

MEMORANDUM

TO: Laura Wildman, P.E.
American Rivers

FROM: James MacBroom, P.E.

DATE: November 25, 2003

RE: Herring River Tide Gate and Dike
Wellfleet, MA
MMI #2259-02-2

Introduction

The tide gate structure and dike across the Herring River was inspected on November 17, 2003, on behalf of American Rivers to assess its physical condition and suitability for sustaining higher velocities with the gates open. Among the attendees were Steven Block (NOAA), John Portnoy (NPS), Steven McKenzie (Mass Coastal), and town public works staff.

Hydrographic Conditions

The Herring River is a bi-directional saltwater tidal watercourse that drains into Wellfleet Harbor and thence to Cape Cod Bay. It originally had an associated 600± acre salt marsh extending inland with several distinct lobes. The tidal flow was restricted in 1908 ± with a dike and tide gate structure that allowed the marsh to drain but limited saltwater inflow during the rising (flood) tide. The purpose of the dike and tidegate was described as being for mosquito control and land drainage to allow agricultural uses, which was a common practice in the colonial period. Portions of the marsh appear to have been subsequently ditched.

The normal response of a marsh with restricted flow is a reduction in its tide range and exchange prism, leading to reduced salinity, vegetation changes, aquatic habitat, and modified water chemistry. Altered sediment regimes are also associated with marsh subsidence and loss of channel cross sectional area.

Project Site

The existing earth dike serves as an embankment for Chequesset Neck Road, a municipal two-lane bituminous concrete street. Herring River passes through (under) the dike via a triple cast-in-place reinforced concrete box culvert equipped with two large top hinged timber flap gates and one vertical lift sluice gate. The flap gates open outward to drain water from the marsh to the bay, the sluice gate allows bi-directional flow. Construction plans dated 1971 are available and were reviewed.

The channel beds upstream (marsh) and downstream (bay) of the dike are a light colored loose fine to coarse sand.

Flow Regime

1. The structure was inspected during the second half of an ebb tide. The flap gates were operating as intended, the sluice gate was partly open.
2. A significant contraction head loss (up to one foot) was occurring at the marsh side approach to the culverts, followed by a turbulent hydraulic jump inside the culverts. This combination reduces the culvert's capacity and places the hydraulic control point for the ebb tide at the marsh side culvert face rather than at the gates. Despite having a limited tidal prism due to the gates, the marsh still fails to fully drain at low tide. The estimated velocity was about eight feet per second for most of the ebb cycle.

Inspection

1. The earth dike and the roadway along its crest are in excellent condition. There is no evidence of settlement, displacement, or misalignment. The crest is level and uniform. The lower embankment is partially covered with large stone slope paving and there is no evidence of scour. The plans show that the dike has a partial core of impervious material and timber sheeting.
2. The timber flap gates, hinges, and hangers were all inspected and found to be in good condition.
3. The sluice gate, channel supports, and threaded riser stem are in good condition. We could not operate the gearbox without the crank or wheel and it is not known if it can be operated. The stem is exposed without a protective tube cover.
4. I walked into all three-culvert cells and poked and probed the concrete with a steel rod. No spalls, cavities, or erosion were found. The concrete is solid and in excellent condition. The culverts have a reinforced concrete floor.
5. The timber handrail at the endwalls is in fair condition. The 6" x 6" wood posts are stable but have numerous cracks and dry rot with a limited useful life span.
6. Steel floor grates are present at all stop log channels and are in good condition.
7. The external concrete surfaces of the main structure and endwalls are in good to excellent condition. Several deep but tight vertical cracks were noted in the left and right bay side endwalls. No repairs are needed.
8. There is about a one-inch lateral displacement at the left and right construction joints between the bayside endwalls and the main culvert. It is not known if they were originally cast this way. No repairs are needed.
9. Stone riprap aprons are present on the bed at both ends of the culverts. Wading over the aprons found they are generally intact without deep scour. However, the aprons at both ends of the sluice-gated culvert have poorly sorted rock with large interstitial voids that should be repaired. Riprap voids at the marsh end of the sluice-gated culvert were up to 1.8 feet in

depth while the plans show a five-foot deep cut off wall. Consequently, the cut off wall is partially exposed but has not been undermined. There is no evidence of settlement.

10. All three culverts were clean, with no sediment or debris in them.
11. The high flow velocities and turbulence in the culverts and at the gates would severely limit fish passage, except for brief periods at slack low water and slack high water.
12. The large flap gates could be opened using a chain or cable pulley system attached to the concrete superstructure. This would allow closure during coastal floods, if needed to limit marsh water elevations.

Summary and Recommendations

The dike and tide gate structure are in excellent condition and suitable for extended use with minor maintenance. I recommend that:

1. The riprap aprons be repaired with grout to fill the larger voids, and stones be reset along the face of the culverts (marsh end) cut off wall.
2. The sluice gate stem and gearbox should be greased and periodically operated to prevent corrosion or blockages.
3. A protective stem cover should be provided. A simple cover can be made from four-inch diameter PVC pipe with an end cap and flange.
4. Additional stone should be placed at the approach to the culverts (marsh) end to reduce the approach angle and the contraction losses.
5. There is no need for further structural inspections at this time.