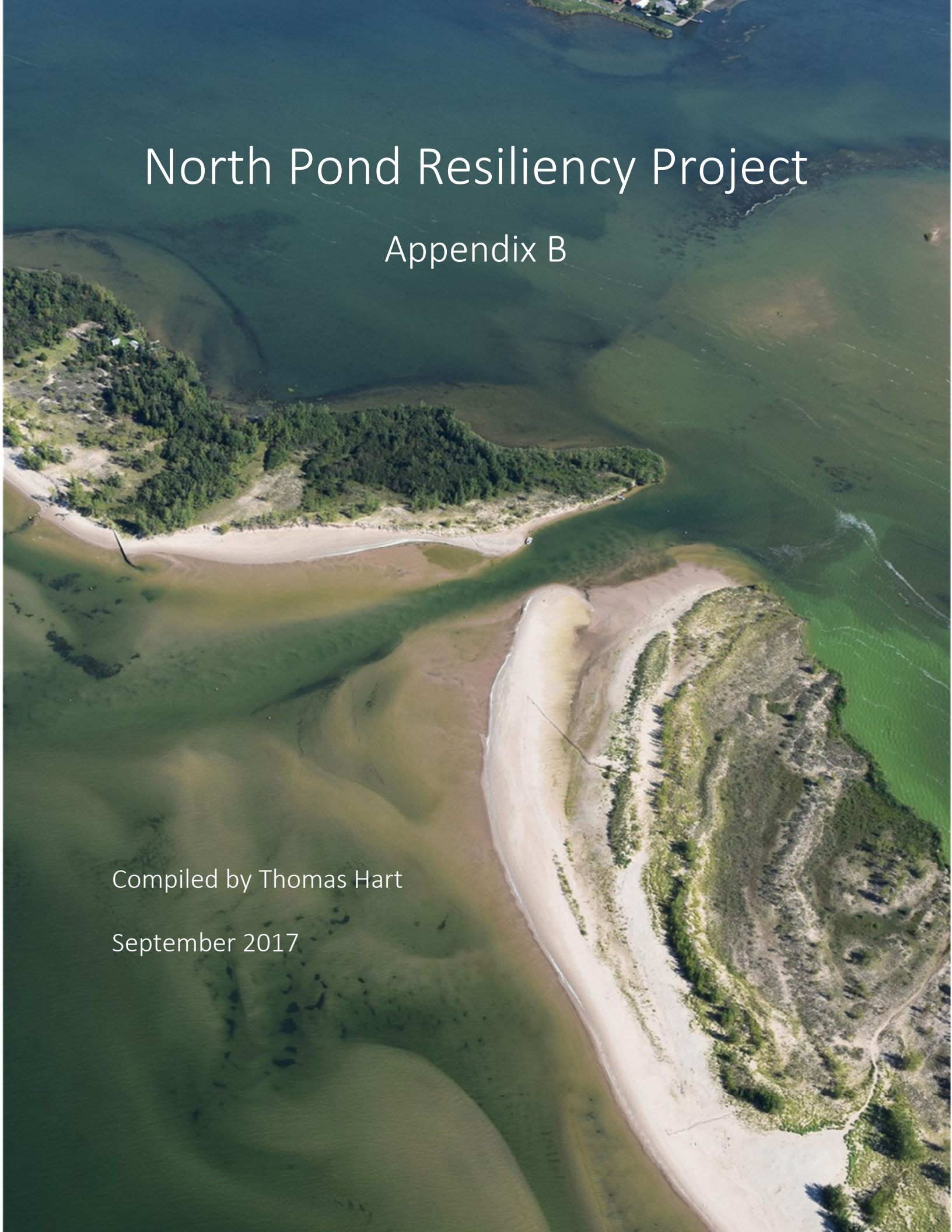


North Pond Resiliency Project

Appendix B

Compiled by Thomas Hart

September 2017

Appendix B: Remote Sensing Data Set Inventory

Introduction

The purpose of this inventory is to document the availability of remote sensing imagery products to support this project. Each imagery data set obtained for or used in the North Pond Resiliency Project (Project) is listed in chronological order of when the imagery was taken. Imagery differs in initial purpose, type, original and digital quality, time of year, lake level represented, and conditions and events captured. The quality of each imagery data set and additional characteristics are described with the digitized pond side of each image set providing an independent measure of precision (consistency) and accuracy (in alignment with features of known location). Water levels were recorded for each of the imagery data sets from the NOAA gage at Oswego. Each water level is characterized in four elevation levels from low to high, relative to long term average elevations. See the project report for more detail.

The appendix is organized in two sections: Historical Photography (requiring scans of paper photography and registration for use in this project) and Modern Digital Orthoimagery (digitally processed by other programs and available for immediate use in GIS). Three Light Detection and Ranging (LiDAR) data, providing three-dimensional information from laser sensors, is also described as a third imagery type. Imagery used in this project is also intended to be made available as an online resource at Cornell GIS.

A wealth of imagery has been collected from a variety of sources including the New York State Library, Oswego County Soil and Water Conservation Service, and from the McClennen collection held by Sandy Bonano. Most imagery was available from online sources, notably the USDA Geospatial Gateway, USGS Earth Explorer, USGS The National Map, and from the New York State GIS Data Clearinghouse. LiDAR data was all available online via the NOAA Digital Data Viewer. Several of the older paper photography sets were only available in the Oswego County Soil and Water Conservation District offices where they were scanned.

Overall, the amount of available historical photography is overwhelming with twenty-seven photographic collections found from 1938 to 1995. Not all of these photography collections were used: some did not cover enough of the study area, some sets were duplicative with comparable photography in time and scale, while others were of marginal or unusable quality. Prior efforts from other research in the area was helpful in clarifying the date of some imagery sets where acquisition records were ambiguous.

Historical Photoimagery- The imagery used in the Project has been collected from a variety of sources including the New York State Library, Oswego County Soil and Water Conservation Service, and from the McClennen collection held by Ms. Sandy Bonanao. Much of the photographic imagery was available from online sources including the U.S. Department of Agriculture (USDA) Geospatial Gateway, U.S. Geological Survey (USGS) Earth Explorer and The National Map, and from New York State GIS Data Clearinghouse. Overall there are twenty-seven photographic collections related to Project's area of study inventoried from 1938 to 1995. Not all photography collections were used because some did not cover enough of the study area, were duplicative of other sets and thus redundant, or were of marginal or unusable quality for this study.

Orthoimagery- Digital orthoimagery became available in 1994 with the USGS Digital Orthophoto Quadrangle program. New York State digital orthoimagery program first produced digital orthoimagery under the state program in 2000 under the direction of William Johnson in NYS DOT and Thomas Hart who was the digital imagery program chair. In 2001, The International Lake Ontario-St. Lawrence River Study produced the first high-quality data and imagery. In 2003, New York State produced its first leaf-off orthoimagery in the Eastern Lake Ontario area. These initial efforts were joined by the USDA's Aerial Photography Field Office and National Agriculture Imagery Program in 2004 when they began collecting leaf-on digital imagery. Google Earth has also added two sets of imagery within the study period in May 2013 and September 2016. In total, seventeen sets of digital orthoimagery were available for this study with sixteen of these sets added since 2001. Only 2002 and 2014 are not represented in orthoimagery data sets.

True Color versus Color Infrared Imagery- In addition to standard black and white and true color photography and orthoimagery, several photographic sets are color-infrared which provided additional analysis opportunity. Color infrared highlights chlorophyll as red and water as black enhancing water edge and wetland detection. Beginning in 2011, digital data was more often captured using 4 band imagery which, again, offered greater analytical value and detail by letting the user choose between color infrared and true color displays.

LiDAR- All Three Light Detection and Ranging (LiDAR) data were obtained online from the National Oceanic and Atmospheric Administration Digital Data Viewer. LiDAR data sets were collected in 2001, 2007, and 2011. Oswego County has LiDAR data from 2010, but did not offer the data. A unique reflectance data set from U.S. Army Corps of Engineers Joint Airborne LIDAR Bathymetry (ACE, JABL, respectively) from 2007 was obtained during LiDAR acquisition and used for this project.

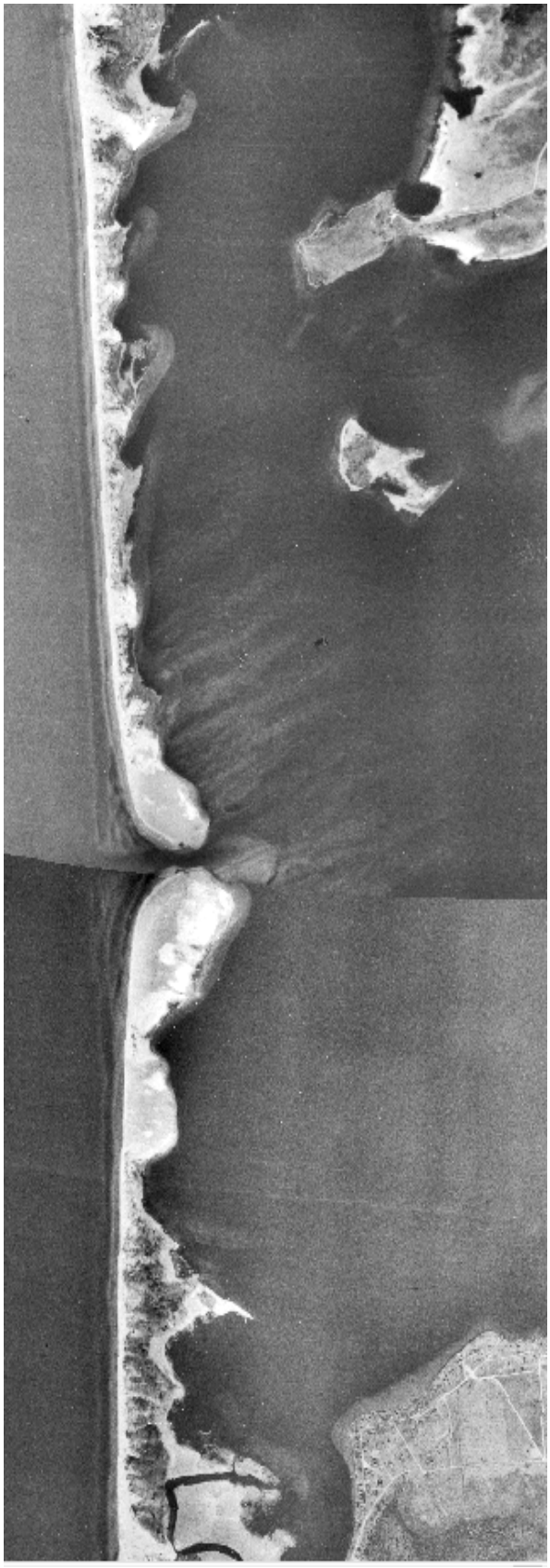
Historical Photography

1938

Lake elevation IGLD Feet: 245.0 (low).

This data set is listed in the National Archives; a quality paper set was available in the Soil and Water Conservation District offices. Two data sets were pursued: the 6/29/1938 image was found while an inventory listed frame was not. The National Archives data is listed as 4/21/1938 but was not obtained via the required vendor scanning services. The quality of this data is excellent for its vintage. Two images cover the study area with edges falling on the 1938 inlet. Image registration was successful with root mean square error (RMSE) values of 21 and 13 for the north and south images, respectively. Images were edge matched with common tie points with the larger south image providing the master reference as it included much of the pond shore for registration points.

Conditions show a well-defined inlet with sand shoaling offshore and an active northward littoral drift supported by wind streaking on the northern image. The old inlet at Sandy Island Beach shows the large dune blow out while the high dunes to the north are intact. The inlet area has little vegetation established and multiple areas of exposed sand. It is not clear when this inlet formed, though records from Wier indicate that 1911 was the year this breach formed. Wier referenced Sandy Creek News but there is no edition with the date he lists and no mention of the inlet in articles reviewed for 1911. The inlet is well-developed with recurved spits in this image, making 1911 plausible. It is possible to measure the rate of formation of later inlets and project how long the 1938 inlet was in place at that time. This study determined that the inlet formed in June 1929.



