ATTACHMENT 6

Town of Marion
Two Spring Street
Marion, Massachusetts 02738

Paul F. Dawson
Town Administrator

e-mail—pdawson@marionma.gov

Telephone—508-748-3550
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September 16, 2015

Ms. Robin Johnson
U.S. Environmental Protection Agency – Region 1
5 Post Office Square, Suite 100 (OEP06-1)
Boston, MA 02109-3912

Mr. David Ferris
Massachusetts Department of Environmental Protection
Wastewater Management Program
1 Winter Street
Boston, MA 02108

Subject: Town of Marion
Update on NPDES Permit Activities

Dear Ms. Johnson and Mr. Ferris:

The Town of Marion (Town) has been actively working on a number of activities related to its Draft NPDES permit received by the EPA in December 2014. The attached letter provides the EPA and the DEP an update on the status of these various activities and provides a schedule for completion of the initial planning work.

Should you have any questions, please feel free to contact me at (508) 748-3550.

Sincerely,

Paul F. Dawson
Town Administrator

cc: Mr. Ken Moraff, EPA
Mr. David Webster, Chief, Water Permits Branch, EPA
Mr. David Burns, MassDEP
Town of Marion Board of Selectman
Robert Zora, Superintendent of Public Works
Jonathan Witten, Esq.
Bernadette Kolb, Shawn Syde, Robert Otoski, Mike Guidice, CDM Smith
Mark Rasmussen, Buzzards Bay Coalition

CDM Smith
75 State Street, Suite 701
Boston, Massachusetts 02109
tel: 617 452-6000

September 16, 2015

Ms. Robin Johnson
U.S. Environmental Protection Agency – Region 1
5 Post Office Square, Suite 100 (OEP06-1)
Boston, MA 02109-3912

Subject: Update on Marion Actions for Treatment Plant Upgrades

Dear Ms. Johnson:

On behalf of the Town of Marion, this letter serves to update EPA and MA DEP on the activities the Town has undertaken in response to the draft NPDES permit that was issued on November 28, 2014. The Town requests that the information in this letter be considered as supplemental comments to the Town's original response to the draft NPDES permit, which was submitted to EPA and MA DEP on February 13, 2015.

On May 11, 2015, the Town of Marion passed an article at Town Meeting to undertake the following studies in support of response and actions required of the draft NPDES permit. The Town contracted this work with CDM Smith on July 7, 2015.

- Prepare an update to the Town's 2001 Wastewater Facilities Plan.
- Prepare a watershed loading analysis of nitrogen loading to Aucoot Cove.
- Perform analyses related to making modification to the lagoons at the treatment plant site including:
  - Perform a water balance for the lagoons to both assess possible leakage from the lagoons and also determine size and volume needed for influent equalization.
  - Conduct a sludge sampling program to determine both the volume and quality of sludge on the bottom of the lagoons.
  - Evaluate sludge management alternatives.
  - Develop a cost estimate for various future lagoon scenarios.
- Conduct an evaluation of eelgrass in upper Aucoot Cove including further research of historical data on the possible presence of eelgrass in the cove and a sampling program to look for the presence of peat layers with eelgrass rhizomes.

- Conduct a preliminary evaluation of the engineering feasibility of constructing either an extension of the outfall pipe to the head of the salt marsh in Aucoot Cove or constructing an ocean outfall discharging to outer Aucoot Cove. The evaluation will include routing, preliminary hydraulic considerations and preliminary costs.

In addition, the Town met with the Buzzards Bay Coalition on September 2, 2015 to discuss the possibility of collaborating on a grant application (also with the Town of Mattapoisett) and agreed to submit an application to study the feasibility of sewering the Indian Cove neighborhood, which is located between the treatment plant and Aucoot Cove, and some adjacent homes in the Harbor Beach neighborhood in Mattapoisett. The Pre-proposal for the grant was submitted to the Buzzards Bay National Estuary Program for the Southeast New England Program Water Quality Management Grant on September 15th.

Progress on Scope of Work

Work on the update to the facilities plan has not begun and will await completion of other tasks. The nitrogen loading analysis and evaluation of outfall options have only just started and there currently is no progress to report.

Lagoon Water Budget

The study of the lagoons began with the installation of three pressure sensors (one in each lagoon) to accurately measure water levels on July 21, 2015. A preliminary water budget was performed with data collected through the end of August, and is described in the attached memorandum to the project files. The initial findings are repeated below.

Of particular note, the water budget analysis supports the Town's position presented in the comments on the draft permit that the water budget used by EPA in the draft permit is fundamentally flawed; with potential losses from the lagoons (due to infiltration or measurement errors) ranging from 2 to 10 percent of the losses included in the draft permit.

Initial Findings

The results of the water balance are preliminary and are based on a short period of flow and depth data collected at the WWTF. In addition, the evaporation for August is estimated based on the Penman equation as described in the memorandum; the final water balance will use measured pan evaporation in Kingston, RI once the data are available from the National Weather Service.

While the results are preliminary and the time period considered in this analysis is limited, water balance results during periods where no precipitation falls (such as the first 10 days of August, excepting one small rain event) suggest a relatively consistent negative flow residual. This suggests the following:

- The lagoons may be leaking a small amount of flow. During periods where there is no significant inflow or precipitation, the residual loss term is on the order of 0.01 to 0.05 mgd.

This underestimated flow is a relatively small term in the water budget compared to the diverted flows to and from the WWTF. Other potential reasons for this discrepancy are a systematic bias in the evaporation estimates in August or underestimated flow into the lagoons.

- The flow residual is greater during periods of net inflow to the lagoons, via diversion and precipitation. The differences during precipitation are notable because they appear to scale to the magnitude of the precipitation. This will be a focus on the updated water budget after additional data are collected.

- The volume of the negative flow residual is small and within the range of error in the evaporation and flow measurements. However, the nearly consistent sign of the residual suggests that at least some of the cause is hydrologic in nature (not due to flow measurement error). While the evaporation has been estimated based on the best available information, it is conceivable that uncertainty in the evaporation could be causing some of the flow residual. This is a possibility because the magnitude of the flow residual is within the range of variation in evaporation estimates based on the best available data.

The water balance results will be refined as additional data is collected from the lagoons and additional evaporation data is available from the National Weather Service.

Eelgrass Study

The draft permit incorporates nitrogen limits in the permit on the basis of the need to support a resource of eelgrass in the waters of Inner Aucoot Cove. Comments submitted by the Town on the draft permit note that eelgrass has never been shown to be present in Inner Aucoot Cove (MassGIS eelgrass maps from 1995 to 2010) and that there are several lines of evidence that suggest that eelgrass will not be found there.

The Town is pursuing two paths to establish whether eelgrass has ever been present in Inner Aucoot Cove (upper region adjacent to Haskell Island and the shallow area to the east): (1) obtain additional historic data on eelgrass to supplement the mapping by MA DEP on MassGIS, and (2) conduct a sampling program in this region to collect sediment cores that will penetrate below the sand waves found in this region and examine the cores for evidence of eelgrass rhizomes/roots which should be preserved if there is significant eelgrass in the region. Note that others have suggested that we look for evidence of seeds in Inner Aucoot Cove; but given the extensive presence of eelgrass in the deeper waters of the cove, we believe the presence of seed or even the density of seed would be an unreliable indictor of eelgrass in the target area.

Concerning the compilation of additional photographic evidence for the presence/absence of eelgrass in Inner Aucoot Cove, we have additional information to offer since the submittal of the draft comments on the permit.

First, we reached out to Dr. Brian Howes to determine if he had any data on eelgrass from his previous water quality work in the area. The attached memorandum from Dr. Howes documents the data observed/collected by CSP-SMAST scientists in July and November 2003. This work shows that there was no evidence of eelgrass at sampling locations AC11 through AC16, which is consistent with observations Dr. Howes and his team have made throughout the region where eelgrass is not found associated with saltmarsh. Dr. Howes' stations outside of Haskell Island match those of previous mapping showing a band of eelgrass in the depth range generally less than 4 m, but not in depths greater than 6 m. This pattern of eelgrass has been stable on its shoreline facing edge for decades, while the outer edge has moved slightly.

We examined available aerial imagery that could be located of Inner Aucoot Cove and found two primary sources: (1) 1960 to 1983 data from the USGS Earth Resources Observation and Science Center, and (2) 1995 to 2015 data from Google earth. A selection of these images is attached to this letter. All of the images show a relatively stable pattern of sand waves in Inner Aucoot Cove. The origin of the sand is unknown but could have been the Hurricane of 1938. Notable is the passage of Hurricane Bob in 1991, which had its center of impact near Aucoot Cove and does not appear to have significantly altered the sand waves. The lack of visual evidence in the images of vegetation on the bottom of Inner Aucoot Cove does not support EPA's contention that this should be an eelgrass resource area.

