

SHANNOCK FISH PASSAGE FEASIBILITY STUDY
PAWCATUCK RIVER
RICHMOND AND CHARLESTOWN, RHODE ISLAND

August 10, 2007

MMI #2989-01



Prepared for:

Wood-Pawcatuck Watershed Association
203 Arcadia Road
Hope Valley, Rhode Island 02832

Prepared by:

MILONE & MACBROOM, INC.
99 Realty Drive
Cheshire, Connecticut 06410
(203) 271-1773
www.miloneandmacbroom.com

TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY

1.0	INTRODUCTION	
1.1	Project Background	1-1
1.2	Work Scope	1-3
1.3	Organization of Document	1-4
2.0	EXISTING CONDITIONS	
2.1	Pawcatuck River Watershed	2-1
2.2	Description of Project Reach	2-3
2.3	Existing Channel Morphology	2-4
2.4	Utilities	2-7
2.5	Natural Resources	2-8
	2.5.1 Fisheries	2-8
	2.5.2 Endangered and Habitat Species	2-11
	2.5.3 Wetlands and Soils	2-11
	2.5.4 Cultural Resources	2-16
2.6	Riverbed Sediment	2-19
	2.6.1 Physical Characterization	2-19
	2.6.2 Chemical Characterization	2-23
	2.6.3 Sediment Transport	2-27
3.0	TARGET FISH SPECIES	3-1
4.0	HYDROLOGY AND HYDRAULIC ANALYSES	
4.1	Introduction	4-1
4.2	Hydrology	4-1
4.3	Hydraulic Analysis	4-5
	4.3.1 HEC-RAS Model Description	4-5
	4.3.2 Existing Conditions Modeling	4-6
	4.3.3 Proposed Conditions Model Runs	4-10
5.0	OVERVIEW OF RESTORATION ALTERNATIVES	
5.1	Overview of Fish Passage Restoration Alternatives	5-1
	5.1.1 Fish Ladders	5-1
	5.1.2 Dam Removal	5-2
	5.1.3 Partial Dam Removal	5-3
	5.1.4 High Gradient Riffles	5-3
	5.1.5 Bypass Channels	5-4
5.2	Summary of Restoration Alternatives Considered	5-5

6.0	LOWER SHANNOCK FALLS DAM	
6.1	Site Description	6-1
6.2	Restoration Alternatives	6-3
6.2.1	S-1 No Action	6-4
6.2.2	S-2 Fish Ladder	6-4
6.2.3	S-3 Full Dam Removal.....	6-7
6.2.4	S-4 Bypass Channel Through Right Raceway	6-13
6.2.5	Summary of Alternatives at Lower Shannock Falls Dam.....	6-14
7.0	UPPER SHANNOCK HORSESHOE FALLS DAM	
7.1	Site Description	7-1
7.2	Restoration Alternatives	7-4
7.2.1	H-1 No Action.....	7-4
7.2.2	H-2 Bypass Channel Through Right Raceway	7-5
7.2.3	H-3 Fish Ladder at Left Abutment.....	7-10
7.2.4	Summary of Alternatives for the Upper Shannock Horseshoe Falls Dam.....	7-13
8.0	KENYON MILL DAM	
8.1	Site Description	8-1
8.2	Restoration Alternatives.....	8-4
8.2.1	K-1 No Action.....	8-5
8.2.2	K-2 Fish Ladder	8-5
8.2.3	K-3 Bypass Channel at Existing Breach on River Left.....	8-9
8.2.4	K-4 Full Dam Removal	8-13
8.2.5	K-5 High Gradient Riffle	8-18
8.2.6	Summary of Alternatives for the Kenyon Mill Dam	8-22
9.0	SELECTION OF RECOMMENDED ALTERNATIVES.....	9-1

REFERENCES

LIST OF TABLES

Table 2-1	Pawcatuck River Data	2-3
Table 2-2	Utility Providers in Project Area	2-7
Table 2-3	Wetlands and Deepwater Habitats Classification Codes and Attributes.....	2-14
Table 2-4	MMI Sediment Observations at Lower Shannock Falls Dam	2-25
Table 2-5	Results of Sediment Chemical Analysis	2-26
Table 3-1	Cruising, Sustained, and Burst Swimming Speeds for Brook Trout and Shad.....	3-2
Table 4-1	FEMA Peak Flow Rates.....	4-3
Table 4-2	Flow Rates Used in the HEC-RAS Hydraulic Model.....	4-5
Table 4-3	Comparison of Model Predicted Water Surface Elevations (WSEL) for the 100-Year Flow Event.....	4-9
Table 5-1	Summary of Alternatives Considered	5-5
Table 6-1	Lower Shannock Falls Dam – Data Summary	6-1
Table 6-2	Comparison of Predicted Water Surface Elevations at Lower Shannock Falls Dam For Alt. S-3 Full Dam Removal	6-10
Table 6-3	Comparison of Predicted Velocities at Lower Shannock Falls Dam For Alt. S-3 Full Dam Removal	6-11
Table 6-4	Summary of Alternatives at the Lower Shannock Falls Dam.....	6-14
Table 7-1	Upper Shannock Horseshoe Falls Dam – Data Summary	7-1
Table 7-2	Summary of Alternatives at the Upper Shannock Horseshoe Falls Dam	7-13
Table 8-1	Kenyon Mill Dam – Data Summary	8-1
Table 8-2	Predicted Water Depths and Velocities for Alt. K-3 Bypass Channel at Kenyon Mill Dam	8-11
Table 8-3	Comparison of Predicted Water Surface Elevations at Kenyon Mill Dam for Alt. K-3 Bypass Channel.....	8-12
Table 8-4	Comparison of Existing and Proposed Water Surface Elevations for Alt. K-4 Kenyon Mill Dam Full Dam Removal	8-15
Table 8-5	Comparison of Existing and Proposed Velocities for Alt. K-4 Kenyon Mill Dam Full Dam Removal	8-16
Table 8-6	Predicted Water Depths for Alt. K-4 Kenyon Mill Dam Full Dam Removal.....	8-17
Table 8-7	Comparison of Existing and Proposed Water Surface Elevations for Alt. K-5 Kenyon Mill Dam High Gradient Riffle.....	8-20
Table 8-8	Comparison of Existing and Proposed Velocity Alt. K-5 Kenyon Mill Dam Rock Riffle	8-20
Table 8-9	Predicted Water Depths – Alt. K-5 Kenyon Mill Dam High Gradient Riffle.....	8-21
Table 8-10	Summary of Alternatives at Kenyon Mill Dam	8-22
Table 9-1	Cost Summary of Individual Alternatives.....	9-1
Table 9-2	Summary of Recommended Alternatives	9-3

