PUBLIC NOTICE

US Army Corps
of Engineers ®
New England District

696 Virginia Road
Concord, MA 01742-2751

Date: August 20, 2013
Comment Period Ends: September 19, 2013
File Number: NAE-2008-1703
In Reply Refer To: Ruth M. Ladd
Or by e-mail: ruth.m.ladd@usace.army.mil

The District Engineer of the New England District, Corps of Engineers ("Corps") has received a prospectus dated August 1, 2013 for an amendment to the Maine Umbrella Mitigation Banking Instrument ("MUMBI") with a specific project site from the Maine Department of Transportation ("MaineDOT"). The site is **Sherman Marsh in Newcastle, Maine** (**N44° 0.550' W69° 35.533'**). The Corps is soliciting comments on the prospectus.

SPONSOR: MaineDOT, State House Station 16, Augusta, ME 04333-0016

ACTIVITY: MaineDOT seeks to include the restoration of Sherman Marsh in the MUMBI. This restoration involves the removal of the remains of a former dam and stabilization of the stream channel beneath Route 1 and would continue in accordance with the proposal outlined in the attached prospectus entitled **"Maine Department of Transportation Sherman Marsh Site Prospectus, August 1, 2013."**

The MUMBI was approved and signed on August 19, 2011. It can be viewed through the Regulatory In-lieu Fee and Bank Information Tracking System ("RIBITS") at http://geo.usace.army.mil/ribits/index.html. Select "State of Maine" in the lower left and then click on "Banks & ILF Sites" on the left side. Search for "MaineDOT-Sears Island."

The process for review of the prospectus and subsequent steps, if appropriate, will follow 33 CFR 332, Compensatory Mitigation for Losses of Aquatic Resources ("Mitigation Rule"). The Mitigation Rule was published in the Federal Register on April 10, 2008.

The Sherman Marsh bank deposit could provide an alternative to permittee-responsible mitigation for unavoidable impacts authorized under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899, if it is deemed appropriate during the review process for proposed impacts.

If the prospectus is deemed sufficient, MaineDOT will be informed that they can draft an amendment to the MUMBI which will be reviewed by the Interagency Review Team. If the instrument is deemed acceptable, it will be signed by MaineDOT and the Corps. The decision whether to authorize the sponsor to proceed to drafting a banking instrument will be based on the District Engineer's determination of the potential of the proposed bank to provide compensatory mitigation for activities authorized by Department of the Army permits.

The Corps of Engineers is soliciting comments from the public; Federal, state, and local agencies and officials; Indian Tribes; and other interested parties in order to consider and evaluate the effects of this proposal. Any comments received will be considered by the Corps of Engineers to determine whether to allow the sponsor to

proceed to develop a draft banking instrument. Comments are also used to determine the need for a public hearing.

SECTION 106 COORDINATION: Based on his initial review, the District Engineer has determined that the proposal outlined in the MaineDOT prospectus has no potential to cause effects upon properties with cultural or Native American significance, or listed in, or eligible for listing in, the National Register of Historic Places. Therefore, no further consideration of the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended, is necessary.

ENDANGERED SPECIES CONSULTATION: The New England District, Army Corps of Engineers has reviewed the list of species protected under the Endangered Species Act of 1973, as amended, which might occur at the project site. The National Marines Fisheries Service has determined that Marsh River most likely supports federally endangered shortnose sturgeon. It is our determination that the proposal outlined in the MaineDOT prospectus is not likely to adversely affect any federally listed endangered or threatened species or their designated critical habitat. Further consultation with the Service regarding this determination will be concluded prior to the final decision.

ESSENTIAL FISH HABITAT: The Marsh River provides Essential Fish Habitat ("EFH"). The proposal outlined in the MaineDOT prospectus is not expected to impact Essential Fish Habitat ("EFH"). Further consultation with the National Marine Fisheries Service regarding this determination will be concluded prior to the final decision.

In order to properly evaluate the Sherman Marsh prospectus, we are seeking public comment. Anyone wishing to comment is encouraged to do so. **Comments should be submitted in writing by September 19, 2013 (letter or email).** If you have any questions, please contact Ruth M. Ladd at (978) 318-8818, (800) 343-4789 or (800) 362-4367, if calling from within Massachusetts.

Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider the application. Requests for a public hearing shall specifically state the reasons for holding a public hearing. The Corps holds public hearings for the purpose of obtaining public comments when that is the best means for understanding a wide variety of concerns from a diverse segment of the public.

The initial determinations made herein will be reviewed in light of facts submitted in response to this notice.

All comments will be considered a matter of public record. Copies of letters of objection will be forwarded to the applicant who will normally be requested to contact objectors directly in an effort to reach an understanding.

For more information on the New England District Corps of Engineers programs, visit our website at http://www.nae.usace.army.mil.

THIS NOTICE IS <u>NOT</u> AN AUTHORIZATION TO DO ANY WORK NOR DOES THE BANK, IF APPROVED, PREJUDGE FUTURE DEVELOPMENT PROJECTS WITHIN THE SERVICE AREA.

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Date: 2013.08.14 14:45:44 -04'00'

Jennifer L. McCarthy
Chief, Regulatory Division

If you would prefer not to continue receiving Public Notices, please contact Ms. Tina Chaisson at (978) 318-8058 or e-mail her at bettina.m.chaisson@usace.army.mil. You may also check here ( ) and return this portion of the Public Notice to: Bettina Chaisson, Regulatory Division, U.S. Army Corps of Engineers, 696 Virginia Road, Concord, MA 01742-2751.

NAME: _____

ADDRESS: _____

Maine Department of Transportation

Sherman Marsh Site Prospectus

for deposit in the

State-Wide

MaineDOT Aquatic Resource Umbrella Mitigation Bank

August 1, 2013

Sponsor:

Maine Department of Transportation

Commenting Federal Agency:

Federal Highway Administration, Maine Division

Interagency Review Team:

U.S. Army Corps of Engineers

U.S. Environmental Protection Agency

U.S. Fish and Wildlife Service

National Marine Fisheries Service

Maine Land Use Regulation Commission

Maine Department of Environmental Protection

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The Maine Umbrella Bank and Sherman Marsh Deposit

The Maine Department of Transportation Umbrella Mitigation Banking Instrument (MUMBI) was developed by MaineDOT (Sponsor), reviewed and approved by the Interagency Review Team (IRT), and signed on August 19, 2011. The MUMBI governs the establishment, use, operation, and maintenance of the Umbrella Bank. The MUMBI also sets the framework by which individual mitigation sites (Bank Sites) will be addended to this MUMBI as they are identified, and by which the IRT for each Bank Site will review Site Specific Mitigation Plans and MUMBI Addenda. It is the intent of this agreement to enable the parties to eliminate redundancy in administration and focus review and resources on technical issues related to the development, implementation, and success of Site Specific Mitigation Plans for each Bank Site addended to the MUMBI.

The Sherman Marsh restoration site will constitute the second site deposit in the banking instrument. This Prospectus outlines the site specific framework for the Sherman Marsh site. Once this Prospectus is approved by the IRT, the Sponsor will develop a banking instrument for the Sherman Marsh site for deposit in the MUMBI. (See **Table 1:** Summary Table)

Table 1: Summary Table for the Sherman Marsh Bank Site.

Ownership	Maine Department of Transportation
Type of Bank	Single Client
Purpose of Bank	Mitigation of natural resource impacts associated with state transportation projects
Location	Newcastle
Driving Directions	From Brunswick, take Route 1 east approx. 22.5 miles to the Sherman Marsh Rest Area. Just prior to the rest area, turn right onto gravel road that accesses state boat launch below the Rte 1 bridge.
Land Use	Private property is mixed residential and grazing farmland. Public property is by permission of Maine Inland Fish & Wildlife and the Damarascotta River Assoc. and is used primarily for recreation.

Size of Parcel	222 acres
Wetland Area	Approximately 212 acres
Type of Wetlands on Site	Riverine tidal streambed, Estuarine intertidal, Upland buffer
Site Description	Sherman Marsh is a large salt marsh within the Sheepscot River watershed in the Midcoast area.
Mitigation Bank Goals & Objectives	Initially the restoration and preservation of a high value salt marsh; Overall goals and objectives include more effective statewide mitigation opportunities.
Service Area	Central Interior and Midcoast Subsection Biophysical Region (See Appendix B – Biophysical Region Map)

Mitigation bank sites are usually selected based upon the needs identified in a watershed assessment. In the State of Maine there have been only two watershed plans developed for major drainages, that being the Sunday River and the Casco Bay Estuary. All other drainage studies have concentrated on small, urban-impaired tributaries in larger watersheds across the state. Under the Comprehensive Planning Framework (CPF) for the Maine Natural Resource Conservation Program (MNRCP), there is identified bioregion conservation objectives listed based on current and future land use projections. The CPF for the Central Interior and Midcoast Biophysical Region is included in **Appendix G**. Given the lack of specific watershed data for the Sheepscot River, the department has reached out to federal and state resource agencies to identify watershed needs based upon local land use practices, field observations and local knowledge. Here are a couple quotes from agency letters of support for the Sherman Marsh restoration. Steward Fefer, USFWS Gulf of Maine Coastal Program, wrote in a letter to MaineDOT dated December 8, 2005, stated "Restoring Marsh River will increase what is currently a limited habitat type in the Gulf of Maine, for coastal and estuarine invertebrates and migratory fish species, such as rainbow smelt, American eel, menhaden, and herring. This habitat would benefit trust resources, including black ducks and other migratory waterfowl, shorebirds and wading birds. The Sheepscot River is one of the eight listed rivers in the Gulf of Maine distinct population segment for Atlantic salmon. Restoring coastal riverine and salt marsh habitat helps to improve native species associated with those habitats, and supports ongoing restoration efforts for Atlantic salmon." A Joint Statement Regarding the Sherman Lake Dam Breach by the Maine Department of Marine Resources and the Department of Inland Fisheries and Wildlife dated December 13, 2005, stated "Both the Department of Marine Resources and the Department of Inland Fisheries and Wildlife support the restoration of tidal salt marsh at Sherman Lake in Newcastle. This restoration of the former freshwater lake offers the opportunity to restore over 200 acres of native salt marsh to the Midcoast region, providing improved habitat for wading and migratory birds, marine fishes, and bivalves. The anticipated outcome of tidal restoration is to re-gain the high value salt marsh habitat that existed prior to dam construction. This restoration also offers opportunity to enhance habitat for marine species that are commercially important to local

and regional economies, as salt marshes provide nursery grounds for finfish and other important species.

Sherman Marsh is located along the southern branch of the Marsh River in Newcastle, Maine. The Marsh River is a tributary to the Sheepscot River, which empties into the Gulf of Maine. The Sheepscot River stretches 58 miles from Montville to Southport, and drains an area of about 364 square miles. The Sheepscot River watershed contains over 40 lakes and ponds, including Sheepscot Lake and Long Pond, and over 530 miles of streams. The West Branch of the Sheepscot River is approximately 15 miles long with Branch Pond at its headwaters. From the Head Tide dam in Alna down to Wiscasset, the river is a five-mile long estuary with extensive mud flats and salt marshes[1] (see **Appendix B** – Sheepscot River Watershed).

The Sheepscot River is designated as an Outstanding River Segment (12 MRSA Section 402 and 38 MRSA Section 480-P), and one of eight Maine rivers included in the Distinct Population Segment (DPS) for the endangered Atlantic salmon. This fish was placed on the Endangered Species List in 2000. It is unlikely that salmon spar use the marsh as nursery habitat. While the marsh itself is not great salmon habitat it may be used by 'cover species' of Atlantic salmon. One of the major parts of the listing and a critical habitat primary constituent element are cover species that relieve predation pressure on migrating salmon. Short nosed sturgeon are likely present in the river and were listed as endangered in 1967. Shortnose and Atlantic sturgeon are known to use the estuary of the Sheepscot River and to use habitats and substrates that are present in the tidal marsh. (*Distribution and Abundance of Shortnose and Atlantic Sturgeon in Kennebec River Estuary, Thomas Squires, Maine Department of Marine Resources, 1979*) The marsh restoration increases potential foraging areas for both Atlantic salmon and sturgeon species.

The Casco Bay Estuary Partnership has worked extensively in the Casco Bay Watershed identifying and restoring vital watershed connections and concentrating on the importance of connectivity that supports the biodiversity of organisms in this marine ecosystem. This Sherman Marsh effort mirrors this type of work in the Sheepscot River Watershed.

Sherman Marsh is located in the rapidly developing mid-coast section of the state. Sandwiched between Wiscasset and Rockland, this area of the state has seen extreme development pressures over the last twenty years in both coastal and inland areas because of high amenity values, water access and rural living with service communities like Brunswick and Portland. The Marsh is located in the Central Interior and Midcoast Subsection Biophysical Region (see **Appendix C** – Biophysical Region Map). Despite continuing development pressure, the watershed still exists for now as largely forested, with rural towns dispersed throughout. Estimates on forest cover range between 60% and 76%, with approximately 19% of the land area in agricultural use.

[1] Maine Rivers. Website at www.mainerivers.org, July 18, 2005

Residential development is rapidly increasing in the watershed, especially along waterways. In the towns represented in the watershed that include Alna, China, Jefferson, Newcastle, Palermo, Somerville, Whitefield and Windsor the population growth over the decade between 1990 and 2000 averaged 3.5 times the growth rate for the state.

Site Selection Criteria

The following site selection criteria identified in the MUMBI were used to identify mitigation sites in the Central Interior and Midcoast Subsection.

- High need for protected land in the mid coast area in general and the Sheepscot River Watershed specifically due to rapid and uncontrolled coastal development;
- Connection of mitigation parcel to protected lands held by a stewardship organization in the interest of maintaining and preserving habitat connectivity;
- Excellent potential for wetland restoration, enhancement and preservation of a rare Maine ecotype on the mitigation site;
- Mitigation site is located in a Maine Natural Areas Program focus area and has high or unique natural resource value;
- Site is located within a watershed where bank credit is difficult to find or in high demand;
- Site is of interest to a local land stewardship entity;
- Ease of acquisition, construction, affordability, achieving success, and ability to satisfy regulatory bank requirements make mitigation site feasible;
- Site provides a wide selection of wetland types and related functions and values; and
- Local support from municipalities, residents and abutters.

Site selection criteria will be explored in the following narratives, which will explain how the Sherman Marsh site successfully meets the requirements of these site selection objectives.

Sherman Marsh Introduction

In 1934, the Sponsor constructed an earthen dam along with a bridge span across the southern branch of the river at the US Route 1 crossing. The use of an earthen dam approach was a typical method of bridge construction over a wide channel during the early 20th century. As a result, the impounded freshwater created a 222.3 acre pond, ranging from 1.9' – 3.9'deep except in former creek channels, which were as deep as 15.7'. These conditions supported freshwater aquatic plants and animals. The earthen dam and bridge became obsolete when the Sponsor built a modern bridge in the 1960's, but the dam remained below the new bridge, maintaining the artificial pond. This impounded water became a significant recreational resource for local and regional fishing and boating. The MDIF&W built a public boat launch at the base of the bridge for public access. A dam breach in October 2005 due to a heavy rain event drained the pond and reintroduced salt water tidal flushing to the lake area. MaineDOT was very concerned about the safety of the Route 1 bridge given the exposed bridge piers that were caused by the breach. An

emergency meeting was held with the regulatory agencies to discuss how the bridge would be repaired. Initially it was decided that the earthen dam would be rebuilt to stabilize the piers along with a spillway to control lake water levels, essentially replacing the old structure. After some discussion the MaineDOT Environmental Office (ENV) questioned whether the dam could be ruled as obsolete and tidal restoration opportunities explored for the lake bed. MaineDOT Bridge Engineers reviewed the bridge and exposed piers and worked with ENV to recommend stabilization measures that would allow for the restoration of the pre-1934 salt marsh. This discussion opened the way for the federal and state agencies to consider this marsh restoration project. Please see Table 3 - Portland and Marsh River Tidal Datums

MaineDOT conducted emergency repairs to the exposed piers while ENV and Bridge Design developed a long-term fix. These design plans included permanent repairs to the piers, widening and deepening of the existing channel and creating a new adjacent channel to restore tidal flow into the marsh and remove the tidal restriction created by the dam breach. In the fall of 2008 the Sponsor completed the reconstruction of the marsh inlet under Route 1 with the intent of active salt marsh restoration, allowing tidal flow to approximate that of the downstream Marsh River. In particular, these modifications have restored a near normal tidal signal to the marsh such that the 2009 growing season was the first season in which the high marsh was regularly flooded.

The variety of estuarine wetland types and functions and the riparian zone intermixing with the wetland complexes provides a richness unique to a salt marsh community. The site has a riparian habitat abutting the estuarine intertidal shoreline that supports 29 species of marine fauna, while the estuarine unconsolidated shoreline consisting of soft substrate areas support 114 species, including mollusks, bivalves, and marine worms. Subtidal areas in the channels are colonized primarily by mussel beds and red algae, with occasional occurrences of kelp and sea urchins. The south end of the marsh is designated as habitat for Least Bittern, a ranked State Endangered species. The Maine Natural Areas Program (MNAP) maps the area as brackish tidal marsh which is ranked S3 or rare in Maine. Sherman Marsh is in the MNAP Lower Sheepscot River Focus Area.

Sherman Marsh Salinity Overview

Salinity (specific conductance) data were collected at various times in 2008, 2009, and 2010 using the Solinst LTC data logger. A brief summary is given here; a more detailed discussion on salinity is provided in Appendix F. The location of Sherman Marsh with respect to the open sea and the Sheepscot River estuary is critical to understanding the marsh salinity regime. The marsh is effectively the headwater of the Marsh River, which subsequently discharges into the Sheepscot River far upstream from the mouth in the Gulf of Maine. The source of saline water for the marsh is at the junction of the Marsh and Sheepscot Rivers. Salinity at this point is greatly influenced by freshwater discharge of the Sheepscot. Maximum salinity in seawater is on the order of 35 ppt; maximum salinity at the Sheepscot-Marsh junction can be significantly less.

Freshwater dilution of Marsh River salinity from Sheepscot River flows (and to a lesser extent, from Sherman Marsh watershed runoff) manifests itself in two way: from sustained "normal high" flows in late winter and early spring, and from individual rainfall runoff events from early spring through late fall/early winter. Spring salinities increase in a fairly regular and predictable manner, whereas summer salinity is much more variable due to the superposition of random major runoff events on otherwise low summer base flows.

