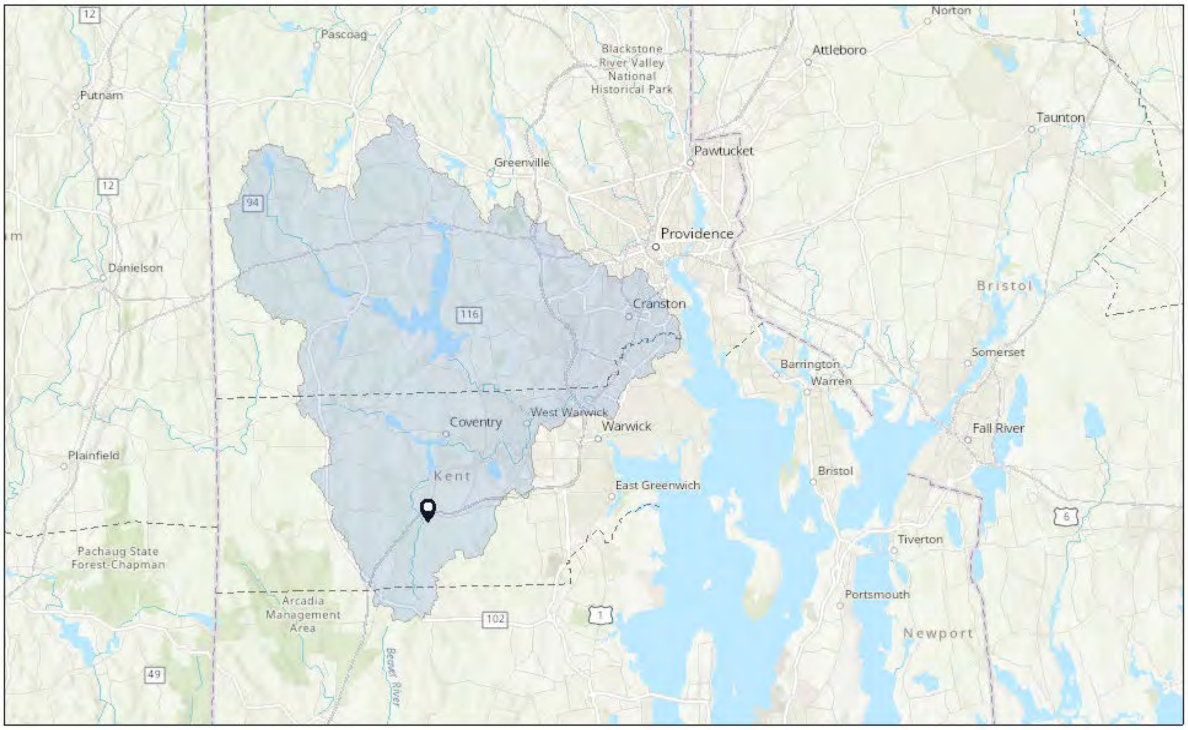
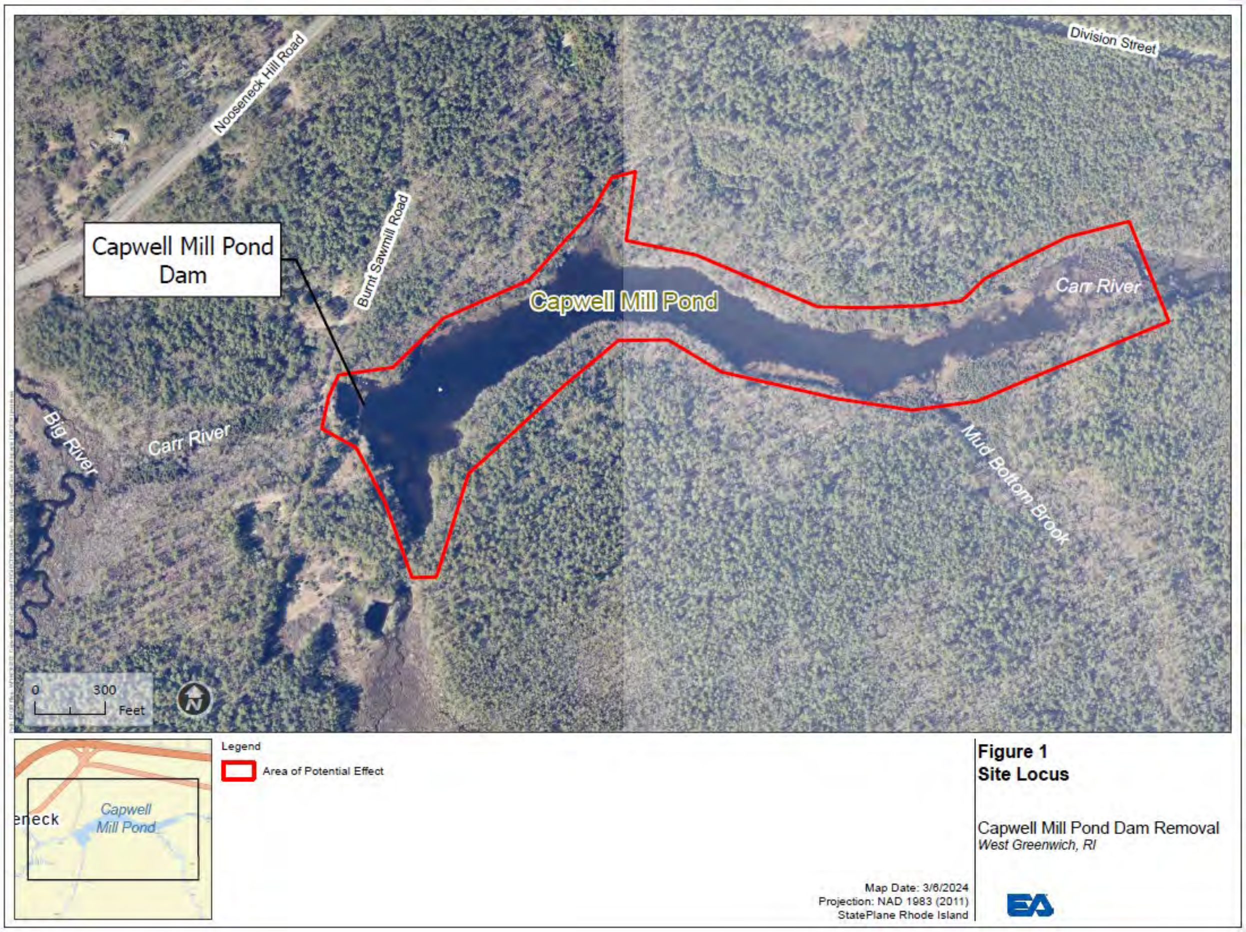
0. Executive Summary

The Capwell Mill Pond Dam is on the Carr River in the Big River Management Area (BRMA) in West Greenwich, Rhode Island. The dam impounds the Carr River just upstream of its confluence with the Big River. The dam was assessed as a significant hazard potential dam that could impact downstream communities if it were to fail. When the dam was built over 100 years ago, it flooded wetlands and created an impassable barrier to aquatic organisms. Currently the dam is creating reverberating impacts throughout the interconnected waterways on biological resources and water quality as well as from an ecosystem and community resiliency perspective.



The long-term goals of the project are to restore essential ecological functions critical to native species and enhance water quality in the headwaters of the Pawtuxet Watershed. Removing the dam would help to achieve SNEP's desired goals related to maintaining diverse and natural lands and habitats, supporting native species, flood protection carbon sequestration, ecosystem climate change resilience, and maintaining stream flows, water temperatures, and steam connectivity. If the dam were to be left standing it would lead to increased water stagnation and increased water temperatures in the impoundment, which genetically isolates populations of aquatic organisms, especially those which are thermally dependent.

For this project, RITU performed initial steps for determining the feasibility of the removal of Capwell Mill Pond Dam. This included identifying the ecological objectives, design criteria, and performance metrics for a preferred dam removal option, collecting and analyzing relevant data; completing an Alternatives Analysis Report to assist in selecting a preferred alternative; soliciting input from the project partners; and completing a Feasibility Study and conceptual design for the preferred dam removal alternative.

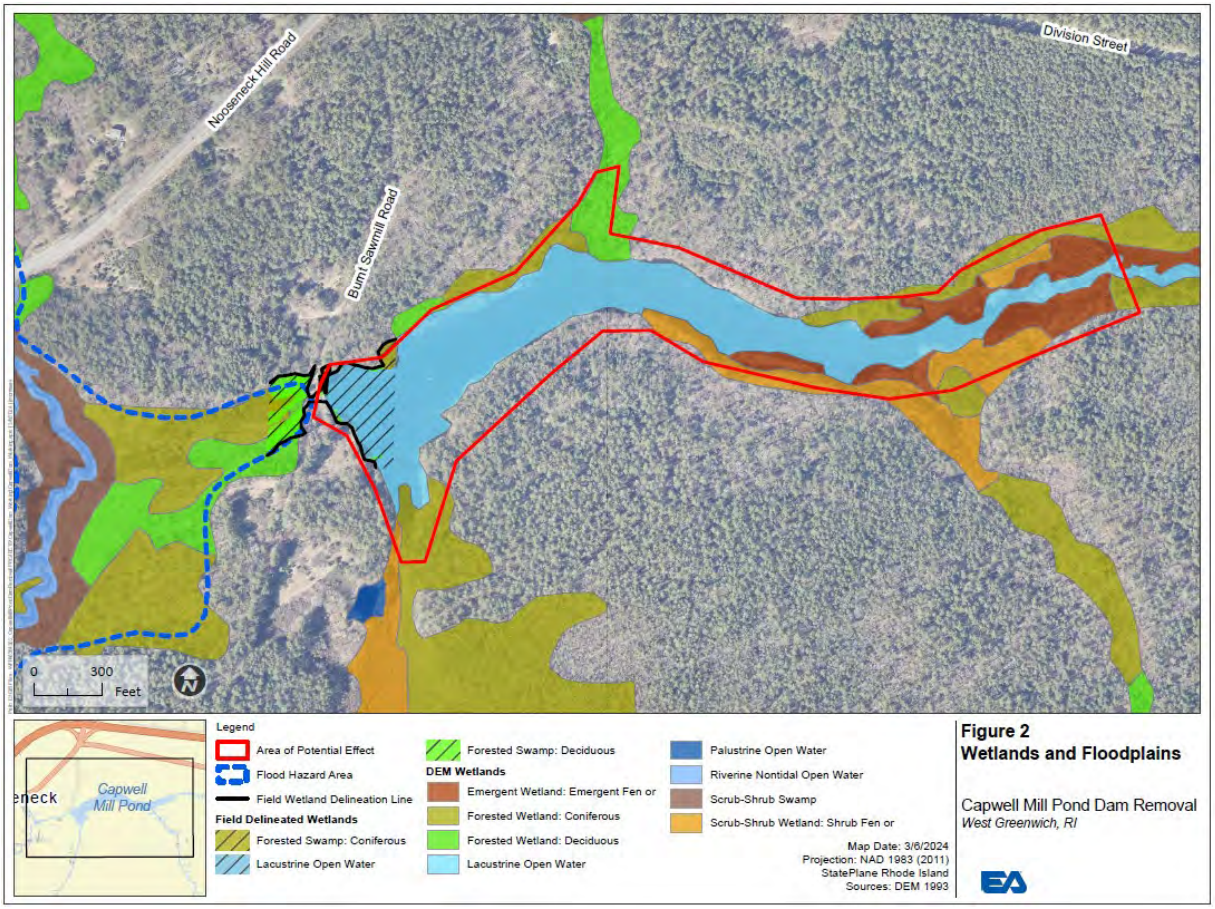


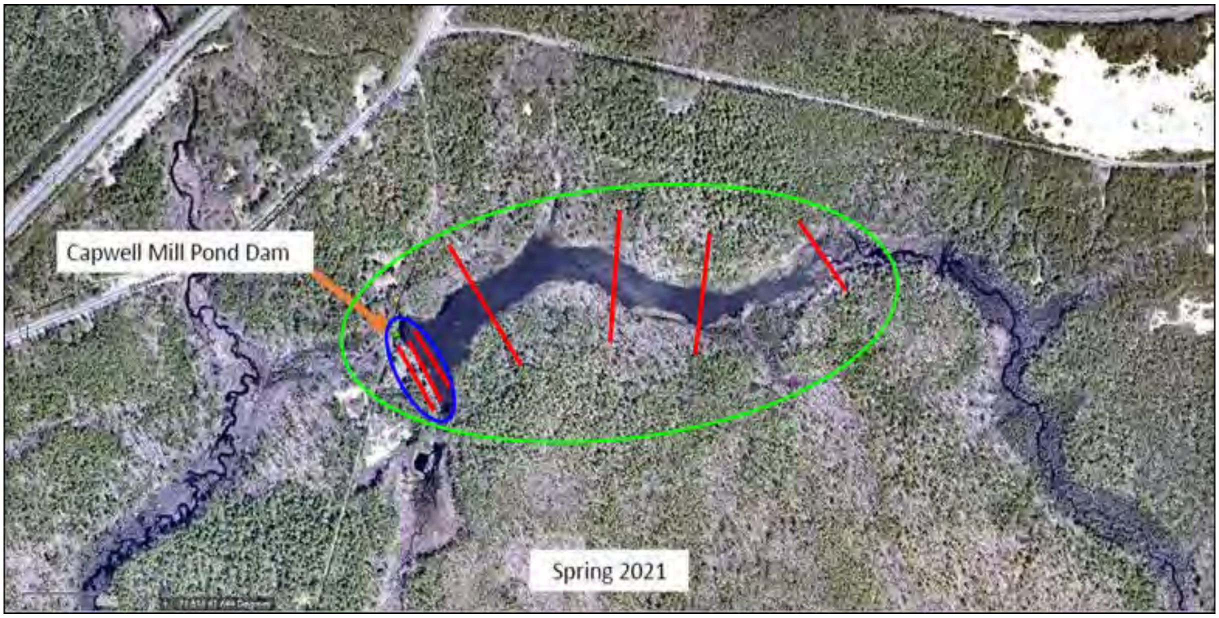
The major tasks completed for the project included QAPP development, field data collection, hydrological and hydraulic analysis, environmental assessment, alternatives analysis report, 35% conceptual engineering design, feasibility study and basis of design report, and regulatory coordination. Rhode Island Trout Unlimited (RITU) hired an environmental engineering consultant, EA Engineering, Science, and Technology, Inc., PBC (EA), to perform these major tasks for the project.

