COASTAL
FRONTIERS

January 9, 2008
CFC-735-06

Mr. Keith Merkel
Merkel and Associates, Inc.
5435 Ruffin Road
San Diego, CA 92123

Subject: Bolsa Chica October 2007 Beach Profile Survey

Mr. Merkel:

This letter report presents the methods and results of the Bolsa Chica October 2007 Beach Profile Survey. The survey represents the third such effort conducted in support of the Bolsa Chica Lowlands Restoration Project Beach Monitoring Program. The sections that follow provide an overview of the monitoring program, describe the program establishment activities, discuss the October 2007 beach profile survey, summarize the monthly beach width measurement activities, and present the results. Beach profile plots accompany this report in Attachment A, while the results of the monthly beach width measurement program are provided in Attachment B.

The vertical datum used throughout this report is North American Vertical Datum of 1988 (NAVD88), with units expressed in meters. At the project site, NAVD88 lies approximately 0.06 m above National Ocean Service (NOS) Mean Lower Low Water (MLLW) and 0.79 m below NOS Mean Sea Level (MSL; NOS, 2007). In the case of the geo-referenced data, the horizontal positions are given in meters relative to California State Plane Zone 6, North American Datum of 1983 (NAD 83).

Overview

The objective of the beach monitoring program is to develop a quantitative understanding of changes in the condition of the beaches adjacent to the newly constructed Bolsa Chica Lagoon entrance channel. The program, which commenced in January 2007, is comprised of semi-annual beach profile surveys and monthly beach width measurements at seven sites located along a 17.5 km section of coastline between Bolsa Chica State Beach and 17th Street in Huntington Beach. The beach profile surveys are conducted by Coastal Frontiers Corporation, while the beach width measurements are obtained by Moffatt and Nichol.

Figure 1 shows the locations of the beach profile transects used in the monitoring program. Two of these were established specifically for the monitoring program, and were

Coastal Frontiers Corporation
9420 Topanga Canyon Blvd, Suite 101
Chatsworth, CA 91311-5759
(818) 341-8133 Fax (818) 341-4498

first surveyed in January 2007. Five of the transects had been established previously, and were included in the Coast of California Storm and Tidal Waves Study for the Orange County Region (CCSTWS-OC) conducted by the U.S. Army Corps of Engineers.

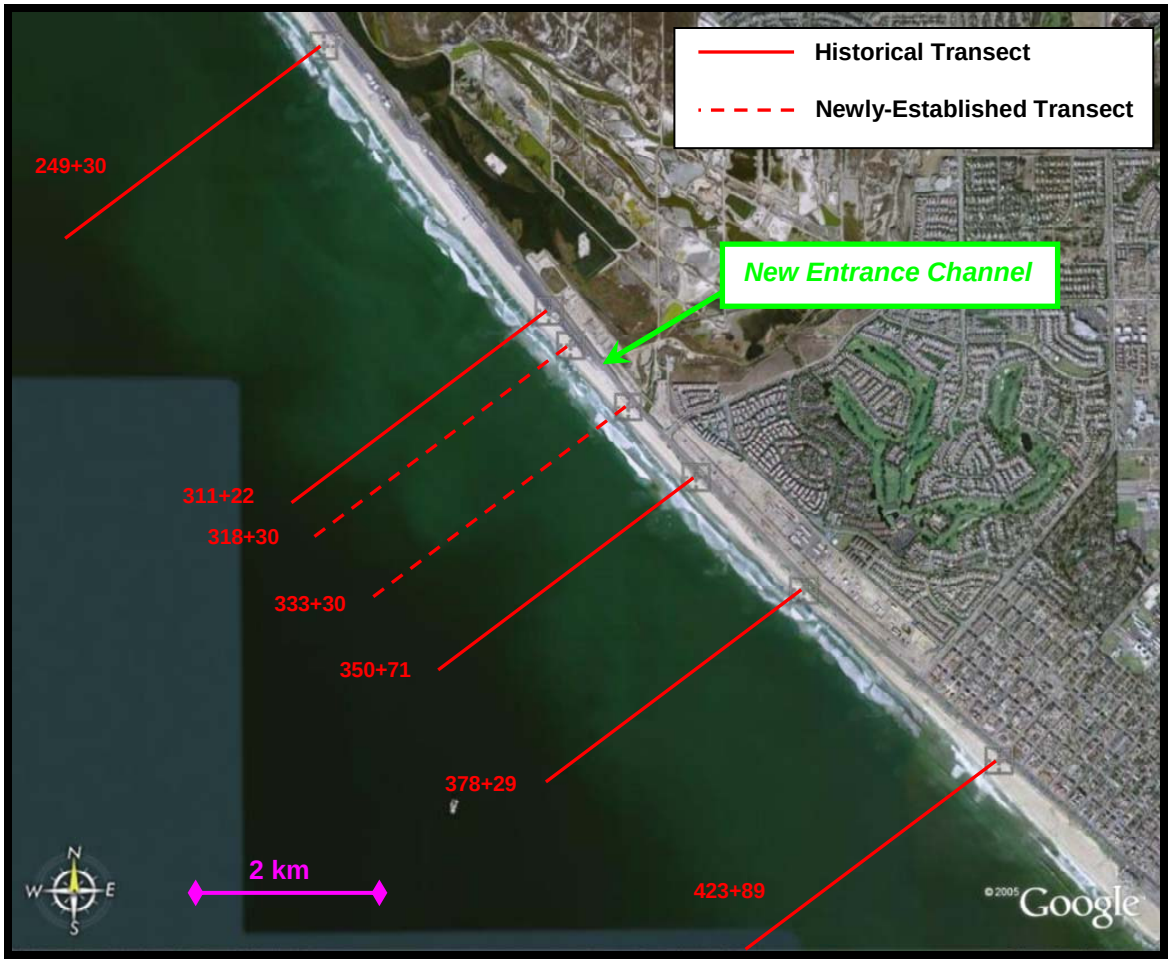


Figure 1. Location Map

Monument Establishment/Re-Establishment

As discussed in the previous section, the beach monitoring program utilizes five historical transects and two newly-established transects. Preliminary transect establishment/re-establishment activities were conducted on January 15 prior to the commencement of the initial beach profile survey. Two of the five historical survey monuments were recovered in good condition, while three were found to be missing or destroyed.

A new survey marker was established for the three historical transects that lacked monuments and for the two new transects. The horizontal position and elevation of the newly-installed survey markers were determined on March 30 and May 8, 2007 by KDM Meridian, Inc., using Real Time Kinematic (RTK) GPS techniques. Additional information regarding program establishment activities can be found in the January 2007 survey report.

It should be noted that the previously reported control information for Transect 378+29 has been revised. During the October 2007 Beach Profile Survey a series of independent checks were carried out to investigate discrepancies in the elevation and location of the marker at Transect 378+29. It was found that that KDM Meridian, Inc. mistakenly obtained control information as a nearby reference mark rather than the survey marker. As a result, both the horizontal and vertical control at the survey marker were revised.

October 2007 Beach Profile Survey

Field activities were conducted on 16 October 2007. The methods employed were similar to those used on previous Orange County surveys. In consequence, the results are directly comparable. The following sections discuss the data acquisition and reduction methods for the October 2007 Beach Profile Survey.

Beach Profile Data Acquisition

The wading and bathymetric portions of the survey were performed concurrently by two crews. Data were acquired along each transect from the back beach to a depth of approximately 14 m below NAVD88. At the time of the October 2007 survey, the wave heights were typically less than 1 m, while the wind speeds varied from calm to approximately 15 kts.

The beach and surf zone were surveyed using a total station and a survey rodman. The total station was used to determine the position and elevation of the beach at each location occupied by the rodman. Each transect was surveyed from the back beach seaward through the surf zone until the survey rod no longer protruded above the water surface when held erect. This location, typically in a water depth of 3.0 to 3.5 m below NAVD88, provided substantial overlap with the landward portion of the bathymetric survey.

Bathymetric data were collected with a digital acoustic echo sounder operated from a shallow-draft inflatable survey vessel. A dynamic motion sensor, which provides real-time corrections to the echo sounder for wave-induced vessel heave, also was utilized. A GPS receiver was used to determine the position of each sounding. To improve the accuracy of each position, differential corrections transmitted in real-time from U.S. Coast Guard

beacons were utilized (DGPS). All systems were interfaced to a laptop computer using the Hypack Max survey package.

The boat traveled along each transect from the offshore terminus to the surf zone guided by DGPS navigation. Soundings were acquired on a continuous basis (approximately 3 soundings per second), while positions were recorded at 1-second intervals. The DGPS position data and sounding data were merged using the Hypack software, with interpolated positions being assigned to the soundings acquired between position fixes.

The calibration of the echo sounder was checked at periodic intervals during the survey using a standard "bar check" procedure. In addition, measurements of the speed of sound in sea water also were obtained at the offshore end of each transect using a recording conductivity, temperature, and depth (CTD) instrument.

Beach Profile Data Reduction

The data from the wading portion of the survey were processed using software developed by Trimble. The raw total station data were read by the software, and the coordinates and elevation of each data point were calculated and inserted into a CAD drawing.

The raw data from the bathymetric portion of the survey consisted of Hypack files containing the position data and heave-compensated soundings. These data were edited for outliers using the Hypack Single-Beam Processing Module. The dynamic motion sensor utilized during the survey removed the majority of the wave contamination from the record in real time.

