# Dare County Beaches, Shore Protection Project
# Physical Monitoring Program
# Thanksgiving Nor'easter Profile Survey Report

**April 2007**

**Photo: South Nags Head, 22 November 2006**
**(photo courtesy of Charles Rocknak)**


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## 1. Purpose

This report presents the results from the profile survey conducted in November/December 2006. This was a supplemental survey to the bi-annual monitoring to capture the changes induced from the 2006 Thanksgiving Nor'easter. Since the monitoring plan began in 2004, this was the largest storm on record with wave heights of 17ft and storm surge of 3.5ft recorded at the USACE Field Reseach Facility in Duck North Carolina. The intent of this report is to provide a written reference for interpretation of the data. This report begins with a brief overview and list of previous surveys. Next, survey methods and datum's are discussed, followed by the last sections which present the data and dissemination.

## 2. Overview

The Dare County Beaches (Bodie Island) Shore Protection Project includes the towns of Kitty Hawk, Kill Devil Hills, and Nags Head along the Outer Banks of North Carolina. The design is to construct a 25-ft wide, 13-ft (ref. National Geodetic Vertical Datum of 1929-NGVD) high dune fronted by a 50-ft wide berm at an elevation of 7 ft (NGVD). In 2004, the South Atlantic Division, Wilmington District (SAW) initiated physical and biological monitoring to assess the performance of the project. SAW partnered with the USACE Engineer Research and Development Center, Coastal and Hydraulics Laboratory's Field Research Facility (FRF) located in Duck, NC for the physical monitoring. Data collected under the physical monitoring plan will be used to: (1) assess the beach response to the fill placement and will serve as the basis for maintaining the project; (2) quantify the movement of fill from the project limits to adjacent non-project areas, and (3) provide data in support of the biological monitoring effort. For this reason, the physical monitoring includes areas outside the project limits.

The physical monitoring will cover the pre, during, and post-construction phases of the project. The plan includes continuous operation of a single Acoustic Doppler Current Profiler (ADCP) to measure waves and currents. Summaries of these measurements can be found on the FRF's web site, http://frf.usace.army.mil/. This gauge will be used to provide a general wave climate and will be re-located approximately annually to address a number of specific issues. The initial location is in the lee of a northern borrow site, **Figure 1**. The next location will likely be close to where sand is initially placed on the beach. At some point in the future, the gauge will be returned to the initial location to determine if excavation has caused a change in the wave characteristics.

The monitoring plan calls for beach and nearshore profile surveys to be taken every 1000 ft starting in Southern Shores, 3-miles north of the Kitty Hawk town limit, and continuing south to Oregon Inlet, **Figures 1** and **2.** See **Appendix A** for a listing of the profile numbers, origin points, and line azimuths. Each of the 144 profile lines extends from a stable point landward of

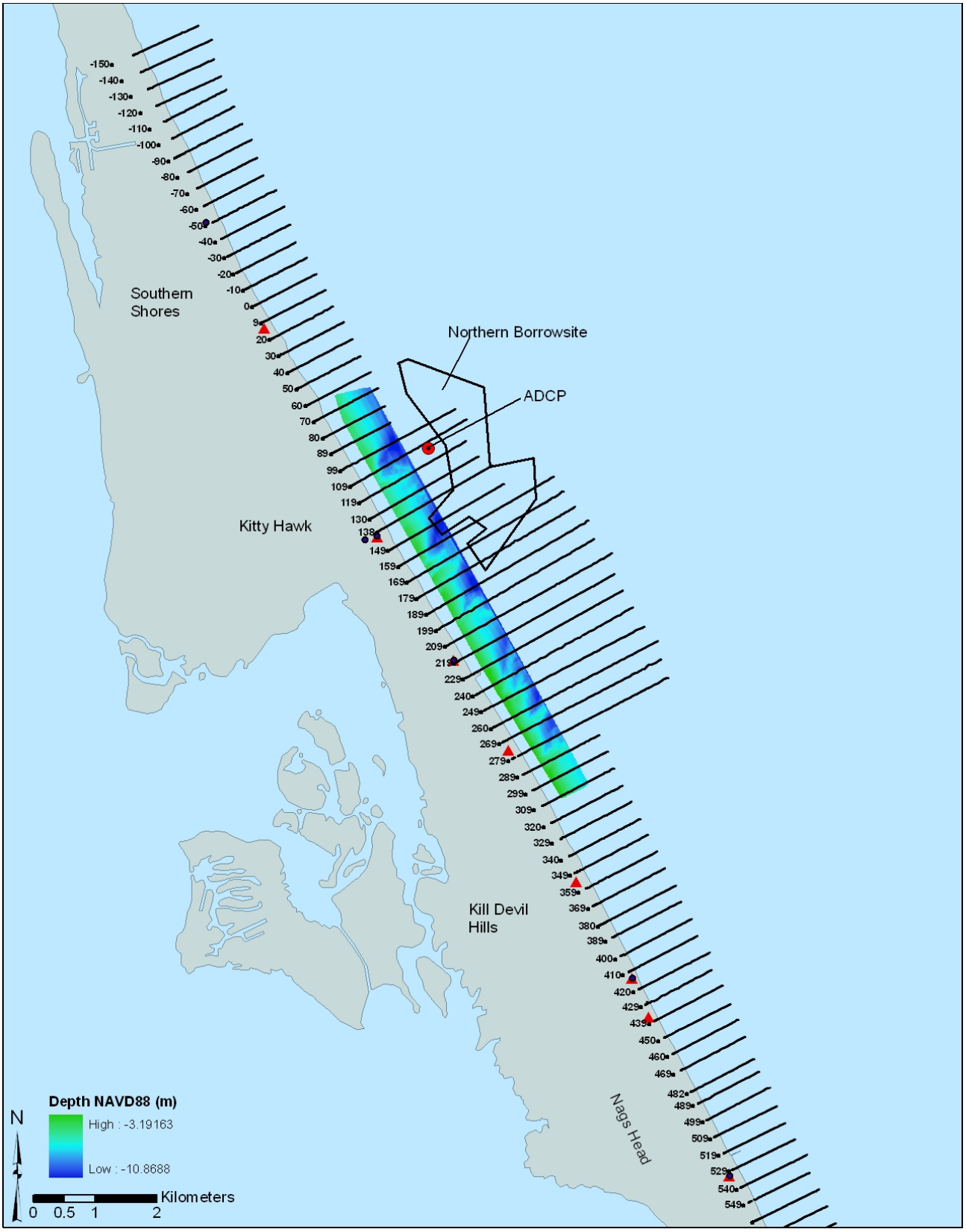



**Figure 1**. Profile lines and control locations (red triangles) in Southern Shores, Kitty Hawk, Kill Devil Hills, and Nags Head. Colored bathymetry is from swath data collected in the spring 2006

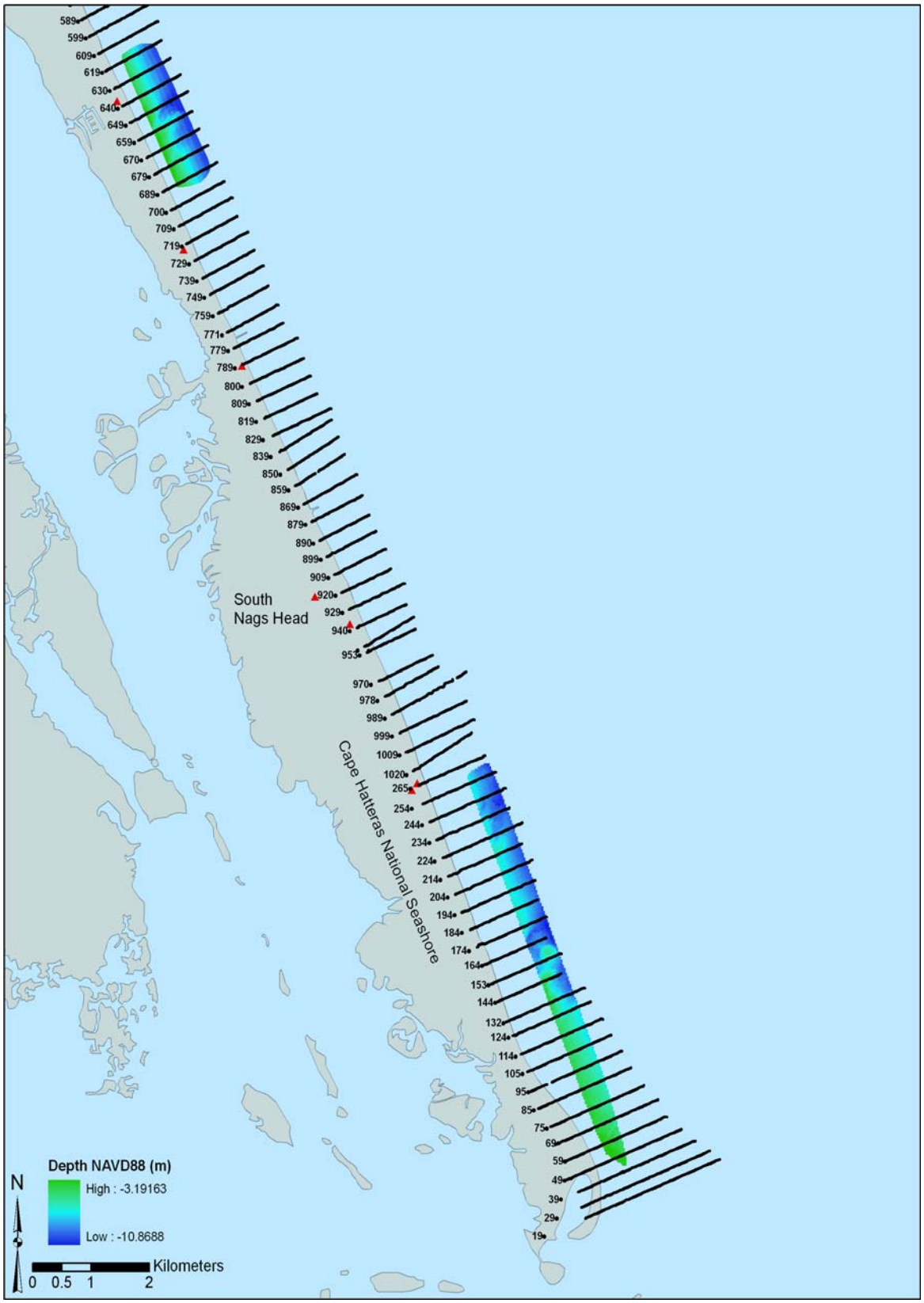



**Figure 2**. Profile lines and control locations (red triangles) in South Nags Head and Cape Hatteras National Seashore. Colored bathymetry is from swath data collected spring, 2006

the dune to the -30 ft depth contour. These profile lines will be surveyed twice per year, scheduled for the spring (Mar-Apr) and fall (Oct-Nov).

The monitoring plan also calls for swath bathymetry and sediment sampling. Swath bathymetry will be collected across shore and along shore where the isobaths are irregular and will supplement the profiling so that a complete model of the ocean bottom can be obtained. Sediment samples are to be taken from 67 selected lines, five sampes along the onshore portion and five along the offshore portion. Sediment sample analysis, the responsibility of SAW, will be used to determine grain size and distribution before the project and any changes during the project.

3. Previous Surveys

The 2004 survey was the first of this monitoring program. The other surveys that exist are listed in **Table 1**. On sixty-two profile lines from Duck to Oregon Inlet, the beach was surveyed monthly from 1974-1977 as part of the USACE Beach Evaluation Program (BEP). In the mid 1990s, SAW established new lines in anticipation of the Dare Co. project. These lines will be referred to as the "DARE" profiles. In 1994, SAW surveyed both the beach and nearshore portion of the DARE profiles. The BEP lines within the project area were then resurveyed by SAW in 1995. In 2001, a subset of the DARE lines, where the anticipated first phase of the project would be located, was surveyed by SAW. The 2001 survey did not include the most northern lines, southern lines, and the middle lines in between the two fill areas. In 2003, the FRF in partnership with the U.S. Geological Society (USGS) surveyed the DARE lines from Southern Shores to Jeannette's pier in Nags Head. In August 2004, all 144 DARE profiles were surveyed by the FRF. In 2005 92 lines were surveyed by the FRF and 52 lines were surveyed by Mckimm and Creed and in 2006 all 144 profiles were surveyed by the FRF in April, September, and November.

**Table 1. Previous Dare County Surveys**

| Data Set | Lines (# surveyed) | By |
|---|---|---|
| 1974-1977 | BEP | USACE BEP |
| 1994 | DARE | SAW |
| 1995 | BEP | SAW |
| 2001 | DARE | SAW |
| 2003 | DARE | FRF/USGS |
| 2004 | DARE (144) | FRF |
| 2005 | DARE (144) | FRF & McKim & Creed |
| 2006 April | DARE (144) | FRF |
| 2006 Sept. | DARE (144) | FRF |
| 2006 Nov. | DARE (144) | FRF |

4. Bathymetric and Topographic Surveys

Bathymetric and topographic surveys began on 25 November and were completed by 11 December 2006. The survey schedule **Appendix B,** shows that 6 of the 17 days were lost to inclement weather (wind and waves).

4.1. LARC Profiles.

The bathymetric data were collected with the FRF's LARC 191, a Korean War era Army *Lighter Amphibious Resupply Cargo* amphibious vessel. The survey system consisted of a Real Time Kinematic (RTK) Global Positioning Satellite (GPS) system, single beam echo sounder, and a motion sensor measuring heave, pitch and roll, **Figure 3**. Using input from a base station at a known location, published accuracies for RTK GPS systems are between 1 to 3 inches depending on satellite configurations and distance from the base station. Trimble 4000 dual frequency receivers were used both on the LARC and at the base station. Equipment specifications are given in **Table 2**. Control, datums, and other considerations are provided below.

The echo sounder was a Knudsen 320BP dual frequency fathometer. This unit has been widely used by the USACE. Although equipped with 50 and 200 kHz frequency transducers, in this application, only the 200 kHz was used to provide better resolution at shallow depths, (0-66 ft.) The Knudsen was also equipped with a close proximity option allowing accurate depths as shallow as 0.5 ft. to be obtained. This was valuable since when the LARC wheels stop touching the sand, in depths over 1.5 ft below the transducer, the fathometer signal was required. The VT TSS Ltd DMS Series 3-25 heave, roll, and pitch sensor was used to track the vessel's motion.

Coastal Oceanographic's Hypack Max v.4.3 was used to guide the vessel along the profiles and to collect the position, depth, and motion information. The RTK-GPS signal was sampled at 1 Hz, the sounder at 9 Hz, and the motion sensor at 20 Hz. Custom software developed at the FRF used the RTK GPS information to remove the wave and water level variation. This was accomplished by careful adjustment of the timing between sounder and GPS data streams such that a precise measure of the depth was obtained at the exact moment that the GPS position was acquired. With this sampling rate, data points were acquired, on average, every10 ft The sounder depth value was also adjusted for the roll and pitch of the boat and for the variation in the speed of sound through the water column. The speed of sound was determined by measuring the

**Figure 3**. Equipment on LARC

| **Table 2. Survey Equipment List** | | |
|---|---|---|
| Model | LARC-V | US Army |
| Length | 10.7 meters / 35 feet | |
| Drive System | Four Wheel plus marine drive | see Figure 1 |
| **Echosounder** | | |
| Model/Manufacturer | 320B/P Portable | Knudsen Engineering |
| Frequency | 50/200 kHz | |
| Resolution | 1cm | 0-99.99 meters range |
| Sound Velocity | 1300-1700 m/s | Resolution 1 m/s |
| Transmit Blanking | 0-5 meters | User Selectable |
| **Motion Reference Unit** | | |
| Model/Manufacturer | DMS Series 3-25 | VT TSS Limited |
| Heave Accuracy | The greater of 5cm or 5% | Resolution 1 cm |
| Pitch/Roll Accuracy | +/-0.25 degree | |
| **GPS Receivers** | | |
| Model/Manufacturer | 4000 SSE, 4700, & 5700 | Trimble |
| Frequency | Dual high precision L1 and L2 | |
| RTK-GPS Accuracy | Dependant on conditions such as multipath, obstructions, satellite geometry, atmospheric parameters and base station control quality. | |
| Published Horizontal Accuracy | 1Hz = 1cm +/-2ppm | |
| Published Vertical Accuracy | 1Hz = 2cm +/-2ppm | |
| Solution Precision | 2 to 5 cm | |
| **Speed of Sound Instrument (CTD)** | | |
| Model/Manufacturer | OS-200 | Ocean Sensors |
| Maximum Scan Rate | 145 per second | |
| Pressure Accuracy | dBar = 0.50% | |
| Temperature | deg C = 0.01 | |
| Conductivity | mS/cm = 0.02 | |
| Salinity | PSU = 0.03 | |
| **Computers & Software** | | |
| Model/Manufacturer | Inspiron Laptop 730 Mhz | Dell |
| Collection Software | Hypack Max version 4.3 | Coastal Oceanographics |
| Echosounder | Sounder Suite | Knudsen Engineering |
| Tablet PC | Stylus ltp-600 | Fujitsu |
| Processing Software | Fathomax | Custom FORTRAN routine |
| CTD Processing | CTD2SSP | Custom PERL routine |

conductivity, temperature, and depth (CTD), with an Ocean Sensors CTD OS200. These CTD casts were performed approximately every 2 hours at the offshore ends of the survey line in approximately 30-ft depth. From the CTD information, the speed of sound was computed. Speed of sound can be important, for example an 80 ft/s error in the speed of sound (nominally 4,950 ft/s) will result in a 5 inch depth error in 30 ft of water.

4.2. Topographic Profiles.

Topographic (Topo), or beach, profiles were obtained with backpack mounted Trimble 5700 RTK GPS systems **Figure 4**. The GPS antennas were mounted on the backpacks at a fixed height, and data points were collected every second (approx. every 2ft) as the surveyor continuously walked along the profile. The beach profiles began at a baseline (such as a road) or a stable point behind the primary dune and continued to the waters edge. The surveyor used a Fujitsu Tablet PC with Hypack v. 4.3 for data logging and navigation along the pre-programmed line. All terrain vehicles (ATV) were used to transport the surveyors to each profile location.

**Figure 4**. Backpack survey

The same control was used for both the beach and offshore surveys. For each profile the Topo overlapped the LARC data to ensure homogeneity. The LARC was used to cover the wet portion of the Topo lines extending up onto the beach to the toe of the dune providing much more than required overlap with the walking backpack data collection.

4.3 Control, Datums, and QA/QC.

Horizontal/vertical control and datums are basic ingredients for accurate surveys. Geodesy controls for this survey were the North American Datum of 1983 (NAD83), as adjusted in 2001, North Carolina State Plane for horizontal and the North American Vertical Datum of 1988 (NAVD88), using the 2003 Geoid for the vertical. The survey data were collected using metric units and post processed to English (feet) units.

The 30 miles of coast was broken up into 5 approximately 5-mile-long sections. In each section a base station and separate calibration station locations were established. First order control for the base and calibration stations was provided by SAW.

**Figure 5**. Topographic Calibration check on Juncos MP 19.7

Both Topo and LARC survey teams occupied calibration stations at least daily to document horizontal and vertical accuracies **Figure 5**. **Appendix C** contains tables for the 3 calibration stations that summarize the daily evaluations. For all of the calibration

stations, both the Topo and LARC systems operated well within the expected vertical RTK-GPS accuracy of 1 to 3 inches.

