Potential Habitat Restoration in the East Branch of the Westport River by Removal of Obstructions to Tidal Flushing at the Hix Bridge

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Problem

The Massachusetts Highway Department recently completed designs for the repaving and reconstruction of the Hix Bridge in Westport, MA, near the shores of Buzzards Bay. The proposed work is estimated to cost $3.5 million.

Sections of the US Environmental Protection Agency and the US Army Corps of Engineers have raised the question as to whether it is appropriate to use the bridge reconstruction work as an opportunity to also improve flushing in the upper East Branch of the Westport River. On June 30, 2000, the Buzzards Bay Project National Estuary Program (BBP) convened a meeting with officials from the Town of Westport, Massachusetts Highway Department, Massachusetts Division of Marine Fisheries, Massachusetts Coastal Zone Management, representatives from the citizens group the Westport River Watershed Alliance, and other interested residents and organizations.

Figure 1. ***Hix Bridge today.***

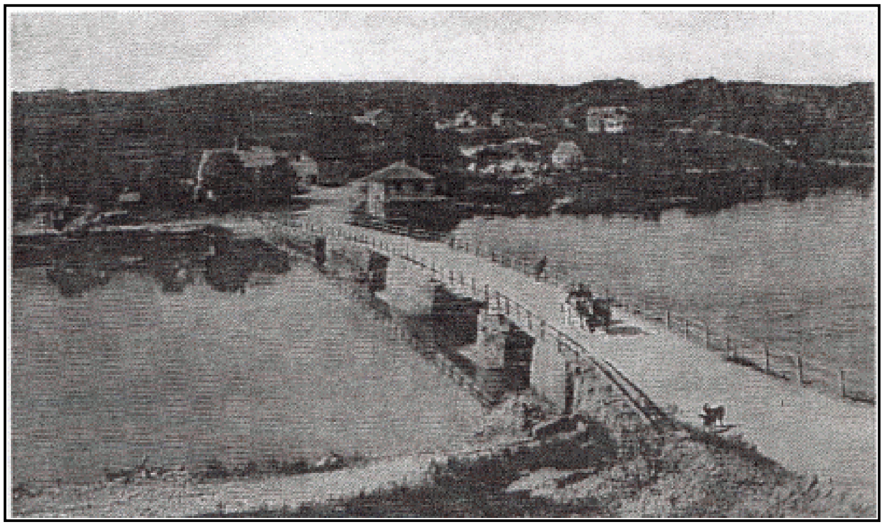

Figure 2. Hix Bridge circa 1901 from old post card.

Background

The present day Hix Bridge was constructed in 1938 in a natural narrows area of the upper East Branch of the Westport River in the Town of Westport, Massachusetts (Figure 1). The existing bridge spans about 280 feet of water. Prior to this date, an earlier bridge with more massive stone columns was constructed as shown in the circa 1901 post card photograph in Figure 2. The proposed new bridge design, which will be somewhat elevated and have fewer, but larger, support columns, is shown in Fig. 3, in comparison to the existing

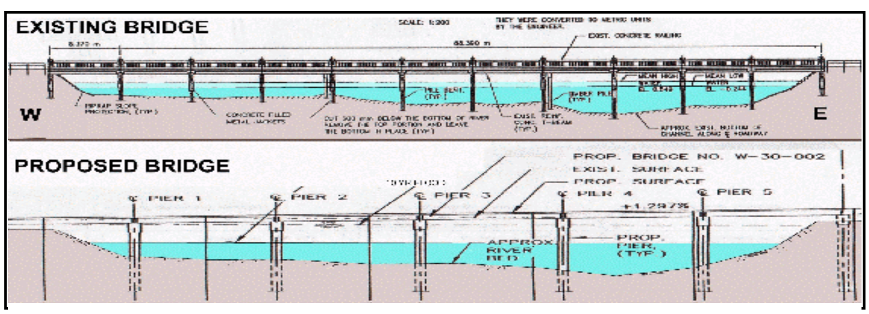

Figure 3. ***Diagram of existing bridge, and proposed bridge design (from MHD permit application). The new bridge will have fewer, but larger, support columns, and its elevation will be increased, especially at the eastern end. The depths in the lower diagram are approximate, and fill removal under the bridge is not proposed, except old column removal.***

design.

Figure 4 shows three aerial photographs of the site, including a photograph from December 1938, before completion of the existing bridge, and after the September Hurricane of 1938 (when the old bridge was damaged, and portions toppled into the river). These photographs show that little upland fill has been placed near the bridge, except at its western end, and that the boundaries of the river have changed little since 1938, except for some accretion on the eastern shore.

The depth of water under the bridge ranges from 3 feet mean low water (MLW) to 8 feet MLW (Fig. 5 and 6). Based on this bathymetric data collected by US EPA Narragansett, it has been suggested that fill was placed under the entire span of the bridge, especially since it is shallow for more than 2/3 of the bridge span. It has been contended that this fill may be restricting tidal flow and exacerbating pollution in the upper East Branch.