Corrections for the draft of the transducer and the measured speed of sound in sea water then were applied to the measured depths. The speed-of-sound profiles were confirmed using the results of the "bar check" calibration procedure. Finally, the corrected soundings were adjusted to NAVD88 datum using tide measurements made by the U.S. Department of Commerce, NOAA, at Los Angeles Harbor. To provide a more accurate representation of local tide conditions, the water levels recorded at Los Angeles Harbor were adjusted to the project site using the time and height differences published by NOAA (NOS, 2007).

The adjusted soundings were thinned to a nominal interval of 3 m to produce a file size suitable for developing beach profile plots. The resulting x, y, z data (easting, northing, and elevation) were inserted into the CAD drawing containing the wading data. As indicated above, the field work was conducted in such a manner as to provide substantial overlap between the wading and bathymetric portions of the survey. The processed data

were examined in this region to insure that the two data sets were compatible. Once this confirmatory inspection had been completed, only the more detailed data in the region of overlap were retained (typically the bathymetric data). The less detailed data were purged, after which the wading and bathymetric data were merged to create a single digital file.

Based on past experience, the vertical accuracy of the processed soundings is approximately ±0.5 ft. According to the Hemisphere GPS equipment specifications, the accuracy of horizontal positions obtained in the manner described above is less than 2.0 ft. The electronic total station used to conduct the survey is capable of measuring ranges to within ±0.5 ft and elevation differences to within ±0.1 ft. However, because the swimmer encountered waves and currents in the surf zone, the horizontal accuracy perpendicular to each transect (parallel to the shoreline) varied from minimal at short ranges to approximately ±15 ft at the offshore end.

Monthly Beach Width Measurements

As indicated previously, the Beach Width Measurement Program is conducted by Moffatt and Nichol. Monthly beach width measurements were acquired at each of the seven profile sites, commencing in January 2007.

The measurements were collected at tide heights ranging from -0.19 m to 1.96 m (MLLW). The beach width was recorded as the distance from a permanent point at the back beach to the approximate intersection of the still water line and the beach face. The foreshore slope also was measured and recorded along with the date and time of the observation. The measurements then were adjusted to approximate the MSL beach width using the foreshore slope and NOAA tide elevations. Although inherently less accurate, the method provides a cost-effective means to supplement the more accurate MSL beach widths derived from the semi-annual beach profile survey data.

In addition, the distance from the back beach to the berm was measured. These data will be used to supplement similar measurements that have been obtained by the U.S. Army Corps of Engineers since the 1970's.

Results

The beach profile plots developed from the October 2007 survey data are provided in Attachment A. The January 2007 and May 2007 profiles also are included on each plot, while the plots for the five historical transects also display beach profile data obtained in March 2002 (the most recent survey preceding the lagoon restoration activities). The range on each profile plot represents the distance in meters seaward of the transect origin. The CCSTWS-OC survey monument serves as the origin for the historical transects, while the

survey markers are used for the newly-established transects. The elevations are given in meters relative to NAVD88.

The results of the beach width measurement program are provided in Attachment B. These data have been modified since the time of the January 2007 Survey report using additional control information obtained during the May 2007 survey. The measurements also have been adjusted to represent the MSL beach width reckoned from the landward limit of the sandy beach as opposed to the transect origin.

The October 2007 beach profile data are included in digital form on an accompanying CD-ROM, which contains ASCII files of: (1) range and elevation for each profile, and (2) northing, easting, and elevation triplets (n,e,z) for the entire survey. In the case of the geo-referenced data, the horizontal positions are in meters relative to California State Plane Zone 6, NAD 83. As indicated previously, elevations are given in meters relative to NAVD88. Due to the recent revision of the survey control at Transect 378+29, the results of the previous two surveys (January 2007 and May 2007) also are included.

A detailed assessment of beach changes will be provided in the annual report. General observations are offered, however, based on the data products presented in the attachments, the MSL beach widths and shoreline changes provided in Tables 1 and 2, and the summary of the beach width measurement program given in Table 3. It should be noted that the MSL beach width data shown in Tables 1 and 3 are reckoned from the landward extent of the sandy beach.

1.) Beach Widths (Table 1): At the time of the October 2007 Survey, MSL beach widths in the Bolsa Chica study area ranged from 41.1 m at Transect 378+29 to 113.3 m at Transect 423+89.

2.) Seasonal Shoreline Changes (Table 2): Shoreline advance predominated the Bolsa Chica-area beaches during the five-month period between the May and October 2007 surveys. This finding is consistent with the expected trend of seasonal shoreline advance during the summer season (May through October). The greatest shoreline advance occurred at Transect 378+29, and measured 13.3 m. Transect 318+30 was the only site which experienced shoreline retreat, a loss of -3.4 m.

3.) Short-Term Shoreline Changes (Table 2): During the nine-month period between the January and October 2007 surveys, the MSL shoreline advanced at four sites, retreated at one site, and was essentially unchanged (3 m or less) at the remaining two locations. The greatest shoreline advance, 17.2 m, occurred at Transect 378+29. The only occurrence of shoreline retreat was a loss of 3.2 m at Transect 318+30.

4.) Long-Term Shoreline Changes (Table 2): Between March 2002 and October 2007 (5.6 years), the MSL shoreline advanced at four of the five sites for which such data are available. The remaining site, Transect 350+71, was essentially unchanged (3 m or less) during the 5.6 year period. The greatest shoreline advance occurred at Transect 311+22, and measured 25.3 m. (It should be noted that the Long-Term MSL shoreline changes reflect a seasonal bias introduced by comparing shoreline positions derived from a March survey and an October survey. Because the shoreline tends to advance during the summer wave season, the gains are most likely larger than they would have been without the seasonal bias. The March-to-October comparison was necessary, however, to bracket the construction of the new entrance channel.)

5.) Beach Width Measurements (Attachment B; Table 3): During the nine-month period between the January and October observations, the MSL beach width decreased at two of the seven sites, increased at three locations, and was essentially unchanged (3 m or less) at the remaining two sites. The greatest shoreline advance was 17 m, and occurred at Transect 378+29. The greatest shoreline retreat was a loss of 12 m immediately south of the Bolsa Chica entrance channel at Transect 333+30. Immediately north of the entrance channel (Transect 318+30), the shoreline retreated 10 m between January and October 2007.

Table 1. MSL Beach Widths Derived From Profile Data [1]

Transect	***March 2002***	***January 2007***	***May 2007***	***October 2007***
249+30	78.1 m	86.8 m	84.7 m	91.0 m
311+22	60.2 m	70.3 m	76.2 m	85.5 m
318+30	- [2]	85.9 m	86.1 m	82.7 m
333+30	- [2]	66.6 m	61.9 m	72.3 m
350+71	57.8 m	54.1 m	48.9 m	54.8 m
378+29	20.7 m	23.9 m	27.8 m	41.1 m
423+89	96.3 m	110.5 m	106.9 m	113.3 m

Notes:
[1] MSL beach width reckoned from the landward extent of the sandy beach.
[2] Transect surveyed for the first time in January 2007.

Table 2. MSL Shorelines Changes Derived From Beach Profile Data [1]

Transect	*MSL Shoreline Change*		
	Seasonal	**Short-Term**	**Long-Term**
	May 2007 – October 2007 (5 months)	***January 2007 – October 2007 (9 months)***	***March 2002-October 2007 (5.6 years)***
249+30	6.3 m	4.2 m	12.9 m
311+22	9.3 m	15.2 m	25.3 m
318+30	-3.4 m	-3.2 m	- [1]
333+30	10.4 m	5.7 m	- [1]
350+71	5.9 m	0.7 m	-3.0 m
378+29	13.3 m	17.2 m	20.4 m
423+89	6.4 m	2.8 m	17.0 m

Note:
[1] Transect surveyed for the first time in January 2007.

Table 3. Beach Width Measurement Program Summary Statistics [1]

Transect	*Distance to Berm (m)*			*MSL Beach Width (m)*		
	Range	***Ave***	***Change Jan-Oct 2007***	***Range***	***Ave***	***Change Jan-Oct 2007***
249+30	52-86	73	20	80-110	90	1
311+22	34-67	55	7	69-85	75	6
318+30	64-72	68	-3	68-87	78	-10
333+30	38-49	41	-10	53-70	61	-12
350+71	35-45	39	-2	46-56	50	-3
378+29	0-12	6	10	10-31	22	17
423+89	84-101	88	0	98-109	103	5

Note:
[1] MSL beach width and berm position reckoned from the landward extent of the sandy beach.

We have sincerely appreciated the opportunity to assist Merkel and Associates, and look forward to continued participation in the Beach Monitoring Program. Please do not hesitate to contact us if you have any questions or require additional information.