Using the lines of evidence approach of the MEP methodology that has been applied to embayments along the Commonwealth's south coast, the lack of evidence of eelgrass presence in Inner Aucoot Cove results in restoration of eelgrass not being a useful or meaningful goal in the cove. As noted above, we intend to further demonstrate the presence/absence of eelgrass with a sampling program designed to look for physical evidence of eelgrass rhizomes/roots below the sandy bottom.

Schedule for Completion of Remaining Work

We estimate that the remaining work of this contract, excepting the wastewater facilities plan update, will be completed by the end of March 2016, with major milestones at the end of each month as noted below. Work on the facilities plan update will occur after all the analysis discussed below are completed.

1. Watershed Loading Analysis – Analysis complete in December 2015
2. Lagoon Analysis
    a. October 2015 – Complete collection of water level data in lagoons to allow for refined water budget.
    b. November 2015 - Complete collection of data in the lagoons on the volume of sludge and samples for quality in October with analytical data arriving in November.

c. November 2015 – Update the water budget analysis

d. February 2016 – Complete analysis of lagoon alternatives, include sludge management and cost analysis

3. Eelgrass Analysis

   a. October 2015 – Sampling program complete

   b. November 2015 – Data analysis documented

4. Outfall Analysis – Analysis complete in February 2016

We expect to provide the Town of Marion a draft report of the work discussed above in February 2016, and allow for a month for the Town to review the report and for a final report to be prepared.

Through this progress update, the Town is providing information to EPA on the efforts it is undertaking to ensure that future efforts to improve the Town's wastewater infrastructure are based on sound science with cost effective decisions made that can be supported by the Town's small ratepayer base. We believe it is in the best interest of both the regulatory agencies and the Town's ratepayers that the Town be allowed to complete these studies, and that the result of the studies be taken into account before issuance of a final permit for the treatment facility. We hope you agree.

If you have any questions about our plans, please contact me or Shawn Syde at CDM Smith.

Sincerely,

Bernadette Kolb
Senior Vice President
CDM Smith

cc: Shawn Syde – CDM Smith
Mark Rasmussen – Buzzards Bay Coalition

Attachments:

1. Memorandum to Project Files on preliminary water budget
2. Memorandum from SMAST on eelgrass data in Aucoot Cove from July 2003
3. Select aerials images of Aucoot Cove as referenced in the text

Memorandum

To: *Project Files – Marion, MA 110602*

From: *Zach Eichenwald*

Date: *September 9, 2015*

Subject: Progress Update: Marion WWTF Lagoon Water Budget

The town of Marion uses 20 acres of open aerated, unlined lagoons for influent flow equalization and sludge treatment at its 0.58 mgd wastewater treatment facility. EPA, in its 2015 draft NPDES permit, asserts that the lagoons are leaking untreated sewage into the groundwater surrounding Aucoot Cove, transporting a nitrogen load of "16,700 lbs/year to groundwater that follows in a diffuse circuitous path and ultimately discharges to Aucoot Cove." This assertion is based on a study performed by the Horsley Witten group and commissioned by the Buzzards Bay Coalition, which concludes that the lagoons are leaking at a rate of 1 inch per day, equivalent to 0.54 mgd of outflow from the lagoons each day, nearly equal to the plant's design flow and exceeding the actual average daily flow into the wastewater treatment facility.

The conclusions from the Horsley Witten report were used in part to set the allowable nitrogen load to Aucoot Cove via the Marion WWTF discharge. While it is clear that the lagoons do not leak at a rate of 1 inch per day – if this was indeed the case, the wastewater in the lagoons would rapidly infiltrate into the ground leaving no water left in storage – no detailed analysis had been done to assess whether leakage to groundwater was occurring. To evaluate the question of potential leakage from the lagoon, we constructed water budget models of the Marion WWTF facility based on a combination of flow metering data, lagoon depth data, and observed meteorological conditions. The water budget analysis provides improved information on the potential leakage of wastewater from the lagoons and their concomitant nitrogen load to groundwater and will also be used to evaluate the area and volume of a basin needed for equalization of the influent.

This memorandum documents (1) a preliminary water budget analysis conducted prior to installation of water level meters and (2) a refined water budget analysis based on the initial five weeks of daily data from the new water level meters. At a minimum, we plan to collect three months of data to complete the refined water budget assessment.

Marion Wastewater Treatment Facility Configuration

A process diagram of the Marion WWTF is shown in Figure 1. Flow can enter the lagoons in several ways.

- Flow into the WWTF is metered at the Front Street Pump Station, located approximately ¾ mile from the headworks. The influent flow passes through the bar screen and grit chamber and then enters a splitter box that can direct flow either into the plant's two SBRs or into the lagoons; flow is directed into the lagoons during wet weather when the influent flow exceeds the treatment capacity at the plant. The volume diverted into the lagoons is unmetered, and is computed as the difference between the daily total at the Front St. Pump Station and the plant's influent flow meter, located immediately before the SBR tanks.
- Waste activated sludge from the SBR tanks is pumped into the lagoons via a metered pump.
- A diversion just prior to the effluent flow meter, the disk filters, and the UV channel can send partially treated effluent back into the lagoons. This is done to maintain volume in the lagoons and to maintain the disk filter and UV treatment apparatus. This diversion is not directly metered; flow sent to the lagoons through this diversion is estimated as the influent minus the WAS pumped flow and the effluent flow.
- The waste sidestream pump is used for the disk filter backwash, sewer service to the WWTF building, floor drains throughout the WWTF, and the biofilter.

If the lagoons are used for flow equalization during wet weather when the influent exceeds the plant capacity, flow is pumped back from the lagoons to the process train once the influent flow is reduced and additional plant capacity is available. This flow is metered.

Preliminary Water Balance

We first computed a preliminary water balance using available data prior to installing new water level instrumentation. Inputs included

- three years of flow data aggregated to a monthly time step,
- lagoon level data measured daily during the work week at a staff gage located in each of the lagoons; the level data, however, is read from a distance and is only accurate to +/- 0.25 inches, which is equivalent to 0.14 million gallons of volume distributed across the 20 acres of lagoons,
- precipitation as reported on the WWTF monthly operating reports,
- monthly average pan evaporation values for the region to estimate loss due to evaporation, and

- a volume calculation based on the differential lagoon depth change to estimate the volume of flow gained or lost from the lagoons on a daily basis.

The estimated inflow or outflow based on the flow data, precipitation, and evaporation was compared with the volume change observed in the lagoons. This analysis found that there was approximately 50,000 gallons per day of flow that is missing from the lagoons based on recorded inflows and assumed losses. This difference may be attributed to groundwater infiltration, but could also be measurement error in the inflows or lagoon level.

Refined Water Balance

Based on the many sources of uncertainty in the preliminary water balance, we added high-resolution depth sensors to the lagoons to accurately measure the depth change at 10-minute intervals within +/- 0.001 feet, and refined the approach for estimating evaporation from the surface of the lagoons. The three lagoon depth meters were installed on July 21, 2015.

Evaporation

Evaporation measurements are sparse, with the closest pan evaporation station in Kingston, RI, 40 miles southwest of Marion, and the data lag by a month or so. As of September 4, 2015 the pan evaporation data from Kingston had been updated through the month of July. As a result, we needed to estimate the evaporation during the month of August using an empirical equation. We compared evaporation measurements from Hamon's, Hargeaves', and Penman's methods to pan evaporation data from Kingston for the latter half of July, and determined that Penman's method with an albedo of 50% best fit the pan evaporation data. The Penman equation with a lower albedo appears to overestimate the evaporation, so the albedo was calibrated to best fit the observed data.

For this analysis, evaporation in July 2015 is Kingston, RI pan evaporation data with a pan coefficient of 0.78 based on Map 4 in NOAA TR-33. August evaporation is based on Penman's equation with an albedo of 50% using solar radiation data from Kingston, RI, and temperature, relative humidity, wind speed, and atmospheric pressure from Marion, MA. The evaporation estimate should be updated to reflect observed pan evaporation data at Kingston, RI once the data is available from the National Weather Service.

Wastewater Treatment Facility Operations

In addition to refined evaporation and lagoon depth calculations, Marion WWTF staff kept detailed notes on facility operations throughout the monitoring period for the refined water balance. The following is a summary of the operators' notes during this period. All flow measurements are daily totals as of 8:00 AM, representing the previous 24 hours of flow.

- All of the treated effluent was diverted to the lagoons from 7/23 to 7/27, which means there was no discharge to Effluent Brook. This occurs either to perform maintenance of the disk filters or the UV system, or maintain adequate water level in the lagoons. For this period the

lagoon inflow was calculated as [influent] – [effluent] – [WAS]. The flow was diverted to the lagoons starting at 10:18 AM on 7/23.

