METHOD FOR THE EVALUATION AND INVENTORY OF VEGETATED TIDAL MARSHES IN NEW HAMPSHIRE

(Coastal Method)

Written by:

Richard A. Cook
Audubon Society of New Hampshire

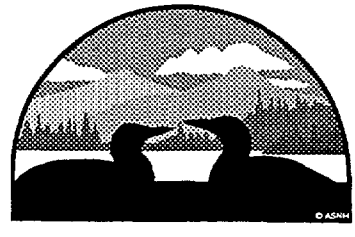
Amanda J. Lindley Stone
Audubon Society of New Hampshire

Alan P. Ammann, Ph.D.
U.S.D.A. Soil Conservation Service

The preparation of this manual was supported in part by a grant from the New Hampshire Coastal Program, Office of State Planning pursuant to National Oceanic and Atmospheric Administration Award No. NA27OZ0286, and in part by the Prospect Hill Foundation

This manual is published by the Audubon Society of New Hampshire

JUNE 1993



To purchase additional copies of the *Coastal Method* , fill out the information below, cut out page, and return using this self addressed mailer.

The authors would appreciate being notified of any organization using the *Coastal Method.* This will allow us to supply you with any revisions that have been made to the Method and to maintain a database of towns in New Hampshire and other organizations both in state and out of state that are using the *Coastal Method.* Please fill out the appropriate lines below and return to the Audubon Society of New Hampshire.

Name _____

Organization _____

Mailing Address _____

_____

_____

Telephone _____

Number of copies _____

Cost per copy $ ~~8.00~~ 10.00

Postage and handling $ 2.50 per copy

Total amount enclosed _____

Check one: ___ Have completed *Coastal Method*

___ Presently using *Coastal Method*

___ Anticipate using *Coastal Method* soon

Please provide any comments you may have on the *Coastal Method*

_____

_____

_____

_____

_____

_____

stamp

Wetlands Project
Audubon Society of New Hampshire
3 Silk Farm Road
Concord NH
03301

TABLE OF CONTENTS

A Note On This Manual:

The format of the *Coastal Method* is based on the *Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire* (*NH Method*) (Ammann and Lindley Stone, 1991). The technical content of the *Coastal Method* is, however, different from that of the *NH Method* due to the very different nature of the ecosystem being evaluated.

The development of the *Coastal Method* was overseen by a steering committee comprised of the following individuals:

***Coastal Method* Steering Committee**

Sarah Allen	Normandeau Associates/NH Assoc. of Wetland Scientists
Janet Bourne	Audubon Society of New Hampshire
Michele Dionne, Ph.D.	Wells National Estuarine Research Reserve, Maine
David Funk	Durham Conservation Commission
Peter Helm	NH Office of State Planning, Coastal Program
Frank D. Richardson, Ph.D.	NH Dept. of Environmental Services, Wetlands Bureau
Christine Rowinski	NH Office of State Planning, Coastal Program
Larry Ward, Ph.D.	Jackson Estuarine Laboratory, UNH
Peter Wellenberger	Great Bay National Estuarine Research Reserve

Our thanks and appreciation go to these individuals for their valuable input and constructive criticism throughout several drafts of this manual.

We would also like to thank those individuals who provided comments on the pre-publication review draft of the *Coastal Method*:

Dave Burdick, Ph.D. Jackson Estuarine Laboratory, UNH
Steve Burns, Strafford Regional Planning Commission
Dave Cowan, Normandeau Associates
Sherry Godlewski, NH Office of State Planning, Coastal Program
Dave Hartman, NH Office of State Planning, Coastal Program
Anna Hicks, The Environmental Institute, UMass
Frank Mitchell, UNH Cooperative Extension
Sid Pilgrim
Ed Reiner, EPA
Marge Swope, NH Association of Conservation Commissions

The *Coastal Method* should be cited as follows:

Cook, R.A., A.J. Lindley Stone and A.P. Ammann, 1993. Method for the evaluation and inventory of vegetated tidal marshes in New Hampshire. Published by the Audubon Society of New Hampshire.

Section 1

INTRODUCTION

1. INTRODUCTION

The *Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire* (known as the *NH Method*) published in 1991 provided communities with a means to inventory and assess the value of the nontidal wetlands within their town. It soon became apparent that a similar method was needed to afford coastal communities the same opportunity. The *Method for the Evaluation and Inventory of Tidal Marshes in New Hampshire* (the *Coastal Method*) was developed to provide coastal communities with a method to inventory and evaluate the vegetated tidal marshes within their town.

The tidal wetlands in New Hampshire include a number of different habitats, ranging from submerged aquatic vegetation to rocky intertidal shores, and from mudflats to marshes. Each of these systems is a unique environment with vastly different flora and fauna, fulfilling a variety of functions within the coastal ecosystem.

Developing a single method for evaluating the diverse functions of each of these differing tidal wetland systems is beyond the scope of this manual. The *Coastal Method* focuses specifically on the ecosystems most threatened by human development, the vegetated tidal marshes. Situated between uplands and barrier beach formations (see glossary) and in the Great Bay Estuary, tidal marshes have long been an obstacle to public accessing of tidal waters. This, together with the fact that the marshes are tidally influenced rather than continuously flooded, has increased their vulnerability to dredging, filling and development. Numerous roads have been built across the marshes since the arrival of the first European settlers, causing extensive fragmentation of many of the marsh systems along the Atlantic Coast.

Evaluation of tidal marshes using the *Coastal Method* will provide towns with information that will allow them to better plan for the protection and management of this valuable wetland resource.

1.1 Intended Use of the *Coastal Method.*

This manual provides coastal communities with a method that can be used to inventory and evaluate their vegetated tidal marshes. Although the format of this manual is similar to the *NH Method*, the basic premise is quite different. Unlike the NH Method, **the *Coastal Method* is not comparative**. Evaluating tidal marshes using this manual provides a site specific method for assessing the importance of tidal marshes for a number of different functions. However, this method is **not** designed for detailed impact assessment.

The *Coastal Method* is designed to be scientifically defensible when used for its intended purpose, as a tool for planning, educating, and inventorying (see discussion in Section 1.4). It is intended to be used by those who have some knowledge of tidal marshes, but are not necessarily wetland ecologists. The Coastal Method will provide communities with site specific information and management options for tidal marshes that may be used in future land-use planning decisions. It is not meant to be used as a definitive site evaluation. If a more detailed evaluation is needed, a wetlands professional should be consulted.

The *Coastal Method* is designed to be used for the following purposes:

1. Educating members of conservation commissions, planning boards and others about tidal marsh functions.
2. Inventorying and gathering site specific information about each of the tidal marshes within the study area.
3. Creating a database containing information about the present condition of each of the tidal marshes and land-use in a 500 foot Zone of Influence surrounding the marsh.
4. Supporting planning and decision-making processes within the town or region.
5. Offering management possibilities for each of the marshes in the study area.
6. Collecting information about the causes of degradation in tidal marsh systems impacted by development that may benefit from restoration.

While it is possible to evaluate a single wetland within a town, the recommended procedure is to inventory and evaluate all of the tidal marshes in a town or region. Gathering this information in a single block of time gives the town the opportunity to look at the management options for a number of their tidal marshes.

1.2 Definition of Tidal Marshes as Used in the *Coastal Method.*

Coastal wetlands can be divided into three categories. Marine wetlands are adjacent to or in the open ocean. Estuarine wetlands includes those habitats partially enclosed by land but having an opening to the ocean, where saltwater from the ocean and freshwater from upland rivers and surface runoff mix. Intertidal riverine wetlands are marshes within a river channel that, while influenced by tides, are beyond the normal reach of saltwater; these are also known as freshwater tidal marshes.

The *Coastal Method* has been developed to evaluate vegetated tidal marshes only. These wetlands occur in estuarine and intertidal riverine coastal habitats, and include salt marshes, brackish marshes and freshwater tidal marshes. The following definitions are taken from the U.S. Fish and Wildlife Service Wetland Classification System (See Appendix C). Salt marshes develop in a range of salinities from that of seawater, about 36 parts per thousand (ppt) of salt, to approximately 18 ppt. Brackish marshes are characterized by salinities ranging from 0.5 – 18 ppt. Freshwater tidal marshes are located where the salinities average less than 0.5 ppt yet tides still affect the movement of water. The range of salinity influences the dominant plant community so that each of the marsh community types is easily identified by the plants present.

1.3 Value of Tidal Marshes.

According to the NH Office of State Planning, approximately 50% of the tidal marshes in New Hampshire have been destroyed by human development in the coastal zone since colonial times. The remaining 7,500 acres have all been impacted by this development to some degree. These tidal marshes are important for the maintenance of a healthy coastal ecosystem. The future integrity of these systems hinges largely on local land-use policy and state and federal protection regulations.

Much of the development along the coast has been on barrier beach formations, such as spits and islands. These areas include Hampton and Seabrook Beaches and the Rye Harbor area. Over the last 4,000 years, large areas of tidal marsh have evolved behind these formations. These marshes provide the developed stretches of coast with a wide variety of valuable functions, including storm surge protection, shoreline anchoring, and recreation and aesthetic enjoyment.

Since humans first arrived in New Hampshire, tidal marshes have been a source of food. Fish, shellfish, and coastal birds were routinely harvested from the marshes. High marsh grasses have been used as livestock fodder since European settlement. However, the bounty that once was harvested is no longer available as the majority of the shellfish beds in the state are closed due to poor water quality. Road and dam construction along the coast and overfishing in the near coastal waters have depleted stocks of fish. The tremendous flocks of migrating birds that once darkened the skies along the coast were hunted to near extinction during the middle of the 19th century. Protection of tidal marshes and other coastal resources may improve the prospects for the survival and controlled harvest of these species for future generations.

Presently, sea level is rising worldwide. This, coupled with residential and commercial development extending to the intertidal zone, poses a threat to the future of tidal marshes. The cycle of alternate flooding and exposure is critical to maintaining a natural tidal marsh community because the flooding tidal water brings sediments and the exposure allows marsh grasses to thrive. These processes have allowed marsh elevations to keep pace with rising sea levels. During the last 4,000 years the area of tidal marshes along the Atlantic Coast has developed. Even during past geological periods of worldwide sea level rise the marshes have kept pace with this rise by continuing to expand into adjacent low-lying areas. Today the extensive commercial and residential development along our coast makes the natural expansion of tidal marshes into these developed low-lying areas problematic. Decisions may have to be made that weigh the cost and benefits of the loss of tidal marshes against the loss of personal property. If sea level continues to rise, large areas of tidal marsh could be lost. Increased duration of flooding in the tidal marshes could result in the dieback of tidal marsh plants with these areas becoming mudflats.

Section 2

USING THE COASTAL METHOD

2. USING THE COASTAL METHOD

2.1 How the *Coastal* Method Works.

The *Coastal Method* should be used to **inventory** all of the tidal marshes in a study area as well as wetlands that were formerly tidal but have become freshwater due to the effects of a man-made obstruction. Only the tidal marshes will be **evaluated** using the Coastal Method. Wetlands that were formerly tidal marshes will not be evaluated.

An inventory of present and formerly tidal marshes should include a review of the National Wetlands Inventory maps, the town maps found in Appendix G, and field observation to identify all of the wetlands within a study area that are vegetated tidal marshes and those wetlands that were formerly tidal. This information should then be recorded on the National Wetlands Inventory map(s) for the town and their tidal status verified to determine which wetlands will be evaluated and which wetlands will be included in the inventory as formerly tidal marshes.

Wetland evaluation is the process of determining the value of a wetland, based on an assessment of the functions that it performs. Functions represent the practical, measurable (either qualitatively or quantitatively) values of wetlands. While many functions of wetlands have been identified, few wetlands perform all these functions, and not all functions are performed equally in each wetland. This manual provides a site specific methodology for evaluating nine functions: Ecological Integrity, Shoreline Anchoring, Storm Surge Protection, Wildlife Finfish & Shellfish Habitats, Water Quality Maintenance, Recreation Potential, Aesthetic Quality, Education Potential, and Noteworthiness. How a wetland functions will depend on the specific biological and physical features of each individual wetland.

The *Coastal Method* evaluation should be applied to individual tidal marshes. The evaluation procedure for each of the functions in the *Coastal Method* is based on the answers to a series of "predictor questions." These questions are based on physical characteristics of wetlands that relate to the ecological and socio-economic functions that wetlands perform. The questions are answered using published data (such as aerial photographs and National Wetlands Inventory maps) and on-site field investigation. Upon completion of the evaluation of each function, a numerical score, the Average Functional Index, is assigned to each Evaluation Unit (defined in Section 3.3). The scores are used in Section 5 of the Manual, Interpretation of Results, to help communities determine which management option is most appropriate for each marsh evaluated.

Section 6 provides a method to collect data that can be used in the assessment of the restoration potential of a marsh system or a piece of it that has been negatively impacted by human development. The impact could be caused by the construction of roads or railroads across the marsh, changes in hydrology, or development in the adjacent upland.

Once a database of wetland functions and a description of the restoration potential has been established for the marshes in a particular town, it will be available to local planners and decision makers to review and implement appropriate management and protection strategies. The *Coastal Method* may also be used as an educational tool to further the understanding of tidal marshes.

2.2 Steps in the Use of the *Coastal Method*.

1. **Determine Study Area**
   The recommended study area would be all of the tidal marshes in a town.

2. **Identify Tidal Marsh Systems**
   Identify all the tidal marsh systems in the study area and assign each a name or number (Section 3.1).

3. **Identify Marsh Category**
   Using maps and legends found in Appendix G, inventory and identify the category (tidal or formerly tidal) of each part of all tidal marsh systems and verify its inclusion in the evaluation. Some marsh systems may include several different categories of marsh (Section 3.1).

4. **Determine Type of Marsh**
   Determine the type of tidal marsh system being evaluated based on location and historic formation processes (Section 3.2).

5. **Determine the Number of Evaluation Units (EUs)**
   Determine the number of Evaluation Units in each tidal marsh system (Section 3.3).

6. **Prepare Marsh Base Map**
   Prepare a base map for each of the Evaluation Units in the study area (Section 3.3).

7. **Conduct Functional Assessment**
   Complete Functional Assessment Data Sheets for all Evaluation Units (Section 4.1).

8. **Interpret Results of Functional Assessment**
   Graphically interpret results of Section 4.1 (Section 5.2 & 5.3).

9. **Assess Restoration Potential**
   Complete the Restoration Potential Narrative for all fragmented tidal marsh systems (Section 6).

10. **Select Appropriate EU Management Option**
    Choose the management option most appropriate to the current condition of the Evaluation Unit (Section 7).

11. **Develop Marsh System Management Plan**
    Develop an approach to the management of the marsh system (Section 8)

12. **Implement Management Plan**

2.3 Materials Needed to Complete the *Coastal Method*.

- Blue line copy of NH Coastal Mapping Project aerial photos for each tidal marsh system in the study area (see Appendix A).
- National Wetlands Inventory (NWI) maps for study area (see Appendix A).
- *Coastal Wetland Plants of the Northeastern United States* by Ralph Tiner (see Section 9). This book should be used in conjunction with Appendix I which lists tidal marsh plant species found in New Hampshire.
- Area calculation grid (see Appendix F).
- Map measuring wheel to measure marsh perimeter; available from office supply store or forestry supply catalog.
- Dividing compass to plot Zone of Influence; available from office supply store.
- Calculator.
- 100-foot tape measure.
- List of federal and state endangered or threatened species (see Appendix A).
- List of NH Natural Heritage Inventory (NHNHI) exemplary communities (see Appendix A).
- Information from the National Register of Historic Landmarks (see Appendix A).
- List of shellfish beds that are open to recreational harvest (see Appendix I).
- List of public boat launches (see Appendix E).

Section 3

PREPARATION FOR FUNCTIONAL ASSESSMENT

3. PREPARATION FOR FUNCTIONAL ASSESSMENT

Section 3 is comprised of three sub-sections. Each provides a method for developing information needed to complete the Functional Assessment in Section 4. Section 3.1 describes the method used to define marsh systems in each town. Section 3.2 helps the user determine what type of marsh is being evaluated based on location and formation processes. Section 3.3 helps determine how these marsh systems will be divided into Evaluation Units and provides instructions for creating a base map for each Evaluation Unit.

3.1 Definitions of Marsh Systems.

This section should be used in conjunction with Appendix G to identify the marsh systems in each of the towns that border on tidal waters (Seabrook, Hampton Falls, Hampton, North Hampton, Rye, New Castle, Portsmouth, Newington, Greenland, Stratham, Exeter, Newfields, Newmarket, Durham, Madbury, Dover, Rollinsford). Appendix G contains maps for each of the coastal towns based on the National Wetlands Inventory (NWI) maps. These maps identify tidal marshes that should be included in the evaluation and other tidal wetlands that should be field checked to determine if they should be evaluated. The maps also divide the marshes in each community into systems to facilitate the use of the *Coastal Method*. **Each marsh system is encircled by a solid line.** These lines were positioned according to location of the marsh, freshwater drainage pattern, and continuity of marsh along a shoreline.

A review of the US Fish and Wildlife Service wetlands classification system (Cowardin et al., 1979) **found in Appendix C is suggested before proceeding with this section.** This classification system is the basis of the wetland identification codes used on the maps in Appendix G.

The maps in Appendix G divide marsh systems or portions of the marsh systems into two categories:

Intertidal Emergent Marshes

The areas shaded in diagonal lines include wetlands identified as intertidal emergent marshes (or vegetated tidal marshes) based on the Cowardin Wetland Classification System (see Figure 3-1).

Other Classifications

The areas shaded in solid black on the town maps include several different wetland classifications that may or may not qualify as tidal marshes and will require field checking to verify their inclusion in the inventory and evaluation. These classifications include: (see Figure 3-1)

estuarine intertidal unconsolidated shore (E2US)
estuarine subtidal unconsolidated bottom (E1UB)
riverine intertidal unconsolidated shore (R1US)
riverine intertidal unconsolidated bottom (R1UB)
palustrine emergent persistent seasonally tidal (PEMR)
palustrine unconsolidated bottom permanently flooded diked/impounded (PUBHh).

These classifications represent several types of tidal wetland that may or may not support persistent vegetation such as: tidal creeks; large pannes that are associated with vegetated tidal marshes; and shoreline along Great Bay, Little Bay and the major tidal rivers. If these areas do support persistent vegetation they should be included in the marsh systems to which they are assigned and evaluated. If they do not support persistent vegetation they should not be evaluated using the *Coastal Method*, **unless** these unvegetated wetland types are contained **within** a marsh system (see Figure 3-1). If so, they should be viewed as diverse habitat within the system and evaluated as such. Wetlands that may have become severely degraded tidal wetlands because the free flow of tidal waters has been restricted and invasive species now dominate should be included in the inventory and evaluation.

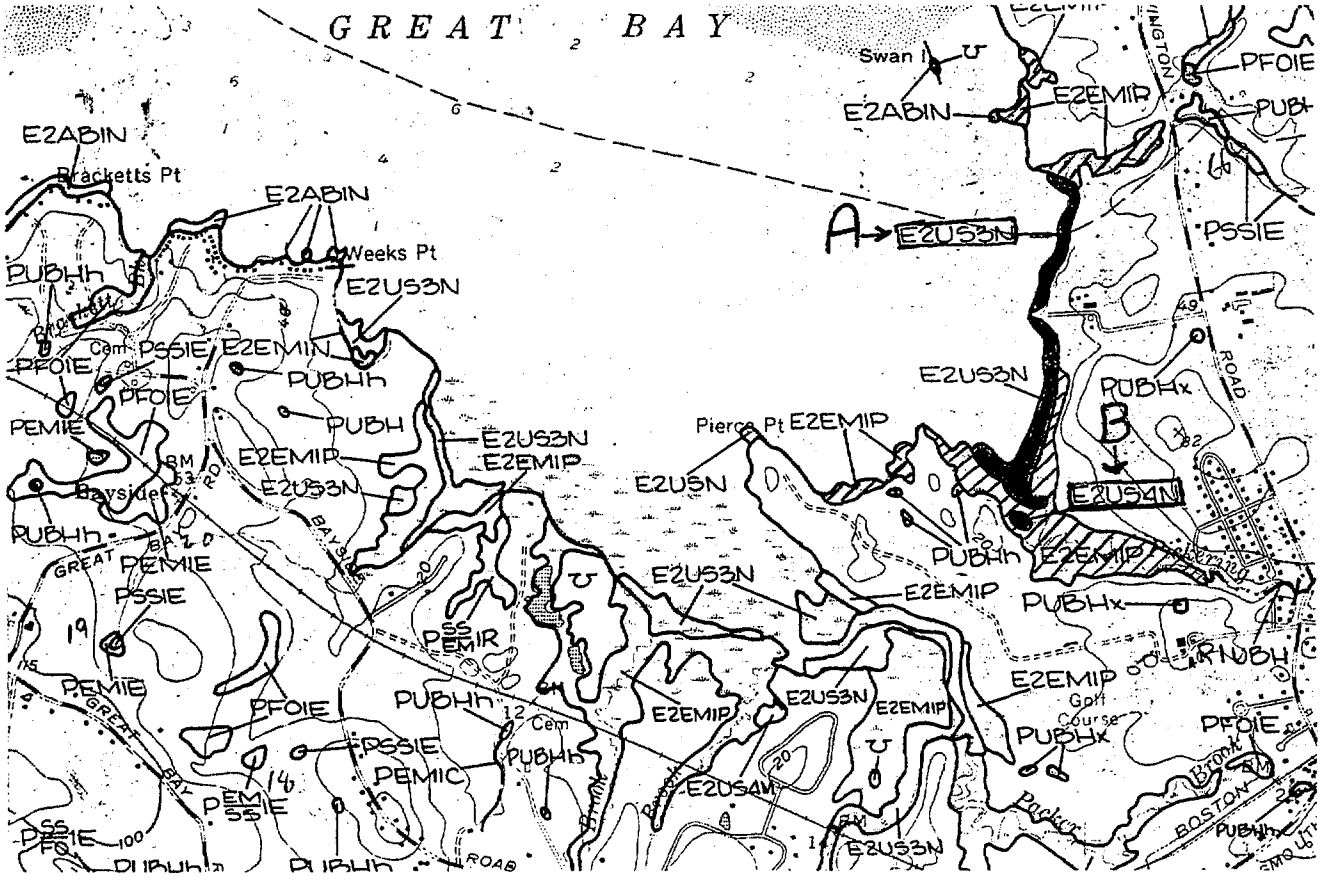


FIGURE 3-1 Sample Map from Appendix G

Intertidal emergent marshes

Wetlands that require field checking

A • (E2US3N) Estuarine Intertidal Unconsolidated Shore Mud Regularly Flooded: would only be evaluated if it supported persistent vegetation such as saltwater cordgrass

B • (E2US4N) Estuarine Intertidal Unconsolidated Shore Organic Regularly Flooded: would be included in the evaluation whether or not it supports persistent vegetation because it is contained within the marsh.

The solid black areas also include wetlands that were once tidal marsh but have since transformed to other types of wetlands (e.g. freshwater) because of the impact of development. It may be that these wetlands have been isolated from tidal influence by the construction of a tide gate, dam, inadequate culvert, or dike and are presently freshwater systems. **These areas that are found to be formerly tidal marshes will not be evaluated by the *Coastal Method*.** However, they should be included in the Interpretation of Results (Section 5) and the Description of Restoration Potential (Section 6). Areas that are found to be freshwater wetlands and are **not formerly tidal** should not be evaluated using the *Coastal Method*. These wetlands should be evaluated using the *NH Method*. Finally, solid areas may represent wetlands that have been mistakenly classified on the NWI maps.

The user of this manual may add or subtract wetlands that appear on the marsh system maps based on their own familiarity with the tidal marshes within the study area. Although the maps may be quite recent, they do not always reflect the present condition of the tidal marsh. If the user determines that an area of marsh included within a larger marsh system is functioning as a separate system, that area should be inventoried and evaluated as a separate system.

The NWI map(s) for a town should be purchased (see Appendix A) and used to identify which wetlands from the maps in Appendix G maps are to be included in the inventory and evaluation. When a survey of the study area has been completed the NWI map should show the current status of each of the wetlands included in the inventory. For example, tidal marsh areas that are included in the inventory and evaluation could be shaded yellow, formerly tidal marshes that are inventoried but not evaluated could be shaded green, and wetlands that were field checked and found to be freshwater systems, that should neither be inventoried nor evaluated using the *Coastal Method*, could be shaded red.

3.2 Type of Tidal Marsh System.

To complete the evaluation for several of the functions, it will be necessary to determine the type of tidal marsh system based on location and the historic processes that led to its formation. The ability to recognize some of the most common tidal marsh plants will be helpful in the identification of marsh types. Saltwater cordgrass (*Spartina alterniflora*) is the dominant plant of low marsh and salt hay grass (*Spartina patens)* will dominate high marsh.

Geomorphological processes led to the formation of tidal marshes in low-lying coastal areas that are protected from excessive winds, waves, and currents. Such low energy environments allow for the deposition of sediments suspended in the tidal waters. Subsequently, marsh plant communities develop on this sediment base. Each of these two processes, the deposition of sediment material and the colonization by tidal marsh plants, reinforce one another. The presence of the plants leads to the trapping of more suspended sediments, and the presence of additional deposited sediments allows building of marsh elevation and for the expansion of the tidal marsh. The combination of these processes leads to the formation of a substrate made up of mineral sediments trapped from the water column and organic matter derived from plant material.

One of the main factors determining the type of marsh system is the primary mode of transport of the mineral sediments into the marsh substrate: a marsh can develop with sediments delivered on the tides, or via river flow. These two different sources of sediments form the basis for the first level of division in the system developed by Dr. Larry Ward of the UNH Jackson Estuarine Laboratory.

The divisions are:

Coastal/Back Barrier Marshes (See Figure 3-2A)

- marshes that derive most of their sediments from sea water
- no **major** tidal rivers flow into these marshes
- marshes located adjacent to Atlantic coast and have direct access to the ocean
- most notably Hampton/Seabrook Saltmarsh
- dominated by *Spartina patens*

Estuarine Marshes

- marshes derive the majority of sediment from freshwater input
- associated with major tidal rivers and bays (Piscataqua River, Salmon Falls River, Bellamy River, Cocheco River, Oyster River, Lamprey River, Squamscott River, Winnicut River, Great Bay, and Little Bay).

The Estuarine Marshes are further subdivided into two classes based on location in the tidal river or bay ecosystem:

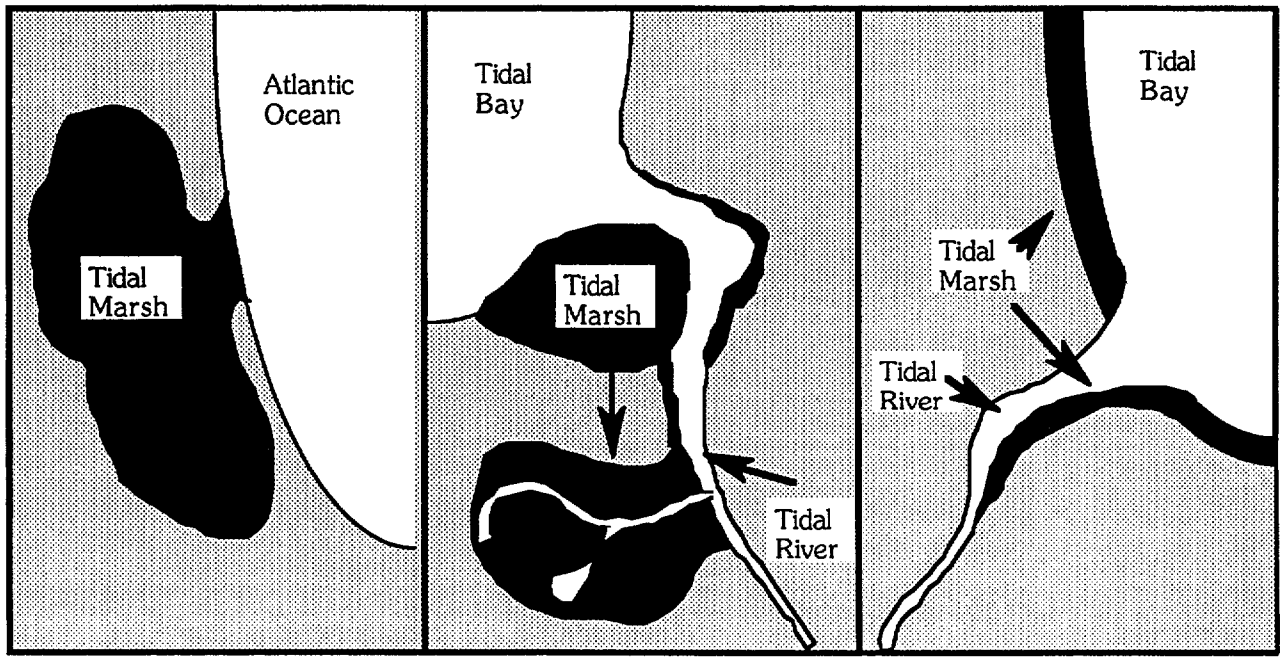
Meadow Marshes (See Figure 3-2B)

- develop in low energy areas
- form along small indentations in shoreline of rivers and bays, inside of meanders, and in floodplain areas associated with tidal rivers
- contain more than 50 percent high marsh
- develop distinct bank between open water and marsh.
- dominated by *Spartina patens*

Fringe Marshes (See Figure 3-2C)

- more exposed to wind and wave energy than other marsh types
- form along river and bay shorelines
- develop little high marsh
- gently grade from open water to upland
- relatively narrow marshes
- dominated by *Spartina alterniflora*
- more susceptible to erosion by erosive forces.

Using the descriptions above, the diagrams in Figure 3-2, and Appendix J determine the type of each marsh system in the study area.