### 4.4 Field Notes

The LARC digital survey notes are included as **Appendix D**. These field notes describe the status of the GPS equipment as each line is surveyed and any notes the survey technician added to better define the field conditions. LARC line notes include the locations of where CTD measurements were collected, and any notes to provide insight when post processing the data. Federal Geographic Data Committee approved metadata files have been created for each survey day and are included in **Appendix E**. These metadata files are named with year, month, and day in the following format 20060413.met.

## 5. Data

The Thanksgiving Nor'easter began on Tuesday 21 November and peaked early Wednesday morning 22 November. Winds of 55 mph and waves of 17.6 ft were measured at the FRF during the morning of 22 November. The detailed monthly summary of FRF observations for November is included as **Appendix F**.

One measure of data consistency and, to some extent, quality is to examine changes at the seaward end of the profile; particularly for parallel offsets between successive surveys and between adjacent lines. For the most part, the offshore ends of all the surveys are tight and consistent alongshore, however the beach and nearshore bar show the effects of a storm. This can be seen in the example "stacked" cross-section plot shown in **Figure 6**, and in the complete set of plots comparing the 2006 October and December profiles in **Appendix G**.

The mean high water contour (3.37 ft) change was calculated between the Sept/October and November/December profiles to get a general idea of the beach response to the storm conditions **Figures 7a** & **7b**. Areas in Northern Kitty Hawk, Nags Head, South Nags Head, and the Cape Hatteras National Seashore exhibited the highest erosion at the MHW contour. Certain profiles exceeded 95 feet of retreat. Kill Devil Hills, southern Kitty Hawk, and other localized areas remained relatively stable during the storm.

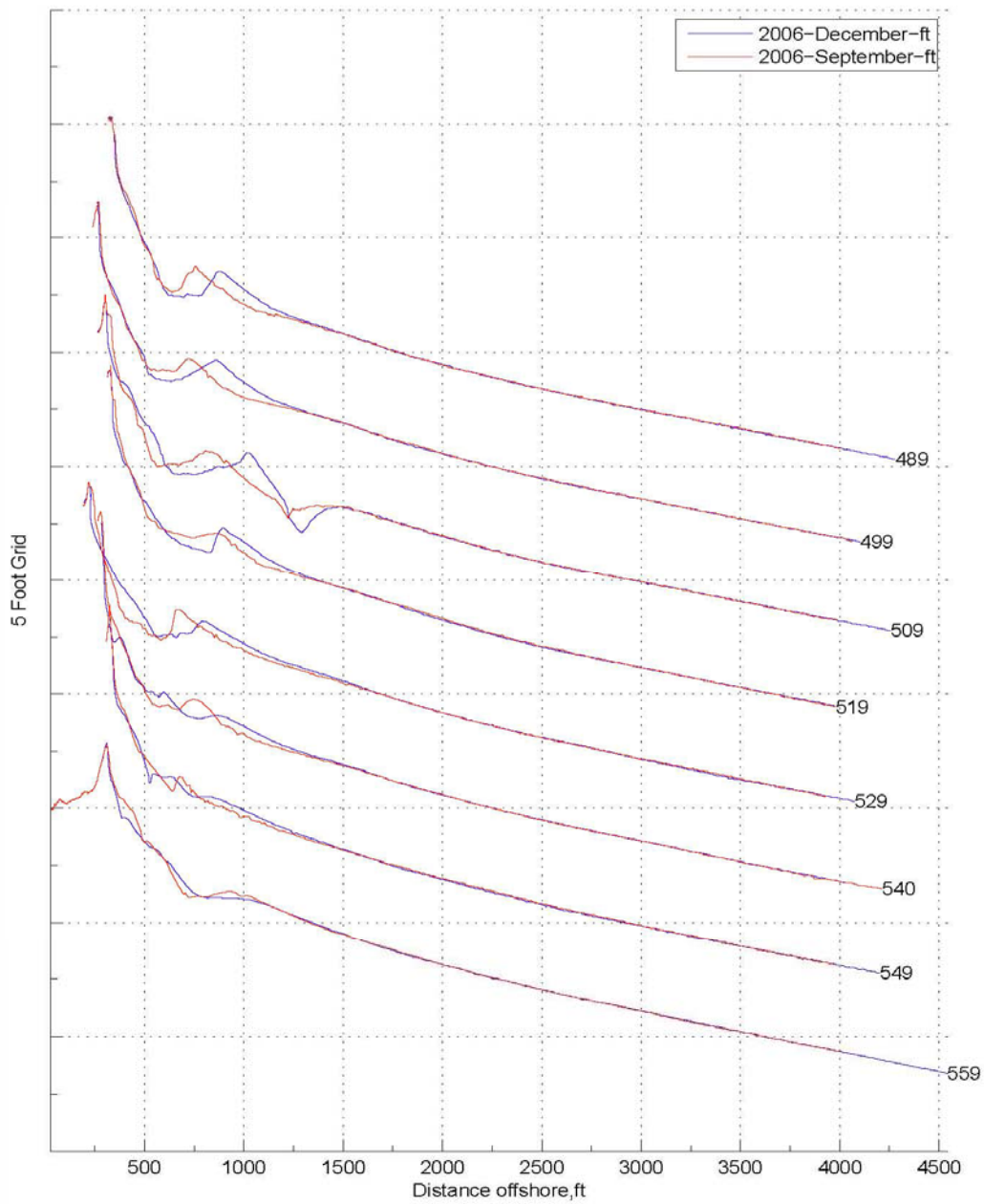



**Figure 6.** Example stackplot from select profiles in Nags Head

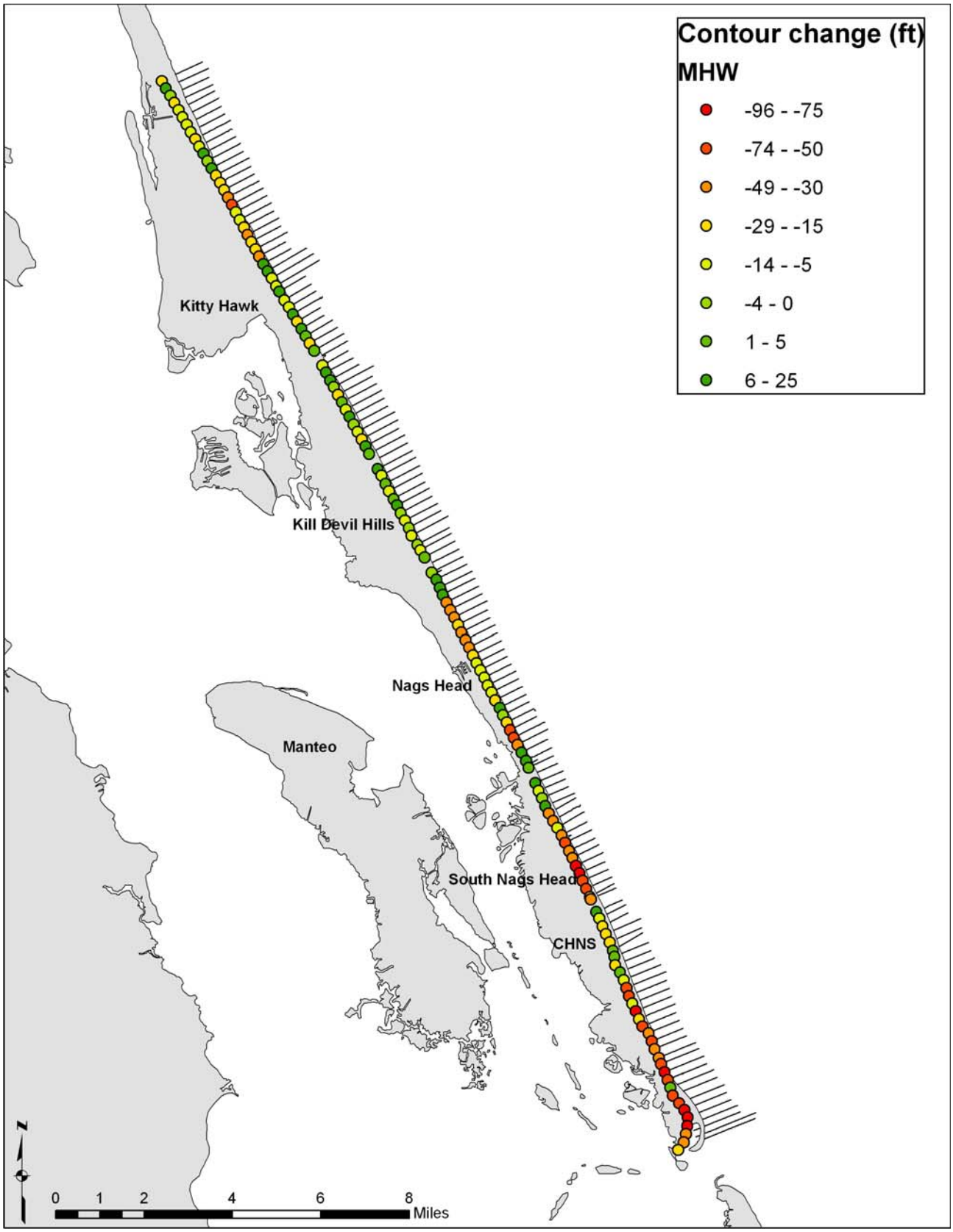



**Figure 7a.** Plot of MHW contour change from October 2006 to December 2006.

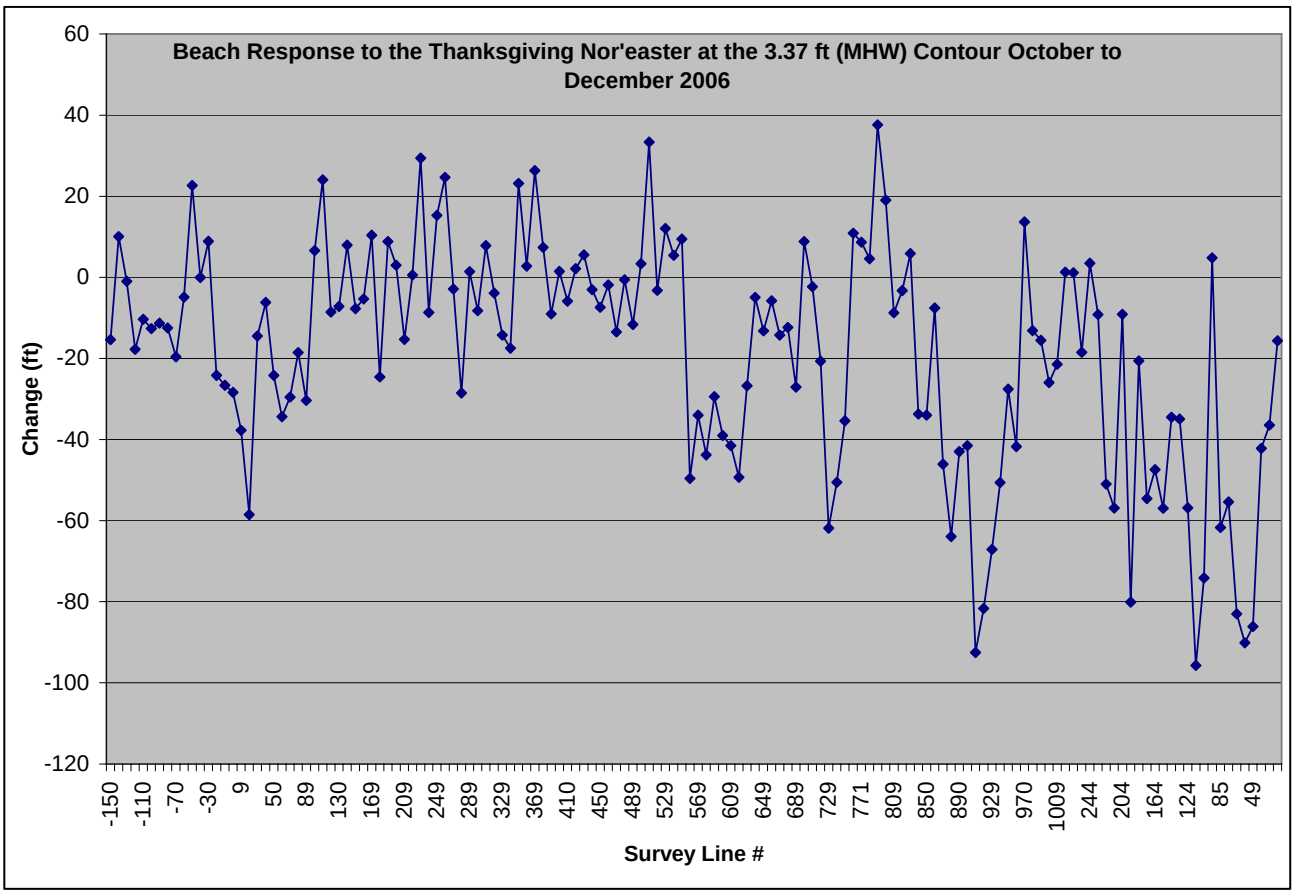



**Figure 7b.** Beach response to the Thanksgiving Nor'easter at the 3.37ft NAVD88 (MHW) contour.

In addition to topographic walking surveys, an area stretching approximately 4 miles from line 254 south to line 39 in Cape Hatteras National Seashore was surveyed using an ATV. RTK GPS was used to log points continuously as the ATV drove the base of the scarped dune. See **Figure 8** for aerial view of dune loss. This data will be included with the 3d file.

**Figure 8.** Near Line 105 in the Cape Hatteras National Seashore displaying dune erosion just three days after storm's passage (Yellow line is base of the dune surveyed using ATV). (Aerial Photo from 2003)

5.1 Data Transfer.

The data products are a 3D file and a BMAP file. The .3D file contains space delimited xyz values. For all of the profiles, each data point is described by 24 columns of information which include: the project location, profile number, survey number, latitude, longitude, northing, easting, distance from baseline, offline distance, depth, date, time and time from midnight. The .bmap file is much simpler and facilitates profile comparisons, see format example to the left. These data along with the data report containing all appendices will be transferred via the CHL Guest FTP site at the following link: ftp://134.164.34.99/FRF/Dare_County/2006_Thanksgiving_Noreaster/

```
BMAP File Example

DC -150 20041013 COMBINED
386
  1256.4000     20.2760
  1262.1700     18.2810
  1268.8000     15.4400
  1278.3400     13.4580
  1289.2400     11.4800
```

where the lines are:
location, line number, date
number of data points
distance along line & depth pairs

This is the fifth in a series of FRF Dare County Beaches, Shore Protection Project Physical Monitoring Program Profile Survey and Sediment Sampling Reports. Future reports will have approximately the same format and content. Suggestions for improving the reports, questions about the contents of this report, and/or about the data should be directed to Mr. Mike Forte, Survey Specialist, at Michael.f.forte@erdc.usace.army.mil or by phone (252) 261-6840 ext 228.

## Appendix A. Profiles numbers, Origins and azimuths

| # | LOCATION | STATION | STATION Abbreviation | SEDIMENT LINES rev Jun06 | ORIGIN Easting (ft) | Northing (ft) | AZIMUTH (deg) |
|---|---|---|---|---|---|---|---|
| 1 | | -150+00 | -150 | | 2,964,665.00 | 885,364.00 | 65.31 |
| 2 | | -140+00 | -140 | S | 2,965,116.00 | 884,444.00 | 65.31 |
| 3 | | -130+00 | -130 | S | 2,965,239.00 | 883,452.00 | 65.31 |
| 4 | | -120+00 | -120 | | 2,965,920.00 | 882,604.00 | 65.31 |
| 5 | | -110+00 | -110 | S | 2,966,366.00 | 881,697.00 | 62.57 |
| 6 | *SOUTHERN* | -100+00 | -100 | S | 2,966,790.00 | 880,778.00 | 62.57 |
| 7 | *SHORES* | -90+00 | -90 | | 2,967,110.00 | 879,895.00 | 62.57 |
| 8 | (CONTROL rev jul04) | -80+00 | -80 | S | 2,967,533.00 | 878,988.00 | 62.57 |
| 9 | | -70+00 | -70 | S | 2,967,951.00 | 878,106.00 | 62.57 |
| 10 | | -60+00 | -60 | | 2,968,381.00 | 877,175.00 | 62.57 |
| 11 | | -50+00 | -50 | S | 2,968,838.00 | 876,228.00 | 62.57 |
| 12 | | -40+00 | -40 | S | 2,969,249.00 | 875,440.00 | 62.57 |
| 13 | | -30+00 | -30 | | 2,969,731.60 | 874,496.08 | 62.57 |
| 14 | | -20+00 | -20 | S | 2,970,189.67 | 873,607.16 | 62.57 |
| 15 | | -10+00 | -10 | S | 2,970,653.00 | 872,720.97 | 62.57 |
| 1 | *KITTY HAWK* | 0+00.00 | 0 | | 2,971,224.16 | 871,890.75 | 62.57 |
| 2 | | 9+99.90 | 9 | | 2,971,685.80 | 871,003.31 | 62.57 |
| 3 | | 20+02.68 | 20 | S | 2,972,153.17 | 870,116.67 | 62.16 |
| 4 | | 30+05.52 | 30 | | 2,972,621.69 | 869,230.04 | 62.15 |
| 5 | | 40+23.88 | 40 | | 2,973,097.45 | 868,329.69 | 62.15 |
| 6 | | 50+28.29 | 50 | S | 2,973,566.68 | 867,441.67 | 62.15 |
| 7 | | 60+50.00 | 60 | | 2,974,044.04 | 866,538.35 | 62.15 |
| 8 | | 70+02.90 | 70 | | 2,974,489.14 | 865,695.84 | 62.15 |
| 9 | | 80+15.19 | 80 | S | 2,974,962.02 | 864,800.83 | 62.15 |
| 10 | | 89+56.91 | 89 | | 2,975,401.91 | 863,968.19 | 62.15 |
| 11 | **START N. PROJ** | 99+99.71 | 99 | | 2,975,900.20 | 863,052.18 | 61.46 |
| 12 | **STA 108+30** | 109+99.46 | 109 | S | 2,976,406.09 | 862,189.91 | 59.60 |
| 13 | | 119+99.14 | 119 | | 2,976,911.94 | 861,327.71 | 59.60 |
| 14 | | 130+33.04 | 130 | | 2,977,435.12 | 860,435.98 | 59.60 |
| 15 | **BEGIN MAIN FILL** | 138+27.64 | 138 | S | 2,977,811.33 | 859,735.48 | 59.60 |
| 16 | **STA 138+30** | 149+99.46 | 149 | | 2,978,430.26 | 858,740.05 | 59.60 |
| 17 | | 159+99.55 | 159 | S | 2,978,966.59 | 857,895.27 | 59.60 |
| 18 | | 169+70.21 | 169 | S | 2,979,427.66 | 857,040.44 | 59.60 |
| 19 | | 179+87.62 | 179 | | 2,979,942.69 | 856,163.07 | 59.59 |
| 20 | *KITTY HAWK* | 189+87.10 | 189 | S | 2,980,448.64 | 855,301.16 | 59.59 |
| 21 | *KILL DEVIL HILLS* | 199+93.01 | 199 | S | 2,980,957.84 | 854,433.71 | 59.59 |
| 22 | | 209+74.44 | 209 | | 2,981,440.37 | 853,579.14 | 60.55 |
| 23 | | 219+99.94 | 219 | S | 2,981,944.55 | 852,686.23 | 60.55 |
| 24 | | 229+83.39 | 229 | S | 2,982,428.55 | 851,830.15 | 60.52 |