- Treated effluent was diverted to the lagoons from 8/12 to 8/17. For this period the lagoon inflow was calculated as [influent] – [effluent] – [WAS]. The flow was diverted to the lagoons starting at 12:30 PM on 8/12.
- No raw sewage was diverted to the lagoons via the splitter box during this 5-week period.
- Nor was any flow was taken from the lagoons and returned to the plant during this 5-week period.

Water Balance Results

The results of the water balance are noisy when examined on a daily basis, but if we look at the trends in the data we can see some general patterns. Figure 2 shows the net flow to or from the lagoons plotted against the change in lagoon storage, and the residual flow, which is the volume that can be attributed to infiltration and error in the precipitation, evaporation, and metering data. The blue shaded areas indicate a negative residual, suggesting infiltration, overestimated precipitation, or underestimated evaporation; the green shaded areas indicate a positive residual, suggesting underestimated precipitation or overestimated evaporation.

The timeseries shown in Figure 2 indicates that the largest negative residual – flow either lost to infiltration or error in the hydrology – occurs during precipitation events. This suggests that the error is caused by inadequate precipitation data. The precipitation falls across a 20 acre area, so it is possible that the geographic distribution of precipitation is not constant across the entire lagoon area. This is especially likely during summer thunderstorms, where intense precipitation can occur over a very small area. The larger errors also occur during the periods when treated effluent is discharged to the lagoons. This could indicate errors due to the timing of the transfer, where the majority of the flow measurements are from 8 AM to 8 AM, whereas the transfer occurs during a subset of a day because it does not start at the beginning of a metering day. Smaller residuals – both positive and negative - occur during periods of no precipitation and no inflow to the lagoons. These are more likely indicative of the actual hydrologic conditions in the lagoons, where the result is separated from the estimated inflow to the lagoons as well as the precipitation measurements.

Preliminary Conclusions

The results of the water balance are preliminary and are based on a short period of flow and depth data collected at the WWTF. In addition, the evaporation for August is estimated based on the Penman equation as described above; the final water balance will use measured pan evaporation in Kingston, RI once the data are available from the National Weather Service.

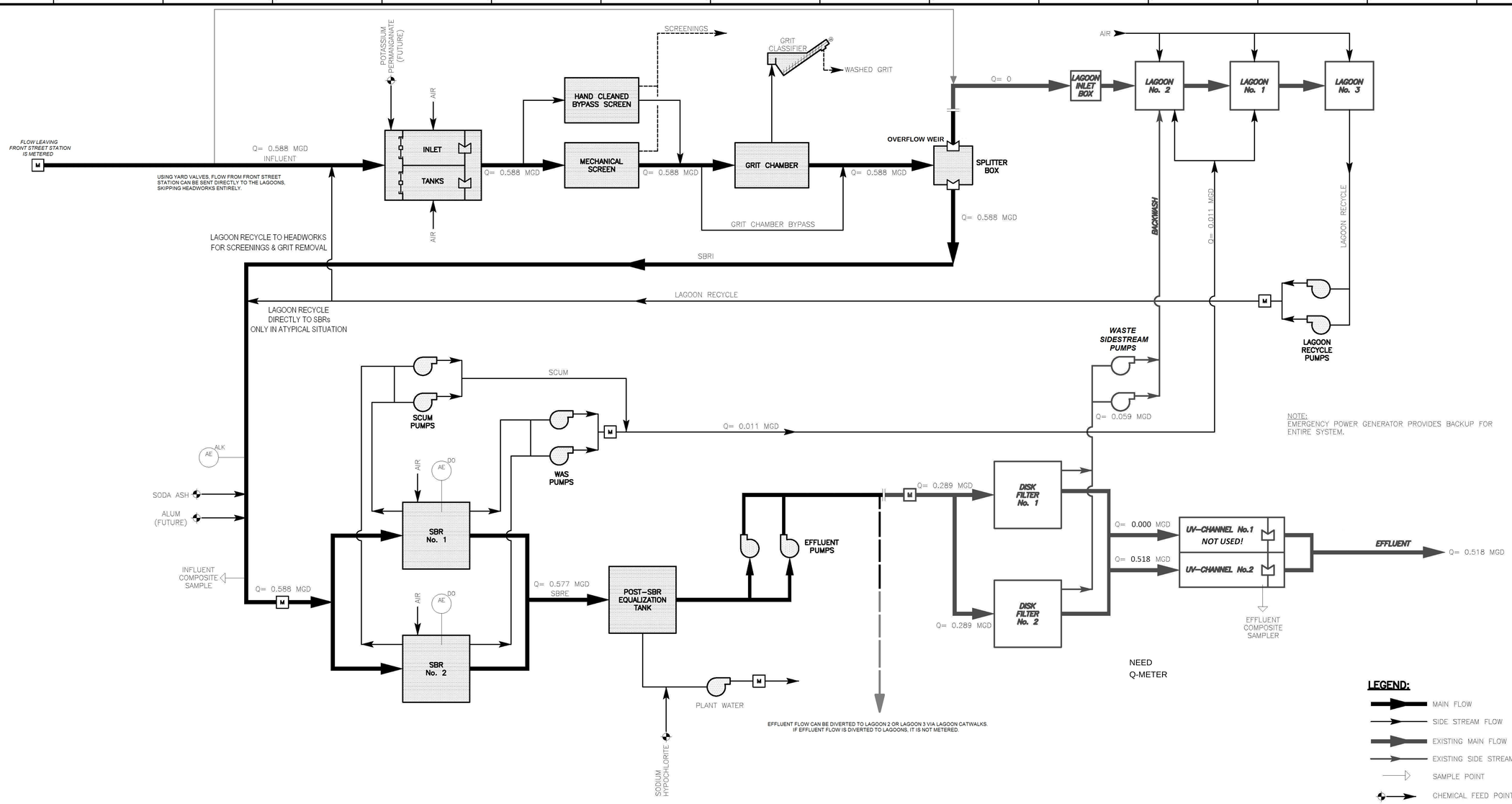
While the results are preliminary and the time period considered in this analysis is limited, water balance results in Figure 2 during periods where no precipitation falls suggest a relatively consistent negative flow residual. This suggests the following.

- The lagoons may be leaking a small amount of flow. During periods where there is no significant inflow or precipitation, the residual loss term is on the order of 0.01 to 0.05 mgd. This underestimated flow is a relatively small term in the water budget compared to the diverted flows to and from the WWTF. Other potential reasons for this discrepancy are a systematic bias in the evaporation estimates in August or underestimated flow into the lagoons.

- The flow residual is greater during periods of net inflow to the lagoons, via diversion and precipitation. The differences during precipitation are notable because they appear to scale to the magnitude of the precipitation. This will be a focus on the updated water budget after additional data are collected.

- The volume of the negative flow residual is small and within the range of error in the evaporation and flow measurements. However, the nearly consistent sign of the residual suggests that the at least some of the cause is hydrologic in nature (not due to flow measurement error). While the evaporation has been estimated based on the best available information, it is conceivable that uncertainty in the evaporation could be causing some of the flow residual. This is a possibility because the magnitude of the flow residual is within the range of variation in evaporation estimates based on the best available data.

The water balance results will be refined as additional data is collected from the lagoons and additional evaporation data is available from the National Weather Service.



LEGEND:

- MAIN FLOW
- SIDE STREAM FLOW
- EXISTING MAIN FLOW
- EXISTING SIDE STREAM FLOW
- SAMPLE POINT
- CHEMICAL FEED POINT
- PUMP (GENERAL TYPE)
- M — MAGNETIC FLOW METER
- AE (XXX) — AUTO ANALYZER

Design Flows and Loads

Wastewater Flows (mgd)

Average Annual Day	0.588
Maximum Day	1.84
Peak Hour	3.00

Influent Loads (lbs/day)

Average Day

BOD	909
TSS	880
TKN	191

Lagoon Recycle Loads, May-Oct.(lbs/day)

Average Day

BOD	83
TSS	neglect
TKN	56

Total Design Loads (lbs/day)

Average Day

BOD	992
TSS	880
TKN	247

Maximum Month (summer)

BOD	1,202
TSS	1,144
TKN	330

Maximum Month (winter)

BOD	1,036
TSS	1,144
TKN	218

Preliminary Treatment

Inlet Tanks

Number of Units	2
Dimensions (ft)	
Length	25
Width	3.75
Sidewater Depth	7.83
Total Effective Volume (gal)	10,980

Influent Screen

Type	Mechanical Bar Screen
Number of Units	1
Spacing (inches)	0.25

Grit Tank

Number of Units	1
Dimensions (ft)	
Diameter	7.0
Depth (inc. hopper)	7.17

Headworks Blowers

Number of Units	2
Type	Rotary Positive Displacement
Capacity per Unit (scfm)	150
Motor Horsepower	10

