Mid-Atlantic Tidal Wetland Rapid Assessment Method
Version 3.0

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METHOD DEVELOPMENT

The Mid-Atlantic Tidal Rapid Assessment Method was developed as part of a collaborative effort among the Delaware Department of Natural Resources and Environmental Control, Maryland Department of Natural Resources and the Virginia Institute of Marine Sciences to assess the condition of tidal wetlands in the Mid-Atlantic region. We are very grateful to the developers of the New England Rapid Assessment Method (NERAM) and the California Rapid Assessment Method (CRAM) from which we borrowed metrics, indicators, and index development. This method and protocol is a living document and will be updated as we collect more information and continue to learn more about tidal wetland processes and stressors and how these impact the ecological integrity or condition of wetlands.

This protocol was originally developed based on data collected in the Indian River watershed (DE), Nanticoke watershed (MD), and York River watershed (VA) in 2006 and 2007. We collected a range of data including vegetation composition and structure, soil attributes, above and below ground biomass, soil stability, macro invertebrate composition, bird community composition, hydrology, surrounding land use, and stressors. Additionally, we used both the NERAM and CRAM on the same sites. Based on our data analysis we selected metrics from both NERAM and CRAM that were suitable to the mid-Atlantic region and were able to discriminate sites along a disturbance gradient. The scaling of individual metrics was then adjusted to fit the range of conditions found in Mid-Atlantic tidal wetlands. We also added several new metrics. Since the first version of MidTRAM we have updated the metrics and scaling of metrics based on additional assessments in the Inland Bays, St. Jones River, and Murderkill River watersheds in Delaware.

The overall formatting follows that of CRAM to depict the major wetland attributes including Plant Community (biotic and physical structure), Hydrology, and Buffer. Each metric is given a score between 3 and 12 and then combined into attribute scores by summing the metric scores and dividing by the total possible value, depending on the number of metrics in that group. That value is adjusted to be on a 0-100 scale since each metric can only score a minimum of 3:

$$\text{Buffer}= ((((\sum(B1\ldots B5))/60)*100)-25)/75)*100$$
$$\text{Hydrology}= ((((\sum(H1\ldots H4))/48)*100)-25)/75)*100$$
$$\text{Habitat}= ((((\sum(HAB1\ldots HAB5))/60)*100)-25)/75)*100$$

Final MidTRAM condition scores range from 0-100 and are calculated by averaging the 3 attribute group scores:

$$\text{MidTRAM} = ((\text{Buffer} + \text{Hydrology} + \text{Habitat})/3)$$

CHANGES IN THIS VERSION

This is the third version (3.0) of MidTRAM. Changes made since version 2.0 were based on data from 150 sites in the Inland Bays, St. Jones River and Murderkill River watersheds. In version 3.0 the habitat metric Plant Fragments is removed due to high sample variability, low responsiveness and failed mean rank condition tests. Also, the test habitat metric Horizontal Vegetative Obstruction is now a scored metric based on strong correlations with above ground biomass. Horizontal Vegetative Obstruction also replaces the metric Vertical Biotic Structure which had low precision among users. The habitat metric Bearing Capacity remains a scored

metric as a result of strong correlations with biomass values even though it exhibited high site variability and poor responsiveness. To capture more site variability, version 3.0 requires that 8, bearing capacity readings are taken at each site (formerly 4). The attribute and final score formulas reflect these metric changes. Lastly, in cooperation with the Partnership for the Delaware Estuary, there are test metrics to measure 2 shoreline attributes: Erosion of shoreline and presence of shoreline alterations.

USE OF METHOD

This method was developed for the primary purpose of assessing the condition of tidal wetlands at the watershed scale using a probabilistic survey. Therefore, the assessment is based on the evaluation of a fixed area of tidal wetland (50m radius circle). We believe that the method also has wider applicability for other uses. Multiple assessment areas may be required to assess larger areas to accurately depict the condition of the site.

***The development team would appreciate any feedback from users on how they are using the method, the applicability in different areas, and suggestions for improvement.**

A. Time and Effort Involved

The time to sample a site with MidTRAM will vary depending on the number of field crewmembers, the familiarity with MidTRAM, and site conditions. Based on our experience, a trained crew of 2 people requires approximately 2 hours to complete the method once on site.

B. Experience and Qualifications Needed

MidTRAM should only be performed by individuals who have completed a training course on how to properly perform this method. Users of this method should have experience in the identification of tidal wetlands including an understanding of the various stressors that impact different wetland types, native flora of the region, and soil properties. For information on training opportunities contact one of the program contacts listed above.

FIELD PREPARATION

A. Landowner Permission

Permission should be obtained before accessing private property. Our experience is that if contact can be made with the landowner there is a high probability that they will allow access to their property. Georeferenced parcel data can be obtained through the State intranet for Delaware and landowner information can be found using the following websites:

Delaware Counties

Sussex County: **http://www.sussexcountyde.gov**

Kent County: **http://www.co.kent.de.us**

New Castle County**:** **http://www.nccde.org/defaulthome/home/webpage1.asp**

Maryland Counties

http://sdatcert3.resiusa.org/rp_rewrite/

Virginia Counties

http://www.dof.virginia.gov/gis/parcel-data.shtml

B. Field Map Production

Field maps should be produced before the initial site visit. They should include the outline of the 50m assessment area, the outline of the 250m buffer area, NWI or State Wetland boundaries, and roads including names if applicable. If an unusual feature exists in the AA or 250m buffer, review and print older maps to convey site history and disturbance considerations. Maps should illustrate the site at multiple levels and dates:

- Wetlands and hydrology (1:3000)
- Wetlands and hydrology (1:24000)
- Tax Parcels (1:5000)
- Road Map (1:24000)
- Soils (1:5000)
- Old aerials 1937, 1954, 1961, 1968, 1992, 1997, 2002 (1:3000)

C. Equipment List

Printed protocol	Plastic folding tape measurer
GPS	Compass
Maps	Datasheets
Clipboard	Pencils
Guide to identifying tidal wetland plants	Sunscreen
Shovel	Slide Hammer
2 100m Tapes or 5 50m tapes	Profile Board
Waders	Refractometer
$1m^2$ Quadrant	Water

CLASSIFICATION OF TIDAL WETLANDS

Key to determining tidal wetland subclass in the mid-Atlantic region (see Figure 1)

I. Is the wetland influenced by tidal cycles from a Bay or Ocean?

No – site is nontidal; please refer to the Delaware Rapid Assessment Protocol or Virginia Rapid Assessment Method for alternate assessment methods for nontidal wetlands.

Yes – go to step II

II. Is the wetland bordered by the ocean on at least one side?

A. Yes – Marine Tidal Fringe subclass

B. No – Estuarine Tidal Fringe subclass

1. Wetland located on the estuary side of a barrier island
   a) Yes – Back barrier Estuarine Tidal Fringe
   b) No – go to 2.
2. Wetland is a narrow fringing marsh along the estuary, bay, or tidal river
   a) Yes – Fringing Estuarine Tidal Fringe
   b) No – Expansive Estuarine Tidal Fringe

Further classify estuarine tidal fringe subclass by salinity

a) Polyhaline – 18 to 30 ppt
b) Mesohaline – 5 to 18 ppt
c) Oligohaline – 0.5 to 5 ppt
d) Freshwater - <0.5 ppt

Figure 1. Examples of tidal wetland classification. Orange outline (top right) is Back barrier estuarine fringe, green outline (bottom left) is Fringing Estuarine Tidal Fringe, yellow outline (bottom middle) is Expansive Estuarine Tidal Fringe.

ESTABLISHING THE ASSESSMENT AREA

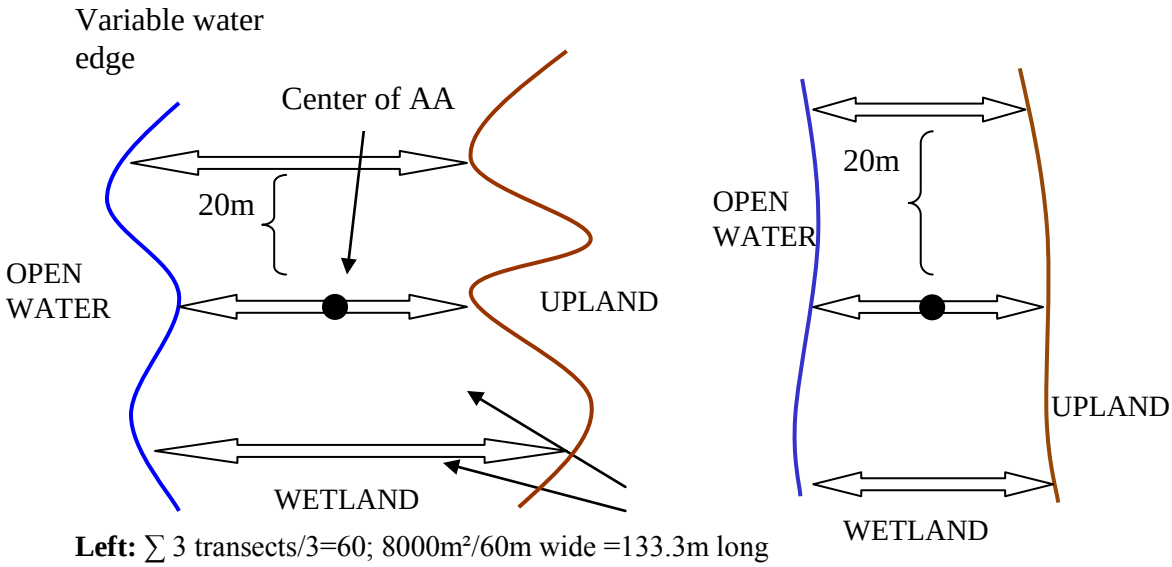
The Assessment Area (AA) is the area within a tidal wetland that will be sampled using MidTRAM. All measurements will be performed in the AA or in the adjacent buffer to the AA. The center point of the AA is either randomly located when using a probabilistic sampling design or can be subjectively selected based on the goals of the assessment.

- Mark the center of the AA.
- Establish the AA as a 50-m radius circle centered on the sample point (0.8ha area). Using 2, 100m tapes, run one transect perpendicular from the open water edge to the upland edge, locate the 2nd transect perpendicular to the first. Walk the tapes out from the center with the tapes on the right side. Look ahead to an approximate destination and try not to trample the wetland surface on the right. Walk back to the center point keeping the tapes on the left. This will prevent walking through and trampling areas that will become the AA subplots.

A. Moving or adjusting the location and/or dimensions of the AA

Several situations may occur that would require that the AA be positioned differently than above. The following circumstances are for adjustments during a probabilistic survey. The placement of the assessment area for reference sampling would allow moving from the original location by more than 100m. Please note: **If the location of the AA is moved or adjusted, make detailed notes on the datasheet explaining why the AA was moved and record the new lat/long.**

1. If the wetland does not extend 50m in all directions without touching upland or if >10% of the AA would be open natural water (water >30m wide):
   - Move the center point the least necessary distance <100m until the entire AA is within the wetland boundaries. If >100m is needed the site should be rejected for a probabilistic survey. If moving the AA away from upland or open water on one side results in a conflict on the other side see item 4 below.
2. If the AA is within or contains a naturally occurring upland inclusion in the wetland:
   - If the upland inclusion is due to a disturbance (e.g. a pile of fill) do not move the center of the AA because you want to include the disturbance in the assessment.
   - If the original point is determined to be natural upland, examine the entire 50m radius circle around the original point for a wetland.
     - If a wetland is found within this area, move the center point the least distance necessary <100m to establish an AA entirely in the wetland.
     - If no wetland is found within the bounds of the original AA, the site should be dropped and recorded as upland for a probabilistic survey.
3. If the wetland is ≤ 0.8ha (8000ft²):
   - The AA becomes the same size as the wetland. Detail this carefully in the site sketch.
4. If the wetland is ≥0.8ha, but is oddly shaped and 50m radius will not fit without touching upland or without covering >10% natural open water (800m^2; Figure 2):
   - Configure the AA as a 0.8ha rectangle positioned long ways across the wetland with the width being from the edge of the open water to the upland. Find the average wetland width by measuring 3 transects, at least 20m apart, perpendicular from the open water to the upland. This average will be the width of the AA. Use the calculated average width to determine the length of your rectangle to equal 0.8ha.
   - Rectangle should be no longer than 150m long due to habitat variability and may be curved to fit along upland and open water edges. Note the new dimensions and shape of the AA on the datasheet.



Left: ∑ 3 transects/3=60; 8000m²/60m wide =133.3m long
Right: ∑ 3 transects/3=75; 8000m²/75m wide =106.6m long

Figure 2. Illustration of how to determine the dimensions of a rectangular AA. Use the average distance between the channel edge and upland as determined from the 3transects to calculate length and achieve a 0.8 ha rectangle.

B. Locating subplots within the AA

Subplots will all be located within the 0.8ha assessment area to perform vegetation structure and bearing capacity.