| # | LOCATION | STATION | STATION Abbreviation | SEDIMENT LINES rev Jun06 | ORIGIN Easting (ft) | Northing (ft) | AZIMUTH (deg) |
|---|---|---|---|---|---|---|---|
| 25 | | 240+41.84 | 240 | | 2,982,949.45 | 850,908.80 | 60.52 |
| 26 | | 249+81.53 | 249 | S | 2,983,384.80 | 850,076.05 | 61.91 |
| 27 | | 260+17.44 | 260 | S | 2,983,879.57 | 849,165.95 | 61.91 |
| 28 | | 269+49.25 | 269 | | 2,984,314.02 | 848,341.66 | 62.21 |
| 29 | | 279+80.81 | 279 | S | 2,984,795.03 | 847,429.13 | 62.21 |
| 30 | **END MAIN FILL** | 289+99.14 | 289 | S | 2,985,305.30 | 846,547.02 | 62.20 |
| 31 | **STA 297+30** | 299+92.48 | 299 | | 2,985,733.15 | 845,649.70 | 62.20 |
| 32 | | 309+71.20 | 309 | S | 2,986,193.06 | 844,785.81 | 61.97 |
| 33 | **STOP NORTH PROJ.** | 320+05.37 | 320 | | 2,986,679.03 | 843,872.99 | 61.97 |
| 34 | **STA 327+30** | 329+88.80 | 329 | | 2,987,138.95 | 843,003.79 | 62.12 |
| 35 | | 340+20.02 | 340 | S | 2,987,621.23 | 842,092.34 | 62.12 |
| 36 | | 349+69.94 | 349 | | 2,988,097.30 | 841,269.59 | 62.12 |
| 37 | | 359+82.85 | 359 | | 2,988,539.16 | 840,357.49 | 62.12 |
| 38 | | 369+89.02 | 369 | S | 2,989,042.40 | 839,485.48 | 62.12 |
| 39 | | 380+71.83 | 380 | | 2,989,558.45 | 838,533.55 | 62.12 |
| 40 | | 389+70.36 | 389 | | 2,989,974.18 | 837,737.02 | 62.12 |
| 41 | | 400+57.86 | 400 | S | 2,990,476.49 | 836,772.51 | 62.12 |
| 42 | | 410+12.16 | 410 | | 2,990,890.88 | 835,912.18 | 62.12 |
| 43 | | 420+89.66 | 420 | | 2,991,438.01 | 834,982.69 | 62.12 |
| 44 | *KILL DEVIL HILLS* | 429+88.10 | 429 | S | 2,991,860.77 | 834,189.98 | 62.12 |
| 45 | *NAGS HEAD* | 439+84.62 | 439 | | 2,992,280.78 | 833,284.86 | 62.12 |
| 46 | | 450+18.31 | 450 | | 2,992,764.13 | 832,371.20 | 62.79 |
| 47 | | 460+03.41 | 460 | S | 2,993,260.87 | 831,519.62 | 62.07 |
| 48 | | 469+90.51 | 469 | | 2,993,571.24 | 830,566.97 | 62.07 |
| 49 | | 482+61.53 | 483 | | 2,994,282.89 | 829,505.73 | 62.14 |
| 50 | **START SOUTH PROJ.** | 489+92.29 | 489 | S | 2,994,624.38 | 828,859.71 | 62.14 |
| 51 | **STA 491+60** | 499+97.64 | 499 | | 2,995,136.62 | 827,993.36 | 62.14 |
| 52 | | 509+86.74 | 509 | S | 2,995,535.43 | 827,085.76 | 63.51 |
| 53 | **START MAIN FILL** | 519+88.58 | 519 | | 2,995,982.37 | 826,189.19 | 63.51 |
| 54 | **STA 521+90** | 529+92.45 | 529 | S | 2,996,546.90 | 825,348.12 | 63.84 |
| 55 | | 540+41.58 | 540 | | 2,996,933.15 | 824,369.30 | 63.51 |
| 56 | | 549+53.69 | 549 | S | 2,997,305.24 | 823,535.68 | 63.50 |
| 57 | | 559+88.71 | 559 | | 2,997,767.08 | 822,609.46 | 63.50 |
| 58 | | 569+88.44 | 569 | S | 2,998,213.17 | 821,714.83 | 63.50 |
| 59 | | 580+06.85 | 580 | | 2,998,666.77 | 820,803.08 | 63.55 |
| 60 | | 589+92.95 | 589 | S | 2,999,105.97 | 819,920.26 | 63.55 |
| 61 | | 599+65.00 | 599 | | 2,999,538.91 | 819,050.02 | 63.55 |
| 62 | | 609+90.87 | 609 | S | 2,999,999.13 | 818,133.25 | 63.35 |
| 63 | | 619+64.56 | 619 | | 3,000,464.71 | 817,277.44 | 63.51 |
| 64 | | 630+09.03 | 630 | S | 3,000,899.20 | 816,327.06 | 63.51 |
| 65 | | 640+20.72 | 640 | | 3,001,350.40 | 815,421.63 | 63.51 |

| # | LOCATION | STATION | STATION Abbreviation | SEDIMENT LINES rev Jun06 | ORIGIN Easting (ft) | Northing (ft) | AZIMUTH (deg) |
|---|---|---|---|---|---|---|---|
| 66 | | 649+79.72 | 649 | S | 3,001,778.10 | 814,563.41 | 63.51 |
| 67 | | 659+99.80 | 659 | | 3,002,272.47 | 813,670.06 | 63.51 |
| 68 | **START PH-I SO. PROJ.** | 670+05.57 | 670 | S | 3,002,681.61 | 812,750.29 | 63.52 |
| 69 | **STA 675+00** | 679+70.59 | 679 | | 3,003,111.96 | 811,886.62 | 63.52 |
| 70 | | 689+93.04 | 689 | S | 3,003,567.92 | 810,971.55 | 63.52 |
| 71 | **START PH-I MAIN FILL** | 700+49.12 | 700 | | 3,004,086.42 | 810,050.04 | 63.47 |
| 72 | **STA 705** | 709+88.06 | 709 | S | 3,004,505.80 | 809,210.02 | 63.47 |
| 73 | | 719+89.21 | 719 | | 3,004,952.98 | 808,314.29 | 63.47 |
| 74 | | 729+74.68 | 729 | S | 3,005,344.90 | 807,408.71 | 63.43 |
| 75 | | 739+87.41 | 739 | | 3,005,797.93 | 806,503.04 | 63.43 |
| 76 | | 749+23.69 | 749 | S | 3,006,216.77 | 805,665.74 | 63.43 |
| 77 | | 759+89.41 | 759 | | 3,006,693.51 | 804,712.69 | 63.43 |
| 78 | | 771+03.13 | 771 | S | 3,007,224.84 | 803,733.28 | 63.43 |
| 79 | | 779+91.07 | 779 | | 3,007,566.98 | 802,912.03 | 65.00 |
| 80 | | 789+52.47 | 789 | S | 3,007,945.92 | 802,028.54 | 66.12 |
| 81 | | 800+05.35 | 800 | | 3,008,360.92 | 801,060.98 | 66.79 |
| 82 | | 809+84.88 | 809 | S | 3,008,747.00 | 800,160.83 | 66.79 |
| 83 | | 819+75.72 | 819 | | 3,009,137.59 | 799,250.30 | 66.78 |
| 84 | | 829+90.14 | 829 | S | 3,009,537.47 | 798,318.10 | 66.79 |
| 85 | **END PH-I MAIN FIL.** | 839+63.41 | 839 | | 3,009,965.04 | 797,443.87 | 60.59 |
| 86 | **STA 845+00** | 850+15.03 | 850 | S | 3,010,499.88 | 796,538.49 | 59.43 |
| 87 | | 859+53.78 | 859 | | 3,010,977.31 | 795,730.29 | 59.43 |
| 88 | **END PH-I PH-I SO PROJ.** | 869+90.85 | 869 | S | 3,011,486.87 | 794,827.11 | 62.40 |
| 89 | **STA 875+00** | 879+84.66 | 879 | | 3,011,915.10 | 793,930.36 | 64.48 |
| 90 | | 890+49.20 | 890 | S | 3,012,373.81 | 792,969.80 | 64.48 |
| 91 | | 899+74.97 | 899 | | 3,012,772.72 | 792,134.44 | 64.48 |
| 92 | | 909+94.51 | 909 | S | 3,013,203.68 | 791,210.53 | 65.00 |
| 93 | | 920+03.57 | 920 | | 3,013,608.79 | 790,286.43 | 66.33 |
| 94 | | 929+76.23 | 929 | S | 3,013,999.30 | 789,395.67 | 66.33 |
| 95 | | 940+08.61 | 940 | | 3,014,413.78 | 788,450.22 | 66.33 |
| 96 | | 951+00.34 | 951 | S | 3,014,852.11 | 787,450.42 | 61.23 |
| 97 | *NAGS HEAD* | 960+00.00 | 960 | | 3,015,213.29 | 786,626.57 | 66.33 |
| 98 | | 970+00.70 | 970 | S | 3,015,615.10 | 785,710.08 | 66.33 |
| 99 | **END MAIN FILL** | 978+95.72 | 978 | | 3,015,974.47 | 784,890.44 | 63.09 |
| 100 | **STA 996+50** | 989+09.57 | 989 | S | 3,016,381.55 | 783,961.97 | 62.69 |
| 101 | | 999+27.65 | 999 | | 3,016,790.36 | 783,029.64 | 66.33 |
| 102 | **END SOUTH PROJ.** | 1009+83.61 | 1009 | S | 3,017,214.37 | 782,062.62 | 66.33 |
| 103 | **STA 1025+00** | 1020+79.29 | 1020 | | 3,017,623.64 | 781,046.43 | 59.32 |
| 104 | | 264+00(ZN) | 265 | S | 3,017,811.35 | 780,343.61 | 68.00 |
| 105 | *CAPE HATTERAS* | 254+00(YN) | 254 | | 3,017,891.89 | 779,297.62 | 68.00 |
| 106 | *N. SEASHORE* | 244+00(XN) | 244 | | 3,018,479.41 | 778,456.45 | 68.00 |
| 107 | | 234+00(WN) | 234 | S | 3,018,896.90 | 777,546.60 | 68.00 |
| 108 | | 224+00(VN) | 224 | | 3,019,207.51 | 776,593.56 | 68.00 |

| # | LOCATION | STATION | STATION Abbreviation | SEDIMENT LINES rev Jun06 | ORIGIN Easting (ft) | Northing (ft) | AZIMUTH (deg) |
|---|---|---|---|---|---|---|---|
| 109 | | 214+00(UN) | 214 | | 3,019,520.51 | 775,641.48 | 68.00 |
| 110 | | 204+00(TN) | 204 | S | 3,019,918.65 | 774,723.81 | 68.00 |
| 111 | | 194+00(SN) | 194 | | 3,020,315.78 | 773,805.72 | 68.00 |
| 112 | | 184+00(RN) | 184 | | 3,020,723.12 | 772,891.76 | 68.00 |
| 113 | | 174+00(QN) | 174 | S | 3,021,118.89 | 771,973.13 | 68.00 |
| 114 | | 164+00(PN) | 164 | | 3,021,859.83 | 771,193.95 | 68.00 |
| 115 | | 153+00(ON) | 153 | | 3,022,228.09 | 770,198.06 | 68.00 |
| 116 | | 144+00(NNII) | 144 | S | 3,022,602.81 | 769,299.66 | 68.00 |
| 117 | | 132+00(MN85) | 132 | | 3,023,064.07 | 768,237.19 | 68.00 |
| 118 | | 124+00(MNI) | 124 | | 3,023,354.48 | 767,492.96 | 68.00 |
| 119 | | 114+00(MNII) | 114 | S | 3,023,763.17 | 766,514.47 | 68.00 |
| 120 | | 105+00(LN) | 105 | | 3,024,145.30 | 765,615.98 | 68.00 |
| 121 | | 95+00(KN85) | 95 | | 3,024,459.99 | 764,666.72 | 68.00 |
| 122 | | 85+00(JN90) | 85 | S | 3,024,774.23 | 763,732.18 | 68.00 |
| 123 | | 75+00(IN) | 75 | | 3,025,510.04 | 762,803.28 | 68.00 |
| 124 | | 69+00(HN) | 69 | | 3,026,141.46 | 762,028.59 | 68.00 |
| 125 | | 59+00(GN) | 59 | S | 3,026,535.19 | 761,110.30 | 68.00 |
| 126 | | 49+00(FN) | 49 | | 3,026,509.29 | 760,111.66 | 68.00 |
| 127 | | 39+00(EN) | 39 | | 3,026,307.17 | 759,129.90 | 68.00 |
| 128 | | 29+00(DN) | 29 | S | 3,026,059.89 | 758,164.18 | 68.00 |
| 129 | *OREGON INLET* | 19+00(CN-350) | 19 | | 3,025,368.41 | 757,231.36 | 68.00 |

**Appendix B Survey Schedule**

| *Dare County 2006 Thanksgiving Storm Survey Schedule* | | | | | | |
|---|---|---|---|---|---|---|
| | **LARC** | **TOPO** | | | | |
| **Date** | **# of Lines This Day** | **# of Lines This day** | **LARC % Complete** | **Topo % Complete** | **Job Cum %** | **Notes** |
| 25-Nov-06 | | **28** | | 19 | 10 | |
| 26-Nov-06 | | **23** | | 35 | 18 | |
| 27-Nov-06 | | **15** | | 46 | 23 | |
| 28-Nov-06 | | **23** | | 62 | 31 | |
| 29-Nov-06 | **39** | | 27 | 62 | 44 | |
| 30-Nov-06 | **40** | | 55 | 62 | 58 | |
| 1-Dec-06 | | | 55 | 62 | 58 | |
| 2-Dec-06 | | **46** | 55 | 94 | 74 | |
| 3-Dec-06 | | | 55 | 94 | 74 | |
| 4-Dec-06 | | 9 | 55 | 100 | 77 | |
| 5-Dec-06 | **14** | | 65 | 100 | 82 | |
| 6-Dec-06 | **28** | | 84 | 100 | 92 | |
| 7-Dec-06 | | | 84 | 100 | 92 | |
| 8-Dec-06 | | | 84 | 100 | 92 | |
| 9-Dec-06 | | | 84 | 100 | 92 | |
| 10-Dec-06 | | | 84 | 100 | 92 | |
| 11-Dec-06 | **23** | | **100** | **100** | **100** | |

## Appendix C Calibration Station Tables

| | METERS | | | | FEET | | | DATE | BASE STA |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Northing Meters | Easting Meters | NAVD88 | | Northing Feet | Easting Feet | NAVD88 | | |
| **CURLEW MP 12.4** | 251501.557 | 913350.274 | 2.140 | | 825134.718 | 2996550.118 | 7.021 | | |
| | | | | | | | | | |
| FILE: 000_1118.RAW | 251501.585 | 913350.254 | 2.023 | | 825134.808 | 2996550.054 | 6.637 | 28-Nov-06 | Clarion |
| FILE: 000_0758.RAW | 251501.549 | 913350.240 | 2.068 | | 825134.691 | 2996550.006 | 6.785 | 30-Nov-06 | Clarion |
| FILE: 000_1351.RAW | 251501.527 | 913350.263 | 2.095 | | 825134.618 | 2996550.082 | 6.873 | 4-Dec-06 | Clarion |
| | | | | | | | | | |
| RMS difference | **0.024** | **0.024** | **0.083** | | **0.079** | **0.078** | **0.274** | | |

| | METERS | | | | FEET | | | DATE | BASE STA |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Northing Meters | Easting Meters | NAVD88 | | Northing Feet | Easting Feet | NAVD88 | | |
| **FORREST MP 15.5** | 246331.581 | 915945.544 | 2.786 | | 808172.887 | 3005064.767 | 9.140 | | |
| | | | | | | | | | |
| FILE: 000_1236.RAW | 246331.588 | 915945.542 | 2.748 | | 808172.909 | 3005064.760 | 9.014 | 27-Nov-06 | Comfort Inn |
| FILE: 000_1706.RAW | 246331.586 | 915945.500 | 2.740 | | 808172.905 | 3005064.624 | 8.988 | 27-Nov-06 | Comfort Inn |
| | | | | | | | | | |
| *ABS(B5-B3)* | 0.007 | 0.002 | 0.039 | | 0.022 | 0.007 | 0.126 | | |

| | METERS | | | | FEET | | | DATE | BASE STA |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Northing Meters | Easting Meters | NAVD88 | | Northing Feet | Easting Feet | NAVD88 | | |
| **NPS PK MP 22** | 237833.62 | 919857.93 | 1.380 | | 780292.493 | 3017900.654 | 4.528 | | |
| | | | | | | | | | |
| FILE: 000_0939.RAW | 237833.634 | 919857.979 | 1.351 | | 780292.540 | 3017900.815 | 4.433 | 25-Nov-06 | NPS |
| FILE: 000_0929.RAW | 237833.614 | 919857.922 | 1.416 | | 780292.474 | 3017900.628 | 4.644 | 26-Nov-06 | Comfort Inn |
| FILE: 000_1530.RAW | 237833.679 | 919857.925 | 1.404 | | 780292.686 | 3017900.636 | 4.605 | 26-Nov-06 | Comfort Inn |
| FILE: 000_0821.RAW | 237833.627 | 919857.952 | 1.388 | | 780292.516 | 3017900.727 | 4.555 | 29-Nov-06 | NPS |
| FILE: 000_0743.RAW | 237833.773 | 919857.598 | 1.323 | | 780292.993 | 3017899.563 | 4.342 | 11-Dec-06 | NPS |
| FILE: 000_0711.RAW | 237833.800 | 919857.621 | 1.340 | | 780293.085 | 3017899.640 | 4.397 | 12-Dec-06 | NPS |
| | | | | | | | | | |
| square root *SQRT(B20)* | 0.100 | 0.187 | 0.035 | | 0.327 | 0.612 | 0.116 | | |