Capwell Mill Pond Dam

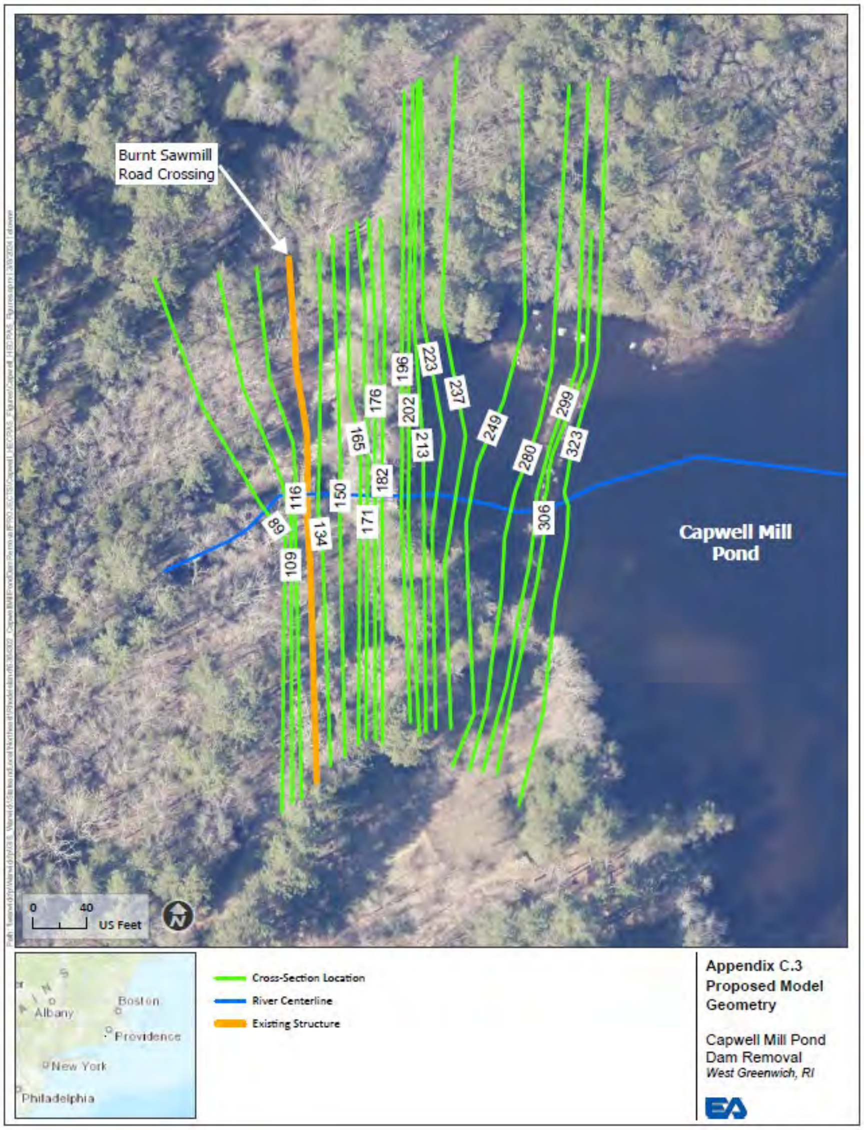
Throughout the project RITU provided public and regulatory outreach to ensure that the interests and concerns of the public as well as regulatory stakeholders were addressed during the project. To achieve this, RITU installed signs at the project site that stated the purpose of the study and included an email address to provide feedback on the project. RITU received two comments in the 8-month public outreach period, which included one email in favor of dam removal and one against removal of the dam. RITU provided frequent updates on the project to the public and RITU members. RITU frequently communicated with project partners on the QAPP development process, field activities, alternatives analysis, as well as discussing the project with the Pawtuxet River Authority and Watershed Council.

Data collection for this project was performed by EA in coordination with RITU and the Rhode Island Water Resources Board (RIWRB) to assess the existing ecological conditions. EA assessed topographic maps, soil survey data, geological data, floodplains maps, aerial photographs, biological data, and publicly available Geographic Information Systems (GIS) data layers available from the RIGIS website. EA's Principal Scientist performed a wetland delineation and geomorphic survey and gathered spatial points using Global Positioning System (GPS) field equipment. Dawood Engineering, Inc. (Dawood) performed a survey of the dam structures and a topographic survey of the project site adjacent to Capwell Mill Pond. Dawood completed eight bathymetric cross sections from 200 feet downstream to 3,200 feet upstream of the impoundment. In addition, RIDEM, who is one of the project partners, collected electrofishing data and temperature logger data from upstream and downstream of the dam.





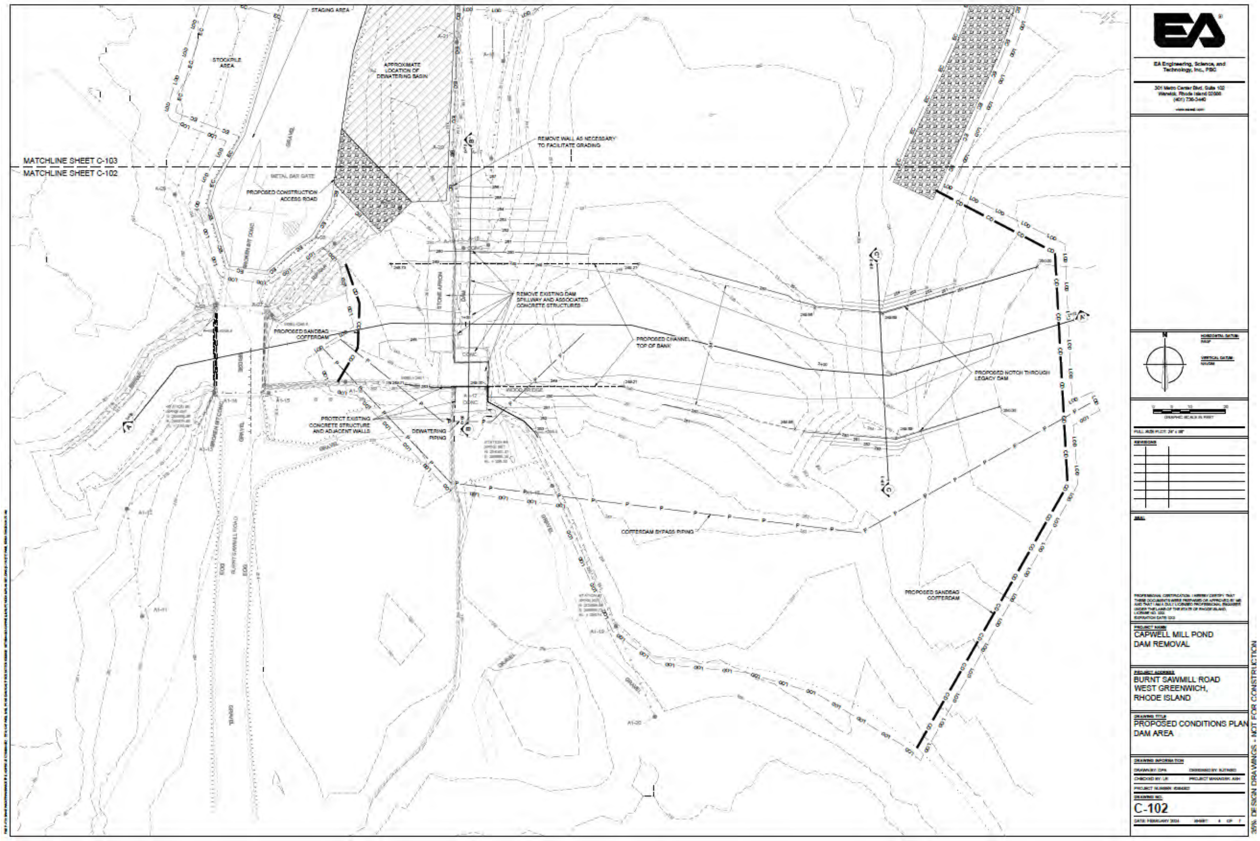
A hydrological and hydraulic analysis was completed via models developed using USACE Hydraulics Engineering Centers-River Analysis System (HEC-RAS). The HEC-RAS model represents the river water level profiles and was developed for the same intervals upstream and downstream as the engineering survey of the structure. Model simulations included 5%, 50%, and 95% flow exceedance values to determine river characteristics. The results of the modeling were used in the feasibility study and can be used for inclusion in future permit applications.

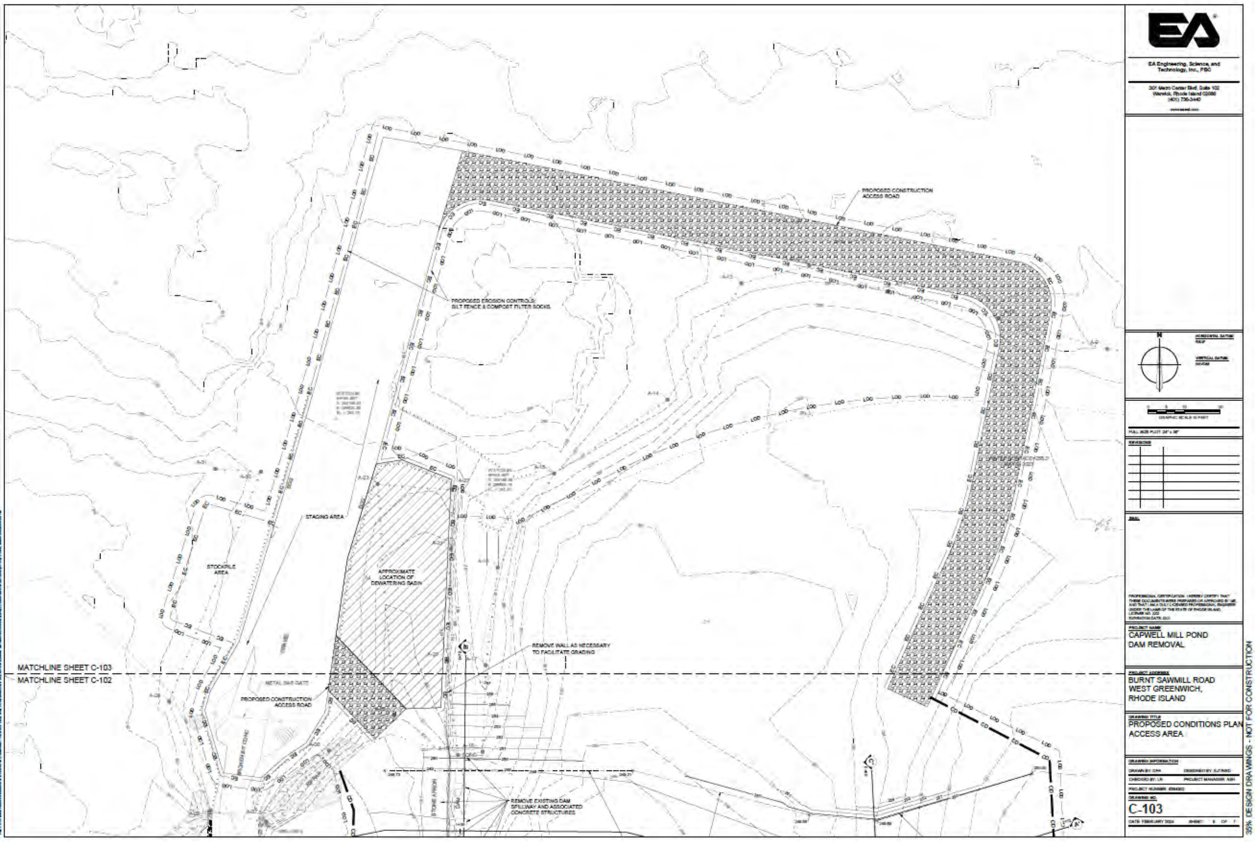


EA evaluated three dam removal alternatives in the Alternative Analysis Report: (1) No Action; (2) Removal of Capwell Mill Pond Dam only; and (3) Removal of Capwell Mill Pond Dam and upstream Legacy Dam. Based on the information reviewed and analyses conducted, EA recommended the removal of the Capwell Mill Pond Dam and Legacy Dam (Alternative 3) to be reviewed in the Engineering Design Report. EA determined that Alternative 3 would achieve the project goals of removing all current impediments to aquatic passage and re-establish the ability for trout to travel up and down stream to access spawning habitat. The alternatives analysis also concluded that Alternative 3 is more likely to be permitted by RIDEM and USACE.

EA then evaluated two options for Alternative 3: (1) complete removal of the legacy dam structure; and (2) partial removal of the legacy dam structure. EA also gathered information on existing conditions at the dam site related to water quality, wetlands, fish and wildlife, vegetation, threatened and endangered species, historic properties, and other relevant resources. This information was used to identify potential issues associated with dam removal and determine if any additional field surveys will be necessary. Generally, dam removal is anticipated to have long-term positive effects to water quality, wetlands, groundwater, and fish and wildlife habitat. The creation of new wetlands will stabilize groundwater levels and provide water quality benefits downstream. Dam removal would restore aquatic organism passage and reconnect approximately 11 miles of stream, which will benefit coldwater fish species, including brook trout. Potential long-term negative effects from dam removal may occur from the removal of the impoundment which would eliminate existing habitat for warmwater fish species. Loss of the impoundment may impact state-listed damselfly species.