Evidence for this fill is also based on the additional underwater survey bathymetric data in Figure 6, which shows that the river depth exceeds 20 feet MLW on either side of the bridge. In contrast to the bathymetric data shown in Figs. 5 and 6, a bathymetric transect (Fig 7), and nautical chart bathymetric data (Fig. 8) north and south of the bridge show a natural channel of a depth of 7 to 9 feet MLW extending far north and south of the bridge. In fact, the deep areas north and south of the bridge (Fig. 7) are probably remnants of the earlier channel since these deep channels often occur in this type of estuary where the land forms a constriction.

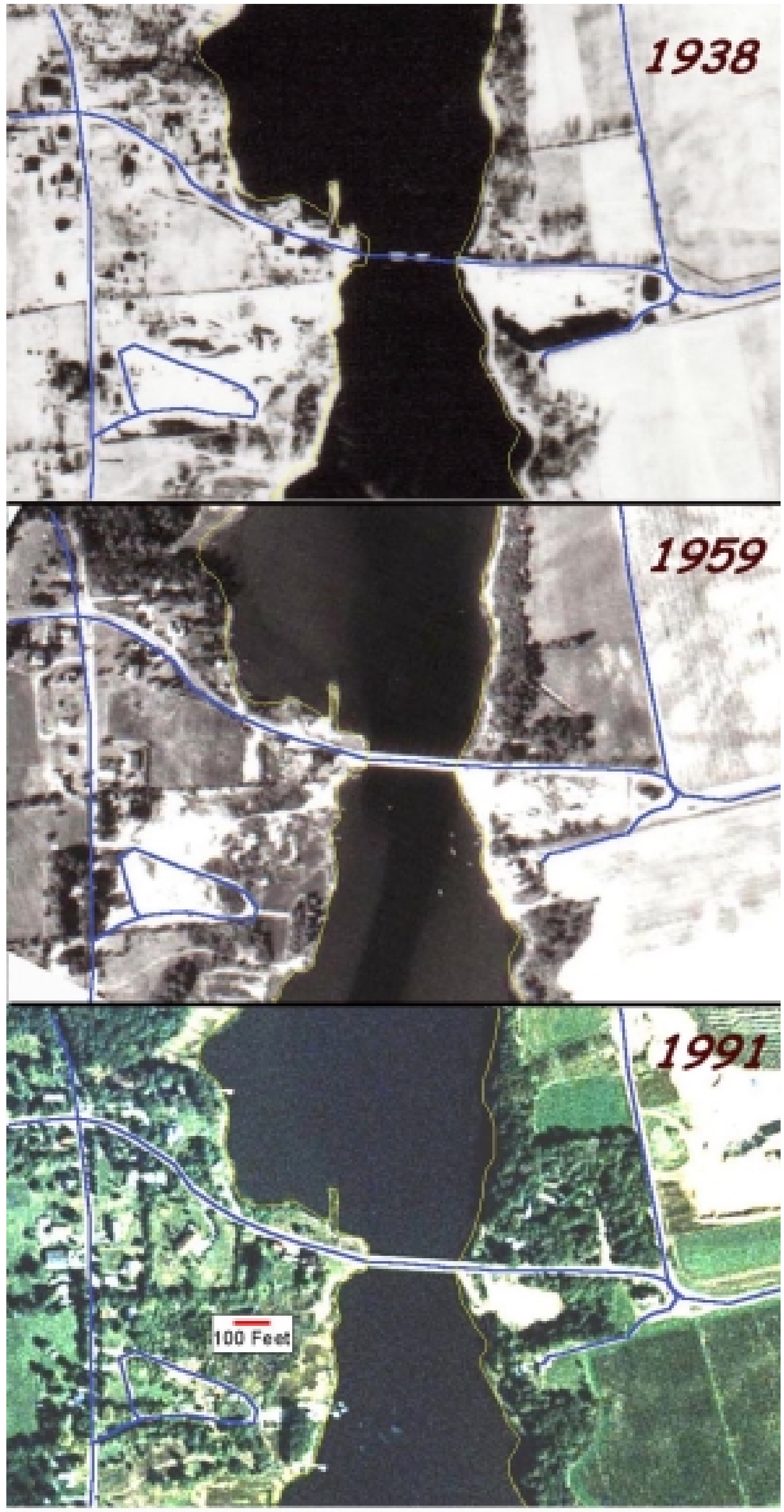

Figure 4. *Three aerial views of the Hix bridge dating from 1938, 1959, and 1991. Overall, river boundaries have been stable, but some filling and accretion may have occurred at the bridges west end, and along the eastern shore. The 1991 coastline is shown in each photograph.*