Salinity patterns from early spring through early summer are fairly regular. Over the month of April, salinities show a regular increase from 2.5 – 5 ppt, up between 10 – 15 ppt by months end. This corresponds to the recession curve of the Sheepscot River spring runoff hydrograph. Through summer and early fall, salinity continues to increase. The highest salinities correspond to the longest periods of little or no rain, reaching peak values as high as 30 ppt. Major runoff events can almost instantaneously and temporarily reduce salinities to 5 ppt, after which they again recover. During salinity recovery periods between major runoff events, average high tide salinity (when the marsh would be flooded) during these periods can range from 15 ppt to 25 ppt.

Hydrology Overview

Tidal data have been collected at Sherman Marsh every summer, starting with 2006. Most years, the efforts have also encompassed spring and fall. Locations always included the "Lower Marsh" (just upstream of the US1 bridge) and the "Marsh River" (downstream of the bridge). "Mid" and "Upper" Marsh locations were also observed during several of the years; however, they added little in the way of useful additional information. Similar to the salinity data collection, the Lower Marsh tidal stage data capture the marsh tidal regime, while the Marsh River data represent the hydrologic driving force as well as the "natural" tidal regime that would presumably prevail in a completely open marsh.

Sherman Marsh is the uppermost marsh on the Marsh River, a tributary to the tidal Sheepscot River. Marsh River joins the Sheepscot just below head of tide. Thus, Sherman Marsh is significantly removed from the direct Gulf of Maine tides and is strongly influenced by freshwater discharge from the Sheepscot River as well from the Sherman Marsh watershed.
In this overview, three tidal data sources are utilized. The Portland tide station is the primary (or "control") station for secondary stations in the midcoast area, so Portland data are presented as reference and are utilized to estimate long-term tidal datums at the marsh. See "Computational Techniques for Tidal Datums Handbook" (NOAA Special Publications NOS CO-OPS 2, September 2003) for definiations and methods of analysis used in this report. The 2006 data are presented because they best represent the tidal regime created by the temporary emergency stabilization after the October 2005 dam failure. Data from 2010 are presented because they are the most consistent data set that captures the tidal regime created by the permanent stabilization and improvement constructed in winter 2008/2009.

Tidal Datums

Table 2 shows the tidal datums for the 1983 – 2001 tidal epoch for Portland (NOAA Tides and Currents / Bench Marks web page) as well as the corresponding datums estimated for Marsh River using the Modified Range Ratio Method (Computational Techniques for Tidal Datums Handbook, NOAA Special Publication NOS CO-OPS 2, September 2003). All elevations reported here are with reference to NAVD88. Typical marsh surface elevations are in the range 5.25-ft to 5.75-ft (Laura Jones, USM Thesis, 2007, Figure 3, p. 44) with lower elevations along the channel banks. The data period 3 July – 2 October 2010 was used to estimate the Marsh River long-term values, because this was a relatively dry period and Marsh River tides were not excessively influenced by Sheepscot River flows. The corresponding datum values for the data period are shown in Table 3; Table 3 also includes calculations for the lower marsh. All values in Table 3 were calculated for the period 3 July – 2 October 2010 from the individual data sources. The long term tidal datums were not transferred to the Lower Marsh station because the falling stage is still limited by a hard control elevation also displays a residual drainage recession curve behavior. However, as discussed below, the post-restoration long-term high and higher tide datums in the marsh are essentially identical for the downstream Marsh River datums, since the tidal restriction has been eliminated.

Table 2: Portland and Marsh River Tidal Datums (ft NAVD) for 1983-2001 epoch

Datum (1983-2001 epoch)	**Portland**	**Marsh River (est)**
Highest observed water level	8.869 (2Jul78)	--
Mean Higher High Water	4.651	5.31
Mean High Water	4.215	4.90
Mean Sea Level	-0.315	
Mean Tide Level	-0.348	-0.23
Mean Low Water	-4.907	-5.36
Mean Lower Low Water	-5.251	-5.86
Lowest Observed Water Level	-8.705 (30Nov55)	--
Marsh Surface	5.25’ – 5.75’ and lower along banks	

Table 3: Portland and Marsh River Tidal Datums (ft NAVD) for 3 July – 2 October 2010

Datum (3 July – 2 Oct 2010)	Portland	Marsh River	Lower Marsh
Highest observed water level	6.84 (9 Sep)	7.34 (9 Sep)	7.23 (9 Sep)
Mean Higher High Water	5.02	5.67	5.61
Mean High Water	4.52	5.21	5.15
Mean Sea Level			
Mean Tide Level	0.00	0.12	0.76
Mean Low Water	-4.52	-4.92	-3.58
Mean Lower Low Water	-4.67	-5.27	--
Lowest Observed Water Level	-6.46 (11 Aug)	-6.48 (10 Sep)	-3.78 (8 Aug)
Marsh Surface	5.25' – 5.75' and lower along banks		

Sherman Marsh Tides and Implications for Marsh Restoration

The purpose of collecting tidal data is several-fold. Initially, the goal was simply to develop a general understanding of tides in the newly reopened marsh. This goal was quickly refined to that of determining whether the new tidal regime was sufficient to maintain a healthy marsh. Figure 1 shows a sample trace from July 2006 spring tide data (red = Portland, + = marsh River, blue = Lower Marsh). The flow and drainage restriction between the Marsh and Marsh River is obvious. Head losses between the two bodies of water are on the order of 1-ft and the effective control elevation is about 2.5-ft. This severely limits drainage of the marsh on the outgoing tide. The Marsh falling limb is nothing like a sinusoidal falling tidal stage; rather, it exhibits all the traits of classic reservoir drainage. These results pointed the way towards design of a permanent stabilization and improvement of the Marsh outlet that make the marsh tides more nearly like those in the Marsh River just downstream. The final design was a combination of a significant enlargement of the opening as well as lowering of the outlet control elevation.

Figure 1: Sample Tide Trace, July 2006 – Spring Tide

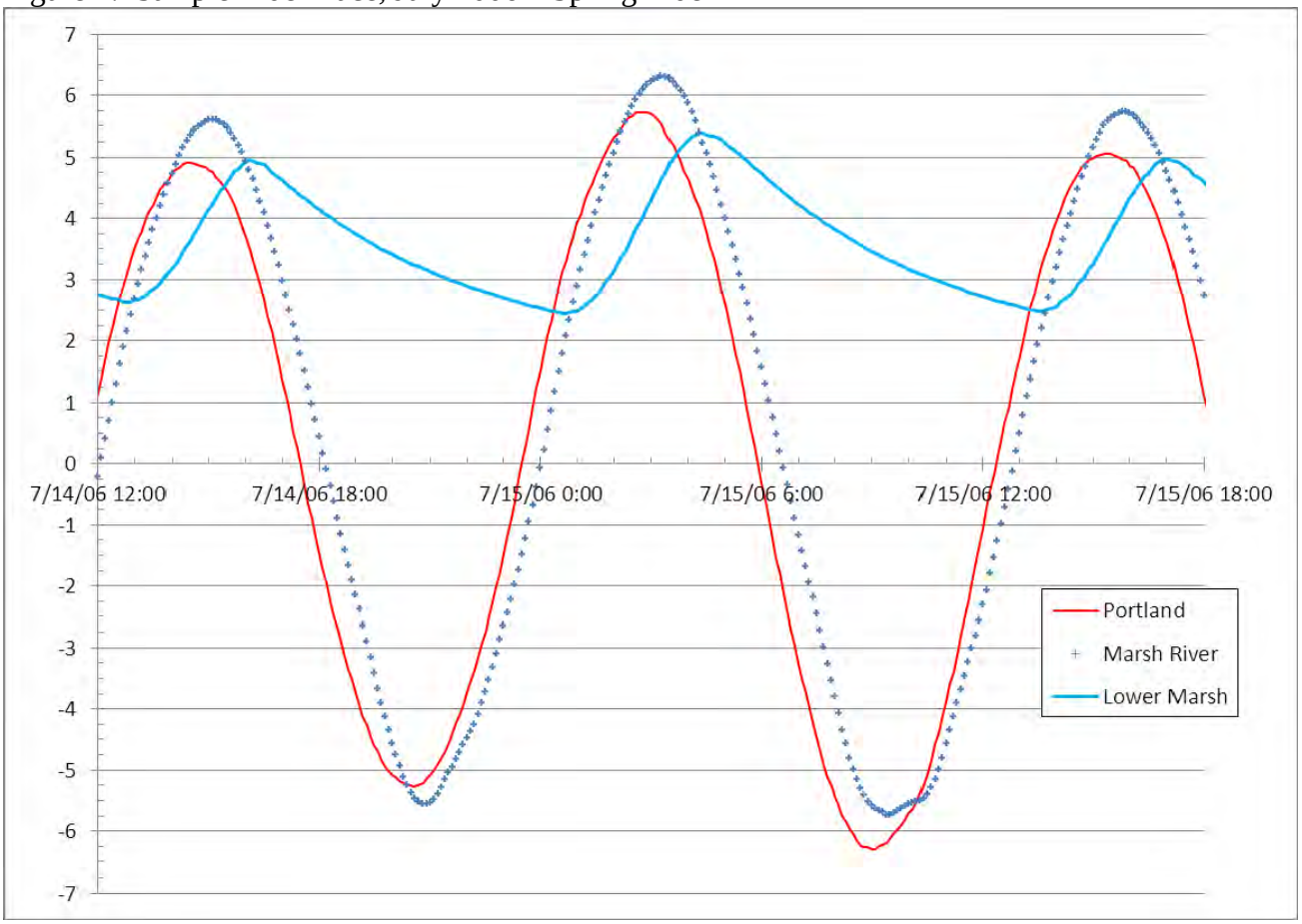


Figure 2a shows a sample data trace from lower high tides (though somewhat greater than neap) in September 2010, showing the dramatic effects of the stabilization and improvement work of winter 2008/2009. This data segment was chosen because the high tide value (about 5') corresponds to the lower limit of marsh surface elevation. The head loss through the bridge has been largely eliminated and the effective control elevation has been lowered by about 5.5-ft, greatly improving marsh drainage. Figure 2b shows the September 2010 spring tide. The tidal elevation restriction has essentially been eliminated for all tide elevations greater than -3' NAVD88.

Figure 2a: Sample Tide Trace after Permanent Improvements – Lower High Tides, 9/2010

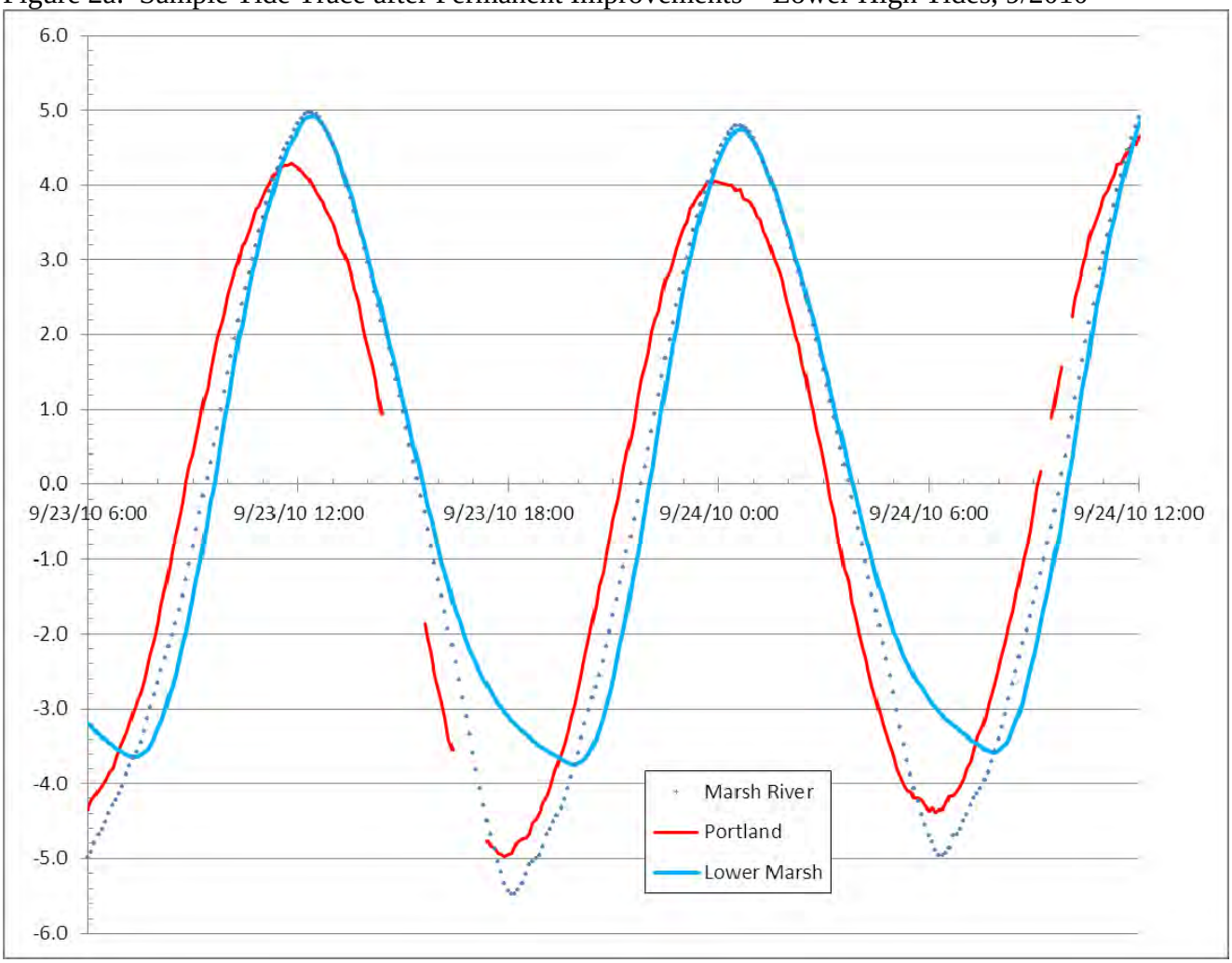
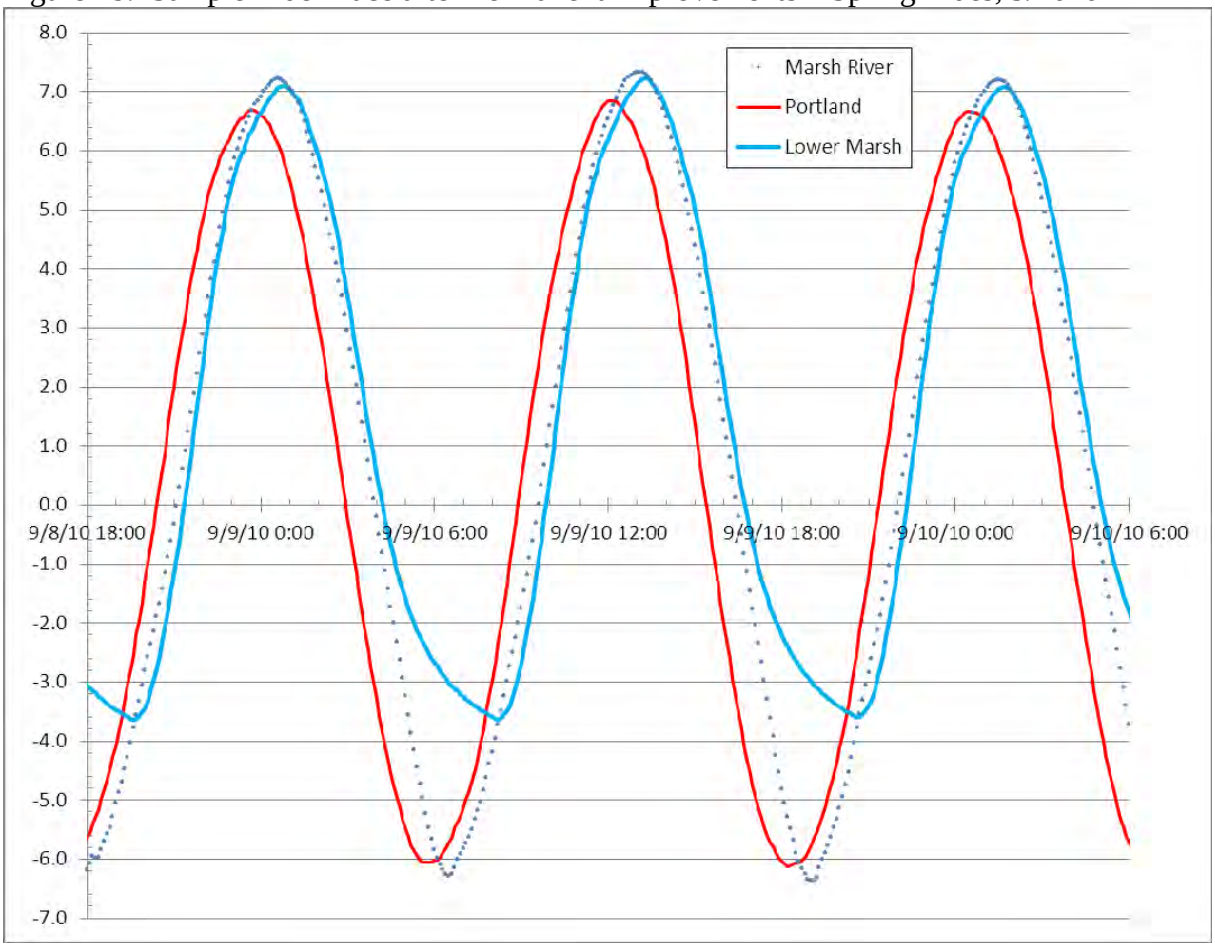


Figure 2b. Sample Tide Trace after Permanent Improvements – Spring Tides, 9/2010



Objective

The Sherman Marsh mitigation site is composed of a high and low salt marsh restoration site (222.3 acres) (see **Appendix A** – Sherman Marsh Aerial Photograph) in the Sheepscot River watershed in Newcastle. This bank site will provide mitigation credit for state transportation related projects in the Central Interior and Midcoast Subsection Biophysical Region.

