant funding requirements and anticipated extension, BioNC anticipates completing the scope of work within 18 months from Notice-to-Proceed, provided there are no delays due to unforeseen conditions including weather delays in conducting field studies, Town of Nags Head delays in meeting schedules and review times for deliverables, or other factors outside of BioNC control. It is anticipated that securing the necessary state and federal permits may require more than 12 months. Work beyond the 18-month period, including permit application tracking, responding to requests for additional information and attending meetings requested by the regulatory agencies is considered supplemental services and not included in this schedule.

**Nags Head Estuarine Shoreline Management Design**

## SCHEDULE



## FEE

Compensation for the services described herein are in accordance with the Scope of Work and Schedule specified above. The LUMP SUM FIXED FEE, including expenses, to perform this work is as follows:

- Project Coordination and Management $74,704
- Data Collection, Field Studies, Coastal Modeling $173,457
- Basis of Design $40,590
- Schematic Design (30%) $84,330
- Regulatory Permitting and Agency Coordination $67,740
- Design Documents (60%) $52,959
- Community Engagement $38,738
- Contingency & Allowances $ 6,500

TOTAL FEE $539,018

# Client Responsibilities

Client shall be responsible for the following:

- Notification to proceed.
- Timely review and comments (or approval) of all deliverables or other information presented for Owner approval.
- Payment of invoices in accordance with Terms and Conditions.
- Notification to Firm of any problems, in accordance with Terms and Conditions.

# General Conditions

- This proposal is valid for 60 days from the above date.
- Reimbursable expenses will be billed in accordance with the attached Rate Schedule.

# Conclusion

We appreciate this opportunity to propose our services. We are eager to pursue this project further and thank you for your consideration.

Sincerely,

**McAdams**

Hunter Freeman, PE, LEED AP | Senior Advisor, Water Resources – Green Stormwater Infrastructure
freeman@mcadamsco.com | 919. 361. 5000

HF/kt

## Acceptance

By: _____ Date: _____

Name: _____

Title: _____

## Accounting Information

Billing Contact: _____

Billing Contact Email Address: _____

Billing Contact Phone Number: _____

Billing Address: _____

_____

McAdams
621 Hillsborough Street
Suite 500
Raleigh, NC 27603
919. 361. 5000

# Hourly Rate Schedule / 2024

1. SPECIFICATIONS FOR CONTRACT BY HOURLY CHARGE, THE FOLLOWING RATES APPLY

| Role | Rate |
|---|---|
| Chairman / President / Vice President | $290 - 400 /hour |
| Principal | $325 /hour |
| Director / Practice Lead | $145 - 265 /hour |
| Technical Manager | $135 - 240 /hour |
| Project Manager | $150 - 230 /hour |
| Assistant Project Manager | $120 - 175 /hour |
| Landscape Architect | $140 - 230 /hour |
| Planner | $110 - 190 /hour |
| Project Engineer | $130 - 240 /hour |
| Graphics + Visualization | $110 - 160 /hour |
| Designer / Analyst | $100 - 200 /hour |
| Intern | $55 - 100 /hour |
| Administrative Services | $80 - 110 /hour |
| Construction Administration | $100 - 155 /hour |
| Survey Technician | $95 - 125 /hour |
| 2 Man Survey Crew | $155 - 175 /hour |
| 3 Man Survey Crew | $185 - 200 /hour |
| UAS LiDAR Crew | $285 /hour |
| SUE Crew Member | $55 - 115 /hour |

*Hourly services are recorded and rounded to the nearest 1/4 hour.*

2. THE FOLLOWING CHARGES APPLY ON ALL CONTRACTS, FOR COPIES OF PLANS AND SPECIFICATIONS SENT OUT OF THE ENGINEER'S OFFICE (TO CLIENT, CITY REGULATORY AGENCIES, BIDDERS, CONTRACTOR, OTHER CONSULTANTS, ETC.):

| Item | Fee | Item | Fee |
|---|---|---|---|
| Oversize + Color Rep. | $3.60 /each | Oversize Mylar Sepia | $24.00 /each |
| Paper Reproductions | $2.40 /each | Mylar Sepia | $18.00 /each |
| Specifications | $0.12 /each | Paper Sepia | $6.00 /each |

3. THE FOLLOWING RATES ARE CHARGED IN ADDITION TO THE ABOVE FEES:

| Item | Fee |
|---|---|
| Fees Paid for Permits and Applications | Cost Plus 10% |
| Outside Photocopying, Travel, Overnight Delivery, Postage for Mass Mailings | Cost Plus 10% |
| Subcontractor Invoices | Cost Plus 12.5% |

4. FEES ARE SUBJECT TO ADJUSTMENT AT THE BEGINNING OF EACH CALENDAR YEAR.

5. PROJECTS ARE BILLED ON A MONTHLY BASIS AND INVOICES ARE DUE UPON RECEIPT. INVOICES WHICH HAVE BEEN NOT BEEN PAID WITHIN 30 DAYS ARE PAST DUE AND SUBJECT TO FINANCE CHARGES OF 1.5% PER MONTH.

Client's Initials _____ Date _____

McAdams
621 Hillsborough Street
Suite 500
Raleigh, NC 27603
919. 361. 5000

# Terms + Conditions

The proposal submitted by THE JOHN R. McADAMS COMPANY ("CONSULTANT") is subject to the following terms and conditions (collectively referred to as the "Agreement") and, by accepting the proposal or any part thereof, CLIENT agrees and accepts the terms and conditions outlined below:

## 1. Payment:

CLIENT will pay CONSULTANT for services and expenses in accordance with periodic invoices to CLIENT and a final invoice upon completion of the services. Each invoice is due and payable in full upon presentation to CLIENT. Invoices are past due if not paid in full after 30 days. Past due amounts are subject to interest at a rate of one and one-half percent per month (18% per annum) on the outstanding balance from the date of the invoice.

In an effort to ensure prompt resolution of questions and disputes regarding CONSULTANT's services and invoices, CLIENT agrees to notify CONSULTANT, in writing / email, of any questions or concerns CLIENT may have regarding the cost, quality or appropriateness of services provided related to an invoice within fifteen (15) days of the invoice date. If CLIENT fails to provide such notice to CONSULTANT, CLIENT waives its right to dispute the accuracy and appropriateness of any portion of such invoice for which notice was not provided.

If CLIENT fails to make payment to CONSULTANT within 30 days after the invoice date, CONSULTANT may, after giving seven (7) days written notice to CLIENT, suspend services under this Agreement until all amounts due are paid in full. If an invoice remains unpaid after sixty (60) days from invoice date, CONSULTANT may terminate the Agreement and/or initiate legal proceedings to collect the fees owed, plus other reasonable expenses of collection including attorney's fees.

## 2. Notification of Breach or Default:

CLIENT shall provide prompt written / email documentation to CONSULTANT if CLIENT becomes aware of any breach of contract, defect, fault, error, omission or inconsistency arising out of or related to CONSULTANT's services. The failure of CLIENT to provide such written notice within fifteen (15) days from the time CLIENT became aware of such breach of contract, defect, fault, error, omission or inconsistency, shall constitute a waiver by CLIENT of any claims against CONSULTANT arising out of such breach of contract, defect, fault, error, omission or inconsistency.

## 3. Ownership of Instruments of Service:

All reports, plans, specifications, instruments of service, field data, notes and other documents, including all documents on electronic media, prepared by CONSULTANT shall remain the property of CONSULTANT. CONSULTANT shall retain all common law, statutory and other rights, including intellectual property rights. In the event of termination of this Agreement and upon full payment of fees owed to CONSULTANT, CONSULTANT shall make available to CLIENT copies of all completed plans, specifications, and electronic files.

## 4. Change Orders:

CONSULTANT will treat as a change order request any documented or oral order (including directions, instructions, interpretations or determinations) from CLIENT which request changes in the Agreement or CONSULTANT's scope of work. If CONSULTANT is willing to proceed with such change, CONSULTANT will give CLIENT written notice within fifteen (15) days of a change order request of any resulting increase in CONSULTANT's fees and/or time of performance (a "Change Order"). Unless CLIENT objects in writing within ten (10) days, the Change Order becomes a part of this Agreement.

## 5. Site Operations:

CLIENT will arrange for right-of-entry to the property for the purpose of performing studies, tests and evaluations pursuant to the agreed services. CLIENT represents that it possesses necessary permits and licenses required for all ongoing activities at the site. If CONSULTANT is advised or given data in writing that shows the presence of underground or overground obstructions, such as utilities, CONSULTANT will give special instructions to our field personnel. However, CONSULTANT is not responsible for any damage or losses due to undisclosed or unknown surface or subsurface conditions, owned by CLIENT or third parties. CONSULTANT will take reasonable precautions to minimize damage to the property caused by our operations. CONSULTANT's fee does not include any cost of restoration due to any damage which may result and CONSULTANT is not responsible for any such repairs unless CONSULTANT fails to take reasonable precautions. If CLIENT desires CONSULTANT to repair such damage, CONSULTANT will comply and add the cost to our fee. Field tests or boring locations described in CLIENT's reports or shown on sketches prepared by CONSULTANT are based on specific information furnished by others or estimates made in the field by CONSULTANT's personnel. Such dimensions, depths or elevations should be considered as approximations unless otherwise stated in CONSULTANT's proposal or report.

## 6. Project Site:

Should CLIENT not be owner of the project site, then CLIENT agrees to notify the owner(s) of the possibility of unavoidable alteration and damage to the site and to obtain permission from the owner(s) for such alteration and damage. CLIENT further agrees to indemnify, defend and hold CONSULTANT harmless against any claims by the owner(s) or persons having possession of the site through the Owner which are related to such alteration or damage.

## 7. Assignment and Third Parties:

Nothing under this Agreement shall be construed to give any rights or benefits in this Agreement to anyone other than CLIENT and CONSULTANT, and all duties and responsibilities undertaken pursuant to this Agreement will be for the sole and exclusive benefit of CLIENT and CONSULTANT and not for the benefit of any other party. Neither CLIENT nor CONSULTANT shall assign, sublet, or transfer any rights under or interests in this Agreement without the written consent of the other which shall not be unreasonably withheld. However, nothing contained herein shall prevent or restrict CONSULTANT from employing independent subconsultants as CONSULTANT may deem appropriate to assist in the performance of services hereunder.

## 8. Survival:

All of CLIENT's payment obligations and liabilities, including but not limited to, its indemnification obligations and limitations, and CONSULTANT's rights and remedies with respect thereto, as well as the terms of Sections 6, 11, 12, and 14, shall survive completion of and the expiration or termination of this Agreement.

## 9. Force Majeure:

Should completion of any portion of the services or any obligation under the Agreement be delayed for causes beyond the control of or without the fault or negligence of CONSULTANT, including force majeure, the reasonable time for performance of the service or the deadline under the Agreement shall be extended for a period at least equal to the delay. Force majeure includes but is not restricted to acts of God, acts or failures of governmental authorities, acts of CLIENT's contractors or agents, fire, floods, epidemics, riots, quarantine restrictions, strikes, civil insurrections, freight embargoes, and unusually severe weather.

## 10. Standard of Care:

CONSULTANT shall perform its services under the Agreement in a professional manner, using the degree of care and skill ordinarily exercised by and consistent with the standards of professionals providing the same services in the same or a similar locality as the project. THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARISING OUT OF OR RELATING TO THE SERVICES PROVIDED BY CONSULTANT UNDER THIS AGREEMENT, AND CLIENT WAIVES ITS RIGHT TO ASSERT SUCH CLAIMS AGAINST CONSULTANT.

## 11. Limitation of Liability:

CLIENT agrees that the total collective and aggregate liability of CONSULTANT and its employees, officers, and directors for any and all claims that may be asserted by CLIENT arising out of or related to this Agreement, except for claims for willful or intentional misconduct by CONSULTANT, is limited to $50,000 or to the fee paid to CONSULTANT under this Agreement, whichever is greater.

## 12. Waiver of Consequential Damages:

Both CLIENT and CONSULTANT hereby waive any right to pursue claims for consequential damages against one another, including any claims for lost profits.

## 13. Safety:

Except with respect to CONSULTANT's own employees, CONSULTANT is not responsible for site safety or compliance with the Occupational Safety and Health Act of 1970 ("OSHA"). Job site safety remains the sole exclusive responsibility of CLIENT or CLIENT's contractors. Likewise, CONSULTANT shall have no right to direct or stop the work of CLIENT's contractors, agents or employees.

## 14. Arbitration:

Any claim or other dispute arising out of or related to this Agreement shall be subject to Arbitration. Such claims and disputes shall first be subject to non- binding mediation, and if mediation is unsuccessful, shall be subject to Arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect. Any demand for Arbitration shall be filed in writing with the other party and with the American Arbitration Association. Nothing in this provision shall prevent CONSULTANT from acting to secure any lien rights it may have under applicable law.

## 15. Independent Contractor:

In carrying out its obligations, CONSULTANT shall be acting at all times as an independent contractor and not an employee, agent, partner or joint venturer of CLIENT. CONSULTANT's work does not include any supervision or direction of the work of other contractors, their employees or agents, and CONSULTANT's presence shall in no way create any liability on behalf of CONSULTANT for failure of other contractors, their employees or agents to properly or correctly perform their work

## 16. Termination:

Either party may terminate the Agreement with cause upon ten (10) days advance written notice, if the other party has not cured or taken reasonable steps to cure the breach giving rise to termination within the ten (10) day notice period. Either party may terminate the Agreement without cause upon thirty (30) days advance written notice to the other party. If CLIENT terminates without cause or if CONSULTANT terminates for cause, CLIENT will pay CONSULTANT for all services performed, costs incurred, non- cancelable commitments, and fees earned to the date of termination and through demobilization, including any cancellation charges of vendors and subcontractors, as well as reasonable demobilization costs.

## 17. Severability:

If any provision of this Agreement, or application thereof to any person or circumstance, is found to be invalid then such provision shall be modified if possible, to fulfill the intent of the parties as reflected in the original provision. The remainder of this Agreement, or the application of such provision to persons or circumstances other than those as to which it is held invalid, shall not be affected thereby, and each provision of this Agreement shall be valid and enforced to the fullest extent permitted by the law.

## 18. No Waiver:

No waiver by either party of any default by the other party in the performance of any provision of this Agreement shall operate as or be construed as a waiver of any future default, whether like or different in character.

## 19. Merger, Amendment:

This Agreement constitutes the entire Agreement between CONSULTANT and CLIENT, and all negotiations, written and oral understandings between the parties are merged herein. This Agreement can be supplemented and/or amended only by a written document executed by both CONSULTANT and CLIENT.

## 20. Choice of Law:

The validity, interpretation, and performance of this Agreement shall be governed by and construed in accordance with the law of the State of North Carolina, excluding only its conflicts of laws principles.

TOWN OF NAGS HEAD

**BUDGET AMENDMENT REQUEST**
**FY 2024-2025**

**BUDGET AMENDMENT NO. 4**
**Amendment 4.A**

SOURCE OF FUNDS

| CODE | ACCOUNT | AMOUNT | | CODE | ACCOUNT | AMOUNT |
|---|---|---|---|---|---|---|
| | **General Fund Revenues** | | | | **General Fund Planning and Development** | |
| 10-432100 | NC DEQ grant | 500,000.00 | | 490-577350 | Capital Outlay Improvements | 500,000.00 |
| TOTAL CHARGES | | $ 500,000.00 | | TOTAL CREDITS | | $ 500,000.00 |

USE OF FUNDS

**JUSTIFICATION**

NC RCCP Grant-ESMP Living Shoreline project design at Villa Dunes Drive and Soundside Road Engineering scope

ADMINISTRATIVE SERVICES 9/27/2024
RECOMMENDED BY DATE

APPROVED BY BOC: DATE

POSTED TO GENERAL LEDGER:

INITIALS

# Agenda Item Summary Sheet

Item No: **I-4**
Meeting Date: **October 2, 2024**

**Item Title**: Consideration of Fire Truck purchase contract

**Item Summary**:

The Fire Department is requesting that the Board authorize the Town Manager to enter into a contract with Atlantic Emergency Services for the procurement of a new fire pumper. This proactive approach to replacing the fire truck is crucial for ensuring timely delivery, following our established replacement schedule. While we are signing the contract now, no funds will be expended until the pumper is delivered.

Given the current manufacturing delays, the lead time for delivery of fire trucks can extend to several years from the date of order. By initiating the replacement process now, we aim to secure the vehicle as planned, which would be in calendar year 2028.

Once delivered, the new pumper will replace the existing 2007 fire pumper at Fire Station 21. The 2019 fire pumper will be used as the backup fire pumper. Back-up apparatus are used when front-line vehicles are down for repair or for responses staffed by volunteers or off-duty career staff. The current backup pumper will be sold. We anticipate the new pumper to be delivered after July 1, 2028, aligning with the Town of Nags Head's vehicle replacement schedule, which allocates 10 years for front-line service vehicles followed by an additional 10 years for backup service vehicles.

Summary of vehicles at each station:

Fire Station 16 – 2013 Quint and 2002 Pumper
Fire Station 21 – 2019 Pumper and 2007 Pumper

Attached is a memo describing the process to procure bids for the replacement of this vehicle.

Number of Attachments: 1

**Specific Action Requested**:

Authorize the execution of the Fire Truck purchase contract pursuant to Town Attorney review.

Submitted By: Randy Wells, Fire Chief Date: September 26, 2024

**Finance Officer Comment**:
There is no budgetary impact this fiscal year by signing this contract.

Signature: Amy Miller Date: September 26, 2024

**Town Attorney Comment**:

Signature: John Leidy Date: September 26, 2024

**Town Manager Comment and/or Recommendation**:

I support this request to maintain the Town's replacement schedule for fire apparatus.

Signature: Andy Garman Date: September 26, 2024

Nags Head Fire
Rescue
Fire Chief Randy C. Wells
P.O. Box 99
Nags Head, NC 27959

To: Town Manager Garman
From: Randy Wells, Fire Chief
Date: September 6, 2024
Re: Recommendation for Purchase of Pierce Custom Fire Pumper

**Overview**

As part of our effort to maintain the fire department's apparatus replacement schedule, we evaluated proposals for the purchase of a new fire pumper. Following a thorough review of the pricing, specifications, and past performance, I recommend purchasing the Pierce Custom pumper from Atlantic Emergency Solutions for a total price of $1,348,807.00, including a contingency for shelving and equipment mounting.

**Background**

Three manufacturers submitted proposals for a new fire pumper in response to a pricing request sent on May 22, 2024, using the HGAC cooperative purchasing alliance. After receiving proposals on June 21, 2024, two met our requirements:

Pierce Custom Pumper – Atlantic Emergency Solutions, initial price: $1,549,180.00

KME/Spartan Pumper – Safe Industries, initial price: $1,388,600.00

<u>After negotiations to reduce costs, the adjusted pricing was as follows:</u>

Pierce: $1,298,807.00 (excluding contingency for shelving)

KME: $1,235,000.00 (excluding contingency for shelving)

Nags Head Fire
Rescue
Fire Chief Randy C. Wells
P.O. Box 99
Nags Head, NC 27959

## Rationale for Recommendation

### Cost and Specifications

The Pierce proposal includes the necessary features at a higher final cost of $1,348,807.00, which includes a $50,000 contingency for shelving but excludes $80,000 for loose equipment (to be budgeted separately).

KME's updated proposal was lower, at $1,285,000.00, which includes a $50,000 contingency for shelving but excludes $80,000 for loose equipment (to be budgeted separately).

### Performance and Reliability Concerns

Experience with KME apparatus has raised concerns, particularly with long delays and significant changes in their manufacturing process. For instance, the ladder truck purchased in 2021 has experienced a delayed delivery timeline extending to three and a half years, due to KME's transition under the REV Group. There is also uncertainty around parts availability and price surcharges due to new EPA regulations. Pierce, on the other hand, has demonstrated more stable manufacturing processes and a shorter supply chain, with no expected price surcharges due to new emissions standards.

### Service and Maintenance

Pierce has a local service facility in Greenville, NC, which offers faster service times, whereas KME's nearest service facility is in Easley, SC.

Pierce has consistently maintained stable production without significant delays or disruptions, ensuring parts availability and a more reliable service network.

### Conclusion and Request

Given the lower cost, more reliable service network, and fewer manufacturing delays, I strongly recommend moving forward with the purchase of the Pierce Custom Pumper for $1,348,807.00. We propose budgeting the additional $80,000 for equipment separately, over the year before delivery and the year of delivery.

Please consider this recommendation for approval.

# Agenda Item Summary Sheet

Item No: **I-5**
Meeting Date: **October 2, 2024**

**Item Title**: Consideration of resolution authorizing application to NC-DEQ Division of Water Infrastructure for Septic Health Project Grant; Consideration of revised Septic Health Initiative Policy

**Item Summary**:

Recently, staff spoke with the North Carolina DEQ, Division of Water Infrastructure to discuss a pilot program they have initiated related to supporting on-site wastewater infrastructure. The Division of Water Infrastructure has a loan program to allow for the replacement of failing and/or malfunctioning septic systems. This would also include principal forgiveness for loans where the applicant meets certain income criteria. Their loan would be 0% interest whereas the Town's current septic replacement loan is the prime rate minus 2.5%. This places our current interest rate at 5.5%. Staff would like to apply for this grant to enhance the program we already have in place. We discussed soliciting interest from property owners in targeted areas where aging systems and low-lying conditions create additional risk for ground and surface water contamination. However, this would be made available to anyone in the Town who has a malfunctioning or failing system. Coupled with this grant we would also like to increase the timeframe for repayment of septic loans under our program to enhance the affordability of the loan.

At the October 2nd Board of Commissioners meeting, staff requests Board consideration of attached resolution authorizing a grant application to the NC-DEQ Division of Water Infrastructure for the Town's Septic Health Initiative project. This is for authorization for funds to be used in accordance with the Town's Septic Health Initiative policy.

The Septic Health Initiative Policy is also attached for your review and approval. This red-lined version updates the policy by authorizing loans to be repaid via automatic bank draft at least monthly and for up to five (5) years instead of the current three (3) years.

Number of Attachments: 2

**Specific Action Requested**:
Provided for Board review and consideration of attached resolution and policy.

Submitted By: Administration Date: September 26, 2024

**Finance Officer Comment**:
Staff will write the grant upon Board approval.
Signature: Amy Miller Date: September 26, 2024

**Town Attorney Comment**:

N/A
Signature: John Leidy Date: September 26, 2024

**Town Manager Comment and/or Recommendation**:

I support pursuing this opportunity and agree with the recommended policy change.

Signature: Andy Garman Date: September 26, 2024

**RESOLUTION AUTHORIZING THE TOWN MANAGER TO EXECUTE AND FILE AN APPLICATION ON BEHALF OF THE TOWN OF NAGS HEAD WITH THE STATE OF NORTH CAROLINA FOR A LOAN AND/OR GRANT**

**WHEREAS**, The Town of Nags Head has need for and intends to apply for Clean Water State Revolving Funds (CWSRF) for wastewater, specifically decentralized wastewater:

- The Town has identified failing and/or malfunctioning decentralized septic systems;
- The Town would like to provide Nags Head homeowners low-interest, no-interest, and/or principal forgiveness loans to replace their failing/malfunctioning septic systems; and

**WHEREAS**, The Town of Nags Head intends to request State loan and/or grant assistance for the projects; and

**NOW THEREFORE, BE IT RESOLVED BY THE BOARD OF COMMISSIONERS OF THE TOWN OF NAGS HEAD:**

1. That the Town of Nags Head, the Applicant, will arrange financing for all remaining costs of the project, if approved for a State loan and/or grant award.

2. That the Town of Nags Head will adopt and place into effect on or before completion of the project a schedule of fees and charges and other available funds which will provide adequate funds for proper operation, maintenance, and administration of the system and the repayment of all principal and interest on the debt.

3. That the governing body of the Town of Nags Head agrees to include in the loan agreement a provision authorizing the State Treasurer, upon failure of the Town of Nags Head to make scheduled repayment of the loan, to withhold from the Town of Nags Head any State funds that would otherwise be distributed to the local government unit in an amount sufficient to pay all sums then due and payable to the State as a repayment of the loan.

4. That the Town of Nags Head will provide for efficient operation and maintenance of the project on completion of construction thereof.

5. The Town Manager, or in absence designee, of the Town of Nags Head is hereby authorized, individually and collectively, to execute and file an application on behalf of the Town of Nags Head with the State of North Carolina for a loan and/or grant to aid in the projects described above.

6. That the Town Manager, and successors so titled, is hereby authorized and directed to furnish such information as the appropriate State agency may request in connection with such application or the project: to make the assurances as contained above; and to execute such other documents as may be required in connection with the application.

7. That the Town of Nags Head has substantially complied or will substantially comply with all Federal, State, and local laws, rules, regulations, and ordinances applicable to the project and to Federal and State grants and loans pertaining thereto.

Adopted this the 2nd day of October 2024.

_____
Benjamin Cahoon, Mayor
Town of Nags Head

ATTEST:

_____
Carolyn F. Morris, Town Clerk

**CERTIFICATION BY RECORDING OFFICER**

**RESOLUTION AUTHORIZING THE TOWN MANAGER TO EXECUTE AND FILE AN APPLICATION ON BEHALF OF THE TOWN OF NAGS HEAD WITH THE STATE OF NORTH CAROLINA FOR A LOAN AND/OR GRANT**

The undersigned duly qualified and acting Town Clerk of the Town of Nags Head does hereby certify: That the above/attached resolution is a true and correct copy of the resolution authorizing the filing of an application with the State of North Carolina, as regularly adopted at a legally convened meeting of the Town of Nags Head duly held on the 2nd day of October, 2024; and, further, that such resolution has been fully recorded in the journal of proceedings and records in my office. IN WITNESS WHEREOF, I have hereunto set my hand this _____ day of October, 2024.

_____
(Signature of Recording Officer)

_____
(Title of Recording Officer)

**Town of Nags Head**
Post Office Box 99
Nags Head, North Carolina 27959
Telephone 252-441-5508
Fax 252-441-0776
www.nagsheadnc.gov

## Board of Commissioners Policy

## Septic Health Initiative Program

Adopted: February 15, 2006
Updated: February 4, 2009
Updated: March 14, 2018
Updated: January 8, 2020
Updated: June 17, 2020
Updated: June 1, 2022
Updated: October 2, 2024

*Septic Tank Inspection and Pumping Program* - Qualified staff may perform septic tank inspections and/or contract with independent inspectors to perform septic tank inspections. The inspection form will document the condition of the septic system. Staff will contact the homeowner and advise them of the results of the inspection and the need to pump the tank.

In order to receive a $150.00 water credit, the homeowner is only to send to the Town proof that the tank was pumped. Water credits are valid for 90 days from issuance and can be claimed once every three years per property address.

*Repair/Replacement Loan Program* - The cost for repair/replacement loans is $12,000. For both owner-occupied homes and non-owner occupied homes, the loan rate is prime less 2.5% but the resultant loan rate shall not be less than 2.50%. Loans are to be repaid via automatic bank draft at least monthly and for up to ~~three~~ five (~~3~~5) years. Loans shall only be made to homeowners who have no delinquent debts to the Town.

*Septic system repairs under the Loan Program* - Upon request from the Deputy Director of Planning and Development, or his or her designee, and upon verification that satisfactory work has been completed, the Town shall issue the loan repair check made out to the contractor who performed the work.

It shall be a policy of the Town of Nags Head not to offer loans to homeowners for the repair or replacement of septic systems on oceanfront or estuarine properties where the septic system has been storm damaged or damaged as a result of erosion.

# Agenda Item Summary Sheet

Item No: **I-6**
Meeting Date: **October 2, 2024**

**Item Title**: Discussion of Stormwater Master Plan process/public engagement

**Item Summary**:

An NCDEQ- Division of Water Infrastructure Stormwater Planning Grant was received in the amount of $400,000 to fund the preparation of a stormwater master plan update. As part of the grant funding requirements, preliminary scoping documents were developed, reviewed, and approved through NCDEQ-Division of Water Infrastructure. The preliminary scope of work in the master plan will expand on planning work established in the 2015 stormwater master plan update with a condition assessment, identification of current system deficiencies, development of an updated stormwater CIP listing, public engagement, and planning level cost information for general budgeting.

Public participation and engagement are identified as an integral part of the stormwater master plan process. Several techniques can be employed to invite participation of various targeted audiences and will be presented for Board consideration. Staff is requesting Board feedback on selecting a public engagement approach considered to be the most beneficial to the stormwater master plan process. A memo is attached which describes in detail prior stormwater planning efforts and public engagement approaches.

The second part of this request is for consideration of the fee proposal submitted by McAdams to initiate the first phase of work for the Stormwater Master Plan. Requesting the Board to authorize the Town Manager to execute the planning proposal with McAdams in the amount of $208,000 to begin the stormwater master plan process. Attached is a copy of the September 25, 2024 McAdams proposal.

Number of Attachments: 4

**Specific Action Requested**:

Discussion/feedback on the public engagement process; approval of the McAdams proposal to provide consulting assistance for the Stormwater Master Plan.

Submitted By: Public Services Date: September 26, 2024

**Finance Officer Comment**:

Grant/project funding has been included in the FY 24/25 adopted budget.

Signature: Amy Miller Date: September 26, 2024

**Town Attorney Comment**: N/A

Signature: John Leidy Date: September 26, 2024

**Town Manager Comment and/or Recommendation**:

The Town has utilized a Stormwater Advisory Committee to guide past stormwater master planning efforts. This consisted of individuals representing various geographic areas of the Town. Staff will review approaches to soliciting public engagement for the upcoming plan. The Board should think about the merits of utilizing a committee approach vs. collecting feedback through a series of workshops.

Signature: Andy Garman Date: September 26, 2024

**Benjamin Cahoon**
Mayor

**Michael Siers**
Mayor Pro Tem

**Andy Garman**
Town Manager

**Town of Nags Head**
Post Office Box 99
Nags Head, NC 27959
Telephone 252-441-5508
Fax 252-441-0776
www.nagsheadnc.gov

**Kevin Brinkley**
Commissioner

**Bob Sanders**
Commissioner

**Megan Lambert**
Commissioner

**MEMORANDUM**

Date: September 24, 2024

To: Board of Commissioners

From: David Ryan, P.E.

**RE: Stormwater Master Plan- Public Engagement Memo**

---

In 2015, the Town of Nags Head began an update to the 2006 Stormwater Management Plan. The plan was comprised of an asset inventory update in conjunction with the development of a Stormwater Capital Improvement Plan, (CIP). Thirteen separate stormwater project improvements were identified spanning from the north end of Town to South Nags Head. Of the thirteen project areas, construction of six projects has been completed, three have received Local Assistance for Stormwater Infrastructure Investments (LASII) grant funding with two of the three nearing the bid phase, two were assigned for remedial maintenance and the remaining two failing to meet a cost effectiveness threshold.

The Stormwater Master Plan update evaluates the current state stormwater management and the conditions of storm systems, ditches, and other management measures. The plan charts a path for a more sustainable community by providing a comprehensive framework for managing stormwater and watersheds for the next 10 years.

On August 18, 2023, the Town of Nags Head received an NCDEQ Division of Water Infrastructure (DWI) Stormwater Planning Grant in the amount of $400,000 for a stormwater master plan update. As part of the grant funding requirements, preliminary scoping documents were developed, reviewed and approved through NCDEQ-DWI. The scope of work in the master plan will expand on planning work established in the 2015 update, with a condition assessment, identification of current system deficiencies, development of an updated stormwater CIP listing, public engagement and planning level cost information for general budgeting.

Several sources were utilized to develop a preliminary stormwater CIP listing in the creation of the preliminary scoping documents. A combination of citizen feedback and post-rainfall event observations were considered in crafting a planning budget for the preliminary project list. This was necessary to meet the grant funding requirements. The location of projects can be altered but the number of projects cannot be exceeded with the total estimate of twelve project improvement areas.

Public participation and engagement is identified as an integral part of the stormwater master plan process. Previously, the Town had selected an advisory stormwater committee comprised of a Board of Commissioners representative, a Planning Board representative and seven citizen representatives from neighborhoods throughout the Town. This committee was in effect for approximately a 12-month duration during the 2015 stormwater master plan update. An advisory committee or working group is one approach of public engagement. Another approach for consideration is to hold a single or multiple workshops to target a broader audience to receive citizen and stakeholder feedback related to local stormwater issues.

Staff is requesting Board feedback on selecting a public engagement approach considered to be the most beneficial to the stormwater master plan process.

As we proceed with initiating the master plan process, authorization to commence with the scope of work will be needed. The engineering consulting firm of McAdams, with support from Moffat & Nichol, Biohabitats, and Coastal Engineering and Surveying will assist with the plan development. The scope of work outlined in the McAdams proposal dated September 25, 2024 segments the work into several different phases. The initial phase of work will consist of initial data collection, stakeholder and public meetings, problem area identification, conceptual design, asset inventory and assessment, geodatabase management and dashboard creation. Future phases will consist of preparation of a stormwater master plan report, watershed restoration plans, and final plan presentation.

The fee proposal for the Phase 1 services is $208,000.00. All funds shall be expended by December 31, 2026.

The requested Board of Commissioners consideration is to authorize the Town Manager to execute the planning proposal with McAdams in the amount of **$208,000** to begin the stormwater master plan process.

DocuSign Envelope ID: DC6E26D4-5C13-473D-9F34-3DDA4FEDD8A6

**STATE OF NORTH CAROLINA**
**DEPARTMENT OF ENVIRONMENTAL QUALITY**
**DIVISION OF WATER INFRASTRUCTURE**

## Funding Offer and Acceptance – Stormwater Planning Grant

**Legal Name and Address of Award Recipient (i.e., Applicant):**

Town of Nags Head
P.O. Box 99
Nags Head, North Carolina 27959

**Project Number:** SRP-SW-ARP-0102
**UEID#:** QHFXEKKHA8R3
**Assistance Listing Number:** 21.027

**Funding Program:**

| | | Additional Amount for Funding Increases | Previous Total | Total Offered |
|---|---|---|---|---|
| **Drinking Water** | ☐ | | | |
| **Stormwater** | ☒ | | | |
| **Wastewater** | ☐ | | | |
| American Rescue Plan Act (ARPA) Grant | ☒ | -- | -- | $400,000 |

**Project Description:**

*Stormwater Master Plan Update*

**Total Financial Assistance Offer:** **$400,000**
Total Project Cost: $400,000
**Estimated Closing Fee:** **$ - 0 -**

Pursuant to North Carolina Session Law 2021-180:

- The Applicant is eligible under Federal and State law;
- The Project is eligible under Federal and State law; and
- The Project has been approved by the Department of Environmental Quality as having sufficient priority to receive financial assistance.

The Department of Environmental Quality, acting on behalf of the State of North Carolina, hereby offers the financial assistance described in this document.

For The State of North Carolina: **Shadi Eskaf, Director, Division of Water Infrastructure**
**North Carolina Department of Environmental Quality**

DocuSigned by:
Shadi Eskaf
6300A872077B4C5...
Signature

12/4/2023
Date

On Behalf of: Town of Nags Head
Name of Representative in Resolution: Andy Garman
Title (Type or Print): Town Manager

I, the undersigned, being duly authorized to take such action, as evidenced by the attached CERTIFIED COPY OF AUTHORIZATION BY THE APPLICANT'S GOVERNING BODY, do hereby accept this Financial Award Offer and will comply with the Assurances and the Standard Conditions.

DocuSigned by:
Andy Garman
D5CD944068184C3...
Signature

1/4/2024
Date

DocuSign Envelope ID: 34A0FD71-0CC6-4A38-8226-130015CBA0C0

# STATE OF NORTH CAROLINA
# DEPARTMENT OF ENVIRONMENTAL QUALITY
# DIVISION OF WATER INFRASTRUCTURE

## Funding Offer and Acceptance

**Legal Name and Address of Award Recipient**

Town of Nags Head
PO Box 99
Nags Head, North Carolina 27959

**Project Number(s):** SRP-SW-ARP-0019

**Assistance Listing Number:** 21.027
**Unique Entity ID Number:** QHFXEKKHA8R3

**Funding Program**

| | | Additional Amount for Funding Increases | Previous Total | Total Offered |
|---|---|---|---|---|
| **Drinking Water** | ☐ | | | |
| **Stormwater** | ☒ | | | |
| **Wastewater** | ☐ | | | |
| State Revolving Fund-Repayable Loan | ☐ | | | |
| State Revolving Fund-Principal Forgiveness | ☐ | | | |
| State Reserve Loan | ☐ | | | |
| State Reserve Grant | ☐ | | | |
| State Reserve Earmark (S.L. 2023-134) | ☐ | | | |
| American Rescue Plan Act - LASII | ☒ | | | $2,957,961 |

**Project Description:**

South Old Oregon Inlet Road Stormwater Infrastructure Improvements

**Total Financial Assistance Offer:** **$2,957,961**
**Total Project Cost:** $3,161,461
**Estimated Closing Fee*:** $0.00
*For Loans*
**Interest Rate:**
**Maximum Loan Term:**

**Estimated closing fee calculated based on grant and loan amount.*

Pursuant to North Carolina General Statute 159G:

- The applicant is eligible under Federal and State law,
- The project is eligible under Federal and State law, and
- The project has been approved by the Department of Environmental Quality as having sufficient priority to receive financial assistance.

The Department of Environmental Quality, acting on behalf of the State of North Carolina, hereby offers the financial assistance described in this document.

For The State of North Carolina: **Shadi Eskaf, Director, Division of Water Infrastructure**
**North Carolina Department of Environmental Quality**

DocuSigned by:
Shadi Eskaf
6300A872077B4C5...
Signature

2/1/2024
Date

On Behalf of: Town of Nags Head
Name of Representative in Resolution: _____
Title (Type or Print): _____

I, the undersigned, being duly authorized to take such action, as evidenced by the attached CERTIFIED COPY OF AUTHORIZATION BY THE APPLICANT'S GOVERNING BODY, do hereby accept this Financial Award Offer and will comply with the attached Assurances and the Standard Conditions.

DocuSigned by:
Andy Garman
D5CD944068184C3...
Signature

6/4/2024
Date

McAdams
621 Hillsborough Street
Suite 500
Raleigh, NC 27603
919. 361. 5000

TNH22001.19

September 25, 2024

David Ryan, PE
Town Engineer
Town of Nags Head
PO Box 99
Nags Head, NC 27959

**RE: Town of Nags Head Stormwater Management Plan Update**
**Nags Head, North Carolina**
**TNH22001.19**

Dear Mr. Ryan,

## Proposed Project

The Town of Nags Head was awarded a Stormwater Planning Grant for $400,000 from NC Division of Water Infrastructure. The grant application included tasks for a stormwater master plan update, asset inventory and condition assessment, and a watershed restoration plan. Phase 1 of this project includes the kickoff of the stormwater master plan update and the stormwater asset inventory and assessment. Completion of the updated stormwater master plan and completion of watershed restorations plans will be completed at a later date.

A scope and fee is provided for the requested tasks, with the remaining budget committed, but not scoped at this time. Change orders will be sent for future tasks. The total contract amount shall not exceed $400,000 without written approval from the Town.

## Assumptions

This proposal is based on the following assumptions:

- Any public notifications will be coordinated through the Town of Nags Head;
- Basic traffic control for pipe inspection work will be conducted by McAdams and its subconsultants. Additional traffic control support may be needed with support by the Town of Nags Head (McAdams will notify the Town at least 48-hours in advance of any needs). Major traffic control needs may need to be sub-contracted out at a higher fee and will be negotiated as an additional service;
- Detailed inspection methodology (visual, pole camera, etc) will be determined during the course of the project based on a number of factors, including but not limited to: known problem areas, visual inspection, discussion and confirmation between McAdams and the Town Nags Head, or other relevant factors;
- Opinions of Probable Construction Costs (OPCCs) will be high level, budgetary estimates for planning purposes, based upon best available data and appropriate engineering judgement for each project area. Detailed survey data, subsurface utility exploration information, geotechnical investigations, etc. may be required later to refine costs and obtain bid-level estimates;
- Project and contract management will be led by McAdams; and

- Tasks will be completed McAdams, Moffatt & Nichol, Biohabitats, and Coastal Engineering & Surveying, or a combination of staff from these firms. Additional firms may be added for specialty work as necessary to complete the grant deliverables.

# Proposed Services + Fees

We propose the following services (alphanumeric task numbers are for internal coding purposes):

## Phase 1A – General Project Administration

A4.10 PROJECT MANAGEMENT + ADMINISTRATION:

> FEE: $8,000

Work under this phase includes the following major tasks and components:

- Initial project due diligence, records research, as-built information, site investigations, data gap analysis, and (as necessary) plat/easement/deed research;
- Assistance with creation of project notifications and communication of site access to impacted residents;
- Periodic project updates and status reports; and
- General project management and administration throughout duration of Phase 1 of contract.

A4.11 PROJECT MEETINGS:

> FEE: $19,000

Work under this phase includes the following major tasks and components:

- In person project kickoff meeting and initial site visits for stormwater master planning (completed August 2024);
- One (1) in person meeting and presentation to Town stakeholders to discuss project prioritization and asset inventory of pipes and structures;
- Up to two (2) virtual public informational meetings/presentations with Town stakeholders, including any committee or council meetings as directed by the Town of Nags Head; and
  - Meetings in this task may include discussion of all three phases of this contract.

## Phase 1B – Stormwater Master Plan Update, Initial Analysis

D4.12 PROBLEM AREA ID + CONCEPTUAL DESIGN:

> FEE: $72,000

For this task, McAdams will provide the following scope of services:

- McAdams will analyze up to eleven (11) areas or systems for flood mitigation and hydraulic improvement;

  - Areas shall be determined by the Town and their stakeholders (anticipated fall 2024);
  - Alternatives analysis and replacement recommendations should balance the replacement longevity and the cost to each community including upfront and maintenance costs. It is envisioned that alternatives will likely include the following:
    - Upgrade of culvert/drainage systems to meet established design criteria;
    - Upgrade of portions of the culvert/drainage system to lesser design standards (with Town approval);
    - Use alternative stormwater control measures such as stormwater pumps, groundwater lowering, floodplain storage, and green stormwater infrastructure for water quantity and quality control;
    - Improvements along alternative alignments to minimize construction cost and impacts to private property, transportation systems, and other existing infrastructure;
    - Non-structural floodproofing options, including alternative flood-hazard mitigation strategies;
- Capacity analysis of South Memorial Avenue Trunk Line
  - Determine existing conditions hydrology for contributing drainage area
  - Compare existing conditions to current Town standards, and if the current system does not meet Town standards, determine minimum pipe size necessary to bring infrastructure up to current standard
  - Additional modeling, conceptual design, corridor study, and constructability assessment can be completed as a future Phase if requested.
- Hydrologic and Hydraulic modeling software(s) will be used to perform high level analyses of select existing storm drainage systems within the project area, including both closed conduit and open channel systems. For the majority of the H+H modeling, McAdams will primarily utilize PC-SWMM to prepare an analysis of integrated systems across Town;
- For each drainage system of interest and S. Memorial Avenue, McAdams will determine peak flow rates (or flood volumes), provided levels of service, and preliminary sizing of pipes and drainageways to meet intended level of service and/or drainage improvements for problem areas;
- McAdams will evaluate 1- 2-, and 10-, 24-hour SCS Type III rainfall distribution events as part of our modeling efforts. Rainfall depths will be based on NOAA Atlas 14 data. Additional storms may be analyzed on a case by case basis;
- Previous completed field survey data and drainage basin maps will be used to develop the hydrologic models;
- Utilize hydrologic models to verify infrastructure capacities, flood prone areas, and identify system deficiencies and critical assets; and
- Concept level plans are proposed to be exhibits generated from GIS, and will show locations, type, sizes, and preliminary elevation information for proposed drainage infrastructure.

## Phase 1C – Asset Inventory + Assessment

### D4.21 ASSEST INVENTORY + FIELD DATA COLLECTION:

> FEE: $38,400

Work under this task will include the following:

- Initial field walks to verify and confirm system connectivity and limits;
- All field work support associated with pipe, structure, and outfall inspections (including site visits and any support during pipe cleaning and inspection work), plus additional pole camera inspections as determined appropriate. McAdams will perform data collection efforts for stormwater assets through the following tasks:

- Deploy one (1) two-person field crew to collect information on existing stormwater assets in priority areas (to be determined and agreed upon by McAdams and the Town of Nags Head). This information will be collected using a Trimble Catalyst subscription plan, ESRI's Field Maps software and GPS equipment. All field data will be configured into a Geodatabase format for the development of a GIS inventory for the priority areas; and
- Conduct detailed evaluation and quality assurance of field surveys for existing drainage basins and stormwater infrastructure within the project areas.

D4.22 GEODATABASE MANAGEMENT + DASHBOARD CREATION:

> FEE: $26,100

McAdams will update the Town's stormwater GIS inventory and integrate asset conditions into a project dashboard based upon inspection results and problem identification. This work will include:

- Data assembly and geodatabase development;
- GIS Dashboard creation, including real-time viewing of field information during data collection based on feedback with Town staff;
- Adding pipeline ratings based on Town priorities and condition data to the dashboard with links to field data;
- Ongoing maintenance of the dashboard throughout the life-cycle of this contract. Data maintenance, revisions to the infrastructure map, and updates to condition assessments after initial project completion can be completed under separate contract, or completed by the Town; and
- A map showing the areas studies in Phase 1 of this scope of work, and areas within the Town limits that are vulnerable to future flooding.

D4.23 ASSET CONDITION ASSESSMENT:

> FEE: $39,500

For this task, McAdams will review all photographs and assess the storm drainage system to determine current condition and where immediate, remedial action may be necessary. A prioritization list relative to repairs needed based on current conditions will be provided. From this information, McAdams will develop an optimized stormwater infrastructure and operation maintenance plan for the Town considering the full inventory of all stormwater control structures and other planned developments. The purpose of this O&M plan will be to extend the life of the existing infrastructure and to optimize its existing operation.

Deliverables:

- Structural assessments of pipes, catch basins, and other storm structures within the area of interest;
- Development of scoring matrix based on structural conditions of pipes and open channels;
- Integration of individual infrastructure repairs (outside of the eleven project areas) into the CIP prioritization, if warranted; and
- Revisions and updates based on feedback from the Town of Nags Head.

## Extra Services

J. ADDITIONAL SERVICES

When requested by the Client and confirmed by the Client and/or Firm in writing, the Firm shall perform services in addition to those described above in this Agreement and the Client shall compensate the Firm by hourly charges in accordance with the attached Rate Schedule.

K. REIMBURSABLE EXPENSES

Valid expenses include mileage, lodging, reproduction and express delivery service with an anticipated total budget of **$5,000**. These expenses may be paid by the Town in addition to the fees listed above.

### Future Phases

Scope and fee for future phases of this project will be completed when requested by the Town.

Stormwater Master Plan Final Report – estimated $55,800

- CIP prioritization, probable construction costs, additional engineering reports for up to five sites, review of Town codes, and implementation planning.

Watershed Restoration Plans – estimated $65,500

- EPA 9 Element Plan to address impaired waters in Roanoke Sound

Final Reporting – estimated $8,000

- Final reporting for grants or deliverables for Town commissioners.

Miscellaneous Contingency – estimated $62,700

- Additional stakeholder meetings, travel, field survey, exhibits, reports, expenses, etc.

### Fee Summary

- Phase 1A – $27,000
- Phase 1B – $72,000
- Phase 1C – $104,000
- Expenses – $5,000

Total for Phase 1 = $208,000
Future Phases = $192,000

Our proposed fee for the scope of services described herein is not to exceed **$400,000** including future phases, contingency, and reimbursables.

## Project Schedule

The Firm's services shall be performed as expeditiously as is consistent with professional skill and care and the orderly progress of the project. The following is the expected schedule for completion of work on this project:

An estimated schedule has been included below. McAdams is proposing to complete all Phase 1 work within approximately 240 working days of Notice to Proceed (NTP) from the Town of Nags Head, including the below breakdown by major milestone. Milestone dates below are approximate and shall be adjusted throughout the duration of the project based on any major changes to the scope of the project and/or site conditions. A more detailed schedule will be completed upon NTP from the Town of Nags Head with more specific deadlines.

- **Milestone 1**: Project Kickoff, Work Planning, and Scheduling: **+30-days** from NTP
- **Milestone 2**: Stakeholder Meetings: **+90 days** from NTP
- **Milestone 3**: Storm Structure Inspections/Field Data Collection: **+120-days** from Milestone 1
- **Milestone 4**: Geodatabase Management + Dashboard Creation: **+30-days** from Milestone 2
- **Milestone 5**: Preliminary Asset Inspection + Assessment Results: **+30-days** from Milestone 3
- **Milestone 6**: Phase 1 Final Report: **+30-days** from Milestone 5

**Phase 1A, 1B, and 1C of this project are anticipated to be completed by June 1, 2025.**

The time limits and schedule set forth above have been agreed to by the Client and Firm, but the time limits and schedule shall be extended for (1) reasonable cause, or for (2) any delays associated with the Firm's work on the project that are not the sole responsibility of the Firm.

## Client Responsibilities

Client shall be responsible for the following:

- Notification to proceed;
- Timely approval of sketches presented for Client approval;
- Payment of invoices in accordance with Terms and Conditions; and
- Notification to Firm of any problems, in accordance with Terms and Conditions.

## Exclusions

The following services are not included in this Agreement:

- Any engineering or surveying service not specifically described above;
- Field surveying and environmental studies, delineation, or investigation, except those specifically described above;
- Court appearances for litigation, or preparation for same;
- Legal advertisements for construction contracts;
- Revised directives from Client after design has begun;
- Historical, archeological, insect, or terrestrial or aquatic animal surveys that require highly specialized expertise;
- Oversight and direction for vegetation clearing to facilitate evaluation of stormwater infrastructure; and
- Scope and detailed fees for Future Phases will be provided at a later date

## General Conditions

- This proposal is valid for 120 days from the above date.
- Reimbursable expenses will be billed in accordance with the attached Rate Schedule.

## Conclusion

We appreciate this opportunity to propose our services. We are eager to pursue this project further and thank you for your consideration.

Sincerely,
**McAdams**

Hunter Freeman, PE, LEED AP | Senior Advisor, Water Resources – Green Stormwater Infrastructure
freeman@mcadamsco.com | 919. 361. 5000

HF/kt

## Acceptance

By: _____ Date: _____

Name: _____

Title: _____

## Accounting Information

Billing Contact: _____

Billing Contact Email Address: _____

Billing Contact Phone Number: _____

Billing Address: _____

_____

# Agenda Item Summary Sheet

Item No: **K-1**
Meeting Date: **October 2, 2024**

**Item Title**: Presentation of Annual Beach Condition Survey – Moffat & Nichol

**Item Summary**:
Annually, the Town subcontracts surveying and engineering services to perform an annual beach condition survey and engineering data analysis in accordance with the Town's Beach Monitoring & Maintenance Plan. The survey scope of work includes the base nourishment project area data acquisition in conjunction with additional transect information data acquisition both north and south of the project area. Results of the beach surveys aid in determining nourishment triggers and initiating planning for the next beach nourishment maintenance project. The attached report describes the findings from our beach surveys which were conducted this past June and July.

Beth Sciaudone, Ph.D., PE and Ayse Karanci, PhD, PE from the consulting firm of Moffat & Nichol will present the findings of the condition surveys and will be available to answer questions from the Board.

One of the items noted in the draft report is the recent significant erosion within Reaches 3 & 4. We have observed additional erosion in these reaches after the surveys were conducted. The Board may want to consider conducting a supplemental fall survey to evaluate the magnitude and extent of changes to the beach condition. Fee proposal amounts have been submitted by McKim & Creed to perform the survey field work in the amount of $44,790 and from Moffat & Nichol to conduct analysis of the data in the amount of $26,350.

If the Board of Commissioners would like to proceed with approving a fall condition survey, a motion will be in order to authorize the Town Manager to execute change orders in the amount of **$44,790** with McKim & Creed and **$26,350** with Moffat & Nichol to conduct the additional monitoring work.

This item is time-specific for 11:00 a.m.
Attachments: Beach Condition Report, McKim & Creed Proposal, Moffat & Nichol Proposal

Number of Attachments: 3

**Specific Action Requested**:
Provided for Board information, discussion and consideration to authorize acceptance of proposals

Submitted By: Town Engineer David Ryan Date: September 24, 2024

**Finance Officer Comment**:

Signature: Amy Miller Date: September 26, 2024

**Town Attorney Comment**:
Attorney Leidy will participate in the discussion as necessary.

Signature: John Leidy Date: September 26, 2024

**Town Manager Comment and/or Recommendation**:
One of the items we will discuss is when to initiate engineering and design for our next project. In light of recent erosion in reaches 3 and 4, and noting the timeframe for design, bidding, and mobilization of a project, staff will suggest initiating this process in the next few months.

Signature: Andy Garman Date: September 26, 2024

**FINAL REPORT**
Produced for the Town of Nags Head, NC
October 2024

moffatt & nichol

McKIM&CREED

# 2024 ANNUAL BEACH MONITORING SURVEY EVALUATION

## Town of Nags Head, NC

10979/17

# TOWN OF NAGS HEAD

# 2024 ANNUAL MONITORING SURVEY EVALUATION

Prepared for:

| Rev No | A | – | – | – | – |
|---|---|---|---|---|---|
| Issue Purpose | Draft Report | | | | |
| Date | 09/24/24 | | | | |
| By | AK/EJS | | | | |
| Checked | | | | | |
| Approved | | | | | |
| | | | | | |

Prepared by:

moffatt & nichol

# TOWN OF NAGS HEAD

# 2024 ANNUAL MONITORING SURVEY EVALUATION

moffatt & nichol

# EXECUTIVE SUMMARY

The Town of Nags Head Beach Monitoring and Maintenance Plan is sponsored by the Town of Nags Head (Town) as a continuation of the 2011 monitoring program initiated for assessing beach conditions. The primary purpose of the program is to assess current and historical shoreline conditions, determine shoreline and volumetric changes and evaluate the performance of beach nourishment and other restoration efforts. Evaluating and documenting these changes consistently over successive years provides information necessary to plan for future beach nourishments and to support development of the Town's multi-decadal Beach Nourishment Master Plan.

The latest annual summer survey took place in June 2024 and was carried out by McKim & Creed. Furthermore, a fall survey, prompted by observed scarping along the Town's beachfront, was conducted by McKim & Creed in October 2023, along with another annual survey in June 2023. This report outlines the data sources, methodologies, and findings of a survey evaluation conducted by Moffatt & Nichol. The evaluation compares the June 2024 survey to the data from October 2023 and June 2023 surveys.

The survey data was used to compute shoreline change at Mean High Water (MHW), which is designated as +1.18 ft NAVD88 for Nags Head, and volume change above +6 ft NAVD88 (berm), MHW, -6 ft NAVD88 (wading depth), -14 ft NAVD88 (outer bar), -19 ft NAVD88 (approximate depth of closure), and -30 ft NAVD88 (offshore).

During the 2019 Beach Nourishment Project approximately 4.0 million cy of material was placed along approximately 10 miles of shoreline. The shoreline position and volume changes above six elevations relative to pre-nourishment conditions (April 2019) along the Nourished Oceanfront (Station 495+00 – 1025+00) were also analyzed.

**Figure ES-1** illustrates the shoreline changes relative to pre-nourishment condition (April 2019) along the Nourished Oceanfront. As can be seen from the figure, a significant landward recession occurred along the Nourished Oceanfront since the completion of the 2019 nourishment project. The majority of this recession, noted before the post-Dorian survey, can be attributed to Hurricane Dorian. However, a portion of it was also due to profile equilibration, a natural occurrence during the stabilization of the nourishment profile. Similarly, the August 2022 post-Dorian renourishment project helped mitigate some of the recession. However, by June 2023, the shoreline had receded again, likely due to ongoing profile equilibration. This year, high-energy wave events caused further significant recession, particularly in the southern reaches (3S and Reach 4). In Reach 4, the shoreline has receded beyond the April 2019 pre-nourishment condition.

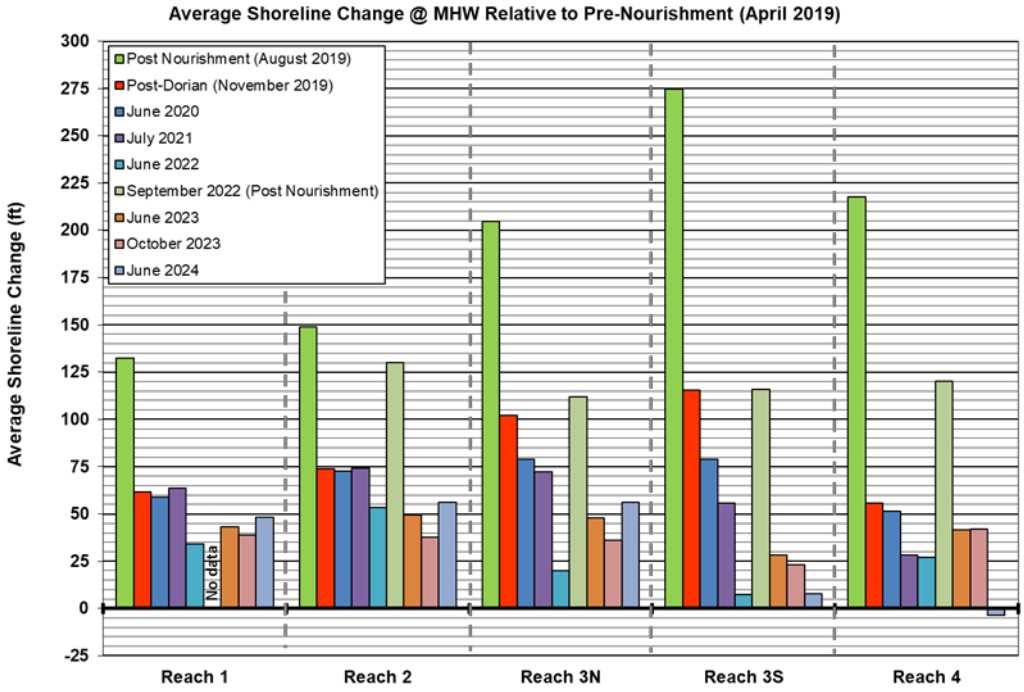



**Figure ES-1. Nourished Oceanfront Average Shoreline Change Relative to Pre-Nourishment Conditions**

**Figure ES-2** illustrates that the overall changes in sand volume vary with the depth above which volumes are assessed. Since the completion of the 2019 nourishment project approximately 598,349 cy (11.3 cy/ft) of volume gain was observed above -19 ft NAVD88 along the Nourished Oceanfront. This indicates that 127% of the volume present in August 2019 above -19 ft NAVD88 has remained within the system through the June 2024 survey. It's important to highlight that 614,106 cubic yards of material were placed during the 2022 Post-Dorian Renourishment project, indicating that without this renourishment, material loss would have likely occurred above -19 ft NAVD88. The results suggest significant cross-shore shifts of sand across various elevations. Notably, much of the sand has moved to lower elevations near the depth of closure, where it becomes vulnerable to being removed from the system during high-energy wave events.

**Figure ES-3** presents the volume changes above -19 ft NAVD88 relative to pre-nourishment conditions (April 2019) along the Nourished Oceanfront. Reach 1 and Reach 2 show volume gains above -19 ft NAVD88 when compared to pre-nourishment levels. In contrast, the remaining reaches experienced material losses, with Reach 3N and Reach 3S both losing less than 50% of the material placed during the 2019 nourishment. However, Reach 4 has undergone significant material loss, having lost 62% of the nourished material by the end of this monitoring period.

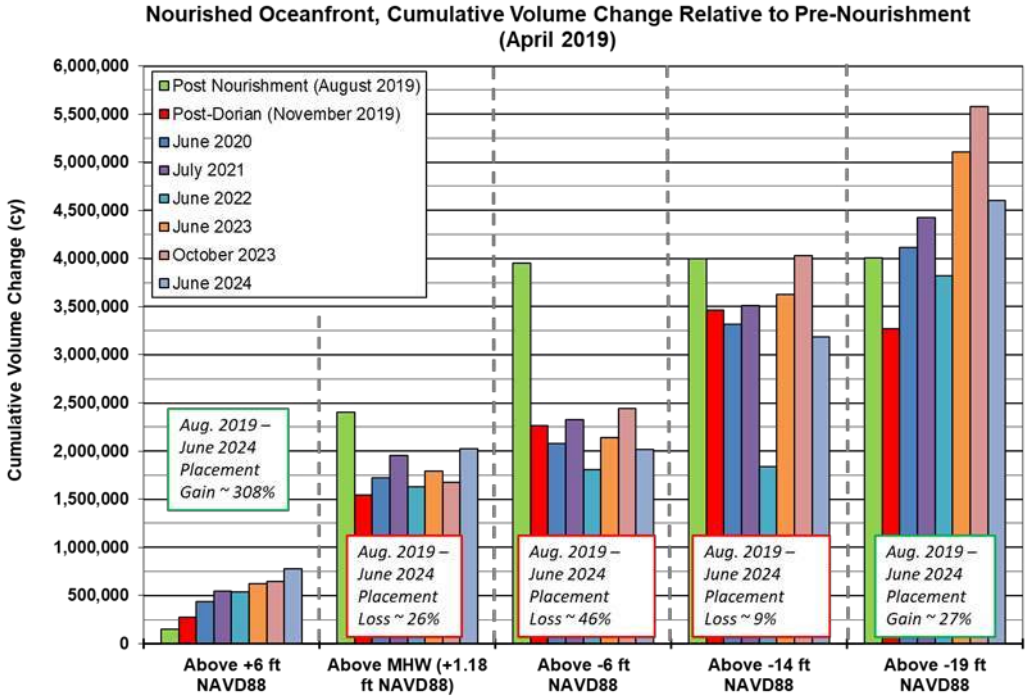



**Figure ES-2. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment**

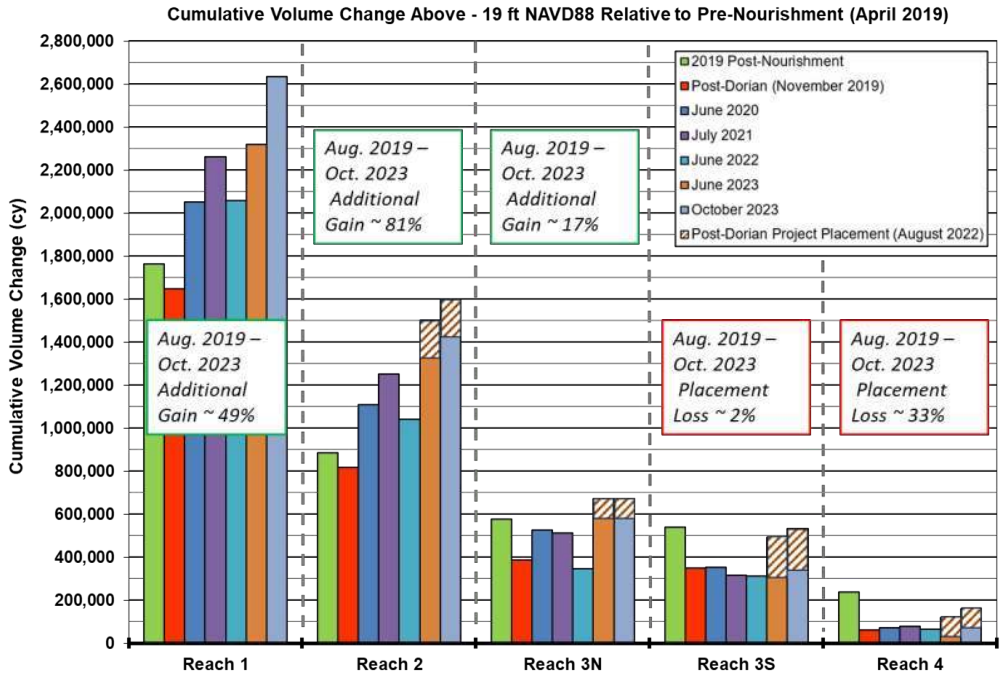



**Figure ES-3. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment**

Volume changes during the monitoring period indicated that the Nourished Oceanfront and Total Monitored Oceanfront both experienced losses in material between June 2023 and June 2024 above -19 ft NAVD88 indicating material being moved out of the Town's sediment system. Key statistics for individual reaches along Nags Head along with the entire oceanfront shoreline were as follows:

**Table ES-1. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - North | 430+00 - 495+00 | 6,500 | 6.1 | 3.4 | 4.5 | 0.8 | 11.8 | 9.6 | 26.6 |
| Nags Head - Reach 1 | 495+00 - 790+00 | 29,500 | 5.1 | 2.5 | 4.2 | 0.2 | 2.2 | -1.4 | 14.7 |
| Nags Head - Reach 2 | 790+00 - 920+00 | 13,000 | 6.4 | 4.7 | 8.0 | -0.3 | -7.6 | -6.6 | 5.5 |
| Nags Head - Reach 3N | 920+00 - 975+00 | 5,500 | 8.2 | 3.7 | 5.9 | -10.0 | -34.3 | -36.6 | -30.2 |
| Nags Head - Reach 3S | 975+00 - 1010+00 | 3,500 | -20.4 | -0.1 | -3.4 | -12.7 | -41.2 | -38.9 | -36.5 |
| Nags Head - Reach 4 | 1010+00 - 1025+00 | 1,500 | -44.9 | -2.5 | -10.4 | -17.9 | -36.1 | -16.1 | -16.5 |
| National Seashore North | 1025+00 - 1200+00 | 17,500 | 20.0 | -2.4 | -0.5 | 9.2 | -26.6 | -18.7 | -33.3 |
| | Transects | Reach Length | weighted avg | weighted avg | weighted avg | weighted avg | weighted avg | weighted avg | weighted avg |
| **Nourished Oceanfront** | **495+00 - 1025+00** | **53,000** | **2.7** | **2.9** | **4.4** | **-2.3** | **-7.9** | **-9.2** | **3.5** |
| **Total Monitored Oceanfront*** | **430+00 - 1200+00** | **77,000** | **6.9** | **1.7** | **3.3** | **0.6** | **-10.5** | **-9.8** | **-2.9** |

**National Seashore South Reach not included in the Total Monitored Oceanfront*

**Table ES-2. Nags Head Cumulative Volume Change Statistics (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - North | 430+00 - 495+00 | 6,500 | 20,432 | 27,027 | 4,771 | 70,965 | 57,395 | 159,508 |
| Nags Head - Reach 1 | 495+00 - 790+00 | 29,500 | 74,639 | 123,358 | 6,401 | 64,852 | -41,313 | 433,683 |
| Nags Head - Reach 2 | 790+00 - 920+00 | 13,000 | 61,511 | 103,820 | -3,551 | -98,804 | -85,912 | 71,490 |
| Nags Head - Reach 3N | 920+00 - 975+00 | 5,500 | 21,031 | 33,981 | -57,347 | -197,490 | -210,239 | -173,746 |
| Nags Head - Reach 3S | 975+00 - 1010+00 | 3,500 | -350 | -11,880 | -44,415 | -144,269 | -136,136 | -127,669 |
| Nags Head - Reach 4 | 1010+00 - 1025+00 | 1,500 | -4,288 | -18,134 | -31,341 | -63,252 | -28,187 | -28,798 |
| National Seashore - North | 1025+00 - 1200+00 | 17,500 | -42,262 | -8,788 | 161,561 | -465,228 | -326,727 | -582,524 |
| | Transects | Reach Length | total | total | total | total | total | total |
| **Nourished Oceanfront** | **495+00 - 1025+00** | **53,000** | 152,543 | 231,146 | -130,252 | -438,963 | -501,787 | 174,960 |
| **Total Monitored Oceanfront*** | **430+00 - 1200+00** | **77,000** | 130,713 | 249,384 | 36,080 | -833,226 | -771,119 | -248,056 |

During the June 2023 - June 2024 monitoring period, Reach 3S and Reach 4 experienced significant shoreline recession, eroding much of the recreational beach. This erosion allowed waves to reach the dunes, resulting in dune scarping especially in Reach 4. The remaining reaches showed slight seaward advancement as material from nearshore was deposited to the beachface.

The Nags Head Oceanfront experienced material gains along the subaerial portions of the profiles (+6 ft NAVD88 and MHW). This was mainly due to nearshore material being deposited on the beachface. However, below MHW, volume losses occurred across all analyzed elevations, except above -30 ft NAVD88, where gains were only observed in Reaches 1 and 2. The most significant volume loss was recorded above -19 ft NAVD88 (-438,963 cy or -9.2 cy/ft), exceeding the historical background erosion rate (-6.7 cy/ft). This elevated loss can be attributed to the active 2023-2024 storm season, which brought 17 events with significant wave heights exceeding 8 ft. The frequent storm activity likely prevented the offshore-deposited material from returning to the beach, instead pushing it further offshore to lower elevations. Additionally, material gains at the Town boundaries in the prior monitoring period (June 2022 – June 2023) were attributed to sediment moving south from northern nourishment projects. The ongoing volume losses above -30 ft NAVD88 suggest that sediment may have been transported further south toward Oregon Inlet, moving out of the Town's system.

The Total Monitored Oceanfront, which includes both the Nags Head North and National Seashore-North reaches flanking the Nourished Oceanfront, exhibited a similar trend of material gains at subaerial elevations and losses below MHW. While the Nags Head North reach showed material gains across all analyzed elevations, the National Seashore-North

reach experienced material losses above all analyzed elevations, similar to the adjacent areas in the Nourished Oceanfront.

During the June 2023 to June 2024 monitoring period, dune growth continued across Reach 1, Reach 2, and Reach 3N, with the most significant growth occurring in Reach 2, which saw an increase of + 65,511 cy +4.7 cy/ft). In contrast, Reach 3S and Reach 4 experienced dune scarping and shoreline recession. This was particularly significant in Reach 4, where -4,288 cy (-2.5 cy/ft) of material was lost above +6 ft NAVD88.

The Town adopted a Multi-Decadal Beach Nourishment Master Plan (Master Plan) in July 2024. This Master Plan included development of volumetric triggers for beach nourishment, based on the profile volume from the landward crest of the primary dune to the outer bar, above the -19 ft NAVD88 elevation. This sand volume was modeled to provide a Level of Protection (LoP) from a 25-year storm. **Figure ES-4** presents the historical and current status of the average profile volumes per reach compared to the volumetric triggers (red and black dashed lines).

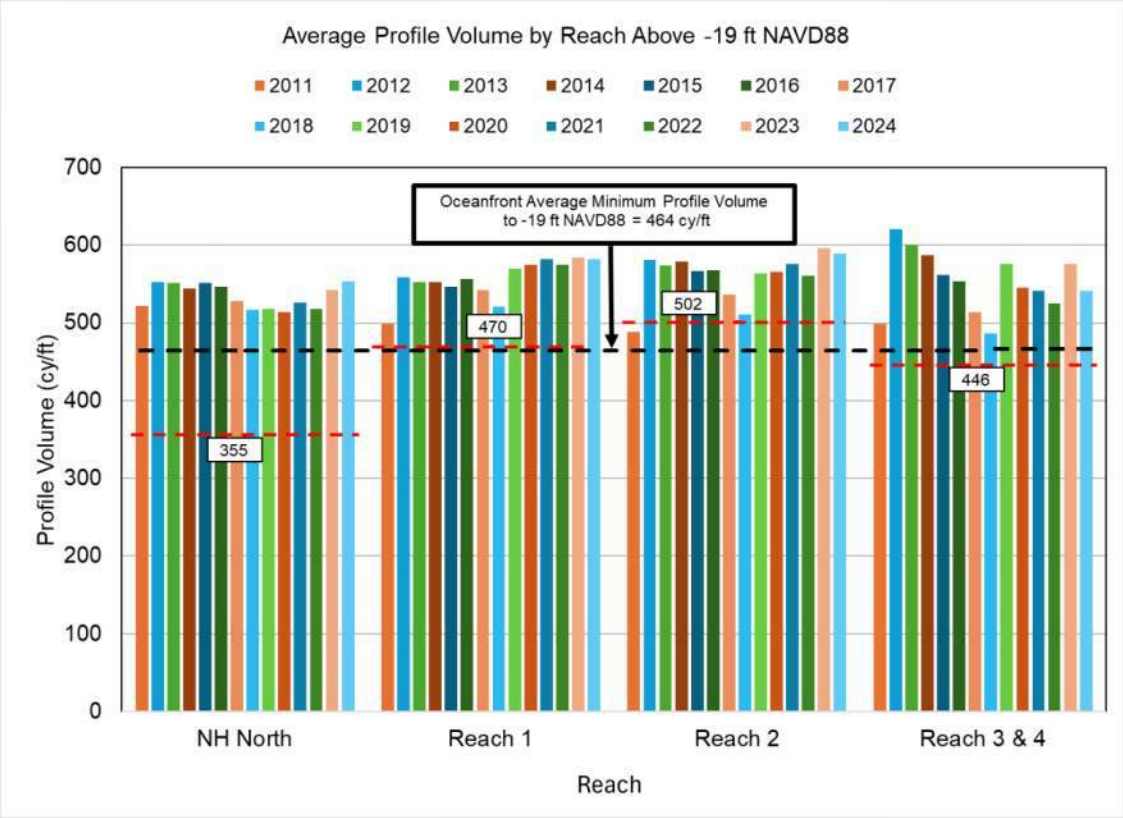



**Figure ES-4. Master Plan Nourishment Trigger Volume Comparison**

All management reaches currently contain average profile volumes above the nourishment triggers, however, there have been localized erosion hotspots observed along the Town's shoreline in the summer of 2024. To more closely examine the current status of the beach, the profile volumes from all transects as of June – July 2024 are presented in **Figure ES-**

**5.** Localized segments of Reaches 3 and 4 have profiles below the trigger volumes (red arrows), and additional localized segments of Reaches 1 and 2 are close to the triggers (yellow arrows).

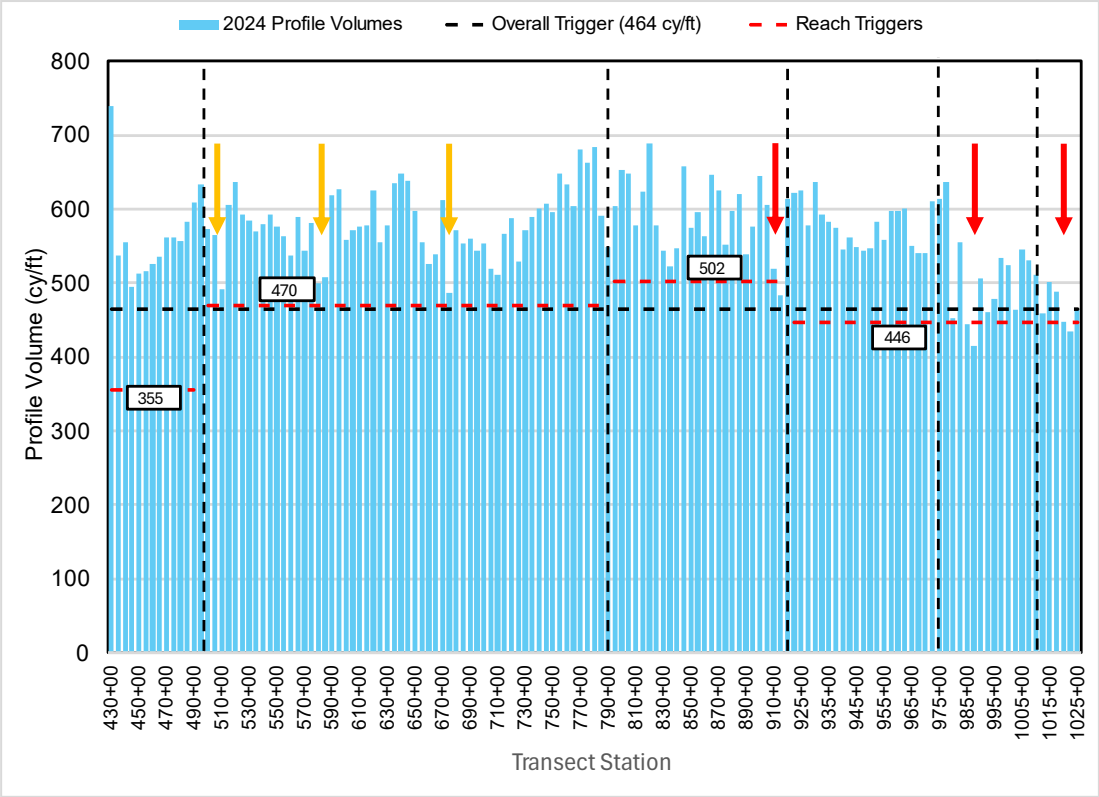



**Figure ES-5. 2024 Beach Profile Volumes and Master Plan Trigger Volume Comparison. Red arrows indicate locations that are below the trigger volumes and yellow areas indicate areas that are close to the trigger volumes.**

Additionally, there have been losses of the recreational dry beach as measured by the distance from the MHW line to the +6 ft NAVD88 elevation throughout the Town. Loss of the dry beach increases the likelihood that the dunes will be further impacted by high water level and wave events. Given these results, the Town may consider accelerating the timeline for the next beach nourishment project, currently planned for Summer 2027.

# TABLE OF CONTENTS

**1.0 OBJECTIVE ..... 1**

**2.0 SUMMARY OF PREVIOUS WORK ..... 2**

**3.0 SURVEY PROCEDURES AND DATA PROCESSING ..... 4**

3.1 Survey Transects and Reaches ..... 4
3.2 Survey Data Acquisition ..... 7

**4.0 SURVEY EVALUATION METHODS ..... 9**

4.1 Shoreline Change ..... 9
4.2 Volume Change ..... 9

**5.0 DISCUSSION OF ANNUAL SURVEYING EVALUATION ..... 12**

5.1 Key Events During the Reporting Period ..... 12
*5.1.1 Sand Placement Events ..... 12*
*5.1.2 Wave Climate and Storm Events ..... 13*
5.2 Determination of Background Erosion Rates for Town of Nags Head (2011 – 2024) ..... 16
5.3 Nags Head Annual Shoreline and Volume Change Analysis (June 2023 – June 2024) ..... 18
*5.3.1 Nags Head - North Reach (June 2023 – June 2024) ..... 19*
*5.3.2 Nags Head - Reach 1 (June 2023 – June 2024) ..... 22*
*5.3.3 Nags Head - Reach 2 (June 2023 – June 2024) ..... 26*
*5.3.4 Nags Head - Reach 3 - North (June 2023 - June 2024) ..... 30*
*5.3.5 Nags Head - Reach 3 - South (June 2023 – June 2024) ..... 34*
*5.3.6 Nags Head - Reach 4 (June 2023 – July 2024) ..... 38*
*5.3.7 National Seashore - North (June 2023 – July 2024) ..... 42*
*5.3.8 National Seashore - South (June 2023 – July 2024) ..... 45*
*5.3.9 Oceanfront Trends Summary for All Reaches (June 2023 – June 2024) ..... 47*
5.4 Nourished Oceanfront Performance Relative to Pre-Nourishment ..... 51
5.5 Multi-Decadal Beach Nourishment Master Plan ..... 56
5.6 Long-Term Volume Change Trends (2011 – 2024) ..... 59
5.7 Long-Term Dune Volume Trends ..... 61

**6.0 SUMMARY ..... 63**

**7.0 REFERENCES ..... 70**

## APPENDICES

**APPENDIX A** McKim & Creed Field Report
**APPENDIX B** Survey Profile Comparison Plots
**APPENDIX C** Tabulated Shoreline and Volume Change Data
**APPENDIX D** Shoreline and Volume Change Plots
**APPENDIX E** Reach 4 Observed Escarpment Survey Analysis

# LIST OF FIGURES

Figure 2-1: Prior Established Monitoring Reaches....2
Figure 3-1. Nags Head Annual Monitoring Profile Line Locations....5
Figure 3-2. Nags Head Fall Monitoring Profile Line Locations....6
Figure 4-1. Tidal Datum for Duck, NC Station 8651370....9
Figure 4-2. Profile Volume Calculation Lenses....11
Figure 5-1. USACE FRF Buoy Locations....13
Figure 5-2. USACE FRF Station 44056 Wave Height....14
Figure 5-3. Station 44056 Significant Wave Height Rose from July 2023 – July 2024....15
Figure 5-4. Station 44056 Significant Wave Height Rose from January 1997 – July 2024....15
Figure 5-5. Nags Head – North Shoreline Change (June 2023 – June 2024)....20
Figure 5-6. Nags Head – North Unit Volume Change (June 2023 – June 2024)....20
Figure 5-7. Example Nags Head – North Profile, Station 450+00 (E. Albatross St.)....21
Figure 5-8. Nags Head – Reach 1 Shoreline Change (June 2023 – June 2024)....24
Figure 5-9. Nags Head – Reach 1 Unit Volume Change (June 2023 – June 2024)....24
Figure 5-10. Example Reach 1 Profile, Station 630+00 (E Small St.)....25
Figure 5-11. Example Reach 1 Profile, Station 705+00 (E Sea Spray Ct.)....25
Figure 5-12. Nags Head – Reach 2 Shoreline Change (June 2023 – June 2024)....28
Figure 5-13. Nags Head – Reach 2 Unit Volume Change (June 2023 – June 2024)....28
Figure 5-14. Example Reach 2 Profile, Station 900+00 (E Jay St.)....29
Figure 5-15. Nags Head – Reach 3 - N Shoreline Change (June 2023 – June 2024)....32
Figure 5-16. Nags Head – Reach 3 - N Unit Volume Change (June 2023 – June 2024)....32
Figure 5-17. Example Reach 3 - North Profile, Station 930+00 (E Jacobs St.)....33

Figure 5-18. Nags Head – Reach 3 – S Shoreline Change (June 2023 – June 2024) .....36

Figure 5-19. Nags Head – Reach 3 – S Unit Volume Change (June 2023 – June 2024) ..36

Figure 5-20. Example Reach 3 - South Profile, Station 980+00 (E Altoona St.) .....37

Figure 5-21. Scarping adjacent to McCall Ct. on July 27, 2024. (D. Ryan Photo) .....39

Figure 5-22. Nags Head – Reach 4 Shoreline Change (June 2023 – June 2024) .....40

Figure 5-23. Nags Head – Reach 4 Unit Volume Change (June 2023 – June 2024).....40

Figure 5-24. Example Reach 4 Profile, Station 1020+00 (McCall Court) .....41

Figure 5-25. National Seashore - North Shoreline Change (June 2023 – June 2024).....43

Figure 5-26. National Seashore - North Unit Volume Change (June 2023 – June 2024) .....43

Figure 5-27. Example National Seashore - North Profile, Station 1045+00 .....44

Figure 5-28. National Seashore - South Shoreline Change (2023 – 2024).....45

Figure 5-29. Oregon Inlet Change (07/01/2023 USGS Sentinel Imagery; 07/20/2024 USGS-Sentinel Imagery) .....46

Figure 5-30. Example National Seashore - North Profile, Station 1240 (Bodie Island Spit).....46

Figure 5-31. Average Unit Volume Change Within Each Reach (June 2023 – June-July 2024) .....49

Figure 5-32. Cumulative Volume Change Within Each Reach (June 2023 – June-July 2024) .....50

Figure 5-33. Nourished Oceanfront Average Shoreline Change Relative to Pre-Nourishment Conditions .....51

Figure 5-34. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment.....53

Figure 5-35. Cumulative Volume Change Above +6 ft NAVD88 Relative to Pre-Nourishment.....54

Figure 5-36. Cumulative Volume Change Above MHW Relative to Pre-Nourishment ...54

Figure 5-37. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment.....55

Figure 5-38. Master Plan Nourishment Trigger Volume Comparison .....57

Figure 5-39. 2024 Beach Profile Volumes and Master Plan Trigger Volume Comparison. Red arrows indicate locations that are below the trigger volumes and yellow areas indicate areas that are close to the trigger volumes. .....58

Figure 5-40. Recreational Beach Width Comparison, 2023 to 2024.....59

Figure 5-41. Mean Volume Change per year (2011 – 2024) (With Nourishment) .....60

Figure 5-42. Mean Volume Change per year (2011 – 2024) (Without Nourishment) .....60

Figure 5-43. Unit Dune Volume Change from 2011 to 2018 (Moving Average Trend Above +6 ft NAVD88) .....62

Figure 5-44. Unit Dune Volume by Year (Moving Average Trend Above +6 ft NAVD88).....62

Figure 6-1.Nourished Oceanfront Average Shoreline Change Relative to Pre-Nourishment Conditions .....64

Figure 6-2. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment.....65

Figure 6-3. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment.....65

Figure 6-4. Master Plan Nourishment Trigger Volume Comparison .....68

Figure 6-5. 2024 Beach Profile Volumes and Master Plan Trigger Volume Comparison. Red arrows indicate locations that are below the trigger volumes and yellow areas indicate areas that are close to the trigger volumes. .....69

# LIST OF TABLES

Table 2-1. Long-term Volume Change (Previous Studies: 2010-2018) ..... 3

Table 3-1. Reach Start and End Points ..... 4

Table 5-1. Project Volume Summary ..... 12

Table 5-2. Nourishment Volumes Post-2011 by Management Reach ..... 16

Table 5-3. Volume Change by Reach Above -19 ft NAVD88 ..... 16

Table 5-4. Average Annual Background Erosion Rates (2012 - 2024) ..... 17

Table 5-5. Average Shoreline and Average Unit Volume Change for Nags Head – North Reach (June 2023 – June 2024) ..... 19

Table 5-6. Cumulative Volume Change for Nags Head – North Reach (June 2023 – June 2024) ..... 19

Table 5-7. Average Shoreline and Average Unit Volume Change for Reach 1 (June 2023 – June 2024) ..... 22

Table 5-8. Cumulative Volume Change for Reach 1 (June 2023 – June 2024) ..... 22

Table 5-9. Average Shoreline and Average Unit Volume Change for Reach 1 (October 2023 – June 2024) ..... 22

Table 5-10. Cumulative Volume Change for Reach 1 (October 2023 – June 2024) ..... 22

Table 5-11. Average Shoreline and Average Unit Volume Change for Reach 2 (June 2023 – June 2024) ..... 26

Table 5-12. Cumulative Volume Change for Reach 2 (June 2023 – June 2024) ..... 26

Table 5-13. Average Shoreline and Average Unit Volume Change for Reach 2 (October 2023 – June 2024) ..... 26

Table 5-14. Cumulative Volume Change for Reach 2 (October 2023 – June 2024) ..... 26

Table 5-15. Average Shoreline and Average Unit Volume Change for Reach 3 - North (June 2023 – June 2024) ..... 30

Table 5-16. Cumulative Volume Change for Reach 3 - North (June 2023 – June 2024) ..... 30

Table 5-17. Average Shoreline and Average Unit Volume Change for Reach 3 - North (October 2023 – June 2024) ..... 30

Table 5-18. Cumulative Volume Change for Reach 3 - North (October 2023 – June 2024) .....30

Table 5-19. Average Shoreline and Average Unit Volume Change for Reach 3 - South (June 2023 – June 2024) .....34

Table 5-20. Cumulative Volume Change for Reach 3 - South (June 2023 – June 2024)..34

Table 5-21. Average Shoreline and Average Unit Volume Change for Reach 3 - South (October 2023 – June 2024).....34

Table 5-22. Cumulative Volume Change for Reach 3 - South (October 2023 – June 2024) .....34

Table 5-23. Average Shoreline and Average Unit Volume Change for Reach 4 (June 2023 – July 2024).....38

Table 5-24. Cumulative Volume Change for Reach 4 (June 2023 – July 2024) .....38

Table 5-25. Average Shoreline and Average Unit Volume Change for Reach 4 (October 2023 – July 2024).....38

Table 5-26. Cumulative Volume Change for Reach 4 (October 2023 – July 2024) .....38

Table 5-27. Average Shoreline and Average Unit Volume Change for National Seashore - North (June 2023 – July 2024).....42

Table 5-28. Cumulative Volume Change for National Seashore - North (June 2023 – July 2024).....42

Table 5-29. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2023 – June 2024).....47

Table 5-30. Nags Head Cumulative Volume Change Statistics (June 2023 – June 2024) .....48

Table 5-31. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment Conditions .....52

Table 5-32. Trigger Volumes Above -19 ft NAVD88 for 25-yr Event.....56

Table 6-1. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2023 – June 2024).....66

Table 6-2. Nags Head Cumulative Volume Change Statistics (June 2023 – June 2024)..67

## 1.0 OBJECTIVE

The Town of Nags Head Beach Monitoring and Maintenance Plan is sponsored by the Town of Nags Head (Town) as a continuation of the 2011 monitoring program initiated for assessing beach conditions. The primary purpose of the program is to assess current and historical shoreline conditions, determine shoreline and volumetric changes and evaluate the performance of beach nourishment and other restoration efforts. Evaluating and documenting these changes consistently over successive years provides information necessary to plan for future beach nourishments and to support development of the Town's multi-decadal Beach Nourishment Master Plan.

The latest annual summer survey took place in June 2024 and was carried out by McKim & Creed. Furthermore, a fall survey, prompted by observed scarping along the Town's beachfront, was conducted by McKim & Creed in October 2023. This report outlines the data sources, methodologies, and findings of a survey evaluation conducted by Moffatt & Nichol. The evaluation compares the June 2024 survey to the data from October 2023 and June 2023 surveys.

## 2.0 SUMMARY OF PREVIOUS WORK

Moffatt & Nichol began preparing the Town's annual beach and nearshore monitoring evaluations in 2020. At that time, Moffatt & Nichol reviewed previous beach monitoring studies performed by Coastal Science & Engineering Inc. (CSE) between 2010 and 2018 to gain an understanding of previous survey methods, associated coastal analysis, and observed trends. Shoreline and volume change data for each year was compared to an initial survey performed in 2010, taken before the 2011 beach nourishment project providing for some long-term analysis. **Figure 2-1** presents the extents of each of the monitoring shoreline reaches. It should be noted that the monitoring Reach 1 begins from Station 495+00 while the 2011 construction reach began from 497+00. **Table 2-1** shows the long-term volume changes from previous studies over the various reaches of shoreline.

**Figure 2-1: Prior Established Monitoring Reaches**

## Table 2-1. Long-term Volume Change (Previous Studies: 2010-2018)

| | | Nov 2010-Nov 2011 | Nov 2010-Jun 2012 | Nov 2010-Nov 2012 | Nov 2010-Jun 2013 | Nov 2010-Jun 2014 | Nov 2010-Jun 2015 | Nov 2010-Jun 2016 | Nov 2010-July 2017 | Nov 2010-May 2018 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | cy | cy | cy | cy | cy | cy | cy | cy | cy |
| **Dune to +6 ft NAVD88** | Reach 1 (495- 790) | 135,789 | 213,713 | 124,589 | 344,963 | 456,407 | 466,904 | 505,144 | 551,781 | 526,825 |
| | Reach 2 (790-920) | 117,999 | 164,846 | 145,705 | 254,009 | 287,513 | 281,663 | 302,382 | 328,262 | 293,650 |
| | Reach 3 (920-1010) | 85,345 | 100,273 | 144,338 | 243,163 | 221,848 | 211,574 | 221,481 | 237,733 | 227,253 |
| | Reach 4 (1010-1025) | 10,824 | 17,767 | 13,678 | 26,771 | 35,216 | 18,915 | 5,486 | 9,292 | 2,746 |
| | **Project Oceanfront** | 349,957 | 496,599 | 428,310 | 868,906 | 1,000,984 | 979,056 | 1,034,493 | 1,127,068 | 1,050,474 |
| **Dune to -6 ft NAVD88** | Reach 1 (495- 790) | 1,138,026 | 1,032,425 | 1,014,648 | 1,219,411 | 1,085,981 | 1,079,356 | 1,086,961 | 1,194,858 | 985,588 |
| | Reach 2 (790-920) | 967,742 | 902,188 | 883,008 | 1,002,007 | 844,702 | 809,453 | 783,717 | 721,915 | 599,858 |
| | Reach 3 (920-1010) | 1,026,681 | 904,870 | 789,190 | 823,748 | 669,903 | 658,157 | 579,130 | 604,978 | 420,428 |
| | Reach 4 (1010-1025) | 110,880 | 118,284 | 93,392 | 90,268 | 77,033 | 31,752 | 29,024 | 22,168 | -14,344 |
| | **Project Oceanfront** | 3,243,329 | 2,957,767 | 2,780,238 | 3,135,434 | 2,677,619 | 2,578,718 | 2,478,832 | 2,543,919 | 1,991,530 |
| **Dune to -19 ft NAVD88** | Reach 1 (495- 790) | 1,700,982 | 2,101,133 | 1,713,410 | 1,911,609 | 1,908,360 | 1,790,705 | 2,088,642 | 1,699,296 | 1,053,383 |
| | Reach 2 (790-920) | 1,297,082 | 1,373,586 | 1,141,685 | 1,292,398 | 1,346,691 | 1,268,412 | 1,305,026 | 888,118 | 573,200 |
| | Reach 3 (920-1010) | 1,281,379 | 1,296,493 | 1,003,944 | 1,137,586 | 1,025,817 | 799,182 | 760,191 | 408,100 | 157,253 |
| | Reach 4 (1010-1025) | 173,344 | 207,830 | 176,447 | 137,614 | 114,850 | 61,492 | 16,051 | -59,743 | -114,154 |
| | **Project Oceanfront** | 4,452,787 | 4,979,042 | 4,035,486 | 4,479,207 | 4,395,718 | 3,919,791 | 4,169,910 | 2,935,771 | 1,669,682 |

# 3.0 SURVEY PROCEDURES AND DATA PROCESSING

## 3.1 Survey Transects and Reaches

The present monitoring survey and evaluation continue to use the existing transect lines and origins established by CSE in monitoring periods prior to 2020. Additional monitoring transects were added in 2020 as recommended by Moffatt & Nichol to better understand sand movement and trends at hotspots and along the National Seashore shoreline south of the Town limits. McKim & Creed conducted the summer 2024 survey in June 2024, including both the additional transects and the previously established transect lines. **Figure 3-1** shows the location of the original and additional survey lines and origins applied by McKim & Creed and Moffatt & Nichol. **Figure 3-2** shows the survey lines used in the fall monitoring survey. As shown, survey transect lines were stationed from north to south along Nags Head. A summary of streets/landmarks present at the start and end of each reach are provided in **Table 3-1**.

**Table 3-1. Reach Start and End Points**

| Reach | Stations | Length (ft) | Start Point | End Point |
|---|---|---|---|---|
| Nags Head - North | 430+00-495+00 | 6,500 | E 8th Street | Bonnett Street |
| Reach 1 | 495+00-790+00 | 29,500 | Bonnett Street | Governor Street |
| Reach 2 | 790+00-920+00 | 13,000 | Governor Street | James Street |
| Reach 3 - North | 920+00-975+00 | 5,500 | James Street | Limulus Drive |
| Reach 3 - South | 975+00-1010+00 | 3,500 | Limulus Drive | Loon Court |
| Reach 4 | 1010+00-1025+00 | 2,000 | Loon Court | McCall Court |
| National Seashore - North | 1025+00-1200+00 | 17,250 | McCall Court | North of Oregon Inlet Campground |
| National Seashore - South | 1200+00-1290+00 | 9,000 | North of Oregon Inlet Campground | Oregon Inlet |

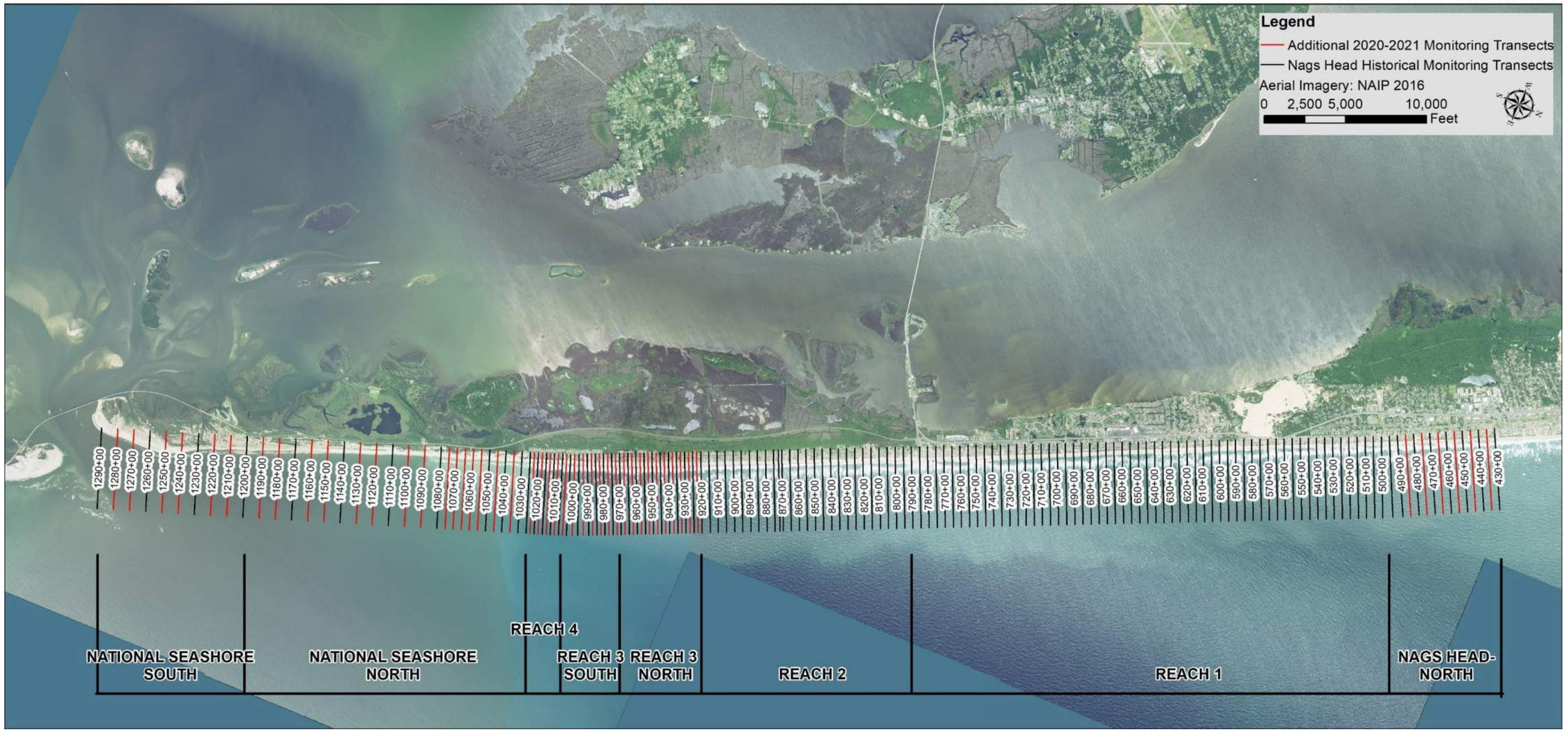



**Figure 3-1. Nags Head Annual Monitoring Profile Line Locations**

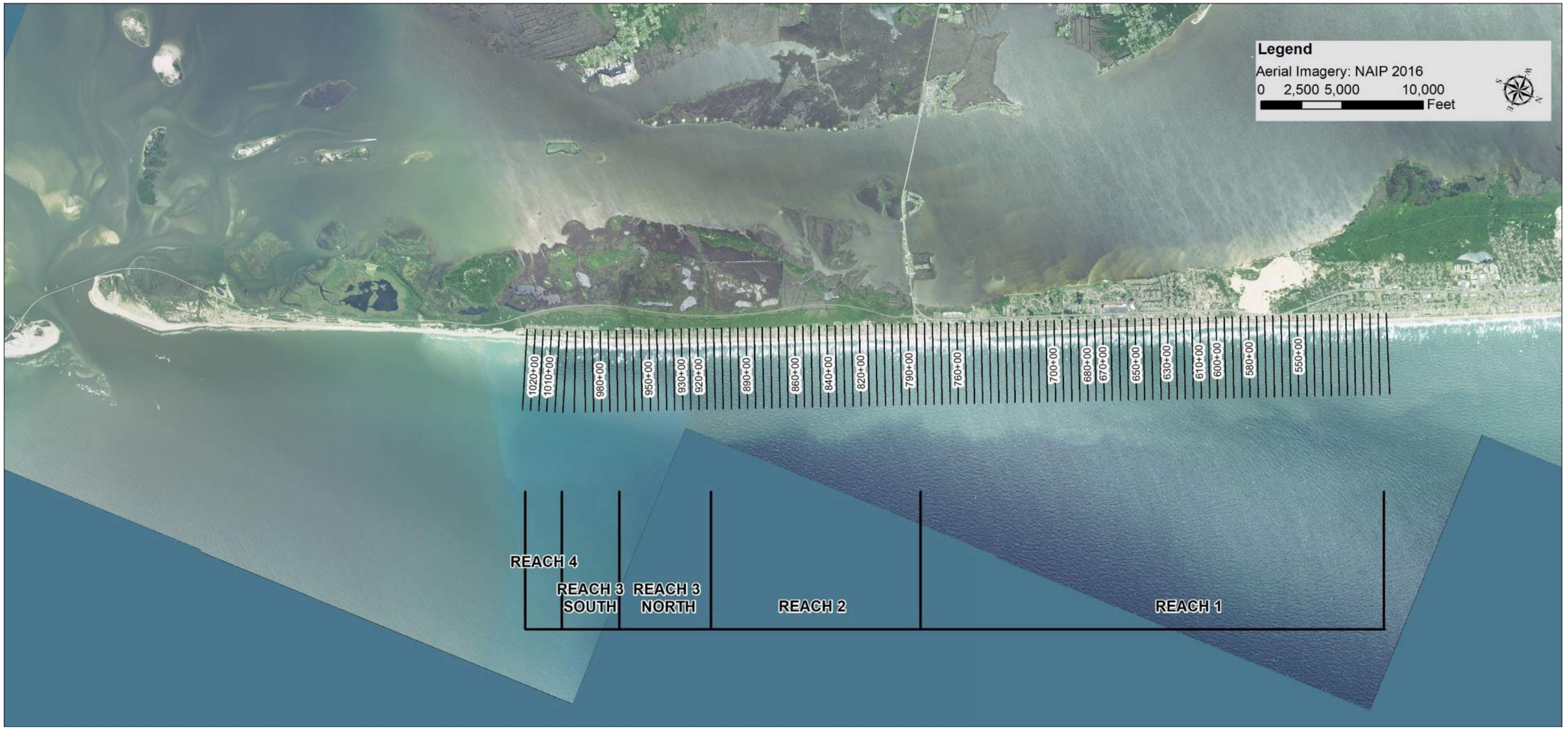



**Figure 3-2. Nags Head Fall Monitoring Profile Line Locations**

## 3.2 Survey Data Acquisition

To enable a reproducible and consistent result for the monitoring analysis, the survey events for each shoreline segment are assigned a single date for their completion. Assigning the survey date allows the determination of a consistent timeframe for each monitoring period between survey events for use in calculating shoreline and volumetric change rates. Surveys referenced during the current monitoring analysis include:

2024 Annual Survey
The most recent annual survey data was collected by McKim & Creed between June 18 and July 31, 2024. The crew initially demobilized on June 26 due to a lack of permission to survey within the Cape Hatteras National Seashore. After obtaining the necessary permit, they resumed work on July 29 and completed surveys for the 32 lines within the park, along with re-surveying an additional 7 lines (Reach 4) at the request of the Town of Nags Head by July 31. The date used for the 2024 Nags Head profiles in this report is June 26, 2024, as the majority of the surveys within the town's boundaries were finished by then (see **Appendix A** for details).

2023 Fall Survey
The present fall survey was conducted from October 17-19. The date used for the 2023 Fall survey is October 19, 2023, when the surveying was completed.

2023 Annual Survey
The previous set of annual survey data was collected by McKim & Creed on June 11-July 1. The date used for the 2023 Nags Head profiles for this report is June 30, 2023, when the majority of the surveying was completed.

2022 Post-Dorian Renourishment Project Pre and Post Construction Surveys
The Post-Dorian beach nourishment project was completed between July 2022 and August 2022. During the project, pre- and post-nourishment profiles were surveyed at 100 ft spacing, immediately before and after filling by Gahagan & Bryant Associates. Volume placed during the renourishment effort was determined using these surveys.

2019 Pre – Nourishment Survey
Before the 2019 Beach Nourishment Project, CSE conducted a pre-nourishment survey in April 2019. The date used for the 2019 Nags Head profiles for this report is April 8, 2019.

McKim & Creed provided the processed survey data to Moffatt & Nichol in ASCII (xyz), Excel (xyz), BMAP (free format), and GIS (shapefile, grid) formats allowing for compatibility with multiple programs. The data referenced the horizontal North American Datum 1983 (NAD83) State Plane North Carolina (U.S. survey feet) and elevations were provided in feet relative to the North American Vertical Datum of 1988 (NAVD88). A copy of the survey data files is included on the attached USB also containing an electronic copy of the report.

**Appendix A** contains the McKim & Creed 2024 Field Report which discusses, in detail, the singlebeam (bathymetric) and topographic data acquisition. The field report also provides the associated equipment and quality control procedures (QA/QC) utilized in the data collection and processing tasks.

# 4.0 SURVEY EVALUATION METHODS

## 4.1 Shoreline Change

Shoreline change designated at the MHW contour, defined as +1.18 ft NAVD88, was calculated at each transect between the June 2023 and June 2024 surveys as well as between the October 2023 and June 2024 surveys. The MHW elevation is based on a National Oceanic and Atmospheric Administration (NOAA) tidal benchmark at Duck, NC shown in **Figure 4-1**. The resulting values represent the shoreline change (ft) over the time between surveys.

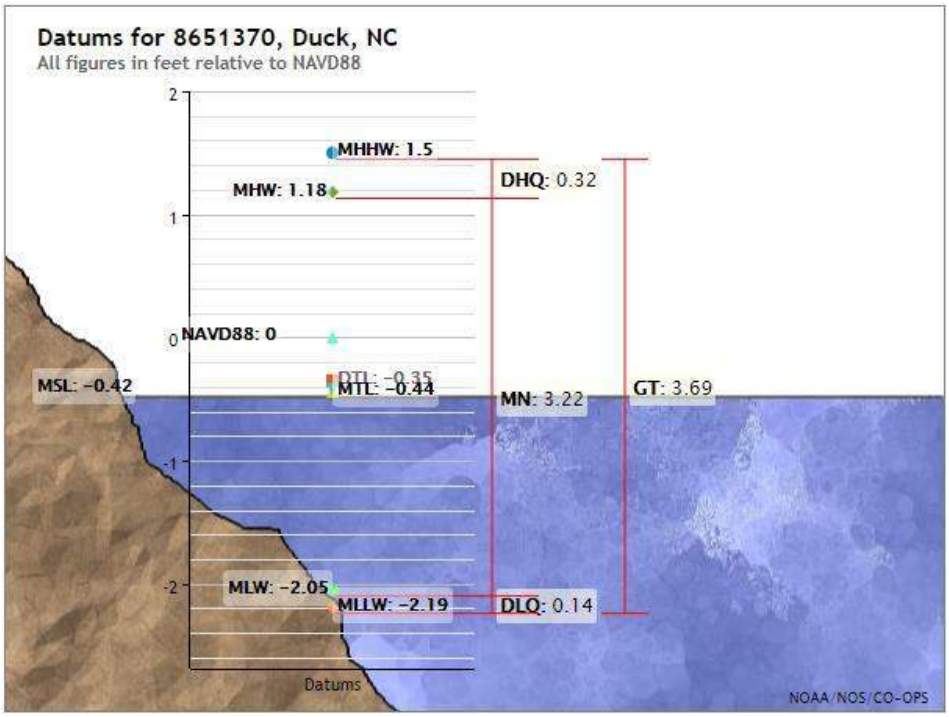



**Figure 4-1. Tidal Datum for Duck, NC Station 8651370**

## 4.2 Volume Change

Representative volume changes were calculated at each transect between the June 2023 and June 2024 surveys as well as between the October 2023 and June 2024 surveys. Volume changes were calculated for six different elevation extents to better understand the processes occurring onshore and offshore of Nags Head. Calculations included volume change above the following elevations:

- above +6 ft NAVD88 (berm),
- above +1.18 ft NAVD88 (MHW),
- above -6 ft NAVD88 (wading depth/recreational beach),
- above -14 ft NAVD88 (outer bar),

- above -19 ft NAVD88 (depth of closure), and
- above -30 ft NAVD88.

For those profiles which did not extend to -30 ft NAVD88, volume calculations were performed above -30 ft NAVD88 out to the extent of the shortest survey. **Figure 4-2** presents a graphical display of the various elevations for which volume change calculations were made.

As with the shoreline change, the results represent volume change (cy/ft) over the period of time between surveys. In addition, the volume changes were converted to cumulative changes over each of the management reaches and for the entire shoreline. This was done by applying the average end area method to the unit volume changes (cy/ft) computed at each transect and summing the total volume changes between each neighboring pair of transects. The resulting value indicated the total loss or gain of material between survey periods based on the applicable profile extents.

It should be noted that the uncertainty in the hydrographic portion of the survey can result in a significant volumetric change in offshore areas where the slope of the seafloor declines gradually. If an uncertainty of ±0.11 ft is applied along the portion of the profile between the seaward side of the depth of closure (approximately 2,050 ft offshore) and a depth of -30 ft NAVD88 (approximately 2,950 ft offshore) along all 77,000 ft of oceanfront shoreline, this lends itself to an uncertainty of approximately ±282,300 cy. For this reason, more attention is given to the volume change calculations at -19 ft NAVD88 and above.

The profile volume calculation lenses (see **Figure 4-2**) were strategically chosen to help understand and track the movement of sand onshore and offshore. Volume changes calculated for portions of the profiles above +6 ft NAVD88 and above MHW are representative of changes in the amount of material in the dune system and on the subaerial beach. These areas of the profile are highly influenced by storm activity, and they are both very significant in the ability of the beach and dune to mitigate storm surge and wave impacts on landward structures and infrastructure. Volume comparisons for portions of the profiles above -6 ft NAVD88, an approximate wading depth, represent changes in the recreational beach area. Volume comparisons above -14 ft NAVD88 help to track sand movement to and from the outer sand bar and are valuable in decision making for future beach nourishment projects. Volume comparisons above -19 ft NAVD88 provide general estimates of the total volumetric change along the respective profile out to the depth of closure. Finally, volume comparisons above -30 ft NAVD88 allow the complete tracking of sand movement offshore. However, hydrographic survey measurement accuracy may impact these calculations. This is a proven, comprehensive way to assess the impact of storm activity on the subaerial beach and dune system as well as track the movement of sand offshore and quantify total gains and losses in the entire system.

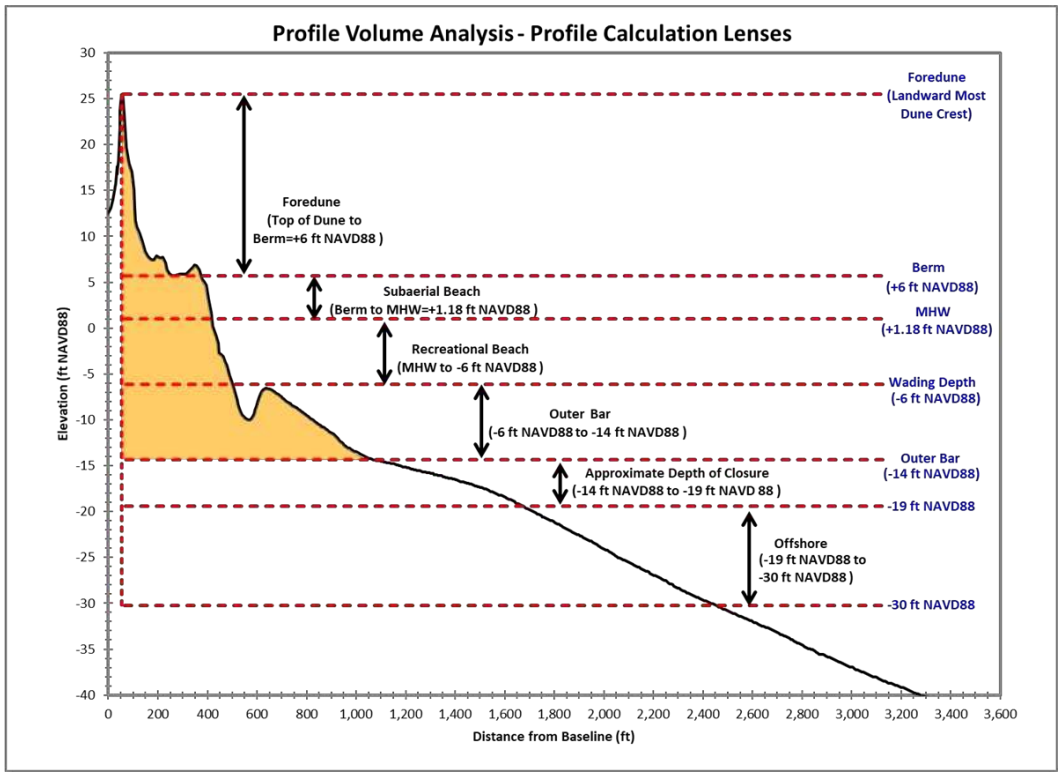



**Figure 4-2. Profile Volume Calculation Lenses**

# 5.0 DISCUSSION OF ANNUAL SURVEYING EVALUATION

This section covers significant events over the past year that have impacted the annual analysis, such as nourishment projects and storms. It also addresses the development of background erosion rates, trends in annual shoreline and volume changes (June 2023 – June 2024), insights into shoreline and volume changes from fall 2023 to summer 2024 (October 2023 – June 2024), and an analysis of long-term trends from 2011 to 2024.

## 5.1 Key Events During the Reporting Period

Beach changes are greatly influenced by natural and engineered processes. This section describes key events that occurred during the reporting period that likely had an impact on shoreline change as well as profile volume gains and losses.

### *5.1.1 Sand Placement Events*

No sand placement events took place during the observation period. The most recent beach nourishment project, 2022 Post-Dorian Project commenced on July 22, 2022, right at the onset of the 2022 - 2023 monitoring period, and was successfully completed by August 29, 2022. During the project a total of 614,106 cy of material was placed along the four reaches of Nags Head. The specific placement volumes are presented in **Table 5-1**.

**Table 5-1. Project Volume Summary**

| Reach | Length | Final Volume (cy) | Final Density (cy/ft) |
|---|---|---|---|
| Reach 2 | 13,000 | 179,355 | 13.8 |
| Reach 3N | 5,500 | 142,137 | 25.8 |
| Reach 3S | 3,500 | 198,441 | 56.7 |
| Reach 4 | 2,000 | 94,173 | 47.1 |
| **Total** | **24,000** | **614,106** | |

### *5.1.2 Wave Climate and Storm Events*

Wave data from the National Data Buoy Center (NDBC) Station 44056 (USACE Field Research Facility (FRF)), located approximately 15 miles north of the Town, was downloaded for July 2023 through July 2024. The wave data was then plotted to analyze wave activity which may have impacted the Town. **Figure 5-1** shows the location of the buoy while **Figure 5-2** presents a plot of the wave heights during the reporting period. During the observation period, the station 44056 buoy was unmoored from December 18, 2023, to January 5, 2024. To assess the wave climate during this time, data from station 44100 (offshore of station 44056) is also presented in **Figure 5-2**.

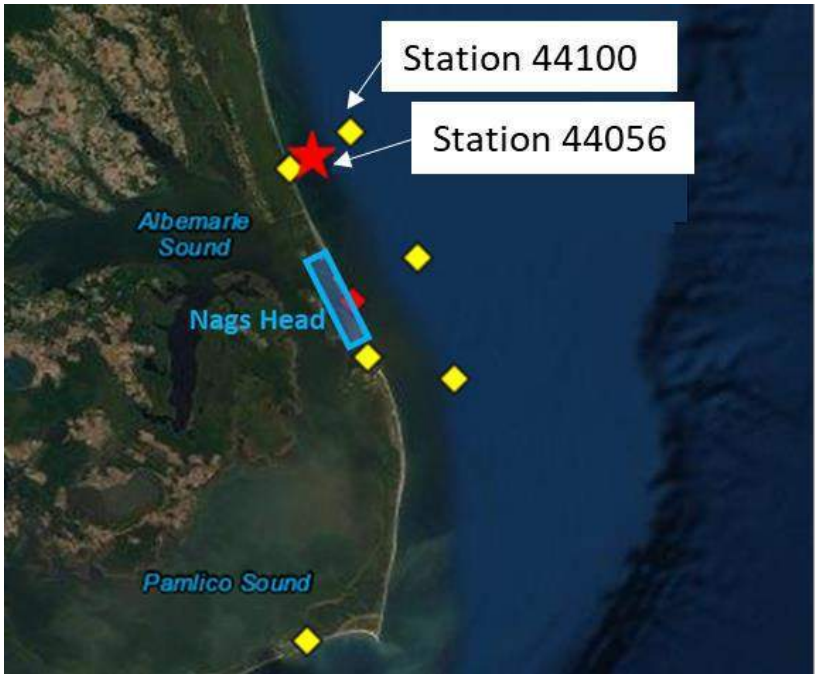



**Figure 5-1. USACE FRF Buoy Locations**

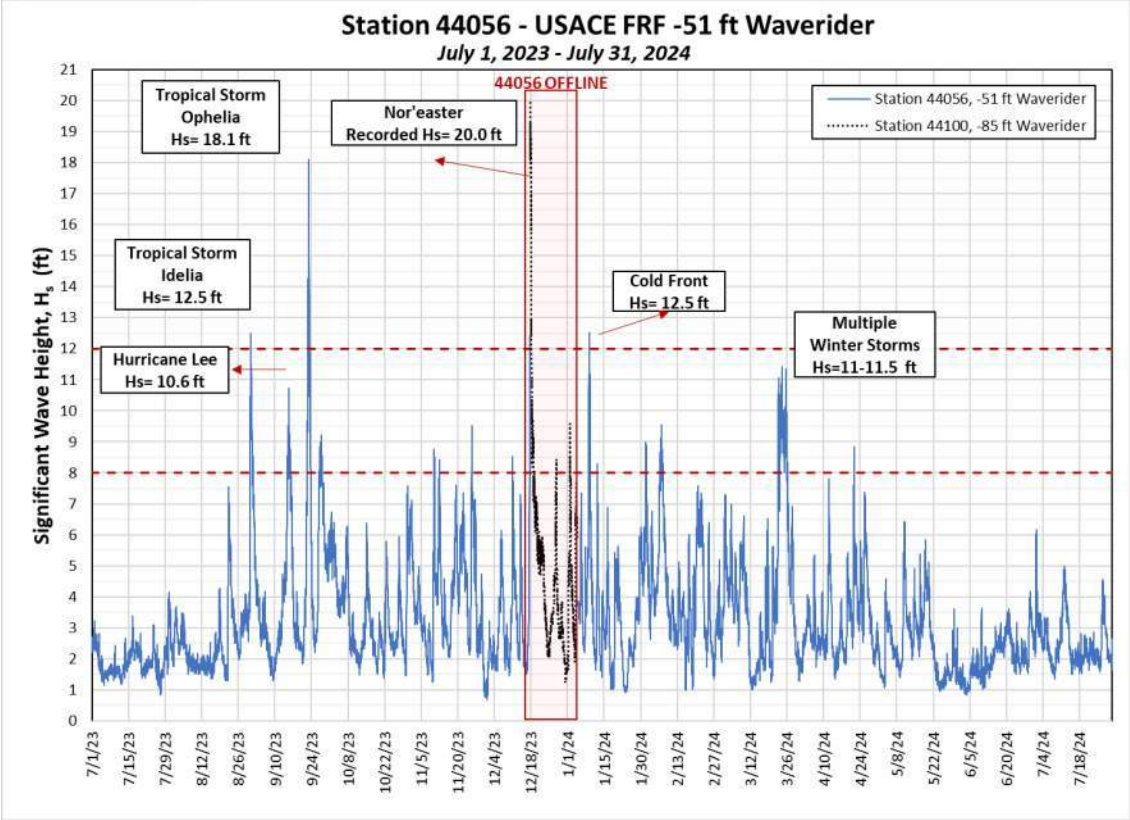



**Figure 5-2. USACE FRF Station 44056 Wave Height**

The data highlights an active wave climate throughout the monitoring period. In the fall/winter season of 2023 (September – December 2023), 10 wave events exceeded 8 ft, with the highest recorded during Tropical Storm Ophelia (18.1 ft) and a December Nor'easter (20.0 ft). In the winter storm season (January – May 2024), seven events occurred with wave heights between 8 ft and 12.5 ft. Notably, a winter storm starting on March 23, 2024, lasted about 70 hours, creating prolonged erosion conditions that prevented recovery of offshore material. The active storm season between the summer 2023 and summer 2024 surveys likely contributed to higher erosion rates than the average annual background rates.

**Figure 5-3** and **Figure 5-4** depict the directional wave roses for the annual monitoring period and the period from January 1997 to July 2024, respectively. Statistical analysis reveals that for both time spans, prevailing waves originate from east-northeast to east-southeast directions. The percentage of waves coming from east-northeast has slightly increased (~3%) in this monitoring period while the percentages for the other two dominant directions (east, east-southeast) remained the same.

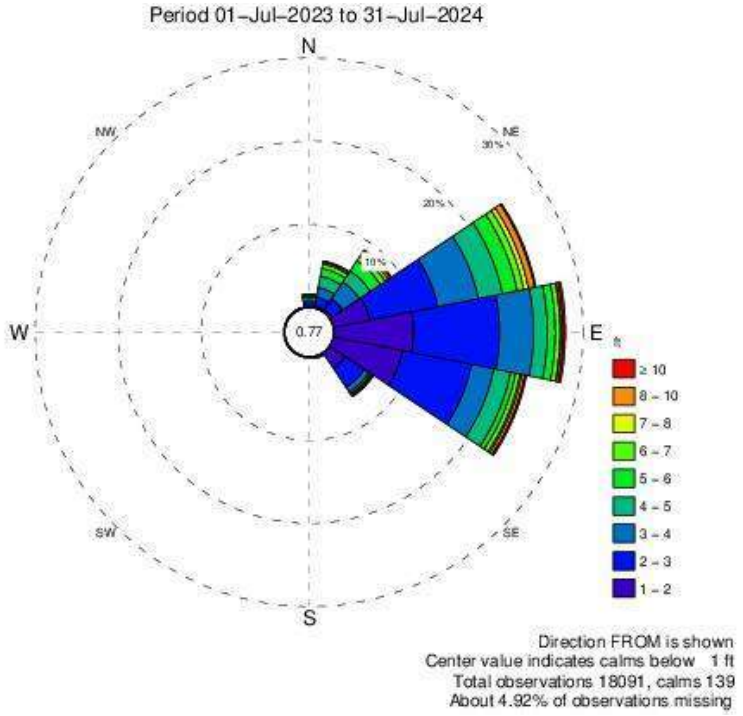



**Figure 5-3. Station 44056 Significant Wave Height Rose from July 2023 – July 2024**

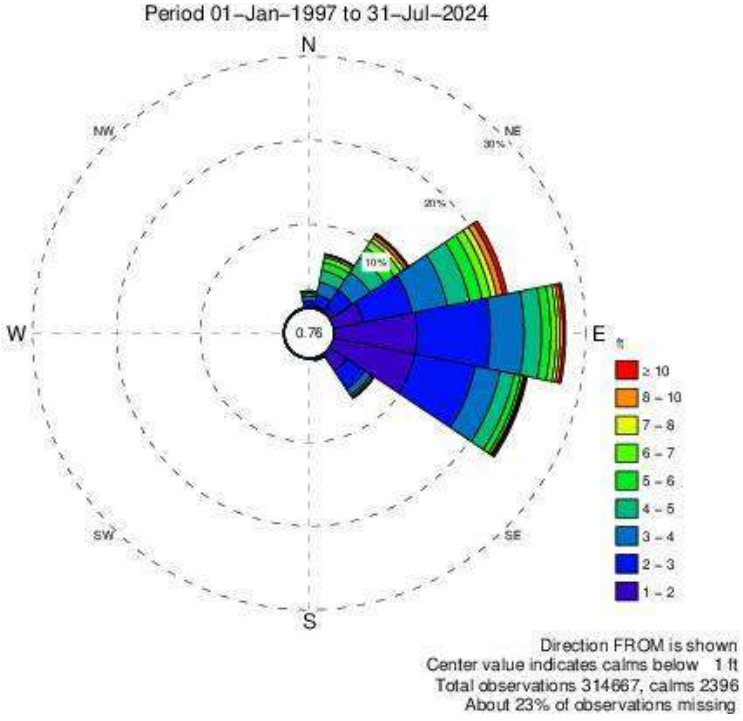



**Figure 5-4. Station 44056 Significant Wave Height Rose from January 1997 – July 2024**

## 5.2 Determination of Background Erosion Rates for Town of Nags Head (2011 – 2024)

To develop long-term trends in volume losses/gains, it is important to determine background erosion rates which do not include the volume gains from nourishment events. Since the establishment of the beach monitoring program immediately after the construction of the 2011 beach nourishment project, the Nags Head oceanfront has undergone one beach nourishment project in 2019 and another one in 2022.
**Table 5-2** shows the nourishment volume placed at each reach within the monitoring program since the 2011 nourishment project.

**Table 5-2. Nourishment Volumes Post-2011 by Management Reach**

| Reach | Nourishment Volume 2019 (cy) | Nourishment Volume 2022 (cy) | Total Nourishment Volume (cy) |
|---|---|---|---|
| **Nags Head - North** | 0 | 0 | 0 |
| **Nags Head - Reach 1** | 1,762,213 | 0 | 1,762,213 |
| **Nags Head - Reach 2** | 885,587 | 179,355 | 1,064,942 |
| **Nags Head - Reach 3N** | 576,703 | 142,137 | 718,840 |
| **Nags Head - Reach 3S** | 540,833 | 198,441 | 739,274 |
| **Nags Head - Reach 4** | 239,298 | 94,173 | 333,471 |
| **National Seashore - North** | 0 | 0 | 0 |
| **Total** | 4,004,634 | 614,106 | 4,618,740 |

Historical volume changes above -19 ft NAVD88 were documented from 2011 through 2024. **Table 5-3** shows the computed volume change (including nourishments) above -19 ft NAVD88 from 2011-2024 for the defined monitoring reaches.

**Table 5-3. Volume Change by Reach Above -19 ft NAVD88**

| Reach | Volume Change (cy) 2011-2012 | Volume Change (cy) 2012-2013 | Volume Change (cy) 2013-2014 | Volume Change (cy) 2014-2015 | Volume Change (cy) 2015-2016 | Volume Change (cy) 2016-2017 | Volume Change (cy) 2017-2018 | Volume Change (cy) 2018-2019 | Volume Change (cy) 2019-2020 | Volume Change (cy) 2020-2021 | Volume Change (cy) 2021-2022 | Volume Change (cy) 2022-2023 | Volume Change (cy) 2023-2024 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nags Head - North (430+00 - 495+00) | 12,512 | 459 | -61,997 | 42,855 | -21,464 | -107,963 | -76,609 | -273 | 14,451 | 82,466 | -9,240 | 156,991 | 57,395 |
| Nags Head - Reach 1 (495+00 - 790+00) | 199,722 | -210,804 | 16,718 | -110,558 | 294,941 | -418,152 | -644,783 | 1,441,871 | 253,604 | 205,765 | -210,748 | 259,165 | -41,313 |
| Nags Head - Reach 2 (790+00 - 920+00) | 117,215 | -195,136 | 54,157 | -81,138 | 33,499 | -429,523 | -328,626 | 696,896 | 156,913 | 143,886 | -206,347 | 461,067 | -85,912 |
| Nags Head - Reach 3N (920+00 - 975+00) | 85,381 | -144,828 | -13,818 | -133,901 | 15,540 | -252,798 | -168,797 | 423,513 | 21,457 | 10,346 | -159,340 | 327,560 | -210,239 |
| Nags Head - Reach 3S (975+00 - 1010+00) | -32,942 | -48,873 | -101,531 | -89,412 | -54,799 | -104,590 | -84,187 | 383,465 | -106,581 | -60,949 | -12,855 | 179,797 | -136,136 |
| Nags Head - Reach 4 (1010+00 - 1025+00) | 71,930 | -105,463 | -14,079 | -33,271 | -42,050 | -57,636 | -31,569 | 136,047 | -42,197 | -11,624 | -8,292 | 54,562 | -28,187 |
| National Seashore - North (1025+00 - 1200+00) | 107,833 | -235,944 | 153,705 | -442,192 | 3,220 | -470,987 | -520,298 | -181,579 | -93,041 | 610,231 | 284,283 | 500,960 | -326,727 |
| **Nourished Oceanfront (495+00 - 1025+00)** | **441,306** | **-705,102** | **-58,553** | **-448,280** | **247,132** | **-1,262,698** | **-1,257,961** | **3,081,792** | **283,196** | **287,425** | **-597,582** | **1,282,153** | **-501,787** |
| **Total Monitored Oceanfront (430+00 - 1200+00)** | **561,651** | **-940,588** | **33,154** | **-847,616** | **228,887** | **-1,841,647** | **-1,854,868** | **2,899,940** | **204,606** | **980,122** | **-322,539** | **1,940,103** | **-771,119** |

To calculate the background erosion rate, the documented nourishment volumes were subtracted from total volume changes above -19 ft NAVD88 between 2012 and 2024 and annualized over the 11-year time period. It should be noted that changes from 2011 to 2012 were omitted from the background erosion calculations. This exclusion was necessitated

by the delayed survey date of the 2011 survey and the identification of atypical erosion trends during this specific observation period. **Table 5-4** shows the average annual background erosion rates for each management reach of the Nags Head oceanfront. The average background erosion rate for the Town's Nourished Oceanfront and the Total Monitored Oceanfront shoreline is approximately -6.7 cy/ft/yr and -5.3 cy/ft/yr, respectively. Nags Head Reaches 3N, 3S, and 4 have considerably higher background erosion rates than the remainder of the oceanfront shoreline, signifying these areas need to be monitored closely and taken into special consideration during future planning and nourishment efforts.

**Table 5-4. Average Annual Background Erosion Rates (2012 - 2024)**

| Reach (Transects) | Length | Volume Change Above -19 ft NAVD88 (cy) 2012-2024 | Nourishment Volume (cy) | Background Erosion (cy) | Average Annual Background Erosion Rates (cy/ft/yr) |
|---|---|---|---|---|---|
| Nags Head - North (430+00 - 495+00) | 6,500 | 77,072 | 0 | 77,072 | 1.0 |
| Nags Head - Reach 1 (495+00 - 790+00) | 29,500 | 835,707 | 1,762,213 | -926,506 | -2.6 |
| Nags Head - Reach 2 (790+00 - 920+00) | 13,000 | 219,737 | 1,064,942 | -845,205 | -5.4 |
| Nags Head - Reach 3N (920+00 - 975+00) | 5,500 | -285,304 | 718,840 | -1,004,144 | -15.2 |
| Nags Head - Reach 3S (975+00 - 1010+00) | 3,500 | -236,650 | 739,274 | -975,924 | -23.2 |
| Nags Head - Reach 4 (1010+00 - 1025+00) | 1,500 | -183,758 | 333,471 | -517,229 | -28.7 |
| National Nearshore - North (1030+00 - 1200+00) | 17,500 | -718,369 | 0 | -718,369 | -3.4 |
| **Nourished Oceanfront (495+00 - 1025+00)** | **53,000** | **349,732** | **4,618,740** | **-4,269,008** | **-6.7** |
| **Total Monitored Oceanfront (430+00 -** | **77,000** | **-291,564** | **4,618,740** | **-4,910,304** | **-5.3** |

## 5.3 Nags Head Annual Shoreline and Volume Change Analysis (June 2023 – June 2024)

This section discusses the results of the shoreline and volume change analysis for the defined monitoring reaches along Nags Head (see **Figure 3-1**). Key statistics were calculated to quantify average shoreline and volume changes for individual monitoring reaches as well as the entire oceanfront shoreline for Nags Head. The computed statistics include average shoreline change, average unit volume change, and cumulative volume change (e.g. total volume of material lost or gained along a section of shoreline). Evaluation of the computed statistics considers volume changes computed for portions of the profile above the berm (+6 ft NAVD88), above MHW (+1.18 ft NAVD88), above -6 ft NAVD88, above -14 ft NAVD88, above -19 ft NAVD88, and above -30 ft NAVD88 to better understand onshore and offshore processes.

**Appendix B** presents profile comparison plots for individual transects. These plots compare the summer 2023, October 2023 and summer 2024 surveys, alongside the after-dredge (AD) surveys following the 2022 Post-Dorian Renourishment project. **Appendix C** provides the computed shoreline changes and volume changes measured at each transect between the summer 2023 and the summer 2024 surveys in tabular format.

### *5.3.1 Nags Head - North Reach (June 2023 – June 2024)*

The Nags Head – North survey reach extends approximately 6,500 ft between E 8th Street and Bonnett Street, containing 13 survey transects (Station 430+00 – 495+00) at approximately 1000 ft spacing (see **Figure 3-1**). As a reminder, six transects were added to this reach during the 2020 surveying effort, creating 500 ft spacing for the whole reach. A summary of average shoreline and volume changes between June 2023 and June 2024 for Nags Head – North in comparison with the Total Monitored Oceanfront is presented in **Table 5-5** and **Table 5-6**.

**Table 5-5. Average Shoreline and Average Unit Volume Change for Nags Head – North Reach (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - North | 430+00 - 495+00 | 6,500 | 6.1 | 3.4 | 4.5 | 0.8 | 11.8 | 9.6 | 26.6 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 6.9 | 1.7 | 3.3 | 0.6 | -10.5 | -9.8 | -2.9 |

**Table 5-6. Cumulative Volume Change for Nags Head – North Reach (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above 30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - North | 430+00 - 495+00 | 6,500 | 20,432 | 27,027 | 4,771 | 70,965 | 57,395 | 159,508 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 130,713 | 249,384 | 36,080 | -833,226 | -771,119 | -248,056 |

**Table 5-5** indicates that North Reach experienced a slight seaward advancement of the shoreline at MHW over the past year. **Figure 5-5** presents the shoreline changes at each transect, indicating widely varying shoreline movement patterns within the reach.

**Table 5-5** and **Table 5-6** show that the Nags Head – North reach experienced volume gains across all analyzed elevations. The largest gains were observed above -30 ft NAVD88 (+159,508 cy or +26.6 cy/ft) and above -14 ft NAVD88 (+70,965 cy or +9.6 cy/ft). Unlike other areas of the monitored oceanfront, which experienced erosion, this reach saw sand accumulation, likely due to alongshore sediment transport from adjacent areas.

**Figure 5-6** illustrates the unit volume change at each transect, with most transects showing gains. Profile plots in **Appendix B** further display the onshore movement of the offshore sandbar, and **Figure 5-7** presents an example of this offshore bar adjustment.

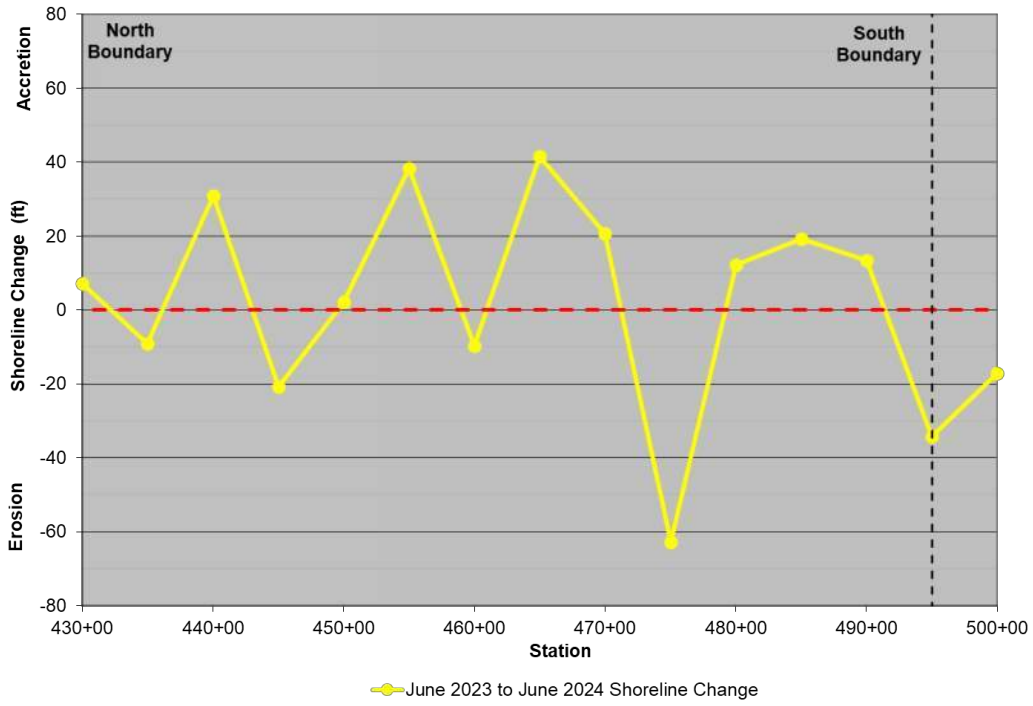



**Figure 5-5. Nags Head – North Shoreline Change (June 2023 – June 2024)**

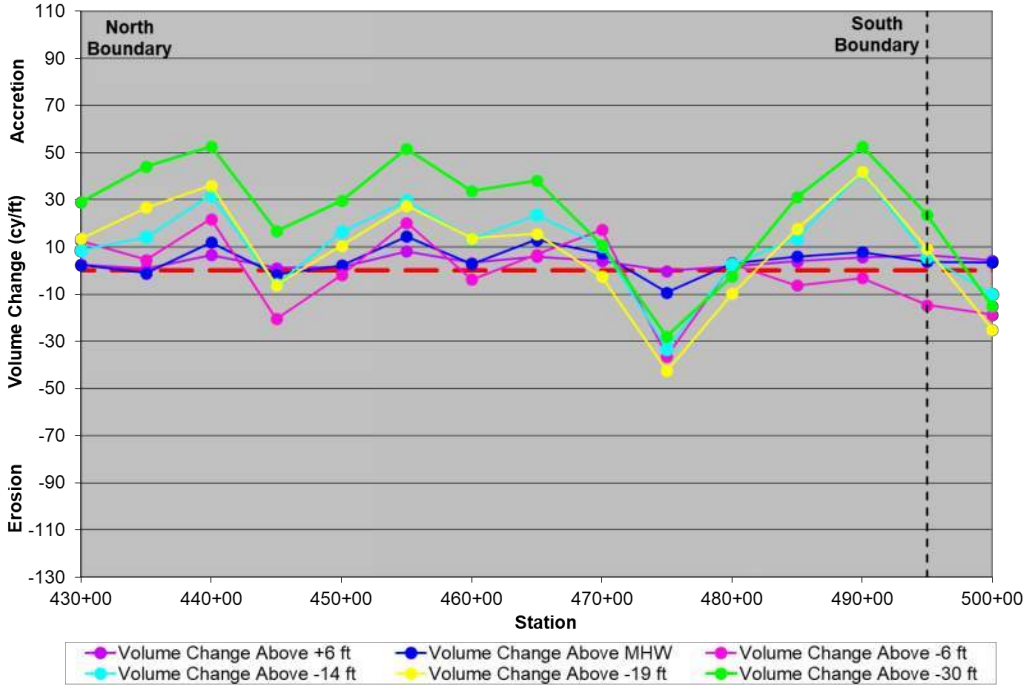



**Figure 5-6. Nags Head – North Unit Volume Change (June 2023 – June 2024)**

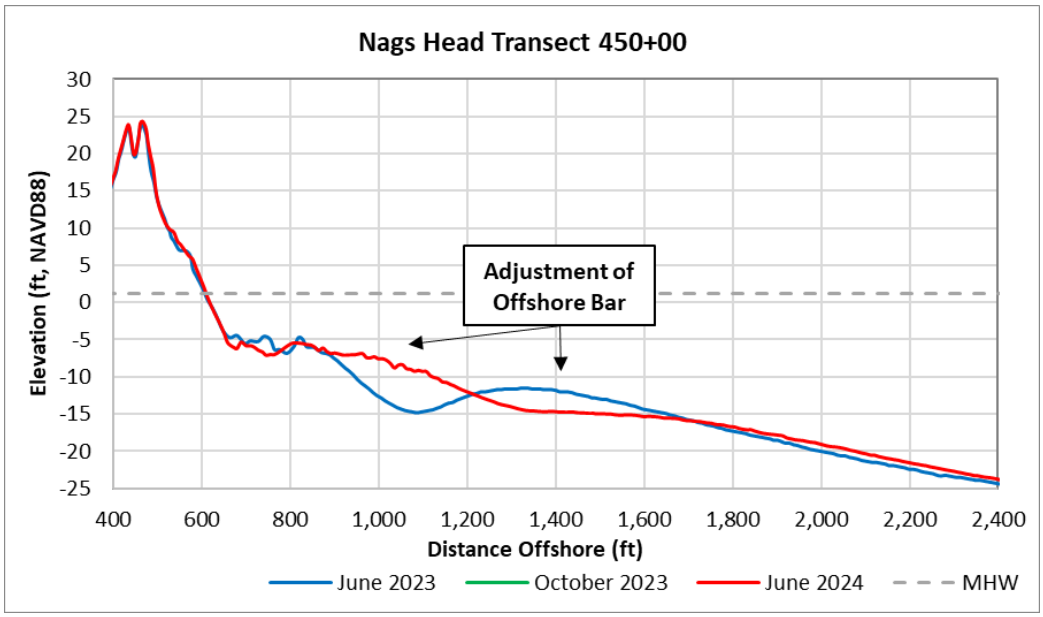



**Figure 5-7. Example Nags Head – North Profile, Station 450+00 (E. Albatross St.)**

### *5.3.2 Nags Head - Reach 1 (June 2023 – June 2024)*

The Nags Head – Reach 1 survey reach extends approximately 29,500 ft between Bonnett Street and Governor Street, containing 59 survey transects (Station 495+00 – 790+00), at 500 ft spacing (see **Figure 3-1**). A summary of average shoreline and volume changes between June 2023 and June 2024 for Reach 1 in comparison with the Total Monitored Oceanfront is presented in **Table 5-7** and **Table 5-8**. Additionally, Reach 1 was surveyed in October 2023 due to observed scarping. The volume and shoreline changes between the October 2023 survey and the June 2024 survey are detailed in **Table 5-9** and **Table 5-10**.

**Table 5-7. Average Shoreline and Average Unit Volume Change for Reach 1 (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - Reach 1 | 495+00 - 790+00 | 29,500 | 5.1 | 2.5 | 4.2 | 0.2 | 2.2 | -1.4 | 14.7 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 6.9 | 1.7 | 3.3 | 0.6 | -10.5 | -9.8 | -2.9 |

**Table 5-8. Cumulative Volume Change for Reach 1 (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above 30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - Reach 1 | 495+00 - 790+00 | 29,500 | 74,639 | 123,358 | 6,401 | 64,852 | -41,313 | 433,683 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 130,713 | 249,384 | 36,080 | -833,226 | -771,119 | -248,056 |

**Table 5-9. Average Shoreline and Average Unit Volume Change for Reach 1 (October 2023 – June 2024)**

| **October 2023 vs. June 2024 (Total Change)** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - Reach 1 | 495+00 - 790+00 | 29,500 | 9.6 | 2.9 | 6.8 | -5.8 | -5.8 | -12.1 | 2.9 |
| Nourished Oceanfront | 495+00 - 1025+00 | 53,000 | 10.2 | 2.5 | 6.6 | -8.1 | -14.5 | -17.5 | -4.7 |

**Table 5-10. Cumulative Volume Change for Reach 1 (October 2023 – June 2024)**

| **October 2023 vs. June 2024 (Total Change)** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - Reach 1 | 495+00 - 790+00 | 29,500 | 84,643 | 201,615 | -170,628 | -170,367 | -357,057 | 86,057 |
| Nourished Oceanfront | 430+00 - 1200+00 | 53,000 | 131,559 | 348,496 | -427,836 | -765,977 | -927,406 | -251,008 |

The annual shoreline change at MHW showed a minor overall seaward advancement of 5.1 ft. **Figure 5-8** presents the shoreline changes at each transect from June 2023 to June 2024. The shoreline shift from October 2023 to June 2024 was slightly greater, indicating partial recovery from the October storms, which had caused material in this reach to be transported offshore to the nearshore zone. The figure indicates widely varying shoreline movement patterns within the reach, spanning from -49.0 ft at station 695+00 to +62.9 ft at station 730+00.

**Table 5-7** and **Table 5-8** show that Reach 1 experienced volume gains above most analyzed elevations during the annual monitoring period, except for a loss at -19 ft NAVD88 (-41,313 cy or -1.4 cy/ft). This loss was even more pronounced between October 2023 and June 2024, with a volume loss of -357,057 cy (-12.1 cy/ft) above -19 ft NAVD88, likely due to continued high-energy wave climate pushing material from the nearshore, as observed in the October 2023 survey, to even lower elevations. Both periods showed material gains above -30 ft NAVD88, suggesting that sediment may be shifting to lower elevations and moving beyond the depth of closure.

During the previous annual monitoring period (June 2022 – June 2023), Reach 1 experienced significant volume losses at Mean High Water (MHW), indicating a steepening of the beachface as material shifted to the nearshore. However, subsequent surveys in October 2023 and June 2024 show a reversal of this trend, with both periods indicating volume gains at subaerial elevations (+6 ft NAVD88 and MHW). Profile plots in **Appendix B** reveal that material was deposited on the beachface from lower elevations. The plots also show that while transects at the northern and southern ends of the reach showed material losses as the offshore bar migrated further offshore to lower elevations, transects in the middle of the reach observed offshore bar adjustments, with the bar moving closer to higher elevations.

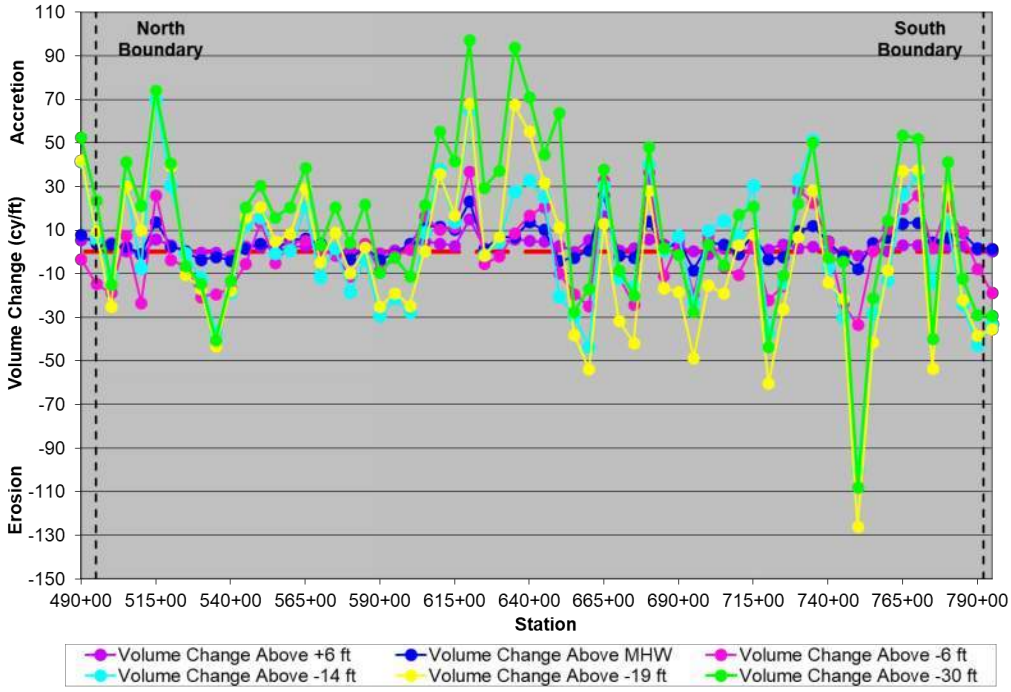



Figure 5-9**Figure 5-9** displays the unit volume change at each transect above the six elevations analyzed and further illustrate the trends observed in comparison plots. **Figure 5-10** presents an example profile from the middle of the reach, showing the offshore bar moving onshore and expanding. Additionally, **Figure 5-11** presents an example profile from south of the reach where the sand bar moved offshore and lost material.

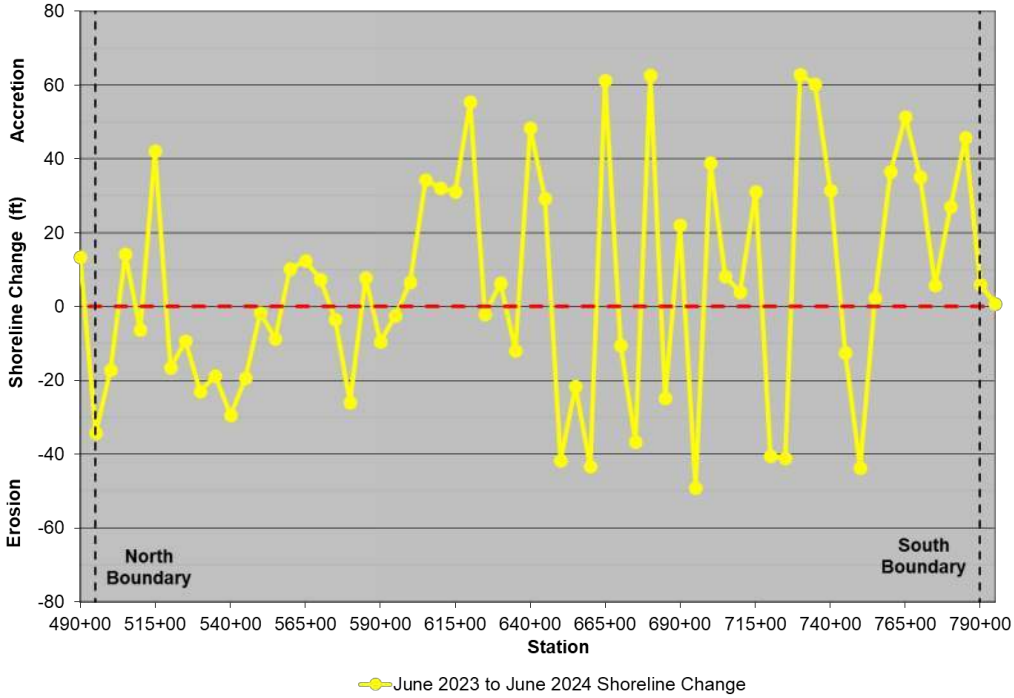


**Figure 5-8. Nags Head – Reach 1 Shoreline Change (June 2023 – June 2024)**

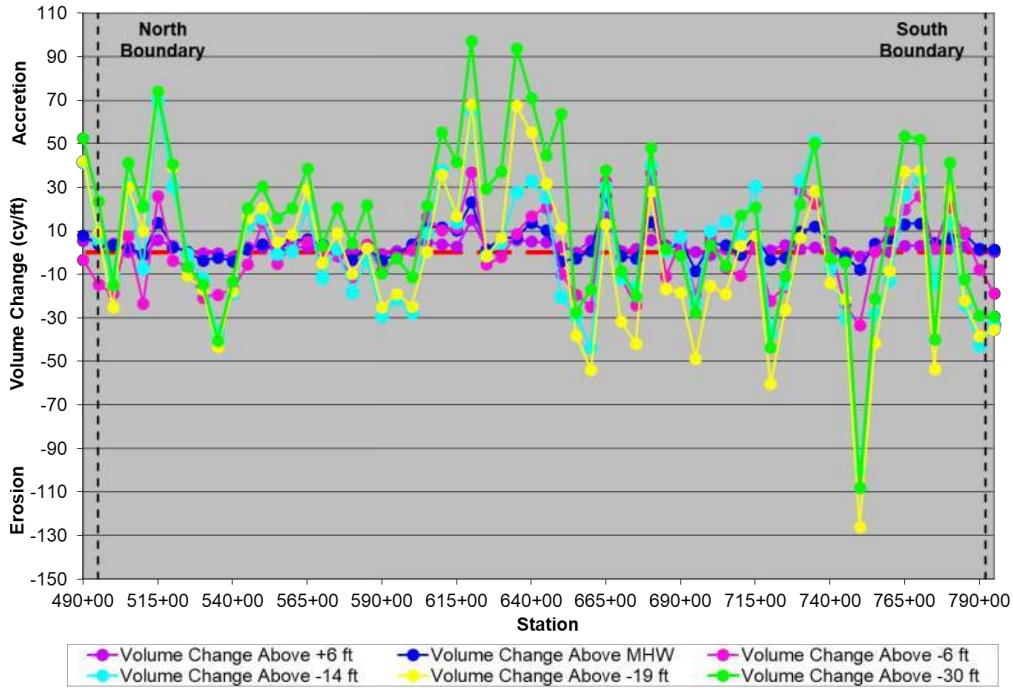



**Figure 5-9. Nags Head – Reach 1 Unit Volume Change (June 2023 – June 2024)**

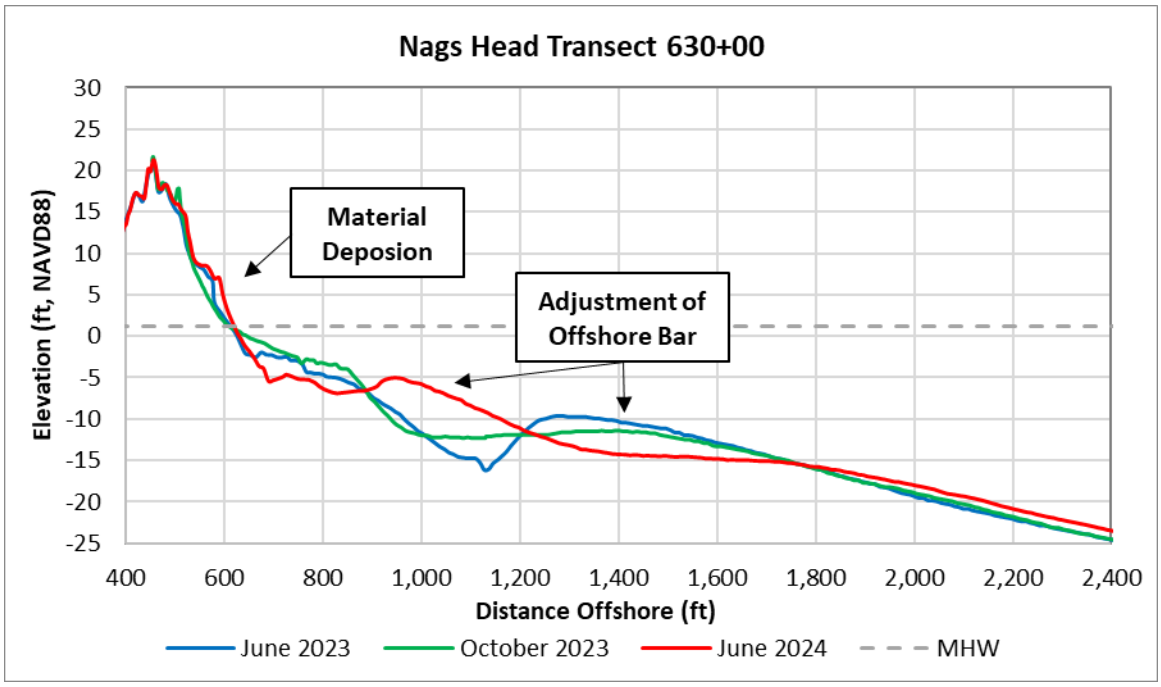


**Figure 5-10. Example Reach 1 Profile, Station 630+00 (E Small St.)**

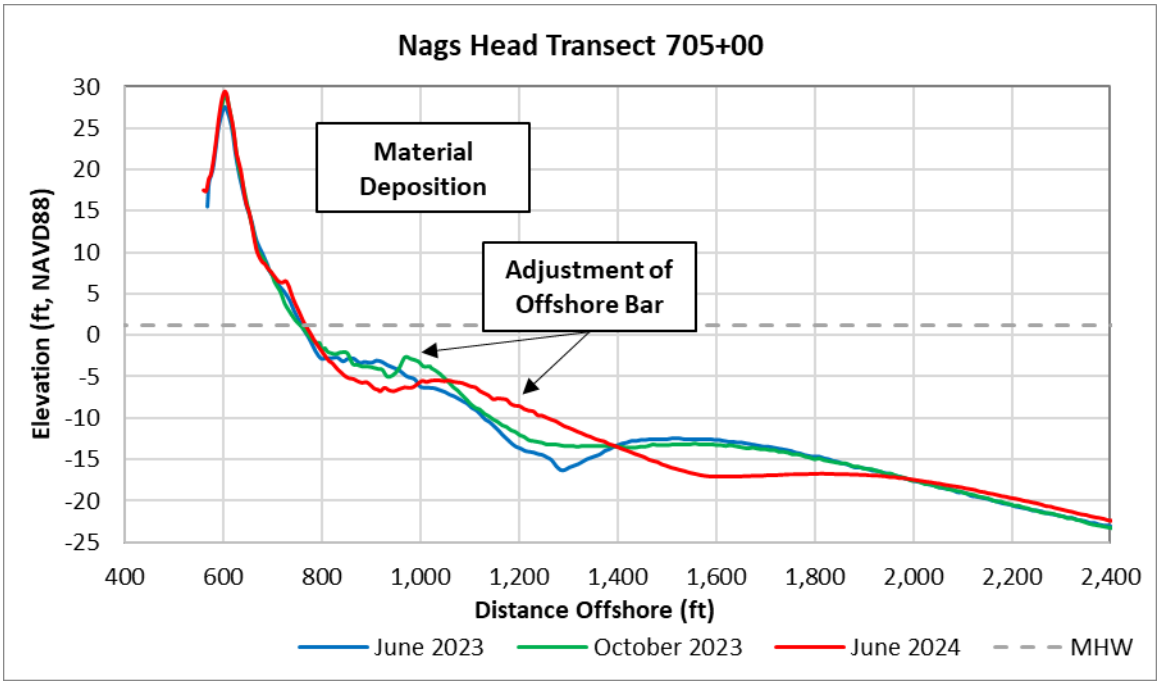



**Figure 5-11. Example Reach 1 Profile, Station 705+00 (E Sea Spray Ct.)**

### *5.3.3 Nags Head - Reach 2 (June 2023 – June 2024)*

The Nags Head – Reach 2 survey reach extends approximately 13,000 ft between Governor Street and James Street, containing 26 survey transects (Station 790+00 – 920+00), at 500 ft spacing (see **Figure 3-1**). A summary of average shoreline and volume changes between June 2023 and June 2024 for Nags Head – Reach 2 in comparison with the Total Monitored Oceanfront is presented in **Table 5-11** and **Table 5-12**. Reach 2 was also surveyed during the October 2023 survey, the volume and shoreline changes observed between this fall survey and June 2024 survey is given in **Table 5-13 and Table 5-14**.

**Table 5-11. Average Shoreline and Average Unit Volume Change for Reach 2 (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - Reach 2 | 790+00 - 920+00 | 13,000 | 6.4 | 4.7 | 8.0 | -0.3 | -7.6 | -6.6 | 5.5 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 6.9 | 1.7 | 3.3 | 0.6 | -10.5 | -9.8 | -2.9 |

**Table 5-12. Cumulative Volume Change for Reach 2 (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above 30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - Reach 2 | 790+00 - 920+00 | 13,000 | 61,511 | 103,820 | -3,551 | -98,804 | -85,912 | 71,490 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 130,713 | 249,384 | 36,080 | -833,226 | -771,119 | -248,056 |

**Table 5-13. Average Shoreline and Average Unit Volume Change for Reach 2 (October 2023 – June 2024)**

| **October 2023 vs. June 2024 (Total Change)** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - Reach 2 | 790+00 - 920+00 | 13,000 | 19.9 | 4.2 | 11.0 | -7.5 | -14.4 | -12.7 | -1.6 |
| Nourished Oceanfront | 495+00 - 1025+00 | 53,000 | 10.2 | 2.5 | 6.6 | -8.1 | -14.5 | -17.5 | -4.7 |

**Table 5-14. Cumulative Volume Change for Reach 2 (October 2023 – June 2024)**

| **October 2023 vs. June 2024 (Total Change)** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - Reach 2 | 790+00 - 920+00 | 13,000 | 54,314 | 143,347 | -98,142 | -186,887 | -164,709 | -21,033 |
| Nourished Oceanfront | 430+00 - 1200+00 | 53,000 | 131,559 | 348,496 | -427,836 | -765,977 | -927,406 | -251,008 |

Shoreline change at MHW showed an overall minor accretion of +6.4 ft. This showed some recovery of the recession observed over June 2023 – October 2023 period. **Figure 5-12** illustrates the shoreline changes at each transect from June 2023 to June 2024, revealing that the majority of transects experienced accretion in the north part of the reach while recession was observed in between 880+00 to 915+00. The seaward advancement observed can be attributed to the material carried onshore to beachface from lower elevations.

**Table 5-11** and **Table 5-12** show that during the annual monitoring period, Reach 2 experienced volume gains at the subaerial beach (+6 ft NAVD88 and MHW) and above -30 ft NAVD88, but lost material at lower elevations. The most significant volume losses were observed above -14 ft NAVD88 (-98,804 cubic yards or -7.6 cy/ft) and above -19 ft NAVD88 (-85,912 cubic yards or -6.6 cy/ft). The volume gain above -30 ft NAVD88 suggests that material lost from higher elevations has shifted offshore.

Similar to Reach 1, Reach 2 experienced increased volume losses between October 2023 and June 2024, particularly above -14 ft NAVD88 and -19 ft NAVD88. This is likely due to persistent high-energy wave events, which have hindered the typical recovery of material during the spring-summer months. **Figure 5-13** displays the unit volume change at each transect above the six elevations analyzed. As can be seen, almost all transects experienced volume losses below MHW.

Profile plots in **Appendix B** reveal multiple instances of material deposition on the beachface, contributing to berm growth. At the same time, troughs have formed between -10 ft NAVD88 and -20 ft NAVD88, indicating material shifting offshore to lower elevations. **Figure 5-14** presents an example profile showing these trends.

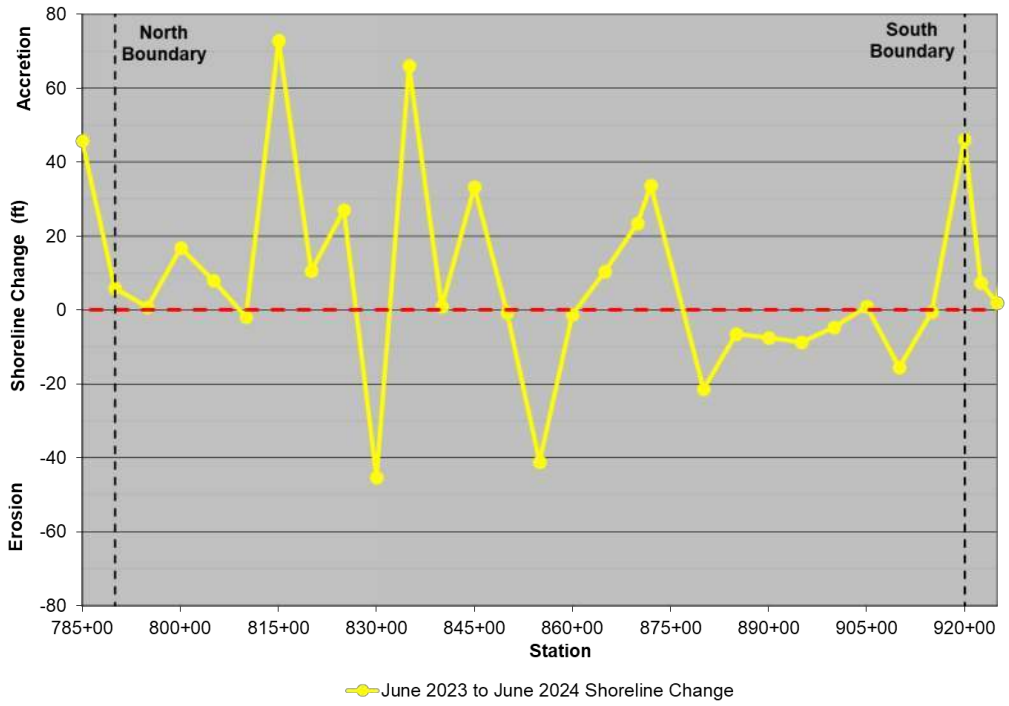



**Figure 5-12. Nags Head – Reach 2 Shoreline Change (June 2023 – June 2024)**

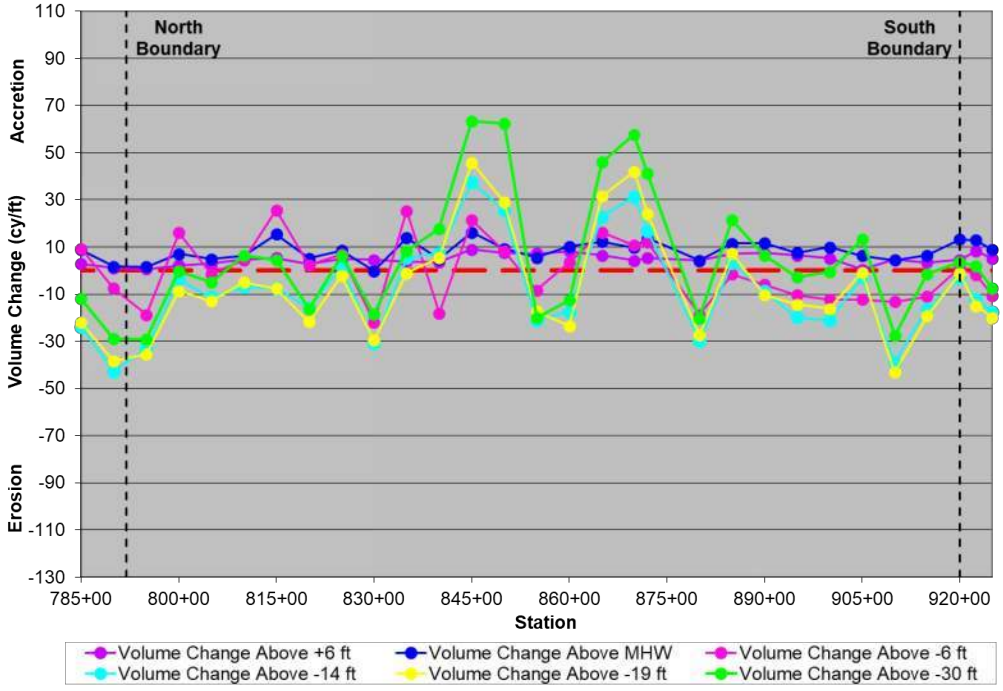



**Figure 5-13. Nags Head – Reach 2 Unit Volume Change (June 2023 – June 2024)**

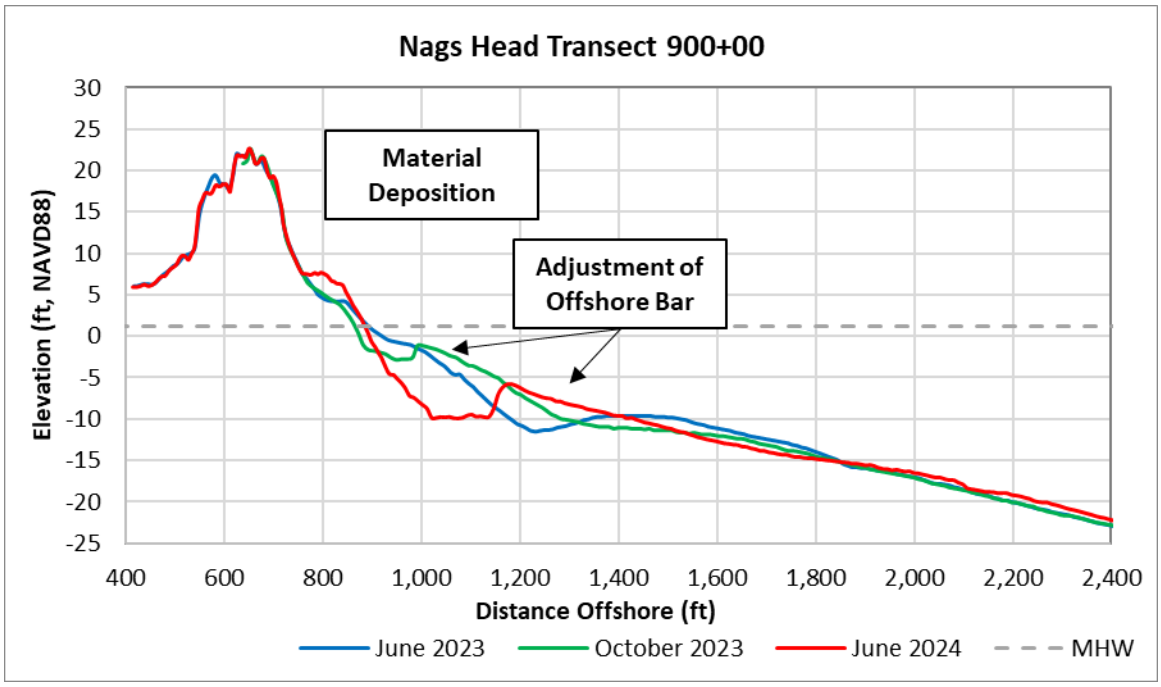



**Figure 5-14. Example Reach 2 Profile, Station 900+00 (E Jay St.)**

### *5.3.4 Nags Head - Reach 3 - North (June 2023 - June 2024)*

The Nags Head – Reach 3 - North survey reach extends approximately 5,500 ft between James Street and Limulus Drive, containing 22 survey transects (Station 920+00 – 975+00), at 500 ft spacing (see **Figure 3-1**). A summary of average shoreline and volume changes between June 2023 and June 2024 for Nags Head – Reach 3 - North in comparison with the Total Monitored Oceanfront is presented in **Table 5-15** and **Table 5-16**. Additionally, **Table 5-27** and **Table 5-28** summarizes the shoreline and volume changes between October 2023 and June 2024.

**Table 5-15. Average Shoreline and Average Unit Volume Change for Reach 3 - North (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - Reach 3 - North | 920+00 - 975+00 | 5,500 | 8.2 | 3.7 | 5.9 | -10.0 | -34.3 | -36.6 | -30.2 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 6.9 | 1.7 | 3.3 | 0.6 | -10.5 | -9.8 | -2.9 |

**Table 5-16. Cumulative Volume Change for Reach 3 - North (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - Reach 3 - North | 920+00 - 975+00 | 5,500 | 21,031 | 33,981 | -57,347 | -197,490 | -210,239 | -173,746 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 130,713 | 249,384 | 36,080 | -833,226 | -771,119 | -248,056 |

**Table 5-17. Average Shoreline and Average Unit Volume Change for Reach 3 - North (October 2023 – June 2024)**

| **October 2023 vs. June 2024 (Total Change)** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - Reach 3 - North | 920+00 - 975+00 | 5,500 | 23.0 | 1.7 | 7.3 | -10.6 | -35.2 | -38.3 | -23.9 |
| Nourished Oceanfront | 495+00 - 1025+00 | 53,000 | 10.2 | 2.5 | 6.6 | -8.1 | -14.5 | -17.5 | -4.7 |

**Table 5-18. Cumulative Volume Change for Reach 3 - North (October 2023 – June 2024)**

| **October 2023 vs. June 2024 (Total Change)** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - Reach 3 - North | 920+00 - 975+00 | 5,500 | 9,142 | 39,897 | -58,243 | -193,529 | -210,619 | -131,518 |
| Nourished Oceanfront | 430+00 - 1200+00 | 53,000 | 131,559 | 348,496 | -427,836 | -765,977 | -927,406 | -251,008 |

Reach 3 - North experienced recession between June 2023 and October 2023, but recovered between October 2023 and June 2024, with material being deposited above MHW. This led to an overall annual seaward advancement of +8.2 ft. **Figure 5-15** shows the shoreline changes at each transect from June 2023 to June 2024, with accretion primarily occurring at the northern transects of the reach.

**Table 5-15** and **Table 5-16** indicate that during the annual monitoring period, Reach 3 - North experienced overall volume loss at elevations below MHW. The most significant volume losses occurred above -14 ft NAVD88 (-197,490 cy or -34.3 cy/ft) and above -19 ft NAVD88 (-210,239 cy or -36.6 cy/ft). These losses are consistent with the erosion observed between October 2023 and June 2024, suggesting that most of the erosion happened during this period. Volume losses above -30 ft NAVD88 suggest that some material may have been transported offshore or to adjacent reaches, as longshore transport rates in this area tend to accelerate compared to the more stable northern reaches.

The volume loss above -19 ft NAVD88 during the monitoring period significantly exceeded the average annual background erosion rate previously observed at Reach 3 - North (-15.2 cy/ft). This is likely due to a combination of high-energy wave conditions and slightly increased east-northeast wave directions, which can cause southerly sediment transport. Additionally, during the prior monitoring period (June 2022 – June 2023), material gains along the Town boundaries were attributed to sediment migrating south from nourishment projects in northern towns. The volume losses above -30 ft NAVD88 support the theory that alongshore transport continued towards Oregon Inlet, removing material from the Town's system.

**Figure 5-16** displays the unit volume change at each transect above the six elevations analyzed. As can be seen, a significant majority of transects experienced volume losses below MHW.

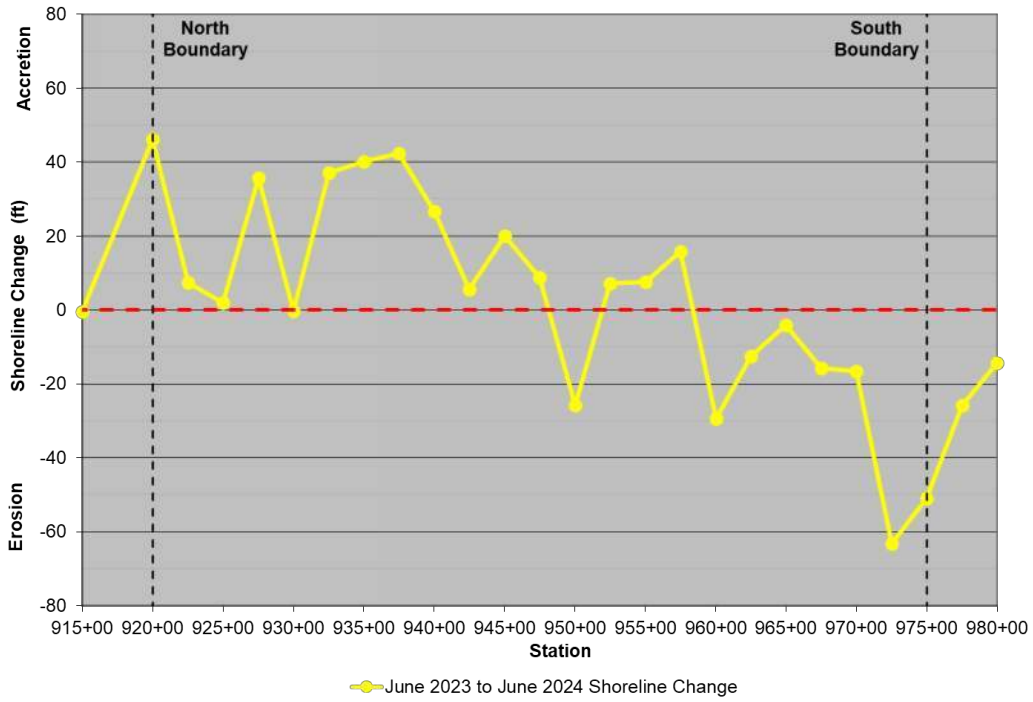



**Figure 5-15. Nags Head – Reach 3 - N Shoreline Change (June 2023 – June 2024)**

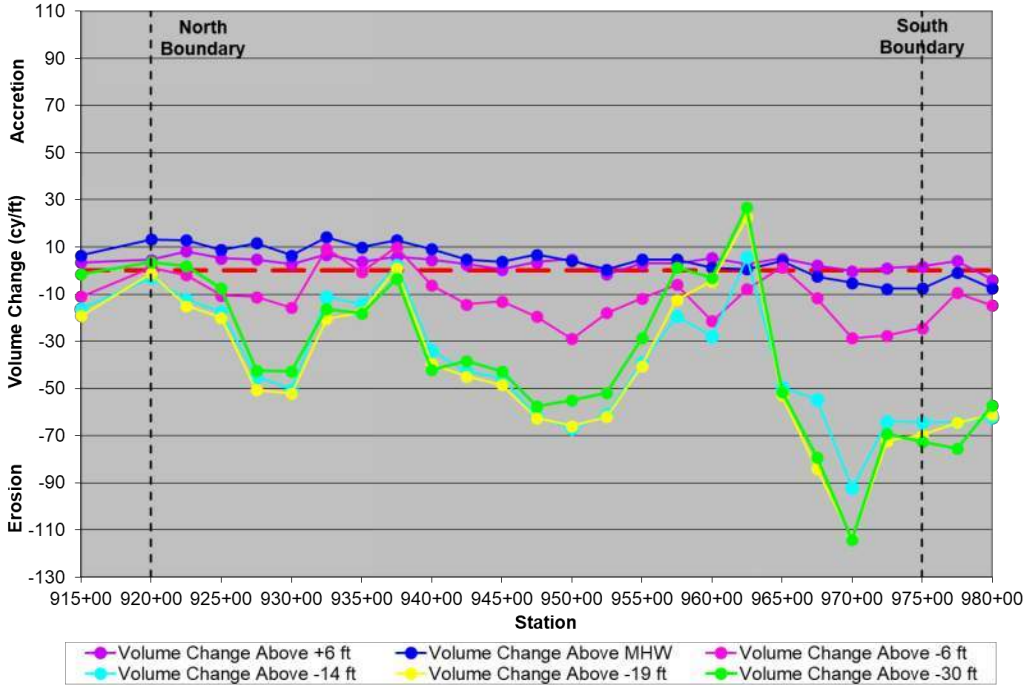



**Figure 5-16. Nags Head – Reach 3 - N Unit Volume Change (June 2023 – June 2024)**

The profile plots in **Appendix B** show several instances where the offshore sand bar shifted further offshore and diminished in size, while a large trough formed in front of it between MHW and -15 ft NAVD88. **Figure 5-17** presents an example profile which shows the adjustment of the offshore sand bar.

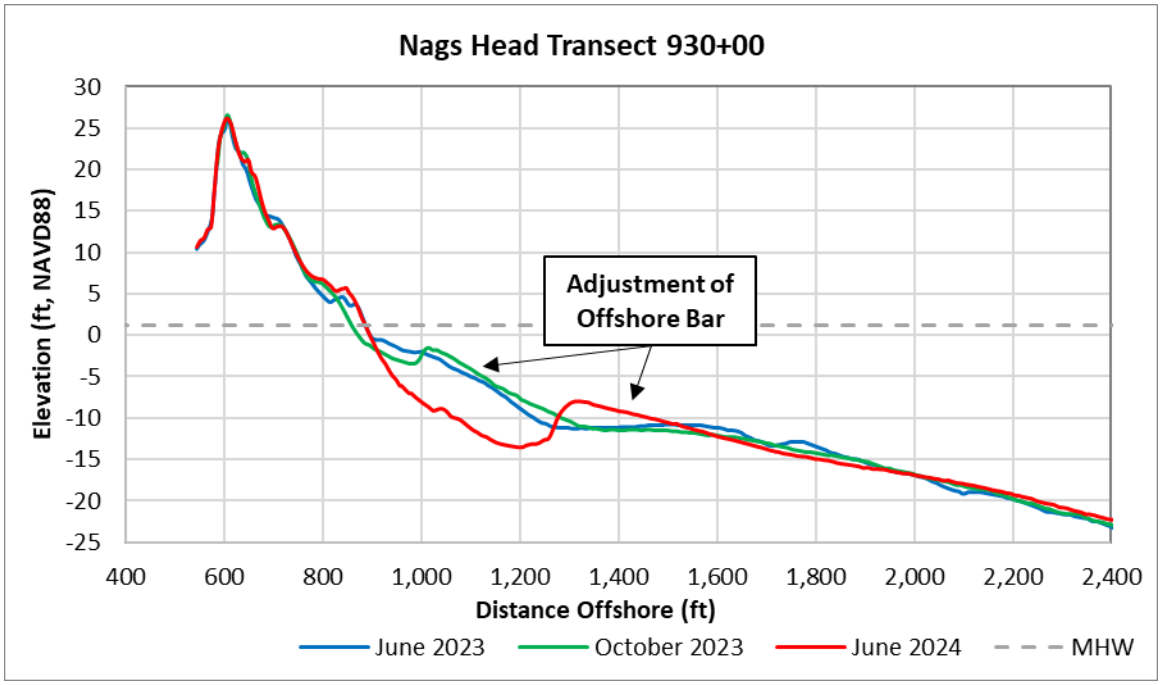



**Figure 5-17. Example Reach 3 - North Profile, Station 930+00 (E Jacobs St.)**

### *5.3.5 Nags Head - Reach 3 - South (June 2023 – June 2024)*

The Nags Head – Reach 3 - South survey reach extends approximately 3,500 ft between Limulus Drive and Loon Court, containing 14 survey transects (Station 975+00 – 1010+00) (see **Figure 3-1**). A summary of average shoreline and volume changes between June 2023 and June 2024 for Reach 3 – South in comparison with the Total Monitored Oceanfront is shown in **Table 5-19** and **Table 5-20**. Additionally, shoreline and volume changes in between October 2023 and June 2024 surveys are presented in **Table 5-21** and **Table 5-22**.

**Table 5-19. Average Shoreline and Average Unit Volume Change for Reach 3 - South (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - Reach 3 - South | 975+00 - 1010+00 | 3,500 | -20.4 | -0.1 | -3.4 | -12.7 | -41.2 | -38.9 | -36.5 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 6.9 | 1.7 | 3.3 | 0.6 | -10.5 | -9.8 | -2.9 |

**Table 5-20. Cumulative Volume Change for Reach 3 - South (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above 30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - Reach 3 - South | 975+00 - 1010+00 | 3,500 | -350 | -11,880 | -44,415 | -144,269 | -136,136 | -127,669 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 130,713 | 249,384 | 36,080 | -833,226 | -771,119 | -248,056 |

**Table 5-21. Average Shoreline and Average Unit Volume Change for Reach 3 - South (October 2023 – June 2024)**

| **October 2023 vs. June 2024 (Total Change)** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - Reach 3 - South | 975+00 - 1010+00 | 3,500 | -16.0 | -3.0 | -4.8 | -17.9 | -42.3 | -41.5 | -38.3 |
| Nourished Oceanfront | 495+00 - 1025+00 | 53,000 | 10.2 | 2.5 | 6.6 | -8.1 | -14.5 | -17.5 | -4.7 |

**Table 5-22. Cumulative Volume Change for Reach 3 - South (October 2023 – June 2024)**

| **October 2023 vs. June 2024 (Total Change)** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - Reach 3 - South | 975+00 - 1010+00 | 3,500 | -10,484 | -16,939 | -62,705 | -148,128 | -145,316 | -134,130 |
| Nourished Oceanfront | 430+00 - 1200+00 | 53,000 | 131,559 | 348,496 | -427,836 | -765,977 | -927,406 | -251,008 |

During the annual monitoring period, the shoreline at MHW experienced significant overall recession, with a retreat of -20.4 ft. The majority of this recession occurred between October 2023 and June 2024, accounting for -16.0 ft of the total. **Figure 5-18** illustrates the shoreline changes at each transect from June 2023 to June 2024, showing recession across all transects.

