# FEASIBILITY ASSESSMENT OF MODIFICATIONS TO THE PLYMCO AND OFF-BILLINGTON STREET DAMS

## TOWN BROOK
## PLYMOUTH, MASSACHUSETTS

July 2007
Revised October 2007

MMI #1982-03

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# EXECUTIVE SUMMARY

## INTRODUCTION

The Town of Plymouth (the Town) has been working to restore anadromous fish passage and cold-water fisheries habitat on Town Brook as part of the Town Brook Herring Run Restoration Project. As part of this project, the Town is currently studying the feasibility of modifications to two dams located at Off-Billington Street and the Plymco property. This document presents the detailed analysis of restoration alternatives. Figure ES-1 presents a USGS location map depicting the site location.

The 269-acre freshwater lake, Billington Sea, forms the headwaters of Town Brook and dominates the hydrology of Town Brook. To reach prime spawning grounds, anadromous fish must traverse the approximately two-mile Town Brook to reach the Billington Sea. Numerous dams have been erected along Town Brook since the colonial period. Following removal of the Billington Street Dam, modifications to the fishladder at the Jenny Grist Mill Dam, lowering of the weir at Water Street, and installation of the proposed Alaskan Steeppass fishladder at Newfield Street, the Off-Billington Street and Plymco Dams become the furthest downstream blockages to fish passage on Town Brook.

The Off-Billington Street and Plymco Dams are both earthen embankment residential access roads with aging spillways. The Off-Billington Street Dam is the furthest downstream of the two dams, located approximately 0.9 miles upstream of Plymouth Harbor. The Plymco Dam is located an additional 0.2 miles upstream of the Off-Billington Street Dam. The project study area begins just downstream of the Off-Billington Street Dam and terminates just upstream of the Billington Street culvert.

Town Brook has been extensively modified by human activity. Town Brook within the project reach varies between artificially created impoundments and artificially constrained channel

sections. The ecological habitat of this reach of Town Brook has been diminished by the presence of the artificially created impoundments. The impoundments have limited life spans. Significant amounts of sediment have accumulated within the impoundments such that emergent marsh vegetation has taken root. This vegetation will cause the impoundments to have greater sediment trapping capacity, accelerating the aggradation process. The impoundments are characterized by elevated temperatures and depleted levels of dissolved oxygen. While these impoundments support limited warm-water fisheries habitat, cold-water fisheries habitat has been destroyed. In addition, upstream migration is limited by the aging and decrepit fishladders present at the Off-Billington Street and Plymco Dams.

The following project goals and objectives have been identified by project stakeholders for evaluation:

→ Improvement of aquatic habitat
→ Habitat diversity
→ Enhanced fish passage
→ Sediment transport (erosion and deposition)
→ Release of contaminants from impoundments
→ Historic value of structures
→ Aesthetics
→ Road safety
→ Public safety (potential dam failure and maintenance needs)
→ Flooding risk
→ Upstream water levels and wetland hydrology alteration

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**Dam Removal Feasibility Study**

LOCATION: **Plymouth, MA**

MMI#: 1982-03
MXD: H:Figure1_location.mxd
SOURCE: MA MAGIC

N

**Plymco Dam and Off Billington Street Dam**

DATE: July 2007
SCALE: 1:12,000

SHEET: **ES-1**

Figure ES-1 – Location Plan

*View of Off-Billington Street Dam Looking Upstream*

*View of Plymco Dam Looking Upstream*

## SEDIMENT MANAGEMENT CONSIDERATIONS

Sediments from the Plymco and Off-Billington Street impoundments were collected and analyzed during three separate events. An initial chemical characterization of the impounded sediments was provided by the USGS. An initial physical analysis was completed by Milone & MacBroom, Inc. (MMI) personnel in October 2006. Based on the results of these two analysis efforts, MMI personnel conducted a secondary sediment collection for chemical analysis in May 2007. The purpose of this secondary analysis was to more accurately ascertain the chemical profile of the impounded sediments to finalize a sediment management scheme. These three sampling events are described in more detail in the following sections.

Sediment depths varied from 0.5 to four feet in the Off-Billington Street impoundment and from two to five feet in the Plymco impoundment. The deposits are generally wedge shaped in profile, with increasing depths in the downstream direction. The estimated volume of sediment is 6,000 cubic yards in the Off-Billington Street impoundment and 8,000 cubic yards in the Plymco impoundment. Sediments have accumulated as a direct result of the location of the dam structures and would not be present in such quantities if the dams were not in place.

Results of the physical analysis indicate that the majority of the Off-Billington Street sediments are composed of silts and clays, with fine to coarse sand and gravel. The material was observed to be fine and silty with high fractions of organics. Sediments from the Plymco impoundment contain silts and clays in the range of 95%. The material was again observed to be fine and silty with high fractions of organics. The loose, silty sediments have a high void ratio and low density. These sediments will be in a highly erosive condition until consolidated and vegetated.

Present day sediment quality in Town Brook reflects agricultural land use and road runoff. A preliminary sediment quality analysis by the U.S. Geologic Survey documented a number of anthropogenic and naturally occurring compounds in the impounded sediments. The results of this initial analysis prompted more detailed sediment sampling and chemical analysis. This secondary round of sediment sampling, performed by MMI in May 2007, indicates similar contaminants to those noted in the USGS samples, with polynuclear aromatic hydrocarbons (PAHs) and arsenic being the most significant contaminants within each impoundment. Results of this secondary chemical analysis indicate that this sediment may be able to be reused or disposed of at a Massachusetts landfill; however, a Landfill Minor Modification permit or a Special Waste Determination will be necessary if the final dredged concentrations are similar to the concentrations in the recently collected samples. In addition, the potential may exist for on-site reuse of the sediments. On-site reuse would require coordination with the Massachusetts Department of Environmental Protection to ensure that the goals of the Massachusetts Contingency Plan (MCP) are met and would only be allowed under special permission.

## RESTORATION ALTERNATIVES CONSIDERED

A total of four alternatives each were considered at the Off-Billington Street Dam, the Plymco Dam, and the culvert. These alternatives are summarized in Table ES-1. From the alternatives presented for the three distinct reaches within the project, three composite alternatives were chosen for future analysis. Conceptual design drawings for select alternatives are appended to this document and show plan view, profile, and typical cross sections.

## TABLE ES-1

## Summary of Alternatives Considered

| Alternative | Description |
|---|---|
| **Off-Billington Street Dam** | |
| OB-A | No Action |
| OB-B | Fish Ladder |
| OB-C | Channel / Adjust Downstream Tailwater |
| OB-D | Partial Dam Removal |
| **Culvert** | |
| C-A | No Action |
| C-B | Daylight in Existing Location |
| C-C | Daylight in Parallel Alternate Location |
| C-D | Partial Daylight |
| **Plymco Dam** | |
| P-A | No Action |
| P-B | Partial Dam Removal at Existing Channel Location |
| P-C | Partial Dam Removal at Alternate Channel Location |
| P-D | Full Dam Removal |

Based on agreement from the project partners, three composite alternatives were chosen. These alternatives are given in Table ES-2.

## Table ES-2

## Summary of Composite Alternatives

| Alternative | Description |
|---|---|
| Alternative 1 | Alternate OB-D: Partial Dam Removal<br>Alternate C-B: Daylight in Existing Location<br>Alternate P-B: Partial Dam Removal at Existing Channel Location |
| Alternative 2 | Alternate OB-D: Partial Dam Removal<br>Alternate C-B: Daylight in Alternate Location<br>Alternate P-B: Partial Dam Removal in Alternate Channel Location |
| Alternative 3 | Alternate OB-D: Raise Downstream Tailwater at Off-Billington Street Dam<br>Alternate C-B: Daylight in Existing Location<br>Alternate P-B: Partial Dam Removal in Existing Channel Location |

All three composite alternatives meet the project goals of providing fish passage for anadromous and resident species. In addition, the design of all three alternatives is such that the upstream water levels are maintained for the protection of upstream agricultural activities.

Alternatives 1 and 2 are believed to meet the project goals of increasing the quality of aquatic habitat and habitat diversity. In addition, these alternatives eliminate the public safety risks associated with the aging spillway structures and eliminate the possibility of potential dam failure, as well as all dam-associated maintenance needs. With the conversion of the impoundments to natural channel sections, flooding risks through the project reach are minimized.

Under Alternative 3, a significant portion of the Off-Billington Street spillway structure would be retained. Raising the downstream tailwater would create a condition in which the downstream section of the Off-Billington Street impoundment would remain in a shallow ponded condition. Cold-water fisheries habitat in this reach would not be improved and, in fact, the shallow nature of the ponded area (on the order of two feet of water depth) would cause overly elevated temperatures, with the associated detrimental habitat conditions of decreased dissolved oxygen concentrations, increased submerged aquatic vegetation, and the propensity toward aggradation. Additionally, the effects of elevated water temperatures in ponded reaches have the potential to adversely impact upstream and downstream reaches for some distances so that the negative effects of shallow ponding would not be limited solely to the reach in which the ponding occurs. Under this alternative, the Off-Billington Street embankment and spillway structure would require significant initial repairs and ongoing maintenance.

For these reasons, Alternatives 1 and 2 are believed to be superior to Alternative 3. Recall that Alternatives 1 and 2 are primarily identical, with Alternative 2 routing the channel around the existing abandoned factory building in the culvert reach and Alternative 1 assuming that this building could be removed and, therefore, routing the channel through the existing factory building. The final selection of an Alternative will depend upon the final ownership and treatment of the parcel of land on which this abandoned factory building stands.

Preliminary engineering opinions of costs were developed for the three composite alternatives. Table ES-3 presents these cost opinions.

**TABLE ES-3**
**Comparison of Preliminary Estimates of Probable Construction Costs**

| Alternative | Cost |
|---|---|
| **Composite Alternative 1**: Partial Dam Breach of Off-Billington Street Dam, Daylight Culvert in Existing Location, Partial Dam Breach of Plymco Dam in Existing Location | $ 1,375,865 |
| **Composite Alternative 2**: Partial Dam Breach of Off-Billington Street Dam, Daylight Culvert in Alternate Location, Partial Dam Breach of Plymco Dam in Alternate Location | $ 1,437,677 |
| **Composite Alternative 3**: Raise Downstream Tailwater at Off-Billington Street Dam, Daylight Culvert in Existing Location, Partial Dam Breach at Plymco Dam | $ 1,019,204 |

Sediment excavation and disposal account for almost half of the total construction costs given in Table ES-3. In addition, bridge cost opinions make up over one-quarter of the cost opinions for Alternatives 1 and 2 and nearly one-quarter of the cost opinion for Alternative 3. The cost opinion was developed for a 32-foot span concrete arch bridge. Less expensive bridge alternatives could be implemented that would still meet project goals, such as a single-span timber bridge. Final selection of a bridge alternative would be accomplished during the design process. A breakdown of costs for removal and bridge replacement at the individual dams is given in the cost opinion worksheets in Appendix D of the report.

Although the abandoned factory building is to be removed under Alternative 1, Alternative 2 is more expensive due to increased volumes of excavation and cost of sediment disposal. Under Alternative 3, the given cost includes expenses associated with necessary repairs to the Off-Billington Street Dam.

## NEXT STEPS

The following "next steps" are recommended:

→ Solicit feedback from the project partners on the alternatives analysis.
→ Confirm ownership and status of Plymco property.
→ Initiate discussions with regulators relative to obtaining input on the alternatives, as well as confirmation of the necessary permits and approvals that will be required to implement the process.
→ Define sediment management requirements through the Massachusetts Department of Environmental Protection and reassess alternatives, as necessary, dependent upon the results.
→ Refine preferred alternatives to a preliminary design level.
→ Secure project implementation funding.
→ Proceed with regulatory permitting, final design, and construction.

# 1.0 INTRODUCTION AND BACKGROUND

## 1.1 Introduction

The Town of Plymouth (the Town) has been working to restore anadromous fish passage and cold-water fisheries habitat on Town Brook as part of the Town Brook Herring Run Restoration Project. As part of this project, the Town is currently studying the feasibility of modifications to two dams located at Off-Billington Street and the Plymco property. The Town has contracted with Milone & MacBroom, Inc. to develop a feasibility study for this project. Milone & MacBroom, Inc. has previously completed a channel restoration and fish passage project at the Billington Street Dam. Fish passage improvements to the Jenny Grist Mill Dam are currently under construction.

The Massachusetts Department of Fish and Game Riverways Program has been coordinating with its sister division, Division of Marine Fisheries, and the Town of Plymouth as well as several federal, state, and local partners to provide funding and technical assistance to the Town.

The primary objective of this study is to examine the feasibility of dam modification or removal for restoration of anadromous fish runs on Town Brook at the Plymco and Off-Billington Street Dams and the improvement and restoration of fisheries and riparian habitat through the project reach. As part of this effort, the feasibility of daylighting the long culvert currently passing under the southeast corner of the former Plymco Factory Building has also been assessed (Refer to Figure 1-1). In addition, water levels at the upstream cranberry bogs need to be maintained to prevent adverse impacts to these agricultural activities.

## 1.2 Background History

Dam construction on Town Brook began soon after colonization by European settlers. As a result, anadromous fish runs on Town Brook diminished drastically by the early 1700s. Today, anadromous fish such as alewife and river herring are caught below the lowest dam on Town Brook and trucked upstream to suitable spawning habitat.

To reach prime spawning grounds, anadromous fish must traverse the approximately two mile Town Brook to reach the 269-acre freshwater Billington Sea. All dams along Town Brook are outfitted with fishladders. Some are now aging, deteriorating structures, with limited functionality. The habitat quality for cold-water fisheries is seriously compromised by the presence of the two impoundments formed by the dams.

Following removal of the Billington Street Dam and modifications to the fishladder at the Jenny Grist Mill Dam, the Off-Billington Street and Plymco Dams become the furthest downstream blockages to fish passage on Town Brook.

In addition to being the furthest downstream blockage to fish passage, these dams and this reach-of-river warrant consideration for other reasons. The dam structures support the main access roads to the residential area south of the river. The two bridges spanning the Off-Billington Street and Plymco Dams are two of the three access points to this neighborhood. The access drive at the Plymco Dam is currently in an unsafe condition due to the structural condition of the Plymco Dam. The structure and roadway at Off-Billington Street is in fair condition.

Between the Plymco Dam and the Off-Billington Street Dam, the channel passes through approximately 150 feet of culvert. This culvert appears to pass underneath the southeast corner of the building. Some fish that would pass the Off-Billington Street Dam would

likely be dissuaded from proceeding further upstream with each obstacle reducing passage efficiency.

Engineering, Landscape Architecture and Environmental Science

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**Dam Removal Feasibility Study**

**LOCATION:** Plymouth, MA

MMI#: 1982-03
MXD: H:Figure1_location.mxd
SOURCE: MA MAGIC

N

**Plymco Dam and Off Billington Street Dam**

DATE: July 2007
SCALE: 1:12,000

SHEET: Figure 1-1

Insert Figure 1-1 Site Location

## 1.3 Scope of Study

The issues addressed as part of the feasibility study include the following:

- Quality of aquatic habitat
- Habitat diversity
- Fish passage
- Sediment transport (erosion and deposition)
- Release of contaminants from impoundments
- Historic value of structures
- Aesthetics
- Road safety
- Public safety (potential dam failure and maintenance needs)
- Flooding risk
- Upstream water levels and wetland hydrology alteration

The following alternative methods of fish passage, providing varying levels of river restoration, were considered as part of this feasibility study:

- No action
- Installation of a bypass channel
- Installation of a fishway
- Modification of the dam with a high-gradient riffle
- Dam breach at the existing location
- Dam breach at an alternate location

In addition, the potential of daylighting of the long culvert was considered as well as stream channel habitat improvements.

The following information was reviewed during the data collection phase of the analysis:

- Information on file with the Commonwealth of Massachusetts Historical Commission;
- Dam inspection reports on file with the Massachusetts Department of Environmental Management (DCR);
- Sediment data collected by the United States Geological Survey (USGS);
- The July 17, 1986 and December 19, 2006 FEMA Flood Insurance Studies (FIS) for the Town;
- Utility information of file with the Town; and
- Abutting property owner information on file with the Town.

The following tasks were performed during field investigations of the site:

- Visual dam inspections were performed at the Off-Billington Street and Plymco Dams;
- The condition of the long culvert was visually observed;
- A survey was conducted of the wetland and vegetation habitats;
- A bathymetric survey was performed; and
- The depth, distribution, physical and chemical condition of impounded sediments were determined.

## 1.4 Report Summary

### 1.4.1 Existing Conditions

The Off-Billington Street Dam structure is in fair condition. The structure consists of an approximately 110-foot long earth embankment with a concrete and stone masonry spillway. The water surface elevation in the impoundment is maintained by weirboards at the spillway. While evidence of piping through the dam structure was observed, and

residents report the formation of sink holes in the road that may be further evidence of piping, repair of the structure is believed to be a viable alternative. The existing fishladder at the Off-Billington Street Dam has very limited functionality and is in poor condition.

The impoundment formed by the Off-Billington Street Dam shows evidence of aggradation and is retaining silty and sandy sediments. This artificially created impoundment will continue to aggrade until the point at which the "pond" will be replaced with a channel naturally formed through the aggraded sediment. The existing, artificially created impoundment has limited quality emergent marsh zones, and supports only warm-water fish species such as large and smallmouth bass, chain pickerel, bluegill, pumpkinseed, and bullhead. These fish species are not found in cold-water riverine environments, which is the natural condition for this reach of Town Brook.

The Plymco Dam structure is in poor condition. The structure consists of an approximately 200-foot long earthen embankment with a concrete box spillway. A 4.4-foot diameter steel plate pipe extends from the downstream face of the spillway. This outlet pipe is perched by an over 5.1-foot drop to the channel bottom below. The Plymco spillway structure shows major leakage through the left abutment, through remnants of the former mill building. The access road over the spillway structure frequently has potholes and sink holes, which may be evidence of severe piping or settlement through the outlet structure. Both a water service and a sewer service line run through the spillway structure. These lines are entirely exposed and are vulnerable to freezing and bursting as well as being damaged during heavy storm events. The existing fishladder is in fair condition with only minor evidence of cracking and seepage. This fishladder likely provides limited fish passage.

The Off-Billington Street and Plymco Dams act as breaks in the river, blocking the passage of fish, sediments, and other components of a healthy river system. Provision of more efficient fish passage at these dams will open the upper reaches of Town Brook to

anadromous fish passage and improve riverine habitat quality for resident species. The water level in both impoundments is controlled by sets of timber weirboards. At each dam, the deposited sediment levels have risen to the bottom of those weirboards.

Testing for physical and chemical parameters was conducted on the sediments of both impoundments. Sediment depths were determined by MMI during field investigations. Initial sediment samples collected by MMI were sent to the Connecticut Testing Laboratories for grain size distribution. The physical parameters were selected to enable a prediction of sediment transport. An initial chemical analysis was conducted by the United States Geological Survey (USGS) as part of a larger study. Based on the results of these two initial sampling efforts, supplemental sediment samples were collected by MMI and sent to Alpha Woods Hole Labs for both physical and chemical analyses. See Chapter 2 for a description of the testing procedures and for discussions of the sediment testing results for the Off-Billington Street and Plymco Dams, respectively.

Utility company information was collected for both dam sites. A municipal sewer line is shown in Appendix F Sheet 01 Existing Conditions Map as passing through the access road. This sewer line is clearly visible running through the Plymco spillway structure. An additional pipe line runs through the sewer and is assumed to be a water line, but was not identified from municipal or other utility mapping. The nature of this pipe will need to be verified as the project develops. Local residents indicate that two four-inch PVC lines run through the Off-Billington Street impoundment. These lines were observed by local residents to run across the top of the impounded sediments. The exact function and location of these lines will need to be verified. Correspondence with utility companies is presented in Appendix A.

### 1.4.2 Report Format

This report provides the information used to generate the recommended alternatives as well as an assessment of the impact of the recommended alternatives. The following list summarizes the content of each chapter of this report.

- Chapter 1 provides introductory and background information related to the project;
- Chapter 2 of this report describes the different theories and methods used in the feasibility study as well as some of the background information collected that pertains to both dams;
- Chapter 3 presents the existing conditions at Off-Billington Street Dam;
- Chapter 4 is a summary of the alternatives considered at the Off-Billington Street Dam;
- Chapters 5 and 6 present the existing conditions and summary of considered alternatives at the culvert;
- Chapters 7 and 8 present the existing conditions and summary of considered alternatives at the Plymco Dam;
- Chapter 9 gives the analysis of the three chosen composite alternatives;
- Chapter 10 provides the Engineer's Estimate of Probable Cost; and
- Chapter 11 summarizes the likely permitting requirements.

## 2.0 METHODS AND BACKGROUND INFORMATION

This chapter describes the theory and methods used in the analysis presented in this report and is intended for use as background material and general documentation. Aside from sediment information, the actual data collected and results of analysis are presented in Chapters 3 through 9.

## 2.1 Hydrology

Milone & MacBroom, Inc. has collected and analyzed hydrologic data in conjunction with previous efforts at the Billington Street Dam and Jenney Grist Mill Dam. No new hydrologic modeling was completed for this feasibility analysis.

Hydrologic analyses are used to determine river flow rates, or discharge. River flow rates are used to predict water levels and velocities during fish migratory periods, to determine the potential for sediment migration, and to determine the hydraulic capacity of dams.

### 2.1.1 Watershed Description

Figure 2-1 depicts the Town Brook watershed as delineated by the Massachusetts Division of Conservation and Recreation (DCR). According to the DEP delineation, the watershed is approximately 6.0 square miles in size. Additional hydrologic and hydraulic data on Town Brook is available in the Flood Insurance Study for Plymouth, prepared by the Federal Emergency Management Agency (FEMA). The watershed size reported in this study is 3.9 square miles. The discrepancies in watershed size may be due to the complicated nature of the upper watershed. As shown in Figure 2-1, there are a number of topographic sinks and ponds in the northwestern and southeastern portions of the watershed that do not have surface drainage to Town Brook under normal flow conditions. These portions of the watershed delineated by DEM were probably not included in the hydrologic model created for the FEMA study.

Insert Figure 2-1 Town Brook Watershed

Engineering, Landscape Architecture and Environmental Science

MILONE & MACBROOM

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www.miloneandmacbroom.com


**Town Brook**
**Dam Removal Feasibility Study**

LOCATION: **Plymouth, MA**

MMI#: 1982-03
MXD: H:Figure1_location.mxd
SOURCE: MassGIS from www.mass.gov

N

**Plymco Dam and Off Billington Street Dam**
**Plymouth Quadrangle**

DATE: July 2007
SCALE: 1:2500'

SHEET: **Figure 2-1**

The Town Brook watershed is underlain by the Plymouth-Carver aquifer, the second largest aquifer in Massachusetts with an aerial extent of 140 square miles. The aquifer consists of glacial outwash and recessional moraines pitted with several hundred kettle ponds. The Billington Sea is one such pond.

The 269-acre freshwater lake Billington Sea (the Sea) forms the headwaters of Town Brook (see Figure 2-1) and is a part of both the watershed defined by DEM and the hydrologic study prepared by FEMA. This large body of water dominates the hydrology of Town Brook. The storage provided by the Sea, combined with the high infiltration rates of the dominant soils in the watershed, limits the peak flow rates of extreme events in the watershed and has the effect of moderating flows in Town Brook. During flood events, water is stored in the Sea and ground water aquifers, attenuating downstream flows. During the drier times of year, the Sea and the aquifers sustain base flows to Town Brook.

### 2.1.2 FEMA Flood Insurance Studies

The hydraulic model used by FEMA as part of the flood insurance study provides peak flood flow rates for events with average return frequencies of 10, 50, 100, and 500 years. The peak flow rates used by FEMA in the river reach including the Plymco Dam and Off-Billington Street Dam are listed in Table 2-1.

**TABLE 2-1**

**FEMA Peak Flow Rates**

| Frequency (years) | Peak Flow (cfs) |
|---|---|
| 10 | 116 |
| 50 | 138 |
| 100 | 155 |
| 500 | 192 |

The project is located on Sheets 02P and 03P in the FEMA FIS. The Off-Billington Street Dam is located at cross section L, and the Plymco Dam at cross section P in the FEMA flood profiles. The FEMA FIS indicates that the bridge over the Off-Billington Street spillway is just barely able to contain the 100-year flood. The Plymco spillway structure and the long culvert, as they existed in 1986, did not have the capacity to pass either the 50- or 100-year frequency floods.

### 2.1.3 Flow Conditions Selected for Analysis

The FEMA study does not provide information on nonflood flow rates. Prediction of these flow rates is necessary to determine whether the designed channel is passable by fish under normal migration flows. The flow rates encountered during upstream fish migration are those that occur during spring flow conditions. It is important that velocities and water depths are passable for fish under these conditions. These flows are approximated as the mean monthly April and mean monthly May flows.

Habitat quality is affected by water depths during low flow conditions. It is important that sufficient depths of flow are maintained during dryer times of the year such that fish populations are maintained. This flow is taken as the mean monthly August flow.

Conditions during annual floods are analyzed to determine the size and shape of the proposed channel. A river channel constructed as part of a restoration project is typically designed to flood its banks every one to two years. MMI has previously determined the annual flood (a one-year probable return frequency) from the flood flows published by FEMA by generating a regression equation according to the natural log of the flow rates versus the natural log of the return frequency. The annual flood event is approximately 80 cubic feet per second.

Conditions during flood flows are analyzed to determine sediment stability and the potential for upstream flooding. The statistical 10-, 50-, and 100-year flood flows have been computed and published by FEMA as described in the previous section titled "FEMA Flood Insurance Studies."

The flow rates that are used in the analyses presented in this report are shown in Table 2-2.

**TABLE 2-2**

**Flow Rates Used in HEC-RAS Hydraulic Model**

| Flow Event | Peak Flow (cfs) |
|---|---|
| Summer | 14.6 |
| Spring | 22 |
| Mean Annual Flood | 80 |
| 10-year | 116 |
| 25-year | 126 |
| 50-year | 138 |
| 100-year | 155 |

A stable, healthy stream or river reach is not designed for a single flow event, rather, a range of flow events are analyzed to determine the most appropriate sizing and flow regime. Issues such as frequency of floodplain inundation, flooding of adjacent infrastructure, sediment stability, and potential ecological conditions are also analyzed. Therefore, various "normal" flow and "flood" flow discharges are used as inputs in the design process.

## 2.2 Hydraulics

A hydraulic computer model has been prepared for Town Brook from its mouth at Plymouth Harbor to approximately 185 feet upstream of Billington Street. The model was used to forecast flow depths, velocities, and water profiles under existing conditions

and was used as the base model for proposed alternatives. The proposed conditions model output was used to assess the following: sediment stability at the dams, resulting channel morphology, water depths in relation to fish passage, impact to upstream water levels, and ecological impacts given the predicted changes in water surface elevations.

This section provides technical documentation of the HEC-RAS hydraulic model and, as such, specific technical terms are used. Effort has been made to clearly present model concepts. The reader is directed to the standard HEC-RAS reference manual, accessible at http://www.hec.usace.army.mil/software/hec-ras/documents/hydref/index.html for further clarification.

### 2.2.1 Model Description

The hydraulic analysis is based on the one-dimensional Hydraulic Engineering Center (HEC) River Analysis System (RAS) designed and maintained by the U.S. Army Corps of Engineers. The model is used to compute water surface profiles for one-dimensional, steady-state, gradually varied flow. This system can accommodate a full network of channels, a dendritic system, or a single river reach. HEC-RAS is capable of modeling water surface profiles under subcritical, supercritical, and mixed flow conditions.

The basic computation procedure is based on the solution of the one-dimensional energy equation. Energy losses are evaluated by friction (Manning's Equation) and contraction/expansion (coefficient multiplied by the change in velocity head). The momentum equation is utilized in situations where the water surface profiles are rapidly varied. These situations include mixed flow regime calculations, hydraulics of dams and bridges, and evaluation of water surface profiles at river junctions.

### 2.2.2 Model Input

The HEC-RAS model of Town Brook was initially developed by MMI from the July 17, 1986 FEMA Flood Insurance Study HEC-2 model, in conjunction with previous work done at the Billington Street Dam. The FEMA duplicate model extended from Plymouth Harbor to just upstream of the Off-Billington Street Dam. An electronic copy of the HEC-2 data was not available, so paper copies of the input data were obtained from the Town of Plymouth and retyped in a text editor.

The newly assembled HEC-2 model for Town Brook was then converted into HEC-RAS format in order to analyze the flooding situation at the dams. Additional cross sections surveyed by MMI were added for the project reach. A graphical depiction of cross sections included in the existing conditions hydraulic model is included in Appendix E Sheet 01.

A mixed flow analysis (that can calculate both subcritical and supercritical water surface conditions) was utilized. The velocity distribution was computed at each cross section. The downstream boundary conditions were obtained from the FEMA HEC-2 model. The upstream boundary condition used the normal water surface elevation method. The low-flow, spring, bankfull, 10-, 25-, 50-, and 100-year flow events described in Section 2.1.3 Flow Conditions Selected for Analysis were modeled. Water surface profiles and velocities were then calculated and compared to the existing FEMA models.

In order to assess the impact of the proposed dam modifications, the existing conditions HEC-RAS model was modified to reflect the anticipated changes to the channel and dam structures. MMI has carefully inspected the river with regard to its upstream and downstream morphology and has plotted the original riverbed profile through both impoundments (see Appendix F Sheet 02). Based on an analysis of anticipated flows and river morphology, proposed conditions channel morphology and geometry were

calculated. Using this morphology and geometry, MMI developed anticipated cross sections and elevations for use in the proposed conditions model. The previously described HEC-RAS model was revised with this geometry to determine water surface profiles and velocities under proposed conditions.

### 2.2.3 Analysis

The HEC-RAS model was used to evaluate three different combined alternatives for modification at the two dams.

The water surface elevations calculated by the model under different alternatives were compared with the calculated existing water surface elevations to determine the potential impact on upstream water levels. The velocities and water depths calculated by the model under the proposed alternatives were compared with the requirements of the target fish species. In order to conduct a sediment stability analysis, the HEC-RAS computed shear values were compared to allowable maximum shear values for the relevant substrates.

## 2.3 Town Brook Morphology

### 2.3.1 Existing Morphology

Town Brook has been extensively modified by human activity. The history of human interaction with the brook goes back thousands of years. Due to such modification, a suitable "reference reach" from which a typical premodification set of characteristics could be found is not present. Town Brook within the project reach varies between artificially created impoundments and artificially constrained channel sections.

Upstream of the Plymco impoundment, the short reach between the Billington Street culvert and Route 3 is typically 15 to 20 feet wide with a loose silty sand bed. It is a low

gradient channel subject to backwater from the Plymco Dam and pond. The earth banks are heavily overgrown with shrubs and small trees, limiting visibility and easy access.

The Plymco Street impoundment is comprised of emergent marsh wetland and open water. The impoundment is in a state of transition from open water to an emergent wetland system. The herbaceous plants and shrubs in the impoundment trap the inflowing sediment load, causing aggradation. Aggrading sediment surfaces cause lower water depths, which aid in the transition to a vegetated system.

The Plymco impoundment is approximately 190 feet wide at the access road. The impoundment grows progressively narrower upstream and is only 20 feet wide at Billington Street. The impoundment is approximately 530 feet long with an average impoundment slope of 0.013 feet per foot.

Like the Plymco impoundment, the Off-Billington Street impoundment is also actively transitioning from open marsh to an emergent wetland system. The impoundment is approximately 170 feet wide at its widest point and approximately 530 feet long. The average slope through the impoundment is 0.0088 feet per foot.

The channel downstream of the Off-Billington Street Dam is fairly uniform with a width of 12 to 16 feet, lined with low fieldstone walls 1.5 to two feet high. It has a gravel and cobble bed creating turbulent flow conditions. The measured bed slope is 0.009 feet per foot. The bankfull capacity for this channel was computed to be 80 cfs.

Channel classification systems are used to identify and describe river characteristics with a common system. In recent years, several geomorphic classification systems have evolved with various applications. Town Brook has been identified with the classification system developed by Rosgen (1996). This system is based upon visual inspection and field or map measurements rather than geologic processes or numerical models.

Town Brook has been subject to extensive disturbance. As such, it does not fit neatly into a stream classification. However, its entrenchment, slope, width to depth ratio, sinuosity and substrate can be used to approximate a class as noted below:

| | |
|---|---|
| Entrenchment | Moderate |
| Width/depth | 15 |
| Sinuosity | <1.2 |
| Slope | 0.016 to 0.020 |
| Substrate | Silt to cobbles |

The Rosgen classification system is a nationally accepted basis of channel description, from which gross channel characteristics can quickly be identified by reviewers and regulators. Based upon the above data, the nearest Rosgen class would be a B3 channel. In the context of this feasibility analysis, in which geomorphic engineering is utilized over the reference reach concept, the Rosgen classification of this channel serves only as a descriptive guide.

### 2.3.2 Proposed Channel

A preliminary determination of channel geometry is used as the initial input during hydraulic modeling. Channel geometry is then appropriately modified to achieve the desired velocities, channel depths, and shear stresses. This allows for creation of a stable channel for the proposed alternatives.

Preliminary computations have been completed to determine the appropriate channel geometry and planform for the existing channel conditions. Small stream channels with sand, gravel, and cobble beds with channel slopes less than 0.02 ft/ft tend to have a meandering planform, with alternating pools and riffles. Pools tend to be located around meander bends, while riffles form on the straight sections between.

Channel geometry was determined using the Stable Channel Design functions Copeland routine within HEC-RAS. The Copeland method uses an analytical approach to solve stable channel design variables of depth, width, and slope.

The 20- to 25-foot channel width was derived through an iterative process. A number of methods were used to derive initial channel width and depth estimates. These include a Lacey derived method and Simon's and Albertson's formula. The uniform flow editor in HEC-RAS was used as a gross initial check of the initially derived channel dimensions. The Copeland subroutine within RAS was utilized to compute the potentially stable width-depth-slope relationships. The Meyer-Peter Muller formulation was then used to calculate equilibrium slope based on estimated water depths and assumed channel substrate sizes. The computed slope was compared to the existing topography for calculation of estimated sinuosity and subsequent meander wavelength. Computed meander wavelength was compared to calculations of meander wavelength based on application of formulas derived from geometric data relating the form of repeating meanders in channels. All of this information was used as the initial input in to the RAS model. Minor modifications were made to localized slope and channel dimensions to achieve the desired riffle and pool depths to maximize fisheries and aquatic habitat.

Table 2-3 presents general characteristics of the proposed channel.
Preliminary computations indicate a channel between 20 to 25 feet wide at bankfull capacity (80 cfs). Water depths in the channel pools are estimated to be approximately two feet deep during low-flow events and three to four feet deep during bankfull events; flow is necessarily slower over riffles. The channel planform is riffle-pool, with average slopes between 0.9 and 0.014 ft/ft and a meander sinuosity of 1.2. To ensure that the channel is a swift, cool water stream, it is important to maintain sufficient width to depth ratios (W/D). The calculated width to depth ratios indicate a narrower, deeper channel.

**TABLE 2-3**

**Proposed Channel Characteristics**

| Channel Characteristic | Value |
|---|---|
| Planform | Riffle-pool |
| Bankfull width | 20-25 feet |
| Bankfull depth (in pools) | 2 feet (low flow), 3-4 feet (high flow) |
| Average slope | 0.009 – 0.014 ft/ft |
| Meander sinuosity | 1.2 |
| W/D | 5-12.5 |

## 2.4 Sediment Testing

Pollutants and sediments naturally transported by rivers can collect behind dams. Dam removal or modification can release the accumulated sediments and pollutants, allowing them to move downstream. As a result, sediment analysis and testing can be an important component of a dam removal or modification project.

### 2.4.1 Known and Potential Sources of Contamination

There are no known major pollutant sources to the impoundments. There are no known combined sewer overflows in the project area. According to mapping provided by the Plymouth Department of Public Works, there is one stormwater catch basin on Billington Street upstream of the Plymco Dam impoundment. The location of the stormwater drainage lines and the outfall for this catch basin are not specified. In addition, a minor incidental drainage swale was observed during field investigations, flowing from Billington Street directly into the Plymco impoundment, approximately 10 feet upstream of the Plymco Dam.

The greatest potential contaminants in the impoundments are likely those associated with agricultural land use and road runoff.

### 2.4.2 Sediment Sampling

Sediments from the Plymco and Off-Billington Street impoundments were collected and analyzed during three separate events. An initial chemical characterization of the impounded sediments was provided by the USGS. An initial physical analysis was completed by MMI personnel in October 2006. Based on the results of these two analysis efforts, MMI personnel conducted a secondary sediment collection for chemical analysis in May 2007. The purpose of this secondary analysis was to more accurately ascertain the chemical profile of the impounded sediments, with the purpose of finalization of a sediment management scheme. These three sampling events are described in more detail in the following paragraphs.

Sediment samples were collected and chemically analyzed by the USGS in conjunction with a larger study to determine the sources of sediment contamination in lakes and ponds across Massachusetts (Personal Communication, Rob Breault, 2006). Samples were collected with the aim of generating a list of chemicals present within each impoundment. As such, all sediment cores taken from a given impoundment were combined and homogenized. This method of sampling does not allow for the determination of "hot spots" and vertical or horizontal stratification. The assumption has been made for this feasibility analysis that, where found, contamination is uniformly distributed throughout the impoundment.

In addition, sediment depths were determined during field investigations conducted on October 21, 2006 by MMI. Sediment samples were collected for physical analysis and sent to Connecticut Testing Laboratories, Inc. of Meriden, Connecticut. Figure 2-2 graphically depicts sediment sample locations. Grain size distribution was determined by

both sieve and hydrometer analysis; percent volatile solids was determined for samples UPD-1, UPD-2, LPD-3, and LPD-5.

Sediment samples collected by the USGS were analyzed for a number of elemental and organic compounds. Please note that data is based on provisional, unpublished data provided by the USGS and is subject to change. The full results of the USGS analysis are included in Appendix C and discussed in Section 2.4.6 Chemical Analysis.

MMI personnel collected additional sediment samples in the Off-Billington Street and Plymco impoundments on May 9 and 10, 2007. Six sediment samples were collected from the Off-Billington Street impoundment and eight samples from the Plymco impoundment. The number of samples collected was determined to meet the requirements of the MCP, which stipulates that one sample per 1,000 cubic yards of sediment material be collected.

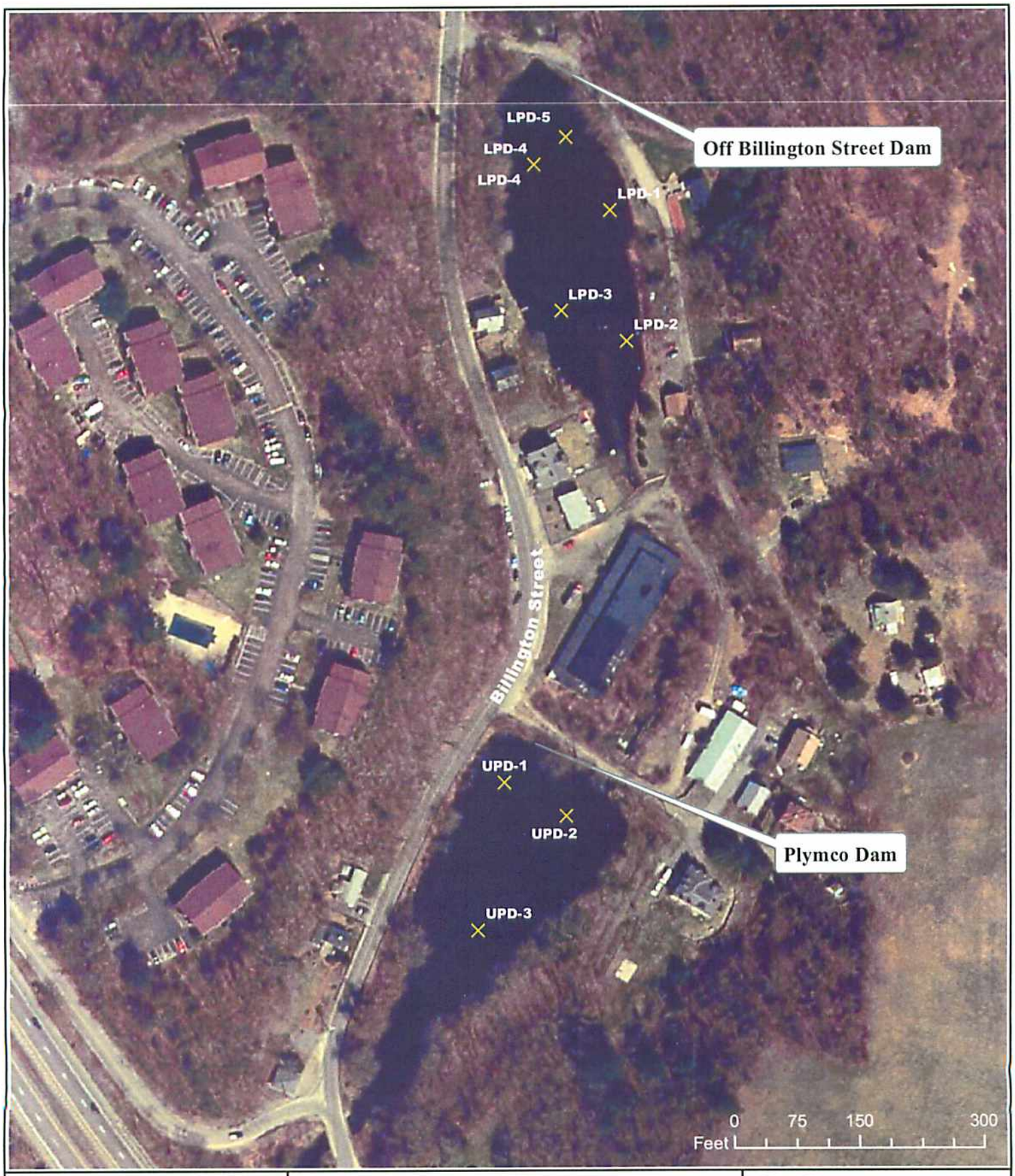
All samples were collected from a flat-bottomed boat to minimize sediment disturbance. Samples were collected using clear Lexon tubing sleeves driven by hand into the sediment until refusal was noted. Each sleeve was inspected upon removal for indications of vertical stratification. The samples were then split, placed in a stainless steel bowl, mixed and a composite sample removed for analysis of 13 Priority Pollutant Metals plus vanadium and barium, polychlorinated biphenyls (PCBs), volatile organic carbon (VOC), polynuclear aromatic hydrocarbons (PAHs), Massachusetts Department of Environmental Protection Extractable Hydrocarbons (EPH), pesticides and Total Organic Carbon.

The samples were packed on ice and prepared for delivery to Alpha Woods Hole Labs (Alpha), a Massachusetts certified laboratory, under proper chain-of-custody procedures. The full results of the Alpha analysis are included in Appendix C and discussed in Section 2.4.6 Chemical Analysis. A comparison of the sediment chemical results to ecological standards and thresholds is outside the scope of this project.

### 2.4.3 Core Locations and Description

MMI collected three grab samples from the Off-Billington Street impoundment and five grab samples from the Plymco impoundment for subsequent analysis during the initial sampling event in October 2006. These samples were used to determine the physical parameters of the impounded sediments for use in the sediment transport and sediment stability analysis. Table 2-4 summarizes the sediment samples collected by MMI during this effort.

Insert Figure 2-2 October 2006 Sediment Sample Locations

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**October 2006**
**MMI Sediment Sample Locations**

LOCATION: **Plymouth, MA**

MMI#: 1982-03
MXD: H:sed_sample_locations.mxd
SOURCE: 2005 Aerials from MassGIS

N

**Plymco Dam and Off Billington Street Dam**

DATE: July 2007
SCALE: 1" = 150'

SHEET: **Figure 2-2**

**TABLE 2-4**

**October 2006 Sediment Sample Summary**

| Sample ID | Type of Analysis | General Sample Location | Sediment Depth (feet) | Type of Material |
|---|---|---|---|---|
| PLYMCO IMPOUNDMENT | | | | |
| UPD-1 | Physical | Open Water | 4.0 | Organic silt and clay (muck) |
| UPD-2 | Physical | Emergent Marsh | 4.0 | Organic silt and clay |
| UPD-3 | Physical | Open Water | 3.0 | Organic silt and clay |
| OFF-BILLINGTON STREET IMPOUNDMENT | | | | |
| LPD-1 | Physical | Emergent Marsh | 3.0 | 0-24": Histic Epipedon<br>24-36": Silty loam and clay |
| LPD-2 | Physical | Middle of Delta | 3.0 | Medium to coarse sand |
| LPD-3 | Physical | Downstream End of Delta | 2.0 | Sand over muck |
| LPD-4 | Physical | Open Water | 3.0 | Muck over cobble bottom |
| LPD-5 | Physical | Open Water | 3.5 | Muck over cobble bottom |

### 2.4.4 Physical Analysis

Sediment depths were determined during field investigations conducted on October 21, 2006 by Milone & MacBroom, Inc. Sediment samples were collected and sent to Connecticut Testing Laboratories, Inc. of Meriden, Connecticut. Results of the lab analysis are presented in Appendix D and discussed below. Refer to Figure 2-3 for a graphical depiction of sediment sample locations. Grain size distribution was determined by both sieve and hydrometer analysis; percent volatile solids was determined for

samples UPD-1, UPD-2, LPD-3 and LPD-5. A physical assessment of channel substrate within the project reach was visually conducted.

The physical characteristics of the Town Brook sediments vary by location. Downstream of the Off-Billington Street Dam, the channel bed is composed of gravel and cobble. Within the Off-Billington Street impoundment, deposited sediments are composed of silts and clays with high organic fractions. At the upstream end of the impoundment, deposition at the exit of the culvert has created a delta of loose sand over bottomset deposits of loose silt. At the outlet of the long culvert, substrate is composed of firm sand with traces of gravel.

The channel between the Plymco Dam and the long culvert, running alongside the former Plymco factory building, has a gravel and cobble bed. Upstream of the Plymco Dam, within the Plymco impoundment, bottomset deposits consist of silts and clays with high organic fractions. At the upstream end of the impoundment, deposition at the outlet of the culvert under Billington Street has created a loose sand over silt delta. Gravel and riprap are present at the outlet of the culvert under Billington Street at the furthest upstream end of this impoundment.

Visual observation of sediments within both the Plymco and Off-Billington Street impoundments revealed that they consist primarily of unconsolidated fine silts and clays, with high fractions of organic material. Grain size distribution was confirmed by lab analysis, in which the sediments were found to be primarily composed of coarse silt to medium clay, with small fractions of very fine gravel and very coarse sands. Percent volatile solids, indicative of organic fractions, were in the range of 20% for all samples tested.

Results of the testing indicate that the Off-Billington Street sediments contain almost 20% on average coarse sand to gravel, 17% on average fine sands, and almost 60% on average silts and clays. The material was observed to be fine, silty material with high

fractions of organics. As expected, the delta area has higher percentages of fine and coarse sands than the remainder of the impoundment. Results of the physical analysis for the Plymco impoundment indicate that greater than 95% of the sediment material collected is finer than 0.075 mm in diameter (silt and clay range). The material was observed to be fine and silty with high fractions of organics. Results of the percent volatile solids analysis are presented in Table 2-5.

**TABLE 2-5**

**Percent Volatile Solids**

| Sample ID | Volatile Solids (%) |
|---|---|
| UPD-1 | 25.4 |
| UPD-2 | 23.4 |
| LPD-3 | 20.8 |
| LPD-5 | 19.4 |

### 2.4.5 Sediment Distribution

The surficial sediments in the project reach of Town Brook vary by location. Accumulated bottomset deposits are present in both dam impoundments. The deposits are generally wedge shaped in profile, increasing in depth in the downstream direction. This is contrary to classic sediment patterns reported in the literature but is constant with many other small dams and impoundments studied by MMI. Refer to Appendix E Sheet 03 for a graphical depiction of the measured sediment profile through the project reach.

Appendix Sheets 04 and 05 graphically depict the predam impoundment bottom estimated from depth-to-refusal probes. No clear evidence of a predam channel is evident from the surveyed impoundment bathymetry. The predam channel refers to a specific and localized path that could be determined to be the water flow path before the

dam was put in place. Cross sections of the impoundment show a very flat pond bottom. Sediment depths varied from two to five feet in the Plymco impoundment and from 0.5 to four feet in the Off-Billington Street impoundment. Classic delta topset deposits are present downstream of the Billington Street culvert as well as downstream of the long culvert passing underneath the abandoned factory building. Table 2-6 presents the estimated volumes of sediment in each impoundment.

**TABLE 2-6**

**Estimated Volume of Sediments in the Off-Billington and Plymco Impoundments**

| Impoundment | Total Estimated Sediment Volume ($yd^3$) (MMI)[1] |
|---|---|
| Off-Billington Street | 6,000 |
| Plymco | 8,000 |

[1] Based on survey and sediment thickness assessment on October 21, 2006 by MMI.

The loose, silty sediments have a high void ratio and low density. They are highly erosive and will remain so until consolidated and vegetated. The minimum volume of sediment likely to be prone to erosion is equal to the expected volume of a new channel through the existing impoundments. For this reason, recommended sediment management consists of excavation of the proposed channel through the existing impoundments, with appropriate disposal as determined by the chemical composition. Exposed bank sediments would remain and be stabilized as necessary.

### 2.4.6 Chemical Analysis

Sediment samples were collected and chemically analyzed by the USGS in conjunction with a larger study to determine the sources of sediment contamination in lakes and ponds across Massachusetts (Personal Communication, Rob Breault, 2006). Samples were collected with the aim of generating a list of chemicals present within each

impoundment. As such, all sediment cores taken from a given impoundment were combined and homogenized. The USGS data indicates that both the Off-Billington and Plymco impounds contain sediment that has been impacted by various metals, PAHs and to a lesser degree, VOCs and pesticides. The sampling methods employed by the USGS were meant simply to identify if certain chemicals were present in the impoundments and were not meant to provide a characterization of the quality of the sediment in relation to state and federal standards for reuse and disposal. For this reason, a supplemental chemical characterization of sediments was coordinated by MMI.

Samples were collected in May 2007 by MMI personnel and sent for laboratory chemical analysis. Figure 2-3 depicts approximate sediment sample locations from the May 2007 sampling event. Samples collected by MMI during this May event were analyzed for 13 Priority Pollutant Metals plus vanadium and barium, polychlorinated biphenyls (PCBs), volatile organic carbon (VOC), polynuclear aromatic hydrocarbons (PAHs), Massachusetts Department of Environmental Protection Extractable Hydrocarbons (EPH), pesticides and Total Organic Carbon by Alpha Laboratories.

Individual sediment cores were vertically homogeneous, with no visual indicators of change in physical properties such as grain size or organic matter content. No visual and olfactory indicators of contaminants were observed. Therefore, individual cores were not vertically stratified for analysis. No vertical pattern of contamination was visually evident.

The results obtained indicate similar types of contaminants within each impoundment as noted from the USGS samples, with PAHs and arsenic being the most significant contaminants in each impoundment. The following sections describe the applicable standards regarding dredged sediments, exposed sediments, and water quality certification, the spatial distribution of contaminants within each impoundment, and the subsequent implications for reuse or disposal of any excavated sediments.

Insert Figure 2-3 May 2007 Sediment Sample Locations

Engineering, Landscape Architecture and Environmental Science
MILONE & MACBROOM®
99 Realty Drive
Cheshire, Connecticut 06410
(203) 271-1773 Fax: (203) 272-9733
www.miloneandmacbroom.com

**Sediment Sampling Locations**

LOCATION: **Plymouth, MA**

MMI#: 1982-03-7
MXD: H:ProposedSampLoc.mxd
SOURCE: MassGIS

N

**MMI May 2007 Sampling Event**

DATE: March 2007
SCALE: 1":200'

SHEET: **Figure 2-3**

*Dredged Sediments*

According to the Massachusetts Department of Environmental Protection (MA DEP) waste policy (COMM-94-007: Sampling, Analysis, Handling and Tracking Requirements for Dredged Sediment Reused or Disposed at Massachusetts Permitted Landfills), the reuse of sediments containing constituent concentrations less than those listed in Table 2-7 at a solid waste landfill in the state is permitted without further necessary approval from the MA DEP. Additional MA DEP approvals are necessary if the sediment contaminant concentrations exceed the values in Table 2-7 or if the sediment is to be disposed and not reused.

**TABLE 2-7**

**Maximum Allowable Contaminant Levels for Sediment Reuse at Lined Landfills**

| **Contaminant** | **Reuse Levels (mg/kg)[1] Lined Landfills** |
|---|---|
| Total Arsenic | 40 |
| Total Cadmium | 80 |
| Total Chromium | 1,000 |
| Total Lead | 2,000 |
| Total Mercury | 10 |
| Total Petroleum Hydrocarbons | 5,000 |
| Total PCBs[2] | < 2 |
| Total PAHs[3] | 100 |
| Total VOCs[4] | 10 |
| Conductivity (umhos/cm) | 10 |
| Listed or Characteristic Hazardous Waste (TCLP)[6] | NONE |

Source: http://www.mass.gov/dep/recycle/laws/dredge.htm

1 Contaminant concentrations are in mg/kg, dry weight.

2 Total concentrations of polychlorinated biphenyls listed in EPA Method 8080.

3 Total concentrations of polynuclear aromatic hydrocarbons listed in EPA Method 8100.

4 Total concentrations of volatile organic compounds listed in EPA Method 8240 or equivalent.

5 TCLP testing should be performed for metals or organic compounds when the total concentrations in the sediments are above the theoretical levels at which the TCLP criteria may be met or exceeded.

*Exposed Sediments*

The Massachusetts Contingency Plan (MCP), 310 CMR 40.00, defines the appropriate response actions at "disposal sites" for soils that are contaminated with oil or hazardous materials as defined in the Massachusetts Oil and Hazardous Material List (MOHML) given in 310 CMR 40.1600. This list can be accessed at http://www.mass.gov/dep/cleanup/mohmla.pdf.

Disposal sites are defined as "*any structure, well, pit, pond, lagoon, impoundment, ditch, landfill, or other place or area, excluding ambient air or surface water, where uncontrolled oil and/or hazardous material has come to be located as a result of any spilling, leaking, pouring, abandoning, emitting, emptying, discharging, injecting, escaping, leaching, dumping, discarding or otherwise disposing of such oil and/or hazardous material.*" The MCP was specifically designed to catch contaminants resulting from discreet releases. According to general discussions with the MA DEP, an impoundment with contaminated sediments may or may not be classified as a disposal site.

Removal of the Plymco and Off-Billington Street Dams will result exposure of existing impounded sediments. Currently, this sediment is relatively inaccessible to human exposure due to the fact that it is generally submerged, although local residents have accounted in public meetings that they and their animals periodically engage in recreation in the impoundments. It can be expected that some contaminated sediments are present in the existing riverbanks as a result of normal fluctuations in the water levels and flow rates of Town Brook. Removal of the dams will result in exposure of additional sediments in what will become the overbank areas. For these reasons, the results of the sediment analysis were compared to the Massachusetts Contingency Plan (MCP; 310 CMR 40) Method 1 Soil Standards. Soil standards S-1 and S-2 appear to be the most appropriate standards, with the S-1 standards being the most conservative. These

standards apply to accessible or potentially accessible soils under the most likely frequency and intensity of use scenarios (Table 2-8). S1 standards are applicable to accessible surface soils to which children are expected to be exposed. Category S2 standards are applicable to a much broader range of both accessibility, frequency, and intensity, as indicated in Table 2-8.

Ground water standard GW-3 appears to be the most applicable ground water standard given the nature of the contaminated media and the fact that the dams are located in highly urbanized areas with a municipal drinking water supply and are not in areas of a medium or high yield aquifer. In any case, it should be noted that chemicals present in the impacted sediment is the result of historic upstream activities and is not believed to be due to a release of oil or hazardous materials within the impoundment areas.

# TABLE 2-8

## 310 CMR Table 40.933(9)

## Soil Category Selection Matrix Human Exposure Potential

| Accessibility of Soil | RECEPTOR CHARACTERISTICS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CHILDREN PRESENT | | | | ADULTS ONLY PRESENT | | | |
| | HIGH FREQUENCY | | LOW FREQUENCY | | HIGH FREQUENCY | | LOW FREQUENCY | |
| | High Intensity | Low Intensity | High Intensity | Low Intensity | High Intensity | Low Intensity | High Intensity | Low Intensity |
| ACCESSIBLE (SURFICIAL) SOIL 0 <= 3' (unpaved) | CATEGORY S-1 | | | S-2 | S-1 | CATEGORY S-2 | | |
| POTENTIALLY ACCESSIBLE SOIL 3 <= 15' (unpaved) or 0 <= 15' (paved) | CATEGORY S-2 | | | | S-2 | CATEGORY S-3 | | |
| ISOLATED SUB-SURFACE SOILS > 15' or under the footprint of a building or permanent structure | CATEGORY S-3 | | | | | | | |

* - Category S-1 also applies to any accessible soil where the current or reasonably foreseeable use of the soil is for growing fruit and vegetables for human consumption.

A summary of the comparison of sediment contaminant levels measured in the May 2007 event to the MCP Method 1 soil standards is shown in Table 2-9.

**TABLE 2-9**

**Constituents Exceeding MCP Remediation Standards**

| Constituent | Measured Concentration[1] | | S-1/GW-3 Standard[2] | S-2/GW-3 Standard[3] |
|---|---|---|---|---|
| | Off-Billington Street | Plymco | | |
| Constituent | *(mg/kg)* | *(mg/kg)* | *(mg/kg)* | *(mg/kg)* |
| Chromium (total) | 240 | <30 | 30 | 200 |
| Arsenic | 49 | 78 | 20 | 20 |
| | | | | |
| Benzo[a]anthracene | 9.5 | <7 | 7 | 40 |
| Chrysene | 9.3 | <7 | 7 | 10 |
| Benzo[a]pyrene | 7.5 | <2 | 2 | 4 |
| Dibenz[a,h]anthracene | 1.3 | <0.7 | 0.7 | 4 |

Notes:

[1] Based on maximum concentrations in samples collected by MMI in May 2007.

[2] Taken from 310 CMR 40.0975(6)(a) Table 2 MCP Method 1: Soil Category S-1 Standards.

[3] Taken from 310 CMR 40.0975(6)(b) Table 3 MCP Method 1: Soil Category S-2 Standards.

[4] The "<" symbol denotes that constituent is present in the sample at a concentration less than the applicable standard

The results of the sediment sampling and chemical analysis indicate that the removal of the dams will result in the exposure of sediment in what will become channel overbank areas in the former impoundments that may require remediation response actions under the MCP. From preliminary discussions with the MA DEP, it is evident that this issue will require further specific coordination with the MA DEP.

*401 Water Quality Standards*

Sediment chemical analysis results were analyzed with respect to 401 Water Quality Standards, as defined by the Massachusetts Surface Water Quality Standards contained in 314 CMR 4.00 and the 401 Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters of the United States within

the Commonwealth, as contained in 314 CMR 9.00. Table 2-10 provides a comparison of the Off-Billington Street sediment chemical analysis results to the Reporting Limits as defined in 314 CMR 9.07(2) Sampling and Analysis Requirements for dredged material. Table 2-11 provides the same information for the Plymco impoundment. Concentrations in bold exceed the documented Reporting Limits.

**TABLE 2-10**

**Comparison of Measured Concentrations to the 401 Water Quality Certification Reporting Limits**

**Off-Billington Street Impoundment**

| Parameter | Reporting Limit [1] (mg/kg unless otherwise noted) | OB-1 | OB-2 | OB-3 | OB-4 | OB-5 | OB-6 |
|---|---|---|---|---|---|---|---|
| arsenic | 0.5 | **28** | **49** | 38 | 21 | 18 | 12 |
| cadmium | 0.1 | **0.29** | **1.1** | 0.28 | **0.69** | 0.49 | 0.42 |
| chromium | 1 | **48** | **54** | 70 | **240** | 92 | 44 |
| copper | 1 | **84** | 42 | 30 | **46** | 41 | 33 |
| lead | 1 | **110** | **290** | **70** | **190** | **200** | 92 |
| mercury | 0.02 | **0.075** | **0.48** | 0.21 | **0.57** | 0.45 | 0.15 |
| nickel | 1 | **17** | 7.8 | 3.6 | **4.8** | **5.0** | **7.2** |
| zinc | 1 | **92** | **180** | 61 | **140** | **150** | 69 |
| PAH (µg/kg) | 0.02 | 0.008 | **0.011** | 0.006 | **0.015** | 0.004 | **0.012** |
| PCB[1] (µg/kg) | | **0.05** | **0.06** | 0.05 | **0.05** | **0.06** | **0.07** |
| Extractable Petroleum Hydrocarbon | 25 | **210** | **1300** | 420 | **640** | 500 | **610** |
| Volatile Organic Compounds (µg/kg) | 0.1 | **0.2** | **0.7** | 0.3 | **NA** | 0.7 | 0.4 |

[1] As given in 314 CMR 9.07 (2)(b)(6)

## TABLE 2-11

## Comparison of Measured Concentrations to the 401 Water Quality Certification Reporting Limits
## Plymco Impoundment

| Parameter | Reporting Limit [1] (mg/kg unless otherwise noted) | PL-1 | PL-2 | PL-3 | PL-4 | PL-5 | PL-6 | PL-7 | PL-8 |
|---|---|---|---|---|---|---|---|---|---|
| arsenic | 0.5 | 7.1 | **12** | **52** | **63** | 53 | **78** | 41 | **54** |
| cadmium | 0.1 | 0.12 | **0.33** | **1.0** | **1.4** | 1.1 | **2.2** | 0.87 | **1.4** |
| chromium | 1 | 2.5 | **7.0** | **13** | **14** | 11 | **17** | 12 | **14** |
| copper | 1 | 4.9 | **8.8** | **35** | **58** | 38 | **150** | 39 | **70** |
| lead | 1 | 17 | **52** | **130** | 130 | 110 | **140** | 94 | **140** |
| mercury | 0.02 | 0.011 | **0.072** | **0.15** | 0.15 | 0.11 | **0.15** | 0.093 | **0.15** |
| nickel | 1 | 1.8 | **3.8** | **7.8** | **9.6** | 7.3 | **13** | 7.1 | **9.5** |
| zinc | 1 | 27 | **44** | **120** | **150** | 110 | **200** | 95 | **210** |
| PAH (µg/kg) | 0.02 | 0.012 | 0.004 | **0.008** | **0.011** | 0.006 | **0.015** | 0.004 | **0.012** |
| PCB[1] (µg/kg) | | 0.0 | **0.0** | **0** | **0.1** | 0.1 | **0.2** | 0.1 | **0.1** |
| Extractable Petroleum Hydrocarbon | 25 | 130 | **150** | **710** | **1100** | 770 | **1800** | 740 | **1000** |
| Volatile Organic Compounds (µg/kg) | 0.1 | 0.2 | **0.6** | **1.3** | **1.5** | 0.0 | 0.0 | **1.1** | **1.9** |

[1] As given in 314 CMR 9.07 (2)(b)(6)

It is clearly evident from these two tables that a number of constituents within each sample from both impoundments exceed the documented Reporting Limits.

As stated in 314 CMR 9.07 (9) Shoreline Placement and Upland Material Reuse under a 401 Certification, "upland placement of dredged material in any upland area as fill or for other reuse activities" may be permitted provided the concentrations of oil and hazardous material in the dredged materials are less than the S-1 soil standards applicable at the

receiving location as specified in 310 CMR 40.0975, as given in this document in Table 2-9. As evidenced in Table 2-9, two metals and four PAH compounds exceed the applicable S-1 standards in the Off-Billington Street impoundment, rendering the potential for upland reuse of dredged sediments at the site unlikely.

However, within the Plymco impoundment, only arsenic exceeds the applicable S-1 standards. The MA DEP may issue a Dredged Material Reuse Decision. This requires that an application stating such be submitted to the MA DEP, as described in 314 CMR 9.07(9)(c). Issuance of said Decision is at the discretion of the MA DEP upon review of the application materials.

*Arsenic Distribution with the Off-Billington Street Impoundment*

One individual sample within the Off-Billington Street impoundment exceeded the arsenic threshold for state landfill disposal. The individual results were averaged to approximate the overall concentration within the sediments; the average concentration of arsenic within the Off-Billington Street impoundment, 27.7 mg/kg, did not exceed the disposal threshold. This indicates that confirmatory sampling of excavated, stockpiled sediments would likely not exceed MCP standards and would be suitable for disposal.

Arsenic concentration tended to generally decrease in the downstream direction; sample OB-2 had the highest concentration (49 mg/kg), and sample OB-6 had the lowest concentration (12 mg/kg). Figure 2-4 charts the concentration of arsenic in the Off-Billington impoundment sediment samples. Only arsenic concentrations in sample OB-2, located approximately 200 feet downstream of the culvert along the western edge of the impoundment, exceeded the MCP standards for sediment disposal in Massachusetts landfills.

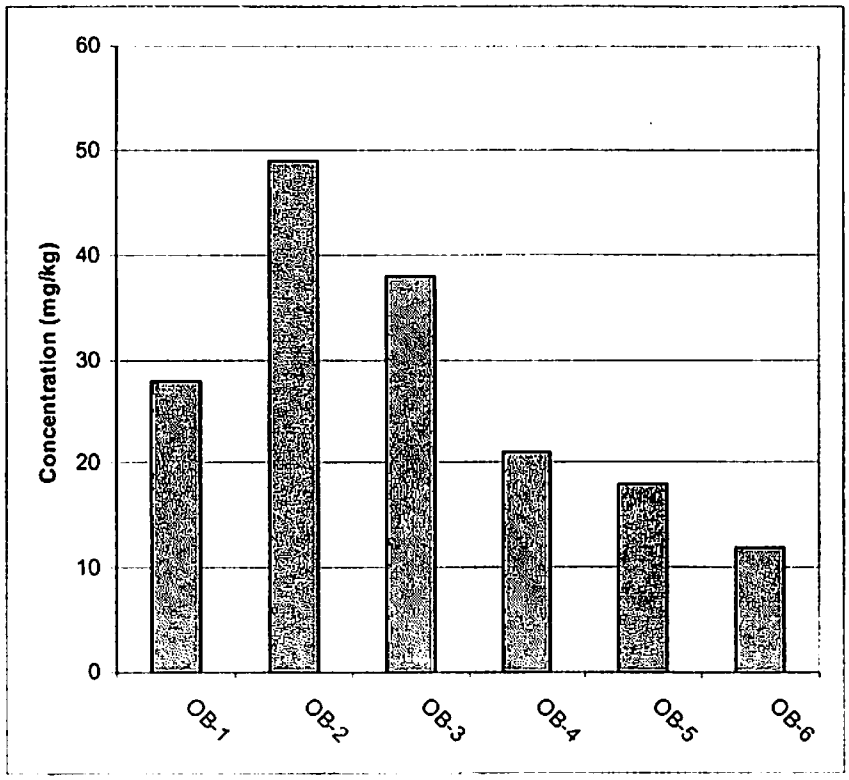



**FIGURE 2-4**

**Arsenic Concentrations in the Off-Billington Street Impoundment**

*PAH Distribution with the Off-Billington Street Impoundment*

The total PAH concentration in just one sample, sample OB-2, exceeded the MCP landfill disposal standard. The measured total PAH concentration also exceeds the 401 Water Quality Certification Reporting Limits. Of these PAHs, four also exceeded the MCP remediation S-1 soil standards regarding human exposure in sample OB-2. Samples OB-4 and OB-5 exceed the S-1 soil standard for Benzo[a]pyrene. Figure 2-5 depicts concentrations of these four PAH compounds. The highest levels of PAHs were routinely found in sample OB-2. Samples OB-4 and OB-5 generally had the next highest concentrations of PAHs, followed by samples OB-1, -6, and -3 in generally equal concentrations.

Concentrations of PAHs in samples OB-1, -3, and -6 do not exceed the S-1 soil standards, implying that if these areas were to be exposed they would be suitable for human exposure. However, due to the high variation in PAH concentration over such limited proximity, the ultimate determination of sediment management will need to be closely coordinated with the DEP.

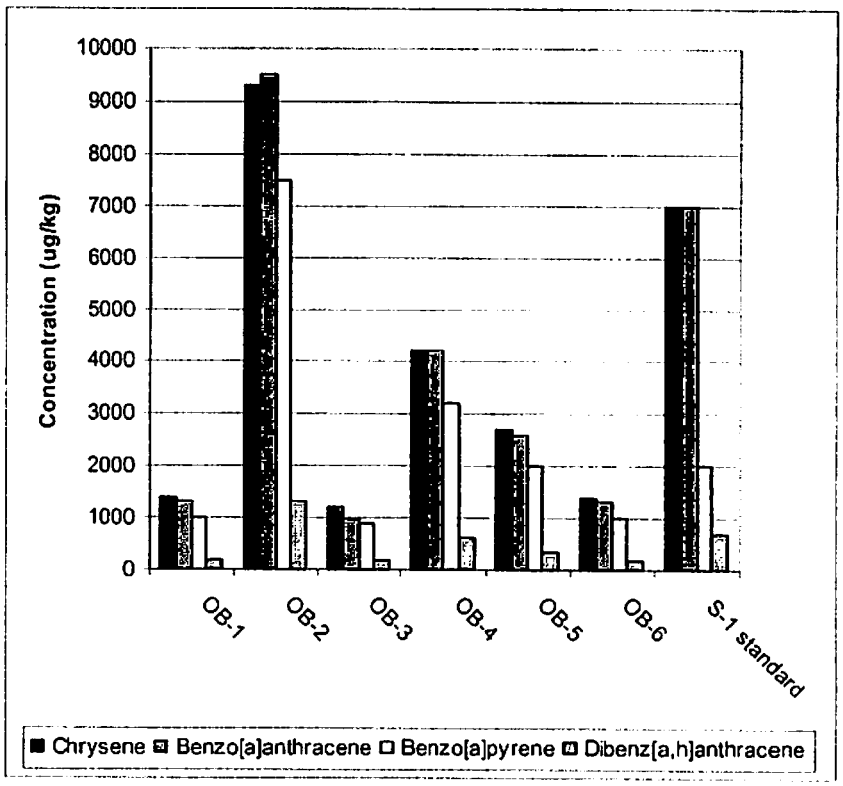



**FIGURE 2-5**

**PAH Concentrations Exceeding S-1 Criteria in the Off-Billington Street Impoundment**

*Implications for Sediment Management*

Any sediment excavated to form a channel may still be able to be reused or disposed of at a Massachusetts landfill; however a Landfill Minor Modification permit or a Special Waste Determination will be necessary if the final dredged concentrations are similar to

the concentrations in the recently collected samples. In addition, the potential may exist for on-site reuse of excavated sediments. On-site reuse would require coordination with the MA DEP to ensure that the goals of the MCP are met, including an application for a Dredged Material Reuse Decision, and would only be allowed under special permission.

Exposed overbank sediments may require a remediation response action if the site is deemed a disposal site. In addition, the concentrations of a number of constituents exceed the S-1 and S-2 soil standards applicable to the site. Earthen capping or some other means to reduce human exposure to the overbank areas may be necessary.

*Arsenic Distribution with the Plymco Impoundment*

Figure 2-6 depicts arsenic concentrations within the Plymco impoundment. The sample with the highest arsenic concentration was sample PL-6. Five of the eight individual samples exceed the landfill disposal threshold. These are samples PL-3, -4, -5, -6, and -8. It appears that the downstream end of the impoundment is more contaminated with arsenic than the upstream portion. The individual results were averaged to approximate the overall concentration within the sediments; the average concentration of arsenic within the Plymco impoundment, 45.0 mg/kg, exceeds the landfill disposal threshold of 40 mg/kg. As the average concentration just exceeds the disposal threshold, it is possible that sediment excavated to form a channel may still be able to be reused or disposed of at a Massachusetts landfill; however, a Landfill Minor Modification permit or a Special Waste Determination will be necessary.

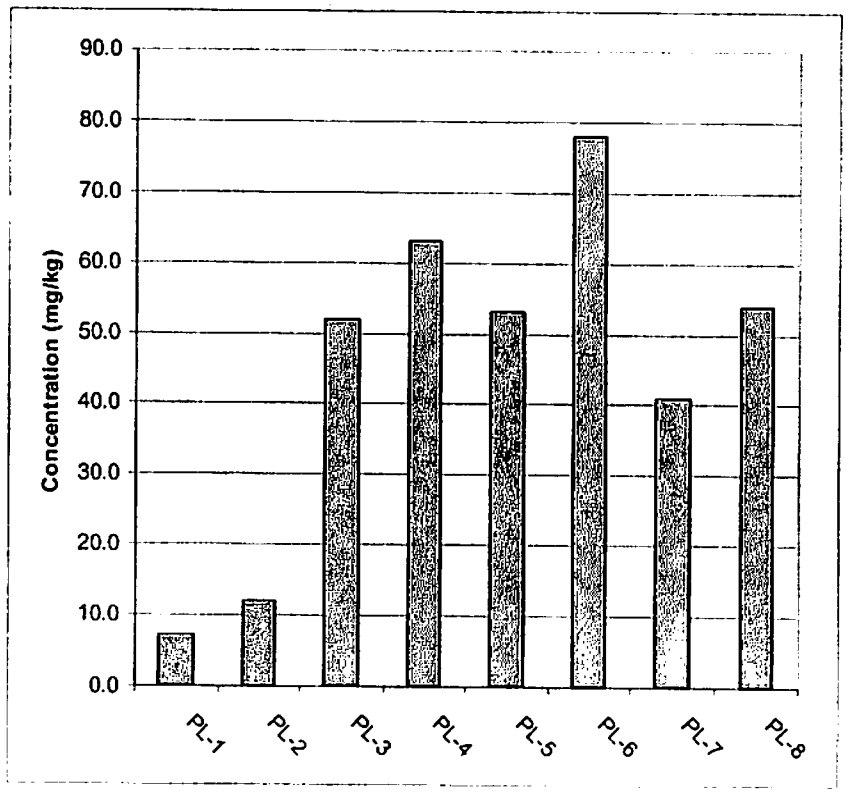



**FIGURE 2-6**

**Arsenic Concentrations in the Plymco Impoundment**

*PAH Distribution with the Plymco Impoundment*

Concentrations of PAHs within the Plymco impoundment were more evenly distributed than those within the Off-Billington Street impoundment. However, none of the samples exceeded the S-1 soil standards. Figure 2-7 depicts the measured PAH concentrations in the Plymco impoundment.

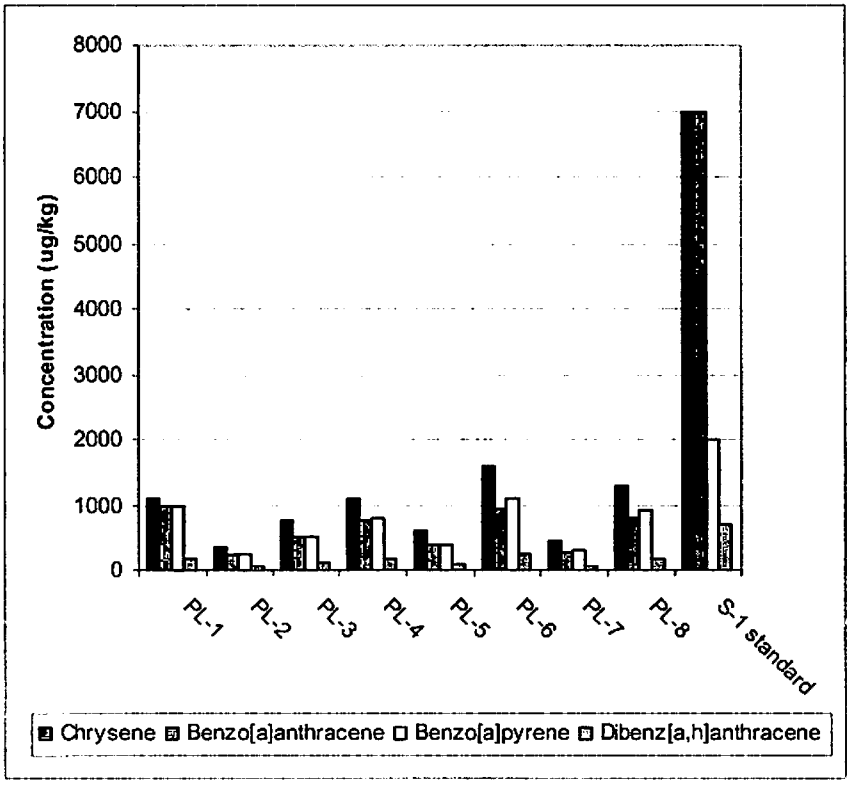



**FIGURE 2-7**

**PAH Concentrations Exceeding S-1 Criteria in the Off-Billington Street Impoundment**

*Implications for Sediment Management*

Arsenic concentrations in five of the eight samples in the Plymco impoundment exceed the landfill reuse threshold. In addition, the average arsenic concentration exceeds the landfill threshold. As arsenic is a potentially naturally occurring compound, and average concentrations just exceed the documented threshold, it is possible that any sediment excavated to form a channel may still be able to be reused or disposed of at a Massachusetts landfill; however, a Landfill Minor Modification permit or a Special Waste Determination may be necessary. In addition, due to the nature and concentrations of the measured constituents, the potential may exist for on-site reuse of

any excavated sediments. As described for the Off-Billington Street impoundment, on-site reuse would require coordination with the MA DEP to ensure that the goals of the MCP are met, including an application for a Dredged Material Reuse Decision, and would only be allowed under special permission.

Six of the eight samples in the Plymco impoundment exceed the S-1 soil criteria standard. None of the samples exceed the S-1 standards for PAH. This implies that exposed overbank sediments may require a remediation response action if the site is deemed a disposal site. *Further coordination with the DEP will be required to determine if overbank soils will require further treatment or modification.*

## 2.5 General Discussion of Sediment Stability and Transport

A thorough knowledge of sediment movement is required to understand the dynamics of both natural rivers and man-made channels. The status and character of sediment in the impoundments are key elements when considering the appropriate dam modification to provide fish passage. The specific concerns include mobilization of potential pollutants. creation of downstream suspended sediment loads and turbidity, downstream sediment deposition that buries native substrate, and unstable incised channels ("headcutting") through existing impoundments.

It is important to understand that sediment transport occurs naturally and is a part of a healthy river. Rivers are considered to be in "dynamic equilibrium," actively undergoing erosion and deposition while maintaining essentially the same overall shape and form. The morphology or shape of a river is created largely according to sediment transport processes. One facet of a successful dam removal is to restore natural sediment transport processes without endangering channel stability. Application of both approaches is required to create a stable and healthy river channel.

The regime or stable slope to which a channel may erode limits the potential depth of degradation in the modern sediment deposits in the Town Brook impoundments. In channels that lack a self-armoring substrate, the bed will erode into sediments until the resulting slope is reduced where dominant flow velocities are too low for further bed erosion. The equilibrium slope of the Town Brook channel was determined using basic sediment transport equations. The equilibrium slope is the slope at which the channel is at an optimum condition for conveying water and sediment with limited scour and deposition.

In the case of Town Brook, the channel is to be excavated to the predam substrate. Under this scenario, the predam substrate may indeed be a self-armoring substrate, in which the smaller size classes will be transported from the graded mix of substrate, leaving the larger gravel and cobble behind. This is a natural channel formation phenomenon and would be expected in the riffle-pool system. In fact, it is expected that the riffles will be predominantly armored gravel and cobble substrate, while the pools will retain finer sand and gravel sediments under lower flows and will self-scour the fines under higher flows.

The other major sediment stability issue with regard to Town Brook is bank stability. If the predam substrate is indeed capable of forming an armored layer, then if not properly managed the channel would have the tendency to widen rather than scour the bed under very large flow events. After the bank has become vegetated, the potential for bank erosion and channel widening is greatly decreased. However, during the first year, or in the time before vegetation becomes established, the banks will be vulnerable to widening. It will be important to implement temporary erosion control measures in the short term as well as to assist the establishment of vegetation to minimize long-term bank erosion.

The stability of the existing impounded sediments has been analyzed with respect to proposed conditions. In essence, this analysis tells us that the shear generated under proposed conditions is sufficient to mobilize the very fine-grained existing sediment deposits. This result is to be expected and is simply verified by this analysis. The HEC-

RAS calculated shear is then used to guide the selection of appropriate channel substrate size ranges and channel stabilization treatments. This analysis is included in Section 9.0 for each of the proposed alternatives.

The sediment transport capacity under proposed conditions has been analyzed, using the grain size distribution that was developed to reflect proposed channel substrate. This analysis is included in Section 9.0 for each proposed alternative. The sediment transport capacity of the existing system, with the impoundments in place and to a great extent filled with collected sediment, has been analyzed. This analysis is compared to the sediment transport capacity of proposed conditions. This type of comparison allows us to determine potential increases or decreases in magnitude of sediment transport between existing and proposed conditions.

Understanding sediment processes requires knowledge of geology, soil mechanics, fluid mechanics, and hydraulics. The erosion, transport, and deposition of sediments are functions of the hydrologic conditions and fluid in which they are immersed. The movement of sediment particles is also dependent upon the particle size, shape, and density, plus the cohesion, shear strength, chemistry, density, and roughness of the sediment deposit.

Sediment transport in rivers depends upon hydraulic forces to initiate motion, suspend material, and transport material along the bed or in suspension. All of the sediment transport analytical methods require one or more of the hydraulic parameters listed below:

- Mean velocity
- Shear velocity
- Bed velocity
- Flow depth
- Hydraulic radius

- Channel width
- Bed slope
- Energy grade line slope
- Turbulence
- Turbulent exchange coefficient
- Friction coefficient
- Shear stress

An accurate and reliable hydraulic analysis of flow conditions is the first requirement for sediment analysis. The hydraulic computational methods must be suitable for the site conditions and available data and be consistent with the selected sediment transport method.

Current knowledge of sediment movement is based on a combination of empirical and theoretical study, and neither has been able to provide consistently accurate results. However, use of both types of the existing analytical methods does provide a basis for estimating the location of areas subject to scour and deposition and relative sediment movement rates and volumes.

The movement of sediments in a river occurs when the flow of water exerts sufficient force on the individual particles to initiate movement and then transport them. Lighter particles are carried in suspension while heavier particles are dragged, rolled, or slide along the riverbed as "bed load." The driving force is due to the drag caused by the flow and related turbulent lift forces; the resistance forces are the weight of the particle, friction, and cohesion.

Critical threshold conditions are said to occur when motion of the particle is imminent. The critical threshold condition is difficult to measure because not all particles of a specified size will begin to move at the same time, depending on their density, exposure, turbulence, and full sediment mass gradation. It is, therefore, somewhat subjective.

## 2.6 General Sediment Management Strategies

*Management Options*

Proper management of the contaminated sediments behind the Off-Billington Street and Plymco Dams is a critical component of the Town Brook restoration effort. Alternatives that require the excavation of a channel or that expose in any manner the impounded sediments are subject to the regulations discussed in Section 2.4.6 of this report. As such, they must be managed appropriately. Sediment management may take the form of physical management to impede unwanted sediment migration and treatment techniques to reduce concentrations of contaminants. The use of management techniques to reduce sediment transport will also effectively reduce the transport of sediment-associated contaminants. However, these techniques may not meet the applicable regulatory requirements. Potential sediment management options are listed below:

→ Do nothing and allow natural erosion to occur.
→ Partial or full sediment removal and on-site or off-site disposal.
→ In situ stabilization/bioengineering.
→ Capping (isolation and/or erosion protection).
→ In situ treatment.
→ Natural attenuation.

A description of each of the sediment treatment technologies is included in the discussion that follows. The discussion of treatment technologies pertains to two classes of sediment at the site. The first is material that is excavated through the impounded sediments to form the channel. The second is impounded sediments that will be exposed on the overbank areas. The final selection of a treatment technology will require coordination with the MA DEP.

*Removal and On-site or Off-site Disposal*

Sediment removal through mechanical dredging and/or excavation can be accomplished under nearly dry conditions through the use of cofferdams or in the wet utilizing water control strategies.

Off-site disposal options are highly dependent on the contaminant levels measured in the excavated sediments. Sediments that contain contaminants at concentrations greater than the threshold criteria for disposal within municipal and/or lined landfills in Massachusetts must be disposed of according to the appropriate federal regulatory requirements. If wastes are classified as hazardous according to federal criteria, they must be properly disposed of in a permitted hazardous waste facility. This option may be a viable alternative for sediments excavated to form the proposed channel. Applicable standards were discussed in Section 2.4.6.

Another alternative includes the use of confined disposal cells that can be located on shore or in adjacent uplands. These cells, filled with the contaminated sediments, can be isolated with sheet piling or other physical barriers. The implications of current regulatory permitting requirements regarding this technique are unclear at this time.

*In Situ Stabilization of Contaminated Sediments*

In situ stabilization consists of the use of admixtures that change the geotechnical properties of the sediments, thus reducing the potential for erosion. Sediments can be stabilized by increasing their strength. An extreme example would be capping a contaminated riverbed with nonerodible materials. While in situ stabilization can be effective, it is difficult to implement due to the ineffectiveness associated with the homogenization of the sediments. As a result, this technique is most effective under conditions where the sediment can be isolated from the waterbody. For instance, sheet

piling or temporary dams can be used to horizontally isolate sediment from the water column. This technique may the most appropriate for overbank sediments.

*Bioengineering*

Under the concept of "bioengineering," natural materials are used to temporarily stabilize sediments to protect them from erosion while long-term vegetation is established. Bioengineering techniques may include the use of biological materials such as coconut fiber logs or biodegradable jute mats that stabilize the upper banks and top sediment surfaces, thus reducing erosion potential. These techniques are valued in areas above the perennial water level in regions with low to moderate velocity. These types of materials would be effective for the stabilization of the banks while waiting for vegetation to establish. Since biological materials decay, their application must be followed with the application of live cuttings or rooted plants to establish long-term cover. Nonbiological materials may also be used in areas highly prone to erosion.

*In Situ Capping*

Contaminated sediment can also be capped with clean granular material such as sand or gravel, or with geotextiles or other types of liners. Sediment caps are intended to provide the following functions:

→ Isolation of contaminated sediments from the aquatic environment and from human exposure.
→ Protection of the contaminated sediments from erosion and prevention of resuspension and transport.
→ Chemical isolation and reduction of the transport of dissolved or colloidal contaminants.

The sediment mass exposed by draining the ponds could be capped in place by clean fill, which would be planted with vegetation.

*In Situ Treatment of Contaminated Sediments*

In situ treatment consists of biological or physical processes that allow for the treatment of the contaminated medium at a site, thus avoiding the need for excavation and removal. Bioremediation is an example of biological in situ treatment where the environmental conditions are controlled for the purpose of increasing microbial growth. The addition of oxygen and nutrients along with pH adjustment or moisture control are typical mechanisms used to increase microbial activity. Under these conditions, microorganisms use contaminants as an energy source, resulting in their biodegradation.

While in situ bioremediation techniques are often successful for hydrocarbon derivatives, this treatment technique has limitations for elements such as chromium and arsenic.

*Natural Attenuation*

Natural attenuation relies on natural processes for the remediation of contaminated sediments. Biodegradation, dilution, and volatilization are also processes that enhance natural attenuation. The biodegradation and volatilization processes of natural attenuation are not highly effective for elements such as chromium and arsenic.

The effectiveness of natural attenuation processes depends on several key issues. First, the risks of the contaminated sediments must be low enough to warrant natural attenuation as a viable remediation alternative. Secondly, the sediments exhibiting high levels of contamination must be located in areas that are depositional. Thirdly, there must be no ongoing sources of contamination. Lastly, the depositional areas must be stable, particularly under future high flow conditions.

## 2.7 Natural and Cultural Resources

### 2.7.1 Fisheries

Fish passage projects have the potential to provide significant benefits to fisheries. The Plymco and Off-Billington Street Dams act as barriers to local fish movement and block the migration of anadromous fish species. These dams have fragmented the Town Brook system into small and disconnected segments characterized by warm-water fisheries. Channel blockages of this type have many negative associated impacts such as loss of access to cold-water refuges, feeding areas, and breeding and spawning areas. Some fish passage structures, such as fishladders, limit migration of other aquatic species such as reptiles and amphibians.

The provision for fish passage at the subject Town Brook dams have the potential to provide increased habitat continuity as well to improve water quality within the existing impoundments. The Town Brook impoundments within the project reach are currently of highly degraded water quality. The impoundments are heavily sedimented and likely receive nutrients from the surrounding residential neighborhood and road runoff from Billington Street. These wide, shallow impoundments are characterized by elevated water temperatures and low concentrations of dissolved oxygen. Provisions for fish passage at the subject dam structures have the potential to not only provide for passage but also to create a healthy, functioning ecosystem through the project reach that represents full riparian restoration.

It is important to have a good understanding of the fish in the system in order to design a project that will provide the potential benefits. This section presents the background information used in evaluation of the analyzed projects' impact on the fisheries.

*Target Species*

The NOAA National Marine Fisheries, The Commonwealth of Massachusetts Riverways Program, and the Town of Plymouth have identified that alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), collectively known as river herring, as well as American eel (*Anguilla rostrata*), and resident and native coldwater species such as brook trout could benefit from increased fish passage opportunities and habitat improvements on Town Brook.

Restoration of river herring runs would provide a base for restoration of many species that use herring as a food source in the freshwater and estuaries of the Town Brook system. Many birds, fishes, and mammals are known to eat migrating adult herring, including striped bass, lake trout, weakfish, bluefish, osprey, green heron, and mink. Additionally, herring eggs provide a food source for freshwater fishes including yellow perch, white perch, and spottail shiner. Largemouth bass, yellow perch, white perch, grass pickerel, pumpkinseed, American eel, and other fish are known to consume the juveniles [Klauda et al. 1991; Department of Marine Fisheries (DMF)].

Because river herring serve as food fish for such a vast number of species, their restoration is key in the promotion of the ecological health of both coastal and offshore waters spanning from the Gulf of Maine to the Mid-Atlantic coastal region. The primary stated objective of restoration of river herring runs will not only contribute to the long-term objective of restoration of the Town Brook ecosystems but also benefit Plymouth Harbor and the entire northeast continental shelf of the United States.

In addition to benefiting from the increased food source, other diadromous (migratory between salt and freshwater) and freshwater fish in Town Brook may also benefit from the increase in habitat connectivity that would occur if one or more dams were removed.

The project reach of Town Brook is a prime location to support a cold-water fisheries brook trout population.