Sincerely,
Coastal Frontiers Corporation

Gregory E. Hearon, P.E.
Project Manager

Brady Richmond
Project Engineer

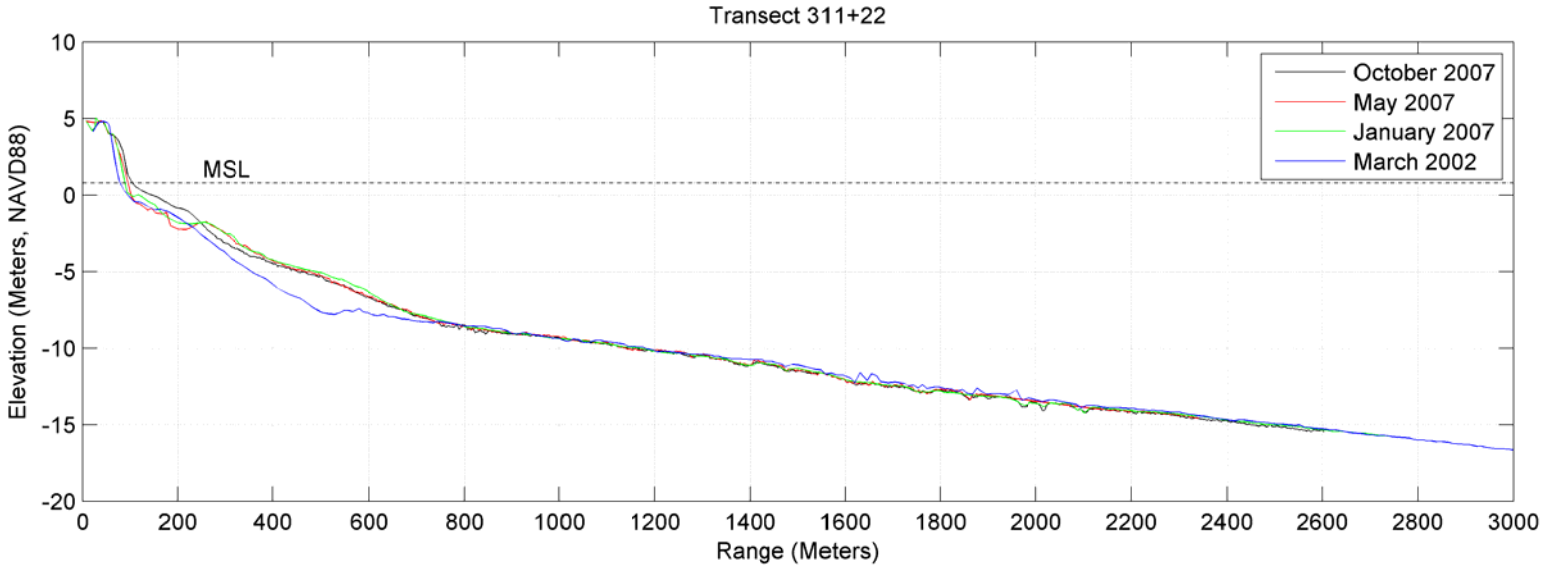
Attachments: (A) Beach Profile Plots,
(B) Monthly Beach Width Measurement Results

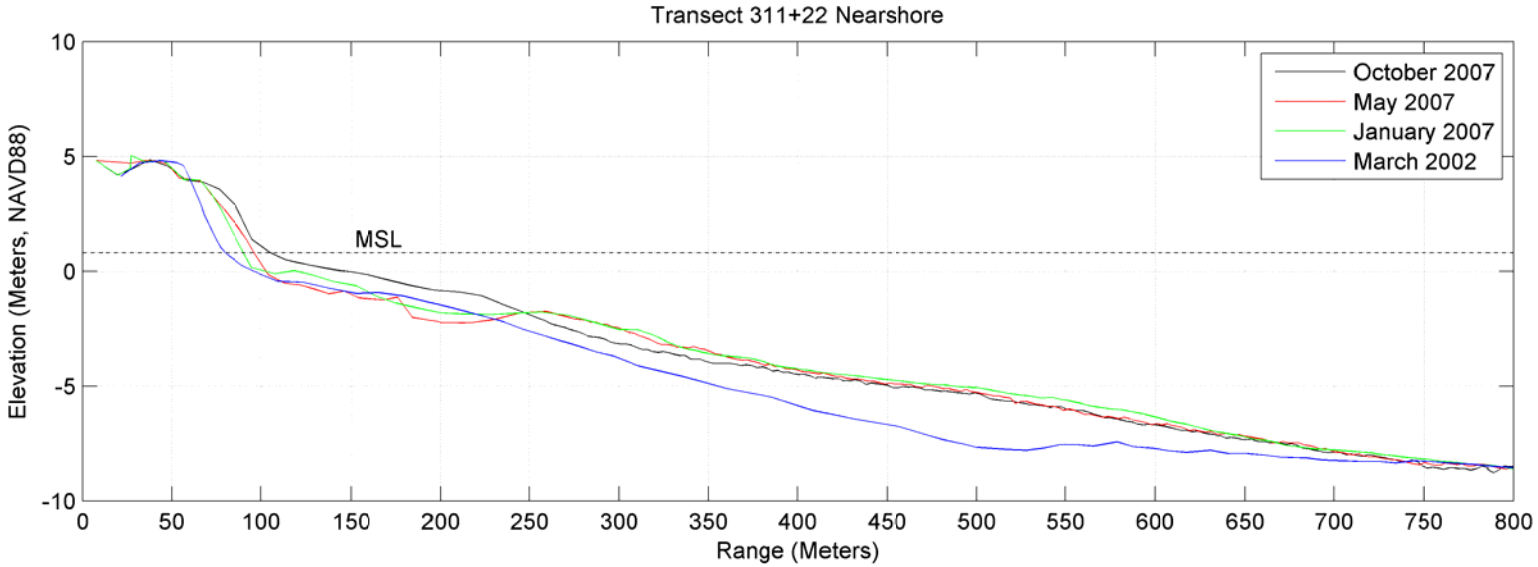
References

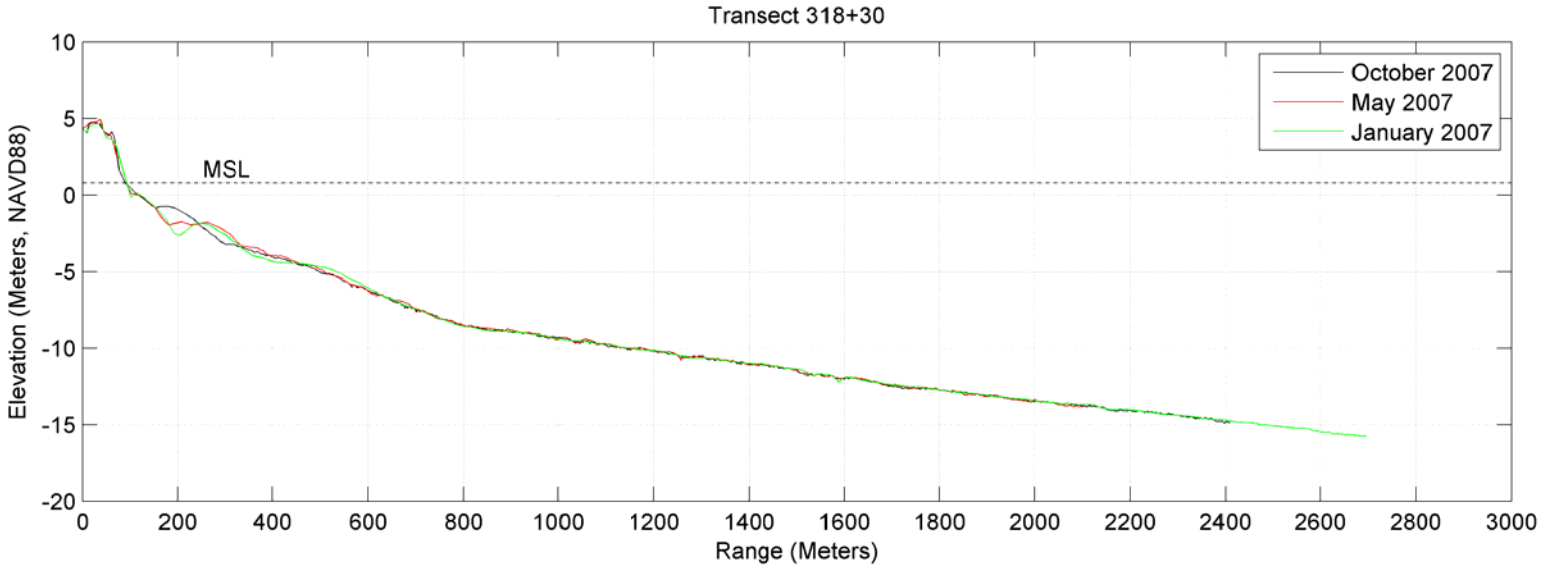
National Ocean Service (NOS). 2007. Center for Operation Oceanographic Products and Services. http://co-ops.nos.noaa.gov.