Coastal/Back Barrier Marsh
Figure A

Estuarine Meadow Marsh
Figure B

Estuarine Fringe Marsh
Figure C

FIGURE 3-2 Marsh Type

3.3 Preparation of Base Maps.

A base map should be created for each marsh system evaluated using a blue line reproduction of the 1:2400 (1 inch = 200 feet) aerial photos available from the NH Coastal Program office in Concord (See Appendix A). Blue line reproductions of these photographs are available at a very reasonable cost. These maps will be used to divide up the marsh system into the proper evaluation units and to plot information that will be needed for the evaluation. These maps will be valuable for future reference, so as much data as possible should be plotted on them.

3.3.A Determination of Evaluation Units.

The fragmentation of marsh systems by the construction of roads and railroads, etc., or the deposition of fill on the surface of the marsh, can interrupt the flow of tidal waters. Waters that once flowed freely through the marsh are frequently restricted to a passage through bridges and culverts or are blocked by the presence of a dike. These changes can drastically limit the amount of tidal water reaching parts of the marsh. The placement of fill on the surface of the marsh can raise surface elevations so that the filled area is flooded by tidal waters only during the highest tides. If elevations are raised sufficiently, tidal waters will not reach the surface of the fill. These changes in the natural hydrologic regime can have a serious negative impact on the ecological integrity of the entire marsh system.

In order to better understand the effects of fragmentation on the marsh system, each of the fragmented units will be evaluated separately in Section 4. They will be analyzed graphically by bringing the data from each of the fragmented Evaluation Units (EUs) together in Section 5, to illustrate the impact of fragmentation on the marsh system as a whole.

The tidal marshes along the Atlantic Coast have been more fragmented by road construction and other types of development than those located along Great Bay and the tidal rivers. The 1986 Coastal Mapping Project aerial photos (available from the NH Coastal Program) have broken the coastal marshes into units that can be used as Evaluation Units if they meet the guidelines described in the following paragraph. These maps include all of the marshes in the towns of New Castle, Rye, North Hampton, Hampton, Hampton Falls and Seabrook. The report that accompanies these maps provides valuable information about the condition of the marsh and the causes of degradation in each of the EUs. For the other towns in the coastal zone (Portsmouth, Newington, Greenland, Stratham, Exeter, Newfields, Newmarket, Durham, Madbury, Dover, and Rollinsford) the 1991–1992 Coastal Mapping Project aerial photos (also available from NH Coastal Program) will serve as the foundation for the base maps. Unlike the 1986 maps, these maps do not separate the marsh into units that may be used as EUs. Each town using the 1991–1992 maps will need to determine EUs using the following guidelines and Figure 3-3.

Starting at the edge of the marsh system closest to the source of tidal waters, follow each tidal creek to its end or until the wetland is no longer identified on the photo as a tidal marsh system. Each time a tidal creek is crossed by restriction to tidal flow (culvert, bridge, dike, tide gate) a new EU is created. These restrictions are identified on the aerial photo by road or railroad crossings. It is possible for an EU to contain several different tidal creeks and it is possible for two restrictions to lead into a single EU (See C & D in Figure 3-3).

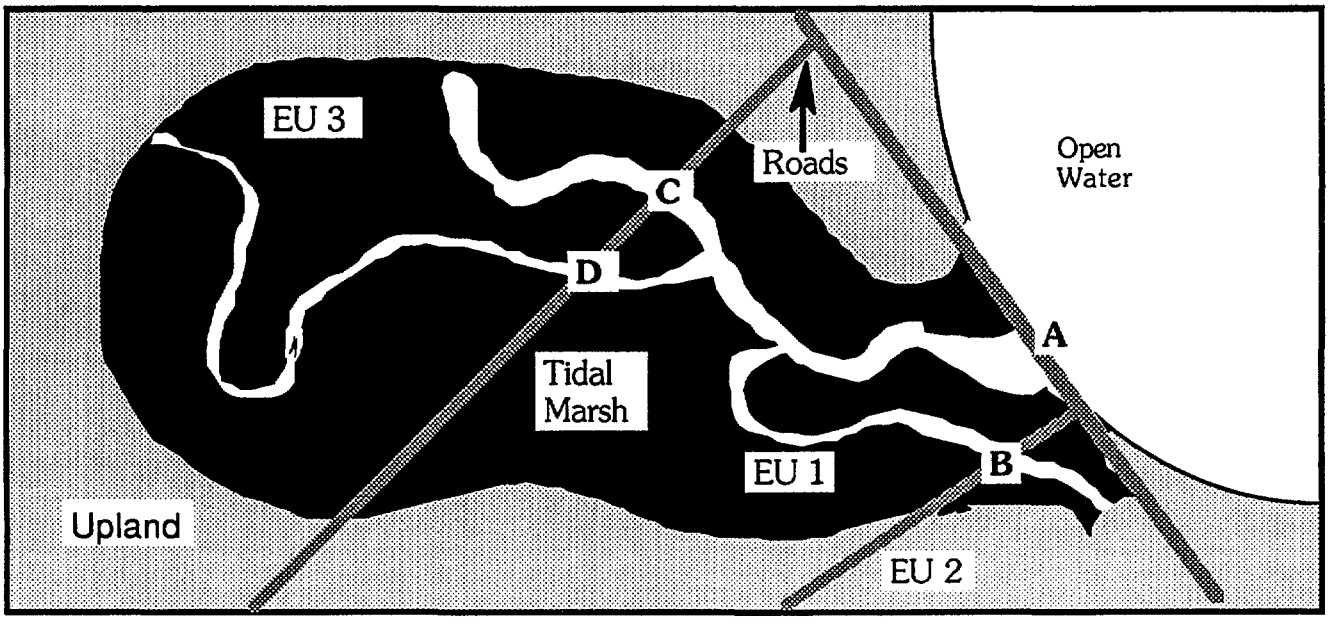


FIGURE 3-3 Determination of EUs

In Figure 3-3, the open water could be either the Atlantic Ocean, Great Bay or one of the tidal rivers. Starting at the point closest to the source of tidal waters, a bridge is encountered at point A. There is no marsh on the ocean side of the bridge so point A marks the beginning of EU 1. After a short distance, the creek then splits into two. Each of these channels must be followed. Point B marks one edge of EU 1 and the begining of EU 2. Returning to the main creek and continuing to follow it inland, there is another split. Each of these channels leads to tidal restrictions at points C & D. This creates another edge of EU 1 and a new EU, #3. Neither one of the tidal creeks in EU 3 flow into any other tidal restriction, and because there is continuous marsh between the two tidal creeks, this area should be treated as a single EU.

3.3.B Information to be Included on Base Map.

The blue line reproductions that were used to identify EUs will serve as the base maps. These maps can provide much of the information for the functional assessment that does not require field observation. Additional information, such as current zoning or number of occupied buildings, may also be available or more easily interpreted from some of the other existing maps (USGS topographic, NWI, or zoning maps) and aerial photos and should be included on the base map. A list of sources of additional information useful for completing the base map can be found in Appendix A.

Each marsh system should have its own base map to make future reference to the collected information more easily accessible. If a system is divided into more than one EU, the information for each EU plotted on the base maps should be color coded so that the data pertaining to each EU is a different color. Some of the work on the base maps should be done before beginning the evaluation in Section 4. However, during the process of evaluating an EU, the user will be directed to plot additional information on the base map.

An example of a base map is provided in Appendix I.

An example of a base map is provided in Appendix I.

Base maps should include the following information:

- **Size of the Evaluation Units in acres.**

Appendix F provides a description of methods that may be used to determine the acreage of the EU. The size of the EU is an important consideration in determining its value for several functions. If an EU occurs on more than one map, all of the maps that cover that EU should be put together to create a single base map that will contain the complete Evaluation Unit. The area of the EU should include any upland islands, pannes, creeks, and other types of habitat that are within the EU on the blue line reproductions used as the base map.

- **The 500 ft. Zone of Influence.**

Each base map should include the area within 500 feet (2.5 inches on 1:2400 base map) of the marsh edge. Land-use in the Zone of Influence has a direct effect on the condition of the marsh. Information about the Zone of Influence that should be recorded on the base maps includes the current use of the land, the zoning classification of the area, occupied buildings, type of septic system, and presence and type of freshwater wetlands.

- **Location of each tidal restriction.**

The location of the tidal restrictions and the cause of the restriction in the EU, such as roads or railroads etc., should be identified on the base map. This information will be needed in the Functional Assessment in Section 4 as well as the Restoration Potential Narrative in Section 5.

- **Location of any fill placed on the marsh surface.**

If during the evaluation or the description of the restoration potential it becomes evident that fill has been placed on the marsh, plot the size and location of the area of fill as accurately as possible on the base map.

- **Location of education, aesthetic viewing sites and public boat launches.**

Mark on the base map the location of each site that would be used for educational purposes or for viewing the aesthetic quality of the marsh. Also indicate the location of public boat launches in the marsh system, boardwalks, trails or visitors centers that enhance access to the marsh. This information should be filled in at the time of the field evaluation.

Section 4

FUNCTIONAL ASSESSMENT

SECTION 4. FUNCTIONAL ASSESSMENT

The *Coastal Method* addresses nine functions of tidal marshes. This does not represent a complete list of all the possible functions of tidal marshes. This functional assessment includes chemical, physical and biological processes that are important for the continued functioning of a marsh, as well as some functions that are important to society.

The functions included are:

1. **Ecological Integrity**: The extent of human development affecting the marsh and the surrounding upland.
2. **Shoreline Anchoring**: The effectiveness of the marsh in controlling and preventing shoreline erosion.
3. **Storm Surge Protection**: The ability of the marsh to protect surrounding upland from storm surges.
4. **Wildlife, Finfish, and Shellfish Habitat**: The suitability of the marsh as habitat for those animals typically associated with tidal marshes and the upland border. No single species is emphasized.
5. **Water Quality Maintenance:** The ability of the marsh to improve the quality of the water passing through the marsh.
6. **Recreation Potential**: The potential of the marsh as a site for recreation. Shellfishing, canoeing, hunting and wildlife observation are among the recreational activities that may take place in tidal marshes.
7. **Aesthetic Quality**: The visual and aesthetic quality of the marsh.
8. **Education Potential**: The suitability of the marsh as an outdoor classroom.
9. **Noteworthiness**: Those attributes that are not identified in the previous functions, but that may be locally or regionally significant.

Instructions for completing Section 4

The following pages provide the framework for evaluating each of the functions in the *Coastal Method*. Each function is prefaced by a short introduction describing its significance in tidal marshes. This is followed by a series of predictor questions. Each question has a set of Directions (instructions on how to answer the question); Evaluation Criteria (descriptive categories and scores ranging from 0.1 to 1.0); and a Rationale (reasons why the question is being asked). This structure assists the user in understanding the fundamental concepts underlying each question.

The questions in each function are divided into those that require the user to be at the study site to answer the question, and those that may not require a site visit. **It is important that the users of the *Coastal Method* spend time in the tidal marshes in their community learning about the plant and animal communities present. This personal knowledge will be helpful when trying to understand the present condition of the marshes and the effects of human disturbance on these systems.**

Data sheets found in Appendix D should be used when recording the results of the evaluation. At the top of each data sheet is a list of materials needed to complete the questions for each function. The sheets are divided into four columns:

Column A – Evaluation Questions: Repeats the question as stated in Section 4.

Column B – Notes: Provides space for notes and should be used to include items of interest in the marsh as they apply to the question and any calculations that are needed to complete the question. This information can prove very valuable for future reference.

Column C – Evaluation Criteria: Repeats the Criteria from Section 4.

Column D – Functional Index (FI): Each criterion in Column C is assigned a FI of 0.1, 0.5, or 1.0 to rate the criteria for each question. When none of the categories seems to clearly define the situation in the Evaluation Unit, the user may interpret the situation and give a score of 0.25 or 0.75 if it seems that the correct answer is somewhere in between the described categories.

When all of the questions in a function have been completed, the scores received for each question should be totaled, divided by the number of questions in the function and rounded off to two decimal points. The resulting number is called the **Average Functional Index** (AFI) and should be recorded in the space provided at the bottom of the data sheet. The AFI will be used in Section 5, Interpretation of Results.

4.1 Functional Assessment.

Function 1 — Ecological Integrity

Tidal marshes are among the most productive and most disturbed ecosystems in the state. It is estimated that 50% of the tidal marshes in New Hampshire have been destroyed. Of the remaining 50%, most of them have been negatively impacted by coastal development to some degree. These impacts include filling and dredging within the EU, construction of roads, railroads or other impounding structures across the surface of the marsh, and adverse land-use in the area surrounding the EU. These impacts can result in the trapping of freshwater from upland drainage, as well as restricting flow of tidal waters that flood the EU. Both of these changes can alter the water and soil chemistry, allowing the EU to be dominated by invasive plant species (e.g. common reed, purple loosestrife), which can lead to the loss of function.

The Ecological Integrity of the marsh is a measure of the extent to which the natural ecosystem has been altered. EUs that have a high Average Functional Index (AFI) for Ecological Integrity have most likely undergone little alteration or degradation. A low AFI for Ecological Integrity indicates an EU that has suffered a high degree of degradation.

This function is divided into two parts. Part A assesses the Ecological Integrity within the EU. Part B assesses the Ecological Integrity of the Zone of Influence by looking at the current condition of the area surrounding the EU. By assessing the two areas separately, the user can gain a better understanding of the factors that influence the integrity of the EU. For example, if the AFI for Part A is high and the AFI for Part B is low, then the EU is being more negatively impacted by what is happening in the Zone of Influence than by a disruption of tidal flushing or extensive damage to the EU itself.

PART A: ECOLOGICAL INTEGRITY OF THE EU

Questions that may require field observation.

Question 1A. Percent of the marsh plant community dominated by invasive plant species.

Directions — Estimate the size of the area of the EU in which plants indicative of changes in the marsh community occur. These species may include common reed (*Phragmites communis*), purple loosestrife (*Lythrum salicaria*), or narrow leaf cattail (*Typha angustifolia*) or other freshwater or upland species that do not naturally occur in tidal marsh communities (see Appendix J).

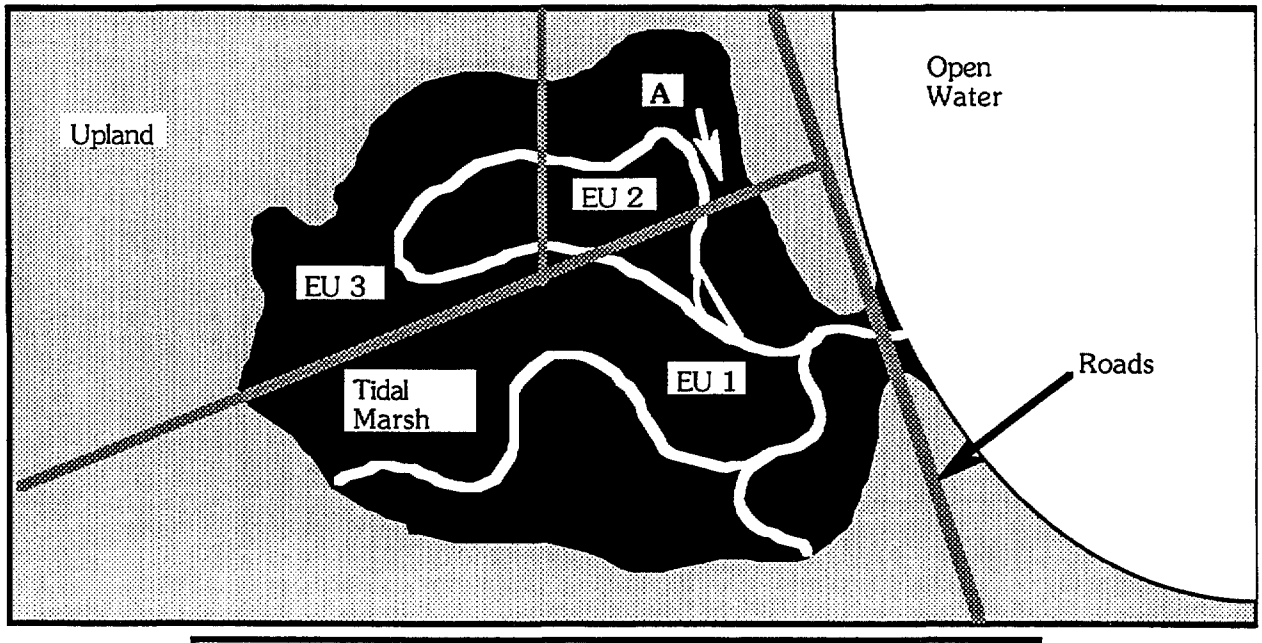
a. less than 5% of EU dominated by invasive species	1.0
b. 5% – 20% of EU dominated by invasive species	0.5
c. more than 20% of EU dominated by invasive species	0.1

Rationale — Invasive plant species may occur in the transition zone of a tidal marsh and not indicate disturbance. However, they can invade and eventually dominate disturbed tidal marshes, causing the loss of the natural diversity in the plant and animal communities. The disturbance can result from changes in drainage patterns caused by road construction, excessive development in the upland, fragmentation of the marsh system, or restriction of tidal flow.

Question 2A. Number of tidal restrictions.

Directions — Count the number of tidal restrictions from the EU to unrestricted tidal flow by the shortest route (see Figure 4-1). Do not consider the bridges over the major tidal rivers as a restriction. A list of the major tidal rivers can be found on page 12.

a.	no tidal restrictions	1.0
b.	one tidal restriction between EU and free tidal flow	0.5
c.	more than one tidal restriction between the EU and free tidal flow	0.1



From point A in EU 2 tidal waters may flow in either direction to reach unrestricted tidal flow. To place this EU in the proper criterion, the shortest route would follow the arrow and have two man-made tidal restrictions

FIGURE 4-1 Counting Tidal Restrictions

Rationale — The restriction of seawater to, and the detention of the freshwater in the marsh can cause changes in the salinity which in turn may affect the natural plant and animal communities of the marsh. The fragmentation of the system by the construction of roads or other types of impoundments and restrictions may influence all of the functions of the marsh. The present condition of the EU may be caused by the cumulative impact of two or more sequential restrictions of tidal flow (see Appendix J).

Question 3A. Type of tidal restriction.

Directions — Identify all the tidal restrictions between the EU and unrestricted tidal waters by the shortest route (See Figure 4-1). Determine which restriction is the most severe and apply the following criteria. Be sure to consider all tidal restrictions affecting flow into the EU (see Appendix J).

a. no restriction affecting flow	1.0
b. flow through bridge appears adequate	0.5
c. flow through bridge appears inadequate and/or flow restricted by culvert(s)	0.1

Rationale —The type of tidal restriction can be one of the main causes of degradation in an EU. A bridge that spans a tidal creek may allow adequate flow in the channel, but the approaches to the bridge are usually associated with the restriction of flow across the surface of the marsh. The presence and type of flow restriction may also cause freshwater flooding in the EU during springtime runoff or major rainstorms. In marsh systems such as the Little River in North Hampton, this flooding can damage surrounding roads and buildings.

There are many types of structures that can influence the free flow of tides, ranging from jetties to culverts. Each type of restriction has different effects on the hydrology of the marsh. For example, jetties, such as those at the mouths of Rye and Hampton Harbors, affect the flow of tidal waters in and out of the marsh. The level of information that will be collected using the *Coastal Method* will not allow for the evaluation of the effects of these changes in hydrology. However, some of the restrictions are so severe that there is a direct effect on the biotic communities of the EU.

Bridges and culverts in the marsh can be of two different types. The restriction with the least effect on a marsh is a structure spanning a tidal creek from headland to headland such as the Rt. 1A bridge over Parsons Creek in Rye. The other type is a road across the surface of the marsh with bridges or culverts over tidal creeks. The construction of the road across the marsh fragments the marsh and creates impoundments which prevent the free flow of tidal waters across the surface of the marsh at the point of construction. Even if the bridge is properly sized for the creek it spans, the amount of tidal water reaching the far side of the road is limited by the presence of the road. Culverts are the most restrictive and are often associated with degraded EUs because of the limited amount of tidal flow that reaches the far side of the culvert.

Question 4A. *Ditching on the surface of the EU.*

Directions — Determine from the base map or a site visit if man-made ditches are present in the EU and in what pattern.

a. no ditching within the EU	1.0
b. ditches present in linear pattern	0.5
c. ditches present in grid pattern	0.1

Rationale — Many of the larger marshes in New Hampshire were ditched either for agricultural purposes or in an attempt to help in the control of salt marsh mosquitoes. The effects of the ditching on the integrity of a marsh are not fully understood, but there is little doubt that the ditches do affect the functioning of the EU. Many times the spoils from the ditching were left on the surface of the marsh next to the ditch, trapping water and leading to the degradation of the marsh peat. A grid pattern of ditches and the associated spoils is more likely to have a negative impact on the EU by trapping both tidal waters and freshwater drainage from the surrounding upland on the marsh surface leading to the dieback of natural tidal marsh plant communities, degradation of the marsh peat and changes in water and soil chemistry.

PART B: ECOLOGICAL INTEGRITY OF THE ZONE OF INFLUENCE

Questions that may require field observation.

Question 1B. Dominant land-use in the 500 foot Zone of Influence surrounding the EU.

Directions — Using the base map, determine the dominant land-use based on the current use of the land. The dominant land-use refers to the use which occupies the largest percentage of the Zone of Influence.

a. forested, fields, open water, or similar open space	1.0
b. agriculture or rural residential	0.5
c. commercial, industrial, high density residential or heavily used highways	0.1

Rationale — The *Coastal Method* assumes that marshes in areas which have low intensity use, such as forestry or open space, are least likely to have undergone past disturbances. In addition, these areas are most likely to remain undisturbed in the future.

Question 2B. Ratio of the number of occupied buildings (including seasonally occupied) within the EU or within the Zone of Influence to the total area of EU.

Directions — Count the number of occupied buildings in the EU and/or within 500 feet of the EUs edge. Use the EU area as previously determined on the base map. Express the number of occupied buildings as a ratio to the area of the EU. If an occupied structure falls half in and half out of the Zone of Influence it should be counted as being in.

$$\frac{\text{number of occupied dwellings}}{\text{total area of EU (acres)}} = \frac{\text{buildings}}{\text{acre}}$$

a. less than 0.1 building/ac.	1.0
b. from 0.1 to 0.5 building/ac.	0.5
c. more than 0.5 building/ac.	0.1

Rationale — Occupied buildings are an indicator of the human impact on the EU. These impacts can include increased runoff, nutrient loading from malfunctioning septic systems and use of fertilizers and increased activity in and around the EU. This activity can be detrimental to water quality and many plants and animals.

Question 3B. Percent of the EU/upland border which has a buffer of woodland or idle land at least 500 feet in width.

Directions — Using the base map, measure the total length of the EU/upland border. Then measure the length of this border which has a 500 foot buffer zone of woodland or idle land. The 500 foot buffer zone will coincide with the Zone of Influence as mapped. **Do not include those areas bordered by agricultural use**. Express the length of the buffer as a percentage of the total length of the EU/upland border.

$$\frac{\text{length of 500 foot wide undeveloped buffer}}{\text{length EU/upland border}} \times 100$$

a. more than 70%	1.0
b. from 30% to 70%	0.5
c. less than 30%	0.1

Rationale — A buffer zone (an uncut area of vegetation providing wildlife cover, and helping to control erosion and maintain water quality) increases the ecological integrity of a EU in several important ways. It provides habitat for upland animals, which may use a tidal marsh during parts of their life cycle, and habitat for water dependent wildlife species that require upland habitat for parts of their life cycle. The vegetation in an undisturbed buffer zone acts as a filter to absorb some of the contaminates from residential, agricultural or commercial development before they can enter the EU. During severe storm events the buffer zone can provide refuge for marsh animals to escape high winds and flooding. These undisturbed areas may also slowly evolve into tidal marsh as sea level rises. Agricultural land is not counted as a buffer zone because the application of fertilizers and pesticides can be harmful to the marsh ecosystem.

Question 4B. Square footage of roads, driveways and parking lots within 150 feet of EU.

Directions — Determine the square footage of roads, driveways and other paved areas such as parking lots within 150 feet of the EU and express it as a ratio to the area of the EU (in acres).

$$\frac{\text{square footage of roads and other paved areas (in sq. feet)}}{\text{area of EU (in acres)}}$$

a. ratio less than 1500 sq. feet/acre	1.0
b. ratio between 1500 – 6000 sq. feet/acre	0.5
c. ratio greater than 6000 sq. feet/acre	0.1

Rationale — Roads, driveways, parking lots, and other paved areas are the focus of considerable disturbance including noise, air pollution and polluted runoff. All of these factors can have an negative effect on populations of plant and animals within the EU.

Function 2 — Shoreline Anchoring

Marshes that border open water, such as those along Great Bay and the major tidal rivers, are exposed daily to the erosive forces of wind and waves. Fringing marshes do not have the extensive peat development that is present in the other types of marsh because they are more regularly exposed to wind and waves. Often they develop in front of eroding upland banks. The eroded material can provide some of the substrate for the initial colonization of saltwater cordgrass. The presence of this marsh vegetation helps to protect the eroding upland by dissipating wave energy. The estuarine meadow marshes develop in areas of lower energy and the vegetation and the root mat of these marshes can help to dissipate wave energy and protect the upland. The coastal/back-barrier marshes along the Atlantic Coast protect the surrounding upland from contact with waves on a daily basis. These areas also serve to protect the upland from severe storm events. This will be dealt with in Function 3, Storm Surge Protection.

In winter, ice is one of the main causes of erosion within New Hampshire tidal marshes. Moving ice, in combination with wind and tides, can do extensive damage. Marshes in areas where there is a significant amount of freshwater input, such as Great Bay and the tidal rivers, and waters salinities are lower are more susceptible to this damage than marshes located along the Atlantic coast. Ice, frozen to the surface of the marsh, rises and falls with each tide. As the tide rises and lifts the ice, large pieces of marsh peat and vegetation can break loose and are deposited lower in the intertidal zone where they are not able to withstand the more prolonged flooding. The upland is protected to a large extent from this ice damage by the presence of a tidal marsh between it and open water.

Questions that may not require field observation.

Question 1. Type of marsh system of which the EU is a part.

Directions — Using Section 3.2, determine the type of marsh system the EU is a part of.

a. estuarine fringing marsh	1.0
b. estuarine meadow marsh	0.5
c. coastal/back-barrier marsh	0.1

Rationale — The type of marsh, based on its location and the processes involved in its formation, will determine the amount of exposure that an EU has to the erosive forces of wind and waves. Fringing marshes develop on the shores of Great and Little Bay as well as along the tidal rivers. These areas are exposed to more daily wind and wave energy than the low energy areas where meadow marshes form (protected coves, inside of river meanders, along small tributaries) as well as coastal/back-barrier marshes (behind barrier beaches and rocky headlands). The criteria are based on the exposure that a marsh has to erosive forces.

Questions that may require field observation.

Question 2. Wetland morphology.

Directions — Determine if there is a distinct bank between the EU and the upland or if the marsh grades slowly into the adjacent upland on the majority of the upland border.

a. no distinct bank evident between EU and upland or freshwater wetland	1.0
b. distinct bank evident but protected by vegetation	0.5
c. distinct bank evident and unprotected by vegetation	0.1

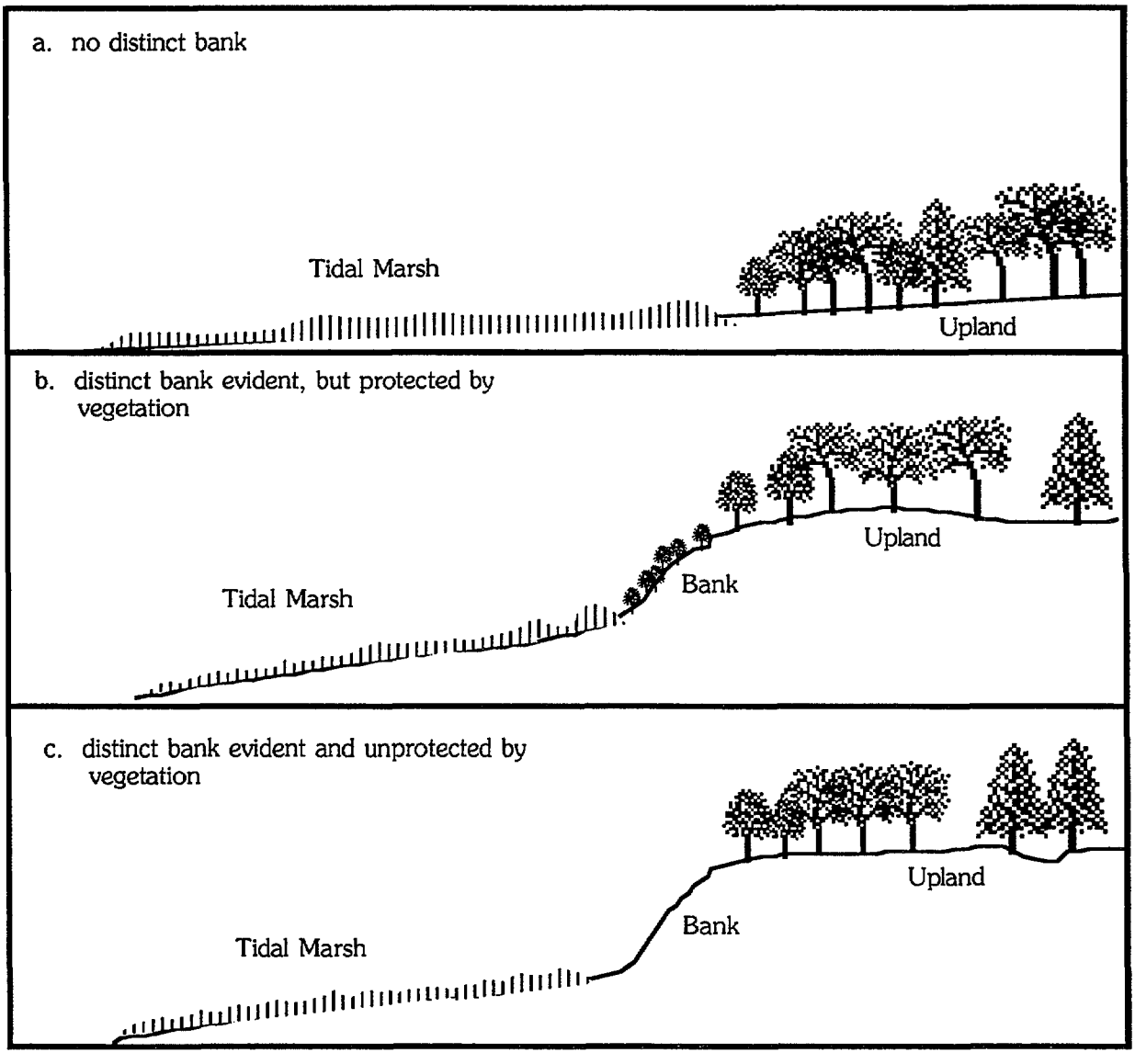


FIGURE 4-2 Wetland Morphology

Rationale — Those EUs that grade from the marsh edge to the upland without a distinct bank are well protected from erosive forces. Steep banks that are protected by vegetation are better protected from erosion than steep banks that are directly exposed to erosion.