1938 Continued

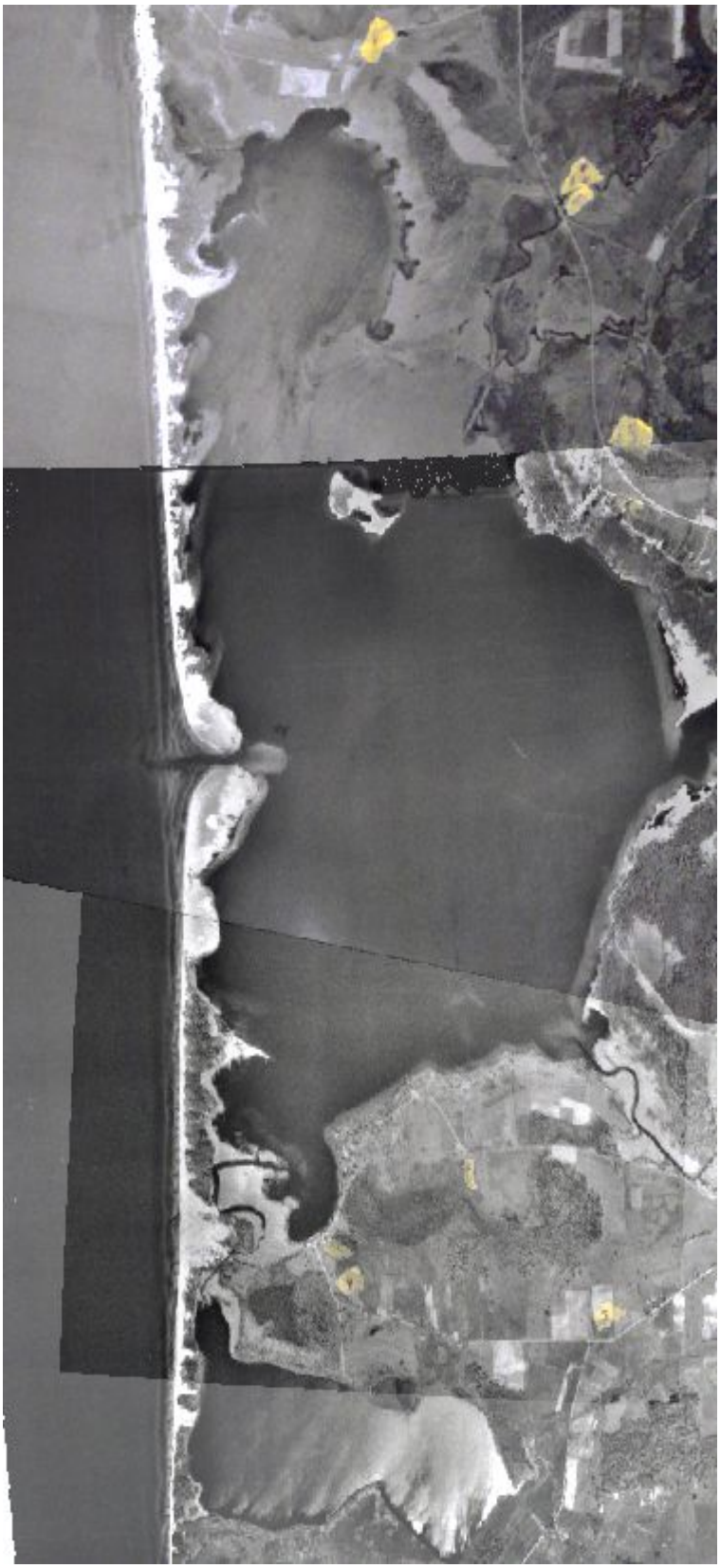
On the northern barrier spit, there are multiple locations where overwash areas are clear. A possible prior inlet channel (shown in the red circle) as indicated by a deep-water channel backing the barrier island. A series of three bare sand areas are located further north, culminating with the large blow-out at the beginning of the high dunes where yet another large channel relict feature is on the pond side. The high dunes are also marked with many bare sand areas, which may be evidence of human disturbance.

1942

Lake elevation: 245.1 (low).

A series of photos were obtained by McClennen in support of the ELOSTS study. Archived digital copies from this study were provided by Ms. S. Bonano. The scanned photo quality is not high, potentially due to the low scan density (72 dpi) provided by the scan service. Normal scan resolution for other imagery used in this study was at least 600 dpi. Registration was challenging, especially for the northern image (RMSE 19.3 - further attempts to improve the actual registration may be warranted but are hampered by the high contrast of the sand areas and general overexposure). RMSE of 9.4 was obtained for the southern photo based on a better distribution of points available including Carl Island - this registered photo was used to master the edge of the northern photo.

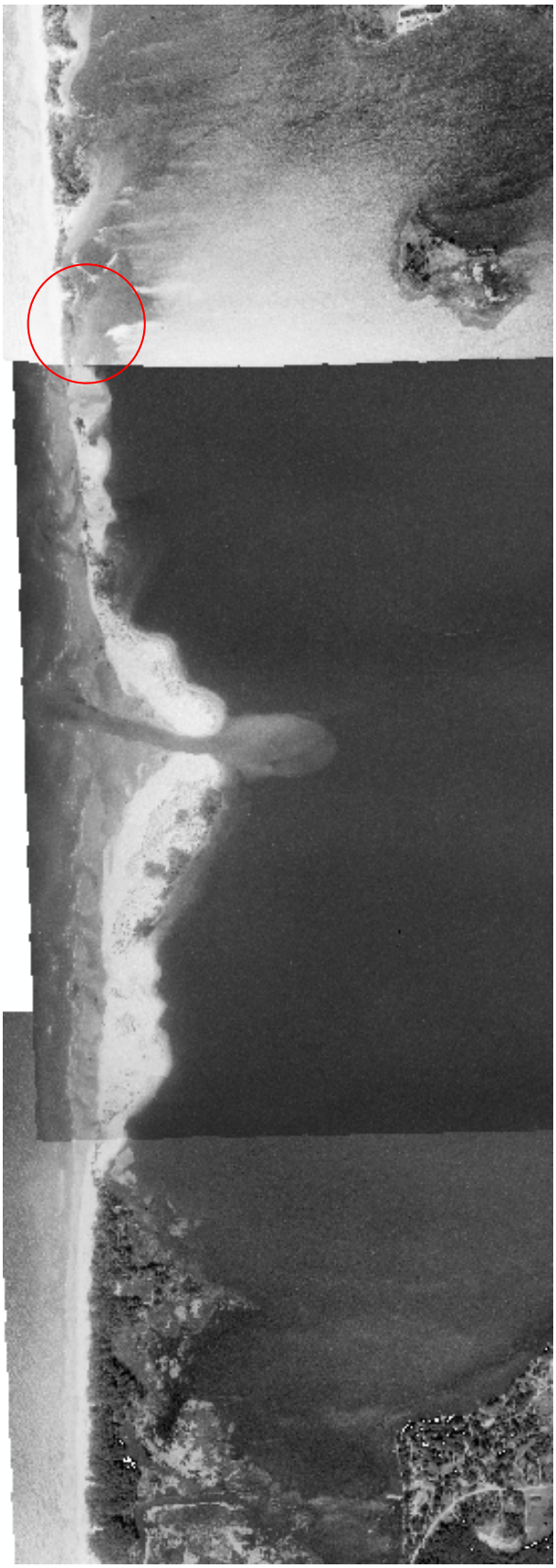
Little change in the inlet occurred over the four-year interval, except for the visible flood shoal in the pond. All other features remain like the 1938 image conditions.



1955

Lake level: 247.5 (High - second highest of imagery sets).

Shown here is a series of four overlapping photos of good quality but suffering from poor frame location. Sections of photography being located with corners or edges only over water required repeated efforts to secure good registration points on north, south, and overview photos. A specific inlet photo was also used, relying solely on reference points from the other registered 1955 photos - not the best practice, but unavoidable in this instance. An RMSE of 0.6 was used for the inlet photo, but that is only relative to the other 1955 photos. North had an RMSE of 26.9, and the south photo was an RMSE of 22. Registration was hampered by very high lake levels, altering much of the barrier beach. Finally, the photo set is not likely to be from the same days and there was reshaping of the shoreline between the overflights (note the overwash north of the inlet in the overview photo is an inlet in the inlet detail photo). The inlet detail photo was used as the master for shoreline delineation; there may be as much as fifty feet of error in using this image compared to the overview image. Determining which image is more correct would be difficult given the magnitude of the change. For the purpose of shoreline change analysis it is likely immaterial but useful in giving historic context to the project as a whole.



High water in combination with high waves captures multiple inlets and overwashes. An overwash or shallow inlet is at the north end of the southern high dunes at the site of the original reputed inlet prior to 1839. This is also the site of the 1898 dredging project. Two overwash areas are identifiable south of the inlet on the south spit. North of the main inlet feature are two additional smaller inlets, leading to two separate barrier islands. Forested habitat in these areas are shown being eroded. A large band of reworked and suspended sand is visible in the surf zone and the barrier has moved toward the pond from the high dunes northward, largely due to inlet processes.

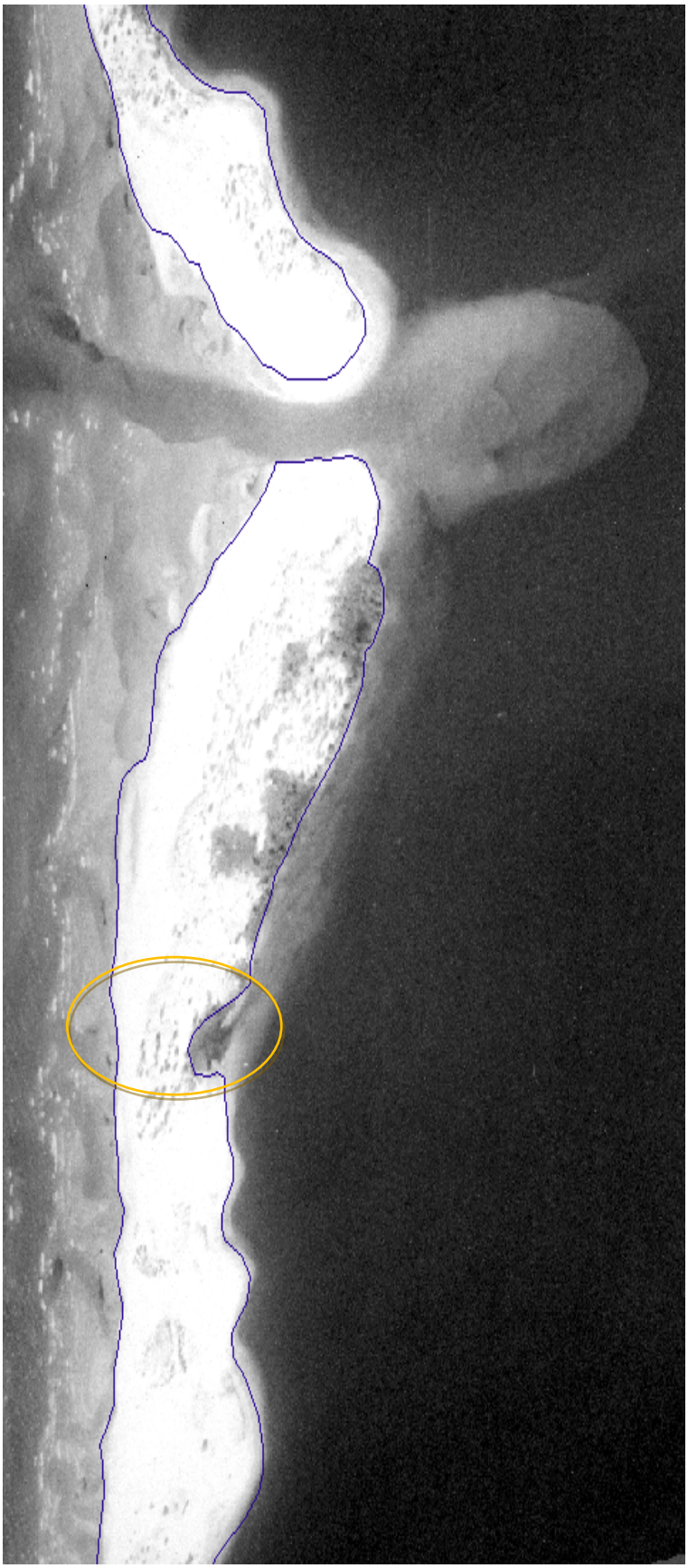
The location of the 1950 dredged inlet, noted as being 2000' south of the existing inlet (extract from the Sandy Creek News, 7/27/1950), appears as an area lacking any vegetation (indicated in the yellow oval).