1. Circle plot (Figure 3)
   - Eight $1m^2$ subplots will be placed along two 100m transects, dissecting the AA perpendicularly.
   - Subplots should be placed 25m and 50m from the center of the AA along each transect.
   - Subplots should be located in a dominant vegetation type of the AA (makes up ≥10% cover in the AA). If the given plot is not representative of a dominant vegetation type (makes up ≥10% cover in the AA; e.g., on a small mud flat or in a ditch) move the sub-plot 1 meter along the transect and note the new location.
2. Rectangle plot (Figure 4)
   - Eight $1m^2$ subplots will be placed along three transects within the AA, within a dominant vegetation type (covering ≥10% of AA).
   - Divide the AA in half length-wise, and into thirds width-wise.
   - Spread the 8 subplots out along the transects depending on the size of the rectangular AA, with 6 subplots along the outside edges and 2 subplots where the transects cross.
   - If the given plot is not representative of a dominant vegetation type (makes up ≥10% cover in the AA; e.g., on a small mud flat or in a ditch) move the subplot 1 meter along the transect and note the new location.

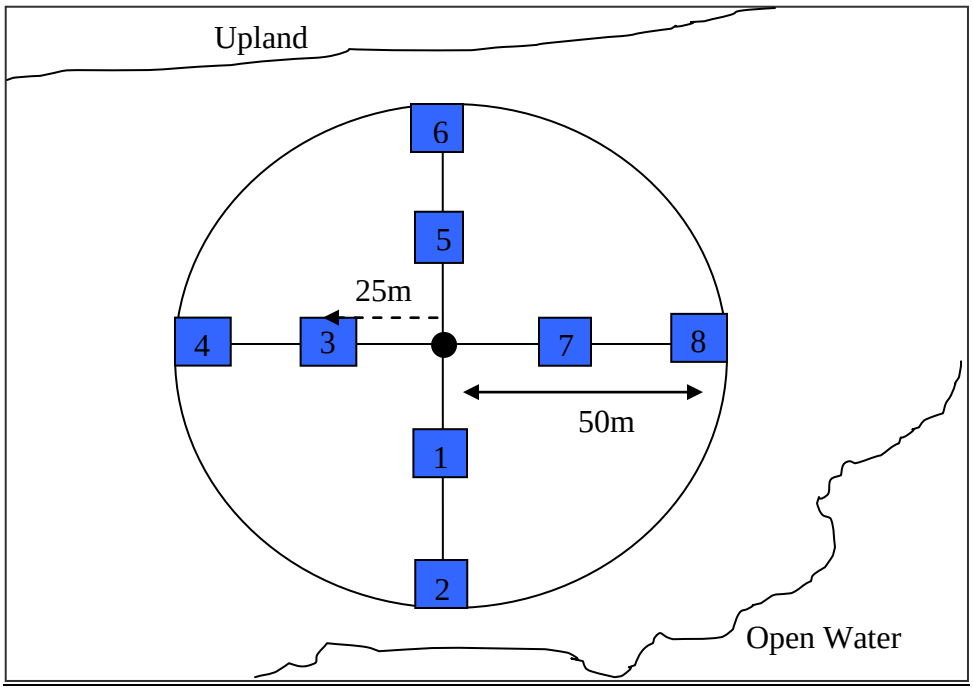


Figure 3: Location of Subplots in a circular assessment area.

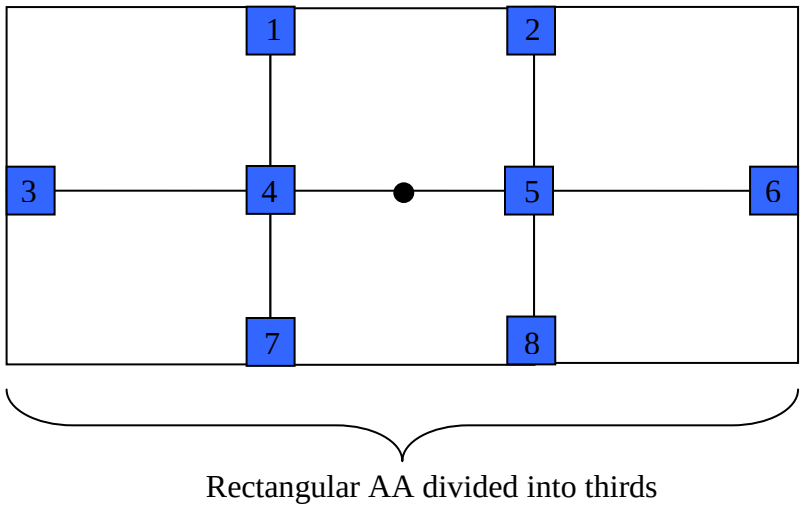


Figure 4. Location of Subplots in a rectangular assessment area.

METRIC OVERVIEW

Attribute	***Metric***	***Description***
Buffer/Landscape	Percent of AA Perimeter with 5m-Buffer	Percent of AA perimeter that has at least 5m of natural or semi-natural condition land cover
Buffer/Landscape	Average Buffer Width	The average buffer width surrounding the AA that is in natural or semi-natural condition
Buffer/Landscape	Surrounding Development	Percent of developed land within 250m from the edge of the AA
Buffer/Landscape	250m Landscape Condition	Landscape condition within 250m surrounding the AA based on the nativeness of vegetation, disturbance to substrate and extent of human visitation
Buffer/Landscape	Barriers to Landward Migration	Percent of landward perimeter of wetland within 250m that has physical barriers preventing wetland migration inland
Hydrology	Ditching & Draining	The presence of ditches in the AA
Hydrology	Fill & Fragmentation	The presence of fill or wetland fragmentation from anthropogenic sources in the AA
Hydrology	Wetland Diking / Tidal Restriction	The presence of dikes or other tidal flow restrictions
Hydrology	Point Sources	The presence of localized sources of pollution
Habitat	Bearing Capacity	Soil resistance using a slide hammer
Habitat	Vegetative Obstruction	Visual obstruction by vegetation <1m measured with a cover board.
Habitat	Number of Plant Layers	Number of plant layers in the AA based on plant height
Habitat	Percent Co-dominant Invasive Species	Percent of co-dominant invasive species in the AA
Habitat	Percent Invasive	Percent cover of invasive species in the AA

DATA COLLECTION – CHARACTERIZATION METRICS

SITE INFORMATION DATASHEET

Site #
Unique number for site (provided by EMAP if a random sample point)

Site Name
Select a unique name for the site.

Date and Time
Month, day, and year and hour and minutes of start and finish of sampling

Field crew
All members of the field crew

Reference or Assessment Site
Circle which applies. Reference sites are subjectively selected because they represent a specific condition such as minimally disturbed or impacted by a specific stressor or represent an ecological variation of a wetland class. Assessment sites are sites that have been randomly selected using a probabilistic sampling design.

Marine tidal fringe, back barrier estuarine tidal fringe, fringing estuarine tidal fringe, expansive estuarine tidal fringe
Based on wetland shape and location – see pages 4-5 of protocol for guidance on classification.

Natural, re-establishment, establishment, rehabilitation, enhancement
Select appropriate classification based on the below definitions.

Natural- wetland that is un-manipulated
Re-establishment- the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former wetland.
Establishment- the manipulation of the physical, chemical, or biological characteristics present to develop a wetland that did not previously exist on an upland or deepwater site.
Rehabilitation- the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions of a degraded wetland.
Enhancement- the manipulation of the physical, chemical, biological characteristics of a wetland (undisturbed or degraded) site to heighten, intensify, or improve specific function(s) or for a purpose such as water quality improvement, flood water retention or wildlife habitat.

Watershed/Sub-Watershed
Watershed and sub-watershed in which the site is located.

Lat/Long
Latitude and longitude coordinates in digital degrees.

AA moved from original location?
Yes or no to indicate if the center of the AA was moved from its original location. If the center was moved record the reason and the distance that the AA was moved. This only applies to assessment sites that are based on a randomly located point.

Tidal stage
Tidal stage that best represents the AA during the site visit. Estimate tidal stage based on wrack lines and water marks.

high= 5, mid-high= 4, mean= 3, mid-low= 2, and low= 1

Photos
The photos should be taken in each cardinal direction and of prominent stressors. Record the photo id number, time, and relevant comments.

Assessment area sketch
Sketch the AA and surrounding area. Include the assessment area, transect orientation, subplots, direction to open water, major habitat features, adjacent land types and note stressors and approximate distances.

Low marsh/High Marsh
Indicate if the AA is dominated by low marsh plants (Spartina alterniflora) or high marsh species (Iva, Baccharis, Juncus, Schenoplectus)

Distance to Upland
Estimate the distance from the edge of the AA to the closest major upland body (not an island).

Distance to Open Water
Estimate the distance from the edge of the AA to the closest source of open water (>30m wide).

Stability of Assessment Area
Estimate the current physical stability of the wetland within the AA based on the below descriptions.

Healthy & stable- wetland surface is mostly covered by vegetation mats, vegetation is healthy (green and robust).

Beginning to deteriorate and/or some fragmentation- wetland surface is moderately covered by vegetation root mats with moderate amounts (~25%) unvegetated unconsolidated muck or open water. Vegetation is showing some signs of stress as indicated by yellowing tips of the vegetation or stunted plants.

Severe deterioration and/or severe fragmentation- wetland surface covered by sparse vegetation root mats with large areas of unvegetated unconsolidated muck or open water, vegetation is severely stressed as indicated by yellowing or browning of leaves and stems, severely stunted plants, or early senescence of plants in the growing season.

Soil Profile
Extract a soil sample from the center point area at least 18cm deep. Examine the core and determine the depth of the organic layer using the folding tape measurer. Note if organic layer appears to be shallow (<16cm deep) or deep (>16cm deep).

Salinity
Salinity of water in parts per thousand on the wetland surface using a refractometer.

Vegetation Communities and Features
After completing the subplot measurements and walking the AA, estimate the percent cover of the plant community and wetland features present in the AA. Use the cover class and midpoint table for assistance. The values will not add up to 100% but should roughly describe the features

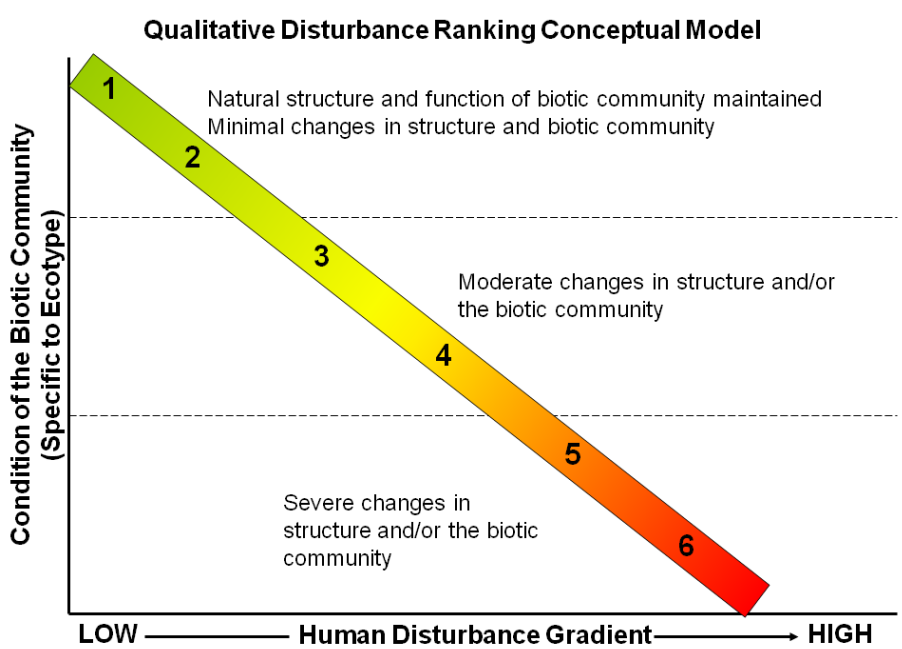
in the AA. Common species/features are listed; if a vegetation type or wetland feature is present that is not listed, use the "other" box and write in a description of the type/feature. If a vegetation type or feature is not present record a "0". These responses will help guide the plant layer worksheet in the Habitat group. The amount of root mat can be affected by deep ditches, hummocks, or mucky ponds. Dead vegetation (e.g. sprayed Phragmites) can be accounted for in 'unhealthy marsh'. Features such as a panne can overlap in both 'pannes/pools/creeks' and as 'unvegetated/mud/sand'.

Qualitative Disturbance Rating: To be agreed upon by entire field crew upon the assessment completion. Through observation of stressors and alterations to the vegetation, soils, hydrology in the wetland site, and the landuse surrounding the site, assessors determine the level of disturbance. Observers should use best professional judgment (BPJ) to assign the site a numerical Qualitative Disturbance Rating (QDR) from least disturbed (1) to highly disturbed (6) relative to other sites in the watershed based on BPJ. General description of the minimal disturbance, moderate disturbance and high disturbance categories are provided below.

Minimal Disturbance Category (QDR 1 or 2): Natural structure and biotic community maintained with only minimal alterations. Minimal disturbance sites have a characteristic native vegetative community unmodified water flow into and out of the site, undisturbed microtopographic relief, and are located in a landscape of natural vegetation (250m buffer). Examples of minimal alterations include a small ditch that is not conveying water, low occurrence of non native species, individual tree harvesting, and small areas of altered habitat in the surrounding landscape, which does not include hardened surfaces along the wetland/upland interface. Use BPJ to assign a QDR of 1 or 2.