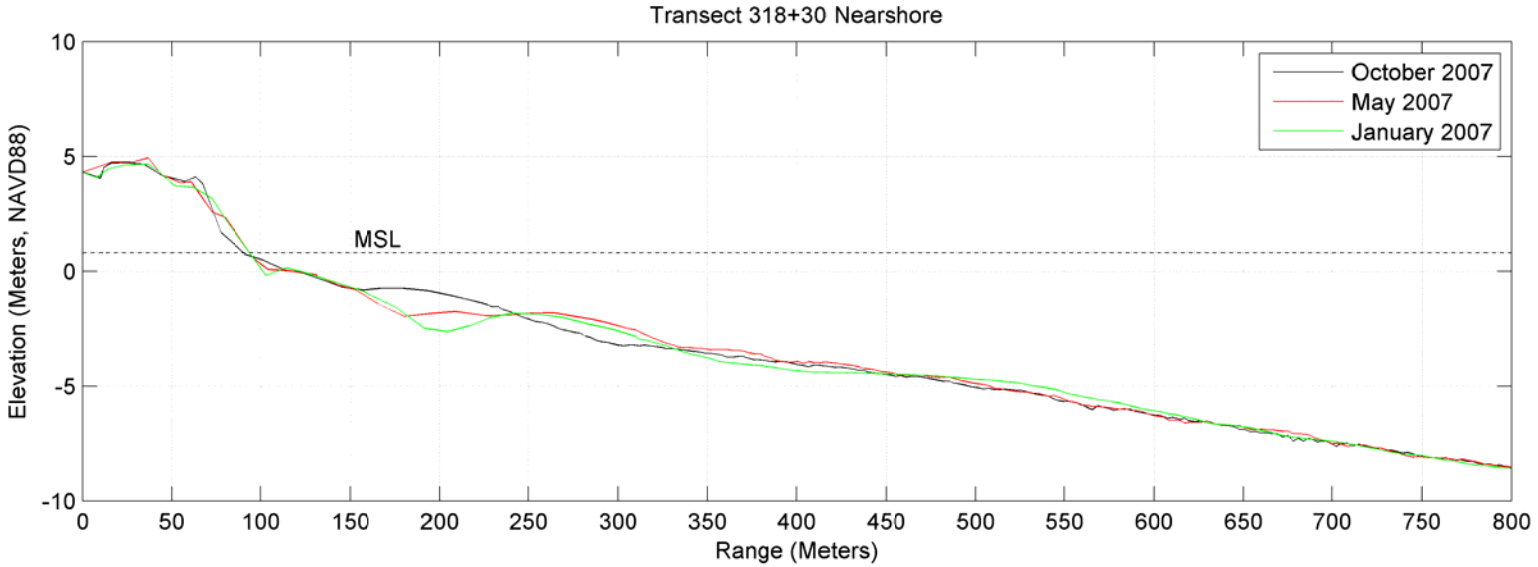
Attachment A

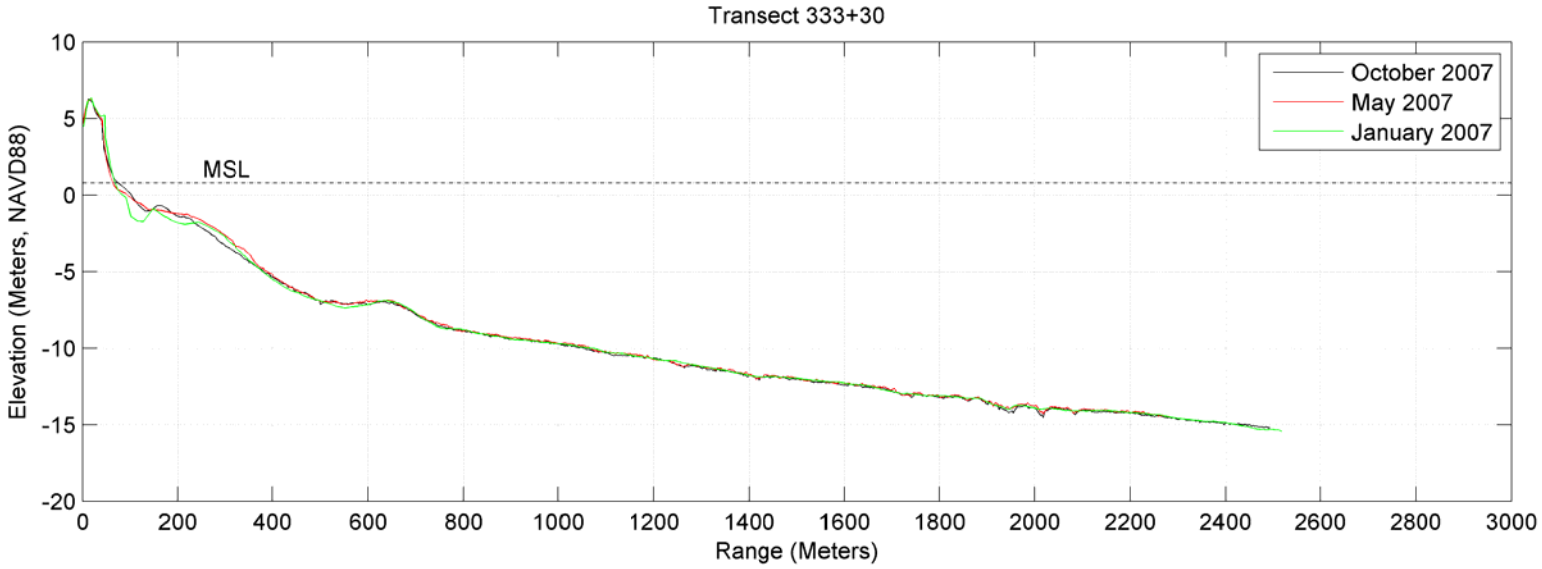
Beach Profile Plots

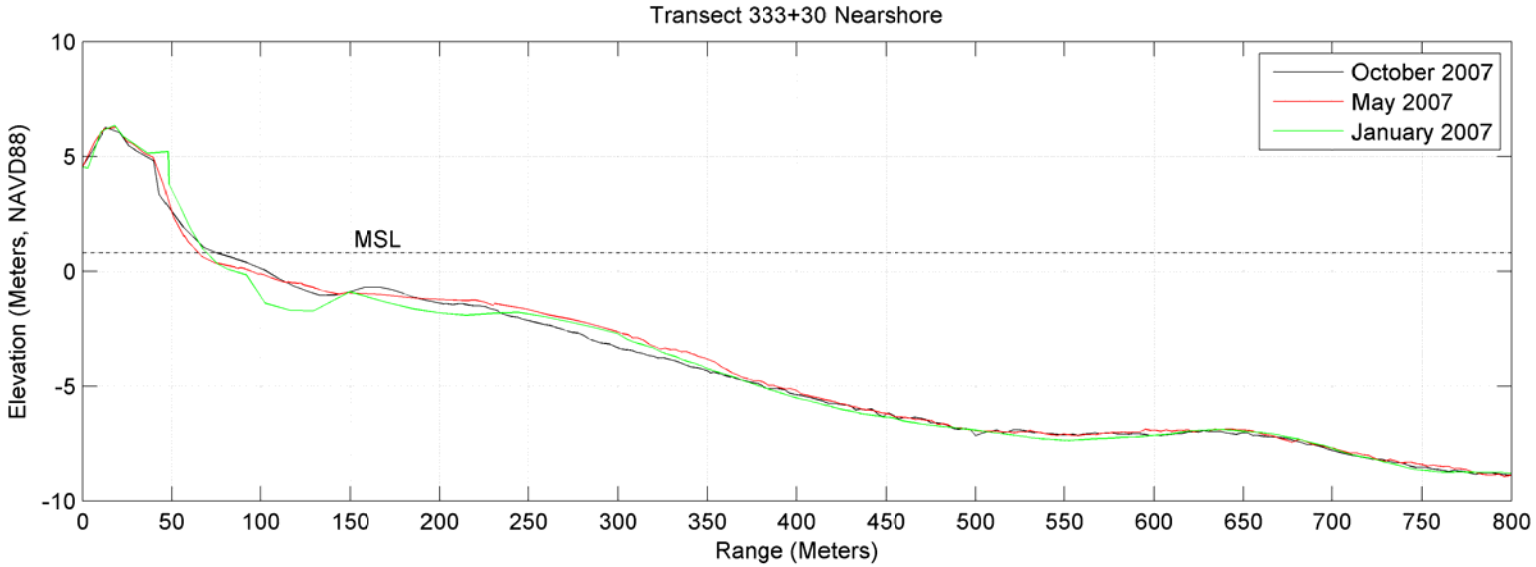

Transect 311+22
Elevation (Meters, NAVD88)
Range (Meters)
MSL
October 2007
May 2007
January 2007
March 2002
10
5
0
-5
-10
-15
-20
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000

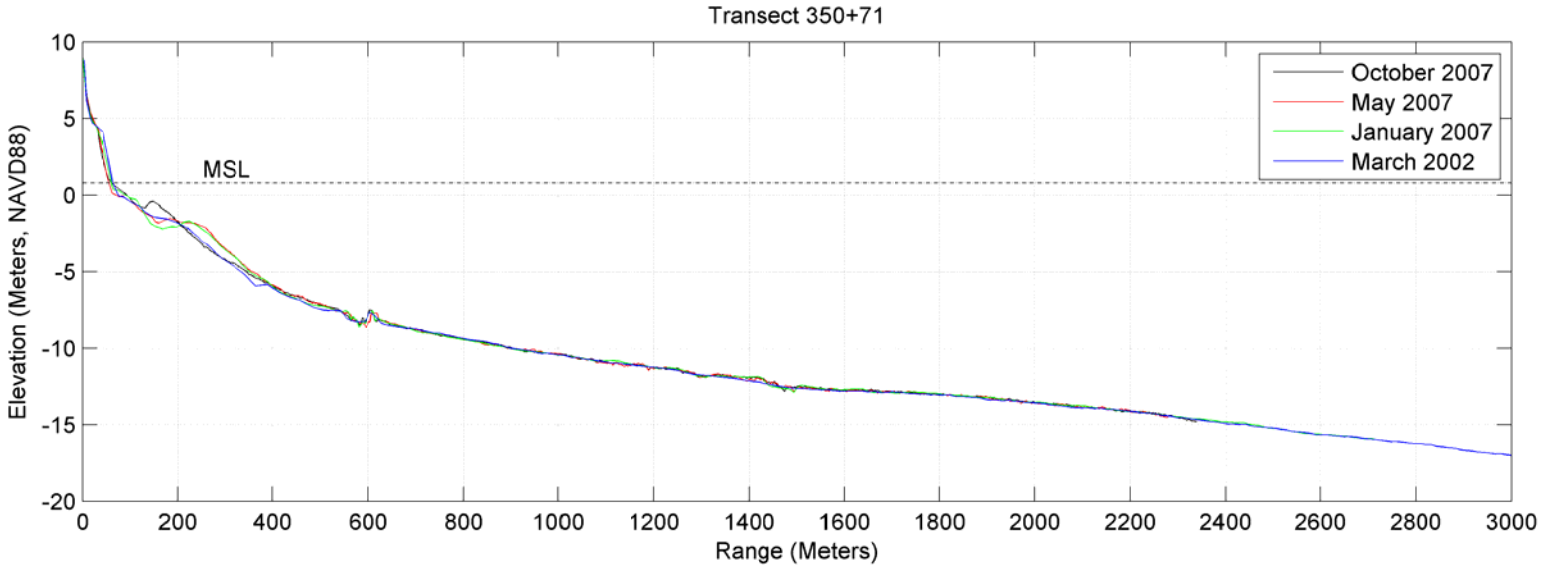

Transect 311+22 Nearshore
Elevation (Meters, NAVD88)
Range (Meters)
MSL
October 2007
May 2007
January 2007
March 2002
10
5
0
-5
-10
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800