*Requirements and Behavior*

Fish that spend part of their lives in fresh water and part of their lives in salt water are collectively called diadromous fish. These include anadromous and catadromous fish. Anadromous fish lay their eggs and develop in fresh water. They then migrate to salt water where they remain until they are sexually mature. Once anadromous fish reach sexual maturity, they return to fresh water to spawn. The anadromous river herring have been targeted for restoration in Town Brook, and a number of other anadromous species may also benefit from restoration activities. These fish are described as follows:

Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalis*) – Alewife and blueback herring are collectively known as river herring. There are river herring runs in many Massachusetts streams. Currently, river herring are caught below the Off-Billington Street Dam and trucked to suitable habitat upstream on Town Brook. Although they can be caught on hook-and-line, river herring are not a highly regarded game fish. Instead, people net them for use as bait in marine sport fisheries, lobster fisheries, and to a much lesser degree as food fish. They are very important forage species on which striped bass, bluefish, and other economically important fish prey. The restoration of river herring runs will not only benefit Town Brook but also Plymouth Harbor.

Adults ascend the rivers of southern New England between April and early to mid June, with blueback herring typically starting their run after the alewife. Alewife juveniles leave the stream for the ocean in June through November of the same year, and blueback juveniles descend between September and November. Downstream migration stops during low flow periods. Adults travel at a cruising speed of 2.8 ft/s and can reach burst speeds of 6.8 ft/s. DMF prefers a minimum water depth greater than six inches in order

to provide river herring passage. Alewife spawning takes place in lakes and ponds as well as sluggish water in rivers and streams. Spawning is correlated with water temperatures between 10.5 and 12.2 °C. Blueback herring prefer larger rivers and spawn to a lesser extent in smaller streams. Spawning will cease when water temperatures exceed 27 °C. Each female will deposit 60,000 to 100,000 eggs on various substrate types including gravel, sand, detritus, or submerged vegetation varying in depth from six inches to 10 feet of water. Adult river herring return to the sea soon after spawning.

Catadromous fish lay their eggs and spend their early lives in saltwater. They then migrate to freshwater areas where they reach sexual maturity. Catadromous fish return to saltwater to spawn. The American eel is the only catadromous fish found locally.

Insert Table 2-12 Fish Passage Requirements for Target Species

| | | |
|---|---|---|
| Common Name | Alewife | |
| *(Scientific Name)* | *(Alosa pseudohare* | *rsoni)* |
| Life Stage of Concern | juvenile | |
| | | |
| Life Cycle Classification | anadromous | |
| | | |
| Average Size (length in inches) | 1-3 | |
| | | |
| *Upstream Migration Period* | | |
| Approximate Dates [3] | | |
| Start | | A |
| Peak | | |
| End | | M |
| Associated Temperature (°C) | | |
| Start | | |
| Peak | | |
| End | | |
| | | |
| *Downstream Migration Period* | | |
| Approximate Dates [3] | | |
| Start | June | |
| Peak | | |
| End | Nov. 15 | Ju |
| Associated Temperature (°C) | | |
| Start | | |
| Peak | | |
| End | | |
| | | |
| Minimum Water Depth (inches)[2] | 6-8 [5] | |
| | | |
| Relative Swimming Depth in Water Column | | |
| | | |
| Swimming Speed (ft/s) | | |
| -crusing speed | | |
| -sustained speed | | |
| -burst speed | 3.2 | |
| | | |
| Swimming Characteristics | schooling | sc |
| | | |
| Behavior Relating to Passage | diurnal | |

Notes:

[1]It is likely that until trout populations increase, it will not be necessary to p downstream passage until June 15.

[2]Based on a minimum of one body depth; although taken together with grac water velocity, 10 - 15 inches minimum was found practical in most rapids River.

[3]Dates are typical and may vary annually

[4]A small percentage of adult river herring will remain in the system unable downstream due to low flow

[5]Minimum 8 - 10 inch depth desired

American Eel *(Anguilla rostrata)* - American eel adults reach a length of 30 inches. Adults descend Massachusetts rivers in the fall, and juveniles travel upstream in the spring. American eels travel at a cruising speed of 2.4 ft/s and can reach a burst speed of 6 to 7 ft/s. They are solitary travelers and travel near the bottom of the river (B. Kynard and other sources. See Fish Passage Requirements Table for sources).

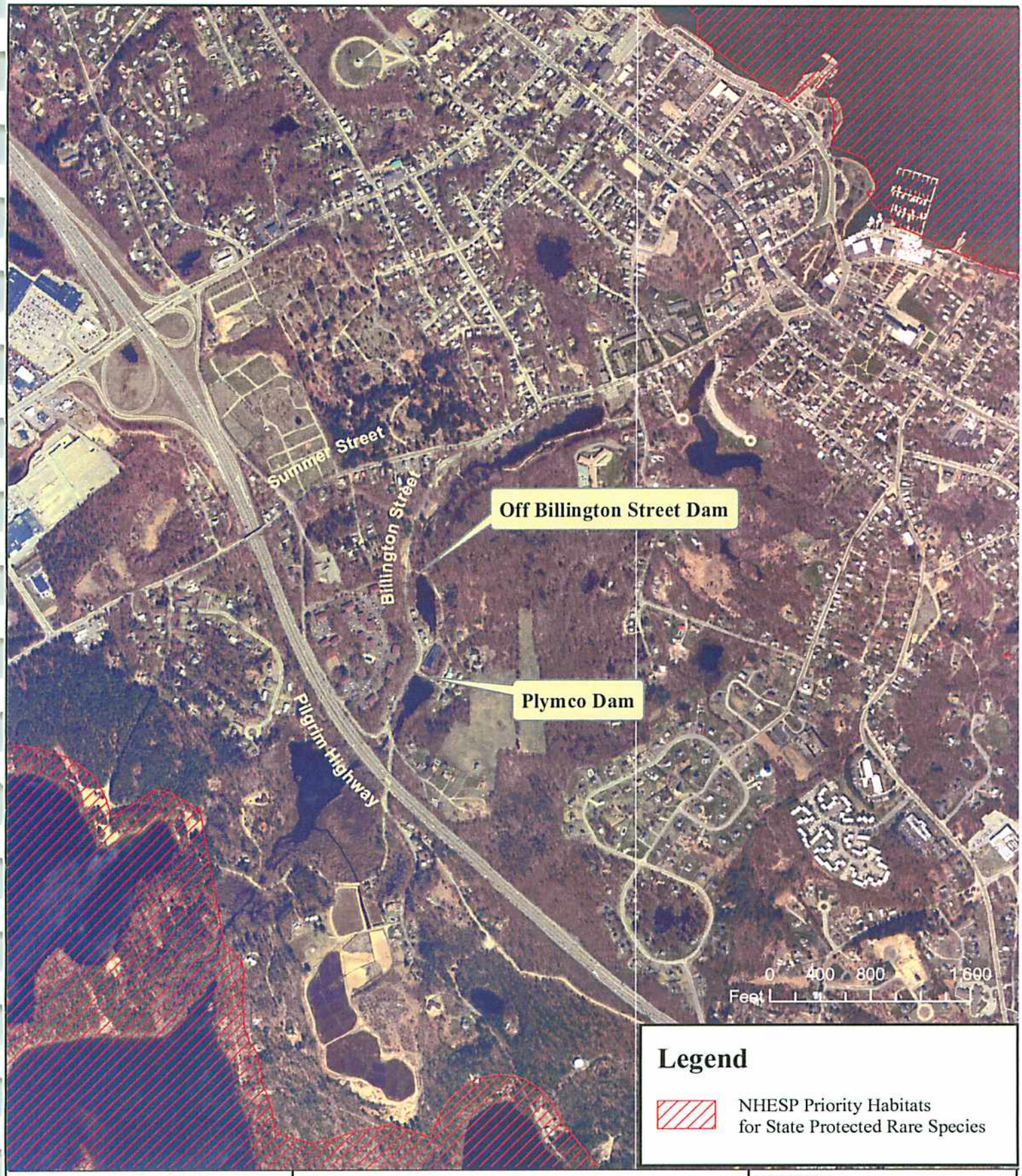
*Fresh Water Target Species*

Also targeted for restoration are species that spend their entire lives in fresh water. Although these species do not follow extensive migration patterns, as do the diadromous fish species, they stand to benefit from the restoration of fish passage in Town Brook. Once passage has been restored, resident freshwater fish will have increased access to upstream spawning, rearing, and adult feeding habitats.

Brook Trout (*Salvelinus fontinalis*) – Brook trout are distributed throughout small to medium sized streams in southern New England (Whitworth, 1996). Adults travel upstream between April and July. A water depth of five inches is required for brook trout to pass. Brook trout that run to the sea due to increased spring water temperatures are called "salters." They may remain at sea for up to three months. Brook trout can reach a burst speed of 12.8 ft/s (B. Kynard and other sources. See Fish Passage Requirements Table for sources).

### 2.7.2 Endangered and Heritage Species

The Massachusetts Division of Fisheries and Wildlife maintains a database of Massachusetts protected rare species under the National Heritage and Endangered Species Program (NHESP). The NHESP Priority Habitats of Rare Species GIS datalayer was accessed through MassGIS (Refer to Figure 2-3). The Priority Habitats presented in Figure 2-4 are those published in the 12th Edition of the Massachusetts Natural Heritage Atlas and are effective beginning October 1, 2006. The project site does not fall within the boundaries of any Priority Habitats of Rare Species.

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**Town Brook**
**Dam Removal Feasibility Study**

LOCATION: **Plymouth, MA**

MMI#: 1982-03
MXD: H:NHESP.mxd
SOURCE: MassGIS from www.mass.gov

N

**Natural Heritage and Endangered Species Program**

DATE: July 2007
SCALE: 1" = 1,000'

SHEET: **Figure 2-8**

### 2.7.3 Historic Information

Town Brook has an extensive history of human interaction. The Plymouth area is known to have been inhabited for about the last 13,000 years. It is known that the Billington Sea/Town Brook drainage has been occupied for at least 8,000 years. The Plymouth vicinity was a major area of Native American settlement prior to the first permanent European settlement of Plymouth in 1620 (Donta, 2000).

The Off-Billington Street Dam was built originally built in 1790 as the Inglee Anchor Forge. The mill and mill works changed hands over the years and was finally closed in 1926. The mill buildings were demolished at this time. The Plymco Dam was originally built in 1812 as the Plymouth Cotton Mill Co. The mill burned down in 1854 and was rebuilt in 1855 as the Samoset Mill. The mill finally closed in 1930, but the building remains. Both dams were reconstructed and/or replaced using 20$^{th}$ century reinforced concrete. The impoundments associated with the dams are clearly evident in the United States Geological Survey (USGS) quadrangle of Plymouth from 1889, graphically depicted in Figure 2-5.

The Town Brook Historic and Archeological District is listed in the National Register of Historic Places, list number 1995-10-12.

Attendees at the public meetings held for this project have indicated that the impoundments themselves hold historic significance for the role they played in early settler history associated with milling.

Section 106 of the Historic Preservation Act will apply. The Massachusetts Historic Commission (MHC) has been consulted in conjunction with the development of this alternatives analysis. A Project Notification Form for the recommended alternative as outlined in this document has been submitted to the MHC for review.

The following is a Section 106 Regulations Flow Chart developed by the Advisory Council on Historic Preservation outlining the process by which the requirements of Section 106 are fulfilled.

**Initiate Section 106 Process**
Establish undertaking
Identify appropriate SHPO/THPO
Plan to involve the public
Identify other consulting parties

► ***No undertaking/no potential to cause effects***

▼

***Undertaking is type that might affect historic properties***

▼

**Identify Historic Properties**
Determine scope of efforts
Identify historic properties
Evaluate historic significance

► ***No historic properties affected***

▼

***Historic properties are affected***

▼

**Assess Adverse Effects**
Apply criteria of adverse effect

► ***No historic properties adversely affected***

▼

***Historic properties are adversely affected***

▼

**Resolve Adverse Effects**
Continue consultation

► ***Memorandum of Agreement***

▼

FAILURE TO AGREE

►

COUNCIL COMMENT

Identification of historic properties includes preliminary work, actual effort to identify properties, and an evaluation of identified properties to determine whether they are historic, they are listed on, or are eligible for inclusion in the National Register of Historic Places. In light of the Native American and early European settlement activities associated with Town Brook, it is likely that an archeological review will be necessary to determine if historically significant elements are present at the site. It is anticipated that

further correspondence with the MHC will elucidate whether any portions of the existing dams are deemed historically significant.

If elements of historic significance are present at the site that the MHC determines will be adversely affected by project activities, the MHC may suggest changes to the project or impose conditions so that adverse effects can be avoided, thus resulting in a no adverse effect determination. Once adverse effects to historic elements have been resolved, the MHC will issue a Memorandum of Agreement.

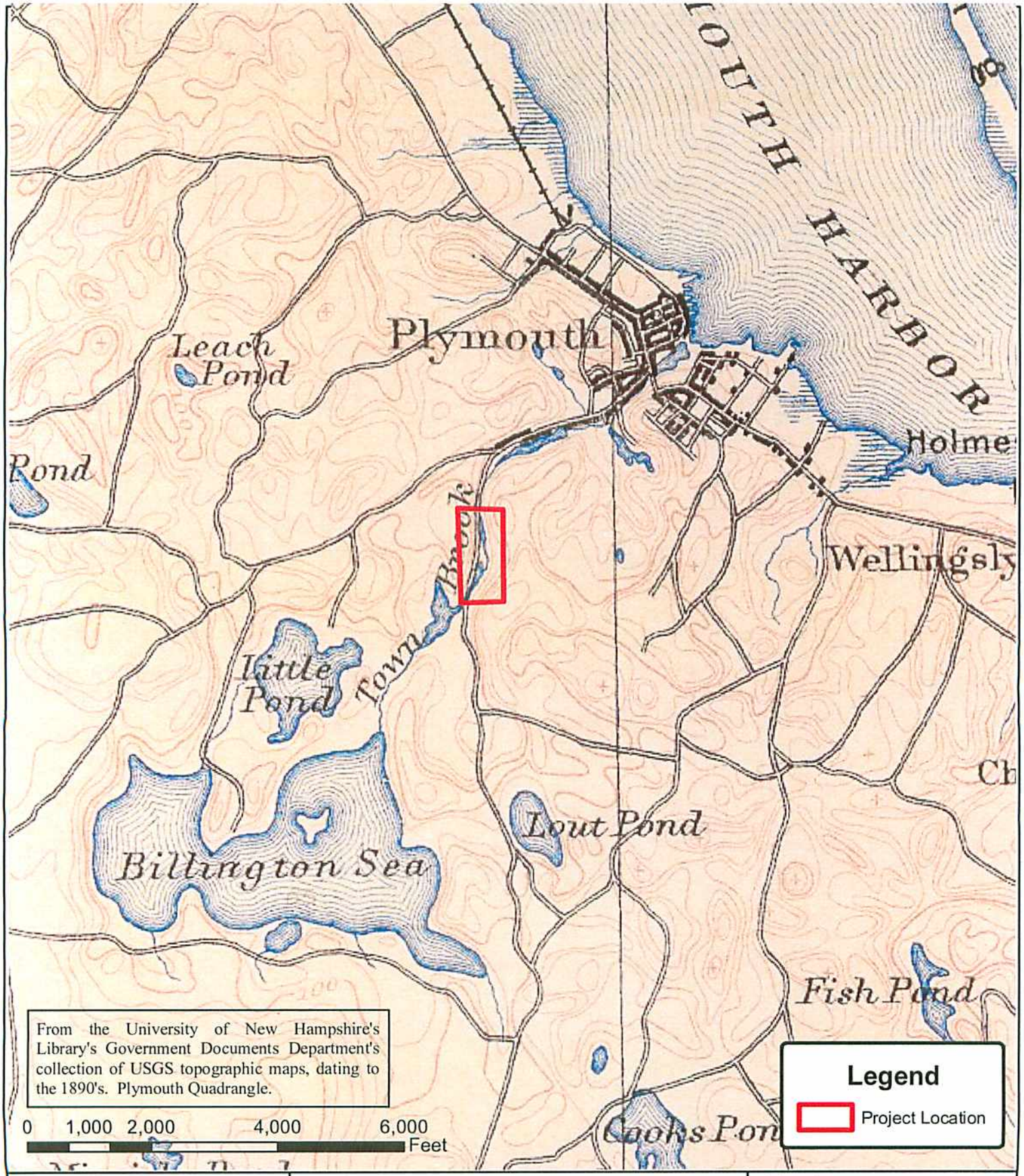
Throughout the development of this feasibility analysis, the MHC has been consulted for coordination. In addition, a number of public meetings have been held. Public involvement is recognized as a critical aspect of the Section 106 process. Efforts have been made to notify the public and to provide sufficient information regarding the project such that meaningful comments from the public are forthcoming. The findings presented in this document constitute an element of the documentation applicable to the Section 106 process.

The following are the next steps that need to be taken to successfully navigate the Section 106 review process:

- Following submission of the Project Notification Form (PNF), MHC should be contacted to determine the scope of effort required to identify historic resources. The MHC may require further documentation of the historic resources at the site, which may require the project partners to contract a full historic and archeological review. In Massachusetts, a permit to conduct an archeological investigation will be necessary.
- A final determination of the area of potential effects needs to be made based on consultation with the MHC.
- Following submission of the Project Notification Form (PNF), and if it is believed by the project partners or determined by the MHC that project

activities will result in a finding of adverse effect, a letter needs to be drafted and sent to the MHC stating that the said project will result in a Finding of Adverse Effect, and that the project partners would like to enter into the mitigation process. A letter should concurrently be sent to the Advisory Council on Historic Preservation (ACHP) asking for comment on the project activities. The ACHP may decline to comment on the project.

- If Native American historic resources will be impacted, MHC should be contacted to determine if the resources belong to a federally recognized tribe. If such is the case, the tribal representative needs to be contacted in writing regarding treatment of the resources at the site.
- Correspondence with the MHC should be maintained through the mitigation process, presumably to adjust design and construction elements such that adverse effects can be avoided.
- Once all of these elements have been resolved, a Memorandum of Agreement will be issued by the MHC.

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**Town Brook**
**Dam Removal Feasibility Study**

**LOCATION:** Plymouth, MA

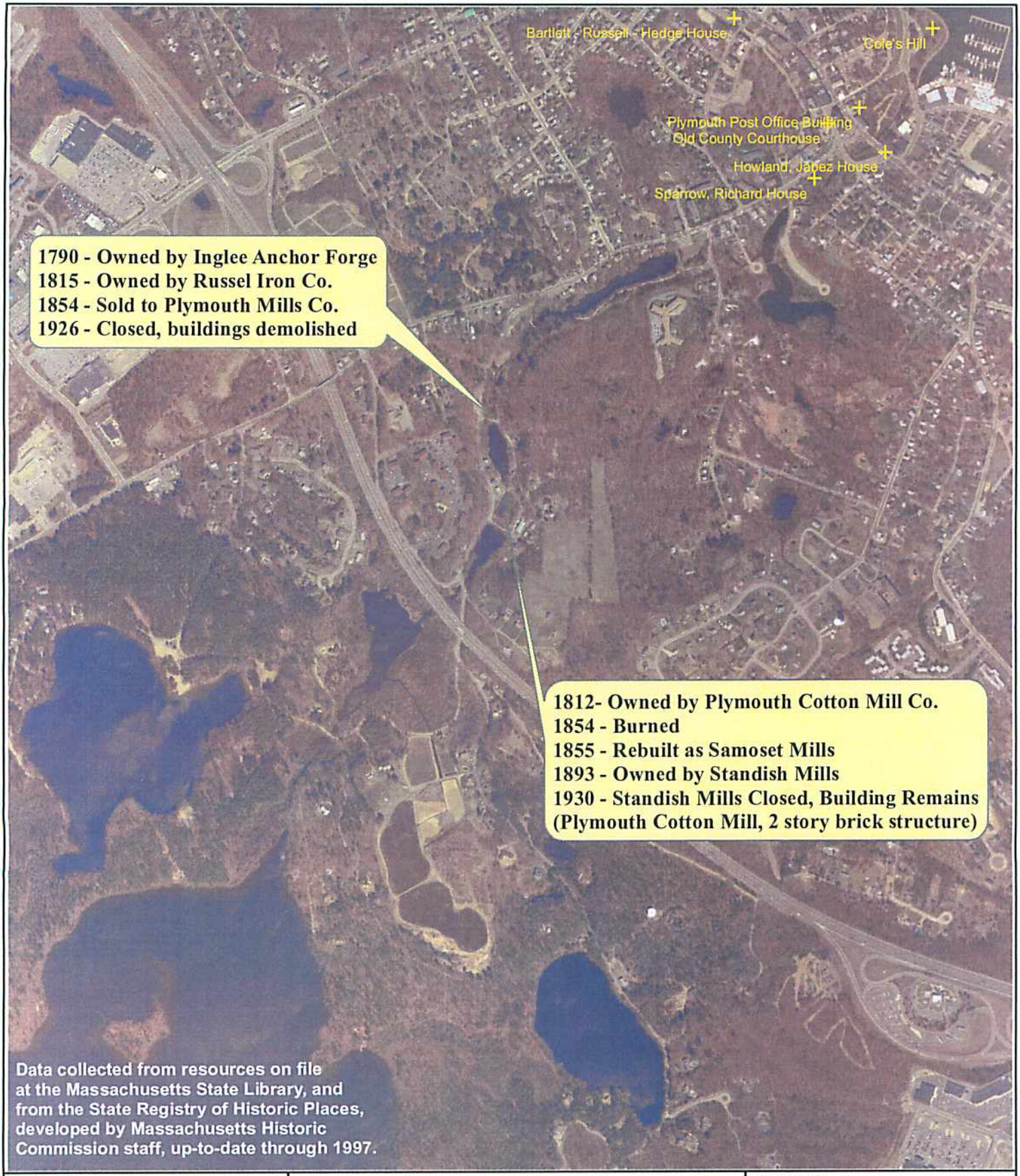
MMI#: 1982-03
MXD: H:historic_quads_1889.mxd
SOURCE: MassGIS from Mass.gov

N

**Historic Quadrangle 1889**

DATE: July 2007
SCALE: 1' = 2,000'

SHEET: Figure 2-9

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**Historic Properties**

LOCATION: **Plymouth, MA**

MMI#: 1982-03
MXD: H:Figure1_ortho.mxd
SOURCE: MA MAGIC

N

**Plymco Dam and Off Billington Street Dam**

DATE: July 2007
SCALE: 1" : 1000'

SHEET: **Figure 2-10**

### 2.7.4 Wetlands and Aquatic Habitat

*Regulated Resources*

According to the Wetlands Protection Act (WPA) (Massachusetts General Laws, Chapter 131, Section 40), "freshwater wetlands" are defined as "wet meadows, marshes, swamps, bogs, areas where groundwater, flowing or standing surface water or ice provide a significant part of the supporting substrate for a plant community for least five months of the year; emergent and submergent plant communities in inland waters; that portion of any bank that touches inland waters."

The following resources, as regulated by the Department of Environmental Protection under the WPA (310 CMR 10.00), are present at the two project sites and within areas of potential impact:

- Bordering Vegetated Wetlands
- Banks
- Lands Under Water Bodies and Waterways
- Lands Subject to Flooding
- Fish Runs
- Riverfront Areas

Wetlands and watercourses are generally accepted as performing certain hydrologic and ecological functions. An evaluation of the on-site wetlands' and watercourses' capability to perform these functions and provide these values is summarized in Table 2-11. The methodology follows the U. S. Army Corps of Engineers Wetland Functions and Values approach.

**TABLE 2-13**
**Functional Evaluation of Plymco and Off-Billington Street Impoundment Wetlands**

| | ***Project Site Wetlands*** | |
|---|---|---|
| | Ground Water Recharge and Discharge | Yes |
| | Floodflow Alteration/ Storage Capacity / Desynchronization | No, the impoundments do not provide significant floodflow alteration or floodwater storage. |
| | Fisheries | Cold-water, anadromous, and catadromous fishery resources are limited by existing dams and deteriorating fishladders. Both impoundments provide warm-water fishery resources. |
| | Sediment / Toxicant Retention | Both impoundments have collected significant volumes of fine grained sediments, some of which contain levels of contamination. |
| | Nutrient Retention / Removal / Transformation | The emergent marsh wetlands and the submerged aquatic vegetation (SAV) provide nutrient retention and remove nutrients such as nitrogen and phosphorous from surface waters. |
| | Production Export / Food Chain Support / Nutrients | The impoundment's vegetative communities provide detritus, allochthonous, and autochthonous materials for downstream habitats. However, downstream migration of these materials is limited by the presence of the dam embankments. |
| | Shoreline Anchoring / Dissipation of Erosive Forces | The shorelines of the impoundments are vegetated and the impoundments help dissipate erosive forces that may degrade downstream habitats. |

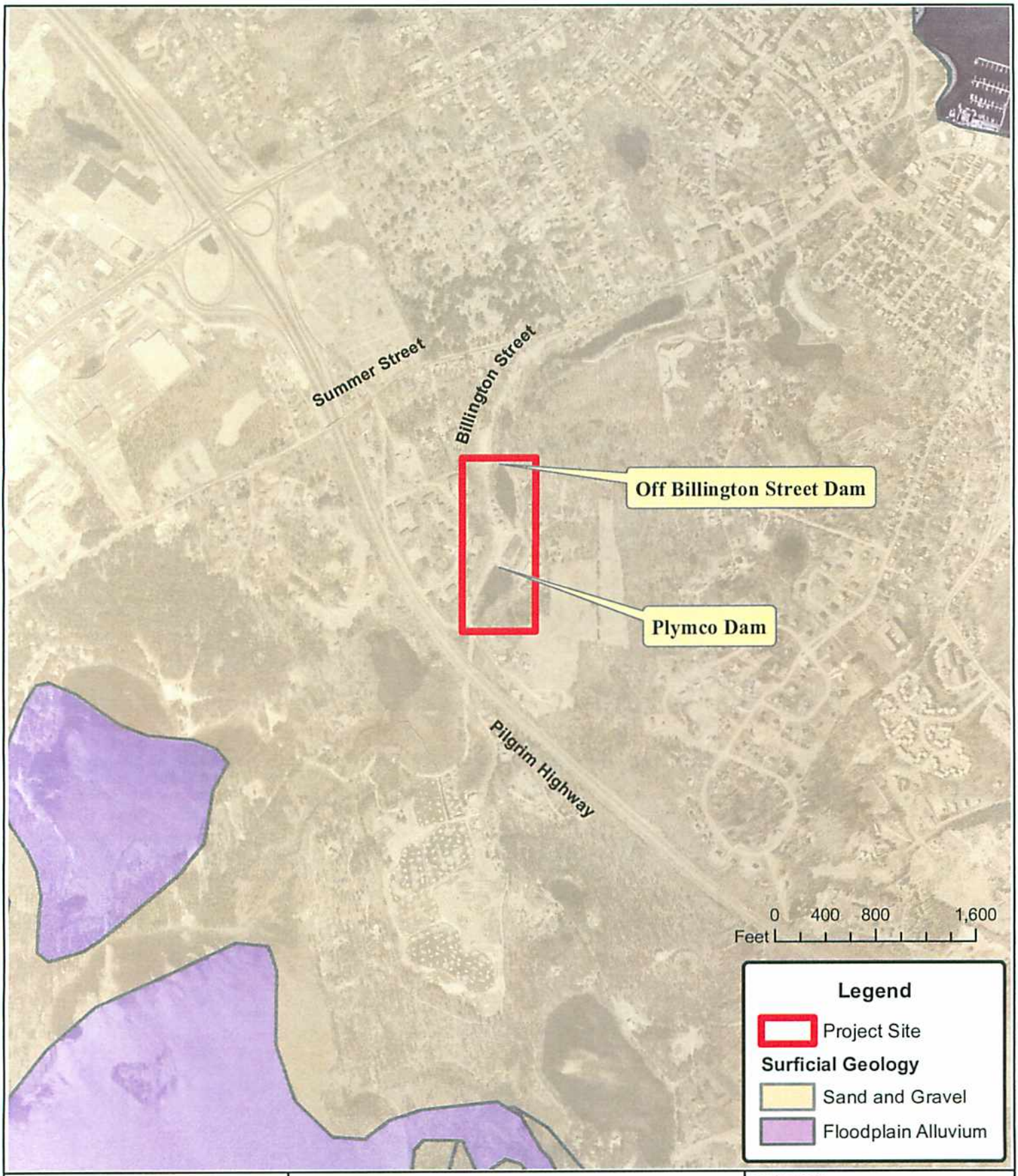
| | | |
|---|---|---|
| | Wildlife | Both impoundments provide wading bird and waterfowl habitats. The open water areas may also be used by mammals. Amphibians and reptiles were observed within the impoundments. |
| | Recreation | The impoundments are not used by abutting property owners for recreation due to their highly degraded state. |
| | Education / Scientific Value | Impoundments are not accessible to the public. |
| | Uniqueness / Heritage | Impoundments and associated wetland habitats are not unique. |
| | Visual Quality / Aesthetics | The impoundments are wide and shallow and become visually unappealing during periods of low flow. |
| **ES** | Species of Special Concern, Endangered, or Threatened Status | No |

It must be noted that the wetlands created by the Off-Billington Street and Plymco Dams are artificially created and are suffering from degraded water quality. Excess sediment deposition and shallow water depths create conditions of elevated temperatures and low dissolved oxygen concentrations.

## 2.8 Surficial Geology

Surficial materials at the project site are composed entirely of sand and gravel (See Figure 2-6). This stratified sand and gravel was deposited by glacial meltwater during the last glacial retreat in the area, approximately 15,000 years ago.

Insert Figure 2-11 Surficial Materials

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**Town Brook**
**Dam Removal Feasibility Study**

LOCATION: **Plymouth, MA**

MMI#: 1982-03
MXD: H:surficial.mxd
SOURCE: Mass GIS from Mass.gov

N

**Surficial Geology**

DATE: July 2007
SCALE: 1" = 1000'

SHEET: **Figure 2-11**

## 2.9 General Alternatives Summary

This section provides a general description of the different alternatives considered as part of a fish passage study and presents the potential benefits and drawbacks of each alternative. More specific descriptions of the alternatives considered in-depth are presented in Chapters 4, 6, and 8 for the Off-Billington Street Dam, culvert, and Plymco Dam, respectively.

### 2.9.1 Full Dam Removal/Breach

Dam removal is often the best alternative for complete restoration of a river to its natural condition. Some of the benefits of dam removal are summarized below.

- Restore natural movement to all species of fish and aquatic organisms
- Eliminate the potential increases in water temperature and decreases in water quality associated with dam impoundments
- Provide a natural system of sediment transport in the river
- Restore natural, unrestricted flow conditions
- Eliminate channel snags and debris associated with dam impoundments
- Eliminate the chance of future dam breaks
- Eliminate a structure requiring maintenance

Dam removal can often be expensive if a large amount of contaminated sediment has accumulated behind the dam. The sediments impounded behind the Off-Billington Street and Plymco Dams have been found to be contaminated. Moderate volumes of sediment have accumulated in these impoundments. Removal of contaminated sediments behind these dams may be a concern.

In some instances, dam removal may not be an option if there is a potential for undermining upstream structures constructed after the dam was built. This was not a concern at either the Off-Billington Street or Plymco Dams. A desire to maintain the dam for historic, aesthetic, hydropower, or other reasons is also a consideration. While there is not much interest in preserving the deteriorated Plymco Dam structure, the Off-Billington Street Dam is part of an aesthetically pleasing stone masonry bridge, in which local residents have expressed interest and use as safe access to their homes.

### 2.9.2 Partial Dam Removal / Breach

Where complete dam removal is not possible or needed, partial dam removal is considered. Partial dam removal alternatives include breaching a dam along only a portion of its length while maintaining some or all of the upstream impoundment or lowering the dam's crest.

Partial dam removal can sometimes be less costly than full dam removal while providing many of the same benefits. When contaminated sediments have been identified behind a dam, lowering a dam crest to the level of the accumulated sediments is often a more cost effective solution than full dam removal. Lowering a dam can be done in combination with another fish passage alternative, such as a roughened ramp, bypass channel or fishladder, and will increase the passage efficiency of the chosen alternative. Partial dam removal would restore fish passage, but it may not necessarily restore the natural geometry, flow regime, and system of sediment transport to a river system.

### 2.9.3 High Gradient Riffle/Raise Tailwater

The high gradient riffle alternative is a method of modifying the face of a low head dam to reduce the velocities over the structure and thereby allow for fish passage of certain target species. High-gradient riffles are not appropriate for fish species that are not strong swimmers and may limit the migration of other aquatic species. High gradient

riffles are ramps extending at a slope from the face of the dam in a downstream direction, with large roughness elements placed to further reduce flow velocities. They are usually constructed of rock, logs, concrete, or gabions or a combination of those materials. These structures are designed to mimic natural stream riffles (Hader 1991, Newbury and Gaboury 1988). Roughened ramps can extend across the entire length of a dam or be limited to just a portion of the dam length.

High gradient riffles are sometimes used when a dam is lowered or is left at its original height. Thus, many of the drawbacks outlined in the partial dam removal alternative also applies to a roughened ramp alternative. Similar to these alternatives, the roughened ramp can have a tendency to back up water, collect debris, reduce water quality immediately upstream of the remaining dam, and limit the natural system of sediment transport within the river. The remaining portion of the dam and the roughened ramp would require periodic maintenance. Providing recreational boating passage past a dam modified with a roughened ramp is not always possible.

### 2.9.4 Bypass Channel

Man-made bypass channels may be feasible when complete or partial dam removal is not possible. This is often the case when a large amount of contaminated sediments has accumulated behind the dam or where hydropower facilities are in use. Bypass channels are designed to integrate the many features of a natural river channel, incorporating elements of fluvial geomorphology, open channel hydraulics, and aquatic ecology.

A bypass channel requires that the dam remains in place. As with the partial removal or roughened ramp alternatives, the dam must be well maintained for a bypass channel to work properly. This alternative also has the same drawbacks regarding river restoration as water and sediment remain impounded. Sufficient land area must exist for the bypass channel to be constructed.

### 2.9.5 Fishway

In general, fishways are designed to pass specific species and life stages of fish or a limited group of species. They do not restore the river to its natural condition, and they reestablish only limited fish passage. Aesthetically, they are often less attractive than dam removal, high gradient riffles and bypass channels.

Fishladders require regular maintenance to clean out debris and maintain their structural integrity. Like high gradient riffles and bypass channels, construction of a fishladder requires that the dam be left in place. Therefore, a fishladder is sometimes not feasible if the dam is in a state of severe disrepair or will require costly repairs and/or maintenance. Many of the drawbacks previously outlined for alternatives other than full dam removal also apply to fishladders. As with these alternatives, the fishladder and remaining dam will have a tendency to back up water, collect debris, reduce water quality just upstream of the dam, block recreational boat passage, and limit the natural system of sediment transport within the river.

### 2.9.6 Combination of Methods

Fish passage alternatives can be combined to improve their overall effectiveness. An example of this is combining partial removal of a dam (dam crest lowering) with the construction of a high gradient riffle, bypass channel, or fishladder. Additionally, roughness elements, like those used for the roughened ramp designs, can be used in combination with a variety of other passage alternatives to reduce flow velocities, thereby increasing the potential for passage. A bypass channel can be combined with fishladders to limit the length of the bypass channel required. Fishladders and bypass channels can be used in combination with resting pools to improve passage efficiency.

Depending on the site conditions, there is a large variety of methods that can be combined to improve the efficiency of fish passage at dams. The impacts of combined

methods vary significantly depending on the fish passage methods chosen. The benefits of dam removal would not be met with this alternative and so the drawbacks would be similar to those outlined above for the options other than full dam removal.

### 2.9.7 No Action

The no action alternative, as the name suggests, involves taking no immediate action. This action does not provide any improvement in fish passage, sediment transport, habitat connectivity, or water quality. Under the no action alternative, an impoundment will continue to collect sediment, transitioning from an open water body to a herbaceous wetland, to a shrub swamp, and portions may eventually transition into a forested swamp or even upland.

If no action is taken at all and the dams are abandoned, they can be expected to eventually fail. Depending on the nature of the dam failure, there may be a loss of sediments downstream. An uncontrolled dam failure may also result in a head cut that could continue to migrate upstream, damaging the upstream resources and providing a continual source of sediment downstream. Depending on the presence and size of a head cut after dam failure, fish passage may or may not be possible.

This alternative is the least expensive in the short run, although it can be the most expensive in the long term if the above conditions are to be prevented through either dam maintenance or cleanup costs after a dam failure.

## 3.0 OFF-BILLINGTON STREET DAM: EXISTING CONDITIONS

### 3.1 Site Description

The Off-Billington Street Dam structure is in poor condition. The structure consists of an approximately 110-foot long earth embankment with a concrete and stone masonry spillway. The water surface elevation in the impoundment is maintained by weirboards at the spillway. While evidence of piping through the dam structure was observed and residents report the formation of sink holes in the road that may be further evidence of piping, repair of the structure is a viable alternative. The existing fishladder at the Off-Billington Street Dam has very limited functionality and is in poor condition.

The impoundment formed by the Off-Billington Street Dam shows evidence of aggradation and is obviously retaining silty and sandy sediments. The impoundment will continue to aggrade until the point at which the "pond" will be replaced with a channel naturally formed through the sediment. The existing impoundment supports a variety of warm-water fish species but has limited quality emergent marsh zones.

### 3.2 Hydraulics

The elevation at the top of the spillway weirboards is 64.4 feet NGVD 29. The impoundment invert immediately upstream of the dam is 62.7 feet NGVD. The concrete floor of the spillway ends abruptly just downstream of the face of the dam, at an elevation of 60.9 feet NGVD 29. The water drops 2.6 feet to the downstream channel bed elevation of 58.3 feet NGVD. An aging concrete fishladder runs through the spillway. The upstream invert of the fishladder is 63.75 feet NGVD. The top of the dam embankment is at an elevation of 69 feet NGVD on average.

The Off-Billington Street impoundment is approximately 175 feet wide at its widest point, located approximately 250 feet upstream of the embankment. The impoundment is

approximately 550 feet long, with an area of 1.3 acres at normal pool elevation. The upstream channel invert elevation is 65.27; the impoundment invert immediately upstream of the spillway is approximately 62.5 feet NGVD. The existing slope through the impoundment is 0.50 percent.

Water surface profiles were created from surface elevations calculated by the HEC-RAS model for the Off-Billington Street river reach. A summary of the hydraulic conditions pertaining to fish passage and aquatic habitat is presented in Table 3-1. Figure 3-1 shows the water surface profile for the mean annual and 100-year storm flows calculated under existing conditions.

**TABLE 3-1**

**Off-Billington Street Hydraulic Conditions Under Existing Conditions**

| HEC-RAS River Station | Location | Mean Annual Flood (80 cfs) | | 100-Year Flood (155 cfs) | |
|---|---|---|---|---|---|
| | | Max. Water Depth (ft) | Velocity (ft/s) | Max. Water Depth (ft) | Velocity (ft/s) |
| 0.9835 | U/S Off-Billington Street Dam | 4.61 | 0.15 | 6.10 | 0.21 |
| 0.9715 | U/S Off-Billington Street Dam | 5.91 | 0.11 | 7.40 | 0.16 |
| 0.9598 | U/S Off-Billington Street Dam | 6.04 | 0.09 | 7.53 | 0.14 |
| 0.9524 | U/S Off-Billington Street Dam | 6.37 | 0.09 | 7.86 | 0.14 |
| 0.9398 | U/S Off-Billington Street Dam | 6.39 | 0.10 | 7.88 | 0.16 |
| 0.9279 | U/S Off-Billington Street Dam | 6.82 | 0.15 | 8.31 | 0.23 |
| 0.9216 | U/S Off-Billington Street Dam | 5.67 | 0.41 | 7.16 | 0.60 |
| 0.916 | D/S Off-Billington Street Dam | 1.51 | 6.98 | 2.0 | 10.21 |

As would be expected, water depths within the impoundment generally increase in the downstream direction, and velocities are very low. Downstream of the Off-Billington Street Dam, at River Station 0.916 within the downstream channel, water depths are shallower than those found in the impoundment, and velocities are much higher. This cross section is located immediately downstream of the spillway. Although velocities are limiting to fish passage in this location, fish would not be able to navigate the spillway regardless. The fishladder entrance is located downstream of this location, where velocities are more conducive to fish passage.

## 3.3 Natural and Cultural Resources

### 3.3.1 Wetland and Aquatic Habitat

The impoundment formed by the Off-Billington Street Dam has a limited life span. Significant amounts of sediment have accumulated within the impoundment, such that emergent marsh vegetation has taken root. This vegetation will cause the impoundment to have a greater trapping capacity, accelerating the aggradation process. The impoundment is characterized by elevated temperatures and depleted levels of dissolved oxygen.

The Off-Billington Street impoundment has two distinct wetland communities that include the emergent marsh wetlands and open water. The emergent marsh areas are located along the southern and western edges of the impoundment. These areas are dominated by water willow, pickerelweed, arrow arum, broad-leaved cattail, sensitive fern, soft rush, lurid sedge, reed canary grass, and yellow iris. The open water areas are dominated by submerged aquatic vegetation (SAV), including Eurasian water-milfoil and widgeon grass. A Wood Duck box was observed at the western end of the impoundment.

### 3.3.2 Fisheries

The submerged aquatic vegetation present in the impoundment support warm-water fish species including large and smallmouth bass, chain pickerel, bluegill, pumpkinseed, bullhead, and other warm-water species. These species are not natural to the riverine environment and are present due to the artificial conditions created by the man-made impoundments.

### 3.3.3 Public and Private Use

The Off-Billington Street impoundment is not currently open to the public. The impoundment was formerly used recreationally by local residents before filling with sediment.

## 4.0 OFF-BILLINGTON STREET DAM: SUMMARY OF ALTERNATIVES

Alternate OB-A: No Action

Alternate OB-B: Installation of New Fishladder

Alternate OB-C: Channel / Adjust Downstream Tailwater

Alternate OB-D: Partial Dam Breach

### 4.1 Alternate OB-A: No Action

Under the No Action alternative, the existing impoundment would be maintained. The No Action alternative does not provide for fish passage nor does it improve habitat quality within the impoundment. As the dam and spillway structure would remain in its existing condition, public safety would not be improved. There would be costs associated with maintaining the structure. This alternative does not meet project goals.

### 4.2 Alternate OB-B: Installation of New Fishladder

This alternative would require that the existing dam and spillway structures be repaired. The existing fishladder, which has very limited functionality, would be removed. A new fishladder would be installed. Fishladders typically achieve limited fish passage as compared to other fish passage alternatives and can require intensive maintenance during fish runs due to their propensity to become clogged with debris.

Under this alternative, the impoundment would remain and thus habitat quality would not be improved. Assuming that all necessary repairs were made to the structure, public safety would be increased. The pool will continue to fill with sediment and eventually be wetland. The dam will have to be maintained.

## 4.3 Alternate OB-C: Channel / Adjust Downstream Tailwater

This alternative would require the creation of a channel through the existing impoundment and adjustment of the tailwater downstream of the existing spillway. The concrete spillway apron terminates abruptly at the downstream face of the Off-Billington Street bridge with a 2.6-foot drop from the top of the apron to the channel bottom. A high gradient rock riffle would be installed to overcome this elevation change to provide fish passage. Assuming an upper limit slope of 0.04 ft/ft, this high gradient riffle would need to extend 65 feet downstream. The 0.04 ft/ft slope was analyzed to limit the amount of material that would need to be placed in the channel.

This alternative would provide for fish passage while increasing habitat quality for native species. However, this alternative would still cause habitat fragmentation as some aquatic species would not be able to navigate the high velocities and high slopes encountered on the slope. The weirboards at the existing spillway would be removed to partially drain the pond and reduce the head differential. The bridge structure would be retained and public safety would be improved under this alternative, assuming that all necessary repairs were made to the dam.

Under this alternative, the channel could either be manually excavated or allowed to self form. Based on the chemical and physical profile of the existing sediments, it is very unlikely that the channel would be allowed to self form.

## 4.4 Alternate OB-D: Partial Dam Breach

Partial dam removal refers to the removal of a section of the Off-Billington Street embankment and spillway structure at a width sufficient for the channel and adequate floodplain connectivity. It has been determined that removal of a 40-foot section of the embankment would sustain the nominally 12-foot wide channel with a sufficient floodplain at the crossing.

This alternative would provide for fish passage and would improve upstream habitat quality. This alternative would reconnect this section of channel with its floodplain, providing benefits to local ecology such as exchange of nutrients and increased habitat and shading.

Under this alternative, channel would be formed through the existing impoundment at a slope of 0.8 percent. The proposed channel is of a riffle-pool morphology with a sinuosity of 1.2. The existing Off-Billington Street spillway structure and a 40-foot section of the existing embankment would be removed. As this road is to remain an access to the existing neighborhood, a new single-span structure would replace the removed bridge.

Local residents indicate that two four-inch utility lines traverse the existing impoundment. It will be necessary to field verify the location of these utilities prior to construction.

## 4.5 Other Alternatives Considered and Rejected

Impoundment/Adjust Downstream Tailwater

This alternative consists of retaining the OB impoundment and raising the downstream tailwater to the elevation at the top of the existing weirboards. As mentioned previously, the Off-Billington Street impoundment has a degraded ecological habitat quality. Although this alternative does provide for fish passage past the dam, it would not address improvements to habitat quality. This alternative does not, therefore, meet project goals.

Combination In-pool and Downstream Tailwater Adjustment

This alternative calls for the placement of a major rock structure within the impoundment, such that upstream water levels can be maintained. A ramp structure

would be installed from the upstream impoundment, passing under the Off-Billington Street bridge and continuing downstream.

Similar to the above alternative, while this alternative would provide for fish passage, it would also maintain the impoundment and would not, therefore, improve cold-water stream habitat quality.

## 4.6 Alternatives Summary

Table 4-1 presents the Goal Benefit Matrix for the alternatives discussed above. This matrix is a qualitative assessment of the various alternatives ability to meet the project goals.

**TABLE 4-1**

**Goal Benefit Matrix**

| PERFORMANCE | ALTERNATIVE ACTION | | | | | |
|---|---|---|---|---|---|---|
| | Alternate OB-A No Action | Alternate OB-B Installation of Fishladder | Alternate OB-C Channel / Adjust Tailwater | Alternate OB-D Full Dam Removal | Impoundment / Adjust Tailwater | In-pool and D/S Rock Ramp |
| Provides Fish Passage | No | Limited | Yes | Yes | Yes | Yes |
| Improves Habitat Quality | No | No | Yes | Yes | No | No |
| Increases Public Safety[1] | No | Potentially | Potentially | Yes | Potentially | Potentially |
| Maintains Structure at Off-Billington Street | Yes | Yes | Yes | No | Yes | Yes |
| Constructability | NA | Good | Fair | Fair | Fair | Fair |
| Capital Cost | NA | Moderate | High | High | High | High |
| Maintenance Cost | Moderate | High | Low | Very Low | Moderate | Moderate |
| Meets Project Goals and Objectives | **No** | **Fair** | **Yes** | **Yes** | **Fair** | **Fair** |

Notes:

[1] Assumes that the necessary structural repairs are made during construction of the chosen alternative.

# 5.0 CULVERT: EXISTING CONDITIONS

## 5.1 Site Description

Between the two impoundments, the channel currently passes through approximately 155 feet of culvert, extending beneath the southeast corner of the former Plymco factory building. While this culvert does not physically block fish passage, the low, dark waterway may deter some fish from continuing upstream. Daylighting this culvert would increase habitat quality by returning the closed and covered reach of channel to its natural ecosystem condition. Daylighting alternatives are dependent on the alternative chosen at the Plymco Dam. For example, if the downstream channel is retained in its existing location, the culvert would need to be daylighted in its existing location; if the channel is moved to an alternate location, the channel would also need to be moved to an alternate location when daylighting the culvert. The existing access road passing over the culvert will potentially be abandoned.

## 5.2 Hydraulics

The culvert is nine feet wide at its upstream face and 12 feet wide at its downstream face. The culvert has a slight bend to the west when looking downstream. The upstream invert is at elevation 65.86 feet NGVD29; the downstream invert is at elevation 65.27 feet NGVD29. The total length of the culvert is approximately 155 feet. The slope through the culvert is 0.4 percent.

Table 5-1 presents existing conditions HEC-RAS model results for the culvert.

**TABLE 5-1**

**Culvert Existing Conditions HEC-RAS Results**

| HEC-RAS River Station | Location | Mean Annual Flood (80 cfs) | | 100-Year Flood (155 cfs) | |
|---|---|---|---|---|---|
| | | Max. Water Depth (ft) | Velocity (ft/s) | Max. Water Depth (ft) | Velocity (ft/s) |
| 1.0507 | U/S Culvert | 4.15 | 1.48 | 10.26 | 0.81 |
| 1.0112 | D/S Culvert | 4.13 | 1.46 | 10.26 | 0.80 |

## 5.3 Fisheries and Aquatic Habitat

Town Brook serves as the primary hydrologic connection between the Plymco and Off-Billington Street impoundments. The watercourse on the downstream side of the upper impoundment, upstream of the culvert, is linear and appears channelized. The watercourse is defined by abrupt banks that are thickly vegetated. Anthropogenic activities have degraded this stretch of the watercourse. Garbage and other debris are found scattered throughout the riparian zone. Most of the understory vegetation is nonnative invasive species such as multiflora rose and oriental bittersweet. The overstory is dominated by box elder, red maple, and black cherry. A deteriorating concrete bridge was observed spanning the brook. The culvert has a natural channel bottom and appears to be free flowing and well oxygenated. However, the dark, enclosed culvert would present a deterrent to fish migration and is prone to debris blockage. The fishery and wildlife habitat within this stretch of the brook is low.

## 6.0 CULVERT: ALTERNATIVES ANALYSIS

Alternate C-A: No Action
Alternate C-B: Daylight in Existing Location
Alternate C-C: Daylight in Parallel Alternate Location
Alternate C-D: Partial Daylight

### 6.1 Alternate C-A: No Action

Under this alternative, it would be necessary to perform a detailed inspection of the culvert to determine necessary repairs and to ensure that the culvert was in safe and functioning condition. The culvert may deter some fish from migrating further upstream.

### 6.2 Alternate C-B: Daylight in Existing Location

This alternative would by necessity be in conjunction with maintaining the channel through the Plymco Dam in the existing location. This alternative would provide for fish passage and increase habitat quality. As at the Plymco Dam, this alternative would present a difficulty to construct in that the channel would need to be controlled and routed during construction.

### 6.3 Alternate C-C: Daylight in Parallel Alternate Location

This alternative would be less difficult to construct as the channel could be dug in the dry. Habitat quality would be improved under this alternative.

### 6.4 Alternate C-D: Partial Daylight

The culvert length and "tunnel-like" waterway could be partially daylighted. One potential partial daylight location is to relocate the channel around the factory, abandoning approximately 100 feet of the culvert.

The ease of construction of this alternative is dependent upon the final location of the daylighted section of channel. If the channel is to be constructed in the location of the existing culvert, a temporary water bypass will need to be set up. Construction under this scenario would be more complicated than if the channel were moved to an alternate location. In this case, the main channel could continue to flow during construction. Flow would be diverted to the new channel after completion of construction, allowing for construction "in the dry."

## 6.5 Alternatives Summary

Table 6-1 presents the Goal Benefit Matrix for the culvert alternatives discussed above. This matrix is a qualitative assessment of the ability of the various alternatives to meet the project goals.

**TABLE 6-1**

**Culvert Goal / Benefit Matrix**

| PERFORMANCE | ALTERNATIVE ACTION | | | |
|---|---|---|---|---|
| | No Action | Daylight Channel in Existing Location | Daylight Channel in Alternate Location | Partial Daylight |
| Improves Habitat Quality | No | Yes | Yes | Moderately |
| Constructability | NA | Fair | Good | Good[1] |
| Capital Cost | NA | Relatively High | Relatively High | Moderate |
| Maintenance Cost | Moderate | Very Low | Very Low | Low |
| Meets Project Goals and Objectives | **No** | **Yes** | **Yes** | **Fair** |

Notes:

[1] The ease of construction is dependent upon the location of the partial daylight. See discussion.

# 7.0 PLYMCO DAM: EXISTING CONDITIONS

## 7.1 Site Description

The Plymco Dam structure is in poor condition. The structure consists of an approximately 200-foot long earthen embankment with a concrete box spillway. A 4.4-foot diameter corrugated metal pipe extends from the downstream face of the spillway. Water exits over a four-foot drop to the channel below. The structure shows major leakage through the left abutment, through remnants of the former mill building. Timber weirboards raise ponded water levels two feet above the concrete weir sill. The access road over the spillway structure frequently has potholes and sink holes, which may be evidence of severe piping or settlement through the outlet structure. Both a water service and a sewer service line run through the spillway structure. These lines are entirely exposed and are vulnerable to freezing and bursting as well as being damaged during heavy storm events. The existing fishladder is in fair condition with only minor evidence of cracking and seepage. This fishladder likely provides limited fish passage.

## 7.2 Hydraulics

The top of the dam embankment is at an average elevation of 82.0 feet NGVD29. The impoundment elevation immediately upstream of the Plymco spillway is approximately 76 feet NGVD29. Wierboards at the spillway inlet are separated into three sections with concrete columns. At the time of observation, the left section was completely sealed with weirboards. The middle section had a three-inch opening above the weirboards. The top of the weirboards in this section are at an elevation of 79.1 feet NGVD29. The right section opens to the fishladder. The majority of flow was passing through the fishladder at the time of observation. The upstream invert of the fishladder is at elevation 77.3 feet NGVD29.

Flow exits the spillway box structure through a 52-inch diameter corrugated metal pipe (CMP) that extends out from the face of the spillway. Water then drops 5.1 feet vertically to the channel bottom invert of 67.54 feet NGVD29. The total change in elevation between the top of the weirboards and the downstream channel is 11.6 feet. The change in elevation between the upstream impoundment invert and the downstream channel is 8.8 feet.

The impoundment is approximately 220 feet wide at its widest point, but only 30 feet wide at its upstream end. The distance through the impoundment is approximately 550 feet; the total impoundment area is 1.5 acres at normal pool elevation. The upstream channel invert is 77.28 feet NGVD. The impoundment invert immediately upstream of the dam is 76.0 feet NGVD. The existing slope through the impoundment is 0.23 percent. The straight-line slope between the upstream existing channel invert elevation and the existing downstream channel invert elevation is 1.7 percent.

Water surface profiles were created from surface elevations calculated by the HEC-RAS model for the Off-Billington Street river reach. A summary of the hydraulic conditions pertaining to fish passage and aquatic habitat is presented in Table 7-1. The values representing barriers to fish migration are highlighted. Detailed output produced by the model is included in Appendix E. Figure 6-1 shows the water surface profile for the mean annual and 100-year storm flows calculated under existing conditions.

**TABLE 7-1**

**Plymco Hydraulic Conditions Under Existing Conditions**

| HEC-RAS River Station | Location | Mean Annual Flood (80 cfs) | | 100-Year Flood (155 cfs) | |
|---|---|---|---|---|---|
| | | Max. Water Depth (ft) | Velocity (ft/s) | Max. Water Depth (ft) | Velocity (ft/s) |
| 1.1837 | D/S Billington Street | 5.36 | 0.42 | 5.59 | 0.77 |

| | | | | | |
|---|---|---|---|---|---|
| 1.1734 | D/S Billington Street | 5.40 | 0.30 | 5.63 | 0.55 |
| 1.1598 | D/S Billington Street | 5.71 | 0.23 | 5.94 | 0.42 |
| 1.1516 | D/S Billington Street | 5.50 | 0.16 | 5.73 | 0.30 |
| 1.1370 | U/S Plymco Dam | 6.36 | 0.10 | 6.59 | 0.19 |
| 1.1255 | U/S Plymco Dam | 6.27 | 0.08 | 6.50 | 0.16 |
| 1.0985 | U/S Plymco Dam | 6.83 | 0.08 | 7.06 | 0.14 |
| 1.0834 | D/S Plymco Dam | 2.65 | 3.32 | 8.67 | 1.22 |
| 1.0788 | D/S Plymco Dam | 2.69 | 3.0 | 8.75 | 1.32 |
| 1.0694 | D/S Plymco Dam | 4.0 | 1.85 | 10.08 | 0.84 |

As with Off-Billington Street, water depths within the impoundment generally increase in the downstream direction, and velocities are very low. Downstream of the Plymco Dam, within the channel section between the dam and culvert, water depths are shallower than those found in the impoundment, and velocities are much higher.

## 7.3 Natural and Cultural Resources

### 7.3.1 Fisheries

The submerged aquatic vegetation present in the impoundment supports warm-water fish species including large and smallmouth bass, chain pickerel, bluegill, pumpkinseed, bullhead, and other warm-water species. However, the shallow pond is also suspected to raise water temperature and deter organic native cold-water fish.

### 7.3.2 Wetland and Aquatic Habitat

As with the Off-Billington Street impoundment, the Plymco impoundment has a limited life span, characterized by elevated temperatures and depleted levels of dissolved oxygen.

The Plymco impoundment has two primary wetland habitats including open water and emergent marsh systems. The emergent marsh habitat is located along the southern, northern, and western edges of the impoundment. The remaining areas are open water habitats dominated by floating and submerged aquatic vegetation (SAV).

The emergent marsh habitats are dominated by a combination of herbaceous plants and shrubs including water willow, northern arrowwood, pickerelweed, arrow arum, broad-leaved cattail, sensitive fern, soft rush, lurid sedge, reed canary grass, and yellow iris. The emergent marsh areas provide refuge for several amphibians including pickerel frogs, green frogs, spring peepers, and bull frogs. In addition, this area is utilized by painted turtles, snapping turtles, water snakes, odonates (e.g., damselflies and dragonflies), coleopterans (e.g., beetles), and other invertebrates. Wading birds such as great blue herons were observed within the emergent marsh habitat. Mammals that may utilize the impoundment include raccoon and muskrat.

The open water habitat which has a water depth ranging between four to six feet is carpeted by thick mats of SAV including coon tail, wild celery, and Eurasian water-milfoil. The Eurasian water-milfoil is a nonnative invasive species that often forms dense mats that shade out native aquatic vegetation. This SAV habitat provides refuge for several fish species including large and smallmouth bass, chain pickerel, bluegill, pumpkinseed, bullhead, and other warm-water species. SAV (e.g., wild celery) also provides important food sources for waterfowl and waterbirds including mute swans, Canada geese, and mallards. It has also been found that SAV may also absorb excessive nutrients from the water column and provide other stormwater quality renovation.

### 7.3.3 Public and Private Use

The Plymco impoundment is not currently open to the public. The impoundment is occasionally used recreationally by local residents.

# 8 PLYMCO DAM: ALTERNATIVES ANALYSIS

Alternate P-A: No Action

Alternate P-B: Dam Breach at Existing Channel Location

Alternate P-C: Dam Breach at Alternate Channel Location

Alternate P-D: Full Dam Removal

## 8.1 Alternate P-A: No Action

The No Action alternative is not a prudent alternative for the Plymco Dam. The Plymco spillway shows major signs of seepage, sink holes, and deterioration. At the minimum, the spillway structure requires repairs to be safe for vehicle traffic. The No Action alternative does not provide fish passage, improve habitat conditions, or increase public safety. This alternative does not meet project goals.

## 8.2 Alternate P-B: Partial Dam Breach at Existing Channel Location

Under this alternative, a channel would be formed through the location of the existing spillway, connecting with the proposed channel for the Off-Billington Street reach. The spillway and a 40-foot section of the earthen embankment would be removed. A new single span bridge structure would replace the existing structure to maintain access at this location to the adjacent neighborhood.

The existing utilities passing through the Plymco Dam would need to be maintained. The utility lines could be relocated in conjunction with construction of the new bridge.

This alternative would present more of a challenge to construct than breaching the dam in an alternate location. It would be necessary to bypass water flow around the existing channel and structure during construction. This alternative would also impact the existing abandoned Plymco factory building. It would be necessary to remove at least a

portion of the existing building for construction of the channel through the culvert reach. These activities would need to be coordinated with the current landowners at the time of design and construction.

Assuming a sinuosity of 1.2, the channel slope through the Plymco impoundment would be approximately 0.014 ft/ft. Habitat quality would be improved based on creation of a channel, which would maintain lower water temperatures and higher dissolved oxygen concentrations than the existing impoundment. Habitat conditions of this type would favor cool water fish species, improving conditions for native cool water fish species such as brook trout.

## 8.3 Alternate P-C: Dam Breach at Alternate Channel Location

This alternative is essentially the same as above. The notable exception is that under this alternative the channel would be routed around the existing factory building such that the building could remain intact in its current location. All other elements as discussed for Alternative P-B apply.

## 8.4 Alternate P-D: Full Dam Removal

Figure 8-2 graphically depicts this alternative. Full dam removal refers to the removal of the entire Plymco embankment and spillway structure. Based on the ability to attain project goals with a partial dam removal, the added expense and complexity of full dam removal was not deemed necessary.

## 8.5 Other Alternatives Considered and Rejected

*Bypass Channel*

There is significant elevation change at the Plymco dam between the upstream pond bed elevation and the downstream channel bed elevation. The total elevation change between

the two locations is in excess of 8.5 feet. To overcome this elevation change, a bypass channel at a 0.01 ft/ft slope would need to be over 850 feet long. Even at 0.03 ft/ft slope, the channel would need to be almost 300 feet long. This length is too excessive for the project site. Installation of a bypass channel is not a viable alternative at the site.

*Repair Fishladder*

The fishladder at the Plymco Dam is in fair condition. It could be maintained with only minor repairs. This fishladder likely has limited functionality and would not represent the most effective means of providing fish passage. Under this alternative, all necessary repairs to the Plymco Dam and spillway structure would be made, which would be costly. This alternative would not improve habitat quality for either target fish species or other area wildlife that are negatively affected by its continued presence. This alternative was ranked as moderately meeting project goals.

*Raise Tailwater*

A rock riffle through the Plymco spillway, assuming an upper limit of 0.04 ft/ft slope, and assuming that the impoundment is drained in favor of a channel would need to be over 200 feet long. Although sufficient length exists at the project site, a riffle of this length would require extensive amounts of fill material. Insufficient length exists to create a rock ramp that maintains the pond as this ramp would need to overcome an elevation change of 14.5 feet, requiring a length of over 360 feet. Under this alternative, the existing spillway structure would be retained, necessitating costly repairs, but also increasing public safety. Fish passage would be provided, and habitat quality would be improved. This alternative is ranked as moderately meeting project goals.

## 8.6 Alternatives Summary

Table 8-1 presents the Goal Benefit Matrix for the Plymco Dam alternatives discussed above. This matrix is a qualitative assessment of the ability of the various alternatives to meet the project goals.

**TABLE 8-1**
**Goal Benefit Matrix**

| PERFORMANCE | ALTERNATIVE ACTION | | | | | | |
|---|---|---|---|---|---|---|---|
| | Alternate P-A No Action | Alternate P-B Breach Dam at Existing Location | Alternate P-C Breach Dam at Alternate Location | Alternate P-D Full Dam Removal | Bypass Channel [1] | Repair Fishladder and Dam | Raise Tailwater |
| Provides Fish Passage | Limited | Yes | Yes | Yes | | Limited | Yes |
| Improves Habitat Quality | No | Yes | Yes | Yes | | No | Yes |
| Increases Public Safety[2] | No | Potentially | Potentially | Potentially | | Yes | Potentially |
| Constructability | NA | Fair | Good | Good to Fair[3] | | NA | Fair |
| Capital Cost | NA | High | High | + | | Moderate | High |
| Maintenance Cost | High | Very Low | Very Low | - | | High | Low |
| Meets Project Goals and Objectives | No | Yes | Yes | No | No | Fair | Yes |

Notes:

[1] A bypass channel is not a viable alternative at the project site.

[2] Assumes that the necessary structural repairs are made during construction of the chosen alternative.

[3] The constructability of this alternative depends on the location and method of construction of the channel through the impoundment. See discussion.

## 9.0 ANALYSIS OF CHOSEN ALTERNATIVES

A HEC-RAS hydraulic model was developed to assess fish passage performance, flooding, and sediment transport for three composite alternatives inclusive of both dams and the culvertized section of the Town Brook channel. A summary of the three composite alternatives is given below. The alternatives are described and the analyses are discussed in the following sections.

| Alternative | Description |
|---|---|
| Alternative 1 | Alternate OB-D: Partial Dam Breach<br>Alternate C-B: Daylight in Existing Location<br>Alternate P-B: Dam Breach at Existing Channel Location |
| Alternative 2 | Alternate OB-D: Partial Dam Breach<br>Alternate C-B: Daylight in Alternate Location<br>Alternate P-B: Partial Dam Breach in Alternate Channel Location |
| Alternative 3 | Alternate OB-D: Raise Downstream Tailwater at Off-Billington Street Dam<br>Alternate C-B: Daylight in Existing Location<br>Alternate P-B: Partial Dam Breach in Existing Channel Location |

### 9.1 Composite Alternative 1: Partial Dam Breach of Off-Billington Street Dam, Daylight Culvert in Existing Location, Partial Dam Breach of Plymco Dam in Existing Location

This alternative is graphically depicted in Appendix E Sheet 06 (plan) and 07 (profile). Alternative 1 consists of the following composite of alternatives:

Alternate OB-D: Partial Dam Breach

Alternate C-B: Daylight in Existing Location

Alternate P-B: Dam Breach at Existing Channel Location

This alternative consists of a partial dam breach at the Off-Billington Street Dam, daylighting of the section of channel that currently passes through the existing culvert in its existing location, and a partial dam breach at the Plymco Dam in the location of the existing culvert. The intent of this alternative is to provide fish passage for diadromous and resident species, to improve river continuity and riverine habitat, to improve dam safety, and to minimize the potential negative impacts to upstream cranberry bogs. This alternative would require a total excavation volume of 7,650 cubic yards for the channel and floodplain.

At the Off-Billington Street Dam, this alternative involves removal of a 40-foot section of the dam embankment, the existing dam spillway, and the existing stone masonry bridge. The existing bridge is to be replaced with a 40-foot single span bridge that will allow the channel floodplain access.

The proposed channel through the Off-Billington Street impoundment is of a riffle-pool configuration. A channel would be excavated through the existing impounded sediments at a nominal slope of 0.009 ft/ft. Sediments would be excavated to form the channel to the depth of the predam ground/channel surface. This would require excavation depths of up to four feet. The channel will meet the downstream channel bed elevation approximately 10 feet downstream of the downstream face of the existing bridge structure. The modeled channel in this reach has a sinuosity of 1.24 and a total length of 675 feet. Approximately four major riffle sections have been designed into the channel, with associated upstream pools at meander bends.

Daylighting the channel in the location of the existing culvert would impact the existing Plymco factory building. Under this alternative, it would be necessary to remove this existing building. From the downstream face of the Plymco Dam to the downstream face of the existing culvert, the total channel length through this section is 361 feet. The channel in this reach has a sinuosity of 1.1 and a nominal slope of 0.009 ft/ft. One major riffle section is present in this reach. Daylighting the channel through this section would

consist of removal of the existing culvert, grading the banks as necessary, and minor channel excavation. The design channel through this reach essentially matches the grade of the existing channel inverts, such that only minor excavation and modification to the channel invert would be necessary through this reach. Modifications to channel substrate would be necessary in which the existing cobble would be relocated to the riffles and the pools would be supplied with sand and gravel substrate.

At the Plymco Dam, this alternative involves removal of a 40-foot section of the dam embankment and the existing spillway structure. The existing bridge is to be replaced with a 40-foot single span bridge that will allow the channel access to its floodplain.

Through the Plymco impoundment, a channel would again be formed through excavation of the existing impounded sediments to the elevation of the predam channel/ground surface. This would require excavation depths of up to five feet. The design channel is at a nominal slope of 0.014 ft/ft and a sinuosity of 1.2 through this reach. As with the Off-Billington Street impoundment, this channel section is also of riffle-pool morphology, with approximately four major riffle sections through the reach, with associated upstream pooling at meander bends.

A series of rock vanes are proposed to maintain water surface elevations both at the Billington Street culvert as well as for the existing upstream cranberry bogs. The hydraulics of the proposed vanes are discussed in more detail in Section 11.1 Recommended Alternative. One vane is proposed downstream of the Billington Street culvert; the remaining vanes are placed upstream of the Billington Street culvert, set two to three channel lengths (60-90 feet) apart. The use of rock vanes is one possible means to maintain upstream water surface elevations. Another alternative would be to increase the slope of the channel through the impoundments. In this analysis, an attempt was made to set the channel slope in such a way that the existing predam channel substrate was stable under the existing flow regime. Increasing the channel slope may simply

require that the channel be supplied with larger, non-native substrate in order to remain stable.

### 9.1.1 Proposed Channel Morphology, Planform, and Dimension

A HEC-RAS model of proposed conditions was prepared for this alternative. The design channel morphology and planform, as discussed in Section 2.3.2 Proposed Channel, was used to create the design channel in AutoCAD. From this input, a surface was created in AutoCAD that combined the existing topography for all regions outside of the channel and the design channel topography for all channel areas. Cross sections were exported from this surface to HEC-RAS. Once the exported cross sections were determined to be accurate and all necessary minor modifications completed, the HEC-RAS model was completed by adjusting Manning's n coefficients, downstream reach lengths, and expansion and contraction coefficients. Model output is included in Appendix C.

Different labeling conventions were used for the existing and proposed conditions models. The existing conditions HEC-RAS model stationed the channel beginning at the furthest downstream extent at Plymouth Harbor increasing upstream with labeling in fractions of a mile. In the proposed conditions model, new cross sections were labeled as integers starting at River Station 1 at a cross section approximately 50 feet downstream of the downstream face of the Off-Billington bridge and increasing upstream along the proposed channel to River Station 68 at the downstream face of the Billington Street culvert. River station labeling downstream of the proposed channel reach was retained as in the existing conditions HEC-RAS model; river station labeling upstream of the proposed channel reach was renumbered based on reach length.

### 9.1.2 Fish Passage and Riparian Habitat

Table 9-1 presents the computed maximum channel depths for Alternative 1 proposed conditions.

Depth over riffles should be greater than a minimum of 0.01 feet (5 cm) to support macroinvertebrate activity and spawning habitat. The optimum depth of water over riffles to support fisheries habitat is between six and 12 inches during spring flows. Riffle depth varies between 0.39 and 0.76 feet (4.7 and 9.1 inches) under spring flows. Under summer flows, flow depth varies between 0.2 and 0.41 feet (2.4 and 4.9 inches). Summer flows are adequate to sustain fisheries habitat, wherein pools will provide depth and cover for resident species. Pools are typically 2.5 to three feet deep. Final depth of flow over riffles and depths of pools can be adjusted during the design phase to optimize fisheries and riverine habitat. Final adjustments to the total channel width, bank side-slope, and low-flow channel dimensions, for instance, can be used to create a channel with optimized flow characteristics.

## TABLE 9-1

### Maximum Water Depth Alternative 1 Proposed Conditions

| River Station Proposed Conditions | Location | Maximum Water Depth (ft) | |
|---|---|---|---|
| | | Spring (22cfs) | Summer (8 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 3.17 | 2.94 |
| 274 | Immediately D/S 4th weir | 2.98 | 2.68 |
| 194.21 | Immediately U/S 3rd weir | 2.98 | 2.68 |
| 189 | Immediately D/S 3rd weir | 2.41 | 1.99 |
| 133 | Immediately U/S 2nd weir | 2.41 | 1.99 |
| 129 | Immediately D/S 2nd weir | 1.90 | 1.67 |
| 119.58 | Immediately U/S Billington Street Culvert | 1.89 | 1.67 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 2.10 | 1.89 |
| 67 | Immediately D/S Weir #1 | 0.43 | 0.22 |
| 64 | Head of Riffle | 0.48 | 0.25 |
| 63 | Mid-riffle | 0.67 | 0.38 |
| 62.5 | Tail of Riffle | 0.62 | 0.37 |
| 59 | Pool | 2.48 | 2.20 |
| 57 | Head of Riffle | 0.45 | 0.22 |
| 56.5 | Mid-riffle | 0.64 | 0.34 |
| 56 | Tail of Riffle | 0.53 | 0.30 |
| 40 | U/S Face Plymco Dam | 0.39 | 0.25 |
| 39 | D/S Face Plymco Dam | 0.38 | 0.24 |
| 31 | Mid-culvert | 0.50 | 0.27 |
| 23 | Pool | 2.90 | 2.66 |
| 21 | Head of Riffle | 0.46 | 0.26 |
| 20.5 | Mid-Riffle | 0.39 | 0.20 |
| 20 | Tail of Riffle | 0.76 | 0.41 |
| 5 | U/S Face Off-Billington Dam | 0.86 | 0.51 |
| 4 | D/S Face Off-Billington Dam | 0.56 | 0.30 |
| 1 | 100' D/S Off-Billington Dam | 3.17 | 2.94 |

Channel velocities support the range of sustained swimming speeds for the target species of river herring and resident brook trout. Velocities range from 0.33 to 4.41 feet per second (fps) under spring flows and 0.14 to 2.95 fps under summer flows.

## TABLE 9-2

## Channel Velocity Alternative 1 Proposed Conditions

| River Station Proposed Conditions | Location | Velocity (feet / second) | |
|---|---|---|---|
| | | Spring (22cfs) | Summer (8 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 0.48 | 0.20 |
| 274 | Immediately D/S 4th weir | 0.36 | 0.16 |
| 194.21 | Immediately U/S 3rd weir | 0.36 | 0.16 |
| 189 | Immediately D/S 3rd weir | 0.49 | 0.25 |
| 133 | Immediately U/S 2nd weir | 0.50 | 0.25 |
| 129 | Immediately D/S 2nd weir | 0.76 | 0.35 |
| 119.58 | Immediately U/S Billington Street Culvert | 0.76 | 0.35 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 0.74 | 0.33 |
| 67 | Immediately D/S Weir #1 | 3.57 | 2.62 |
| 64 | Head of Riffle | 3.76 | 2.77 |
| 63 | Mid-riffle | 2.54 | 1.72 |
| 62.5 | Tail of Riffle | 2.74 | 1.74 |
| 59 | Pool | 0.44 | 0.19 |
| 57 | Head of Riffle | 2.69 | 2.07 |
| 56.5 | Mid-riffle | 1.96 | 1.37 |
| 56 | Tail of Riffle | 3.84 | 2.77 |
| 40 | U/S Face Plymco Dam | 4.23 | 2.41 |
| 39 | D/S Face Plymco Dam | 4.41 | 2.58 |
| 31 | Mid-culvert | 3.71 | 2.78 |
| 23 | Pool | 0.33 | 0.14 |
| 21 | Head of Riffle | 2.36 | 1.61 |
| 20 | Tail of Riffle | 3.46 | 2.52 |
| 5 | U/S Face Off-Billington Dam | 2.05 | 1.42 |
| 4 | D/S Face Off-Billington Dam | 1.97 | 1.38 |
| 1 | 100' D/S Off-Billington Dam | 3.98 | 2.95 |

### 9.1.3 Flood Flows

Due to the large amount of attenuation in the upper watershed, predicted water surface elevations for the 10- and 100-year events do not differ greatly and generally differ by approximately 0.3 feet (3.6 inches). Overtopping of Billington Street at the upstream end of the project reach is not predicted. Billington Street in this location is at elevation 85.0 feet NGVD29; predicted water surface elevations immediately upstream of the Billington Street culvert are 79.73 feet and 80.01 feet NGVD29 for the 10- and 100-year flows, respectively. Likewise, flooding of Billington Street parallel to the project reach is not predicted under proposed conditions. This street runs from elevation 76.0 feet NGVD29 adjacent to Off-Billington Street to elevation 85.0 feet NGVD29 at the upstream extent of the project reach. Due to the fact that the proposed channel is to be excavated to predam surface, the predicted water surface elevations are 10 feet and greater below the elevation of this road. Removal of the subject dams greatly decreases the risk of flooding of the adjacent roads in this location. Table 9-3 gives predicted water surface elevations associated with the 10- and 100-year events.

## TABLE 9-3
## Alternative 1 Flood Water Surface Elevations

| River Station Proposed Conditions | Location | Water Surface Elevation (ft, NGVD29) | |
|---|---|---|---|
| | | 10-Year (116cfs) | 100-Year (155 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 80.52 | 80.73 |
| 274 | Immediately D/S 4th weir | 80.35 | 80.58 |
| 194.21 | Immediately U/S 3rd weir | 80.34 | 80.56 |
| 189 | Immediately D/S 3rd weir | 80.31 | 80.52 |
| 133 | Immediately U/S 2nd weir | 80.30 | 80.50 |
| 129 | Immediately D/S 2nd weir | 79.74 | 80.03 |
| 119.58 | Immediately U/S Billington Street Culvert | 79.73 | 80.01 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 79.53 | 79.69 |
| 67 | Immediately D/S Weir #1 | 78.46 | 78.83 |
| 64 | Head of Riffle | 77.95 | 78.23 |
| 63 | Mid-riffle | 77.23 | 77.51 |
| 62.5 | Tail of Riffle | 76.94 | 77.12 |
| 59 | Pool | 75.26 | 75.57 |
| 57 | Head of Riffle | 75.02 | 75.31 |
| 56.5 | Mid-riffle | 74.86 | 75.16 |
| 56 | Tail of Riffle | 74.14 | 74.40 |
| 40 | U/S Face Plymco Dam | 69.58 | 69.86 |
| 39 | D/S Face Plymco Dam | 68.76 | 68.99 |
| 31 | Mid-culvert | 66.64 | 66.88 |
| 23 | Pool | 64.03 | 64.24 |
| 21 | Head of Riffle | 63.63 | 63.84 |
| 20 | Tail of Riffle | 62.37 | 62.70 |
| 5 | U/S Face Off-Billington Dam | 60.09 | 60.41 |
| 4 | D/S Face Off-Billington Dam | 60.09 | 60.42 |
| 1 | 100' D/S Off-Billington Dam | 59.31 | 59.58 |

## TABLE 9-4

### Alternative 1 Flood Velocities

| River Station Proposed Conditions | Location | Velocity (feet / second) | |
|---|---|---|---|
| | | 10-Year (116cfs) | 100-Year (155 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 1.68 | 2.04 |
| 274 | Immediately D/S 4th weir | 1.08 | 1.30 |
| 194.21 | Immediately U/S 3rd weir | 1.08 | 1.30 |
| 189 | Immediately D/S 3rd weir | 1.56 | 1.90 |
| 133 | Immediately U/S 2nd weir | 1.57 | 1.91 |
| 129 | Immediately D/S 2nd weir | 2.09 | 2.39 |
| 119.58 | Immediately U/S Billington Street Culvert | 2.15 | 2.47 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 2.37 | 2.88 |
| 67 | Immediately D/S Weir #1 | 4.00 | 4.20 |
| 64 | Head of Riffle | 6.27 | 6.80 |
| 63 | Mid-riffle | 4.72 | 5.23 |
| 62.5 | Tail of Riffle | 5.57 | 6.48 |
| 59 | Pool | 1.42 | 1.70 |
| 57 | Head of Riffle | 3.97 | 4.26 |
| 56.5 | Mid-riffle | 3.44 | 3.80 |
| 56 | Tail of Riffle | 6.02 | 6.50 |
| 40 | U/S Face Plymco Dam | 8.11 | 8.76 |
| 39 | D/S Face Plymco Dam | 6.28 | 7.23 |
| 31 | Mid-culvert | 5.80 | 6.22 |
| 23 | Pool | 1.18 | 1.45 |
| 21 | Head of Riffle | 4.91 | 4.92 |
| 20 | Tail of Riffle | 3.57 | 3.84 |
| 5 | U/S Face Off-Billington Dam | 3.91 | 4.40 |
| 4 | D/S Face Off-Billington Dam | 3.46 | 3.78 |
| 1 | 100' D/S Off-Billington Dam | 6.31 | 6.91 |

Predicted velocities range from 1.08 to 8.11 feet per second (fps) for the 10-year event and from 1.30 to 8.76 cfs under the 100-year event. Due to the large amount of attenuation in the upper watershed, the difference in discharge between the 10- and 100-year events is minimal, such that it results in velocities profiles that are very similar.

### 9.1.4 Sediment Stability and Transport Analysis

Sediment Stability of Proposed Channel

A sediment stability analysis was conducted to verify the stability of channel substrate as well as to identify the need for bank protection measures and to appropriately size channel substrate where necessary.

The channel velocity and generated shear stress typically support one-inch to four-inch pebble/cobble over the riffles and coarse sand and gravel in the pools under normal flow conditions. Table 9-5 gives the Permissible Shear Stress for a variety of channel substrates. These values allow us to assess the erodibility of various substrates under proposed channel conditions. Refer to Section 2.5 Sediment Stability and Transport for a discussion of sediment stability theory and application. Table 9-5 also lists Permissible Shear Stress for a variety of bank stability treatments.

**TABLE 9-5**
**Permissible Shear Stress by Boundary Category**

| Boundary Category | Permissible Shear Stress[1] (lb/sq ft) |
|---|---|
| Fine colloidal sand | 0.02 – 0.03 |
| 1-in. pebble | 0.33 |
| 2-in. pebble | 0.67 |
| 6-in. cobble | 2.0 |
| 12-in. cobble | 4.0 |
| Long native grasses | 1.2 - 1.7 |
| Coconut fiber with net | 2.25 |
| Live fascine | 1.25 – 3.10 |
| Live willow stakes | 2.10 – 3.10 |
| Temporary RECP, Fully Vegetated | 8.0 – 21.0 |

[1] Fischenich, Craig. 2001.

Tables 9-6 and 9-7 give the HEC-RAS computed minimum, average, and maximum channel shear stresses for proposed riffles for the mean annual, 10- and 25-year events.

The complete HEC-RAS output can be found in Appendix F. Computed channel shear stress for mean annual flow over the riffles ranges from 0.14 to 1.6 lb/sq. ft., with an average of 0.89 lb/sq. ft. These shear stresses generally support the one-inch to four-inch pebble/cobble size class, with smaller fractions of channel substrate over the riffles in the smaller (less than one inch) size class. Adjustment of riffle substrate is to be expected under larger storm events, such as the 10-year and 25-year storms. During these flow events, transport of the smaller size classes and adjustment of the larger size classes is likely.

**TABLE 9-6**
**Riffle Average HEC-RAS Computed Shear Stress**

| Return Interval | Channel Shear Stress (lb/sq ft) | | |
|---|---|---|---|
| | Minimum | Average | Maximum |
| Mean Annual | 0.14 | 0.89 | 1.6 |
| 10-year | 0.21 | 1.03 | 1.69 |
| 25-year | 0.23 | 1.05 | 1.74 |

Sediment Transport

*Sediment Yield*

The Town Brook mean annual sediment yield is important information used to assess probable background conditions and the potential impact of releasing sediments stored in the dam impoundments. There are no long-term measurements of total suspended solids on Town Brook. Therefore, its sediment yield has been estimated based on gauges in other New England watersheds. A compilation of this data from USGS records indicate that sediment yields vary from 25 to 150 tons per year per square mile of watershed area, with many values ranging from 50 to 75 tons per year per square mile. Based upon the characteristics of and soil types in the Town Brook watershed, a sediment yield of 50 tons per year per square mile was assumed.

Based on a yield of 50 tons per year per square mile and a watershed 6.0 square miles in size, the annual load of solids is calculated to be 300 tons per year. At a typical density of 75 pounds per cubic foot for loose fine sediments, each ton is estimated to equal one cubic yard of material. The total sediment volume generated by the watershed on an annual basis is, therefore, 300 cubic yards. The estimated volume of impounded sediments is 6,000 cubic yards and 8,000 cubic yards in the Off-Billington Street and Plymco impoundments, respectively. Based upon the estimated watershed sediment yield, the impoundment material is approximately equivalent to 20 and 27 years' supply of sediment in the Off-Billington and Plymco impoundments, respectively, assuming a 100% trap efficiency. However, a trap efficiency of 100% is unlikely, in which case the sediment deposits in the reservoirs are indicative of a much greater depositional period.

*Reservoir Trap Efficiency*

The ability of the Off-Billington Street and Plymco impoundments to trap sediments is clearly evidenced by the volumes of impounded sediments. By estimating the trap efficiency of the impoundments, it is possible to determine the relative volume of the total watershed sediment yield that is delivered downstream under existing conditions. The impact of the proposed conditions on downstream sediment migration can be determined through comparison of this value to the volume of sediment expected to migrate through the project reach under proposed conditions.

A number of methods exist by which the reservoir trap efficiency may be calculated. The Reservoir Trap Efficiency Curve adapted from Brune (BOR, 1974) presents a set of empirically derived envelope curves for use with normal impounded reservoirs (as opposed to desilting basins or semidry reservoirs) using a capacity-inflow relationship. Brown developed a curve relating the ratio of reservoir capacity (C, in acre-feet) to watershed area (W, in square miles) to trap efficiency (sediment trapped, in percent) (USACE, 1889). Trap efficiency of reservoirs is influenced by the hydraulic characteristics of the reservoir and the sediment characteristics of the inflowing sediment.

The greater the retention time in an impoundment, the lower the transmit velocity, and the greater the rate of deposition. Impoundments with significant amounts of submerged aquatic vegetation, such as the Off-Billington and Plymco impoundments, will more efficiently trap inflowing sediment.

The capacity of the Off-Billington and Plymco impoundments was determined for normal flows from a triangular irregular network (TIN) built in AutoCAD based on MMI survey data. The reservoir trap efficiency was determined for the mean annual (80 cfs) flow. The reservoir trap efficiency was initially calculated as per the Brune method. Calculated capacity to inflow ratios (C/I) were less than $1x10^{-3}$, the lower range of the curve, for both flow conditions. The trap efficiency was then calculated using the reservoir capacity to watershed area ratio method of Brown. Based on the Brown curve, the reservoir trap efficiency was determined to be approximately 5% for both impoundments. Table 9-7 gives the computed reservoir trap efficiencies for the Off-Billington and Plymco impoundments.

**TABLE 9-7**

**Reservoir Trap Efficiency**

| **Impoundment** | **Trap Efficiency** *(Sediment Trapped in Percent)* |
|---|---|
| Off-Billington | 5 |
| Plymco | 5 |

Both impoundments fall within the range of extrapolation of the Brown curve. Thus, the trap efficiency presented can only be taken as estimations. Trap efficiency values of 5% indicate that very little of the annual sediment yield is trapped within the given impoundments. This also indicates that the two subject impoundments must have been retaining sediment for a very long period of time to accumulate the observed volumes of sediment.

Based on these findings, it can be surmised that removal of the Off-Billington Street and Plymco Dams would result in a minor increase in downstream sediment transport.

*Sediment Transport*

Flowing water can transport sediment as bedload, suspended bed material, and wash load. Bedload consists of larger heavy material that may roll, bounce, or slide along the riverbed and is usually a small part of the total load. Most dynamic sediment moves while suspended in the water column, suspended by turbulence and the vertical component of flow velocity. Some very small particles stay in suspension almost indefinitely and are referred to as the wash load fraction of the suspended sediment load.

The amount of sediment that can be transported by flowing water depends on many variables including flow rate, flow velocity, turbulence, water temperature, viscosity, and the weight and settling velocity of the particles. Extensive research has been conducted on sediment transport rates, but the processes are not yet fully understood. Sediment transport computations are not exact; therefore, they are usually used to assess relative or comparative transport rates at various channel reaches.

In the subject study, sediment transport rates were computed for existing conditions and selected alternatives to help identify areas prone to scour or deposition along the longitudinal profile of the river.

Town Brook sediment transport rates were computed for the existing and proposed conditions. For existing conditions, the sediment size gradation is based upon MMI sieve test results from the two impoundments. For proposed conditions, sediment size gradations were developed that reflect the proposed channel substrate. The intent is to check for abnormal patterns that would indicate channel problems at the representative cross sections. The primary solution is for the mean annual flow, although the 10- and

100-year flows were also run. At lower flows, little transport occurs, and at larger flows, widespread sediment transport would be expected.

For existing conditions, the Yang algorithm was used to assess sediment transport potential, where the substrate is dominated by fine grained deposits. The Meyer-Peter Muller algorithm was used in the reach that extends from downstream of the Plymco Dam to the upstream extent of the Off-Billington impoundment as well as downstream of the Off-Billington Street impoundment. Both of these channel reaches are dominated by cobble and larger channel substrate. For proposed conditions, the Meyer-Peter Muller algorithm was used to assess sediment transport potential across the riffles, in which the primary channel substrate is within the gravel and cobble size range. The Meyer-Peter Muller is applicable within this size class. The Yang algorithm, which has verified with gravel but was developed in the sand size class range, was utilized to determine sediment transport potential in pool and run regions.

Table 9-8 presents sediment transport rates for existing and proposed conditions associated with the mean annual flow. Under proposed conditions, the existing sediment trap in the Plymco impoundment can be expected to change to a sediment transport zone, as evidenced by the increase in sediment transport capacity. Sediment transport in the proposed reach within the existing Off-Billington Street impoundment is predicted for the 10-year storm event, but not for the mean annual flow. This data indicates that under proposed conditions for the mean annual flow minor sediment deposition from the Plymco reach can be expected. This reach will minimize the amount of downstream sediment transport under these conditions. For larger flow events, material will be scoured from this reach. The reach downstream of the Off-Billington Street Dam is a scour zone under existing conditions, evidenced by the high sediment transport capacity predicted in this location. Under proposed conditions, the sediment transport potential in this reach is decreased and is closer to the overall magnitude of sediment transport capacity within the proposed reach, indicating that the reach is closer to an equilibrium condition in which zones of equal sediment transport and deposition exist.

## TABLE 9-8

## Modeled Sediment Transport Capacity for the 1-Year Event

| *River Station* | | *Location* | *Sediment Transport (tons/day)* | |
|---|---|---|---|---|
| *Existing Conditions* | *Alt. 1* | | *Existing Conditions* | *Post-Dam Removal* |
| 1.1837 | 65 | Plymco Impoundment, pool | 0 | 0.04761 |
| 1.1734 | 63 | Plymco Impoundment, riffle | 0.00841 | 140.6 |
| 0.9598 | 18 | Off-Billington Street Impoundment, pool | 0 | 0 |
| 0.9598 | 17 | Off-Billington Street Impoundment, riffle | 0 | 0 |
| 0.9126 | 3 | Downstream of the Off-Billington Street Impoundment | 1054 | 86.29 |

The predicted transport capacity is greater than the available sediment in the system. Recall that the estimated sediment yield in the watershed is 300 tons per year. Converting this figure to a daily value, the sediment yield is approximately 0.8 tons per day. However, since the majority of sediment is transported during single large flow events, the average daily value of sediment transport is likely lower than 0.8 tons per day. The sediment transport capacity predicted for riffle zones is 140.6 tons per day. These results indicate that the proposed riffles would become armored, such that the largest stable substrate, as discussed above under Sediment Stability of Proposed Channel would remain, and finer substrate would be scoured. This is indicative of the natural sediment regime in which finer substrates deposited under lower flow events are self-scoured by the channel during higher flow events.