The above information was summarized in an Engineering Design Report. The report included 35% conceptual design drawings were prepared for the preferred alternative. The designs will provide sufficient detail for RITU, project partners, and regulatory agencies to review and comment on during a pre-permitting meeting with regulators, which will be conducted in the future.





Additionally, EA conducted initial consultations with regulatory agencies including Rhode Island Historical Preservation and Heritage Commission (RIHPHC), RIDEM, USACE, and USFWS to see keep RITU informed on potential permits required for future stages of the project. In response to RIHPHC's request that the dams be evaluated for listing in the National Register of Historic Place, the Public Archaeology Laboratory, Inc. (PAL) performed a historic property reconnaissance survey of Capwell Mill Pond Dam and Legacy Dam in Spring 2024. Findings of the survey indicate that the structures are potentially eligible for inclusion on the National Register under Criterion A at the local level for their important associations with the history of West Greenwich's lumber industry. PAL recommends a more thorough effects assessment be conducted for the project when design plans for the proposed modifications of the Capewell Mill Pond Dam and Legacy Dam have advanced to a stage where all effects can be determined. PAL further recommends that the Section 106 consultation process be initiated by the lead federal agency for the project, once that agency is determined.

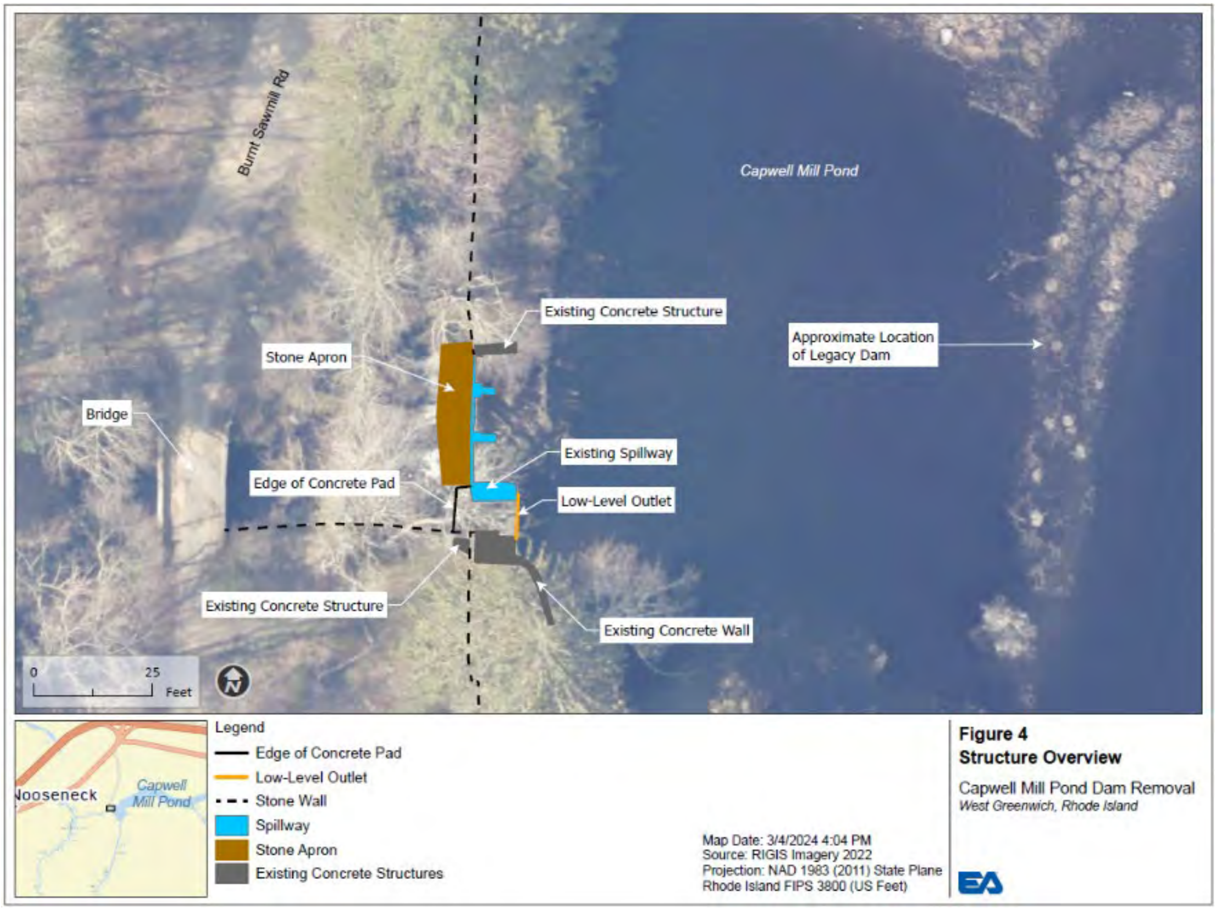


Figure 4
Structure Overview
Capwell Mill Pond Dam Removal
West Greenwich, Rhode Island

The majority of the project costs were allocated to the hired consultant, EA Engineering, Science, and Technology, Inc., PBC, who completed all project tasks. Match time was provided by RITU and by staff members from the project partners including RIDEM and RIWRB. This included time spent reviewing project deliverables, site visits and fieldwork, and general coordination and meetings.

Future steps for the project include:

- Present the EDR and 35% design drawings to the landowner (RIWRB) and receive approval from them to advance the project further.
- Acquire grant funding for 65% design and permitting.
- Complete a 65% dam removal design of the selected alternative (full removal of the Capwell Mill Pond Dam with partial removal of the Legacy Dam) supported by additional field effort to collect sediment samples, hydrologic and hydraulic modeling, and a 65% Engineering Design Report.
- Complete 100% designs and develop bid documents.
- Remove the Capwell Mill Pond Dam, partially remove the Legacy Dam, and restore the site.

1. Cover Information

September 30, 2024

Capwell Mill Pond Dam Removal Feasibility Study and Design

SWIG22-4-RITU

Reporting Period: 12/22/2022-07/19/2024

Final Report

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2. Project Report Narrative

2.A. Project Results

The ultimate goals of the Project are to restore essential ecological functions critical to native species and enhance water quality in the headwaters of the Pawtuxet Watershed. In addition, the project will enhance local resiliency by removing an aging dam no longer serving its intended purpose and improve greenspace important to the surrounding communities. The short-term goals of the project were to collect sufficient data to perform a feasibility study and alternative analysis for the potential eventual removal of the dam. Over the course of the project, the following progress has been made towards achieving these goals:

- Collected fish survey data and temperature logger data upstream and downstream of the dam
- Collected topographic and bathymetric survey data of portions of the impoundment and upstream and downstream of the dam
- Performed a wetland delineation in the immediate vicinity of the dam
- Developed hydrologic and hydraulic (H&H) analysis of existing and proposed conditions
- Performed general environmental assessment of the impoundment
- Developed 35% design drawings for the removal of Capwell Mill Pond Dam
- Completed initial agency consultation
- Responded to Rhode Island State Historic Preservation Office (SHPO) comments from consultation
- Performed cultural resources evaluation of the dam
- Prepared a Basis of Design Report summarizing all collected, analysis, assumptions, drawings,

RITU's consultant EA Engineering completed an Alternative Analysis report in October of 2023. In that analysis, EA Engineering recommended the full removal of the existing Capwell Dam spillway, and the full removal of the upstream "legacy" dam structure. However, RITU indicated that their preference was to move forward with the most "cost effective" approach, which still would accomplish the project goals and objectives. As a result, after discussions with EA Engineering, RITU chose to move forward with the full removal of the existing Capwell Dam spillway, and only a partial removal of the upstream "legacy" dam structure. The partial removal of the upstream legacy structure would be of a width similar to the Capwell Dam spillway being removed and aligned in a hydraulically efficient way.

As such, EA Engineering proceeded with the 35% designs for this alternative, and completed a detailed Engineering Design Report to accompany the 35% designs. The Draft Engineering Design Report was reviewed by RITU, RIWRB, RIDEM, and USFWS. Their comments were incorporated and the report was finalized in July 2024.

2.B. Next Steps and Recommendations

- RIWRB (landowner) authorize next phase of project (design and permitting)

- Secure more funding and progress designs to permit-level designs

2.C. Compliance

- Final QAPP approved by EPA on May 16, 2023

2.D. Project Partners

U.S. Fish and Wildlife Service USFWS

- USFWS provided general technical assistance and engineering support. As part of this project, USFWS biologists and engineers served as technical resources to review all engineering and modeling deliverables prepared, and provided biological guidance for RITU for the project.

R.I. Department of Environmental Management (RIDEM); Fisheries Division

- RIDEM provided general technical support by serving as a technical resource and representative of the State for all fisheries related issues. RIDEM also installed temperature loggers and conducted electroshocking upstream and downstream of the dam to establish existing conditions on the site.

Rhode Island Water Resources Board (RIWRB)

- RIWRB acts as the State entity charged with oversight and administration of the Big River Management Area. RIWRB provided project management, access and logistical coordination, review of technical deliverables, and technical assistance.

2.E. Volunteer and Community Involvement

RITU's approach to community involvement focused on public outreach, regulatory outreach, and peer to peer transfer of project information. Public outreach will be critical to the overall removal of the Capwell Mill Pond Dam. Recreational users from across the state frequent the BRMA, and the project included public outreach to gauge the public interest/concerns with the removal of the Capwell Mill Pond Dam. RITU has been providing updates to TU members and the public on the project.

2.F. Outreach & Communications

RITU has been in regular communication with project partners on the status of the project and reached out to many of them during the QAPP development process and field activities. RITU's consultant has discussed the project with the Pawtuxet River Authority and Watershed Council.

3. Project Budget Report

3.A. Summary Budget Tables

Summary Budget Table 1: Expenditures by Federal Cost Category

Budget Category	Total SWIG Award	Total Non-Fed Match	Grant Funds Expended This Period	Grant Funds Expended Cumulative	Match Funds Expended This Period	Match Funds Expended Cumulative	Match Source (note cash or in-kind)
Travel	$0	$0	$0	$0	$0	$0	
Supplies	$0	$1,200	$0	$0	$0	$0	
Consultant Fees	$116,000	$0	$27,133	$116,000	$0	$0	
Other	$2,000	$39,720	$2,000	$2,000	$3,981.98	$43,124.46	RITU (in-kind), RIWRB (in-kind), RIDEM (in-kind)
Total Direct	$118,000	$40,920	$27,133	$118,000	$3,981.98	$43,124.46	
Indirect	$6,000	$0	$500	$6,000	$0	$0	
Total	**$124,000**	**$40,920**	**$27,633**	**$124,000**	**$3,981.98**	**$43,124.46**	

Note: The $2,000 in the "Other" category and the additional $54.20 that did not go to the consultant went towards the SHPO consultation and National Register of Historic Places assessment.

Summary Budget Table 2: Expenditures by Project Task (Grant Funds Only)

Project Task	Total SWIG Award	Expended Progress Period 1	Expended Progress Period 2	Expended Progress Period 3	Expended Progress Period 4	Actual Expended to Date
Task 1 – Contractual Services: QAPP, H&H, Design, etc.	$116,000	$10,089	$34,978	$43,800	$27,133	$116,000
Task 2 – Conference Travel and Attendance	$2,000	$0	$0	$0	$2,000	$2,000
Task 3 – Indirect for RITU	$6,000	$2,500	$1,000	$2,000	$500	$6,000
Total	**$124,000**	**$12,589**	**$35,978**	**$45,800**	**$29,633**	**$124,000**

3.B. Budget Narrative

TU Matching Contributions (Match)

- Monthly updates to Trout Unlimited Membership
- Monthly updates to Trout Unlimited Board members
- Review of budget sheets
- General Project management and grant administrative tasks.
- Review of Project Documents from Consultant (Engineering Design Report)
- Coordination with EA Engineering (the Contractor)
- Monitoring public comments

RI Water Resources Board (Match)

- Review of Engineering Design Report
- General calls, emails, and coordination
- Project Status update calls/meetings with EA and RITU
- Providing updates to the RI Water Resources Board (i.e., The Property Owner)

RI Department of Environmental Management (Match)

- Review of Engineering Design Report
- General calls, emails, and coordination

Consultant Tasks

- Received Final QAPP approval from EPA on May 16, 2023
- Wetland Delineation conducted on June 5, 2023
- Preparation of Wetland Delineation Technical Memorandum
- Bathymetric Survey conducted in June 2023
- H&H Analysis conducted September-October 2023
- Preparation of 35% Design (November 2023-February 2024)
- SHPO coordination (February-June2024)
- Preparation of Engineering Design Report finalized in July 2024

4. Supporting Materials (Attached)

- Final Engineering Design Report

5. Achievement of EPA SNEP Project Metrics

- Metrics spreadsheet attached

6. Certification

Include this language: *The undersigned verifies that the descriptions of activities and expenditures in this progress report are accurate to the best of my knowledge; and that the activities were conducted in agreement with the grant contract. I also understand that matching fund levels established in the grant contract must be met.*

Grantee Signature:

Name: Glenn Place

Job Title: RITU President

Date: 9/30/2024

Organization: Rhode Island Chapter of Trout Unlimited

Supporting Materials

Engineering Design Report
Capwell Mill Pond Dam Removal
West Greenwich, Rhode Island

Prepared for

Trout Unlimited, RI Chapter 225
203 Arcadia Road
Hope Valley, Rhode Island 02832

Partnership with

Rhode Island Water Resources Board
235 Promenade Street, Suite 230
Providence, Rhode Island 02908

Prepared by

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301 Metro Center Boulevard, Suite 102
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July 2024
Version: Final
EA Project No. 6364302

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LIST OF ACRONYMS AND ABBREVIATIONS

APE	Area of Potential Effect
cfs	Cubic feet per second
BRMA	Big River Management Area
EA	EA Engineering, Science, and Technology, Inc., PBC
FEMA	Federal Emergency Management Agency
ft	Foot (feet)
ft/s	Foot (feet) per second
HEC-RAS	Hydrologic Engineering Center River Analysis System
HUC-12	Hydrologic Unit Boundary 12-digit
NHA	Natural Heritage Areas
NAVD88	North American Vertical Datum of 1988
PAL	The Public Archaeology Laboratory, Inc.
PDA	Preliminary Determination Application
RIDEM	Rhode Island Department of Environmental Management
RIHPHC	Rhode Island Historical Preservation and Heritage Commission
RINHS	Rhode Island Natural History Survey
RITU	Rhode Island Chapter of Trout Unlimited
RIWRB	Rhode Island Water Resources Board
USACE	U. S. Army Corps of Engineers
USFWS	U. S. Fish and Wildlife Service
USGS	U. S. Geological Survey
WQC	Water Quality Certificate
WSE	Water Surface Elevation

ES. EXECUTIVE SUMMARY

The Rhode Island Chapter of Trout Unlimited (RITU), partnered with the Rhode Island Water Resources Board (RIWRB), has contracted EA Engineering, Science, and Technology, Inc., PBC (EA) to provide engineering and design services as part of their efforts to restore aquatic organism passage in the Big River Management Area (BRMA). RITU also seeks to reduce downstream water temperature and to reduce thermal impacts to the Big River downstream of Capwell Mill Pond. The Capwell Mill Pond Dam, located in the BRMA directly east of Burnt Sawmill Road in West Greenwich, Rhode Island, creates an impoundment on the Carr River just before the Carr River's confluence with the Big River. The Capwell Mill Pond Dam and impoundment inhibit aquatic passage due to the physical barrier of the dam structure and environmental barriers caused by the impoundment. EA previously completed an Alternatives Analysis for dam removal and recommended one of the alternatives for evaluation in an Engineering Design Report (EDR).