Lagoon Aeration

Air Requirements (scfm)	375
No. of Blowers	2
Type	Rotary Positive Displacement
Capacity per Unit (acfm)	375
Motor HP	15
No. of Diffusers	
Lagoon No. 2	52
Lagoon No. 1	20
Lagoon No. 3	38

Biological Treatment

Sequencing Batch Reactors

Number of Units	2
Dimensions (each unit) (ft)	
Length	99
Width	33
Sidewater depth (ft)	
High Water Level (HWL)	19.9
Low Water Level (LWL)	15
Total Effective Volume (@ LWL) (mil gal)	0.73
SRT @ max month loadings (days)	10.6
MLSS (@ LWL)	4,700
MLVSS (@LWL)	3,760
Air Requirements (scfm)	
Average	620
Max Day	1,150

Blowers

Number of Units	3
Type	Rotary Positive Displacement
Capacity per unit (acfm)	660
Motor HP	60

Post-SBR Equalization Tank

Number of Tanks	1
Dimensions (ft)	
Length	83
Width	15
Side Water Depth (HWL)	10.5
Total Effective Volume (gal)	97,800

Final Filtration (Existing)

Type	Cloth Disk Filters
Number of Filters	2
Number of Disks per Filter	2
Filter Surface Area (sf)	
Per Disk	54
Per Filter	108
Hydraulic Loading Rates (gpm/sf)	
Average Day	1.6
Maximum Day	5.0

Disinfection (Existing)

Type	Ultraviolet-Low Pressure
Number of Reactors	2
Number of Banks	4
Number of Modules per Bank	7
Total Number of Lamps	224

pH Control

Chemical	Soda Ash (Na2CO3)
Dosage (mg/L)	137
Silo Capacity (cf)	576
Silo Dimensions (ft)	
Diameter	12
Height	20

Sludge Quantities

Waste Activated (dry lbs/day)

Annual Average	879
Maximum Month (summer)	1,165
Maximum Month (winter)	1,000

DESIGN CRITERIA

UPDATED RECORD DRAWING

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	2/12	JP	AB	NO CHANGES FURNISHED

DESIGNED BY: McCONNELL W.
DRAWN BY: SZAWLOWSKI P.
SHEET CHK'D BY: McCONNELL W.
CROSS CHK'D BY: WALENCIS L.
APPROVED BY: FIRMIN A.
DATE: MARCH 2003

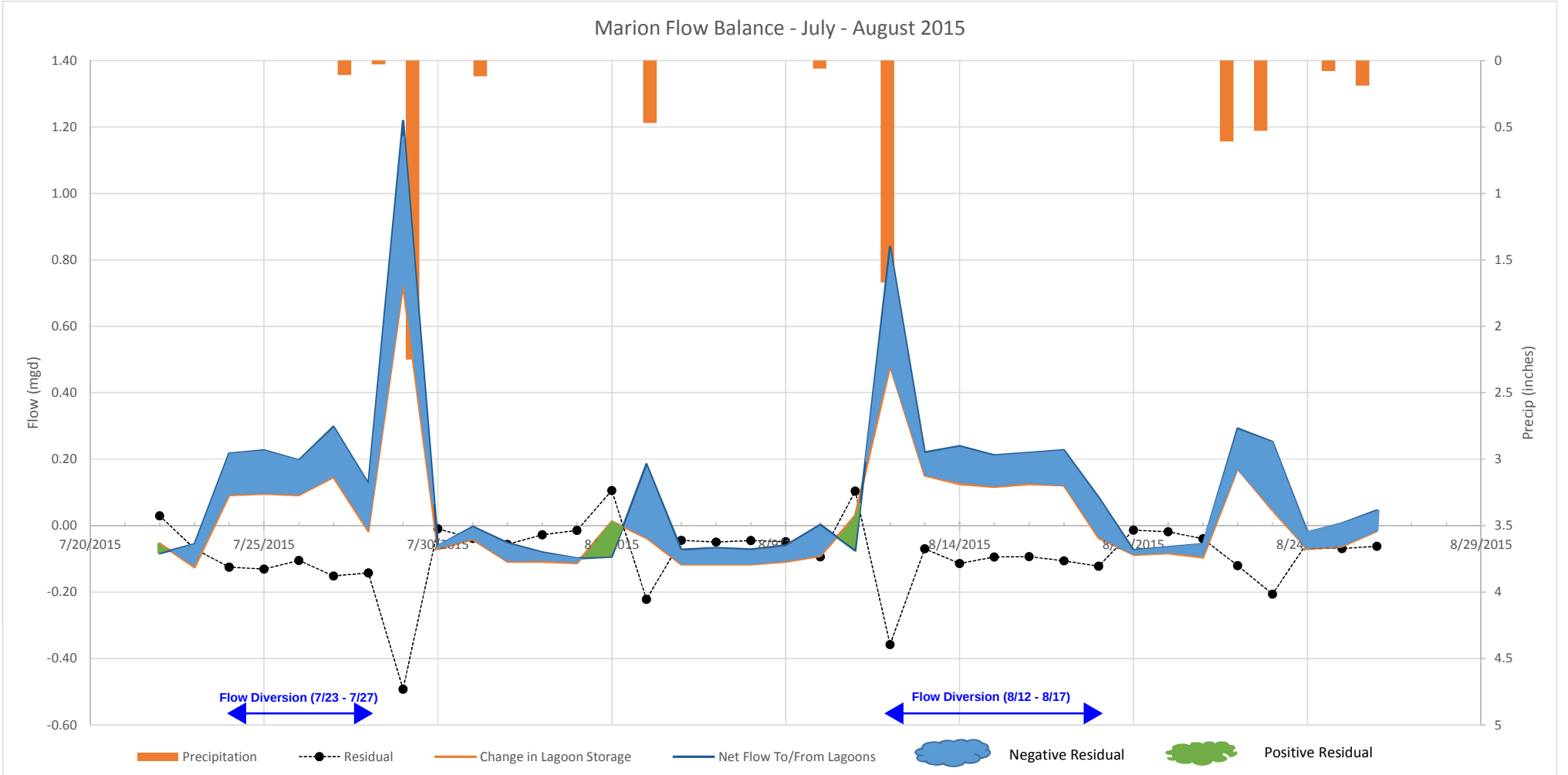
CDM Camp Dresser & McKee Inc.
consulting engineering construction operations

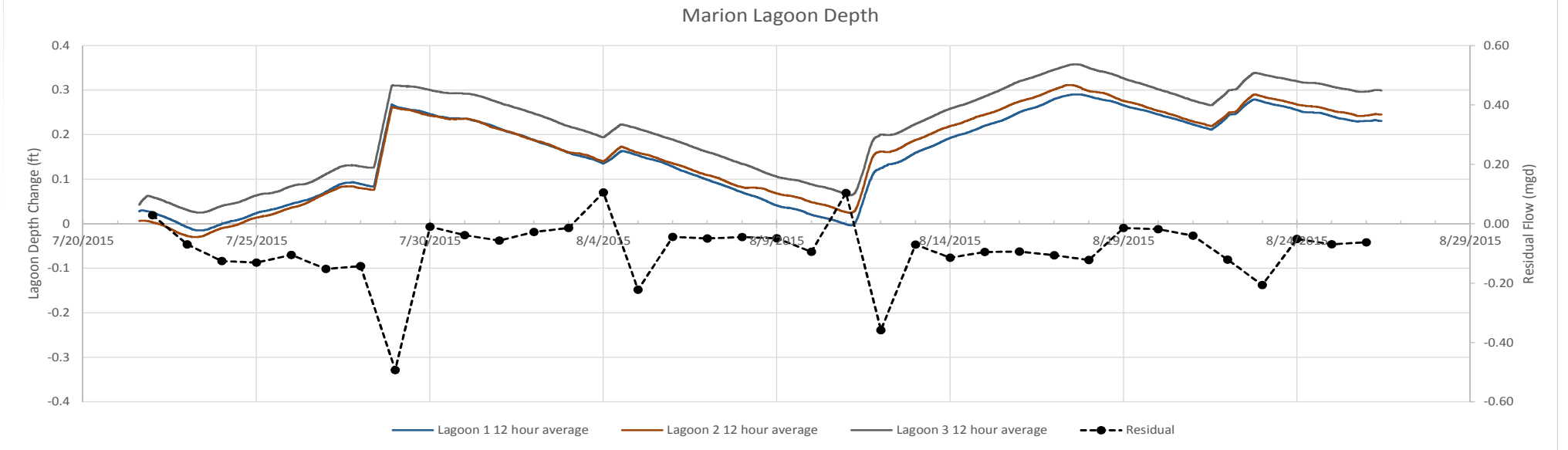
TOWN OF MARION, MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS
CONTRACT NO. WW-01
WASTEWATER TREATMENT PLANT UPGRADE

FUTURE PROCESS FLOW DIAGRAM AND DESIGN CRITERIA TABLE

PROJECT NO. 0357-36212
FILE NAME: MPRDI001

SHEET NO.
G-3
0357-P-XXXX


Marion Flow Balance - July - August 2015
Flow (mgd)
Precip (inches)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
7/20/2015
7/25/2015
7/30/2015
8/14/2015
8/29/2015
Flow Diversion (7/23 - 7/27)
Flow Diversion (8/12 - 8/17)
Precipitation
Residual
Change in Lagoon Storage
Net Flow To/From Lagoons
Negative Residual
Positive Residual


Marion Lagoon Depth
Lagoon Depth Change (ft)
Residual Flow (mgd)
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
7/20/2015
7/25/2015
7/30/2015
8/4/2015
8/14/2015
8/29/2015
Lagoon 1 12 hour average
Lagoon 2 12 hour average
Lagoon 3 12 hour average
Residual

Technical Memorandum

To: Bernadette Kolb, CDM Smith

From: Brian Howes, Director, Coastal Systems Program

Re: Summary of Eelgrass MEP Information Aucoot Cove, July 2003.