## 9.2 Composite Alternative 2: Partial Dam Breach of Off-Billington Street Dam, Daylight Culvert in Alternate Location, Partial Dam Breach of Plymco Dam in Alternate Location

This alternative is graphically depicted in Appendix E Sheet 08 (plan) and 09 (profile). Alternative 2 consists of the following composite of alternatives:

Alternate OB-D: Partial Dam Breach

Alternate C-B: Daylight in Alternate Location

Alternate P-B: Dam Breach in Alternate Channel Location

Alternative 2 is essentially the same as Alternative 1, with the exception that the channel is diverted around the existing abandoned Plymco factory building. Recall that the existing culvert passes under the corner of this building. Under this alternative, it is necessary to form the proposed channel outside of the existing channel bed. It will be necessary to excavate into the existing hill west of the existing channel. Sections of the existing gravel road running parallel to the channel will be impacted and may need to be abandoned. The section of the channel within the existing culvert will be daylighted to the southwest of sections of the existing culvert. This alternative will require a greater amount of excavation than Alternative 1, an estimated 8,500 cubic yards.

### 9.2.1 Proposed Channel Morphology, Planform, and Dimension

The proposed channel morphology, planform, and dimension are nearly identical to those presented for Alternative 1, with the exception that the proposed channel will be 160 feet longer, as the channel will need to be routed around the existing factory building. Please refer to Section 9.1.1 for a full discussion of channel characteristics.

### 9.2.2 Fish Passage and Riparian Habitat

This alternative is almost hydraulically identical to Alternative 1. Under this alternative, the channel through the culvert reach is 160 feet longer, with steeper channel banks. However, the impact of these differences on fisheries habitat is negligible. Tables 9-9 and 9-10 present predicted channel depths and velocities for Alternative 2. Refer to Section 9.1.2 Fish Passage and Riparian Habitat for a discussion of the impact of the proposed alternative on fisheries habitat.

## TABLE 9-9
## Maximum Water Depth Alternative 2 Proposed Conditions

| River Station Proposed Conditions | Location | Maximum Water Depth (ft) | |
|---|---|---|---|
| | | Spring (22cfs) | Summer (8 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 3.17 | 2.94 |
| 274 | Immediately D/S 4th weir | 2.98 | 2.68 |
| 194.21 | Immediately U/S 3rd weir | 2.98 | 2.68 |
| 189 | Immediately D/S 3rd weir | 2.41 | 1.98 |
| 133 | Immediately U/S 2nd weir | 2.41 | 1.99 |
| 129 | Immediately D/S 2nd weir | 1.90 | 1.67 |
| 119.58 | Immediately U/S Billington Street Culvert | 1.89 | 1.67 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 2.10 | 1.89 |
| 67 | Immediately D/S Weir #1 | 0.43 | 0.22 |
| 64 | Head of Riffle | 0.48 | 0.25 |
| 62.5 | Mid-riffle | 0.62 | 0.37 |
| 62 | Tail of Riffle | 0.48 | 0.27 |
| 59 | Pool | 2.50 | 2.21 |
| 57 | Head of Riffle | 0.50 | 0.25 |
| 56.5 | Mid-riffle | 0.67 | 0.36 |
| 56 | Tail of Riffle | 0.53 | 0.32 |
| 40 | U/S Face Plymco Dam | 0.44 | 0.23 |
| 39 | D/S Face Plymco Dam | 0.32 | 0.17 |
| 31 | Mid-culvert | 0.50 | 0.27 |
| 23 | Pool | 2.93 | 2.67 |
| 21 | Head of Riffle | 0.50 | 0.29 |
| 20 | Tail of Riffle | 0.39 | 0.20 |
| 5 | U/S Face Off-Billington Dam | 0.76 | 0.41 |
| 4 | D/S Face Off-Billington Dam | 0.86 | 0.51 |
| 1 | 100' D/S Off-Billington Dam | 0.56 | 0.30 |

## TABLE 9-10

### Channel Velocity Alternative 2 Proposed Conditions

| River Station Proposed Conditions | Location | Velocity (feet / second) | |
|---|---|---|---|
| | | Spring (22cfs) | Summer (8 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 0.48 | 0.20 |
| 274 | Immediately D/S 4th weir | 0.36 | 0.16 |
| 194.21 | Immediately U/S 3rd weir | 0.36 | 0.16 |
| 189 | Immediately D/S 3rd weir | 0.49 | 0.25 |
| 133 | Immediately U/S 2nd weir | 0.50 | 0.25 |
| 129 | Immediately D/S 2nd weir | 0.76 | 0.35 |
| 119.58 | Immediately U/S Billington Street Culvert | 0.76 | 0.35 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 0.74 | 0.33 |
| 67 | Immediately D/S Weir #1 | 3.54 | 2.61 |
| 64 | Head of Riffle | 3.70 | 2.74 |
| 63.5 | Mid-riffle | 2.54 | 1.72 |
| 63 | Tail of Riffle | 2.74 | 1.74 |
| 59 | Pool | 0.43 | 0.19 |
| 57 | Head of Riffle | 2.41 | 1.87 |
| 56.5 | Mid-riffle | 1.84 | 1.29 |
| 56 | Tail of Riffle | 3.84 | 2.58 |
| 40 | U/S Face Plymco Dam | 3.72 | 2.68 |
| 39 | D/S Face Plymco Dam | 5.39 | 3.78 |
| 31 | Mid-culvert | 3.71 | 2.78 |
| 23 | Pool | 0.32 | 0.13 |
| 21 | Head of Riffle | 2.10 | 1.44 |
| 20 | Tail of Riffle | 3.46 | 2.52 |
| 5 | U/S Face Off-Billington Dam | 2.05 | 1.42 |
| 4 | D/S Face Off-Billington Dam | 1.97 | 1.38 |
| 1 | 100' D/S Off-Billington Dam | 3.98 | 2.95 |

### 9.2.3 Flood Flows

Table 9-11 presents predicted water surface elevations for Alternative 2 for the 10- and 100-year flow events.

**TABLE 9-11**

**Alternative 2 Flood Water Surface Elevations**

| River Station Proposed Conditions | Location | Water Surface Elevation (ft, NGVD29) | |
|---|---|---|---|
| | | 10-Year (116cfs) | 100-Year (155 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 80.52 | 80.73 |
| 274 | Immediately D/S 4th weir | 80.36 | 80.59 |
| 194.21 | Immediately U/S 3rd weir | 80.35 | 80.57 |
| 189 | Immediately D/S 3rd weir | 80.32 | 80.52 |
| 133 | Immediately U/S 2nd weir | 80.30 | 80.50 |
| 129 | Immediately D/S 2nd weir | 79.74 | 80.03 |
| 119.58 | Immediately U/S Billington Street Culvert | 79.73 | 80.01 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 79.53 | 79.69 |
| 67 | Immediately D/S Weir #1 | 78.46 | 78.78 |
| 64 | Head of Riffle | 78.07 | 78.30 |
| 63 | Mid-riffle | 77.43 | 77.70 |
| 62.5 | Tail of Riffle | 77.02 | 77.27 |
| 59 | Pool | 75.30 | 75.62 |
| 57 | Head of Riffle | 75.10 | 75.40 |
| 56.5 | Mid-riffle | 74.92 | 75.23 |
| 56 | Tail of Riffle | 74.14 | 74.40 |
| 40 | U/S Face Plymco Dam | 69.58 | 69.86 |
| 39 | D/S Face Plymco Dam | 68.76 | 68.99 |
| 31 | Mid-culvert | 66.64 | 66.88 |
| 23 | Pool | 64.03 | 64.24 |
| 21 | Head of Riffle | 63.63 | 63.85 |
| 20 | Tail of Riffle | 62.42 | 62.72 |
| 5 | U/S Face Off-Billington Dam | 60.09 | 60.41 |
| 4 | D/S Face Off-Billington Dam | 60.09 | 60.42 |
| 1 | 100' D/S Off-Billington Dam | 59.31 | 59.58 |

This table evidences that water surface elevations predicted under Alternative 2 are nearly identical to those predicted for Alternative 1. This stands to reason since the two alternatives are nearly hydraulically identical. As with Alternative 1, overtopping of Billington Street is not predicted, either parallel to the project reach or at the upstream culvert.

**TABLE 9-12**

**Alternative 2 Flood Velocities**

| River Station Proposed Conditions | Location | Velocity (feet / second) | |
|---|---|---|---|
| | | 10-Year (116cfs) | 100-Year (155 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 1.68 | 2.04 |
| 274 | Immediately D/S 4th weir | 1.08 | 1.30 |
| 194.21 | Immediately U/S 3rd weir | 1.08 | 1.30 |
| 189 | Immediately D/S 3rd weir | 1.56 | 1.90 |
| 133 | Immediately U/S 2nd weir | 1.57 | 1.91 |
| 129 | Immediately D/S 2nd weir | 2.09 | 2.39 |
| 119.58 | Immediately U/S Billington Street Culvert | 2.15 | 2.47 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 2.37 | 2.88 |
| 67 | Immediately D/S Weir #1 | 4.00 | 4.20 |
| 64 | Head of Riffle | 6.27 | 6.80 |
| 63 | Mid-riffle | 4.72 | 5.23 |
| 62.5 | Tail of Riffle | 5.57 | 6.48 |
| 59 | Pool | 1.42 | 1.70 |
| 57 | Head of Riffle | 3.97 | 4.26 |
| 56.5 | Mid-riffle | 3.44 | 3.80 |
| 56 | Tail of Riffle | 6.02 | 6.50 |
| 40 | U/S Face Plymco Dam | 8.11 | 8.76 |
| 39 | D/S Face Plymco Dam | 6.28 | 7.23 |
| 31 | Mid-culvert | 5.80 | 6.22 |
| 23 | Pool | 1.18 | 1.45 |
| 21 | Head of Riffle | 4.91 | 4.92 |
| 20 | Tail of Riffle | 3.57 | 3.84 |
| 5 | U/S Face Off-Billington Dam | 3.91 | 4.40 |
| 4 | D/S Face Off-Billington Dam | 3.46 | 3.78 |
| 1 | 100' D/S Off-Billington Dam | 6.31 | 6.91 |

The range of predicted velocities is identical to Alternative 1.

### 9.2.4 Sediment Stability and Transport Analysis

*Sediment Stability of Proposed Channel*

Refer to Section 9.1.4 Sediment Stability and Transport Analysis for a discussion of the sediment stability analysis for the proposed channel.

*Sediment Transport*

Table 9-13 presents the results of the Sediment Transport Analysis for Alternative 2. Sediment transport under Alternative 2 is nearly identical to that predicted for Alternative 1, as would be expected based on the minimal differences between the two alternatives. One notable exception is the lack of sediment transport predicted in the reach downstream of the existing Off-Billington Street Dam for the mean annual event. However, sediment transport is predicted in this reach for the 10-year event, at a rate higher than that predicted for the mean annual event under Alternative 1. This would indicate that transport in this reach is triggered between the mean annual and 10-year events. As with the reach through the Off-Billington Street impoundment, sediment that may be deposited in this reach during lower flow events can be expected to be scoured to the armored condition during higher flow events, provided that the channel banks are sufficiently stable that scouring does not occur. Refer to Section 9.1.4 Sediment Stability and Transport Analysis for a full discussion of proposed conditions sediment transport.

**TABLE 9-13**

**Modeled Sediment Transport Capacity for the 1-Year Event**

| *Alt. 1* | *Location* | *Sediment Transport (tons/day)* | |
|---|---|---|---|
| | | *Existing Conditions* | *Post-Dam Removal* |
| 65 | Plymco Impoundment, pool | 0 | 0.03784 |
| 63 | Plymco Impoundment, riffle | 0.00841 | 119.2 |
| 18 | Off-Billington Street Impoundment, pool | 0 | 0 |
| 17 | Off-Billington Street Impoundment, riffle | 0 | 0 |
| 3 | Downstream of the Off-Billington Street Impoundment | 1054 | 0 |

## 9.3 Composite Alternative 3: Raise Downstream Tailwater at Off-Billington Street Dam, Daylight Culvert in Existing Location, Partial Dam Breach at Plymco Dam

### 9.3.1 Proposed Channel Morphology, Planform, and Dimension

This alternative is graphically depicted in Appendix E, Sheet 10 (plan) and 11 (profile). Alternative 3 consists of the following composite of alternatives:

Alternate OB-D: Raise Downstream Tailwater at Off-Billington Street Dam
Alternate C-B: Daylight in Existing Location
Alternate P-B: Partial Dam Breach in Existing Channel Location

Under this alternative, a rock riffle would be placed in the channel downstream of the existing Off-Billington Street bridge. The intention of this alternative is to retain the bridge structure. At a slope of 0.04 ft/ft, the ramp would extend 62 feet downstream and require approximately 48 cubic yards of fill. The riffle would extend from the base of the existing culvert apron, which sits approximately 2.5 feet above the existing channel. The

weirboards at the Off-Billington Street Dam would be removed, but the majority of the spillway structure would remain. This alternative would create a flat water surface profile that would extend 440 feet upstream through the Off-Billington Street impoundment for the mean annual flow. A significant portion of the Off-Billington Street impoundment would remain in a ponded condition. In the upstream reaches, from the downstream face of the culvert to the downstream face of Billington Street, a riffle-pool channel would be created as described under Alternatives 1 and 2. This alternative would require approximately 6,400 cubic yards of excavation.

## TABLE 9-14

## Predicted Water Depth Alternative 3 Proposed Conditions

| River Station Proposed Conditions | Location | Maximum Water Depth (ft) | |
|---|---|---|---|
| | | Spring (22cfs) | Summer (8 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 3.17 | 2.94 |
| 274 | Immediately D/S 4th weir | 2.98 | 2.68 |
| 194.21 | Immediately U/S 3rd weir | 2.98 | 2.68 |
| 189 | Immediately D/S 3rd weir | 2.41 | 1.99 |
| 133 | Immediately U/S 2nd weir | 2.41 | 1.99 |
| 129 | Immediately D/S 2nd weir | 1.90 | 1.67 |
| 119.58 | Immediately U/S Billington Street Culvert | 1.89 | 1.67 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 2.10 | 1.89 |
| 67 | Immediately D/S Weir #1 | 0.43 | 0.22 |
| 64 | Head of Riffle | 0.48 | 0.25 |
| 62.5 | Mid-riffle | 0.62 | 0.37 |
| 62 | Tail of Riffle | 0.48 | 0.27 |
| 59 | Pool | 2.48 | 2.20 |
| 57 | Head of Riffle | 0.45 | 0.22 |
| 56.5 | Mid-riffle | 0.64 | 0.34 |
| 56 | Tail of Riffle | 0.53 | 0.30 |
| 40 | U/S Face Plymco Dam | 0.44 | 0.23 |
| 39 | D/S Face Plymco Dam | 0.32 | 0.17 |
| 31 | Mid-culvert | 0.50 | 0.27 |
| 27 | U/S end of impoundment Off-Billington Street | 0.34 | 0.25 |
| 25 | U/S end of Impoundment Off-Billington Street | 1.62 | 1.17 |
| 23 | Mid-impoundment Off-Billington Street | 1.97 | 1.52 |
| 19 | U/S Off-Billington Street Dam | 0.33 | 0.14 |
| 18 | D/S Off-Billington Street Dam | 0.30 | 0.12 |
| 15 | D/S channel | 1.04 | 0.73 |

### 9.3.2 Fish Passage and Riparian Habitat

Table 9-14 gives predicted water depths for Alternative 3. Water depths through the existing culvert reach and extending upstream to the Billington Street culvert are predicted to be nearly the same as those encountered under Alternatives 1 and 2. Under this alternative, water is predicted to be in a shallow ponded condition through much of the existing Off-Billington Street impoundment. For spring flow conditions, the upstream swift moving riffling reach will flow into a wide, shallow pool in the Off-Billington Street impoundment with water depths less than two feet. Decreased water quality can be expected in this ponded section, where the shallow water depths will cause elevated temperatures and lower dissolved oxygen concentrations. Increased sedimentation can be expected in this impoundment as entrained sediment from the swift flowing upstream reaches will be deposited in this shallow, low velocity region.

River Stations 23 and 25 represent the ponded area within the Off-Billington Street impoundment. Table 9-15 evidences that this location will be a slow moving, sluggish reach. Very high velocities are predicted immediately upstream and downstream of the existing dam and would be a barrier to fish passage to the upper reaches.

## TABLE 9-15
## Channel Velocity Alternative 3 Proposed Conditions

| River Station Proposed Conditions | Location | Velocity (feet / second) | |
|---|---|---|---|
| | | Spring (22cfs) | Summer (8 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 0.48 | 0.20 |
| 274 | Immediately D/S 4th weir | 0.36 | 0.16 |
| 194.21 | Immediately U/S 3rd weir | 0.36 | 0.16 |
| 189 | Immediately D/S 3rd weir | 0.49 | 0.25 |
| 133 | Immediately U/S 2nd weir | 0.50 | 0.25 |
| 129 | Immediately D/S 2nd weir | 0.76 | 0.35 |
| 119.58 | Immediately U/S Billington Street Culvert | 0.76 | 0.35 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 0.74 | 0.33 |
| 67 | Immediately D/S Weir #1 | 3.57 | 2.62 |
| 64 | Head of Riffle | 3.76 | 2.77 |
| 62.5 | Mid-riffle | 2.74 | 1.74 |
| 62 | Tail of Riffle | 3.64 | 2.66 |
| 59 | Pool | 0.44 | 0.19 |
| 57 | Head of Riffle | 2.69 | 2.07 |
| 56.5 | Mid-riffle | 1.96 | 1.37 |
| 56 | Tail of Riffle | 3.84 | 2.77 |
| 40 | U/S Face Plymco Dam | 3.72 | 2.68 |
| 39 | D/S Face Plymco Dam | 5.39 | 3.78 |
| 31 | Mid-culvert | 3.71 | 2.78 |
| 27 | U/S end of impoundment Off-Billington Street | 2.13 | 1.75 |
| 25 | U/S end of Impoundment Off-Billington Street | 0.14 | 0.08 |
| 23 | Mid-impoundment Off-Billington Street | 0.12 | 0.06 |
| 19 | U/S Off-Billington Street Dam | 8.56 | 7.54 |
| 18 | D/S Off-Billington Street Dam | 9.69 | 8.76 |
| 15 | D/S channel | 1.35 | 0.89 |

### 9.3.3 Flood Flows

Table 9-16 presents predicted water surface elevations for Alternative 3 for the 10- and 100-year flow events.

**TABLE 9-16**
**Alternative 3 Flood Water Surface Elevations**

| River Station Proposed Conditions | Location | Water Surface Elevation (ft, NGVD29) | |
|---|---|---|---|
| | | 10-Year (116cfs) | 100-Year (155 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 80.52 | 80.73 |
| 274 | Immediately D/S 4th weir | 80.35 | 80.58 |
| 194.21 | Immediately U/S 3rd weir | 80.34 | 80.56 |
| 189 | Immediately D/S 3rd weir | 80.31 | 80.52 |
| 133 | Immediately U/S 2nd weir | 80.30 | 80.50 |
| 129 | Immediately D/S 2nd weir | 79.74 | 80.03 |
| 119.58 | Immediately U/S Billington Street Culvert | 79.73 | 80.01 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 79.53 | 79.69 |
| 67 | Immediately D/S Weir #1 | 78.46 | 78.83 |
| 64 | Head of Riffle | 77.95 | 78.23 |
| 62.5 | Mid-riffle | 76.94 | 77.12 |
| 62 | Tail of Riffle | 76.72 | 76.98 |
| 59 | Pool | 75.26 | 75.57 |
| 57 | Head of Riffle | 75.02 | 75.31 |
| 56.5 | Mid-riffle | 74.86 | 75.16 |
| 56 | Tail of Riffle | 74.14 | 74.40 |
| 40 | U/S Face Plymco Dam | 69.58 | 69.86 |
| 39 | D/S Face Plymco Dam | 68.76 | 68.99 |
| 31 | Mid-culvert | 66.64 | 66.88 |
| 27 | U/S end of impoundment Off-Billington Street | 65.61 | 66.18 |
| 25 | U/S end of Impoundment Off-Billington Street | 65.61 | 66.18 |
| 23 | Mid-impoundment Off-Billington Street | 65.61 | 66.18 |
| 19 | U/S Off-Billington Street Dam | 64.67 | 65.15 |
| 18 | D/S Off-Billington Street Dam | 61.11 | *61.41* |
| 15 | D/S channel | 59.69 | 60.06 |

Table 9-16 evidences that overtopping of Billington Street is not predicted, either parallel to the project reach or at the upstream culvert.

**TABLE 9-17**
**Alternative 1 Flood Velocities**

| River Station Proposed Conditions | Location | Velocity (feet / second) | |
|---|---|---|---|
| | | 10-Year (116cfs) | 100-Year (155 cfs) |
| 279.4 | 80' U/S Billington Street Culvert | 1.68 | 2.04 |
| 274 | Immediately D/S 4th weir | 1.08 | 1.30 |
| 194.21 | Immediately U/S 3rd weir | 1.08 | 1.30 |
| 189 | Immediately D/S 3rd weir | 1.56 | 1.90 |
| 133 | Immediately U/S 2nd weir | 1.57 | 1.91 |
| 129 | Immediately D/S 2nd weir | 2.09 | 2.39 |
| 119.58 | Immediately U/S Billington Street Culvert | 2.15 | 2.47 |
| 68 | Immediately D/S Billington Street Culvert U/S Weir #1 | 2.37 | 2.88 |
| 67 | Immediately D/S Weir #1 | 4.00 | 4.20 |
| 64 | Head of Riffle | 6.27 | 6.80 |
| 62.5 | Mid-riffle | 5.57 | 6.48 |
| 62 | Tail of Riffle | 6.07 | 6.59 |
| 59 | Pool | 1.42 | 1.70 |
| 57 | Head of Riffle | 3.97 | 4.26 |
| 56.5 | Mid-riffle | 3.44 | 3.80 |
| 56 | Tail of Riffle | 6.02 | 6.50 |
| 40 | U/S Face Plymco Dam | 6.30 | 6.80 |
| 39 | D/S Face Plymco Dam | 8.41 | 9.03 |
| 31 | Mid-culvert | 5.79 | 6.22 |
| 27 | U/S end of impoundment Off-Billington Street | 0.58 | 0.57 |
| 25 | U/S end of Impoundment Off-Billington Street | 0.27 | 0.29 |
| 23 | Mid-impoundment Off-Billington Street | 0.28 | 0.31 |
| 19 | U/S Off-Billington Street Dam | 5.43 | 6.19 |
| 18 | D/S Off-Billington Street Dam | 11.71 | 12.75 |
| 15 | D/S channel | 2.49 | 2.75 |

### 9.3.4 Sediment Stability and Transport Analysis

Due to the fact that much of the Off-Billington Street impoundment would remain in a ponded condition under this alternative, the reach remains a sediment trap. The reach through the Plymco impoundment, which is to be abandoned in favor of a riffle-pool channel, changes from a sediment trap to a sediment transport zone. This is evidenced by the sediment transport capacity values given in Table 9-18 as well as by the high predicted velocities given in Table 9-17. Downstream of the Off-Billington Street Dam, scour can be expected as the flow, sediment starved because it just deposited the sediment carried from the upstream reaches into the Off-Billington Street impoundment, exits the impoundment with high velocity and therefore high shear potential over the high-gradient riffle.

**TABLE 9-18**
**Modeled Sediment Transport Capacity for the 1-Year Event**

| *River Station* | | *Location* | *Sediment Transport (tons/day)* | |
|---|---|---|---|---|
| *Existing Conditions* | *Alt. 1* | | *Existing Conditions* | *Post-Dam Removal* |
| 1.1837 | 65 | Plymco Impoundment, pool | 0 | 0.04761 |
| 1.1734 | 63 | Plymco Impoundment, riffle | 0.00841 | 140.6 |
| 0.9598 | 18 | Off-Billington Street Impoundment, pool | 0 | 0 |
| 0.9598 | 17 | Off-Billington Street Impoundment, riffle | 0 | 0 |
| 0.9126 | 0.875 | Downstream of the Off-Billington Street Impoundment | 1054 | 180.1 |

## 10.0 ENGINEER'S ESTIMATE OF PROBABLE COST

The preliminary opinion of probable construction costs is presented in Tables 10-1 through 10-3. More detailed cost worksheets are included herein as Appendix E. As is evidenced by these tables, Alternative 3, in which no removal of the Off-Billington Street structure and less channel work are proposed, is the least expensive alternative. Alternative 1, which requires circumventing the abandoned factory building to allow this building to remain, is approximately $50,000 more expensive than Alternative 2, in which the building is proposed to be removed. The increase in cost is entirely associated with the increased excavation and volume of sediment for which disposal is required. Excavation and disposal costs assume that sediments are disposed of in a Massachusetts landfill.

Utility costs were developed with the following assumptions:

- A small pump station will be necessary at the Plymco access drive in conjunction with a new sewer line at the bridge, which would connect to the existing sewer line at Off-Billington Street;
- The water line at the Plymco access drive would be extended along the new bridge at this location;
- Existing water lines through the Off-Billington Street impoundment would be rerouted through the eastern access drive.

It is assumed that no other utilities will be impacted during construction.

Bridge cost opinions make up over one-quarter of the cost opinions for Alternatives 1 and 2 and nearly one-quarter of the cost opinion for Alternative 3. The cost opinion was developed for a 32-foot span precast concrete arch bridge. Less expensive bridge alternatives could be implemented that would still meet project goals. Other possible types of bridges include timber and precast concrete box culvert bridges. In order of cost, the precast concrete box culvert is the least expensive, a precast concrete arch bridge is

the most expensive, and the cost of a timber bridge falls in between the two. It is recommended that a bridge type study be performed during the design process to identify the most economical type of bridge that meets the ecological needs of the project. As noted in previous sections, the final selection of a bridge treatment will ultimately depend upon a balance between optimum ecological functionality and available funding.

**TABLE 10-1**
**Alternative 1 Preliminary Estimate of Probable Construction Costs**

| Description | Amount |
|---|---|
| Mobilization | $15,000 |
| Sedimentation and Erosion Control | $4,750 |
| Traffic Diversion / Signage | $1,000 |
| Site Preparation | $11,600 |
| Water Control | $16,500 |
| Channel Excavation – Earth | $114,750 |
| Disposal of Excavated Sediments | $459,000 |
| Remove Plymco Structure | $10,234 |
| Remove Culvert | $11,390 |
| Remove Off-Billington Street Structure | $22,160 |
| Remove Existing Shed | $250 |
| Remove Abandoned Factory Building | $10,000 |
| Instream Stone Features | $4,020 |
| Bank Protection | $10,350 |
| Site Restoration | $10,000 |
| Relocate Utilities | $32,100 |
| Bridge at Plymco Dam | $231,650 |
| Bridge at Off-Billington Street Dam | $231,650 |
| | |
| | |
| Subtotal | $1,196,404 |
| 15% Incidental and Contingency | $179,461 |
| **Total Construction Cost** | **$1,375,865** |

## TABLE 10-2

## Alternative 2 Preliminary Estimate of Probable Construction Costs

| Description | Amount |
|---|---|
| Mobilization | $15,000 |
| Sedimentation and Erosion Control | $4,750 |
| Traffic Diversion / Signage | $1,000 |
| Site Preparation | $11,600 |
| Water Control | $16,500 |
| Channel Excavation – Earth | $127,500 |
| Disposal of Excavated Sediments | $510,000 |
| Remove Plymco Structure | $10,234 |
| Remove Culvert | $11,390 |
| Remove Off-Billington Street Structure | $22,160 |
| Remove Existing Shed | $250 |
| Instream Stone Features | $4,020 |
| Bank Protection | $10,350 |
| Site Restoration | $10,000 |
| Relocate Utilities | $32,100 |
| Bridge at Plymco Dam | $231,650 |
| Bridge at Off-Billington Street Dam | $231,650 |
| | |
| | |
| Subtotal | $1,250,154 |
| 15% Incidental and Contingency | $187,523 |
| **Total Construction Cost** | **$1,437,677** |

## TABLE 10-3

## Alternative 3 Preliminary Estimate of Probable Construction Costs

| Description | Amount |
|---|---|
| Mobilization | $15,000 |
| Sedimentation and Erosion Control | $4,750 |
| Traffic Diversion / Signage | $1,000 |
| Site Preparation | $11,600 |
| Water Control | $16,500 |
| Channel Excavation – Earth | $96,000 |
| Disposal of Excavated Sediments | $384,000 |
| Remove Plymco Structure | $10,234 |
| Remove Culvert | $11,390 |
| Remove Existing Shed | $250 |
| Instream Stone Features | $3,640 |
| Bank Protection | $8,150 |
| Site Restoration | $10,000 |
| Relocate Utilities | $32,100 |
| Bridge at Plymco Dam | $231,650 |
| Repair Off-Billington Street Structure | $50,000 |
| | |
| | |
| Subtotal | $886,264 |
| 15% Incidental and Contingency | $132,940 |
| **Total Construction Cost** | **$1,019,204** |

## TABLE 10-4

## Comparison of Preliminary Estimates of Probable Construction Costs

| Alternative | Cost |
|---|---|
| **Composite Alternative 1**: Partial Dam Breach of Off-Billington Street Dam, Daylight Culvert in Existing Location, Partial Dam Breach of Plymco Dam in Existing Location | $ 1,375,865 |
| **Composite Alternative 2**: Partial Dam Breach of Off-Billington Street Dam, Daylight Culvert in Alternate Location, Partial Dam Breach of Plymco Dam in Alternate Location | $ 1,437,677 |
| **Composite Alternative 3**: Raise Downstream Tailwater at Off-Billington Street Dam, Daylight Culvert in Existing Location, Partial Dam Breach at Plymco Dam | $ 1,019,204 |

## 11.0 RECOMMENDED ALTERNATIVE

As indicated in Table 10-4, the least expensive alternative is Composite Alternative 3. However, although this alternative would provide fish passage, it does not improve habitat or riverine quality in the Off-Billington Street impoundment. Composite Alternatives 1 and 2 are essentially identical, with Alternative 1 going through the location of the existing factory building and Alternative 2 circumventing this building.

The recommended alternative is Composite Alternative 1, consisting of a partial dam breach at Off-Billington Street, daylighting of the existing culvert in its existing location, and a partial dam breach of the Plymco Dam in the location of the existing spillway. This alternative requires less excavation than Alternative 2 and is, therefore, less costly.

### 11.1 Impact of Recommended Alternative

#### 11.1.1 Impact to Upstream Cranberry Bogs

Cranberry bog operations upstream of the project location are dependent upon existing water surface elevations, according to comments from the operator at public meetings. An effort has been made to maintain upstream water surface elevations at near existing levels. This has been achieved through the use of four low-head rock vanes at the upstream end of the project reach. Table 11-1 illustrates the predicted water surface elevations with and without these vanes in place.

**TABLE 11-1**
**Predicted Water Surface Elevations With and Without Vanes in Place**

| Condition | Water Surface Elevation *(feet, NGVD29)* |
|---|---|
| Existing | 79.78 |
| With Vanes | 79.68 |
| Without Vanes | 78.24 |

Upstream water surface elevations without the proposed vanes in place are predicted to drop by over 1.5 feet. It is anticipated that this will adversely affect upstream cranberry bog operations. The proposed vanes bring the predicted water surface elevations to within 1.2 inches of existing.

The use of vanes is one method by which upstream water surface elevations can be maintained. Another method would be to increase the slope of the proposed channel. One concern with this option is the potential for a reduction in the capacity of the existing culvert under Billington Street at the upstream end of the project reach. Adjustment of the channel slope would require raising the channel bed in this location. In addition, the channel slope has been developed to be in a stable condition with the suspected predam channel substrate, such that excessive vertical erosion will not occur in the channel. A channel slope greater than what has been proposed may potentially exacerbate vertical channel erosion.

Other options for maintaining upstream water surface elevations can be explored as the channel design progresses. The intent of this feasibility analysis was to develop conceptual alternatives.

### 11.1.2 Expected Wetland Succession

The existing wetland habitat consists of palustrine emergent marsh and open water wetlands dominated by floating aquatic vegetation (FAV) and submerged aquatic vegetation (SAV). The emergent marsh areas are dominated by water willow, pickerelweed, arrow arum, broad-leaved cattail, sensitive fern, soft rush, lurid sedge, reed canary grass, and yellow iris. The latter two species are considered invasive. The open water areas are dominated by FAV such as the water shield and SAV such as Eurasian water-milfoil and widgeon grass.

A change in the surrounding wetland ecology and habitats can be expected following restoration of Town Brook into a free-flowing stream condition.

Immediately following restoration activities, it can be expected that wetland vegetation, with the exception of FAV and SAV, will remain until water has fully drained out of the exposed overbank soils. Some areas may never fully drain such as those with perched ground water over clay lenses or locally machine-compacted areas and areas over hardpan and/or bedrock. In these locations, local ponding may continue to support diverse assemblages of emergent and wet meadow wetland species.

During the first growing season, species from the plant families such as the grasses, sedges, rushes, and smartweeds can be expected to develop along the water's edge and on the mucky exposed soils. Herbaceous plants can be expected to quickly germinate along the exposed overbank areas during the first growing season. Herbaceous plants may consist of boneset, Joe-pye weed, and various grasses, sedges, and rushes. Invasive species such as *Phragmites*, purple loosestrife, rice cut grass, reed canary grass, and Japanese knotweed may also become dominant if not monitored and removed. Many of these plants will develop from the existing seed bank sources already stored within the mucky overbank soils or by bordering vegetation. One can expect a combination of facultative wet, facultative, and facultative upland species to dominate until the overbank soils fully dry out. Facultative wet plants occur more in wetlands than nonwetlands (estimated probability 67-99% in wetlands), facultative plants occur equally in wetlands and nonwetlands (estimated probability 34-66% in wetlands), and facultative upland plants are more common in uplands than wetlands (estimated probability 1-33% in wetlands).

In the first two to four years after restoration as the overbank soils continue to dry, the plant succession will continue as a combination of facultative wet, facultative, and facultative upland plants. The relative bank stabilization capacity of these early colonizing herbaceous plants will be minimal. The root structure of the herbaceous plant

species is expected to extend only six to eight inches below the soil surface. It can be assumed that the overbank area will be more prone to flooding and erosion during this transition period.

It is expected that between years five to 10 following restoration, the exposed overbank areas are expected to transition from herbaceous dominated wetland community to scrub-shrub wetland and upland community. Expected seedling and sapling sized tree species would be birches, sycamores, aspens, cottonwoods, red and silver maples, and pin oaks. Shrubby species that may colonize the area include spireas, silky dogwoods, speckled and smooth alders, and willows. Trees and shrubs have deeper and more developed root masses than the herbaceous plants and will form a more stabilized overbank area.

The long-term transition for much of the exposed overbank area will be toward a forested wetland and upland community. This transition may take 30 to 60 years to complete with the forested areas being dominated by mature birches, sycamores, aspens, cottonwoods, red and silver maples, and pin oaks. As mentioned previously, and during all periods of wetland succession, areas with locally perched water tables and areas influenced by seeps or springs may remain as localized wet areas supporting emergent, wet meadow, and shrubby vegetation.

The following discussion of wetland succession at the site assumes that natural succession will take place, without intervention of plantings, site maintenance such as mowing and/or natural disasters such as fire, hurricanes, etc. Should such interventions and/or events take place, the natural succession rate at this site would be obviously altered. Best management practices such as long-term site monitoring will be required to help minimize the colonization of invasive non-native plant species.

### 11.1.3 Impact of Recommended Alternative on Regulated Resources

Wetlands

Restoration of Town Brook to a riverine environment meets the goals of the Wetlands Protection Act by improving wildlife habitat, restoring native cold-water fisheries, and providing increased prevention of pollution, storm damage prevention, and flood control over the existing artificially impounded and created warm-water wetlands.

The Massachusetts Wetlands Protection Act (Massachusetts General Laws Chapter 131, §40) and the accompanying Massachusetts Wetlands Protection Act Regulations (310 CMR 10) provide a means by which wetlands are protected in the State of Massachusetts. The act stipulates that alteration to existing wetlands must not result in adverse impacts to the nine interests of the act. These interests are protection of:

- Public and water supplies
- Private water supplies
- Flood control
- Protection of land containing shellfish
- Storm damage prevention
- Wildlife habitat
- Ground water supplies
- Prevention of pollution
- Protection of fisheries

Alteration of the existing wetlands as described in Section 11.2.1 of this report will not cause adverse impacts to the nine interests of the Wetlands Protection Act and will, in fact, benefit the interests of the act. A discussion of impacts to the individual interests is included in the following paragraphs.

*Public and Private Water Supplies* – The project reach of Town Brook does not currently serve any public or private water supplies.

*Flood Control and Storm Damage Prevention* – The flood control function of Town Brook within the project reach will be improved under proposed conditions. Under existing conditions, the impoundments provide only minimal retention and, therefore, only minimal mitigation of flood flow peaks. In addition, during large storm events, there is a high potential for suspension and distribution of impounded sediments, causing downstream sedimentation.

The proposed river channel and associated floodplain fringe through the project reach will provide increased flood retention capabilities. Under proposed conditions, the impounded sediments within the river channel are to be removed, such that the potential for scour through the project reach is minimized. Overbank areas will be secured and stabilized through the succession of mature vegetation, further reducing the potential for erosion.

*Protection of Land Containing Shellfish* – There is no land containing shellfish within the project reach.

*Wildlife Habitat* – Protection of wildlife habitat occurs primarily within the Riverfront Areas regulated under the Wetlands Protection Act as well as under the Massachusetts River's Protection Act. Impacts to Riverfront Areas are described in detail in subsequent sections.

*Ground Water Supplies and Prevention of Pollution* – Wetlands protect ground water supplies by removing pollutants carried from nearby roads and residential areas as well as by allowing water to infiltrate or seep into the ground. Under existing conditions, pollutants from nearby roads and residential areas likely become bound to the impounded

sediments. Although impounded sediments are generally retained within the impoundments, they can potentially be transported downstream under high flow events. Any associated pollutants are, therefore, simply redistributed and not removed from the system. Under proposed conditions, the transition in Riverbank Area from primarily roadways and residential areas to areas containing riverine vegetation provides the necessary land area over which removal of pollutants from surface runoff can occur.

*Protection of Fisheries* – Perhaps the greatest benefit from the transition of wetland types at the site is the restoration, enhancement, and protection of fisheries habitat at the site. Under existing conditions, the artificially created impoundments support warm-water fish species including large and smallmouth bass, chain pickerel, bluegill, pumpkinseed, and bullhead. The proposed conditions provide protection for resident and native fisheries in the Town Brook system by moderating stream temperatures with a deeper and faster flowing system and established mature riparian vegetation providing shade to the channel. The presence of cold-water species such as trout is generally indicative of improved water and habitat quality, characterized by lower water temperatures and higher dissolved oxygen concentrations. These characteristics also support a stronger basis to the food chain, which strengthens the local fisheries habitat.

Riverfront Area

The existing conditions Riverfront Area resource zone for the Off-Billington Street and Plymco impoundments is depicted on Sheet 02. The Riverfront Area is defined in the River's Protection Act Chapter 258 of the Acts of 1996, as "a 200-foot wide corridor on each side of a perennial river or stream, measured from the mean annual high-water line of the river." The Riverfront Area is designated as 25 feet in "densely developed areas," which are defined as any area of 10 acres or more in which residential dwelling structures are present at a density of three or more per two acres.

A river is any natural flowing body of water that empties into any ocean, lake, or other river and that flows throughout the year. Rivers end where they meet the ocean, a lake,

or pond. By the definition of a river as given in the River's Protection Act, the land area surrounding the impoundments would not be designated as Riverfront Area. However, taking the conservative view, a 200-foot setback from the mean annual high water line, as measured in March 2005, has been graphically depicted.

The existing Riverfront Area surrounding the Billington impoundment includes a number of residences, driveways, and the roadway Off-Billington Street. The goal of the River's Protection Act is to permit activities within the Riverfront Area that do not have significant adverse impact to:

- Public or private water supply;
- Flood control;
- Storm damage prevention;
- Prevention of pollution;
- Protection of land containing shellfish;
- Protection of wildlife habitat;
- Protection of fisheries; and
- Protection of riverfront area.

It is clearly evident that the existing conditions Riverfront Area does not meet the goals of the River's Protection Act. Specific items are addressed as follows:

- The area is not part of the public or private water supply of the Town of Plymouth and, thus, adverse impacts to this resource are not applicable.
- According to the FEMA designation of the 100-year flood boundaries, the 100-year flood event in the project reach is contained within the existing impoundments and short river reach. The existing configuration of the impoundments does not provide for reductions in flood peaks. In addition, the excessive sediment within the impoundment could be resuspended under storm flows, thus exacerbating rather than preventing downstream sedimentation.

- Significant residential development in the existing conditions Riverfront Area exacerbates storm damage, as opposed to providing storm damage prevention.
- The existing conditions Riverfront Area has only minimal value for trapping sediments, oils, and other pollutants, some of which run directly from Off-Billington Street into the impoundments. The chemical removal of toxins in soils and plant roots is expected to be achieved within existing lawns and yards, which are themselves likely inputs of fertilizers, and potentially pesticides and herbicides.
- The project area in question in not tidal and, therefore, has no impact to areas containing shellfish.
- The existing Riverfront Area provides minimal to no wildlife habitat. The existing area is primarily residential in nature. A critical wildlife corridor connecting areas downstream and upstream is bisected by the residential development in the project area. No rare or endangered plants or animals were found within the project area.
- The Riverfront Area as defined in the River's Protection Act is intended to protect fisheries by moderating stream temperatures. The existing Riverfront Area lacks sufficient vegetation to moderate temperatures within the existing impoundments, which are characterized by elevated temperatures and decreased oxygen concentrations.

The proposed restored riverine environment will create a Riverfront Area of overbank and floodplain areas, which are currently inundated within the existing impoundment. As described in Section 11.1.1 Expected Wetlands Succession, this area will become vegetated with a varied multistory canopy of vegetation.

The newly created Riverfront Area, which will not be encapsulated by residential areas as it is under existing conditions, will better meet the goals of River's Protection Act. The vegetated floodplain will provide greater opportunity for filtering of pollutants, especially those associated with direct runoff from roads. Multistory vegetation will

reduce stream temperatures. Residences will be a greater distance from the water, thus mitigating storm damages. Restoration of a floodplain will provide for greater flood control in the project reach.

The recommended alternative represents a highly improved habitat condition that will benefit local fisheries and wildlife while restoring a natural riverine environment capable of supporting a healthy cold-water fishery.

## 12.0 LIKELY PERMITTING REQUIREMENTS

Dam Removal Permitting requires approvals from various federal, state and local agencies. Due to the highly sensitive nature of dam removal, great emphasis is placed on ensuring environmental safety and attention to detail. As such, the permitting process can take from 90 days to several years to complete. The entire process is fully open to the public for review. In addition to paperwork submission, permitting requires attendance at public regulatory hearings and consultation with regulators.

### 12.1 Federal

- Army Corps of Engineers' Permit Category II – Dredge and Fill
- Federal Consistency Statement
    - Administered by the Massachusetts Coastal Zone Management
- 401 Water Quality Certification
    - Administered by the Commonwealth of Massachusetts
- Section 106 Historical Review
    - Administered by the Commonwealth of Massachusetts

### 12.2 State

- Division of Marine Fisheries
- MEPA Review
    - Environmental Notification Form (ENF)
    - Potential Expanded ENF
    - Environmental Impact Report
- Jurisdictional Determination, Chapter 253 Permit
    - Administered by the Office of Dam Safety
- Chapter 91 Project Notification

- Water Quality Certification
    - Administered by the Massachusetts DEP
- Application for Beneficial Use of Solid Waste Permit
    - Administered by the Massachusetts DEP
    - Applicable if material from dam is being reused for bank stabilization or on-site use
- Massachusetts Historical Commission Project Notification
- Section 106 Historical Certificate
    - Administered by the Massachusetts Historic Commission
    - Applicable to dam removals that require USACE review under Section 404 or projects that are state funded

## 12.3 Local

- Order of Conditions (Plymouth Conservation Commission)
- Special Permit for Work in a Floodplain
- Building Permit

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# Appendix A
# Utility Company Correspondence

*Engineering,*
*Landscape Architecture*
*and Environmental Science*

MILONE & MACBROOM®

*John M. Milone, P.E.*
*James G. MacBroom, P.E.*
*Vincent C. McDermott, FASLA, AICP*

*Robert A. Jackson, L.S.*
*John R. Gilmore, P.E.*
*Edward A. Hart, P.E.*
*Thomas R. Sheil, L.A.*
*Stephen R. Dietzko, P.E.*
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*Davin L. Overton, P.E.*
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*James F. Kulpa, P.E.*
*Ted G. Crawford, P.E.*
*Steven D. George, P.E.*
*Ryan R. Chmielewski, L.A.*
*Reuben S. Jones, III, P.E.*

December 18, 2006

Adelphia
91 Industrial Park Road
Plymouth, MA 02360

**RE: Plymco Dam and Off-Billington Street Dam Anadromous Fish Restoration Feasibility Analysis**
**Plymouth, Massachusetts**
**MMI #1982-03**

Dear Sir or Madam:

Milone and MacBroom, Inc. (MMI) has been retained by the Town of Plymouth, NOAA, and the Commonwealth of Massachusetts' Riverways Program to complete a dam modification and river restoration feasibility study for the Off-Billington Street Dam and Plymco Dam located on Town Brook in Plymouth, Massachusetts. As part of our analysis, we have been charged with conducting background research relative to the existing utilities in the area. The project area limits are as follows:

- Billington Street to the south and west; and
- Off-Billington Street to the north and east.

Figure 1 (enclosed herewith) graphically depicts the project area.

In conjunction with this effort, MMI would like to request for our review any available information profiling the size, type, and location of your utilities in this area. A map, or maps, graphically displaying the location of these utilities would prove most useful. In addition, please provide details of conditions or requirements for construction activities in the vicinity of these utilities.

Thank you for your assistance. Please feel free to contact me at (203) 271-1773 or elsal@miloneandmacbroom.com if you have any questions regarding this request.

Very truly yours,

MILONE & MACBROOM, INC.

Elsa Loehmann, E.I.T.
Water Resource Engineer

Enclosure

1982-03-d1806-2-ltr

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*Landscape Architecture*
*and Environmental Science*

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*Ted G. Crawford, P.E.*
*Steven D. George, P.E.*
*Ryan R. Chmielewski, L.A.*
*Reuben S. Jones, III, P.E.*

December 18, 2006

Ms. Vicky Merchant
NSTAR
One NSTAR Way
Westwood, MA 02090

**RE: Plymco Dam and Off-Billington Street Dam Anadromous Fish Restoration Feasibility Analysis**
**Plymouth, Massachusetts**
**MMI #1982-03**

Dear Ms. Merchant:

Milone and MacBroom, Inc. (MMI) has been retained by the Town of Plymouth, NOAA, and the Commonwealth of Massachusetts' Riverways Program to complete a dam modification and river restoration feasibility study for the Off-Billington Street Dam and Plymco Dam located on Town Brook in Plymouth, Massachusetts. As part of our analysis, we have been charged with conducting background research relative to the existing utilities in the area. The project area limits are as follows:

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Very truly yours,

MILONE & MACBROOM, INC.

Elsa Loehmann, E.I.T.
Water Resource Engineer

Enclosure

1982-03-d1806-3-ltr

*Engineering,*
*Landscape Architecture*
*and Environmental Science*

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*James F. Kulpa, P.E.*
*Ted G. Crawford, P.E.*
*Steven D. George, P.E.*
*Ryan R. Chmielewski, L.A.*
*Reuben S. Jones, III, P.E.*

December 18, 2006

Verizon – New England
185 Franklin Street
Boston, MA 02107

**RE: Plymco Dam and Off-Billington Street Dam Anadromous Fish Restoration Feasibility Analysis**
**Plymouth, Massachusetts**
**MMI #1982-03**

Dear Sir or Madam:

Milone and MacBroom, Inc. (MMI) has been retained by the Town of Plymouth, NOAA, and the Commonwealth of Massachusetts' Riverways Program to complete a dam modification and river restoration feasibility study for the Off-Billington Street Dam and Plymco Dam located on Town Brook in Plymouth, Massachusetts. As part of our analysis, we have been charged with conducting background research relative to the existing utilities in the area. The project area limits are as follows:

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Very truly yours,

MILONE & MACBROOM, INC.

Elsa Loehmann, E.I.T.
Water Resource Engineer

Enclosure

1982-03-d1806-1-ltr

# Appendix B
# Results of Sediment Analysis

November 27, 2006

Milone & MacBroom Inc.
99 Realty Drive
Cheshire, CT 06410

**Attn: Mr. Matthew Sanford**

RECEIVED
NOV 29 2006
MILONE AND MACBROOM

Please find attached laboratory report(s) for the samples submitted on:
**November 13, 2006.**

All pertinent information for this analysis is located on the report. Should it be necessary to contact us regarding billing or the test results, please have the following information readily available:

| | | |
|---|---|---|
| **Lab No.** | : | 1106185 |
| **PO/Job No.** | : | 1982-03-3 |
| **Invoice No.** | : | 145385 |
| **Customer No.** | : | 894 |

Please contact us if you have any questions.

Very truly yours,

Stephen J. Franco
Laboratory Director
PH-0547

connecticut testing laboratories inc.
WATER SOIL AIR

STEPHEN J. FRANCO
Laboratory Director
PHONE 203/634-3731
www.ctl-web.com / ctestlab@erols.com
165 GRACEY AVENUE MERIDEN, CT 06451

Date Samples Received: 11/13/06

| | | | |
|---|---|---|---|
| Client Name : | **Milone & MacBroom** | CTL Lab No. : | 1106185 |
| Report Date : | 11/22/06 | PO/ Job No. : | 1982-03-3 |

## RESULTS OF ANALYSIS

**Soil Gradation ASTM D-422**

| | | | | | |
|---|---|---|---|---|---|
| **Matrix Type :** | | **S** | **S** | **S** | **S** |
| **CTL Sample No.:** | | **20396** | **20397** | **20398** | **20399** |
| **Field ID :** | | **UPD-1** | **UPD-2** | **UPD-3** | **LPD-1** |
| | Sieve **Size** | | | | |
| Percent by Wt. Passing | No. 4 (4.75 mm) | 100.0 | 100.0 | 100.0 | 90.0 |
| | No. 10 (2.0 mm) | 99.7 | 100.0 | 99.7 | 85.0 |
| | No. 40 (0.425mm) | 98.3 | 98.1 | 97.1 | 60.2 |
| | No. 200 (0.075mm) | 95.5 | 94.6 | 94.5 | 38.3 |

| | | | | | |
|---|---|---|---|---|---|
| **Matrix Type :** | | **S** | **S** | **S** | **S** |
| **CTL Sample No.:** | | **20400** | **20401** | **20402** | **20403** |
| **Field ID :** | | **LPD-2** | **LPD-3** | **LPD-4** | **LPD-5** |
| | Sieve **Size** | | | | |
| Percent by Wt. Passing | No. 4 (4.75 mm) | 96.2 | 94.9 | 95.0 | 91.2 |
| | No. 10 (2.0 mm) | 59.1 | 90.3 | 91.0 | 83.9 |
| | No. 40 (0.425mm) | 16.9 | 77.3 | 79.2 | 67.7 |
| | No. 200 (0.075mm) | 3.9 | 57.4 | 64.7 | 50.7 |

**Matrix Type:** W= Water/Aqueous S= Soil/Solid O= Oil/Hydrocarbon

**Connecticut Testing Laboratories, Inc.**
**165 Gracey Avenue / Meriden, CT 06451**
**(203) 634-3731 (Fax) 630-1336**
**Certification CT-PH0547/ MA-CT035**

Date Samples Received: 11/13/06

| | | | |
|---|---|---|---|
| Client Name : | **Milone & MacBroom** | CTL Lab No. : | 1106185 |
| Report Date : | 11/22/06 | PO/ Job No. : | 1982-03-3 |

**RESULTS OF ANALYSIS**

| | | | | | |
|---|---|---|---|---|---|
| **Matrix Type :** | | **S** | **S** | **S** | **S** |
| **CTL Sample No.** | | **20396** | **20397** | **20401** | **20403** |
| **Field ID :** | | **UPD-1** | **UPD-2** | **LPD-3** | **LPD-5** |
| **Parameters** | **MDL** | | | | |
| Volatile Solids % | 0.1 | 25.4 | 23.4 | 20.8 | 19.4 |

MDL= Method Detection Level BDL= Below Detection Level

Matrix Types: W = Water/Aqueous S= Soil/Solid O= Oil/Hydrocarbon

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**Certification CT-PH0547/ MA-CT035**

**Grain Size Distribution**
**Hydrometer Analysis Data**

| | | | |
|---|---|---|---|
| Client: | Milone & McBroom | Date of Report: | 11/22/2006 |
| CTL Lab No. | 1106185 | Date Samples Recieved: | 11/13/2006 |
| Method # | ASTM D422 | | |

Field ID **UPD-1**
CTL # **20396**

| Sieve Size mm | % Finer |
|---|---|
| 0.0328 | 41.4 |
| 0.0212 | 36.8 |
| 0.0153 | 32.2 |
| 0.0129 | 24.5 |
| 0.0097 | 6.1 |
| 0.0069 | 4.5 |
| 0.0049 | 3.0 |
| 0.0035 | 1.5 |
| 0.0014 | 1.5 |

Field ID **UPD-2**
CTL # **20397**

| Sieve Size mm | % Finer |
|---|---|
| 0.0332 | 41.6 |
| 0.0215 | 36.6 |
| 0.0157 | 28.3 |
| 0.0133 | 16.6 |
| 0.0097 | 8.3 |
| 0.0069 | 6.6 |
| 0.0049 | 4.9 |
| 0.0035 | 3.3 |
| 0.0014 | 1.6 |

Field ID **UPD-3**
CTL # **20398**

| Sieve Size mm | % Finer |
|---|---|
| 0.0330 | 39.8 |
| 0.0213 | 35.2 |
| 0.0156 | 27.5 |
| 0.0128 | 26.0 |
| 0.0097 | 7.6 |
| 0.0069 | 6.1 |
| 0.0049 | 4.5 |
| 0.0035 | 3.0 |
| 0.0014 | 1.5 |

Field ID **LPD-1**
CTL # **20399**

| Sieve Size mm | % Finer |
|---|---|
| 0.0325 | 23.8 |
| 0.0212 | 20.4 |
| 0.0154 | 17.0 |
| 0.0128 | 14.4 |
| 0.0092 | 11.9 |
| 0.0067 | 7.6 |
| 0.0048 | 5.9 |
| 0.0034 | 5.1 |
| 0.0014 | 4.2 |

Field ID **LPD-3**
CTL # **20401**

| Sieve Size mm | % Finer |
|---|---|
| 0.0361 | 16.6 |
| 0.0232 | 12.4 |
| 0.0165 | 11.1 |
| 0.0136 | 9.7 |
| 0.0097 | 5.5 |
| 0.0070 | 2.7 |
| 0.0050 | 1.3 |
| 0.0035 | 1.3 |
| 0.0014 | 1.2 |

Field ID **LPD-4**
CTL # **20402**

| Sieve Size mm | % Finer |
|---|---|
| 0.0359 | 19.7 |
| 0.0231 | 15.1 |
| 0.0167 | 9.0 |
| 0.0138 | 6.0 |
| 0.0098 | 4.5 |
| 0.0070 | 3.0 |
| 0.0050 | 1.5 |
| 0.0035 | 1.5 |
| 0.0014 | 1.5 |

Field ID **LPD-5**
CTL # **20403**

| Sieve Size mm | % Finer |
|---|---|
| 0.0363 | 15.3 |
| 0.0234 | 11.1 |
| 0.0168 | 6.9 |
| 0.0139 | 4.1 |
| 0.0099 | 2.7 |
| 0.0070 | 1.3 |
| 0.0050 | 1.3 |
| 0.0035 | 1.3 |
| 0.0014 | 1.2 |

# CHAIN OF CUSTODY RECORD

Connecticut Testing Laboratories Inc.

Lab Tracking #: 1106185

Client: Milone and MacBroom Inc

Project/PO # 1982-03-3

Sampler(s): [signature] (signature)

Matthew Sanford (print)

Requested Analyses

Reference

| Lab Use | Field ID (please print) | Date | Time | Matrix | RSR Criteria | Sive Analysis | Hydrometer | | | | | | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20396 | UPD-1 | 10-13-06 | | Soil | | X | X | | | | | | | | | |
| 97 | UPD-2 | 10-13-06 | | Soil | | X | Y | | | | | | | | | |
| 98 | UPD-3 | 10-13-06 | | Soil | | X | Y | | | | | | | | | |
| 99 | LPD-1 | 10-13-06 | | Soil | | X | X | | | | | | | | | |
| 20400 | LPD-2 | 10-13-06 | | Soil | | X | | | | | | | | | | |
| 01 | LPD-3 | 10-13-06 | | Soil | | X | X | | | | | | | | | |
| 02 | LPD-4 | 10-13-06 | | Soil | | X | X | | | | | | | | | |
| 03 | LPD-5 | 10-13-06 | | Soil | | X | X | | | | | | | | | |

| Relinquished By: (Signature) | Date / Time | Received By: (Signature) | Date / Time | Received By Laboratory: (Signature) | Date / Time |
|---|---|---|---|---|---|
| Edward P Belitzky | 11-13-06 3:11 | | | [signature] | 11/15/06 1511 |
| Relinquished By: (Signature) | Date / Time | Received By: (Signature) | Date / Time | Turn Around Time | |
| | | | | 24 HR* ☐ 3 Day* ☐ 5 Day ☒ | |
| Relinquished By: (Signature) | Date / Time | Received By: (Signature) | Date / Time | 48 HR* ☐ 4 Day* ☐ 10 Day ☐ | |

*Turnaround times less than "5 Days" may be subject to priority fee charges.

Matrices = A - Aqueous S - Soil/Solid H - Hydrocarbon (Oil)

CTL will not be held liable for incorrectly filled out Chain of Custody Records.

Samples held for 45 days from receipt.

**Connecticut Testing Laboratories, Inc.**
165 Gracey Ave. / Meriden, CT 06451
Tel. (203)-634-3731 / Fax (203) 630-1336

11/13/2006 16:27

# MMI 2007 Sediment Sampling Results

| SAMPLE ID | | OB-1 | | OB-2 | | OB-3 | |
|---|---|---|---|---|---|---|---|
| SAMPLING DATE | | 5/9/2007 | | 5/9/2007 | | 5/9/2007 | |
| LAB SAMPLE ID | | 0705087-01 | | 0705087-02 | | 0705087-03 | |
| | Units | | Qual | | Qual | | Qual |
| | | | | | | | |
| **Metals** | | | | | | | |
| Antimony | mg/Kg | 1.7 | | 1.0 | | 0.38 | |
| Vanadium | mg/Kg | 14 | | 23 | | 18 | |
| Nickel | mg/Kg | 17 | | 7.8 | | 3.6 | |
| Selenium | mg/Kg | 0.48 | U | 1.3 | | 0.82 | |
| Thallium | mg/Kg | 0.033 | | 0.14 | | 0.13 | |
| Arsenic | mg/Kg | 28 | | 49 | | 38 | |
| Chromium | mg/Kg | 48 | | 54 | | 70 | |
| Silver | mg/Kg | 0.079 | | 0.20 | | 0.16 | |
| Barium | mg/Kg | 48 | | 74 | | 61 | |
| Cadmium | mg/Kg | 0.29 | | 1.1 | | 0.28 | |
| Beryllium | mg/Kg | 0.24 | | 0.57 | | 0.51 | |
| Lead | mg/Kg | 110 | | 290 | | 70 | |
| Zinc | mg/Kg | 92 | | 180 | | 61 | |
| Copper | mg/Kg | 84 | | 42 | | 30 | |
| | | | | | | | |
| **Metals** | | | | | | | |
| Mercury | mg/Kg | 0.075 | | 0.48 | | 0.21 | |
| | | | | | | | |
| **Pesticides by 8081** | | | | | | | |
| 2,4'-DDD | µg/Kg | 4.2 | P | 8.6 | | 1.7 | P |
| 2,4'-DDE | µg/Kg | 0.15 | U | 0.17 | U | 0.14 | U |
| 2,4'-DDT | µg/Kg | 0.15 | U | 1.1 | P | 0.17 | |
| 4,4'-DDD | µg/Kg | 11 | | 33 | P | 2.1 | |
| 4,4'-DDE | µg/Kg | 7.4 | I | 27 | I | 6.8 | I |
| 4,4'-DDT | µg/Kg | 4.4 | P | 9.3 | P | 0.98 | I |
| alpha-Chlordane | µg/Kg | 0.49 | | 0.88 | P | 0.27 | |
| Dieldrin | µg/Kg | 0.22 | I | 0.32 | I | 0.14 | U |
| Endrin | µg/Kg | 0.15 | U | 0.17 | U | 0.14 | U |
| gamma-BHC | µg/Kg | 0.15 | U | 0.17 | U | 0.14 | U |
| gamma-Chlordane | µg/Kg | 0.96 | | 2.6 | | 0.32 | |
| Heptachlor epoxide (B) | µg/Kg | 0.15 | U | 0.17 | U | 0.14 | U |
| | | | | | | | |
| **Polychlorinated Biphenyls by 8082** | | | | | | | |
| Aroclor 1016 | µg/Kg | 7.0 | U | 8.5 | U | 7.2 | U |
| Aroclor 1221 | µg/Kg | 7.0 | U | 8.5 | U | 7.2 | U |
| Aroclor 1232 | µg/Kg | 7.0 | U | 8.5 | U | 7.2 | U |
| Aroclor 1242 | µg/Kg | 7.0 | U | 8.5 | U | 7.2 | U |
| Aroclor 1248 | µg/Kg | 7.0 | U | 8.5 | U | 7.2 | U |
| Aroclor 1254 | µg/Kg | 7.0 | U | 8.5 | U | 7.2 | U |
| Aroclor 1260 | µg/Kg | 7.0 | U | 8.5 | U | 7.2 | U |
| | | | | | | | |
| **Volatile Organics by 8260** | | | | | | | |
| Dichlorodifluoromethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Chloromethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Vinyl chloride | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Bromomethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Chloroethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Trichlorofluoromethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Diethyl ether | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Acetone | µg/Kg | 61 | | 200 | | 58 | |
| 1,1-Dichloroethene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Carbon disulfide | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Methylene chloride | µg/Kg | 4.2 | U | 12 | U | 4.9 | U |
| Methyl tert-butyl ether (MTBE) | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| trans-1,2-Dichloroethene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Diisopropyl Ether (DIPE) | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,1-Dichloroethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Ethyl Tertiary Butyl Ether (ETBE) | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 2-Butanone (MEK) | µg/Kg | 16 | | 35 | | 12 | |
| cis-1,2-Dichloroethene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 2,2-Dichloropropane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Bromochloromethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Chloroform | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,1,1-Trichloroethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,1-Dichloropropene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Carbon tetrachloride | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Benzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Tertiary Amyl Methyl Ether (TAME) | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Tetrahydrofuran | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,2-Dichloroethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Trichloroethene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,2-Dichloropropane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Dibromomethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,4-Dioxane | µg/Kg | 42 | U | 120 | U | 49 | U |
| Bromodichloromethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Methyl isobutyl ketone (MIBK) | µg/Kg | 4.2 | U | 12 | U | 4.9 | U |
| 1,3-Dichloropropene, Total | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Toluene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,1,2-Trichloroethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 2-Hexanone | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Tetrachloroethene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,3-Dichloropropane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Dibromochloromethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,2-Dibromoethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Chlorobenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,1,1,2-Tetrachloroethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Ethylbenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Xylenes, Total | µg/Kg | 5.0 | U | 14 | U | 5.8 | U |
| Styrene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Bromoform | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Isopropylbenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,1,2,2-Tetrachloroethane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Bromobenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,2,3-Trichloropropane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| n-Propylbenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 2-Chlorotoluene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,3,5-Trimethylbenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 4-Chlorotoluene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| tert-Butylbenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,2,4-Trimethylbenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| sec-Butylbenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,3-Dichlorobenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| p-Isopropyltoluene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,4-Dichlorobenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| n-Butylbenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,2-Dibromo-3-chloropropane | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,2-Dichlorobenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| 1,2,4-Trichlorobenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Hexachlorobutadiene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| Naphthalene | µg/Kg | 4.2 | U | 12 | U | 4.9 | U |
| 1,2,3-Trichlorobenzene | µg/Kg | 1.7 | U | 4.8 | U | 1.9 | U |
| | | | | | | | |
| **Semi-Volatile Organics by 8270 - SIM** | | | | | | | |
| Naphthalene | µg/Kg | 180 | | 630 | | 97 | |
| 2-Methylnaphthalene | µg/Kg | 110 | | 320 | | 69 | |
| Acenaphthylene | µg/Kg | 140 | | 1800 | | 150 | |
| Acenaphthene | µg/Kg | 210 | | 520 | | 83 | |
| Fluorene | µg/Kg | 370 | | 1600 | | 110 | |
| Phenanthrene | µg/Kg | 2500 | | 17000 | | 1100 | |
| Anthracene | µg/Kg | 620 | | 5700 | | 290 | |
| Fluoranthene | µg/Kg | 2900 | | 23000 | | 2100 | |
| Pyrene | µg/Kg | 2200 | | 17000 | | 1700 | |
| Benz[a]anthracene | µg/Kg | 1300 | | 9500 | | 980 | |
| Chrysene | µg/Kg | 1400 | | 9300 | | 1200 | |
| Benzo[b]fluoranthene | µg/Kg | 980 | | 6200 | | 880 | |
| Benzo[k]fluoranthene | µg/Kg | 970 | | 6500 | | 780 | |
| Benzo[a]pyrene | µg/Kg | 1000 | | 7500 | | 890 | |
| Indeno[1,2,3-cd]pyrene | µg/Kg | 800 | | 4700 | | 700 | |
| Dibenz[a,h]anthracene | µg/Kg | 200 | | 1300 | | 180 | |
| Benzo[g,h,i]perylene | µg/Kg | 690 | | 4200 | | 590 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Inorganics** | | | | | | | |
| Total Organic Carbon (Run 1) | % | 2.3 | | 7.6 | | 3.1 | |
| Total Organic Carbon (Run 2) | % | 2.6 | | 6.5 | | 3.2 | |
| | | | | | | | |
| **Inorganics** | | | | | | | |
| Total Organic Matter | mg/Kg | 90 | | 79 | | 90 | |
| | | | | | | | |
| **Total Petroleum Hydrocarbons by EPH** | | | | | | | |
| Total Petroleum Hydrocarbons | mg/Kg | 210 | | 1300 | | 420 | |
| | | | | | | | |
| **Grain Size Analysis** | | | | | | | |
| % Cobbles | % | 0.0 | | 0.0 | | | |
| % Coarse Gravel | % | 0.0 | | 0.0 | | | |
| % Fine Gravel | % | 0.0 | | 0.0 | | | |
| % Coarse Sand | % | 5.5 | | 11.4 | | | |
| % Medium Sand | % | 36.4 | | 31.5 | | | |
| % Fine Sand | % | 40.2 | | 21.4 | | | |
| % Silt | % | 7.2 | | 8.2 | | | |
| % Clay | % | 1.3 | | 1.5 | | | |
| USCS | % | | SP-SM | | SW-SM | | |

| SAMPLE ID | | OB-4 | | OB-5 | | OB-6 | |
|---|---|---|---|---|---|---|---|
| SAMPLING DATE | | 5/9/2007 | | 5/9/2007 | | 5/9/2007 | |
| LAB SAMPLE ID | | 0705087-04 | | 0705087-05 | | 0705087-06 | |
| | Units | | Qual | | Qual | | Qual |
| | | | | | | | |
| **Metals** | | | | | | | |
| Antimony | mg/Kg | 0.76 | | 2.2 | | 0.41 | |
| Vanadium | mg/Kg | 14 | | 11 | | 13 | |
| Nickel | mg/Kg | 4.8 | | 5.0 | | 7.2 | |
| Selenium | mg/Kg | 1.3 | | 0.87 | | 1.0 | |
| Thallium | mg/Kg | 0.14 | | 0.085 | | 0.070 | |
| Arsenic | mg/Kg | 21 | | 18 | | 12 | |
| Chromium | mg/Kg | 240 | | 92 | | 44 | |
| Silver | mg/Kg | 0.21 | | 0.27 | | 0.088 | |
| Barium | mg/Kg | 58 | | 86 | | 78 | |
| Cadmium | mg/Kg | 0.69 | | 0.49 | | 0.42 | |
| Beryllium | mg/Kg | 0.47 | | 0.39 | | 0.53 | |
| Lead | mg/Kg | 190 | | 200 | | 92 | |
| Zinc | mg/Kg | 140 | | 150 | | 69 | |
| Copper | mg/Kg | 46 | | 41 | | 33 | |
| | | | | | | | |
| **Metals** | | | | | | | |
| Mercury | mg/Kg | 0.57 | | 0.45 | | 0.15 | |
| | | | | | | | |
| ***Pesticides by 8081*** | | | | | | | |
| 2,4'-DDD | µg/Kg | 4.0 | | 3.6 | | 2.2 | P |
| 2,4'-DDE | µg/Kg | 0.14 | U | 0.14 | U | 0.14 | U |
| 2,4'-DDT | µg/Kg | 0.36 | | 0.81 | | 0.24 | |
| 4,4'-DDD | µg/Kg | 20 | | 13 | P | 2.6 | |
| 4,4'-DDE | µg/Kg | 14 | I | 8.9 | I | 2.8 | I |
| 4,4'-DDT | µg/Kg | 4.4 | | 3.7 | | 1.3 | |
| alpha-Chlordane | µg/Kg | 0.31 | | 0.36 | | 0.31 | |
| Dieldrin | µg/Kg | 0.14 | U | 0.19 | I | 0.14 | U |
| Endrin | µg/Kg | 0.14 | U | 0.14 | U | 0.14 | U |
| gamma-BHC | µg/Kg | 0.14 | U | 0.14 | U | 0.14 | U |
| gamma-Chlordane | µg/Kg | 1.8 | | 1.1 | | 0.52 | |
| Heptachlor epoxide (B) | µg/Kg | 0.14 | U | 0.14 | U | 0.14 | U |
| | | | | | | | |
| **Polychlorinated Biphenyls by 8082** | | | | | | | |
| Aroclor 1016 | µg/Kg | 7.4 | U | 9.2 | U | 9.4 | U |
| Aroclor 1221 | µg/Kg | 7.4 | U | 9.2 | U | 9.4 | U |
| Aroclor 1232 | µg/Kg | 7.4 | U | 9.2 | U | 9.4 | U |
| Aroclor 1242 | µg/Kg | 7.4 | U | 9.2 | U | 9.4 | U |
| Aroclor 1248 | µg/Kg | 7.4 | U | 9.2 | U | 9.4 | U |
| Aroclor 1254 | µg/Kg | 7.4 | U | 9.2 | U | 9.4 | U |
| Aroclor 1260 | µg/Kg | 7.4 | U | 9.2 | U | 9.4 | U |
| | | | | | | | |
| **Volatile Organics by 8260** | | | | | | | |
| Dichlorodifluoromethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Chloromethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Vinyl chloride | µg/Kg | | | 4.9 | U | 2.8 | U |
| Bromomethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Chloroethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Trichlorofluoromethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Diethyl ether | µg/Kg | | | 4.9 | U | 2.8 | U |
| Acetone | µg/Kg | | | 220 | | 67 | |
| 1,1-Dichloroethene | µg/Kg | | | 4.9 | U | 2.8 | U |
| Carbon disulfide | µg/Kg | | | 4.9 | U | 2.8 | U |
| Methylene chloride | µg/Kg | | | 12 | U | 6.9 | U |
| Methyl tert-butyl ether (MTBE) | µg/Kg | | | 4.9 | U | 2.8 | U |
| trans-1,2-Dichloroethene | µg/Kg | | | 4.9 | U | 2.8 | U |
| Diisopropyl Ether (DIPE) | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,1-Dichloroethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Ethyl Tertiary Butyl Ether (ETBE) | µg/Kg | | | 4.9 | U | 2.8 | U |
| 2-Butanone (MEK) | µg/Kg | | | 54 | | 16 | |
| cis-1,2-Dichloroethene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 2,2-Dichloropropane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Bromochloromethane | µg/Kg | | | 4.9 | U | 2.8 | U |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Chloroform | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,1,1-Trichloroethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,1-Dichloropropene | µg/Kg | | | 4.9 | U | 2.8 | U |
| Carbon tetrachloride | µg/Kg | | | 4.9 | U | 2.8 | U |
| Benzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| Tertiary Amyl Methyl Ether (TAME) | µg/Kg | | | 4.9 | U | 2.8 | U |
| Tetrahydrofuran | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,2-Dichloroethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Trichloroethene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,2-Dichloropropane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Dibromomethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,4-Dioxane | µg/Kg | | | 120 | U | 69 | U |
| Bromodichloromethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Methyl isobutyl ketone (MIBK) | µg/Kg | | | 12 | U | 6.9 | U |
| 1,3-Dichloropropene, Total | µg/Kg | | | 4.9 | U | 2.8 | U |
| Toluene | µg/Kg | | | 5.5 | | 2.8 | U |
| 1,1,2-Trichloroethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| 2-Hexanone | µg/Kg | | | 4.9 | U | 2.8 | U |
| Tetrachloroethene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,3-Dichloropropane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Dibromochloromethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,2-Dibromoethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Chlorobenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,1,1,2-Tetrachloroethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Ethylbenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| Xylenes, Total | µg/Kg | | | 15 | U | 8.2 | U |
| Styrene | µg/Kg | | | 4.9 | U | 2.8 | U |
| Bromoform | µg/Kg | | | 4.9 | U | 2.8 | U |
| Isopropylbenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,1,2,2-Tetrachloroethane | µg/Kg | | | 4.9 | U | 2.8 | U |
| Bromobenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,2,3-Trichloropropane | µg/Kg | | | 4.9 | U | 2.8 | U |
| n-Propylbenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 2-Chlorotoluene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,3,5-Trimethylbenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 4-Chlorotoluene | µg/Kg | | | 4.9 | U | 2.8 | U |
| tert-Butylbenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,2,4-Trimethylbenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| sec-Butylbenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,3-Dichlorobenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| p-Isopropyltoluene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,4-Dichlorobenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| n-Butylbenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,2-Dibromo-3-chloropropane | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,2-Dichlorobenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| 1,2,4-Trichlorobenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| Hexachlorobutadiene | µg/Kg | | | 4.9 | U | 2.8 | U |
| Naphthalene | µg/Kg | | | 12 | U | 6.9 | U |
| 1,2,3-Trichlorobenzene | µg/Kg | | | 4.9 | U | 2.8 | U |
| | | | | | | | |
| **Semi-Volatile Organics by 8270 - SIM** | | | | | | | |
| Naphthalene | µg/Kg | 440 | | 480 | | 280 | |
| 2-Methylnaphthalene | µg/Kg | 280 | | 370 | | 160 | |
| Acenaphthylene | µg/Kg | 380 | | 300 | | 150 | |
| Acenaphthene | µg/Kg | 960 | | 980 | | 240 | |
| Fluorene | µg/Kg | 1100 | | 1000 | | 270 | |
| Phenanthrene | µg/Kg | 7800 | | 6300 | | 2300 | |
| Anthracene | µg/Kg | 2400 | | 2000 | | 640 | |
| Fluoranthene | µg/Kg | 9000 | | 6600 | | 3200 | |
| Pyrene | µg/Kg | 6600 | | 4600 | | 2500 | |
| Benz[a]anthracene | µg/Kg | 4200 | | 2600 | | 1300 | |
| Chrysene | µg/Kg | 4200 | | 2700 | | 1400 | |
| Benzo[b]fluoranthene | µg/Kg | 2800 | | 1800 | | 960 | |
| Benzo[k]fluoranthene | µg/Kg | 2800 | | 1800 | | 910 | |
| Benzo[a]pyrene | µg/Kg | 3200 | | 2000 | | 1000 | |
| Indeno[1,2,3-cd]pyrene | µg/Kg | 2400 | | 1500 | | 730 | |
| Dibenz[a,h]anthracene | µg/Kg | 610 | | 350 | | 180 | |
| Benzo[g,h,i]perylene | µg/Kg | 1900 | | 1200 | | 630 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Inorganics** | | | | | | | |
| Total Organic Carbon (Run 1) | % | 5.1 | | 3.7 | | 8.6 | |
| Total Organic Carbon (Run 2) | % | 4.4 | | 4.0 | | 11 | |
| | | | | | | | |
| **Inorganics** | | | | | | | |
| Total Organic Matter | mg/Kg | 84 | | 81 | | 78 | |
| | | | | | | | |
| **Total Petroleum Hydrocarbons by EPH** | | | | | | | |
| Total Petroleum Hydrocarbons | mg/Kg | 640 | | 500 | | 610 | |
| | | | | | | | |
| **Grain Size Analysis** | | | | | | | |
| % Cobbles | % | | | 0.0 | | 0.0 | |
| % Coarse Gravel | % | | | 0.0 | | 0.0 | |
| % Fine Gravel | % | | | 0.0 | | 0.0 | |
| % Coarse Sand | % | | | 12.3 | | 19.1 | |
| % Medium Sand | % | | | 29.9 | | 32.7 | |
| % Fine Sand | % | | | 35.0 | | 26.6 | |
| % Silt | % | | | 10.7 | | 12.6 | |
| % Clay | % | | | 2.0 | | 1.7 | |
| USCS | % | | | | SM | | SM |

| SAMPLE ID | | PL-1 | | PL-1 | | PL-2 | | PL-3 | | PL-4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLING DATE | | 5/10/2007 | | 5/10/2007 | | 5/10/2007 | | 5/10/2007 | | 5/10/2007 | |
| LAB SAMPLE ID | | 0705087-07 | | 0705087-07E | | 0705087-08 | | 0705087-09 | | 0705087-10 | |
| | Units | | Qual | | Qual | | Qua | | Qual | | Qual |
| | | | | | | | | | | | |
| **Metals** | | | | | | | | | | | |
| Antimony | mg/Kg | 0.12 | | | | 0.24 | U | 0.44 | U | 0.55 | |
| Vanadium | mg/Kg | 8.1 | | | | 13 | | 22 | | 24 | |
| Nickel | mg/Kg | 1.8 | | | | 3.8 | | 7.8 | | 8.6 | |
| Selenium | mg/Kg | 0.44 | U | | | 0.95 | U | 1.8 | | 2.4 | U |
| Thallium | mg/Kg | 0.022 | U | | | 0.077 | | 0.12 | | 0.13 | |
| Arsenic | mg/Kg | 7.1 | | | | 12 | | 52 | | 63 | |
| Chromium | mg/Kg | 2.5 | | | | 7.0 | | 13 | | 14 | |
| Silver | mg/Kg | 0.046 | U | | | 0.096 | U | 0.17 | U | 0.24 | U |
| Barium | mg/Kg | 14 | | | | 50 | | 85 | | 84 | |
| Cadmium | mg/Kg | 0.12 | | | | 0.33 | | 1.0 | | 1.4 | |
| Beryllium | mg/Kg | 0.17 | | | | 0.40 | | 0.64 | | 0.59 | |
| Lead | mg/Kg | 17 | | | | 52 | | 130 | | 130 | |
| Zinc | mg/Kg | 27 | | | | 44 | | 120 | | 150 | |
| Copper | mg/Kg | 4.9 | | | | 8.8 | | 35 | | 58 | |
| | | | | | | | | | | | |
| **Metals** | | | | | | | | | | | |
| Mercury | mg/Kg | 0.011 | | | | 0.072 | | 0.15 | | 0.15 | |
| | | | | | | | | | | | |
| **Pesticides by 8081** | | | | | | | | | | | |
| 2,4'-DDD | µg/Kg | 36 | | 48 | | 0.80 | | 7.1 | | 5.1 | |
| 2,4'-DDE | µg/Kg | 0.14 | U | 2.9 | U | 0.15 | U | 0.28 | U | 0.37 | U |
| 2,4'-DDT | µg/Kg | 71 | E | 100 | | 0.15 | U | 0.71 | | 0.81 | |
| 4,4'-DDD | µg/Kg | 51 | | 67 | | 2.8 | | 33 | | 18 | |
| 4,4'-DDE | µg/Kg | 7.9 | I | 11 | I | 2.2 | I | 26 | I | 22 | I |
| 4,4'-DDT | µg/Kg | 780 | E | 970 | | 1.9 | | 2.4 | I | 2.8 | I |
| alpha-Chlordane | µg/Kg | 0.14 | U | 2.9 | U | 0.15 | U | 0.28 | U | 0.37 | U |
| Dieldrin | µg/Kg | 0.40 | I | 2.9 | U | 0.15 | U | 0.45 | | 0.37 | U |
| Endrin | µg/Kg | 0.14 | U | 2.9 | U | 0.15 | U | 0.28 | U | 0.37 | U |
| gamma-BHC | µg/Kg | 0.14 | U | 2.9 | U | 0.15 | U | 0.28 | U | 0.37 | U |
| gamma-Chlordane | µg/Kg | 0.76 | | 2.9 | U | 0.26 | | 2.4 | | 1.8 | |
| Heptachlor epoxide (B) | µg/Kg | 0.14 | U | 2.9 | U | 0.15 | U | 0.28 | U | 0.37 | U |
| | | | | | | | | | | | |
| **Polychlorinated Biphenyls by 8082** | | | | | | | | | | | |
| Aroclor 1016 | µg/Kg | 6.5 | U | | | 7.1 | U | 14 | U | 19 | U |
| Aroclor 1221 | µg/Kg | 6.5 | U | | | 7.1 | U | 14 | U | 19 | U |
| Aroclor 1232 | µg/Kg | 6.5 | U | | | 7.1 | U | 14 | U | 19 | U |
| Aroclor 1242 | µg/Kg | 6.5 | U | | | 7.1 | U | 14 | U | 19 | U |
| Aroclor 1248 | µg/Kg | 6.5 | U | | | 7.1 | U | 14 | U | 19 | U |
| Aroclor 1254 | µg/Kg | 6.5 | U | | | 7.1 | U | 14 | U | 19 | U |
| Aroclor 1260 | µg/Kg | 6.5 | U | | | 7.1 | U | 14 | U | 19 | U |
| | | | | | | | | | | | |
| **Volatile Organics by 8260** | | | | | | | | | | | |
| Dichlorodifluoromethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Chloromethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Vinyl chloride | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Bromomethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Chloroethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Trichlorofluoromethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Diethyl ether | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Acetone | µg/Kg | 47 | | | | 160 | | 330 | | 240 | |
| 1,1-Dichloroethene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Carbon disulfide | µg/Kg | 1.6 | | | | 5.1 | | 8.8 | U | 11 | U |
| Methylene chloride | µg/Kg | 3.2 | U | | | 11 | U | 22 | U | 28 | U |
| Methyl tert-butyl ether (MTBE) | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| trans-1,2-Dichloroethene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Diisopropyl Ether (DIPE) | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,1-Dichloroethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Ethyl Tertiary Butyl Ether (ETBE) | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 2-Butanone (MEK) | µg/Kg | 11 | | | | 47 | | 93 | | 53 | |
| cis-1,2-Dichloroethene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 2,2-Dichloropropane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Bromochloromethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Chloroform | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,1,1-Trichloroethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,1-Dichloropropene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Carbon tetrachloride | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Benzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Tertiary Amyl Methyl Ether (TAME) | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Tetrahydrofuran | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,2-Dichloroethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Trichloroethene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,2-Dichloropropane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Dibromomethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,4-Dioxane | µg/Kg | 32 | U | | | 110 | U | 220 | U | 260 | U |
| Bromodichloromethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Methyl isobutyl ketone (MIBK) | µg/Kg | 3.2 | U | | | 11 | U | 22 | U | 28 | U |
| 1,3-Dichloropropene, Tota | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Toluene | µg/Kg | 1.3 | U | | | 4.4 | U | 9.5 | | 130 | |
| 1,1,2-Trichloroethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 2-Hexanone | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Tetrachloroethene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,3-Dichloropropane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Dibromochloromethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,2-Dibromoethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Chlorobenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,1,1,2-Tetrachloroethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Ethylbenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Xylenes, Total | µg/Kg | 3.8 | U | | | 13 | U | 26 | U | 33 | U |
| Styrene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Bromoform | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Isopropylbenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,1,2,2-Tetrachloroethane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Bromobenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,2,3-Trichloropropane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| n-Propylbenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 2-Chlorotoluene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,3,5-Trimethylbenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 4-Chlorotoluene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| tert-Butylbenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,2,4-Trimethylbenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| sec-Butylbenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,3-Dichlorobenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| p-Isopropyltoluene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,4-Dichlorobenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| n-Butylbenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,2-Dibromo-3-chloropropane | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,2-Dichlorobenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| 1,2,4-Trichlorobenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Hexachlorobutadiene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| Naphthalene | µg/Kg | 3.2 | U | | | 11 | U | 22 | U | 28 | U |
| 1,2,3-Trichlorobenzene | µg/Kg | 1.3 | U | | | 4.4 | U | 8.8 | U | 11 | U |
| | | | | | | | | | | | |
| **Semi-Volatile Organics by 8270 - SIM** | | | | | | | | | | | |
| Naphthalene | µg/Kg | 23 | | | | 22 | | 31 | | 55 | |
| 2-Methylnaphthalene | µg/Kg | 10 | | | | 14 | | 20 | | 32 | |
| Acenaphthylene | µg/Kg | 140 | | | | 38 | | 73 | | 130 | |
| Acenaphthene | µg/Kg | 48 | | | | 35 | | 44 | | 54 | |
| Fluorene | µg/Kg | 96 | | | | 33 | | 64 | | 89 | |
| Phenanthrene | µg/Kg | 1200 | | | | 340 | | 650 | | 950 | |
| Anthracene | µg/Kg | 300 | | | | 55 | | 130 | | 200 | |
| Fluoranthene | µg/Kg | 2300 | | | | 760 | | 1600 | | 2200 | |
| Pyrene | µg/Kg | 1600 | | | | 500 | | 1000 | | 1500 | |
| Benz(a)anthracene | µg/Kg | 1000 | | | | 250 | | 520 | | 770 | |
| Chrysene | µg/Kg | 1100 | | | | 360 | | 760 | | 1100 | |
| Benzo(b)fluoranthene | µg/Kg | 900 | | | | 300 | | 630 | | 940 | |
| Benzo(k)fluoranthene | µg/Kg | 830 | | | | 260 | | 570 | | 930 | |
| Benzo(a)pyrene | µg/Kg | 980 | | | | 260 | | 510 | | 810 | |
| Indeno(1,2,3-cd)pyrene | µg/Kg | 840 | | | | 240 | | 470 | | 760 | |
| Dibenz(a,h)anthracene | µg/Kg | 200 | | | | 53 | | 110 | | 180 | |
| Benzo(g,h,i)perylene | µg/Kg | 700 | | | | 210 | | 370 | | 610 | |
| | | | | | | | | | | | |
| **Inorganics** | | | | | | | | | | | |
| Total Organic Carbon (Run 1) | % | 1.5 | | | | 4.0 | | 5.0 | | 5.0 | |
| Total Organic Carbon (Run 2) | % | 1.4 | | | | 3.4 | | 5.2 | | 5.1 | |
| | | | | | | | | | | | |
| **Inorganics** | | | | | | | | | | | |
| Total Organic Matter | mg/Kg | 97 | | | | 87 | | 77 | | 78 | |
| | | | | | | | | | | | |
| **Total Petroleum Hydrocarbons by EPH** | | | | | | | | | | | |
| Total Petroleum Hydrocarbons | mg/Kg | 130 | | | | 150 | | 710 | | 1100 | |
| | | | | | | | | | | | |
| **Grain Size Analysis** | | | | | | | | | | | |
| % Cobbles | % | 0.0 | | | | 0.0 | | 0.0 | | 0.0 | |
| % Coarse Gravel | % | 0.0 | | | | 0.0 | | 0.0 | | 0.0 | |
| % Fine Gravel | % | 0.0 | | | | 0.0 | | 0.0 | | 0.0 | |
| % Coarse Sand | % | 8.0 | | | | 4.9 | | 11.7 | | 15.9 | |
| % Medium Sand | % | 55.8 | | | | 41.2 | | 30.8 | | 25.9 | |
| % Fine Sand | % | 20.7 | | | | 35.1 | | 25.4 | | 25.4 | |
| % Silt | % | 3.0 | | | | 14.0 | | 27.2 | | 26.3 | |
| % Clay | % | 0.9 | | | | 2.0 | | 3.0 | | 3.8 | |
| USCS | % | | SP | | | | SM | | SM | | SM |

| SAMPLE ID | | PL-5 | | PL-6 | | PL-7 | | PL-8 | |
|---|---|---|---|---|---|---|---|---|---|
| SAMPLING DATE | | 5/10/2007 | | 5/10/2007 | | 5/10/2007 | | 5/10/2007 | |
| LAB SAMPLE ID | | 0705087-11 | | 0705087-12 | | 0705087-13 | | 0705087-14 | |
| | Units | | Qual | | Qual | | Qual | | Qual |
| | | | | | | | | | |
| **Metals** | | | | | | | | | |
| Antimony | mg/Kg | 0.45 | | 0.85 | U | 0.41 | U | 0.61 | U |
| Vanadium | mg/Kg | 20 | | 30 | | 22 | | 23 | |
| Nickel | mg/Kg | 7.3 | | 13 | | 7.1 | | 9.5 | |
| Selenium | mg/Kg | 1.8 | | 3.5 | U | 1.7 | U | 2.5 | U |
| Thallium | mg/Kg | 0.11 | | 0.18 | U | 0.13 | | 0.13 | |
| Arsenic | mg/Kg | 53 | | 78 | | 41 | | 54 | |
| Chromium | mg/Kg | 11 | | 17 | | 12 | | 14 | |
| Silver | mg/Kg | 0.16 | U | 0.34 | U | 0.16 | U | 0.24 | U |
| Barium | mg/Kg | 85 | | 130 | | 73 | | 180 | |
| Cadmium | mg/Kg | 1.1 | | 2.2 | | 0.87 | | 1.4 | |
| Beryllium | mg/Kg | 0.54 | | 1.0 | | 0.54 | | 0.67 | |
| Lead | mg/Kg | 110 | | 140 | | 94 | | 140 | |
| Zinc | mg/Kg | 110 | | 200 | | 85 | | 210 | |
| Copper | mg/Kg | 38 | | 150 | | 39 | | 70 | |
| | | | | | | | | | |
| **Metals** | | | | | | | | | |
| Mercury | mg/Kg | 0.11 | | 0.15 | | 0.093 | | 0.15 | |
| | | | | | | | | | |
| **Pesticides by 8081** | | | | | | | | | |
| 2,4'-DDD | µg/Kg | 6.7 | | 7.1 | P | 1.9 | I | 6.5 | |
| 2,4'-DDE | µg/Kg | 0.97 | I | 0.55 | U | 0.26 | U | 0.40 | U |
| 2,4'-DDT | µg/Kg | 0.49 | | 1.8 | | 0.71 | P | 1.2 | |
| 4,4'-DDD | µg/Kg | 27 | | 20 | | 7.7 | | 21 | |
| 4,4'-DDE | µg/Kg | 28 | I | 39 | I | 18 | I | 29 | I |
| 4,4'-DDT | µg/Kg | 2.3 | I | 4.2 | I | 1.9 | I | 3.2 | I |
| alpha-Chlordane | µg/Kg | 0.27 | U | 0.98 | | 0.39 | | 0.59 | |
| Dieldrin | µg/Kg | 0.35 | | 0.87 | | 0.53 | | 0.72 | |
| Endrin | µg/Kg | 0.27 | U | 0.55 | U | 0.26 | U | 0.40 | U |
| gamma-BHC | µg/Kg | 0.27 | U | 0.55 | U | 0.26 | U | 0.40 | U |
| gamma-Chlordane | µg/Kg | 2.3 | | 2.4 | | 1.1 | | 2.1 | |
| Heptachlor epoxide (B) | µg/Kg | 0.27 | U | 0.55 | U | 0.26 | U | 0.40 | U |
| | | | | | | | | | |
| **Polychlorinated Biphenyls by 8082** | | | | | | | | | |
| Aroclor 1016 | µg/Kg | 14 | U | 28 | U | 14 | U | 20 | U |
| Aroclor 1221 | µg/Kg | 14 | U | 28 | U | 14 | U | 20 | U |
| Aroclor 1232 | µg/Kg | 14 | U | 28 | U | 14 | U | 20 | U |
| Aroclor 1242 | µg/Kg | 14 | U | 28 | U | 14 | U | 20 | U |
| Aroclor 1248 | µg/Kg | 14 | U | 28 | U | 14 | U | 20 | U |
| Aroclor 1254 | µg/Kg | 14 | U | 28 | U | 14 | U | 20 | U |
| Aroclor 1260 | µg/Kg | 14 | U | 28 | U | 14 | U | 20 | U |
| | | | | | | | | | |
| **Volatile Organics by 8260** | | | | | | | | | |
| Dichlorodifluoromethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Chloromethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Vinyl chloride | µg/Kg | | | | | 8.5 | U | 12 | U |
| Bromomethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Chloroethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Trichlorofluoromethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Diethyl ether | µg/Kg | | | | | 8.5 | U | 12 | U |
| Acetone | µg/Kg | | | | | 190 | | 580 | |
| 1,1-Dichloroethene | µg/Kg | | | | | 8.5 | U | 12 | U |
| Carbon disulfide | µg/Kg | | | | | 14 | | 19 | |
| Methylene chloride | µg/Kg | | | | | 21 | U | 30 | U |
| Methyl tert-butyl ether (MTBE) | µg/Kg | | | | | 8.5 | U | 12 | U |
| trans-1,2-Dichloroethene | µg/Kg | | | | | 8.5 | U | 12 | U |
| Diisopropyl Ether (DIPE) | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,1-Dichloroethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Ethyl Tertiary Butyl Ether (ETBE) | µg/Kg | | | | | 8.5 | U | 12 | U |
| 2-Butanone (MEK) | µg/Kg | | | | | 50 | | 140 | |
| cis-1,2-Dichloroethene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 2,2-Dichloropropane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Bromochloromethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Chloroform | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,1,1-Trichloroethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,1-Dichloropropene | µg/Kg | | | | | 8.5 | U | 12 | U |
| Carbon tetrachloride | µg/Kg | | | | | 8.5 | U | 12 | U |
| Benzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| Tertiary Amyl Methyl Ether (TAME) | µg/Kg | | | | | 8.5 | U | 12 | U |
| Tetrahydrofuran | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,2-Dichloroethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Trichloroethene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,2-Dichloropropane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Dibromomethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,4-Dioxane | µg/Kg | | | | | 210 | U | 300 | U |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Bromodichloromethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Methyl isobutyl ketone (MIBK) | µg/Kg | | | | | 21 | U | 30 | U |
| 1,3-Dichloropropene, Total | µg/Kg | | | | | 8.5 | U | 12 | U |
| Toluene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,1,2-Trichloroethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| 2-Hexanone | µg/Kg | | | | | 8.5 | U | 12 | U |
| Tetrachloroethene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,3-Dichloropropane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Dibromochloromethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,2-Dibromoethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Chlorobenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,1,1,2-Tetrachloroethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Ethylbenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| Xylenes, Total | µg/Kg | | | | | 26 | U | 37 | U |
| Styrene | µg/Kg | | | | | 8.5 | U | 12 | U |
| Bromoform | µg/Kg | | | | | 8.5 | U | 12 | U |
| Isopropylbenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,1,2,2-Tetrachloroethane | µg/Kg | | | | | 8.5 | U | 12 | U |
| Bromobenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,2,3-Trichloropropane | µg/Kg | | | | | 8.5 | U | 12 | U |
| n-Propylbenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 2-Chlorotoluene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,3,5-Trimethylbenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 4-Chlorotoluene | µg/Kg | | | | | 8.5 | U | 12 | U |
| tert-Butylbenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,2,4-Trimethylbenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| sec-Butylbenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,3-Dichlorobenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| p-Isopropyltoluene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,4-Dichlorobenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| n-Butylbenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,2-Dibromo-3-chloropropane | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,2-Dichlorobenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| 1,2,4-Trichlorobenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| Hexachlorobutadiene | µg/Kg | | | | | 8.5 | U | 12 | U |
| Naphthalene | µg/Kg | | | | | 21 | U | 30 | U |
| 1,2,3-Trichlorobenzene | µg/Kg | | | | | 8.5 | U | 12 | U |
| | | | | | | | | | |
| **Semi-Volatile Organics by 8270 - SIM** | | | | | | | | | |
| Naphthalene | µg/Kg | 24 | 40 | | 24 | | 39 | | |
| 2-Methylnaphthalene | µg/Kg | 15 | 24 | | 14 | | 26 | | |
| Acenaphthylene | µg/Kg | 67 | 140 | | 53 | | 110 | | |
| Acenaphthene | µg/Kg | 33 | 50 | | 22 | | 46 | | |
| Fluorene | µg/Kg | 55 | 94 | | 32 | | 75 | | |
| Phenanthrene | µg/Kg | 600 | 1200 | | 340 | | 980 | | |
| Anthracene | µg/Kg | 100 | 220 | | 67 | | 170 | | |
| Fluoranthene | µg/Kg | 1300 | 3000 | | 860 | | 2400 | | |
| Pyrene | µg/Kg | 880 | 1800 | | 580 | | 1600 | | |
| Benz[a]anthracene | µg/Kg | 410 | 960 | | 280 | | 790 | | |
| Chrysene | µg/Kg | 620 | 1600 | | 450 | | 1300 | | |
| Benzo[b]fluoranthene | µg/Kg | 540 | 1500 | | 410 | | 1200 | | |
| Benzo[k]fluoranthene | µg/Kg | 430 | 1200 | | 340 | | 960 | | |
| Benzo[a]pyrene | µg/Kg | 390 | 1100 | | 320 | | 910 | | |
| Indeno[1,2,3-cd]pyrene | µg/Kg | 350 | 1100 | | 300 | | 810 | | |
| Dibenz[a,h]anthracene | µg/Kg | 89 | 250 | | 71 | | 200 | | |
| Benzo[g,h,i]perylene | µg/Kg | 270 | 940 | | 240 | | 720 | | |
| | | | | | | | | | |
| **Inorganics** | | | | | | | | | |
| Total Organic Carbon (Run 1) | % | 5.4 | 5.4 | | 3.5 | | 5.7 | | |
| Total Organic Carbon (Run 2) | % | 6.5 | 5.6 | | 3.1 | | 5.3 | | |
| | | | | | | | | | |
| **Inorganics** | | | | | | | | | |
| Total Organic Matter | mg/Kg | 76 | 62 | | 82 | | 74 | | |
| | | | | | | | | | |
| **Total Petroleum Hydrocarbons by EPH** | | | | | | | | | |
| Total Petroleum Hydrocarbons | mg/Kg | 770 | 1600 | | 740 | | 1000 | | |
| | | | | | | | | | |
| **Grain Size Analysis** | | | | | | | | | |
| % Cobbles | % | | 0.0 | | 0.0 | | 0.0 | | |
| % Coarse Gravel | % | | 0.0 | | 0.0 | | 0.0 | | |
| % Fine Gravel | % | | 0.0 | | 0.0 | | 0.0 | | |
| % Coarse Sand | % | | 29.8 | | 13.8 | | 21.0 | | |
| % Medium Sand | % | | 27.8 | | 25.7 | | 29.5 | | |
| % Fine Sand | % | | 15.6 | | 21.3 | | 19.0 | | |
| % Silt | % | | 11.1 | | 30.3 | | 22.9 | | |
| % Clay | % | | 4.4 | | 4.1 | | 2.9 | | |
| USCS | % | | | SM | | SM | | SM | |