This 222.3 acre site will be preserved through a series of conservation easements with the abutting land owners. The State of Maine through the Department of Inland Fisheries and Wildlife and the Damariscotta River Association own large abutting land tracks adjacent to the marsh (See **Appendix D** – Ownership Map). Two land trusts in the region (Damariscotta River Association and the Sheepscot Valley Conservation Association) have shown interest in holding these easements and adopting long-term stewardship once the site is deposited in the MUMBI. A riparian/upland buffer will be preserved that will be, on average, approximately 25'

in width on the privately owned land. This will run from the high water mark of the marsh to a point 9'- 0" in elevation above this point in the riparian/upland area surrounding the marsh. A wider buffer width will be recommended to the property owners and negotiated if owners are in agreement. The Sponsor will make every effort to acquire a minimum 100' buffer on all private property given projected sea level rise due to climate change. Once property acquisition is complete a map showing the areas of preservation will be included in the banking instrument.

The Sponsor is including in this section a discussion regarding the available credit at Sherman Marsh because this is directly tied to MaineDOT's objectives for the Sherman Marsh mitigation site. All of the 222.3 acres is composed of wetted area within the extreme high tide limit and a ribbon of intertidal shoreline surrounding this area. All of this area will be available for credit use except for the marsh channel footprint. See wetland type; acreage; functions and values; and proposed ratios and credit in **Table 4**.

Table 4: Wetland, Acreage, Functions and Proposed Credit Ratios, Type and Credit*

Wetland Type	Acreage	Functions & Values	Proposed Credit Ratio	Credit Type	Proposed Credit (acres)
Estuarine Intertidal Shoreline (marsh)	180.5	WH, AQ, SH	7:1	Enhancement	25.8*
Upland Buffer (riparian edge)	122.6	WH, SS	15:1	Preservation	1.5*

*As agreed upon at the U.S. Institute for Environmental Conflict Resolution facilitated meeting with the IRT and MaineDOT on July 2, 2013.

Determination of Credits

The Sponsor is proposing a credit balance for the Sherman Marsh deposit of 1.5 acres of preservation credit (using the Corps recommended 15:1 ratio for preservation) and 25.8 acres of enhancement credit (using the IRT recommended 7:1 ratio for restoration).

Long-Term Protection

The Sherman Marsh site will be held under a Conservation Easement with either the Sheepscot Valley Conservation Association (SVCA) or the Damariscotta River Association (DRA). The Maine Department of Environmental Protection (MDEP) will be named the third party enforcer.

See Long Term Management Section for details regarding management and long term sustainability of the resources. See Financial Assurance Section for funding mechanisms.

Service Area

The Sherman Marsh site is located in the Central Interior and Midcoast Subsection defined in the MNRCP Ecoregions Map (TNC 2011). The credit from this site may be used for projects requiring mitigation in this Subsection (See **Appendix C** – Biophysical Region Map).

Schedule

The restoration work on the channel inlet that restored the tidal flooding in Sherman Marsh to pre-Route 1 dam construction status was completed in winter 2008. Phragmites has been mapped in the entire marsh and experimental herbicide treatment began in fall 2008. Broad based treatment of all Phragmites patches was completed in fall 2009 and follow-up mapping and treatment is on-going. This work will continue until the Phragmites is eliminated and/or a sustainable management plan is adopted.

Performance Standards

The performance standards developed for this site focus on two areas: salinity and vegetation . All of the vegetation and salinity standards have been met over the last 5 years detailed in the post construction monitoring reports performed by the University of Southern Maine. The remaining vegetation performance standard is managing a less than 1% density of Phragmites australis growing on the marsh surface. The banking instrument will follow the Corps Mitigation Guidance on the development of monitoring process and procedures.

Pore-Water Salinity -

Pore water salinity wells are located along the vegetation transects in the ‘high marsh’, usually 2-3 per transect. Salinity wells are constructed of 35 cm length of 1.9 cm diameter (3/4”) CPVC pipe with holes located from 5 to 25 cm below the surface. The bottom of the well is taped with duct tape and the top capped with two 90 degree elbows to prevent rainwater intrusion but allow pressure equalization. Salinity is measured using a temperature-corrected refractometer during June, July and August.

Vegetative Surveys –

Permanent vegetation transects running perpendicular to the tidal creek located at random positions within 250 m stretch of the tidal creek are sampled. Transects begin at the low water mark and run to the uplands. Permanent vegetation plots are situated at 1, 3 and 15 m and every

15 m thereafter. Most permanent vegetation plots are marked with short PVC poles or bamboo stakes. Sampling is on 13 transects originating along the main tidal creek, 2 transects in the west arm, and 2 transects in the reference marsh just north of Route 1 and 3 transects at the terminus of the Marsh River (Guptile Marsh). Transect lengths range from 15 to 360 m for a total of 182 plots.

Phragmites Management -

Interim Control Evaluation:

In 2008 it was determined that there was an active population of Phragmites becoming established in the marsh and that the Sponsor would need to implement control measures (see **Appendix E** – Phragmites Map). A marsh wide survey was conducted to map Phragmites and 500+ patches were identified. In anticipation that a more extensive control program would be necessary in 2009, the Sponsor implemented a very limited *Phragmites* control effort using herbicide in the fall 2008. The purpose of this control effort was to evaluate different herbicide formulations and try out different application techniques to determine which would be most suitable for use as part of a larger scale effort anticipated for 2009. Two different application methods were used: Foliar wick/wipe-on and foliar backpack spray application. For the foliar wick/wipe-on technique, the herbicide was applied by hand using commercially available wick applicators, sponges and/or with cotton gloves (worn over rubber or nitrile gloves) sprayed with herbicide and rubbed over the stems and leaves. For the foliar backpack technique, *Phragmites* patches were sprayed applying herbicide with a low-flow nossil to foliage and stems and minimizing overspray onto adjacent marsh vegetation. The Sponsor tested each technique with two herbicide types. It was determined that a foliar backpack spray application using both herbicides would be implemented in fall 2009 with very good results. Follow-up applications in 2010 and 2011 have eliminated large monoculture patches of Phragmites leaving small, individual plants and some runners in need of control.

On-going Phragmites Surveillance and Treatment:

The Sponsor will conduct annual inspections and map Phragmites and other invasive species needing treatment. Any Phragmites or other invasive species identified and mapped will be sprayed using the recommended herbicide and backpack treatment of the Interim Control Evaluation. This management plan will continue until the Phragmites and/or other invasive species have been eliminated or a sustainable management plan is adopted for future control to meet the less than 1% density standard.

Phragmites Monitoring Plan

The monitoring plan for the vegetative transects and the pore-water salinity have ended with the meeting of these performance standards. Phragmites australis management will be on-going until the Phragmites and/or other invasive species have been eliminated or a sustainable management plan is adopted for future control. Annual reports for these performance standards will be developed outlining the data collected, analysis of the treatment and its affects, and an estimated density for Phragmites.

Phragmites Long Term Management

Sponsor will be responsible for the on-going management of the Phragmites until this species is eliminated or a sustainable management plan is adopted and implemented by the Sponsor. There will be a Conservation Easement held by the SVCO or the DRA who will take over future long term management for the entire parcel once the site is deposited in the MUMBI. It is the general intent of this Conservation Easement to assure that the Protected Property will be retained forever in its substantially undeveloped, open and natural condition, consistent with the terms of this Conservation Easement and to prevent any use of the Protected Property that will impair or interfere with these conditions. The Sponsor and SVCO or DRA intend that this Conservation Easement will limit, in perpetuity, the uses of the Protected Property to activities which are compatible with these purposes and the protection of wildlife habitat and preservation of its open space, natural values and its scenic character when viewed from the Public Vantage Points. The Sponsor will negotiate with the SVCO and/or DRA on long term management costs and provide an endowment if needed. The management plan will be reviewed and approved by the IRT.

Contingency and Remedial Plans

Contingency and remedial funding from the Biennial Transportation Improvement Plan is reserved in the Construction Engineering phase of this project. The contingency and remedial plan consists of the monitoring of the Phragmites australis in the marsh and the sustainable management of this species.

Financial Assurances

Sponsor has allocated $240,000 for FY 2013 – 2015 to cover all costs associated with the Sherman Marsh bank site and the current balance is $195,000. The Sponsor will appropriate funding on a biennial basis to meet the financial management and maintenance requirements of the site and appropriate negotiated endowment funding when long-term stewardship is assigned.

Maintenance Provision

Sponsor agrees to perform all necessary work in accordance with the provisions of the MUMBI and approved Site Specific Mitigation Plan/MUMBI Addenda, to establish and maintain the Sherman Marsh bank site until credits have been exhausted or banking activity

is voluntarily terminated with written notice by the Sponsor provided to the Corps and other members of the IRT. After all the bank credits are used, the maintenance responsibility of the Protected Property will be conveyed to the SVCA or DRA, herein after the long-term steward. See Long Term Management for the roles of the long-term steward.

Qualifications of Sponsor

MaineDOT has 27 years of experience conducting mitigation site searches, negotiating federal and state regulatory site selection, site acquisition, design and construction, post construction monitoring, site remediation, and long term management. The MaineDOT Field Services & Mitigation Division, who manages the mitigation program, oversees 109 sites statewide. The majority of these sites have received regulatory approval and signoff. These sites consist of wetland and riverine restoration, enhancement, creation and preservation and range in size between 1,200 s/f and 1751 acres. The Sponsor has recently been an active player in the formation of alternative mitigation strategies in New England. The Department successfully developed a Maine Umbrella Mitigation Banking Instrument (MUMBI), the first in the Northeast Region, and made the Sears Island Site the first deposit. The Sponsor initiated agency discussion regarding the development of an In Lieu Fee Program that accepted its first mitigation fee in 2008. The Sponsor actively participates with the resource agencies in new mitigation initiatives and understands the value of ingenuity and creative problem solving.

Sponsor and IRT Members

The following is a list of those involved in this wetland banking project:

Sponsor:
Maine Department of Transportation
Environmental Office
16 State House Station
Augusta, ME 04333
(207) 624-3100

IRT Members:

Corps:
Chief Regulatory Branch
U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751
(978)-318-8818

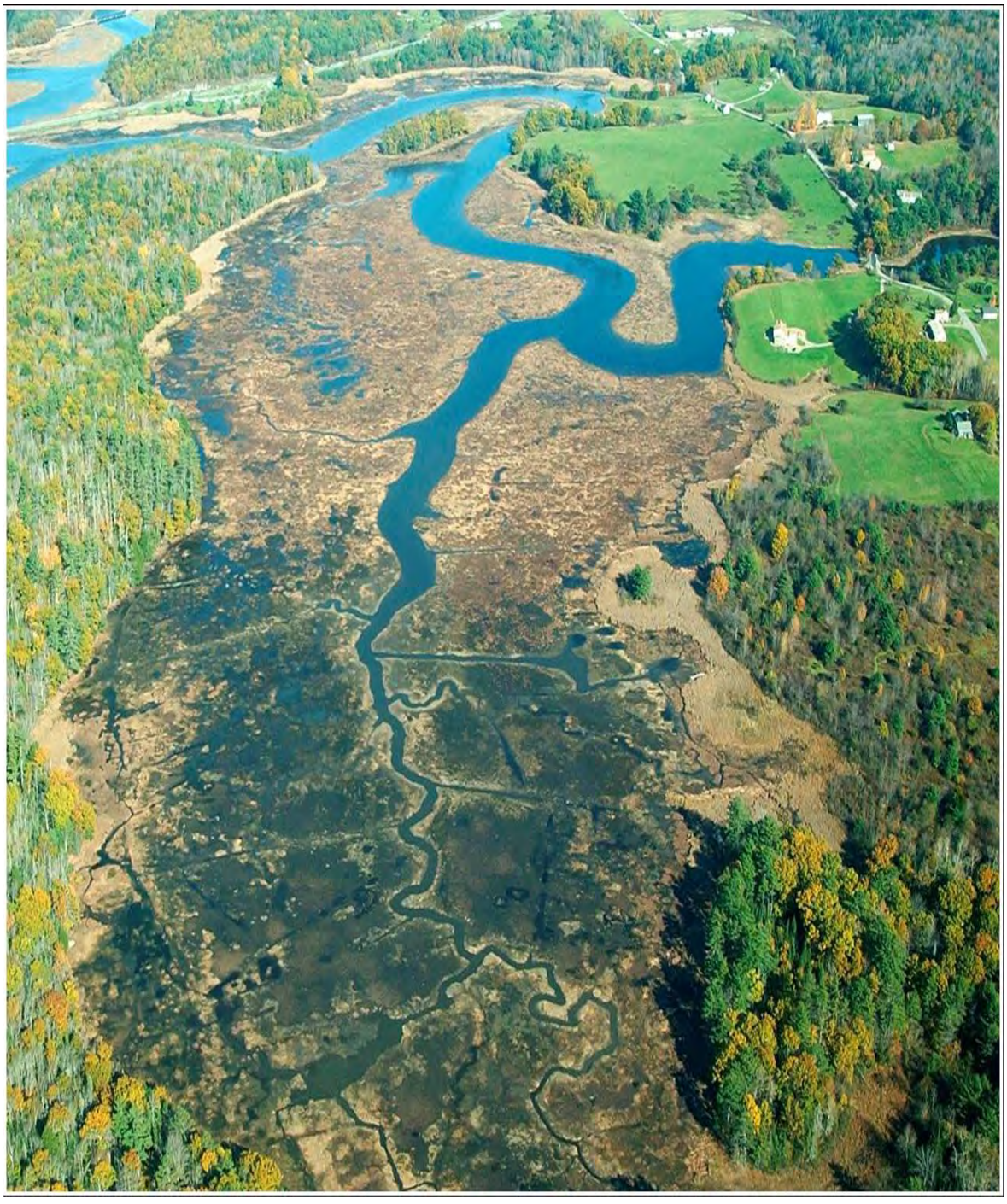
EPA:
Wetlands Regulatory Unit - Region I
U.S. Environmental Protection Agency
1 Congress Street
Boston, MA 02114-2023
(888) 372-7341

FWS:
U.S. Fish and Wildlife Service
1168 Main Street
Old Town, ME 04468
(207) 827-5938

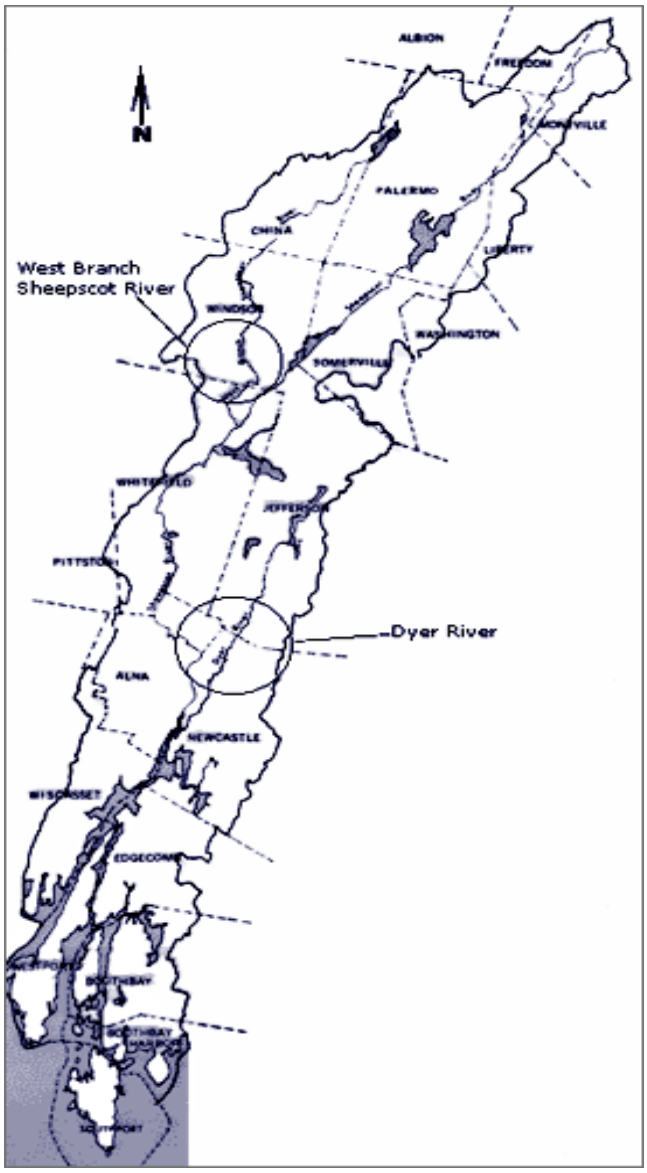
NMFS:
National Marine Fisheries Service
55 Great Republic Drive
Gloucester, MA 01930-2276
(978) 281-9300

MDEP:
Maine Department of Environmental Protection
Bureau of Land and Water Quality
17 State House Station
Augusta, ME 04333
(207) 287-7691

APPENDIX A
Sherman Marsh Aerial Photograph



APPENDIX B
Sheepscot River Watershed


N
ALBION
FREEDOM
PALERMO
CHINA
LIBERTY
West Branch
Sheepscot River
WINDSOR
WASHINGTON
SOMERVILLE
JEFFERSON
PITTSTON
Dyer River
ALNA
NEWCASTLE
WISCASSET
EDGECOMB
BOOTHBAY
SOUTHPORT

APPENDIX C
Biophysical Region Map


Maine Natural Resource Conservation Program Regions
Fort Kent
Allagash
Presque Isle
Northwest Maine
Eagle Lake Twp
Aroostook Hills & Lowlands
Houlton
Comstock Twp
Patten
Mount Katahdin Twp
Millinocket
Danforth
Jackman
Greenville
Central & Eastern Lowlands
Central & Western Mountains
Dover-Foxcroft
Grand Falls Twp
Princeton
Calais
Rangeley
Hartland
Bangor
Aurora
Downeast Maine
Whiting
Farmington
Cherryfield
Rumford
Ellsworth
Central Interior & Midcoast
Augusta
Rockland
Fryeburg
Brunswick
Gray
Southern Maine
Portland
Sanford
N
W
E
S
The Nature Conservancy
Protecting nature. Preserving life.™

