Executive Summary

The Royal River Restoration Project (RRRP) is evaluating opportunities for restoration of aquatic resources in the reach of the Royal River in Yarmouth and upstream tributaries, such as Chandler, East Branch, Collins, and Eddy brooks. The RRRP is being undertaken by the Town of Yarmouth in collaboration with project partners Maine Rivers, the National Oceanic and Atmospheric Administration (NOAA), the Royal River Conservation Trust (RRCT), and the Casco Bay Estuary Partnership.

Project studies completed by Stantec and others have evaluated a broad range of existing conditions, resources, and uses along the Royal River in Yarmouth, including fisheries resources, recreational use, and adjacent infrastructure such as bridges over the river and two aging dams owned by the Town of Yarmouth at Bridge Street and East Elm Street, and the harbor in the tidally affected section of the river seaward from the State Route 88 (East Main Street) Bridge.

A primary focus of the RRRP is to improve upstream fish passage at the Bridge Street and East Elm Street dams. Project investigations and studies have identified poor upstream fish passage at the Bridge Street and East Elm Street dams as a primary cause of reduced numbers of migratory fish in the Royal River watershed. While there are fish ladders at both dams, they have been ineffective at providing upstream fish passage. Removal of one or both of the dams would result in conditions that would provide for upstream passage of native fish species, and eliminate financial concerns related to ongoing maintenance costs and the potential liability associated with this aging infrastructure.

This Phase II report and previous project studies evaluate potential benefits and constraints associated with removal of the Bridge Street Dam and/or East Elm Street Dam, which are owned by the Town of Yarmouth.

Following on Phase I studies, the Bridge Street Dam impoundment was drawn down in August 2011. This drawdown event provided an opportunity to observe conditions between the Bridge Street Dam and Middle Falls similar to those that would occur if that dam was removed. Unlike the Bridge Street Dam, however, there is no feasible means to draw down the East Elm Street Dam impoundment and thus no opportunity to observe potential conditions upstream from the East Elm Street Dam if that dam was removed.

Discussions with stakeholders during the development of previous project studies identified a number of specific concerns regarding removal of East Elm Street Dam, including:

a) Impacts to recreational use of the river between East Elm Street Dam and the upstream limit of the impoundment in the vicinity of State Route 9 in North Yarmouth;

b) The potential for increased sediment delivery to Yarmouth Harbor; and

c) Potential presence of environmental contaminants in sediment in the dam impoundment.

Work performed as part of this Phase II study included technical studies to evaluate the three specific concerns identified above and to comply with the project's budget constraints. These studies included:

- Review of existing information regarding sediments in the harbor;
- Topographic and bathymetric surveys to assist in development of a hydraulic model;
- Sediment probing, sampling, and analysis in the East Elm street impoundment;
- Review of hydrology (flows) in the Royal River;
- Hydraulic modeling to determine potential post-removal water surface elevations and flow conditions;
- Development of an order-of-magnitude estimate of the volume of potentially mobile sediment in the Royal River between East Elm Street Dam and the State Route 9 Bridge; and
- A preliminary analysis of potential sediment remobilization issues.

This Phase II report presents the results from desktop and field studies that evaluated potential changes in the reach of the Royal River upstream from East Elm Street Dam that would result if the dam were removed. Findings associated with this work are described below, including brief summaries relevant to the three specific issues identified above.

General Conditions

- Removal of East Elm Street Dam would lower the normal water surface elevation in the impoundment between the dam and the vicinity of the State Route 9 Bridge in North Yarmouth by 5 to 6 feet.
- During flood events, the effects of dam removal would be reduced progressing upstream and would result in lowering of the water surface at the State Route 9 Bridge by less than 1 foot during the 100-year flood.
- The lower water surface elevations following removal of the dam would result in increased flow speeds and a resultant increase in sediment transport capacity in the Royal River in the currently impounded section of the river.

Recreational Use

- Removal of East Elm Street Dam would result in lower water levels in the river between the location of the dam and the vicinity of the State Route 9 Bridge. Project studies suggest that most opportunities for recreational use of the river upstream from the dam, including boating and swimming, will be sustained.

- The existing boat launch behind the Yarmouth Historical Society building upstream from the East Elm Street Bridge may no longer be a suitable location for putting in boats and paddling upstream, however, as it is expected that the river will be too swift and shallow to paddle upstream adjacent to the boat launch. The Town of Yarmouth is investigating a new boat launch in the vicinity of Sligo Road approximately a one-half mile upstream.