Moderate Disturbance Category (QDR 3 or 4): Moderate changes in structure and/or the biotic community. Moderate disturbance sites maintain some components of minimal disturbance sites such as unaltered hydrology, undisturbed soils and microtopography, intact landscape, or characteristic native biotic community despite some structural or biotic alterations. Alterations in moderate disturbance sites may include one or two of the following: a large ditch or a dam either increasing or decreasing flooding, mowing, grazing, moderate stream channelization, moderate presence of invasives, forest harvesting, high impact landuses in the buffer, and minimal hardened surfaces along the wetland/upland interface. Use BPJ to assign a QDR of 3 or 4.

High Disturbance Category (QDR 5 or 6): Severe changes in structure and/or the biotic community. High disturbance sites have severe alterations to the vegetative community, hydrology and/or soils. This can be a result of one or



several severe alterations or more than two moderate alterations. These disturbances lead to a decline in the wetland's ability to effectively function in the landscape. Examples of severe alterations include extensive ditching or stream channelization, recent clear cutting or conversion to a non-native vegetative community, hardened surfaces along the wetland/upland interfaces for most of the site, and roads, excessive fill, excavation or farming in the wetland. Use PBJ to assign a QDR of 5 or 6.

Figure 5. Diagram of narrative criteria for qualitative ranking of disturbance.

Comments

Information that would otherwise be undocumented.

Attribute 1: Buffer/Landscape

The area surrounding a wetland is a critical transition zone that is important to the overall health and continued existence of a wetland. The surrounding landscape can control runoff and improve water quality by processing pollutants from upland areas. The surrounding landscape will also determine if a wetland has the ability to migrate inland with increasing sea-levels. Wetland buffers can provide protection from adjacent anthropogenic stressors (e.g. development), protect against outside human activities (e.g. farming) and can serve as habitat corridors for movement and recolonization of plants and wildlife.

Five metrics are used to assess the buffer and landscape attributes of the assessment area. The percent of assessment area perimeter with a buffer and the average buffer width are used to characterize the landuses surrounding the AA (see below). The landscape metrics (250m landscape condition, surrounding development, and barriers to landward migration) characterize the condition of the surrounding landuses. The following definitions should be used when evaluating metrics in the Buffer/ Landscape Attribute:

Buffer – The buffer is the area adjoining the AA that is in a natural or semi-natural state and currently not dedicated to anthropogenic uses. To be considered as buffer, a suitable land cover type as defined in Table 1 must be at least 5m wide and extend along the perimeter of the AA for at least 5 m. The buffer width is evaluated out to 250m from the edge of the AA.

Landscape – The surrounding landscape is defined as matrix of land in a natural or semi-natural condition as well as those dedicated to anthropogenic uses within 250m from the edge of the AA.

B1. Percent of Assessment Area Perimeter with 5m-Buffer

Metric Source: California Rapid Assessment Method (CRAM), modified

Definition: The buffer is the area adjoining the AA that is in a natural or semi-natural state and currently not dedicated to anthropogenic uses. To be considered as buffer, a suitable land cover type as defined below and must be at least 5m wide and extend along the perimeter of the AA for at least 5 m.

Assessment Protocol: Evaluate the landuse within 5m of the edge of the AA and determine the percent of the AA perimeter that has a buffer meeting the following criteria:

- Adjacent to the AA
- Natural or semi-natural landuse (see Table 1 for examples)
- 5m wide from the edge of AA
- Not Open Water- open water at least 30m wide that is in or adjacent to the AA (e.g. lake, bay, large river, or large slough) is considered to be neutral, neither part of the wetland nor part of the buffer because it protects the wetland from some stresses (e.g. preventing development) but can also be a source of stress (e.g. boat wakes, conveyance of trash).

Follow guidelines below:

- Draw a perimeter around the AA 5m wide.
- Exclude open water from the equation as neither buffer nor nonbuffer.
- Consider the rest of the perimeter to be 100%.
- Determine the proportion of the perimeter that is buffer versus nonbuffer perimeter. Refer to Table 1 for examples.
- Record the estimated percent and circle the correct score based on the alternative states listed.

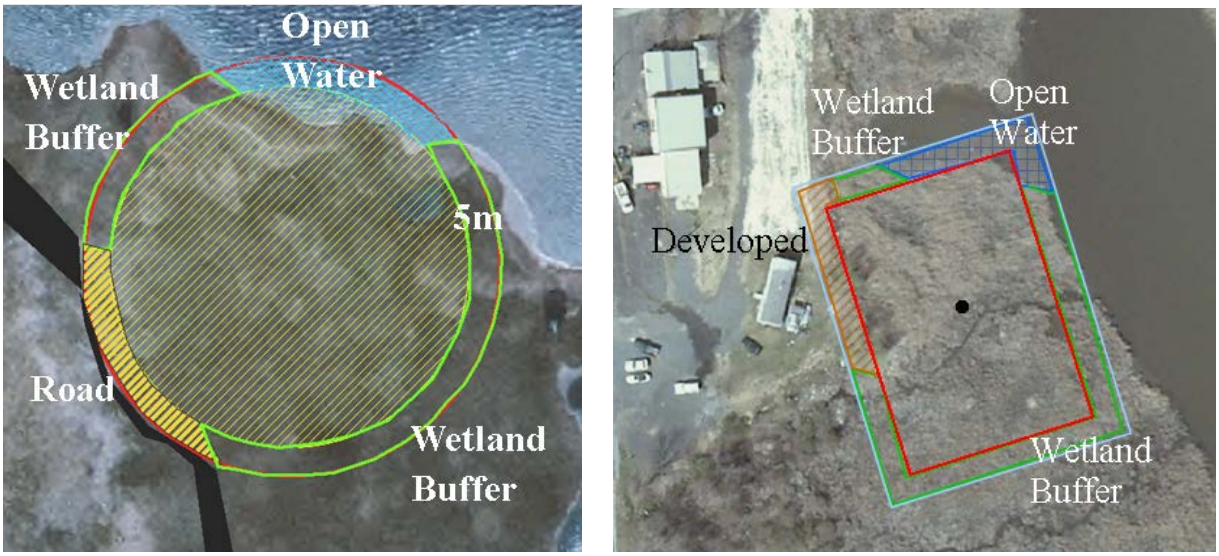


Figure 6: Examples of determining % of AA with 5m buffer. In both examples above a portion of the perimeter is open water and is not counted. Of the remaining perimeter, 70% is natural wetland buffer, 30% is nonbuffer (road or developed).

Table 1: Guidelines for identifying wetland buffers and breaks in buffers.

Examples of Land Covers *Included* in Buffers	**Examples of Land Covers *Excluded* from Buffers** Notes: buffers do not cross these land covers	
bike trails	commercial developments	residential areas
foot trails	fences that interfere with the movement of wildlife	sports fields
horse trails	agriculture	golf courses
natural upland habitats	roads	urbanized parks with active recreation
nature or wildland parks	lawns	pedestrian/bike trails with nearly constant traffic
Raised dock or walkway	parking lots	Impoundments or berms

Scoring: Percent of Assessment Area Perimeter with 5m-Buffer

Record Estimated Percent _____%	
Alternative States (not including open-water areas)	**Rating (circle one)**
Buffer is 100% of AA perimeter.	**12**
Buffer is 75-99% of AA perimeter.	**9**
Buffer is 50-74% of AA perimeter.	**6**
Buffer is <50% of AA perimeter.	**3**

B2. Average Buffer Width

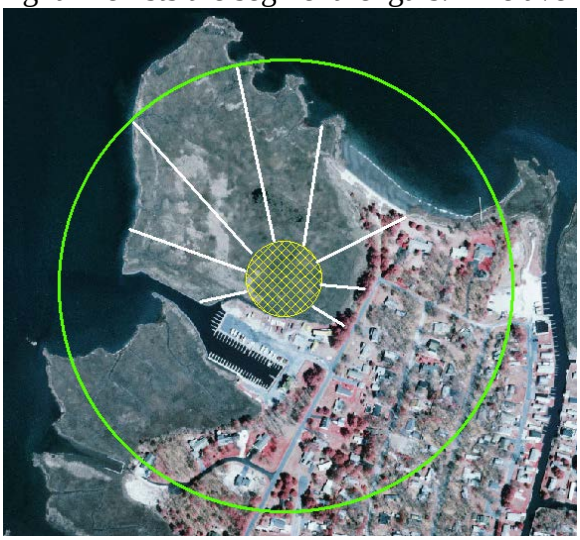
Metric Source: California Rapid Assessment Method (CRAM)

Definition: This metric assessed the width of area that was considered buffer in metric B1. The average width of the buffer adjoining the AA is estimated by averaging the lengths of eight straight lines drawn at regular intervals around the portions of the AA with buffer (as determined in B1). Lines are drawn from the AA perimeter outward to the nearest non-buffer land cover or 250m, whichever is encountered first (Figure 7B). The transect length will very between 5m (<5m does not meet the buffer definition above) and 250m (Figure7A).

Assessment Protocol:

1. Use the results of B1 and an aerial image of the AA and 250m buffer to determine the areas considered to be buffer. Be sure to exclude open water and non-buffer habitat.
2. Draw eight straight lines from the edge of the AA out through the buffer area at regular intervals in the portions of perimeter that are considered buffer (see Figure 7). Drawing the lines on the printed map makes verification and Quality Assurance procedures easier.
3. Measure the length (buffer width).
4. Assign a metric score based on the average buffer width.

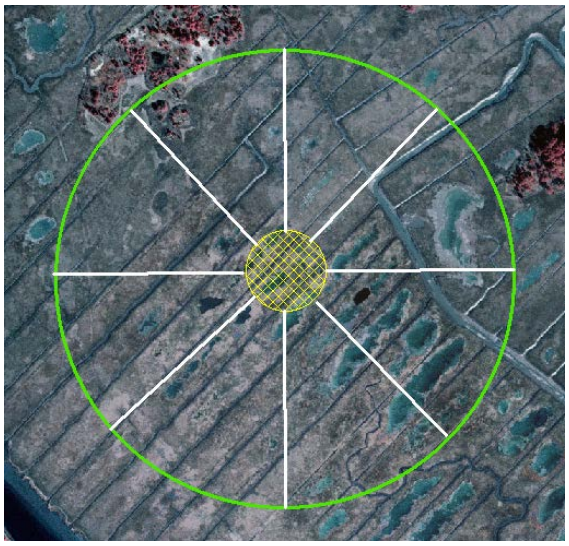
Example A: Figure 7A below details a scenario where a circular buffer is limited by adjacent non-buffer land uses. Lines A-H are evenly spaced in the buffer area, starting bottom left moving clockwise. The lines do not include open water or non-buffer habitat. The table on the right line lists the segment lengths. The average buffer width for this site would be 147meters.



Line	Buffer Width (m)
A	75
B	180
C	225
D	240
E	175
F	150
G	70
H	60
Average Buffer Width	**147**

Max length= 250m

Example B: Figure 7B below shows a scenario in which the maximum buffer width of 250m is reached in all directions. The 8 lines are evenly spaced. The table lists the lengths; the average buffer width is equal to the maximum, 250meters.



Line	Buffer Width (m)
A	250
B	250
C	250
D	250
E	250
F	250
G	250
H	250
Average Buffer Width	**250**

Max length 250m

Example C: Figure 7C below depicts a rectangular buffer. The lines do not include open water or non-buffer habitat. Four of the lines are directed off of the corners and the remaining four are positioned perpendicular to the middle of each edge of the rectangle. The table on the right line lists the segment lengths. The average buffer width for this site would be 111meters.

Line	Buffer Width (m)
A	250
B	250
C	85
D	33
E	53
F	136
G	15
H	65
Average Buffer Width	**106**

Max length= 250m

Scoring: Average buffer width

Alternative States	Rating (circle one)
Average buffer width 190-250m.	**12**
Average buffer width 130-189m.	**9**
Average buffer width 65-129m.	**6**
Average buffer width 0-64m.	**3**

B3. Surrounding Development

Metric Source: California Rapid Assessment Method (CRAM), modified

Definition: Developed land within 250m of the edge of the AA. Suburban, urban, and industrial development as well as lawns, yards and golf courses that are mowed and maintained open are considered developed. Agricultural land is not considered developed for this metric.

Assessment Protocol: Evaluate the surrounding land from the edge of the AA out to 250m and determine the percent of the areas that is developed.

1. Use aerial photo of sites with AA and a 250m buffer from the edge of the AA.
2. Estimate the percent of developed area within 250m of the edge of the AA.
3. Confirm field estimates in office with ArcGIS and the latest landuse data available.

Scoring: Surrounding Development between AA edge and 250m

Estimate Development _____%	
Alternative States	**Rating (circle one)**
0% development	**12**
>0-5% development	**9**
>5-15% development	**6**
>15% development	**3**

B4. 250m Landscape Condition

Metric Source: California Rapid Assessment Method (CRAM), modified

Definition: The present condition of the surrounding landscape based on landuse practices surrounding the AA including the extent and nativeness of the vegetative cover, disturbance to the substrate, and human visitation. The surrounding landscape is assessed in a 250m buffer which starts at the edge of the AA.

Assessment Protocol: Evaluate the landscape condition within 250m of the edge of the AA and use Table 3 to assign a metric score.

