SECTION 5. EVALUATION OF ALTERNATIVES

5.1 INTRODUCTION

This section details the conditions resulting should various alternatives be applied. For a more complete description of the environmental impacts and benefits of restoration see Section 7 of the Environmental Assessment. The analyses address the potential issues of water and sediment quality, habitat improvement, aesthetics, preservation of important resources, and recreation.

Under Alternatives 2 and 3, the dam and walls at Mill Park would be removed and the former area of the Mill Pond would be reshaped to restore floodplain habitat and fringe wetlands and to allow visual and physical access to the water. Alternative 2 restores a stream channel through the park area.

Alternative 3 includes the creation of a series of pools through the park. These step pools would have small rock weir structures composed of boulders with an average drop in grade of 1 foot. These pools would retain sediment and create additional maintenance needs. Alternative 4 involves retaining the dam, partial removal of the walls encompassing Mill Pond, regrading the area, and installing a fish ladder.

5.2 HYDRAULIC AND SEDIMENT TRANSPORT EVALUATION

The purpose of the hydraulic and sediment transport investigations is to evaluate hydraulic and sediment transport implications of the various restoration alternatives for the lower reach of Mill River, with emphasis on Mill Pond Park and Mill Pond. The following section provides a summary of the hydraulic and sediment transport findings. More detailed analysis is documented in the Hydrology and Hydraulics Appendix (Appendix B) of this report.

The study scope includes estimating the hydraulic and sediment transport implications of Alternative 1 (no action); Alternative 2 (removing the Main Street Dam and regrading the affected channel into riffles and pools); Alternative 3 (removing the Main Street Bridge and regrading the affected channel into stepped pools); and Alternative 4 (leaving the dam in place and partially removing the walls within the park). In particular, channel modifications considered under Alternatives 2 and 4 were reviewed for their impact on flood elevations. For the purposes of this study, Alternative 3 was considered to have similar effects on the flood elevations as that of Alternative 2.

Hydraulic analyses were performed using the U.S. Army Corps of Engineers HEC-RAS hydraulic model. Analyses include flow, channel velocity, top width, energy gradients, shear stress, and minimum particle size for incipient motion. Hydraulic conditions in the vicinity of Mill Pond Park were analyzed for the 1, 2, 10, 50, 100, and 500-year floods, as well as average daily flow, representing a non-flood scenario. Shear stress and particle stability analyses were performed for the three alternatives. While the focus of the restoration efforts is in the vicinity of Mill Pond, hydraulic analyses were extended from 550 feet upstream of Long Island Sound to approximately 2.5 river miles upstream from the Main Street Dam since the study area encompasses this entire reach. Including this entire reach in the model insured that hydraulic parameters were available for all restoration measures considered in addition to the basic alternatives.

5.2.1 Background

The Main Street Dam impounds the Mill River to form Mill Pond within Mill Pond Park, and the impoundment extends upstream of the Broad Street bridge. The crest elevation of the dam is approximately 12.5 feet (NGVD 29). The park is approximately 6.4 acres and the pond within the park is about 3.5 acres (140 feet wide by 1100 feet long), with depths ranging from 1 to 5.5 feet. The pond is constrained within concrete walls that are approximately 15 feet high for the full length of the park.

The dam disrupts sediment transport and is causing channel aggradation within the impoundment. As much as 5.5 feet of sediment deposition has occurred. The total estimated volume of sediment behind the dam is 18,600 cubic yards (Appendix J).