Function 3 — Storm Surge Protection

Along the Atlantic Coast severe storms can cause serious coastal flooding and wind and wave damage to private property. Tidal marshes provide protection from the tremendous wave energy associated with these storms. The barrier beaches absorb the brunt of the winds and waves, but the coastal/back-barrier marshes also play an important role in the dissipation of this energy. The estuarine marshes, while not as exposed as coastal marshes to these storm events, do provide some protection to the surrounding uplands. Although a storm surge has an unlimited source of water in the ocean, tidal marshes are the first areas to flood providing the surrounding upland with a degree of protection.

EUs that have restricted outlets may decrease the possibility of flooding from a storm surge by reducing the amount of water that is able to flow into the EU. At the same time they also increase the possibility of flooding from upland drainage especially during spring runoff. The storm surge protection provided by marshes with restricted outlets must be viewed within the context of **all** the functions of a tidal marsh. The greater the restriction, the higher the storm surge protection. However, the restriction also negatively impacts the marsh preventing the tidal marsh from functioning as a natural system.

The following questions attempt to assess the ability of the marsh to function as a natural tidal marsh during a storm and not assess the value of a restriction or impoundment that prevents the marsh from storing waters and dissipating the associated storm energy.

Questions that may not require field observation.

Question 1. Acreage of the EU.

Directions — Use the acreage of the EU as previously determined in Section 3.3.

a. greater than 50 acres	1.0
b. between 10 and 50 acres	0.5
c. less than 10 acres	0.1

Rationale — During severe storm events when wind and wave damage is a threat, the size of the EU is a determining factor in its ability to dissipate the energy associated with a storm and to prevent damage to upland areas. Larger wetlands generally have a greater capacity to lessen the impact.

Question 2. Type of marsh system of which the EU is a part.

Directions — Using Section 3.2, determine the type of marsh system the EU is a part of.

a. coastal/back-barrier marsh	1.0
b. estuarine meadow marsh	0.5
c. estuarine fringing marsh	0.1

Rationale — The type of marsh system is a factor in the importance that the EU plays in this function. Size and location of a marsh system will determine the amount of storm energy a marsh is exposed to and how much protection it can provide to the surrounding upland.

Function 4 — Wildlife, Finfish & Shellfish Habitat

Tidal wetlands in New Hampshire are used by a variety of terrestrial and avian species for feeding, breeding, protection and resting on long migration flights. Many marine animals spend a portion of their lives in the marsh, or depend on resident species for food. Certain environments in the marsh rivers and creeks provide habitat for the numerous species of shellfish that can be found on the seacoast. The limited number of salt marshes and the high degree of disturbance to the coastal ecosystem make the remaining marshes critical to maintaining wildlife diversity on the coast.

Questions that may not require field observation.

Question 1. Acreage of the EU.

Directions — Record the FI from Function 3, question 1.

Rationale — The size of the EU is one of the most important factors in determining the diversity and abundance of wildlife living in or using the EU. It is generally accepted that the larger the marsh, the greater the species diversity and abundance.

Question 2. Ecological Integrity of the EU.

Directions — Record the Average Functional Index of the EU in Part A of Function 1.

Rationale — The ecological integrity of the EU will affect its use by all types of fauna. Areas that have been heavily impacted by human activity are regarded as providing less suitable habitat for wildlife.

Question 3. Type of tidal restriction.

Directions — Record the FI from Function 1, Part A, question 3A.

Rationale — Access to the EU may be impeded for many aquatic animals by the size of tidal restrictions. Although the EU may have the potential to support aquatic life, if the access to these habitats is limited, its use by aquatic species may also be limited.

Questions that may require field observation.

Question 4. Diversity of habitat types.

Directions — Count the number of different types of marsh habitats, from those listed below, that occur in the EU at low tide (See the glossary and Appendix B for habitat type definitions).

1. high marsh
2. low marsh
3. open water
4. tidal flats
5. upland islands and peninsulas
6. shallow pannes
7. freshwater source
8. tidal creek
9. freshwater tidal marsh

a. 7 – 9 types present	1.0
b. 4 – 6 types present	0.5
c. less than 4 types present	0.1

Rationale — A higher diversity of the available habitats will increase both richness and diversity of the wildlife population.

Question 5. Presence of submerged (aquatic bed) vegetation.

Directions — On the aerial photos available, locate up to three of the largest pannes or ponds in the EU. Field check these sites in July or August at low tide to determine the presence and extent of submerged vegetation such as widgeon grass (*Ruppia maritima*). If the evaluation is conducted at a time that this question cannot be answered, eliminate it and only use those question answered to determine the AFI.

a. submerged vegetation abundant	1.0
b. submerged vegetation present but not abundant	0.5
c. no submerged vegetation present	0.1

Rationale — The presence of this vegetation adds to the diversity of the plant communities and provides habitat and food for various animals such as black ducks.

Question 6. Percent of the EU edge bordered by a buffer of woodland, idle land or agricultural land at least 500 feet in width.

Directions — First measure the total length of the EU/upland border. Then measure the length of this border which has a 500 foot buffer zone of woodland, agricultural land, and idle land. Express the length of the buffer as a percentage of the total length of the EU/upland border.

Note: While this is very similar to question 3B in Function 1, it includes agricultural land which can provide important foraging areas for wildlife.

$$\frac{\text{length of 500 ft. wide undeveloped/agricultural buffer}}{\text{total length of EU/upland border}} \times 100$$

a. more than 70%	1.0
b. from 30% to 70%	0.5
c. less than 30%	0.1

Rationale — A buffer zone (an uncut area of vegetation providing wildlife cover) increases the wildlife habitat potential of a marsh in several important ways. As well as providing habitat for upland animals which may use the marsh for feeding, a buffer zone provides habitat for water dependant wildlife species that require upland habitat for parts of their life cycle. Agricultural land is included in this question because these areas can provide foraging areas for wildlife which might not use woodlands. A relatively undisturbed buffer zone decreases the amount of human impact within the marsh, and during severe storm events it may act as a refuge for marsh animals to escape high winds and flooding.

Question 7. Proximity to freshwater wetlands.

Directions — Determine from NWI maps and site visits if the marsh system of which the EU is a part is connected to a perennial stream or if there are any freshwater wetlands within a quarter mile.

a. marsh system connected to a perennial stream or freshwater wetland	1.0
b. marsh system not connected to a perennial stream but within a quarter mile of a freshwater wetland	0.5
c. marsh system not connected to a perennial stream and not within a quarter mile of a freshwater wetland	0.1

Rationale — EUs that are connected to other wetlands by a perennial water course allow the free movement of aquatic species and may provide corridors for the movement of avian and terrestrial species. Other freshwater wetlands that are in close proximity to the EU but not hydrologically connected also offer a more diverse habitat for wildlife.

Function 5 — Water Quality Maintenance

Tidal marshes play a critical role in the maintenance and improvement of water quality. The location of many of these marshes adjacent to the major tidal rivers and the presence of dense stands of vegetation facilitate the uptake and transformation of many of the pollutants and excess nutrients that are present in the water column.

Salt marshes are tremendously productive ecosystems. The enormous amount of primary production (plant growth) that takes place in marshes requires the uptake of large amounts of nutrients. The uptake of the nutrients also serves to improve the quality of the water going out with the tide. During the growing season more nutrients are entering the system than leaving it. However, as the plants die back in the fall, much of the energy stored in low marsh vegetation is exported on the tide to the ocean where it serves as an important source of food for marine animals. A large percentage of the plant material decays and enters the detrital food chain with only a small amount being used by primary consumers. Critical to this export is the capacity of tidal waters to reach the marsh surface. A system of creeks and channels is needed in the marsh to facilitate this exchange, as well as a strong tidal regime supplying enough seawater to flush the marshes.

The improvement of water quality is also closely associated with the marsh's ability to trap sediments. Tidal marshes remove sediments suspended in the tidal waters and in the freshwater from rivers and streams. As the tide rises its waters crest above the surface of the marsh and lose velocity, causing much of the solid material suspended in the water to be deposited. The removal of sediment reduces the turbidity and improves the quality of the water flowing out of the marsh. Deposition of sediments raises the surface of the marsh allowing it to keep pace with sea level rise. This accretion is part of the marsh's natural growth expanding the vegetated portion of the intertidal zone.

Many of the pollutants and excess nutrients in the water are attached to sediment particles and are deposited on the surface of the marsh along with these sediments. The organic soils of the marsh (the high marsh in particular) may adsorb heavy metals that have accumulated in the water and incorporate them in the marsh peat. This process removes them from the water cycle for extended periods of time. Waste water treatment plants, residential septic systems, agriculture and upland development all have had a negative effect on the quality of the waters along our coast.

Questions that may not require field observation.

Question 1. Acreage of the EU.

Directions — Record the FI from Function 3, question 1.

Rationale — The greater the acreage of the EU, the more sheet flow across the surface. This provides the EU with a greater opportunity to trap sediments and uptake and transform nutrients. The larger EUs will most likely contain a considerable area of high marsh where soil conditions allow for more adsorption and retention of heavy metals.

Question 2. Number of tidal restrictions.

Directions — Record the FI from Function 1, Part A, question 2A.

Rationale — The majority of sediments accreted by the EU are suspended in the tidal waters. The restriction of the flow of these waters can limit the amount of tidal waters and suspended sediments flowing into the EU.

Question 3. Type of tidal restriction.

Directions — Record the FI from Function 1, Part A, question 3A.

Rationale — The more the severe the restriction of flow into the EU, the less tidal water the EU has the potential to improve.

Function 6 — Recreation Potential

Tidal marshes are important areas for recreation along the New Hampshire coastline. The extensive use of these marshes by nesting and migrating birds makes them popular sites for hunting and birdwatching. Some of the larger marshes have shellfish beds which attract the recreational harvester. Several marsh systems in the state are located in state or federal areas that are managed for recreation and may have visitor centers, trails and boardwalks. The presence of these facilities enhance the recreation potential of a marsh and improve public access.

Boating takes place in some of the larger marshes along the Atlantic coast. While some of the larger rivers and creeks within or adjacent to these systems can handle power boats, the wakes, noise and water pollution from motorized watercraft can affect the wildlife and other qualities that enhance the recreation potential. Non-motorized boating is a less disturbing way to enjoy tidal marshes and numerous public boat launches provide easy access to them. Questions four and five examine boating access. If it is not possible to use a boat in or adjacent to an EU and it receives a 0.1 for question 4, do not answer question 5 concerning the proximity to a public boat launch.

Questions that may require field observation.

Question 1. Presence of shellfish beds.

Directions — Determine from state and local officials if there are shellfish beds large enough to allow for recreational harvest in the EU and if these beds are presently closed due to poor water quality.

Note: If there is no open water in the EU skip this question and base the AFI on the remaining answered questions.

a. shellfish beds present and open for harvest	1.0
b. shellfish beds present but currently closed for harvest	0.5
c. no shellfish beds present	0.1

Rationale — The harvesting of shellfish for personal consumption has long been a recreational activity on the New Hampshire coast. Today most of the beds are closed because poor water quality contaminates the shellfish, thereby endangering the health of human consumers.

Question 2. Waterfowl hunting.

Directions — Determine if the EU is accessible for hunting by land or boat, and whether it is currently being used for that purpose. NH Fish & Game Dept. Conservation Officers and

local hunters may know if an area is presently used for hunting. Hunting is not permitted within 500 ft. of a dwelling so some EUs may not be used for hunting.

a. EU accessible and currently used by hunters	1.0
b. EU accessible but not presently used	0.5
c. EU not easily accessible or hunting not permitted	0.1

Rationale — Hunting is a popular sport in New Hampshire and many of the tidal marshes are used for waterfowl hunting. The presence of dwellings and the ease of access can influence the use of the marsh for hunting.

Question 3. Opportunities for wildlife observation.

Directions — Record the AFI from Function 4.

Rationale — Non-consumptive recreation which includes observation, photography, etc. is the most popular form of wildlife related recreation. The marshes that rank higher for the Wildlife Habitat Function are more likely to be potential sites for wildlife observation.

Question 4. Canoe and boat passage in or adjacent to the EU.

Directions — Determine the suitability of tidal rivers and creeks within the EU or water adjacent to the EU for canoeing and non-powered boating. In some cases, water levels may only be adequate during high tide.

a. watercourses within EU at least 10 feet wide and one foot deep at high tide and free of obstructions to canoeing and non-powered boating, **OR** EU adjacent to a canoeable waterway	1.0
b. EUs watercourses contain some exposed obstructions and/or shallow areas which may hinder the use of canoes or non-powered boats, **AND** EU not adjacent to canoeable waterway	0.5
c. watercourses too small and shallow or non-existent, watercourses contain obstructions which prohibit the use of canoes and non-powered boats **AND** EU is not adjacent to canoeable waterway	0.1

Rationale — Some EUs are large enough to have rivers or creeks within them which can support use by canoes and non-powered boats. Some EUs are adjacent to open waters such as the major tidal rivers or Great Bay. Both allow for the enjoyment of the aesthetic beauty and the wildlife of the marsh.

Question 5. Canoe and boat access.

Note: If the EU received a 0.1 in question 4, do not answer question 5 and divide only by the number of questions answered when calculating the AFI.

Directions — Determine the distance from the closest public boat launch to the EU by non-powered boat or canoe.

a. access point within a half mile of EU by non-powered boat	1.0
b. access point between a half mile and a mile from EU by non-powered boat	0.5
c. no access or access point more than one mile from EU	0.1

Rationale — The presence of a boat launch near the EU may determine the EUs availability as a boating site. Appendix E contains a list of public boat launches along New Hampshire's tidal waters. There may be other points from which a canoe could be launched.

Question 6. Off-road public parking at the potential recreation site.

Directions — Determine if there is a suitable parking area at the EU edge. Adequate parking requires an open area with a firm soil or gravel base. For safety, the parking area should be located on the same side of the road as the EU and should have an unobstructed view of oncoming traffic at the point of entrance and exit.

a. EU is within 10 minutes or less walking distance of suitable parking	1.0
b. available parking more than 10 minutes walk but less than 20 minutes away from the EU	0.5
c. parking is not available within 20 minutes walk of EU	0.1

Rationale — Parking near the EU is necessary to allow access for many types of recreation.

Question 7. Handicap accessibility.

Directions — Determine whether the edge of the EU is accessible to the handicapped, e.g. trails designed for wheelchair accessibility, special handicapped parking areas, or access via existing roads or trails.

a. specially constructed handicap accessibility	1.0
b. access via existing roads and trails	0.5
c. no handicap access	0.1

Rationale — The recreation potential of the marsh is increased if it is accessible to both handicapped and non-handicapped persons alike.

Question 8. Presence of visitors center, maintained trails or boardwalks.

Directions — Determine if the EU is located within a marsh system that is associated with a visitors center or has trails and/or boardwalks that provide easy access to the EU.

a. visitors center and maintained trails/boardwalks present 1.0
b. maintained trails/boardwalks present but no visitors center 0.5
c. neither a visitors center nor maintained trails/boardwalks present 0.1

Rationale — The presence of a visitors center or maintained trails and boardwalks can enhance the recreation opportunity by providing activities and easy access to the EU.

Function 7 — Aesthetic Quality

The open spaces of tidal marshes are highly valued for their aesthetic quality and contrast to the forests which dominate much of New Hampshire. Marshes that are surrounded by upland forests and freshwater wetlands appear more attractive than those systems which have urban development within the marsh or adjacent to the marsh edge. The fringing marshes along the Great Bay and the estuarine rivers add diversity to the transition of open waters and tidal flats to upland forests and fields, affording the viewer an opportunity to enjoy a vista that is rare within the state.

Before answering the questions for this function, visit the EU and determine if there are one or more viewing sites. Most marshes are viewed from public roads, but other important viewing points might be located along rivers or bays, from a canoe, from a nature trail, or from an overlook. Because some EUs are large and can be viewed from several locations it is important to note on the base map which viewing locations are being evaluated. The Average Functional Index can be based on an average of several viewing locations or the EU can be rated on one outstanding location.

Questions that may not require field observation.

Question 1. Ecological Integrity of the EU.

Directions — Record the AFI of the EU from Function 1, Part A.

Rationale — The ecological integrity of the EU will give some indication of the impacts that transportation, residential, and commercial development have had on the marsh. These types of development will affect the aesthetic quality of the EU.

Question 2. Opportunities for wildlife observation.

Directions — Record the AFI of the EU from Function 4.

Rationale — Vistas that include wildlife enhance the aesthetic quality of the EU. The Average Functional Index received for Function 4 will indicate the potential for wildlife observation.

Questions that may require field observation.

Question 3. Dominant visible land-use surrounding the EU from primary viewing location(s).

Directions — Determine the dominant land-use visible from the primary viewing location(s).

a. woodland, agricultural land, or similar open space	1.0
b. rural residential use (such as 2 acre lots)	0.5
c. commercial, industrial, transportation use or high density residential use (such as quarter acre lots) dominates the visible area	0.1

Rationale — The *Coastal Method* assumes that the most appealing views of tidal marshes include other areas of natural beauty such as upland forests or other open space.

Question 4. General appearance of the EU from the primary viewing location(s).

Directions — Judge the visual quality of the EU from the primary viewing location(s) based on the criteria provided.

a. undisturbed and natural with no visual detractors present such as litter, EU dominated by natural tidal marsh plant community	1.0
b. limited disturbance in the EU, minor visual detractors present and/or invasive species present	0.5
c. severe detractors present and/or EU dominated by invasive species	0.1

Rationale — The aesthetic quality of the EU lies in the natural beauty of its open space and tidal marsh plant community. Trash and other signs of disturbance, including the presence of invasive species, detract from this beauty. Even though some invasive species may be attractive, their presence detracts from the beauty of the more diverse natural tidal marsh plant community.

Question 5. Noise level at the primary viewing location(s).

Directions — In most cases, it will be sufficient to judge the sound level after a period of careful listening at a time at which visitors would be present. It may be necessary to visit several EUs in the study area to determine what constitutes low, medium, or high noise levels in a town.

a. low: birds, wildlife and other natural sounds predominate	1.0
b. moderate: some traffic, airplane or other noise audible	0.5
c. loud: continuous traffic, industrial or other noise	0.1

Rationale — Subjective impressions of noise levels vary from person to person, but it is assumed that continual noise such as that from a busy highway detracts significantly from the aesthetic appreciation of marshes. Noise can be particularly distracting when listening for bird songs and other wildlife sounds.

Question 6. Odors present at the primary viewing location(s).

Directions — Attempt to identify odors present at viewing locations. This may require becoming familiar with the sometimes unpleasant natural odors of tidal marshes.

a. natural odors only (some natural odors may be unpleasant)	1.0
b. unnatural odors present at certain times such as auto exhaust or a sewage treatment plant	0.5
c. unnatural odors distinct, more or less continuous, and noticeably unpleasant	0.1

Rationale — Unnatural odors, such as auto exhaust and factory emissions, are assumed to reduce aesthetic quality of tidal marshes.

Function 8 — Education Potential

Tidal marshes can be important outdoor classrooms for teaching ecological principles. The severe impact of coastal development is easily illustrated by comparing a healthy tidal marsh community with an EU that has been degraded. The ease of access and the proximity of other tidal marshes influences the educational potential of the EU. Large groups are encouraged to restrict themselves to a small area of the marsh that is easily accessed to prevent damage to a more extensive area.

Determine the location of sites which are appropriate for educational purposes and mark them on the base map. An EU may have one or more educational sites.

Questions that may not require field observation.

Question 1. Opportunity for wildlife observation.

Directions — Record the AFI of the EU from Function 4.

Rationale — The educational potential of a site is enhanced by high value wildlife habitat.

Question 2. Presence of visitors center, maintained trails or boardwalks.

Directions — Record the FI from Function 6, question 8.

Rationale — Management for public use or wildlife can increase the educational opportunities associated with an EU. Visitor centers, kiosks, and well marked trials provide interpretation and access to tidal marsh communities.

Questions that may require field observation.

Question 3. Proximity of potential educational site to other habitats.

Directions — Examine the area adjacent to the educational site for other habitats such as tidal marshes (disturbed or undisturbed), freshwater wetlands, formerly tidal areas, mudflats, rocky intertidal shores, rivers, bays, or upland forests.

a. three or more habitat types within a short walk of potential education site	1.0
b. two habitat types within a short walk of potential education site	0.5
c. potential educational site not within short walk to other habitat types	0.1

Rationale — The presence of other natural habitats increases the educational value of the marsh by allowing students to compare and contrast different habitat types. The presence of degraded systems or formerly tidal areas will provide the students with an opportunity to learn about the effects of human disturbance.

Question 4. Off-road parking at potential educational site for school buses or other vehicles (carpools, vans etc.).

Directions — Determine if there is an area large enough for parking and turning a school bus or a small number of cars associated with a carpool.

a. EU within 10 minutes or less walking distance of suitable parking	1.0
b. available parking more than 10 minutes walk but less than 20 minutes away from the EU	0.5
c. parking not available within 20 minutes walk of EU	0.1

Rationale — Parking within easy walking distance of the EU increases its value as an education site.

Question 5. Student safety.

Directions — Examine the potential education site for possible hazards, such as busy roads, railroad trestles, etc.

a. no known safety hazards such as busy roads, steep embankments, railroad trestles, etc. within potential education site	1.0
b. safety hazard present but easily avoidable	0.5
c. safety hazards present and not easily avoidable	0.1

Rationale — A safety hazard is an obvious drawback to an educational site.

Question 6. Handicap accessibility at potential education site.

Note: While handicapped access was assessed in Recreation Potential, the education site may or may not have handicapped access.

Directions — Determine whether the education site is accessible to the handicapped, e.g. trails designed for wheelchair accessibility, special handicapped parking areas, or access via existing roads or trails.

a. specially constructed handicap accessibility	1.0
b. access via existing roads and trails	0.5
c. no handicap access	0.1

Rationale — The education potential of the marsh is increased if it is accessible to both handicapped and non-handicapped persons alike.

Function 9 — Noteworthiness

Noteworthiness refers to a particular physical, biological or social feature which may entitle the EU to be considered especially significant. This may include the presence of a rare or endangered plant or animal species, a site of historical significance, or the designation of the site as an exemplary community. If the AFI for this function is greater than 0.1 the EU should be considered significant. The higher the AFI the more significant features present.

Questions that may not require field observation.

Question 1. EU is habitat for a state or federally listed threatened or endangered species.

Directions — Determine if the EU is used by any threatened or endangered plant or animal species. This information may be obtained from the NH Natural Heritage Inventory (NHNHI), the US Fish and Wildlife Service, the NH Fish & Game Dept. Non-game & Endangered Wildlife Program, the Coastal Zone Program of the Office of State Planning, and the Audubon Society of NH.

a. EU is currently used by threatened or endangered species	1.0
b. EU is not currently used by threatened or endangered species	0.1

Rationale — EUs used by threatened or endangered species may be necessary for the survival of those species. EUs that are currently used by these species should be considered for protection to help ensure their survival.

Question 2. EU has significance because it has biological, geological, or other features which are locally rare or unique OR EU is listed as an exemplary community by NHNHI.

Directions — Determine if the EU contains biological or geological features of significance or is listed as an exemplary community by NHNHI. This could be a freshwater tidal community, the presence of plant and animal species of concern that are not on the threatened or endangered species list, or noteworthy geological features such as remnants of maritime forests indicating the effects of sea level rise over the last 4,000 years.

a. EU contains feature(s) of significance	1.0
b. EU does not contain feature of significance	0.1

Rationale — It is possible that the EU has an attribute which in itself makes the marsh valuable, but was not identified by the functional assessment. These locally rare or unique factors can be highlighted in this question.

Question 3. EU is known to contain an important historical or archaeological site.

Directions — Consult state and local historic resources or enquire through the state archaeological office to determine if the EU has any sites of significance. Photographs or visits to the EU may reveal evidence of historical use.

a. EU is a known site of historical or archaeological significance	1.0
b. no historical or archaeological significance	0.1

Rationale — Coastal marshes have been used by humans as a source of food for consumption and fodder for livestock for a very long time. Some marshes still have remnants of the staddles used to store salt hay until such time as the marsh was flooded to the point that barges could float to the site to haul the hay off. Shellfishing has been an important source of food for centuries (in particular by Native Americans) and evidence of the historical harvest is still visible in certain marshes as shell middens.

Questions that may require field observation.

Question 4. Tidal marshes in an urban setting.

Directions — Determine the dominant land-use within a 1/4 mile of the marsh during a site visit or from aerial photos. The dominant land-use is defined in this question as the land-use which occupies 50% or more of the area within a 1/4 mile of the marsh.

a. commercial, industrial, or transportation use or high density residential use (such as quarter acre lots) occupies more than 50% of the area within one quarter mile of the marsh	1.0
b. rural residential use (such as 2 acre lots), agricultural, forestry or similar open space	0.1

Rationale — Tidal marshes have the potential to enhance the quality of life in an urban environment. Historically, many marshes in urbanized areas were left undeveloped because of severe site limitations. As a result, those marshes remaining in urban areas may be among the last refuges for wildlife as well as some of the few remaining natural landscapes.

Because of the impact of intense human activity, urban marshes may not perform certain functions as well as marshes in undeveloped areas. For this reason, they tend to rank low in the *Coastal Method* for several functions including Ecological Integrity, Wildlife Habitat, and Aesthetic Potential. This should not be interpreted to mean that urban marshes have no value for these functions. These marshes may have considerable value when considered in the context of the surrounding urban land.

Tidal marshes in an urban environment are often marred by dumping of trash and litter. However, when evaluating an urban marsh, take into account how easily the visual detractors can be removed. A somewhat degraded marsh can be the target of a neighborhood cleanup campaign, for instance.

Question 5. EU used as long term research site.

Directions — Check with local colleges, universities and research labs to determine if the EU is used as a site for long term research.

a. EU a site for long term research	1.0
b. EU not a site for long term research	0.1

Rationale — Data that has been collected over a number of years at a single site provides scientists with valuable information about changes in our environment.

Section 5

INTERPRETATION OF RESULTS

5. INTERPRETATION OF RESULTS

The information that has been gathered up to this point in the *Coastal Method* provides a basis for land-use planning decisions to ensure the protection and management of tidal wetland resources. These decisions may be based on the current condition of the marsh, the present land-use in the Zone of Influence, or the town's policy on future growth in the Zone of Influence.

The evaluation of a marsh system may reveal that some of the EUs are highly functioning and healthy while others are degraded to some degree and candidates for restoration. In either case, EUs may benefit from changes in local land-use policies which will protect them from future impacts and further degradation. While these recommendations will focus on a single Evaluation Unit, a management plan should be developed for the entire marsh system whenever possible (See Section 8).

NOTE: Section 5 cannot be completed before the functions in Section 4 of the Method are fully evaluated.

5.1 Average Functional Indices.

To determine the Average Functional Index for each EU, total the Functional Indices received for all the questions answered for a function. Then divide this total by the number of questions answered in that function. This is the Average Functional Index (AFI). The AFI should be rounded off to two decimal place and will fall within a range from 0.10 and 1.00.

The score received for the AFI is an indication of the present condition of the EU. The site specific approach to the functional assessment compares the EU to a imaginary marsh which would receive an AFI of 1.0 for each function. This is not always possible because some questions in the assessment are based on the type of marsh system of which the EU is a part and different functions are better performed by different types of marsh.

5.2 Evaluation Unit Analysis.

For each EU, complete a copy of the Summary Data Sheet and the EU Analysis Graphs contained in Appendix D (see Appendix I for examples of completed forms). The Summary Data Sheet provides space for recording information on the size of the EU, the AFI for each of the functions, and a summary of the reasons for the AFIs received in the evaluation.

The EU Analysis Graphs allow for the evaluation of the EUs in a marsh system in the context of the entire system. To complete the graphs, calculate the percentage of the system each EU occupies. For example, the marsh may be divided into four EUs which represent 12%, 50%, 23%, and 15% of the system. Once the percentages have been determined, they will remain the same for each of the nine functions. If a portion of the marsh has been isolated from tidal flow and is presently a freshwater system (formerly tidal marsh), it should be included as a unit but will be represented differently in this analysis. These formerly tidal marshes will not be evaluated in the *Coastal Method* and will not have any data to be analyzed. However, including the presence of the formerly tidal areas on each graph gives some indication about the overall loss of functional capacity of the tidal marsh system.