Date: August 31, 2015

This Technical Memorandum is being provided to CDM Smith to assist the Town of Marion relative to its WWTF discharge permit. Data was collected under the Massachusetts Estuaries Project (MEP) QAPP by the Coastal Systems Program (CSP), University of Massachusetts-Dartmouth, School for Marine Science and Technology (SMAST).

The field data collection program was part of the SCUBA diver survey for sediment collection and the survey of benthic animal communities.survey. The survey results are "point" surveys, with the divers covering about a 5 meter diameter area. Observations were recorded in the field when the diver's surfaced. Eelgrass presence/absence was recorded along with the relative density (sparse, medium, high density) and whether epiphytes were present and if the blades were intact, senescing, etc. What follows is a synthesis of these observations. The stations were determined by GPS.

Marsh Associated Sites (AC11 thru AC16): No eelgrass was observed in either survey. This is consistent with MEP observations of the lack of eelgrass habitat associated with salt marsh creeks. For depth reasons, there was not a station between the marsh edge and Haskell Island. However, the proximity of the marsh and lack of eelgrass at AC16, AC12 and AC11 suggest that this is not likely eelgrass habitat. Direct evidence is not available.

Inner Aucoot Cove Sites (AC4 thru AC10, AC17): Most of the eelgrass habitat in Aucoot Cove was found in the main open water basin outside of Haskell Island generally at depths <4 meters with Secchi depths of 3 meters. The exception was AC4 which due to circulation has eelgrass at 5.1 meters and a 5.1 meter Secchi depth.
AC4 – moderate patches of low density eelgrass
AC10 – Eelgrass, rock attached macroalgae
AC9 - dense eelgrass with high coverage (60%-70%)

AC5 & 6 – large area of dense eelgrass
AC7 - large area of dense eelgrass
AC8 - large area of dense eelgrass
AC17 – In marina channel, no eelgrass

Outer Aucoot Cove Sites (AC1 thru AC3): No eelgrass was found in the outer basin and water depths were 6.1 meters. The lack of eelgrass may result from the deeper waters and Secchi depths of 2.1 – 2.5 meters.

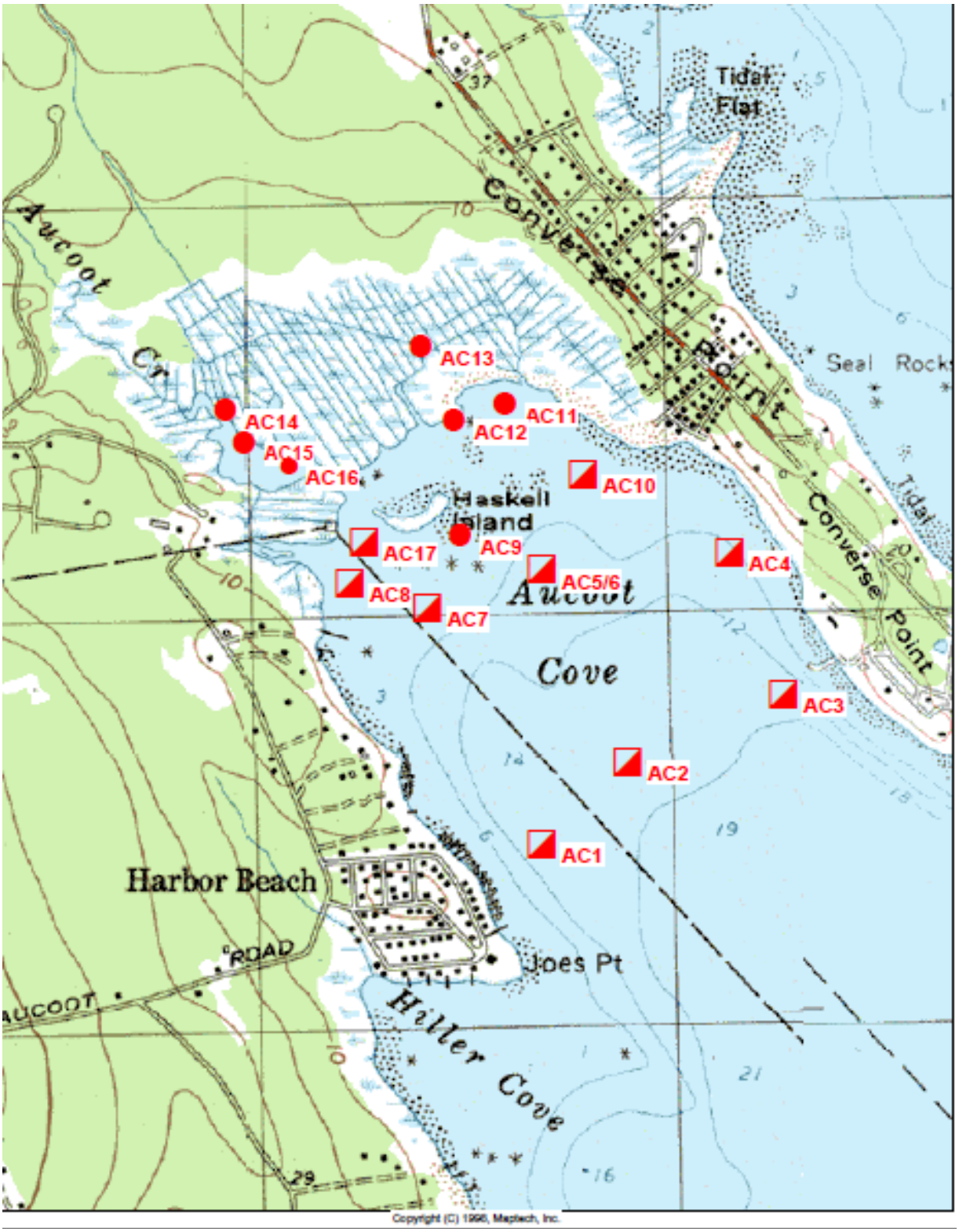
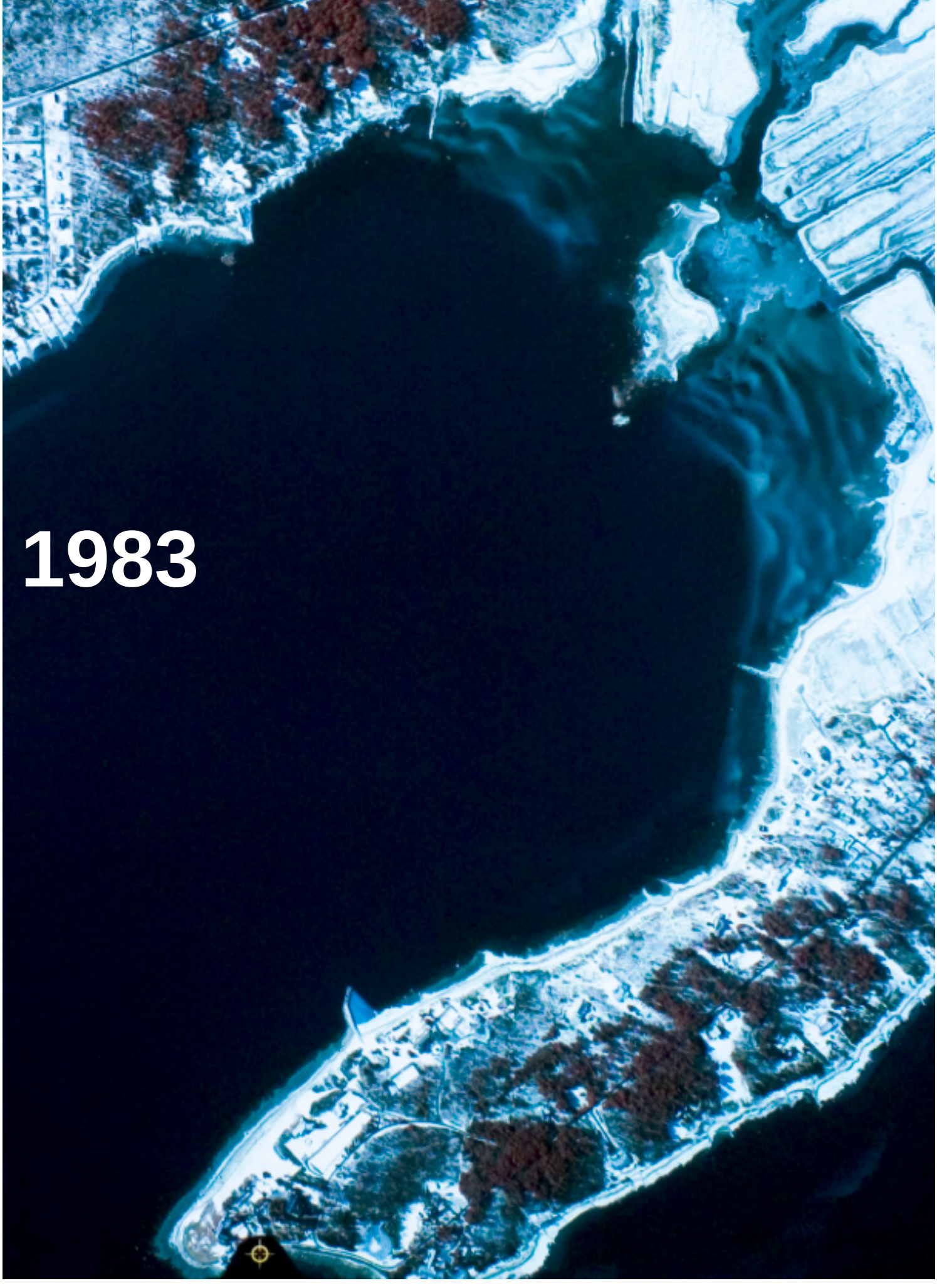