**Table 5-19** and **Table 5-20** show that Reach 3 - South experienced volume losses across all analyzed elevations. The most significant losses were above -14 ft NAVD88 (-144,269 cubic yards or -41.2 cy/ft) and above -19 ft NAVD88 (-136,131 cubic yards or -38.9 cy/ft), mainly occurring between October 2023 and June 2024. Volume losses above -30 ft NAVD88 suggest that material may have been transported alongshore out of the reach, rather than simply being deposited offshore.

As with Reach 3-North, the volume loss above -19 ft NAVD88 far exceeded the previously observed average annual erosion rate at Reach 3 - South (-23.2 cy/ft), likely due to high-energy wave conditions and slightly increased east-northeast wave directions causing sediment to be transported offshore or southward. In addition, during the previous monitoring period (June 2022 – June 2023), material gains at the Town boundaries were thought to be caused by sediment drifting south from nourishment projects in northern areas. The continued volume losses above -30 ft NAVD88 suggest that sediment was likely transported further south toward Oregon Inlet, moving out of the Town's system altogether.

Reach 3S also experienced volume losses at subaerial elevations. As the material shifted offshore the shoreline receded and material from the beachface and dune shifted lower, causing slight dune scarping and narrowing of recreational beach.

**Figure 5-19** displays the unit volume change at each transect across the six analyzed elevations, indicating volume losses at most transects. Notably, significant losses are observed at the northern transects below -6 ft NAVD88. Similar to Reach 3 - North, the profile plots in **Appendix B** illustrate the offshore sand bar moving further offshore and shrinking in size, while a large trough formed between -6 ft NAVD88 and -15 ft NAVD88. Concurrently, material loss from the berm is also evident.

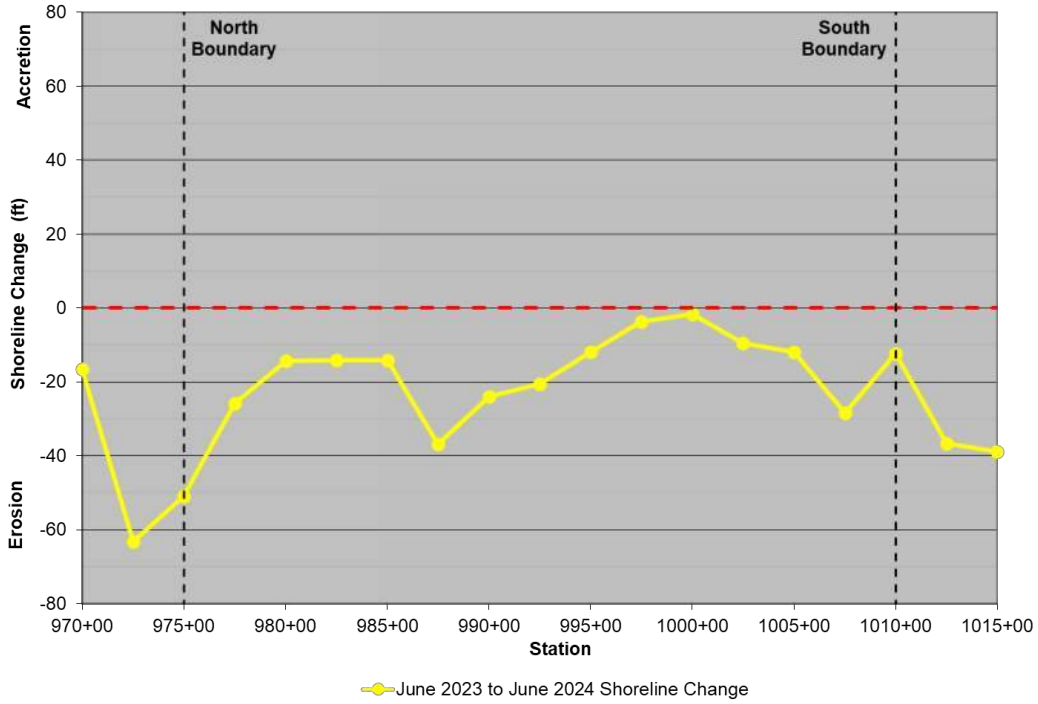



**Figure 5-18. Nags Head – Reach 3 – S Shoreline Change (June 2023 – June 2024)**

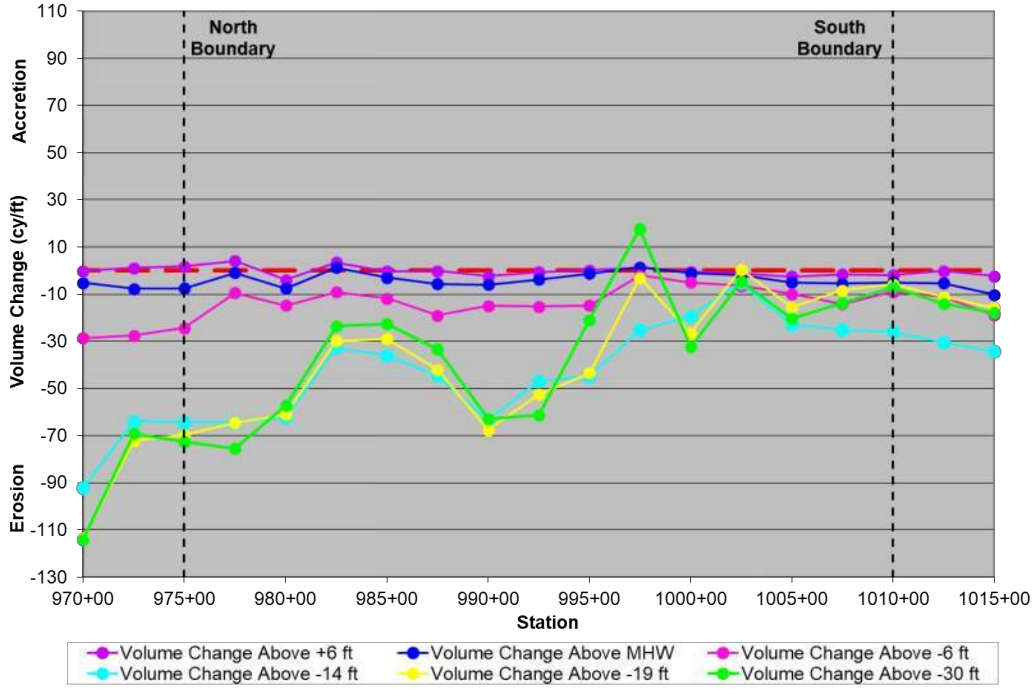



**Figure 5-19. Nags Head – Reach 3 – S Unit Volume Change (June 2023 – June 2024)**

**Figure 5-20** presents an example profile from Reach 3 - South that provides an example profile illustrating the adjustment of the offshore sand bar and shoreline recession.

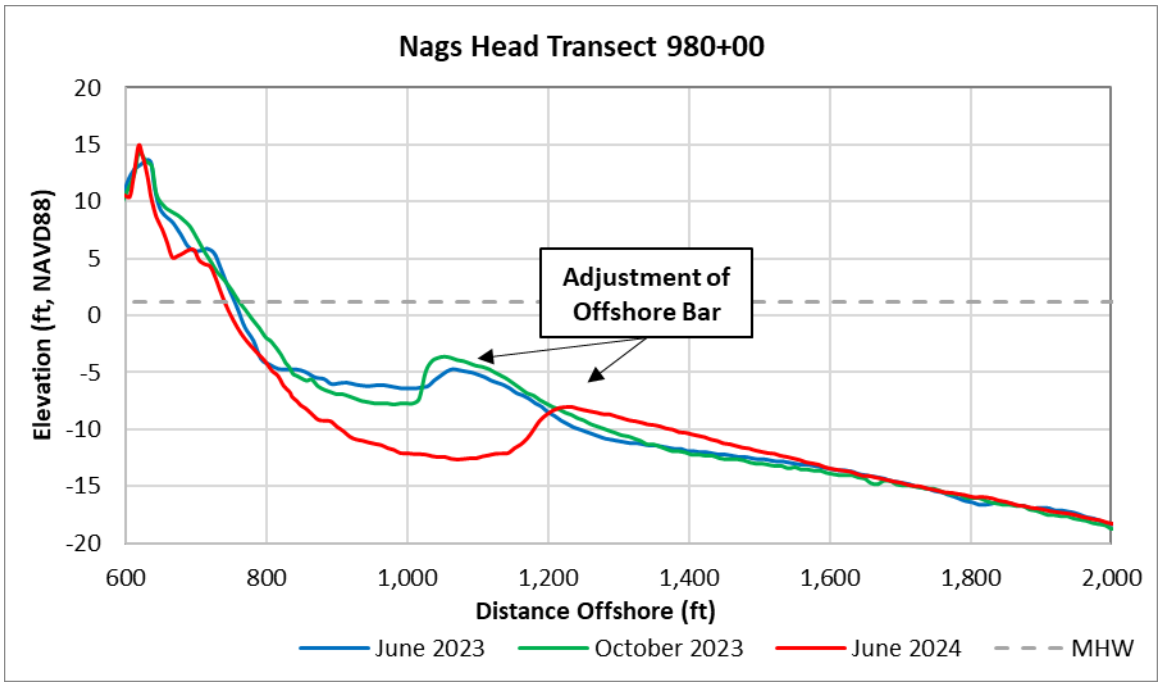



**Figure 5-20. Example Reach 3 - South Profile, Station 980+00 (E Altoona St.)**

### *5.3.6 Nags Head - Reach 4 (June 2023 – July 2024)*

The Nags Head – Reach 4 survey reach extends approximately 1,500 ft between Loon Court and McCall Court, containing seven survey transects (Station 1010+00 – 1025+00), at 500 ft spacing (see **Figure 3-1**). **Table 5-23** and **Table 5-24** summarize the shoreline and volume changes between June 2023 and July 2024 for this reach in comparison with the Total Monitored Oceanfront. Note that this reach was resurveyed in July 2024 due to scarping observed after several storms post-June 2024 survey, so the results reflect changes over the June 2023 – July 2024 period. The volume changes between June and July 2024 surveys are presented in **Appendix E**. Additionally, **Table 5-25** and **Table 5-26** present shoreline and volume changes between the October 2023 and July 2024 surveys.

**Table 5-23. Average Shoreline and Average Unit Volume Change for Reach 4 (June 2023 – July 2024)**

| **June 2023 vs. July 2024** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - Reach 4 | 1010+00 - 1025+00 | 1,500 | -44.9 | -2.5 | -10.4 | -17.9 | -36.1 | -16.1 | -16.5 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 6.9 | 1.7 | 3.3 | 0.6 | -10.5 | -9.8 | -2.9 |

**Table 5-24. Cumulative Volume Change for Reach 4 (June 2023 – July 2024)**

| **June 2023 vs. July 2024** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above 30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - Reach 4 | 1010+00 - 1025+00 | 1,500 | -4,288 | -18,134 | -31,341 | -63,252 | -28,187 | -28,798 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 130,713 | 249,384 | 36,080 | -833,226 | -771,119 | -248,056 |

**Table 5-25. Average Shoreline and Average Unit Volume Change for Reach 4 (October 2023 – July 2024)**

| **October 2023 vs. July 2024 (Total Change)** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - Reach 4 | 1010+00 - 1025+00 | 1,500 | -47 | -4 | -13 | -25 | -45 | -33 | -33.6 |
| Nourished Oceanfront | 495+00 - 1025+00 | 53,000 | 10.2 | 2.5 | 6.6 | -8.1 | -14.5 | -17.5 | -4.7 |

**Table 5-26. Cumulative Volume Change for Reach 4 (October 2023 – July 2024)**

| **October 2023 vs. July 2024 (Total Change)** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - Reach 4 | 1010+00 - 1025+00 | 1,500 | -6,056 | -19,425 | -38,118 | -67,067 | -49,705 | -50,384 |
| Nourished Oceanfront | 430+00 - 1200+00 | 53,000 | 131,559 | 348,496 | -427,836 | -765,977 | -927,406 | -251,008 |

During the annual monitoring period, the shoreline at MHW experienced a significant overall recession of -44.9 ft, with the entire retreat occurring between October 2023 and July 2024. This led to the significant narrowing of the recreational beach and began causing dune scarping, as shown in the photo in **Figure 5-21**. **Figure 5-22** illustrates the shoreline changes at each transect from June 2023 to July 2024, showing recession across all transects.

**Figure 5-21. Scarping adjacent to McCall Ct. on July 27, 2024. (D. Ryan Photo)**

Similar to Reach 3 - South, Reach 4 experienced volume losses across all analyzed elevations during the annual monitoring period, particularly between October 2023 and July 2024. The most significant losses occurred above -14 ft NAVD88 (-144,269 cy or -41.2 cy/ft), primarily due to the removal of the offshore sand bar. Although some material was recovered above -19 ft NAVD88, the volume losses above -30 ft NAVD88 suggest that sediment may have been transported out of the reach.

As with previous reaches, the volume loss above -19 ft NAVD88 greatly exceeded the average annual erosion rate previously observed at Reach 4 (-28.7 cy/ft), likely due to high-energy wave conditions and slightly increased east-northeast wave directions causing southward and offshore sediment transport. Material gains at the Town boundaries in the prior monitoring period (June 2022 – June 2023) were attributed to sediment moving south from northern nourishment projects. The ongoing volume losses above -30 ft NAVD88 suggest that sediment was transported further south toward Oregon Inlet, moving out of the Town's system.

**Figure 5-23** shows unit volume changes at each transect above the six elevations analyzed, indicating volume losses across all transects and elevations. Correspondingly, profile plots in **Appendix B** illustrate erosion along the profiles with a significant removal of the offshore sand bar. **Figure 5-24** presents an example profile displaying the erosion along the profile with and offshore bar removal.

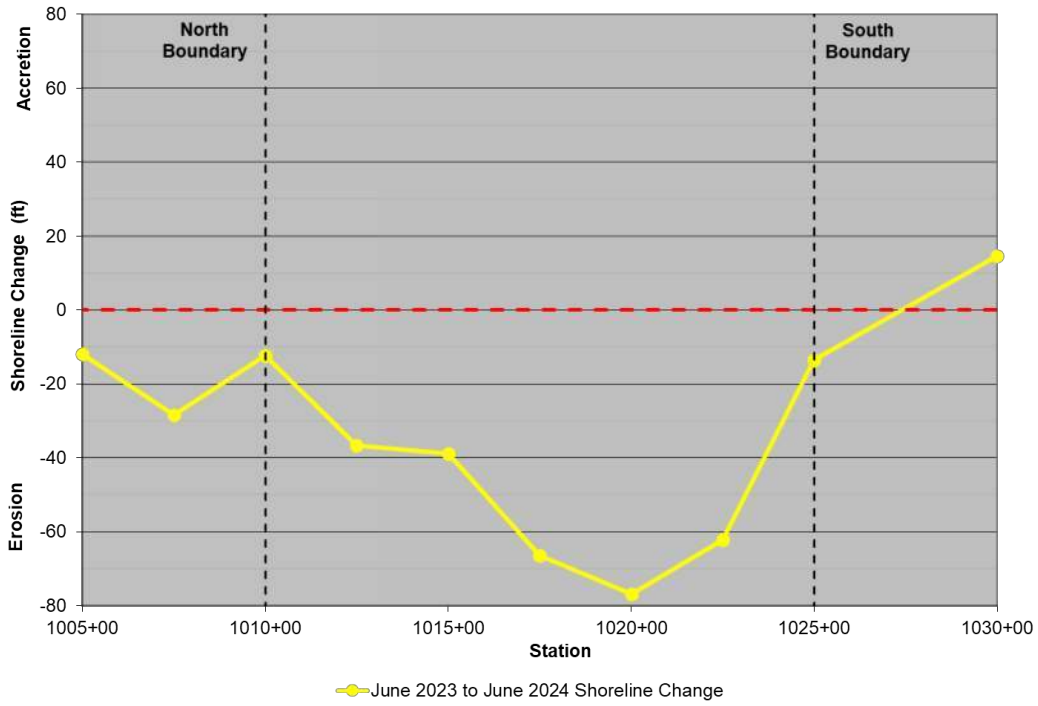



**Figure 5-22. Nags Head – Reach 4 Shoreline Change (June 2023 – June 2024)**

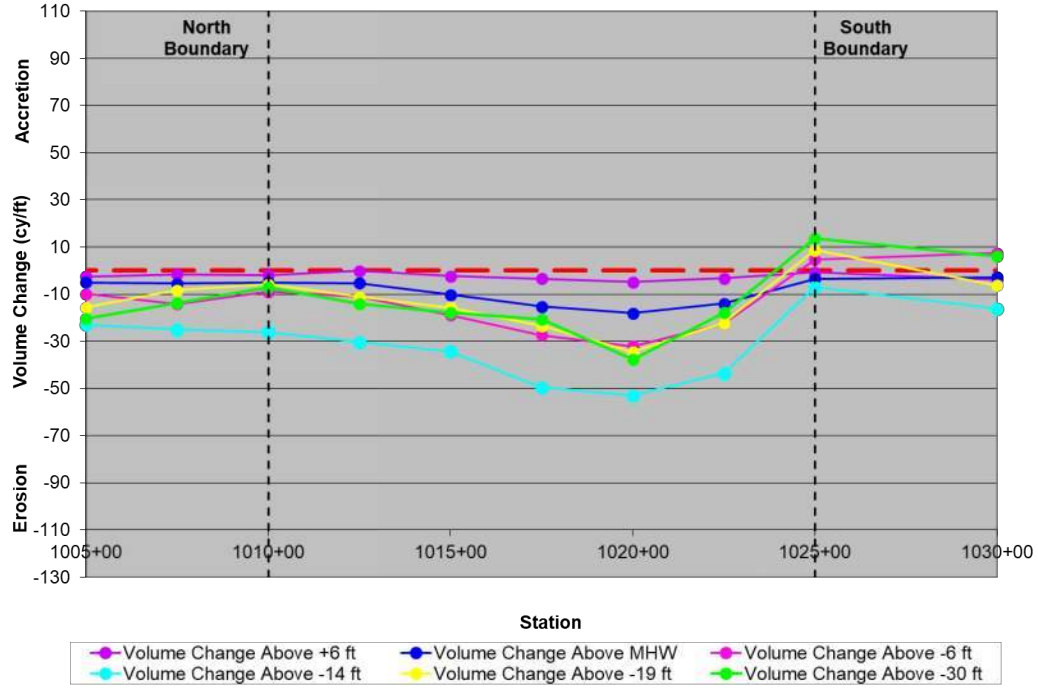



**Figure 5-23. Nags Head – Reach 4 Unit Volume Change (June 2023 – June 2024)**

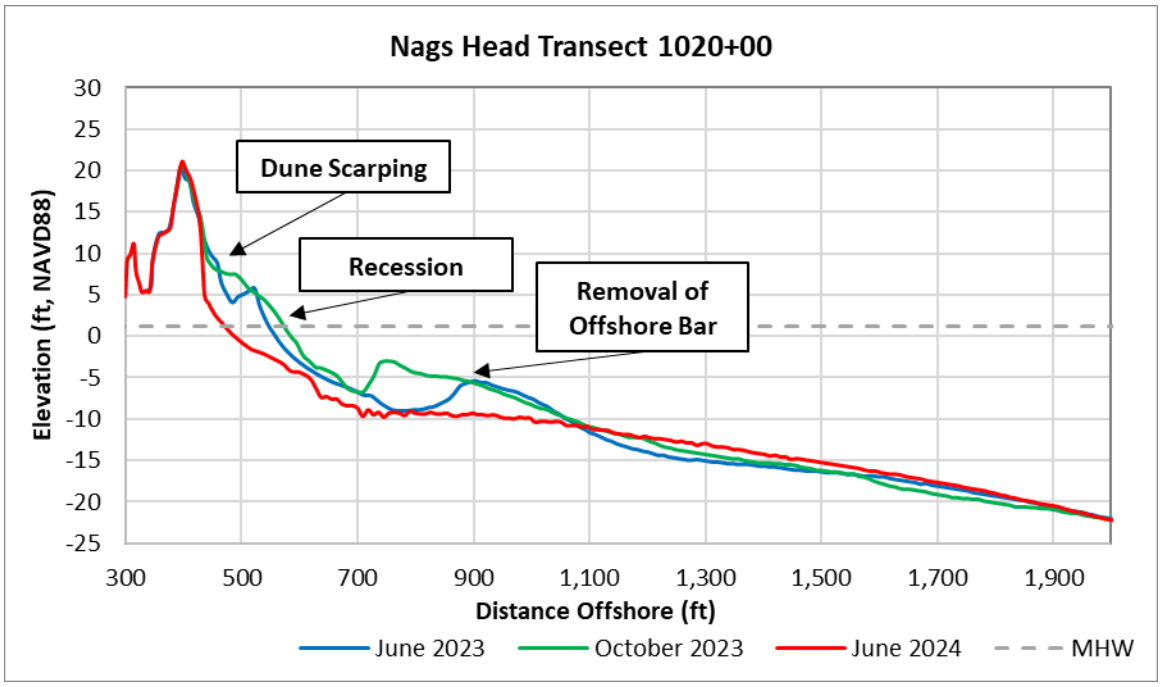



**Figure 5-24. Example Reach 4 Profile, Station 1020+00 (McCall Court)**

### *5.3.7 National Seashore - North (June 2023 – July 2024)*

The National Seashore - North survey reach extends approximately 17,500 ft between McCall Court and Oregon Inlet Campground. The National Seashore - North reach contains 23 survey transects (Station 1025+00 – 1200+00), varying in spacing between 500 ft and 1,000 ft (see **Figure 3-1**). A summary of average shoreline and volume changes between June 2023 and July 2024 for the National Seashore - North Reach is presented along with total oceanfront changes in **Table 5-27** and **Table 5-28**.

**Table 5-27. Average Shoreline and Average Unit Volume Change for National Seashore - North (June 2023 – July 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| National Seashore - North | 1025+00 - 1200+00 | 17,500 | 20.0 | -2.4 | -0.5 | 9.2 | -26.6 | -18.7 | -33.3 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 6.9 | 1.7 | 3.3 | 0.6 | -10.5 | -9.8 | -2.9 |

**Table 5-28. Cumulative Volume Change for National Seashore - North (June 2023 – July 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above 30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| National Seashore - North | 1025+00 - 1200+00 | 17,500 | -42,262 | -8,788 | 161,561 | -465,228 | -326,727 | -582,524 |
| Total Monitored Oceanfront | 430+00 - 1200+00 | 77,000 | 130,713 | 249,384 | 36,080 | -833,226 | -771,119 | -248,056 |

Shoreline change at MHW showed an overall average seaward advancement of +20.0 ft. **Figure 5-25** presents the shoreline changes at each transect, showing accretion along most of the transects.

Overall, the National Seashore - North reach experienced volume losses across all analyzed elevations except above -6 ft NAVD88. The most significant losses occurred above -14 ft NAVD88 (-465,228 cy or -26.6 cy/ft) and above -30 ft NAVD88 (-582,524 cy or -33.3 cy/ft). Losses above -19 ft NAVD88 (-326,727 cy or -18.7 cy/ft) were also substantial but slightly smaller than those above -14 ft NAVD88, indicating only partial recovery of the material lost beyond the depth of closure. Some transects also showed removal of the frontal dune.

**Figure 5-26** displays unit volume changes at each transect across the six analyzed elevations, with most transects showing volume losses below -6 ft NAVD88. Profile plots in **Appendix B** reveal that the slope between MHW and the offshore bar has become milder due to material deposition. The offshore bar is observed to be moving further offshore, lowering, shrinking, and in some cases being removed. **Figure 5-27** provides an example profile illustrating these trends.

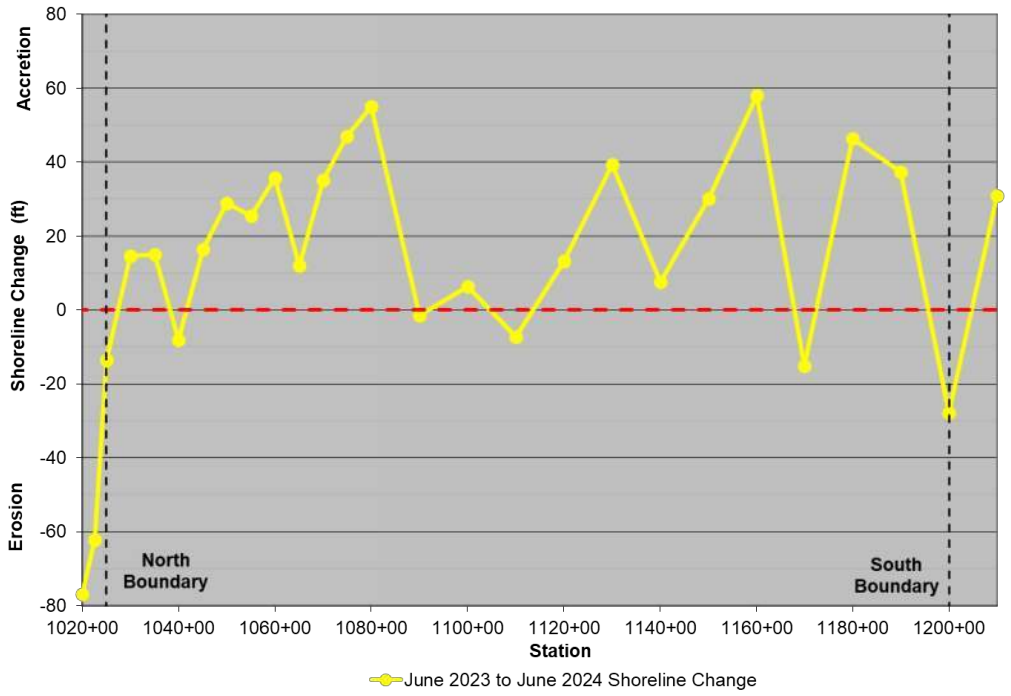



**Figure 5-25. National Seashore - North Shoreline Change (June 2023 – June 2024)**

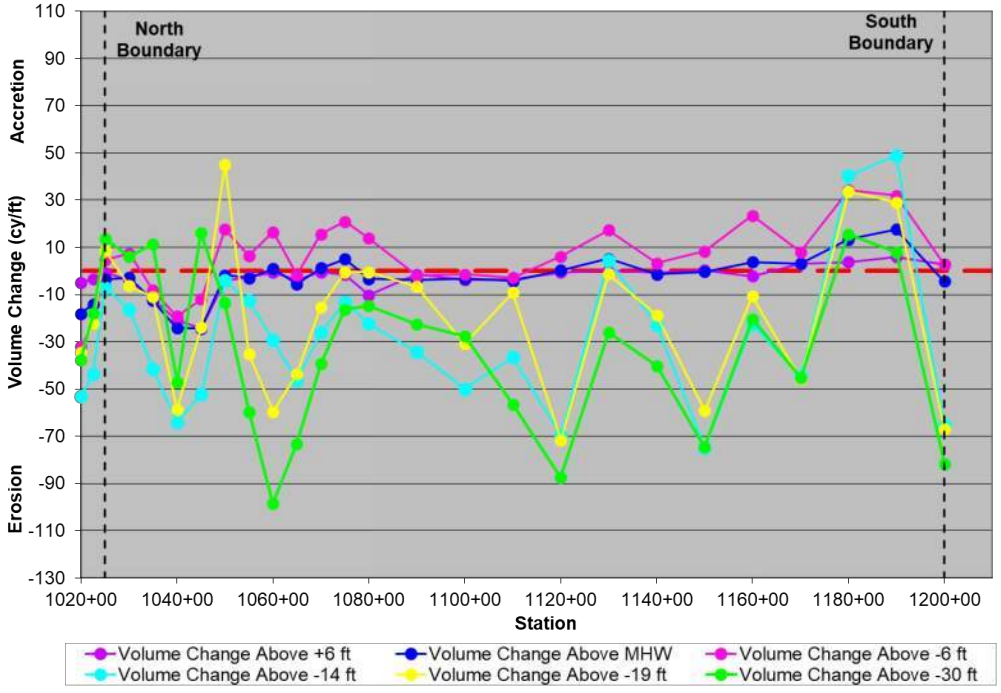



**Figure 5-26. National Seashore - North Unit Volume Change (June 2023 – June 2024)**

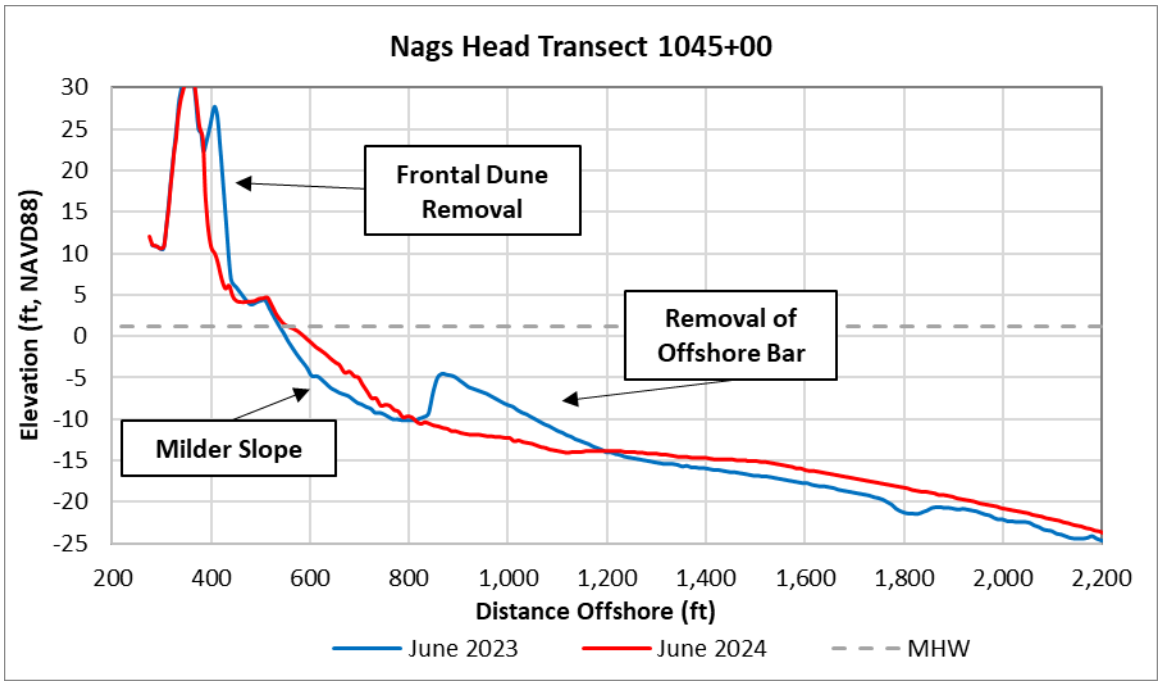



**Figure 5-27. Example National Seashore - North Profile, Station 1045+00**

### *5.3.8 National Seashore - South (June 2023 – July 2024)*

The National Seashore - South survey reach extends approximately 9,000 ft north of Oregon Inlet, containing eight survey transects (Station 1200+00 – 1290+00), at 1,000 ft spacing (see **Figure 3-1**). Shorelines adjacent to an inlet are typically very active due to more complex hydrodynamics and often greater sediment transport rates, which can lead to more extreme profile changes from year to year. **Figure 5-28** presents the shoreline changes at each transect, revealing a predominant seaward advancement in transects to the north and recession in transects to the south except Station 1270+00. **Figure 5-29** shows the aerial image of Oregon Inlet from the beginning and end of the monitoring period. During the monitoring period, material from Station 1230+00 to 1260+00 shifted southward into Bodie Island Spit (**Figure 5-29**), causing recession at the transects in between while leading to significant accretion at Station 1270+00.

Due to the dynamic nature of Oregon Inlet, volume calculations were not meaningful. Instead, profile comparisons between June 2023 and July 2024 (**Appendix B**) were investigated to determine trends. At northern transects, material was deposited on the beachface, leading to the accretion of the shoreline, while transects from Station 1230+00 to 1260+00 experienced erosion. **Figure 5-30** provides an example profile illustrating the erosion.

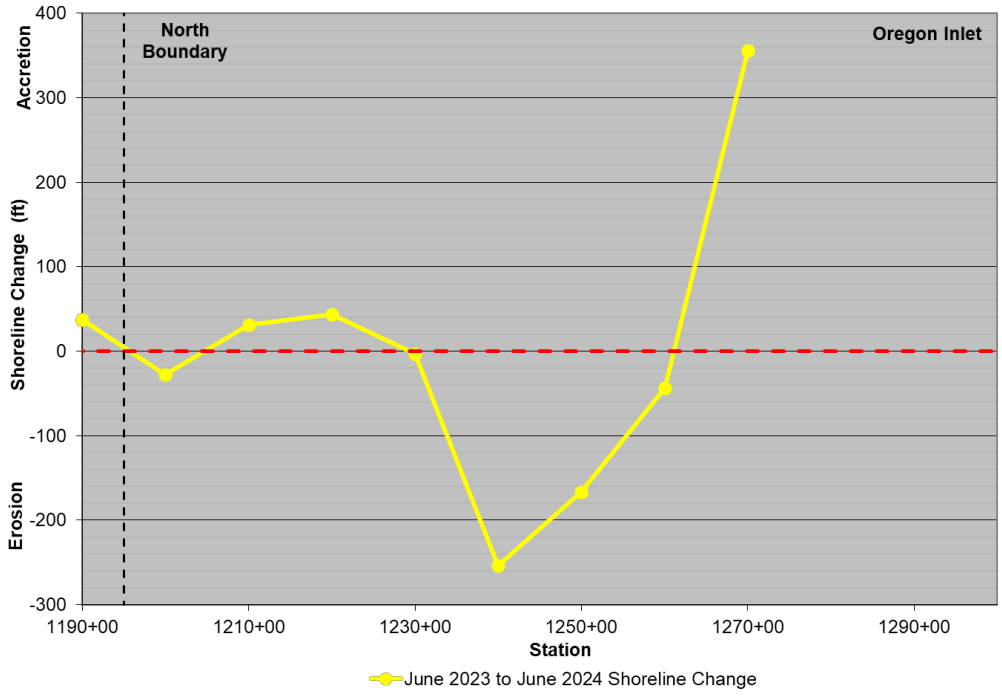



**Figure 5-28. National Seashore - South Shoreline Change (2023 – 2024)**

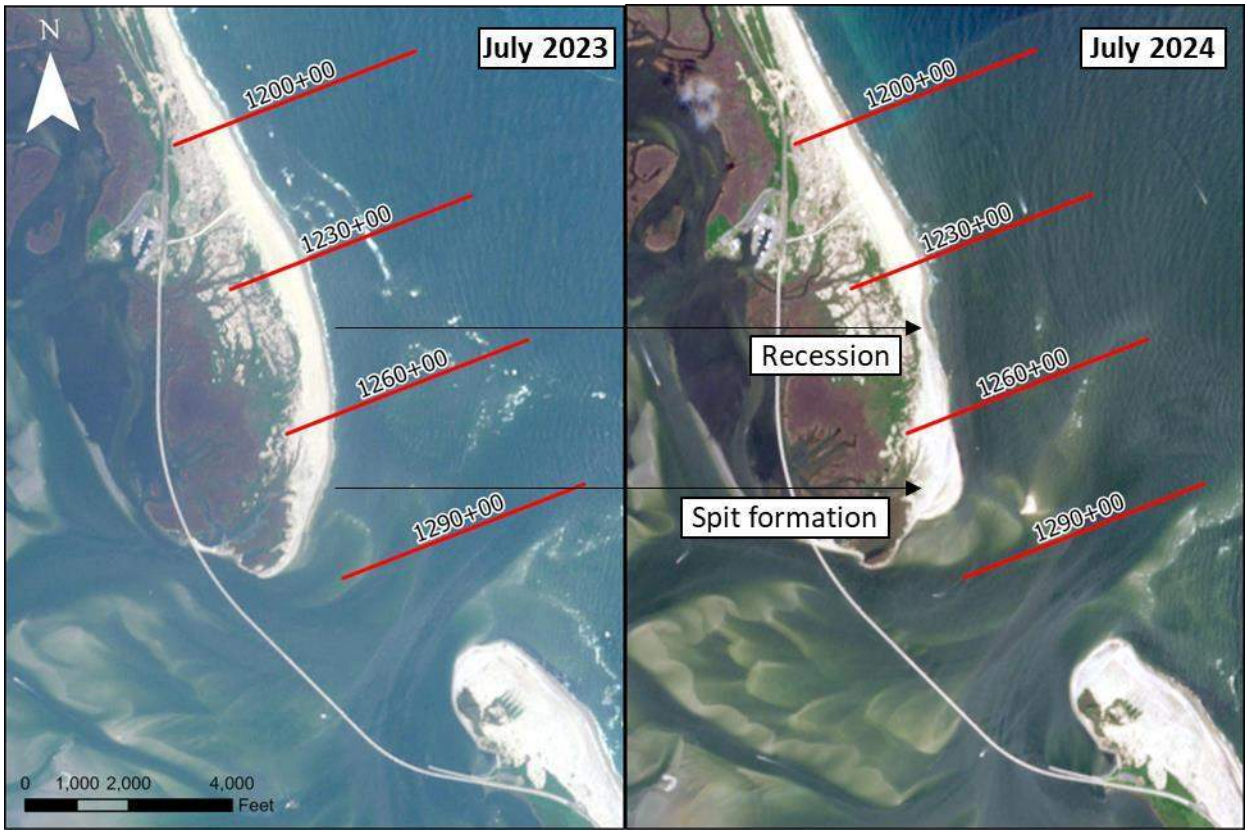



**Figure 5-29. Oregon Inlet Change (07/01/2023 USGS Sentinel Imagery; 07/20/2024 USGS-Sentinel Imagery)**

**Figure 5-30. Example National Seashore - North Profile, Station 1240 (Bodie Island Spit)**

### *5.3.9 Oceanfront Trends Summary for All Reaches (June 2023 – June 2024)*

**Table 5-29** and **Table 5-30** provides a summary of the shoreline and volume changes along Nags Head as presented in the previous sections along with average and total oceanfront values. For Nags Head, since each reach consists of a different length of shoreline, the calculations provide a weighted average for unit shoreline change (ft) and unit volume change (cy/ft) along the Nags Head oceanfront. The weighted average also accounts for differences in the shoreline length between each transect. **Appendix D** contains plots of the shoreline and volume changes between the June 2023 and the June 2024 surveys at each transect along Nags Head.

**Table 5-29. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - North | 430+00 - 495+00 | 6,500 | 6.1 | 3.4 | 4.5 | 0.8 | 11.8 | 9.6 | 26.6 |
| Nags Head - Reach 1 | 495+00 - 790+00 | 29,500 | 5.1 | 2.5 | 4.2 | 0.2 | 2.2 | -1.4 | 14.7 |
| Nags Head - Reach 2 | 790+00 - 920+00 | 13,000 | 6.4 | 4.7 | 8.0 | -0.3 | -7.6 | -6.6 | 5.5 |
| Nags Head - Reach 3N | 920+00 - 975+00 | 5,500 | 8.2 | 3.7 | 5.9 | -10.0 | -34.3 | -36.6 | -30.2 |
| Nags Head - Reach 3S | 975+00 - 1010+00 | 3,500 | -20.4 | -0.1 | -3.4 | -12.7 | -41.2 | -38.9 | -36.5 |
| Nags Head - Reach 4 | 1010+00 - 1025+00 | 1,500 | -44.9 | -2.5 | -10.4 | -17.9 | -36.1 | -16.1 | -16.5 |
| National Seashore North | 1025+00 - 1200+00 | 17,500 | 20.0 | -2.4 | -0.5 | 9.2 | -26.6 | -18.7 | -33.3 |
| | Transects | Reach Length | weighted avg | weighted avg | weighted avg | weighted avg | weighted avg | weighted avg | weighted avg |
| **Nourished Oceanfront** | **495+00 - 1025+00** | **53,000** | **2.7** | **2.9** | **4.4** | **-2.3** | **-7.9** | **-9.2** | **3.5** |
| **Total Monitored Oceanfront*** | **430+00 - 1200+00** | **77,000** | **6.9** | **1.7** | **3.3** | **0.6** | **-10.5** | **-9.8** | **-2.9** |

**National Seashore South Reach not included in the Total Monitored Oceanfront*

**Table 5-30. Nags Head Cumulative Volume Change Statistics (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - North | 430+00 - 495+00 | 6,500 | 20,432 | 27,027 | 4,771 | 70,965 | 57,395 | 159,508 |
| Nags Head - Reach 1 | 495+00 - 790+00 | 29,500 | 74,639 | 123,358 | 6,401 | 64,852 | -41,313 | 433,683 |
| Nags Head - Reach 2 | 790+00 - 920+00 | 13,000 | 61,511 | 103,820 | -3,551 | -98,804 | -85,912 | 71,490 |
| Nags Head - Reach 3N | 920+00 - 975+00 | 5,500 | 21,031 | 33,981 | -57,347 | -197,490 | -210,239 | -173,746 |
| Nags Head - Reach 3S | 975+00 - 1010+00 | 3,500 | -350 | -11,880 | -44,415 | -144,269 | -136,136 | -127,669 |
| Nags Head - Reach 4 | 1010+00 - 1025+00 | 1,500 | -4,288 | -18,134 | -31,341 | -63,252 | -28,187 | -28,798 |
| National Seashore - North | 1025+00 - 1200+00 | 17,500 | -42,262 | -8,788 | 161,561 | -465,228 | -326,727 | -582,524 |
| | Transects | Reach Length | total | total | total | total | total | total |
| **Nourished Oceanfront** | **495+00 - 1025+00** | **53,000** | 152,543 | 231,146 | -130,252 | -438,963 | -501,787 | 174,960 |
| **Total Monitored Oceanfront*** | **430+00 - 1200+00** | **77,000** | 130,713 | 249,384 | 36,080 | -833,226 | -771,119 | -248,056 |

**National Seashore South Reach not included in the Total Monitored Oceanfront*

During the June 2023 - June 2024 monitoring period, Reach 3S and Reach 4 experienced significant shoreline recession, eroding much of the recreational beach. This erosion allowed waves to reach the dunes, resulting in dune scarping especially in Reach 4. The remaining reaches showed slight seaward advancement as material from nearshore was deposited to beachface.

The Nags Head Oceanfront experienced material gains along the subaerial portions of the profiles (+6 ft NAVD88 and MHW), as shown in the profile plots in **Appendix B**. This was mainly due to nearshore material being deposited on the beachface. However, below MHW, volume losses occurred across all analyzed elevations, except above -30 ft NAVD88, where gains were only observed in Reaches 1 and 2. The most significant volume loss was recorded above -19 ft NAVD88 (-438,963 cy or -9.2 cy/ft), exceeding the historical background erosion rate (-6.7 cy/ft). This elevated loss can be attributed to the active 2023-2024 storm season, which brought 17 events with significant wave heights exceeding 8 ft. The frequent storm activity likely prevented the offshore-deposited material from returning to the beach, instead pushing it further offshore to lower elevations. Additionally, material gains at the Town boundaries in the prior monitoring period (June 2022 – June 2023) were attributed to sediment moving south from northern nourishment projects. The ongoing volume losses above -30 ft NAVD88 suggest that sediment was transported further south toward Oregon Inlet, moving out of the Town's system.

The Total Monitored Oceanfront, which includes both the Nags Head North and National Seashore-North reaches flanking the Nourished Oceanfront, exhibited a similar trend of

material gains at subaerial elevations and losses below MHW. While the Nags Head North reach showed material gains across all analyzed elevations, the National Seashore-North reach experienced material losses above all analyzed elevations.

**Figure 5-31** and **Figure 5-32** display the trends seen in **Table 5-29** and **Table 5-30** with bar plots of the average unit volume changes as well as total cumulative volume changes at each sub-reach to help visualize changes that occurred to the Nags Head monitoring area as a whole and how the magnitude of changes compares from one reach to the next. These figures help to visualize the overall changes within the Nags Head monitoring area and highlight how the magnitude of changes compares between reaches. Both figures show significant volume losses above -14 ft NAVD88 and -19 ft NAVD88 across all monitored shoreline reaches, with the exception of the Nags Head North reach. Reaches south of Reach 2 also experienced volume losses above -30 ft NAVD88, suggesting that sediment was either transported further offshore or alongshore, leaving the Town's sediment system.

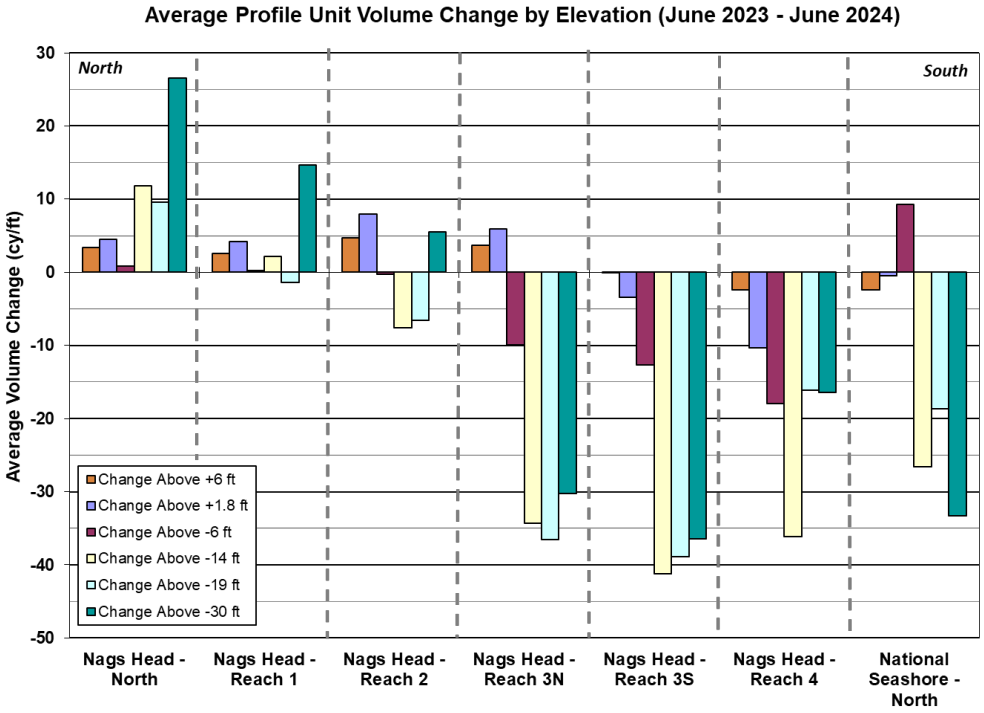



**Figure 5-31. Average Unit Volume Change Within Each Reach (June 2023 – June-July 2024)**

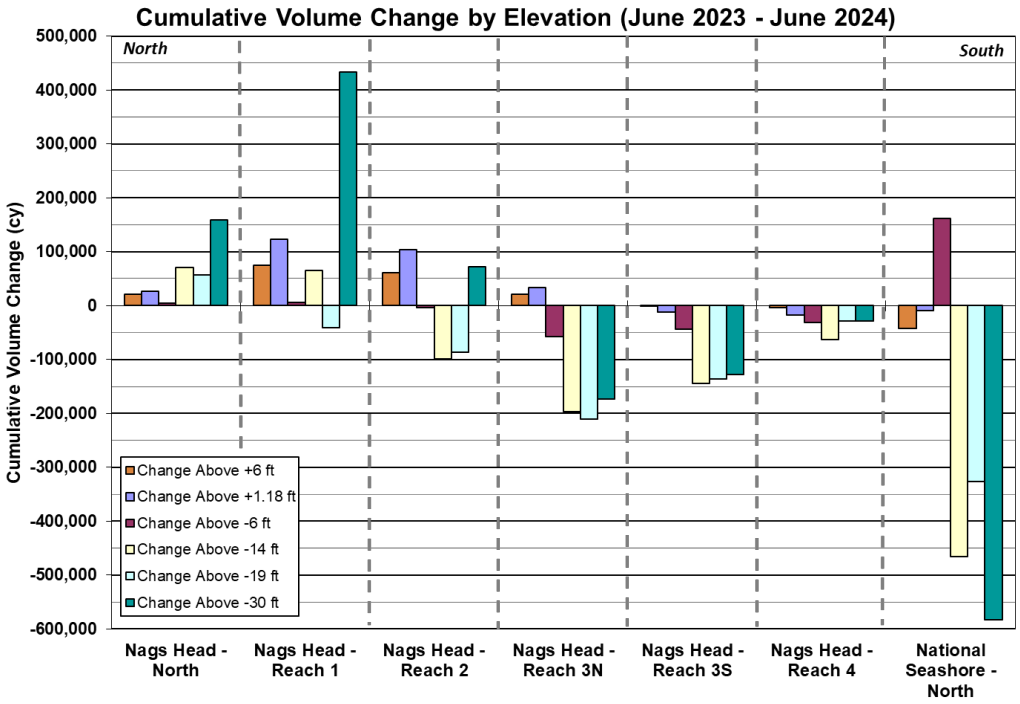



**Figure 5-32. Cumulative Volume Change Within Each Reach (June 2023 – June-July 2024)**

## 5.4 Nourished Oceanfront Performance Relative to Pre-Nourishment

Construction of the 2019 Nags Head Beach Nourishment Project was carried out between May 1, 2019 and August 18, 2019. During the project, a total of 4 million cy of material was placed along approximately 10 miles of shoreline. CSE conducted a pre-construction survey in April 2019. To quantify the performance of the nourishment project, the volume changes between the pre-nourishment survey and the subsequent monitoring surveys were analyzed.

**Figure 5-33** illustrates the shoreline changes relative to pre-nourishment condition (April 2019) along the Nourished Oceanfront. As can be seen from the figure, a significant landward recession occurred along the Nourished Oceanfront since the completion of the 2019 nourishment project. The majority of this recession, noted before the post-Dorian survey, can be attributed to Hurricane Dorian. However, a portion of it was also due to profile equilibration, a natural occurrence during the stabilization of the nourishment profile. Similarly, the August 2022 post-Dorian renourishment project helped mitigate some of the recession. However, by June 2023, the shoreline had receded again, likely due to ongoing profile equilibration. This year, high-energy wave events caused further significant recession, particularly in the southern reaches (3S and Reach 4). In Reach 4, the shoreline has receded beyond the April 2019 pre-nourishment condition.

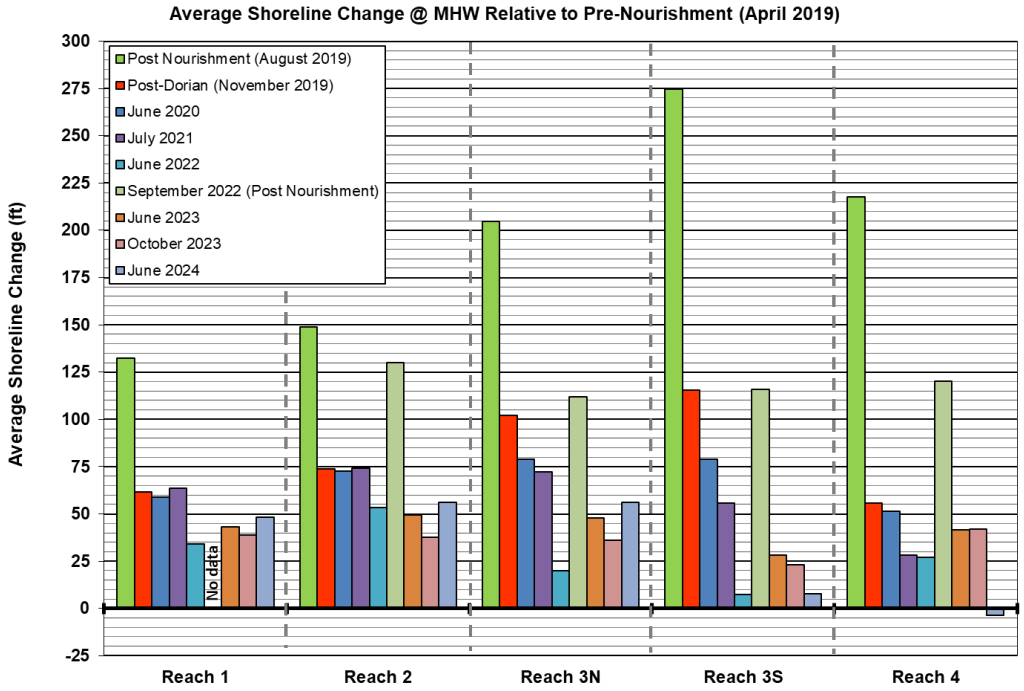



**Figure 5-33. Nourished Oceanfront Average Shoreline Change Relative to Pre-Nourishment Conditions**

**Figure 5-34** and **Table 5-31** presents the volume changes relative to pre-nourishment conditions (April 2019) above six elevations along the Nourished Oceanfront. Notably, the Nourished Oceanfront exhibited material gains along the subaerial elevations (+6 ft NAVD88 and MHW) while losing significant material below MHW.

**Table 5-31** confirms that since the completion of the 2019 nourishment project approximately 598,349 cy (11.3 cy/ft) of volume gain was observed above -19 ft NAVD88 along the Nourished Oceanfront. It's important to highlight that 614,106 cubic yards of material were placed during the 2022 Post-Dorian Renourishment project, indicating that without this renourishment, material loss would have likely occurred above -19 ft NAVD88. The results suggest significant cross-shore shifts of sand across various elevations. Notably, much of the sand has moved to lower elevations near the depth of closure, where it becomes vulnerable to being removed from the system during high-energy wave events.

**Table 5-31. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment Conditions**

| | Reaches | Stations | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 |
|---|---|---|---|---|---|---|---|
| Pre-Nourishment (April 2019) -Post Nourishment (August 2019) | Reach 1 | 495+00 - 790+00 | 47,918 | 1,258,165 | 1,693,618 | 1,755,354 | 1,762,213 |
| | Reach 2 | 790+00 - 920+00 | 15,959 | 568,190 | 861,317 | 883,160 | 885,587 |
| | Reach 3N | 920+00 - 975+00 | 45,018 | 447,070 | 602,835 | 579,316 | 576,703 |
| | Reach 3S | 975+00 - 1010+00 | 24,590 | 94,184 | 521,783 | 538,928 | 540,833 |
| | Reach 4 | 1010+00 - 1025+00 | 19,612 | 37,063 | 270,325 | 242,401 | 239,298 |
| | **Nourished Oceanfront** | **495+00 - 1025+00** | **153,098** | **2,404,672** | **3,949,879** | **3,999,158** | **4,004,634** |
| Pre-Nourishment (April 2019) -Post Dorian (November 2019) | Reach 1 | 495+00 - 790+00 | 122,742 | 890,211 | 1,043,259 | 1,670,583 | 1,649,959 |
| | Reach 2 | 790+00 - 920+00 | 53,589 | 441,740 | 550,539 | 906,718 | 817,193 |
| | Reach 3N | 920+00 - 975+00 | 53,200 | 273,200 | 304,616 | 414,929 | 388,407 |
| | Reach 3S | 975+00 - 1010+00 | 29,753 | -14,098 | 295,230 | 387,901 | 350,928 |
| | Reach 4 | 1010+00 - 1025+00 | 10,924 | -47,450 | 67,788 | 85,461 | 62,951 |
| | **Nourished Oceanfront** | **495+00 - 1025+00** | **270,208** | **1,543,604** | **2,261,432** | **3,465,591** | **3,269,438** |
| Pre-Nourishment (April 2019) - June 2020 | Reach 1 | 495+00 - 790+00 | 193,057 | 964,264 | 991,610 | 1,633,023 | 2,052,621 |
| | Reach 2 | 790+00 - 920+00 | 110,115 | 502,260 | 554,438 | 935,933 | 1,109,539 |
| | Reach 3N | 920+00 - 975+00 | 72,432 | 288,994 | 261,920 | 383,133 | 526,039 |
| | Reach 3S | 975+00 - 1010+00 | 41,649 | -4,082 | 235,215 | 316,084 | 354,188 |
| | Reach 4 | 1010+00 - 1025+00 | 21,996 | -28,740 | 33,984 | 45,101 | 71,796 |
| | **Nourished Oceanfront** | **495+00 - 1025+00** | **439,248** | **1,722,697** | **2,077,167** | **3,313,273** | **4,114,183** |
| Pre-Nourishment (April 2019) - July 2021 | Reach 1 | 495+00 - 790+00 | 272,387 | 1,144,705 | 1,177,224 | 1,849,575 | 2,263,667 |
| | Reach 2 | 790+00 - 920+00 | 139,655 | 559,446 | 705,370 | 1,035,767 | 1,250,047 |
| | Reach 3N | 920+00 - 975+00 | 75,007 | 303,408 | 242,005 | 349,588 | 511,176 |
| | Reach 3S | 975+00 - 1010+00 | 39,685 | -14,715 | 184,822 | 252,470 | 316,292 |
| | Reach 4 | 1010+00 - 1025+00 | 18,948 | -35,699 | 15,219 | 22,910 | 79,520 |
| | **Nourished Oceanfront** | **495+00 - 1025+00** | **545,682** | **1,957,146** | **2,324,639** | **3,510,310** | **4,420,702** |
| Pre-Nourishment (April 2019) - June 2022 | Reach 1 | 495+00 - 790+00 | 326,493 | 1,076,208 | 983,159 | 1,188,310 | 2,059,260 |
| | Reach 2 | 790+00 - 920+00 | 124,552 | 437,580 | 512,104 | 498,138 | 1,039,949 |
| | Reach 3N | 920+00 - 975+00 | 46,334 | 206,727 | 156,733 | 11,292 | 344,958 |
| | Reach 3S | 975+00 - 1010+00 | 22,972 | -45,066 | 153,151 | 142,466 | 313,583 |
| | Reach 4 | 1010+00 - 1025+00 | 14,154 | -43,008 | -523 | -5,248 | 64,869 |
| | **Nourished Oceanfront** | **495+00 - 1025+00** | **534,504** | **1,632,442** | **1,804,624** | **1,834,958** | **3,822,618** |
| Pre-Nourishment (April 2019) - June 2023 | Reach 1 | 495+00 - 790+00 | 335,917 | 1,059,107 | 1,006,248 | 1,713,208 | 2,318,425 |
| | Reach 2 | 790+00 - 920+00 | 164,020 | 522,559 | 672,631 | 1,116,802 | 1,501,016 |
| | Reach 3N | 920+00 - 975+00 | 69,003 | 259,624 | 260,863 | 445,635 | 672,518 |
| | Reach 3S | 975+00 - 1010+00 | 39,437 | -12,111 | 198,971 | 315,891 | 493,380 |
| | Reach 4 | 1010+00 - 1025+00 | 16,489 | -39,790 | 4,174 | 31,740 | 119,431 |
| | **Nourished Oceanfront** | **495+00 - 1025+00** | **624,865** | **1,789,389** | **2,142,887** | **3,623,277** | **5,104,771** |
| Pre-Nourishment (April 2019) - June 2024 | Reach 1 | 495+00 - 790+00 | 410,557 | 1,182,465 | 1,012,650 | 1,778,061 | 2,277,112 |
| | Reach 2 | 790+00 - 920+00 | 225,530 | 626,379 | 669,080 | 1,017,997 | 1,415,104 |
| | Reach 3N | 920+00 - 975+00 | 90,033 | 293,605 | 203,516 | 248,145 | 462,279 |
| | Reach 3S | 975+00 - 1010+00 | 39,087 | -23,991 | 154,556 | 171,622 | 357,244 |
| | Reach 4 | 1010+00 - 1025+00 | 12,201 | -57,924 | -27,167 | -31,512 | 91,244 |
| | **Nourished Oceanfront** | **495+00 - 1025+00** | **777,408** | **2,020,534** | **2,012,635** | **3,184,313** | **4,602,983** |

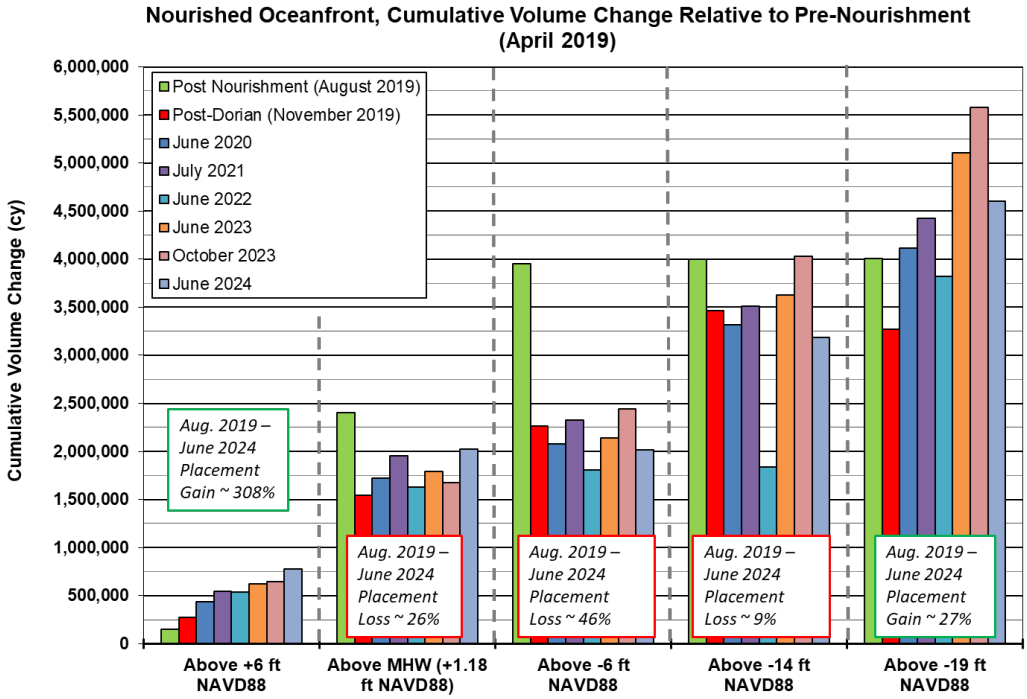



**Figure 5-34. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment**

**Figure 5-35** illustrates the volume changes relative to pre-nourishment conditions (April 2019) above +6 ft NAVD88 along the Nourished Oceanfront. All the reaches, excluding Reach 4, experienced a gain in material above +6 ft NAVD88. However, Reach 4 incurred a loss of approximately 38% of the material that was originally placed above +6 ft NAVD88 during the 2019 Nourishment Project. Notably, 31% of this loss occurred this year, driven by substantial recession that led to dune scarping.

**Figure 5-36** shows the volume changes relative to pre-nourishment conditions (April 2019) above MHW (+1.18 ft NAVD88) along the Nourished Oceanfront. Notably, all reaches except Reach 2, experienced material losses above MHW following the completion of the 2019 nourishment project. Similar to shoreline changes (see **Figure 5-33**), the majority of these losses were observed during the Post-Dorian survey, encompassing both the erosion caused by Hurricane Dorian and the equilibrium of the nourishment profile.

**Figure 5-37** presents the volume changes above -19 ft NAVD88 relative to pre-nourishment conditions (April 2019) along the Nourished Oceanfront. Reach 1 and Reach 2 show volume gains above -19 ft NAVD88 when compared to pre-nourishment levels. In contrast, the remaining reaches experienced material losses, with Reach 3N and Reach 3S both losing less than 50% of the material placed during the 2019 nourishment. However, Reach 4 has undergone significant material loss, having lost 62% of the nourished material by the end of this monitoring period.

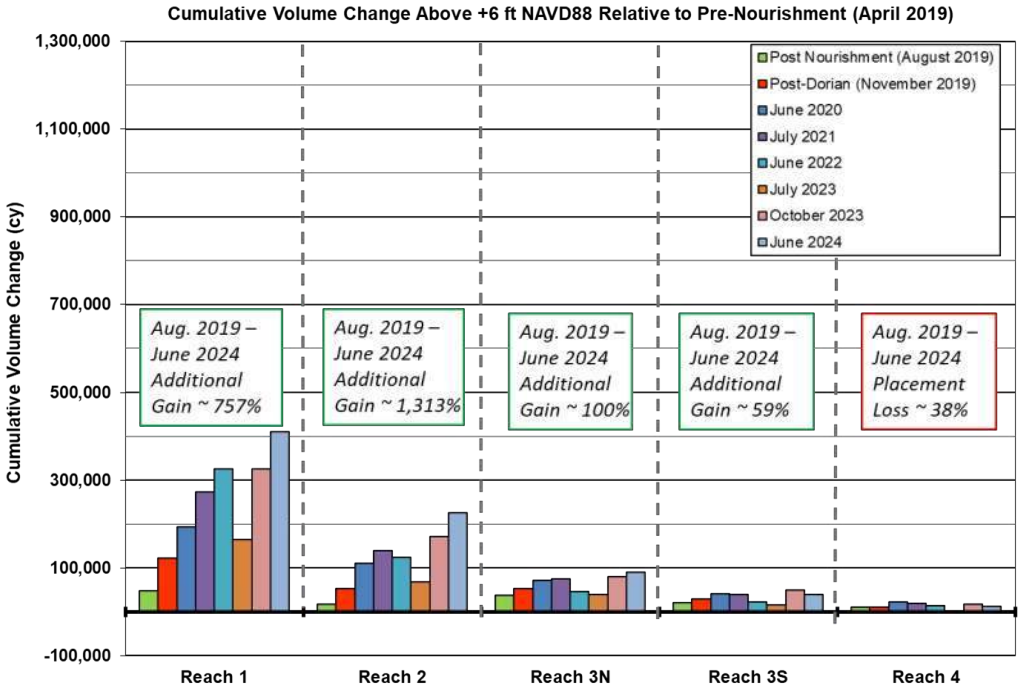



**Figure 5-35. Cumulative Volume Change Above +6 ft NAVD88 Relative to Pre-Nourishment**

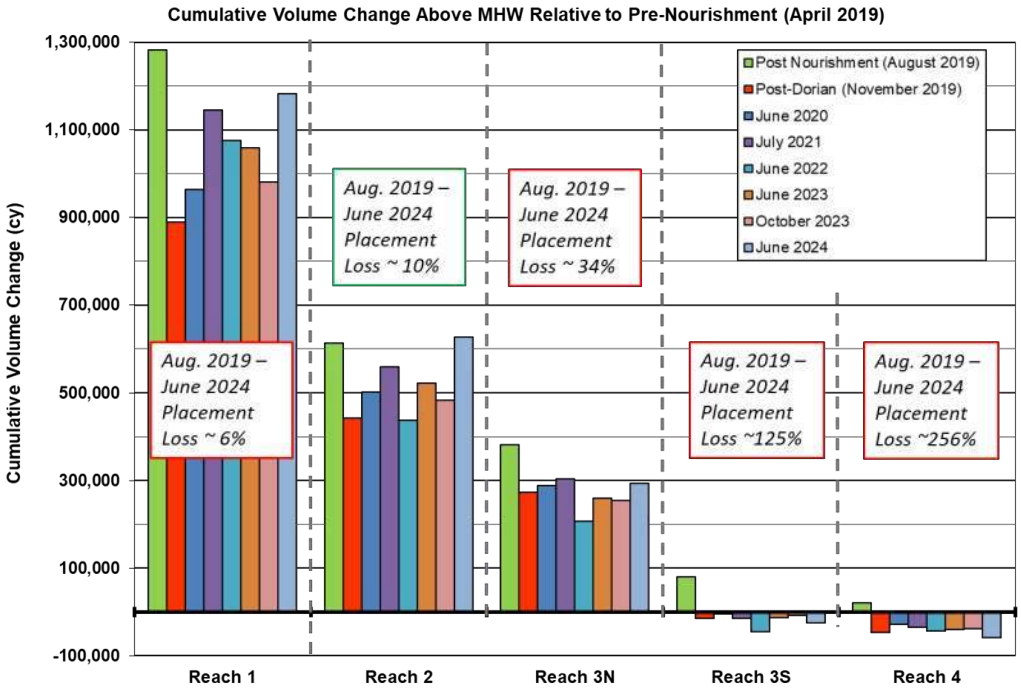



**Figure 5-36. Cumulative Volume Change Above MHW Relative to Pre-Nourishment**

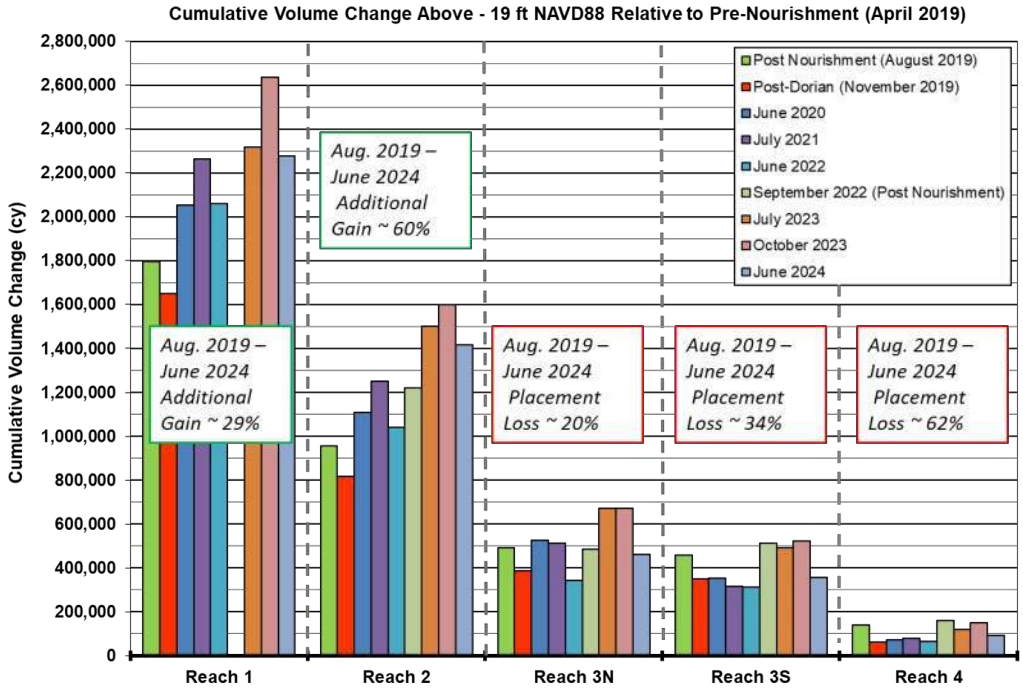



**Figure 5-37. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment**

## 5.5 Multi-Decadal Beach Nourishment Master Plan

The Town of Nags Head has developed a Multi-Decadal Beach Nourishment Master Plan (Master Plan), adopted in July 2024, to provide a framework to plan and conduct beach maintenance and storm response projects over a 50-year timeframe. With this framework in place, the Town will be able to efficiently plan the permitting, financing, and construction of future beach nourishment projects.

The annual monitoring efforts will decide the timing and extents of these projects by tracking the average profile volume in each management reach as compared to the nourishment triggers that define the minimum profile volumes required to provide an equivalent level of protection along the Nags Head shoreline. While future beach nourishment projects will be sequenced and designed predominantly upon volumetric needs for infrastructure protection, other factors including funding sources and availability, feasibility of construction, and tourism and recreational use can also influence design considerations and may be considered on a project-by-project basis.

The volumetric triggers developed as part of the Master Plan are based on the profile volume from the foredune (landward most crest of primary dune) to the outer bar, above the -19 ft NAVD88 elevation. These triggers were developed to provide equivalent protection along the Nags Head oceanfront. Based on the engineering analysis and historical and expected future funding levels, it was determined that the Town would be able to maintain a Level of Protection (LoP) from a 25-year return period storm event. Detailed CSHORE modeling (a 1-D cross-shore numerical model) was used to determine the amount of sand above -19 ft NAVD88 that is needed to provide the 25-year event LoP in each management reach. This is different for each reach, depending on the existing dune height, berm width, and other profile characteristics. **Table 5-32** presents the management reaches and nourishment triggers determined in the Master Plan. As shown in the table, each reach has a slightly different volume trigger, with a Town-wide average of 464 cy/ft.

**Table 5-32. Trigger Volumes Above -19 ft NAVD88 for 25-yr Event**

| Reach | Stations | Length (ft) | Reach Trigger for 25-yr event (cy/ft) |
|---|---|---|---|
| **Nags Head - North** | 430+00- 495+00 | 6,500 | 355 |
| **Reach 1** | 495+00- 790+00 | 29,500 | 470 |
| **Reach 2** | 790+00- 920+00 | 13,000 | 502 |
| **Reach 3 - North** | 920+00- 975+00 | 5,500 | 446 |
| **Reach 3 - South** | 975+00- 1010+00 | 3,500 | |
| **Reach 4** | 1010+00- 1025+00 | 1,500 | |
| **TOTAL** | | 59,500 | 464 |

Because this is a new protocol for evaluating the state of the Town's beach, all profile data from 2011 to present was re-evaluated considering these volumetric triggers, as shown in **Figure 5-38**. It is noted that the start position for the volumetric computation in the trigger

evaluation is different from the Xon (computation start) location for the historical volume change analysis presented in this and previous reports. The volumetric trigger is computed from the approximate dune crest location to the offshore location of the -19 ft NAVD88 contour.

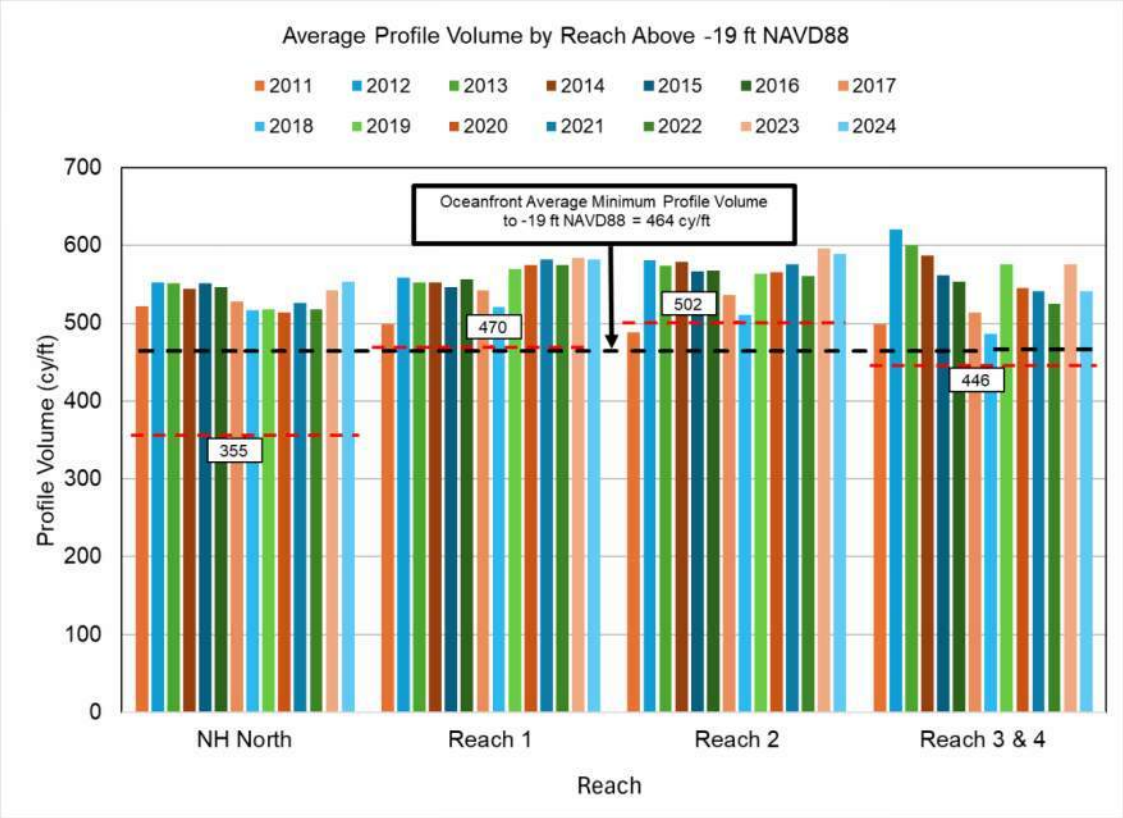



**Figure 5-38. Master Plan Nourishment Trigger Volume Comparison**

All management reaches currently contain average profile volumes above the nourishment triggers, however, there have been localized erosion hotspots observed along the Town's shoreline in the summer of 2024. To more closely examine the current status of the beach, the profile volumes from all transects as of June – July 2024 are presented in **Figure 5-39**. Localized segments of Reaches 3 and 4 have profiles below the trigger volumes (red arrows), and additional localized segments of Reaches 1 and 2 are close to the triggers (yellow arrows).

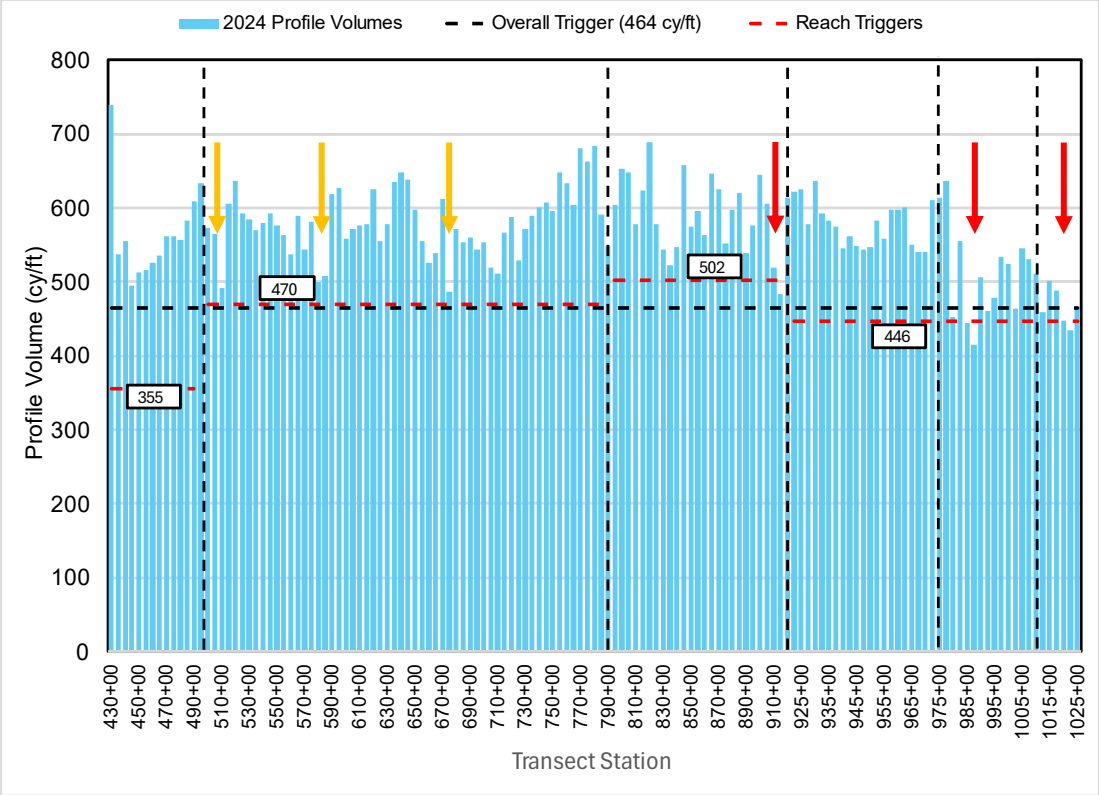



**Figure 5-39. 2024 Beach Profile Volumes and Master Plan Trigger Volume Comparison. Red arrows indicate locations that are below the trigger volumes and yellow areas indicate areas that are close to the trigger volumes.**

An evaluation of the recreational beach width as approximated by the distance from the MHW contour to the +6 ft NAVD88 contour is also presented in **Figure 5-40**. Because of the scatter in the data points, a 9-point moving average was employed to more clearly illustrate overall trends along the shoreline. There has been substantial loss of the recreational beach width in several sections of the shoreline, including STA 470+00 to 570+00, 810+00 to 925+00, and 975+00 south to the Town boundary. The loss of the dry beach also makes it more likely that the dunes will be impacted by high water level and wave events.

Given these results, the Town may consider accelerating the timeline for the next beach nourishment project, currently planned for Summer 2027.

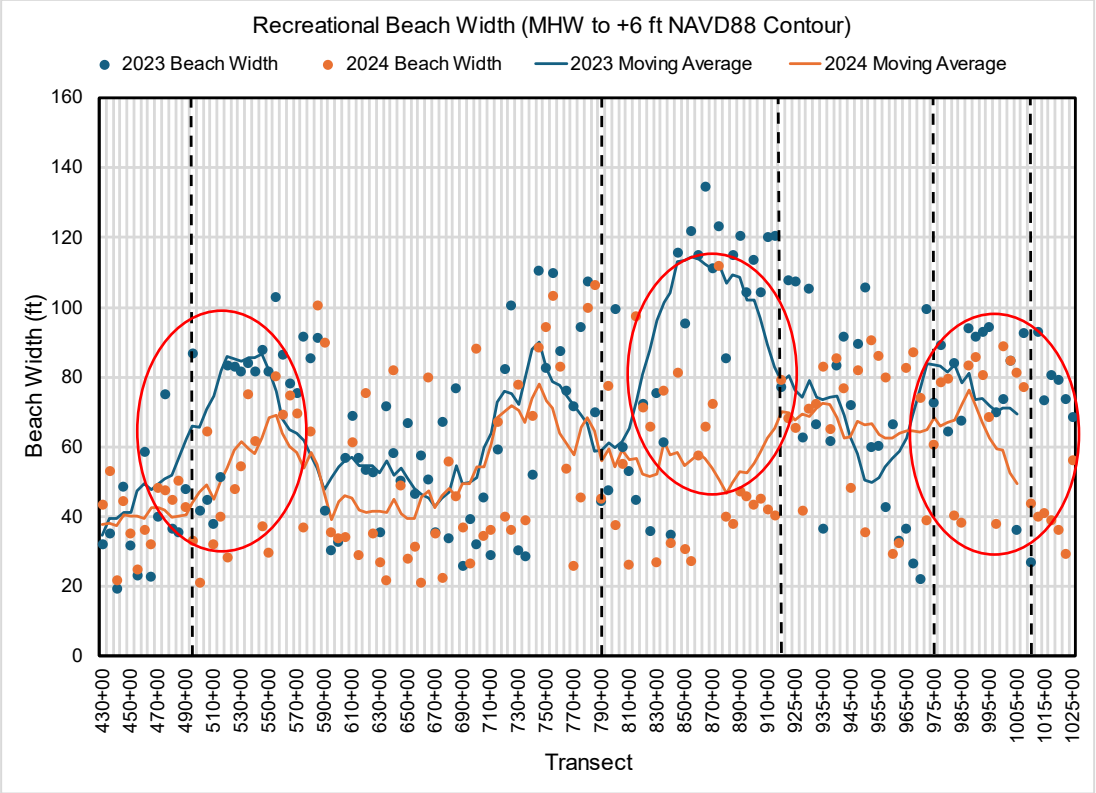



**Figure 5-40. Recreational Beach Width Comparison, 2023 to 2024**

## 5.6 Long-Term Volume Change Trends (2011 – 2024)

To determine the long-term trends along Nags Head, annual volume changes from the present and previous monitoring reports were averaged at each transect. Material placed during the 2019 and 2022 beach nourishment projects was subtracted out of the total volume change at each transect in order to determine the background erosion rate. **Figure 5-41** shows the mean volume change from 2011 to 2024 with nourishment, and **Figure 5-42** shows the mean volume change over the same years with the nourishment subtracted out. In comparison of the two figures, the hotspot at Reach 3-South (in the center of the red circle on each figure) is very visible when nourishment effects are subtracted out. In both figures increases in volume losses from north to south can be observed. The majority of profiles to the south of Reach 2 experience volume losses above all elevations analyzed when the nourishment material is subtracted.

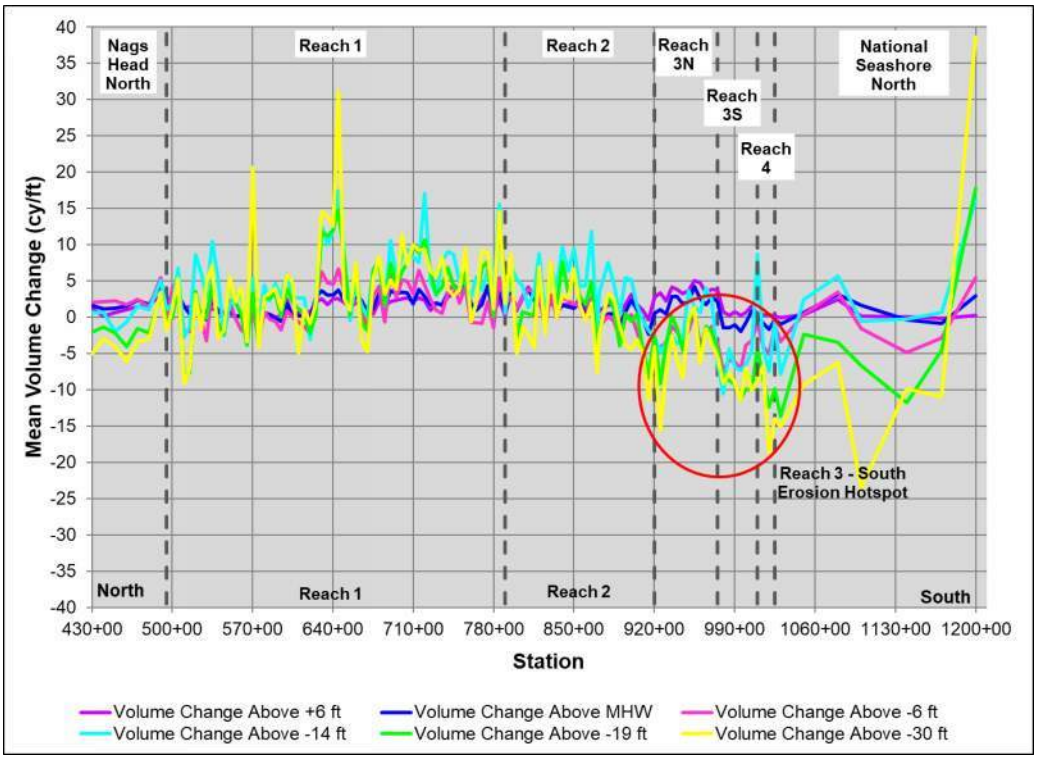



**Figure 5-41. Mean Volume Change per year (2011 – 2024) (With Nourishment)**

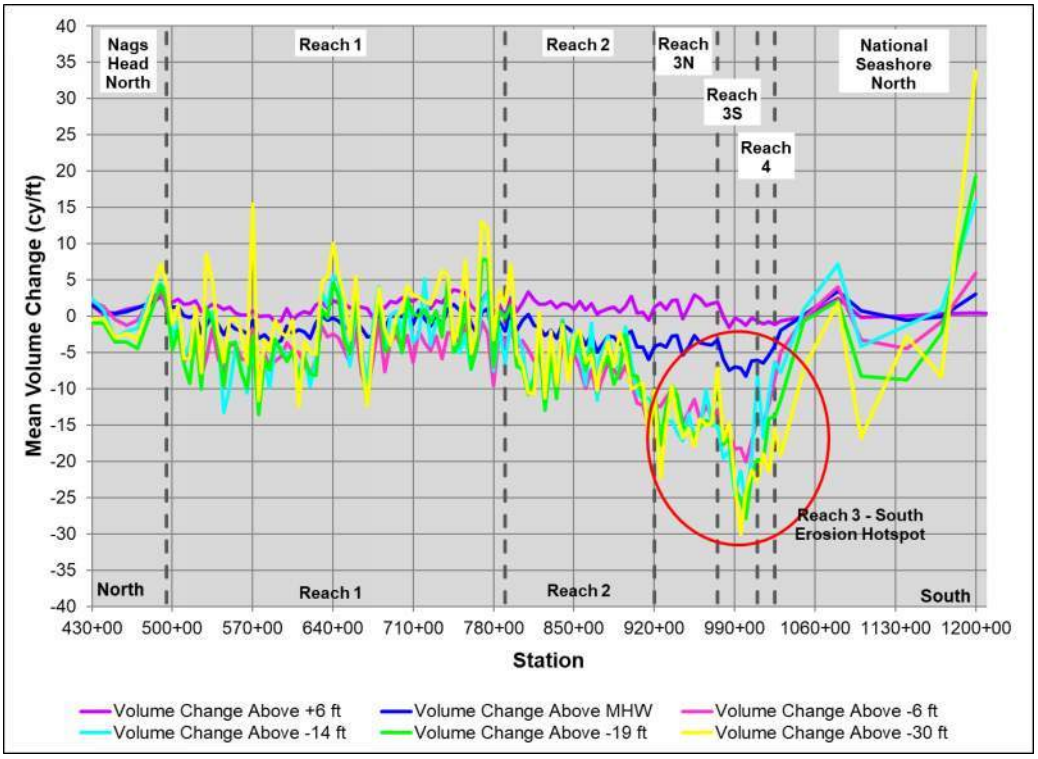



**Figure 5-42. Mean Volume Change per year (2011 – 2024) (Without Nourishment)**

## 5.7 Long-Term Dune Volume Trends

After the 2011 Beach Nourishment study it was noted (CSE 2018) that sand fencing has managed to capture the wind-blown sand and caused steady dune growth until 2014. The dune growth rates declined after 2014 as the available sand for aeolian transport decreased. Shoreline recession and reduction in dry beach width for aeolian transport caused dunes to lose sand from 2016 to 2018. The wider beaches created by the 2019 Beach Nourishment Project allowed for aeolian transport, and during the next two monitoring periods (2019 - 2023) dune growth was observed above +6 ft NAVD88. During the June 2023 to June 2024 monitoring period, dune growth continued across Reach 1, Reach 2, and Reach 3N, with the most significant growth occurring in Reach 2, which saw an increase of + 65,511 cy +4.7 cy/ft) (**Table 5-29**). In contrast, Reach 3S and Reach 4 experienced dune scarping due to shoreline recession. This was particularly significant in Reach 4, where -4,288 cy (-2.5 cy/ft) of material was lost above +6 ft NAVD88.

In an attempt to determine the vulnerable locations, the mean volume change above +6 ft NAVD88 in between 2011 and 2019 beach nourishment projects was examined. **Figure 5-43** shows the mean volume change above +6 ft NAVD88, indicating two erosional locations. The first location is observed at Reach 1, in front of the Jockey's Ridge State Park, between E Hollowell Street and E Soundside Road. The second area covers the south part of the monitoring area starting from the hotspot location at Reach 3-South and extending south to National Seashore – North reach. The rest of the dunes across the Nags Head Oceanfront display either volume gain or no overall change.

To investigate how the volume changes occurred over time a moving average analysis was done by averaging the unit volume of a profile with profiles within 1,000 ft distance to it. Using moving average helps visualize the trends by displaying the localized trends while smoothing the instantaneous changes of volume between profiles. **Figure 5-44** presents the moving average analysis of unit volumes above +6 NAVD88 ft along the monitoring shoreline from 2019 to 2024. The analysis reveals dune erosion at Reach 4, as well as other areas where dune erosion has been ongoing.

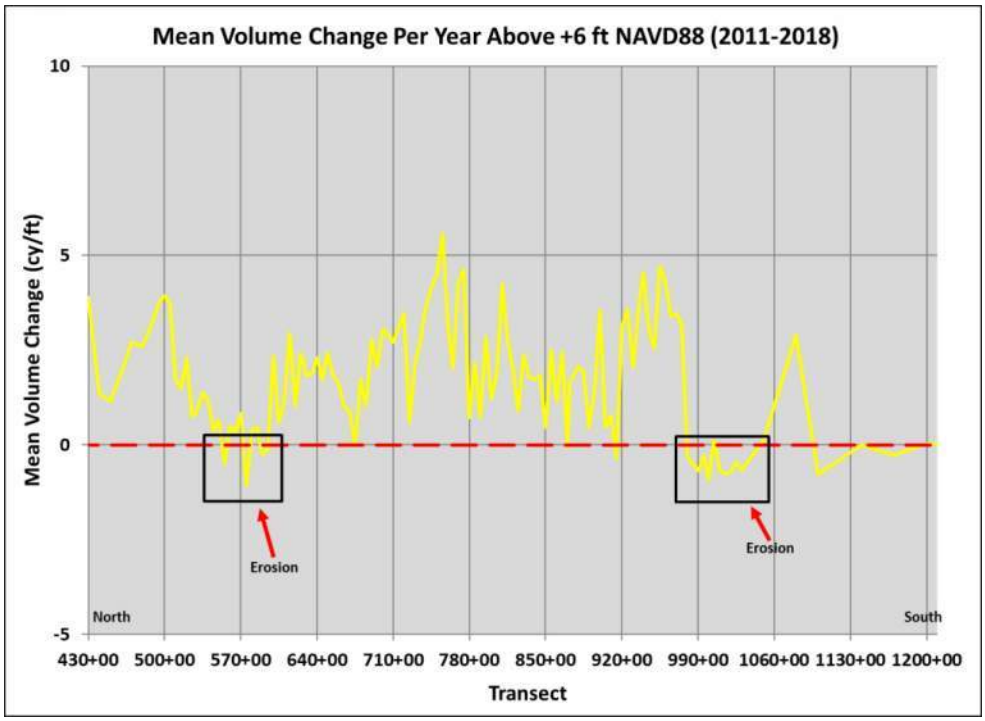



**Figure 5-43. Unit Dune Volume Change from 2011 to 2018 (Moving Average Trend Above +6 ft NAVD88)**

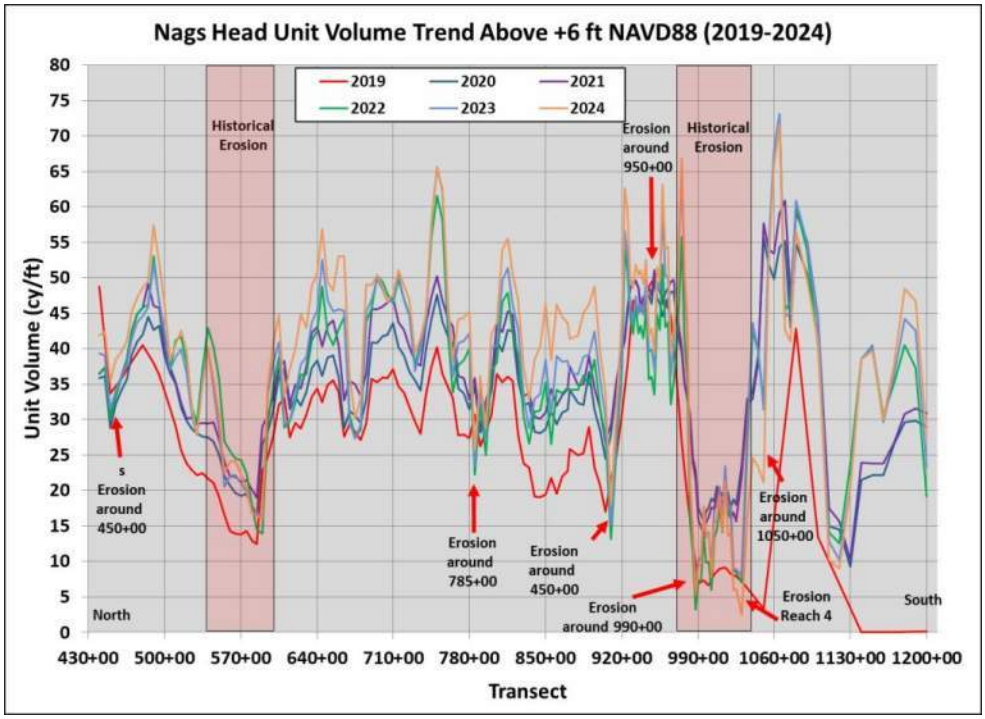



**Figure 5-44. Unit Dune Volume by Year (Moving Average Trend Above +6 ft NAVD88)**

# 6.0 SUMMARY

The Town of Nags Head Beach Monitoring and Maintenance Plan is sponsored by the Town of Nags Head (Town) as a continuation of the 2011 monitoring program initiated for assessing beach conditions. The primary purpose of the program is to assess current and historical shoreline conditions, determine shoreline and volumetric changes and evaluate the performance of beach nourishment and other restoration efforts. Evaluating and documenting these changes consistently over successive years provides information necessary to plan for future beach nourishments and to support development of the Town's multi-decadal Beach Nourishment Master Plan.

The latest annual summer survey took place in June 2024 and was carried out by McKim & Creed. Furthermore, a fall survey, prompted by observed scarping along the Town's beachfront, was conducted by McKim & Creed in October 2023, along with another annual survey in June 2023. This report outlines the data sources, methodologies, and findings of a survey evaluation conducted by Moffatt & Nichol. The evaluation compares the June 2024 survey to the data from October 2023 and June 2023 surveys.

The survey data was used to compute shoreline change at Mean High Water (MHW), which is designated as +1.18 ft NAVD88 for Nags Head, and volume change above +6 ft NAVD88 (berm), MHW, -6 ft NAVD88 (wading depth), -14 ft NAVD88 (outer bar), -19 ft NAVD88 (approximate depth of closure), and -30 ft NAVD88 (offshore).

During the 2019 Beach Nourishment Project approximately 4.0 million cy of material was placed along approximately 10 miles of shoreline. The shoreline position and volume changes above six elevations relative to pre-nourishment conditions (April 2019) along the Nourished Oceanfront (Station 495+00 – 1025+00) were also analyzed.

**Figure 6-1** illustrates the shoreline changes relative to pre-nourishment condition (April 2019) along the Nourished Oceanfront. As can be seen from the figure, a significant landward recession occurred along the Nourished Oceanfront since the completion of the 2019 nourishment project. The majority of this recession, noted before the post-Dorian survey, can be attributed to Hurricane Dorian. However, a portion of it was also due to profile equilibration, a natural occurrence during the stabilization of the nourishment profile. Similarly, the August 2022 post-Dorian renourishment project helped mitigate some of the recession. However, by June 2023, the shoreline had receded again, likely due to ongoing profile equilibration. This year, high-energy wave events caused further significant recession, particularly in the southern reaches (3S and Reach 4). In Reach 4, the shoreline has receded beyond the April 2019 pre-nourishment condition.

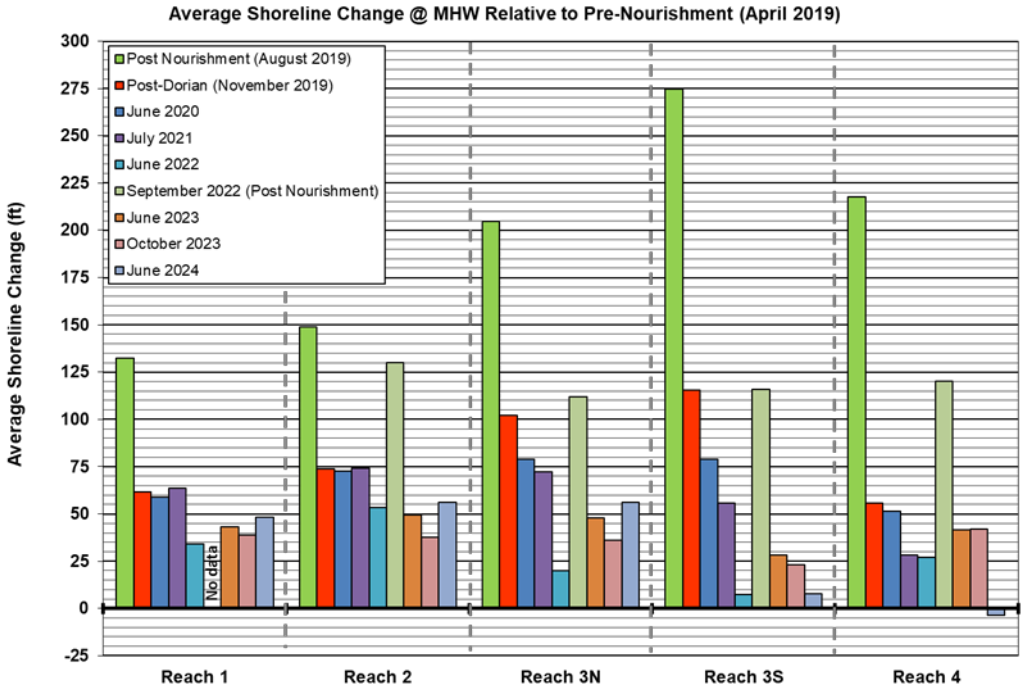



**Figure 6-1.Nourished Oceanfront Average Shoreline Change Relative to Pre-Nourishment Conditions**

**Figure 6-2** illustrates that the overall changes in sand volume vary with the depth above which volumes are assessed. Since the completion of the 2019 nourishment project approximately 598,349 cy (11.3 cy/ft) of volume gain was observed above -19 ft NAVD88 along the Nourished Oceanfront. This indicates that 127% of the volume present in August 2019 above -19 ft NAVD88 has remained within the system through the June 2024 survey. It's important to highlight that 614,106 cubic yards of material were placed during the 2022 Post-Dorian Renourishment project, indicating that without this renourishment, material loss would have likely occurred above -19 ft NAVD88. The results suggest significant cross-shore shifts of sand across various elevations. Notably, much of the sand has moved to lower elevations near the depth of closure, where it becomes vulnerable to being removed from the system during high-energy wave events.

**Figure 6-3** presents the volume changes above -19 ft NAVD88 relative to pre-nourishment conditions (April 2019) along the Nourished Oceanfront. Reach 1 and Reach 2 show volume gains above -19 ft NAVD88 when compared to pre-nourishment levels. In contrast, the remaining reaches experienced material losses, with Reach 3N and Reach 3S both losing less than 50% of the material placed during the 2019 nourishment. However, Reach 4 has undergone significant material loss, having lost 62% of the nourished material by the end of this monitoring period.

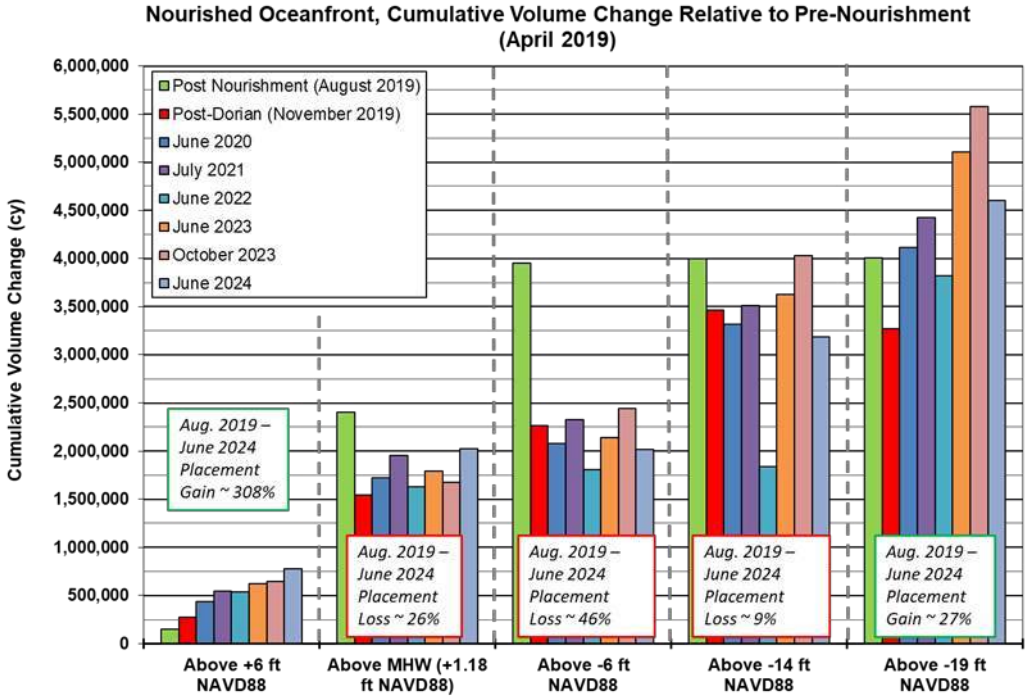



**Figure 6-2. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment**

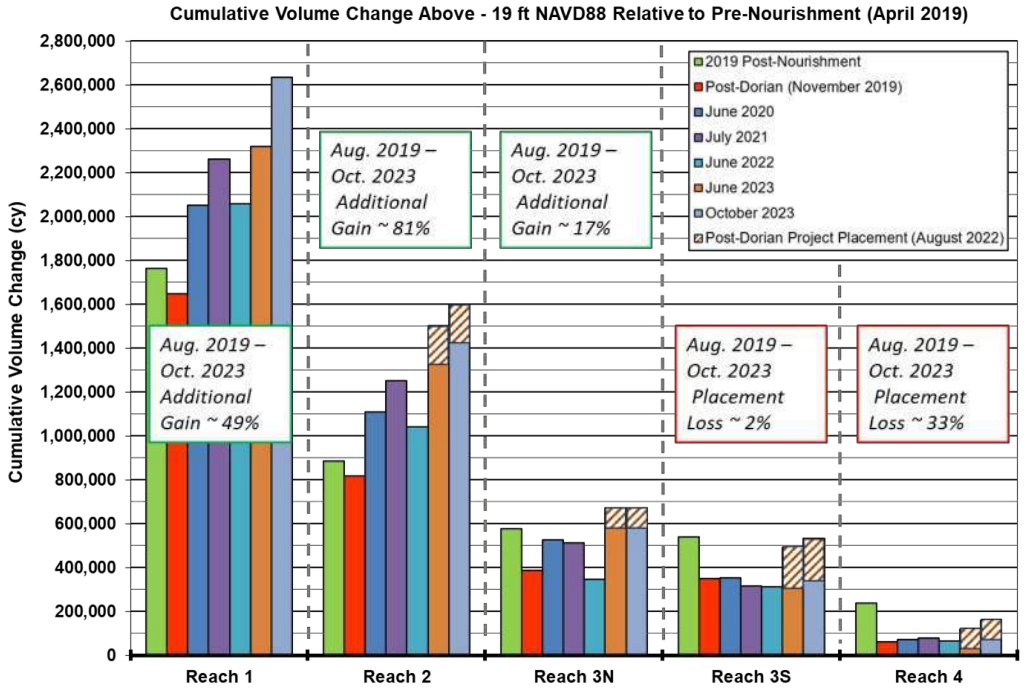



**Figure 6-3. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment**

Volume changes during the monitoring period indicated that the Nourished Oceanfront and Total Monitored Oceanfront both experienced losses in material between June 2023 and June 2024 above -19 ft NAVD88 indicating material being moved out of the Town's sediment system. Key statistics for individual reaches along Nags Head along with the entire oceanfront shoreline are shown in **Table 6-1** and **Table 6-2**.

**Table 6-1. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | avg shoreline change @ +1.18 ft NAVD88 | avg volume change above +6 ft NAVD88 | avg volume change above +1.18 ft NAVD88 | avg volume change above -6 ft NAVD88 | avg volume change above -14 ft NAVD88 | avg volume change above -19 ft NAVD88 | avg volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| Nags Head - North | 430+00 - 495+00 | 6,500 | 6.1 | 3.4 | 4.5 | 0.8 | 11.8 | 9.6 | 26.6 |
| Nags Head - Reach 1 | 495+00 - 790+00 | 29,500 | 5.1 | 2.5 | 4.2 | 0.2 | 2.2 | -1.4 | 14.7 |
| Nags Head - Reach 2 | 790+00 - 920+00 | 13,000 | 6.4 | 4.7 | 8.0 | -0.3 | -7.6 | -6.6 | 5.5 |
| Nags Head - Reach 3N | 920+00 - 975+00 | 5,500 | 8.2 | 3.7 | 5.9 | -10.0 | -34.3 | -36.6 | -30.2 |
| Nags Head - Reach 3S | 975+00 - 1010+00 | 3,500 | -20.4 | -0.1 | -3.4 | -12.7 | -41.2 | -38.9 | -36.5 |
| Nags Head - Reach 4 | 1010+00 - 1025+00 | 1,500 | -44.9 | -2.5 | -10.4 | -17.9 | -36.1 | -16.1 | -16.5 |
| National Seashore North | 1025+00 - 1200+00 | 17,500 | 20.0 | -2.4 | -0.5 | 9.2 | -26.6 | -18.7 | -33.3 |
| | Transects | Reach Length | weighted avg | weighted avg | weighted avg | weighted avg | weighted avg | weighted avg | weighted avg |
| **Nourished Oceanfront** | **495+00 - 1025+00** | **53,000** | **2.7** | **2.9** | **4.4** | **-2.3** | **-7.9** | **-9.2** | **3.5** |
| **Total Monitored Oceanfront*** | **430+00 - 1200+00** | **77,000** | **6.9** | **1.7** | **3.3** | **0.6** | **-10.5** | **-9.8** | **-2.9** |

**National Seashore South Reach not included in the Total Monitored Oceanfront*

**Table 6-2. Nags Head Cumulative Volume Change Statistics (June 2023 – June 2024)**

| **June 2023 vs. June 2024** | Transects | Reach Length | cumulative volume change above +6 ft NAVD88 | cumulative volume change above +1.18 ft NAVD88 | cumulative volume change above -6 ft NAVD88 | cumulative volume change above -14 ft NAVD88 | cumulative volume change above -19 ft NAVD88 | cumulative volume change above -30 ft NAVD88 |
|---|---|---|---|---|---|---|---|---|
| Reach | # | ft | cy | cy | cy | cy | cy | cy |
| Nags Head - North | 430+00 - 495+00 | 6,500 | 20,432 | 27,027 | 4,771 | 70,965 | 57,395 | 159,508 |
| Nags Head - Reach 1 | 495+00 - 790+00 | 29,500 | 74,639 | 123,358 | 6,401 | 64,852 | -41,313 | 433,683 |
| Nags Head - Reach 2 | 790+00 - 920+00 | 13,000 | 61,511 | 103,820 | -3,551 | -98,804 | -85,912 | 71,490 |
| Nags Head - Reach 3N | 920+00 - 975+00 | 5,500 | 21,031 | 33,981 | -57,347 | -197,490 | -210,239 | -173,746 |
| Nags Head - Reach 3S | 975+00 - 1010+00 | 3,500 | -350 | -11,880 | -44,415 | -144,269 | -136,136 | -127,669 |
| Nags Head - Reach 4 | 1010+00 - 1025+00 | 1,500 | -4,288 | -18,134 | -31,341 | -63,252 | -28,187 | -28,798 |
| National Seashore - North | 1025+00 - 1200+00 | 17,500 | -42,262 | -8,788 | 161,561 | -465,228 | -326,727 | -582,524 |
| | Transects | Reach Length | total | total | total | total | total | total |
| **Nourished Oceanfront** | **495+00 - 1025+00** | **53,000** | 152,543 | 231,146 | -130,252 | -438,963 | -501,787 | 174,960 |
| **Total Monitored Oceanfront*** | **430+00 - 1200+00** | **77,000** | 130,713 | 249,384 | 36,080 | -833,226 | -771,119 | -248,056 |

During the June 2023 - June 2024 monitoring period, Reach 3S and Reach 4 experienced significant shoreline recession, eroding much of the recreational beach. This erosion allowed waves to reach the dunes, resulting in dune scarping especially in Reach 4. The remaining reaches showed slight seaward advancement as material from nearshore was deposited to the beachface.

The Nags Head Oceanfront experienced material gains along the subaerial portions of the profiles (+6 ft NAVD88 and MHW). This was mainly due to nearshore material being deposited on the beachface. However, below MHW, volume losses occurred across all analyzed elevations, except above -30 ft NAVD88, where gains were only observed in Reaches 1 and 2. The most significant volume loss was recorded above -19 ft NAVD88 (-438,963 cy or -9.2 cy/ft), exceeding the historical background erosion rate (-6.7 cy/ft). This elevated loss can be attributed to the active 2023-2024 storm season, which brought 17 events with significant wave heights exceeding 8 ft. The frequent storm activity likely prevented the offshore-deposited material from returning to the beach, instead pushing it further offshore to lower elevations. Additionally, material gains at the Town boundaries in the prior monitoring period (June 2022 – June 2023) were attributed to sediment moving south from northern nourishment projects. The ongoing volume losses above -30 ft NAVD88 suggest that sediment may have been transported further south toward Oregon Inlet, moving out of the Town's system.

The Total Monitored Oceanfront, which includes both the Nags Head North and National Seashore-North reaches flanking the Nourished Oceanfront, exhibited a similar trend of material gains at subaerial elevations and losses below MHW. While the Nags Head North

reach showed material gains across all analyzed elevations, the National Seashore-North reach experienced material losses above all analyzed elevations, similar to the adjacent areas in the Nourished Oceanfront.

During the June 2023 to June 2024 monitoring period, dune growth continued across Reach 1, Reach 2, and Reach 3N, with the most significant growth occurring in Reach 2, which saw an increase of + 65,511 cy +4.7 cy/ft). In contrast, Reach 3S and Reach 4 experienced dune scarping and shoreline recession. This was particularly significant in Reach 4, where -4,288 cy (-2.5 cy/ft) of material was lost above +6 ft NAVD88.

The Town adopted a Multi-Decadal Beach Nourishment Master Plan (Master Plan) in July 2024. This Master Plan included development of volumetric triggers for beach nourishment, based on the profile volume from the landward crest of the primary dune to the outer bar, above the -19 ft NAVD88 elevation. This sand volume was modeled to provide a Level of Protection (LoP) from a 25-year storm. **Figure 6-5** presents the historical and current status of the average profile volumes per reach compared to the volumetric triggers (red and black dashed lines).

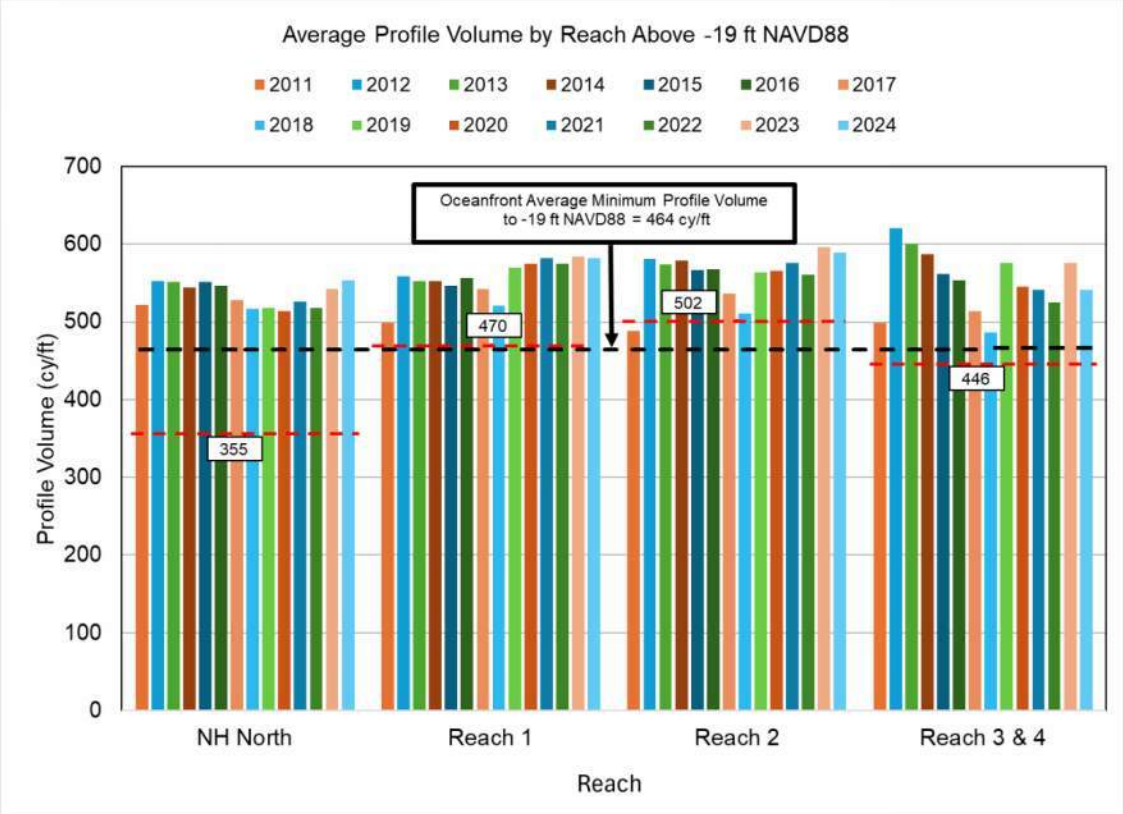



**Figure 6-4. Master Plan Nourishment Trigger Volume Comparison**

All management reaches currently contain average profile volumes above the nourishment triggers, however, there have been localized erosion hotspots observed along the Town's shoreline in the summer of 2024. The profile volumes from all transects as of June – July

2024 are presented in **Figure 6-5.** Localized segments of Reaches 3 and 4 have profiles below the trigger volumes (red arrows), and additional localized segments of Reaches 1 and 2 are close to the triggers (yellow arrows).

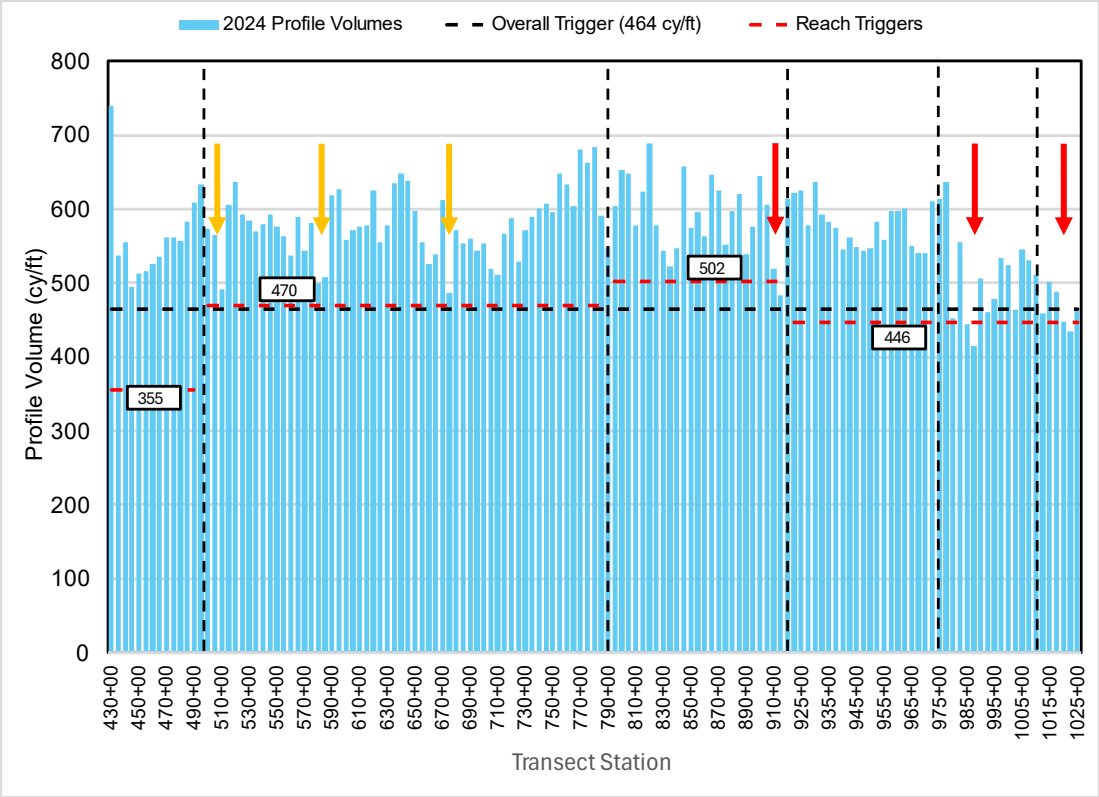



**Figure 6-5. 2024 Beach Profile Volumes and Master Plan Trigger Volume Comparison. Red arrows indicate locations that are below the trigger volumes and yellow areas indicate areas that are close to the trigger volumes.**

Additionally, there have been losses of the recreational dry beach as measured by the distance from the MHW line to the +6 ft NAVD88 elevation throughout the Town. Loss of the dry beach increases the likelihood that the dunes will be further impacted by high water level and wave events.

Given these results, the Town may consider accelerating the timeline for the next beach nourishment project, currently planned for Summer 2027.

## 7.0 REFERENCES

Coastal Science & Engineering Inc. (CSE), 2018. Monitoring and Analyses of the 2011 Nags Head Beach Nourishment Project. Year 7 (2018) Beach Monitoring Report for Town of Nags Head., NC. Columbia, SC. October 2018.

Moffatt & Nichol (MN), 2020. Town of Nags Head Beach Monitoring Analysis Program. 2020 Summer Annual Monitoring Survey Evaluation. Raleigh, NC. October 2020.

moffatt & nichol

**Contact:**
Moffatt & Nichol
4700 Falls of Neuse Road, Suite 300
Raleigh, NC 27609
P: (919) 781-4626

101 W. Main Street, Suite 3000
Norfolk, VA 23510
P: (757) 628-8222

moffattnichol.com

# APPENDIX A
# MCKIM & CREED SURVEY REPORT

10979/17

# 2024 Nag's Head
# Annual Beach Monitoring
# Data Acquisition Survey Report

## Town of Nags Head, Dare County, North Carolina

Prepared for:

Town of Nags Head

Prepared by:

McKim & Creed, Inc.

243 North Front
Street Wilmington,
NC 28401

2024 Nag's Head Annual Beach Monitoring Data Acquisition Survey Report

August 2024

## Survey Certification

I, Raymond B Dawber NCPLS 3898, certify that this project was completed under my direct and responsible charge from an actual survey made under my supervision; meeting the requirements of the SOW, the hydrographic and topographic survey was performed at the 95% percent confidence level to meet Federal Geographic Data Committee Standards; meets the requirements for a topographic/planimetric survey to the horizontal and vertical accuracy of Class III surveys, and that the original data was obtained on 17 June 2024 through 31 July 2024; horizontal coordinates are presented in the North Carolina State Plane Coordinates (NAD83 2011) and all elevations are based on North American Vertical Datum of 1988 (NAVD88). All coordinates are ground unless specified otherwise.

THIS 16 DAY OF AUGUST, AD 2024.

NORTH CAROLINA PROFESSIONAL SEAL L-3898 LAND SURVEYOR RAYMOND B. DAWBER 8/14/2024

RAYMOND B DAWBER

PROFESSIONAL LAND SURVEYOR NCPLS 3898

# Table of Contents

General scope of work ..... 3
Planning ..... 3
Phase 1-Control Reconnaissance/Establishment/Verification ..... 3
Phase 2-Beach Profiles ..... 4
Phase 3-Nearshore/Offshore Profiles ..... 4
Phase 4-Data Processing/Submittals ..... 5
Map Preparation ..... 5
Ground Digital Photography ..... 5
Control and GNSS Quality Checks ..... 6
List of Equipment Used ..... 9
Appendix A ..... 10

*Table 1 - Control provided by client* ..... 6
*Table 2 - 3-minute GNSS observations* ..... 6
*Table 3 - Variations from provided controls to RTK GNNS measurements* ..... 7
*Table 4 - Results of daily control checks* ..... 7
*Table 5 - Results of daily control checks* ..... 8
*Table 6-Daily tide checks* ..... 8
*Table 7-Daily Bar Checks* ..... 8
*Table 8-Daily Sound Velocity* ..... 9

**Digital Addendums:**

*2024 Nags's Head Monitoring DWG*
*2024 Nags's Head Monitoring ASCII XYZ Data*
*2024 Nag's Head Monitoring Plan View Map*
*2024 Nag's Head Monitoring 5-column File*
*2024 Nag's Head Monitoring BMAP Files*
*2024 Nag's Head Monitoring MHWL Extracted Shape File*
*2024 Nag's Head Monitoring DEM*
*2024 Nag's Head Monitoring Beach Profile PDF Plots*
*2024 Nag's Head Monitoring Digital Ground Photography*

# General scope of work

The work under the Task Order consisted of topographic and hydrographic beach profiles collected along the entire 10.1 miles of Nag's Head Atlantic Ocean Shoreline. 174 beach profiles were surveyed using a crew of employees of McKim & Creed Inc.

## Planning

On 14 June 2024 a project kickoff meeting was held between the field and office crew to review the scope of work in detail. All anticipated safety conditions were discussed along with the necessary safety equipment. The field team began monitoring the weather conditions at the beginning of June to determine the best time to mobilize to the survey area. Field work commenced on 17 June 2024, with a reconnaissance of control monuments and general mobilization activities. Survey data was collected from 18 June 2024 through 31 July 2024. The crew demobilized for the first time on June 26, 2024, due to not having permission to survey inside the Cape Hatteras National Seashore. The permit (Appendix A) was signed on July 9, 2024, and received by McKim & Creed on July 19, 2024. McKim & Creed mobilized for the second time on July 29, 2024, after weather conditions improved on site, and finished surveying the 32 lines inside the park and resurveyed an additional 7 lines (requested by the Town of Nags Head) on July 31, 2024.

The surveys were conducted to meet or exceed the Minimum Performance Standards for the U.S. Army Corps of Engineers (USACE), Engineering and Design Hydrographic Surveying Manual (EM 1110-2-1003) and in accordance with Chapter 56.1606 of the North Carolina Administrative Code (NCAC) specifications established by The North Carolina Engineering and Land Surveying Act (GS89C). The hydrographic survey was conducted under the direct supervision of an NSPS-THSOA Certified Hydrographer (CH).

Vertical data was collected in the North American Vertical Datum of 1988 (NAVD88) using Geoid 18. All Horizontal data is provided in the North Carolina State Plane Coordinate System, North American Datum (NAD) of 1983(2011).

All survey personnel adhered to the safety standards and used the necessary PPE as required for this type of project.

The field survey and data collection activities encompassed four (4) phases. Brief descriptions of each survey phase, including methodologies and quality control/quality assurance procedures, are described below.

## Phase 1-Control Reconnaissance/Establishment/Verification

Prior to surveying beach profiles, reconnaissance of the monuments was conducted to confirm that survey control was in place and undisturbed. Real Time Kinematic Global Positioning System (RTK GNSS) base stations were used in conjunction with the North Carolina virtual reference station (NCVRS) network to locate and confirm survey control

for this project using a 3-minute observation at each monument The horizontal and vertical accuracy of control data meets the accuracy requirements as set forth in the Engineering and Design Hydrographic Surveying Manual (EM 1110-2-1003). To achieve required accuracy, the surveys were controlled using 2nd order monuments, including T168 and CAHA 2 from the National Geodetic Survey (NGS). Three-minute GNSS observations were measured on all monuments utilized and temporary benchmarks (TBM) established. Horizontal and vertical positioning checks were conducted at the beginning and end of each day using at least two control benchmarks in the project area. The control check shots were acquired using a minimum of five (5) epochs.

## Phase 2-Beach Profiles

Upon completion of the control reconnaissance survey, beach/upland and nearshore operations were initiated. Profiles of the beach in the project area were surveyed using extended rod RTK GNSS rovers, and standard RTK GNSS rovers. Extended rod RTK GNSS rovers were used to augment RTK GNSS survey capability into the nearshore.

Profiles commenced from the baseline and extended seaward overlapping the nearshore/wade data. Nearshore portions of the profiles were surveyed by two (2) surveyors with an Extended Rod Trimble R8 or R10 RTK GNSS rovers. The nearshore survey extended seaward to a point overlapping the offshore portion of the profiles by at least fifty (50) feet.

Elevations were taken at a maximum of twenty-five (25) foot intervals along each profile line and at all grade breaks. The integrity of the profiles line directions used the RTK GNSS feature to remain on azimuth.

## Phase 3-Nearshore/Offshore Profiles

The Nearshore/Offshore profiles were conducted along each required profile station. The profiles were obtained 3,500 feet beyond the shoreline or to the -30' NAVD88 contour, whichever is more landward. The landward limits of the nearshore profiles were based on a minimum overlap of fifty (50) feet beyond the seaward extent of beach profiles.

Soundings were collected at 200kHz with an Odom Echotrac E20 single beam echosounder, hull-mounted transducer on McKim & Creed's twenty-five (25) foot survey vessel, the *S/V Cawood*. To maintain the vessel navigation along the profile lines, HYPACK navigation software was used.

These soundings were reduced to 9' spacing, sufficient to provide a smooth and accurate depiction of the seafloor.

Data was digitally stored using HYPACK 2023 Software. An Applanix POSMV Inertia Navigation System onboard the survey vessel provided pitch, roll, heave, and tide corrections. Bar checks were performed daily and as needed to check and calibrate the system. Tide verifications, echosounder checks, and sound velocity results are presented in the tables presented below.

The AML sound velocity profiler was used to measure the sound velocity along the water column, with casts performed inside the project area. Bar-checks were performed from a depth of five (5) feet to a depth of at least twenty-five (25) feet. Offshore data was collected within 2 (two) days of onshore data collection for each line.

## Phase 4-Data Processing/Submittals

Upon completion of the field work, data was edited using Trimble Business Center, and HYPACK 2023. The upland and nearshore portions of the beach profile were viewed and edited in Trimble Business Center to provide the required comma delimited XYZ file. The raw bathymetry digital data was viewed and edited in HYPACK Single Beam Editor. The collected tide data was compared to NOAA measured water levels using NOAA Tide Stations 8651370 (Duck, NC) and 8652587 (Oregon Inlet, NC). Tide corrected offshore data was exported and included into a comma delimited XYZ file. All overlapping profile data was reviewed in the cross sections to ensure system accuracy. The edited beach profile data and offshore profile data were merged to create a representative profile for each station. The final plots were edited and reviewed with comparisons to previous years; discrepancies were noted and resolved. The profiles were developed using HYPACK C*ross-section and Volumes* software. Profiles are presented in PDF format with the digital files accompanying this report.

## Map Preparation

Upon completion of the surveys and data reduction, the plan view map was prepared in Autodesk Civil 3D. Elevations are displayed in NAVD88 and are spaced at 75' for better visualization. Dare County GIS parcel lines were used for background reference.

## Ground Digital Photography

A total of two (2) digital photos were taken at a mid-beach location at each profile line, facing Northerly and Westerly directions. Additional photographs were taken as needed. Digital files are included with the deliverables in .jpeg format. Ground Photography is presented in digital format with files accompanying this report.

## Control and GNSS Quality Checks

All Control Monuments provided by the client are shown in Table 1. Monuments utilized for survey control were found to be in good condition.

| NAG'S HEAD, NC - Control Status<br>UNITS: US Survey Feet | | | | | |
|---|---|---|---|---|---|
| **Station** | **Easting** | **Northing** | **Elevation** | **Status** | **Comment** |
| T 168 | 2993941.37 | 827213.86 | 10.57 | Found | Recovered as Described |
| W 168 (BM 72) | 3005850.14 | 806503.64 | 7.53 | Found | Recovered as Described |
| CAHA 2 | 3007349.70 | 801455.42 | 4.20 | Found | Recovered as Described |
| F 255 | 3018120.00 | 778913.91 | 2.78 | Found | Recovery Drawing in Notes |
| EDEN | 3009247.87 | 799346.34 | 32.66 | Not Found | Under House |
| BREW | 2997818.79 | 823218.51 | 16.93 | Not Found | Missing |
| LOGGERHEAD | 3001986.83 | 814705.66 | 15.49 | Not Found | Missing |
| BROOKE | 3020429.10 | 774768.51 | 19.38 | Not Found | Missing |

*TABLE 1 - CONTROL PROVIDED BY CLIENT*

Using RTK GNSS, a 3-minute observation was performed on all monuments. Results of control measurements are presented in Table 2.

| RTK GNSS 3-Minute Observations<br>Measured Values - June 2024<br>UNITS: US Survey Feet | | | |
|---|---|---|---|
| **Station** | **Easting** | **Northing** | **Elevation** |
| T 168 | 2993941.37 | 827213.86 | 10.39 |
| T 168 | 2993941.37 | 827213.89 | 10.34 |
| T 168 | 2993941.34 | 827213.87 | 10.33 |
| T 168 | 2993941.31 | 827213.89 | 10.28 |
| T 168 | 2993941.30 | 827213.88 | 10.28 |
| W 168 | 3005850.15 | 806503.71 | 7.42 |
| CAHA 2 | 3007349.67 | 801455.52 | 4.05 |
| CAHA 2 | 3007349.62 | 801455.51 | 4.12 |
| F255 | 3018119.99 | 778913.88 | 2.71 |
| F255 | 3018120.00 | 778913.90 | 2.78 |
| F255 | 3018119.95 | 778913.99 | 2.75 |
| F255 | 3018119.93 | 778914.00 | 2.79 |

*TABLE 2 - 3-MINUTE GNSS OBSERVATIONS*

The provided control data was compared to the measurements from the surveyed 3-minute observations, the variations (delta values) are presented in Table 3.

| Variations Provided values vs. Measured Values | | | |
|---|---|---|---|
| **Station** | **Easting Var.** | **Northing Var.** | **Elevation Var.** |
| T 168 | 0.00 | -0.01 | -0.18 |
| T 168 | 0.00 | 0.03 | -0.23 |
| T 168 | -0.04 | 0.01 | -0.24 |
| T 168 | -0.06 | 0.03 | -0.29 |
| T 168 | -0.07 | 0.02 | -0.29 |
| W 168 | 0.01 | 0.07 | -0.11 |
| CAHA 2 | -0.03 | 0.10 | -0.15 |
| CAHA 2 | -0.08 | 0.09 | -0.08 |
| F255 | -0.01 | -0.03 | -0.07 |
| F255 | 0.00 | -0.01 | 0.00 |
| F255 | -0.05 | 0.08 | -0.03 |
| F255 | -0.07 | 0.09 | 0.01 |

*TABLE 3 - VARIATIONS FROM PROVIDED CONTROLS TO RTK GNNS MEASUREMENTS*

Control checks were performed at the beginning and end of each survey day. Measurements are compared to the client provided control or results from an average of the 3-minute observations performed on TBMS. Inverses are presented in table 4 and table 5.

| Beginning of Survey Day TRIMBLE R8/TSC5 - UNIT: HYDRO 1 | | | |
|---|---|---|---|
| **Date** | **Station** | **Δ Horizontal** | **Δ Vertical** |
| 6/18/2024 | T 168 | 0.10 | -0.05 |
| 6/19/2024 | T 168 | 0.13 | 0.04 |
| 6/20/2024 | CAHA 2 | 0.13 | -0.08 |
| 6/20/2024 | F 255 | 0.14 | -0.14 |
| 6/21/2024 | T 168 | 0.10 | 0.03 |
| 6/23/2024 | CAHA 2 | 0.13 | -0.08 |
| 6/25/2024 | F 255 | 0.10 | -0.05 |
| 7/30/2024 | F 255 | 0.08 | 0.02 |
| 7/31/2024 | F 255 | 0.09 | -0.01 |

| End of Survey Day TRIMBLE R8/TSC5 - UNIT: HYDRO 1 | | | |
|---|---|---|---|
| **Date** | **Station** | **Δ Horizontal** | **Δ Vertical** |
| 6/18/2024 | T 168 | 0.11 | 0.05 |
| 6/19/2024 | T 168 | 0.10 | -0.06 |
| 6/20/2024 | CAHA 2 | 0.15 | -0.08 |
| 6/20/2024 | F 255 | 0.15 | 0.04 |
| 6/21/2024 | T 168 | 0.08 | -0.01 |
| 6/23/2024 | CAHA 2 | 0.09 | 0.03 |
| 6/25/2024 | F 255 | 0.12 | -0.06 |
| 7/30/2024 | F 255 | 0.07 | -0.09 |
| 7/31/2024 | F 255 | 0.09 | -0.03 |

*TABLE 4 - RESULTS OF DAILY CONTROL CHECKS*

| Beginning of Survey Day TRIMBLE R8/TSC5 - UNIT: HYDRO 2 | | | |
|---|---|---|---|
| Date | Station | Δ Horizontal | Δ Vertical |
| 6/18/2024 | T 168 | 0.11 | -0.04 |
| 6/19/2024 | T 168 | 0.15 | -0.06 |
| 6/20/2024 | CAHA 2 | 0.13 | 0.10 |
| 6/20/2024 | F255 | 0.17 | -0.01 |
| 6/21/2024 | T 168 | 0.07 | 0.04 |
| 6/22/2024 | CAHA 2 | 0.15 | -0.04 |
| 6/23/2024 | CAHA 2 | 0.14 | 0.10 |
| 6/24/2024 | F 255 | 0.17 | -0.04 |
| 6/25/2024 | F 255 | 0.18 | 0.02 |

| End of Survey Day TRIMBLE R8/TSC5 - UNIT: HYDRO 2 | | | |
|---|---|---|---|
| Date | Station | Δ Horizontal | Δ Vertical |
| 6/18/2024 | T 168 | 0.10 | 0.02 |
| 6/19/2024 | T 168 | 0.11 | 0.08 |
| 6/20/2024 | CAHA 2 | 0.15 | 0.11 |
| 6/20/2024 | F255 | 0.16 | -0.04 |
| 6/21/2024 | T 168 | 0.10 | -0.01 |
| 6/22/2024 | CAHA 2 | 0.10 | -0.01 |
| 6/23/2024 | CAHA 2 | 0.10 | 0.06 |
| 6/24/2024 | F 255 | 0.04 | 0.16 |
| 6/25/2024 | F 255 | 0.17 | -0.11 |

*TABLE 5 - RESULTS OF DAILY CONTROL CHECKS*

## VESSEL CALIBRATIONS

The Survey Vessel *Cawood* (a 25' Safe Boat) was used for this survey. Offsets were measured and calculated on May 28, 2024.

Daily vessel calibration verifications were performed in the survey area with values presented in table 6, table 7, and table 8.

| Daily Tide Checks | | |
|---|---|---|
| Date | R8s Elevation (Ft) | Hypack Corr.(Ft) |
| 6/18/2024 | -0.18 | 0.17 |
| 6/22/2024 | 0.32 | -0.36 |
| 6/23/2024 | 0.61 | 0.71 |
| 6/24/2024 | 0.76 | -0.73 |
| 6/25/2024 | -0.37 | 0.30 |
| 6/26/2024 | 0.84 | -0.84 |
| 7/30/2024 | 0.23 | -0.22 |

*TABLE 6-DAILY TIDE CHECKS*

| Daily Bar Checks | |
|---|---|
| Date | Confirmed Depths (ft) |
| 6/18/2024 | 5, 10, 15, 20 * |
| 6/22/2024 | 5, 10, 15, 20, 25, 30 |
| 6/23/2024 | 5, 10, 15, 20, 25 |
| 6/24/2024 | 5, 10, 15, 20, 25 |
| 6/25/2024 | 5, 10, 15, 20, 25, 30 |
| 6/26/2024 | 5, 10, 15 * |
| 7/30/2024 | 5, 10, 15 * |

**DEEPER CHECKS IMPOSSIBLE DUE TO ROUGH SEA*

*TABLE 7-DAILY BAR CHECKS*

| Daily Sound Velocity Checks | |
|---|---|
| **Date** | **Average (ft/sec)** |
| 6/18/2024 | 4963.5 |
| 6/22/2024 | 4950 |
| 6/23/2024 | 4958 |
| 6/24/2024 | 5012.5 |
| 6/25/2024 | 4979.5 |
| 6/26/2024 | 4996 |
| 7/30/2024 | 4974 |

*TABLE 8-DAILY SOUND VELOCITY*

## List of Equipment Used

Below is a summary list of equipment utilized for the survey for data collection, processing, and deliverables.

- 25' Safe Boat *S/V Cawood*

- Teledyne ECHOTRAC E20 transducer 200 kHz

- Applanix Pos-MV Inertia Navigation System I2NS

- Sound Velocity Profiler AML CTD Base X Profiler

- Hypack 2023 for hydrographic data collection and processing (23.2.2.0)

- Trimble R8 GNSS Receivers/ TSC3 data collectors Trimble Access (23.002.12)

- Trimble R10 GNSS Receivers/ TSC5 data collectors Trimble Access (23.00.212)

- Trimble Business Center (2023.11)

- AutoCAD Civil 3D 2020.5.1 Update (13.2.3093.0)

# Appendix A

Cape Hatteras National Seashore Signed Permit

| **SCIENTIFIC RESEARCH AND COLLECTING PERMIT**<br>Grants permission in accordance with the attached general and special conditions<br>**United States Department of the Interior**<br>**National Park Service**<br>**Cape Hatteras** | **Study#: CAHA-00184**<br>**Permit#: CAHA-2024-SCI-0013**<br>**Start Date: Jun 18, 2024**<br>**Expiration Date: Dec 31, 2024**<br>**Coop Agreement#:**<br>**Optional Park Code:** |
|---|---|

**Name of principal investigator:**

**Name:**Mr David Ryan **Phone:**2524416221 **Email:**david.ryan@nagsheadnc.gov

**Name of institution represented:**

Town of Nags Head

**Additional investigators or key field assistants:**

| | | |
|---|---|---|
| **Name:** Andy Garman | **Phone:** 252.449.2006 | **Email:** andy.garman@nagsheadnc.gov |
| **Name:** Jared Lambert | **Phone:** 336.263.8128 | **Email:** JLambert@mckimcreed.com |
| **Name:** David Ryan | **Phone:** 252.441.6221 | **Email:** david.ryan@nagsheadnc.gov |

**Study Title:**

Town of Nags Head Annual Beach Monitoring Plan

**Purpose of study:**

To conduct annual dry sand beach, nearshore, and offshore surveys to monitor the condition of beach nourishment sand volumes in accordance with the Town Beach Maintenance and Monitoring Plan to maintain eligibility for FEMA Public Assistance Funding

**Subject/Discipline:**

Coastal / Marine Systems

**Locations authorized:**

The survey activities are planned to begin at the southern corporate limits of the Town of Nags Head and extend through to the north side of Oregon Inlet along the Cape Hatteras National Seashore

**Transportation method to research site(s):**

Land access will occur via a 4x4 pickup truck or a side by side (Kawasaki Mule) for traversing the dry sand beach. Water access will be conducted via a single 22' to 28' survey vessel and utilized for hydrographic surveys.

**Collection of the following specimens or materials, quantities, and any limitations on collecting:**

**Name of repository for specimens or sample materials if applicable:**

**NPS General Conditions for Scientific Research and Collecting Permit (available at the RPRS HELP page) apply to this permit. The following specific conditions or restrictions, and any attached conditions, also apply to this permit:**

PROJECT SPECIFIC CONDITIONS

(1) Prior to conducting surveys within CAHA, the PI shall contact Bodie Island Supervisory Biological Technician Paul Doshkov (252-305-1048, paul_doshkov@nps.gov) at least 24 hours prior to the actual survey as a notice of intent.

(2) The survey team shall not enter any Resource Protection Areas (RPA) installed on Bodie Island Spit for the protection of nesting shorebirds. If the team seeks to survey the shoreline within the closed area, they must contact Bodie Island Supervisory Biological Technician Paul Doshkov (252-305-1048, paul_doshkov@nps.gov) to assess feasibility of the survey.

PARK SPECIFIC CONDITIONS

(1) Only minor hand trimming of shrubs and trees or mowing of grasses in order to allow access to data collection sites when vegetation is impenetrable otherwise is authorized. Complete removable of entire vegetation is not allowed.

(2) If field work is proposed for a historic area (property listed or eligible for listing on the National Register or as a National Historic Landmark, a historic district, or a historic structure), the activities are reviewed to ensure there will be no effect on the historic resource. The Cultural Program Manager will be contacted for any proposed work in historic areas.

(3) In the event that human remains are discovered during research activities, all work on the project must stop and the Cultural

Program Manager (252-475-0463) contacted immediately. As required by law, the coroner will be notified first. All provisions outlined in the Native American Graves Protection and Repatriation Act (1990) will be followed.

(4) Archeological excavation will require an ARPA permit and related documents prior to beginning of activities.

(5) Researchers who perform research during periods of darkness (bat surveys, etc.) must follow project-specific mitigation. Guidance will be applied on a case-by-case basis to enhance researcher safety, resource protection, and reduce impacts to visitor experience.

(6) No species collected from outside the park is permitted to be introduced or reintroduced into the park.

(7) Any commercial or for-profit activity is prohibited without the express permission of the Superintendent of the Outer Banks Group.

(8) All research staff must adhere to all conditions of research and collection permit. Field staff must possess a copy of the permit at all times while in the field.

(9) All general park regulations must be followed, unless a specific exemption was granted by the Chief of Resource Management. All conditions listed in the National Park Service, General Conditions for Scientific Research and Collecting Permit, and any project-specific Research Permit Conditions must be followed unless an exemption was granted.

(10) As mandated by Cape Hatteras National Seashore's Off-Road Vehicle (ORV) Management Plan, everyone driving on the beach at the Seashore is required to have a beach driving permit, including those operating under a NPS research permit. In the event a researcher needs to drive an ORV on the beach for research, the park will provide this permit to them free of charge. To obtain an ORV permit, they must stop by NPS Headquarters in Manteo, NC when they arrive and present a valid driver's license, vehicle registration, and your current research permit. After watching a orientation video, staff will provide them with a temporary voucher. If they will be making multiple visits to the Seashore throughout the year, they will need to stop by an office each time to pick up a new temporary voucher, though they will not be required to go through the orientation again.

(11) Permission to enter closed or restricted areas may be granted to select researchers that meet certain criteria. Examples of restricted areas include most service roads, shorebird nesting areas and sea turtle nesting areas. If exemptions are granted, mitigation for entering closed areas may include restriction to party size, period of entry, or date/s of entry (36 CFR 1.5 (a)(2)).

(12) Any research activities proposed to impact state species of concern requires consultation with NC Wildlife Resources Commission and NC National Heritage Program.

(13) Equipment installed and left in the field (e.g. plot markers, seismic equipment, dataloggers) must be placed in a way that will reduce or eliminate public view of the equipment. Unless explicitly permitted to remain, all equipment deployed in the field must be retrieved by the researcher.

(14) Any collecting or research that will result in permanent changes or degradation of habitat is prohibited. Researchers must follow Leave No Trace ethics when conducting research in the park. Access trails shall be brushed in; natural contours shall be reestablished; soil scarified and mulched with native leaf litter.

(15) If researchers propose the collection of vegetation, sampling amounts are approved and evaluated on a case-by-case basis. Mitigation may be required. If the collection of plant material is proposed, the Research Coordinator will consult with the RM staff to confirm there is no potential impact on listed species or species of concern. Plant surveys may need to be completed before any collection or ground disturbance can occur.

(16) If authorized to collect sediment or vegetation samples, researchers must take samples from areas out of public view. They may not sample adjacent to roads, trails, ramps, pullouts or other visible areas. Where possible, researchers are asked to rehab collection site(s) to make them look natural. To avoid visitor reports of illegal collecting, specimens must be carried inside packs after sampling.

(17) Unless otherwise authorized, all research activities must be conducted out of the public view. Exemptions may be granted if the researcher demonstrates that the work cannot occur at another location and if impacts to visitor experience are negligible. Project-specific mitigation (such as wearing orange vests, displaying placards, working with NPS staff, working while park is closed, etc.) will be recommended.

(18) Approval to conduct social science surveys is contingent on the approval of the investigators' university Human Subjects Committee. Social science surveys may not unduly impact visitor experience. Conditions of approval include submission of specific staging locations, specific study dates, number of visitors to be contacted, and submission of the approach script and survey for pre-approval. Social science surveys may be sent to the NPS Social Science Program staff for peer review. Park or government-sponsored surveys may be subject to OMB approval. Research coordinator should consult with Chief of Interpretation for appropriate locations to conduct social science surveys.

(19) Any project or activity must avoid altering stream flow characteristics, affecting a watershed, wetland or floodplain.

(20) Most animal handling is subject to the Animal Welfare Act and requires the review of an institution's Animal Care and Use Committee (IACUC), researchers must submit proof of IACUC approval for consideration. Researchers are required to submit an animal capture and handling plan for any wildlife handling proposal. This plan should include at minimum emergency contacts, employee medical response procedures, animal physiological norms and drug use protocol, processing procedure, and euthanasia procedure. The Resource Management staff will determine an acceptable level of mortality and consultation with wildlife specialists; if this level is exceeded the researcher must stop capture work and notify the park. A capture evaluation will occur, after which the park may allow continued capture work or require the researcher to cease operations.

CONDITIONS SUBJECT TO ALL NATIONAL PARK SERVICE RESEARCH PERMITS

(1) Authority - The permittee is granted privileges covered under this permit subject to the supervision of the superintendent or a designee, and shall comply with all applicable laws and regulations of the National Park System area and other federal and state laws. A National Park Service (NPS) representative may accompany the permittee in the field to ensure compliance with regulations.

(2) Responsibility - The permittee is responsible for ensuring that all persons working on the project adhere to permit conditions and applicable NPS regulations.

(3) False information - The permittee is prohibited from giving false information that is used to issue this permit. To do so will be considered a breach of conditions and be grounds for revocation of this permit and other applicable penalties.

(4) Assignment - This permit may not be transferred or assigned. Additional investigators and field assistants are to be coordinated by the person(s) named in the permit and should carry a copy of the permit while they are working in the park. The principal investigator shall notify the park's Research and Collecting Permit Office when there are desired changes in the approved study protocols or methods, changes in the affiliation or status of the principal investigator, or modification of the name of any project member.

(5) Revocation - This permit may be terminated for breach of any condition. The permittee may consult with the appropriate NPS Regional Science Advisor to clarify issues resulting in a revoked permit and the potential for reinstatement by the park superintendent or a designee.

(6) Collection of specimens (including materials) - No specimens (including materials) may be collected unless authorized on the Scientific Research and Collecting permit.
The general conditions for specimen collections are:
- Collection of archeological materials without a valid Federal Archeology Permit is prohibited.
- Collection of federally listed threatened or endangered species without a valid U.S. Fish and Wildlife Service endangered species permit is prohibited.
- Collection methods shall not attract undue attention or cause unapproved damage, depletion, or disturbance to the environment and other park resources, such as historic sites.
- New specimens must be reported to the NPS annually or more frequently if required by the park issuing the permit. Minimum information for annual reporting includes specimen classification, number of specimens collected, location collected, specimen status (e.g., herbarium sheet, preserved in alcohol/formalin, tanned and mounted, dried and boxed, etc.), and current location.
- Collected specimens that are not consumed in analysis or discarded after scientific analysis remain federal property. The NPS reserves the right to designate the repositories of all specimens removed from the park and to approve or restrict reassignment of specimens from one repository to another. Because specimens are Federal property, they shall not be destroyed or discarded without prior NPS authorization.
- Each specimen (or groups of specimens labeled as a group) that is retained permanently must bear NPS labels and must be accessioned and cataloged in the NPS National Catalog. Unless exempted by additional park-specific stipulations, the permittee will complete the labels and catalog records and will provide accession information. It is the permittee's responsibility to contact the park for cataloging instructions and specimen labels as well as instructions on repository designation for the specimens.
- Collected specimens may be used for scientific or educational purposes only, and shall be dedicated to public benefit and be accessible to the public in accordance with NPS policies and procedures.
- Any specimens collected under this permit, any components of any specimens (including but not limited to natural organisms, enzymes or other bioactive molecules, genetic materials, or seeds), and research results derived from collected specimens are to be used for scientific or educational purposes only, and may not be used for commercial or other revenue-generating purposes unless the permittee has entered into a Cooperative Research And Development Agreement (CRADA) or other approved benefit-sharing agreement with the NPS. The sale of collected research specimens or other unauthorized transfers to third parties is prohibited. Furthermore, if the permittee sells or otherwise transfers collected specimens, any components thereof, or any products or research results developed from such specimens or their components without a CRADA or other approved benefit-sharing agreement with NPS, permittee will pay the NPS a royalty rate of twenty percent (20%) of gross revenue from such sales or other revenues. In addition to such royalty, the NPS may seek other damages to which the NPS may be entitled including but not limited to injunctive relief against

the permittee.

(7) Reports - The permittee is required to submit an Investigator's Annual Report and copies of final reports, publications, and other materials resulting from the study. Instructions for how and when to submit an annual report will be provided by NPS staff. Park research coordinators will analyze study proposals to determine whether copies of field notes, databases, maps, photos, and/or other materials may also be requested. The permittee is responsible for the content of reports and data provided to the National Park Service.

(8) Confidentiality - The permittee agrees to keep the specific location of sensitive park resources confidential. Sensitive resources include threatened species, endangered species, and rare species, archeological sites, caves, fossil sites, minerals, commercially valuable resources, and sacred ceremonial sites.

(9) Methods of travel - Travel within the park is restricted to only those methods that are available to the general public unless otherwise specified in additional stipulations associated with this permit.

(10) Other permits - The permittee must obtain all other required permit(s) to conduct the specified project.

(11) Insurance - If liability insurance is required by the NPS for this project, then documentation must be provided that it has been obtained and is current in all respects before this permit is considered valid.

(12) Mechanized equipment - No use of mechanized equipment in designated, proposed, or potential wilderness areas is allowed unless authorized by the superintendent or a designee in additional specific conditions associated with this permit.

(13) NPS participation - The permittee should not anticipate assistance from the NPS unless specific arrangements are made and documented in either an additional stipulation attached to this permit or in other separate written agreements.

(14) Permanent markers and field equipment - The permittee is required to remove all markers or equipment from the field after the completion of the study or prior to the expiration date of this permit. The superintendent or a designee may modify this requirement through additional park specific conditions that may be attached to this permit. Additional conditions regarding the positioning and identification of markers and field equipment may be issued by staff at individual parks.

(15) Access to park and restricted areas - Approval for any activity is contingent on the park being open and staffed for required operations. No entry into restricted areas is allowed unless authorized in additional park specific stipulations attached to this permit.

(16) Notification - The permittee is required to contact the park's Research and Collecting Permit Office (or other offices if indicated in the stipulations associated with this permit) prior to initiating any fieldwork authorized by this permit. Ideally this contact should occur at least one week prior to the initial visit to the park.

(17) Expiration date - Permits expire on the date listed. Nothing in this permit shall be construed as granting any exclusive research privileges or automatic right to continue, extend, or renew this or any other line of research under new permit(s).

(18) Other stipulations - This permit includes by reference all stipulations listed in the application materials or in additional attachments to this permit provided by the superintendent or a designee. Breach of any of the terms of this permit will be grounds for revocation of this permit and denial of future permits.

**Summary of permitted field methods and activities:**

provide land based surveys using Trimble R8/R10 dual frequency GNSS receivers beginning at the landward toe of the Primary Dune and extend out to the surf zone at wading depth (wading will occur at low tide). Land survey crews will have survey-grade GNSS receivers mounted on fixed height rover poles that are equipped with topo shoes (flat rod tips that do not sink into the sand). The data collectors are clamped onto the pole; the systems is lightweight and ideal for one person. To move up and down the beach efficiently, side by side utility vehicles (Kawasaki Mule) will be used. Crew trucks are painted with the Mckim and Creed company logo, field crews wear highly visible orange/yellow shirts and vests. Hydrographic surveys will collect data from -30 ft NAVD88 to the surf zone (during high tide cycle) to achieve overlapping data as weather/sea conditions allow. Our survey vessels range from 22' to 28' in length and are equipped with inertial navigations systems that include survey grade dual frequency sonar, IMU, VRS RTK GNSS and sound velocity probes, all of which compensate for heave, pitch, roll, heading and the speed of sound, to calculate position and depth.

**Recommended by park staff(name and title):** MEAGHAN JOHNSON Digitally signed by MEAGHAN JOHNSON Date: 2024.07.09 07:54:03 -04'00'

**Reviewed by Collections Manager:**

Yes ____ No ____

**Approved by park official:**

**Date Approved:**

ROBIN SNYDER Digitally signed by ROBIN SNYDER Date: 2024.07.09 08:21:39 -04'00'

**Title:**

Deputy Superintendent

**I Agree To All Conditions And Restrictions Of this Permit As Specified**
(Not valid unless signed and dated by the principal investigator)

(Principal investigator's signature) (Date)

**THIS PERMIT AND ATTACHED CONDITIONS AND RESTRICTIONS MUST BE CARRIED AT ALL TIMES WHILE CONDUCTING RESEARCH ACTIVITIES IN THE DESIGNATED PARK(S)**

# GENERAL CONDITIONS
# For
# SCIENTIFIC RESEARCH AND COLLECTING PERMIT

**United States Department of the Interior**
**National Park Service**

1. **Authority** - The permittee is granted privileges covered under this permit subject to the supervision of the superintendent or a designee, and shall comply with all applicable laws and regulations of the National Park System area and other federal and state laws. A National Park Service (NPS) representative may accompany the permittee in the field to ensure compliance with regulations.

2. **Responsibility** - The permittee is responsible for ensuring that all persons working on the project adhere to permit conditions and applicable NPS regulations.

3. **False information** - The permittee is prohibited from giving false information that is used to issue this permit. To do so will be considered a breach of conditions and be grounds for revocation of this permit and other applicable penalties.

4. **Assignment** - This permit may not be transferred or assigned. Additional investigators and field assistants are to be coordinated by the person(s) named in the permit and should carry a copy of the permit while they are working in the park. The principal investigator shall notify the park's Research and Collecting Permit Office when there are desired changes in the approved study protocols or methods, changes in the affiliation or status of the principal investigator, or modification of the name of any project member.

5. **Revocation** - This permit may be terminated for breach of any condition. The permittee may consult with the appropriate NPS Regional Science Advisor to clarify issues resulting in a revoked permit and the potential for reinstatement by the park superintendent or a designee.

6. **Collection of specimens (including materials)** - No specimens (including materials) may be collected unless authorized on the Scientific Research and Collecting permit.

The general conditions for specimen collections are:

- Collection of archeological materials without a valid Federal Archeology Permit is prohibited.
- Collection of federally listed threatened or endangered species without a valid U.S. Fish and Wildlife Service endangered species permit is prohibited.
- Collection methods shall not attract undue attention or cause unapproved damage, depletion, or disturbance to the environment and other park resources, such as historic sites.
- New specimens must be reported to the NPS annually or more frequently if required by the park issuing the permit.Minimum information for annual reporting includes specimen classification, number of specimens collected, location collected, specimen status(e.g., herbarium sheet, preserved in alcohol / formalin, tanned and mounted, dried and boxed, etc.), and current location.
- Collected specimens that are not consumed in analysis or discarded after scientific analysis remain federal property.The NPS reserves the right to designate the repositories of all specimens removed from the park and to approve or restrict reassignment of specimens from one repository to another. Because specimens are Federal property, they shall not be destroyed or discarded without prior NPS authorization.
- Each specimen (or groups of specimens labeled as a group) that is retained permanently must bear NPS labels and must be accessioned and cataloged in the NPS National Catalog.Unless exempted by additional park - specific stipulations, the permittee will complete the labels and catalog records and will provide accession information.It is the permittee's responsibility to contact the park for cataloging instructions and specimen labels as well as instructions on repository designation for the specimens.
- Collected specimens may be used for scientific or educational purposes only, and shall be dedicated to public benefit and be accessible to the public in accordance with NPS policies and procedures.
- Any specimens collected under this permit, any components of any specimens (including but not limited to natural organisms, enzymes or other bioactive molecules, genetic materials, or seeds), and research results derived from collected specimens are to be used for

scientific or educational purposes only, and may not be used for commercial or other revenue - generating purposes unless the permittee has entered into a Cooperative Research And Development Agreement(CRADA) or other approved benefit - sharing agreement with the NPS.The sale of collected research specimens or other unauthorized transfers to third parties is prohibited.Furthermore, if the permittee sells or otherwise transfers collected specimens, any components thereof, or any products or research results developed from such specimens or their components without a CRADA or other approved benefit-sharing agreement with NPS, permittee will pay the NPS a royalty rate of twenty percent(20 %) of gross revenue from such sales or other revenues. In addition to such royalty, the NPS may seek other damages to which the NPS may be entitled including but not limited to injunctive relief against the permittee.

7. **Reports** - - The permittee is required to submit an Investigator's Annual Report and copies of final reports, publications, and other materials resulting from the study. Instructions for how and when to submit an annual report will be provided by NPS staff.Park research coordinators will analyze study proposals to determine whether copies of field notes, databases, maps, photos, and / or other materials may also be requested.The permittee is responsible for the content of reports and data provided to the National Park Service

8. **Confidentiality** - - The permittee agrees to keep the specific location of sensitive park resources confidential. Sensitive resources include threatened species, endangered species, and rare species, archeological sites, caves, fossil sites, minerals, commercially valuable resources, and sacred ceremonial sites.

9. **Methods of travel** - Travel within the park is restricted to only those methods that are available to the general public unless otherwise specified in additional stipulations associated with this permit.

10. **Other permits** - The permittee must obtain all other required permit(s) to conduct the specified project.

11. **Insurance** - If liability insurance is required by the NPS for this project, then documentation must be provided that it has been obtained and is current in all respects before this permit is considered valid.

12. **Mechanized equipment** - No use of mechanized equipment in designated, proposed, or potential wilderness areas is allowed unless authorized by the superintendent or a designee in additional specific conditions associated with this permit.

13. **NPS participation** - The permittee should not anticipate assistance from the NPS unless specific arrangements are made and documented in either an additional stipulation attached to this permit or in other separate written agreements.

14. **Permanent markers and field equipment** - The permittee is required to remove all markers or equipment from the field after the completion of the study or prior to the expiration date of this permit. The superintendent or a designee may modify this requirement through additional park specific conditions that may be attached to this permit. Additional conditions regarding the positioning and identification of markers and field equipment may be issued by staff at individual parks.

15. **Access to park and restricted areas** - Approval for any activity is contingent on the park being open and staffed for required operations. No entry into restricted areas is allowed unless authorized in additional park specific stipulations attached to this permit.

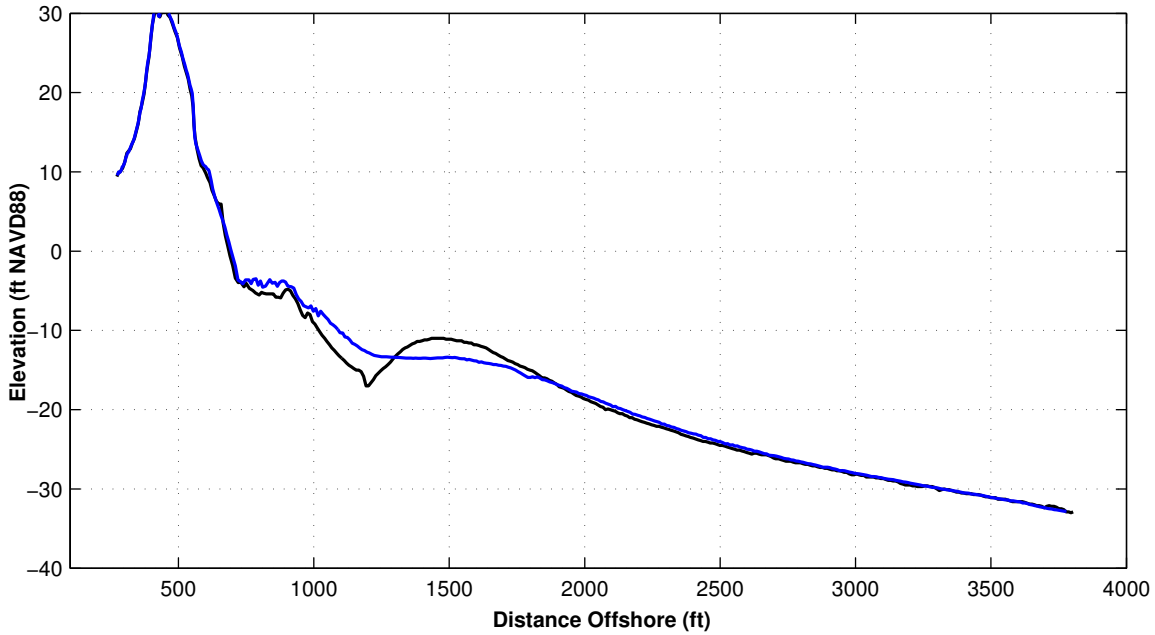
16. **Notification** - The permittee is required to contact the park's Research and Collecting Permit Office (or other offices if indicated in the stipulations associated with this permit) prior to initiating any fieldwork authorized by this permit.Ideally this contact should occur at least one week prior to the initial visit to the park.

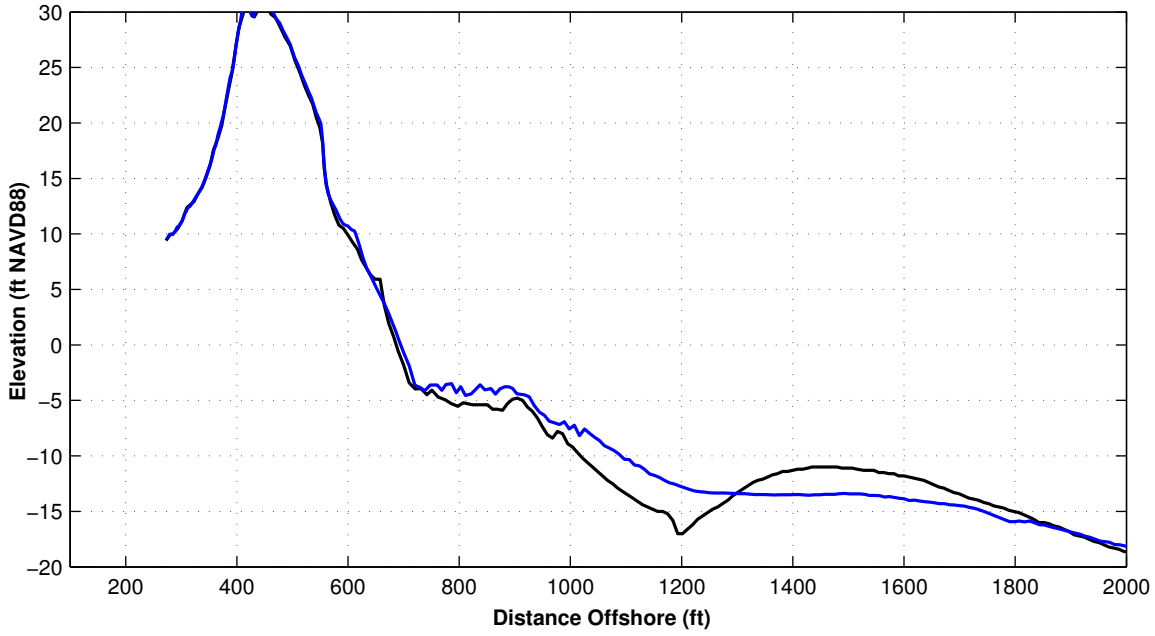
17. **Expiration date** - Permits expire on the date listed. Nothing in this permit shall be construed as granting any exclusive research privileges or automatic right to continue, extend, or renew this or any other line of research under new permit(s).

18. **Other stipulations** - This permit includes by reference all stipulations listed in the application materials or in additional attachments to this permit provided by the superintendent or a designee. Breach of any of the terms of this permit will be grounds for revocation of this permit and denial of future permits.

# APPENDIX B
# SURVEY PROFILE COMPARISON PLOTS

10979/17




| Survey Transect 430+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 62.71 ft | −45.68 ft |
| Volume Change Above +6 ft NAVD88 | 5.87 cy/ft | 1.85 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.96 cy/ft | −5.08 cy/ft |
| Volume Change Above −6 ft NAVD88 | 36.59 cy/ft | −24.31 cy/ft |
| Volume Change Above −14 ft NAVD88 | 40.06 cy/ft | −27.28 cy/ft |
| Volume Change Above −19 ft NAVD88 | 28.16 cy/ft | −18.95 cy/ft |
| Volume Change Above −30 ft NAVD88 | 48.16 cy/ft | −31.74 cy/ft |

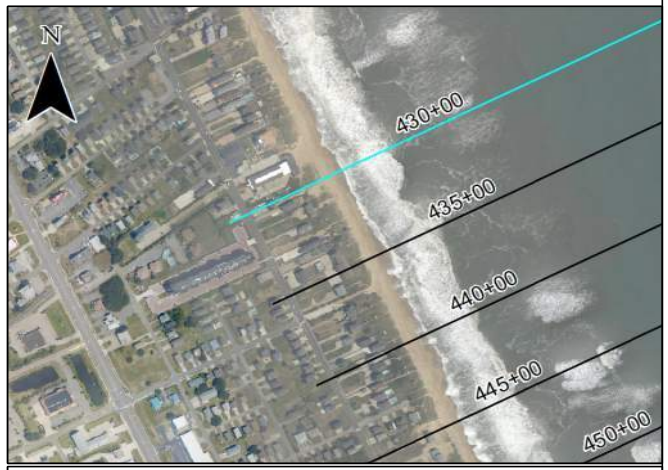
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

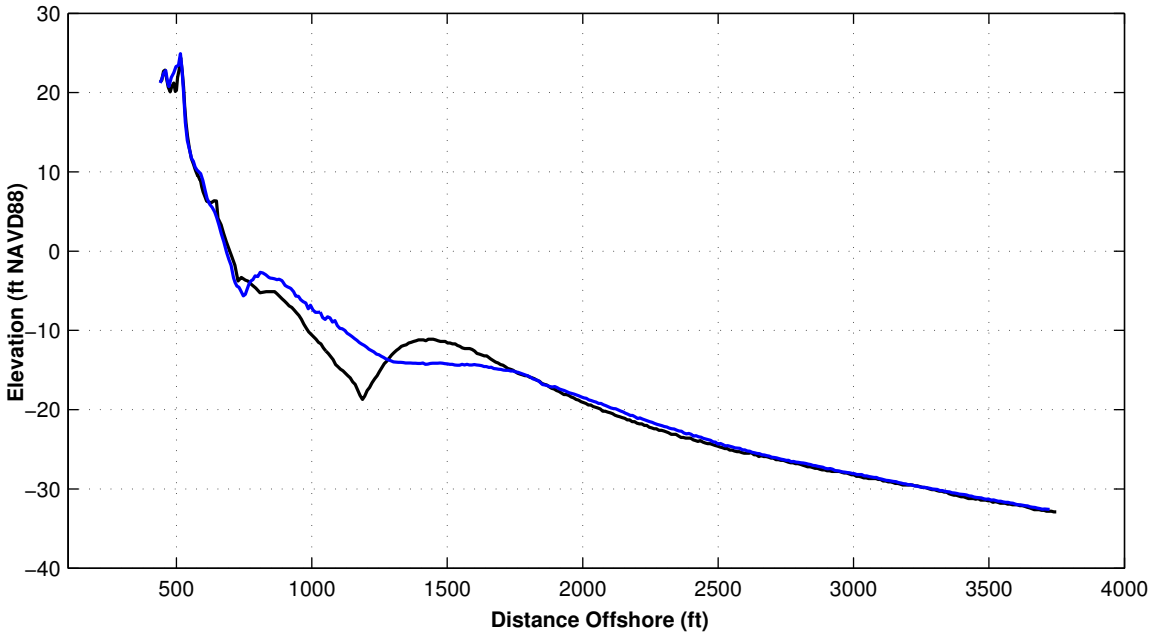
Notes:

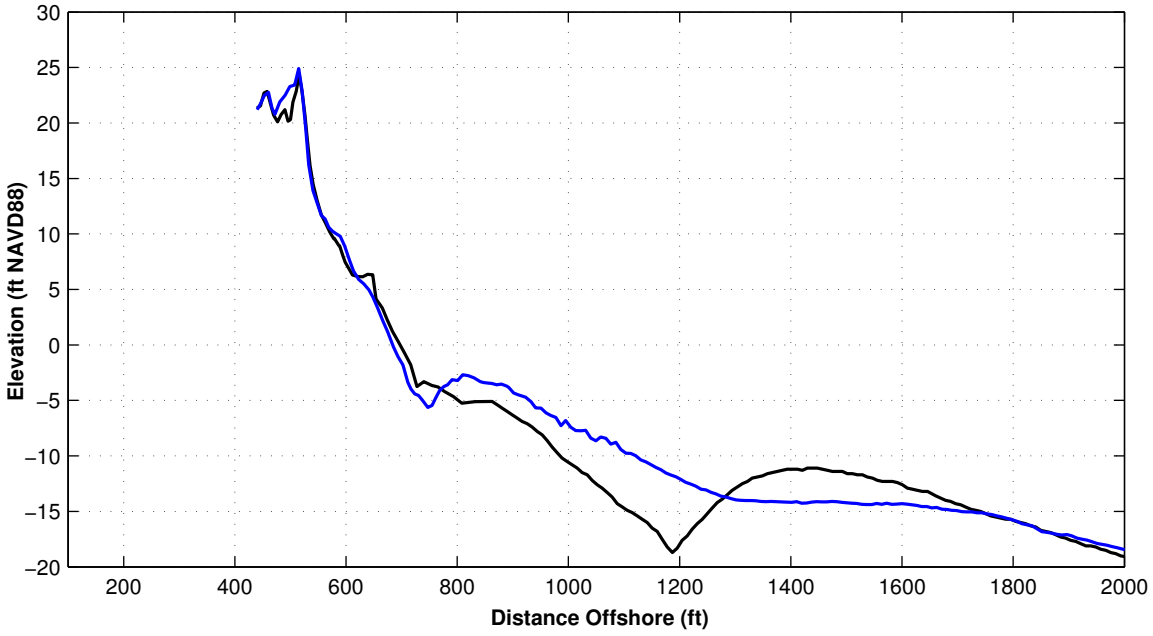
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 430+00 | Pg 44 of 173 | 2024 |
|---|---|---|




| Survey Transect 435+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −24.87 ft | 18.28 ft |
| Volume Change Above +6 ft NAVD88 | 3.47 cy/ft | 0.62 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.29 cy/ft | 0.63 cy/ft |
| Volume Change Above −6 ft NAVD88 | −10.86 cy/ft | −0.49 cy/ft |
| Volume Change Above −14 ft NAVD88 | 0.56 cy/ft | −3.76 cy/ft |
| Volume Change Above −19 ft NAVD88 | −16.74 cy/ft | 4.88 cy/ft |
| Volume Change Above −30 ft NAVD88 | 1.80 cy/ft | −12.29 cy/ft |

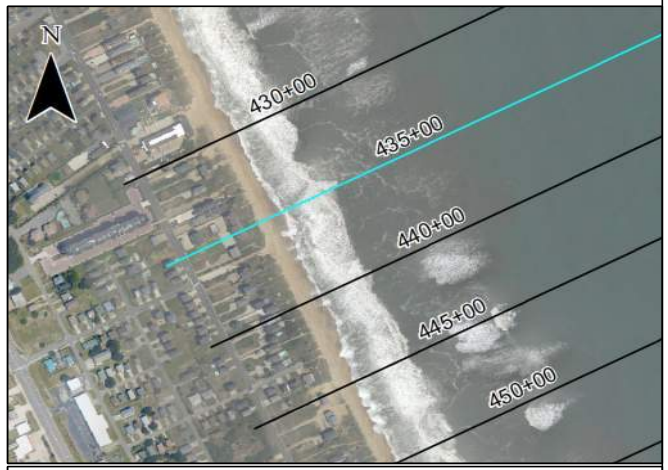
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

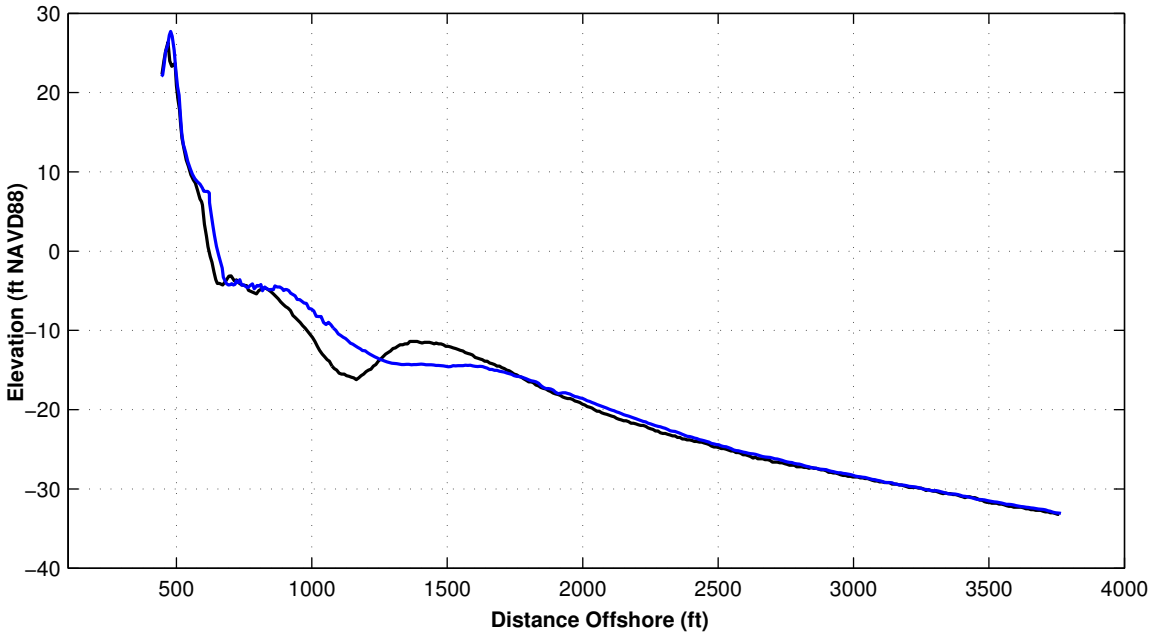
Notes:

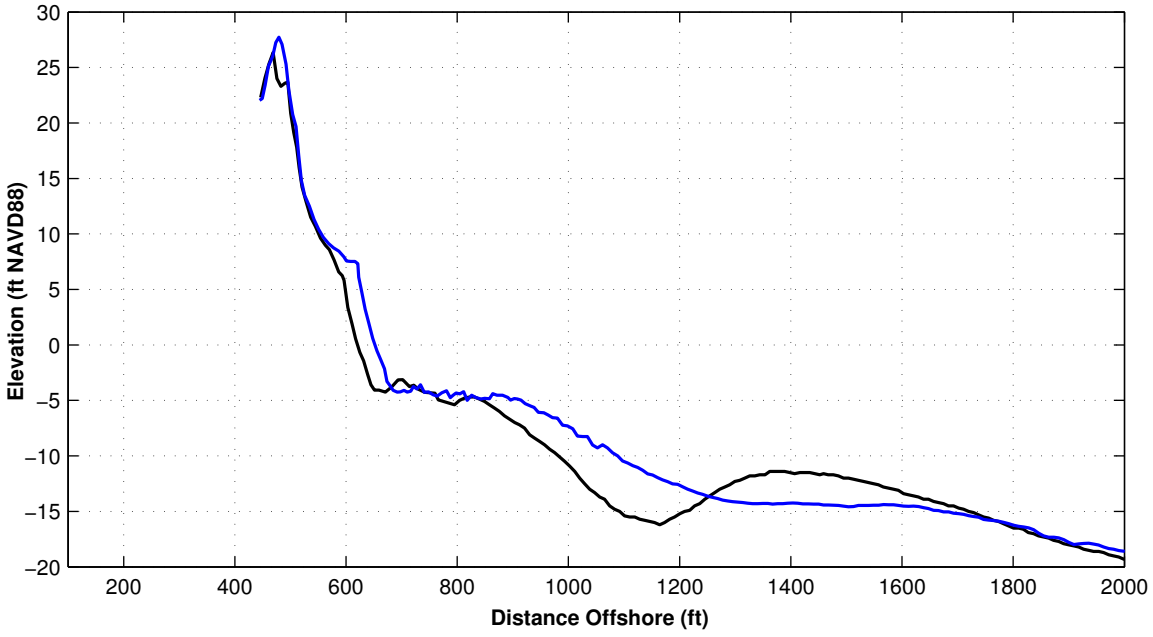
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 435+00 | Pg 45 of 173 | 2024 |
|---|---|---|




| Survey Transect 440+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 22.14 ft | −36.03 ft |
| Volume Change Above +6 ft NAVD88 | 2.35 cy/ft | 1.57 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 5.20 cy/ft | −3.33 cy/ft |
| Volume Change Above −6 ft NAVD88 | 5.54 cy/ft | −3.96 cy/ft |
| Volume Change Above −14 ft NAVD88 | 7.30 cy/ft | 14.47 cy/ft |
| Volume Change Above −19 ft NAVD88 | −18.20 cy/ft | 37.83 cy/ft |
| Volume Change Above −30 ft NAVD88 | −1.22 cy/ft | 23.37 cy/ft |

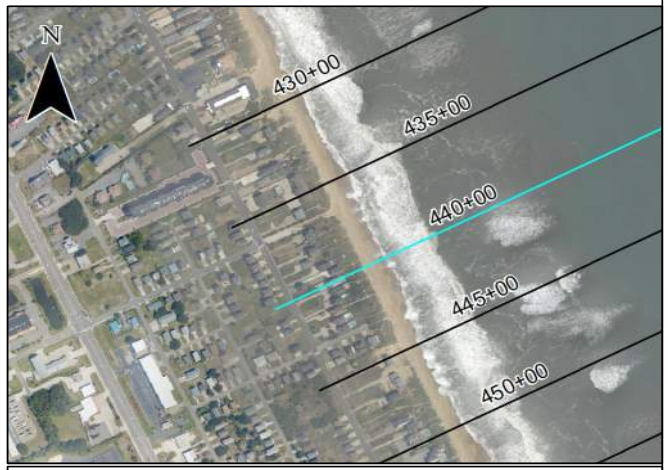
**LEGEND:**

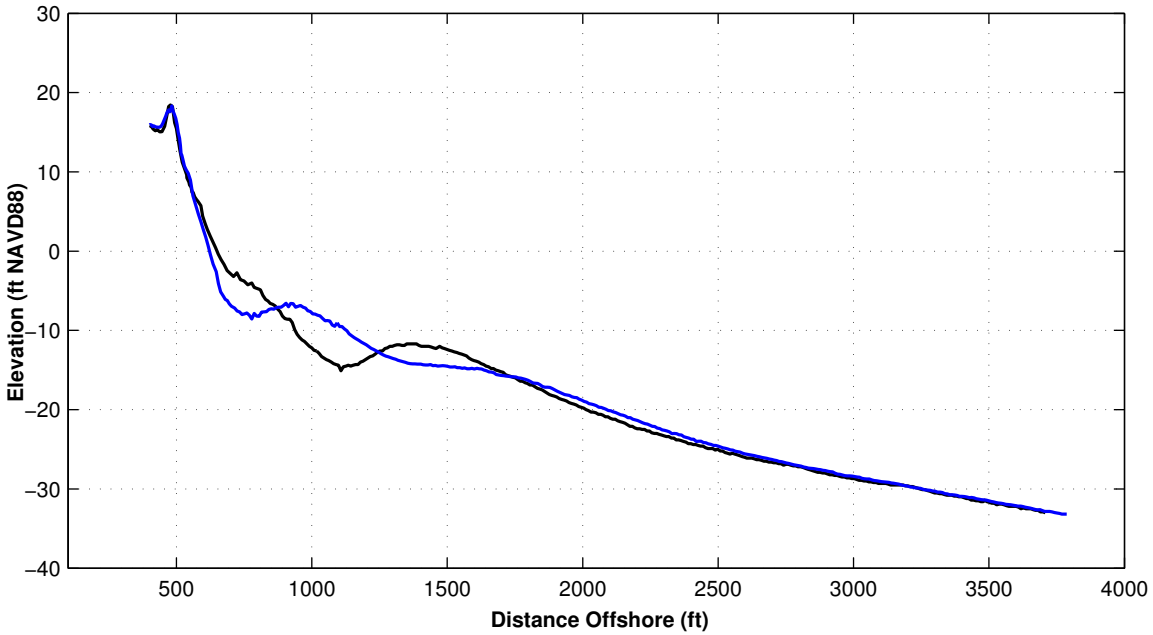
JUNE 2024 — OCTOBER 2023

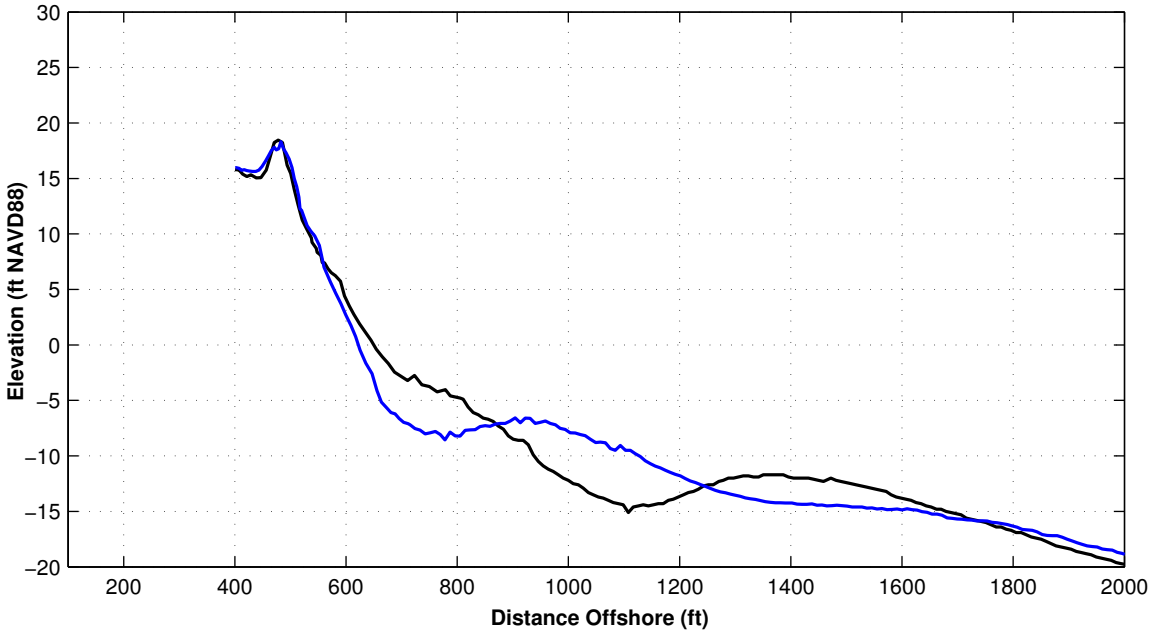
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 445+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −49.04 ft | −10.66 ft |
| Volume Change Above +6 ft NAVD88 | 0.42 cy/ft | 1.39 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −8.28 cy/ft | −0.56 cy/ft |
| Volume Change Above −6 ft NAVD88 | −19.45 cy/ft | −10.54 cy/ft |
| Volume Change Above −14 ft NAVD88 | −22.99 cy/ft | 6.80 cy/ft |
| Volume Change Above −19 ft NAVD88 | −48.51 cy/ft | 27.77 cy/ft |
| Volume Change Above −30 ft NAVD88 | −27.44 cy/ft | 14.16 cy/ft |

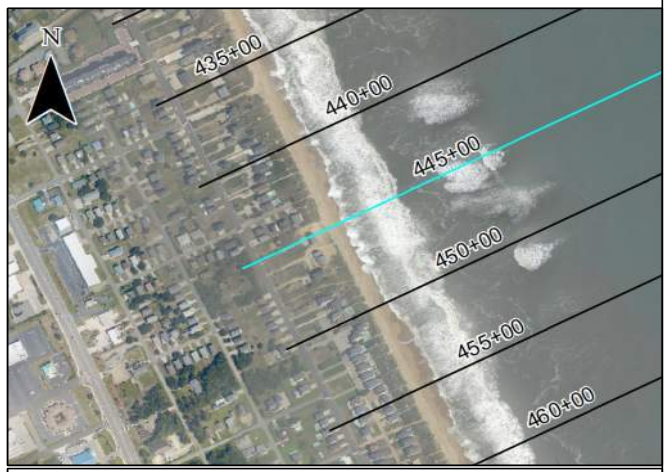
**LEGEND:**

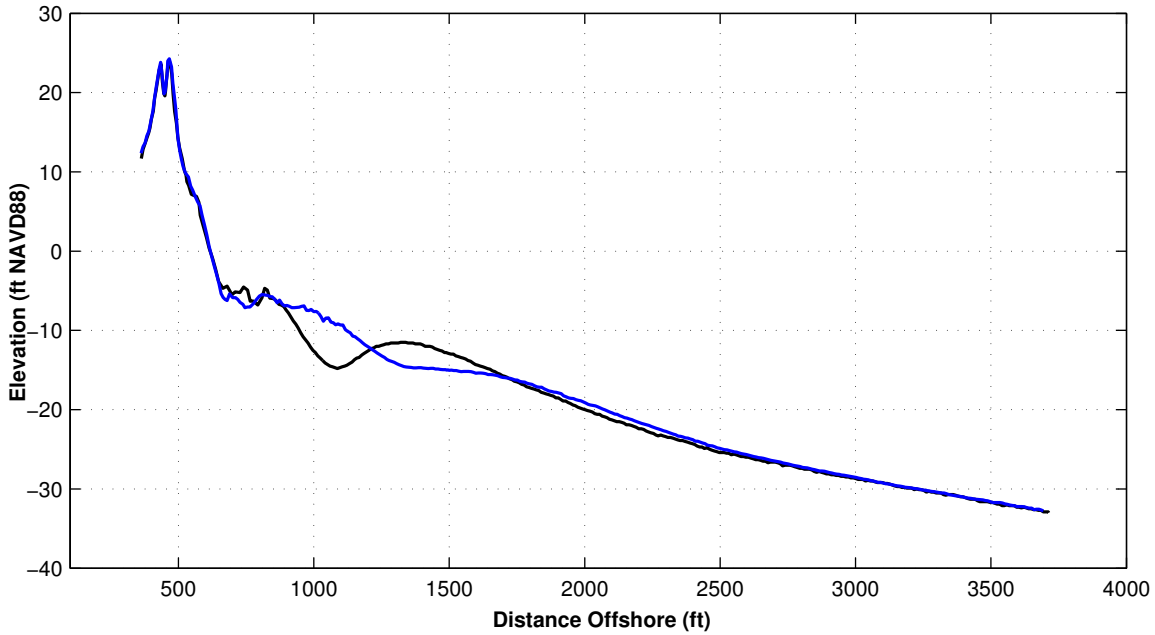
JUNE 2024 — OCTOBER 2023

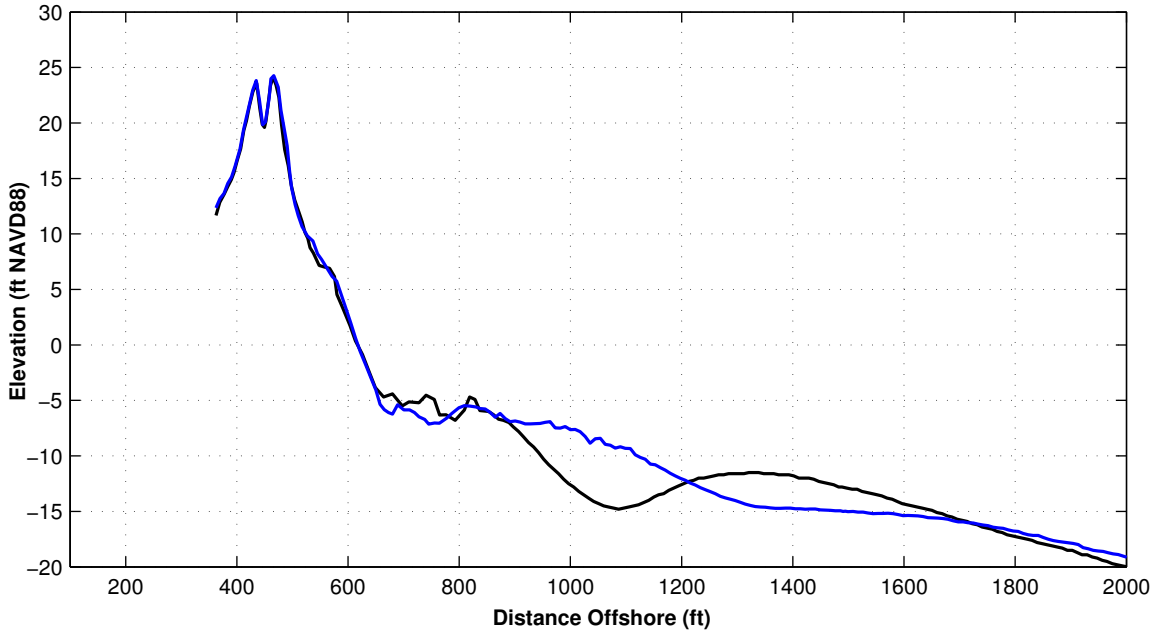
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 450+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 38.88 ft | −12.45 ft |
| Volume Change Above +6 ft NAVD88 | −0.86 cy/ft | −4.48 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.13 cy/ft | −5.80 cy/ft |
| Volume Change Above −6 ft NAVD88 | 7.42 cy/ft | −7.64 cy/ft |
| Volume Change Above −14 ft NAVD88 | 9.94 cy/ft | −15.63 cy/ft |
| Volume Change Above −19 ft NAVD88 | −15.15 cy/ft | −2.03 cy/ft |
| Volume Change Above −30 ft NAVD88 | 3.64 cy/ft | −12.14 cy/ft |

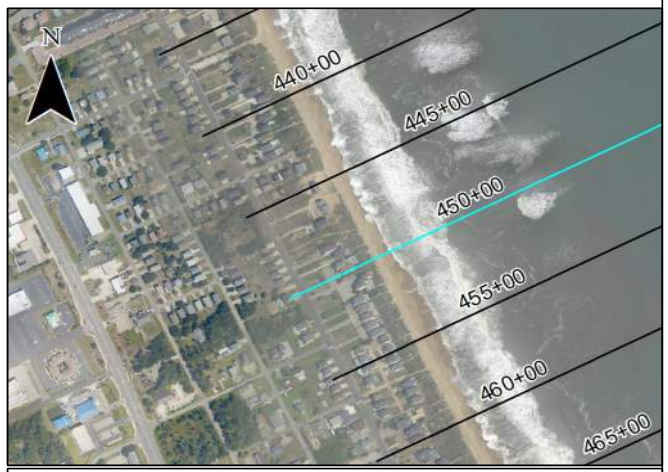
**LEGEND:**

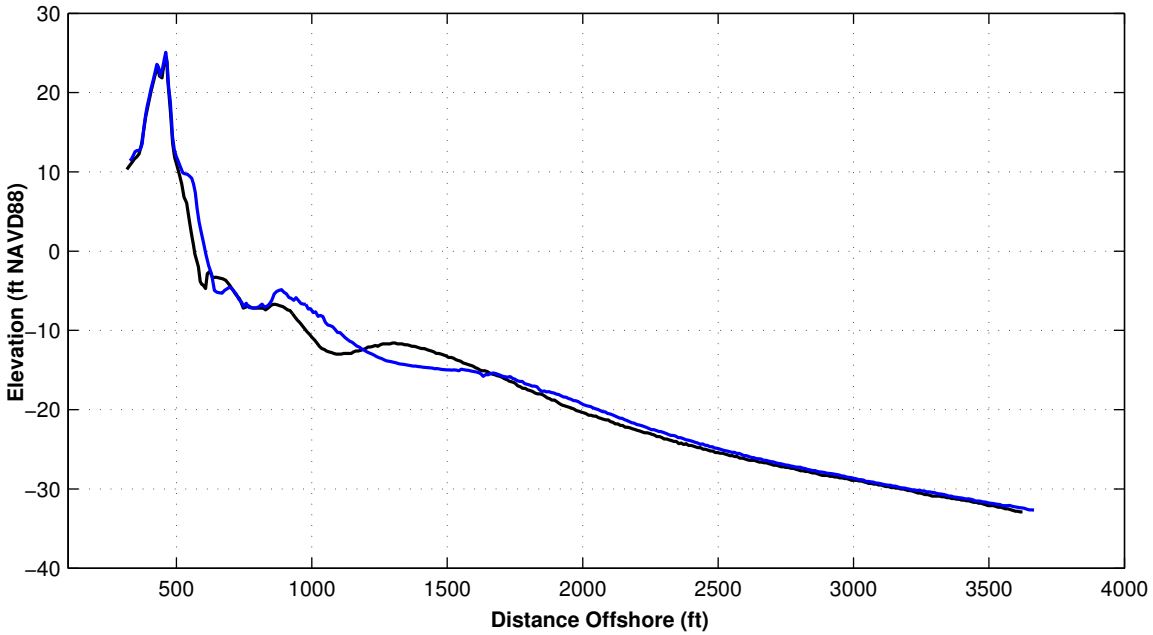
JUNE 2024 — OCTOBER 2023

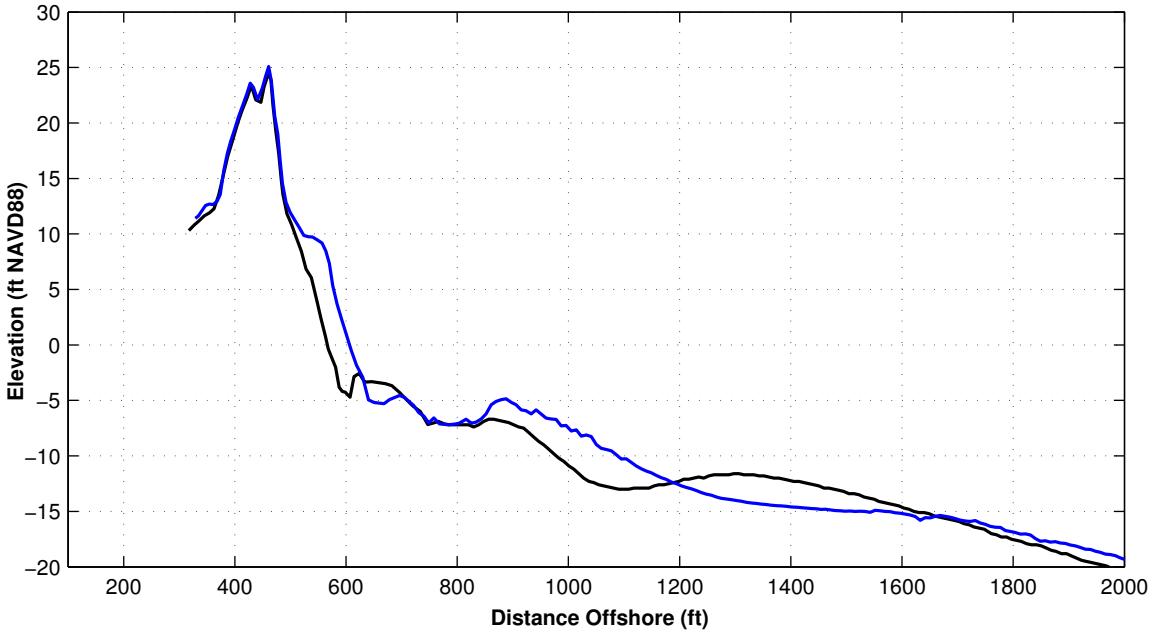
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.