For each marsh system a series of ten graphs, representing each function, must be completed. The graphs are composed of two axes, the vertical representing the AFI for the specific function, and the horizontal representing the percentage of area of the marsh system each EU occupies. Starting with the smallest tidally influenced EU draw and fill in a bar whose height represents the AFI and whose width represents the percentage of the marsh system the EU occupies. This should be done for each tidally influenced EU from the smallest to the largest, starting each bar on the horizontal axis where the previous bar ended (see example in Appendix I).

If there are any formerly tidal wetlands included in the marsh system, the bar for these should be drawn last (after the largest tidal marsh EU) and they should be drawn below the horizontal axis to illustrate the loss of function.

When the graph is complete, 100% of the horizontal axis should be filled.

The graphs provide an opportunity to see how the EU functions in response to the impacts of coastal development. The graphs also facilitate an overview of how the different sizes of the EUs relate to the functioning and fragmentation of the entire marsh system.

The information contained on the Summary Data Sheets and the graphs will provide some of the information needed to assess the current condition of the EU and choose the appropriate management option.

SUMMARY DATA SHEET

MARSH SYSTEM _____

EVALUATION UNIT # _____ OF _____

SIZE OF EU _____ acres

PERCENTAGE OF SYSTEM THAT EU REPRESENTS _____

STATUS OF EU (check one) TIDAL____ FORMERLY TIDAL ____

Function	Average Functional Index (AFI)
1A. Ecological Integrity of EU	_____
1B. Ecological Integrity of Zone of Influence	_____
2. Shoreline Anchoring	_____
3. Storm Surge Protection	_____
4. Wildlife, Finfish & Shellfish Habitat	_____
5. Water Quality Maintenance	_____
6. Recreation Potential	_____
7. Aesthetic Quality	_____
8. Education Potential	_____
9. Noteworthiness	_____

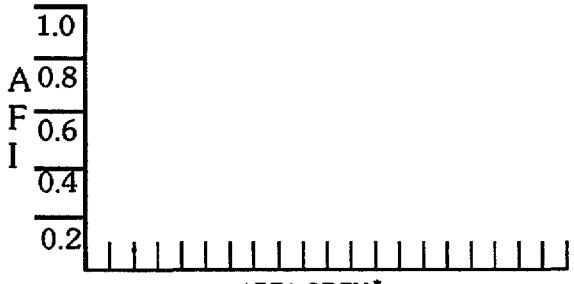
SUMMARY

EU ANALYSIS GRAPHS

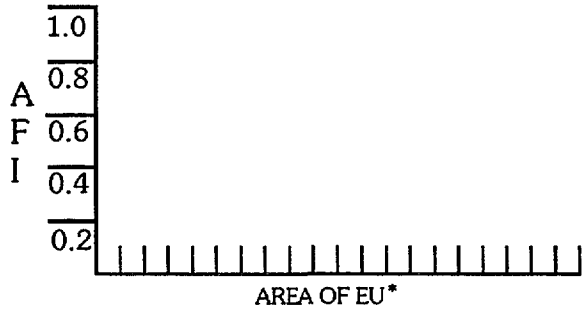
MARSH SYSTEM _____ TOTAL AREA _____

NUMBER OF EUs _____

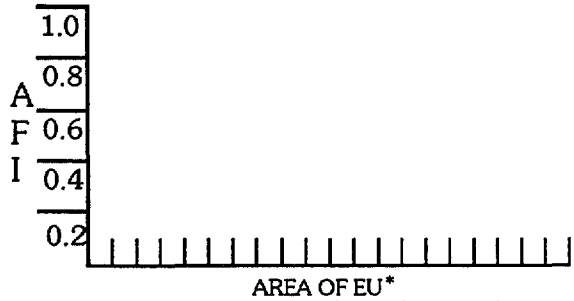
ECOLOGICAL INTEGRITY OF **EU**



ECOLOGICAL INTEGRITY OF **ZONE OF INFLUENCE**

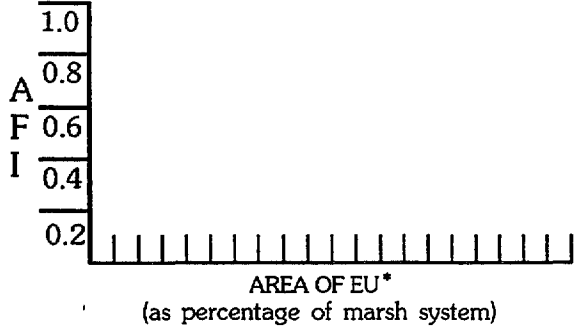


SHORELINE ANCHORING



STORM SURGE PROTECTION

WILDLIFE , FINFISH AND SHELLFISH HABITAT



GRAPH LEGEND

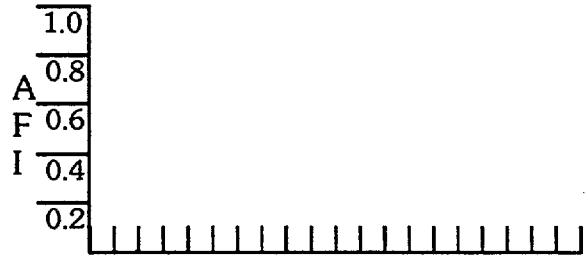
***NOTE**: Each dash on the horizontal axis represents 5% of the marsh system

EU ANALYSIS GRAPHS cont.

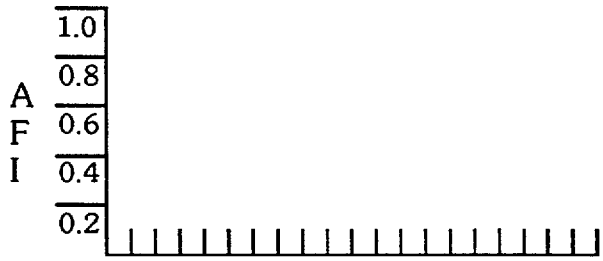
MARSH SYSTEM _____ TOTAL AREA _____

NUMBER OF EUs _____

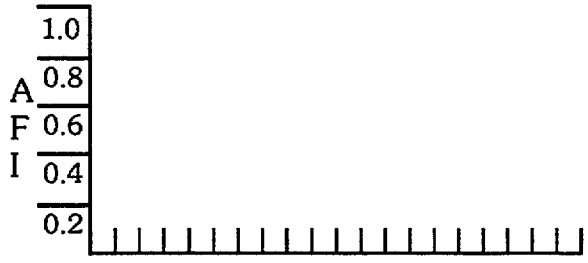
WATER QUALITY MAINTAINANCE



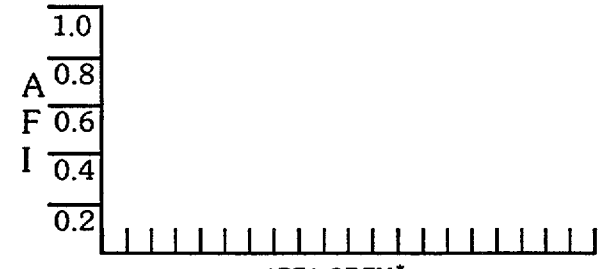
RECREATION POTENTIAL



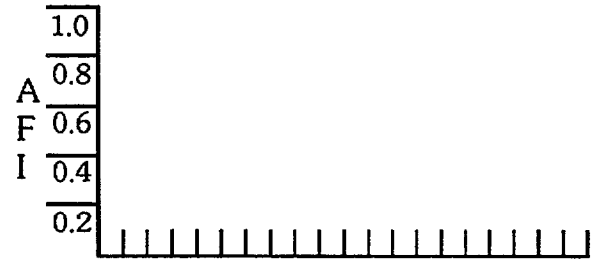
AESTHETIC QUALITY



EDUCATION POTENTIAL



NOTEWORTHINESS



GRAPH LEGEND

***NOTE**: Each dash on the horizontal axis represents 5% of the marsh system

Section 6

DESCRIPTION OF RESTORATION POTENTIAL

6. DESCRIPTION OF RESTORATION POTENTIAL

6.1 Why Do Tidal Marshes Need Restoration?

Many of the tidal marshes in New Hampshire have been impacted by coastal development including fragmentation caused by the construction of roads and railroads and deposition of fill on the surface of the marsh. In many marshes, the free flow of tidal waters across the surface of the marsh at high tide has been either eliminated, or restricted to passage through bridges or culverts. With less salt water inflow into these fragmented portions of the marsh, changes in the water and soil chemistry, such as reduced salinities, can lead to the introduction and possible domination of the marsh system by invasive plant species. These plant species, such as common reed, purple loosestrife, and narrow-leaved cattails can rapidly colonize, out-competing the natural tidal marsh plants and lowering the value of the marsh for many of its tidal marsh functions.

Much of the impact caused by the fragmentation of the marsh system can be lessened or eliminated. Often the tidal restrictions can be corrected. For example, increasing the diameter of a culvert or installing additional culverts allows for better flow of tidal waters onto the fragmented portions of the marsh, and helps to mitigate the impacts of the impoundment. Fill on the marsh can be removed returning the marsh elevation back to a natural level to allow for adequate tidal flushing.

These restorations can have a positive impact on the coastal ecosystem and increase the functional capabilities of marshes, enhancing these areas for the plants and animals that use them.

6.2 What Will This Section Accomplish?

The selection of a restoration site involves many complex issues beyond the scope of this manual. The data collected in this part of the *Coastal Method* will be used to identify, on a preliminary level, potential restoration sites within the study area. Some of the information needed to complete the questions in this section will come from data collected for Section 4.1 of the *Coastal Method*. At times more details will be required to provide the information needed to describe the impacts of development on the marsh.

6.3 Use of Information Collected in Section 6.

The information gathered in this section can provide a preliminary analysis for prioritizing restoration efforts. Other factors that may require more expertise to assess (e.g. site elevations, flow capacity of restriction, and cumulative effect of other associated restrictions) must be taken into consideration. The data collected will form the basis of analysis to determine what marshes or EUs within in a town might be the best candidates for restoration. If a town is interested in pursuing the restoration of a particular EU, or prioritizing the EUs inventoried in Section 4, expert advice should be sought. Depending on the type of impact affecting the EU, different state and federal agencies could be contacted for further information. For example, if dredge spoils have been placed on the surface of the marsh, the NH Coastal Program or the Army Corps of Engineers may be able to provide further assistance. If the impact to the EU is caused by the crossings of roads and railroads, the NH Coastal Program, NH Department of

Transportation, or the town road agent should be contacted to assess the possibility of restoration.

6.4 Restoration Potential of Evaluation Units.

A description should be compiled for each EU that has been negatively impacted by human development. Be as specific as possible. Each EU will have a different restoration potential based on the several factors such as type of restriction and distance to free tidal flow. The information concerning the restoration potential will be compiled but not analyzed because much of the data needed to make decisions concerning restoration requires specialized training and equipment. However, the collected data will help identify those areas that deserve closer scrutiny.

Answer only the following questions that are appropriate for the EU.

Question 1. Number and type of restrictions between the EU and free tidal flow.

Directions — Describe the type, size, location, and impacts of all the tidal restrictions between the seaward edge of the EU and free tidal flow using the shortest route possible (see Figure 4-1). Make a note of any rocks, trees, or other debris that may be blocking tidal creeks. Plot the location of the restrictions on the base map.

Rationale — The EU may be influenced by restrictions of tidal flow that are located in other portions of the marsh. The cumulative effects of these restrictions may have an influence on the present condition of the EU. The number of restrictions will also influence the economic feasibility of restoration. By comparing the size of the creek or channel with the size of the structure restricting tidal flow, valuable information can be provided about the effects of the restriction, and the economic feasibility of altering such a restriction to improve or restore tidal flow.

Question 2. Percent of the EU dominated by invasive species.

Directions — Determine if common reed, purple loosestrife, narrow-leaved cattail or other nontidal marsh plants are present and to what extent they dominate the EU. Estimate the percentage of the EU that is dominated by these invasive species and describe the location of major areas where invasive species dominate.

Rationale — The plant species identified above as invasive species will often occur naturally as indicators of the transition from salt to freshwater or from tidal marsh to upland. However, the domination of an EU by common reed, purple loosestrife, or narrow-leaved cattail may indicate that changes in hydrology have led to the loss of natural tidal marsh plant communities. The identification of areas where these invasive plant species dominate can help determine the effect the flow restriction is having on the EU. The restriction of tidal flow and/or the trapping of freshwater from upland drainage in the marsh can lead to the dominance of the EU by any one or more of these species and will adversely affect the functioning of the EU.

Question 3a. Acreage of fill deposited on the marsh surface.

Directions — Determine if any fill has been placed on the surface of the marsh and estimate the total acreage in the EU. Information about fill in the marsh may be obtained from long time residents, early aerial photos, and from field visits.

Rationale — The acreage of fill placed in the EU will affect the economic feasibility of removing it as part of a restoration project.

Question 3b. Existing plant community located on the fill.

Directions — Describe the plant community found on the fill. Does it presently support a natural tidal marsh community, or does it now support invasive species or upland vegetation?

Rationale — The plant community located on the fill will indicate the present effects of the change in elevation associated with the deposition of fill on the surface of the marsh. Tidal flushing may be limited to only the highest tides or eliminated from these areas entirely and precipitation may be trapped on the surface of the fill. Each of these changes in hydrology can reduce the soil and water salinity. If the fill is sufficiently elevated, this area may support upland vegetation. Some areas of fill, still affected by the tides, may be dominated by invasive species.

Question 3c. Presence of structures on the fill.

Directions — Describe any development such as roads or buildings that have occurred on the fill.

Rationale — The presence of roads and buildings on the fill will affect the economic feasibility of restoration.

Question 4. Other causes of degradation.

Directions — List and describe any disturbances not yet described that may be causing degradation in the EU.

Rationale — At times there may be degradation of an EU caused by an impact not covered in the previous questions. These could include adverse land-use in the Zone of Influence, changes in upland drainage patterns which divert additional freshwater onto the marsh, or impacts associated with changes in the marsh and/or adjacent freshwater wetlands. Any of these factors could influence the hydrology of the marsh or disrupt the nutrient balance of the marsh.

Section 7

EU MANAGEMENT OPTIONS

7. EU MANAGEMENT OPTIONS

Since every EU will be different in terms of the functions it performs, and the degree to which it may be degraded, it is impossible to provide management options for all possible scenarios. Rather, a general framework is provided in which appropriate management and planning decisions can be made. These options do not attempt to preclude communities from developing site specific plans that are more appropriate for the EU and the marsh system. The details of these plans should be made at the local level, using the information gathered for the *Coastal Method* and any other available resources or data. A familiarity with state and federal regulations pertaining to tidal marshes will be helpful in developing the management plan.

The Summary Data Sheet and EU Analysis Graphs completed in Section 5, as well as the Description of Restoration Potential (Section 6) will be used as the basis for choosing the best management options. Some of the functions evaluated are based on the size and type of marsh system of which the EU is part. The size and type of the marsh are fixed characteristics of the EU. Consequently, the scores received for functions such as Storm Surge Protection and Shoreline Anchoring cannot be improved by management of the marsh, but the marshes ability to continue providing these functions is important for the protection of the surrounding upland. However, the AFIs for functions such as Ecological Integrity, Parts A & B, do indicate the effects of human influence on the EU and implementation of a management plan can improve the functional capacity for these and other functions.

The first step in choosing a management plan is the interpretation of the scores received for Ecological Integrity. If the marsh scored high for Part A of Ecological Integrity, it can be assumed that the EU is receiving adequate tidal flushing and supporting a natural tidal marsh community; a low score indicates some problem with tidal flow which in turn may lead to the degradation of the EU. A high score for Part B of Ecological Integrity indicates the Zone of Influence of the EU is relatively undisturbed and provides the marsh with some protection from the impacts of human development; a low score indicates extensive development around the EU which can lower the value of the marsh for several other functions. A review of the Description of the Restoration Potential section should indicate the exact problems causing the degradation of the marsh.

Following the initial interpretation of the results for Ecological Integrity, the interpretation of the AFIs received for Wildlife Habitat, Water Quality Maintenance, and Aesthetic Potential will lead to the choice of a management option. A review of the questions in each of these functions will help to understand what might be done to improve the functioning of the EU.

The remaining functions; Recreation Potential, Education Potential, and Noteworthiness should be analyzed differently. The first two functions can be used in the context of the marsh system or the study area to choose the best location s for recreation and education. If an EU is found to be Noteworthy, it should be given special consideration. The protection of the noteworthy feature must be a priority when developing a management plan based on the results of the evaluation of the other functions. No changes should be made in the EU that will threaten the noteworthiness value.

What can be done to improve or restore an EU can be divided into improvements within the marsh, such as reducing or eliminating the effects of restriction to tidal flow, or

improvements in the Zone of Influence, such as changes in land-use. These changes could include new land-use planning regulations or changes in current usage that may presently be having a detrimental effect on the EU.

The following table provides a matrix to help choose the most appropriate management option for the EU. When using the following table, high will be interpreted as an AFI greater than 0.60 and low will be 0.60 or lower. Most of the EUs will not match any one of the options exactly, choose the one that best describes the results of the evaluation.

EU MANAGEMENT OPTION MATRIX

OPTION A	OPTION B	OPTION C	OPTION D	OPTION E
High Ecological Integrity Part A	High Ecological Integrity Part A	Low Ecological Integrity Part A	Low Ecological Integrity Part A	Low Ecological Integrity Part A
High Ecological Integrity Part B	Low Ecological Integrity Part B	High Ecological Integrity Part B	Low Ecological Integrity Part B	Low Ecological Integrity Part B
High Water Quality Maintainence	High Water Quality Maintainence	Low Water Quality Maintainence	Low Water Quality Maintainence	Low Water Quality Maintainence
High Aesthetic Potential	Low Aesthetic Potential	High Aesthetic Potential	Low Aesthetic Potential	Low Aesthetic Potential
High Wildlife Habitat			Low Wildlife Habitat	High Wildlife Habitat

The following five options provide some suggestions for possible management plans for the EUs. Conservation Commissions may use available expertise to develop management options that are site specific to the EUs in their town.

OPTION A: A plan should be developed to ensure future protection of this EU. The town should investigate the possibility of purchasing or obtaining conservation easements on land in the Zone of Influence. A review of the current zoning and other land-use regulations covering the Zone of Influence should be done and any changes that ensure the continued protection be made. Consideration of a tidal marsh buffer zone will help to maintain a high Ecological Integrity and Aesthetic Potential for the EU. The Conservation Commissions should carefully review any plan that might affect the flow of fresh or salt water into and out of the EU. This includes road construction or improvement and development in the watershed of the EU.

OPTION B: Continued protection of the tidal flow to the EU is critical to maintaining it's integrity. A review of those functions that consider the Zone of Influence, Ecological Integrity Part B, Wildlife Habitat, and Aesthetic Quality, and question 6 of the Description of the Restoration Potential should help to identify those upland influences that are affecting the EU. A careful survey of the current use and land-use regulations in the Zone of Influence may reveal a problem which is negatively impacting the EU. If a current activity in the area is leading to the degradation of the EU and the Zone of Influence, a plan to mitigate the effects should be developed. Any changes in land-use regulations that can prevent further use of the Zone of Influence in ways that lead to damage of the EU should be explored.

OPTION C: A further assessment of the possibility of restoring tidal flow should be done including the economic and engineering feasibility of improving or removing the structure restricting the flow. More specific information about the causes of the low Ecological Integrity of the EU should be collected, this may require expertise in wetland science and hydrology. A review of the current land-use regulations covering the Zone of Influence should be done and changes made that ensure the continued protection of this area.

OPTION D: The management plan for this EU should carefully analyze what steps can be taken that will most directly influence the marsh. If changes in the current use of the Zone of Influence are unrealistic, it may be most effective to try to improve the flow of tidal waters to the EU. This action may have the greatest impact on the most functions. The control or elimination of invasive species present in the marsh will improve the Wildlife Habitat, Aesthetic Potential and Ecological Integrity of the EU. Activities in the Zone of Influence that can be easily changed to lessen the impact on the EU should be considered.

OPTION E: Although this EU has received low scores for several functions it has a high score for wildlife habitat. When developing a plan for EUs such as this one, consideration should be given to the effect changes will have on the wildlife potential. Implementation of changes that will improve the Ecological Integrity of the EU while maintaining or improving the Wildlife Habitat should be considered. However, changes that may negatively impact the current use of the EU by wildlife must be balanced against the improvement in other functions.

Section 8

MARSH SYSTEM ANALYSIS

8. MARSH SYSTEM ANALYSIS

Once management options have been chosen for each EU in a marsh system, a review of the system as a whole will help to set priorities for an overall management approach. It is up to the community to determine the management priorities for their town. Consideration should be given to the possible effects that changes in any one EU might have on the marsh system. The cumulative and secondary impacts of all the management plans should be investigated so that the appropriate system plans can be developed. When developing a marsh system management plan it is important to consider the following factors:

- **Size of each EU**

The acreage of the EU should be considered when setting priorities for the marsh system plan. For example, when looking at developing a plan for a marsh system that has a small degraded EU and a relatively large healthy unit, it is important to weigh the benefits of restoration of the small unit and the benefits of land protection or acquisition of land in and around the larger unit. On the other hand, where several large EUs are degraded in the marsh system, consideration should be given to a marsh system restoration plan.

- **Current condition of marsh system**

Based on the EU Analysis Graphs, assess the overall condition of the marsh system. Determine what problems, if any, are influencing the functioning of the system.

- **Noteworthy features**

Protection of EUs that are determined to be noteworthy should be prioritized in the formation of the marsh system management plan.

- **Local management priorities (restoration/protection)**

Towns must decide what is most important to their community (e.g. restoration of degraded marsh systems, protection of systems that are presently in good condition).

- **Local land-use regulations**

A review of all of the land-use regulations that affect the marsh system should help to identify those regulations that are responsible for negative impacts on the EU. Planners and other town decision makers should work on developing proposals, such as tidal marsh buffer zones, that will provide the best protection and enhancement to the marsh system.

- **State and federal protection policies**

Towns should have a good working knowledge of state and federal policies that affect the tidal marshes in New Hampshire. This information is available from the NH Coastal Program at the Office of State Planning.

A Marsh System Data Sheet should be filled out for each marsh system with more than one EU. A blank copy of the sheet is contained in Appendix D. If a formerly tidal marsh was identified as one of the EUs in a system, its tidal status should be identified in the column for Management Options.

MARSH SYSTEM DATA SHEET

It is not necessary to complete the marsh system data sheet for those systems that have a single EU

MARSH SYSTEM _____ NUMBER OF EUs _____

EU Number	Size in acres	Management Option Chosen

Best Education Site(s) in Marsh System _____

Best Recreation Site(s) in Marsh System _____

Public Access Points In or Adjacent to the Marsh System _____

_____

Noteworthy Feature(s) _____

_____

Section 9

GLOSSARY OF TECHNICAL TERMS

9. GLOSSARY OF TECHNICAL TERMS

This glossary provides non-technical definitions of technical terms, some of which are used in this manual. This is by no means an exhaustive list of all the terminology pertaining to tidal marshes. For more detailed reference to tidal marsh terminology, see the references listed in Section 9.2 of this manual.

accretion	the gradual build up of surface elevations due to the deposition of suspended sediments on the marsh surface
adsorb	the chemical adhesion of one substance to the surface of another e.g. nutrients and pollutants may be adsorbed to the surface of sediment particles
aquatic	in or near water in such habitats as ponds, lakes, rivers and oceans
avian	relating to birds
back-barrier marsh	a marsh that forms in the low-lying area behind a barrier beach formation
barrier beach	an elongated landform created by the deposition of sedimentary materials by wind and wave currents, usually parallel to the shoreline, with water on at least two sides, and composed of sand, gravel, or cobblestones
benthic	relating to or occurring on the bottom of a body of water
biota	the flora and fauna of an area
brackish marshes	tidal marshes where the average water salinity is less than 18 parts per thousand (ppt) but greater than 0.5 ppt which is the upper limit of salinity in a freshwater tidal wetland
buffer zone	a naturally occurring undeveloped area of unspecified width, bordering on a wetland, that serves to lessen the impact of disturbance, (e.g. urban development)
carrying capacity	the population of a species that an area can support without deterioration
cobble	a naturally rounded stone larger than a pebble but smaller than a boulder
deepwater habitats	permanently flooded areas deeper than 6.6 feet, e.g. lakes

degraded	characterized by loss of natural ecological structure or function
detrital food chain	food chain dependent upon decomposed plant and animal material as the source of energy
detritus	particles that result from the disintegration of organic material
diurnal flooding	flooding that occurs on a daily basis
dominant plant community	a single species or association of plants that are indicative of the ecology of an area, e.g. in a cattail marsh the dominant plant community is cattails
drainage pattern	the paths followed by surface runoff from precipitation within a watershed
ecology	the study of interactions between living things and their environment
ecological integrity	the natural (undisturbed) quality of an environment
ecosystem	a community of plants and animals and the physical environment they inhabit (such as estuaries and tidal wetlands) which results from the interactions among soil, climate, vegetation, and animal life
emergent plant	erect, rooted, herbaceous plants that can tolerate flooded soil conditions, but not prolonged periods of being completely submerged, these include grasses, sedges, rushes, and rooted aquatic plants; there are two types of emergent plants: persistent – emergent plants whose stems remain standing through the winter until the beginning of the next growing season (i.e. they persist) e.g. cattails or bulrushes non-persistent – emergent plants whose stems and leaves break down at the end of the growing season; from late fall to early spring there are no visible traces of these plants above the surface of the water (i.e. they do not persist)
estuary	environments where tidal waters mix with freshwater: estuaries exist wherever rivers meet the sea
exemplary community	an area selected by NHNHI as representative of the natural plant and animals found in a particular ecosystem
fill	material, usually associated with the dredging of a harbor or inlet, placed on the surface of the marsh; the change in elevation caused by the

	disposal of this material in the marsh can lead to the loss of the area as a functioning tidal marsh
food chain	an arrangement of organisms of an ecological community according to the order of predation; at the bottom of the food chain are animals that eat plants while the animals at the top eat other animals
formerly tidal marshes	coastal wetlands that were once connected to tidal flow but have since been isolated from tidal waters by the construction of a man-made obstruction
freshwater marshes	emergent wetlands that are usually seasonally or permanently flooded, and support a growth of emergent plants (e.g. cattails, pickerel weed) floating leaved plants (waterlilies, pondweed), and submergents (e.g. coontail)
freshwater source	the point of origin of nontidal waters including rivers, streams and surface runoff
freshwater tidal marshes	marshes that are tidally influenced, but where the average water salinity is less than 0.5 parts per thousand (ppt)
geomorphology	the study of the natural processes involved in the creation of landforms such as tidal marshes and barrier beaches
habitat	the environment in which the requirements of a specific plant or animal are met
heavy metal	a group of dense metals, including mercury, lead, cadmium, and others, that share the characteristic of being accumulated in organisms and tend to become increasingly concentrated in organisms higher up on the food chain
herbaceous plant	a non-woody plant with a soft stem, e.g. bulrushes and cattails
high marsh	areas of tidal marshes that are irregularly flooded (frequently beyond the reach of daily flooding) and are dominated by salt hay grass (*Spartina patens*)
hydric soil	a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic (oxygen deficient) conditions in the upper part of the soil. Hydric soils are generally poorly drained or very poorly drained poorly drained – water is removed from the soil so slowly that the soil is saturated periodically during the growing season or remains wet for long periods

	very poorly drained – water is removed from the soil so slowly that water remains at or near the surface during most of the growing season; this is the most dominant soil drainage class of tidal marshes
hydrology	the scientific study of the properties, circulation, and distribution of water as it occurs in the atmosphere and at the earth's surface as streamflow, precipitation, soil moisture, and ground water
hydrologic regime	the dominant process by which water enters and leaves an ecosystem
hydroperiod	the time period during which the surface water remains on the wetland (marsh) surface; in tidal marshes, the hydroperiod can range from daily flooding to irregular flooding (e.g. every few days, weeks, or months)
hydrophyte	a plant that is adapted for life in water or in periodically flooded and/or saturated anaerobic (oxygen poor) soils e.g. cattails, saltwater cordgrass
intertidal emergent	an erect rooted herbaceous plant growing in the intertidal zone
intertidal unconsolidated bottom	wetlands that have at least 25% cover of particles smaller than stones, less than 30% vegetative coverage, and are only intermittently exposed, such as pannes and tidal creeks
intertidal unconsolidated shore	wetlands which have at least 75% coverage of stones, boulders or rocks, less than 30% vegetative coverage, and are alternately flooded and exposed by the tides
intertidal zone	areas that are alternately exposed and flooded by tides
invasive species	plant species that, when introduced to an ecosystem, can disturb the natural balance and habitat diversity by invading and dominating the natural tidal marsh plant community and establishing dense monotypical stands of vegetation
low marsh	areas of marsh that are flooded twice a day and are dominated by saltwater cordgrass (*Spartina alterniflora*)
marine	relating to ocean environments
marsh hydrology	this term describes (1) the hydrologic pathways such as precipitation, surface runoff, ground water, tidal fluctuations and flooding rivers which transport nutrients to and from wetlands; (2) the water depth; (3) frequency and duration of flooding in tidal marshes

marsh peat	the organic soil formed by the accumulation of dead marsh plant material and trapped sediments from tidal waters
marsh restoration	improvement of existing marsh condition by reversing some of the adverse impacts caused by coastal development
marsh system	an area of marsh associated with a single opening to the ocean, a single freshwater input, or adjacent to and contiguously along the shore of a tidal river or bay
mitigation	the restoration or creation of a wetland to replace the loss of a wetland due to development or construction.
open water	areas within a marsh that may be only intermittently flooded and are not supporting persistent emergent vegetation
organic matter	a combination of decayed and decaying plant and animal residue
organic soil	soil consisting of at least 18% organic material
overland flow	a term to describe the sheet-like flow of water over a land surface, not concentrated in individual channels; usually associated with areas of low infiltration such as paved surfaces or surfaces lacking vegetation (see also surface runoff)
pannes	shallow ponds that form on the surface of the marsh and hold salt water between tides
primary consumer	animals that eat plant material as their main source of energy
primary production	the generation of plant material by photosynthesis
riverine	within the channel of a river
intertidal emergent	wetlands in a river channel that are influenced by the tides and are dominated by erect rooted herbaceous hydrophytes
scrub-shrub	woody vegetation less than 20 feet in height including true shrubs, saplings and trees and shrubs stunted by environmental conditions
sea level	the level of the surface of the ocean at its mean (average) position between high and low tide
sheet flow	unchannelized flow of water across the surface of a marsh or upland

shell middens	a pile of shells remaining from the harvesting of shellfish by Native Americans and early settlers; shell middens are historic relics
site specific method	an evaluation method which examines only the subject area without comparison to any other area
spit	a small point of land, especially sand or gravel, formed by the deposition of material by wind and water currents that runs into a body of water
spoils	dredged or excavated soil
spring high tide	tides higher and lower than the average tide associated with the full and new moon
staddle	a structure consisting of numerous pilings driven into the marsh on which to stack salt hay to keep it above the tidewaters until it could be hauled off
substrate	the type of bottom sediments such as sand, gravel, peat
surface runoff	the movement of water over the land surface (usually in defined channels), resulting from rainfall or snowmelt; percentage of precipitation that becomes runoff varies depending on the slope of the area, the degree of soil saturation, amount of vegetated coverage, or type of surface e.g. paved areas
tidal amplitude	the variations in the height of tides caused by the lunar cycle, elevation above sea level, the barometric pressure, tidal restrictons and the seasons
tidal creeks	small streams in the tidal marsh whose main source of water is dominated by tidal action
tidal flats	areas that are irregularly exposed and are devoid of vascular plant species, also called mud flats or unconsolidated bottom
transition zone	area surrounding a wetland where conditions gradually change from wetland biota to upland biota
turbidity	the clarity of the water column as determined by the presence of suspended particles making the water cloudy
upland islands	areas of upland soils and vegetation located within a tidal marsh
upland peninsula	areas of upland soils and vegetation that extend into the tidal marsh, and are surrounded on three sides by the tidal marsh
vegetated tidal marsh	marshes dominated by emergent vegetation and influenced by the tides

water column	the habitat that exists in standing or flowing water extending in a column from the surface of the water to the surface of the substrate
watershed	the area from which all water including precipitation, streams and rivers drain to a single point
wetlands	those areas that are inundated or saturated by surface or ground water, support a prevalence of vegetation adapted to life in saturated conditions (i.e. hydrophytes), and are characterized by hydric soils; these include bogs, marshes, swamps, wet meadows, and similar areas
Zone of Influence	area surrounding a wetland in which the activities that take place have an impact on the wetland; in the *Coastal Method* the Zone of Influence is defined as 500 feet

Section 10

REFERENCES

10. REFERENCES

10.1 Principal References Used in the Development of the Manual

Adamus, P.R. and L.T. Stockwell. 1983.
A Method of Wetland Functional Assessment: Volumes I & II Report No. FHWA -1P-82-23 and FHWA-1P-82-24. Office of Research and Development, Federal Highway Administration, U.S. Department of Transportation, Washington, D.C.