Table 3: 250m Landscape Condition

Alternative States	**Rating (circle one)**
AA's surrounding landscape is comprised of *only* native vegetation, has undisturbed soils, and there is no evidence of human disturbance.	**12**
AA's surrounding landscape is dominated by native vegetation, has undisturbed soils, and there is little or no evidence of human visitation.	**9**
AA's surrounding landscape is characterized by an intermediate mix of native and non-native vegetation, and/or a moderate degree of soil disturbance/compaction, and/or there is evidence of moderate human visitation.	**6**

AA's surrounding landscape is characterized by barren ground and/or dominated by invasive species and/or highly compacted or otherwise disturbed soils, and/or there is evidence of intensive human visitation.	**3**

B5. Barriers to Landward Migration

Metric Source: New England Rapid Assessment Method (NERAM)

Definition: Barriers to landward migration are physical barriers along the shoreline that would prevent the wetland from migrating inland with increasing sea levels. Barriers can include hardened surfaces on the landward perimeter of the wetland such as sea walls, rip rap, debris or rock stabilization, a road or driveway that would be maintained, or other development within 50m of wetland/ upland edge.

Assessment Protocol: Determine the proportion of wetland/upland shoreline that is obstructed from future marsh migration in the event of sea level rise.

1. Determine the direction of open water.
2. Draw a 90º 'pie wedge' behind the AA pointing away from the open water side of the AA directed landward (Figure 8, 9 and 10) to identify the area to evaluate. The wetland/upland shoreline or the 250m buffer line within the pie wedge is the perimeter to evaluate, whichever is encountered first. Do not include islands in this calculation. Draw this perimeter line on the map. (Drawing the pie and perimeter lines allow verification and Quality Assurance checks.)
3. Visually estimate the percentage of that perimeter that is obstructed by a barrier to marsh landward migration. Use aerial photography to estimate barriers and use field visits for confirmation. Perimeter that is not hardened or maintained and would allow for marsh migration in the future is unobstructed. If there is a barrier present in the upland (e.g. yard, berm, raised road) but there are >50m of unobstructed land (e.g. forest, scrub shrub, ag field) between the upland edge and the barrier, do not include as a barrier. If the wetland/upland edge is >250m from the edge of the AA (the entire 250m buffer is marsh) record no barriers present and estimate the nearest distance to a barrier from the <u>center</u> of the AA.

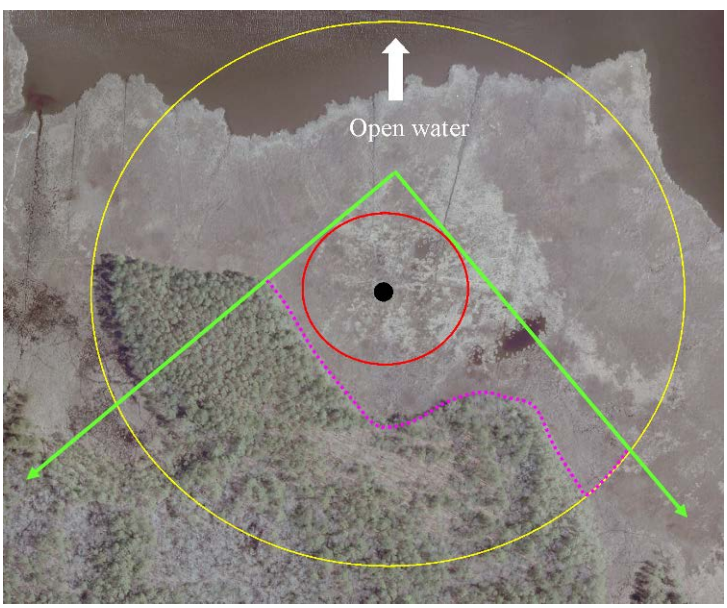


Figure 8. An example of BLM scoring. The black center point is surrounded by the red AA and yellow 250m buffer. The green arrows point landward to create the 'pie' area to be evaluated. The pink dashed line follows the wetland/upland perimeter along forest and is unobstructed. A small portion of the 250m perimeter is included in this perimeter. 0% of the landward perimeter is obstructed.

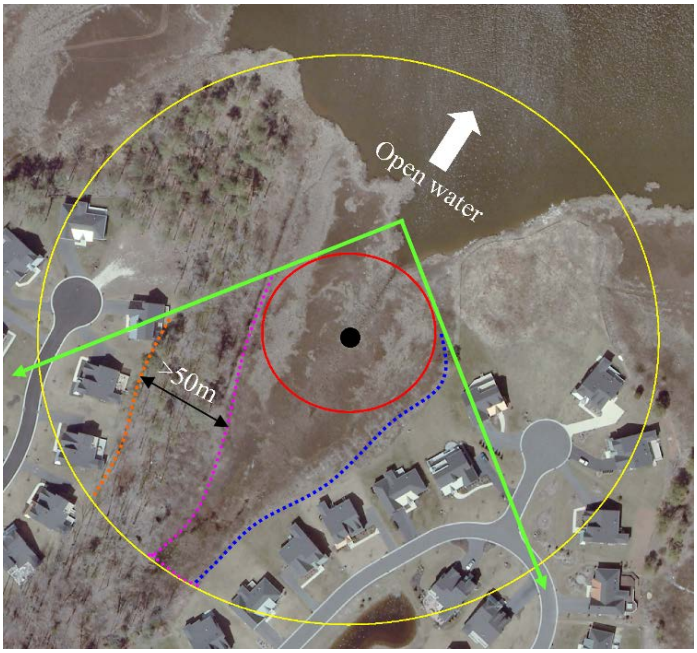


Figure 9. An example of BLM scoring. The green arrows create the 'pie' of area to be evaluated. The blue dashed line follows wetland/upland perimeter that is obstructed by development. The pink dashed line follows wetland/upland perimeter along forest and is unobstructed. A small portion of perimeter line runs along the 250m buffer boundary and is not obstructed. A measurement verified that nearby houses on the left are >50m from the perimeter line and do not count as obstructed. About 45% of the perimeter is obstructed.

Figure 10. An example of BLM for a rectangular AA. The black center point is surrounded by the red AA and yellow 250m buffer. The green arrows point landward to create the 'pie' area to be evaluated. The pink dashed line follows the wetland/upland perimeter along forest >50m wide and is unobstructed. The blue dashed line follows the wetland/upland perimeter that is obstructed by either adjacent. In this example, 60% of the perimeter is obstructed by road or yard.

Scoring: Barriers to Landward Migration

% Perimeter Obstructed _____%	**Estimated distance from center of AA _____m**
Alternative States	**Rating (circle one)**
Absent: no barriers, 0%	**12**
Low: <10% of perimeter obstructed	**9**
Moderate: 10-25% of perimeter obstructed	**6**
High: 26-100% of perimeter obstructed	**3**

Attribute 2: Hydrology

Hydrology is the driving force that maintains the unique characteristics of wetlands, including hydrophytic vegetation and hydric soils, which differentiate wetlands from uplands. Hydrology is integral to supporting numerous functions which define the wetland's plant and animal composition and richness, physical borders, and nutrient cycling.

The hydrology attribute is composed of four metrics. Ditching & Draining and Fill & Fragmentation are measured within the assessment area; Diking & Tidal Restriction and Point Sources are measured in the AA and the surrounding 250m area.

H1. Ditching & Draining

Metric Source: New England Rapid Assessment Method (NERAM)

Definition: The quantity of ditches within the AA. Ditches increase or decrease the residency of water in the AA.

Assessment Protocol:
Evaluation of this variable is performed using recent aerial photographs of the site and then a field visit to verify the presence and functionality of ditches. Examples below should be used as a reference for scoring. (Figures 11-14 show varying levels of ditching).

1. Use an aerial photo of the site that is zoomed to the extent of the AA.
2. Identify ditches within the AA looking for the number and size of ditches.
3. Confirm ditches in the field during the site visit as well.

Examples:

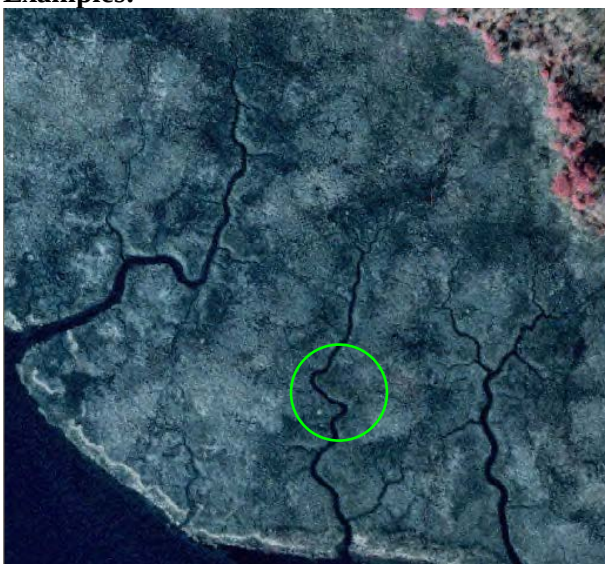


Figure 11: No Ditching- No ditches present within the AA.

Figure 12: Low Ditching- One small ditch within the AA.

Figure 13: Moderate Ditching- One to two ditches present in the AA.

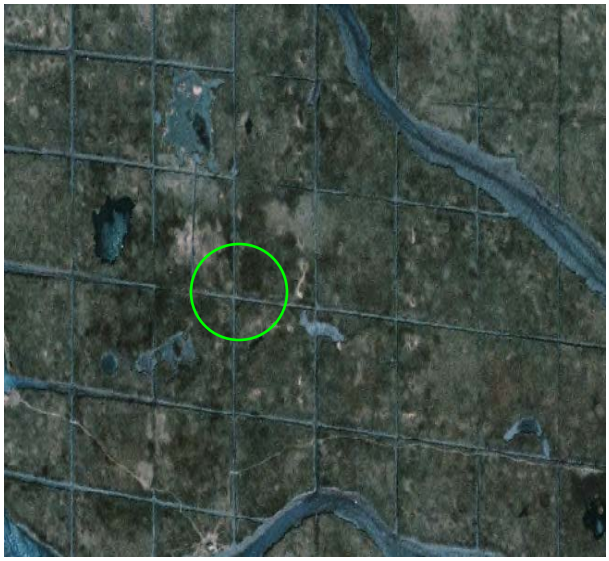


Figure 14: Severe Ditching- At least two ditches present in the AA.

Scoring: Ditching & Draining

Alternative States	Rating (circle one)
No Ditching	**12**
Low Ditching	**9**
Moderate Ditching	**6**
Severe Ditching	**3**

H2. Fill & Fragmentation

Metric Source: New England Rapid Assessment Method (NERAM)

Definition: To measure the presence and extent of fill within the AA and the amount of fragmentation of the wetland due to anthropogenic alterations (e.g. roads, berms, walkways, docks). These disturbances can change the natural hydrology and plant community of the wetland.

Assessment Protocol:
Evaluation of this variable is performed using recent aerial photographs of the site and then a field visit to verify the presence of fill and barriers causing fragmentation of the AA. Examples below should be used as a reference for scoring. (Figures 12-13 show varying levels of fill and fragmentation).

1. Use an aerial photo of the site that is zoomed to the extent of the AA
2. Identify areas of fragmentation within the AA
3. Validate observations in the field by walking the entire AA and recording the presence of fill and barriers causing fragmentation of the AA
4. Estimate and record the surface area that fill is covering
5. Determine appropriate score for site based on examples below

Note: Ditches should not be included in the evaluation of fragmentation since they are evaluated under a separate metric.

None- No fill within the AA or sources of fragmentation
Low – Small amounts of fill
Moderate – Elevated walkways or docks that somewhat interfere with water moving in or out of the site
Severe – Substantial fill or obstructions on the wetland surface and/or artificially fragment a once whole wetland unit.

Examples: Refer to figures 15-18 for depictions of various degrees of fragmentation.

Figure 15. No fill or fragmentation.

Figure 16. Low fill as piles along ditches.

Figure 17: Moderate fill and fragmentation caused by a dirt path (left). Fragmentation from raised walkway (right).

Figure 18: Severe fragmentation caused by gravel driveway or paved road.

Scoring: Fill and Fragmentation

Estimate amount of fill _____% of AA		**Comments**
Dimensions of Fill Pile _____		
Alternative States	**Rating (circle one)**	
No fill or fragmentation	**12**	
Low fill or fragmentation	**9**	
Moderate fill or fragmentation	**6**	
Severe fill or fragmentation	**3**	

Note: the poorer rating of fill or fragmentation should be used to score the metric.

H3. Wetland Diking/ Tidal Restriction

Metric Source: New England Rapid Assessment Method (NERAM)

Definition: The presence of wetland diking and/or other tidal restrictions that interfere with the natural hydrology of the wetland. Knowledge of local tide regimes is critical in determining the severity of tidal restrictions.

Assessment Protocol: Observe the AA and the surrounding 250m for sources of restrictions. Look for wrack lines and water lines near structures as a sign that they cause restrictions. If a significant restriction is detected outside of the 250m buffer, it may also be scored down if it is known to cause restriction at the sampling location. Note the distance and provide a description. Examples of diking and tidal restriction:

- Under-sized culverts or bridge crossings
- Roads
- Man-made berms and dikes
- Stabilized inlet (e.g. Indian River inlet)

Scoring: Diking and Restriction

Description of restriction: _____	
Alternative States	**Rating (circle one)**
Absent: no restriction, free flow, normal range	**12**
Low: restriction presumed (<10% alteration of normal range)	**9**
Moderate restriction (10-25% alteration of normal range)	**6**
High (26-100 alteration of normal range)	**3**

H4. Point Sources

Metric Source: New England Rapid Assessment Method (NERAM), modified

Definition: The presence of localized sources of pollution that are entering the wetland through a confined pathway (i.e. pipe, culvert, or ditch). Point sources can contribute significant amounts of polluted waters from adjacent land practices.