The alternative evaluated in this EDR is removal of the Capwell Mill Pond Dam and removal of a Legacy Dam located approximately 120 feet (ft) upstream of the Capwell Mill Pond Dam. The evaluation consisted of creating a hydrologic and hydraulic model to assess the existing and proposed hydraulic conditions at the project site. EA used available U.S. Geological Survey (USGS) stream gage data to determine operating flows and peak flows at the Capwell Mill Pond Dam. Survey data and flow data were then incorporated into the hydraulic model. Two proposed conditions were modeled: full removal of the Legacy Dam and partial removal of the Legacy Dam. Ultimately, EA found that full removal of the Legacy Dam offered minimal additional benefits when compared to a partial removal of the Legacy Dam; therefore, EA recommends the project design proceed with the removal of the Capwell Mill Pond Dam and partial removal of the Legacy Dam. This will result in significant enhancement of the ecosystem services and restoration of the natural system and processes, while having minimal to negligible adverse environmental impacts.

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1. INTRODUCTION

RITU has contracted EA to provide engineering and design services as part of their efforts to restore aquatic organism passage past the Capwell Mill Pond Dam in the BRMA. EA has previously completed an Alternatives Analysis to assist with the selection of the alternative that best meets the project goals (described in Section 3). The Alternatives Analysis evaluated the following three dam removal options:

- Alt 1 - No Action
- Alt 2 - Removal of Capwell Mill Pond Dam only
- Alt 3 - Removal of Capwell Mill Pond Dam and upstream Legacy Dam

EA recommended Alternative 3 (removal of Capwell Mill Pond Dam and upstream Legacy Dam) to be reviewed based on the results of the Alternatives Analysis. Two options for this alternative are evaluated in this EDR:

- Alt 3, Opt 1 - Removal of Capwell Mill Pond Dam and partial removal of upstream Legacy Dam
- Alt 3, Opt 2 - Removal of Capwell Mill Pond Dam and full removal of upstream Legacy Dam

Based on the information reviewed and analyses conducted, EA recommends Alternative 3, Option 2 (removal of Capwell Mill Pond Dam and partial removal of upstream Legacy Dam) for final design. This report summarizes EA's assessment of the two options, including information about existing conditions, a hydrologic and hydraulic analysis, and a proposed 35% design plan and drawings for the recommended option.

All elevations reported are in the North American Vertical Datum of 1988 (NAVD88).

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2. EXISTING CONDITIONS

2.1 CAPWELL MILL POND OVERVIEW

The Capwell Mill Pond Dam is in the upper portion of the Pawtuxet River Watershed (Hydrologic Unit Boundary 12-digit [HUC-12] 010900040601) on the Carr River in the BRMA. The Carr River is a tributary of the Big River, which eventually flows into Reynolds Pond before entering Flat River Reservoir, and then into the South Branch of the Pawtuxet River. The Pawtuxet River Watershed is 231 square miles and provides drinking water to over 60% of Rhode Islanders.

2.2 NATURAL RESOURCES

The summary of natural resources within the project's Area of Potential Effect (APE) (Appendix A: Figure 1) is based on information developed in previous studies of the pond, publicly available data, previous data collected, and observations made by Rhode Island Department of Environmental Management (RIDEM), RITU, and EA from 2020-2023.

2.2.1 Water Quality

Neither Capwell Mill Pond nor the Carr River are listed as impaired waterbodies in the State of Rhode Island 2022 Impaired Waters Report (RIDEM 2022a). Tarbox Pond, approximately 1.5 miles upstream from the Capwell Mill Pond Dam, is listed as impaired for mercury in fish tissue.

A 2001 study analyzed groundwater and surface water samples from throughout the BRMA for water quality (Craft 2001). Specific conductance, which is a direct measure of dissolved solids in water, was the primary parameter used to evaluate water quality. Data collected for the study between 1996 and 1998 showed that groundwater quality in the BRMA was generally clean and unaffected by anthropogenic contaminants. Surface water data showed that water quality in the Big River and Carr River were less affected by anthropogenic influences than water in the Nooseneck River and Mishnock River further north (Craft 2001, Granato et al. 2003).

2.2.2 Wetlands and Wetlands Vegetation

EA completed a delineation of jurisdictional wetland resource areas at Capwell Mill Pond Dam on June 5th, 2023 (the wetland delineation technical memorandum was included in the Alternatives Analysis report). EA delineated three areas under the jurisdiction of RIDEM at the site: a forested swamp system which includes a deciduous forested swamp greater than ten acres and an evergreen forested swamp greater than 1 acre which runs through the site from east to west (Wetland A), a deciduous forested swamp less than 1 acre (Wetland B), and Capwell Mill Pond. Wetlands are depicted on Figure 2 in Appendix A.

Vegetation observed in Wetland A included red maple (*Acer rubrum*), Atlantic white cedar (*Chamaecyparis thyoides*), yellow birch (*Betula alleghaniensis*), sweet pepperbush (*Clethra alnifolia*), highbush blueberry (*Vaccinium corymbosum*), poison sumac (*Toxicodendron vernix*), eastern poison ivy (*Toxicodendron radicans*), royal fern (*Osmunda spectabilis*), cinnamon fern

(*Osmundastrum cinnamomeum*), skunk cabbage (*Symplocarpus foetidus*), three-leaf goldthread (*Coptis trifolia*), sensitive fern (*Onoclea sensibilis*), New York fern (*Parathelypteris noveboracensis*), and *Sphagnum* moss. Plant species observed growing within Capwell Mill Pond included pickerelweed (*Pontederia cordata*), white water lily (*Nymphaea odorata*), bayonet rush (*Juncus militaris*), blue flag (*Iris versicolor*), and common reed (*Phragmites australis*), which is an invasive species. Primary plant species observed within Wetland B included skunk cabbage, red maple, sweet pepperbush, highbush blueberry, cinnamon fern, *Sphagnum* moss, poison ivy, royal fern, three-leaf goldthread, sensitive fern, and New York fern.

2.2.3 Fish

Aquatic habitats at the project site include Capwell Mill Pond, Carr River, and the surrounding freshwater wetlands. A RIDEM fishery survey conducted in the Carr River in August 2023 immediately downstream of the Capwell Milll Pond Dam found pumpkinseed (*Lepomis gibbonsus*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), golden shiner (*Notemigonus crysoleucas*), and brown bullhead (*Ameiurus nebulosus*) (RIDEM 2023b). Fisheries surveys conducted in July and September 2021 in the two tributaries downstream to the west and south of the Capwell Mill Pond Dam found 5 species including chain pickerel (*Esox niger),* largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), yellow perch (*Perca flavescens*), and pumpkinseed (*Lepomis gibbonsus*) (EA 2022).During the same 2021 fish survey, brook trout were found in the Nooseneck River, Bear Brook, Congdon River, and unnamed tributaries of Bear Brook, Big River, Congdon Brook, and Carr River.

Other common freshwater fish of Rhode Island include various species of trout (*Oncorhynchus*) and char (*Salvelinus*), smallmouth bass (*Micropterus dolomieu*), fallfish (*Semotilus corpralis*), and American eel (*Anguilla rostrata*) (RIDEM 2022b). Some of these species may also be present in the impoundment and streams.

RIDEM begins stocking various streams and ponds with trout throughout Rhode Island in the spring and continues throughout the summer and fall with brown trout, golden trout, rainbow trout, tiger trout, and brook trout. The Big River is stocked with brown, rainbow, and brook trout where it crosses under Route 3, approximately 0.5 miles downstream of the Capwell Mill Pond Dam (RIDEM 2023c). These hatchery-raised trout are stocked for recreational purposes in order to support recreational fishing opportunities for resident and non-resident anglers.

The Capwell Mill Pond Dam structure creates an impassable barrier to fish and other aquatic organisms restricting downstream and upstream passage and genetically isolating populations of aquatic organisms impacting species fitness.

2.2.4 Wildlife

The APE provides habitat for a wide range of birds, mammals, reptiles, and amphibians. The majority of the APE surrounding the pond is made up of woody wetlands, riparian areas, and mixed forest creating a diversity of habitats.

Wildlife species observed by EA staff include coyote, deer, fox, squirrels, and various bird species. Additional species observations in and surrounding the APE from the iNaturalist webpage include: bufflehead (*Bucephala albeola*), American red squirrel (*Tamiasciurus hudsonicus*), northern watersnake (*Nerodia sipedon*), eastern garter snake (*Thamnophis sirtalis*), northern ringneck snake (*Diadophis punctatus edwardsii*), eastern phoebe (*Sayornis phoebe*), pine warbler (*Setophaga pinus*), pickerel frog (*Lithobates palustris*), and four-toed salamander (*Hemidactylium scutatum*) (iNaturalist 2023). Observations from iNaturalist are incidental observations submitted by members of the community and do not reflect the results of formal biological surveys of the site. Other animal species that likely inhabit the APE include common frog, toad, snake, and salamander species as well as small to medium sized mammals such as beavers, deer, bobcats, and fox, among others, and various bird species.

2.2.5 State-Listed Species

The Rhode Island Natural History Survey (RINHS) developed a map of Natural Heritage Areas (NHA) across Rhode Island. NHAs are locations that have occurrences of heritage data elements, including observations of state or federally listed rare or threatened animal and plant species (RINHS 2019). The APE is located in NHA 154 (Appendix A: Figure 3). According to data provided by RIDEM, rare animal species that have been observed within the project's APE include scarlet bluet (*Enallagma pictum*), Hessel's hairstreak (*Callophrys hesseli*), pine barrens bluet (*Enallagma recurvatum*), and Eastern ribbon snake (*Thamnophis sauritus*), though the database indicates that observations of these species were made at least 20 years ago (see **Table 2-1**) (RIDEM 2023d).

Table 2-1. State-listed Species Observed at Capwell Mill Pond

Common name	Scientific name	Taxon	Listing status	Year of last observation
Scarlet bluet	*Enallagma pictum*	Damselfly	State concern	2002
Pine barren's bluet	*Enallagma recurvatum*	Damselfly	State concern	2002
Hessel's hairstreak	*Callophrys hesseli*	Butterfly	State concern	1993
Eastern ribbon snake	*Thamnophis sauritus*	Snake	State concern	1989

Additionally, the USFWS Information for Planning and Consultation identified four federally listed species with the potential to inhabit the area: northern long-eared bat (*Myotis septentrionalis*), monarch butterfly (*Danaus plexippus*), sandplain gerardia (*Agalinis acuta*), and small whorled pogonia (*Isotria medeoloides*) (USFWS 2024).

2.2.6 Other Special Designations

Portions of the APE are classified by RIDEM as high value/high vulnerability habitat indicating that they are comprised of various forest types and/or marshes, swamps, or other vulnerable habitats (Appendix A: Figure 3) (RIDEM 2023e). All areas surrounding Capwell Mill Pond are designated as an unfragmented forest block of 500 acres or more (RIDEM 2023e).

2.3 COMMUNITY RESOURCES

Community resources include assets such as recreation, drinking water sources, flood protection, historical and cultural resources, and aesthetics. A brief summary of each of these resources in the context of Capwell Mill Pond is provided below.

2.3.1 Recreational Resources

The BRMA is a popular recreational area for local residents. Its designation as an open space requires that "any use of the Big River Management Area preserves and protects the quality and quantity of water in the aquifer, protects public safety and is consistent with the development and use of the area for water supply" (Big River Management Area 490-RICR-00-00-5). Some popular and permissible passive recreational uses include: hiking, backpacking, fishing, canoeing and kayaking (limited to ponds and Big River), and horseback riding.

The APE, specifically the area near the Capwell Mill Pond Dam, is a popular area for fishing and wildlife viewing; the Capwell Mill Pond Dam structure itself is frequently used as a shoreline fishing access point. Some recreational users also occasionally use the pond to canoe and kayak, but the heavy vegetation surrounding the pond hinders access to the pond.