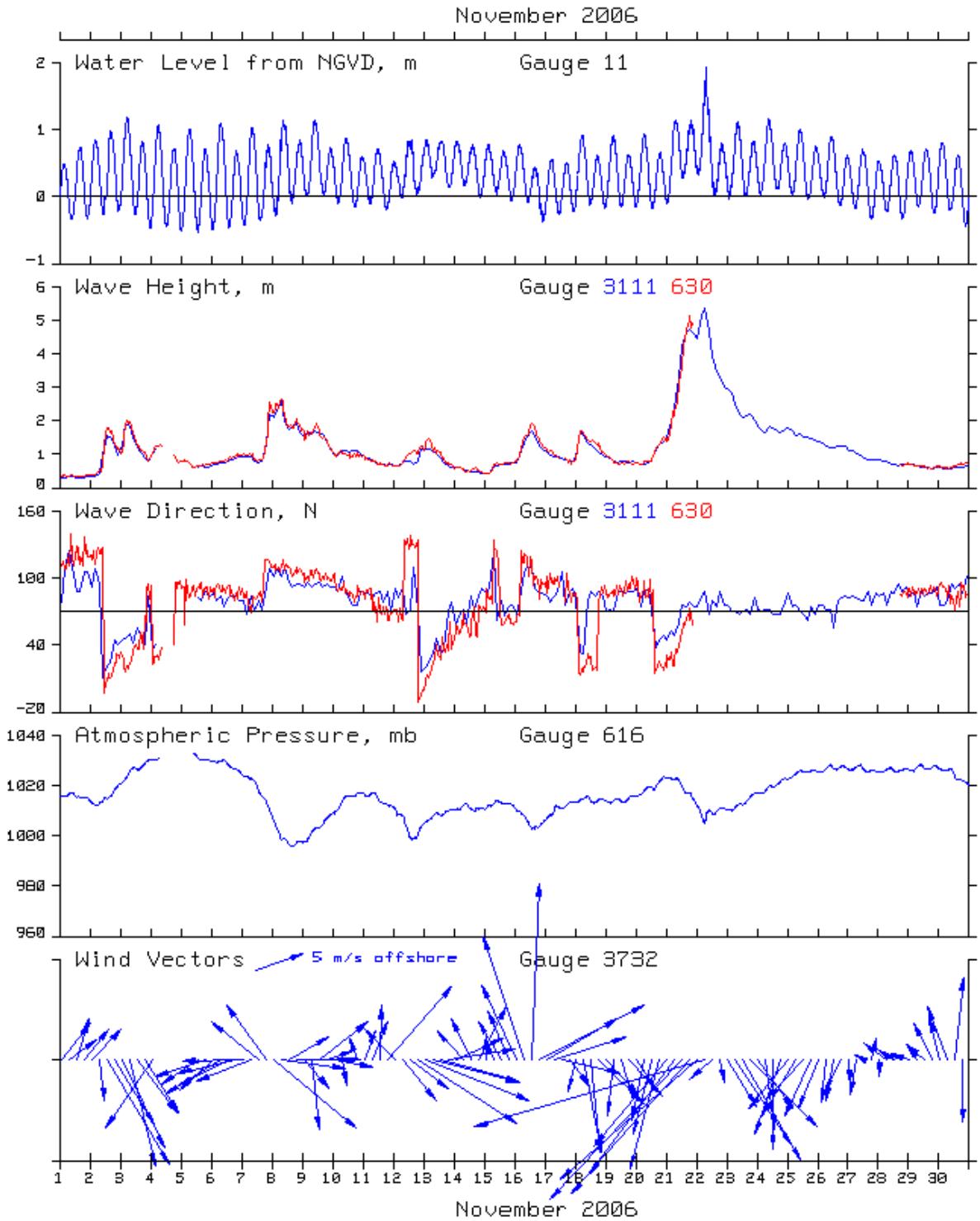
## Appendix D LARC Field Notes

| *Line #* | *Date Surveyed* | *Hypack Raw file 1* | *vessel (dir)* | *Notes* |
|---|---|---|---|---|
| -150 | 20061206 | M150B.raw | in | good line |
| -140 | 20061206 | M140B.raw | out | good line |
| -130 | 20061206 | M130C.raw | in | good line (minus three digit line numbers from previous survey not being found in FathoPlot) |
| -120 | 20061206 | M120B.raw | out | good line |
| -110 | 20061206 | M110B.raw | in | good line, some trouble getting up on beach |
| -100 | 20061206 | M100B.raw | out | good line took ctd cast at end of this line 200612061757 |
| -90 | 20061206 | -090_1234.raw | in | got stuck during exit fromocean. Backed off beach very steep beach face. |
| -80 | 20061206 | -080_1223.raw | out | good line |
| -70 | 20061206 | -070_1211.raw | in | good line |
| -60 | 20061206 | -060_1200.raw | out | spikes in surfzone and midoffshore need removal. |
| -50 | 20061206 | -050_1148.raw | in | good line |
| -40 | 20061206 | -040_1137.raw | | good line surfzone needs some spike removal. |
| -30 | 20061206 | -030_1120.raw | in | good line |
| -20 | 20061206 | -020_1109.raw | out | good line some spikes in surfzone need removing |
| -10 | 20061206 | -010_1057.raw | in | good line |
| 0 | 20061206 | 000_1047.raw | out | good line significant erosion on north side of pier. Sandbags old wood seawalls and pilings exposed. |
| 9 | 20061206 | 009_1031.raw | in | took ctd at end of this line 20061206.1527 |
| 20 | 20061206 | 020_1017.raw | out | |
| 30 | 20061206 | 0301003.raw | in | |
| 40 | 20061206 | 040_0953.raw | out | |
| 50 | 20061206 | 050_0942.raw | in | |
| 60 | 20061206 | 060_0932.raw | out | |
| 70 | 20061206 | 070_0922.raw | in | |
| 80 | 20061206 | 080_0912.raw | out | |
| 89 | 20061206 | 089_0903.raw | in | |
| 99 | 20061206 | 099_0855.raw | out | |
| 109 | 20061206 | 109_0845.raw | in | good line /plot comparison |
| 119 | 20061206 | 119_0826.raw | out | good line/plot comparison |
| 130 | 20061205 | 130_1459.raw | in | Ashly pilot beginning of line |
| 138 | 20061205 | 138_1441.raw | out | |
| 149 | 20061205 | 149_1429.raw | in | |
| 159 | 20061205 | 159_1419.raw | out | |
| 169 | 20061205 | 169_1408.raw | in | |

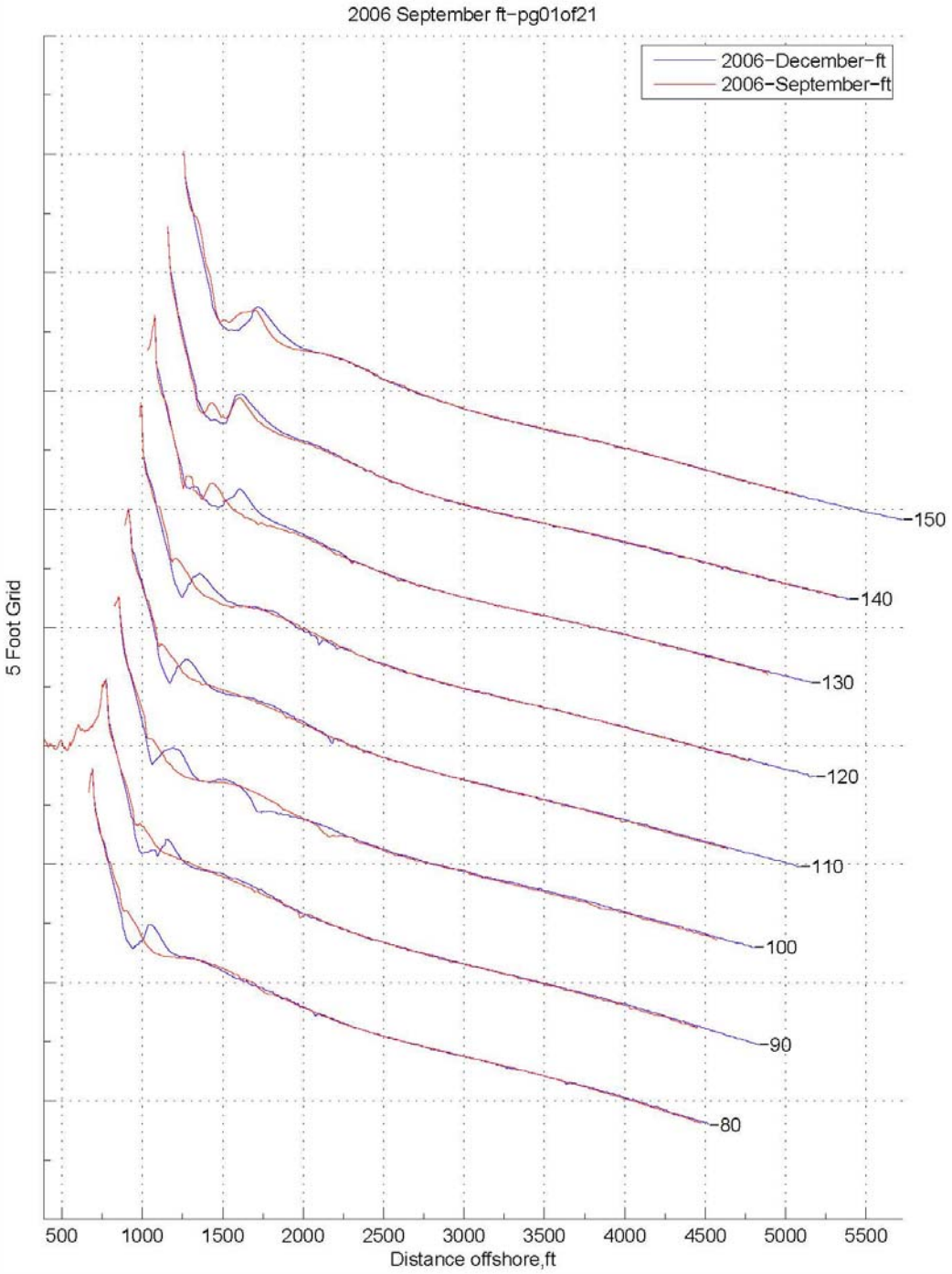
| Line # | Date Surveyed | Hypack Raw file 1 | vessel (dir) | Notes |
|---|---|---|---|---|
| 179 | 20061205 | 179_1354.raw | out | |
| 189 | 20061205 | 189_1342.raw | in | |
| 199 | 20061205 | 199_1326.raw | out | |
| 209 | 20061205 | 209_1312.raw | in | |
| 219 | 20061205 | 219_1259.raw | out | |
| 229 | 20061205 | 229_1247.raw | in | |
| 240 | 20061205 | 240_1235.raw | out | |
| 249 | 20061205 | 249_1221.raw | in | CTD at end of line 260 |
| 260 | 20061130/20061205 | 260_1207.raw | in/out | 80 lines in 2 days! Yeah Capt Mike…/Black Pelican Base/Pause in surf zone hi hdop |
| 269 | 20061130 | 269_1621.raw | out | Surf zone needs editing. Some drop outs. |
| 279 | 20061130 | 279_1609.raw | in | |
| 289 | 20061130 | 289.1558.raw | out | good line |
| 299 | 20061130 | 299_1544.raw | in | good line |
| 309 | 20061130 | 309_1534.raw | out | good line |
| 320 | 20061130 | 320_1521.raw | in | good line |
| 329 | 20061130 | 329_1508.raw | out | good line take ctd at end of this line 20061130.2017.53_LARC.ctd |
| 340 | 20061130 | 340_1455.raw | in | good line |
| 349 | 20061130 | 349_1444.raw | out | good line |
| 359 | 20061130 | 359_1433.raw | in | good line |
| 369 | 20061130 | 369_1421.raw | out | good line |
| 380 | 20061130 | 380_1409.raw | in | good line |
| 389 | 20061130 | 389_1358.raw | out | good line |
| 400 | 20061130 | 400_1344.raw | in | good line |
| 410 | 20061130 | 410_1334.raw | out | good line |
| 420 | 20061130 | 420_1321.raw | in | had trouble coming out of water. Backed off beach and tried again. Good line |
| 429 | 20061130 | 429_1308.raw | out | good line took ctd cast at end of this line 20061129.1837.17 |
| 439 | 20061130 | 439_1248.raw | in | good line |
| 450 | 20061130 | 450_1237.raw | out | |
| 460 | 20061130 | 460_1224.raw | in | good line |
| 469 | 20061130 | 469_1213.raw | out | good line |
| 482 | 20061130 | 482_1159.raw | in | Good line |
| 489 | 20061130 | 489_1149.raw | out | Good line |
| 499 | 20061130 | 499_1138.raw | in | Good line |
| 509 | 20061130 | 509_1128.raw | out | Good line |
| 519 | 20061130 | 519_1107.raw | in | |
| 529 | 20061130 | 529_1056.raw | out | surfzone needs editing. Plenty of bottom return on the screen but clouds need removal. Offshore bar present here just south of the NH pier. |

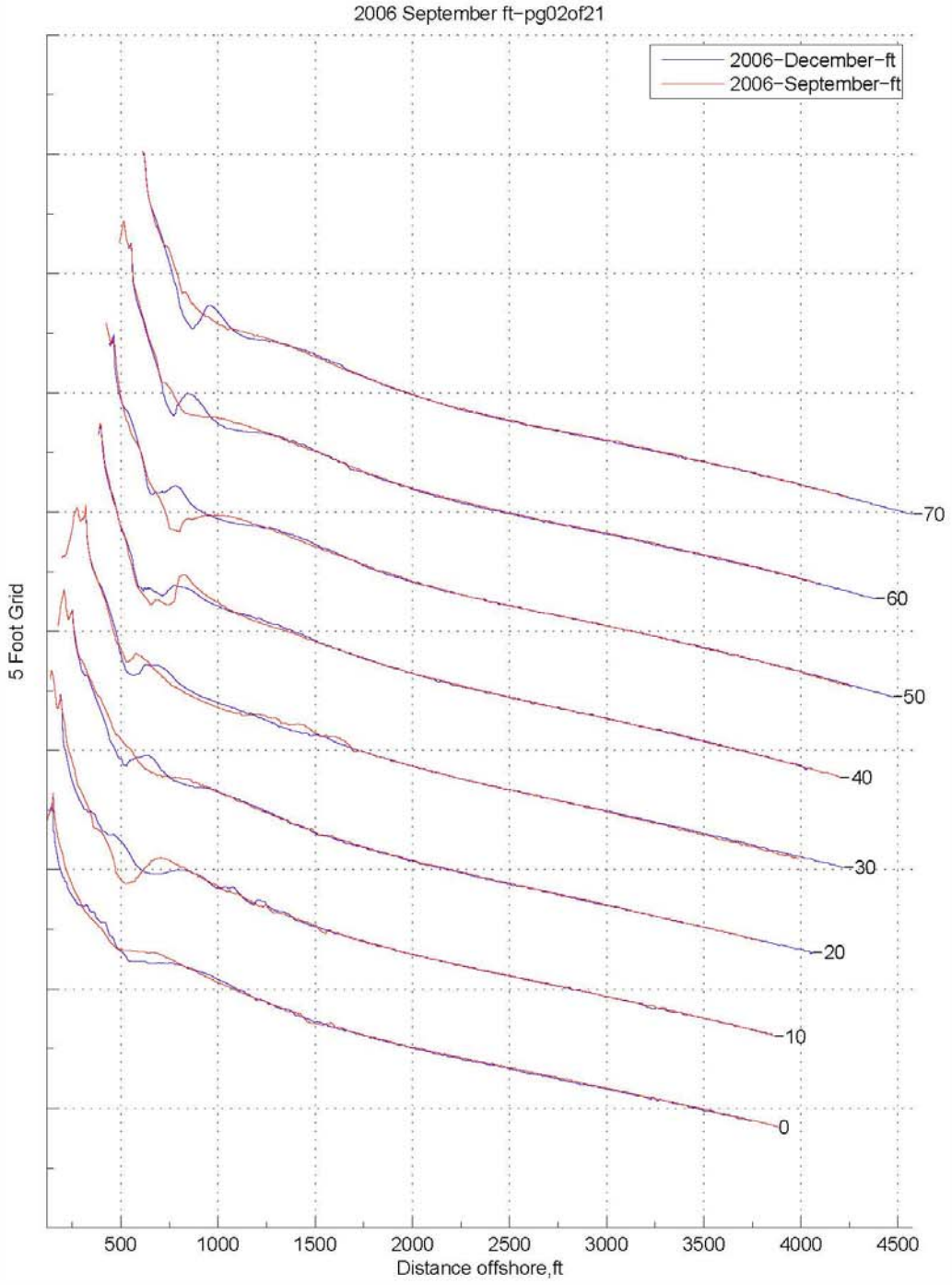
| Line # | Date Surveyed | Hypack Raw file 1 | vessel (dir) | Notes |
|---|---|---|---|---|
| 540 | 20061130 | 540_1045.raw | in | good line |
| 549 | 20061130 | 549_1033.raw | out | some surfzone edits needed. |
| 559 | 20061130 | 559_1018.raw | in | lost gps momentarily.good line |
| 569 | 20061130 | 569_1004.raw | out | took ctd at end of this line 20061130.1513.46 |
| 580 | 20061130 | 580_0953.raw | in | good line |
| 589 | 20061130 | 589_0943.raw | out | good line |
| 599 | 20061130 | 599_0932.raw | in | |
| 609 | 20061130 | 609_0919.raw | out | Log paused along track 1 time |
| 619 | 20061130 | 619_0909.raw | in | |
| 630 | 20061130 | 630_0853.raw | out | Log paused along track 3 times |
| 640 | 20061130 | 640_0842.raw | in | |
| 649 | 20061130 | 649_0832.raw | out | |
| 659 | 20061130 | 659_0819.raw | in | 20061130.1316.41_LARC.ctd; Had to back up when exiting ocean up on to beach. |
| 670 | 20061129 | 670_1626.raw | out | 20061129.2134.02_LARC.ctd |
| 679 | 20061129 | 679_1615.raw | in | |
| 689 | 20061129 | 689_1606.raw | out | good line |
| 700 | 20061129 | 700_1556.raw | in | |
| 709 | 20061129 | 709_1547.raw | out | had some droputs in surfzone. |
| 719 | 20061129 | 719_1538.raw | in | |
| 729 | 20061129 | 729_1527.raw | out | |
| 739 | 20061129 | 739_1517.raw | in | |
| 749 | 20061129 | 749_1508.raw | out | |
| 759 | 20061129 | 759_1458.raw | in | |
| 771 | 20061129 | 771_1447.raw | out | 20061129.1954.11_LARC.ctd |
| 779 | 20061129 | 779_1434.raw | in | |
| 789 | 20061129 | 789A1423.raw | out | Dropped out logging on entry - close to base |
| 800 | 20061129 | 800_0815 | in | |
| 809 | 20061129 | 809_0830 | out | 20061129.1340.13_LARC.ctd |
| 819 | 20061129 | 819_1336.raw | out | good line. Pause on this line to move cars up the road. |
| 829 | 20061129 | 829_1326.raw | in | need some edits in the surfzone. Lots of bubbles on surface but still a faint bottom return. |
| 839 | 20061129 | 839_1318.raw | out | |
| 850 | 20061129 | 850_1309.raw | in | |
| 859 | 20061129 | 859_1301.raw | out | |
| 869 | 20061129 | 869_1252.raw | in | |
| 879 | 20061129 | 879_1243.raw | out | |
| 890 | 20061129 | 890_1234.raw | in | |
| 899 | 20061129 | 899_1225.raw | out | |
| 909 | 20061129 | 909_1215.raw | in | |