Dredge Starts Excavation of New Channel

Dredging operations have started on the proposed new channel from Lake Ontario into Sandy Pond 2,000 ft. south of the present channel, on land donated by Perry A. Bartlett, of Sandy Creek. Donald M. Page is in charge of operations for the A. S. Wikstrom Co. of Skaneateles, who are doing the job. Two shovels, one operating from a barge and the other from the sandbar, are now at work.

A total of 4,860 yards of material will have to be excavated. Donald M. Page, of the Wikstrom Company, flew over the area on Friday, July 21st, and found that there were three sand bars on the lake side extending approximately 500 feet into the lake. These were not taken into consideration on the previous estimate, as they could not be seen except from by air. Mr. Page flew over the area ten times, at an altitude of 100 feet, thoroughly examining the proposed site.

As much of the digging as can be done from dry land will be done by a clam; and the rest of the dredging, out in the water part, will be done by a self-propelled dredge that is coming from Brewerton and is expected to arrive today. The dredge will work on the lake side, unless the water is rough. In that event, Dr. Groman will pilot the dredge through the old channel into the pond, and the work will be done on the pond side.

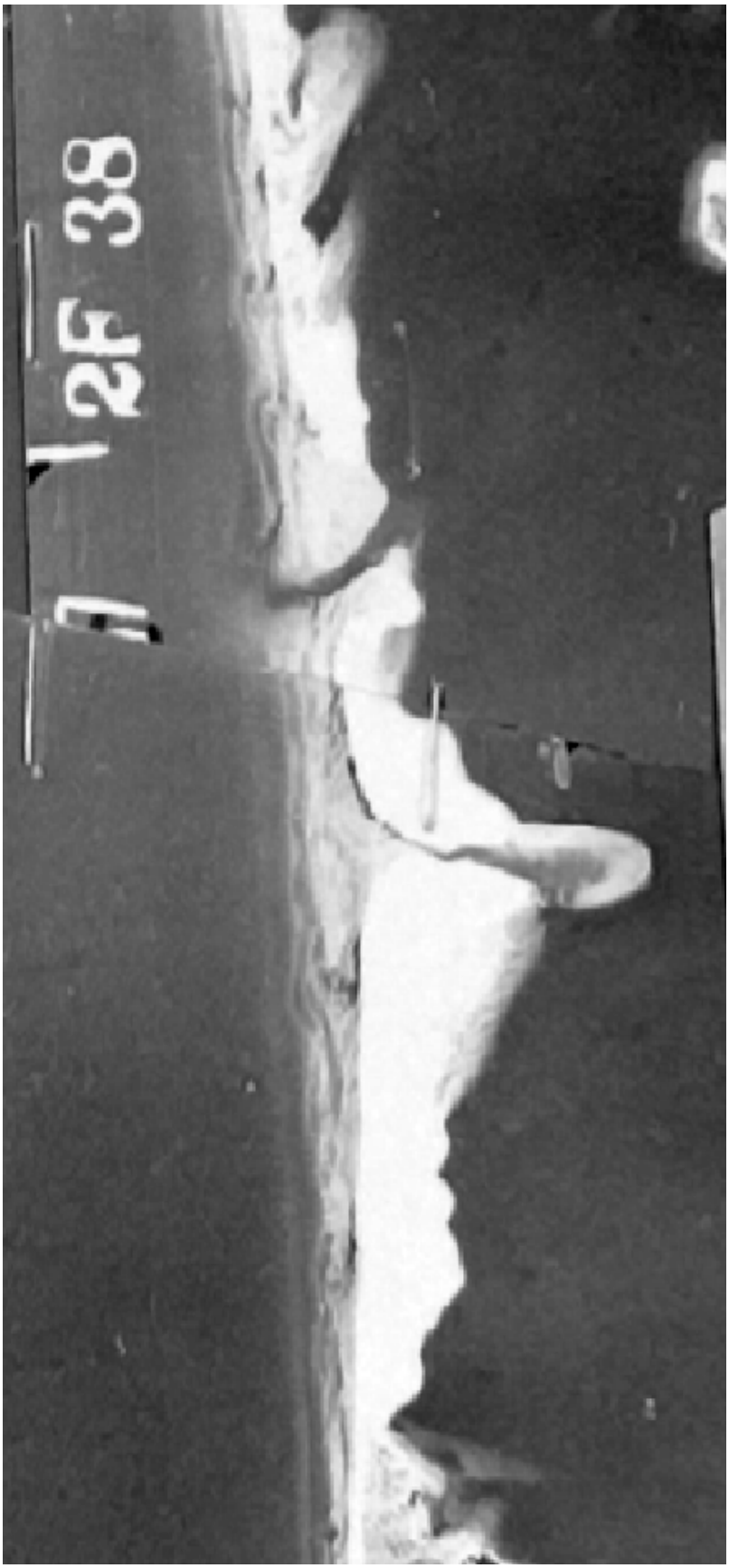


1957

Lake Level: 245.6 (average).

A mosaic of USGS photos was obtained from SWCS. Each photograph had been previously trimmed, aligned, and physically stapled in place. The clarity and quality of the image is very good and was worth adding to the analysis. Multiple attempts to use registration control points in combination with polynomial solutions to stretch the image to correct alignment was met with limited success. Rather, control points were used to focus on low error reports for individual points along the barrier beach while accepting higher error from points falling on physically separate photographs stapled to the ones capturing the beach. Error for this registration is assumed to be higher at a value of 70 feet RMSE. However, comparison with the 1960 imagery with excellent accuracy shows good alignment of barrier features. This is true only in the areas near the inlet while the stapled panel to the north is misaligned with a shoreline appearing too far lakeward in relation to the high dunes to the north.

After the previous high water episode and reshaping of the barrier, this imagery captures the transitioning closure of the 1938 inlet and the start of the new inlet 2000' to the north. With Lake level a foot lower than average, beach faces are re-established at least 200 feet lakeward. The barrier continues to be reshaped and it appears that a significant amount of near-shore sand remains mobilized in a series of bars.



1960

Lake elevation: 246.5 (very high).

This USGS image is grainy, likely due to higher altitude of the overflight for this 1:60,000 scale photography. The image is significant in that it is the first image that covers the study area in a single frame. This is important in establishing the first consistent georeferenced image. Accurate registration was possible with an RMSE of 9.7 using a second order polynomial solution and empirical agreement of stable shorelines and upland features with image locations. The result is very good accuracy, matching the 2008 USGS base orthoimagery.

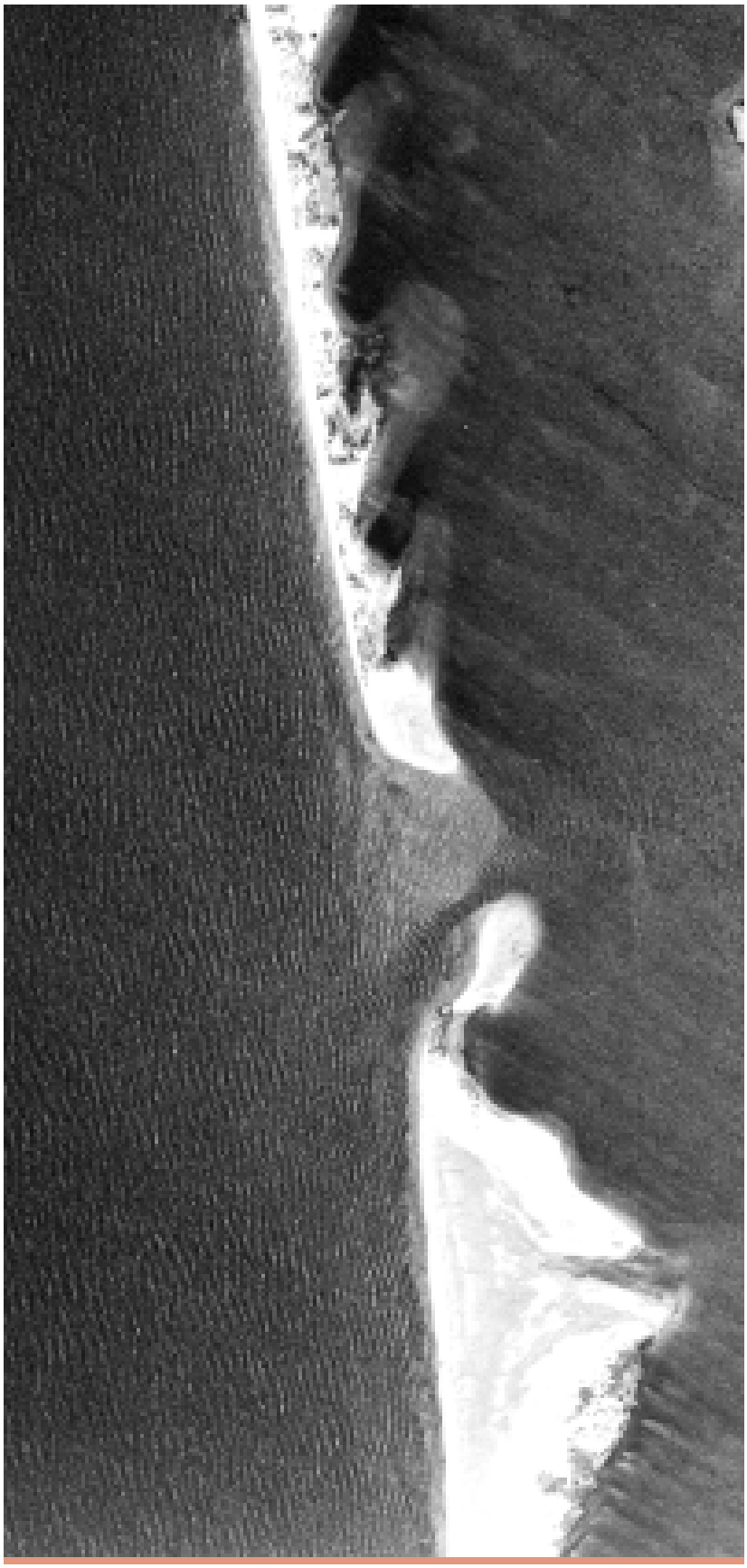
Nearshore sand deposits have consolidated into a straight shore with large sand flats. High water overwashes these sand flats and nearshore sand bars are large and active. In addition to the dominant inlet to the north, the 1938 inlet remains open with clear water exchange. To the south, four minor inlets show flowing water. The north most of these is the 1950 dredge site, and the southernmost is the 1898 dredge site. The inlets create five separate islands, a phenomenon not seen on other imagery.

1961

Lake elevation: 245.6 (high).

A New York State Department of Transportation single frame covering from the old 1950 dredged inlet to the northern portion of the study area was obtained at the NYS Museum. The quality is good, but with incomplete coverage and the availability of other imagery, it was not georeferenced.

With the same Lake elevation as the 1960 image the configuration and function of the inlet appears similar.