APPENDIX D
Ownership Map

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

NEWCASTLE

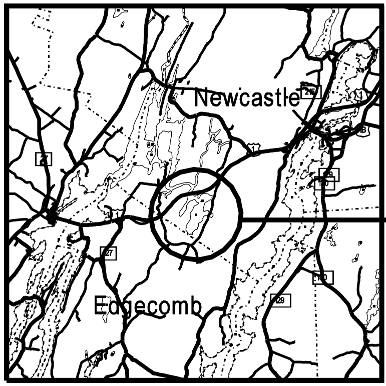
LINCOLN COUNTY

SHERMAN MARSH

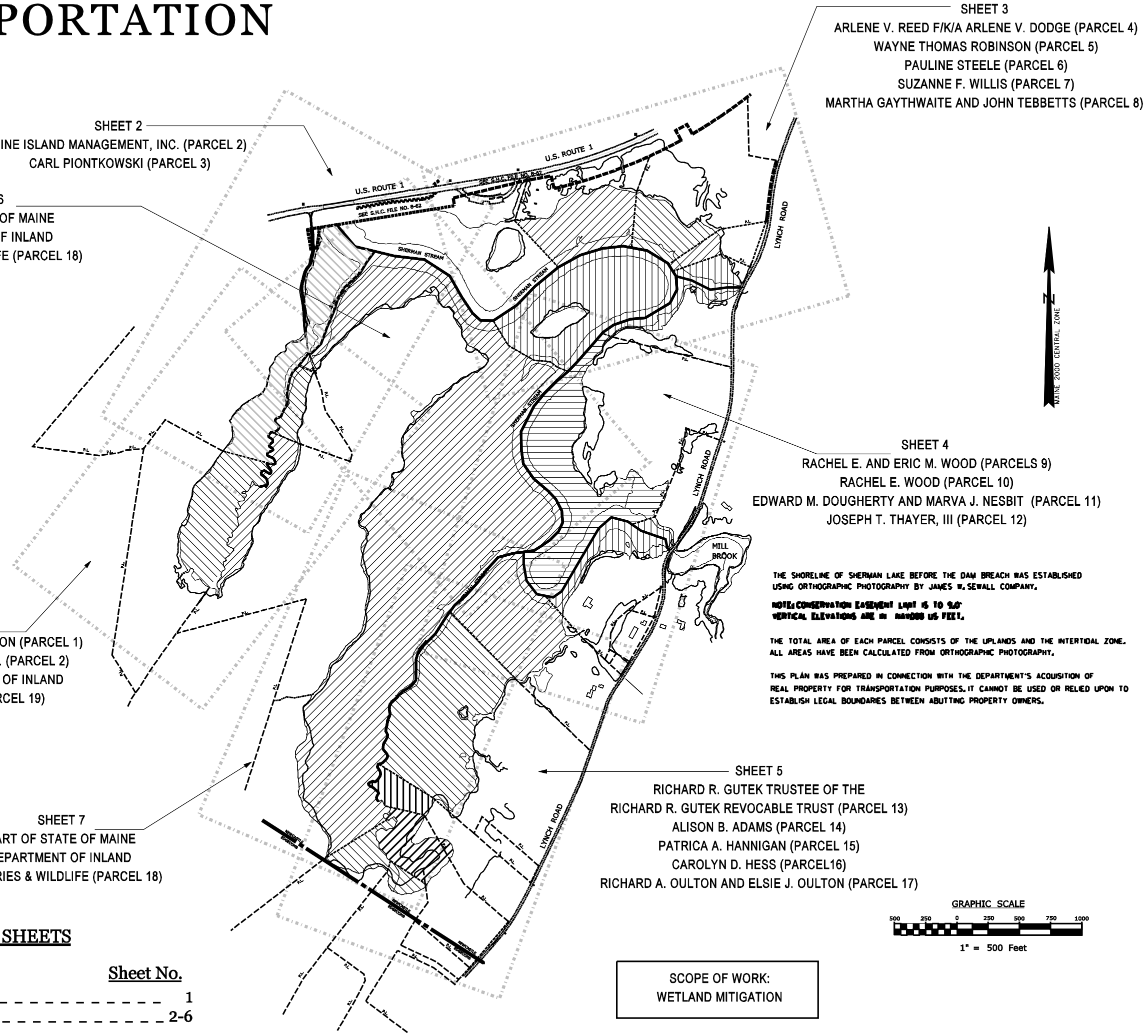
ROUTE 1 AND LYNCH ROADS

STATE PROJECT 17279.40

WETLAND MITIGATION



NOT TO SCALE



THE SHORELINE OF SHERMAN LAKE BEFORE THE DAM BREACH WAS ESTABLISHED USING ORTHOGRAPHIC PHOTOGRAPHY BY JAMES W. SEWALL COMPANY.

NOTE: CONSERVATION EASEMENT LIMIT IS TO 9.0' VERTICAL ELEVATIONS ARE IN NAVD88 US FEET.

THE TOTAL AREA OF EACH PARCEL CONSISTS OF THE UPLANDS AND THE INTERTIDAL ZONE. ALL AREAS HAVE BEEN CALCULATED FROM ORTHOGRAPHIC PHOTOGRAPHY.

THIS PLAN WAS PREPARED IN CONNECTION WITH THE DEPARTMENT'S ACQUISITION OF REAL PROPERTY FOR TRANSPORTATION PURPOSES. IT CANNOT BE USED OR RELIED UPON TO ESTABLISH LEGAL BOUNDARIES BETWEEN ABUTTING PROPERTY OWNERS.

SCOPE OF WORK:
WETLAND MITIGATION

INDEX OF SHEETS

(WORK DONE IN PIN 10243.00)
PIN 17279.40

SYMBOLS

- ◆ IP or ◆ IPF (IRON PIPE or PIN FOUND)
- S.T. (SEPTIC TANK)
- (ROW MONUMENT)
- (TRAVERSE POINT)
- WATER LINE
- GAS LINE
- ELECTRIC LINE
- TELEPHONE LINE
- SEWER LINE
- WELL (WELL)
- GRADING LIMIT LINE
- CONSTRUCTION LIMIT LINE
- PROPERTY LINE PL
- LIMITS OF WROUGHT PORTION (L.O.W.P.)
- EXISTING RIGHT OF WAY
- NEW RIGHT OF WAY
- NEW ROW WITHIN EXIST. ROW
- CONTROL OF ACCESS

ITEM	TECH	CHECKED
BASE MAP	M.A.D.	
EXIST. R/W	M.A.D.	
PROP. LINES	M.A.D.	
AREAS	M.A.D.	

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION - AUGUSTA, ME 04333-0016
NEWCASTLE
RIGHT OF WAY MAP

REVISIONS			
NO.	DATE	DESCRIPTION	BY

PLAN FILED IN PLAN BOOK		PAGE	COUNTY RECORD			
NO.	GRANTOR	INSTRUMENT	DATE	BOOK	PAGE	

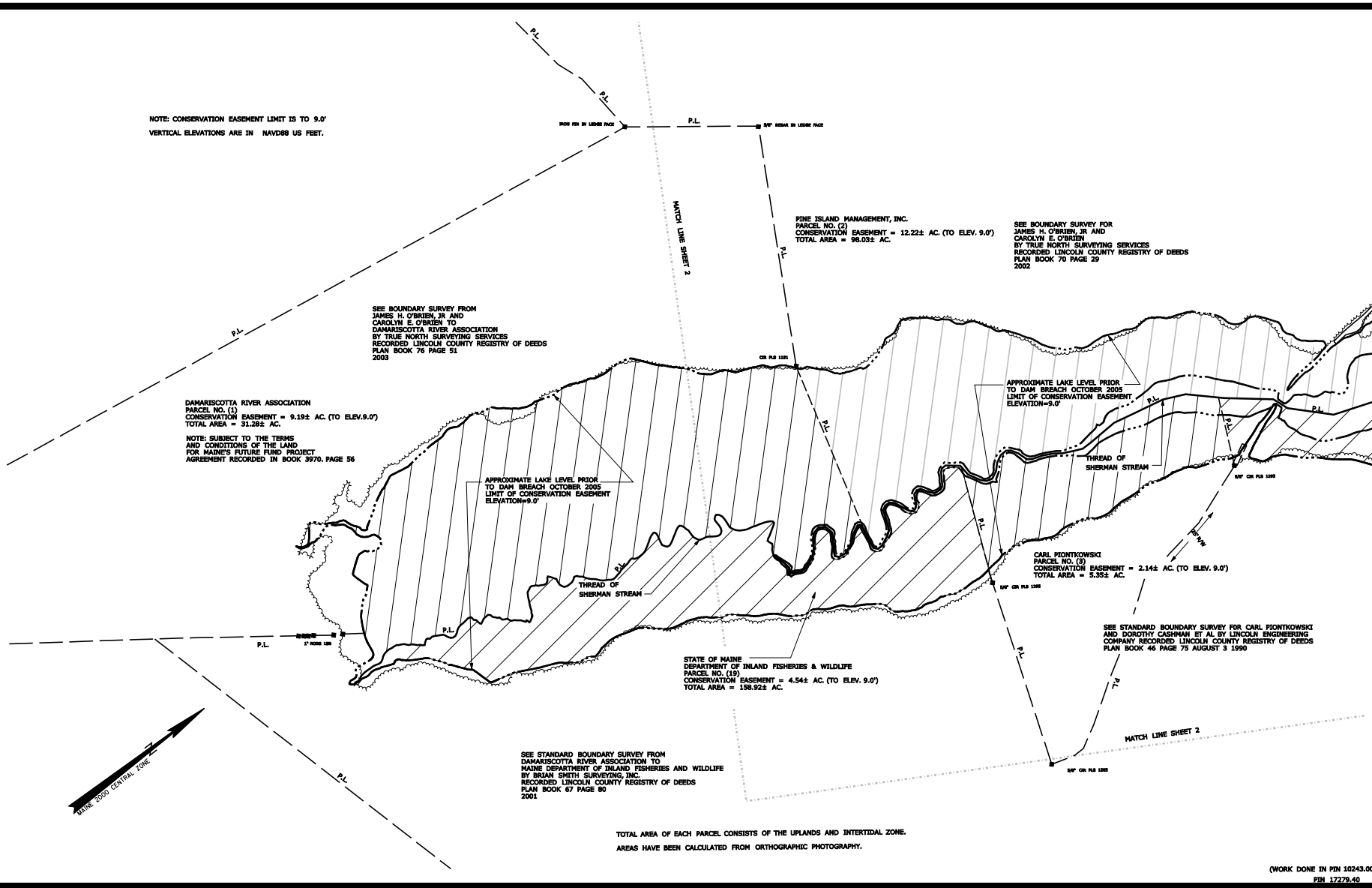
DAVID A. COLE
COMMISSIONER
KENNETH L. SWEENEY
CHIEF ENGINEER
DATE

SHERMAN MARSH MITIGATION

NEWCASTLE LINCOLN COUNTY
FEDERAL AID PROJECT NO. STP-1727(940)X

JANUARY 2010 | SCALE 1" = 500' | RIGHT-OF-WAY MAP INDEX SHEET | D.O.T. FILE NO. 8-168

SHEET NUMBER
1
OF 8



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KENNETH L. SWEENEY
CHIEF ENGINEER
DATE

SHERMAN MARSH MITIGATION

NEWCASTLE LINCOLN COUNTY
FEDERAL AID PROJECT NO. STP-1727(940)X

JANUARY 2010 | RIGHT-OF-WAY MAP | D.O.T. FILE NO. 8-168
SCALE 1"= 100' | SHEET 1 OF 7

SHEET NUMBER
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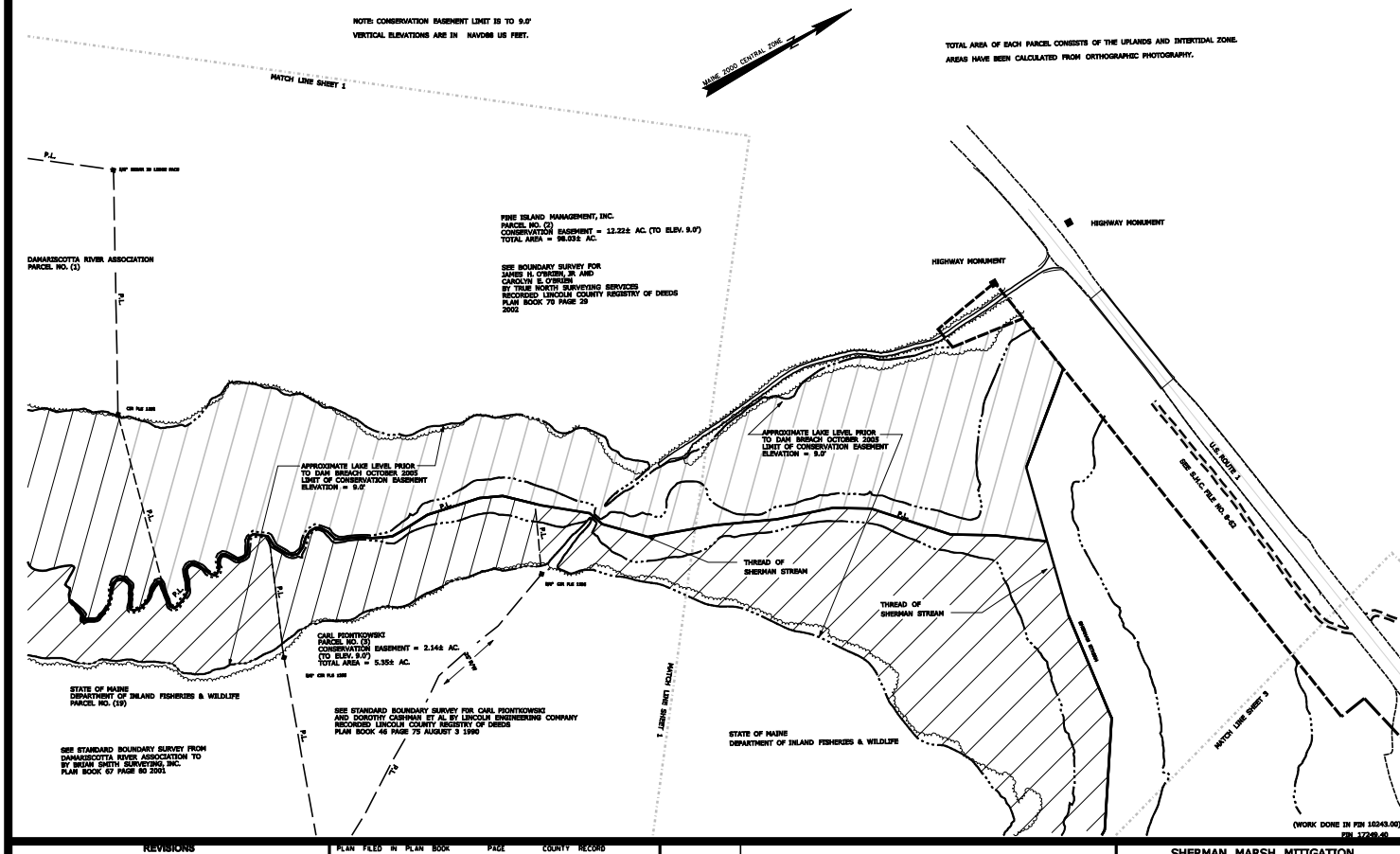
OF 8



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EXIST. R/W	M.A.D.	
PROP. LINES	M.A.D.	
AREAS	M.A.D.	

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION - AUGUSTA, ME 04333-0016
NEWCASTLE
RIGHT OF WAY MAP

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SHERMAN MARSH MITIGATION

NEWCASTLE LINCOLN COUNTY
FEDERAL AID PROJECT NO. STP-1727(940)X

JANUARY 2010 | RIGHT-OF-WAY MAP | D.O.T. FILE NO. 8-168
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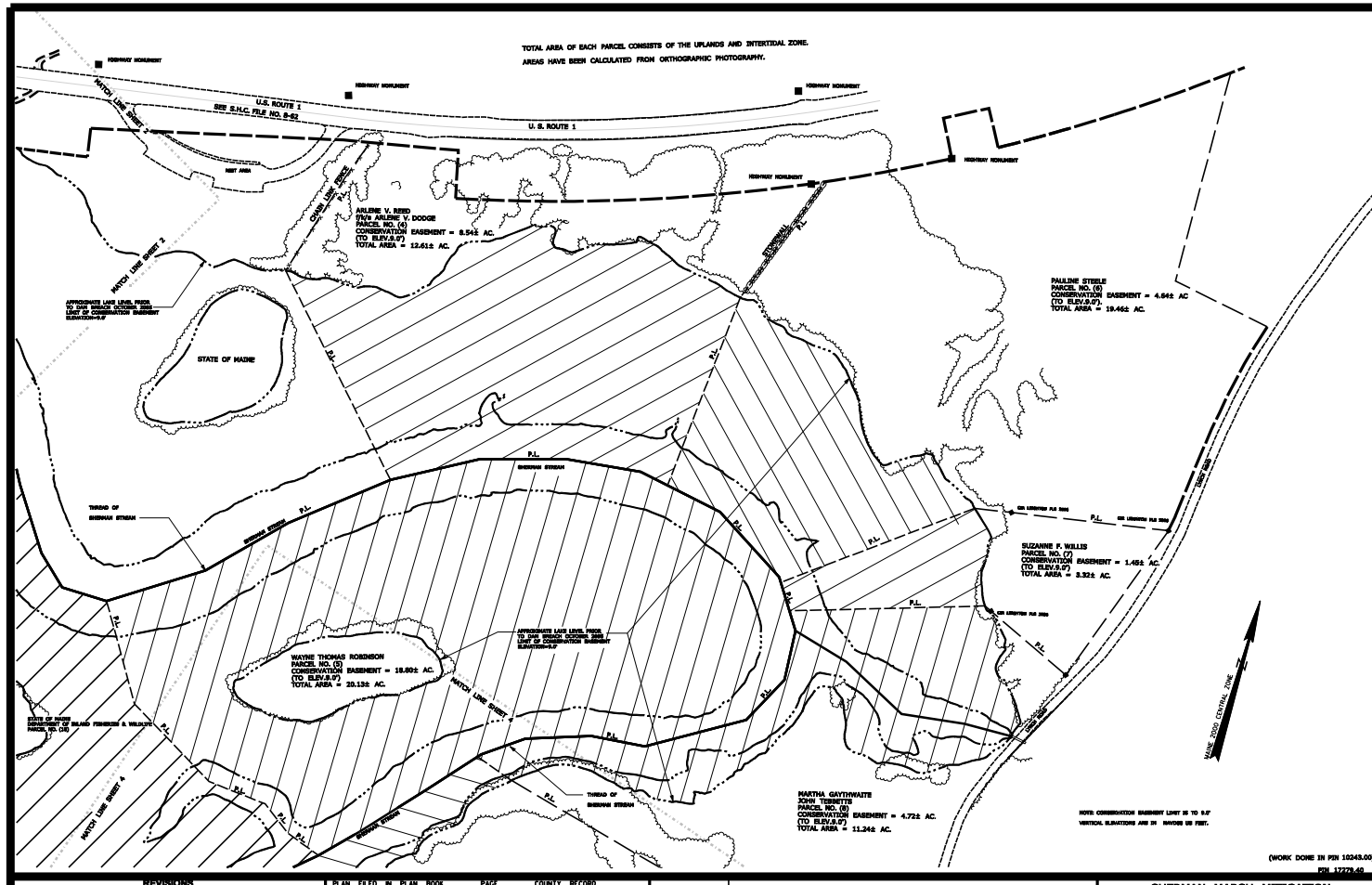
OF 8