Adamus, P.R. et al. 1987.
Wetlands Evaluation Technique. (WET): Volume II: Methodology, Operational Draft Technical Report Y-87-__, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Ammann, A.P. and A. Lindley Stone. 1991.
Method for the Comparitive Evaluation of Nontidal Wetlands in New Hampshire. NH Department of Environmental Services, Concord, NH NHDES-WRD-1991-3

Cowardin, A.P. et al. 1979.
Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, Washington, D.C. FWS/OBS-79/31

Montgomery, C.W. 1989
Environmental Geology.
Wm. C. Brown Publishers, Dubuque, Iowa

Short, F.T. 1992. ed.
The Ecology of the Great Bay Estuary, New Hampshire and Maine: An Estuarine Profile and Bibliography.
National Oceanic and Atmospheric Administration, Washington, D.C.
Coastal Ocean Program Publication

Tiner, R.W. 1987.
Coastal Wetland Plants of the Northeastern United States.
The University of Massachusetts Press, Amherst, Mass.

10.2 Recommended Reading/Suggested Field Guides

Bertness, M.D. 1992
The Ecology of a New England Salt Marsh
American Scientist Vol. 80 pp. 260-268

Breeding, C.H., F.D. Richardson, S.A.L. Pilgrim. 1974.
Soils Survey of New Hampshire Tidal Marshes.
NH Agricultural Experimental Station
UNH Durham, N.H.

Cowardin, A.P. et al. 1979.
Classification of Wetlands and Deepwater Habitats of the United States.
U.S. Fish and Wildlife Service, Washington, D.C. FWS/OBS-79/31

Mitsch W.J., J.G. Gosselink 1986
Wetlands.
Van Nostrand Reinhold, New York, N.Y.

Niering, W.A. 1988.
Wetlands: The Audubon Society Nature Guide.
Alfred A. Knopf Inc., New York, N.Y.

Nixon S.W. 1982.
The ecology of New England high salt marsh: a community profile.
U.S. Fish & Wildlife Service, Office of Biological Services
Washington, D.C. FWS/OBS-81/55

Odum W.E. et al. 1984.
The ecology of tidal freshwater marshes of the United States east coast: a community profile.
US Fish & Wildlife Service, Office of Biological Services
Washington, D.C. FWS/OBS-83/17

Short, F.T. 1992. ed.
The Ecology of the Great Bay Estuary, New Hampshire and Maine: An Estuarine Profile and Bibliography.
National Oceanic and Atmospheric Administration, Washington, D.C.
Coastal Ocean Program Publication

Teal, J., M. Teal. 1969.
Life and Death of the Salt Marsh.
Ballantine Books, New York, N.Y.

10.2 Recommended Reading/Suggested Field Guides cont.

Tiner, R.W. 1987.
Coastal Wetland Plants of the Northeastern United States.
The University of Massachusetts Press, Amherst, Mass.

10.3 OSP Coastal Program Publications of Interest

The NH Office of State Planning Coastal Program has numerous publications that may be helpful when using the *Coastal Method*. A list of these publications is available from the Coastal Progam Concord Office.

APPENDIX A

SUGGESTED SOURCES OF INFORMATION FOR COMPLETING THE COASTAL METHOD

SUGGESTED SOURCES OF INFORMATION FOR COMPLETING THE COASTAL METHOD

ASCS – Agricultural Stabilization and Conservation Service
NHF&G – NH Fish & Game Department
OSP – Office of State Planning
DOT – NH Department of Transportation
ASNH – Audubon Society of New Hampshire
NHNHI – New Hampshire Natural Heritage Inventory
GBNERR – Great Bay National Estuarine Research Reserve
ACOE – US Army Corps of Engineers

Information:	**Available From:**
Aerial Photographs	OSP Coastal Program, DOT, County ASCS, Municipal Offices
Archaeological Information	NH Division of Historical Resources
Endangered and Threatened Wildlife	NHF&G Non-Game Wildlife Program, ASNH
Endangered and Threatened Plants	NHNHI
Exemplary Natural Community Listings	NHNHI
Historic Preservation Information	NH Division of Historical Resources Local Historical Societies
Municipal Tax and Zoning Maps	Municipal Offices
National Wetlands Inventory Maps	OSP, or by calling 1-800-USAMAPS
National Register of Historic Landmarks	NH Department of Historic Resources,
Protected Lands	NHF&G, ASNH, Municipal Offices, GBNERR, Local Land Trusts
Public Boat Launches	NHF&G, OSP, Appendix I
Restoration	ACOE, OSP Coastal Program
Shellfishing Information	NHF&G
USGS Topographic Maps	Local bookstores, sporting goods stores National Survey, Chester, Vt. (802) 875-2121 or by calling 1-800-USAMAPS

CONTACT ADDRESSES

Office of State Planning
Coastal Program
2 1/2 Beacon Street
Concord, NH 03301
271-2155

Office of State Planning
Coastal Program, Portsmouth Office
152 Court St
Portsmouth, NH 03801
431-9366

NH Fish & Game Dept. Region 3
225 Main Street
Durham, NH 03824
868-1095

Great Bay National Estuarine Research Reserve
NH Fish & Game Region 3
225 Main Street
Durham, NH 03824
868-1095

NH Division Of Historical Resources
P.O. Box 2042
16 North Fruit Street
Concord, NH 03302
271-3623

NH Natural Heritage Inventory
NH Dept. of Resources and
Economic Development
P.O. Box 586
172 Pembroke Road
Concord, NH 03302-0856

NH Department of Transportation
PO Box 483, John F. Morten Bldg.
Hazen Drive
Concord, NH 03302
271-3731

Rockingham/Strafford County Agricultural
Stabilization and Conservation Service
P.O. Annex, P.O. Box 96
Front Street, Room 102
Exeter, NH 03833
772-4384

Rockingham Planning Commission
121 Water Street
Exeter, NH 03833
778-0885

Rockingham County Conservation District
32 Front Street
Exeter, NH 03833
772-4385

Strafford Regional Planning Commission
County Farm Road
Dover, NH 03820
742-2523

Strafford County Conservation District
County Farm Road
Dover, NH 03820
742-7430

Audubon Society of New Hampshire
3 Silk Farm Road
Concord, NH 03301
224-9909

US Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149
800-343-4789

OTHER ADRESSES OF INTEREST

Great Bay Estuarine System Conservation Trust
PO Box 34
Durham, NH 03824

Sea Grant College Program
Kingman Farm - UNH
Durham, NH 03824
749-1565

Jackson Estuarine Laboratory - UNH
Adams Point Road
Durham, NH 03824
862-2175

The Strafford Rivers Conservancy
PO Box 623
Dover, NH 03820
742-4730

NH Assoc. of Conservation Commissions
54 Portsmouth Street
Concord, NH 03301
224-7867

NH Port Authority
55 Market Street
PO Box 506
Portsmouth, NH 03801
436-8500

Appendix B

COASTAL WETLAND TYPES

COASTAL WETLAND TYPES

Rocky Shores: This type of coastal wetland is very common in northern New England. It can be found in areas where bedrock is exposed by nearly continuous wind and water driven energy. These wetlands can be divided into three zones: the salt spray zone – rarely flooded but influenced by waves; the intertidal zone – regularly flooded and exposed by the tides; and the sub-tidal zone – rarely exposed and underwater most of the time. Plants and animals such as seaweeds, barnacles, and periwinkles can be easily found.

Cobble, Gravel, and Sand Beaches: These are high energy coastal wetlands formed by the sorting of sediment material moved by wind and wave energy. The intertidal zone of these wetlands is nearly devoid of visible biota. The higher reaches of these wetlands, where the wave energy only reaches during storm events, may form sand dunes. New Hampshire has few remaining dune fields, but all of these areas are presently protected by law. Dunes support a specialized plant community that is very susceptible to damage during the dune overwash that accompanies large storms.

Tidal or Mud Flats: These wetlands are unvegetated, low relief environments particularly common in Great Bay. They are of critical importance for the production of numerous invertebrate species which are a food source for many bird and fish species. When flooded, the mud flats are scoured by fish feeding on the worm and mollusk population found in the muddy substrate. As the tide recedes, wading birds feed on the same food source. Mud flats can also be found in the larger tidal marshes providing diverse habitat within the marsh.

Aquatic Beds: These wetlands form in sub-tidal areas of both marine and estuarine waters. Along the coast, aquatic beds are areas of seaweed that grow below the low tide level. In the estuarine waters of the state the most important aquatic beds are the *Zostera marina* (eelgrass) beds found in Great and Little Bays and the major tidal rivers. Eelgrass beds are important as nursery and feeding areas for fish, feeding areas for geese, ducks and wading birds, and for trapping and accreting suspended sediments in the water column. Within some of the larger tidal marshes along the NH coast aquatic bed habitats of *Ruppia maritima* (widgeon grass) can add to the diversity of the tidal marshes.

Salt Marshes: These vegetated tidal wetlands, where salinities range from 18 ppt. to 36 ppt. (the latter is equal to that of seawater), are dominated by *Spartina* grasses. In low marsh areas that are flooded twice daily, *Spartina alterniflora* (saltwater cordgrass) forms nearly monospecific stands that vary in height from a few inches to five feet in height. On the high marsh *Spartina patens* (salt meadow grass) is the dominant plant but usually found in association with numerous other plants that can tolerate high salinity levels (halophytes).

Brackish Marshes: In areas where average salinities range from 0.5 ppt. to 18 ppt., a wide variety of plant communities can grow which represent the transition from salt marsh to freshwater marsh. These marshes can be found along the major tidal rivers and bays and along the smaller freshwater tributaries flowing into salt marshes. Plants that can be found in brackish areas include *Juncus gerardii* (black grass), *Typha angustifolia* (narrow-leaved cattail), and *Scirpus robustus* (salt marsh bulrush).

Freshwater Tidal Marshes: In areas where the tides still affect the flow of waters but where the average salinity is below 0.5 ppt. freshwater tidal marshes can form. Vegetation in these marshes is extremely diverse. In the regularly flooded areas one may find *Pontederia cordata* (pickerelweed) and *Zizania aquatica* (wild rice). In areas that are irregularly flooded *Acorus calamus* (sweet flag) and *Scirpus fluviatilis* (river bulrush) are common. Freshwater tidal areas are rare in New Hampshire and those that exist are usually quite small.

Appendix C

US FISH & WILDLIFE SERVICE WETLAND CLASSIFICATION SYSTEM

US FISH AND WILDLIFE SERVICE WETLAND CLASSIFICATION SYSTEM

In 1979 the US Fish & Wildlife Service (USFWS) published a classification of wetlands and deepwater habitats (Cowardin et al, 1979). In this classification scheme, wetlands are defined by hydrology, soils, and vegetation. The USFWS classification scheme serves as the national standard for wetland classification, and has been used to classify wetlands appearing in National Wetlands Inventory (NWI) maps which are used to define marsh systems in the *Coastal Method.*

The wetland and deepwater habitats of the coastal zone are defined in the USFWS classification as follows:

Wetlands: Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. For the purposes of the classification, wetlands must have one or more of these three attributes: (1) at least periodically, the land must support predominantly hydrophytes (wetland plants); (2) the substrate is predominantly undrained hydric soil; and (3) rocky, gravelly, or sandy areas that are saturated with or covered by shallow water at some time during the growing season.

Deepwater Habitats: Deepwater habitats include permanently flooded areas deeper than 6.6 feet. Shallower permanently flooded areas are often vegetated with emergent plants and are considered wetlands rather than deepwater habitats.

The structure of the classification scheme is hierarchical, with systems forming the highest level of the classification hierarchy. Of the five major systems, three are of interest with regard to the tidal waters.

1. Marine System – Open ocean overlying the continental shelf including high energy shoreline such as beaches and rocky headlands.

2. Estuarine System – Deepwater and wetland areas that are usually semi-enclosed with an opening to the ocean and in which there is some mixing of fresh and sea water.

3. Riverine System – Freshwater rivers and their tributaries along with most associated wetlands.

Marine and Estuarine systems are divided into two sub-systems:

1. Sub-tidal – Areas that are continuously submerged.

2. Intertidal – Areas that are alternately flooded and exposed.

Riverine Systems are divided into four sub-systems, only one of which is relevant to the *Coastal Method*;

1. Tidal – The movement of the water is influenced by the tides but water salinity is less than 0.5 ppt.

The next step in the hierarchical system is class. These classification terms describe the general appearance of the habitat in terms of the type of substrate or the dominant plant community type.

1. Aquatic Bed – Wetlands that are dominated by plants that grow principally on or below the surface of the water.

2. Rocky Shore – Wetlands that are characterized by bedrock, boulders or stones which cover more than 75% of the area.

3. Unconsolidated Shore – Wetland habitats having three characteristics. (1) less than 75% coverage by bedrock, boulders, or stones; (2) less than 30% coverage by persistent vegetation; (3) alternately exposed and flooded.

4. Unconsolidated Bottom – Wetland habitats having at least 25% cover of particles smaller than stones, and a vegetation cover of less than 30%.

5. Emergent Wetland – Wetlands dominated by erect, rooted herbaceous hydrophytes.

These wetland classifications should cover any tidal wetland that will be evaluated using the *Coastal Method*. **Formerly tidal areas** that will be included in the inventory may have changed to any one of a variety of freshwater systems. A brief description of some of these systems may help in the identification of these formerly tidal wetlands.

1. Palustrine System – All non-tidal wetlands dominated by trees, shrubs, and persistent emergent vegetation.

2. Lacustrine System –Open water wetlands situated in topographic depressions with less than 30% vegetative cover and greater than 20 acres in size.

Some of the classes that may apply to these formerly tidal areas are:

1. Scrub-shrub – Wetlands dominated by shrubs and tree saplings less than twenty feet in height, e.g. buttonbush, alders and red maple saplings.

2. Forested Wetland – Wetlands dominated by trees greater than twenty feet in height, e.g. red maple, ash, spruce.

3. Emergent Wetland – Wetlands dominated by erect, rooted herbaceous hydrophytes.

Also included in the classification scheme are a number of modifiers that are added to the end of the classification abbreviation. One of these is important in the recognition of formerly tidal areas. A small "h" signifies that a wetland has been impounded by the purposeful obstruction of flow.

The USFWS wetlands classification system is used as the basis for the wetland identification codes used on the National Wetland Inventory maps. On the bottom of each NWI map is a key to the complete codes. The examples below and the chart on the following page provide examples of some of the wetland classes that will be encountered when using the maps in Appendix G.

E2EM1P —
E = Estuarine
2 = Intertidal
EM = Emergent
1 = Persistent
P = Irregularly Flooded

E2US4M —
E = Estuarine
2 = Intertidal
US = Unconsolidated Shore
4 = Organic
M = Irregularly Exposed

E2US3N —
E = Estuarine
2 = Intertidal
US = Unconsolidated Shore
3 = Mud
N = Regularly Flooded

PUBHh —
P = Palustrine
UB = Unconslidated Bottom
H = Permanently Flooded
h = Diked/Impounded

E1UB4 —
E = Estuarine
1 = Subtidal
UB = Unconsolidated Bottom
4 = Organic

R1UBH —
R = Riverine
1 = Subtidal
UB = Unconsolidated Bottom
H = Permanently Flooded

For a more complete explanation of the classification scheme, the reader may obtain copies of the *Classification of Wetlands and Deepwater Habitats of the United States* from the US Fish & Wildlife Service depending on availability. Reprints of the publication may be purchased from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, (703) 487-4780.

E — ESTUARINE

1 — SUBTIDAL

RB — ROCK BOTTOM
1 Bedrock
2 Rubble

UB — UNCONSOLIDATED BOTTOM
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

AB — AQUATIC BED
1 Algal
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

RF — REEF
2 Mollusc
3 Worm

OW — *OPEN WATER/ Unknown Bottom*

2 — INTERTIDAL

AB — AQUATIC BED
1 Algal
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

RF — REEF
2 Mollusc
3 Worm

SB — STREAMBED
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

RS — ROCKY SHORE
1 Bedrock
2 Rubble

US — UNCONSOLIDATED SHORE
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

EM — EMERGENT
1 Persistent
2 Nonpersistent

SS — SCRUB-SHRUB
1 Broad-Leaved Deciduous
2 Needle-Leaved Deciduous
3 Broad-Leaved Evergreen
4 Needle-Leaved Evergreen
5 Dead
6 *Deciduous*
7 *Evergreen*

FO — FORESTED
1 Broad-Leaved Deciduous
2 Needle-Leaved Deciduous
3 Broad-Leaved Evergreen
4 Needle-Leaved Evergreen
5 Dead
6 *Deciduous*
7 *Evergreen*

R — RIVERINE

1 — TIDAL

RB — ROCK
1 Bedrock
2 Rubble

UB — UNCONSOLIDATED BOTTOM
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

2 — LOWER PERENNIAL

***SB — STREAMBED**
1 Bedrock
2 Rubble
3 Cobble-Gravel
4 Sand
5 Mud
6 Organic
7 Vegetated

AB — AQUATIC BED
1 Algal
2 Aquatic Moss
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

3 — UPPER PERENNIAL

RS — ROCKY SHORE
1 Bedrock
2 Rubble

US — UNCONSOLIDATED SHORE
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic
5 Vegetated

4 — INTERMITTENT

****EM — EMERGENT**
2 Nonpersistent

5 — UNKNOWN PERENNIAL

OW — *OPEN WATER/ Unknown Bottom*

P — PALUSTRINE

RB — ROCK BOTTOM
1 Bedrock
2 Rubble

UB — UNCONSOLIDATED BOTTOM
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

AB — AQUATIC BED
1 Algal
2 Aquatic Moss
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

US — UNCONSOLIDATED SHORE
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic
5 Vegetated

ML — MOSS-LICHEN
1 Moss
2 Lichen

EM — EMERGENT
1 Persistent
2 Nonpersistent

SS — SCRUB-SHRUB
1 Broad-Leaved Deciduous
2 Needle-Leaved Deciduous
3 Broad-Leaved Evergreen
4 Needle-Leaved Evergreen
5 Dead
6 *Deciduous*
7 *Evergreen*

FO — FORESTED
1 Broad-Leaved Deciduous
2 Needle-Leaved Deciduous
3 Broad-Leaved Evergreen
4 Needle-Leaved Evergreen
5 Dead
6 *Deciduous*
7 *Evergreen*

OW — *OPEN WATER/ Unknown Bottom*

MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

Non-Tidal

A Temporarily Flooded
B Saturated
C Seasonally Flooded
D *Seasonally Flooded/ Well Drained*
E *Seasonally Flooded/ Saturated*
F Semipermanently Flooded
G Intermittently Exposed
H Permanently Flooded
J Intermittently Flooded
K Artificially Flooded
W Intermittently Flooded/Temporary
Y Saturated/Semipermanent/ Seasonal
Z Intermittently Exposed/Permanent
U *Unknown*

Tidal

K *Artificially Flooded*
L Subtidal
M Irregularly Exposed
N Regularly Flooded
P Irregularly Flooded
*S Temporary-Tidal
*R Seasonal-Tidal
*T Semipermanent-Tidal
*V Permanent-Tidal
U *Unknown*

*These water regimes are only used in tidally influenced, freshwater systems.

WATER CHEMISTRY

Coastal Halinity

1 Hyperhaline
2 Euhaline
3 Mixohaline *(Brackish)*
4 Polyhaline
5 Mesohaline
6 Oligohaline
0 Fresh

Inland Salinity

7 Hypersaline
8 Eusaline
9 Mixosaline
0 Fresh

pH Modifiers for all Fresh Water

a Acid
t Circumneutral
i Alkaline

SOIL

g Organic
n Mineral

SPECIAL MODIFIERS

b *Beaver*
d *Partially Drained/Ditched*
f Farmed
h *Diked/Impounded*
r Artificial Substrate
s *Spoil*
x Excavated

Appendix D

DATA SHEETS REQUIRED FOR THE COASTAL METHOD

Checklist of Materials Needed to Complete the Coastal Method.

- ☐ Blue line copy of NH Coastal Mapping Project aerial photos for each tidal marsh system in the study area (see Appendix A).
- ☐ National Wetlands Inventory (NWI) maps for study area (see Appendix A).
- ☐ *Coastal Wetland Plants of the Northeastern United States* by Ralph Tiner (see Section 9). This book should be used in conjunction with Appendix I which lists tidal marsh plant species found in NH.
- ☐ Area calculation grid (see Appendix F).
- ☐ Map measuring wheel to measure marsh perimeter; available from office supply store or forestry supply catalog.
- ☐ Dividing compass to plot Zone of Influence; available from office supply store.
- ☐ Calculator.
- ☐ 100-foot tape measure.
- ☐ List of federal and state endangered or threatened species (see Appendix A).
- ☐ List of NH Natural Heritage Inventory (NHNHI) exemplary communities (see Appendix A).
- ☐ Information from the National Register of Historic Landmarks (see Appendix A).
- ☐ List of shellfish beds that are open to recreational harvest (see Appendix I).
- ☐ List of public boat launches (see Appendix E).

EU # _____ of Marsh System _____

NEEDED FOR THIS EVALUATION:

- Base map
- *Coastal Wetland Plants of the Northeastern US*

Function 1 ECOLOGICAL INTEGRITY Part A

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Part A: Ecological Integrity of the Evaluation Unit			
Questions that may require field observation			
1A. Percent of the marsh plant community dominated by invasive plant species.		a. < 5% dominated by invasive species	1.0
		b. 5% – 20% dominated	0.5
		c. > 20% dominated	0.1
2A. Number of tidal restrictions.		a. no tidal restrictions	1.0
		b. one tidal restriction	0.5
		c. more than one tidal restriction	0.1
3A. Type of tidal restriction.		a. no restriction	1.0
		b. flow through bridge appears adequate	0.5
		c. flow through bridge appears inadequate, or flow restricted by culvert	0.1
4A. Ditching on surface of the EU.		a. no ditching	1.0
		b. ditches present in linear pattern	0.5
		c. ditches present in grid pattern	0.1

AVERAGE FUNCTIONAL INDEX FOR Part A of FUNCTION 1 = Average of Column D = _____.

EU # ____ of Marsh System _____

NEEDED FOR THIS EVALUATION:

- Base map
- Map wheel/measurer
- 100 foot tape measure
- Calculator

Function 1 ECOLOGICAL INTEGRITY Part B

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Part B: Ecological Integrity of the Zone of Influence			
Questions that may require field observation			
1B. Dominant land-use in the 500 foot Zone of Influence surrounding the EU.		a. forested, fields, open water or similar open space	1.0
		b. agricultural or rural residential	0.5
		c. commercial, industrial, high density residential, or heavily used highways	0.1
2B. Ratio of the number of occupied buildings (including seasonal) within the EU **and/or** Zone of Influence to total area of EU.		a. < 0.1 bldg./acre	1.0
		b. from 0.1 – 0.5 bldg./acre	0.5
		c. > 0.5 bldg./acre	0.1
3B. Percent of EU/upland border which has a buffer of woodland or idle land 500 feet in width.		a. more than 70%	1.0
		b. from 30% – 70%	0.5
		c. less than 30%	0.1
4B. Square footage of roads, driveways, and parking lots within 150 feet of EU.		a. < 1500 sq. feet/acre	1.0
		b. from 1500 – 6000 sq. feet/acre	0.5
		c. > 6000 sq. feet/acre	0.1

AVERAGE FUNCTIONAL INDEX FOR Part B of FUNCTION 1 = Average of Column D = _____.

EU # _____ of Marsh System _____

NEEDED FOR THIS EVALUATION:

- Base map

Function 2
SHORELINE ANCHORING

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Type of marsh system of which the EU is a part.		a. estuarine fringe marsh b. estuarine meadow marsh c. coastal/back-barrier marsh	1.0 0.5 0.1
Questions that may require field observation			
2. Wetland morphology.		a. no distinct bank evident between EU and upland or freshwater wetland b. distinct bank evident but protected by vegetation c. distinct bank evident and unprotected by vegetation	1.0 0.5 0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 2 = Average of Column D = _____.

EU # ____ of Marsh System _____

NEEDED FOR THIS EVALUATION:

- Acreage grid
- Base map

Function 3
STORM SURGE PROTECTION

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Acreage of the EU.		a. > 50 acres b. between 10 – 50 acres c. < 10 acres	1.0 0.5 0.1
2. Type of marsh system of which the EU is a part.		a. coastal/back barrier marsh b. estuarine meadow marsh c. estuarine fringe marsh	1.0 0.5 0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 3 = Average of Column D = _____.

EU # ____ of Marsh System _____

NEEDED FOR THIS EVALUATION:

- Acreage grid
- Base map
- Map wheel
- *Coastal Wetland Plants of the Northeastern US*
- NWI map(s)

Function 4 WILDLIFE, FINFISH & SHELLFISH HABITAT

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Acreage of the EU.		Record the FI from Function 3, question 1 (page D-5)	____
2. Ecological Integrity of the EU.		Record the AFI for Part A of Function 1 (page D-2)	____
3. Type of tidal restriction.		Record the FI from Function 1, Part A, question 3A (page D-2)	____
Questions that may require field observation			
4. Diversity of habitat types.		a. 7 – 9 types present b. 4 – 6 types present c. < 4 types present	1.0 0.5 0.1
5. Presence of submerged (aquatic bed) vegetation.		a. submergent vegetation abundant b. submergent vegetation present, but not abundant c. no submergent vegetation present	1.0 0.5 0.1
6. Percent of EU edge bordered by a buffer of woodland, idle land, *or agricultural land* at least 500 feet in width.		a. > 70% b. from 30% – 70% c. < 30%	1.0 0.5 0.1
7. Proximity to freshwater wetlands.		a. marsh system connected to a perennial stream or freshwater wetland b. marsh not connected to a perennial stream, but within 1/4 mile of fresh water wetland c. marsh not connected to stream, and not within 1/4 mile of freshwater wetland	1.0 0.5 0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 4 = Average of Column D = _____.

EU # ____ of Marsh System _____

NEEDED FOR THIS EVALUATION:

- Base map
- Acreage grid

Function 5
WATER QUALITY MAINTENANCE

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Acreage of the EU.		Record the FI from Function 3, question 1 (page D-5)	____
2. Number of tidal restrictions.		Record the FI from Function 1, Part A, question 2A (page D-2)	____
3. Type of tidal restriction.		Record the FI from Function 1, Part A, question 3A (page D-2)	____

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 5 = Average of Column D = _____.

