Development of a Comprehensive State Monitoring and Assessment Program for Wetlands in Massachusetts: Salt Marsh Component

Appendix B

Standard Operating Procedures: Assessment of Tidal Flow Restrictions to Salt Marshes

Phase 1: 2009

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Standard Operating Procedures: Tidal Restriction Assessment

1. Scope and Application

This SOP establishes a standard set of procedures to be followed for field data collection towards the development of a tidal restriction metric for use in the Conservation Assessment and Prioritization System's (CAPS) landscape level analysis (Level 1) of ecological integrity. This project will compliment a separate effort to classify potential tidal restrictions with the use of photo interpretation techniques and various GIS data. Field data collected under this SOP will replace photo interpreted data where available. They will also be used to train photo interpreted data for classification of tidal restrictions.

Described below are the procedures that will be followed in collecting data on tidal hydrology, specifically the degree that tidal flow is restricted to salt marshes.

2. Summary

This SOP is applicable for salt marshes throughout Massachusetts. This wetland community is known as tidal fringe wetland in the hydrogeomorphic (HGM) classification and estuarine emergent (E2EM) in the Classification of Wetlands and Deepwater Habitats of the United States. Data collection for this study may occur in the following coastal watersheds. The watersheds included in the site selection process are Cape Cod, Charles, Ipswich, Merrimack, Mystic, Neponset, North Coastal, North and South Rivers, Parker, South Coastal Shore, and Weymouth & Weir Watersheds; however this SOP can be applied to all salt marshes in Massachusetts. Field data collection will involve measuring water levels upstream and downstream of tidal restrictions during a spring tide cycle. Locations will be identified using a combination of field observations, remotely sensed data, local knowledge, and best professional judgment. They will be targeted for accessibility, potential for tidal restriction, and total area of salt marsh present upstream.

The two main goals for field data collection are: 1) determine the relative magnitude of tidal restriction at select sites, and 2) develop a magnitude of tidal restriction data set that will be used to train a tidal restriction model developed from remotely sensed data interpretation. A tidal restriction metric will be developed from the field data collected under this SOP and photo interpreted data collected by the UMass team. This will occur at a later time, outside the scope of this SOP.

3. Safety Considerations

- Sampling will always be conducted by two or more persons.
- Fieldwork will not be conducted during heavy rain events or unsafe conditions such as electrical storms or high wind events. Practice "safety first".

- Fieldwork (especially optical leveling) will not be conducted in a travel or breakdown lane of any roadway.
- Tide gauge installations will not occur at high tide (though may occur during periods of flood and ebb tide, in addition to low tide).
- First aid kits must be taken on all sampling trips; inspect and re-stock as needed before going on-site.
- Brightly colored safety vests will be worn by all field personnel.
- Orange safety cones will be placed behind any vehicle stopped or parked along a busy roadway.
- Work at a reasonable pace to ensure personal safety (and data quality). Rapid, frantic or rushed sampling will usually lead to poor results.
- If there is no safe access to a sampling point, the field sampling will not be conducted for that site (e.g. access via active railroad only, roadway with four or more lanes of traffic).
- Good judgment will be used in selecting clothes and personal protection items. Common items needed include: extra clothing, sunshade, sunscreen, hats, insect repellent, and waterproof knee boots—chest waders or hip waders for highest anticipated depths. Any staff not dressed appropriately for field work should not participate in the survey. Proper footwear is a must (e.g., no "flip-flops" for field work).
- Private property will be respected using the following guidelines.
    - If property is in close proximity to buildings or other heavily used areas, landowner permission will be sought.
    - Posted property will not be accessed without permission of the landowner.
    - Otherwise, sampling will proceed without any special effort to gain landowner permission.

4. Equipment/Apparatus

Before leaving for the field the Field Manager will confirm the following equipment is available.

Cable ties
Clipboard
Compass
Cork dust
Data sheets
Digital camera w/extra batteries
Field guide and technical key
Field notebook
GPS (Global Positioning System)

Location maps
Optical level
Pens and pencils
Rebar
Road atlas
Safety vests
Safety cones
Scissors or jack knife
Site Reconnaissance Sheets (previously completed)
SOP
Stadia rod
Survey tripod
Tap water
Tide chart
Tide gauges (constructed from PVC pipe and 1" wooden slats)

5. Calibration & Training

Equipment calibration procedures for the GPS unit and automatic optical level will be done according to the manufacturers' recommendations. See section 2.6 of the QAPP for details.

Field crew members will have sufficient previous training and experience to reliably conduct field data collection or they will receive training from the CZM QA Manager, CZM Project Manager, and/or other project scientists with relevant expertise. All field crew members will receive training from the CZM QA Manager on appropriate QA/QC procedures.