Figure 1. Aucoot Cove sampling locations for sediment survey (all points) and benthic animal survey (boxes) by CSP-SMAST scientists in July and November 2003, respectively.

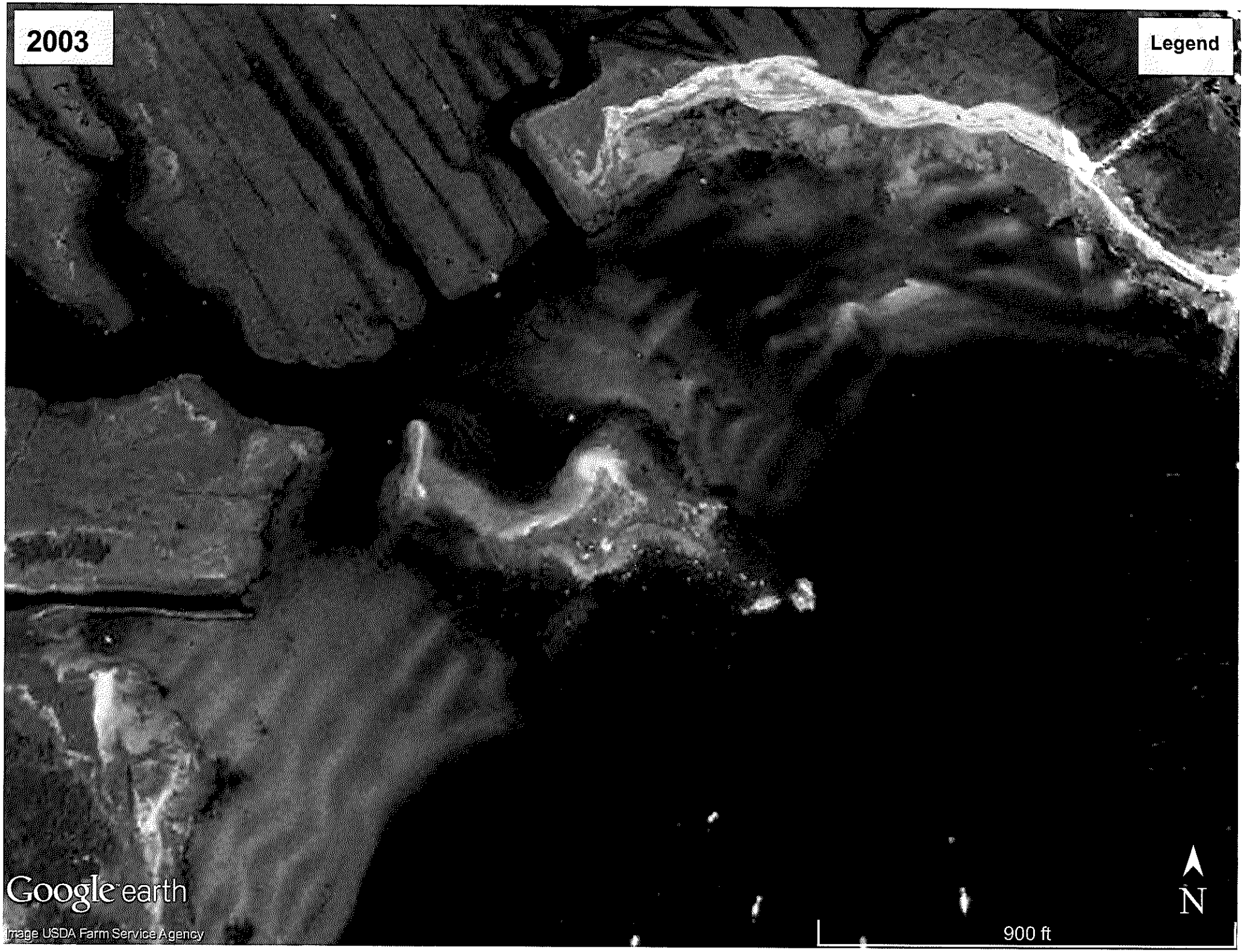

1960


1977

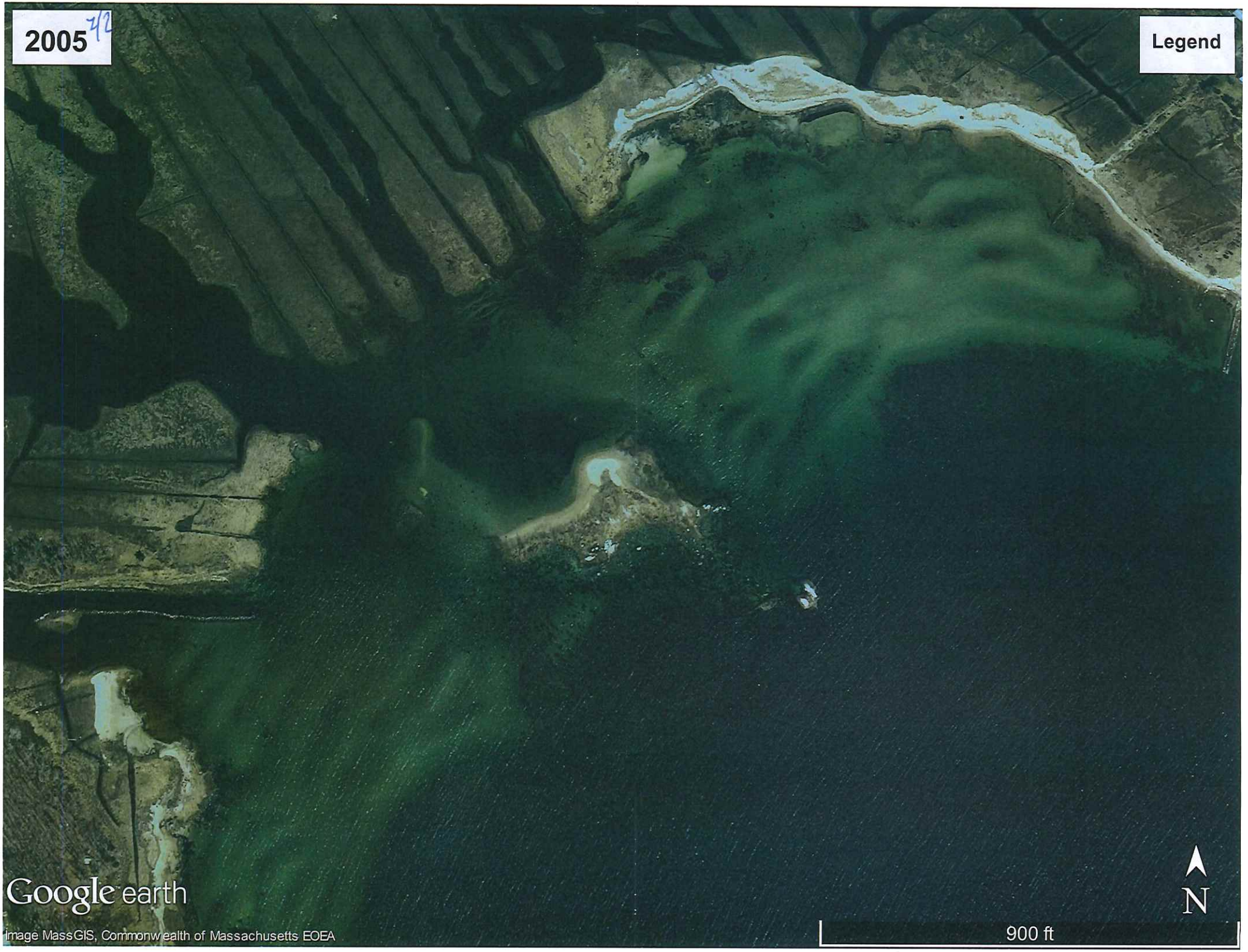

1983


1995
Legend
Google earth
Image MassGIS, Commonwealth of Massachusetts EOEA
N
900 ft

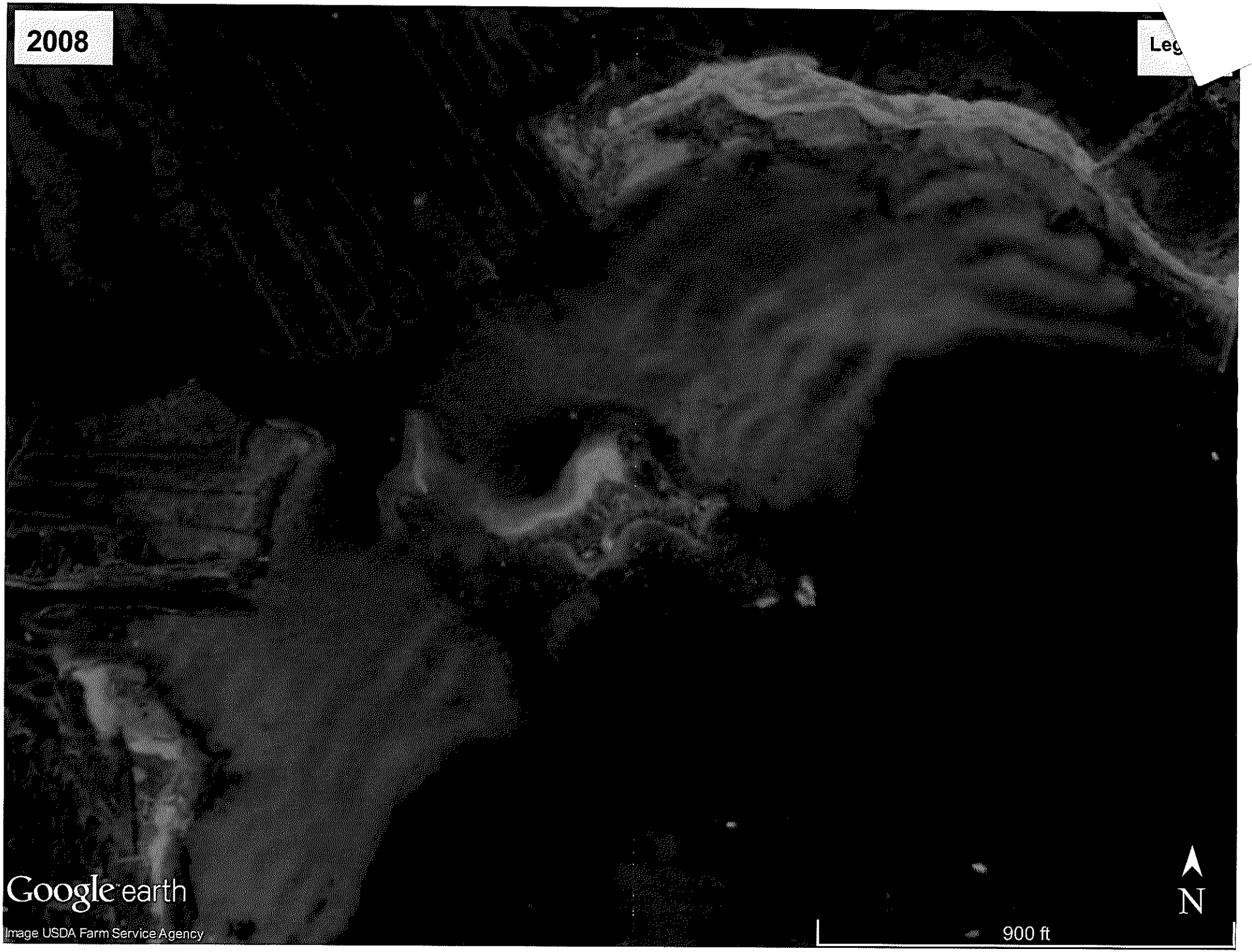