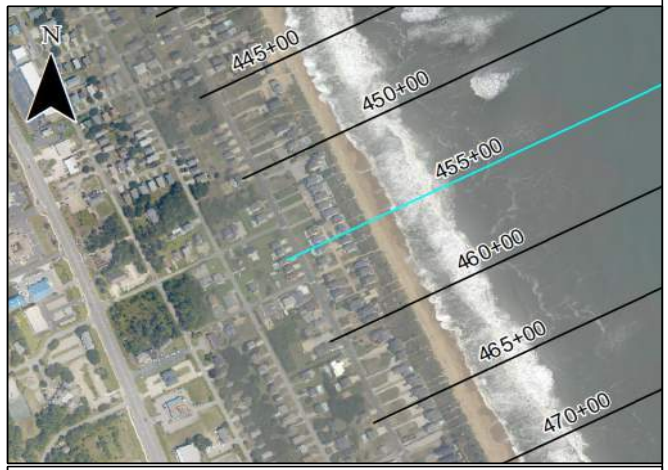

| Survey Transect 455+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 8.09 ft | −17.61 ft |
| Volume Change Above +6 ft NAVD88 | 1.87 cy/ft | −0.25 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 3.66 cy/ft | −4.35 cy/ft |
| Volume Change Above −6 ft NAVD88 | −6.74 cy/ft | 0.71 cy/ft |
| Volume Change Above −14 ft NAVD88 | 14.36 cy/ft | −18.98 cy/ft |
| Volume Change Above −19 ft NAVD88 | −19.11 cy/ft | −27.07 cy/ft |
| Volume Change Above −30 ft NAVD88 | −5.99 cy/ft | −41.09 cy/ft |

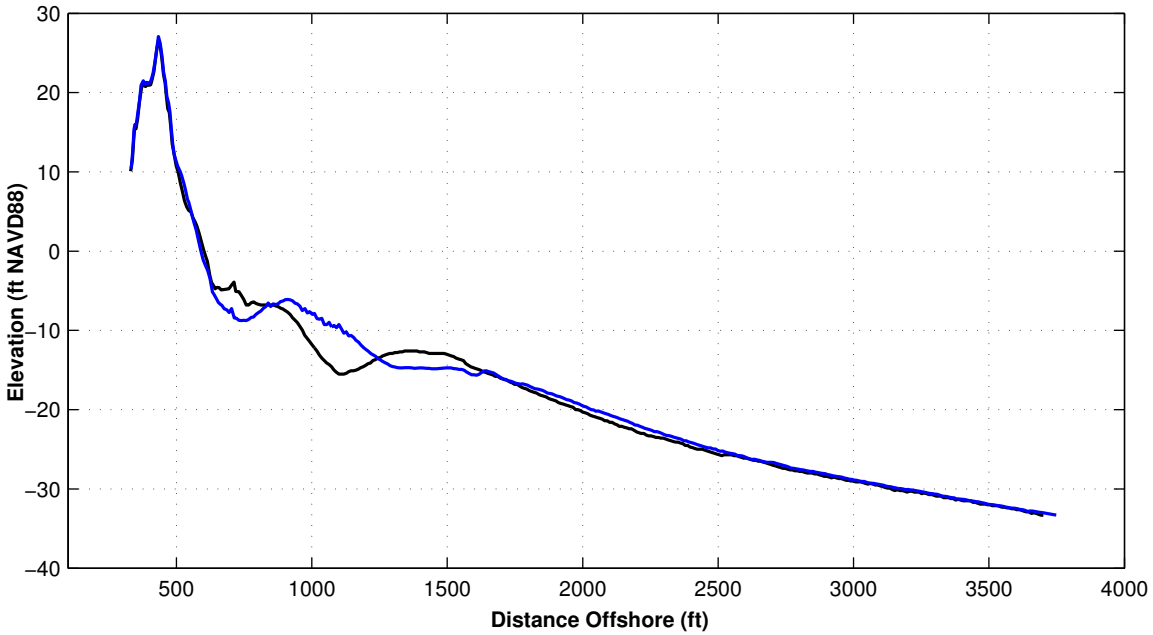
**LEGEND:**

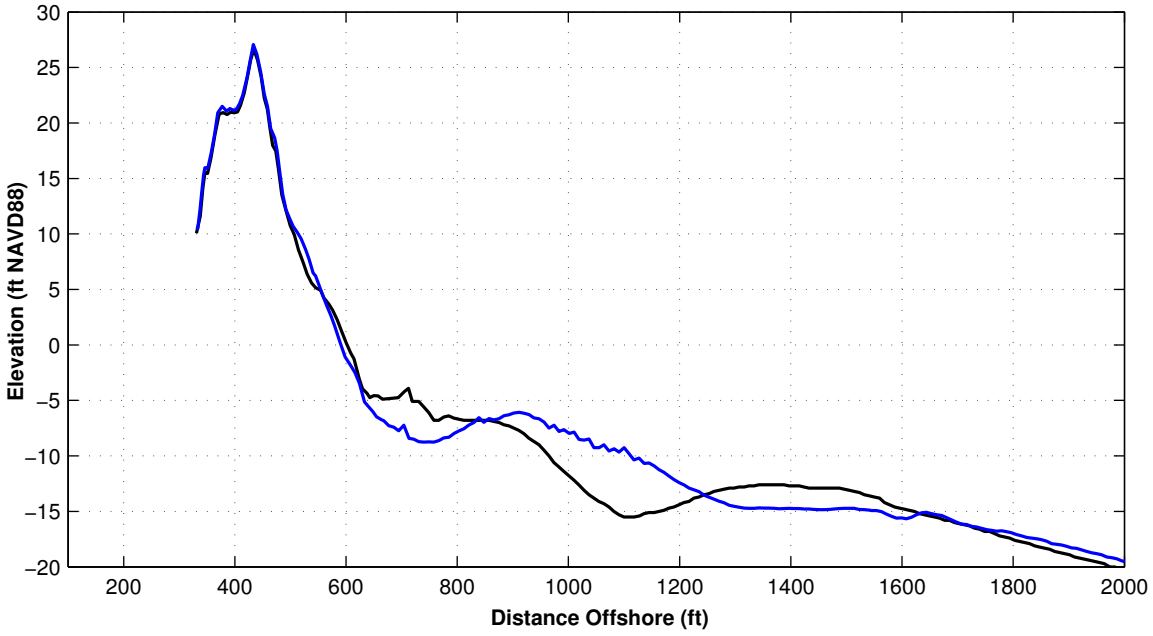
JUNE 2024 — OCTOBER 2023 / JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 460+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 3.96 ft | 12.46 ft |
| Volume Change Above +6 ft NAVD88 | −1.04 cy/ft | 1.44 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −1.00 cy/ft | 4.58 cy/ft |
| Volume Change Above −6 ft NAVD88 | −10.59 cy/ft | 20.08 cy/ft |
| Volume Change Above −14 ft NAVD88 | 7.62 cy/ft | 5.25 cy/ft |
| Volume Change Above −19 ft NAVD88 | 3.04 cy/ft | −20.00 cy/ft |
| Volume Change Above −30 ft NAVD88 | 17.03 cy/ft | −33.63 cy/ft |

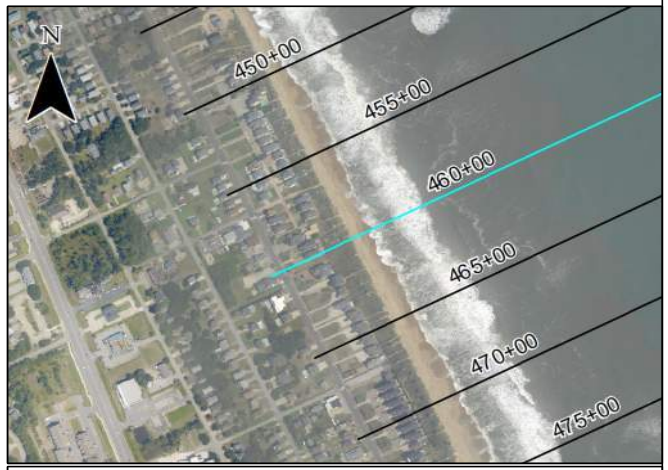
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

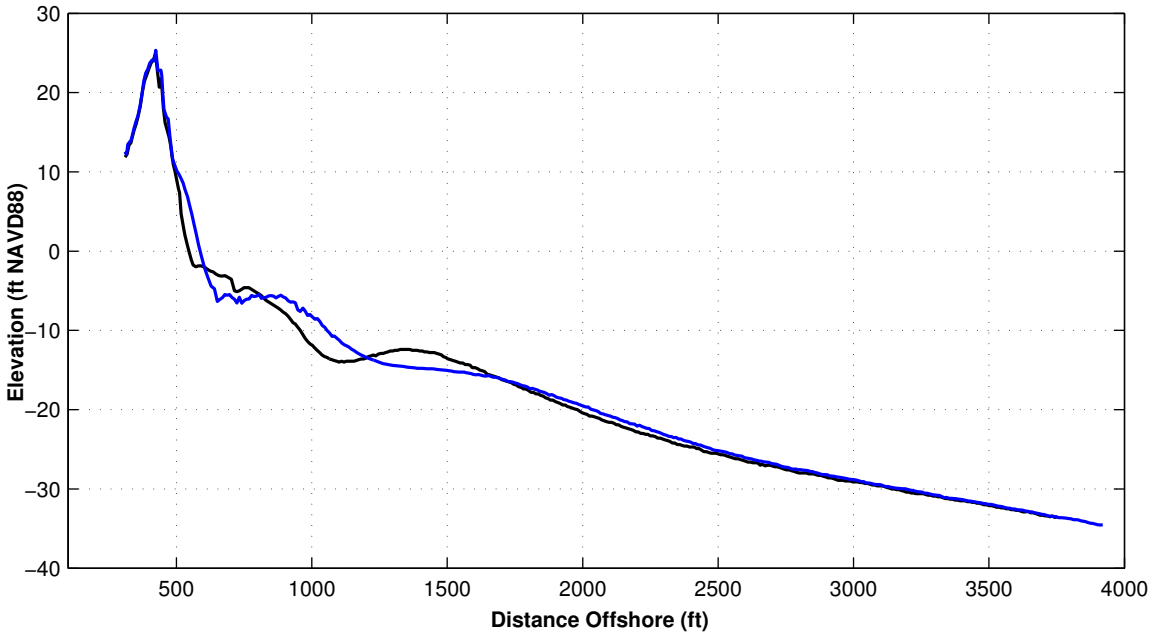
Notes:

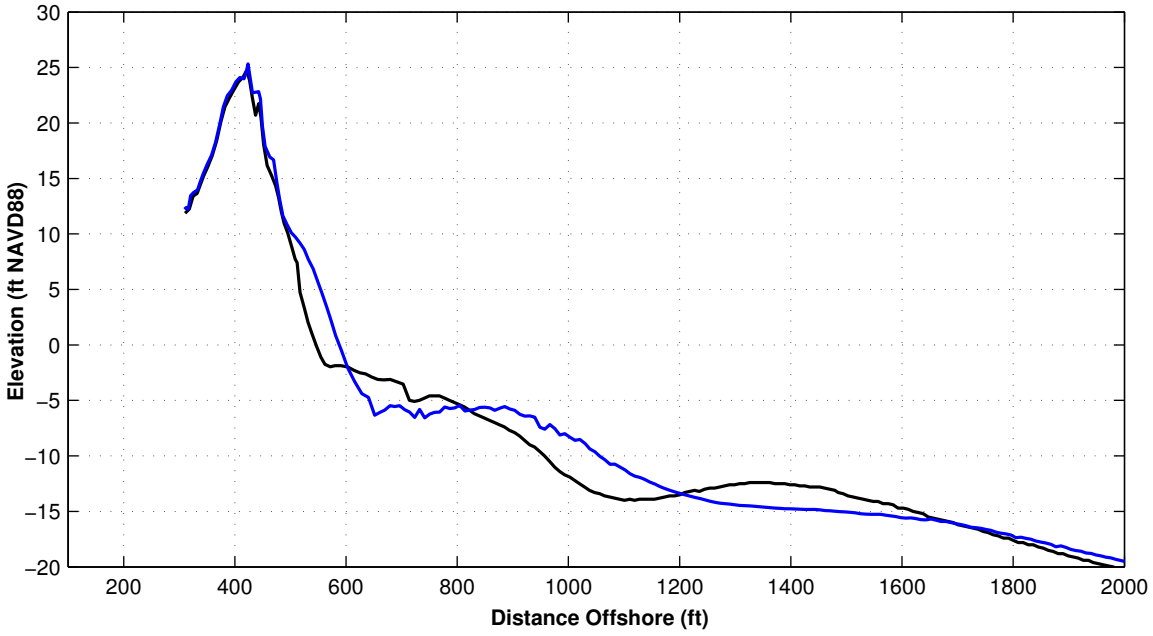
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 460+00 | Pg 50 of 173 | 2024 |
|---|---|---|




| Survey Transect 465+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 31.14 ft | −27.25 ft |
| Volume Change Above +6 ft NAVD88 | 1.67 cy/ft | −0.34 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 8.27 cy/ft | −7.29 cy/ft |
| Volume Change Above −6 ft NAVD88 | 3.08 cy/ft | −9.31 cy/ft |
| Volume Change Above −14 ft NAVD88 | 30.64 cy/ft | −29.17 cy/ft |
| Volume Change Above −19 ft NAVD88 | 8.01 cy/ft | −22.72 cy/ft |
| Volume Change Above −30 ft NAVD88 | 21.05 cy/ft | −35.79 cy/ft |

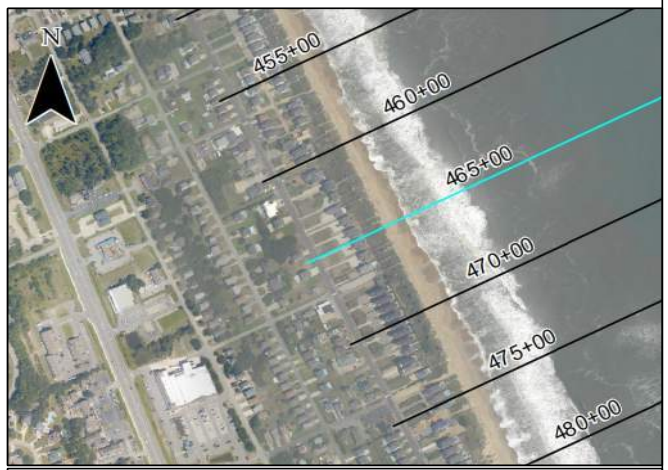
**LEGEND:**

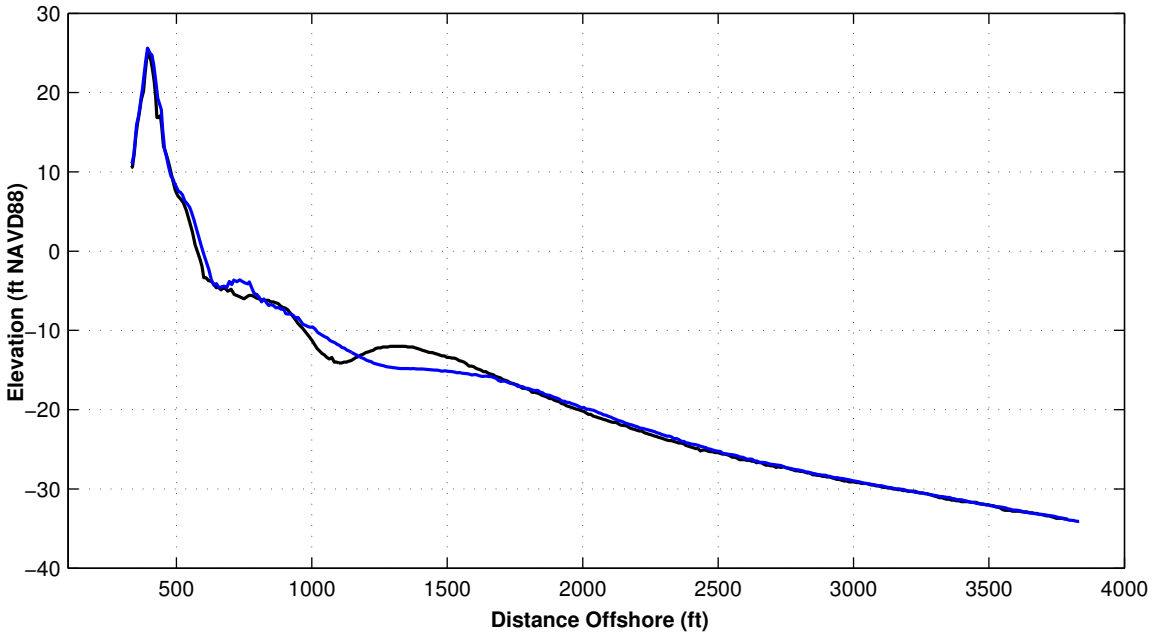
JUNE 2024 — OCTOBER 2023

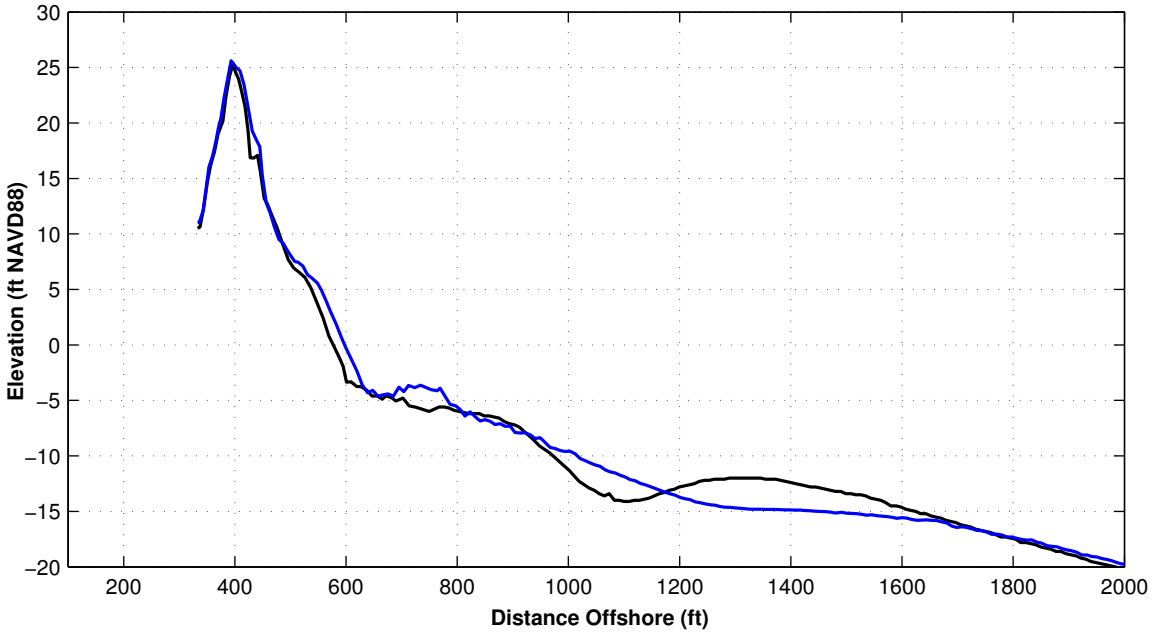
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 470+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −40.56 ft | 49.23 ft |
| Volume Change Above +6 ft NAVD88 | 1.22 cy/ft | 1.01 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −3.17 cy/ft | 6.48 cy/ft |
| Volume Change Above −6 ft NAVD88 | −21.99 cy/ft | 22.03 cy/ft |
| Volume Change Above −14 ft NAVD88 | −36.92 cy/ft | 46.22 cy/ft |
| Volume Change Above −19 ft NAVD88 | −60.27 cy/ft | 53.66 cy/ft |
| Volume Change Above −30 ft NAVD88 | −43.53 cy/ft | 38.69 cy/ft |

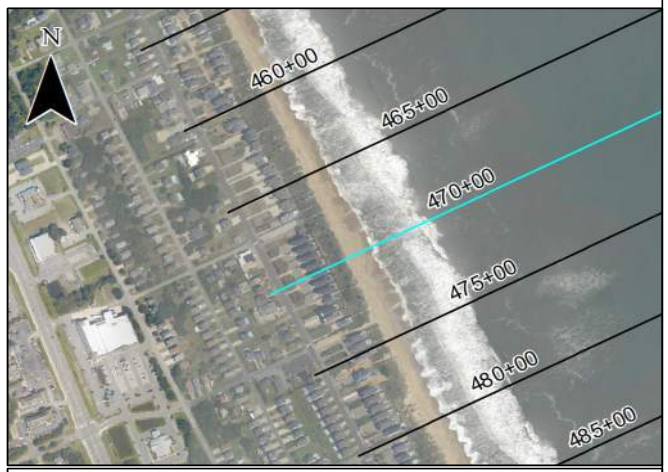
**LEGEND:**

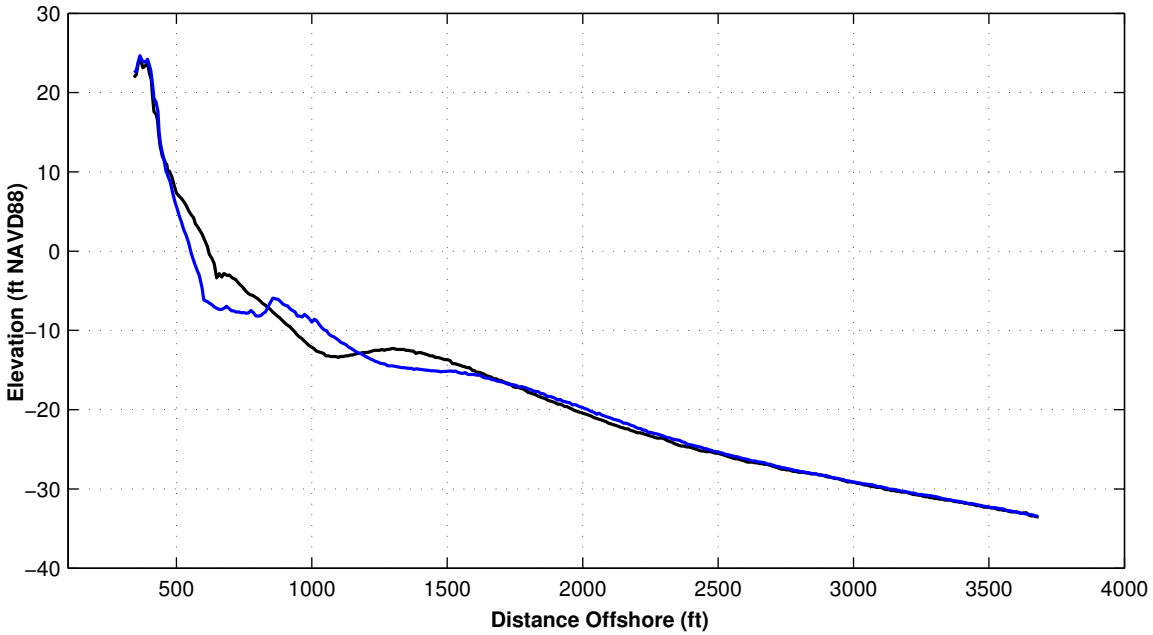
JUNE 2024 — OCTOBER 2023

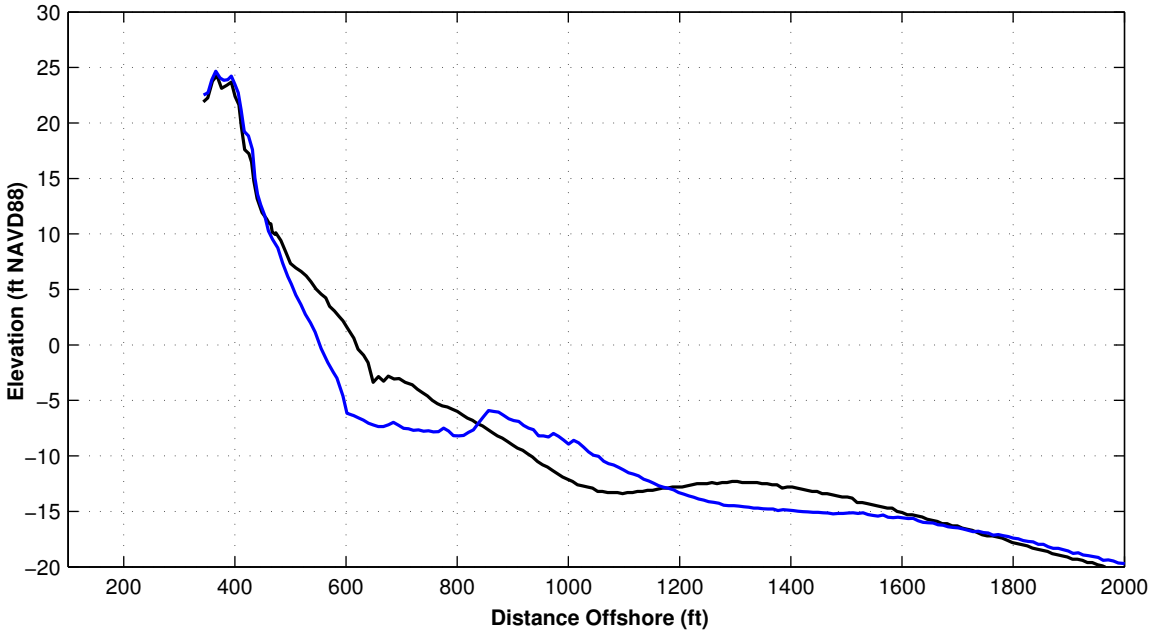
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 475+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −41.03 ft | 19.44 ft |
| Volume Change Above +6 ft NAVD88 | 3.69 cy/ft | −1.30 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −2.31 cy/ft | 0.50 cy/ft |
| Volume Change Above −6 ft NAVD88 | −15.61 cy/ft | −2.53 cy/ft |
| Volume Change Above −14 ft NAVD88 | −14.36 cy/ft | 0.62 cy/ft |
| Volume Change Above −19 ft NAVD88 | −26.02 cy/ft | 0.21 cy/ft |
| Volume Change Above −30 ft NAVD88 | −10.93 cy/ft | −18.45 cy/ft |

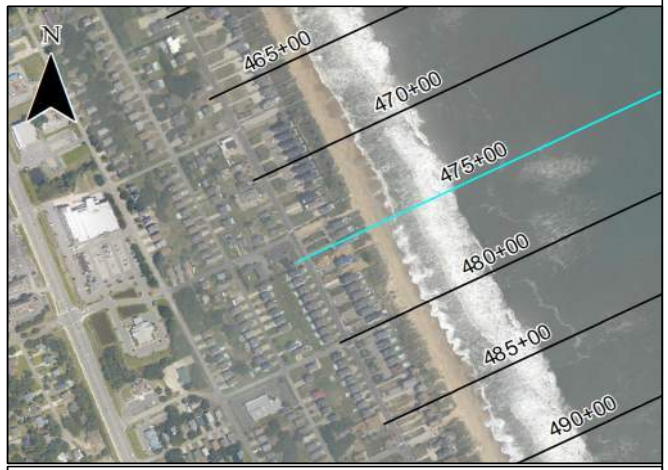
**LEGEND:**

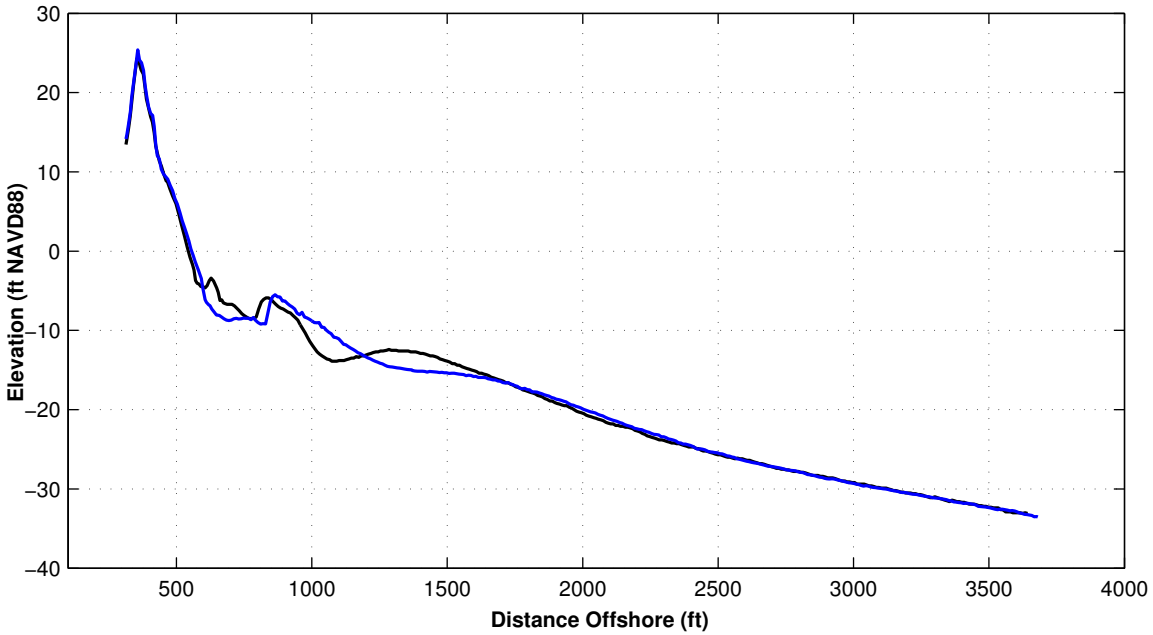
JUNE 2024 — OCTOBER 2023

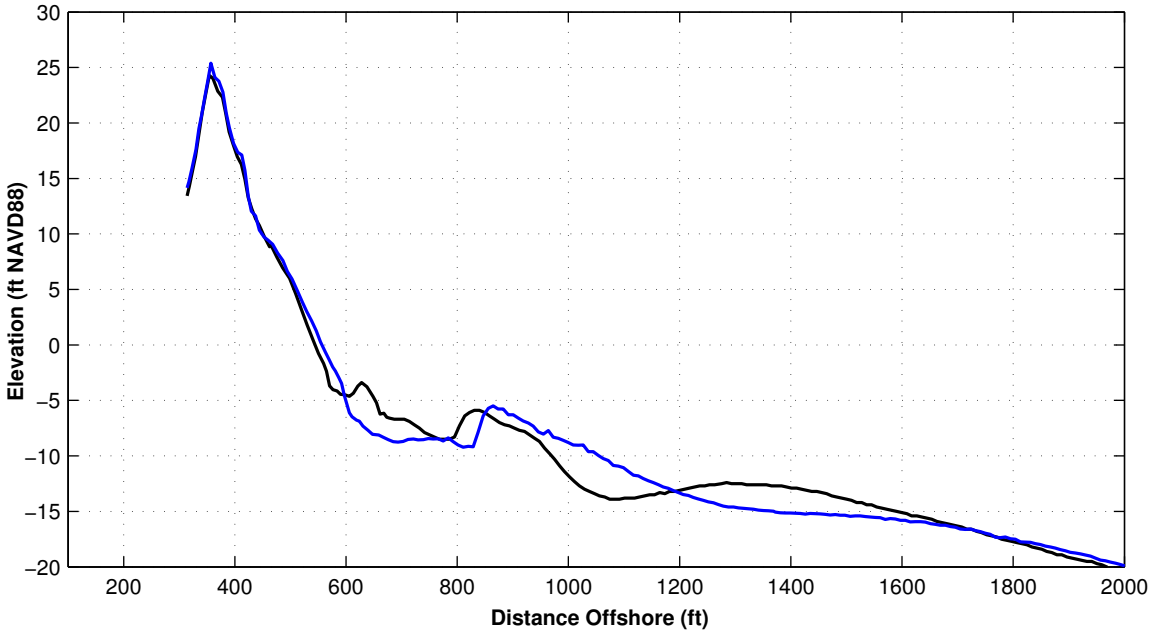
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.





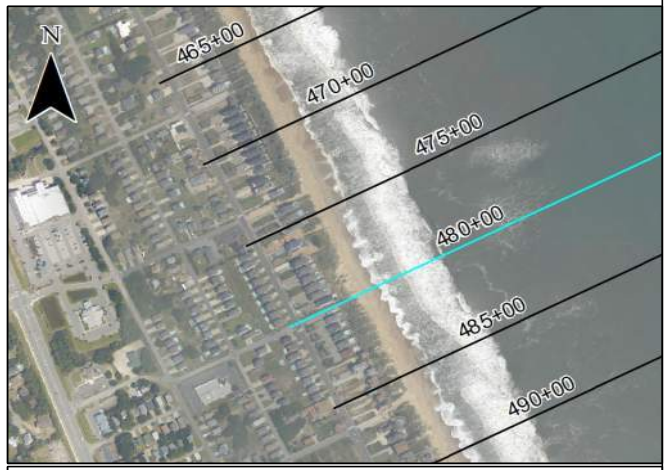

| Survey Transect 480+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 62.85 ft | −42.05 ft |
| Volume Change Above +6 ft NAVD88 | 1.91 cy/ft | −0.24 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.56 cy/ft | −7.39 cy/ft |
| Volume Change Above −6 ft NAVD88 | 28.44 cy/ft | −27.70 cy/ft |
| Volume Change Above −14 ft NAVD88 | 33.05 cy/ft | −23.99 cy/ft |
| Volume Change Above −19 ft NAVD88 | 7.07 cy/ft | −14.50 cy/ft |
| Volume Change Above −30 ft NAVD88 | 22.32 cy/ft | −27.59 cy/ft |

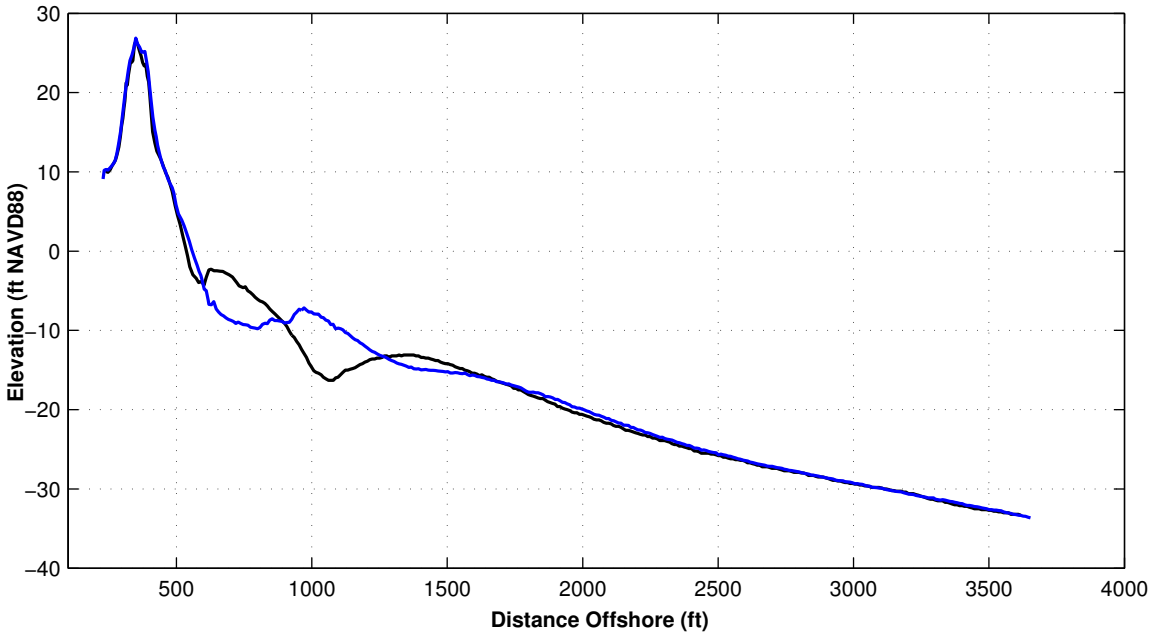
**LEGEND:**

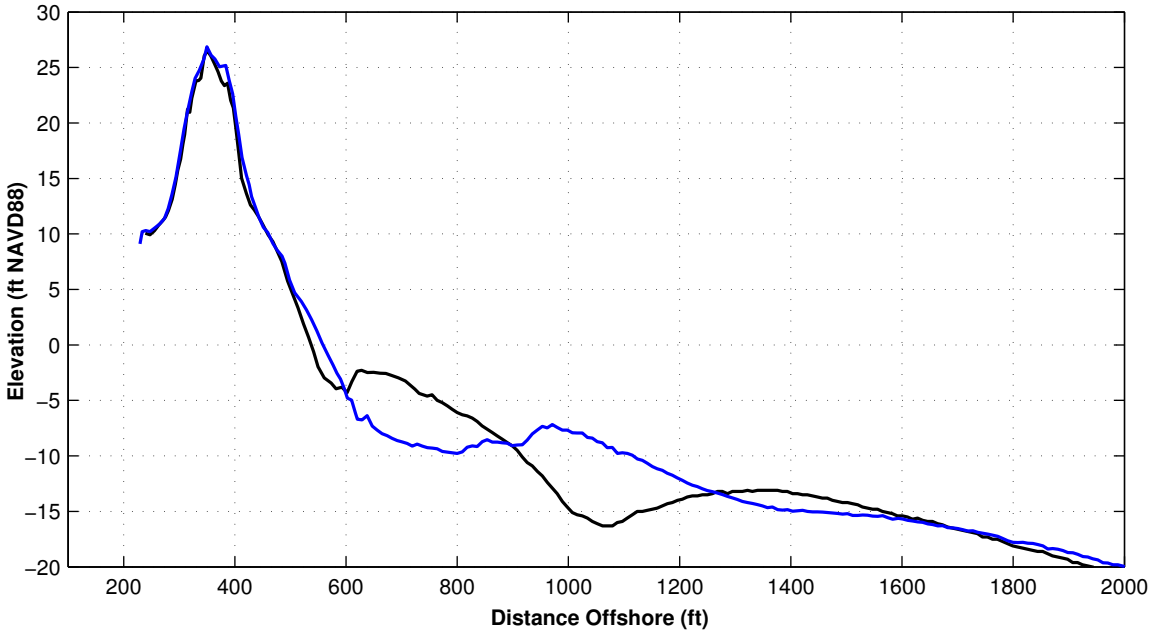
JUNE 2024 — OCTOBER 2023 / JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 485+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 60.32 ft | −38.15 ft |
| Volume Change Above +6 ft NAVD88 | 2.42 cy/ft | −1.31 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 12.00 cy/ft | −6.06 cy/ft |
| Volume Change Above −6 ft NAVD88 | 22.78 cy/ft | −6.99 cy/ft |
| Volume Change Above −14 ft NAVD88 | 51.40 cy/ft | −16.58 cy/ft |
| Volume Change Above −19 ft NAVD88 | 28.57 cy/ft | −12.36 cy/ft |
| Volume Change Above −30 ft NAVD88 | 50.41 cy/ft | −87.48 cy/ft |

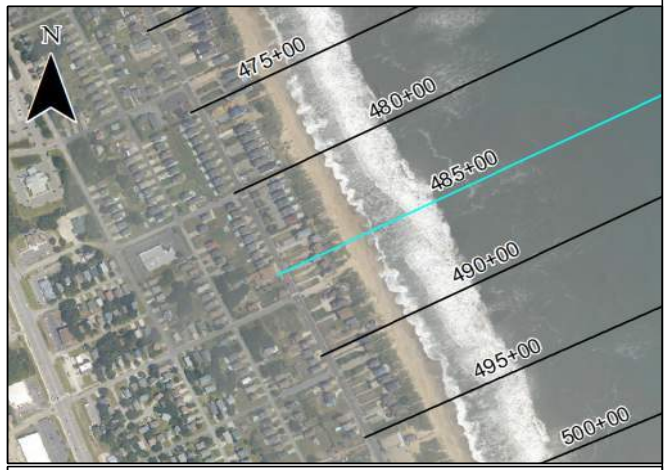
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

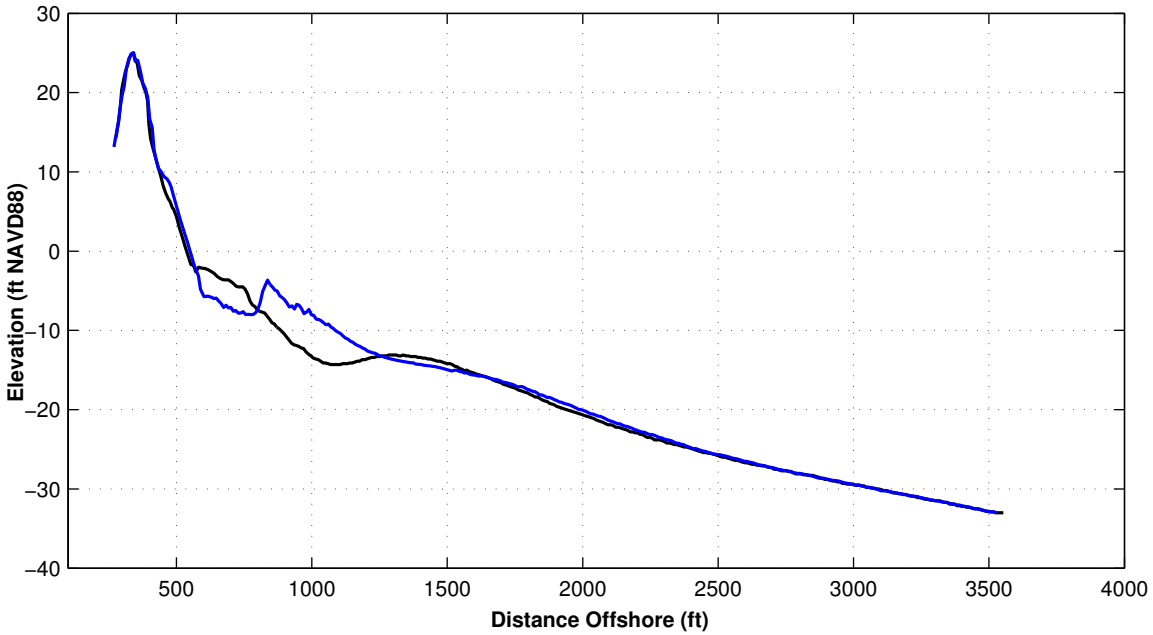
Notes:

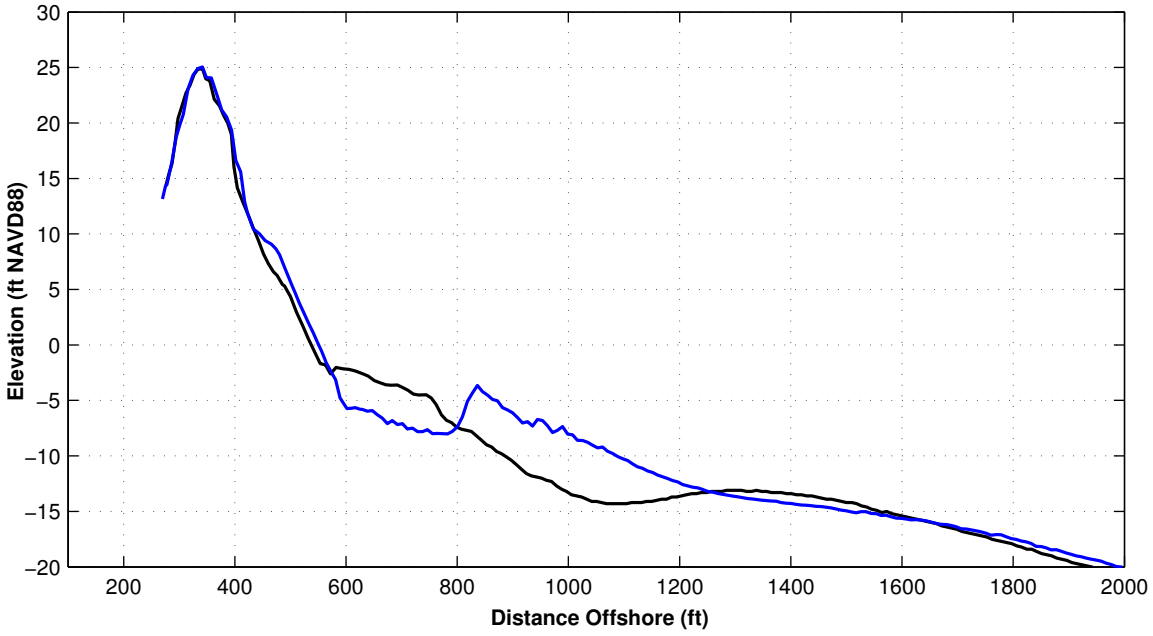
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 485+00 | Pg 55 of 173 | 2024 |
|---|---|---|




| Survey Transect 490+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 31.51 ft | −43.79 ft |
| Volume Change Above +6 ft NAVD88 | 0.23 cy/ft | −0.64 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.90 cy/ft | −8.00 cy/ft |
| Volume Change Above −6 ft NAVD88 | 4.73 cy/ft | −15.49 cy/ft |
| Volume Change Above −14 ft NAVD88 | −7.01 cy/ft | −26.00 cy/ft |
| Volume Change Above −19 ft NAVD88 | −13.98 cy/ft | −48.41 cy/ft |
| Volume Change Above −30 ft NAVD88 | −2.52 cy/ft | −57.10 cy/ft |

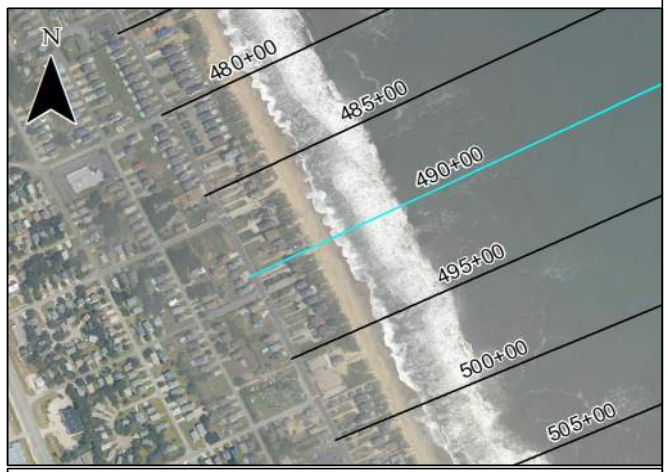
**LEGEND:**

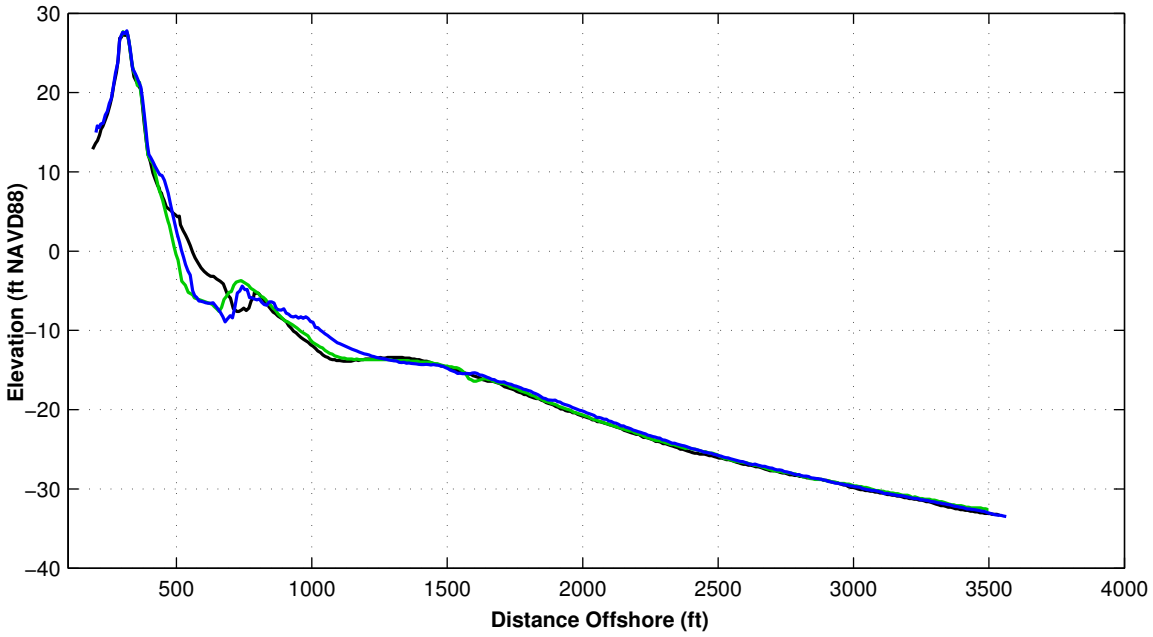
JUNE 2024 — OCTOBER 2023

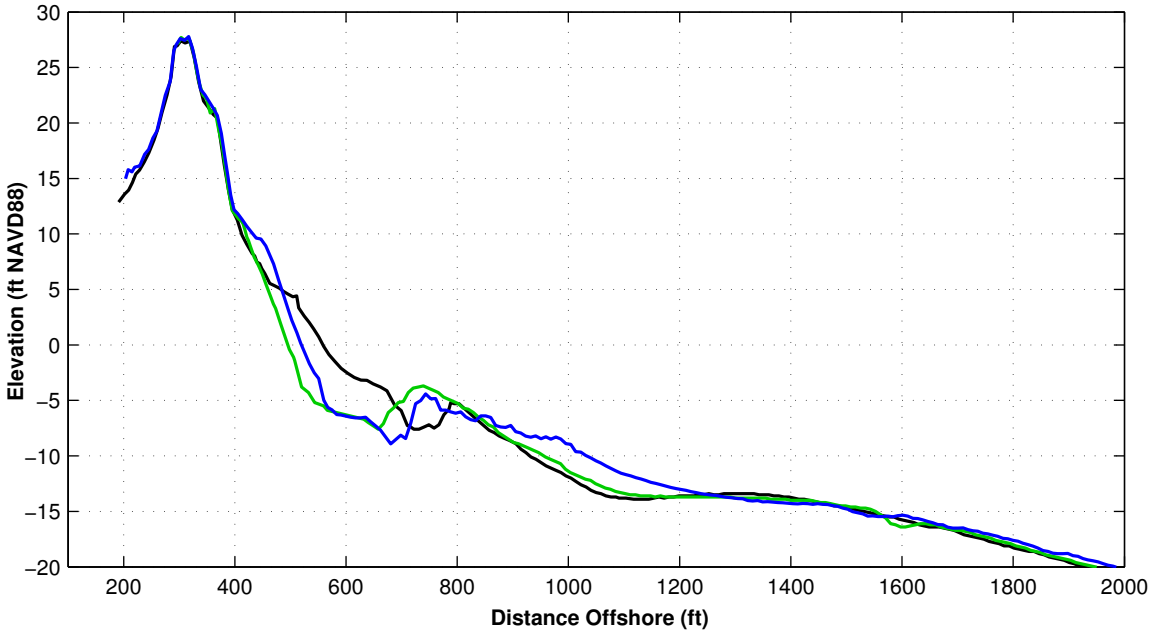
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 495+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −12.58 ft | 54.64 ft |
| Volume Change Above +6 ft NAVD88 | 0.12 cy/ft | −0.35 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −1.60 cy/ft | 6.69 cy/ft |
| Volume Change Above −6 ft NAVD88 | −23.90 cy/ft | 40.98 cy/ft |
| Volume Change Above −14 ft NAVD88 | −29.72 cy/ft | 31.59 cy/ft |
| Volume Change Above −19 ft NAVD88 | −21.19 cy/ft | −8.04 cy/ft |
| Volume Change Above −30 ft NAVD88 | −4.23 cy/ft | −19.56 cy/ft |

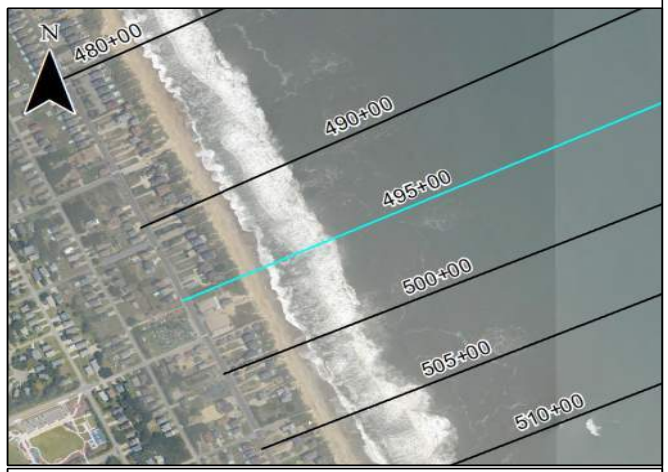
**LEGEND:**

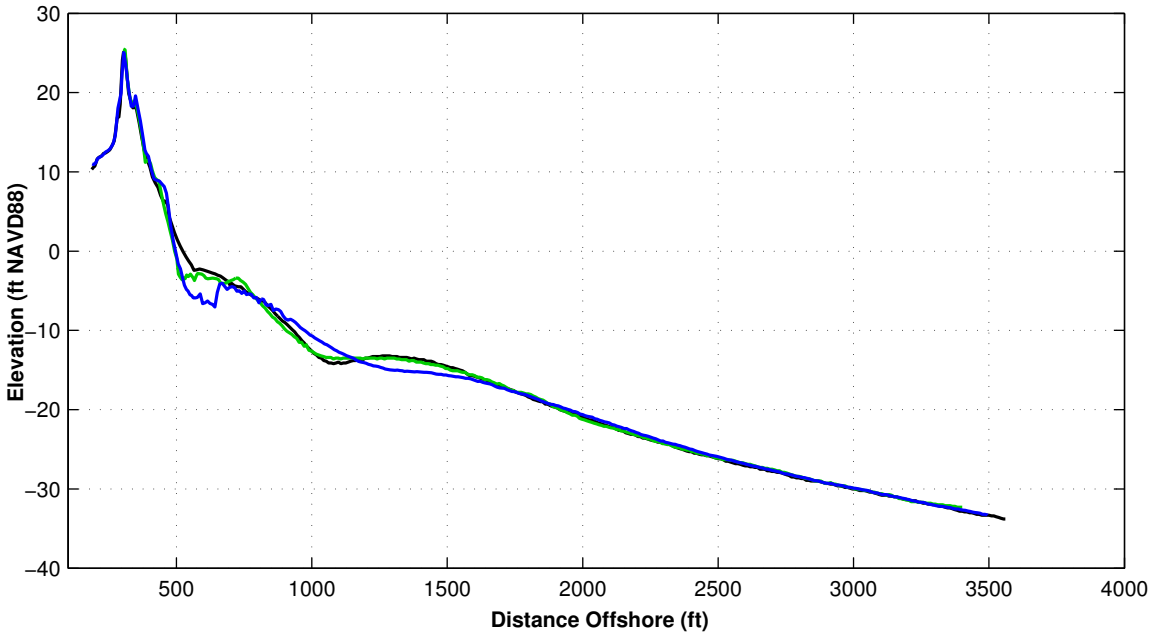
JUNE 2024 — OCTOBER 2023

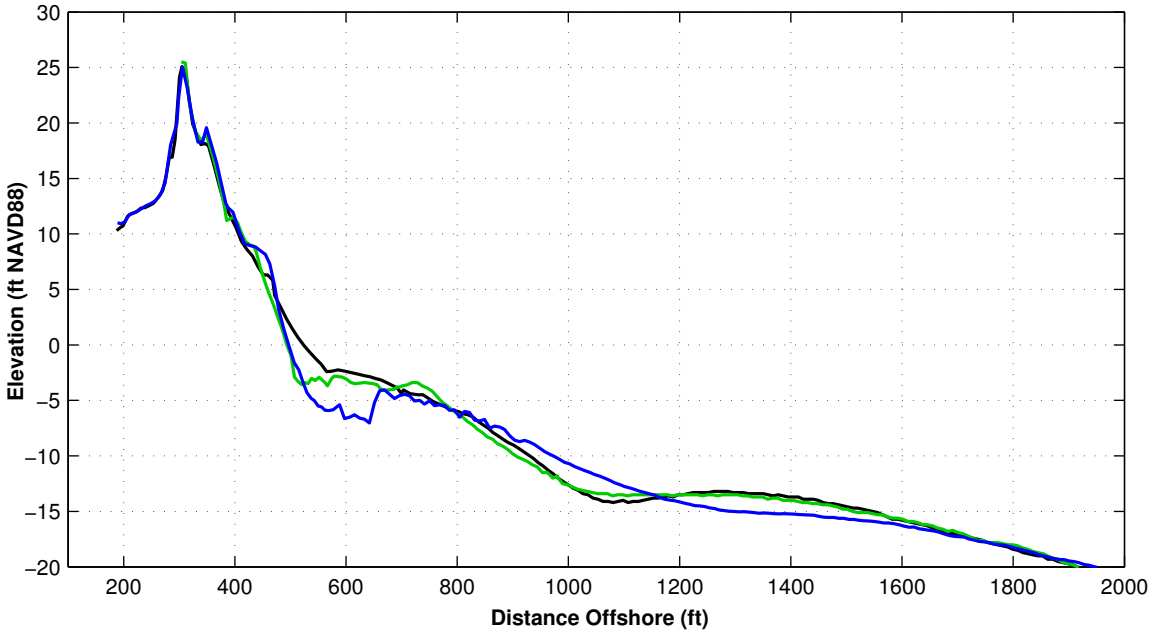
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 500+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −43.77 ft | 38.99 ft |
| Volume Change Above +6 ft NAVD88 | −1.69 cy/ft | 7.53 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −7.67 cy/ft | 11.58 cy/ft |
| Volume Change Above −6 ft NAVD88 | −33.36 cy/ft | 31.06 cy/ft |
| Volume Change Above −14 ft NAVD88 | −99.84 cy/ft | 88.18 cy/ft |
| Volume Change Above −19 ft NAVD88 | −125.98 cy/ft | 77.74 cy/ft |
| Volume Change Above −30 ft NAVD88 | −108.10 cy/ft | 61.32 cy/ft |

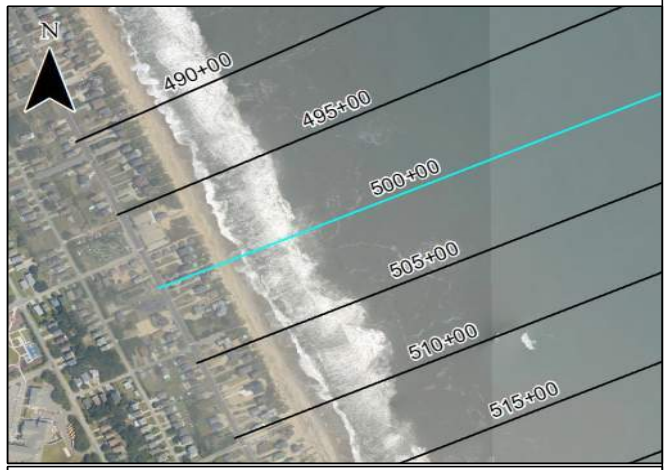
**LEGEND:**

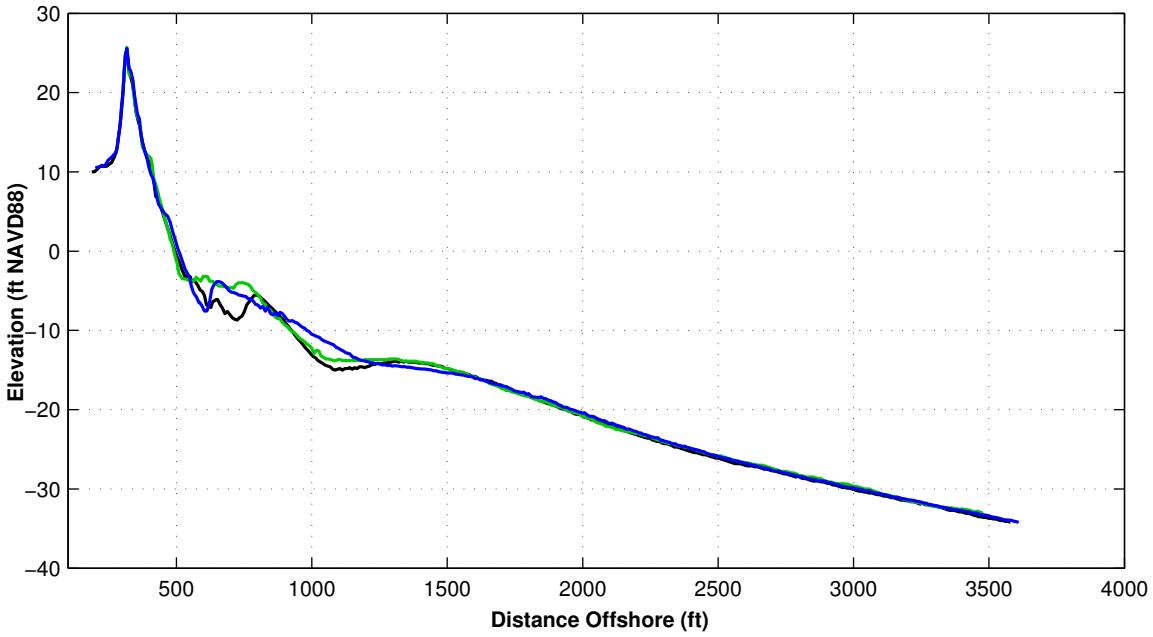
JUNE 2024 — OCTOBER 2023

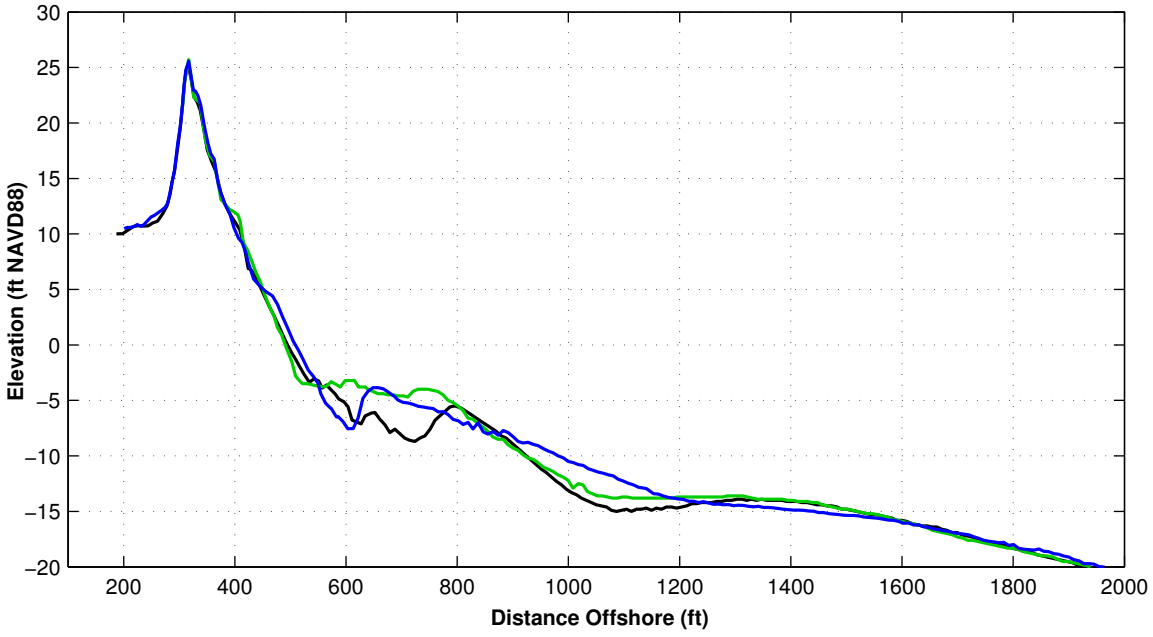
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 505+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 2.31 ft | 29.91 ft |
| Volume Change Above +6 ft NAVD88 | 2.17 cy/ft | 4.34 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.15 cy/ft | 7.71 cy/ft |
| Volume Change Above −6 ft NAVD88 | 0.47 cy/ft | 21.61 cy/ft |
| Volume Change Above −14 ft NAVD88 | −28.04 cy/ft | 51.19 cy/ft |
| Volume Change Above −19 ft NAVD88 | −41.38 cy/ft | 25.24 cy/ft |
| Volume Change Above −30 ft NAVD88 | −21.14 cy/ft | 5.28 cy/ft |

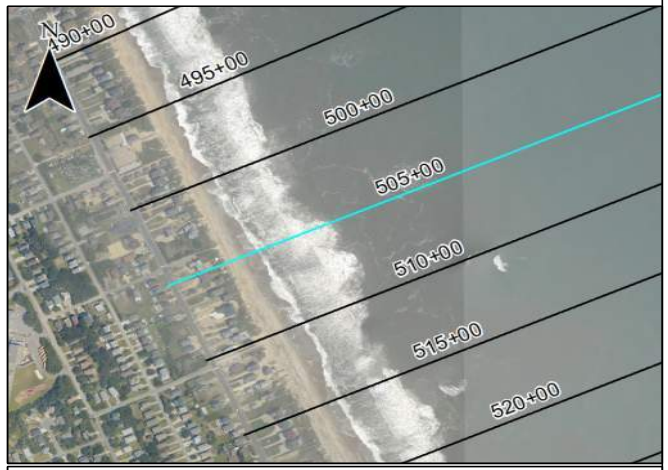
**LEGEND:**

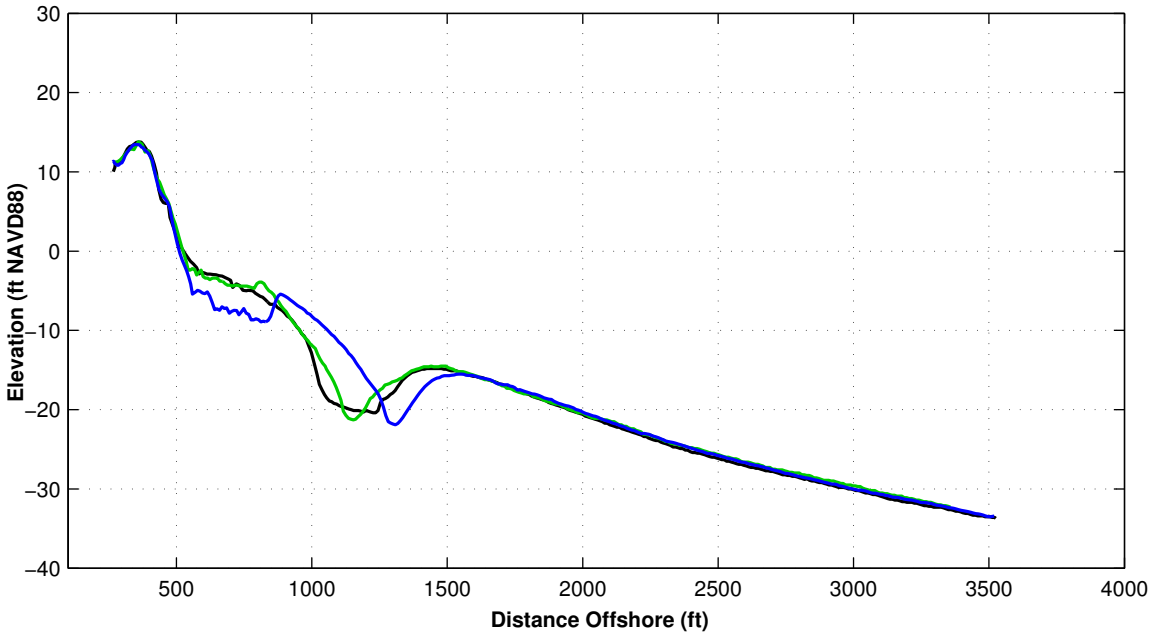
JUNE 2024 — OCTOBER 2023

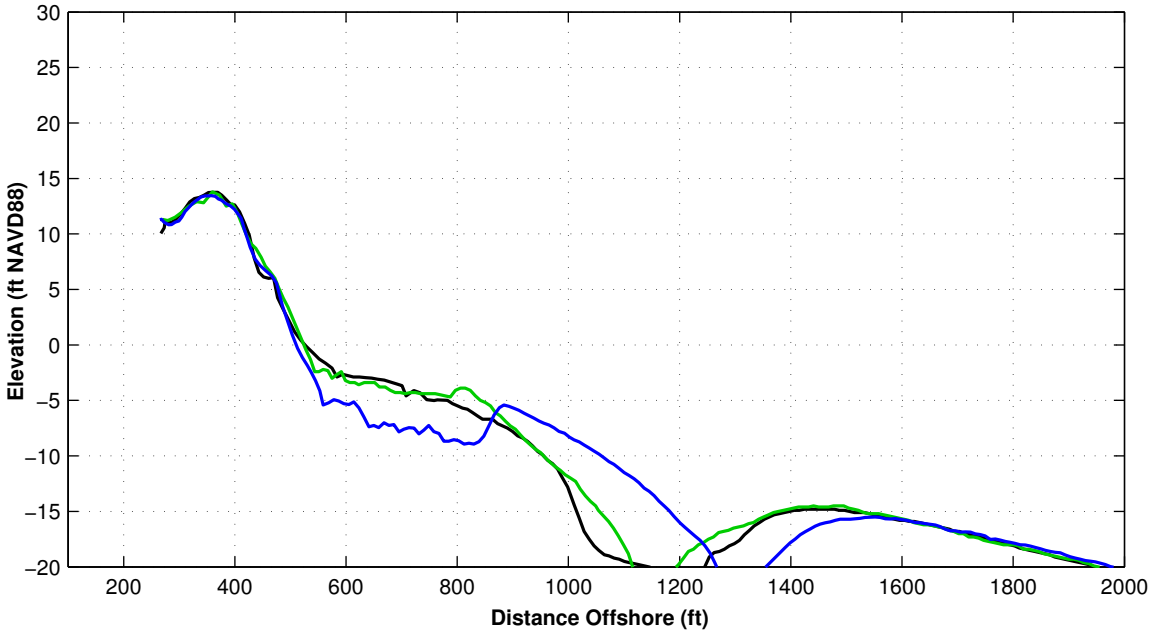
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 510+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 36.54 ft | 1.86 ft |
| Volume Change Above +6 ft NAVD88 | 0.36 cy/ft | 0.70 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.45 cy/ft | 5.28 cy/ft |
| Volume Change Above −6 ft NAVD88 | 10.79 cy/ft | 11.36 cy/ft |
| Volume Change Above −14 ft NAVD88 | −12.86 cy/ft | 68.69 cy/ft |
| Volume Change Above −19 ft NAVD88 | −8.27 cy/ft | 41.85 cy/ft |
| Volume Change Above −30 ft NAVD88 | 14.42 cy/ft | 21.22 cy/ft |

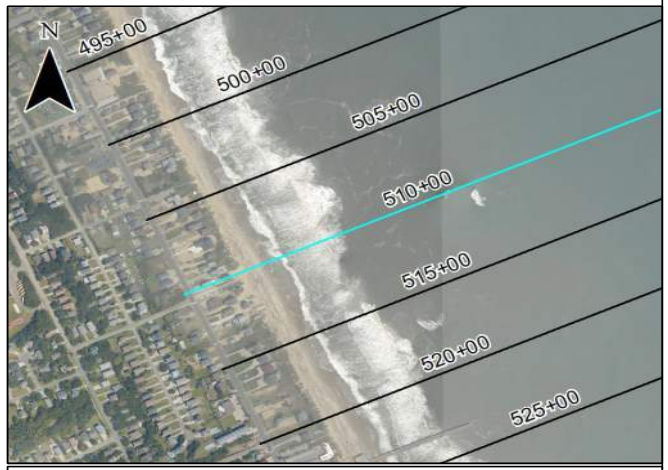
**LEGEND:**

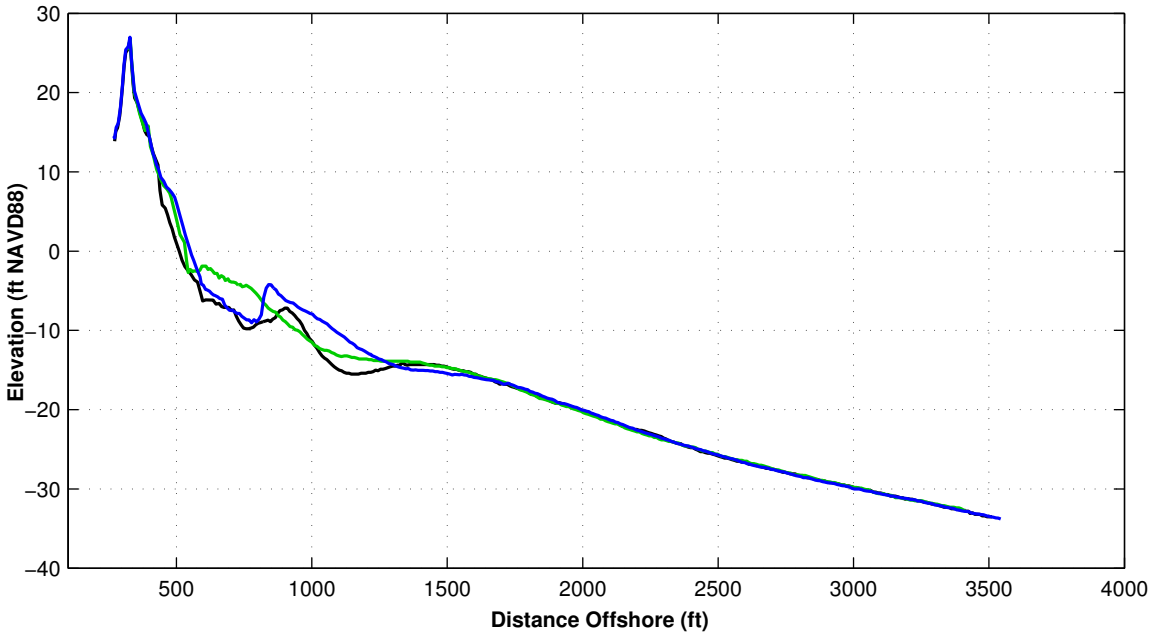
JUNE 2024 — OCTOBER 2023

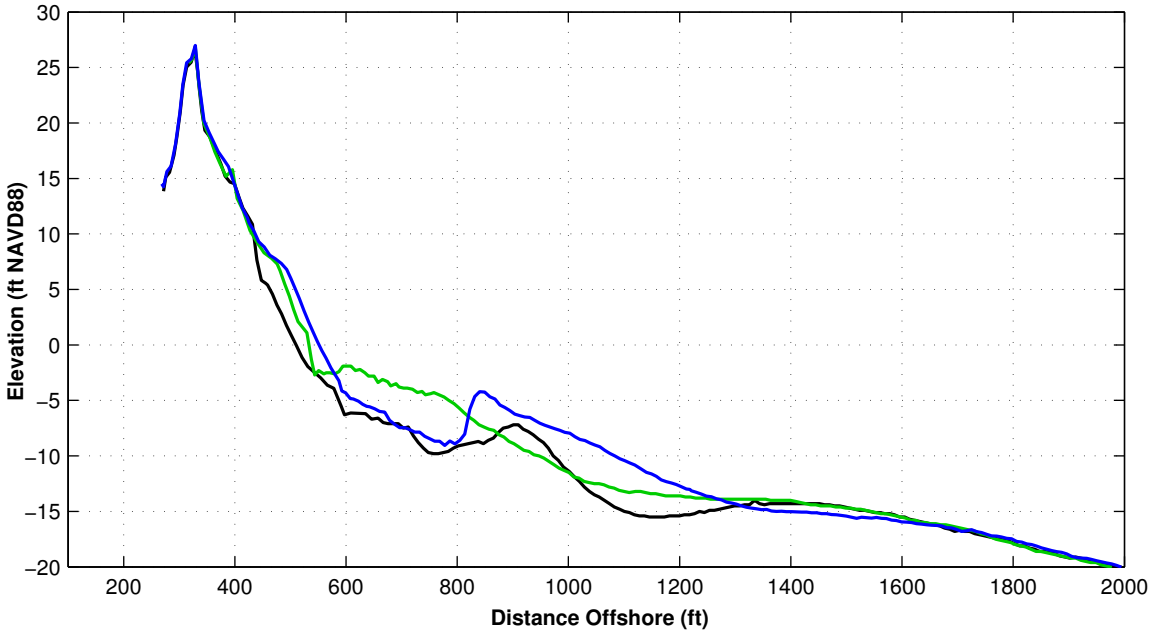
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 515+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 51.50 ft | −10.61 ft |
| Volume Change Above +6 ft NAVD88 | 3.10 cy/ft | 2.58 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.15 cy/ft | 7.00 cy/ft |
| Volume Change Above −6 ft NAVD88 | 19.95 cy/ft | 6.62 cy/ft |
| Volume Change Above −14 ft NAVD88 | 26.67 cy/ft | 55.45 cy/ft |
| Volume Change Above −19 ft NAVD88 | 37.32 cy/ft | 28.67 cy/ft |
| Volume Change Above −30 ft NAVD88 | 53.72 cy/ft | 8.61 cy/ft |

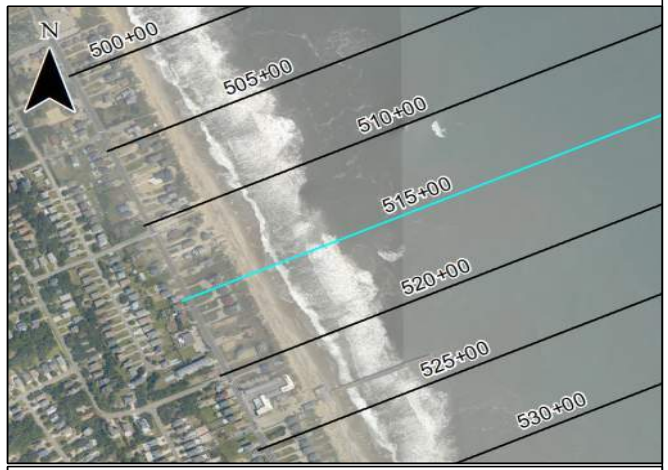
**LEGEND:**

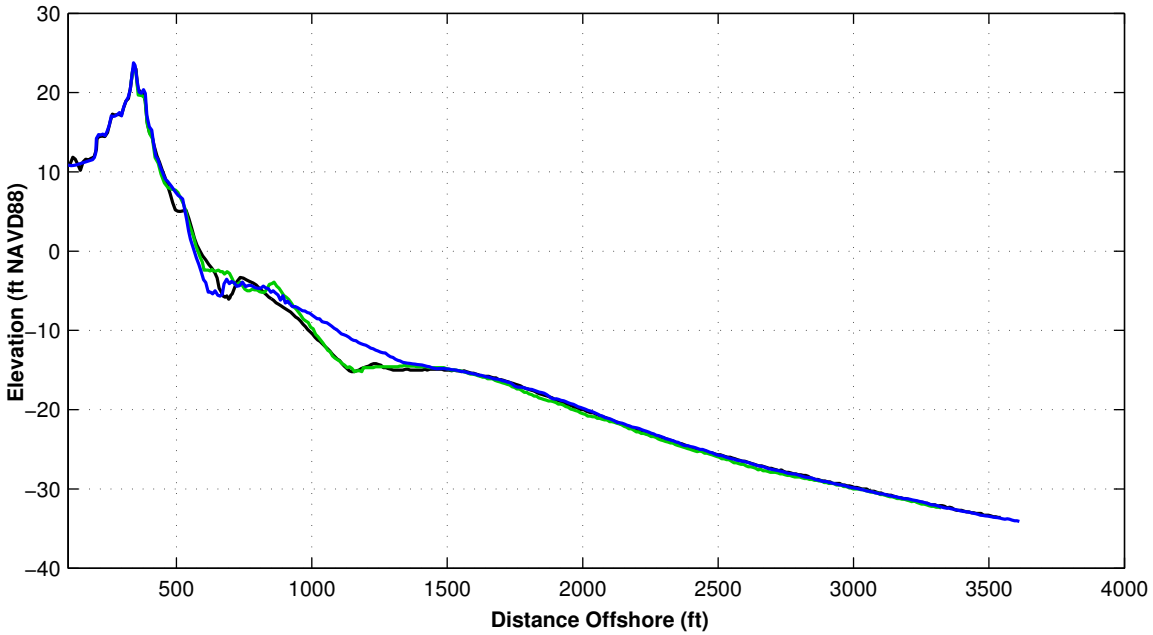
JUNE 2024 — OCTOBER 2023

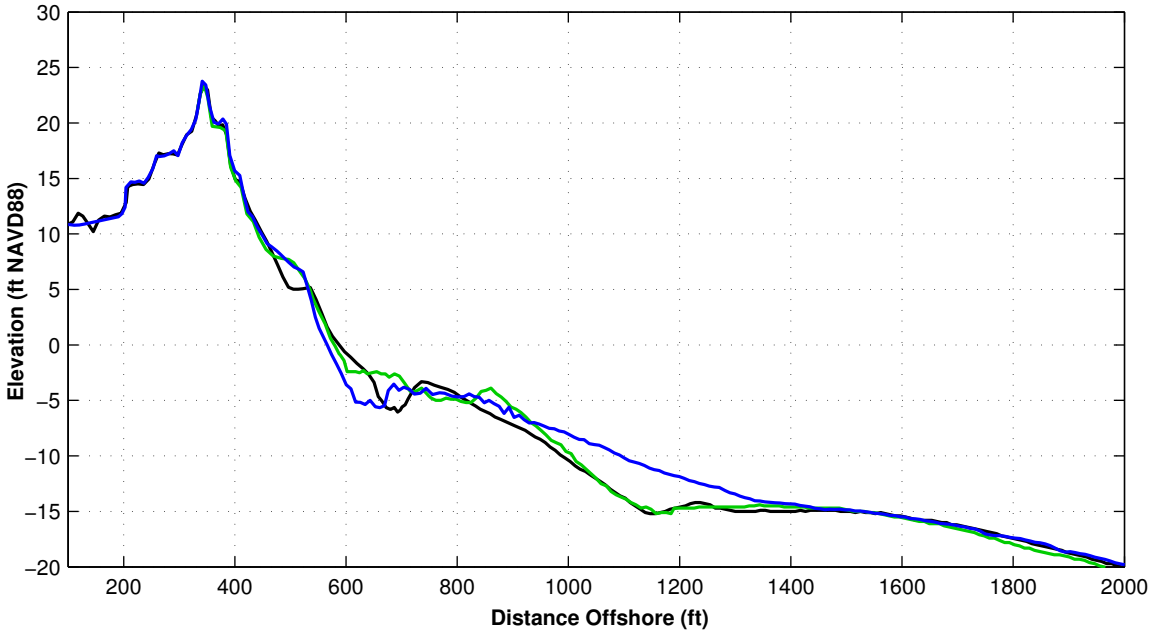
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 520+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 35.08 ft | −18.63 ft |
| Volume Change Above +6 ft NAVD88 | 3.27 cy/ft | 3.26 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.48 cy/ft | 1.74 cy/ft |
| Volume Change Above −6 ft NAVD88 | 26.12 cy/ft | −0.99 cy/ft |
| Volume Change Above −14 ft NAVD88 | 34.80 cy/ft | 45.00 cy/ft |
| Volume Change Above −19 ft NAVD88 | 37.51 cy/ft | 17.07 cy/ft |
| Volume Change Above −30 ft NAVD88 | 51.90 cy/ft | −0.65 cy/ft |

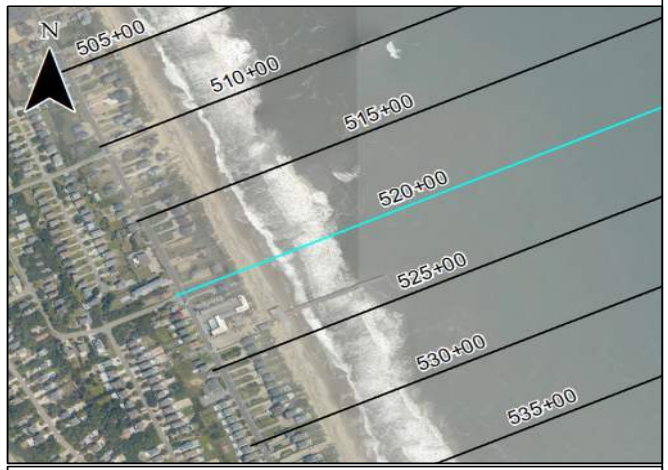
**LEGEND:**

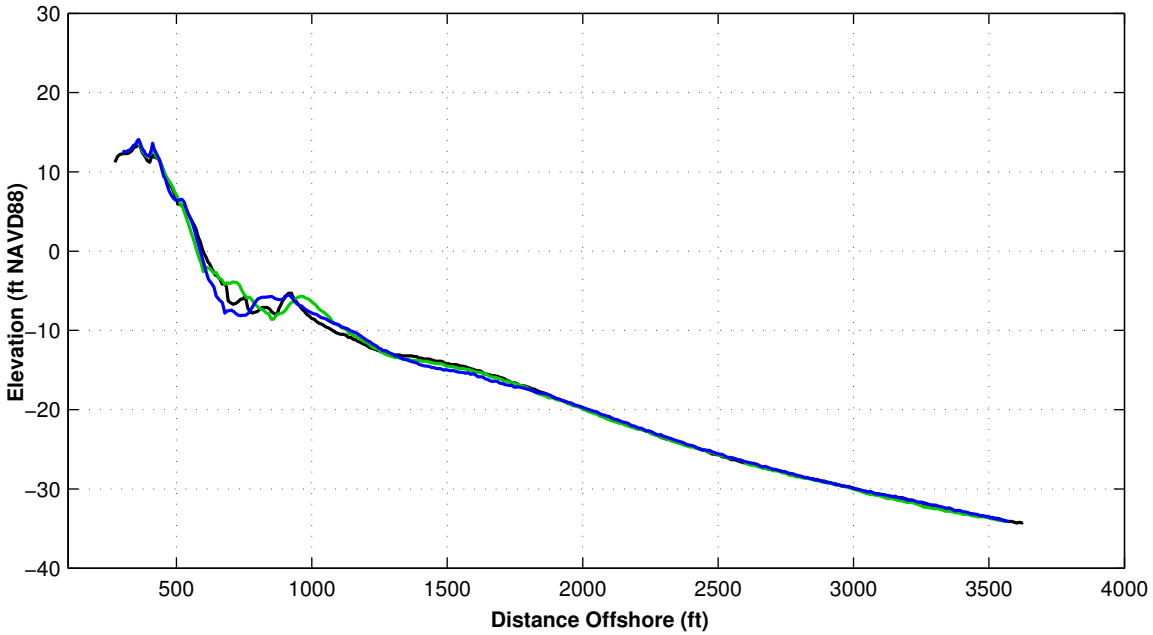
JUNE 2024 — OCTOBER 2023

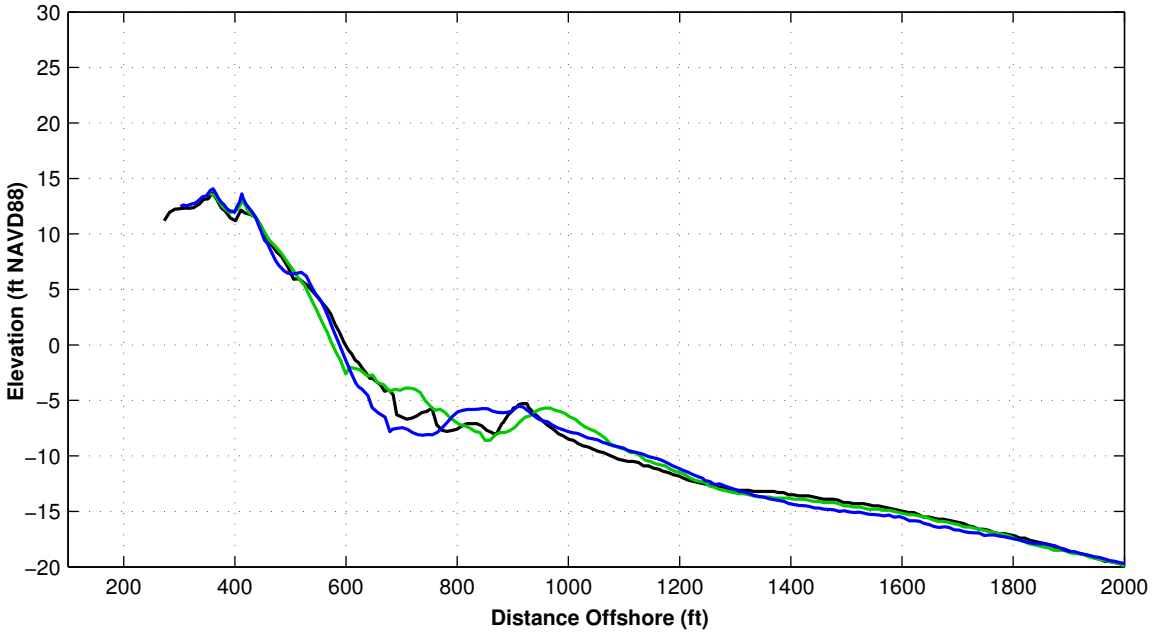
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 525+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 5.86 ft | 27.12 ft |
| Volume Change Above +6 ft NAVD88 | 3.47 cy/ft | 3.41 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.66 cy/ft | 7.97 cy/ft |
| Volume Change Above −6 ft NAVD88 | 1.89 cy/ft | 27.28 cy/ft |
| Volume Change Above −14 ft NAVD88 | −13.72 cy/ft | 69.58 cy/ft |
| Volume Change Above −19 ft NAVD88 | −53.28 cy/ft | 44.63 cy/ft |
| Volume Change Above −30 ft NAVD88 | −39.91 cy/ft | 30.48 cy/ft |

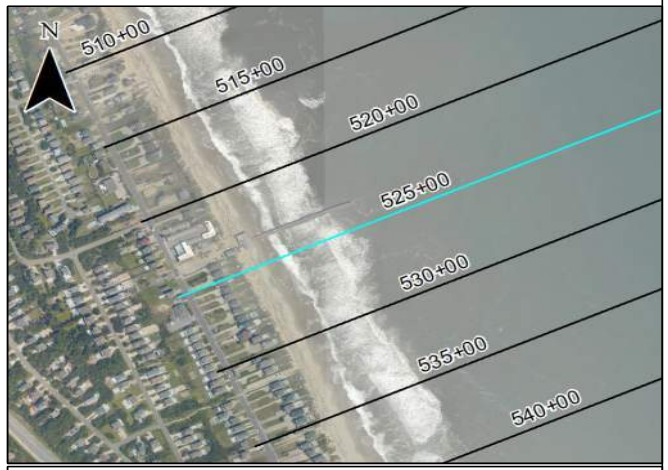
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

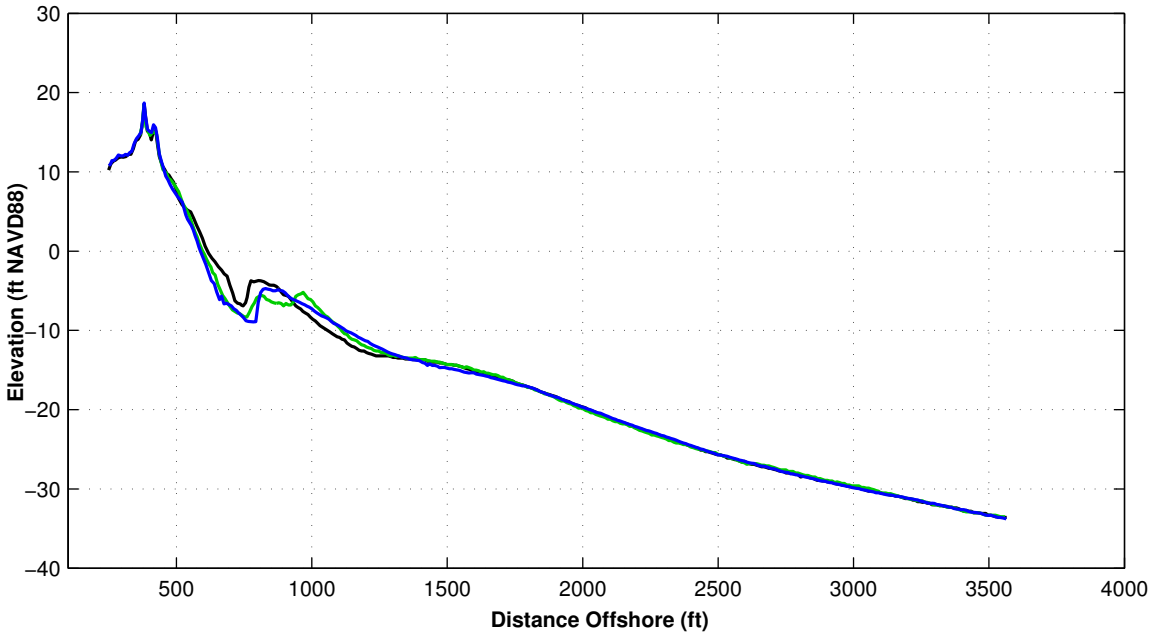
Notes:

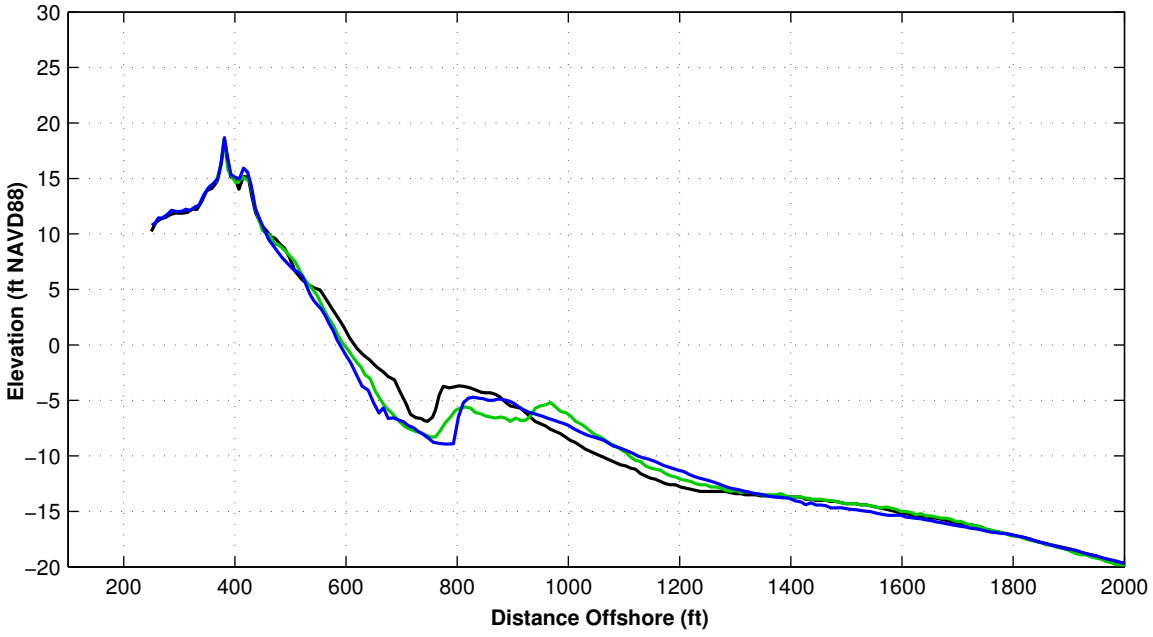
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 525+00 | Pg 63 of 173 | 2024 |
|---|---|---|




| Survey Transect 530+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 27.15 ft | −3.79 ft |
| Volume Change Above +6 ft NAVD88 | 2.94 cy/ft | 1.54 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.52 cy/ft | 4.11 cy/ft |
| Volume Change Above −6 ft NAVD88 | 21.09 cy/ft | 7.51 cy/ft |
| Volume Change Above −14 ft NAVD88 | 14.22 cy/ft | 60.39 cy/ft |
| Volume Change Above −19 ft NAVD88 | 29.15 cy/ft | 36.30 cy/ft |
| Volume Change Above −30 ft NAVD88 | 41.41 cy/ft | 21.62 cy/ft |

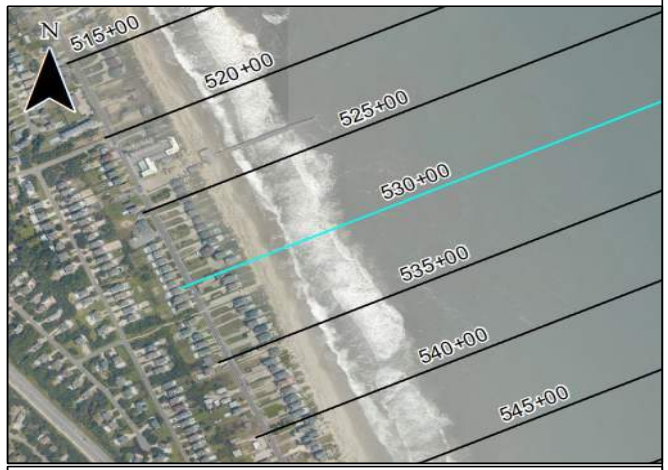
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

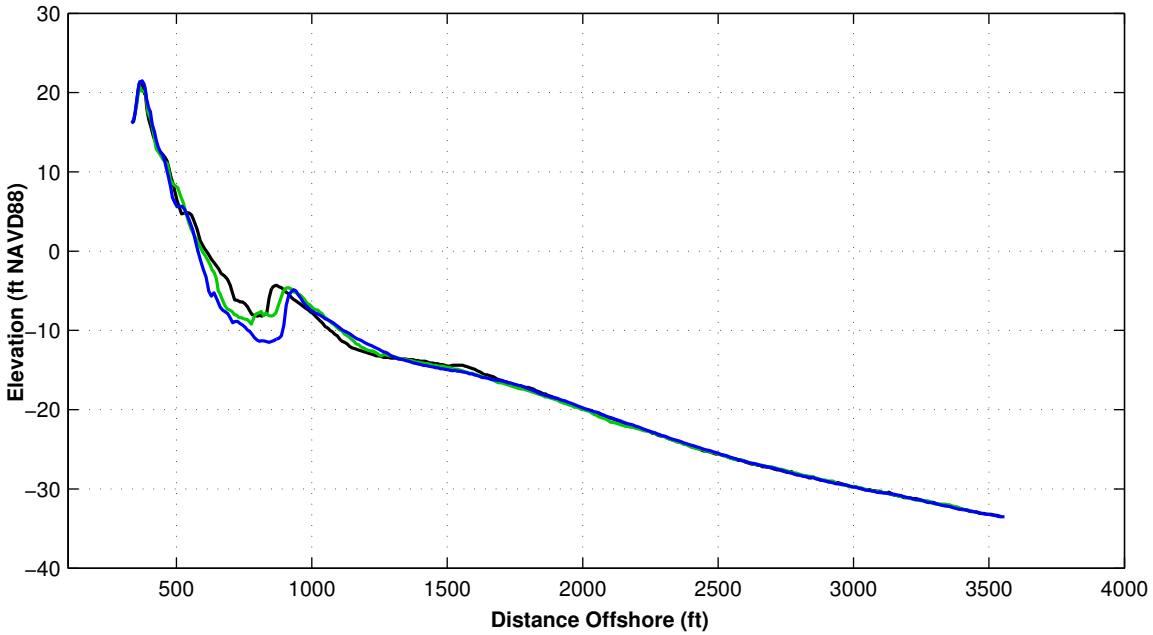
Notes:

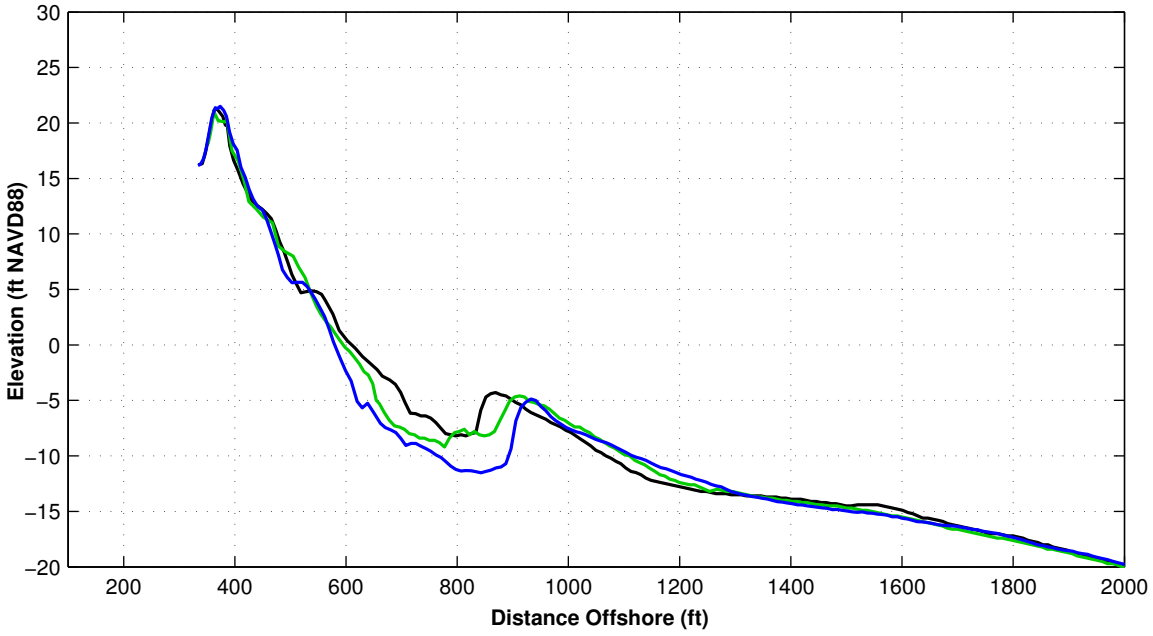
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 530+00 | Pg 64 of 173 | 2024 |
|---|---|---|




| Survey Transect 535+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 45.78 ft | −44.38 ft |
| Volume Change Above +6 ft NAVD88 | 2.85 cy/ft | 1.53 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 8.83 cy/ft | −4.15 cy/ft |
| Volume Change Above −6 ft NAVD88 | 9.31 cy/ft | −17.26 cy/ft |
| Volume Change Above −14 ft NAVD88 | −23.95 cy/ft | 48.05 cy/ft |
| Volume Change Above −19 ft NAVD88 | −22.07 cy/ft | 24.70 cy/ft |
| Volume Change Above −30 ft NAVD88 | −11.98 cy/ft | 11.46 cy/ft |

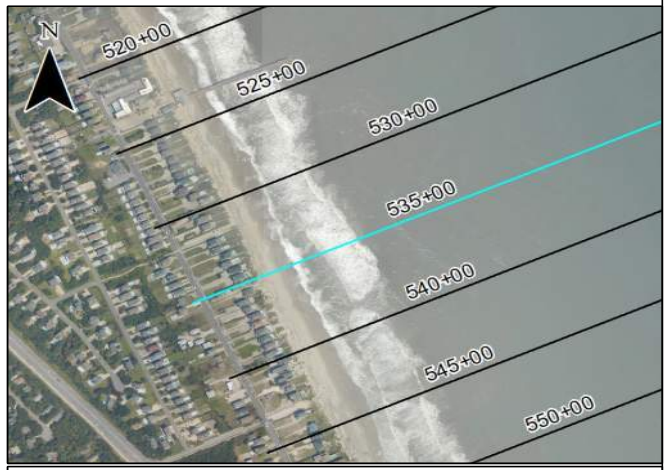
**LEGEND:**

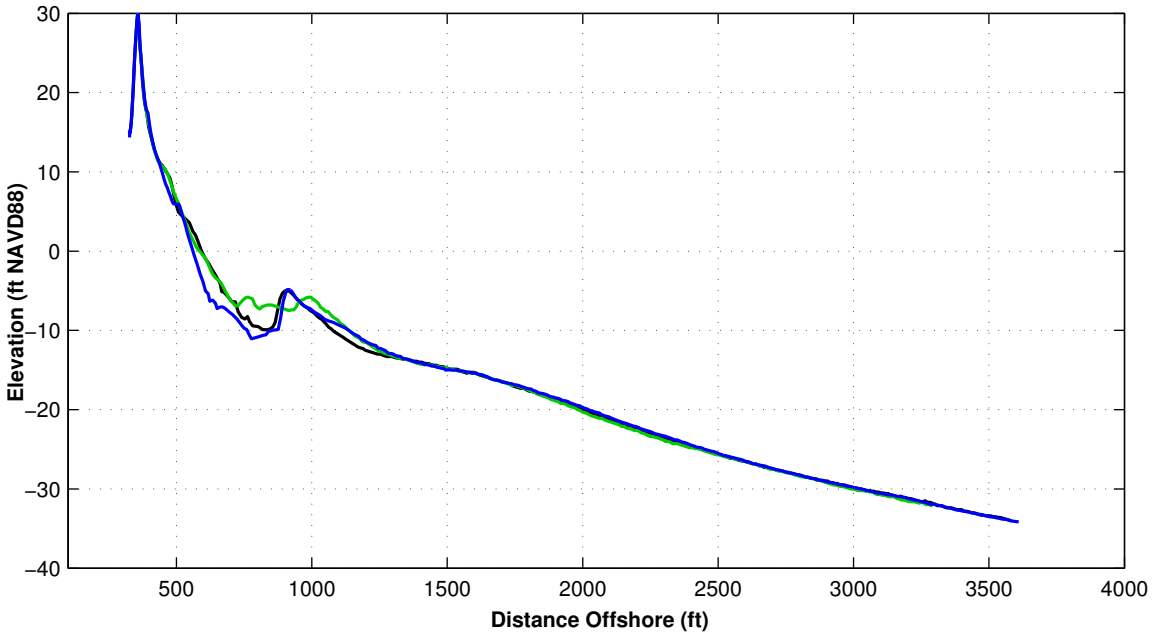
JUNE 2024 — OCTOBER 2023

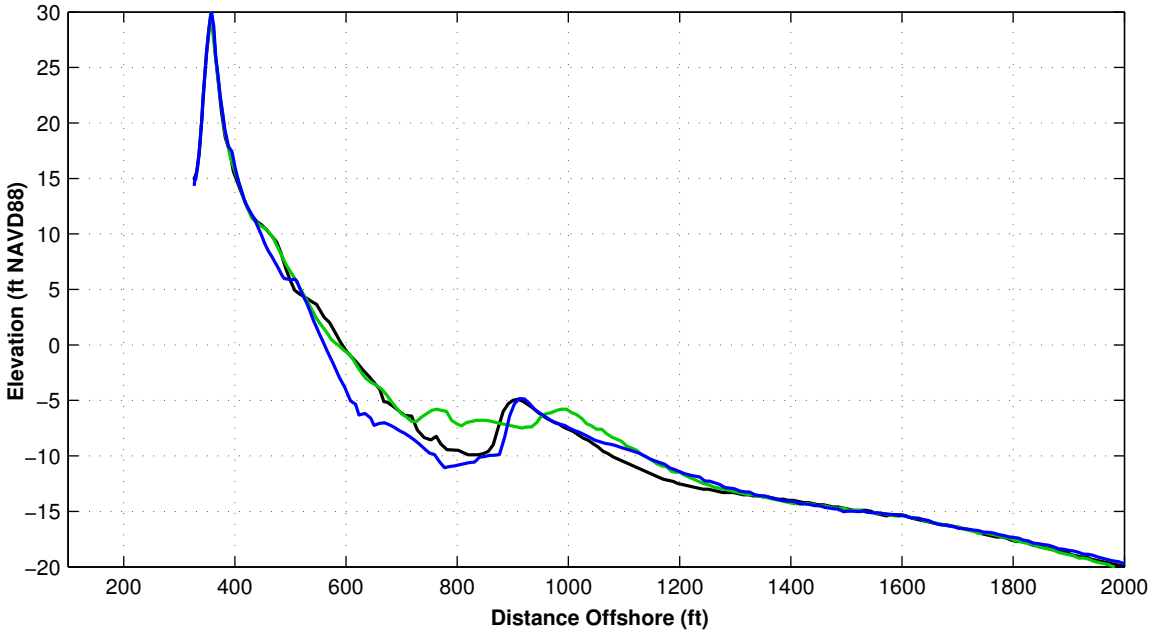
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 540+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 5.93 ft | −3.31 ft |
| Volume Change Above +6 ft NAVD88 | 1.04 cy/ft | 0.53 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.74 cy/ft | 1.37 cy/ft |
| Volume Change Above −6 ft NAVD88 | −7.60 cy/ft | −2.23 cy/ft |
| Volume Change Above −14 ft NAVD88 | −42.66 cy/ft | 24.64 cy/ft |
| Volume Change Above −19 ft NAVD88 | −38.41 cy/ft | −6.86 cy/ft |
| Volume Change Above −30 ft NAVD88 | −28.98 cy/ft | −23.78 cy/ft |

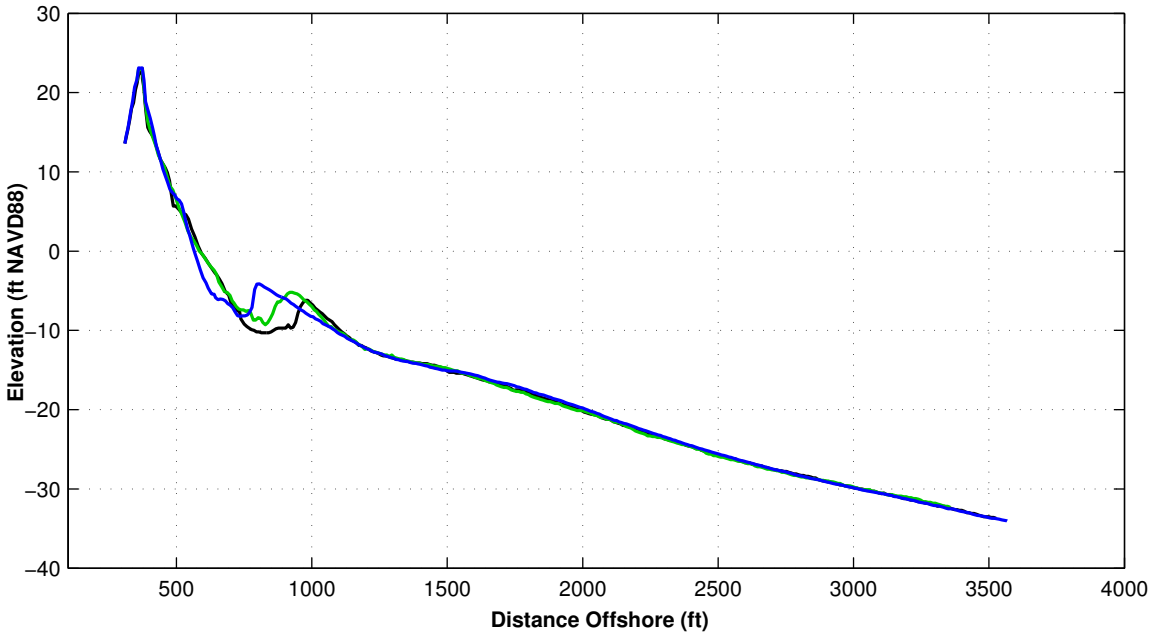
**LEGEND:**

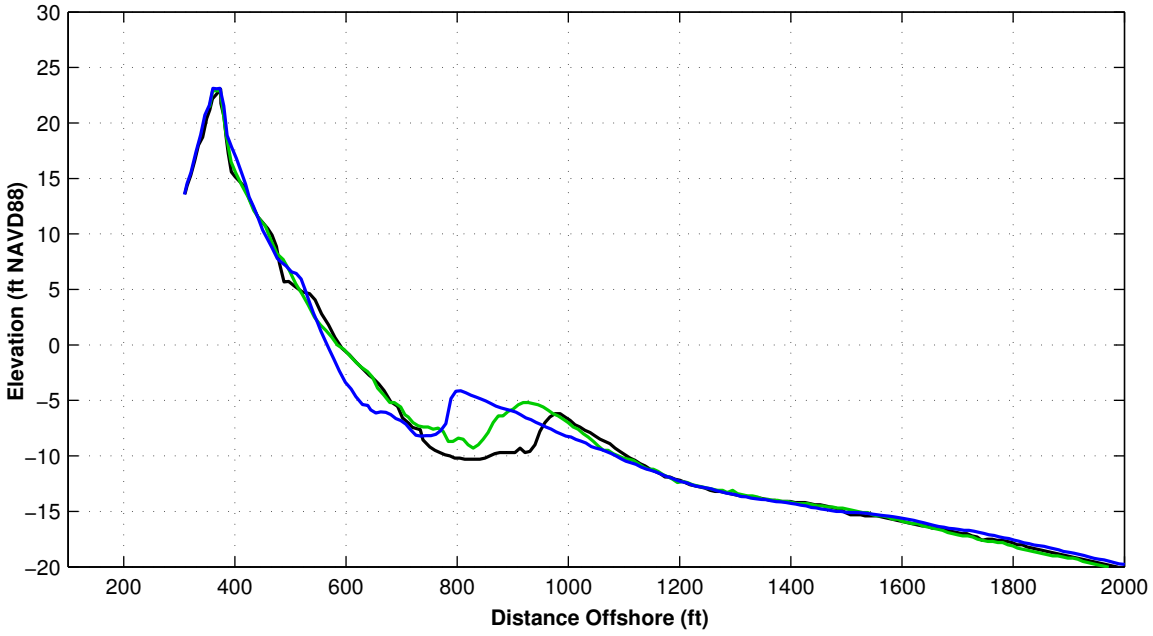
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 545+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 0.71 ft | −23.57 ft |
| Volume Change Above +6 ft NAVD88 | 0.61 cy/ft | 5.07 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.53 cy/ft | 3.86 cy/ft |
| Volume Change Above −6 ft NAVD88 | −18.68 cy/ft | 3.82 cy/ft |
| Volume Change Above −14 ft NAVD88 | −33.05 cy/ft | 55.46 cy/ft |
| Volume Change Above −19 ft NAVD88 | −35.45 cy/ft | 39.44 cy/ft |
| Volume Change Above −30 ft NAVD88 | −29.26 cy/ft | 25.50 cy/ft |

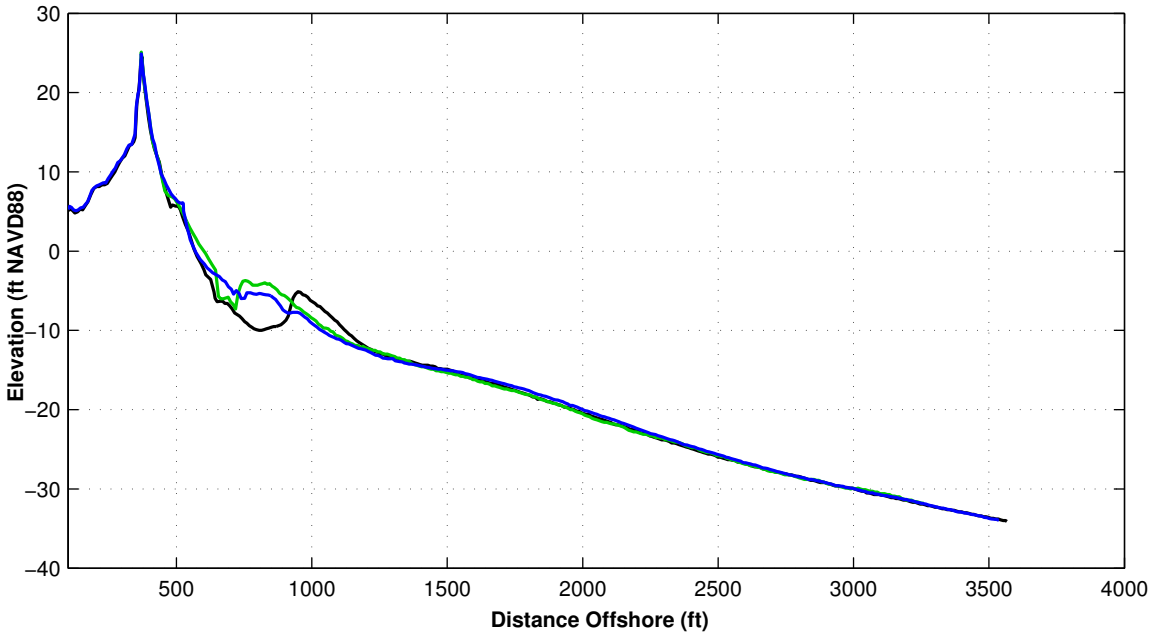
**LEGEND:**

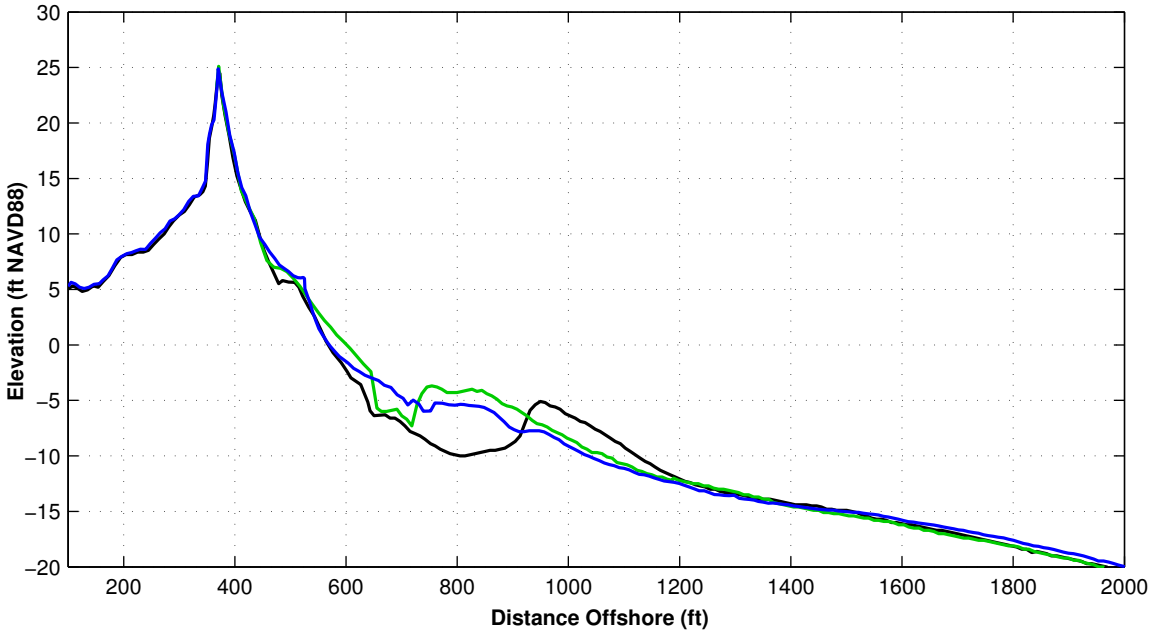
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 550+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 16.82 ft | 25.96 ft |
| Volume Change Above +6 ft NAVD88 | 2.21 cy/ft | 1.68 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 7.12 cy/ft | 7.30 cy/ft |
| Volume Change Above −6 ft NAVD88 | 16.09 cy/ft | 6.88 cy/ft |
| Volume Change Above −14 ft NAVD88 | −3.70 cy/ft | 67.77 cy/ft |
| Volume Change Above −19 ft NAVD88 | −8.60 cy/ft | 47.88 cy/ft |
| Volume Change Above −30 ft NAVD88 | −0.13 cy/ft | 33.94 cy/ft |

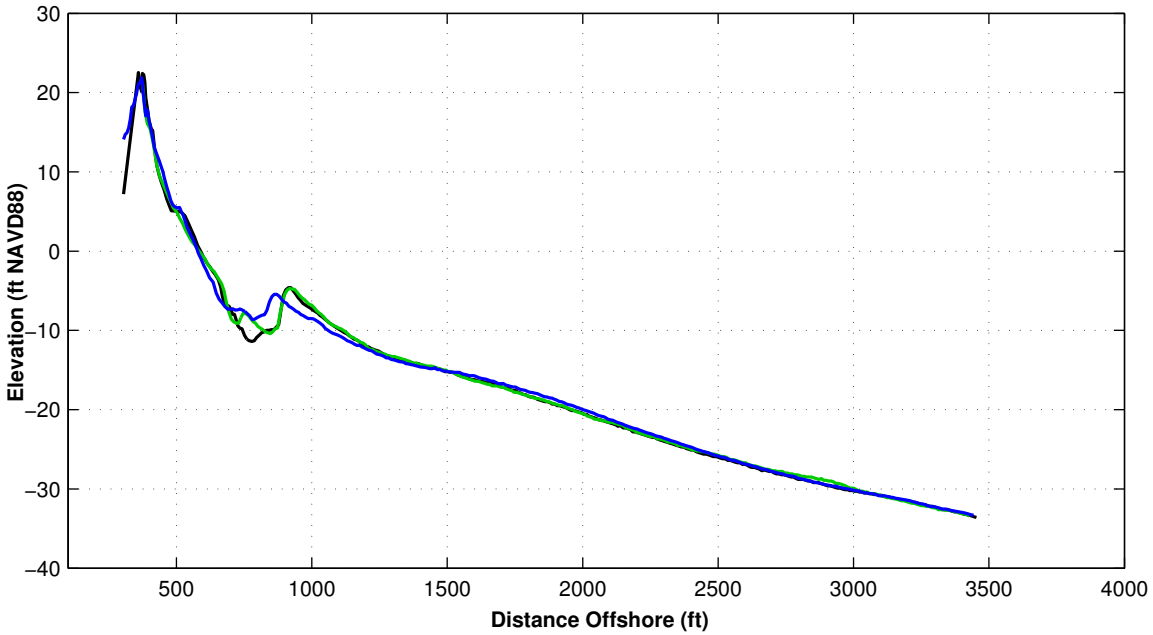
**LEGEND:**

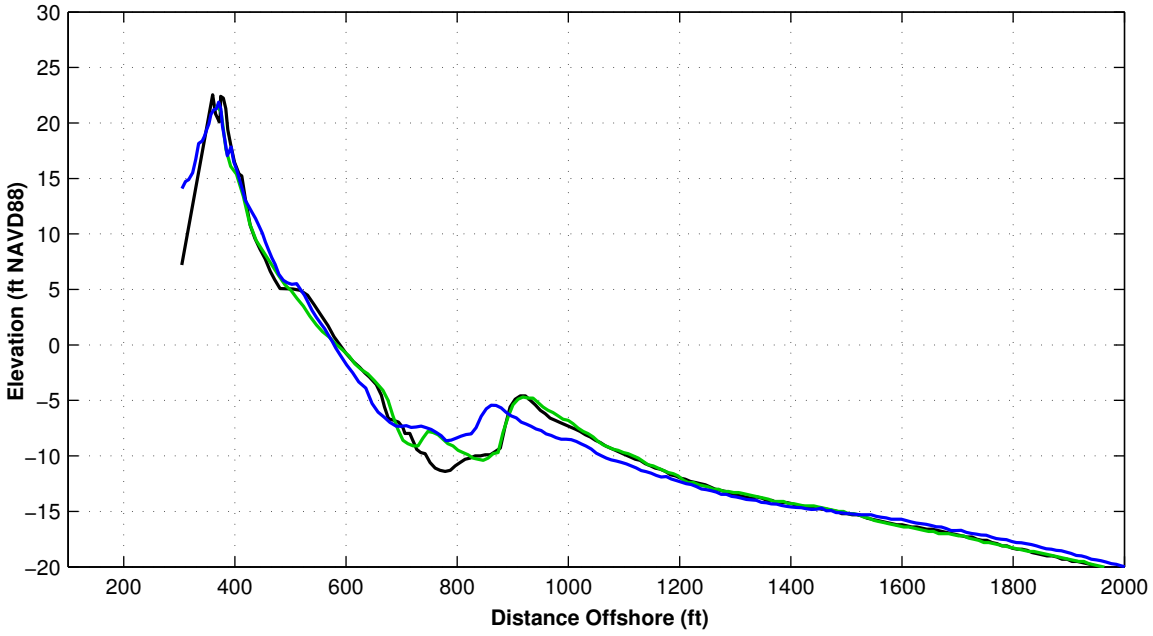
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 555+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 8.05 ft | 9.65 ft |
| Volume Change Above +6 ft NAVD88 | 3.04 cy/ft | 3.14 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.87 cy/ft | 6.22 cy/ft |
| Volume Change Above −6 ft NAVD88 | −1.37 cy/ft | 2.51 cy/ft |
| Volume Change Above −14 ft NAVD88 | −11.33 cy/ft | 65.28 cy/ft |
| Volume Change Above −19 ft NAVD88 | −12.93 cy/ft | 71.24 cy/ft |
| Volume Change Above −30 ft NAVD88 | −4.83 cy/ft | 58.56 cy/ft |

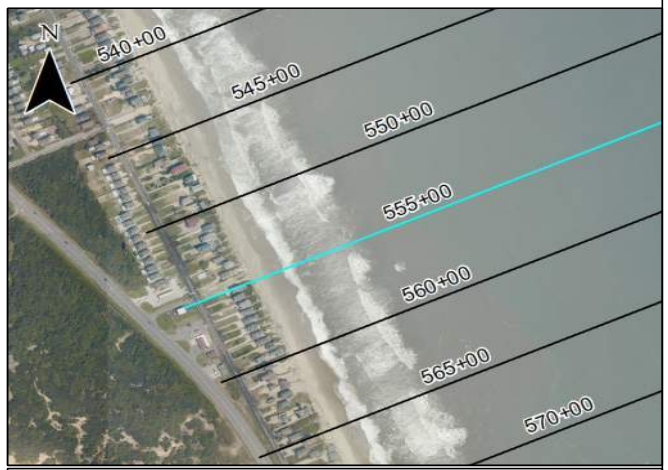
**LEGEND:**

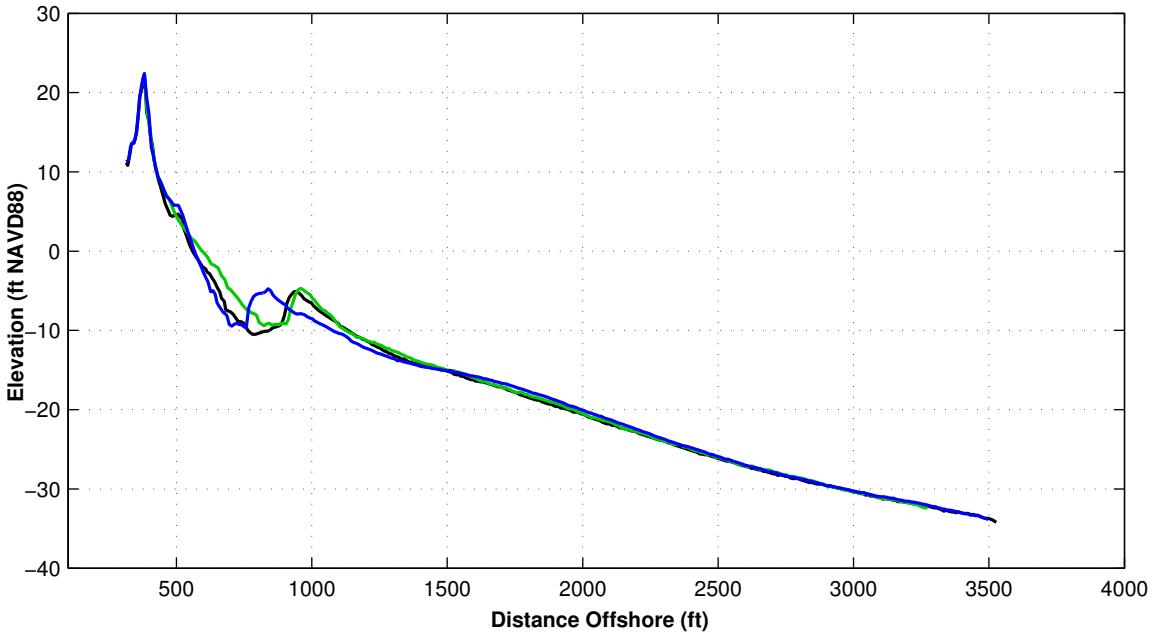
JUNE 2024 — OCTOBER 2023

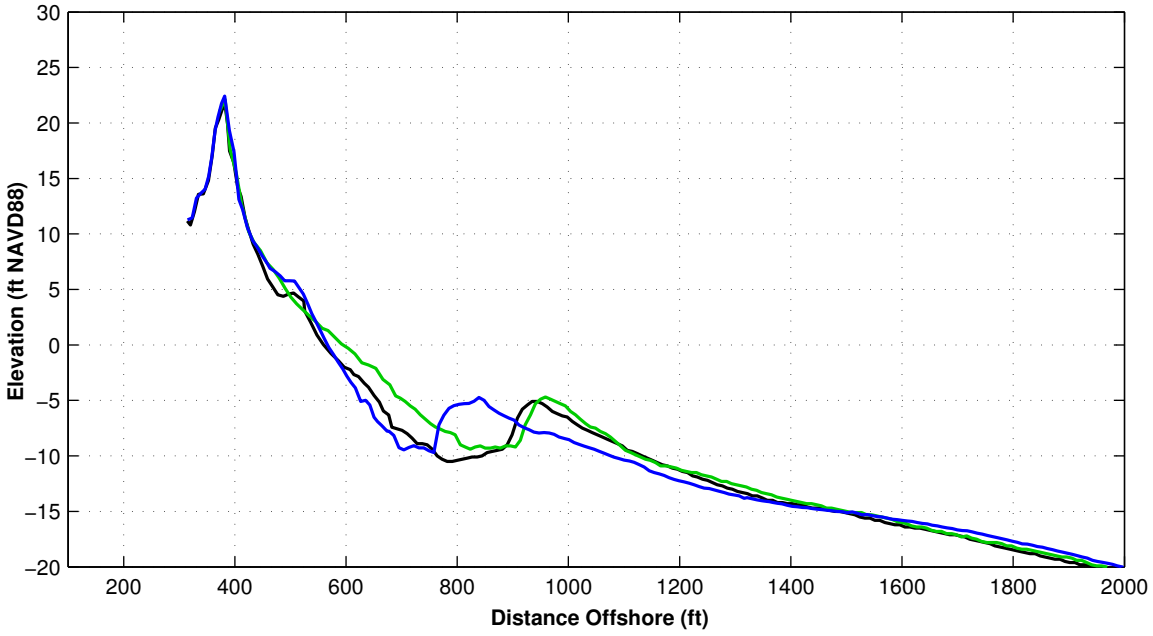
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 560+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −1.86 ft | −12.43 ft |
| Volume Change Above +6 ft NAVD88 | 4.51 cy/ft | 2.35 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.19 cy/ft | −0.23 cy/ft |
| Volume Change Above −6 ft NAVD88 | 4.40 cy/ft | 1.75 cy/ft |
| Volume Change Above −14 ft NAVD88 | −6.91 cy/ft | 43.71 cy/ft |
| Volume Change Above −19 ft NAVD88 | −5.08 cy/ft | 49.97 cy/ft |
| Volume Change Above −30 ft NAVD88 | 6.29 cy/ft | 35.89 cy/ft |

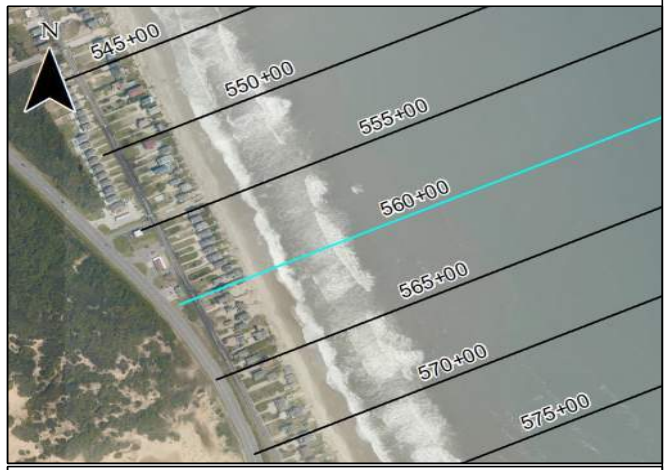
**LEGEND:**

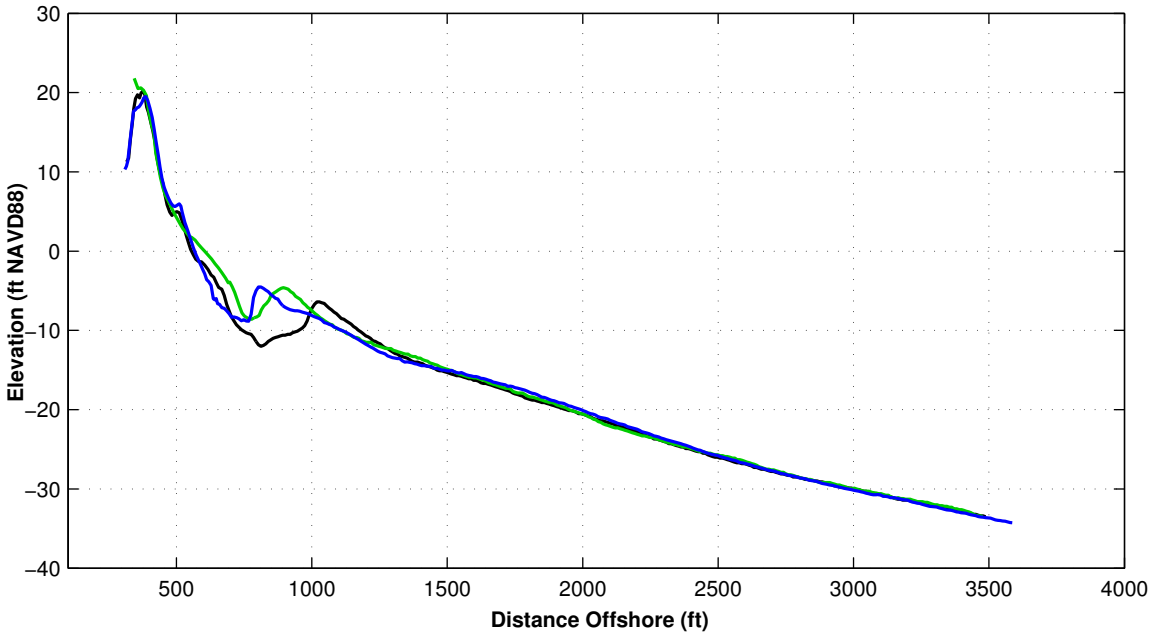
JUNE 2024 — OCTOBER 2023

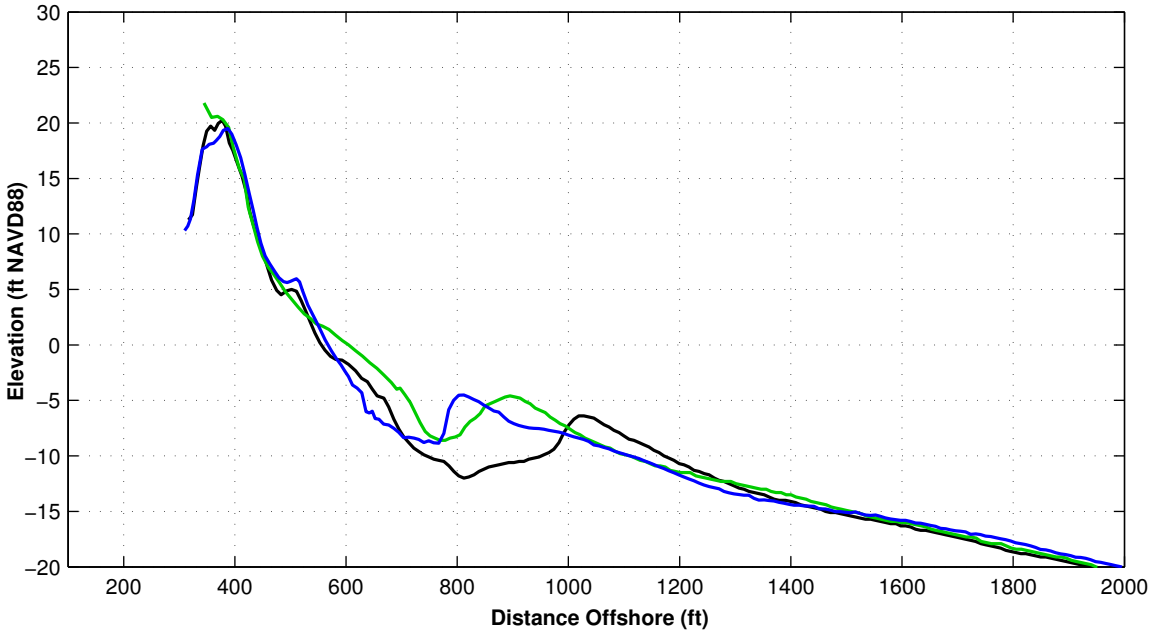
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 565+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 72.97 ft | −14.60 ft |
| Volume Change Above +6 ft NAVD88 | 5.36 cy/ft | 3.50 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 15.42 cy/ft | 1.62 cy/ft |
| Volume Change Above −6 ft NAVD88 | 25.59 cy/ft | 4.27 cy/ft |
| Volume Change Above −14 ft NAVD88 | −7.44 cy/ft | 52.61 cy/ft |
| Volume Change Above −19 ft NAVD88 | −7.57 cy/ft | 37.85 cy/ft |
| Volume Change Above −30 ft NAVD88 | 4.49 cy/ft | 24.36 cy/ft |

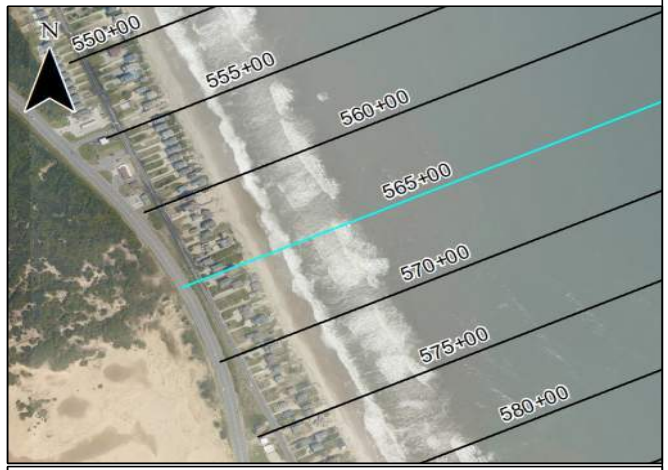
**LEGEND:**

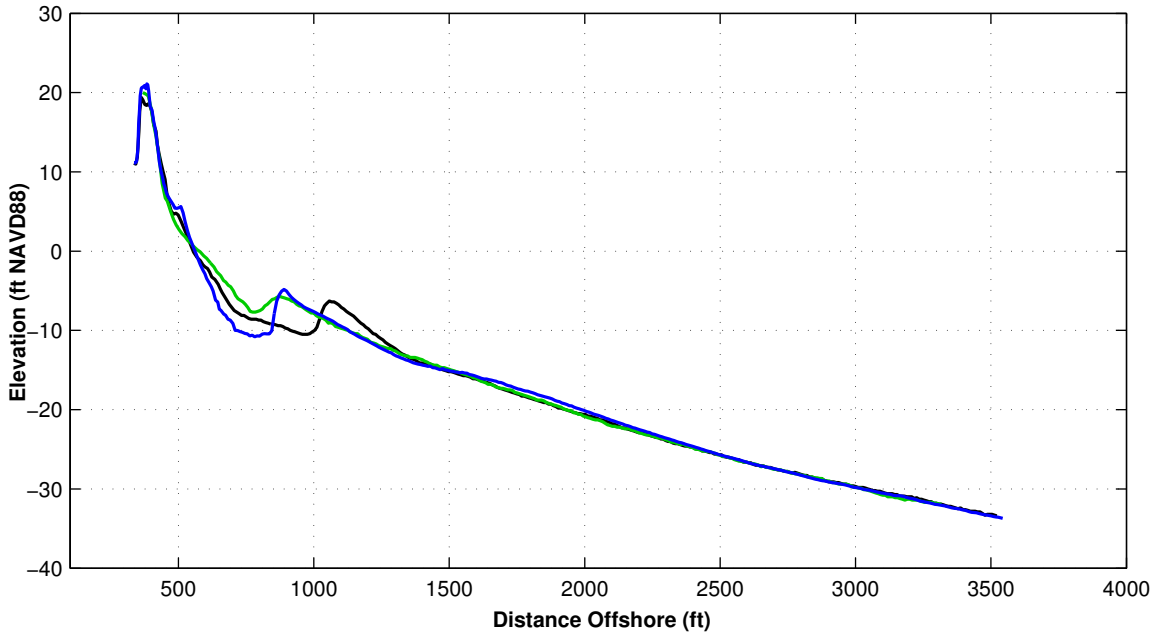
JUNE 2024 — OCTOBER 2023

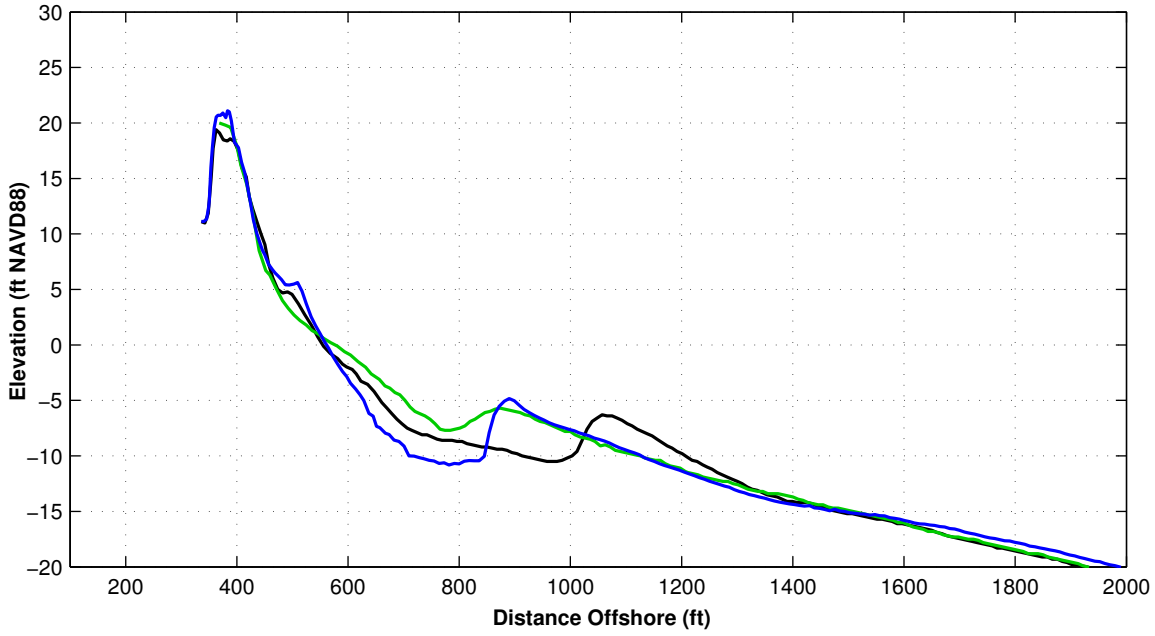
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 570+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 10.62 ft | 28.24 ft |
| Volume Change Above +6 ft NAVD88 | 2.81 cy/ft | 4.62 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 5.16 cy/ft | 8.18 cy/ft |
| Volume Change Above −6 ft NAVD88 | 2.30 cy/ft | 14.16 cy/ft |
| Volume Change Above −14 ft NAVD88 | −15.78 cy/ft | 57.19 cy/ft |
| Volume Change Above −19 ft NAVD88 | −21.66 cy/ft | 62.54 cy/ft |
| Volume Change Above −30 ft NAVD88 | −16.20 cy/ft | 40.95 cy/ft |

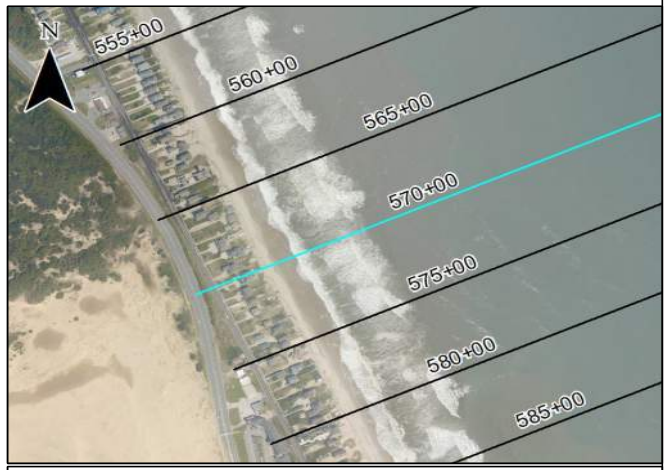
**LEGEND:**

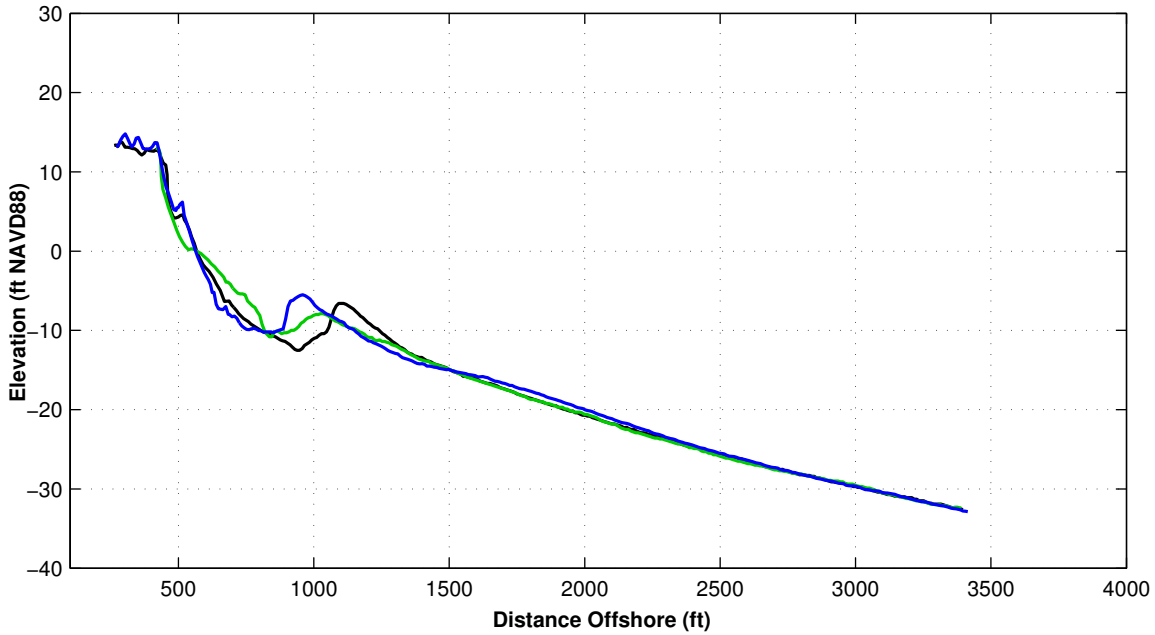
JUNE 2024 — OCTOBER 2023

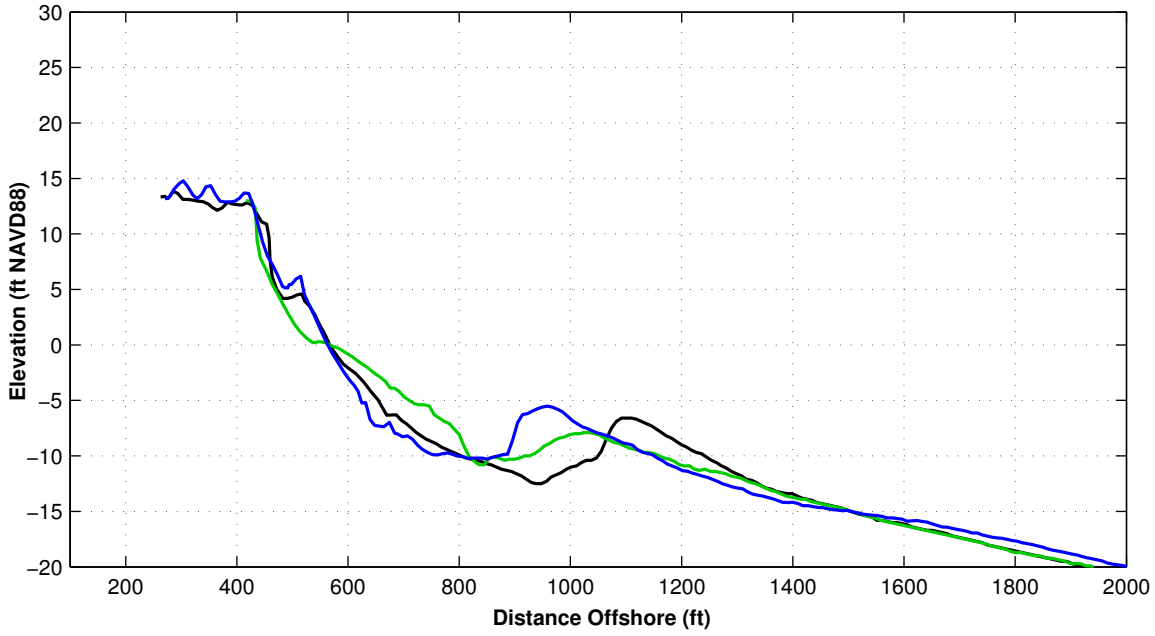
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 575+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 27.16 ft | −23.85 ft |
| Volume Change Above +6 ft NAVD88 | 4.85 cy/ft | 3.97 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 8.53 cy/ft | 0.56 cy/ft |
| Volume Change Above −6 ft NAVD88 | 6.90 cy/ft | −2.05 cy/ft |
| Volume Change Above −14 ft NAVD88 | 1.58 cy/ft | 33.61 cy/ft |
| Volume Change Above −19 ft NAVD88 | −2.23 cy/ft | 29.33 cy/ft |
| Volume Change Above −30 ft NAVD88 | 6.44 cy/ft | 20.10 cy/ft |

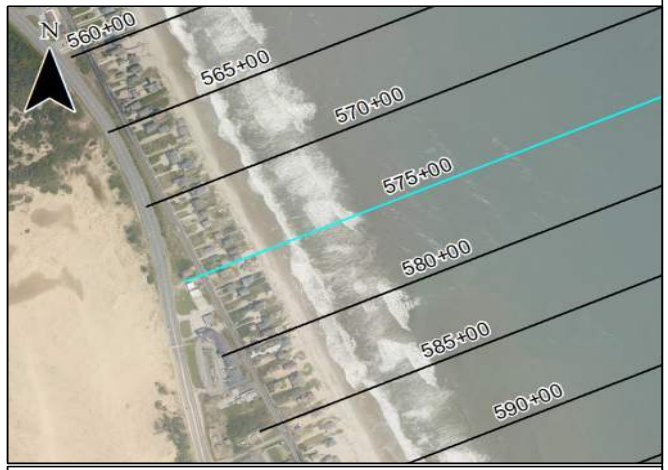
**LEGEND:**

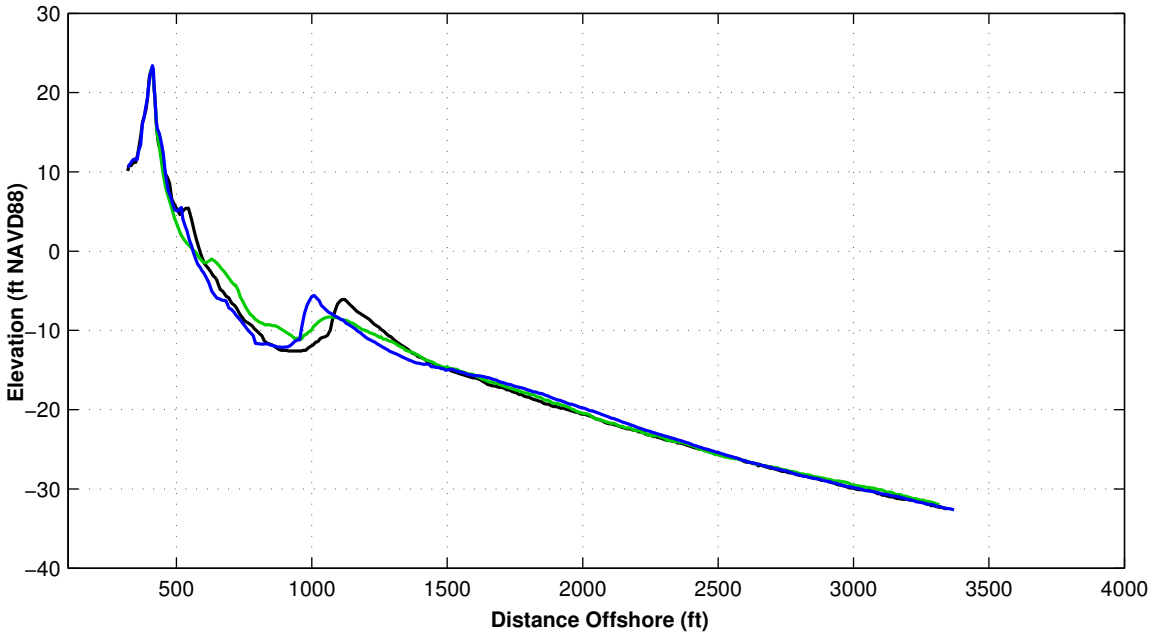
JUNE 2024 — OCTOBER 2023

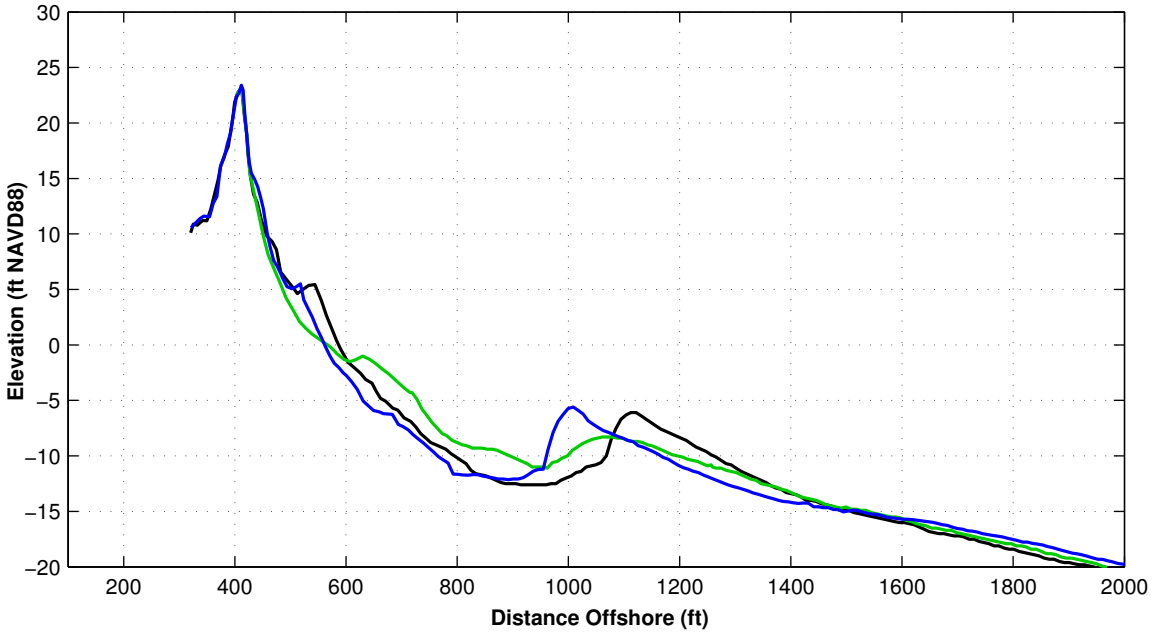
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 580+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −45.40 ft | 12.49 ft |
| Volume Change Above +6 ft NAVD88 | 4.50 cy/ft | 2.43 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −0.23 cy/ft | 6.30 cy/ft |
| Volume Change Above −6 ft NAVD88 | −21.88 cy/ft | 6.53 cy/ft |
| Volume Change Above −14 ft NAVD88 | −30.72 cy/ft | 34.15 cy/ft |
| Volume Change Above −19 ft NAVD88 | −29.52 cy/ft | 23.89 cy/ft |
| Volume Change Above −30 ft NAVD88 | −18.35 cy/ft | 10.16 cy/ft |

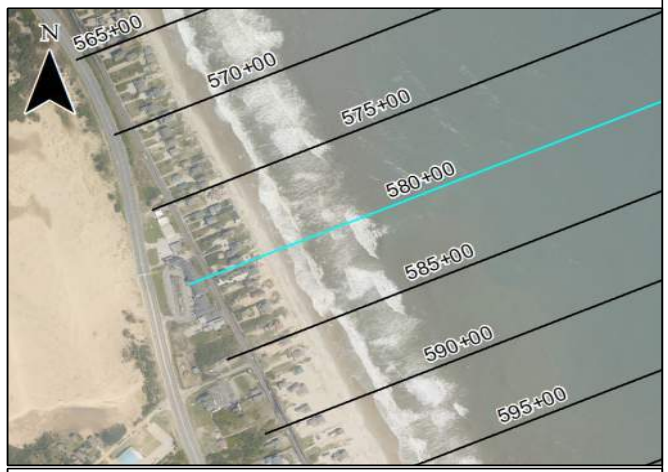
**LEGEND:**

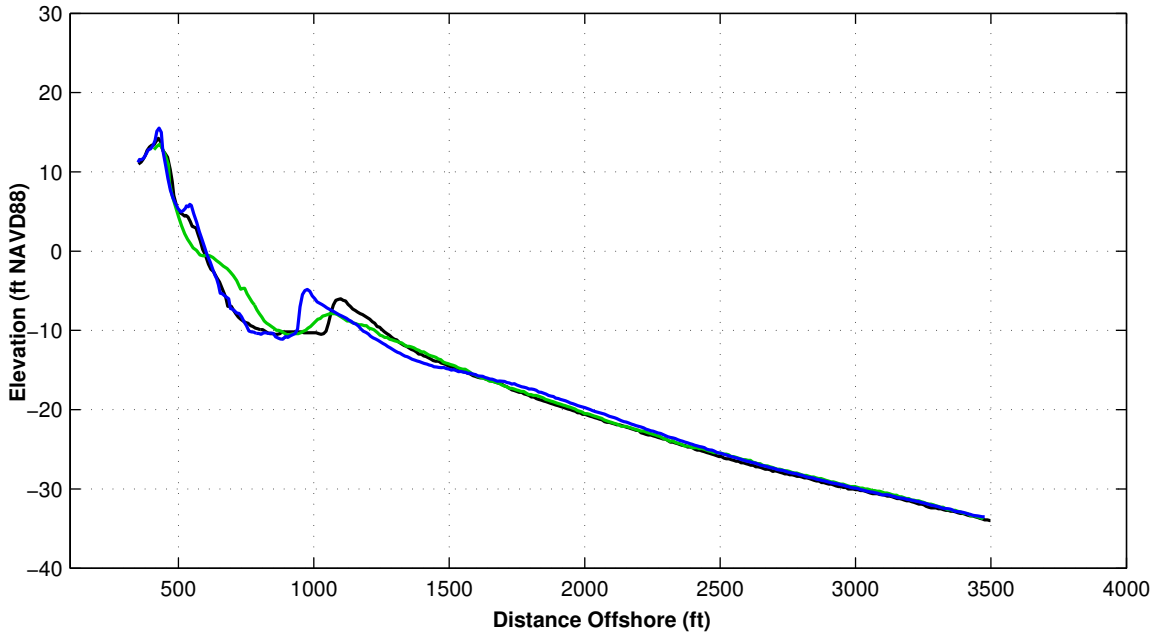
JUNE 2024 — OCTOBER 2023

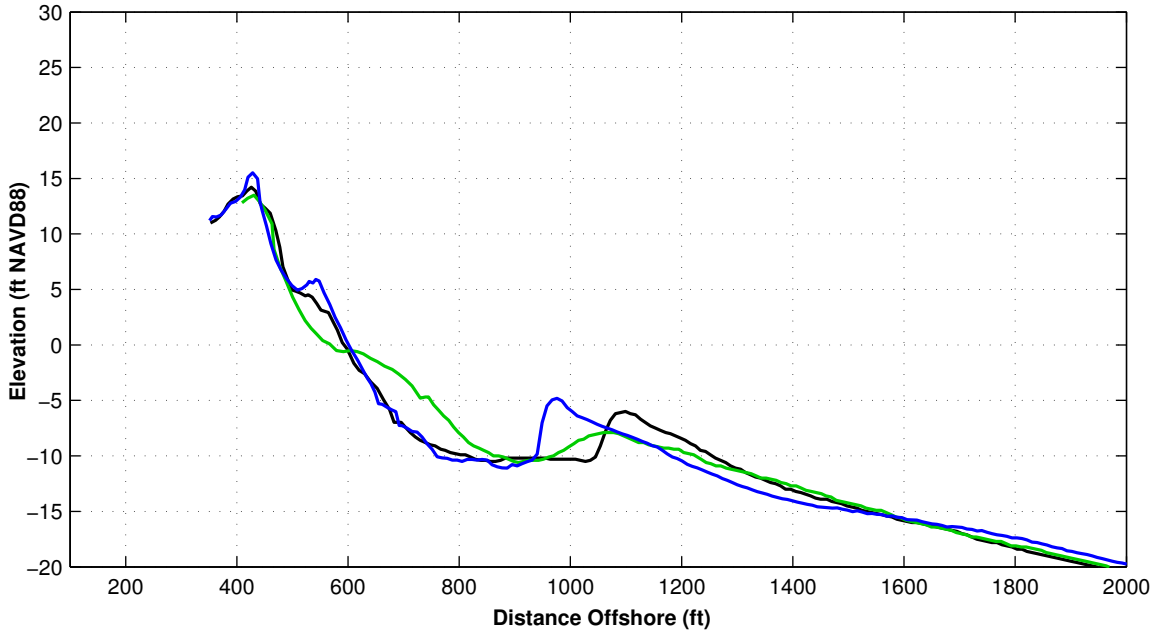
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 585+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 66.19 ft | −0.08 ft |
| Volume Change Above +6 ft NAVD88 | 3.79 cy/ft | 1.77 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.92 cy/ft | 1.80 cy/ft |
| Volume Change Above −6 ft NAVD88 | 25.31 cy/ft | −3.26 cy/ft |
| Volume Change Above −14 ft NAVD88 | 5.36 cy/ft | 39.39 cy/ft |
| Volume Change Above −19 ft NAVD88 | −1.16 cy/ft | 57.76 cy/ft |
| Volume Change Above −30 ft NAVD88 | 8.26 cy/ft | 44.20 cy/ft |

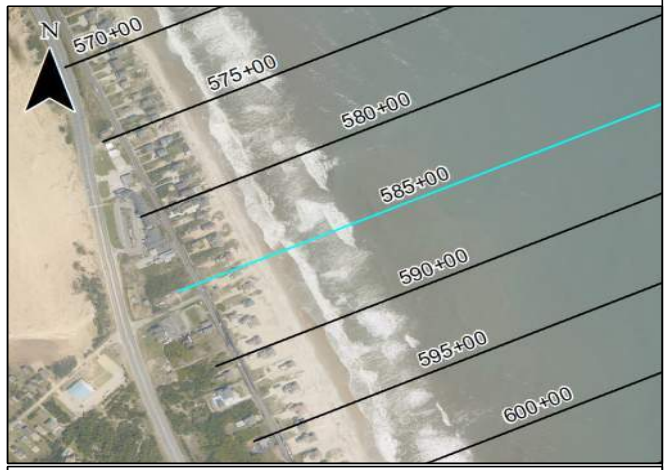
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

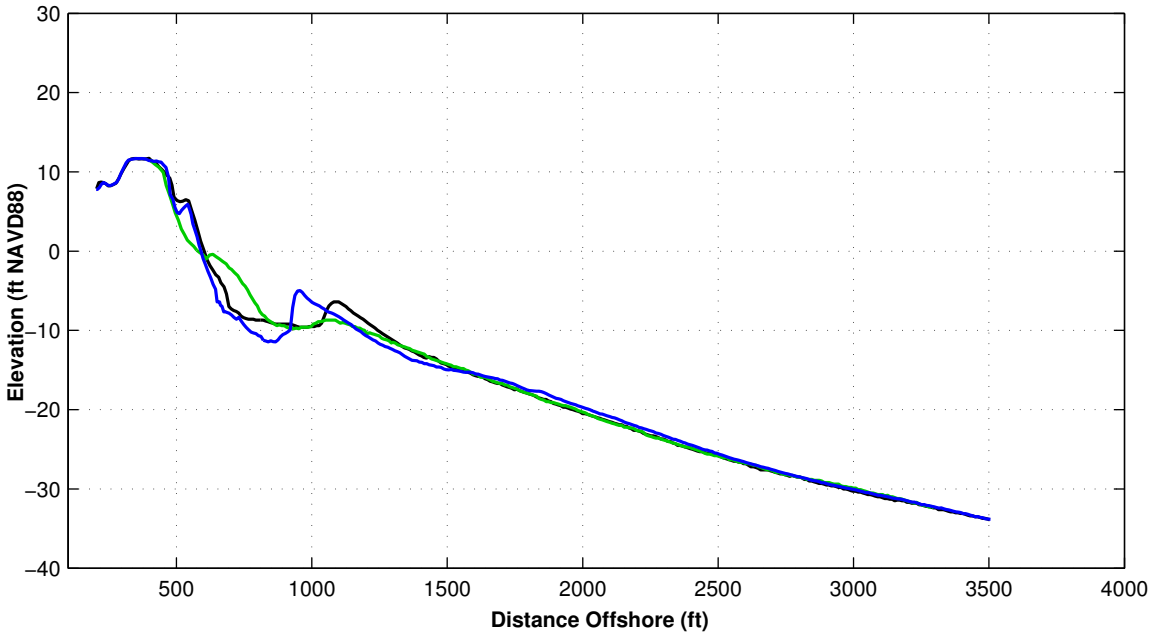
Notes:

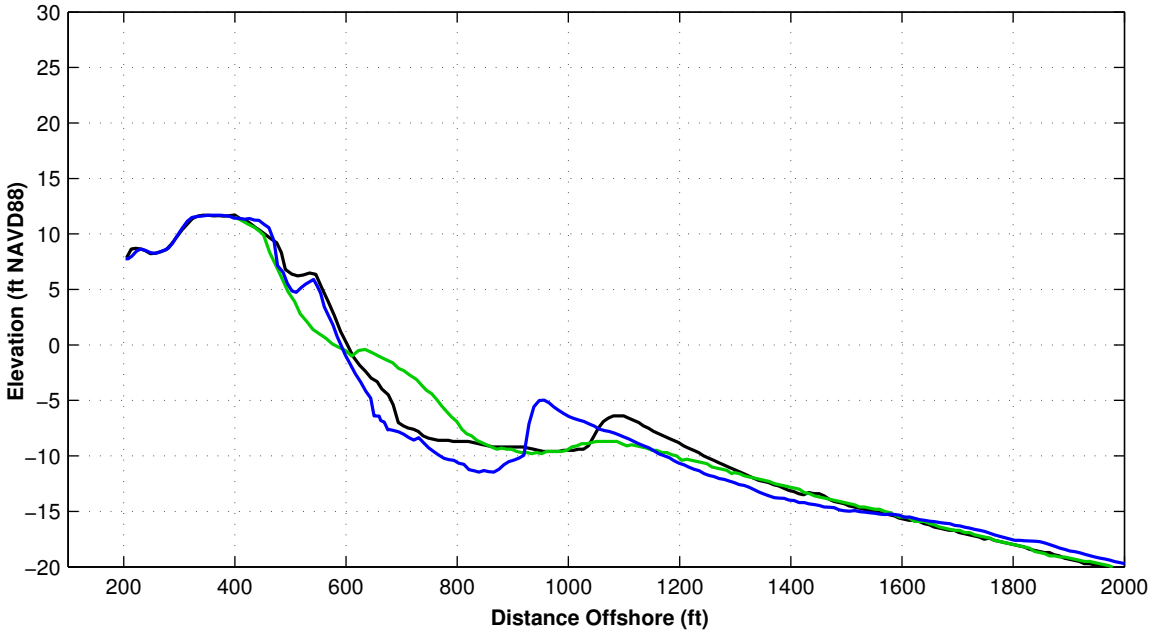
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 585+00 | Pg 75 of 173 | 2024 |
|---|---|---|




| Survey Transect 590+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 0.89 ft | 0.98 ft |
| Volume Change Above +6 ft NAVD88 | 3.65 cy/ft | 2.25 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.83 cy/ft | 3.15 cy/ft |
| Volume Change Above −6 ft NAVD88 | −18.03 cy/ft | 8.65 cy/ft |
| Volume Change Above −14 ft NAVD88 | 7.35 cy/ft | 22.50 cy/ft |
| Volume Change Above −19 ft NAVD88 | 5.55 cy/ft | 12.16 cy/ft |
| Volume Change Above −30 ft NAVD88 | 17.83 cy/ft | 0.06 cy/ft |