Assessment Protocol: Evaluate the AA and 250m buffer using aerial photography for point sources such as outfalls and drains entering the AA or 250m buffer. Field validate to confirm sources. Determine if the source of the input is from a 'developed' or 'natural' land use. Examples of natural landuse include from a forest or through a fallow field. Developed land has been dedicated to anthropogenic uses such as urban, suburban or industrial buildings, agriculture, lawns, yards, and golf courses. Man-made water bodies that drain from developed land (e.g. a storm water retention pond) and exit into a wetland should be considered as a developed source.

Scoring: Point Sources

Alternative States	**Rating (circle one)**
Absent: no discharge	**12**
Low: 1 small discharge from a natural area	**9**
Moderate: 1 discharge from a developed area or 2 discharges from a natural area	**6**
High: ≥2 discharges from a developed area or ≥3 from a natural area	**3**

Attribute 3: Habitat

Wetlands provide habitat for a diverse array of plants and animals ranging from large mammals to invertebrates in the soil. These species are dependent on the availability of resources provided by the wetland including vegetative structure and standing water. Additionally, the wildlife communities that are supported provide valuable social and economical benefits to society through hunting and non-consumptive activities (e.g. bird watching).

The habitat attribute is composed of six metrics: bearing capacity, plant fragments, vertical biotic structure, number of plant layers, percent of co-dominant invasive species, and percent invasive. These metrics characterize the biotic and abiotic shelter and structure components of the wetland. All measurements for habitat are taken within the assessment area.

HAB1. Bearing Capacity

Metric Source: New England Rapid Assessment Method (NERAM)

Definition: Bearing capacity is the ability of soil to support the loads applied to the ground as measured by the penetration of a capped 2" PVC tube into the wetland soil surface by applying a standard force with a slide hammer. Bearing capacity assesses the below-ground stability of the wetland with the assumption that as a wetland deteriorates due to natural and anthropogenic influences, below-ground organic material and the soil bearing capacity will also decrease. Reduced below-ground organic material may precede above-ground changes in the plant community and other indicators of stress.

Assessment Protocol: The base of the instrument is a 2inch capped PVC tube with a millimeter scale marked on its side. The PVC pipe is one meter long and has a flat cap on the bottom. The slide hammer is the top, weighs eighteen pounds and is attached to a PVC ring with a 5/8th inch bolt. Measure bearing capacity in all 8 sub-plots following the directions below:

1. Within each sub-plot toss a small ball (white or brightly colored golf balls work well) to determine a random sampling spot to place the flat cap bottom of the base. Push aside vegetation and place the instrument on bare ground.
2. Measure water depth at sampling location.
3. Assemble the PVC tube and the slide hammer together and place gently on wetland surface at determined location.
4. Measure initial compaction by recording how deep the PVC penetrates into the ground without exerting any force, using the millimeter scale on the PVC pipe.
5. Lift and extend the slide hammer fully; release and allow it to fall freely with gravity.
6. Without moving the slide hammer, measure compaction by recording how deep the PVC penetrated into the ground, using the millimeter scale on the PVC pipe. Record the depth as 'blow 1'.
7. Repeat steps 4-5 for blows 2-5. Record values in the space provided.
8. Calculate the initial and final difference, average the 8 subplots and score using the options below. If water is present at sampling location subtract depth from initial reading prior to calculating initial and final difference.

**IF there are unvegetated areas void of a root mat (hollows) make up >10% of the AA, bearing capacity readings should also be taken in exposed areas within the 8 sub-plots.

- Take the 'hummocks' readings as directed above.
- Repeat the procedure in the hollows as well and record values in the 'unvegetated hollows' area provided at the end of the datasheet.
- Try to sample the unvegetated hollows right next to the location sampled for hummocks.
- To score, estimate the percent of the AA that is in hummocks and in hollows (should add up to 100%). Weight the average bearing capacity with the percent. Add the 2 weighted values. Score using the original cutoffs.

X= (hummock subplot average*hummock %)+(hollow subplot average*hollow %)

Table 6: Bearing Capacity

	Mark Depth (cm)							
	Subplot 1	Subplot 2	Subplot 3	Subplot 4	Subplot 5	Subplot 6	Subplot 7	Subplot 8
Water Depth								
Initial capacity								
Blow 1								
Blow 2								
Blow 3								
Blow 4								
Blow 5								
Final – (Initial – Water depth)								

Scoring: Bearing Capacity

Average of Final – Initial Over the Eight Sub-plots	Rating
≤1.8	**12**
1.9-4.0	**9**
4.1-6.2	**6**
>6.2	**3**

HAB2. Horizontal Vegetative Obstruction

Metric Source: This parameter was a test metric in 2008-09 and has been added to the protocol as a scored metric 2010.

Definition: Measures the amount of visual obstruction through the subplot area due to vegetation at 3 levels in each subplot using a profile board. The profile board is 1m long and divided into 10 decimeter painted sections. Measurements are taken as the amount of board visible through vegetation.

Assessment Protocol: Obtain profile board measurements in each of the 4 sub-plots.

- The recorder stands along the 100m tape at the subplot with a 1m dowel and the profile board.
- The observer stands 4m away from the recorder, perpendicular to the tape with the other 1m dowel.
- The profile board is held horizontally at 0.25m, 0.5m and 0.75m above the wetland surface (each height increment is measured from the top edge of board).
- The observer counts how many of the decimeter segments are visible at all through vegetation at each of the 3 heights.
- For each reading, the observer should be eye level to the height held by the recorder. The 1m dowels can be marked with the 3 heights increments and used for accuracy.

- Record the value at each height and note the dominant vegetation found between the observer and the recorder.
- Sum the 3 height values for each subplot and average the 4 subplots. Use the table below to assign a score.

Table 1. Horizontal Vegetative Obstruction Place a 0 in boxes where board is obstructed from view by vegetation.

Sub-plot	1	2	3	4
0.25m				
0.50m				
0.75m				
Dominant vegetation				

Scoring: Horizontal Vegetative Obstruction

Average of 4 Subplot Totals	Rating
<7	**12**
<12 ≥7	**9**
<22 ≥12	**6**
≥22	**3**

Plant Community Worksheet

After completing the subplot measurements and walking the AA, survey the AA for the number of living, vascular plant species for the height layers defined below. One species may be found in multiple layers if the minimum coverage is met in each height layer. Each species in a height layer must cover ≥5% of the AA (20mx20m) and is identified by present plant height within the AA, not the potential growth of the plant. Height is measured as the vegetation stands and should not be held upright for measurement. Record each plant species present in the height layer including trees, shrubs, herbs, emergent, submergent, floating and invasive species. Note if the species is invasive (see Appendix A). Also record if that species is co-dominant with other species in that height layer only. Co-dominant species make up ≥10% relative cover for that height layer only.

Fill out the Plant Community Worksheet after walking the entire AA. This worksheet will be used for 2 plant metrics.

Floating or Aquatic Species	**Invasive?**	**Co-dom?**	**Short Species <0.3m**	**Invasive?**	**Co-dom?**
Medium Sp. 0.3-0.75m	**Invasive?**	**Co-dom?**	**Tall Species 0.75-1.5m**	**Invasive?**	**Co-dom?**
			A. # of Plant Layers (max=5)		
Very Tall Spp.>1.5m	**Invasive?**	**Co-dom?**	**B. Total # of *Native* co-dominant species for all layers combined**		
			C. Total # of *Invasive* co-dominant species for all layers combined		
			D. % of Invasive co-dominant species for all layers combined		
			E. % Invasive cover in AA (0-100)		

- Floating Layer- rooted and non-rooted aquatic plants that form floating canopies
- Short Vegetation- plant heights < 30cm tall
- Medium Vegetation- plant heights are between 30-75cm tall
- Tall Vegetation- plant heights are between 75cm-1.5m tall
- Very Tall Vegetation- plant heights are ≥ 1.5m tall

HAB3. Number of Plant Layers

Metric Source: California Rapid Assessment Method (CRAM), modified

Definition: The number of plant layers of varying heights in the AA. Any layer with at least 1 live species counts.

Assessment Protocol: Use the Plant Community Worksheet to count the number of plant layers present within the AA that have any species listed. Use the categories below to score the metric.

Scoring: Number of Plant Layers

Alternative States	Rating
4-5 Layers	**12**
2-3 Layers	**9**
1 Layer	**6**
0 Layer	**3**

HAB4. Percent Co-dominant Invasive Species

Metric Source: California Rapid Assessment Method (CRAM), modified

Definition: Percent of co-dominant species in the AA that are non-native. To be considered a co-dominant species, it must represent >10% relative cover within that layer.

Assessment Protocol: Using the Plant Community Worksheet, sum the number of native, co-dominant species in all height layers (B). Sum the number of invasive, co-dominant species in all height layers (C). Species in multiple layers are counted more than once. Invasive species can be identified using state invasive species lists (Appendix A). Divide the number of invasive co-dominant species (C) by the total number of co-dominant species (B+C). Use the cutoffs below to score the metric.

Scoring: Percent Co-Dominant Invasive Species

Alternative States	Rating
0-15%	**12**
16-30%	**9**
31-45%	**6**
46-100%	**3**

HAB5. Percent Invasive Cover

Metric Source: Mid-Atlantic Tidal Wetland Rapid Assessment Method

Definition: Percent cover of invasive species in the AA.

Assessment Protocol: Survey the AA for live invasive species and estimate their total percent cover, 0-100%. For a complete list of Mid-Atlantic Invasive species refer to State Invasive Species Lists (Appendix A). Record the estimate. Use the cutoffs below to assign a metric score.

Scoring: Percent Invasive

Alternative States	Rating
0%	**12**
>0-25%	**9**
26-50%	**6**
>50%	**3**

APPENDIX A. State Invasive Species Lists

Delaware Invasive Species

Draft from W.A. McAvoy, 6-08-2010

Acer platanoides Norway maple
Acorus calamus European sweetflag
Ailanthus altissima tree-of-Heaven
Akebia quinata five-leaf akebia
Alliaria petiolata garlic mustard
Ampelopsis brevipedunculata porcelain-berry
Aralia elata Japanese angelica-tree
Arthraxon hispidus joint-head arthraxon
Berberis thunbergii Japanese barberry
Bromus inermis awnless brome
Bidens polylepis awnless beggar-ticks
Cabomba caroliniana Carolina fanwort
Carex kobomugi Japanese sand sedge
Celastrus orbiculata Oriental bittersweet knotweed
Centaurea stoebe subsp. micranthos spotted knapweed
Cirsium arvense Canada thistle
Clematis terniflora Japanese virgin's-bower
Conium maculatum poison-hemlock
Echinochloa crus-galli barnyard grass
Egeria densa Brazilian waterweed
Elaeagnus umbellata autumn olive
Euonymus alatus winged euonymus
Euonymus fortunei winter creeper
Ficaria verna/Ranunculus ficaria lesser celandine
Galanthus nivalis snowdrops
Gleditsia triacanthos honey-locust
Hedera helix English ivy
Hemerocallis fulva orange daylily
Humulus japonicus Japanese hops
Hydrilla verticillata hydrilla
Iris pseudacorus yellow iris
Leucojum aestivum summer snowflake
Ligustrum obtusifolium border privet
Lisustrum sinense Chinese privet
Ligustrum vulgare European privet
Lonicera japonica Japanese honeysuckle
Lonicera maackii Amur honeysuckle
Lonicera morrowii Morrow’s honeysuckle
Ludwigia leptocarpa water-willow
Ludwigia peploides subsp. glabrescens floating seedbox
Lysimachia nummularia creeping loosestrife
Lythrum salicaria purple loosestrife
Magnolia kobus Kobus magnolia
Microstegium vimineum Japanese stilt grass
Miscanthus sinensis Chinese silver grass
Murdannia keisak marsh dewflower
Myriophyllum aquaticum parrot's-feather
Ornithogalum umbellatum Star-of-Bethlehem
Pachysandra terminalis pachysandra
Persicaria longiseta/Polygonum cespitosum longbristle
Persicaria perfoliata/Polygonum perfoliatum mile-a-minute
Phalaris arundinacea reed canary grass
Photinia villosa oriental redtip
Phragmites australis subsp. australis common reed
Phyllostachys aurea bamboo
Pinus thunbergiana Japanese black pine
Poa trivialis rough bluegrass
Pyrus calleryana Callery pear
Quercus acutissima sawtooth oak
Reynoutria japonica/ Polygonum cuspidatum Japanese knotweed
Rhodotypos scandens jetbead
Rosa multiflora multiflora rose
Rubus phoenicolasius wineberry
Rubus triphyllus three-leaf blackberry
Schoenoplectus mucronatus/Scirpus mucronatus alien bulrush
Sorghum halepense Johnson grass
Thlaspi alliaceum roadside penny-cress
Typha angustifolia narrowleaf cattail
Urtica dioica subsp. dioica stinging nettle
Viburnum dilatatum exotic arrow-wood
Viburnum setigerum tea viburnum
Vinca minor lesser periwinkle
Wisteria sinensis Chinese wisteria