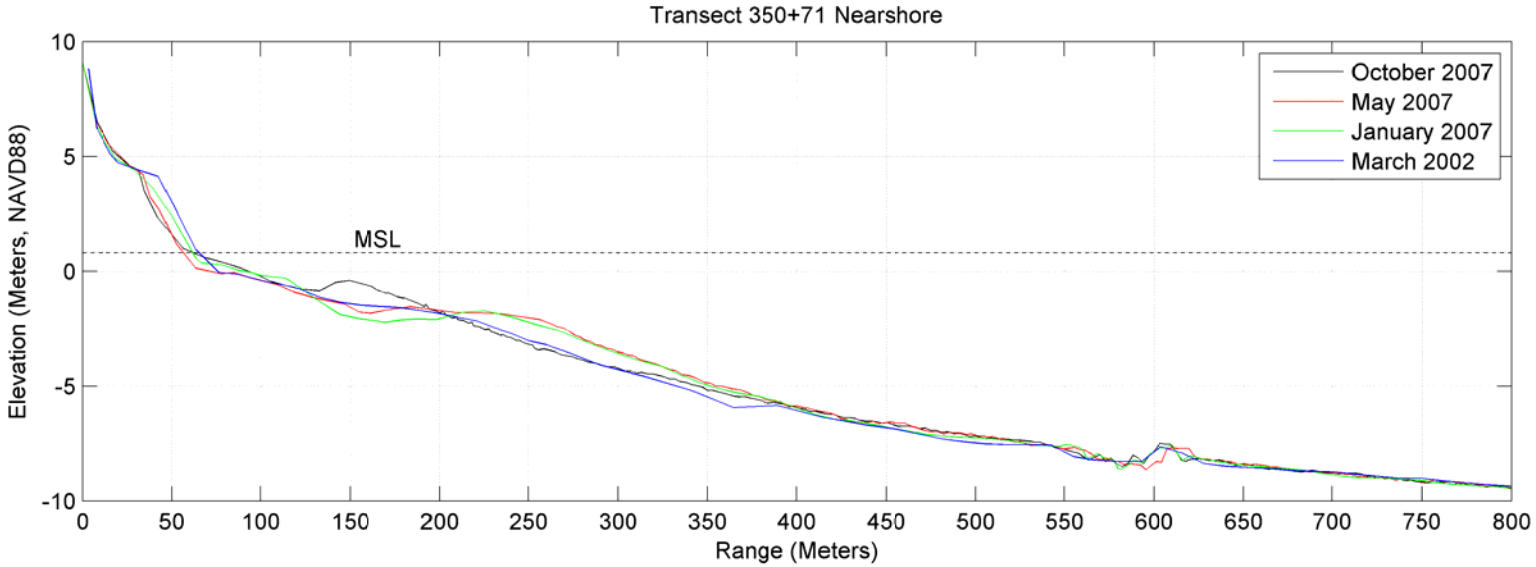

Transect 318+30
October 2007
May 2007
January 2007
MSL
Elevation (Meters, NAVD88)
Range (Meters)
10
5
0
-5
-10
-15
-20
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000

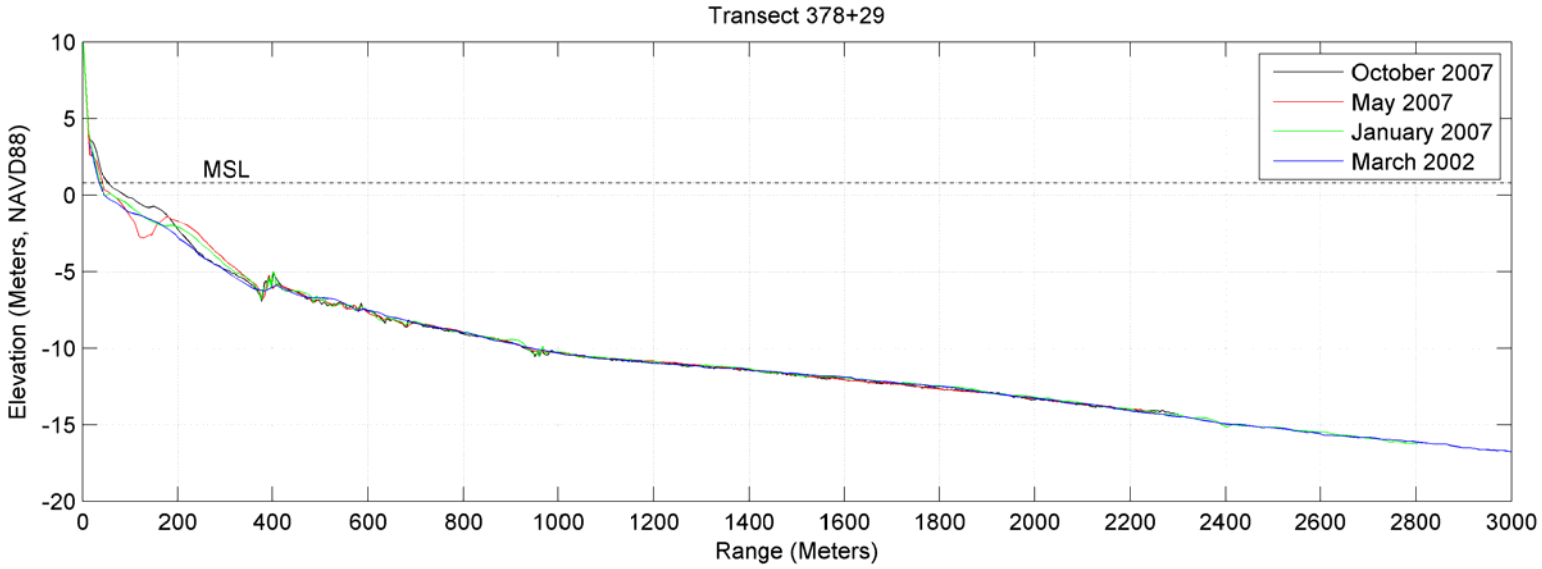

Transect 318+30 Nearshore
October 2007
May 2007
January 2007
MSL
Elevation (Meters, NAVD88)
Range (Meters)
10
5
0
-5
-10
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800

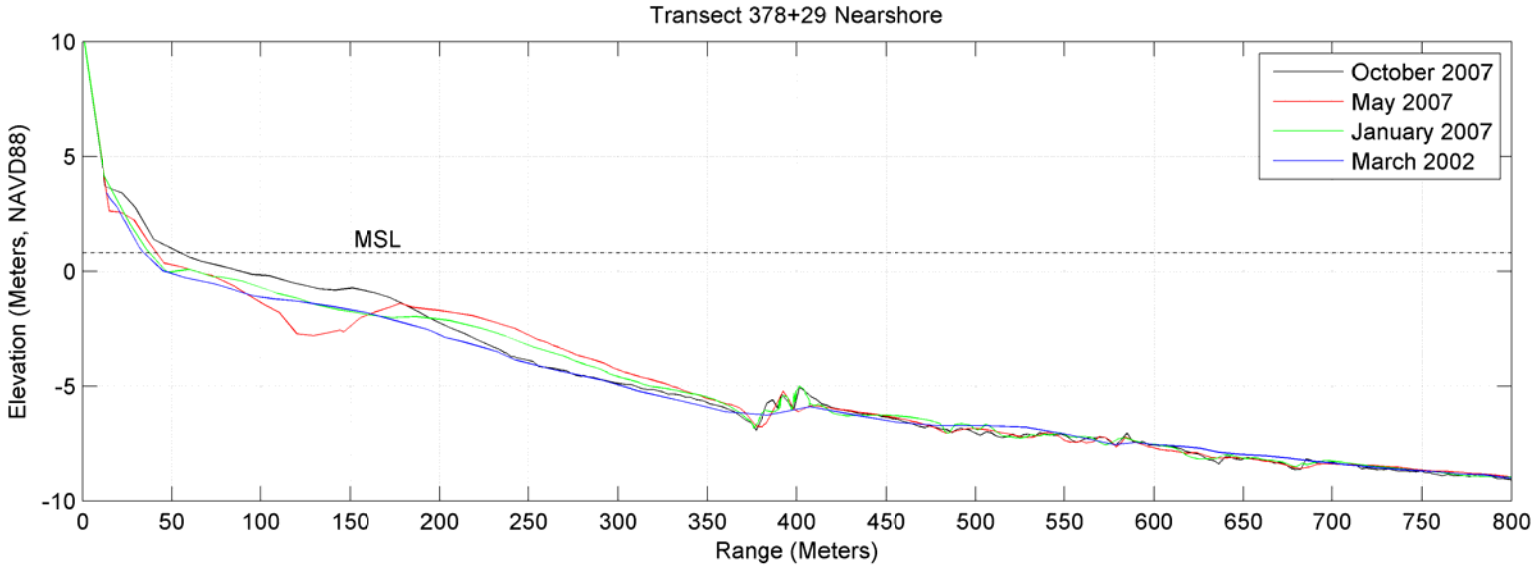

Transect 333+30
October 2007
May 2007
January 2007
MSL
Elevation (Meters, NAVD88)
Range (Meters)
10
5
0
-5
-10
-15
-20
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000