# Appendix C
# HEC-RAS Output

# Appendix C
# Alternative 1
# HEC-RAS Output

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 279.40 | August | 8.00 | 76.62 | 79.56 | 77.34 | 79.56 | 0.000024 | 0.20 | 39.79 | 28.66 | 0.03 |
| Reach-1 | 279.40 | Spring - meas. | 14.60 | 76.62 | 79.68 | 77.53 | 79.69 | 0.000060 | 0.34 | 43.38 | 30.45 | 0.05 |
| Reach-1 | 279.40 | Spring | 22.00 | 76.62 | 79.79 | 77.70 | 79.79 | 0.000110 | 0.48 | 46.64 | 32.81 | 0.07 |
| Reach-1 | 279.40 | Mean Annual | 80.00 | 76.62 | 80.29 | 78.42 | 80.32 | 0.000574 | 1.30 | 65.94 | 42.05 | 0.16 |
| Reach-1 | 279.40 | 10-year | 116.00 | 76.62 | 80.52 | 78.72 | 80.56 | 0.000845 | 1.68 | 75.51 | 44.02 | 0.19 |
| Reach-1 | 279.40 | 25-year | 126.00 | 76.62 | 80.57 | 78.80 | 80.62 | 0.000917 | 1.78 | 77.94 | 44.51 | 0.20 |
| Reach-1 | 279.40 | 50-year | 138.00 | 76.62 | 80.64 | 78.87 | 80.69 | 0.000994 | 1.89 | 80.99 | 45.11 | 0.21 |
| Reach-1 | 279.40 | 100-year | 155.00 | 76.62 | 80.73 | 79.00 | 80.79 | 0.001107 | 2.04 | 84.94 | 45.90 | 0.22 |
| | | | | | | | | | | | | |
| Reach-1 | 278 | | Inl Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 274 | August | 8.00 | 76.43 | 79.11 | | 79.11 | 0.000013 | 0.16 | 48.65 | 43.83 | 0.03 |
| Reach-1 | 274 | Spring - meas. | 14.60 | 76.43 | 79.26 | | 79.26 | 0.000030 | 0.27 | 55.10 | 47.18 | 0.04 |
| Reach-1 | 274 | Spring | 22.00 | 76.43 | 79.41 | | 79.41 | 0.000045 | 0.36 | 62.62 | 50.82 | 0.05 |
| Reach-1 | 274 | Mean Annual | 80.00 | 76.43 | 80.11 | | 80.13 | 0.000146 | 0.84 | 105.37 | 68.34 | 0.10 |
| Reach-1 | 274 | 10-year | 116.00 | 76.43 | 80.35 | | 80.37 | 0.000210 | 1.08 | 121.78 | 71.13 | 0.12 |
| Reach-1 | 274 | 25-year | 126.00 | 76.43 | 80.40 | | 80.42 | 0.000229 | 1.14 | 125.52 | 71.75 | 0.13 |
| Reach-1 | 274 | 50-year | 138.00 | 76.43 | 80.49 | | 80.51 | 0.000242 | 1.20 | 131.72 | 72.76 | 0.13 |
| Reach-1 | 274 | 100-year | 155.00 | 76.43 | 80.58 | | 80.60 | 0.000268 | 1.30 | 138.34 | 74.07 | 0.14 |
| | | | | | | | | | | | | |
| Reach-1 | 194.21 | August | 8.00 | 76.43 | 79.11 | 77.08 | 79.11 | 0.000013 | 0.16 | 48.62 | 43.81 | 0.03 |
| Reach-1 | 194.21 | Spring - meas. | 14.60 | 76.43 | 79.25 | 77.25 | 79.26 | 0.000030 | 0.27 | 55.03 | 47.15 | 0.04 |
| Reach-1 | 194.21 | Spring | 22.00 | 76.43 | 79.41 | 77.40 | 79.41 | 0.000046 | 0.36 | 62.50 | 50.77 | 0.05 |
| Reach-1 | 194.21 | Mean Annual | 80.00 | 76.43 | 80.11 | 78.05 | 80.12 | 0.000148 | 0.84 | 104.86 | 68.25 | 0.10 |
| Reach-1 | 194.21 | 10-year | 116.00 | 76.43 | 80.34 | 78.34 | 80.36 | 0.000214 | 1.08 | 121.00 | 71.00 | 0.13 |
| Reach-1 | 194.21 | 25-year | 126.00 | 76.43 | 80.39 | 78.40 | 80.41 | 0.000233 | 1.15 | 124.67 | 71.61 | 0.13 |
| Reach-1 | 194.21 | 50-year | 138.00 | 76.43 | 80.48 | 78.48 | 80.50 | 0.000246 | 1.21 | 130.80 | 72.61 | 0.14 |
| Reach-1 | 194.21 | 100-year | 155.00 | 76.43 | 80.56 | 78.57 | 80.59 | 0.000273 | 1.30 | 137.31 | 73.86 | 0.14 |
| | | | | | | | | | | | | |
| Reach-1 | 193 | | Inl Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 189 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.70 | 30.02 | 0.04 |
| Reach-1 | 189 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.21 | 0.000057 | 0.38 | 39.08 | 33.10 | 0.06 |
| Reach-1 | 189 | Spring | 22.00 | 76.98 | 79.39 | | 79.40 | 0.000081 | 0.49 | 45.54 | 35.58 | 0.07 |
| Reach-1 | 189 | Mean Annual | 80.00 | 76.98 | 80.08 | | 80.10 | 0.000288 | 1.20 | 72.86 | 43.12 | 0.14 |
| Reach-1 | 189 | 10-year | 116.00 | 76.98 | 80.31 | | 80.35 | 0.000423 | 1.56 | 83.11 | 45.21 | 0.18 |
| Reach-1 | 189 | 25-year | 126.00 | 76.98 | 80.36 | | 80.40 | 0.000463 | 1.65 | 85.45 | 45.57 | 0.19 |
| Reach-1 | 189 | 50-year | 138.00 | 76.98 | 80.43 | | 80.47 | 0.000506 | 1.76 | 88.45 | 46.02 | 0.20 |
| Reach-1 | 189 | 100-year | 155.00 | 76.98 | 80.52 | | 80.57 | 0.000564 | 1.90 | 92.58 | 46.64 | 0.21 |
| | | | | | | | | | | | | |

ALTERNATIVE 1

HEC-RAS Plan: 070626 all1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 153 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.70 | 30.02 | 0.04 |
| Reach-1 | 153 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.21 | 0.000057 | 0.38 | 39.07 | 33.10 | 0.06 |
| Reach-1 | 153 | Spring | 22.00 | 76.98 | 79.39 | | 79.39 | 0.000081 | 0.49 | 45.53 | 35.58 | 0.07 |
| Reach-1 | 153 | Mean Annual | 80.00 | 76.98 | 80.08 | | 80.10 | 0.000289 | 1.20 | 72.81 | 43.11 | 0.14 |
| Reach-1 | 153 | 10-year | 116.00 | 76.98 | 80.31 | | 80.34 | 0.000424 | 1.56 | 83.03 | 45.20 | 0.18 |
| Reach-1 | 153 | 25-year | 126.00 | 76.98 | 80.36 | | 80.40 | 0.000464 | 1.65 | 85.36 | 45.55 | 0.19 |
| Reach-1 | 153 | 50-year | 138.00 | 76.98 | 80.42 | | 80.47 | 0.000507 | 1.76 | 88.35 | 46.01 | 0.20 |
| Reach-1 | 153 | 100-year | 155.00 | 76.98 | 80.51 | | 80.57 | 0.000565 | 1.90 | 92.47 | 46.62 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 149 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.69 | 30.02 | 0.04 |
| Reach-1 | 149 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.21 | 0.000057 | 0.38 | 39.07 | 33.10 | 0.06 |
| Reach-1 | 149 | Spring | 22.00 | 76.98 | 79.39 | | 79.39 | 0.000081 | 0.49 | 45.52 | 35.57 | 0.07 |
| Reach-1 | 149 | Mean Annual | 80.00 | 76.98 | 80.08 | | 80.10 | 0.000289 | 1.20 | 72.76 | 43.10 | 0.14 |
| Reach-1 | 149 | 10-year | 116.00 | 76.98 | 80.31 | | 80.34 | 0.000426 | 1.56 | 82.95 | 45.19 | 0.18 |
| Reach-1 | 149 | 25-year | 126.00 | 76.98 | 80.36 | | 80.40 | 0.000466 | 1.66 | 85.27 | 45.54 | 0.19 |
| Reach-1 | 149 | 50-year | 138.00 | 76.98 | 80.42 | | 80.47 | 0.000509 | 1.76 | 88.26 | 45.99 | 0.20 |
| Reach-1 | 149 | 100-year | 155.00 | 76.98 | 80.51 | | 80.56 | 0.000567 | 1.90 | 92.35 | 46.61 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 144.91 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.69 | 30.02 | 0.04 |
| Reach-1 | 144.91 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.20 | 0.000057 | 0.38 | 39.06 | 33.10 | 0.06 |
| Reach-1 | 144.91 | Spring | 22.00 | 76.98 | 79.39 | | 79.39 | 0.000081 | 0.50 | 45.50 | 35.57 | 0.07 |
| Reach-1 | 144.91 | Mean Annual | 80.00 | 76.98 | 80.07 | | 80.10 | 0.000290 | 1.20 | 72.70 | 43.09 | 0.14 |
| Reach-1 | 144.91 | 10-year | 116.00 | 76.98 | 80.30 | | 80.34 | 0.000427 | 1.56 | 82.87 | 45.17 | 0.18 |
| Reach-1 | 144.91 | 25-year | 126.00 | 76.98 | 80.36 | | 80.40 | 0.000467 | 1.66 | 85.18 | 45.53 | 0.19 |
| Reach-1 | 144.91 | 50-year | 138.00 | 76.98 | 80.42 | | 80.47 | 0.000510 | 1.76 | 88.15 | 45.98 | 0.20 |
| Reach-1 | 144.91 | 100-year | 155.00 | 76.98 | 80.51 | | 80.56 | 0.000569 | 1.90 | 92.24 | 46.59 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 133 | August | 8.00 | 76.98 | 78.97 | 77.54 | 78.97 | 0.000033 | 0.25 | 31.68 | 30.01 | 0.04 |
| Reach-1 | 133 | Spring - meas. | 14.60 | 76.98 | 79.20 | 77.69 | 79.20 | 0.000057 | 0.38 | 39.04 | 33.09 | 0.06 |
| Reach-1 | 133 | Spring | 22.00 | 76.98 | 79.39 | 77.82 | 79.39 | 0.000082 | 0.50 | 45.47 | 35.56 | 0.07 |
| Reach-1 | 133 | Mean Annual | 80.00 | 76.98 | 80.07 | 78.38 | 80.09 | 0.000292 | 1.21 | 72.55 | 43.06 | 0.14 |
| Reach-1 | 133 | 10-year | 116.00 | 76.98 | 80.30 | 78.61 | 80.34 | 0.000430 | 1.57 | 82.62 | 45.13 | 0.18 |
| Reach-1 | 133 | 25-year | 126.00 | 76.98 | 80.35 | 78.67 | 80.39 | 0.000471 | 1.66 | 84.91 | 45.48 | 0.19 |
| Reach-1 | 133 | 50-year | 138.00 | 76.98 | 80.41 | 78.73 | 80.46 | 0.000515 | 1.77 | 87.85 | 45.93 | 0.20 |
| Reach-1 | 133 | 100-year | 155.00 | 76.98 | 80.50 | 78.82 | 80.56 | 0.000575 | 1.91 | 91.89 | 46.54 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 132 | | Inl Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 129 | August | 8.00 | 76.98 | 78.65 | | 78.65 | 0.000082 | 0.35 | 22.75 | 25.80 | 0.07 |
| Reach-1 | 129 | Spring - meas. | 14.60 | 76.98 | 78.76 | | 78.76 | 0.000198 | 0.57 | 25.62 | 27.22 | 0.10 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 129 | Spring | 22.00 | 76.98 | 78.88 | | 78.89 | 0.000321 | 0.76 | 29.00 | 28.81 | 0.13 |
| Reach-1 | 129 | Mean Annual | 80.00 | 76.98 | 79.46 | | 79.50 | 0.000928 | 1.72 | 47.88 | 36.44 | 0.24 |
| Reach-1 | 129 | 10-year | 116.00 | 76.98 | 79.74 | | 79.81 | 0.001092 | 2.09 | 58.81 | 40.18 | 0.27 |
| Reach-1 | 129 | 25-year | 126.00 | 76.98 | 79.82 | | 79.89 | 0.001118 | 2.17 | 61.91 | 41.05 | 0.28 |
| Reach-1 | 129 | 50-year | 138.00 | 76.98 | 79.90 | | 79.98 | 0.001153 | 2.27 | 65.43 | 41.93 | 0.28 |
| Reach-1 | 129 | 100-year | 155.00 | 76.98 | 80.03 | | 80.11 | 0.001178 | 2.39 | 70.64 | 42.73 | 0.29 |
| | | | | | | | | | | | | |
| Reach-1 | 119.58 | August | 8.00 | 76.98 | 78.65 | 77.54 | 78.65 | 0.000082 | 0.35 | 22.72 | 25.79 | 0.07 |
| Reach-1 | 119.58 | Spring - meas. | 14.60 | 76.98 | 78.75 | 77.69 | 78.76 | 0.000199 | 0.57 | 25.55 | 27.20 | 0.10 |
| Reach-1 | 119.58 | Spring | 22.00 | 76.98 | 78.87 | 77.82 | 78.88 | 0.000313 | 0.76 | 28.89 | 28.77 | 0.13 |
| Reach-1 | 119.58 | Mean Annual | 80.00 | 76.98 | 79.44 | 78.38 | 79.49 | 0.000936 | 1.77 | 47.41 | 36.27 | 0.25 |
| Reach-1 | 119.58 | 10-year | 116.00 | 76.98 | 79.73 | 78.61 | 79.80 | 0.001122 | 2.15 | 58.15 | 39.99 | 0.26 |
| Reach-1 | 119.58 | 25-year | 126.00 | 76.98 | 79.80 | 78.67 | 79.88 | 0.001154 | 2.24 | 61.18 | 40.84 | 0.28 |
| Reach-1 | 119.58 | 50-year | 138.00 | 76.98 | 79.88 | 78.74 | 79.97 | 0.001195 | 2.35 | 64.63 | 41.79 | 0.29 |
| Reach-1 | 119.58 | 100-year | 155.00 | 76.98 | 80.01 | 78.82 | 80.10 | 0.001225 | 2.47 | 69.79 | 42.60 | 0.30 |
| | | | | | | | | | | | | |
| Reach-1 | 96.20 | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 68.00 | August | 8.00 | 76.76 | 78.65 | 77.30 | 78.65 | 0.000034 | 0.33 | 24.35 | 28.24 | 0.06 |
| Reach-1 | 68.00 | Spring - meas. | 14.60 | 76.76 | 78.75 | 77.48 | 78.75 | 0.000081 | 0.54 | 27.36 | 30.65 | 0.09 |
| Reach-1 | 68.00 | Spring | 22.00 | 76.76 | 78.86 | 77.63 | 78.87 | 0.000129 | 0.74 | 31.00 | 33.81 | 0.12 |
| Reach-1 | 68.00 | Mean Annual | 80.00 | 76.76 | 79.33 | 78.32 | 79.39 | 0.000518 | 1.85 | 49.73 | 44.40 | 0.26 |
| Reach-1 | 68.00 | 10-year | 116.00 | 76.76 | 79.53 | 78.55 | 79.61 | 0.000731 | 2.37 | 58.60 | 47.99 | 0.31 |
| Reach-1 | 68.00 | 25-year | 126.00 | 76.76 | 79.57 | 78.60 | 79.67 | 0.000788 | 2.50 | 60.85 | 48.75 | 0.32 |
| Reach-1 | 68.00 | 50-year | 138.00 | 76.76 | 79.62 | 78.66 | 79.73 | 0.000865 | 2.67 | 63.14 | 49.50 | 0.34 |
| Reach-1 | 68.00 | 100-year | 155.00 | 76.76 | 79.69 | 78.74 | 79.81 | 0.000962 | 2.88 | 66.53 | 50.47 | 0.36 |
| | | | | | | | | | | | | |
| Reach-1 | 67.5 | | Inl Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 67 | August | 8.00 | 76.80 | 77.02 | 77.02 | 77.13 | 0.015358 | 2.62 | 3.05 | 14.32 | 1.00 |
| Reach-1 | 67 | Spring - meas. | 14.60 | 76.80 | 77.13 | 77.13 | 77.29 | 0.013768 | 3.17 | 4.61 | 14.98 | 1.01 |
| Reach-1 | 67 | Spring | 22.00 | 76.80 | 77.23 | 77.23 | 77.43 | 0.012581 | 3.57 | 6.17 | 15.61 | 1.00 |
| Reach-1 | 67 | Mean Annual | 80.00 | 76.80 | 78.06 | | 78.29 | 0.003859 | 3.81 | 21.00 | 19.45 | 0.65 |
| Reach-1 | 67 | 10-year | 116.00 | 76.80 | 78.46 | | 78.71 | 0.003064 | 4.00 | 28.97 | 20.72 | 0.60 |
| Reach-1 | 67 | 25-year | 126.00 | 76.80 | 78.56 | | 78.82 | 0.002930 | 4.05 | 31.08 | 21.04 | 0.59 |
| Reach-1 | 67 | 50-year | 138.00 | 76.80 | 78.68 | | 78.94 | 0.002800 | 4.11 | 33.55 | 21.41 | 0.58 |
| Reach-1 | 67 | 100-year | 155.00 | 76.80 | 78.83 | | 79.11 | 0.002638 | 4.20 | 36.94 | 22.09 | 0.57 |
| | | | | | | | | | | | | |
| Reach-1 | 66 | August | 8.00 | 74.50 | 76.98 | 74.72 | 76.98 | 0.000006 | 0.23 | 35.48 | 15.43 | 0.03 |
| Reach-1 | 66 | Spring - meas. | 14.60 | 74.50 | 77.16 | 74.83 | 77.16 | 0.000017 | 0.38 | 38.29 | 16.11 | 0.04 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 66 | Spring | 22.00 | 74.50 | 77.32 | 74.94 | 77.33 | 0.000033 | 0.54 | 40.98 | 16.95 | 0.06 |
| Reach-1 | 66 | Mean Annual | 80.00 | 74.50 | 78.19 | | 78.22 | 0.000190 | 1.37 | 58.32 | 23.09 | 0.15 |
| Reach-1 | 66 | 10-year | 116.00 | 74.50 | 78.59 | | 78.64 | 0.000252 | 1.71 | 68.17 | 25.99 | 0.18 |
| Reach-1 | 66 | 25-year | 126.00 | 74.50 | 78.69 | | 78.74 | 0.000264 | 1.79 | 70.87 | 26.75 | 0.18 |
| Reach-1 | 66 | 50-year | 138.00 | 74.50 | 78.81 | | 78.87 | 0.000278 | 1.88 | 74.06 | 27.63 | 0.19 |
| Reach-1 | 66 | 100-year | 155.00 | 74.50 | 78.97 | | 79.03 | 0.000295 | 2.01 | 78.54 | 28.99 | 0.20 |
| | | | | | | | | | | | | |
| Reach-1 | 65 | August | 8.00 | 74.30 | 76.98 | | 76.98 | 0.000003 | 0.16 | 48.84 | 22.02 | 0.02 |
| Reach-1 | 65 | Spring - meas. | 14.60 | 74.30 | 77.16 | | 77.16 | 0.000008 | 0.28 | 52.82 | 22.53 | 0.03 |
| Reach-1 | 65 | Spring | 22.00 | 74.30 | 77.32 | | 77.33 | 0.000014 | 0.39 | 56.56 | 23.00 | 0.04 |
| Reach-1 | 65 | Mean Annual | 80.00 | 74.30 | 78.20 | | 78.21 | 0.000077 | 1.03 | 77.68 | 25.47 | 0.10 |
| Reach-1 | 65 | 10-year | 116.00 | 74.30 | 78.60 | | 78.63 | 0.000109 | 1.32 | 88.43 | 29.80 | 0.13 |
| Reach-1 | 65 | 25-year | 126.00 | 74.30 | 78.70 | | 78.73 | 0.000116 | 1.39 | 92.09 | 37.27 | 0.13 |
| Reach-1 | 65 | 50-year | 138.00 | 74.30 | 78.82 | | 78.86 | 0.000125 | 1.47 | 96.58 | 38.33 | 0.14 |
| Reach-1 | 65 | 100-year | 155.00 | 74.30 | 78.98 | | 79.02 | 0.000136 | 1.58 | 102.81 | 39.75 | 0.14 |
| | | | | | | | | | | | | |
| Reach-1 | 64 | August | 8.00 | 76.60 | 76.85 | 76.85 | 76.97 | 0.037906 | 2.77 | 2.89 | 12.11 | 1.00 |
| Reach-1 | 64 | Spring - meas. | 14.60 | 76.60 | 76.97 | 76.97 | 77.14 | 0.033733 | 3.33 | 4.38 | 12.70 | 1.00 |
| Reach-1 | 64 | Spring | 22.00 | 76.60 | 77.08 | 77.08 | 77.30 | 0.031176 | 3.76 | 5.85 | 13.25 | 1.00 |
| Reach-1 | 64 | Mean Annual | 80.00 | 76.60 | 77.68 | 77.68 | 78.16 | 0.025482 | 5.58 | 14.33 | 14.91 | 1.00 |
| Reach-1 | 64 | 10-year | 116.00 | 76.60 | 77.95 | 77.95 | 78.56 | 0.024368 | 6.27 | 18.52 | 15.36 | 1.01 |
| Reach-1 | 64 | 25-year | 126.00 | 76.60 | 78.02 | 78.02 | 78.67 | 0.024247 | 6.44 | 19.58 | 15.47 | 1.01 |
| Reach-1 | 64 | 50-year | 138.00 | 76.60 | 78.11 | 78.11 | 78.79 | 0.023449 | 6.60 | 20.96 | 16.59 | 1.00 |
| Reach-1 | 64 | 100-year | 155.00 | 76.60 | 78.23 | 78.23 | 78.95 | 0.022270 | 6.80 | 23.05 | 18.67 | 0.99 |
| | | | | | | | | | | | | |
| Reach-1 | 63 | August | 8.00 | 75.60 | 75.98 | 75.85 | 76.03 | 0.008758 | 1.72 | 4.66 | 13.28 | 0.51 |
| Reach-1 | 63 | Spring - meas. | 14.60 | 75.60 | 76.14 | 75.97 | 76.21 | 0.009216 | 2.17 | 6.74 | 14.04 | 0.55 |
| Reach-1 | 63 | Spring | 22.00 | 75.60 | 76.27 | 76.08 | 76.37 | 0.009641 | 2.54 | 8.68 | 14.71 | 0.58 |
| Reach-1 | 63 | Mean Annual | 80.00 | 75.60 | 76.94 | 76.66 | 77.20 | 0.010320 | 4.08 | 19.73 | 18.17 | 0.67 |
| Reach-1 | 63 | 10-year | 116.00 | 75.60 | 77.23 | 76.92 | 77.57 | 0.010323 | 4.72 | 25.10 | 19.70 | 0.69 |
| Reach-1 | 63 | 25-year | 126.00 | 75.60 | 77.30 | 76.99 | 77.67 | 0.010284 | 4.87 | 26.56 | 20.09 | 0.70 |
| Reach-1 | 63 | 50-year | 138.00 | 75.60 | 77.39 | 77.06 | 77.78 | 0.010183 | 5.03 | 28.33 | 20.55 | 0.70 |
| Reach-1 | 63 | 100-year | 155.00 | 75.60 | 77.51 | 77.17 | 77.93 | 0.009966 | 5.23 | 30.89 | 21.21 | 0.70 |
| | | | | | | | | | | | | |
| Reach-1 | 62.5 | August | 8.00 | 75.52 | 75.89 | | 75.94 | 0.009024 | 1.74 | 4.60 | 13.16 | 0.52 |
| Reach-1 | 62.5 | Spring - meas. | 14.60 | 75.52 | 76.02 | | 76.10 | 0.010707 | 2.28 | 6.40 | 13.77 | 0.59 |
| Reach-1 | 62.5 | Spring | 22.00 | 75.52 | 76.14 | | 76.26 | 0.011977 | 2.74 | 8.04 | 14.31 | 0.64 |
| Reach-1 | 62.5 | Mean Annual | 80.00 | 75.52 | 76.70 | 76.58 | 77.05 | 0.017258 | 4.77 | 16.78 | 16.88 | 0.84 |
| Reach-1 | 62.5 | 10-year | 116.00 | 75.52 | 76.94 | 76.84 | 77.42 | 0.017889 | 5.57 | 20.93 | 18.14 | 0.89 |
| Reach-1 | 62.5 | 25-year | 126.00 | 75.52 | 77.00 | 76.91 | 77.51 | 0.017998 | 5.77 | 22.02 | 18.46 | 0.90 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 62.5 | 50-year | 138.00 | 75.52 | 77.05 | 76.98 | 77.62 | 0.018838 | 6.06 | 23.00 | 18.75 | 0.92 |
| Reach-1 | 62.5 | 100-year | 155.00 | 75.52 | 77.12 | 77.09 | 77.77 | 0.020190 | 6.48 | 24.25 | 19.10 | 0.96 |
| | | | | | | | | | | | | |
| Reach-1 | 62 | August | 8.00 | 75.43 | 75.70 | 75.70 | 75.81 | 0.015119 | 2.66 | 3.01 | 13.64 | 1.00 |
| Reach-1 | 62 | Spring - meas. | 14.60 | 75.43 | 75.81 | 75.81 | 75.97 | 0.013653 | 3.22 | 4.53 | 14.21 | 1.01 |
| Reach-1 | 62 | Spring | 22.00 | 75.43 | 75.91 | 75.91 | 76.12 | 0.012519 | 3.64 | 6.04 | 14.76 | 1.00 |
| Reach-1 | 62 | Mean Annual | 80.00 | 75.43 | 76.46 | 76.46 | 76.91 | 0.009744 | 5.39 | 14.91 | 17.45 | 1.00 |
| Reach-1 | 62 | 10-year | 116.00 | 75.43 | 76.72 | 76.72 | 77.29 | 0.008828 | 6.07 | 19.54 | 18.69 | 1.00 |
| Reach-1 | 62 | 25-year | 126.00 | 75.43 | 76.78 | 76.78 | 77.38 | 0.008637 | 6.23 | 20.78 | 19.01 | 0.99 |
| Reach-1 | 62 | 50-year | 138.00 | 75.43 | 76.87 | 76.86 | 77.50 | 0.008225 | 6.36 | 22.44 | 19.42 | 0.98 |
| Reach-1 | 62 | 100-year | 155.00 | 75.43 | 76.98 | 76.97 | 77.65 | 0.007920 | 6.59 | 24.58 | 19.95 | 0.98 |
| | | | | | | | | | | | | |
| Reach-1 | 61 | August | 8.00 | 75.02 | 75.33 | 75.35 | 75.47 | 0.017573 | 3.04 | 2.63 | 10.85 | 1.09 |
| Reach-1 | 61 | Spring - meas. | 14.60 | 75.02 | 75.45 | 75.47 | 75.66 | 0.016937 | 3.74 | 3.90 | 11.45 | 1.13 |
| Reach-1 | 61 | Spring | 22.00 | 75.02 | 75.56 | 75.59 | 75.83 | 0.015642 | 4.22 | 5.22 | 12.04 | 1.13 |
| Reach-1 | 61 | Mean Annual | 80.00 | 75.02 | 76.19 | 76.22 | 76.70 | 0.010993 | 5.75 | 13.92 | 15.46 | 1.06 |
| Reach-1 | 61 | 10-year | 116.00 | 75.02 | 76.46 | 76.50 | 77.10 | 0.009738 | 6.43 | 18.26 | 16.94 | 1.04 |
| Reach-1 | 61 | 25-year | 126.00 | 75.02 | 76.53 | 76.57 | 77.20 | 0.009412 | 6.57 | 19.50 | 17.34 | 1.04 |
| Reach-1 | 61 | 50-year | 138.00 | 75.02 | 76.65 | 76.65 | 77.32 | 0.008377 | 6.58 | 21.54 | 17.98 | 0.99 |
| Reach-1 | 61 | 100-year | 155.00 | 75.02 | 76.76 | 76.76 | 77.48 | 0.008111 | 6.82 | 23.57 | 18.60 | 0.99 |
| | | | | | | | | | | | | |
| Reach-1 | 60 | August | 8.00 | 74.40 | 74.62 | 74.62 | 74.72 | 0.017519 | 2.55 | 3.14 | 17.06 | 1.04 |
| Reach-1 | 60 | Spring - meas. | 14.60 | 74.40 | 74.71 | 74.72 | 74.85 | 0.014996 | 3.00 | 4.88 | 18.77 | 1.03 |
| Reach-1 | 60 | Spring | 22.00 | 74.40 | 74.77 | 74.80 | 74.98 | 0.017669 | 3.70 | 5.98 | 19.29 | 1.15 |
| Reach-1 | 60 | Mean Annual | 80.00 | 74.40 | 75.05 | 75.28 | 75.84 | 0.028738 | 7.16 | 11.69 | 21.83 | 1.63 |
| Reach-1 | 60 | 10-year | 116.00 | 74.40 | 75.18 | 75.51 | 76.26 | 0.030113 | 8.41 | 14.76 | 23.01 | 1.73 |
| Reach-1 | 60 | 25-year | 126.00 | 74.40 | 75.22 | 75.57 | 76.38 | 0.030396 | 8.71 | 15.56 | 23.27 | 1.75 |
| Reach-1 | 60 | 50-year | 138.00 | 74.40 | 75.25 | 75.63 | 76.53 | 0.031832 | 9.15 | 16.29 | 23.52 | 1.80 |
| Reach-1 | 60 | 100-year | 155.00 | 74.40 | 75.31 | 75.73 | 76.70 | 0.031655 | 9.56 | 17.67 | 23.97 | 1.82 |
| | | | | | | | | | | | | |
| Reach-1 | 59 | August | 8.00 | 71.70 | 73.90 | 71.90 | 73.90 | 0.000005 | 0.19 | 42.77 | 25.02 | 0.03 |
| Reach-1 | 59 | Spring - meas. | 14.60 | 71.70 | 74.04 | 72.00 | 74.04 | 0.000014 | 0.31 | 46.43 | 26.33 | 0.04 |
| Reach-1 | 59 | Spring | 22.00 | 71.70 | 74.18 | 72.09 | 74.18 | 0.000026 | 0.44 | 50.07 | 27.57 | 0.06 |
| Reach-1 | 59 | Mean Annual | 80.00 | 71.70 | 74.92 | 72.60 | 74.94 | 0.000113 | 1.12 | 73.02 | 34.39 | 0.13 |
| Reach-1 | 59 | 10-year | 116.00 | 71.70 | 75.26 | 72.84 | 75.29 | 0.000154 | 1.42 | 85.51 | 39.46 | 0.15 |
| Reach-1 | 59 | 25-year | 126.00 | 71.70 | 75.34 | 72.90 | 75.37 | 0.000164 | 1.50 | 88.88 | 40.77 | 0.16 |
| Reach-1 | 59 | 50-year | 138.00 | 71.70 | 75.44 | 72.97 | 75.48 | 0.000176 | 1.58 | 92.94 | 42.28 | 0.16 |
| Reach-1 | 59 | 100-year | 155.00 | 71.70 | 75.57 | 73.07 | 75.61 | 0.000191 | 1.70 | 98.61 | 44.26 | 0.17 |
| | | | | | | | | | | | | |
| Reach-1 | 58 | August | 8.00 | 71.30 | 73.90 | | 73.90 | 0.000007 | 0.22 | 36.63 | 21.00 | 0.03 |

HEC-RAS Plan: 070626 all1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 58 | Spring - meas. | 14.60 | 71.30 | 74.04 | | 74.04 | 0.000019 | 0.37 | 39.68 | 22.06 | 0.05 |
| Reach-1 | 58 | Spring | 22.00 | 71.30 | 74.17 | | 74.18 | 0.000036 | 0.52 | 42.70 | 23.07 | 0.07 |
| Reach-1 | 58 | Mean Annual | 80.00 | 71.30 | 74.90 | | 74.93 | 0.000159 | 1.33 | 62.26 | 31.61 | 0.15 |
| Reach-1 | 58 | 10-year | 116.00 | 71.30 | 75.24 | | 75.28 | 0.000220 | 1.70 | 73.53 | 36.29 | 0.18 |
| Reach-1 | 58 | 25-year | 126.00 | 71.30 | 75.32 | | 75.37 | 0.000235 | 1.79 | 76.56 | 37.45 | 0.18 |
| Reach-1 | 58 | 50-year | 138.00 | 71.30 | 75.41 | | 75.47 | 0.000252 | 1.89 | 80.20 | 38.80 | 0.19 |
| Reach-1 | 58 | 100-year | 155.00 | 71.30 | 75.54 | | 75.60 | 0.000276 | 2.03 | 85.27 | 40.60 | 0.20 |
| | | | | | | | | | | | | |
| Reach-1 | 57 | August | 8.00 | 73.60 | 73.82 | 73.79 | 73.89 | 0.024352 | 2.07 | 3.86 | 18.05 | 0.79 |
| Reach-1 | 57 | Spring - meas. | 14.60 | 73.60 | 73.94 | | 74.03 | 0.020388 | 2.45 | 5.96 | 18.93 | 0.77 |
| Reach-1 | 57 | Spring | 22.00 | 73.60 | 74.05 | | 74.17 | 0.017138 | 2.69 | 8.19 | 19.82 | 0.74 |
| Reach-1 | 57 | Mean Annual | 80.00 | 73.60 | 74.71 | | 74.91 | 0.009113 | 3.64 | 23.18 | 27.08 | 0.63 |
| Reach-1 | 57 | 10-year | 116.00 | 73.60 | 75.02 | | 75.25 | 0.007673 | 3.97 | 32.26 | 31.14 | 0.60 |
| Reach-1 | 57 | 25-year | 126.00 | 73.60 | 75.10 | | 75.34 | 0.007421 | 4.06 | 34.72 | 32.15 | 0.60 |
| Reach-1 | 57 | 50-year | 138.00 | 73.60 | 75.19 | | 75.44 | 0.007136 | 4.15 | 37.72 | 33.43 | 0.59 |
| Reach-1 | 57 | 100-year | 155.00 | 73.60 | 75.31 | | 75.58 | 0.006805 | 4.26 | 41.94 | 35.15 | 0.58 |
| | | | | | | | | | | | | |
| Reach-1 | 56.5 | August | 8.00 | 73.15 | 73.49 | | 73.52 | 0.006078 | 1.37 | 5.84 | 17.78 | 0.42 |
| Reach-1 | 56.5 | Spring - meas. | 14.60 | 73.15 | 73.64 | | 73.69 | 0.005908 | 1.70 | 8.58 | 18.43 | 0.44 |
| Reach-1 | 56.5 | Spring | 22.00 | 73.15 | 73.79 | | 73.84 | 0.005736 | 1.96 | 11.23 | 19.03 | 0.45 |
| Reach-1 | 56.5 | Mean Annual | 80.00 | 73.15 | 74.53 | | 74.67 | 0.004928 | 3.03 | 27.00 | 24.74 | 0.47 |
| Reach-1 | 56.5 | 10-year | 116.00 | 73.15 | 74.86 | | 75.04 | 0.004702 | 3.44 | 35.85 | 29.10 | 0.48 |
| Reach-1 | 56.5 | 25-year | 126.00 | 73.15 | 74.94 | | 75.13 | 0.004674 | 3.55 | 38.22 | 30.14 | 0.48 |
| Reach-1 | 56.5 | 50-year | 138.00 | 73.15 | 75.04 | | 75.24 | 0.004621 | 3.66 | 41.13 | 31.37 | 0.48 |
| Reach-1 | 56.5 | 100-year | 155.00 | 73.15 | 75.16 | | 75.38 | 0.004563 | 3.80 | 45.20 | 33.08 | 0.49 |
| | | | | | | | | | | | | |
| Reach-1 | 56 | August | 8.00 | 72.70 | 73.00 | 72.99 | 73.12 | 0.035892 | 2.77 | 2.89 | 11.63 | 0.98 |
| Reach-1 | 56 | Spring - meas. | 14.60 | 72.70 | 73.12 | 73.12 | 73.30 | 0.033837 | 3.40 | 4.30 | 12.17 | 1.01 |
| Reach-1 | 56 | Spring | 22.00 | 72.70 | 73.23 | 73.23 | 73.46 | 0.031292 | 3.84 | 5.73 | 12.69 | 1.01 |
| Reach-1 | 56 | Mean Annual | 80.00 | 72.70 | 73.85 | 73.85 | 74.33 | 0.025043 | 5.52 | 14.49 | 15.49 | 1.01 |
| Reach-1 | 56 | 10-year | 116.00 | 72.70 | 74.14 | 74.14 | 74.71 | 0.023675 | 6.02 | 19.31 | 18.21 | 1.01 |
| Reach-1 | 56 | 25-year | 126.00 | 72.70 | 74.21 | 74.21 | 74.80 | 0.022726 | 6.14 | 20.63 | 19.14 | 1.00 |
| Reach-1 | 56 | 50-year | 138.00 | 72.70 | 74.29 | 74.29 | 74.91 | 0.022056 | 6.31 | 22.13 | 20.14 | 0.99 |
| Reach-1 | 56 | 100-year | 155.00 | 72.70 | 74.40 | 74.40 | 75.05 | 0.020958 | 6.50 | 24.42 | 21.57 | 0.98 |
| | | | | | | | | | | | | |
| Reach-1 | 55 | August | 8.00 | 72.50 | 72.79 | 72.78 | 72.91 | 0.013614 | 2.78 | 2.88 | 11.28 | 0.97 |
| Reach-1 | 55 | Spring - meas. | 14.60 | 72.50 | 72.90 | 72.91 | 73.09 | 0.014482 | 3.48 | 4.20 | 12.28 | 1.05 |
| Reach-1 | 55 | Spring | 22.00 | 72.50 | 73.00 | 73.03 | 73.25 | 0.015289 | 4.05 | 5.43 | 13.15 | 1.11 |
| Reach-1 | 55 | Mean Annual | 80.00 | 72.50 | 73.47 | 73.62 | 74.10 | 0.017046 | 6.38 | 12.54 | 16.59 | 1.29 |
| Reach-1 | 55 | 10-year | 116.00 | 72.50 | 73.69 | 73.88 | 74.48 | 0.016565 | 7.13 | 16.27 | 17.76 | 1.31 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 55 | 25-year | 126.00 | 72.50 | 73.73 | 73.96 | 74.58 | 0.016897 | 7.37 | 17.09 | 18.00 | 1.33 |
| Reach-1 | 55 | 50-year | 138.00 | 72.50 | 73.80 | 74.02 | 74.69 | 0.016842 | 7.58 | 18.20 | 18.31 | 1.34 |
| Reach-1 | 55 | 100-year | 155.00 | 72.50 | 73.88 | 74.12 | 74.84 | 0.016784 | 7.86 | 19.73 | 18.74 | 1.35 |
| | | | | | | | | | | | | |
| Reach-1 | 54 | August | 8.00 | 72.30 | 72.55 | 72.55 | 72.65 | 0.014306 | 2.59 | 3.09 | 14.06 | 0.97 |
| Reach-1 | 54 | Spring - meas. | 14.60 | 72.30 | 72.64 | 72.66 | 72.81 | 0.016434 | 3.32 | 4.40 | 15.24 | 1.09 |
| Reach-1 | 54 | Spring | 22.00 | 72.30 | 72.72 | 72.76 | 72.95 | 0.016736 | 3.82 | 5.76 | 16.39 | 1.14 |
| Reach-1 | 54 | Mean Annual | 80.00 | 72.30 | 73.07 | 73.27 | 73.73 | 0.024762 | 6.51 | 12.28 | 21.02 | 1.50 |
| Reach-1 | 54 | 10-year | 116.00 | 72.30 | 73.22 | 73.48 | 74.10 | 0.026839 | 7.52 | 15.42 | 22.57 | 1.60 |
| Reach-1 | 54 | 25-year | 126.00 | 72.30 | 73.25 | 73.54 | 74.19 | 0.027213 | 7.76 | 16.24 | 22.93 | 1.62 |
| Reach-1 | 54 | 50-year | 138.00 | 72.30 | 73.29 | 73.60 | 74.29 | 0.027563 | 8.03 | 17.19 | 23.28 | 1.65 |
| Reach-1 | 54 | 100-year | 155.00 | 72.30 | 73.35 | 73.67 | 74.44 | 0.028000 | 8.39 | 18.48 | 23.70 | 1.67 |
| | | | | | | | | | | | | |
| Reach-1 | 53 | August | 8.00 | 71.60 | 71.80 | 71.80 | 71.88 | 0.016806 | 2.29 | 3.50 | 21.58 | 1.00 |
| Reach-1 | 53 | Spring - meas. | 14.60 | 71.60 | 71.87 | 71.87 | 71.99 | 0.015618 | 2.80 | 5.21 | 22.50 | 1.02 |
| Reach-1 | 53 | Spring | 22.00 | 71.60 | 71.94 | 71.95 | 72.11 | 0.016366 | 3.31 | 6.66 | 23.18 | 1.09 |
| Reach-1 | 53 | Mean Annual | 80.00 | 71.60 | 72.30 | 72.37 | 72.70 | 0.015232 | 5.09 | 15.71 | 27.07 | 1.18 |
| Reach-1 | 53 | 10-year | 116.00 | 71.60 | 72.45 | 72.56 | 72.98 | 0.015889 | 5.84 | 19.85 | 28.67 | 1.24 |
| Reach-1 | 53 | 25-year | 126.00 | 71.60 | 72.48 | 72.60 | 73.05 | 0.016128 | 6.04 | 20.88 | 29.05 | 1.25 |
| Reach-1 | 53 | 50-year | 138.00 | 71.60 | 72.52 | 72.66 | 73.13 | 0.016443 | 6.26 | 22.05 | 29.48 | 1.28 |
| Reach-1 | 53 | 100-year | 155.00 | 71.60 | 72.57 | 72.73 | 73.24 | 0.016902 | 6.56 | 23.63 | 30.06 | 1.30 |
| | | | | | | | | | | | | |
| Reach-1 | 52 | August | 8.00 | 69.40 | 70.85 | 69.62 | 70.85 | 0.000025 | 0.33 | 24.06 | 19.45 | 0.05 |
| Reach-1 | 52 | Spring - meas. | 14.60 | 69.40 | 71.00 | 69.72 | 71.01 | 0.000057 | 0.54 | 27.21 | 20.07 | 0.08 |
| Reach-1 | 52 | Spring | 22.00 | 69.40 | 71.16 | 69.82 | 71.17 | 0.000096 | 0.72 | 30.38 | 20.94 | 0.11 |
| Reach-1 | 52 | Mean Annual | 80.00 | 69.40 | 71.97 | 70.36 | 72.01 | 0.000339 | 1.61 | 49.60 | 26.56 | 0.21 |
| Reach-1 | 52 | 10-year | 116.00 | 69.40 | 72.34 | 70.62 | 72.39 | 0.000454 | 1.94 | 59.94 | 30.50 | 0.24 |
| Reach-1 | 52 | 25-year | 126.00 | 69.40 | 72.43 | 70.68 | 72.49 | 0.000478 | 2.01 | 62.77 | 31.50 | 0.25 |
| Reach-1 | 52 | 50-year | 138.00 | 69.40 | 72.53 | 70.76 | 72.60 | 0.000504 | 2.09 | 66.13 | 32.55 | 0.26 |
| Reach-1 | 52 | 100-year | 155.00 | 69.40 | 72.67 | 70.86 | 72.75 | 0.000534 | 2.19 | 70.82 | 33.96 | 0.27 |
| | | | | | | | | | | | | |
| Reach-1 | 51 | August | 8.00 | 69.00 | 70.84 | | 70.85 | 0.000061 | 0.36 | 21.97 | 14.31 | 0.05 |
| Reach-1 | 51 | Spring - meas. | 14.60 | 69.00 | 71.00 | | 71.01 | 0.000155 | 0.60 | 24.26 | 14.98 | 0.08 |
| Reach-1 | 51 | Spring | 22.00 | 69.00 | 71.15 | | 71.16 | 0.000277 | 0.83 | 26.59 | 15.74 | 0.11 |
| Reach-1 | 51 | Mean Annual | 80.00 | 69.00 | 71.93 | | 71.99 | 0.001066 | 2.01 | 40.59 | 20.63 | 0.23 |
| Reach-1 | 51 | 10-year | 116.00 | 69.00 | 72.27 | | 72.36 | 0.001409 | 2.53 | 48.02 | 23.56 | 0.27 |
| Reach-1 | 51 | 25-year | 126.00 | 69.00 | 72.35 | | 72.46 | 0.001492 | 2.66 | 50.02 | 24.29 | 0.28 |
| Reach-1 | 51 | 50-year | 138.00 | 69.00 | 72.44 | | 72.56 | 0.001587 | 2.80 | 52.39 | 25.16 | 0.29 |
| Reach-1 | 51 | 100-year | 155.00 | 69.00 | 72.57 | | 72.71 | 0.001712 | 3.00 | 55.68 | 26.10 | 0.31 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 50 | August | 8.00 | 70.50 | 70.76 | 70.72 | 70.83 | 0.024100 | 2.19 | 3.65 | 15.49 | 0.80 |
| Reach-1 | 50 | Spring - meas. | 14.60 | 70.50 | 70.84 | 70.82 | 70.97 | 0.030419 | 2.95 | 4.94 | 15.94 | 0.94 |
| Reach-1 | 50 | Spring | 22.00 | 70.50 | 70.92 | 70.92 | 71.11 | 0.032347 | 3.51 | 6.28 | 16.38 | 1.00 |
| Reach-1 | 50 | Mean Annual | 80.00 | 70.50 | 71.44 | 71.44 | 71.85 | 0.025592 | 5.16 | 15.53 | 19.61 | 1.00 |
| Reach-1 | 50 | 10-year | 116.00 | 70.50 | 71.68 | 71.68 | 72.20 | 0.022794 | 5.78 | 20.45 | 21.51 | 0.99 |
| Reach-1 | 50 | 25-year | 126.00 | 70.50 | 71.74 | 71.74 | 72.28 | 0.022271 | 5.93 | 21.77 | 22.00 | 0.99 |
| Reach-1 | 50 | 50-year | 138.00 | 70.50 | 71.81 | 71.81 | 72.38 | 0.021581 | 6.08 | 23.39 | 22.66 | 0.98 |
| Reach-1 | 50 | 100-year | 155.00 | 70.50 | 71.91 | 71.91 | 72.52 | 0.020728 | 6.29 | 25.68 | 23.59 | 0.97 |
| | | | | | | | | | | | | |
| Reach-1 | 49 | August | 8.00 | 70.30 | 70.52 | 70.52 | 70.63 | 0.016697 | 2.59 | 3.09 | 15.77 | 1.03 |
| Reach-1 | 49 | Spring - meas. | 14.60 | 70.30 | 70.63 | 70.63 | 70.77 | 0.013950 | 2.99 | 4.88 | 17.51 | 1.00 |
| Reach-1 | 49 | Spring | 22.00 | 70.30 | 70.71 | 70.72 | 70.90 | 0.014995 | 3.50 | 6.28 | 18.75 | 1.07 |
| Reach-1 | 49 | Mean Annual | 80.00 | 70.30 | 71.04 | 71.19 | 71.60 | 0.020966 | 6.01 | 13.32 | 22.68 | 1.38 |
| Reach-1 | 49 | 10-year | 116.00 | 70.30 | 71.18 | 71.40 | 71.94 | 0.022411 | 6.96 | 16.68 | 23.94 | 1.47 |
| Reach-1 | 49 | 25-year | 126.00 | 70.30 | 71.22 | 71.45 | 72.02 | 0.022715 | 7.18 | 17.55 | 24.26 | 1.49 |
| Reach-1 | 49 | 50-year | 138.00 | 70.30 | 71.26 | 71.51 | 72.12 | 0.022901 | 7.42 | 18.60 | 24.64 | 1.50 |
| Reach-1 | 49 | 100-year | 155.00 | 70.30 | 71.32 | 71.58 | 72.26 | 0.023498 | 7.77 | 19.95 | 25.11 | 1.54 |
| | | | | | | | | | | | | |
| Reach-1 | 48 | August | 8.00 | 68.10 | 70.06 | 68.31 | 70.06 | 0.000007 | 0.21 | 38.43 | 24.56 | 0.03 |
| Reach-1 | 48 | Spring - meas. | 14.60 | 68.10 | 70.22 | 68.41 | 70.22 | 0.000018 | 0.34 | 42.50 | 25.39 | 0.05 |
| Reach-1 | 48 | Spring | 22.00 | 68.10 | 70.37 | 68.50 | 70.37 | 0.000032 | 0.48 | 46.25 | 26.13 | 0.06 |
| Reach-1 | 48 | Mean Annual | 80.00 | 68.10 | 71.11 | 69.02 | 71.13 | 0.000162 | 1.16 | 68.68 | 34.42 | 0.15 |
| Reach-1 | 48 | 10-year | 116.00 | 68.10 | 71.45 | 69.26 | 71.49 | 0.000218 | 1.43 | 81.24 | 38.27 | 0.17 |
| Reach-1 | 48 | 25-year | 126.00 | 68.10 | 71.54 | 69.32 | 71.57 | 0.000226 | 1.49 | 84.51 | 39.21 | 0.18 |
| Reach-1 | 48 | 50-year | 138.00 | 68.10 | 71.64 | 69.39 | 71.67 | 0.000236 | 1.57 | 88.34 | 40.28 | 0.18 |
| Reach-1 | 48 | 100-year | 155.00 | 68.10 | 71.77 | 69.49 | 71.81 | 0.000248 | 1.67 | 93.75 | 41.75 | 0.19 |
| | | | | | | | | | | | | |
| Reach-1 | 47 | August | 8.00 | 67.70 | 70.06 | | 70.06 | 0.000004 | 0.17 | 46.95 | 27.77 | 0.02 |
| Reach-1 | 47 | Spring - meas. | 14.60 | 67.70 | 70.22 | | 70.22 | 0.000011 | 0.28 | 51.58 | 29.16 | 0.04 |
| Reach-1 | 47 | Spring | 22.00 | 67.70 | 70.37 | | 70.37 | 0.000020 | 0.39 | 55.94 | 30.50 | 0.05 |
| Reach-1 | 47 | Mean Annual | 80.00 | 67.70 | 71.11 | | 71.13 | 0.000104 | 0.98 | 81.95 | 39.09 | 0.12 |
| Reach-1 | 47 | 10-year | 116.00 | 67.70 | 71.46 | | 71.48 | 0.000135 | 1.21 | 96.02 | 42.08 | 0.14 |
| Reach-1 | 47 | 25-year | 126.00 | 67.70 | 71.54 | | 71.57 | 0.000142 | 1.27 | 99.61 | 42.81 | 0.14 |
| Reach-1 | 47 | 50-year | 138.00 | 67.70 | 71.64 | | 71.67 | 0.000150 | 1.34 | 103.80 | 43.65 | 0.15 |
| Reach-1 | 47 | 100-year | 155.00 | 67.70 | 71.77 | | 71.80 | 0.000160 | 1.43 | 109.65 | 44.79 | 0.15 |
| | | | | | | | | | | | | |
| Reach-1 | 45 | August | 8.00 | 69.30 | 70.05 | | 70.06 | 0.000267 | 0.69 | 11.66 | 19.45 | 0.16 |
| Reach-1 | 45 | Spring - meas. | 14.60 | 69.30 | 70.21 | | 70.22 | 0.000449 | 0.99 | 14.79 | 21.07 | 0.21 |
| Reach-1 | 45 | Spring | 22.00 | 69.30 | 70.34 | | 70.37 | 0.000605 | 1.24 | 17.78 | 22.56 | 0.25 |
| Reach-1 | 45 | Mean Annual | 80.00 | 69.30 | 71.03 | | 71.11 | 0.001086 | 2.25 | 35.52 | 28.38 | 0.35 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 45 | 10-year | 116.00 | 69.30 | 71.36 | | 71.46 | 0.001089 | 2.57 | 45.24 | 30.86 | 0.37 |
| Reach-1 | 45 | 25-year | 126.00 | 69.30 | 71.44 | | 71.55 | 0.001084 | 2.65 | 47.71 | 31.46 | 0.37 |
| Reach-1 | 45 | 50-year | 138.00 | 69.30 | 71.53 | | 71.65 | 0.001081 | 2.75 | 50.60 | 32.15 | 0.37 |
| Reach-1 | 45 | 100-year | 155.00 | 69.30 | 71.66 | | 71.78 | 0.001076 | 2.87 | 54.66 | 33.09 | 0.38 |
| | | | | | | | | | | | | |
| Reach-1 | 44 | August | 8.00 | 69.70 | 69.93 | 69.93 | 70.04 | 0.039280 | 2.62 | 3.06 | 14.36 | 1.00 |
| Reach-1 | 44 | Spring - meas. | 14.60 | 69.70 | 70.04 | 70.04 | 70.19 | 0.035287 | 3.12 | 4.68 | 15.58 | 1.00 |
| Reach-1 | 44 | Spring | 22.00 | 69.70 | 70.14 | 70.14 | 70.33 | 0.032683 | 3.49 | 6.30 | 16.71 | 1.00 |
| Reach-1 | 44 | Mean Annual | 80.00 | 69.70 | 70.79 | | 71.07 | 0.015490 | 4.19 | 19.10 | 21.88 | 0.79 |
| Reach-1 | 44 | 10-year | 116.00 | 69.70 | 71.13 | | 71.42 | 0.012008 | 4.34 | 26.75 | 23.94 | 0.72 |
| Reach-1 | 44 | 25-year | 126.00 | 69.70 | 71.21 | | 71.51 | 0.011470 | 4.40 | 28.62 | 24.42 | 0.71 |
| Reach-1 | 44 | 50-year | 138.00 | 69.70 | 71.29 | | 71.61 | 0.010887 | 4.50 | 30.74 | 24.95 | 0.70 |
| Reach-1 | 44 | 100-year | 155.00 | 69.70 | 71.41 | | 71.74 | 0.010207 | 4.62 | 33.73 | 25.78 | 0.69 |
| | | | | | | | | | | | | |
| Reach-1 | 43 | August | 8.00 | 68.70 | 69.11 | 69.01 | 69.18 | 0.012987 | 2.15 | 3.72 | 10.11 | 0.63 |
| Reach-1 | 43 | Spring - meas. | 14.60 | 68.70 | 69.26 | 69.15 | 69.38 | 0.014612 | 2.74 | 5.32 | 10.93 | 0.69 |
| Reach-1 | 43 | Spring | 22.00 | 68.70 | 69.40 | 69.28 | 69.56 | 0.015975 | 3.24 | 6.80 | 11.63 | 0.75 |
| Reach-1 | 43 | Mean Annual | 80.00 | 68.70 | 70.02 | 69.96 | 70.46 | 0.020989 | 5.33 | 15.01 | 14.73 | 0.93 |
| Reach-1 | 43 | 10-year | 116.00 | 68.70 | 70.27 | 70.26 | 70.86 | 0.023074 | 6.16 | 18.83 | 15.91 | 1.00 |
| Reach-1 | 43 | 25-year | 126.00 | 68.70 | 70.34 | 70.33 | 70.96 | 0.022930 | 6.30 | 20.00 | 16.26 | 1.00 |
| Reach-1 | 43 | 50-year | 138.00 | 68.70 | 70.42 | 70.42 | 71.07 | 0.022736 | 6.45 | 21.40 | 16.66 | 1.00 |
| Reach-1 | 43 | 100-year | 155.00 | 68.70 | 70.54 | 70.54 | 71.22 | 0.022500 | 6.65 | 23.32 | 17.20 | 1.01 |
| | | | | | | | | | | | | |
| Reach-1 | 42 | August | 8.00 | 68.60 | 68.89 | 68.89 | 69.03 | 0.014274 | 2.94 | 2.72 | 10.15 | 1.00 |
| Reach-1 | 42 | Spring - meas. | 14.60 | 68.60 | 69.03 | 69.03 | 69.22 | 0.012925 | 3.52 | 4.14 | 10.85 | 1.01 |
| Reach-1 | 42 | Spring | 22.00 | 68.60 | 69.16 | 69.16 | 69.40 | 0.011948 | 3.96 | 5.56 | 11.51 | 1.00 |
| Reach-1 | 42 | Mean Annual | 80.00 | 68.60 | 69.82 | 69.82 | 70.31 | 0.009649 | 5.62 | 14.23 | 14.58 | 1.00 |
| Reach-1 | 42 | 10-year | 116.00 | 68.60 | 70.12 | 70.12 | 70.71 | 0.009130 | 6.18 | 18.76 | 15.91 | 1.00 |
| Reach-1 | 42 | 25-year | 126.00 | 68.60 | 70.19 | 70.19 | 70.81 | 0.009021 | 6.31 | 19.96 | 16.24 | 1.00 |
| Reach-1 | 42 | 50-year | 138.00 | 68.60 | 70.28 | 70.28 | 70.92 | 0.008900 | 6.46 | 21.37 | 16.63 | 1.00 |
| Reach-1 | 42 | 100-year | 155.00 | 68.60 | 70.39 | 70.39 | 71.08 | 0.008755 | 6.64 | 23.33 | 17.15 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 41 | August | 8.00 | 68.41 | 68.68 | 68.72 | 68.86 | 0.022298 | 3.37 | 2.37 | 10.05 | 1.22 |
| Reach-1 | 41 | Spring - meas. | 14.60 | 68.41 | 68.79 | 68.85 | 69.06 | 0.021969 | 4.17 | 3.50 | 10.59 | 1.28 |
| Reach-1 | 41 | Spring | 22.00 | 68.41 | 68.90 | 68.98 | 69.24 | 0.020542 | 4.72 | 4.66 | 11.10 | 1.28 |
| Reach-1 | 41 | Mean Annual | 80.00 | 68.41 | 69.49 | 69.64 | 70.17 | 0.015649 | 6.62 | 12.08 | 13.93 | 1.25 |
| Reach-1 | 41 | 10-year | 116.00 | 68.41 | 69.75 | 69.94 | 70.58 | 0.015080 | 7.34 | 15.81 | 15.15 | 1.27 |
| Reach-1 | 41 | 25-year | 126.00 | 68.41 | 69.82 | 70.01 | 70.68 | 0.014833 | 7.48 | 16.85 | 15.48 | 1.26 |
| Reach-1 | 41 | 50-year | 138.00 | 68.41 | 69.89 | 70.10 | 70.80 | 0.014620 | 7.65 | 18.05 | 15.84 | 1.26 |
| Reach-1 | 41 | 100-year | 155.00 | 68.41 | 70.00 | 70.22 | 70.95 | 0.014288 | 7.85 | 19.74 | 16.34 | 1.26 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| | | | | | | | | | | | | |
| Reach-1 | 40 | August | 8.00 | 68.00 | 68.25 | 68.23 | 68.34 | 0.010754 | 2.41 | 3.32 | 13.30 | 0.85 |
| Reach-1 | 40 | Spring - meas. | 14.60 | 68.00 | 68.32 | 68.34 | 68.51 | 0.017034 | 3.50 | 4.17 | 13.40 | 1.10 |
| Reach-1 | 40 | Spring | 22.00 | 68.00 | 68.39 | 68.44 | 68.67 | 0.018998 | 4.23 | 5.20 | 13.51 | 1.20 |
| Reach-1 | 40 | Mean Annual | 80.00 | 68.00 | 68.81 | 69.03 | 69.63 | 0.022859 | 7.25 | 11.03 | 14.34 | 1.46 |
| Reach-1 | 40 | 10-year | 116.00 | 68.00 | 69.04 | 69.31 | 70.06 | 0.021463 | 8.11 | 14.30 | 14.84 | 1.46 |
| Reach-1 | 40 | 25-year | 126.00 | 68.00 | 69.10 | 69.39 | 70.16 | 0.020923 | 8.29 | 15.20 | 14.93 | 1.45 |
| Reach-1 | 40 | 50-year | 138.00 | 68.00 | 69.17 | 69.47 | 70.29 | 0.020428 | 8.49 | 16.25 | 15.03 | 1.44 |
| Reach-1 | 40 | 100-year | 155.00 | 68.00 | 69.26 | 69.58 | 70.45 | 0.019779 | 8.76 | 17.70 | 15.17 | 1.43 |
| | | | | | | | | | | | | |
| Reach-1 | 39 | August | 8.00 | 67.76 | 68.00 | 68.00 | 68.11 | 0.013412 | 2.58 | 3.11 | 13.34 | 0.94 |
| Reach-1 | 39 | Spring - meas. | 14.60 | 67.76 | 68.05 | 68.11 | 68.29 | 0.026023 | 3.98 | 3.67 | 13.43 | 1.34 |
| Reach-1 | 39 | Spring | 22.00 | 67.76 | 68.14 | 68.21 | 68.45 | 0.021804 | 4.41 | 4.98 | 13.62 | 1.29 |
| Reach-1 | 39 | Mean Annual | 80.00 | 67.76 | 68.77 | 68.80 | 69.29 | 0.011272 | 5.77 | 13.86 | 14.90 | 1.05 |
| Reach-1 | 39 | 10-year | 116.00 | 67.76 | 69.07 | 69.08 | 69.68 | 0.009904 | 6.28 | 18.48 | 15.69 | 1.02 |
| Reach-1 | 39 | 25-year | 126.00 | 67.76 | 69.15 | 69.15 | 69.78 | 0.009509 | 6.37 | 19.79 | 15.91 | 1.01 |
| Reach-1 | 39 | 50-year | 138.00 | 67.76 | 69.18 | 69.24 | 69.90 | 0.010760 | 6.84 | 20.18 | 15.98 | 1.07 |
| Reach-1 | 39 | 100-year | 155.00 | 67.76 | 69.26 | 69.35 | 70.07 | 0.011354 | 7.23 | 21.43 | 16.18 | 1.11 |
| | | | | | | | | | | | | |
| Reach-1 | 38 | August | 8.00 | 67.40 | 67.70 | | 67.75 | 0.005125 | 1.80 | 4.45 | 16.08 | 0.60 |
| Reach-1 | 38 | Spring - meas. | 14.60 | 67.40 | 67.83 | 67.71 | 67.90 | 0.005061 | 2.23 | 6.55 | 16.97 | 0.63 |
| Reach-1 | 38 | Spring | 22.00 | 67.40 | 67.93 | 67.81 | 68.04 | 0.005311 | 2.62 | 8.39 | 17.65 | 0.67 |
| Reach-1 | 38 | Mean Annual | 80.00 | 67.40 | 68.53 | 68.33 | 68.78 | 0.004999 | 3.99 | 20.03 | 21.23 | 0.72 |
| Reach-1 | 38 | 10-year | 116.00 | 67.40 | 68.80 | 68.56 | 69.11 | 0.004886 | 4.46 | 25.99 | 22.84 | 0.74 |
| Reach-1 | 38 | 25-year | 126.00 | 67.40 | 68.87 | 68.62 | 69.19 | 0.004859 | 4.57 | 27.56 | 23.25 | 0.74 |
| Reach-1 | 38 | 50-year | 138.00 | 67.40 | 68.95 | 68.69 | 69.29 | 0.004831 | 4.69 | 29.40 | 23.72 | 0.74 |
| Reach-1 | 38 | 100-year | 155.00 | 67.40 | 68.55 | 68.78 | 69.45 | 0.017816 | 7.60 | 20.38 | 21.33 | 1.37 |
| | | | | | | | | | | | | |
| Reach-1 | 37 | August | 8.00 | 67.00 | 67.23 | 67.23 | 67.34 | 0.015186 | 2.65 | 3.02 | 13.76 | 1.00 |
| Reach-1 | 37 | Spring - meas. | 14.60 | 67.00 | 67.34 | 67.34 | 67.50 | 0.013485 | 3.19 | 4.58 | 14.45 | 1.00 |
| Reach-1 | 37 | Spring | 22.00 | 67.00 | 67.44 | 67.44 | 67.65 | 0.012671 | 3.62 | 6.07 | 15.07 | 1.01 |
| Reach-1 | 37 | Mean Annual | 80.00 | 67.00 | 68.00 | 68.00 | 68.42 | 0.010037 | 5.19 | 15.41 | 18.53 | 1.00 |
| Reach-1 | 37 | 10-year | 116.00 | 67.00 | 68.25 | 68.25 | 68.76 | 0.009444 | 5.72 | 20.29 | 20.09 | 1.00 |
| Reach-1 | 37 | 25-year | 126.00 | 67.00 | 68.32 | 68.32 | 68.84 | 0.009317 | 5.84 | 21.59 | 20.51 | 1.00 |
| Reach-1 | 37 | 50-year | 138.00 | 67.00 | 68.39 | 68.39 | 68.94 | 0.009190 | 5.97 | 23.13 | 21.04 | 1.00 |
| Reach-1 | 37 | 100-year | 155.00 | 67.00 | 68.49 | 68.49 | 69.07 | 0.009028 | 6.13 | 25.28 | 21.76 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 36 | August | 8.00 | 64.70 | 66.59 | 64.90 | 66.59 | 0.000008 | 0.22 | 36.23 | 22.25 | 0.03 |
| Reach-1 | 36 | Spring - meas. | 14.60 | 64.70 | 66.78 | 64.99 | 66.78 | 0.000018 | 0.36 | 40.43 | 22.86 | 0.05 |
| Reach-1 | 36 | Spring | 22.00 | 64.70 | 66.94 | 65.08 | 66.95 | 0.000032 | 0.50 | 44.28 | 23.40 | 0.06 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 36 | Mean Annual | 80.00 | 64.70 | 67.79 | 65.58 | 67.81 | 0.000143 | 1.22 | 65.46 | 27.33 | 0.14 |
| Reach-1 | 36 | 10-year | 116.00 | 64.70 | 68.16 | 65.83 | 68.20 | 0.000202 | 1.52 | 76.11 | 29.64 | 0.17 |
| Reach-1 | 36 | 25-year | 126.00 | 64.70 | 68.26 | 65.89 | 68.30 | 0.000217 | 1.60 | 78.96 | 30.25 | 0.17 |
| Reach-1 | 36 | 50-year | 138.00 | 64.70 | 68.36 | 65.96 | 68.41 | 0.000234 | 1.68 | 82.30 | 30.96 | 0.18 |
| Reach-1 | 36 | 100-year | 155.00 | 64.70 | 68.51 | 66.05 | 68.56 | 0.000253 | 1.78 | 86.96 | 31.89 | 0.19 |
| | | | | | | | | | | | | |
| Reach-1 | 35 | August | 8.00 | 65.80 | 66.58 | | 66.59 | 0.000463 | 0.63 | 12.66 | 17.61 | 0.13 |
| Reach-1 | 35 | Spring - meas. | 14.60 | 65.80 | 66.76 | | 66.78 | 0.000765 | 0.92 | 15.88 | 18.27 | 0.17 |
| Reach-1 | 35 | Spring | 22.00 | 65.80 | 66.92 | | 66.94 | 0.001030 | 1.17 | 18.84 | 18.86 | 0.21 |
| Reach-1 | 35 | Mean Annual | 80.00 | 65.80 | 67.72 | | 67.80 | 0.002162 | 2.28 | 35.06 | 22.13 | 0.32 |
| Reach-1 | 35 | 10-year | 116.00 | 65.80 | 68.07 | | 68.18 | 0.002607 | 2.68 | 43.26 | 24.67 | 0.36 |
| Reach-1 | 35 | 25-year | 126.00 | 65.80 | 68.16 | | 68.28 | 0.002691 | 2.77 | 45.52 | 25.36 | 0.36 |
| Reach-1 | 35 | 50-year | 138.00 | 65.80 | 68.26 | | 68.39 | 0.002777 | 2.86 | 48.19 | 26.13 | 0.37 |
| Reach-1 | 35 | 100-year | 155.00 | 65.80 | 68.41 | | 68.55 | 0.002860 | 2.98 | 51.98 | 27.11 | 0.38 |
| | | | | | | | | | | | | |
| Reach-1 | 34 | August | 8.00 | 66.15 | 66.50 | | 66.55 | 0.009878 | 1.73 | 4.61 | 14.17 | 0.54 |
| Reach-1 | 34 | Spring - meas. | 14.60 | 66.15 | 66.63 | 66.49 | 66.71 | 0.010997 | 2.23 | 6.54 | 14.84 | 0.59 |
| Reach-1 | 34 | Spring | 22.00 | 66.15 | 66.75 | 66.60 | 66.86 | 0.011938 | 2.66 | 8.28 | 15.35 | 0.64 |
| Reach-1 | 34 | Mean Annual | 80.00 | 66.15 | 67.30 | 67.16 | 67.63 | 0.016093 | 4.57 | 17.52 | 17.81 | 0.81 |
| Reach-1 | 34 | 10-year | 116.00 | 66.15 | 67.49 | 67.42 | 67.97 | 0.019962 | 5.54 | 20.93 | 18.64 | 0.92 |
| Reach-1 | 34 | 25-year | 126.00 | 66.15 | 67.54 | 67.49 | 68.06 | 0.020765 | 5.77 | 21.84 | 18.86 | 0.94 |
| Reach-1 | 34 | 50-year | 138.00 | 66.15 | 67.60 | 67.56 | 68.16 | 0.021345 | 6.00 | 23.02 | 19.13 | 0.96 |
| Reach-1 | 34 | 100-year | 155.00 | 66.15 | 67.67 | 67.67 | 68.30 | 0.022609 | 6.34 | 24.43 | 19.46 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 33 | August | 8.00 | 66.01 | 66.25 | 66.25 | 66.35 | 0.013359 | 2.50 | 3.20 | 14.52 | 0.94 |
| Reach-1 | 33 | Spring - meas. | 14.60 | 66.01 | 66.36 | 66.35 | 66.51 | 0.012505 | 3.06 | 4.77 | 15.12 | 0.96 |
| Reach-1 | 33 | Spring | 22.00 | 66.01 | 66.46 | 66.45 | 66.65 | 0.011907 | 3.50 | 6.28 | 15.66 | 0.98 |
| Reach-1 | 33 | Mean Annual | 80.00 | 66.01 | 67.00 | 66.99 | 67.41 | 0.009792 | 5.15 | 15.54 | 18.64 | 0.99 |
| Reach-1 | 33 | 10-year | 116.00 | 66.01 | 67.26 | 67.24 | 67.75 | 0.009043 | 5.64 | 20.56 | 20.18 | 0.98 |
| Reach-1 | 33 | 25-year | 126.00 | 66.01 | 67.32 | 67.30 | 67.84 | 0.008876 | 5.75 | 21.91 | 20.58 | 0.98 |
| Reach-1 | 33 | 50-year | 138.00 | 66.01 | 67.40 | 67.38 | 67.94 | 0.008693 | 5.87 | 23.49 | 21.04 | 0.98 |
| Reach-1 | 33 | 100-year | 155.00 | 66.01 | 67.50 | 67.48 | 68.07 | 0.008458 | 6.03 | 25.70 | 21.66 | 0.98 |
| | | | | | | | | | | | | |
| Reach-1 | 32 | August | 8.00 | 65.69 | 66.01 | | 66.05 | 0.004431 | 1.71 | 4.68 | 16.35 | 0.56 |
| Reach-1 | 32 | Spring - meas. | 14.60 | 65.69 | 66.14 | | 66.21 | 0.004386 | 2.13 | 6.87 | 17.18 | 0.59 |
| Reach-1 | 32 | Spring | 22.00 | 65.69 | 66.26 | | 66.35 | 0.004365 | 2.46 | 8.96 | 17.93 | 0.61 |
| Reach-1 | 32 | Mean Annual | 80.00 | 65.69 | 66.92 | | 67.12 | 0.003775 | 3.62 | 22.13 | 22.08 | 0.64 |
| Reach-1 | 32 | 10-year | 116.00 | 65.69 | 67.21 | | 67.46 | 0.003630 | 4.01 | 28.94 | 23.94 | 0.64 |
| Reach-1 | 32 | 25-year | 126.00 | 65.69 | 67.29 | | 67.55 | 0.003600 | 4.10 | 30.73 | 24.41 | 0.64 |
| Reach-1 | 32 | 50-year | 138.00 | 65.69 | 67.37 | | 67.65 | 0.003568 | 4.20 | 32.83 | 24.95 | 0.65 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 32 | 100-year | 155.00 | 65.69 | 67.49 | | 67.78 | 0.003527 | 4.34 | 35.74 | 25.67 | 0.65 |
| | | | | | | | | | | | | |
| Reach-1 | 31 | August | 8.00 | 65.29 | 65.56 | 65.56 | 65.68 | 0.015268 | 2.78 | 2.88 | 12.30 | 1.01 |
| Reach-1 | 31 | Spring - meas. | 14.60 | 65.29 | 65.68 | 65.68 | 65.85 | 0.013286 | 3.30 | 4.42 | 13.08 | 1.00 |
| Reach-1 | 31 | Spring | 22.00 | 65.29 | 65.79 | 65.79 | 66.00 | 0.012226 | 3.71 | 5.93 | 13.81 | 1.00 |
| Reach-1 | 31 | Mean Annual | 80.00 | 65.29 | 66.38 | 66.38 | 66.81 | 0.009966 | 5.29 | 15.13 | 17.65 | 1.01 |
| Reach-1 | 31 | 10-year | 116.00 | 65.29 | 66.64 | 66.64 | 67.16 | 0.009412 | 5.80 | 20.01 | 19.41 | 1.01 |
| Reach-1 | 31 | 25-year | 126.00 | 65.29 | 66.70 | 66.70 | 67.25 | 0.009295 | 5.92 | 21.30 | 19.85 | 1.01 |
| Reach-1 | 31 | 50-year | 138.00 | 65.29 | 66.78 | 66.78 | 67.35 | 0.009168 | 6.05 | 22.82 | 20.36 | 1.01 |
| Reach-1 | 31 | 100-year | 155.00 | 65.29 | 66.88 | 66.88 | 67.48 | 0.009031 | 6.22 | 24.91 | 21.04 | 1.01 |
| | | | | | | | | | | | | |
| Reach-1 | 30 | August | 8.00 | 62.90 | 64.98 | 63.09 | 64.98 | 0.000006 | 0.21 | 38.83 | 20.73 | 0.03 |
| Reach-1 | 30 | Spring - meas. | 14.60 | 62.90 | 65.17 | 63.19 | 65.17 | 0.000015 | 0.34 | 42.79 | 21.11 | 0.04 |
| Reach-1 | 30 | Spring | 22.00 | 62.90 | 65.35 | 63.28 | 65.35 | 0.000026 | 0.47 | 46.51 | 21.46 | 0.06 |
| Reach-1 | 30 | Mean Annual | 80.00 | 62.90 | 66.25 | 63.78 | 66.27 | 0.000120 | 1.20 | 66.91 | 24.10 | 0.13 |
| Reach-1 | 30 | 10-year | 116.00 | 62.90 | 66.64 | 64.02 | 66.67 | 0.000175 | 1.51 | 76.64 | 25.74 | 0.15 |
| Reach-1 | 30 | 25-year | 126.00 | 62.90 | 66.73 | 64.08 | 66.77 | 0.000190 | 1.59 | 79.18 | 26.23 | 0.16 |
| Reach-1 | 30 | 50-year | 138.00 | 62.90 | 66.84 | 64.15 | 66.89 | 0.000206 | 1.68 | 82.07 | 26.78 | 0.17 |
| Reach-1 | 30 | 100-year | 155.00 | 62.90 | 66.99 | 64.25 | 67.04 | 0.000223 | 1.80 | 86.06 | 27.50 | 0.18 |
| | | | | | | | | | | | | |
| Reach-1 | 29 | August | 8.00 | 64.50 | 64.95 | | 64.98 | 0.001802 | 1.41 | 5.67 | 13.29 | 0.38 |
| Reach-1 | 29 | Spring - meas. | 14.60 | 64.50 | 65.11 | | 65.17 | 0.002088 | 1.84 | 7.92 | 13.77 | 0.43 |
| Reach-1 | 29 | Spring | 22.00 | 64.50 | 65.27 | | 65.34 | 0.002252 | 2.19 | 10.05 | 14.21 | 0.46 |
| Reach-1 | 29 | Mean Annual | 80.00 | 64.50 | 66.04 | | 66.24 | 0.002854 | 3.61 | 22.18 | 17.47 | 0.56 |
| Reach-1 | 29 | 10-year | 116.00 | 64.50 | 66.39 | | 66.64 | 0.002980 | 4.07 | 28.51 | 19.33 | 0.59 |
| Reach-1 | 29 | 25-year | 126.00 | 64.50 | 66.47 | | 66.74 | 0.002993 | 4.17 | 30.21 | 19.80 | 0.59 |
| Reach-1 | 29 | 50-year | 138.00 | 64.50 | 66.57 | | 66.85 | 0.003031 | 4.30 | 32.12 | 20.31 | 0.60 |
| Reach-1 | 29 | 100-year | 155.00 | 64.50 | 66.70 | | 67.01 | 0.002987 | 4.46 | 34.80 | 21.01 | 0.60 |
| | | | | | | | | | | | | |
| Reach-1 | 28 | August | 8.00 | 64.45 | 64.71 | 64.71 | 64.84 | 0.014900 | 2.82 | 2.83 | 11.54 | 1.00 |
| Reach-1 | 28 | Spring - meas. | 14.60 | 64.45 | 64.84 | 64.84 | 65.02 | 0.013032 | 3.39 | 4.31 | 12.08 | 1.00 |
| Reach-1 | 28 | Spring | 22.00 | 64.45 | 64.95 | 64.95 | 65.18 | 0.012267 | 3.85 | 5.71 | 12.53 | 1.01 |
| Reach-1 | 28 | Mean Annual | 80.00 | 64.45 | 65.58 | 65.58 | 66.06 | 0.009755 | 5.56 | 14.40 | 15.12 | 1.00 |
| Reach-1 | 28 | 10-year | 116.00 | 64.45 | 65.87 | 65.87 | 66.45 | 0.009194 | 6.13 | 18.94 | 16.34 | 1.00 |
| Reach-1 | 28 | 25-year | 126.00 | 64.45 | 65.94 | 65.94 | 66.55 | 0.009131 | 6.27 | 20.10 | 16.66 | 1.01 |
| Reach-1 | 28 | 50-year | 138.00 | 64.45 | 66.03 | 66.03 | 66.66 | 0.008966 | 6.40 | 21.56 | 17.05 | 1.00 |
| Reach-1 | 28 | 100-year | 155.00 | 64.45 | 66.13 | 66.13 | 66.81 | 0.008751 | 6.63 | 23.40 | 17.53 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 27 | August | 8.00 | 64.25 | 64.51 | 64.52 | 64.64 | 0.016366 | 2.92 | 2.74 | 11.39 | 1.05 |
| Reach-1 | 27 | Spring - meas. | 14.60 | 64.25 | 64.62 | 64.65 | 64.83 | 0.017081 | 3.70 | 3.95 | 11.91 | 1.13 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 27 | Spring | 22.00 | 64.25 | 64.72 | 64.76 | 65.00 | 0.016591 | 4.24 | 5.19 | 12.41 | 1.16 |
| Reach-1 | 27 | Mean Annual | 80.00 | 64.25 | 65.24 | 65.39 | 65.69 | 0.015830 | 6.46 | 12.38 | 15.03 | 1.25 |
| Reach-1 | 27 | 10-year | 116.00 | 64.25 | 65.48 | 65.65 | 66.29 | 0.015100 | 7.20 | 16.11 | 16.23 | 1.26 |
| Reach-1 | 27 | 25-year | 126.00 | 64.25 | 65.54 | 65.72 | 66.39 | 0.014576 | 7.37 | 17.13 | 16.55 | 1.26 |
| Reach-1 | 27 | 50-year | 138.00 | 64.25 | 65.61 | 65.80 | 66.50 | 0.014095 | 7.56 | 18.33 | 16.90 | 1.25 |
| Reach-1 | 27 | 100-year | 155.00 | 64.25 | 65.72 | 65.90 | 66.66 | 0.013397 | 7.80 | 20.05 | 17.41 | 1.23 |
| | | | | | | | | | | | | |
| Reach-1 | 26 | August | 8.00 | 63.60 | 63.73 | 63.81 | 64.02 | 0.088195 | 4.32 | 1.85 | 15.24 | 2.19 |
| Reach-1 | 26 | Spring - meas. | 14.60 | 63.60 | 63.88 | 63.91 | 64.06 | 0.019432 | 3.38 | 4.32 | 16.48 | 1.16 |
| Reach-1 | 26 | Spring | 22.00 | 63.60 | 64.03 | 64.00 | 64.19 | 0.010379 | 3.21 | 6.86 | 17.66 | 0.91 |
| Reach-1 | 26 | Mean Annual | 80.00 | 63.60 | 64.34 | 64.51 | 64.96 | 0.021259 | 6.34 | 12.62 | 19.99 | 1.41 |
| Reach-1 | 26 | 10-year | 116.00 | 63.60 | 64.48 | 64.73 | 65.34 | 0.023353 | 7.41 | 15.66 | 21.03 | 1.51 |
| Reach-1 | 26 | 25-year | 126.00 | 63.60 | 64.52 | 64.79 | 65.44 | 0.024264 | 7.71 | 16.34 | 21.25 | 1.55 |
| Reach-1 | 26 | 50-year | 138.00 | 63.60 | 64.56 | 64.85 | 65.56 | 0.025013 | 8.03 | 17.19 | 21.53 | 1.58 |
| Reach-1 | 26 | 100-year | 155.00 | 63.60 | 64.61 | 64.94 | 65.72 | 0.026039 | 8.45 | 18.34 | 21.90 | 1.63 |
| | | | | | | | | | | | | |
| Reach-1 | 25 | August | 8.00 | 62.90 | 63.20 | 63.20 | 63.31 | 0.015020 | 2.72 | 2.94 | 12.80 | 1.00 |
| Reach-1 | 25 | Spring - meas. | 14.60 | 62.90 | 63.32 | 63.32 | 63.47 | 0.013782 | 3.19 | 4.58 | 14.77 | 1.01 |
| Reach-1 | 25 | Spring | 22.00 | 62.90 | 63.42 | 63.42 | 63.62 | 0.012586 | 3.56 | 6.19 | 15.80 | 1.00 |
| Reach-1 | 25 | Mean Annual | 80.00 | 62.90 | 63.96 | 63.96 | 64.34 | 0.010269 | 4.99 | 16.02 | 21.03 | 1.01 |
| Reach-1 | 25 | 10-year | 116.00 | 62.90 | 64.19 | 64.19 | 64.65 | 0.009690 | 5.46 | 21.25 | 23.31 | 1.01 |
| Reach-1 | 25 | 25-year | 126.00 | 62.90 | 64.25 | 64.25 | 64.73 | 0.009568 | 5.57 | 22.63 | 23.87 | 1.01 |
| Reach-1 | 25 | 50-year | 138.00 | 62.90 | 64.32 | 64.32 | 64.82 | 0.009440 | 5.69 | 24.25 | 24.50 | 1.01 |
| Reach-1 | 25 | 100-year | 155.00 | 62.90 | 64.41 | 64.41 | 64.94 | 0.009305 | 5.85 | 26.47 | 25.35 | 1.01 |
| | | | | | | | | | | | | |
| Reach-1 | 24 | August | 8.00 | 60.60 | 62.96 | 60.81 | 62.96 | 0.000004 | 0.17 | 46.55 | 25.01 | 0.02 |
| Reach-1 | 24 | Spring - meas. | 14.60 | 60.60 | 63.08 | 60.91 | 63.09 | 0.000011 | 0.29 | 49.81 | 25.58 | 0.04 |
| Reach-1 | 24 | Spring | 22.00 | 60.60 | 63.20 | 61.00 | 63.20 | 0.000021 | 0.42 | 52.86 | 26.52 | 0.05 |
| Reach-1 | 24 | Mean Annual | 80.00 | 60.60 | 63.77 | 61.53 | 63.79 | 0.000147 | 1.14 | 70.12 | 33.73 | 0.14 |
| Reach-1 | 24 | 10-year | 116.00 | 60.60 | 64.03 | 61.77 | 64.06 | 0.000230 | 1.47 | 79.12 | 36.54 | 0.18 |
| Reach-1 | 24 | 25-year | 126.00 | 60.60 | 64.09 | 61.84 | 64.12 | 0.000254 | 1.55 | 81.27 | 37.18 | 0.18 |
| Reach-1 | 24 | 50-year | 138.00 | 60.60 | 64.15 | 61.91 | 64.19 | 0.000284 | 1.65 | 83.65 | 37.88 | 0.20 |
| Reach-1 | 24 | 100-year | 155.00 | 60.60 | 64.23 | 62.01 | 64.28 | 0.000347 | 1.79 | 86.80 | 40.75 | 0.22 |
| | | | | | | | | | | | | |
| Reach-1 | 23 | August | 8.00 | 60.30 | 62.96 | | 62.96 | 0.000002 | 0.14 | 58.79 | 31.18 | 0.02 |
| Reach-1 | 23 | Spring - meas. | 14.60 | 60.30 | 63.08 | | 63.09 | 0.000007 | 0.23 | 62.88 | 32.40 | 0.03 |
| Reach-1 | 23 | Spring | 22.00 | 60.30 | 63.20 | | 63.20 | 0.000013 | 0.33 | 66.77 | 33.51 | 0.04 |
| Reach-1 | 23 | Mean Annual | 80.00 | 60.30 | 63.78 | | 63.79 | 0.000085 | 0.91 | 87.56 | 38.93 | 0.11 |
| Reach-1 | 23 | 10-year | 116.00 | 60.30 | 64.03 | | 64.06 | 0.000136 | 1.18 | 98.02 | 42.27 | 0.14 |
| Reach-1 | 23 | 25-year | 126.00 | 60.30 | 64.09 | | 64.12 | 0.000151 | 1.25 | 100.52 | 43.07 | 0.14 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 23 | 50-year | 138.00 | 60.30 | 64.16 | | 64.18 | 0.000169 | 1.34 | 103.31 | 44.36 | 0.15 |
| Reach-1 | 23 | 100-year | 155.00 | 60.30 | 64.24 | | 64.27 | 0.000191 | 1.45 | 107.07 | 47.47 | 0.16 |
| | | | | | | | | | | | | |
| Reach-1 | 22 | August | 8.00 | 61.71 | 62.95 | | 62.96 | 0.000033 | 0.32 | 25.30 | 28.30 | 0.06 |
| Reach-1 | 22 | Spring - meas. | 14.60 | 61.71 | 63.08 | | 63.08 | 0.000075 | 0.50 | 28.97 | 29.67 | 0.09 |
| Reach-1 | 22 | Spring | 22.00 | 61.71 | 63.20 | | 63.20 | 0.000124 | 0.68 | 32.47 | 30.93 | 0.12 |
| Reach-1 | 22 | Mean Annual | 80.00 | 61.71 | 63.75 | | 63.79 | 0.000499 | 1.56 | 51.30 | 39.81 | 0.24 |
| Reach-1 | 22 | 10-year | 116.00 | 61.71 | 64.00 | | 64.05 | 0.000689 | 1.86 | 62.37 | 47.42 | 0.29 |
| Reach-1 | 22 | 25-year | 126.00 | 61.71 | 64.05 | | 64.11 | 0.000728 | 1.94 | 65.07 | 48.52 | 0.29 |
| Reach-1 | 22 | 50-year | 138.00 | 61.71 | 64.11 | | 64.18 | 0.000756 | 2.03 | 68.09 | 49.82 | 0.30 |
| Reach-1 | 22 | 100-year | 155.00 | 61.71 | 64.19 | | 64.26 | 0.000796 | 2.16 | 72.09 | 53.06 | 0.31 |
| | | | | | | | | | | | | |
| Reach-1 | 21 | August | 8.00 | 62.65 | 62.91 | | 62.95 | 0.012668 | 1.61 | 4.98 | 20.89 | 0.58 |
| Reach-1 | 21 | Spring - meas. | 14.60 | 62.65 | 63.01 | | 63.08 | 0.013598 | 2.03 | 7.18 | 22.30 | 0.63 |
| Reach-1 | 21 | Spring | 22.00 | 62.65 | 63.11 | | 63.19 | 0.013942 | 2.36 | 9.33 | 23.59 | 0.66 |
| Reach-1 | 21 | Mean Annual | 80.00 | 62.65 | 63.43 | 63.43 | 63.75 | 0.027744 | 4.53 | 17.65 | 28.04 | 1.01 |
| Reach-1 | 21 | 10-year | 116.00 | 62.65 | 63.63 | 63.63 | 64.01 | 0.025255 | 4.91 | 23.61 | 30.94 | 0.99 |
| Reach-1 | 21 | 25-year | 126.00 | 62.65 | 63.70 | 63.70 | 64.07 | 0.026159 | 4.88 | 25.82 | 35.11 | 1.00 |
| Reach-1 | 21 | 50-year | 138.00 | 62.65 | 63.76 | 63.76 | 64.13 | 0.026233 | 4.89 | 28.21 | 38.30 | 1.00 |
| Reach-1 | 21 | 100-year | 155.00 | 62.65 | 63.84 | 63.84 | 64.22 | 0.026123 | 4.92 | 31.51 | 42.32 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 20 | August | 8.00 | 60.70 | 60.90 | 60.90 | 61.00 | 0.040925 | 2.52 | 3.17 | 16.22 | 1.01 |
| Reach-1 | 20 | Spring - meas. | 14.60 | 60.70 | 61.00 | 61.00 | 61.14 | 0.035612 | 3.04 | 4.80 | 16.72 | 1.00 |
| Reach-1 | 20 | Spring | 22.00 | 60.70 | 61.09 | 61.09 | 61.28 | 0.033097 | 3.46 | 6.35 | 17.18 | 1.00 |
| Reach-1 | 20 | Mean Annual | 80.00 | 60.70 | 61.98 | 61.60 | 62.16 | 0.007744 | 3.41 | 23.49 | 21.61 | 0.58 |
| Reach-1 | 20 | 10-year | 116.00 | 60.70 | 62.37 | 61.84 | 62.57 | 0.006234 | 3.57 | 32.46 | 23.48 | 0.54 |
| Reach-1 | 20 | 25-year | 126.00 | 60.70 | 62.47 | 61.90 | 62.68 | 0.005976 | 3.62 | 34.83 | 23.93 | 0.53 |
| Reach-1 | 20 | 50-year | 138.00 | 60.70 | 62.57 | 61.97 | 62.79 | 0.005867 | 3.70 | 37.28 | 24.39 | 0.53 |
| Reach-1 | 20 | 100-year | 155.00 | 60.70 | 62.70 | 62.06 | 62.93 | 0.005878 | 3.84 | 40.39 | 25.04 | 0.53 |
| | | | | | | | | | | | | |
| Reach-1 | 19 | August | 8.00 | 58.50 | 60.76 | 58.69 | 60.76 | 0.000004 | 0.19 | 42.93 | 21.47 | 0.02 |
| Reach-1 | 19 | Spring - meas. | 14.60 | 58.50 | 60.96 | 58.79 | 60.97 | 0.000011 | 0.31 | 47.30 | 21.92 | 0.04 |
| Reach-1 | 19 | Spring | 22.00 | 58.50 | 61.15 | 58.88 | 61.15 | 0.000019 | 0.43 | 51.37 | 22.32 | 0.05 |
| Reach-1 | 19 | Mean Annual | 80.00 | 58.50 | 62.08 | | 62.10 | 0.000094 | 1.09 | 73.51 | 25.70 | 0.11 |
| Reach-1 | 19 | 10-year | 116.00 | 58.50 | 62.48 | | 62.51 | 0.000139 | 1.38 | 84.20 | 27.72 | 0.14 |
| Reach-1 | 19 | 25-year | 126.00 | 58.50 | 62.58 | | 62.61 | 0.000230 | 1.44 | 87.20 | 40.08 | 0.17 |
| Reach-1 | 19 | 50-year | 138.00 | 58.50 | 62.68 | | 62.71 | 0.000358 | 1.50 | 92.08 | 56.93 | 0.21 |
| Reach-1 | 19 | 100-year | 155.00 | 58.50 | 62.81 | | 62.85 | 0.000404 | 1.55 | 100.14 | 65.04 | 0.22 |
| | | | | | | | | | | | | |
| Reach-1 | 18 | August | 8.00 | 58.00 | 60.76 | | 60.76 | 0.000006 | 0.22 | 36.15 | 16.20 | 0.03 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 18 | Spring - meas. | 14.60 | 58.00 | 60.96 | | 60.96 | 0.000016 | 0.37 | 39.51 | 17.36 | 0.04 |
| Reach-1 | 18 | Spring | 22.00 | 58.00 | 61.15 | | 61.15 | 0.000030 | 0.51 | 42.79 | 18.42 | 0.06 |
| Reach-1 | 18 | Mean Annual | 80.00 | 58.00 | 62.07 | | 62.10 | 0.000149 | 1.30 | 61.75 | 22.29 | 0.14 |
| Reach-1 | 18 | 10-year | 116.00 | 58.00 | 62.46 | | 62.51 | 0.000304 | 1.62 | 71.73 | 33.60 | 0.19 |
| Reach-1 | 18 | 25-year | 126.00 | 58.00 | 62.56 | | 62.60 | 0.000311 | 1.68 | 75.23 | 42.51 | 0.20 |
| Reach-1 | 18 | 50-year | 138.00 | 58.00 | 62.66 | | 62.70 | 0.000324 | 1.77 | 80.16 | 55.22 | 0.20 |
| Reach-1 | 18 | 100-year | 155.00 | 58.00 | 62.78 | | 62.84 | 0.000341 | 1.88 | 87.60 | 61.56 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 17 | August | 8.00 | 60.30 | 60.67 | | 60.75 | 0.016594 | 2.31 | 3.46 | 10.12 | 0.70 |
| Reach-1 | 17 | Spring - meas. | 14.60 | 60.30 | 60.82 | | 60.95 | 0.017767 | 2.92 | 4.99 | 10.76 | 0.76 |
| Reach-1 | 17 | Spring | 22.00 | 60.30 | 60.95 | | 61.13 | 0.018504 | 3.41 | 6.45 | 11.33 | 0.80 |
| Reach-1 | 17 | Mean Annual | 80.00 | 60.30 | 61.63 | 61.55 | 62.05 | 0.020254 | 5.23 | 15.30 | 15.01 | 0.91 |
| Reach-1 | 17 | 10-year | 116.00 | 60.30 | 61.91 | 61.85 | 62.44 | 0.020616 | 5.86 | 19.80 | 16.55 | 0.94 |
| Reach-1 | 17 | 25-year | 126.00 | 60.30 | 62.06 | 61.95 | 62.55 | 0.020758 | 5.58 | 22.59 | 20.55 | 0.94 |
| Reach-1 | 17 | 50-year | 138.00 | 60.30 | 62.15 | 62.10 | 62.65 | 0.019688 | 5.64 | 24.56 | 25.01 | 0.92 |
| Reach-1 | 17 | 100-year | 155.00 | 60.30 | 62.25 | 62.19 | 62.78 | 0.018681 | 5.81 | 27.38 | 30.35 | 0.91 |
| | | | | | | | | | | | | |
| Reach-1 | 16 | August | 8.00 | 59.37 | 59.72 | 59.72 | 59.86 | 0.035967 | 3.01 | 2.66 | 9.37 | 1.00 |
| Reach-1 | 16 | Spring - meas. | 14.60 | 59.37 | 59.86 | 59.86 | 60.06 | 0.032932 | 3.63 | 4.03 | 10.01 | 1.01 |
| Reach-1 | 16 | Spring | 22.00 | 59.37 | 59.99 | 59.99 | 60.25 | 0.030536 | 4.07 | 5.40 | 10.62 | 1.01 |
| Reach-1 | 16 | Mean Annual | 80.00 | 59.37 | 60.69 | 60.69 | 61.20 | 0.024830 | 5.73 | 13.97 | 13.92 | 1.01 |
| Reach-1 | 16 | 10-year | 116.00 | 59.37 | 61.00 | 61.00 | 61.61 | 0.023499 | 6.27 | 18.51 | 15.39 | 1.01 |
| Reach-1 | 16 | 25-year | 126.00 | 59.37 | 61.08 | 61.08 | 61.71 | 0.023213 | 6.39 | 19.72 | 15.75 | 1.01 |
| Reach-1 | 16 | 50-year | 138.00 | 59.37 | 61.16 | 61.16 | 61.83 | 0.022987 | 6.54 | 21.10 | 16.14 | 1.01 |
| Reach-1 | 16 | 100-year | 155.00 | 59.37 | 61.28 | 61.28 | 61.98 | 0.022723 | 6.74 | 23.00 | 16.64 | 1.01 |
| | | | | | | | | | | | | |
| Reach-1 | 15 | August | 8.00 | 59.08 | 59.55 | 59.38 | 59.59 | 0.002795 | 1.70 | 4.70 | 11.57 | 0.47 |
| Reach-1 | 15 | Spring - meas. | 14.60 | 59.08 | 59.69 | 59.50 | 59.77 | 0.003489 | 2.26 | 6.46 | 12.23 | 0.55 |
| Reach-1 | 15 | Spring | 22.00 | 59.08 | 59.83 | 59.62 | 59.94 | 0.003942 | 2.70 | 8.14 | 12.89 | 0.60 |
| Reach-1 | 15 | Mean Annual | 80.00 | 59.08 | 60.49 | 60.27 | 60.81 | 0.005267 | 4.49 | 17.80 | 16.15 | 0.75 |
| Reach-1 | 15 | 10-year | 116.00 | 59.08 | 60.34 | 60.56 | 61.22 | 0.017005 | 7.56 | 15.34 | 15.39 | 1.33 |
| Reach-1 | 15 | 25-year | 126.00 | 59.08 | 60.40 | 60.64 | 61.33 | 0.016907 | 7.74 | 16.27 | 15.68 | 1.34 |
| Reach-1 | 15 | 50-year | 138.00 | 59.08 | 60.47 | 60.72 | 61.45 | 0.016777 | 7.94 | 17.38 | 16.02 | 1.34 |
| Reach-1 | 15 | 100-year | 155.00 | 59.08 | 60.56 | 60.83 | 61.60 | 0.016605 | 8.19 | 18.92 | 16.48 | 1.35 |
| | | | | | | | | | | | | |
| Reach-1 | 14 | August | 8.00 | 58.90 | 59.57 | | 59.58 | 0.000451 | 0.87 | 9.16 | 15.69 | 0.20 |
| Reach-1 | 14 | Spring - meas. | 14.60 | 58.90 | 59.73 | | 59.75 | 0.000703 | 1.24 | 11.79 | 16.65 | 0.26 |
| Reach-1 | 14 | Spring | 22.00 | 58.90 | 59.88 | | 59.91 | 0.000898 | 1.54 | 14.31 | 17.52 | 0.30 |
| Reach-1 | 14 | Mean Annual | 80.00 | 58.90 | 60.62 | | 60.74 | 0.001525 | 2.75 | 29.07 | 21.94 | 0.42 |
| Reach-1 | 14 | 10-year | 116.00 | 58.90 | 60.96 | 60.19 | 61.11 | 0.001688 | 3.15 | 36.80 | 24.41 | 0.45 |