Maryland Invasive Species

Acer platanoides
Ailanthus altissima
Ajuga repans
Alliaria petiolata
Allium vineale
Ampelopsis brevipedunculata
Artemisia vulgaris
Arthraxon hispidus
Bidens polylepis
Bromus sterillis
Carduus acanthoides
Carduus natans
Catalpa spp.
Caulerpa taxifolia
Celastrus orbiculatus
Centaurea maculosa
Cirsium arvense
Cirsium vulgare
Clematis terniflora
Coronilla varia
Dioscorea oppositifolia
Dipsacus sylvestris
Duchesnea indica
Eichhornia azurea crassipes
Elodea densa
Euonymus fortunei
Festuca elatior
Glechoma herderacea
Hedera helix
Heraceleum mantegazzianum
Hermerocallis fulva
Humulus japonicus
Hydrilla verticillata
Iris pseudacorus
Laminum amplexicaule
Lamium purpureum
Lespedeza cuneata
Liriope spicata
Lonicera japonica
Lysimachia nummularia
Lythrum salicaria
Microstegium vimineum (Eulalia viminea)
Miscanthus sinensis
Morus albus
Myiophyllum brasiliense
Myiophyllum spictatum
Myosoton aquaticum (Stellaria aquatica)
Ornithogalum nutans
Ornithogalum umbellatum
Paulownia tomentosa
Perilla frutescens
Phalaris arundinacea
Pharagmites australis
Picea glauca
Pinellia ternata
Polygonum cuspidatum
Polygonum perfoliatum
Polygonum sachalinense
Populus alba
Potamogeton crispus
Prunus avium
Pueraria loboata
Ranunculus ficaria
Salvinia molesta
Solanum dulcamara
Sorghum bicolor
Sorghum halepense
Trapa natans
Vinca minor
Wisteria floribunda

Virginia Invasive Species

Acer platanoides
Agropyron repens
Agrostis tenuis
Ailanthus altissima
Ajuga reptans
Akebia quinata
Albizia julibrissin
Alliaria petiolata
Allium vineale
Alternanthera philoxeroides
Ampelopsis brevipedunculata
Arostis gigantea
Arrhenatherum elatius
Artemisia vulgaris
Arthraxon hispidus
Arundo donax
Berberis thunbergii
Carduus nutans
Carex kobomugi
Cassia obtusifolia
Celatrus orbiculata
Centaurea biebersteinii
Centaurea jacea
Cirsium arvense
Cirsium vulgare
Commelina communis
Conium maculatum
Conron varia
Convolvulus arvensis
Dactylis glomerata
Dioscorea oppositifolia
Dipsacus laciniatus
Dipsacus sylvestris
Egeria densa
Elaeagnus angustifolia
Elaeagnus pungens
Elaeagnus umbellata
Eragrostis curvula
Euonymus alata
Euonymus fortunei
Euphorbia esula
Festuca elatior (F. pratensis)
Foeniculum vulgare
Glechoma hederacea
Hedera helix
Holcus lanatus
Humulus japonicus
Hydrilla verticillata
Imperata cylindrica
Ipomoea coccinea
Ipomoea hederacea
Ipomoea purpurea
Iris pseudacorus
Lapsana communis
Lespedeza bicolor
Lespedeza cuneata
Ligustrum obtusifolium
Ligustrum sinense
Lonicera fragrantissima
Lonicera japonica
Lonicera maackii
Lonicera morrowii
Lonicera standishii
Lonicera tatarica
Lonicera x bella
Lotus corniculatus
Lysimachia nummularia
Lythrum salicaria
Melia azedarach
Melilotus alba
Melilotus officinalis
Microstegium vimineum
Miscanthus sinensis
Morus alba
Murdannia keisak
Myriophyllum aquaticum
Myriophyllum spicatum
Pastinaca sativa
Paulownia tomentosa
Perilla frutescens
Phleum pratense
Phragmites australis
Phyllostachys aurea
Poa comressa
Poa trivialis
Polygonum cespitosum
Polygonum cuspidatum
Polygonum perfoliatum
Populus alba
Pueraria montana
Ranunculus ficaria
Rosa multiflora
Rubus phoenicolasius
Rumex acetosella
Rumex crispus
Setaria faberi
Sorghum halepense
Spriaea japonica
Stellaria media
Trapa natans
Ulmus pumila
Veronica hederifolia
Viburnum dilatatum
Vinca minor (V. major)
Wisteria floribunda
Wisteria sinensis
Xanthium strumarium

APPENDIX B. Identifying Native *Phragmites*

Phragmites australis subsp. *americanus* Saltonstall, Peterson & Soreng

Adapted from Key Field Characteristics in the Tidal Mid-Atlantic Region

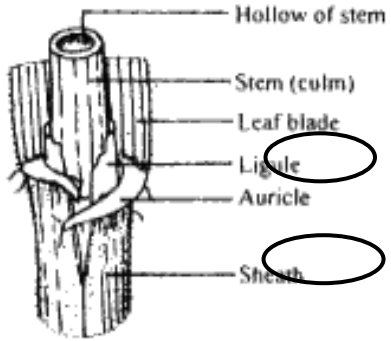
By Robert Meadows - Delaware Division of Fish & Wildlife, Newark, Delaware (robert.meadows@state.de.us)

No.	Characteristic	Native	Introduced	Remarks
1[a]	**Leaf Color**	Lighter Green	Darker Blue Green	Summer
2	**Leaf Texture**	Smoother	Coarse (midrib apparent)	Late Summer
	Leaf Sheath:			
4[a]	Clasping Stem	Very loosely wrapped	Very tightly wrapped	Late Summer, Fall and Winter
5[ab]	Retention on stem	Caducous: most fall off.	All are still tightly wrapped	If in doubt, look at dead reeds!
6[b]	Ligule width	Wider (1.0-1.7 mm)	Narrower (0.4-0.9 mm)	See Diagrams
	Culm: *Remember to remove leaf sheath first!*			
7[a]	Color in Summer	Maroon ("sunburnt")	Light Green	In exposed portions of stand
8	Color in Winter	Chestnut	Tan	
9[a]	Spots	Distinct Black Spots	None	On culm, not sheath (at node)
10	Height	Shorter, to ca. 12-ft	Taller, to ca. 15-ft	
12	Stem smoothness	Glossy (polished)	Ridged, can feel with fingernail	
b	**Flower**: Lower Glumes	Longer 3.0-6.5 mm	Shorter 2.5-5.0 mm	See Diagrams
c	Upper Glumes	5.5-11.0 mm	4.5-7.5 mm	
d	Lemmas	8.0-13.5 mm	7.5-12.0 mm	Flower at nearly same time
14	**Rhizome**	Less dense, softer/fewer root hairs	Denser, firmer/thicker root hairs	
15	**Senescence**	ca. mid to late September	ca. Late October- November	Best times to survey for native
	Habitat:			
16	Salinity	Fresh to Oligohaline (<8ppt)	Fresh to Mesohaline (≤18ppt)	Native historically occurred in mesohaline
17	Disturbance	Undisturbed wetlands	Highly disturbed to pristine	
18	Biodiversity	Other plant sp. common	Monotypic stands common	

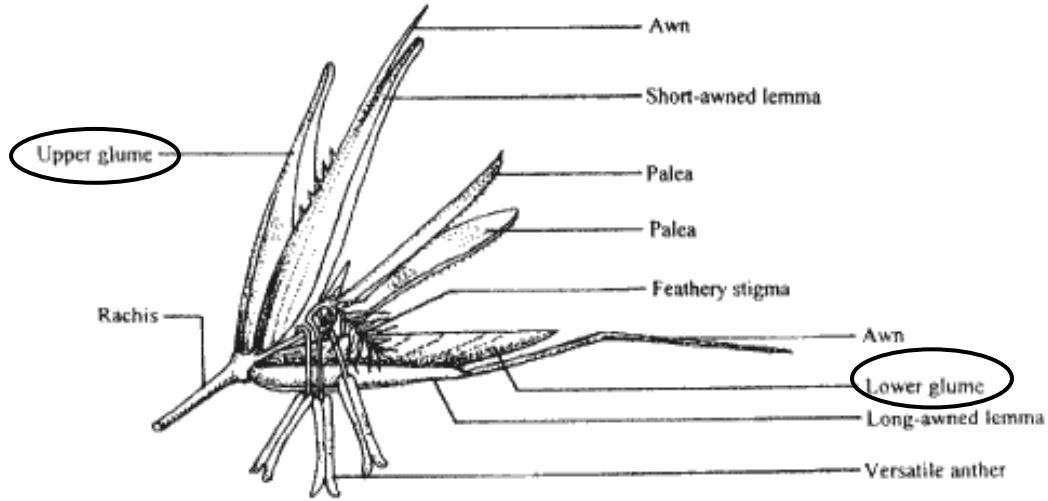
[a] Characteristics 1, 4, 5, 7, and 9 are additional key field traits (the remaining traits are not required to make a positive ID).

[b] Leaf Sheath Retention (5) and Ligule width (6) are universal traits; always check these on dead stems to confirm a presumptive ID.

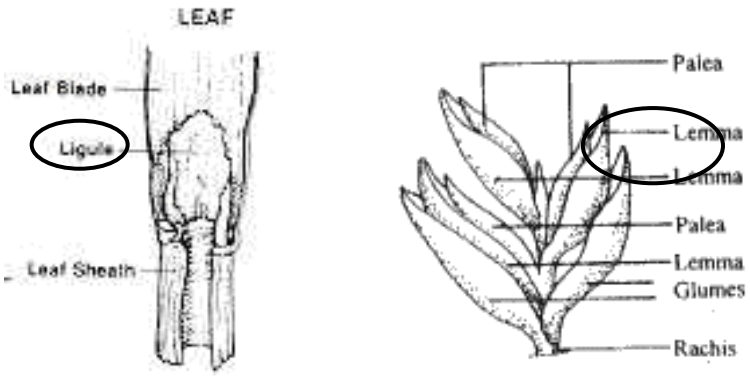
Leaf Sheath Parts



Flower Parts



Spikelet Parts (containing 3 Florets)



APPENDIX C: MidTRAM DATASHEETS

APPENDIX D: Shoreline Test Metrics

Proposed Shoreline Additions to MidTRAM v.2.0
DK, AP 6/4/10

Notes:

The MidTRAM has three core attributes, and this would add a fourth optional component. The goal is to assess the condition of the seaward edge, balancing the assessment of the landward buffer (already in MidTRAM). The shoreline component scores can be omitted from the overall RAM scoring in cases where results are to be directly compared to other MidTRAM results (i.e., the scoring is MidTRAM). If the shoreline component is included in the overall RAM scoring, the results will be presented as "modified MidTRAM" or some other name TBD.

A shoreline is defined as the area between the edge of the vegetated marsh and mean low water along the nearest adjacent water body to the assessment area. The water body must be a tidally influenced creek or open bay with a minimum width of 30 m. This criterion will ensure that the water body has sufficient surface area and fetch to be exposed to wave and erosion energies. If no suitable water body is within 250 m of the center of the assessment area, then shoreline condition will not be assessed for that point.

If >50% of the points do not meet these criteria and cannot be assessed for shoreline condition, and if additional funds allow for added fieldwork, then alternative points that satisfy these criteria can be selected from the overdraw field of random points for analysis of just the shoreline condition metrics.

The following is for potential modification of the Metric Overview table on pg 12 of MIDTRAM v. 2.0 pdf. For 2010, just test these metrics and later decide whether and how to add them to MidTRAM.

SHORELINE (S)

Attribute	Metric	Description
SHORELINE	S1: Shoreline Alterations	Presence of built structures or non-natural materials along the shoreline at transect points, such as bulkheads, old wharfs, rip rap, but not natural materials such as shell, debris and living shorelines.
	S2: Shoreline Erosion	Shoreline condition at shoreline transect points based on the erosion:accretion ratio.

Article I. **Attribute: 4: Shoreline**

While shorelines naturally change and move, their susceptibility to increased wave action due to human activities, as well as sea level rise, are not fully understood in the Delaware Estuary region. In marshes, the shoreline represents the "front-line" for either retreating or advancing marsh.

Shoreline condition is assessed with two metrics; erosion and alterations. Both of these metrics are assessed at the seaward termini for each of five transects that are oriented perpendicular to the shoreline as shown in Figure 1. These termini are referred to as "transect points."