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STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION - AUGUSTA, ME 04333-0016
NEWCASTLE
RIGHT OF WAY MAP

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PLAN NO.	FILED IN PLAN BOOK	PAGE	COUNTY RECORD		
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SHERMAN MARSH MITIGATION

NEWCASTLE LINCOLN COUNTY
FEDERAL AID PROJECT NO. STP-1727(940)X

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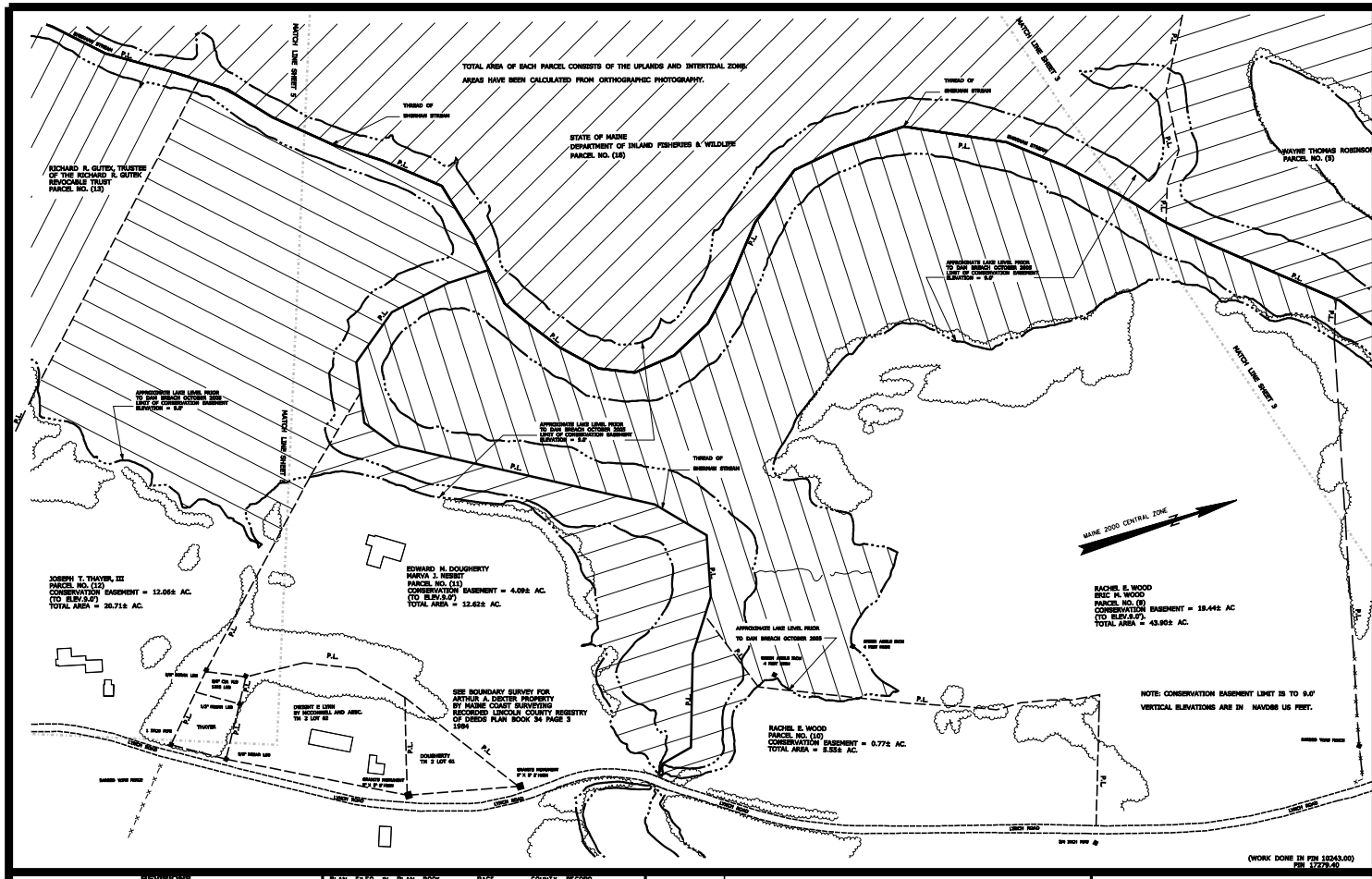

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PROP. LINES	M.A.D.	
AREAS	M.A.D.	

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION - AUGUSTA, ME 04333-0016
NEWCASTLE
RIGHT OF WAY MAP

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PLAN FILED IN PLAN BOOK NO.	PAGE	COUNTY RECORD GRANTOR	INSTRUMENT	DATE	BOOK	PAGE

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SHERMAN MARSH MITIGATION

NEWCASTLE LINCOLN COUNTY
FEDERAL AID PROJECT NO. STP-1727(940)X

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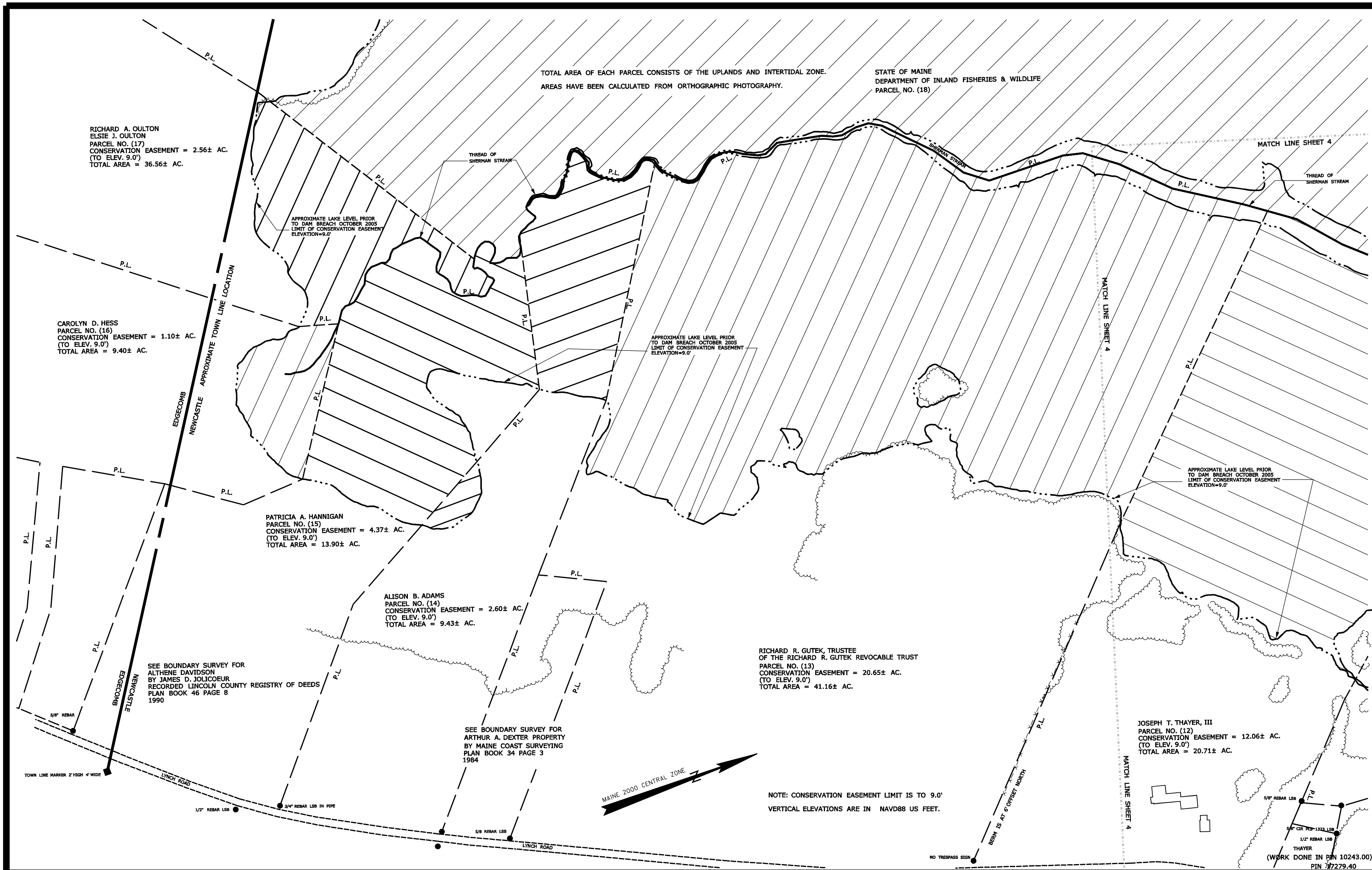

SYMBOLS

ITEM	TECH	CHECKED
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PROP. LINES	M.A.D.	
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STATE OF MAINE
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16 STATE HOUSE STATION - AUGUSTA, ME 04333-0016
NEWCASTLE
RIGHT OF WAY MAP

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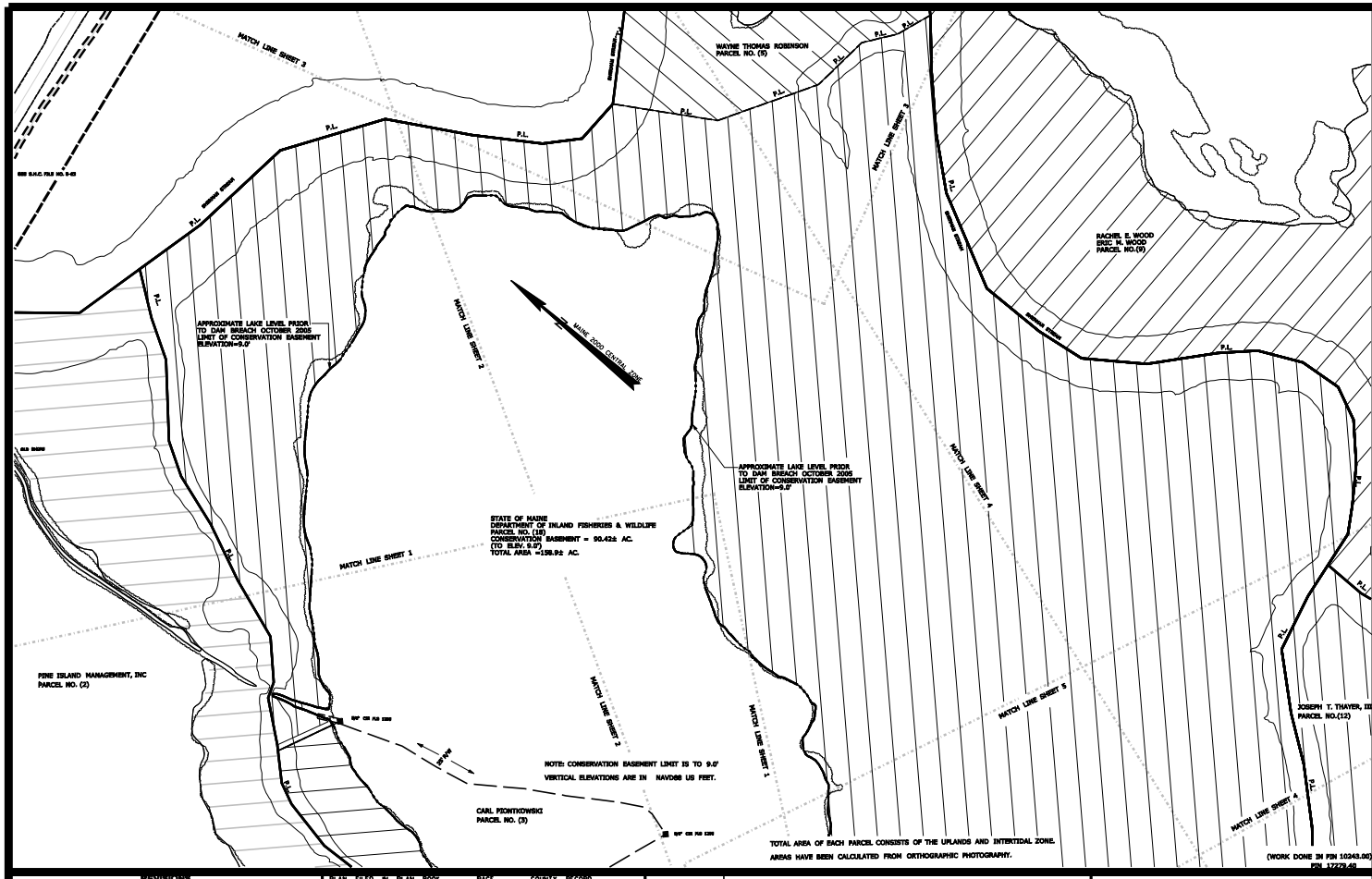
SHERMAN MARSH MITIGATION

NEWCASTLE LINCOLN COUNTY
FEDERAL AID PROJECT NO. STP-1727(940)X

JANUARY 2010 | SCALE 1" = 100' | RIGHT-OF-WAY MAP SHEET 5 OF 7 | D.O.T. FILE NO. 8-168

SHEET NUMBER
6
OF 8



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PROP. LINES	M.A.D.	
AREAS	M.A.D.	

STATE OF MAINE
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16 STATE HOUSE STATION - AUGUSTA, ME 04333-0016
NEWCASTLE
RIGHT OF WAY MAP

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SHERMAN MARSH MITIGATION

NEWCASTLE LINCOLN COUNTY
FEDERAL AID PROJECT NO. STP-1727(940)X

JANUARY 2010 | RIGHT-OF-WAY MAP | D.O.T. FILE NO. 8-168
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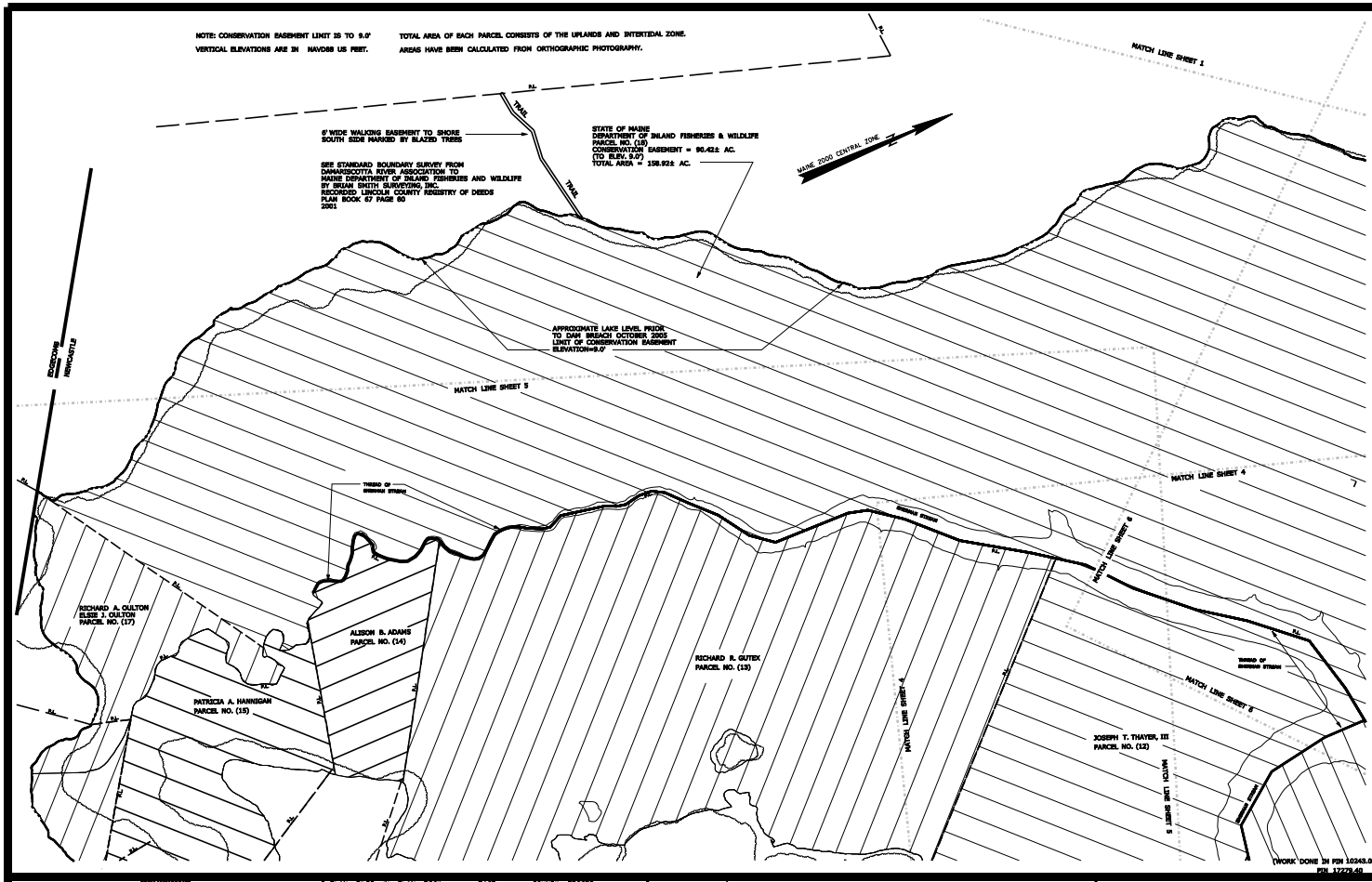
SHEET NUMBER
7
OF 8



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PROP. LINES	M.A.D.	
AREAS	M.A.D.	