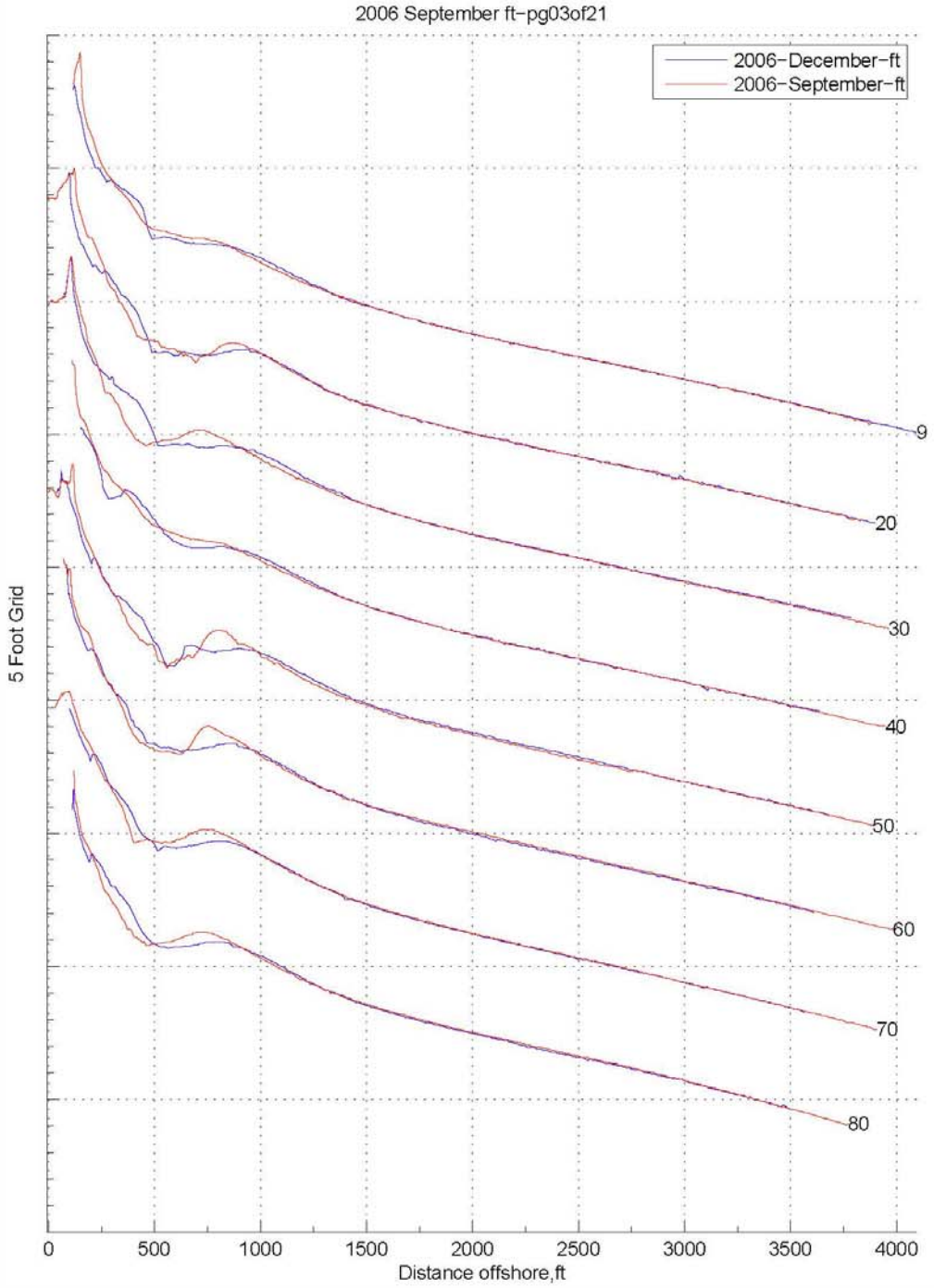
| Line # | Date Surveyed | Hypack Raw file 1 | vessel (dir) | Notes |
|---|---|---|---|---|
| 920 | 20061129 | 920_1203.raw | out | 20061129.1711.13_LARC.ctd |
| 929 | 20061129 | 929_1152.raw | in | |
| 940 | 20061129 | 940_1144.raw | out | |
| 951 | 20061129 | 951_1133.raw | in | good line |
| 953 | 20061129 | 953_1124.raw | out | good line tide beginning to fill in creating less of a surfzone |
| 970 | 20061129 | 970_1111.raw | in | good line |
| 978 | 20061129 | 978_1101.raw | out | took some waves in surfzone |
| 989 | 20061129 | 989_1049.raw | in | took some waves in surfzone |
| 999 | 20061129 | 999_1038.raw | out | took some waves in surfzone |
| 1009 | 20061129 | 1009B.raw | in | took some waves in surfzone |
| 1020 | 20061129 | 1020B.raw | out | 20061129.1522.49_LARC.ctd |
| 265 | 20061129 | 265_0959.raw | in | took some waves in surfzone |
| 254 | 20061129 | 254_0945.raw | out | took some waves in surfzone |
| 244 | 20061129 | 244_0931.raw | in | took some waves in surfzone |
| 234 | 20061211 | 234_1257.raw | in | good line |
| 224 | 20061212 | 224_0724.raw | out | good line good plots, ctd end of line 200612121233 |
| 214 | 20061212 | 214_0738.raw | in | good line good plots |
| 204 | 20061212 | 204_0750.raw | out | good line good plots |
| 194 | 20061212 | 194_0801.raw | in | good line good plots |
| 184 | 20061212 | 184_0813.raw | out | lost gps just outside surf zone, good line good plots |
| 174 | 20061212 | 174_0830.raw | in | good line good plots |
| 164 | 20061212 | 164_0842.raw | out | good line good plots, ctd 200612121350 |
| 153 | 20061211 | 153_1234.raw | out | good line |
| 144 | 20061211 | 144_1221.raw | in | good line |
| 132 | 20061211 | 132_1208.raw | out | good line |
| 124 | 20061211 | 124_1156.raw | in | good line |
| 114 | 20061211 | 114_1145.raw | out | good line |
| 105 | 20061211 | 105_1129.raw | in | lost rtk momentarily just outside surfzone.good line |
| 95 | 20061211 | 095_1109.raw | out | .good line, good plots, ctd end of line 200612111626 |
| 85 | 20061211 | 085_1047.raw | in | .good line, good plots |
| 75 | 20061211 | 075_1035.raw | out | .good line, good plots |
| 69 | 20061211 | 069_1018.raw | in | fathoplot terminated w/ exit code 1, nothing noteworthy during line |
| 59 | 20061211 | 059_1005.raw | out | .good line, good plots |
| 49 | 20061211 | 049_0945.raw | in | .good line, good plots |
| 39 | 20061211 | 039_0928.raw | out | good line, good plots |
| 29 | 20061211 | 029_0906.raw | in | on wheels sandbar, then trough then beach, good line plots match offshore |
| 19 | 20061211 | 019_0847.raw | out | good line, good plots, ctd at end of this line 200612111402 |

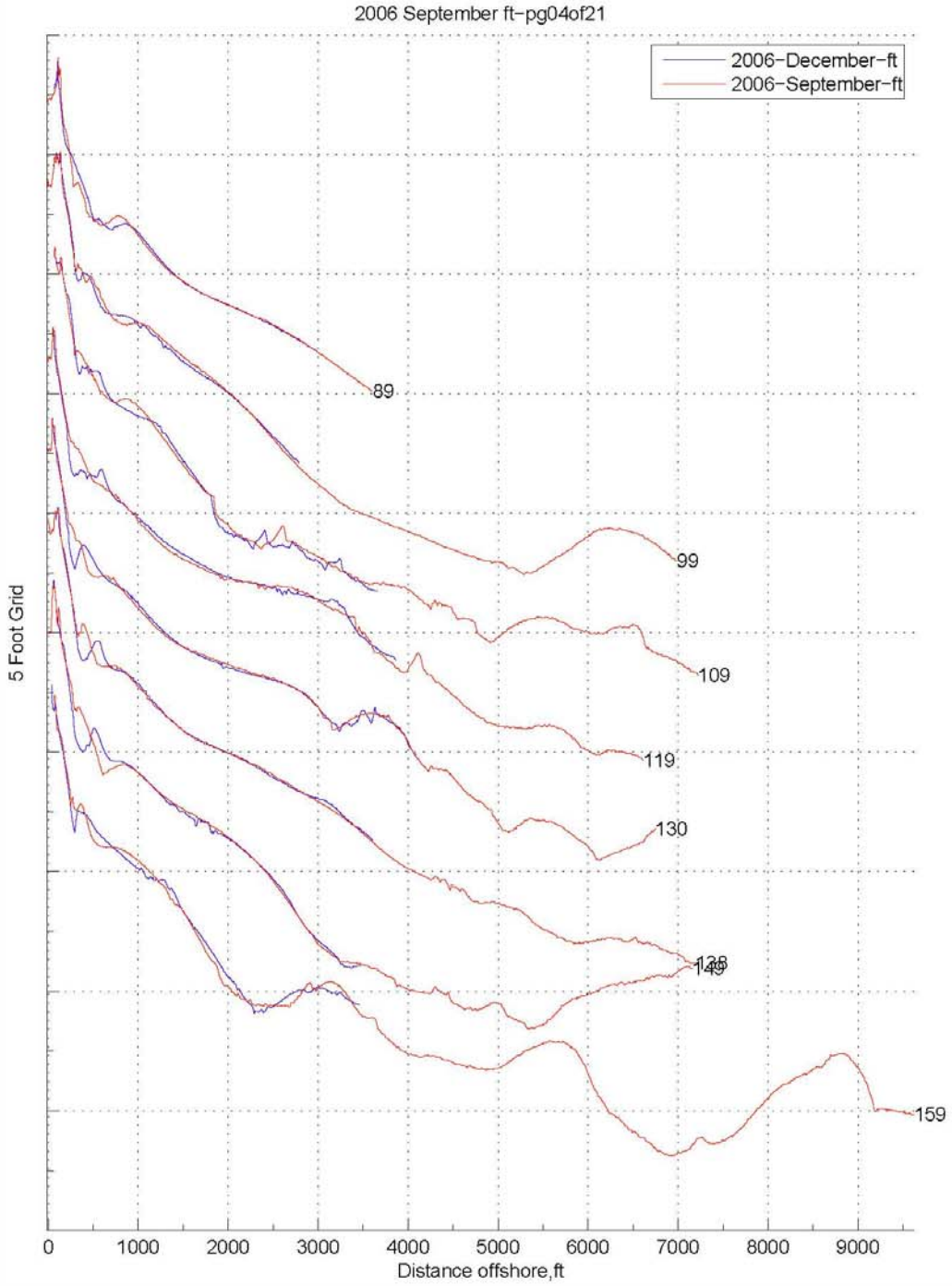

November 2006
Water Level from NGVD, m
Gauge 11
Wave Height, m
Gauge 3111 630
Wave Direction, N
Gauge 3111 630
Atmospheric Pressure, mb
Gauge 616
Wind Vectors
5 m/s offshore
Gauge 3732
November 2006

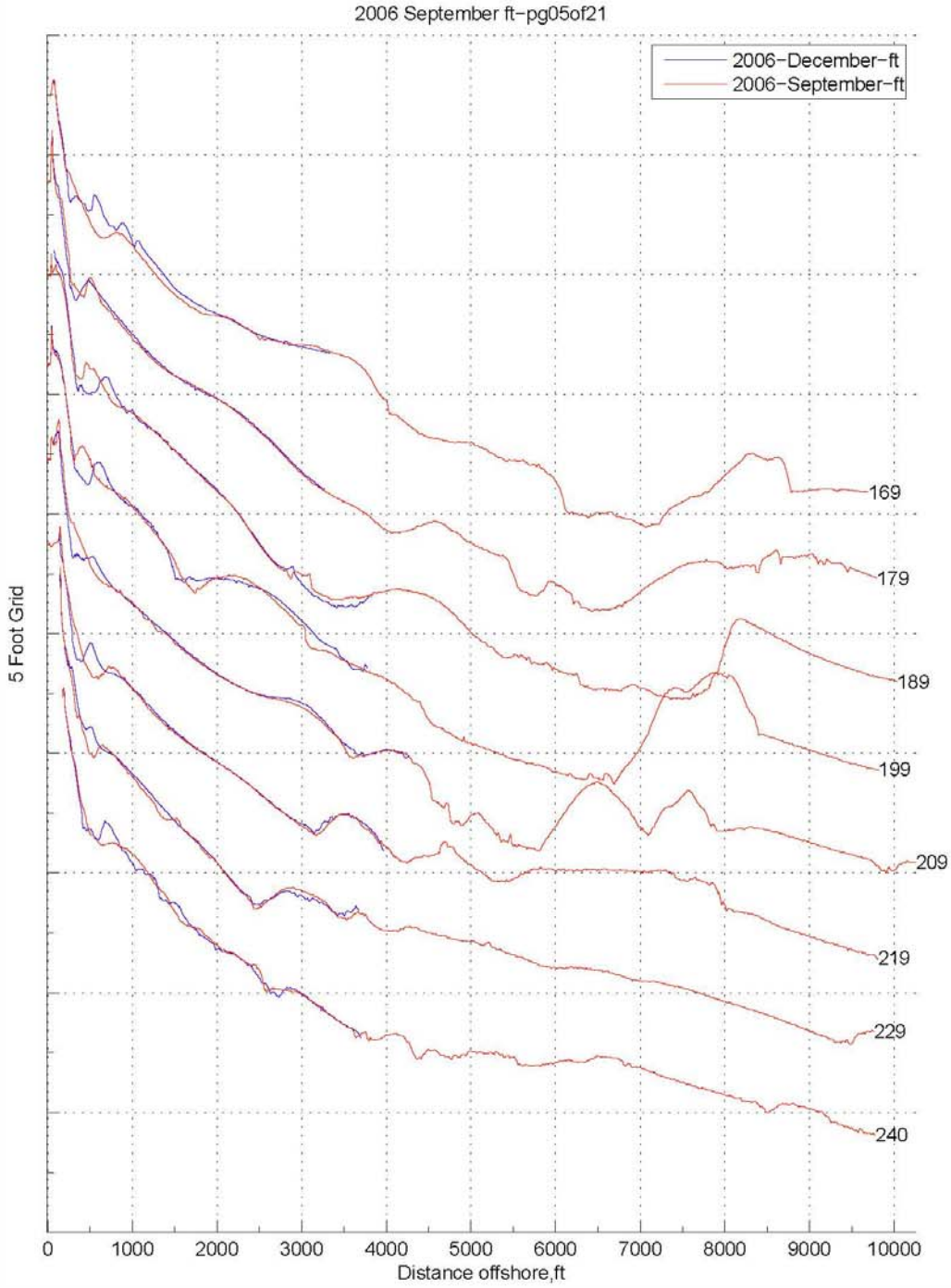
**Appendix F Profile Stackplots Sept/October to Nov/Dec 2006.**

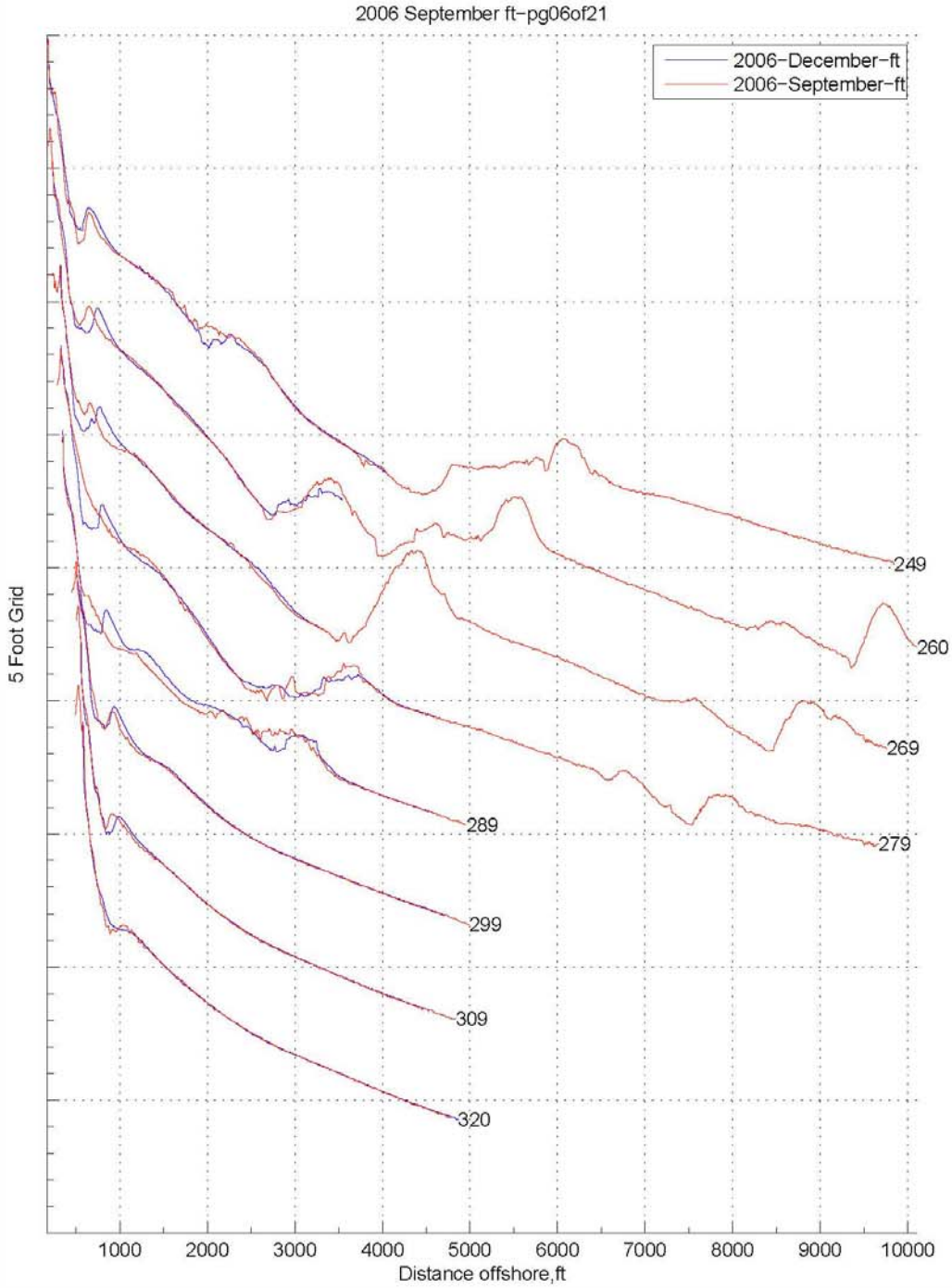


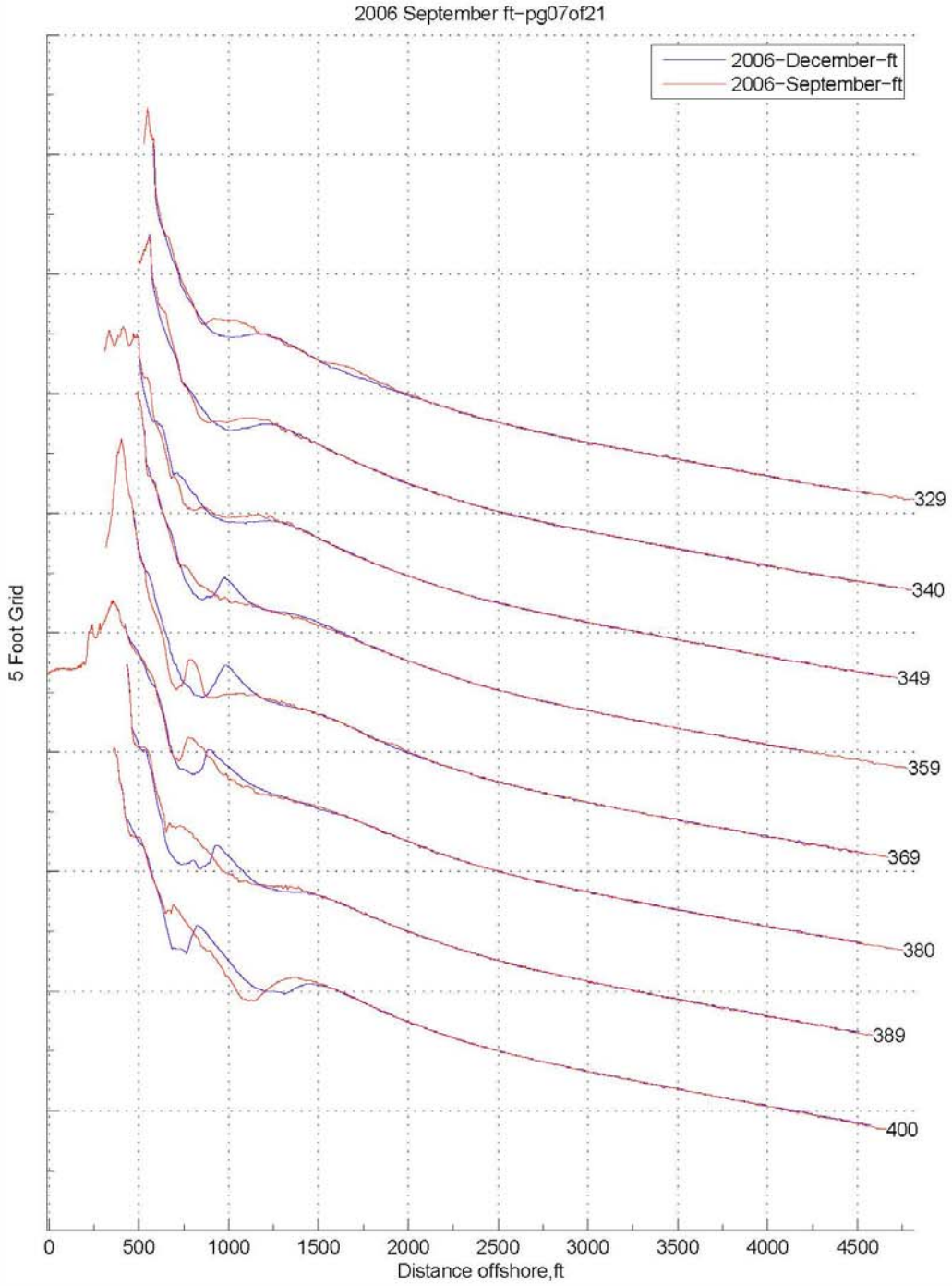

2006 September ft-pg02of21
2006-December-ft
2006-September-ft
5 Foot Grid
Distance offshore,ft
500
1000
1500
2000
2500
3000
3500
4000
4500
-70
-60
-50
-40
-30
-20
-10
0