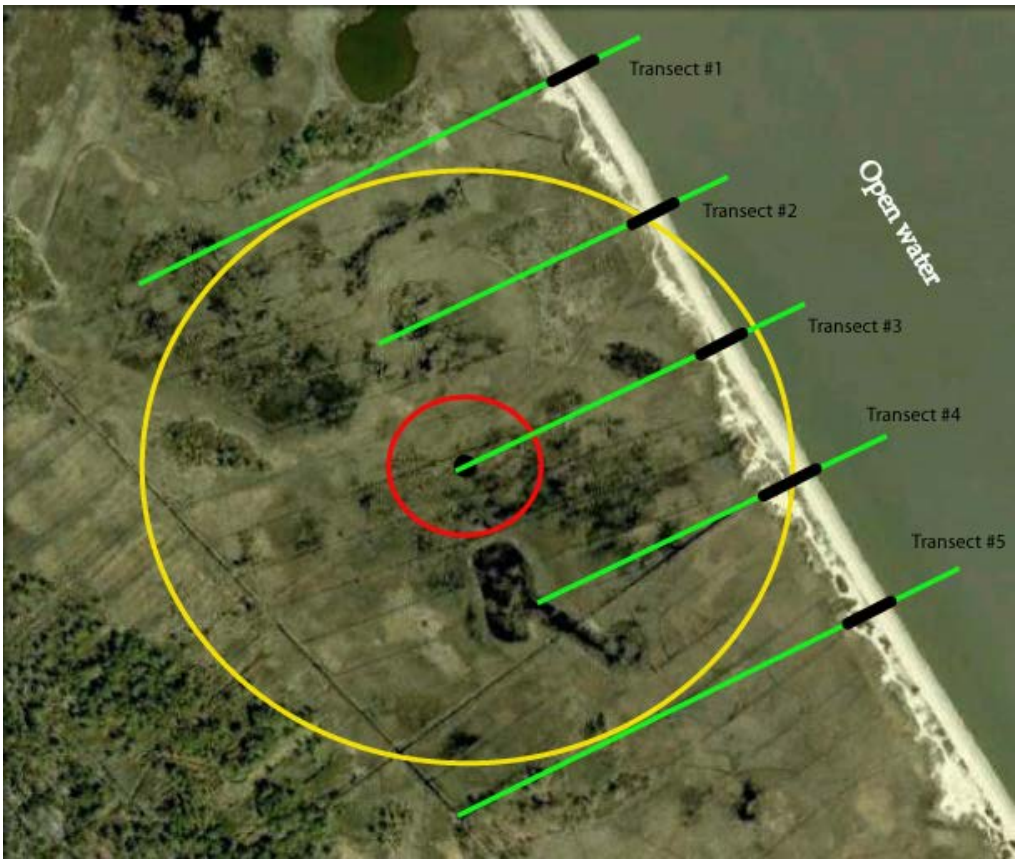


Figure 1. Configuration of the assessment area (red circle,) buffer area (yellow circle,) and shoreline transects (green lines) for each random wetland sample point.

<u>Steps for determining transect point location</u> (see Figure 1). Steps 1-3 should be completed using GIS prior to field work. The field crew will survey shoreline condition at five transect points using predetermined GPS coordinates. Once in the field, the field crew can adjust the location (or delete as a last resort) transect points that are found to be inaccessible or unsuitable. If a site is moved (in accordance with the MIDTRAM) then a transect will be drawn from the new point to the nearest tidal influenced, at least 30m wide, body of water. From this mid point (Point 3), the other 4 points can be determined by using GPS to pace out 150m in either direction from the midpoint then 300m from the midpoint in either direction. Shorelines are not considered if human built, ie levies, or a bay shoreline.

Identify the circular buffer area that extends 250m beyond the edge of the assessment area (AA.) Establish a linear transect from the center of the AA to the nearest tidal influenced, at least 30m wide, body of water.

In cases where the shoreline is curved, the linear transect will still be set as the shortest distance between the center of the AA and the shoreline. In cases where the AA is situated within an impoundment and there is a man-made levee or some other hydrological impediment between the AA and the shoreline, the transect will be kept as long as the body of water is tidally influenced and at least 30m wide. If this is not true the next nearest tidally influenced, at least 30m wide, body of water will be used.

In cases where transect is repositioned in the field, the location of the five transect points (see #1-5 below) will be set approximately 150m apart and actual GPS measurements will be recorded enabling calculation of exact distances later. A minimum of 3 transect points set at least 100 m apart are needed to constitute a valid shoreline assessment per point.

1. Find the nearest tidally influenced, at least 30m wide body of water.
2. Establish a transect from the center of the AA to this body of water. Where the transect intersects shoreline is Point #3.
3. Establish two transects that are parallel to the main center transect 300m on each side of the center of the AA, the outer boundary of the buffer area (see Figure 1.).
4. Establish two parallel transects that are 150m from the center of the AA. Facing the water from the AA, the transects are consistently numbered from 1-5 moving from North to South or East to West. The five transects are 150m apart.
5. The intersection of Transects #1-5 with the shoreline are the Transect Points #1-5. See above for the definition of the shoreline.
6. Two shoreline condition metrics will each be assessed at each of the five transect points preferably during the time between mid-ebb and mid-flood tides if possible for consistancy. Therefore, during field assessments, the shoreline assessment portion should be completed near the beginning or end of the effort per point to ensure that at least half of the intertidal zone can be surveyed for shoreline condition. If this time frame cannot be accomplished, and the shoreline cannot be adequately viewd a score of “0”, stable, will be assigned.
7. At each point, for shoreline alteration the area of focus will be a 50 m wide band through the intertidal zone, extending from the seaward edge of the contiguous vegetation to the middle of the intertidal zone (since the low intertidal zone might not always be visible). Shorelines with steep slopes will have a smaller area of focus than shorelines with gradual or terraced slopes (e.g. for examples, see Figure 2.) For the shoreline erosion metric a 20m area of focus will be considered.

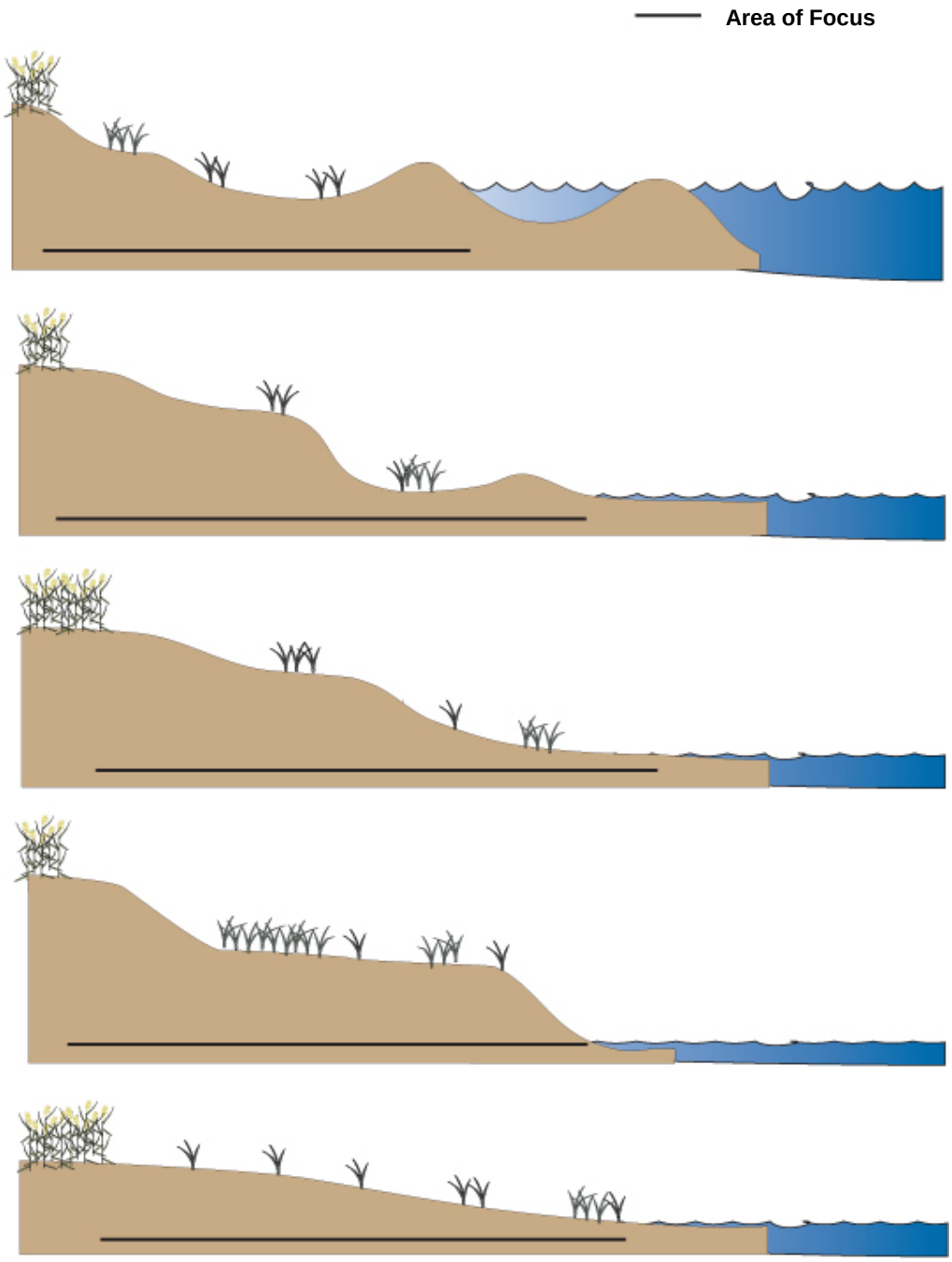


Figure 2. Area of focus (black line) for shoreline assessment for marsh edges having different slope configurations. In all examples, the dense clump of taller grasses to the left signifies the seaward margin of the contiguous vegetation, whereas small clusters of grasses within the area of focus signify clumps of vegetation or broken terraces.

Article II. S1: Shoreline Alteration

Definition:
Shoreline alterations are built structures that consist of hard surfaces or substrates that are not typically found along tidal wetland shorelines. Any structure that shades or disrupts the normal hydrology; examples include bulkheads, rip rap, wharfs and piers. These structures and alterations can be derelict or still maintained (for examples, see Figures 3 and 4.) Not to be included are restoration alterations that use soft or natural materials along the edge (e.g. some installed "living shorelines", Figure 5), flotsam, or natural fill such as shell piles or woody debris.

Assessment Protocol:
Standing at the transect point where the transect exits the contiguous vegetated marsh and begins to drop in elevation through the non-vegetated intertidal zone (i.e., between the contiguous vegetated marsh edge and the mid-intertidal zone on the foreshore,) scan the immediate viewable upper intertidal zone along the shoreline for 25 m in either direction. Assess whether this 50 m section of shoreline is eroding, stable, or accreting, on average. If this is unclear, score it as stable.

Standing at the transect points scan the immediate viewable upper intertidal zone along the linear shoreline for 25 m in either direction. Assess whether this 50 m section of shoreline contains any shoreline alterations, and if so, measure the total linear shoreline that is altered (occupied by structures or otherwise manipulated.)

Assessment Protocol:
At each transect point, measure the linear expanse of shoreline that is altered within the 50 m area of interest straddling the transect (25 m to either side.) Divide the altered shoreline length by 50 m to calculate a percentage of linear shoreline that is altered. Average this percentage among the (up to 5) transects.

Figure 3. Example of Shoreline Alteration of non-natural manipulation, a derelict pier.

Figure 4. Example of non-natural shoreline manipulation, bulkheads.

Figure 5. Example of living shoreline installed for erosion control and consisting of natural fiber logs and mats, oyster shell, and seeded with mussels and vascular plants.

Scoring: Shoreline Alterations

Percent Shoreline Altered	%
Transect 1	
Transect 2	
Transect 3	
Transect 4	
Transect 5	
Average	

Article III. S2: Shoreline Erosion

Definition:
Standing at the transect point where the transect exits the contiguous vegetated marsh and begins to drop in elevation through the non-vegetated intertidal zone (i.e., between the contiguous vegetated marsh edge and the mid-intertidal zone on the foreshore,) scan the immediate viewable upper intertidal zone along the shoreline for 25 m in either direction. Assess whether this 50 m section of shoreline is eroding, stable, or accreting, on average. If this is unclear, score it as stable.

See Figures 6 and 7 for examples of accretion and Figure 8 and 9 for examples of erosion. Typically, accretion is evidenced by accumulated soft sediments and seaward colonization of the foreshore by sprigs of vegetation. Erosion is typically indicated by a lack of accumulated soft sediments, exposure of non-vegetated peat, peat terraces, and sharp slopes with undercut vegetation and cusps. This metric requires that the observer estimate whether the shorelines is either generally eroding, generally accreting, or is generally stable, within a 20 m shoreline section bounded 10 m to either side of the transect point.

Assessment Protocol:
Scan the shoreline for 10 m in either direction of the transect point, focusing on the intertidal zone between the contiguous vegetated marsh and the mid-intertidal zone of the foreshore. In this 20 m of upper intertidal shoreline, estimate if the average condition is either generally eroding (-1), generally stable (0), or generally accreting (+1).

In cases where erosion or accretion is not evident, the area should be considered stable. If erosion and accretion are both evident, but balanced, then the shoreline is considered stable. Only score the area as eroding if >50% of the 20m is eroding, and only score it as accreting if >50% is accreting. If mixed patterns occur and it is unclear how to score the transect point, use a tape measure to dissect the 20 m into 10 m subsections (with the middle set on the transect point), score each subsection, average the scores, and round to the nearest whole number (-1, 0, 1).

After all transect points are surveyed (minimum of 3, ideally 5), average the scores. These will range between -1 to +1.