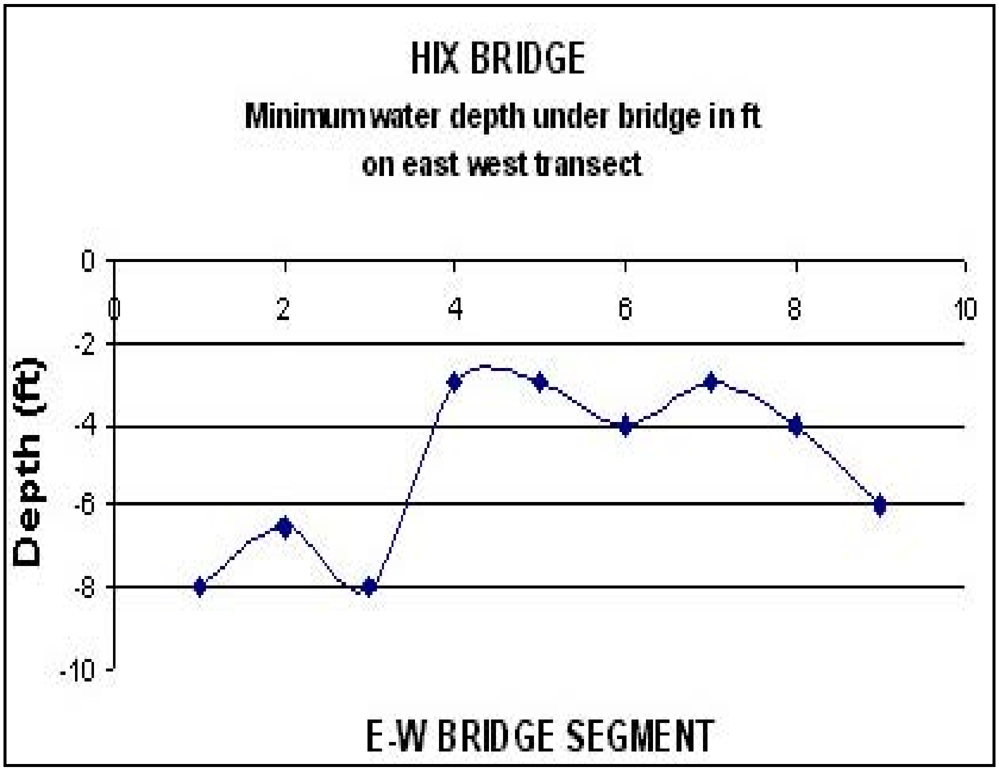

Figure 5. *Depth under the Hix Bridge and to the north. Data courtesy of Ken Perez.*

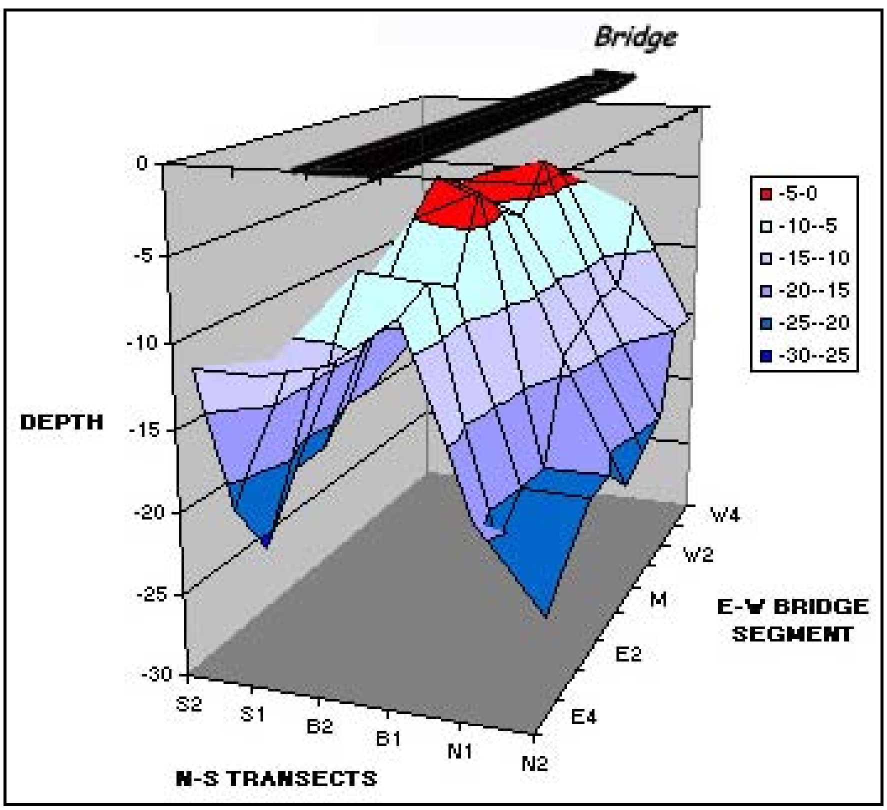

Figure 6. *Bathymetric Profile under the Hix Bridge based on EPA-Narragansett data. The data shows that there are deep areas on either side of the bridge.*