6.0 Procedures

Sampling will occur during spring tide cycles between June 22 and August 31, 2009. Potential tidal restrictions will be identified using various GIS data representing road and rail centerlines, linear hydrological features, and existing tidal restriction atlas data developed for the Massachusetts Wetlands Restoration Program. CZM and DEP staff will remotely assess each site on a set of criteria using local knowledge and GIS resources, including but not limited to aerial photography (oblique and orthophotography), DEP Wetlands, and MassGIS Open Space data. Sites are assessed for sampling based on the following criteria:

- Physical access (including safety considerations)
- Legal access
- Potential for restriction
- Lack of control structures (e.g. flapper, electric sluice, or self-regulating tide gates)

Sites that meet these criteria are prioritized for sampling based on the total acreage of salt marsh upstream (as depicted in MassDEP Wetlands mapping data; 1:12,000 based on photography from 1990-1993), with emphasis placed on those with greater acreage. The goal is to sample 50 potential tidal restrictions. By prioritizing sites by the area of salt marsh they potentially impact, we can better provide more accurate data inputs to the tidal restriction model.
GPS navigation, road atlases, and/or GIS maps will be used to navigate to potential tidal restriction to be sampled.

6.1 Tide Gauge Construction

Tide gauges were constructed by field personnel according to CZM modifications to specifications by Delta Laboratories' (Rochester, NY) Adopt-A-Stream program (http://www.adopt-a-stream.org/pdf/monitoring_tools/combination_staff_gauge.pdf).

A prototype was built by CZM staff. Rebar and 1" diameter PVC pipe were cut in 5-ft sections. A small air hole was drilled in the PVC pipe section at what becomes the top end of the tide gauge. Three small water holes are drilled at the bottom end of the gauge. A ¾" wide wooden slat is cut to 5½-ft sections. Field personnel built an additional eight sets (pairs) of tide gauges to deploy at sites simultaneously. See Section 6.3.2 for on-site assembly and installation instructions.

6.2 Site Reconnaissance

All sites require a site reconnaissance (pre-deployment) visit to verify access and safety feasibility and potential for tidal restriction. Field personnel will assess the site, record their observations, and sketch a diagram of the site including the potentially restricting structure(s), water feature(s), and visual plant indicators (*Phragmites australis* and *Typha* spp.). Information will be transferred to an Excel spreadsheet and submitted to CZM staff weekly.

6.3 Overview of Tidal Restriction Assessment

Each of the potential tidal restrictions sampled will be characterized and assessed by observation and direct measurement. Qualitative data (see Section 6.3.1) and quantitative data (see Section 6.3.5) will be used to train photo-interpreted data on tidal restrictions. Quantitative data will supersede photo-interpreted data for any given site.

6.3.1 Supplemental Site Information

The following supplemental information on hydrological alterations will be observed at each site and recorded on the Tidal Restriction Data Sheet (Appendix D).

- Length (culvert) or width (bridge) of structure from downstream (seaward) to upstream openings in feet
- Type of restricting structure and respective information:
    - **Bridge:** does or does not span the across the entire channel
    - **Road:** number of lanes; width of road; paved or unpaved
        - If culvert is present, material (e.g. concrete, corrugated metal) at the downstream and upstream openings

        - Size of culvert opening (pipe diameter or box culvert height x width
        - Is the culvert broken
        - Is the culvert clogged with debris
    - **Railroad:** if culvert is present, see Road above
    - **Other**
- Condition of crossing structure (key: 1=excellent, 2=good, 3=fair, 4=poor, 5=need immediate repair)
- Estimated width of channel (fixed distance from opening)
- Visual indicators (if yes, rank presence upstream and downstream of restricting structure: 1. Dominant/Major, 2. Significant, 3. Minor)
    - *Phragmites australis* (Common Reed)
    - *Typha angustifolia* or *T.latifolia* (Cattail spp.)
    - Scouring Basin
    - Bank Erosion
    - Low marsh slumping
    - Vegetation die back
    - Impounded water near restriction

6.3.2 Installation of Tide Gauges

Tide gauges are installed on both sides of a potential tidal restriction: downstream (seaward) and upstream (towardss headwaters). Placement of tide gauges in relation to restricting structures will vary from site-to-site, but there are a few things to consider.