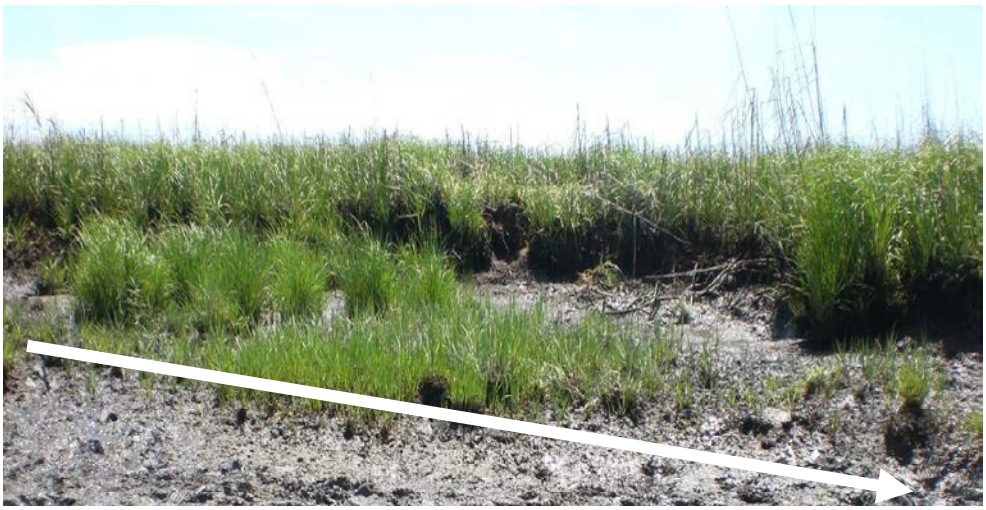


Figure 6. Accretion and Erosion; marsh plants expanding from marsh edge towards water line, but clearly previous erosion behind with an undercut bank.

Figure 7. Accretion; specifically of plants expanding onto foreshore.

Figure 8. Erosion; undercutting of banks leading to marsh slumping.

Figure 9. Erosion; specifically cusping.

Scoring:Shoreline Erosion

Approximate Shoreline Erosion	Generally eroding (-1)/ Generally stable (0)/ Generally accreting (+1).
Transect 1	

Transect 2	
Transect 3-Mid Point	
Transect 4	
Transect 5	
Average	

Figure 10. Erosion. Exposure of peat.

Figure 11. Exposure of erosion; peat and undercutting of banks.

Figure 12. Example of erosion; terracing.

Figure 13. Example of erosion, exposed roots.

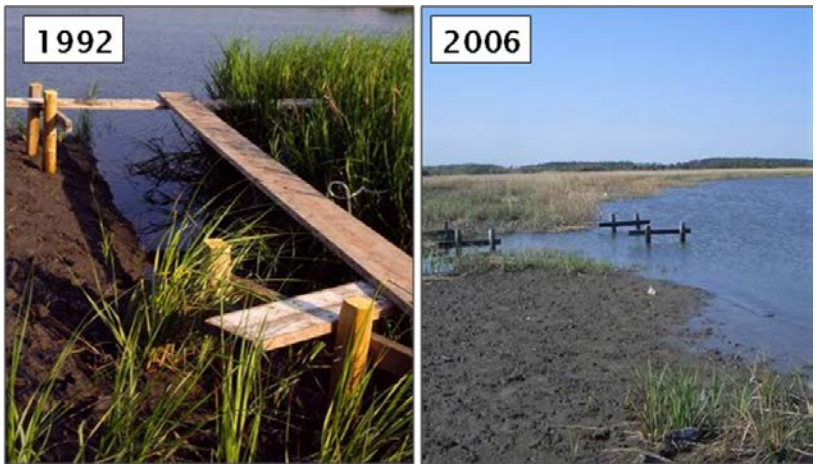


Figure 14. Evidence of water body expansion and landward marsh retreat can be found if structures are seen in the water that were formerly located within the marsh.

Figure 16. Typical vegetation zonation along the intertidal edge of a freshwater tidal wetland in the Delaware Estuary

Mid-Atlantic Tidal Wetland Rapid Assessment Method V3.0

Site # _____ Site Name _____ Date _____

Time of Start& Finish____:____ ____:____ Crew _____

Watershed _____ Sub-Watershed_____

lat/long _____ AA shape: circle or rectangle or entire wetland polygon (circle)

AA moved from original location? Yes or No (circle one) If yes, reason _____

Classification: (circle one)	Reference or Assessment (circle one)
Marine Tidal Fringe	
Fringing Estuarine Tidal Fringe	Natural, Re-establishment, establishment
Expansive Estuarine Tidal Fringe	Enhancement, Impoundment (circle one)
Back Barrier Estuarine Tidal Fringe	

What best describes the tidal stage over the course of the time spent in the field? (circle one)
Note: It is recommended that the assessment be conducted at low tide.

Tide Stage

H <----------M----------> L

5 4 3 2 1

Range of Photo Identification Numbers:

Stressor Photo Description:

Assessment Area Sketch

low marsh or high marsh (circle one)
Distance to Upland _____meters
Distance to Open Water _____ meters

Stability of AA (check one)
____Healthy & Stable
____Beginning to deteriorate and/or some fragmentation
____Severe deterioration and/or substantial fragmentation

Soils
Depth of organic layer (cm):
Comments on soil sample:

Salinity _____ppt

Vegetation Communities and Features

enter midpoint for each species/combination present using the cover class chart below

_____Spartina alterniflora	_____Phragmites australis	_____root mat
_____Spartina patens	_____pannes, pools, creeks	_____unvegetated, mud or sand
_____Spart. alterniflora/Spart. cynosuroides	_____open water	_____unhealthy marsh- SWD, deterioration
_____Spartina patens-Distichlis spicata	_____ditches	_____other 1_____

Cover Classes	MidPt	Cover Classes	MidPt	Cover Classes	MidPt
0	0	6-25%	15.5	76-99%	88.5
<1%	0.5	26-50%	38	100%	100
1-5%	2.5	51-75%	63		

Comments:

Qualitative Disturbance Rating						
1	2	3	4	5	6	(circle one)
Low <----------Disturbace----------> High						

Assessment Complete: Yes No (circle one)

Mid-Atlantic Tidal Wetland Rapid Assessment Method V.3.0

Site # _____ Date ____/_____/_____

Attribute 1: Buffer/Landscape (All W/in 250m)

B1. Percent of Assessment Area Perimeter with 5m-Buffer

Record Estimated Percent _____%	
Alternative States(not including open-water areas)	**Rating (circle one)**
Buffer is 100% of AA perimeter.	**12**
Buffer is 75-99% of AA perimeter.	**9**
Buffer is 50-74% of AA perimeter.	**6**
Buffer is <50% of AA perimeter.	**3**

B2. Average Buffer Width (max 250m)

Line	Buffer Width (m)
A	
B	
C	
D	
E	
F	
G	
H	
Average Buffer Width _____	
Alternative States	**Rating (circle one)**
Average buffer width 190-250m	**12**
Average buffer width 130-189m	**9**
Average buffer width 65-129m	**6**
Average buffer width 0-64m	**3**

B3. Surrounding Development between AA edge and 250m

Estimate Development _____%	
Alternative States	**Rating (circle one)**
0% development	**12**
>0-5% development	**9**
>5-15% development	**6**
>15% development	**3**

B4. 250m Landscape Condition

Alternative States	Rating (circle one)
AA's surrounding landscape is comprised of only native vegetation, has undisturbed soils, and there is no evidence of human disturbance.	**12**
AA's surrounding landscape is dominated by native vegetation, has undisturbed soils, and there is to little or no evidence of human visitation.	**9**
AA's surrounding landscape is characterized by an intermediate mix of native and non-native vegetation, and/or a moderate degree of soil disturbance/compaction, and/or there is evidence of moderate human visitation.	**6**
AA's surrounding landscape is characterized by barren ground and/or dominated by invasive species and/or highly compacted or otherwise disturbed soils, and/or there is evidence of very intensive human visitation.	**3**

B5. Barriers to Landward Migration

% Perimeter Obstructed _____%

Dist. From Center of AA _____m

Alternative States	Rating (circle one)
Absent: no barriers	**12**
Low: <10% of perimeter obstructed	**9**
Moderate: 10-25% of perimeter obstructed	**6**
High: 26-100% of perimeter obstructed	**3**

Shoreline Test Metrics (comlete at low tide along open water shoreline)

S1: Shoreline Erosion

	Erosion Rating (1, 0, -1)
Transect #1	
Transect #2	
Transect #3	
Transect #4	
Transect #5	
Average:	

S2: Shoreline Alteration

	Shoreline altered or
Transect #1	
Transect #2	
Transect #3	
Transect #4	
Transect #5	
Average:	

Coorindates of Transects		
#1		
#2		
#3		
#4		
#5		

Attribute 2: Hydrology

H1. Ditching/Draining (AA only)

Alternative States	Rating (circle one)
No Ditching	12
Low Ditching	9
Moderate Ditching	6
Severe Ditching	3

H2. Fill & Fragmentation (AA only)

Alternative States	Rating (circle one)
No fill or fragmentation	12
Low fill or fragmentation	9
Moderate fill or fragmentation	6
Severe fill or fragmentation	3

Estimate amount of fill_____% of AA
Dimensions of Fill Pile _____

H3. Diking & Tidal Restriction (250m)

Description of restriction: _____

Alternative States	Rating (circle one)
Absent: no restriction, free flow, normal range	12
Low: restriction presumed (<10% of normal range)	9
Moderate restriction (10-25% normal range)	6
High (26-100 of normal range)	3

H4. Point Sources (250m)

Alternative States	Rating (circle one)
Absent: no discharge	12
Low: one small discharge from a natural area	9
Moderate: one discharge from a developed area or two discharges from a natural area	6
High: ≥ 2 discharges from a developed area or ≥ 3 from a natural area	3

Attribute 3: Habitat (All W/in AA)

HAB1. Bearing Capacity (Hummocks)

% Hummocks____	Mark Depth (cm)							
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8
Water Depth (cm)								
Initial capacity								
Blow 1								
Blow 2								
Blow 3								
Blow 4								
Blow 5 (Final)								
Final - Initial								

AVG= _____

*** % of AA in hollows x hollows average (HAB1) = _____**
% of AA in hummocks x hummocks avg (HAB1b)= _____
Sum of two weighted averages = _____

Av. of Final - Initial for the 8 Sub-plots	Rating (circle one)	
≤ 1.8	12	Average Final-Initial =_____cm
1.9-4.0	9	
4.1-6.2	6	
> 6.2	3	

HAB2. Horizontal Vegetative Obstruction

Sub-plot	1	3	5	7
0.25m				
0.50m				
0.75m				
Sum				
Veg. type				

Average of 4 Sub-plots_____

Average of 4 Sub-plot totals	Rating
< 7	12
< 12 ≥ 7	9
<22 ≥ 12	6
≥22	3

AA = 8000m² 5% of AA = 400m² = 20mx20m 400m² = 11.3m radius circle
Buffer = 274,750m² 5% of Buffer = 13,737m² = 117m x 117m

HAB1b. Bearing Capacity (Unvegetated Hollows) if applicable*

% Hollows_____	Mark Depth (cm)							
	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8
Water depth (cm)								
Initial capacity								
Blow 1								
Blow 2								
Blow 3								
Blow 4								
Blow 5								
Final - Initial								

AVG= _____

HAB3-5. Plant Community Worksheet

Floating or Aquatic Spp	Invasive? Y/N	Co-dom?	Short spp <0.3m	Invasive?	Co-dom?

Medium spp 0.3-0.75m	Invasive?	Co-dom?	Tall spp 0.75-1.5m	Invasive?	Co-dom?

Very Tall spp >1.5m	Invasive?	Co-dom?		
			(A) # of Plant Layers	
			(B) Total # of Native co-dominant species for all layers combined	
			(C) Total # of Invasive co-dominant species for all layers combined	
			(D) % of Invasive co-dominant species for all layers combined C/(B+C)	
			(E) % Invasive cover in AA	

HAB3. # of Plant Layers (A)

Alternative States	Rating (circle one)
4-5 layers	**12**
2-3 layers	**9**
1 layer	**6**
0 layer	**3**

HAB4. % Co-Dominant Invasive Species (D)

Alternative States	Rating (circle one)
0-15%	**12**
16-30%	**9**
31-45%	**6**
46-100%	**3**

HAB5. % Invasive Cover in AA (E)

Alternative States	Rating (circle one)
0%	**12**
>0-25%	**9**
26-50%	**6**
>50%	**3**

COMMENTS:

Mid-Atlantic Tidal Wetland Rapid Assessment Method V.3.0

Site Number:	Site Name:	Date:_____/____/____

Attributes and Metrics		Scores	Comments
Buffer/Landscape	**Raw #**		
B1. % of AA Perimeter with 5m Buffer			
B2. Average Buffer Width			
B3. Surrounded Developed			
B4. 250 Landscape Condition			
B5. Barriers to Landward Migration			
((((∑(B1,B2,B3,B4,B5))/60)*100)-25)/75)*100 = **Buffer Attribute Score**		Score	
Hydrology	**Raw #**		
H1. Ditching & Draining			
H2. Fill & Fragmentation			
H3. Diking/Restriction			
H4. Point Sources			
((((∑(H1,H2,H3,H4))/48)*100)-25)/75)*100 = **Hydrology Attribute Score**		Score	
Habitat	**Raw #**		
HAB1. Bearing Capacity			
HAB2. Horizontal Vegetative Obstruction			
HAB3. Number of Plant Layers			
HAB4. Percent Co-dominant Invasive Species			
HAB5. Percent Invasives			
((((∑(HAB1,HAB2,HAB3,HAB4,HAB5))/60)*100)-25)/75)*100 = **Habitat Attribute Score**		Score	

((Buf/Land + Hydrology + Habitat Attribute Scores)/3)= Final Score	**Final Score =_____**