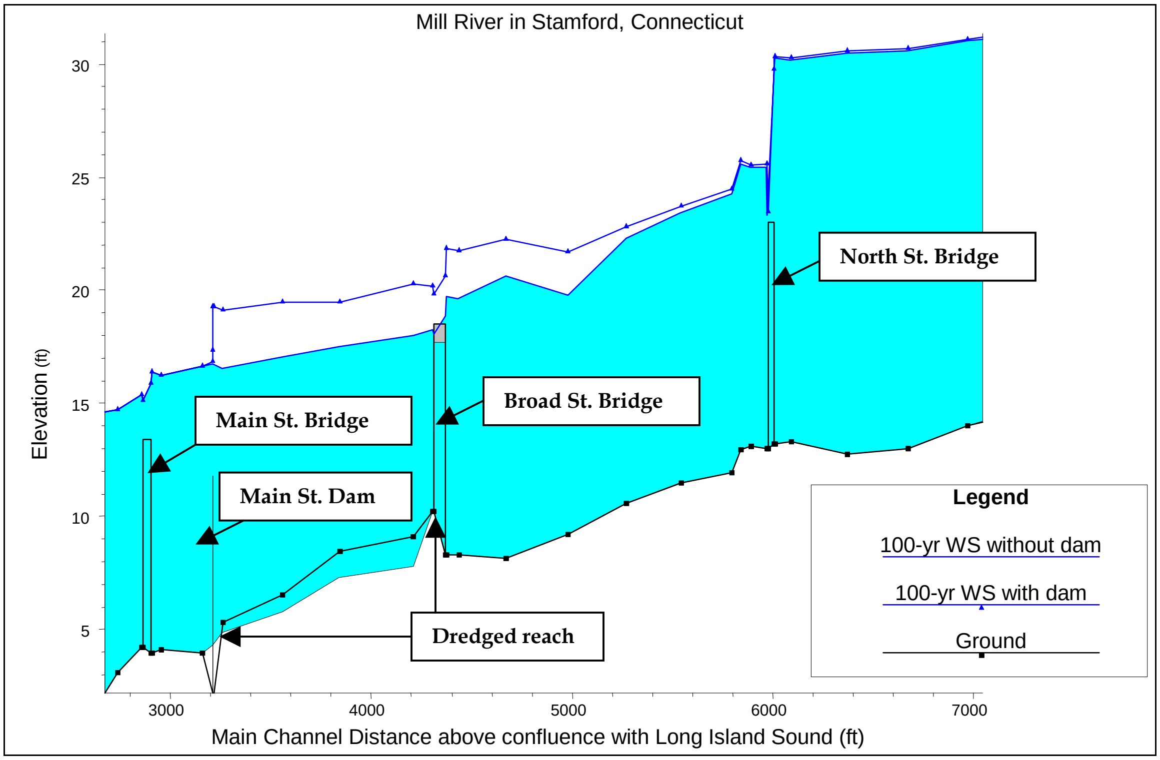
5.2.2 Summary of Findings

HEC-RAS hydraulic model results indicate that established FEMA flood elevations (existing conditions and no action) would be either maintained or reduced for the restoration alternatives that propose modifications (See Figure 13).

For Alternative 2, HEC-RAS model results indicate that established flood elevations would be reduced significantly if Main Street Dam and the walls along Mill Pond Park were removed, and the channel bottom dredged (See Figure 13). For example, at the 100-year recurrence interval, peak water surface elevations would be lowered by between approximately 2.0 and 2.6 feet between the location of the (removed) dam and Broad Street, located approximately 1,000 feet upstream. The reduction in the 100-year flood level would be approximately 1.6 feet at the upstream end of the current impoundment (approximately 330 feet upstream of Broad Street). Water levels associated with normal flows, as indicated by the modeling of average daily flows, would be reduced by several feet, especially in the reach extending from the damsite to Broad Street. In addition, for Alternative 2, the lateral extent of flooding in downtown Stamford would be reduced for the 100-year recurrence interval flood, as shown in Figure 14.

For Alternative 4, HEC-RAS model results indicate that peak water surface elevations associated with all major floods would be reduced by only a small amount upstream of Main Street Dam if the walls along the Mill River Park were removed and the dam remained in place. For example, at the 100-year recurrence interval, peak water surface elevations would be lowered by approximately 0.5 feet between dam and Broad Street, located 1100 feet upstream of the dam. The reduction in the 100-year flood level would be approximately 0.4 feet at the upstream end of the impoundment, with the reduction in water level dwindling to 0.1 feet at a location 1500 feet upstream of the Broad Street Bridge. Water surface elevations of normal flows would be unchanged by removal of the walls.