2.3.1.1 Public Outreach

Due to the nature of the Pond being located at a primary access point to the BRMA, RITU carried out public outreach for the project. The public outreach had two primary goals: 1) to notify the public that the dam was being considered for removal, and 2) to determine the public's interest (positive or negative) on the proposed dam removal. To achieve this, RITU conducted public outreach by installing three signs at the project site in July 2023 (see Appendix F for photos of the sign). Two of the signs were installed at/on the dam structure and one was installed at a kiosk in the parking area. The signs stated the purpose of the study and included an email address to provide feedback on the project. RITU received two comments in the 8-month public outreach period (July 2023 through February 2024). The results of the outreach effort were one email received in favor of the dam removal and one against removal of the dam.

Data collected during a separate study by the RIWRB indicated that over 3,247 BRMA users passed the RITU signage in total while the signage was deployed, and monthly users engaged by the signage averaged 464 per month.

2.3.2 Drinking Water Resources

Capwell Mill Pond Dam is located in the BRMA, which is set aside in state statute as a future drinking water supply for the State of Rhode Island, making the preservation and protection of water quality critically important. Though not slated for immediate development as a drinking water reservoir, the area remains an invaluable water resource as a potential future drinking water source.

2.3.3 Flood Risk

The area immediately downstream of the Capwell Mill Pond Dam is within a Federal Emergency Management Agency (FEMA) special flood hazard area (Zone A), which is defined as an area with a 1% annual chance of flooding – also known as the 100-year floodplain (Appendix A: Figure 2) (RIDEM 2023e). No base flood elevations have been defined.

The Capwell Mill Pond Dam has been assessed as a Low Hazard Potential dam, which is defined by the RIDEM Office of Compliance and Inspections as a dam where *"failure or misoperation results in no probable loss of human life and low economic losses."* (RIDEM 2023a)

The Capwell Mill Dam was last inspected by GZA GeoEnvironmental, Inc. in 2007 (GZA GeoEnvironmental Inc. 2007). The assessment (previously included in the Alternatives Analysis report to RITU and project Partners in October 2023) found that the dam was in poor structural condition. The report stated that a failure of the dam would wash out Burnt Sawmill Road just downstream, with the potential to impact recreational users. A dam failure may also destroy a USGS gaging station downstream of the Burnt Sawmill Road bridge. No repairs or improvements have been made to the dam since the 2007 assessment. It is likely that the condition of the dam has further deteriorated since the assessment. As of the development of this report, no other assessments of this structure have been completed or are scheduled.

2.3.4 Historical and Cultural Resources

The Rhode Island Water Resources Board (RIWRB), as the landowner, submitted a consultation letter to the Rhode Island Historical Preservation and Heritage Commission (RIHPHC) on November 1st, 2023 describing the site and project. The RIHPHC provided a response on November 6th, 2023 requesting that the Capwell Mill Pond Dam structure, given its age, be evaluated for listing in the National Register of Historic Places.

The Public Archaeology Laboratory, Inc. (PAL) performed a historic property reconnaissance survey of Capwell Mill Pond Dam and Legacy Dam in Spring 2024. Findings of the survey indicate that the structures are potentially eligible for inclusion on the National Register under Criterion A at the local level for their important associations with the history of West Greenwich's lumber industry. PAL recommends a more thorough effects assessment be conducted for the project when design plans for the proposed modifications of the Capewell Mill Pond Dam and Legacy Dam have advanced to a stage where all effects can be determined. PAL further recommends that the Section 106 consultation process be initiated by the lead federal agency for the project, once that agency is determined. A copy of PAL's report is included as Appendix G.

2.3.5 Aesthetics

While the aesthetic qualities of an area can be subjective, several factors influence whether a natural area is generally understood to provide high aesthetic value (USACE 1999). These include:

- Multiple habitat types visible from primary viewing locations
- Expansive views and relatively unobstructed sight lines available from primary viewing locations
- Diversity of vegetative species visible from primary viewing locations
- Diversity of wildlife viewing (e.g., birds)
- Abundance of flowering plants and/or vibrantly-colored plants that change with seasons
- Surrounding land use is undeveloped as seen from primary viewing locations
- Contrasting landforms
- Absence of visible trash, debris, or signs of disturbance
- Low levels of noise and unpleasant odors at primary viewing locations

Based on a consideration of these factors, the aesthetic value of Capwell Mill Pond and surrounding areas is moderate. Dense and widespread growths of aquatic invasive plants inhibit viewing points and decrease the aesthetic value, although people are known to conduct viewings at the pond from the dam and appurtenances.

3. PROJECT GOALS AND OBJECTIVES

The following two sections present the overarching goals of the project and list objectives that can help achieve the project goals. These goals and objectives guided the evaluation and design of the selected alternative in this EDR.

3.1 PROJECT GOALS

The project goals represent the desired outcomes achieved through the project after completion. The following is a list of the project goals:

- Restore the Carr River to its natural state within the constraints of nearby public infrastructure.
- Restore aquatic passage in the BRMA.
- Reduce liability to the dam owner from damages or injuries as a result of future dam failure.

3.2 PROJECT OBJECTIVES

The project objectives are actionable items that can be taken to help achieve the project goals. The following is a list of the project objectives:

- Remove barriers to aquatic organisms (i.e the Capwell Mill Pond Dam and the Legacy Dam).
- Eliminate stagnated water and increased temperatures in the impoundment that are currently isolating thermally dependent species, and genetically isolating populations of aquatic organisms.
- Open the now closed fluvial river system to coldwater dependent species (i.e., brook trout) and assist them in their ability to seek and successfully reach thermal refugia, which are critical to species and population survival through species fitness, genetic diversity, and population resiliency throughout the upper Pawtuxet River Watershed.
- Remove sediment build-up caused by the dam structure.
- Comply with local and state regulations.

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4. PROPOSED DAM REMOVAL OPTIONS

EA recommended evaluating removal of the Capwell Mill Pond Dam and the upstream Legacy Dam in the Alternatives Analysis. EA evaluated two options; both options consist of removing the Capwell Mill Pond Dam, with Option 1 including full removal of the upstream Legacy Dam and Option 2 including partial removal of the upstream Legacy Dam. These two options are described in more detail below and depicted on the 35% design drawings included in Appendix B.

4.1 OPTION 1 – FULL REMOVAL OF LEGACY DAM

Removal of the Capwell Mill Pond Dam with full removal of the Legacy Dam would include the following:

Removal of the Capwell Mill Pond Dam – Removal of the existing dam spillway, the low-level outlet, the stone apron and concrete pad just downstream of the spillway, and associated concrete and stone structures on the right[1] overbank. Existing concrete structures and adjacent walls on the left overbank to remain. The proposed graded areas on the overbanks have a slope of 3H:1V or less and tie into the existing grade. A new channel will be established that ties into the existing stream profile upstream and downstream of the dam, which would involve excavating impounded sediment upstream of the dam.

Full removal of the Legacy Dam – Complete excavation of remaining stone, soil, and sediment from the Legacy Dam. The proposed graded areas on the overbanks have a slope of 4H:1V or less and tie into the existing grade. A new channel will be established that ties into the existing stream profile upstream and downstream of the Legacy Dam; therefore, the new channel created from the removal of the Legacy Dam will also tie into the new channel established from removal of the Capwell Mill Pond Dam. This creates a smooth profile from upstream of the Legacy Dam to the Burnt Sawmill Road crossing.

See Figure 4 in Appendix A for an overview of the Capwell Mill Pond Dam structure elements and the location of the Legacy Dam.

4.2 OPTION 2 – PARTIAL REMOVAL OF LEGACY DAM

Removal of the Capwell Mill Pond Dam – same as Option 1.

Partial removal of the Legacy Dam – Excavation of stone, soil, and sediment from a 34-feet long notch into the Legacy Dam structure. This width is the approximate width of the spillway in the Capwell Mill Pond Dam and was chosen to create a consistent bank width within the restoration area. The proposed grades on the overbanks have a slope of 1H:1V and tie into the existing grade. A new channel will be established that ties into the existing stream profile upstream and downstream of the Legacy Dam; therefore, the new channel created from the removal of the Legacy Dam will also tie into the new channel established from removal of the Capwell Mill Pond

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[1] Designations of right and left refer to river right and river left looking downstream.

Dam. This creates a smooth profile from upstream of the Legacy Dam to the Burnt Sawmill Road crossing.

5. ENVIRONMENTAL IMPACTS

The anticipated positive and negative effects of the removal of Capwell Mill Pond Dam to resource area functions and values are summarized in **Table 5-1**. Additional detail for the primary resource area functions and values anticipated to be affected (positively or negatively) by the dam removal are provided following Table 5-1.

Table 5-1. Summary of Anticipated Effects of Capwell Mill Pond Dam Removal

Resource Area Functions and Values	Anticipated Positive Effects	Anticipated Negative Effects
Public or Private Water Supply	Long-term positive effects. Removal of the dam will enhance the water quality and natural filtration benefits for surface water. Enhancing and maintaining a higher water quality will be beneficial if the BRMA is eventually used as a drinking water source for the State of Rhode Island.	Likely no negative effects. Effects to drinking water wells from a decrease in surface and groundwater elevations are not expected; there are no private residences, wells, or businesses near the pond which use the water.
Groundwater	Long-term negligible effects. The creation of new wetlands will similarly stabilize groundwater levels as the existing shallow pond does, and maintain groundwater recharge. Capwell Mill Pond is in the bottom of the BRMA groundwater system based on previously assessed USGS hydrologic modeling and, as such, removal of the pond is anticipated to have minimal impacts to groundwater (see groundwater contour map in the Alternatives Analysis Report [Appendix E]).	Long-term negligible effects. Removal of the pond could have minimal impacts to groundwater immediately adjacent to the pond, but the creation of new wetlands will similarly stabilize and maintain groundwater levels as the existing shallow pond does, as well as maintain groundwater recharge. The establishment of an expansive 20-acre wet meadow once the dam is removed will help minimize any minor impacts.
Flood Control	Long-term positive effects. The dam is assessed as a low hazard dam (Office of Compliance and Inspection 2022). Removal of the dam would remove the risk of a dam failure which could impact downstream communities with flooding.	Likely no negative effects. The existing dam is a run-of-river structure and does not currently provide any flood attenuation.

Resource Area Functions and Values	**Anticipated Positive Effects**	**Anticipated Negative Effects**
Water Quality/Pollution Prevention	Long-term positive effects. The newly restored wetlands and stream channel will provide water quality benefits downstream due to reduced water temperatures, an increase in dissolved oxygen concentrations, and ability to trap sediment, which would also enhance biological filtration and ecosystem services.	Short-term negative effects due to temporary increase in sediment flowing to the Carr River during construction, though these will be mitigated through the use of BMPs and standard construction stormwater measures. Some sediment will be slowly released downstream as the upstream channel reestablishes post dam removal. However, this is a natural process which would have occurred with the same sediments had the dam not been in place.
Fish and Wildlife	Long-term positive effects to coldwater fish species and wildlife. Removal of the dam would restore aquatic organism passage, reduce water temperatures upstream and downstream of the dam, and create new riparian and wetland habitat (estimated to be 20 acres). Additionally, there are anticipated to be long-term positive effects from reconnecting approximately 11 miles of stream with expansive wet meadow and riparian habitat which will establish approximately 20 acres of wildlife habitat.	Long-term negative impacts to warmwater fish species. Warmwater fish species habitat will be significantly reduced with the removal of the impoundment, although a slow moving stream will remain within the impoundment footprint. Warmwater fish habitat is relatively abundant in Rhode Island. Trading warmwater for coldwater habitat will allow for a more natural system with enhanced aquatic habitat. Short-term negative effects due to disruption during construction activities, including noise and habitat disturbance to terrestrial and aquatic species.

Resource Area Functions and Values	Anticipated Positive Effects	Anticipated Negative Effects
State-listed Species	Long-term positive effects through restoration of the natural stream channel which would reconnect 11 miles of stream. This would create suitable habitat for coldwater fish species including brook trout, which are listed as a Species of Greatest Conservation Need in Rhode Island. Additional habitat would be established for the state-listed eastern ribbon snake. Positive impacts to the state-listed Hessel's hairstreak are anticipated because removing the impounding effects of the dam may allow for an expansion of the Atlantic white cedar swamp, which the species uses as their larval host plant.	Short-term negative effects during construction to state-listed species of concern that have been observed in or surrounding the impoundment, including scarlet bluet, pine barrens bluet, Hessel's hairstreak, and eastern ribbon snake from noise and habitat disturbance. Initial consultation with RIDEM indicated dam removal would result in long-term negative effects to the state-listed damselflies, the scarlet bluet and pine barrens bluet, due to loss of pond habitat. If the project moves forward, formal consultation with RIDEM will be conducted to determine mitigation strategies for the species.
Recreation	Long-term positive effects. Site access for the public will be maintained. Fishing will still be possible in the newly established stream channel. Fishing opportunities will be enhanced in the Carr River as water temperatures will be better suited for coldwater fish species. The newly established wet meadow may attract species sought after by hunters (e.g., deer, turkey, etc.). The newly created wetland will also provide habitat for various waterfowl and riparian-dependent birds. Removal of the dam may allow for seasonally sufficient water for kayaking into the created wetland and downstream, possibly to the Big River.	Long-term negative effects from the removal of the Capwell Mill Pond. The dam is currently used as a shoreline fishing access point, so removal of the dam would remove fishing from the dam structure itself. Removal of the dam will also reduce the habitat area for the warmwater fish currently inhabiting the pond. Although the pond is heavily vegetated, it is occasionally used by canoers and kayakers. Removing the impoundment will remove these opportunities within the pond environment.

Resource Area Functions and Values	Anticipated Positive Effects	Anticipated Negative Effects
Visual Quality/Aesthetics	Dam removal would result in significant, long-term changes in the visual quality of the system. The changes may be positive, negative, or neutral, depending upon personal preference. Based on common indicators of visual quality and aesthetics, the aesthetic value of the system following dam removal is expected to be high. Dam removal would benefit the visual quality of the system by re-establishing a native vegetative community within the existing impounded area.	There are anticipated to be short-term negative impacts to visual quality during construction.