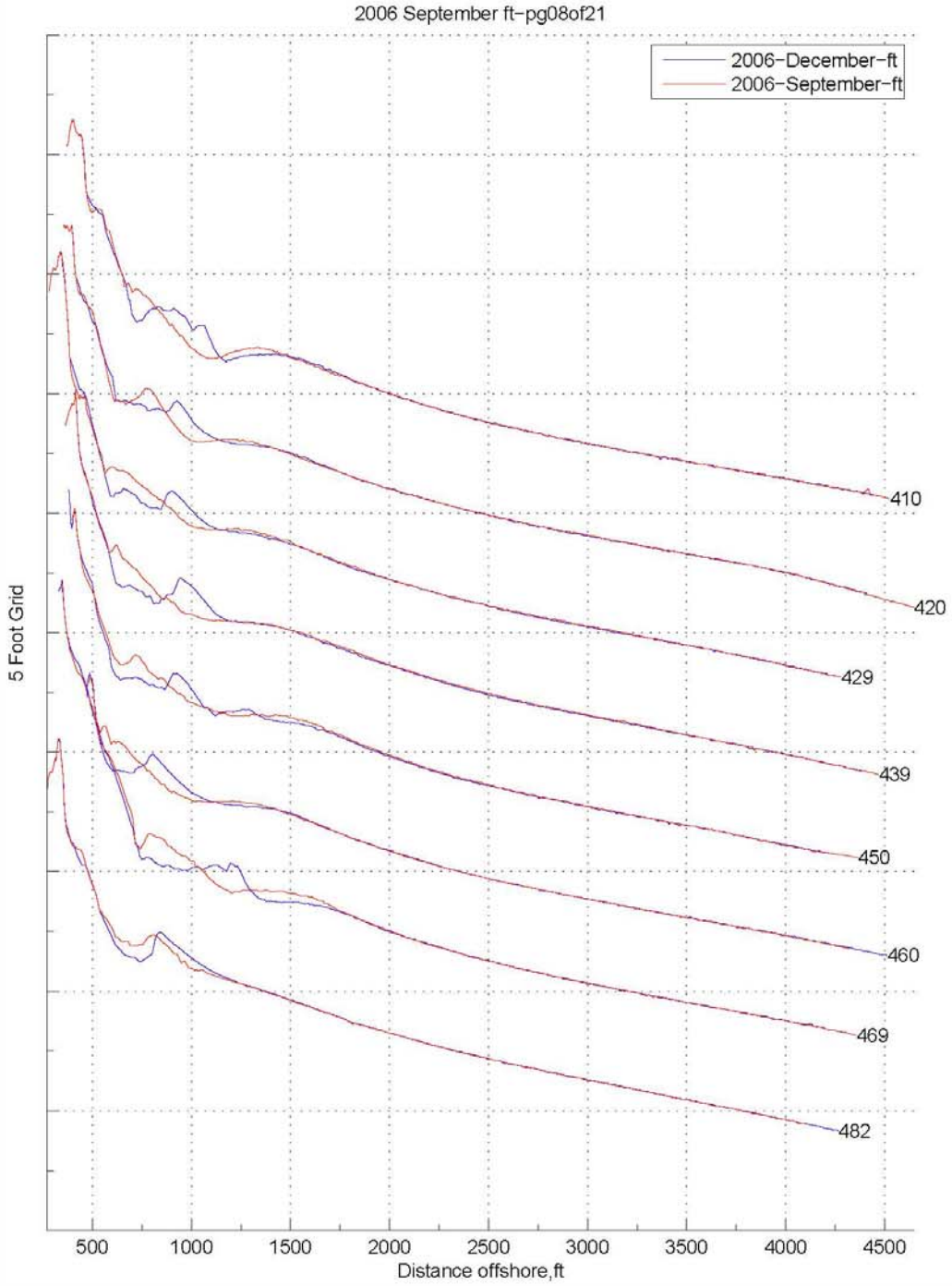

2006 September ft-pg03of21
2006-December-ft
2006-September-ft
5 Foot Grid
Distance offshore,ft
0
500
1000
1500
2000
2500
3000
3500
4000
9
20
30
40
50
60
70
80


2006 September ft-pg04of21
2006-December-ft
2006-September-ft
5 Foot Grid
Distance offshore,ft
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
89
99
109
119
130
136
149
159


2006 September ft-pg05of21
2006-December-ft
2006-September-ft
169
179
189
199
209
219
229
240
5 Foot Grid
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Distance offshore,ft


2006 September ft-pg06of21
2006-December-ft
2006-September-ft
5 Foot Grid
Distance offshore,ft
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
249
260
269
279
289
299
309
320


2006 September ft-pg07of21
2006-December-ft
2006-September-ft
329
340
349
359
369
380
389
400
5 Foot Grid
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Distance offshore,ft


2006 September ft-pg08of21
2006-December-ft
2006-September-ft
5 Foot Grid
Distance offshore,ft
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1000
1500
2000
2500
3000
3500
4000
4500
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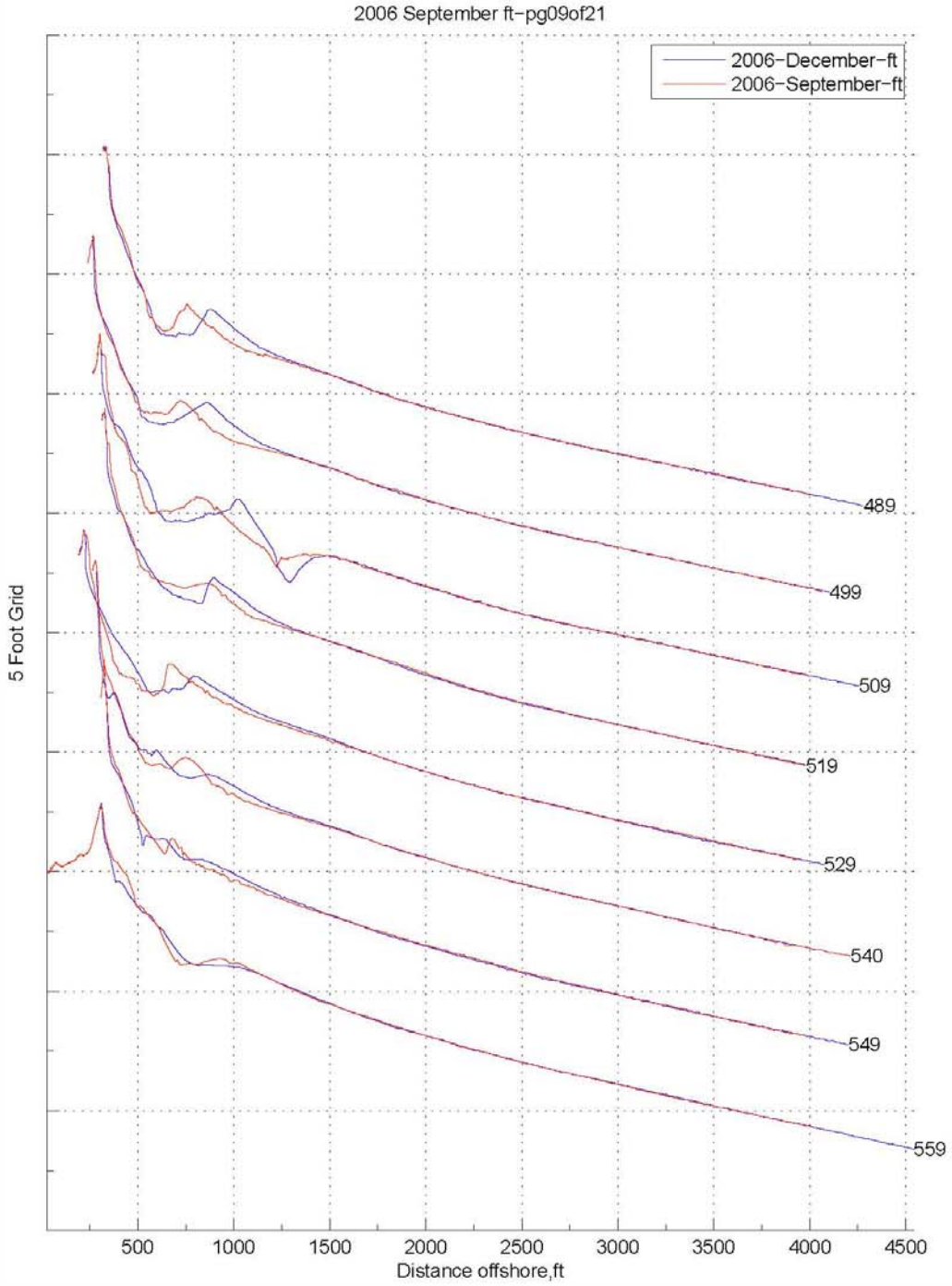
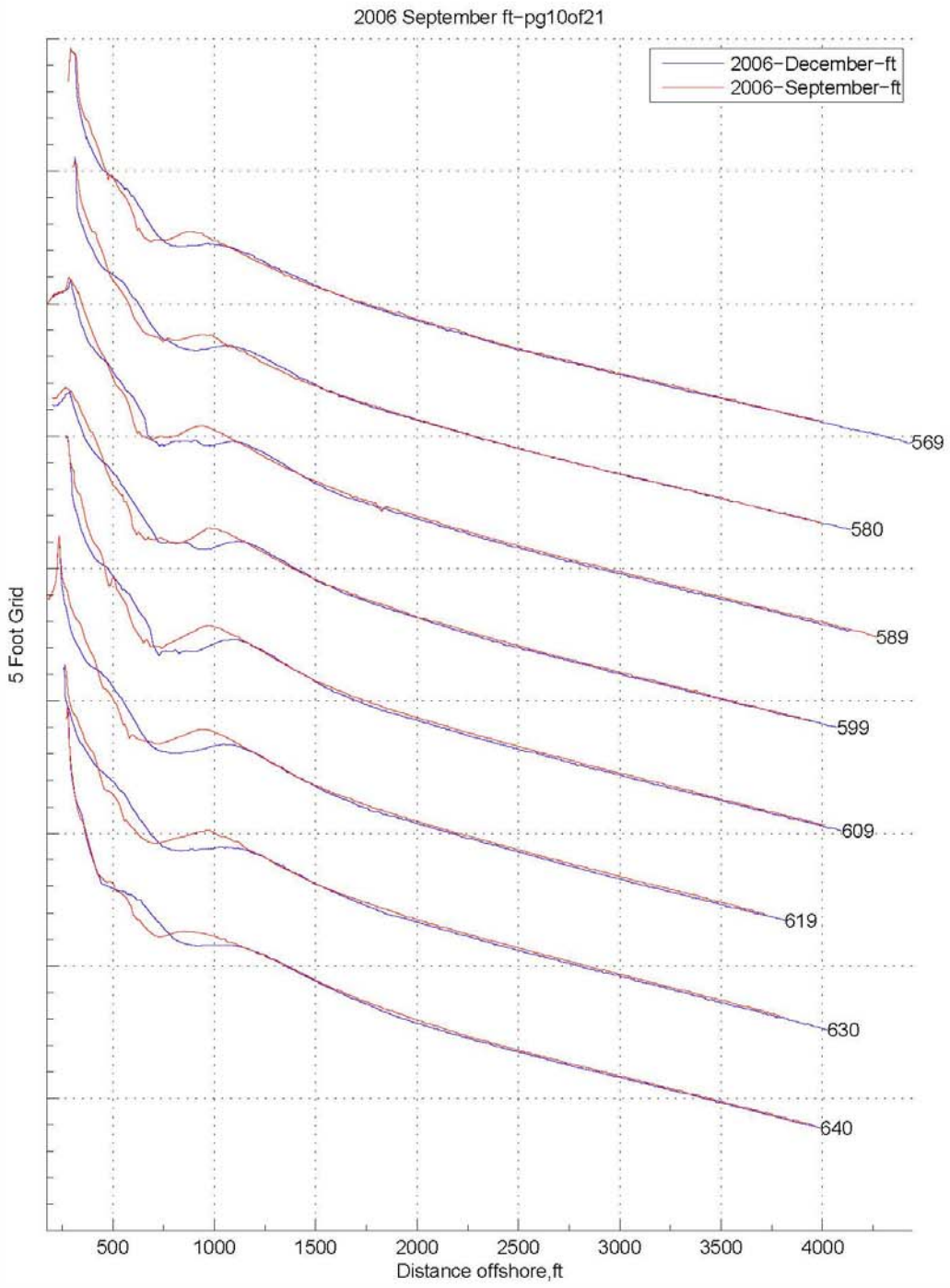
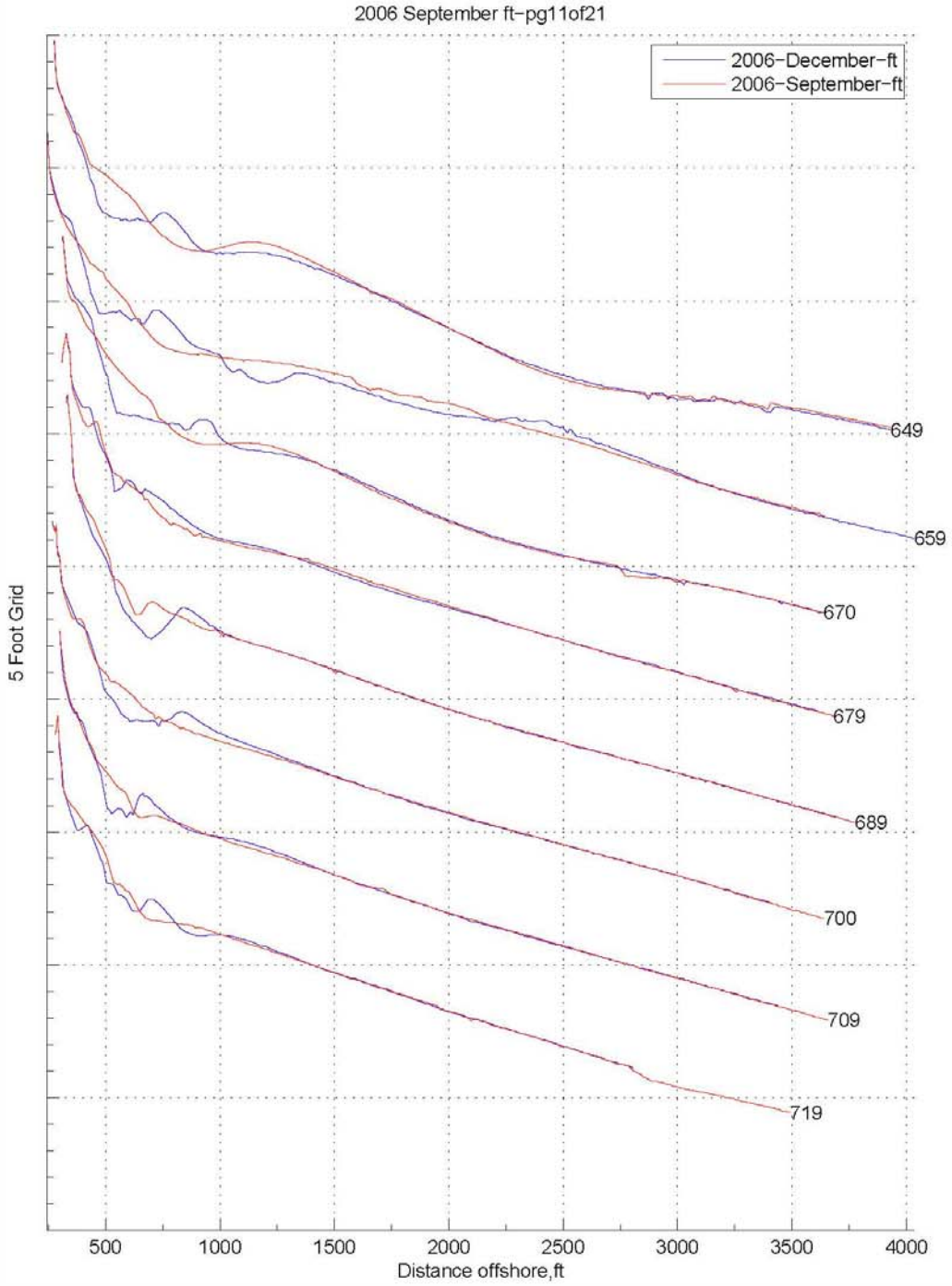
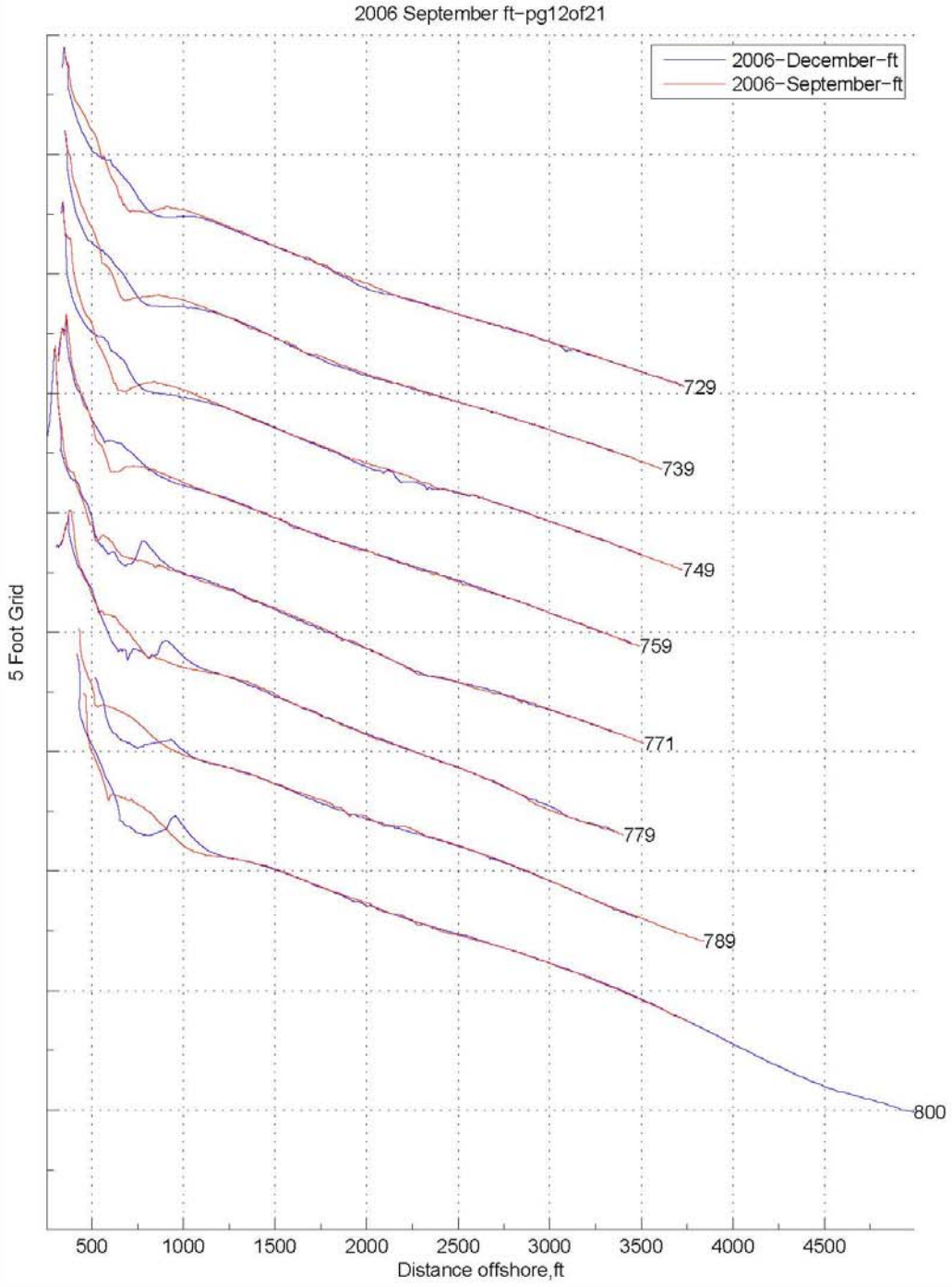
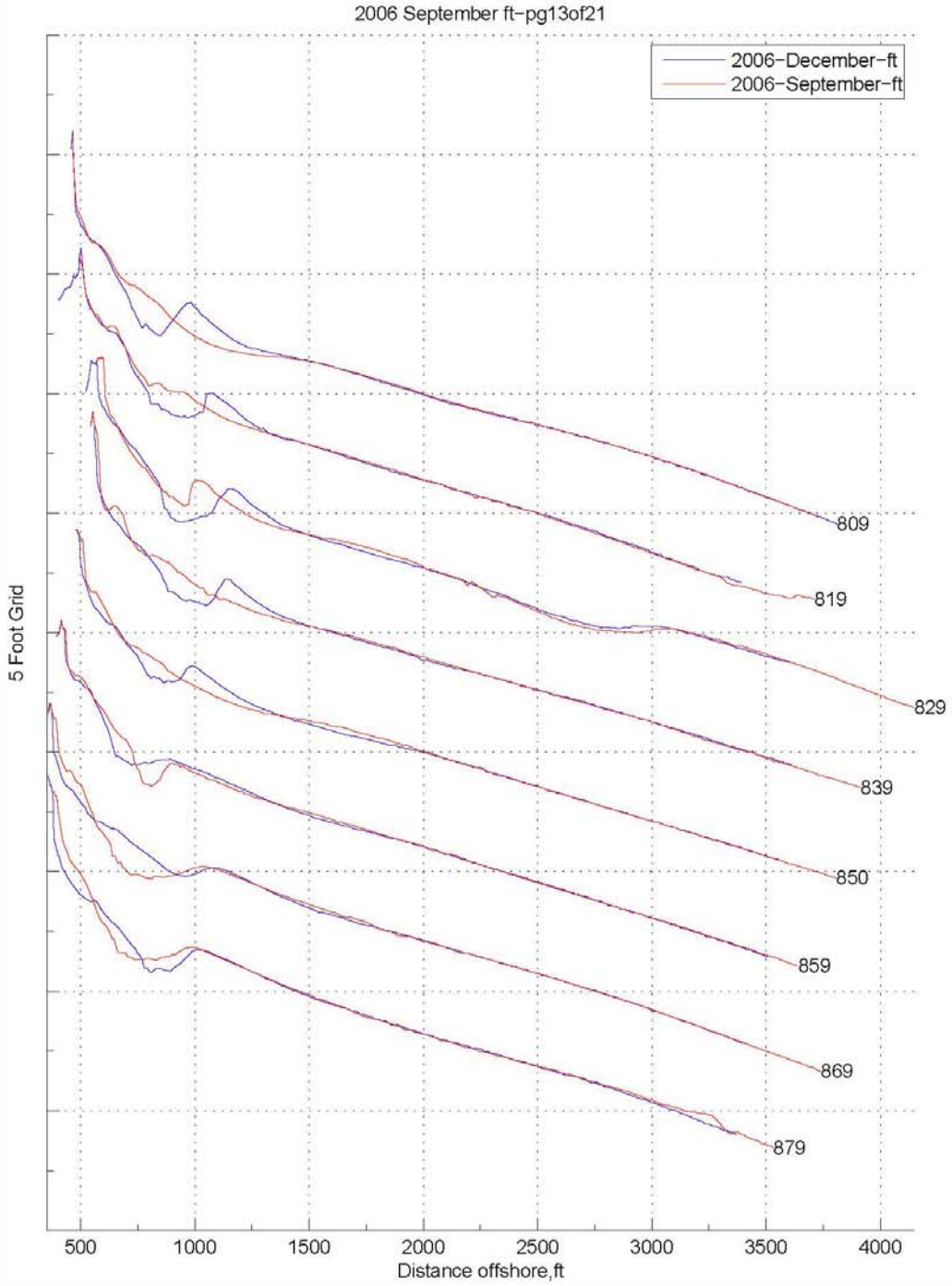
420
429
439
450
460
469
482