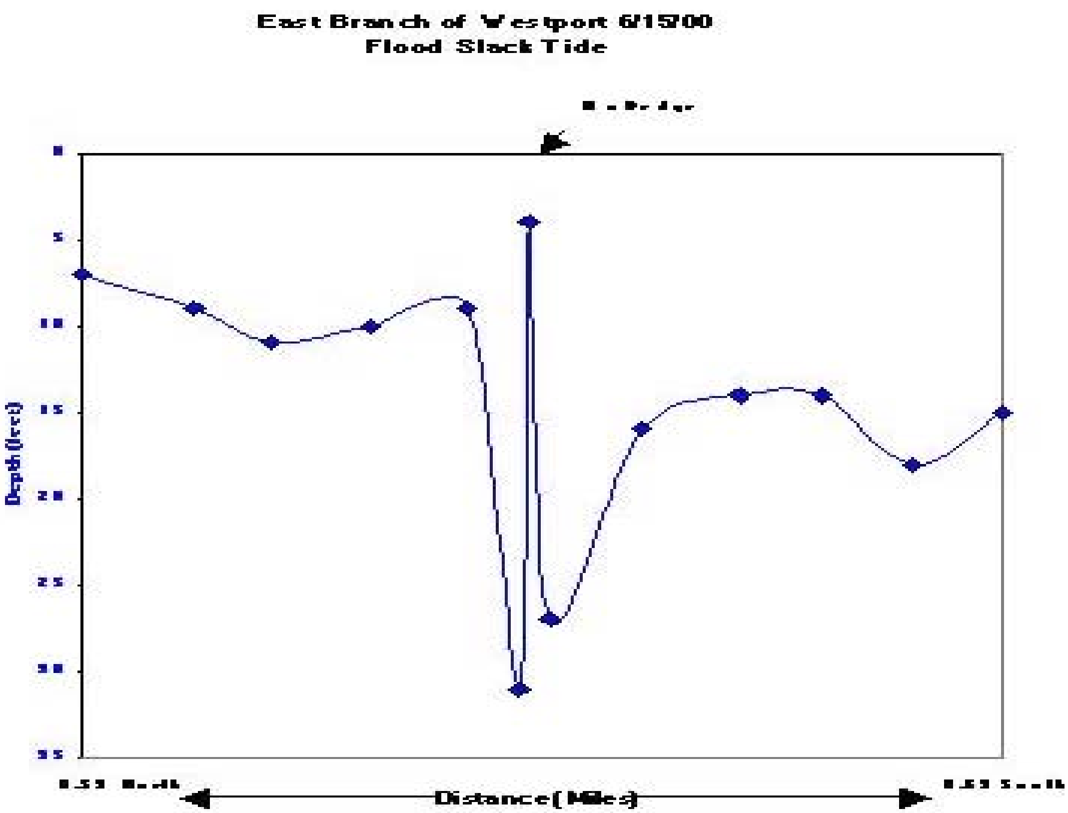

Figure 7. *Mean river depth under the Hix Bridge and about 0.6 miles north and south. (Data courtesy of Ken Perez, US EPA.)*

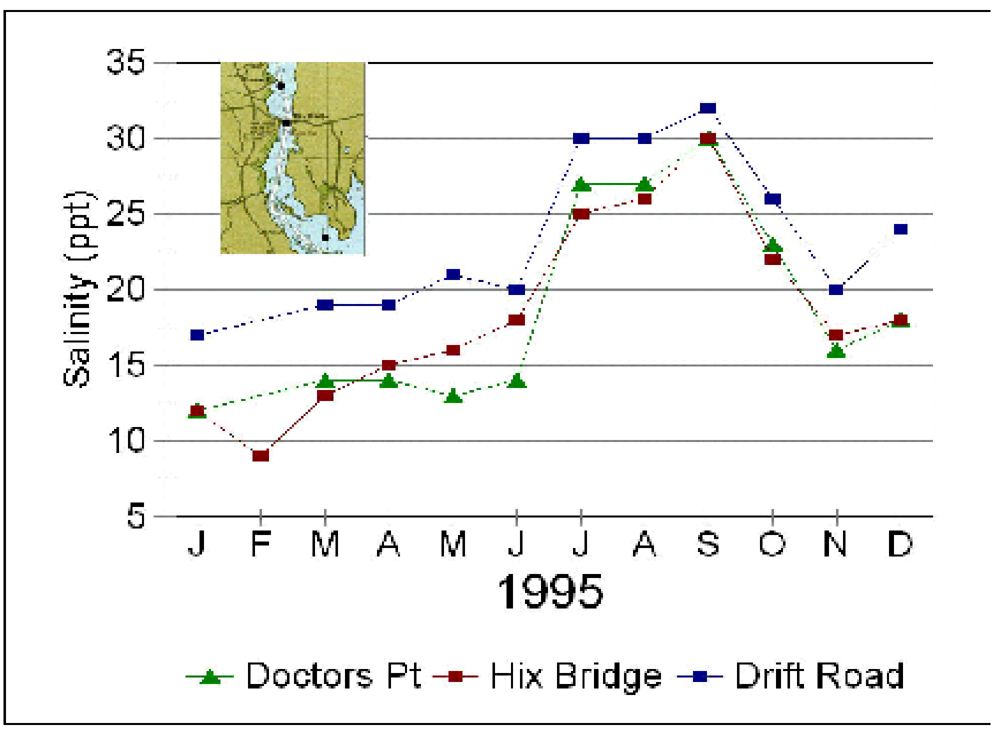

Figure 9. *Mean salinity at the Hix Bridge and stations north and south. Data courtesy of the Westport River Watershed Alliance. See Figure 8. for detail of inset map.*