2001
Legend
Google earth
Image MassGIS, Commonwealth of Massachusetts EOEA
N
900 ft


2003
Legend
Google earth
Image USDA Farm Service Agency
N
900 ft

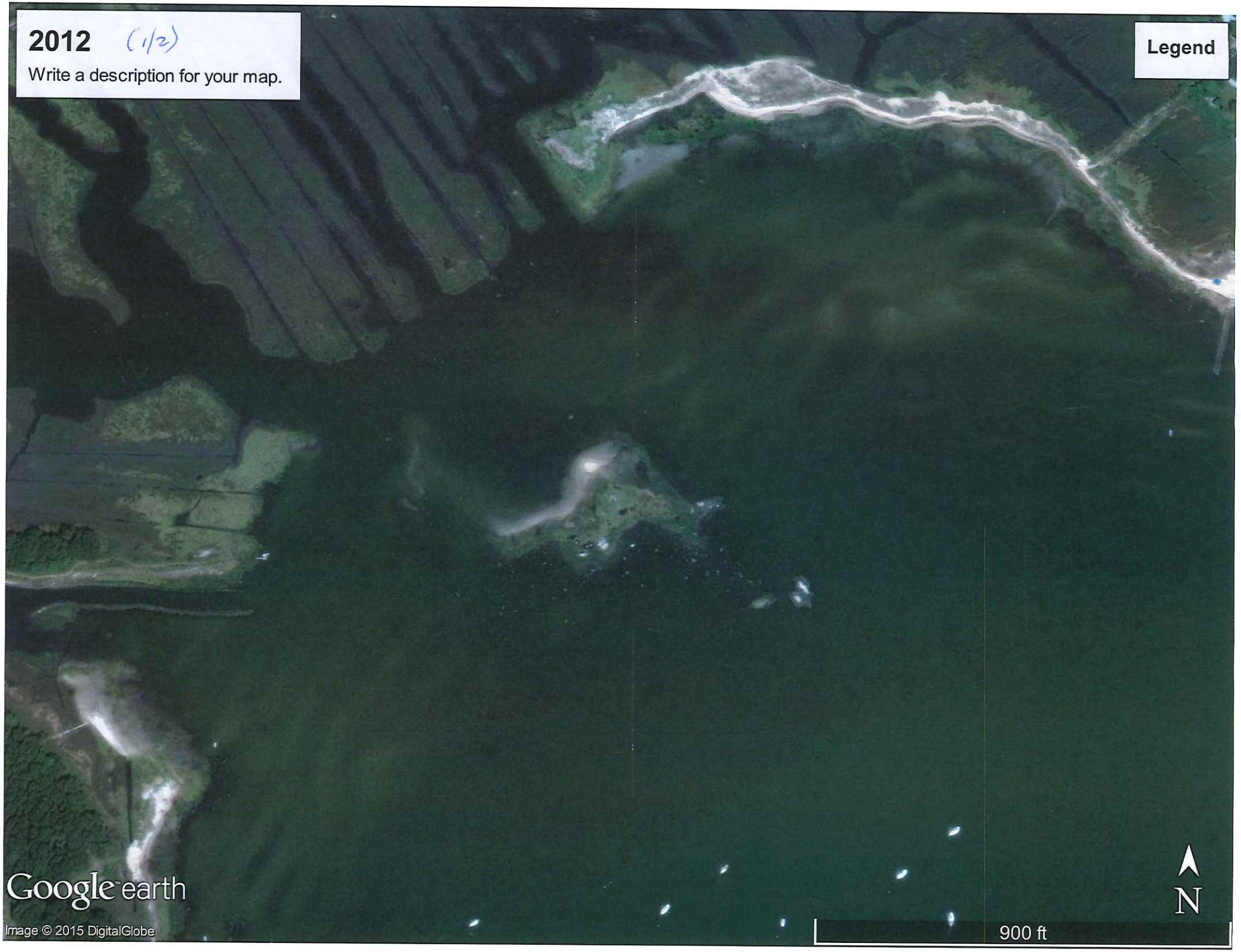

2005 1/2
Legend
Google earth
Image © 2015 DigitalGlobe
N
900 ft

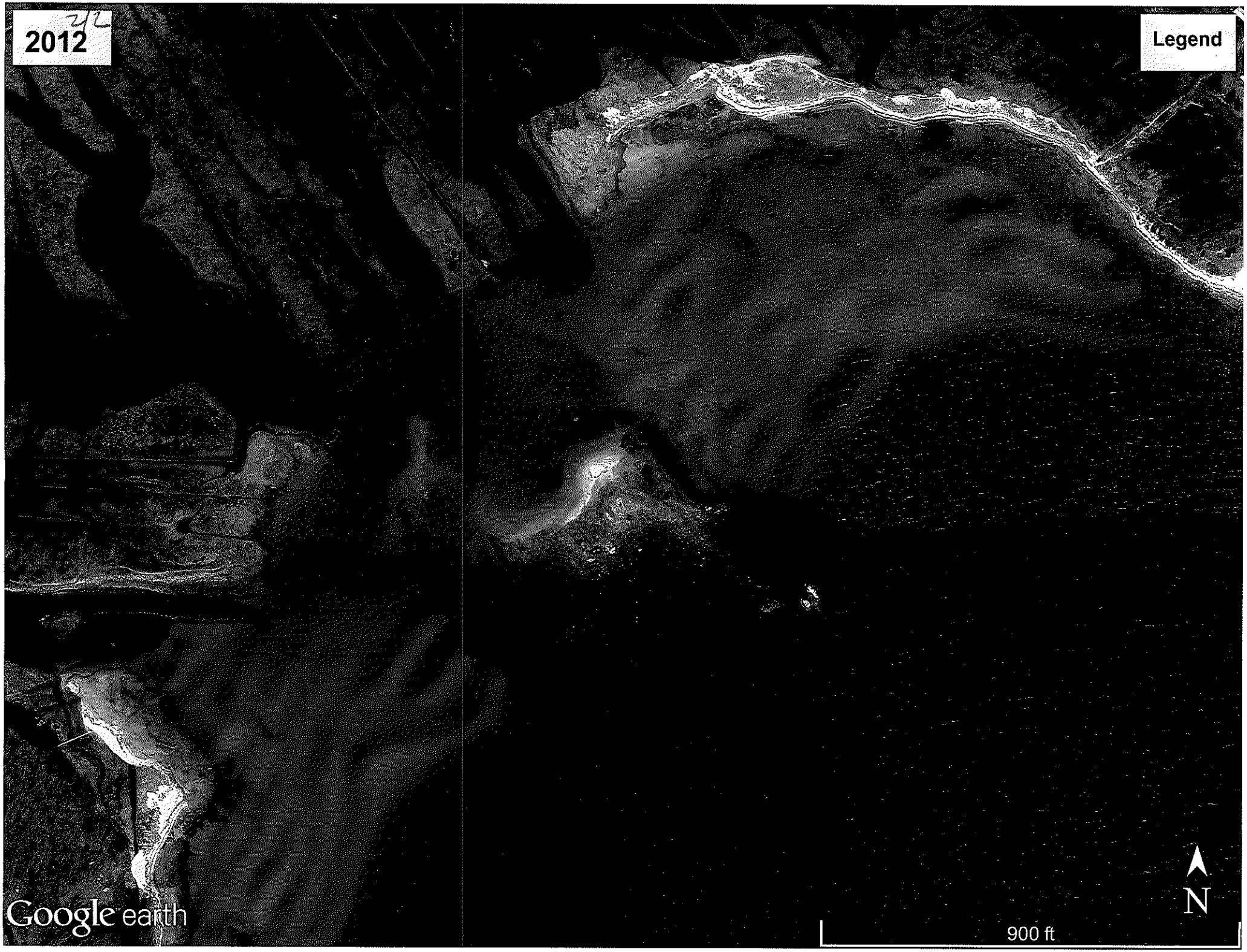

2005 4/2
Legend
Google earth
image MassGIS, Commonwealth of Massachusetts EOEA
N
900 ft