2006 September ft-pg09of21
2006-December-ft
2006-September-ft
489
499
509
519
529
540
549
559
5 Foot Grid
500
1000
1500
2000
2500
3000
3500
4000
4500
Distance offshore,ft


2006 September ft-pg10of21
2006-December-ft
2006-September-ft
569
580
589
599
609
619
630
640
5 Foot Grid
500
1000
1500
2000
2500
3000
3500
4000
Distance offshore,ft


2006 September ft-pg11of21
2006-December-ft
2006-September-ft
649
659
670
679
689
700
709
719
5 Foot Grid
500
1000
1500
2000
2500
3000
3500
4000
Distance offshore,ft


2006 September ft-pg12of21
2006-December-ft
2006-September-ft
729
739
749
759
771
779
789
800
5 Foot Grid
500
1000
1500
2000
2500
3000
3500
4000
4500
Distance offshore,ft


2006 September ft-pg13of21
2006-December-ft
2006-September-ft
809
819
829
839
850
859
869
879
5 Foot Grid
500
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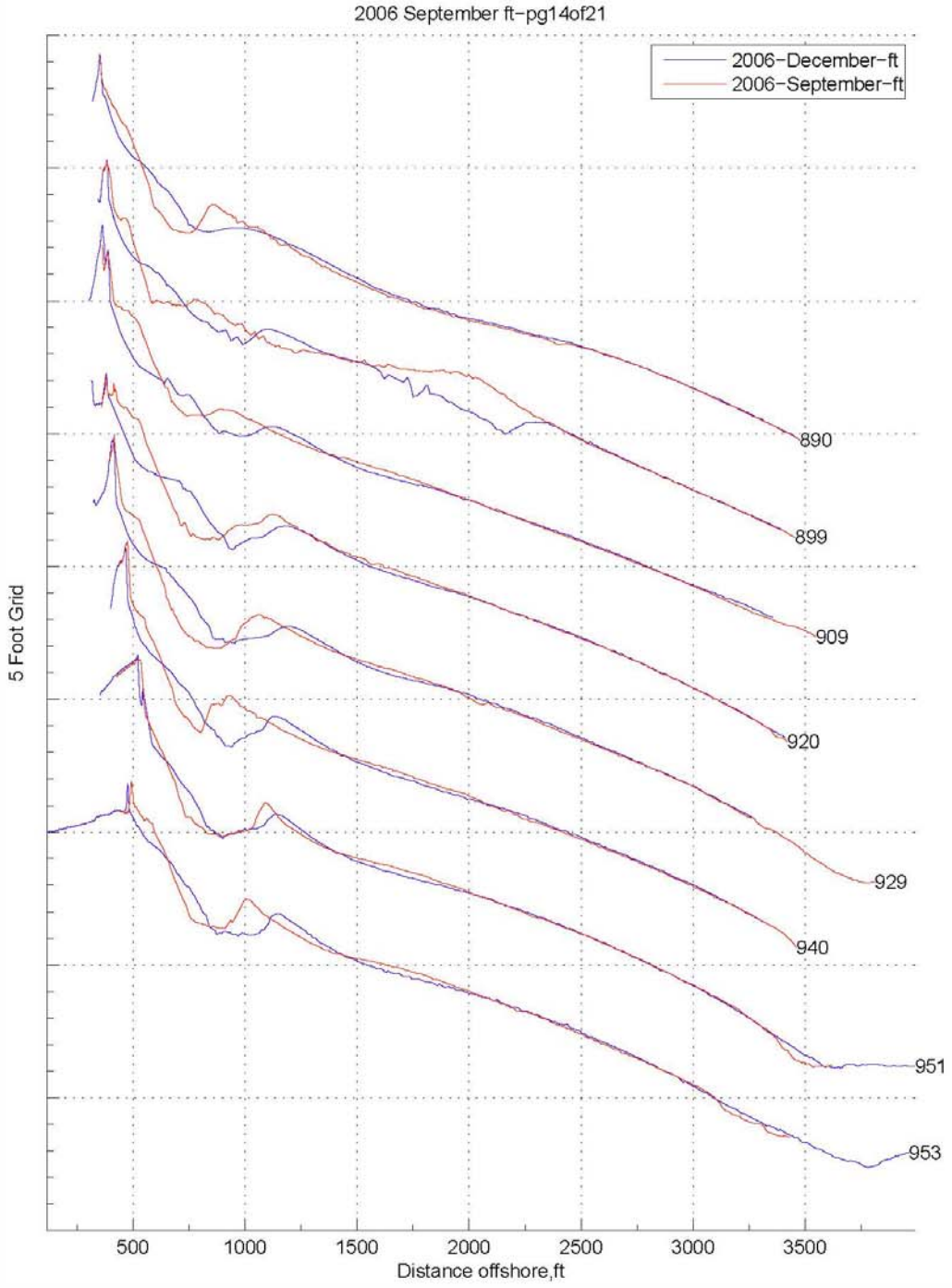
2000
2500
3000
3500
4000
Distance offshore,ft


2006 September ft-pg14of21
2006-December-ft
2006-September-ft
890
899
909
920
929
940
951
953
5 Foot Grid
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1000
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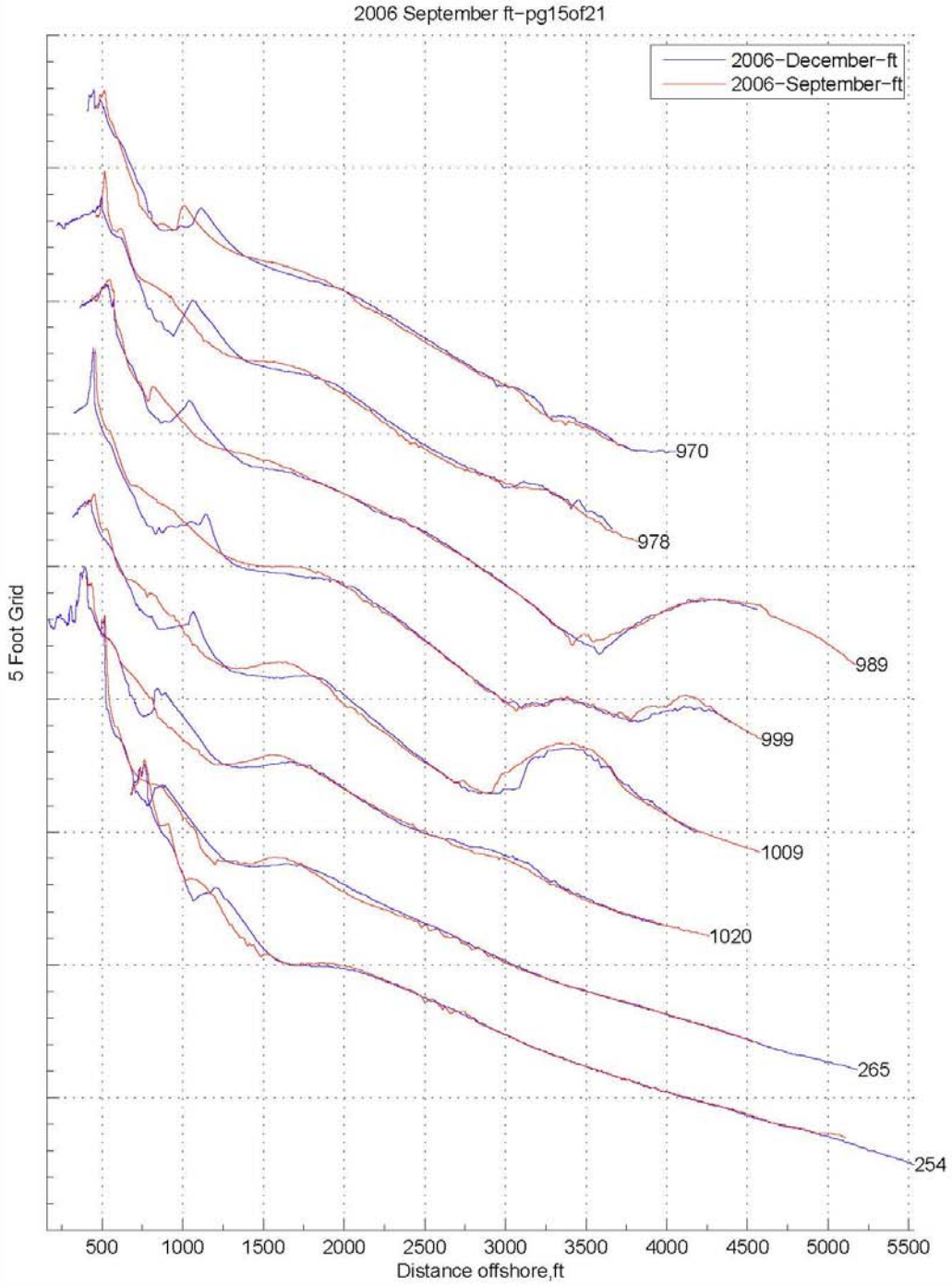
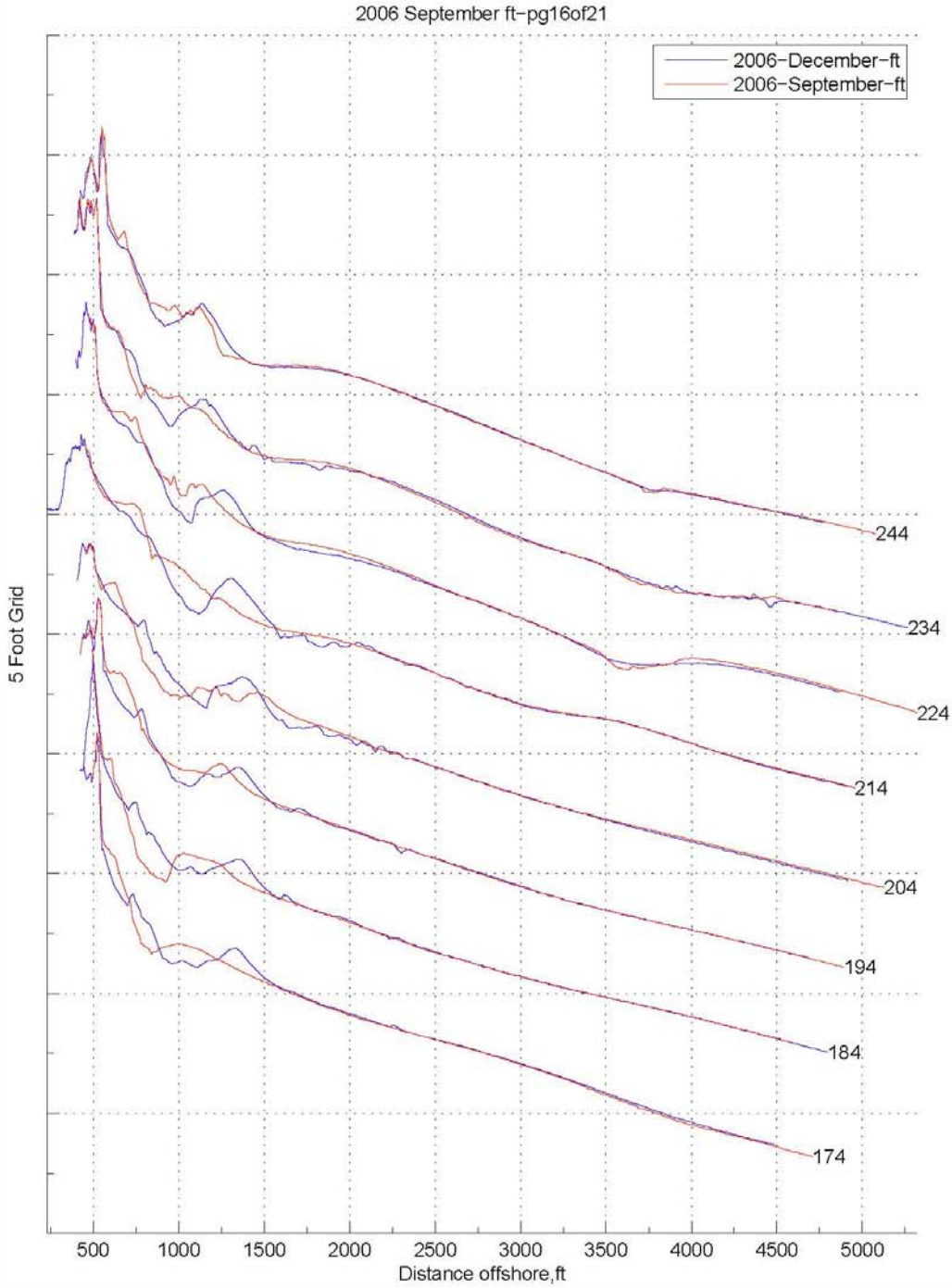
2000
2500
3000
3500
Distance offshore,ft