Figure 13: Water Surface Profiles for the 100-Year Frequency Discharge (Feet, NGVD) for scenarios with and without Main Street Dam.



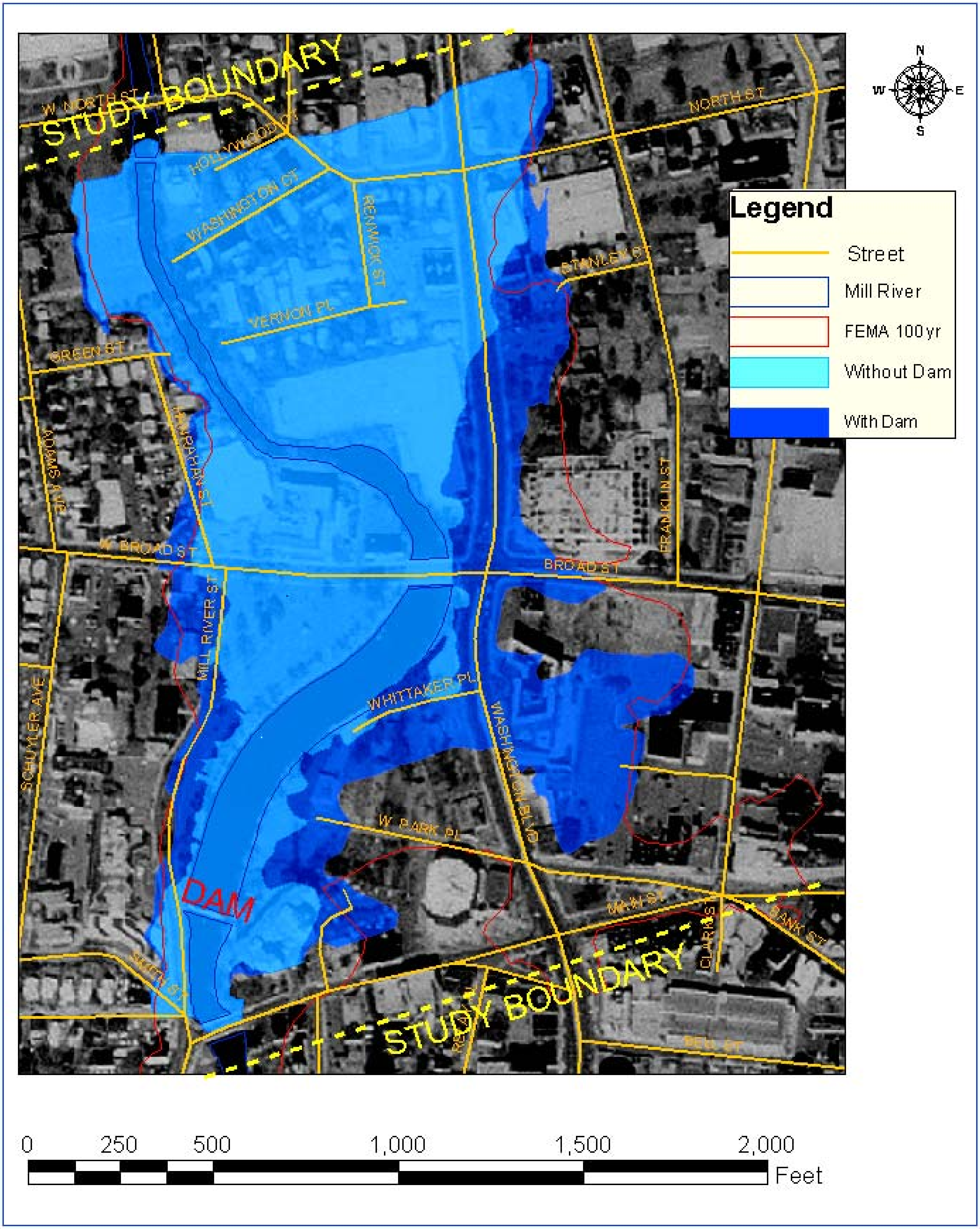


Figure 14. 100-Year Floodplain Boundaries with and without Main Street Dam

An analysis was conducted on effects of tides on the project reach. The analysis concluded that for the dam-removal alternatives, the reach of river currently submerged by Mill Pond would not experience any tidal fluctuations during normal tides, since the restored river channel would range from approximately 5 – 8 feet NGVD (as compared to a mean spring high water elevation of 4.9 feet NGVD, for example).