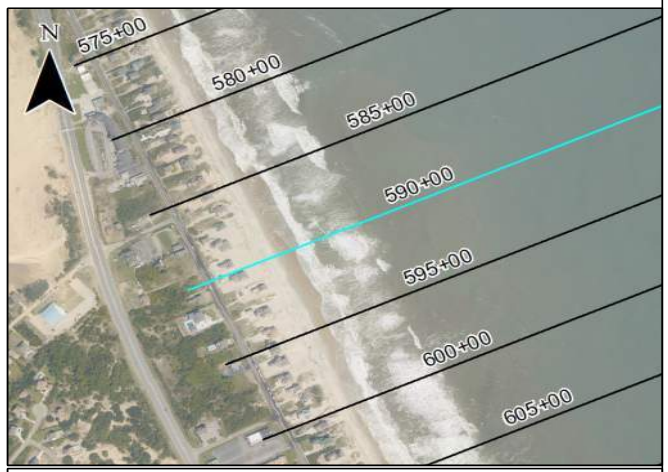
**LEGEND:**

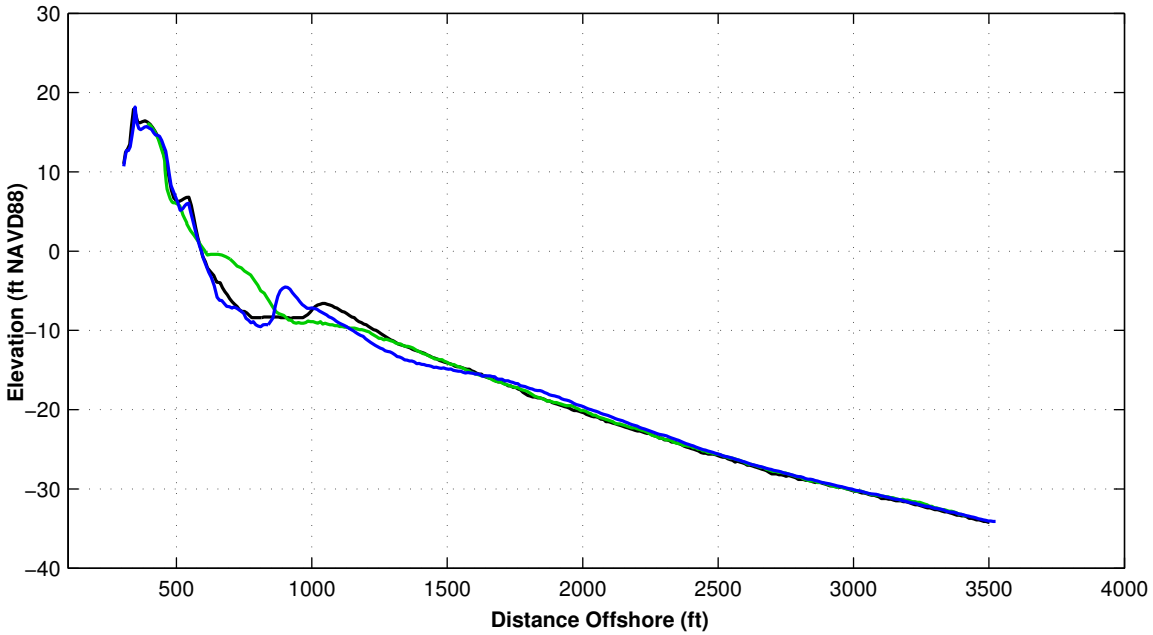
JUNE 2024 — OCTOBER 2023

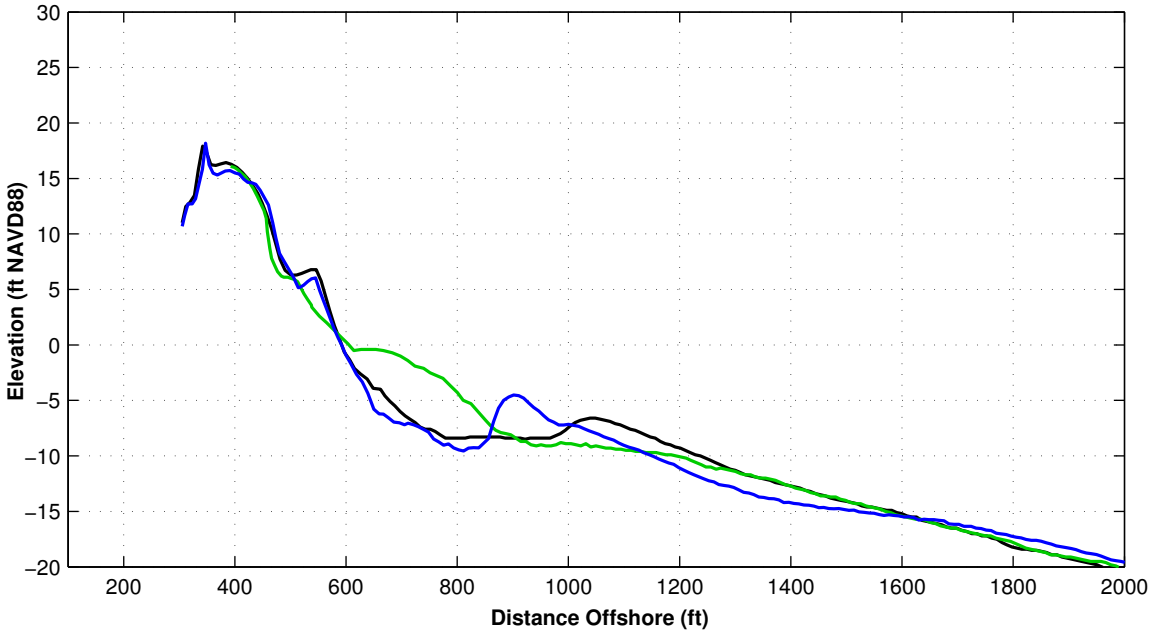
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 595+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 33.35 ft | 23.78 ft |
| Volume Change Above +6 ft NAVD88 | 8.92 cy/ft | 1.78 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 16.28 cy/ft | 3.78 cy/ft |
| Volume Change Above −6 ft NAVD88 | 21.44 cy/ft | 5.54 cy/ft |
| Volume Change Above −14 ft NAVD88 | 37.39 cy/ft | 29.66 cy/ft |
| Volume Change Above −19 ft NAVD88 | 45.75 cy/ft | 32.24 cy/ft |
| Volume Change Above −30 ft NAVD88 | 63.29 cy/ft | 31.27 cy/ft |

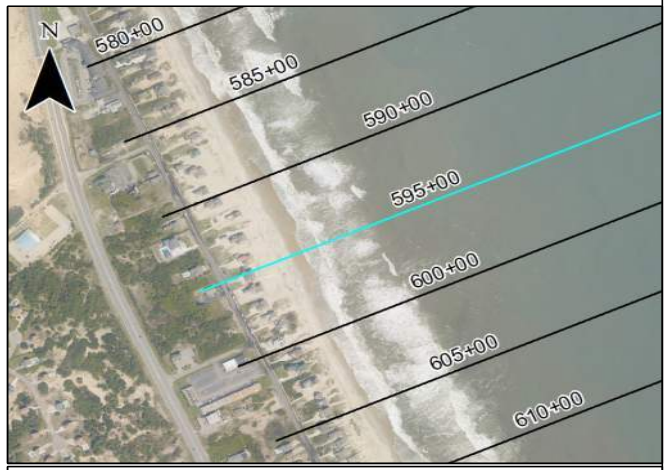
**LEGEND:**

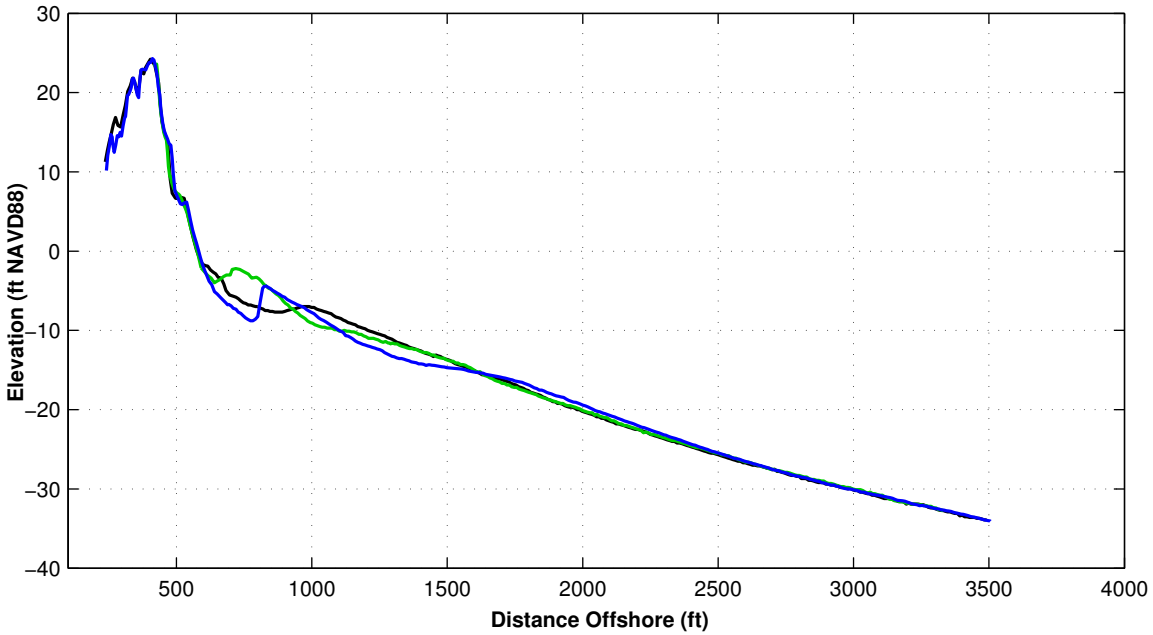
JUNE 2024 — OCTOBER 2023

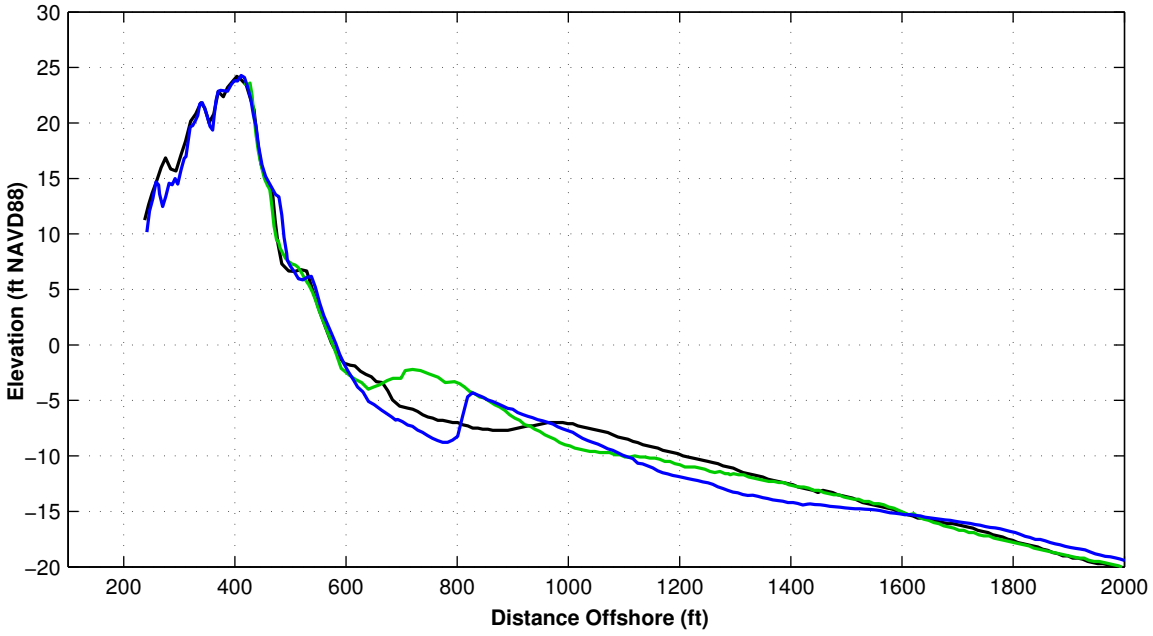
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 600+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −0.67 ft | 5.12 ft |
| Volume Change Above +6 ft NAVD88 | 7.63 cy/ft | 3.05 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.26 cy/ft | 6.00 cy/ft |
| Volume Change Above −6 ft NAVD88 | 8.42 cy/ft | 5.17 cy/ft |
| Volume Change Above −14 ft NAVD88 | 25.72 cy/ft | 16.00 cy/ft |
| Volume Change Above −19 ft NAVD88 | 29.17 cy/ft | 20.71 cy/ft |
| Volume Change Above −30 ft NAVD88 | 62.32 cy/ft | −52.84 cy/ft |

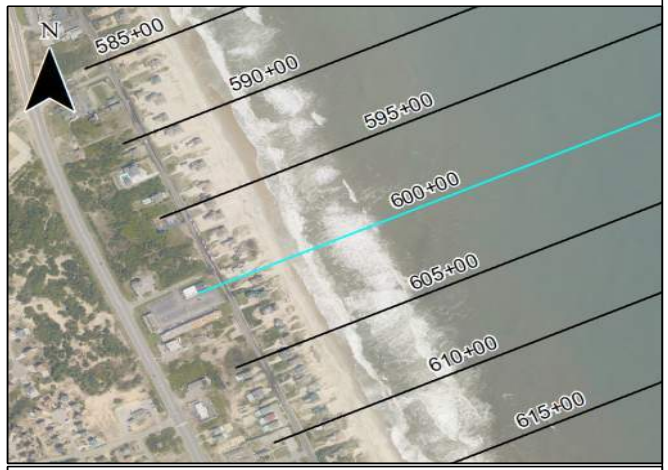
**LEGEND:**

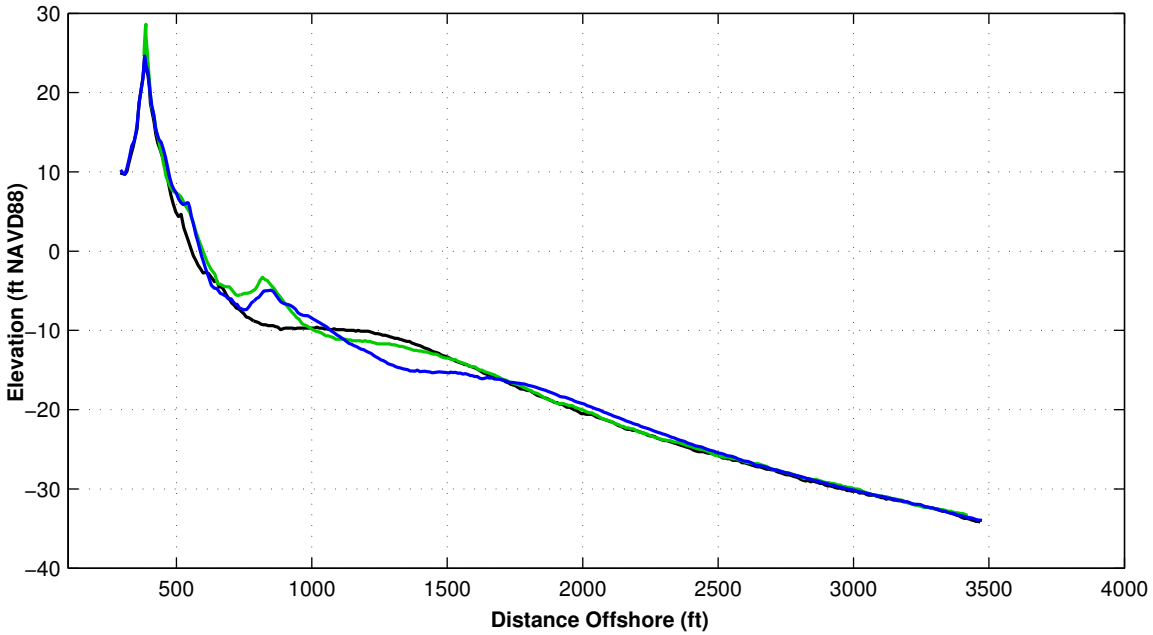
JUNE 2024 — OCTOBER 2023

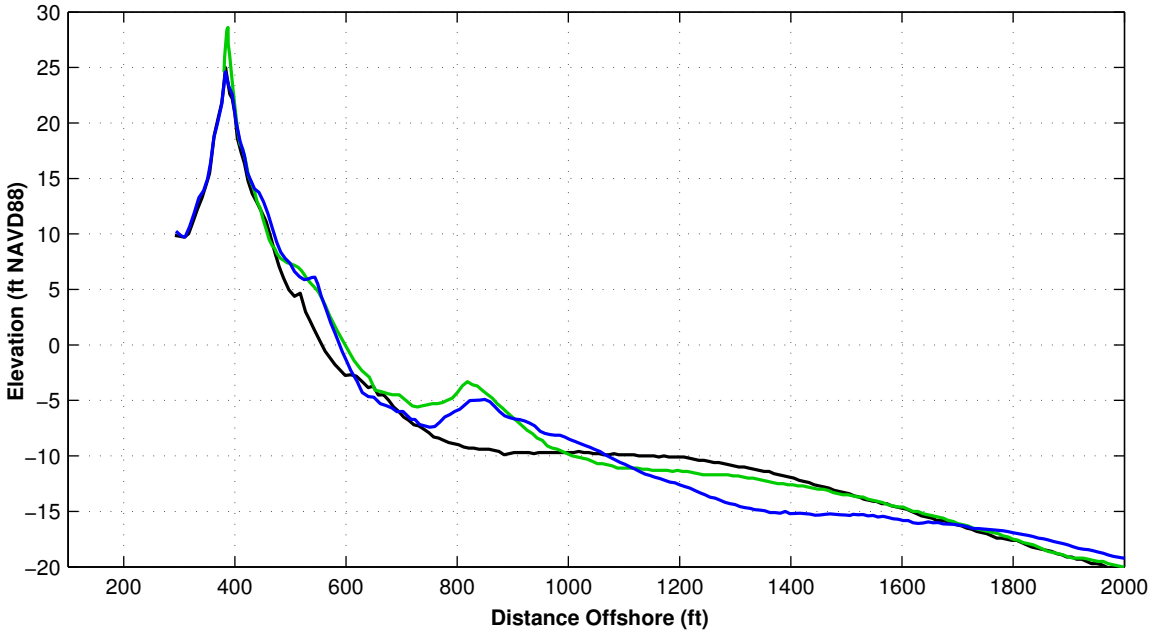
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 605+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −41.02 ft | 46.11 ft |
| Volume Change Above +6 ft NAVD88 | 7.25 cy/ft | 4.79 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 5.45 cy/ft | 9.23 cy/ft |
| Volume Change Above −6 ft NAVD88 | −8.31 cy/ft | 18.01 cy/ft |
| Volume Change Above −14 ft NAVD88 | −20.95 cy/ft | 31.84 cy/ft |
| Volume Change Above −19 ft NAVD88 | −17.32 cy/ft | 6.46 cy/ft |
| Volume Change Above −30 ft NAVD88 | −20.06 cy/ft | 14.15 cy/ft |

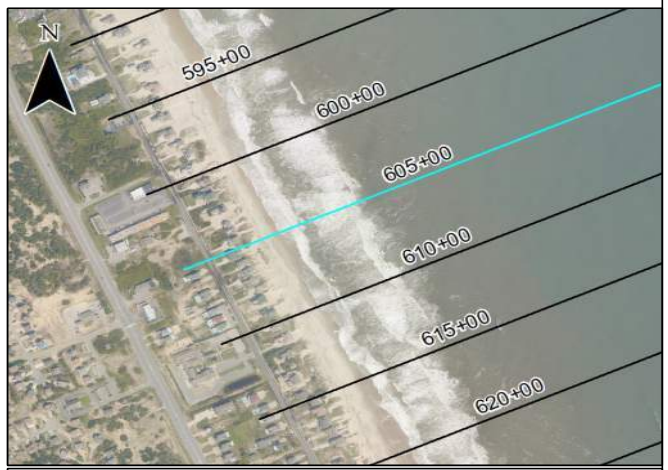
**LEGEND:**

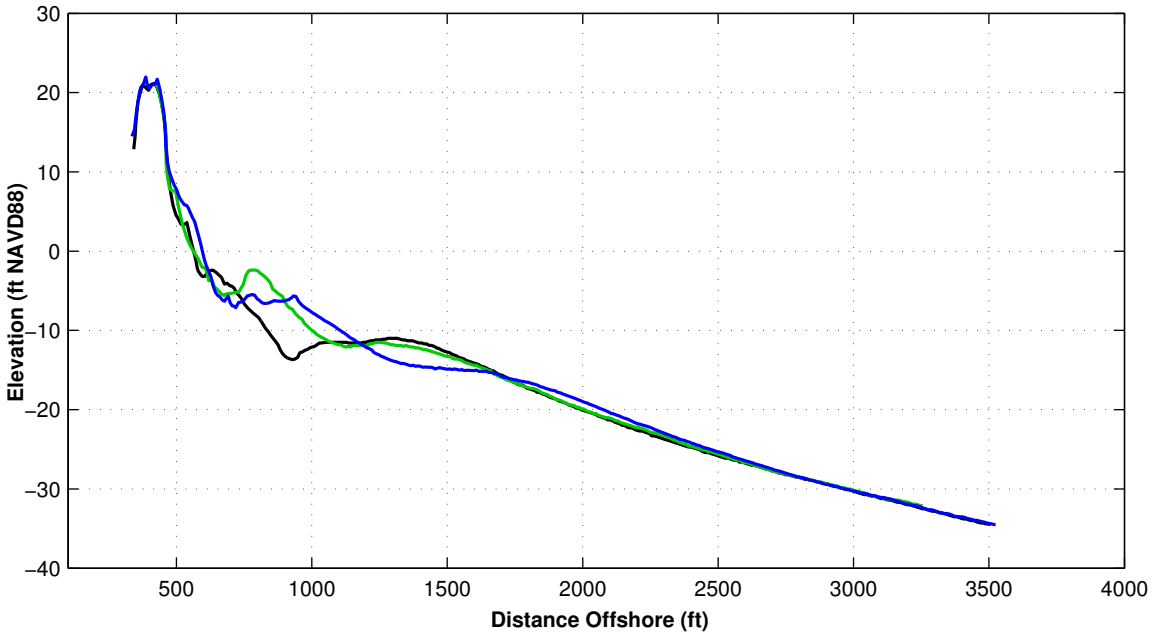
JUNE 2024 — OCTOBER 2023

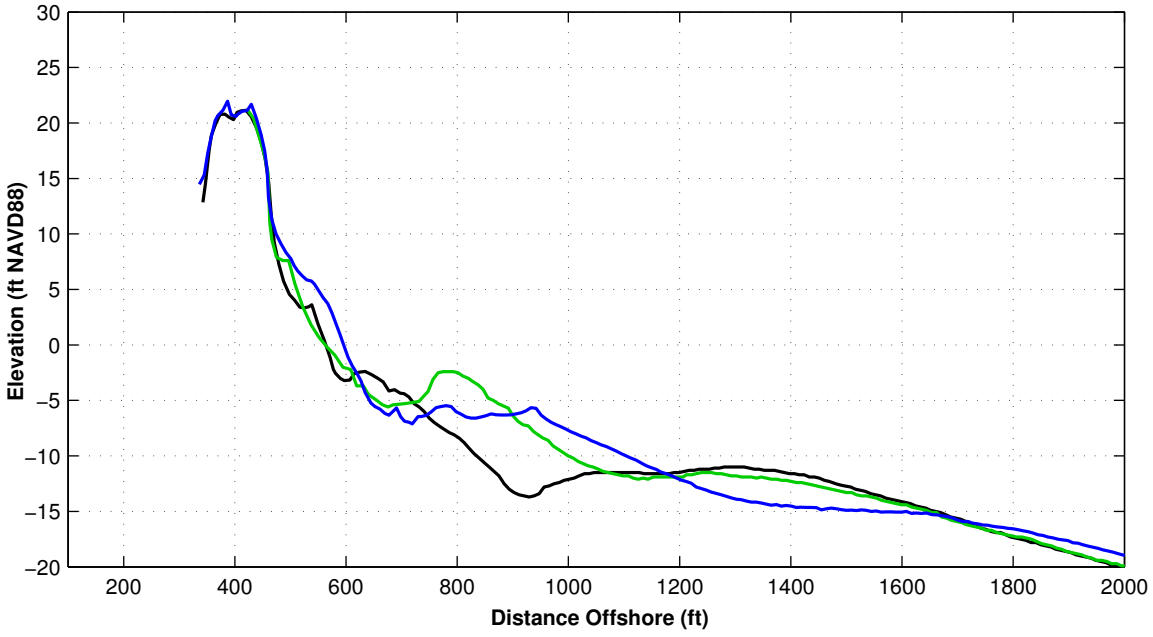
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 610+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −1.25 ft | 71.84 ft |
| Volume Change Above +6 ft NAVD88 | 8.22 cy/ft | 4.66 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 10.21 cy/ft | 14.25 cy/ft |
| Volume Change Above −6 ft NAVD88 | 3.41 cy/ft | 32.97 cy/ft |
| Volume Change Above −14 ft NAVD88 | −17.40 cy/ft | 77.63 cy/ft |
| Volume Change Above −19 ft NAVD88 | −23.46 cy/ft | 54.49 cy/ft |
| Volume Change Above −30 ft NAVD88 | −12.40 cy/ft | 27.31 cy/ft |

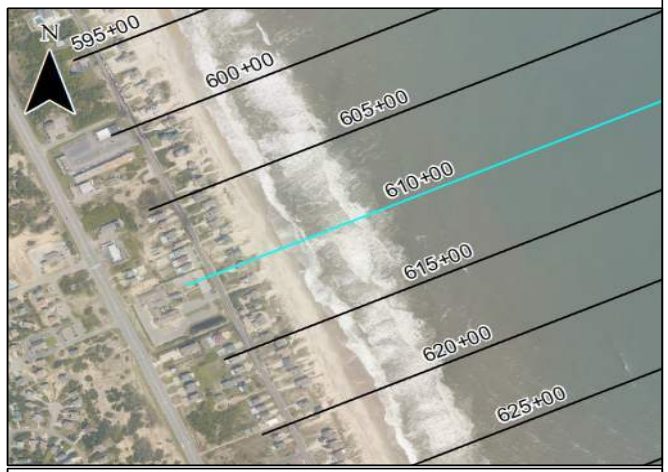
**LEGEND:**

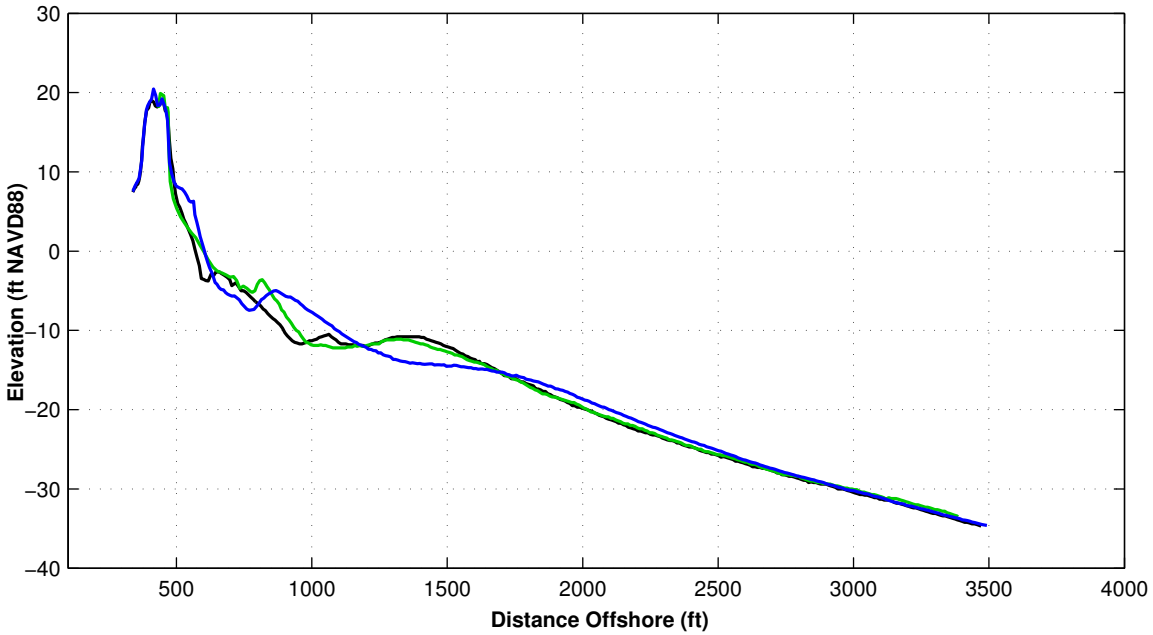
JUNE 2024 — OCTOBER 2023

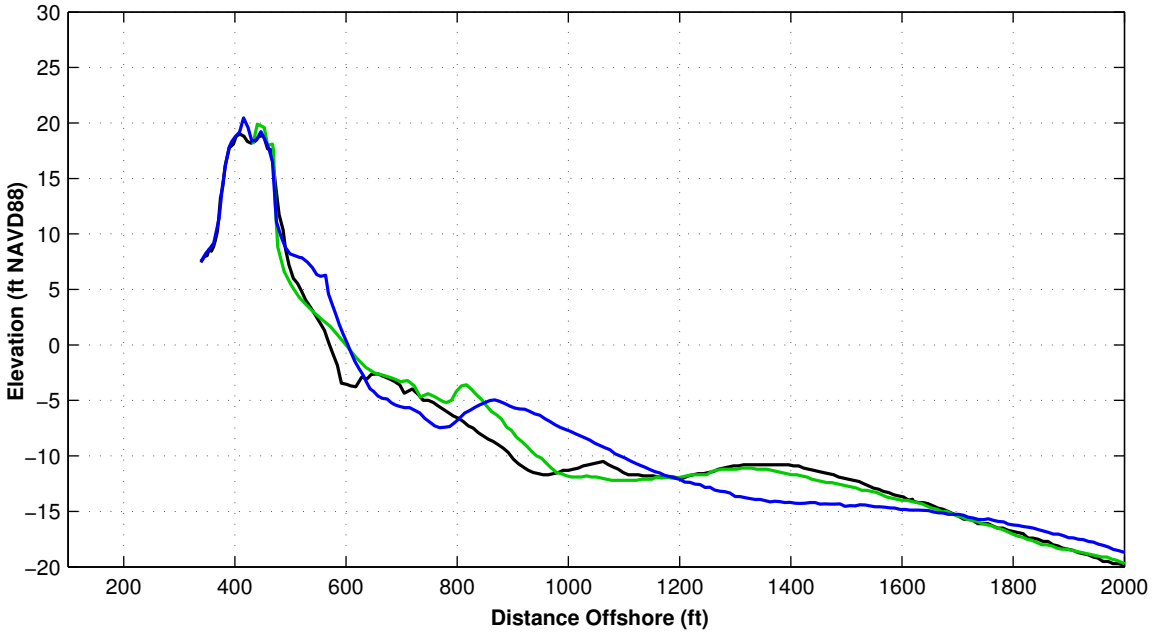
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 615+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 10.39 ft | 61.45 ft |
| Volume Change Above +6 ft NAVD88 | 6.40 cy/ft | 4.85 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 12.24 cy/ft | 9.80 cy/ft |
| Volume Change Above −6 ft NAVD88 | 16.29 cy/ft | 23.19 cy/ft |
| Volume Change Above −14 ft NAVD88 | 22.77 cy/ft | 61.81 cy/ft |
| Volume Change Above −19 ft NAVD88 | 31.42 cy/ft | 48.30 cy/ft |
| Volume Change Above −30 ft NAVD88 | 46.15 cy/ft | 28.73 cy/ft |

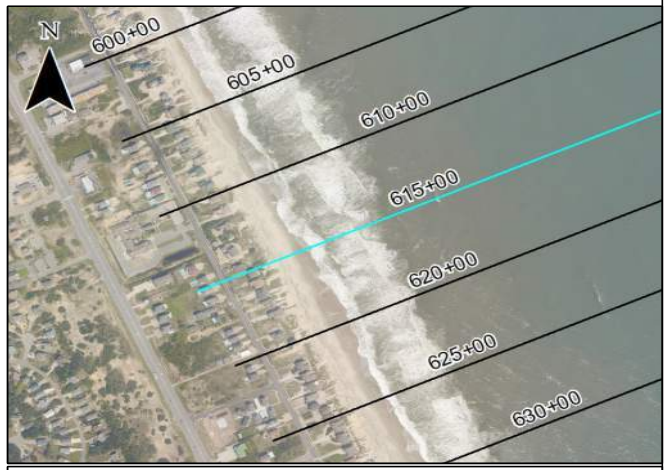
**LEGEND:**

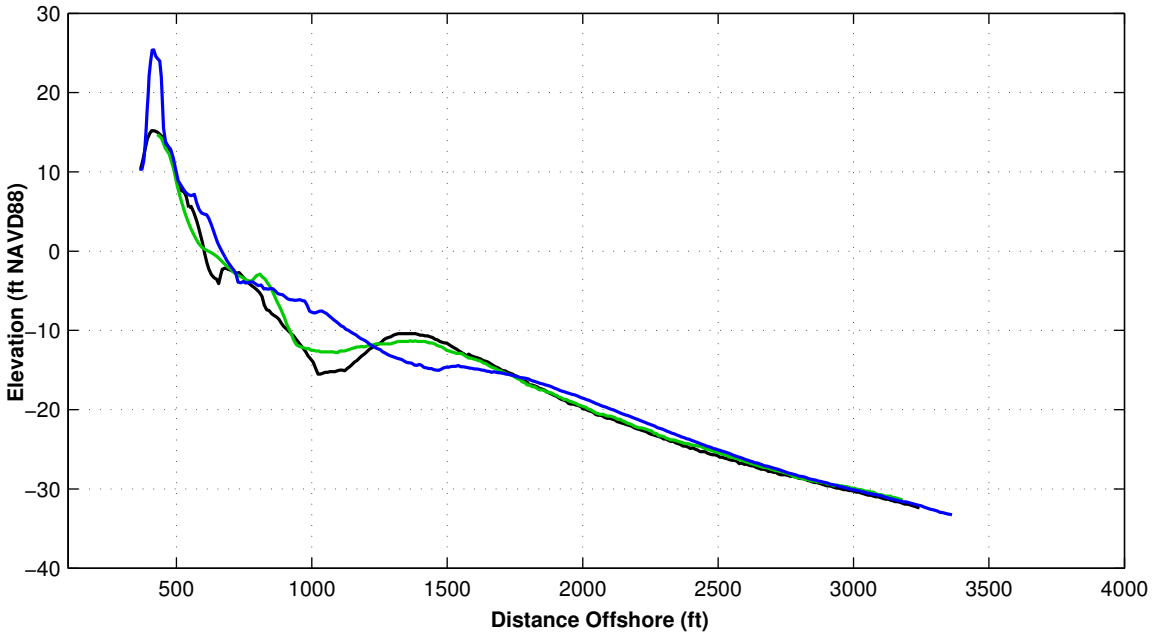
JUNE 2024 — OCTOBER 2023

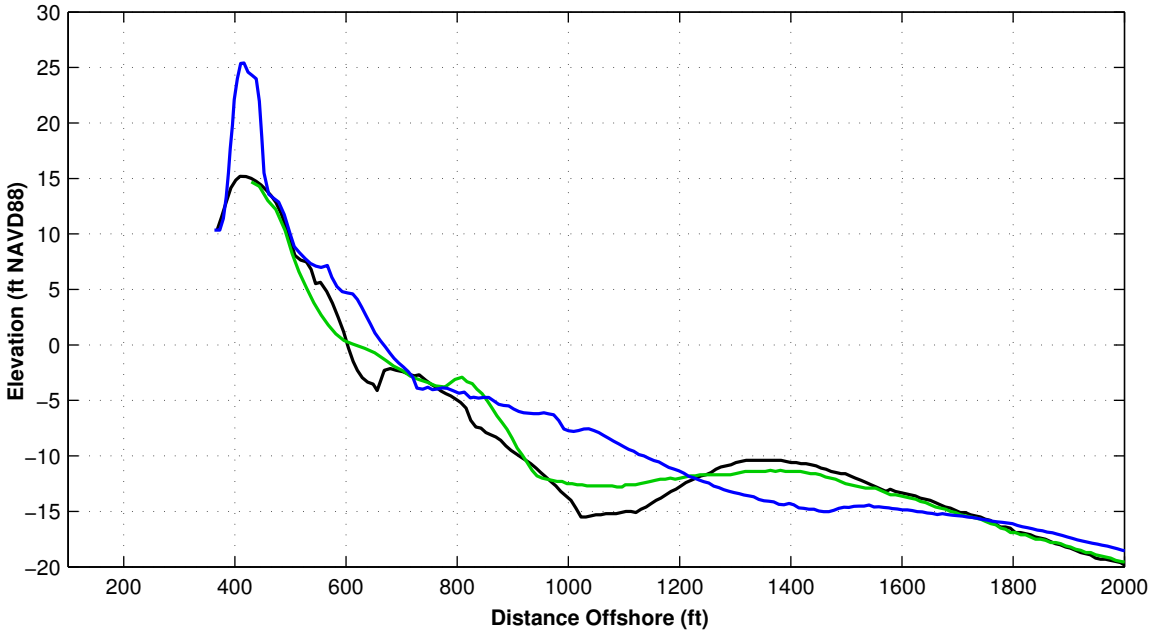
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 620+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 23.53 ft | 52.68 ft |
| Volume Change Above +6 ft NAVD88 | 4.33 cy/ft | 3.73 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.76 cy/ft | 9.03 cy/ft |
| Volume Change Above −6 ft NAVD88 | 10.77 cy/ft | 15.87 cy/ft |
| Volume Change Above −14 ft NAVD88 | 31.37 cy/ft | 12.75 cy/ft |
| Volume Change Above −19 ft NAVD88 | 42.03 cy/ft | −12.33 cy/ft |
| Volume Change Above −30 ft NAVD88 | 57.63 cy/ft | −36.29 cy/ft |

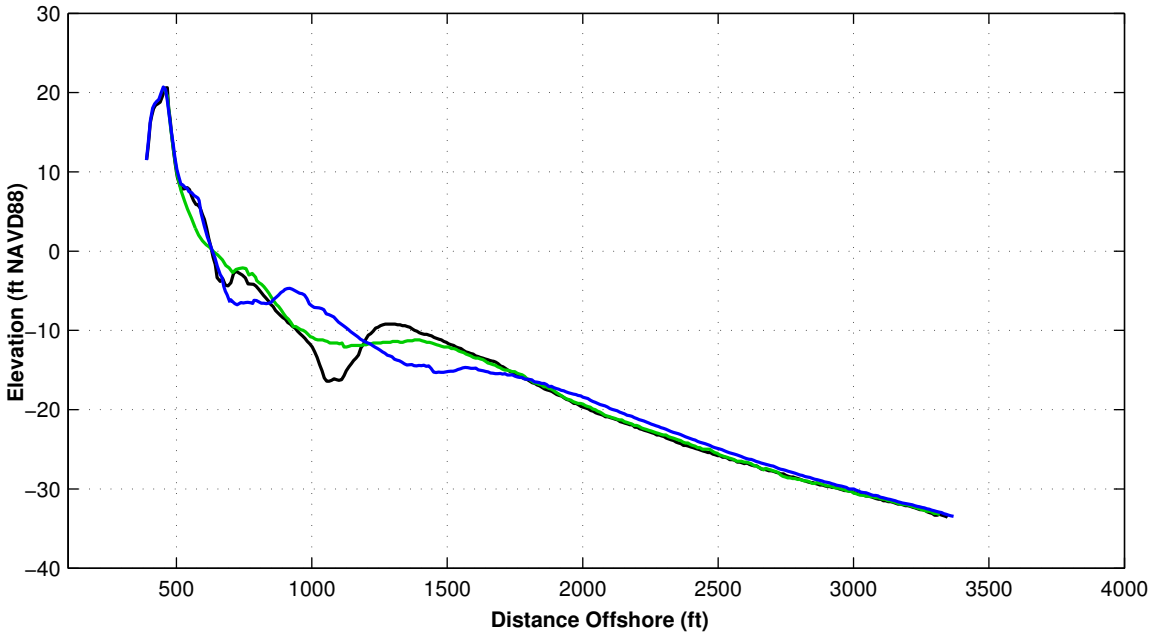
**LEGEND:**

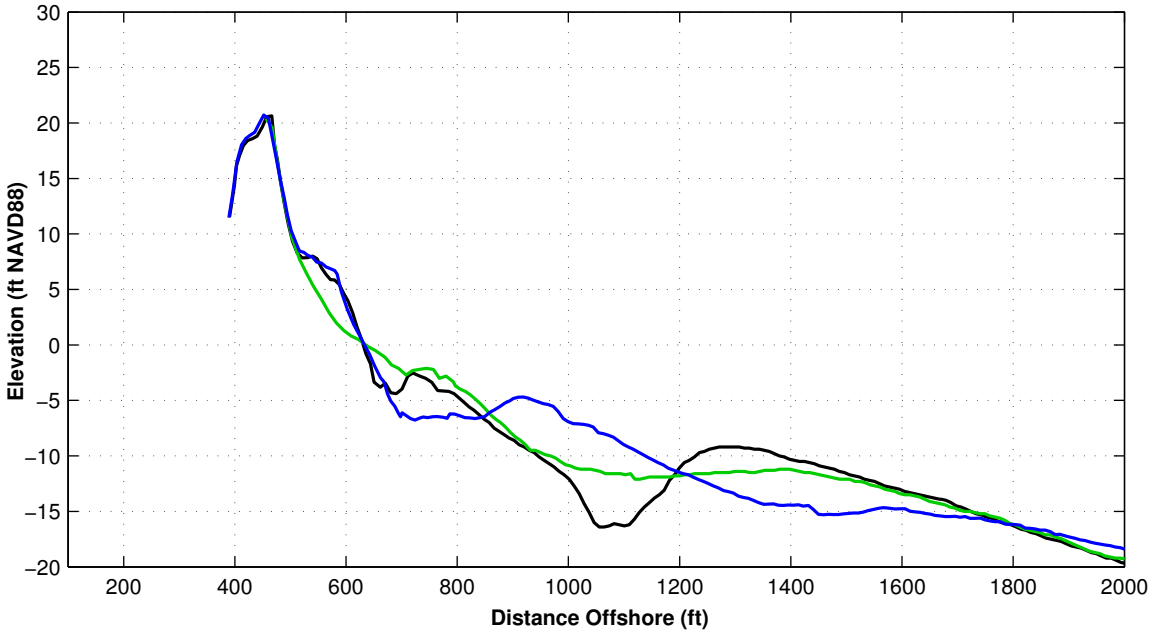
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 625+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 33.74 ft | 52.93 ft |
| Volume Change Above +6 ft NAVD88 | 5.32 cy/ft | 2.78 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.76 cy/ft | 8.41 cy/ft |
| Volume Change Above –6 ft NAVD88 | 11.94 cy/ft | 14.40 cy/ft |
| Volume Change Above –14 ft NAVD88 | 16.92 cy/ft | 29.50 cy/ft |
| Volume Change Above –19 ft NAVD88 | 23.98 cy/ft | 12.35 cy/ft |
| Volume Change Above –30 ft NAVD88 | 41.27 cy/ft | –12.26 cy/ft |

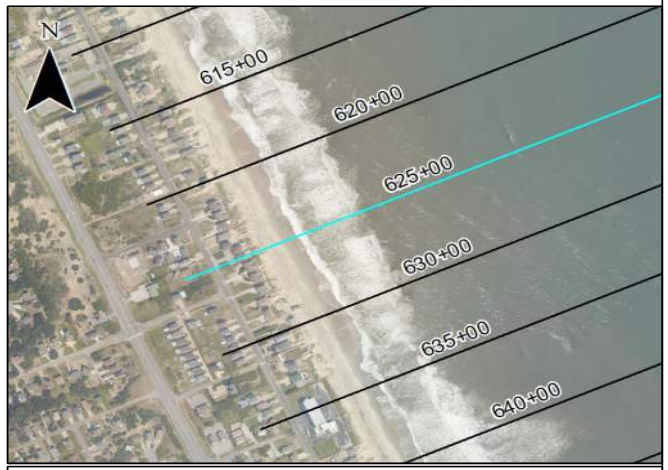
**LEGEND:**

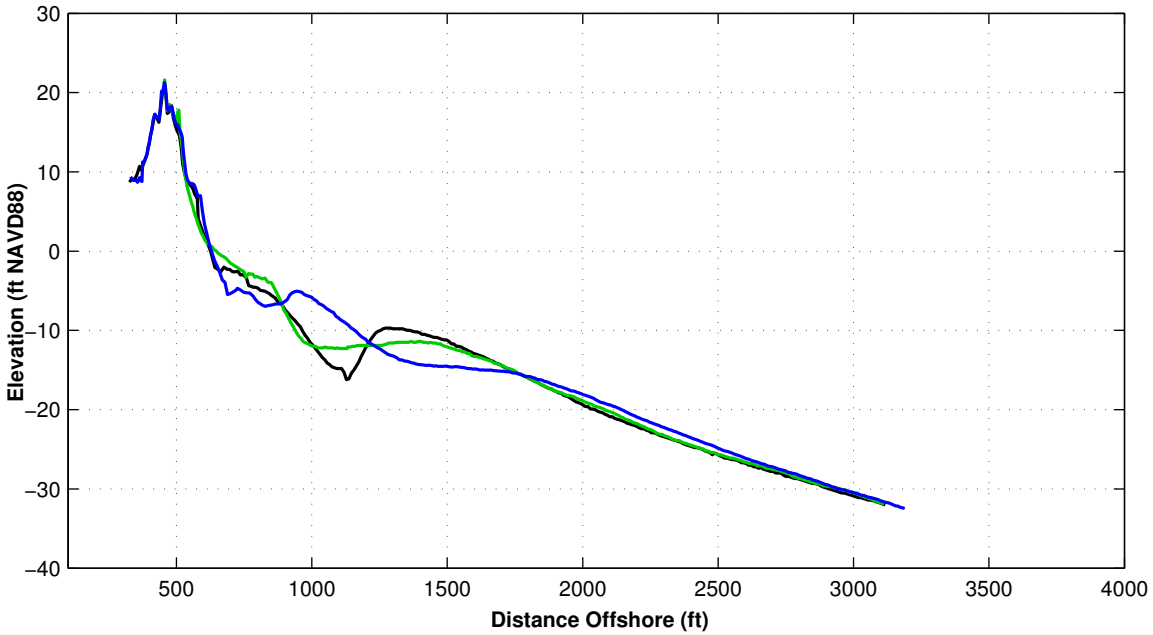
JUNE 2024 — OCTOBER 2023

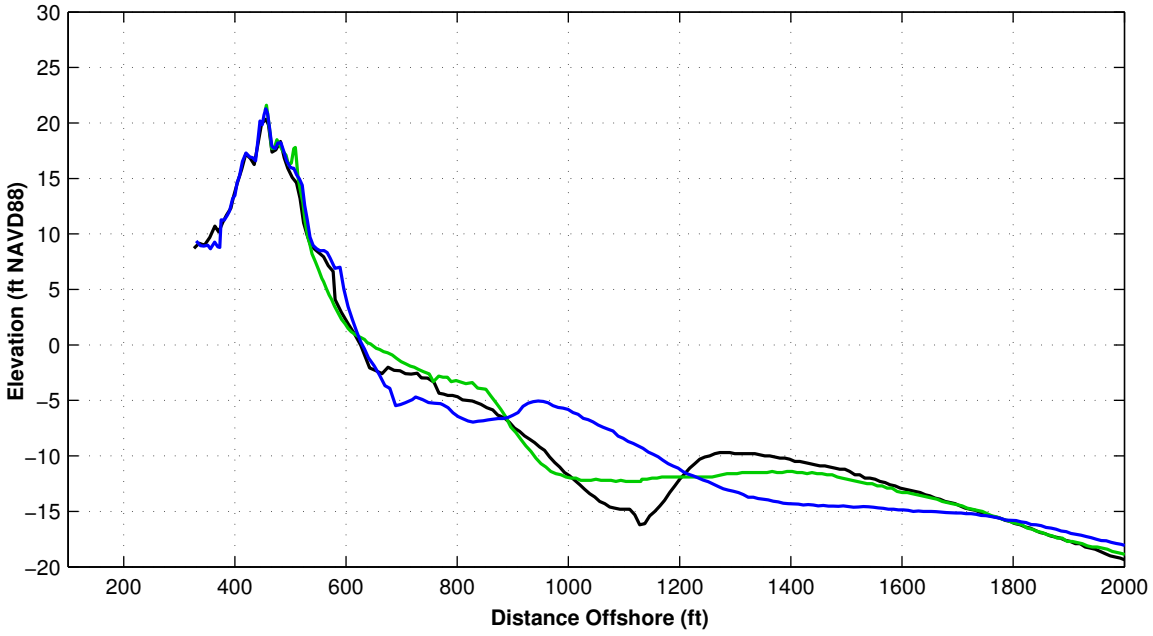
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 630+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −21.34 ft | 52.83 ft |
| Volume Change Above +6 ft NAVD88 | 4.20 cy/ft | 1.01 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.27 cy/ft | 6.24 cy/ft |
| Volume Change Above −6 ft NAVD88 | −18.69 cy/ft | 13.27 cy/ft |
| Volume Change Above −14 ft NAVD88 | −29.72 cy/ft | 51.73 cy/ft |
| Volume Change Above −19 ft NAVD88 | −27.32 cy/ft | 53.51 cy/ft |
| Volume Change Above −30 ft NAVD88 | −20.41 cy/ft | 17.87 cy/ft |

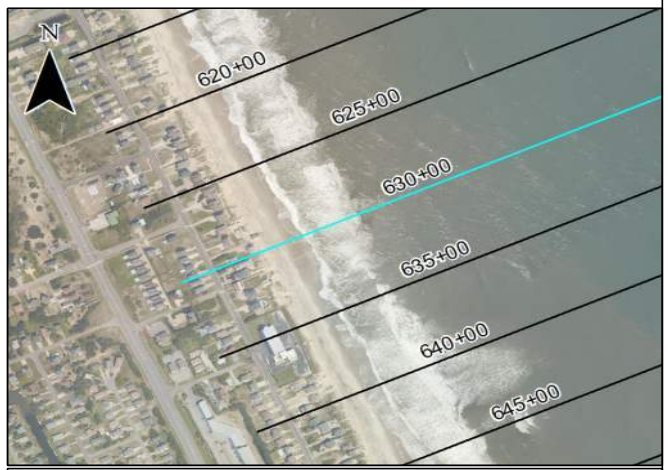
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

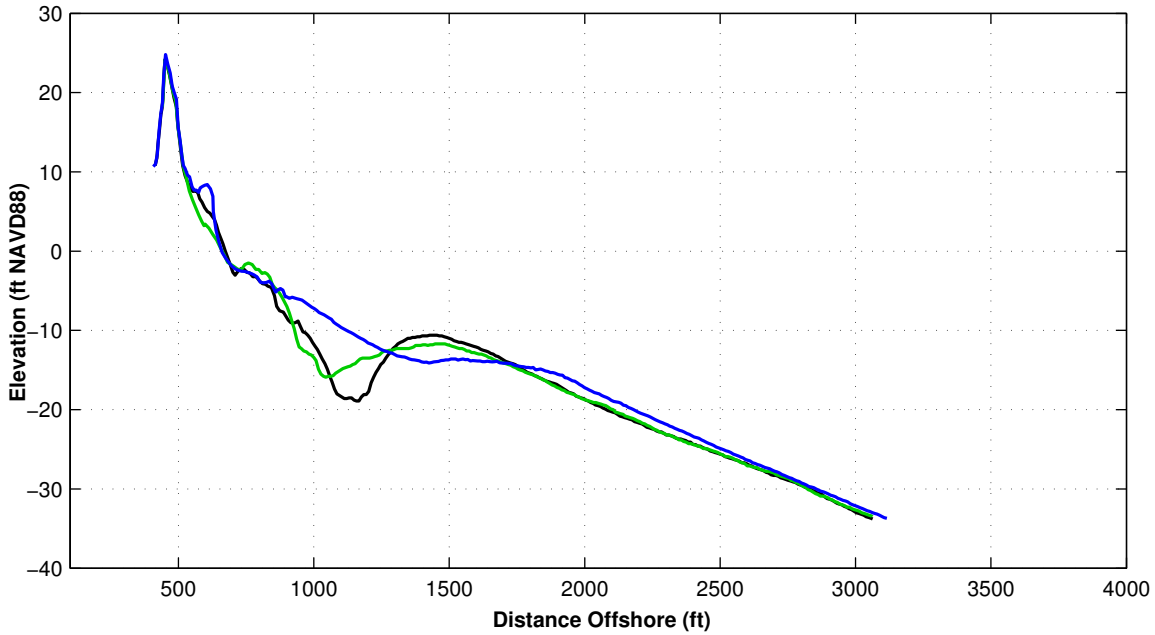
Notes:

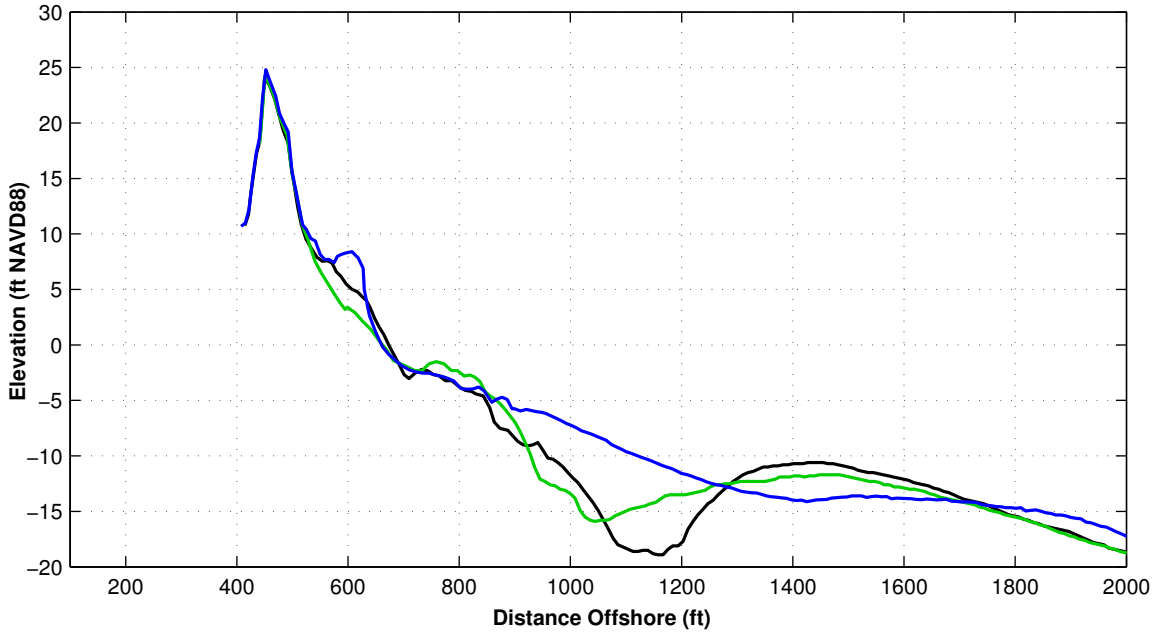
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 630+00 | Pg 84 of 173 | 2024 |
|---|---|---|




| Survey Transect 635+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −6.44 ft | 38.81 ft |
| Volume Change Above +6 ft NAVD88 | 7.17 cy/ft | 2.49 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 11.45 cy/ft | 6.18 cy/ft |
| Volume Change Above −6 ft NAVD88 | −1.55 cy/ft | 13.61 cy/ft |
| Volume Change Above −14 ft NAVD88 | 3.25 cy/ft | 49.32 cy/ft |
| Volume Change Above −19 ft NAVD88 | 7.24 cy/ft | 53.53 cy/ft |
| Volume Change Above −30 ft NAVD88 | 21.54 cy/ft | 38.70 cy/ft |

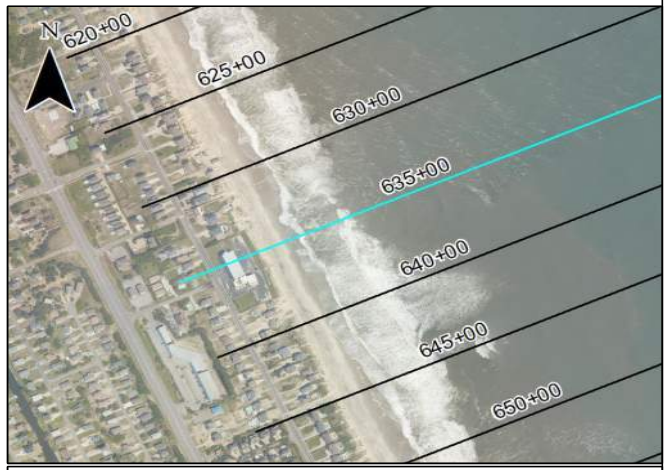
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

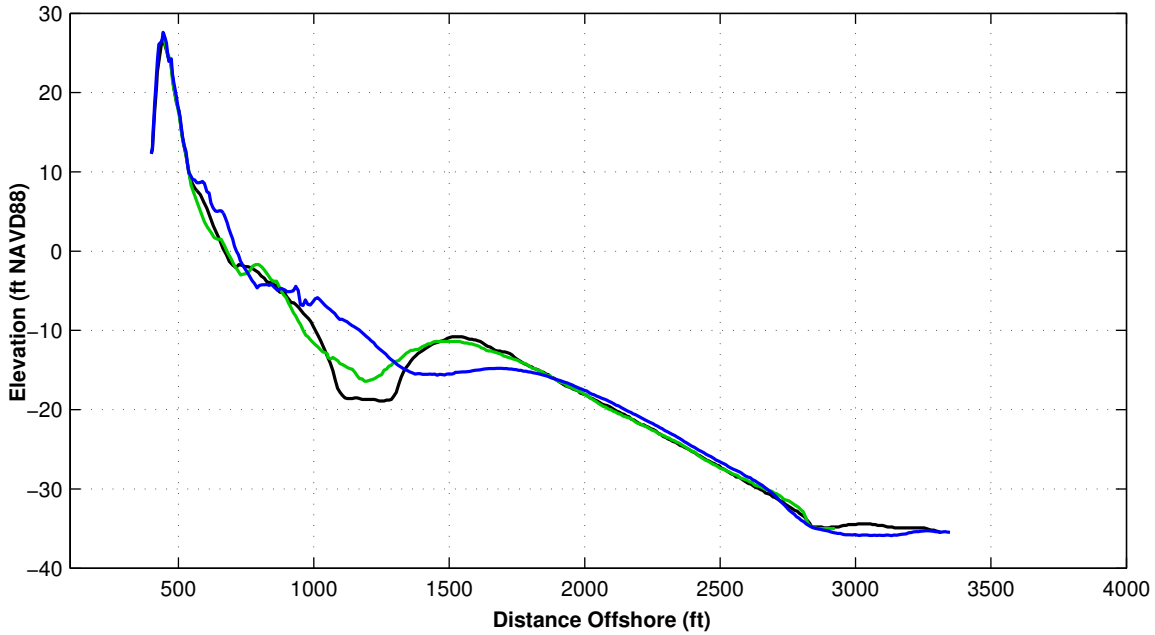
Notes:

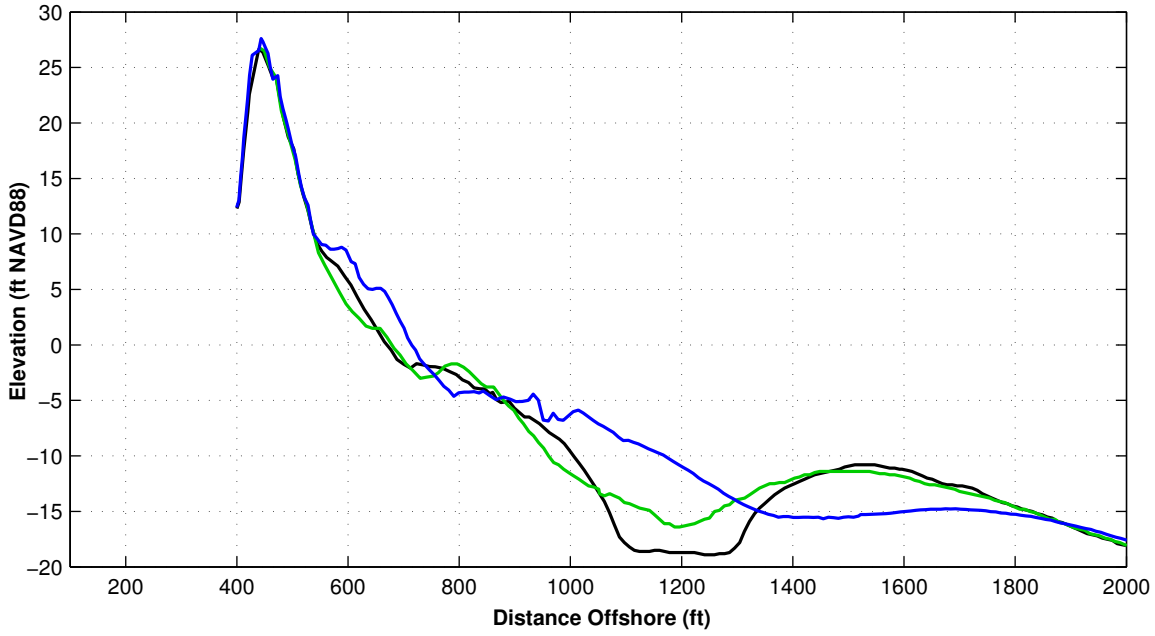
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 635+00 | Pg 85 of 173 | 2024 |
|---|---|---|




| Survey Transect 640+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −7.56 ft | 70.66 ft |
| Volume Change Above +6 ft NAVD88 | 7.46 cy/ft | 4.18 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 11.61 cy/ft | 11.47 cy/ft |
| Volume Change Above −6 ft NAVD88 | −6.01 cy/ft | 25.69 cy/ft |
| Volume Change Above −14 ft NAVD88 | −8.81 cy/ft | 60.93 cy/ft |
| Volume Change Above −19 ft NAVD88 | −10.42 cy/ft | 33.96 cy/ft |
| Volume Change Above −30 ft NAVD88 | 6.22 cy/ft | 9.44 cy/ft |

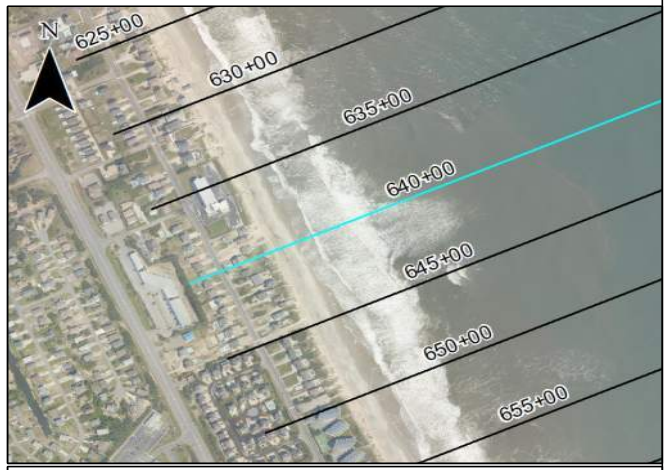
**LEGEND:**

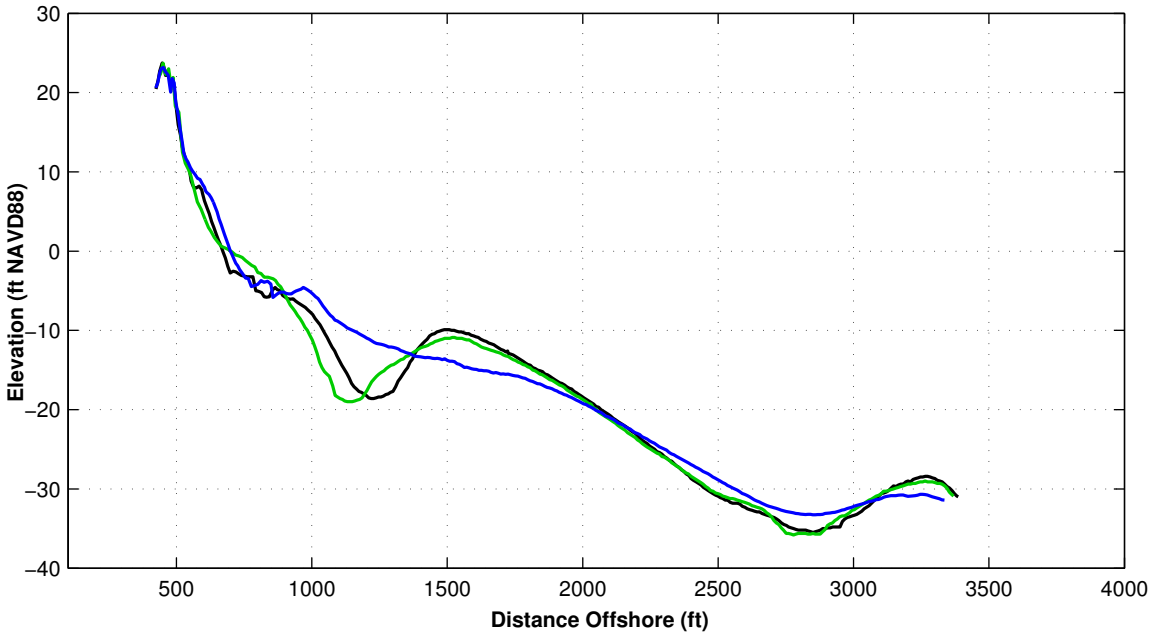
JUNE 2024 — OCTOBER 2023

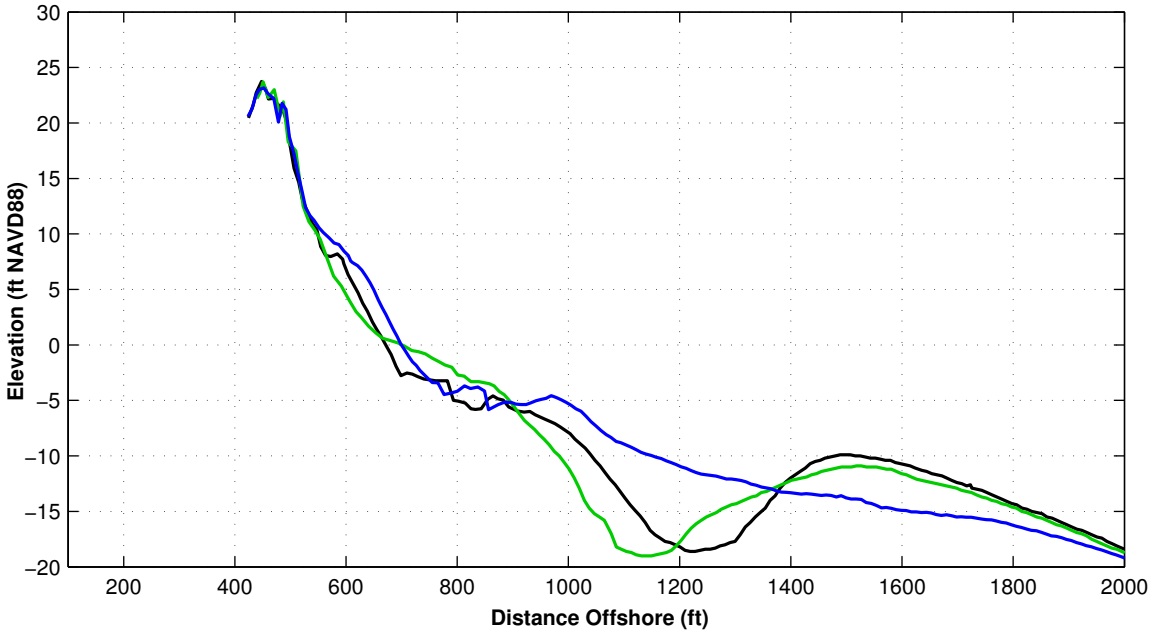
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 645+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −8.73 ft | 70.01 ft |
| Volume Change Above +6 ft NAVD88 | 6.48 cy/ft | 6.05 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 7.61 cy/ft | 17.15 cy/ft |
| Volume Change Above −6 ft NAVD88 | −10.45 cy/ft | 33.28 cy/ft |
| Volume Change Above −14 ft NAVD88 | −19.77 cy/ft | 70.84 cy/ft |
| Volume Change Above −19 ft NAVD88 | −14.39 cy/ft | 44.24 cy/ft |
| Volume Change Above −30 ft NAVD88 | −2.80 cy/ft | 21.36 cy/ft |

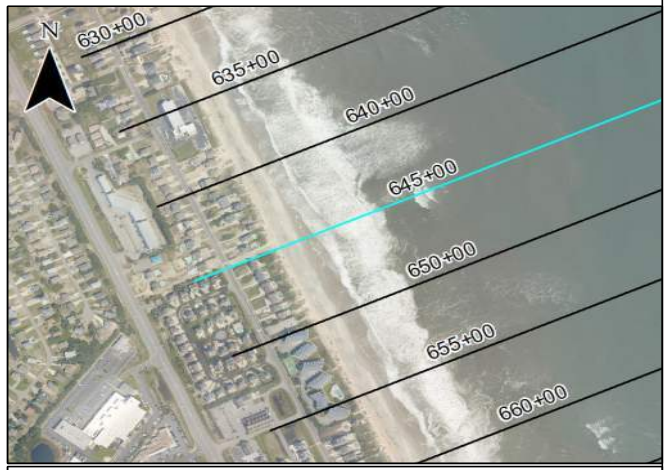
**LEGEND:**

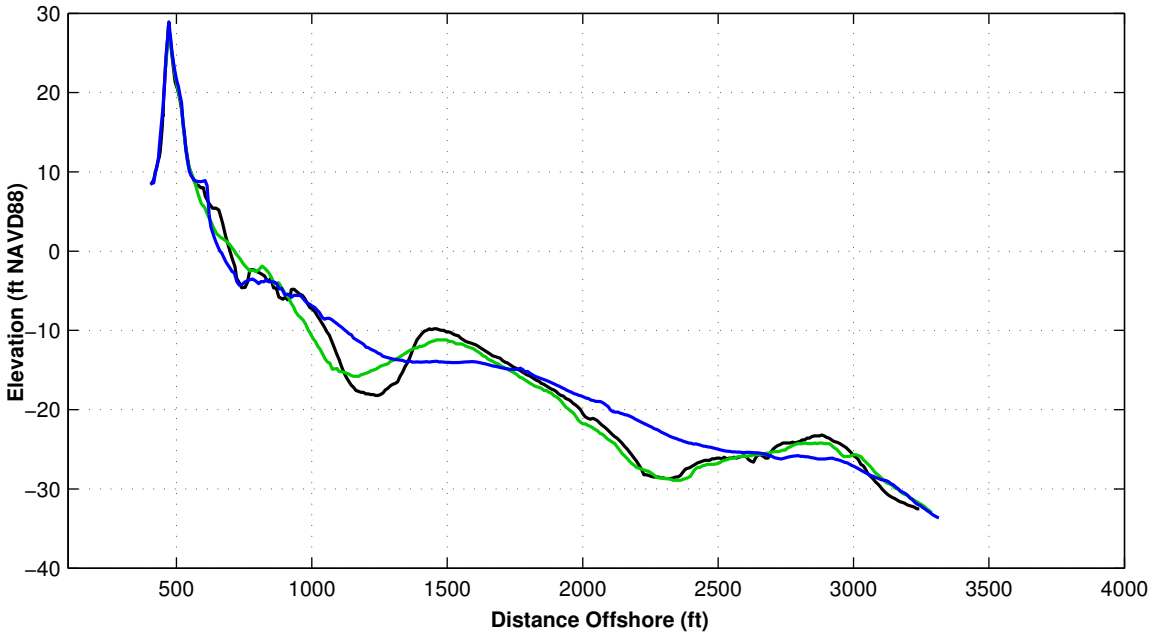
JUNE 2024 — OCTOBER 2023

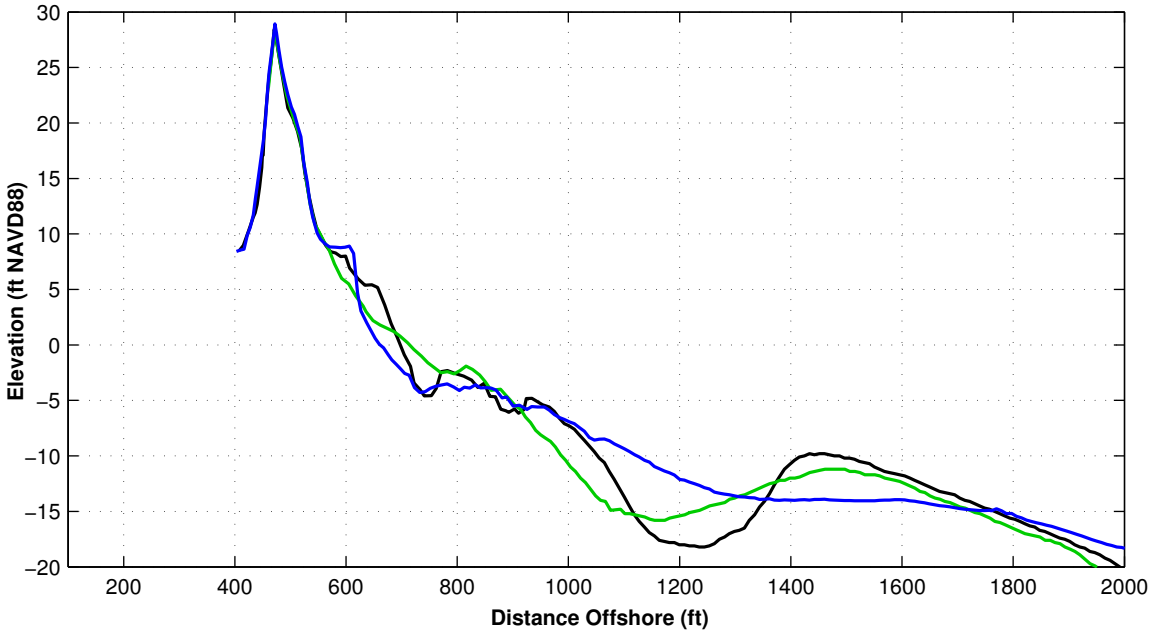
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 650+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −4.64 ft | 70.90 ft |
| Volume Change Above +6 ft NAVD88 | 5.18 cy/ft | 1.70 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.93 cy/ft | 8.06 cy/ft |
| Volume Change Above −6 ft NAVD88 | −12.30 cy/ft | 28.68 cy/ft |
| Volume Change Above −14 ft NAVD88 | −21.01 cy/ft | 62.22 cy/ft |
| Volume Change Above −19 ft NAVD88 | −16.18 cy/ft | 32.11 cy/ft |
| Volume Change Above −30 ft NAVD88 | −0.69 cy/ft | 8.79 cy/ft |

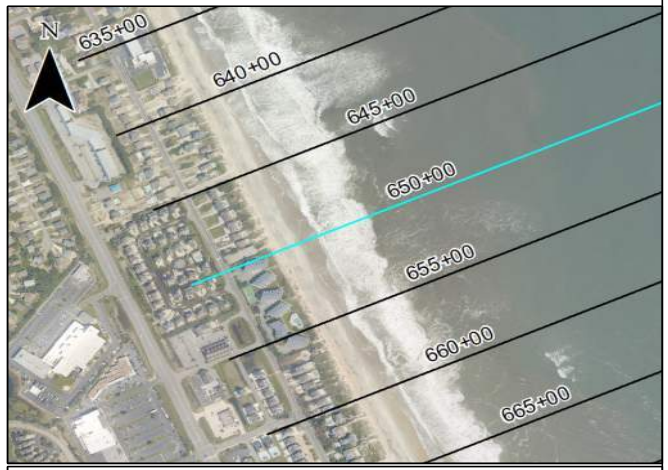
**LEGEND:**

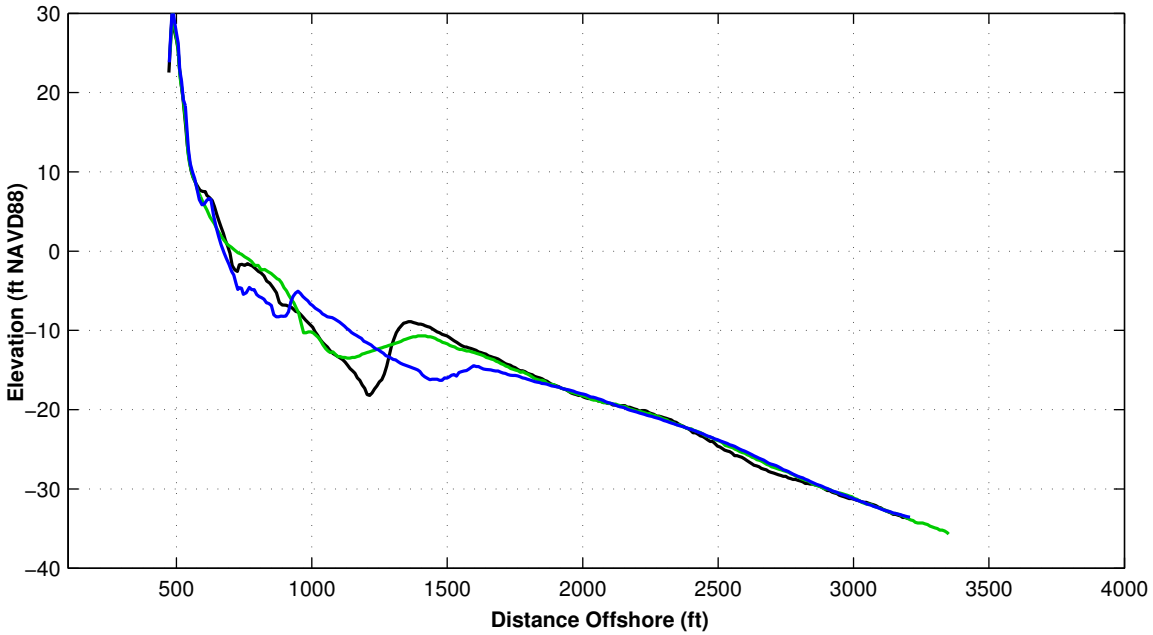
JUNE 2024 — OCTOBER 2023

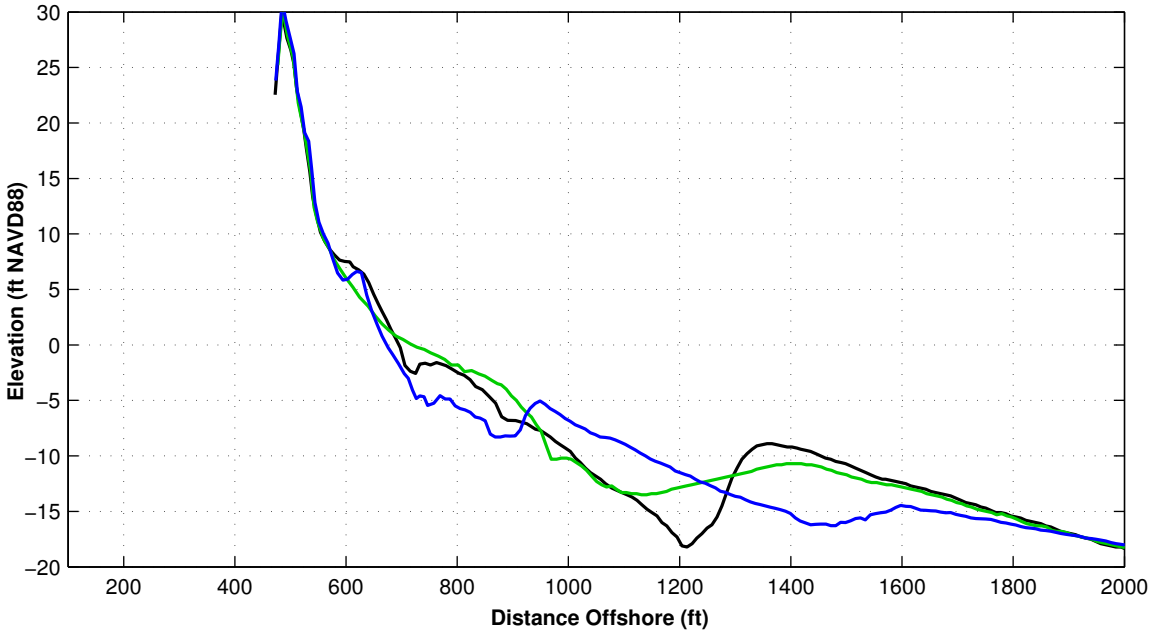
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 655+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 0.88 ft | 64.68 ft |
| Volume Change Above +6 ft NAVD88 | 0.40 cy/ft | 4.32 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.37 cy/ft | 9.50 cy/ft |
| Volume Change Above −6 ft NAVD88 | −12.21 cy/ft | 28.48 cy/ft |
| Volume Change Above −14 ft NAVD88 | −2.81 cy/ft | 51.32 cy/ft |
| Volume Change Above −19 ft NAVD88 | −0.75 cy/ft | 25.26 cy/ft |
| Volume Change Above −30 ft NAVD88 | 13.30 cy/ft | 1.63 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

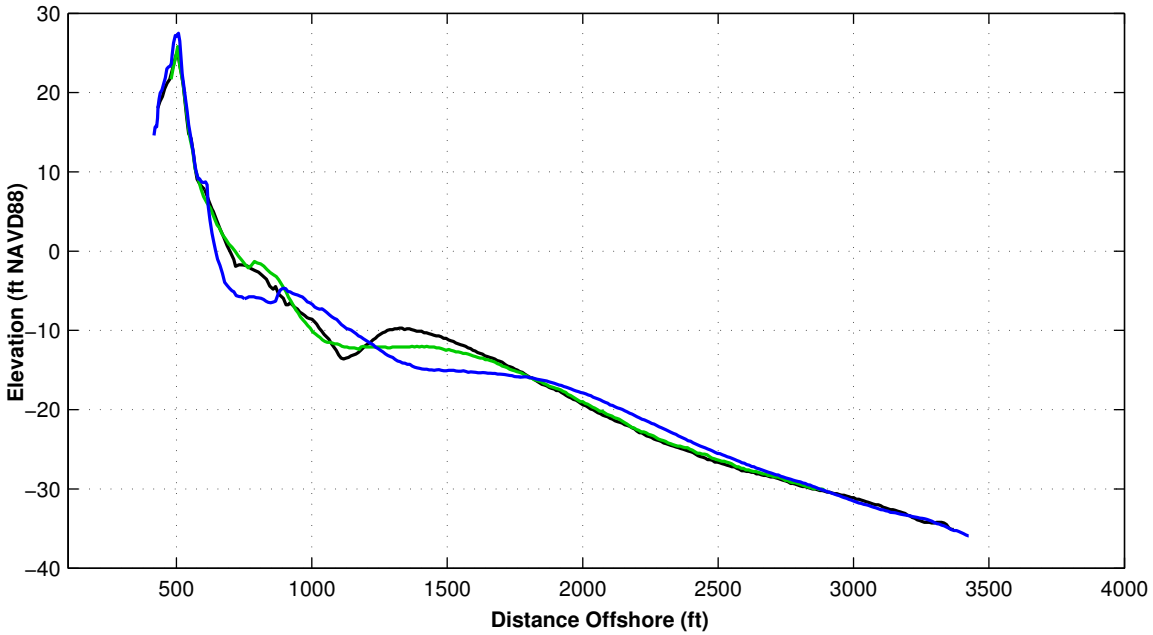
JUNE 2023

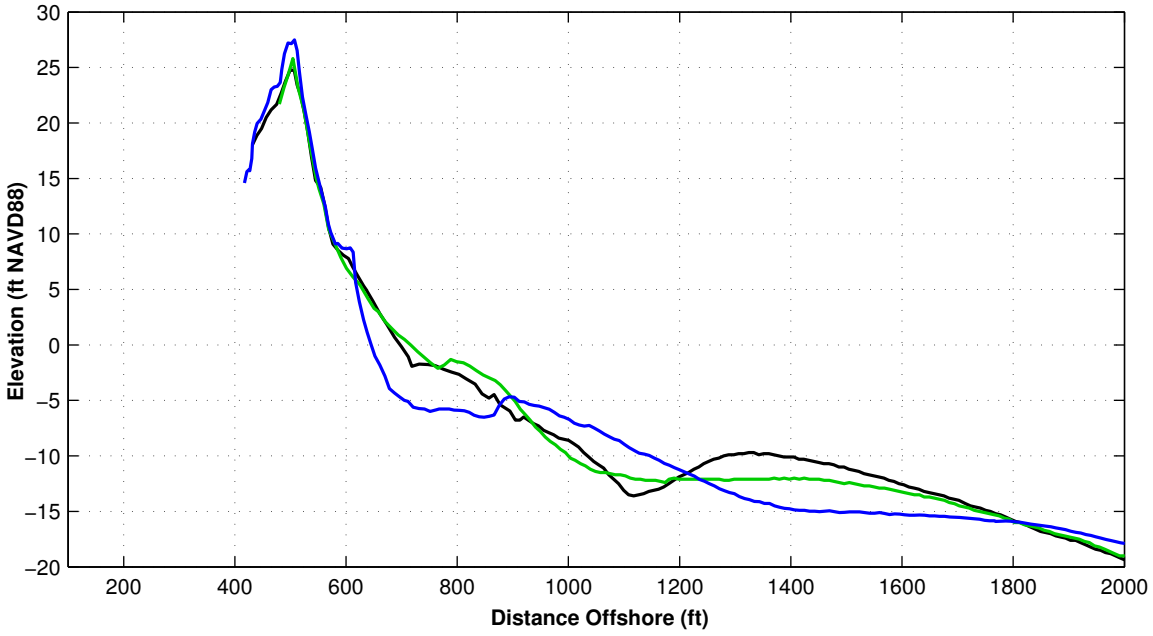
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 655+00 | Pg 89 of 173 | 2024 |
|---|---|---|




| Survey Transect 660+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | –15.48 ft | 51.91 ft |
| Volume Change Above +6 ft NAVD88 | 4.57 cy/ft | 2.46 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.37 cy/ft | 10.38 cy/ft |
| Volume Change Above –6 ft NAVD88 | –13.16 cy/ft | 22.85 cy/ft |
| Volume Change Above –14 ft NAVD88 | –38.87 cy/ft | 66.40 cy/ft |
| Volume Change Above –19 ft NAVD88 | –43.10 cy/ft | 38.83 cy/ft |
| Volume Change Above –30 ft NAVD88 | –27.72 cy/ft | 15.60 cy/ft |

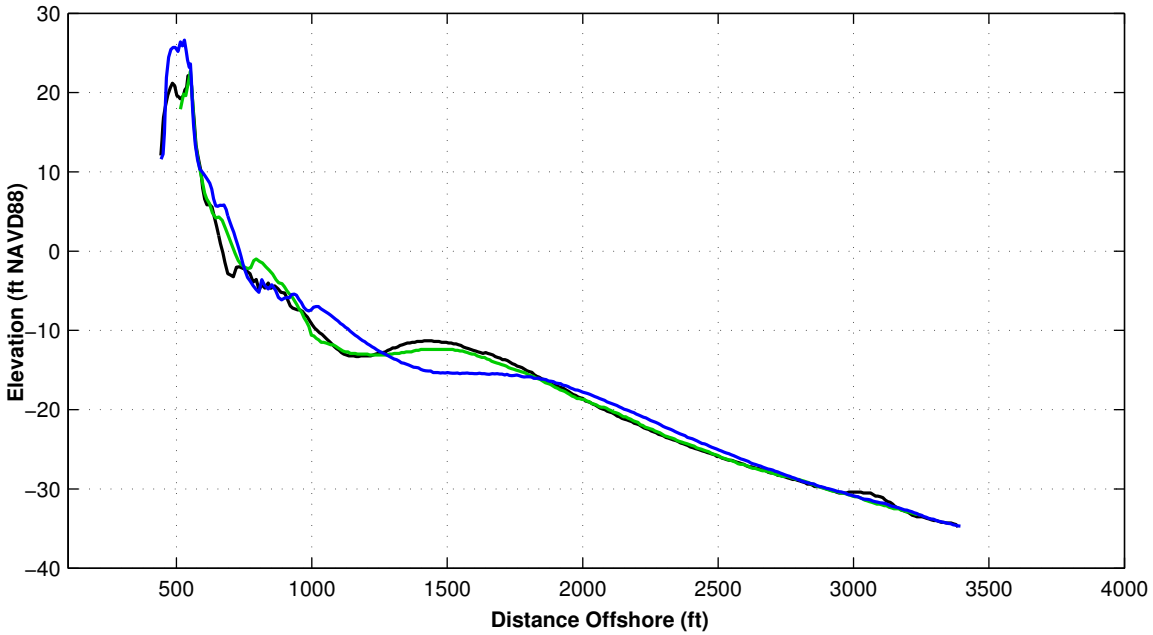
**LEGEND:**

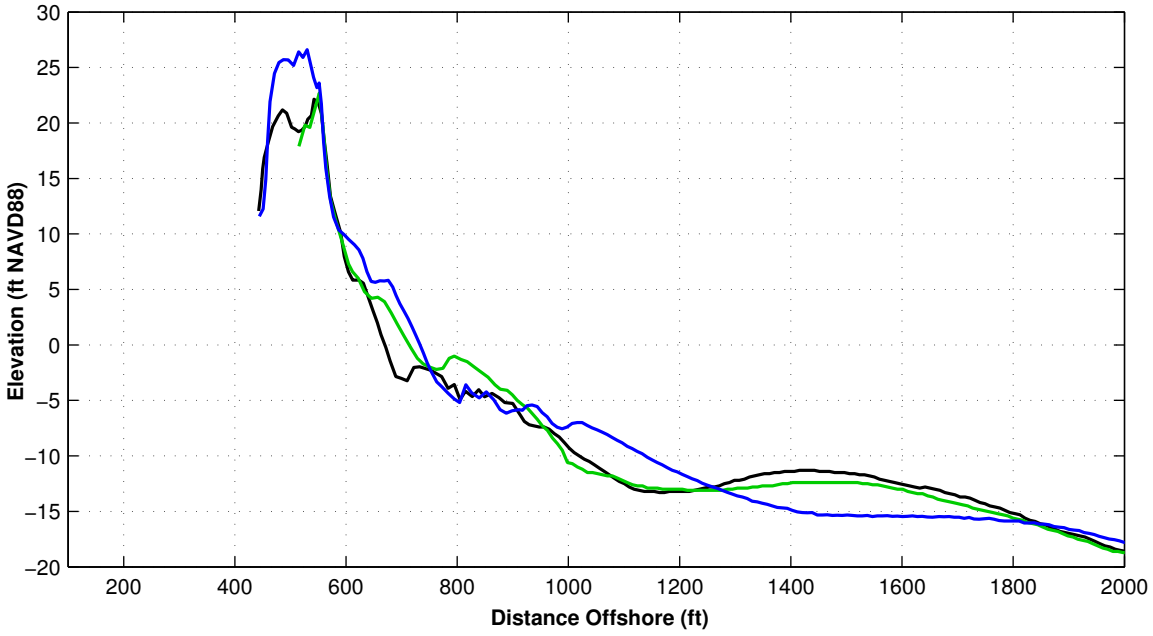
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 665+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −0.50 ft | 42.02 ft |
| Volume Change Above +6 ft NAVD88 | 3.43 cy/ft | −0.35 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.50 cy/ft | 6.53 cy/ft |
| Volume Change Above −6 ft NAVD88 | −11.07 cy/ft | 16.89 cy/ft |
| Volume Change Above −14 ft NAVD88 | −16.14 cy/ft | 66.70 cy/ft |
| Volume Change Above −19 ft NAVD88 | −19.16 cy/ft | 42.37 cy/ft |
| Volume Change Above −30 ft NAVD88 | −1.64 cy/ft | 17.48 cy/ft |

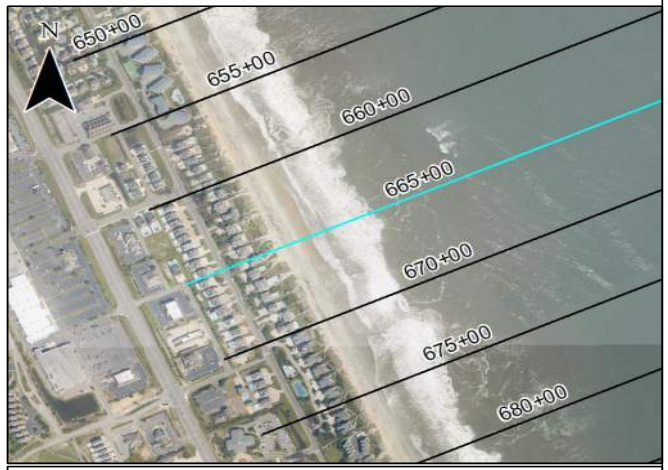
**LEGEND:**

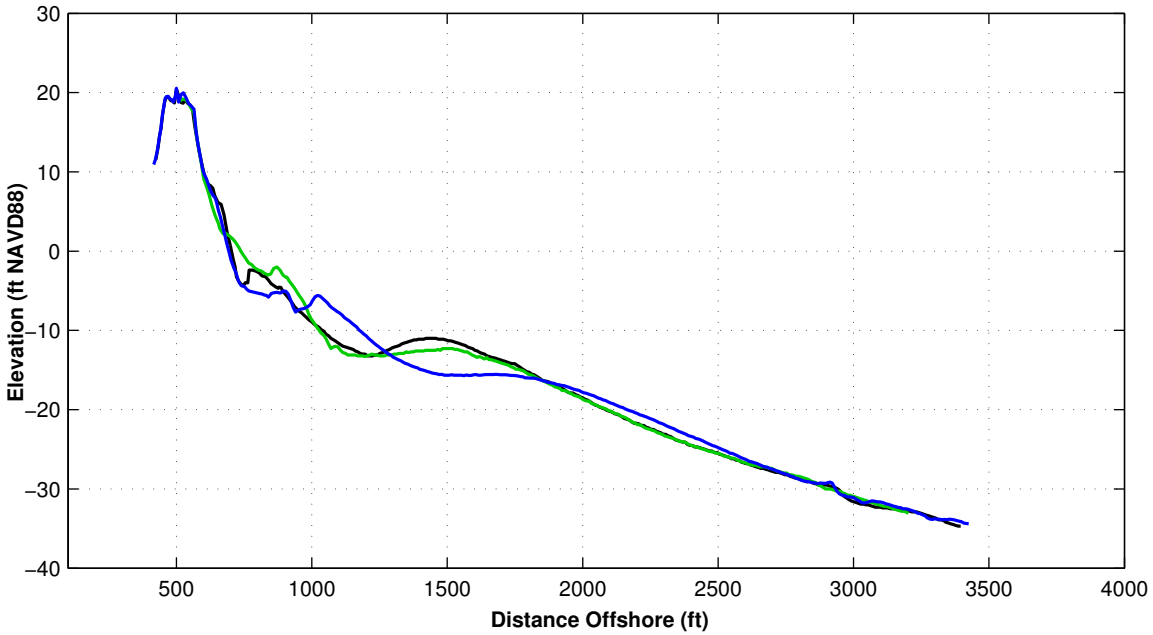
JUNE 2024 — OCTOBER 2023

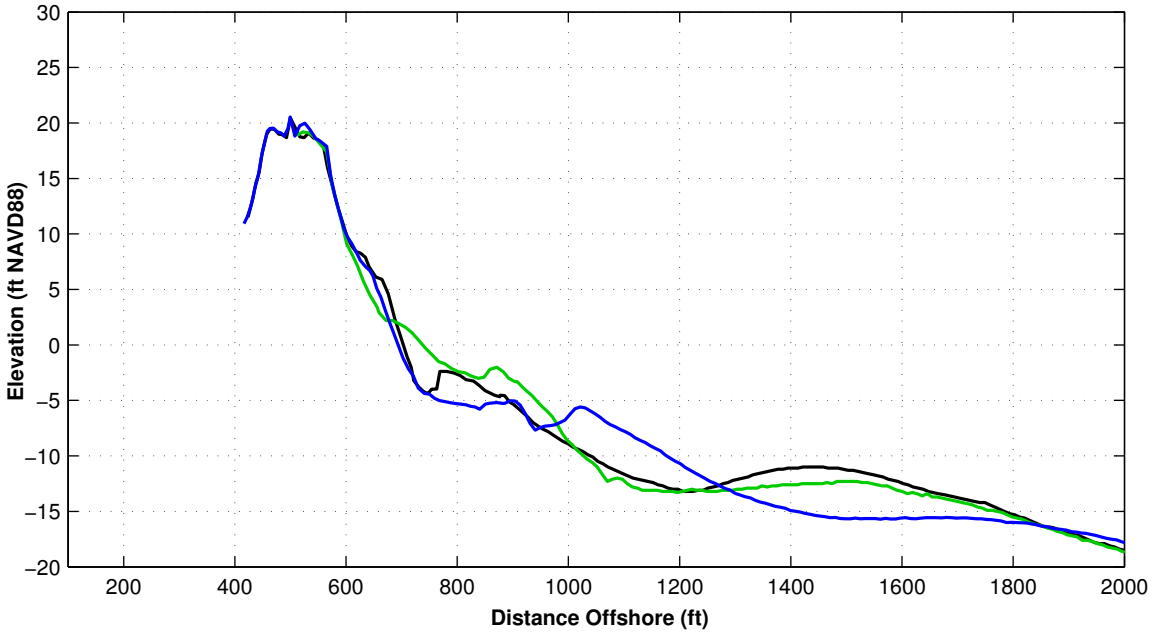
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 670+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 46.20 ft | 3.42 ft |
| Volume Change Above +6 ft NAVD88 | 4.61 cy/ft | 3.56 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.15 cy/ft | 6.07 cy/ft |
| Volume Change Above −6 ft NAVD88 | 1.29 cy/ft | 11.94 cy/ft |
| Volume Change Above −14 ft NAVD88 | −3.16 cy/ft | 59.33 cy/ft |
| Volume Change Above −19 ft NAVD88 | −1.21 cy/ft | 37.15 cy/ft |
| Volume Change Above −30 ft NAVD88 | 3.41 cy/ft | 24.79 cy/ft |

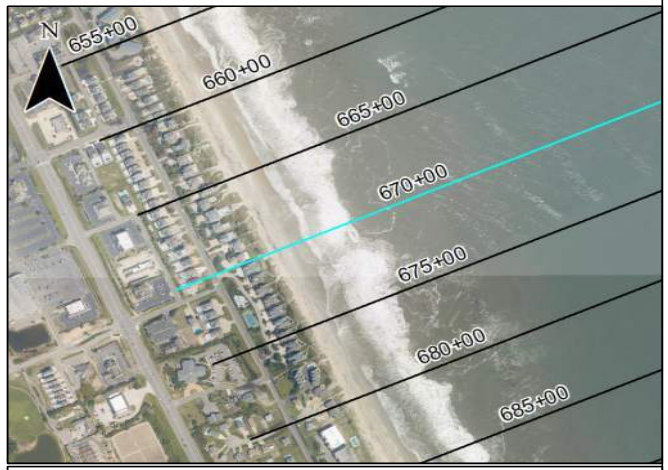
**LEGEND:**

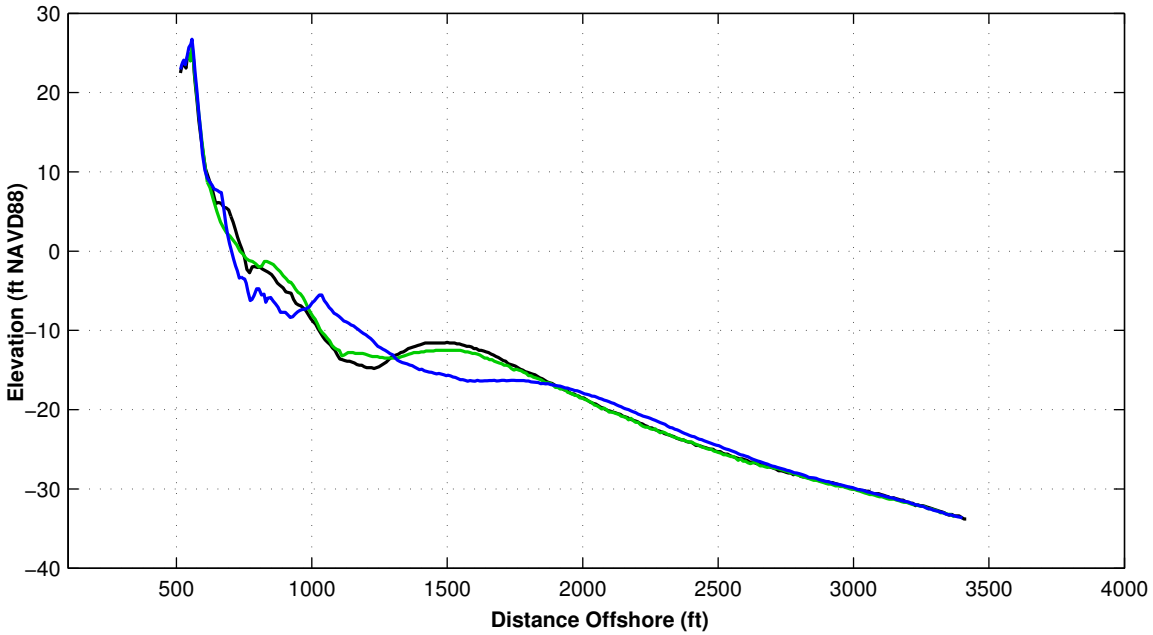
JUNE 2024 — OCTOBER 2023

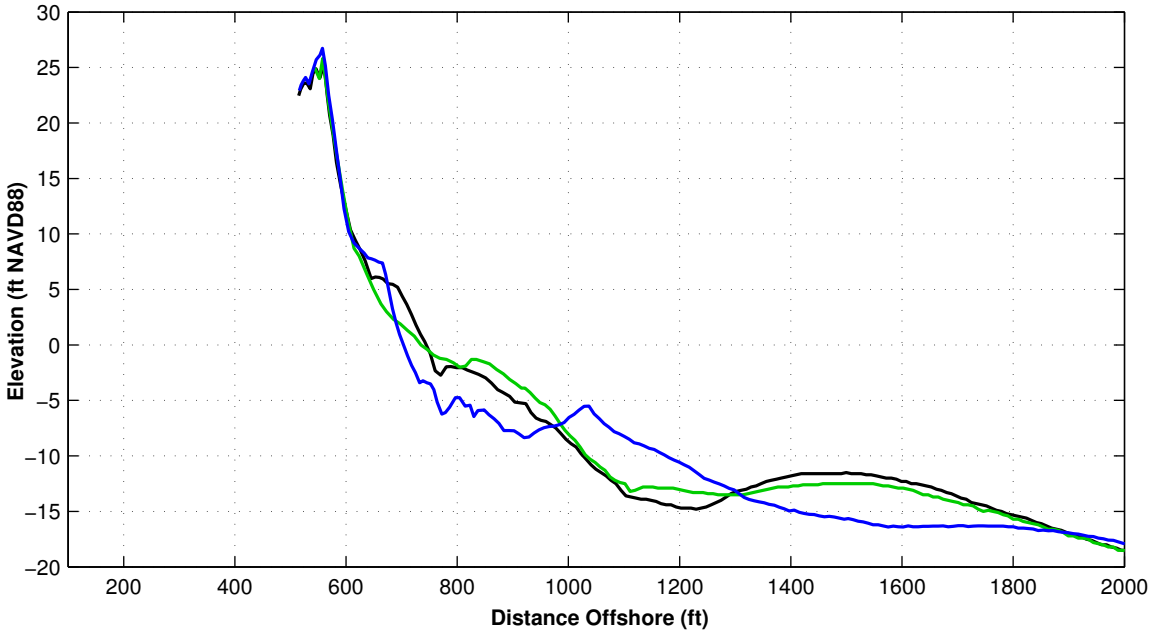
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 675+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 1.87 ft | 34.49 ft |
| Volume Change Above +6 ft NAVD88 | 5.12 cy/ft | 1.36 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 8.88 cy/ft | 6.94 cy/ft |
| Volume Change Above −6 ft NAVD88 | −10.47 cy/ft | 18.25 cy/ft |
| Volume Change Above −14 ft NAVD88 | −17.62 cy/ft | 69.62 cy/ft |
| Volume Change Above −19 ft NAVD88 | −19.92 cy/ft | 46.82 cy/ft |
| Volume Change Above −30 ft NAVD88 | −7.43 cy/ft | 28.00 cy/ft |

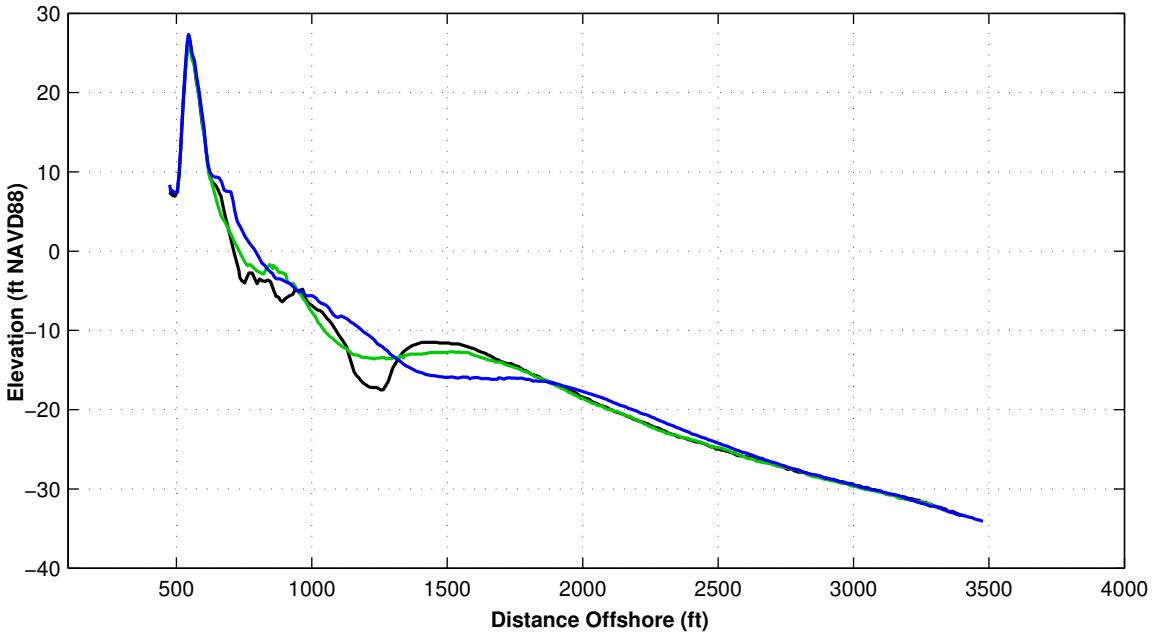
**LEGEND:**

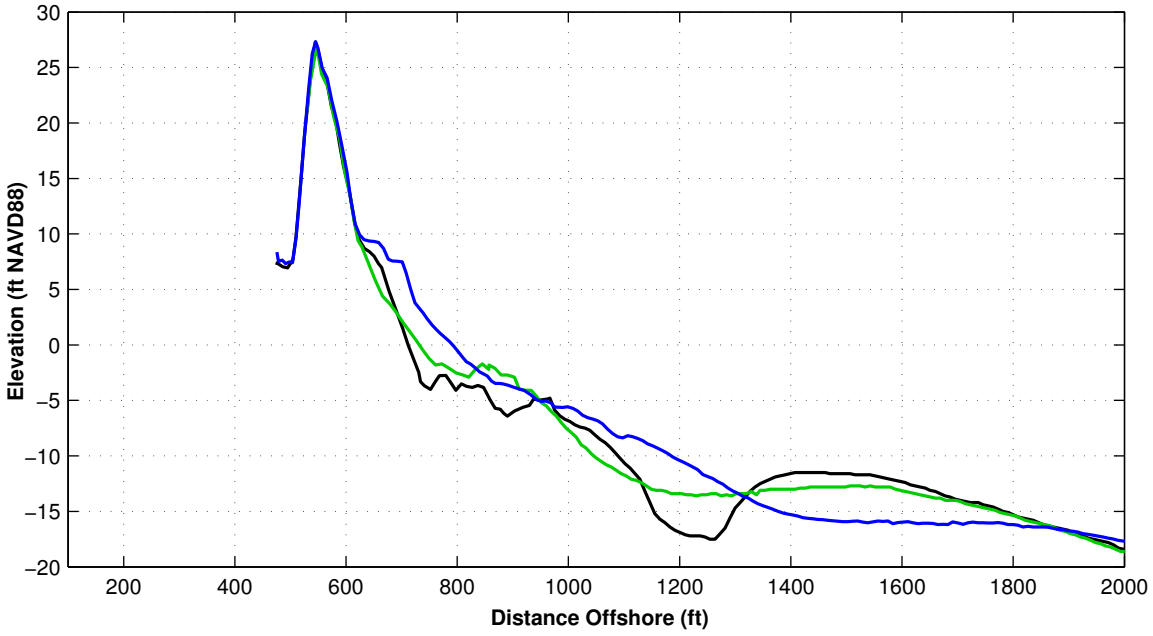
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 680+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −0.27 ft | 33.35 ft |
| Volume Change Above +6 ft NAVD88 | 2.87 cy/ft | −1.46 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.43 cy/ft | 1.65 cy/ft |
| Volume Change Above −6 ft NAVD88 | −15.73 cy/ft | 17.24 cy/ft |
| Volume Change Above −14 ft NAVD88 | −50.53 cy/ft | 83.74 cy/ft |
| Volume Change Above −19 ft NAVD88 | −52.14 cy/ft | 61.43 cy/ft |
| Volume Change Above −30 ft NAVD88 | −42.75 cy/ft | 40.17 cy/ft |

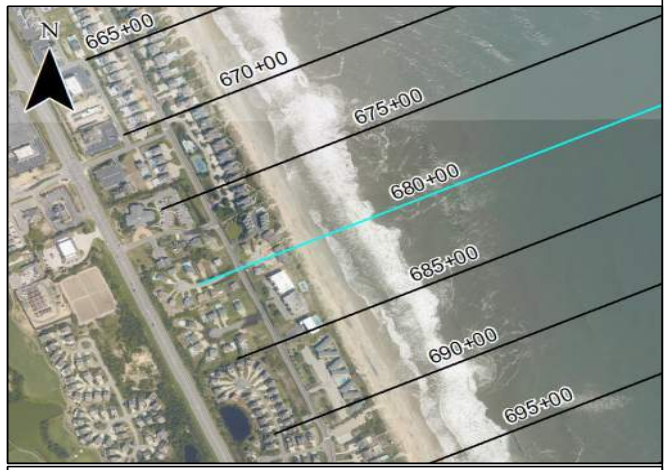
**LEGEND:**

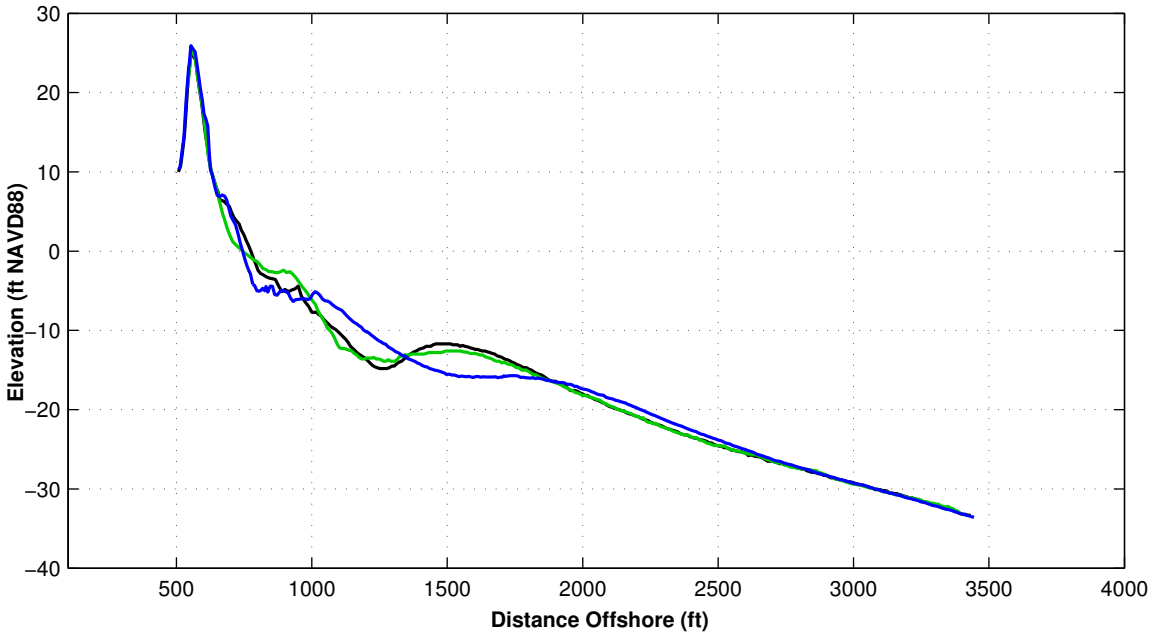
JUNE 2024 — OCTOBER 2023

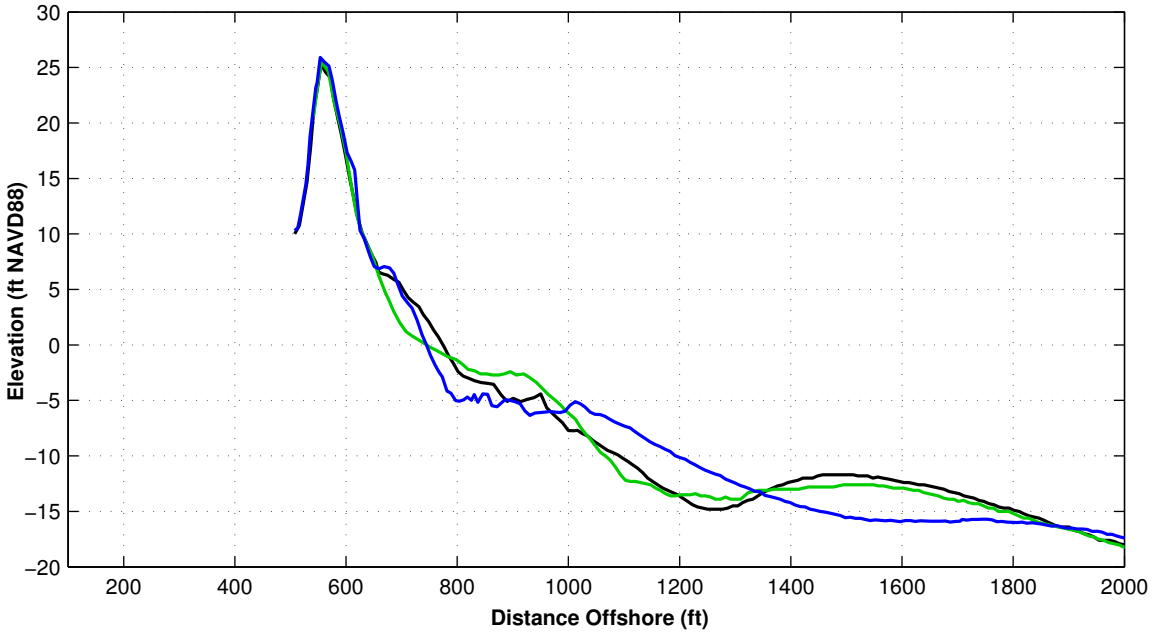
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 685+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 40.13 ft | –16.61 ft |
| Volume Change Above +6 ft NAVD88 | 3.85 cy/ft | 3.28 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.88 cy/ft | 5.11 cy/ft |
| Volume Change Above –6 ft NAVD88 | –0.55 cy/ft | 10.14 cy/ft |
| Volume Change Above –14 ft NAVD88 | –14.18 cy/ft | 68.75 cy/ft |
| Volume Change Above –19 ft NAVD88 | –17.70 cy/ft | 47.16 cy/ft |
| Volume Change Above –30 ft NAVD88 | –18.12 cy/ft | 24.73 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

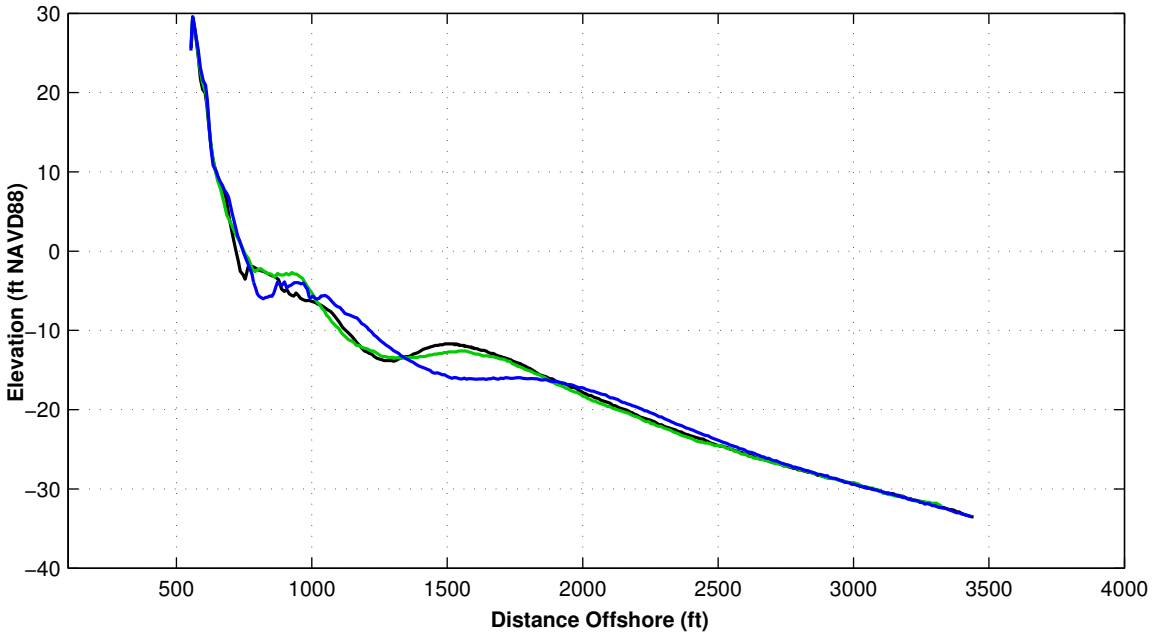
JUNE 2023

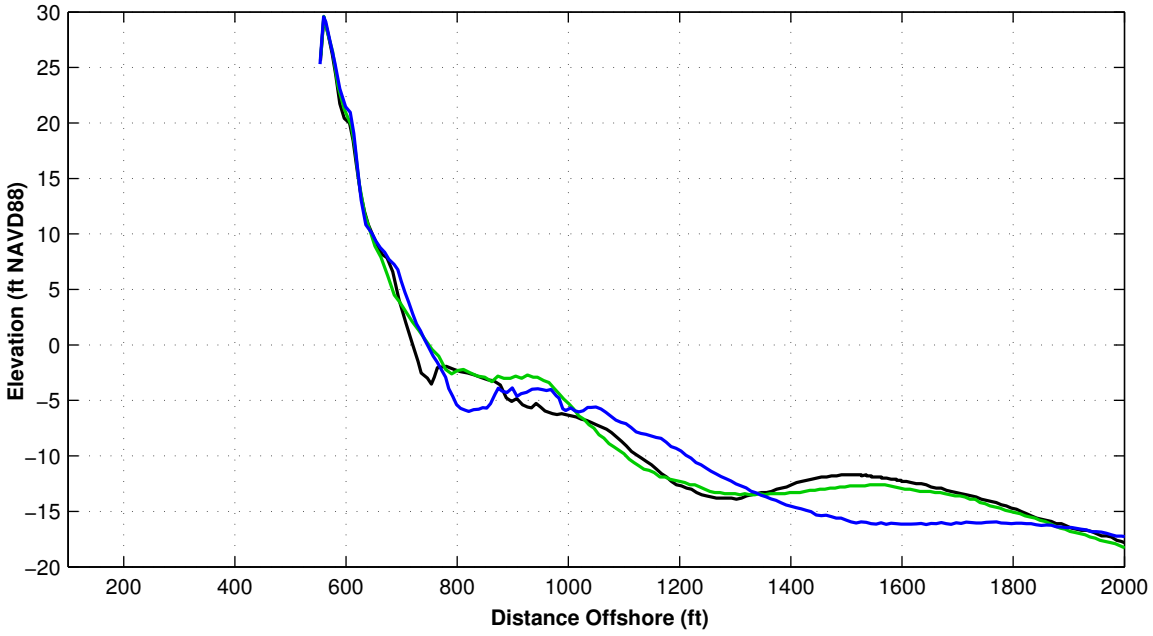
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 685+00 | Pg 95 of 173 | 2024 |
|---|---|---|




| Survey Transect 690+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 26.63 ft | 9.07 ft |
| Volume Change Above +6 ft NAVD88 | 4.55 cy/ft | 3.66 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.13 cy/ft | 6.51 cy/ft |
| Volume Change Above −6 ft NAVD88 | −6.23 cy/ft | 17.87 cy/ft |
| Volume Change Above −14 ft NAVD88 | −34.06 cy/ft | 66.03 cy/ft |
| Volume Change Above −19 ft NAVD88 | −39.61 cy/ft | 39.71 cy/ft |
| Volume Change Above −30 ft NAVD88 | −41.97 cy/ft | 18.29 cy/ft |

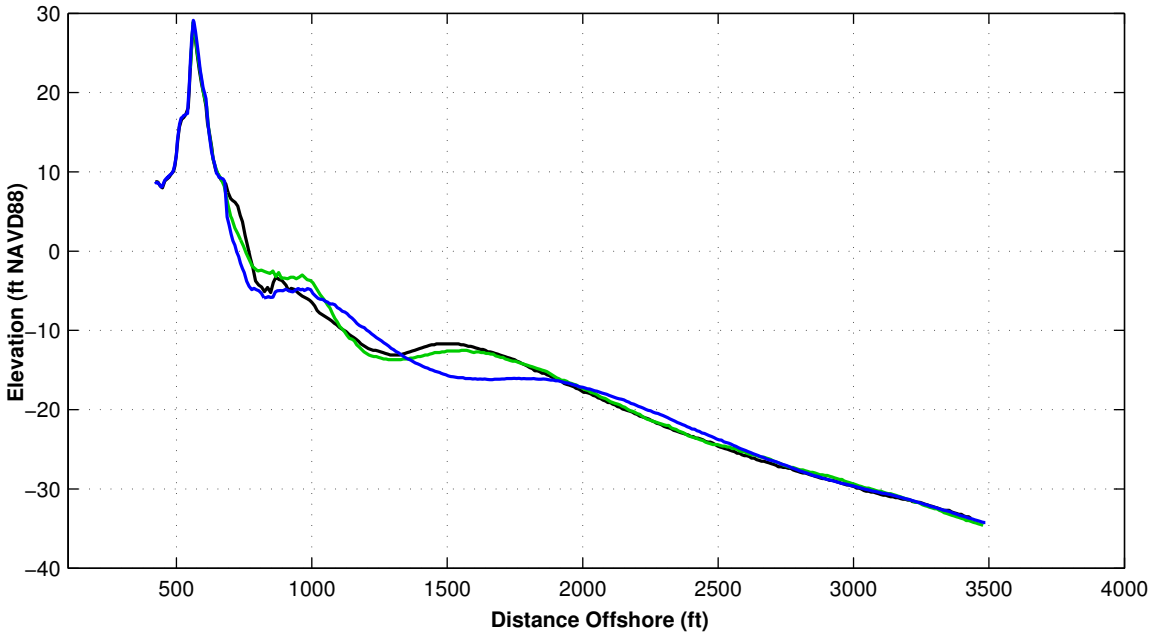
**LEGEND:**

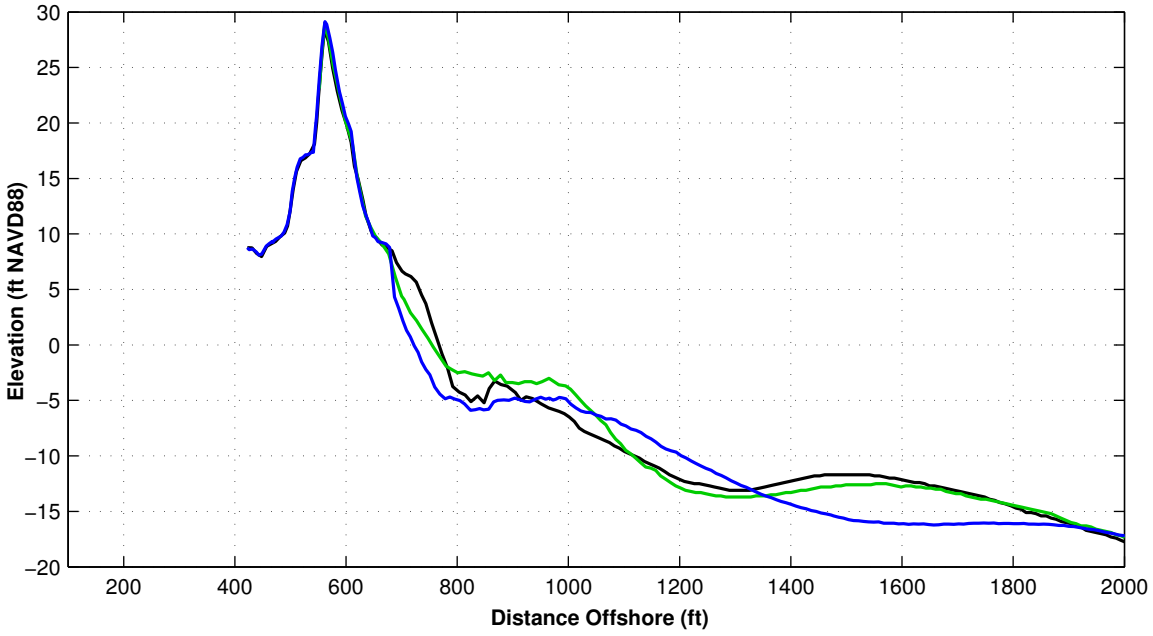
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 695+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 20.05 ft | 8.81 ft |
| Volume Change Above +6 ft NAVD88 | 0.48 cy/ft | 5.41 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 3.81 cy/ft | 8.30 cy/ft |
| Volume Change Above −6 ft NAVD88 | −13.08 cy/ft | 18.13 cy/ft |
| Volume Change Above −14 ft NAVD88 | −45.25 cy/ft | 76.47 cy/ft |
| Volume Change Above −19 ft NAVD88 | −48.49 cy/ft | 54.92 cy/ft |
| Volume Change Above −30 ft NAVD88 | −42.77 cy/ft | 26.12 cy/ft |

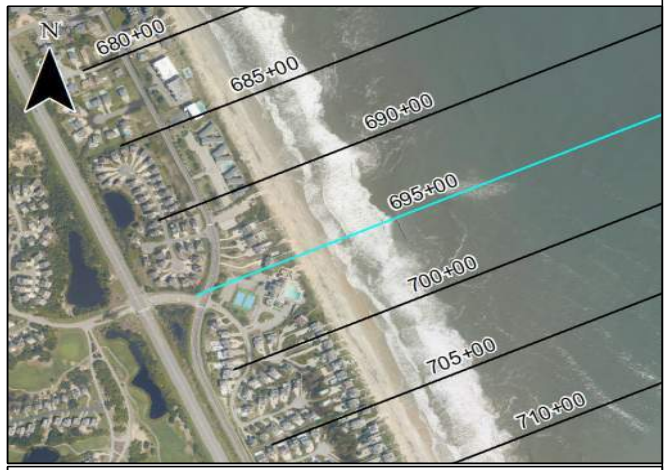
**LEGEND:**

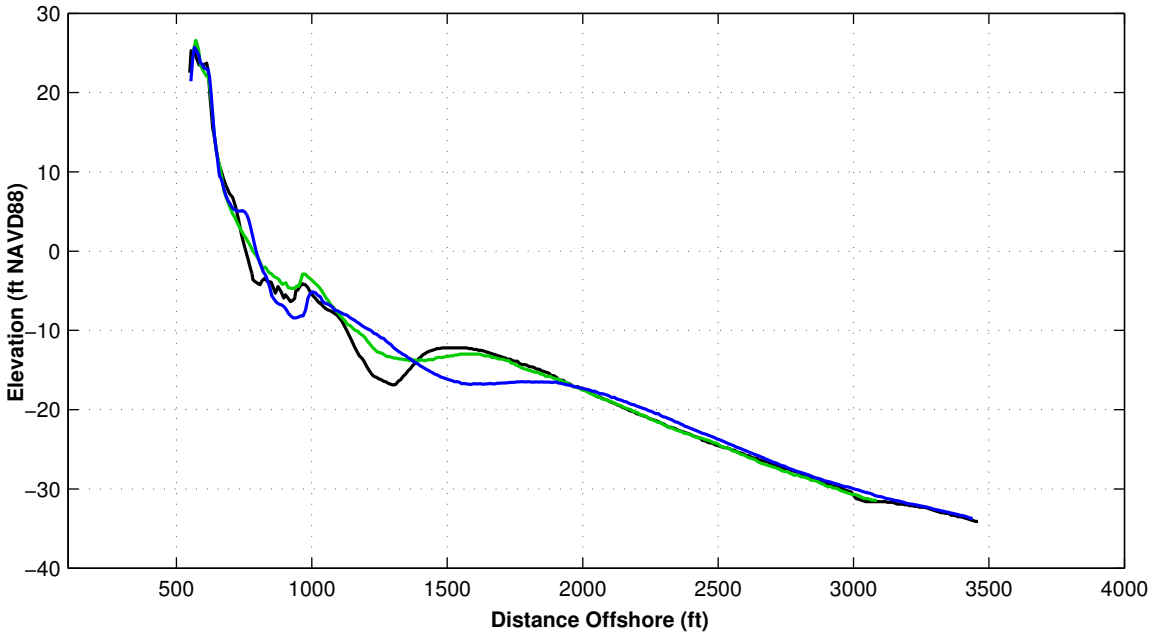
JUNE 2024 — OCTOBER 2023

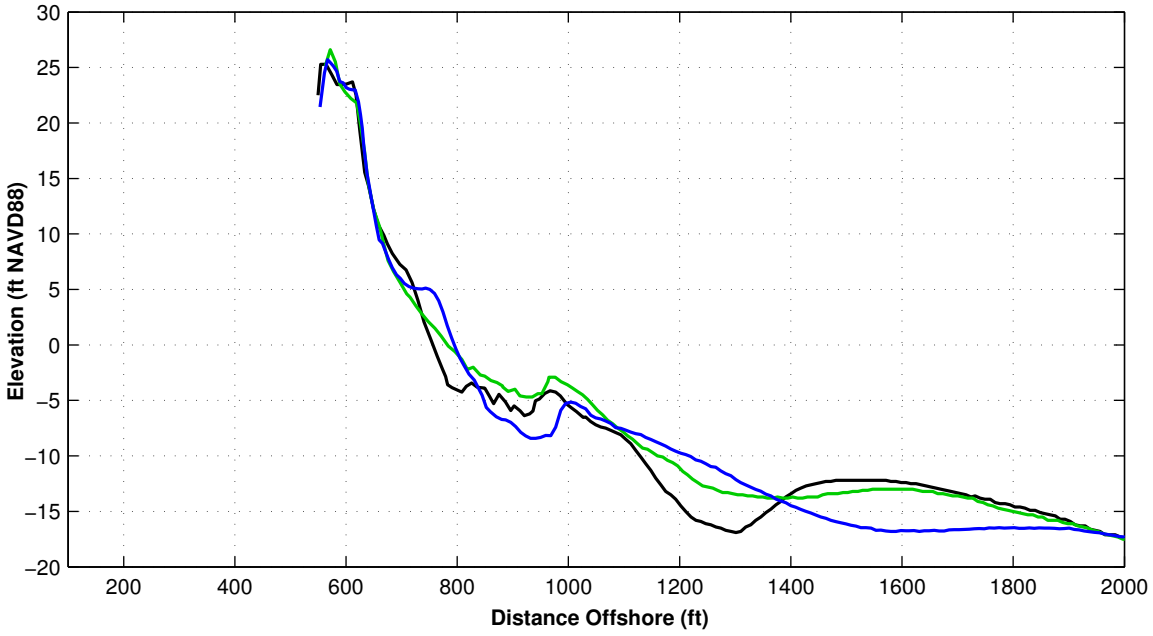
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 700+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −25.81 ft | 35.24 ft |
| Volume Change Above +6 ft NAVD88 | 4.83 cy/ft | 3.84 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.07 cy/ft | 9.85 cy/ft |
| Volume Change Above −6 ft NAVD88 | −28.92 cy/ft | 27.91 cy/ft |
| Volume Change Above −14 ft NAVD88 | −67.08 cy/ft | 101.52 cy/ft |
| Volume Change Above −19 ft NAVD88 | −65.94 cy/ft | 81.93 cy/ft |
| Volume Change Above −30 ft NAVD88 | −55.09 cy/ft | 48.33 cy/ft |

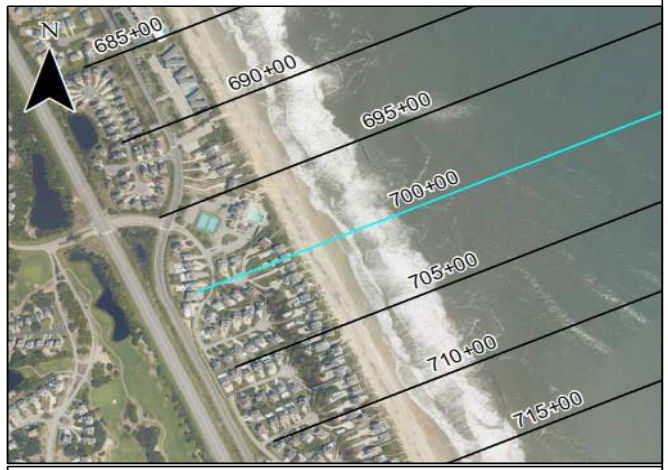
**LEGEND:**

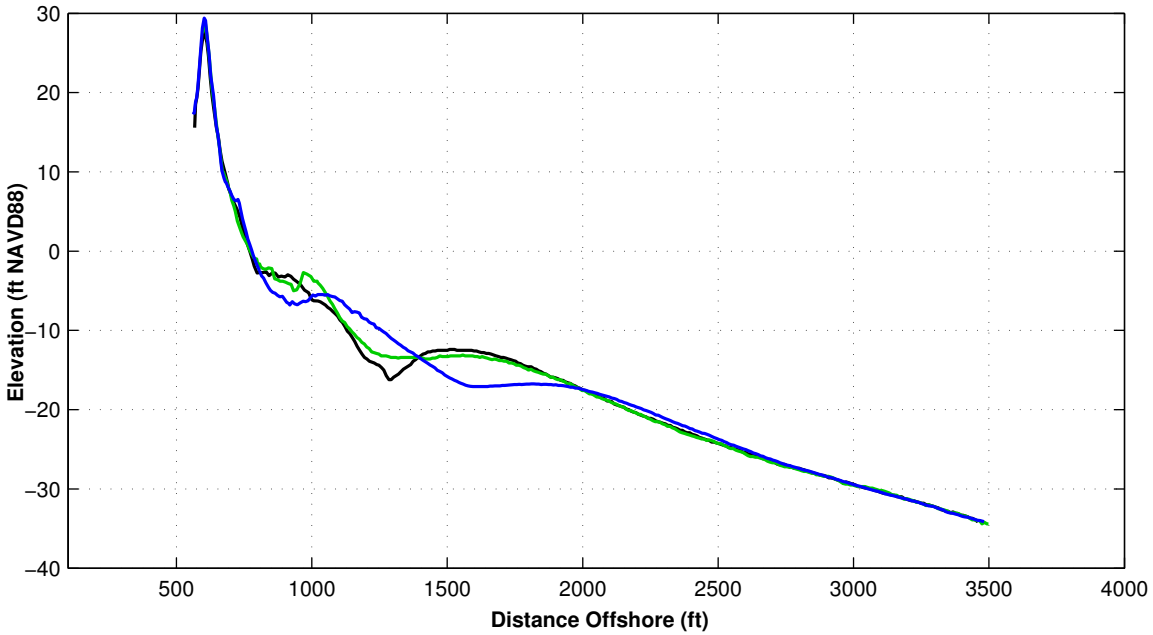
JUNE 2024 — OCTOBER 2023

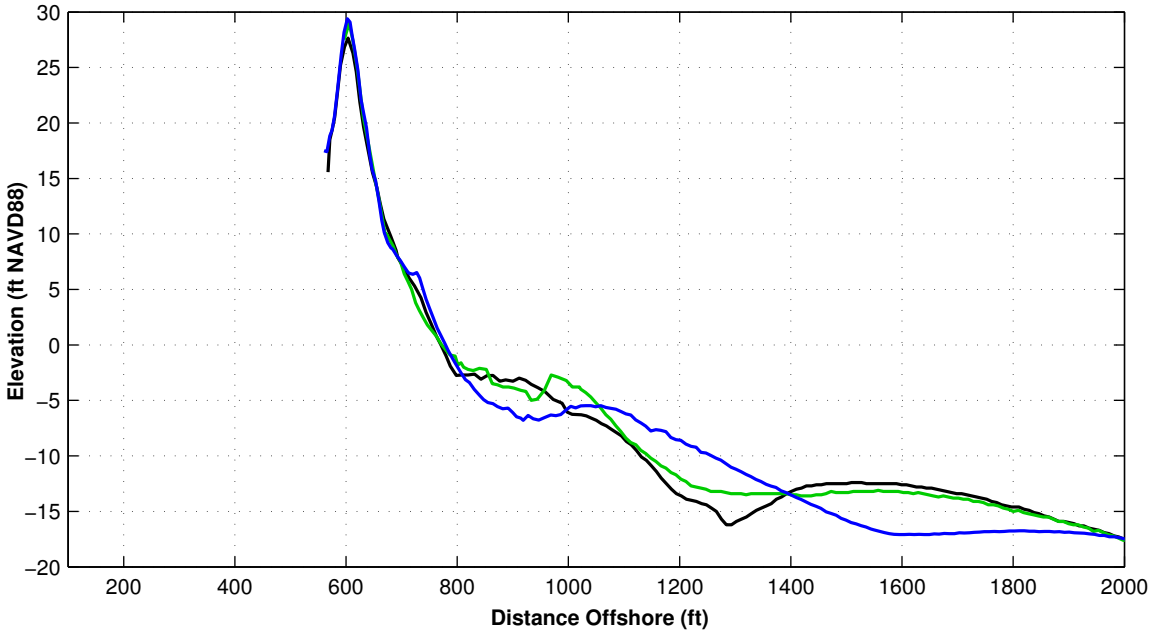
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 705+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 7.48 ft | 36.11 ft |
| Volume Change Above +6 ft NAVD88 | 2.92 cy/ft | 5.74 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.75 cy/ft | 13.98 cy/ft |
| Volume Change Above –6 ft NAVD88 | –11.80 cy/ft | 25.82 cy/ft |
| Volume Change Above –14 ft NAVD88 | –39.06 cy/ft | 89.84 cy/ft |
| Volume Change Above –19 ft NAVD88 | –40.51 cy/ft | 100.96 cy/ft |
| Volume Change Above –30 ft NAVD88 | –28.65 cy/ft | 82.58 cy/ft |

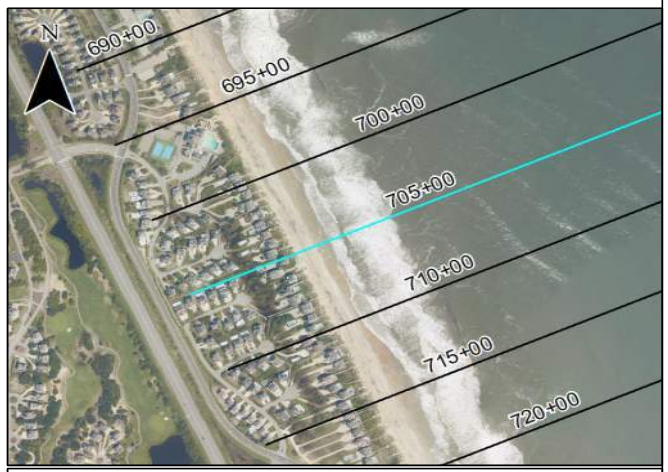
**LEGEND:**

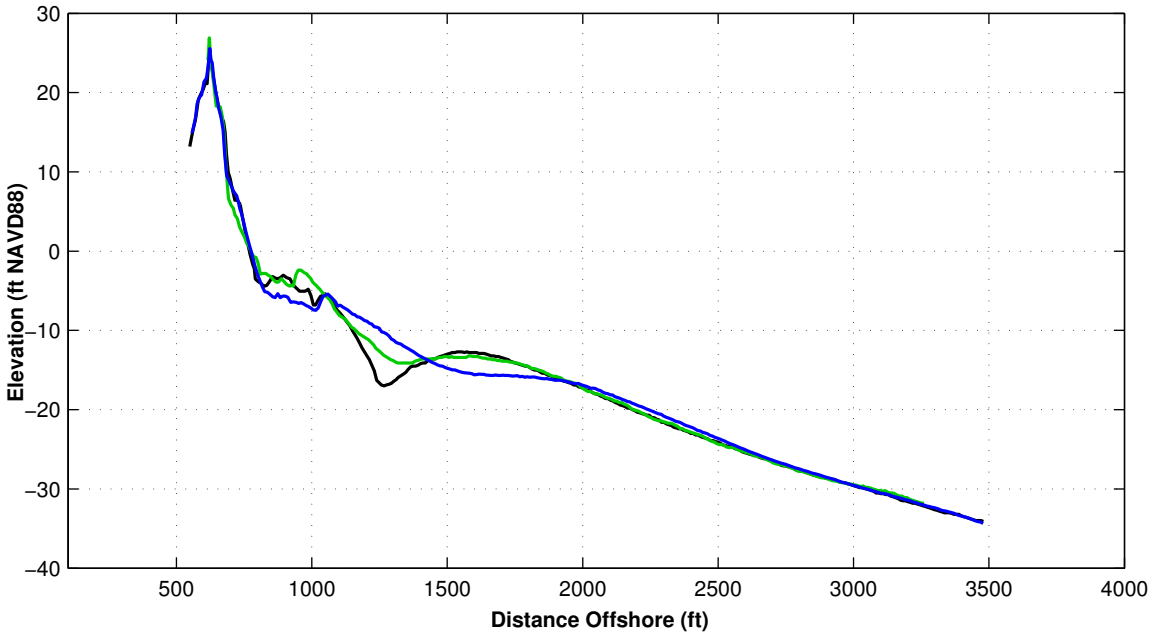
JUNE 2024 — OCTOBER 2023

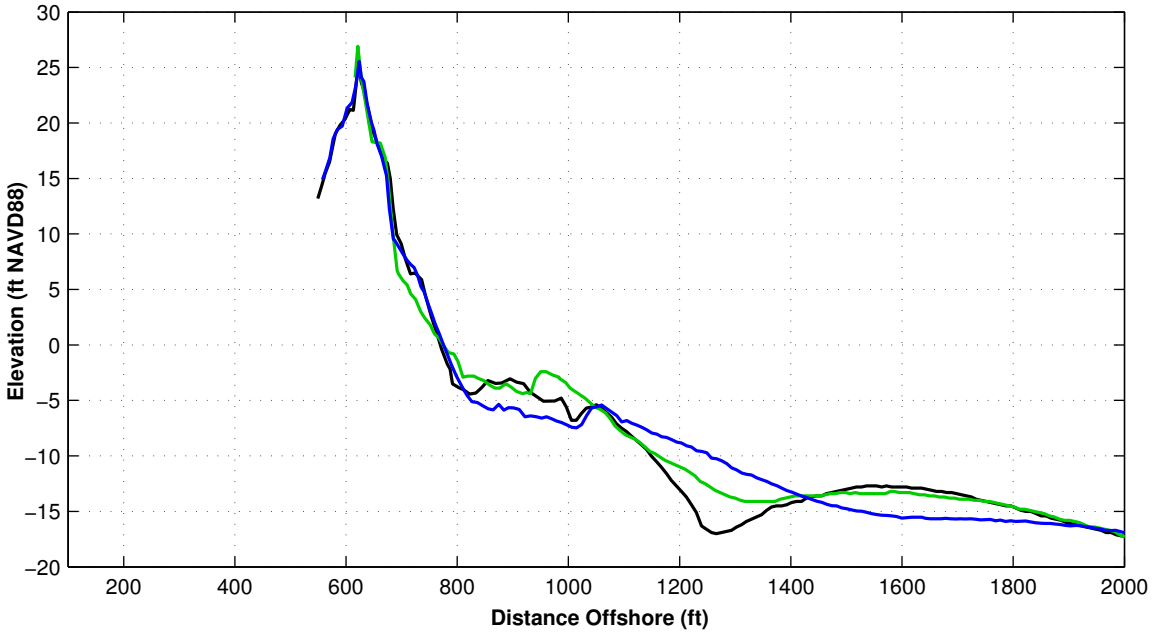
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 710+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −29.42 ft | 43.26 ft |
| Volume Change Above +6 ft NAVD88 | 5.38 cy/ft | 9.87 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.23 cy/ft | 21.82 cy/ft |
| Volume Change Above −6 ft NAVD88 | −21.43 cy/ft | 37.04 cy/ft |
| Volume Change Above −14 ft NAVD88 | −27.79 cy/ft | 93.40 cy/ft |
| Volume Change Above −19 ft NAVD88 | −4.57 cy/ft | 43.34 cy/ft |
| Volume Change Above −30 ft NAVD88 | −2.97 cy/ft | 14.81 cy/ft |

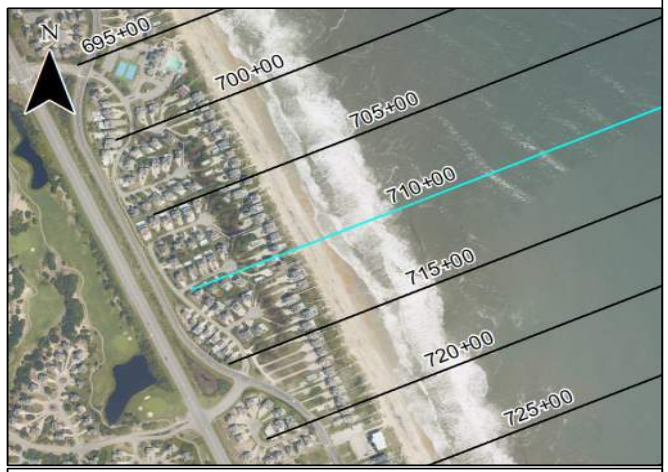
**LEGEND:**

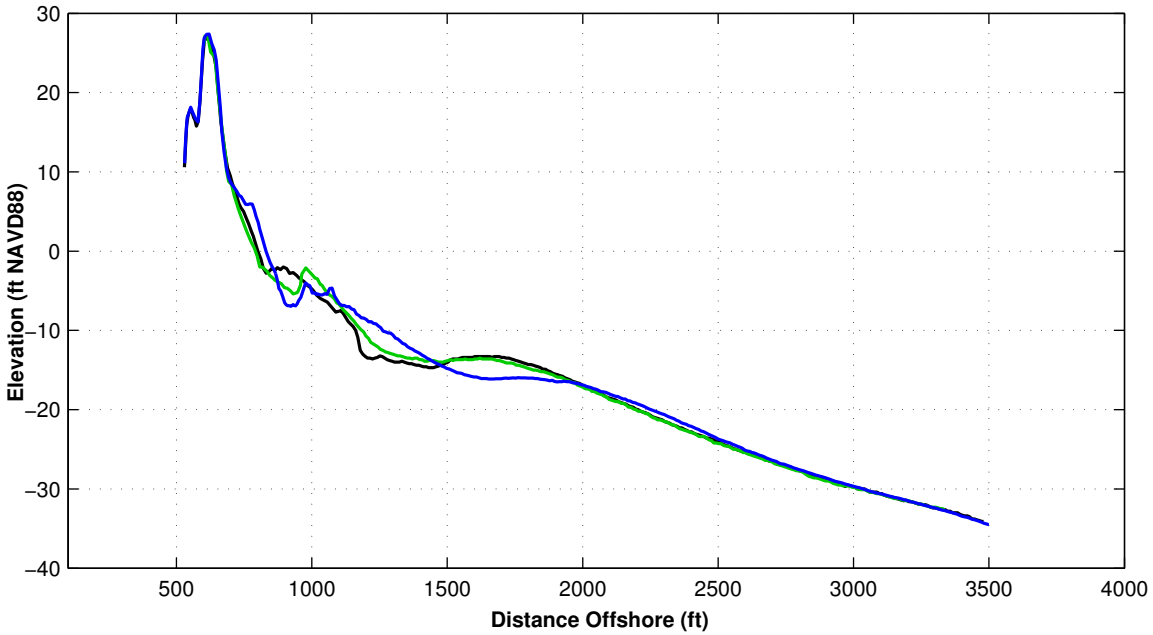
JUNE 2024 — OCTOBER 2023

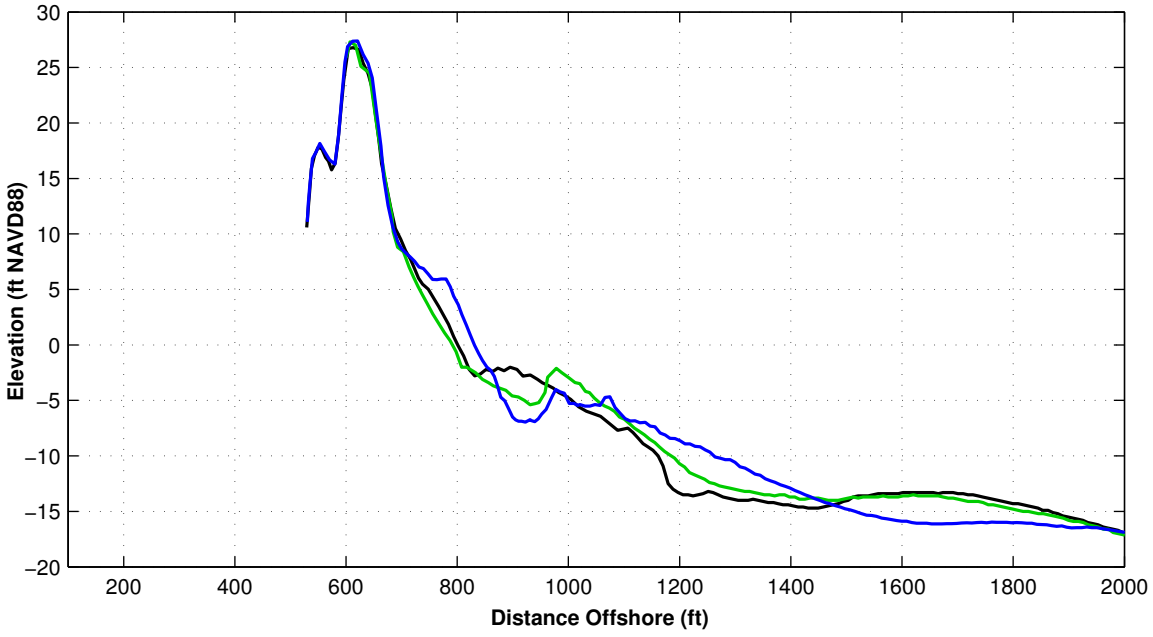
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 715+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −4.09 ft | 31.77 ft |
| Volume Change Above +6 ft NAVD88 | 5.27 cy/ft | 3.41 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.12 cy/ft | 11.53 cy/ft |
| Volume Change Above −6 ft NAVD88 | 1.43 cy/ft | 13.46 cy/ft |
| Volume Change Above −14 ft NAVD88 | −49.41 cy/ft | 77.89 cy/ft |
| Volume Change Above −19 ft NAVD88 | −52.94 cy/ft | 72.31 cy/ft |
| Volume Change Above −30 ft NAVD88 | −51.56 cy/ft | 52.33 cy/ft |

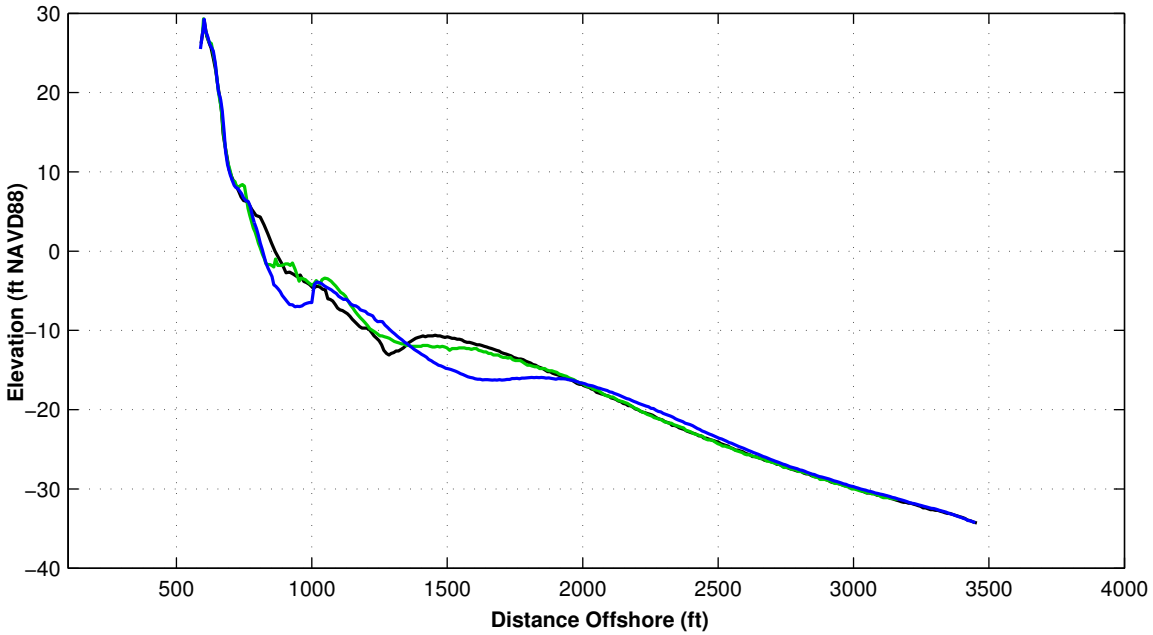
**LEGEND:**

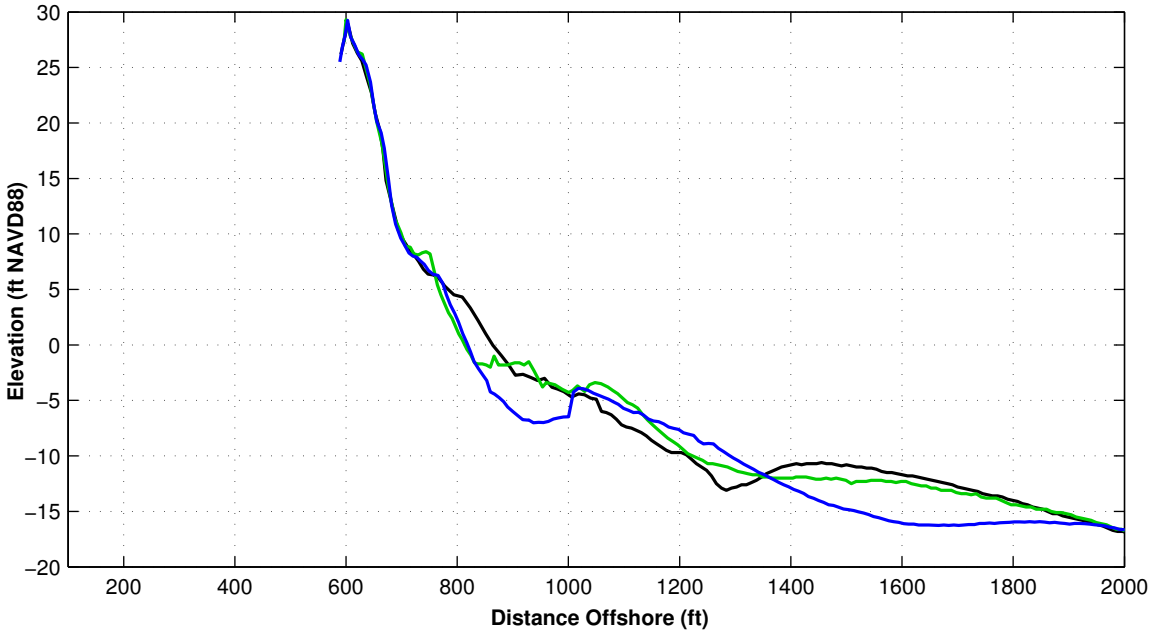
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 720+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −16.64 ft | 27.33 ft |
| Volume Change Above +6 ft NAVD88 | −0.17 cy/ft | 7.68 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −5.17 cy/ft | 16.77 cy/ft |
| Volume Change Above −6 ft NAVD88 | −28.58 cy/ft | 30.27 cy/ft |
| Volume Change Above −14 ft NAVD88 | −92.24 cy/ft | 100.43 cy/ft |
| Volume Change Above −19 ft NAVD88 | −113.63 cy/ft | 86.85 cy/ft |
| Volume Change Above −30 ft NAVD88 | −114.19 cy/ft | 52.18 cy/ft |

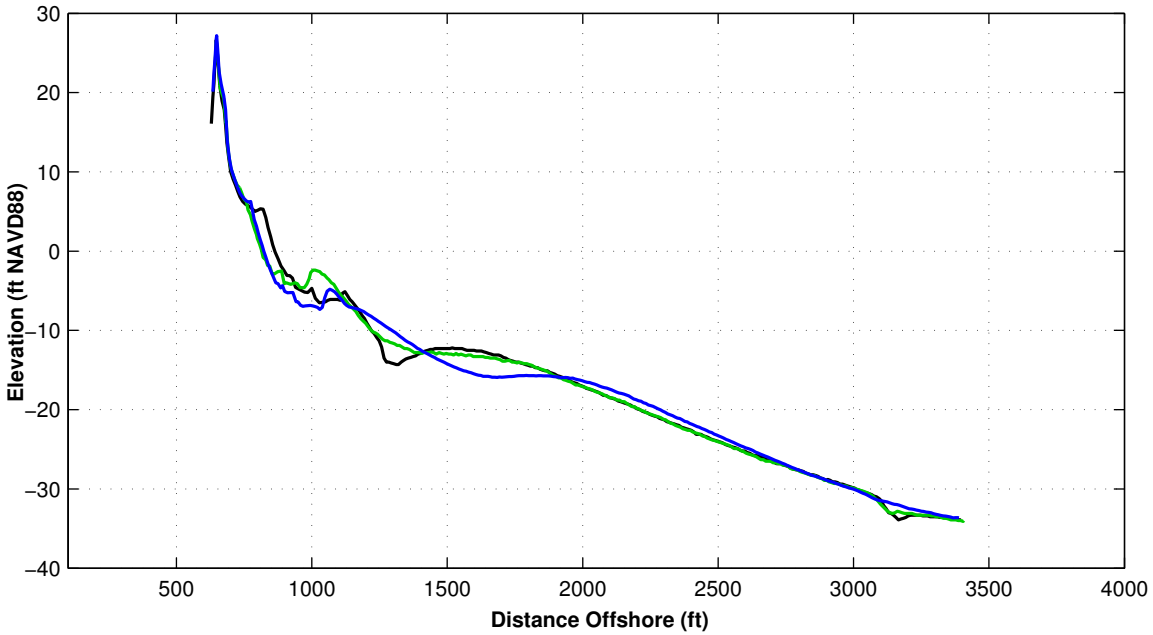
**LEGEND:**

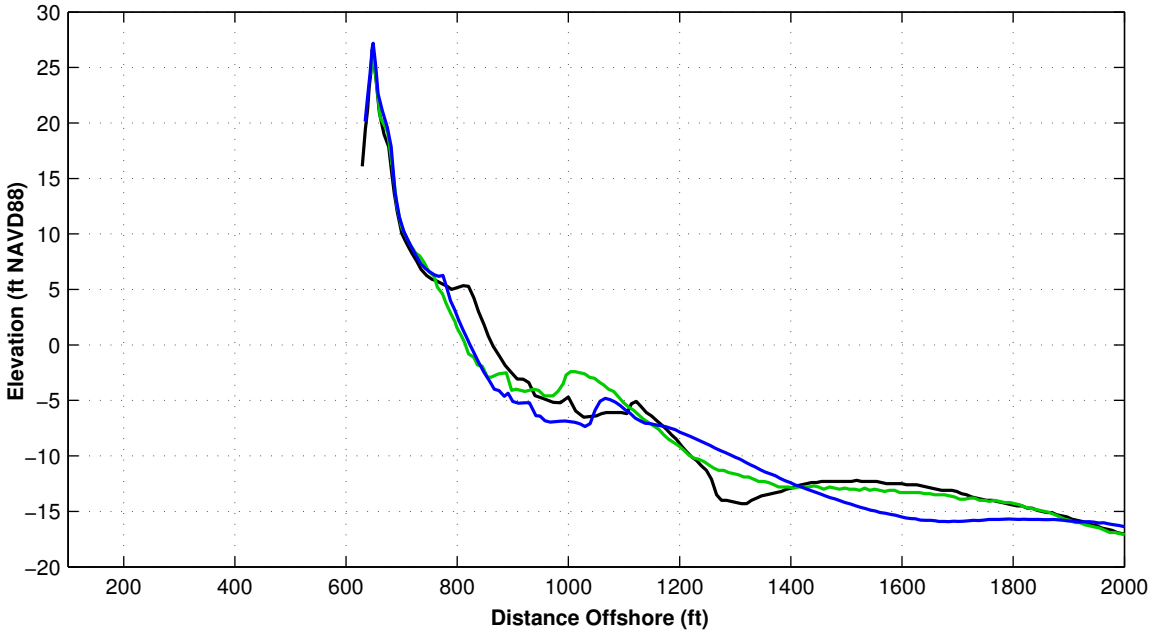
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.