HEC-RAS Plan: 070626 all1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 14 | 25-year | 126.00 | 58.90 | 61.04 | 60.25 | 61.21 | 0.001795 | 3.24 | 38.85 | 25.88 | 0.47 |
| Reach-1 | 14 | 50-year | 138.00 | 58.90 | 61.14 | 60.33 | 61.31 | 0.001925 | 3.32 | 41.54 | 28.17 | 0.48 |
| Reach-1 | 14 | 100-year | 155.00 | 58.90 | 61.28 | 60.43 | 61.46 | 0.002046 | 3.40 | 45.57 | 31.29 | 0.50 |
| | | | | | | | | | | | | |
| Reach-1 | 13 | August | 8.00 | 58.70 | 59.56 | | 59.57 | 0.000083 | 0.43 | 18.61 | 25.94 | 0.09 |
| Reach-1 | 13 | Spring - meas. | 14.60 | 58.70 | 59.73 | | 59.73 | 0.000149 | 0.64 | 22.96 | 27.67 | 0.12 |
| Reach-1 | 13 | Spring | 22.00 | 58.70 | 59.88 | | 59.89 | 0.000212 | 0.81 | 27.23 | 29.80 | 0.15 |
| Reach-1 | 13 | Mean Annual | 80.00 | 58.70 | 60.65 | | 60.68 | 0.000424 | 1.47 | 54.43 | 40.81 | 0.22 |
| Reach-1 | 13 | 10-year | 116.00 | 58.70 | 61.00 | | 61.04 | 0.000455 | 1.67 | 69.63 | 45.62 | 0.24 |
| Reach-1 | 13 | 25-year | 126.00 | 58.70 | 61.08 | | 61.13 | 0.000463 | 1.71 | 73.55 | 46.80 | 0.24 |
| Reach-1 | 13 | 50-year | 138.00 | 58.70 | 61.18 | | 61.23 | 0.000467 | 1.76 | 78.40 | 48.22 | 0.24 |
| Reach-1 | 13 | 100-year | 155.00 | 58.70 | 61.32 | | 61.37 | 0.000471 | 1.82 | 85.18 | 50.13 | 0.25 |
| | | | | | | | | | | | | |
| Reach-1 | 12 | August | 8.00 | 56.75 | 59.57 | | 59.57 | 0.000001 | 0.12 | 68.88 | 30.77 | 0.01 |
| Reach-1 | 12 | Spring - meas. | 14.60 | 56.75 | 59.73 | | 59.73 | 0.000004 | 0.20 | 74.10 | 32.76 | 0.02 |
| Reach-1 | 12 | Spring | 22.00 | 56.75 | 59.88 | | 59.88 | 0.000008 | 0.28 | 79.18 | 34.59 | 0.03 |
| Reach-1 | 12 | Mean Annual | 80.00 | 56.75 | 60.66 | | 60.67 | 0.000049 | 0.73 | 109.85 | 44.06 | 0.08 |
| Reach-1 | 12 | 10-year | 116.00 | 56.75 | 61.01 | | 61.03 | 0.000072 | 0.92 | 126.14 | 48.00 | 0.10 |
| Reach-1 | 12 | 25-year | 126.00 | 56.75 | 61.10 | | 61.11 | 0.000078 | 0.97 | 130.28 | 48.94 | 0.10 |
| Reach-1 | 12 | 50-year | 138.00 | 56.75 | 61.20 | | 61.22 | 0.000085 | 1.02 | 135.35 | 50.07 | 0.11 |
| Reach-1 | 12 | 100-year | 155.00 | 56.75 | 61.34 | | 61.36 | 0.000095 | 1.09 | 142.38 | 51.59 | 0.12 |
| | | | | | | | | | | | | |
| Reach-1 | 11 | August | 8.00 | 56.60 | 59.57 | | 59.57 | 0.000003 | 0.16 | 49.70 | 22.12 | 0.02 |
| Reach-1 | 11 | Spring - meas. | 14.60 | 56.60 | 59.73 | | 59.73 | 0.000007 | 0.27 | 53.38 | 22.71 | 0.03 |
| Reach-1 | 11 | Spring | 22.00 | 56.60 | 59.88 | | 59.88 | 0.000015 | 0.39 | 56.83 | 23.66 | 0.04 |
| Reach-1 | 11 | Mean Annual | 80.00 | 56.60 | 60.65 | | 60.67 | 0.000111 | 1.00 | 79.71 | 37.17 | 0.12 |
| Reach-1 | 11 | 10-year | 116.00 | 56.60 | 61.00 | | 61.03 | 0.000164 | 1.24 | 93.75 | 43.07 | 0.15 |
| Reach-1 | 11 | 25-year | 126.00 | 56.60 | 61.09 | | 61.11 | 0.000177 | 1.29 | 97.44 | 44.47 | 0.15 |
| Reach-1 | 11 | 50-year | 138.00 | 56.60 | 61.19 | | 61.22 | 0.000192 | 1.35 | 102.03 | 46.17 | 0.16 |
| Reach-1 | 11 | 100-year | 155.00 | 56.60 | 61.32 | | 61.36 | 0.000207 | 1.43 | 108.51 | 48.45 | 0.17 |
| | | | | | | | | | | | | |
| Reach-1 | 10 | August | 8.00 | 59.20 | 59.45 | 59.44 | 59.56 | 0.037122 | 2.62 | 3.06 | 13.78 | 0.98 |
| Reach-1 | 10 | Spring - meas. | 14.60 | 59.20 | 59.60 | 59.56 | 59.72 | 0.024079 | 2.78 | 5.25 | 15.59 | 0.84 |
| Reach-1 | 10 | Spring | 22.00 | 59.20 | 59.73 | | 59.87 | 0.019446 | 2.95 | 7.46 | 17.22 | 0.79 |
| Reach-1 | 10 | Mean Annual | 80.00 | 59.20 | 60.46 | | 60.65 | 0.010432 | 3.50 | 22.86 | 25.52 | 0.65 |
| Reach-1 | 10 | 10-year | 116.00 | 59.20 | 60.83 | | 61.01 | 0.008924 | 3.38 | 34.33 | 35.89 | 0.61 |
| Reach-1 | 10 | 25-year | 126.00 | 59.20 | 60.92 | | 61.09 | 0.008403 | 3.34 | 37.68 | 38.25 | 0.59 |
| Reach-1 | 10 | 50-year | 138.00 | 59.20 | 61.03 | | 61.20 | 0.007682 | 3.28 | 42.10 | 41.15 | 0.57 |
| Reach-1 | 10 | 100-year | 155.00 | 59.20 | 61.18 | | 61.34 | 0.006802 | 3.19 | 48.55 | 45.05 | 0.54 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 9 | August | 8.00 | 58.50 | 58.95 | | 59.00 | 0.009214 | 1.87 | 4.28 | 11.12 | 0.53 |
| Reach-1 | 9 | Spring - meas. | 14.60 | 58.50 | 59.09 | | 59.18 | 0.011411 | 2.46 | 5.93 | 11.91 | 0.62 |
| Reach-1 | 9 | Spring | 22.00 | 58.50 | 59.21 | | 59.35 | 0.013061 | 2.95 | 7.45 | 12.60 | 0.68 |
| Reach-1 | 9 | Mean Annual | 80.00 | 58.50 | 59.91 | | 60.23 | 0.014469 | 4.57 | 17.51 | 16.44 | 0.78 |
| Reach-1 | 9 | 10-year | 116.00 | 58.50 | 60.26 | | 60.63 | 0.013060 | 4.90 | 23.66 | 18.44 | 0.76 |
| Reach-1 | 9 | 25-year | 126.00 | 58.50 | 60.35 | | 60.73 | 0.012750 | 4.97 | 25.34 | 18.99 | 0.76 |
| Reach-1 | 9 | 50-year | 138.00 | 58.50 | 60.50 | | 60.87 | 0.011479 | 4.88 | 28.25 | 20.09 | 0.73 |
| Reach-1 | 9 | 100-year | 155.00 | 58.50 | 60.64 | | 61.02 | 0.012336 | 4.97 | 31.17 | 22.84 | 0.75 |
| | | | | | | | | | | | | |
| Reach-1 | 8 | August | 8.00 | 58.47 | 58.84 | | 58.89 | 0.004820 | 1.87 | 4.28 | 13.98 | 0.59 |
| Reach-1 | 8 | Spring - meas. | 14.60 | 58.47 | 58.98 | | 59.06 | 0.004810 | 2.29 | 6.37 | 15.24 | 0.62 |
| Reach-1 | 8 | Spring | 22.00 | 58.47 | 59.11 | | 59.22 | 0.004591 | 2.59 | 8.50 | 16.31 | 0.63 |
| Reach-1 | 8 | Mean Annual | 80.00 | 58.47 | 59.92 | | 60.09 | 0.002882 | 3.32 | 24.13 | 22.33 | 0.56 |
| Reach-1 | 8 | 10-year | 116.00 | 58.47 | 60.31 | | 60.50 | 0.002427 | 3.48 | 33.34 | 25.16 | 0.53 |
| Reach-1 | 8 | 25-year | 126.00 | 58.47 | 60.41 | | 60.60 | 0.002344 | 3.52 | 35.81 | 25.86 | 0.53 |
| Reach-1 | 8 | 50-year | 138.00 | 58.47 | 60.53 | | 60.72 | 0.003133 | 3.50 | 39.46 | 35.94 | 0.59 |
| Reach-1 | 8 | 100-year | 155.00 | 58.47 | 60.69 | | 60.87 | 0.002694 | 3.42 | 45.32 | 38.14 | 0.55 |
| | | | | | | | | | | | | |
| Reach-1 | 7 | August | 8.00 | 58.33 | 58.66 | | 58.73 | 0.005853 | 1.97 | 4.05 | 14.07 | 0.65 |
| Reach-1 | 7 | Spring - meas. | 14.60 | 58.33 | 58.83 | | 58.91 | 0.004604 | 2.25 | 6.49 | 15.43 | 0.61 |
| Reach-1 | 7 | Spring | 22.00 | 58.33 | 58.99 | | 59.08 | 0.003813 | 2.42 | 9.09 | 16.81 | 0.58 |
| Reach-1 | 7 | Mean Annual | 80.00 | 58.33 | 59.87 | | 60.00 | 0.002181 | 2.92 | 27.41 | 24.99 | 0.49 |
| Reach-1 | 7 | 10-year | 116.00 | 58.33 | 60.27 | | 60.42 | 0.001822 | 3.02 | 38.35 | 28.94 | 0.46 |
| Reach-1 | 7 | 25-year | 126.00 | 58.33 | 60.38 | | 60.52 | 0.001744 | 3.05 | 41.35 | 29.84 | 0.46 |
| Reach-1 | 7 | 50-year | 138.00 | 58.33 | 60.49 | | 60.64 | 0.001721 | 3.07 | 44.91 | 31.67 | 0.45 |
| Reach-1 | 7 | 100-year | 155.00 | 58.33 | 60.65 | | 60.80 | 0.001688 | 3.10 | 50.07 | 34.43 | 0.45 |
| | | | | | | | | | | | | |
| Reach-1 | 6 | August | 8.00 | 58.25 | 58.62 | | 58.65 | 0.002326 | 1.35 | 5.91 | 18.08 | 0.42 |
| Reach-1 | 6 | Spring - meas. | 14.60 | 58.25 | 58.81 | | 58.85 | 0.001844 | 1.56 | 9.38 | 19.54 | 0.40 |
| Reach-1 | 6 | Spring | 22.00 | 58.25 | 58.98 | | 59.03 | 0.001604 | 1.71 | 12.86 | 20.90 | 0.38 |
| Reach-1 | 6 | Mean Annual | 80.00 | 58.25 | 59.88 | | 59.96 | 0.001129 | 2.32 | 34.53 | 27.16 | 0.36 |
| Reach-1 | 6 | 10-year | 116.00 | 58.25 | 60.28 | | 60.38 | 0.001029 | 2.52 | 46.05 | 29.68 | 0.36 |
| Reach-1 | 6 | 25-year | 126.00 | 58.25 | 60.38 | | 60.48 | 0.001005 | 2.57 | 49.10 | 30.19 | 0.35 |
| Reach-1 | 6 | 50-year | 138.00 | 58.25 | 60.50 | | 60.60 | 0.000984 | 2.62 | 52.60 | 30.73 | 0.35 |
| Reach-1 | 6 | 100-year | 155.00 | 58.25 | 60.65 | | 60.76 | 0.000958 | 2.70 | 57.37 | 31.35 | 0.35 |
| | | | | | | | | | | | | |
| Reach-1 | 5 | August | 8.00 | 58.16 | 58.57 | | 58.60 | 0.002036 | 1.42 | 5.65 | 14.38 | 0.40 |
| Reach-1 | 5 | Spring - meas. | 14.60 | 58.16 | 58.75 | | 58.80 | 0.001969 | 1.76 | 8.30 | 14.71 | 0.41 |
| Reach-1 | 5 | Spring | 22.00 | 58.16 | 58.92 | | 58.98 | 0.001963 | 2.05 | 10.75 | 15.02 | 0.43 |
| Reach-1 | 5 | Mean Annual | 80.00 | 58.16 | 59.74 | | 59.91 | 0.002235 | 3.38 | 23.65 | 16.52 | 0.50 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 5 | 10-year | 116.00 | 58.16 | 60.09 | | 60.33 | 0.002377 | 3.91 | 29.68 | 17.26 | 0.53 |
| Reach-1 | 5 | 25-year | 126.00 | 58.16 | 60.18 | | 60.43 | 0.002420 | 4.04 | 31.22 | 17.49 | 0.53 |
| Reach-1 | 5 | 50-year | 138.00 | 58.16 | 60.28 | | 60.55 | 0.002461 | 4.19 | 32.95 | 17.55 | 0.54 |
| Reach-1 | 5 | 100-year | 155.00 | 58.16 | 60.41 | | 60.71 | 0.002529 | 4.40 | 35.25 | 17.63 | 0.55 |
| | | | | | | | | | | | | |
| Reach-1 | 4 | August | 8.00 | 58.02 | 58.53 | | 58.56 | 0.001909 | 1.38 | 5.78 | 14.72 | 0.39 |
| Reach-1 | 4 | Spring - meas. | 14.60 | 58.02 | 58.72 | | 58.76 | 0.001839 | 1.71 | 8.56 | 15.35 | 0.40 |
| Reach-1 | 4 | Spring | 22.00 | 58.02 | 58.88 | | 58.94 | 0.001823 | 1.97 | 11.15 | 15.92 | 0.42 |
| Reach-1 | 4 | Mean Annual | 80.00 | 58.02 | 59.71 | | 59.86 | 0.002032 | 3.11 | 25.69 | 19.74 | 0.48 |
| Reach-1 | 4 | 10-year | 116.00 | 58.02 | 60.09 | | 60.27 | 0.002050 | 3.46 | 33.50 | 22.06 | 0.50 |
| Reach-1 | 4 | 25-year | 126.00 | 58.02 | 60.18 | | 60.38 | 0.002006 | 3.54 | 35.58 | 22.20 | 0.49 |
| Reach-1 | 4 | 50-year | 138.00 | 58.02 | 60.29 | | 60.49 | 0.001977 | 3.64 | 37.91 | 22.35 | 0.49 |
| Reach-1 | 4 | 100-year | 155.00 | 58.02 | 60.42 | | 60.65 | 0.001947 | 3.78 | 41.02 | 22.54 | 0.49 |
| | | | | | | | | | | | | |
| Reach-1 | 3 | August | 8.00 | 58.10 | 58.50 | | 58.55 | 0.002911 | 1.62 | 4.95 | 13.69 | 0.47 |
| Reach-1 | 3 | Spring - meas. | 14.60 | 58.10 | 58.69 | | 58.75 | 0.002639 | 1.92 | 7.59 | 15.04 | 0.48 |
| Reach-1 | 3 | Spring | 22.00 | 58.10 | 58.86 | | 58.93 | 0.002482 | 2.15 | 10.22 | 16.27 | 0.48 |
| Reach-1 | 3 | Mean Annual | 80.00 | 58.10 | 59.71 | | 59.84 | 0.002109 | 2.97 | 26.97 | 23.40 | 0.49 |
| Reach-1 | 3 | 10-year | 116.00 | 58.10 | 60.09 | | 60.25 | 0.001991 | 3.16 | 36.67 | 27.60 | 0.48 |
| Reach-1 | 3 | 25-year | 126.00 | 58.10 | 60.19 | | 60.35 | 0.001873 | 3.20 | 39.37 | 27.70 | 0.47 |
| Reach-1 | 3 | 50-year | 138.00 | 58.10 | 60.30 | | 60.46 | 0.001770 | 3.25 | 42.45 | 27.82 | 0.46 |
| Reach-1 | 3 | 100-year | 155.00 | 58.10 | 60.44 | | 60.62 | 0.001661 | 3.34 | 46.47 | 27.98 | 0.46 |
| | | | | | | | | | | | | |
| Reach-1 | 2 | August | 8.00 | 57.90 | 58.38 | | 58.42 | 0.002278 | 1.57 | 5.09 | 12.21 | 0.43 |
| Reach-1 | 2 | Spring - meas. | 14.60 | 57.90 | 58.56 | | 58.62 | 0.002462 | 1.97 | 7.40 | 13.31 | 0.47 |
| Reach-1 | 2 | Spring | 22.00 | 57.90 | 58.72 | | 58.80 | 0.002545 | 2.28 | 9.65 | 14.31 | 0.49 |
| Reach-1 | 2 | Mean Annual | 80.00 | 57.90 | 59.54 | | 59.72 | 0.002660 | 3.44 | 23.29 | 19.10 | 0.55 |
| Reach-1 | 2 | 10-year | 116.00 | 57.90 | 59.91 | | 60.13 | 0.002591 | 3.78 | 30.72 | 21.39 | 0.56 |
| Reach-1 | 2 | 25-year | 126.00 | 57.90 | 60.00 | | 60.23 | 0.002555 | 3.84 | 32.83 | 22.06 | 0.55 |
| Reach-1 | 2 | 50-year | 138.00 | 57.90 | 60.11 | | 60.35 | 0.002499 | 3.91 | 35.33 | 22.72 | 0.55 |
| Reach-1 | 2 | 100-year | 155.00 | 57.90 | 60.26 | | 60.51 | 0.002336 | 4.01 | 38.74 | 23.61 | 0.54 |
| | | | | | | | | | | | | |
| Reach-1 | 1 | August | 8.00 | 57.80 | 58.10 | 58.10 | 58.23 | 0.014194 | 2.95 | 2.71 | 9.95 | 1.00 |
| Reach-1 | 1 | Spring - meas. | 14.60 | 57.80 | 58.23 | 58.23 | 58.43 | 0.012873 | 3.54 | 4.12 | 10.66 | 1.00 |
| Reach-1 | 1 | Spring | 22.00 | 57.80 | 58.36 | 58.36 | 58.61 | 0.011978 | 3.98 | 5.52 | 11.32 | 1.01 |
| Reach-1 | 1 | Mean Annual | 80.00 | 57.80 | 59.03 | 59.03 | 59.52 | 0.009728 | 5.61 | 14.27 | 14.80 | 1.01 |
| Reach-1 | 1 | 10-year | 116.00 | 57.80 | 59.31 | 59.31 | 59.93 | 0.008793 | 6.31 | 18.57 | 16.24 | 1.00 |
| Reach-1 | 1 | 25-year | 126.00 | 57.80 | 59.38 | 59.38 | 60.03 | 0.008637 | 6.48 | 19.71 | 16.60 | 1.00 |
| Reach-1 | 1 | 50-year | 138.00 | 57.80 | 59.46 | 59.46 | 60.15 | 0.008427 | 6.67 | 21.11 | 17.03 | 1.00 |
| Reach-1 | 1 | 100-year | 155.00 | 57.80 | 59.58 | 59.58 | 60.32 | 0.008127 | 6.91 | 23.11 | 17.63 | 0.99 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| | | | | | | | | | | | | |
| Reach-1 | 0.8885 | August | 8.00 | 56.82 | 57.61 | 57.23 | 57.63 | 0.001733 | 1.04 | 7.70 | 13.75 | 0.24 |
| Reach-1 | 0.8885 | Spring - meas. | 14.60 | 56.82 | 57.79 | 57.36 | 57.82 | 0.002403 | 1.43 | 10.25 | 14.46 | 0.30 |
| Reach-1 | 0.8885 | Spring | 22.00 | 56.82 | 57.95 | 57.47 | 57.99 | 0.002960 | 1.75 | 12.54 | 15.07 | 0.34 |
| Reach-1 | 0.8885 | Mean Annual | 80.00 | 56.82 | 58.70 | 58.07 | 58.86 | 0.005056 | 3.24 | 24.71 | 17.45 | 0.48 |
| Reach-1 | 0.8885 | 10-year | 116.00 | 56.82 | 59.00 | 58.35 | 59.24 | 0.005576 | 3.87 | 30.20 | 18.82 | 0.52 |
| Reach-1 | 0.8885 | 25-year | 126.00 | 56.82 | 59.08 | 58.42 | 59.33 | 0.005690 | 4.02 | 31.65 | 19.12 | 0.53 |
| Reach-1 | 0.8885 | 50-year | 138.00 | 56.82 | 59.17 | 58.50 | 59.44 | 0.005813 | 4.19 | 33.35 | 19.47 | 0.54 |
| Reach-1 | 0.8885 | 100-year | 155.00 | 56.82 | 59.29 | 58.62 | 59.59 | 0.005965 | 4.43 | 35.69 | 19.66 | 0.55 |
| | | | | | | | | | | | | |
| Reach-1 | 0.882 | August | 8.00 | 57.00 | 57.47 | | 57.50 | 0.013510 | 1.38 | 5.81 | 17.36 | 0.42 |
| Reach-1 | 0.882 | Spring - meas. | 14.60 | 57.00 | 57.60 | | 57.65 | 0.014838 | 1.79 | 8.17 | 17.55 | 0.46 |
| Reach-1 | 0.882 | Spring | 22.00 | 57.00 | 57.72 | | 57.79 | 0.016339 | 2.15 | 10.22 | 17.72 | 0.50 |
| Reach-1 | 0.882 | Mean Annual | 80.00 | 57.00 | 58.31 | | 58.54 | 0.021979 | 3.82 | 20.95 | 18.56 | 0.63 |
| Reach-1 | 0.882 | 10-year | 116.00 | 57.00 | 58.56 | | 58.88 | 0.023980 | 4.55 | 25.55 | 18.91 | 0.68 |
| Reach-1 | 0.882 | 25-year | 126.00 | 57.00 | 58.62 | | 58.97 | 0.024398 | 4.73 | 26.73 | 19.00 | 0.69 |
| Reach-1 | 0.882 | 50-year | 138.00 | 57.00 | 58.69 | | 59.07 | 0.024856 | 4.93 | 28.10 | 19.10 | 0.71 |
| Reach-1 | 0.882 | 100-year | 155.00 | 57.00 | 58.79 | | 59.21 | 0.025451 | 5.20 | 29.96 | 19.24 | 0.72 |
| | | | | | | | | | | | | |
| Reach-1 | 0.875 | August | 8.00 | 56.20 | 56.71 | | 56.76 | 0.030416 | 1.75 | 4.58 | 17.78 | 0.61 |
| Reach-1 | 0.875 | Spring - meas. | 14.60 | 56.20 | 56.85 | 56.73 | 56.91 | 0.027425 | 2.01 | 7.27 | 21.06 | 0.60 |
| Reach-1 | 0.875 | Spring | 22.00 | 56.20 | 56.98 | 56.82 | 57.05 | 0.024014 | 2.15 | 10.23 | 24.16 | 0.58 |
| Reach-1 | 0.875 | Mean Annual | 80.00 | 56.20 | 57.52 | | 57.70 | 0.021442 | 3.40 | 23.55 | 25.05 | 0.62 |
| Reach-1 | 0.875 | 10-year | 116.00 | 56.20 | 57.74 | | 57.98 | 0.022530 | 4.00 | 29.03 | 25.23 | 0.65 |
| Reach-1 | 0.875 | 25-year | 126.00 | 56.20 | 57.79 | | 58.06 | 0.022764 | 4.15 | 30.42 | 25.28 | 0.66 |
| Reach-1 | 0.875 | 50-year | 138.00 | 56.20 | 57.85 | | 58.14 | 0.023073 | 4.32 | 32.01 | 25.33 | 0.67 |
| Reach-1 | 0.875 | 100-year | 155.00 | 56.20 | 57.94 | | 58.26 | 0.023494 | 4.55 | 34.16 | 25.41 | 0.69 |
| | | | | | | | | | | | | |
| Reach-1 | 0.866 | August | 8.00 | 55.00 | 55.52 | | 55.55 | 0.011600 | 1.28 | 6.23 | 14.77 | 0.35 |
| Reach-1 | 0.866 | Spring - meas. | 14.60 | 55.00 | 55.73 | | 55.77 | 0.011365 | 1.53 | 9.54 | 17.05 | 0.36 |
| Reach-1 | 0.866 | Spring | 22.00 | 55.00 | 55.90 | | 55.95 | 0.011645 | 1.74 | 12.64 | 18.95 | 0.38 |
| Reach-1 | 0.866 | Mean Annual | 80.00 | 55.00 | 56.60 | | 56.67 | 0.010615 | 2.14 | 37.40 | 46.28 | 0.42 |
| Reach-1 | 0.866 | 10-year | 116.00 | 55.00 | 56.85 | | 56.94 | 0.010451 | 2.37 | 49.27 | 48.48 | 0.40 |
| Reach-1 | 0.866 | 25-year | 126.00 | 55.00 | 56.91 | | 57.01 | 0.010356 | 2.42 | 52.41 | 49.04 | 0.40 |
| Reach-1 | 0.866 | 50-year | 138.00 | 55.00 | 56.99 | | 57.08 | 0.010247 | 2.48 | 56.09 | 49.69 | 0.40 |
| Reach-1 | 0.866 | 100-year | 155.00 | 55.00 | 57.09 | | 57.19 | 0.010163 | 2.57 | 61.01 | 50.55 | 0.40 |
| | | | | | | | | | | | | |
| Reach-1 | 0.859 | August | 8.00 | 54.10 | 54.80 | | 54.86 | 0.025477 | 1.96 | 4.09 | 11.68 | 0.58 |
| Reach-1 | 0.859 | Spring - meas. | 14.60 | 54.10 | 54.96 | | 55.05 | 0.028185 | 2.36 | 6.19 | 14.36 | 0.63 |
| Reach-1 | 0.859 | Spring | 22.00 | 54.10 | 55.11 | | 55.22 | 0.029501 | 2.57 | 8.55 | 16.97 | 0.64 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 0.859 | Mean Annual | 80.00 | 54.10 | 55.75 | | 55.94 | 0.031868 | 3.49 | 23.02 | 28.18 | 0.66 |
| Reach-1 | 0.859 | 10-year | 116.00 | 54.10 | 55.97 | | 56.22 | 0.031715 | 4.03 | 29.46 | 31.94 | 0.68 |
| Reach-1 | 0.859 | 25-year | 126.00 | 54.10 | 56.02 | | 56.29 | 0.031761 | 4.16 | 31.18 | 33.25 | 0.69 |
| Reach-1 | 0.859 | 50-year | 138.00 | 54.10 | 56.08 | | 56.37 | 0.032150 | 4.33 | 33.14 | 35.31 | 0.70 |
| Reach-1 | 0.859 | 100-year | 155.00 | 54.10 | 56.16 | | 56.47 | 0.032059 | 4.52 | 36.17 | 38.29 | 0.70 |
| | | | | | | | | | | | | |
| Reach-1 | 0.853 | August | 8.00 | 53.40 | 54.05 | | 54.09 | 0.021594 | 1.51 | 5.29 | 15.62 | 0.46 |
| Reach-1 | 0.853 | Spring - meas. | 14.60 | 53.40 | 54.23 | | 54.28 | 0.018976 | 1.75 | 8.32 | 17.80 | 0.45 |
| Reach-1 | 0.853 | Spring | 22.00 | 53.40 | 54.39 | | 54.45 | 0.018293 | 1.96 | 11.20 | 19.64 | 0.46 |
| Reach-1 | 0.853 | Mean Annual | 80.00 | 53.40 | 55.01 | | 55.13 | 0.018813 | 2.82 | 28.41 | 36.08 | 0.56 |
| Reach-1 | 0.853 | 10-year | 116.00 | 53.40 | 55.23 | | 55.39 | 0.019305 | 3.17 | 36.89 | 39.36 | 0.56 |
| Reach-1 | 0.853 | 25-year | 126.00 | 53.40 | 55.29 | | 55.45 | 0.019383 | 3.26 | 39.12 | 40.17 | 0.56 |
| Reach-1 | 0.853 | 50-year | 138.00 | 53.40 | 55.35 | | 55.53 | 0.019464 | 3.36 | 41.72 | 41.10 | 0.56 |
| Reach-1 | 0.853 | 100-year | 155.00 | 53.40 | 55.44 | | 55.63 | 0.019561 | 3.50 | 45.31 | 42.36 | 0.56 |
| | | | | | | | | | | | | |
| Reach-1 | 0.845 | August | 8.00 | 52.50 | 53.19 | | 53.25 | 0.022591 | 1.95 | 4.10 | 12.20 | 0.59 |
| Reach-1 | 0.845 | Spring - meas. | 14.60 | 52.50 | 53.34 | | 53.43 | 0.026703 | 2.39 | 6.12 | 15.07 | 0.66 |
| Reach-1 | 0.845 | Spring | 22.00 | 52.50 | 53.47 | | 53.58 | 0.028860 | 2.68 | 8.20 | 17.56 | 0.69 |
| Reach-1 | 0.845 | Mean Annual | 80.00 | 52.50 | 54.14 | | 54.30 | 0.024922 | 3.30 | 24.28 | 30.58 | 0.64 |
| Reach-1 | 0.845 | 10-year | 116.00 | 52.50 | 54.40 | | 54.60 | 0.022242 | 3.61 | 32.88 | 35.67 | 0.61 |
| Reach-1 | 0.845 | 25-year | 126.00 | 52.50 | 54.46 | | 54.67 | 0.021666 | 3.68 | 35.27 | 36.95 | 0.61 |
| Reach-1 | 0.845 | 50-year | 138.00 | 52.50 | 54.54 | | 54.75 | 0.021037 | 3.76 | 38.13 | 38.44 | 0.60 |
| Reach-1 | 0.845 | 100-year | 155.00 | 52.50 | 54.64 | | 54.87 | 0.020238 | 3.86 | 42.19 | 40.46 | 0.59 |
| | | | | | | | | | | | | |
| Reach-1 | 0.841 | August | 8.00 | 52.50 | 52.85 | 52.70 | 52.88 | 0.018708 | 1.32 | 6.08 | 19.84 | 0.42 |
| Reach-1 | 0.841 | Spring - meas. | 14.60 | 52.50 | 53.02 | | 53.05 | 0.015408 | 1.51 | 9.64 | 22.04 | 0.40 |
| Reach-1 | 0.841 | Spring | 22.00 | 52.50 | 53.16 | | 53.20 | 0.014358 | 1.72 | 12.78 | 22.82 | 0.41 |
| Reach-1 | 0.841 | Mean Annual | 80.00 | 52.50 | 53.85 | | 53.96 | 0.014040 | 2.69 | 29.76 | 26.64 | 0.45 |
| Reach-1 | 0.841 | 10-year | 116.00 | 52.50 | 54.10 | | 54.26 | 0.014701 | 3.16 | 36.88 | 28.28 | 0.47 |
| Reach-1 | 0.841 | 25-year | 126.00 | 52.50 | 54.17 | | 54.34 | 0.014836 | 3.27 | 38.74 | 28.76 | 0.48 |
| Reach-1 | 0.841 | 50-year | 138.00 | 52.50 | 54.25 | | 54.42 | 0.014990 | 3.40 | 40.93 | 29.32 | 0.49 |
| Reach-1 | 0.841 | 100-year | 155.00 | 52.50 | 54.35 | | 54.54 | 0.015192 | 3.58 | 43.92 | 30.07 | 0.49 |
| | | | | | | | | | | | | |
| Reach-1 | 0.833 | August | 8.00 | 51.50 | 52.25 | 52.00 | 52.28 | 0.013619 | 1.34 | 5.98 | 14.98 | 0.37 |
| Reach-1 | 0.833 | Spring - meas. | 14.60 | 51.50 | 52.43 | 52.14 | 52.47 | 0.014861 | 1.63 | 8.98 | 17.90 | 0.40 |
| Reach-1 | 0.833 | Spring | 22.00 | 51.50 | 52.59 | 52.25 | 52.64 | 0.015185 | 1.83 | 12.04 | 20.45 | 0.42 |
| Reach-1 | 0.833 | Mean Annual | 80.00 | 51.50 | 53.25 | 52.80 | 53.37 | 0.016414 | 2.78 | 28.80 | 28.41 | 0.49 |
| Reach-1 | 0.833 | 10-year | 116.00 | 51.50 | 53.49 | 53.02 | 53.66 | 0.017136 | 3.26 | 35.65 | 29.72 | 0.51 |
| Reach-1 | 0.833 | 25-year | 126.00 | 51.50 | 53.55 | 53.08 | 53.73 | 0.017126 | 3.37 | 37.53 | 30.07 | 0.52 |
| Reach-1 | 0.833 | 50-year | 138.00 | 51.50 | 53.62 | 53.12 | 53.81 | 0.017213 | 3.50 | 39.66 | 30.46 | 0.52 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

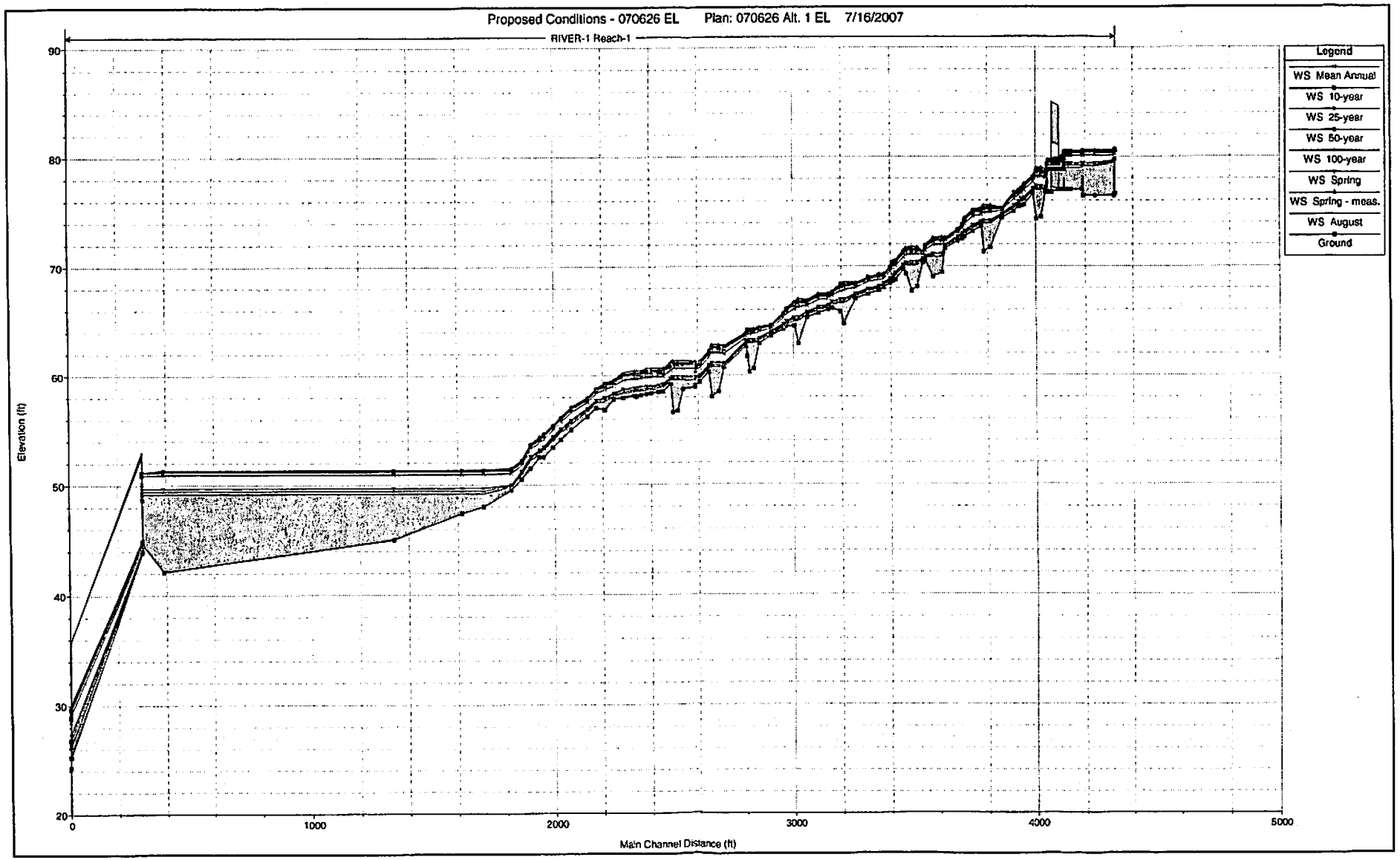
| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 0.833 | 100-year | 155.00 | 51.50 | 53.71 | 53.20 | 53.92 | 0.017485 | 3.68 | 42.44 | 30.96 | 0.53 |
| | | | | | | | | | | | | |
| Reach-1 | 0.827 | August | 8.00 | 50.50 | 50.99 | 50.99 | 51.11 | 0.117773 | 2.83 | 2.83 | 11.65 | 1.01 |
| Reach-1 | 0.827 | Spring - meas. | 14.60 | 50.50 | 51.12 | 51.12 | 51.28 | 0.103185 | 3.27 | 4.47 | 13.39 | 1.00 |
| Reach-1 | 0.827 | Spring | 22.00 | 50.50 | 51.22 | 51.22 | 51.43 | 0.099811 | 3.67 | 5.99 | 14.69 | 1.01 |
| Reach-1 | 0.827 | Mean Annual | 80.00 | 50.50 | 51.78 | 51.78 | 52.17 | 0.081770 | 4.98 | 16.08 | 21.40 | 1.01 |
| Reach-1 | 0.827 | 10-year | 116.00 | 50.50 | 52.02 | 52.02 | 52.48 | 0.067487 | 5.43 | 21.54 | 24.14 | 0.96 |
| Reach-1 | 0.827 | 25-year | 126.00 | 50.50 | 52.07 | 52.07 | 52.55 | 0.066472 | 5.58 | 22.82 | 24.46 | 0.96 |
| Reach-1 | 0.827 | 50-year | 138.00 | 50.50 | 52.14 | 52.14 | 52.64 | 0.064693 | 5.73 | 24.39 | 24.85 | 0.96 |
| Reach-1 | 0.827 | 100-year | 155.00 | 50.50 | 52.23 | 52.23 | 52.76 | 0.062266 | 5.91 | 26.59 | 25.38 | 0.95 |
| | | | | | | | | | | | | |
| Reach-1 | 0.818 | August | 8.00 | 49.50 | 49.83 | 49.84 | 49.94 | 0.012165 | 2.57 | 3.16 | 18.55 | 1.08 |
| Reach-1 | 0.818 | Spring - meas. | 14.60 | 49.50 | 49.91 | 49.94 | 50.06 | 0.013396 | 3.12 | 4.81 | 22.73 | 1.18 |
| Reach-1 | 0.818 | Spring | 22.00 | 49.50 | 49.98 | 50.02 | 50.17 | 0.014237 | 3.55 | 6.42 | 26.18 | 1.24 |
| Reach-1 | 0.818 | Mean Annual | 80.00 | 49.50 | 51.04 | 50.40 | 51.12 | 0.000723 | 2.25 | 41.72 | 38.76 | 0.36 |
| Reach-1 | 0.818 | 10-year | 116.00 | 49.50 | 51.32 | 50.59 | 51.42 | 0.000775 | 2.66 | 52.63 | 41.50 | 0.38 |
| Reach-1 | 0.818 | 25-year | 126.00 | 49.50 | 51.37 | 50.64 | 51.49 | 0.000820 | 2.80 | 54.79 | 43.00 | 0.39 |
| Reach-1 | 0.818 | 50-year | 138.00 | 49.50 | 51.43 | 50.69 | 51.56 | 0.000869 | 2.95 | 57.37 | 44.03 | 0.41 |
| Reach-1 | 0.818 | 100-year | 155.00 | 49.50 | 51.50 | 50.77 | 51.65 | 0.000938 | 3.16 | 60.67 | 44.31 | 0.43 |
| | | | | | | | | | | | | |
| Reach-1 | 0.798 | August | 8.00 | 48.00 | 49.20 | 48.42 | 49.21 | 0.000702 | 0.65 | 12.35 | 16.30 | 0.13 |
| Reach-1 | 0.798 | Spring - meas. | 14.60 | 48.00 | 49.46 | 48.58 | 49.47 | 0.000997 | 0.86 | 16.89 | 18.80 | 0.16 |
| Reach-1 | 0.798 | Spring | 22.00 | 48.00 | 49.70 | 48.71 | 49.72 | 0.001088 | 1.02 | 21.67 | 20.14 | 0.17 |
| Reach-1 | 0.798 | Mean Annual | 80.00 | 48.00 | 50.97 | | 51.00 | 0.001205 | 1.59 | 50.40 | 25.44 | 0.20 |
| Reach-1 | 0.798 | 10-year | 116.00 | 48.00 | 51.22 | | 51.29 | 0.001691 | 2.04 | 57.03 | 26.52 | 0.24 |
| Reach-1 | 0.798 | 25-year | 126.00 | 48.00 | 51.26 | | 51.34 | 0.001872 | 2.17 | 58.17 | 26.70 | 0.25 |
| Reach-1 | 0.798 | 50-year | 138.00 | 48.00 | 51.31 | | 51.40 | 0.002090 | 2.33 | 59.50 | 26.91 | 0.27 |
| Reach-1 | 0.798 | 100-year | 155.00 | 48.00 | 51.37 | | 51.47 | 0.002421 | 2.55 | 61.12 | 27.16 | 0.29 |
| | | | | | | | | | | | | |
| Reach-1 | 0.782 | August | 8.00 | 47.40 | 49.20 | | 49.20 | 0.000033 | 0.19 | 43.05 | 37.36 | 0.03 |
| Reach-1 | 0.782 | Spring - meas. | 14.60 | 47.40 | 49.45 | | 49.46 | 0.000060 | 0.28 | 52.99 | 40.13 | 0.04 |
| Reach-1 | 0.782 | Spring | 22.00 | 47.40 | 49.70 | | 49.70 | 0.000082 | 0.35 | 62.97 | 41.99 | 0.05 |
| Reach-1 | 0.782 | Mean Annual | 80.00 | 47.40 | 50.96 | | 50.97 | 0.000154 | 0.67 | 120.09 | 48.55 | 0.07 |
| Reach-1 | 0.782 | 10-year | 116.00 | 47.40 | 51.21 | | 51.23 | 0.000233 | 0.88 | 132.64 | 49.87 | 0.09 |
| Reach-1 | 0.782 | 25-year | 126.00 | 47.40 | 51.26 | | 51.27 | 0.000261 | 0.94 | 134.77 | 50.09 | 0.10 |
| Reach-1 | 0.782 | 50-year | 138.00 | 47.40 | 51.31 | | 51.32 | 0.000295 | 1.01 | 137.26 | 50.35 | 0.11 |
| Reach-1 | 0.782 | 100-year | 155.00 | 47.40 | 51.37 | | 51.39 | 0.000347 | 1.11 | 140.29 | 50.66 | 0.12 |
| | | | | | | | | | | | | |
| Reach-1 | 0.729 | August | 8.00 | 45.00 | 49.20 | | 49.20 | 0.000000 | 0.04 | 201.03 | 74.16 | 0.00 |
| Reach-1 | 0.729 | Spring - meas. | 14.60 | 45.00 | 49.45 | | 49.45 | 0.000001 | 0.07 | 220.12 | 75.06 | 0.01 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 0.729 | Spring | 22.00 | 45.00 | 49.70 | | 49.70 | 0.000002 | 0.09 | 238.41 | 75.90 | 0.01 |
| Reach-1 | 0.729 | Mean Annual | 80.00 | 45.00 | 50.96 | | 50.96 | 0.000010 | 0.24 | 338.87 | 86.67 | 0.02 |
| Reach-1 | 0.729 | 10-year | 116.00 | 45.00 | 51.21 | | 51.21 | 0.000017 | 0.32 | 361.24 | 90.01 | 0.03 |
| Reach-1 | 0.729 | 25-year | 126.00 | 45.00 | 51.25 | | 51.25 | 0.000019 | 0.35 | 365.04 | 90.57 | 0.03 |
| Reach-1 | 0.729 | 50-year | 138.00 | 45.00 | 51.30 | | 51.30 | 0.000022 | 0.38 | 369.47 | 91.21 | 0.03 |
| Reach-1 | 0.729 | 100-year | 155.00 | 45.00 | 51.36 | | 51.36 | 0.000027 | 0.42 | 374.86 | 91.99 | 0.03 |
| | | | | | | | | | | | | |
| Reach-1 | 0.549 | August | 8.00 | 42.10 | 49.20 | | 49.20 | 0.000000 | 0.01 | 724.15 | 178.41 | 0.00 |
| Reach-1 | 0.549 | Spring - meas. | 14.60 | 42.10 | 49.45 | | 49.45 | 0.000000 | 0.02 | 769.91 | 179.30 | 0.00 |
| Reach-1 | 0.549 | Spring | 22.00 | 42.10 | 49.70 | | 49.70 | 0.000000 | 0.03 | 813.42 | 180.14 | 0.00 |
| Reach-1 | 0.549 | Mean Annual | 80.00 | 42.10 | 50.95 | | 50.96 | 0.000001 | 0.08 | 1042.94 | 184.53 | 0.01 |
| Reach-1 | 0.549 | 10-year | 116.00 | 42.10 | 51.21 | | 51.21 | 0.000001 | 0.11 | 1089.63 | 185.41 | 0.01 |
| Reach-1 | 0.549 | 25-year | 126.00 | 42.10 | 51.25 | | 51.25 | 0.000001 | 0.11 | 1097.39 | 185.55 | 0.01 |
| Reach-1 | 0.549 | 50-year | 138.00 | 42.10 | 51.30 | | 51.30 | 0.000002 | 0.12 | 1106.38 | 185.72 | 0.01 |
| Reach-1 | 0.549 | 100-year | 155.00 | 42.10 | 51.36 | | 51.36 | 0.000002 | 0.14 | 1117.21 | 185.92 | 0.01 |
| | | | | | | | | | | | | |
| Reach-1 | 0.5325 | August | 8.00 | 44.70 | 49.20 | | 49.20 | 0.000036 | 0.31 | 28.87 | 10.86 | 0.03 |
| Reach-1 | 0.5325 | Spring - meas. | 14.60 | 44.70 | 49.45 | | 49.45 | 0.000091 | 0.53 | 31.63 | 10.99 | 0.05 |
| Reach-1 | 0.5325 | Spring | 22.00 | 44.70 | 49.69 | | 49.70 | 0.000163 | 0.74 | 34.26 | 11.10 | 0.07 |
| Reach-1 | 0.5325 | Mean Annual | 80.00 | 44.70 | 50.89 | | 50.95 | 0.000828 | 2.03 | 49.72 | 30.71 | 0.17 |
| Reach-1 | 0.5325 | 10-year | 116.00 | 44.70 | 51.09 | | 51.20 | 0.001453 | 2.77 | 57.79 | 50.83 | 0.22 |
| Reach-1 | 0.5325 | 25-year | 126.00 | 44.70 | 51.11 | | 51.24 | 0.001674 | 2.98 | 58.98 | 53.16 | 0.24 |
| Reach-1 | 0.5325 | 50-year | 138.00 | 44.70 | 51.13 | | 51.28 | 0.001958 | 3.24 | 60.30 | 55.63 | 0.26 |
| Reach-1 | 0.5325 | 100-year | 155.00 | 44.70 | 51.15 | | 51.34 | 0.002419 | 3.61 | 61.38 | 57.58 | 0.29 |
| | | | | | | | | | | | | |
| Reach-1 | 0.532 | August | 8.00 | 48.68 | 48.99 | 48.99 | 49.15 | 0.053591 | 3.18 | 2.52 | 8.03 | 1.00 |
| Reach-1 | 0.532 | Spring - meas. | 14.60 | 48.68 | 49.15 | 49.15 | 49.38 | 0.047456 | 3.90 | 3.75 | 8.04 | 1.01 |
| Reach-1 | 0.532 | Spring | 22.00 | 48.68 | 49.30 | 49.30 | 49.61 | 0.042812 | 4.46 | 4.95 | 8.06 | 1.00 |
| Reach-1 | 0.532 | Mean Annual | 80.00 | 48.68 | 50.10 | 50.10 | 50.77 | 0.031603 | 6.68 | 13.03 | 10.33 | 0.99 |
| Reach-1 | 0.532 | 10-year | 116.00 | 48.68 | 50.86 | 50.86 | 51.14 | 0.009686 | 4.92 | 43.53 | 83.96 | 0.59 |
| Reach-1 | 0.532 | 25-year | 126.00 | 48.68 | 50.90 | 50.90 | 51.19 | 0.009884 | 5.03 | 47.05 | 85.35 | 0.59 |
| Reach-1 | 0.532 | 50-year | 138.00 | 48.68 | 50.94 | 50.94 | 51.24 | 0.010281 | 5.20 | 50.62 | 86.76 | 0.61 |
| Reach-1 | 0.532 | 100-year | 155.00 | 48.68 | 51.01 | 51.01 | 51.30 | 0.010405 | 5.33 | 56.39 | 89.01 | 0.62 |
| | | | | | | | | | | | | |
| Reach-1 | .5303 | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 0.478 | August | 8.00 | 25.25 | 25.90 | 25.90 | 26.22 | 0.060622 | 4.57 | 1.75 | 44.90 | 1.00 |
| Reach-1 | 0.478 | Spring - meas. | 14.60 | 25.25 | 26.21 | 26.21 | 26.70 | 0.060199 | 5.52 | 2.60 | 44.90 | 0.99 |
| Reach-1 | 0.478 | Spring | 22.00 | 25.25 | 26.52 | 26.52 | 27.17 | 0.060052 | 6.21 | 3.43 | 44.90 | 0.97 |
| Reach-1 | 0.478 | Mean Annual | 80.00 | 25.25 | 28.52 | 28.52 | 29.06 | 0.026182 | 4.75 | 15.15 | 53.75 | 0.76 |

HEC-RAS Plan: 070626 alt1 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 0.478 | 10-year | 116.00 | 25.25 | 28.82 | 28.82 | 29.52 | 0.028825 | 5.77 | 18.63 | 53.82 | 0.83 |
| Reach-1 | 0.478 | 25-year | 126.00 | 25.25 | 28.90 | 28.90 | 29.64 | 0.029127 | 6.01 | 19.57 | 53.84 | 0.84 |
| Reach-1 | 0.478 | 50-year | 138.00 | 25.25 | 28.99 | 28.99 | 29.78 | 0.029672 | 6.29 | 20.61 | 53.86 | 0.85 |
| Reach-1 | 0.478 | 100-year | 155.00 | 25.25 | 29.11 | 29.11 | 29.97 | 0.030250 | 6.65 | 22.04 | 53.89 | 0.87 |
| | | | | | | | | | | | | |
| Reach-1 | 0.477 | August | 8.00 | 24.30 | 25.97 | 24.54 | 25.97 | 0.000001 | 0.11 | 74.26 | 54.22 | 0.02 |
| Reach-1 | 0.477 | Spring - meas. | 14.60 | 24.30 | 26.29 | 24.63 | 26.29 | 0.000002 | 0.16 | 91.61 | 54.22 | 0.02 |
| Reach-1 | 0.477 | Spring | 22.00 | 24.30 | 26.48 | 24.70 | 26.48 | 0.000004 | 0.22 | 101.91 | 54.23 | 0.03 |
| Reach-1 | 0.477 | Mean Annual | 80.00 | 24.30 | 26.83 | 25.00 | 26.84 | 0.000029 | 0.66 | 120.89 | 54.23 | 0.08 |
| Reach-1 | 0.477 | 10-year | 116.00 | 24.30 | 26.83 | 25.12 | 26.84 | 0.000060 | 0.96 | 120.89 | 54.23 | 0.11 |
| Reach-1 | 0.477 | 25-year | 126.00 | 24.30 | 26.83 | 25.15 | 26.85 | 0.000071 | 1.04 | 120.89 | 54.23 | 0.12 |
| Reach-1 | 0.477 | 50-year | 138.00 | 24.30 | 26.83 | 25.18 | 26.85 | 0.000085 | 1.14 | 120.89 | 54.23 | 0.13 |
| Reach-1 | 0.477 | 100-year | 155.00 | 24.30 | 26.83 | 25.23 | 26.86 | 0.000107 | 1.28 | 120.89 | 54.23 | 0.15 |


Proposed Conditions - 070626 EL Plan: 070626 Alt. 1 EL 7/16/2007
RIVER-1 Reach-1
Elevation (ft)
90
80
70
60
50
40
30
20
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)
Legend
WS Mean Annual
WS 10-year
WS 25-year
WS 50-year
WS 100-year
WS Spring
WS Spring - meas.
WS August
Ground

# Appendix C
# Alternative 2
# HEC-RAS Output

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 279.40 | August | 8.00 | 76.62 | 79.56 | 77.34 | 79.56 | 0.000024 | 0.20 | 39.80 | 28.66 | 0.03 |
| Reach-1 | 279.40 | Spring - meas. | 14.60 | 76.62 | 79.68 | 77.53 | 79.69 | 0.000060 | 0.34 | 43.38 | 30.45 | 0.05 |
| Reach-1 | 279.40 | Spring | 22.00 | 76.62 | 79.79 | 77.70 | 79.79 | 0.000110 | 0.48 | 46.64 | 32.81 | 0.07 |
| Reach-1 | 279.40 | Mean Annual | 80.00 | 76.62 | 80.29 | 78.42 | 80.32 | 0.000574 | 1.30 | 65.92 | 42.05 | 0.16 |
| Reach-1 | 279.40 | 10-year | 116.00 | 76.62 | 80.52 | 78.72 | 80.56 | 0.000845 | 1.68 | 75.52 | 44.02 | 0.19 |
| Reach-1 | 279.40 | 25-year | 126.00 | 76.62 | 80.57 | 78.80 | 80.62 | 0.000916 | 1.78 | 77.98 | 44.51 | 0.20 |
| Reach-1 | 279.40 | 50-year | 138.00 | 76.62 | 80.64 | 78.87 | 80.69 | 0.000992 | 1.89 | 81.06 | 45.13 | 0.21 |
| Reach-1 | 279.40 | 100-year | 155.00 | 76.62 | 80.73 | 79.00 | 80.79 | 0.001104 | 2.04 | 85.00 | 45.92 | 0.22 |
| | | | | | | | | | | | | |
| Reach-1 | 278 | | Inl Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 274 | August | 8.00 | 76.43 | 79.11 | | 79.11 | 0.000013 | 0.16 | 48.60 | 43.80 | 0.03 |
| Reach-1 | 274 | Spring - meas. | 14.60 | 76.43 | 79.25 | | 79.26 | 0.000030 | 0.27 | 55.07 | 47.17 | 0.04 |
| Reach-1 | 274 | Spring | 22.00 | 76.43 | 79.41 | | 79.41 | 0.000045 | 0.36 | 62.67 | 50.85 | 0.05 |
| Reach-1 | 274 | Mean Annual | 80.00 | 76.43 | 80.12 | | 80.13 | 0.000145 | 0.84 | 105.64 | 68.39 | 0.10 |
| Reach-1 | 274 | 10-year | 116.00 | 76.43 | 80.36 | | 80.37 | 0.000208 | 1.08 | 122.20 | 71.20 | 0.12 |
| Reach-1 | 274 | 25-year | 126.00 | 76.43 | 80.41 | | 80.43 | 0.000227 | 1.14 | 125.99 | 71.82 | 0.13 |
| Reach-1 | 274 | 50-year | 138.00 | 76.43 | 80.50 | | 80.52 | 0.000239 | 1.20 | 132.22 | 72.84 | 0.13 |
| Reach-1 | 274 | 100-year | 155.00 | 76.43 | 80.59 | | 80.61 | 0.000265 | 1.29 | 138.91 | 74.19 | 0.14 |
| | | | | | | | | | | | | |
| Reach-1 | 194.21 | August | 8.00 | 76.43 | 79.11 | 77.08 | 79.11 | 0.000013 | 0.16 | 48.57 | 43.78 | 0.03 |
| Reach-1 | 194.21 | Spring - meas. | 14.60 | 76.43 | 79.25 | 77.25 | 79.25 | 0.000030 | 0.27 | 55.00 | 47.13 | 0.04 |
| Reach-1 | 194.21 | Spring | 22.00 | 76.43 | 79.41 | 77.40 | 79.41 | 0.000046 | 0.36 | 62.56 | 50.79 | 0.05 |
| Reach-1 | 194.21 | Mean Annual | 80.00 | 76.43 | 80.11 | 78.05 | 80.12 | 0.000147 | 0.84 | 105.14 | 68.30 | 0.10 |
| Reach-1 | 194.21 | 10-year | 116.00 | 76.43 | 80.35 | 78.34 | 80.36 | 0.000212 | 1.08 | 121.43 | 71.07 | 0.12 |
| Reach-1 | 194.21 | 25-year | 126.00 | 76.43 | 80.40 | 78.40 | 80.42 | 0.000231 | 1.15 | 125.14 | 71.68 | 0.13 |
| Reach-1 | 194.21 | 50-year | 138.00 | 76.43 | 80.48 | 78.48 | 80.50 | 0.000244 | 1.21 | 131.31 | 72.70 | 0.14 |
| Reach-1 | 194.21 | 100-year | 155.00 | 76.43 | 80.57 | 78.57 | 80.60 | 0.000270 | 1.30 | 137.88 | 73.98 | 0.14 |
| | | | | | | | | | | | | |
| Reach-1 | 193 | | Inl Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 189 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.71 | 30.03 | 0.04 |
| Reach-1 | 189 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.21 | 0.000056 | 0.38 | 39.11 | 33.11 | 0.06 |
| Reach-1 | 189 | Spring | 22.00 | 76.98 | 79.39 | | 79.40 | 0.000081 | 0.49 | 45.58 | 35.60 | 0.07 |
| Reach-1 | 189 | Mean Annual | 80.00 | 76.98 | 80.08 | | 80.10 | 0.000286 | 1.20 | 73.03 | 43.16 | 0.14 |
| Reach-1 | 189 | 10-year | 116.00 | 76.98 | 80.32 | | 80.35 | 0.000420 | 1.55 | 83.38 | 45.25 | 0.18 |
| Reach-1 | 189 | 25-year | 126.00 | 76.98 | 80.37 | | 80.41 | 0.000459 | 1.65 | 85.75 | 45.61 | 0.19 |
| Reach-1 | 189 | 50-year | 138.00 | 76.98 | 80.43 | | 80.48 | 0.000501 | 1.75 | 88.78 | 46.07 | 0.19 |
| Reach-1 | 189 | 100-year | 155.00 | 76.98 | 80.52 | | 80.58 | 0.000558 | 1.89 | 92.94 | 46.69 | 0.21 |

ALTERNATIVE 2

HEC-RAS Plan: 070626 all2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 153 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.71 | 30.03 | 0.04 |
| Reach-1 | 153 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.21 | 0.000056 | 0.38 | 39.10 | 33.11 | 0.06 |
| Reach-1 | 153 | Spring | 22.00 | 76.98 | 79.39 | | 79.40 | 0.000081 | 0.49 | 45.57 | 35.59 | 0.07 |
| Reach-1 | 153 | Mean Annual | 80.00 | 76.98 | 80.08 | | 80.10 | 0.000287 | 1.20 | 72.98 | 43.15 | 0.14 |
| Reach-1 | 153 | 10-year | 116.00 | 76.98 | 80.31 | | 80.35 | 0.000421 | 1.55 | 83.30 | 45.24 | 0.18 |
| Reach-1 | 153 | 25-year | 126.00 | 76.98 | 80.37 | | 80.41 | 0.000460 | 1.65 | 85.66 | 45.60 | 0.19 |
| Reach-1 | 153 | 50-year | 138.00 | 76.98 | 80.43 | | 80.48 | 0.000502 | 1.75 | 88.68 | 46.06 | 0.19 |
| Reach-1 | 153 | 100-year | 155.00 | 76.98 | 80.52 | | 80.57 | 0.000559 | 1.89 | 92.83 | 46.68 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 149 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.71 | 30.03 | 0.04 |
| Reach-1 | 149 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.21 | 0.000056 | 0.38 | 39.09 | 33.11 | 0.06 |
| Reach-1 | 149 | Spring | 22.00 | 76.98 | 79.39 | | 79.40 | 0.000081 | 0.49 | 45.56 | 35.59 | 0.07 |
| Reach-1 | 149 | Mean Annual | 80.00 | 76.98 | 80.08 | | 80.10 | 0.000287 | 1.20 | 72.93 | 43.14 | 0.14 |
| Reach-1 | 149 | 10-year | 116.00 | 76.98 | 80.31 | | 80.35 | 0.000422 | 1.56 | 83.22 | 45.23 | 0.18 |
| Reach-1 | 149 | 25-year | 126.00 | 76.98 | 80.36 | | 80.40 | 0.000461 | 1.65 | 85.57 | 45.59 | 0.19 |
| Reach-1 | 149 | 50-year | 138.00 | 76.98 | 80.43 | | 80.48 | 0.000504 | 1.75 | 88.58 | 46.04 | 0.19 |
| Reach-1 | 149 | 100-year | 155.00 | 76.98 | 80.52 | | 80.57 | 0.000561 | 1.90 | 92.72 | 46.66 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 144.91 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.70 | 30.03 | 0.04 |
| Reach-1 | 144.91 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.21 | 0.000056 | 0.38 | 39.08 | 33.11 | 0.06 |
| Reach-1 | 144.91 | Spring | 22.00 | 76.98 | 79.39 | | 79.40 | 0.000081 | 0.49 | 45.54 | 35.58 | 0.07 |
| Reach-1 | 144.91 | Mean Annual | 80.00 | 76.98 | 80.08 | | 80.10 | 0.000288 | 1.20 | 72.88 | 43.13 | 0.14 |
| Reach-1 | 144.91 | 10-year | 116.00 | 76.98 | 80.31 | | 80.35 | 0.000423 | 1.56 | 83.14 | 45.22 | 0.18 |
| Reach-1 | 144.91 | 25-year | 126.00 | 76.98 | 80.36 | | 80.40 | 0.000463 | 1.65 | 85.48 | 45.57 | 0.19 |
| Reach-1 | 144.91 | 50-year | 138.00 | 76.98 | 80.43 | | 80.47 | 0.000505 | 1.76 | 88.48 | 46.03 | 0.19 |
| Reach-1 | 144.91 | 100-year | 155.00 | 76.98 | 80.52 | | 80.57 | 0.000563 | 1.90 | 92.61 | 46.64 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 133 | August | 8.00 | 76.98 | 78.97 | 77.54 | 78.97 | 0.000033 | 0.25 | 31.68 | 30.01 | 0.04 |
| Reach-1 | 133 | Spring - meas. | 14.60 | 76.98 | 79.20 | 77.69 | 79.20 | 0.000057 | 0.38 | 39.04 | 33.09 | 0.06 |
| Reach-1 | 133 | Spring | 22.00 | 76.98 | 79.39 | 77.82 | 79.39 | 0.000082 | 0.50 | 45.47 | 35.56 | 0.07 |
| Reach-1 | 133 | Mean Annual | 80.00 | 76.98 | 80.07 | 78.38 | 80.09 | 0.000292 | 1.21 | 72.55 | 43.06 | 0.14 |
| Reach-1 | 133 | 10-year | 116.00 | 76.98 | 80.30 | 78.61 | 80.34 | 0.000430 | 1.57 | 82.62 | 45.13 | 0.18 |
| Reach-1 | 133 | 25-year | 126.00 | 76.98 | 80.35 | 78.67 | 80.39 | 0.000471 | 1.66 | 84.91 | 45.49 | 0.19 |
| Reach-1 | 133 | 50-year | 138.00 | 76.98 | 80.41 | 78.73 | 80.46 | 0.000515 | 1.77 | 87.84 | 45.93 | 0.20 |
| Reach-1 | 133 | 100-year | 155.00 | 76.98 | 80.50 | 78.82 | 80.56 | 0.000575 | 1.91 | 91.88 | 46.54 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 132 | | Inl Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 129 | August | 8.00 | 76.98 | 78.65 | | 78.65 | 0.000082 | 0.35 | 22.75 | 25.80 | 0.07 |
| Reach-1 | 129 | Spring - meas. | 14.60 | 76.98 | 78.76 | | 78.76 | 0.000198 | 0.57 | 25.62 | 27.22 | 0.10 |

HEC-RAS Plan: 070626 all2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 129 | Spring | 22.00 | 76.98 | 78.88 | | 78.89 | 0.000321 | 0.76 | 29.00 | 28.81 | 0.13 |
| Reach-1 | 129 | Mean Annual | 80.00 | 76.98 | 79.46 | | 79.50 | 0.000928 | 1.72 | 47.88 | 36.44 | 0.24 |
| Reach-1 | 129 | 10-year | 116.00 | 76.98 | 79.74 | | 79.81 | 0.001090 | 2.09 | 58.84 | 40.18 | 0.27 |
| Reach-1 | 129 | 25-year | 126.00 | 76.98 | 79.82 | | 79.89 | 0.001118 | 2.17 | 61.90 | 41.04 | 0.28 |
| Reach-1 | 129 | 50-year | 138.00 | 76.98 | 79.91 | | 79.99 | 0.001143 | 2.26 | 65.63 | 41.96 | 0.28 |
| Reach-1 | 129 | 100-year | 155.00 | 76.98 | 80.03 | | 80.11 | 0.001173 | 2.39 | 70.75 | 42.75 | 0.29 |
| | | | | | | | | | | | | |
| Reach-1 | 119.58 | August | 8.00 | 76.98 | 78.65 | 77.54 | 78.65 | 0.000082 | 0.35 | 22.72 | 25.79 | 0.07 |
| Reach-1 | 119.58 | Spring - meas. | 14.60 | 76.98 | 78.75 | 77.69 | 78.76 | 0.000199 | 0.57 | 25.55 | 27.20 | 0.10 |
| Reach-1 | 119.58 | Spring | 22.00 | 76.98 | 78.87 | 77.82 | 78.88 | 0.000313 | 0.76 | 28.89 | 28.77 | 0.13 |
| Reach-1 | 119.58 | Mean Annual | 80.00 | 76.98 | 79.44 | 78.38 | 79.49 | 0.000936 | 1.77 | 47.41 | 36.27 | 0.25 |
| Reach-1 | 119.58 | 10-year | 116.00 | 76.98 | 79.73 | 78.61 | 79.80 | 0.001121 | 2.15 | 58.17 | 39.99 | 0.28 |
| Reach-1 | 119.58 | 25-year | 126.00 | 76.98 | 79.80 | 78.67 | 79.88 | 0.001153 | 2.24 | 61.19 | 40.85 | 0.28 |
| Reach-1 | 119.58 | 50-year | 138.00 | 76.98 | 79.89 | 78.74 | 79.97 | 0.001184 | 2.34 | 64.84 | 41.84 | 0.29 |
| Reach-1 | 119.58 | 100-year | 155.00 | 76.98 | 80.01 | 78.82 | 80.10 | 0.001220 | 2.47 | 69.90 | 42.61 | 0.30 |
| | | | | | | | | | | | | |
| Reach-1 | 96.20 | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 68.00 | August | 8.00 | 76.76 | 78.65 | 77.30 | 78.65 | 0.000034 | 0.33 | 24.35 | 28.24 | 0.06 |
| Reach-1 | 68.00 | Spring - meas. | 14.60 | 76.76 | 78.75 | 77.48 | 78.75 | 0.000081 | 0.54 | 27.36 | 30.65 | 0.09 |
| Reach-1 | 68.00 | Spring | 22.00 | 76.76 | 78.86 | 77.63 | 78.87 | 0.000129 | 0.74 | 31.00 | 33.81 | 0.12 |
| Reach-1 | 68.00 | Mean Annual | 80.00 | 76.76 | 79.33 | 78.32 | 79.39 | 0.000517 | 1.85 | 49.73 | 44.41 | 0.26 |
| Reach-1 | 68.00 | 10-year | 116.00 | 76.76 | 79.53 | 78.55 | 79.61 | 0.000730 | 2.37 | 58.63 | 48.01 | 0.31 |
| Reach-1 | 68.00 | 25-year | 126.00 | 76.76 | 79.57 | 78.60 | 79.67 | 0.000787 | 2.50 | 60.88 | 48.76 | 0.32 |
| Reach-1 | 68.00 | 50-year | 138.00 | 76.76 | 79.63 | 78.66 | 79.73 | 0.000854 | 2.66 | 63.46 | 49.61 | 0.34 |
| Reach-1 | 68.00 | 100-year | 155.00 | 76.76 | 79.69 | 78.74 | 79.81 | 0.000956 | 2.87 | 66.70 | 50.50 | 0.36 |
| | | | | | | | | | | | | |
| Reach-1 | 67.5 | | Int Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 67 | August | 8.00 | 76.80 | 77.11 | 77.11 | 77.24 | 0.014393 | 2.86 | 2.80 | 10.98 | 1.00 |
| Reach-1 | 67 | Spring - meas. | 14.60 | 76.80 | 77.25 | 77.25 | 77.42 | 0.013046 | 3.33 | 4.38 | 12.69 | 1.00 |
| Reach-1 | 67 | Spring | 22.00 | 76.80 | 77.36 | 77.36 | 77.57 | 0.012444 | 3.70 | 5.95 | 14.18 | 1.01 |
| Reach-1 | 67 | Mean Annual | 80.00 | 76.80 | 78.11 | | 78.37 | 0.005317 | 4.08 | 19.60 | 21.17 | 0.75 |
| Reach-1 | 67 | 10-year | 116.00 | 76.80 | 78.46 | | 78.74 | 0.004297 | 4.24 | 27.36 | 23.71 | 0.70 |
| Reach-1 | 67 | 25-year | 126.00 | 76.80 | 78.55 | | 78.83 | 0.004121 | 4.28 | 29.41 | 24.33 | 0.69 |
| Reach-1 | 67 | 50-year | 138.00 | 76.80 | 78.65 | | 78.94 | 0.003794 | 4.33 | 31.87 | 24.92 | 0.67 |
| Reach-1 | 67 | 100-year | 155.00 | 76.80 | 78.78 | | 79.08 | 0.003456 | 4.41 | 35.27 | 25.73 | 0.65 |
| | | | | | | | | | | | | |
| Reach-1 | 66 | August | 8.00 | 74.50 | 77.08 | 74.72 | 77.09 | 0.000006 | 0.22 | 37.08 | 15.82 | 0.02 |
| Reach-1 | 66 | Spring - meas. | 14.60 | 74.50 | 77.28 | 74.83 | 77.28 | 0.000015 | 0.36 | 40.25 | 16.64 | 0.04 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 66 | Spring | 22.00 | 74.50 | 77.45 | 74.94 | 77.45 | 0.000029 | 0.51 | 43.17 | 17.84 | 0.06 |
| Reach-1 | 66 | Mean Annual | 80.00 | 74.50 | 78.27 | | 78.29 | 0.000177 | 1.33 | 60.12 | 23.64 | 0.15 |
| Reach-1 | 66 | 10-year | 116.00 | 74.50 | 78.61 | | 78.66 | 0.000246 | 1.70 | 68.67 | 26.14 | 0.18 |
| Reach-1 | 66 | 25-year | 126.00 | 74.50 | 78.70 | | 78.75 | 0.000263 | 1.79 | 70.95 | 26.77 | 0.18 |
| Reach-1 | 66 | 50-year | 138.00 | 74.50 | 78.80 | | 78.85 | 0.000282 | 1.89 | 73.67 | 27.52 | 0.19 |
| Reach-1 | 66 | 100-year | 155.00 | 74.50 | 78.93 | | 79.00 | 0.000307 | 2.03 | 77.48 | 28.67 | 0.20 |
| | | | | | | | | | | | | |
| Reach-1 | 65 | August | 8.00 | 74.30 | 77.08 | | 77.08 | 0.000003 | 0.16 | 51.12 | 22.31 | 0.02 |
| Reach-1 | 65 | Spring - meas. | 14.60 | 74.30 | 77.28 | | 77.28 | 0.000007 | 0.26 | 55.54 | 22.87 | 0.03 |
| Reach-1 | 65 | Spring | 22.00 | 74.30 | 77.45 | | 77.45 | 0.000012 | 0.37 | 59.47 | 23.35 | 0.04 |
| Reach-1 | 65 | Mean Annual | 80.00 | 74.30 | 78.27 | | 78.29 | 0.000072 | 1.00 | 79.63 | 25.69 | 0.10 |
| Reach-1 | 65 | 10-year | 116.00 | 74.30 | 78.62 | | 78.65 | 0.000107 | 1.31 | 89.03 | 33.10 | 0.12 |
| Reach-1 | 65 | 25-year | 126.00 | 74.30 | 78.71 | | 78.74 | 0.000116 | 1.39 | 92.20 | 37.30 | 0.13 |
| Reach-1 | 65 | 50-year | 138.00 | 74.30 | 78.81 | | 78.84 | 0.000126 | 1.47 | 96.03 | 38.20 | 0.14 |
| Reach-1 | 65 | 100-year | 155.00 | 74.30 | 78.95 | | 78.98 | 0.000140 | 1.59 | 101.36 | 39.42 | 0.14 |
| | | | | | | | | | | | | |
| Reach-1 | 64 | August | 8.00 | 76.60 | 76.94 | 76.94 | 77.07 | 0.045966 | 2.96 | 2.70 | 9.92 | 1.00 |
| Reach-1 | 64 | Spring - meas. | 14.60 | 76.60 | 77.08 | 77.08 | 77.26 | 0.041436 | 3.44 | 4.25 | 11.53 | 1.00 |
| Reach-1 | 64 | Spring | 22.00 | 76.60 | 77.20 | 77.20 | 77.43 | 0.039633 | 3.82 | 5.76 | 12.90 | 1.01 |
| Reach-1 | 64 | Mean Annual | 80.00 | 76.60 | 77.81 | 77.81 | 78.24 | 0.032247 | 5.28 | 15.15 | 17.75 | 1.01 |
| Reach-1 | 64 | 10-year | 116.00 | 76.60 | 78.07 | 78.07 | 78.59 | 0.030589 | 5.80 | 20.00 | 19.62 | 1.01 |
| Reach-1 | 64 | 25-year | 126.00 | 76.60 | 78.13 | 78.13 | 78.68 | 0.029636 | 5.94 | 21.23 | 19.95 | 1.00 |
| Reach-1 | 64 | 50-year | 138.00 | 76.60 | 78.20 | 78.20 | 78.78 | 0.029148 | 6.13 | 22.57 | 20.30 | 1.01 |
| Reach-1 | 64 | 100-year | 155.00 | 76.60 | 78.30 | 78.30 | 78.92 | 0.028013 | 6.34 | 24.58 | 20.82 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 63 | August | 8.00 | 75.60 | 76.09 | 75.95 | 76.15 | 0.009833 | 1.92 | 4.17 | 10.99 | 0.55 |
| Reach-1 | 63 | Spring - meas. | 14.60 | 75.60 | 76.27 | 76.09 | 76.35 | 0.010142 | 2.33 | 6.28 | 12.67 | 0.58 |
| Reach-1 | 63 | Spring | 22.00 | 75.60 | 76.43 | 76.22 | 76.54 | 0.010032 | 2.61 | 8.43 | 14.18 | 0.60 |
| Reach-1 | 63 | Mean Annual | 80.00 | 75.60 | 77.14 | 76.84 | 77.38 | 0.009272 | 3.96 | 20.57 | 19.24 | 0.64 |
| Reach-1 | 63 | 10-year | 116.00 | 75.60 | 77.43 | 77.09 | 77.75 | 0.009347 | 4.59 | 26.26 | 20.76 | 0.67 |
| Reach-1 | 63 | 25-year | 126.00 | 75.60 | 77.50 | 77.16 | 77.84 | 0.009334 | 4.74 | 27.79 | 21.15 | 0.67 |
| Reach-1 | 63 | 50-year | 138.00 | 75.60 | 77.58 | 77.23 | 77.95 | 0.009332 | 4.91 | 29.58 | 21.60 | 0.68 |
| Reach-1 | 63 | 100-year | 155.00 | 75.60 | 77.70 | 77.34 | 78.10 | 0.009237 | 5.12 | 32.15 | 22.09 | 0.68 |
| | | | | | | | | | | | | |
| Reach-1 | 62.5 | August | 8.00 | 75.52 | 75.96 | | 76.03 | 0.013339 | 2.16 | 3.71 | 10.32 | 0.63 |
| Reach-1 | 62.5 | Spring - meas. | 14.60 | 75.52 | 76.08 | | 76.21 | 0.018003 | 2.88 | 5.07 | 11.40 | 0.76 |
| Reach-1 | 62.5 | Spring | 22.00 | 75.52 | 76.17 | 76.13 | 76.37 | 0.024205 | 3.62 | 6.08 | 12.14 | 0.90 |
| Reach-1 | 62.5 | Mean Annual | 80.00 | 75.52 | 76.77 | 76.77 | 77.21 | 0.025124 | 5.34 | 14.97 | 17.24 | 1.00 |
| Reach-1 | 62.5 | 10-year | 116.00 | 75.52 | 77.02 | 77.02 | 77.58 | 0.022633 | 6.01 | 19.51 | 18.61 | 0.99 |
| Reach-1 | 62.5 | 25-year | 126.00 | 75.52 | 77.09 | 77.09 | 77.68 | 0.022225 | 6.17 | 20.70 | 18.95 | 0.99 |