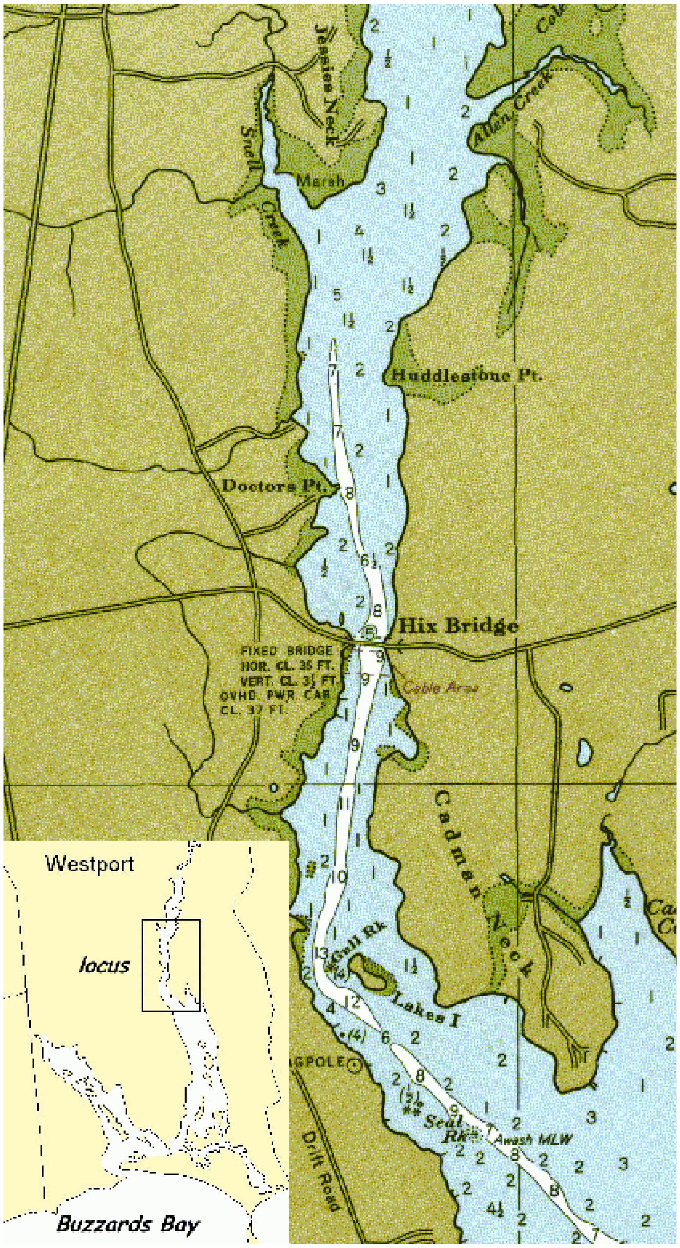

Figure 8. Hix Bridge area bathymetry from NOAA nautical chart. Depths in feet MLW.

It is also possible that the hard fill under the bridge has caused scouring and removal of soft sediments on both sides as a result of strong tidal currents so evident in Figure 7.

The fill present under the bridge includes large cut granite blocks. These are especially evident in the Western two-thirds of the span. These blocks are the remnants of the old bridge columns, which were knocked into the water, mostly on the north side, when the 1939 bridge was built, and from the 1938 hurricane.

Flushing time of the upper East Branch was estimated by Aubrey (1995) to be 56 days. During 1995, there was generally a 1 or 5 ppt salinity gradient over a 1 mile distance north and south of the bridge, with more extreme wintertime conditions (Fig. 9). This suggests that the river does help maintain a restricted flushing regime north of the bridge, since the Cadmans neck station to the south shows a distinctly higher salinity.

Figure 10 suggests that the sill barrier under the bridge alters surface salinity in a dramatic way compared to a comparable natural restriction in the Slocums River just a few miles to the northeast. This abrupt change in surface salinity is seen in ebb and flood tides (Figure 11).

Resources Affected

The Hix Bridge was identified as a tidal restriction in the 1999 draft Atlas of Tidal Restrictions: Buzzards Bay Watershed. In the report it was estimated that 560 acres of tidal wetland occur north of the bridge, and that some of these wetlands may be affected by *Phragmites* invasion as a result of restriction of tidal flow. Because of the potential costs of restoring tidal flow, and the inability to quantify benefits of improved flushing at this site, this restriction only received a Medium priority for restoration.

A field survey conducted by BBP staff on June 15, 2000 found 113 acres of salt marsh and other wetlands were dominated by *Phragmites* (Fig. 12). To ascertain whether *Phragmites* abundance would decline with increased flushing at the Hix Bridge, a hydrological study to predict upstream salinities and ecological impacts would need to be undertaken.