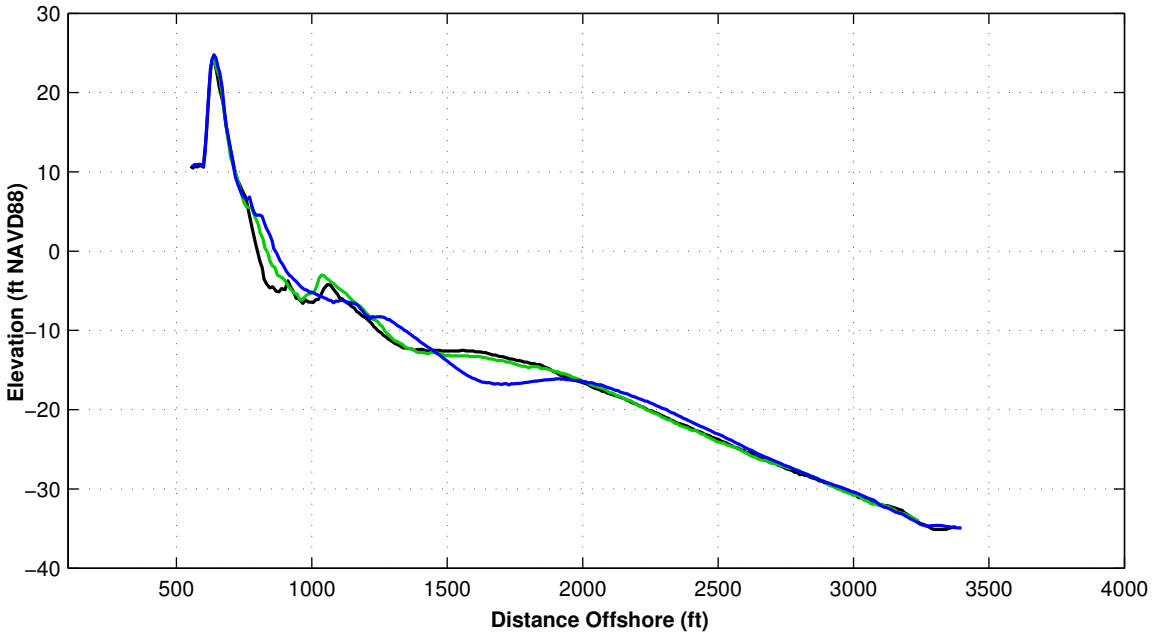

| Survey Transect 725+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −50.98 ft | 37.48 ft |
| Volume Change Above +6 ft NAVD88 | 1.68 cy/ft | 8.15 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −7.48 cy/ft | 19.13 cy/ft |
| Volume Change Above −6 ft NAVD88 | −24.34 cy/ft | 22.00 cy/ft |
| Volume Change Above −14 ft NAVD88 | −64.35 cy/ft | 66.76 cy/ft |
| Volume Change Above −19 ft NAVD88 | −69.71 cy/ft | 33.74 cy/ft |
| Volume Change Above −30 ft NAVD88 | −72.48 cy/ft | −4.02 cy/ft |

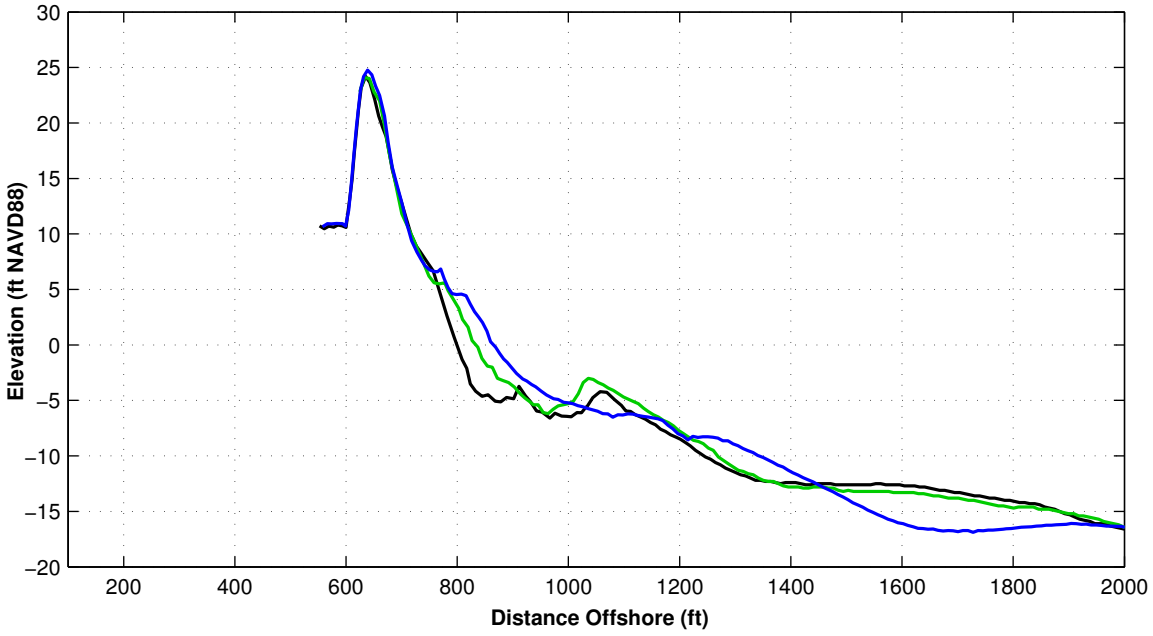
**LEGEND:**

JUNE 2024 — OCTOBER 2023 / JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 730+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −14.38 ft | 11.69 ft |
| Volume Change Above +6 ft NAVD88 | −3.96 cy/ft | 8.10 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −7.48 cy/ft | 12.68 cy/ft |
| Volume Change Above −6 ft NAVD88 | −14.86 cy/ft | 11.30 cy/ft |
| Volume Change Above −14 ft NAVD88 | −62.34 cy/ft | 59.51 cy/ft |
| Volume Change Above −19 ft NAVD88 | −61.09 cy/ft | 83.58 cy/ft |
| Volume Change Above −30 ft NAVD88 | −57.06 cy/ft | 64.57 cy/ft |

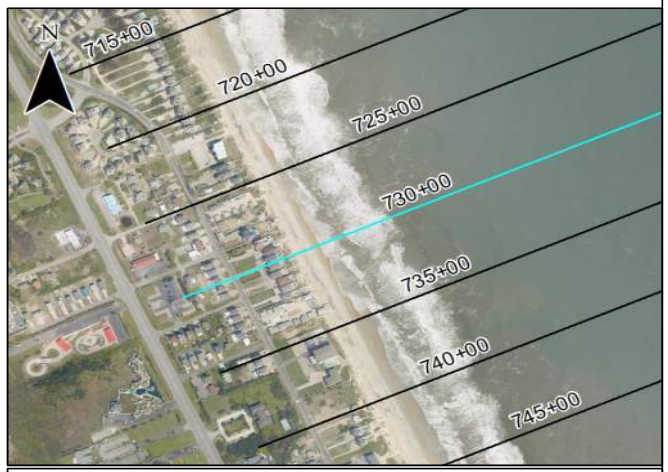
**LEGEND:**

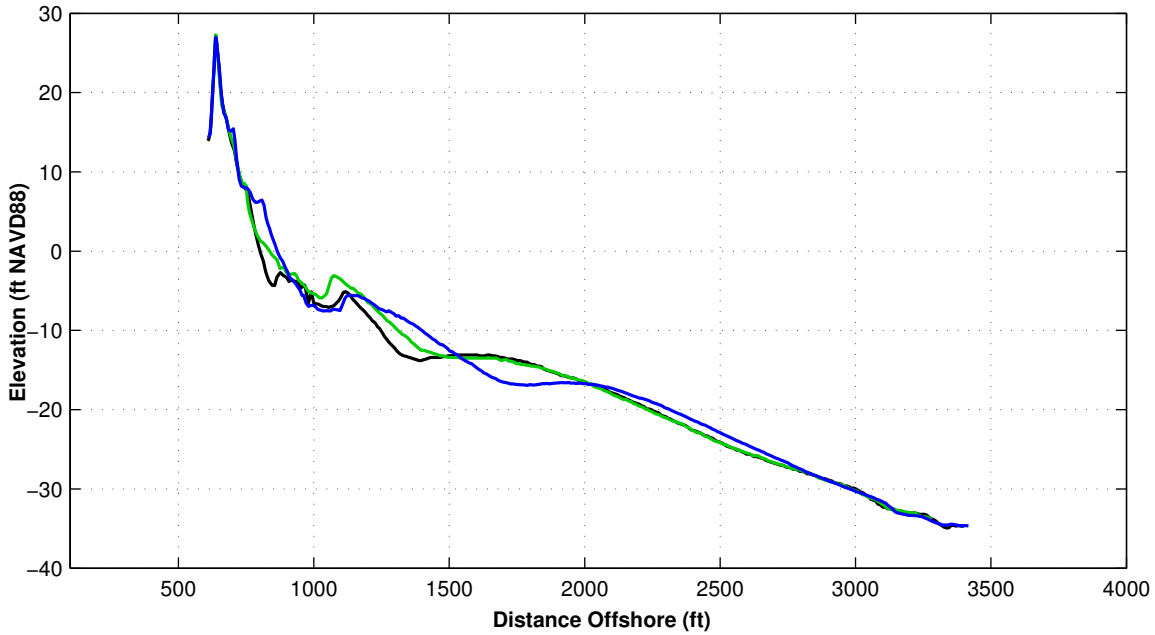
JUNE 2024 — OCTOBER 2023

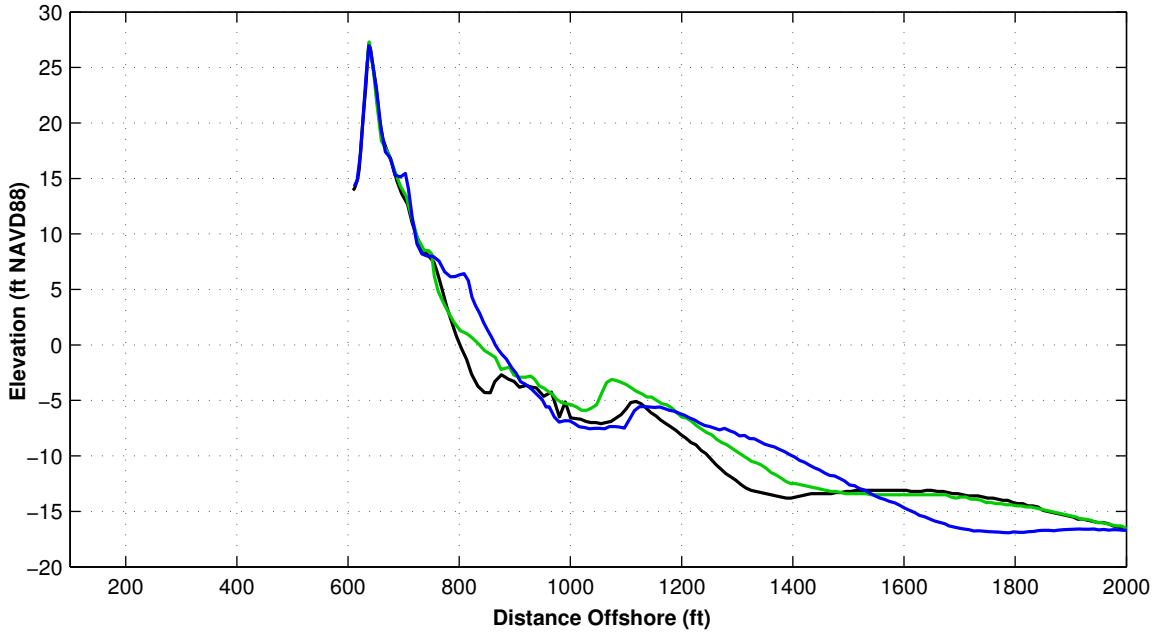
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 735+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −14.11 ft | −11.46 ft |
| Volume Change Above +6 ft NAVD88 | −0.25 cy/ft | 4.19 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −3.06 cy/ft | 5.56 cy/ft |
| Volume Change Above −6 ft NAVD88 | −11.80 cy/ft | 5.18 cy/ft |
| Volume Change Above −14 ft NAVD88 | −36.12 cy/ft | 35.36 cy/ft |
| Volume Change Above −19 ft NAVD88 | −28.99 cy/ft | 19.97 cy/ft |
| Volume Change Above −30 ft NAVD88 | −22.67 cy/ft | −3.85 cy/ft |

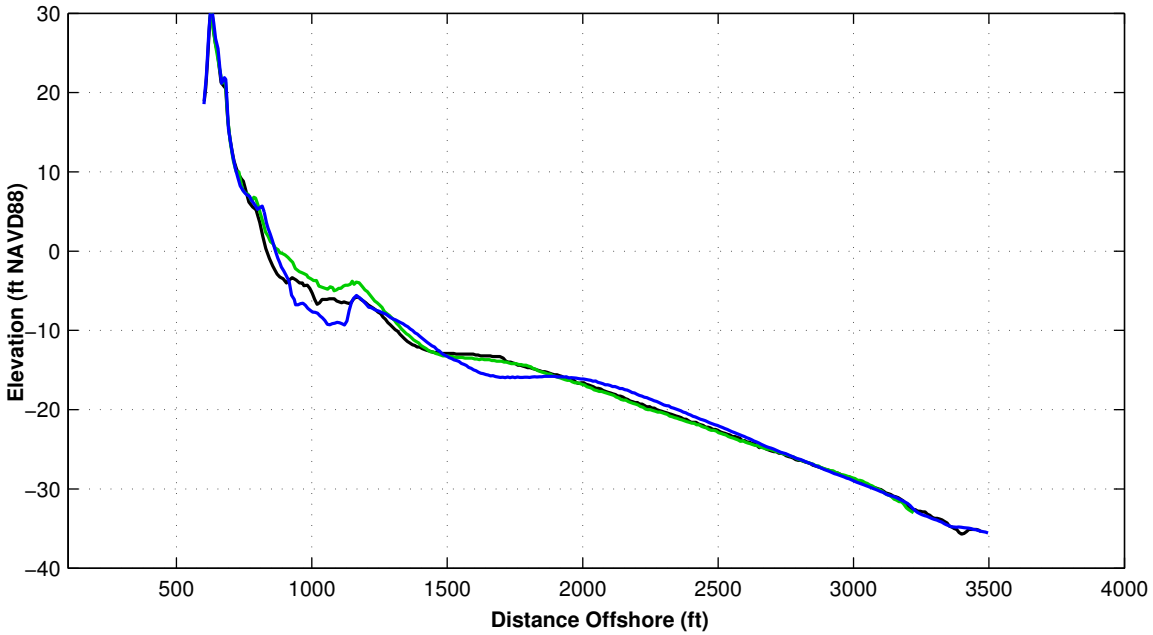
**LEGEND:**

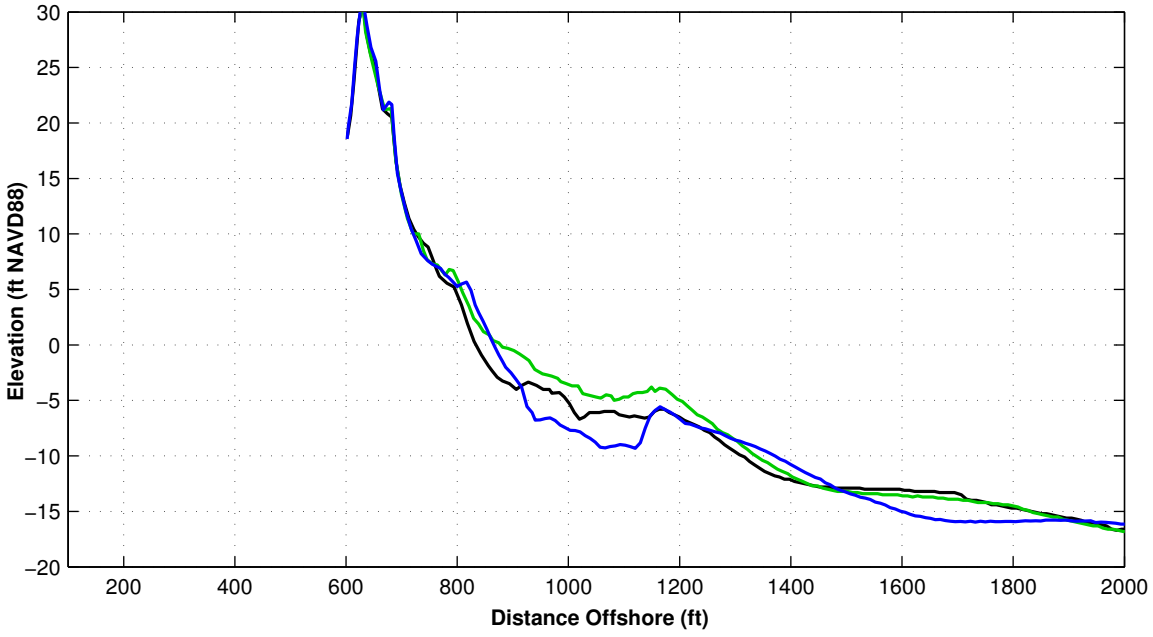
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 740+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −24.04 ft | 17.24 ft |
| Volume Change Above +6 ft NAVD88 | −2.28 cy/ft | 4.54 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −5.99 cy/ft | 9.48 cy/ft |
| Volume Change Above −6 ft NAVD88 | −14.90 cy/ft | 12.48 cy/ft |
| Volume Change Above −14 ft NAVD88 | −63.50 cy/ft | 58.51 cy/ft |
| Volume Change Above −19 ft NAVD88 | −67.47 cy/ft | 61.68 cy/ft |
| Volume Change Above −30 ft NAVD88 | −62.74 cy/ft | 41.15 cy/ft |

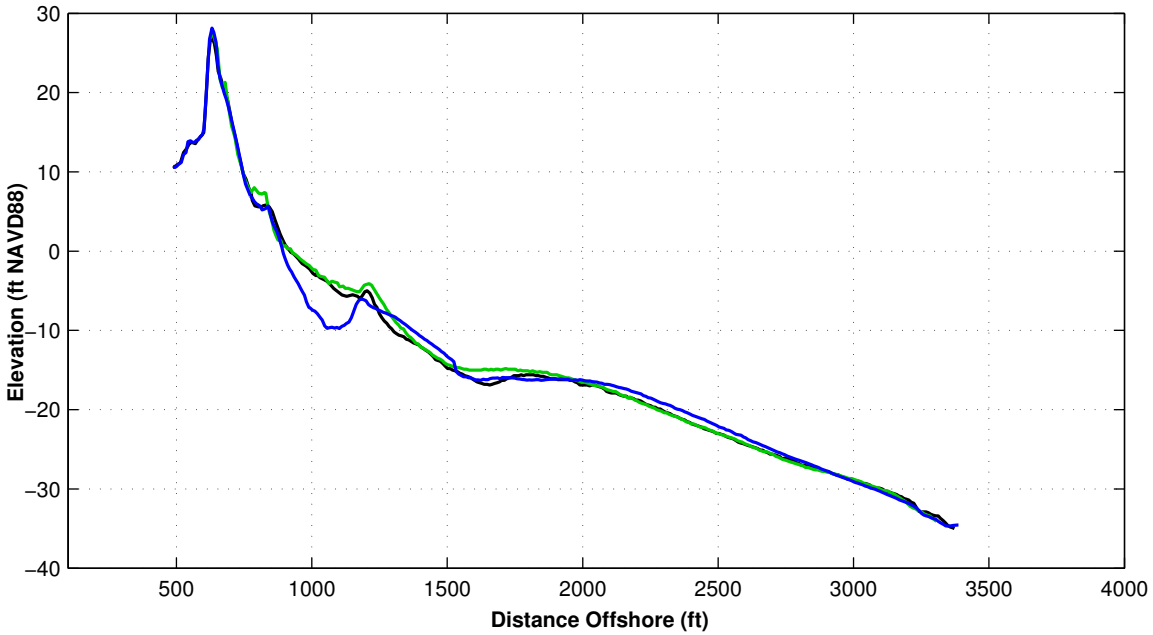
**LEGEND:**

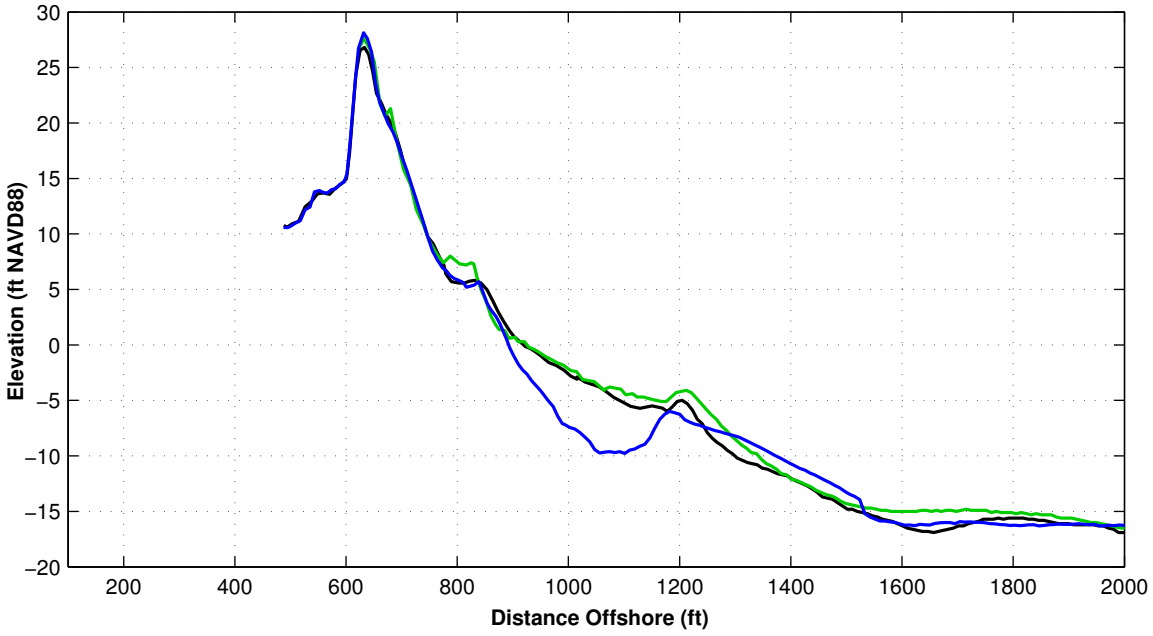
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 745+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −11.96 ft | 2.60 ft |
| Volume Change Above +6 ft NAVD88 | 0.17 cy/ft | 1.29 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −1.18 cy/ft | 4.36 cy/ft |
| Volume Change Above −6 ft NAVD88 | −14.72 cy/ft | 12.96 cy/ft |
| Volume Change Above −14 ft NAVD88 | −44.86 cy/ft | 50.81 cy/ft |
| Volume Change Above −19 ft NAVD88 | −43.45 cy/ft | 83.85 cy/ft |
| Volume Change Above −30 ft NAVD88 | −20.91 cy/ft | 61.03 cy/ft |

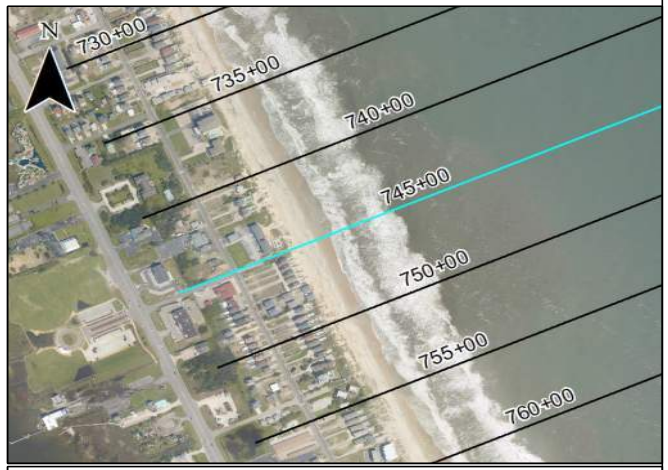
**LEGEND:**

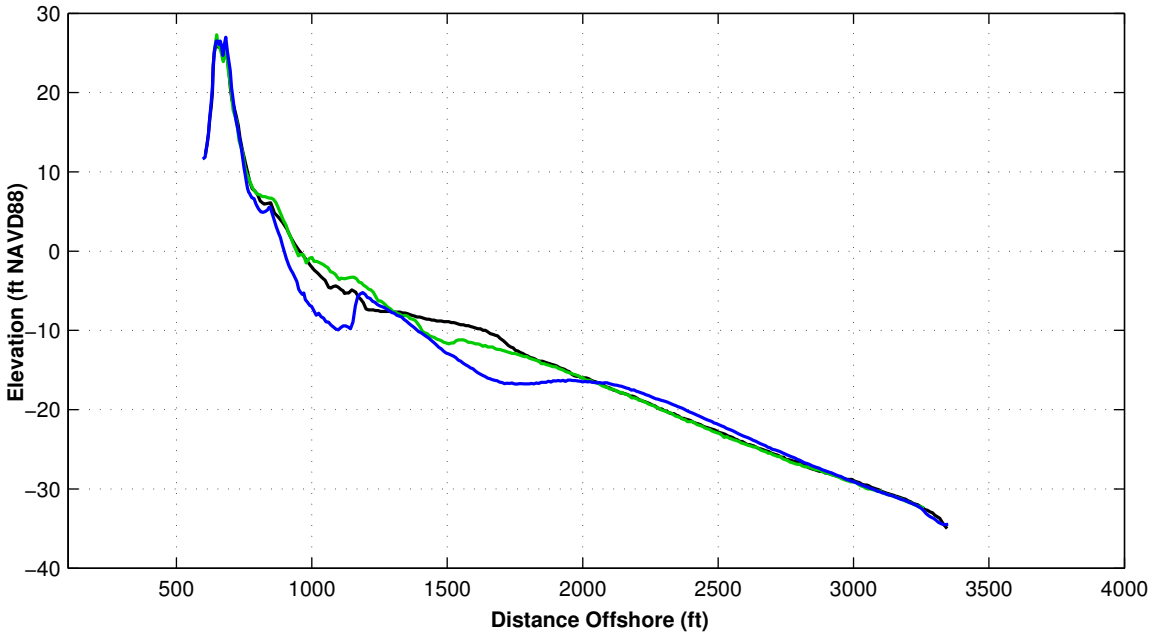
JUNE 2024 — OCTOBER 2023

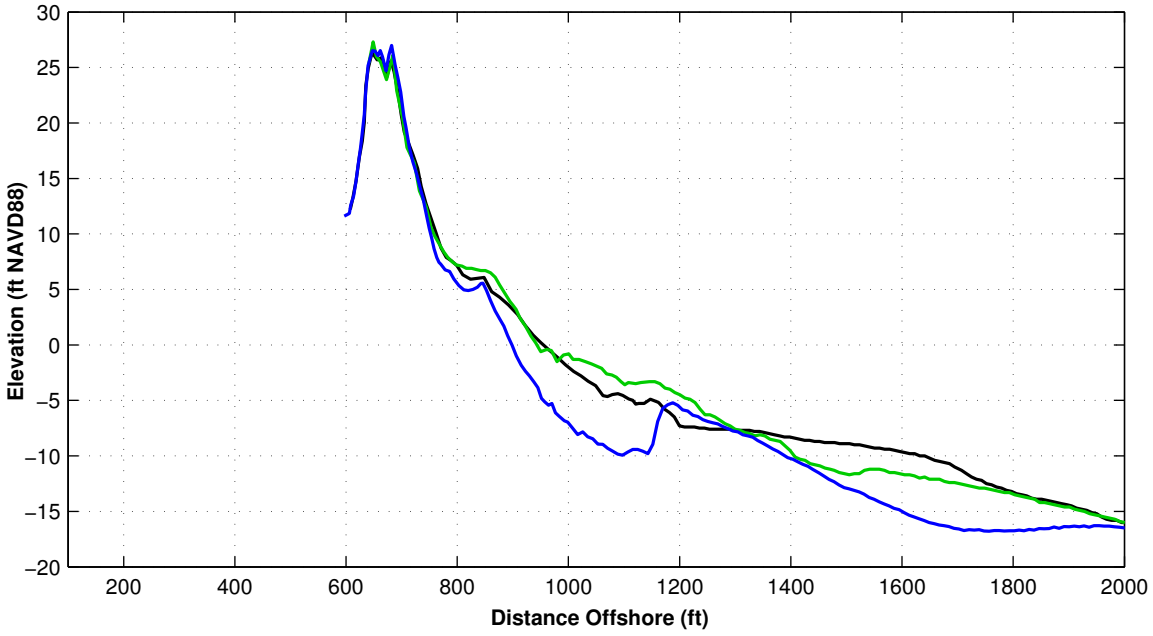
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 750+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | ft | ft |
| Volume Change Above +6 ft NAVD88 | cy/ft | cy/ft |
| Volume Change Above 1.18 ft NAVD88 | cy/ft | cy/ft |
| Volume Change Above −6 ft NAVD88 | cy/ft | cy/ft |
| Volume Change Above −14 ft NAVD88 | cy/ft | cy/ft |
| Volume Change Above −19 ft NAVD88 | cy/ft | cy/ft |
| Volume Change Above −30 ft NAVD88 | cy/ft | cy/ft |

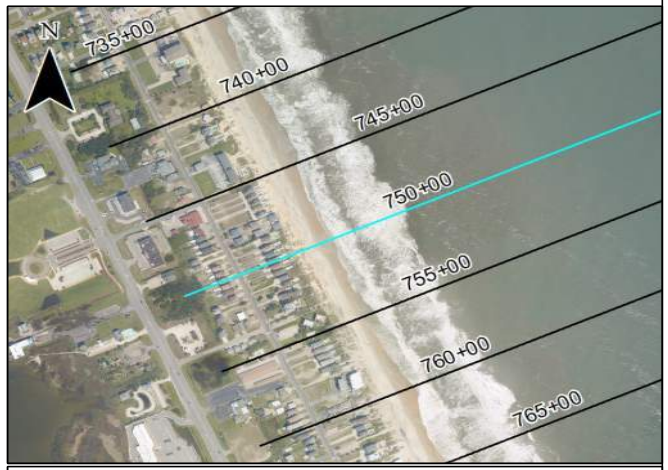
**LEGEND:**

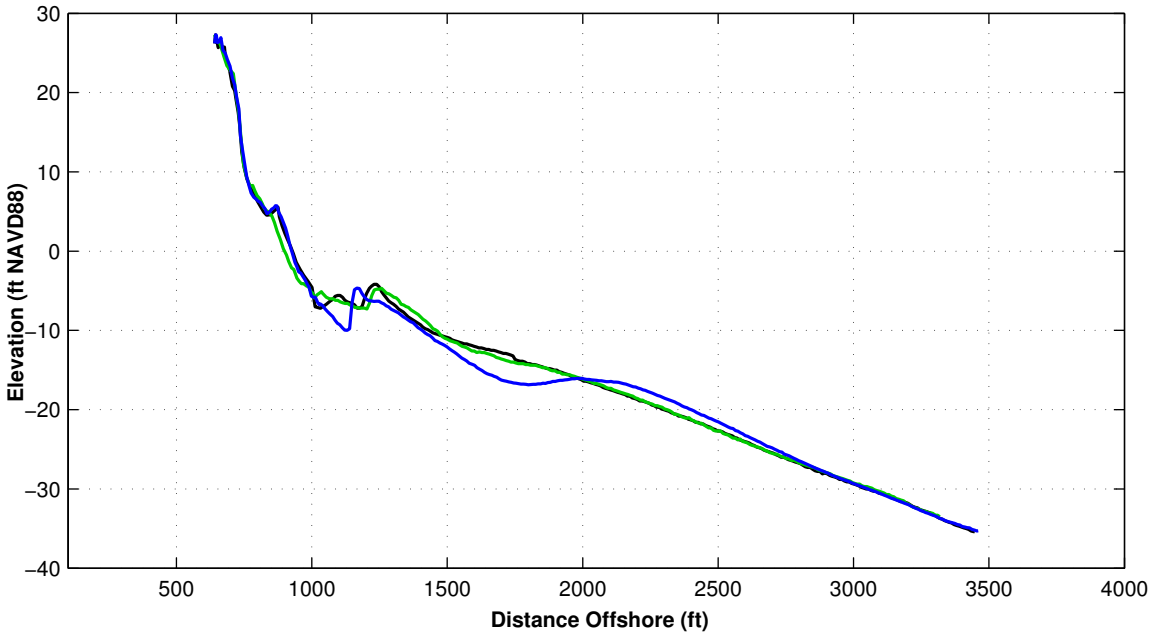
JUNE 2024 — OCTOBER 2023

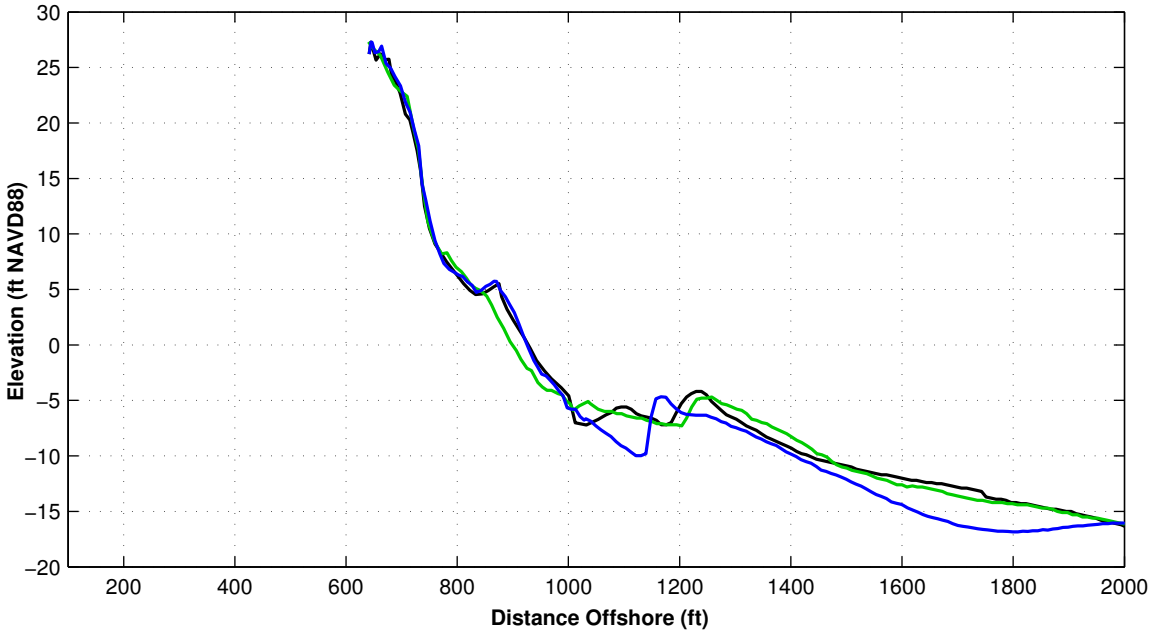
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 755+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 2.31 ft | 29.91 ft |
| Volume Change Above +6 ft NAVD88 | 2.17 cy/ft | 4.34 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.15 cy/ft | 7.71 cy/ft |
| Volume Change Above −6 ft NAVD88 | 0.47 cy/ft | 21.61 cy/ft |
| Volume Change Above −14 ft NAVD88 | −28.04 cy/ft | 51.19 cy/ft |
| Volume Change Above −19 ft NAVD88 | −41.38 cy/ft | 25.24 cy/ft |
| Volume Change Above −30 ft NAVD88 | −21.14 cy/ft | 5.28 cy/ft |

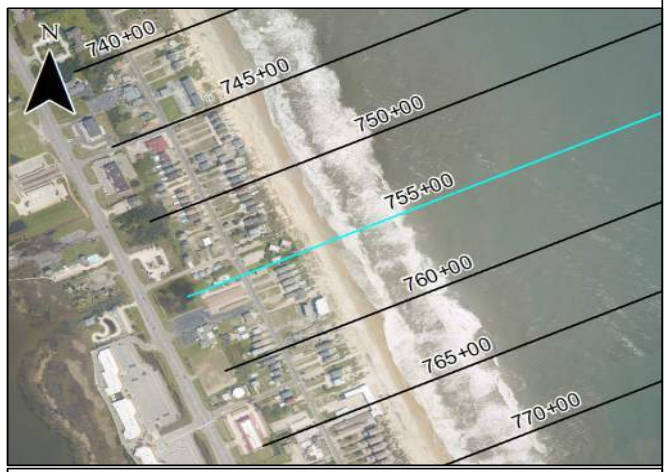
**LEGEND:**

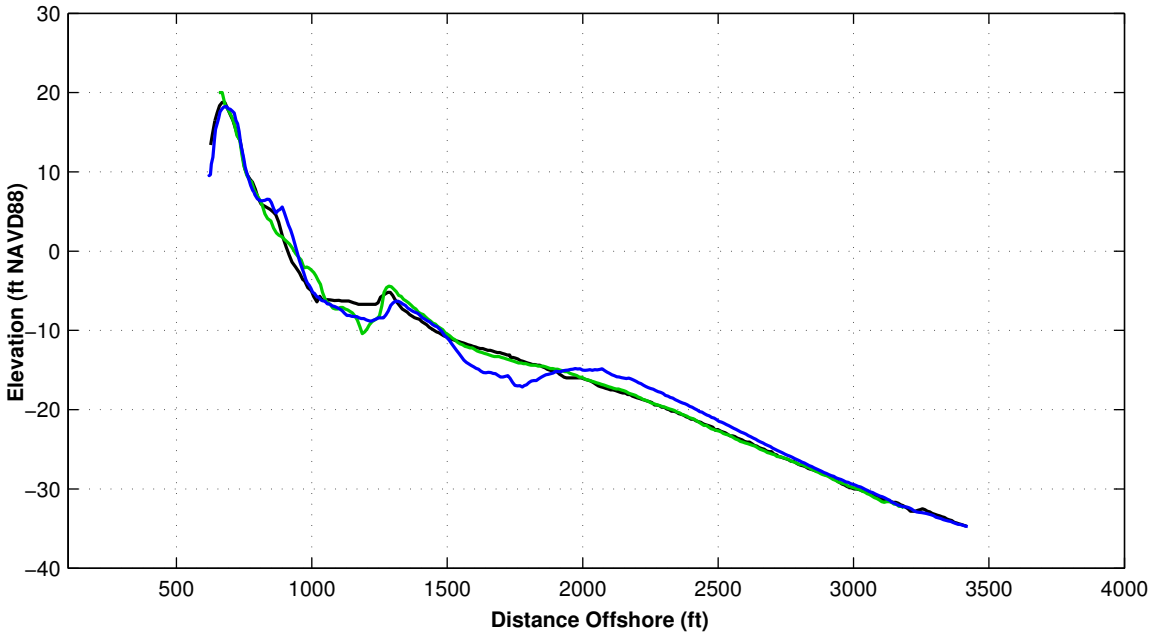
JUNE 2024 — OCTOBER 2023

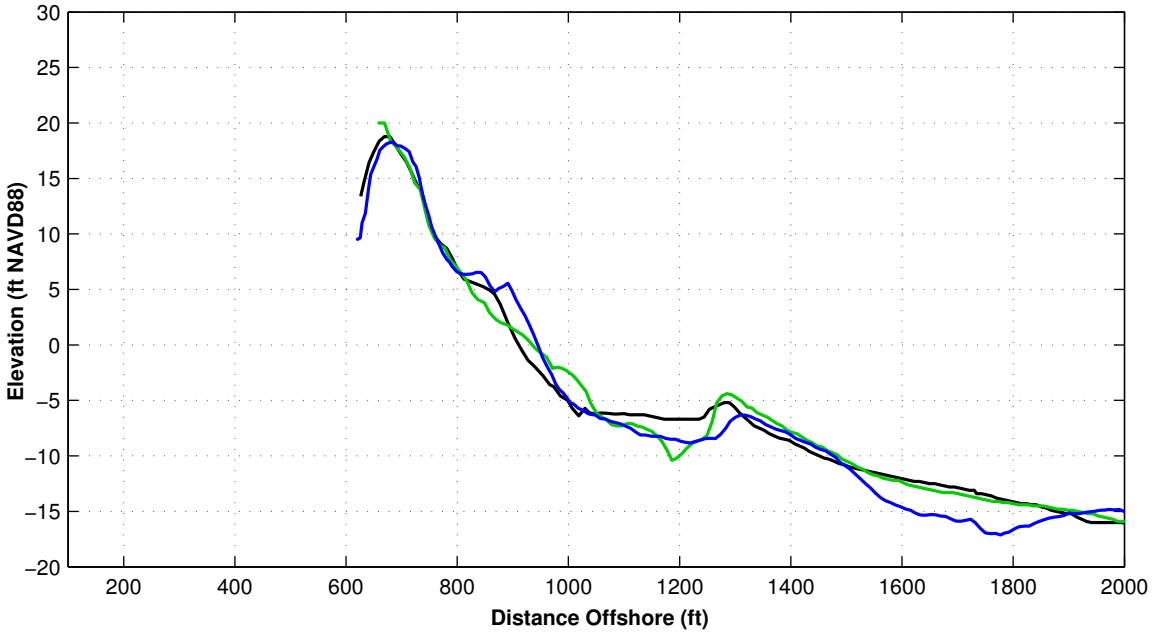
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 760+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 36.54 ft | 1.86 ft |
| Volume Change Above +6 ft NAVD88 | 0.36 cy/ft | 0.70 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.45 cy/ft | 5.28 cy/ft |
| Volume Change Above −6 ft NAVD88 | 10.79 cy/ft | 11.36 cy/ft |
| Volume Change Above −14 ft NAVD88 | −12.86 cy/ft | 68.69 cy/ft |
| Volume Change Above −19 ft NAVD88 | −8.27 cy/ft | 41.85 cy/ft |
| Volume Change Above −30 ft NAVD88 | 14.42 cy/ft | 21.22 cy/ft |

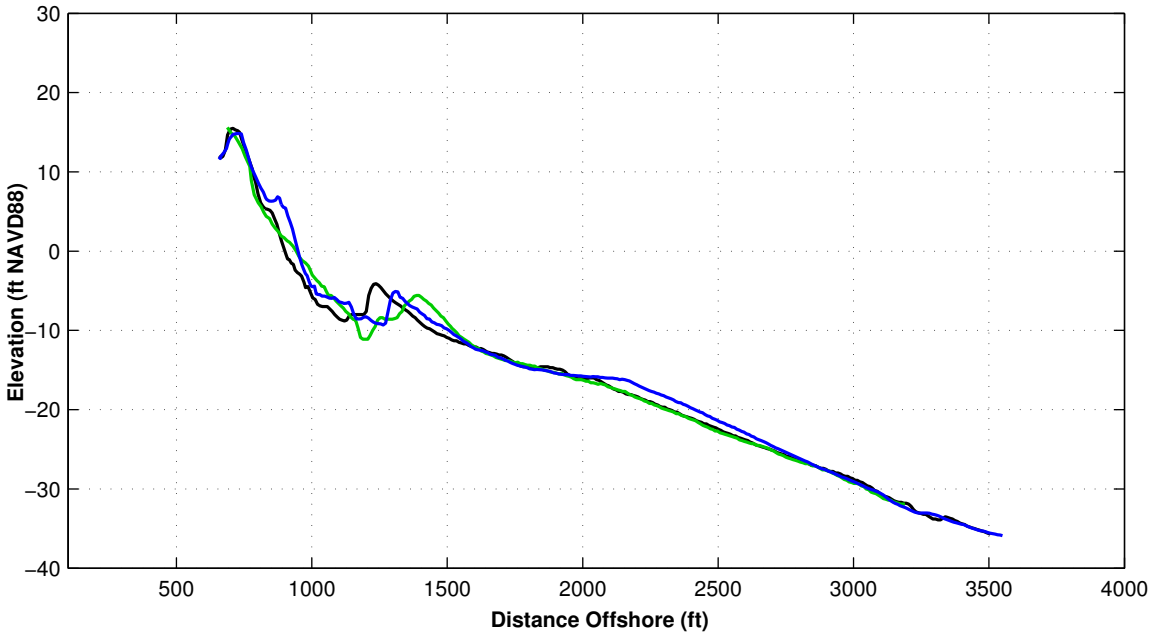
**LEGEND:**

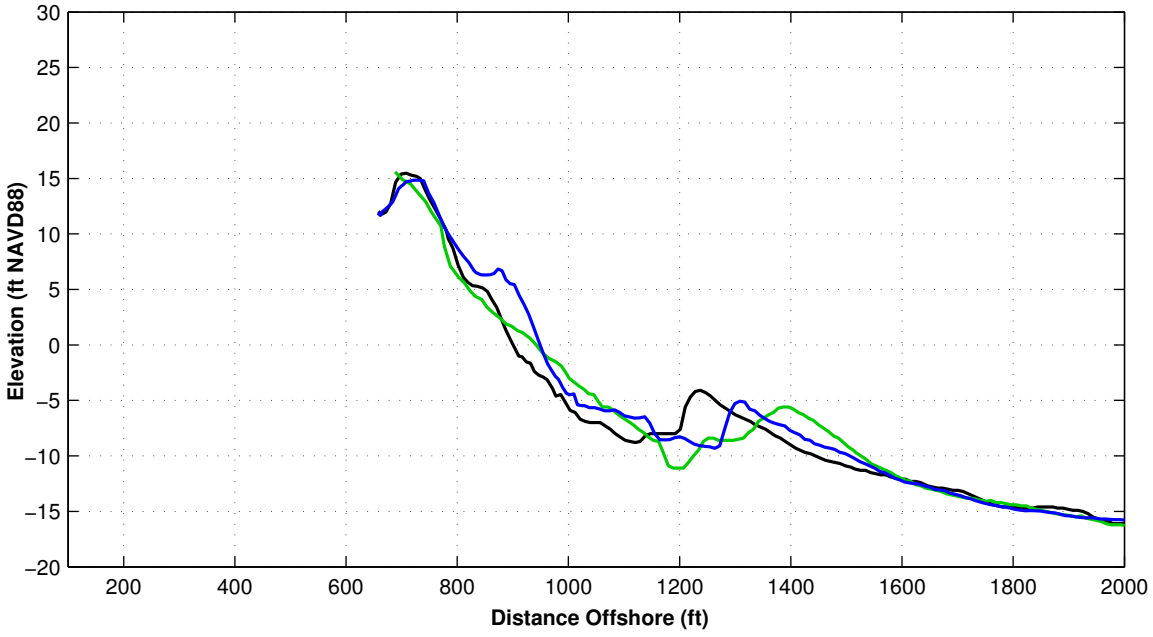
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 765+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 51.50 ft | −10.61 ft |
| Volume Change Above +6 ft NAVD88 | 3.10 cy/ft | 2.58 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.15 cy/ft | 7.00 cy/ft |
| Volume Change Above −6 ft NAVD88 | 19.95 cy/ft | 6.62 cy/ft |
| Volume Change Above −14 ft NAVD88 | 26.67 cy/ft | 55.45 cy/ft |
| Volume Change Above −19 ft NAVD88 | 37.32 cy/ft | 28.67 cy/ft |
| Volume Change Above −30 ft NAVD88 | 53.72 cy/ft | 8.61 cy/ft |

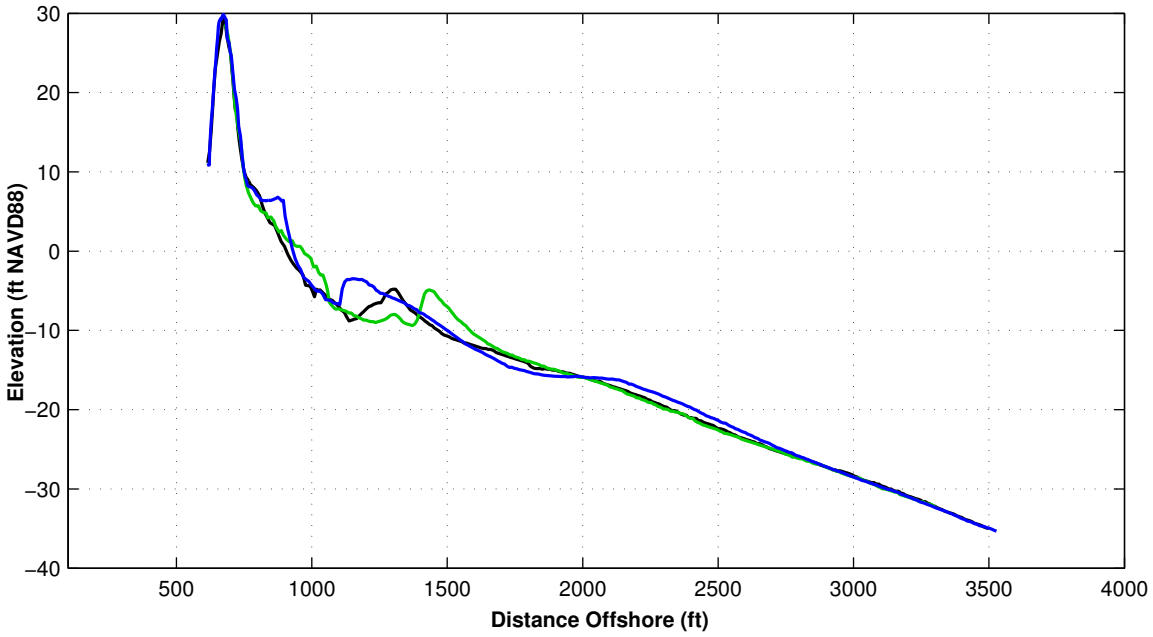
**LEGEND:**

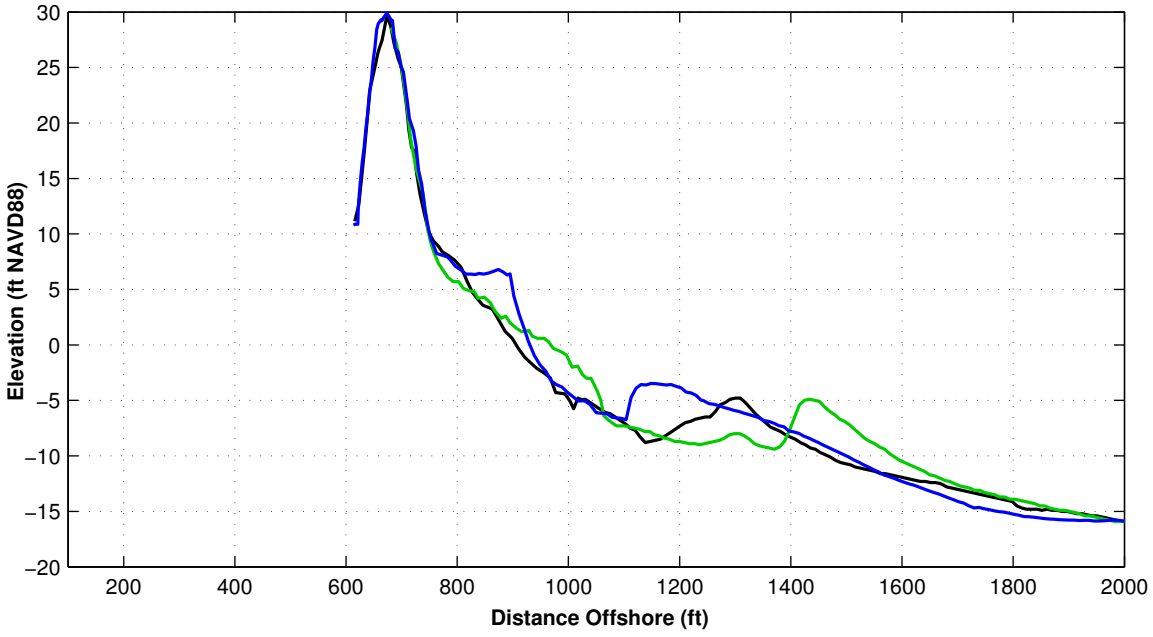
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 770+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 35.08 ft | −18.63 ft |
| Volume Change Above +6 ft NAVD88 | 3.27 cy/ft | 3.26 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.48 cy/ft | 1.74 cy/ft |
| Volume Change Above −6 ft NAVD88 | 26.12 cy/ft | −0.99 cy/ft |
| Volume Change Above −14 ft NAVD88 | 34.80 cy/ft | 45.00 cy/ft |
| Volume Change Above −19 ft NAVD88 | 37.51 cy/ft | 17.07 cy/ft |
| Volume Change Above −30 ft NAVD88 | 51.90 cy/ft | −0.65 cy/ft |

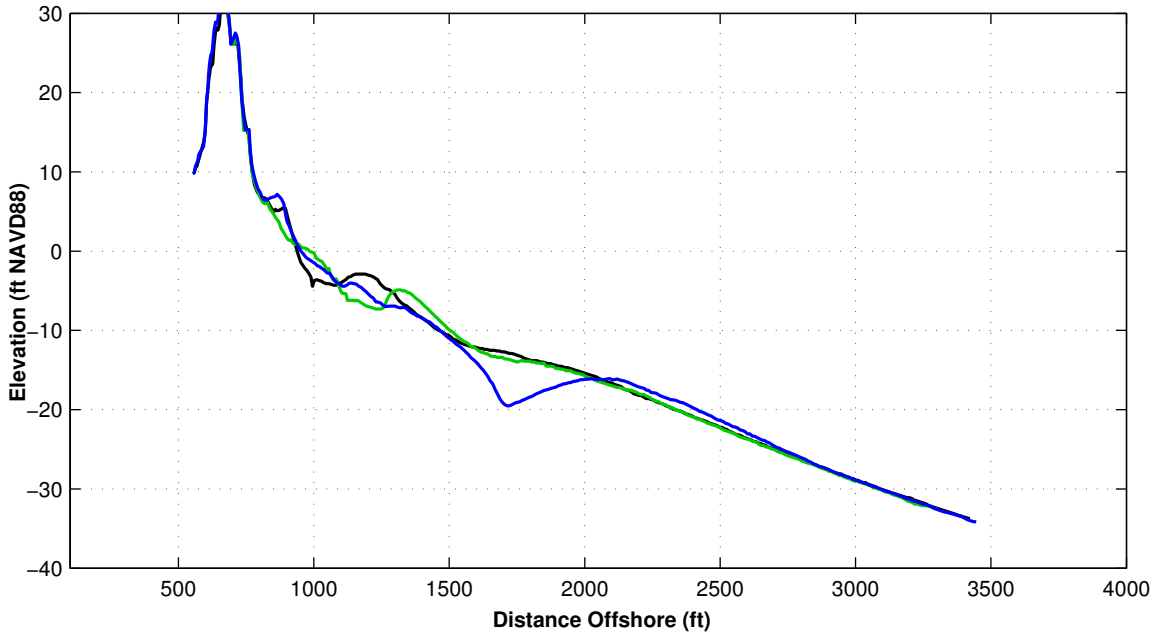
**LEGEND:**

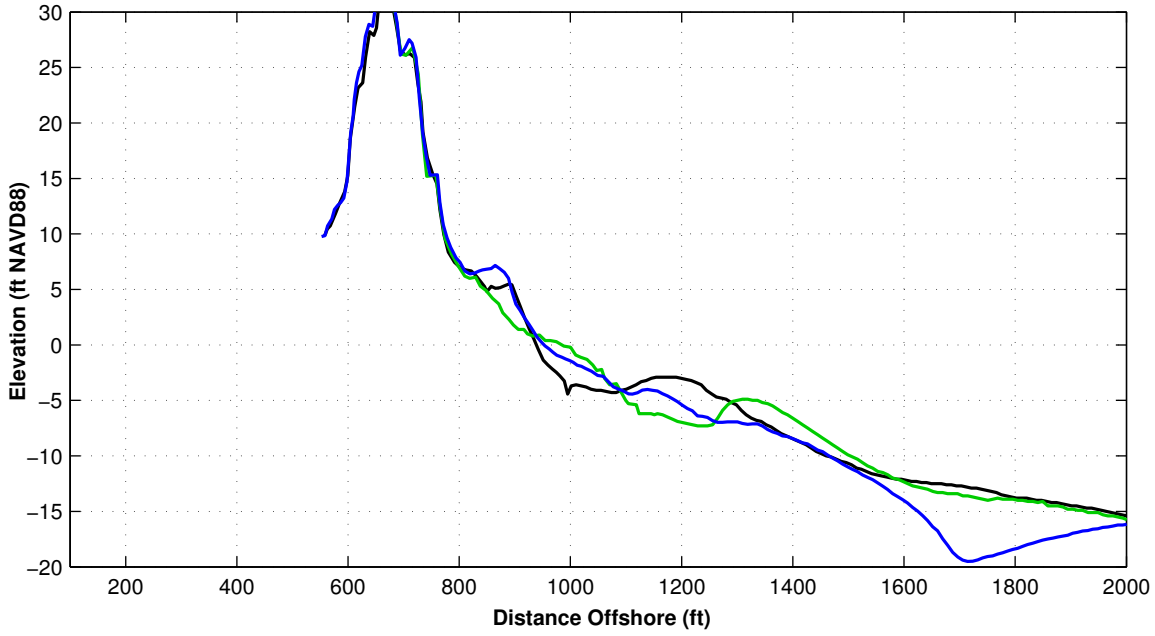
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 775+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 5.86 ft | 27.12 ft |
| Volume Change Above +6 ft NAVD88 | 3.47 cy/ft | 3.41 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.66 cy/ft | 7.97 cy/ft |
| Volume Change Above −6 ft NAVD88 | 1.89 cy/ft | 27.28 cy/ft |
| Volume Change Above −14 ft NAVD88 | −13.72 cy/ft | 69.58 cy/ft |
| Volume Change Above −19 ft NAVD88 | −53.28 cy/ft | 44.63 cy/ft |
| Volume Change Above −30 ft NAVD88 | −39.91 cy/ft | 30.48 cy/ft |

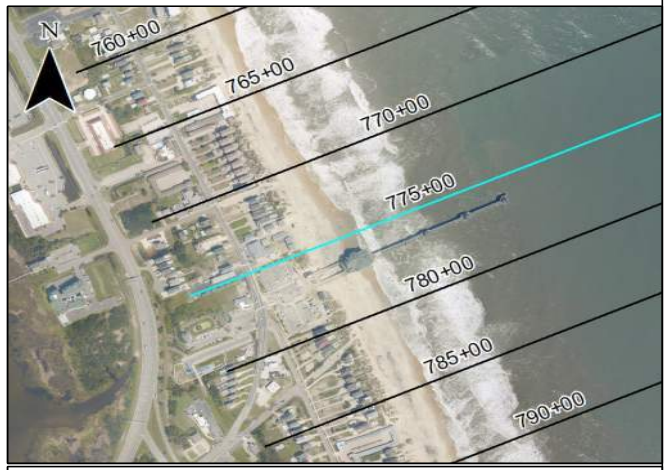
**LEGEND:**

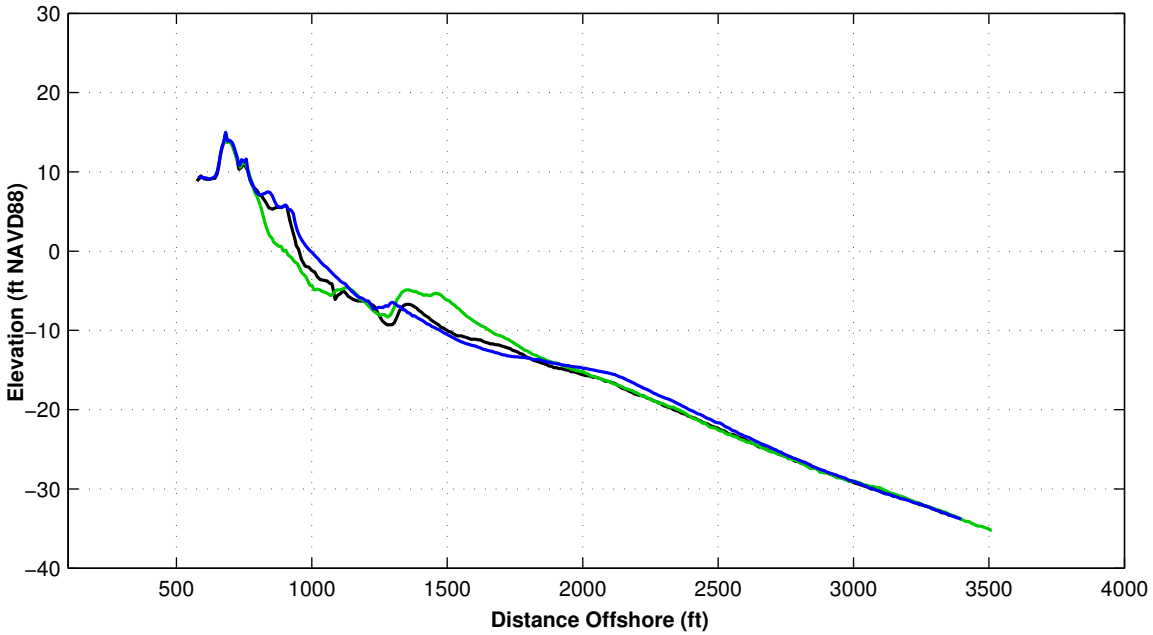
JUNE 2024 — OCTOBER 2023

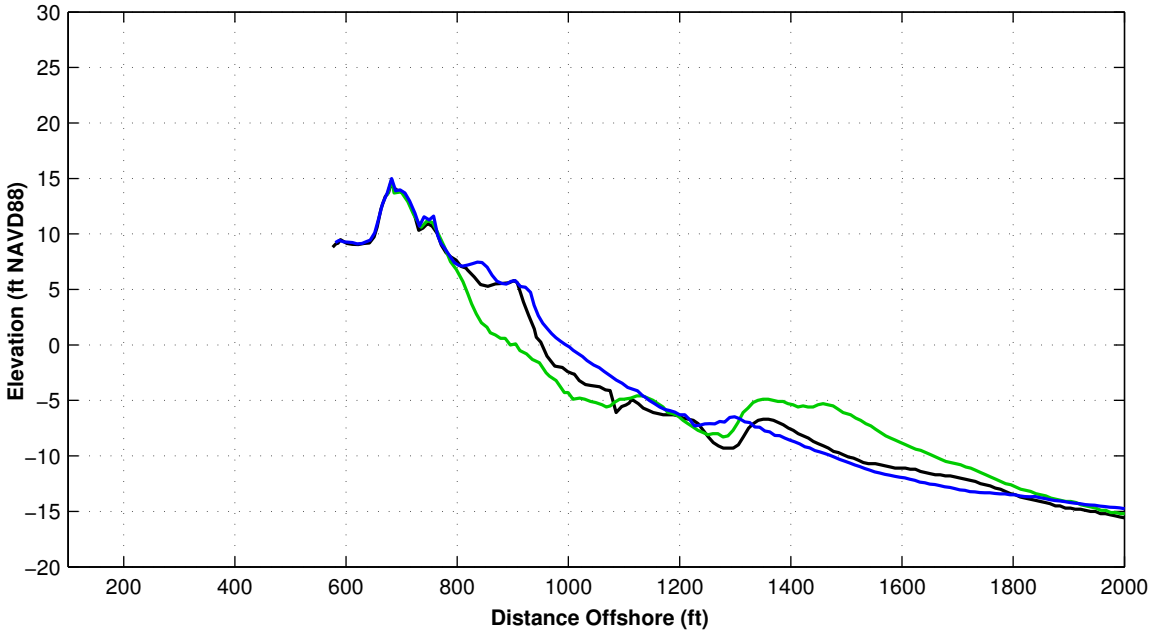
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 780+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 27.15 ft | −3.79 ft |
| Volume Change Above +6 ft NAVD88 | 2.94 cy/ft | 1.54 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.52 cy/ft | 4.11 cy/ft |
| Volume Change Above −6 ft NAVD88 | 21.09 cy/ft | 7.51 cy/ft |
| Volume Change Above −14 ft NAVD88 | 14.22 cy/ft | 60.39 cy/ft |
| Volume Change Above −19 ft NAVD88 | 29.15 cy/ft | 36.30 cy/ft |
| Volume Change Above −30 ft NAVD88 | 41.41 cy/ft | 21.62 cy/ft |

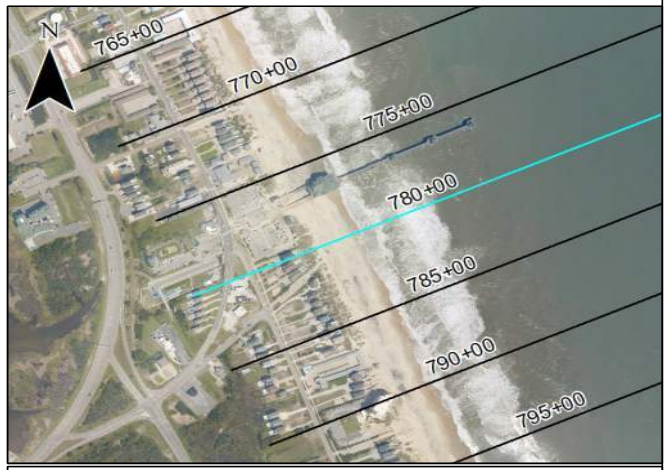
**LEGEND:**

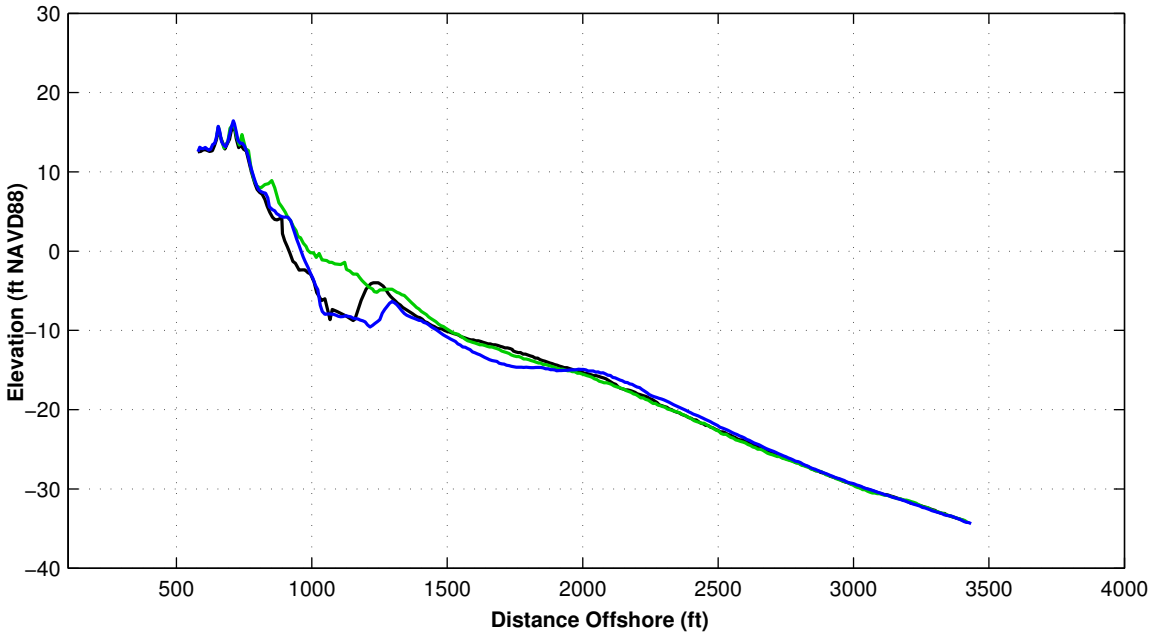
JUNE 2024 — OCTOBER 2023

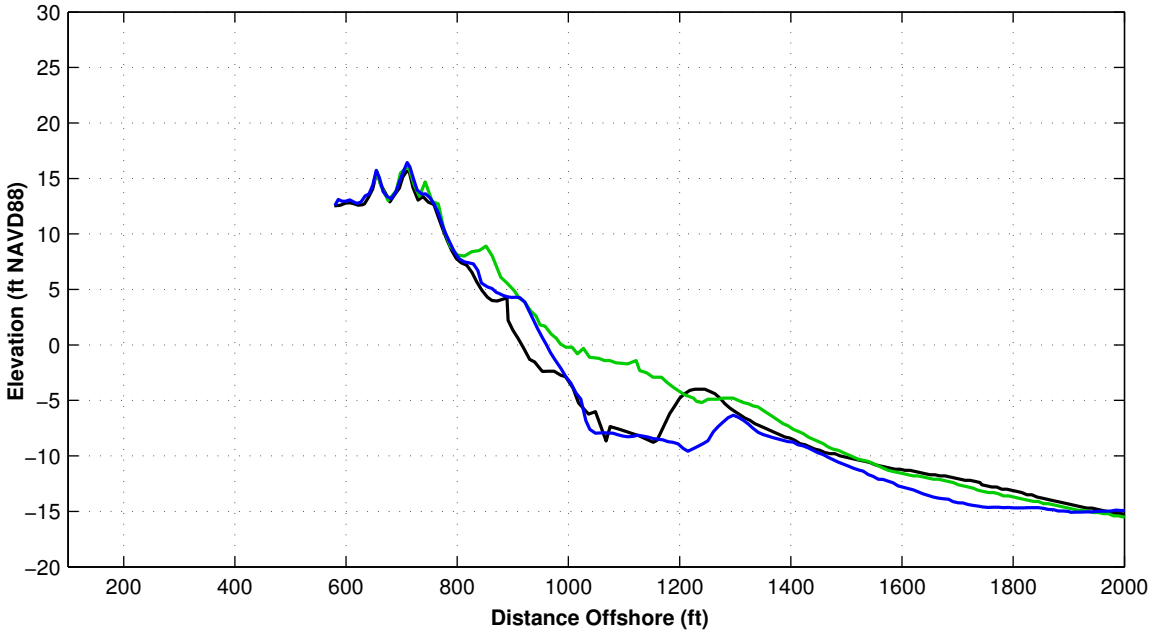
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 785+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 45.78 ft | −44.38 ft |
| Volume Change Above +6 ft NAVD88 | 2.85 cy/ft | 1.53 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 8.83 cy/ft | −4.15 cy/ft |
| Volume Change Above −6 ft NAVD88 | 9.31 cy/ft | −17.26 cy/ft |
| Volume Change Above −14 ft NAVD88 | −23.95 cy/ft | 48.05 cy/ft |
| Volume Change Above −19 ft NAVD88 | −22.07 cy/ft | 24.70 cy/ft |
| Volume Change Above −30 ft NAVD88 | −11.98 cy/ft | 11.46 cy/ft |

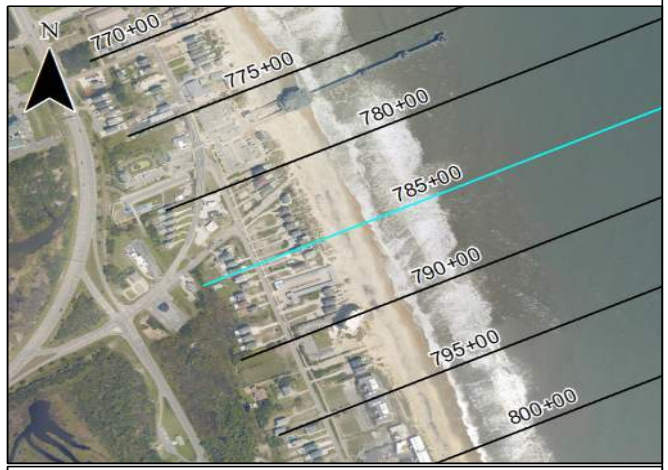
**LEGEND:**

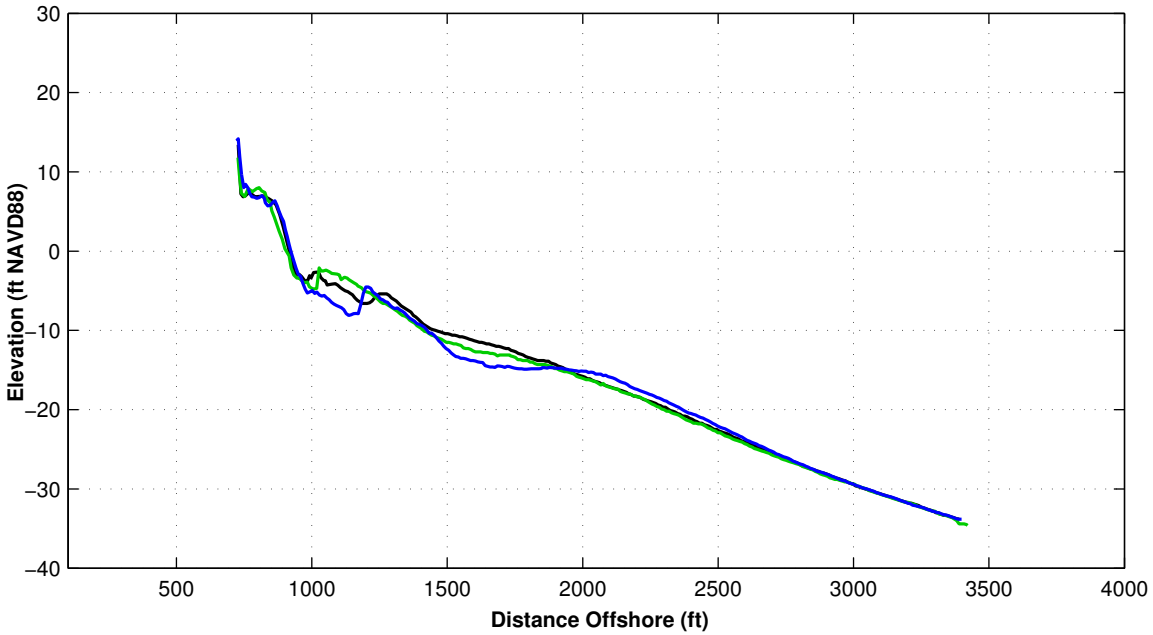
JUNE 2024 — OCTOBER 2023

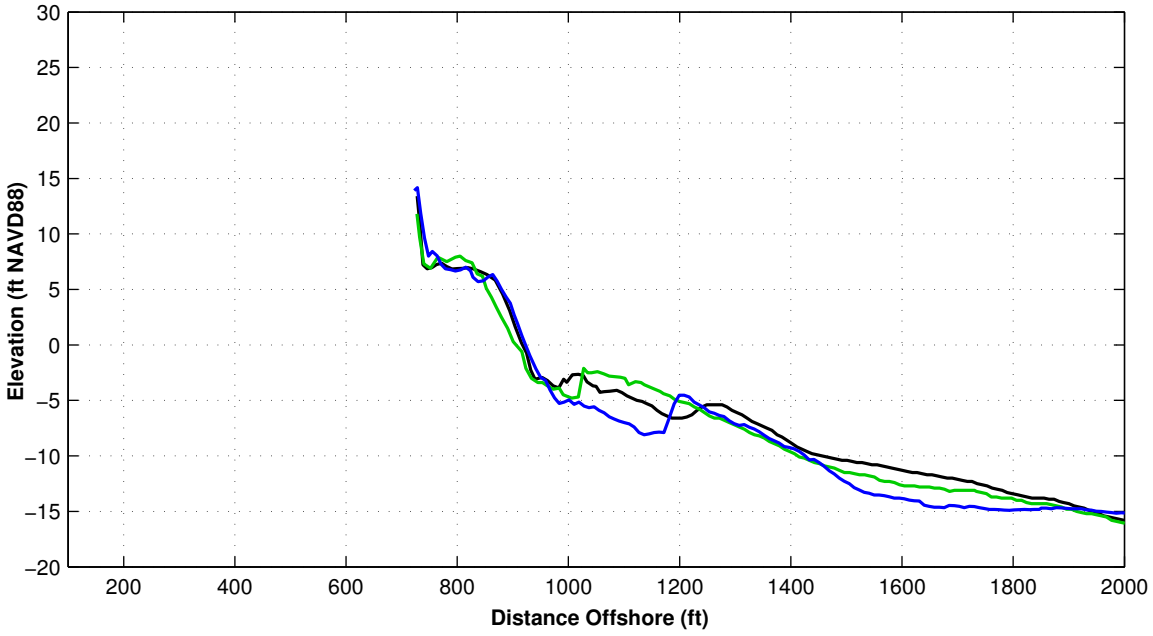
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 790+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 5.93 ft | −3.31 ft |
| Volume Change Above +6 ft NAVD88 | 1.04 cy/ft | 0.53 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.74 cy/ft | 1.37 cy/ft |
| Volume Change Above −6 ft NAVD88 | −7.60 cy/ft | −2.23 cy/ft |
| Volume Change Above −14 ft NAVD88 | −42.66 cy/ft | 24.64 cy/ft |
| Volume Change Above −19 ft NAVD88 | −38.41 cy/ft | −6.86 cy/ft |
| Volume Change Above −30 ft NAVD88 | −28.98 cy/ft | −23.78 cy/ft |

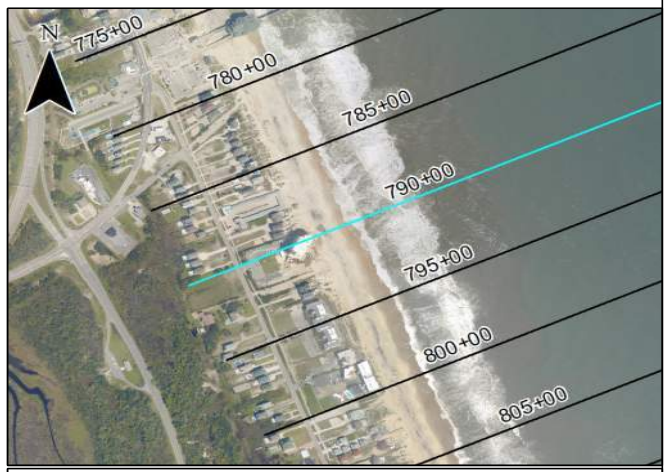
**LEGEND:**

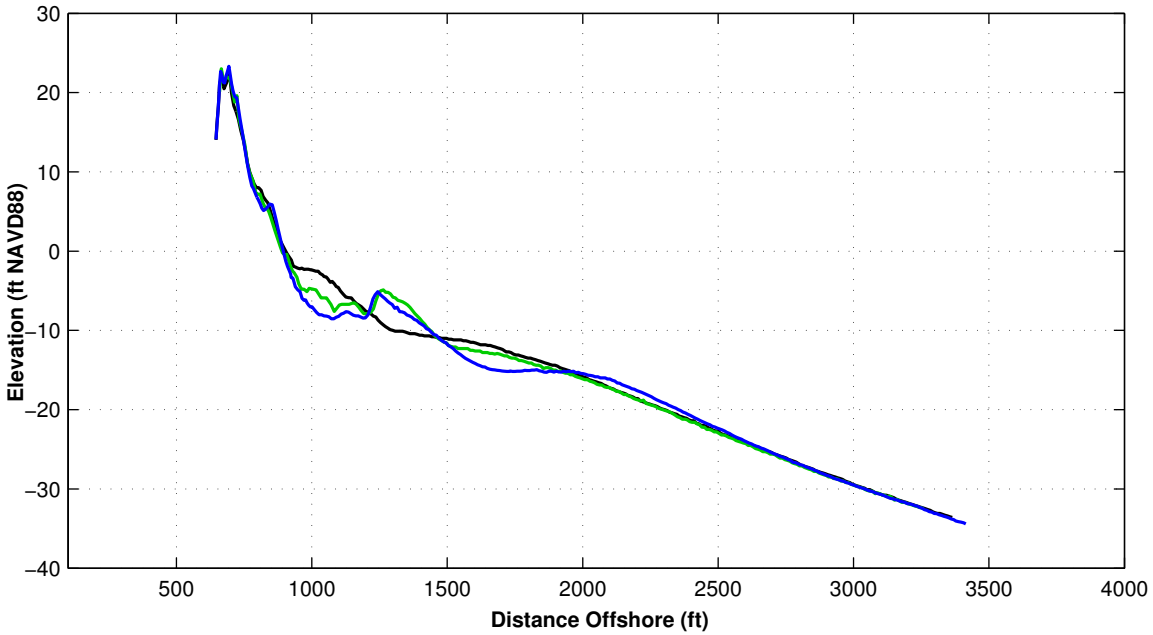
JUNE 2024 — OCTOBER 2023

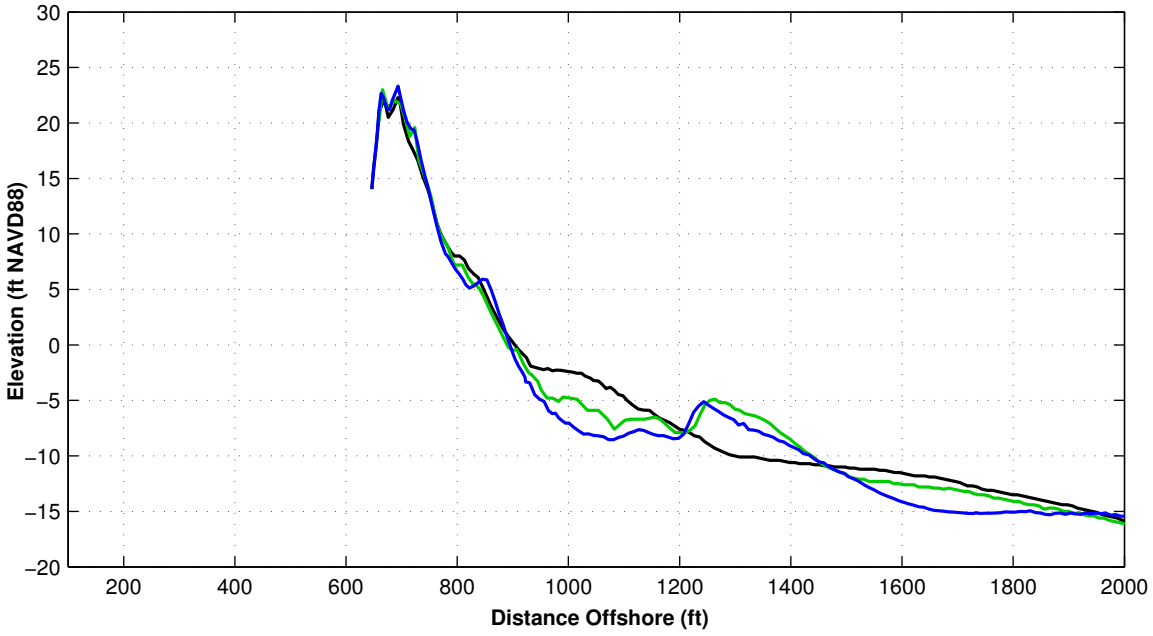
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 795+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 0.71 ft | −23.57 ft |
| Volume Change Above +6 ft NAVD88 | 0.61 cy/ft | 5.07 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.53 cy/ft | 3.86 cy/ft |
| Volume Change Above −6 ft NAVD88 | −18.68 cy/ft | 3.82 cy/ft |
| Volume Change Above −14 ft NAVD88 | −33.05 cy/ft | 55.46 cy/ft |
| Volume Change Above −19 ft NAVD88 | −35.45 cy/ft | 39.44 cy/ft |
| Volume Change Above −30 ft NAVD88 | −29.26 cy/ft | 25.50 cy/ft |

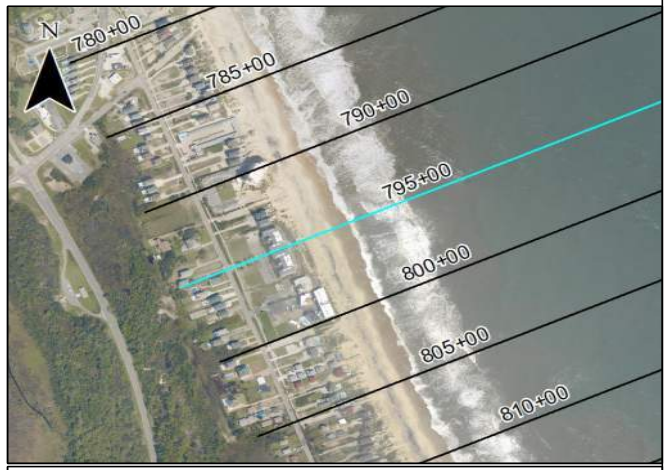
**LEGEND:**

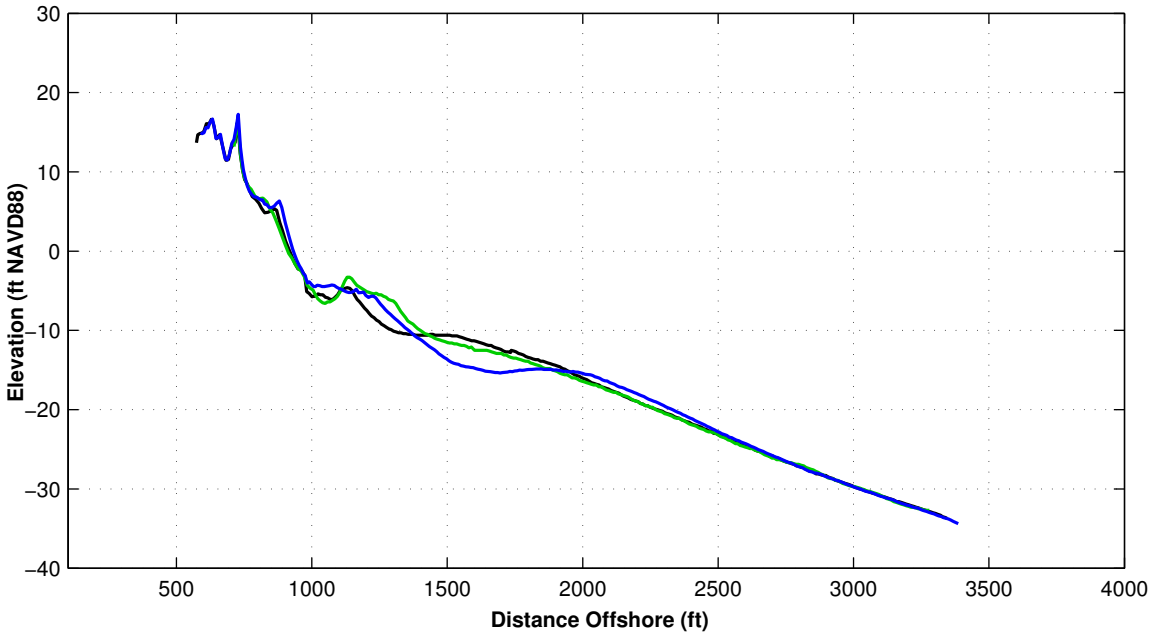
JUNE 2024 — OCTOBER 2023

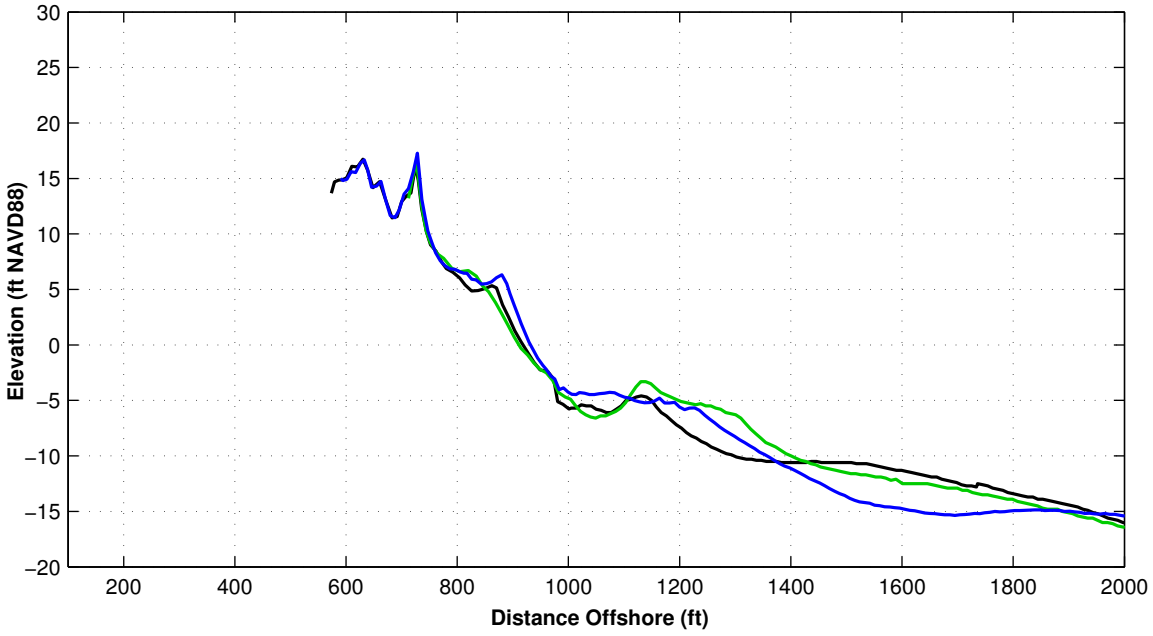
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 800+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 16.82 ft | 25.96 ft |
| Volume Change Above +6 ft NAVD88 | 2.21 cy/ft | 1.68 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 7.12 cy/ft | 7.30 cy/ft |
| Volume Change Above −6 ft NAVD88 | 16.09 cy/ft | 6.88 cy/ft |
| Volume Change Above −14 ft NAVD88 | −3.70 cy/ft | 67.77 cy/ft |
| Volume Change Above −19 ft NAVD88 | −8.60 cy/ft | 47.88 cy/ft |
| Volume Change Above −30 ft NAVD88 | −0.13 cy/ft | 33.94 cy/ft |

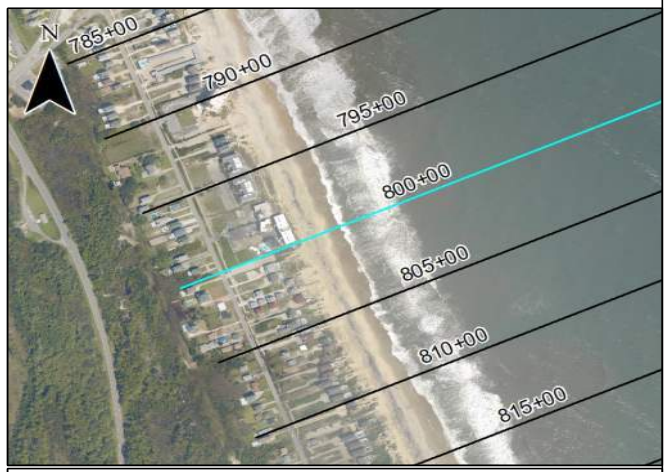
**LEGEND:**

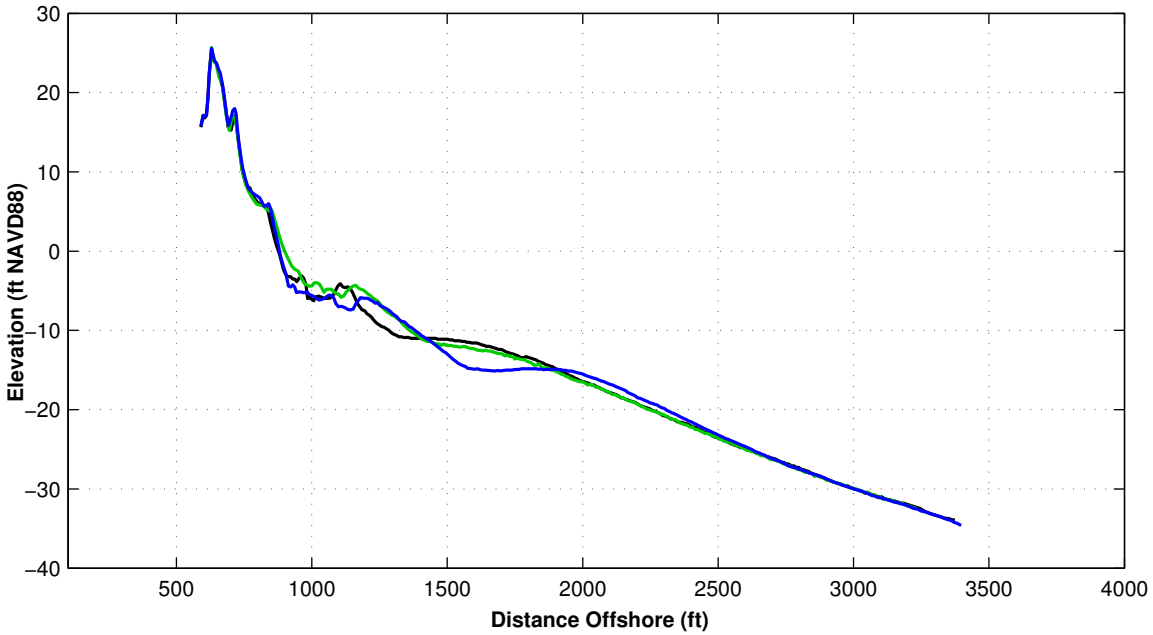
JUNE 2024 — OCTOBER 2023

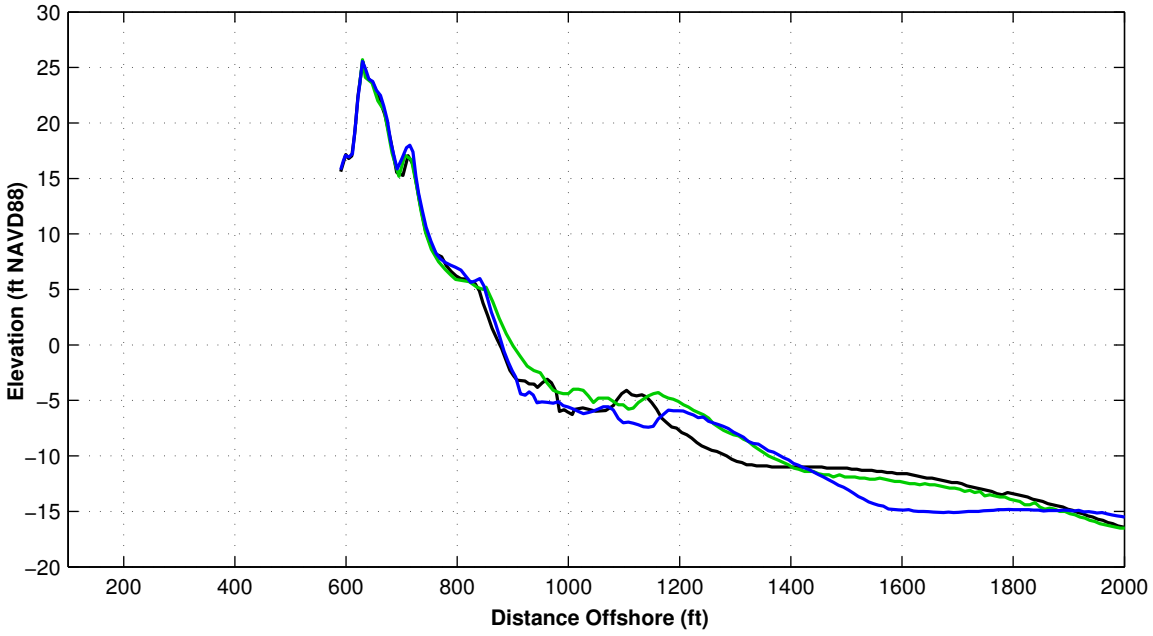
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 805+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 8.05 ft | 9.65 ft |
| Volume Change Above +6 ft NAVD88 | 3.04 cy/ft | 3.14 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.87 cy/ft | 6.22 cy/ft |
| Volume Change Above −6 ft NAVD88 | −1.37 cy/ft | 2.51 cy/ft |
| Volume Change Above −14 ft NAVD88 | −11.33 cy/ft | 65.28 cy/ft |
| Volume Change Above −19 ft NAVD88 | −12.93 cy/ft | 71.24 cy/ft |
| Volume Change Above −30 ft NAVD88 | −4.83 cy/ft | 58.56 cy/ft |

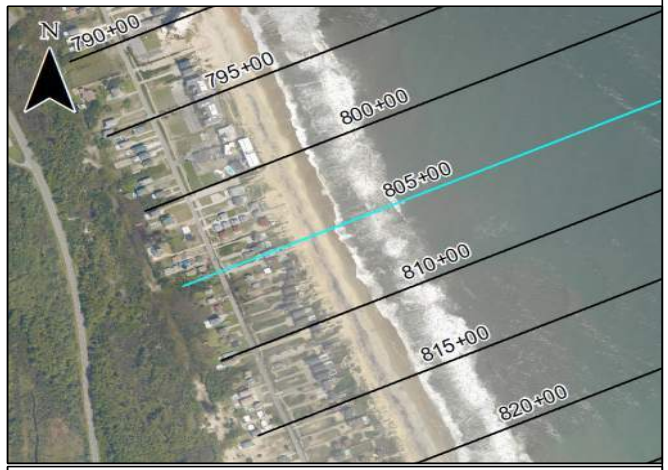
**LEGEND:**

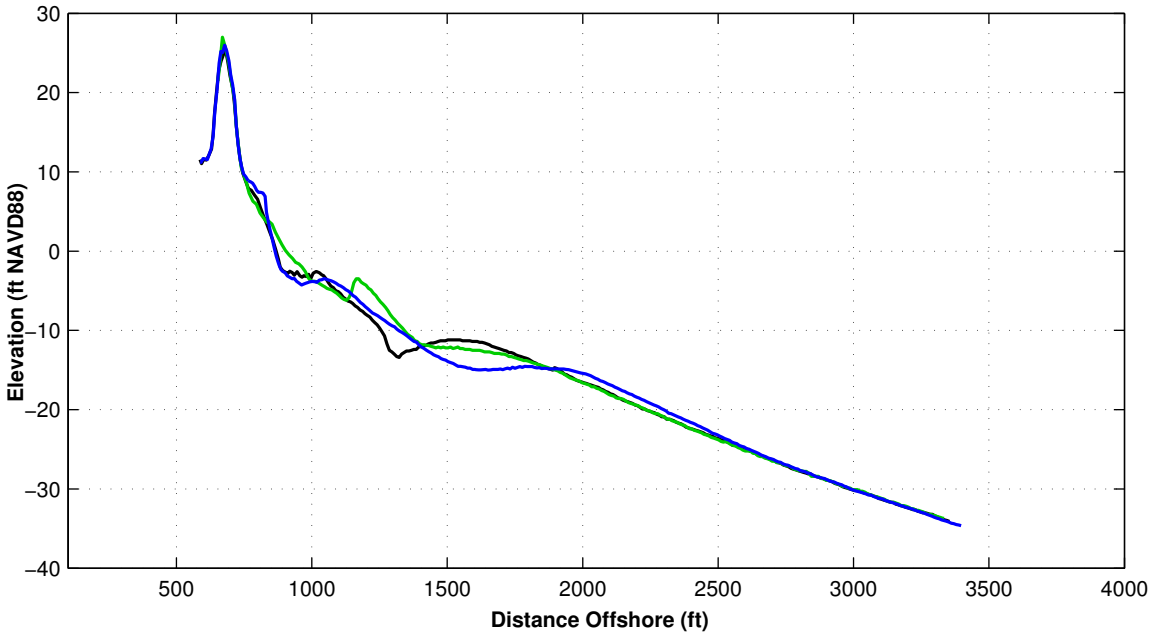
JUNE 2024 — OCTOBER 2023

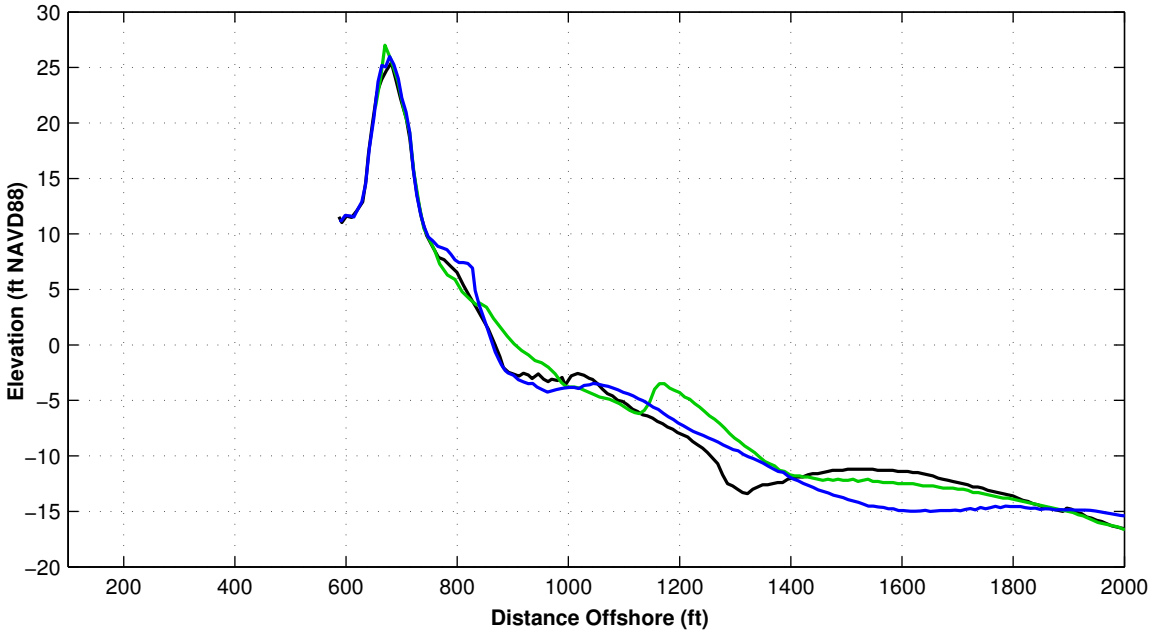
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 810+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −1.86 ft | −12.43 ft |
| Volume Change Above +6 ft NAVD88 | 4.51 cy/ft | 2.35 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.19 cy/ft | −0.23 cy/ft |
| Volume Change Above −6 ft NAVD88 | 4.40 cy/ft | 1.75 cy/ft |
| Volume Change Above −14 ft NAVD88 | −6.91 cy/ft | 43.71 cy/ft |
| Volume Change Above −19 ft NAVD88 | −5.08 cy/ft | 49.97 cy/ft |
| Volume Change Above −30 ft NAVD88 | 6.29 cy/ft | 35.89 cy/ft |

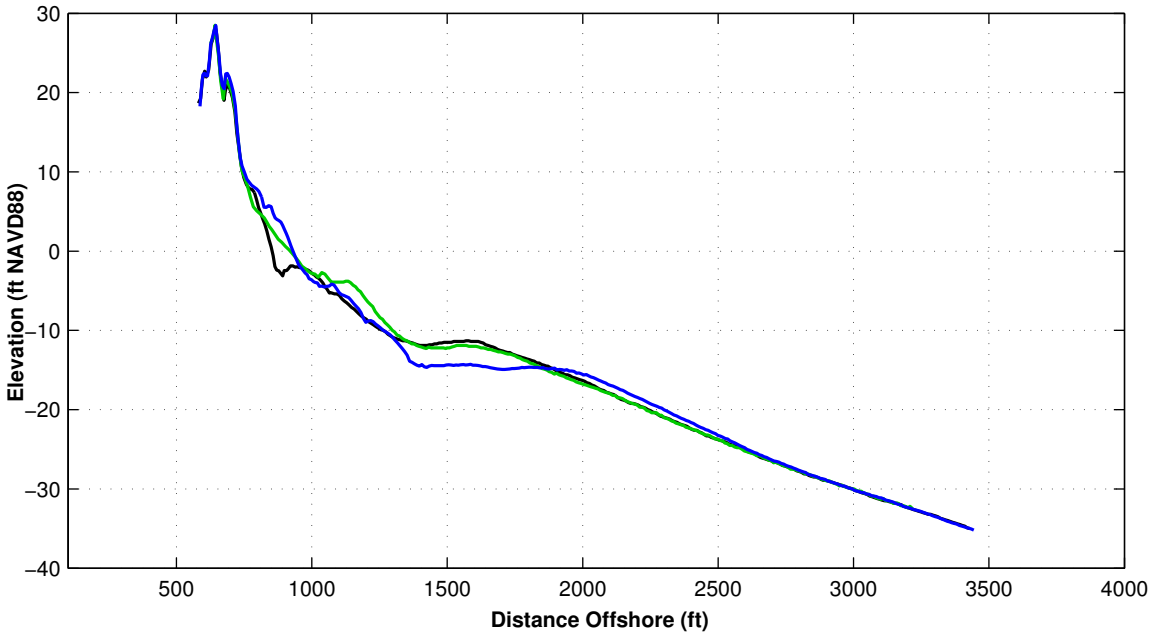
**LEGEND:**

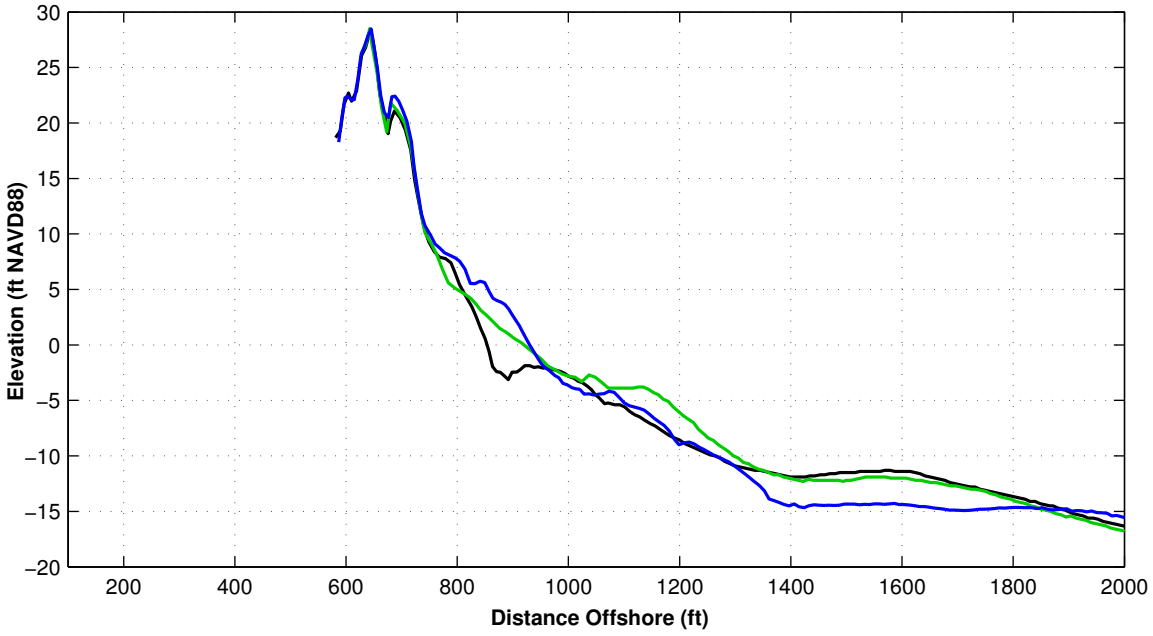
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 815+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 72.97 ft | −14.60 ft |
| Volume Change Above +6 ft NAVD88 | 5.36 cy/ft | 3.50 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 15.42 cy/ft | 1.62 cy/ft |
| Volume Change Above −6 ft NAVD88 | 25.59 cy/ft | 4.27 cy/ft |
| Volume Change Above −14 ft NAVD88 | −7.44 cy/ft | 52.61 cy/ft |
| Volume Change Above −19 ft NAVD88 | −7.57 cy/ft | 37.85 cy/ft |
| Volume Change Above −30 ft NAVD88 | 4.49 cy/ft | 24.36 cy/ft |

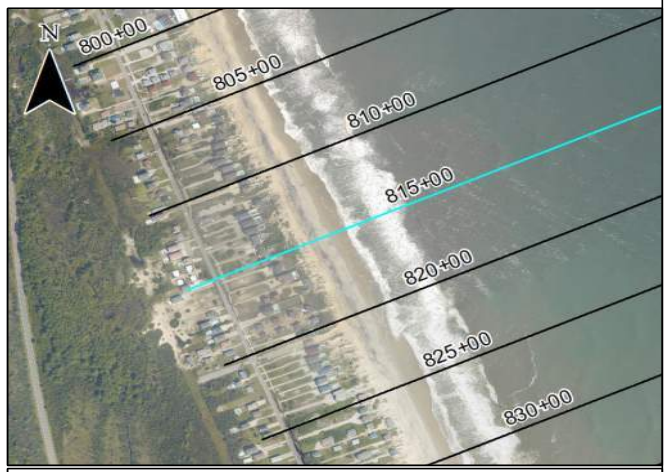
**LEGEND:**

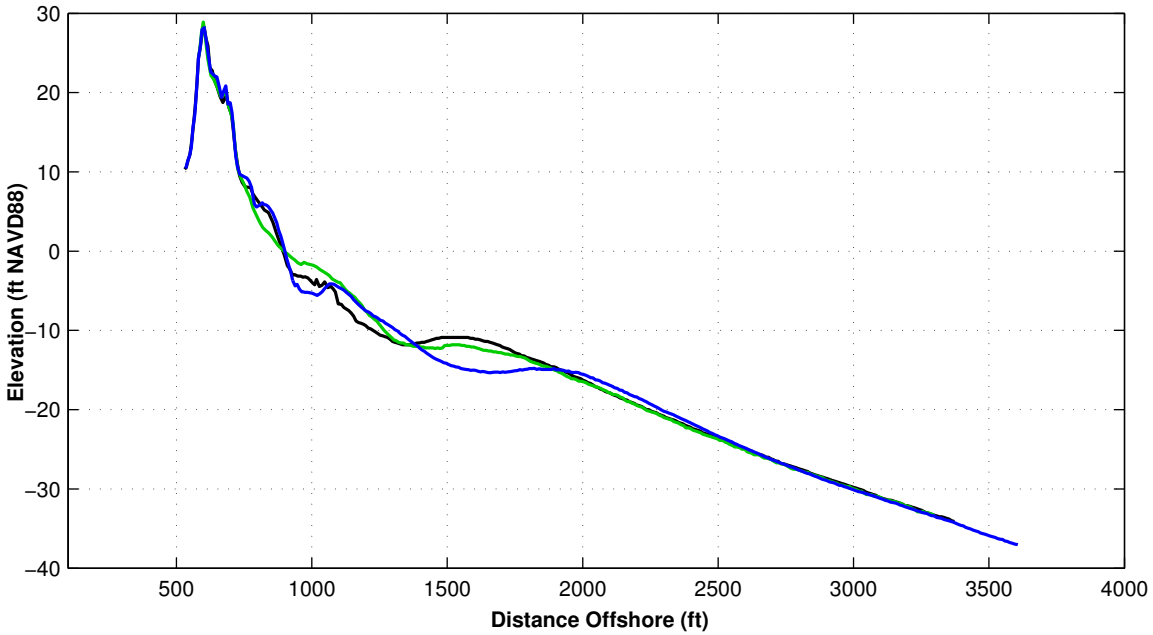
JUNE 2024 — OCTOBER 2023

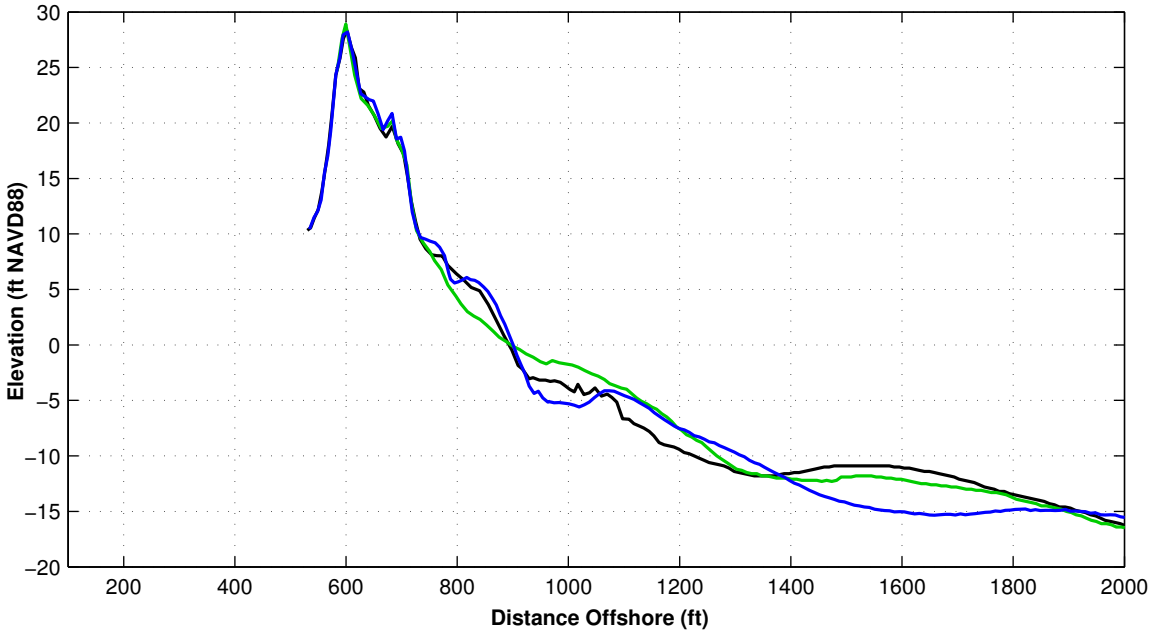
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 820+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 10.62 ft | 28.24 ft |
| Volume Change Above +6 ft NAVD88 | 2.81 cy/ft | 4.62 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 5.16 cy/ft | 8.18 cy/ft |
| Volume Change Above −6 ft NAVD88 | 2.30 cy/ft | 14.16 cy/ft |
| Volume Change Above −14 ft NAVD88 | −15.78 cy/ft | 57.19 cy/ft |
| Volume Change Above −19 ft NAVD88 | −21.66 cy/ft | 62.54 cy/ft |
| Volume Change Above −30 ft NAVD88 | −16.20 cy/ft | 40.95 cy/ft |

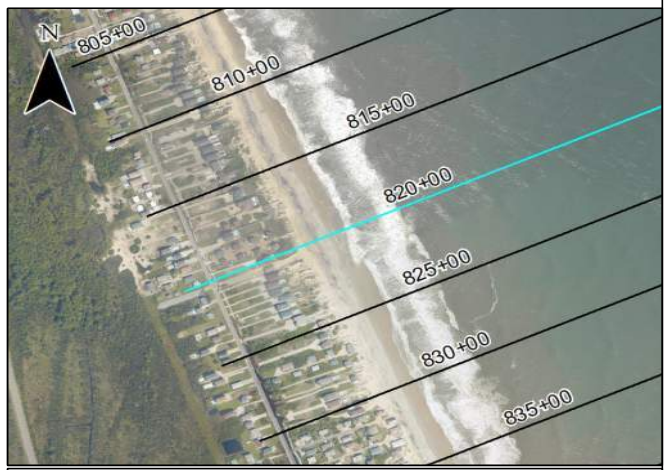
**LEGEND:**

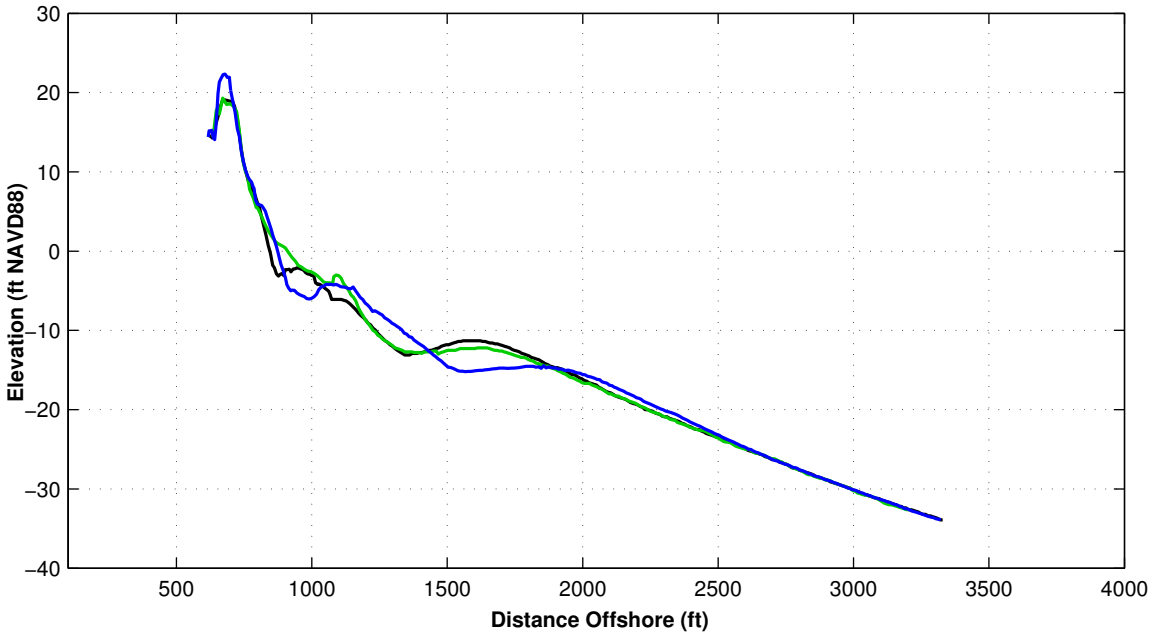
JUNE 2024 — OCTOBER 2023

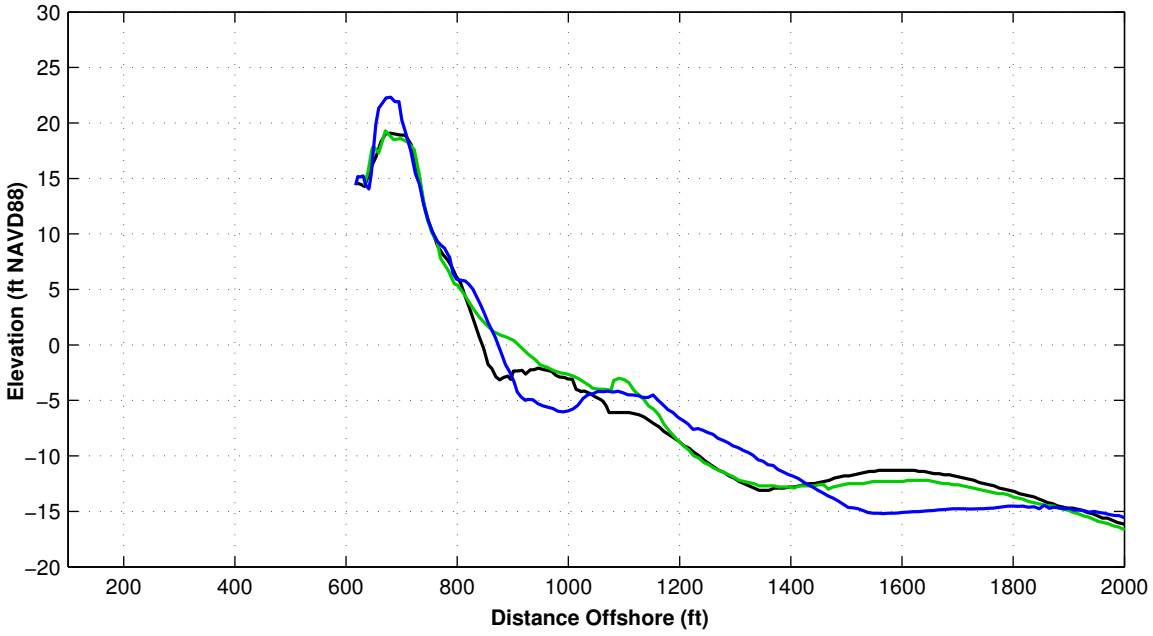
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 825+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 27.16 ft | −23.85 ft |
| Volume Change Above +6 ft NAVD88 | 4.85 cy/ft | 3.97 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 8.53 cy/ft | 0.56 cy/ft |
| Volume Change Above −6 ft NAVD88 | 6.90 cy/ft | −2.05 cy/ft |
| Volume Change Above −14 ft NAVD88 | 1.58 cy/ft | 33.61 cy/ft |
| Volume Change Above −19 ft NAVD88 | −2.23 cy/ft | 29.33 cy/ft |
| Volume Change Above −30 ft NAVD88 | 6.44 cy/ft | 20.10 cy/ft |

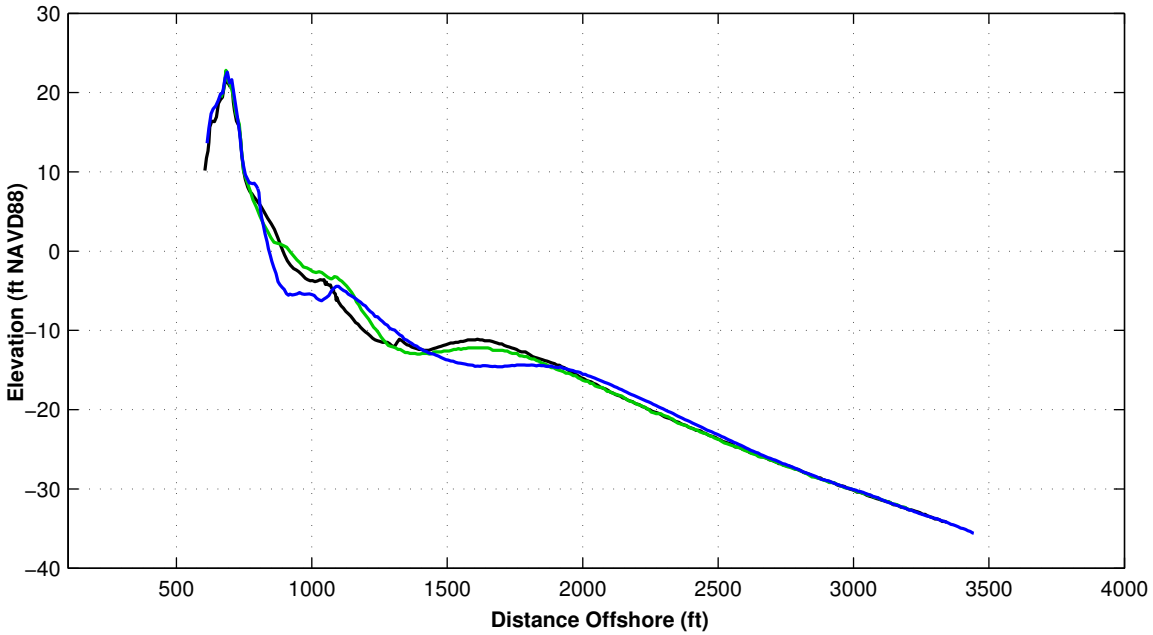
**LEGEND:**

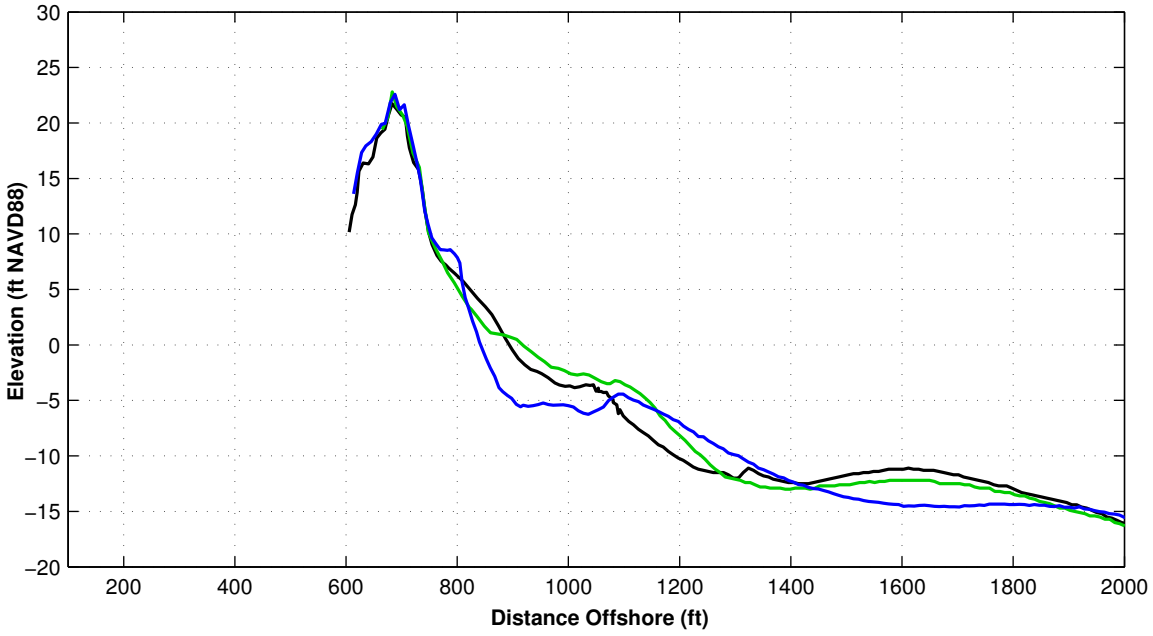
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 830+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −45.40 ft | 12.49 ft |
| Volume Change Above +6 ft NAVD88 | 4.50 cy/ft | 2.43 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −0.23 cy/ft | 6.30 cy/ft |
| Volume Change Above −6 ft NAVD88 | −21.88 cy/ft | 6.53 cy/ft |
| Volume Change Above −14 ft NAVD88 | −30.72 cy/ft | 34.15 cy/ft |
| Volume Change Above −19 ft NAVD88 | −29.52 cy/ft | 23.89 cy/ft |
| Volume Change Above −30 ft NAVD88 | −18.35 cy/ft | 10.16 cy/ft |

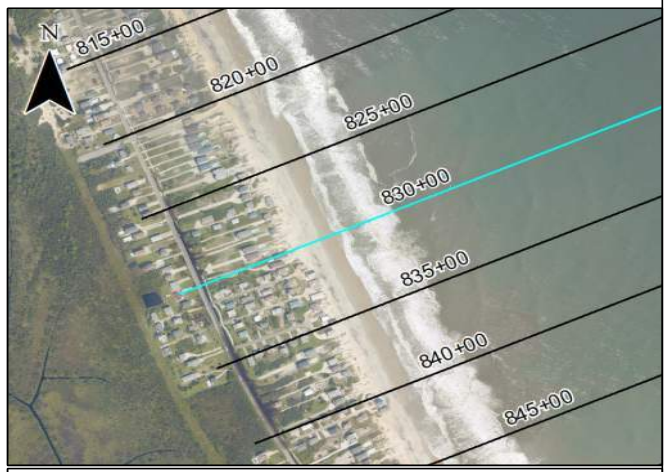
**LEGEND:**

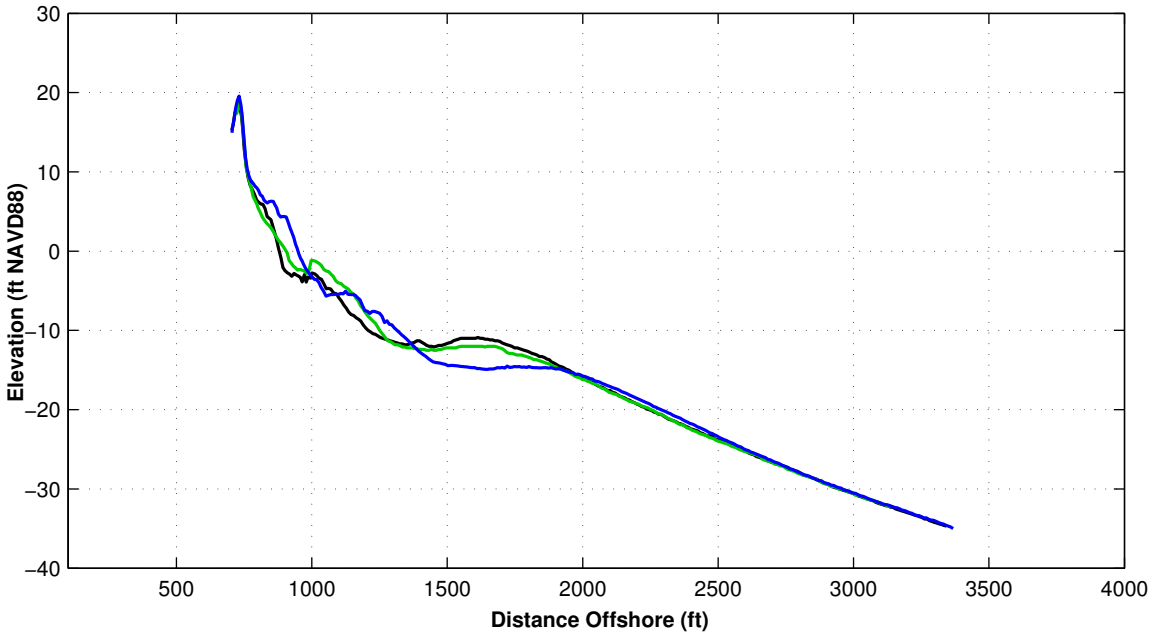
JUNE 2024 — OCTOBER 2023

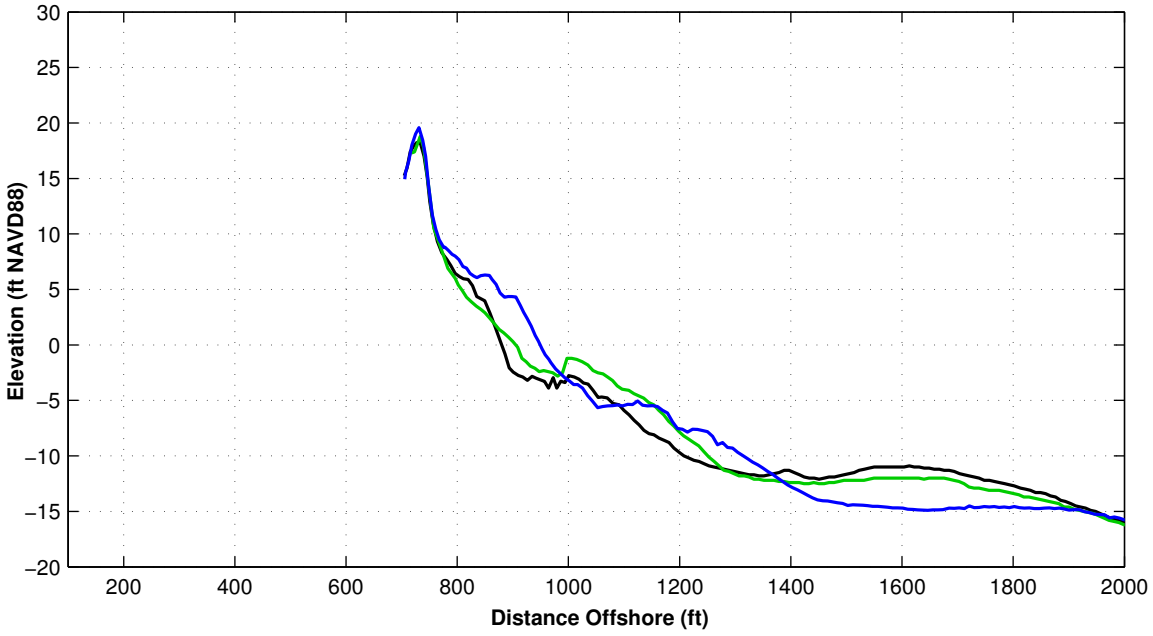
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 835+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 66.19 ft | −0.08 ft |
| Volume Change Above +6 ft NAVD88 | 3.79 cy/ft | 1.77 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.92 cy/ft | 1.80 cy/ft |
| Volume Change Above −6 ft NAVD88 | 25.31 cy/ft | −3.26 cy/ft |
| Volume Change Above −14 ft NAVD88 | 5.36 cy/ft | 39.39 cy/ft |
| Volume Change Above −19 ft NAVD88 | −1.16 cy/ft | 57.76 cy/ft |
| Volume Change Above −30 ft NAVD88 | 8.26 cy/ft | 44.20 cy/ft |

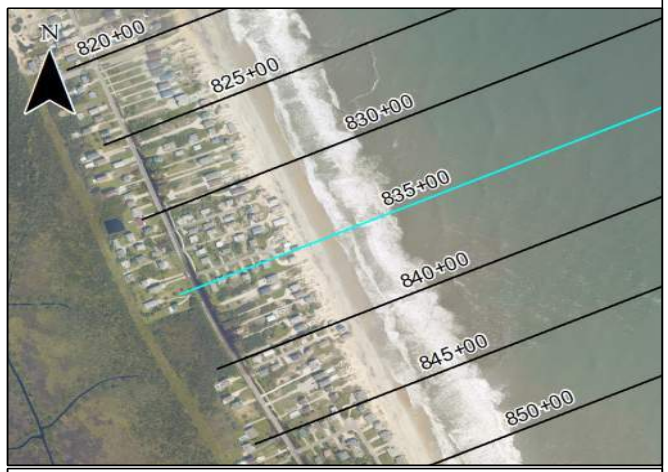
**LEGEND:**

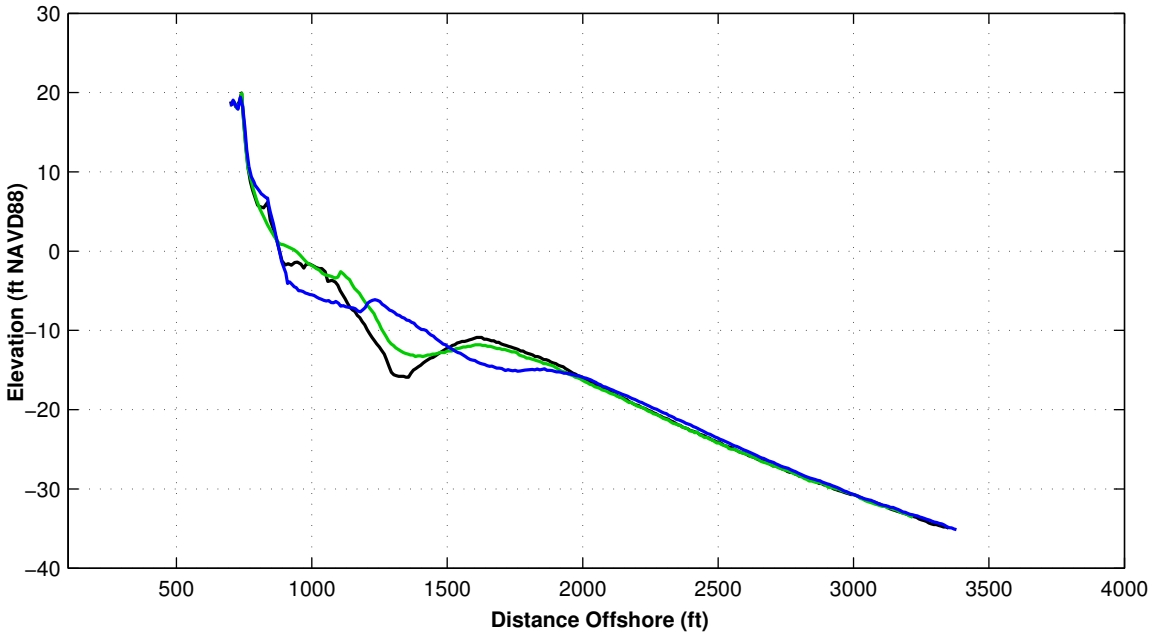
JUNE 2024 — OCTOBER 2023

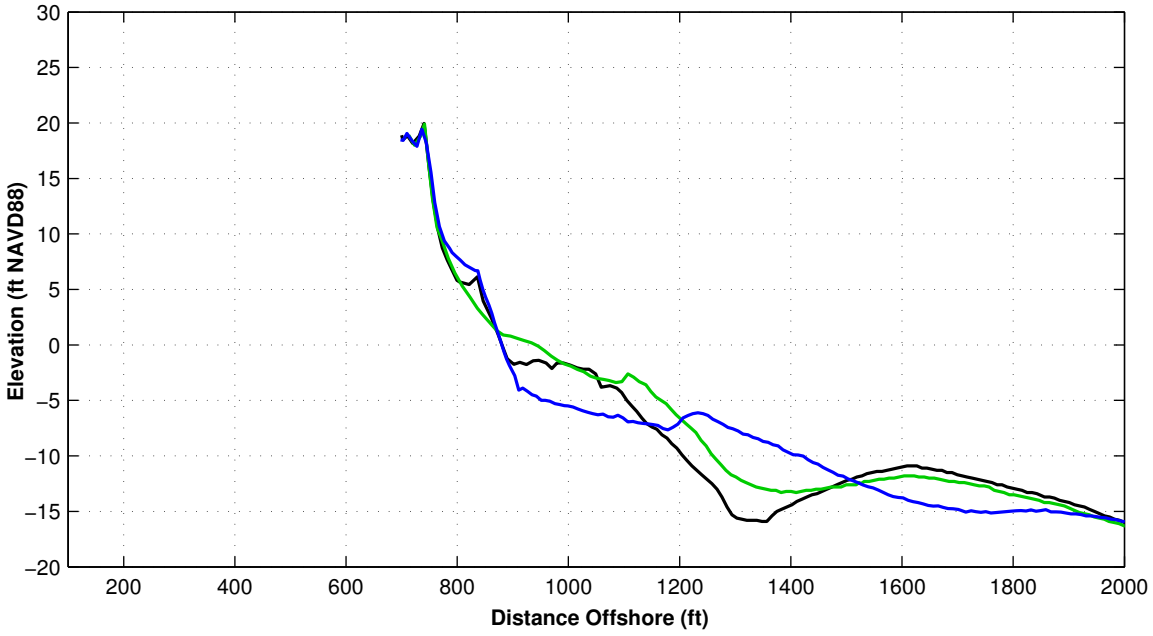
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 840+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 0.89 ft | 0.98 ft |
| Volume Change Above +6 ft NAVD88 | 3.65 cy/ft | 2.25 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.83 cy/ft | 3.15 cy/ft |
| Volume Change Above −6 ft NAVD88 | −18.03 cy/ft | 8.65 cy/ft |
| Volume Change Above −14 ft NAVD88 | 7.35 cy/ft | 22.50 cy/ft |
| Volume Change Above −19 ft NAVD88 | 5.55 cy/ft | 12.16 cy/ft |
| Volume Change Above −30 ft NAVD88 | 17.83 cy/ft | 0.06 cy/ft |

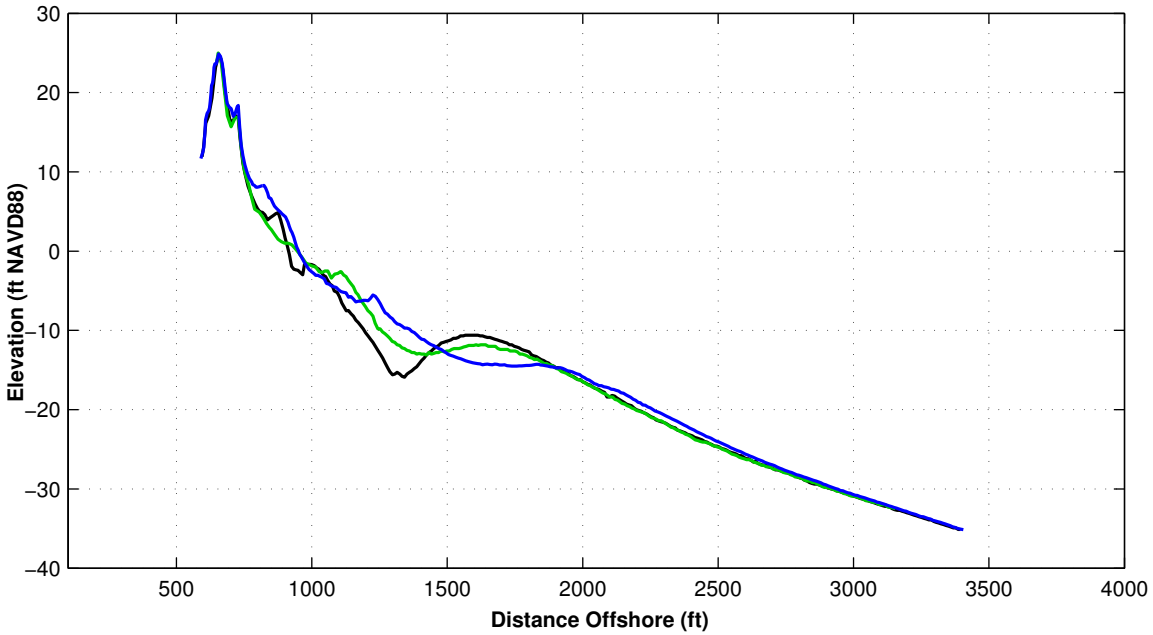
**LEGEND:**

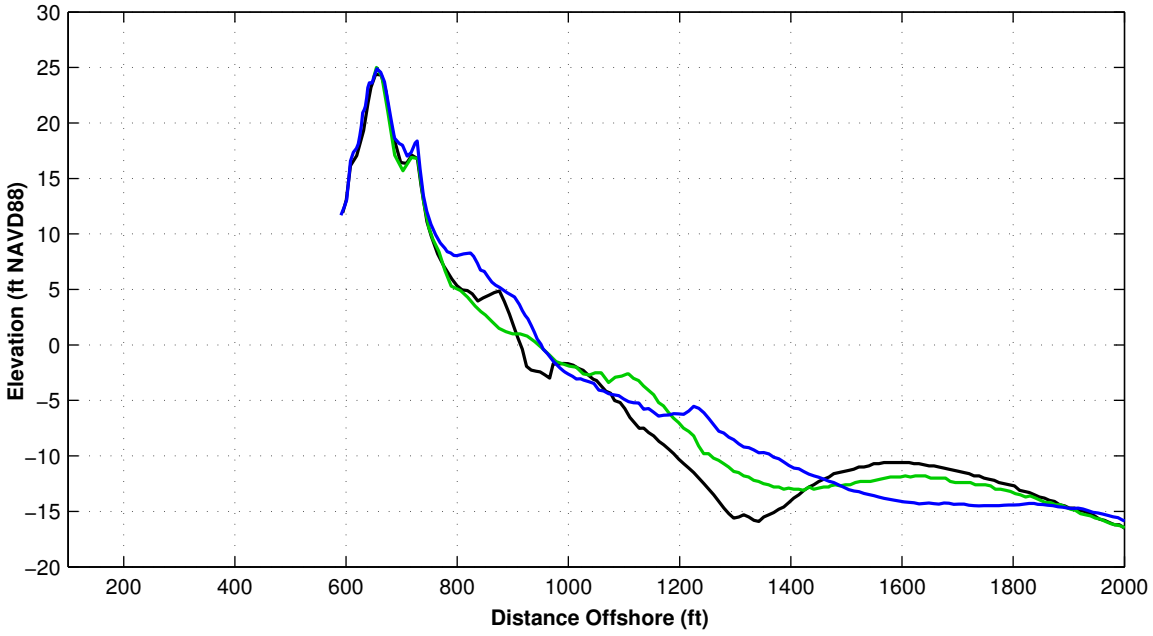
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 845+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 33.35 ft | 23.78 ft |
| Volume Change Above +6 ft NAVD88 | 8.92 cy/ft | 1.78 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 16.28 cy/ft | 3.78 cy/ft |
| Volume Change Above −6 ft NAVD88 | 21.44 cy/ft | 5.54 cy/ft |
| Volume Change Above −14 ft NAVD88 | 37.39 cy/ft | 29.66 cy/ft |
| Volume Change Above −19 ft NAVD88 | 45.75 cy/ft | 32.24 cy/ft |
| Volume Change Above −30 ft NAVD88 | 63.29 cy/ft | 31.27 cy/ft |

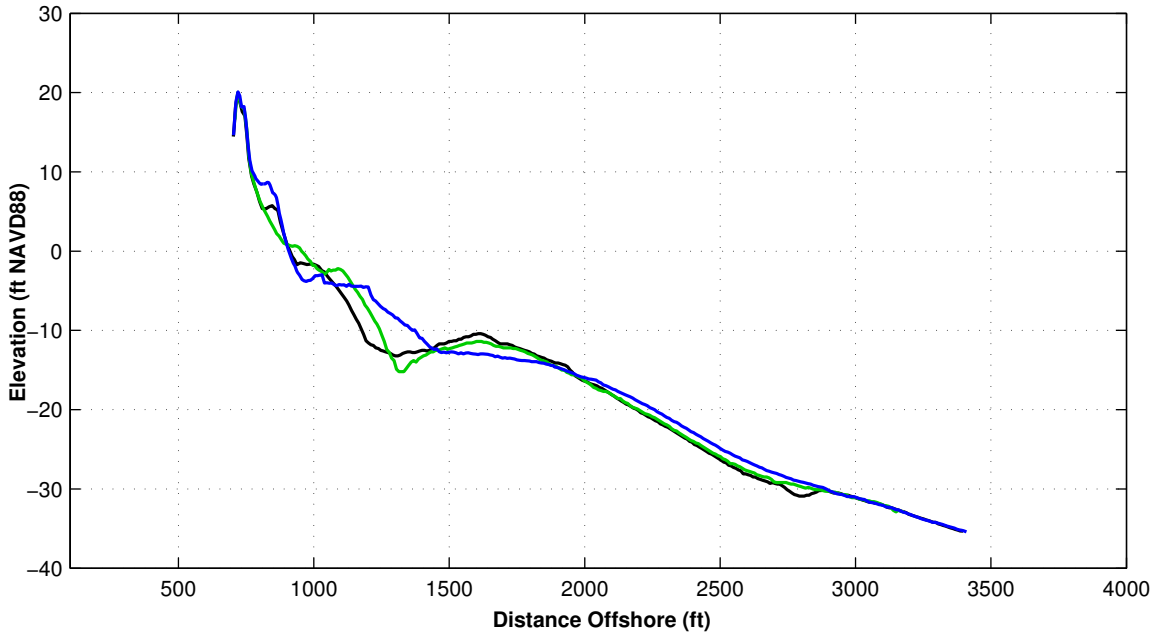
**LEGEND:**

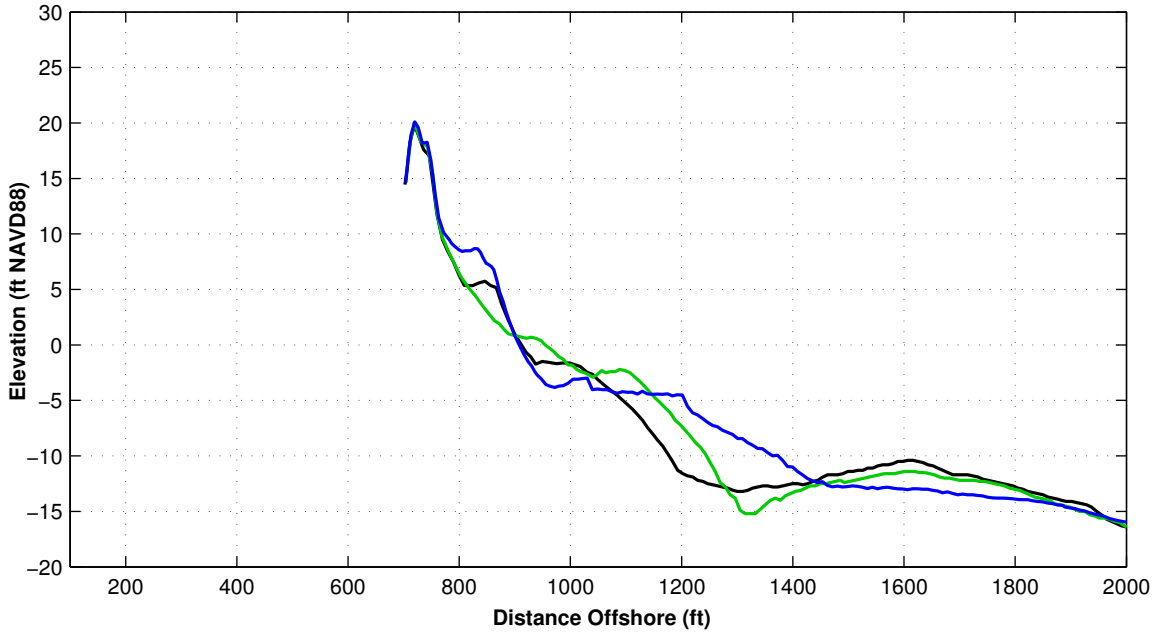
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 850+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −0.67 ft | 5.12 ft |
| Volume Change Above +6 ft NAVD88 | 7.63 cy/ft | 3.05 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.26 cy/ft | 6.00 cy/ft |
| Volume Change Above −6 ft NAVD88 | 8.42 cy/ft | 5.17 cy/ft |
| Volume Change Above −14 ft NAVD88 | 25.72 cy/ft | 16.00 cy/ft |
| Volume Change Above −19 ft NAVD88 | 29.17 cy/ft | 20.71 cy/ft |
| Volume Change Above −30 ft NAVD88 | 62.32 cy/ft | −52.84 cy/ft |

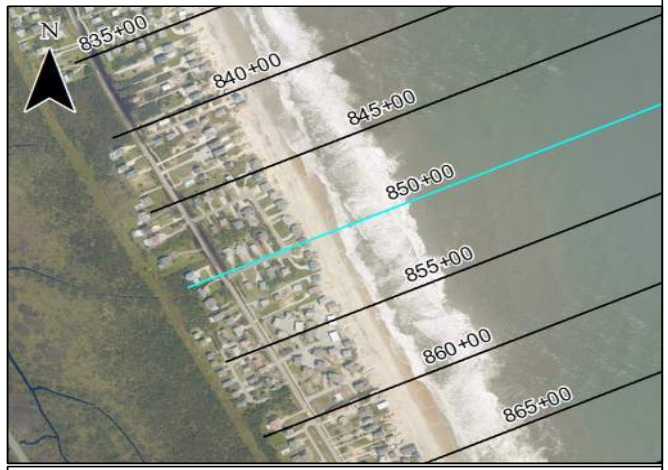
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

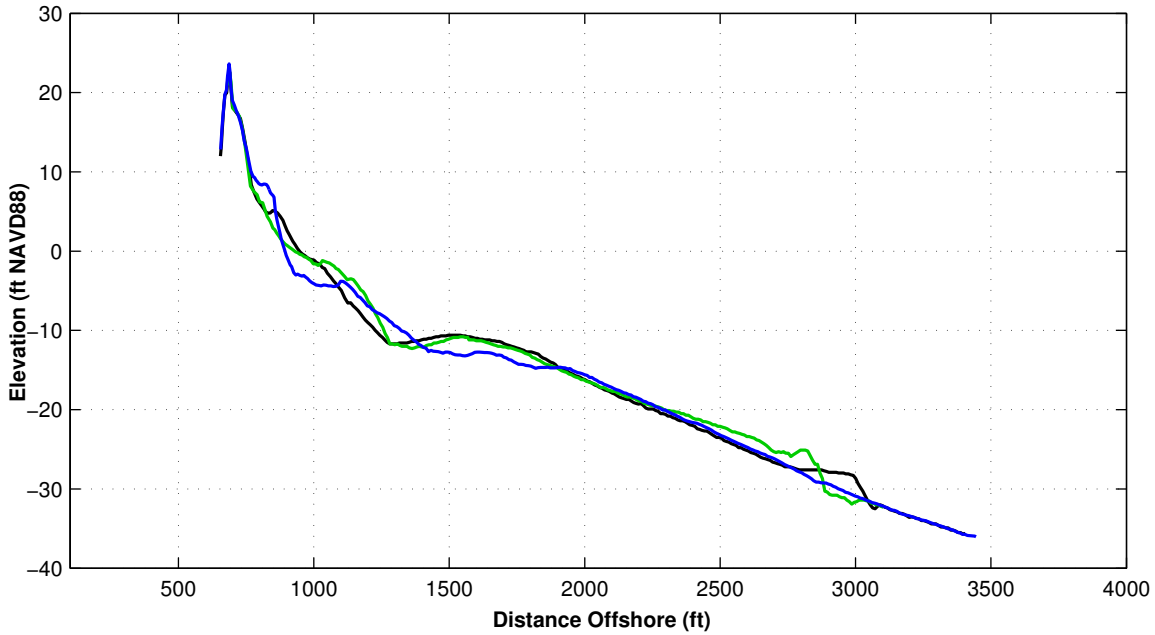
Notes:

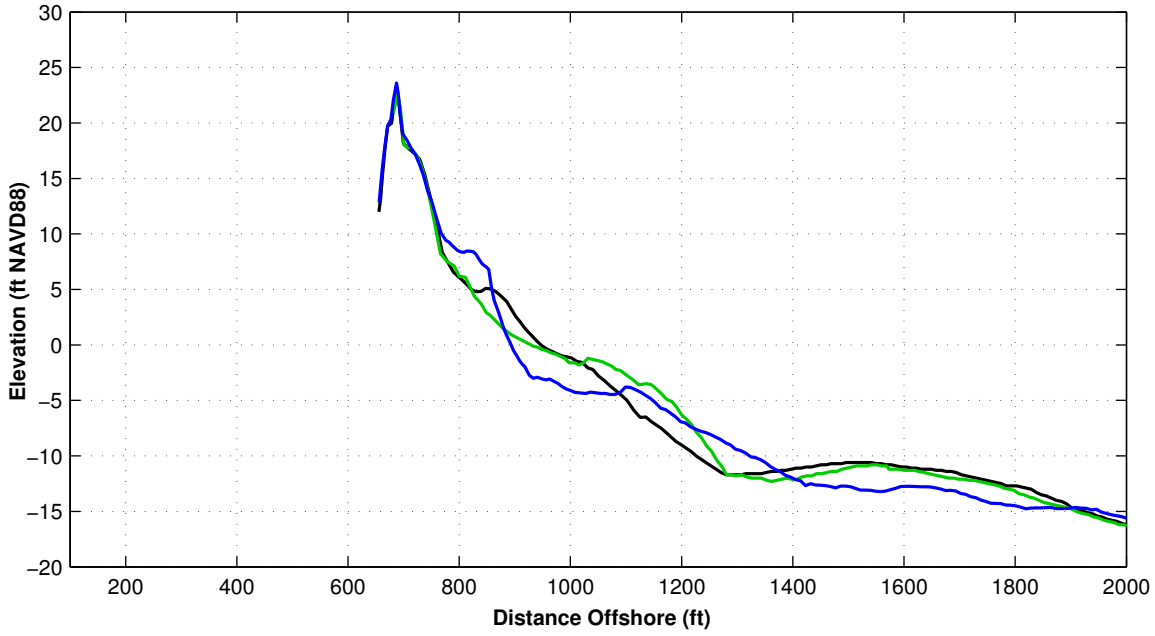
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 850+00 | Pg 128 of 173 | 2024 |
|---|---|---|




| Survey Transect 855+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −41.02 ft | 46.11 ft |
| Volume Change Above +6 ft NAVD88 | 7.25 cy/ft | 4.79 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 5.45 cy/ft | 9.23 cy/ft |
| Volume Change Above −6 ft NAVD88 | −8.31 cy/ft | 18.01 cy/ft |
| Volume Change Above −14 ft NAVD88 | −20.95 cy/ft | 31.84 cy/ft |
| Volume Change Above −19 ft NAVD88 | −17.32 cy/ft | 6.46 cy/ft |
| Volume Change Above −30 ft NAVD88 | −20.06 cy/ft | 14.15 cy/ft |

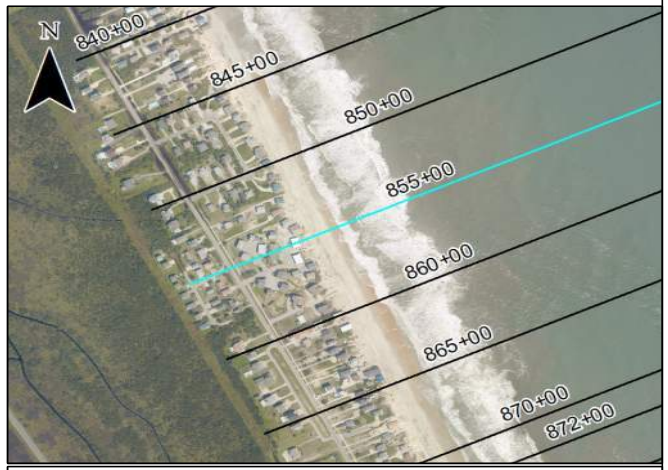
**LEGEND:**

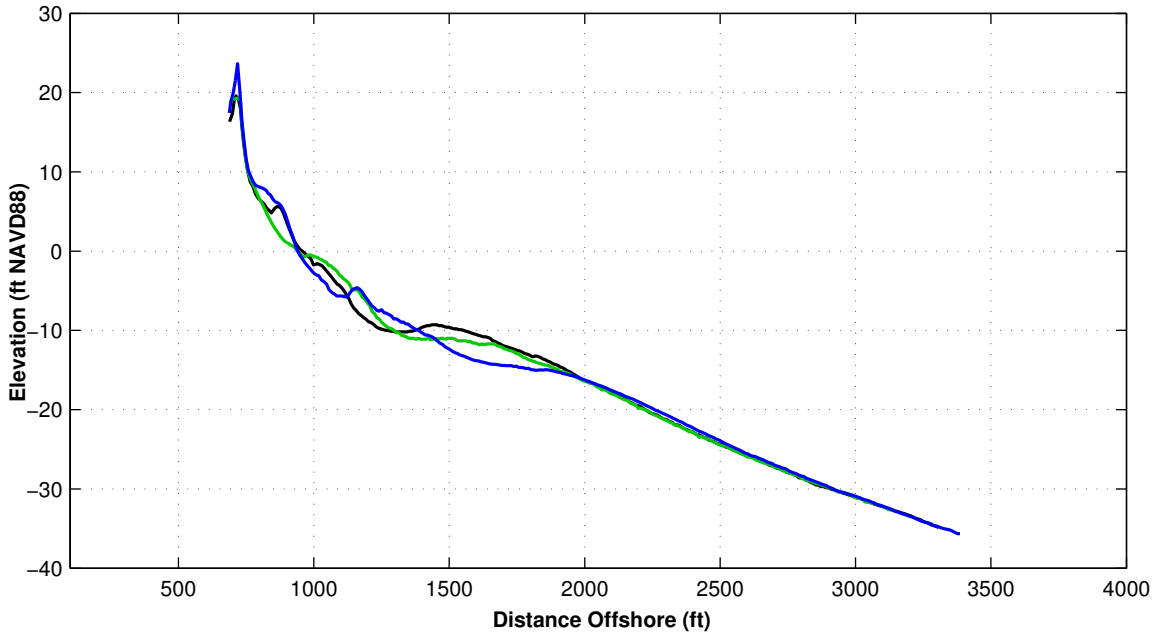
JUNE 2024 — OCTOBER 2023

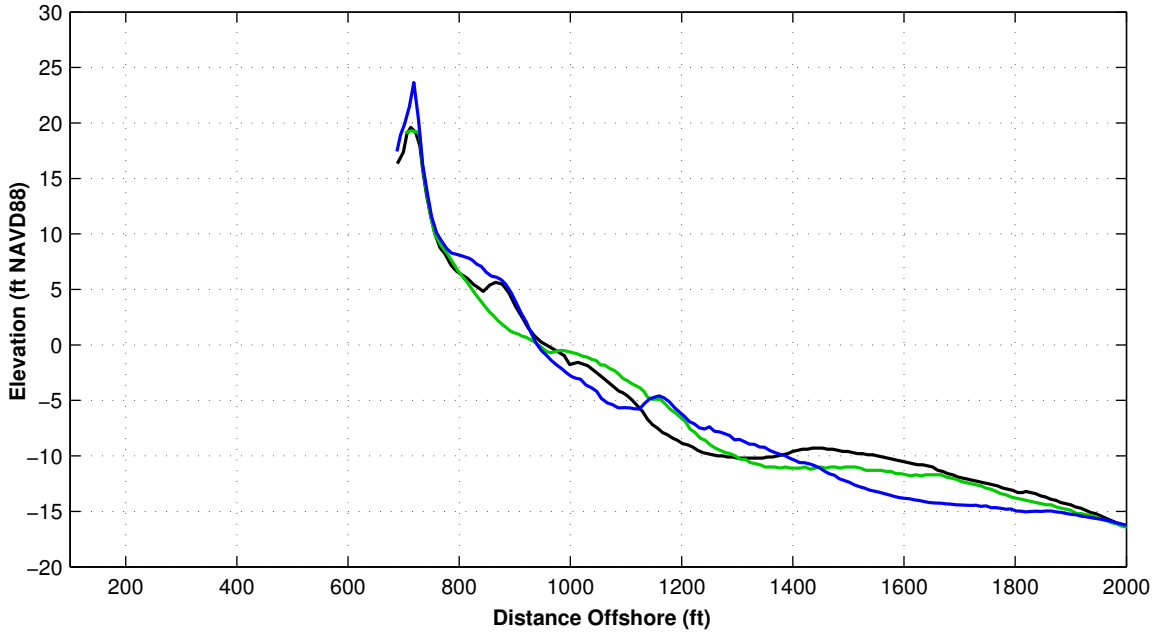
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 860+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −1.25 ft | 71.84 ft |
| Volume Change Above +6 ft NAVD88 | 8.22 cy/ft | 4.66 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 10.21 cy/ft | 14.25 cy/ft |
| Volume Change Above −6 ft NAVD88 | 3.41 cy/ft | 32.97 cy/ft |
| Volume Change Above −14 ft NAVD88 | −17.40 cy/ft | 77.63 cy/ft |
| Volume Change Above −19 ft NAVD88 | −23.46 cy/ft | 54.49 cy/ft |
| Volume Change Above −30 ft NAVD88 | −12.40 cy/ft | 27.31 cy/ft |

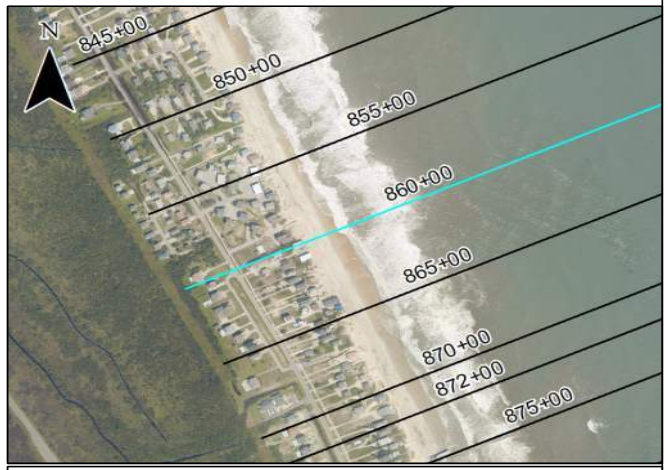
**LEGEND:**

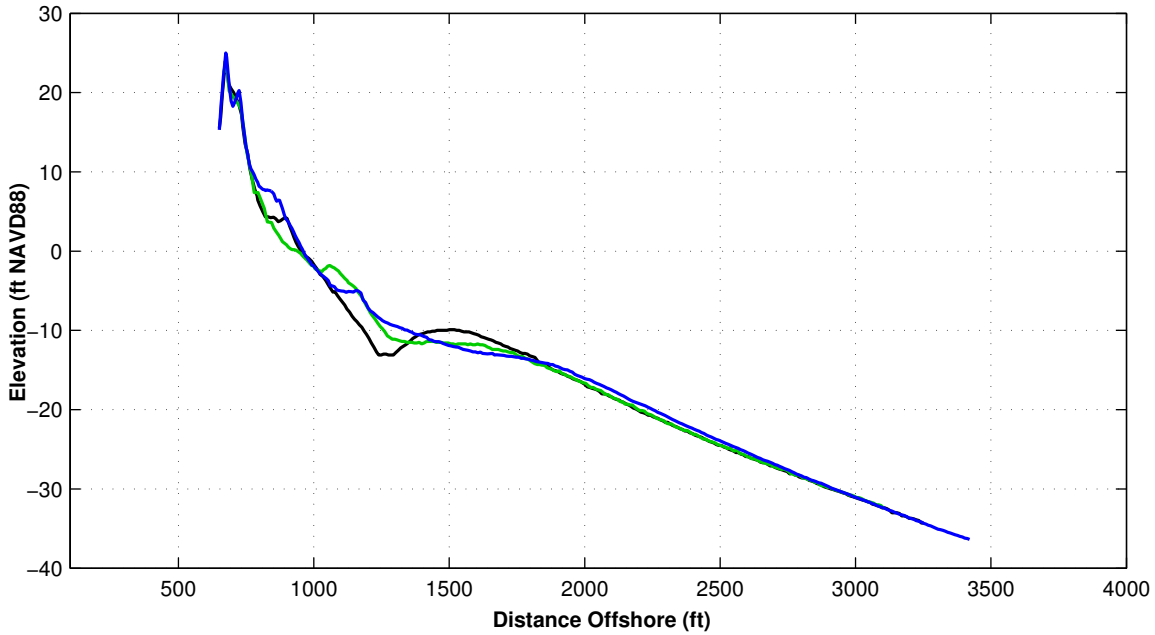
JUNE 2024 — OCTOBER 2023

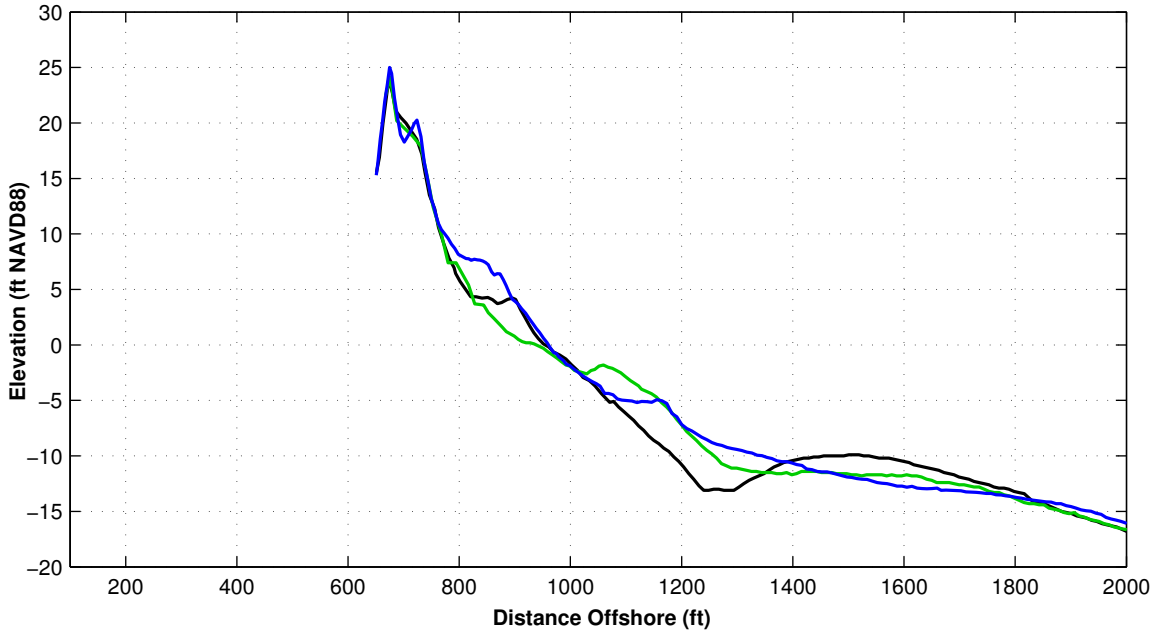
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 865+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 10.39 ft | 61.45 ft |
| Volume Change Above +6 ft NAVD88 | 6.40 cy/ft | 4.85 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 12.24 cy/ft | 9.80 cy/ft |
| Volume Change Above −6 ft NAVD88 | 16.29 cy/ft | 23.19 cy/ft |
| Volume Change Above −14 ft NAVD88 | 22.77 cy/ft | 61.81 cy/ft |
| Volume Change Above −19 ft NAVD88 | 31.42 cy/ft | 48.30 cy/ft |
| Volume Change Above −30 ft NAVD88 | 46.15 cy/ft | 28.73 cy/ft |

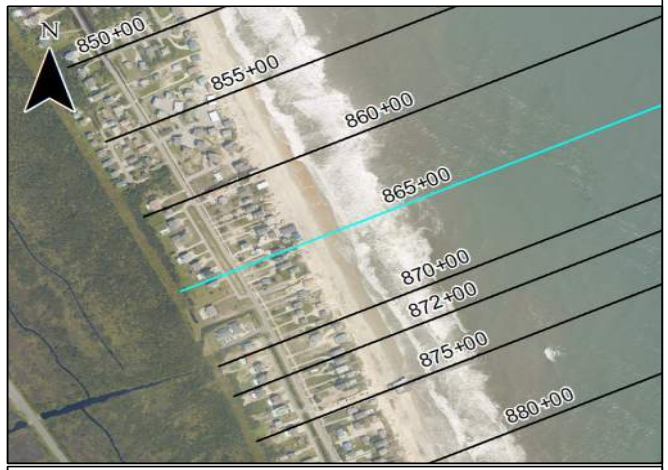
**LEGEND:**

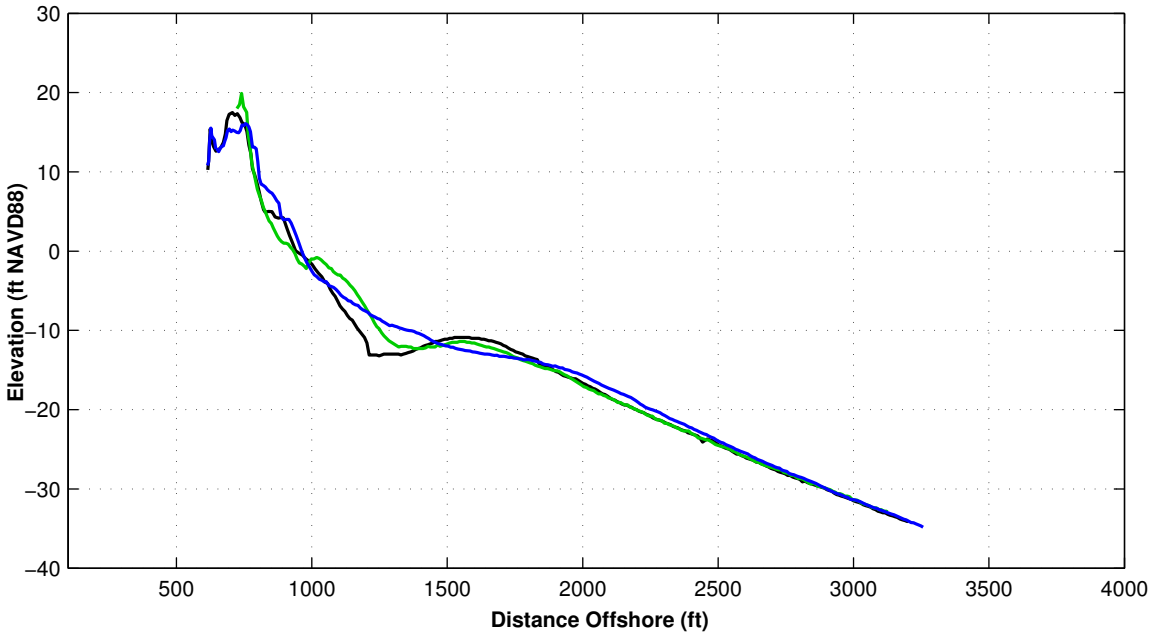
JUNE 2024 — OCTOBER 2023

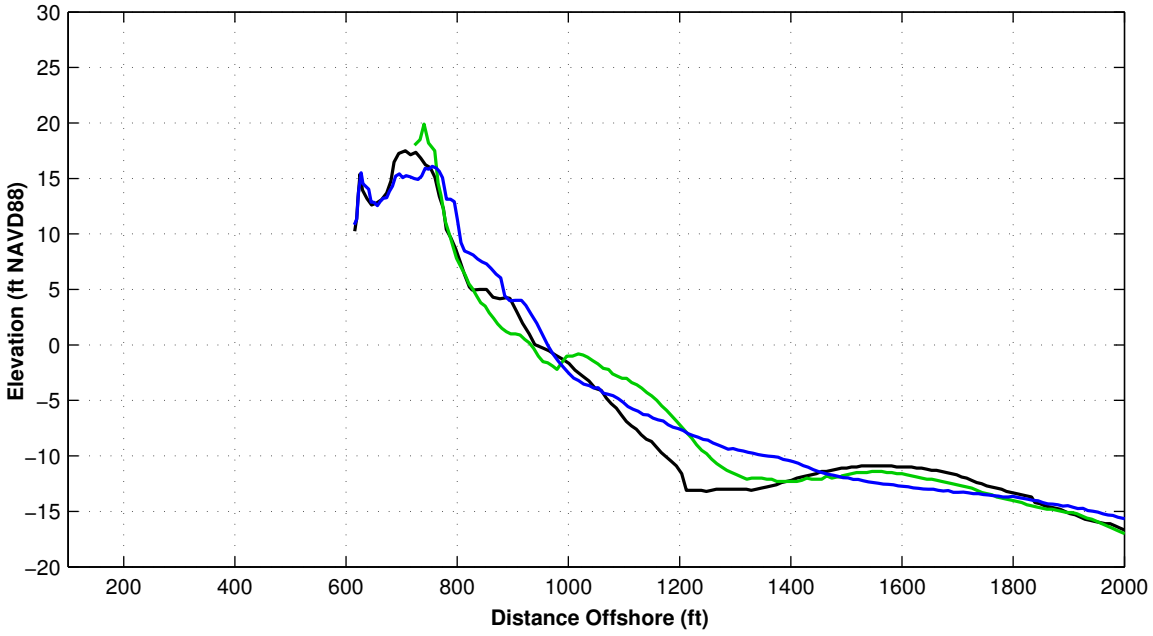
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 870+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 23.53 ft | 52.68 ft |
| Volume Change Above +6 ft NAVD88 | 4.33 cy/ft | 3.73 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.76 cy/ft | 9.03 cy/ft |
| Volume Change Above −6 ft NAVD88 | 10.77 cy/ft | 15.87 cy/ft |
| Volume Change Above −14 ft NAVD88 | 31.37 cy/ft | 12.75 cy/ft |
| Volume Change Above −19 ft NAVD88 | 42.03 cy/ft | −12.33 cy/ft |
| Volume Change Above −30 ft NAVD88 | 57.63 cy/ft | −36.29 cy/ft |

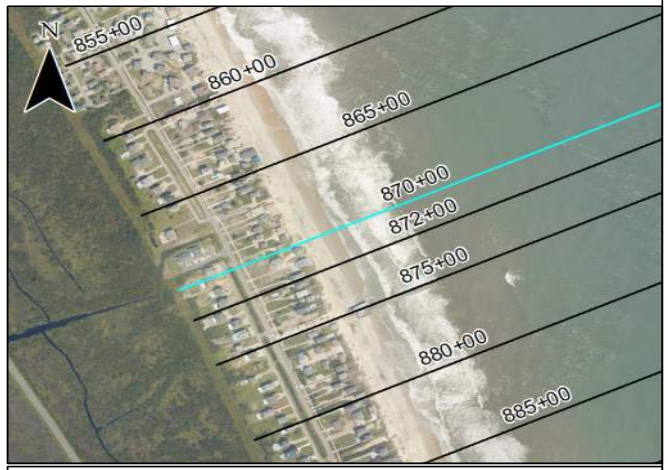
**LEGEND:**

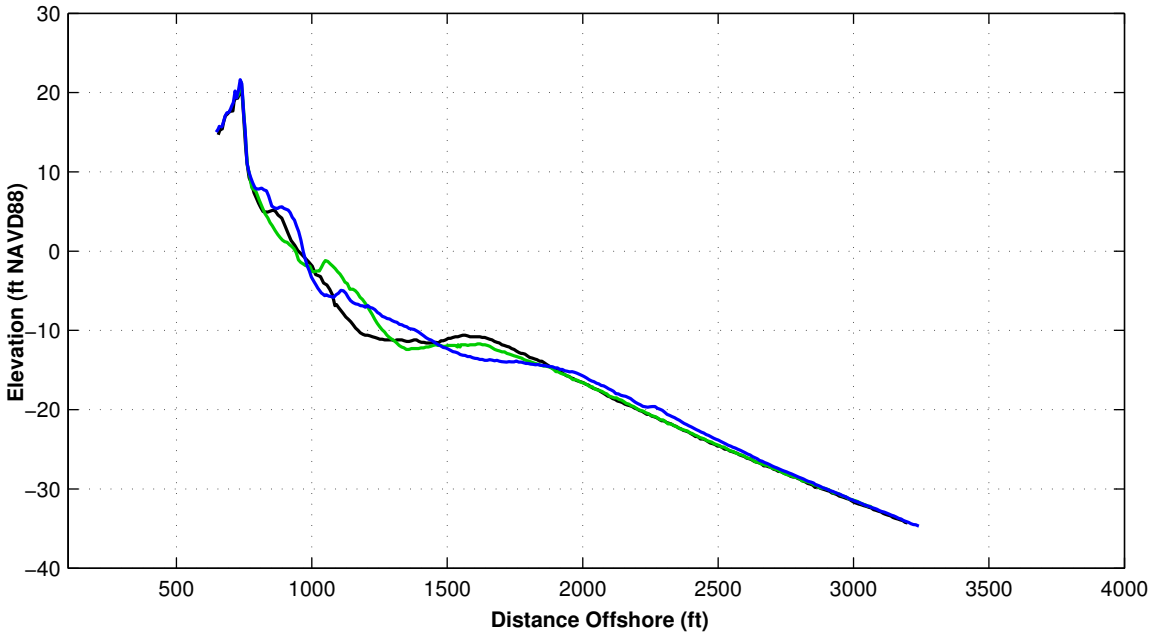
JUNE 2024 — OCTOBER 2023

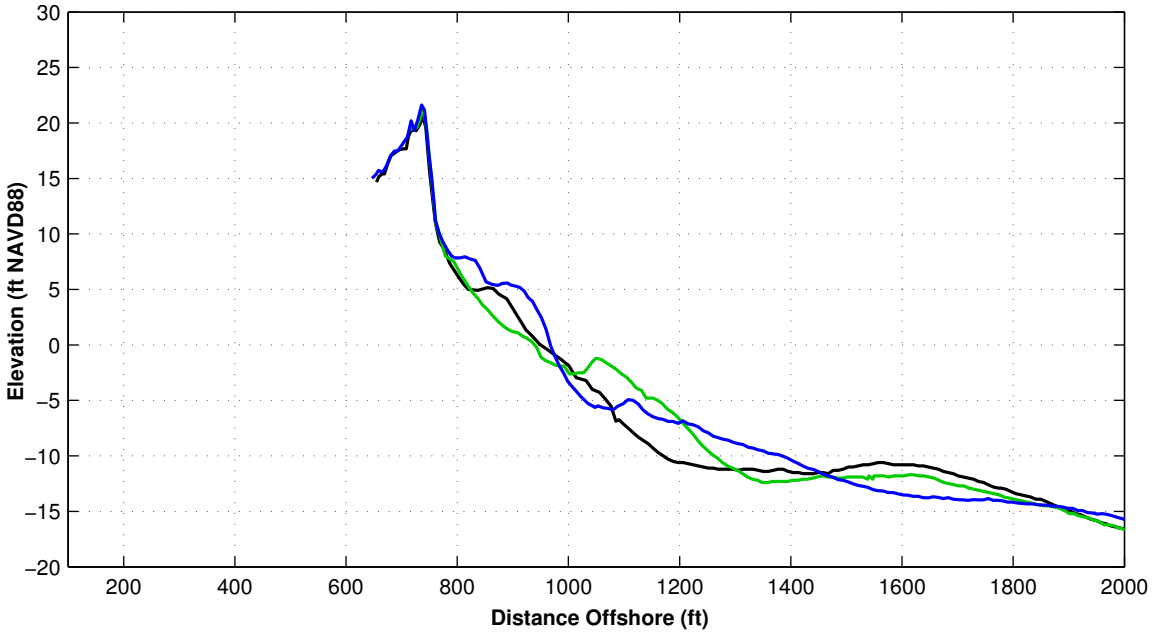
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 872+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 33.74 ft | 52.93 ft |
| Volume Change Above +6 ft NAVD88 | 5.32 cy/ft | 2.78 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.76 cy/ft | 8.41 cy/ft |
| Volume Change Above −6 ft NAVD88 | 11.94 cy/ft | 14.40 cy/ft |
| Volume Change Above −14 ft NAVD88 | 16.92 cy/ft | 29.50 cy/ft |
| Volume Change Above −19 ft NAVD88 | 23.98 cy/ft | 12.35 cy/ft |
| Volume Change Above −30 ft NAVD88 | 41.27 cy/ft | −12.26 cy/ft |

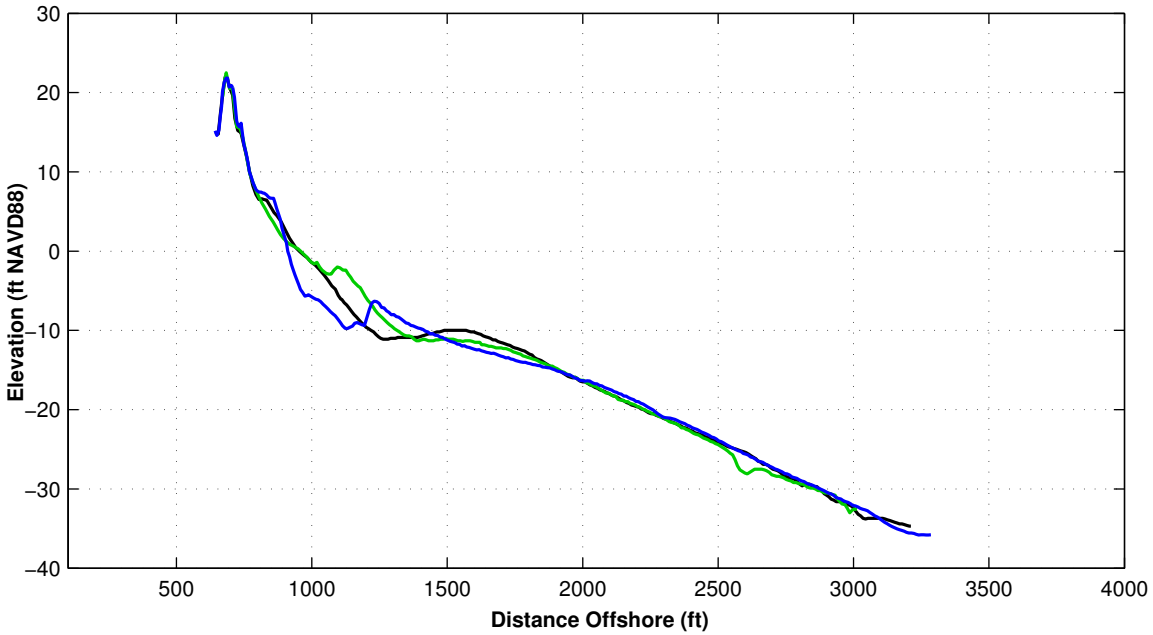
**LEGEND:**

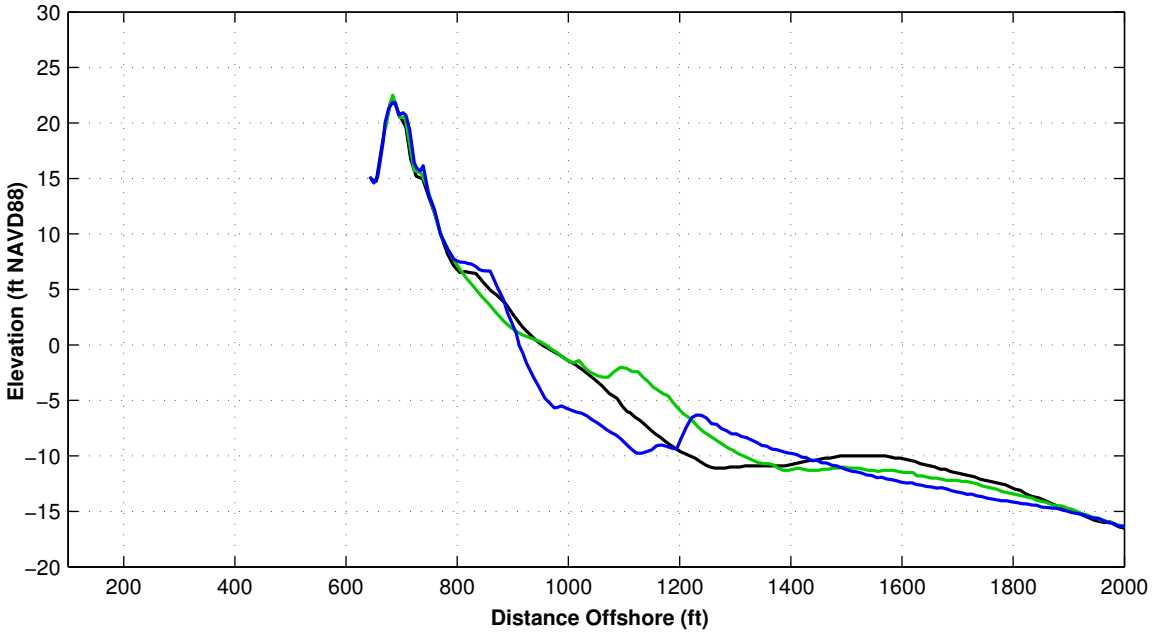
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 880+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −21.34 ft | 52.83 ft |
| Volume Change Above +6 ft NAVD88 | 4.20 cy/ft | 1.01 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.27 cy/ft | 6.24 cy/ft |
| Volume Change Above −6 ft NAVD88 | −18.69 cy/ft | 13.27 cy/ft |
| Volume Change Above −14 ft NAVD88 | −29.72 cy/ft | 51.73 cy/ft |
| Volume Change Above −19 ft NAVD88 | −27.32 cy/ft | 53.51 cy/ft |
| Volume Change Above −30 ft NAVD88 | −20.41 cy/ft | 17.87 cy/ft |

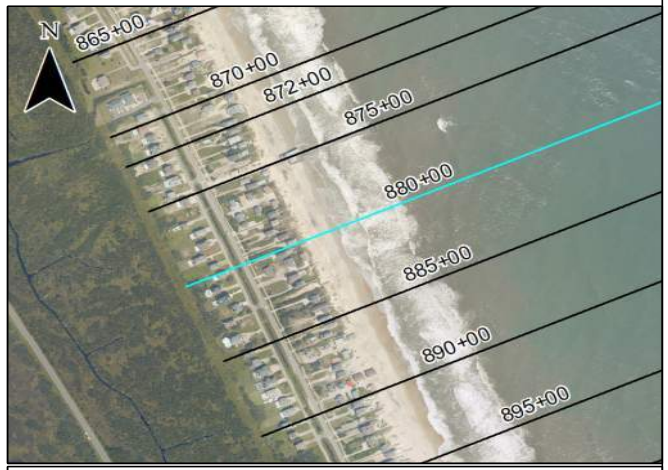
**LEGEND:**

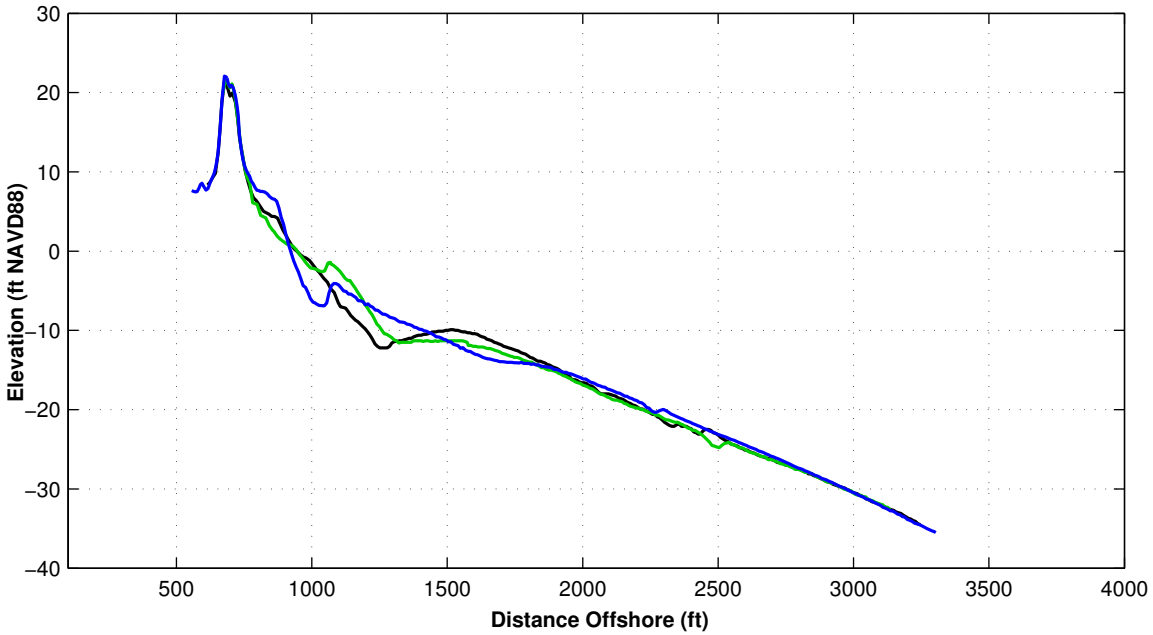
JUNE 2024 — OCTOBER 2023

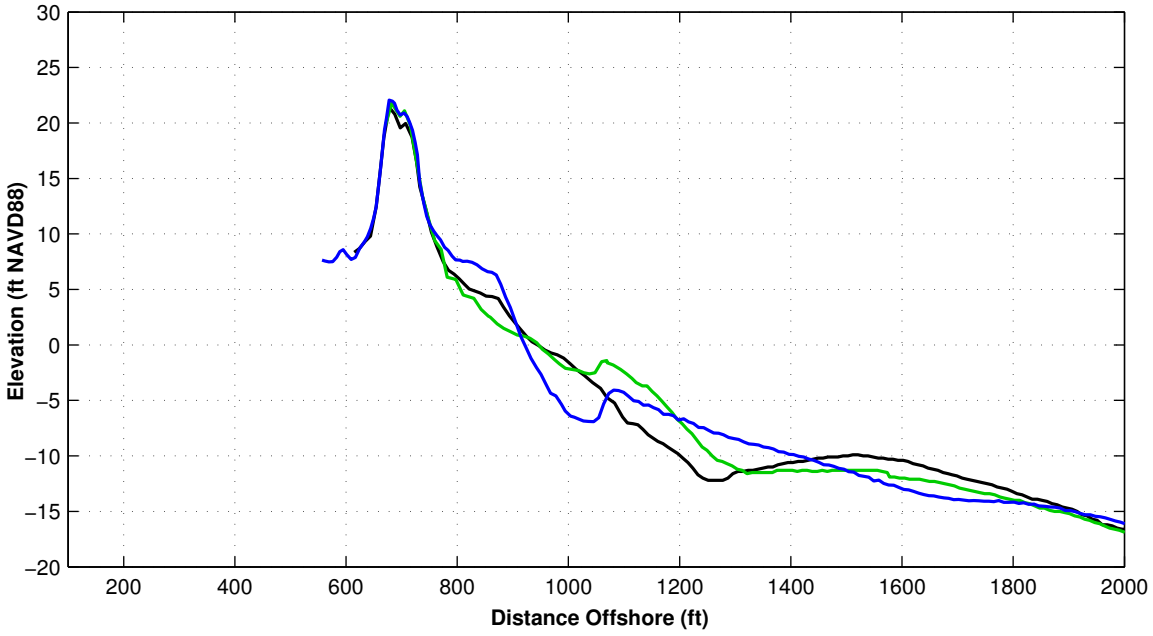
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 885+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | –6.44 ft | 38.81 ft |
| Volume Change Above +6 ft NAVD88 | 7.17 cy/ft | 2.49 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 11.45 cy/ft | 6.18 cy/ft |
| Volume Change Above –6 ft NAVD88 | –1.55 cy/ft | 13.61 cy/ft |
| Volume Change Above –14 ft NAVD88 | 3.25 cy/ft | 49.32 cy/ft |
| Volume Change Above –19 ft NAVD88 | 7.24 cy/ft | 53.53 cy/ft |
| Volume Change Above –30 ft NAVD88 | 21.54 cy/ft | 38.70 cy/ft |

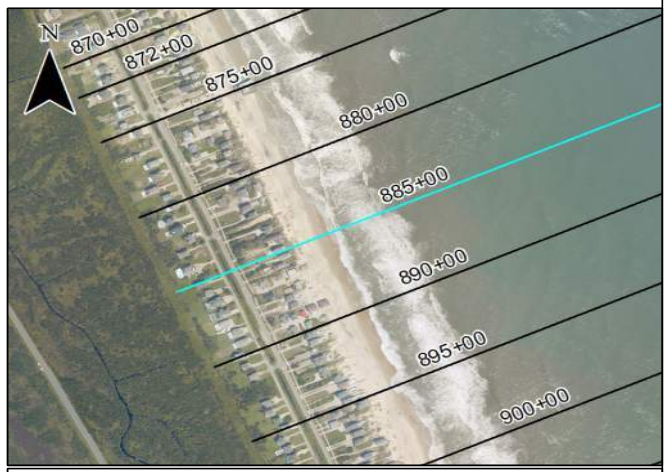
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

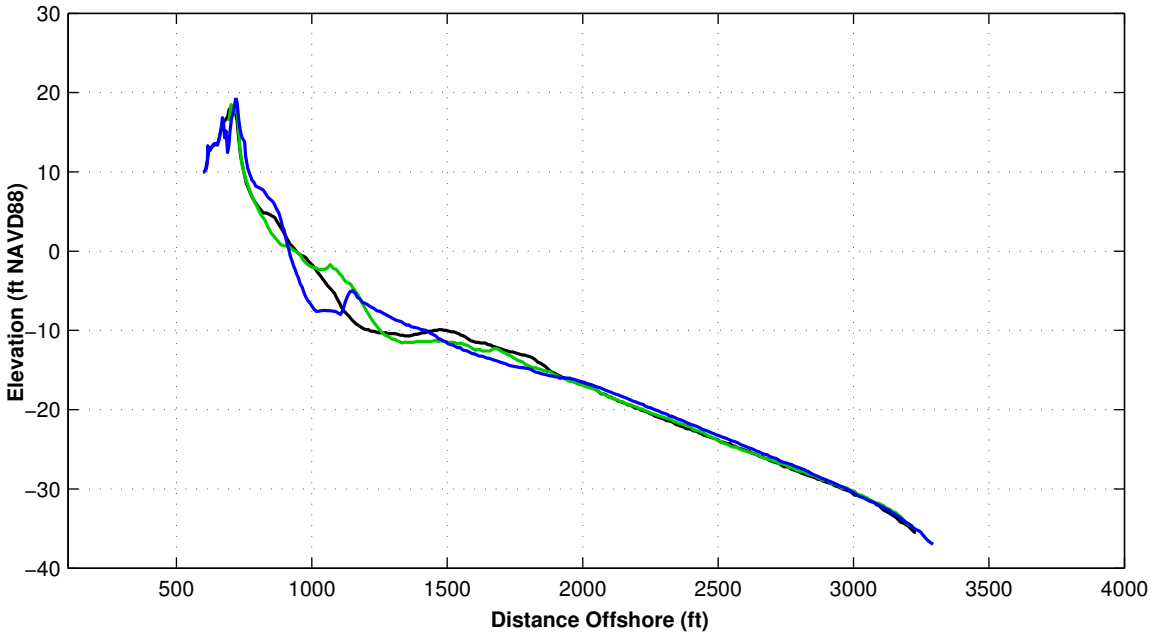
Notes:

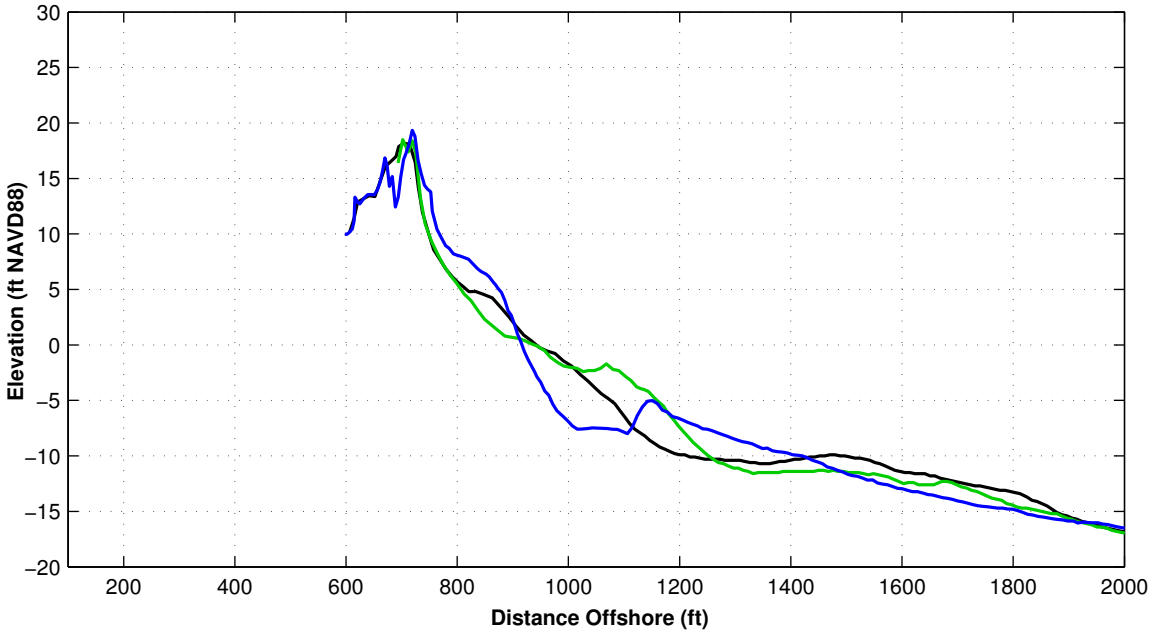
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 885+00 | Pg 135 of 173 | 2024 |
|---|---|---|




| Survey Transect 890+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −7.56 ft | 70.66 ft |
| Volume Change Above +6 ft NAVD88 | 7.46 cy/ft | 4.18 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 11.61 cy/ft | 11.47 cy/ft |
| Volume Change Above −6 ft NAVD88 | −6.01 cy/ft | 25.69 cy/ft |
| Volume Change Above −14 ft NAVD88 | −8.81 cy/ft | 60.93 cy/ft |
| Volume Change Above −19 ft NAVD88 | −10.42 cy/ft | 33.96 cy/ft |
| Volume Change Above −30 ft NAVD88 | 6.22 cy/ft | 9.44 cy/ft |

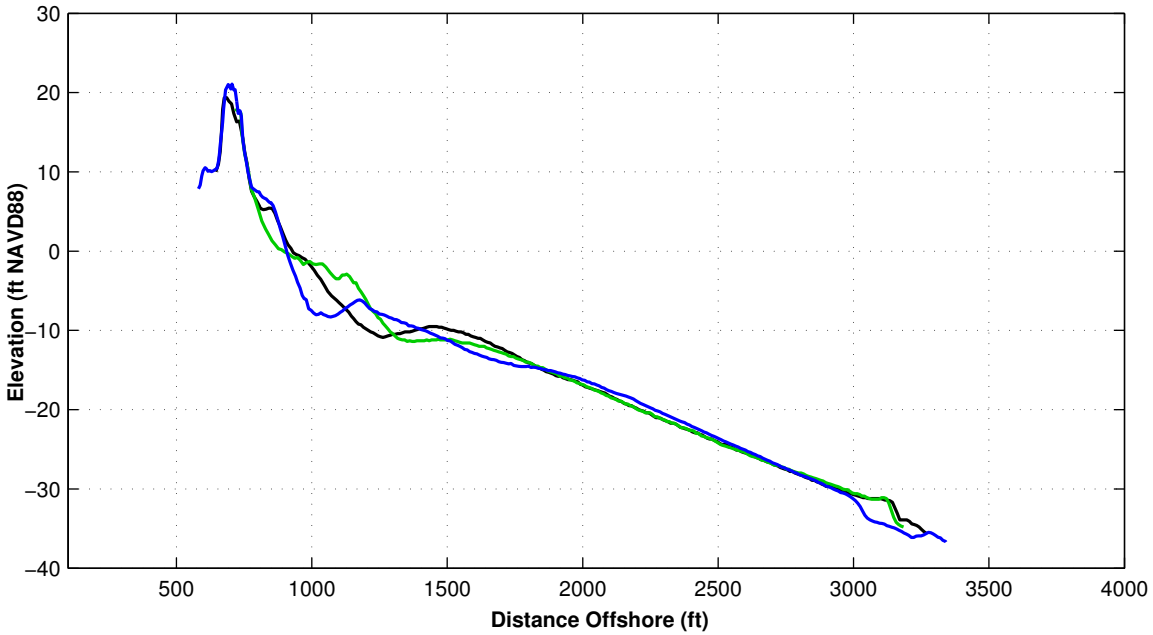
**LEGEND:**

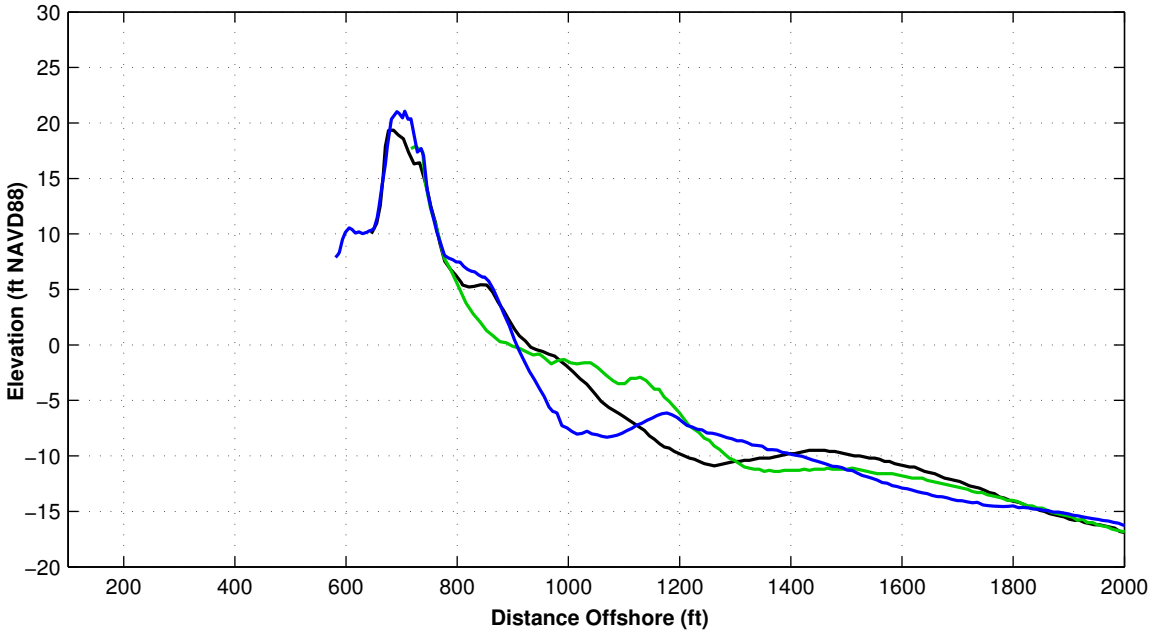
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 895+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −8.73 ft | 70.01 ft |
| Volume Change Above +6 ft NAVD88 | 6.48 cy/ft | 6.05 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 7.61 cy/ft | 17.15 cy/ft |
| Volume Change Above −6 ft NAVD88 | −10.45 cy/ft | 33.28 cy/ft |
| Volume Change Above −14 ft NAVD88 | −19.77 cy/ft | 70.84 cy/ft |
| Volume Change Above −19 ft NAVD88 | −14.39 cy/ft | 44.24 cy/ft |
| Volume Change Above −30 ft NAVD88 | −2.80 cy/ft | 21.36 cy/ft |