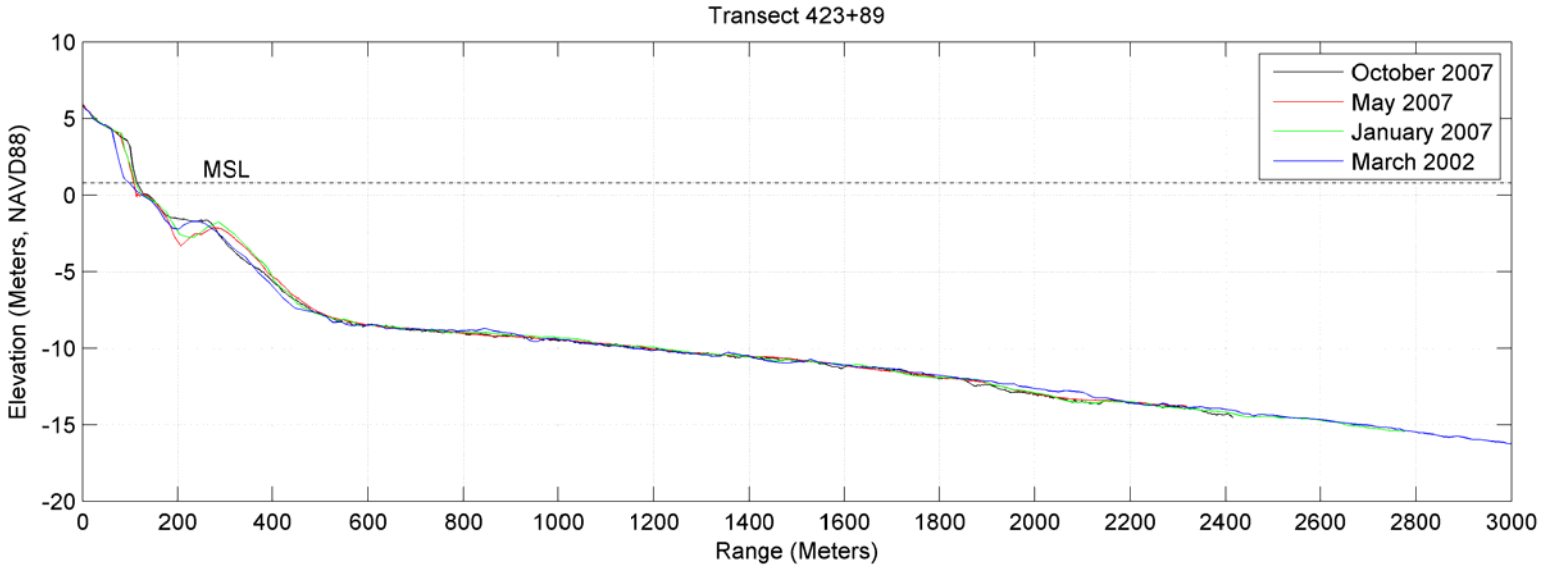

Transect 333+30 Nearshore
October 2007
May 2007
January 2007
MSL
Elevation (Meters, NAVD88)
Range (Meters)
10
5
0
-5
-10
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800

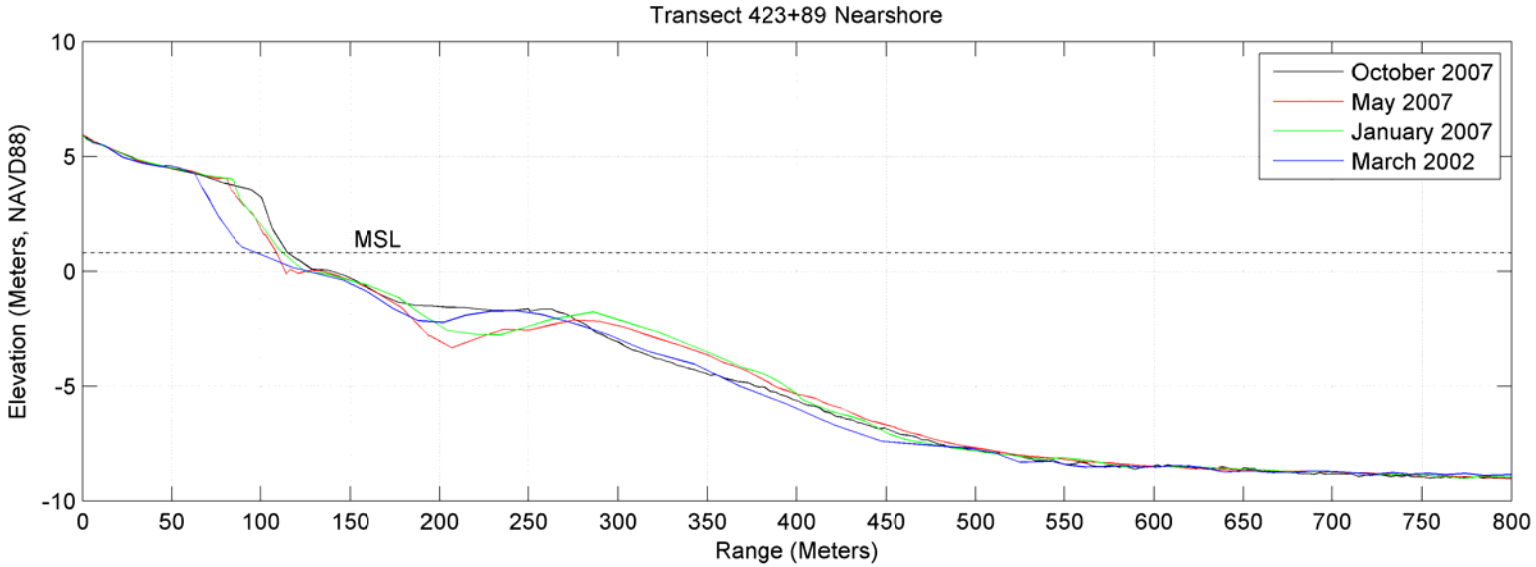

Transect 350+71
October 2007
May 2007
January 2007
March 2002
MSL
Elevation (Meters, NAVD88)
Range (Meters)
10
5
0
-5
-10
-15
-20
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000


Transect 350+71 Nearshore
October 2007
May 2007
January 2007
March 2002
MSL
Elevation (Meters, NAVD88)
Range (Meters)
10
5
0
-5
-10
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800


Transect 378+29
October 2007
May 2007
January 2007
March 2002
MSL
Elevation (Meters, NAVD88)
Range (Meters)
10
5
0
-5
-10
-15
-20
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000

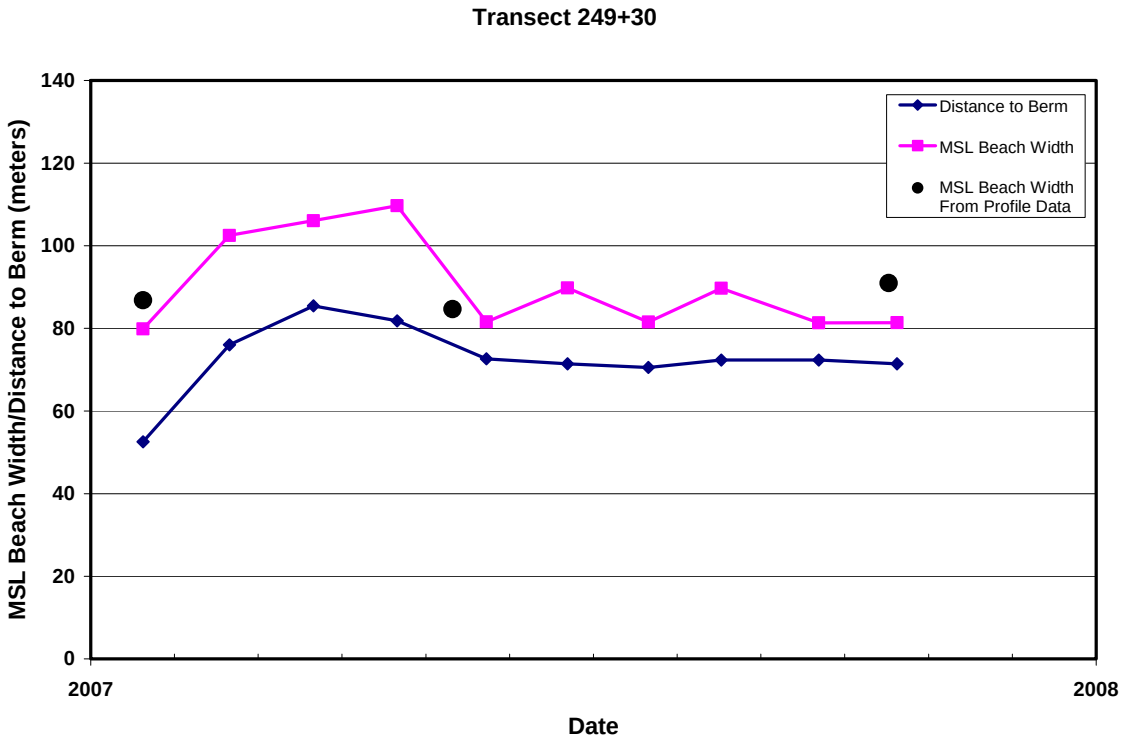

Transect 378+29 Nearshore
October 2007
May 2007
January 2007
March 2002
MSL
Elevation (Meters, NAVD88)
Range (Meters)
10
5
0
-5
-10
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800