Sediment transport analyses indicate that siltation would continue to occur in the impoundment if the dam were left in place (Alternatives 1 and 4). Results show that dam removal (Alternatives 2 and 3) would considerably improve sediment transport in the Mill Pond Park reach such that deposition of fine-grained sediments would be stemmed or greatly reduced.

Sediment transport analysis of Alternative 1 (with-dam) indicates that during average daily flows, sands, clays, and silts should pass through upstream reaches of the Rippowam River, but settle in the stilled waters of Mill Pond impoundment, as confirmed by field observations. Sediment transport analysis of Alternative 2 (removing the Main Street Dam) indicates that sediment transport would revert to its natural cycle, with sand, fines, and clay largely passing through the former impoundment reach without settling during normal flows. For Alternative 2, the channel bottom could be expected to resemble that of the reference reaches upstream of Mill Pond, where sediments consist largely of gravel, and the channel is self-maintaining.

Channel water velocities and shear stresses associated with Alternative 4 (removal of walls only) were found (in the HEC-RAS model) to be virtually the same as those of Alternative 1. Therefore, the particle stability analyses indicate that siltation would occur during normal flows within the impoundment for Alternative 4, similar to the condition for Alternative 1.

During storm events (two-year occurrence intervals or larger), the analysis shows that sediments up to gravel size would be transported through Mill Pond with the dam in place. Therefore, the river would transport sediment to Stamford Harbor during storm events whether or not the dam is in place. In Alternative 1, the only amount of sediment not reaching the harbor is the amount the city chooses to dredge from Mill Pond. In Alternatives 2 through 4, the reduction in sediment would be at least 18,600 cubic yards, since these alternatives require full dredging of Mill Pond prior to dam removal.

Alternative 3, with the construction of step pools retained by low-elevation weirs, would probably collect some sediment in the constructed pools during normal flows, due to the reduced flow velocities in the pools. The volume of sediment and rate of sedimentation would depend on the configuration of the constructed pools.

5.3 ENVIRONMENTAL EVALUATION

Environmental effects are summarized below for Alternatives 2, 3, and 4. The environmental effects of the no-action alternative are summarized in Section 3.3, Future Without-Project Conditions. More detailed information on ecosystem effects of the restoration measures and the no-action alternative is contained in Appendix D, Incremental Analysis.

5.3.1 Environmental Evaluation of removing the Main Street Dam (Alternatives 2 and 3)

Currently, the Mill Pond provides highly degraded habitat for aquatic resources and attracts a large population of Canada geese. The primary environmental benefit to removing the Main Street Dam (Alternatives 2 and 3) is the restoration of fish passage and the upstream river channel, in particular the reconnection of anadromous fish species to their spawning grounds in upper reaches. The breaching of the dam would restore the reach's stream flow, tidal influence, and sediment transport. Habitat connectivity would assist the movement of terrestrial species through the riparian corridors. Aquatic species could range between river, estuarine, and marine environments. The confluence of marine and riparian ecosystems is highly productive and valuable for biodiversity. The restoration of riparian habitat and a riffle-and-pool channel morphology will be less attractive to Canada geese and more attractive to a diversity of native birds.
The re-establishment of a more natural river channel north of Main Street would restore sediment transport processes. This would improve water quality by decreasing sedimentation and eutrophication in the currently impounded reach during normal flows. In addition, increased flow velocities would improve benthic habitat through exposure to flowing water and higher levels of dissolved oxygen. Removal of the dam and retaining walls would allow for the restoration of natural banks and emergent vegetation that would assist the uptake of nutrients and the capture of pollutants from overland flow. Terracing would imitate a floodplain and allow riparian plantings to provide habitat, shade, and a buffer for the river corridor.