2006 September ft-pg15of21
2006-December-ft
2006-September-ft
970
978
989
999
1009
1020
265
254
5 Foot Grid
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
Distance offshore,ft


2006 September ft-pg16of21
2006-December-ft
2006-September-ft
5 Foot Grid
Distance offshore,ft
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
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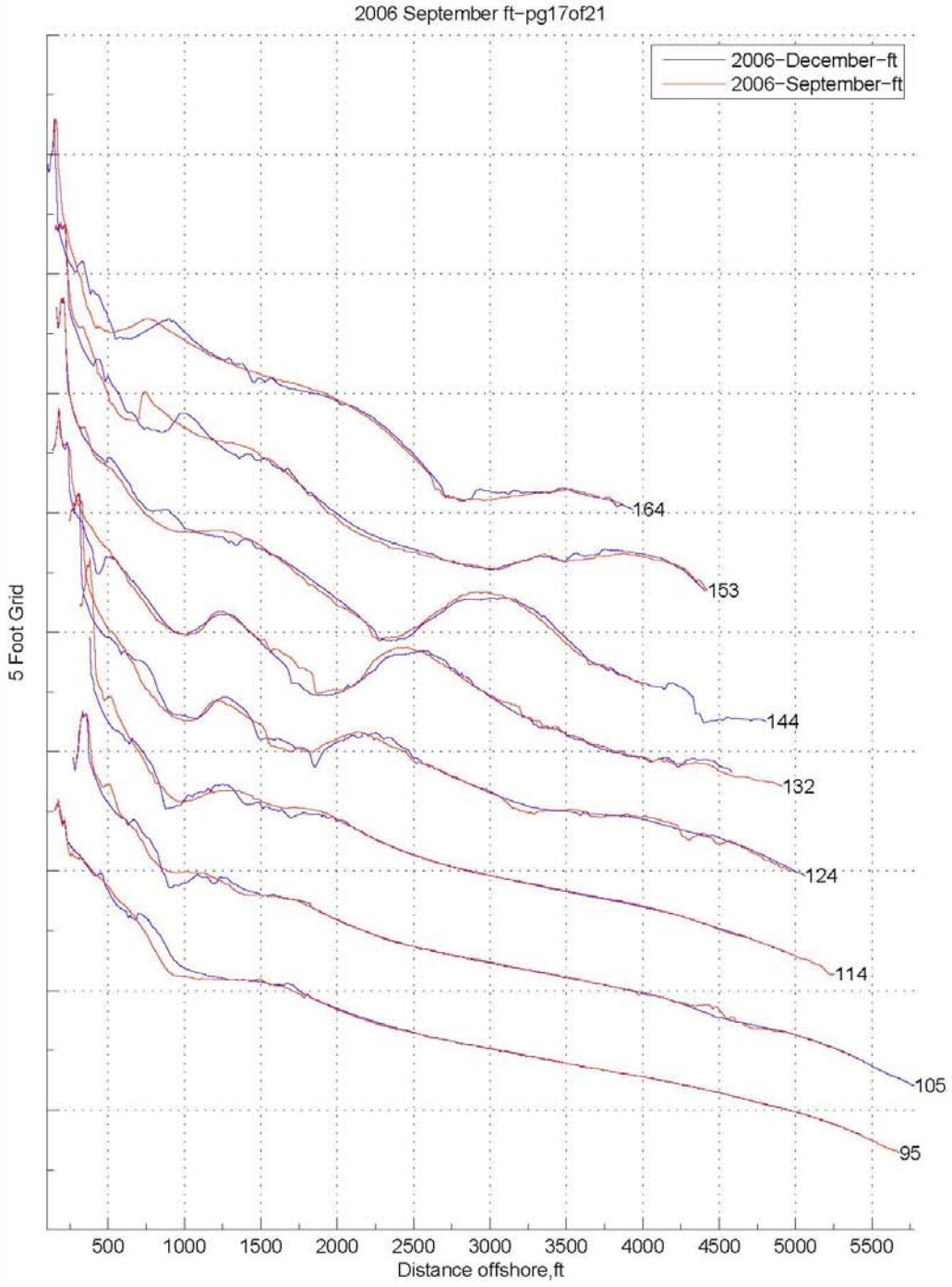
234
224
214
204
194
184
174


2006 September ft-pg17of21
2006-December-ft
2006-September-ft
5 Foot Grid
Distance offshore,ft
500
1000
1500
2000
2500
3000
3500
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4500
5000
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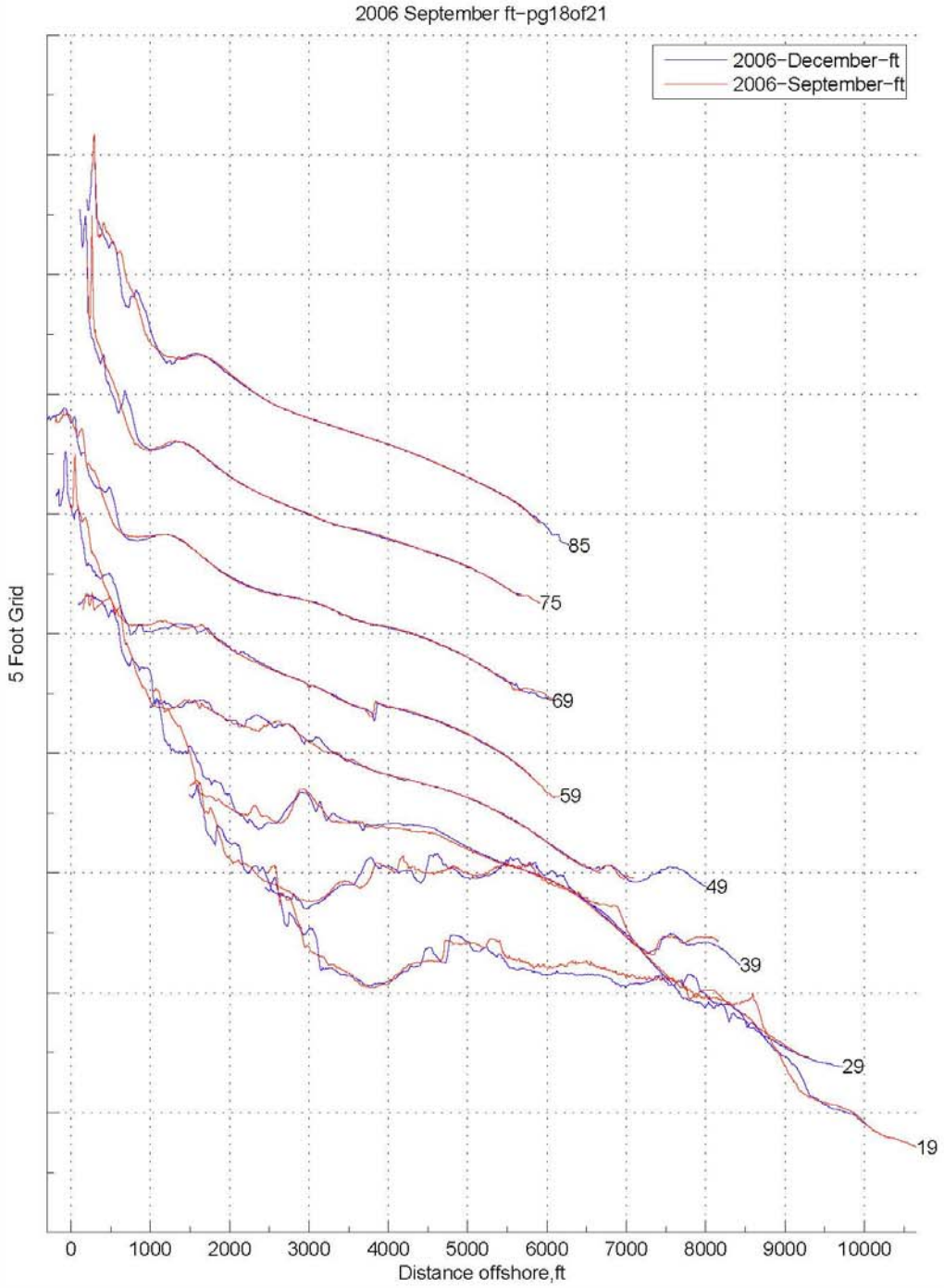
144
132
124
114
105
95


2006 September ft-pg18of21
2006-December-ft
2006-September-ft
5 Foot Grid
Distance offshore,ft
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
85
75
69
59
49
39
29
19

**Appendix G Photos**

Cape Hatteras National Seashore

Just North of Nags Head
Fishing Pier Near line 519

North of Nags Head Fishing Pier

Just South of Nags Head Fishing Pier

South Nags Head 22 November 2006

South Nags Head 22 November 2006

## Appendix H Metadata Files

```
Identification_Information:
  Citation:
    Citation_Information:
      Originator: USACE Field Research Facility
      Publication_Date: 20070118
      Title:
        RTK-GPS Shoreface and Nearshore Topographic and
        Bathymetric Data
      Geospatial_Data_Presentation_Form: Map
      Publication_Information:
        Publication_Place: Duck, North Carolina
        Publisher: USACE Field Research Facility
      Larger_Work_Citation:
        Citation_Information:
          Originator: USACE Field Research Facility
          Publication_Date: 20010613
          Title:
            Dare County Beaches, Shore Protection Project
            Physical Monitoring Program
          Publication_Information:
            Publication_Place: Duck, North Carolina
            Publisher: USACE Field Research Facility
          Other_Citation_Details:
            This data is x,y,z of the shoreface
            and nearshore area collected with a Real Time Kinematic GPS
            system.
  Description:
    Abstract:
      The USACE Wilmington District initiated a physical
      monitoring program associated with the Dare Co
      Beaches project.The physical monitoring consists of four
      parts: beach profile surveys, beach sediment sampling,
      aerial photography and wave/current/water level
      measurements.
      The surveys include 144 profiles starting 3 miles north of
      Kitty Hawk and extending south 30 miles to Oregon Inlet.
      Each profile began at a stable location landward of the
      dune and ended at the -30-ft isobath. Swath surveys were
      used to supplement the profiles in regions with complicated
      morphology. Sediment samples were obtained along every
      other profile. Five samples below MSL and 5 above. The
      physical monitoring will include pre-, during- and post
      construction phases of the project.
    Purpose:
      To collect process and analyze data to assess the beach
      response to the fill placement and serve as the basis for
      maintaining the project. To also provide data in support of
      the biological monitoring effort
    Supplemental_Information:
      Weather/Survey Conditions:
      Land based observations:
      Sky:N/A
      Wind:N/A
      Temp:N/A
```

```
    Precipitation:N/A
    Notes:

    Ocean based observations:
    Seas:N/A
    Wind:N/A
    Swell Direction:N/A
    Tides:
    low (am):N/A
    low (pm):N/A
    high (am):N/A
    high (pm):N/A
    Notes:Base Station NPS DUNE. BM Check NPS PK Nail using
    LARC DELTA Z=0.04m Dare County Project Profile Lines 174
    thru 224.  LARC survey only.

Time_Period_of_Content:
  Time_Period_Information:
    Range_of_Dates/Times:
      Beginning_Date: 20061212 0700
      Ending_Date: 20061212 0900
  Currentness_Reference: Publication Date
Status:
  Progress: Complete
  Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
  Bounding_Coordinates:
    West_Bounding_Coordinate: 75.71
    East_Bounding_Coordinate: 75.52
    North_Bounding_Coordinate: 36.1
    South_Bounding_Coordinate: 35.8
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    Theme_Keyword: Shoreline
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    Theme_Keyword: Beach Renourishnment
    Theme_Keyword: Erosion
    Theme_Keyword: Beach Data
    Theme_Keyword: Nearshore Bathymetry
    Theme_Keyword: GIS
    Theme_Keyword: GPS
  Place:
    Place_Keyword_Thesaurus: None
    Place_Keyword: North Carolina
    Place_Keyword: Atlantic Coast
    Place_Keyword: Southeast Coast
Access_Constraints: None
Use_Constraints: Not for Navigational Purposes
Point_of_Contact:
  Contact_Information:
    Contact_Organization_Primary:
      Contact_Organization: USACE Field Research Facility
      Contact_Person: Mike Forte
    Contact_Position: Survey Specialist
    Contact_Address:
      Address_Type: mailing and physical address
```

```
        Address: 1261 Duck Road
        City: Kitty Hawk
        State_or_Province: North Carolina
        Postal_Code: 27949
        Country: USA
      Contact_Voice_Telephone: (252)261-6840 x.228
      Contact_Facsimile_Telephone: (252)261-4432
      Contact_Electronic_Mail_Address: Michael.F.Forte@erdc.usace.army.mil
      Hours_of_Service:
        Monday-Friday, 8am-5pm, Eastern Standard
        Time
  Native_Data_Set_Environment:
Data_Quality_Information:
  Attribute_Accuracy:
    Attribute_Accuracy_Report:
      GPS quality was checked by
      determining the difference in RTK-GPS baseline solution to
      a known geodetic benchmark.
  Logical_Consistency_Report:
    GPS data was overlayed with
    previous Dare County profile data and aerial imagery to
    visualize logical consistancy.
  Completeness_Report:
  Positional_Accuracy:
    Horizontal_Positional_Accuracy:
      Horizontal_Positional_Accuracy_Report:
        Base station horizontal position was established by MKimm &
        Creed (2004)
        Control points were tested by determining the horizontal
        difference in an RTK-GPS baseline solution to a known
        geodetic benchmark.
    Vertical_Positional_Accuracy:
      Vertical_Positional_Accuracy_Report:
        Base station vertical position was determined by Mkimm &
        Creed (2004) and met specifications
        for geometric relative positioning techniques, 1st order.
        This was tested by determining the vertical difference in
        an RTK-GPS baseline solution to a known geodetic benchmark.
  Lineage:
    Source_Information:
      Source_Citation:
        Citation_Information:
          Originator:
            SAW Dare County Beaches Physical Monitoring
            Project
          Publication_Date: 2003
          Title:
            Dare County Beaches, Shore Protection Project
            Physical Monitoring Program
          Edition:
          Geospatial_Data_Presentation_Form: map
          Publication_Information:
            Publication_Place: Kitty Hawk, North Carolina
            Publisher: USACE Field Research Facility
      Source_Scale_Denominator:
      Type_of_Source_Media:
      Source_Time_Period_of_Content:
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        Time_Period_Information:
          Range_of_Dates/Times:
            Beginning_Date: 2003
            Ending_Date: Present
        Source_Currentness_Reference: Publication Date
      Source_Citation_Abbreviation:
      Source_Contribution:
        Used to determine erosion rates,
        volumes, and set-back lines
    Process_Step:
      Process_Description:
        Beach and nearshore (-11m NAVD88) shore-perpindicular
        survey lines are aquired with Trimble 4000 and
        4700 dual frequency Real-Time-Kinematic Global Positioning
        Satellite (RTK-GPS) system. Land-based survey
        lines are collected with a backpack and rangepole while
        bathymetric profiles are collected using a Knudsen
        310 survey-grade fathometer, TSS motion sensor, and
        RTK-GPS.
        Processing software consists of a custom built FORTRAN
        routine that combines the GPS and echosounder data
        in order to remove the motion of the vessel due to the wave
        motion. The survey software also adjusts the
        measurements to the changes in speed of sound over the
        survey area.  This program also correctly aligns the
        time of the echosounder and GPS data.  This is accomplished
        by dynamically adjusting the time or "latency"
        of the GPS data, relative to the echosounder data, until a
        best fit is obtained.
      Process_Date: 20070105
      Process_Contact:
        Contact_Information:
          Contact_Organization_Primary:
            Contact_Organization: USACE Field Research Facility
            Contact_Person: Mike Forte/Carl Miller
          Contact_Position: Survey Specialist
          Contact_Address:
            Address_Type: mailing and physical address
            Address: 1261 Duck Road
            City: Kitty Hawk
            State_or_Province: North Carolina
            Postal_Code: 27949
            Country: USA
          Contact_Voice_Telephone: (252) 261-6840 x.228
          Contact_Facsimile_Telephone: (252) 261-4432
          Contact_Electronic_Mail_Address:
Michael.F.Forte@erdc.usace.army.mil
          Hours_of_Service:
            Monday-Friday, 8am-5pm, Eastern Standard
            Time
Spatial_Reference_Information:
  Horizontal_Coordinate_System_Definition:
    Planar:
      Grid_Coordinate_System:
        Grid_Coordinate_System_Name:
        State_Plane_Coordinate_System:
          SPCS_Zone_Identifier: 3200
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```
          Lambert_Conformal_Conic:
            Standard_Parallel:
            Longitude_of_Central_Meridian:
            Latitude_of_Projection_Origin:
            False_Easting:
            False_Northing:
      Planar_Coordinate_Information:
        Coordinate_Representation:
          Abscissa_Resolution:
          Ordinate_Resolution:
        Planar_Distance_Units:
        Planar_Coordinate_Encoding_Method:
    Geodetic_Model:
      Horizontal_Datum_Name:
        North American Datum of 1983
        Elevations are referenced to NAVD88 and recorded in meters
      Ellipsoid_Name: WGS 1984 (Geoid 2003)
      Semi-major_Axis: 6378.137km
      Denominator_of_Flattening_Ratio: 1/298.25722
Entity_and_Attribute_Information:
  Detailed_Description:
    Entity_Type:
      Entity_Type_Label: profiles, shoreface and nearshore
      Entity_Type_Definition:
      Entity_Type_Definition_Source:
  Overview_Description:
    Entity_and_Attribute_Overview:
    Entity_and_Attribute_Detail_Citation:
Distribution_Information:
  Distributor:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: USACE Field Research Facility
        Contact_Person: Mike Forte/Carl Miller
      Contact_Position: Survey Specialist
      Contact_Address:
        Address_Type: mailing or physical address
        Address: 1261 Kitty Hawk Road
        City: Kitty Hawk
        State_or_Province: North Carolina
        Postal_Code: 27949
        Country: USA
      Contact_Voice_Telephone: (252) 261-6840 x.228
      Contact_Facsimile_Telephone: (252) 261-4432
      Contact_Electronic_Mail_Address: Michael.F.Forte@erdc.usace.army.mil
      Hours_of_Service:
        Monday-Friday, 8am-5pm, Eastern Standard
        Time
  Resource_Description:
    This dataset is part of the Dare
    County Beaches, Shore Protection Project
  Distribution_Liability:
    Users must assume responsibility to
    determine the appropriate use of these data.
  Standard_Order_Process:
    Digital_Form:
      Digital_Transfer_Information:
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  Metadata_Date: 20070118
  Metadata_Review_Date: 20070118
  Metadata_Contact:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: USACE Field Research Facility
      Contact_Position: Survey Specialist
      Contact_Address:
        Address_Type: mailing and physical address
        Address: 1261 Duck Road
        City: Kitty Hawk
        State_or_Province: North Carolina
        Postal_Code: 27949
        Country: USA
      Contact_Voice_Telephone: (252) 261-6840 x.228
      Contact_Facsimile_Telephone: (252) 261-4432
      Contact_Electronic_Mail_Address: Michael.F.Forte@erdc.usace.army.mil
      Hours_of_Service:
        Monday-Friday, 8am-5pm, Eastern Standard
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