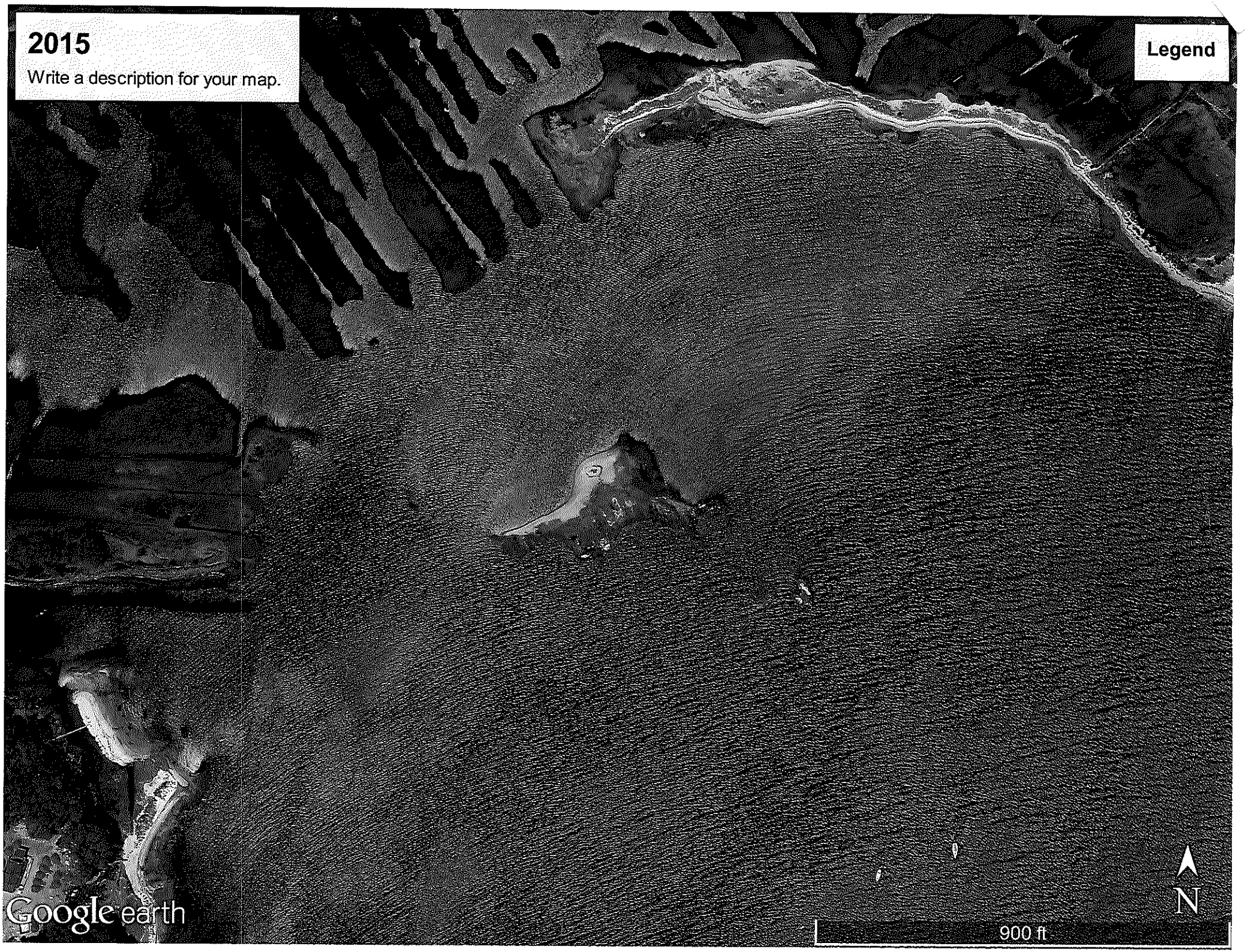

2007
Legend
Google earth
N
900 ft


2008
Leg
Google earth
Image USDA Farm Service Agency
N
900 ft


2010
Legend
Google earth
Image USDA Farm Service Agency
N
900 ft


2012 (1/2)
Write a description for your map.
Legend
Google earth
Image © 2015 DigitalGlobe
N
900 ft


2012
Legend
Google earth
N
900 ft


2015
Write a description for your map.
Legend
Google earth
900 ft
N