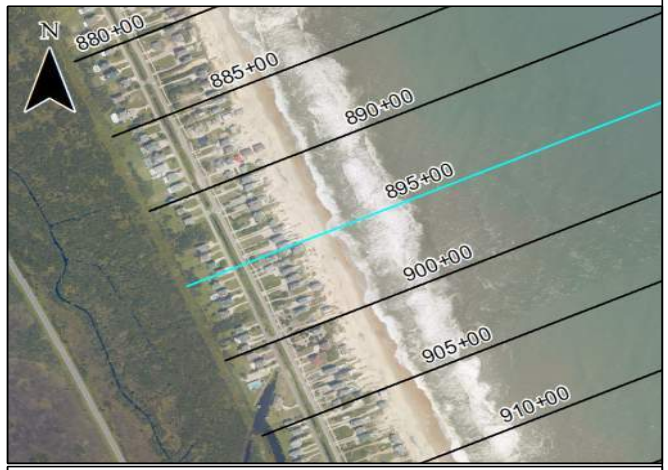
**LEGEND:**

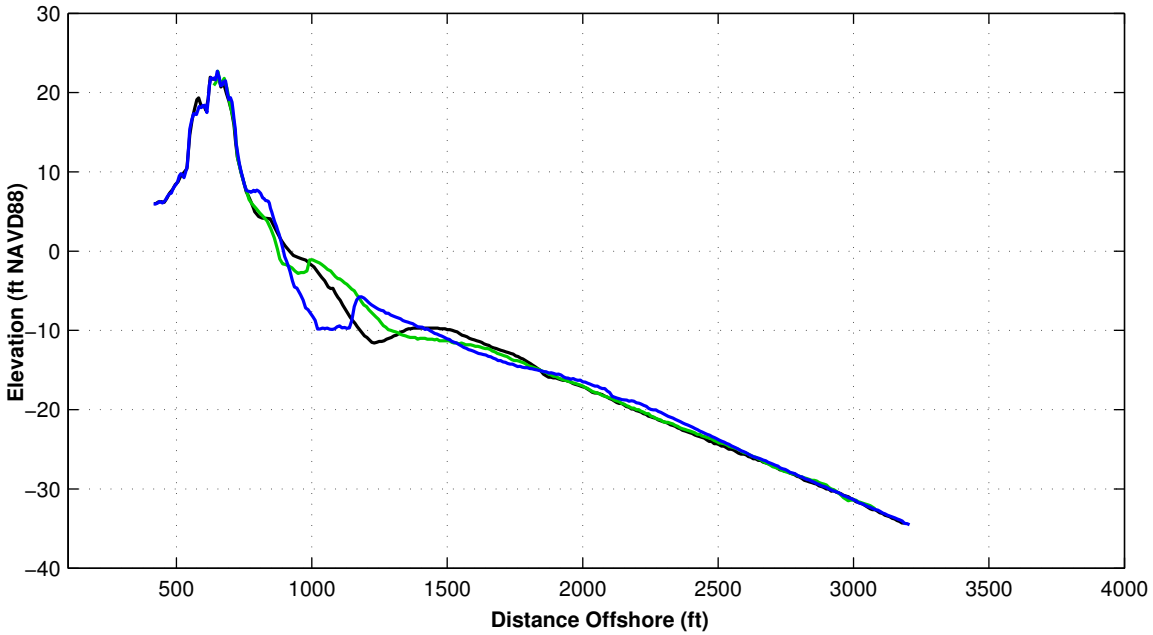
JUNE 2024 — OCTOBER 2023

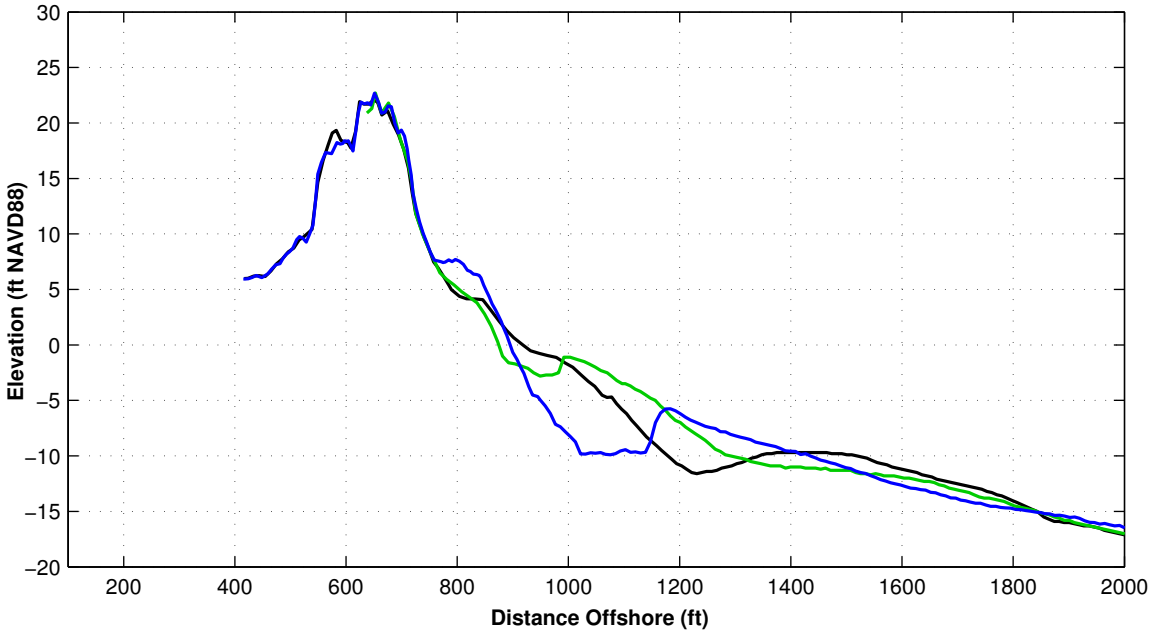
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 900+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −4.64 ft | 70.90 ft |
| Volume Change Above +6 ft NAVD88 | 5.18 cy/ft | 1.70 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.93 cy/ft | 8.06 cy/ft |
| Volume Change Above −6 ft NAVD88 | −12.30 cy/ft | 28.68 cy/ft |
| Volume Change Above −14 ft NAVD88 | −21.01 cy/ft | 62.22 cy/ft |
| Volume Change Above −19 ft NAVD88 | −16.18 cy/ft | 32.11 cy/ft |
| Volume Change Above −30 ft NAVD88 | −0.69 cy/ft | 8.79 cy/ft |

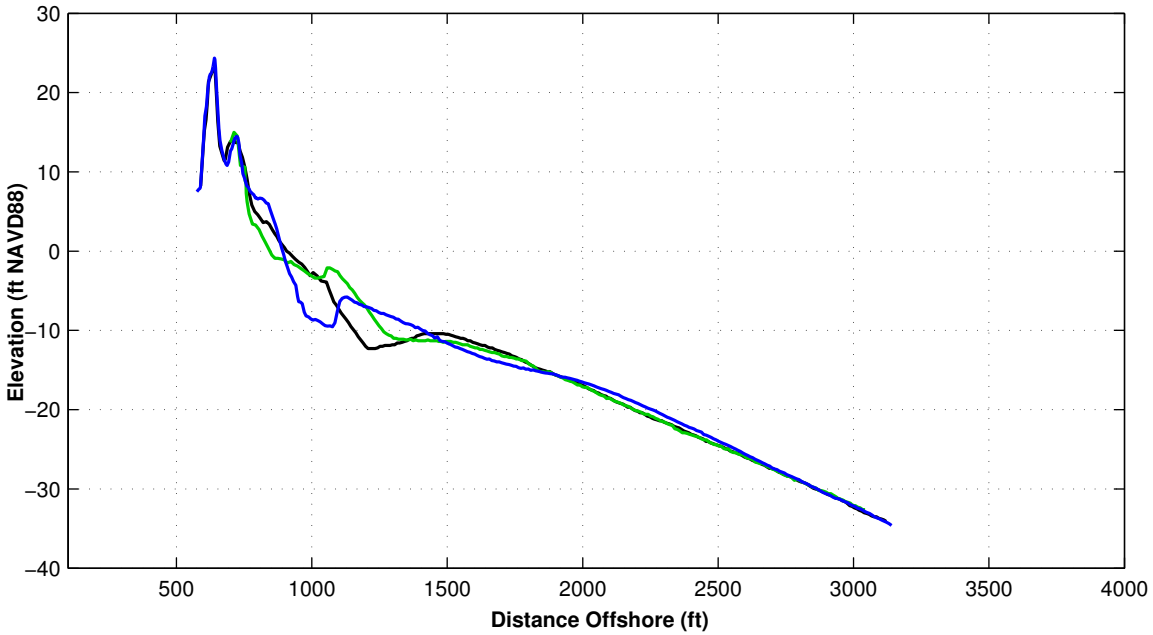
**LEGEND:**

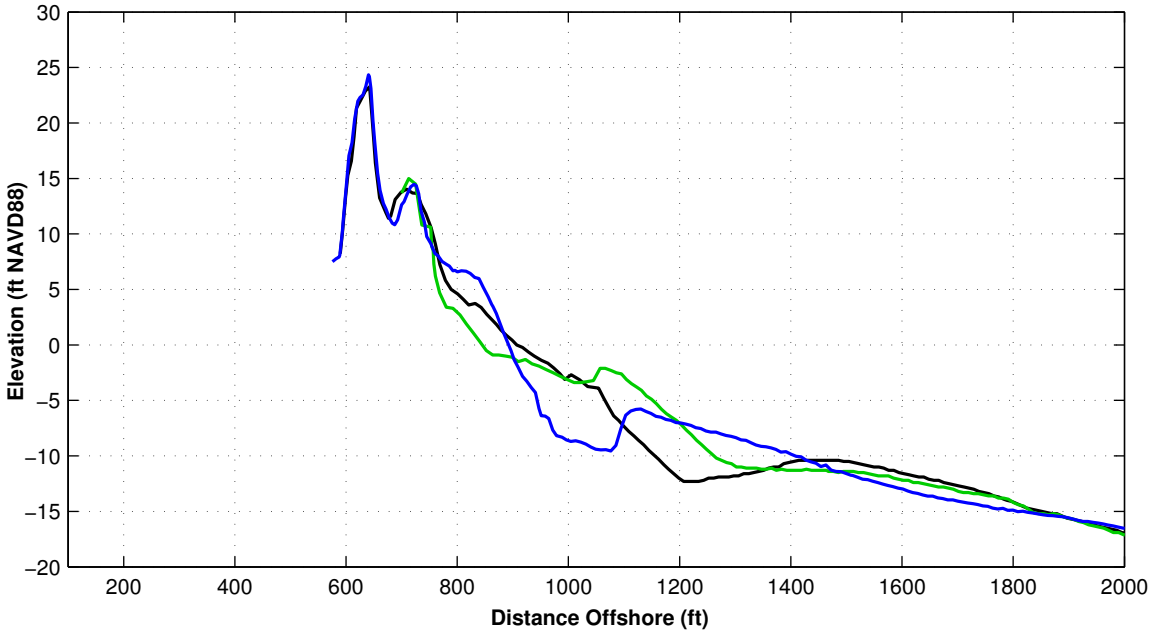
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 905+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 0.88 ft | 64.68 ft |
| Volume Change Above +6 ft NAVD88 | 0.40 cy/ft | 4.32 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.37 cy/ft | 9.50 cy/ft |
| Volume Change Above −6 ft NAVD88 | −12.21 cy/ft | 28.48 cy/ft |
| Volume Change Above −14 ft NAVD88 | −2.81 cy/ft | 51.32 cy/ft |
| Volume Change Above −19 ft NAVD88 | −0.75 cy/ft | 25.26 cy/ft |
| Volume Change Above −30 ft NAVD88 | 13.30 cy/ft | 1.63 cy/ft |

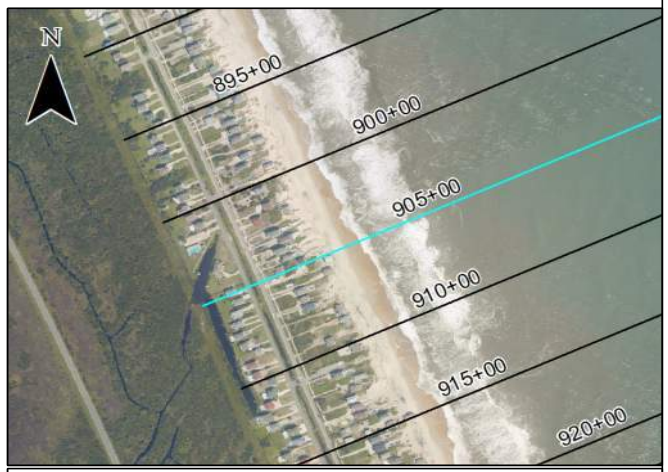
**LEGEND:**

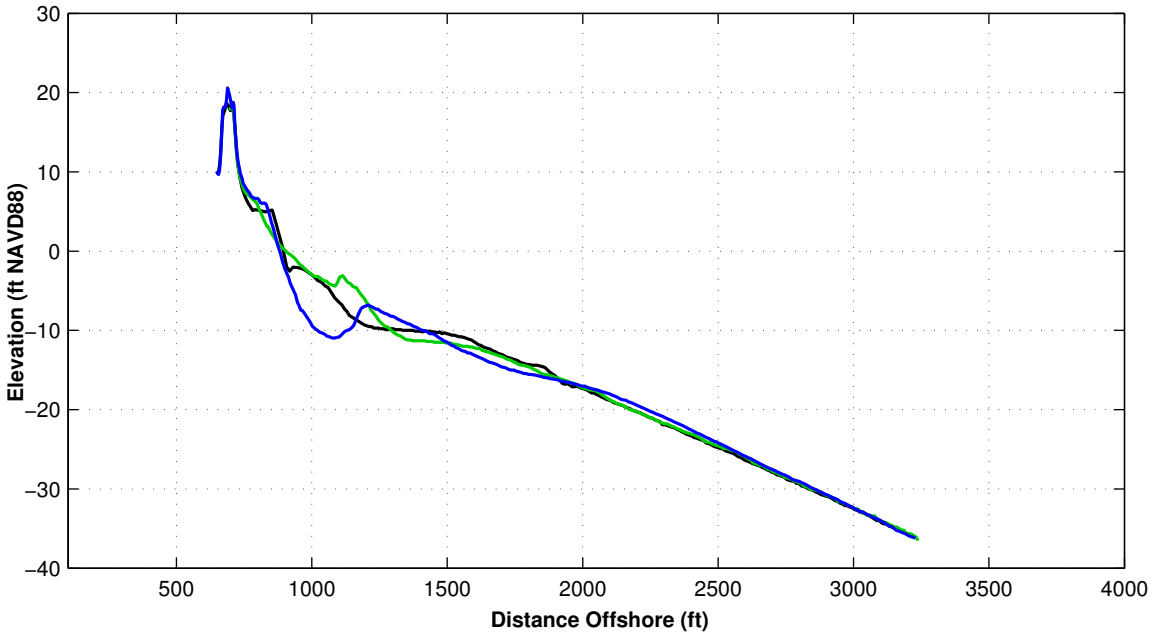
JUNE 2024 — OCTOBER 2023

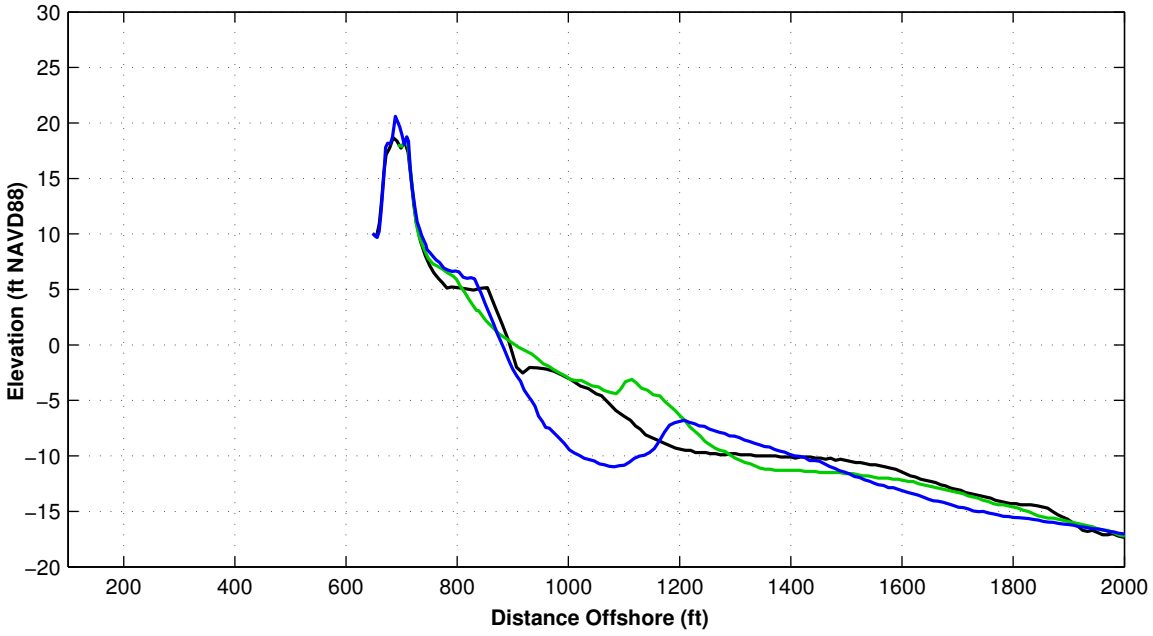
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 910+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −15.48 ft | 51.91 ft |
| Volume Change Above +6 ft NAVD88 | 4.57 cy/ft | 2.46 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.37 cy/ft | 10.38 cy/ft |
| Volume Change Above −6 ft NAVD88 | −13.16 cy/ft | 22.85 cy/ft |
| Volume Change Above −14 ft NAVD88 | −38.87 cy/ft | 66.40 cy/ft |
| Volume Change Above −19 ft NAVD88 | −43.10 cy/ft | 38.83 cy/ft |
| Volume Change Above −30 ft NAVD88 | −27.72 cy/ft | 15.60 cy/ft |

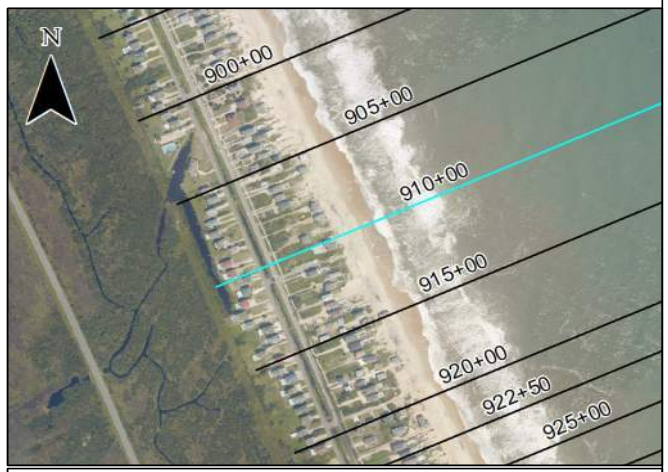
**LEGEND:**

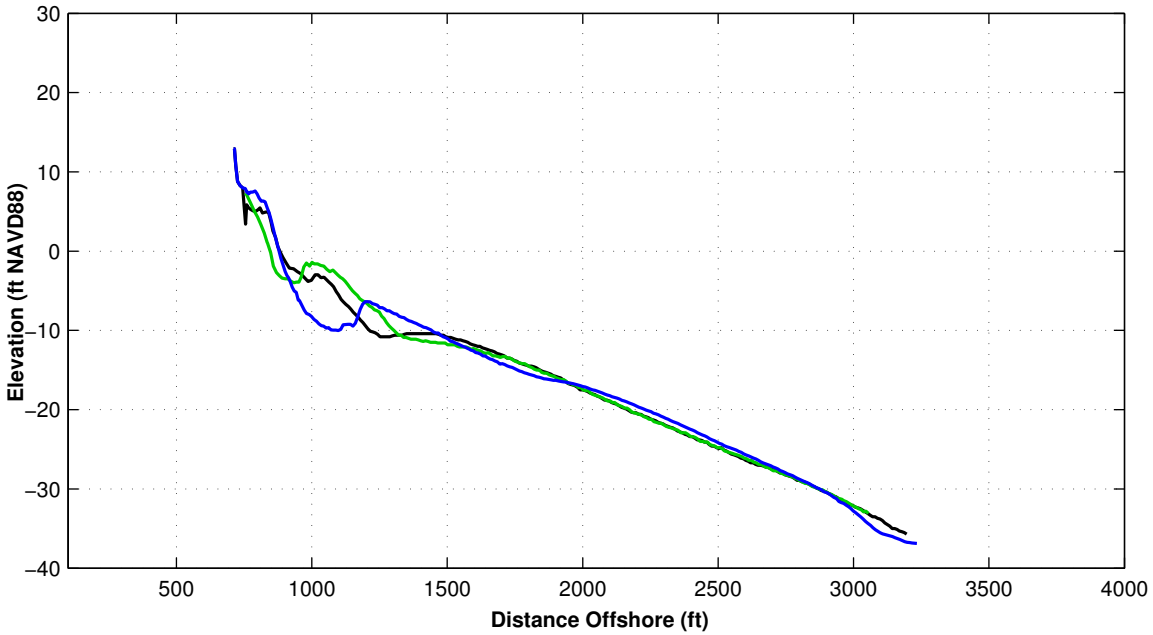
JUNE 2024 — OCTOBER 2023

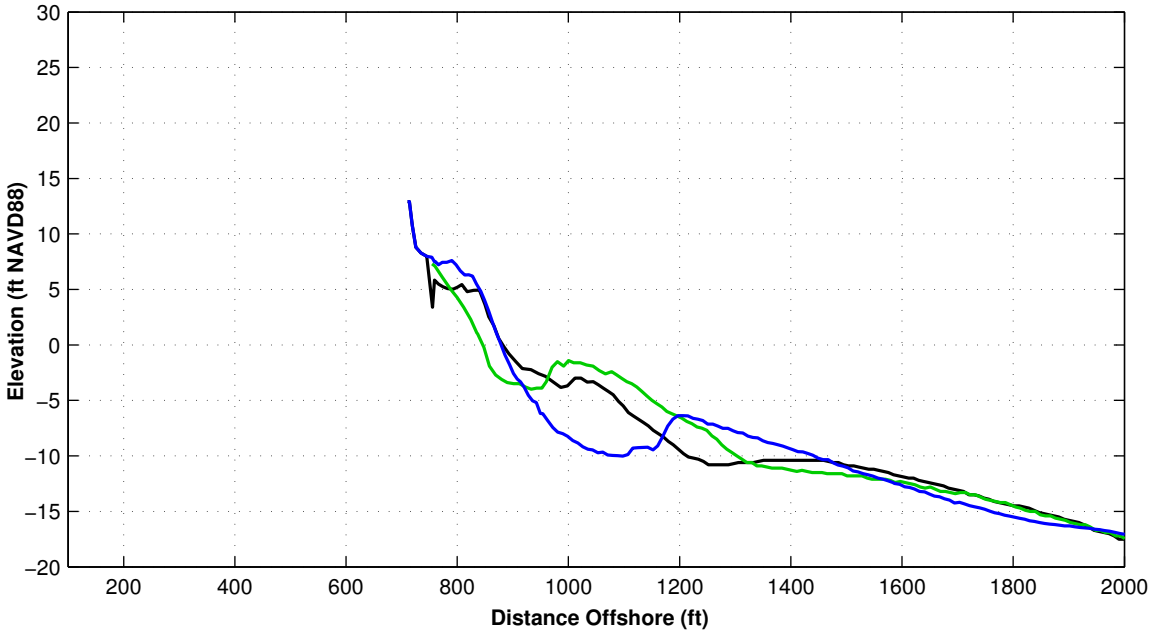
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 915+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −0.50 ft | 42.02 ft |
| Volume Change Above +6 ft NAVD88 | 3.43 cy/ft | −0.35 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.50 cy/ft | 6.53 cy/ft |
| Volume Change Above −6 ft NAVD88 | −11.07 cy/ft | 16.89 cy/ft |
| Volume Change Above −14 ft NAVD88 | −16.14 cy/ft | 66.70 cy/ft |
| Volume Change Above −19 ft NAVD88 | −19.16 cy/ft | 42.37 cy/ft |
| Volume Change Above −30 ft NAVD88 | −1.64 cy/ft | 17.48 cy/ft |

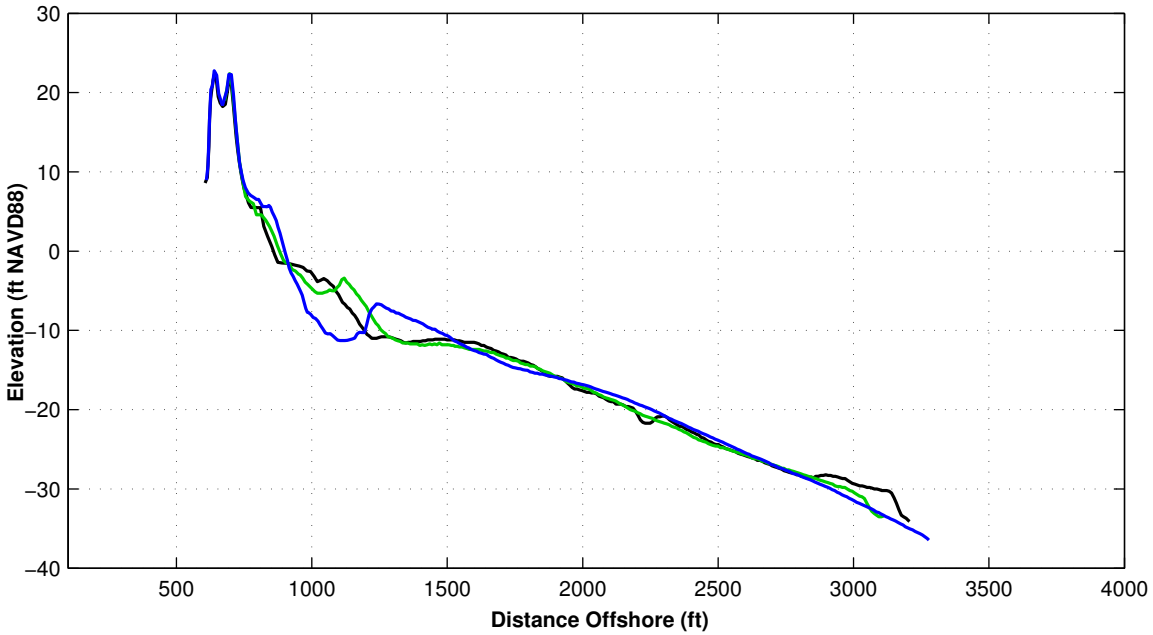
**LEGEND:**

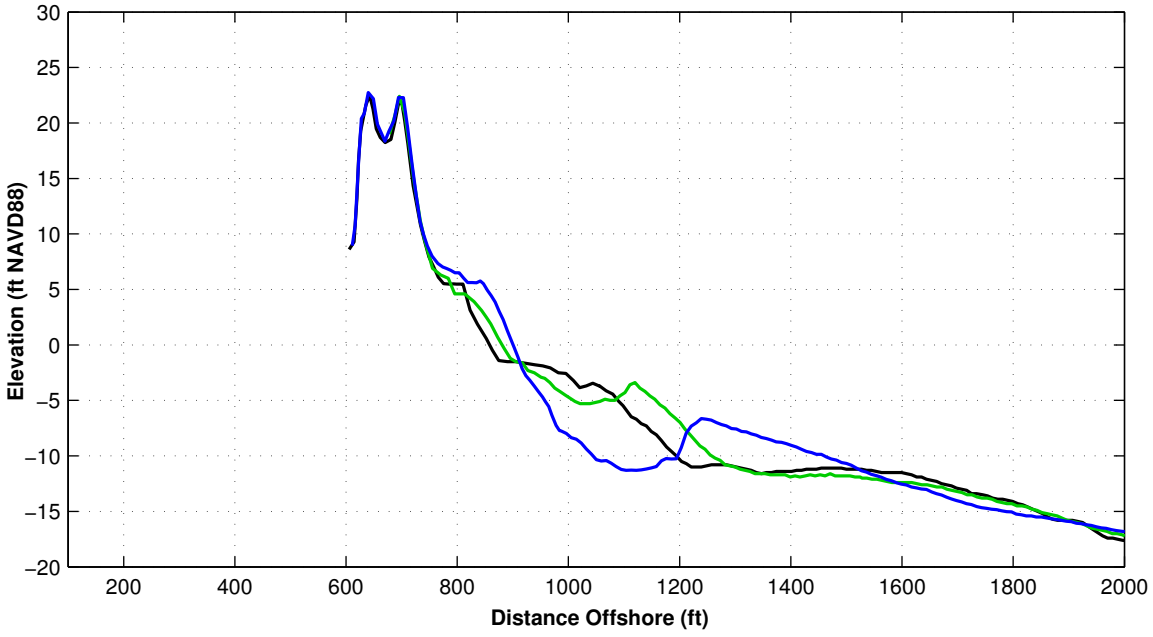
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 920+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 46.20 ft | 3.42 ft |
| Volume Change Above +6 ft NAVD88 | 4.61 cy/ft | 3.56 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.15 cy/ft | 6.07 cy/ft |
| Volume Change Above −6 ft NAVD88 | 1.29 cy/ft | 11.94 cy/ft |
| Volume Change Above −14 ft NAVD88 | −3.16 cy/ft | 59.33 cy/ft |
| Volume Change Above −19 ft NAVD88 | −1.21 cy/ft | 37.15 cy/ft |
| Volume Change Above −30 ft NAVD88 | 3.41 cy/ft | 24.79 cy/ft |

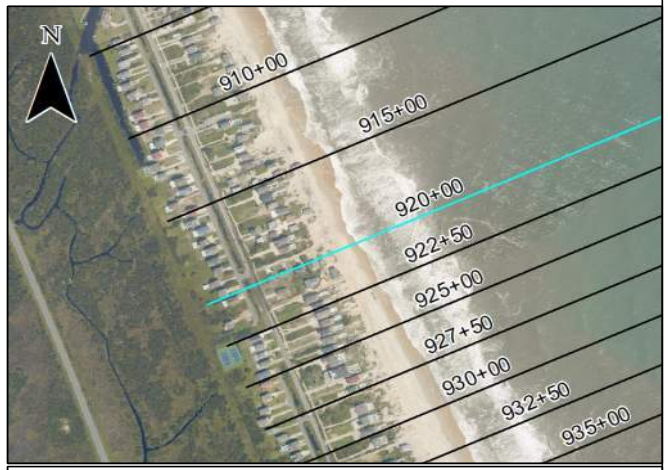
**LEGEND:**

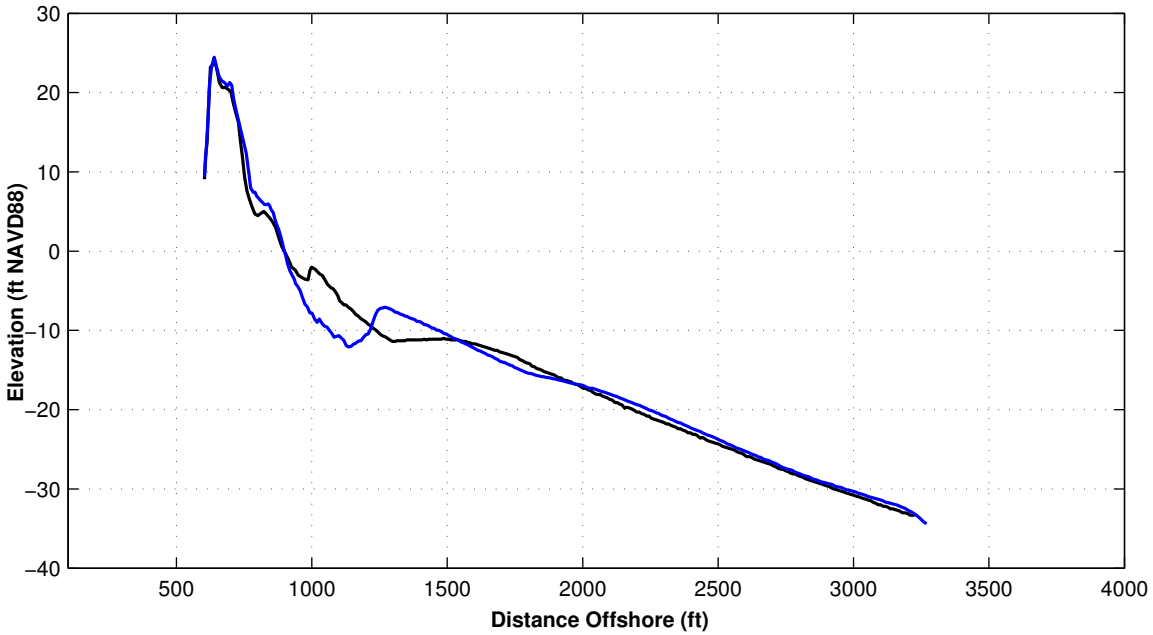
JUNE 2024 — OCTOBER 2023

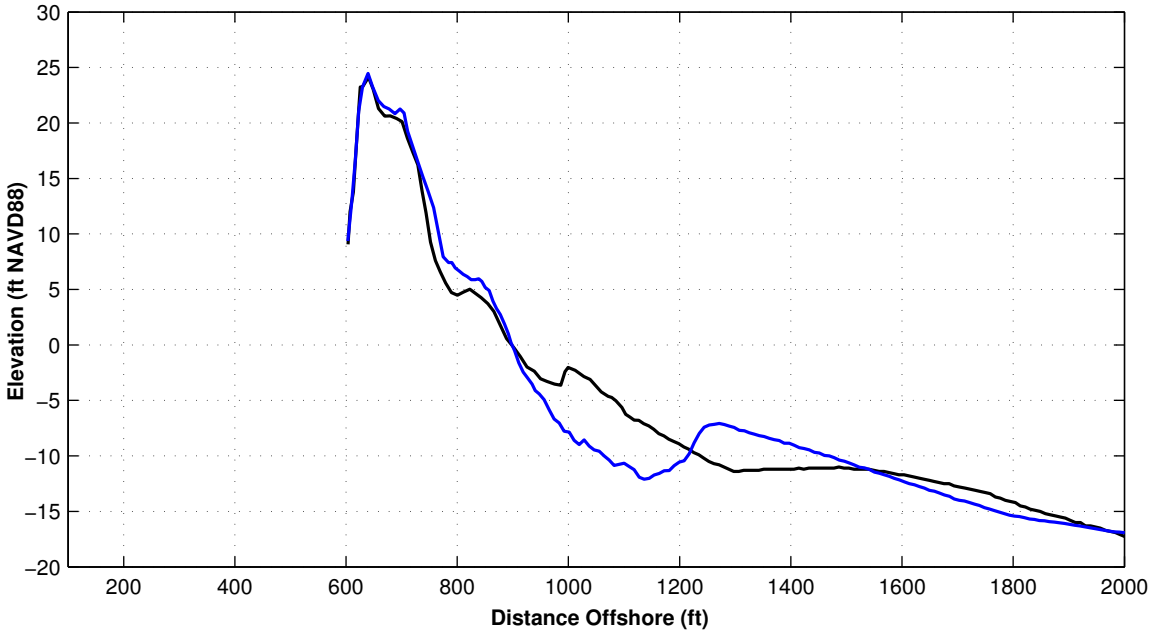
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 922+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 7.30 ft | 40.65 ft |
| Volume Change Above +6 ft NAVD88 | 8.24 cy/ft | 2.84 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 12.84 cy/ft | 7.70 cy/ft |
| Volume Change Above −6 ft NAVD88 | −1.91 cy/ft | 16.80 cy/ft |
| Volume Change Above −14 ft NAVD88 | −12.09 cy/ft | 65.59 cy/ft |
| Volume Change Above −19 ft NAVD88 | −14.89 cy/ft | 43.89 cy/ft |
| Volume Change Above −30 ft NAVD88 | 2.01 cy/ft | 21.73 cy/ft |

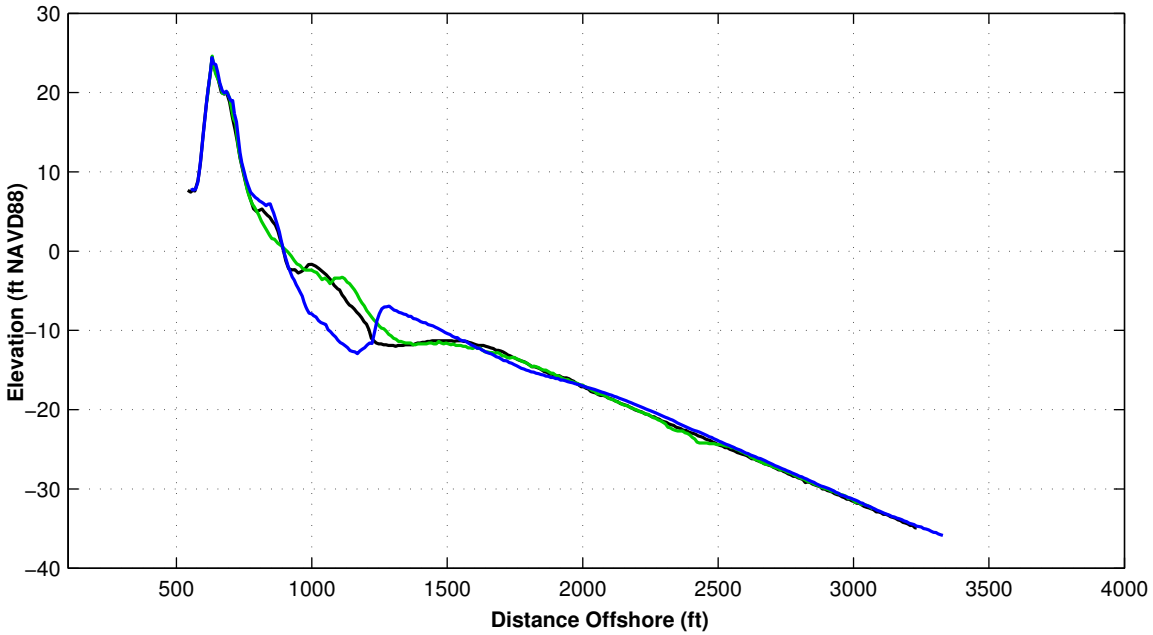
**LEGEND:**

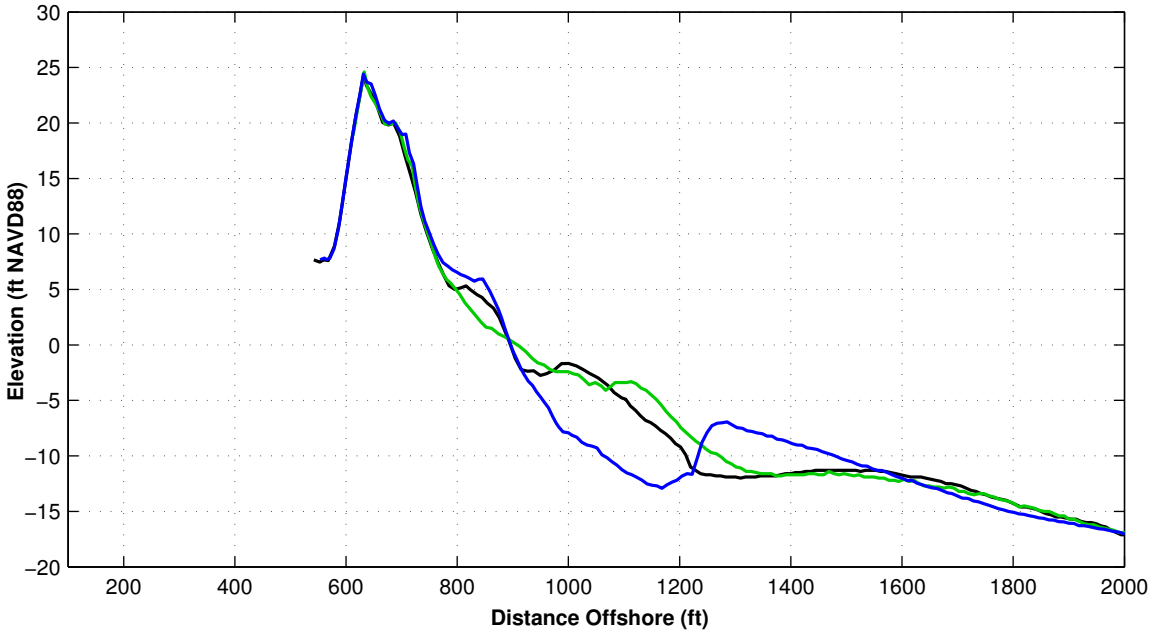
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 925+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 1.87 ft | 34.49 ft |
| Volume Change Above +6 ft NAVD88 | 5.12 cy/ft | 1.36 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 8.88 cy/ft | 6.94 cy/ft |
| Volume Change Above −6 ft NAVD88 | −10.47 cy/ft | 18.25 cy/ft |
| Volume Change Above −14 ft NAVD88 | −17.62 cy/ft | 69.62 cy/ft |
| Volume Change Above −19 ft NAVD88 | −19.92 cy/ft | 46.82 cy/ft |
| Volume Change Above −30 ft NAVD88 | −7.43 cy/ft | 28.00 cy/ft |

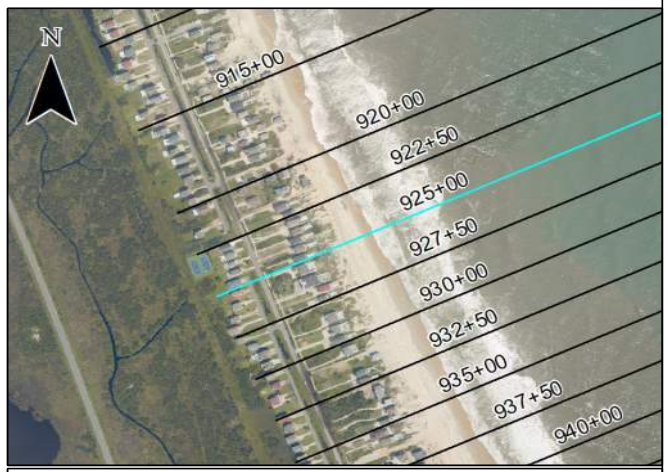
**LEGEND:**

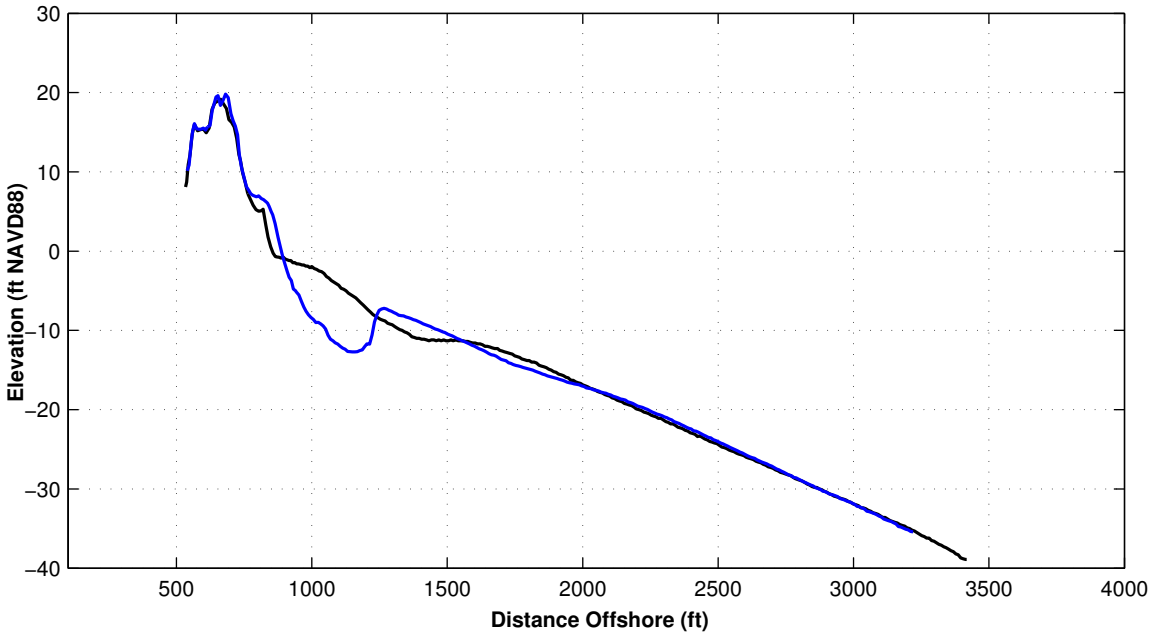
JUNE 2024 — OCTOBER 2023

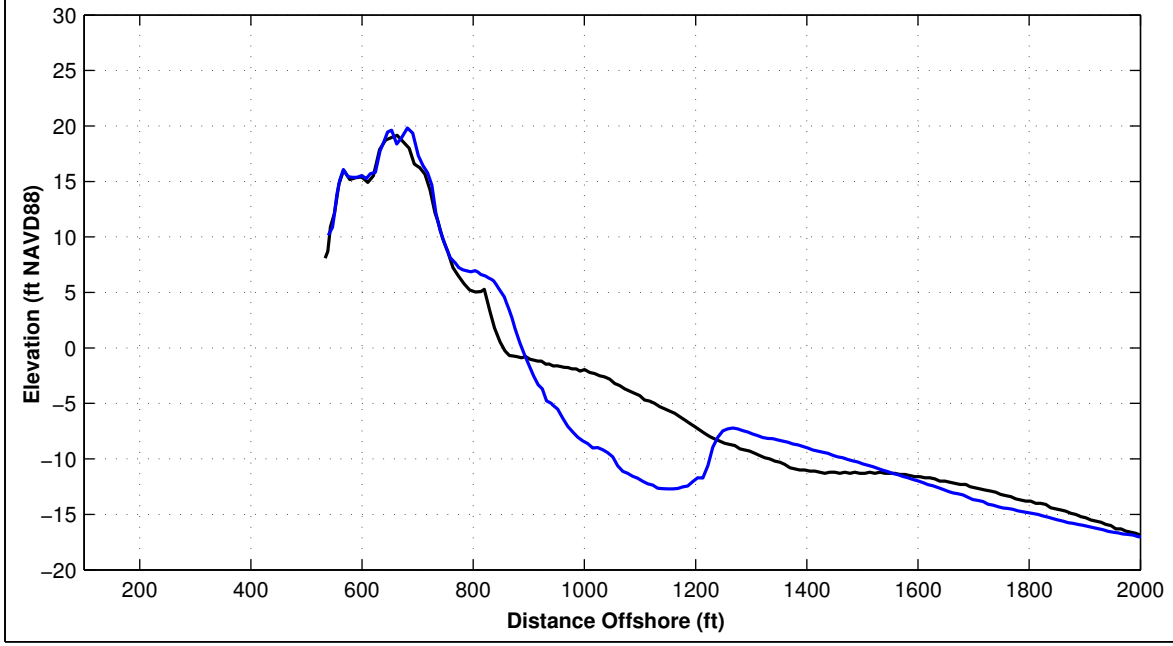
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 927+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 35.78 ft | –13.77 ft |
| Volume Change Above +6 ft NAVD88 | 4.75 cy/ft | 3.76 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 11.61 cy/ft | 3.81 cy/ft |
| Volume Change Above –6 ft NAVD88 | –11.10 cy/ft | 16.42 cy/ft |
| Volume Change Above –14 ft NAVD88 | –44.81 cy/ft | 95.19 cy/ft |
| Volume Change Above –19 ft NAVD88 | –50.65 cy/ft | 76.01 cy/ft |
| Volume Change Above –30 ft NAVD88 | –42.45 cy/ft | 58.28 cy/ft |

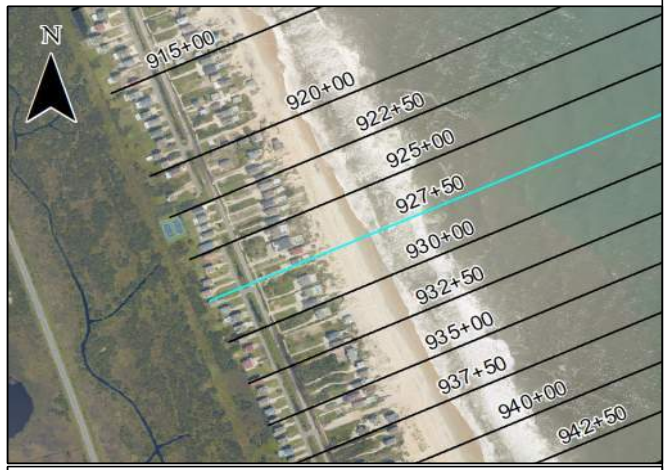
**LEGEND:**

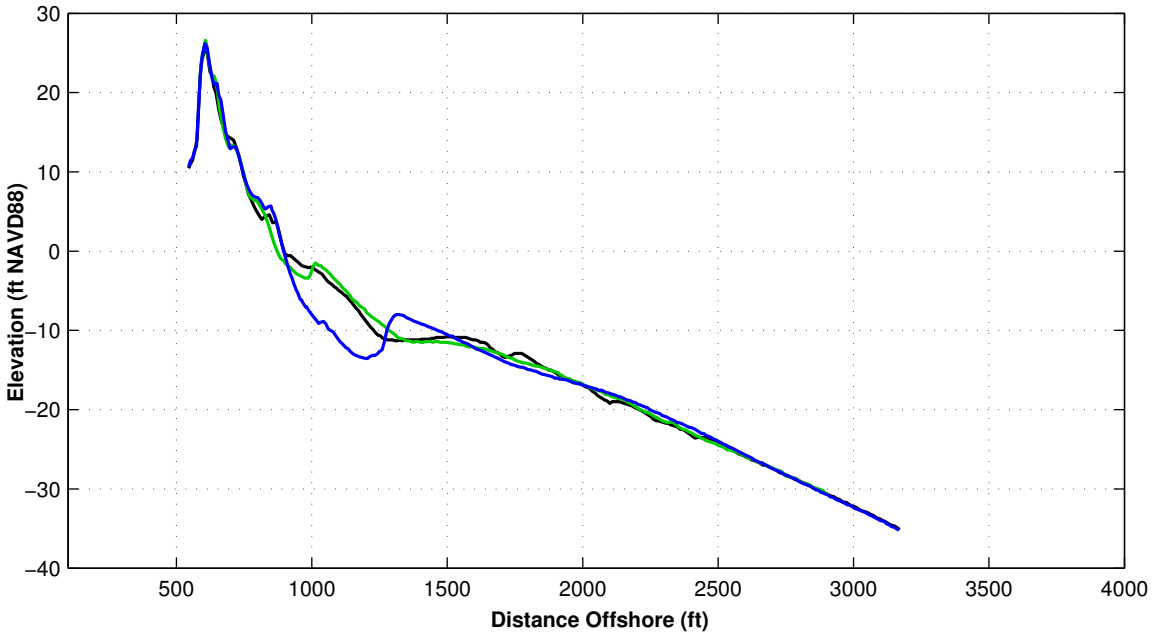
JUNE 2024 — OCTOBER 2023

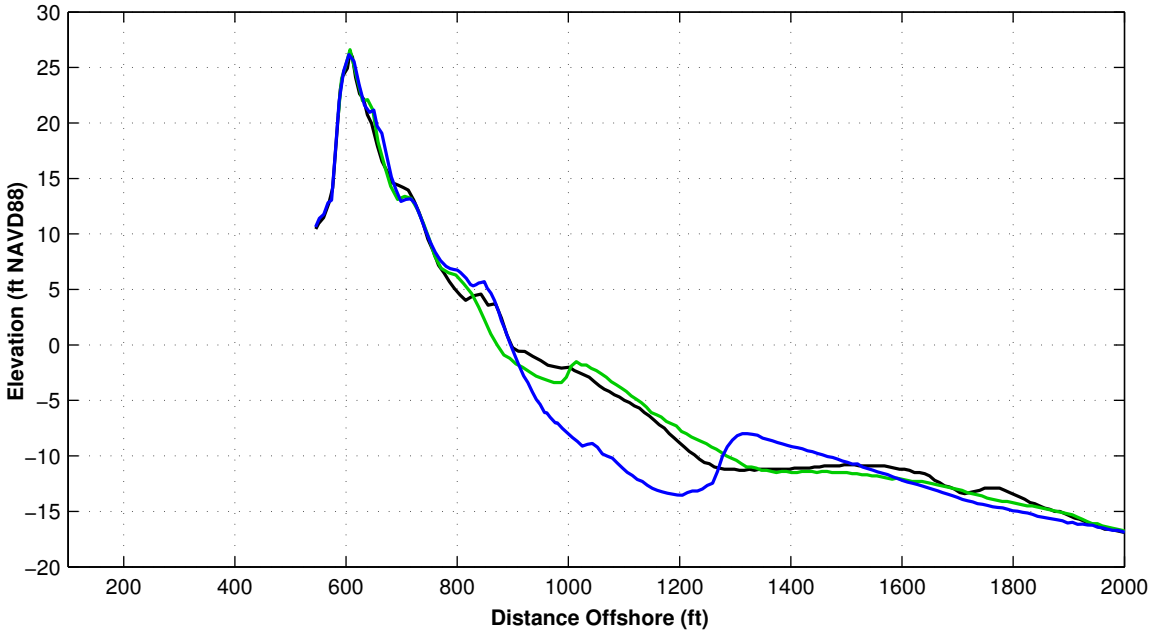
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 930+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −0.27 ft | 33.35 ft |
| Volume Change Above +6 ft NAVD88 | 2.87 cy/ft | −1.46 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.43 cy/ft | 1.65 cy/ft |
| Volume Change Above −6 ft NAVD88 | −15.73 cy/ft | 17.24 cy/ft |
| Volume Change Above −14 ft NAVD88 | −50.53 cy/ft | 83.74 cy/ft |
| Volume Change Above −19 ft NAVD88 | −52.14 cy/ft | 61.43 cy/ft |
| Volume Change Above −30 ft NAVD88 | −42.75 cy/ft | 40.17 cy/ft |

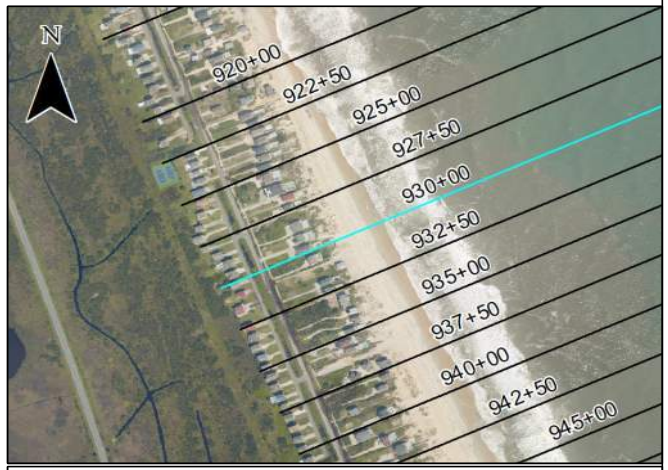
**LEGEND:**

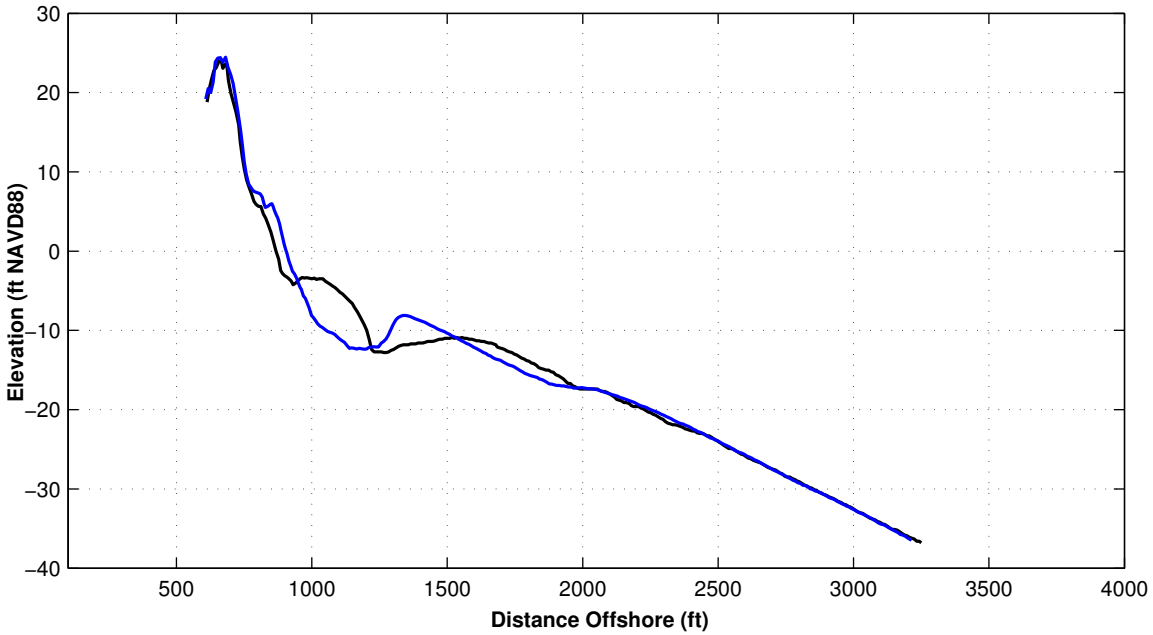
JUNE 2024 — OCTOBER 2023

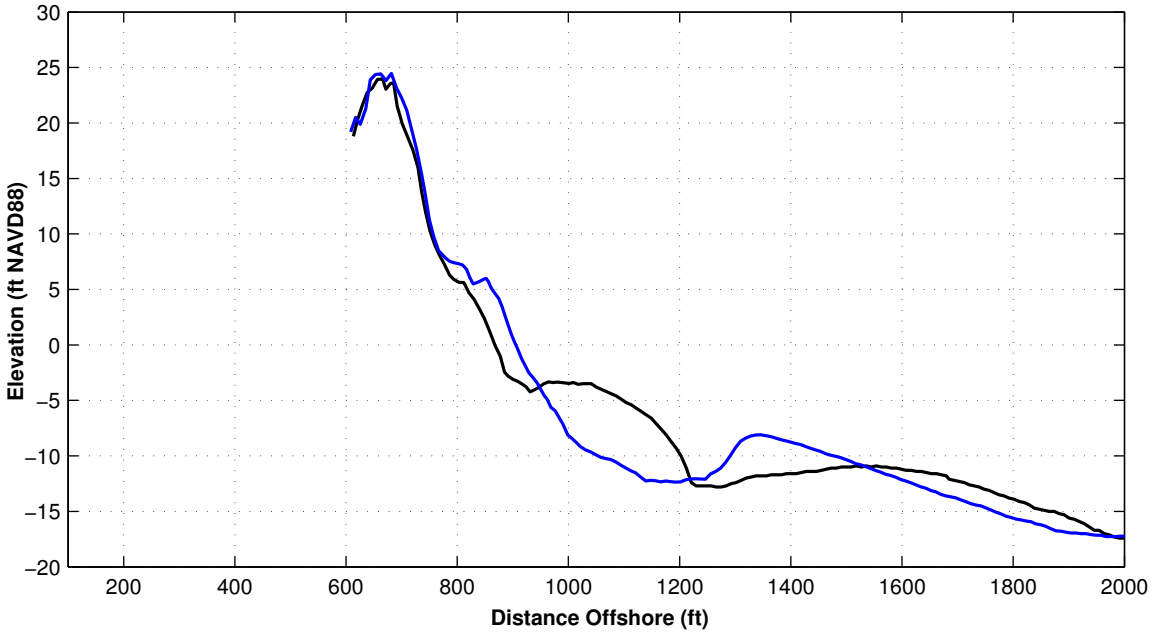
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 932+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 37.21 ft | −5.48 ft |
| Volume Change Above +6 ft NAVD88 | 6.76 cy/ft | 2.61 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 14.21 cy/ft | 2.15 cy/ft |
| Volume Change Above −6 ft NAVD88 | 9.27 cy/ft | 1.20 cy/ft |
| Volume Change Above −14 ft NAVD88 | −11.13 cy/ft | 44.78 cy/ft |
| Volume Change Above −19 ft NAVD88 | −20.52 cy/ft | 20.80 cy/ft |
| Volume Change Above −30 ft NAVD88 | −16.18 cy/ft | −1.06 cy/ft |

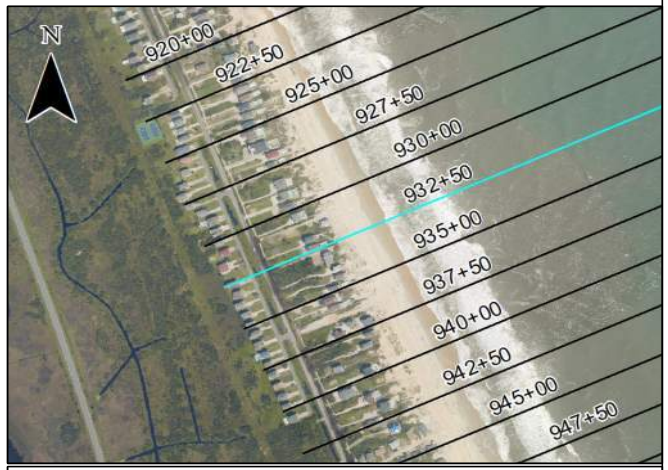
**LEGEND:**

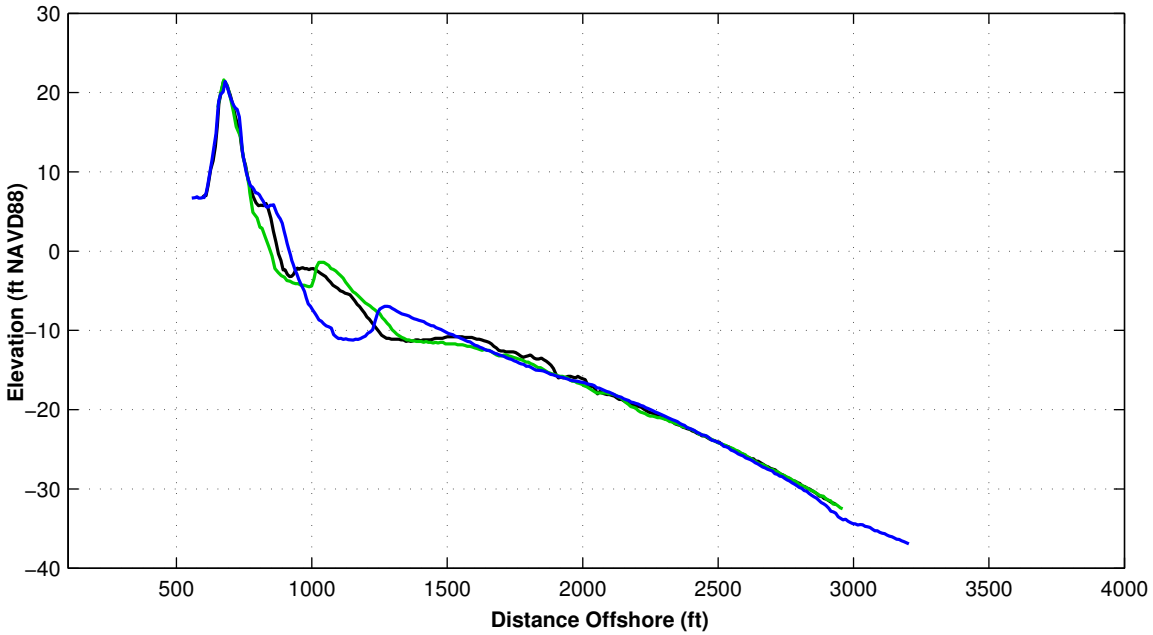
JUNE 2024 — OCTOBER 2023

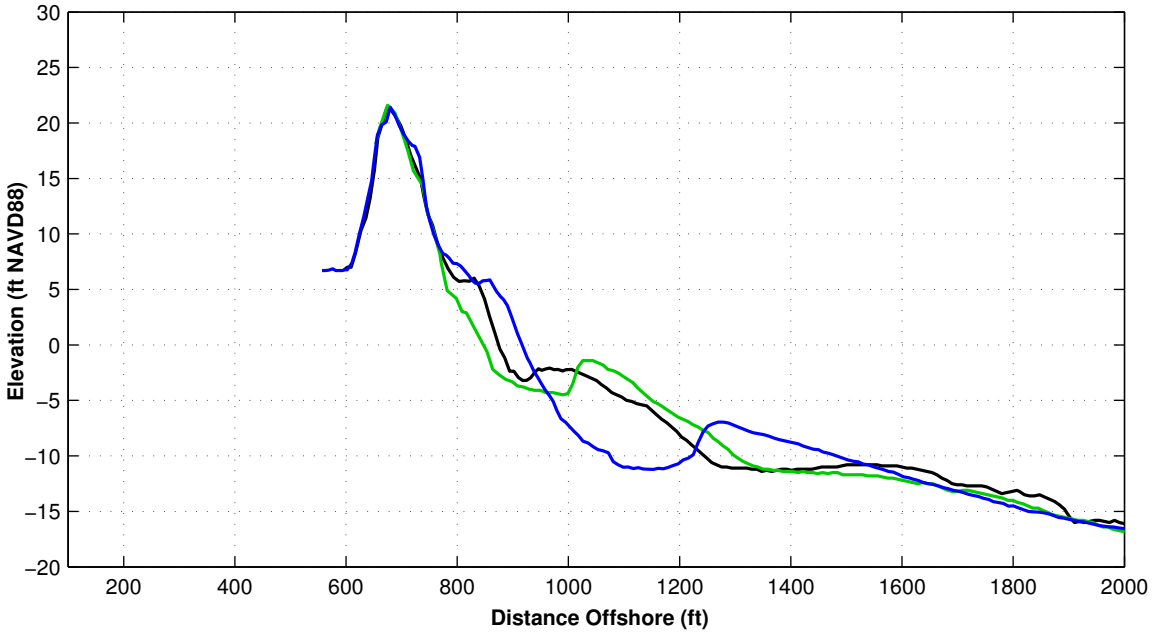
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 935+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 40.13 ft | −16.61 ft |
| Volume Change Above +6 ft NAVD88 | 3.85 cy/ft | 3.28 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.88 cy/ft | 5.11 cy/ft |
| Volume Change Above −6 ft NAVD88 | −0.55 cy/ft | 10.14 cy/ft |
| Volume Change Above −14 ft NAVD88 | −14.18 cy/ft | 68.75 cy/ft |
| Volume Change Above −19 ft NAVD88 | −17.70 cy/ft | 47.16 cy/ft |
| Volume Change Above −30 ft NAVD88 | −18.12 cy/ft | 24.73 cy/ft |

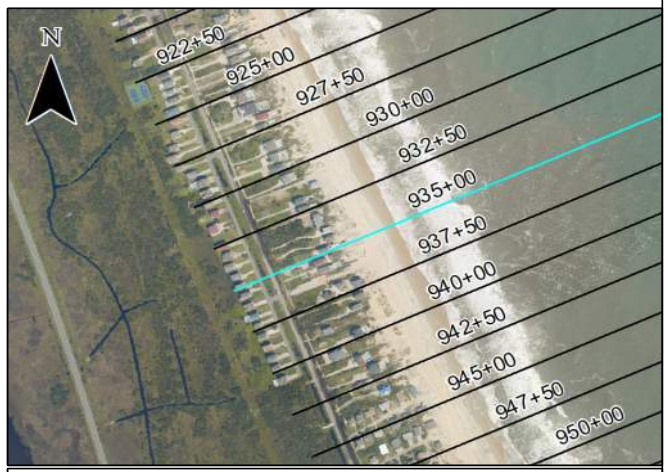
**LEGEND:**

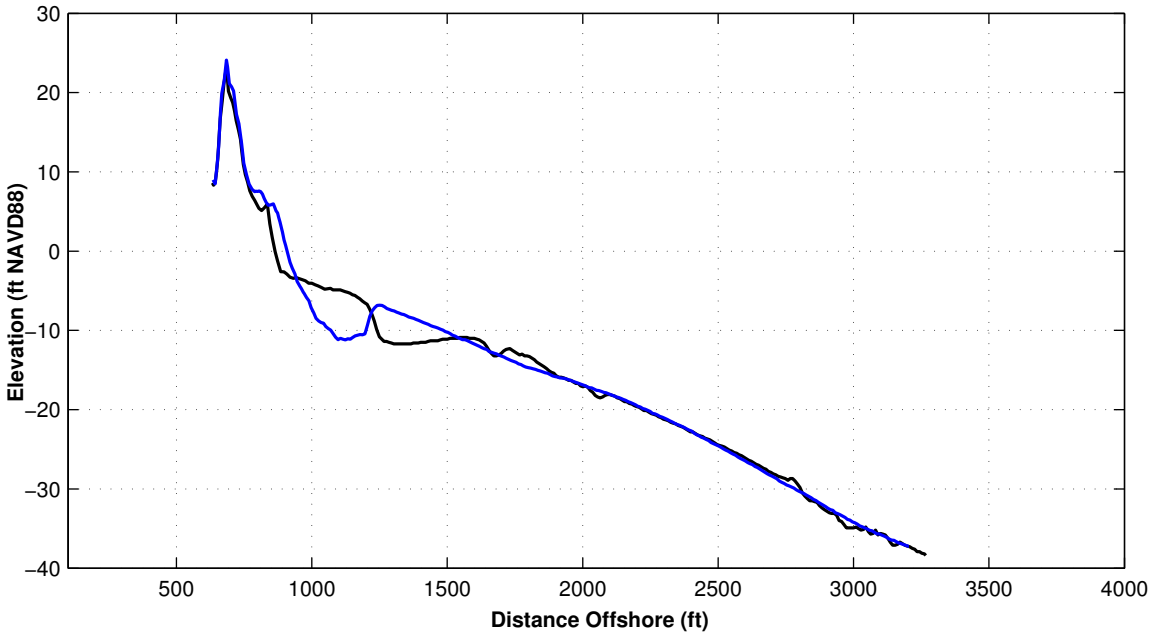
JUNE 2024 — OCTOBER 2023

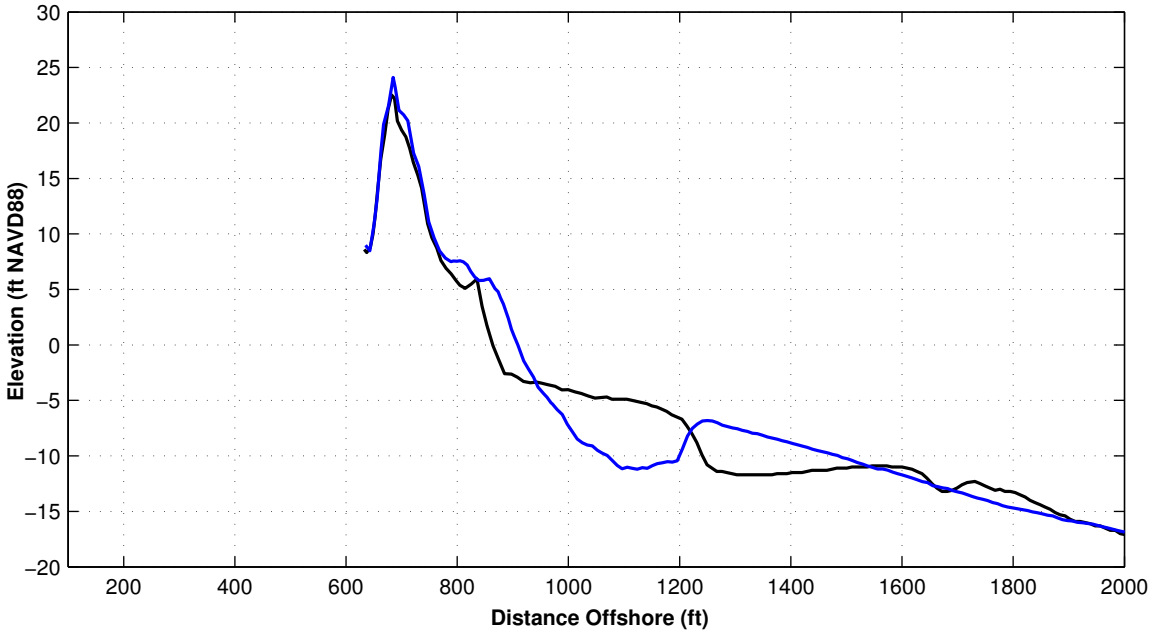
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 937+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 42.43 ft | −16.61 ft |
| Volume Change Above +6 ft NAVD88 | 5.80 cy/ft | 2.36 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 12.95 cy/ft | 2.55 cy/ft |
| Volume Change Above −6 ft NAVD88 | 9.99 cy/ft | −2.43 cy/ft |
| Volume Change Above −14 ft NAVD88 | 2.26 cy/ft | 41.64 cy/ft |
| Volume Change Above −19 ft NAVD88 | 0.99 cy/ft | 10.32 cy/ft |
| Volume Change Above −30 ft NAVD88 | −3.46 cy/ft | −13.65 cy/ft |

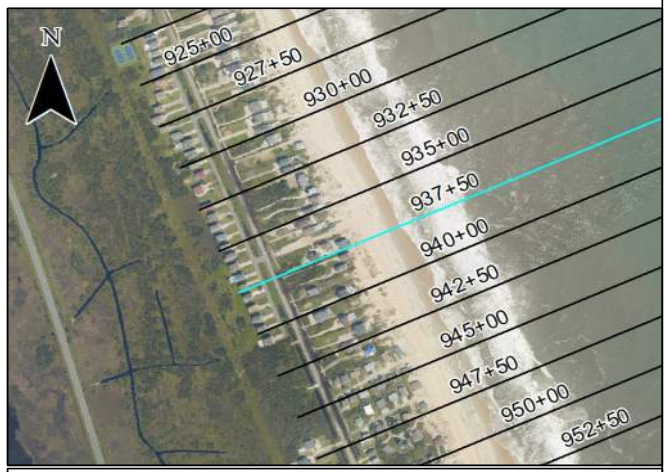
**LEGEND:**

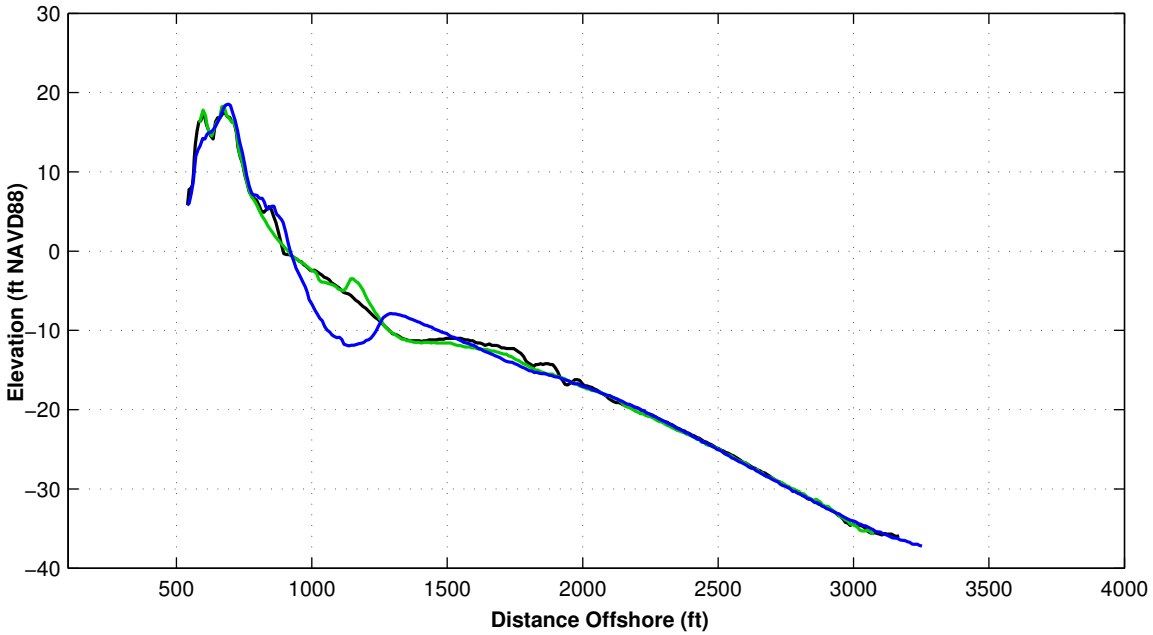
JUNE 2024 — OCTOBER 2023

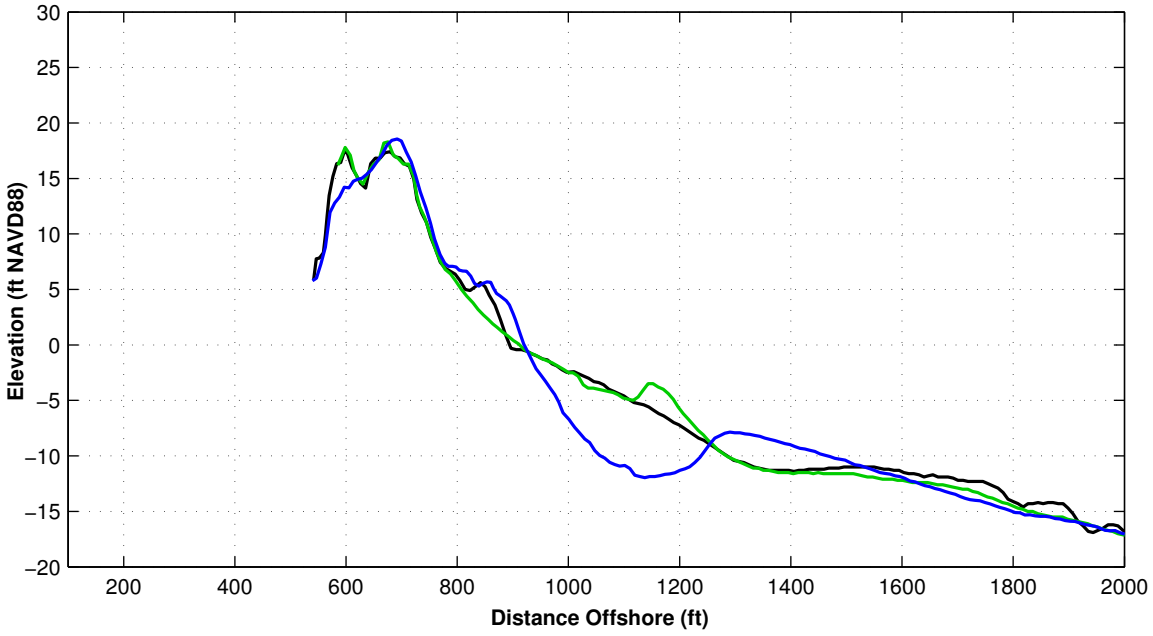
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 940+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 26.63 ft | 9.07 ft |
| Volume Change Above +6 ft NAVD88 | 4.55 cy/ft | 3.66 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 9.13 cy/ft | 6.51 cy/ft |
| Volume Change Above −6 ft NAVD88 | −6.23 cy/ft | 17.87 cy/ft |
| Volume Change Above −14 ft NAVD88 | −34.06 cy/ft | 66.03 cy/ft |
| Volume Change Above −19 ft NAVD88 | −39.61 cy/ft | 39.71 cy/ft |
| Volume Change Above −30 ft NAVD88 | −41.97 cy/ft | 18.29 cy/ft |

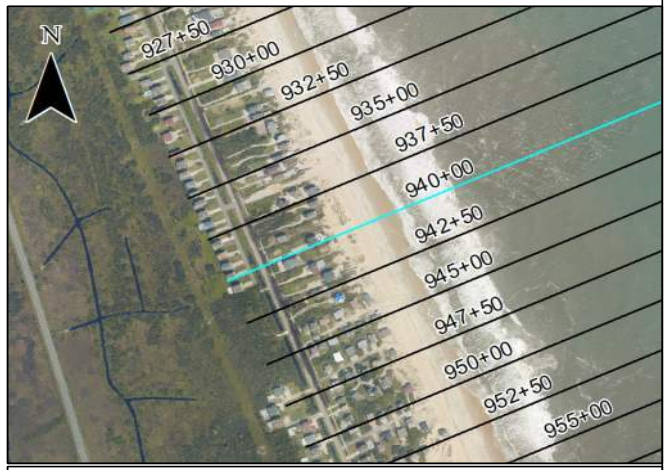
**LEGEND:**

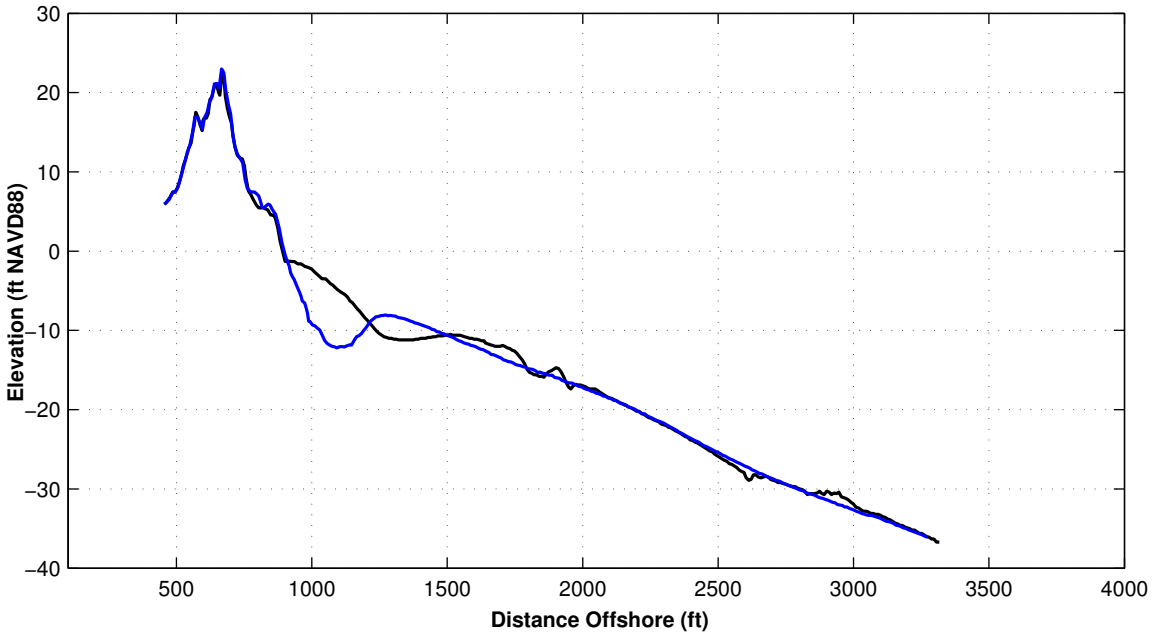
JUNE 2024 — OCTOBER 2023

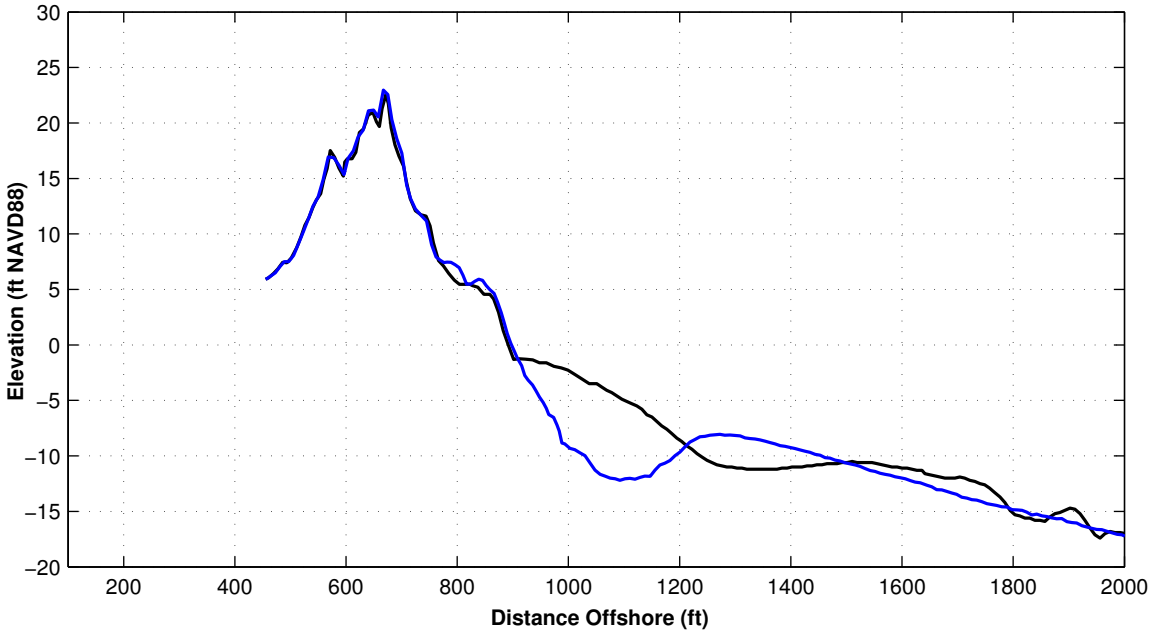
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.





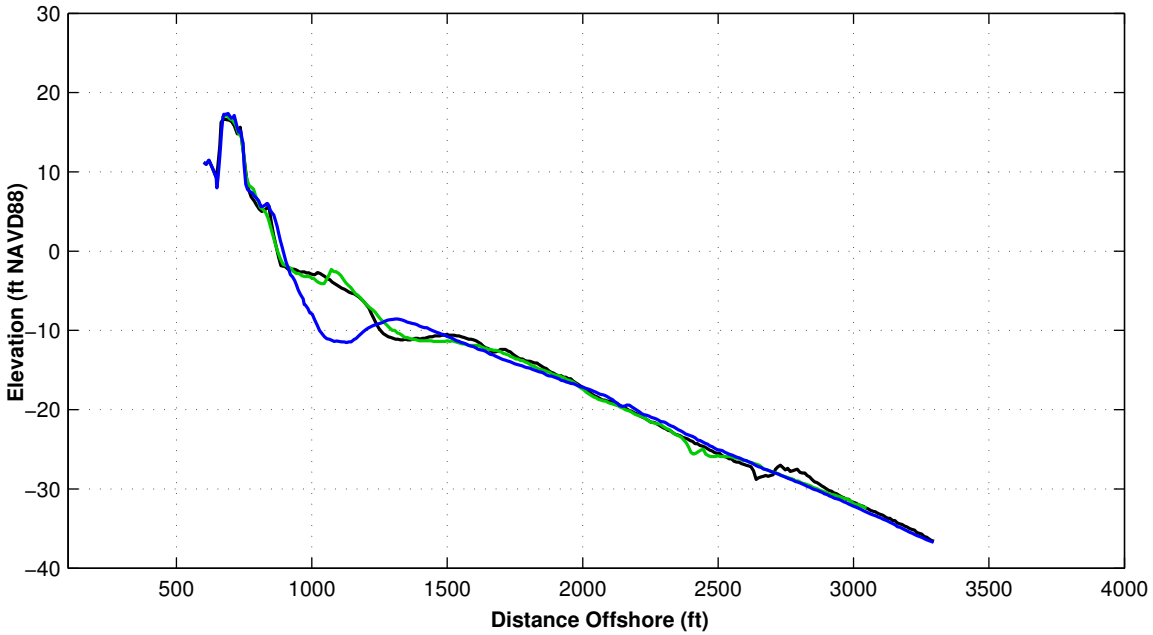



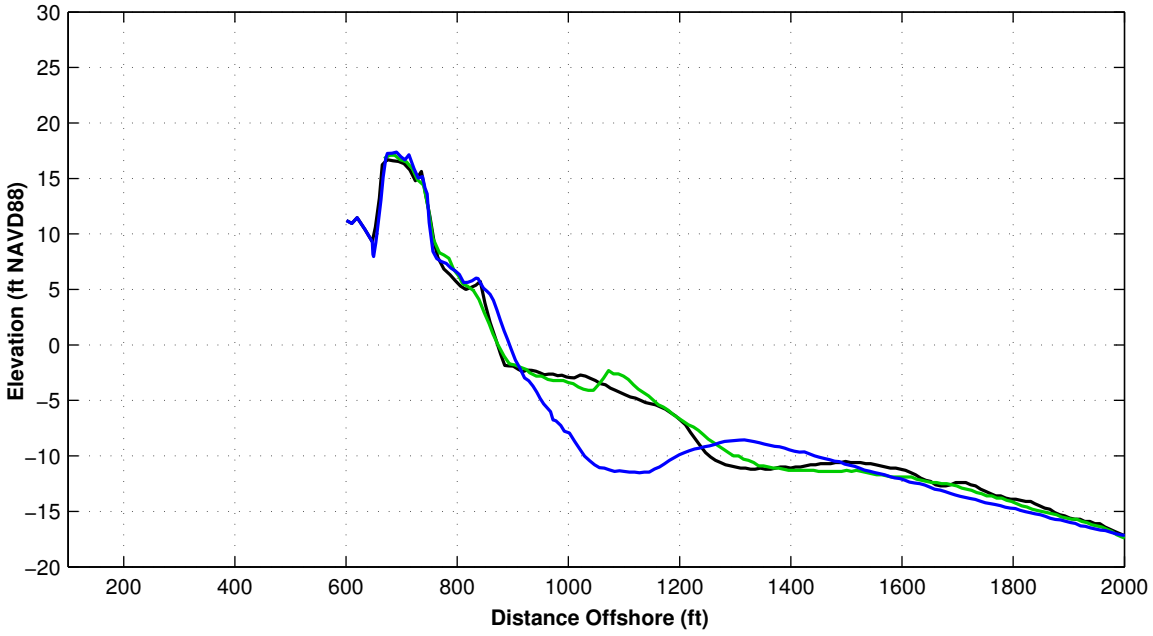

| Survey Transect 942+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 5.57 ft | 15.15 ft |
| Volume Change Above +6 ft NAVD88 | 2.71 cy/ft | 3.92 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.66 cy/ft | 8.05 cy/ft |
| Volume Change Above –6 ft NAVD88 | –14.33 cy/ft | 17.62 cy/ft |
| Volume Change Above –14 ft NAVD88 | –42.82 cy/ft | 72.10 cy/ft |
| Volume Change Above –19 ft NAVD88 | –44.91 cy/ft | 44.59 cy/ft |
| Volume Change Above –30 ft NAVD88 | –38.18 cy/ft | 12.52 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023 / JUNE 2023

Notes:
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 945+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 20.05 ft | 8.81 ft |
| Volume Change Above +6 ft NAVD88 | 0.48 cy/ft | 5.41 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 3.81 cy/ft | 8.30 cy/ft |
| Volume Change Above −6 ft NAVD88 | −13.08 cy/ft | 18.13 cy/ft |
| Volume Change Above −14 ft NAVD88 | −45.25 cy/ft | 76.47 cy/ft |
| Volume Change Above −19 ft NAVD88 | −48.49 cy/ft | 54.92 cy/ft |
| Volume Change Above −30 ft NAVD88 | −42.77 cy/ft | 26.12 cy/ft |

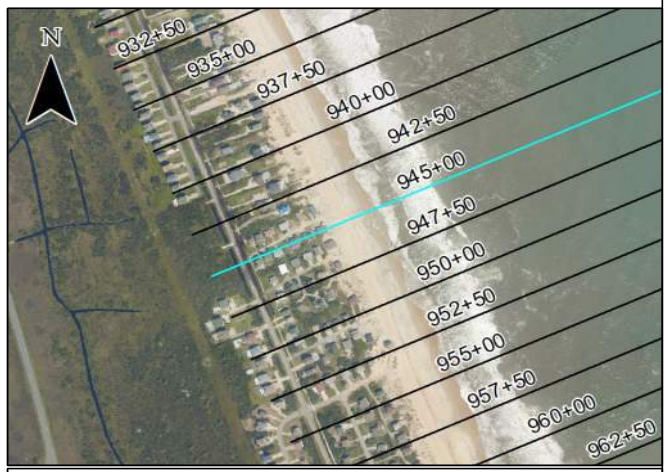
**LEGEND:**

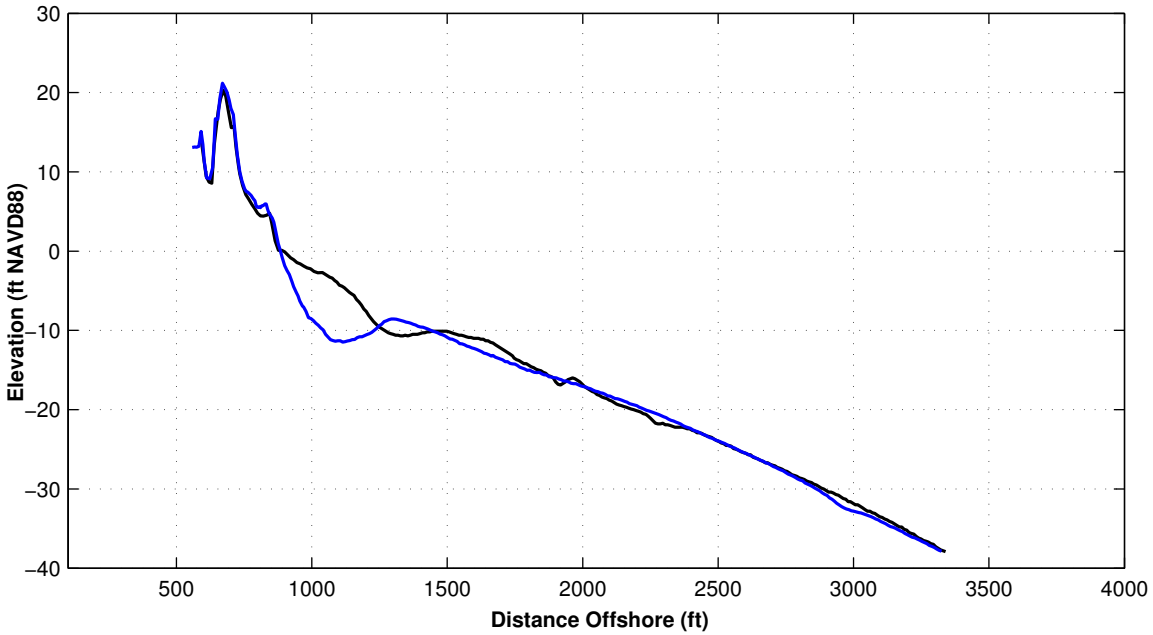
JUNE 2024 — OCTOBER 2023

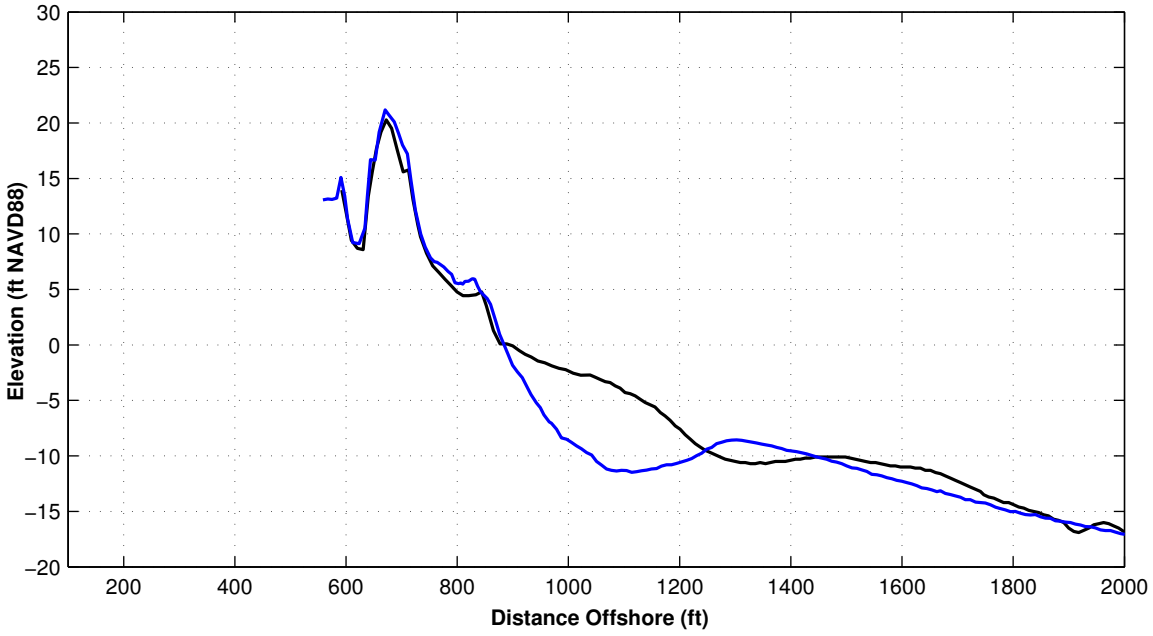
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.





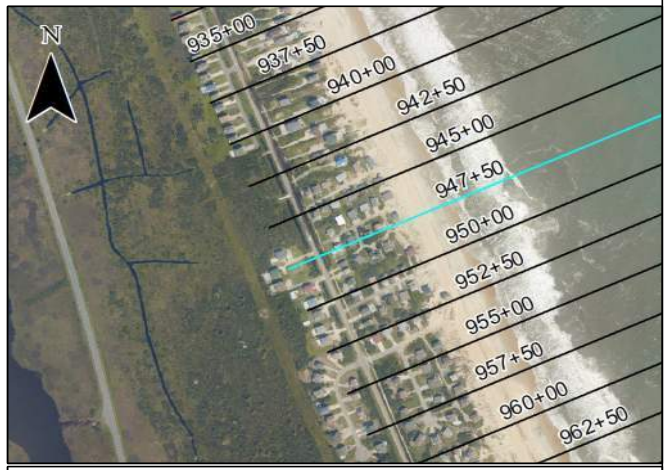



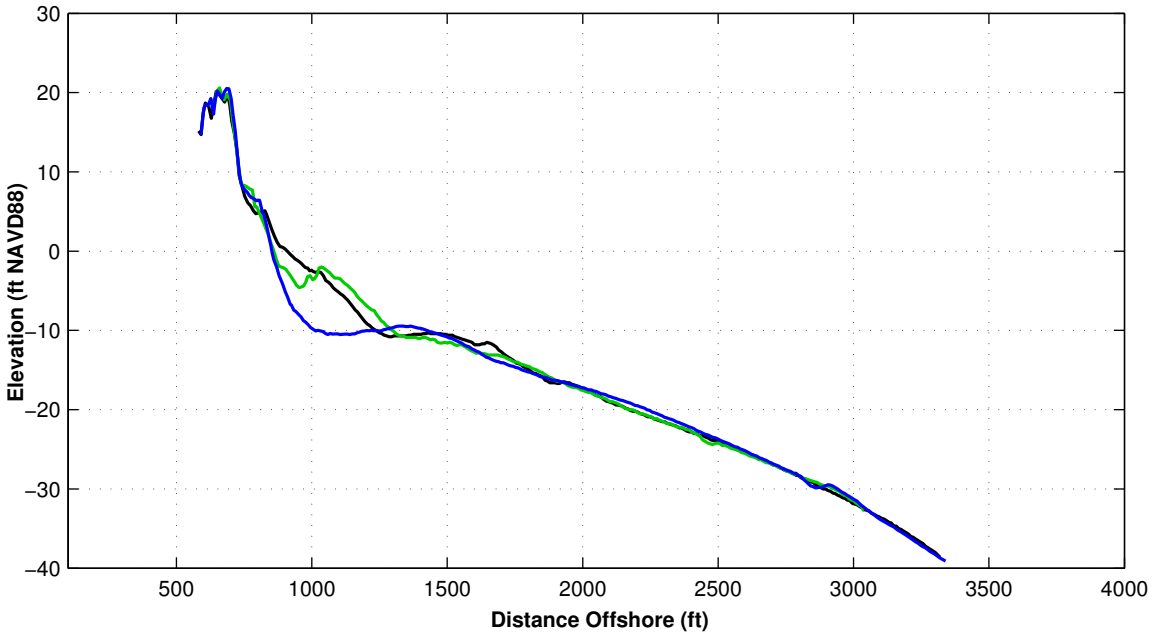

| Survey Transect 947+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 8.79 ft | 27.06 ft |
| Volume Change Above +6 ft NAVD88 | 3.62 cy/ft | 2.35 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.77 cy/ft | 6.48 cy/ft |
| Volume Change Above −6 ft NAVD88 | −19.53 cy/ft | 27.14 cy/ft |
| Volume Change Above −14 ft NAVD88 | −61.75 cy/ft | 96.16 cy/ft |
| Volume Change Above −19 ft NAVD88 | −62.52 cy/ft | 77.47 cy/ft |
| Volume Change Above −30 ft NAVD88 | −57.46 cy/ft | 60.16 cy/ft |

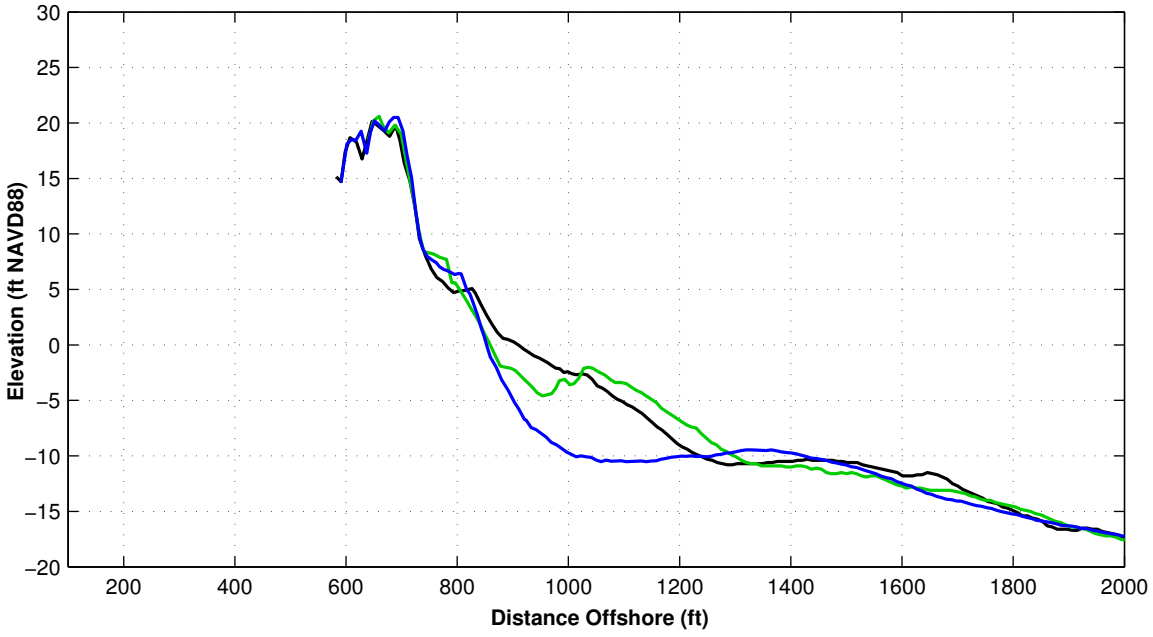
**LEGEND:**

JUNE 2024 — OCTOBER 2023 / JUNE 2023

Notes:
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 950+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −25.81 ft | 35.24 ft |
| Volume Change Above +6 ft NAVD88 | 4.83 cy/ft | 3.84 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.07 cy/ft | 9.85 cy/ft |
| Volume Change Above −6 ft NAVD88 | −28.92 cy/ft | 27.91 cy/ft |
| Volume Change Above −14 ft NAVD88 | −67.08 cy/ft | 101.52 cy/ft |
| Volume Change Above −19 ft NAVD88 | −65.94 cy/ft | 81.93 cy/ft |
| Volume Change Above −30 ft NAVD88 | −55.09 cy/ft | 48.33 cy/ft |

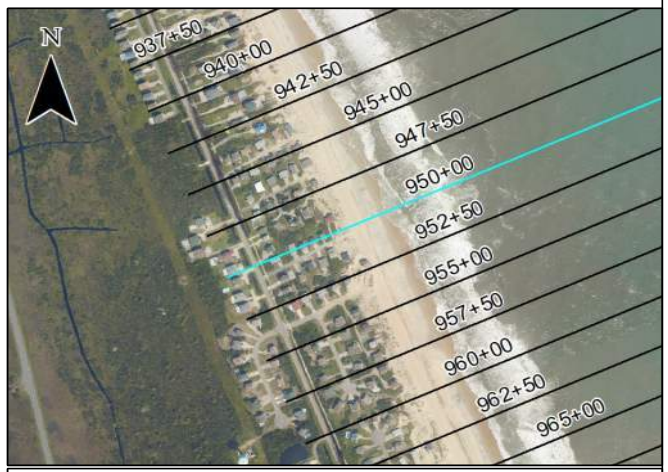
**LEGEND:**

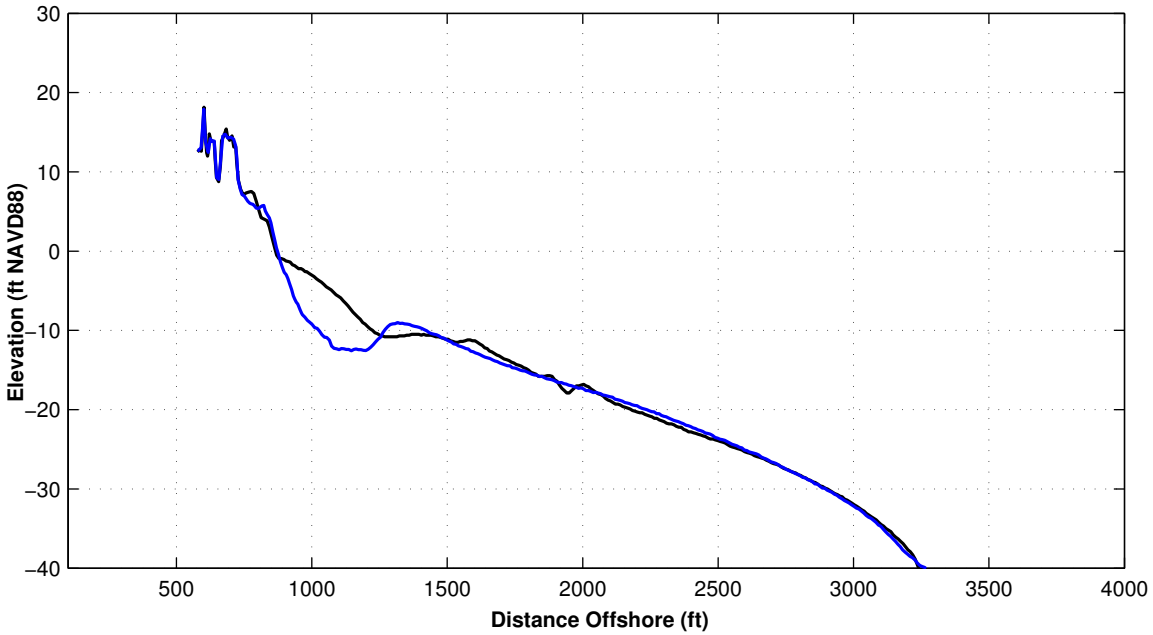
JUNE 2024 — OCTOBER 2023

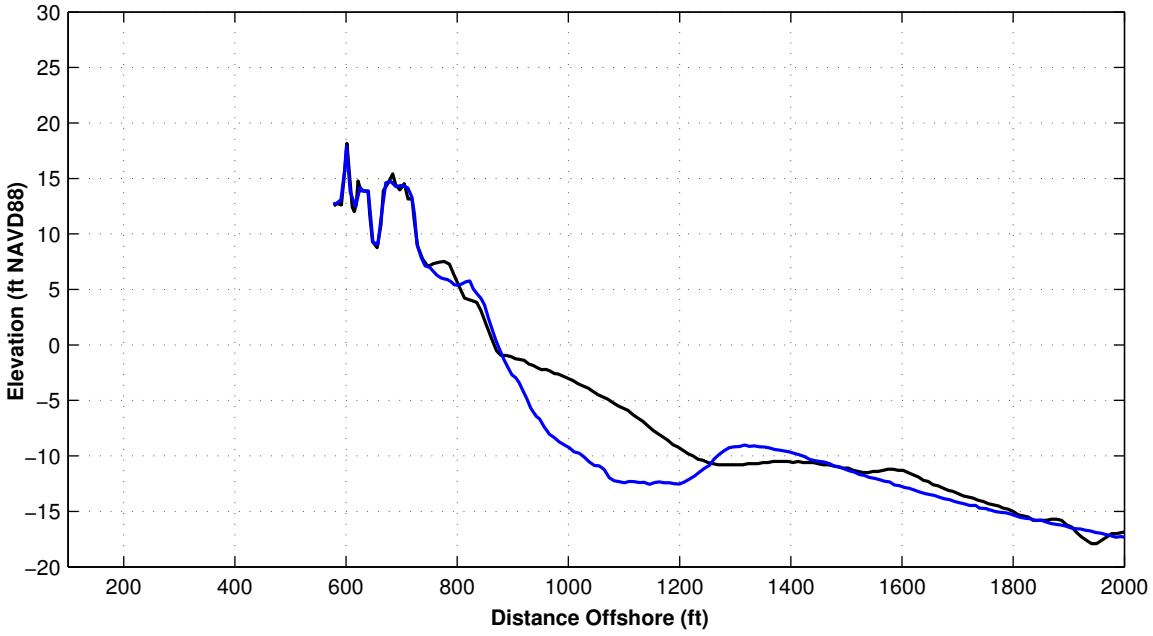
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 952+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 7.23 ft | 27.36 ft |
| Volume Change Above +6 ft NAVD88 | −1.62 cy/ft | 4.41 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 0.53 cy/ft | 10.10 cy/ft |
| Volume Change Above −6 ft NAVD88 | −17.91 cy/ft | 21.76 cy/ft |
| Volume Change Above −14 ft NAVD88 | −61.12 cy/ft | 88.84 cy/ft |
| Volume Change Above −19 ft NAVD88 | −62.08 cy/ft | 80.48 cy/ft |
| Volume Change Above −30 ft NAVD88 | −51.92 cy/ft | 56.13 cy/ft |

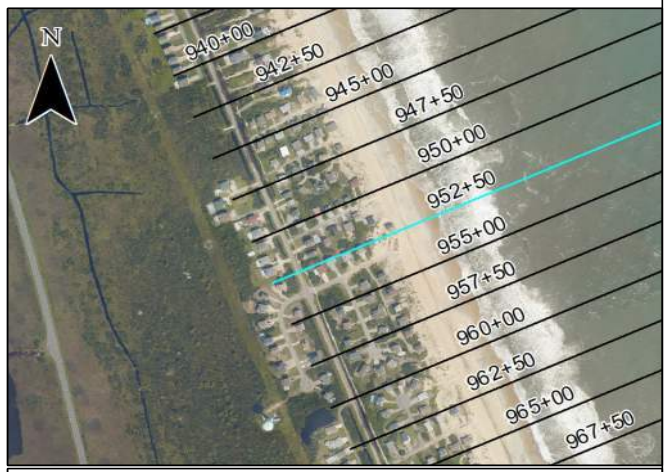
**LEGEND:**

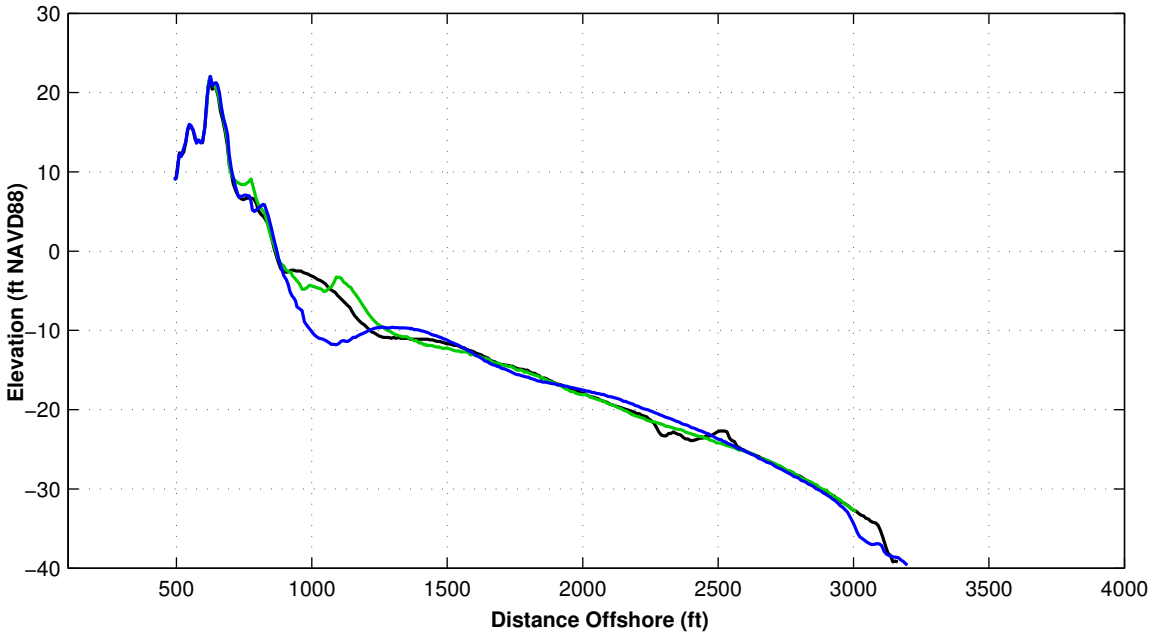
JUNE 2024 — OCTOBER 2023

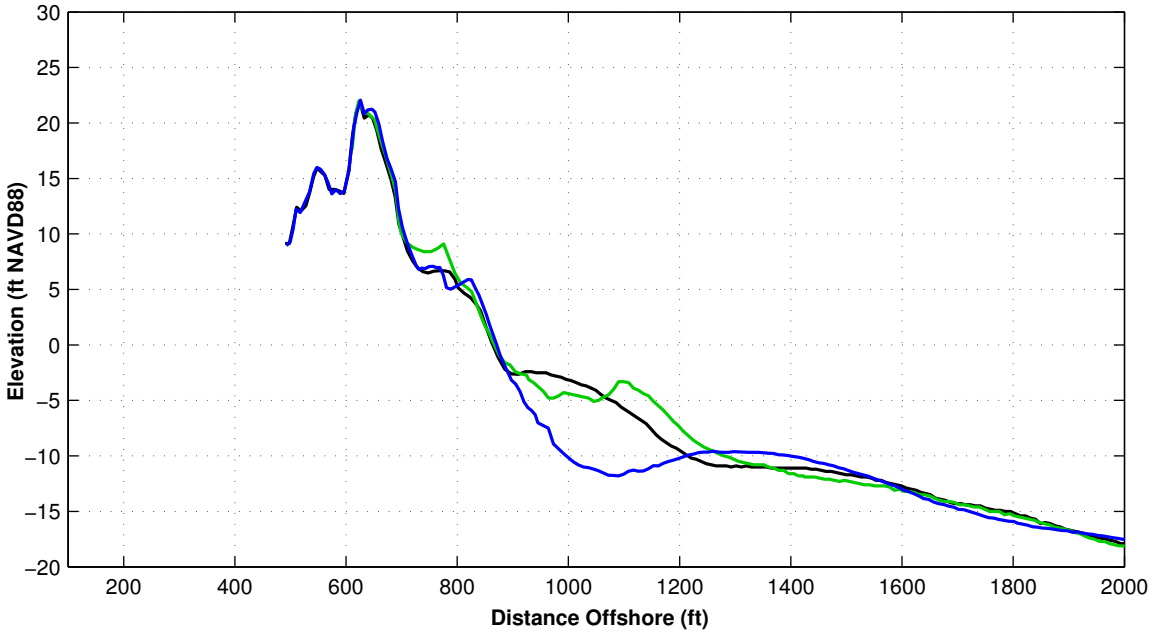
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 955+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 7.48 ft | 36.11 ft |
| Volume Change Above +6 ft NAVD88 | 2.92 cy/ft | 5.74 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.75 cy/ft | 13.98 cy/ft |
| Volume Change Above −6 ft NAVD88 | −11.80 cy/ft | 25.82 cy/ft |
| Volume Change Above −14 ft NAVD88 | −39.06 cy/ft | 89.84 cy/ft |
| Volume Change Above −19 ft NAVD88 | −40.51 cy/ft | 100.96 cy/ft |
| Volume Change Above −30 ft NAVD88 | −28.65 cy/ft | 82.58 cy/ft |

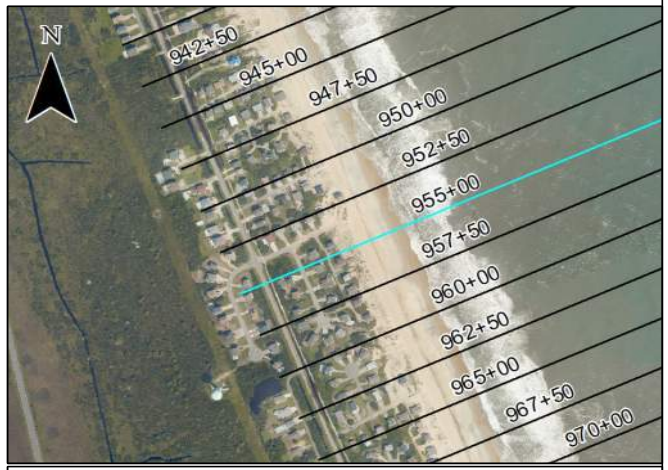
**LEGEND:**

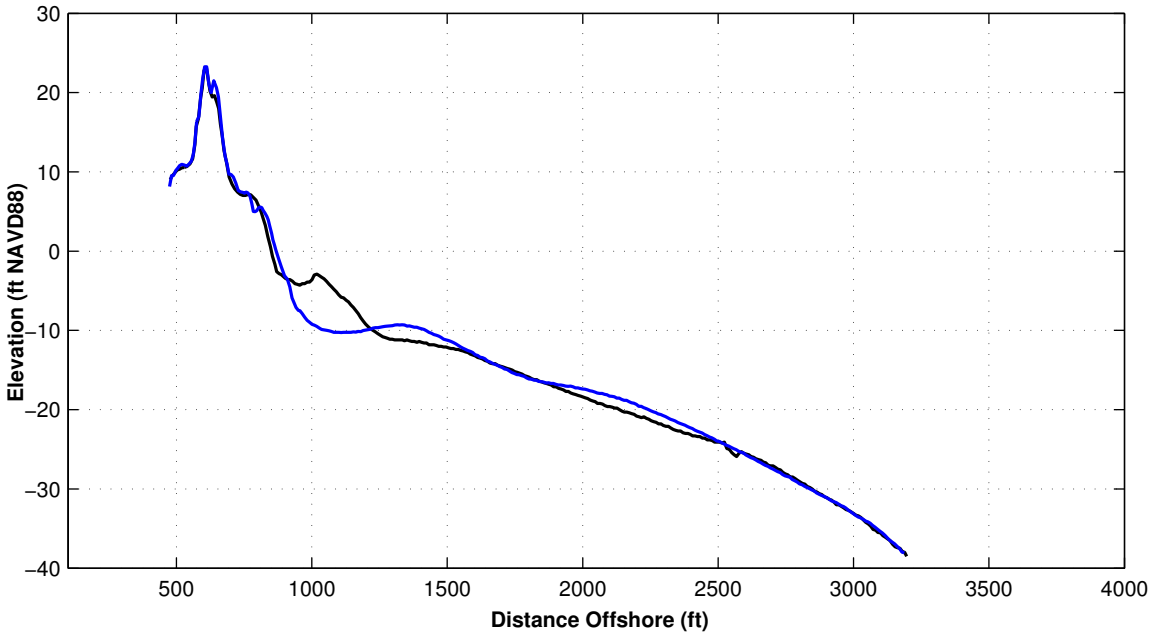
JUNE 2024 — OCTOBER 2023

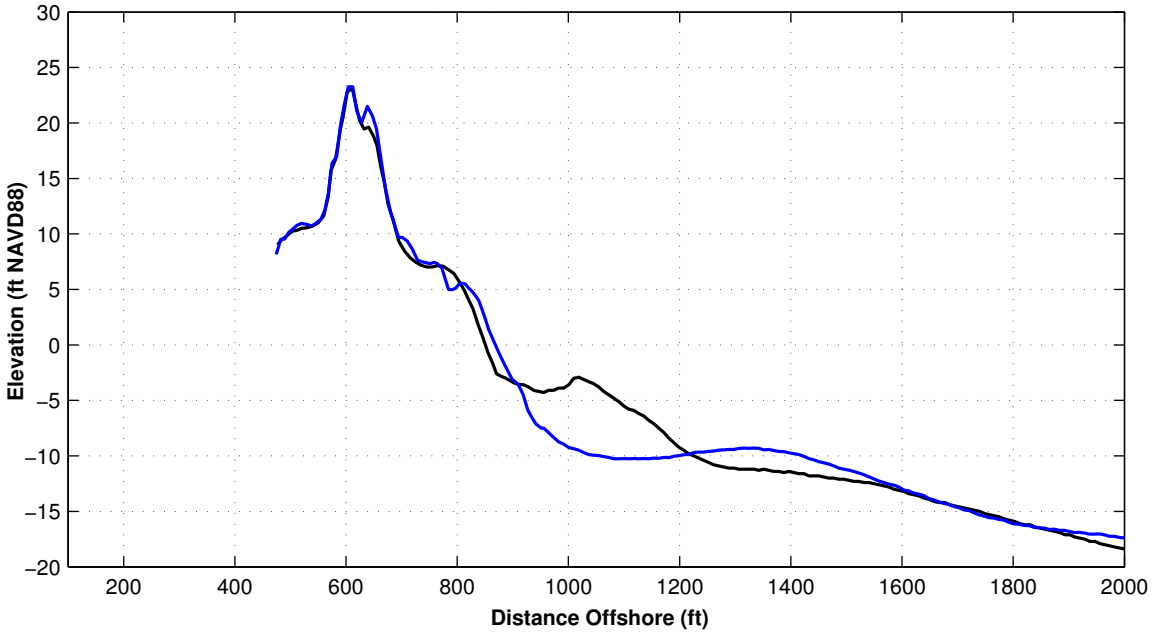
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 957+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 15.84 ft | 20.37 ft |
| Volume Change Above +6 ft NAVD88 | 3.09 cy/ft | 6.86 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.78 cy/ft | 13.98 cy/ft |
| Volume Change Above −6 ft NAVD88 | −6.05 cy/ft | 22.02 cy/ft |
| Volume Change Above −14 ft NAVD88 | −19.42 cy/ft | 88.03 cy/ft |
| Volume Change Above −19 ft NAVD88 | −12.50 cy/ft | 97.32 cy/ft |
| Volume Change Above −30 ft NAVD88 | 1.47 cy/ft | 57.97 cy/ft |

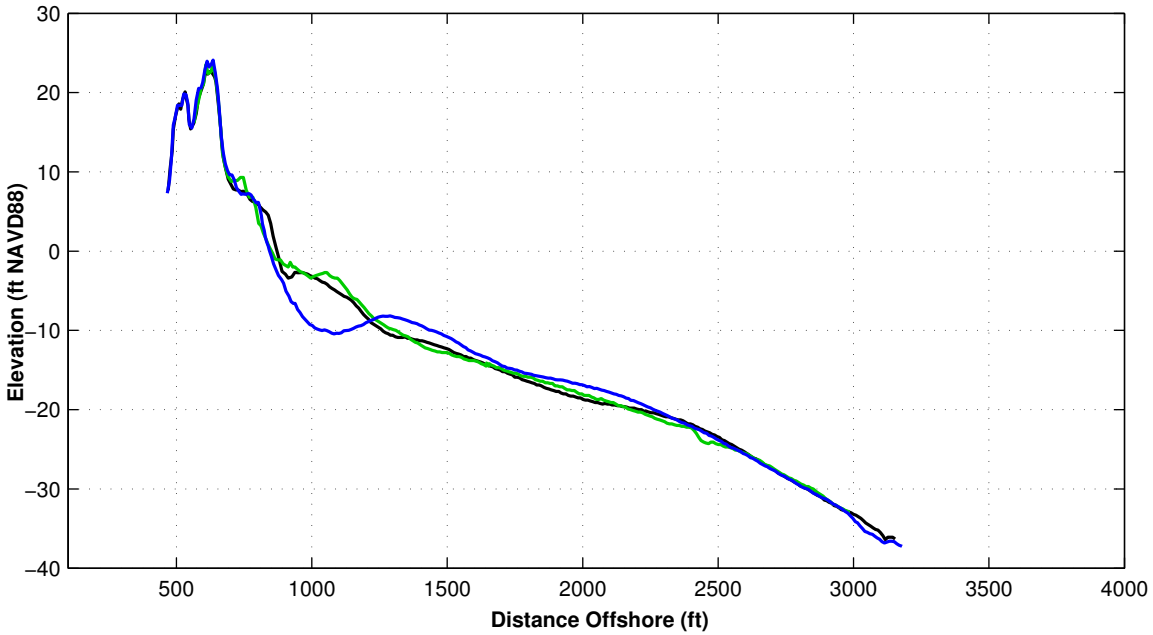
**LEGEND:**

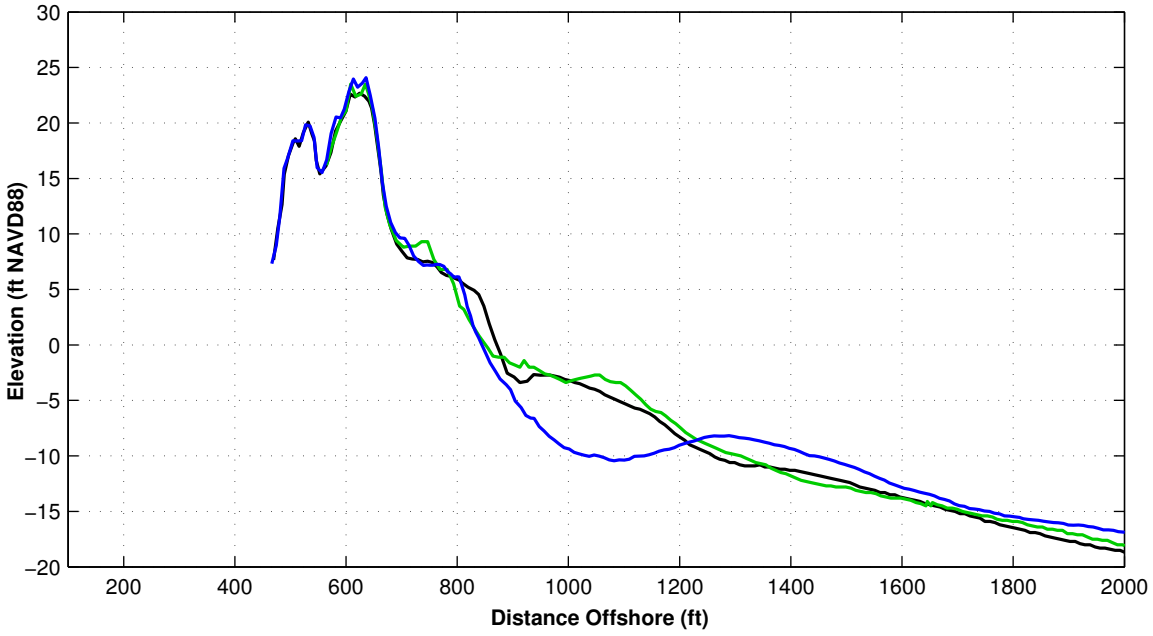
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 960+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −29.42 ft | 43.26 ft |
| Volume Change Above +6 ft NAVD88 | 5.38 cy/ft | 9.87 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.23 cy/ft | 21.82 cy/ft |
| Volume Change Above −6 ft NAVD88 | −21.43 cy/ft | 37.04 cy/ft |
| Volume Change Above −14 ft NAVD88 | −27.79 cy/ft | 93.40 cy/ft |
| Volume Change Above −19 ft NAVD88 | −4.57 cy/ft | 43.34 cy/ft |
| Volume Change Above −30 ft NAVD88 | −2.97 cy/ft | 14.81 cy/ft |

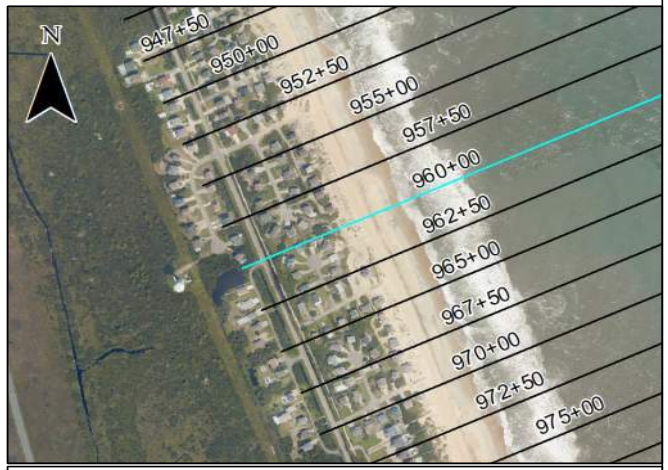
**LEGEND:**

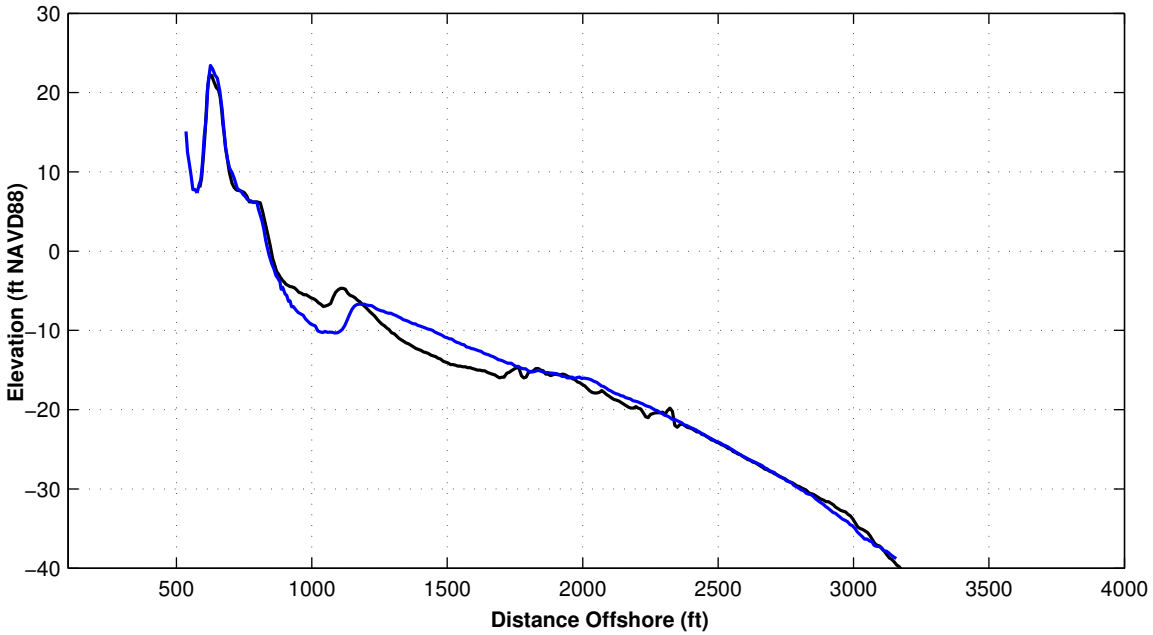
JUNE 2024 — OCTOBER 2023

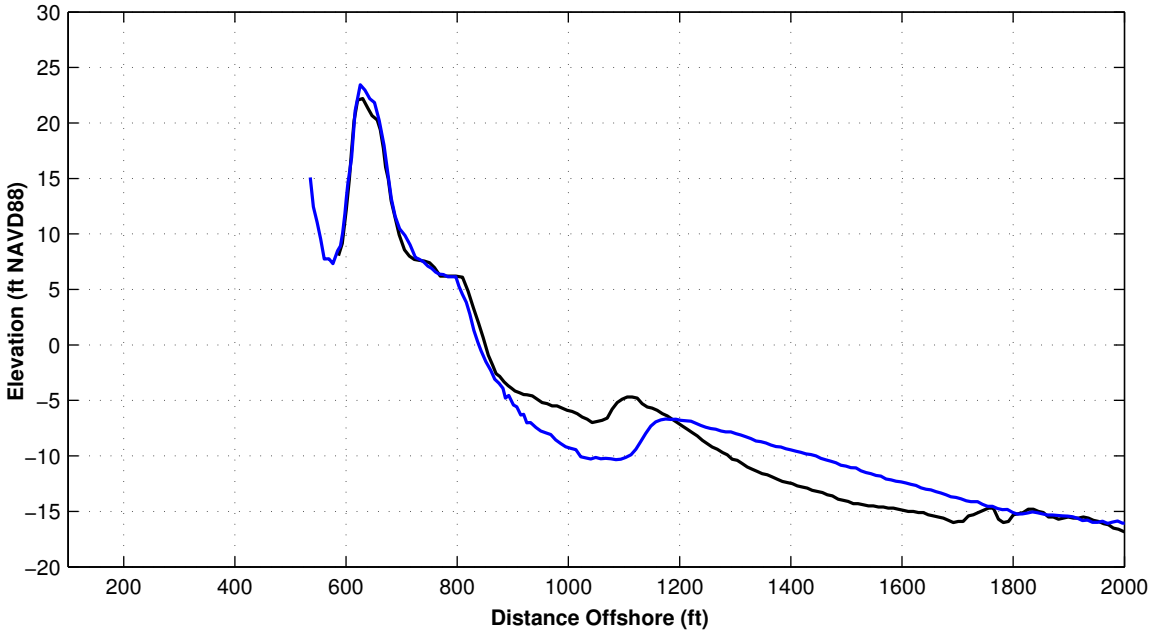
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.





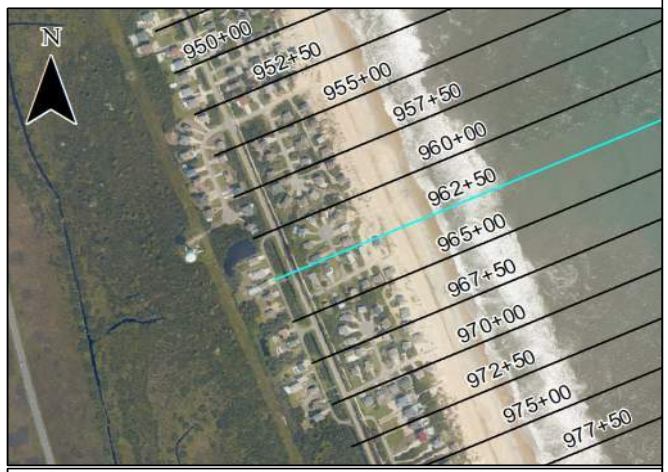



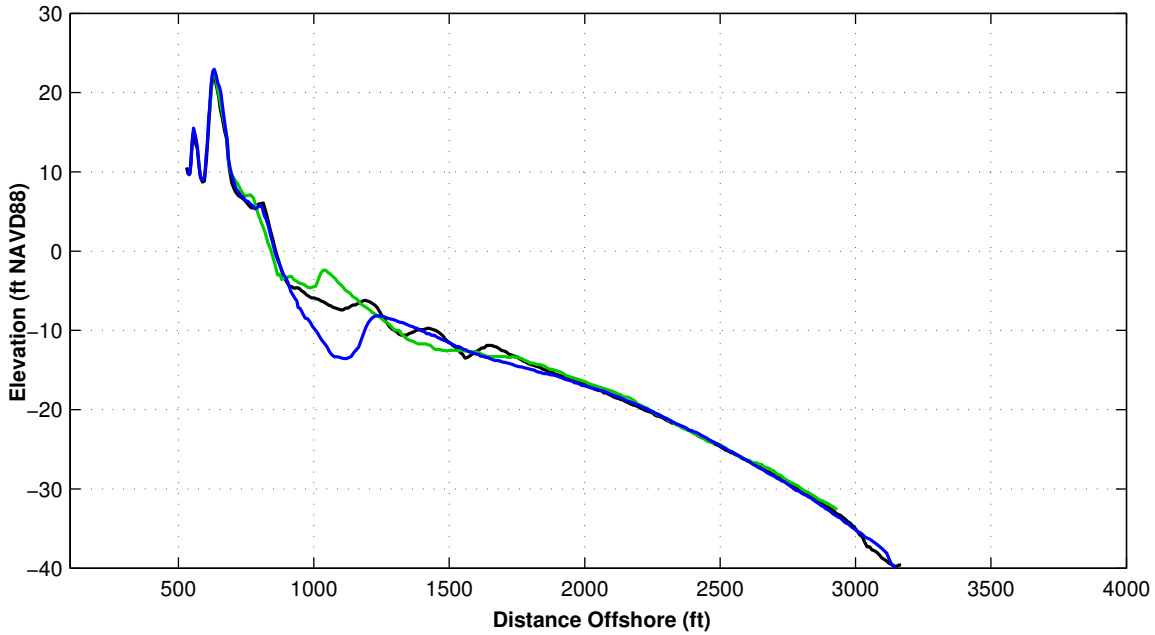

| Survey Transect 962+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −12.48 ft | 30.71 ft |
| Volume Change Above +6 ft NAVD88 | 2.61 cy/ft | 5.28 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 0.60 cy/ft | 14.16 cy/ft |
| Volume Change Above −6 ft NAVD88 | −7.84 cy/ft | 14.48 cy/ft |
| Volume Change Above −14 ft NAVD88 | 5.75 cy/ft | 58.30 cy/ft |
| Volume Change Above −19 ft NAVD88 | 22.68 cy/ft | 23.15 cy/ft |
| Volume Change Above −30 ft NAVD88 | 26.91 cy/ft | −1.30 cy/ft |

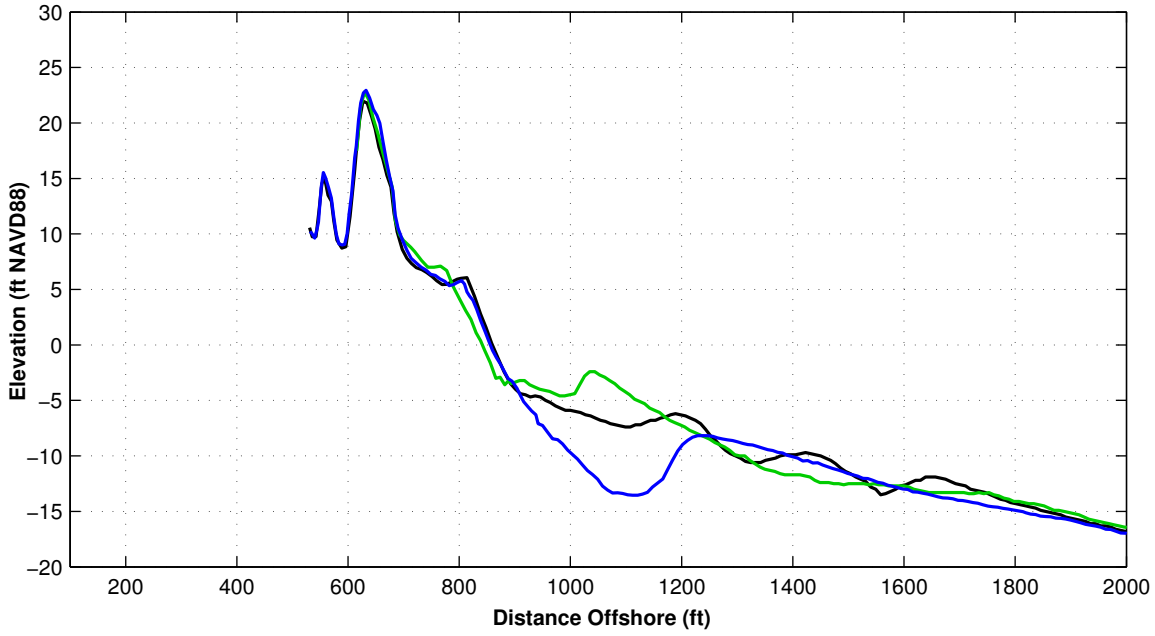
**LEGEND:**

JUNE 2024 — OCTOBER 2023 / JUNE 2023

Notes:
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 965+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −4.09 ft | 31.77 ft |
| Volume Change Above +6 ft NAVD88 | 5.27 cy/ft | 3.41 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 4.12 cy/ft | 11.53 cy/ft |
| Volume Change Above −6 ft NAVD88 | 1.43 cy/ft | 13.46 cy/ft |
| Volume Change Above −14 ft NAVD88 | −49.41 cy/ft | 77.89 cy/ft |
| Volume Change Above −19 ft NAVD88 | −52.94 cy/ft | 72.31 cy/ft |
| Volume Change Above −30 ft NAVD88 | −51.56 cy/ft | 52.33 cy/ft |

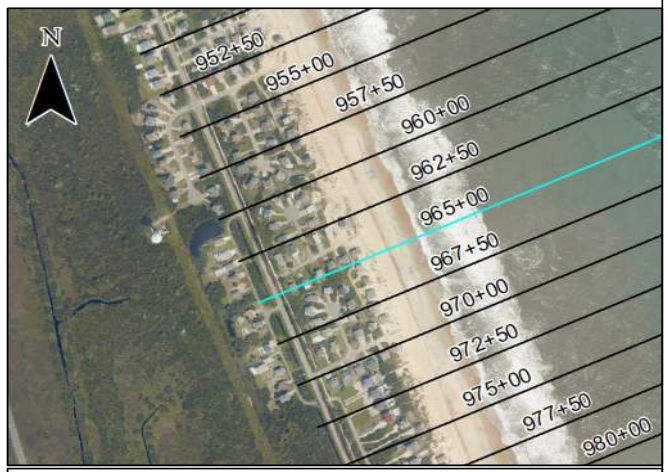
**LEGEND:**

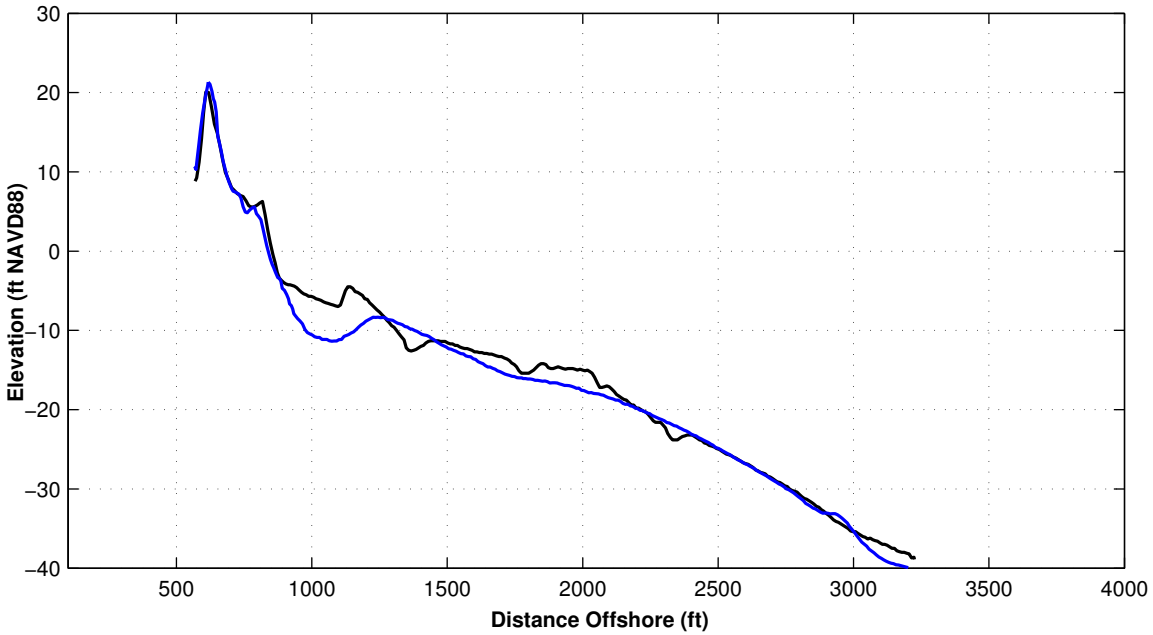
JUNE 2024 — OCTOBER 2023

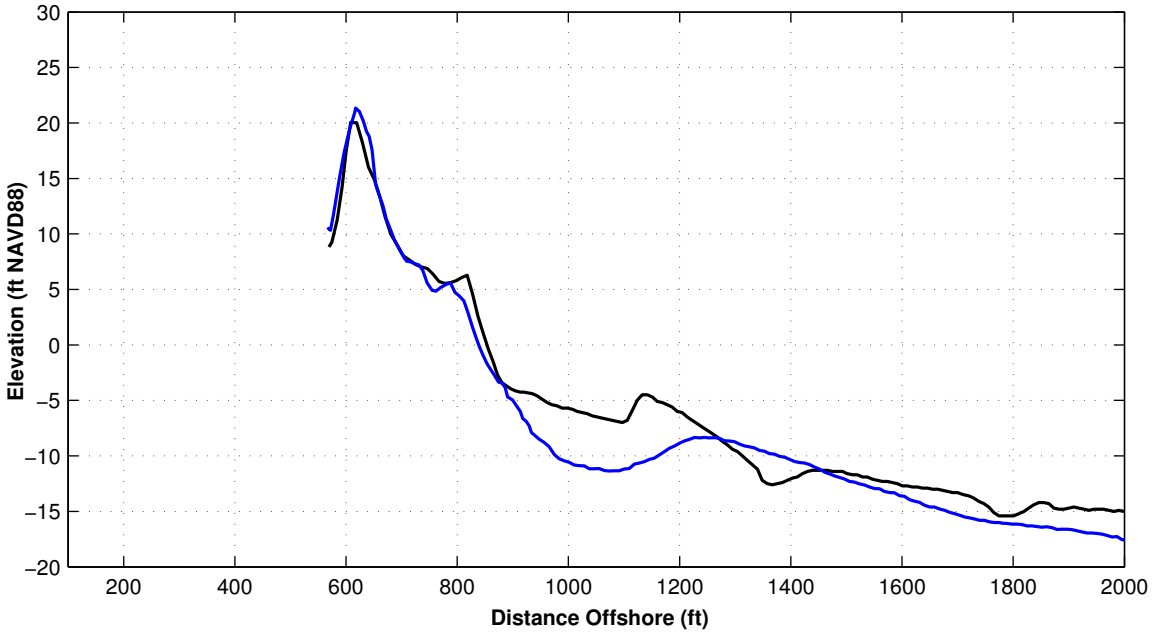
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 967+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −15.73 ft | 36.42 ft |
| Volume Change Above +6 ft NAVD88 | 2.19 cy/ft | 3.43 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −2.54 cy/ft | 13.80 cy/ft |
| Volume Change Above −6 ft NAVD88 | −11.70 cy/ft | 17.01 cy/ft |
| Volume Change Above −14 ft NAVD88 | −54.64 cy/ft | 66.83 cy/ft |
| Volume Change Above −19 ft NAVD88 | −84.06 cy/ft | 76.19 cy/ft |
| Volume Change Above −30 ft NAVD88 | −79.13 cy/ft | 51.73 cy/ft |

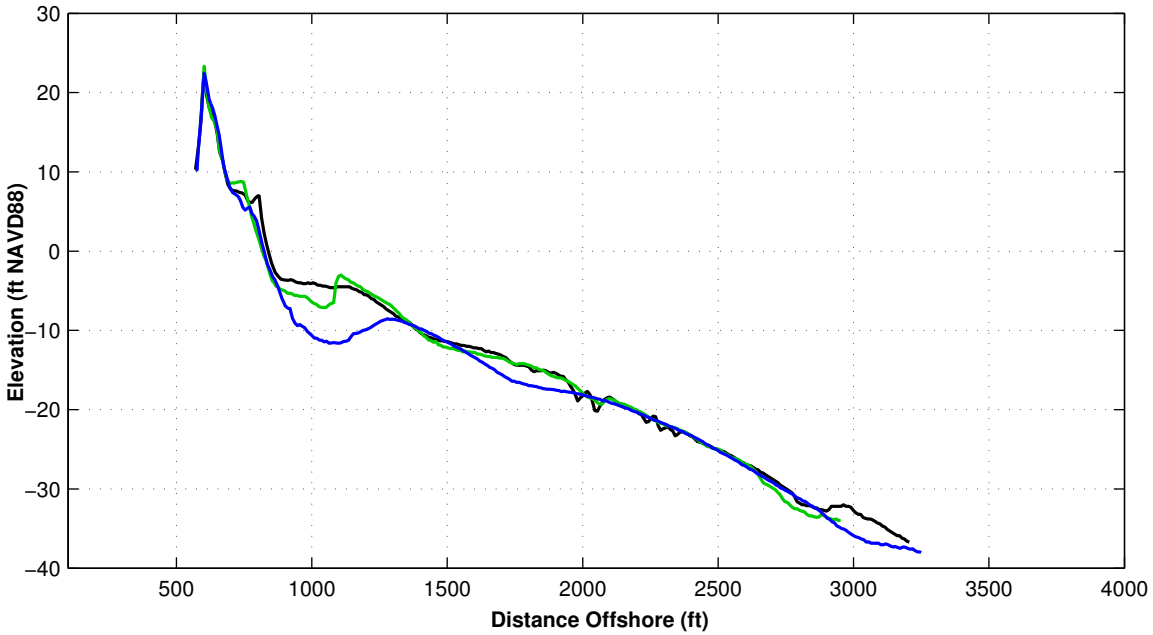
**LEGEND:**

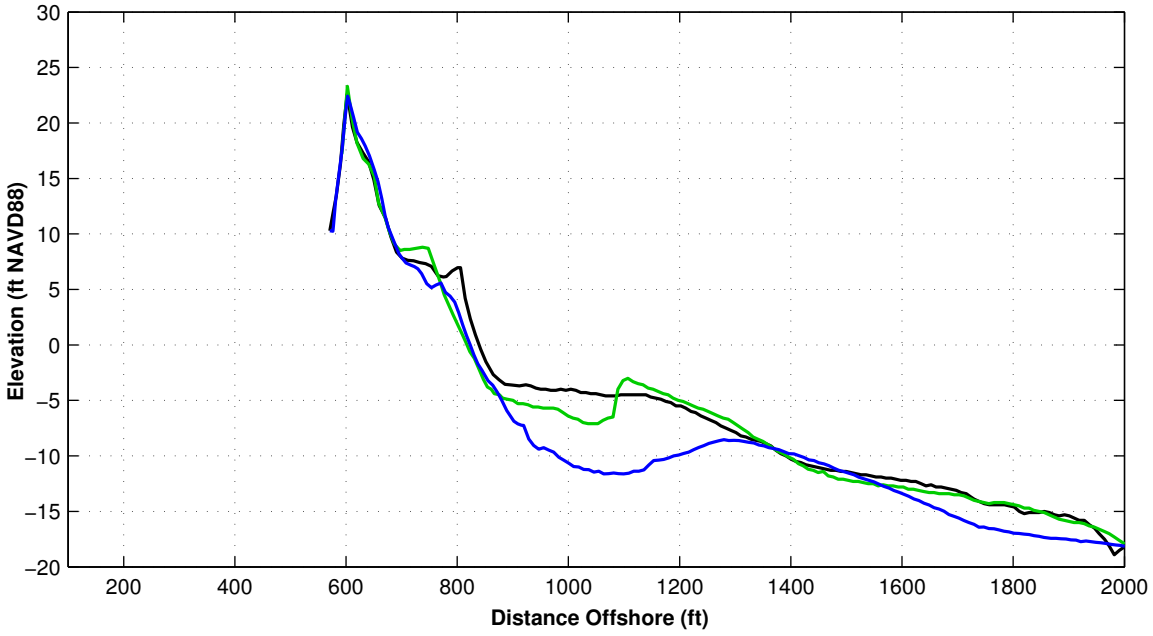
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 970+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −16.64 ft | 27.33 ft |
| Volume Change Above +6 ft NAVD88 | −0.17 cy/ft | 7.68 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −5.17 cy/ft | 16.77 cy/ft |
| Volume Change Above −6 ft NAVD88 | −28.58 cy/ft | 30.27 cy/ft |
| Volume Change Above −14 ft NAVD88 | −92.24 cy/ft | 100.43 cy/ft |
| Volume Change Above −19 ft NAVD88 | −113.63 cy/ft | 86.85 cy/ft |
| Volume Change Above −30 ft NAVD88 | −114.19 cy/ft | 52.18 cy/ft |

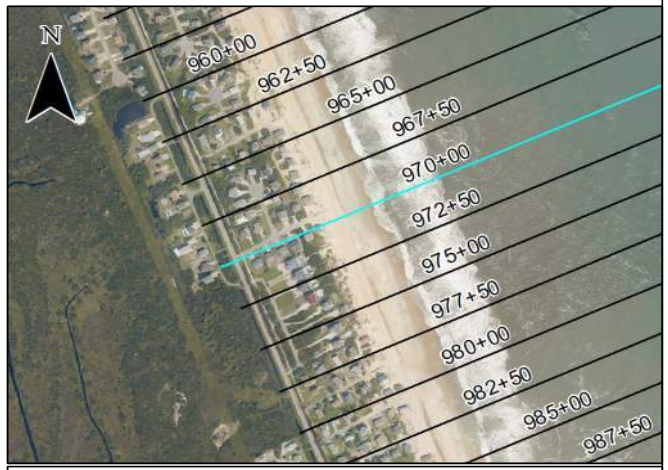
**LEGEND:**

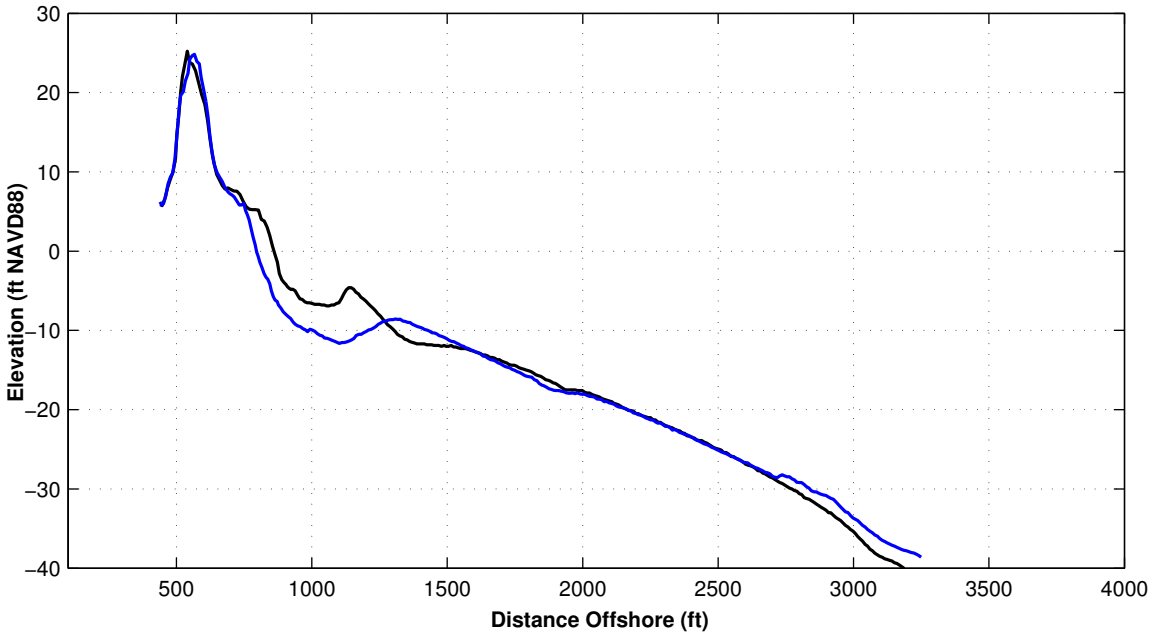
JUNE 2024 — OCTOBER 2023

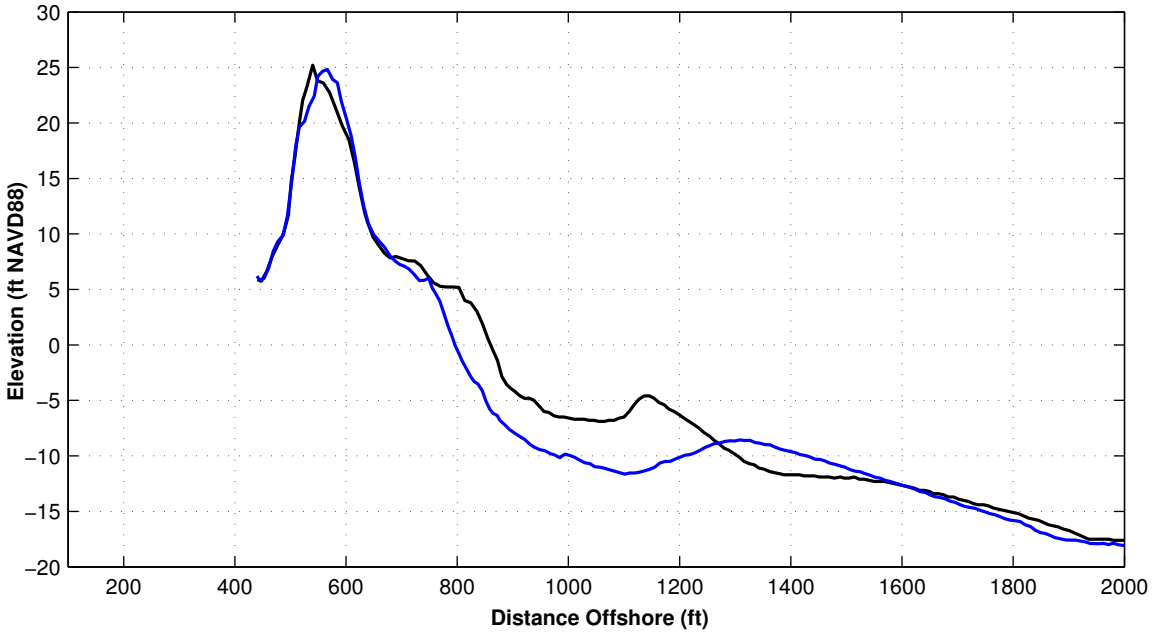
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 972+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −63.16 ft | 54.91 ft |
| Volume Change Above +6 ft NAVD88 | 1.03 cy/ft | 10.14 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −7.70 cy/ft | 21.41 cy/ft |
| Volume Change Above −6 ft NAVD88 | −27.55 cy/ft | 27.15 cy/ft |
| Volume Change Above −14 ft NAVD88 | −64.13 cy/ft | 73.03 cy/ft |
| Volume Change Above −19 ft NAVD88 | −72.21 cy/ft | 53.02 cy/ft |
| Volume Change Above −30 ft NAVD88 | −69.08 cy/ft | 28.66 cy/ft |

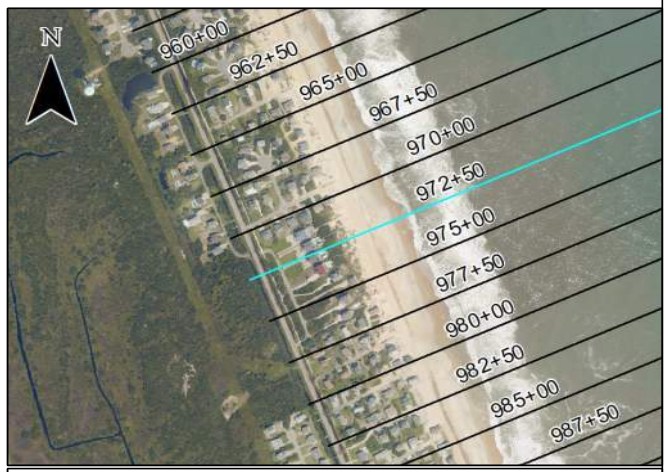
**LEGEND:**

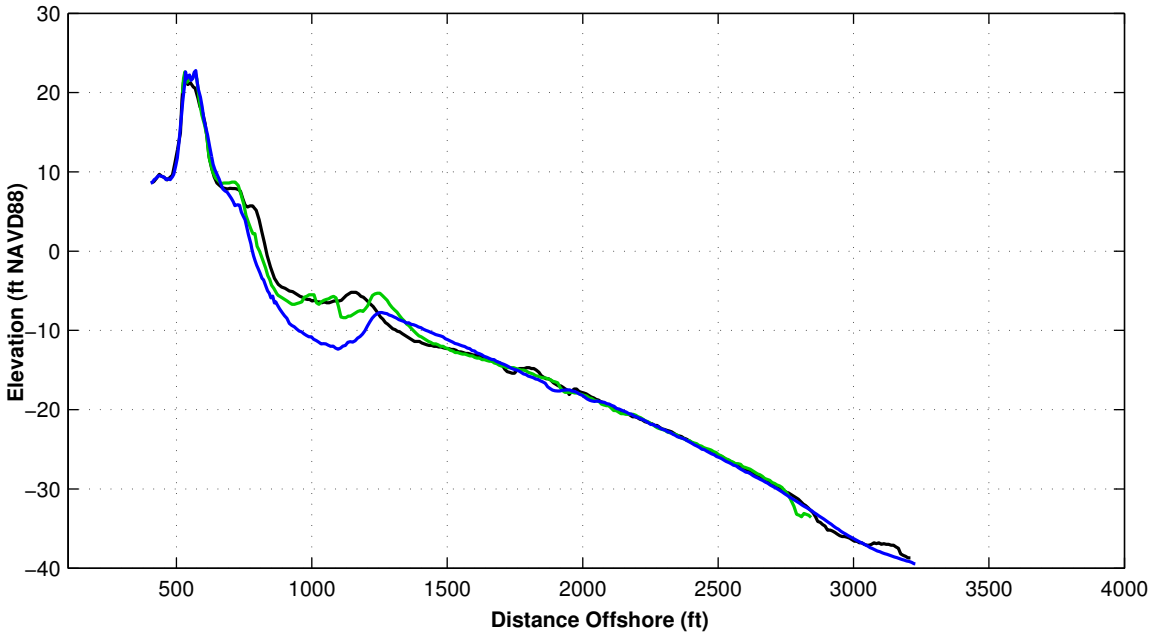
JUNE 2024 — OCTOBER 2023

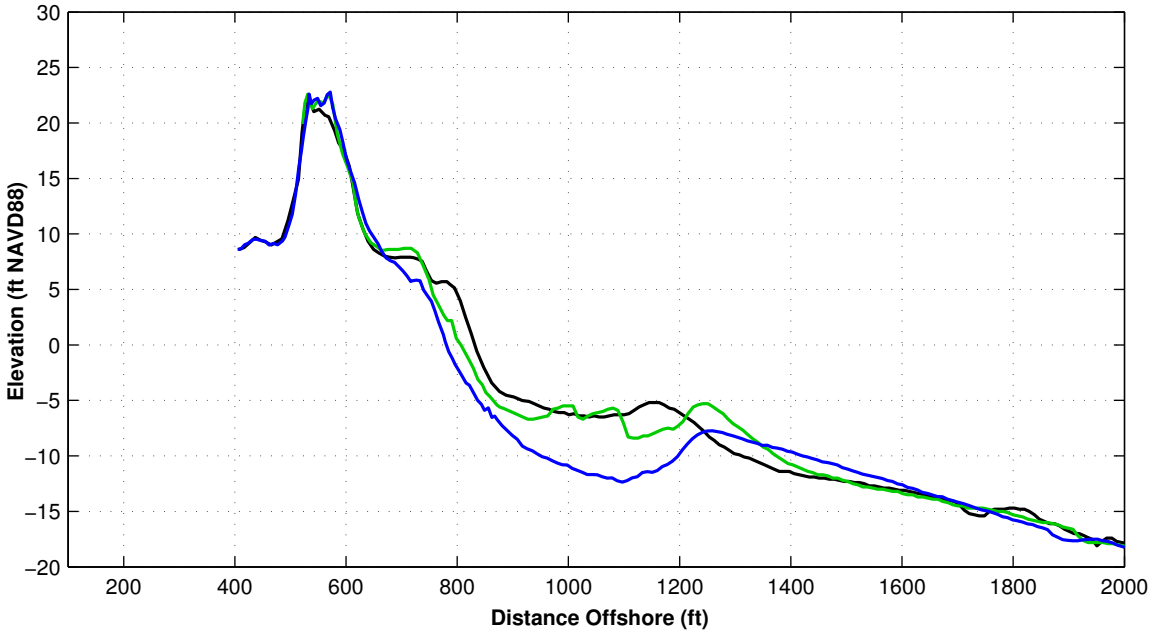
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 975+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −50.98 ft | 37.48 ft |
| Volume Change Above +6 ft NAVD88 | 1.68 cy/ft | 8.15 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −7.48 cy/ft | 19.13 cy/ft |
| Volume Change Above −6 ft NAVD88 | −24.34 cy/ft | 22.00 cy/ft |
| Volume Change Above −14 ft NAVD88 | −64.35 cy/ft | 66.76 cy/ft |
| Volume Change Above −19 ft NAVD88 | −69.71 cy/ft | 33.74 cy/ft |
| Volume Change Above −30 ft NAVD88 | −72.48 cy/ft | −4.02 cy/ft |

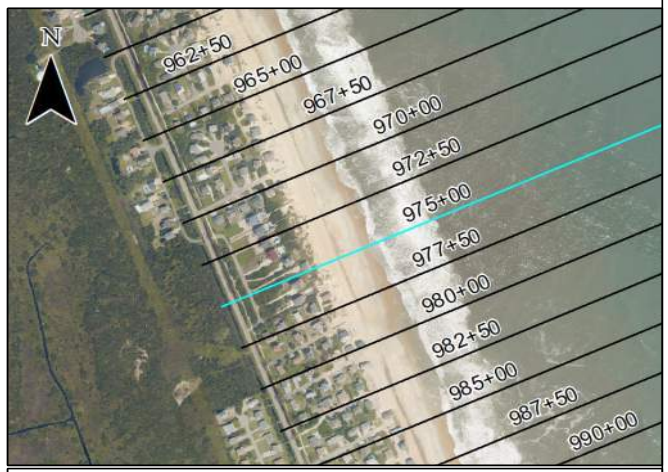
**LEGEND:**

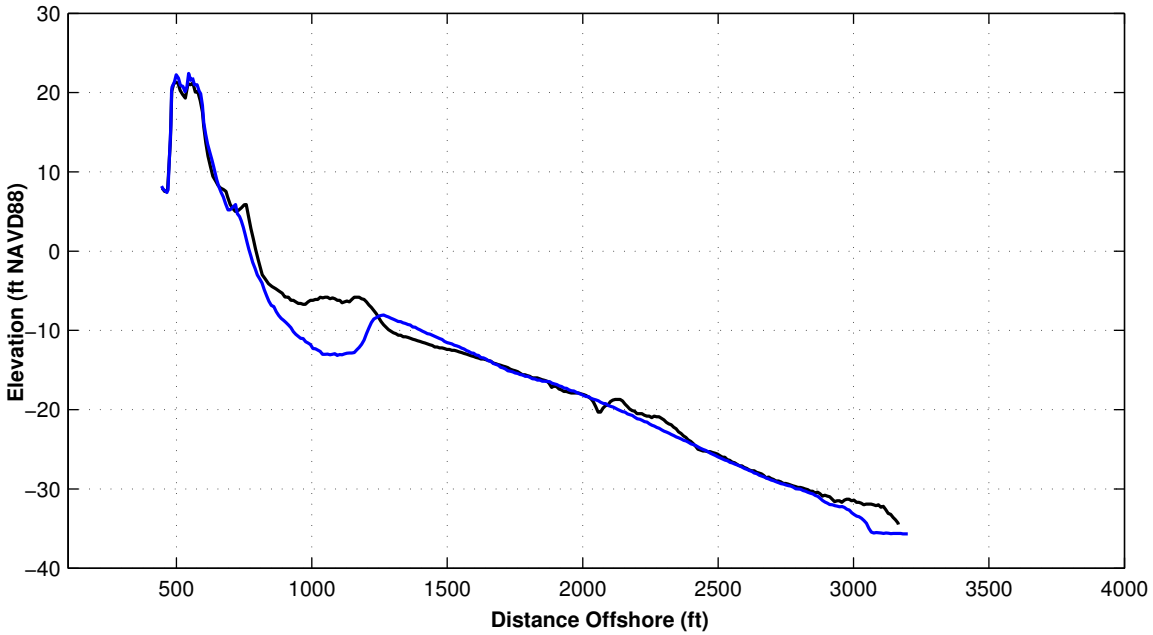
JUNE 2024 — OCTOBER 2023

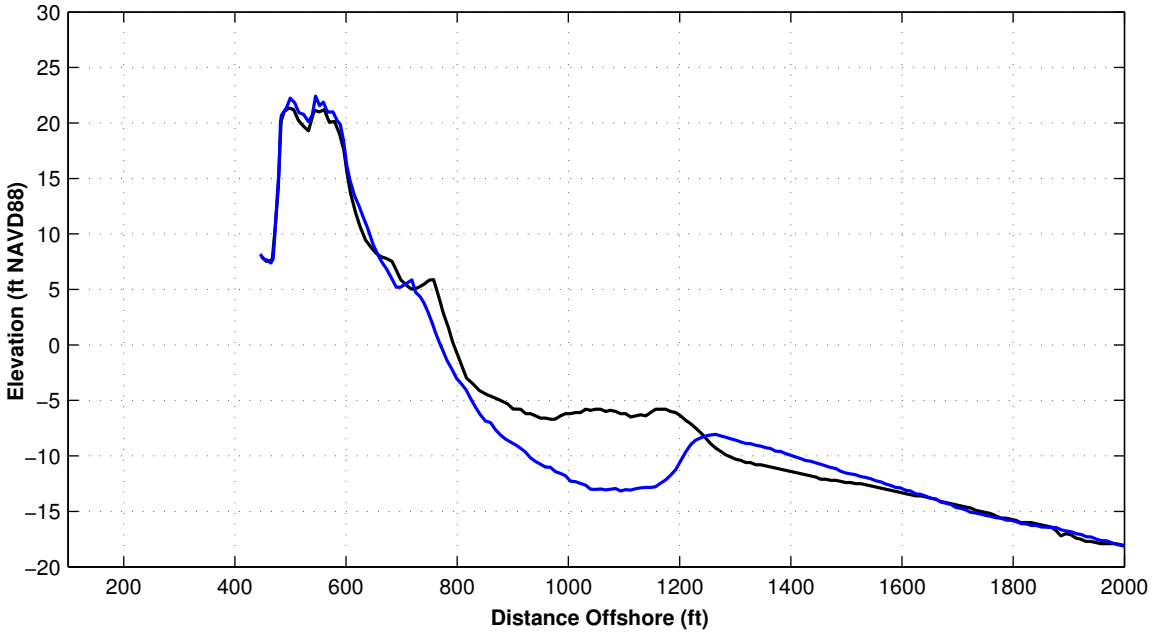
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 977+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −25.84 ft | 16.55 ft |
| Volume Change Above +6 ft NAVD88 | 4.08 cy/ft | 8.28 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −1.00 cy/ft | 14.35 cy/ft |
| Volume Change Above −6 ft NAVD88 | −9.37 cy/ft | 11.14 cy/ft |
| Volume Change Above −14 ft NAVD88 | −64.41 cy/ft | 60.65 cy/ft |
| Volume Change Above −19 ft NAVD88 | −64.61 cy/ft | 48.21 cy/ft |
| Volume Change Above −30 ft NAVD88 | −75.48 cy/ft | 32.73 cy/ft |

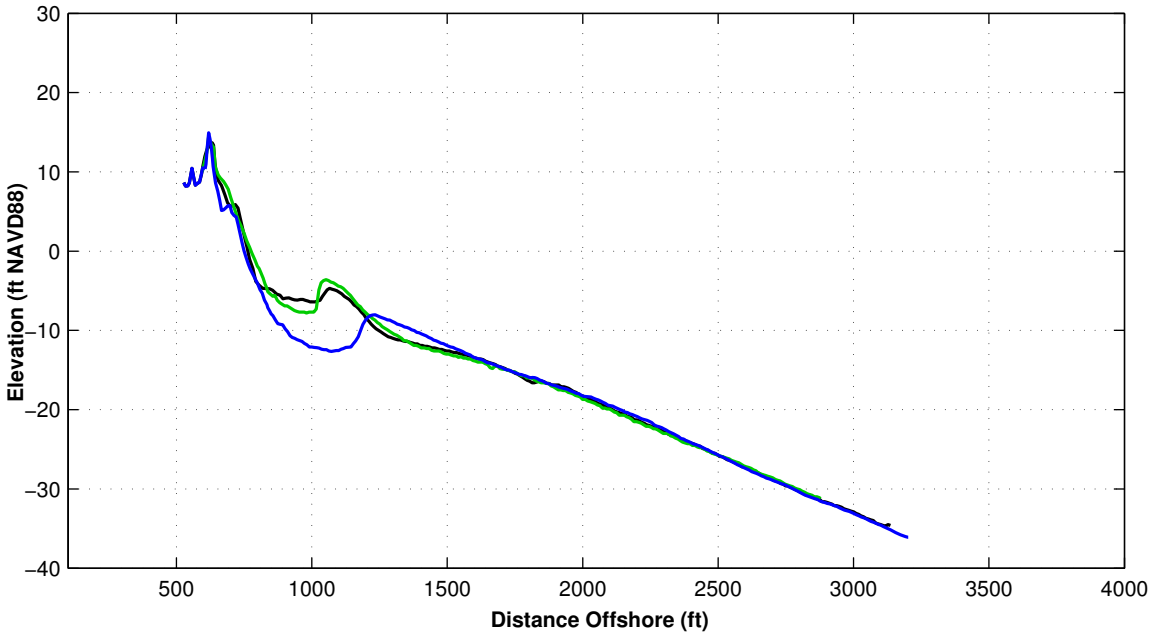
**LEGEND:**

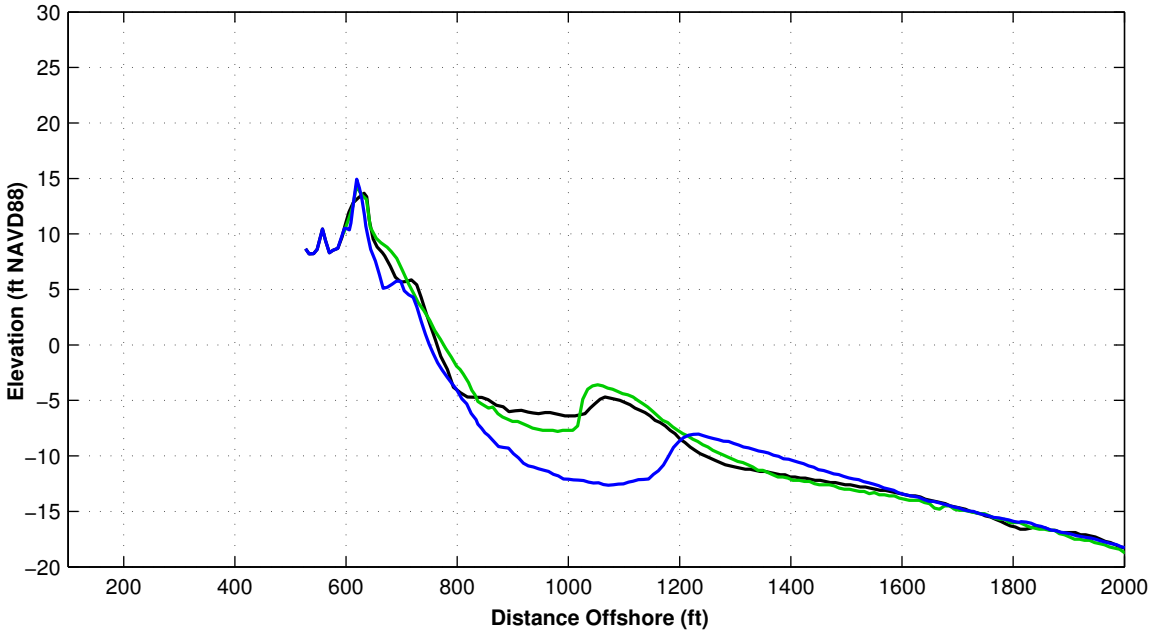
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 980+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −14.38 ft | 11.69 ft |
| Volume Change Above +6 ft NAVD88 | −3.96 cy/ft | 8.10 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −7.48 cy/ft | 12.68 cy/ft |
| Volume Change Above −6 ft NAVD88 | −14.86 cy/ft | 11.30 cy/ft |
| Volume Change Above −14 ft NAVD88 | −62.34 cy/ft | 59.51 cy/ft |
| Volume Change Above −19 ft NAVD88 | −61.09 cy/ft | 83.58 cy/ft |
| Volume Change Above −30 ft NAVD88 | −57.06 cy/ft | 64.57 cy/ft |

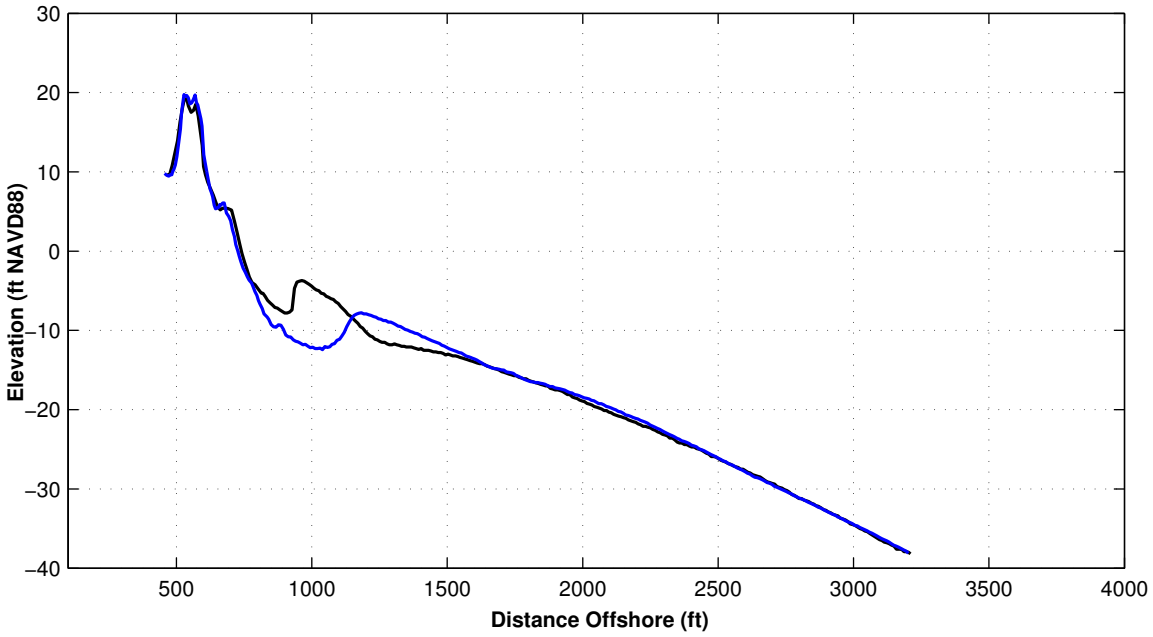
**LEGEND:**

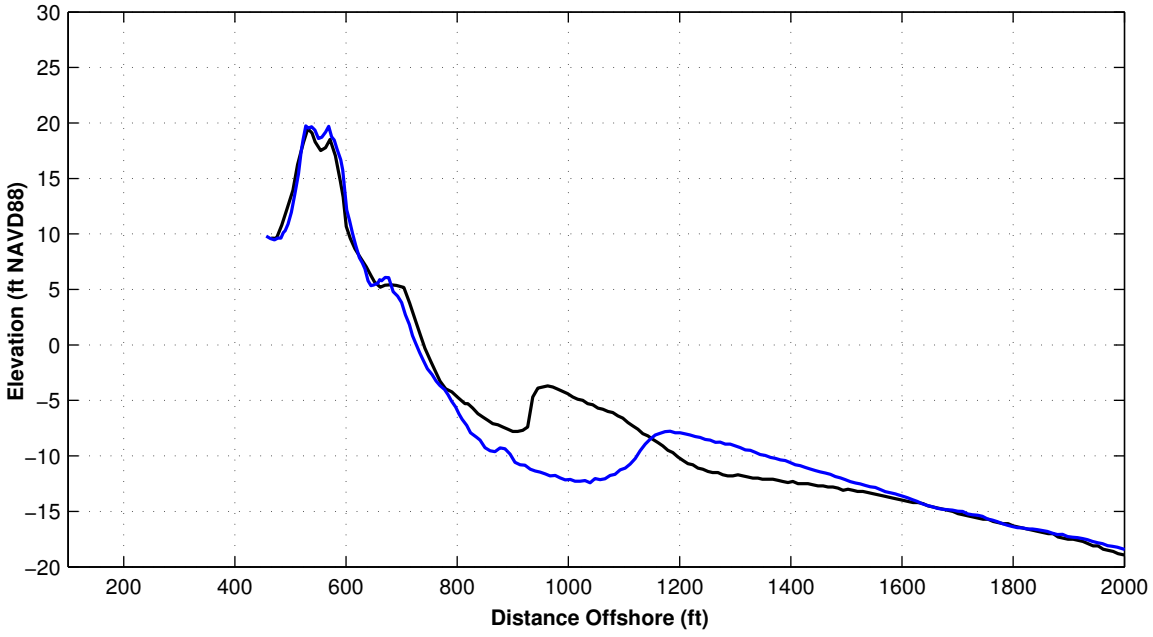
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 982+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −14.08 ft | 1.44 ft |
| Volume Change Above +6 ft NAVD88 | 3.49 cy/ft | 3.58 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.30 cy/ft | 5.92 cy/ft |
| Volume Change Above −6 ft NAVD88 | −9.07 cy/ft | 7.80 cy/ft |
| Volume Change Above −14 ft NAVD88 | −32.74 cy/ft | 45.64 cy/ft |
| Volume Change Above −19 ft NAVD88 | −29.92 cy/ft | 34.62 cy/ft |
| Volume Change Above −30 ft NAVD88 | −23.53 cy/ft | 11.18 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

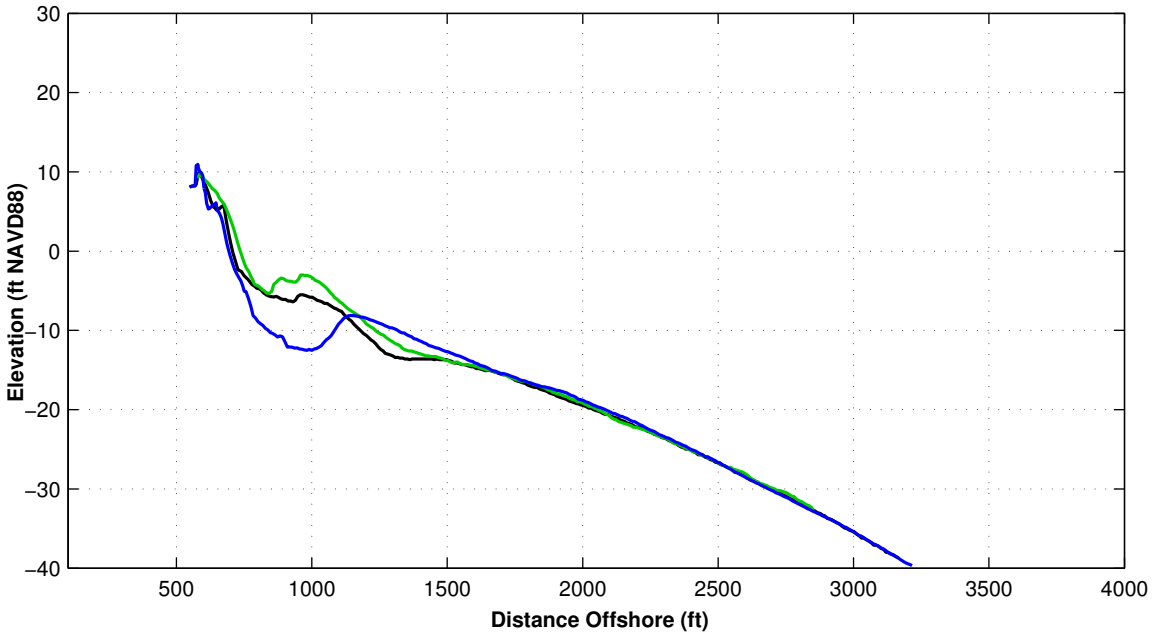
JUNE 2023

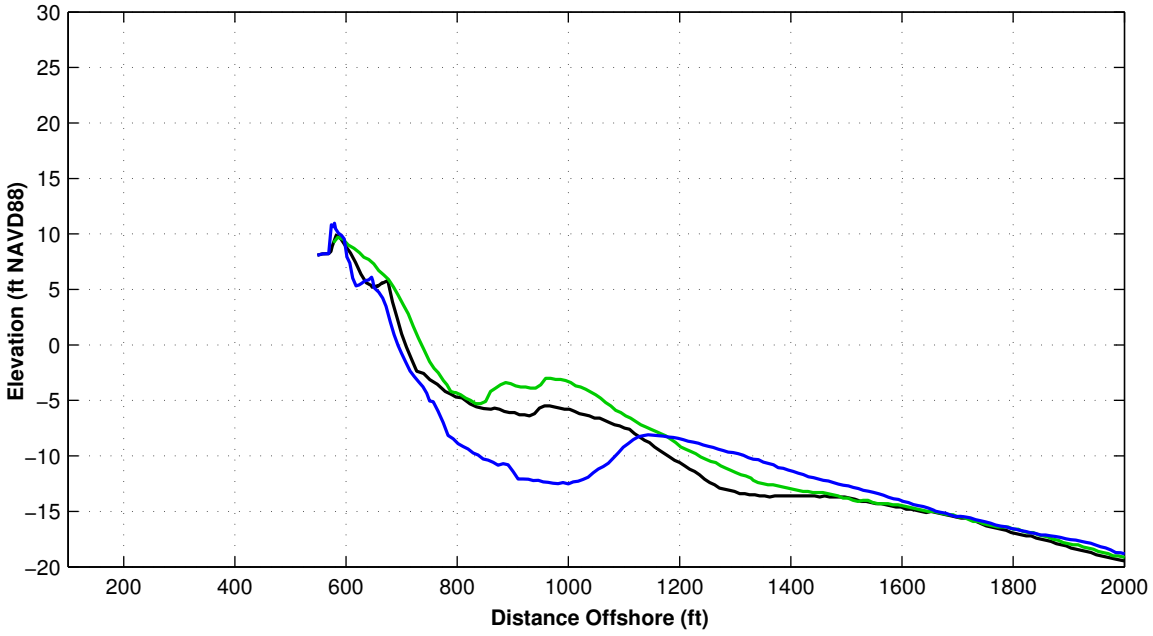
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 982+50 | Pg 167 of 173 | 2024 |
|---|---|---|




| Survey Transect 985+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −14.11 ft | −11.46 ft |
| Volume Change Above +6 ft NAVD88 | −0.25 cy/ft | 4.19 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −3.06 cy/ft | 5.56 cy/ft |
| Volume Change Above −6 ft NAVD88 | −11.80 cy/ft | 5.18 cy/ft |
| Volume Change Above −14 ft NAVD88 | −36.12 cy/ft | 35.36 cy/ft |
| Volume Change Above −19 ft NAVD88 | −28.99 cy/ft | 19.97 cy/ft |
| Volume Change Above −30 ft NAVD88 | −22.67 cy/ft | −3.85 cy/ft |

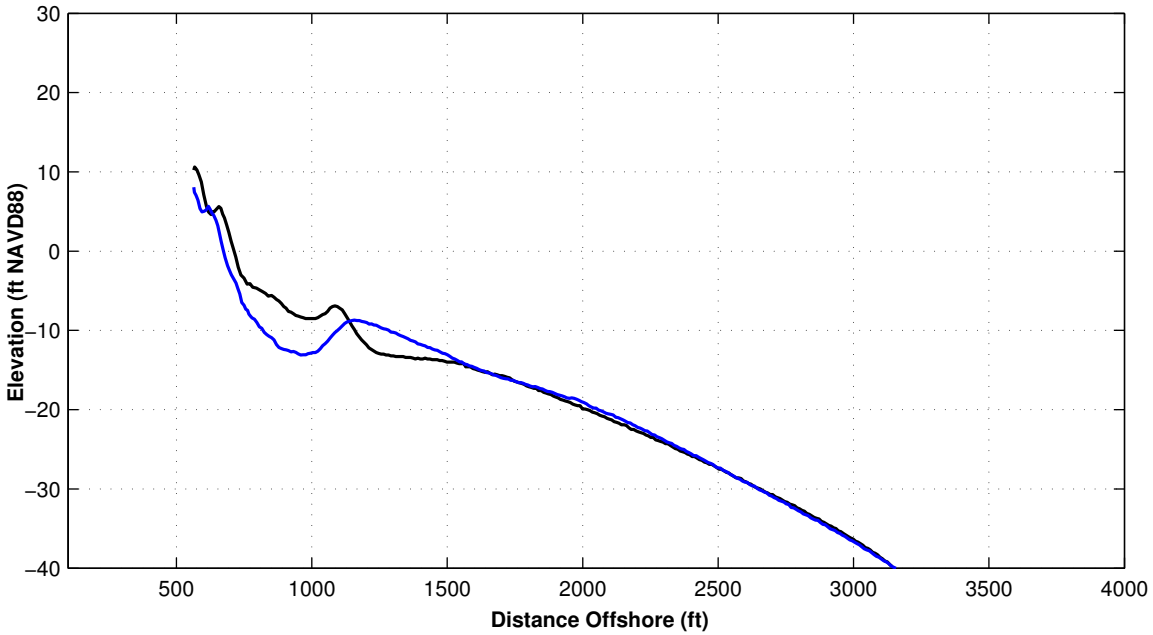
**LEGEND:**

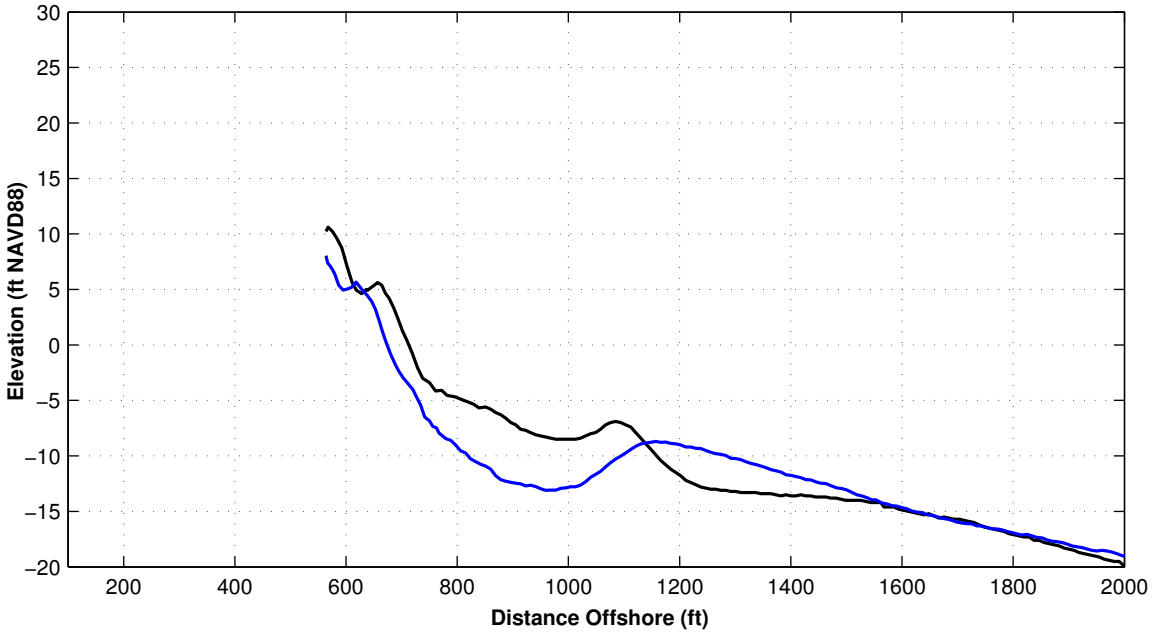
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 987+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −36.77 ft | 25.45 ft |
| Volume Change Above +6 ft NAVD88 | −0.21 cy/ft | 0.12 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −5.58 cy/ft | 4.72 cy/ft |
| Volume Change Above −6 ft NAVD88 | −18.99 cy/ft | 10.58 cy/ft |
| Volume Change Above −14 ft NAVD88 | −44.63 cy/ft | 35.53 cy/ft |
| Volume Change Above −19 ft NAVD88 | −41.99 cy/ft | 26.25 cy/ft |
| Volume Change Above −30 ft NAVD88 | −33.36 cy/ft | 6.24 cy/ft |

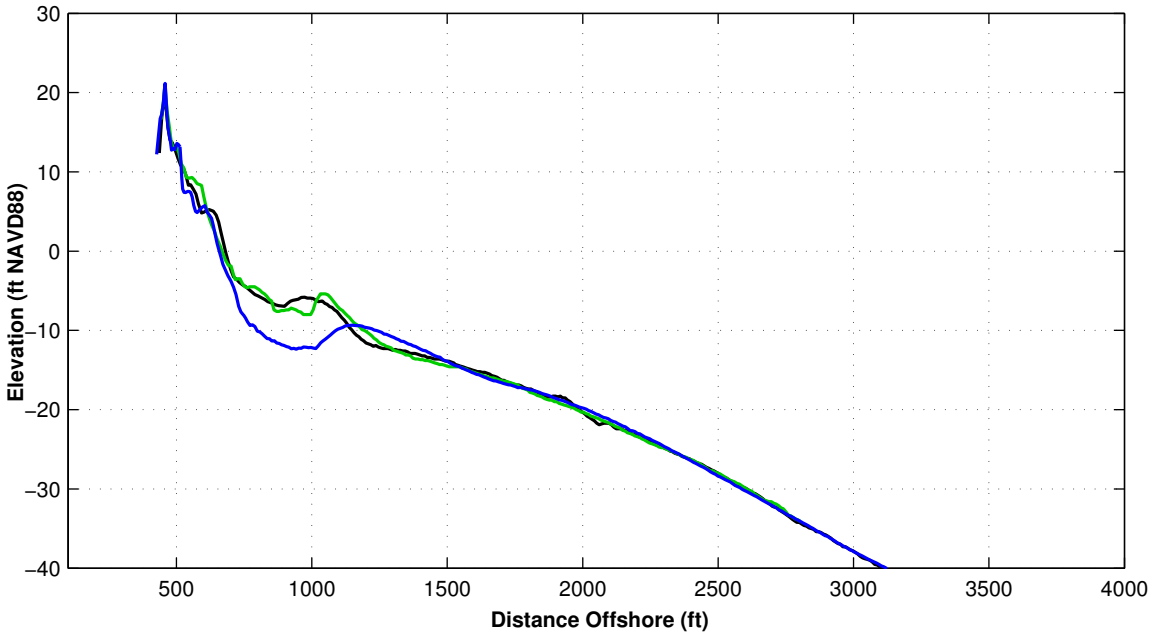
**LEGEND:**

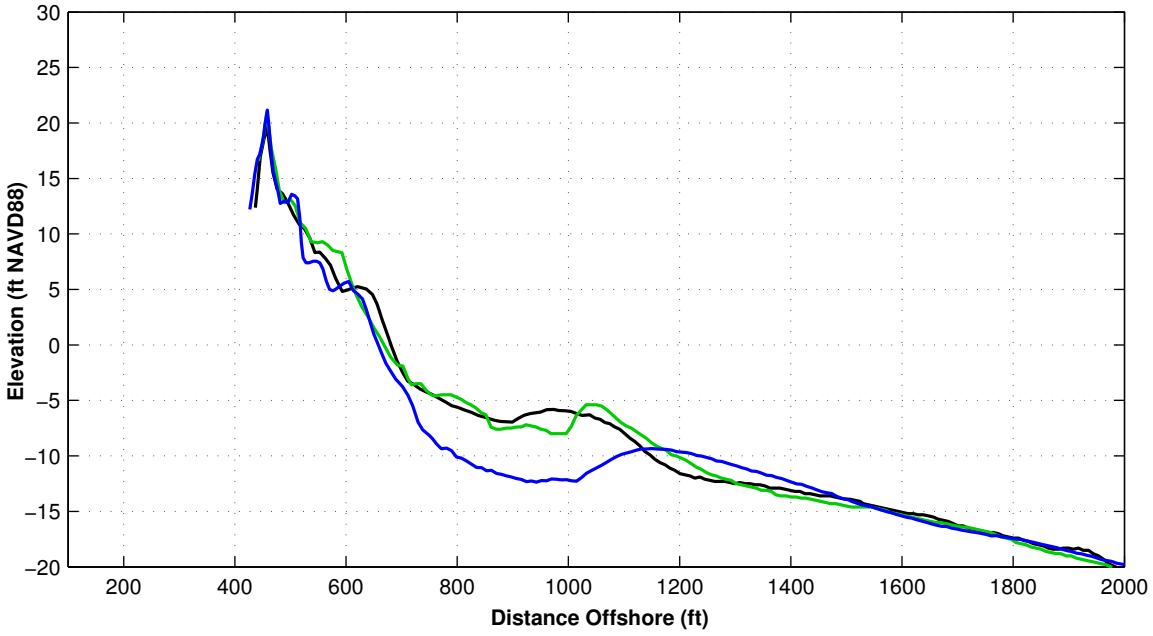
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 990+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −24.04 ft | 17.24 ft |
| Volume Change Above +6 ft NAVD88 | −2.28 cy/ft | 4.54 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −5.99 cy/ft | 9.48 cy/ft |
| Volume Change Above −6 ft NAVD88 | −14.90 cy/ft | 12.48 cy/ft |
| Volume Change Above −14 ft NAVD88 | −63.50 cy/ft | 58.51 cy/ft |
| Volume Change Above −19 ft NAVD88 | −67.47 cy/ft | 61.68 cy/ft |
| Volume Change Above −30 ft NAVD88 | −62.74 cy/ft | 41.15 cy/ft |

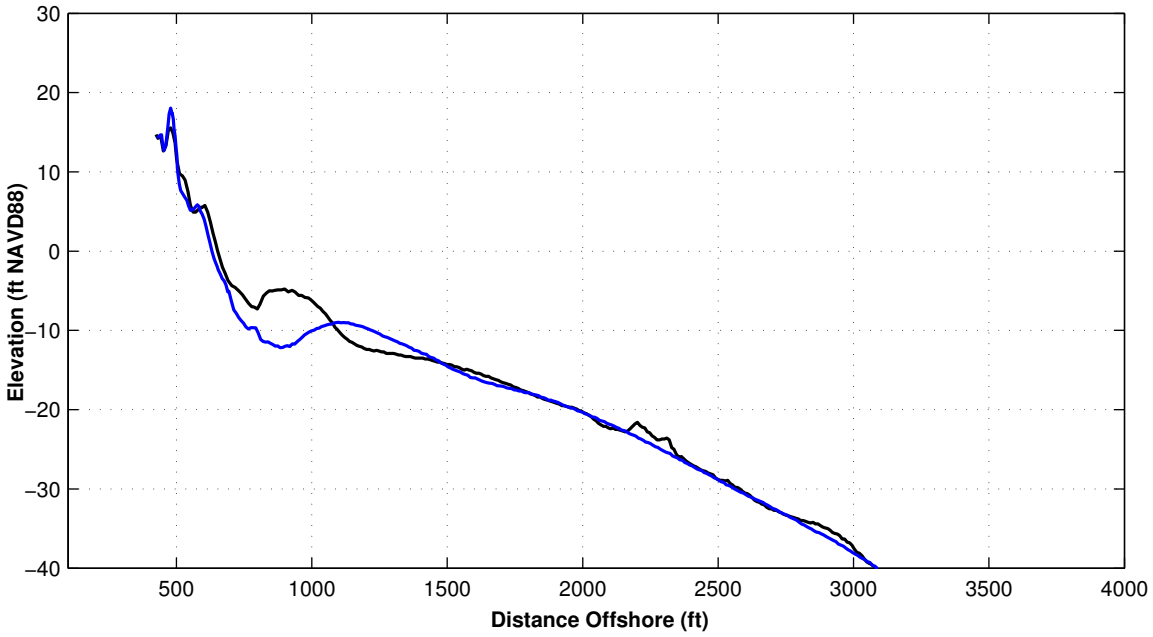
**LEGEND:**

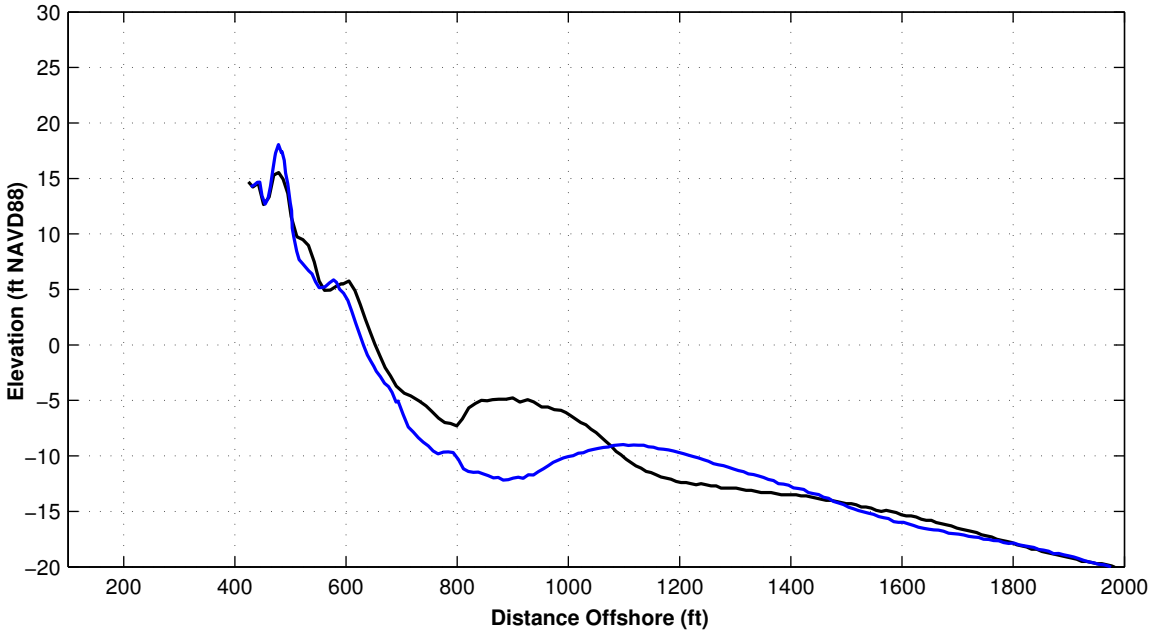
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.