Water Quality

Removal of the dam is expected to result in long-term water quality improvements in the Carr River. Water quality improvements would occur due to increased flow velocities, which would reduce water temperature and increase dissolved oxygen concentrations. The removal of the dam would also result in the establishment of new wetlands which will help filter surface water and trap sediment, in turn improving water quality and enhancing biological filtration and ecosystem services. These outcomes would provide several ecological and community benefits, including improving habitat for fish and other aquatic life, reducing algal growth, and improving the value of the resource for contact recreation. Thus, the impounding effect of the dam has resulted in water quality impairments to the system which would be expected to be ameliorated through dam removal.

Dam removal may also result in temporary negative impacts to water quality downstream of the dam, primarily due to the downstream migration of sediment currently trapped by the dam, which is likely to increase turbidity. These effects may temporarily impair habitat for fish and benthic organisms downstream of the dam. However, the impacts will be mitigated through the use of best management practices and standard construction stormwater measures. Regular stream flow dynamics would help to flush accumulated sediment downstream, thus restoring downstream water quality. Overall, the long-term benefits to water quality from dam removal are expected to outweigh potential short-term adverse effects.

Fish and Wildlife

Dam removal will reconnect the Carr River to its historic floodplain and restore aquatic organism passage to over 11 miles of stream, enhancing the long-term stability of ecosystem services and habitat in the upper portions of the watershed. Removal of the dam will reduce water temperatures both upstream and downstream of the dam due to the removal of the impoundment, which currently heats water to lethal temperatures for coldwater fish species. The newly established stream system with cooler water temperatures will be suitable habitat for native brook trout and other coldwater fish species. As such, the removal of the impoundment will significantly reduce habitat for warmwater fish species, resulting in long-term negative impacts. Overall, impacts to fish species are anticipated to be positive because the project will allow for a more natural site with aquatic connectivity and free flowing streams which will increase productivity and enhance aquatic habitat.

As with any project that fundamentally changes the physical and ecological character of a landscape, the changes to the wildlife habitat functions provided by the system after dam removal would be beneficial to some wildlife species and detrimental to others. In general, as the impoundment is an artificial system dominated by dense growths of invasive plant species, the wildlife habitat value provided by Capwell Mill Pond under current conditions is relatively poor. Relatively few native wildlife species are adapted to these conditions compared to the higher number of species adapted to the native plant communities which would become re-established following dam removal, including wet meadows and riparian corridors. Wildlife species that could benefit from dam removal include a variety of migratory songbirds, reptiles and amphibians, and small- to medium-sized mammals.

State-listed Species

Scarlet Bluet and Pine Barrens Bluet

The scarlet bluet (*Enallagma pictum*) and pine barrens bluet (*Enallagma recurvatum*) are listed as species of concern in Rhode Island. The species are small, semi-aquatic insects in the pond damselfly family. Scarlet bluets typically inhabit acidic, sandy coastal plain ponds with floating vegetation, specifically with water lilies. Pine barrens bluets typically inhabit acidic, coastal plain ponds with sandy substrate and emergent vegetation along the shoreline. Capwell Mill Pond contains a variety of pond habitats, including emergent and floating vegetation similar to that found in coastal plain ponds.

Potential project impacts: The scarlet bluet and pine barrens bluet are anticipated to experience long-term negative impacts due to loss of habitat from the removal of the pond. The removal of the dam will also result in the removal of floating and emergent vegetation that the damselfly species use to lay eggs. Based on initial consultation with RIDEM, the damselfly species will not be able to occupy the area once it returns to its natural state and becomes a moving stream channel. Formal consultation with RIDEM will be conducted during future phases of the project to determine appropriate mitigation strategies.

Hessel's Hairstreak

The Hessel's hairstreak (*Mitoura hessli*) is a butterfly species listed as a species of concern in Rhode Island. The caterpillar feeds exclusively on Atlantic white cedar and the species inhabits exclusively coastal and inland Atlantic white cedar swamps and associated swamps and bogs. Adults feed on shrubs such as blueberry and chokeberry.

Potential project impacts: The Hessel's hairstreak is anticipated to experience short-term impacts from disruption during construction activities. Long-term impacts to the species are anticipated to be positive because removing the impounding effects of the dam may allow for an expansion of the Atlantic white cedar swamp that currently borders part of the impoundment. Reductions in surface water and groundwater levels from dam removal may make areas where Atlantic white cedar currently grow unsuitable, so the project may result in a net neutral impact on the species. Future design phases for the project should strive to include Atlantic white cedar in the planting plan.

Eastern Ribbon Snake

The Eastern ribbon snake (*Thamnophis sauritus*) is a slender snake species listed as a species of concern in Rhode Island. The species are semi-aquatic and typically inhabit the edges of lakes, bogs, wetlands, vernal pools, salt marshes, often with abundant vegetation. They feed on small fish and amphibians and often swim in water along the shoreline.

Potential project impacts: The Eastern ribbon snake is anticipated to experience short-term impacts from disruption during construction activities. Although the project will alter the existing habitat at the dam site, effects to the species are anticipated to be neutral. The existing pond and surrounding habitat will be replaced by a natural stream and wetlands, which the eastern ribbon snake can inhabit post dam removal.

Recreation

Dam removal would convert the Capwell Mill Pond from a shallow open waterbody to a flowing riverine system, which would change the nature of recreational opportunities provided by the resource. Under current conditions, Capwell Mill Pond is used primarily for recreational fishing and the surrounding areas are used for passive recreation (e.g., wildlife viewing). The pond is also occasionally used for canoeing and kayaking. These recreational opportunities are currently significantly impaired due to shallow water depths and dense vegetation, making the area difficult to access. Dam removal would improve recreational fishing opportunities as the enhanced connectivity of the stream would improve habitat for coldwater fish populations. However, the dam structure would no longer be present as a shoreline fishing access point. The creation of nearly 20 acres of wildlife habitat would also enhance opportunities for wildlife viewing and bird watching. However, removal of the impoundment would eliminate the opportunity for canoeing and kayaking within pond.

Historical and Cultural Resources

Impacts to the historical and cultural resources from dam removal will be determined after the dam structure undergoes evaluation for listing in the National Register of Historic Places. Consultation letters will be sent to tribal organizations if the project is carried through to the next phase. This evaluation is scheduled to proceed in Spring 2024.

6. HYDROLOGIC AND HYDRAULIC ANALYSIS

6.1 MODELING USES

Hydraulic and Hydrologic modeling involves computer software applications that simulate the flow of rainfall runoff to predict the rise of creek and river water levels and potential flood reduction for pre-and post dam removal conditions. EA has attempted to include as much relevant information as possible, however, while hydrologic and hydraulic modeling is invaluable for assessing flood risks and reduction, designing or removing infrastructure, and managing water resources, its use as a planning tool emphasizes understanding the range of possible outcomes and informing decision-making rather than predicting specific water levels with high precision.

6.2 HYDROLOGIC ANALYSIS

EA used appropriate, commonly accepted methodology to define flow conditions of existing and proposed conditions at Capwell Mill Pond Dam.

6.2.1 FEMA Flood Study

A review of FEMA documents was performed to identify any pertinent flood studies performed for Capwell Mill Pond. No previous flood studies were identified.

6.2.2 Daily Exceedance Flow

The USGS stream gage located at Carr River near Nooseneck, Rhode Island (No. 01115770) is located at the project site just downstream of the Capwell Mill Pond Dam. This gage recorded flow data directly at the project site, so it was used to calculate an annual flood exceedance curve for the site. Operating flows of minimum (95 percent daily exceedance), normal (50 percent daily exceedance), and maximum (5 percent daily exceedance) rates were calculated to represent varying flow events throughout the year, shown in **Table 6-1**. The design species for aquatic passage (trout) require passage through much of the year, so daily maximum flow rate data throughout the calendar year was analyzed to determine design flows. These exceedance values represent the percent likelihood of the flow magnitude exceeding the listed values on a day, based on historical flow data. Operating aquatic passage flows were calculated using methodology described in the Fish Passage Engineering Design Criteria (U.S. Fish and Wildlife [USFWS] NE Region 2019).

Table 6-1. Annual Flow Duration Curve

Flow Event	Flow (cfs) for Percent Time Exceeded
95 percent Exceedance	1
50 percent Exceedance	11
5 percent Exceedance	41

Notes:
cfs = Cubic feet per second

6.2.3 Peak Flow Recurrence Intervals

Flood conditions were estimated using data from a different gage than the one used for exceedance flows. The period of record for stream flow at the Carr River gauge at the project site is too short for annual recurrence analysis, as the Fish Passage Engineering Design Criteria dictate that no less than 10 years be available for flood flow events up to and including the 100-year flood, and the Carr River gauge only includes 6 years of data. The gage at Nooseneck River was determined to be an appropriate comparison to the Carr River gage because the topography, slope, and land cover of the contributing watersheds are similar. An area-ratio based approximation was used to estimate flow intervals for the project site based on methodology in the Fish Passage Engineering Design Criteria (USFWS NE Region 2019). Flow data was available from 2007 to 2023 at the Nooseneck gauge location, providing a large enough sample size that is recent enough to reflect current climatic conditions for the area.

The 50-year and 100-year recurrence flow was calculated to represent flood conditions at the project site. A Log-Pearson Type III distribution curve was used to extrapolate data from the gage and calculate flood flows. This is standard practice for predicting flow recurrence intervals, and the methodology described in USGS guidelines. The existing historical annual maximum flow data was fit to the flow distribution curve, and flow intervals for 50 and 100 years were calculated and are presented in **Table 6-2**.

Table 6-2. Peak Flow Intervals at Project Site

Storm Event	Peak Discharge (cfs)
100-year	689
50-year	533

Notes:
cfs = Cubic feet per second

6.2.4 Recent Storm Events

On average, the Northeast has seen a roughly 60% increase in the number of days with extreme precipitation. Review of the recent gage data at the Nooseneck River gage show recorded flows of 651 cfs on January 13th and 1060 cfs on January 10th. These values are higher than the calculated 50-year and 200-year storm events, respectively. The 50-, 100-, and 200-year peak discharges at the Nooseneck River gage were calculated using the same methodology described in the above section. The values are presented in **Table 6-3**. These values were compared to data from the previous 3 months at the Nooseneck River gage to provide a point of reference for recent storm events that have occurred in the watershed.

Table 6-3. Peak Flow Intervals at Nooseneck River Gage

Storm Event	Peak Discharge (cfs)

200-year	992
100-year	773
50-year	598

Notes:
cfs = Cubic feet per second

As a reference, **Photo 1** identifies several elevations on the dam which are all below the 100-year storm event water surface elevation above the spillway (and most below the 50-year event). With an increase in the frequency of these large storm events, overtopping the structure has become a more regular occurrence.

Photo 1. Peak Flow Water Surface Elevation Comparison

6.3 HYDRAULIC ANALYSIS

EA developed a Hydrologic Engineering Center River Analysis System (HEC-RAS) model of the Carr River at the Capwell Mill Pond Dam to evaluate existing and proposed water levels and velocities in the river over the range of aquatic passage flows and flood event flows. Results of the existing condition HEC-RAS model are presented in **Table 6-3** and **Table 6-4**, and results of the proposed condition HEC-RAS models are presented in **Table 6-5**, **Table 6-6**, and **Table 6-7**. Full HEC-RAS results are included in Appendix C.

6.3.1 Existing Conditions

The existing HEC-RAS model was developed to represent localized flows under existing conditions near the Capwell Mill Pond Dam. The following sections describe the methodology for creating the existing conditions model and the modeling results.

6.3.1.1 Existing Conditions Geometry

The model incorporates cross sectional data obtained from the topographic survey and lidar data supplied by USGS. Cross sections from the survey extend approximately 3,643 ft upstream and 100 ft downstream of the Capwell Mill Pond Dam. The model has 24 cross-sections, 9 of which are downstream of the dam and 15 of which are upstream of the dam.

Manning's n, a roughness coefficient to describe how water will flow over various surfaces, was calculated for three different surface types: main channel, submerged vegetated areas in the pond, and forested overbank. Manning's n was calculated using Cowan's method, which categorizes various surface and river characteristics and calculates a value. In the existing conditions model, a Manning's n of 0.046 was used for the channel, 0.069 was used for the submerged vegetated areas, and 0.101 was used for left and right forested overbanks. Bridge shape and dimensions, and dam spillway dimensions were based on survey data and analyzed in Civil3D CADD software. HEC-RAS output files are included in Appendix C.

6.3.1.2 Existing Conditions Results

Flow was modeled through the existing channel at the three operating flows and at the two flood events calculated. Results of the modeling up and downstream of the Capwell Mill Pond Dam (cross-section 196 and 182, respectively) are displayed in **Table 6-3** and **Table 6-4**. For reference, the elevation of the bottom of the bridge at the top of its arch is 252.3 ft, the elevation of the top of the bridge is 254.8 ft, and the elevation of the spillway crest is 256.6 ft.

Table 6-4. Existing Water Levels and Velocities Immediately Upstream of Dam

Flow Condition	Water Surface Elevation (ft)	Channel Velocity (ft/s)
Minimum Operating Flow	254.91	0.02
Normal Operating Flow	255.15	0.21
Maximum Operating Flow	255.49	0.64
50-Year Storm Event	257.12	4.29
100-Year Storm Event	257.27	5.14

Notes:
ft/s = Foot (feet) per second

Table 6-5. Existing Water Levels and Velocities Immediately Downstream of Dam

Flow Condition	Water Surface Elevation (ft)	Channel Velocity (ft/s)
Minimum Operating Flow	249.57	1.57
Normal Operating Flow	249.85	3.35
Maximum Operating Flow	250.35	5.06
50-Year Storm Event	252.63	9.81

100-Year Storm Event	253.65	8.66

Flow is overtopping the spillway during the 50-year and 100-year storm event. Flow is estimated to overtop the dam when flow exceeds 242 cfs in the basin. In the last 17 years the spillway is estimated to have been overtopped two times. One estimated overtopping occurred on 14 March 2010. The other lasted at least two days, with flows exceeding the estimated overtopping from 30 to 31 March 2010.