The pond would be drained, and sediment that is impounded behind the dam would be dredged before dam removal. This would limit the possibility of excessive turbidity downstream during construction. Turbidity during construction would be contained as much as practicable using erosion control measures. The sediment behind the Main Street Dam is not considered hazardous but may not be suitable for residential disposal. An appropriate site for disposal, such as the municipal landfill in Manchester, Connecticut, would be identified before construction. Sedimentation controls and best management practices would be applied during construction. Construction would be timed to coincide with low flow periods.

5.3.2 Environmental Evaluation of Alternative 4

Currently, the Mill Pond provides highly degraded habitat for aquatic resources and attracts a large population of Canada geese. With Alternative 4 (Partial Removal of Concrete Retaining Walls – Dam Remains), the Main Street Dam is retained and the associated retaining walls are partially removed (complete removal of the walls would compromise the structural stability of the dam). The partial wall removal would allow possibilities for reshaping the pond to a slightly more natural, curvilinear form and augmenting the banks with riparian vegetation and fringe wetlands. During construction, there would be a temporary disturbance to waterfowl, however the pond would remain attractive to the large geese population.

The Main Street Dam would require repairs to retrofit a fish ladder and to ensure structural stability. To avoid impacts to FEMA flood elevations, the pond banks would be sloped to provide an equivalent flood conveyance through the park. This limits pond reshaping and preserving adjacent trees. As in Alternatives 2 and 3, the pond would be drained and dredged prior to construction. Likewise, the sediment would be disposed of in an appropriate site, such as the municipal landfill in Manchester, Connecticut. Turbidity would be contained as much as practicable using erosion control measures. After construction, periodic dredging would maintain a deep pool. Otherwise, during normal flow periods, sediment would accumulate in the pond. With a deeper pool configuration, the pond would be inhabited by warm-water fish however, this resource would be periodically disrupted by maintenance dredging.

Dredging would require river access for a heavy vehicle and disruption of bed sediments and benthic habitats on a regular basis. Periodic dredging would reduce the amount of sediment eventually reaching Stamford Harbor by up to the amount of sediment dredged, and could slightly reduce the sedimentation rate in the harbor. However, this method of reducing sedimentation in Stamford Harbor is impractical due to the high levels of environmental impacts of dredging in the river and disruptions to the city on a regular basis as well as the high cost and inefficiencies of removing relatively small amounts of sediment from the pond in an urban setting.

Under Alternative 4, wetland habitat and floodplain vegetation would stabilize banks and restore habitat around the pond and within the park. Sediment would need to be detained before reaching constructed wetlands, as there may be insufficient flow to flush particles downstream, and dredging of wetlands in a park setting would be problematic.

Fish passage would be facilitated through the placement of a fish ladder at the Main Street Dam. Restoration of stream banks and the planting of emergent and riparian vegetation would serve to uptake nutrients and provide temperature moderation, shelter, and forage for many aquatic species. The reshaping of banks to preserve the floodplain would require the loss of upland habitat in the park and the removal or relocation of existing cherry trees along the Mill Pond.

5.4 GEOTECHNICAL EVALUATION

The predominant upper soils identified at the Mill Pond site are sandy loam, sand, and gravels. The main subsoil stratum comprises sand and gravel glacial deposits (see Appendix C). Granular fill material is also expected behind the retaining walls. In general, the material itself should be easy to excavate, grade, shape, haul, and stockpile. However, due to the geological randomness of many soil formations it is likely that some large cobbles, boulders, and rock outcrop formations can be found on this site, mostly at a distance away from the retaining wall fill.

For Alternatives 2 and 3, excavation to remove the Main Street Dam should not present any major geotechnical problems. Likewise, excavation at the pond site for regrading and reshaping the banks should not present any major geotechnical problems. After clearing of brush, excavation of the sands, silty sands, and gravels to the shallow depths required should proceed without difficulty.