LIST OF FIGURES

Figure 1-1	Site Location Map	1-2
Figure 2-1	Pawcatuck River Watershed	2-2
Figure 2-2	Rare Species Habitat	2-12
Figure 2-3	NOAA Sediment Sample Locations Lower Shannock Falls Impoundment	2-21
Figure 2-4	NOAA Sediment Sample Locations Kenyon Mill Impoundment	2-22
Figure 2-5	MMI Sediment Sample Locations	2-24
Figure 6-1	Alt. S-1 Lower Shannock Falls Dam No Action.....	6-5
Figure 6-2	Alt. S-3 Lower Shannock Falls Dam Full Dam Removal.....	6-8
Figure 7-1	Alt. H-1 Upper Shannock Horseshoe Falls Dam No Action	7-6
Figure 7-2	Alt. H-2 Upper Shannock Horseshoe Falls Dam Bypass Channel Through Right Raceway	7-7
Figure 7-3	Alt. H-3 Upper Shannock Horseshoe Falls Dam Fish Ladder at Left Abutment.....	7-11
Figure 8-1	Alt. K-1 Kenyon Mill Dam No Action	8-6
Figure 8-2	Alt. K-2 Kenyon Mill Dam Fish Ladder on Right Bank.....	8-8
Figure 8-3	Alt. K-3 Kenyon Mill Dam Bypass through Existing Breach	8-10
Figure 8-4	Alt. K-4 Kenyon Mill Dam Full Dam Removal	8-14

LIST OF APPENDICES

Appendix A	Utility Correspondence
Appendix B	Hydraulic Sections Sheet
Appendix C	Appended Sheet Set
Appendix D	Engineer's Estimate of Probable Cost Spreadsheets
Appendix E	Sediment Analysis Data
Appendix F	HEC-RAS Model Results
Appendix G	Wetland and River Assessment Report by NOAA
Appendix H	URI Bulk Density Data

EXECUTIVE SUMMARY

The Wood-Pawcatuck Watershed Association in partnership with the Town of Richmond has been awarded funding through the National Oceanic and Atmospheric Administration-American Rivers partnership and the Rhode Island Coastal Resources Management Council to conduct a Feasibility Study to assess anadromous fish passage and riverine habitat restoration at three dam sites on the Pawcatuck River in Richmond and Charlestown, Rhode Island. This document presents the detailed analysis of restoration alternatives. Figure ES-1 is a location plan of the project corridor identifying the three dams.

The Pawcatuck River watershed encompasses a total drainage area of 317 square miles. Approximately 260 square miles lie within Rhode Island; the remaining 57 square miles lie within Connecticut. The basin is approximately 25 miles long and 24 miles wide at its widest point. The upper and middle portions of the basin are characterized by gently rolling hills interspersed with wetlands and ponds. The Pawcatuck River meanders 33 miles through rural areas in Rhode Island before entering a more urban setting in the Westerly-Pawcatuck area. The lower five miles of the Pawcatuck River are tidal. The river flows in to the Narragansett Bay.

Historically, it is believed that the Pawcatuck River was of regional importance to diadromous fisheries, including Atlantic salmon and American shad. The system may have also supported a strong brook trout population. Over the last several centuries, the river has been physically and ecologically altered as a result of human activity. The many dams placed within the river have impacted the anadromous and resident fisheries habitat.

Three early run-of-the-river dams are located on the main stem of the Pawcatuck River, all of which currently block fish passage. From downstream to upstream, they are known as the Lower Shannock Falls Dam, the Upper Shannock Horseshoe Falls Dam, and the Kenyon Mill Dam. The Lower Shannock Falls Dam is located approximately 25 river miles above the estuary. The Upper Shannock Horseshoe Falls Dam is located approximately one-half mile above the Lower Shannock Falls Dam; the Kenyon Mill Dam is located an additional three-quarters of a mile upstream of the Upper Shannock Horseshoe Falls Dam. These three dams are currently the furthest upstream fish blockages to spawning and nursery habitat.

The following goals and objectives have been identified for the restoration of the Pawcatuck River:

- Achieve diadromous and resident fish passage;
- Improve riverine habitat conditions;
- Maintain or enhance aesthetics;
- Address dam safety;
- Minimize long-term dam maintenance;
- Consider and address cultural resources; and
- Identify cost-effective solutions.