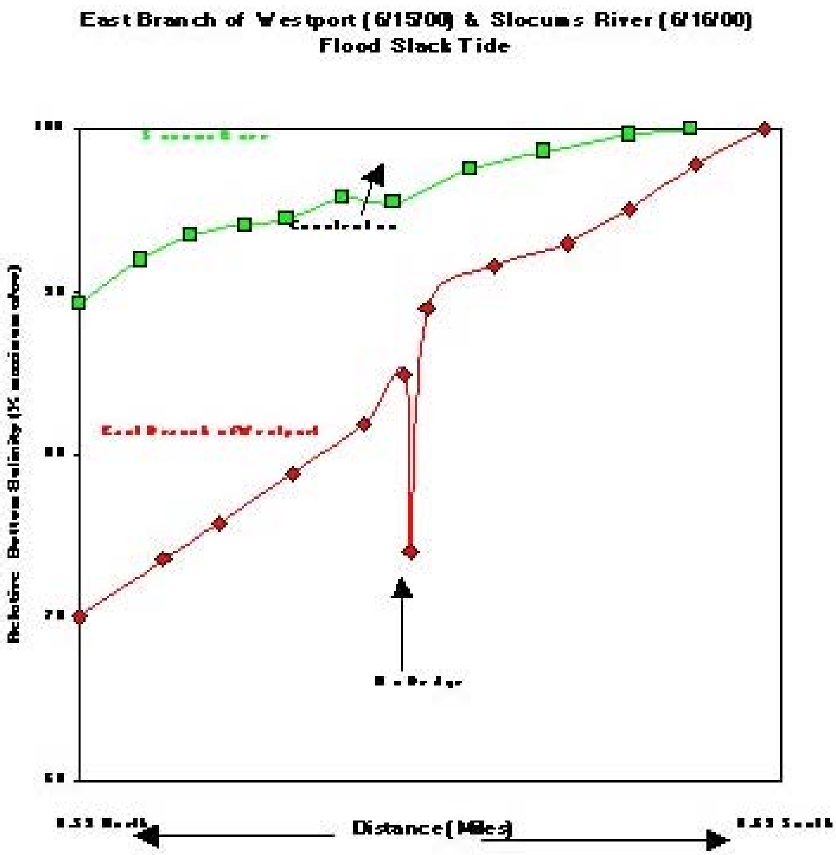

Figure 10. *Salinity transect north and south of the Hix Bridge compared to a similar natural constriction on the Slocums River***.**

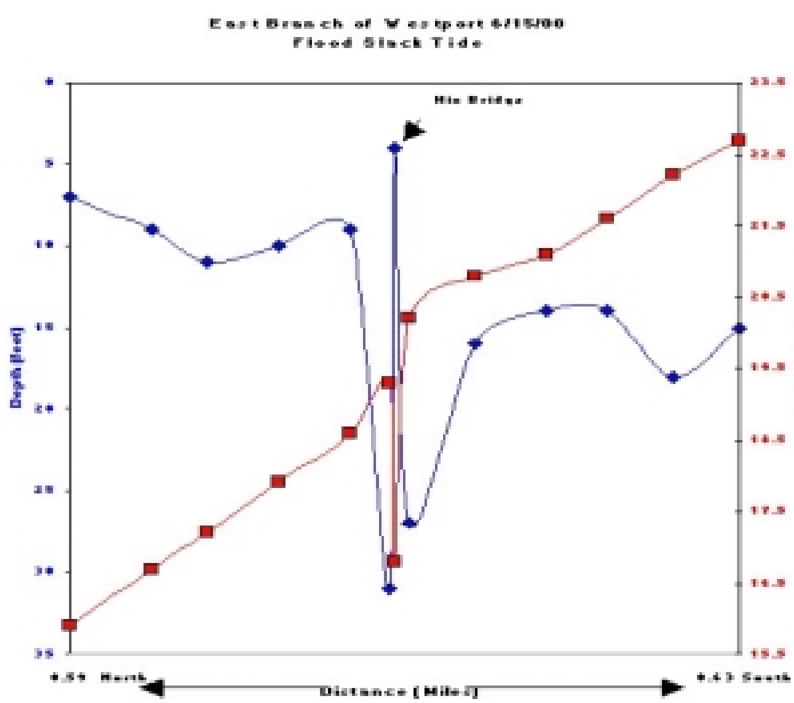

Figure 11. *Comparison of salinity transect north and south of the Hix Bridge during ebb and flood tides***.**

Figure 12. Distribution of Phragmites dominated salt marshes and other wetlands.