1965

Lake elevation: 245 (low).

Image quality is moderate with overexposure of light sandy areas. Wet edges are determined using contrast increase and brightness decrease settings.

Georeferencing was successful with RMSE values for south, center and north images of 16.2, 7.8, and 7.2 feet, respectively. The central image is not used in shoreline delineation, relying on the overlap between the two end images.

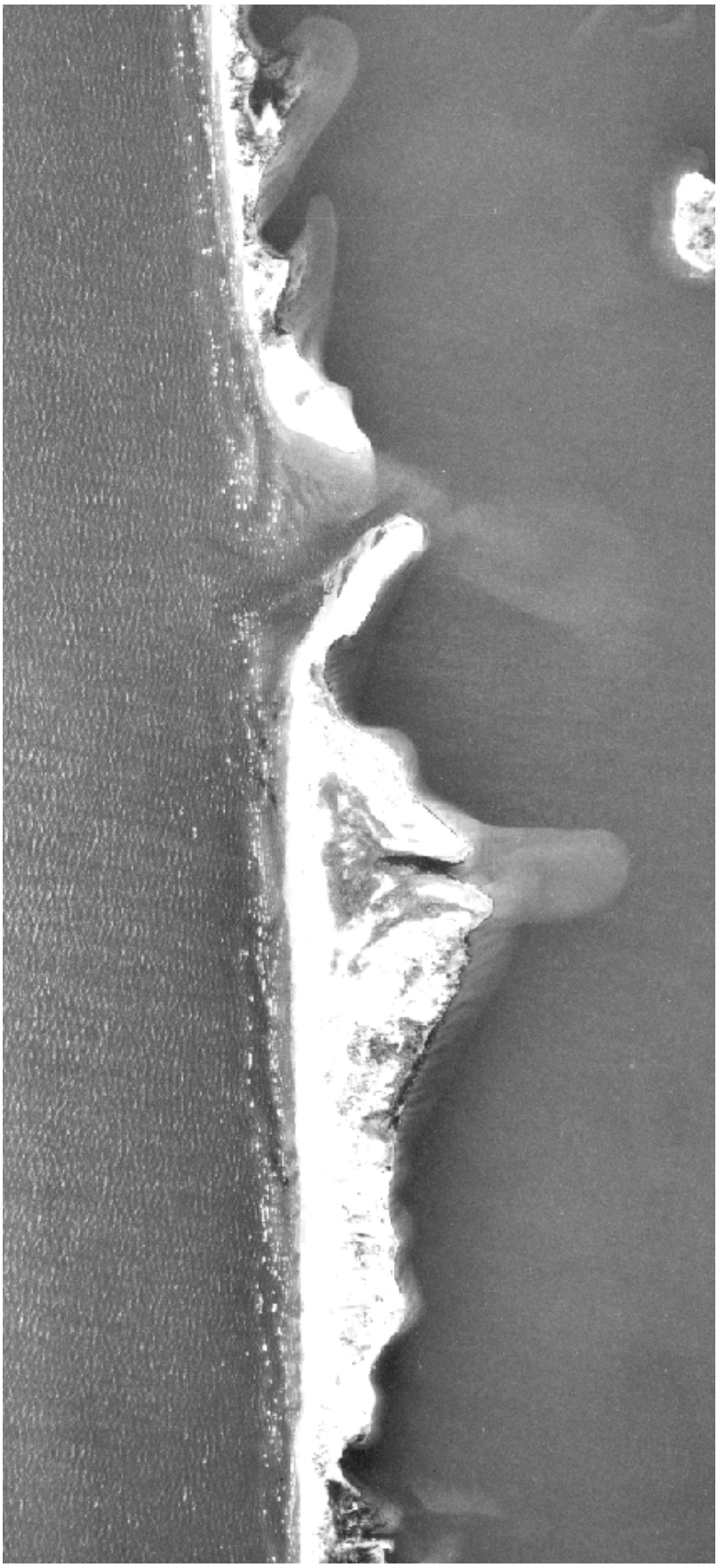
The date of the imagery is not documented. Planting stage of upland fields nearby suggests mid-June at least. Lower water has led to the final closure of the 1938 inlet, a process that took about 8 years to complete. Nearshore sand bars are visible, but sand is less abundant compare to prior high-water years. The photography was taken with an unusual south wind with possible nearshore littoral drift cells showing sand movement.

1967

Lake elevation: 245.6 (average).

Imagery is from the first state planning agency, the New York State Office of Planning and Coordination. Single frame registered with an RMSE of 19.4 with a 3rd order polynomial. More difficult to register, possibly due to tilt on the image.

The inlet is wider than the low water 1965 imagery. Wave environment is higher than in many other photography sets, with winds from the WNW based on langmuir cell directions. Higher waves show beach face runup and intrusion on two prior overwash areas south of the 1938 inlet. Nearshore sand is organized in large elongated bars with long troughs near shore rather than smaller circulation cells seen in other photography. Direction of littoral drift is to the south, differing from most other photography.

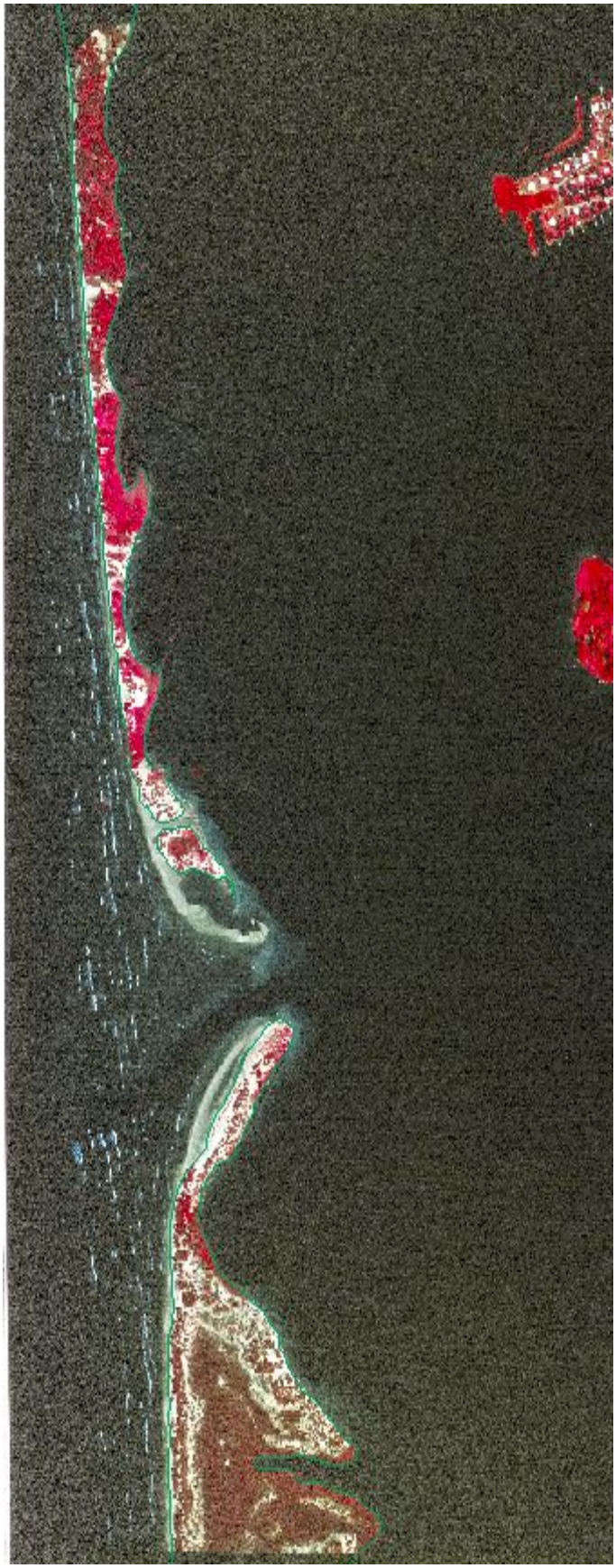


1970

Lake elevation: 245.9 (high).

A set of four higher resolution color infrared photography from the USGS single frame collection. All were successfully georeferenced with RMSE values of 3.7, 9.2, 2.0, and 7.0 for photos 151, 171, 191, and 211, respectively. Alignment of each photo with each other and more recent reference sets was successful. Each photograph retains its collar and would have to be trimmed and mosaicked for further use.

The inlet formed in 1957 remained in the same relative location until 1970. This image captures formation of a new inlet 1000' to the north of the main 1957 channel. The northern spit is undergoing dissolution between these inlets with a small island and shoal complex remaining. An additional overwash area is 950 feet further to the north, fronting the large channel feature visible since 1938 photography. This is the starting location of the current 2015 inlet. Imagery shows vibrant late June vegetation and provides an opportunity for long-term vegetation change analysis.

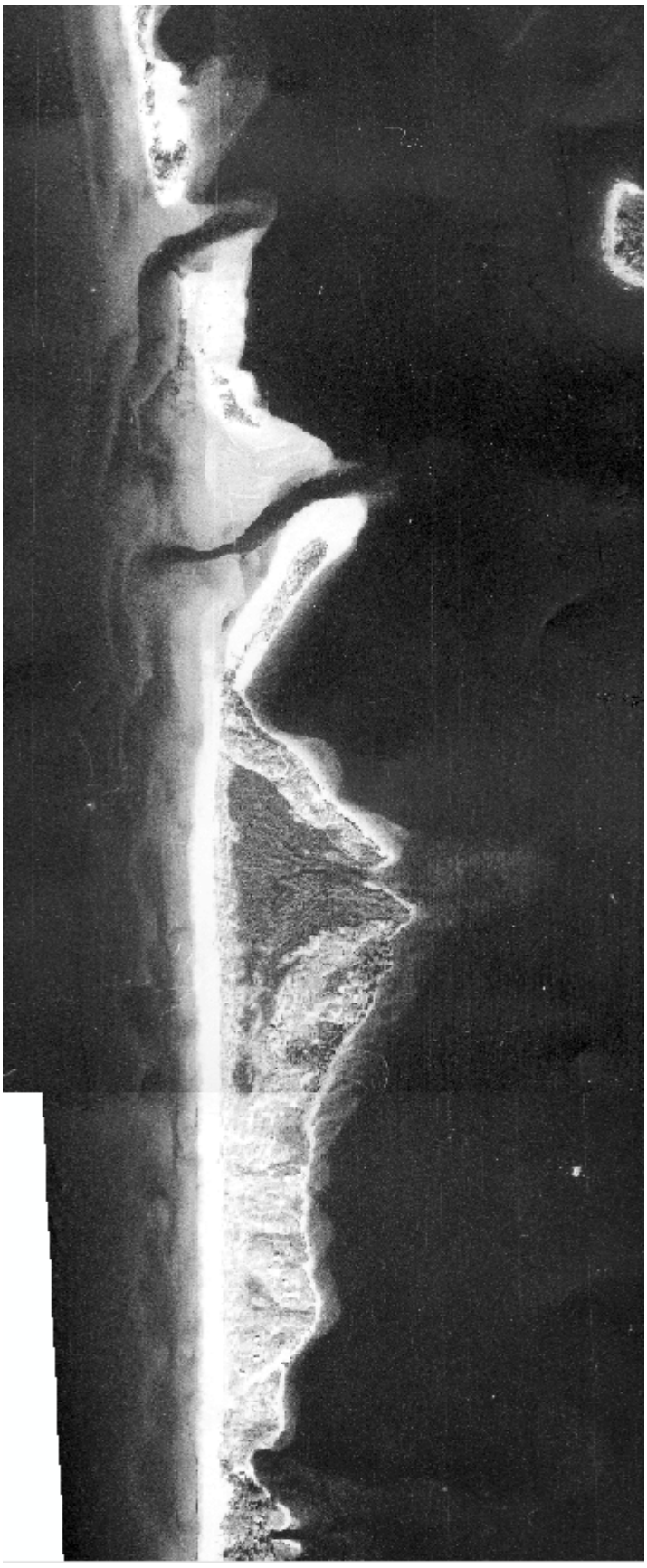


1974

Lake elevation: 248 (highest of all data sets).