6.3.2 Proposed Conditions

Two proposed scenarios were modeled in HEC-RAS for this EDR; see Section 4 for a detailed description of the two scenarios (Option 1, hereafter referred to as full removal and Option 2, hereafter referred to as partial removal). The following sections describe the methodology for creating the proposed conditions model and the modeling results.

6.3.2.1 Proposed Conditions Geometry

EA prepared two surfaces in Civil 3D representing the proposed grading for each scenario. The terrain used in HEC-RAS for each scenario was created by pasting each proposed surface on top of the existing conditions surface in RAS Mapper. The station-elevation data for the cross-sections in each proposed geometry were subsequently updated in RAS Mapper to reflect the new terrains. The channel station-elevation data within the extent of the cut through the Legacy Dam (an approximate 34-foot width centered on the thalweg) and the profile of the river are the same between proposed geometries. The proposed channel thalweg elevation ties into the existing channel thalweg elevation at the upstream and downstream extent of the project site to create a smooth, linear slope through the site. Both proposed condition geometries use the same cross-section layout as the existing condition geometry; no cross-sections were added or deleted.

In both proposed geometries, the Capwell Mill Pond Dam structure and all ineffective areas associated with the structure were removed. In the partial removal geometry, ineffective areas were added upstream and downstream of the Legacy Dam to represent the contraction and expansion effect that the remaining remnants have from being left in the river. The bank stations were also updated to reflect the new proposed terrain.

It is assumed that the water levels in the submerged vegetated area between the channel and forested overbanks will drop, turning this area into a wet meadow. The Manning’s n value for this area was recalculated using Cowan’s method to be 0.076. In the partial removal plan, the notch that is cut into the Legacy Dam is shown in the station-elevation data as smooth, steep vertical walls. In order to accurately model the roughness of the walls, the higher Manning’s n value (0.076) extends slightly beyond the channel banks to include the steep vertical walls created by the notch in the Legacy Dam structure.

6.3.2.2 Proposed Conditions Results

The proposed conditions plans modeled the same flows as the existing condition plan. Water surface elevation (WSE) results for the normal operating flow (50% exceedance event) and the 100-year storm event are shown in **Table 6-5** and **Table 6-6**, respectively. Velocity results for the 100-year storm event are shown in **Table 6-7**. Complete HEC-RAS results for all hydrologic scenarios are in Appendix C.

Table 6-6. Proposed Water Level Comparison for 50% Exceedance Probability Event

Cross-section	Water Surface Elevation (ft)		Difference from Existing (ft)[1]	Water Surface Elevation (ft)	Difference from Existing (ft)[1]	Difference between Partial and Full Removal (ft)[2]
	Existing Conditions	Proposed Conditions – Full Removal		Proposed Conditions – Partial Removal		
3832	255.15	253.94	-1.21	253.94	-1.21	0.00
2880	255.15	253.49	-1.66	253.49	-1.66	0.00
1936	255.15	253.09	-2.06	253.09	-2.06	0.00
1016	255.15	251.46	-3.69	251.47	-3.68	0.01
884	255.15	251.09	-4.06	251.09	-4.06	0.00
323	255.15	249.36	-5.79	249.36	-5.79	0.00
306	255.15	249.27	-5.88	249.28	-5.87	0.01
299	255.15	249.25	-5.90	249.25	-5.90	0.00
280	255.15	249.15	-6.00	249.16	-5.99	0.01
249	255.15	248.98	-6.17	248.99	-6.16	0.01
237	255.15	249.95	-6.20	248.96	-6.19	0.01
223	255.15	248.88	-6.27	248.88	-6.27	0.00
213	255.15	248.82	-6.33	248.82	-6.33	0.00
202	255.15	248.74	-6.41	248.74	-6.41	0.00
196	255.15	248.71	-6.44	248.71	-6.44	0.00
182	249.85	248.61	-1.24	248.61	-1.24	0.00
176	248.58	248.57	-0.01	248.57	-0.01	0.00
171	248.50	248.52	0.02	248.52	0.02	0.00
165	248.48	248.46	-0.02	248.46	-0.02	0.00
150	248.46	248.44	-0.02	248.44	-0.02	0.00
134	248.40	248.37	-0.03	248.37	-0.03	0.00
116	248.21	248.19	-0.02	248.19	-0.02	0.00
109	247.97	247.97	0.00	247.97	-0.00	0.00
89	247.67	247.68	0.01	247.68	0.01	0.00

Notes:

1. A negative value denotes an decrease in WSE from existing conditions.
2. A positive value denotes a higher WSE in the partial removal plan compared to the full removal plan.

Table 6-7. Proposed Water Level Comparison for 100-year Storm Event

Cross-section	Water Surface Elevation (ft)		Difference from Existing (ft)[1]	Water Surface Elevation (ft)	Difference from Existing (ft)[1]	Difference between Partial and Full Removal (ft)[2]
	Existing Conditions	Proposed Conditions – Full Removal		Proposed Conditions – Partial Removal		
3832	257.97	256.78	-1.19	256.80	-1.17	0.02
2880	257.88	256.21	-1.67	256.25	-1.63	0.04
1936	257.80	255.59	-2.21	255.67	-2.13	0.08
1016	257.75	254.47	-3.28	254.79	-2.96	0.32
884	257.74	254.32	-3.42	254.69	-3.05	0.37
323	257.72	254.01	-3.71	254.02	-3.70	0.01
306	257.71	254.00	-3.71	254.00	-3.71	0.00
299	257.71	254.00	-3.71	253.98	-3.73	-0.02
280	257.71	253.99	-3.72	253.97	-3.74	-0.02
249	257.71	253.98	-3.73	253.96	-3.75	-0.02
237	257.70	253.96	-3.74	253.97	-3.73	0.01
223	257.70	253.94	-3.76	253.94	-3.76	0.00
213	257.68	253.83	-3.85	253.93	-3.85	0.00
202	257.58	253.79	-3.79	253.79	-3.79	0.00
196	257.27	253.79	-3.48	253.79	-3.48	0.00
182	253.65	253.79	0.14	253.79	0.14	0.00
176	253.84	253.79	-0.05	253.79	-0.05	0.00
171	253.87	253.79	-0.08	253.79	-0.08	0.00
165	253.92	253.78	-0.14	253.78	-0.14	0.00
150	253.82	253.67	-0.15	253.67	-0.15	0.00
134	252.93	252.71	-0.22	252.71	-0.22	0.00
116	252.01	251.76	-0.25	251.76	-0.25	0.00
109	252.06	251.84	-0.22	251.84	-0.22	0.00
89	251.88	251.78	-0.10	251.78	-0.10	0.00

Notes:

1. A negative value denotes an decrease in WSE from existing conditions.
2. A positive value denotes a higher WSE in the partial removal plan compared to the full removal plan. A negative value denotes a lower WSE in the partial removal plan compared to the full removal plan.

Table 6-8. Proposed Water Velocity in Channel for 100-year Storm Event

Cross-section	Water Velocity in Channel (ft/s)			Difference between Partial and Full Removal (ft/s)[1]
	Existing Conditions	Proposed Conditions – Full Removal	Proposed Conditions – Partial Removal	
3832	1.15	2.12	2.1	-0.02
2880	0.89	1.82	1.79	-0.03
1936	0.86	1.95	1.87	-0.08
1016	0.72	2.65	2.34	-0.31
884	0.64	2.08	1.75	-0.33
323	0.93	1.73	3.54	1.81
306	1.3	1.71	3.24	1.53
299	1.21	1.71	3.33	1.62
280	0.9	1.66	2.81	1.15
249	0.82	1.78	2.37	0.59
237	0.98	1.85	1.85	0
223	1.12	2.11	2.11	0
213	1.71	3.25	3.25	0
202	2.98	3.35	3.35	0
196	5.14	3.19	3.19	0
182	8.66	2.79	2.79	0
176	5.68	2.69	2.69	0
171	4.52	2.61	2.61	0
165	2.59	2.7	2.7	0
150	3.44	3.54	3.54	0
134	7.29	7.58	7.58	0
116	8.01	8.76	8.76	0
109	7.06	7.47	7.47	0
89	7.2	6.71	6.71	0

Notes:

1. A positive value denotes a higher velocity value in the partial removal plan compared to the full removal plan. A negative value denotes a lower velocity value in the partial removal plan compared to the full removal plan.

The results show a reduction in the WSE from existing to proposed conditions (in both the partial and full removal scenarios) except for two cross-sections during the 50% exceedance event and one cross-section during the 100-year event. This is due to the creation of a smooth, linear channel profile in the proposed plans, which also smooths out the WSE profile and causes an increase in WSE around where the WSE drops in existing conditions just downstream of the Capwell Mill Pond Dam.

The results also show that the WSEs in the partial removal plan are slightly higher than the WSEs in the full removal plan, except for three cross-sections during the 100-year event. The WSEs are mostly higher in the partial removal plan due to a smaller available flow area in the channel and overbanks than the full removal plan. The WSEs at cross-sections 299, 280, and 249 are lower in the partial removal plan compared to the full removal plan because the channel contracts through the notch and then expands after the notch, causing the velocity to increase and the WSE to decrease.

Overall, fully removing the Legacy Dam offers minimal additional benefits from partially removing the Legacy Dam. The partial removal scenario will experience higher velocities around the Legacy Dam; therefore, material that is removed from the Legacy Dam to create the notch will be used to stabilize and armor the channel.

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7. RECOMMENDED OPTION

EA recommends that Option 2 – removal of the Capwell Mill Pond Dam and partial removal of the Legacy Dam be pursued for final design based on the information reviewed and the modeling results. EA has prepared 35% design drawings for this option, which are in Appendix B. The following sections present a cost estimate for the recommended option, permitting considerations, and next steps.

This project is forecasted to have impacts to state-listed species of concern and SGCN, and EA recommends that the Dam owner work with RIDEM to determine whether these concerns warrant repairing, maintaining the existing structure, or if removal is an option. However, the costs of repairing and maintaining the existing dam structure to support the existing habitat is estimated to be more than double the cost of removing the structure at this time.

7.1 PROBABLE CONSTRUCTION COST ESTIMATE

EA's opinion of probable construction cost (-30% - +50%) for the Capwell Mill Pond Dam removal is based on the 35% design plans for the Capwell Mill Pond Dam removal and the partial removal of the Legacy Dam. The range of probable costs (-30% - +50%) are based on industry standard methods of estimating from a 35%, or conceptual level design. Quantity takeoffs for the major construction items were developed, and engineer's estimates of the probable construction costs were completed based on reference material, including RS Means Heavy Construction Cost Data, previous similar construction projects, and Rhode Island Department of Transportation Weighted Average Unit Prices. The project is estimated to cost between $381,000 and $816,000. Appendix D presents the probable construction cost estimate.

7.2 ANTICIPATED REGULATORY PERMITS

The removal of the Capwell Mill Pond Dam and partial removal of the Legacy Dam will require review and approval from local, state, and federal regulatory agencies. A summary of the anticipated permits, the issuing authority, and other applicable information regarding project permits is provided below:

- A RIDEM Application for Significant Alternation pursuant to Section 3.12 of the Fresh Water Wetland Regulations will be required to address resource impacts and minimization.
- The RIDEM Water Quality Regulations require that a Water Quality Certificate (WQC) be obtained for site disturbances that have the potential to contribute increased pollutants to Waters of the State and/or that require a U.S. Army Corps of Engineers (USACE) permit. A RIDEM water quality certification application will be submitted concurrently with the RIDEM PDA; the PDA will include all pertinent supporting information for the WQC.
- USACE Rhode Island General Permit No. 10. The project is anticipated to impact Waters of the U.S. and wetlands adjacent to the Capwell Mill Pond Dam, as such, this project will require approval from the USACE through the USACE Rhode Island General Permit. It is

anticipated that the proposed activity will fall under General Permit No. 10 (Aquatic habitat restoration, establishment, and enhancement activities), and require a Pre-Construction Notification, formerly known as the Programmatic General Permit or Category II Permit. This review process involves a simultaneous review by the state and federal regulatory agencies.

7.3 NEXT STEPS

This section lists next steps that will need to be taken following this EDR and 35% design:

- Present the EDR and 35% design drawings to the landowner (RIWRB) and receive approval from them to advance the project further.
- Acquire grant funding for 65% design and permitting.
- Complete a 65% dam removal design of the selected alternative (full removal of the Capwell Mill Pond Dam with partial removal of the Legacy Dam) supported by additional field effort to collect sediment samples, hydrologic and hydraulic modeling, and a 65% Engineering Design Report.
- Complete 100% designs and develop bid documents.
- Remove the Capwell Mill Pond Dam, partially remove the Legacy Dam, and restore the site.

The estimated costs to complete the remaining project phases are:

Project Phase	**Cost**
Complete 65% Designs and Secure Permit Approvals	$ 85,000
Complete 100% Design and Bid Documents	$ 35,000
Construction (i.e. dam removal and site restoration)	$ 381,000 - $816,000*
Design Build Option**	Construction cost + $85,000

* Costs based on 35% designs and can be reassessed and refined post 65% designs and permitting.
** Cost excludes 100% design and bid documents.

7.3.1 Securing Funding

In order to secure the additional finds as outlined above, it is anticipated that RITU and RIWRB will need to use internal and external funding to complete the project. There are several external options currently anticipated to be available over the next few years which will fund inland dam removals of this type. A sample of those grants are provided below:

Southeast New England Program (SNEP)
Watershed Implementation Grant

National Fish and Wildlife Foundation (NFWF)
NFWF America the Beautiful Challenge
NFWF Northeast Forests and Rivers Fund

NFWF National Coastal Resilience Fund

U.S. Fish and Wildlife Service (USFWS)
USFWS National Fish Passage Program
USFWS National Fish Passage Program Bipartisan Infrastructure Law: Restoring River, Floodplain, and Coastal Connectivity and Resiliency.