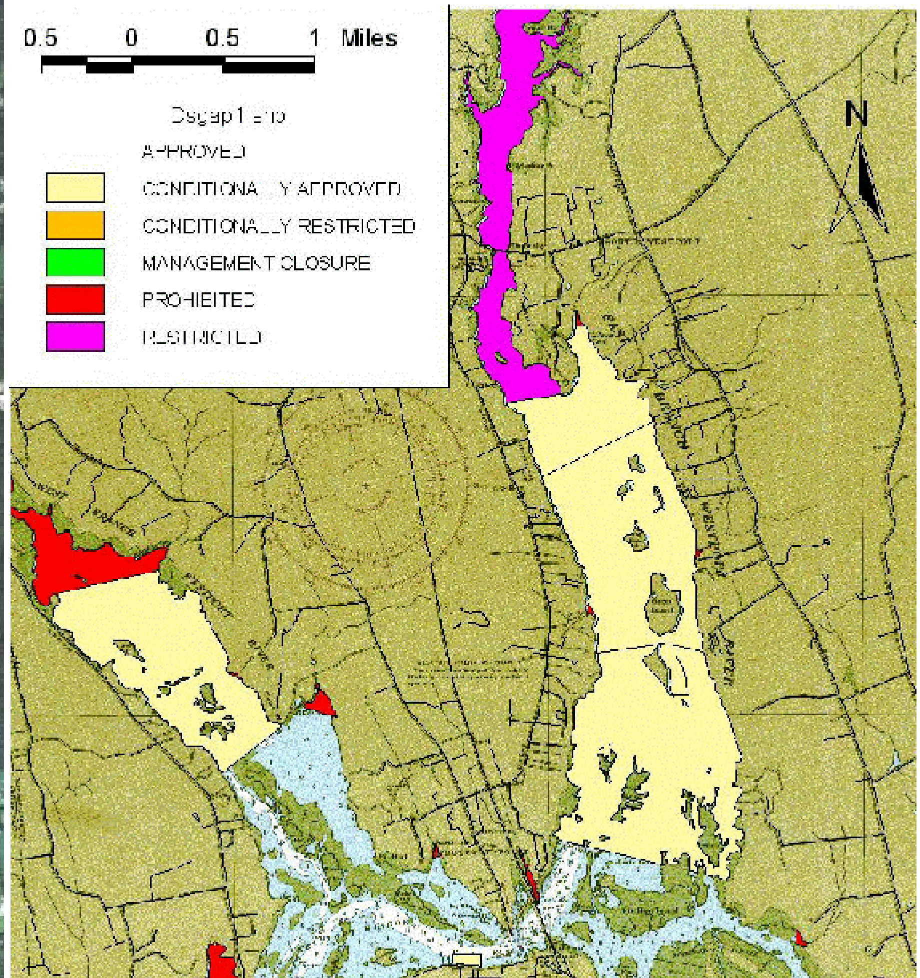

Figure 13. ***Shellfish beds remain closed to Cadman's Neck 0.5 miles south of Hix Bridge. Improved flushing at Hix bridge will not reduce shellfish closures south of the bridge. This map is based on late 1990s closure-lines.***

Eelgrass was not observed as far north as the Hix Bridge in the Costa 1988 study. The 1959 aerial photograph shows patchy eelgrass cover as far north as Drift Road. The 1959 eelgrass cover represents a period when eelgrass was recovering from the Wasting disease of 1931-32. Based on salinities, it is conceivable that eelgrass grew north of the Hix Bridge prior to 1931. This past distribution of eelgrass (prior to 1930) could only be confirmed through the analysis of sediment cores.

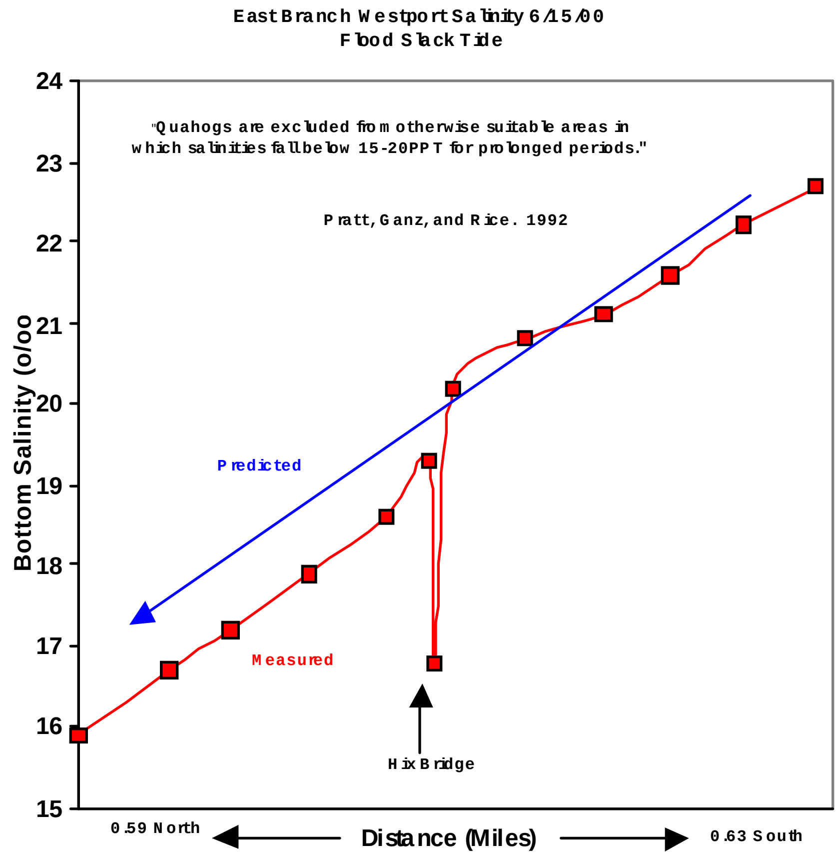

Figure 14. Prediction of salinity change with removal of tidal restriction

Bottom anoxia or hypoxia north of the Hix Bridge has not been reported but may occur in deep areas.

Shellfish areas north of the Hix Bridge have been closed for many years (Fig. 13). This restricted area extends south of Hix Bridge 0.5 miles to Cadmans Neck. Improved flushing of waters north of Hix Bridge, which have documented high levels of fecal coli-forms, will not likely result in reduced shellfish closure areas south of Hix Bridge. Elimination of the restriction, however, will improve water quality north of the bridge, and this may become an important factor some day when pollution sources from dairy farms and failed septic systems are eliminated.