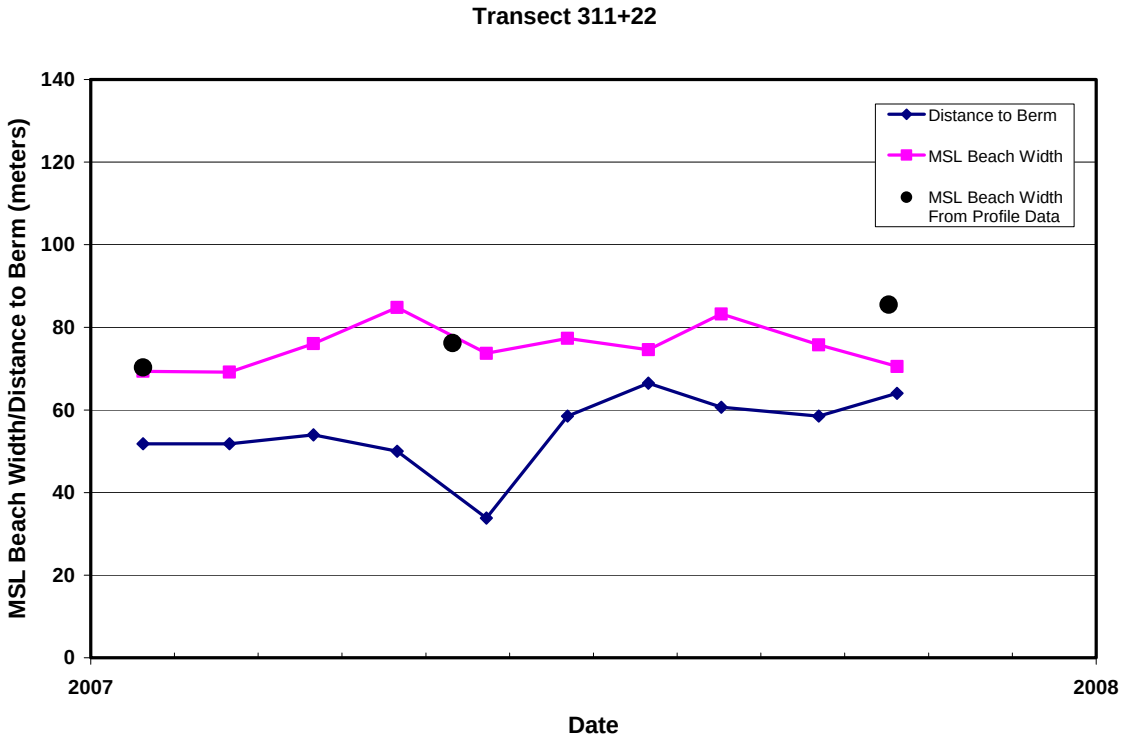

Transect 423+89
October 2007
May 2007
January 2007
March 2002
MSL
Elevation (Meters, NAVD88)
Range (Meters)
10
5
0
-5
-10
-15
-20
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000

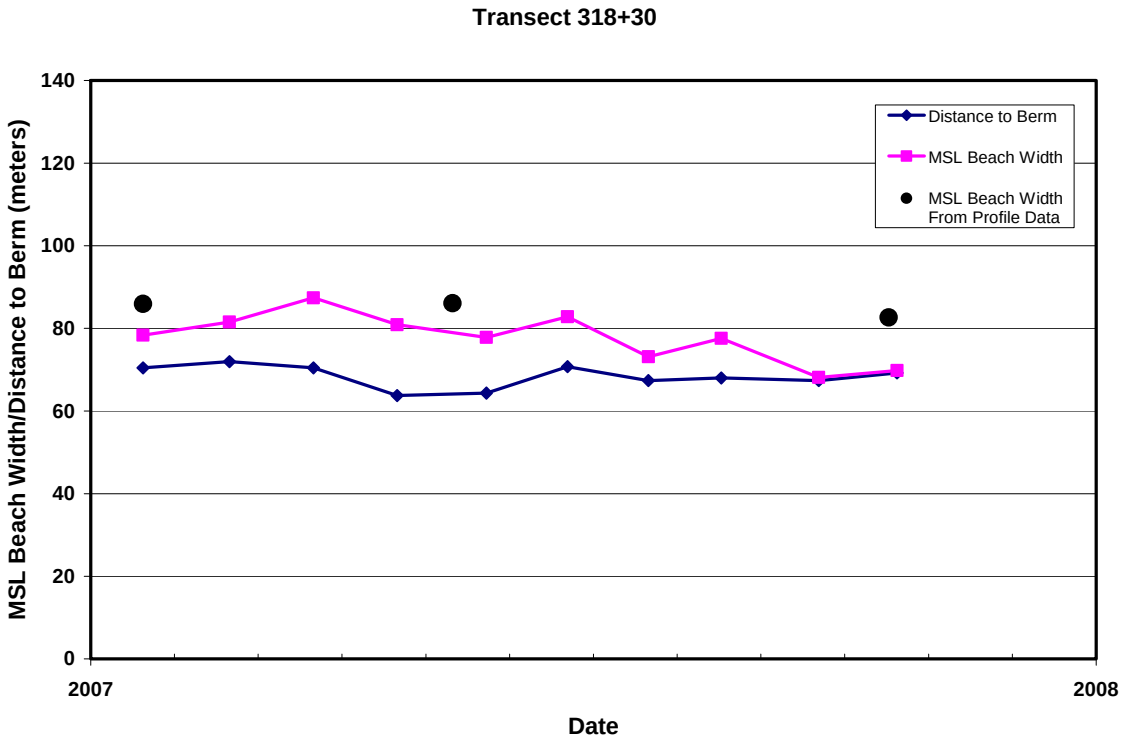

Transect 423+89 Nearshore
October 2007
May 2007
January 2007
March 2002
MSL
Elevation (Meters, NAVD88)
Range (Meters)
10
5
0
-5
-10
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800