HEC-RAS Plan: 070626 all2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 62.5 | 50-year | 138.00 | 75.52 | 77.16 | 77.16 | 77.79 | 0.021665 | 6.35 | 22.15 | 19.35 | 0.99 |
| Reach-1 | 62.5 | 100-year | 155.00 | 75.52 | 77.27 | 77.27 | 77.93 | 0.020852 | 6.57 | 24.22 | 19.92 | 0.99 |
| | | | | | | | | | | | | |
| Reach-1 | 62 | August | 8.00 | 75.43 | 75.76 | 75.76 | 75.88 | 0.014986 | 2.78 | 2.87 | 12.11 | 1.01 |
| Reach-1 | 62 | Spring - meas. | 14.60 | 75.43 | 75.88 | 75.88 | 76.04 | 0.013555 | 3.25 | 4.50 | 13.92 | 1.01 |
| Reach-1 | 62 | Spring | 22.00 | 75.43 | 75.99 | 75.99 | 76.19 | 0.012577 | 3.62 | 6.07 | 15.07 | 1.01 |
| Reach-1 | 62 | Mean Annual | 80.00 | 75.43 | 76.42 | 76.53 | 77.01 | 0.014875 | 6.14 | 13.08 | 17.25 | 1.22 |
| Reach-1 | 62 | 10-year | 116.00 | 75.43 | 76.65 | 76.79 | 77.38 | 0.013294 | 6.88 | 17.16 | 18.36 | 1.20 |
| Reach-1 | 62 | 25-year | 126.00 | 75.43 | 76.71 | 76.85 | 77.48 | 0.013000 | 7.06 | 18.25 | 18.64 | 1.20 |
| Reach-1 | 62 | 50-year | 138.00 | 75.43 | 76.78 | 76.93 | 77.59 | 0.012589 | 7.25 | 19.57 | 18.98 | 1.19 |
| Reach-1 | 62 | 100-year | 155.00 | 75.43 | 76.87 | 77.03 | 77.75 | 0.012227 | 7.53 | 21.35 | 19.43 | 1.19 |
| | | | | | | | | | | | | |
| Reach-1 | 61 | August | 8.00 | 75.02 | 75.31 | 75.35 | 75.48 | 0.024484 | 3.38 | 2.37 | 10.73 | 1.27 |
| Reach-1 | 61 | Spring - meas. | 14.60 | 75.02 | 75.41 | 75.47 | 75.68 | 0.023702 | 4.17 | 3.50 | 11.26 | 1.32 |
| Reach-1 | 61 | Spring | 22.00 | 75.02 | 75.51 | 75.59 | 75.85 | 0.021389 | 4.67 | 4.71 | 11.82 | 1.30 |
| Reach-1 | 61 | Mean Annual | 80.00 | 75.02 | 76.13 | 76.22 | 76.72 | 0.013731 | 6.18 | 12.95 | 15.10 | 1.18 |
| Reach-1 | 61 | 10-year | 116.00 | 75.02 | 76.37 | 76.50 | 77.12 | 0.012827 | 6.98 | 16.71 | 16.43 | 1.18 |
| Reach-1 | 61 | 25-year | 126.00 | 75.02 | 76.43 | 76.57 | 77.23 | 0.012510 | 7.16 | 17.77 | 16.78 | 1.18 |
| Reach-1 | 61 | 50-year | 138.00 | 75.02 | 76.50 | 76.65 | 77.35 | 0.012378 | 7.40 | 18.92 | 17.15 | 1.18 |
| Reach-1 | 61 | 100-year | 155.00 | 75.02 | 76.60 | 76.76 | 77.51 | 0.011893 | 7.66 | 20.70 | 17.72 | 1.18 |
| | | | | | | | | | | | | |
| Reach-1 | 60 | August | 8.00 | 74.40 | 74.62 | 74.62 | 74.72 | 0.017519 | 2.55 | 3.14 | 17.06 | 1.04 |
| Reach-1 | 60 | Spring - meas. | 14.60 | 74.40 | 74.72 | 74.72 | 74.85 | 0.014269 | 2.95 | 4.95 | 18.80 | 1.00 |
| Reach-1 | 60 | Spring | 22.00 | 74.40 | 74.80 | 74.80 | 74.98 | 0.013361 | 3.41 | 6.52 | 19.54 | 1.02 |
| Reach-1 | 60 | Mean Annual | 80.00 | 74.40 | 75.07 | 75.28 | 75.80 | 0.025037 | 6.87 | 12.24 | 22.05 | 1.53 |
| Reach-1 | 60 | 10-year | 116.00 | 74.40 | 75.21 | 75.51 | 76.21 | 0.026360 | 8.07 | 15.44 | 23.23 | 1.63 |
| Reach-1 | 60 | 25-year | 126.00 | 74.40 | 75.25 | 75.57 | 76.31 | 0.026606 | 8.36 | 16.28 | 23.51 | 1.65 |
| Reach-1 | 60 | 50-year | 138.00 | 74.40 | 75.29 | 75.63 | 76.44 | 0.026753 | 8.68 | 17.28 | 23.84 | 1.66 |
| Reach-1 | 60 | 100-year | 155.00 | 74.40 | 75.35 | 75.73 | 76.61 | 0.027146 | 9.12 | 18.62 | 24.28 | 1.69 |
| | | | | | | | | | | | | |
| Reach-1 | 59 | August | 8.00 | 71.70 | 73.91 | 71.90 | 73.91 | 0.000005 | 0.19 | 43.01 | 25.11 | 0.03 |
| Reach-1 | 59 | Spring - meas. | 14.60 | 71.70 | 74.06 | 72.00 | 74.06 | 0.000014 | 0.31 | 46.83 | 26.47 | 0.04 |
| Reach-1 | 59 | Spring | 22.00 | 71.70 | 74.20 | 72.09 | 74.20 | 0.000026 | 0.43 | 50.70 | 27.78 | 0.06 |
| Reach-1 | 59 | Mean Annual | 80.00 | 71.70 | 74.96 | 72.60 | 74.98 | 0.000107 | 1.10 | 74.55 | 34.89 | 0.12 |
| Reach-1 | 59 | 10-year | 116.00 | 71.70 | 75.30 | 72.84 | 75.33 | 0.000145 | 1.40 | 87.45 | 40.22 | 0.15 |
| Reach-1 | 59 | 25-year | 126.00 | 71.70 | 75.39 | 72.90 | 75.42 | 0.000155 | 1.47 | 90.92 | 41.53 | 0.15 |
| Reach-1 | 59 | 50-year | 138.00 | 71.70 | 75.49 | 72.97 | 75.52 | 0.000166 | 1.56 | 95.06 | 43.05 | 0.16 |
| Reach-1 | 59 | 100-year | 155.00 | 71.70 | 75.62 | 73.07 | 75.66 | 0.000181 | 1.67 | 100.83 | 44.95 | 0.17 |
| | | | | | | | | | | | | |
| Reach-1 | 58 | August | 8.00 | 71.30 | 73.91 | | 73.91 | 0.000007 | 0.22 | 36.83 | 21.07 | 0.03 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 58 | Spring - meas. | 14.60 | 71.30 | 74.05 | | 74.06 | 0.000019 | 0.36 | 40.01 | 22.18 | 0.05 |
| Reach-1 | 58 | Spring | 22.00 | 71.30 | 74.20 | | 74.20 | 0.000035 | 0.51 | 43.23 | 23.24 | 0.07 |
| Reach-1 | 58 | Mean Annual | 80.00 | 71.30 | 74.95 | | 74.97 | 0.000150 | 1.31 | 63.69 | 32.24 | 0.14 |
| Reach-1 | 58 | 10-year | 116.00 | 71.30 | 75.29 | | 75.33 | 0.000207 | 1.67 | 75.35 | 36.99 | 0.17 |
| Reach-1 | 58 | 25-year | 126.00 | 71.30 | 75.37 | | 75.42 | 0.000222 | 1.76 | 78.47 | 38.16 | 0.18 |
| Reach-1 | 58 | 50-year | 138.00 | 71.30 | 75.46 | | 75.52 | 0.000238 | 1.86 | 82.19 | 39.51 | 0.19 |
| Reach-1 | 58 | 100-year | 155.00 | 71.30 | 75.59 | | 75.65 | 0.000261 | 2.00 | 87.36 | 41.41 | 0.20 |
| | | | | | | | | | | | | |
| Reach-1 | 57 | August | 8.00 | 73.60 | 73.85 | 73.79 | 73.90 | 0.022174 | 1.87 | 4.28 | 18.23 | 0.68 |
| Reach-1 | 57 | Spring - meas. | 14.60 | 73.60 | 73.97 | | 74.05 | 0.018541 | 2.20 | 6.62 | 19.20 | 0.66 |
| Reach-1 | 57 | Spring | 22.00 | 73.60 | 74.10 | | 74.19 | 0.015495 | 2.41 | 9.12 | 20.18 | 0.63 |
| Reach-1 | 57 | Mean Annual | 80.00 | 73.60 | 74.78 | | 74.96 | 0.008931 | 3.36 | 25.34 | 28.10 | 0.56 |
| Reach-1 | 57 | 10-year | 116.00 | 73.60 | 75.10 | | 75.31 | 0.007697 | 3.69 | 35.01 | 32.28 | 0.54 |
| Reach-1 | 57 | 25-year | 126.00 | 73.60 | 75.18 | | 75.39 | 0.007489 | 3.77 | 37.61 | 33.38 | 0.54 |
| Reach-1 | 57 | 50-year | 138.00 | 73.60 | 75.28 | | 75.49 | 0.007248 | 3.86 | 40.76 | 34.68 | 0.53 |
| Reach-1 | 57 | 100-year | 155.00 | 73.60 | 75.40 | | 75.63 | 0.006967 | 3.97 | 45.18 | 36.41 | 0.53 |
| | | | | | | | | | | | | |
| Reach-1 | 56.5 | August | 8.00 | 73.15 | 73.51 | | 73.54 | 0.006342 | 1.29 | 6.20 | 17.86 | 0.39 |
| Reach-1 | 56.5 | Spring - meas. | 14.60 | 73.15 | 73.67 | | 73.71 | 0.006138 | 1.60 | 9.13 | 18.55 | 0.40 |
| Reach-1 | 56.5 | Spring | 22.00 | 73.15 | 73.82 | | 73.88 | 0.005921 | 1.84 | 11.98 | 19.20 | 0.41 |
| Reach-1 | 56.5 | Mean Annual | 80.00 | 73.15 | 74.59 | | 74.72 | 0.005387 | 2.89 | 28.39 | 25.49 | 0.44 |
| Reach-1 | 56.5 | 10-year | 116.00 | 73.15 | 74.92 | | 75.09 | 0.005182 | 3.29 | 37.68 | 29.91 | 0.45 |
| Reach-1 | 56.5 | 25-year | 126.00 | 73.15 | 75.00 | | 75.18 | 0.005164 | 3.39 | 40.14 | 30.96 | 0.45 |
| Reach-1 | 56.5 | 50-year | 138.00 | 73.15 | 75.10 | | 75.28 | 0.005122 | 3.50 | 43.14 | 32.20 | 0.45 |
| Reach-1 | 56.5 | 100-year | 155.00 | 73.15 | 75.23 | | 75.42 | 0.005081 | 3.65 | 47.33 | 33.97 | 0.46 |
| | | | | | | | | | | | | |
| Reach-1 | 56 | August | 8.00 | 72.70 | 73.02 | 72.99 | 73.12 | 0.036058 | 2.58 | 3.10 | 11.72 | 0.88 |
| Reach-1 | 56 | Spring - meas. | 14.60 | 72.70 | 73.13 | 73.12 | 73.30 | 0.038222 | 3.27 | 4.46 | 12.23 | 0.96 |
| Reach-1 | 56 | Spring | 22.00 | 72.70 | 73.23 | 73.23 | 73.46 | 0.039604 | 3.84 | 5.73 | 12.69 | 1.01 |
| Reach-1 | 56 | Mean Annual | 80.00 | 72.70 | 73.85 | 73.85 | 74.33 | 0.031696 | 5.52 | 14.49 | 15.49 | 1.01 |
| Reach-1 | 56 | 10-year | 116.00 | 72.70 | 74.14 | 74.14 | 74.71 | 0.029945 | 6.02 | 19.31 | 18.22 | 1.01 |
| Reach-1 | 56 | 25-year | 126.00 | 72.70 | 74.22 | 74.22 | 74.80 | 0.028688 | 6.14 | 20.64 | 19.15 | 0.99 |
| Reach-1 | 56 | 50-year | 138.00 | 72.70 | 74.29 | 74.29 | 74.91 | 0.027772 | 6.30 | 22.17 | 20.16 | 0.99 |
| Reach-1 | 56 | 100-year | 155.00 | 72.70 | 74.40 | 74.40 | 75.05 | 0.026308 | 6.48 | 24.48 | 21.61 | 0.98 |
| | | | | | | | | | | | | |
| Reach-1 | 55 | August | 8.00 | 72.50 | 72.79 | 72.78 | 72.91 | 0.013614 | 2.78 | 2.88 | 11.28 | 0.97 |
| Reach-1 | 55 | Spring - meas. | 14.60 | 72.50 | 72.91 | 72.91 | 73.09 | 0.013219 | 3.37 | 4.33 | 12.37 | 1.01 |
| Reach-1 | 55 | Spring | 22.00 | 72.50 | 73.01 | 73.03 | 73.25 | 0.013536 | 3.89 | 5.66 | 13.30 | 1.05 |
| Reach-1 | 55 | Mean Annual | 80.00 | 72.50 | 73.48 | 73.62 | 74.10 | 0.016229 | 6.27 | 12.76 | 16.67 | 1.26 |
| Reach-1 | 55 | 10-year | 116.00 | 72.50 | 73.70 | 73.88 | 74.47 | 0.015928 | 7.04 | 16.49 | 17.82 | 1.29 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 55 | 25-year | 126.00 | 72.50 | 73.76 | 73.96 | 74.56 | 0.015817 | 7.21 | 17.48 | 18.11 | 1.29 |
| Reach-1 | 55 | 50-year | 138.00 | 72.50 | 73.82 | 74.02 | 74.67 | 0.015797 | 7.42 | 18.60 | 18.43 | 1.30 |
| Reach-1 | 55 | 100-year | 155.00 | 72.50 | 73.90 | 74.12 | 74.82 | 0.015963 | 7.71 | 20.11 | 18.93 | 1.32 |
| | | | | | | | | | | | | |
| Reach-1 | 54 | August | 8.00 | 72.30 | 72.55 | 72.55 | 72.65 | 0.014306 | 2.59 | 3.09 | 14.06 | 0.97 |
| Reach-1 | 54 | Spring - meas. | 14.60 | 72.30 | 72.63 | 72.66 | 72.81 | 0.018163 | 3.43 | 4.25 | 15.12 | 1.14 |
| Reach-1 | 54 | Spring | 22.00 | 72.30 | 72.71 | 72.76 | 72.96 | 0.018722 | 3.97 | 5.55 | 16.21 | 1.20 |
| Reach-1 | 54 | Mean Annual | 80.00 | 72.30 | 73.07 | 73.27 | 73.73 | 0.024913 | 6.53 | 12.26 | 21.00 | 1.51 |
| Reach-1 | 54 | 10-year | 116.00 | 72.30 | 73.22 | 73.48 | 74.09 | 0.026731 | 7.51 | 15.44 | 22.58 | 1.60 |
| Reach-1 | 54 | 25-year | 126.00 | 72.30 | 73.25 | 73.54 | 74.19 | 0.027067 | 7.74 | 16.27 | 22.94 | 1.62 |
| Reach-1 | 54 | 50-year | 138.00 | 72.30 | 73.30 | 73.60 | 74.29 | 0.027374 | 8.01 | 17.23 | 23.29 | 1.64 |
| Reach-1 | 54 | 100-year | 155.00 | 72.30 | 73.35 | 73.67 | 74.44 | 0.027645 | 8.35 | 18.56 | 23.72 | 1.66 |
| | | | | | | | | | | | | |
| Reach-1 | 53 | August | 8.00 | 71.60 | 71.80 | 71.80 | 71.88 | 0.016806 | 2.29 | 3.50 | 21.58 | 1.00 |
| Reach-1 | 53 | Spring - meas. | 14.60 | 71.60 | 71.83 | 71.87 | 72.01 | 0.029547 | 3.42 | 4.27 | 22.04 | 1.37 |
| Reach-1 | 53 | Spring | 22.00 | 71.60 | 71.95 | 71.95 | 72.10 | 0.014774 | 3.20 | 6.88 | 23.28 | 1.04 |
| Reach-1 | 53 | Mean Annual | 80.00 | 71.60 | 72.30 | 72.37 | 72.70 | 0.015186 | 5.09 | 15.73 | 27.07 | 1.18 |
| Reach-1 | 53 | 10-year | 116.00 | 71.60 | 72.44 | 72.56 | 72.98 | 0.015916 | 5.85 | 19.84 | 28.66 | 1.24 |
| Reach-1 | 53 | 25-year | 126.00 | 71.60 | 72.48 | 72.60 | 73.05 | 0.016161 | 6.04 | 20.86 | 29.04 | 1.26 |
| Reach-1 | 53 | 50-year | 138.00 | 71.60 | 72.52 | 72.66 | 73.13 | 0.016483 | 6.26 | 22.03 | 29.48 | 1.28 |
| Reach-1 | 53 | 100-year | 155.00 | 71.60 | 72.57 | 72.73 | 73.24 | 0.016970 | 6.57 | 23.60 | 30.04 | 1.31 |
| | | | | | | | | | | | | |
| Reach-1 | 52 | August | 8.00 | 69.40 | 70.85 | 69.62 | 70.85 | 0.000024 | 0.33 | 24.18 | 19.47 | 0.05 |
| Reach-1 | 52 | Spring - meas. | 14.60 | 69.40 | 71.01 | 69.72 | 71.02 | 0.000056 | 0.53 | 27.35 | 20.09 | 0.08 |
| Reach-1 | 52 | Spring | 22.00 | 69.40 | 71.17 | 69.82 | 71.18 | 0.000094 | 0.72 | 30.54 | 20.99 | 0.11 |
| Reach-1 | 52 | Mean Annual | 80.00 | 69.40 | 72.00 | 70.36 | 72.04 | 0.000328 | 1.59 | 50.28 | 26.83 | 0.20 |
| Reach-1 | 52 | 10-year | 116.00 | 69.40 | 72.37 | 70.62 | 72.42 | 0.000437 | 1.91 | 60.87 | 30.83 | 0.24 |
| Reach-1 | 52 | 25-year | 126.00 | 69.40 | 72.46 | 70.68 | 72.52 | 0.000460 | 1.98 | 63.76 | 31.81 | 0.25 |
| Reach-1 | 52 | 50-year | 138.00 | 69.40 | 72.56 | 70.76 | 72.63 | 0.000484 | 2.05 | 67.18 | 32.87 | 0.25 |
| Reach-1 | 52 | 100-year | 155.00 | 69.40 | 72.70 | 70.86 | 72.78 | 0.000510 | 2.15 | 71.93 | 34.28 | 0.26 |
| | | | | | | | | | | | | |
| Reach-1 | 51 | August | 8.00 | 69.00 | 70.85 | | 70.85 | 0.000076 | 0.36 | 22.06 | 14.33 | 0.05 |
| Reach-1 | 51 | Spring - meas. | 14.60 | 69.00 | 71.01 | | 71.01 | 0.000194 | 0.60 | 24.36 | 15.02 | 0.08 |
| Reach-1 | 51 | Spring | 22.00 | 69.00 | 71.16 | | 71.17 | 0.000346 | 0.82 | 26.70 | 15.78 | 0.11 |
| Reach-1 | 51 | Mean Annual | 80.00 | 69.00 | 71.95 | | 72.01 | 0.001300 | 1.99 | 41.10 | 20.81 | 0.23 |
| Reach-1 | 51 | 10-year | 116.00 | 69.00 | 72.30 | | 72.39 | 0.001710 | 2.50 | 48.74 | 23.81 | 0.27 |
| Reach-1 | 51 | 25-year | 126.00 | 69.00 | 72.38 | | 72.49 | 0.001809 | 2.62 | 50.79 | 24.58 | 0.28 |
| Reach-1 | 51 | 50-year | 138.00 | 69.00 | 72.48 | | 72.59 | 0.001922 | 2.76 | 53.21 | 25.46 | 0.29 |
| Reach-1 | 51 | 100-year | 155.00 | 69.00 | 72.61 | | 72.74 | 0.002070 | 2.95 | 56.57 | 26.33 | 0.30 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 50 | August | 8.00 | 70.50 | 70.77 | 70.72 | 70.84 | 0.026088 | 2.09 | 3.83 | 15.56 | 0.74 |
| Reach-1 | 50 | Spring - meas. | 14.60 | 70.50 | 70.86 | 70.82 | 70.98 | 0.031691 | 2.78 | 5.25 | 16.04 | 0.86 |
| Reach-1 | 50 | Spring | 22.00 | 70.50 | 70.93 | 70.92 | 71.11 | 0.037494 | 3.41 | 6.45 | 16.44 | 0.96 |
| Reach-1 | 50 | Mean Annual | 80.00 | 70.50 | 71.44 | 71.44 | 71.85 | 0.032360 | 5.16 | 15.53 | 19.62 | 1.00 |
| Reach-1 | 50 | 10-year | 116.00 | 70.50 | 71.68 | 71.68 | 72.19 | 0.028703 | 5.77 | 20.47 | 21.52 | 0.99 |
| Reach-1 | 50 | 25-year | 126.00 | 70.50 | 71.74 | 71.74 | 72.28 | 0.028045 | 5.92 | 21.79 | 22.01 | 0.98 |
| Reach-1 | 50 | 50-year | 138.00 | 70.50 | 71.81 | 71.81 | 72.38 | 0.027131 | 6.07 | 23.42 | 22.68 | 0.98 |
| Reach-1 | 50 | 100-year | 155.00 | 70.50 | 71.91 | 71.91 | 72.52 | 0.026022 | 6.27 | 25.72 | 23.61 | 0.97 |
| | | | | | | | | | | | | |
| Reach-1 | 49 | August | 8.00 | 70.30 | 70.52 | 70.52 | 70.63 | 0.016697 | 2.59 | 3.09 | 15.77 | 1.03 |
| Reach-1 | 49 | Spring - meas. | 14.60 | 70.30 | 70.63 | 70.63 | 70.77 | 0.013950 | 2.99 | 4.88 | 17.51 | 1.00 |
| Reach-1 | 49 | Spring | 22.00 | 70.30 | 70.72 | 70.72 | 70.90 | 0.013223 | 3.36 | 6.56 | 18.99 | 1.01 |
| Reach-1 | 49 | Mean Annual | 80.00 | 70.30 | 71.06 | 71.19 | 71.59 | 0.019235 | 5.84 | 13.70 | 22.83 | 1.33 |
| Reach-1 | 49 | 10-year | 116.00 | 70.30 | 71.20 | 71.40 | 71.92 | 0.021035 | 6.81 | 17.03 | 24.07 | 1.43 |
| Reach-1 | 49 | 25-year | 126.00 | 70.30 | 71.24 | 71.45 | 72.00 | 0.021344 | 7.03 | 17.92 | 24.39 | 1.45 |
| Reach-1 | 49 | 50-year | 138.00 | 70.30 | 71.27 | 71.51 | 72.11 | 0.021999 | 7.32 | 18.86 | 24.73 | 1.48 |
| Reach-1 | 49 | 100-year | 155.00 | 70.30 | 71.33 | 71.58 | 72.23 | 0.022140 | 7.62 | 20.35 | 25.25 | 1.49 |
| | | | | | | | | | | | | |
| Reach-1 | 48 | August | 8.00 | 68.10 | 70.06 | 68.31 | 70.06 | 0.000007 | 0.21 | 38.44 | 24.57 | 0.03 |
| Reach-1 | 48 | Spring - meas. | 14.60 | 68.10 | 70.22 | 68.41 | 70.22 | 0.000018 | 0.34 | 42.49 | 25.39 | 0.05 |
| Reach-1 | 48 | Spring | 22.00 | 68.10 | 70.37 | 68.50 | 70.37 | 0.000032 | 0.48 | 46.28 | 26.13 | 0.06 |
| Reach-1 | 48 | Mean Annual | 80.00 | 68.10 | 71.13 | 69.02 | 71.15 | 0.000157 | 1.15 | 69.52 | 34.69 | 0.14 |
| Reach-1 | 48 | 10-year | 116.00 | 68.10 | 71.48 | 69.26 | 71.51 | 0.000209 | 1.41 | 82.26 | 38.56 | 0.17 |
| Reach-1 | 48 | 25-year | 126.00 | 68.10 | 71.57 | 69.32 | 71.60 | 0.000217 | 1.47 | 85.64 | 39.53 | 0.17 |
| Reach-1 | 48 | 50-year | 138.00 | 68.10 | 71.67 | 69.39 | 71.70 | 0.000225 | 1.55 | 89.61 | 40.63 | 0.18 |
| Reach-1 | 48 | 100-year | 155.00 | 68.10 | 71.80 | 69.49 | 71.84 | 0.000236 | 1.64 | 95.23 | 42.14 | 0.18 |
| | | | | | | | | | | | | |
| Reach-1 | 47 | August | 8.00 | 67.70 | 70.06 | | 70.06 | 0.000004 | 0.17 | 46.96 | 27.77 | 0.02 |
| Reach-1 | 47 | Spring - meas. | 14.60 | 67.70 | 70.22 | | 70.22 | 0.000011 | 0.28 | 51.57 | 29.16 | 0.04 |
| Reach-1 | 47 | Spring | 22.00 | 67.70 | 70.37 | | 70.37 | 0.000020 | 0.39 | 55.97 | 30.51 | 0.05 |
| Reach-1 | 47 | Mean Annual | 80.00 | 67.70 | 71.13 | | 71.15 | 0.000101 | 0.96 | 82.91 | 39.30 | 0.12 |
| Reach-1 | 47 | 10-year | 116.00 | 67.70 | 71.48 | | 71.51 | 0.000130 | 1.20 | 97.14 | 42.31 | 0.14 |
| Reach-1 | 47 | 25-year | 126.00 | 67.70 | 71.57 | | 71.59 | 0.000137 | 1.26 | 100.84 | 43.06 | 0.14 |
| Reach-1 | 47 | 50-year | 138.00 | 67.70 | 71.67 | | 71.70 | 0.000144 | 1.32 | 105.16 | 43.91 | 0.14 |
| Reach-1 | 47 | 100-year | 155.00 | 67.70 | 71.81 | | 71.84 | 0.000153 | 1.41 | 111.22 | 45.09 | 0.15 |
| | | | | | | | | | | | | |
| Reach-1 | 45 | August | 8.00 | 69.30 | 70.05 | | 70.06 | 0.000267 | 0.69 | 11.66 | 19.45 | 0.16 |
| Reach-1 | 45 | Spring - meas. | 14.60 | 69.30 | 70.21 | | 70.22 | 0.000450 | 0.99 | 14.78 | 21.07 | 0.21 |
| Reach-1 | 45 | Spring | 22.00 | 69.30 | 70.35 | | 70.37 | 0.000602 | 1.24 | 17.80 | 22.57 | 0.25 |
| Reach-1 | 45 | Mean Annual | 80.00 | 69.30 | 71.06 | | 71.14 | 0.001018 | 2.20 | 36.32 | 28.59 | 0.34 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 45 | 10-year | 116.00 | 69.30 | 71.39 | | 71.49 | 0.001018 | 2.52 | 46.19 | 31.09 | 0.36 |
| Reach-1 | 45 | 25-year | 126.00 | 69.30 | 71.47 | | 71.58 | 0.001012 | 2.60 | 48.76 | 31.71 | 0.36 |
| Reach-1 | 45 | 50-year | 138.00 | 69.30 | 71.57 | | 71.68 | 0.001007 | 2.69 | 51.78 | 32.43 | 0.36 |
| Reach-1 | 45 | 100-year | 155.00 | 69.30 | 71.70 | | 71.82 | 0.000999 | 2.81 | 56.02 | 33.40 | 0.36 |
| | | | | | | | | | | | | |
| Reach-1 | 44 | August | 8.00 | 69.70 | 69.93 | 69.93 | 70.04 | 0.049714 | 2.62 | 3.06 | 14.36 | 1.00 |
| Reach-1 | 44 | Spring - meas. | 14.60 | 69.70 | 70.06 | 70.04 | 70.19 | 0.038271 | 2.97 | 4.92 | 15.76 | 0.94 |
| Reach-1 | 44 | Spring | 22.00 | 69.70 | 70.18 | 70.14 | 70.34 | 0.030624 | 3.16 | 6.97 | 17.15 | 0.87 |
| Reach-1 | 44 | Mean Annual | 80.00 | 69.70 | 70.86 | | 71.10 | 0.015617 | 3.88 | 20.61 | 22.30 | 0.71 |
| Reach-1 | 44 | 10-year | 116.00 | 69.70 | 71.19 | | 71.45 | 0.012960 | 4.12 | 28.17 | 24.31 | 0.67 |
| Reach-1 | 44 | 25-year | 126.00 | 69.70 | 71.27 | | 71.54 | 0.012273 | 4.19 | 30.12 | 24.80 | 0.66 |
| Reach-1 | 44 | 50-year | 138.00 | 69.70 | 71.36 | | 71.64 | 0.011665 | 4.28 | 32.37 | 25.40 | 0.65 |
| Reach-1 | 44 | 100-year | 155.00 | 69.70 | 71.48 | | 71.78 | 0.010929 | 4.39 | 35.57 | 26.28 | 0.64 |
| | | | | | | | | | | | | |
| Reach-1 | 43 | August | 8.00 | 68.70 | 69.13 | 69.01 | 69.19 | 0.014580 | 2.07 | 3.87 | 10.19 | 0.59 |
| Reach-1 | 43 | Spring - meas. | 14.60 | 68.70 | 69.28 | 69.15 | 69.39 | 0.016582 | 2.65 | 5.52 | 11.02 | 0.66 |
| Reach-1 | 43 | Spring | 22.00 | 68.70 | 69.42 | 69.28 | 69.57 | 0.018138 | 3.12 | 7.05 | 11.74 | 0.71 |
| Reach-1 | 43 | Mean Annual | 80.00 | 68.70 | 70.09 | 69.96 | 70.47 | 0.021919 | 4.99 | 16.05 | 15.06 | 0.85 |
| Reach-1 | 43 | 10-year | 116.00 | 68.70 | 70.36 | 70.26 | 70.86 | 0.023608 | 5.72 | 20.30 | 16.34 | 0.90 |
| Reach-1 | 43 | 25-year | 126.00 | 68.70 | 70.43 | 70.33 | 70.96 | 0.023840 | 5.88 | 21.44 | 16.67 | 0.91 |
| Reach-1 | 43 | 50-year | 138.00 | 68.70 | 70.51 | 70.42 | 71.08 | 0.024082 | 6.05 | 22.80 | 17.06 | 0.92 |
| Reach-1 | 43 | 100-year | 155.00 | 68.70 | 70.61 | 70.54 | 71.23 | 0.024600 | 6.31 | 24.56 | 17.52 | 0.94 |
| | | | | | | | | | | | | |
| Reach-1 | 42 | August | 8.00 | 68.60 | 68.89 | 68.89 | 69.03 | 0.014274 | 2.94 | 2.72 | 10.15 | 1.00 |
| Reach-1 | 42 | Spring - meas. | 14.60 | 68.60 | 69.03 | 69.03 | 69.22 | 0.012925 | 3.52 | 4.14 | 10.85 | 1.01 |
| Reach-1 | 42 | Spring | 22.00 | 68.60 | 69.16 | 69.16 | 69.40 | 0.011948 | 3.96 | 5.56 | 11.51 | 1.00 |
| Reach-1 | 42 | Mean Annual | 80.00 | 68.60 | 69.82 | 69.82 | 70.31 | 0.009652 | 5.62 | 14.23 | 14.58 | 1.00 |
| Reach-1 | 42 | 10-year | 116.00 | 68.60 | 70.12 | 70.12 | 70.71 | 0.009131 | 6.18 | 18.76 | 15.91 | 1.00 |
| Reach-1 | 42 | 25-year | 126.00 | 68.60 | 70.19 | 70.19 | 70.81 | 0.009020 | 6.31 | 19.96 | 16.25 | 1.00 |
| Reach-1 | 42 | 50-year | 138.00 | 68.60 | 70.28 | 70.28 | 70.92 | 0.008904 | 6.46 | 21.37 | 16.63 | 1.00 |
| Reach-1 | 42 | 100-year | 155.00 | 68.60 | 70.39 | 70.39 | 71.08 | 0.008758 | 6.64 | 23.33 | 17.15 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 41 | August | 8.00 | 68.41 | 68.81 | 68.72 | 68.88 | 0.005588 | 2.17 | 3.69 | 10.68 | 0.65 |
| Reach-1 | 41 | Spring - meas. | 14.60 | 68.41 | 68.94 | 68.85 | 69.07 | 0.006761 | 2.85 | 5.12 | 11.30 | 0.75 |
| Reach-1 | 41 | Spring | 22.00 | 68.41 | 68.90 | 68.98 | 69.24 | 0.020542 | 4.72 | 4.66 | 11.10 | 1.28 |
| Reach-1 | 41 | Mean Annual | 80.00 | 68.41 | 69.49 | 69.64 | 70.17 | 0.015652 | 6.62 | 12.08 | 13.93 | 1.25 |
| Reach-1 | 41 | 10-year | 116.00 | 68.41 | 69.75 | 69.94 | 70.58 | 0.015078 | 7.33 | 15.81 | 15.15 | 1.27 |
| Reach-1 | 41 | 25-year | 126.00 | 68.41 | 69.82 | 70.01 | 70.68 | 0.014830 | 7.48 | 16.85 | 15.48 | 1.26 |
| Reach-1 | 41 | 50-year | 138.00 | 68.41 | 69.89 | 70.10 | 70.80 | 0.014567 | 7.64 | 18.07 | 15.85 | 1.26 |
| Reach-1 | 41 | 100-year | 155.00 | 68.41 | 70.00 | 70.21 | 70.95 | 0.014244 | 7.84 | 19.76 | 16.35 | 1.26 |

HEC-RAS Plan: 070626 all2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| | | | | | | | | | | | | |
| Reach-1 | 40 | August | 8.00 | 68.30 | 68.53 | 68.53 | 68.64 | 0.015458 | 2.68 | 2.98 | 13.38 | 1.00 |
| Reach-1 | 40 | Spring - meas. | 14.60 | 68.30 | 68.64 | 68.64 | 68.80 | 0.013621 | 3.25 | 4.49 | 13.67 | 1.00 |
| Reach-1 | 40 | Spring | 22.00 | 68.30 | 68.74 | 68.74 | 68.96 | 0.012706 | 3.72 | 5.92 | 13.94 | 1.00 |
| Reach-1 | 40 | Mean Annual | 80.00 | 68.30 | 69.29 | 69.32 | 69.80 | 0.011465 | 5.77 | 13.87 | 15.17 | 1.06 |
| Reach-1 | 40 | 10-year | 116.00 | 68.30 | 69.58 | 69.60 | 70.20 | 0.010035 | 6.30 | 18.42 | 15.68 | 1.02 |
| Reach-1 | 40 | 25-year | 126.00 | 68.30 | 69.65 | 69.67 | 70.30 | 0.009840 | 6.44 | 19.57 | 15.80 | 1.02 |
| Reach-1 | 40 | 50-year | 138.00 | 68.30 | 69.74 | 69.75 | 70.42 | 0.009696 | 6.61 | 20.87 | 15.93 | 1.02 |
| Reach-1 | 40 | 100-year | 155.00 | 68.30 | 69.86 | 69.86 | 70.57 | 0.009246 | 6.80 | 22.80 | 16.13 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 39 | August | 8.00 | 67.76 | 67.93 | 68.00 | 68.15 | 0.047091 | 3.78 | 2.12 | 13.20 | 1.66 |
| Reach-1 | 39 | Spring - meas. | 14.60 | 67.76 | 68.00 | 68.11 | 68.35 | 0.045194 | 4.72 | 3.10 | 13.34 | 1.73 |
| Reach-1 | 39 | Spring | 22.00 | 67.76 | 68.08 | 68.21 | 68.53 | 0.041575 | 5.39 | 4.08 | 13.49 | 1.72 |
| Reach-1 | 39 | Mean Annual | 80.00 | 67.76 | 68.54 | 68.80 | 69.44 | 0.026898 | 7.63 | 10.48 | 14.38 | 1.58 |
| Reach-1 | 39 | 10-year | 116.00 | 67.76 | 68.76 | 69.08 | 69.86 | 0.024079 | 8.41 | 13.79 | 14.88 | 1.54 |
| Reach-1 | 39 | 25-year | 126.00 | 67.76 | 68.82 | 69.15 | 69.96 | 0.023365 | 8.57 | 14.70 | 15.04 | 1.53 |
| Reach-1 | 39 | 50-year | 138.00 | 67.76 | 68.89 | 69.24 | 70.09 | 0.022734 | 8.76 | 15.75 | 15.23 | 1.52 |
| Reach-1 | 39 | 100-year | 155.00 | 67.76 | 68.99 | 69.35 | 70.25 | 0.022085 | 9.03 | 17.17 | 15.47 | 1.51 |
| | | | | | | | | | | | | |
| Reach-1 | 38 | August | 8.00 | 67.40 | 67.70 | 67.62 | 67.75 | 0.005125 | 1.80 | 4.45 | 16.08 | 0.60 |
| Reach-1 | 38 | Spring - meas. | 14.60 | 67.40 | 67.83 | 67.71 | 67.90 | 0.005061 | 2.23 | 6.55 | 16.97 | 0.63 |
| Reach-1 | 38 | Spring | 22.00 | 67.40 | 67.93 | 67.81 | 68.04 | 0.005311 | 2.62 | 8.39 | 17.65 | 0.67 |
| Reach-1 | 38 | Mean Annual | 80.00 | 67.40 | 68.53 | 68.33 | 68.78 | 0.004982 | 3.99 | 20.05 | 21.23 | 0.72 |
| Reach-1 | 38 | 10-year | 116.00 | 67.40 | 68.80 | 68.56 | 69.11 | 0.004863 | 4.46 | 26.03 | 22.86 | 0.74 |
| Reach-1 | 38 | 25-year | 126.00 | 67.40 | 68.87 | 68.62 | 69.19 | 0.004839 | 4.57 | 27.59 | 23.26 | 0.74 |
| Reach-1 | 38 | 50-year | 138.00 | 67.40 | 68.95 | 68.69 | 69.29 | 0.004831 | 4.69 | 29.40 | 23.72 | 0.74 |
| Reach-1 | 38 | 100-year | 155.00 | 67.40 | 69.05 | 68.78 | 69.42 | 0.004800 | 4.86 | 31.92 | 24.35 | 0.75 |
| | | | | | | | | | | | | |
| Reach-1 | 37 | August | 8.00 | 67.00 | 67.23 | 67.23 | 67.34 | 0.015186 | 2.65 | 3.02 | 13.76 | 1.00 |
| Reach-1 | 37 | Spring - meas. | 14.60 | 67.00 | 67.34 | 67.34 | 67.50 | 0.013485 | 3.19 | 4.58 | 14.45 | 1.00 |
| Reach-1 | 37 | Spring | 22.00 | 67.00 | 67.44 | 67.44 | 67.65 | 0.012671 | 3.62 | 6.07 | 15.07 | 1.01 |
| Reach-1 | 37 | Mean Annual | 80.00 | 67.00 | 68.00 | 68.00 | 68.42 | 0.010103 | 5.20 | 15.38 | 18.51 | 1.01 |
| Reach-1 | 37 | 10-year | 116.00 | 67.00 | 68.25 | 68.25 | 68.76 | 0.009534 | 5.74 | 20.22 | 20.07 | 1.01 |
| Reach-1 | 37 | 25-year | 126.00 | 67.00 | 68.31 | 68.31 | 68.84 | 0.009394 | 5.85 | 21.53 | 20.49 | 1.01 |
| Reach-1 | 37 | 50-year | 138.00 | 67.00 | 68.39 | 68.39 | 68.94 | 0.009191 | 5.97 | 23.13 | 21.04 | 1.00 |
| Reach-1 | 37 | 100-year | 155.00 | 67.00 | 68.49 | 68.49 | 69.07 | 0.009029 | 6.13 | 25.28 | 21.76 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 36 | August | 8.00 | 64.70 | 66.60 | 64.90 | 66.60 | 0.000008 | 0.22 | 36.45 | 22.29 | 0.03 |
| Reach-1 | 36 | Spring - meas. | 14.60 | 64.70 | 66.79 | 64.99 | 66.79 | 0.000018 | 0.36 | 40.71 | 22.90 | 0.05 |
| Reach-1 | 36 | Spring | 22.00 | 64.70 | 66.96 | 65.08 | 66.96 | 0.000031 | 0.49 | 44.63 | 23.45 | 0.06 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 36 | Mean Annual | 80.00 | 64.70 | 67.82 | 65.58 | 67.84 | 0.000138 | 1.21 | 66.28 | 27.50 | 0.14 |
| Reach-1 | 36 | 10-year | 116.00 | 64.70 | 68.20 | 65.83 | 68.23 | 0.000195 | 1.50 | 77.22 | 29.88 | 0.16 |
| Reach-1 | 36 | 25-year | 126.00 | 64.70 | 68.29 | 65.89 | 68.33 | 0.000209 | 1.57 | 80.08 | 30.49 | 0.17 |
| Reach-1 | 36 | 50-year | 138.00 | 64.70 | 68.40 | 65.96 | 68.44 | 0.000226 | 1.65 | 83.42 | 31.20 | 0.18 |
| Reach-1 | 36 | 100-year | 155.00 | 64.70 | 68.54 | 66.05 | 68.59 | 0.000244 | 1.76 | 87.95 | 31.98 | 0.19 |
| | | | | | | | | | | | | |
| Reach-1 | 35 | August | 8.00 | 65.80 | 66.59 | | 66.60 | 0.000561 | 0.62 | 12.84 | 17.65 | 0.13 |
| Reach-1 | 35 | Spring - meas. | 14.60 | 65.80 | 66.77 | | 66.79 | 0.000927 | 0.91 | 16.11 | 18.32 | 0.17 |
| Reach-1 | 35 | Spring | 22.00 | 65.80 | 66.94 | | 66.96 | 0.001244 | 1.15 | 19.13 | 18.91 | 0.20 |
| Reach-1 | 35 | Mean Annual | 80.00 | 65.80 | 67.75 | | 67.83 | 0.002584 | 2.24 | 35.78 | 22.30 | 0.31 |
| Reach-1 | 35 | 10-year | 116.00 | 65.80 | 68.11 | | 68.22 | 0.003104 | 2.62 | 44.28 | 24.99 | 0.35 |
| Reach-1 | 35 | 25-year | 126.00 | 65.80 | 68.20 | | 68.32 | 0.003208 | 2.71 | 46.56 | 25.66 | 0.35 |
| Reach-1 | 35 | 50-year | 138.00 | 65.80 | 68.31 | | 68.43 | 0.003318 | 2.80 | 49.26 | 26.43 | 0.36 |
| Reach-1 | 35 | 100-year | 155.00 | 65.80 | 68.44 | | 68.58 | 0.003416 | 2.93 | 52.93 | 27.18 | 0.37 |
| | | | | | | | | | | | | |
| Reach-1 | 34 | August | 8.00 | 66.15 | 66.50 | | 66.55 | 0.012298 | 1.73 | 4.64 | 14.18 | 0.53 |
| Reach-1 | 34 | Spring - meas. | 14.60 | 66.15 | 66.63 | | 66.71 | 0.014254 | 2.25 | 6.49 | 14.82 | 0.60 |
| Reach-1 | 34 | Spring | 22.00 | 66.15 | 66.74 | | 66.85 | 0.015610 | 2.69 | 8.19 | 15.32 | 0.65 |
| Reach-1 | 34 | Mean Annual | 80.00 | 66.15 | 67.29 | | 67.62 | 0.021406 | 4.64 | 17.23 | 17.74 | 0.83 |
| Reach-1 | 34 | 10-year | 116.00 | 66.15 | 67.53 | | 67.97 | 0.023070 | 5.37 | 21.58 | 18.80 | 0.88 |
| Reach-1 | 34 | 25-year | 126.00 | 66.15 | 67.59 | | 68.06 | 0.023200 | 5.53 | 22.79 | 19.08 | 0.89 |
| Reach-1 | 34 | 50-year | 138.00 | 66.15 | 67.66 | 67.56 | 68.17 | 0.023330 | 5.70 | 24.20 | 19.40 | 0.90 |
| Reach-1 | 34 | 100-year | 155.00 | 66.15 | 67.76 | 67.67 | 68.31 | 0.023662 | 5.94 | 26.08 | 19.83 | 0.91 |
| | | | | | | | | | | | | |
| Reach-1 | 33 | August | 8.00 | 66.01 | 66.28 | | 66.36 | 0.009667 | 2.26 | 3.54 | 14.65 | 0.81 |
| Reach-1 | 33 | Spring - meas. | 14.60 | 66.01 | 66.40 | | 66.51 | 0.008803 | 2.74 | 5.33 | 15.32 | 0.82 |
| Reach-1 | 33 | Spring | 22.00 | 66.01 | 66.51 | | 66.66 | 0.008335 | 3.13 | 7.04 | 15.92 | 0.83 |
| Reach-1 | 33 | Mean Annual | 80.00 | 66.01 | 67.10 | | 67.43 | 0.006905 | 4.57 | 17.50 | 19.25 | 0.85 |
| Reach-1 | 33 | 10-year | 116.00 | 66.01 | 67.38 | | 67.77 | 0.006529 | 5.04 | 23.00 | 20.90 | 0.85 |
| Reach-1 | 33 | 25-year | 126.00 | 66.01 | 67.45 | | 67.86 | 0.006448 | 5.15 | 24.46 | 21.31 | 0.85 |
| Reach-1 | 33 | 50-year | 138.00 | 66.01 | 67.53 | | 67.96 | 0.006360 | 5.27 | 26.18 | 21.79 | 0.85 |
| Reach-1 | 33 | 100-year | 155.00 | 66.01 | 67.63 | | 68.09 | 0.006254 | 5.43 | 28.55 | 22.43 | 0.85 |
| | | | | | | | | | | | | |
| Reach-1 | 32 | August | 8.00 | 65.69 | 66.03 | | 66.07 | 0.003532 | 1.59 | 5.02 | 16.49 | 0.51 |
| Reach-1 | 32 | Spring - meas. | 14.60 | 65.69 | 66.17 | | 66.23 | 0.003459 | 1.97 | 7.41 | 17.38 | 0.53 |
| Reach-1 | 32 | Spring | 22.00 | 65.69 | 66.29 | | 66.38 | 0.003506 | 2.29 | 9.62 | 18.16 | 0.55 |
| Reach-1 | 32 | Mean Annual | 80.00 | 65.69 | 66.97 | | 67.15 | 0.003253 | 3.44 | 23.28 | 22.41 | 0.59 |
| Reach-1 | 32 | 10-year | 116.00 | 65.69 | 67.27 | | 67.50 | 0.003182 | 3.83 | 30.28 | 24.30 | 0.60 |
| Reach-1 | 32 | 25-year | 126.00 | 65.69 | 67.34 | | 67.58 | 0.003167 | 3.92 | 32.12 | 24.77 | 0.61 |
| Reach-1 | 32 | 50-year | 138.00 | 65.69 | 67.43 | | 67.68 | 0.003152 | 4.03 | 34.28 | 25.31 | 0.61 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 32 | 100-year | 155.00 | 65.69 | 67.55 | | 67.81 | 0.003128 | 4.16 | 37.25 | 26.01 | 0.61 |
| | | | | | | | | | | | | |
| Reach-1 | 31 | August | 8.00 | 65.29 | 65.56 | 65.56 | 65.68 | 0.015268 | 2.78 | 2.88 | 12.30 | 1.01 |
| Reach-1 | 31 | Spring - meas. | 14.60 | 65.29 | 65.68 | 65.68 | 65.85 | 0.013286 | 3.30 | 4.42 | 13.08 | 1.00 |
| Reach-1 | 31 | Spring | 22.00 | 65.29 | 65.79 | 65.79 | 66.00 | 0.012226 | 3.71 | 5.93 | 13.81 | 1.00 |
| Reach-1 | 31 | Mean Annual | 80.00 | 65.29 | 66.38 | 66.38 | 66.81 | 0.009966 | 5.29 | 15.13 | 17.65 | 1.01 |
| Reach-1 | 31 | 10-year | 116.00 | 65.29 | 66.64 | 66.64 | 67.16 | 0.009412 | 5.80 | 20.01 | 19.41 | 1.01 |
| Reach-1 | 31 | 25-year | 126.00 | 65.29 | 66.70 | 66.70 | 67.25 | 0.009295 | 5.92 | 21.30 | 19.85 | 1.01 |
| Reach-1 | 31 | 50-year | 138.00 | 65.29 | 66.78 | 66.78 | 67.35 | 0.009168 | 6.05 | 22.82 | 20.36 | 1.01 |
| Reach-1 | 31 | 100-year | 155.00 | 65.29 | 66.88 | 66.88 | 67.48 | 0.009031 | 6.22 | 24.91 | 21.04 | 1.01 |
| | | | | | | | | | | | | |
| Reach-1 | 30 | August | 8.00 | 62.90 | 64.98 | 63.09 | 64.98 | 0.000006 | 0.21 | 38.83 | 20.73 | 0.03 |
| Reach-1 | 30 | Spring - meas. | 14.60 | 62.90 | 65.17 | 63.19 | 65.17 | 0.000015 | 0.34 | 42.79 | 21.11 | 0.04 |
| Reach-1 | 30 | Spring | 22.00 | 62.90 | 65.35 | 63.28 | 65.35 | 0.000026 | 0.47 | 46.51 | 21.46 | 0.06 |
| Reach-1 | 30 | Mean Annual | 80.00 | 62.90 | 66.25 | 63.78 | 66.27 | 0.000120 | 1.20 | 66.91 | 24.10 | 0.13 |
| Reach-1 | 30 | 10-year | 116.00 | 62.90 | 66.64 | 64.02 | 66.67 | 0.000175 | 1.51 | 76.65 | 25.75 | 0.15 |
| Reach-1 | 30 | 25-year | 126.00 | 62.90 | 66.74 | 64.08 | 66.77 | 0.000190 | 1.59 | 79.19 | 26.23 | 0.16 |
| Reach-1 | 30 | 50-year | 138.00 | 62.90 | 66.84 | 64.15 | 66.89 | 0.000206 | 1.68 | 82.08 | 26.78 | 0.17 |
| Reach-1 | 30 | 100-year | 155.00 | 62.90 | 66.99 | 64.25 | 67.04 | 0.000223 | 1.80 | 86.06 | 27.50 | 0.18 |
| | | | | | | | | | | | | |
| Reach-1 | 29 | August | 8.00 | 64.50 | 64.95 | | 64.98 | 0.001802 | 1.41 | 5.67 | 13.29 | 0.38 |
| Reach-1 | 29 | Spring - meas. | 14.60 | 64.50 | 65.11 | | 65.17 | 0.002088 | 1.84 | 7.92 | 13.77 | 0.43 |
| Reach-1 | 29 | Spring | 22.00 | 64.50 | 65.27 | | 65.34 | 0.002252 | 2.19 | 10.05 | 14.21 | 0.46 |
| Reach-1 | 29 | Mean Annual | 80.00 | 64.50 | 66.04 | | 66.24 | 0.002854 | 3.61 | 22.18 | 17.47 | 0.56 |
| Reach-1 | 29 | 10-year | 116.00 | 64.50 | 66.39 | | 66.64 | 0.002980 | 4.07 | 28.51 | 19.33 | 0.59 |
| Reach-1 | 29 | 25-year | 126.00 | 64.50 | 66.47 | | 66.74 | 0.002993 | 4.17 | 30.21 | 19.80 | 0.59 |
| Reach-1 | 29 | 50-year | 138.00 | 64.50 | 66.57 | | 66.85 | 0.003031 | 4.30 | 32.12 | 20.31 | 0.60 |
| Reach-1 | 29 | 100-year | 155.00 | 64.50 | 66.70 | | 67.01 | 0.002987 | 4.46 | 34.80 | 21.01 | 0.60 |
| | | | | | | | | | | | | |
| Reach-1 | 28 | August | 8.00 | 64.45 | 64.71 | 64.71 | 64.84 | 0.014900 | 2.82 | 2.83 | 11.54 | 1.00 |
| Reach-1 | 28 | Spring - meas. | 14.60 | 64.45 | 64.84 | 64.84 | 65.02 | 0.013032 | 3.39 | 4.31 | 12.06 | 1.00 |
| Reach-1 | 28 | Spring | 22.00 | 64.45 | 64.95 | 64.95 | 65.18 | 0.012267 | 3.85 | 5.71 | 12.53 | 1.01 |
| Reach-1 | 28 | Mean Annual | 80.00 | 64.45 | 65.58 | 65.58 | 66.06 | 0.009755 | 5.56 | 14.40 | 15.12 | 1.00 |
| Reach-1 | 28 | 10-year | 116.00 | 64.45 | 65.87 | 65.87 | 66.45 | 0.009194 | 6.13 | 18.94 | 16.34 | 1.00 |
| Reach-1 | 28 | 25-year | 126.00 | 64.45 | 65.94 | 65.94 | 66.55 | 0.009131 | 6.27 | 20.10 | 16.66 | 1.01 |
| Reach-1 | 28 | 50-year | 138.00 | 64.45 | 66.03 | 66.03 | 66.66 | 0.008966 | 6.40 | 21.56 | 17.05 | 1.00 |
| Reach-1 | 28 | 100-year | 155.00 | 64.45 | 66.13 | 66.13 | 66.81 | 0.008751 | 6.63 | 23.40 | 17.53 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 27 | August | 8.00 | 64.25 | 64.51 | 64.52 | 64.64 | 0.016366 | 2.92 | 2.74 | 11.39 | 1.05 |
| Reach-1 | 27 | Spring - meas. | 14.60 | 64.25 | 64.62 | 64.65 | 64.83 | 0.017081 | 3.70 | 3.95 | 11.91 | 1.13 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 27 | Spring | 22.00 | 64.25 | 64.72 | 64.76 | 65.00 | 0.016591 | 4.24 | 5.19 | 12.41 | 1.16 |
| Reach-1 | 27 | Mean Annual | 80.00 | 64.25 | 65.24 | 65.39 | 65.89 | 0.015830 | 6.46 | 12.38 | 15.03 | 1.25 |
| Reach-1 | 27 | 10-year | 116.00 | 64.25 | 65.48 | 65.65 | 66.29 | 0.015100 | 7.20 | 16.11 | 16.23 | 1.26 |
| Reach-1 | 27 | 25-year | 126.00 | 64.25 | 65.54 | 65.72 | 66.39 | 0.014576 | 7.37 | 17.13 | 16.55 | 1.26 |
| Reach-1 | 27 | 50-year | 138.00 | 64.25 | 65.61 | 65.80 | 66.50 | 0.014095 | 7.56 | 18.33 | 16.90 | 1.25 |
| Reach-1 | 27 | 100-year | 155.00 | 64.25 | 65.72 | 65.90 | 66.66 | 0.013397 | 7.80 | 20.05 | 17.41 | 1.23 |
| | | | | | | | | | | | | |
| Reach-1 | 26 | August | 8.00 | 63.60 | 63.73 | 63.81 | 64.02 | 0.088195 | 4.32 | 1.85 | 15.24 | 2.19 |
| Reach-1 | 26 | Spring - meas. | 14.60 | 63.60 | 63.88 | 63.91 | 64.06 | 0.019432 | 3.38 | 4.32 | 16.48 | 1.16 |
| Reach-1 | 26 | Spring | 22.00 | 63.60 | 64.03 | 64.00 | 64.19 | 0.010379 | 3.21 | 6.86 | 17.66 | 0.91 |
| Reach-1 | 26 | Mean Annual | 80.00 | 63.60 | 64.34 | 64.51 | 64.96 | 0.021259 | 6.34 | 12.62 | 19.99 | 1.41 |
| Reach-1 | 26 | 10-year | 116.00 | 63.60 | 64.48 | 64.73 | 65.34 | 0.023353 | 7.41 | 15.66 | 21.03 | 1.51 |
| Reach-1 | 26 | 25-year | 126.00 | 63.60 | 64.52 | 64.79 | 65.44 | 0.024264 | 7.71 | 16.34 | 21.25 | 1.55 |
| Reach-1 | 26 | 50-year | 138.00 | 63.60 | 64.56 | 64.85 | 65.56 | 0.025013 | 8.03 | 17.19 | 21.53 | 1.58 |
| Reach-1 | 26 | 100-year | 155.00 | 63.60 | 64.61 | 64.94 | 65.72 | 0.026039 | 8.45 | 18.34 | 21.90 | 1.63 |
| | | | | | | | | | | | | |
| Reach-1 | 25 | August | 8.00 | 62.90 | 63.20 | 63.20 | 63.31 | 0.015020 | 2.72 | 2.94 | 12.80 | 1.00 |
| Reach-1 | 25 | Spring - meas. | 14.60 | 62.90 | 63.32 | 63.32 | 63.47 | 0.013782 | 3.19 | 4.58 | 14.77 | 1.01 |
| Reach-1 | 25 | Spring | 22.00 | 62.90 | 63.42 | 63.42 | 63.62 | 0.012586 | 3.56 | 6.19 | 15.80 | 1.00 |
| Reach-1 | 25 | Mean Annual | 80.00 | 62.90 | 63.96 | 63.96 | 64.34 | 0.010269 | 4.99 | 16.02 | 21.03 | 1.01 |
| Reach-1 | 25 | 10-year | 116.00 | 62.90 | 64.19 | 64.19 | 64.65 | 0.009690 | 5.46 | 21.25 | 23.31 | 1.01 |
| Reach-1 | 25 | 25-year | 126.00 | 62.90 | 64.25 | 64.25 | 64.73 | 0.009565 | 5.57 | 22.63 | 23.87 | 1.01 |
| Reach-1 | 25 | 50-year | 138.00 | 62.90 | 64.32 | 64.32 | 64.82 | 0.009440 | 5.69 | 24.25 | 24.50 | 1.01 |
| Reach-1 | 25 | 100-year | 155.00 | 62.90 | 64.41 | 64.41 | 64.94 | 0.009302 | 5.85 | 26.48 | 25.35 | 1.01 |
| | | | | | | | | | | | | |
| Reach-1 | 24 | August | 8.00 | 60.60 | 62.97 | 60.81 | 62.97 | 0.000004 | 0.17 | 47.01 | 25.09 | 0.02 |
| Reach-1 | 24 | Spring - meas. | 14.60 | 60.60 | 63.11 | 60.91 | 63.11 | 0.000010 | 0.29 | 50.43 | 25.69 | 0.04 |
| Reach-1 | 24 | Spring | 22.00 | 60.60 | 63.23 | 61.00 | 63.23 | 0.000020 | 0.41 | 53.62 | 26.87 | 0.05 |
| Reach-1 | 24 | Mean Annual | 80.00 | 60.60 | 63.77 | 61.53 | 63.79 | 0.000147 | 1.14 | 70.13 | 33.74 | 0.14 |
| Reach-1 | 24 | 10-year | 116.00 | 60.60 | 64.03 | 61.77 | 64.06 | 0.000230 | 1.47 | 79.14 | 36.55 | 0.18 |
| Reach-1 | 24 | 25-year | 126.00 | 60.60 | 64.09 | 61.84 | 64.13 | 0.000254 | 1.55 | 81.28 | 37.19 | 0.18 |
| Reach-1 | 24 | 50-year | 138.00 | 60.60 | 64.15 | 61.91 | 64.19 | 0.000283 | 1.65 | 83.66 | 37.88 | 0.20 |
| Reach-1 | 24 | 100-year | 155.00 | 60.60 | 64.23 | 62.01 | 64.28 | 0.000347 | 1.79 | 86.78 | 40.73 | 0.22 |
| | | | | | | | | | | | | |
| Reach-1 | 23 | August | 8.00 | 60.30 | 62.97 | | 62.97 | 0.000002 | 0.13 | 59.36 | 31.35 | 0.02 |
| Reach-1 | 23 | Spring - meas. | 14.60 | 60.30 | 63.11 | | 63.11 | 0.000006 | 0.23 | 63.67 | 32.62 | 0.03 |
| Reach-1 | 23 | Spring | 22.00 | 60.30 | 63.23 | | 63.23 | 0.000012 | 0.32 | 67.73 | 33.78 | 0.04 |
| Reach-1 | 23 | Mean Annual | 80.00 | 60.30 | 63.78 | | 63.79 | 0.000085 | 0.91 | 87.56 | 38.93 | 0.11 |
| Reach-1 | 23 | 10-year | 116.00 | 60.30 | 64.03 | | 64.06 | 0.000136 | 1.18 | 98.03 | 42.27 | 0.14 |
| Reach-1 | 23 | 25-year | 126.00 | 60.30 | 64.09 | | 64.12 | 0.000151 | 1.25 | 100.54 | 43.07 | 0.14 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 23 | 50-year | 138.00 | 60.30 | 64.16 | | 64.19 | 0.000169 | 1.34 | 103.33 | 44.38 | 0.15 |
| Reach-1 | 23 | 100-year | 155.00 | 60.30 | 64.24 | | 64.27 | 0.000191 | 1.45 | 107.06 | 47.46 | 0.16 |
| | | | | | | | | | | | | |
| Reach-1 | 22 | August | 8.00 | 61.71 | 62.97 | | 62.97 | 0.000031 | 0.31 | 25.83 | 28.50 | 0.06 |
| Reach-1 | 22 | Spring - meas. | 14.60 | 61.71 | 63.11 | | 63.11 | 0.000070 | 0.49 | 29.70 | 29.94 | 0.09 |
| Reach-1 | 22 | Spring | 22.00 | 61.71 | 63.22 | | 63.23 | 0.000114 | 0.66 | 33.36 | 31.24 | 0.11 |
| Reach-1 | 22 | Mean Annual | 80.00 | 61.71 | 63.75 | | 63.79 | 0.000499 | 1.56 | 51.31 | 39.82 | 0.24 |
| Reach-1 | 22 | 10-year | 116.00 | 61.71 | 64.00 | | 64.05 | 0.000689 | 1.86 | 62.39 | 47.43 | 0.29 |
| Reach-1 | 22 | 25-year | 126.00 | 61.71 | 64.05 | | 64.11 | 0.000727 | 1.94 | 65.09 | 48.53 | 0.29 |
| Reach-1 | 22 | 50-year | 138.00 | 61.71 | 64.12 | | 64.18 | 0.000756 | 2.03 | 68.11 | 49.84 | 0.30 |
| Reach-1 | 22 | 100-year | 155.00 | 61.71 | 64.19 | | 64.26 | 0.000797 | 2.16 | 72.07 | 53.04 | 0.31 |
| | | | | | | | | | | | | |
| Reach-1 | 21 | August | 8.00 | 62.65 | 62.94 | | 62.97 | 0.011443 | 1.44 | 5.55 | 21.27 | 0.50 |
| Reach-1 | 21 | Spring - meas. | 14.60 | 62.65 | 63.05 | | 63.10 | 0.012110 | 1.81 | 8.06 | 22.84 | 0.54 |
| Reach-1 | 21 | Spring | 22.00 | 62.65 | 63.15 | | 63.22 | 0.012408 | 2.10 | 10.49 | 24.26 | 0.56 |
| Reach-1 | 21 | Mean Annual | 80.00 | 62.65 | 63.43 | 63.43 | 63.75 | 0.035113 | 4.53 | 17.65 | 28.04 | 1.01 |
| Reach-1 | 21 | 10-year | 116.00 | 62.65 | 63.63 | 63.63 | 64.01 | 0.031963 | 4.91 | 23.61 | 30.94 | 0.99 |
| Reach-1 | 21 | 25-year | 126.00 | 62.65 | 63.70 | 63.70 | 64.07 | 0.033109 | 4.88 | 25.82 | 35.11 | 1.00 |
| Reach-1 | 21 | 50-year | 138.00 | 62.65 | 63.76 | 63.76 | 64.13 | 0.033197 | 4.89 | 28.21 | 38.31 | 1.00 |
| Reach-1 | 21 | 100-year | 155.00 | 62.65 | 63.85 | 63.84 | 64.22 | 0.032362 | 4.87 | 31.82 | 42.68 | 0.99 |
| | | | | | | | | | | | | |
| Reach-1 | 20 | August | 8.00 | 60.70 | 60.90 | 60.90 | 61.00 | 0.051796 | 2.52 | 3.17 | 16.22 | 1.01 |
| Reach-1 | 20 | Spring - meas. | 14.60 | 60.70 | 61.00 | 61.00 | 61.14 | 0.045072 | 3.04 | 4.80 | 16.72 | 1.00 |
| Reach-1 | 20 | Spring | 22.00 | 60.70 | 61.09 | 61.09 | 61.28 | 0.041889 | 3.46 | 6.35 | 17.18 | 1.00 |
| Reach-1 | 20 | Mean Annual | 80.00 | 60.70 | 62.01 | 61.60 | 62.18 | 0.008835 | 3.29 | 24.33 | 21.80 | 0.55 |
| Reach-1 | 20 | 10-year | 116.00 | 60.70 | 62.42 | 61.84 | 62.60 | 0.007204 | 3.47 | 33.48 | 23.68 | 0.51 |
| Reach-1 | 20 | 25-year | 126.00 | 60.70 | 62.50 | 61.90 | 62.70 | 0.007108 | 3.54 | 35.57 | 24.07 | 0.51 |
| Reach-1 | 20 | 50-year | 138.00 | 60.70 | 62.60 | 61.97 | 62.81 | 0.007064 | 3.64 | 37.92 | 24.51 | 0.52 |
| Reach-1 | 20 | 100-year | 155.00 | 60.70 | 62.72 | | 62.94 | 0.007169 | 3.79 | 40.92 | 25.15 | 0.52 |
| | | | | | | | | | | | | |
| Reach-1 | 19 | August | 8.00 | 58.50 | 60.78 | 58.69 | 60.78 | 0.000004 | 0.18 | 43.36 | 21.52 | 0.02 |
| Reach-1 | 19 | Spring - meas. | 14.60 | 58.50 | 60.99 | 58.79 | 60.99 | 0.000010 | 0.31 | 47.87 | 21.98 | 0.04 |
| Reach-1 | 19 | Spring | 22.00 | 58.50 | 61.18 | 58.88 | 61.18 | 0.000019 | 0.42 | 52.03 | 22.39 | 0.05 |
| Reach-1 | 19 | Mean Annual | 80.00 | 58.50 | 62.11 | | 62.13 | 0.000092 | 1.08 | 74.29 | 25.86 | 0.11 |
| Reach-1 | 19 | 10-year | 116.00 | 58.50 | 62.52 | | 62.55 | 0.000135 | 1.36 | 85.19 | 27.89 | 0.14 |
| Reach-1 | 19 | 25-year | 126.00 | 58.50 | 62.60 | | 62.64 | 0.000246 | 1.43 | 88.22 | 43.71 | 0.18 |
| Reach-1 | 19 | 50-year | 138.00 | 58.50 | 62.70 | | 62.74 | 0.000354 | 1.48 | 93.31 | 58.49 | 0.21 |
| Reach-1 | 19 | 100-year | 155.00 | 58.50 | 62.83 | | 62.87 | 0.000397 | 1.53 | 101.27 | 66.03 | 0.22 |
| | | | | | | | | | | | | |
| Reach-1 | 18 | August | 8.00 | 58.00 | 60.78 | | 60.78 | 0.000006 | 0.22 | 36.47 | 16.32 | 0.03 |

HEC-RAS Plan: 070626 all2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 18 | Spring - meas. | 14.60 | 58.00 | 60.99 | | 60.99 | 0.000016 | 0.37 | 39.97 | 17.51 | 0.04 |
| Reach-1 | 18 | Spring | 22.00 | 58.00 | 61.18 | | 61.18 | 0.000029 | 0.51 | 43.34 | 18.60 | 0.06 |
| Reach-1 | 18 | Mean Annual | 80.00 | 58.00 | 62.10 | | 62.13 | 0.000145 | 1.28 | 62.44 | 22.40 | 0.14 |
| Reach-1 | 18 | 10-year | 116.00 | 58.00 | 62.50 | | 62.54 | 0.000288 | 1.59 | 72.99 | 35.75 | 0.19 |
| Reach-1 | 18 | 25-year | 126.00 | 58.00 | 62.58 | | 62.63 | 0.000300 | 1.67 | 76.34 | 50.69 | 0.19 |
| Reach-1 | 18 | 50-year | 138.00 | 58.00 | 62.68 | | 62.72 | 0.000314 | 1.75 | 81.36 | 56.58 | 0.20 |
| Reach-1 | 18 | 100-year | 155.00 | 58.00 | 62.80 | | 62.85 | 0.000333 | 1.86 | 88.69 | 62.32 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 17 | August | 8.00 | 60.30 | 60.71 | | 60.78 | 0.015178 | 2.08 | 3.84 | 10.29 | 0.60 |
| Reach-1 | 17 | Spring - meas. | 14.60 | 60.30 | 60.87 | | 60.98 | 0.015817 | 2.61 | 5.60 | 11.00 | 0.64 |
| Reach-1 | 17 | Spring | 22.00 | 60.30 | 61.02 | | 61.16 | 0.016259 | 3.02 | 7.28 | 11.64 | 0.67 |
| Reach-1 | 17 | Mean Annual | 80.00 | 60.30 | 61.76 | | 62.09 | 0.017865 | 4.60 | 17.39 | 15.75 | 0.77 |
| Reach-1 | 17 | 10-year | 116.00 | 60.30 | 62.14 | | 62.50 | 0.018125 | 4.79 | 24.31 | 24.26 | 0.79 |
| Reach-1 | 17 | 25-year | 126.00 | 60.30 | 62.21 | 61.95 | 62.58 | 0.017704 | 4.91 | 26.05 | 28.05 | 0.78 |
| Reach-1 | 17 | 50-year | 138.00 | 60.30 | 62.29 | 62.10 | 62.68 | 0.017038 | 5.03 | 28.46 | 32.11 | 0.78 |
| Reach-1 | 17 | 100-year | 155.00 | 60.30 | 62.40 | 62.19 | 62.81 | 0.015941 | 5.14 | 32.44 | 37.86 | 0.76 |
| | | | | | | | | | | | | |
| Reach-1 | 16 | August | 8.00 | 59.37 | 59.72 | 59.72 | 59.86 | 0.045521 | 3.01 | 2.66 | 9.37 | 1.00 |
| Reach-1 | 16 | Spring - meas. | 14.60 | 59.37 | 59.86 | 59.86 | 60.06 | 0.041680 | 3.63 | 4.03 | 10.01 | 1.01 |
| Reach-1 | 16 | Spring | 22.00 | 59.37 | 59.99 | 59.99 | 60.25 | 0.038647 | 4.07 | 5.40 | 10.62 | 1.01 |
| Reach-1 | 16 | Mean Annual | 80.00 | 59.37 | 60.69 | 60.69 | 61.20 | 0.031426 | 5.73 | 13.97 | 13.92 | 1.01 |
| Reach-1 | 16 | 10-year | 116.00 | 59.37 | 61.00 | 61.00 | 61.61 | 0.029741 | 6.27 | 18.51 | 15.39 | 1.01 |
| Reach-1 | 16 | 25-year | 126.00 | 59.37 | 61.08 | 61.08 | 61.71 | 0.029378 | 6.39 | 19.72 | 15.75 | 1.01 |
| Reach-1 | 16 | 50-year | 138.00 | 59.37 | 61.16 | 61.16 | 61.83 | 0.029093 | 6.54 | 21.10 | 16.14 | 1.01 |
| Reach-1 | 16 | 100-year | 155.00 | 59.37 | 61.28 | 61.28 | 61.98 | 0.028758 | 6.74 | 23.00 | 16.64 | 1.01 |
| | | | | | | | | | | | | |
| Reach-1 | 15 | August | 8.00 | 59.08 | 59.55 | 59.38 | 59.60 | 0.002669 | 1.68 | 4.77 | 11.60 | 0.46 |
| Reach-1 | 15 | Spring - meas. | 14.60 | 59.08 | 59.71 | 59.50 | 59.79 | 0.003165 | 2.19 | 6.67 | 12.31 | 0.52 |
| Reach-1 | 15 | Spring | 22.00 | 59.08 | 59.85 | 59.62 | 59.96 | 0.003491 | 2.59 | 8.48 | 13.01 | 0.57 |
| Reach-1 | 15 | Mean Annual | 80.00 | 59.08 | 60.57 | 60.27 | 60.84 | 0.004323 | 4.19 | 19.07 | 16.53 | 0.69 |
| Reach-1 | 15 | 10-year | 116.00 | 59.08 | 60.87 | 60.56 | 61.23 | 0.004606 | 4.79 | 24.22 | 17.98 | 0.73 |
| Reach-1 | 15 | 25-year | 126.00 | 59.08 | 60.94 | 60.64 | 61.32 | 0.004672 | 4.93 | 25.55 | 18.34 | 0.74 |
| Reach-1 | 15 | 50-year | 138.00 | 59.08 | 61.03 | 60.72 | 61.43 | 0.004685 | 5.07 | 27.23 | 18.78 | 0.74 |
| Reach-1 | 15 | 100-year | 155.00 | 59.08 | 61.15 | 60.83 | 61.58 | 0.004782 | 5.24 | 29.56 | 19.67 | 0.75 |
| | | | | | | | | | | | | |
| Reach-1 | 14 | August | 8.00 | 58.90 | 59.57 | | 59.58 | 0.000438 | 0.87 | 9.25 | 15.72 | 0.20 |
| Reach-1 | 14 | Spring - meas. | 14.60 | 58.90 | 59.74 | | 59.77 | 0.000661 | 1.21 | 12.04 | 16.73 | 0.25 |
| Reach-1 | 14 | Spring | 22.00 | 58.90 | 59.90 | | 59.93 | 0.000830 | 1.50 | 14.70 | 17.65 | 0.29 |
| Reach-1 | 14 | Mean Annual | 80.00 | 58.90 | 60.68 | | 60.79 | 0.001360 | 2.64 | 30.27 | 22.26 | 0.40 |
| Reach-1 | 14 | 10-year | 116.00 | 58.90 | 61.01 | | 61.16 | 0.001566 | 3.05 | 38.09 | 25.16 | 0.44 |

HEC-RAS Plan: 070626 all2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 14 | 25-year | 126.00 | 58.90 | 61.09 | | 61.25 | 0.001695 | 3.13 | 40.24 | 27.09 | 0.45 |
| Reach-1 | 14 | 50-year | 138.00 | 58.90 | 61.19 | | 61.35 | 0.001804 | 3.20 | 43.06 | 29.39 | 0.47 |
| Reach-1 | 14 | 100-year | 155.00 | 58.90 | 61.33 | | 61.50 | 0.001905 | 3.28 | 47.26 | 32.51 | 0.48 |
| | | | | | | | | | | | | |
| Reach-1 | 13 | August | 8.00 | 58.70 | 59.57 | | 59.57 | 0.000081 | 0.43 | 18.75 | 25.99 | 0.09 |
| Reach-1 | 13 | Spring - meas. | 14.60 | 58.70 | 59.74 | | 59.75 | 0.000142 | 0.62 | 23.38 | 27.89 | 0.12 |
| Reach-1 | 13 | Spring | 22.00 | 58.70 | 59.90 | | 59.91 | 0.000198 | 0.79 | 27.89 | 30.11 | 0.14 |
| Reach-1 | 13 | Mean Annual | 80.00 | 58.70 | 60.70 | | 60.73 | 0.000381 | 1.41 | 56.63 | 41.57 | 0.21 |
| Reach-1 | 13 | 10-year | 116.00 | 58.70 | 61.05 | | 61.09 | 0.000417 | 1.61 | 71.93 | 46.32 | 0.23 |
| Reach-1 | 13 | 25-year | 126.00 | 58.70 | 61.13 | | 61.18 | 0.000425 | 1.66 | 75.90 | 47.49 | 0.23 |
| Reach-1 | 13 | 50-year | 138.00 | 58.70 | 61.23 | | 61.28 | 0.000430 | 1.71 | 80.83 | 48.91 | 0.23 |
| Reach-1 | 13 | 100-year | 155.00 | 58.70 | 61.37 | | 61.42 | 0.000437 | 1.77 | 87.68 | 50.96 | 0.24 |
| | | | | | | | | | | | | |
| Reach-1 | 12 | August | 8.00 | 56.75 | 59.57 | | 59.57 | 0.000001 | 0.12 | 69.05 | 30.84 | 0.01 |
| Reach-1 | 12 | Spring - meas. | 14.60 | 56.75 | 59.75 | | 59.75 | 0.000004 | 0.20 | 74.59 | 32.94 | 0.02 |
| Reach-1 | 12 | Spring | 22.00 | 56.75 | 59.90 | | 59.90 | 0.000008 | 0.28 | 79.94 | 34.86 | 0.03 |
| Reach-1 | 12 | Mean Annual | 80.00 | 56.75 | 60.71 | | 60.72 | 0.000046 | 0.71 | 112.15 | 44.68 | 0.08 |
| Reach-1 | 12 | 10-year | 116.00 | 56.75 | 61.06 | | 61.08 | 0.000069 | 0.90 | 128.48 | 48.53 | 0.10 |
| Reach-1 | 12 | 25-year | 126.00 | 56.75 | 61.15 | | 61.16 | 0.000075 | 0.95 | 132.66 | 49.47 | 0.10 |
| Reach-1 | 12 | 50-year | 138.00 | 56.75 | 61.25 | | 61.27 | 0.000082 | 1.00 | 137.80 | 50.60 | 0.11 |
| Reach-1 | 12 | 100-year | 155.00 | 56.75 | 61.39 | | 61.41 | 0.000089 | 1.07 | 144.87 | 52.12 | 0.11 |
| | | | | | | | | | | | | |
| Reach-1 | 11 | August | 8.00 | 56.60 | 59.57 | | 59.57 | 0.000003 | 0.16 | 49.82 | 22.14 | 0.02 |
| Reach-1 | 11 | Spring - meas. | 14.60 | 56.60 | 59.74 | | 59.75 | 0.000007 | 0.27 | 53.71 | 22.76 | 0.03 |
| Reach-1 | 11 | Spring | 22.00 | 56.60 | 59.90 | | 59.90 | 0.000014 | 0.38 | 57.36 | 23.89 | 0.04 |
| Reach-1 | 11 | Mean Annual | 80.00 | 56.60 | 60.70 | | 60.72 | 0.000105 | 0.98 | 81.68 | 38.11 | 0.12 |
| Reach-1 | 11 | 10-year | 116.00 | 56.60 | 61.05 | | 61.07 | 0.000156 | 1.21 | 95.89 | 43.89 | 0.14 |
| Reach-1 | 11 | 25-year | 126.00 | 56.60 | 61.13 | | 61.16 | 0.000169 | 1.26 | 99.65 | 45.29 | 0.15 |
| Reach-1 | 11 | 50-year | 138.00 | 56.60 | 61.24 | | 61.26 | 0.000182 | 1.32 | 104.33 | 46.99 | 0.16 |
| Reach-1 | 11 | 100-year | 155.00 | 56.60 | 61.37 | | 61.40 | 0.000193 | 1.40 | 110.91 | 49.27 | 0.16 |
| | | | | | | | | | | | | |
| Reach-1 | 10 | August | 8.00 | 59.20 | 59.49 | 59.44 | 59.56 | 0.029310 | 2.24 | 3.57 | 14.22 | 0.79 |
| Reach-1 | 10 | Spring - meas. | 14.60 | 59.20 | 59.64 | 59.56 | 59.74 | 0.021036 | 2.45 | 5.95 | 16.13 | 0.71 |
| Reach-1 | 10 | Spring | 22.00 | 59.20 | 59.79 | | 59.89 | 0.017482 | 2.62 | 8.39 | 17.87 | 0.67 |
| Reach-1 | 10 | Mean Annual | 80.00 | 59.20 | 60.55 | | 60.70 | 0.010810 | 3.17 | 25.27 | 28.23 | 0.59 |
| Reach-1 | 10 | 10-year | 116.00 | 59.20 | 60.90 | | 61.06 | 0.009321 | 3.12 | 37.17 | 37.90 | 0.56 |
| Reach-1 | 10 | 25-year | 126.00 | 59.20 | 60.99 | | 61.14 | 0.008855 | 3.10 | 40.61 | 40.20 | 0.54 |
| Reach-1 | 10 | 50-year | 138.00 | 59.20 | 61.10 | | 61.25 | 0.008185 | 3.06 | 45.13 | 43.03 | 0.53 |
| Reach-1 | 10 | 100-year | 155.00 | 59.20 | 61.25 | | 61.39 | 0.007344 | 3.00 | 51.69 | 46.83 | 0.50 |