More importantly, the fill under the Hix Bridge appears to have impaired quahog distribution. Presently, no quahogs are found North of the Hix Bridge (Gary Sherman, Westport Shellfish Warden, personal communication). However, old shells of quahogs can be found within the sediments (Ken Perez, pers. Comm.). This suggests that quahogs may have been historically present north of the bridge priori to its construction. Shellfish biologists have noted that quahogs tend to be excluded from otherwise suitable areas in which salinities fall below 15-20 ppt for prolonged periods. Presently salinities north of the bridge are at, or below, this minimum 15 ppt level during large portions of the year (Fig. 9). Because the Bridge seems to be at the ecological boundary for quahogs, small changes in salinity there could affect quahog distribution in that area.

The Westport shellfish officer has noted that large beds of oysters are found north of the bridge. In fact, more than $1 million of oysters are estimated to exist between Cadmans neck south of the bridge and northward. It is possible that the removal of the restriction, sediment erosion, or change of salinity could adversely affect these oyster beds. On the other hand, it is also conceivable that oysters could become reestablished further to the north after removal of the restriction.

In recent years, the area north of Hix Bridge has been occasionally closed to swimming. Formerly this was a popular swimming area for many residents. Improved flushing at the bridge may help reduce the frequency of these swimming closures.

Discussion

The East Branch is a very long estuary which results in a naturally long residence time because of its length. It is not conclusive if increased salinity or improved flushing will restore habitat or improve water quality without a more detailed analysis than provided here. Before expending large amounts of public funds, an evaluation of the expected hydrological and ecological changes need to be evaluated by a qualified hydrologist and biologist. Potential positive or adverse impacts resulting from increases of salinity or tidal range need to be evaluated as follows:

- Will properties, wetlands, oyster and other shellfish habitat be positively or adversely affected by increased salinity and tidal range?
- Will oyster beds immediately north of the bridge be destroyed by erosion? Could they be relocated and reestablished further north?
- Removal of the restriction is expected to increases salinity by about 1 ppt for more than a half mile north of Hix Bridge (Fig. 14). This may result in the expansion of quahog areas north of the bridge and a migration of oysters to the north. Will the salinity increases and tidal range be sufficient to reduce *Phragmites* populations?
- Does the bridge and sill create a sediment "sink" north of the bridge that also acts as a sink for pollutants? In other words, will increased flushing help transfer contaminants (fecal coliforms bound in sediments) to open shellfish areas south of the bridge causing an expansion of shellfish closures to the south?
- How much of the old debris in Figure 15 should be removed, and how much will this work cost?

Summary

The debris under and just north of the Hix Bridge restricts tidal flushing, which in turn lowers salinity north of the Hix Bridge. This lowered salinity may have contributed to the expansion and invasion of the Common Reed *Phragmites* into fringing salt marshes, eliminating valuable salt marsh habitat. Elimination of the tidal restriction will elevate salinities by at least 1 ppt, and possibly more near the surface. This increased salinity could contribute to the stabilization or possibly decline of the invasive *Phragmites* beds, and also may contribute to the expansion of soft shell clam and quahog populations north of the bridge. It is warranted to conduct at this time a more detailed evaluation of the cost and potential benefits or adverse effects from the removal of this fill.

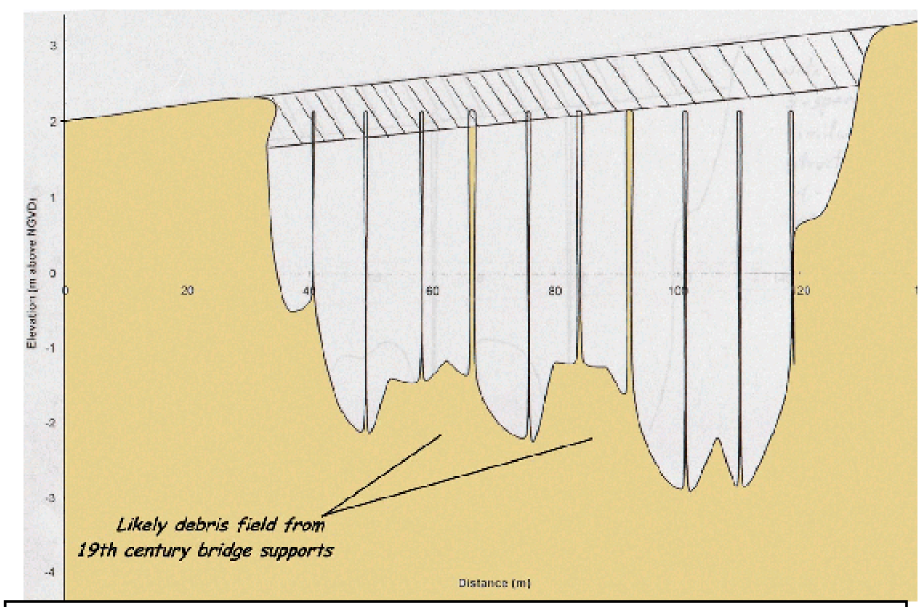

Figure 15. Bottom profile under Hix Bridge from 1997 Hydraulic Report prepared by Lamson Engineering Corporation.