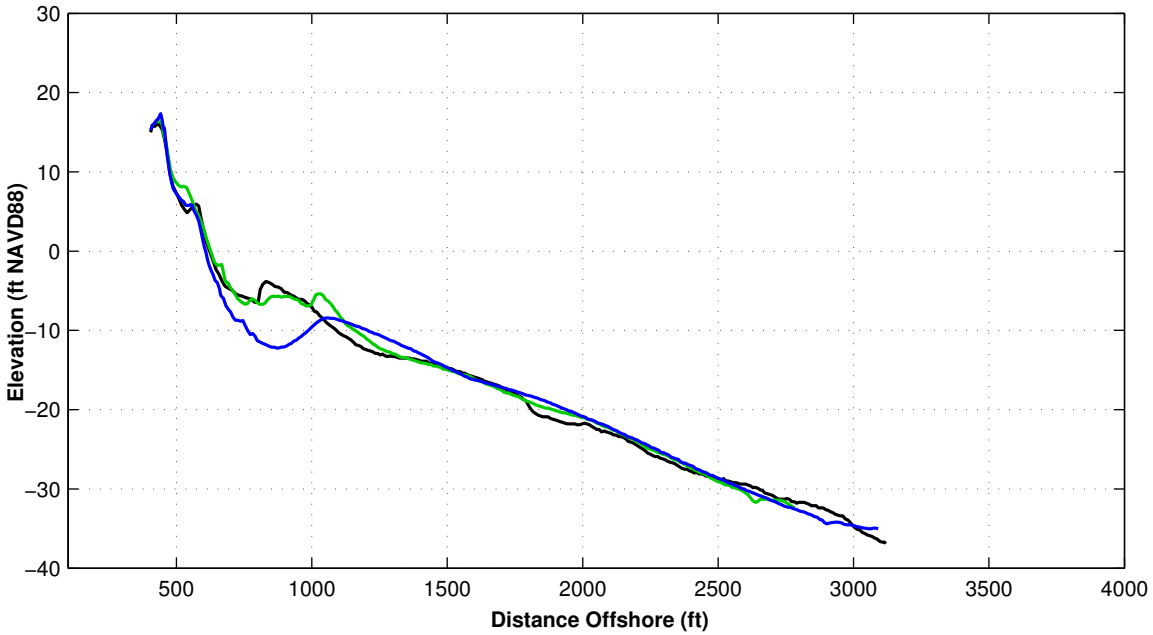



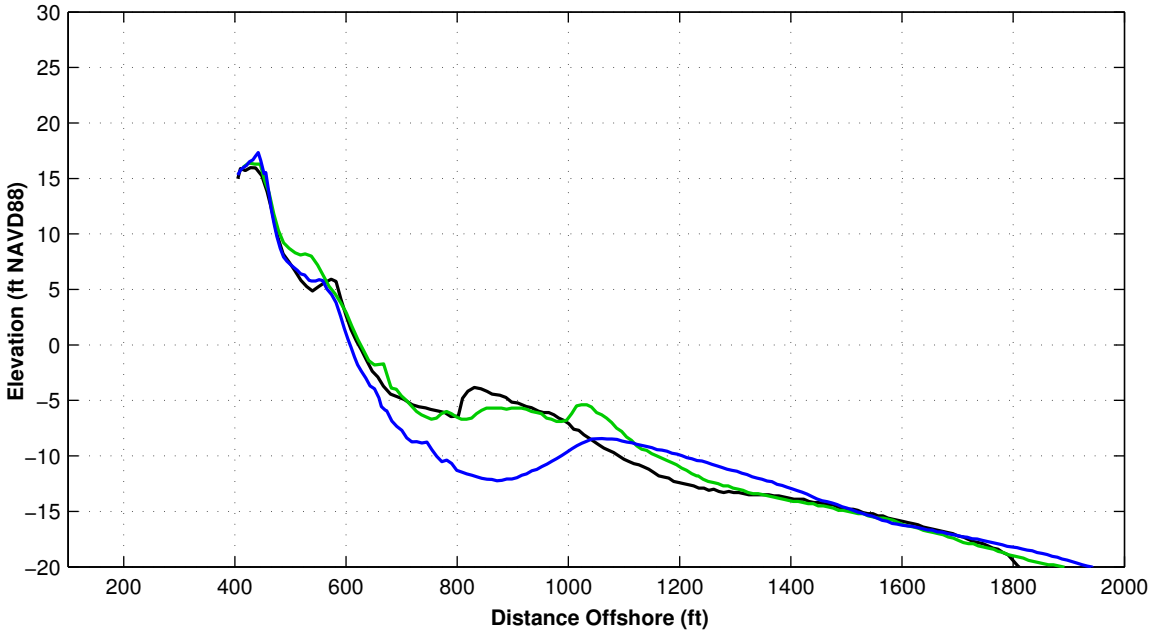

| Survey Transect 992+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −20.57 ft | −7.82 ft |
| Volume Change Above +6 ft NAVD88 | −0.70 cy/ft | 4.33 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −3.83 cy/ft | 7.14 cy/ft |
| Volume Change Above −6 ft NAVD88 | −15.30 cy/ft | 10.82 cy/ft |
| Volume Change Above −14 ft NAVD88 | −46.85 cy/ft | 48.85 cy/ft |
| Volume Change Above −19 ft NAVD88 | −52.50 cy/ft | 66.73 cy/ft |
| Volume Change Above −30 ft NAVD88 | −61.38 cy/ft | 53.16 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023 / JUNE 2023

Notes:
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 995+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −11.96 ft | 2.60 ft |
| Volume Change Above +6 ft NAVD88 | 0.17 cy/ft | 1.29 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −1.18 cy/ft | 4.36 cy/ft |
| Volume Change Above −6 ft NAVD88 | −14.72 cy/ft | 12.96 cy/ft |
| Volume Change Above −14 ft NAVD88 | −44.86 cy/ft | 50.81 cy/ft |
| Volume Change Above −19 ft NAVD88 | −43.45 cy/ft | 83.85 cy/ft |
| Volume Change Above −30 ft NAVD88 | −20.91 cy/ft | 61.03 cy/ft |

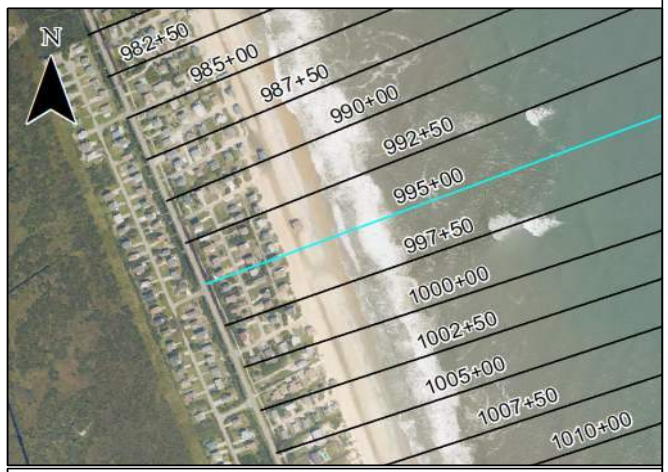
**LEGEND:**

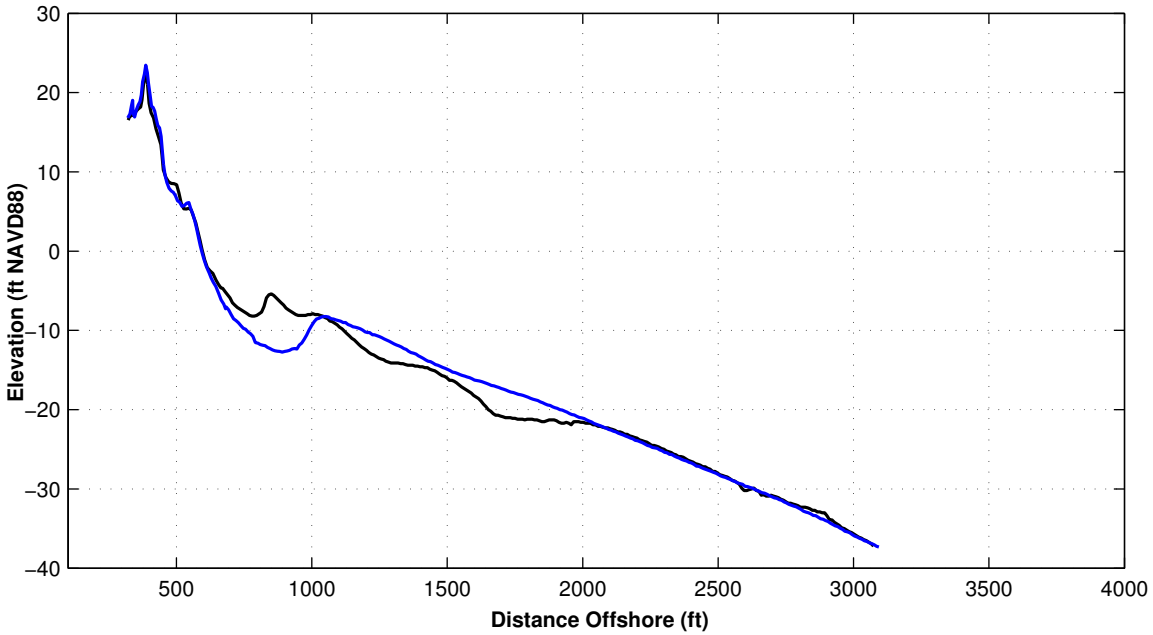
JUNE 2024 — OCTOBER 2023

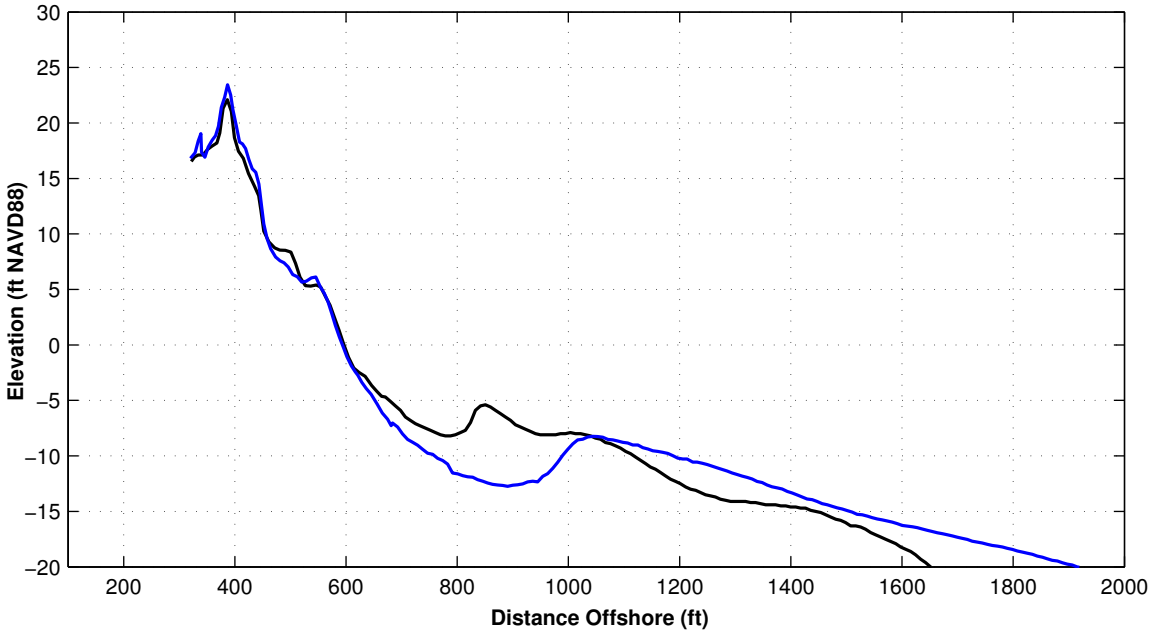
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.





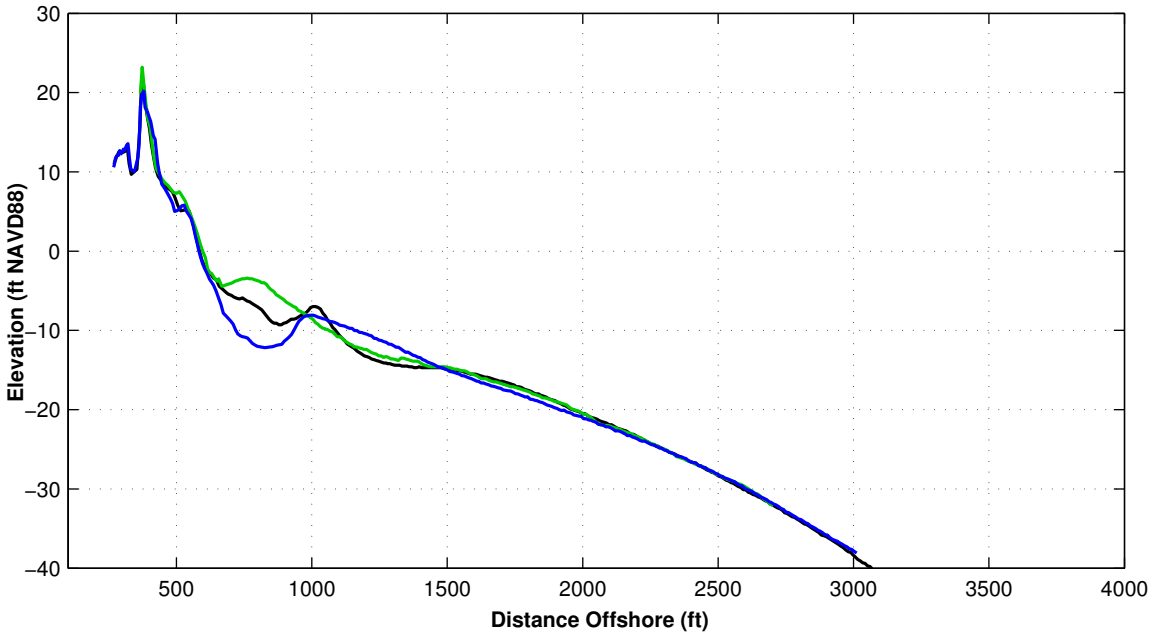

| Survey Transect 997+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −3.65 ft | 5.63 ft |
| Volume Change Above +6 ft NAVD88 | 1.23 cy/ft | 5.74 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.49 cy/ft | 8.85 cy/ft |
| Volume Change Above −6 ft NAVD88 | −1.96 cy/ft | 11.61 cy/ft |
| Volume Change Above −14 ft NAVD88 | −25.23 cy/ft | 47.21 cy/ft |
| Volume Change Above −19 ft NAVD88 | −2.94 cy/ft | 25.54 cy/ft |
| Volume Change Above −30 ft NAVD88 | 17.64 cy/ft | −39.67 cy/ft |

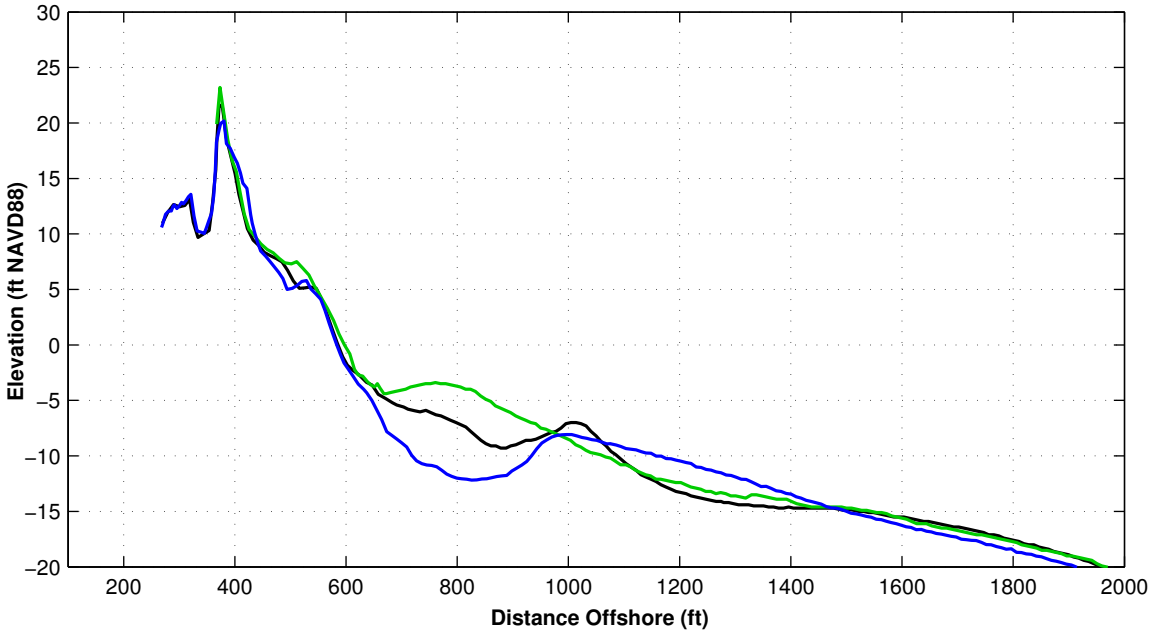
**LEGEND:**

JUNE 2024 — OCTOBER 2023 / JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1000+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −1.66 ft | 16.89 ft |
| Volume Change Above +6 ft NAVD88 | −0.54 cy/ft | 3.58 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −1.17 cy/ft | 8.30 cy/ft |
| Volume Change Above −6 ft NAVD88 | −5.10 cy/ft | 15.78 cy/ft |
| Volume Change Above −14 ft NAVD88 | −19.28 cy/ft | 50.82 cy/ft |
| Volume Change Above −19 ft NAVD88 | −26.57 cy/ft | 64.94 cy/ft |
| Volume Change Above −30 ft NAVD88 | −32.23 cy/ft | 46.46 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

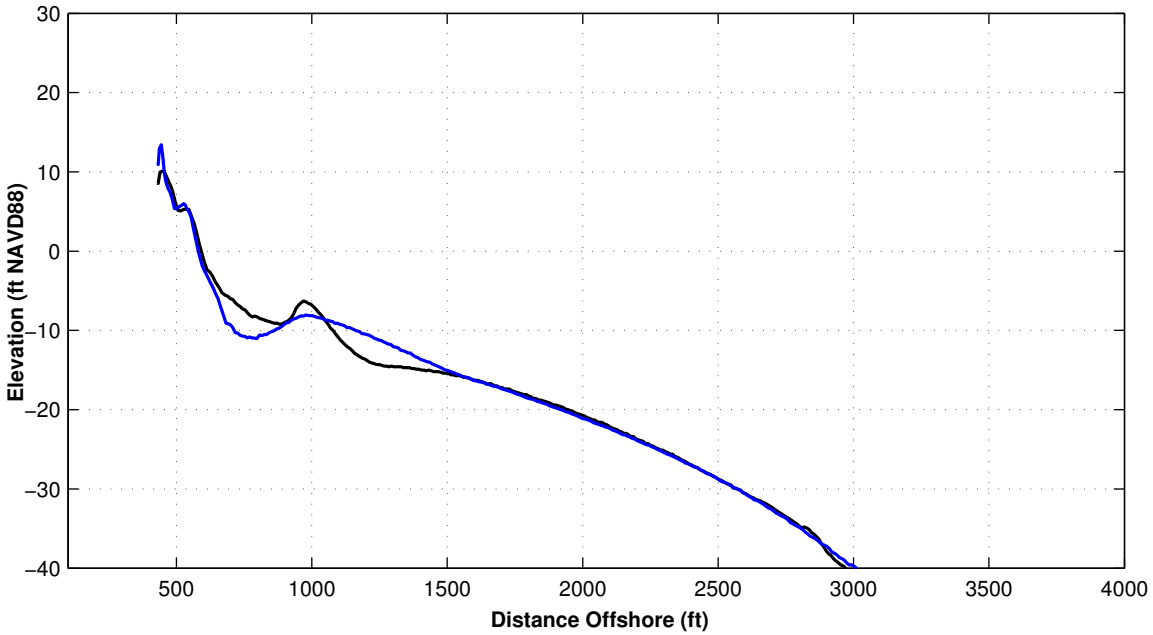
JUNE 2023

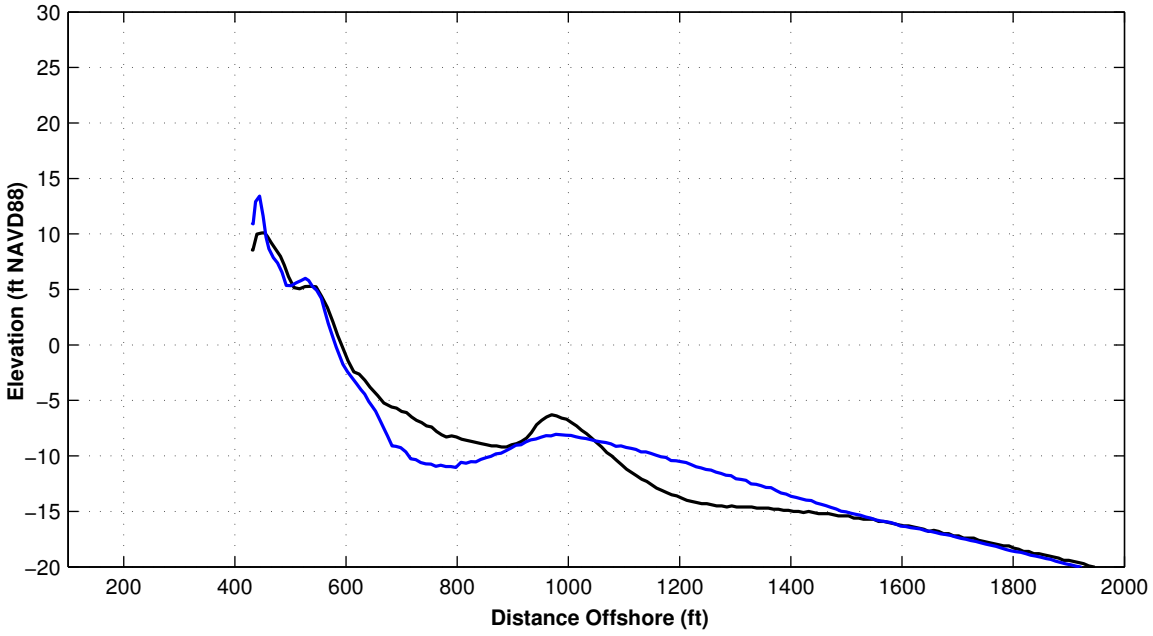
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1000+00 | Pg 1 of 173 | 2024 |
|---|---|---|




| Survey Transect 1002+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −11.89 ft | 20.37 ft |
| Volume Change Above +6 ft NAVD88 | −2.47 cy/ft | 3.17 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −5.03 cy/ft | 7.95 cy/ft |
| Volume Change Above −6 ft NAVD88 | −9.89 cy/ft | 14.10 cy/ft |
| Volume Change Above −14 ft NAVD88 | −23.02 cy/ft | 36.75 cy/ft |
| Volume Change Above −19 ft NAVD88 | −15.54 cy/ft | 57.44 cy/ft |
| Volume Change Above −30 ft NAVD88 | −20.52 cy/ft | 32.72 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

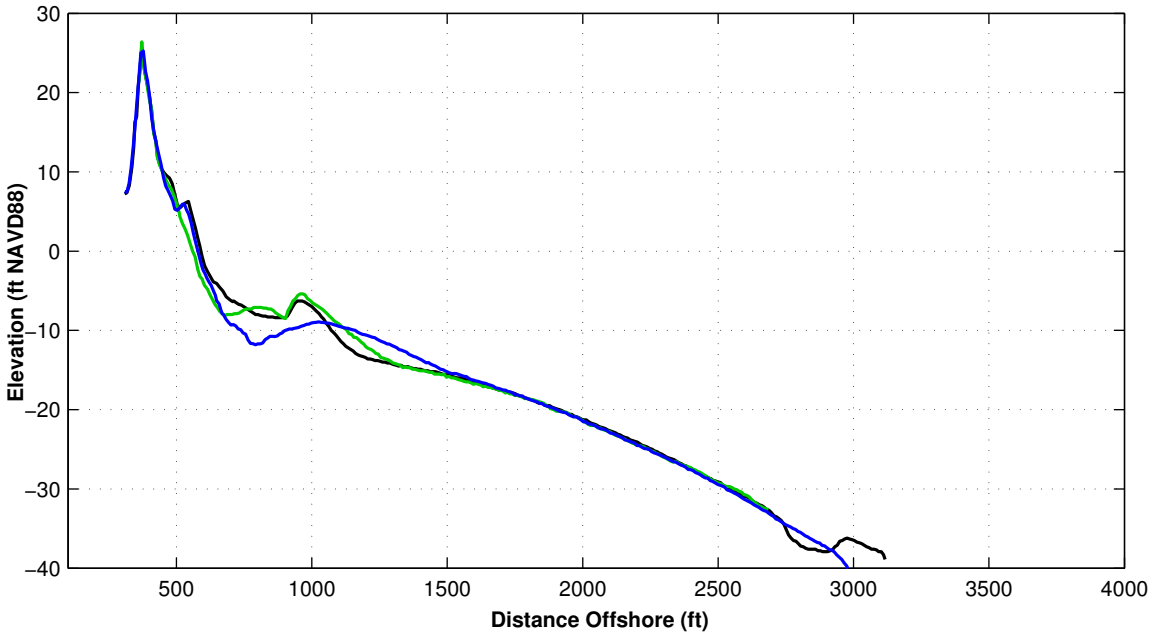
JUNE 2023

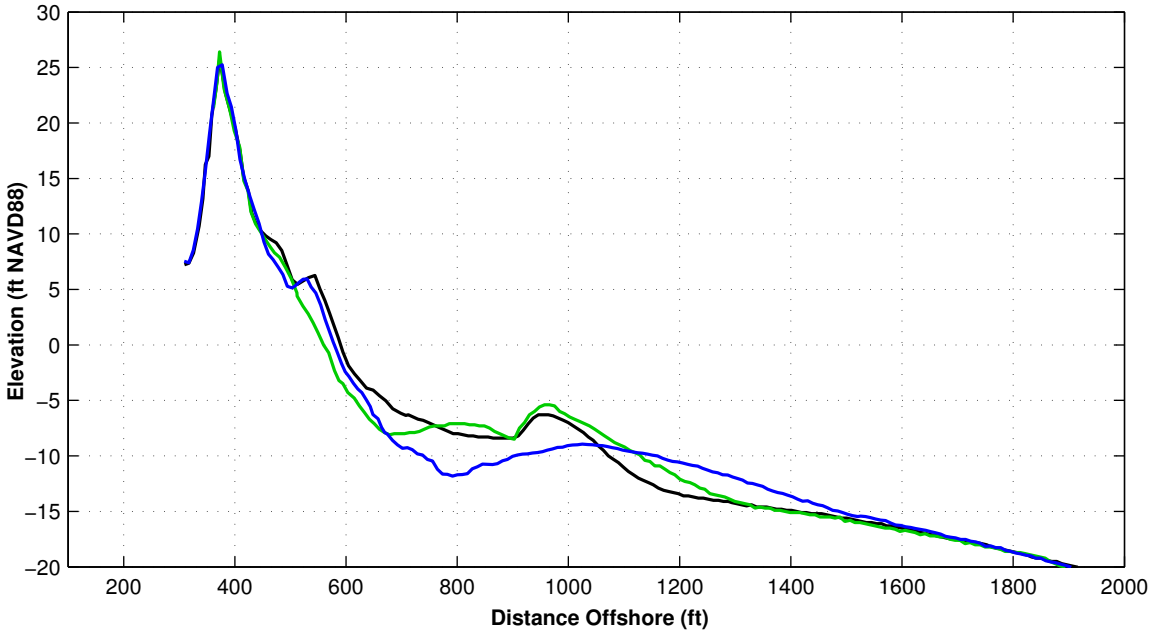
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1002+50 | Pg 2 of 173 | 2024 |
|---|---|---|




| Survey Transect 1005+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −12.39 ft | −6.90 ft |
| Volume Change Above +6 ft NAVD88 | −1.86 cy/ft | 1.60 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −5.01 cy/ft | 2.72 cy/ft |
| Volume Change Above −6 ft NAVD88 | −8.91 cy/ft | 5.32 cy/ft |
| Volume Change Above −14 ft NAVD88 | −26.12 cy/ft | 37.20 cy/ft |
| Volume Change Above −19 ft NAVD88 | −5.75 cy/ft | 45.81 cy/ft |
| Volume Change Above −30 ft NAVD88 | −7.21 cy/ft | 21.60 cy/ft |

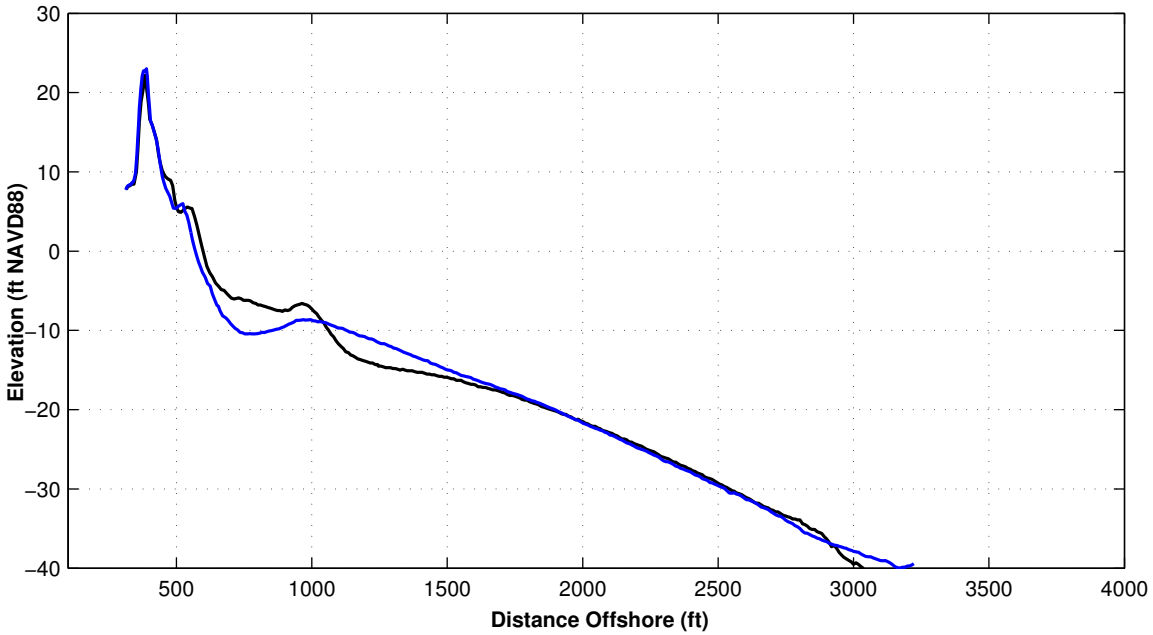
**LEGEND:**

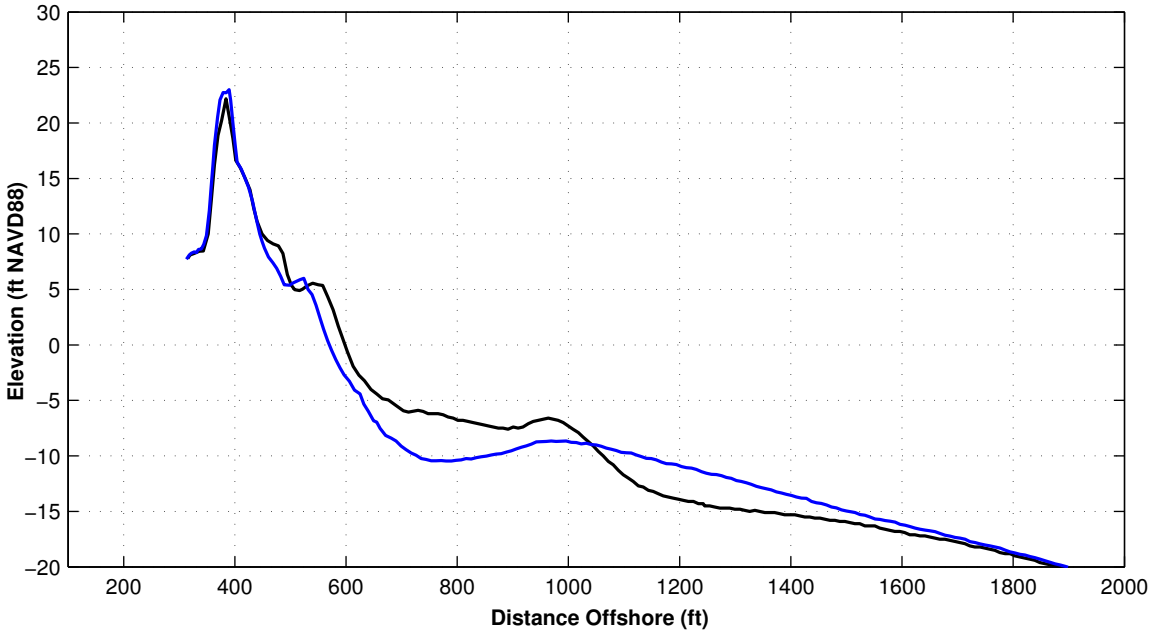
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1007+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −38.83 ft | −0.74 ft |
| Volume Change Above +6 ft NAVD88 | −2.41 cy/ft | 1.79 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −10.18 cy/ft | 3.93 cy/ft |
| Volume Change Above −6 ft NAVD88 | −18.88 cy/ft | 5.85 cy/ft |
| Volume Change Above −14 ft NAVD88 | −34.34 cy/ft | 22.44 cy/ft |
| Volume Change Above −19 ft NAVD88 | −15.76 cy/ft | 39.33 cy/ft |
| Volume Change Above −30 ft NAVD88 | −17.86 cy/ft | 19.60 cy/ft |

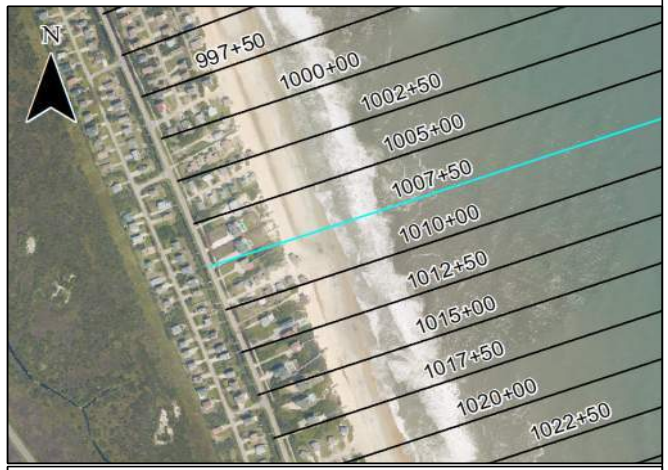
**LEGEND:**

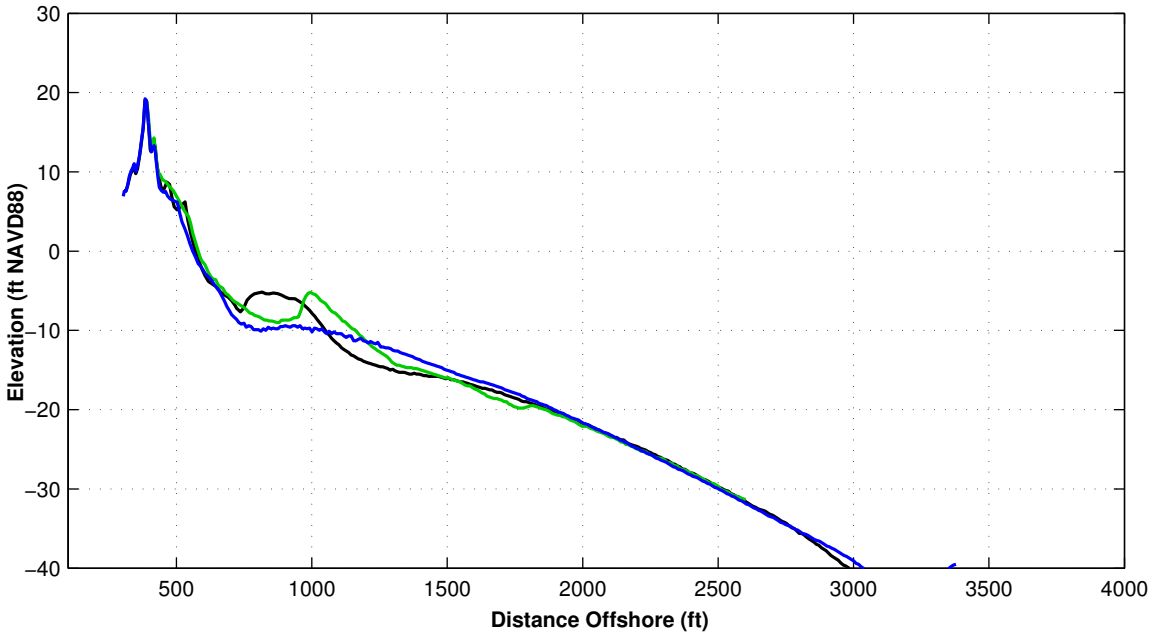
JUNE 2024 — OCTOBER 2023

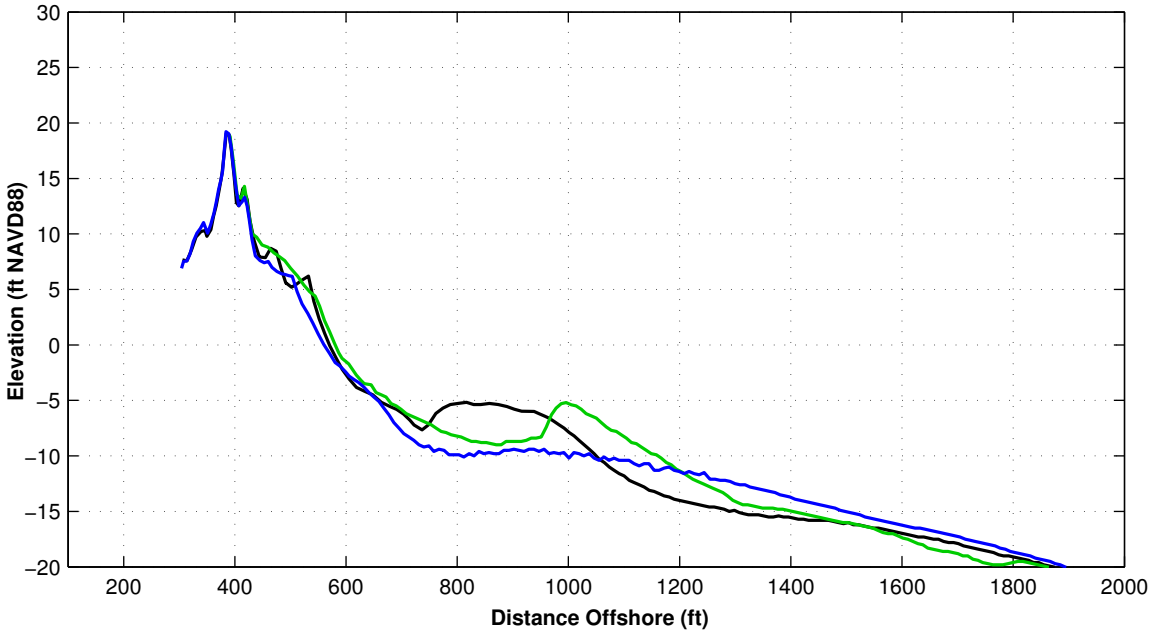
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 1010+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −76.86 ft | −9.77 ft |
| Volume Change Above +6 ft NAVD88 | −4.83 cy/ft | −0.77 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −18.17 cy/ft | −1.73 cy/ft |
| Volume Change Above −6 ft NAVD88 | −32.05 cy/ft | −3.39 cy/ft |
| Volume Change Above −14 ft NAVD88 | −53.04 cy/ft | −0.85 cy/ft |
| Volume Change Above −19 ft NAVD88 | −34.50 cy/ft | 6.01 cy/ft |
| Volume Change Above −30 ft NAVD88 | −37.78 cy/ft | −31.33 cy/ft |

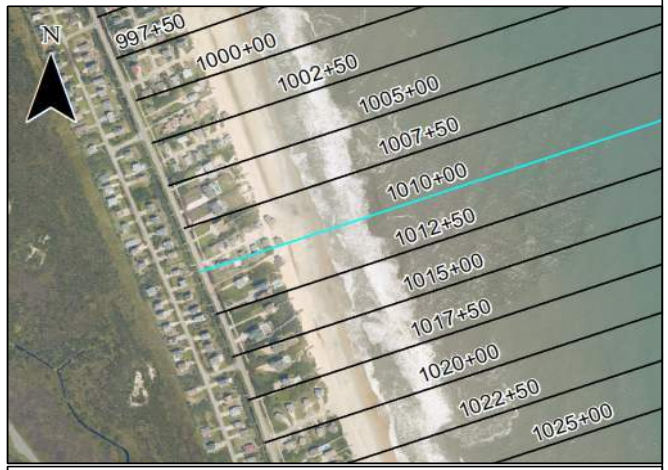
**LEGEND:**

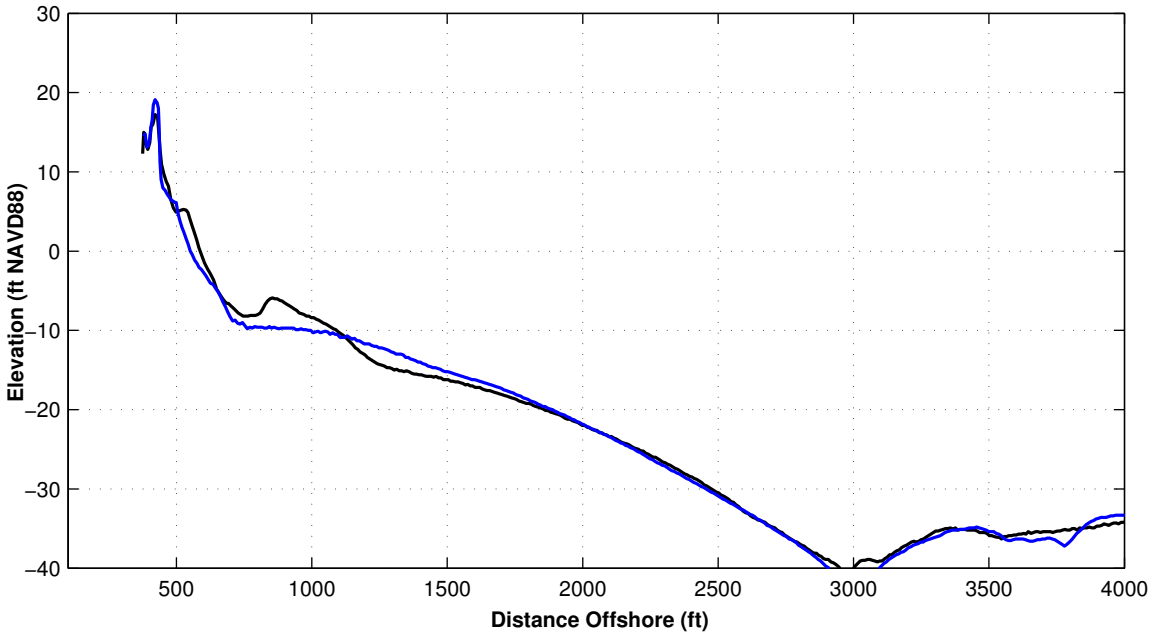
JUNE 2024 — OCTOBER 2023

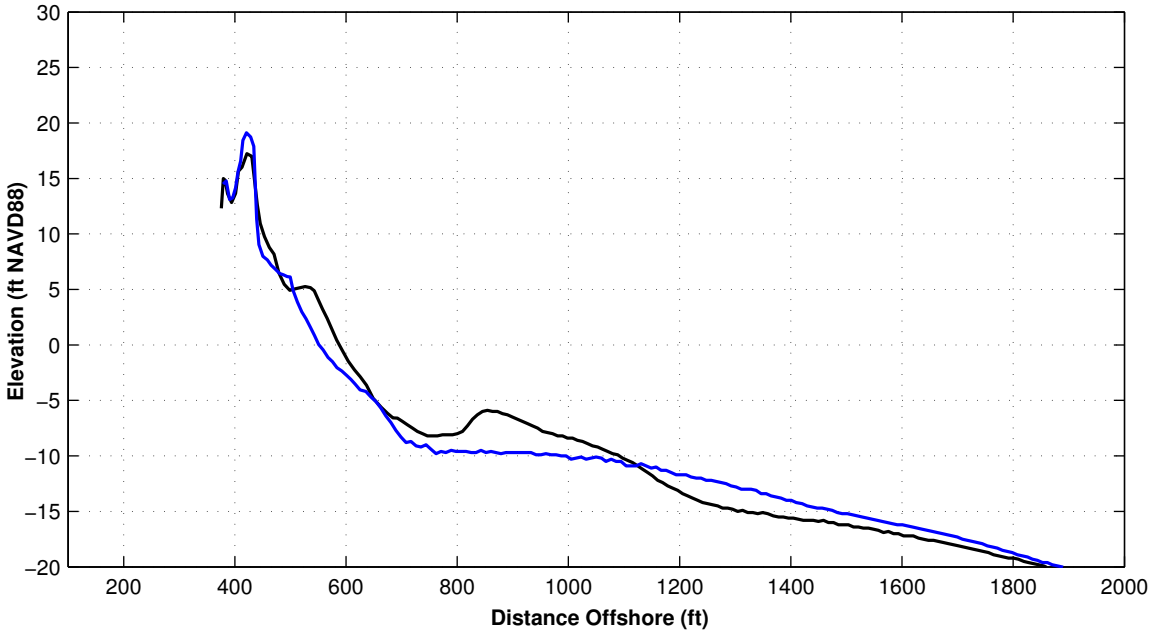
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 1012+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −13.50 ft | −24.85 ft |
| Volume Change Above +6 ft NAVD88 | −0.82 cy/ft | 0.50 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −3.48 cy/ft | −2.24 cy/ft |
| Volume Change Above −6 ft NAVD88 | 4.71 cy/ft | −8.48 cy/ft |
| Volume Change Above −14 ft NAVD88 | −7.12 cy/ft | 1.37 cy/ft |
| Volume Change Above −19 ft NAVD88 | 8.65 cy/ft | 17.26 cy/ft |
| Volume Change Above −30 ft NAVD88 | 13.73 cy/ft | −13.37 cy/ft |

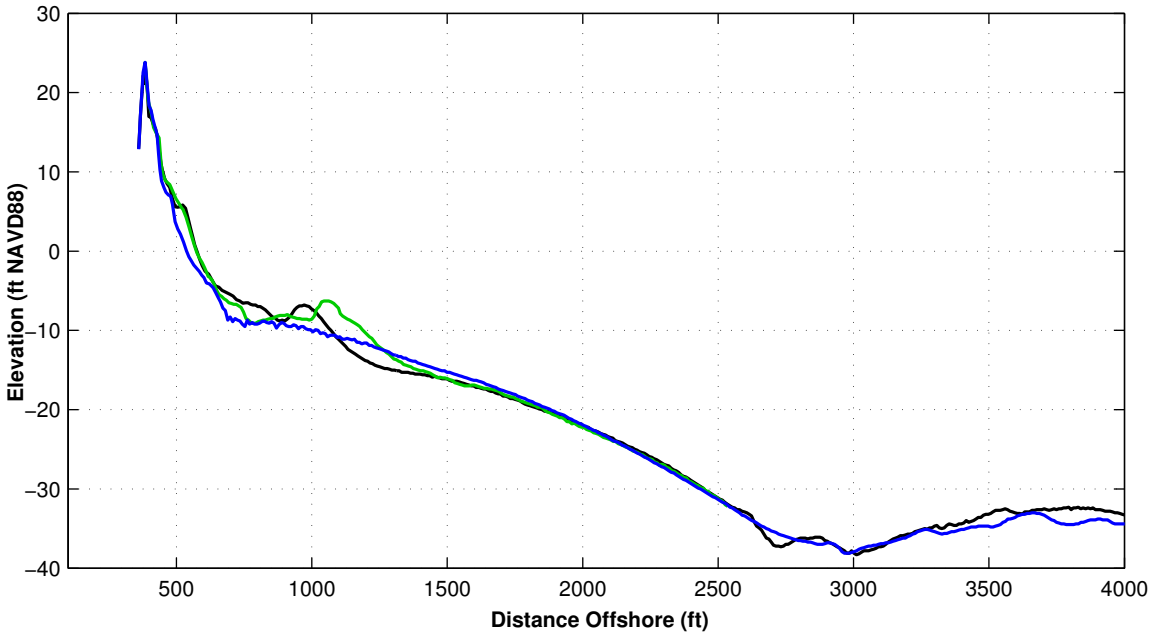
**LEGEND:**

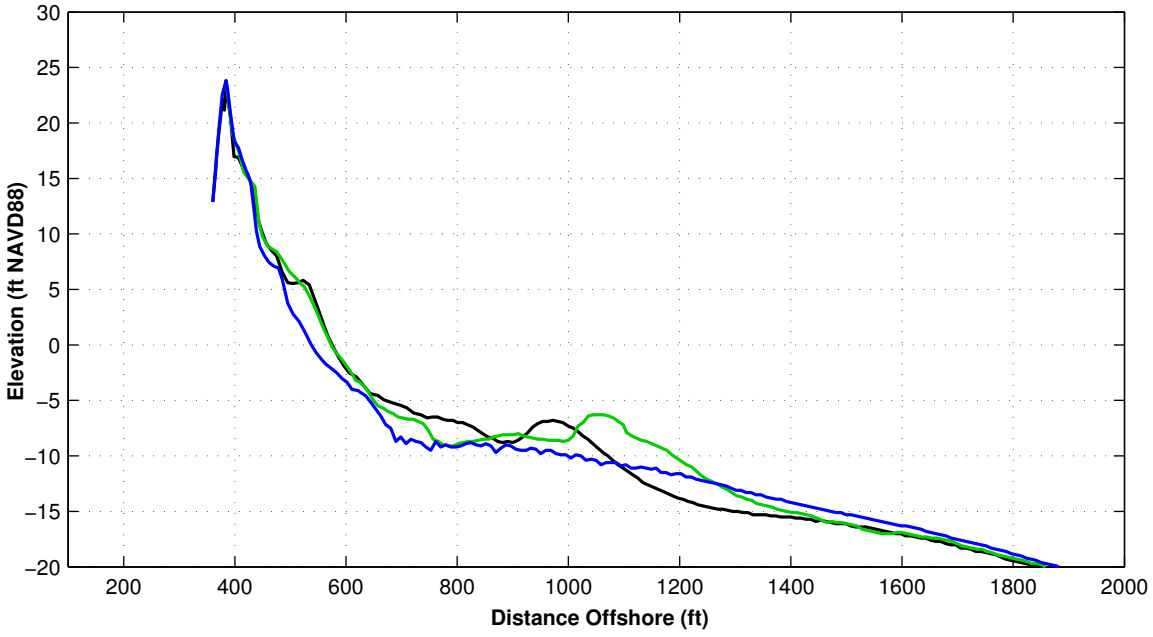
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1015+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −34.16 ft | 12.90 ft |
| Volume Change Above +6 ft NAVD88 | 6.45 cy/ft | −1.04 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 3.77 cy/ft | −0.77 cy/ft |
| Volume Change Above −6 ft NAVD88 | −14.61 cy/ft | 7.95 cy/ft |
| Volume Change Above −14 ft NAVD88 | 5.77 cy/ft | 8.81 cy/ft |
| Volume Change Above −19 ft NAVD88 | 9.28 cy/ft | 17.88 cy/ft |
| Volume Change Above −30 ft NAVD88 | 23.57 cy/ft | −7.54 cy/ft |

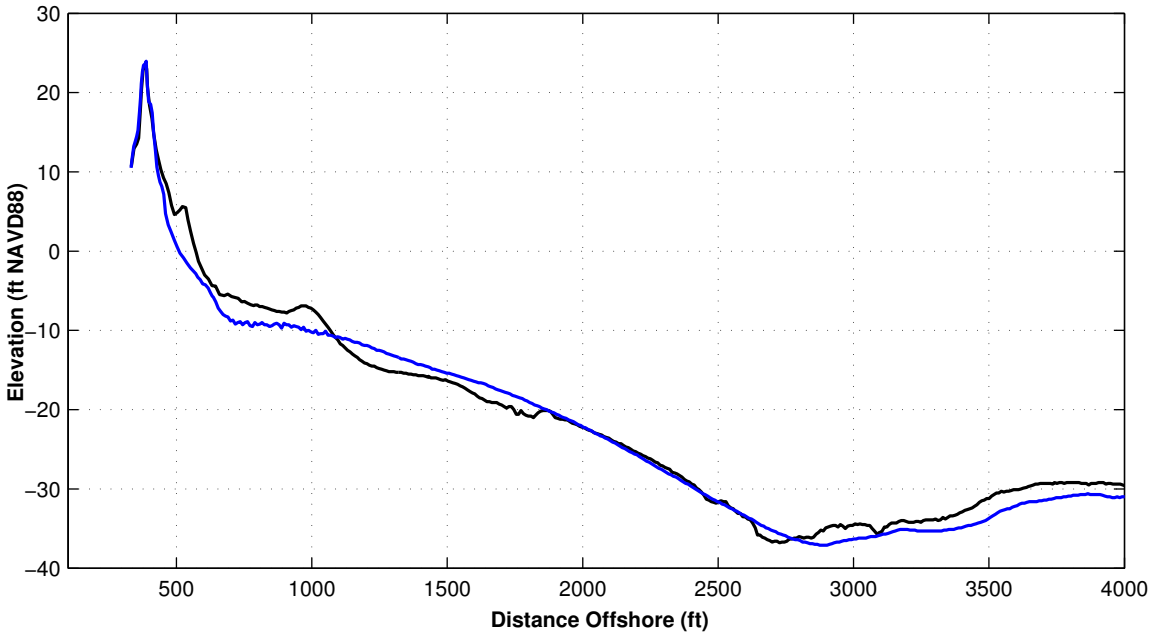
**LEGEND:**

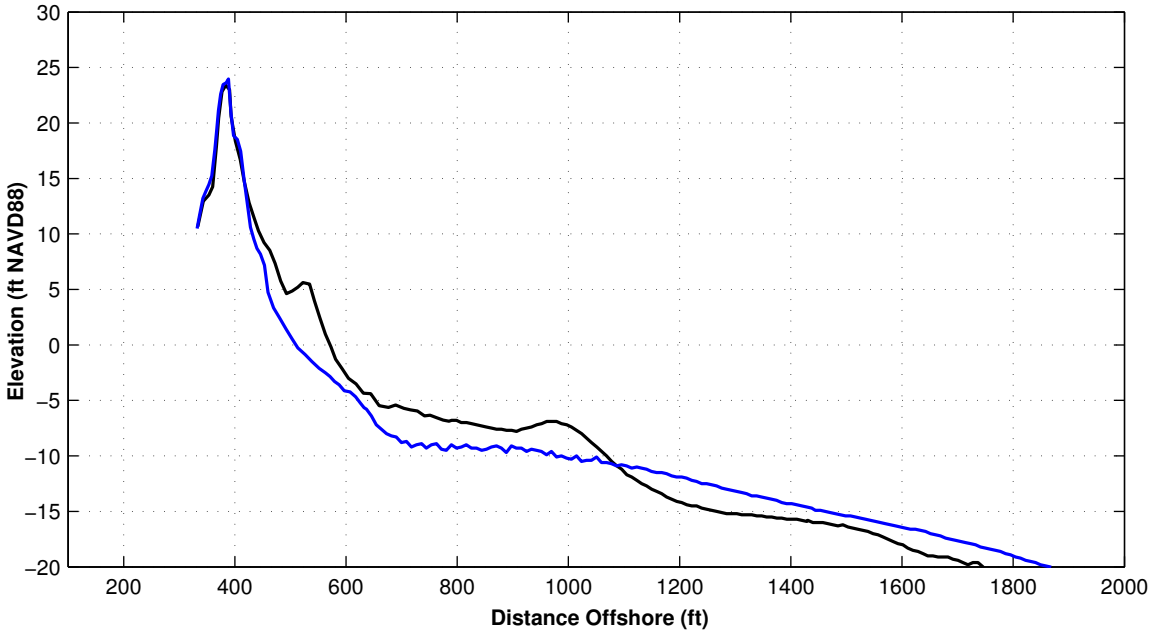
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1017+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −17.25 ft | 43.45 ft |
| Volume Change Above +6 ft NAVD88 | 4.19 cy/ft | 4.22 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 3.45 cy/ft | 10.75 cy/ft |
| Volume Change Above −6 ft NAVD88 | −18.69 cy/ft | 46.23 cy/ft |
| Volume Change Above −14 ft NAVD88 | −9.99 cy/ft | 61.17 cy/ft |
| Volume Change Above −19 ft NAVD88 | −25.05 cy/ft | 76.80 cy/ft |
| Volume Change Above −30 ft NAVD88 | −14.90 cy/ft | 54.98 cy/ft |

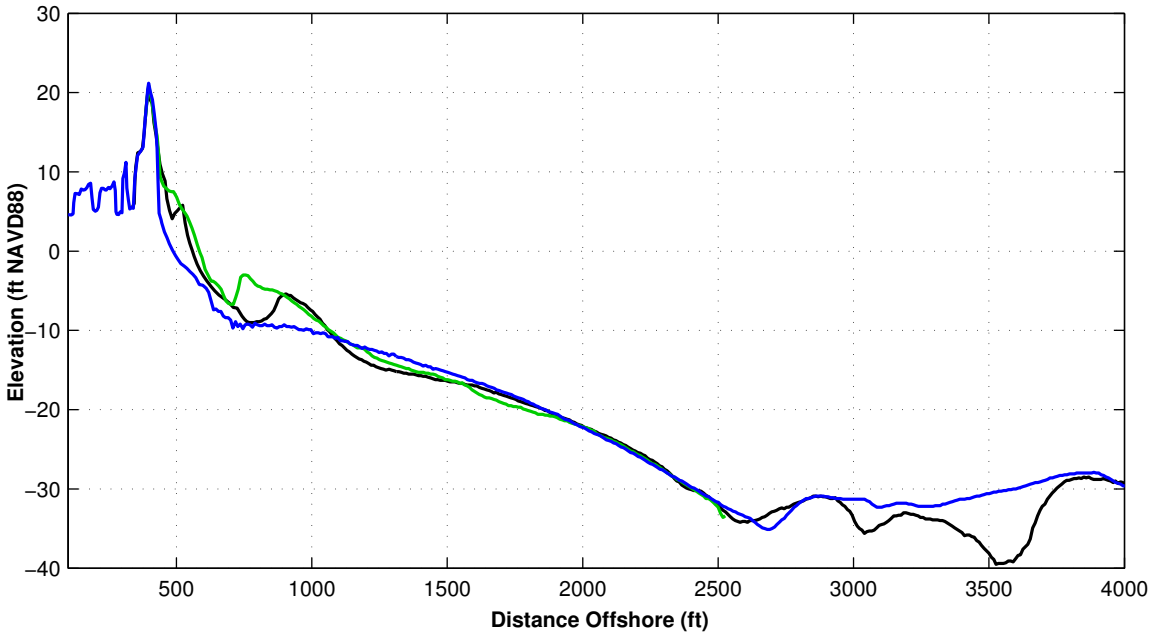
**LEGEND:**

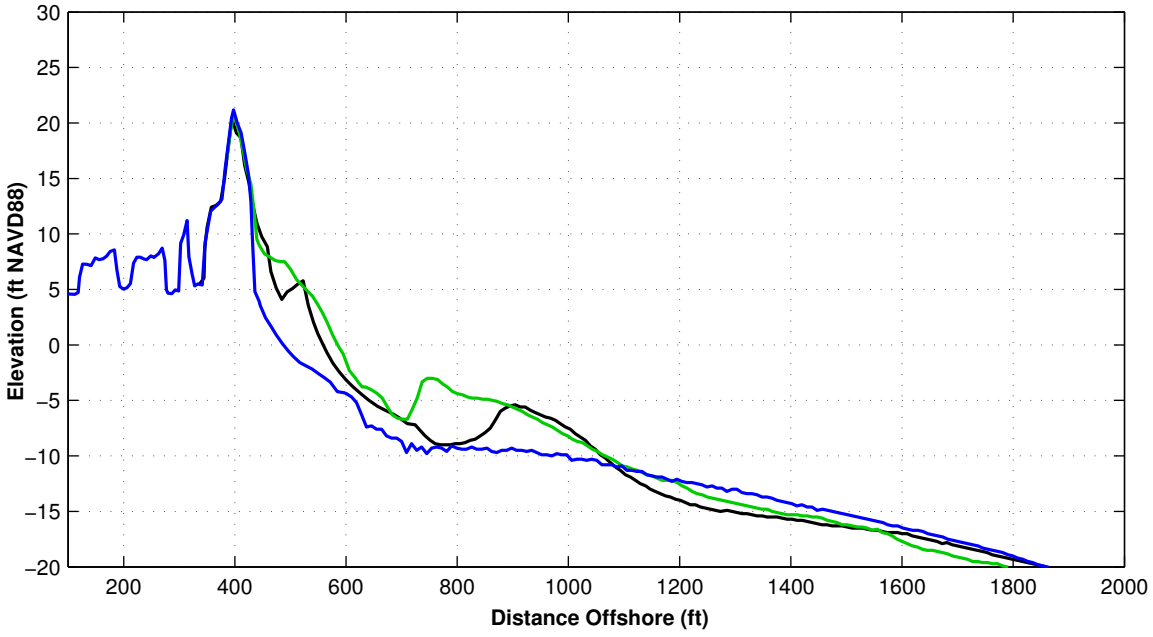
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1020+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 14.16 ft | 9.37 ft |
| Volume Change Above +6 ft NAVD88 | 0.60 cy/ft | −1.33 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 2.51 cy/ft | −1.00 cy/ft |
| Volume Change Above −6 ft NAVD88 | 7.55 cy/ft | 5.87 cy/ft |
| Volume Change Above −14 ft NAVD88 | 31.10 cy/ft | −3.38 cy/ft |
| Volume Change Above −19 ft NAVD88 | 30.37 cy/ft | 2.27 cy/ft |
| Volume Change Above −30 ft NAVD88 | 41.53 cy/ft | −16.90 cy/ft |

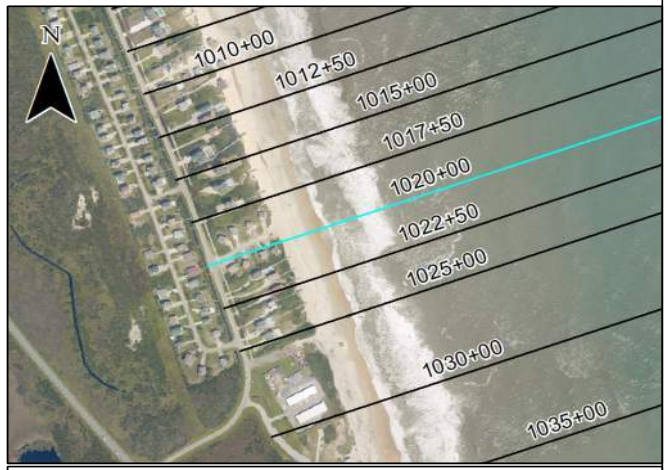
**LEGEND:**

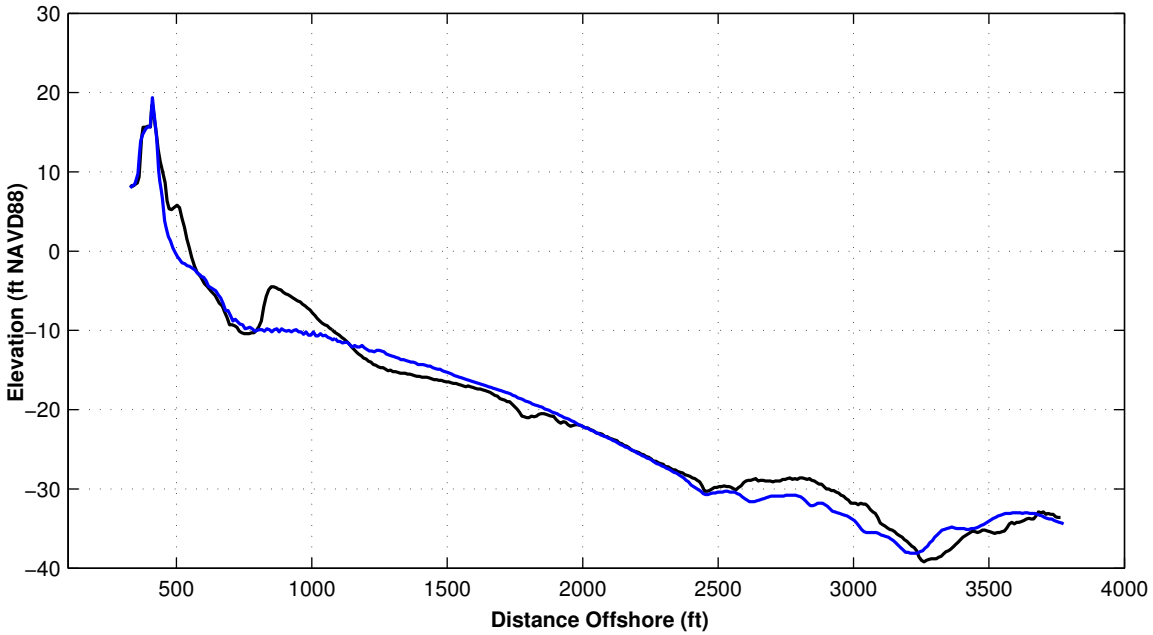
JUNE 2024 — OCTOBER 2023

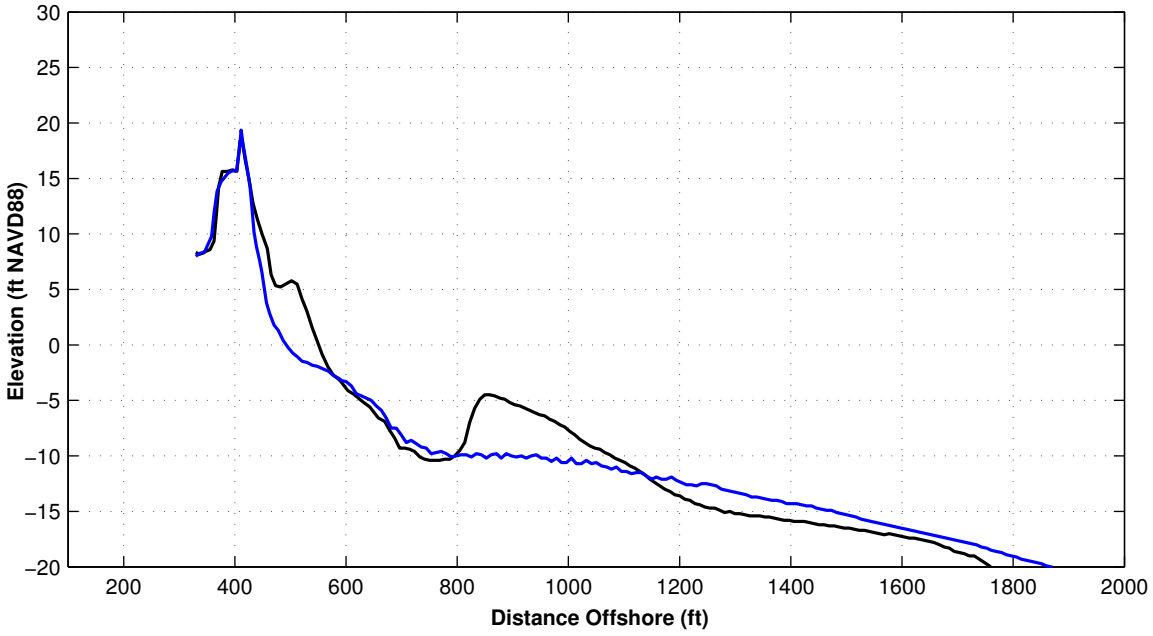
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 1022+50 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −6.22 ft | −10.46 ft |
| Volume Change Above +6 ft NAVD88 | −0.97 cy/ft | −2.90 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −0.83 cy/ft | −4.81 cy/ft |
| Volume Change Above −6 ft NAVD88 | −23.39 cy/ft | 13.45 cy/ft |
| Volume Change Above −14 ft NAVD88 | −7.35 cy/ft | 9.78 cy/ft |
| Volume Change Above −19 ft NAVD88 | 9.91 cy/ft | −28.19 cy/ft |
| Volume Change Above −30 ft NAVD88 | 21.12 cy/ft | −26.68 cy/ft |

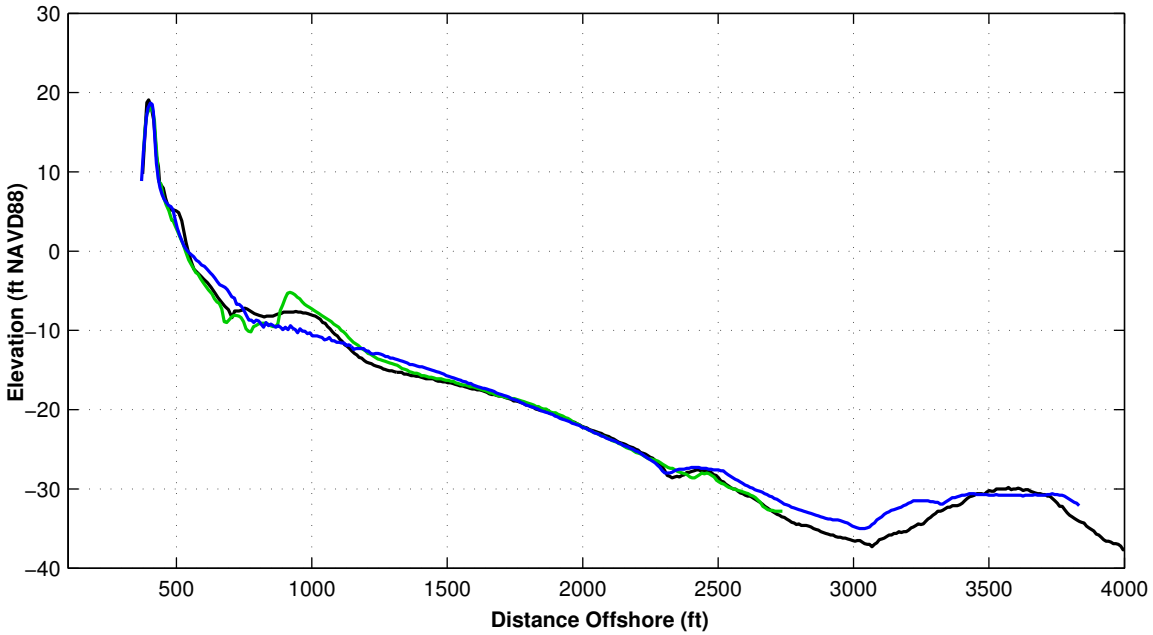
**LEGEND:**

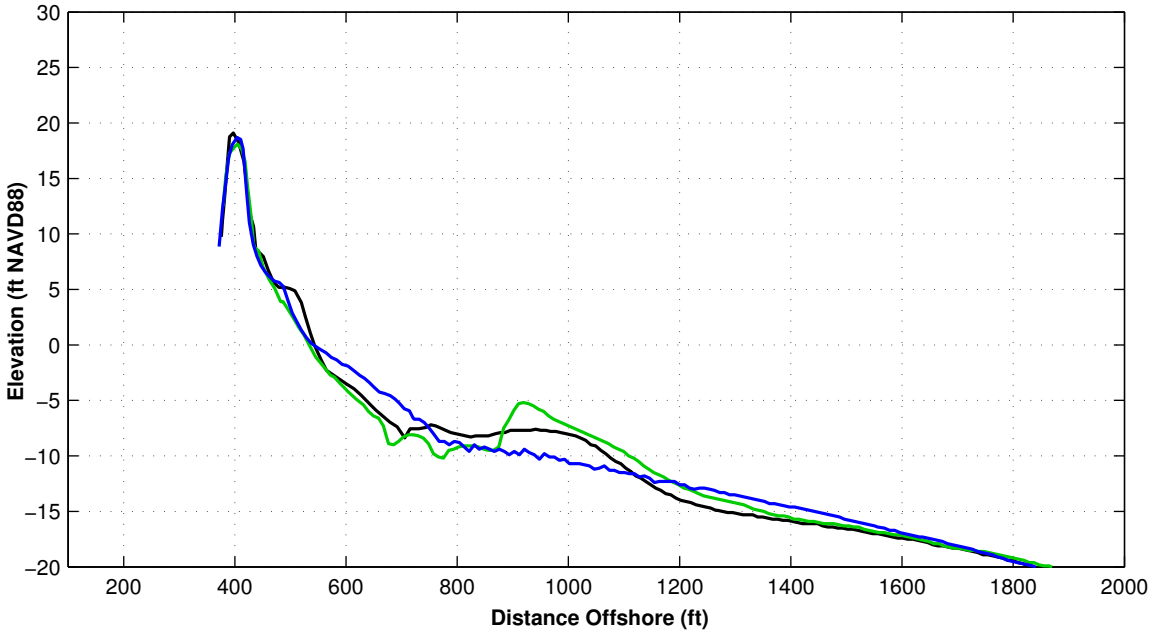
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1025+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 42.23 ft | −33.16 ft |
| Volume Change Above +6 ft NAVD88 | 5.79 cy/ft | −2.72 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.80 cy/ft | −9.37 cy/ft |
| Volume Change Above −6 ft NAVD88 | 26.12 cy/ft | −15.50 cy/ft |
| Volume Change Above −14 ft NAVD88 | 69.98 cy/ft | −24.13 cy/ft |
| Volume Change Above −19 ft NAVD88 | 73.62 cy/ft | −5.14 cy/ft |
| Volume Change Above −30 ft NAVD88 | 73.98 cy/ft | −14.79 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

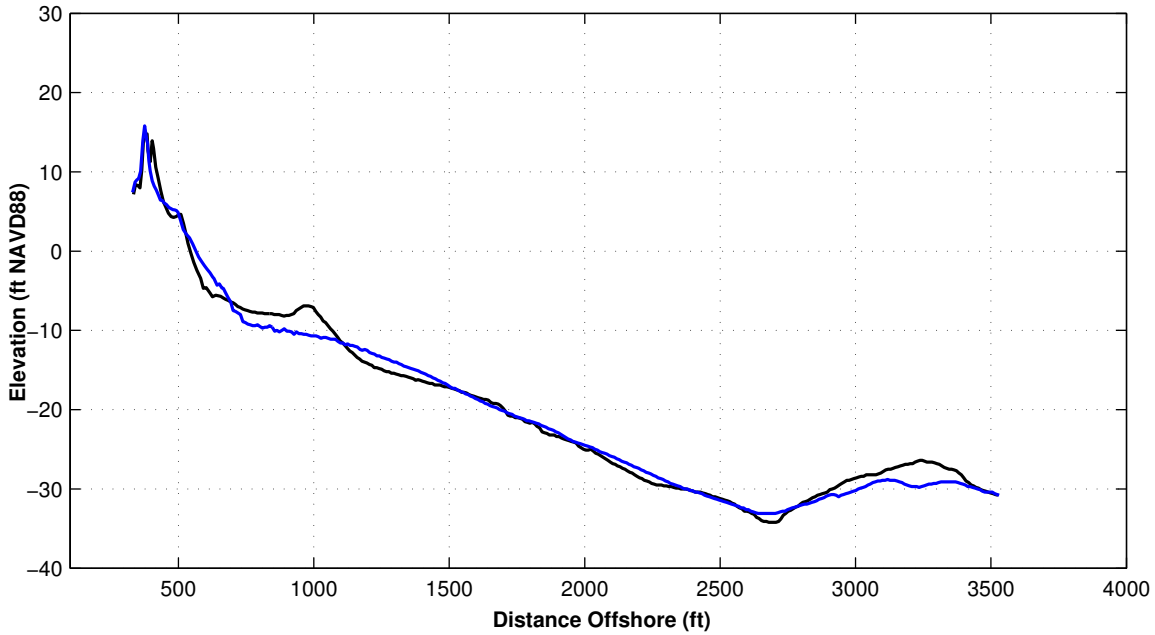
JUNE 2023

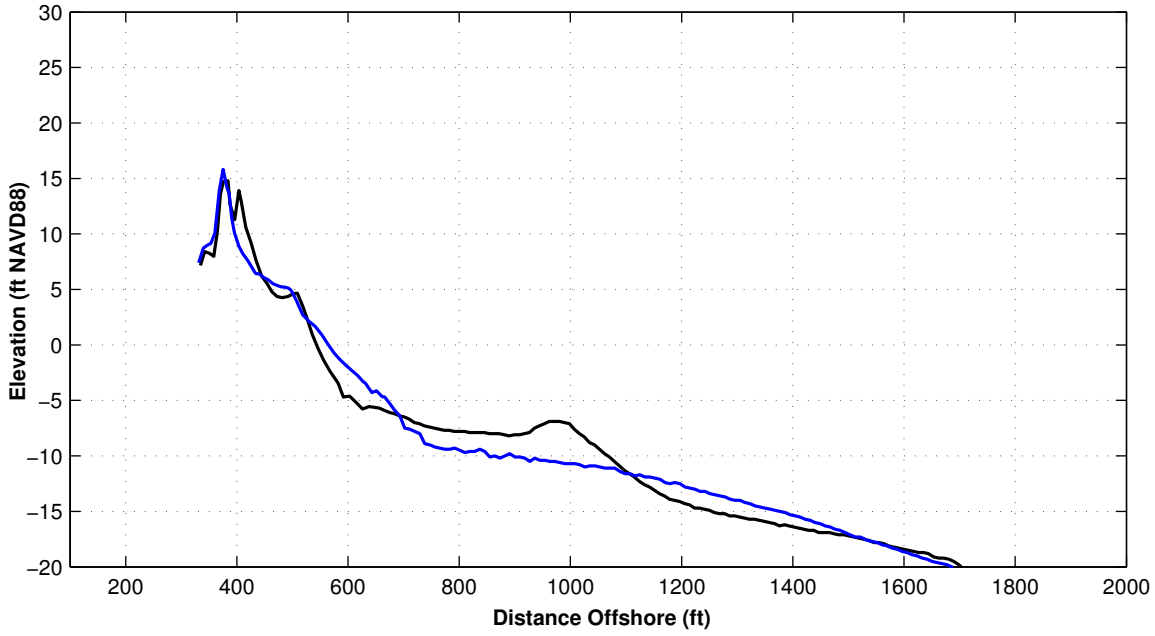
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1025+00 | Pg 11 of 173 | 2024 |
|---|---|---|




| Survey Transect 1030+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −16.61 ft | 19.46 ft |
| Volume Change Above +6 ft NAVD88 | 3.08 cy/ft | 0.32 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 2.62 cy/ft | 2.16 cy/ft |
| Volume Change Above −6 ft NAVD88 | −3.49 cy/ft | 22.06 cy/ft |
| Volume Change Above −14 ft NAVD88 | 30.32 cy/ft | 10.02 cy/ft |
| Volume Change Above −19 ft NAVD88 | 39.49 cy/ft | −9.82 cy/ft |
| Volume Change Above −30 ft NAVD88 | 40.77 cy/ft | −20.75 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

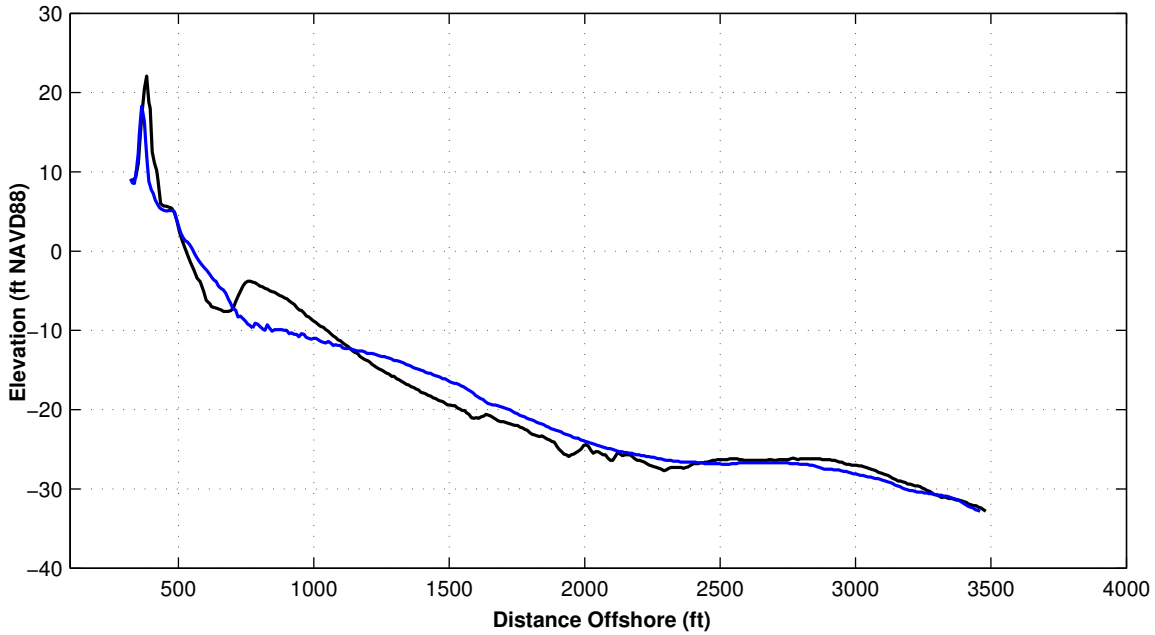
JUNE 2023

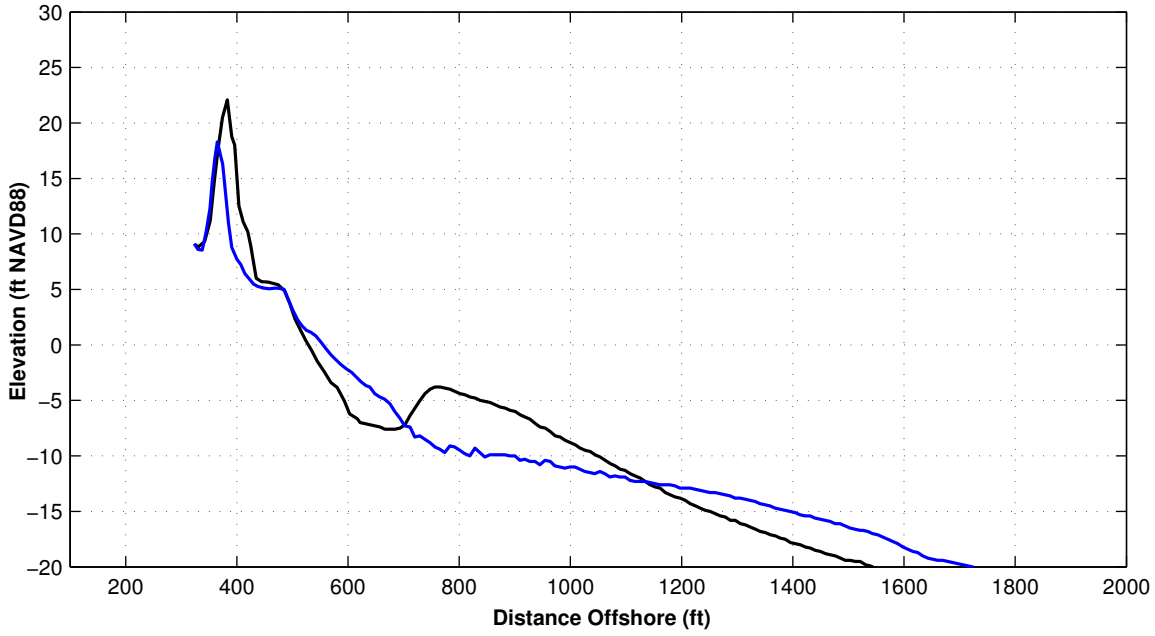
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1030+00 | Pg 12 of 173 | 2024 |
|---|---|---|




| Survey Transect 1035+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −9.30 ft | 15.93 ft |
| Volume Change Above +6 ft NAVD88 | 0.52 cy/ft | −2.26 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 0.34 cy/ft | 0.00 cy/ft |
| Volume Change Above −6 ft NAVD88 | −6.86 cy/ft | 7.70 cy/ft |
| Volume Change Above −14 ft NAVD88 | −0.53 cy/ft | 55.64 cy/ft |
| Volume Change Above −19 ft NAVD88 | −10.46 cy/ft | 43.45 cy/ft |
| Volume Change Above −30 ft NAVD88 | −6.40 cy/ft | 28.09 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

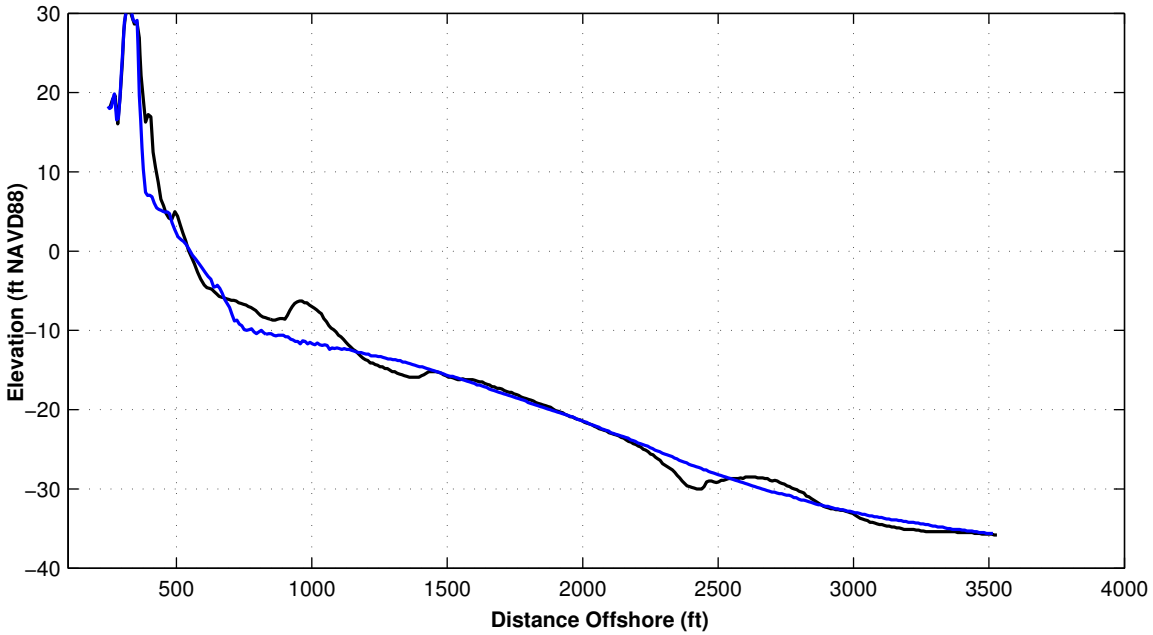
JUNE 2023

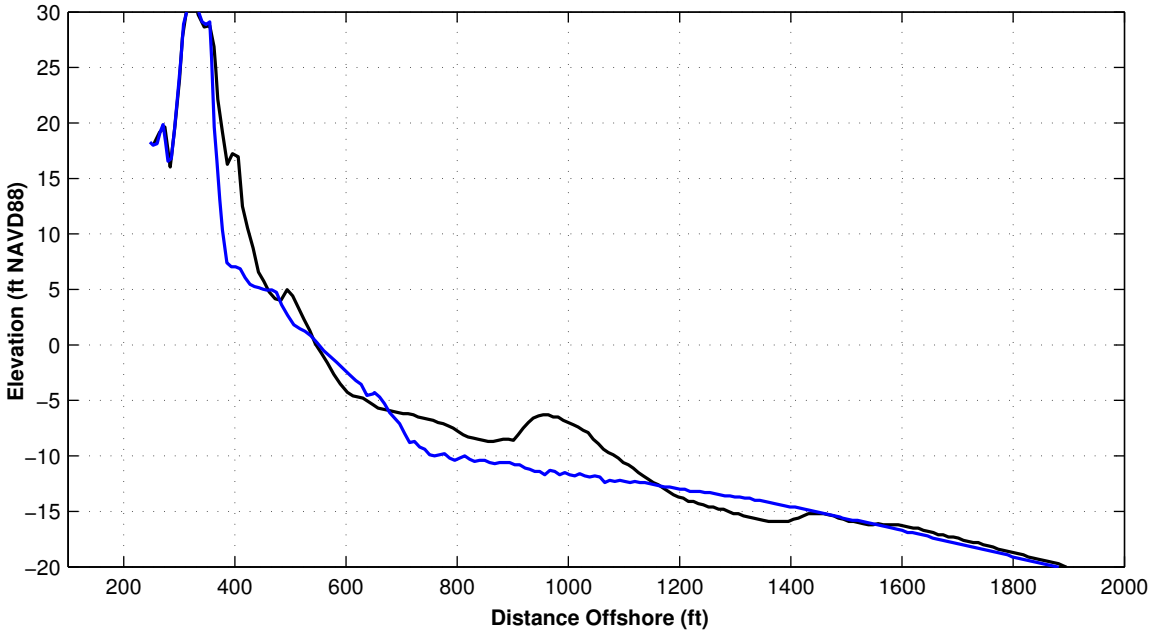
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1035+00 | Pg 13 of 173 | 2024 |
|---|---|---|




| Survey Transect 1040+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −22.93 ft | 12.98 ft |
| Volume Change Above +6 ft NAVD88 | −0.36 cy/ft | −1.91 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −3.63 cy/ft | −1.78 cy/ft |
| Volume Change Above −6 ft NAVD88 | −20.62 cy/ft | 18.59 cy/ft |
| Volume Change Above −14 ft NAVD88 | −11.97 cy/ft | 30.95 cy/ft |
| Volume Change Above −19 ft NAVD88 | −16.79 cy/ft | 17.45 cy/ft |
| Volume Change Above −30 ft NAVD88 | −14.68 cy/ft | 2.17 cy/ft |

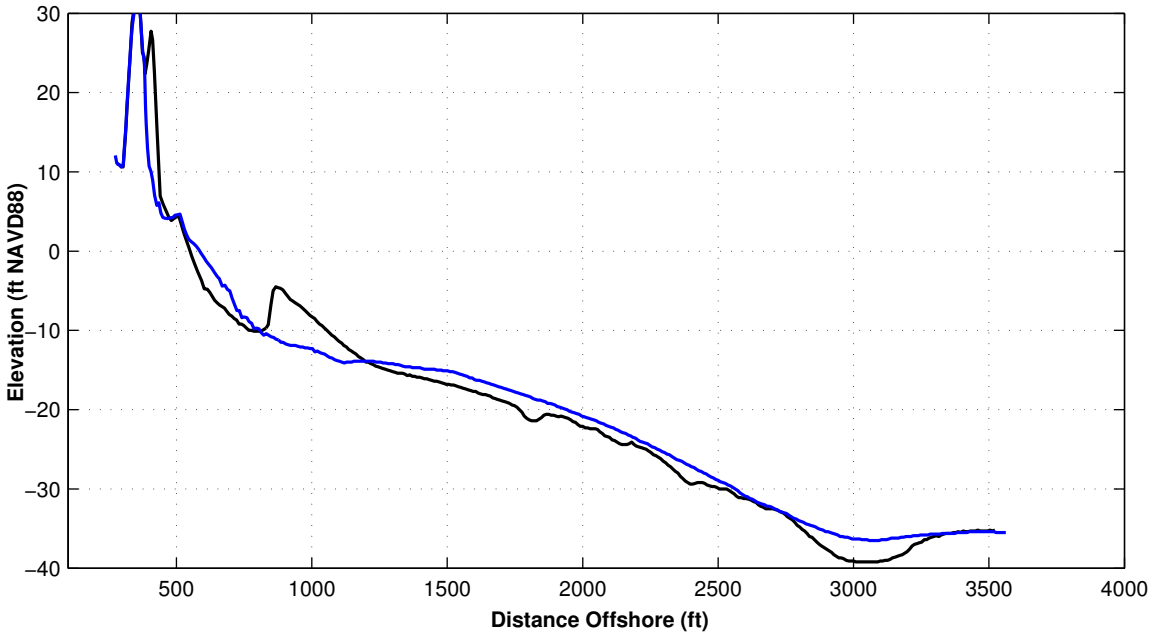
**LEGEND:**

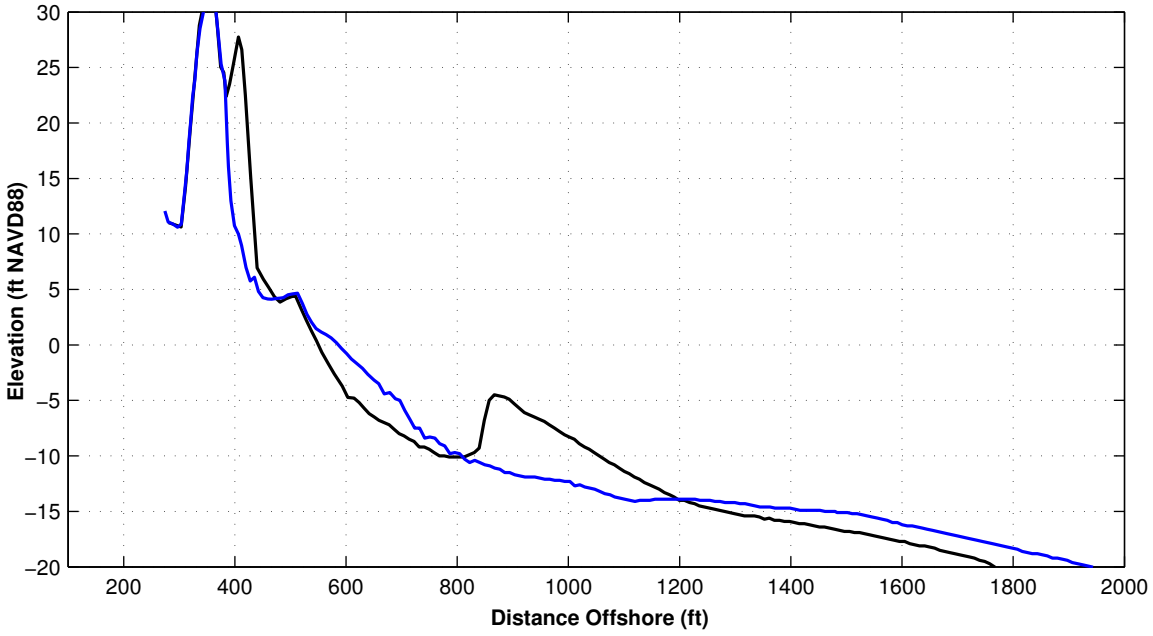
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1045+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −18.79 ft | −3.60 ft |
| Volume Change Above +6 ft NAVD88 | −0.24 cy/ft | −0.90 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −2.11 cy/ft | −2.83 cy/ft |
| Volume Change Above −6 ft NAVD88 | −19.30 cy/ft | 7.13 cy/ft |
| Volume Change Above −14 ft NAVD88 | −36.83 cy/ft | 38.06 cy/ft |
| Volume Change Above −19 ft NAVD88 | −43.20 cy/ft | 15.77 cy/ft |
| Volume Change Above −30 ft NAVD88 | −40.53 cy/ft | −2.88 cy/ft |

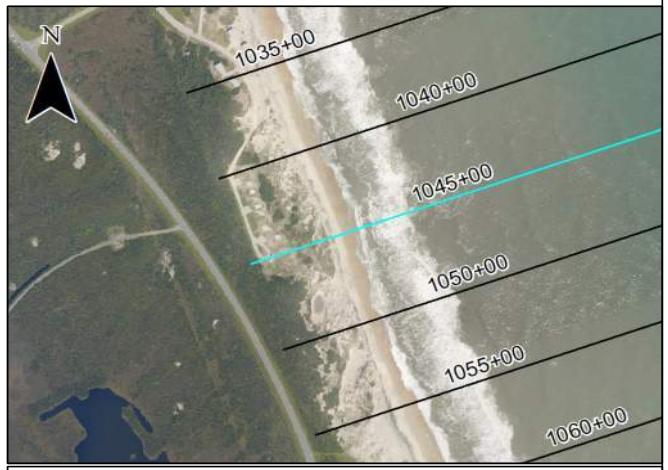
**LEGEND:**

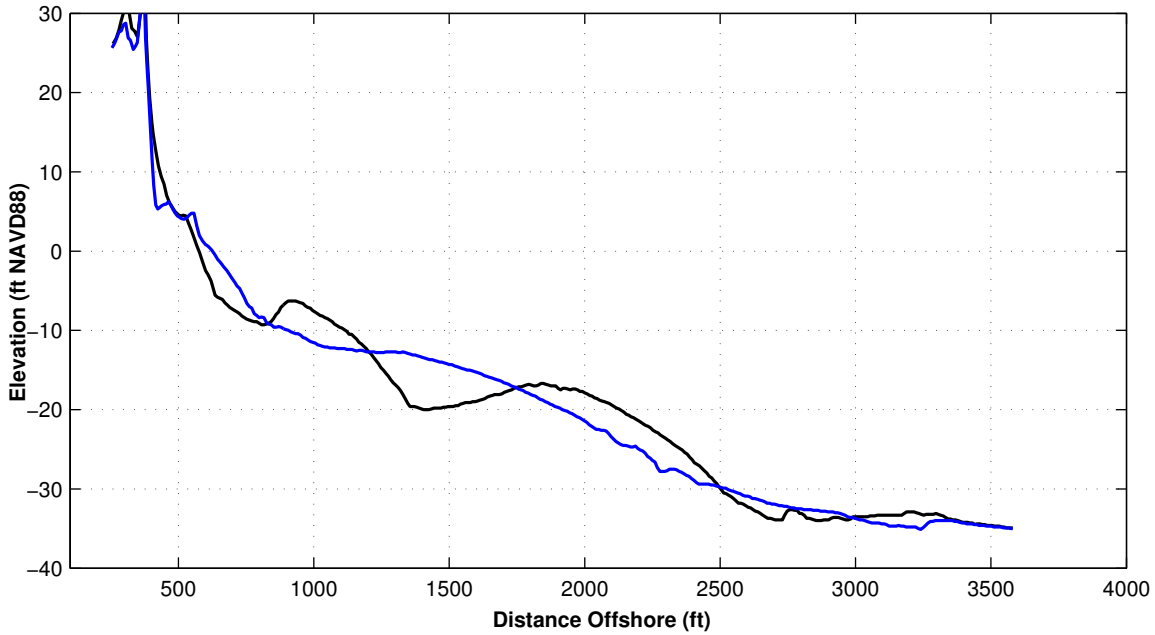
JUNE 2024 — OCTOBER 2023

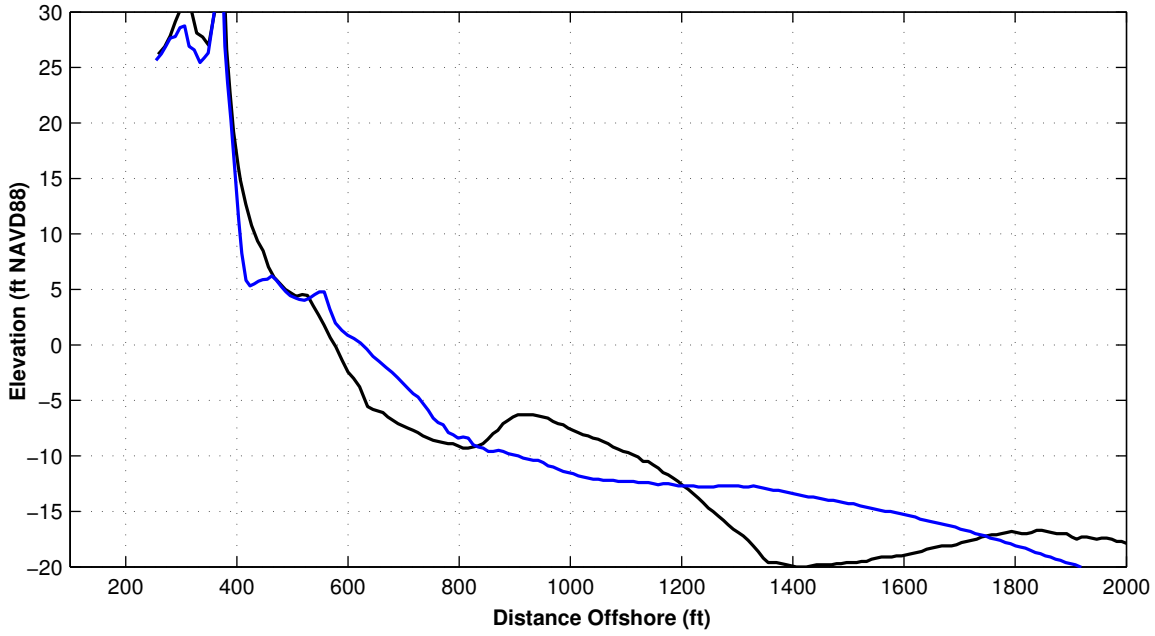
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 1050+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −29.42 ft | −3.90 ft |
| Volume Change Above +6 ft NAVD88 | −1.98 cy/ft | −1.72 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −3.82 cy/ft | −4.49 cy/ft |
| Volume Change Above −6 ft NAVD88 | −16.99 cy/ft | 0.11 cy/ft |
| Volume Change Above −14 ft NAVD88 | −18.78 cy/ft | 29.71 cy/ft |
| Volume Change Above −19 ft NAVD88 | −17.73 cy/ft | 3.83 cy/ft |
| Volume Change Above −30 ft NAVD88 | −13.17 cy/ft | −15.12 cy/ft |

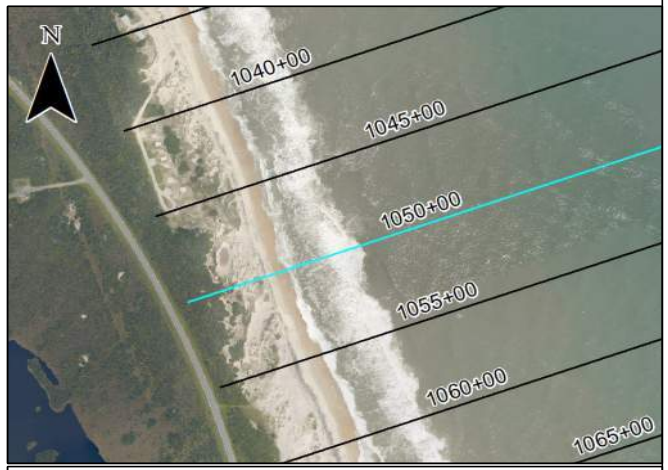
**LEGEND:**

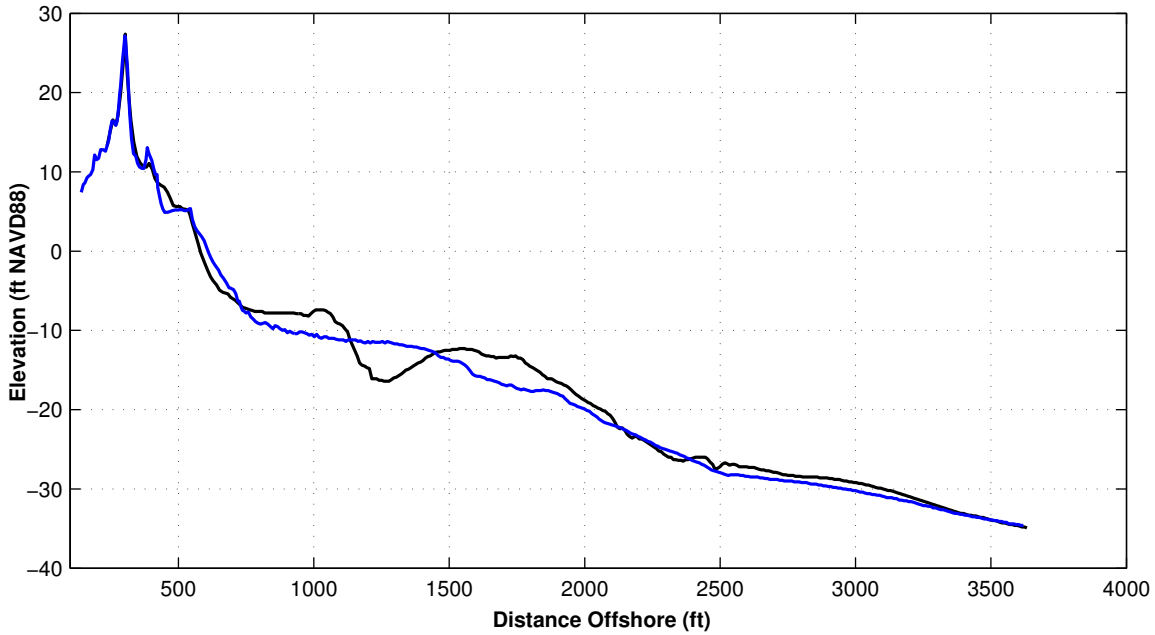
JUNE 2024 — OCTOBER 2023

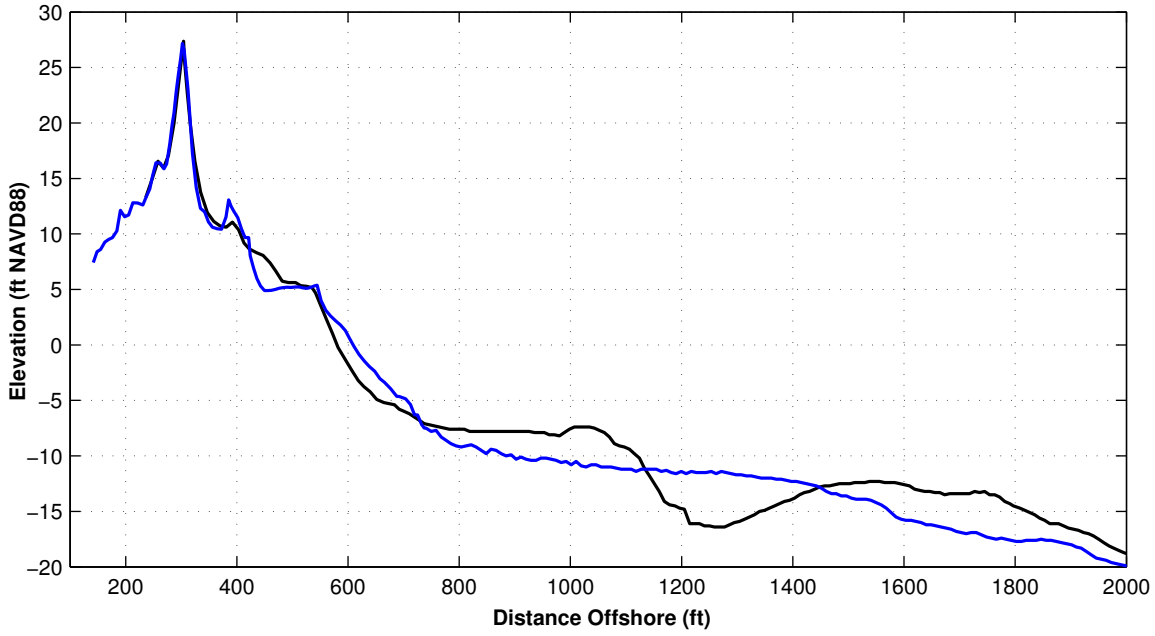
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 1055+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −19.34 ft | −9.31 ft |
| Volume Change Above +6 ft NAVD88 | 2.52 cy/ft | −5.91 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.59 cy/ft | −8.01 cy/ft |
| Volume Change Above −6 ft NAVD88 | −5.35 cy/ft | −3.48 cy/ft |
| Volume Change Above −14 ft NAVD88 | 12.26 cy/ft | 14.48 cy/ft |
| Volume Change Above −19 ft NAVD88 | 15.71 cy/ft | −6.47 cy/ft |
| Volume Change Above −30 ft NAVD88 | 20.61 cy/ft | −25.20 cy/ft |

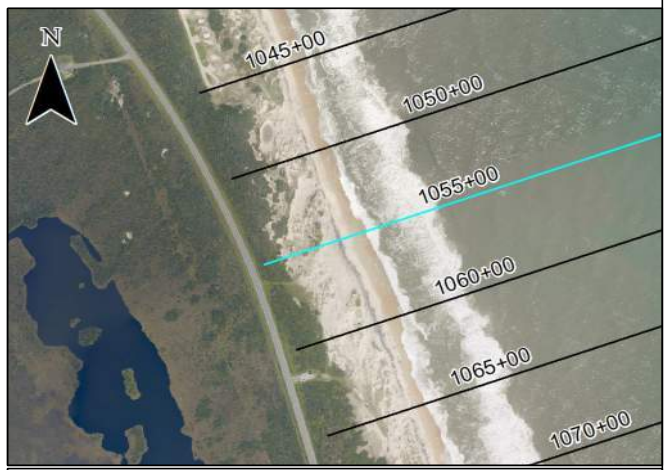
**LEGEND:**

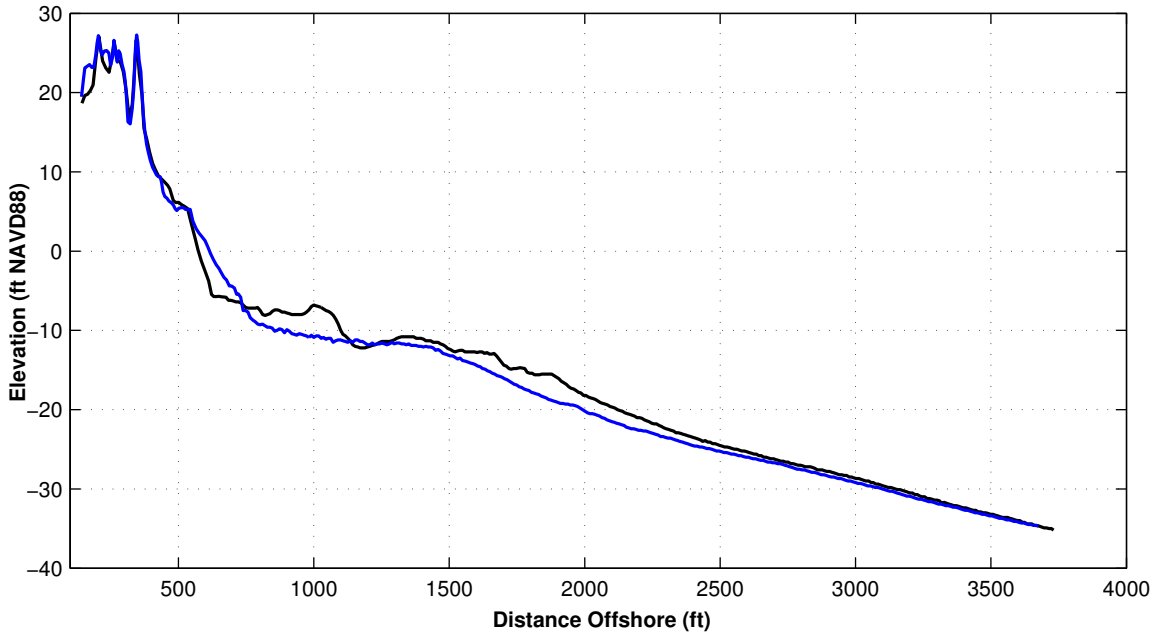
JUNE 2024 — OCTOBER 2023

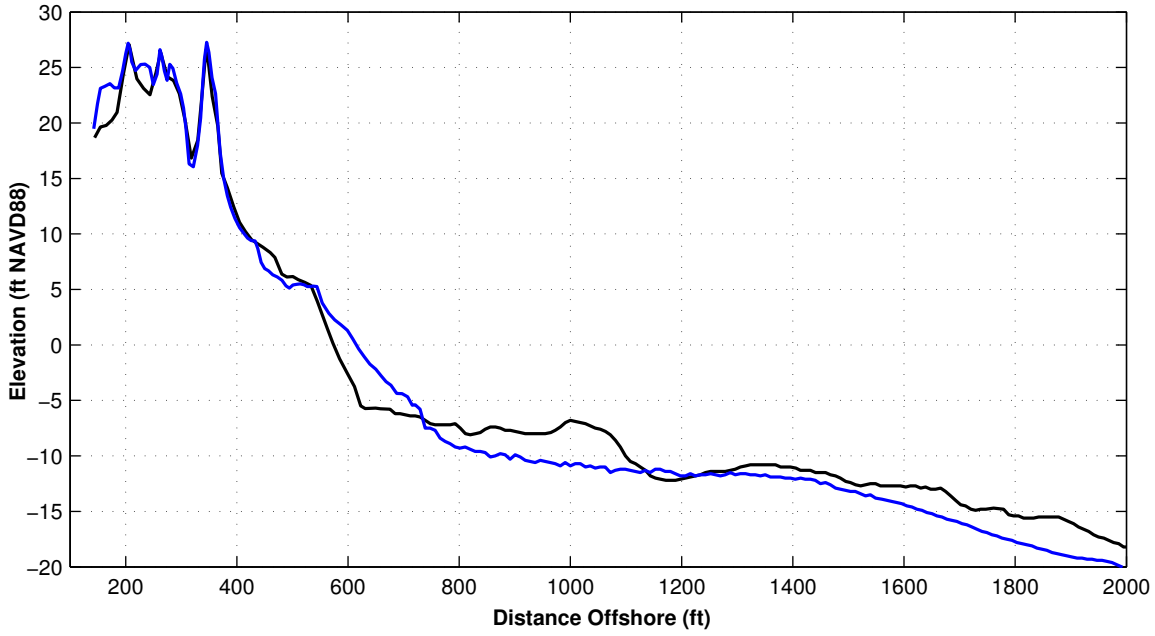
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.





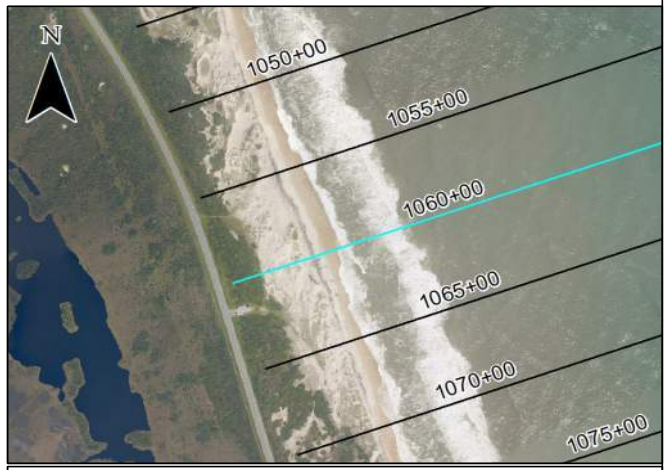




| Survey Transect 1060+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −1.65 ft | −21.25 ft |
| Volume Change Above +6 ft NAVD88 | 2.66 cy/ft | −9.55 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 3.98 cy/ft | −13.59 cy/ft |
| Volume Change Above −6 ft NAVD88 | 13.62 cy/ft | −15.25 cy/ft |
| Volume Change Above −14 ft NAVD88 | 15.76 cy/ft | −0.55 cy/ft |
| Volume Change Above −19 ft NAVD88 | 20.48 cy/ft | −18.56 cy/ft |
| Volume Change Above −30 ft NAVD88 | 30.46 cy/ft | −37.88 cy/ft |

**LEGEND:**

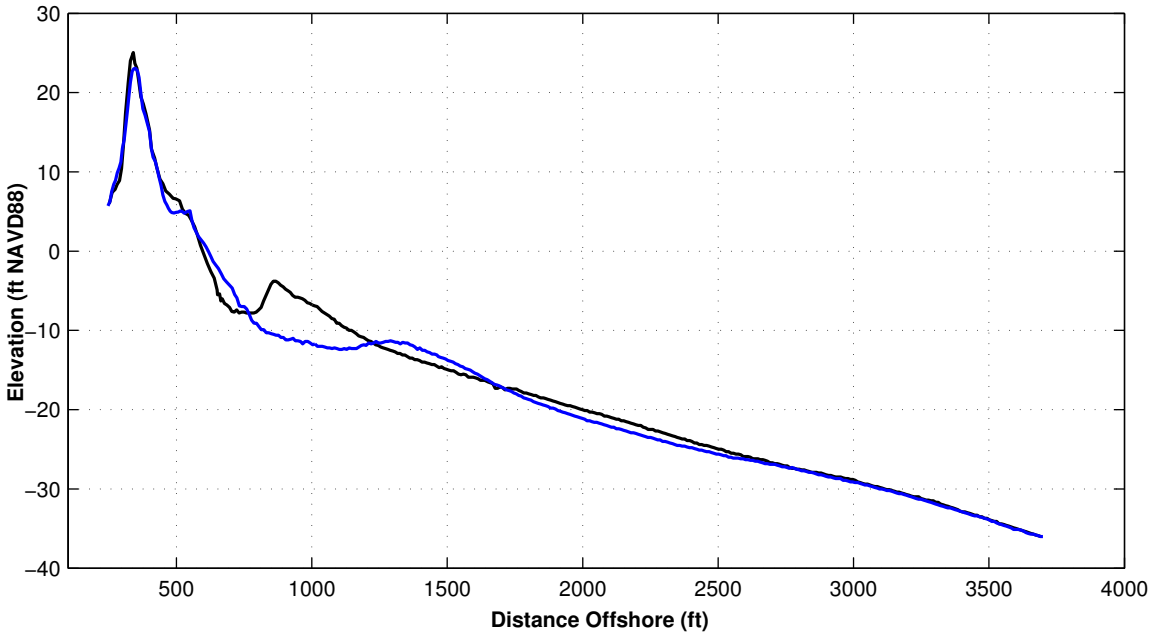
JUNE 2024 — OCTOBER 2023 / JUNE 2023

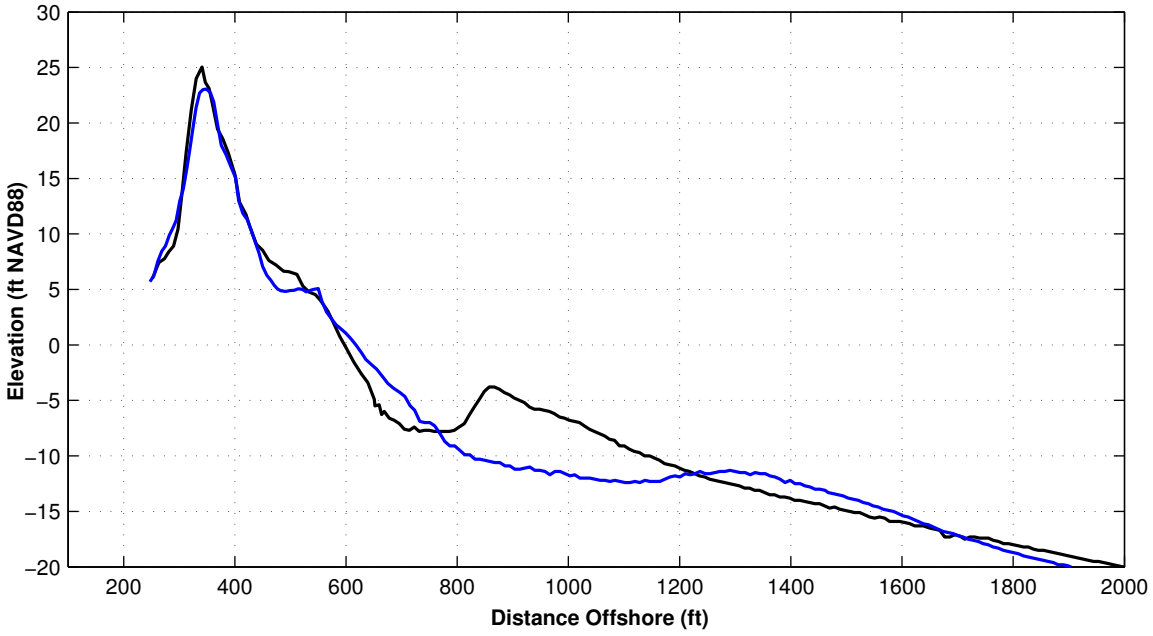
Notes:
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1060+00 | Pg 18 of 173 | 2024 |
|---|---|---|




| Survey Transect 1065+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −8.79 ft | −3.71 ft |
| Volume Change Above +6 ft NAVD88 | 1.43 cy/ft | −6.77 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.16 cy/ft | −9.25 cy/ft |
| Volume Change Above −6 ft NAVD88 | −4.98 cy/ft | −4.44 cy/ft |
| Volume Change Above −14 ft NAVD88 | −0.43 cy/ft | 13.08 cy/ft |
| Volume Change Above −19 ft NAVD88 | 4.93 cy/ft | −0.68 cy/ft |
| Volume Change Above −30 ft NAVD88 | 15.90 cy/ft | −15.58 cy/ft |

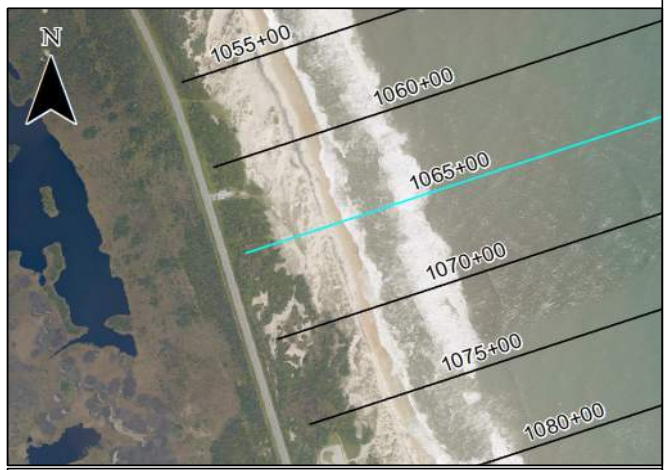
**LEGEND:**

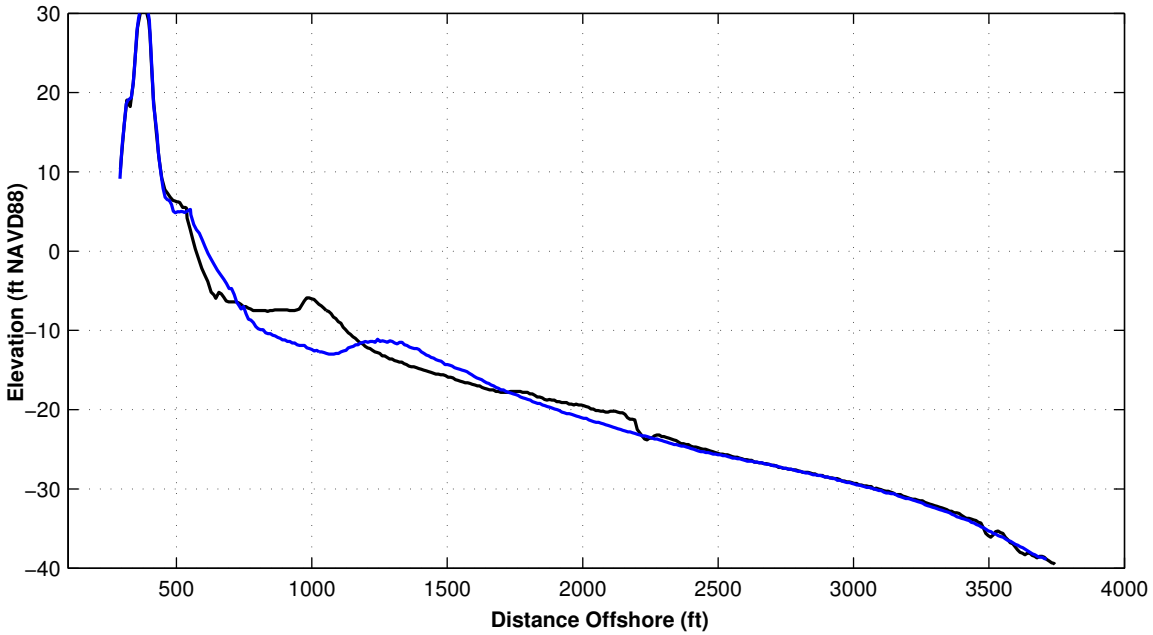
JUNE 2024 — OCTOBER 2023

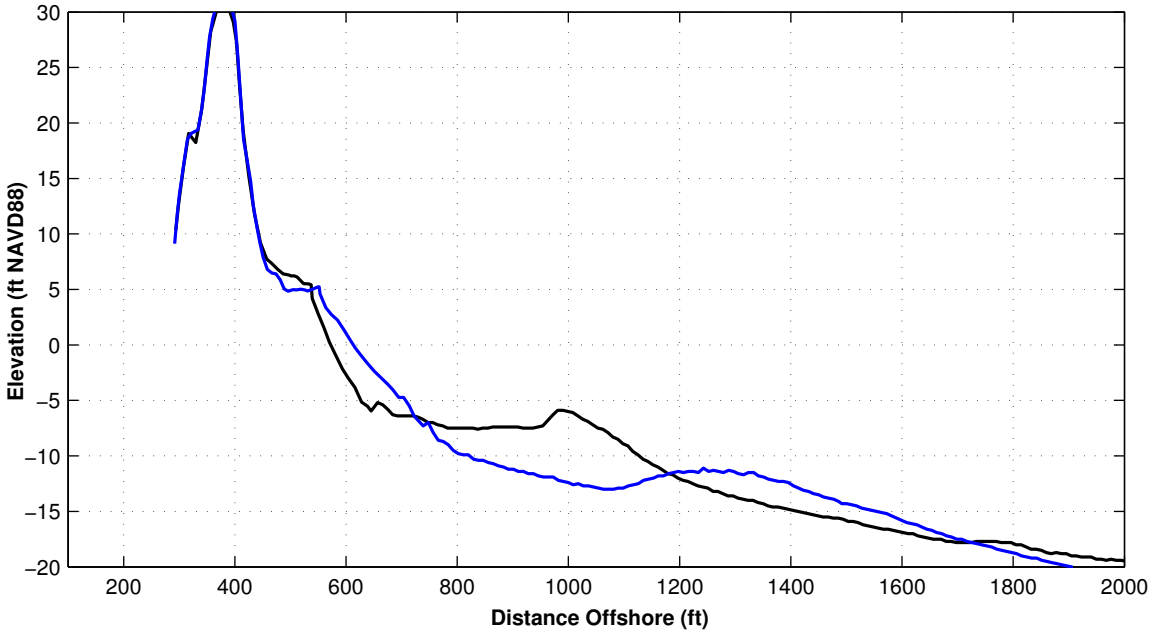
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 1070+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 10.10 ft | −22.00 ft |
| Volume Change Above +6 ft NAVD88 | 1.82 cy/ft | −2.78 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 5.35 cy/ft | −6.90 cy/ft |
| Volume Change Above −6 ft NAVD88 | 3.60 cy/ft | −5.26 cy/ft |
| Volume Change Above −14 ft NAVD88 | 0.65 cy/ft | 28.06 cy/ft |
| Volume Change Above −19 ft NAVD88 | 8.18 cy/ft | 14.12 cy/ft |
| Volume Change Above −30 ft NAVD88 | 20.48 cy/ft | −1.40 cy/ft |

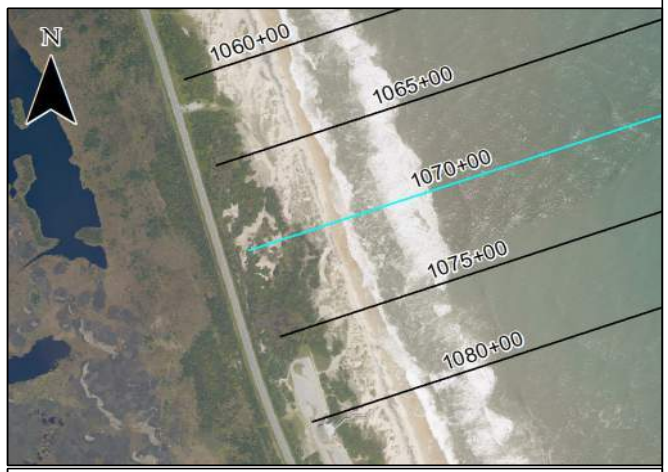
**LEGEND:**

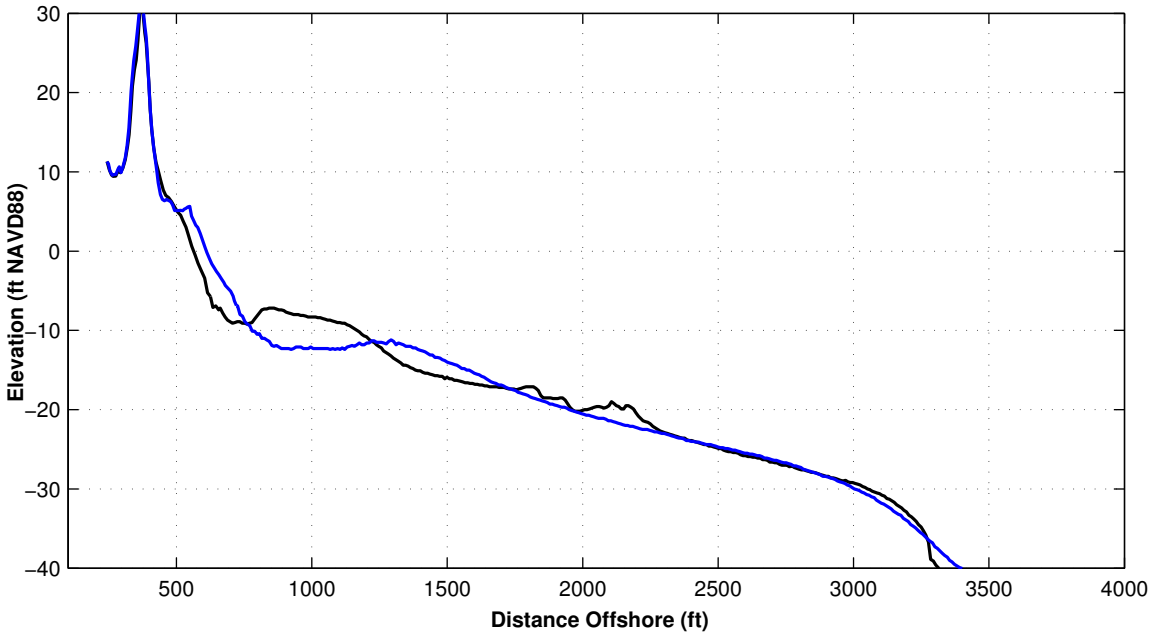
JUNE 2024 — OCTOBER 2023

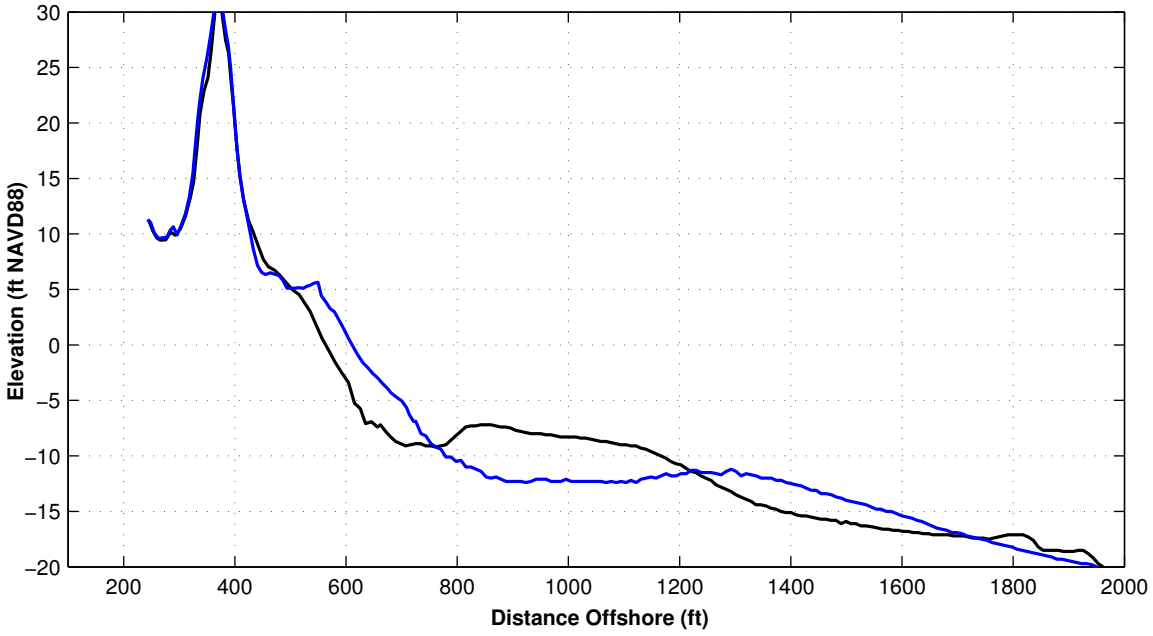
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 1075+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 12.45 ft | −2.68 ft |
| Volume Change Above +6 ft NAVD88 | 2.99 cy/ft | −0.99 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.21 cy/ft | −1.94 cy/ft |
| Volume Change Above −6 ft NAVD88 | 5.26 cy/ft | 2.89 cy/ft |
| Volume Change Above −14 ft NAVD88 | 20.82 cy/ft | 30.53 cy/ft |
| Volume Change Above −19 ft NAVD88 | 29.09 cy/ft | 9.60 cy/ft |
| Volume Change Above −30 ft NAVD88 | 38.55 cy/ft | −6.16 cy/ft |

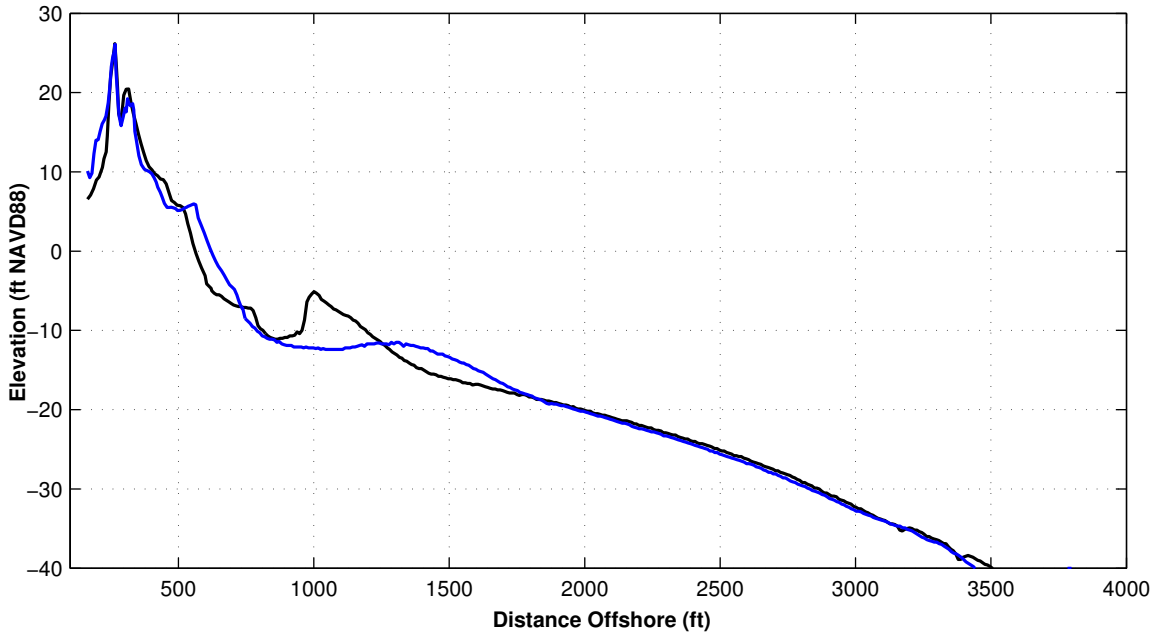
**LEGEND:**

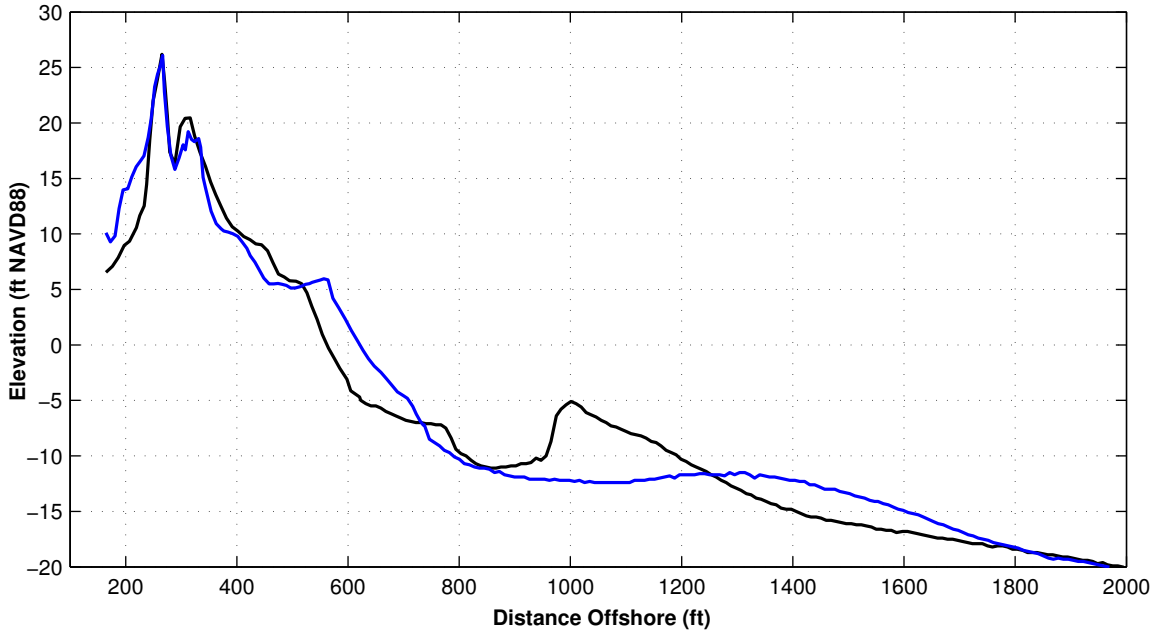
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1080+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 7.36 ft | −11.51 ft |
| Volume Change Above +6 ft NAVD88 | 0.90 cy/ft | −3.04 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 3.90 cy/ft | −5.86 cy/ft |
| Volume Change Above −6 ft NAVD88 | 1.41 cy/ft | −4.76 cy/ft |
| Volume Change Above −14 ft NAVD88 | −11.46 cy/ft | 43.38 cy/ft |
| Volume Change Above −19 ft NAVD88 | −4.53 cy/ft | 22.82 cy/ft |
| Volume Change Above −30 ft NAVD88 | 3.19 cy/ft | 5.42 cy/ft |

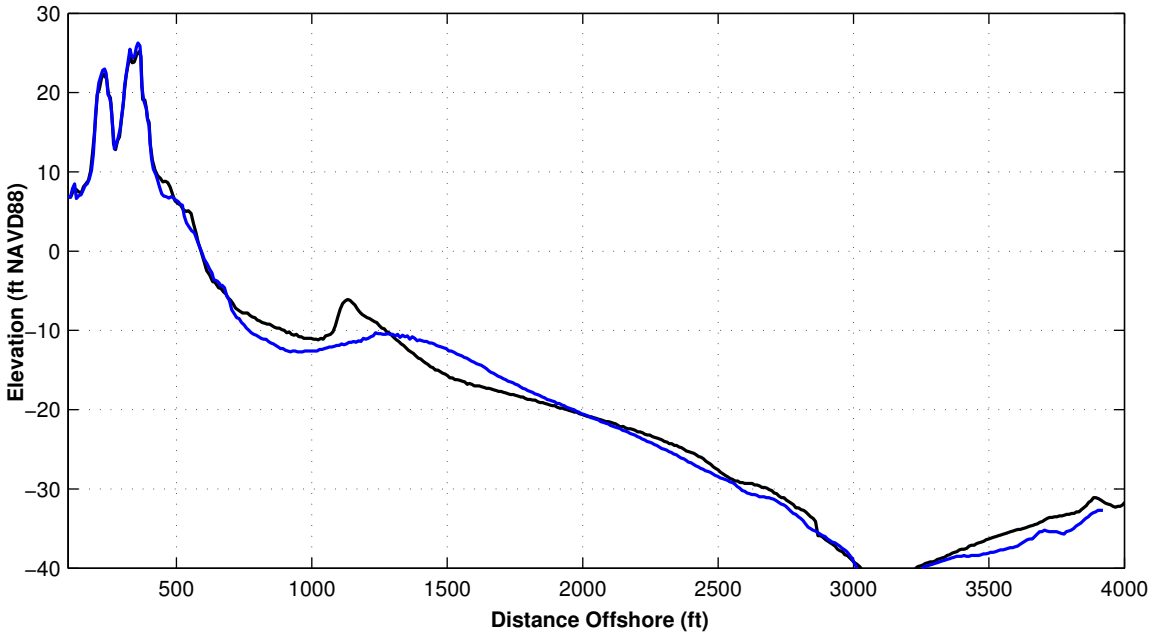
**LEGEND:**

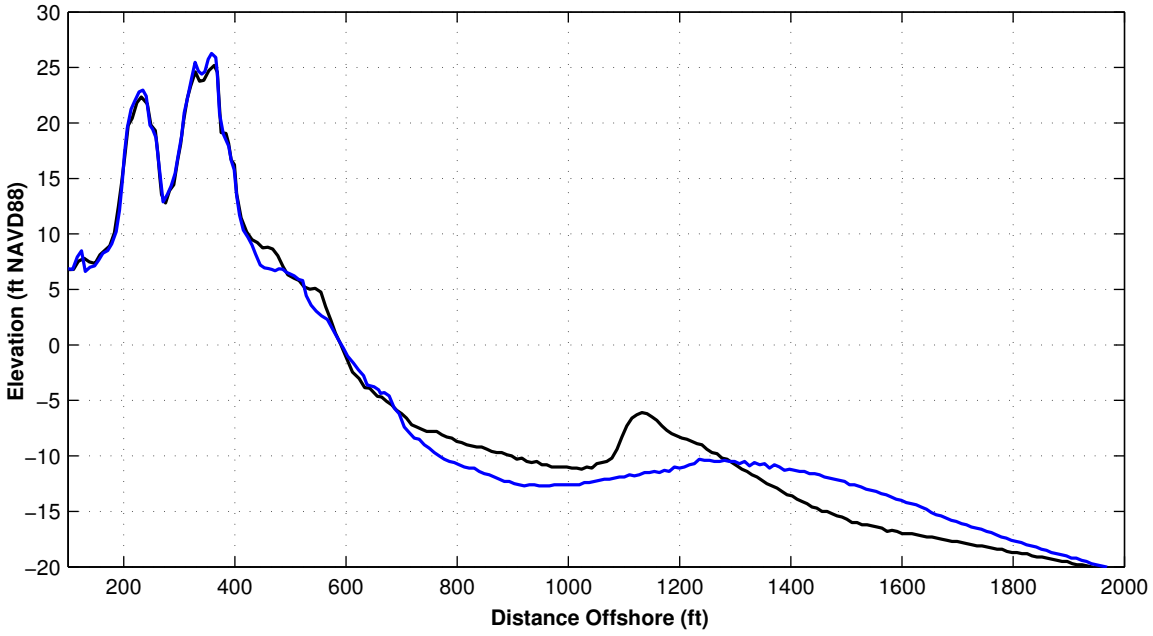
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1090+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −3.54 ft | 9.31 ft |
| Volume Change Above +6 ft NAVD88 | −0.37 cy/ft | −5.73 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.88 cy/ft | −6.17 cy/ft |
| Volume Change Above −6 ft NAVD88 | −1.64 cy/ft | −5.41 cy/ft |
| Volume Change Above −14 ft NAVD88 | 1.92 cy/ft | 32.65 cy/ft |
| Volume Change Above −19 ft NAVD88 | 8.93 cy/ft | 14.45 cy/ft |
| Volume Change Above −30 ft NAVD88 | 20.59 cy/ft | −2.08 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

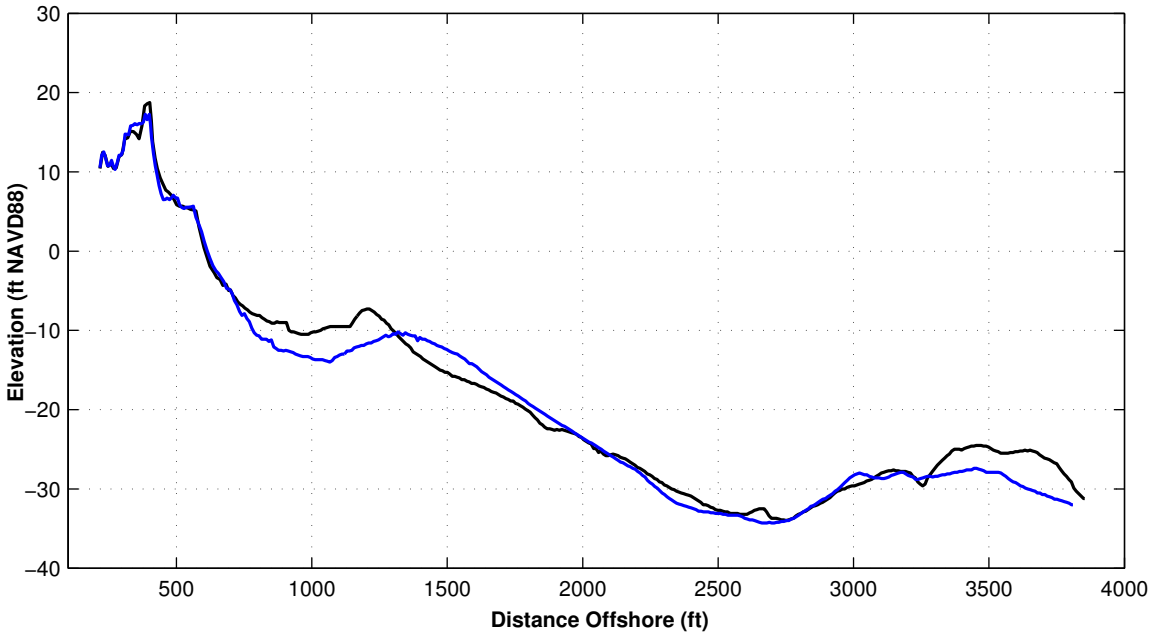
JUNE 2023

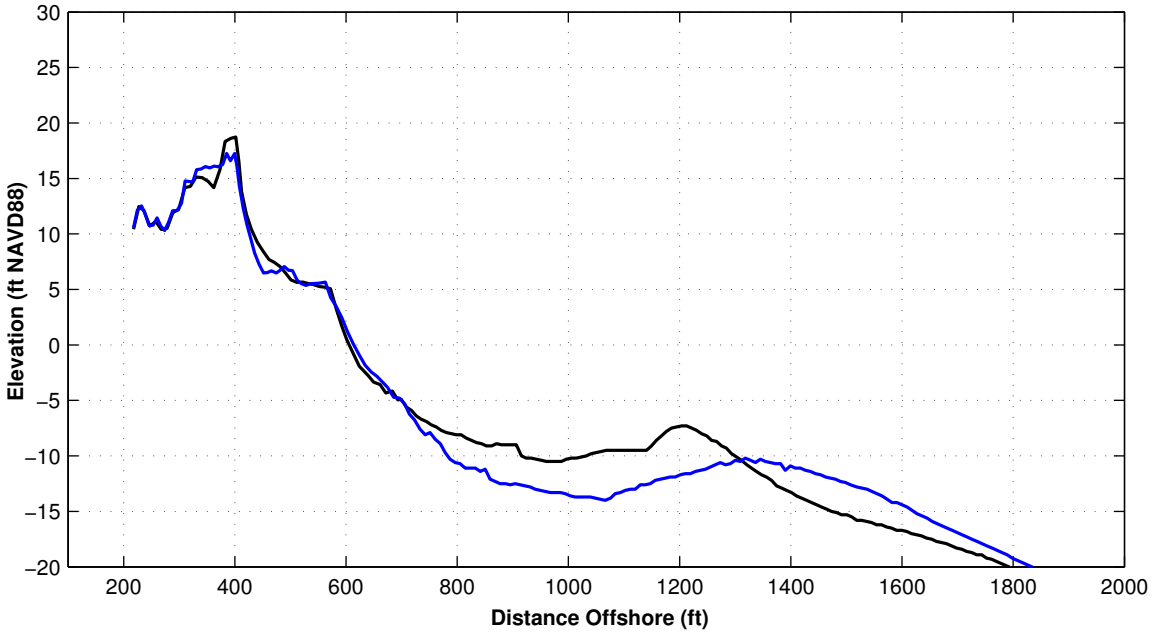
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1090+00 | Pg 23 of 173 | 2024 |
|---|---|---|




| Survey Transect 1100+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −25.93 ft | 15.43 ft |
| Volume Change Above +6 ft NAVD88 | 0.98 cy/ft | 1.25 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −3.25 cy/ft | 5.47 cy/ft |
| Volume Change Above −6 ft NAVD88 | −11.07 cy/ft | 3.10 cy/ft |
| Volume Change Above −14 ft NAVD88 | −18.22 cy/ft | 36.45 cy/ft |
| Volume Change Above −19 ft NAVD88 | −9.84 cy/ft | 16.21 cy/ft |
| Volume Change Above −30 ft NAVD88 | 4.28 cy/ft | −1.84 cy/ft |

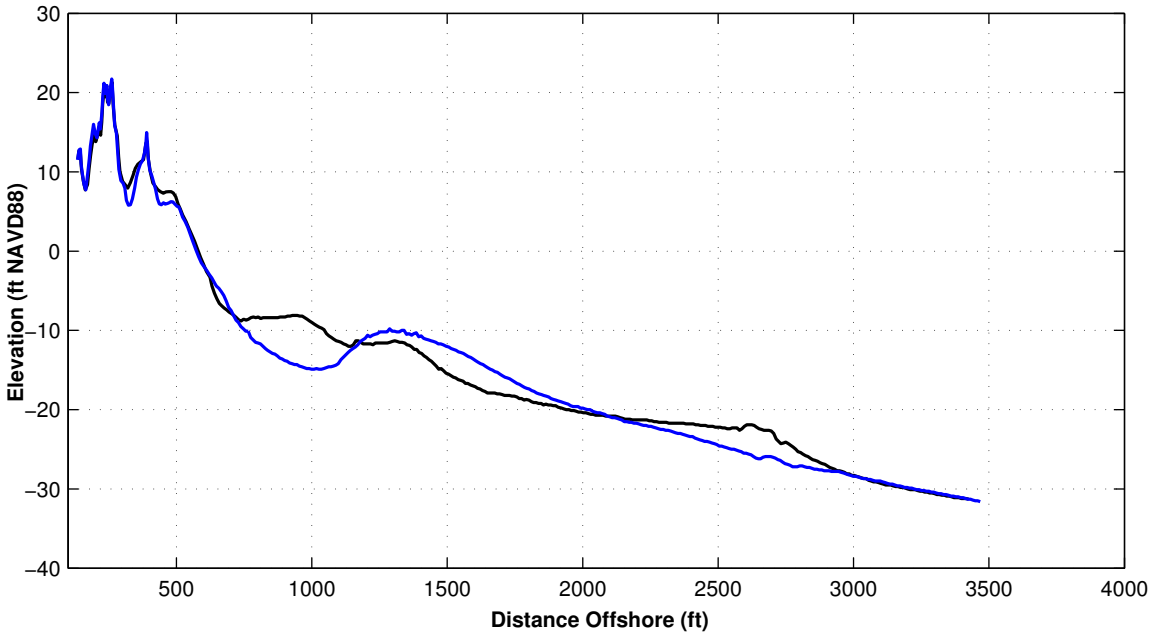
**LEGEND:**

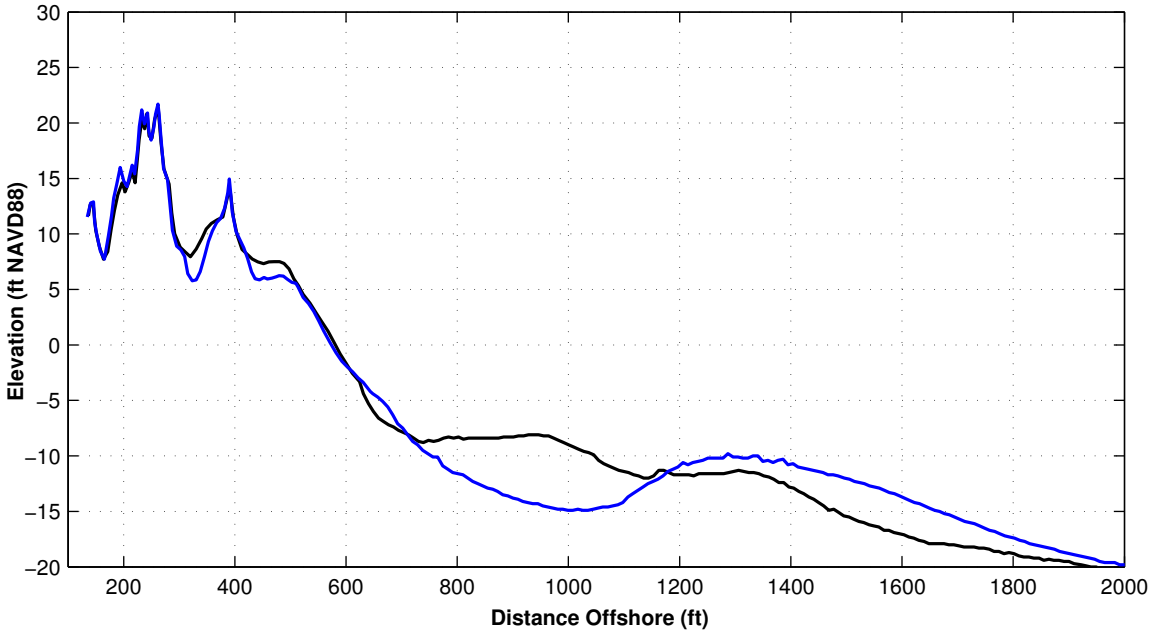
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1110+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 7.74 ft | 16.59 ft |
| Volume Change Above +6 ft NAVD88 | −1.49 cy/ft | 1.84 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 2.04 cy/ft | 3.00 cy/ft |
| Volume Change Above −6 ft NAVD88 | 3.80 cy/ft | −1.95 cy/ft |
| Volume Change Above −14 ft NAVD88 | −3.16 cy/ft | 35.75 cy/ft |
| Volume Change Above −19 ft NAVD88 | 2.02 cy/ft | 10.81 cy/ft |
| Volume Change Above −30 ft NAVD88 | 22.05 cy/ft | −9.60 cy/ft |

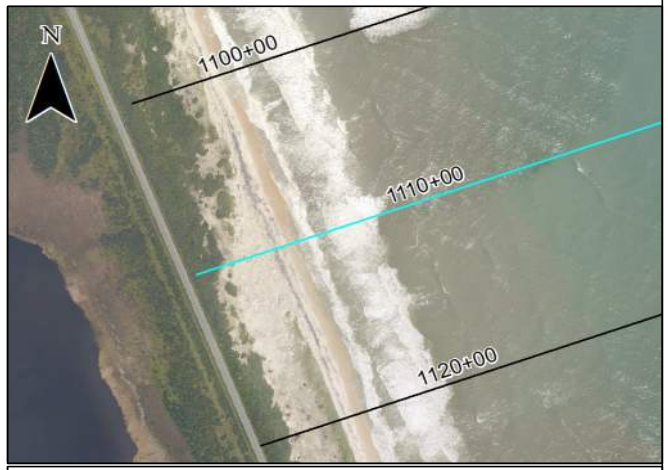
**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

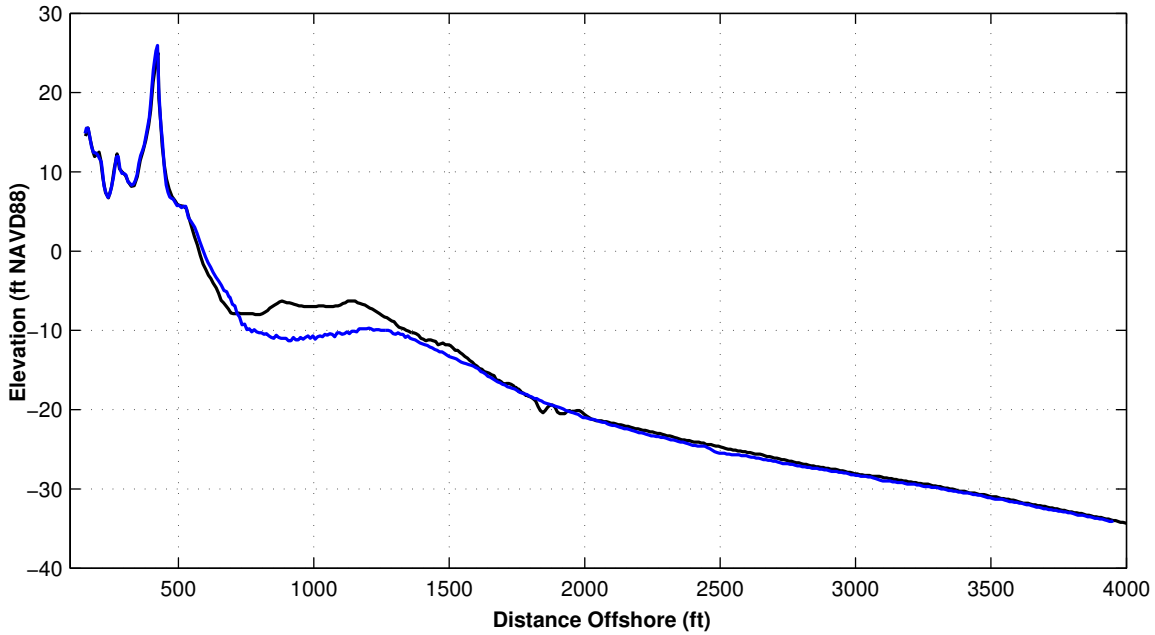
Notes:

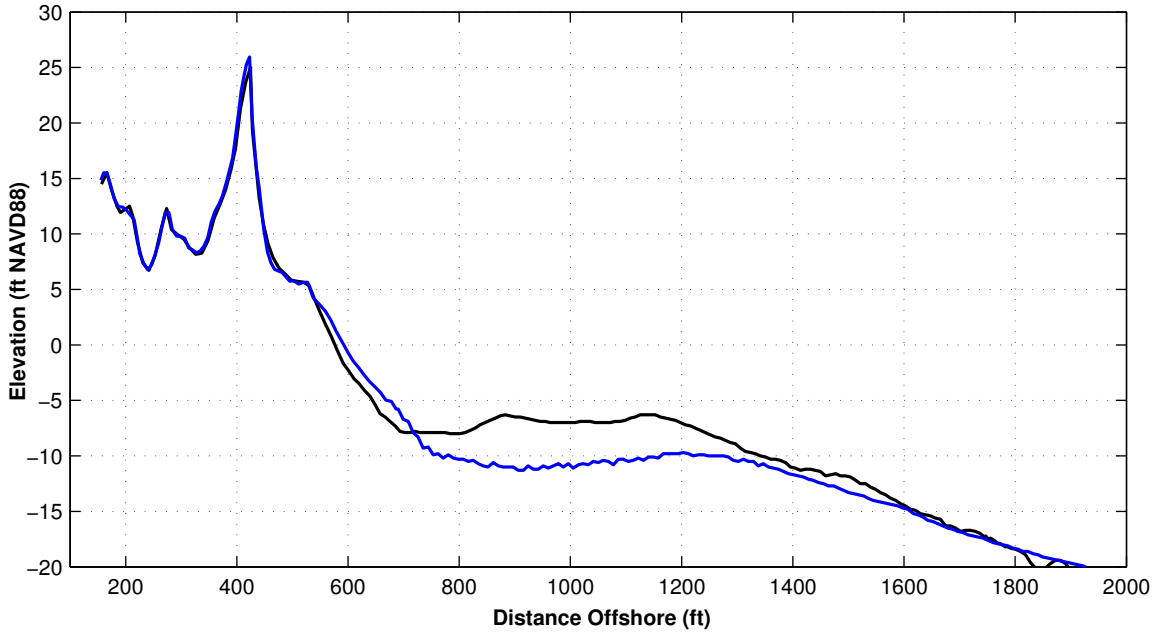
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1110+00 | Pg 25 of 173 | 2024 |
|---|---|---|




| Survey Transect 1120+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −9.49 ft | 8.63 ft |
| Volume Change Above +6 ft NAVD88 | −0.63 cy/ft | 4.05 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −3.56 cy/ft | 8.50 cy/ft |
| Volume Change Above −6 ft NAVD88 | −8.40 cy/ft | 1.97 cy/ft |
| Volume Change Above −14 ft NAVD88 | −29.28 cy/ft | 42.87 cy/ft |
| Volume Change Above −19 ft NAVD88 | −25.07 cy/ft | 17.09 cy/ft |
| Volume Change Above −30 ft NAVD88 | −9.32 cy/ft | −0.40 cy/ft |

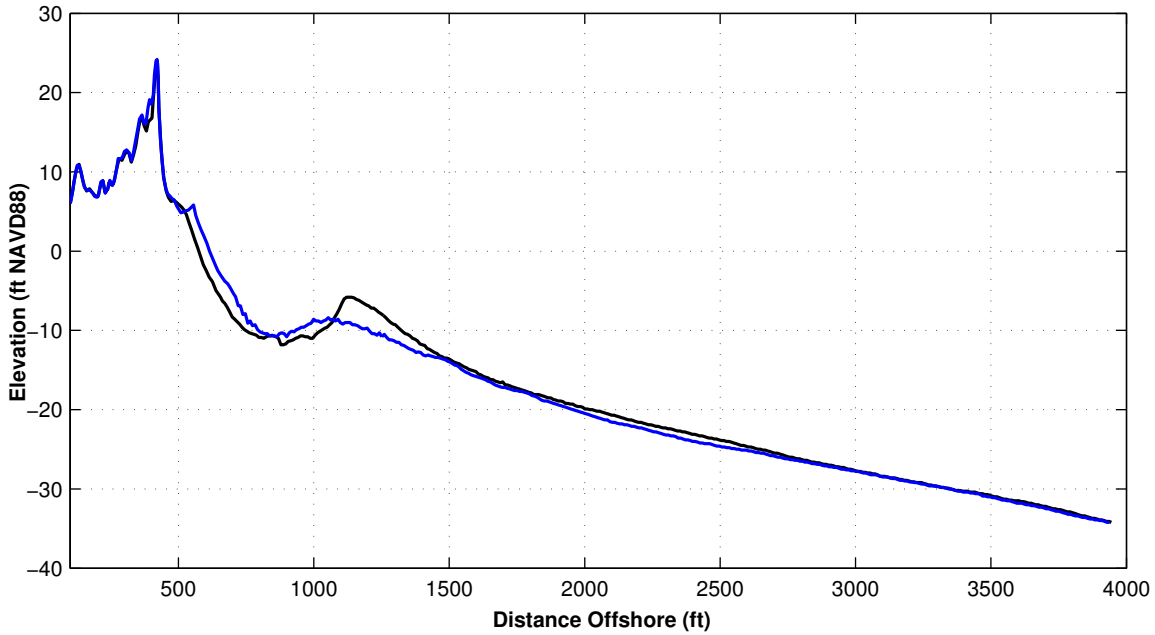
**LEGEND:**

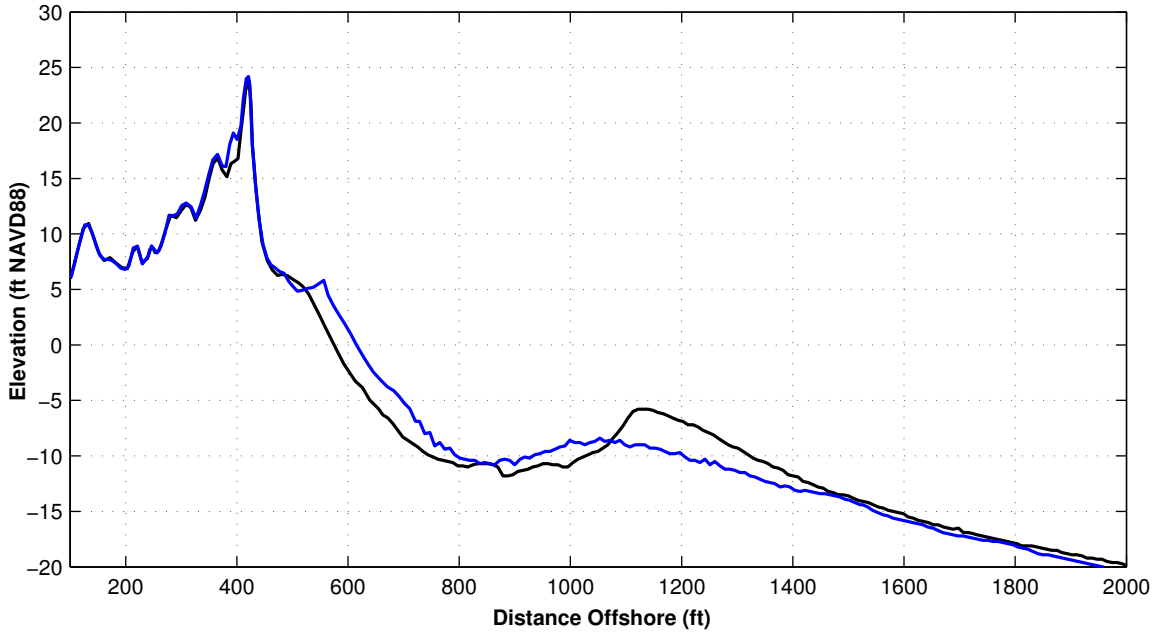
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1130+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −2.44 ft | 9.16 ft |
| Volume Change Above +6 ft NAVD88 | 0.65 cy/ft | 1.86 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −0.85 cy/ft | 4.31 cy/ft |
| Volume Change Above −6 ft NAVD88 | −1.66 cy/ft | −1.91 cy/ft |
| Volume Change Above −14 ft NAVD88 | −21.51 cy/ft | 47.26 cy/ft |
| Volume Change Above −19 ft NAVD88 | −18.83 cy/ft | 24.05 cy/ft |
| Volume Change Above −30 ft NAVD88 | −2.50 cy/ft | 5.12 cy/ft |

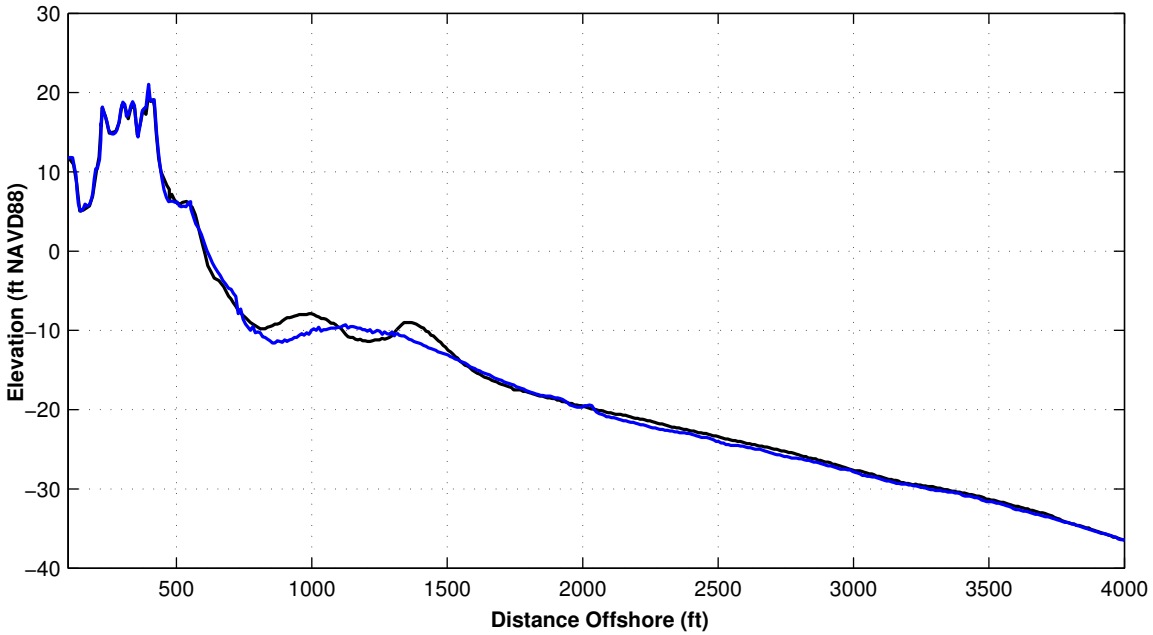
**LEGEND:**

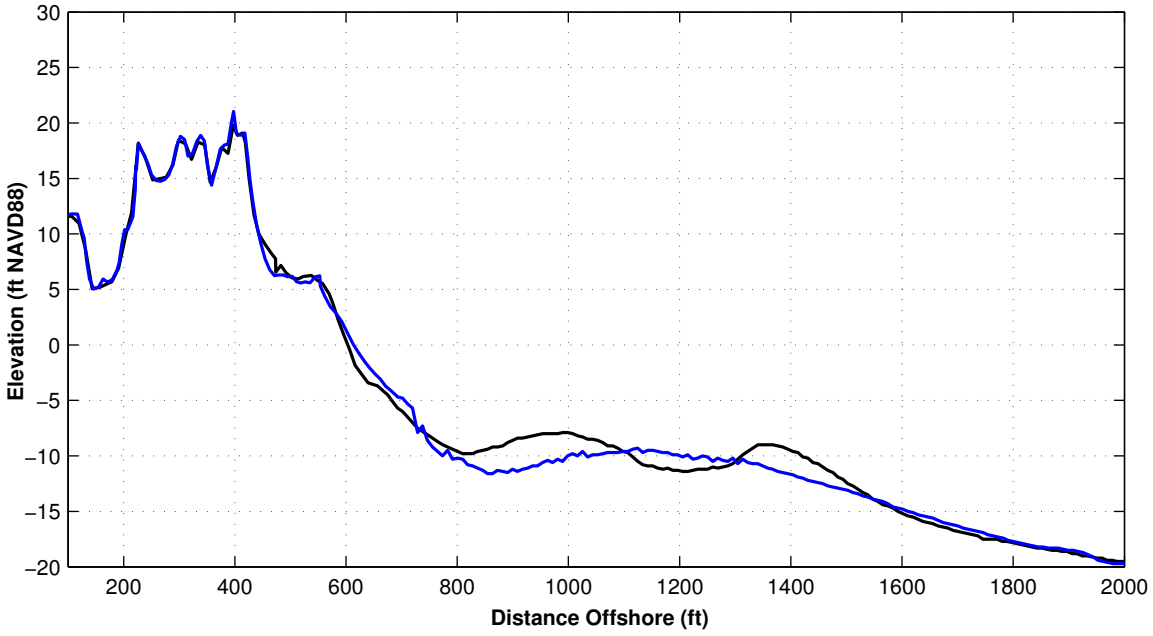
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1140+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 6.51 ft | −5.62 ft |
| Volume Change Above +6 ft NAVD88 | 2.80 cy/ft | 6.56 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 3.77 cy/ft | 6.40 cy/ft |
| Volume Change Above −6 ft NAVD88 | 1.09 cy/ft | 2.26 cy/ft |
| Volume Change Above −14 ft NAVD88 | −27.60 cy/ft | 64.88 cy/ft |
| Volume Change Above −19 ft NAVD88 | −24.70 cy/ft | 50.62 cy/ft |
| Volume Change Above −30 ft NAVD88 | −11.11 cy/ft | 36.49 cy/ft |

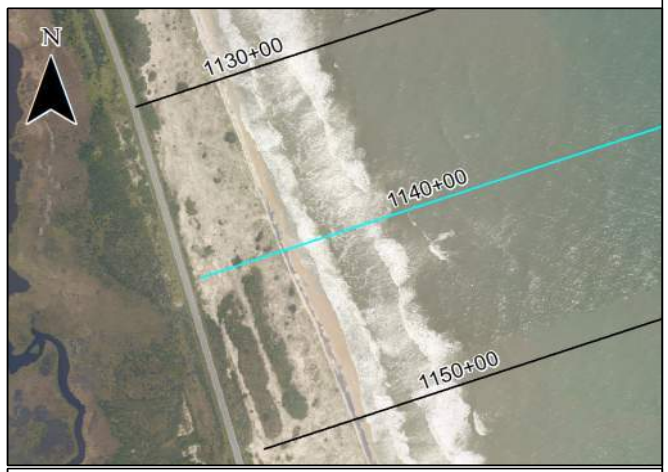
**LEGEND:**

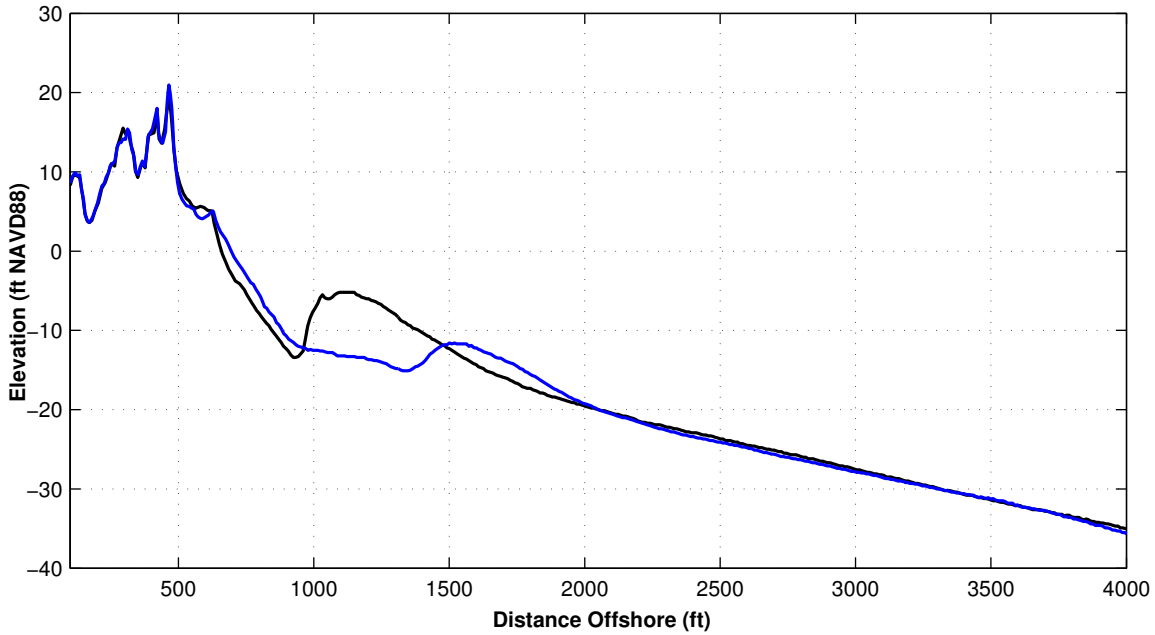
JUNE 2024 — OCTOBER 2023

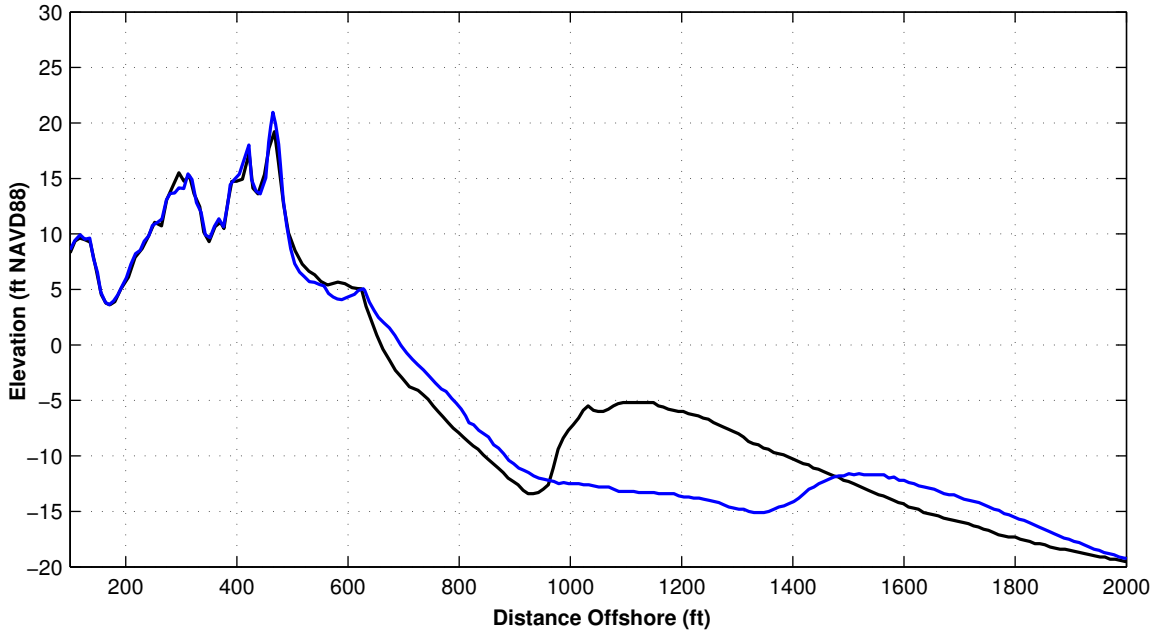
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.






| Survey Transect 1150+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 34.23 ft | −40.84 ft |
| Volume Change Above +6 ft NAVD88 | 4.80 cy/ft | 1.23 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 12.33 cy/ft | −5.65 cy/ft |
| Volume Change Above −6 ft NAVD88 | 16.47 cy/ft | −20.58 cy/ft |
| Volume Change Above −14 ft NAVD88 | 9.12 cy/ft | 15.47 cy/ft |
| Volume Change Above −19 ft NAVD88 | 0.56 cy/ft | 4.99 cy/ft |
| Volume Change Above −30 ft NAVD88 | 21.52 cy/ft | −13.61 cy/ft |

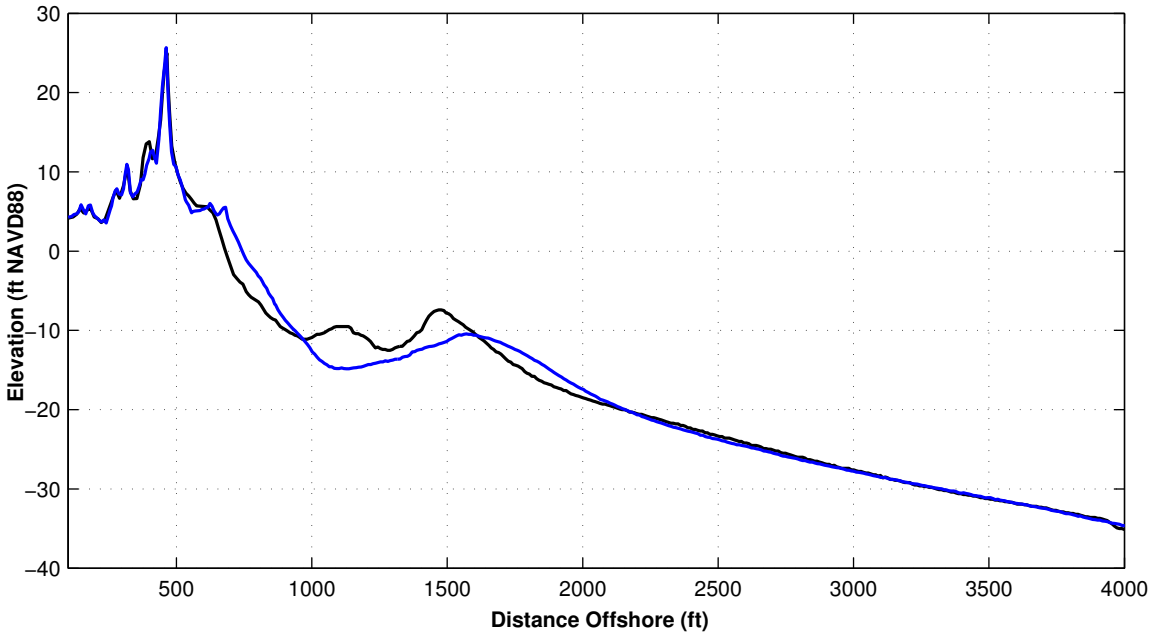
**LEGEND:**

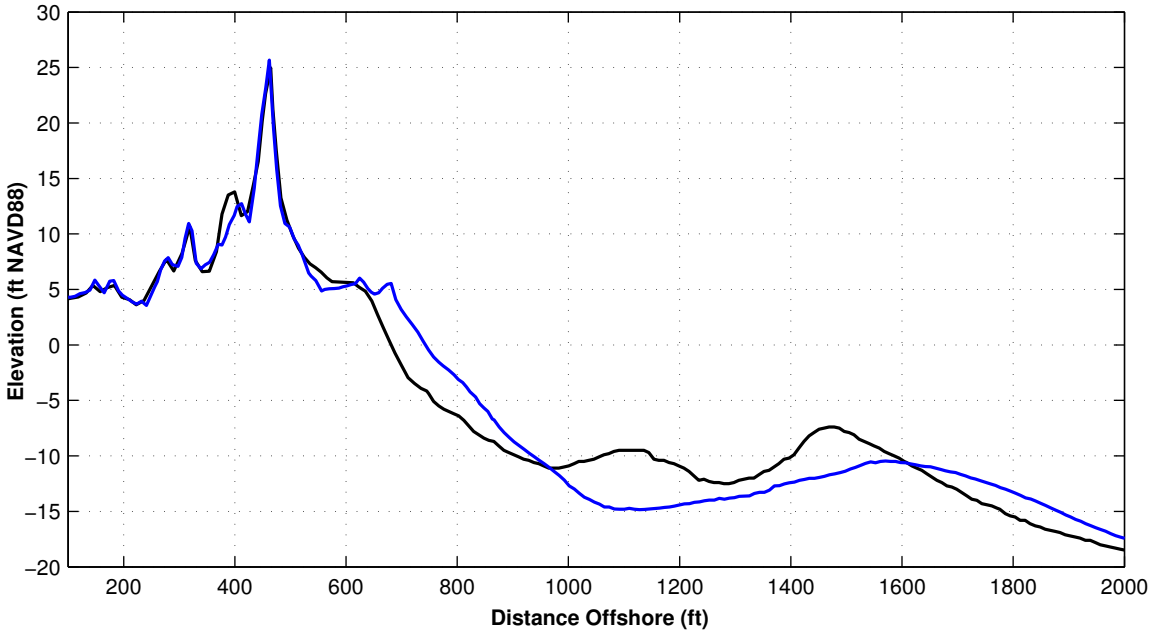
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1160+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 32.20 ft | −46.98 ft |
| Volume Change Above +6 ft NAVD88 | 3.89 cy/ft | −1.34 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 11.63 cy/ft | −10.03 cy/ft |
| Volume Change Above −6 ft NAVD88 | 10.38 cy/ft | −26.01 cy/ft |
| Volume Change Above −14 ft NAVD88 | 37.91 cy/ft | −12.53 cy/ft |
| Volume Change Above −19 ft NAVD88 | 35.93 cy/ft | −18.23 cy/ft |
| Volume Change Above −30 ft NAVD88 | 55.37 cy/ft | −30.75 cy/ft |

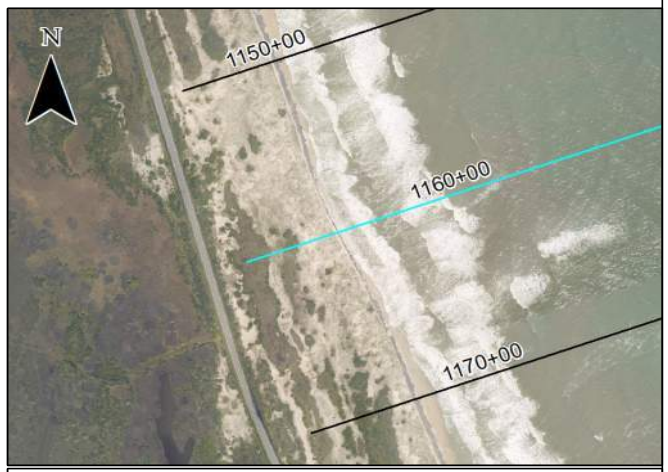
**LEGEND:**

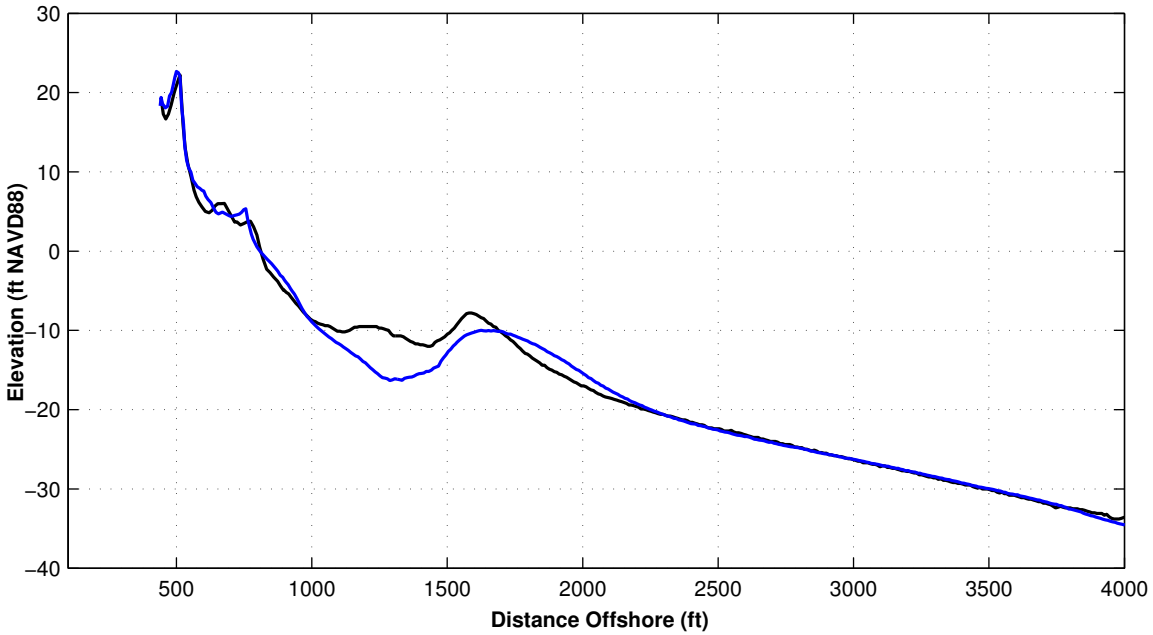
JUNE 2024 — OCTOBER 2023

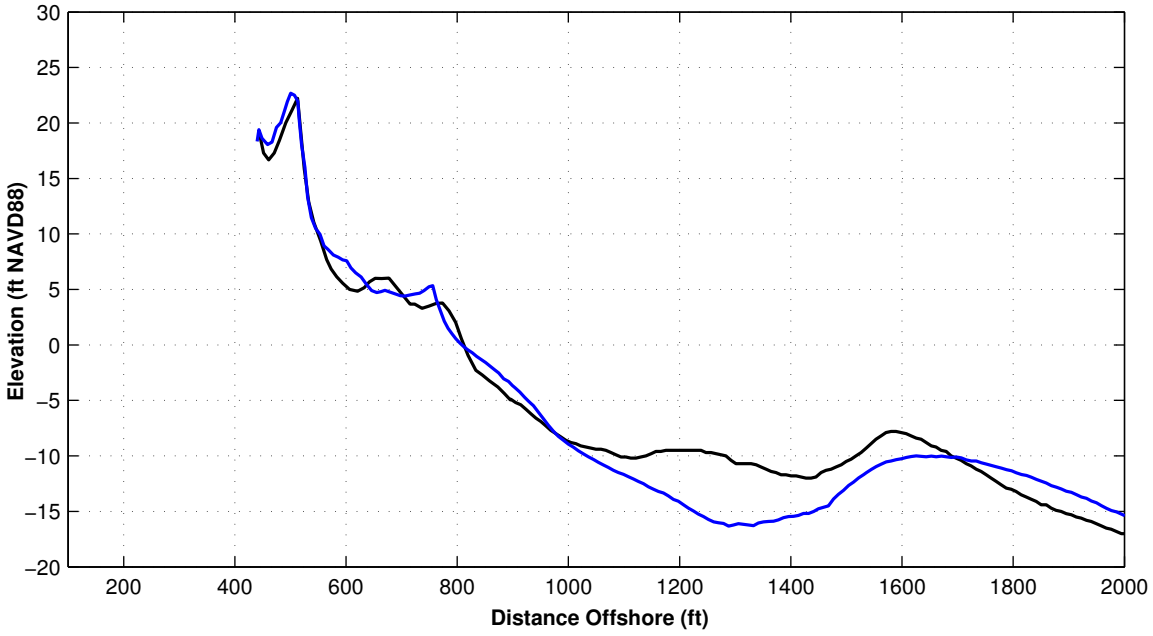
JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.