Two photographs cover the study area and were registered with RMSE values of 12.0 and 5.2. Black and white photos with good contrast allow detailed inspection. Location of features correspond with other data sets.

The small overwash seen in 1970 is the major inlet by 1974, leaving a 1275' island under assault between two inlets. The lobe of the south spit remains visible in the current 2015 inlet complex preserved in location when the southern inlet filled. Offshore sand is moving in complex large circulation cells with a wide band of mobile sand.



1974 Continued

USGS single frame imagery at a scale of 1:10,390 is available via the USGS Earth Explorer online application. The imagery is excellent color-infrared imagery. At this scale, many images are necessary to cover the barrier beach, let alone the study area. With the amount of water occupying the edges of imagery, time was not available that would have been needed to accurately register the image set.

1976

Images shown are Landsat MSS. No aerial imagery is available between May 1974 and September 1976 corresponding to the high-water period in 1976. Low altitude oblique images of the inlet are available but cannot easily contribute to shoreline measurements. Early satellite imagery from the second Landsat MSS series was found. June 22 images are registered well and a general shoreline can be delineated, however, it may not be enough to compare land form to the 1974 photography. The June 4 image registration is off to the west several hundred feet.

The period of high water after 1974 is important to document. Landsat satellite imagery is available since 1972 and, though at a much coarser resolution, a June 1976 images confirms expansion of the inlet, establishing an inlet opening sequence from the early 1974 SWCD image, to the higher resolution 1974 imagery and the 1976 satellite images. The 1974 shoreline is shown on a relatively blurry landsat image showing retention of a shoal or island feature near the north end of the south spit and opening of the inlet further to the north at the cost of the north spit.

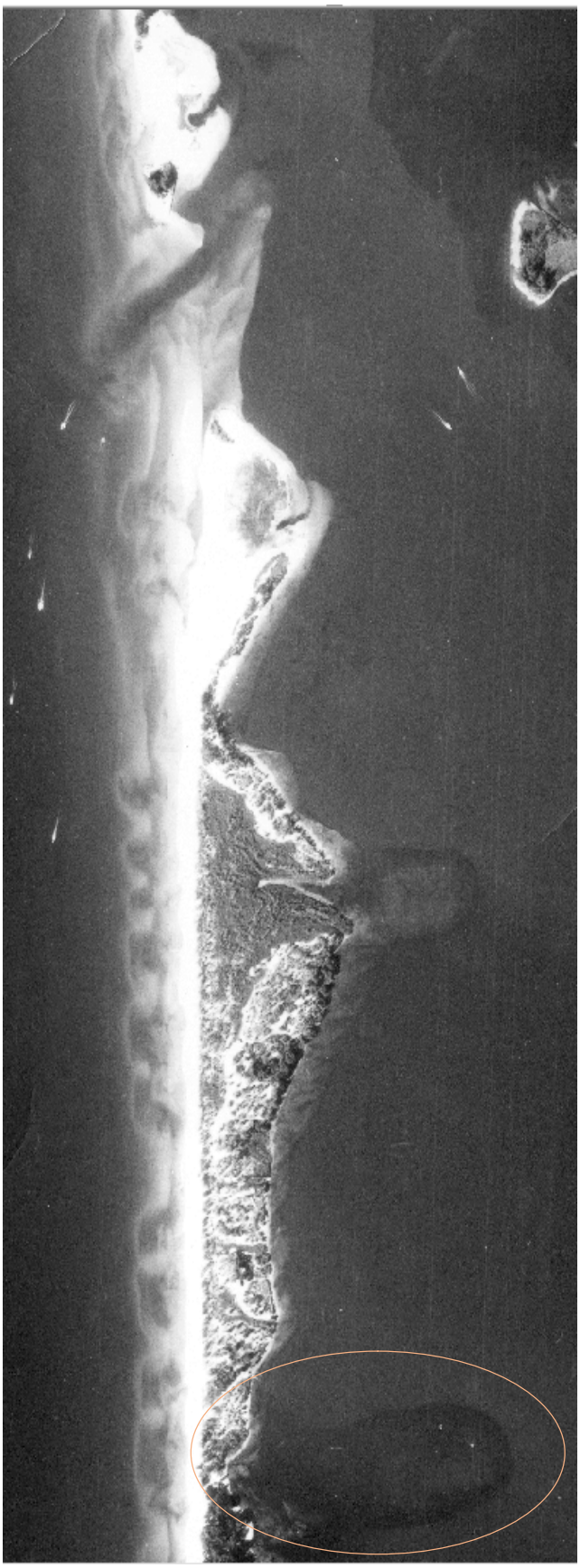
June 22 1976 (above); June 04 1976 (below); June 22 1976

1978

Lake elevation: 245.0 (low).

A single USDA SCS frame from the NYS Museum collection covering the study area referenced at 7.0 RMSE. A high-quality image with good contrast in a rare late September timeframe.

Compared to other photographs in the collection, this photograph contains a wealth of qualitative data while capturing unique conditions. Lake levels were three feet higher (248.0) in 1974 and similarly high in 1976 (during Landsat imagery) while lake levels earlier in 1978 were also high at 247.0. High waters in these time periods reworked much of the area surrounding the inlet. The inlet is 1280' feet wide even at low water level and the 1957 inlet is solidly closed, though evidence shows an overwash at the old channel location while shoals fill the southern portion of the inlet. The island with the forested center may be the Howard Hayes bulk headed property featured in the Syracuse Herald in July 1974. North of this small refuge is the remnant of an inlet 850' north of the 2015 inlet location, with a small channel remaining on the pond side with two depositional sand lobes. The old inlet remains visible today by its inlet channel succession vegetation. The south barrier spit clearly shows clearly former inlets and overwashes with vegetation. The nearshore sand shoals and circulation cells are repeating nodes of about 300 feet wide. Finally, a shoal is clearly shown extending into North Pond 2000 feet from the end of the high dunes, providing evidence of either the inlet prior to 1838 reported by Wier and Sutton, et al. or the effect of the 1898 dredged inlet, though this is doubtful since the inlet may not have been open long enough to support a depositional lobe of this size.



1983

Lake elevation: 246.2 (moderately high).

A series of six USGS color infrared images shows the study area in vivid color at a scale of 1:13,167. Imagery at this scale is difficult to georeference if land elements are not available to provide registration reference points. The imagery was registered with a minimum RMSE of 12.0, however, care must be applied in areas near the inlet based on observed distortion of the imagery.

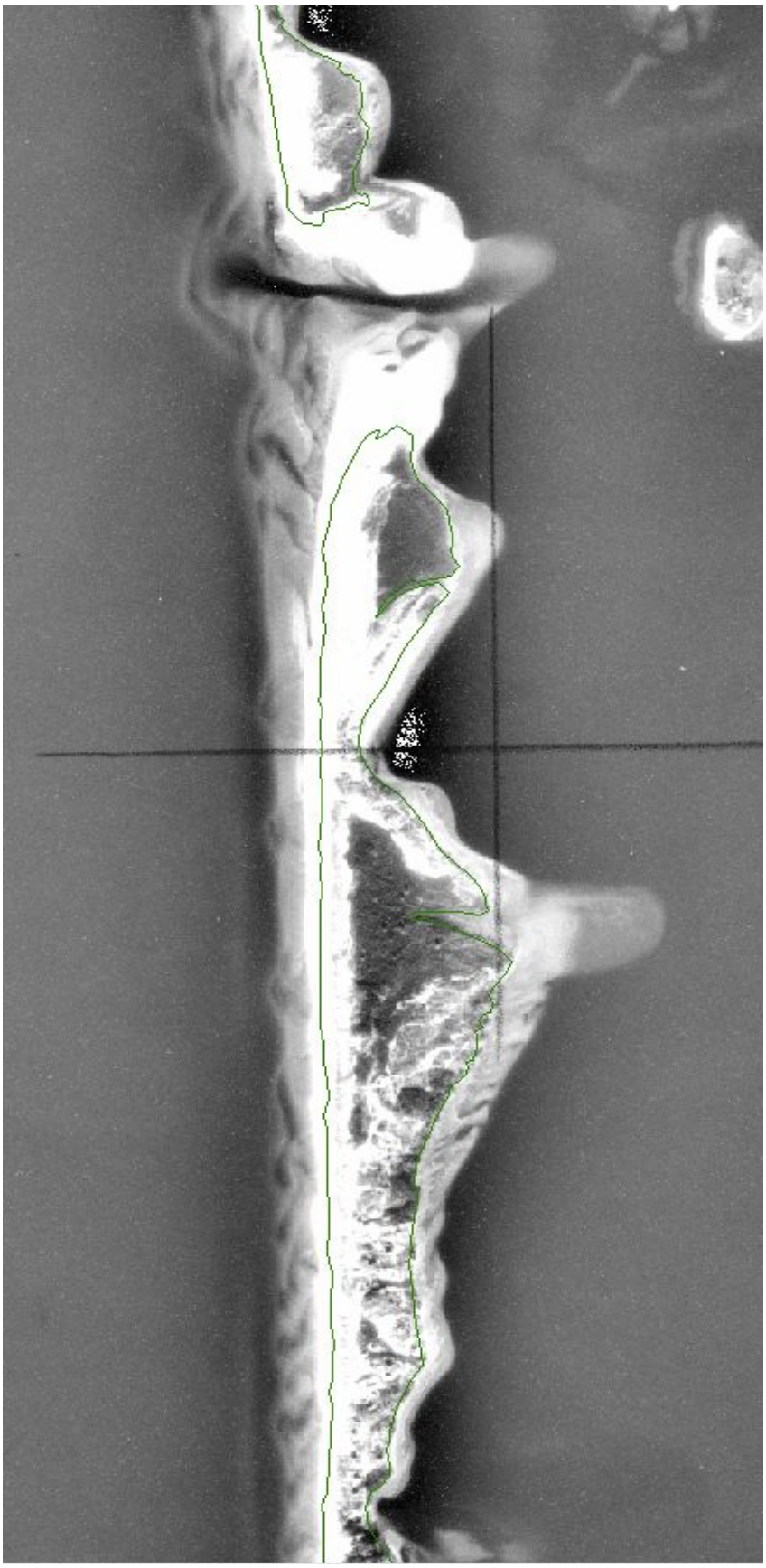
The inlet remains 1500 feet wide, with a clear central channel and adjacent underwater shoals. Sand appears to have been stripped from the system during the prior decade of high water. The north spit shows a definite overwash area north of the inlet while the broader lobe of the northern spit may also have two overwash areas. The southern spit shows the northern extent of the 1970 inlet, a feature still evident on the barrier spit today. All vegetation north of this feature on the southern spit is from 1977 or is more recent. The imagery of the southern spit also shows the signature vegetation succession clearly demarking former overwash and inlet areas.

1991

Lake elevation: 244.1 (lowest elevation in the collection).

A NYS DOT photograph was obtained from the NYS Museum at a scale of 1:24000. The image is a high quality panchromatic photograph showing a wet sand edge of the shoreline, and a complex set of shoals at the inlet directly across from Carl Island. Imagery was easily georeferenced with an RMSE of 7.2.

Shoals on either side of the central channel are exposed and show recurving landward formation beginning while the beginnings of a depositional fan are present. Overwash areas have stabilized and are 125 feet wider than the 1983 beach. Depositional fans along the backside of the southern barrier beach may have their origins in wind-blown (aeolian) deposition from the greater expanse of exposed beach.