EU # _____ of Marsh System _____

NEEDED FOR THIS EVALUATION:

- NH Fish & Game shellfishing information
- Base map
- State listing of public access points

Function 6
RECREATION POTENTIAL

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may require field observation			
1. Presence of shellfish beds.		a. shellfish beds present and open for harvest	1.0
		b. shellfish beds present but currently closed for harvest	0.5
		c. no shellfish beds present	0.1
2. Waterfowl hunting.		a. EU accessible and currently used by hunters	1.0
		b. EU accessible, but no evidence of use	0.5
		c. EU not easily accessible, **or** hunting not permitted	0.1
3. Opportunities for wildlife observation.		Record the AFI for Function 4 (page D-6)	____
4. Canoe and boat passage in or adjacent to the EU.		a. watercourses within EU at least 10 feet wide and 1 foot deep at high tide and free of obstructions, **or** EU adjacent to canoeable waterway	1.0
		b. watercourses within EU contain some exposed obstructions and/or shallow areas, **and** EU not adjacent to canoeable waterway	0.5
		c. watercourses too small, shallow, has obstructions, or non-existent, **and** EU not adjacent to canoeable waterway	0.1
5. Canoe and boat access.		a. access point within 1/2 mile of EU by non-powered boat	1.0
		b. access point between 1/2 – 1 mile of EU by non-powered boat	0.5
		c. no access, or access point more than 1 mile	0.1

Continued on next page...

EU # ____ of Marsh System _____

Function 6
RECREATION POTENTIAL
(continued)

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
6. Off-road public parking.		a. EU within 10 minutes of suitable parking area	1.0
		b. suitable parking more than 10 minutes but less than 20 minutes	0.5
		c. parking not available within 20 minute walk of EU	0.1
7. Handicap accessibility.		a. specially constructed handicap accessibility	1.0
		b. access via existing roads and trails	0.5
		c. no handicap access	0.1
8. Presence of visitors center, maintained trails, or board walks.		a. visitors center and maintained trails, and/or boardwalks present	1.0
		b. maintained trails and/or boardwalks present, but no visitors center	0.5
		c. neither a visitors center nor trails or boardwalks present	0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 6 = Average of Column D = _____.

EU # ____ of Marsh System _____

NEEDED FOR THIS EVALUATION:

- Field visit

Function 7
AESTHETIC QUALITY

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Ecological Integrity of the EU.		Record the AFI for Part A of Function 1 (page D-2)	____
2. Opportunities for wildlife observation.		Record the AFI for Function 4 (page D-6)	____
Questions that may require field observation			
3. Dominant visible land-use surrounding the EU from primary viewing location(s).		a. woodland, agricultural land, or similar open space	1.0
		b. rural residential	0.5
		c. commercial, industrial, transportation use, or high density residential dominates the visible area	0.1
4. General appearance of the EU from primary viewing location(s).		a. undisturbed and natural with no visual detractors, natural plant communities	1.0
		b. limited disturbance, minor visual detractors, and/or invasive species present	0.5
		c. severe detractors and/or dominated by invasive species	0.1
5. Noise level at primary viewing location(s).		a. low: natural sounds predominate	1.0
		b. moderate: some traffic or other noise audible	0.5
		c. loud: continuous traffic or other noise	0.1
6. Odors present at primary viewing location(s).		a. natural odors only	1.0
		b. unnatural odors present at certain times	0.5
		c. unnatural, unpleasant odors distinct and fairly continuous	0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 7 = Average of Column D = _____.

EU # ____ of Marsh System _____

NEEDED FOR THIS EVALUATION:

- List of estuarine research reserves, nature preserves, and wildlife management areas from local agencies
- Base map
- NWI map(s)

Function 8
EDUCATION POTENTIAL

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Opportunity for wildlife observation.		AFI for Function 4 (page D-6)	____
2. Presence of visitors center, maintained trails, or board walks.		Record the FI from Function 6, question 8 (page D-9)	____
Questions that may require field observation			
3. Proximity of potential educational site to other habitats.		a. 3 or more habitat types within a short walk of potential education site	1.0
		b. 2 habitat types within a short walk of education site	0.5
		c. education site not within short walk to other habitat types	1.0
4. Off-road parking at educational site for school buses or other vehicles. (carpools, vans etc.)		a. EU < 10 minute walk from suitable parking	1.0
		b. EU within 20 minute walk from suitable parking	0.5
		c. parking not available within 20 minute walk of EU	0.1
5. Student safety.		a. no known safety hazards	1.0
		b. safety hazards present but easily avoidable	0.5
		c. safety hazards present and not easily avoidable	0.1
6. Handicap accessibility at potential educational site.		a. specially constructed handicap access	1.0
		b. access via existing roads and trails	0.5
		c. no handicap access	0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 8 = Average of Column D = _____.

EU # ____ of Marsh System _____

NEEDED FOR THIS EVALUATION:

- List of federal and state endangered and threatened species
- List of NHNHI exemplary communities
- Natural Register of Historic Places

Function 9 NOTEWORTHINESS

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. EU is habitat for a state or federally listed threatened or endangered species.		a. EU is currently habitat for a threatened or endangered species	1.0
		b. EU is not currently habitat for threatened or endangered species	0.1
2. EU has significance because it has biological, geological or other features which are locally rare or unique, **or** is listed as an exemplary community by NHNHI.		a. EU contains feature(s) of significance	1.0
		b. EU does not contain feature of significance	0.1
3. EU is known to contain an important historical or archaeological site.		a. EU is known site of historical or archaeological significance	1.0
		b. no evidence of historical or archaeological use	0.1
4. Tidal marshes in an urban setting.		a. commercial, industrial, transportation use or high density residential use occupies >50% of area within 1/4 mile of the marsh	1.0
		b. rural residential (>1 acre lots), agricultural, forestry or similar open space	0.1
5. EU used as long term research site.		a. EU a site for long term research	1.0
		b. EU not a site for long term research	0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 9 = Average of Column D = _____.

Section 6 — Description of Restoration Potential DATA SHEETS

Question 1. Number and type of restrictions between EU and free tidal flow.

Question 2. Percent of the EU dominated by invasive species.

Question 3a. Acreage of fill deposited on the marsh surface.

Description of Restoration Potential Data Sheets *(continued)*

Question 3b. Existing plant community located on fill.

Question 3c. Presence of structures on the fill.

Question 4. Other causes of degradation.

MARSH SYSTEM _____

EVALUATION UNIT # _____ OF _____

SIZE OF EU _____ acres

PERCENTAGE OF SYSTEM THAT EU REPRESENTS _____

STATUS OF EU (check one) TIDAL____ FORMERLY TIDAL ____

Function	Average Functional Index (AFI)
1A. Ecological Integrity of EU	_____
1B. Ecological Integrity of Zone of Influence	_____
2. Shoreline Anchoring	_____
3. Storm Surge Protection	_____
4. Wildlife, Finfish & Shellfish Habitat	_____
5. Water Quality Maintenance	_____
6. Recreation Potential	_____
7. Aesthetic Quality	_____
8. Education Potential	_____
9. Noteworthiness	_____

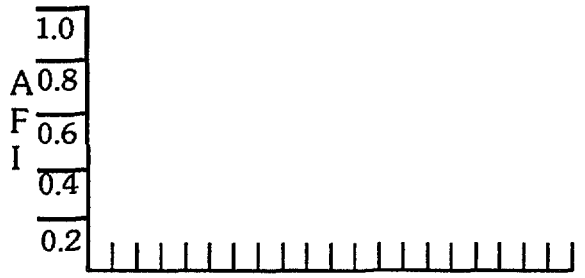
SUMMARY

EU ANALYSIS GRAPHS

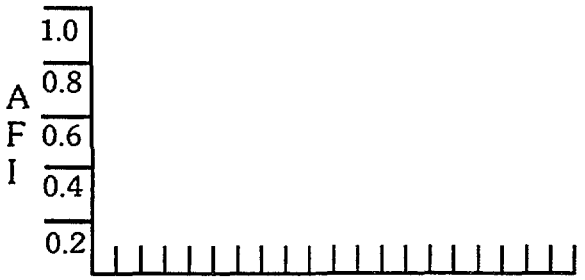
MARSH SYSTEM _____ TOTAL AREA _____

NUMBER OF EUs _____

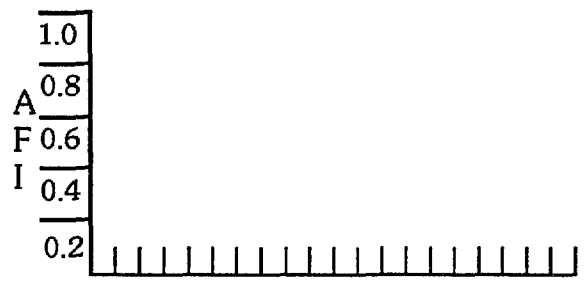
ECOLOGICAL INTEGRITY OF **EU**



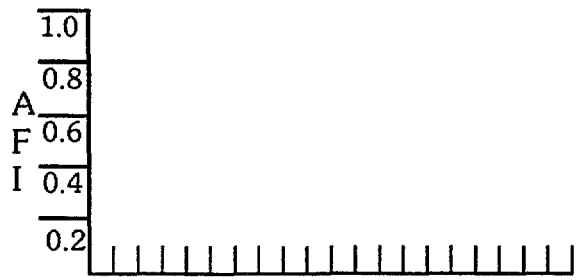
ECOLOGICAL INTEGRITY OF **ZONE OF INFLUENCE**



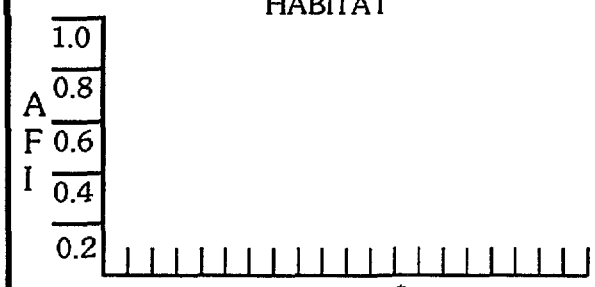
SHORELINE ANCHORING



STORM SURGE PROTECTION



WILDLIFE, FINFISH AND SHELLFISH HABITAT



GRAPH LEGEND

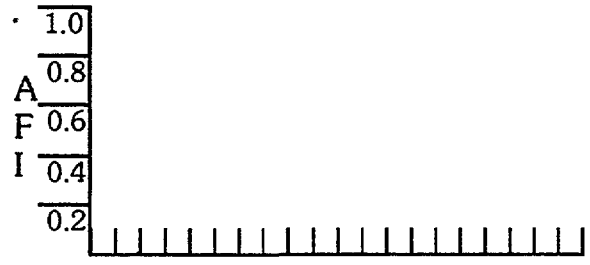
***NOTE:** Each dash on the horizontal axis represents 5% of the marsh system

EU ANALYSIS GRAPHS cont.

MARSH SYSTEM _____ TOTAL AREA _____

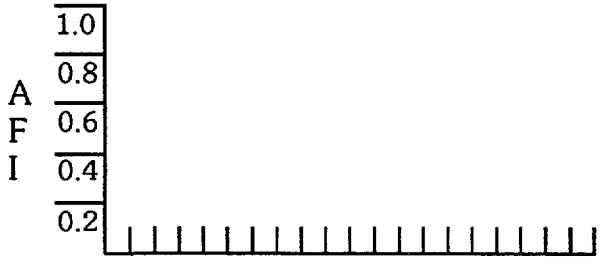
NUMBER OF EUs _____

WATER QUALITY MAINTAINANCE



AREA OF EU*
(as percentage of marsh system)

RECREATION POTENTIAL

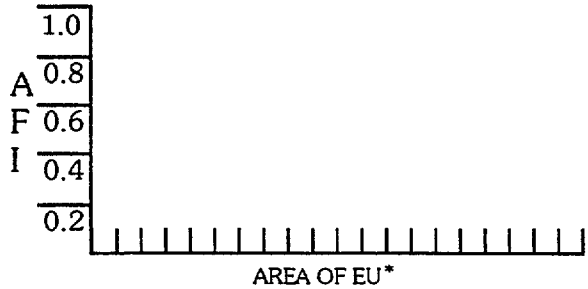


AREA OF EU*
(as percentage of marsh system)

AESTHETIC QUALITY

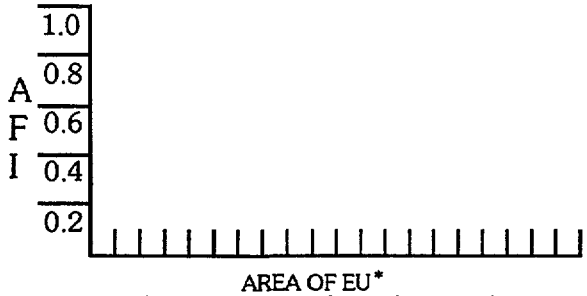
AREA OF EU*
(as percentage of marsh system)

EDUCATION POTENTIAL



AREA OF EU*
(as percentage of marsh system)

NOTEWORTHINESS



AREA OF EU*
(as percentage of marsh system)

GRAPH LEGEND

***NOTE**: Each dash on the horizontal axis represents 5% of the marsh system

MARSH SYSTEM DATA SHEET

It is not necessary to complete the marsh system data sheet for those systems that have a single EU

MARSH SYSTEM _____ NUMBER OF EUs _____

EU Number	Size in acres	Management Option Chosen

Best Education Site(s) in Marsh System _____

Best Recreation Site(s) in Marsh System _____

Public Access Points In or Adjacent to the Marsh System _____

_____

Noteworthy Feature(s) _____

_____

Appendix E

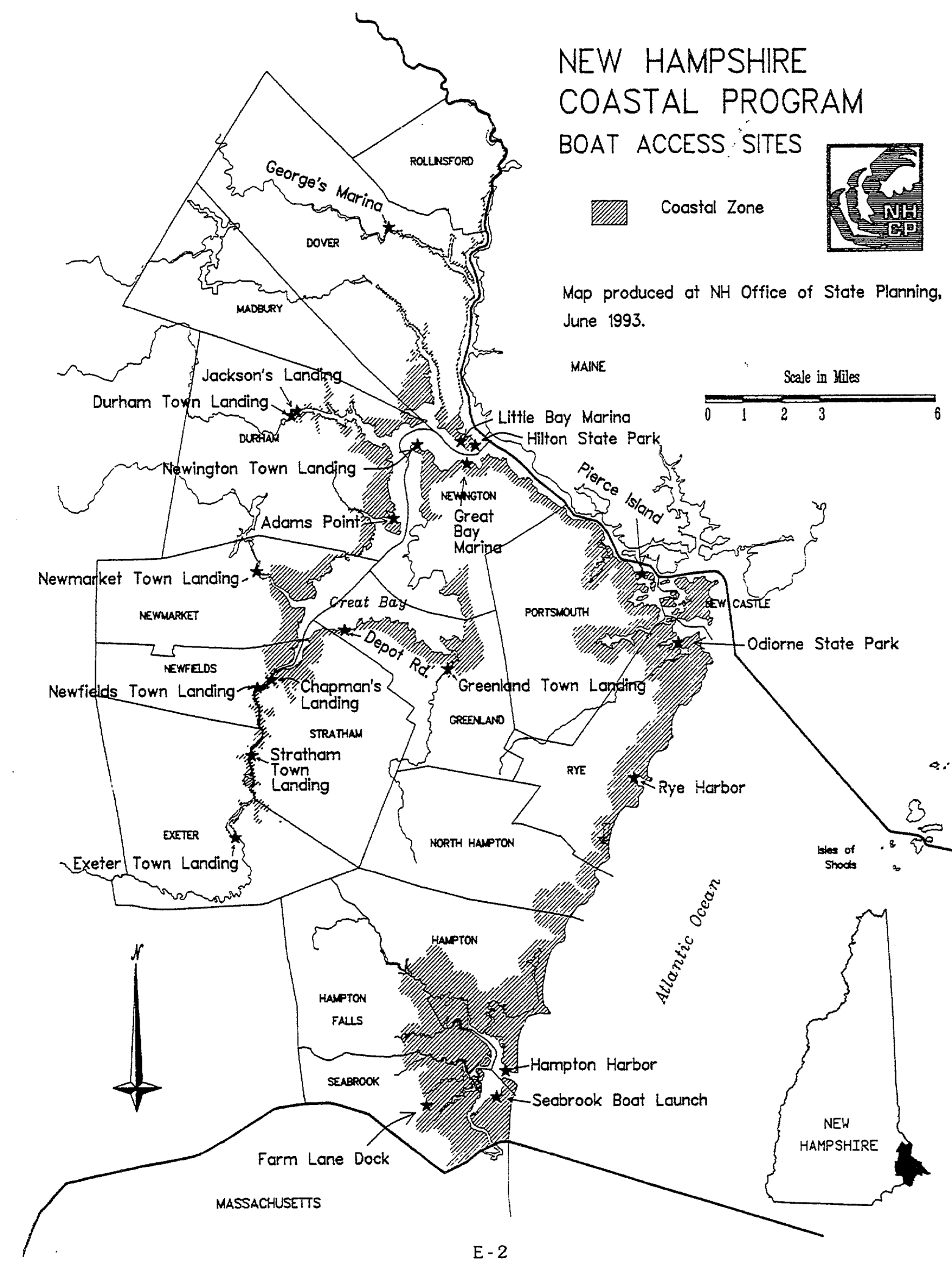
BOAT ACCESS SITES IN THE COASTAL ZONE

BOAT ACCESS SITES IN THE COASTAL ZONE

To assess portions of the Recreation Potential Function it will be necessary to determine their proximity to a public boat launch. The map and list on the following pages was provided by the NH Coastal Program.

For more information on public access to tidal waters contact the NH Fish & Game Department or the NH Coastal Program at the addresses found in Appendix A.

Pierce Island, Portsmouth
Odiorne State Park, Rye
Rye Harbor State Marina, Rye
Hampton Harbor State Marina, Hampton
Seabrook Boat Launch, Seabrook
Farm Lane Dock, Seabrook
Exeter Town Landing, Exeter
Stratham Town Landing, Stratham
Newfields Town Landing, Newfields
Chapman's Landing, Stratham
Depot Road Boat Launch, Greenland
Greenland Town Landing, Greenland
Newmarket Town Landing, Newmarket
Adams Point Boat Launch, Durham
Great Bay Marina, Newington
Hilton State Park, Dover
Little Bay Marina, Dover
Newington Town Landing, Newington
Jackson's Landing, Durham
Durham Town Landing, Durham
George's Marina, Dover


NEW HAMPSHIRE
COASTAL PROGRAM
BOAT ACCESS SITES
Coastal Zone
NH CP
Map produced at NH Office of State Planning, June 1993.
MAINE
Scale in Miles
0 1 2 3 6
George's Marina
ROLLINSFORD
DOVER
MADBURY
Jackson's Landing
Durham Town Landing
DURHAM
Little Bay Marina
Hilton State Park
Newington Town Landing
NEWINGTON
Pierce Island
Great Bay Marina
Adams Point
Newmarket Town Landing
NEWMARKET
Great Bay
PORTSMOUTH
NEW CASTLE
Odiorne State Park
Depot Rd.
Greenland Town Landing
NEWFIELDS
Newfields Town Landing
Chapman's Landing
GREENLAND
STRATHAM
Stratham Town Landing
RYE
Rye Harbor
EXETER
Exeter Town Landing
NORTH HAMPTON
Isles of Shoals
Atlantic Ocean
HAMPTON
HAMPTON FALLS
Hampton Harbor
SEABROOK
Seabrook Boat Launch
Farm Lane Dock
NEW HAMPSHIRE
MASSACHUSETTS

Appendix F

CALCULATION OF EVALUATION UNIT SIZE

CALCULATION OF EVALUATION UNIT SIZE

There are two widely available methods for measuring the area of a wetland from a base map: **the grid method** and a **planimeter**.

The grid method is a simple inexpensive technique that is quite accurate. A measuring grid is provided in this appendix. It is made up of individual 1/4 inch blocks. For every 16 blocks (one square inch), the lines are bolded to make it simpler to count large areas.

1. Make a transparent copy of the grid.

2. Place the transparent grid over the area to be measured. If the area to be measured is larger than the grid, mark the location of the grid corners on the map so that it can be moved around in order that the whole area can be determined.

3. Count all of the squares that are completely within the tidal marsh.

4. Count all of the squares which are partially within the tidal marsh and divide this number by two.

5. Add the totals from steps 3 & 4.

6. To determine acreage, multiply the total from step 5 by the conversion factor at the bottom of the grid (acres/square) that matches the map scale.

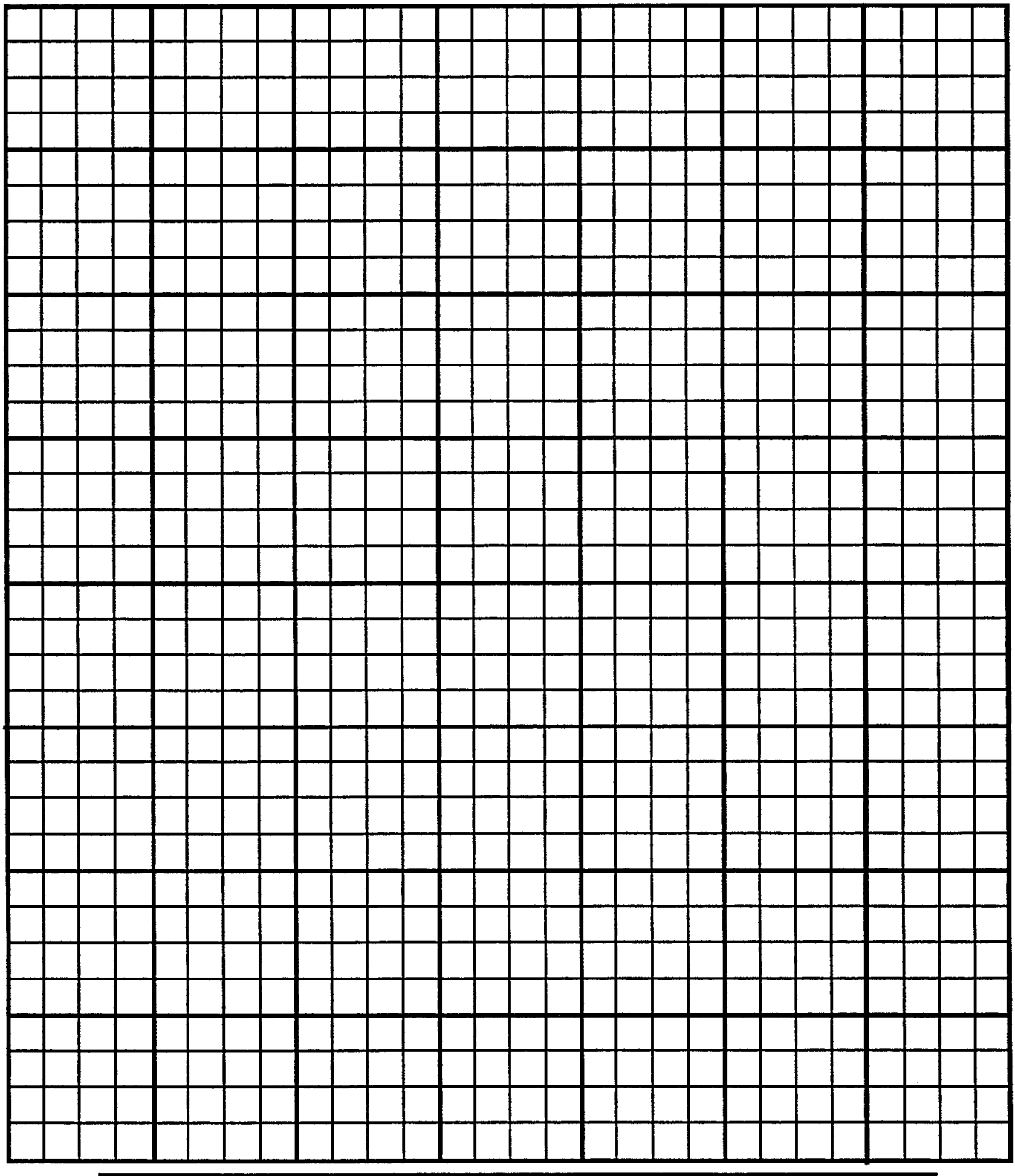
For example, 56 whole blocks and 34 partial blocks equals
$56 + (34 \div 2) = 73$
73 x conversion factor for appropriate scale =
area of marsh in acres

A planimeter is a small device with a hinged mechanical arm. One end of the arm is fixed to a weighted base while the other end has an attached magnifying lens with a cross hair or other pointer. The user spreads the map with the wetland area on a flat surface. After placing the base of the planimeter in a convenient location the user traces the perimeter of the wetland area to be measured. A dial or other readout registers the area being measured.

Planimeters can cost up to a thousand dollars or more depending on the degree of sophistication. For the purpose of the Coastal Method, a basic model would be sufficient. Planimeters are available from engineering and forestry supply companies. Some towns may currently own a planimeter or regional planning commissions may have one that towns could use.

Some regional planning commissions may have a Geographic Imformation System (GIS) that is capable of producing computer generated maps and other information that could be used in the Coastal Method such as wetland size and perimeter. Check with your regional planning commission to see if GIS maps are available for the tidal marshes in your town.

ACREAGE GRID



Scale:		Miles/inch	Acres/square
1:2,400	or 1" =200 '	0.038	0.057
1:12,000	or 1" =1000'	0.189	1.438
1:2,000	or 1" =1667'	0.316	3.987
1:24,000	or 1" =2000'	0.379	5.739
1:31,680	or 1" =2640'	0.5	10.0
1:63,360	or 1" =5280'	1.0	40.0

Appendix G

MARSH SYSTEM MAPS FOR COASTAL COMMUNITIES

MARSH SYSTEM MAPS FOR COASTAL TOWNS

This appendix contains a tidal marsh system map for all of the towns that border on tidal waters. These maps are based on the National Wetlands Inventory maps that are explained in Section 3.1 and Appendix C. Each map defines the marsh systems within each town and identifies areas that are to be included in the inventory and evaluation as well as areas that must be field checked to verify their inclusion. The areas encircled by the bold lines represent the marsh systems in the town. There may be areas in a system that are not identified on the map as tidal marsh but do support tidal marsh community. If so, these areas should be included in the inventory and evaluation as a part of the system within which they are contained.

If a marsh system is located in two or more towns, the conservation commissions from each of the towns should attempt to coordinate efforts to ensure that the whole system is evaluated. The Hampton-Seabrook Estuary is a good example of the need for cooperation among towns in using the Coastal Method. The evaluation of this tidal marsh should be done through the cooperation between the three towns involved. If this is not possible, any one town could choose to do the whole marsh, or alternatively, that portion of the system that falls within its boundaries.

The maps that follow are:

Dover
Durham, Madbury
Exeter, Stratham, Newfields
Greenland
Hampton
Hampton Falls, Seabrook
Newington
Newmarket
North Hampton
Portsmouth, New Castle
Rollinsford
Rye

CITY OF DOVER

National Wetlands Inventory Map

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

TOWNS OF DURHAM & MADBURY

National Wetlands Inventory Map

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

TOWNS OF EXETER, STRATHAM & NEWFIELDS

National Wetlands Inventory Map

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

TOWN OF GREENLAND

National Wetlands Inventory Map

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

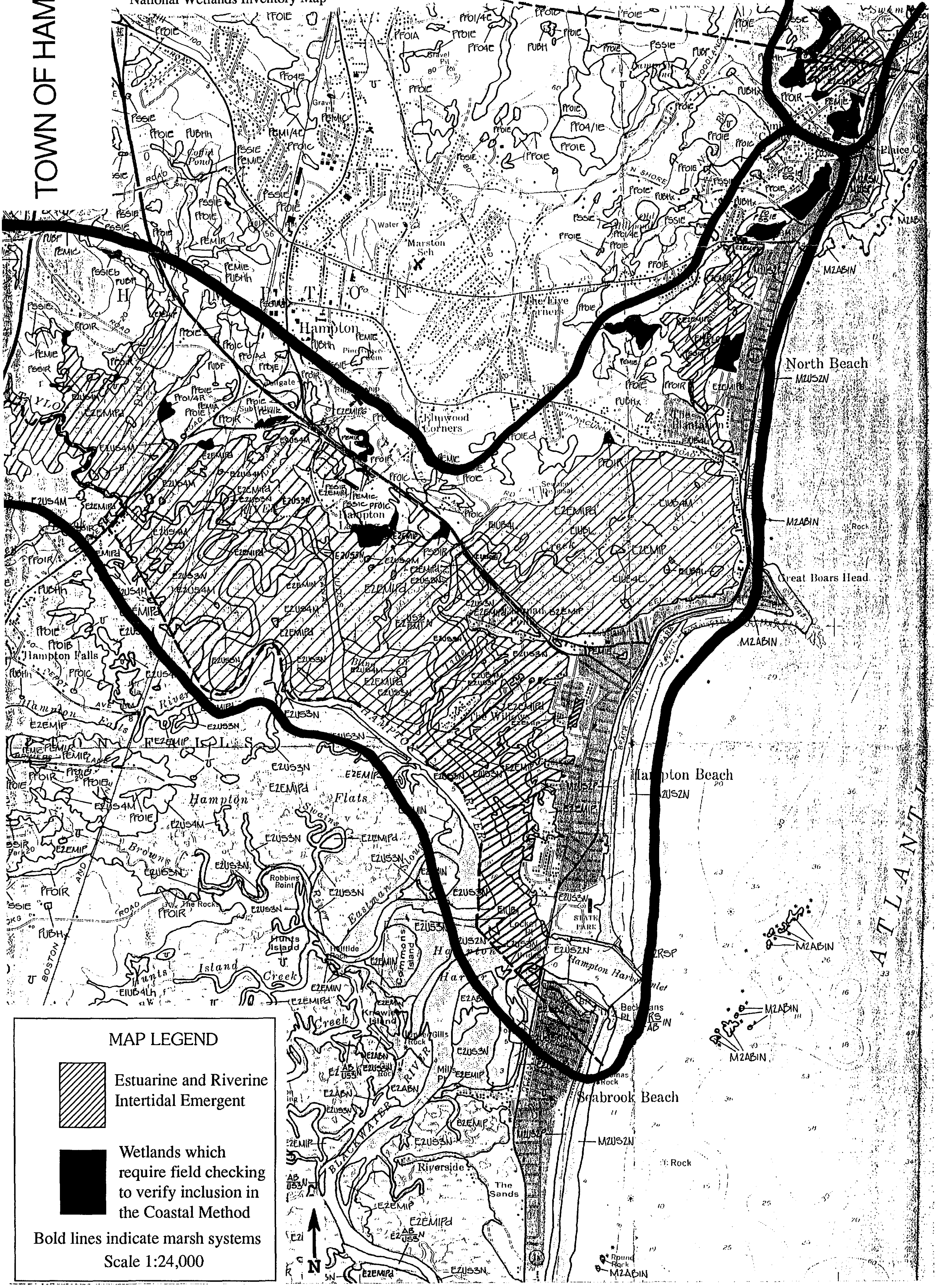
Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

TOWN OF HAMPTON

National Wetlands Inventory Map



TOWNS OF HAMPTON FALLS & SEABROOK

National Wetlands Inventory Map

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

TOWN OF NEWINGTON

National Wetlands Inventory Map

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

TOWN OF NEWMARKET

National Wetlands Inventory Map

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

TOWN OF NORTH HAMPTON

National Wetlands Inventory Map

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

CITY OF PORTSMOUTH, TOWN OF NEW CASTLE

National Wetlands Inventory Map

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

TOWN OF ROLLINSFORD

National Wetlands Inventory Map

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

TOWN OF RYE

National Wetlands Inventory Map

N

MAP LEGEND

Estuarine and Riverine Intertidal Emergent

Wetlands which require field checking to verify inclusion in the Coastal Method

Bold lines indicate marsh systems

Scale 1:24,000

SPECIAL NOT

Appendix H

TIDAL MARSH PLANTS OF NEW HAMPSHIRE

TIDAL MARSH PLANTS OF NEW HAMPSHIRE

The following list of plants contains those species found in NH tidal marshes. This list should be used in conjunction with *COASTAL WETLAND PLANTS OF NORTHEASTERN UNITED STATES* by Ralph Tiner to help in the identification of plant species needed to complete the Coastal Method.