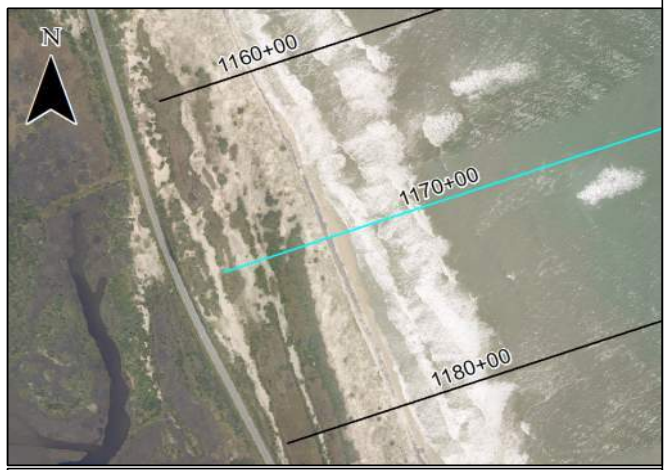




| Survey Transect 1170+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 31.13 ft | −56.41 ft |
| Volume Change Above +6 ft NAVD88 | 2.83 cy/ft | 1.89 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 10.37 cy/ft | −7.47 cy/ft |
| Volume Change Above −6 ft NAVD88 | 11.41 cy/ft | −30.60 cy/ft |
| Volume Change Above −14 ft NAVD88 | 13.74 cy/ft | −3.59 cy/ft |
| Volume Change Above −19 ft NAVD88 | 16.81 cy/ft | −16.12 cy/ft |
| Volume Change Above −30 ft NAVD88 | 41.73 cy/ft | −29.91 cy/ft |

**LEGEND:**

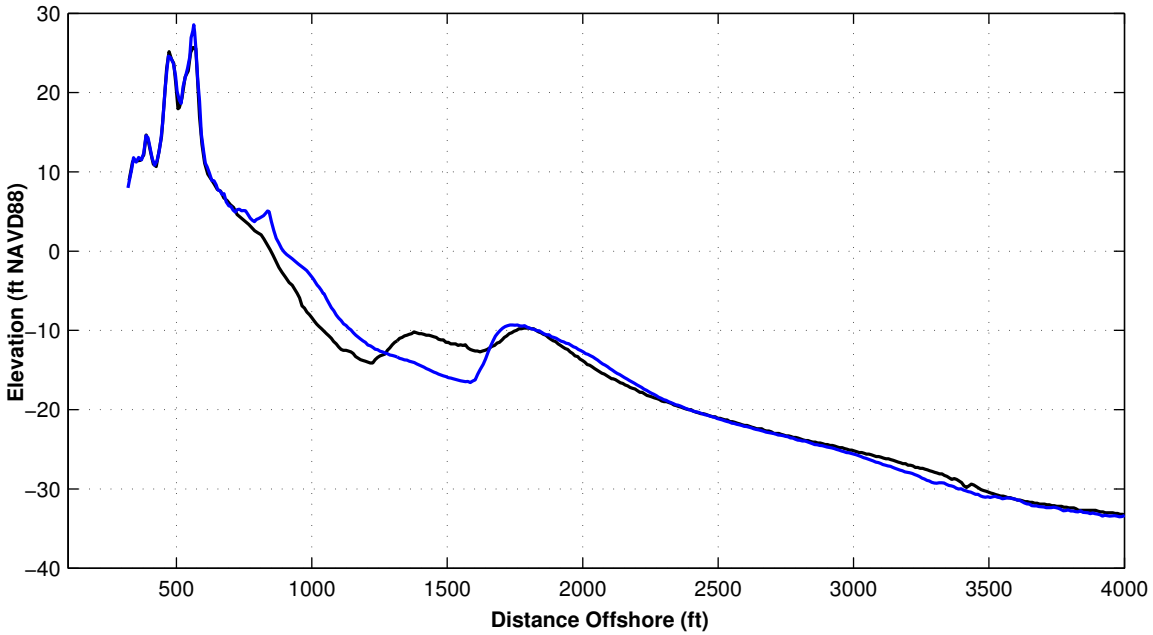
JUNE 2024 — OCTOBER 2023 / JUNE 2023

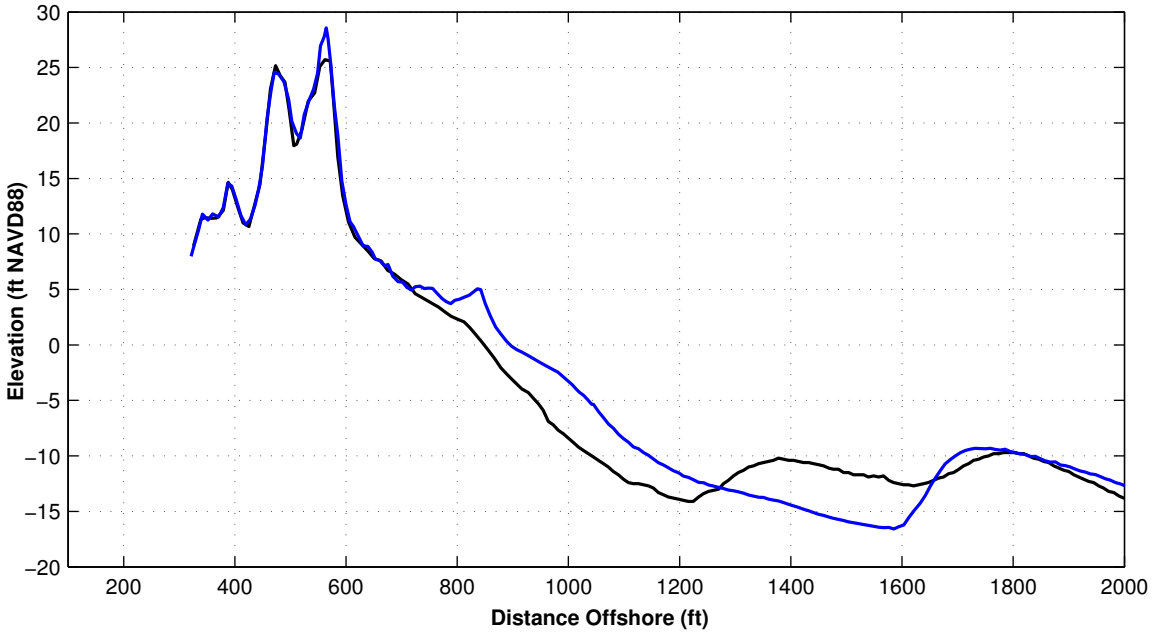
Notes:
1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1170+00 | Pg 31 of 173 | 2024 |
|---|---|---|




| Survey Transect 1180+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 55.42 ft | −16.76 ft |
| Volume Change Above +6 ft NAVD88 | 15.20 cy/ft | −0.32 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 23.17 cy/ft | −3.16 cy/ft |
| Volume Change Above −6 ft NAVD88 | 37.11 cy/ft | −9.48 cy/ft |
| Volume Change Above −14 ft NAVD88 | 64.79 cy/ft | −4.17 cy/ft |
| Volume Change Above −19 ft NAVD88 | 68.05 cy/ft | −17.75 cy/ft |
| Volume Change Above −30 ft NAVD88 | 97.30 cy/ft | −34.56 cy/ft |

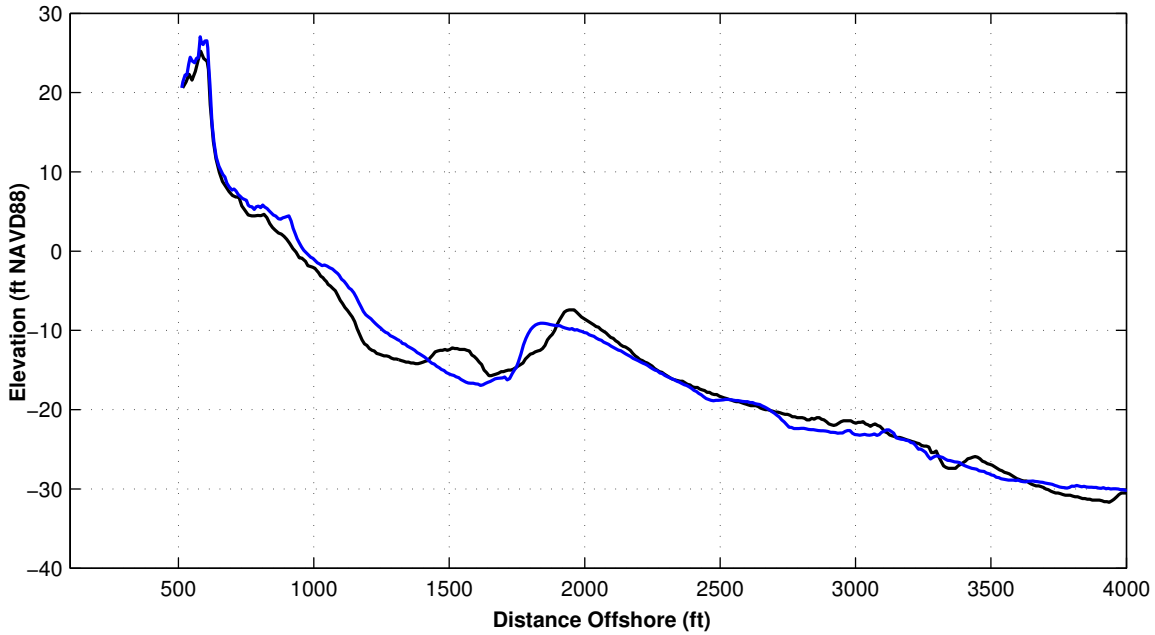
**LEGEND:**

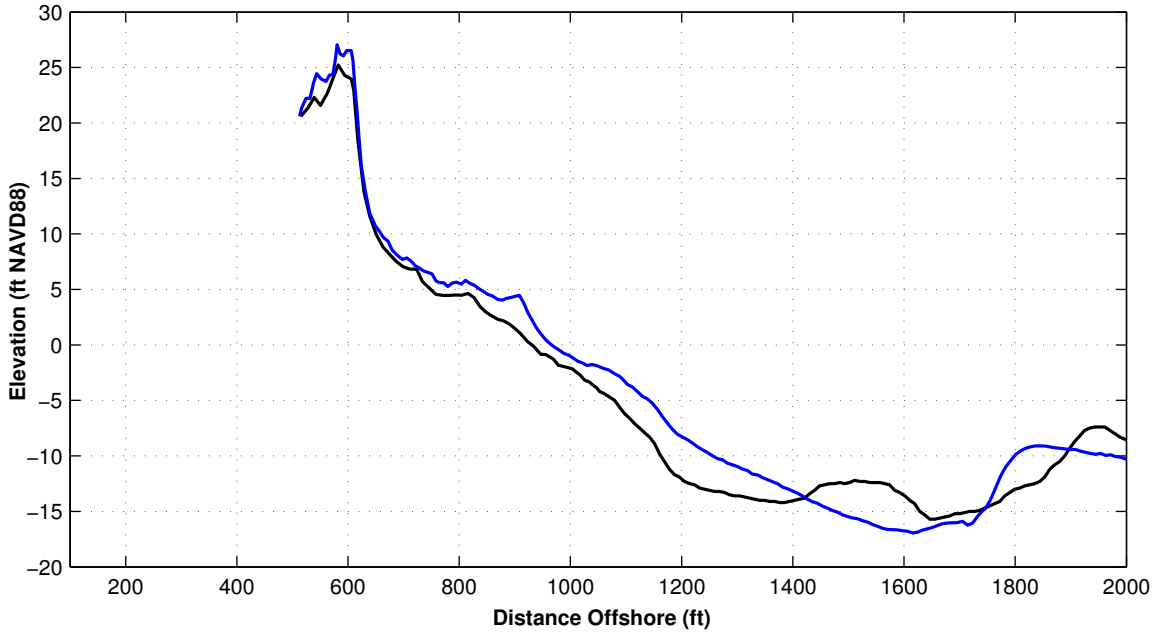
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1190+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | –2.11 ft | 1.58 ft |
| Volume Change Above +6 ft NAVD88 | 1.80 cy/ft | 1.44 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 1.17 cy/ft | 1.83 cy/ft |
| Volume Change Above –6 ft NAVD88 | –5.37 cy/ft | –4.64 cy/ft |
| Volume Change Above –14 ft NAVD88 | –1.25 cy/ft | 20.59 cy/ft |
| Volume Change Above –19 ft NAVD88 | –1.57 cy/ft | 16.63 cy/ft |
| Volume Change Above –30 ft NAVD88 | 29.61 cy/ft | 2.55 cy/ft |

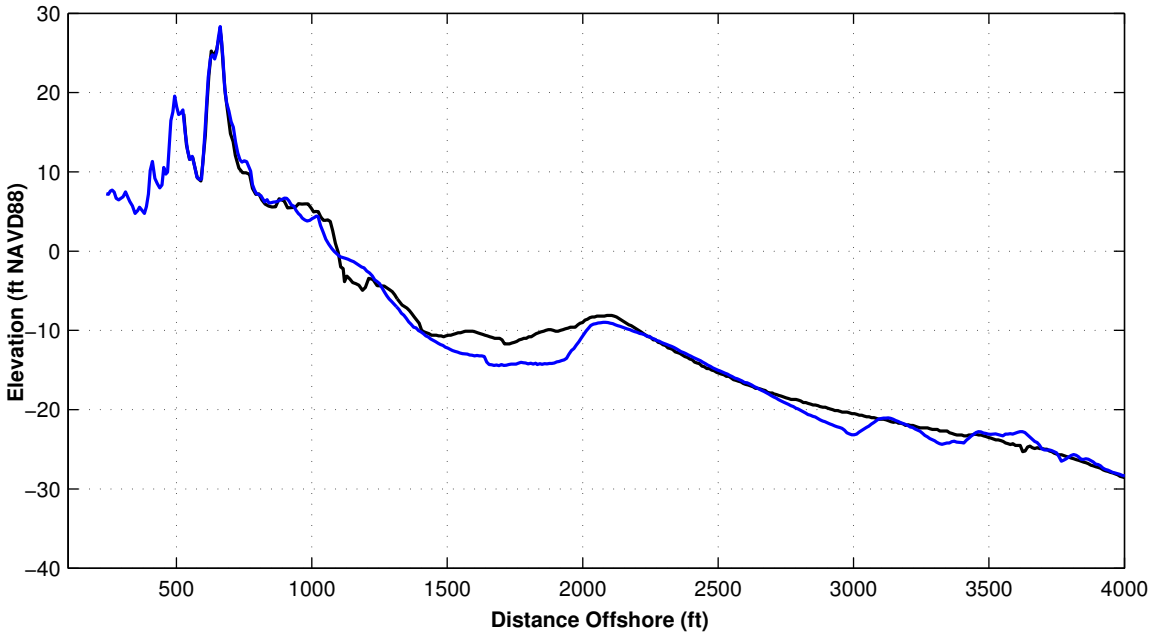
**LEGEND:**

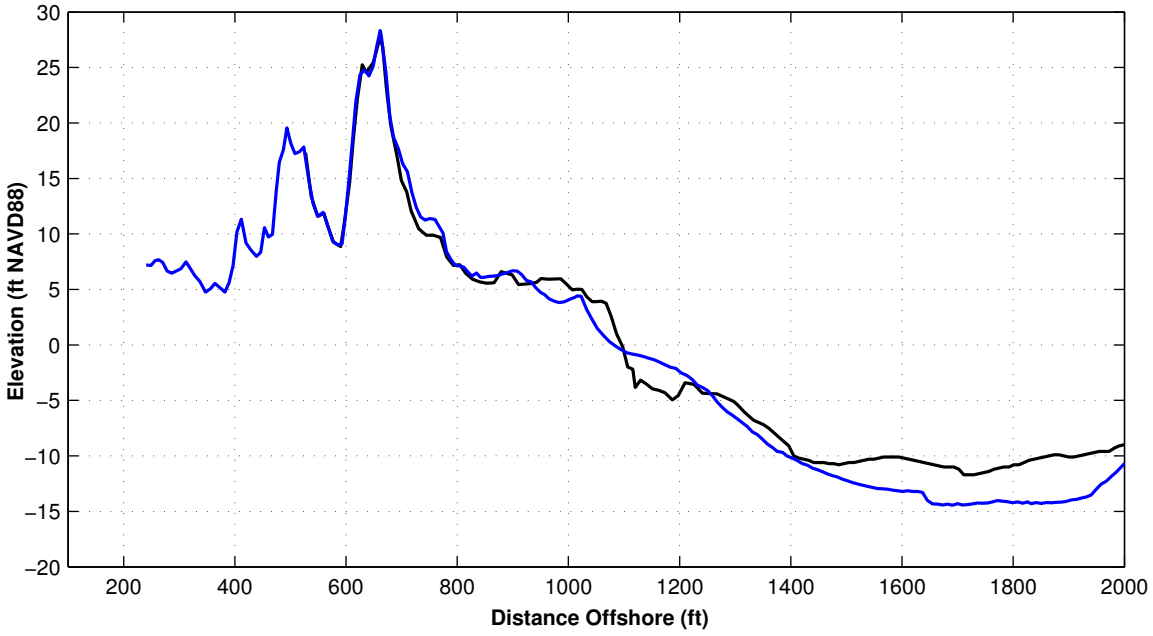
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1200+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 6.42 ft | −23.60 ft |
| Volume Change Above +6 ft NAVD88 | 4.13 cy/ft | 3.29 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.83 cy/ft | −1.67 cy/ft |
| Volume Change Above −6 ft NAVD88 | −2.05 cy/ft | −6.26 cy/ft |
| Volume Change Above −14 ft NAVD88 | 4.60 cy/ft | 14.10 cy/ft |
| Volume Change Above −19 ft NAVD88 | 6.88 cy/ft | 26.31 cy/ft |
| Volume Change Above −30 ft NAVD88 | 37.40 cy/ft | 11.19 cy/ft |

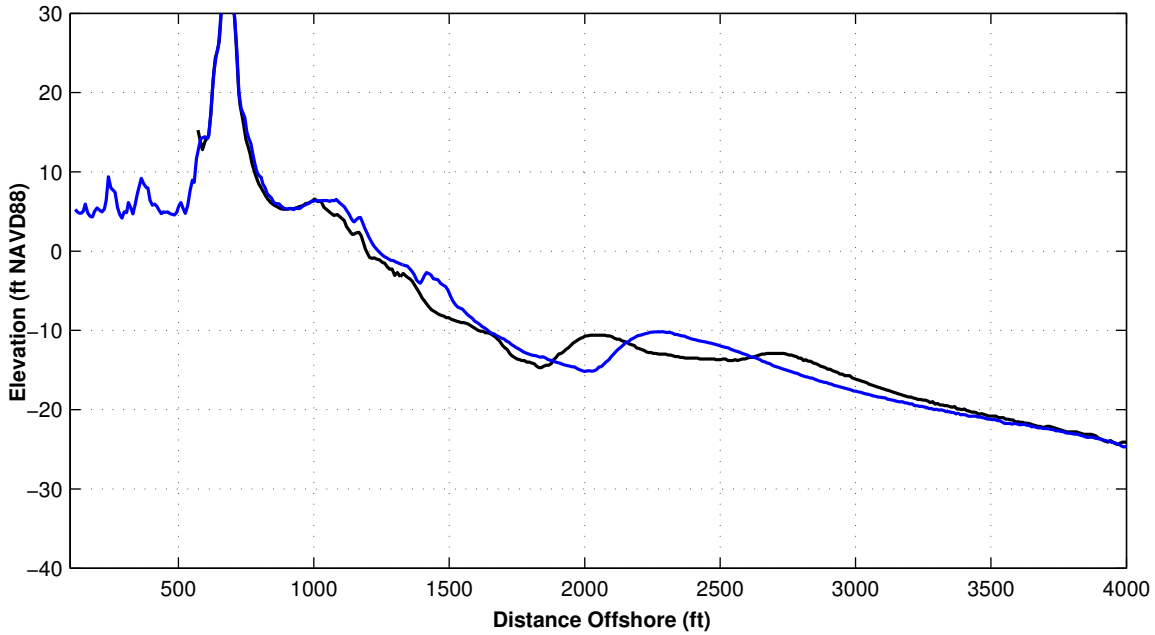
**LEGEND:**

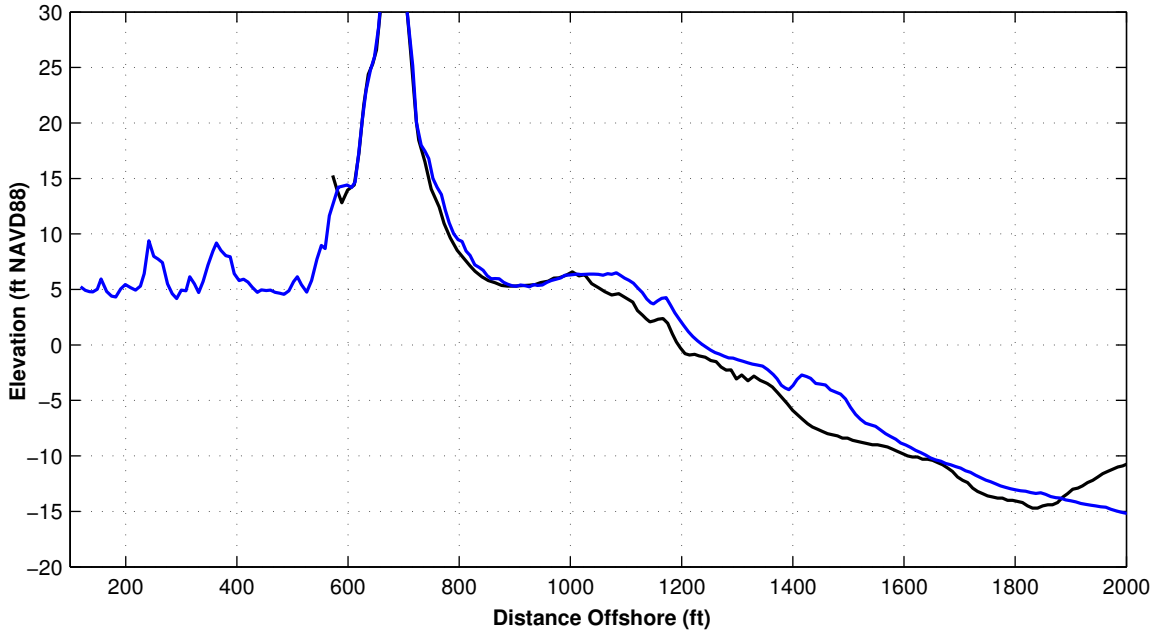
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1210+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −11.89 ft | 6.29 ft |
| Volume Change Above +6 ft NAVD88 | 6.07 cy/ft | 2.83 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 6.88 cy/ft | 2.80 cy/ft |
| Volume Change Above −6 ft NAVD88 | 8.81 cy/ft | 2.51 cy/ft |
| Volume Change Above −14 ft NAVD88 | 27.82 cy/ft | −2.46 cy/ft |
| Volume Change Above −19 ft NAVD88 | 67.64 cy/ft | 2.13 cy/ft |
| Volume Change Above −30 ft NAVD88 | 93.79 cy/ft | −10.92 cy/ft |

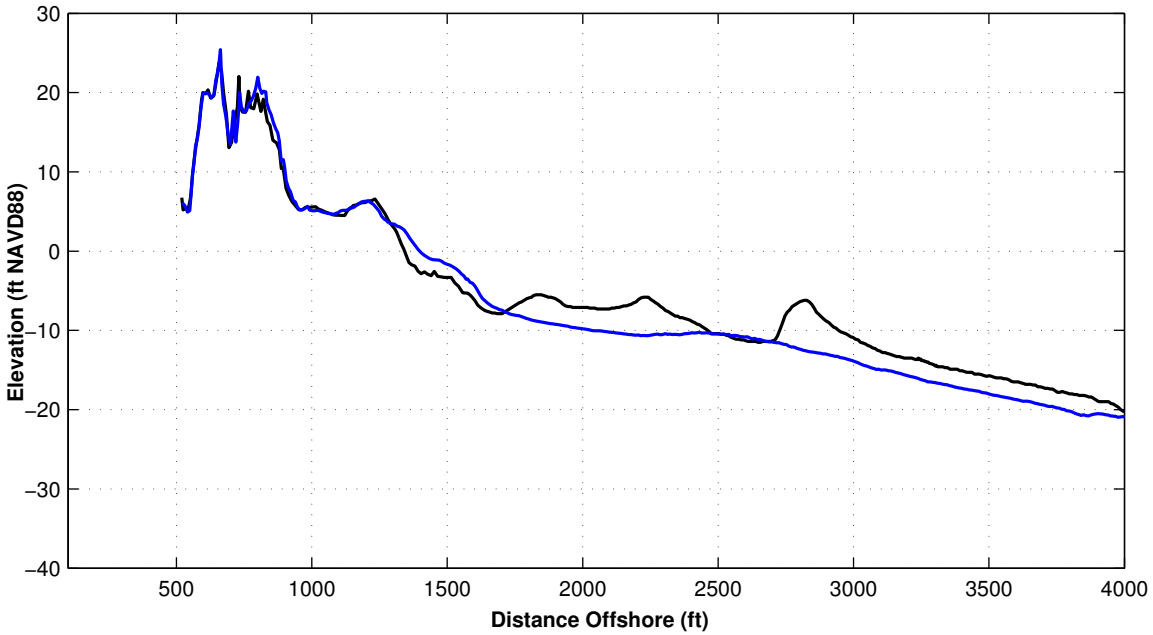
**LEGEND:**

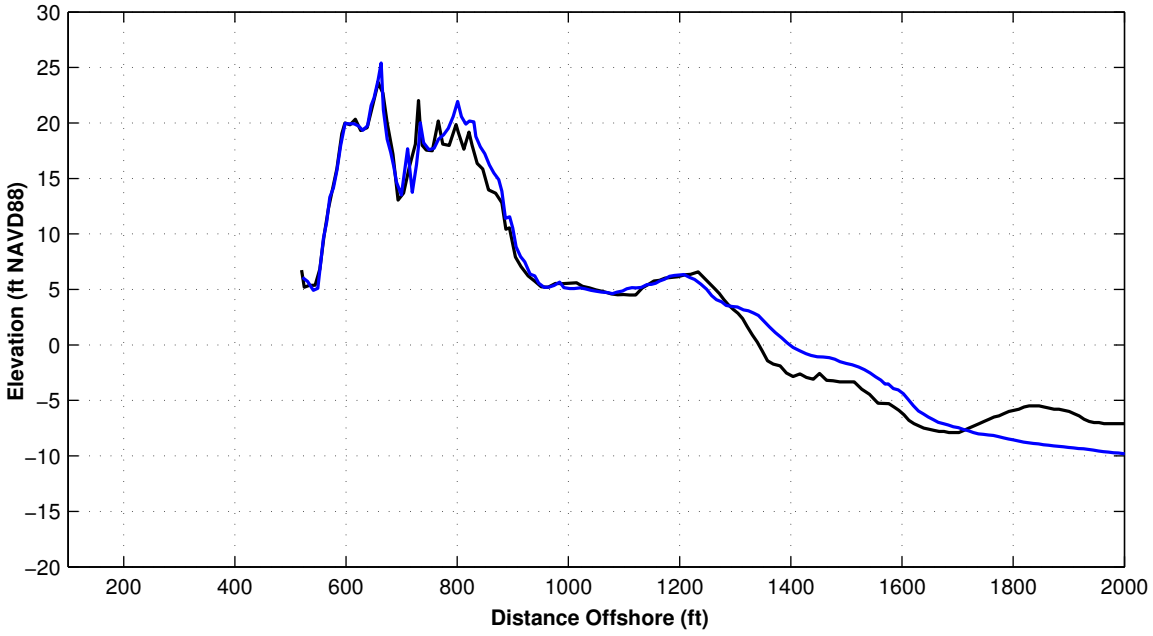
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1220+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 48.31 ft | −10.79 ft |
| Volume Change Above +6 ft NAVD88 | 5.24 cy/ft | 1.44 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 13.69 cy/ft | −2.38 cy/ft |
| Volume Change Above −6 ft NAVD88 | 16.74 cy/ft | −3.27 cy/ft |
| Volume Change Above −14 ft NAVD88 | 32.79 cy/ft | −18.54 cy/ft |
| Volume Change Above −19 ft NAVD88 | 55.22 cy/ft | −41.16 cy/ft |
| Volume Change Above −30 ft NAVD88 | 70.98 cy/ft | −45.31 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

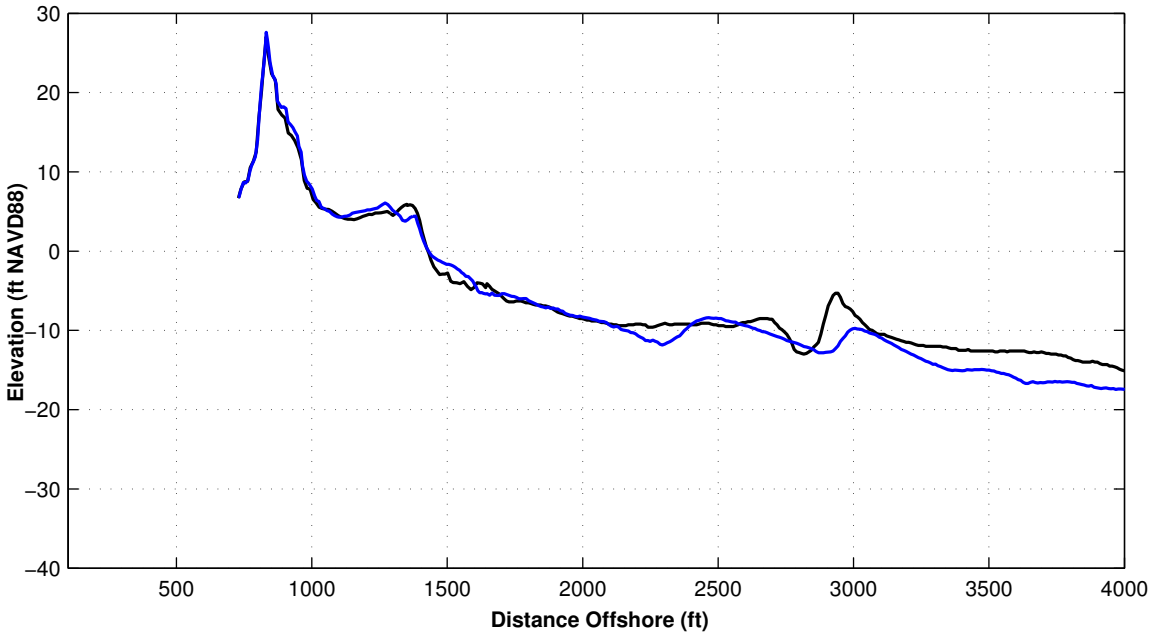
JUNE 2023

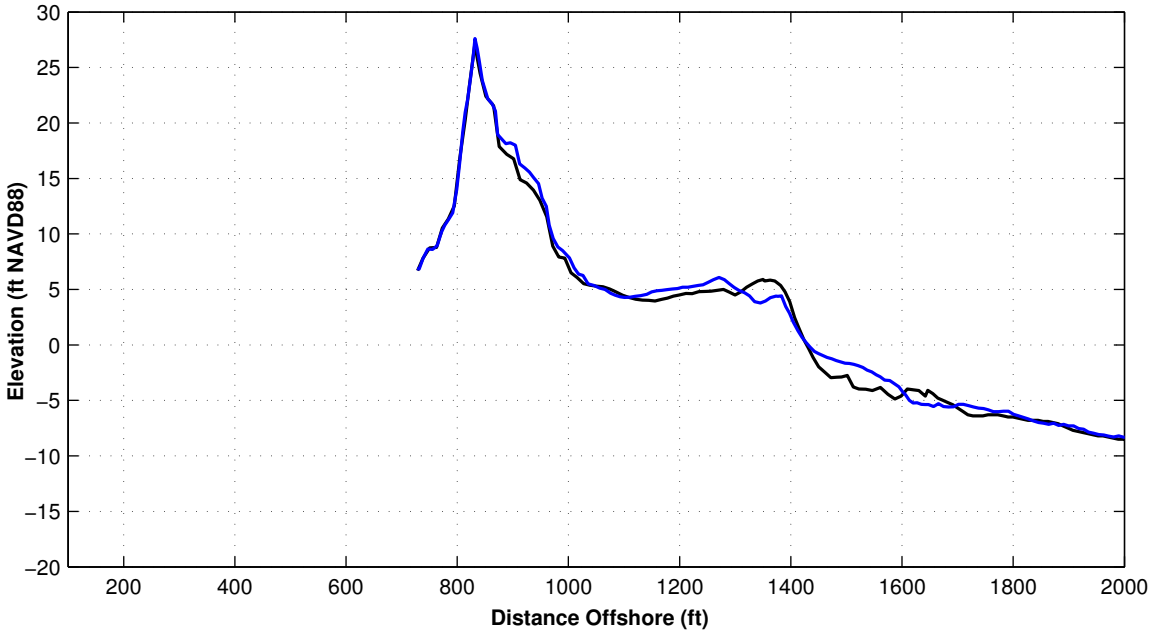
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1220+00 | Pg 36 of 173 | 2024 |
|---|---|---|




| Survey Transect 1230+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 29.36 ft | −23.76 ft |
| Volume Change Above +6 ft NAVD88 | 4.81 cy/ft | 4.49 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 10.29 cy/ft | 0.11 cy/ft |
| Volume Change Above −6 ft NAVD88 | 20.67 cy/ft | −17.06 cy/ft |
| Volume Change Above −14 ft NAVD88 | 25.34 cy/ft | −6.49 cy/ft |
| Volume Change Above −19 ft NAVD88 | 31.92 cy/ft | −18.43 cy/ft |
| Volume Change Above −30 ft NAVD88 | 44.70 cy/ft | −34.30 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

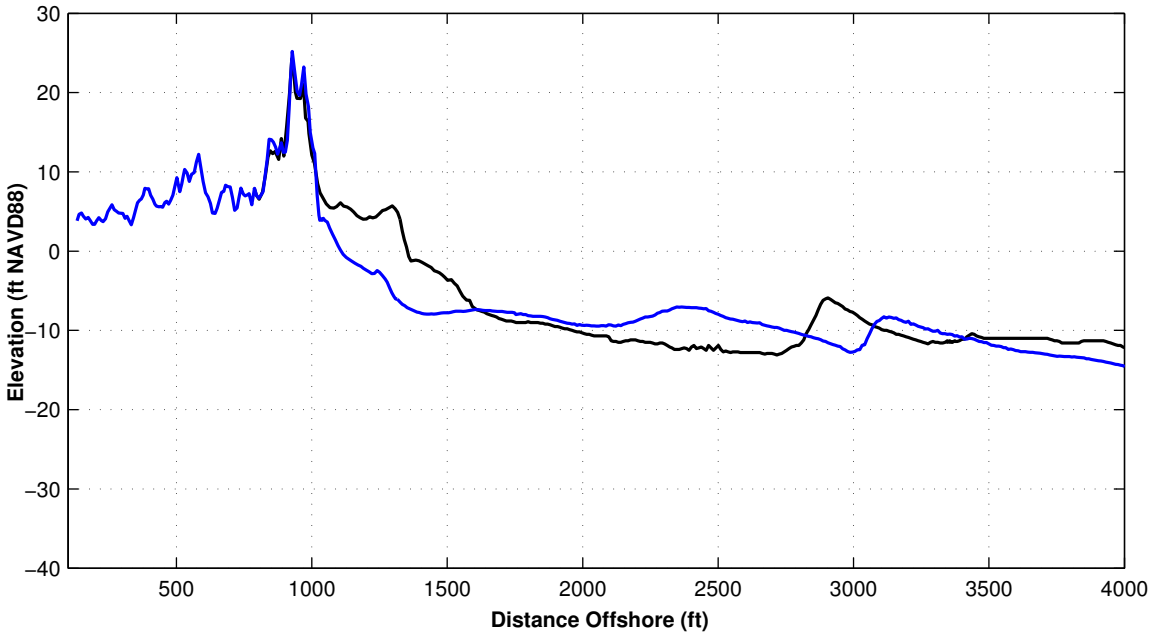
JUNE 2023

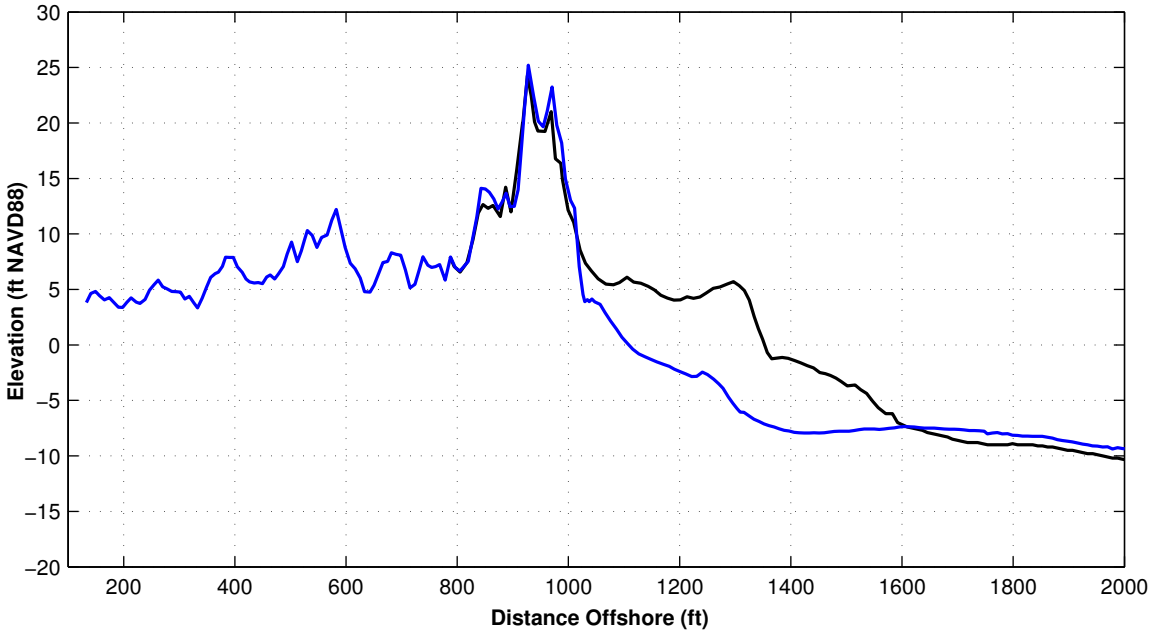
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1230+00 | Pg 37 of 173 | 2024 |
|---|---|---|




| Survey Transect 1240+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −41.70 ft | 7.71 ft |
| Volume Change Above +6 ft NAVD88 | 2.95 cy/ft | 5.40 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −3.91 cy/ft | 7.44 cy/ft |
| Volume Change Above −6 ft NAVD88 | −9.79 cy/ft | 0.33 cy/ft |
| Volume Change Above −14 ft NAVD88 | −20.18 cy/ft | 7.67 cy/ft |
| Volume Change Above −19 ft NAVD88 | 11.26 cy/ft | −6.04 cy/ft |
| Volume Change Above −30 ft NAVD88 | 63.95 cy/ft | −101.22 cy/ft |

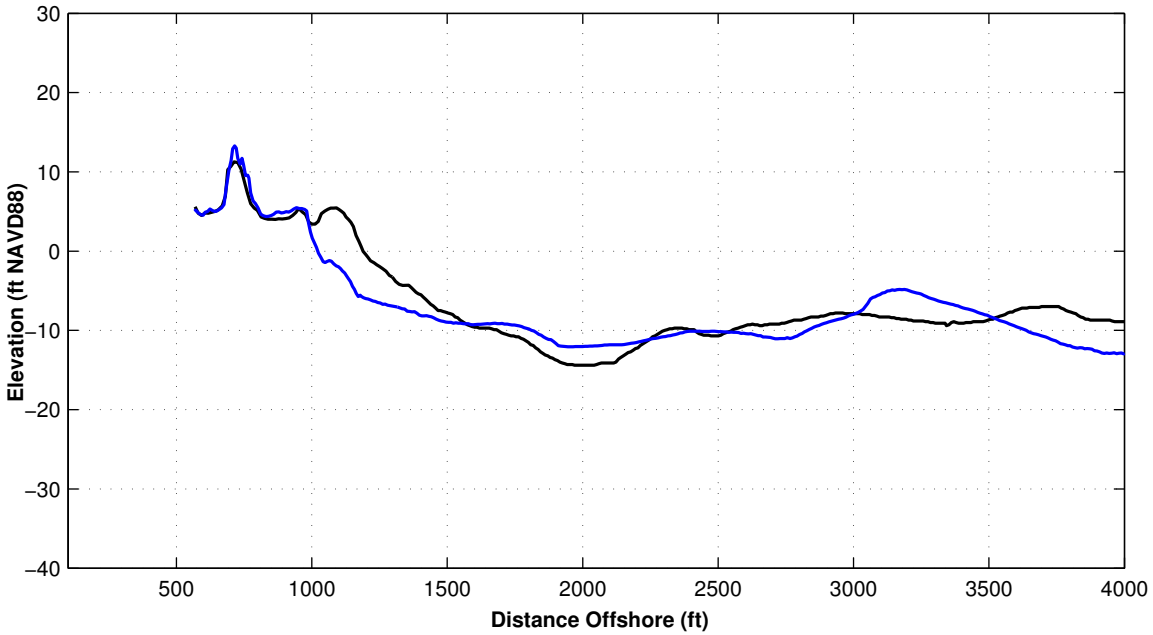
**LEGEND:**

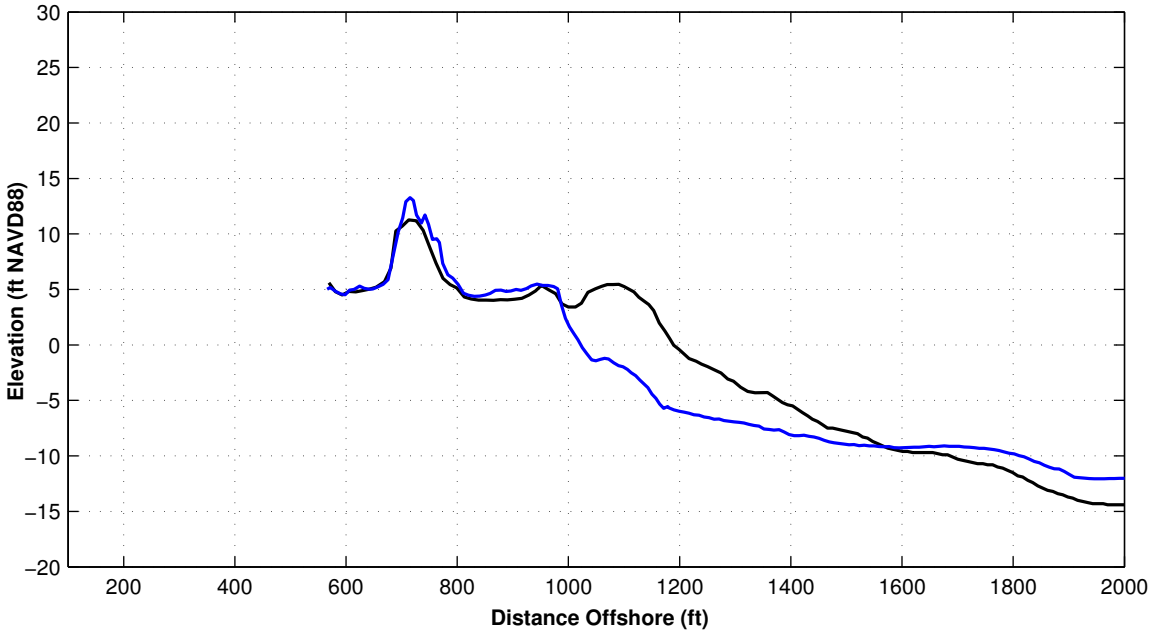
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1250+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −21.55 ft | 8.06 ft |
| Volume Change Above +6 ft NAVD88 | 0.22 cy/ft | 3.83 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −2.61 cy/ft | 5.65 cy/ft |
| Volume Change Above −6 ft NAVD88 | −19.23 cy/ft | 4.11 cy/ft |
| Volume Change Above −14 ft NAVD88 | −29.49 cy/ft | 4.03 cy/ft |
| Volume Change Above −19 ft NAVD88 | −37.94 cy/ft | −15.81 cy/ft |
| Volume Change Above −30 ft NAVD88 | −27.35 cy/ft | 21.22 cy/ft |

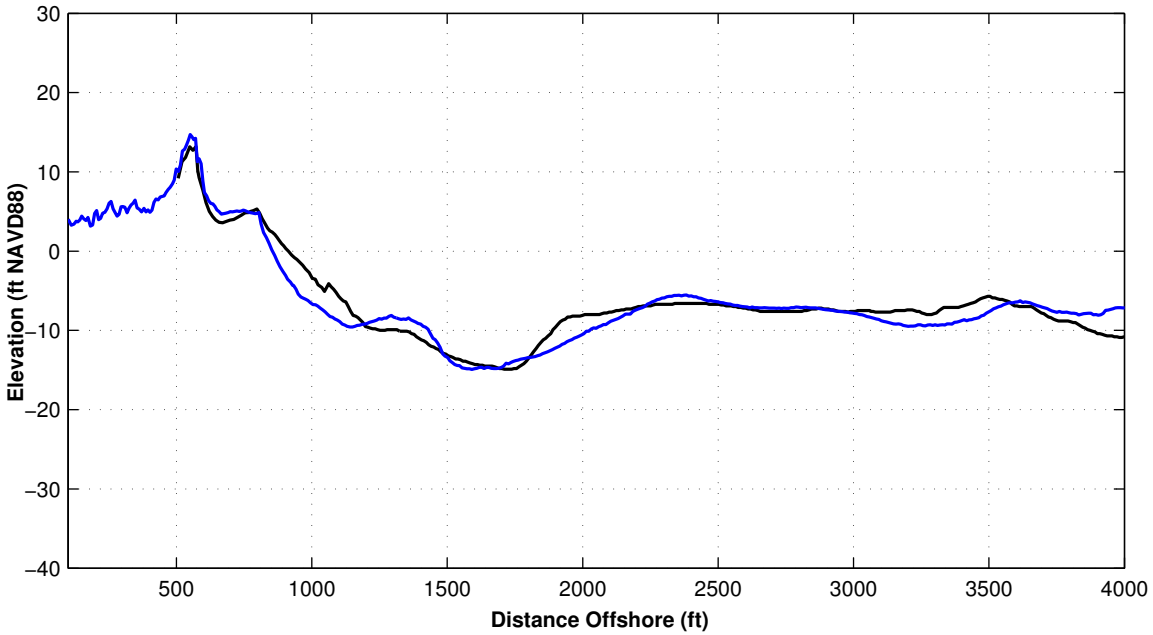
**LEGEND:**

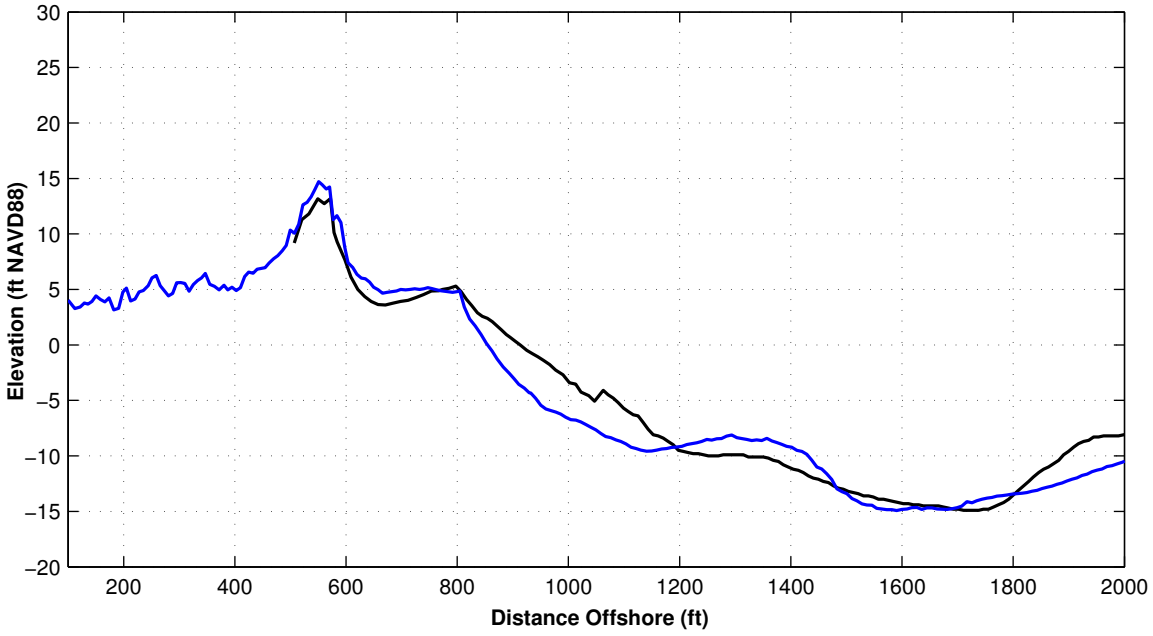
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1260+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −43.38 ft | −4.86 ft |
| Volume Change Above +6 ft NAVD88 | 5.62 cy/ft | 5.06 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 0.91 cy/ft | 3.70 cy/ft |
| Volume Change Above −6 ft NAVD88 | −24.85 cy/ft | 0.28 cy/ft |
| Volume Change Above −14 ft NAVD88 | −43.62 cy/ft | 19.54 cy/ft |
| Volume Change Above −19 ft NAVD88 | −53.81 cy/ft | 22.94 cy/ft |
| Volume Change Above −30 ft NAVD88 | −17.00 cy/ft | −3.73 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

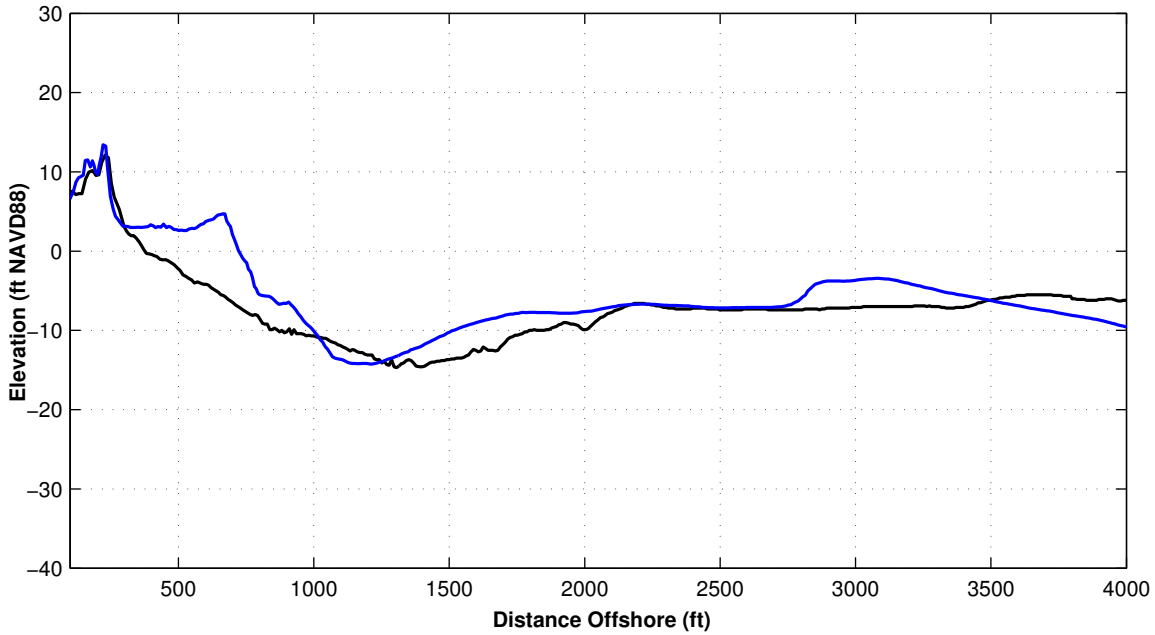
JUNE 2023

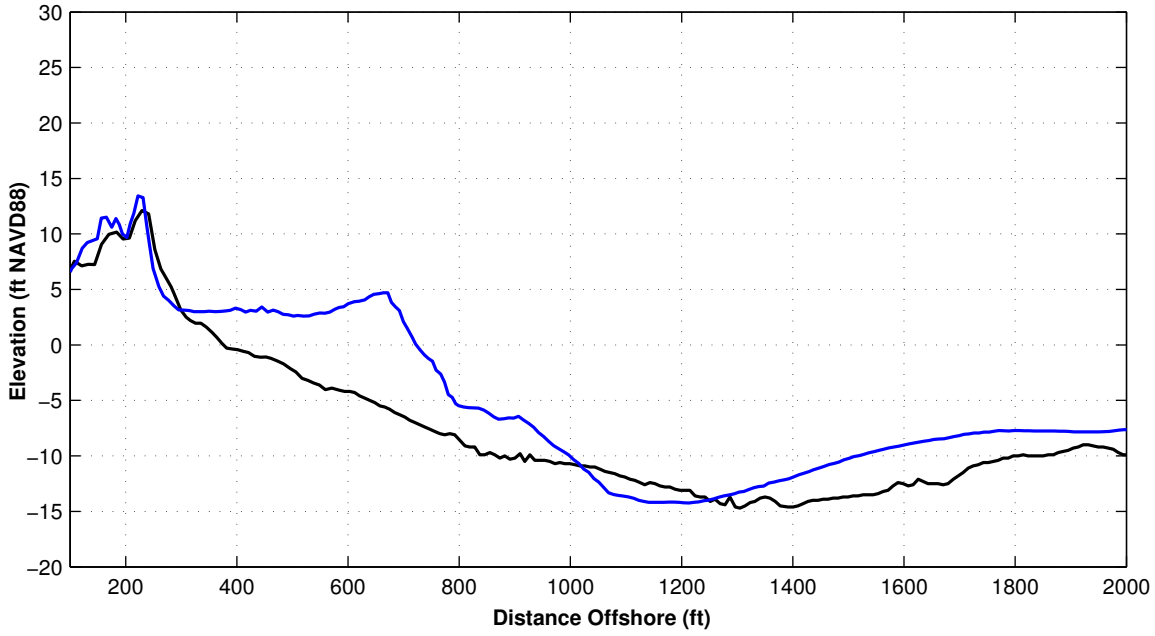
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1260+00 | Pg 40 of 173 | 2024 |
|---|---|---|




| Survey Transect 1270+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | 61.27 ft | −17.50 ft |
| Volume Change Above +6 ft NAVD88 | 16.64 cy/ft | −0.53 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | 26.10 cy/ft | −3.51 cy/ft |
| Volume Change Above −6 ft NAVD88 | 33.01 cy/ft | −7.92 cy/ft |
| Volume Change Above −14 ft NAVD88 | 30.41 cy/ft | −1.61 cy/ft |
| Volume Change Above −19 ft NAVD88 | 13.23 cy/ft | 1.50 cy/ft |
| Volume Change Above −30 ft NAVD88 | 37.98 cy/ft | −12.79 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

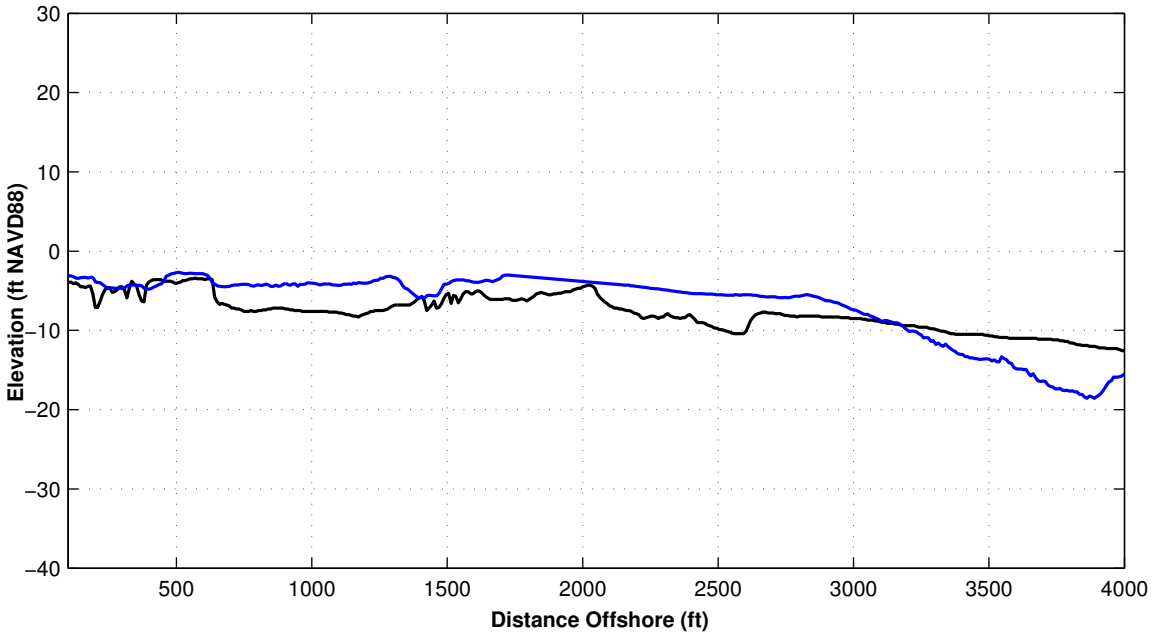
JUNE 2023

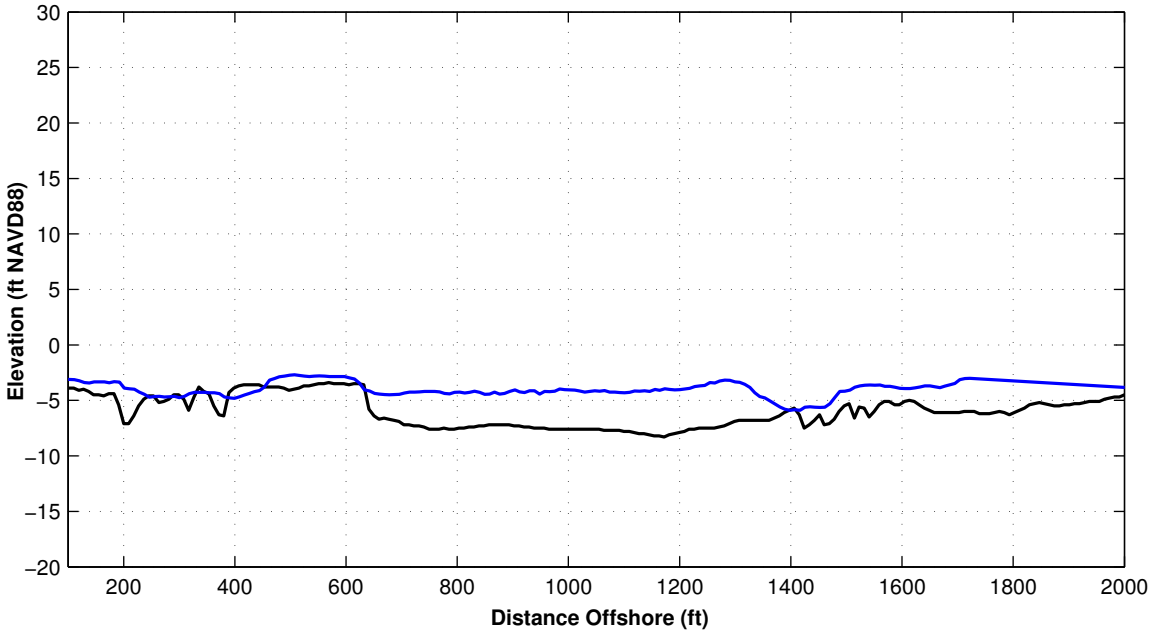
Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

**Town of Nags Head Periodic Surveying Data Analysis**

| ST 1270+00 | Pg 41 of 173 | 2024 |
|---|---|---|




| Survey Transect 1280+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | –10.60 ft | –8.97 ft |
| Volume Change Above +6 ft NAVD88 | 0.69 cy/ft | –1.92 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | –1.72 cy/ft | –3.43 cy/ft |
| Volume Change Above –6 ft NAVD88 | –11.34 cy/ft | –10.15 cy/ft |
| Volume Change Above –14 ft NAVD88 | –11.85 cy/ft | 2.69 cy/ft |
| Volume Change Above –19 ft NAVD88 | –31.55 cy/ft | 24.01 cy/ft |
| Volume Change Above –30 ft NAVD88 | –8.28 cy/ft | 15.08 cy/ft |

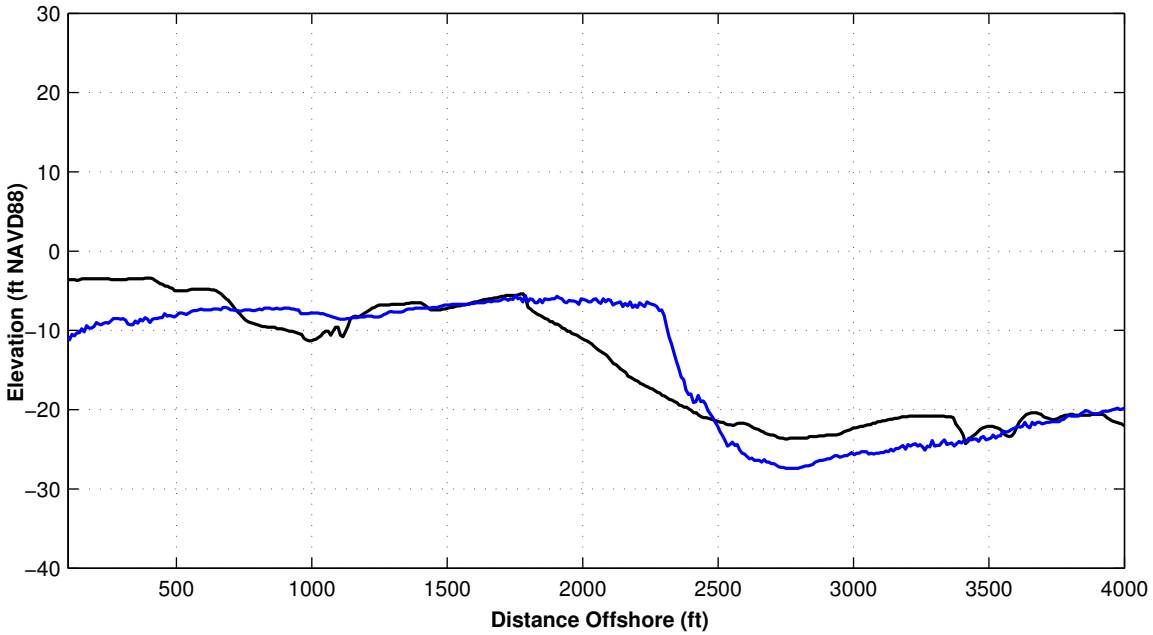
**LEGEND:**

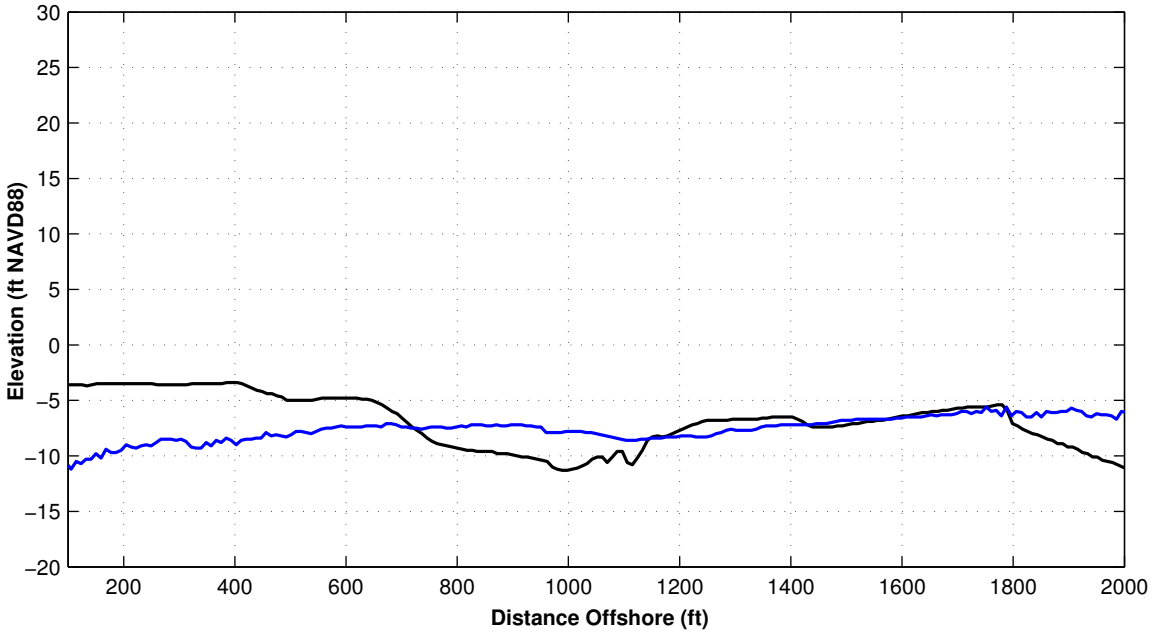
JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.




| Survey Transect 1290+00 | JUNE 2023 – OCTOBER 2023 | OCTOBER 2023 – JUNE 2024 |
|---|---|---|
| Shoreline Change at MHW (1.18 ft NAVD88) | −36.76 ft | 27.40 ft |
| Volume Change Above +6 ft NAVD88 | 1.87 cy/ft | −0.34 cy/ft |
| Volume Change Above 1.18 ft NAVD88 | −2.47 cy/ft | 3.94 cy/ft |
| Volume Change Above −6 ft NAVD88 | −24.01 cy/ft | 14.32 cy/ft |
| Volume Change Above −14 ft NAVD88 | −15.95 cy/ft | 5.22 cy/ft |
| Volume Change Above −19 ft NAVD88 | −41.74 cy/ft | 32.08 cy/ft |
| Volume Change Above −30 ft NAVD88 | −20.01 cy/ft | 26.95 cy/ft |

**LEGEND:**

JUNE 2024 — OCTOBER 2023

JUNE 2023

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

# APPENDIX C
# TABULATED SHORELINE AND VOLUME CHANGE DATA

10979/17

NOTES:
1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.

| Reach | Transect Number | Station | Shoreline Change @ MHW (+1.18 ft NAVD) | Above Berm (+6 ft NAVD88) | | Above MHW (+1.18 ft NAVD88) | | Above -6 ft NAVD88 | | Above -14 ft NAVD88 | | Above -19 ft NAVD88 | | Above -30 ft NAVD88 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) |
| Nags Head - North | 1 | 430+00 | 7.27 | 87.44 | 2.51 | 125.01 | 2.40 | 208.25 | 12.63 | 404.56 | 8.67 | 665.11 | 13.47 | 1538.26 | 28.98 |
| | 2 | 435+00 | -9.18 | 23.57 | 0.73 | 48.00 | -1.09 | 114.50 | 4.58 | 292.90 | 14.21 | 535.19 | 26.81 | 1377.30 | 44.11 |
| | 3 | 440+00 | 30.96 | 41.67 | 6.65 | 69.95 | 11.98 | 135.18 | 21.87 | 318.69 | 31.88 | 561.63 | 36.03 | 1409.39 | 52.72 |
| | 4 | 445+00 | -20.73 | 24.98 | 1.12 | 46.68 | -1.68 | 92.64 | -20.52 | 270.96 | -6.00 | 511.65 | -6.15 | 1354.36 | 16.64 |
| | 5 | 450+00 | 2.19 | 31.47 | 1.40 | 55.73 | 2.21 | 104.32 | -1.87 | 292.99 | 16.33 | 525.35 | 10.57 | 1364.57 | 29.78 |
| | 6 | 455+00 | 38.27 | 44.55 | 8.11 | 71.74 | 14.55 | 127.17 | 20.31 | 320.10 | 29.63 | 558.76 | 27.53 | 1402.46 | 51.57 |
| | 7 | 460+00 | -9.71 | 43.71 | 3.24 | 68.70 | 2.83 | 118.61 | -3.81 | 303.75 | 13.48 | 539.98 | 13.74 | 1379.19 | 33.62 |
| | 8 | 465+00 | 41.55 | 37.67 | 5.91 | 62.98 | 12.99 | 115.01 | 6.75 | 304.06 | 23.62 | 537.31 | 15.66 | 1375.92 | 38.20 |
| | 9 | 470+00 | 20.73 | 45.16 | 4.10 | 76.71 | 7.28 | 147.78 | 17.31 | 332.20 | 10.61 | 567.21 | -2.51 | 1413.61 | 10.78 |
| | 10 | 475+00 | -62.74 | 49.38 | -0.10 | 76.60 | -9.22 | 131.91 | -36.32 | 320.91 | -33.27 | 559.55 | -42.50 | 1410.72 | -27.79 |
| | 11 | 480+00 | 12.12 | 35.43 | 1.72 | 63.01 | 3.10 | 118.92 | 2.77 | 300.72 | 2.51 | 535.97 | -9.74 | 1378.30 | -2.53 |
| | 12 | 485+00 | 19.23 | 60.10 | 3.91 | 91.80 | 5.94 | 154.89 | -6.24 | 348.27 | 13.75 | 590.69 | 17.64 | 1441.82 | 31.13 |
| | 13 | 490+00 | 13.32 | 58.66 | 5.60 | 92.27 | 7.94 | 160.42 | -3.21 | 377.27 | 41.67 | 627.48 | 41.94 | 1479.38 | 52.61 |
| Reach 1 | 14 | 495+00 | -34.16 | 53.30 | 6.45 | 84.28 | 3.77 | 144.95 | -14.61 | 349.71 | 5.77 | 601.12 | 9.28 | 1450.97 | 23.57 |
| | 15 | 500+00 | -17.25 | 44.53 | 4.19 | 74.57 | 3.45 | 135.61 | -18.69 | 332.81 | -9.99 | 566.33 | -25.05 | 1409.52 | -14.90 |
| | 16 | 505+00 | 14.16 | 40.69 | 0.60 | 69.05 | 2.51 | 133.80 | 7.55 | 329.85 | 31.10 | 571.34 | 30.37 | 1417.38 | 41.53 |
| | 17 | 510+00 | -6.22 | 29.82 | -0.97 | 61.23 | -0.83 | 123.30 | -23.39 | 326.93 | -7.35 | 535.56 | 9.91 | 1377.60 | 21.12 |
| | 18 | 515+00 | 42.23 | 51.38 | 5.79 | 86.81 | 13.80 | 158.65 | 26.12 | 372.96 | 69.98 | 616.37 | 73.62 | 1465.86 | 73.98 |
| | 19 | 520+00 | -16.61 | 46.38 | 3.08 | 81.30 | 2.62 | 159.70 | -3.49 | 383.94 | 30.32 | 632.80 | 39.49 | 1477.62 | 40.77 |
| | 20 | 525+00 | -9.30 | 21.25 | 0.52 | 53.97 | 0.34 | 118.26 | -6.86 | 335.98 | -0.53 | 577.64 | -10.46 | 1414.15 | -6.40 |
| | 21 | 530+00 | -22.93 | 26.52 | -0.36 | 56.21 | -3.63 | 122.45 | -20.62 | 337.34 | -11.97 | 582.23 | -16.79 | 1415.20 | -14.68 |
| | 22 | 535+00 | -18.79 | 35.66 | -0.24 | 67.07 | -2.11 | 129.55 | -19.30 | 318.35 | -36.83 | 561.92 | -43.20 | 1401.41 | -40.53 |
| | 23 | 540+00 | -29.42 | 42.08 | -1.98 | 73.44 | -3.82 | 135.94 | -16.99 | 337.76 | -18.78 | 585.89 | -17.73 | 1431.69 | -13.17 |
| | 24 | 545+00 | -19.34 | 42.90 | 2.52 | 75.12 | 1.59 | 142.38 | -5.35 | 354.78 | 12.26 | 598.81 | 15.71 | 1440.92 | 20.61 |
| | 25 | 550+00 | -1.65 | 21.91 | 2.66 | 48.81 | 3.98 | 117.17 | 13.62 | 315.16 | 15.76 | 552.00 | 20.48 | 1377.24 | 30.46 |
| | 26 | 555+00 | -8.79 | 27.11 | 1.43 | 55.60 | 1.16 | 119.35 | -4.98 | 316.76 | -0.43 | 554.52 | 4.93 | 1379.93 | 15.90 |
| | 27 | 560+00 | 10.10 | 18.42 | 1.82 | 44.71 | 5.35 | 104.01 | 3.60 | 298.93 | 0.65 | 535.74 | 8.18 | 1354.17 | 20.48 |
| | 28 | 565+00 | 12.45 | 26.86 | 2.99 | 54.46 | 6.21 | 116.08 | 5.26 | 320.64 | 20.82 | 558.07 | 29.09 | 1381.25 | 38.55 |
| | 29 | 570+00 | 7.36 | 27.00 | 0.90 | 53.66 | 3.90 | 113.05 | 1.41 | 307.66 | -11.46 | 545.49 | -4.53 | 1375.48 | 3.19 |
| | 30 | 575+00 | -3.54 | 12.79 | -0.37 | 35.62 | 1.88 | 87.67 | -1.64 | 279.76 | 1.92 | 514.36 | 8.93 | 1340.37 | 20.59 |
| | 31 | 580+00 | -25.93 | 21.45 | 0.98 | 42.71 | -3.25 | 93.00 | -11.07 | 270.39 | -18.22 | 506.46 | -9.84 | 1332.04 | 4.28 |
| | 32 | 585+00 | 7.74 | 16.13 | -1.49 | 43.54 | 2.04 | 103.78 | 3.80 | 297.12 | -3.16 | 534.13 | 2.02 | 1358.69 | 22.05 |
| | 33 | 590+00 | -9.49 | 12.04 | -0.63 | 37.72 | -3.56 | 93.65 | -8.40 | 283.64 | -29.28 | 521.91 | -25.07 | 1342.14 | -9.32 |
| | 34 | 595+00 | -2.44 | 19.78 | 0.65 | 46.48 | -0.85 | 104.15 | -1.66 | 306.38 | -21.51 | 545.93 | -18.83 | 1366.78 | -2.50 |
| | 35 | 600+00 | 6.51 | 71.83 | 2.80 | 108.50 | 3.77 | 180.68 | 1.09 | 398.15 | -27.60 | 653.45 | -24.70 | 1502.76 | -11.11 |
| | 36 | 605+00 | 34.23 | 30.53 | 4.80 | 60.76 | 12.33 | 122.53 | 16.47 | 320.38 | 9.12 | 557.53 | 0.56 | 1391.12 | 21.52 |
| | 37 | 610+00 | 32.20 | 31.96 | 3.89 | 59.58 | 11.63 | 115.89 | 10.38 | 319.48 | 37.91 | 566.13 | 35.93 | 1395.76 | 55.37 |
| | 38 | 615+00 | 31.13 | 37.33 | 2.83 | 67.75 | 10.37 | 130.62 | 11.41 | 335.18 | 13.74 | 592.18 | 16.81 | 1429.37 | 41.73 |
| | 39 | 620+00 | 55.42 | 42.07 | 15.20 | 79.06 | 23.17 | 165.63 | 37.11 | 380.34 | 64.79 | 633.70 | 68.05 | 1472.54 | 97.30 |
| | 40 | 625+00 | -2.11 | 40.56 | 1.80 | 72.99 | 1.17 | 139.72 | -5.37 | 351.50 | -1.25 | 601.68 | -1.57 | 1442.58 | 29.61 |
| | 41 | 630+00 | 6.42 | 51.99 | 4.13 | 85.40 | 6.83 | 154.05 | -2.05 | 371.92 | 4.60 | 631.21 | 6.88 | 1474.20 | 37.40 |
| | 42 | 635+00 | -11.89 | 36.12 | 6.07 | 67.50 | 6.88 | 145.60 | 8.81 | 347.57 | 27.82 | 622.36 | 67.64 | 1445.18 | 93.79 |
| | 43 | 640+00 | 48.31 | 58.52 | 5.24 | 100.28 | 13.69 | 190.90 | 16.74 | 403.14 | 32.79 | 656.67 | 55.22 | 1452.04 | 70.98 |
| | 44 | 645+00 | 29.36 | 57.86 | 4.81 | 97.86 | 10.29 | 187.57 | 20.67 | 408.63 | 25.35 | 658.48 | 31.92 | 1407.24 | 44.70 |
| | 45 | 650+00 | -41.70 | 54.32 | 2.95 | 84.21 | -3.91 | 160.97 | -9.79 | 358.51 | -20.18 | 618.36 | 11.26 | 1479.04 | 63.95 |
| | 46 | 655+00 | -21.55 | 36.21 | 0.22 | 63.29 | -2.61 | 122.53 | -19.23 | 308.61 | -29.49 | 542.79 | -37.94 | 1371.46 | -27.35 |
| | 47 | 660+00 | -43.38 | 54.06 | 5.62 | 80.12 | 0.91 | 134.08 | -24.85 | 330.70 | -43.62 | 572.55 | -53.81 | 1374.69 | -17.00 |
| | 48 | 665+00 | 61.27 | 68.91 | 16.64 | 107.68 | 26.10 | 186.50 | 33.01 | 381.08 | 30.41 | 622.27 | 13.23 | 1434.78 | 37.98 |
| | 49 | 670+00 | -10.60 | 36.04 | 0.69 | 62.83 | -1.72 | 121.27 | -11.34 | 313.87 | -11.85 | 545.59 | -31.55 | 1349.23 | -8.27 |
| | 50 | 675+00 | -36.76 | 3.26 | 1.87 | 14.10 | -2.47 | 44.53 | -24.01 | 200.00 | -15.95 | 403.61 | -41.74 | 1173.25 | -20.01 |
| | 51 | 680+00 | 62.71 | 51.11 | 5.87 | 85.55 | 13.96 | 171.02 | 36.59 | 360.17 | 40.06 | 581.84 | 28.16 | 1397.51 | 48.16 |
| | 52 | 685+00 | -24.87 | 44.69 | 3.47 | 73.90 | 1.29 | 137.31 | -10.86 | 330.72 | 0.56 | 561.34 | -16.74 | 1385.81 | 1.80 |
| | 53 | 690+00 | 22.14 | 51.37 | 2.35 | 79.51 | 5.20 | 145.69 | 5.54 | 339.65 | 7.30 | 565.35 | -18.20 | 1385.30 | -1.22 |
| | 54 | 695+00 | -49.04 | 50.85 | 0.42 | 75.44 | -8.28 | 133.91 | -19.45 | 326.53 | -22.99 | 554.68 | -48.51 | 1374.32 | -27.44 |
| | 55 | 700+00 | 38.88 | 49.13 | -0.86 | 82.94 | 4.13 | 150.51 | 7.42 | 332.84 | 9.94 | 548.44 | -15.15 | 1358.98 | 3.64 |
| | 56 | 705+00 | 8.09 | 46.52 | 1.87 | 74.49 | 3.66 | 134.50 | -6.74 | 329.25 | 14.36 | 538.37 | -19.11 | 1345.37 | -5.99 |
| | 57 | 710+00 | 3.96 | 44.13 | -1.04 | 70.05 | -1.00 | 123.41 | -10.59 | 311.90 | 7.62 | 542.71 | 3.04 | 1346.90 | 17.03 |
| | 58 | 715+00 | 31.14 | 52.04 | 1.67 | 87.13 | 8.27 | 159.00 | 3.08 | 353.35 | 30.64 | 580.43 | 8.01 | 1384.52 | 21.05 |
| | 59 | 720+00 | -40.56 | 57.18 | 1.22 | 90.72 | -3.17 | 160.68 | -21.99 | 361.49 | -36.92 | 591.58 | -60.27 | 1398.69 | -43.53 |
| | 60 | 725+00 | -41.03 | 37.67 | 3.69 | 65.78 | -2.31 | 126.39 | -15.61 | 317.57 | -14.36 | 551.05 | -26.02 | 1346.77 | -10.93 |
| | 61 | 730+00 | 62.85 | 45.67 | 1.91 | 80.05 | 9.56 | 157.79 | 28.44 | 364.56 | 33.05 | 591.27 | 7.07 | 1391.67 | 22.32 |
| | 62 | 735+00 | 60.32 | 35.04 | 2.42 | 68.41 | 12.00 | 138.30 | 22.78 | 352.28 | 51.40 | 578.62 | 28.57 | 1377.70 | 50.41 |
| | 63 | 740+00 | 31.51 | 43.80 | 0.23 | 78.12 | 4.90 | 146.24 | 4.73 | 343.77 | -7.01 | 584.10 | -13.98 | 1413.34 | -2.52 |
| | 64 | 745+00 | -12.58 | 55.92 | 0.12 | 95.59 | -1.60 | 173.45 | -23.90 | 372.64 | -29.72 | 606.27 | -21.19 | 1436.87 | -4.23 |
| | 65 | 750+00 | -43.77 | 73.02 | -1.69 | 114.48 | -7.67 | 195.62 | -33.36 | 403.86 | -99.84 | 640.73 | -125.98 | 1477.73 | -108.10 |
| | 66 | 755+00 | 2.31 | 68.01 | 2.17 | 111.51 | 4.15 | 196.68 | 0.47 | 411.89 | -28.04 | 653.20 | -41.38 | 1484.75 | -21.14 |
| | 67 | 760+00 | 36.54 | 46.52 | 0.36 | 93.01 | 6.45 | 179.52 | 10.79 | 402.38 | -12.86 | 661.38 | -8.27 | 1493.72 | 14.42 |
| | 68 | 765+00 | 51.50 | 25.29 | 3.10 | 62.77 | 13.15 | 135.39 | 19.95 | 357.63 | 26.67 | 613.11 | 37.32 | 1424.05 | 53.72 |
| | 69 | 770+00 | 35.08 | 42.95 | 3.27 | 83.54 | 13.48 | 171.52 | 26.12 | 413.71 | 34.80 | 668.52 | 37.51 | 1497.65 | 51.90 |
| | 70 | 775+00 | 5.86 | 63.97 | 3.47 | 105.36 | 4.66 | 205.66 | 1.89 | 434.48 | -13.72 | 654.51 | -53.28 | 1480.62 | -39.91 |
| | 71 | 780+00 | 27.15 | 26.10 | 2.94 | 71.60 | 6.52 | 174.60 | 21.09 | 413.82 | 14.22 | 687.09 | 29.15 | 1503.49 | 41.41 |
| | 72 | 785+00 | 45.79 | 45.68 | 2.85 | 93.79 | 8.83 | 187.60 | 9.31 | 410.36 | -23.95 | 681.26 | -22.07 | 1506.96 | -11.98 |

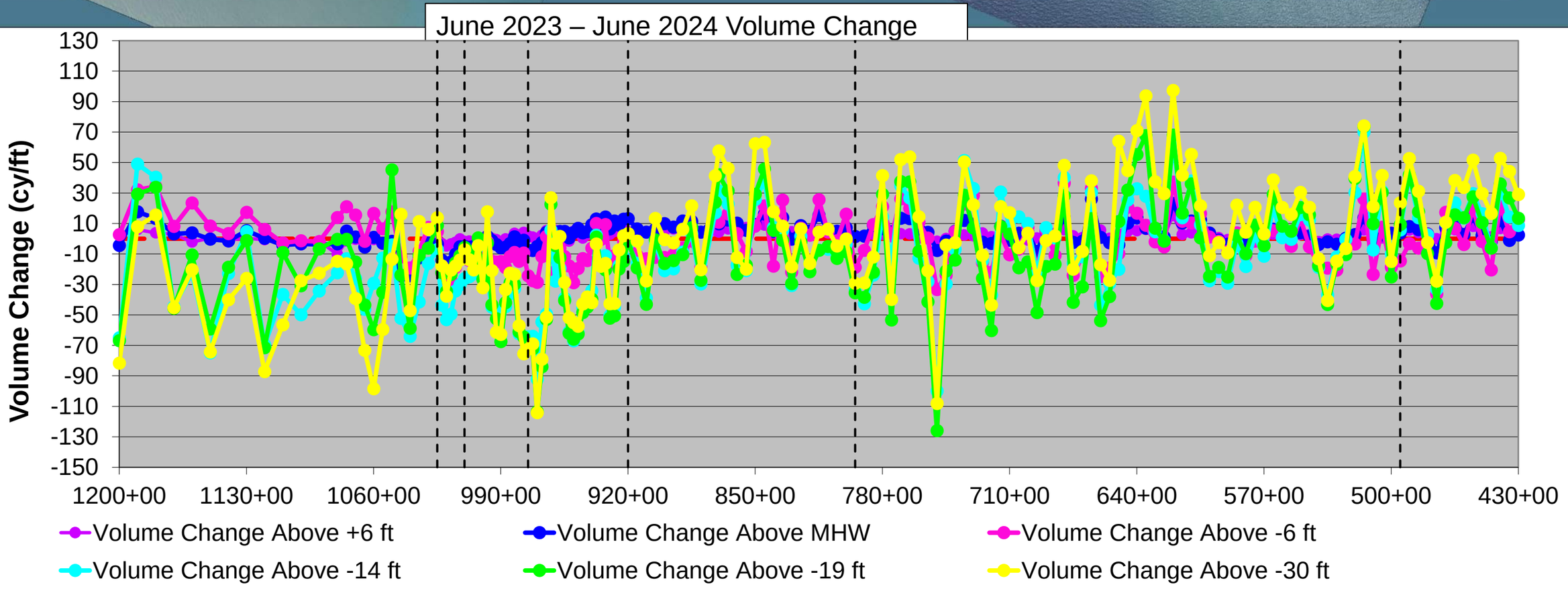
| Reach | Transect Number | Station | Shoreline Change @ MHW (+1.18 ft NAVD) | Above Berm (+6 ft NAVD88) | | Above MHW (+1.18 ft NAVD88) | | Above -6 ft NAVD88 | | Above -14 ft NAVD88 | | Above -19 ft NAVD88 | | Above -30 ft NAVD88 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) |
| Reach 2 | 73 | 790+00 | 5.93 | 5.32 | 1.04 | 33.51 | 1.74 | 94.04 | -7.60 | 291.07 | -42.66 | 540.07 | -38.41 | 1324.21 | -28.98 |
| | 74 | 795+00 | 0.71 | 57.28 | 0.61 | 95.87 | 1.53 | 168.30 | -18.68 | 382.14 | -33.05 | 638.46 | -35.45 | 1451.58 | -29.26 |
| | 75 | 800+00 | 16.82 | 23.57 | 2.21 | 63.70 | 7.12 | 150.21 | 16.09 | 354.17 | -3.70 | 600.97 | -8.60 | 1395.20 | -0.13 |
| | 76 | 805+00 | 8.05 | 45.29 | 3.04 | 82.25 | 4.87 | 151.98 | -1.37 | 364.96 | -11.33 | 615.29 | -12.93 | 1409.55 | -4.82 |
| | 77 | 810+00 | -1.86 | 62.18 | 4.51 | 98.04 | 6.19 | 182.08 | 4.40 | 384.32 | -6.91 | 637.80 | -5.08 | 1433.44 | 6.29 |
| | 78 | 815+00 | 72.97 | 54.34 | 5.36 | 95.49 | 15.42 | 186.64 | 25.59 | 367.11 | -7.44 | 617.66 | -7.57 | 1408.74 | 4.49 |
| | 79 | 820+00 | 10.62 | 50.21 | 2.81 | 91.48 | 5.16 | 175.74 | 2.30 | 375.56 | -15.78 | 624.96 | -21.66 | 1421.19 | -16.20 |
| | 80 | 825+00 | 27.16 | 47.27 | 4.85 | 79.82 | 8.53 | 152.64 | 6.90 | 352.05 | 1.58 | 599.93 | -2.23 | 1388.78 | 6.44 |
| | 81 | 830+00 | -45.40 | 43.03 | 4.50 | 69.90 | -0.23 | 128.08 | -21.88 | 318.91 | -30.72 | 572.26 | -29.52 | 1356.46 | -18.35 |
| | 82 | 835+00 | 66.19 | 22.28 | 3.79 | 55.78 | 13.92 | 130.90 | 25.31 | 306.20 | 5.36 | 543.27 | -1.16 | 1301.26 | 8.26 |
| | 83 | 840+00 | 0.89 | 33.05 | 3.65 | 60.95 | 4.83 | 117.37 | -18.03 | 322.74 | 7.35 | 561.11 | 5.55 | 1321.23 | 17.83 |
| | 84 | 845+00 | 33.35 | 59.97 | 8.92 | 106.59 | 16.28 | 205.46 | 21.44 | 420.54 | 37.39 | 675.10 | 45.75 | 1448.83 | 63.29 |
| | 85 | 850+00 | -0.67 | 28.00 | 7.63 | 56.90 | 9.26 | 132.54 | 8.42 | 332.19 | 25.72 | 575.96 | 29.17 | 1302.12 | 62.32 |
| | 86 | 855+00 | -41.02 | 51.14 | 7.25 | 87.94 | 5.45 | 172.18 | -8.31 | 378.90 | -20.95 | 633.69 | -17.32 | 1416.37 | -20.06 |
| | 87 | 860+00 | -1.25 | 36.11 | 8.22 | 73.94 | 10.21 | 158.17 | 3.41 | 363.00 | -17.40 | 602.59 | -23.46 | 1357.33 | -12.40 |
| | 88 | 865+00 | 10.39 | 51.56 | 6.40 | 94.20 | 12.24 | 189.75 | 16.29 | 403.63 | 22.77 | 655.30 | 31.42 | 1418.91 | 46.15 |
| | 89 | 870+00 | 23.53 | 45.67 | 4.33 | 88.08 | 9.76 | 178.38 | 10.77 | 388.10 | 31.37 | 641.15 | 42.03 | 1401.07 | 57.63 |
| | 90 | 872+00 | 33.74 | 33.69 | 5.32 | 73.96 | 13.76 | 153.10 | 11.94 | 352.19 | 16.92 | 597.74 | 23.98 | 1348.07 | 41.27 |
| | 91 | 880+00 | -21.33 | 44.75 | 4.20 | 82.34 | 4.27 | 151.88 | -18.69 | 361.63 | -29.72 | 609.81 | -27.32 | 1367.67 | -20.41 |
| | 92 | 885+00 | -6.44 | 47.26 | 7.17 | 87.60 | 11.45 | 166.75 | -1.55 | 385.72 | 3.25 | 636.32 | 7.24 | 1422.46 | 21.53 |
| | 93 | 890+00 | -7.56 | 43.27 | 7.46 | 84.41 | 11.61 | 160.83 | -6.01 | 376.08 | -8.81 | 618.95 | -10.42 | 1406.59 | 6.22 |
| | 94 | 895+00 | -8.73 | 48.06 | 6.48 | 86.62 | 7.61 | 158.64 | -10.45 | 369.76 | -19.77 | 617.50 | -14.39 | 1391.35 | -2.80 |
| | 95 | 900+00 | -4.64 | 55.07 | 5.18 | 96.24 | 9.93 | 172.34 | -12.30 | 386.31 | -21.01 | 634.65 | -16.18 | 1415.09 | -0.69 |
| | 96 | 905+00 | 0.88 | 16.13 | 0.40 | 45.06 | 6.37 | 102.69 | -12.21 | 296.88 | -2.81 | 532.51 | -0.75 | 1278.73 | 13.30 |
| | 97 | 910+00 | -15.49 | 30.20 | 4.57 | 62.57 | 4.37 | 125.04 | -13.16 | 312.22 | -38.87 | 544.33 | -43.10 | 1296.56 | -27.72 |
| | 98 | 915+00 | -0.50 | 8.03 | 3.43 | 33.09 | 6.50 | 84.56 | -11.07 | 274.45 | -16.14 | 498.72 | -19.16 | 1237.71 | -1.64 |
| Reach 3 - North | 99 | 920+00 | 46.20 | 57.91 | 4.61 | 100.67 | 13.15 | 179.99 | 1.29 | 388.16 | -3.16 | 633.16 | -1.21 | 1414.50 | 3.41 |
| | 100 | 922+50 | 7.30 | 68.17 | 8.24 | 110.37 | 12.84 | 188.21 | -1.91 | 394.12 | -12.09 | 635.90 | -14.89 | 1419.64 | 2.01 |
| | 101 | 925+00 | 1.87 | 61.85 | 5.12 | 104.96 | 8.88 | 183.43 | -10.47 | 387.85 | -17.62 | 631.94 | -19.92 | 1411.58 | -7.43 |
| | 102 | 927+50 | 35.78 | 48.53 | 4.75 | 88.63 | 11.61 | 161.56 | -11.10 | 358.59 | -44.81 | 601.23 | -50.65 | 1371.31 | -42.44 |
| | 103 | 930+00 | -0.27 | 39.82 | 2.87 | 80.09 | 6.43 | 154.13 | -15.73 | 338.72 | -50.53 | 582.32 | -52.14 | 1351.07 | -42.75 |
| | 104 | 932+50 | 37.21 | 57.21 | 6.76 | 96.74 | 14.21 | 170.56 | 9.27 | 355.46 | -11.13 | 589.07 | -20.52 | 1350.86 | -16.18 |
| | 105 | 935+00 | 40.13 | 58.56 | 3.85 | 106.52 | 9.88 | 193.26 | -0.55 | 412.65 | -14.18 | 664.92 | -17.70 | 1437.86 | -18.12 |
| | 106 | 937+50 | 42.43 | 35.39 | 5.80 | 70.54 | 12.95 | 137.07 | 9.99 | 338.61 | 2.26 | 575.51 | 0.99 | 1310.99 | -3.46 |
| | 107 | 940+00 | 26.63 | 59.20 | 4.55 | 109.71 | 9.13 | 201.87 | -6.23 | 414.27 | -34.06 | 663.33 | -39.61 | 1422.60 | -41.97 |
| | 108 | 942+50 | 5.57 | 52.73 | 2.71 | 94.95 | 4.66 | 171.97 | -14.33 | 369.95 | -42.82 | 611.83 | -44.91 | 1353.35 | -38.18 |
| | 109 | 945+00 | 20.05 | 45.69 | 0.48 | 92.41 | 3.81 | 177.03 | -13.08 | 383.22 | -45.25 | 631.11 | -48.49 | 1396.33 | -42.77 |
| | 110 | 947+50 | 8.79 | 27.08 | 3.62 | 58.96 | 6.77 | 121.52 | -19.53 | 302.04 | -61.75 | 536.71 | -62.52 | 1292.30 | -57.46 |
| | 111 | 950+00 | -25.81 | 55.82 | 4.83 | 93.65 | 4.07 | 162.31 | -28.92 | 352.78 | -67.08 | 594.86 | -65.94 | 1380.03 | -55.09 |
| | 112 | 952+50 | 7.23 | 34.97 | -1.62 | 77.76 | 0.53 | 156.51 | -17.91 | 338.97 | -61.12 | 582.05 | -62.08 | 1376.03 | -51.92 |
| | 113 | 955+00 | 7.48 | 63.70 | 2.92 | 114.49 | 4.75 | 204.50 | -11.80 | 404.69 | -39.06 | 650.54 | -40.51 | 1459.10 | -28.65 |
| | 114 | 957+50 | 15.84 | 50.59 | 3.09 | 92.75 | 4.78 | 171.67 | -6.05 | 369.88 | -19.42 | 608.94 | -12.50 | 1393.78 | 1.47 |
| | 115 | 960+00 | -29.42 | 75.04 | 5.38 | 123.28 | 1.23 | 209.58 | -21.43 | 432.82 | -27.79 | 690.16 | -4.57 | 1497.01 | -2.97 |
| | 116 | 962+50 | -12.48 | 36.54 | 2.61 | 70.11 | 0.60 | 133.08 | -7.84 | 344.86 | 5.75 | 597.07 | 22.68 | 1366.48 | 26.91 |
| | 117 | 965+00 | -4.09 | 51.52 | 5.27 | 98.35 | 4.12 | 184.28 | 1.43 | 380.59 | -49.41 | 638.00 | -52.94 | 1423.61 | -51.56 |
| | 118 | 967+50 | -15.73 | 30.68 | 2.19 | 64.68 | -2.54 | 132.04 | -11.70 | 314.20 | -54.64 | 546.25 | -84.06 | 1302.80 | -79.13 |
| | 119 | 970+00 | -16.64 | 45.06 | -0.17 | 84.19 | -5.17 | 158.12 | -28.58 | 351.26 | -92.24 | 580.36 | -113.63 | 1345.53 | -114.19 |
| Reach 3 - South | 120 | 972+50 | -63.16 | 68.19 | 1.03 | 111.53 | -7.70 | 190.30 | -27.55 | 399.83 | -64.13 | 645.85 | -72.21 | 1435.83 | -69.08 |
| | 121 | 975+00 | -50.98 | 55.91 | 1.68 | 95.68 | -7.48 | 169.40 | -24.34 | 374.41 | -64.35 | 620.33 | -69.71 | 1386.20 | -72.48 |
| | 122 | 977+50 | -25.84 | 76.44 | 4.08 | 121.03 | -1.00 | 203.38 | -9.37 | 402.74 | -64.41 | 657.29 | -64.61 | 1443.72 | -75.48 |
| | 123 | 980+00 | -14.38 | 17.84 | -3.96 | 50.14 | -7.48 | 114.30 | -14.86 | 295.02 | -62.35 | 539.53 | -61.09 | 1308.31 | -57.06 |
| | 124 | 982+50 | -14.08 | 37.64 | 3.49 | 67.87 | 1.30 | 128.46 | -9.07 | 314.72 | -32.74 | 555.96 | -29.92 | 1319.04 | -23.53 |
| | 125 | 985+00 | -14.11 | 6.76 | -0.25 | 27.39 | -3.06 | 72.79 | -11.80 | 237.21 | -36.12 | 469.14 | -28.99 | 1208.07 | -22.67 |
| | 126 | 987+50 | -36.77 | 0.00 | -0.21 | 7.57 | -5.58 | 34.01 | -18.99 | 166.46 | -44.63 | 381.86 | -41.99 | 1088.25 | -33.36 |
| | 127 | 990+00 | -24.04 | 9.02 | -2.28 | 32.31 | -5.99 | 83.14 | -14.90 | 237.94 | -63.50 | 462.71 | -67.47 | 1192.15 | -62.75 |
| | 128 | 992+50 | -20.57 | 18.22 | -0.70 | 43.50 | -3.83 | 96.86 | -15.30 | 263.93 | -46.85 | 486.94 | -52.50 | 1217.25 | -61.38 |
| | 129 | 995+00 | -11.96 | 2.00 | 0.17 | 19.61 | -1.18 | 59.63 | -14.72 | 216.84 | -44.86 | 432.41 | -43.45 | 1147.35 | -20.91 |
| | 130 | 997+50 | -3.65 | 33.16 | 1.23 | 65.66 | 1.49 | 128.08 | -1.96 | 305.84 | -25.23 | 536.74 | -2.94 | 1292.47 | 17.64 |
| | 131 | 1000+00 | -1.66 | 5.86 | -0.54 | 28.45 | -1.17 | 78.50 | -5.10 | 245.39 | -19.28 | 468.38 | -26.57 | 1211.98 | -32.24 |
| | 132 | 1002+50 | -9.48 | 2.55 | -1.36 | 20.38 | -1.86 | 61.45 | -6.47 | 228.78 | -5.17 | 445.97 | 0.52 | 1169.81 | -4.56 |
| | 133 | 1005+00 | -11.89 | 14.89 | -2.47 | 40.50 | -5.03 | 93.50 | -9.89 | 265.54 | -23.02 | 490.57 | -15.54 | 1221.40 | -20.52 |
| Reach 4 | 134 | 1007+50 | -28.48 | 28.46 | -1.59 | 57.43 | -5.58 | 115.40 | -14.21 | 300.04 | -25.00 | 531.10 | -8.36 | 1265.62 | -13.70 |
| | 135 | 1010+00 | -12.39 | 4.38 | -1.86 | 22.43 | -5.01 | 70.59 | -8.91 | 238.73 | -26.12 | 461.67 | -5.75 | 1175.10 | -7.21 |
| | 136 | 1012+50 | -36.69 | 25.19 | -0.14 | 49.81 | -5.30 | 107.86 | -11.17 | 283.92 | -30.31 | 513.12 | -11.21 | 1235.00 | -14.03 |
| | 137 | 1015+00 | -38.83 | 13.44 | -2.41 | 30.16 | -10.18 | 77.36 | -18.88 | 246.06 | -34.34 | 468.81 | -15.76 | 1175.10 | -17.86 |
| | 138 | 1017+50 | -66.43 | 25.63 | -3.44 | 42.21 | -15.29 | 91.30 | -27.32 | 264.00 | -49.50 | 490.07 | -23.43 | 1201.64 | -20.60 |
| | 139 | 1020+00 | -76.86 | 1.90 | -4.83 | 5.97 | -18.17 | 38.14 | -32.05 | 192.05 | -53.04 | 409.52 | -34.50 | 1100.61 | -37.78 |
| | 140 | 1022+50 | -62.17 | 14.85 | -3.26 | 26.15 | -14.06 | 70.72 | -22.30 | 230.44 | -43.63 | 452.92 | -22.24 | 1161.95 | -17.72 |
| | 141 | 1025+00 | -13.50 | 1.19 | -0.82 | 12.49 | -3.48 | 60.02 | 4.71 | 216.46 | -7.12 | 425.67 | 8.65 | 1133.36 | 13.73 |

| Reach | Transect Number | Station | Shoreline Change @ MHW (+1.18 ft NAVD) | Above Berm (+6 ft NAVD88) | | Above MHW (+1.18 ft NAVD88) | | Above -6 ft NAVD88 | | Above -14 ft NAVD88 | | Above -19 ft NAVD88 | | Above -30 ft NAVD88 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) | 2024 Measured Volume (cy/ft) | 2023-2024 Volume Change (cy/ft) |
| National Seashore - North | 115 | 1030+00 | 14.58 | 2.45 | -3.99 | 21.81 | -2.80 | 78.23 | 7.37 | 235.80 | -16.24 | 433.58 | -6.25 | 1085.57 | 6.06 |
| | 116 | 1035+00 | 15.06 | 3.73 | -12.07 | 23.36 | -12.63 | 83.80 | -8.24 | 243.73 | -41.56 | 450.65 | -10.95 | 1216.88 | 11.32 |
| | 117 | 1040+00 | -8.06 | 41.68 | -20.71 | 69.74 | -24.28 | 144.34 | -19.22 | 311.18 | -64.04 | 543.52 | -58.76 | 1319.06 | -47.18 |
| | 118 | 1045+00 | 16.51 | 28.37 | -24.23 | 53.71 | -24.36 | 127.46 | -11.97 | 273.11 | -52.29 | 505.46 | -23.87 | 1270.34 | 15.99 |
| | 119 | 1050+00 | 28.93 | 0.05 | -4.13 | 20.84 | -1.70 | 87.91 | 17.63 | 248.63 | -4.08 | 482.32 | 45.24 | 1190.37 | -13.55 |
| | 120 | 1055+00 | 25.54 | 34.75 | -2.53 | 77.99 | -3.01 | 171.37 | 6.39 | 385.87 | -12.66 | 647.17 | -35.16 | 1464.87 | -59.61 |
| | 121 | 1060+00 | 35.69 | 120.53 | -0.56 | 182.93 | 0.88 | 303.56 | 16.57 | 547.32 | -29.26 | 829.57 | -59.72 | 1743.88 | -98.47 |
| | 122 | 1065+00 | 12.05 | 41.92 | -3.88 | 79.42 | -5.43 | 165.49 | -1.66 | 356.28 | -46.35 | 602.50 | -43.52 | 1445.38 | -73.28 |
| | 123 | 1070+00 | 35.22 | 52.12 | -0.41 | 85.53 | 1.19 | 162.48 | 15.53 | 337.09 | -26.16 | 573.97 | -15.30 | 1401.52 | -39.23 |
| | 124 | 1075+00 | 46.89 | 33.97 | -1.51 | 68.01 | 5.00 | 142.42 | 20.98 | 310.01 | -13.14 | 551.69 | -0.45 | 1404.57 | -16.44 |
| | 125 | 1080+00 | 55.07 | 36.77 | -10.19 | 86.72 | -3.33 | 184.95 | 13.83 | 380.09 | -22.37 | 639.24 | -0.40 | 1493.03 | -14.79 |
| | 126 | 1090+00 | -1.56 | 98.77 | -1.48 | 154.95 | -3.83 | 261.58 | -1.97 | 484.05 | -34.25 | 763.39 | -6.64 | 1590.52 | -22.56 |
| | 127 | 1100+00 | 6.39 | 13.91 | -3.83 | 46.95 | -3.33 | 116.17 | -1.35 | 283.03 | -49.94 | 522.45 | -30.86 | 1195.27 | -27.61 |
| | 128 | 1110+00 | -7.22 | 10.42 | -3.39 | 39.39 | -4.18 | 104.40 | -2.78 | 269.20 | -36.57 | 521.27 | -9.06 | 1399.29 | -56.52 |
| | 129 | 1120+00 | 13.29 | 6.41 | -0.67 | 26.92 | 0.27 | 78.92 | 6.12 | 258.75 | -69.60 | 491.67 | -71.54 | 1319.45 | -87.29 |
| | 130 | 1130+00 | 39.38 | 9.97 | 0.28 | 35.55 | 5.23 | 96.66 | 17.36 | 287.43 | 4.64 | 517.33 | -1.25 | 1376.71 | -26.05 |
| | 131 | 1140+00 | 7.66 | 44.63 | -0.74 | 86.25 | -1.48 | 170.22 | 3.34 | 384.79 | -22.87 | 641.54 | -18.67 | 1552.32 | -40.16 |
| | 132 | 1150+00 | 30.10 | 60.67 | 0.37 | 118.61 | -0.32 | 236.61 | 8.37 | 438.92 | -74.94 | 722.63 | -59.22 | 1651.98 | -74.41 |
| | 133 | 1160+00 | 58.07 | 13.75 | -2.19 | 51.49 | 3.82 | 137.39 | 23.45 | 318.51 | -22.46 | 590.14 | -10.73 | 1469.54 | -20.33 |
| | 134 | 1170+00 | -15.12 | 15.55 | 2.94 | 55.06 | 3.17 | 148.97 | 8.06 | 350.95 | -44.64 | 620.24 | -45.70 | 1542.44 | -45.27 |
| | 135 | 1180+00 | 46.48 | 84.85 | 3.85 | 145.96 | 13.33 | 278.15 | 34.39 | 528.97 | 40.37 | 831.28 | 33.75 | 1803.00 | 15.54 |
| | 136 | 1190+00 | 37.38 | 45.00 | 6.00 | 100.17 | 17.65 | 227.11 | 32.03 | 484.15 | 49.01 | 789.52 | 29.20 | 1837.26 | 7.81 |
| | 137 | 1200+00 | -27.89 | 10.41 | 2.90 | 57.13 | -4.38 | 174.74 | 2.63 | 432.56 | -65.06 | 773.49 | -66.95 | 1900.61 | -81.64 |
| National Seashore - South | 138 | 1210+00 | 30.82 | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A |
| | 139 | 1220+00 | 43.40 | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A |
| | 140 | 1230+00 | -3.26 | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A |
| | 141 | 1240+00 | -253.96 | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A |
| | 142 | 1250+00 | -166.49 | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A |
| | 143 | 1260+00 | -43.66 | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A |
| | 144 | 1270+00 | 355.62 | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A |
| | 145 | 1280+00 | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A |
| | 146 | 1290+00 | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A | N\A |

# APPENDIX D
# SHORELINE AND VOLUME CHANGE PLOTS

Legend
Additional 2020-2021 Monitoring Transects
Nags Head Historical Monitoring Transects
Aerial Imagery: NAIP 2016
0 2,500 5,000 10,000
Feet
1290+00
1280+00
1270+00
1260+00
1250+00
1240+00
1230+00
1220+00
1210+00
1200+00
1190+00
1180+00
1170+00
1160+00
1150+00
1140+00
1130+00
1120+00
1110+00
1100+00
1090+00
1080+00
1070+00
1060+00
1050+00
1040+00
1030+00
1020+00
1010+00
1000+00
990+00
980+00
970+00
960+00
950+00
940+00
930+00
920+00
910+00
900+00
890+00
880+00
870+00
860+00
850+00
840+00
830+00
820+00
810+00
800+00
790+00
780+00
770+00
760+00
750+00
740+00
730+00
720+00
710+00
700+00
690+00
680+00
670+00
660+00
650+00
640+00
630+00
620+00
610+00
600+00
590+00
580+00
570+00
560+00
550+00
540+00
530+00
520+00
510+00
500+00
490+00
480+00
470+00
460+00
450+00
440+00
430+00
REACH 4
NATIONAL SEASHORE SOUTH
NATIONAL SEASHORE NORTH
REACH 3 SOUTH
REACH 3 NORTH
REACH 2
REACH 1
NAGS HEAD-NORTH
Shoreline Change (ft)
Accretion
Erosion
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
1230+00
1150+00
1070+00
990+00
910+00
830+00
750+00
670+00
590+00
510+00
430+00
June 2023 to June 2024 Shoreline Change

Legend
Additional 2020-2021 Monitoring Transects
Nags Head Historical Monitoring Transects
Aerial Imagery: NAIP 2016
0 2,500 5,000 10,000
Feet
1290+00
1280+00
1270+00
1260+00
1250+00
1240+00
1230+00
1220+00
1210+00
1200+00
1190+00
1180+00
1170+00
1160+00
1150+00
1140+00
1130+00
1120+00
1110+00
1100+00
1090+00
1080+00
1070+00
1060+00
1050+00
1040+00
1030+00
1020+00
1010+00
1000+00
990+00
980+00
970+00
960+00
950+00
940+00
930+00
920+00
910+00
900+00
890+00
880+00
870+00
860+00
850+00
840+00
830+00
820+00
810+00
800+00
790+00
780+00
770+00
760+00
750+00
740+00
730+00
720+00
710+00
700+00
690+00
680+00
670+00
660+00
650+00
640+00
630+00
620+00
610+00
600+00
590+00
580+00
570+00
560+00
550+00
540+00
530+00
520+00
510+00
500+00
490+00
480+00
470+00
460+00
450+00
440+00
430+00
NATIONAL SEASHORE SOUTH
NATIONAL SEASHORE NORTH
REACH 4
REACH 3 SOUTH
REACH 3 NORTH
REACH 2
REACH 1
NAGS HEAD-NORTH


June 2023 – June 2024 Volume Change
Volume Change (cy/ft)
130
110
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
1200+00
1130+00
1060+00
990+00
920+00
850+00
780+00
710+00
640+00
570+00
500+00
430+00
Volume Change Above +6 ft
Volume Change Above MHW
Volume Change Above -6 ft
Volume Change Above -14 ft
Volume Change Above -19 ft
Volume Change Above -30 ft

# APPENDIX E
# REACH 4 OBSERVED ESCARPMENT SURVEY ANALYSIS

moffatt & nichol

4700 Falls of Neuse Road, Suite 300
Raleigh, NC 27609

(919) 781-4626 Fax: (919) 781-4626
www.moffattnichol.com

# MEMORANDUM

To: David Ryan, Town Engineer, Town of Nags Head

From: Ayse Karanci, Project Manager & Beth Sciaudone, Assistant Project Manager

Date: September 24, 2024

Subject: Observed Escarpment Survey Analysis at McCall Ct. (Reach 4) Memo Report

This memo provides survey data and brief analysis of volumetric changes observed from late June to late July, 2024, in South Nags Head adjacent to McCall Ct. This segment of shoreline is within Reach 4 of the monitoring area, and was initially surveyed June 24-25, 2024. Due to observed erosion and escarpment formation (Figure 1), the Town of Nags Head requested that McKim and Creed resurvey the transects from STA 1010+00 to STA 1025+00 to quantify the volumetric changes. The second survey of those transect lines was completed on July 31, 2024. A location map of the surveyed transect lines is presented in Figure 2.

***Figure 1. Scarping observed adjacent to McCall Ct. on July 27, 2024. (D. Ryan Photo)***

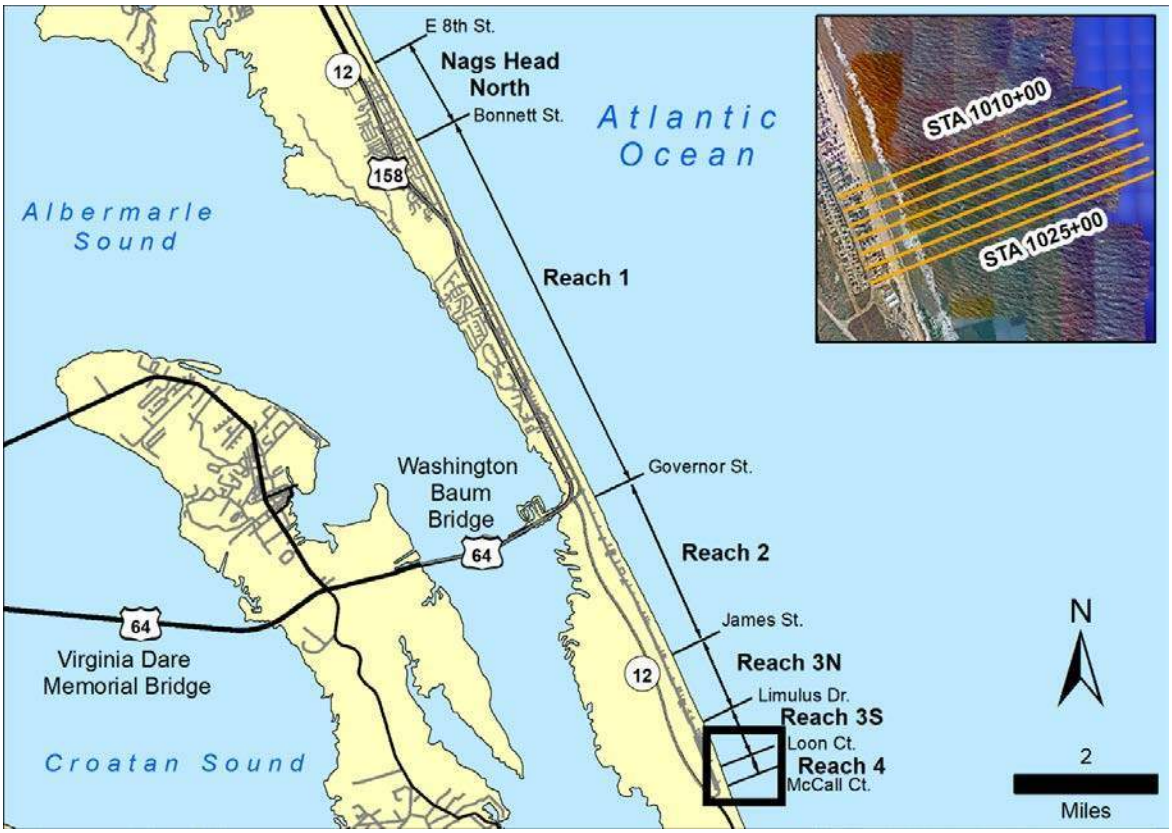



***Figure 2. Location map of surveyed transect lines 1010+00 to 1025+00.***

The computed profile volumes above the varying datums developed for the annual monitoring program for the late June survey are presented in Table 1. Note that the profile volume above the -19 ft NAVD88 elevation at Transects 1020+00 and 1025+00 were below the reach trigger volume, 446 cy/ft, during this survey.

***Table 1. Profile Volumes, June 2024 (cubic yards per linear foot)***
***[Reach 3&4 Trigger Volume above -19 ft: 446 cy/ft]***

| | Above Berm Height (+6 ft NAVD88) | Above MHW (+1.18 ft NAVD88) | Above -6 ft NAVD88 | Above -14 ft NAVD88 | Above -19 ft NAVD88 | Above -30 ft NAVD88 |
|---|---|---|---|---|---|---|
| | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| **1010+00** | 4.43 | 24.65 | 70.79 | 235.67 | 459.73 | 1172.46 |
| **1012+50** | 24.98 | 52.28 | 111.41 | 288.65 | 518.87 | 1240.89 |
| **1015+00** | 13.43 | 34.51 | 82.64 | 255.89 | 478.41 | 1183.62 |
| **1017+50** | 26.65 | 49.42 | 100.28 | 277.38 | 504.49 | 1216.38 |
| **1020+00** | 4.98 | 15.97 | 49.41 | 206.69 | **424.96** | 1116.54 |
| **1022+50** | 15.70 | 33.24 | 78.55 | 239.92 | 463.75 | 1172.86 |
| **1025+00** | 1.26 | 16.80 | 63.97 | 223.07 | **433.28** | 1141.60 |

The computed profile volumes above the varying datums developed for the annual monitoring program for the late July survey are presented in Table 2. The profile volume above the -19 ft NAVD88 elevation at Transects 1020+00 and 1025+00 were further below the reach trigger volume during this survey. The computed volume changes are presented in Table 3. The largest volume changes were observed at STA 1017+50 and STA 1020+00, and it is noted that with the exception of STA 1010+00, net volume loss was observed at all of the surveyed transects. This suggests that sediment removed from the dry sand beach/berm was not simply deposited locally offshore but rather there was significant longshore transport removing sand from the surveyed area. Plots of the surveyed profiles are shown in Figure 3 to Figure 9. There is some nearshore deposition shown in some of the profiles, generally between the -5 ft and – 10 ft NAVD88 elevations, however as indicated by the volume change analysis, there is net loss of sand from all of the profiles except STA 1010+00.

For comparison purposes, the average annual volume change in Reach 4 above -19 ft NAVD88 is -48,699 cy over 2,000 ft alongshore, or approximately -24.3 cy/ft. The changes over this June-July timeframe are on the order of half of the expected annual losses.

***Table 2. Profile Volumes, July 2024 (cubic yards per linear foot)***
***[Reach 3&4 Trigger Volume above -19 ft: 446 cy/ft]***

| | Above Berm Height (+6 ft NAVD88) | Above MHW (+1.18 ft NAVD88) | Above -6 ft NAVD88 | Above -14 ft NAVD88 | Above -19 ft NAVD88 | Above -30 ft NAVD88 |
|---|---|---|---|---|---|---|
| | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| **1010+00** | 4.38 | 22.43 | 70.59 | 238.73 | 461.67 | 1175.10 |
| **1012+50** | 25.19 | 49.81 | 107.86 | 283.92 | 513.12 | 1235.00 |
| **1015+00** | 13.44 | 30.16 | 77.36 | 246.06 | 468.81 | 1175.10 |
| **1017+50** | 25.63 | 42.21 | 91.30 | 264.00 | 490.07 | 1201.64 |
| **1020+00** | 1.90 | 5.97 | 38.14 | 192.05 | **409.52** | 1100.61 |
| **1022+50** | 14.85 | 26.15 | 70.72 | 230.44 | 452.92 | 1161.95 |
| **1025+00** | 1.19 | 12.49 | 60.02 | 216.46 | **425.67** | 1133.36 |

***Table 3. Volume Change, June to July 2024 (cubic yards per linear foot)***

| | Above Berm Height (+6 ft NAVD88) | Above MHW (+1.18 ft NAVD88) | Above -6 ft NAVD88 | Above -14 ft NAVD88 | Above -19 ft NAVD88 | Above -30 ft NAVD88 |
|---|---|---|---|---|---|---|
| | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft | cy/ft |
| **1010+00** | -0.05 | -2.22 | -0.20 | 3.06 | 1.93 | 2.64 |
| **1012+50** | 0.21 | -2.48 | -3.56 | -4.73 | -5.75 | -5.89 |
| **1015+00** | 0.01 | -4.34 | -5.28 | -9.83 | -9.60 | -8.52 |
| **1017+50** | -1.02 | -7.21 | -8.98 | -13.38 | -14.42 | -14.74 |
| **1020+00** | -3.08 | -10.00 | -11.27 | -14.63 | -15.44 | -15.93 |
| **1022+50** | -0.86 | -7.09 | -7.84 | -9.47 | -10.83 | -10.91 |
| **1025+00** | -0.07 | -4.31 | -3.95 | -6.61 | -7.61 | -8.23 |

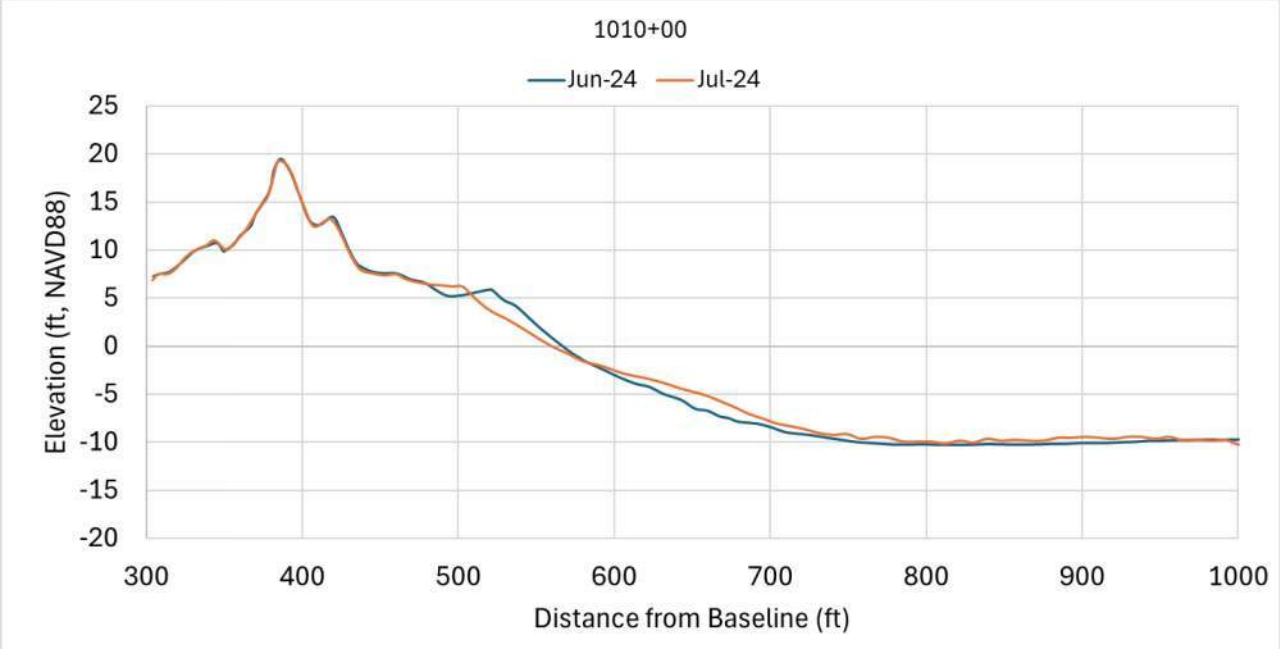



***Figure 3. Transect STA 1010+00 Observed Change, June to July 2024.***

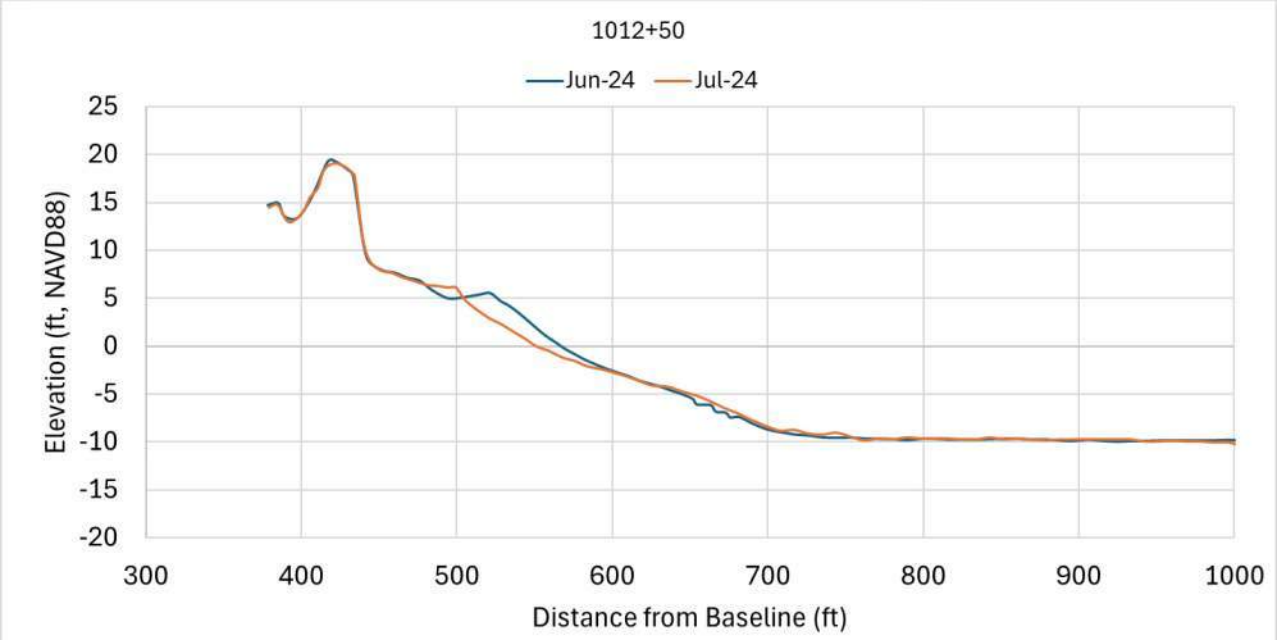



***Figure 4. Transect STA 1012+50 Observed Change, June to July 2024.***

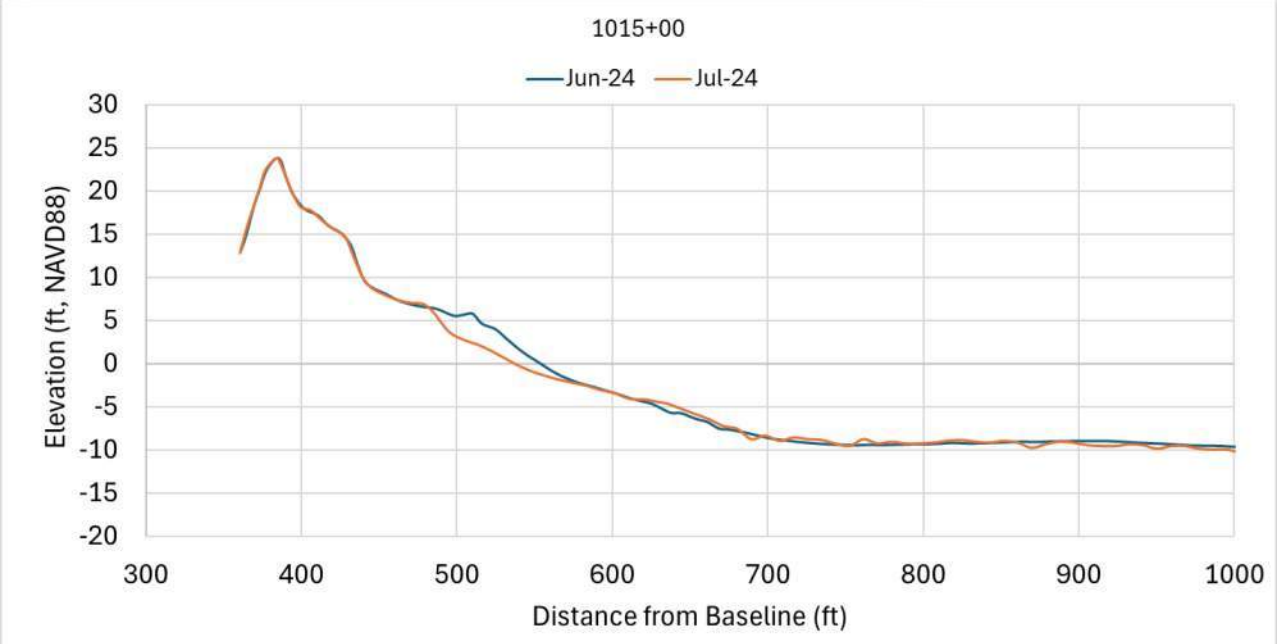



***Figure 5. Transect STA 1015+00 Observed Change, June to July 2024.***

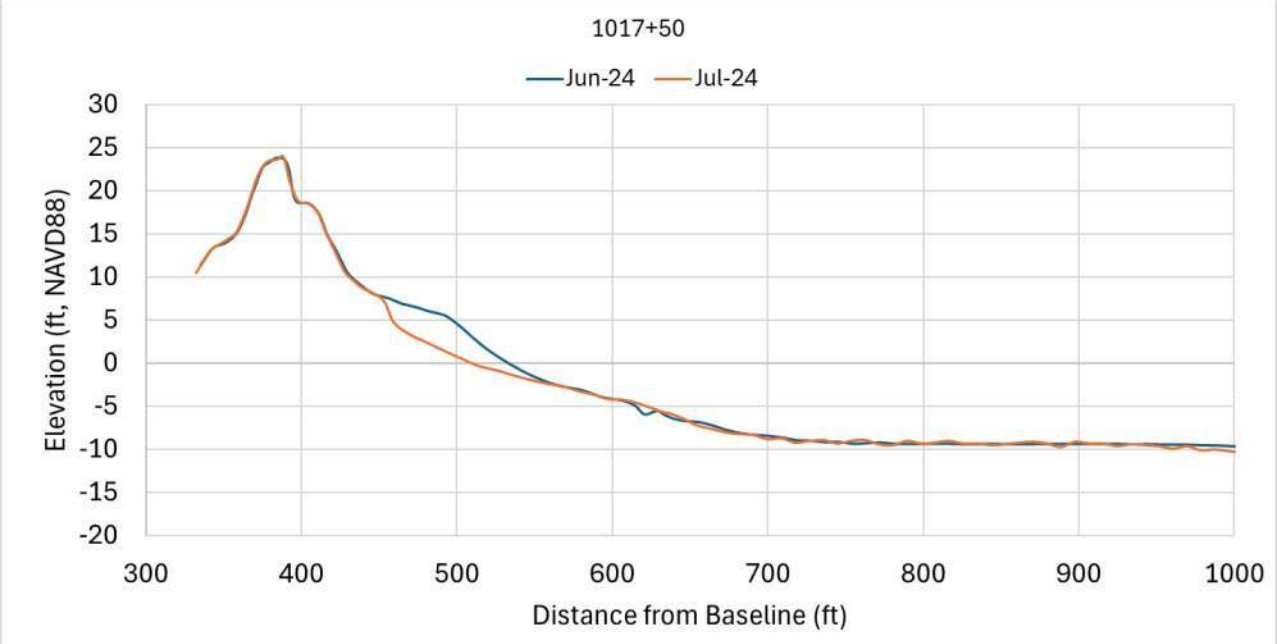



***Figure 6. Transect STA 1017+50 Observed Change, June to July 2024.***

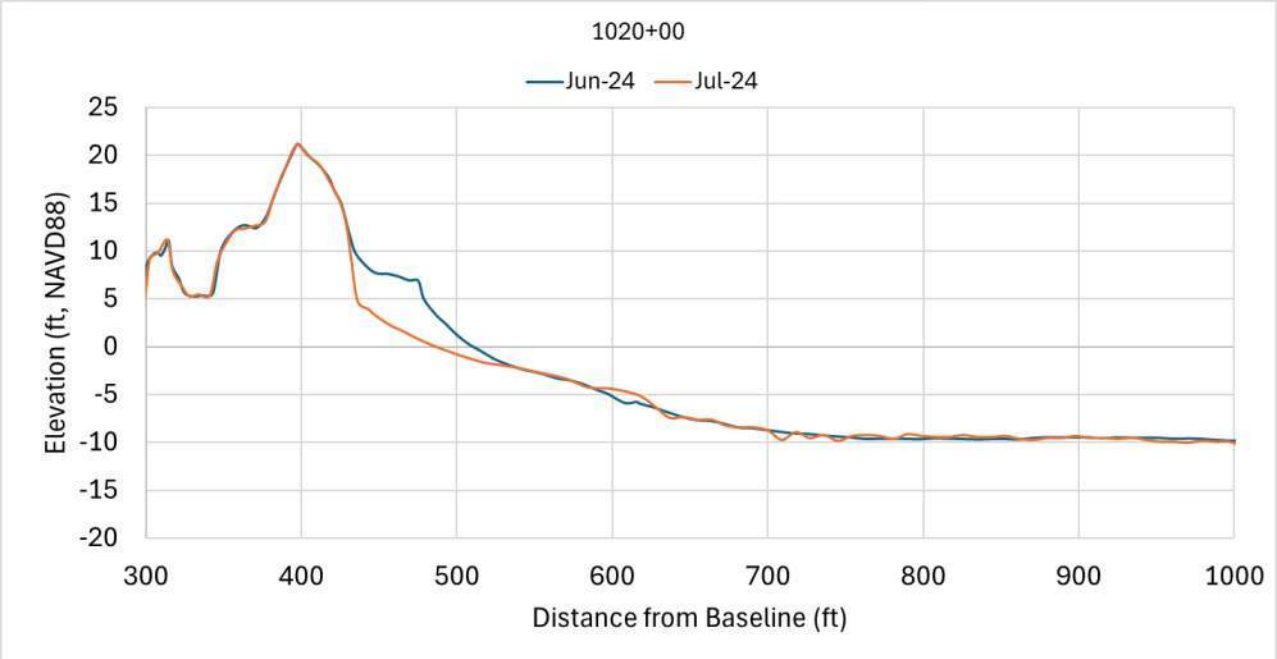



***Figure 7. Transect STA 1020+00 Observed Change, June to July 2024.***

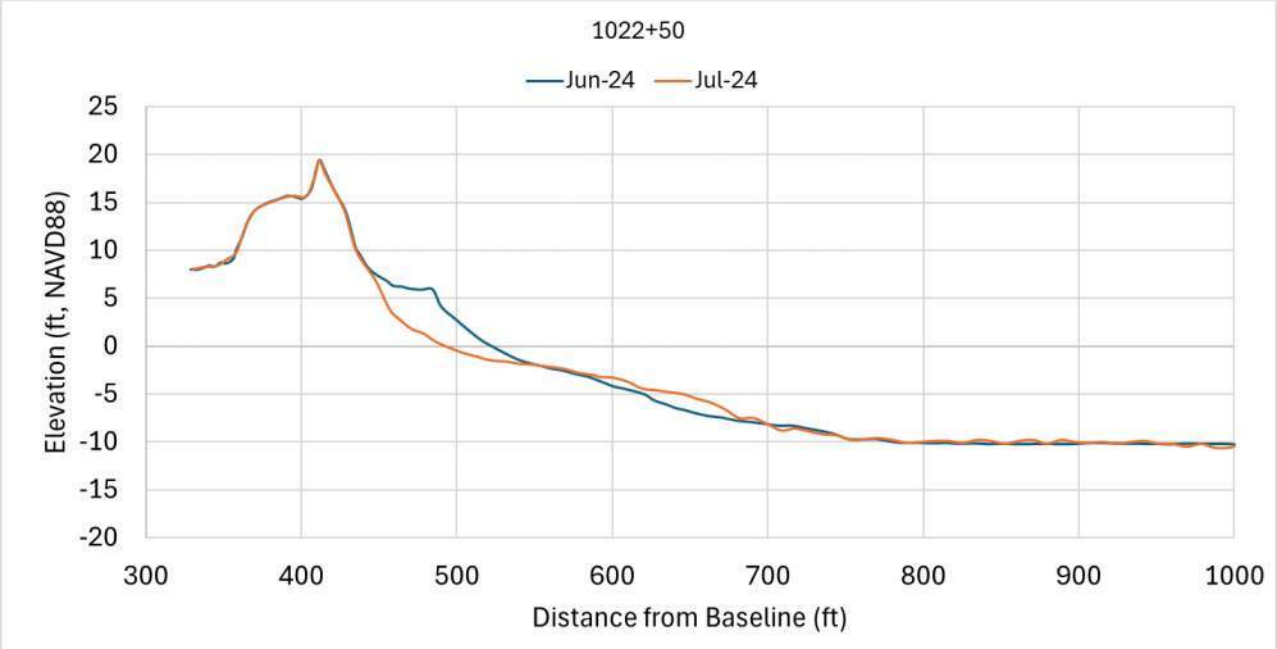



***Figure 8. Transect STA 1022+50 Observed Change, June to July 2024.***

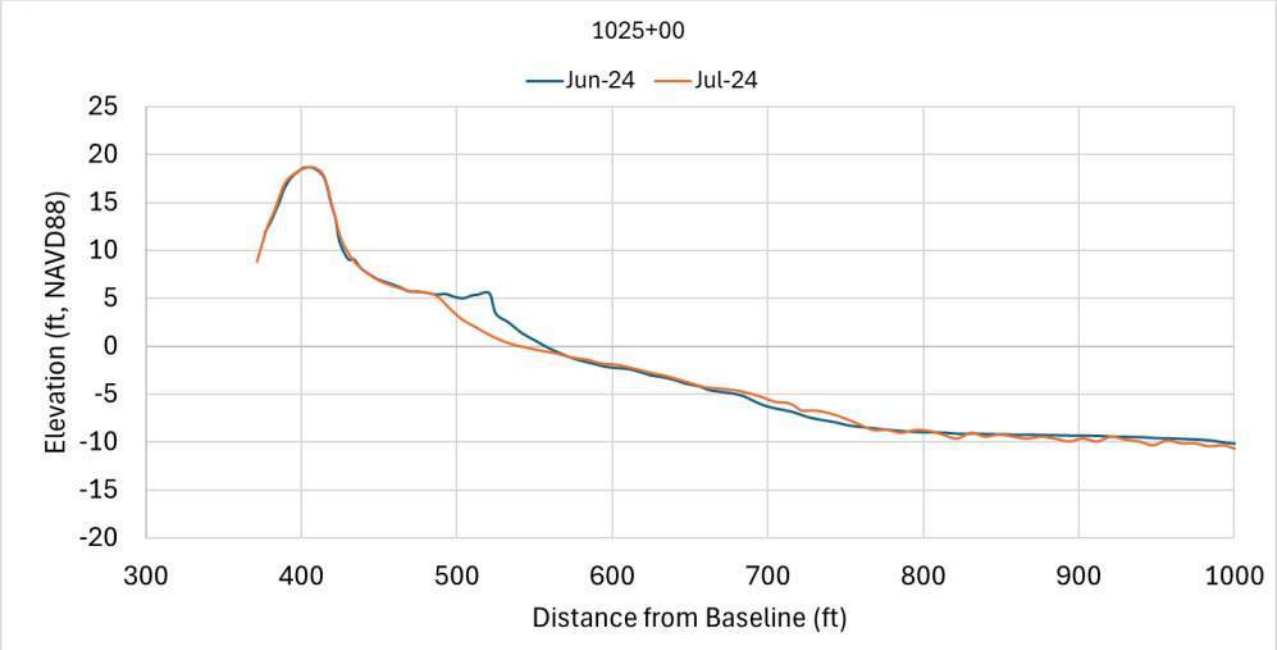



***Figure 9. Transect STA 1025+00 Observed Change, June to July 2024.***

Wave height and period rose plots for the time period between surveys are shown in Figure 10. As shown in the figure, waves were predominantly from the east-southeast during this time period, with wave periods generally from 8 to 10 seconds.

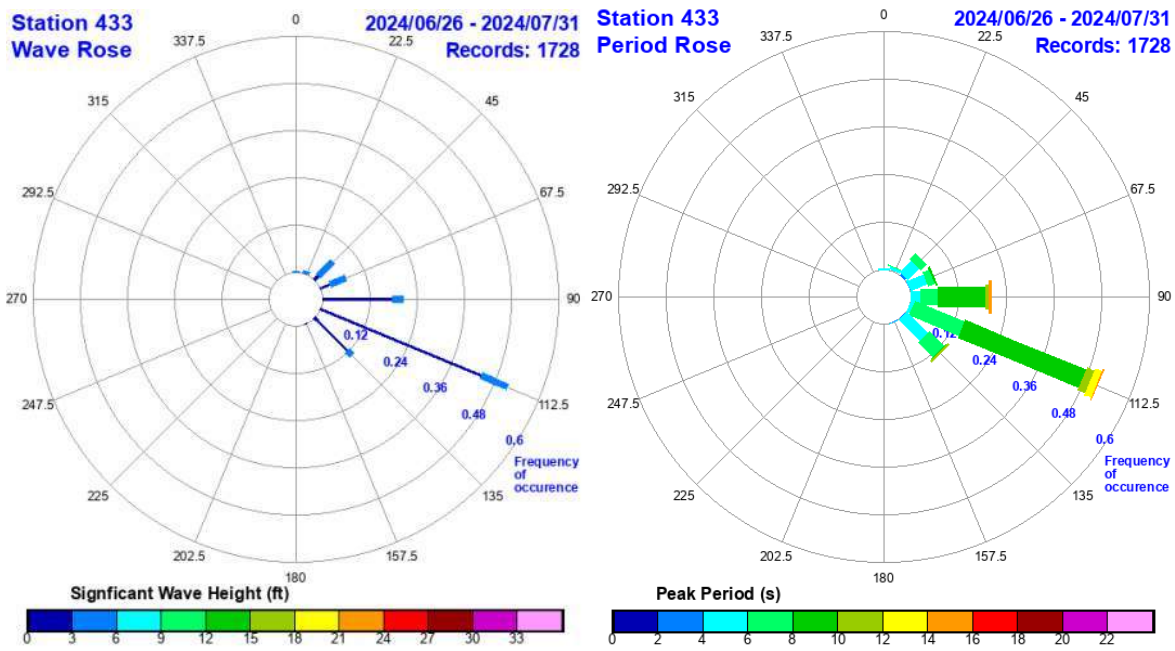



***Figure 10. Wave Height (left) and Wave Period (right) Roses for June 26, 2024 to July 31, 2024, at Station 433 (Duck -51ft waverider buoy).***

The wave properties time series is presented in Figure 11. This time series shows that although the predominant wave direction over this time frame was from the east-southeast, there were a number of higher wave events (~4-5 ft wave heights) coming from the northeast. Several of these events, including the event occurring immediately prior to and during the observed scarping, were characterized by shorter wave periods, resulting in more choppy conditions rather than swell. One hypothesis may be that these shorter-term events moved sand from the dry sand beach and dune to the nearshore, where the east-southeasterly waves then transported it alongshore to the north. There may also be some sand waves or other bathymetric features offshore of the surveyed areas that are concentrating wave energy within the area where the scarping has been observed.

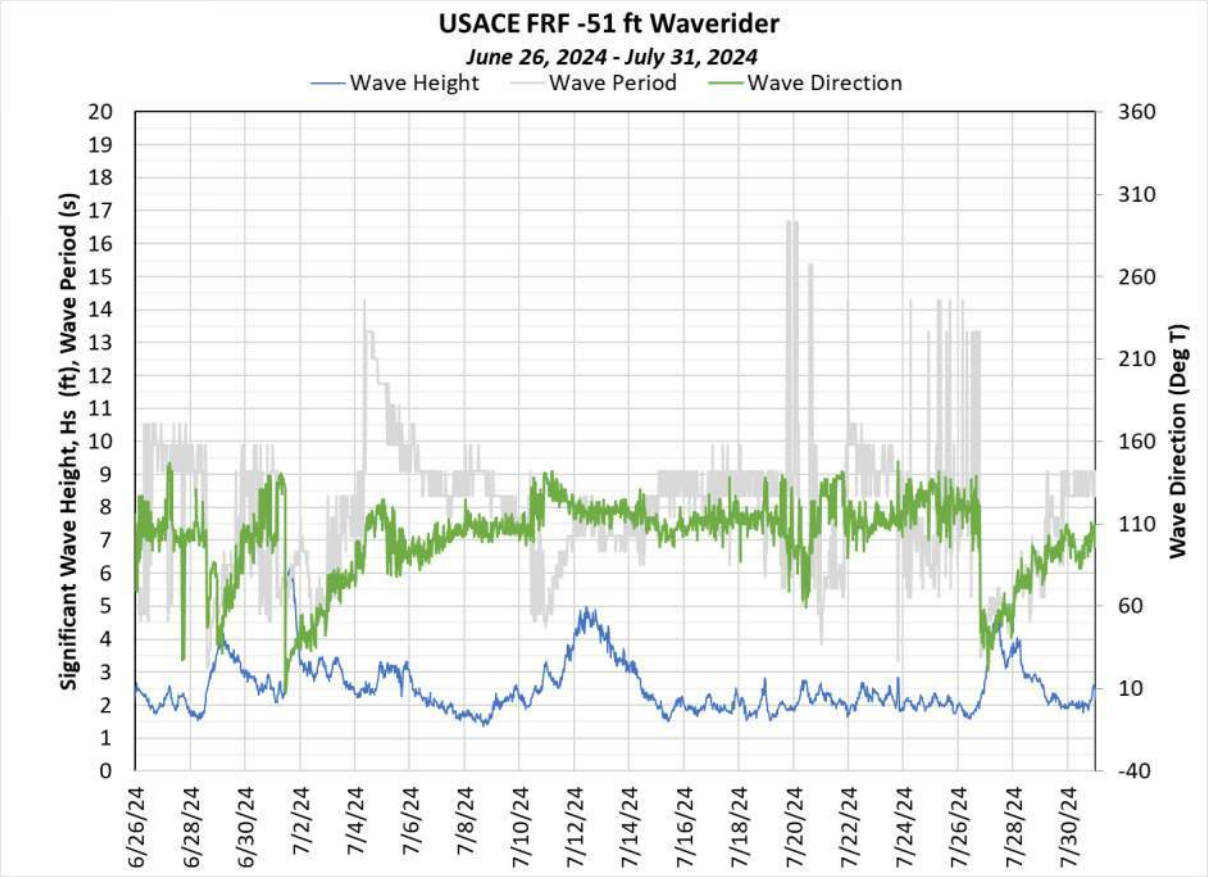



***Figure 11. Wave Height (blue), Period (gray), and Direction (green) Time Series for June 26, 2024 to July 31, 2024, at Duck -51ft waverider buoy.***

The shoreline change at the mean high water (MHW) elevation was also examined and is presented in Table 4. The largest changes were observed at Stations 1017+50, 1020+00, and 1022+50, with approximately 30 ft of shoreline erosion observed at those transects. At the time of the survey, and subsequently during a site visit on August 2, 2024, there was little to no dry beach present at the site during high tide.

***Table 4. Shoreline Change, June to July 2024***

| | June Shoreline Position @ MHW (+1.18 ft NAVD88) | July Shoreline Position @ MHW (+1.18 ft NAVD88) | Shoreline Change @ MHW (+1.18 ft NAVD88) |
|---|---|---|---|
| | ft | ft | ft |
| **1010+00** | 557.664 | 547.957 | -9.707 |
| **1012+50** | 556.098 | 540.023 | -16.075 |
| **1015+00** | 543.696 | 525.737 | -17.959 |
| **1017+50** | 522.53 | 495.096 | -27.434 |
| **1020+00** | 500.518 | 471.063 | -29.455 |
| **1022+50** | 511.544 | 479.555 | -31.989 |
| **1025+00** | 544.228 | 521.64 | -22.588 |

Summary

The transects STA 1010+00 to 1025+00 were surveyed at the end of June 2024 and again at the end of July 2024 after significant erosion and scarping were reported. Examination of the profile survey data indicates that there was net loss of volume above the -30 ft NAVD88 elevation contour in all of the profiles except STA 1010+00. Some deposition was observed in the nearshore on the majority of the profiles, however, most of the sand eroded from these profiles was transported alongshore out of the immediate area and based on a qualitative assessment of the wave directions, it seems likely that it may have been transported to the north. Observations in late July and early August suggest that in this section of Reach 4, there is little to no dry beach during high tides. Additionally, reach trigger volumes are exceeded at two of the surveyed transects (1020+00 and 1025+00). The combination of these observations along with continued high wave and water level events, merit continued monitoring to assess and determine appropriate next steps.

McKIM&CREED

ENGINEERS

SURVEYORS

PLANNERS

September 26, 2024 243703

David Ryan, PE
Town Engineer
Town of Nags Head
PO Box 99
Nags Head, NC 27959

**Re: Town of Nags Head – 2024 Fall Beach Monitoring Survey**

David,

McKim & Creed would like to present our proposal for professional surveying services in connection with the referenced project. We understand the scope of work to include a fall survey of 112 predetermined beach profile lines based on the files and email from Moffat & Nichol dated 09.24.2024.

For the requested fall survey, the profiles will extend landward to the limits of the Summer 2024 survey and extend seaward to a distance that is approximately three thousand five hundred feet offshore or -30 ft NAVD 88, whichever is achieved first.

This fall survey includes 112 beach profile monitoring lines between stations 495+00 and 1110+00 (≈12 Miles).

**Scope of Work**

- All survey work will be performed to the Standards of Practice for Land Surveying in North Carolina.
- Hydrographic surveys will be performed to meet or exceed the minimum performance standards for the Corps of Engineers Hydrographic Surveys, USACE specifications manual EM 1110-2-1003.
- Horizontal data will be referenced to NC Grid NAD83/2011 or to existing control datum and Vertical datum will be NAVD88.

243 North Front Street

Wilmington, NC 28401

910.343.1048

Fax 910.251.8282

www.mckimcreed.com

- Over land data will be captured using Trimble R8/R10 dual frequency GNSS receivers beginning at the Landward toe of the Primary dune and extend out to the surf zone at wading depth (wading will occur at low tide). Land survey crews will have survey grade GNSS receivers mounted on fixed height rover poles that are equipped with topo shoes (flat rod tips that do not sink in the sand). The data collectors are clamped onto the pole; the system is lightweight and ideal for one person. To move up and down the beach efficiently, we will use Side by Side utility vehicles (Kawasaki Mule). Crew trucks are painted with our company logo, field crews wear highly visible orange/yellow shirts and vests.
- Hydrographic surveys will be collected from -30 ft NAVD88 to the surf zone (during the high tide cycle) to achieve overlapping data as weather/sea conditions allow. Our survey vessels range from 22′ to 28′ in length and are equipped with Inertial Navigation systems that include survey grade dual frequency sonar, IMU, VRS RTK GNSS and sound velocity probes, all of which compensates for heave, pitch, roll, heading and the speed of sound, to calculate position and depth. Prior to beginning work, we perform a bar check to ensure the accuracy of our sonar and we perform sound velocity checks periodically during the survey.
- We will provide the following deliverables:
    - XYZ files of the Land, Wade, and Hydro data
    - BMAP file
    - Field Survey Report

**Accuracy**

- Land: The integrated GNSS system (Trimble R8) that we use is rated at a precision of .02′ horizontal and .05′ vertically. Based on the conditions and stability of the sand, we can provide an accuracy of 0.1′ horizontally and less than 0.2′ vertically.
- Hydro: Our equipment is well within the requirements of the USACE Hydrographic Survey Standards. Our soundings will be accurate to within 3′ horizontal and 0.25′ vertically.

**Assumptions**

The Town of Nags Head will apply for a permit to enter the Park in case the one used in the Summer 2024 is not accepted.

**Schedule**

We estimate the data collection to start beginning of November, depending on weather, and take approximately 2 weeks to collect all data sets. We can provide the final deliveries and reports within 2-3 weeks of completion of field work.

For services described in the above Scope of Work, the lump sum fee will be **$44,790.00** *(forty-four thousand seven-hundred and ninety dollars)* inclusive of reimbursable expenses.

2024 Fall Survey (112 Profiles) ……. $44,790.00

This proposal is submitted contingent upon the negotiation of a contract with mutually acceptable terms and conditions prior to the commencement of any work.

We appreciate the opportunity to provide this proposal to you and look forward to working on the project with you.

Sincerely,

McKIM & CREED, INC.

Gabriela De Oliveira
Hydrographic Project Manager

## TASK 18 INTRODUCTION

Task 18 includes professional services to conduct the Town of Nags Head 2024 Fall Survey Analysis. The Town's Beach Monitoring and Analysis program represents a continued effort of conducting beach monitoring surveys and providing analyses, building upon past efforts by Town of Nags Head from 2012 through 2024 in association with the 2011 and 2019 Nags Head Beach Nourishment post-construction monitoring. The primary purpose of the beach monitoring is to determine the condition of the beaches, measure shoreline change and volumetric rates of erosion and accretion, maintain eligibility for designation as a FEMA engineered beach, estimate when future maintenance activities may be warranted, and evaluate the performance of beach nourishment and other restoration efforts.

It is understood that McKim & Creed will be conducting the fall monitoring surveys under a separate contract with the Town. M&N has been coordinating with McKim & Creed to confirm that their survey scope and M&N's analysis scope are in alignment. Under this proposed scope of work, M&N will be responsible for receiving the survey data products from McKim & Creed, writing and production of the reports, and the shoreline/volumetric analyses associated with the reports.

## TASK 18 SCOPE OF WORK

As stated above, the proposed Scope of Work is for the Town of Nags Head 2024 Fall Survey Analysis. In general, the task includes preparation of a supplemental report to summarize the shoreline and volume change analysis of 112 profiles along the Town of Nags Head shoreline that will be surveyed under a separate contract between the Town and McKim & Creed. A more detailed outline of project tasks is as follows.

### Task 18.1 – Completion of Fall Survey Analysis and Supplemental Beach Condition Memo

(A) Survey Scheduling and Client Coordination - McKim & Creed will provide fall season beach condition surveying under a separate contract between the Town and **McKim & Creed**. **M&N** will assist the Town to coordinate the survey with McKim & Creed. The survey of the transects is scheduled to take place during the month of November 2024, with the objective of capturing the effects of storms that have occurred during the 2024 late summer and fall season. M&N will work closely with McKim & Creed and the Town to facilitate McKim & Creed's surveys within this designated time frame.

(B) Survey Profiles – The 112 survey transects established in 2012 for the 2011 Nags Head Beach Nourishment post-construction monitoring covering the Nourished Oceanfront and part of National Seashore North will be used for analysis.

(C) Data Analysis and Reporting - Using data provided by **McKim & Creed**, **M&N** will perform the following monitoring analysis:

Shoreline and Volume Change

**M&N** will compute shoreline changes between the 2024 summer and fall surveys for the MHW elevation of +1.18 ft NAVD88. **M&N** will report these results at each transect as well as the

average changes for each of the previously established subreaches. Comparison between the status of the shoreline in Fall 2023 and Fall 2024 will also be conducted.

**M&N** will compute volume changes between the 2024 summer and fall surveys above several strategically selected elevations to track sand movement along the profile. **M&N** will calculate these volume changes in accordance with the 2024 annual monitoring efforts from a landward point on the back of the dune out to the seaward edge of the nourishment berm (+6 ft NAVD88), above MHW (+1.18 ft NAVD88), above -6 ft NAVD (wading depth), above -14 ft NAVD88 (capturing the offshore bar), above -19 ft NAVD (depth of closure), and above -30 ft NAVD (approximate seaward extent of surveys). **M&N** will report these results at each transect as well as the overall changes for each of the previously established subreaches. Comparison between the measured profile volumes in Fall 2023 and Fall 2024 will also be conducted. The volumetric change calculations performed during the analyses will be used to identify areas vulnerable to significant scarping and overwash or exhibiting significant dune growth.

Beach Nourishment Project Performance

The volumetric change calculations performed during the annual analyses will be used to track the performance of any beach nourishment or other maintenance projects. Annual changes from each placement area will be documented throughout the nourishment cycle to gain an understanding of actual volume lost, providing insight into future volume need. Comparisons will be made between the current condition of the beach and the volumetric triggers established in the Nags Head Multi-Decadal Beach Nourishment Master Plan, allowing for estimates of when the next nourishment will be needed.

Reporting

Once all of the analyses are completed, the resulting calculations and analysis will be included within a supplemental beach condition memorandum. One (1) copy of the draft memorandum will be submitted to the Town by January 22, 2025 (or six weeks after receiving all survey products from **McKim & Creed**) for Town review and comment. The memorandum will summarize the status of the beach with regards to the volumetric triggers. The data will also be included in the 2025 Annual Monitoring Report. **M&N** will submit eight (8) hard copies of the memo and one (1) electronic copy of the memo to the Town by February 5, 2025, or within two weeks after receiving the Town's comments on the draft memo. **M&N** will also attend and provide a presentation to the Town's Board of Commissioners at one of their monthly, regularly scheduled meetings. All data collected for each survey event by McKim & Creed will also be provided by file transfer or on a USB flash drive.

## TASK 18 PROJECT COST

The total estimated fee for the Town of Nags Head 2024 Fall Survey Analysis is a lump sum of **$26,350**, including expenses for reproduction. M&N proposes to invoice the Town monthly on a percent complete basis by Task.

# Agenda Item Summary Sheet

Item No: **K-2**
Meeting Date: **October 2, 2024**

**Item Title**: Town Manager Garman – Update on construction of the Public Services Facility

**Item Summary**:

At the October 2nd Board of Commissioners meeting, Town Manager Andy Garman, along with Town Engineer David Ryan, will present an update on the construction progress of the new Public Services Facility.

Number of Attachments: 0

**Specific Action Requested**:

Provided for Board information and update.

Submitted By: Administration Date: September 26, 2024

**Finance Officer Comment**:

Insufficient information to determine fiscal impact.

Signature: Amy Miller Date: September 26, 2024

**Town Attorney Comment**:

N/A

Signature: John Leidy Date: September 26, 2024

**Town Manager Comment and/or Recommendation**:

I will participate in the discussion as necessary.

Signature: Andy Garman Date: September 26, 2024