HEC-RAS Plan: 070626 all2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 9 | August | 8.00 | 58.50 | 58.96 | | 59.01 | 0.010785 | 1.82 | 4.39 | 11.17 | 0.51 |
| Reach-1 | 9 | Spring - meas. | 14.60 | 58.50 | 59.10 | | 59.19 | 0.013546 | 2.41 | 6.05 | 11.97 | 0.60 |
| Reach-1 | 9 | Spring | 22.00 | 58.50 | 59.23 | | 59.36 | 0.015595 | 2.90 | 7.60 | 12.67 | 0.66 |
| Reach-1 | 9 | Mean Annual | 80.00 | 58.50 | 59.92 | | 60.23 | 0.017829 | 4.53 | 17.67 | 16.49 | 0.77 |
| Reach-1 | 9 | 10-year | 116.00 | 58.50 | 60.27 | | 60.64 | 0.016230 | 4.87 | 23.81 | 18.49 | 0.76 |
| Reach-1 | 9 | 25-year | 126.00 | 58.50 | 60.36 | | 60.74 | 0.015867 | 4.94 | 25.50 | 19.04 | 0.75 |
| Reach-1 | 9 | 50-year | 138.00 | 58.50 | 60.51 | | 60.87 | 0.014322 | 4.85 | 28.47 | 20.26 | 0.72 |
| Reach-1 | 9 | 100-year | 155.00 | 58.50 | 60.64 | | 61.02 | 0.015444 | 4.94 | 31.39 | 23.07 | 0.75 |
| | | | | | | | | | | | | |
| Reach-1 | 8 | August | 8.00 | 58.47 | 58.84 | | 58.89 | 0.004820 | 1.87 | 4.28 | 13.98 | 0.59 |
| Reach-1 | 8 | Spring - meas. | 14.60 | 58.47 | 58.98 | | 59.06 | 0.004810 | 2.29 | 6.37 | 15.24 | 0.62 |
| Reach-1 | 8 | Spring | 22.00 | 58.47 | 59.11 | | 59.22 | 0.004591 | 2.59 | 8.50 | 16.31 | 0.63 |
| Reach-1 | 8 | Mean Annual | 80.00 | 58.47 | 59.92 | | 60.09 | 0.002882 | 3.32 | 24.13 | 22.33 | 0.56 |
| Reach-1 | 8 | 10-year | 116.00 | 58.47 | 60.31 | | 60.50 | 0.002427 | 3.48 | 33.34 | 25.16 | 0.53 |
| Reach-1 | 8 | 25-year | 126.00 | 58.47 | 60.41 | | 60.60 | 0.002344 | 3.52 | 35.81 | 25.86 | 0.53 |
| Reach-1 | 8 | 50-year | 138.00 | 58.47 | 60.53 | | 60.72 | 0.003133 | 3.50 | 39.46 | 35.94 | 0.59 |
| Reach-1 | 8 | 100-year | 155.00 | 58.47 | 60.69 | | 60.87 | 0.002694 | 3.42 | 45.32 | 38.14 | 0.55 |
| | | | | | | | | | | | | |
| Reach-1 | 7 | August | 8.00 | 58.33 | 58.66 | | 58.73 | 0.005853 | 1.97 | 4.05 | 14.07 | 0.65 |
| Reach-1 | 7 | Spring - meas. | 14.60 | 58.33 | 58.83 | | 58.91 | 0.004604 | 2.25 | 6.49 | 15.43 | 0.61 |
| Reach-1 | 7 | Spring | 22.00 | 58.33 | 58.99 | | 59.08 | 0.003813 | 2.42 | 9.09 | 16.81 | 0.58 |
| Reach-1 | 7 | Mean Annual | 80.00 | 58.33 | 59.87 | | 60.00 | 0.002181 | 2.92 | 27.41 | 24.99 | 0.49 |
| Reach-1 | 7 | 10-year | 116.00 | 58.33 | 60.27 | | 60.42 | 0.001822 | 3.02 | 38.35 | 28.94 | 0.46 |
| Reach-1 | 7 | 25-year | 126.00 | 58.33 | 60.38 | | 60.52 | 0.001744 | 3.05 | 41.35 | 29.84 | 0.46 |
| Reach-1 | 7 | 50-year | 138.00 | 58.33 | 60.49 | | 60.64 | 0.001721 | 3.07 | 44.91 | 31.67 | 0.45 |
| Reach-1 | 7 | 100-year | 155.00 | 58.33 | 60.65 | | 60.80 | 0.001688 | 3.10 | 50.07 | 34.43 | 0.45 |
| | | | | | | | | | | | | |
| Reach-1 | 6 | August | 8.00 | 58.25 | 58.62 | | 58.65 | 0.002326 | 1.35 | 5.91 | 18.08 | 0.42 |
| Reach-1 | 6 | Spring - meas. | 14.60 | 58.25 | 58.81 | | 58.85 | 0.001844 | 1.56 | 9.38 | 19.54 | 0.40 |
| Reach-1 | 6 | Spring | 22.00 | 58.25 | 58.98 | | 59.03 | 0.001604 | 1.71 | 12.86 | 20.90 | 0.38 |
| Reach-1 | 6 | Mean Annual | 80.00 | 58.25 | 59.88 | | 59.96 | 0.001129 | 2.32 | 34.53 | 27.16 | 0.36 |
| Reach-1 | 6 | 10-year | 116.00 | 58.25 | 60.28 | | 60.38 | 0.001029 | 2.52 | 46.05 | 29.68 | 0.36 |
| Reach-1 | 6 | 25-year | 126.00 | 58.25 | 60.38 | | 60.48 | 0.001005 | 2.57 | 49.10 | 30.19 | 0.35 |
| Reach-1 | 6 | 50-year | 138.00 | 58.25 | 60.50 | | 60.60 | 0.000984 | 2.62 | 52.60 | 30.73 | 0.35 |
| Reach-1 | 6 | 100-year | 155.00 | 58.25 | 60.65 | | 60.76 | 0.000958 | 2.70 | 57.37 | 31.35 | 0.35 |
| | | | | | | | | | | | | |
| Reach-1 | 5 | August | 8.00 | 58.16 | 58.57 | | 58.60 | 0.002036 | 1.42 | 5.65 | 14.38 | 0.40 |
| Reach-1 | 5 | Spring - meas. | 14.60 | 58.16 | 58.75 | | 58.80 | 0.001969 | 1.76 | 8.30 | 14.71 | 0.41 |
| Reach-1 | 5 | Spring | 22.00 | 58.16 | 58.92 | | 58.98 | 0.001963 | 2.05 | 10.75 | 15.02 | 0.43 |
| Reach-1 | 5 | Mean Annual | 80.00 | 58.16 | 59.74 | | 59.91 | 0.002235 | 3.38 | 23.65 | 16.52 | 0.50 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 5 | 10-year | 116.00 | 58.16 | 60.09 | | 60.33 | 0.002377 | 3.91 | 29.68 | 17.26 | 0.53 |
| Reach-1 | 5 | 25-year | 126.00 | 58.16 | 60.18 | | 60.43 | 0.002420 | 4.04 | 31.22 | 17.49 | 0.53 |
| Reach-1 | 5 | 50-year | 138.00 | 58.16 | 60.28 | | 60.55 | 0.002461 | 4.19 | 32.95 | 17.55 | 0.54 |
| Reach-1 | 5 | 100-year | 155.00 | 58.16 | 60.41 | | 60.71 | 0.002529 | 4.40 | 35.25 | 17.63 | 0.55 |
| | | | | | | | | | | | | |
| Reach-1 | 4 | August | 8.00 | 58.02 | 58.53 | | 58.56 | 0.001909 | 1.38 | 5.78 | 14.72 | 0.39 |
| Reach-1 | 4 | Spring - meas. | 14.60 | 58.02 | 58.72 | | 58.76 | 0.001839 | 1.71 | 8.56 | 15.35 | 0.40 |
| Reach-1 | 4 | Spring | 22.00 | 58.02 | 58.88 | | 58.94 | 0.001823 | 1.97 | 11.15 | 15.92 | 0.42 |
| Reach-1 | 4 | Mean Annual | 80.00 | 58.02 | 59.71 | | 59.86 | 0.002032 | 3.11 | 25.69 | 19.74 | 0.48 |
| Reach-1 | 4 | 10-year | 116.00 | 58.02 | 60.09 | | 60.27 | 0.002050 | 3.46 | 33.50 | 22.06 | 0.50 |
| Reach-1 | 4 | 25-year | 126.00 | 58.02 | 60.18 | | 60.38 | 0.002006 | 3.54 | 35.58 | 22.20 | 0.49 |
| Reach-1 | 4 | 50-year | 138.00 | 58.02 | 60.29 | | 60.49 | 0.001977 | 3.64 | 37.91 | 22.35 | 0.49 |
| Reach-1 | 4 | 100-year | 155.00 | 58.02 | 60.42 | | 60.65 | 0.001947 | 3.78 | 41.02 | 22.54 | 0.49 |
| | | | | | | | | | | | | |
| Reach-1 | 3 | August | 8.00 | 58.10 | 58.50 | | 58.55 | 0.002911 | 1.62 | 4.95 | 13.69 | 0.47 |
| Reach-1 | 3 | Spring - meas. | 14.60 | 58.10 | 58.69 | | 58.75 | 0.002639 | 1.92 | 7.59 | 15.04 | 0.48 |
| Reach-1 | 3 | Spring | 22.00 | 58.10 | 58.86 | | 58.93 | 0.002482 | 2.15 | 10.22 | 16.27 | 0.48 |
| Reach-1 | 3 | Mean Annual | 80.00 | 58.10 | 59.71 | | 59.84 | 0.002109 | 2.97 | 26.97 | 23.40 | 0.49 |
| Reach-1 | 3 | 10-year | 116.00 | 58.10 | 60.09 | | 60.25 | 0.001991 | 3.16 | 36.67 | 27.60 | 0.48 |
| Reach-1 | 3 | 25-year | 126.00 | 58.10 | 60.19 | | 60.35 | 0.001873 | 3.20 | 39.37 | 27.70 | 0.47 |
| Reach-1 | 3 | 50-year | 138.00 | 58.10 | 60.30 | | 60.46 | 0.001770 | 3.25 | 42.45 | 27.82 | 0.46 |
| Reach-1 | 3 | 100-year | 155.00 | 58.10 | 60.44 | | 60.62 | 0.001661 | 3.34 | 46.47 | 27.98 | 0.46 |
| | | | | | | | | | | | | |
| Reach-1 | 2 | August | 8.00 | 57.90 | 58.38 | | 58.42 | 0.002278 | 1.57 | 5.09 | 12.21 | 0.43 |
| Reach-1 | 2 | Spring - meas. | 14.60 | 57.90 | 58.56 | | 58.62 | 0.002462 | 1.97 | 7.40 | 13.31 | 0.47 |
| Reach-1 | 2 | Spring | 22.00 | 57.90 | 58.72 | | 58.80 | 0.002545 | 2.28 | 9.65 | 14.31 | 0.49 |
| Reach-1 | 2 | Mean Annual | 80.00 | 57.90 | 59.54 | | 59.72 | 0.002660 | 3.44 | 23.29 | 19.10 | 0.55 |
| Reach-1 | 2 | 10-year | 116.00 | 57.90 | 59.91 | | 60.13 | 0.002591 | 3.78 | 30.72 | 21.39 | 0.56 |
| Reach-1 | 2 | 25-year | 126.00 | 57.90 | 60.00 | | 60.23 | 0.002555 | 3.84 | 32.83 | 22.06 | 0.55 |
| Reach-1 | 2 | 50-year | 138.00 | 57.90 | 60.11 | | 60.35 | 0.002499 | 3.91 | 35.33 | 22.72 | 0.55 |
| Reach-1 | 2 | 100-year | 155.00 | 57.90 | 60.26 | | 60.51 | 0.002336 | 4.01 | 38.74 | 23.61 | 0.54 |
| | | | | | | | | | | | | |
| Reach-1 | 1 | August | 8.00 | 57.80 | 58.10 | 58.10 | 58.23 | 0.014194 | 2.95 | 2.71 | 9.95 | 1.00 |
| Reach-1 | 1 | Spring - meas. | 14.60 | 57.80 | 58.23 | 58.23 | 58.43 | 0.012873 | 3.54 | 4.12 | 10.66 | 1.00 |
| Reach-1 | 1 | Spring | 22.00 | 57.80 | 58.36 | 58.36 | 58.61 | 0.011978 | 3.98 | 5.52 | 11.32 | 1.01 |
| Reach-1 | 1 | Mean Annual | 80.00 | 57.80 | 59.03 | 59.03 | 59.52 | 0.009728 | 5.61 | 14.27 | 14.80 | 1.01 |
| Reach-1 | 1 | 10-year | 116.00 | 57.80 | 59.31 | 59.31 | 59.93 | 0.008793 | 6.31 | 18.57 | 16.24 | 1.00 |
| Reach-1 | 1 | 25-year | 126.00 | 57.80 | 59.38 | 59.38 | 60.03 | 0.008637 | 6.48 | 19.71 | 16.60 | 1.00 |
| Reach-1 | 1 | 50-year | 138.00 | 57.80 | 59.46 | 59.46 | 60.15 | 0.008427 | 6.67 | 21.11 | 17.03 | 1.00 |
| Reach-1 | 1 | 100-year | 155.00 | 57.80 | 59.58 | 59.58 | 60.32 | 0.008127 | 6.91 | 23.11 | 17.63 | 0.99 |

HEC-RAS Plan: 070626 all2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| | | | | | | | | | | | | |
| Reach-1 | 0.8885 | August | 8.00 | 56.82 | 57.61 | 57.23 | 57.63 | 0.001733 | 1.04 | 7.70 | 13.75 | 0.24 |
| Reach-1 | 0.8885 | Spring - meas. | 14.60 | 56.82 | 57.79 | 57.36 | 57.82 | 0.002403 | 1.43 | 10.25 | 14.46 | 0.30 |
| Reach-1 | 0.8885 | Spring | 22.00 | 56.82 | 57.95 | 57.47 | 57.99 | 0.002960 | 1.75 | 12.54 | 15.07 | 0.34 |
| Reach-1 | 0.8885 | Mean Annual | 80.00 | 56.82 | 58.70 | 58.07 | 58.86 | 0.005056 | 3.24 | 24.71 | 17.45 | 0.48 |
| Reach-1 | 0.8885 | 10-year | 116.00 | 56.82 | 59.00 | 58.35 | 59.24 | 0.005576 | 3.87 | 30.20 | 18.82 | 0.52 |
| Reach-1 | 0.8885 | 25-year | 126.00 | 56.82 | 59.08 | 58.42 | 59.33 | 0.005690 | 4.02 | 31.65 | 19.12 | 0.53 |
| Reach-1 | 0.8885 | 50-year | 138.00 | 56.82 | 59.17 | 58.50 | 59.44 | 0.005813 | 4.19 | 33.35 | 19.47 | 0.54 |
| Reach-1 | 0.8885 | 100-year | 155.00 | 56.82 | 59.29 | 58.62 | 59.59 | 0.005965 | 4.43 | 35.69 | 19.66 | 0.55 |
| | | | | | | | | | | | | |
| Reach-1 | 0.882 | August | 8.00 | 57.00 | 57.47 | | 57.50 | 0.013510 | 1.38 | 5.81 | 17.36 | 0.42 |
| Reach-1 | 0.882 | Spring - meas. | 14.60 | 57.00 | 57.60 | | 57.65 | 0.014838 | 1.79 | 8.17 | 17.55 | 0.46 |
| Reach-1 | 0.882 | Spring | 22.00 | 57.00 | 57.72 | | 57.79 | 0.016339 | 2.15 | 10.22 | 17.72 | 0.50 |
| Reach-1 | 0.882 | Mean Annual | 80.00 | 57.00 | 58.31 | | 58.54 | 0.021979 | 3.82 | 20.95 | 18.56 | 0.63 |
| Reach-1 | 0.882 | 10-year | 116.00 | 57.00 | 58.56 | | 58.88 | 0.023980 | 4.55 | 25.55 | 18.91 | 0.68 |
| Reach-1 | 0.882 | 25-year | 126.00 | 57.00 | 58.62 | | 58.97 | 0.024398 | 4.73 | 26.73 | 19.00 | 0.69 |
| Reach-1 | 0.882 | 50-year | 138.00 | 57.00 | 58.69 | | 59.07 | 0.024856 | 4.93 | 28.10 | 19.10 | 0.71 |
| Reach-1 | 0.882 | 100-year | 155.00 | 57.00 | 58.79 | | 59.21 | 0.025451 | 5.20 | 29.96 | 19.24 | 0.72 |
| | | | | | | | | | | | | |
| Reach-1 | 0.875 | August | 8.00 | 56.20 | 56.71 | | 56.76 | 0.030416 | 1.75 | 4.58 | 17.78 | 0.61 |
| Reach-1 | 0.875 | Spring - meas. | 14.60 | 56.20 | 56.85 | 56.73 | 56.91 | 0.027425 | 2.01 | 7.27 | 21.06 | 0.60 |
| Reach-1 | 0.875 | Spring | 22.00 | 56.20 | 56.98 | 56.82 | 57.05 | 0.024014 | 2.15 | 10.23 | 24.16 | 0.58 |
| Reach-1 | 0.875 | Mean Annual | 80.00 | 56.20 | 57.52 | | 57.70 | 0.021442 | 3.40 | 23.55 | 25.05 | 0.62 |
| Reach-1 | 0.875 | 10-year | 116.00 | 56.20 | 57.74 | | 57.98 | 0.022530 | 4.00 | 29.03 | 25.23 | 0.65 |
| Reach-1 | 0.875 | 25-year | 126.00 | 56.20 | 57.79 | | 58.06 | 0.022764 | 4.15 | 30.42 | 25.28 | 0.66 |
| Reach-1 | 0.875 | 50-year | 138.00 | 56.20 | 57.85 | | 58.14 | 0.023073 | 4.32 | 32.01 | 25.33 | 0.67 |
| Reach-1 | 0.875 | 100-year | 155.00 | 56.20 | 57.94 | | 58.26 | 0.023494 | 4.55 | 34.16 | 25.41 | 0.69 |
| | | | | | | | | | | | | |
| Reach-1 | 0.866 | August | 8.00 | 55.00 | 55.52 | | 55.55 | 0.011600 | 1.28 | 6.23 | 14.77 | 0.35 |
| Reach-1 | 0.866 | Spring - meas. | 14.60 | 55.00 | 55.73 | | 55.77 | 0.011365 | 1.53 | 9.54 | 17.05 | 0.36 |
| Reach-1 | 0.866 | Spring | 22.00 | 55.00 | 55.90 | | 55.95 | 0.011645 | 1.74 | 12.64 | 18.95 | 0.38 |
| Reach-1 | 0.866 | Mean Annual | 80.00 | 55.00 | 56.60 | | 56.67 | 0.010615 | 2.14 | 37.40 | 46.28 | 0.42 |
| Reach-1 | 0.866 | 10-year | 116.00 | 55.00 | 56.85 | | 56.94 | 0.010451 | 2.37 | 49.27 | 48.48 | 0.40 |
| Reach-1 | 0.866 | 25-year | 126.00 | 55.00 | 56.91 | | 57.01 | 0.010356 | 2.42 | 52.41 | 49.04 | 0.40 |
| Reach-1 | 0.866 | 50-year | 138.00 | 55.00 | 56.99 | | 57.08 | 0.010247 | 2.48 | 56.09 | 49.69 | 0.40 |
| Reach-1 | 0.866 | 100-year | 155.00 | 55.00 | 57.09 | | 57.19 | 0.010163 | 2.57 | 61.01 | 50.55 | 0.40 |
| | | | | | | | | | | | | |
| Reach-1 | 0.859 | August | 8.00 | 54.10 | 54.80 | | 54.86 | 0.025477 | 1.96 | 4.09 | 11.68 | 0.58 |
| Reach-1 | 0.859 | Spring - meas. | 14.60 | 54.10 | 54.96 | | 55.05 | 0.028185 | 2.36 | 6.19 | 14.36 | 0.63 |
| Reach-1 | 0.859 | Spring | 22.00 | 54.10 | 55.11 | | 55.22 | 0.029501 | 2.57 | 8.55 | 16.97 | 0.64 |

HEC-RAS Plan: 070626 all2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 0.859 | Mean Annual | 80.00 | 54.10 | 55.75 | | 55.94 | 0.031868 | 3.49 | 23.02 | 28.18 | 0.66 |
| Reach-1 | 0.859 | 10-year | 116.00 | 54.10 | 55.97 | | 56.22 | 0.031715 | 4.03 | 29.46 | 31.94 | 0.68 |
| Reach-1 | 0.859 | 25-year | 126.00 | 54.10 | 56.02 | | 56.29 | 0.031761 | 4.16 | 31.18 | 33.25 | 0.69 |
| Reach-1 | 0.859 | 50-year | 138.00 | 54.10 | 56.08 | | 56.37 | 0.032150 | 4.33 | 33.14 | 35.31 | 0.70 |
| Reach-1 | 0.859 | 100-year | 155.00 | 54.10 | 56.16 | | 56.47 | 0.032059 | 4.52 | 36.17 | 38.29 | 0.70 |
| | | | | | | | | | | | | |
| Reach-1 | 0.853 | August | 8.00 | 53.40 | 54.05 | | 54.09 | 0.021594 | 1.51 | 5.29 | 15.62 | 0.46 |
| Reach-1 | 0.853 | Spring - meas. | 14.60 | 53.40 | 54.23 | | 54.28 | 0.018976 | 1.75 | 8.32 | 17.80 | 0.45 |
| Reach-1 | 0.853 | Spring | 22.00 | 53.40 | 54.39 | | 54.45 | 0.018293 | 1.96 | 11.20 | 19.64 | 0.46 |
| Reach-1 | 0.853 | Mean Annual | 80.00 | 53.40 | 55.01 | | 55.13 | 0.018813 | 2.82 | 28.41 | 36.08 | 0.56 |
| Reach-1 | 0.853 | 10-year | 116.00 | 53.40 | 55.23 | | 55.39 | 0.019305 | 3.17 | 36.89 | 39.36 | 0.56 |
| Reach-1 | 0.853 | 25-year | 126.00 | 53.40 | 55.29 | | 55.45 | 0.019383 | 3.26 | 39.12 | 40.17 | 0.56 |
| Reach-1 | 0.853 | 50-year | 138.00 | 53.40 | 55.35 | | 55.53 | 0.019464 | 3.36 | 41.72 | 41.10 | 0.56 |
| Reach-1 | 0.853 | 100-year | 155.00 | 53.40 | 55.44 | | 55.63 | 0.019561 | 3.50 | 45.31 | 42.36 | 0.56 |
| | | | | | | | | | | | | |
| Reach-1 | 0.845 | August | 8.00 | 52.50 | 53.19 | | 53.25 | 0.022591 | 1.95 | 4.10 | 12.20 | 0.59 |
| Reach-1 | 0.845 | Spring - meas. | 14.60 | 52.50 | 53.34 | | 53.43 | 0.026703 | 2.39 | 6.12 | 15.07 | 0.66 |
| Reach-1 | 0.845 | Spring | 22.00 | 52.50 | 53.47 | | 53.58 | 0.028860 | 2.68 | 8.20 | 17.56 | 0.69 |
| Reach-1 | 0.845 | Mean Annual | 80.00 | 52.50 | 54.14 | | 54.30 | 0.024922 | 3.30 | 24.28 | 30.58 | 0.64 |
| Reach-1 | 0.845 | 10-year | 116.00 | 52.50 | 54.40 | | 54.60 | 0.022242 | 3.61 | 32.88 | 35.67 | 0.61 |
| Reach-1 | 0.845 | 25-year | 126.00 | 52.50 | 54.46 | | 54.67 | 0.021666 | 3.68 | 35.27 | 36.95 | 0.61 |
| Reach-1 | 0.845 | 50-year | 138.00 | 52.50 | 54.54 | | 54.75 | 0.021037 | 3.76 | 38.13 | 38.44 | 0.60 |
| Reach-1 | 0.845 | 100-year | 155.00 | 52.50 | 54.64 | | 54.87 | 0.020238 | 3.86 | 42.19 | 40.46 | 0.59 |
| | | | | | | | | | | | | |
| Reach-1 | 0.841 | August | 8.00 | 52.50 | 52.85 | 52.70 | 52.88 | 0.018708 | 1.32 | 6.08 | 19.84 | 0.42 |
| Reach-1 | 0.841 | Spring - meas. | 14.60 | 52.50 | 53.02 | | 53.05 | 0.015408 | 1.51 | 9.64 | 22.04 | 0.40 |
| Reach-1 | 0.841 | Spring | 22.00 | 52.50 | 53.16 | | 53.20 | 0.014358 | 1.72 | 12.78 | 22.82 | 0.41 |
| Reach-1 | 0.841 | Mean Annual | 80.00 | 52.50 | 53.85 | | 53.96 | 0.014040 | 2.69 | 29.76 | 26.64 | 0.45 |
| Reach-1 | 0.841 | 10-year | 116.00 | 52.50 | 54.10 | | 54.26 | 0.014701 | 3.16 | 36.88 | 28.28 | 0.47 |
| Reach-1 | 0.841 | 25-year | 126.00 | 52.50 | 54.17 | | 54.34 | 0.014836 | 3.27 | 38.74 | 28.76 | 0.48 |
| Reach-1 | 0.841 | 50-year | 138.00 | 52.50 | 54.25 | | 54.42 | 0.014990 | 3.40 | 40.93 | 29.32 | 0.49 |
| Reach-1 | 0.841 | 100-year | 155.00 | 52.50 | 54.35 | | 54.54 | 0.015192 | 3.58 | 43.92 | 30.07 | 0.49 |
| | | | | | | | | | | | | |
| Reach-1 | 0.833 | August | 8.00 | 51.50 | 52.25 | 52.00 | 52.28 | 0.013619 | 1.34 | 5.98 | 14.98 | 0.37 |
| Reach-1 | 0.833 | Spring - meas. | 14.60 | 51.50 | 52.43 | 52.14 | 52.47 | 0.014861 | 1.63 | 8.98 | 17.90 | 0.40 |
| Reach-1 | 0.833 | Spring | 22.00 | 51.50 | 52.59 | 52.25 | 52.64 | 0.015185 | 1.83 | 12.04 | 20.45 | 0.42 |
| Reach-1 | 0.833 | Mean Annual | 80.00 | 51.50 | 53.25 | 52.80 | 53.37 | 0.016414 | 2.78 | 28.80 | 28.41 | 0.49 |
| Reach-1 | 0.833 | 10-year | 116.00 | 51.50 | 53.49 | 53.02 | 53.66 | 0.017136 | 3.26 | 35.65 | 29.72 | 0.51 |
| Reach-1 | 0.833 | 25-year | 126.00 | 51.50 | 53.55 | 53.08 | 53.73 | 0.017126 | 3.37 | 37.53 | 30.07 | 0.52 |
| Reach-1 | 0.833 | 50-year | 138.00 | 51.50 | 53.62 | 53.12 | 53.81 | 0.017213 | 3.50 | 39.66 | 30.46 | 0.52 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 0.833 | 100-year | 155.00 | 51.50 | 53.71 | 53.20 | 53.92 | 0.017485 | 3.68 | 42.44 | 30.96 | 0.53 |
| | | | | | | | | | | | | |
| Reach-1 | 0.827 | August | 8.00 | 50.50 | 50.99 | 50.99 | 51.11 | 0.117773 | 2.83 | 2.83 | 11.65 | 1.01 |
| Reach-1 | 0.827 | Spring - meas. | 14.60 | 50.50 | 51.12 | 51.12 | 51.28 | 0.103185 | 3.27 | 4.47 | 13.39 | 1.00 |
| Reach-1 | 0.827 | Spring | 22.00 | 50.50 | 51.22 | 51.22 | 51.43 | 0.099811 | 3.67 | 5.99 | 14.69 | 1.01 |
| Reach-1 | 0.827 | Mean Annual | 80.00 | 50.50 | 51.78 | 51.78 | 52.17 | 0.081770 | 4.98 | 16.08 | 21.40 | 1.01 |
| Reach-1 | 0.827 | 10-year | 116.00 | 50.50 | 52.02 | 52.02 | 52.48 | 0.067487 | 5.43 | 21.54 | 24.14 | 0.96 |
| Reach-1 | 0.827 | 25-year | 126.00 | 50.50 | 52.07 | 52.07 | 52.55 | 0.066472 | 5.58 | 22.82 | 24.46 | 0.96 |
| Reach-1 | 0.827 | 50-year | 138.00 | 50.50 | 52.14 | 52.14 | 52.64 | 0.064693 | 5.73 | 24.39 | 24.85 | 0.96 |
| Reach-1 | 0.827 | 100-year | 155.00 | 50.50 | 52.23 | 52.23 | 52.76 | 0.062266 | 5.91 | 26.59 | 25.38 | 0.95 |
| | | | | | | | | | | | | |
| Reach-1 | 0.818 | August | 8.00 | 49.50 | 49.83 | 49.84 | 49.94 | 0.012165 | 2.57 | 3.16 | 18.55 | 1.08 |
| Reach-1 | 0.818 | Spring - meas. | 14.60 | 49.50 | 49.91 | 49.94 | 50.06 | 0.013396 | 3.12 | 4.81 | 22.73 | 1.18 |
| Reach-1 | 0.818 | Spring | 22.00 | 49.50 | 49.98 | 50.02 | 50.17 | 0.014237 | 3.55 | 6.42 | 26.18 | 1.24 |
| Reach-1 | 0.818 | Mean Annual | 80.00 | 49.50 | 51.04 | 50.40 | 51.12 | 0.000723 | 2.25 | 41.72 | 38.76 | 0.36 |
| Reach-1 | 0.818 | 10-year | 116.00 | 49.50 | 51.32 | 50.59 | 51.42 | 0.000775 | 2.66 | 52.63 | 41.50 | 0.38 |
| Reach-1 | 0.818 | 25-year | 126.00 | 49.50 | 51.37 | 50.64 | 51.49 | 0.000820 | 2.80 | 54.79 | 43.00 | 0.39 |
| Reach-1 | 0.818 | 50-year | 138.00 | 49.50 | 51.43 | 50.69 | 51.56 | 0.000869 | 2.95 | 57.37 | 44.03 | 0.41 |
| Reach-1 | 0.818 | 100-year | 155.00 | 49.50 | 51.50 | 50.77 | 51.65 | 0.000938 | 3.16 | 60.67 | 44.31 | 0.43 |
| | | | | | | | | | | | | |
| Reach-1 | 0.798 | August | 8.00 | 48.00 | 49.20 | 48.42 | 49.21 | 0.000702 | 0.65 | 12.35 | 16.30 | 0.13 |
| Reach-1 | 0.798 | Spring - meas. | 14.60 | 48.00 | 49.46 | 48.58 | 49.47 | 0.000997 | 0.86 | 16.89 | 18.80 | 0.16 |
| Reach-1 | 0.798 | Spring | 22.00 | 48.00 | 49.70 | 48.71 | 49.72 | 0.001088 | 1.02 | 21.67 | 20.14 | 0.17 |
| Reach-1 | 0.798 | Mean Annual | 80.00 | 48.00 | 50.97 | | 51.00 | 0.001205 | 1.59 | 50.40 | 25.44 | 0.20 |
| Reach-1 | 0.798 | 10-year | 116.00 | 48.00 | 51.22 | | 51.29 | 0.001691 | 2.04 | 57.03 | 26.52 | 0.24 |
| Reach-1 | 0.798 | 25-year | 126.00 | 48.00 | 51.26 | | 51.34 | 0.001872 | 2.17 | 58.17 | 26.70 | 0.25 |
| Reach-1 | 0.798 | 50-year | 138.00 | 48.00 | 51.31 | | 51.40 | 0.002090 | 2.33 | 59.50 | 26.91 | 0.27 |
| Reach-1 | 0.798 | 100-year | 155.00 | 48.00 | 51.37 | | 51.47 | 0.002421 | 2.55 | 61.12 | 27.16 | 0.29 |
| | | | | | | | | | | | | |
| Reach-1 | 0.782 | August | 8.00 | 47.40 | 49.20 | | 49.20 | 0.000033 | 0.19 | 43.05 | 37.36 | 0.03 |
| Reach-1 | 0.782 | Spring - meas. | 14.60 | 47.40 | 49.45 | | 49.46 | 0.000060 | 0.28 | 52.99 | 40.13 | 0.04 |
| Reach-1 | 0.782 | Spring | 22.00 | 47.40 | 49.70 | | 49.70 | 0.000082 | 0.35 | 62.97 | 41.99 | 0.05 |
| Reach-1 | 0.782 | Mean Annual | 80.00 | 47.40 | 50.96 | | 50.97 | 0.000154 | 0.67 | 120.09 | 48.55 | 0.07 |
| Reach-1 | 0.782 | 10-year | 116.00 | 47.40 | 51.21 | | 51.23 | 0.000233 | 0.88 | 132.64 | 49.87 | 0.09 |
| Reach-1 | 0.782 | 25-year | 126.00 | 47.40 | 51.26 | | 51.27 | 0.000261 | 0.94 | 134.77 | 50.09 | 0.10 |
| Reach-1 | 0.782 | 50-year | 138.00 | 47.40 | 51.31 | | 51.32 | 0.000295 | 1.01 | 137.26 | 50.35 | 0.11 |
| Reach-1 | 0.782 | 100-year | 155.00 | 47.40 | 51.37 | | 51.39 | 0.000347 | 1.11 | 140.29 | 50.66 | 0.12 |
| | | | | | | | | | | | | |
| Reach-1 | 0.729 | August | 8.00 | 45.00 | 49.20 | | 49.20 | 0.000000 | 0.04 | 201.03 | 74.16 | 0.00 |
| Reach-1 | 0.729 | Spring - meas. | 14.60 | 45.00 | 49.45 | | 49.45 | 0.000001 | 0.07 | 220.12 | 75.06 | 0.01 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 0.729 | Spring | 22.00 | 45.00 | 49.70 | | 49.70 | 0.000002 | 0.09 | 238.41 | 75.90 | 0.01 |
| Reach-1 | 0.729 | Mean Annual | 80.00 | 45.00 | 50.96 | | 50.96 | 0.000010 | 0.24 | 338.87 | 86.67 | 0.02 |
| Reach-1 | 0.729 | 10-year | 116.00 | 45.00 | 51.21 | | 51.21 | 0.000017 | 0.32 | 361.24 | 90.01 | 0.03 |
| Reach-1 | 0.729 | 25-year | 126.00 | 45.00 | 51.25 | | 51.25 | 0.000019 | 0.35 | 365.04 | 90.57 | 0.03 |
| Reach-1 | 0.729 | 50-year | 138.00 | 45.00 | 51.30 | | 51.30 | 0.000022 | 0.38 | 369.47 | 91.21 | 0.03 |
| Reach-1 | 0.729 | 100-year | 155.00 | 45.00 | 51.36 | | 51.36 | 0.000027 | 0.42 | 374.86 | 91.99 | 0.03 |
| | | | | | | | | | | | | |
| Reach-1 | 0.549 | August | 8.00 | 42.10 | 49.20 | | 49.20 | 0.000000 | 0.01 | 724.15 | 178.41 | 0.00 |
| Reach-1 | 0.549 | Spring - meas. | 14.60 | 42.10 | 49.45 | | 49.45 | 0.000000 | 0.02 | 769.91 | 179.30 | 0.00 |
| Reach-1 | 0.549 | Spring | 22.00 | 42.10 | 49.70 | | 49.70 | 0.000000 | 0.03 | 813.42 | 180.14 | 0.00 |
| Reach-1 | 0.549 | Mean Annual | 80.00 | 42.10 | 50.95 | | 50.96 | 0.000001 | 0.08 | 1042.94 | 184.53 | 0.01 |
| Reach-1 | 0.549 | 10-year | 116.00 | 42.10 | 51.21 | | 51.21 | 0.000001 | 0.11 | 1089.63 | 185.41 | 0.01 |
| Reach-1 | 0.549 | 25-year | 126.00 | 42.10 | 51.25 | | 51.25 | 0.000001 | 0.11 | 1097.39 | 185.55 | 0.01 |
| Reach-1 | 0.549 | 50-year | 138.00 | 42.10 | 51.30 | | 51.30 | 0.000002 | 0.12 | 1106.38 | 185.72 | 0.01 |
| Reach-1 | 0.549 | 100-year | 155.00 | 42.10 | 51.36 | | 51.36 | 0.000002 | 0.14 | 1117.21 | 185.92 | 0.01 |
| | | | | | | | | | | | | |
| Reach-1 | 0.5325 | August | 8.00 | 44.70 | 49.20 | | 49.20 | 0.000036 | 0.31 | 28.87 | 10.86 | 0.03 |
| Reach-1 | 0.5325 | Spring - meas. | 14.60 | 44.70 | 49.45 | | 49.45 | 0.000091 | 0.53 | 31.63 | 10.99 | 0.05 |
| Reach-1 | 0.5325 | Spring | 22.00 | 44.70 | 49.69 | | 49.70 | 0.000163 | 0.74 | 34.26 | 11.10 | 0.07 |
| Reach-1 | 0.5325 | Mean Annual | 80.00 | 44.70 | 50.89 | | 50.95 | 0.000828 | 2.03 | 49.72 | 30.71 | 0.17 |
| Reach-1 | 0.5325 | 10-year | 116.00 | 44.70 | 51.09 | | 51.20 | 0.001453 | 2.77 | 57.79 | 50.83 | 0.22 |
| Reach-1 | 0.5325 | 25-year | 126.00 | 44.70 | 51.11 | | 51.24 | 0.001674 | 2.98 | 58.98 | 53.16 | 0.24 |
| Reach-1 | 0.5325 | 50-year | 138.00 | 44.70 | 51.13 | | 51.28 | 0.001958 | 3.24 | 60.30 | 55.63 | 0.26 |
| Reach-1 | 0.5325 | 100-year | 155.00 | 44.70 | 51.15 | | 51.34 | 0.002419 | 3.61 | 61.38 | 57.58 | 0.29 |
| | | | | | | | | | | | | |
| Reach-1 | 0.532 | August | 8.00 | 48.68 | 48.99 | 48.99 | 49.15 | 0.053591 | 3.18 | 2.52 | 8.03 | 1.00 |
| Reach-1 | 0.532 | Spring - meas. | 14.60 | 48.68 | 49.15 | 49.15 | 49.38 | 0.047456 | 3.90 | 3.75 | 8.04 | 1.01 |
| Reach-1 | 0.532 | Spring | 22.00 | 48.68 | 49.30 | 49.30 | 49.61 | 0.042812 | 4.46 | 4.95 | 8.06 | 1.00 |
| Reach-1 | 0.532 | Mean Annual | 80.00 | 48.68 | 50.10 | 50.10 | 50.77 | 0.031603 | 6.68 | 13.03 | 10.33 | 0.99 |
| Reach-1 | 0.532 | 10-year | 116.00 | 48.68 | 50.86 | 50.86 | 51.14 | 0.009686 | 4.92 | 43.53 | 83.96 | 0.59 |
| Reach-1 | 0.532 | 25-year | 126.00 | 48.68 | 50.90 | 50.90 | 51.19 | 0.009884 | 5.03 | 47.05 | 85.35 | 0.59 |
| Reach-1 | 0.532 | 50-year | 138.00 | 48.68 | 50.94 | 50.94 | 51.24 | 0.010281 | 5.20 | 50.62 | 86.76 | 0.61 |
| Reach-1 | 0.532 | 100-year | 155.00 | 48.68 | 51.01 | 51.01 | 51.30 | 0.010405 | 5.33 | 56.39 | 89.01 | 0.62 |
| | | | | | | | | | | | | |
| Reach-1 | .5303 | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 0.478 | August | 8.00 | 25.25 | 25.90 | 25.90 | 26.22 | 0.060622 | 4.57 | 1.75 | 44.90 | 1.00 |
| Reach-1 | 0.478 | Spring - meas. | 14.60 | 25.25 | 26.21 | 26.21 | 26.70 | 0.060199 | 5.52 | 2.60 | 44.90 | 0.99 |
| Reach-1 | 0.478 | Spring | 22.00 | 25.25 | 26.52 | 26.52 | 27.17 | 0.060052 | 6.21 | 3.43 | 44.90 | 0.97 |
| Reach-1 | 0.478 | Mean Annual | 80.00 | 25.25 | 28.52 | 28.52 | 29.06 | 0.026182 | 4.75 | 15.15 | 53.75 | 0.76 |

HEC-RAS Plan: 070626 alt2 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 0.478 | 10-year | 116.00 | 25.25 | 28.82 | 28.82 | 29.52 | 0.028825 | 5.77 | 18.63 | 53.82 | 0.83 |
| Reach-1 | 0.478 | 25-year | 126.00 | 25.25 | 28.90 | 28.90 | 29.64 | 0.029127 | 6.01 | 19.57 | 53.84 | 0.84 |
| Reach-1 | 0.478 | 50-year | 138.00 | 25.25 | 28.99 | 28.99 | 29.78 | 0.029672 | 6.29 | 20.61 | 53.86 | 0.85 |
| Reach-1 | 0.478 | 100-year | 155.00 | 25.25 | 29.11 | 29.11 | 29.97 | 0.030250 | 6.65 | 22.04 | 53.89 | 0.87 |
| | | | | | | | | | | | | |
| Reach-1 | 0.477 | August | 8.00 | 24.30 | 25.97 | 24.54 | 25.97 | 0.000001 | 0.11 | 74.26 | 54.22 | 0.02 |
| Reach-1 | 0.477 | Spring - meas. | 14.60 | 24.30 | 26.29 | 24.63 | 26.29 | 0.000002 | 0.16 | 91.61 | 54.22 | 0.02 |
| Reach-1 | 0.477 | Spring | 22.00 | 24.30 | 26.48 | 24.70 | 26.48 | 0.000004 | 0.22 | 101.91 | 54.23 | 0.03 |
| Reach-1 | 0.477 | Mean Annual | 80.00 | 24.30 | 26.83 | 25.00 | 26.84 | 0.000029 | 0.66 | 120.89 | 54.23 | 0.08 |
| Reach-1 | 0.477 | 10-year | 116.00 | 24.30 | 26.83 | 25.12 | 26.84 | 0.000060 | 0.96 | 120.89 | 54.23 | 0.11 |
| Reach-1 | 0.477 | 25-year | 126.00 | 24.30 | 26.83 | 25.15 | 26.85 | 0.000071 | 1.04 | 120.89 | 54.23 | 0.12 |
| Reach-1 | 0.477 | 50-year | 138.00 | 24.30 | 26.83 | 25.18 | 26.85 | 0.000085 | 1.14 | 120.89 | 54.23 | 0.13 |
| Reach-1 | 0.477 | 100-year | 155.00 | 24.30 | 26.83 | 25.23 | 26.86 | 0.000107 | 1.28 | 120.89 | 54.23 | 0.15 |

# Appendix C
# Alternative 3
# HEC-RAS Output

# ALTERNATIVE 3

HEC-RAS Plan: 070626 alt3 River: RIVER-1 Reach: Reach-1

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 279.40 | August | 8.00 | 76.62 | 79.56 | 77.34 | 79.56 | 0.000024 | 0.20 | 39.79 | 28.66 | 0.03 |
| Reach-1 | 279.40 | Spring - meas. | 14.60 | 76.62 | 79.68 | 77.53 | 79.69 | 0.000060 | 0.34 | 43.38 | 30.45 | 0.05 |
| Reach-1 | 279.40 | Spring | 22.00 | 76.62 | 79.79 | 77.70 | 79.79 | 0.000110 | 0.48 | 46.64 | 32.81 | 0.07 |
| Reach-1 | 279.40 | Mean Annual | 80.00 | 76.62 | 80.29 | 78.42 | 80.32 | 0.000574 | 1.30 | 65.94 | 42.05 | 0.16 |
| Reach-1 | 279.40 | 10-year | 116.00 | 76.62 | 80.52 | 78.72 | 80.56 | 0.000845 | 1.68 | 75.51 | 44.02 | 0.19 |
| Reach-1 | 279.40 | 25-year | 126.00 | 76.62 | 80.57 | 78.80 | 80.62 | 0.000917 | 1.78 | 77.94 | 44.51 | 0.20 |
| Reach-1 | 279.40 | 50-year | 138.00 | 76.62 | 80.64 | 78.87 | 80.69 | 0.000994 | 1.89 | 80.99 | 45.11 | 0.21 |
| Reach-1 | 279.40 | 100-year | 155.00 | 76.62 | 80.73 | 79.00 | 80.79 | 0.001107 | 2.04 | 84.94 | 45.90 | 0.22 |
| | | | | | | | | | | | | |
| Reach-1 | 278 | | Inl Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 274 | August | 8.00 | 76.43 | 79.11 | | 79.11 | 0.000013 | 0.16 | 48.65 | 43.83 | 0.03 |
| Reach-1 | 274 | Spring - meas. | 14.60 | 76.43 | 79.26 | | 79.26 | 0.000030 | 0.27 | 55.10 | 47.18 | 0.04 |
| Reach-1 | 274 | Spring | 22.00 | 76.43 | 79.41 | | 79.41 | 0.000045 | 0.36 | 62.62 | 50.82 | 0.05 |
| Reach-1 | 274 | Mean Annual | 80.00 | 76.43 | 80.11 | | 80.13 | 0.000148 | 0.84 | 105.37 | 68.34 | 0.10 |
| Reach-1 | 274 | 10-year | 116.00 | 76.43 | 80.35 | | 80.37 | 0.000210 | 1.08 | 121.78 | 71.13 | 0.12 |
| Reach-1 | 274 | 25-year | 126.00 | 76.43 | 80.40 | | 80.42 | 0.000229 | 1.14 | 125.52 | 71.75 | 0.13 |
| Reach-1 | 274 | 50-year | 138.00 | 76.43 | 80.49 | | 80.51 | 0.000242 | 1.20 | 131.72 | 72.76 | 0.13 |
| Reach-1 | 274 | 100-year | 155.00 | 76.43 | 80.58 | | 80.60 | 0.000268 | 1.30 | 138.34 | 74.07 | 0.14 |
| | | | | | | | | | | | | |
| Reach-1 | 194.21 | August | 8.00 | 76.43 | 79.11 | 77.08 | 79.11 | 0.000013 | 0.16 | 48.62 | 43.81 | 0.03 |
| Reach-1 | 194.21 | Spring - meas. | 14.60 | 76.43 | 79.25 | 77.25 | 79.26 | 0.000030 | 0.27 | 55.03 | 47.15 | 0.04 |
| Reach-1 | 194.21 | Spring | 22.00 | 76.43 | 79.41 | 77.40 | 79.41 | 0.000046 | 0.36 | 62.50 | 50.77 | 0.05 |
| Reach-1 | 194.21 | Mean Annual | 80.00 | 76.43 | 80.11 | 78.05 | 80.12 | 0.000148 | 0.84 | 104.86 | 68.25 | 0.10 |
| Reach-1 | 194.21 | 10-year | 116.00 | 76.43 | 80.34 | 78.34 | 80.36 | 0.000214 | 1.08 | 121.00 | 71.00 | 0.13 |
| Reach-1 | 194.21 | 25-year | 126.00 | 76.43 | 80.39 | 78.40 | 80.41 | 0.000233 | 1.15 | 124.67 | 71.61 | 0.13 |
| Reach-1 | 194.21 | 50-year | 138.00 | 76.43 | 80.48 | 78.48 | 80.50 | 0.000246 | 1.21 | 130.80 | 72.61 | 0.14 |
| Reach-1 | 194.21 | 100-year | 155.00 | 76.43 | 80.56 | 78.57 | 80.59 | 0.000273 | 1.30 | 137.31 | 73.86 | 0.14 |
| | | | | | | | | | | | | |
| Reach-1 | 193 | | Inl Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 189 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.70 | 30.02 | 0.04 |
| Reach-1 | 189 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.21 | 0.000057 | 0.38 | 39.08 | 33.10 | 0.06 |
| Reach-1 | 189 | Spring | 22.00 | 76.98 | 79.39 | | 79.40 | 0.000081 | 0.49 | 45.54 | 35.58 | 0.07 |
| Reach-1 | 189 | Mean Annual | 80.00 | 76.98 | 80.08 | | 80.10 | 0.000288 | 1.20 | 72.86 | 43.12 | 0.14 |
| Reach-1 | 189 | 10-year | 116.00 | 76.98 | 80.31 | | 80.35 | 0.000423 | 1.56 | 83.11 | 45.21 | 0.18 |
| Reach-1 | 189 | 25-year | 126.00 | 76.98 | 80.36 | | 80.40 | 0.000463 | 1.65 | 85.45 | 45.57 | 0.19 |
| Reach-1 | 189 | 50-year | 138.00 | 76.98 | 80.43 | | 80.47 | 0.000506 | 1.76 | 88.45 | 46.02 | 0.20 |
| Reach-1 | 189 | 100-year | 155.00 | 76.98 | 80.52 | | 80.57 | 0.000564 | 1.90 | 92.58 | 46.64 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 153 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.70 | 30.02 | 0.04 |
| Reach-1 | 153 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.21 | 0.000057 | 0.38 | 39.07 | 33.10 | 0.06 |
| Reach-1 | 153 | Spring | 22.00 | 76.98 | 79.39 | | 79.39 | 0.000081 | 0.49 | 45.53 | 35.58 | 0.07 |
| Reach-1 | 153 | Mean Annual | 80.00 | 76.98 | 80.08 | | 80.10 | 0.000289 | 1.20 | 72.81 | 43.11 | 0.14 |
| Reach-1 | 153 | 10-year | 116.00 | 76.98 | 80.31 | | 80.34 | 0.000424 | 1.56 | 83.03 | 45.20 | 0.18 |
| Reach-1 | 153 | 25-year | 126.00 | 76.98 | 80.36 | | 80.40 | 0.000464 | 1.65 | 85.36 | 45.55 | 0.19 |
| Reach-1 | 153 | 50-year | 138.00 | 76.98 | 80.42 | | 80.47 | 0.000507 | 1.76 | 88.35 | 46.01 | 0.20 |
| Reach-1 | 153 | 100-year | 155.00 | 76.98 | 80.51 | | 80.57 | 0.000565 | 1.90 | 92.47 | 46.62 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 149 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.69 | 30.02 | 0.04 |
| Reach-1 | 149 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.21 | 0.000057 | 0.38 | 39.07 | 33.10 | 0.06 |
| Reach-1 | 149 | Spring | 22.00 | 76.98 | 79.39 | | 79.39 | 0.000081 | 0.49 | 45.52 | 35.57 | 0.07 |
| Reach-1 | 149 | Mean Annual | 80.00 | 76.98 | 80.08 | | 80.10 | 0.000289 | 1.20 | 72.76 | 43.10 | 0.14 |
| Reach-1 | 149 | 10-year | 116.00 | 76.98 | 80.31 | | 80.34 | 0.000426 | 1.56 | 82.95 | 45.19 | 0.18 |
| Reach-1 | 149 | 25-year | 126.00 | 76.98 | 80.36 | | 80.40 | 0.000466 | 1.66 | 85.27 | 45.54 | 0.19 |
| Reach-1 | 149 | 50-year | 138.00 | 76.98 | 80.42 | | 80.47 | 0.000509 | 1.76 | 88.26 | 45.99 | 0.20 |
| Reach-1 | 149 | 100-year | 155.00 | 76.98 | 80.51 | | 80.56 | 0.000567 | 1.90 | 92.35 | 46.61 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 144.91 | August | 8.00 | 76.98 | 78.97 | | 78.97 | 0.000033 | 0.25 | 31.69 | 30.02 | 0.04 |
| Reach-1 | 144.91 | Spring - meas. | 14.60 | 76.98 | 79.20 | | 79.20 | 0.000057 | 0.38 | 39.06 | 33.10 | 0.06 |
| Reach-1 | 144.91 | Spring | 22.00 | 76.98 | 79.39 | | 79.39 | 0.000081 | 0.50 | 45.50 | 35.57 | 0.07 |
| Reach-1 | 144.91 | Mean Annual | 80.00 | 76.98 | 80.07 | | 80.10 | 0.000290 | 1.20 | 72.70 | 43.09 | 0.14 |
| Reach-1 | 144.91 | 10-year | 116.00 | 76.98 | 80.30 | | 80.34 | 0.000427 | 1.56 | 82.87 | 45.17 | 0.18 |
| Reach-1 | 144.91 | 25-year | 126.00 | 76.98 | 80.36 | | 80.40 | 0.000467 | 1.66 | 85.18 | 45.53 | 0.19 |
| Reach-1 | 144.91 | 50-year | 138.00 | 76.98 | 80.42 | | 80.47 | 0.000510 | 1.76 | 88.15 | 45.98 | 0.20 |
| Reach-1 | 144.91 | 100-year | 155.00 | 76.98 | 80.51 | | 80.56 | 0.000569 | 1.90 | 92.24 | 46.59 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 133 | August | 8.00 | 76.98 | 78.97 | 77.54 | 78.97 | 0.000033 | 0.25 | 31.68 | 30.01 | 0.04 |
| Reach-1 | 133 | Spring - meas. | 14.60 | 76.98 | 79.20 | 77.69 | 79.20 | 0.000057 | 0.38 | 39.04 | 33.09 | 0.06 |
| Reach-1 | 133 | Spring | 22.00 | 76.98 | 79.39 | 77.82 | 79.39 | 0.000082 | 0.50 | 45.47 | 35.56 | 0.07 |
| Reach-1 | 133 | Mean Annual | 80.00 | 76.98 | 80.07 | 78.38 | 80.09 | 0.000292 | 1.21 | 72.55 | 43.06 | 0.14 |
| Reach-1 | 133 | 10-year | 116.00 | 76.98 | 80.30 | 78.61 | 80.34 | 0.000430 | 1.57 | 82.62 | 45.13 | 0.18 |
| Reach-1 | 133 | 25-year | 126.00 | 76.98 | 80.35 | 78.67 | 80.39 | 0.000471 | 1.66 | 84.91 | 45.48 | 0.19 |
| Reach-1 | 133 | 50-year | 138.00 | 76.98 | 80.41 | 78.73 | 80.46 | 0.000515 | 1.77 | 87.85 | 45.93 | 0.20 |
| Reach-1 | 133 | 100-year | 155.00 | 76.98 | 80.50 | 78.82 | 80.56 | 0.000575 | 1.91 | 91.89 | 46.54 | 0.21 |
| | | | | | | | | | | | | |
| Reach-1 | 132 | | Inl Struct | | | | | | | | | |

HEC-RAS Plan: 070626 alt3 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| | | | | | | | | | | | | |
| Reach-1 | 129 | August | 8.00 | 76.98 | 78.65 | | 78.65 | 0.000082 | 0.35 | 22.75 | 25.80 | 0.07 |
| Reach-1 | 129 | Spring - meas. | 14.60 | 76.98 | 78.76 | | 78.76 | 0.000199 | 0.57 | 25.62 | 27.22 | 0.10 |
| Reach-1 | 129 | Spring | 22.00 | 76.98 | 78.88 | | 78.89 | 0.000321 | 0.76 | 29.00 | 28.81 | 0.13 |
| Reach-1 | 129 | Mean Annual | 80.00 | 76.98 | 79.46 | | 79.50 | 0.000928 | 1.72 | 47.88 | 36.44 | 0.24 |
| Reach-1 | 129 | 10-year | 116.00 | 76.98 | 79.74 | | 79.81 | 0.001092 | 2.09 | 58.81 | 40.18 | 0.27 |
| Reach-1 | 129 | 25-year | 126.00 | 76.98 | 79.82 | | 79.89 | 0.001118 | 2.17 | 61.91 | 41.05 | 0.28 |
| Reach-1 | 129 | 50-year | 138.00 | 76.98 | 79.90 | | 79.98 | 0.001153 | 2.27 | 65.43 | 41.93 | 0.28 |
| Reach-1 | 129 | 100-year | 155.00 | 76.98 | 80.03 | | 80.11 | 0.001178 | 2.39 | 70.64 | 42.73 | 0.29 |
| | | | | | | | | | | | | |
| Reach-1 | 119.58 | August | 8.00 | 76.98 | 78.65 | 77.54 | 78.65 | 0.000082 | 0.35 | 22.72 | 25.79 | 0.07 |
| Reach-1 | 119.58 | Spring - meas. | 14.60 | 76.98 | 78.75 | 77.69 | 78.76 | 0.000199 | 0.57 | 25.55 | 27.20 | 0.10 |
| Reach-1 | 119.58 | Spring | 22.00 | 76.98 | 78.87 | 77.82 | 78.88 | 0.000313 | 0.76 | 28.89 | 28.77 | 0.13 |
| Reach-1 | 119.58 | Mean Annual | 80.00 | 76.98 | 79.44 | 78.38 | 79.49 | 0.000936 | 1.77 | 47.41 | 36.27 | 0.25 |
| Reach-1 | 119.58 | 10-year | 116.00 | 76.98 | 79.73 | 78.61 | 79.80 | 0.001122 | 2.15 | 58.15 | 39.99 | 0.28 |
| Reach-1 | 119.58 | 25-year | 126.00 | 76.98 | 79.80 | 78.67 | 79.88 | 0.001154 | 2.24 | 61.18 | 40.84 | 0.28 |
| Reach-1 | 119.58 | 50-year | 138.00 | 76.98 | 79.88 | 78.74 | 79.97 | 0.001195 | 2.35 | 64.63 | 41.79 | 0.29 |
| Reach-1 | 119.58 | 100-year | 155.00 | 76.98 | 80.01 | 78.82 | 80.10 | 0.001225 | 2.47 | 69.79 | 42.60 | 0.30 |
| | | | | | | | | | | | | |
| Reach-1 | 98.20 | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 68.00 | August | 8.00 | 76.76 | 78.65 | 77.30 | 78.65 | 0.000034 | 0.33 | 24.35 | 28.24 | 0.06 |
| Reach-1 | 68.00 | Spring - meas. | 14.60 | 76.76 | 78.75 | 77.48 | 78.75 | 0.000081 | 0.54 | 27.36 | 30.65 | 0.09 |
| Reach-1 | 68.00 | Spring | 22.00 | 76.76 | 78.86 | 77.63 | 78.87 | 0.000129 | 0.74 | 31.00 | 33.81 | 0.12 |
| Reach-1 | 68.00 | Mean Annual | 80.00 | 76.76 | 79.33 | 78.32 | 79.39 | 0.000518 | 1.85 | 49.73 | 44.40 | 0.26 |
| Reach-1 | 68.00 | 10-year | 116.00 | 76.76 | 79.53 | 78.55 | 79.61 | 0.000731 | 2.37 | 58.60 | 47.96 | 0.31 |
| Reach-1 | 68.00 | 25-year | 126.00 | 76.76 | 79.57 | 78.60 | 79.67 | 0.000788 | 2.50 | 60.85 | 48.75 | 0.32 |
| Reach-1 | 68.00 | 50-year | 138.00 | 76.76 | 79.62 | 78.66 | 79.73 | 0.000865 | 2.67 | 63.14 | 49.50 | 0.34 |
| Reach-1 | 68.00 | 100-year | 155.00 | 76.76 | 79.69 | 78.74 | 79.81 | 0.000962 | 2.88 | 66.53 | 50.47 | 0.36 |
| | | | | | | | | | | | | |
| Reach-1 | 67.5 | | Int Struct | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 67 | August | 8.00 | 76.80 | 77.02 | 77.02 | 77.13 | 0.015356 | 2.62 | 3.05 | 14.32 | 1.00 |
| Reach-1 | 67 | Spring - meas. | 14.60 | 76.80 | 77.13 | 77.13 | 77.29 | 0.013768 | 3.17 | 4.61 | 14.98 | 1.01 |
| Reach-1 | 67 | Spring | 22.00 | 76.80 | 77.23 | 77.23 | 77.43 | 0.012581 | 3.57 | 6.17 | 15.61 | 1.00 |
| Reach-1 | 67 | Mean Annual | 80.00 | 76.80 | 78.06 | | 78.29 | 0.003859 | 3.81 | 21.00 | 19.45 | 0.65 |
| Reach-1 | 67 | 10-year | 116.00 | 76.80 | 78.46 | | 78.71 | 0.003064 | 4.00 | 28.97 | 20.72 | 0.60 |
| Reach-1 | 67 | 25-year | 126.00 | 76.80 | 78.56 | | 78.82 | 0.002930 | 4.05 | 31.08 | 21.04 | 0.59 |
| Reach-1 | 67 | 50-year | 138.00 | 76.80 | 78.68 | | 78.94 | 0.002800 | 4.11 | 33.55 | 21.41 | 0.58 |
| Reach-1 | 67 | 100-year | 155.00 | 76.80 | 78.83 | | 79.11 | 0.002638 | 4.20 | 36.94 | 22.09 | 0.57 |
| | | | | | | | | | | | | |
| Reach-1 | 66 | August | 8.00 | 74.50 | 76.98 | 74.72 | 76.98 | 0.000006 | 0.23 | 35.48 | 15.43 | 0.03 |
| Reach-1 | 66 | Spring - meas. | 14.60 | 74.50 | 77.16 | 74.83 | 77.16 | 0.000017 | 0.38 | 38.29 | 16.11 | 0.04 |
| Reach-1 | 66 | Spring | 22.00 | 74.50 | 77.32 | 74.94 | 77.33 | 0.000033 | 0.54 | 40.98 | 16.95 | 0.06 |
| Reach-1 | 66 | Mean Annual | 80.00 | 74.50 | 78.19 | | 78.22 | 0.000190 | 1.37 | 58.32 | 23.09 | 0.15 |
| Reach-1 | 66 | 10-year | 116.00 | 74.50 | 78.59 | | 78.64 | 0.000252 | 1.71 | 68.17 | 25.99 | 0.18 |
| Reach-1 | 66 | 25-year | 126.00 | 74.50 | 78.69 | | 78.74 | 0.000264 | 1.79 | 70.87 | 26.75 | 0.18 |
| Reach-1 | 66 | 50-year | 138.00 | 74.50 | 78.81 | | 78.87 | 0.000278 | 1.88 | 74.06 | 27.63 | 0.19 |
| Reach-1 | 66 | 100-year | 155.00 | 74.50 | 78.97 | | 79.03 | 0.000295 | 2.01 | 78.54 | 28.99 | 0.20 |
| | | | | | | | | | | | | |
| Reach-1 | 65 | August | 8.00 | 74.30 | 76.98 | | 76.98 | 0.000003 | 0.16 | 48.84 | 22.02 | 0.02 |
| Reach-1 | 65 | Spring - meas. | 14.60 | 74.30 | 77.16 | | 77.16 | 0.000008 | 0.28 | 52.82 | 22.53 | 0.03 |
| Reach-1 | 65 | Spring | 22.00 | 74.30 | 77.32 | | 77.33 | 0.000014 | 0.39 | 56.56 | 23.00 | 0.04 |
| Reach-1 | 65 | Mean Annual | 80.00 | 74.30 | 78.20 | | 78.21 | 0.000077 | 1.03 | 77.68 | 25.47 | 0.10 |
| Reach-1 | 65 | 10-year | 116.00 | 74.30 | 78.60 | | 78.63 | 0.000109 | 1.32 | 88.43 | 29.80 | 0.13 |
| Reach-1 | 65 | 25-year | 126.00 | 74.30 | 78.70 | | 78.73 | 0.000116 | 1.39 | 92.09 | 37.27 | 0.13 |
| Reach-1 | 65 | 50-year | 138.00 | 74.30 | 78.82 | | 78.86 | 0.000125 | 1.47 | 96.58 | 38.33 | 0.14 |
| Reach-1 | 65 | 100-year | 155.00 | 74.30 | 78.98 | | 79.02 | 0.000136 | 1.58 | 102.81 | 39.75 | 0.14 |
| | | | | | | | | | | | | |
| Reach-1 | 64 | August | 8.00 | 76.60 | 76.85 | 76.85 | 76.97 | 0.037906 | 2.77 | 2.89 | 12.11 | 1.00 |
| Reach-1 | 64 | Spring - meas. | 14.60 | 76.60 | 76.97 | 76.97 | 77.14 | 0.033733 | 3.33 | 4.38 | 12.70 | 1.00 |
| Reach-1 | 64 | Spring | 22.00 | 76.60 | 77.08 | 77.08 | 77.30 | 0.031176 | 3.76 | 5.85 | 13.25 | 1.00 |
| Reach-1 | 64 | Mean Annual | 80.00 | 76.60 | 77.68 | 77.68 | 78.16 | 0.025482 | 5.58 | 14.33 | 14.91 | 1.00 |
| Reach-1 | 64 | 10-year | 116.00 | 76.60 | 77.95 | 77.95 | 78.56 | 0.024368 | 6.27 | 18.52 | 15.36 | 1.01 |
| Reach-1 | 64 | 25-year | 126.00 | 76.60 | 78.02 | 78.02 | 78.67 | 0.024247 | 6.44 | 19.58 | 15.47 | 1.01 |
| Reach-1 | 64 | 50-year | 138.00 | 76.60 | 78.11 | 78.11 | 78.79 | 0.023449 | 6.60 | 20.96 | 16.59 | 1.00 |
| Reach-1 | 64 | 100-year | 155.00 | 76.60 | 78.23 | 78.23 | 78.95 | 0.022270 | 6.80 | 23.05 | 18.67 | 0.99 |
| | | | | | | | | | | | | |
| Reach-1 | 63 | August | 8.00 | 75.60 | 75.98 | 75.85 | 76.03 | 0.008758 | 1.72 | 4.66 | 13.28 | 0.51 |
| Reach-1 | 63 | Spring - meas. | 14.60 | 75.60 | 76.14 | 75.97 | 76.21 | 0.009216 | 2.17 | 6.74 | 14.04 | 0.55 |
| Reach-1 | 63 | Spring | 22.00 | 75.60 | 76.27 | 76.08 | 76.37 | 0.009641 | 2.54 | 8.68 | 14.71 | 0.58 |
| Reach-1 | 63 | Mean Annual | 80.00 | 75.60 | 76.94 | 76.66 | 77.20 | 0.010320 | 4.08 | 19.73 | 18.17 | 0.67 |
| Reach-1 | 63 | 10-year | 116.00 | 75.60 | 77.23 | 76.92 | 77.57 | 0.010323 | 4.72 | 25.10 | 19.70 | 0.69 |
| Reach-1 | 63 | 25-year | 126.00 | 75.60 | 77.30 | 76.99 | 77.67 | 0.010284 | 4.87 | 26.56 | 20.09 | 0.70 |
| Reach-1 | 63 | 50-year | 138.00 | 75.60 | 77.39 | 77.06 | 77.78 | 0.010183 | 5.03 | 28.33 | 20.55 | 0.70 |
| Reach-1 | 63 | 100-year | 155.00 | 75.60 | 77.51 | 77.17 | 77.93 | 0.009966 | 5.23 | 30.89 | 21.21 | 0.70 |
| | | | | | | | | | | | | |

HEC-RAS Plan: 070626 alt3 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 62.5 | August | 8.00 | 75.52 | 75.89 | | 75.94 | 0.009024 | 1.74 | 4.60 | 13.16 | 0.52 |
| Reach-1 | 62.5 | Spring - meas. | 14.60 | 75.52 | 76.02 | | 76.10 | 0.010707 | 2.28 | 6.40 | 13.77 | 0.59 |
| Reach-1 | 62.5 | Spring | 22.00 | 75.52 | 76.14 | | 76.26 | 0.011977 | 2.74 | 8.04 | 14.31 | 0.64 |
| Reach-1 | 62.5 | Mean Annual | 80.00 | 75.52 | 76.70 | 76.58 | 77.05 | 0.017258 | 4.77 | 16.78 | 16.88 | 0.84 |
| Reach-1 | 62.5 | 10-year | 116.00 | 75.52 | 76.94 | 76.84 | 77.42 | 0.017889 | 5.57 | 20.93 | 18.14 | 0.89 |
| Reach-1 | 62.5 | 25-year | 126.00 | 75.52 | 77.00 | 76.91 | 77.51 | 0.017998 | 5.77 | 22.02 | 18.46 | 0.90 |
| Reach-1 | 62.5 | 50-year | 138.00 | 75.52 | 77.05 | 76.98 | 77.62 | 0.018838 | 6.06 | 23.00 | 18.75 | 0.92 |
| Reach-1 | 62.5 | 100-year | 155.00 | 75.52 | 77.12 | 77.09 | 77.77 | 0.020190 | 6.48 | 24.25 | 19.10 | 0.96 |
| | | | | | | | | | | | | |
| Reach-1 | 62 | August | 8.00 | 75.43 | 75.70 | 75.70 | 75.81 | 0.015119 | 2.66 | 3.01 | 13.64 | 1.00 |
| Reach-1 | 62 | Spring - meas. | 14.60 | 75.43 | 75.81 | 75.81 | 75.97 | 0.013653 | 3.22 | 4.53 | 14.21 | 1.01 |
| Reach-1 | 62 | Spring | 22.00 | 75.43 | 75.91 | 75.91 | 76.12 | 0.012519 | 3.64 | 6.04 | 14.76 | 1.00 |
| Reach-1 | 62 | Mean Annual | 80.00 | 75.43 | 76.46 | 76.46 | 76.91 | 0.009744 | 5.39 | 14.91 | 17.45 | 1.00 |
| Reach-1 | 62 | 10-year | 116.00 | 75.43 | 76.72 | 76.72 | 77.29 | 0.008828 | 6.07 | 19.54 | 18.69 | 1.00 |
| Reach-1 | 62 | 25-year | 126.00 | 75.43 | 76.78 | 76.78 | 77.38 | 0.008637 | 6.23 | 20.78 | 19.01 | 0.99 |
| Reach-1 | 62 | 50-year | 138.00 | 75.43 | 76.87 | 76.86 | 77.50 | 0.008225 | 6.36 | 22.44 | 19.42 | 0.98 |
| Reach-1 | 62 | 100-year | 155.00 | 75.43 | 76.98 | 76.97 | 77.65 | 0.007920 | 6.59 | 24.58 | 19.95 | 0.98 |
| | | | | | | | | | | | | |
| Reach-1 | 61 | August | 8.00 | 75.02 | 75.33 | 75.35 | 75.47 | 0.017573 | 3.04 | 2.63 | 10.85 | 1.09 |
| Reach-1 | 61 | Spring - meas. | 14.60 | 75.02 | 75.45 | 75.47 | 75.66 | 0.016937 | 3.74 | 3.90 | 11.45 | 1.13 |
| Reach-1 | 61 | Spring | 22.00 | 75.02 | 75.58 | 75.59 | 75.83 | 0.015642 | 4.22 | 5.22 | 12.04 | 1.13 |
| Reach-1 | 61 | Mean Annual | 80.00 | 75.02 | 76.19 | 76.22 | 76.70 | 0.010993 | 5.75 | 13.92 | 15.46 | 1.06 |
| Reach-1 | 61 | 10-year | 116.00 | 75.02 | 76.46 | 76.50 | 77.10 | 0.009738 | 6.43 | 18.26 | 16.94 | 1.04 |
| Reach-1 | 61 | 25-year | 126.00 | 75.02 | 76.53 | 76.57 | 77.20 | 0.009412 | 6.57 | 19.50 | 17.34 | 1.04 |
| Reach-1 | 61 | 50-year | 138.00 | 75.02 | 76.65 | 76.65 | 77.32 | 0.008377 | 6.58 | 21.54 | 17.98 | 0.99 |
| Reach-1 | 61 | 100-year | 155.00 | 75.02 | 76.76 | 76.76 | 77.48 | 0.008111 | 6.82 | 23.57 | 18.60 | 0.99 |
| | | | | | | | | | | | | |
| Reach-1 | 60 | August | 8.00 | 74.40 | 74.62 | 74.62 | 74.72 | 0.017519 | 2.55 | 3.14 | 17.06 | 1.04 |
| Reach-1 | 60 | Spring - meas. | 14.60 | 74.40 | 74.71 | 74.72 | 74.85 | 0.014996 | 3.00 | 4.88 | 18.77 | 1.03 |
| Reach-1 | 60 | Spring | 22.00 | 74.40 | 74.77 | 74.80 | 74.98 | 0.017569 | 3.70 | 5.98 | 19.29 | 1.15 |
| Reach-1 | 60 | Mean Annual | 80.00 | 74.40 | 75.05 | 75.28 | 75.84 | 0.028738 | 7.16 | 11.69 | 21.83 | 1.63 |
| Reach-1 | 60 | 10-year | 116.00 | 74.40 | 75.18 | 75.51 | 76.26 | 0.030113 | 8.41 | 14.76 | 23.01 | 1.73 |
| Reach-1 | 60 | 25-year | 126.00 | 74.40 | 75.22 | 75.57 | 76.38 | 0.030395 | 8.71 | 15.56 | 23.27 | 1.75 |
| Reach-1 | 60 | 50-year | 138.00 | 74.40 | 75.25 | 75.63 | 76.53 | 0.031832 | 9.15 | 16.29 | 23.52 | 1.80 |
| Reach-1 | 60 | 100-year | 155.00 | 74.40 | 75.31 | 75.73 | 76.70 | 0.031655 | 9.56 | 17.67 | 23.97 | 1.82 |
| | | | | | | | | | | | | |
| Reach-1 | 59 | August | 8.00 | 71.70 | 73.90 | 71.90 | 73.90 | 0.000005 | 0.19 | 42.77 | 25.02 | 0.03 |
| Reach-1 | 59 | Spring - meas. | 14.60 | 71.70 | 74.04 | 72.00 | 74.04 | 0.000014 | 0.31 | 46.43 | 26.33 | 0.04 |
| Reach-1 | 59 | Spring | 22.00 | 71.70 | 74.18 | 72.09 | 74.18 | 0.000026 | 0.44 | 50.07 | 27.57 | 0.06 |
| Reach-1 | 59 | Mean Annual | 80.00 | 71.70 | 74.92 | 72.60 | 74.94 | 0.000113 | 1.12 | 73.02 | 34.39 | 0.13 |
| Reach-1 | 59 | 10-year | 116.00 | 71.70 | 75.25 | 72.84 | 75.29 | 0.000154 | 1.42 | 85.51 | 39.46 | 0.15 |
| Reach-1 | 59 | 25-year | 126.00 | 71.70 | 75.34 | 72.90 | 75.37 | 0.000164 | 1.50 | 88.88 | 40.77 | 0.16 |
| Reach-1 | 59 | 50-year | 138.00 | 71.70 | 75.44 | 72.97 | 75.48 | 0.000176 | 1.58 | 92.94 | 42.26 | 0.16 |
| Reach-1 | 59 | 100-year | 155.00 | 71.70 | 75.57 | 73.07 | 75.61 | 0.000191 | 1.70 | 98.61 | 44.26 | 0.17 |
| | | | | | | | | | | | | |
| Reach-1 | 58 | August | 8.00 | 71.30 | 73.90 | | 73.90 | 0.000007 | 0.22 | 36.63 | 21.00 | 0.03 |
| Reach-1 | 58 | Spring - meas. | 14.60 | 71.30 | 74.04 | | 74.04 | 0.000019 | 0.37 | 39.68 | 22.06 | 0.05 |
| Reach-1 | 58 | Spring | 22.00 | 71.30 | 74.17 | | 74.18 | 0.000036 | 0.52 | 42.70 | 23.07 | 0.07 |
| Reach-1 | 58 | Mean Annual | 80.00 | 71.30 | 74.90 | | 74.93 | 0.000159 | 1.33 | 62.26 | 31.61 | 0.15 |
| Reach-1 | 58 | 10-year | 116.00 | 71.30 | 75.24 | | 75.28 | 0.000220 | 1.70 | 73.53 | 36.29 | 0.18 |
| Reach-1 | 58 | 25-year | 126.00 | 71.30 | 75.32 | | 75.37 | 0.000235 | 1.79 | 76.56 | 37.45 | 0.18 |
| Reach-1 | 58 | 50-year | 138.00 | 71.30 | 75.41 | | 75.47 | 0.000252 | 1.89 | 80.20 | 38.80 | 0.19 |
| Reach-1 | 58 | 100-year | 155.00 | 71.30 | 75.54 | | 75.60 | 0.000276 | 2.03 | 85.27 | 40.60 | 0.20 |
| | | | | | | | | | | | | |
| Reach-1 | 57 | August | 8.00 | 73.60 | 73.82 | 73.79 | 73.89 | 0.024352 | 2.07 | 3.86 | 18.05 | 0.79 |
| Reach-1 | 57 | Spring - meas. | 14.60 | 73.60 | 73.94 | | 74.03 | 0.020388 | 2.45 | 5.96 | 18.93 | 0.77 |
| Reach-1 | 57 | Spring | 22.00 | 73.60 | 74.05 | | 74.17 | 0.017138 | 2.69 | 8.19 | 19.82 | 0.74 |
| Reach-1 | 57 | Mean Annual | 80.00 | 73.60 | 74.71 | | 74.91 | 0.009113 | 3.64 | 23.18 | 27.08 | 0.63 |
| Reach-1 | 57 | 10-year | 116.00 | 73.60 | 75.02 | | 75.25 | 0.007673 | 3.97 | 32.26 | 31.14 | 0.60 |
| Reach-1 | 57 | 25-year | 126.00 | 73.60 | 75.10 | | 75.34 | 0.007421 | 4.06 | 34.72 | 32.15 | 0.60 |
| Reach-1 | 57 | 50-year | 138.00 | 73.60 | 75.19 | | 75.44 | 0.007136 | 4.15 | 37.72 | 33.43 | 0.59 |
| Reach-1 | 57 | 100-year | 155.00 | 73.60 | 75.31 | | 75.58 | 0.006805 | 4.26 | 41.94 | 35.15 | 0.58 |
| | | | | | | | | | | | | |
| Reach-1 | 56.5 | August | 8.00 | 73.15 | 73.49 | | 73.52 | 0.006078 | 1.37 | 5.84 | 17.78 | 0.42 |
| Reach-1 | 56.5 | Spring - meas. | 14.60 | 73.15 | 73.64 | | 73.69 | 0.005908 | 1.70 | 8.58 | 18.43 | 0.44 |
| Reach-1 | 56.5 | Spring | 22.00 | 73.15 | 73.79 | | 73.84 | 0.005736 | 1.96 | 11.23 | 19.03 | 0.45 |
| Reach-1 | 56.5 | Mean Annual | 80.00 | 73.15 | 74.53 | | 74.67 | 0.004928 | 3.03 | 27.00 | 24.74 | 0.47 |
| Reach-1 | 56.5 | 10-year | 116.00 | 73.15 | 74.88 | | 75.04 | 0.004702 | 3.44 | 35.85 | 29.10 | 0.48 |
| Reach-1 | 56.5 | 25-year | 126.00 | 73.15 | 74.94 | | 75.13 | 0.004674 | 3.55 | 38.22 | 30.14 | 0.48 |
| Reach-1 | 56.5 | 50-year | 138.00 | 73.15 | 75.04 | | 75.24 | 0.004621 | 3.66 | 41.13 | 31.37 | 0.48 |
| Reach-1 | 56.5 | 100-year | 155.00 | 73.15 | 75.16 | | 75.38 | 0.004563 | 3.80 | 45.20 | 33.08 | 0.49 |
| | | | | | | | | | | | | |
| Reach-1 | 56 | August | 8.00 | 72.70 | 73.00 | 72.99 | 73.12 | 0.035892 | 2.77 | 2.89 | 11.63 | 0.98 |
| Reach-1 | 56 | Spring - meas. | 14.60 | 72.70 | 73.12 | 73.12 | 73.30 | 0.033837 | 3.40 | 4.30 | 12.17 | 1.01 |
| Reach-1 | 56 | Spring | 22.00 | 72.70 | 73.23 | 73.23 | 73.46 | 0.031292 | 3.84 | 5.73 | 12.69 | 1.01 |
| Reach-1 | 56 | Mean Annual | 80.00 | 72.70 | 73.85 | 73.85 | 74.33 | 0.025043 | 5.52 | 14.49 | 15.49 | 1.01 |
| Reach-1 | 56 | 10-year | 116.00 | 72.70 | 74.14 | 74.14 | 74.71 | 0.023075 | 6.02 | 19.31 | 18.21 | 1.01 |

HEC-RAS Plan: 070626 alt3 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 56 | 25-year | 126.00 | 72.70 | 74.21 | 74.21 | 74.80 | 0.022726 | 6.14 | 20.63 | 19.14 | 1.00 |
| Reach-1 | 56 | 50-year | 138.00 | 72.70 | 74.29 | 74.29 | 74.91 | 0.022056 | 6.31 | 22.13 | 20.14 | 0.99 |
| Reach-1 | 56 | 100-year | 155.00 | 72.70 | 74.40 | 74.40 | 75.05 | 0.020958 | 6.50 | 24.42 | 21.57 | 0.98 |
| | | | | | | | | | | | | |
| Reach-1 | 55 | August | 8.00 | 72.50 | 72.79 | 72.78 | 72.91 | 0.013614 | 2.78 | 2.88 | 11.28 | 0.97 |
| Reach-1 | 55 | Spring - mean. | 14.60 | 72.50 | 72.90 | 72.91 | 73.09 | 0.014482 | 3.48 | 4.20 | 12.28 | 1.05 |
| Reach-1 | 55 | Spring | 22.00 | 72.50 | 73.00 | 73.03 | 73.25 | 0.015289 | 4.05 | 5.43 | 13.15 | 1.11 |
| Reach-1 | 55 | Mean Annual | 80.00 | 72.50 | 73.47 | 73.62 | 74.10 | 0.017046 | 6.38 | 12.54 | 16.59 | 1.29 |
| Reach-1 | 55 | 10-year | 116.00 | 72.50 | 73.69 | 73.88 | 74.48 | 0.016585 | 7.13 | 16.27 | 17.76 | 1.31 |
| Reach-1 | 55 | 25-year | 126.00 | 72.50 | 73.73 | 73.96 | 74.58 | 0.016897 | 7.37 | 17.09 | 18.00 | 1.33 |
| Reach-1 | 55 | 50-year | 138.00 | 72.50 | 73.80 | 74.02 | 74.69 | 0.016842 | 7.58 | 18.20 | 18.31 | 1.34 |
| Reach-1 | 55 | 100-year | 155.00 | 72.50 | 73.88 | 74.12 | 74.84 | 0.016784 | 7.86 | 19.73 | 18.74 | 1.35 |
| | | | | | | | | | | | | |
| Reach-1 | 54 | August | 8.00 | 72.30 | 72.55 | 72.55 | 72.65 | 0.014306 | 2.59 | 3.09 | 14.06 | 0.97 |
| Reach-1 | 54 | Spring - mean. | 14.60 | 72.30 | 72.64 | 72.66 | 72.81 | 0.016434 | 3.32 | 4.40 | 15.24 | 1.09 |
| Reach-1 | 54 | Spring | 22.00 | 72.30 | 72.72 | 72.78 | 72.95 | 0.016736 | 3.82 | 5.78 | 16.39 | 1.14 |
| Reach-1 | 54 | Mean Annual | 80.00 | 72.30 | 73.07 | 73.27 | 73.73 | 0.024762 | 6.51 | 12.28 | 21.02 | 1.50 |
| Reach-1 | 54 | 10-year | 116.00 | 72.30 | 73.22 | 73.48 | 74.10 | 0.026839 | 7.52 | 15.42 | 22.57 | 1.60 |
| Reach-1 | 54 | 25-year | 126.00 | 72.30 | 73.25 | 73.54 | 74.19 | 0.027213 | 7.76 | 16.24 | 22.93 | 1.62 |
| Reach-1 | 54 | 50-year | 138.00 | 72.30 | 73.29 | 73.60 | 74.29 | 0.027563 | 8.03 | 17.19 | 23.28 | 1.65 |
| Reach-1 | 54 | 100-year | 155.00 | 72.30 | 73.35 | 73.67 | 74.44 | 0.028000 | 8.39 | 18.48 | 23.70 | 1.67 |
| | | | | | | | | | | | | |
| Reach-1 | 53 | August | 8.00 | 71.60 | 71.80 | 71.80 | 71.88 | 0.016806 | 2.29 | 3.50 | 21.58 | 1.00 |
| Reach-1 | 53 | Spring - mean. | 14.60 | 71.60 | 71.87 | 71.87 | 71.99 | 0.015618 | 2.80 | 5.21 | 22.50 | 1.02 |
| Reach-1 | 53 | Spring | 22.00 | 71.60 | 71.94 | 71.95 | 72.11 | 0.016366 | 3.31 | 6.66 | 23.18 | 1.09 |
| Reach-1 | 53 | Mean Annual | 80.00 | 71.60 | 72.30 | 72.37 | 72.70 | 0.015232 | 5.09 | 15.71 | 27.07 | 1.18 |
| Reach-1 | 53 | 10-year | 116.00 | 71.60 | 72.45 | 72.56 | 72.98 | 0.015889 | 5.84 | 19.85 | 28.67 | 1.24 |
| Reach-1 | 53 | 25-year | 126.00 | 71.60 | 72.48 | 72.60 | 73.05 | 0.016128 | 6.04 | 20.88 | 29.05 | 1.25 |
| Reach-1 | 53 | 50-year | 138.00 | 71.60 | 72.52 | 72.66 | 73.13 | 0.016443 | 6.26 | 22.05 | 29.48 | 1.28 |
| Reach-1 | 53 | 100-year | 155.00 | 71.60 | 72.57 | 72.73 | 73.24 | 0.016802 | 6.56 | 23.63 | 30.06 | 1.30 |
| | | | | | | | | | | | | |
| Reach-1 | 52 | August | 8.00 | 69.40 | 70.85 | 69.62 | 70.85 | 0.000025 | 0.33 | 24.06 | 19.45 | 0.05 |
| Reach-1 | 52 | Spring - mean. | 14.60 | 69.40 | 71.00 | 69.72 | 71.01 | 0.000057 | 0.54 | 27.21 | 20.07 | 0.08 |
| Reach-1 | 52 | Spring | 22.00 | 69.40 | 71.16 | 69.82 | 71.17 | 0.000096 | 0.72 | 30.38 | 20.94 | 0.11 |
| Reach-1 | 52 | Mean Annual | 80.00 | 69.40 | 71.97 | 70.36 | 72.01 | 0.000339 | 1.61 | 49.60 | 26.56 | 0.21 |
| Reach-1 | 52 | 10-year | 116.00 | 69.40 | 72.34 | 70.62 | 72.39 | 0.000454 | 1.94 | 59.94 | 30.50 | 0.24 |
| Reach-1 | 52 | 25-year | 126.00 | 69.40 | 72.43 | 70.68 | 72.49 | 0.000478 | 2.01 | 62.77 | 31.50 | 0.25 |
| Reach-1 | 52 | 50-year | 138.00 | 69.40 | 72.53 | 70.76 | 72.60 | 0.000504 | 2.09 | 66.13 | 32.55 | 0.26 |
| Reach-1 | 52 | 100-year | 155.00 | 69.40 | 72.67 | 70.86 | 72.75 | 0.000534 | 2.19 | 70.82 | 33.96 | 0.27 |
| | | | | | | | | | | | | |
| Reach-1 | 51 | August | 8.00 | 69.00 | 70.84 | | 70.85 | 0.000061 | 0.36 | 21.97 | 14.31 | 0.05 |
| Reach-1 | 51 | Spring - mean. | 14.60 | 69.00 | 71.00 | | 71.01 | 0.000155 | 0.60 | 24.26 | 14.98 | 0.08 |
| Reach-1 | 51 | Spring | 22.00 | 69.00 | 71.15 | | 71.16 | 0.000277 | 0.83 | 26.59 | 15.74 | 0.11 |
| Reach-1 | 51 | Mean Annual | 80.00 | 69.00 | 71.93 | | 71.99 | 0.001066 | 2.01 | 40.59 | 20.63 | 0.23 |
| Reach-1 | 51 | 10-year | 116.00 | 69.00 | 72.27 | | 72.36 | 0.001409 | 2.53 | 48.02 | 23.56 | 0.27 |
| Reach-1 | 51 | 25-year | 126.00 | 69.00 | 72.35 | | 72.46 | 0.001492 | 2.66 | 50.02 | 24.29 | 0.28 |
| Reach-1 | 51 | 50-year | 138.00 | 69.00 | 72.44 | | 72.56 | 0.001587 | 2.80 | 52.39 | 25.16 | 0.29 |
| Reach-1 | 51 | 100-year | 155.00 | 69.00 | 72.57 | | 72.71 | 0.001712 | 3.00 | 55.68 | 26.10 | 0.31 |
| | | | | | | | | | | | | |
| Reach-1 | 50 | August | 8.00 | 70.50 | 70.76 | 70.72 | 70.83 | 0.024100 | 2.19 | 3.65 | 15.49 | 0.80 |
| Reach-1 | 50 | Spring - mean. | 14.60 | 70.50 | 70.84 | 70.82 | 70.97 | 0.030419 | 2.95 | 4.94 | 15.94 | 0.94 |
| Reach-1 | 50 | Spring | 22.00 | 70.50 | 70.92 | 70.92 | 71.11 | 0.032347 | 3.51 | 6.28 | 16.38 | 1.00 |
| Reach-1 | 50 | Mean Annual | 80.00 | 70.50 | 71.44 | 71.44 | 71.85 | 0.025592 | 5.16 | 15.53 | 19.61 | 1.00 |
| Reach-1 | 50 | 10-year | 116.00 | 70.50 | 71.68 | 71.68 | 72.20 | 0.022794 | 5.78 | 20.45 | 21.51 | 0.99 |
| Reach-1 | 50 | 25-year | 126.00 | 70.50 | 71.74 | 71.74 | 72.28 | 0.022271 | 5.93 | 21.77 | 22.00 | 0.99 |
| Reach-1 | 50 | 50-year | 138.00 | 70.50 | 71.81 | 71.81 | 72.38 | 0.021581 | 6.08 | 23.39 | 22.66 | 0.98 |
| Reach-1 | 50 | 100-year | 155.00 | 70.50 | 71.91 | 71.91 | 72.52 | 0.020728 | 6.29 | 25.68 | 23.59 | 0.97 |
| | | | | | | | | | | | | |
| Reach-1 | 49 | August | 8.00 | 70.30 | 70.52 | 70.52 | 70.63 | 0.016697 | 2.59 | 3.09 | 15.77 | 1.03 |
| Reach-1 | 49 | Spring - mean. | 14.60 | 70.30 | 70.63 | 70.63 | 70.77 | 0.013950 | 2.99 | 4.88 | 17.51 | 1.00 |
| Reach-1 | 49 | Spring | 22.00 | 70.30 | 70.71 | 70.72 | 70.90 | 0.014995 | 3.50 | 6.28 | 18.75 | 1.07 |
| Reach-1 | 49 | Mean Annual | 80.00 | 70.30 | 71.04 | 71.19 | 71.60 | 0.020966 | 6.01 | 13.32 | 22.68 | 1.38 |
| Reach-1 | 49 | 10-year | 116.00 | 70.30 | 71.18 | 71.40 | 71.94 | 0.022411 | 6.96 | 16.68 | 23.94 | 1.47 |
| Reach-1 | 49 | 25-year | 126.00 | 70.30 | 71.22 | 71.45 | 72.02 | 0.022715 | 7.18 | 17.55 | 24.26 | 1.49 |
| Reach-1 | 49 | 50-year | 138.00 | 70.30 | 71.26 | 71.51 | 72.12 | 0.022901 | 7.42 | 18.60 | 24.64 | 1.50 |
| Reach-1 | 49 | 100-year | 155.00 | 70.30 | 71.32 | 71.58 | 72.26 | 0.023498 | 7.77 | 19.95 | 25.11 | 1.54 |
| | | | | | | | | | | | | |
| Reach-1 | 48 | August | 8.00 | 68.10 | 70.06 | 68.31 | 70.06 | 0.000007 | 0.21 | 38.43 | 24.56 | 0.03 |
| Reach-1 | 48 | Spring - mean. | 14.60 | 68.10 | 70.22 | 68.41 | 70.22 | 0.000018 | 0.34 | 42.50 | 25.39 | 0.05 |
| Reach-1 | 48 | Spring | 22.00 | 68.10 | 70.37 | 68.50 | 70.37 | 0.000032 | 0.48 | 46.25 | 26.13 | 0.06 |
| Reach-1 | 48 | Mean Annual | 80.00 | 68.10 | 71.11 | 69.02 | 71.13 | 0.000182 | 1.16 | 68.68 | 34.42 | 0.15 |
| Reach-1 | 48 | 10-year | 116.00 | 68.10 | 71.45 | 69.26 | 71.49 | 0.000218 | 1.43 | 81.24 | 38.27 | 0.17 |
| Reach-1 | 48 | 25-year | 126.00 | 68.10 | 71.54 | 69.32 | 71.57 | 0.000226 | 1.49 | 84.51 | 39.21 | 0.18 |
| Reach-1 | 48 | 50-year | 138.00 | 68.10 | 71.64 | 69.39 | 71.67 | 0.000236 | 1.57 | 88.34 | 40.28 | 0.18 |
| Reach-1 | 48 | 100-year | 155.00 | 68.10 | 71.77 | 69.49 | 71.81 | 0.000248 | 1.67 | 93.75 | 41.75 | 0.19 |
| | | | | | | | | | | | | |
| Reach-1 | 47 | August | 8.00 | 67.70 | 70.06 | | 70.06 | 0.000004 | 0.17 | 46.95 | 27.77 | 0.02 |