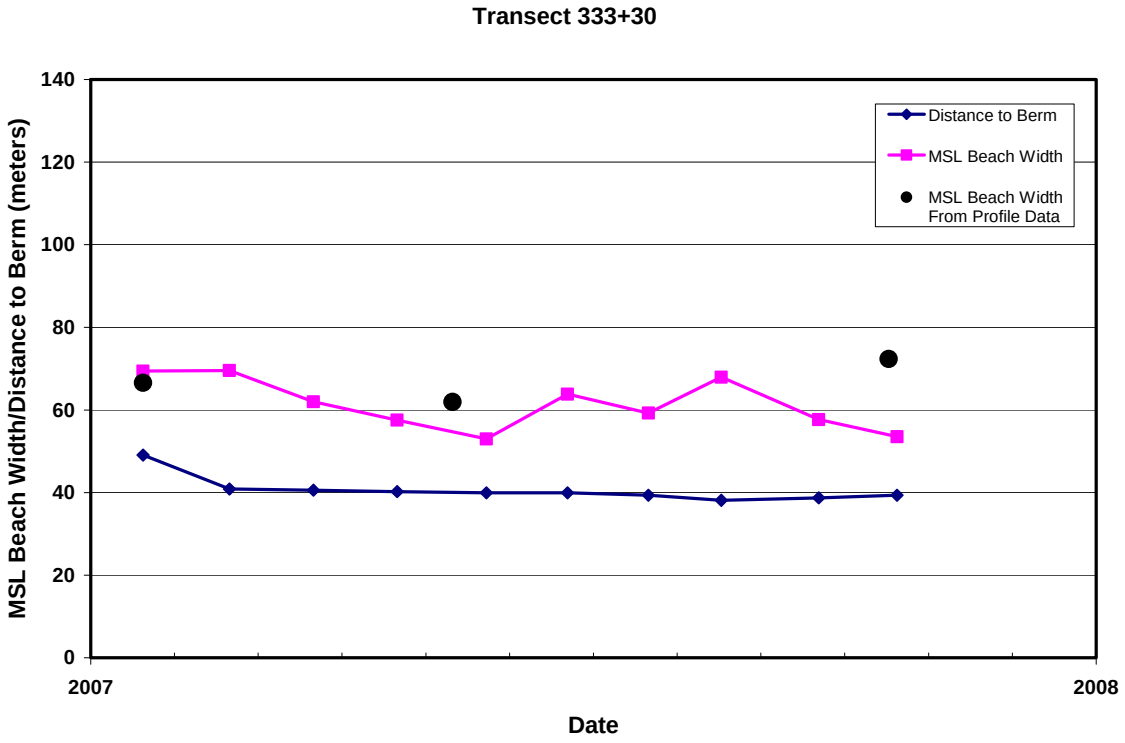
Attachment B

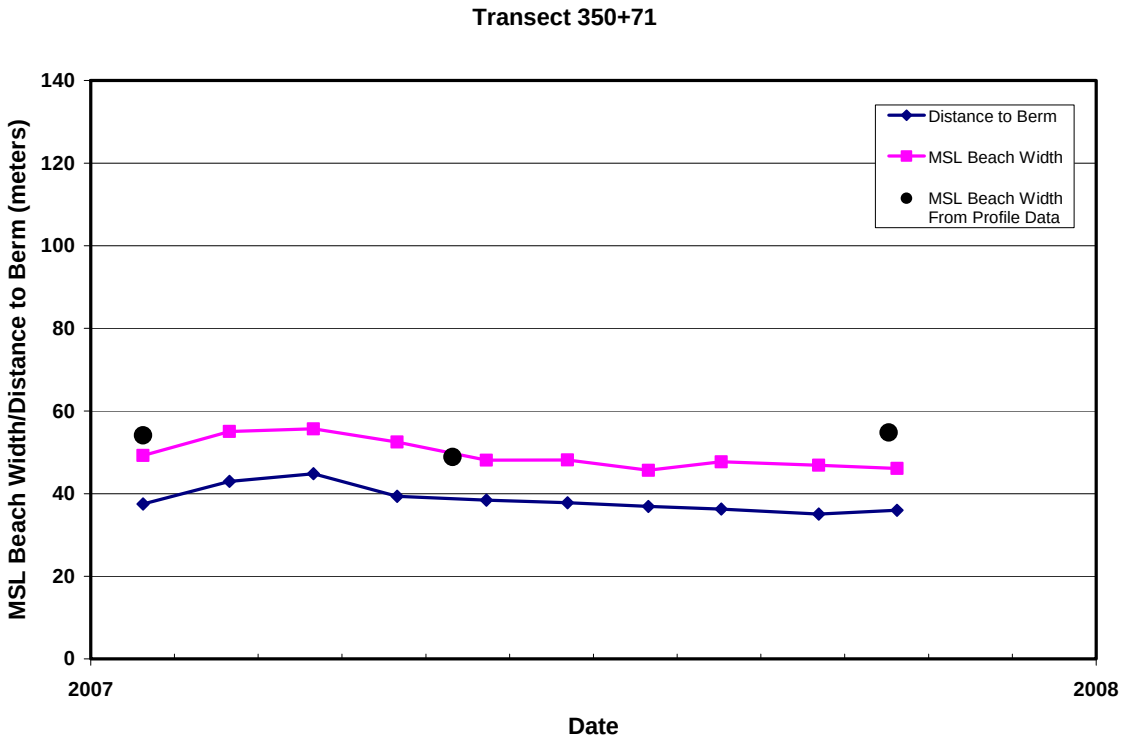
Monthly Beach Width Measurement Results

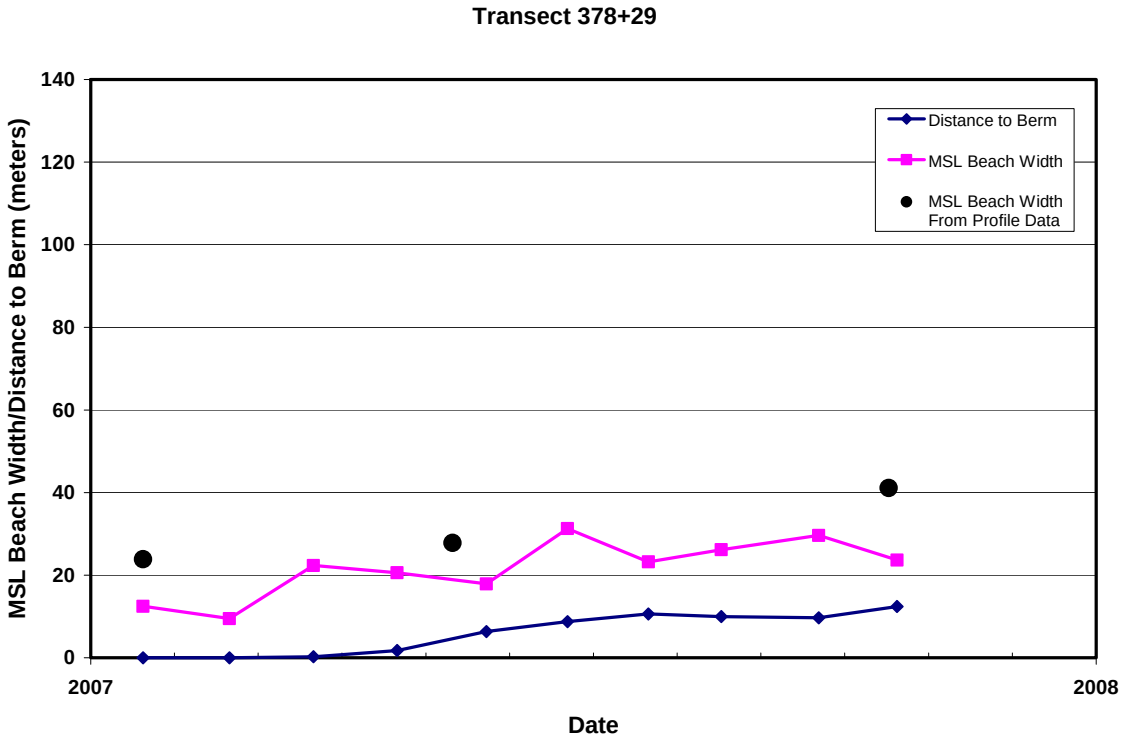

Transect 249+30
MSL Beach Width/Distance to Berm (meters)
140
120
100
80
60
40
20
0
2007
2008
Date
Distance to Berm
MSL Beach Width
MSL Beach Width From Profile Data

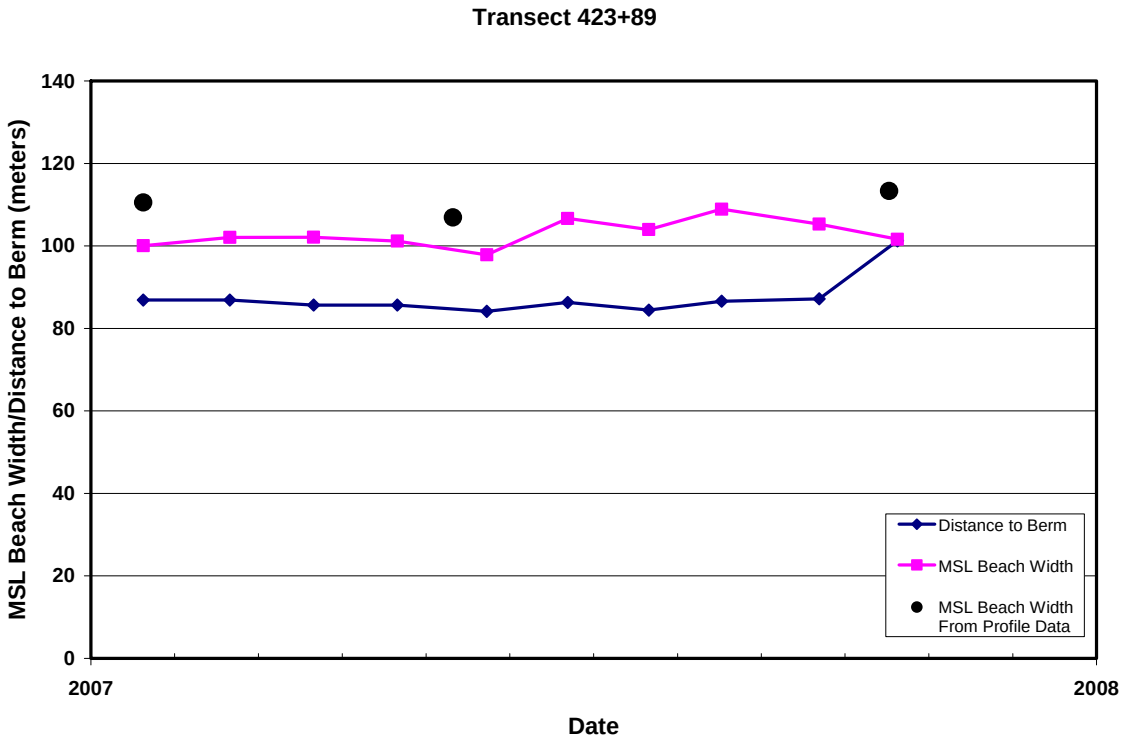

Transect 311+22
MSL Beach Width/Distance to Berm (meters)
140
120
100
80
60
40
20
0
2007
2008
Date
Distance to Berm
MSL Beach Width
MSL Beach Width From Profile Data


Transect 318+30
MSL Beach Width/Distance to Berm (meters)
140
120
100
80
60
40
20
0
2007
2008
Date
Distance to Berm
MSL Beach Width
MSL Beach Width From Profile Data


Transect 333+30
MSL Beach Width/Distance to Berm (meters)
140
120
100
80
60
40
20
0
2007
2008
Date
Distance to Berm
MSL Beach Width
MSL Beach Width From Profile Data


Transect 350+71
MSL Beach Width/Distance to Berm (meters)
140
120
100
80
60
40
20
0
2007
2008
Date
Distance to Berm
MSL Beach Width
MSL Beach Width From Profile Data


Transect 378+29
MSL Beach Width/Distance to Berm (meters)
140
120
100
80
60
40
20
0
2007
2008
Date
Distance to Berm
MSL Beach Width
MSL Beach Width From Profile Data


Transect 423+89
MSL Beach Width/Distance to Berm (meters)
140
120
100
80
60
40
20
0
2007
2008
Date
Distance to Berm
MSL Beach Width
MSL Beach Width From Profile Data