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION - AUGUSTA, ME 04333-0016
NEWCASTLE
RIGHT OF WAY MAP

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NO.	GRANTOR	INSTRUMENT	DATE	BOOK	PAGE

DAVID A. COLE
COMMISSIONER
KENNETH L. SWEENEY
CHIEF ENGINEER
DATE

SHERMAN MARSH MITIGATION

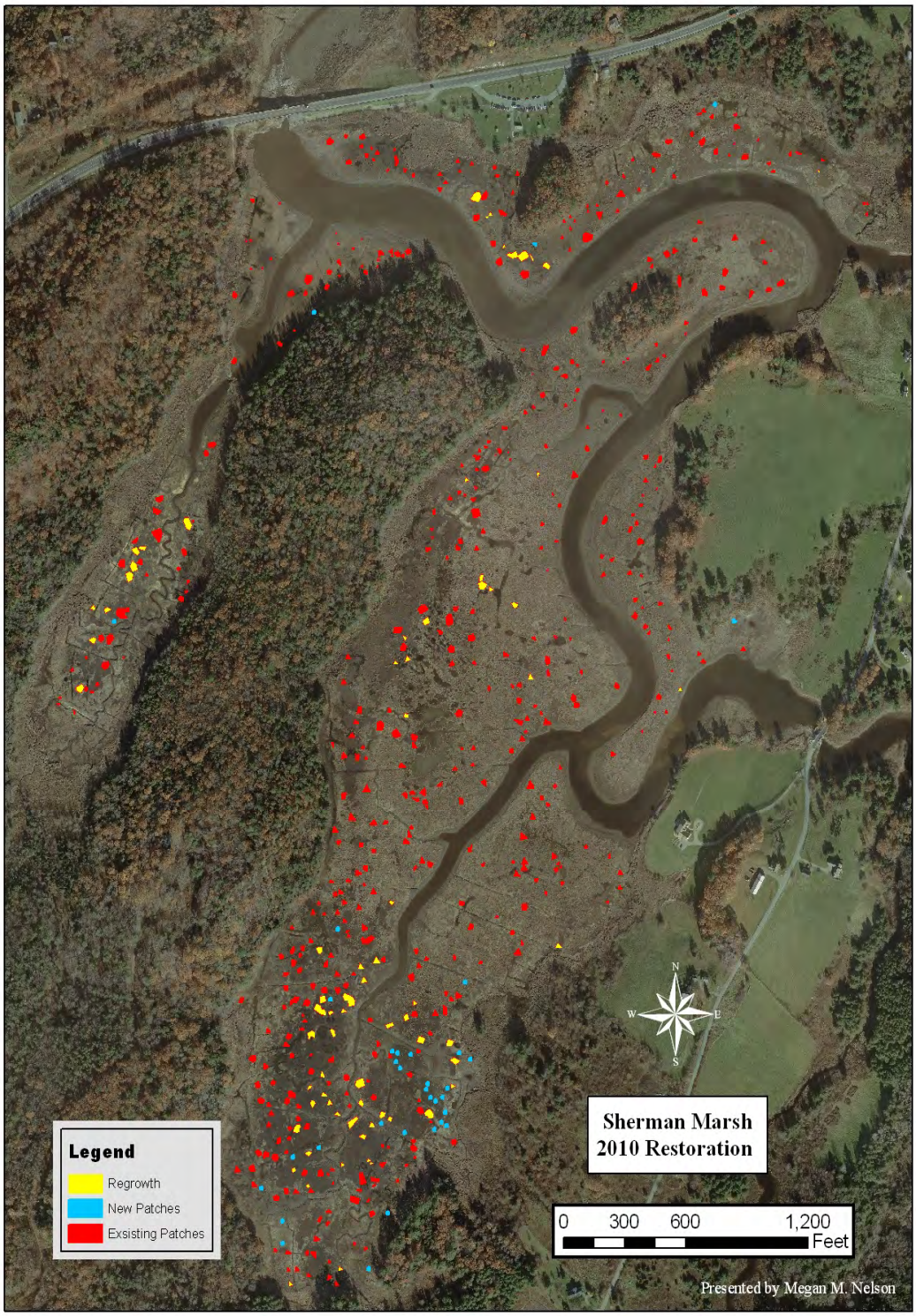
NEWCASTLE LINCOLN COUNTY
FEDERAL AID PROJECT NO. STP-1727(940)X

JANUARY 2010 | RIGHT-OF-WAY MAP
SCALE 1" = 100' | SHEET 7 OF 7

D.O.T. FILE NO. 8-168

SHEET NUMBER
8
OF 8

APPENDIX E
Phragmites Map



Note: The colored areas provide a relative distribution of Phragmites patches in 2010. These are not to scale due to GIS capabilities. The smallest dot represents 8-15 stems.

Appendix F

Detailed Discussion of Sherman Marsh Salinity

Sherman Marsh Salinity Analysis

Salinity (specific conductance) data were collected at various times in 2008, 2009, and 2010 using the Solinst LTC data logger. Data collection was somewhat problematic as the equipment was not entirely reliable. However, enough data were collected as to allow for a general understanding of salinity behavior in the marsh.

The location of Sherman Marsh with respect to the open sea and the Sheepscot River estuary is critical to understanding the marsh salinity regime. The marsh is effectively the headwater of the Marsh River, which subsequently discharges into the Sheepscot River far upstream from the mouth in the Gulf of Maine. The source of saline water for the marsh is at the junction of the Marsh and Sheepscot Rivers. Salinity at this point is greatly influenced by freshwater discharge of the Sheepscot. Maximum salinity in seawater is on the order of 35 ppt; maximum salinity at the Sheepscot-Marsh junction can be significantly less.

Loggers were installed at various times between early spring and late fall in 2008, 2009 and 2010. Salinities were generally low in April and May as a result of the spring runoff in the Sheepscot River. Salinities then gradually increased over the summer, peaking at about 25 ppt in late summer. However, these periods of higher salinities could be dramatically impacted by large storm runoff events in the Sheepscot. No doubt runoff from the Marsh River watershed could also have an impact, but likely much less due to much smaller size as compared to the Sheepscot.

Selections of data that illustrate general patterns are offered below. Due to the mass of data obtained, only representative examples can be given in a written report. Furthermore, the natural variability of the system, due to variability in Sheepscot River and Marsh River runoff, means that it is difficult to characterize the salinity regime except in the broadest of terms.

The single most important observation is that the Sheepscot River discharge and the location of the marsh high up in the system and away from direct seawater inputs effectively cap the maximum attainable salinity in the Marsh River and Sherman Marsh. Two subsidiary observations are

1) freshwater runoff in spring severely depress salinity until from early spring thru early summer;

2) even after salinity approaches maximum attainable levels in mid to late summer, runoff events can quickly and sharply dilute salinity; recovery is a length process.

The highest observed salinities were about 30 ppt, but these only persisted for short periods of time only to be diluted by runoff events. Average values in the range of 15 ppt to 25 ppt were more likely for extended periods of time.

Salinities during Spring Runoff

Figure 1 shows the Sheepscot River long term average monthly flows as well as the 2010 monthly flows. Flow values are from the US Geological Survey gage at North Whitefield, Maine. Figure 2 shows mid-marsh salinity and Sheepscot daily runoff in April and May 2010. There is clearly less freshwater to dilute incoming seawater as the season progresses from spring into summer. By June, daily peak salinity is up to about 20 ppt. This peak generally continues to increase deep into summer and early fall, subject to dilution by individual runoff events.

Salinity in Response to Runoff Events

Salinity shows a strong response to individual runoff events. Figure 3 shows monthly flows for 2008 as context to consideration of runoff events in summer 2008. May, August and September were all somewhat wetter than average while June and July were somewhat drier. Figure 4 shows a data trace for August thru October 2008. The Sheepscot flow data are at 15-minute intervals; salinity data are at 5-minute intervals. The salinity logger was located just downstream of the US 1 bridge over the March River (Sherman March outlet). There are three (3) major flow events; each event triggers a significant dilution of salinity. The recovery takes much longer than the initial dilution. Similar graphs are shown for 2009 in Figures 5 and 6.