This list is based on the list found in the *SOIL SURVEY OF NEW HAMPSHIRE TIDAL MARSHES* (see Section 9 for reference).

Amaranthus cannabinus	Water Hemp
Ammophila breviligulata	Marram or Beachgrass
Arenaria peploides	Seabeach Sandwort
Artemisia stelleriana	Dusty Miller
Artemisia caudata	Tall Wormwood
Aster subulatus	Annual Salt Marsh Aster
Aster tenuifolius	Perennial Salt Marsh Aster
Atriplex glabriuscula	Orach
Atriplex patula	Orach
Bassia hirsuta	Hairy Smotherweed
Cakile edentual	Sea-Rocket
Carex scoparia	Pointed Broom Sedge
Carex hormathodes	Marsh Sraw Sedge
Cladium mariscoides	Twig-Rush
Distichlis spicata	Spike Grass
Eleocharis halophila	Salt Marsh Spike-Rush
Eleocharis parvula	Dwarf Spike-Rush
Eleocharis smallii	Small's Spike Rush
Elymus virginicus	Virginia Rye Grass
Euphorbia polygonifolia	Seaside Spurge
Agalinis maritima	Seaside Gerardia
Glaux maritima	Sea Milkwort
Hordeum jubatum	Squirrel-Tail Grass
Hudsonia tomentosa	Beach Heather
Iva frutescens	Marsh Elder of High-tide Bush
Juncus balticus	Baltic Rush
Juncus canadensis	Canada Rush
Juncus gerardii	Black Grass
Juncus greenei	Green's Rush
Lathyrus japonicus	Beach Pea
Lechea maritima	Pinweed
Limonium nashii	Sea Lavender or Marsh Rosemary
Lythrum salicaria	Purple Loosestrife
Myrica pensylvanica	Northern Bayberry
Panicum virgatum	Switchgrass
Phragmites australis	Common Reed

Pinus rigida	Pitch Pine
Plantago maritima	Seaside Plantain
Polygonella articulata	Sand Jointweed
Polygonum aviculare	Common Knotgrass
Polygonum ramosissium	Bushy Knotweed
Potamogeton pectinatus	Sago Pondweed
Potentilla anserina	Silverweed
Prunus maritima	Beach Plum
Puccinellia maritima	Seaside Alkali Gras
Quercus alba	White Oak
Quercus bicolor	Swamp White Oak
Ranunculus cymbalaria	Seaside Crowfoot
Rosa palustris	Swamp Rose
Rosa rugosa	Salt Spray Rose or Rugosa Rose
Rosa virginiana	Virginia Rose
Ruppia maritima	Ditch or Widgeon Grass
Salicornia bigelovii	Bigelow's Glasswort
Salicornia europaea	Common Glasswort or Samphire
Salicornia virginica	Perennial or Woody Glasswort
Sanguisorba canadensis	Canadian Burnet
Scirpus acutus	Hard-stemmed Bulrush
Scirpus americanus	Three-Square
Scirpus atrovirens	Green Bulrush
Scirpus cyperinus	Wool Grass
Scirpus maritimus	Salt Marsh Bulrush
Scirpus paludosus	Bayonet-Grass
Scirpus robustus	Salt Marsh Bulrush
Scirpus validus	Great or Soft-stemmed Bulrush
Smilax rotundifolia	Common Greenbriar
Solidago sempervirens	Seaside Goldenrod
Spartina alterniflora	Salt Water Cord Grass or Thatch
Spartina patens	Salt Hay Grass
Spartina pectinata	Fresh Water Cord Grass or Slough Grass
Spergularia canadensis	Canada Sand Spurrey
Spergularia marina	Salt Marsh Sand Spurrey
Suaeda linearis	Sea Blite
Suaeda maritima	Sea Blite
Suaeda richii	Sea Blite
Toxicodendron radicans	Poison Ivy
Triglochin maritima	Seaside Arrow Grass
Typha angustifolia	Narrow-leaved Cattail
Typha latifolia	Broad-Leaved or Common Cattail
Zannichellia palustris	Horned Pondweed
Zostera marina	Eelgrass

Appendix I

EXAMPLES OF COASTAL METHOD DATA SHEETS

EXAMPLE OF COASTAL METHOD DATA SHEETS

Two examples are provided on the pages that follow:

EXAMPLE #1: Little River Marsh

The Little River Marsh (approximately 209 acres) is located in the towns of Hampton and North Hampton along Route 1A. It is divided into three EUs by Appledore Road and Huckleberry Lane. The original outlet of the Little River no longer exists and a culvert under Route 1A is presently the only connection to tidal flow. This marsh has been degraded as a result of the severely restricted tidal flow.

EXAMPLE #2: Sandy Point Marsh

The Sandy Point marsh (approximately 32 acres) is located on Depot Road in the towns of Greenland and Stratham on the southeastern corner of Great Bay. This marsh system comprises a single EU. The Sandy Point marsh drains into Great Bay and has no tidal restrictions. This marsh system is relatively healthy. However, there is a stand of Common Reed (*Phragmites australis*), an invasive species that is of current concern.

EXAMPLE #3 Hampton–Seabrook Marsh

Hampton–Seabrook marsh (approximately 7500 acres) comprises about half of the tidal marsh in the state. It is divided into multiple EUs, some of which are in relatively good condition and some of which are no longer connected to tidal flow. The EU, used in this example, is a very small portion of the marsh. It is surrounded by dense residential development and the only connection to tidal waters is a long culvert that runs under a parking lot and a town road.

The intention of these examples is to provide samples of completed data sheets and a base map. Example 1 (Little River) includes the data sheets from Sections 4 and 6 for EU #1 and the Summary Data sheets and EU analysis Graphs for all three EUs that make up the Little River marsh system. Example 2 (Sandy Point) only includes the Summary Data Sheet and the EU analysis Graphs to show how these data sheets are filled out for a single EU. The remaining data sheets will completed in the same way as for Example 1. Example 3 (Hampton–Seabrook) includes a base map showing some of the information that should be plotted on all base maps. Users of the *Coastal Method* may decide to plot additional information on the base maps for their towns.

NOTE: The remaining pages in this Appendix are numbered as the Data Sheets appear in Appendix D.

LITTLE RIVER MARSH

DATA SHEETS
SUMMARY DATA SHEETS
EU ANALYSIS GRAPHS

EU # 1 of Marsh System LITTLE RIVER

NEEDED FOR THIS EVALUATION:

- Base map
- *Coastal Wetland Plants of the Northeastern US*

Function 1 ECOLOGICAL INTEGRITY Part A

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Part A: Ecological Integrity of the Evaluation Unit			
Questions that may require field observation			
1A. Percent of the marsh plant community dominated by invasive plant species.	PHRAGMITES AND PURPLE LOOSESTRIFE	a. < 5% dominated by invasive species b. 5% – 20% dominated (c.) > 20% dominated	1.0 0.5 (0.1)
2A. Number of tidal restrictions.		a. no tidal restrictions (b.) one tidal restriction c. more than one tidal restriction	1.0 (0.5) 0.1
3A. Type of tidal restriction.	36" CULVERT UNDER ROUTE 1A (NORTH-EASTERN CORNER OF EU).	a. no restriction b. flow through bridge appears adequate (c.) flow through bridge appears inadequate, or flow restricted by culvert	1.0 0.5 (0.1)
4A. Ditching on surface of the EU.	SOME DITCHING PRESENT	a. no ditching (b.) ditches present in linear pattern c. ditches present in grid pattern	1.0 (0.5) 0.1

AVERAGE FUNCTIONAL INDEX FOR Part A of FUNCTION 1 = Average of Column D = 0.30

EU # 1 of Marsh System LITTLE RIVER

NEEDED FOR THIS EVALUATION:

- Base map
- Map wheel/measurer
- 100 foot tape measure
- Calculator

Function 1 ECOLOGICAL INTEGRITY Part B

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Part B: Ecological Integrity of the Zone of Influence			
Questions that may require field observation			
1B. Dominant land-use in the 500 foot Zone of Influence surrounding the EU.	- RURAL RESIDENTIAL - COMMERCIAL - ROUTE 1A	a. forested, fields, open water or similar open space (b.) agricultural or rural residential (c.) commercial, industrial, high density residential, or heavily used highways	1.0 0.5 (0.25) 0.1
2B. Ratio of the number of occupied buildings (including seasonal) within the EU **and/or** Zone of Influence to total area of EU.	93 BUILDINGS 93 BLDG / 159 ACRES = 0.58	a. < 0.1 bldg./acre b. from 0.1 – 0.5 bldg./acre (c.) > 0.5 bldg./acre	1.0 0.5 (0.1)
3B. Percent of EU/upland border which has a buffer of woodland or idle land 500 feet in width.		a. more than 70% b. from 30% – 70% (c.) less than 30%	1.0 0.5 (0.1)
4B. Square footage of roads, driveways, and parking lots within 150 feet of EU.	213,800 SQ. FT / 159 ACRES = 1344 SQ. FT/ACRE	(a.) < 1500 sq. feet/acre b. from 1500 – 6000 sq. feet/acre c. > 6000 sq. feet/acre	(1.0) 0.5 0.1

AVERAGE FUNCTIONAL INDEX FOR Part B of FUNCTION 1 = Average of Column D = 0.36

EU # 1 of Marsh System LITTLE RIVER

NEEDED FOR THIS EVALUATION:

- Base map

Function 2
SHORELINE ANCHORING

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Type of marsh system of which the EU is a part.		(a.) estuarine fringe marsh b. estuarine meadow marsh c. coastal/back-barrier marsh	(1.0) 0.5 0.1
Questions that may require field observation			
2. Wetland morphology.	NO SIGNS OF EROSION	a. no distinct bank evident between EU and upland or freshwater wetland (b.) distinct bank evident but protected by vegetation c. distinct bank evident and unprotected by vegetation	1.0 (0.5) 0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 2 = Average of Column D = 0.75

EU # 1 of Marsh System LITTLE RIVER

NEEDED FOR THIS EVALUATION:

- Acreage grid
- Base map

Function 3
STORM SURGE PROTECTION

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Acreage of the EU.	159 ACRES	(a.) > 50 acres b. between 10 – 50 acres c. < 10 acres	(1.0) 0.5 0.1
2. Type of marsh system of which the EU is a part.		a. coastal/back barrier marsh b. estuarine meadow marsh (c.) estuarine fringe marsh	1.0 0.5 (0.1)

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 3 = Average of Column D = 0.55.

EU # 1 of Marsh System LITTLE RIVER

NEEDED FOR THIS EVALUATION:

- Acreage grid
- Base map
- Map wheel
- *Coastal Wetland Plants of the Northeastern US*
- NWI map(s)

Function 4 WILDLIFE, FINFISH & SHELLFISH HABITAT

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Acreage of the EU.		Record the FI from Function 3, question 1 (page D-5)	1.0
2. Ecological Integrity of the EU.		Record the AFI for Part A of Function 1 (page D-2)	0.30
3. Type of tidal restriction.		Record the FI from Function 1, Part A, question 3A (page D-2)	0.1
Questions that may require field observation			
4. Diversity of habitat types.	OPEN WATER, HIGH MARSH, UPLAND ISLANDS, SHALLOW PANNES, FRESHWATER SOURCE	a. 7 – 9 types present (b.) 4 – 6 types present c. < 4 types present	1.0 (0.5) 0.1
5. Presence of submerged (aquatic bed) vegetation.	QUESTION NOT EVALUATED - WRONG TIME OF YEAR (SPRING)	a. submergent vegetation abundant b. submergent vegetation present, but not abundant c. no submergent vegetation present	1.0 0.5 0.1
6. Percent of EU edge bordered by a buffer of woodland, idle land, *or agricultural land* at least 500 feet in width.		a. > 70% b. from 30% – 70% (c.) < 30%	1.0 0.5 (0.1)
7. Proximity to freshwater wetlands.		(a.) marsh system connected to a perennial stream or freshwater wetland b. marsh not connected to a perennial stream, but within 1/4 mile of fresh water wetland c. marsh not connected to stream, and not within 1/4 mile of freshwater wetland	(1.0) 0.5 0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 4 = Average of Column D = 0.50

EU # 1 of Marsh System LITTLE RIVER

NEEDED FOR THIS EVALUATION:

- Base map
- Acreage grid

Function 5
WATER QUALITY MAINTENANCE

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Acreage of the EU.		Record the FI from Function 3, question 1 (page D-5)	1.0
2. Number of tidal restrictions.		Record the FI from Function 1, Part A, question 2A (page D-2)	0.5
3. Type of tidal restriction.		Record the FI from Function 1, Part A, question 3A (page D-2)	0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 5 = Average of Column D = 0.53

EU # 1 of Marsh System LITTLE RIVER

NEEDED FOR THIS EVALUATION:

- NH Fish & Game shellfishing information
- Base map
- State listing of public access points

Function 6
RECREATION POTENTIAL

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may require field observation			
1. Presence of shellfish beds.		a. shellfish beds present and open for harvest	1.0
		b. shellfish beds present but currently closed for harvest	0.5
		(c.) no shellfish beds present	(0.1)
2. Waterfowl hunting.	NO EASY ACCESS - PRIVATE PROPERTIES. RESIDENCES WITHIN 500' OF MARSH	a. EU accessible and currently used by hunters	1.0
		b. EU accessible, but no evidence of use	0.5
		(c.) EU not easily accessible, **or** hunting not permitted	(0.1)
3. Opportunities for wildlife observation.		Record the AFI for Function 4 (page D-6)	0.50
4. Canoe and boat passage in or adjacent to the EU.	LITTLE RIVER	(a.) watercourses within EU at least 10 feet wide and 1 foot deep at high tide and free of obstructions, **or** EU adjacent to canoeable waterway	(1.0)
		b. watercourses within EU contain some exposed obstructions and/or shallow areas, **and** EU not adjacent to canoeable waterway	0.5
		c. watercourses too small, shallow, has obstructions, or non-existent, **and** EU not adjacent to canoeable waterway	0.1
5. Canoe and boat access.	ACCESS AT APPLEDORE ROAD, BUT NO PARKING CLOSE BY	a. access point within 1/2 mile of EU by non-powered boat	1.0
		(b.) access point between 1/2 – 1 mile of EU by non-powered boat	(0.5)
		c. no access, or access point more than 1 mile	0.1

Continued on next page...

EU # 1 of Marsh System LITTLE RIVER

Function 6
RECREATION POTENTIAL
(continued)

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
6. Off-road public parking.		a. EU within 10 minutes of suitable parking area	1.0
		b. suitable parking more than 10 minutes but less than 20 minutes	0.5
		(c.) parking not available within 20 minute walk of EU	(0.1)
7. Handicap accessibility.		a. specially constructed handicap accessibility	1.0
		b. access via existing roads and trails	0.5
		(c.) no handicap access	(0.1)
8. Presence of visitors center, maintained trails, or board walks.		a. visitors center and maintained trails, and/or boardwalks present	1.0
		b. maintained trails and/or boardwalks present, but no visitors center	0.5
		(c.) neither a visitors center nor trails or boardwalks present	(0.1)

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 6 = Average of Column D = 0.31.

EU # 1 of Marsh System LITTLE RIVER

NEEDED FOR THIS EVALUATION:

- Field visit

Function 7
AESTHETIC QUALITY

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Ecological Integrity of the EU.		Record the AFI for Part A of Function 1 (page D-2)	0.30
2. Opportunities for wildlife observation.		Record the AFI for Function 4 (page D-6)	0.50
Questions that may require field observation			
3. Dominant visible land-use surrounding the EU from primary viewing location(s).	- RURAL RESIDENTIAL - COMMERCIAL - ROUTE 1A	a. woodland, agricultural land, or similar open space (b.) rural residential (c.) commercial, industrial, transportation use, or high density residential dominates the visible area	1.0 0.5 (0.25) 0.1
4. General appearance of the EU from primary viewing location(s).	- INVASIVE PLANT SPECIES - ROUTE 1A	a. undisturbed and natural with no visual detractors, natural plant communities (b.) limited disturbance, minor visual detractors, and/or invasive species present c. severe detractors and/or dominated by invasive species	1.0 (0.5) 0.1
5. Noise level at primary viewing location(s).	TRAFFIC ON ROUTE 1A	a. low: natural sounds predominate (b.) moderate: some traffic or other noise audible c. loud: continuous traffic or other noise	1.0 (0.5) 0.1
6. Odors present at primary viewing location(s).		(a.) natural odors only b. unnatural odors present at certain times c. unnatural, unpleasant odors distinct and fairly continuous	(1.0) 0.5 0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 7 = Average of Column D = 0.51

EU # 1 of Marsh System LITTLE RIVER

NEEDED FOR THIS EVALUATION:

- List of estuarine research reserves, nature preserves, and wildlife management areas from local agencies
- Base map
- NWI map(s)

Function 8
EDUCATION POTENTIAL

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. Opportunity for wildlife observation.		AFI for Function 4 (page D-6)	0.50
2. Presence of visitors center, maintained trails, or board walks.		Record the FI from Function 6, question 8 (page D9)	0.1
Questions that may require field observation			
3. Proximity of potential educational site to other habitats.	OPEN WATER, HIGH MARSH, UPLAND ISLANDS, SHALLOW PANNES, FRESHWATER SOURCE (LITTLE RIVER)	(a.) 3 or more habitat types within a short walk of potential education site	(1.0)
		b. 2 habitat types within a short walk of education site	0.5
		c. education site not within short walk to other habitat types	1.0
4. Off-road parking at educational site for school buses or other vehicles. (carpools, vans etc.)		a. EU < 10 minute walk from suitable parking	1.0
		b. EU within 20 minute walk from suitable parking	0.5
		(c.) parking not available within 20 minute walk of EU	(0.1)
5. Student safety.	ROUTE 1A	a. no known safety hazards	1.0
		(b.) safety hazards present but easily avoidable	(0.5)
		c. safety hazards present and not easily avoidable	0.1
6. Handicap accessibility at potential educational site.		a. specially constructed handicap access	1.0
		(b.) access via existing roads and trails	(0.5)
		c. no handicap access	0.1

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 8 = Average of Column D = 0.45

EU # 1 of Marsh System LITTLE RIVER

NEEDED FOR THIS EVALUATION:

- List of federal and state endangered and threatened species
- List of NHNHI exemplary communities
- Natural Register of Historic Places

Function 9 NOTEWORTHINESS

A Evaluation Questions	B Notes	C Evaluation Criteria	D Functional Index (FI)
Questions that may not require field observation			
1. EU is habitat for a state or federally listed threatened or endangered species.		a. EU is currently habitat for a threatened or endangered species	1.0
		(b.) EU is not currently habitat for threatened or endangered species	(0.1)
2. EU has significance because it has biological, geological or other features which are locally rare or unique, **or** is listed as an exemplary community by NHNHI.		a. EU contains feature(s) of significance	1.0
		(b.) EU does not contain feature of significance	(0.1)
3. EU is known to contain an important historical or archaeological site.		a. EU is known site of historical or archaeological significance	1.0
		(b.) no evidence of historical or archaeological use	(0.1)
4. Tidal marshes in an urban setting.		a. commercial, industrial, transportation use or high density residential use occupies >50% of area within 1/4 mile of the marsh	1.0
		(b.) rural residential (>1 acre lots), agricultural, forestry or similar open space	(0.1)
5. EU used as long term research site.		a. EU a site for long term research	1.0
		(b.) EU not a site for long term research	(0.1)

AVERAGE FUNCTIONAL INDEX FOR FUNCTION 9 = Average of Column D = 0.1

Section 6 — Description of Restoration Potential
DATA SHEETS

Question 1. Number and type of restrictions between EU and free tidal flow.

EU #1 HAS ONE RESTRICTION BETWEEN IT AND THE ATLANTIC OCEAN - A 36" CULVERT LOCATED IN THE NORTHEASTERN CORNER OF THE MARSH, UNDER ROUTE 1A. A DITCH HAS BEEN DUG TO CONNECT THE CULVERT TO THE LITTLE RIVER. THE ORIGINAL OUTLET OF THE LITTLE RIVER NO LONGER EXISTS.

Question 2. Percent of the EU dominated by invasive species.

MUCH OF THIS EU HAS BECOME A FRESHWATER SCRUB-SHRUB WETLAND. ABOUT 50% OF THE EU STILL SUPPORTS SOME TIDAL MARSH PLANTS. THIS AREA ALSO CONTAINS SOME FRESHWATER PLANT SPECIES MIXED IN WITH SPARTINA PATENS AND DISTICHLIS SPICATA.

Question 3a. Acreage of fill deposited on the marsh surface.

IT APPEARS THAT APPLEDORE ROAD WAS BUILT THROUGH THE MARSH. THIS ROAD WOULD HAVE BEEN BUILT ON FILL THAT CONNECTED UPLAND ISLANDS IN THE MARSH TO ROUTE 1A. THE FILL OCCUPIES LESS THAN 1/4 ACRE OF THE EU; HOWEVER, IT HAS SEVERELY RESTRICTED TIDAL FLOW.

Description of Restoration Potential Data Sheets *(continued)*

Question 3b. Existing plant community located on fill.

THE FILL IS A PAVED ROAD WITH A SINGLE CULVERT CONNECTING IT TO EU #2. THERE IS NO PLANT COMMUNITY PRESENT.

Question 3c. Presence of structures on the fill.

APPLEDORE ROAD

Question 4. Other causes of degradation.

THERE IS EXTENSIVE RESIDENTIAL DEVELOPMENT AND ROADS SURROUNDING THE EU. THIS MAY BE AFFECTING THE QUALITY OF RUNOFF FROM THE UPLAND INTO THE EU.

MARSH SYSTEM LITTLE RIVER

EVALUATION UNIT # 1 OF 3

SIZE OF EU 159 acres

PERCENTAGE OF SYSTEM THAT EU REPRESENTS 76.2

STATUS OF EU (check one) TIDAL X FORMERLY TIDAL ___

Function	Average Functional Index (AFI)
1A. Ecological Integrity of EU	0.30
1B. Ecological Integrity of Zone of Influence	0.36
2. Shoreline Anchoring	0.75
3. Storm Surge Protection	0.55
4. Wildlife, Finfish & Shellfish Habitat	0.50
5. Water Quality Maintenance	0.53
6. Recreation Potential	0.31
7. Aesthetic Quality	0.51
8. Education Potential	0.45
9. Noteworthiness	0.10

SUMMARY

THIS EU IS SEVERELY DEGRADED. THE ORIGINAL OUTLET OF THE LITTLE RIVER HAS BEEN BLOCKED, AND THE ONLY CONNECTION TO THE OCEAN IS A CULVERT UNDER ROUTE 1A. THIS CULVERT DOES NOT ALLOW FOR ADEQUATE TIDAL FLUSHING. IN TIMES OF HEAVY RUNOFF FROM THE UPLAND, THIS EU IS EASILY FLOODED BY FRESHWATER. MANY FRESHWATER PLANT SPECIES ARE PRESENT IN THIS EU AND MOST LIKELY WILL CONTINUE TO SPREAD UNLESS SOME CHANGES ARE MADE IN THE TIDAL RESTRICTION.

MARSH SYSTEM LITTLE RIVER

EVALUATION UNIT # 2 OF 3

SIZE OF EU 38 acres

PERCENTAGE OF SYSTEM THAT EU REPRESENTS 18.2%

STATUS OF EU (check one) TIDAL X FORMERLY TIDAL ___

Function	Average Functional Index (AFI)
1A. Ecological Integrity of EU	0.20
1B. Ecological Integrity of Zone of Influence	0.24
2. Shoreline Anchoring	0.87
3. Storm Surge Protection	0.35
4. Wildlife, Finfish & Shellfish Habitat	0.53
5. Water Quality Maintenance	0.33
6. Recreation Potential	0.41
7. Aesthetic Quality	0.40
8. Education Potential	0.42
9. Noteworthiness	0.10

SUMMARY

THIS EU IS DOMINATED BY PURPLE LOOSESTRIFE AND PHRAGMITES. IT IS SEVERELY DEGRADED, AND THE AMOUNT OF TIDAL WATER REACHING THE EU MUST BE INCREASED TO REVERSE THE DEGRADATION. THE ORIGINAL OUTLET OF THE LITTLE RIVER MUST HAVE FLOWED THROUGH THIS EU. PRESENTLY, LITTLE TIDAL WATER REACHES THE EU. SOMETIMES, WHEN THE EU IS FLOODED BY FRESHWATER IN THE SPRING, NHDOT OPENS A TEMPORARY CHANNEL TO THE OCEAN FROM THE BOX CULVERT UNDER ROUTE 1A TO DRAIN THE FLOOD WATERS.

THIS EU NEEDS SOME IMMEDIATE ATTENTION!

MARSH SYSTEM LITTLE RIVER

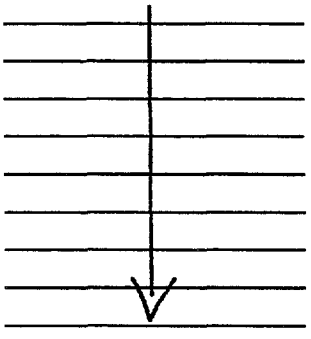
EVALUATION UNIT # 3 OF 3

SIZE OF EU 11.7 acres

PERCENTAGE OF SYSTEM THAT EU REPRESENTS 5.6%

STATUS OF EU (check one) TIDAL___ FORMERLY TIDAL X

Function	Average Functional Index (AFI)
1A. Ecological Integrity of EU	NA
1B. Ecological Integrity of Zone of Influence	
2. Shoreline Anchoring	
3. Storm Surge Protection	
4. Wildlife, Finfish & Shellfish Habitat	
5. Water Quality Maintenance	
6. Recreation Potential	
7. Aesthetic Quality	
8. Education Potential	
9. Noteworthiness	



SUMMARY

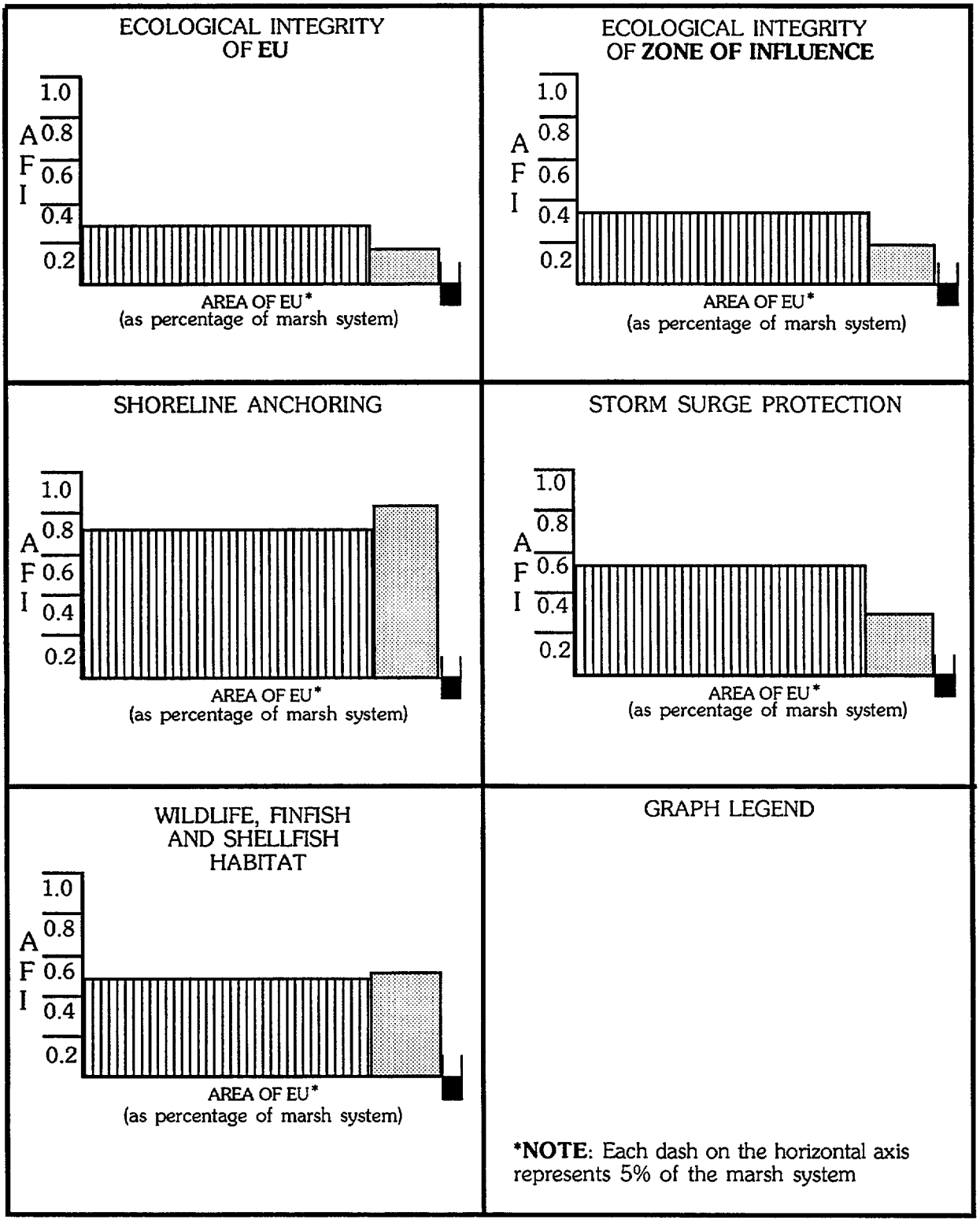
ALTHOUGH THERE ARE CULVERTS CONNECTING THIS EU TO EU#2, IT CAN NO LONGER BE CONSIDERED A TIDAL MARSH - i.e. IT IS FORMERLY TIDAL. THE CULVERT PROVIDES FOR FRESHWATER DRAINAGE OUT OF THE EU.