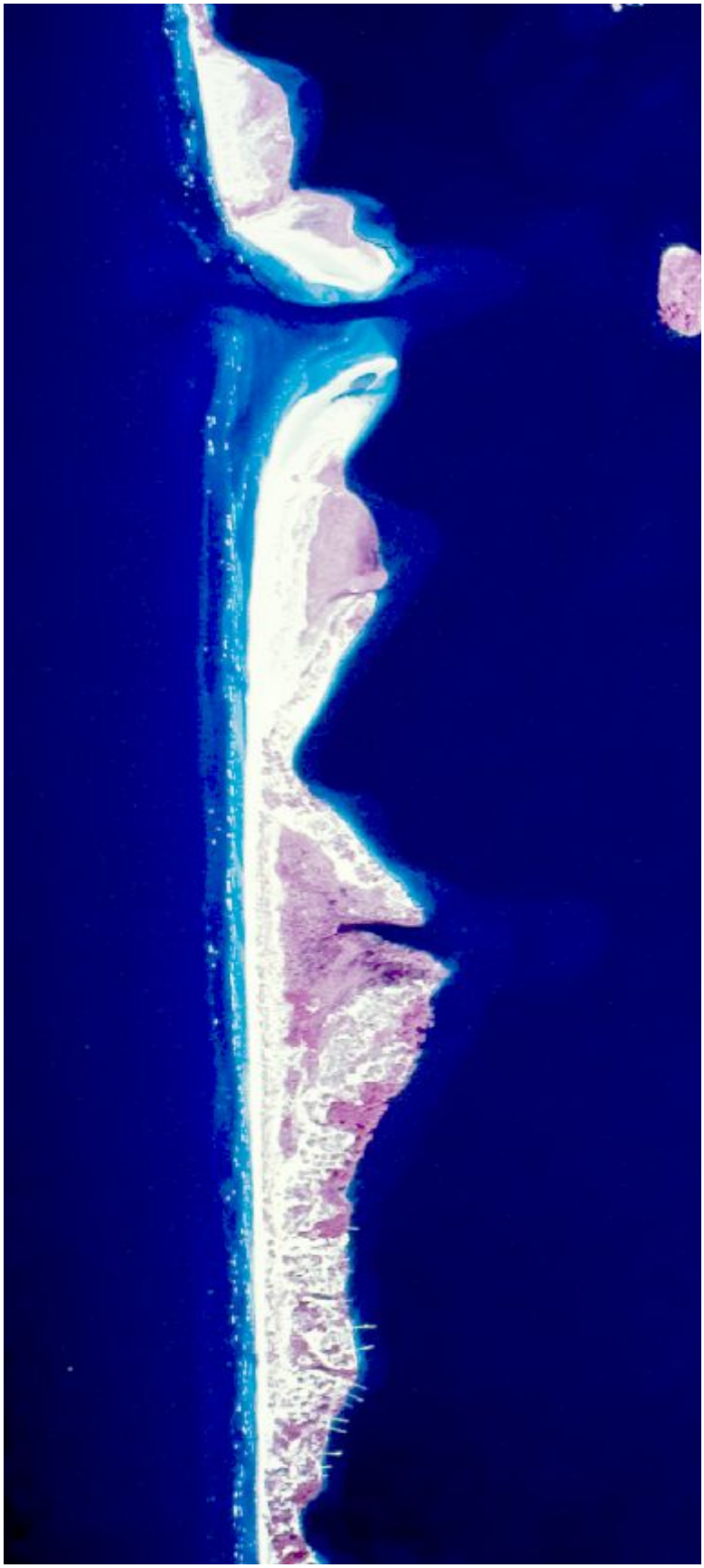
1994

Lake elevation: 246.4 (high).

One of two 1994 image sets is from USGS at 1:20,000 scale CIR. This imagery is from June 9, 1994 providing the first high quality repeat image in the same year showing seasonal succession and shift in inlet sand bar formation.

Inlet sand bars on the north shoal area are absent while waves and drifts are from the south-west based on wave break direction on the north spit. Lake elevation is 0.2 feet higher compared to early May, showing additional submersion of the south spit inlet shoal.

The second imagery from 1994 is a digital orthoimagery set included in the next section.



1995

Lake level: 245.0 (low).

Imagery from the USGS NAPP program provided CIR imagery at 1: 20,000 scale dated April 17, 1995. Imagery is excellent quality for shoreline delineation, but most of the sand surfaces are over-exposed. Shallow and nearshore submerged features are visible, and show a complex set of sand bars near the inlet.

Channels are complex with the central channel forking into two parts in the inlet while a small channel runs south from the inlet on the pond side. Deposition has increased in the inlet shoal and it appears that the winds are out of the north (based on surface streaking in the pond), and the flow of faintly discolored water to the south from the inlet. Bedrock is exposed at Lakeview, south of Cranberry Pond lakefront, and at the rock outcrop short of a mile north of Carl Island on the lakefront. This is unusual, and may show a southerly littoral drift at low lake level exposing these submerged bedrock shoals.

Digital Orthoimagery

1994

The first available digital orthoimagery is from May 3rd, 1994 originating from the joint USGS/NYSDEC program instituted by Howard Pike at DEC (Hart, personal knowledge). This involved a monumental task utilizing SUNY Albany interns who were tasked with digitizing (tracing on digital tables) every contour line from USGS topographic maps in the State. The resulting digital ortho quarter quad (DOQQ) imagery has a stated accuracy of 20' (twice as accurate as a 1:24000 series topographic map) and is based on color infrared (CIR) NAPP imagery.

The shoreline is readily discerned from this CIR imagery which also shows extension of the depositional lobe while sand bars are stacked in the inlet's lakeside mouth. The existing shoal in front of Carl Island may have been moved towards the island by higher energy wave forcing but pre-existed the current inlet location as shown in 1948 bathymetry. Winds appear to be directly onshore, showing complex bar formation at the inlet and possibly illustrating a migration of suspended sand into the pond.

2001

Lake elevation: 246.0 (moderately high).

As part of the IJC study, the USACE JALB flew what may be the first high resolution digital orthoimagery missions in this part of NYS on June 23, 2001. Imagery is stunning true color showing significant evolution of the inlet geomorphology and accrual of a depositional fan reaching the Carl Island shoal. The imagery is unusual from a technical perspective using a Lambert Conformal Conic projection used that is not part of a standard GIS library of projections (imagery here is reprojected) requiring a new projection matching metadata parameters to be created. The data displays 0.5 m pixel imagery (a fourfold increase in resolution over prior products) and the imagery was accompanied by the first LiDAR acquisition of the lake shore.

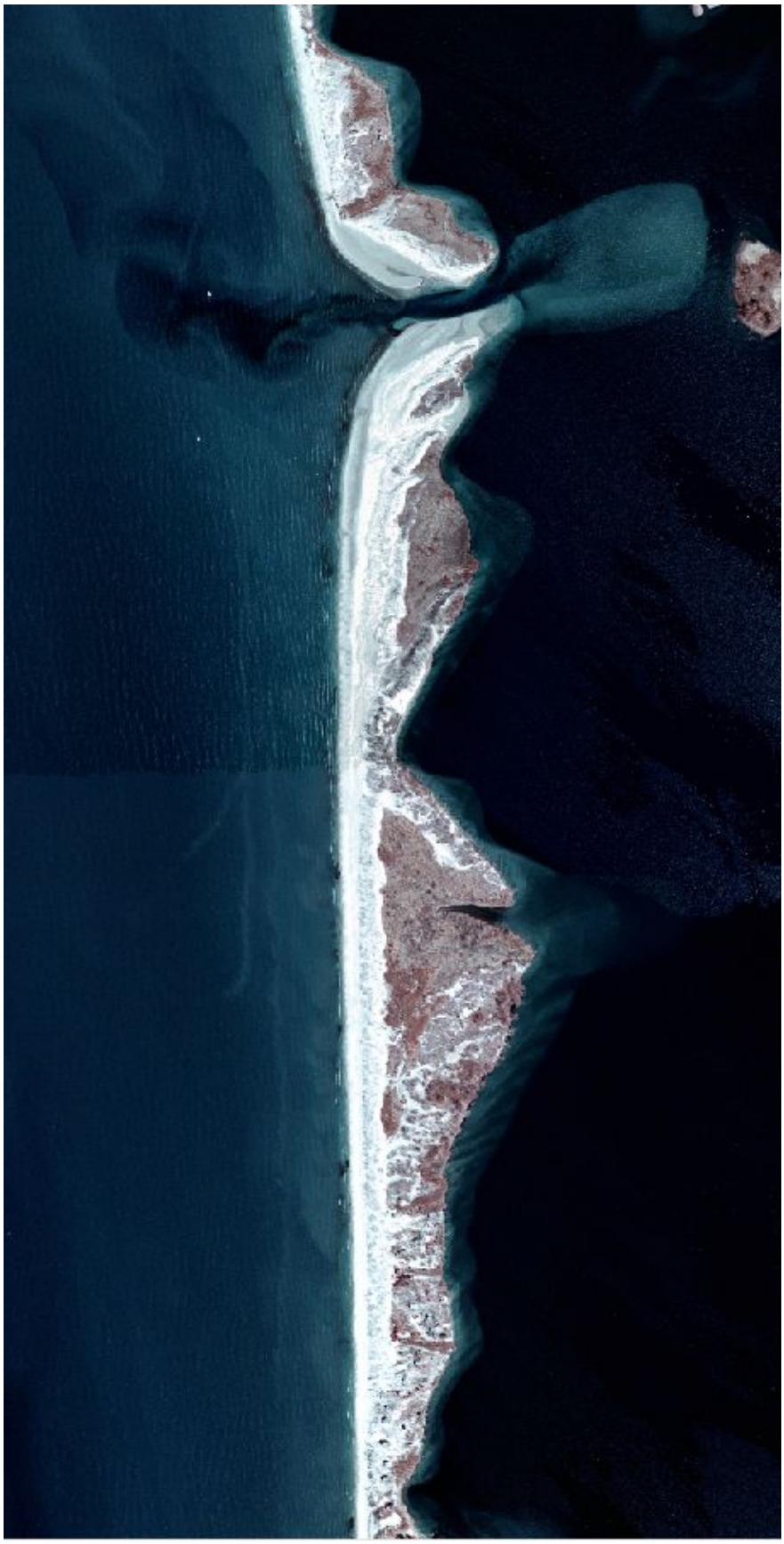
Recent high lake elevation, storm, or wind-driven waves may have been occurred to account for several overwash areas. One area north of the inlet shows an overwash fan into the pond. A much larger overwash south of the inlet shows an overwash channel of approximately 40' width. This southern overwash represents the northern end of the 1983 inlet and the current path at the pond boat landing. The overwash fan has since disappeared while tree trunks litter the northern shore and a trough of detritus runs between the beach and the first sand bar along the southern barrier.

2003

Lake elevation: 244.6 (second lowest from the collection).

The first NYS Digital Orthoimagery Program (NYS DOP) product from April 1, 2003 is a color infrared, 2-foot pixel image set. The NYS DOP was developed as a trusted basemap with a high degree of accuracy, generally +/- 8 feet for a 2-foot pixel image.

Winds may be from the northwest possibly causing very interesting cells of beach sand circulation which are present with what looks like a higher wave set. The boat landing path south of the inlet still shows evidence of overwash seen in 2001, and a little dune formation is present in front of this overwash point. Additionally, the inlet, channel, and shoals show little change from 2001.



2004

Lake elevation: 246.4 (high).

USDA National Agriculture Imagery Program provides its first true color imagery from July 1, 2004, adding to the programs that provide repeat coverage of the state with summer imagery and a 1 meter pixel size with a stated accuracy of 6 meters. In practice, accuracy estimates seem conservative with many features matching the location of higher accuracy NYS DOP products.

This calm wave and wind state image shows complex sand cells in front of the barrier beaches and well-formed bars within the inlet and a clear channel. The channel is pinched by intruding lobes at the recurving point of the inlet arms. The depositional fan shoal shows some expansion, but maintains similar form to the 2001 fan. One exception is the appearance of side channels to the north and south, making a 'T' shaped configuration. Water clarity is poor in the pond, obscuring bottom features.