Figure 1. Sheepscot River Monthly Average Flow – Water Year 2010

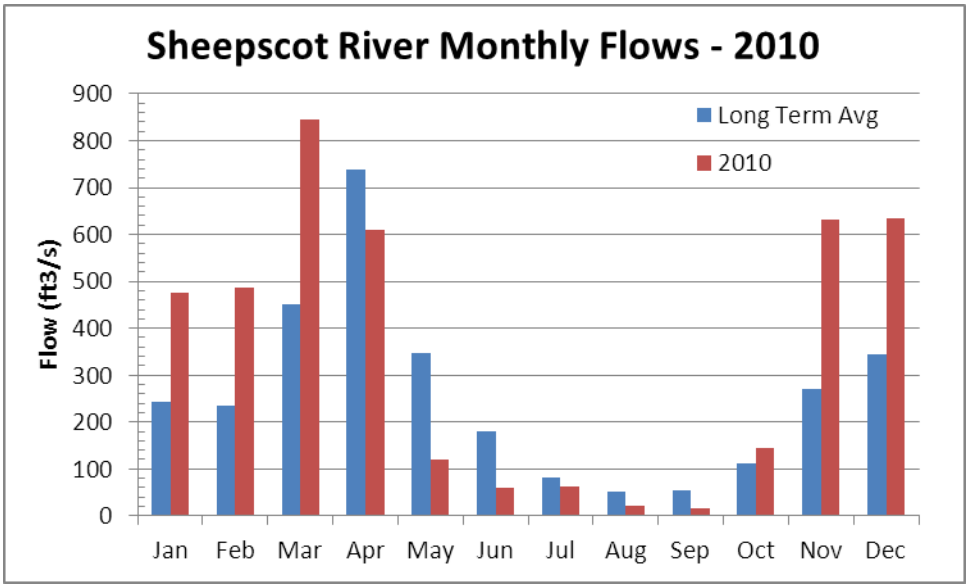


Figure 2. Spring Runoff Mid-Marsh Salinity – 2010

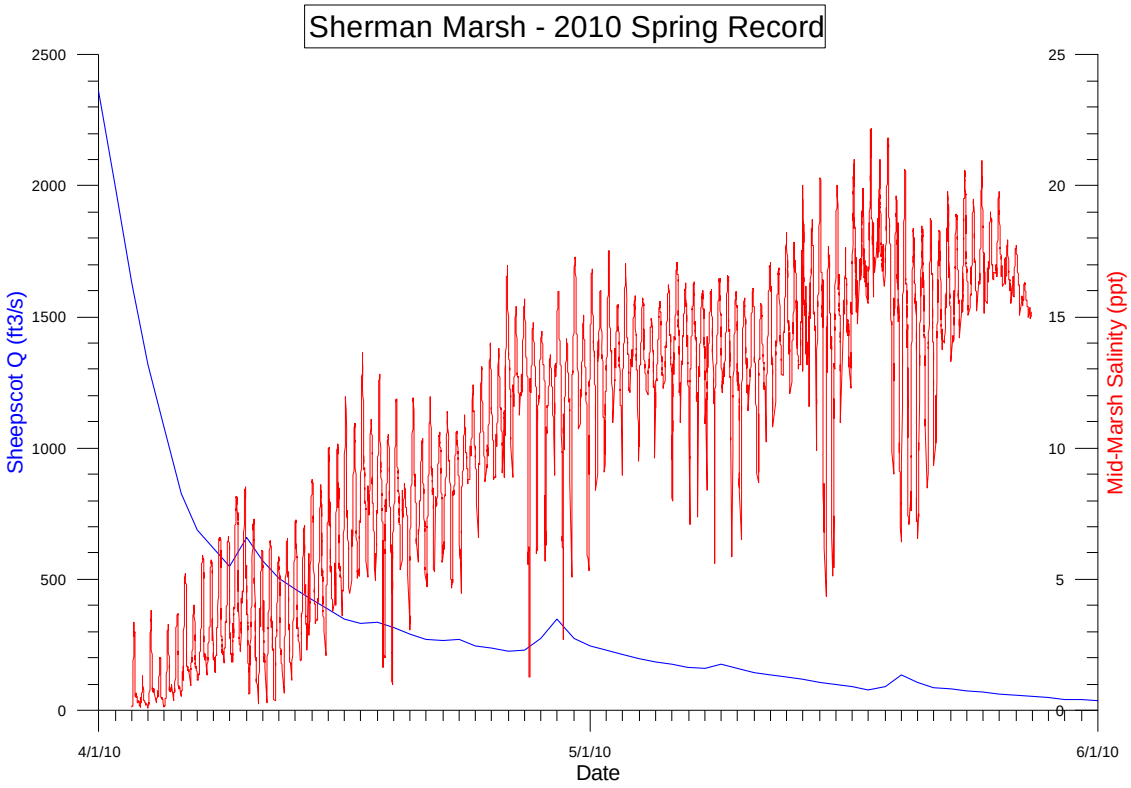


Figure 3. Sheepscot River Monthly Average Flow – 2008

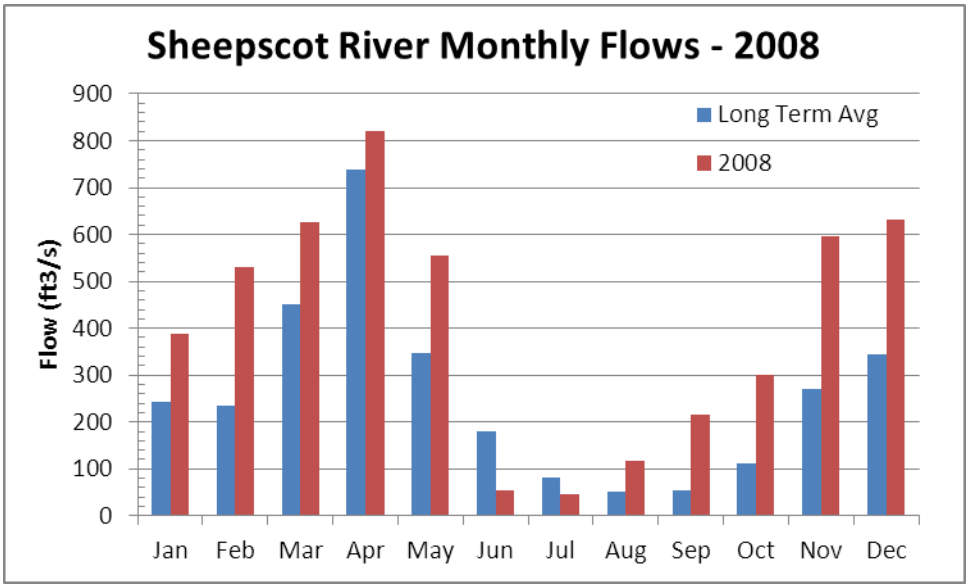


Figure 4. Effect of Freshwater Dilution on Salinity - 2008

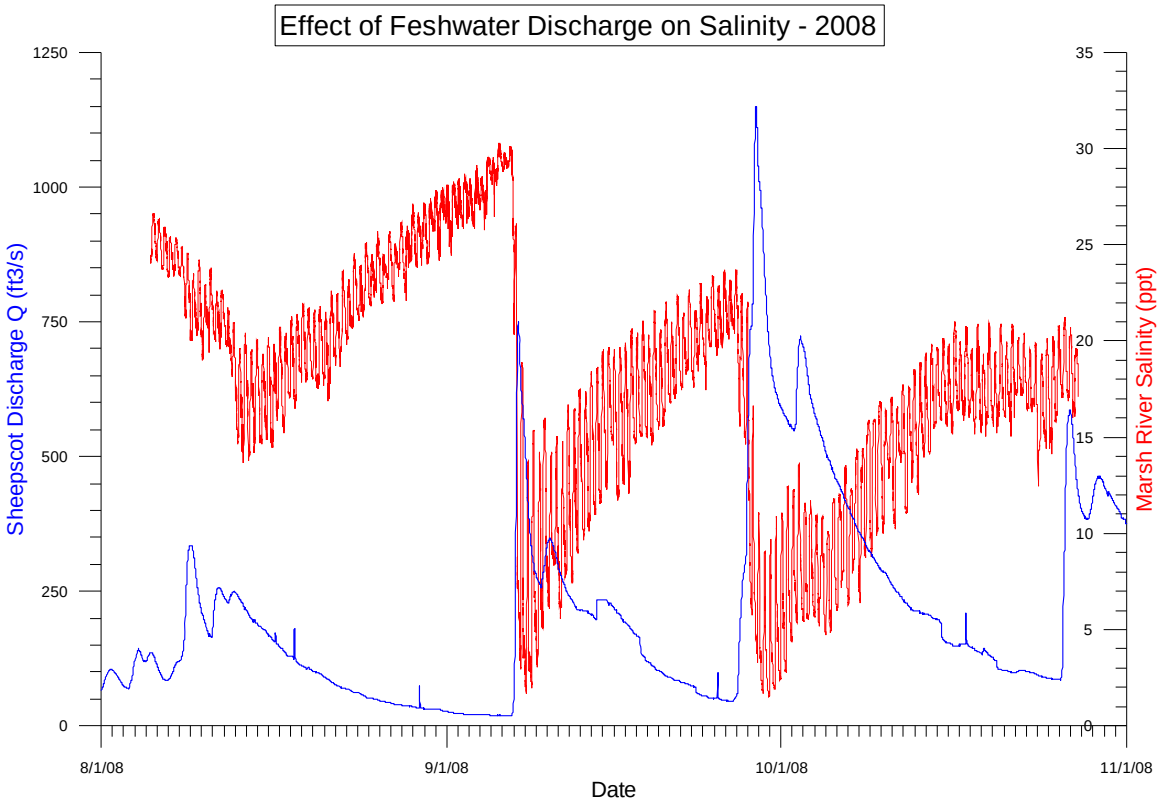


Figure 5. Sheepscot River Monthly Average Flow – 2009

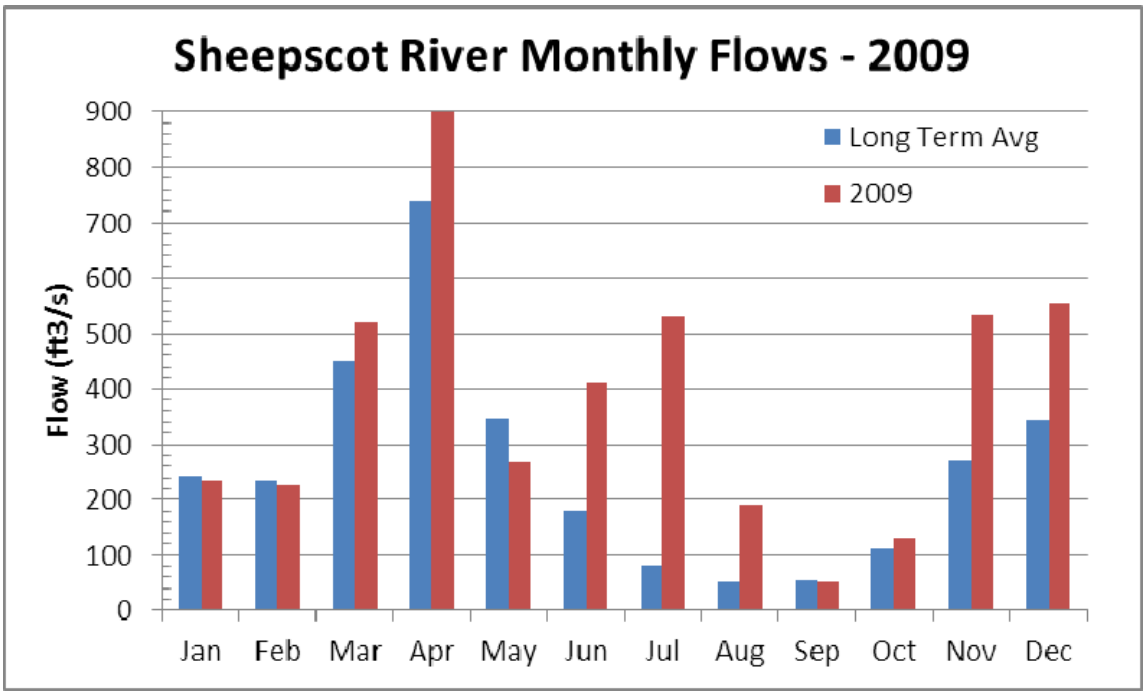
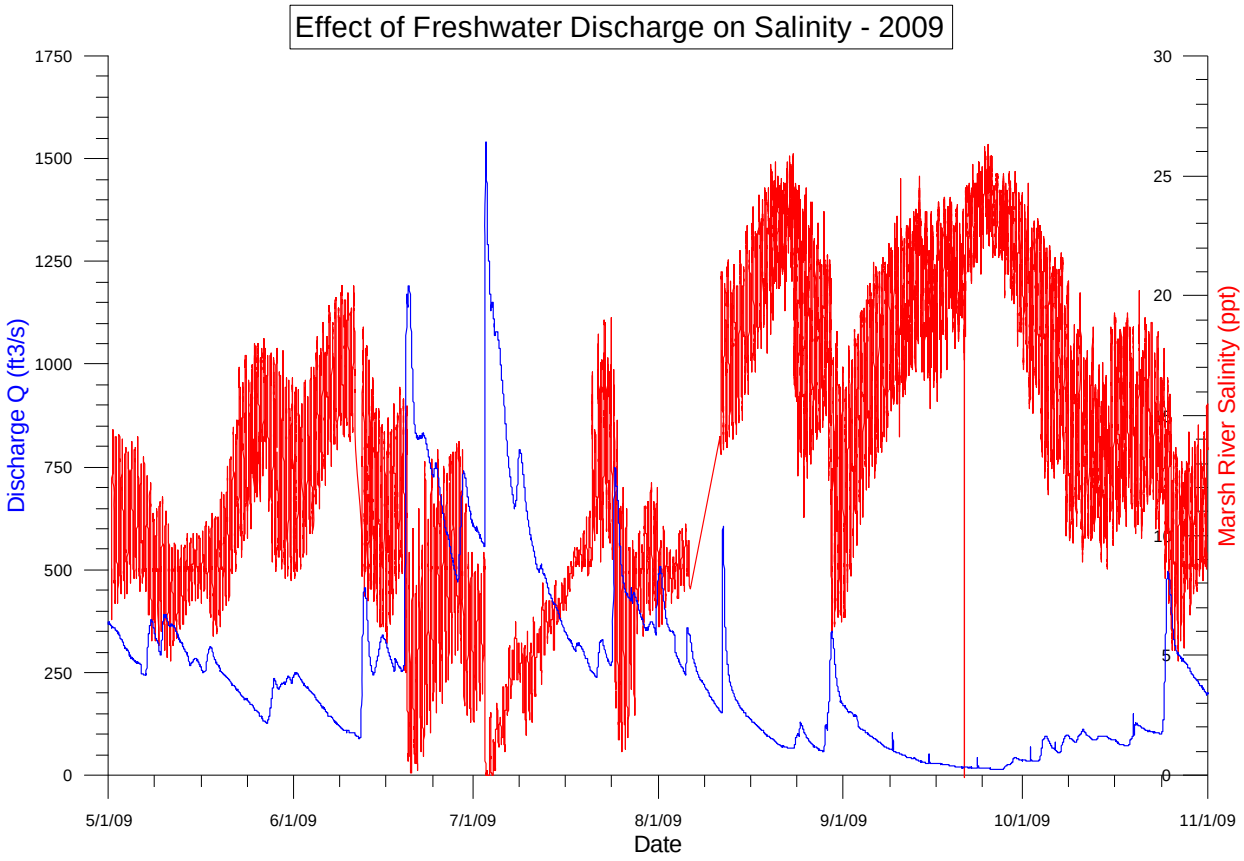


Figure 6. Effect of Freshwater Dilution on Salinity - 2009



Difference Between Mid-Marsh and Marsh River Below US1

Over the course of three seasons, we attempted to log salinity at the “Mid Marsh” (upstream) and “Marsh River” (downstream) locations. “Mid Marsh” is in the marsh channel, between the former island (downstream) and the channel junction (upstream). “Marsh River” is in the channel downstream of the US-1 bridge, away from entrance/exit effects. The equipment proved to be unreliable and it was difficult to obtain coincident upstream and downstream data sets. The few complete data sets that were obtained did not always allow for simple and clear conclusions.

Figure 7a shows one such data segment in October 2009; it contains a few days of quasi-steady behavior followed by a small dilution event. A couple of simple conclusions can be drawn, consistent with what had been expected. Once a quasi-steady regime has been reached, there is essentially no significant difference over most of the tidal cycle. After a dilution event, the difference is more pronounced. The recovery in the Mid-Marsh appears to be even slower than in the Marsh River.

Figure 7b shows the quasi-steady period in more detail. Low tide corresponds to low salinity. At low tides and for a certain period following, salinities are lower in the Mid-Marsh. At these times the channels upstream have mostly drained and flow is more fresh. At the Marsh River logger, with more channel storage upstream than Mid Marsh logger, salinities are somewhat higher than at Mid Marsh during these periods. With regards to surface vegetation, this difference is not significant since water levels are well down in the channel and this low salinity water is not on the marsh surface.

Figure 7c shows the effect of a small dilution event. The peak Marsh River salinities are higher than in the Mid Marsh. The differences between the salinity low points is even more pronounced, probably due to watershed drainage.

There are undoubtedly systematic differences between Marsh River and Mid Marsh salinities. However, these differences are probably less important than the limiting factor on attainable salinities exercised by the Sheepscot River, both during quasi-steady higher salinity periods as well as during runoff events.

Figure 7a. Difference Between Mid-Marsh & Marsh River Salinity

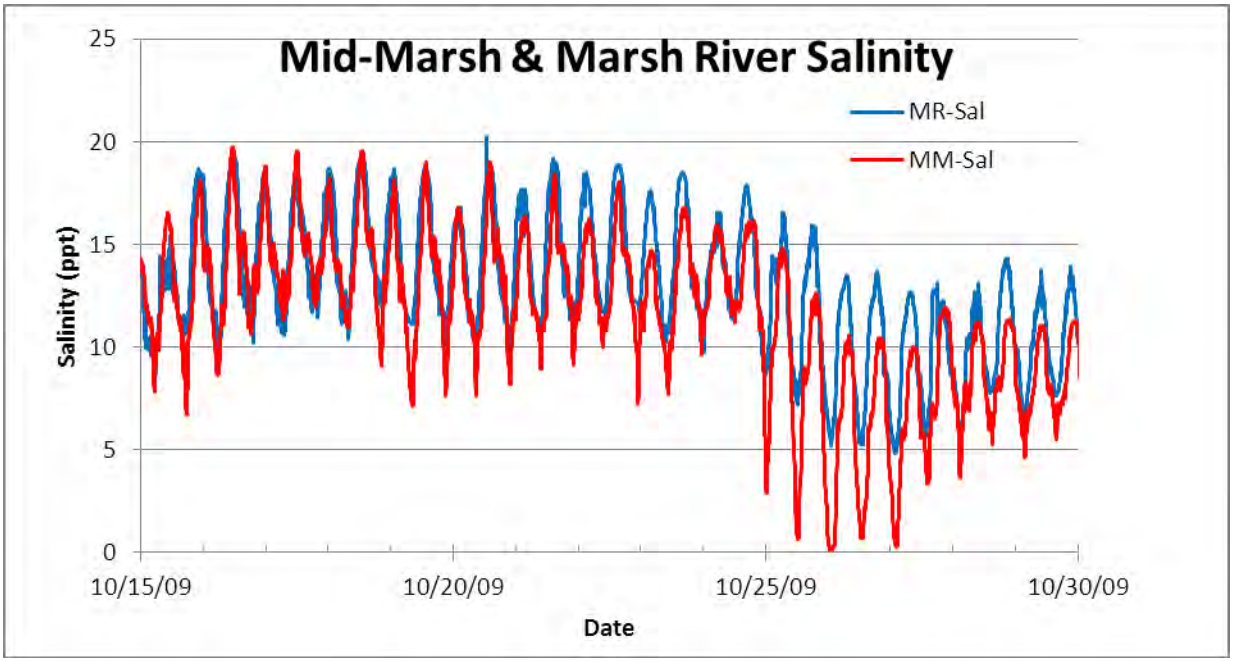


Figure 7b. Difference Between Mid-Marsh & Marsh River Salinity: Quasi-Steady Period

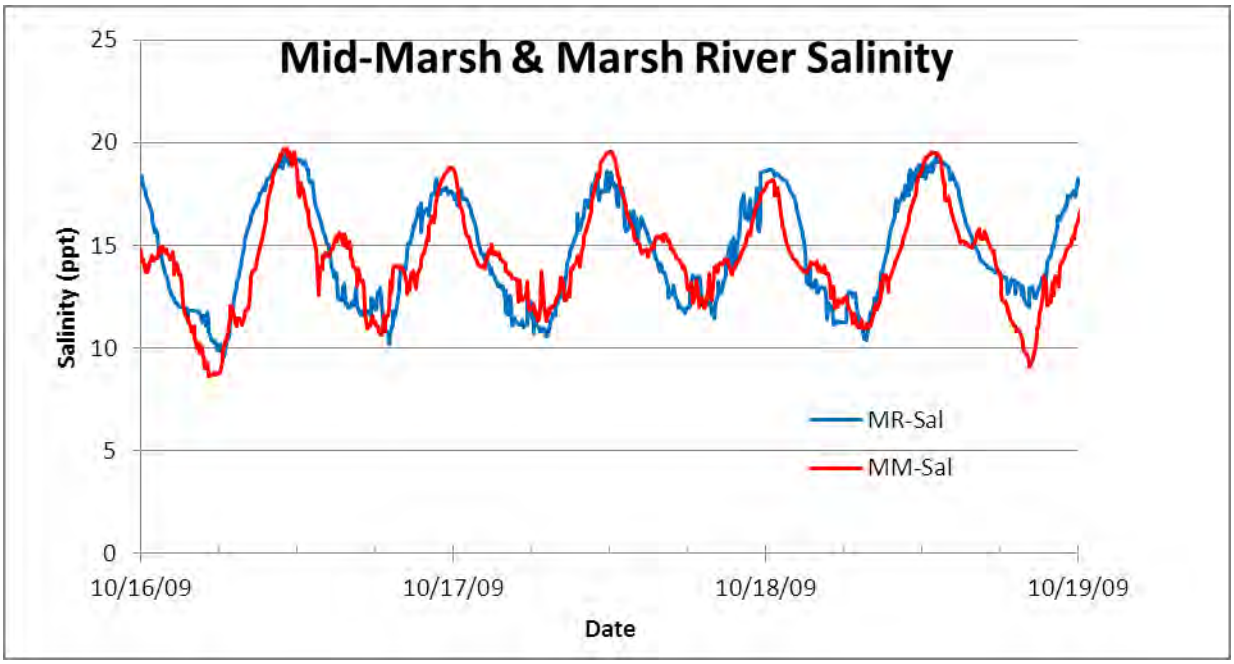
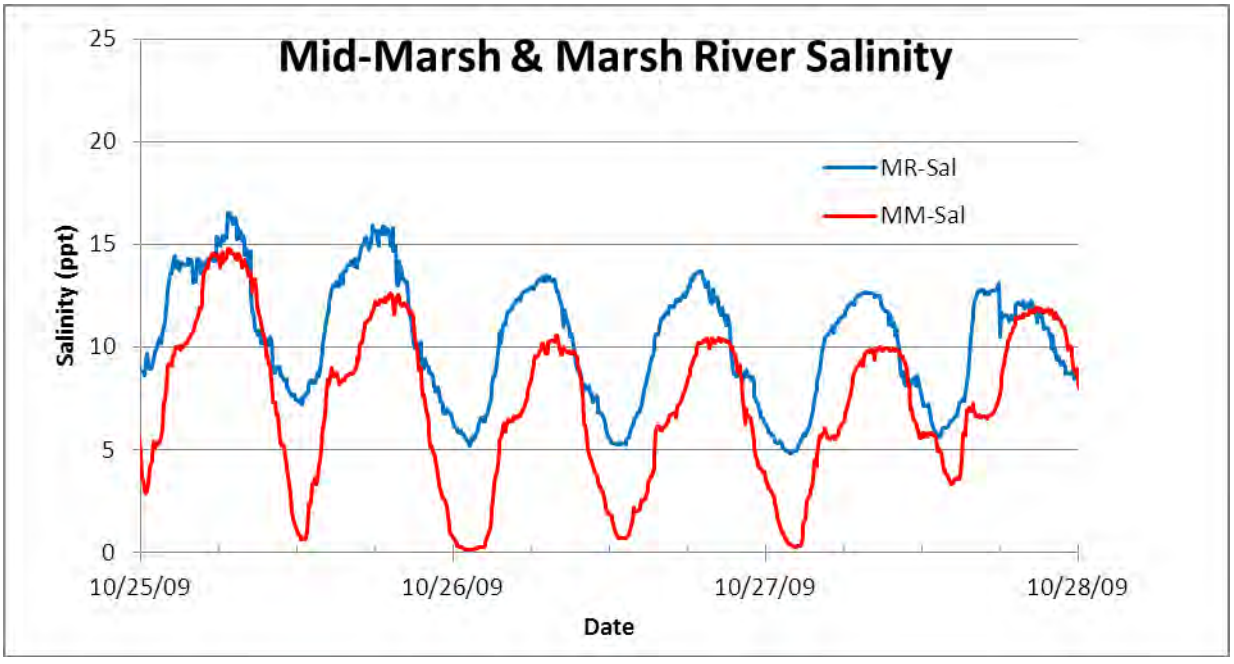


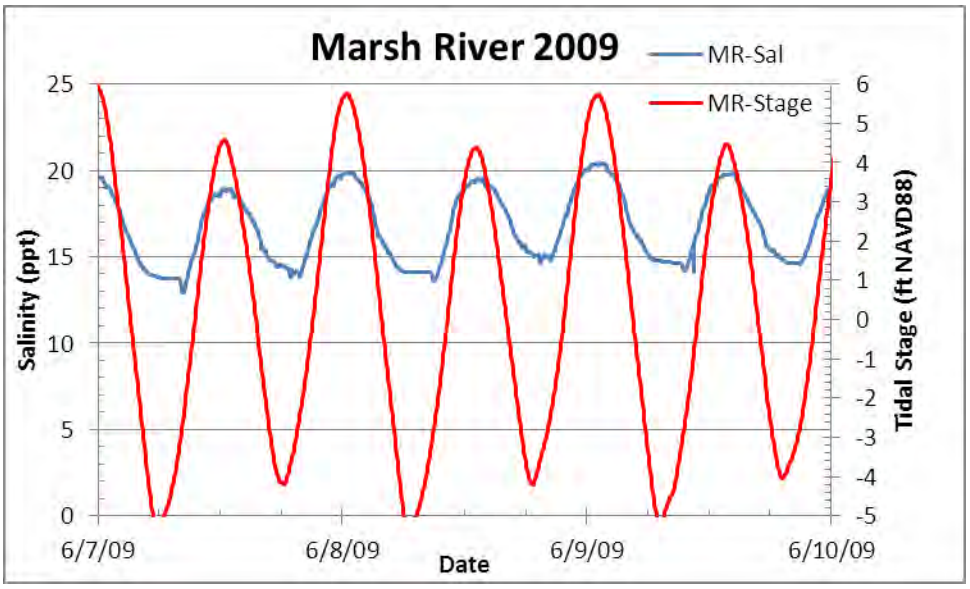
Figure 7c. Difference Between Mid-Marsh & Marsh River Salinity: Small Dilution Event



Relation of Salinity to Tidal Stage

The relation of salinity to stage is as expected. Peak salinity corresponds to high tide. The recession limb of the salinity curve can resemble a drainage curve and the salinity minimum lags the tidal minimum. Once the tide turns, the initial slug of incoming water is predominantly water that passed the logger on the way out. It takes some time for higher salinity water to makes its way back upriver, accounting for the observed lag. A small data sample is shown in Figure 8. Similar patterns were observed at the Mid Marsh logger.

Figure 8. Relation of Tidal and Salinity Cycles



Appendix G
Maine Natural Resource Conservation Program
Comprehensive Planning Framework for the
Central Interior and Midcoast Biophysical Region

Central Interior and Midcoast

The Central Interior and Midcoast region is one of the fastest growing regions in the state, with several urban areas projected to grow considerably and large areas of agricultural cultivation. As shown in Figure 13 below, projections for development expansion over the next twenty years are considerable. The Aquatic Resources Base layer suggests this region had the potential to support extensive wetland and aquatic resources (including both saltwater and freshwater types), covering approximately 1.5 million acres, the second highest acreage of any region in Maine (see Figure 14). This represents 40% of the regional area (or 39% of the section area if intertidal offshore wetlands are excluded from the calculation) and 19% of Maine's total potential wetland and aquatic resources.