THE EU IS DOMINATED BY FRESHWATER SWAMP SPECIES, SUCH AS RED MAPLE.

EU ANALYSIS GRAPHS

MARSH SYSTEM LITTLE RIVER TOTAL AREA 209 ACRES

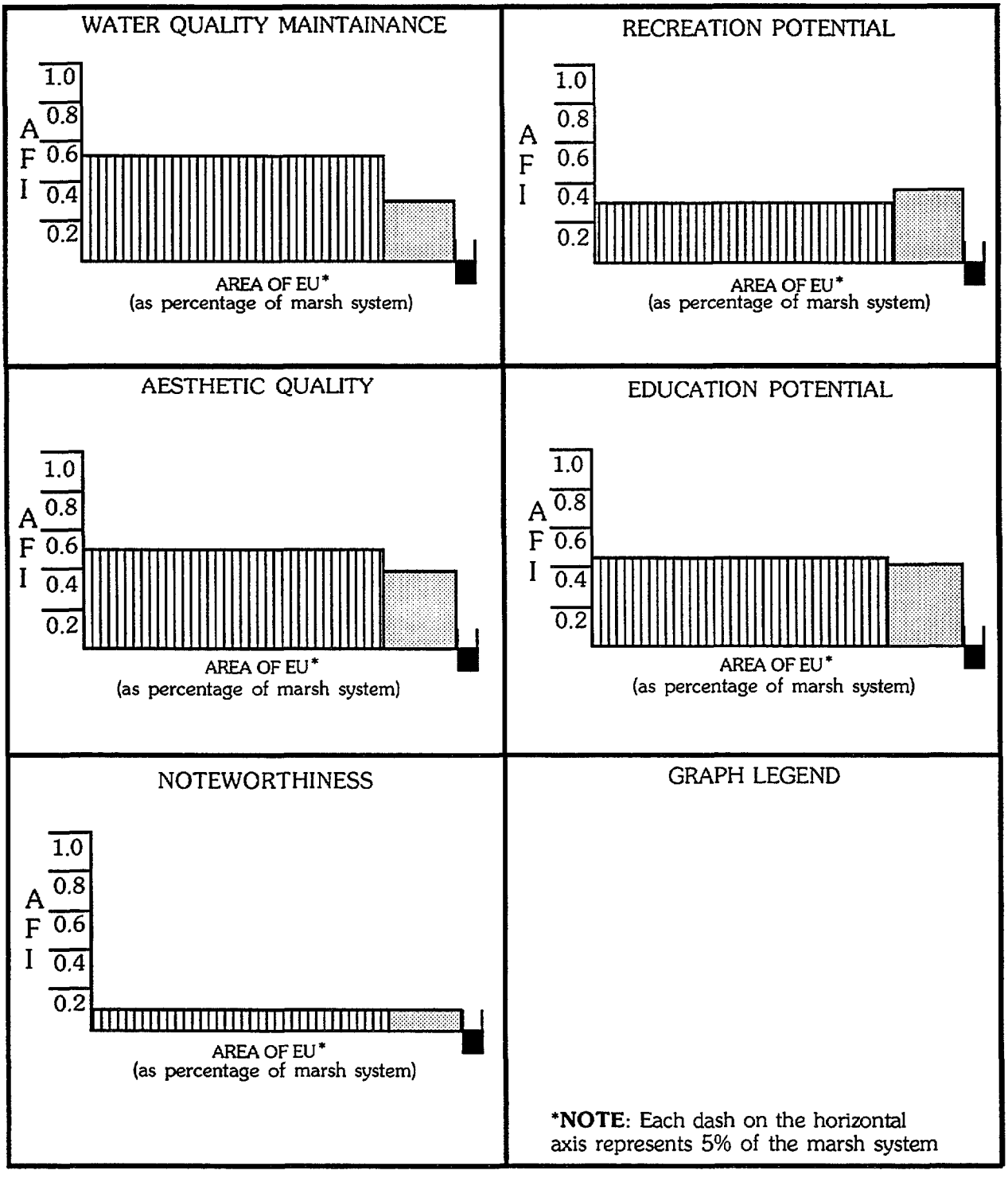
NUMBER OF EUs 3



EU ANALYSIS GRAPHS cont.

MARSH SYSTEM LITTLE RIVER TOTAL AREA 209 ACRES

NUMBER OF EUs 3



MARSH SYSTEM DATA SHEET

It is not necessary to complete the marsh system data sheet for those systems that have a single EU

MARSH SYSTEM LITTLE RIVER NUMBER OF EUs 3

EU Number	Size in acres	Management Option Chosen
1	159	D
2	38	D
3	11.7	NOT EVALUATED - FORMERLY TIDAL

Best Education Site/s in Marsh System NO SUITABLE EDUCATION SITES

Best Recreation Site/s in Marsh System LITTLE RIVER (BUT DIFFICULT ACCESS)

Public Access Points In or Adjacent to the Marsh System CANOE OFF APPLEDORE ROAD, BUT NO PARKING CLOSE BY.

Noteworthy Feature(s) NONE

SANDY POINT MARSH

SUMMARY DATA SHEET
EU ANALYSIS GRAPHS

MARSH SYSTEM SANDY POINT

EVALUATION UNIT # 1 OF 1

SIZE OF EU 32.4 acres

PERCENTAGE OF SYSTEM THAT EU REPRESENTS 100%

STATUS OF EU (check one) TIDAL X FORMERLY TIDAL ___

Function	Average Functional Index (AFI)
1A. Ecological Integrity of EU	0.56
1B. Ecological Integrity of Zone of Influence	1.0
2. Shoreline Anchoring	0.66
3. Storm Surge Protection	0.66
4. Wildlife, Finfish & Shellfish Habitat	0.64
5. Water Quality Maintenance	0.53
6. Recreation Potential	0.82
7. Aesthetic Quality	0.74
8. Education Potential	0.94
9. Noteworthiness	0.10

SUMMARY

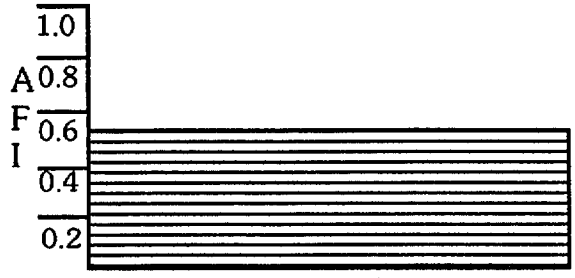
THE LOCATION OF THIS MARSH ON THE SOUTHERN END OF GREAT BAY EXPOSES THIS MARSH TO THE PREVAILING WIND. CONSEQUENTLY A TREMENDOUS AMOUNT OF TIDAL TRASH ENDS UP IN THIS MARSH. EVEN THOUGH THE MARSH RECEIVED A 1.0 FOR FUNCTION 1B, THE DEVELOPMENT OF DUNBARTON OAKS COULD BE AFFECTING THE QUALITY OF THE FRESHWATER DRAINAGE INTO THE MARSH. THIS MARSH IS LOCATED ON THE SITE OF THE SANDY POINT VISITORS CENTER AT THE GBNERR AND IS AN IMPORTANT EDUCATION AND RECREATION SITE. THE REMOVAL OF SOME OF THE TIDAL TRASH WOULD ENHANCE THE AESTHETIC QUALITY OF THIS MARSH.

EU ANALYSIS GRAPHS

MARSH SYSTEM SANDY POINT TOTAL AREA 32.4 ACRES

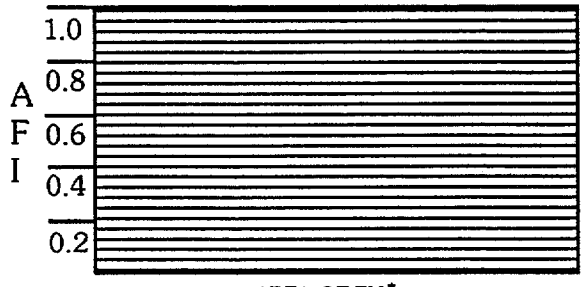
NUMBER OF EUs 1

ECOLOGICAL INTEGRITY OF **EU**



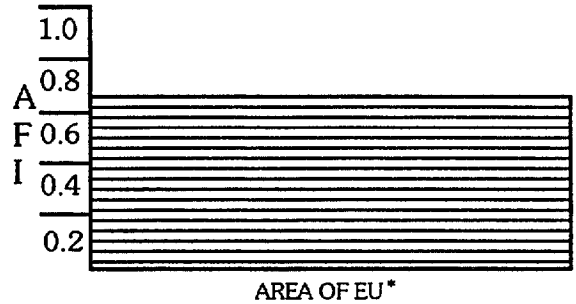
AREA OF EU*
(as percentage of marsh system)

ECOLOGICAL INTEGRITY OF **ZONE OF INFLUENCE**



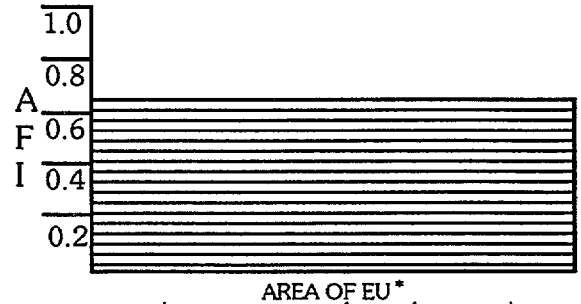
AREA OF EU*
(as percentage of marsh system)

SHORELINE ANCHORING



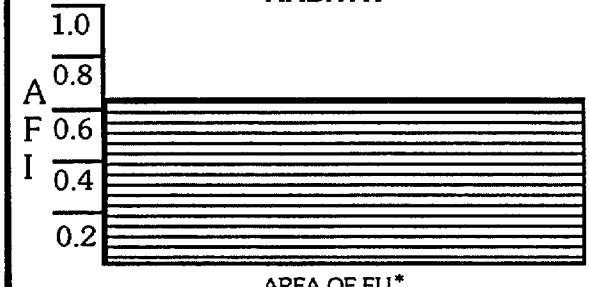
AREA OF EU*
(as percentage of marsh system)

STORM SURGE PROTECTION



AREA OF EU*
(as percentage of marsh system)

WILDLIFE, FINFISH AND SHELLFISH HABITAT



AREA OF EU*
(as percentage of marsh system)

GRAPH LEGEND

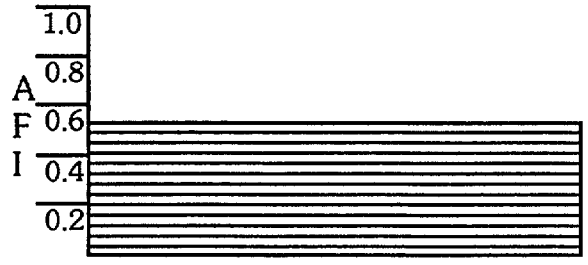
***NOTE**: Each dash on the horizontal axis represents 5% of the marsh system

EU ANALYSIS GRAPHS cont.

MARSH SYSTEM SANDY POINT TOTAL AREA 32.4 ACRES

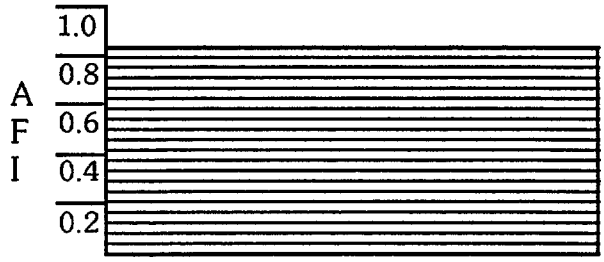
NUMBER OF EUs 1

WATER QUALITY MAINTAINANCE



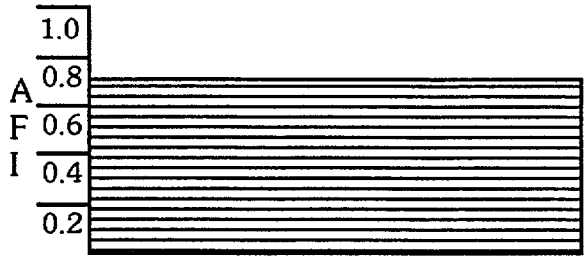
AREA OF EU*
(as percentage of marsh system)

RECREATION POTENTIAL



AREA OF EU*
(as percentage of marsh system)

AESTHETIC QUALITY

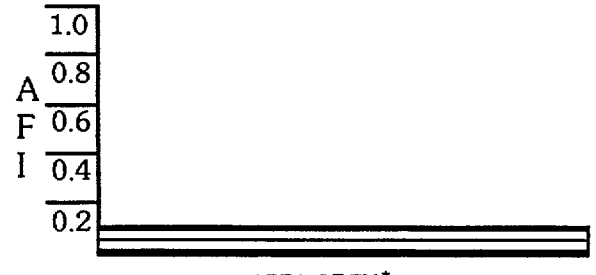


AREA OF EU*
(as percentage of marsh system)

EDUCATION POTENTIAL

AREA OF EU*
(as percentage of marsh system)

NOTEWORTHINESS



AREA OF EU*
(as percentage of marsh system)

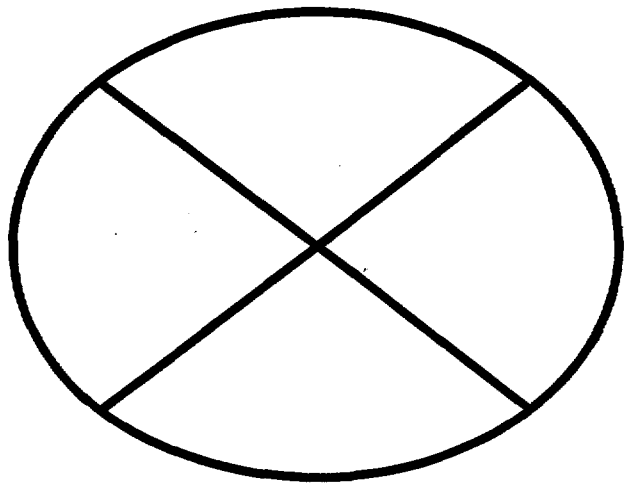
GRAPH LEGEND

***NOTE**: Each dash on the horizontal axis represents 5% of the marsh system

HAMPTON–SEABROOK MARSH

EU BASE MAP

Do Not Scan



Reprep-Insert Do Not Scan Document Here

Document ID: SM065

EU Base Map

Page #:

Appendix J

PHOTOGRAPHIC EXAMPLES OF SOME TIDAL MARSH FEATURES

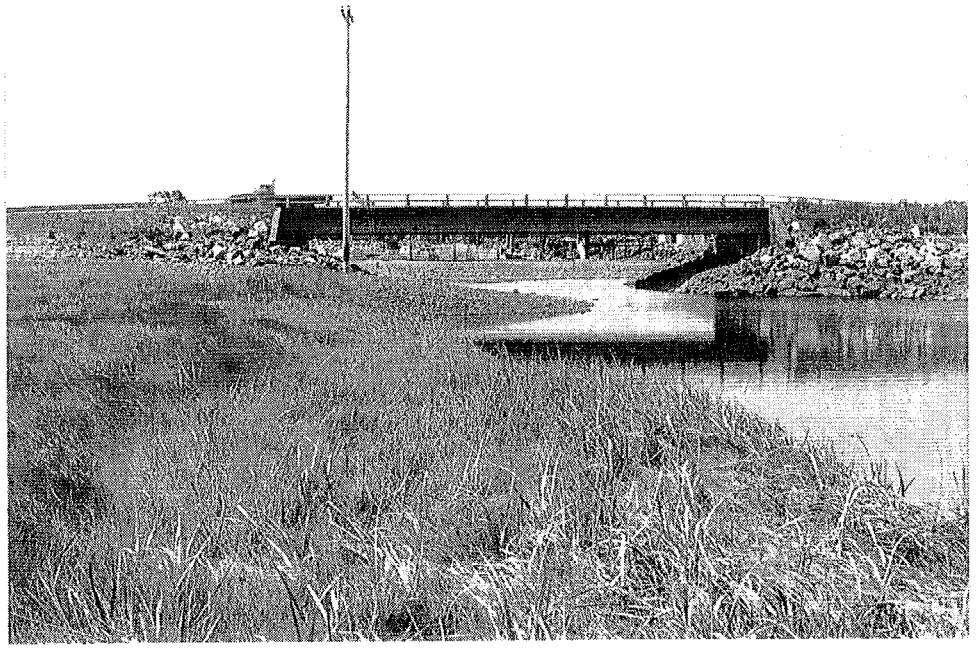


Photo 1

This is the bridge under Rt. 1A on the northern side of Rye Harbor. The restriction of flow associated with this bridge has not reduced the flow in this channel enough to affect the tidal marsh plant community. However, Rt.1A is built across the marsh and does have an effect on the amount of water reaching the marsh at high tide.

This type of restriction should be considered " b. flow through bridge adequate" and receive a 0.5 for Function 1, Part A, question 3.

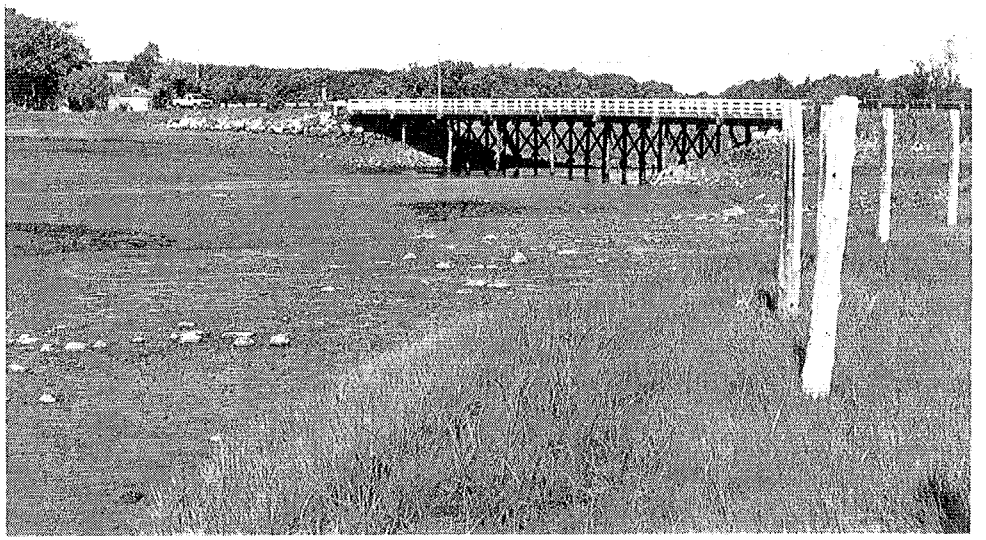


Photo 2

This bridge at the mouth of Berry Brook in Rye is similar to the bridge at Rye Harbor. The pilings in the water under the bridge create turbulence that affects the flow through the bridge, but the reduction of flow associated with this bridge has not had a significant effect on the integrity of the marsh.

This bridge should also receive a 0.5 for Function 1, Part A, question 3.

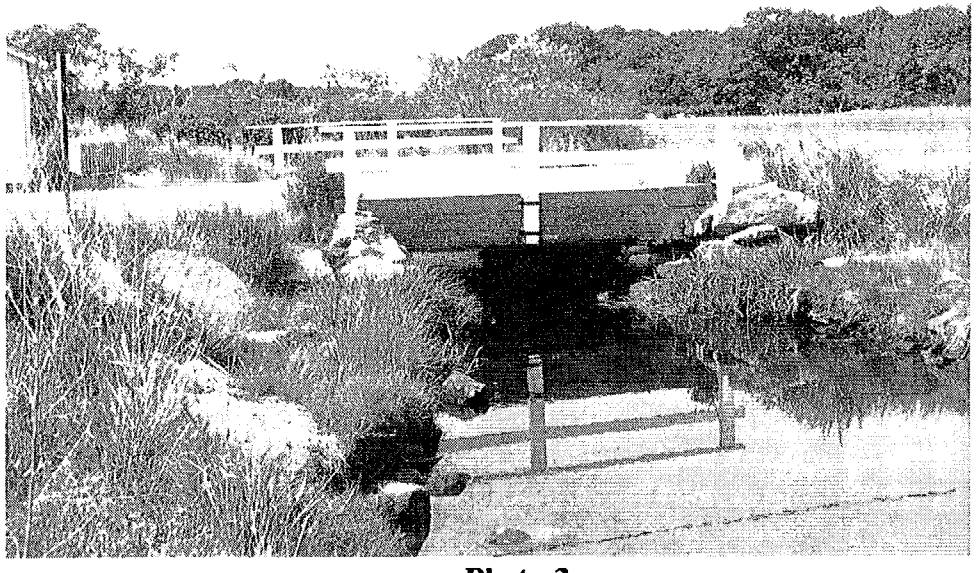


Photo 3

Bridges such as this one over Parsons Creek on Wallis Road in Rye can severely affect the health of the marsh because they affect the amount of tidal flow through the channel as well as preventing the flow of tidal waters across the surface of the marsh at high tide. The bridge, and debris collected in the water around the bridge, have restricted flow if water in to and out of the marsh to such an extent that the future existence of the tidal marsh is threatened. A visit to this marsh during spring runoff will demonstrate the problem. The freshwater running into the marsh from the Parsons Creek watershed becomes trapped on the upstream side of the bridge. This causes changes in the chemical properties of the soil that can lead to changes in the plant and animal communities. The opposite effect can be seen at spring high tide when tidal waters being held back by this bridge, do not reach the upper sections of this marsh.

This type of restriction should be considered "c. flow through bridge appears inadequate or flow restricted by culvert" and receive a 0.1 for Function 1, Part A, question 3.

Photo 4

Here is another example of a bridge that is undersized for the channel it crosses, preventing flow across the surface of the marsh at high tide. This bridge is located on Rt. 1A just south of Rye Harbor. This is one of a series of restrictions that are affecting the southern portion of the Rye Harbor marshes.

This bridge should also receive a score of 0.1 for Function 1, Part A, question 3.

Photo 5

Culverts are usually the most restrictive of the types of restriction found in tidal marshes. Many times the culvert, such as this one located under a private driveway, have a flow capacity much less than that of the stream running through them. Culverts are also associated with problems described in Photo 3 and can be associated with the spread of an invasive plant species in the marsh.

Culverts should be inspected to see if any type of mechanism has been installed to control tidal flow through the culvert such as a tide gate.

This type of restriction should be considered "c. flow through bridge appears inadequate or flow restricted by culvert" and receive a 0.1 for Function 1, Part A, question 3.

Photo 6

Culverts such as this one located on Marsh Road in Rye at the northern end of the Parsons Creek marsh restrict flow to such an extent that the wetland on the downstream side may no longer be considered tidal. Areas with such severe restrictions in flow are usually dominated by invasive species. When inventorying wetlands such as this one, careful consideration should be given to whether or not the area is still functioning as a tidal marsh and included in the evaluation or whether the wetland should be looked at as a formerly tidal marsh.

If the wetland is still a tidal marsh, it should receive a score of 0.1 for Function 1, Part A, question 3.

Photo 7

Estuarine Fringe Marsh

Adams Point in Durham

- linear in shape
- provides protection to eroding upland bank
- dominated by low marsh, saltwater cordgrass (*Spartina alterniflora*)
- generally no high marsh
- located along shore of Great Bay
- exposed to winds and waves in Furber Strait
- gently grades from open water to upland

Photo 8

Estuarine Meadow Marsh

Johnsons Creek in Durham

- located along tributary to Oyster River, protected somewhat from wind and waves
- dominated by high marsh, salt hay grass (*Spartina patens)*
- some low marsh present along creek edge (may not always be present)
- develops distinct bank between open water and the marsh

Photo 9

Coastal/Back-barrier Marsh

Hampton–Seabrook Marsh

- adjacent to Atlantic Ocean with direct access to seawater
- dominated by high marsh, salt hay grass (Spartina patens)
- usually a system of tidal creeks and channels present
- can be quite large

Photo 10

Common reed

Phragmites australis

- 6 – 14 feet high
- long, flat, tapering leaves
- round, hollow erect stems
- feathery flower head, purplish to brown in color

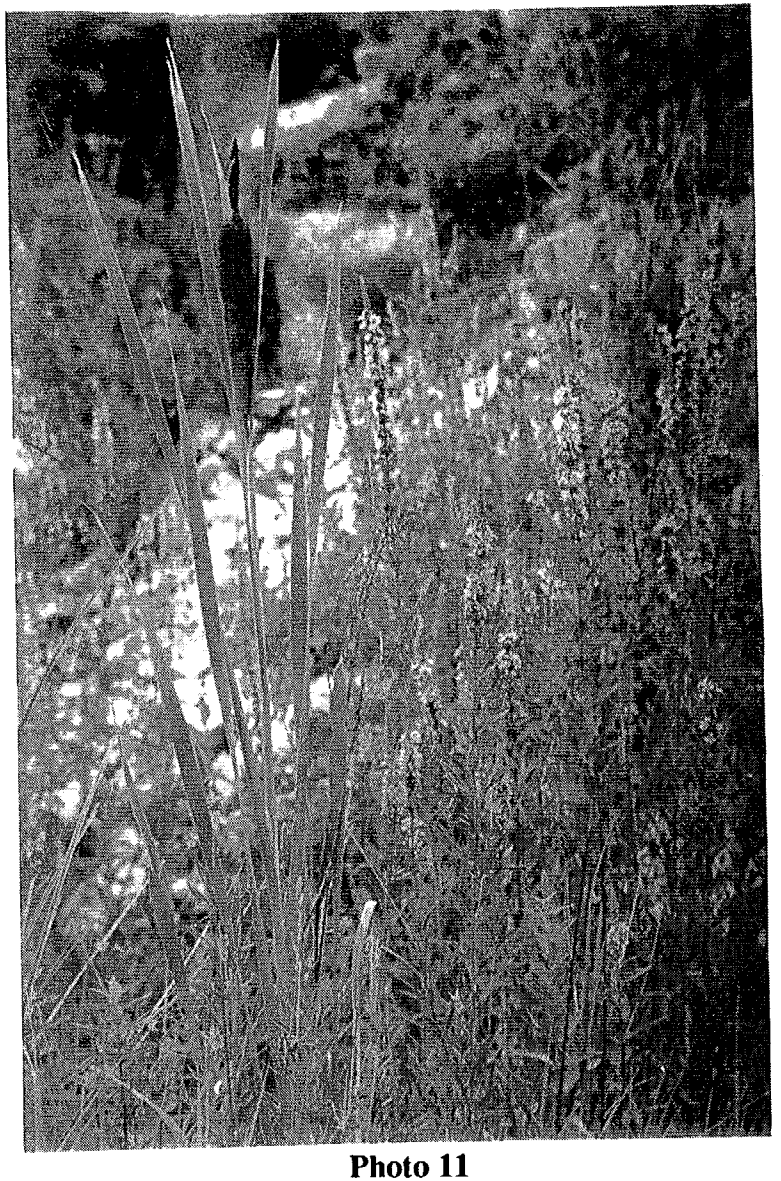


Photo 11

Common cattail
Typha latifolia

- 5 - 9 feet tall
- simple, entire, elongate, linear, basal leaves up to 1 inch wide
- no separation of male and female flower

Photo 12

Narrow-leaved cattail
Typha angustifolia

- up to 6 feet tall
- simple, entire, elongate, linear, basal leaves 1/5—1/2 inch wide
- male flower separate and above female flower
- can be confused with common cattail (see photo 11)

Photo 13

Purple loosestrife

Lythrum salicaria

- 2 – 4 feet high
- stems angled and almost woody
- simple, entire, lance-shaped leaves
- purple five–six petaled flower borne on spikelike inflorescences