2006

Lake elevation: 245.5 (NYS DOP, 1 April; moderately low).

Two image sets are available in 2006, revisits by both NYS DOP on April 1st, and by USDA NAIP on June 6th. NYS DOP Imagery shows the effect of tiled image acquisition and uneven color balancing.
The NAIP pond image was from a flight on July 7th, not matching the barrier beach imagery date of June 6th.

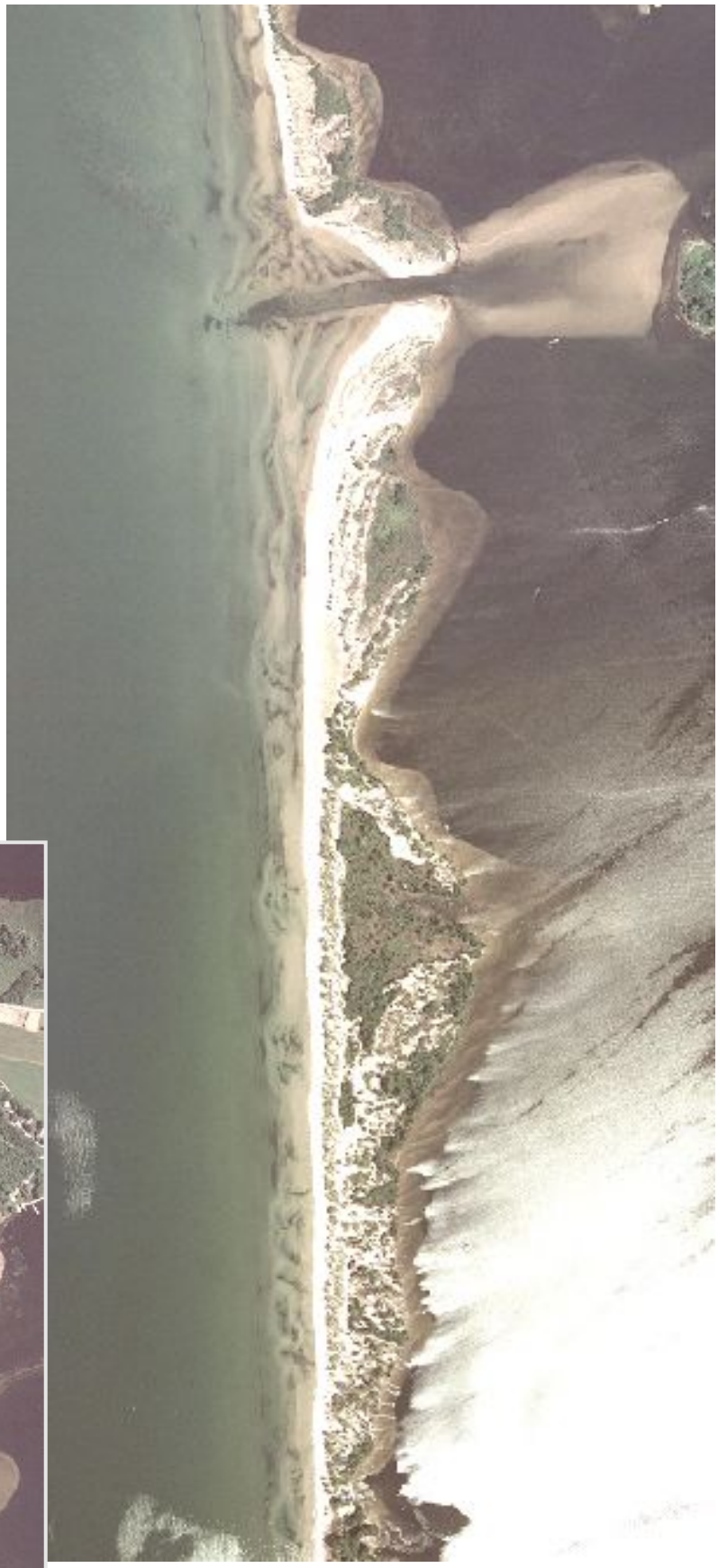
NYS DOP imagery shows a complex sand cell and bar structure. Often sand cells exist in front of the more stable, higher elevation sections of the barrier beach, while elongated sand bars form nearer the inlet, suggesting more net littoral flow. The depositional fan is more pronounced with a higher shoal arm on the north and in front of Carl Island. A digital shoreline was not completed for this data set as it is redundant with the NAIP imagery at nearly the same lake elevation.

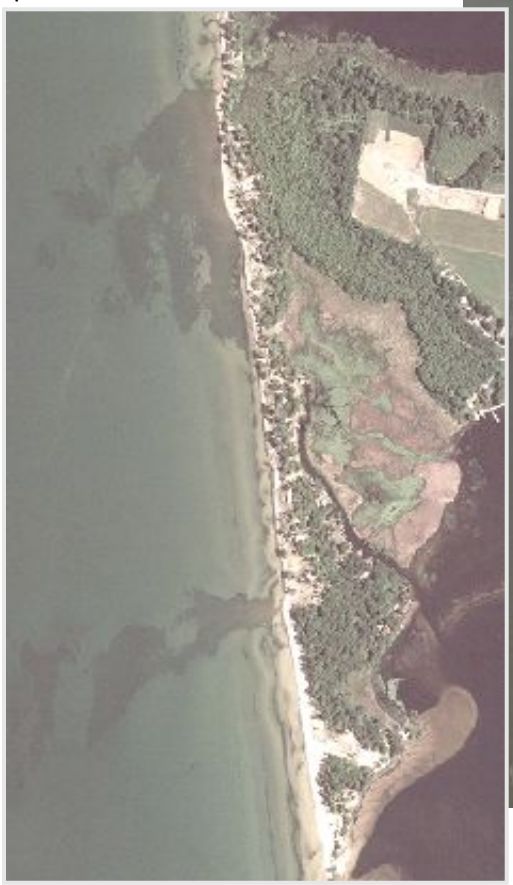
2016 Continued

Lake elevation: 245.7 (USDA NAIP, 6 June 06; moderately low).

Winds are from the west/south west, but with low wave set. The clarity of this image is excellent, depicting a clear shoreline, complex sand cells and bars, apparent algae growth, and bands of beach vegetation along forming dunes. Only the southern portion of the image is poor due to sun glare.

The inlet appears to show dredging done after the April 1 imagery with spoil moved to the north by hydraulic dredging. A set of 'C' shaped crescents of sand are present near shore with rocky shoals indicating shallow sand sheet depth are evident along the north spit.





2007

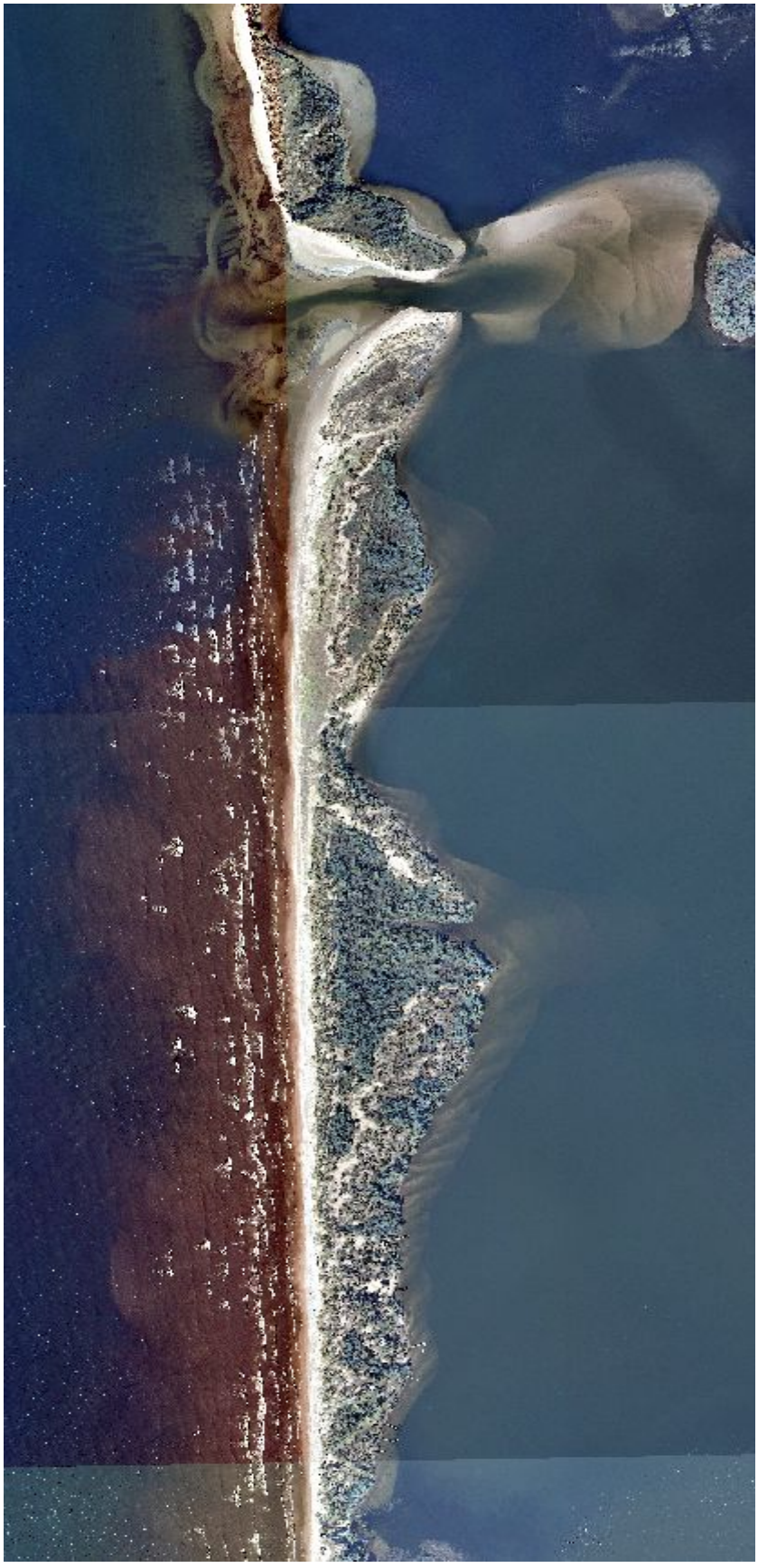
Lake elevation: 246.0 (moderately high).

USACE JALB revisited the area 14 June 2007, collecting LiDAR, reflectance, and imagery data using a digital scan camera for the first time. The resulting imagery at 0.4 m pixel size includes a stated 2.5-foot accuracy, the highest accuracy achieved up to that date. Scan lines and collection artifacts are present throughout the image set and include a gap just south of the inlet. The imagery was accompanied by the second LiDAR acquisition.

Features near shore, on the barrier beach, and within the deposition shoal are remarkably clear. More sand has been obviously deposited in the shoal since prior images.

2008

Lake elevation: 246.0 (USGS; moderately high).
USGS created a 0.3m pixel product with high accuracy from August 9th, 2008. A USDA NAIP (below) 1m pixel image is also available from September 24th (the pond image is from July 2nd). NAIP imagery is relatively grainy.
The rare August image date shows progression of vegetation on the barrier. The inlet illustrates significant channel constriction with lakeward shoals. The northern arm of the deposition shoal is above water and bands of sand are clearly present in the shoal. The eastern edge of the shoal remains well defined, with a 75-foot offset from Carl Island's shore maintaining some water exchange between north and south basins in front of the island.



2008 Continued

Lake elevation: 245.1 (USDA NAIP; low water).

The six-week period between 2008 images shows a 0.9 foot drop in lake level, a common occurrence at the end of summer. The inlet channel is only 70 feet wide on the lake side while shoals are exposed both adjacent to the channel and on the north and east sides of the pond shoal. Calm conditions are present, shown by the small globe of a darker water plume from the pond outflow into the lake. Nearshore sand bars are long linear structures.