- During flood events, it may be unsafe to boat or swim in the section of the river downstream from the St. Lawrence and Atlantic Railroad trestle bridge near the Yarmouth Historical Society building due to swift flows and the likely presence of rapids between the trestle bridge and East Elm Street. These conditions, however, may be attractive to experienced whitewater kayakers.

Sediment Delivery to Yarmouth Harbor

- The order-of-magnitude estimate of the volume of potentially mobile sediment in the Royal River between the East Elm Street Dam and the State Route 9 Bridge is 100,000 cubic yards (CY). In comparison, the estimated total dredge volume in Yarmouth Harbor (anchorage and channel) is 67,000 CY.

- Removal of East Elm Street Dam is expected to result in increased delivery of sediment to the harbor during relatively frequent (e.g., annual) floods, but is not expected to increase sediment delivery during less frequent, high-magnitude floods (i.e., the 100-year return-interval event). The amount of sediment and duration of effects associated with removal of the dam would depend on the number and frequency of flood events following removal of the dam.

- If removal of East Elm Street Dam is pursued, coordination with proposed dredging of the harbor is recommended.

Environmental Contaminants

- Laboratory analyses indicate that concentrations of environmental contaminants in sediment samples collected in the Royal River upstream from East Elm Street Dam are similar to those in the downstream reach of the river.

- From sediment samples that were analyzed, there appears to be minimal potential risk of adverse effects to aquatic life.

5.0 DISCUSSION

Removal of the East Elm Street Dam would result in lowering of normal water surface elevations in the Royal River upstream from the location of the dam. Lower water surface elevations would be most apparent in the approximately quarter-mile long reach of the river immediately upstream from the dam, and would have relatively swift currents under normal and high-flow conditions. Further upstream, the normal water surface would be 5 ft to 6 ft lower to the upstream limit of the dam impoundment, which is upstream from the State Route 9 Bridge.

Effects of dam removal are reduced as flows increase and progressing upstream from East Elm Street Dam towards the State Route 9 Bridge. Based on the hydraulic modeling described in this report, removal of East Elm Street Dam would have little effect on conditions in the Royal River upstream from the State Route 9 Bridge during higher-flow events, and are minimal (less than 1 ft) during the 100-year return-interval event.

Recreational use on the currently impounded reach of the river upstream from East Elm Street Dam would be affected by removal of the dam. The existing boat launch behind the Yarmouth Historical Society building upstream from the East Elm Street Bridge would no longer be a suitable location for putting in boats and paddling upstream, as it is expected that the river will be too swift and shallow to paddle upstream adjacent to the boat launch. Opportunities for recreational boating would remain upstream from this area, however, and the Town of Yarmouth is investigating a new boat launch in the vicinity of Sligo Road approximately a one-half mile upstream as an alternative site for launching small boats.

Observed conditions and gradation analyses indicate that sediments in the Royal River upstream from East Elm Street Dam largely consist of sand-size and smaller material, and that this material is similar in size to material that has accumulated in Yarmouth Harbor. The order-of-magnitude estimate of the potentially mobile sediment in the Royal River between East Elm Street Dam and the State Route 9 Bridge that was developed as part of this study is 100,000 CY.

Observations as part of this study, identified sedimentation in Yarmouth Harbor, and hydraulic model studies performed as part of this study indicate that sediment in the Royal River currently mobilizes during high-flow events. The hydraulic model simulations indicate that removal of the dam would result in increased shear stress at lower-magnitude high-flow events and could result in increased mobilization of sediment in the river upstream from East Elm Street Dam. For example, comparison of calculated shear stresses for existing and dam removal conditions indicates that sediment mobilization that would currently happen during a 5-year return interval event would be similar to that which would occur during a 2-year return interval event following dam removal. Similarly, sediment mobilization that would currently happen during a 10-year return interval event would be similar to that which would occur during a 5-year return interval event following dam removal. Comparison of calculated sediment transport capacity for existing and dam removal conditions for the 100-year return interval event indicates, however, that

removal of the dam has little effect on flow speeds and sediment transport capacity during high-magnitude floods. This finding is consistent with the geomorphic assessment that was performed as part of this study.

In summary, sediment is currently transported through the Royal River between East Elm Street Dam and the State Route 9 Bridge, and likely contributes to sedimentation of Yarmouth Harbor. Removal of East Elm Street Dam could result in increased delivery of sediment to the harbor during relatively frequent runoff events, such as those that occur on an annual basis, but would have less effect on sediment transport – and delivery of sediment to Yarmouth Harbor – during less frequent but higher magnitude floods. The amount of sediment that is remobilized and duration of effects associated with removal of the dam would depend on the number and frequency of flood events following removal of the dam.