HEC-RAS Plan: 070028 alt3 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 47 | Spring - meas. | 14.60 | 67.70 | 70.22 | | 70.22 | 0.000011 | 0.28 | 51.58 | 29.16 | 0.04 |
| Reach-1 | 47 | Spring | 22.00 | 67.70 | 70.37 | | 70.37 | 0.000020 | 0.39 | 55.94 | 30.50 | 0.05 |
| Reach-1 | 47 | Mean Annual | 80.00 | 67.70 | 71.11 | | 71.13 | 0.000104 | 0.98 | 81.95 | 39.09 | 0.12 |
| Reach-1 | 47 | 10-year | 116.00 | 67.70 | 71.46 | | 71.48 | 0.000135 | 1.21 | 96.02 | 42.08 | 0.14 |
| Reach-1 | 47 | 25-year | 126.00 | 67.70 | 71.54 | | 71.57 | 0.000142 | 1.27 | 99.61 | 42.81 | 0.14 |
| Reach-1 | 47 | 50-year | 138.00 | 67.70 | 71.64 | | 71.67 | 0.000150 | 1.34 | 103.80 | 43.65 | 0.15 |
| Reach-1 | 47 | 100-year | 155.00 | 67.70 | 71.77 | | 71.80 | 0.000160 | 1.43 | 109.65 | 44.79 | 0.15 |
| | | | | | | | | | | | | |
| Reach-1 | 45 | August | 8.00 | 69.30 | 70.05 | | 70.06 | 0.000267 | 0.69 | 11.66 | 19.45 | 0.16 |
| Reach-1 | 45 | Spring - meas. | 14.60 | 69.30 | 70.21 | | 70.22 | 0.000449 | 0.99 | 14.76 | 21.07 | 0.21 |
| Reach-1 | 45 | Spring | 22.00 | 69.30 | 70.34 | | 70.37 | 0.000605 | 1.24 | 17.78 | 22.56 | 0.25 |
| Reach-1 | 45 | Mean Annual | 80.00 | 69.30 | 71.03 | | 71.11 | 0.001086 | 2.25 | 35.52 | 28.38 | 0.35 |
| Reach-1 | 45 | 10-year | 116.00 | 69.30 | 71.36 | | 71.46 | 0.001089 | 2.57 | 45.24 | 30.86 | 0.37 |
| Reach-1 | 45 | 25-year | 126.00 | 69.30 | 71.44 | | 71.55 | 0.001084 | 2.65 | 47.71 | 31.46 | 0.37 |
| Reach-1 | 45 | 50-year | 138.00 | 69.30 | 71.53 | | 71.65 | 0.001081 | 2.75 | 50.60 | 32.15 | 0.37 |
| Reach-1 | 45 | 100-year | 155.00 | 69.30 | 71.66 | | 71.78 | 0.001076 | 2.87 | 54.66 | 33.09 | 0.38 |
| | | | | | | | | | | | | |
| Reach-1 | 44 | August | 8.00 | 69.70 | 69.93 | 69.93 | 70.04 | 0.039280 | 2.62 | 3.06 | 14.36 | 1.00 |
| Reach-1 | 44 | Spring - meas. | 14.60 | 69.70 | 70.04 | 70.04 | 70.19 | 0.035287 | 3.12 | 4.68 | 15.58 | 1.00 |
| Reach-1 | 44 | Spring | 22.00 | 69.70 | 70.14 | 70.14 | 70.33 | 0.032683 | 3.49 | 6.30 | 16.71 | 1.00 |
| Reach-1 | 44 | Mean Annual | 80.00 | 69.70 | 70.79 | | 71.07 | 0.015491 | 4.19 | 19.10 | 21.88 | 0.79 |
| Reach-1 | 44 | 10-year | 116.00 | 69.70 | 71.13 | | 71.42 | 0.012008 | 4.34 | 26.75 | 23.94 | 0.72 |
| Reach-1 | 44 | 25-year | 126.00 | 69.70 | 71.21 | | 71.51 | 0.011470 | 4.40 | 28.62 | 24.42 | 0.71 |
| Reach-1 | 44 | 50-year | 138.00 | 69.70 | 71.29 | | 71.61 | 0.010887 | 4.50 | 30.74 | 24.95 | 0.70 |
| Reach-1 | 44 | 100-year | 155.00 | 69.70 | 71.41 | | 71.74 | 0.010207 | 4.62 | 33.73 | 25.78 | 0.69 |
| | | | | | | | | | | | | |
| Reach-1 | 43 | August | 8.00 | 68.70 | 69.11 | 69.01 | 69.18 | 0.013006 | 2.15 | 3.72 | 10.11 | 0.63 |
| Reach-1 | 43 | Spring - meas. | 14.60 | 68.70 | 69.26 | 69.15 | 69.38 | 0.014603 | 2.74 | 5.32 | 10.93 | 0.69 |
| Reach-1 | 43 | Spring | 22.00 | 68.70 | 69.40 | 69.28 | 69.56 | 0.015758 | 3.22 | 6.83 | 11.54 | 0.74 |
| Reach-1 | 43 | Mean Annual | 80.00 | 68.70 | 70.02 | 69.96 | 70.46 | 0.020986 | 5.33 | 15.01 | 14.73 | 0.93 |
| Reach-1 | 43 | 10-year | 116.00 | 68.70 | 70.27 | 70.26 | 70.86 | 0.023075 | 6.16 | 18.83 | 15.91 | 1.00 |
| Reach-1 | 43 | 25-year | 126.00 | 68.70 | 70.34 | 70.33 | 70.96 | 0.022930 | 6.30 | 20.00 | 16.26 | 1.00 |
| Reach-1 | 43 | 50-year | 138.00 | 68.70 | 70.42 | 70.42 | 71.07 | 0.022735 | 6.45 | 21.40 | 16.66 | 1.00 |
| Reach-1 | 43 | 100-year | 155.00 | 68.70 | 70.54 | 70.54 | 71.22 | 0.022501 | 6.65 | 23.32 | 17.20 | 1.01 |
| | | | | | | | | | | | | |
| Reach-1 | 42 | August | 8.00 | 68.60 | 68.89 | 68.89 | 69.03 | 0.014274 | 2.94 | 2.72 | 10.15 | 1.00 |
| Reach-1 | 42 | Spring - meas. | 14.60 | 68.60 | 69.03 | 69.03 | 69.22 | 0.012925 | 3.52 | 4.14 | 10.85 | 1.01 |
| Reach-1 | 42 | Spring | 22.00 | 68.60 | 69.16 | 69.16 | 69.40 | 0.011948 | 3.96 | 5.56 | 11.51 | 1.00 |
| Reach-1 | 42 | Mean Annual | 80.00 | 68.60 | 69.82 | 69.82 | 70.31 | 0.009552 | 5.62 | 14.23 | 14.58 | 1.00 |
| Reach-1 | 42 | 10-year | 116.00 | 68.60 | 70.12 | 70.12 | 70.71 | 0.009130 | 6.18 | 18.76 | 15.91 | 1.00 |
| Reach-1 | 42 | 25-year | 126.00 | 68.60 | 70.19 | 70.19 | 70.81 | 0.009020 | 6.31 | 19.96 | 16.25 | 1.00 |
| Reach-1 | 42 | 50-year | 138.00 | 68.60 | 70.28 | 70.28 | 70.92 | 0.008904 | 6.46 | 21.37 | 16.63 | 1.00 |
| Reach-1 | 42 | 100-year | 155.00 | 68.60 | 70.39 | 70.39 | 71.08 | 0.008758 | 6.64 | 23.33 | 17.15 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 41 | August | 8.00 | 68.41 | 68.81 | 68.72 | 68.88 | 0.005588 | 2.17 | 3.69 | 10.68 | 0.65 |
| Reach-1 | 41 | Spring - meas. | 14.60 | 68.41 | 68.94 | 68.85 | 69.07 | 0.006761 | 2.85 | 5.12 | 11.30 | 0.75 |
| Reach-1 | 41 | Spring | 22.00 | 68.41 | 68.90 | 68.98 | 69.24 | 0.020542 | 4.72 | 4.66 | 11.10 | 1.28 |
| Reach-1 | 41 | Mean Annual | 80.00 | 68.41 | 69.49 | 69.64 | 70.17 | 0.015652 | 6.62 | 12.08 | 13.93 | 1.25 |
| Reach-1 | 41 | 10-year | 116.00 | 68.41 | 69.75 | 69.94 | 70.58 | 0.015078 | 7.34 | 15.81 | 15.15 | 1.27 |
| Reach-1 | 41 | 25-year | 126.00 | 68.41 | 69.82 | 70.01 | 70.68 | 0.014830 | 7.48 | 16.85 | 15.48 | 1.26 |
| Reach-1 | 41 | 50-year | 138.00 | 68.41 | 69.89 | 70.10 | 70.80 | 0.014567 | 7.64 | 18.07 | 15.85 | 1.26 |
| Reach-1 | 41 | 100-year | 155.00 | 68.41 | 70.00 | 70.21 | 70.95 | 0.014244 | 7.84 | 19.76 | 16.35 | 1.26 |
| | | | | | | | | | | | | |
| Reach-1 | 40 | August | 8.00 | 68.30 | 68.53 | 68.53 | 68.64 | 0.015458 | 2.68 | 2.98 | 13.38 | 1.00 |
| Reach-1 | 40 | Spring - meas. | 14.60 | 68.30 | 68.64 | 68.64 | 68.80 | 0.013621 | 3.25 | 4.49 | 13.67 | 1.00 |
| Reach-1 | 40 | Spring | 22.00 | 68.30 | 68.74 | 68.74 | 68.96 | 0.012706 | 3.72 | 5.92 | 13.94 | 1.00 |
| Reach-1 | 40 | Mean Annual | 80.00 | 68.30 | 69.29 | 69.32 | 69.80 | 0.011465 | 5.77 | 13.87 | 15.17 | 1.06 |
| Reach-1 | 40 | 10-year | 116.00 | 68.30 | 69.58 | 69.60 | 70.20 | 0.010033 | 6.30 | 18.42 | 15.68 | 1.02 |
| Reach-1 | 40 | 25-year | 126.00 | 68.30 | 69.65 | 69.67 | 70.30 | 0.009840 | 6.44 | 19.57 | 15.80 | 1.02 |
| Reach-1 | 40 | 50-year | 138.00 | 68.30 | 69.74 | 69.75 | 70.42 | 0.009695 | 6.61 | 20.87 | 15.93 | 1.02 |
| Reach-1 | 40 | 100-year | 155.00 | 68.30 | 69.86 | 69.86 | 70.57 | 0.009246 | 6.80 | 22.80 | 16.13 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 39 | August | 8.00 | 67.76 | 67.93 | 68.00 | 68.15 | 0.047091 | 3.78 | 2.12 | 13.20 | 1.66 |
| Reach-1 | 39 | Spring - meas. | 14.60 | 67.76 | 68.00 | 68.11 | 68.35 | 0.045194 | 4.72 | 3.10 | 13.34 | 1.73 |
| Reach-1 | 39 | Spring | 22.00 | 67.76 | 68.08 | 68.21 | 68.53 | 0.041575 | 5.39 | 4.08 | 13.49 | 1.72 |
| Reach-1 | 39 | Mean Annual | 80.00 | 67.76 | 68.54 | 68.80 | 69.44 | 0.026898 | 7.63 | 10.48 | 14.38 | 1.58 |
| Reach-1 | 39 | 10-year | 116.00 | 67.76 | 68.76 | 69.08 | 69.86 | 0.024074 | 8.41 | 13.79 | 14.88 | 1.54 |
| Reach-1 | 39 | 25-year | 126.00 | 67.76 | 68.82 | 69.15 | 69.96 | 0.023365 | 8.57 | 14.70 | 15.04 | 1.53 |
| Reach-1 | 39 | 50-year | 138.00 | 67.76 | 68.89 | 69.24 | 70.09 | 0.022734 | 8.76 | 15.75 | 15.23 | 1.52 |
| Reach-1 | 39 | 100-year | 155.00 | 67.76 | 68.99 | 69.35 | 70.25 | 0.022085 | 9.03 | 17.17 | 15.47 | 1.51 |
| | | | | | | | | | | | | |
| Reach-1 | 38 | August | 8.00 | 67.40 | 67.70 | 67.62 | 67.75 | 0.005125 | 1.80 | 4.45 | 16.08 | 0.60 |
| Reach-1 | 38 | Spring - meas. | 14.60 | 67.40 | 67.83 | 67.71 | 67.90 | 0.005061 | 2.23 | 6.55 | 16.97 | 0.63 |
| Reach-1 | 38 | Spring | 22.00 | 67.40 | 67.93 | 67.81 | 68.04 | 0.005311 | 2.62 | 8.39 | 17.65 | 0.67 |
| Reach-1 | 38 | Mean Annual | 80.00 | 67.40 | 68.53 | 68.33 | 68.78 | 0.004999 | 3.99 | 20.03 | 21.23 | 0.72 |
| Reach-1 | 38 | 10-year | 116.00 | 67.40 | 68.80 | 68.56 | 69.11 | 0.004886 | 4.45 | 25.99 | 22.84 | 0.74 |
| Reach-1 | 38 | 25-year | 126.00 | 67.40 | 68.87 | 68.62 | 69.19 | 0.004859 | 4.57 | 27.56 | 23.25 | 0.74 |

HEC-RAS Plan: 070926 alt3 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 38 | 50-year | 138.00 | 67.40 | 68.95 | 68.69 | 69.29 | 0.004831 | 4.69 | 29.39 | 23.72 | 0.74 |
| Reach-1 | 38 | 100-year | 155.00 | 67.40 | 69.05 | 68.78 | 69.42 | 0.004800 | 4.86 | 31.92 | 24.35 | 0.75 |
| | | | | | | | | | | | | |
| Reach-1 | 37 | August | 8.00 | 67.00 | 67.23 | 67.23 | 67.34 | 0.015186 | 2.65 | 3.02 | 13.76 | 1.00 |
| Reach-1 | 37 | Spring - meas. | 14.60 | 67.00 | 67.34 | 67.34 | 67.50 | 0.013485 | 3.19 | 4.58 | 14.45 | 1.00 |
| Reach-1 | 37 | Spring | 22.00 | 67.00 | 67.44 | 67.44 | 67.65 | 0.012671 | 3.62 | 6.07 | 15.07 | 1.01 |
| Reach-1 | 37 | Mean Annual | 80.00 | 67.00 | 68.00 | 68.00 | 68.42 | 0.010037 | 5.19 | 15.41 | 18.53 | 1.00 |
| Reach-1 | 37 | 10-year | 116.00 | 67.00 | 68.25 | 68.25 | 68.76 | 0.009445 | 5.72 | 20.29 | 20.09 | 1.00 |
| Reach-1 | 37 | 25-year | 126.00 | 67.00 | 68.32 | 68.32 | 68.84 | 0.009320 | 5.84 | 21.59 | 20.51 | 1.00 |
| Reach-1 | 37 | 50-year | 138.00 | 67.00 | 68.39 | 68.39 | 68.94 | 0.009190 | 5.97 | 23.13 | 21.04 | 1.00 |
| Reach-1 | 37 | 100-year | 155.00 | 67.00 | 68.49 | 68.49 | 69.07 | 0.009027 | 6.13 | 25.28 | 21.76 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 36 | August | 8.00 | 64.70 | 66.59 | 64.90 | 66.59 | 0.000008 | 0.22 | 36.23 | 22.25 | 0.03 |
| Reach-1 | 36 | Spring - meas. | 14.60 | 64.70 | 66.78 | 64.99 | 66.78 | 0.000018 | 0.36 | 40.43 | 22.86 | 0.05 |
| Reach-1 | 36 | Spring | 22.00 | 64.70 | 66.94 | 65.08 | 66.95 | 0.000032 | 0.50 | 44.28 | 23.40 | 0.06 |
| Reach-1 | 36 | Mean Annual | 80.00 | 64.70 | 67.79 | 65.58 | 67.81 | 0.000143 | 1.22 | 65.47 | 27.33 | 0.14 |
| Reach-1 | 36 | 10-year | 116.00 | 64.70 | 68.16 | 65.83 | 68.20 | 0.000202 | 1.52 | 76.11 | 29.64 | 0.17 |
| Reach-1 | 36 | 25-year | 126.00 | 64.70 | 68.26 | 65.89 | 68.30 | 0.000217 | 1.60 | 78.96 | 30.25 | 0.17 |
| Reach-1 | 36 | 50-year | 138.00 | 64.70 | 68.36 | 65.96 | 68.41 | 0.000234 | 1.68 | 82.30 | 30.96 | 0.18 |
| Reach-1 | 36 | 100-year | 155.00 | 64.70 | 68.51 | 66.05 | 68.56 | 0.000253 | 1.78 | 86.96 | 31.89 | 0.19 |
| | | | | | | | | | | | | |
| Reach-1 | 35 | August | 8.00 | 65.80 | 66.58 | | 66.59 | 0.000463 | 0.63 | 12.66 | 17.61 | 0.13 |
| Reach-1 | 35 | Spring - meas. | 14.60 | 65.80 | 66.76 | | 66.78 | 0.000765 | 0.92 | 15.88 | 18.27 | 0.17 |
| Reach-1 | 35 | Spring | 22.00 | 65.80 | 66.92 | | 66.94 | 0.001030 | 1.17 | 18.84 | 18.86 | 0.21 |
| Reach-1 | 35 | Mean Annual | 80.00 | 65.80 | 67.72 | | 67.80 | 0.002162 | 2.28 | 35.06 | 22.13 | 0.32 |
| Reach-1 | 35 | 10-year | 116.00 | 65.80 | 68.07 | | 68.18 | 0.002607 | 2.68 | 43.26 | 24.67 | 0.36 |
| Reach-1 | 35 | 25-year | 126.00 | 65.80 | 68.16 | | 68.28 | 0.002691 | 2.77 | 45.52 | 25.36 | 0.36 |
| Reach-1 | 35 | 50-year | 138.00 | 65.80 | 68.26 | | 68.39 | 0.002777 | 2.86 | 48.19 | 26.13 | 0.37 |
| Reach-1 | 35 | 100-year | 155.00 | 65.80 | 68.41 | | 68.55 | 0.002860 | 2.98 | 51.98 | 27.11 | 0.38 |
| | | | | | | | | | | | | |
| Reach-1 | 34 | August | 8.00 | 66.15 | 66.50 | | 66.55 | 0.009878 | 1.73 | 4.61 | 14.17 | 0.54 |
| Reach-1 | 34 | Spring - meas. | 14.60 | 66.15 | 66.63 | 66.49 | 66.71 | 0.010897 | 2.23 | 6.54 | 14.84 | 0.59 |
| Reach-1 | 34 | Spring | 22.00 | 66.15 | 66.75 | 66.60 | 66.86 | 0.011938 | 2.66 | 8.28 | 15.35 | 0.64 |
| Reach-1 | 34 | Mean Annual | 80.00 | 66.15 | 67.30 | 67.16 | 67.63 | 0.016062 | 4.56 | 17.53 | 17.82 | 0.81 |
| Reach-1 | 34 | 10-year | 116.00 | 66.15 | 67.49 | 67.42 | 67.97 | 0.019945 | 5.54 | 20.93 | 18.64 | 0.92 |
| Reach-1 | 34 | 25-year | 126.00 | 66.15 | 67.54 | 67.49 | 68.06 | 0.020764 | 5.77 | 21.84 | 18.86 | 0.94 |
| Reach-1 | 34 | 50-year | 138.00 | 66.15 | 67.60 | 67.56 | 68.16 | 0.021344 | 6.00 | 23.02 | 19.13 | 0.96 |
| Reach-1 | 34 | 100-year | 155.00 | 66.15 | 67.67 | 67.67 | 68.30 | 0.022610 | 6.34 | 24.43 | 19.46 | 1.00 |
| | | | | | | | | | | | | |
| Reach-1 | 33 | August | 8.00 | 66.01 | 66.25 | 66.25 | 66.35 | 0.013359 | 2.50 | 3.20 | 14.52 | 0.94 |
| Reach-1 | 33 | Spring - meas. | 14.60 | 66.01 | 66.36 | 66.35 | 66.51 | 0.012505 | 3.06 | 4.77 | 15.12 | 0.96 |
| Reach-1 | 33 | Spring | 22.00 | 66.01 | 66.46 | 66.45 | 66.65 | 0.011907 | 3.50 | 6.28 | 15.66 | 0.98 |
| Reach-1 | 33 | Mean Annual | 80.00 | 66.01 | 67.00 | 66.99 | 67.41 | 0.009817 | 5.15 | 15.53 | 18.63 | 0.99 |
| Reach-1 | 33 | 10-year | 116.00 | 66.01 | 67.26 | 67.24 | 67.75 | 0.009057 | 5.64 | 20.55 | 20.18 | 0.99 |
| Reach-1 | 33 | 25-year | 126.00 | 66.01 | 67.32 | 67.30 | 67.84 | 0.008878 | 5.75 | 21.91 | 20.58 | 0.98 |
| Reach-1 | 33 | 50-year | 138.00 | 66.01 | 67.40 | 67.38 | 67.94 | 0.008693 | 5.87 | 23.49 | 21.04 | 0.98 |
| Reach-1 | 33 | 100-year | 155.00 | 66.01 | 67.50 | 67.48 | 68.07 | 0.008463 | 6.03 | 25.70 | 21.65 | 0.98 |
| | | | | | | | | | | | | |
| Reach-1 | 32 | August | 8.00 | 65.69 | 66.01 | | 66.05 | 0.004431 | 1.71 | 4.68 | 16.35 | 0.56 |
| Reach-1 | 32 | Spring - meas. | 14.60 | 65.69 | 66.14 | | 66.21 | 0.004386 | 2.13 | 6.87 | 17.18 | 0.59 |
| Reach-1 | 32 | Spring | 22.00 | 65.69 | 66.26 | | 66.35 | 0.004365 | 2.46 | 8.95 | 17.93 | 0.61 |
| Reach-1 | 32 | Mean Annual | 80.00 | 65.69 | 66.92 | | 67.12 | 0.003792 | 3.62 | 22.10 | 22.07 | 0.64 |
| Reach-1 | 32 | 10-year | 116.00 | 65.69 | 67.21 | | 67.46 | 0.003636 | 4.01 | 28.92 | 23.94 | 0.64 |
| Reach-1 | 32 | 25-year | 126.00 | 65.69 | 67.29 | | 67.55 | 0.003501 | 4.10 | 30.72 | 24.41 | 0.64 |
| Reach-1 | 32 | 50-year | 138.00 | 65.69 | 67.37 | | 67.65 | 0.003568 | 4.20 | 32.83 | 24.95 | 0.65 |
| Reach-1 | 32 | 100-year | 155.00 | 65.69 | 67.49 | | 67.78 | 0.003529 | 4.34 | 35.73 | 25.67 | 0.65 |
| | | | | | | | | | | | | |
| Reach-1 | 31 | August | 8.00 | 65.29 | 65.56 | 65.56 | 65.68 | 0.015268 | 2.78 | 2.88 | 12.30 | 1.01 |
| Reach-1 | 31 | Spring - meas. | 14.60 | 65.29 | 65.68 | 65.68 | 65.85 | 0.013285 | 3.30 | 4.42 | 13.08 | 1.00 |
| Reach-1 | 31 | Spring | 22.00 | 65.29 | 65.79 | 65.79 | 66.00 | 0.012226 | 3.71 | 5.93 | 13.81 | 1.00 |
| Reach-1 | 31 | Mean Annual | 80.00 | 65.29 | 66.38 | 66.38 | 66.81 | 0.009853 | 5.26 | 15.19 | 17.68 | 1.00 |
| Reach-1 | 31 | 10-year | 116.00 | 65.29 | 66.64 | 66.64 | 67.16 | 0.009360 | 5.79 | 20.04 | 19.43 | 1.00 |
| Reach-1 | 31 | 25-year | 126.00 | 65.29 | 66.70 | 66.70 | 67.25 | 0.009287 | 5.91 | 21.30 | 19.86 | 1.01 |
| Reach-1 | 31 | 50-year | 138.00 | 65.29 | 66.78 | 66.78 | 67.35 | 0.009169 | 6.05 | 22.82 | 20.36 | 1.01 |
| Reach-1 | 31 | 100-year | 155.00 | 65.29 | 66.88 | 66.88 | 67.48 | 0.009015 | 6.22 | 24.92 | 21.04 | 1.01 |
| | | | | | | | | | | | | |
| Reach-1 | 30 | August | 8.00 | 62.90 | 64.93 | 63.09 | 64.93 | 0.000006 | 0.21 | 37.78 | 20.63 | 0.03 |
| Reach-1 | 30 | Spring - meas. | 14.60 | 62.90 | 65.10 | 63.19 | 65.10 | 0.000016 | 0.35 | 41.19 | 20.96 | 0.04 |
| Reach-1 | 30 | Spring | 22.00 | 62.90 | 65.24 | 63.28 | 65.24 | 0.000030 | 0.50 | 44.13 | 21.24 | 0.06 |
| Reach-1 | 30 | Mean Annual | 80.00 | 62.90 | 65.93 | 63.78 | 65.98 | 0.000167 | 1.34 | 59.48 | 23.10 | 0.15 |
| Reach-1 | 30 | 10-year | 116.00 | 62.90 | 66.21 | 64.02 | 66.26 | 0.000262 | 1.76 | 66.05 | 23.99 | 0.19 |
| Reach-1 | 30 | 25-year | 126.00 | 62.90 | 66.29 | 64.08 | 66.34 | 0.000288 | 1.86 | 67.89 | 24.23 | 0.20 |
| Reach-1 | 30 | 50-year | 138.00 | 62.90 | 66.37 | 64.15 | 66.43 | 0.000314 | 1.97 | 70.05 | 24.52 | 0.21 |
| Reach-1 | 30 | 100-year | 155.00 | 62.90 | 66.49 | 64.25 | 66.56 | 0.000355 | 2.12 | 72.94 | 25.02 | 0.22 |
| | | | | | | | | | | | | |
| Reach-1 | 29 | August | 8.00 | 64.40 | 64.82 | 64.80 | 64.92 | 0.036569 | 2.50 | 3.20 | 12.77 | 0.88 |
| Reach-1 | 29 | Spring - meas. | 14.60 | 64.40 | 64.97 | 64.93 | 65.08 | 0.031539 | 2.78 | 5.29 | 16.27 | 0.85 |

HEC-RAS Plan: 070626 alt3 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 29 | Spring | 22.00 | 64.40 | 65.07 | 65.03 | 65.22 | 0.030117 | 3.10 | 7.09 | 17.66 | 0.86 |
| Reach-1 | 29 | Mean Annual | 80.00 | 64.40 | 65.67 | 65.52 | 65.93 | 0.018890 | 4.06 | 19.75 | 23.23 | 0.77 |
| Reach-1 | 29 | 10-year | 116.00 | 64.40 | 65.74 | 65.74 | 66.20 | 0.031202 | 5.47 | 21.29 | 23.32 | 1.00 |
| Reach-1 | 29 | 25-year | 126.00 | 64.40 | 65.78 | 65.78 | 66.28 | 0.031106 | 5.65 | 22.43 | 23.38 | 1.01 |
| Reach-1 | 29 | 50-year | 138.00 | 64.40 | 65.85 | 65.85 | 66.37 | 0.030562 | 5.81 | 23.67 | 23.47 | 1.01 |
| Reach-1 | 29 | 100-year | 155.00 | 64.40 | 65.98 | 65.94 | 66.50 | 0.025993 | 5.78 | 26.99 | 23.65 | 0.95 |
| | | | | | | | | | | | | |
| Reach-1 | 28 | August | 8.00 | 64.17 | 64.65 | 64.46 | 64.67 | 0.002651 | 1.12 | 7.17 | 24.73 | 0.37 |
| Reach-1 | 28 | Spring - meas. | 14.60 | 64.17 | 64.76 | 64.57 | 64.79 | 0.003319 | 1.43 | 10.20 | 28.61 | 0.42 |
| Reach-1 | 28 | Spring | 22.00 | 64.17 | 64.86 | 64.65 | 64.90 | 0.003788 | 1.68 | 13.09 | 31.69 | 0.46 |
| Reach-1 | 28 | Mean Annual | 80.00 | 64.17 | 65.03 | 65.03 | 65.31 | 0.016695 | 4.20 | 19.04 | 35.65 | 1.01 |
| Reach-1 | 28 | 10-year | 116.00 | 64.17 | 65.53 | 65.19 | 65.68 | 0.004010 | 3.09 | 37.49 | 37.82 | 0.55 |
| Reach-1 | 28 | 25-year | 126.00 | 64.17 | 65.69 | 65.22 | 65.82 | 0.002922 | 2.89 | 43.65 | 38.52 | 0.48 |
| Reach-1 | 28 | 50-year | 138.00 | 64.17 | 65.88 | 65.27 | 65.99 | 0.002159 | 2.72 | 50.84 | 39.33 | 0.42 |
| Reach-1 | 28 | 100-year | 155.00 | 64.17 | 66.13 | | 66.23 | 0.001559 | 2.58 | 60.71 | 40.39 | 0.37 |
| | | | | | | | | | | | | |
| Reach-1 | 27 | August | 8.00 | 63.62 | 63.87 | 63.87 | 63.92 | 0.038463 | 1.75 | 4.56 | 59.50 | 1.12 |
| Reach-1 | 27 | Spring - meas. | 14.60 | 63.62 | 63.92 | 63.92 | 63.98 | 0.026501 | 1.91 | 7.66 | 66.56 | 0.99 |
| Reach-1 | 27 | Spring | 22.00 | 63.62 | 63.96 | 63.98 | 64.03 | 0.024636 | 2.13 | 10.34 | 72.12 | 0.99 |
| Reach-1 | 27 | Mean Annual | 80.00 | 63.62 | 65.02 | 64.15 | 65.03 | 0.000163 | 0.63 | 126.16 | 125.40 | 0.11 |
| Reach-1 | 27 | 10-year | 116.00 | 63.62 | 65.61 | | 65.61 | 0.000075 | 0.58 | 200.37 | 127.23 | 0.08 |
| Reach-1 | 27 | 25-year | 126.00 | 63.62 | 65.76 | | 65.77 | 0.000065 | 0.57 | 219.72 | 127.65 | 0.08 |
| Reach-1 | 27 | 50-year | 138.00 | 63.62 | 65.94 | | 65.94 | 0.000057 | 0.57 | 242.33 | 128.10 | 0.07 |
| Reach-1 | 27 | 100-year | 155.00 | 63.62 | 66.18 | | 66.18 | 0.000048 | 0.57 | 273.42 | 128.73 | 0.07 |
| | | | | | | | | | | | | |
| Reach-1 | 26 | August | 8.00 | 62.32 | 63.36 | 62.63 | 63.36 | 0.000048 | 0.23 | 35.46 | 66.13 | 0.05 |
| Reach-1 | 26 | Spring - meas. | 14.60 | 62.32 | 63.60 | 62.72 | 63.60 | 0.000062 | 0.27 | 53.48 | 90.78 | 0.06 |
| Reach-1 | 26 | Spring | 22.00 | 62.32 | 63.81 | 62.79 | 63.81 | 0.000059 | 0.29 | 76.23 | 115.66 | 0.06 |
| Reach-1 | 26 | Mean Annual | 80.00 | 62.32 | 65.02 | | 65.02 | 0.000023 | 0.33 | 241.45 | 147.87 | 0.05 |
| Reach-1 | 26 | 10-year | 116.00 | 62.32 | 65.61 | | 65.61 | 0.000018 | 0.35 | 328.97 | 149.83 | 0.04 |
| Reach-1 | 26 | 25-year | 126.00 | 62.32 | 65.76 | | 65.76 | 0.000017 | 0.36 | 351.77 | 150.35 | 0.04 |
| Reach-1 | 26 | 50-year | 138.00 | 62.32 | 65.94 | | 65.94 | 0.000016 | 0.37 | 378.41 | 150.96 | 0.04 |
| Reach-1 | 26 | 100-year | 155.00 | 62.32 | 66.18 | | 66.18 | 0.000015 | 0.37 | 415.06 | 151.79 | 0.04 |
| | | | | | | | | | | | | |
| Reach-1 | 25 | August | 8.00 | 62.19 | 63.36 | | 63.36 | 0.000004 | 0.08 | 96.94 | 122.38 | 0.02 |
| Reach-1 | 25 | Spring - meas. | 14.60 | 62.19 | 63.60 | | 63.60 | 0.000006 | 0.12 | 126.88 | 129.48 | 0.02 |
| Reach-1 | 25 | Spring | 22.00 | 62.19 | 63.81 | | 63.81 | 0.000007 | 0.14 | 155.28 | 135.88 | 0.02 |
| Reach-1 | 25 | Mean Annual | 80.00 | 62.19 | 65.02 | | 65.02 | 0.000009 | 0.24 | 339.57 | 163.35 | 0.03 |
| Reach-1 | 25 | 10-year | 116.00 | 62.19 | 65.61 | | 65.61 | 0.000008 | 0.27 | 436.57 | 166.50 | 0.03 |
| Reach-1 | 25 | 25-year | 126.00 | 62.19 | 65.76 | | 65.76 | 0.000008 | 0.27 | 461.93 | 167.25 | 0.03 |
| Reach-1 | 25 | 50-year | 138.00 | 62.19 | 65.94 | | 65.94 | 0.000008 | 0.29 | 491.58 | 168.10 | 0.03 |
| Reach-1 | 25 | 100-year | 155.00 | 62.19 | 66.18 | | 66.18 | 0.000008 | 0.29 | 532.43 | 169.25 | 0.03 |
| | | | | | | | | | | | | |
| Reach-1 | 24 | August | 8.00 | 61.86 | 63.36 | | 63.36 | 0.000002 | 0.07 | 119.43 | 121.46 | 0.01 |
| Reach-1 | 24 | Spring - meas. | 14.60 | 61.86 | 63.60 | | 63.60 | 0.000003 | 0.10 | 149.05 | 127.72 | 0.02 |
| Reach-1 | 24 | Spring | 22.00 | 61.86 | 63.81 | | 63.81 | 0.000004 | 0.12 | 176.99 | 133.36 | 0.02 |
| Reach-1 | 24 | Mean Annual | 80.00 | 61.86 | 65.02 | | 65.02 | 0.000007 | 0.22 | 355.97 | 157.56 | 0.03 |
| Reach-1 | 24 | 10-year | 116.00 | 61.86 | 65.61 | | 65.61 | 0.000007 | 0.26 | 450.16 | 161.50 | 0.03 |
| Reach-1 | 24 | 25-year | 126.00 | 61.86 | 65.76 | | 65.76 | 0.000007 | 0.27 | 474.73 | 161.92 | 0.03 |
| Reach-1 | 24 | 50-year | 138.00 | 61.86 | 65.94 | | 65.94 | 0.000007 | 0.28 | 503.41 | 162.40 | 0.03 |
| Reach-1 | 24 | 100-year | 155.00 | 61.86 | 66.18 | | 66.18 | 0.000007 | 0.29 | 542.82 | 163.06 | 0.03 |
| | | | | | | | | | | | | |
| Reach-1 | 23 | August | 8.00 | 61.84 | 63.36 | | 63.36 | 0.000001 | 0.06 | 137.15 | 108.70 | 0.01 |
| Reach-1 | 23 | Spring - meas. | 14.60 | 61.84 | 63.60 | | 63.60 | 0.000002 | 0.09 | 163.39 | 112.19 | 0.01 |
| Reach-1 | 23 | Spring | 22.00 | 61.84 | 63.81 | | 63.81 | 0.000003 | 0.12 | 187.73 | 115.33 | 0.02 |
| Reach-1 | 23 | Mean Annual | 80.00 | 61.84 | 65.02 | | 65.02 | 0.000007 | 0.24 | 339.49 | 134.09 | 0.03 |
| Reach-1 | 23 | 10-year | 116.00 | 61.84 | 65.61 | | 65.61 | 0.000007 | 0.28 | 419.05 | 136.21 | 0.03 |
| Reach-1 | 23 | 25-year | 126.00 | 61.84 | 65.76 | | 65.76 | 0.000007 | 0.29 | 439.77 | 136.61 | 0.03 |
| Reach-1 | 23 | 50-year | 138.00 | 61.84 | 65.94 | | 65.94 | 0.000007 | 0.30 | 463.97 | 137.08 | 0.03 |
| Reach-1 | 23 | 100-year | 155.00 | 61.84 | 66.18 | | 66.18 | 0.000007 | 0.31 | 497.24 | 137.72 | 0.03 |
| | | | | | | | | | | | | |
| Reach-1 | 22 | August | 8.00 | 61.41 | 63.36 | | 63.36 | 0.000002 | 0.08 | 96.12 | 74.70 | 0.01 |
| Reach-1 | 22 | Spring - meas. | 14.60 | 61.41 | 63.60 | | 63.60 | 0.000004 | 0.13 | 114.14 | 77.06 | 0.02 |
| Reach-1 | 22 | Spring | 22.00 | 61.41 | 63.81 | | 63.81 | 0.000006 | 0.17 | 130.84 | 79.19 | 0.02 |
| Reach-1 | 22 | Mean Annual | 80.00 | 61.41 | 65.02 | | 65.02 | 0.000013 | 0.34 | 233.71 | 90.40 | 0.04 |
| Reach-1 | 22 | 10-year | 116.00 | 61.41 | 65.61 | | 65.61 | 0.000014 | 0.41 | 287.34 | 92.08 | 0.04 |
| Reach-1 | 22 | 25-year | 126.00 | 61.41 | 65.76 | | 65.76 | 0.000015 | 0.42 | 301.35 | 92.47 | 0.04 |
| Reach-1 | 22 | 50-year | 138.00 | 61.41 | 65.93 | | 65.94 | 0.000015 | 0.44 | 317.73 | 92.93 | 0.04 |
| Reach-1 | 22 | 100-year | 155.00 | 61.41 | 66.18 | | 66.18 | 0.000015 | 0.46 | 340.29 | 93.56 | 0.04 |
| | | | | | | | | | | | | |
| Reach-1 | 21 | August | 8.00 | 62.55 | 63.35 | | 63.36 | 0.000316 | 0.56 | 14.31 | 28.14 | 0.14 |
| Reach-1 | 21 | Spring - meas. | 14.60 | 62.55 | 63.59 | | 63.59 | 0.000310 | 0.69 | 21.09 | 29.62 | 0.14 |
| Reach-1 | 21 | Spring | 22.00 | 62.55 | 63.80 | | 63.81 | 0.000310 | 0.80 | 27.48 | 30.95 | 0.15 |
| Reach-1 | 21 | Mean Annual | 80.00 | 62.55 | 65.00 | | 65.02 | 0.000247 | 1.16 | 68.86 | 37.80 | 0.15 |
| Reach-1 | 21 | 10-year | 116.00 | 62.55 | 65.58 | | 65.60 | 0.000210 | 1.28 | 91.54 | 39.96 | 0.14 |
| Reach-1 | 21 | 25-year | 126.00 | 62.55 | 65.73 | | 65.76 | 0.000203 | 1.31 | 97.61 | 40.53 | 0.14 |
| Reach-1 | 21 | 50-year | 138.00 | 62.55 | 65.91 | | 65.93 | 0.000195 | 1.34 | 104.78 | 41.26 | 0.14 |

HEC-RAS Plan: 070826 alt3 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 21 | 100-year | 155.00 | 62.55 | 66.15 | | 66.18 | 0.000188 | 1.39 | 114.84 | 42.45 | 0.14 |
| | | | | | | | | | | | | |
| Reach-1 | 20 | August | 8.00 | 62.60 | 63.16 | 63.16 | 63.32 | 0.145092 | 3.28 | 2.44 | 7.54 | 1.01 |
| Reach-1 | 20 | Spring - meas. | 14.60 | 62.60 | 63.33 | 63.33 | 63.56 | 0.132796 | 3.84 | 3.80 | 8.49 | 1.01 |
| Reach-1 | 20 | Spring | 22.00 | 62.60 | 63.47 | 63.47 | 63.76 | 0.126443 | 4.34 | 5.07 | 8.91 | 1.01 |
| Reach-1 | 20 | Mean Annual | 80.00 | 62.60 | 64.25 | 64.25 | 64.94 | 0.114183 | 6.63 | 12.06 | 8.94 | 1.01 |
| Reach-1 | 20 | 10-year | 116.00 | 62.60 | 64.63 | 64.63 | 65.51 | 0.114902 | 7.51 | 15.44 | 8.95 | 1.01 |
| Reach-1 | 20 | 25-year | 126.00 | 62.60 | 64.73 | 64.73 | 65.66 | 0.115235 | 7.72 | 16.32 | 8.96 | 1.01 |
| Reach-1 | 20 | 50-year | 138.00 | 62.60 | 64.84 | 64.84 | 65.83 | 0.115644 | 7.95 | 17.35 | 8.96 | 1.01 |
| Reach-1 | 20 | 100-year | 155.00 | 62.60 | 65.00 | 65.00 | 66.06 | 0.116290 | 8.26 | 18.76 | 8.97 | 1.01 |
| | | | | | | | | | | | | |
| Reach-1 | 19 | August | 8.00 | 61.90 | 62.04 | 62.22 | 62.92 | 2.429352 | 7.54 | 1.06 | 7.71 | 3.58 |
| Reach-1 | 19 | Spring - meas. | 14.60 | 61.90 | 62.13 | 62.38 | 63.16 | 1.452845 | 8.14 | 1.79 | 7.71 | 2.98 |
| Reach-1 | 19 | Spring | 22.00 | 61.90 | 62.23 | 62.53 | 63.37 | 1.028103 | 8.56 | 2.57 | 7.71 | 2.61 |
| Reach-1 | 19 | Mean Annual | 80.00 | 61.90 | 64.17 | 63.39 | 64.49 | 0.037795 | 4.58 | 17.48 | 7.71 | 0.54 |
| Reach-1 | 19 | 10-year | 116.00 | 61.90 | 64.67 | 63.81 | 65.13 | 0.045292 | 5.43 | 21.35 | 7.71 | 0.58 |
| Reach-1 | 19 | 25-year | 126.00 | 61.90 | 64.80 | 63.92 | 65.29 | 0.047184 | 5.64 | 22.33 | 7.71 | 0.58 |
| Reach-1 | 19 | 50-year | 138.00 | 61.90 | 64.95 | 64.04 | 65.48 | 0.049182 | 5.87 | 23.50 | 7.71 | 0.59 |
| Reach-1 | 19 | 100-year | 155.00 | 61.90 | 65.15 | 64.22 | 65.74 | 0.052139 | 6.19 | 25.04 | 7.71 | 0.61 |
| | | | | | | | | | | | | |
| Reach-1 | 18.5 | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 18 | August | 8.00 | 59.80 | 59.92 | 60.13 | 61.11 | 0.533413 | 8.76 | 0.91 | 16.61 | 4.44 |
| Reach-1 | 18 | Spring - meas. | 14.60 | 59.80 | 60.01 | 60.28 | 61.32 | 0.283793 | 9.17 | 1.59 | 17.44 | 3.52 |
| Reach-1 | 18 | Spring | 22.00 | 59.80 | 60.10 | 60.44 | 61.56 | 0.199905 | 9.69 | 2.27 | 18.26 | 3.11 |
| Reach-1 | 18 | Mean Annual | 80.00 | 59.80 | 60.91 | 61.31 | 62.32 | 0.038346 | 9.51 | 8.41 | 25.72 | 1.59 |
| Reach-1 | 18 | 10-year | 116.00 | 59.80 | 61.11 | 61.74 | 63.24 | 0.048201 | 11.71 | 9.90 | 26.55 | 1.81 |
| Reach-1 | 18 | 25-year | 126.00 | 59.80 | 61.19 | 61.85 | 63.43 | 0.047464 | 12.01 | 10.49 | 26.56 | 1.80 |
| Reach-1 | 18 | 50-year | 138.00 | 59.80 | 61.28 | 61.98 | 63.64 | 0.046583 | 12.33 | 11.19 | 26.57 | 1.79 |
| Reach-1 | 18 | 100-year | 155.00 | 59.80 | 61.41 | 62.16 | 63.93 | 0.045399 | 12.75 | 12.16 | 26.59 | 1.78 |
| | | | | | | | | | | | | |
| Reach-1 | 17 | August | 8.00 | 57.69 | 58.57 | 58.27 | 58.60 | 0.011154 | 1.22 | 6.46 | 21.09 | 0.41 |
| Reach-1 | 17 | Spring - meas. | 14.60 | 57.69 | 58.74 | 58.46 | 58.77 | 0.008759 | 1.44 | 10.35 | 23.44 | 0.39 |
| Reach-1 | 17 | Spring | 22.00 | 57.69 | 58.86 | 58.60 | 58.90 | 0.009531 | 1.75 | 13.02 | 24.14 | 0.42 |
| Reach-1 | 17 | Mean Annual | 80.00 | 57.69 | 59.48 | 59.02 | 59.61 | 0.009635 | 2.99 | 29.39 | 28.06 | 0.49 |
| Reach-1 | 17 | 10-year | 116.00 | 57.69 | 59.83 | 59.23 | 59.98 | 0.008455 | 3.28 | 39.65 | 30.25 | 0.47 |
| Reach-1 | 17 | 25-year | 126.00 | 57.69 | 59.93 | 59.27 | 60.08 | 0.008133 | 3.35 | 42.47 | 30.83 | 0.46 |
| Reach-1 | 17 | 50-year | 138.00 | 57.69 | 60.03 | 59.33 | 60.20 | 0.007783 | 3.42 | 45.83 | 31.50 | 0.46 |
| Reach-1 | 17 | 100-year | 155.00 | 57.69 | 60.18 | 59.42 | 60.35 | 0.007347 | 3.51 | 50.56 | 32.43 | 0.45 |
| | | | | | | | | | | | | |
| Reach-1 | 16 | August | 8.00 | 57.69 | 58.28 | 58.27 | 58.43 | 0.050327 | 3.23 | 2.69 | 8.11 | 0.98 |
| Reach-1 | 16 | Spring - meas. | 14.60 | 57.69 | 58.47 | 58.47 | 58.63 | 0.059493 | 3.29 | 4.61 | 14.15 | 1.05 |
| Reach-1 | 16 | Spring | 22.00 | 57.69 | 58.60 | 58.60 | 58.75 | 0.057294 | 3.13 | 7.07 | 22.29 | 1.02 |
| Reach-1 | 16 | Mean Annual | 80.00 | 57.69 | 59.36 | | 59.52 | 0.012256 | 3.39 | 26.01 | 27.29 | 0.58 |
| Reach-1 | 16 | 10-year | 116.00 | 57.69 | 59.74 | | 59.92 | 0.008988 | 3.57 | 36.81 | 29.66 | 0.53 |
| Reach-1 | 16 | 25-year | 126.00 | 57.69 | 59.84 | | 60.02 | 0.008456 | 3.61 | 39.71 | 30.26 | 0.52 |
| Reach-1 | 16 | 50-year | 138.00 | 57.69 | 59.95 | | 60.13 | 0.007923 | 3.67 | 43.15 | 30.97 | 0.51 |
| Reach-1 | 16 | 100-year | 155.00 | 57.69 | 60.10 | | 60.29 | 0.007310 | 3.74 | 47.98 | 31.93 | 0.49 |
| | | | | | | | | | | | | |
| Reach-1 | 15 | August | 8.00 | 57.45 | 58.18 | 57.92 | 58.19 | 0.003352 | 0.89 | 9.24 | 24.94 | 0.26 |
| Reach-1 | 15 | Spring - meas. | 14.60 | 57.45 | 58.34 | 58.02 | 58.36 | 0.003412 | 1.14 | 13.29 | 25.56 | 0.28 |
| Reach-1 | 15 | Spring | 22.00 | 57.45 | 58.49 | 58.09 | 58.51 | 0.003446 | 1.35 | 17.08 | 26.13 | 0.29 |
| Reach-1 | 15 | Mean Annual | 80.00 | 57.45 | 59.30 | | 59.37 | 0.003187 | 2.19 | 39.64 | 29.29 | 0.32 |
| Reach-1 | 15 | 10-year | 116.00 | 57.45 | 59.69 | | 59.78 | 0.003007 | 2.49 | 51.45 | 30.81 | 0.32 |
| Reach-1 | 15 | 25-year | 126.00 | 57.45 | 59.79 | | 59.89 | 0.002974 | 2.56 | 54.52 | 31.20 | 0.32 |
| Reach-1 | 15 | 50-year | 138.00 | 57.45 | 59.91 | | 60.01 | 0.002936 | 2.64 | 58.14 | 31.65 | 0.32 |
| Reach-1 | 15 | 100-year | 155.00 | 57.45 | 60.06 | | 60.17 | 0.002888 | 2.75 | 63.13 | 32.25 | 0.32 |
| | | | | | | | | | | | | |
| Reach-1 | 14 | August | 8.00 | 56.82 | 57.22 | 57.22 | 57.35 | 0.037704 | 2.90 | 2.76 | 10.88 | 1.01 |
| Reach-1 | 14 | Spring - meas. | 14.60 | 56.82 | 57.36 | 57.36 | 57.54 | 0.031514 | 3.46 | 4.32 | 12.74 | 0.99 |
| Reach-1 | 14 | Spring | 22.00 | 56.82 | 57.47 | 57.47 | 57.71 | 0.028537 | 3.94 | 5.84 | 13.21 | 0.98 |
| Reach-1 | 14 | Mean Annual | 80.00 | 56.82 | 58.12 | 58.11 | 58.63 | 0.021444 | 5.93 | 15.17 | 15.45 | 0.98 |
| Reach-1 | 14 | 10-year | 116.00 | 56.82 | 58.41 | 58.41 | 59.07 | 0.020526 | 6.75 | 19.82 | 16.44 | 0.99 |
| Reach-1 | 14 | 25-year | 126.00 | 56.82 | 58.49 | 58.49 | 59.18 | 0.020194 | 6.93 | 21.09 | 16.71 | 0.99 |
| Reach-1 | 14 | 50-year | 138.00 | 56.82 | 58.58 | 58.58 | 59.31 | 0.019765 | 7.13 | 22.62 | 17.03 | 0.99 |
| Reach-1 | 14 | 100-year | 155.00 | 56.82 | 58.70 | 58.70 | 59.48 | 0.019175 | 7.38 | 24.78 | 17.47 | 0.99 |
| | | | | | | | | | | | | |
| Reach-1 | 13 | August | 8.00 | 56.20 | 57.07 | 56.62 | 57.07 | 0.001774 | 0.65 | 12.30 | 24.67 | 0.16 |
| Reach-1 | 13 | Spring - meas. | 14.60 | 56.20 | 57.25 | 56.73 | 57.26 | 0.002077 | 0.86 | 16.95 | 24.83 | 0.18 |
| Reach-1 | 13 | Spring | 22.00 | 56.20 | 57.41 | 56.82 | 57.43 | 0.002389 | 1.05 | 20.89 | 24.96 | 0.20 |
| Reach-1 | 13 | Mean Annual | 80.00 | 56.20 | 58.17 | | 58.23 | 0.003927 | 2.00 | 40.03 | 25.60 | 0.28 |
| Reach-1 | 13 | 10-year | 116.00 | 56.20 | 58.50 | 57.44 | 58.59 | 0.004516 | 2.39 | 48.47 | 25.88 | 0.31 |
| Reach-1 | 13 | 25-year | 126.00 | 56.20 | 58.58 | 57.49 | 58.67 | 0.004656 | 2.49 | 50.60 | 25.95 | 0.31 |
| Reach-1 | 13 | 50-year | 138.00 | 56.20 | 58.68 | 57.55 | 58.78 | 0.004788 | 2.60 | 53.15 | 26.03 | 0.32 |
| Reach-1 | 13 | 100-year | 155.00 | 56.20 | 58.80 | 57.63 | 58.92 | 0.005007 | 2.75 | 56.45 | 26.14 | 0.33 |
| | | | | | | | | | | | | |
| Reach-1 | 0.875 | August | 8.00 | 56.20 | 56.71 | | 56.76 | 0.030416 | 1.75 | 4.58 | 17.78 | 0.61 |

HEC-RAS Plan: 070626 alt3 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 0.875 | Spring - meas. | 14.60 | 56.20 | 56.85 | 56.73 | 56.91 | 0.027425 | 2.01 | 7.27 | 21.06 | 0.60 |
| Reach-1 | 0.875 | Spring | 22.00 | 56.20 | 56.98 | 56.82 | 57.05 | 0.024014 | 2.15 | 10.23 | 24.16 | 0.58 |
| Reach-1 | 0.875 | Mean Annual | 80.00 | 56.20 | 57.52 | | 57.70 | 0.021442 | 3.40 | 23.55 | 25.05 | 0.62 |
| Reach-1 | 0.875 | 10-year | 116.00 | 56.20 | 57.74 | | 57.88 | 0.022530 | 4.00 | 29.03 | 25.23 | 0.65 |
| Reach-1 | 0.875 | 25-year | 126.00 | 56.20 | 57.79 | | 58.06 | 0.022764 | 4.15 | 30.42 | 25.28 | 0.66 |
| Reach-1 | 0.875 | 50-year | 138.00 | 56.20 | 57.85 | | 58.14 | 0.023073 | 4.32 | 32.01 | 25.33 | 0.67 |
| Reach-1 | 0.875 | 100-year | 155.00 | 56.20 | 57.94 | | 58.26 | 0.023494 | 4.55 | 34.16 | 25.41 | 0.69 |
| | | | | | | | | | | | | |
| Reach-1 | 0.866 | August | 8.00 | 55.00 | 55.52 | | 55.55 | 0.011600 | 1.28 | 6.23 | 14.77 | 0.35 |
| Reach-1 | 0.866 | Spring - meas. | 14.60 | 55.00 | 55.73 | | 55.77 | 0.011365 | 1.53 | 9.54 | 17.05 | 0.36 |
| Reach-1 | 0.866 | Spring | 22.00 | 55.00 | 55.90 | | 55.95 | 0.011645 | 1.74 | 12.64 | 18.95 | 0.38 |
| Reach-1 | 0.866 | Mean Annual | 80.00 | 55.00 | 56.60 | | 56.67 | 0.010615 | 2.14 | 37.40 | 46.28 | 0.42 |
| Reach-1 | 0.866 | 10-year | 116.00 | 55.00 | 56.85 | | 56.94 | 0.010451 | 2.37 | 49.27 | 48.48 | 0.40 |
| Reach-1 | 0.866 | 25-year | 126.00 | 55.00 | 56.91 | | 57.01 | 0.010356 | 2.42 | 52.41 | 49.04 | 0.40 |
| Reach-1 | 0.866 | 50-year | 138.00 | 55.00 | 56.99 | | 57.08 | 0.010247 | 2.48 | 56.09 | 49.69 | 0.40 |
| Reach-1 | 0.866 | 100-year | 155.00 | 55.00 | 57.09 | | 57.19 | 0.010163 | 2.57 | 61.01 | 50.55 | 0.40 |
| | | | | | | | | | | | | |
| Reach-1 | 0.859 | August | 8.00 | 54.10 | 54.80 | | 54.88 | 0.025477 | 1.86 | 4.09 | 11.68 | 0.58 |
| Reach-1 | 0.859 | Spring - meas. | 14.60 | 54.10 | 54.96 | | 55.05 | 0.028185 | 2.36 | 6.19 | 14.36 | 0.63 |
| Reach-1 | 0.859 | Spring | 22.00 | 54.10 | 55.11 | | 55.22 | 0.029501 | 2.57 | 8.55 | 16.97 | 0.64 |
| Reach-1 | 0.859 | Mean Annual | 80.00 | 54.10 | 55.75 | | 55.84 | 0.031668 | 3.49 | 23.02 | 28.18 | 0.66 |
| Reach-1 | 0.859 | 10-year | 116.00 | 54.10 | 55.97 | | 56.22 | 0.031715 | 4.03 | 29.46 | 31.94 | 0.68 |
| Reach-1 | 0.859 | 25-year | 126.00 | 54.10 | 56.02 | | 56.29 | 0.031761 | 4.16 | 31.18 | 33.25 | 0.69 |
| Reach-1 | 0.859 | 50-year | 138.00 | 54.10 | 56.08 | | 56.37 | 0.032150 | 4.33 | 33.14 | 35.31 | 0.70 |
| Reach-1 | 0.859 | 100-year | 155.00 | 54.10 | 56.16 | | 56.47 | 0.032059 | 4.52 | 36.17 | 38.29 | 0.70 |
| | | | | | | | | | | | | |
| Reach-1 | 0.853 | August | 8.00 | 53.40 | 54.05 | | 54.09 | 0.021594 | 1.51 | 5.29 | 15.62 | 0.46 |
| Reach-1 | 0.853 | Spring - meas. | 14.60 | 53.40 | 54.23 | | 54.28 | 0.018976 | 1.76 | 8.32 | 17.80 | 0.45 |
| Reach-1 | 0.853 | Spring | 22.00 | 53.40 | 54.39 | | 54.45 | 0.018293 | 1.96 | 11.20 | 19.64 | 0.46 |
| Reach-1 | 0.853 | Mean Annual | 80.00 | 53.40 | 55.01 | | 55.13 | 0.018813 | 2.82 | 28.41 | 36.08 | 0.56 |
| Reach-1 | 0.853 | 10-year | 116.00 | 53.40 | 55.23 | | 55.39 | 0.019305 | 3.17 | 36.89 | 39.36 | 0.56 |
| Reach-1 | 0.853 | 25-year | 126.00 | 53.40 | 55.29 | | 55.45 | 0.019383 | 3.26 | 39.12 | 40.17 | 0.56 |
| Reach-1 | 0.853 | 50-year | 138.00 | 53.40 | 55.35 | | 55.53 | 0.019464 | 3.36 | 41.72 | 41.10 | 0.56 |
| Reach-1 | 0.853 | 100-year | 155.00 | 53.40 | 55.44 | | 55.63 | 0.019561 | 3.50 | 45.31 | 42.36 | 0.56 |
| | | | | | | | | | | | | |
| Reach-1 | 0.845 | August | 8.00 | 52.50 | 53.19 | | 53.25 | 0.022591 | 1.95 | 4.10 | 12.20 | 0.59 |
| Reach-1 | 0.845 | Spring - meas. | 14.60 | 52.50 | 53.34 | | 53.43 | 0.026703 | 2.39 | 6.12 | 15.07 | 0.66 |
| Reach-1 | 0.845 | Spring | 22.00 | 52.50 | 53.47 | | 53.58 | 0.028860 | 2.68 | 8.20 | 17.56 | 0.69 |
| Reach-1 | 0.845 | Mean Annual | 80.00 | 52.50 | 54.14 | | 54.30 | 0.024922 | 3.30 | 24.28 | 30.58 | 0.64 |
| Reach-1 | 0.845 | 10-year | 116.00 | 52.50 | 54.40 | | 54.60 | 0.022242 | 3.61 | 32.88 | 35.67 | 0.61 |
| Reach-1 | 0.845 | 25-year | 126.00 | 52.50 | 54.46 | | 54.67 | 0.021666 | 3.68 | 35.27 | 36.95 | 0.61 |
| Reach-1 | 0.845 | 50-year | 138.00 | 52.50 | 54.54 | | 54.75 | 0.021037 | 3.76 | 38.13 | 38.44 | 0.60 |
| Reach-1 | 0.845 | 100-year | 155.00 | 52.50 | 54.64 | | 54.87 | 0.020238 | 3.86 | 42.19 | 40.46 | 0.59 |
| | | | | | | | | | | | | |
| Reach-1 | 0.841 | August | 8.00 | 52.50 | 52.85 | 52.70 | 52.88 | 0.018708 | 1.32 | 6.08 | 19.84 | 0.42 |
| Reach-1 | 0.841 | Spring - meas. | 14.60 | 52.50 | 53.02 | | 53.05 | 0.015408 | 1.51 | 9.64 | 22.04 | 0.40 |
| Reach-1 | 0.841 | Spring | 22.00 | 52.50 | 53.18 | | 53.20 | 0.014358 | 1.72 | 12.78 | 22.82 | 0.41 |
| Reach-1 | 0.841 | Mean Annual | 80.00 | 52.50 | 53.85 | | 53.96 | 0.014040 | 2.69 | 29.76 | 26.64 | 0.45 |
| Reach-1 | 0.841 | 10-year | 116.00 | 52.50 | 54.10 | | 54.26 | 0.014701 | 3.16 | 36.88 | 28.28 | 0.47 |
| Reach-1 | 0.841 | 25-year | 126.00 | 52.50 | 54.17 | | 54.34 | 0.014836 | 3.27 | 38.74 | 28.76 | 0.48 |
| Reach-1 | 0.841 | 50-year | 138.00 | 52.50 | 54.25 | | 54.42 | 0.014990 | 3.40 | 40.93 | 29.32 | 0.49 |
| Reach-1 | 0.841 | 100-year | 155.00 | 52.50 | 54.35 | | 54.54 | 0.015192 | 3.58 | 43.92 | 30.07 | 0.49 |
| | | | | | | | | | | | | |
| Reach-1 | 0.833 | August | 8.00 | 51.50 | 52.25 | 52.00 | 52.28 | 0.013619 | 1.34 | 5.98 | 14.98 | 0.37 |
| Reach-1 | 0.833 | Spring - meas. | 14.60 | 51.50 | 52.43 | 52.14 | 52.47 | 0.014861 | 1.63 | 8.98 | 17.90 | 0.40 |
| Reach-1 | 0.833 | Spring | 22.00 | 51.50 | 52.59 | 52.25 | 52.64 | 0.015185 | 1.83 | 12.04 | 20.45 | 0.42 |
| Reach-1 | 0.833 | Mean Annual | 80.00 | 51.50 | 53.25 | 52.80 | 53.37 | 0.016414 | 2.78 | 28.80 | 28.41 | 0.49 |
| Reach-1 | 0.833 | 10-year | 116.00 | 51.50 | 53.49 | 53.02 | 53.66 | 0.017136 | 3.26 | 35.65 | 29.72 | 0.51 |
| Reach-1 | 0.833 | 25-year | 126.00 | 51.50 | 53.55 | 53.08 | 53.73 | 0.017126 | 3.37 | 37.53 | 30.07 | 0.52 |
| Reach-1 | 0.833 | 50-year | 138.00 | 51.50 | 53.62 | 53.12 | 53.81 | 0.017213 | 3.50 | 39.66 | 30.46 | 0.52 |
| Reach-1 | 0.833 | 100-year | 155.00 | 51.50 | 53.71 | 53.20 | 53.92 | 0.017485 | 3.68 | 42.44 | 30.96 | 0.53 |
| | | | | | | | | | | | | |
| Reach-1 | 0.827 | August | 8.00 | 50.50 | 50.99 | 50.99 | 51.11 | 0.117773 | 2.83 | 2.83 | 11.65 | 1.01 |
| Reach-1 | 0.827 | Spring - meas. | 14.60 | 50.50 | 51.12 | 51.12 | 51.28 | 0.103185 | 3.27 | 4.47 | 13.39 | 1.00 |
| Reach-1 | 0.827 | Spring | 22.00 | 50.50 | 51.22 | 51.22 | 51.43 | 0.099811 | 3.67 | 5.99 | 14.69 | 1.01 |
| Reach-1 | 0.827 | Mean Annual | 80.00 | 50.50 | 51.78 | 51.78 | 52.17 | 0.081770 | 4.98 | 16.08 | 21.40 | 1.01 |
| Reach-1 | 0.827 | 10-year | 116.00 | 50.50 | 52.02 | 52.02 | 52.48 | 0.067487 | 5.43 | 21.54 | 24.14 | 0.96 |
| Reach-1 | 0.827 | 25-year | 126.00 | 50.50 | 52.07 | 52.07 | 52.55 | 0.066472 | 5.58 | 22.82 | 24.46 | 0.96 |
| Reach-1 | 0.827 | 50-year | 138.00 | 50.50 | 52.14 | 52.14 | 52.64 | 0.064693 | 5.73 | 24.39 | 24.85 | 0.96 |
| Reach-1 | 0.827 | 100-year | 155.00 | 50.50 | 52.23 | 52.23 | 52.76 | 0.062266 | 5.91 | 26.59 | 25.38 | 0.95 |
| | | | | | | | | | | | | |
| Reach-1 | 0.818 | August | 8.00 | 49.50 | 49.83 | 49.84 | 49.94 | 0.012165 | 2.57 | 3.16 | 18.55 | 1.08 |
| Reach-1 | 0.818 | Spring - meas. | 14.60 | 49.50 | 49.91 | 49.94 | 50.06 | 0.013396 | 3.12 | 4.81 | 22.73 | 1.18 |
| Reach-1 | 0.818 | Spring | 22.00 | 49.50 | 49.98 | 50.02 | 50.17 | 0.014237 | 3.55 | 6.42 | 26.18 | 1.24 |
| Reach-1 | 0.818 | Mean Annual | 80.00 | 49.50 | 51.04 | 50.40 | 51.12 | 0.000723 | 2.25 | 41.72 | 38.78 | 0.36 |
| Reach-1 | 0.818 | 10-year | 116.00 | 49.50 | 51.32 | 50.59 | 51.42 | 0.000775 | 2.66 | 52.63 | 41.50 | 0.38 |
| Reach-1 | 0.818 | 25-year | 126.00 | 49.50 | 51.37 | 50.64 | 51.49 | 0.000820 | 2.80 | 54.79 | 43.00 | 0.39 |

HEC-RAS Plan: 070626 alt3 River: RIVER-1 Reach: Reach-1 (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach-1 | 0.818 | 50-year | 138.00 | 49.50 | 51.43 | 50.69 | 51.56 | 0.000869 | 2.95 | 57.37 | 44.03 | 0.41 |
| Reach-1 | 0.818 | 100-year | 155.00 | 49.50 | 51.50 | 50.77 | 51.65 | 0.000938 | 3.16 | 60.67 | 44.31 | 0.43 |
| | | | | | | | | | | | | |
| Reach-1 | 0.798 | August | 8.00 | 48.00 | 49.20 | 48.42 | 49.21 | 0.000702 | 0.65 | 12.35 | 16.30 | 0.13 |
| Reach-1 | 0.798 | Spring - meas. | 14.60 | 48.00 | 49.46 | 48.58 | 49.47 | 0.000997 | 0.86 | 16.89 | 18.80 | 0.16 |
| Reach-1 | 0.798 | Spring | 22.00 | 48.00 | 49.70 | 48.71 | 49.72 | 0.001088 | 1.02 | 21.67 | 20.14 | 0.17 |
| Reach-1 | 0.798 | Mean Annual | 80.00 | 48.00 | 50.97 | | 51.00 | 0.001205 | 1.59 | 50.40 | 25.44 | 0.20 |
| Reach-1 | 0.798 | 10-year | 116.00 | 48.00 | 51.22 | | 51.29 | 0.001691 | 2.04 | 57.03 | 26.52 | 0.24 |
| Reach-1 | 0.798 | 25-year | 126.00 | 48.00 | 51.26 | | 51.34 | 0.001872 | 2.17 | 58.17 | 26.70 | 0.25 |
| Reach-1 | 0.798 | 50-year | 138.00 | 48.00 | 51.31 | | 51.40 | 0.002090 | 2.33 | 59.50 | 26.91 | 0.27 |
| Reach-1 | 0.798 | 100-year | 155.00 | 48.00 | 51.37 | | 51.47 | 0.002421 | 2.55 | 61.12 | 27.16 | 0.29 |
| | | | | | | | | | | | | |
| Reach-1 | 0.782 | August | 8.00 | 47.40 | 49.20 | | 49.20 | 0.000033 | 0.19 | 43.05 | 37.36 | 0.03 |
| Reach-1 | 0.782 | Spring - meas. | 14.60 | 47.40 | 49.45 | | 49.46 | 0.000060 | 0.28 | 52.99 | 40.13 | 0.04 |
| Reach-1 | 0.782 | Spring | 22.00 | 47.40 | 49.70 | | 49.70 | 0.000082 | 0.35 | 62.97 | 41.99 | 0.05 |
| Reach-1 | 0.782 | Mean Annual | 80.00 | 47.40 | 50.96 | | 50.97 | 0.000154 | 0.67 | 120.09 | 48.55 | 0.07 |
| Reach-1 | 0.782 | 10-year | 116.00 | 47.40 | 51.21 | | 51.23 | 0.000233 | 0.88 | 132.64 | 49.87 | 0.09 |
| Reach-1 | 0.782 | 25-year | 126.00 | 47.40 | 51.26 | | 51.27 | 0.000261 | 0.94 | 134.77 | 50.09 | 0.10 |
| Reach-1 | 0.782 | 50-year | 138.00 | 47.40 | 51.31 | | 51.32 | 0.000295 | 1.01 | 137.26 | 50.35 | 0.11 |
| Reach-1 | 0.782 | 100-year | 155.00 | 47.40 | 51.37 | | 51.39 | 0.000347 | 1.11 | 140.29 | 50.66 | 0.12 |
| | | | | | | | | | | | | |
| Reach-1 | 0.729 | August | 8.00 | 45.00 | 49.20 | | 49.20 | 0.000000 | 0.04 | 201.03 | 74.16 | 0.00 |
| Reach-1 | 0.729 | Spring - meas. | 14.60 | 45.00 | 49.45 | | 49.45 | 0.000001 | 0.07 | 220.12 | 75.06 | 0.01 |
| Reach-1 | 0.729 | Spring | 22.00 | 45.00 | 49.70 | | 49.70 | 0.000002 | 0.09 | 238.41 | 75.90 | 0.01 |
| Reach-1 | 0.729 | Mean Annual | 80.00 | 45.00 | 50.96 | | 50.96 | 0.000010 | 0.24 | 338.87 | 86.67 | 0.02 |
| Reach-1 | 0.729 | 10-year | 116.00 | 45.00 | 51.21 | | 51.21 | 0.000017 | 0.32 | 361.24 | 90.01 | 0.03 |
| Reach-1 | 0.729 | 25-year | 126.00 | 45.00 | 51.25 | | 51.25 | 0.000019 | 0.35 | 365.04 | 90.57 | 0.03 |
| Reach-1 | 0.729 | 50-year | 138.00 | 45.00 | 51.30 | | 51.30 | 0.000022 | 0.38 | 369.47 | 91.21 | 0.03 |
| Reach-1 | 0.729 | 100-year | 155.00 | 45.00 | 51.36 | | 51.36 | 0.000027 | 0.42 | 374.86 | 91.99 | 0.03 |
| | | | | | | | | | | | | |
| Reach-1 | 0.549 | August | 8.00 | 42.10 | 49.20 | | 49.20 | 0.000000 | 0.01 | 724.15 | 178.41 | 0.00 |
| Reach-1 | 0.549 | Spring - meas. | 14.60 | 42.10 | 49.45 | | 49.45 | 0.000000 | 0.02 | 769.91 | 179.30 | 0.00 |
| Reach-1 | 0.549 | Spring | 22.00 | 42.10 | 49.70 | | 49.70 | 0.000000 | 0.03 | 813.42 | 180.14 | 0.00 |
| Reach-1 | 0.549 | Mean Annual | 80.00 | 42.10 | 50.95 | | 50.96 | 0.000001 | 0.08 | 1042.94 | 184.53 | 0.01 |
| Reach-1 | 0.549 | 10-year | 116.00 | 42.10 | 51.21 | | 51.21 | 0.000001 | 0.11 | 1089.63 | 185.41 | 0.01 |
| Reach-1 | 0.549 | 25-year | 126.00 | 42.10 | 51.25 | | 51.25 | 0.000001 | 0.11 | 1097.39 | 185.55 | 0.01 |
| Reach-1 | 0.549 | 50-year | 138.00 | 42.10 | 51.30 | | 51.30 | 0.000002 | 0.12 | 1106.38 | 185.72 | 0.01 |
| Reach-1 | 0.549 | 100-year | 155.00 | 42.10 | 51.36 | | 51.36 | 0.000002 | 0.14 | 1117.21 | 185.92 | 0.01 |
| | | | | | | | | | | | | |
| Reach-1 | 0.5325 | August | 8.00 | 44.70 | 49.20 | | 49.20 | 0.000036 | 0.31 | 28.87 | 10.86 | 0.03 |
| Reach-1 | 0.5325 | Spring - meas. | 14.60 | 44.70 | 49.45 | | 49.45 | 0.000091 | 0.53 | 31.63 | 10.99 | 0.05 |
| Reach-1 | 0.5325 | Spring | 22.00 | 44.70 | 49.69 | | 49.70 | 0.000163 | 0.74 | 34.26 | 11.10 | 0.07 |
| Reach-1 | 0.5325 | Mean Annual | 80.00 | 44.70 | 50.89 | | 50.95 | 0.000828 | 2.03 | 49.72 | 30.71 | 0.17 |
| Reach-1 | 0.5325 | 10-year | 116.00 | 44.70 | 51.09 | | 51.20 | 0.001453 | 2.77 | 57.79 | 50.83 | 0.22 |
| Reach-1 | 0.5325 | 25-year | 126.00 | 44.70 | 51.11 | | 51.24 | 0.001674 | 2.98 | 58.98 | 53.16 | 0.24 |
| Reach-1 | 0.5325 | 50-year | 138.00 | 44.70 | 51.13 | | 51.28 | 0.001958 | 3.24 | 60.30 | 55.63 | 0.26 |
| Reach-1 | 0.5325 | 100-year | 155.00 | 44.70 | 51.15 | | 51.34 | 0.002419 | 3.61 | 61.38 | 57.58 | 0.29 |
| | | | | | | | | | | | | |
| Reach-1 | 0.532 | August | 8.00 | 48.68 | 48.99 | 48.99 | 49.15 | 0.053591 | 3.18 | 2.52 | 8.03 | 1.00 |
| Reach-1 | 0.532 | Spring - meas. | 14.60 | 48.68 | 49.15 | 49.15 | 49.38 | 0.047456 | 3.90 | 3.75 | 8.04 | 1.01 |
| Reach-1 | 0.532 | Spring | 22.00 | 48.68 | 49.30 | 49.30 | 49.61 | 0.042812 | 4.46 | 4.95 | 8.06 | 1.00 |
| Reach-1 | 0.532 | Mean Annual | 80.00 | 48.68 | 50.10 | 50.10 | 50.77 | 0.031603 | 6.68 | 13.03 | 10.33 | 0.99 |
| Reach-1 | 0.532 | 10-year | 116.00 | 48.68 | 50.86 | 50.86 | 51.14 | 0.009686 | 4.92 | 43.53 | 83.96 | 0.59 |
| Reach-1 | 0.532 | 25-year | 126.00 | 48.68 | 50.90 | 50.90 | 51.19 | 0.009884 | 5.03 | 47.05 | 85.35 | 0.59 |
| Reach-1 | 0.532 | 50-year | 138.00 | 48.68 | 50.94 | 50.94 | 51.24 | 0.010281 | 5.20 | 50.62 | 86.76 | 0.61 |
| Reach-1 | 0.532 | 100-year | 155.00 | 48.68 | 51.01 | 51.01 | 51.30 | 0.010405 | 5.33 | 56.39 | 89.01 | 0.62 |
| | | | | | | | | | | | | |
| Reach-1 | .5303 | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | |
| Reach-1 | 0.478 | August | 8.00 | 25.25 | 25.90 | 25.90 | 26.22 | 0.060622 | 4.57 | 1.75 | 44.90 | 1.00 |
| Reach-1 | 0.478 | Spring - meas. | 14.60 | 25.25 | 26.21 | 26.21 | 26.70 | 0.060199 | 5.52 | 2.60 | 44.90 | 0.99 |
| Reach-1 | 0.478 | Spring | 22.00 | 25.25 | 26.52 | 26.52 | 27.17 | 0.060052 | 6.21 | 3.43 | 44.90 | 0.97 |
| Reach-1 | 0.478 | Mean Annual | 80.00 | 25.25 | 28.52 | 28.52 | 29.06 | 0.028182 | 4.75 | 15.15 | 53.75 | 0.76 |
| Reach-1 | 0.478 | 10-year | 116.00 | 25.25 | 28.82 | 28.82 | 29.52 | 0.028825 | 5.77 | 18.63 | 53.82 | 0.83 |
| Reach-1 | 0.478 | 25-year | 126.00 | 25.25 | 28.90 | 28.90 | 29.64 | 0.029127 | 6.01 | 19.57 | 53.84 | 0.84 |
| Reach-1 | 0.478 | 50-year | 138.00 | 25.25 | 28.99 | 28.99 | 29.78 | 0.029672 | 6.29 | 20.61 | 53.86 | 0.85 |
| Reach-1 | 0.478 | 100-year | 155.00 | 25.25 | 29.11 | 29.11 | 29.97 | 0.030250 | 6.65 | 22.04 | 53.89 | 0.87 |
| | | | | | | | | | | | | |
| Reach-1 | 0.477 | August | 8.00 | 24.30 | 25.97 | 24.54 | 25.97 | 0.000001 | 0.11 | 74.26 | 54.22 | 0.02 |
| Reach-1 | 0.477 | Spring - meas. | 14.60 | 24.30 | 26.29 | 24.63 | 26.29 | 0.000002 | 0.16 | 91.61 | 54.22 | 0.02 |
| Reach-1 | 0.477 | Spring | 22.00 | 24.30 | 26.48 | 24.70 | 26.48 | 0.000004 | 0.22 | 101.91 | 54.23 | 0.03 |
| Reach-1 | 0.477 | Mean Annual | 80.00 | 24.30 | 26.83 | 25.00 | 26.84 | 0.000029 | 0.66 | 120.89 | 54.23 | 0.08 |
| Reach-1 | 0.477 | 10-year | 116.00 | 24.30 | 26.83 | 25.12 | 26.84 | 0.000060 | 0.96 | 120.89 | 54.23 | 0.11 |
| Reach-1 | 0.477 | 25-year | 126.00 | 24.30 | 26.83 | 25.15 | 26.85 | 0.000071 | 1.04 | 120.89 | 54.23 | 0.12 |
| Reach-1 | 0.477 | 50-year | 138.00 | 24.30 | 26.83 | 25.18 | 26.85 | 0.000085 | 1.14 | 120.89 | 54.23 | 0.13 |
| Reach-1 | 0.477 | 100-year | 155.00 | 24.30 | 26.83 | 25.23 | 26.86 | 0.000107 | 1.28 | 120.89 | 54.23 | 0.15 |

# Appendix D
## Preliminary Opinion of Probable Construction Cost Worksheets

OPINION OF PROBABLE CONSTRUCTION COSTS

ALT 1 DESIGN

**PLYMCO DAM REMOVAL**

**Townbrook River**

PLYMOUTH, MASSACHUSETTS

July 6, 2007

M&M # 1952-03

MILONE & MACBROOM.

| Description | Unit | Quantity | Unit Price ($) | Amount ($) |
|---|---|---|---|---|
| MOBILIZATION | LS | 1 | 15,000.00 | $15,000.00 |
| CLEARING AND GRUBBING | LS | 1 | 5,000.00 | $5,000.00 |
| TRAFFIC DIVERSION / SIGNAGE | LS | 1 | 1,000.00 | $1,000.00 |
| TEMPORARY CONSTRUCTION FENCING | LF | 200 | 3.00 | $600.00 |
| CONSTRUCTION STAKING | LS | 1 | 5,000.00 | $5,000.00 |
| CONSTRUCTION ACCESS | LS | 1 | 1,000.00 | $1,000.00 |
| TURBIDITY CURTAIN/ ABSORBANT BOOM | LS | 1 | 1,000.00 | $1,000.00 |
| SEDIMENTATION CONTROL - SILT FENCE/ HAY BALES | LF | 750 | 5.00 | $3,750.00 |
| WATER CONTROL: | | | | $18,500.00 |
| DEWATERING/ PUMPING | LS | 1 | 5,000.00 | $5,000.00 |
| COFFERDAM | LS | 1 | 2,500.00 | $2,500.00 |
| TEMPORARY DIVERSION CHANNEL/PIPE | LS | 1 | 9,000.00 | $9,000.00 |
| CHANNEL EXCAVATION-EARTH | CY | 7,650 | 15.00 | $114,750.00 |
| DISPOSAL OF EXCAVATED SEDIMENTS | CY | 7,650 | 60.00 | $459,000.00 |
| REMOVE PLYMCO STRUCTURE: | | | | $10,234.00 |
| STRUCTURE EXCAVATION - EARTH | CY | 224 | 20.00 | $4,480.00 |
| REMOVE TIMBER DECK | LS | 1 | 2,000.00 | $2,000.00 |
| REMOVE CONCRETE DECK | CY | 8 | 200.00 | $1,600.00 |
| EXCAVATE CONCRETE FISH LADDER | CY | 38 | 30.00 | $1,146.00 |
| EXCAVATE CONCRETE SPILLWAY UPSTREAM FACE AND WINGWALLS | CY | 5 | 200.00 | $948.00 |
| REMOVE DOWNSTREAM STEEL FRAME | LS | 1 | 2,000.00 | $2,000.00 |
| REMOVE OFF-BILLINGTON STRUCTURE: | | | | $22,160.00 |
| STRUCTURE EXCAVATION - EARTH | CY | 1 | 1,500.00 | $1,500.00 |
| REMOVAL OF STONE MASONRY | CY | 200 | 100.00 | $20,000.00 |
| REMOVAL OF CONCRETE SPILLWAY | CY | 3 | 200.00 | $660.00 |
| REMOVE EXISTING SHED | LS | 1 | 250.00 | $250.00 |
| REMOVE ABANDONED FACTORY BUILDING | LS | 1 | 10,000.00 | $10,000.00 |
| REMOVE EXISTING CULVERT: | | | | $11,390.00 |
| REMOVE STONE MASONRY WALLS | CY | 19 | 100.00 | $1,850.00 |
| REMOVE RAILS / REINFORCED CONCRETE | CY | 44 | 200.00 | $8,690.00 |
| EXCAVATE COBBLE BOTTOM | CY | 44 | 15.00 | $650.00 |
| INSTREAM STONE FEATURES | | | | $4,020.00 |
| RIFFLE - GRAVEL AND COBBLE | CY | 18 | 100.00 | $1,780.00 |
| BOULDER WEIR | EA | 4 | 500.00 | $2,240.00 |
| SITE RESTORATION | LS | 1 | 10,000.00 | $10,000.00 |
| INSTALL BANK PROTECTION | | | | $10,350.00 |
| TEMPORARY RECP | SY | 900 | $7.00 | $6,300.00 |
| HYDROSEEDING | SY | 900 | $1.50 | $1,350.00 |
| LIVE STAKES | LS | 1 | $200.00 | $200.00 |
| LOG REVETMENT | LS | 1 | $3,500.00 | $2,500.00 |
| RELOCATE WATER AND SEWER LINES | LS | 1 | 30,000 | $30,000.00 |
| PROTECT/RELOCATE UTILITY PIPES | LF | 300 | $7.00 | $2,100.00 |
| BRIDGE AT OFF-BILLINGTON STREET DAM | | | | $231,650.00 |
| CONCRETE | CY | 50 | $2,500.00 | $125,000.00 |
| FOOTINGS | CY | 35 | $750.00 | $26,250.00 |
| EXCAVATION AND BACKFILLING | LS | 1 | $50,000.00 | $50,000.00 |
| PAVING | SF | 1600 | $4.00 | $6,400.00 |
| WATER CONTROL | LS | 12000 | $2.00 | $24,000.00 |
| BRIDGE AT PLYMCO DAM | | | | $231,650.00 |
| CONCRETE | CY | 50 | $2,500.00 | $125,000.00 |
| FOOTINGS | CY | 35 | $750.00 | $26,250.00 |
| EXCAVATION AND BACKFILLING | LS | 1 | $50,000.00 | $50,000.00 |
| PAVING | SF | 1600 | $4.00 | $6,400.00 |
| WATER CONTROL | LS | 12000 | $2.00 | $24,000.00 |
| * Cost does not include the treatment or removal and disposal of exposed site soils | | | | |
| | | | SUBTOTAL | $1,196,404.00 |

MILONE & MACBROOM

OPINION OF PROBABLE CONSTRUCTION COSTS
ALT 2 DESIGN
PLYMCO DAM REMOVAL
Townbrook River
PLYMOUTH, MASSACHUSETTS
July-07
M&M # 1982-03

MILONE & MACBROOM

| Description | Unit | Quantity | Unit Price ($) | Amount ($) |
|---|---|---|---|---|
| MOBILIZATION | LS | 1 | $15,000.00 | $15,000 |
| CLEARING AND GRUBBING | LS | 1 | $5,000.00 | $5,000 |
| TRAFFIC DIVERSION / SIGNAGE | LS | 1 | $1,000.00 | $1,000 |
| TEMPORARY CONSTRUCTION FENCING | LF | 200 | $3.00 | $600 |
| CONSTRUCTION STAKING | LS | 1 | $5,000.00 | $5,000 |
| CONSTRUCTION ACCESS | LS | 1 | $1,000.00 | $1,000 |
| TURBIDITY CURTAIN/ ABSORBANT BOOM | LS | 1 | $1,000.00 | $1,000 |
| SEDIMENTATION CONTROL - SILT FENCE/ HAY BALES | LF | 750 | $5.00 | $3,750 |
| WATER CONTROL: | | | | $16,500 |
| DEWATERING/ PUMPING | LS | 1 | $5,000.00 | $5,000 |
| COFFERDAM | LS | 1 | $2,500.00 | $2,500 |
| TEMPORARY DIVERSION CHANNEL/PIPE | LS | 1 | $9,000.00 | $9,000 |
| CHANNEL EXCAVATION-EARTH | CY | 8,500 | $15.00 | $127,500 |
| DISPOSAL OF EXCAVATED SEDIMENTS | CY | 8,500 | $60.00 | $510,000 |
| REMOVE PLYMCO SPILLWAY STRUCTURE*: | | | | $10,234 |
| STRUCTURE EXCAVATION - EARTH | CY | 224 | $20.00 | $4,480 |
| REMOVE TIMBER DECK | LS | 1 | $2,000.00 | $2,000 |
| REMOVE CONCRETE DECK | CY | 8 | $200.00 | $1,600 |
| EXCAVATE CONCRETE FISH LADDER | CY | 38 | $30.00 | $1,146 |
| EXCAVATE CONCRETE SPILLWAY UPSTREAM FACE AND WINGWALLS | CY | 5 | $200.00 | $948 |
| REMOVE DOWNSTREAM STEEL FRAME | LS | 1 | $2,000.00 | $2,000 |
| REMOVE OFF-BILLINGTON STRUCTURE | | | | $22,160 |
| STRUCTURE EXCAVATION - EARTH | CY | 1 | $1,500.00 | $1,500 |
| REMOVAL OF STONE MASONRY | CY | 200 | $100.00 | $20,000 |
| REMOVAL OF CONCRETE SPILLWAY | CY | 3 | $200.00 | $660 |
| REMOVE EXISTING SHED | LS | 1 | $250.00 | $250 |
| REMOVE EXISTING CULVERT: | | | | $11,380 |
| REMOVE STONE MASONRY WALLS | CY | 19 | $100.00 | $1,850 |
| REMOVE RAILS / REINFORCED CONCRETE | CY | 44 | $200.00 | $8,880 |
| EXCAVATE COBBLE BOTTOM | CY | 44 | $15.00 | $660 |
| INSTREAM STONE FEATURES | | | | $4,020 |
| RIFFLE - GRAVEL AND COBBLE | CY | 18 | $100.00 | $1,780 |
| BOULDER WEIR | EA | 4 | $560.00 | $2,240 |
| SITE RESTORATION | LS | 1 | $10,000.00 | $10,000 |
| INSTALL BANK PROTECTION | | | | $10,350 |
| TEMPORARY RECP | SY | 900 | $7.00 | $6,300 |
| HYDROSEEDING | SY | 900 | $1.50 | $1,350 |
| LIVE STAKES | LS | 1 | $200.00 | $200 |
| LOG REVETMENT | LS | 1 | $3,500.00 | $2,500 |
| RELOCATE WATER AND SEWER LINES | LS | 1 | $30,000.00 | $30,000 |
| PROTECT/RELOCATE UTILITY PIPES | LF | 300 | $7.00 | $2,100 |
| BRIDGE AT OFF-BILLINGTON STREET DAM | | | | $231,650 |
| CONCRETE | CY | 50 | $2,500.00 | $125,000 |
| FOOTINGS | CY | 35 | $750.00 | $26,250 |
| EXCAVATION AND BACKFILLING | LS | 1 | $50,000.00 | $50,000 |
| PAVING | SF | 1600 | $4.00 | $6,400 |
| WATER CONTROL | LS | 12000 | $2.00 | $24,000 |
| BRIDGE AT PLYMCO DAM | | | | $231,650 |
| CONCRETE | CY | 50 | $2,500.00 | $125,000 |
| FOOTINGS | CY | 35 | $750.00 | $26,250 |
| EXCAVATION AND BACKFILLING | LS | 1 | $50,000.00 | $50,000 |
| PAVING | SF | 1600 | $4.00 | $6,400 |
| WATER CONTROL | LS | 12000 | $2.00 | $24,000 |
| * Cost does not include the treatment or removal and disposal of exposed ace soils | | | | |
| | | | SUBTOTAL | $1,250,154 |

OPINION OF PROBABLE CONSTRUCTION COSTS
ALT 3 DESIGN
**PLYMCO DAM REMOVAL**
**Town Brook**
PLYMOUTH, MASSACHUSETTS
July-07
MMI # 1932-03

Engineering, Landscape Architecture and Environmental Science
MILONE & MACBROOM.

| Description | Unit | Quantity | Unit Price ($) | Amount ($) |
|---|---|---|---|---|
| MOBILIZATION | LS | 1 | $15,000.00 | $15,000 |
| CLEARING AND GRUBBING | LS | 1 | $5,000.00 | $5,000 |
| TRAFFIC DIVERSION / SIGNAGE | LS | 1 | $1,000.00 | $1,000 |
| TEMPORARY CONSTRUCTION FENCING | LF | 200 | $3.00 | $600 |
| CONSTRUCTION STAKING | LS | 1 | $5,000.00 | $5,000 |
| CONSTRUCTION ACCESS | LS | 1 | $1,000.00 | $1,000 |
| TURBIDITY CURTAIN/ ABSORBANT BOOM | LS | 1 | $1,000.00 | $1,000 |
| SEDIMENTATION CONTROL - SILT FENCE/ HAY BALES | LF | 750 | $5.00 | $3,750 |
| WATER CONTROL: | | | | $16,500 |
| DEWATERING/ PUMPING | LS | 1 | $5,000.00 | $5,000 |
| COFFERDAM | LS | 1 | $2,500.00 | $2,500 |
| TEMPORARY DIVERSION CHANNEL/PIPE | LS | 1 | $9,000.00 | $9,000 |
| CHANNEL EXCAVATION-EARTH | CY | 6,400 | $15.00 | $96,000 |
| DISPOSAL OF EXCAVATED SEDIMENTS | CY | 6,400 | $60.00 | $384,000 |
| REMOVE PLYMCO SPILLWAY STRUCTURE*: | | | | $10,234 |
| STRUCTURE EXCAVATION - EARTH | CY | 224 | $20.00 | $4,480 |
| REMOVE TIMBER DECK | LS | 1 | $2,000.00 | $2,000 |
| REMOVE CONCRETE DECK | CY | 8 | $200.00 | $1,660 |
| EXCAVATE CONCRETE FISH LADDER | CY | 38 | $30.00 | $1,146 |
| EXCAVATE CONCRETE SPILLWAY UPSTREAM FACE AND WINGWALLS | CY | 5 | $200.00 | $946 |
| REMOVE DOWNSTREAM STEEL FRAME | LS | 1 | $2,000.00 | $2,000 |
| REMOVE EXISTING SHED | LS | 1 | $250.00 | $250 |
| REMOVE EXISTING CULVERT: | | | | $11,390 |
| REMOVE STONE MASONRY WALLS | CY | 19 | $100.00 | $1,850 |
| REMOVE RAILS / REINFORCED CONCRETE | CY | 44 | $200.00 | $8,880 |
| EXCAVATE COBBLE BOTTOM | CY | 44 | $15.00 | $660 |
| INSTREAM STONE FEATURES | | | | $3,640 |
| RIFFLE - GRAVEL AND COBBLE | CY | 14 | $100.00 | $1,400 |
| BOULDER WEIR | EA | 4 | $560.00 | $2,240 |
| SITE RESTORATION | LS | 1 | $10,000.00 | $10,000 |
| INSTALL BANK PROTECTION | | | | $8,150 |
| TEMPORARY RECP | SY | 700 | $7.00 | $4,900 |
| HYDROSEEDING | SY | 700 | $1.50 | $1,050 |
| LIVE STAKES | LS | 1 | $200.00 | $200 |
| LOG REVETMENT | LS | 1 | $2,000.00 | $2,000 |
| RELOCATE WATER AND SEWER LINES | LS | 1 | $30,000.00 | $30,000 |
| PROTECT/RELOCATE UTILITY PIPES | LF | 300 | $7.00 | $2,100 |
| BRIDGE AT PLYMCO DAM | | | | $231,650 |
| CONCRETE | CY | 50 | $2,500.00 | $125,000 |
| FOOTINGS | CY | 35 | $750.00 | $26,250 |
| EXCAVATION AND BACKFILLING | LS | 1 | $50,000.00 | $50,000 |
| PAVING | SF | 1600 | $4.00 | $6,400 |
| WATER CONTROL | LS | 12000 | $2.00 | $24,000 |
| REPAIR OFF-BILLINGTON STREET STRUCTURE | LS | 1 | $50,000.00 | $50,000 |
| * Cost does not include the treatment or removal and disposal of exposed site soils | | | | |
| | | | SUBTOTAL | $886,264 |

# Appendix E
# Concept Design Plans

**Concept Design Plans attached under separate cover.**