2009

Lake elevation: 246.5 (high).

USDA NAIP imagery from 10 July 2009 is true color imagery, taken during light winds from the southeast.

Calm water provides an opportunity to see rock shoals offshore, including a possible small area offshore from the southern high dunes visible for the first time. The inlet has significant shoaling with a series of sand waves present in the base of the channel. On the north spit, a high wrack line may be present and several new deposits of sand are evident on the backside of the barrier, shown by lighter colored unvegetated fans. The northern most of these is a broad area, likely due to wind transport of sand, while the more southerly area may be either from overwash or wind-borne processes. Suspension of sand in the water column is shown on the north side of the deposition shoal with wave overwashing to the northwest. Boat propeller tracks are seen across the shoal in front of Carl Island. On the lake side, nearshore sand cells are backed by a deeper single sand bar.

2011

Lake elevation: 246.6 (both high).

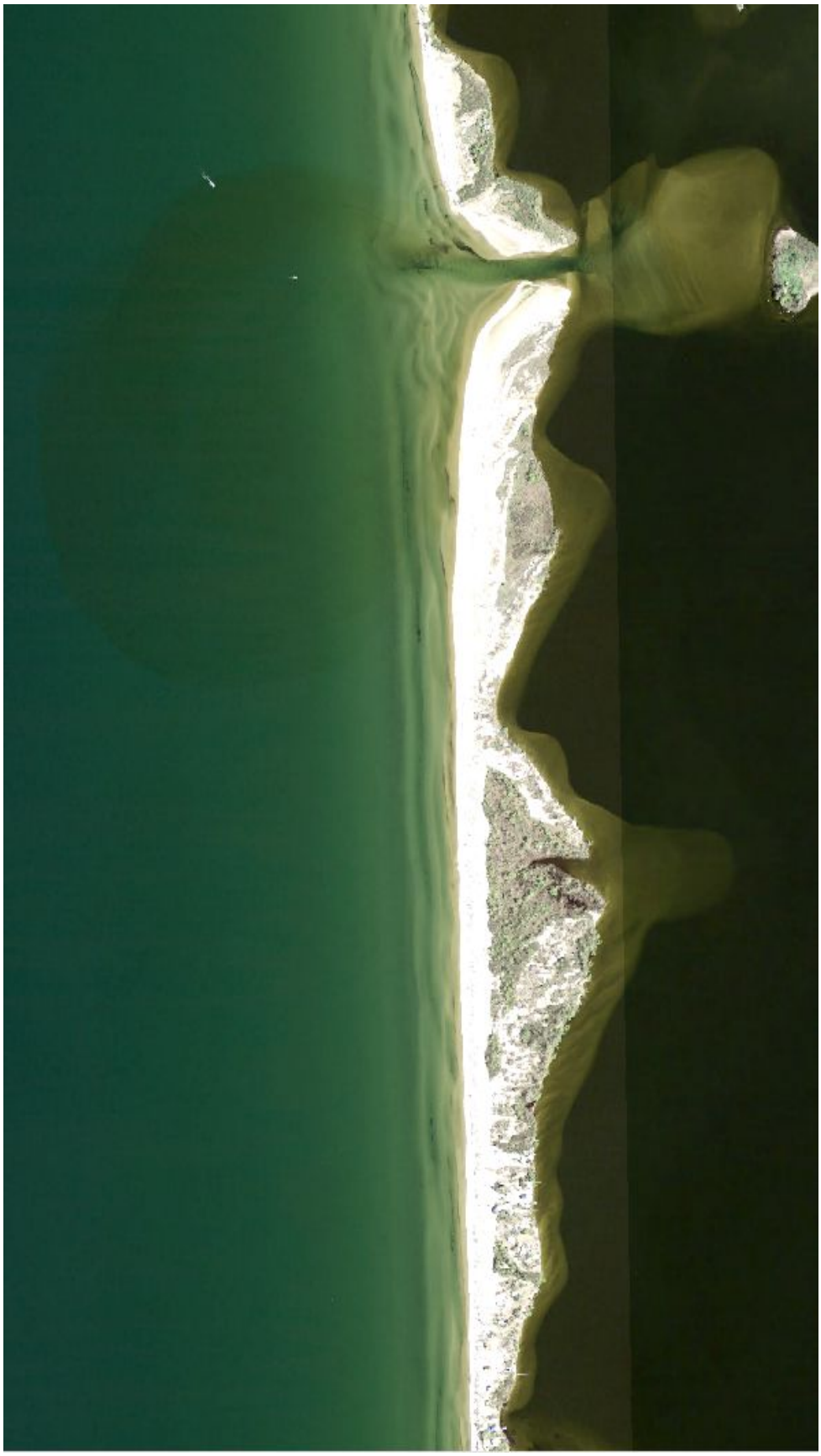
Two data sets are available in 2011. NYSDOP on May 9 and USDA NAIP on May 11. Both are 4 band imagery with the accuracy stated for each is 8 feet (2 foot pixel) and 6 meters (1 meter pixel), respectively. A separate LiDAR data set was also acquired in 2011.

The NYSDOP imagery has perfect contrast and brightness to give clarity of the beach and barrier details. This comes at the expense of ideal viewing of water features which are also reduced by a northwest wind. A mild southerly littoral current is present, shown by some sand movement on shore, and by a barely visible tannin cloud from outflow from the pond. Trails are readily discerned in the upland while at the south side of the inlet, water forcing into the ponded low area behind the first lake shore is visible from wind set.

2011 Continued

NAIP imagery from two days later is of very different character, with upland beach areas overexposed. The water features are very clear, even to the extent of the small bars of sand within the boat channel and the pond shoal. It is a still, calm day and the tannin colored plume of pond outflow is a round bubble with a very slight shift to the south. The inlet's south shore shows water receded after the NW wind of the prior image.

The combination of these two 4 band images with their different characteristics offers a unique opportunity for remote sensing analysis where both sets of data could be combined into an 8-band image set. LiDAR data is also available in 2011 making a possible interesting compilation of imagery.



2013

Lake elevation: 246.5 (high).

USDA NAIP imagery is available from June 6th at a 1 m resolution.

Winds are out of the northwest with matching wave set and nearshore sand bars are well developed. The mechanical dredging operation underway with the excavator at the midpoint in the inlet at the head of a newly dredged channel. Stockpiled sand is seen on the inlet south side and a series of dump trucks are hauling sand to the south. The new channels on the pond side, now offset from the back-side shores of the inlet, are shown. The progression of dunes and recurved arcs are clear while the north barrier spit shows extensive algal blooms in Renshaw Bay and in sheltered areas on the backside of the barrier.

2015

Lake elevation: NYS DOP - 244.8 - 245.3 (low)

NYS GIS imagery is dated from April 15 with 1 foot pixel and +/- 4' accuracy. Imagery of the eastern half of the pond may have been taken up to May 9 according to metadata and confirmed by different wind patterns and more advanced vegetation growth. Imagery is 4 band format.

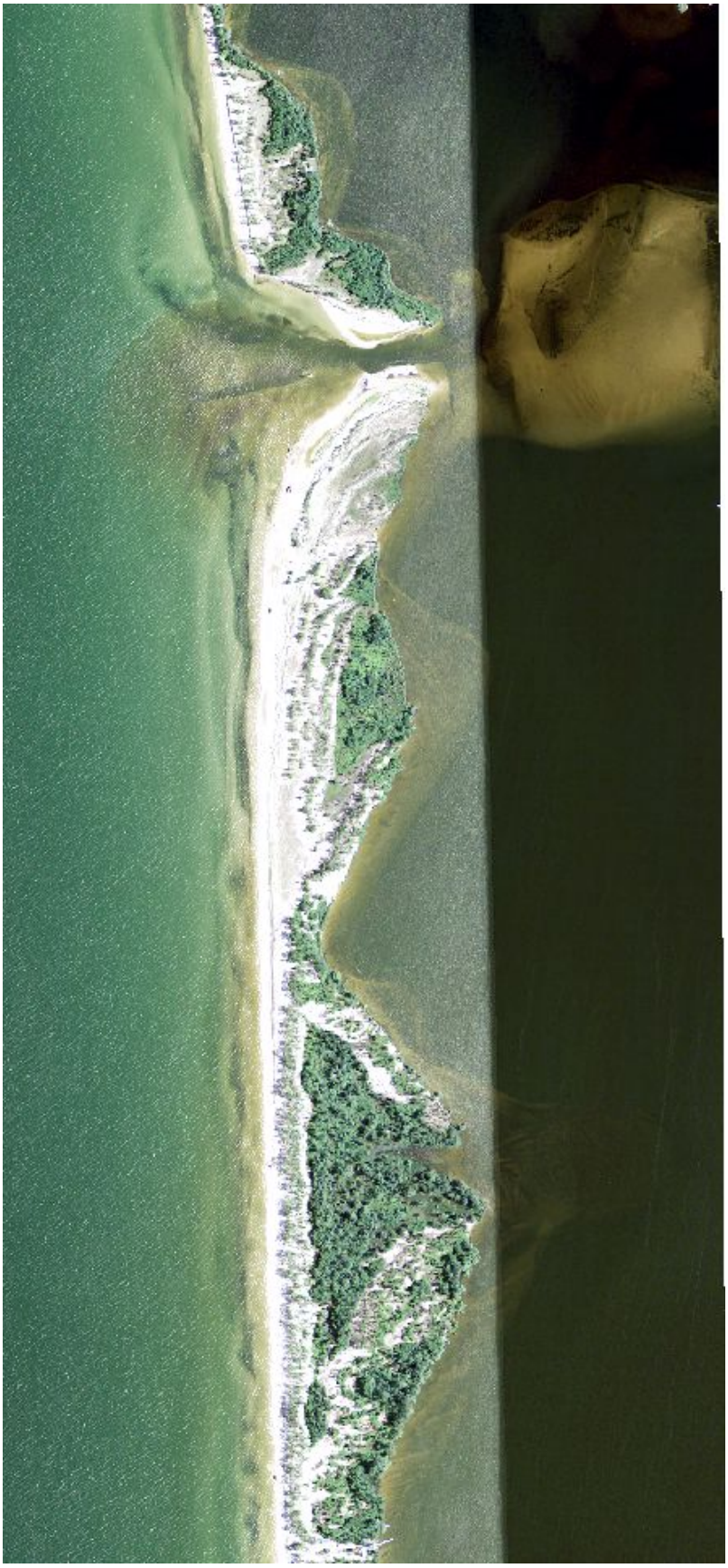
NYS DOP imagery was taken with winds from the north-west. Wind-driven waves obscure much of the nearshore lake bottom, although very little sand seems to be entrained in the north-west wind set. Calmer winds lead to much clearer imagery of the depositional shoal taken several weeks later and merged with the earlier imagery. The extent of exposed area of the shoal is substantial.

2015 Continued

USDA - 245.7 (relatively low).

USDA NAIP imagery was taken on June 6th with an increase in resolution from 1.0 m to 0.5m over prior products and in 4 band configuration (true color plus infrared).

The USDA image was taken during light winds, possibly from the southeast. The channel is shoaling with sand waves seen on the channel bottom. The deposition shoal has changed in that sand from fans near the inlet appear to have been pushed towards Carl Island and a large exposed shoal is above water. The approach to the inlet from the south remains open while that to the north is more heavily shoaled.



Satellite imagery (a full representative series set from 1974 to 2016 is available)

Keywords

North Pond, Sandy Pond, Shoreline change, Inlet, Barrier beach, NY Sea Grant, Lake Ontario

Years: 1938 - 2015

Programs:
USDA NAIP
NRCS
USACE
USGS EE
USACE JALB
USGS
NYS GIS
SWCS
NYS Museum
NYS DOQQ

Credits:
NY Sea Grant, Oswego County SWCS, Thomas Hart