Maine Landcover data (MELCD 2004) suggests that almost 5% of the original potential aquatic resource cover has been converted to development (see Figure 14). An additional 5% has been converted to agriculture. Aside from Southern Maine, this represents the highest percent area converted of any of Maine's regions. The MELCD 2004 data suggests that 20.4% of the shoreline buffer (100m) around lakes and ponds and 12.1% of the riparian area along streams and rivers has been converted to agriculture or development, the highest levels of any region in the state (see Section 8.3). This region is also subject to higher development pressures and potential conversion of wetland acres. Between 2006 and 2011, 1,947 Natural Resource Protection Act (NRPA) and Permit-by Rule (PBR) permits were issued for development-related wetland impacts in this ecoregion, the highest number for any ecoregional section in the state (see Figure 15). Central Interior and Midcoast is one of Maine's largest ecoregional sections; however, by contrast, Northwest Maine (similar in size) only had 163 permits issued in the same time period (8% of what was issued in Central Interior). Figure 16 shows the MDEP water quality classifications for the watersheds of the region and Table 12 shows the extent of aquatic resources found on permanently conserved land (Gap 1, 2 and Ecological Reserves) and on other conserved land (Gap 3).

Regional conservation objectives:

- Actively pursue opportunities to restore priority resource types, particularly coastal resources, as well as opportunities to restore marginal or non-productive agricultural land.
- Support efforts to restore fish passage in the Penobscot River watershed.
- Encourage preservation projects, particularly for vernal pools, headwater streams (1st and 2nd order) and their associated upland buffers, and in areas of projected development expansion, to ensure that the region's extensive aquatic resources remain intact and functional into the future.
- Encourage preservation and restoration (e.g., barrier removal) projects in coastal areas that would facilitate the projected future migration of coastal wetland communities in response to climate change and sea level rise.

Table 12. Extent of aquatic resources found on permanently conserved land (Gap Status 1, 2 and Ecological Reserves) and on other conserved land (Gap Status 3) for the region.

Aquatic Resource Type	Total Area in Region (ac)	Permanently Conserved	% Prmnntly Conserved	Other Conserved	% Other Conserved
Estuarine Intertidal Emergent	11,689	822	7.0%	1,400	12.0%
Estuarine Intertidal Forested/Shrub	0	0	n/a	0	n/a
Estuarine Subtidal	7,172	27	0.4%	124	1.7%
Lacustrine	151,832	90	0.1%	1,066	0.7%
Marine Intertidal	25,802	451	1.7%	464	1.8%
Marine Subtidal	6,303	28	0.4%	24	0.4%
Other Estuarine Intertidal	21,717	88	0.4%	194	0.9%
Palustrine Emergent	45,401	1,253	2.8%	2,218	4.9%
Palustrine Forested	195,656	7,402	3.8%	7,954	4.1%
Palustrine Non-vegetated	11,120	122	1.1%	184	1.7%
Palustrine Shrub	113,514	5,958	5.2%	3,303	2.9%
Riverine	23,605	107	0.5%	103	0.4%
Regional Total	**613,810**	**16,348**	**2.7%**	**17,035**	**2.8%**

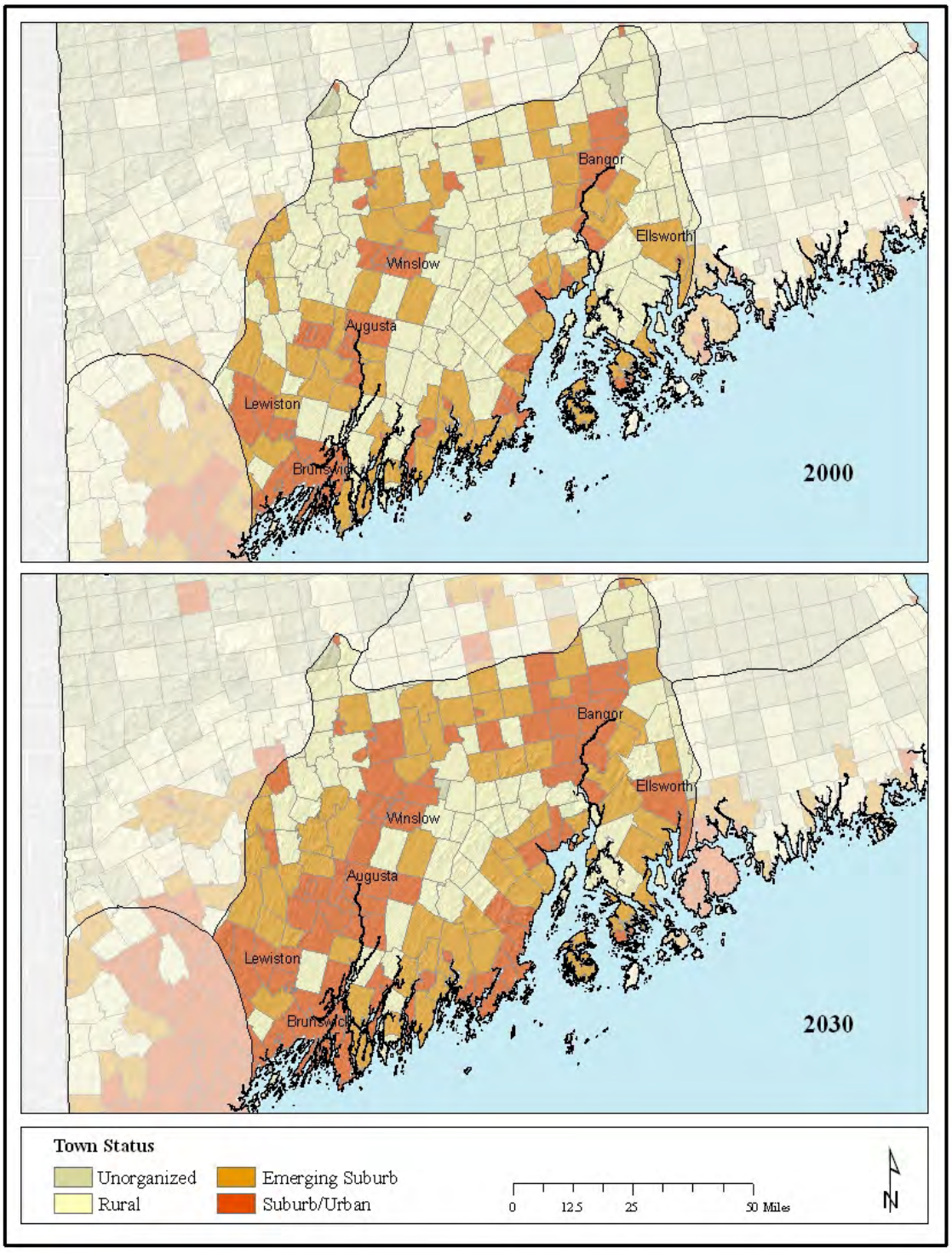


Figure 13. Projected expansion of development, by U.S. census block, for the *Central Interior and Midcoast* biophysical region based on State Planning Office analysis.

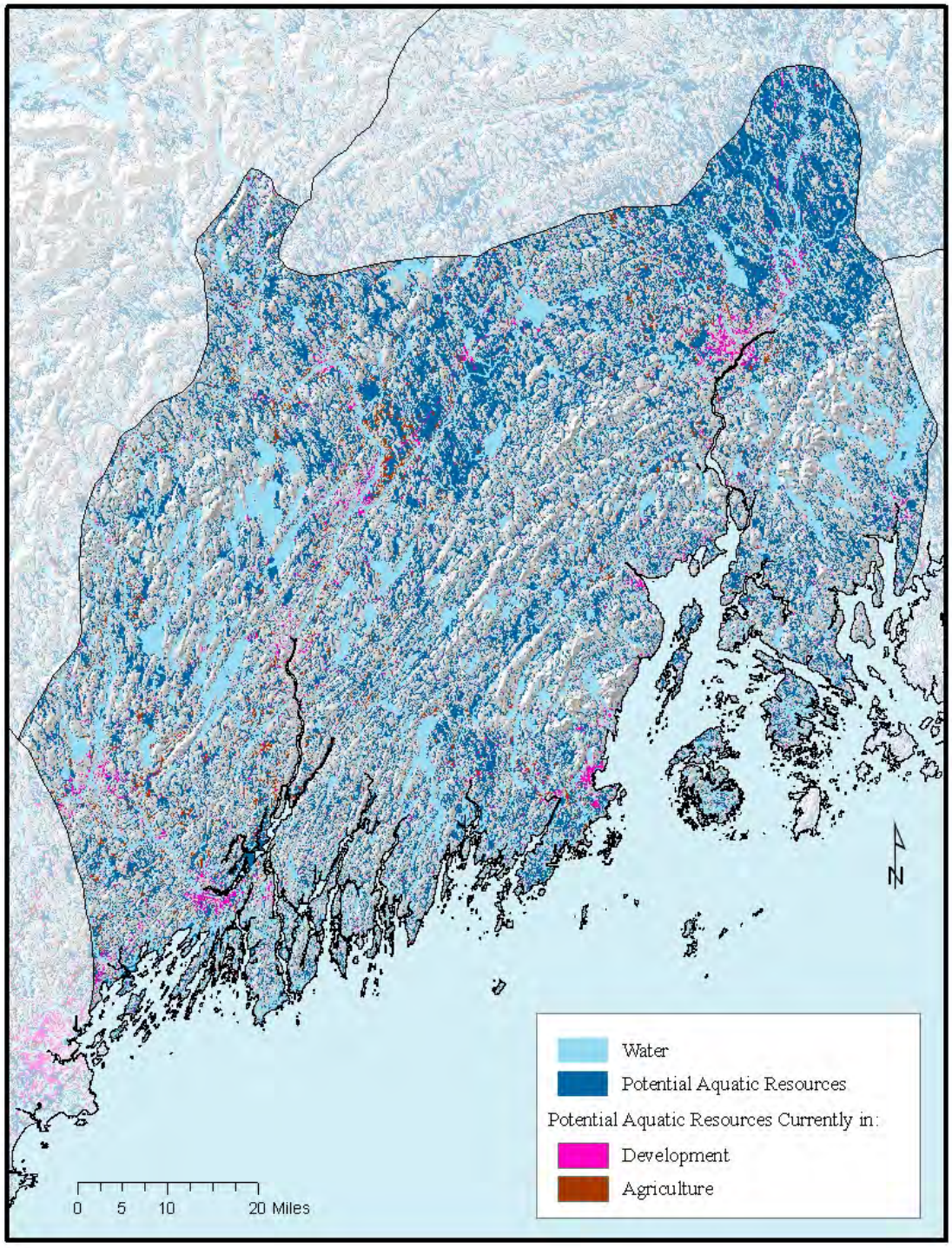


Figure 14. Aquatic Resource Base Layer (ARBL) for the *Central Interior and Midcoast* biophysical region.

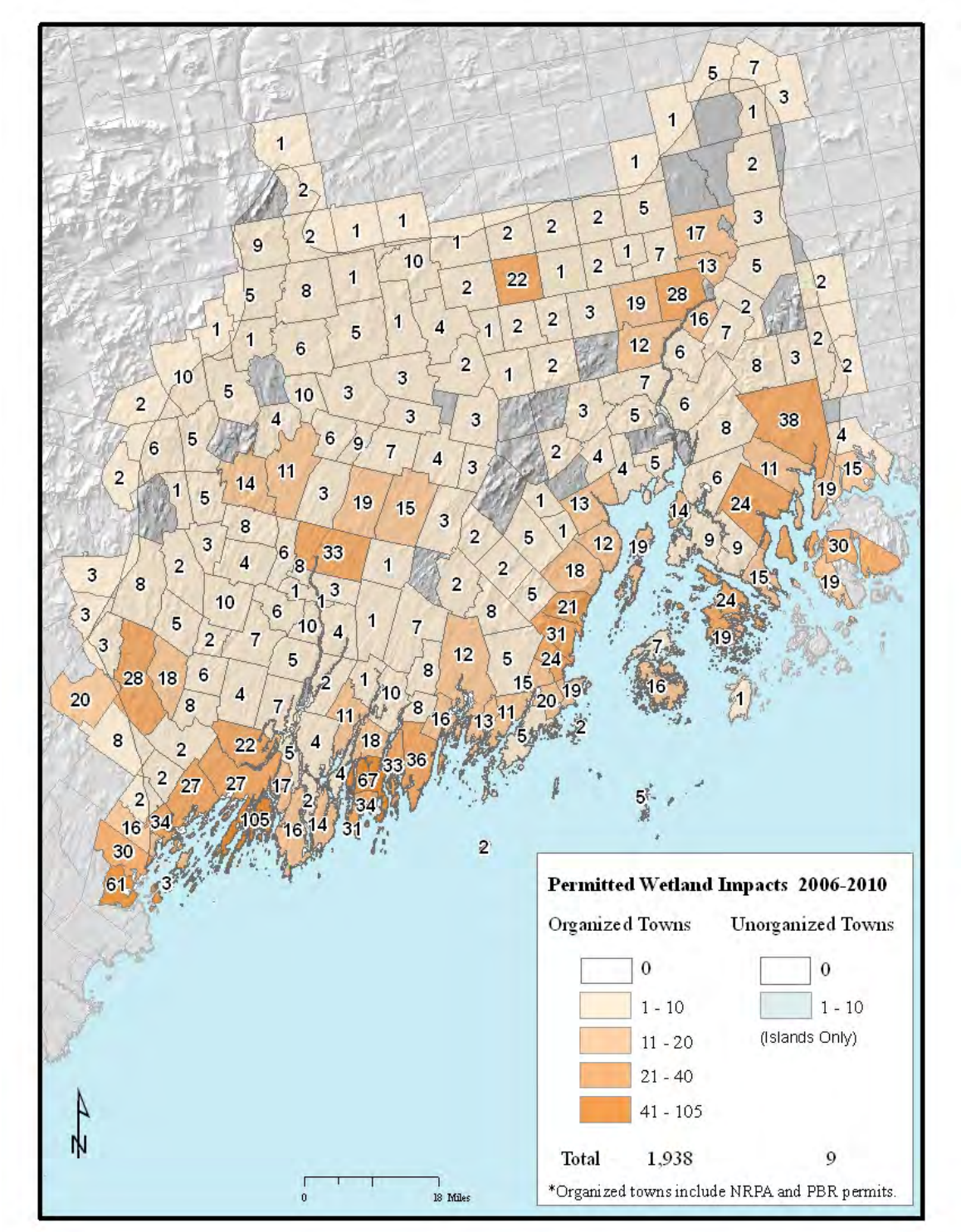


Figure 15. Permitted wetland impacts (from WLTS and GOAT) for the *Central Interior and Midcoast* region.

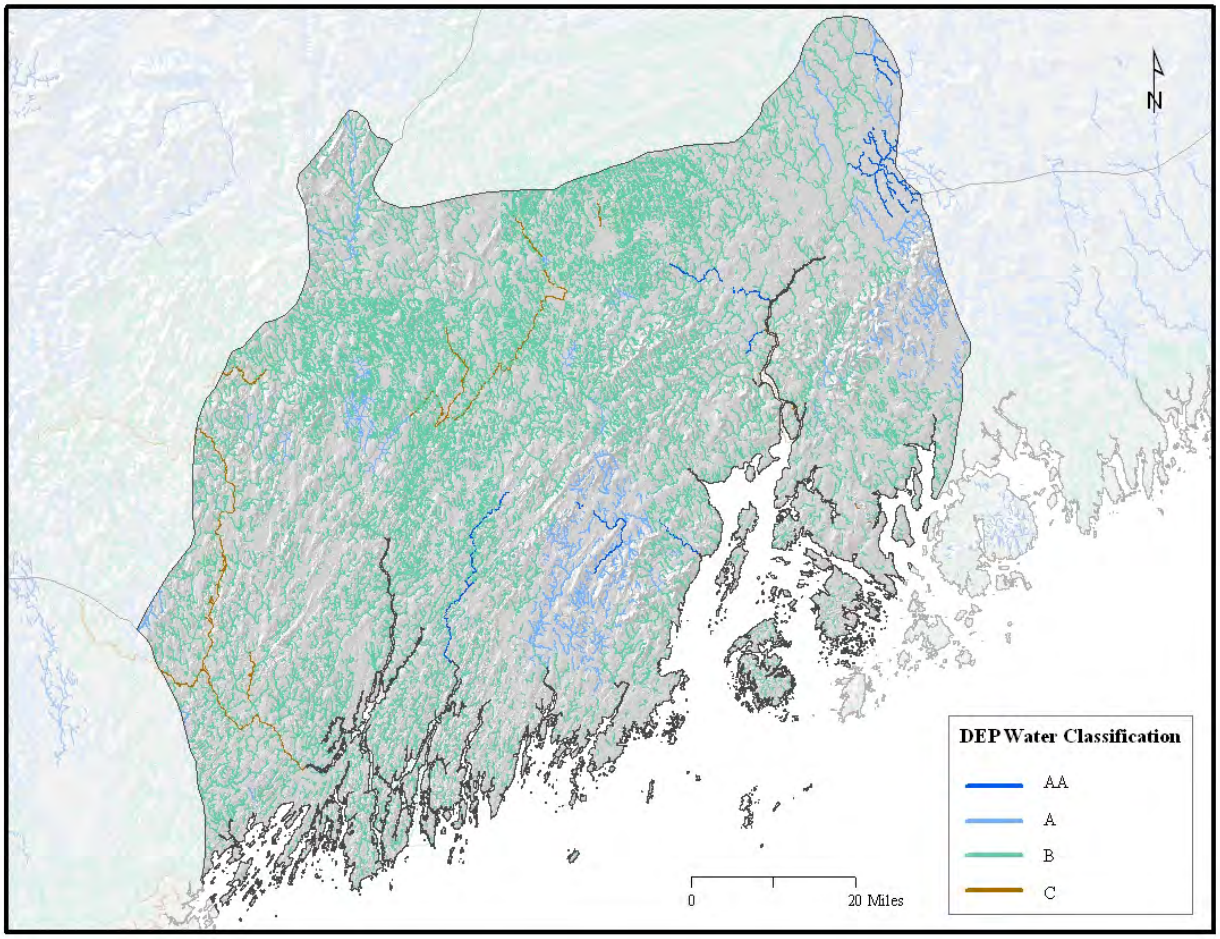


Figure 16. MDEP water quality classifications for the *Central Interior and Midcoast* region.