- Field personnel must use good judgment when locating a gauge. Access and safety are of paramount concern (see Section 3). If a desired gauge location cannot be safely accessed, an alternate location should be considered. If not feasible, the site should be discarded.
- Tide gauges should only be installed at low tide or during periods of flood and ebb tide. They should not be installed at high tide. Note that sampling will occur during spring tide cycles, which is when extreme high tides occur.
- Horizontally, gauges should be located in close proximity to the tidal restriction. It is not important to place the upstream and downstream gauges equidistant from the restricting structure, but their location should be carefully approximated on the site diagram sketched during the reconnaissance visit.
- Vertically, gauges can be located on the banks of the water features, below grade or on the marsh platform. The platform, or surface, will be inundated during the spring tide cycle, thereby allowing water to enter the gauge and produce results.
- Use the stadia rod to measure the height of the rebar from the ground. Record this measurement on the Tidal Restriction Data Sheet. This measurement will be repeated when the gauge is read to verify that the vertical position of the rebar and gauge has not changed. If it has, then the entire process—beginning with optical leveling—will have to be repeated for the site.

6.3.3 Surveying / Optical Leveling

Leveling the tide gauges is a critical process in order to achieve valid results. The following instructions will be supplemented by the optical level manufacturer's operator's manual (Appendix E).

1. Find a suitable location to set up the tripod and optical level. It is important to position the level with a line of sight to both the upstream and downstream gauges. (Note the gauges can sit below the line of sight, as long as the 17-ft stadia rod is visible when standing upright next to each gauge).
2. Consider the substrate when locating your level position. Soft, uneven surfaces can make it difficult to anchor the tripod. Use the tripod's adjustable, telescoping legs to secure it in a stable position. Lock the telescoping legs into place.
3. Once the tripod is secure, attach to optical level to the platform according to the manufacturer's instructions. Ensure that the instrument is correctly fastened to the tripod platform.
4. Level the instrument by adjusting the three thumb screws as necessary. Use the bubble level to guide the adjustments. The instrument is level when the bubble is in the dead-center of the target circle. Now rotate the instrument 90 degrees and check the bubble level. If the bubble is no-longer centered, make the necessary corrections.
5. The stadia rod telescopes to a maximum height of 17 feet. It is important to note that intervals are hundredths of a foot (in decimals). For example, a reading of 2.5 in the 10-ft range does not translate to 10 ft 2½ in. It equals 10.25 feet, or 10 ft 3 in. Notice the stadia rod's interval tics. The bottom edge of each tic is shorter than the top edge. Each edge represents 0.01 ft. For instance, the top edge of the 5 tic within the 10-ft range equals 10.5, but the bottom edge of that same tic equals 10.49.
6. One person is required to hold the stadia rod in an upright position next to the tidal gauge. It is important to ensure that the bottom of the stadia rod sits on the surface, not above or below ground. The rod holder must be sure not to obstruct the level reader's view of the rod's markings. S/he must work with the level reader to find the correct angle at which the rod should be held. The level reader will use hand or verbal cues to instruct the rod holder in finding the best upright position for the rod. The entire section of stadia rod as seen through the optical level will appear focused when positioned correctly. Once the level reader indicates that the rod is positioned correctly, the rod holder must keep it still to ensure that a precise reading is taken.
7. The reading should be taken at the major crosshairs when viewing the rod through the level. See Step 5 above for instructions on how to read the stadia rod markings. Repeat this for a total of three readings, whereby one person reads, walks away, reads again, etc. Record the measurements on the Tidal Restriction Data Sheet. Average the three measurements. By doing so user error—from positioning the stadia rod to reading the height measurement—is reduced.

6.3.4 Measuring High Water Level

The high water level will be measured from the gauge after one tide cycle during the overnight spring tide period. Usually, this means that gauges will be deployed one afternoon, and read the next morning.

1. Use the stadia rod to measure the height of the rebar from the ground. Compare this measurement with the rebar height recorded on the Tidal Restriction Data Sheet during installation of the gauge. The entire process—beginning with optical leveling—will have to be repeated for the site if the measurements are different.
2. Remove the gauge's top cap and gently pull out the wooden slat. Use the stadia rod to measure the bottom edge of the slat to the line of cork dust running across the slat face. This line is the high water mark left when the tide waters receded and the cork dust adhered to the slat. Record this height on the Tidal Restriction Data Sheet.
3. Wash the gauge components before deploying at a new site. This includes the rebar, wooden slat, and PVC pipe and caps.

6.3.5 Calculating Difference in Relative Tide Elevations

The high water levels measured downstream and upstream of a restriction are used to calculate the difference in relative tide elevations. Use the diagram in Figure 1—also included on the Tidal Restriction Data Sheet—as a guide.

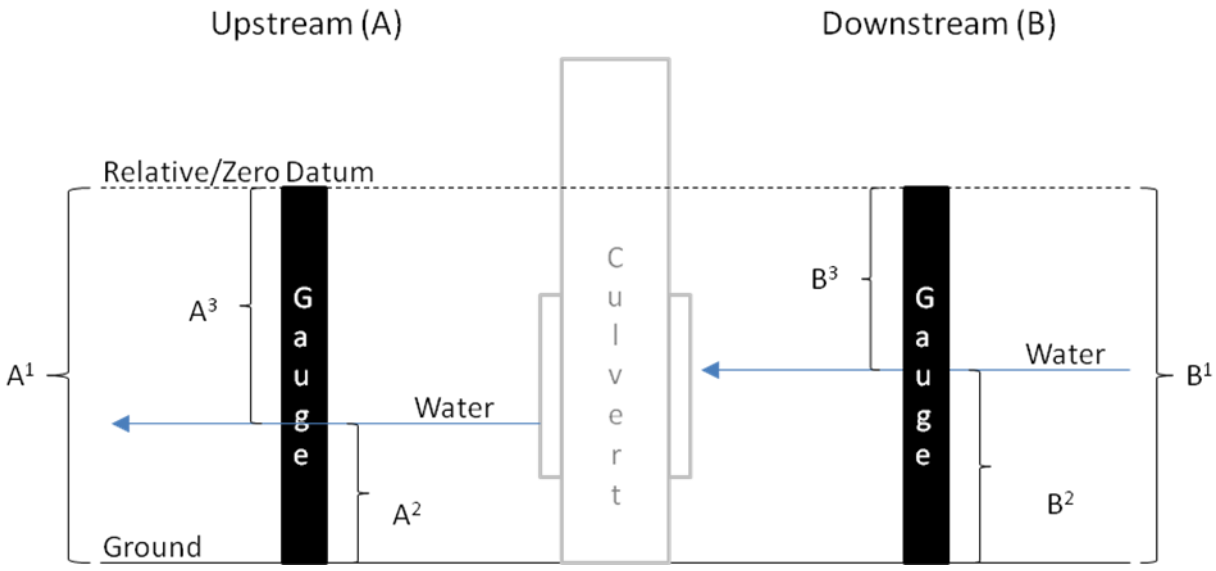

Figure 1. Diagram of downstream and upstream gauge measurements and calculations necessary to determine whether a tidal restriction exists.

A^1 and B^1 are "line of sight" / instrument height measurements used to establish the gauges' relative elevations as described above. A^2 and B^2 are water level heights measured from the gauge's wooden slat and cork dust. A^3 and B^3 are the upstream and downstream relative tide elevations. The quantitative tidal restriction equals the difference between the upstream and downstream relative tide elevations (A^3 and B^3,

respectively). This value will be used to later classify restrictions by severity during development of the CAPS tidal restriction metric.

A^1 = instrument height / relative elevation at A

A^2 = water level height at A

A^3 = relative tide elevation at A

B^1 = instrument height / relative elevation at B

B^2 = water level height at B

B^3 = relative tide elevation at B

TR = Tidal Restriction

Relative tide elevation at A (A^3) = $A^1 - A^2$

Relative tide elevation at B (B^3) = $B^1 - B^2$

Tidal restriction (TR) = $A^3 - B^3$

7. Protocol for Decontamination of Field Equipment

Inspect all equipment for debris and removed before leaving a site. Dispose of debris in a trash bag or on dry, high ground. When possible, leave equipment to air dry and inspect to remove any remaining plant fragments. Clean the optical level according to the manufacturer's recommendations.

8. Quality Control

Compliance with procedures in this SOP will be maintained through monthly internal reviews. Personnel will conduct periodic self-checks by comparing their results with similarly trained personnel working on the project. See sections 2.5 and 2.6 of the QAPP for details about QA/QC measures.

9. Interferences

Inclement weather (heavy rain) may interfere with our ability to collect representative data on a variety of parameters. Severe weather may delay field data collection due to safety concerns. Access may be a challenging aspect of data collection in more developed areas of the study area. Posted property or sites that are too difficult to access or unsafe to sample will be replaced with alternate site by priority specifications described in Section 6.0.

10. Preventative Maintenance

Field equipment will be inspected by field personnel each day before going out to collect field data. At the field site equipment will be tested prior to data collection to ensure that it is working properly. Equipment will be subject to regular maintenance as needed and as recommended by the manufacturer. See section 2.6 of the QAPP for more detail.

11. Corrective Actions

Data quality control ensures high quality data, however we are prepared to re-measure any plots within the same season or period of monitoring which contain data anomalies. Any plots that contain anomalous data that cannot be resolved will be removed from the data set.

12. Waste Minimization and Pollution Prevention

Care will be taken to avoid transport of vegetation and soil to other sites. This will be done by thorough inspection of all equipment and clothing prior to departure from a site. Invasive plant samples will be disposed of in a way to avoid accidental release into the environment.

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