While grant funding is available, grants can be highly competitive and often have specific and dynamic metrics, goals, and “priority areas” which can fluctuate from year to year and impact a projects competitiveness. Additionally, the process for securing grants can be time consuming and this becomes particularly important when dealing with aging infrastructure like the Capwell Mill Pond Dam.

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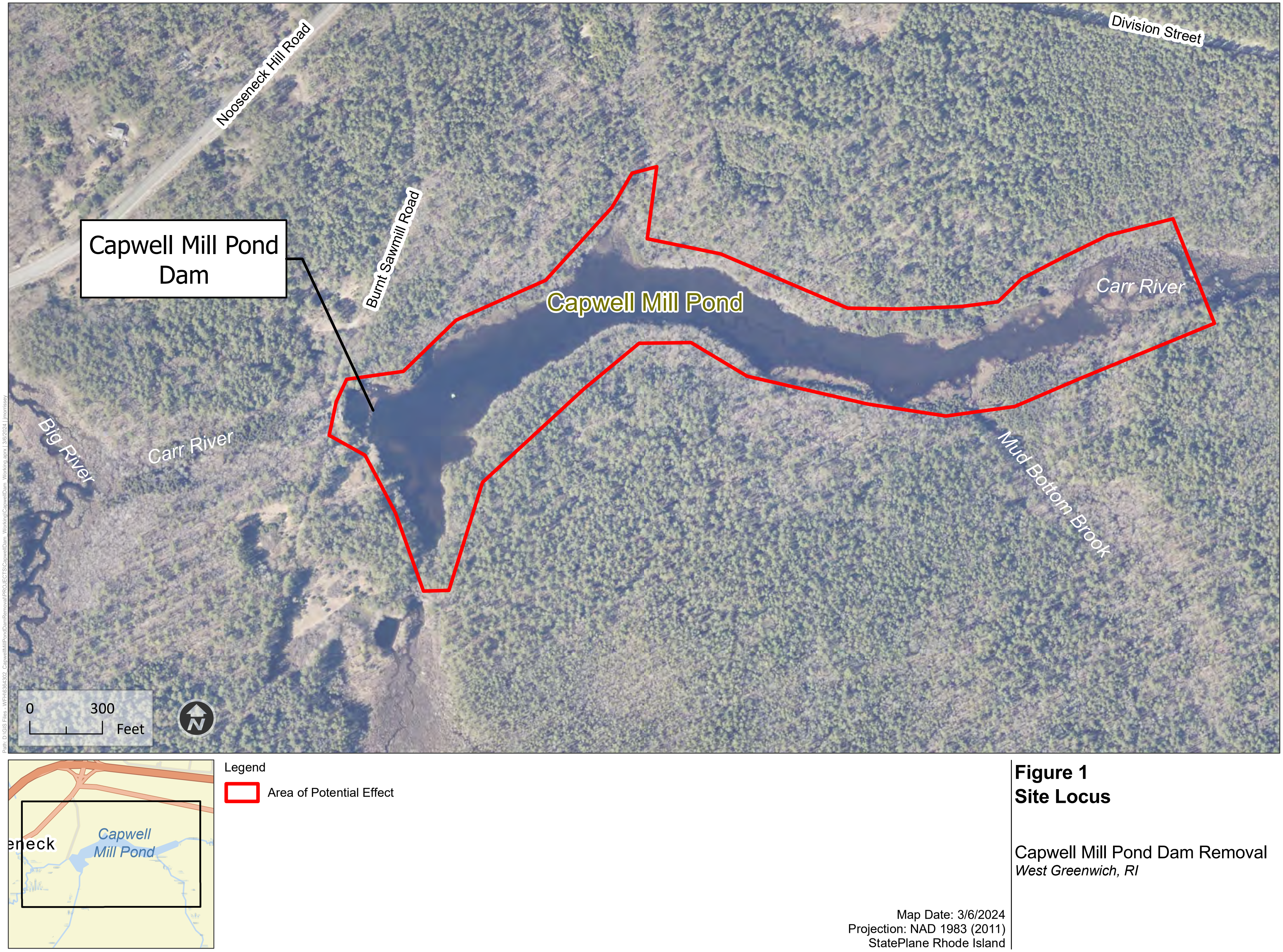
Appendix A.

Figures



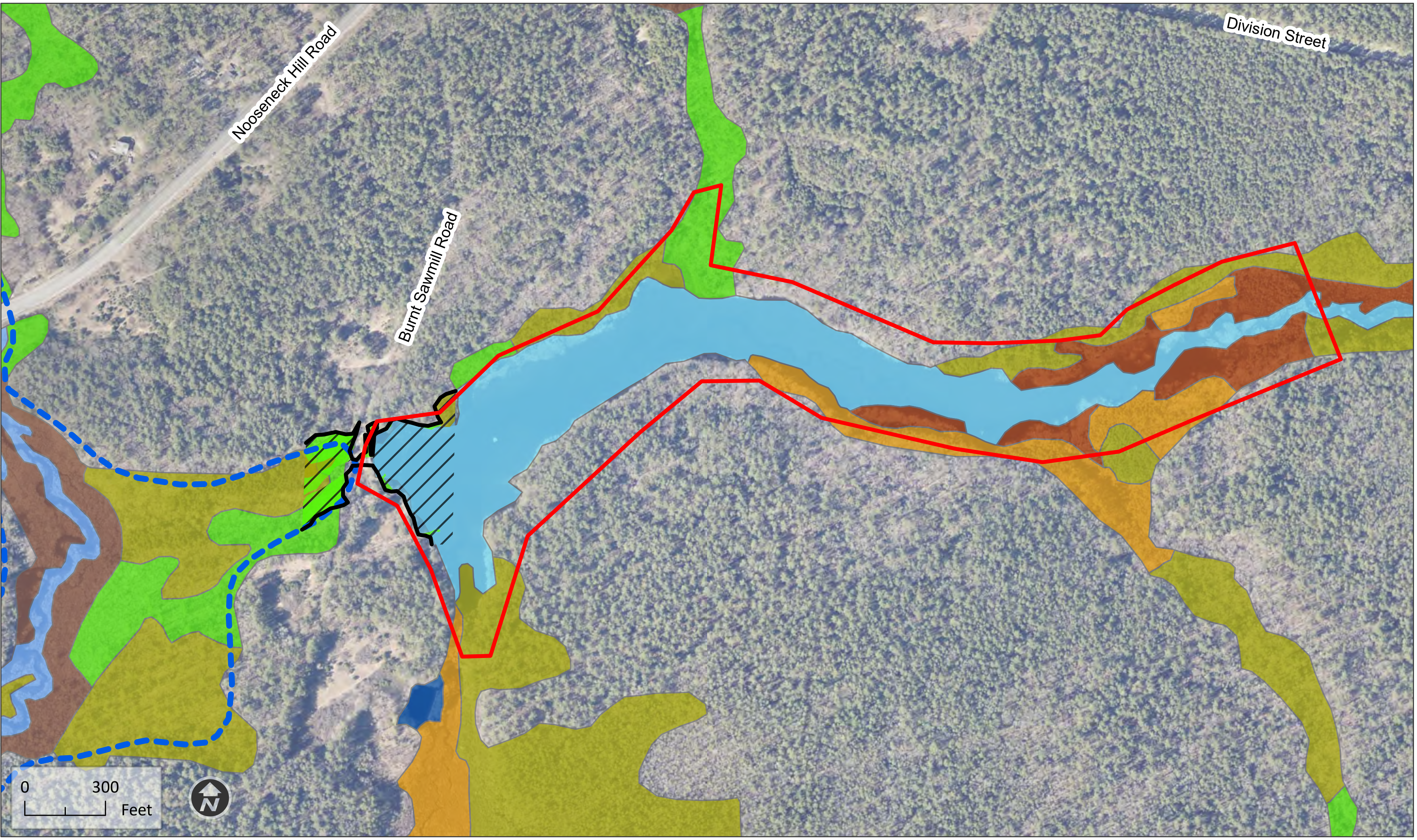
Legend

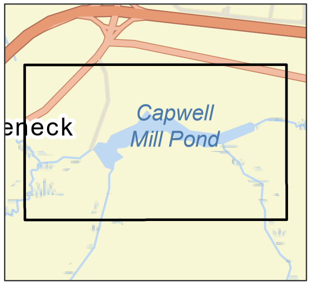
🟥 Area of Potential Effect

Map Date: 3/6/2024
Projection: NAD 1983 (2011)
StatePlane Rhode Island

Figure 1
Site Locus

Capwell Mill Pond Dam Removal
West Greenwich, RI





Legend

- 🟥 Area of Potential Effect
- ⬚ Flood Hazard Area
- — Field Wetland Delineation Line

Field Delineated Wetlands

- ▨ Forested Swamp: Coniferous
- ▨ Lacustrine Open Water
- ▨ Forested Swamp: Deciduous

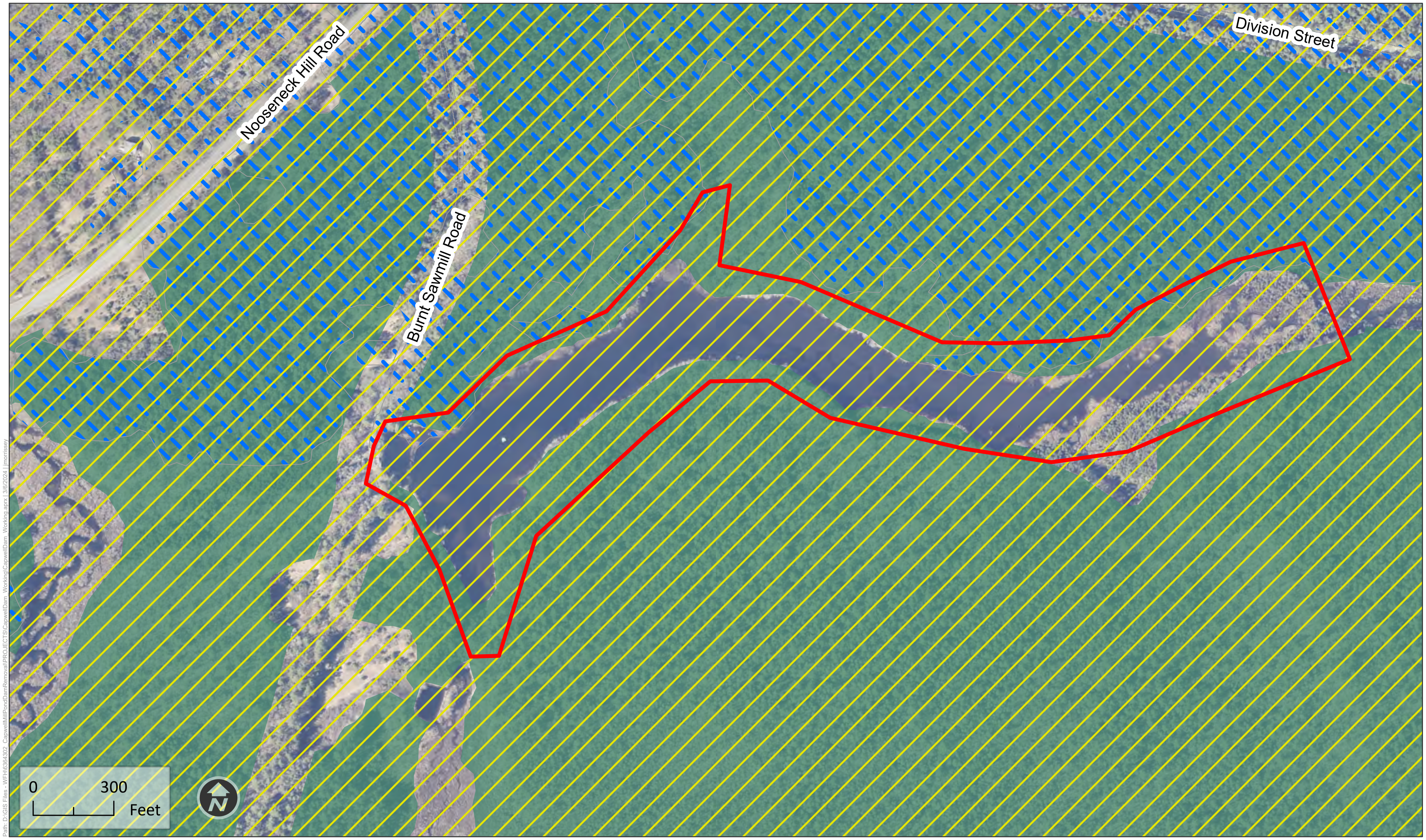
DEM Wetlands

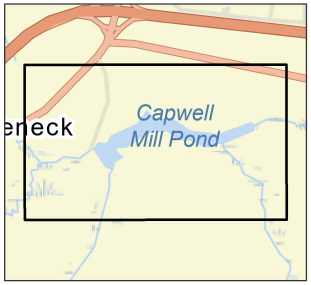
- 🟫 Emergent Wetland: Emergent Fen or
- 🟨 Forested Wetland: Coniferous
- 🟩 Forested Wetland: Deciduous
- 🟦 Lacustrine Open Water
- 🟦 Palustrine Open Water
- 🟦 Riverine Nontidal Open Water
- 🟫 Scrub-Shrub Swamp
- 🟧 Scrub-Shrub Wetland: Shrub Fen or

Map Date: 3/6/2024
Projection: NAD 1983 (2011)
StatePlane Rhode Island
Sources: DEM 1993

Figure 2
Wetlands and Floodplains

Capwell Mill Pond Dam Removal
West Greenwich, RI





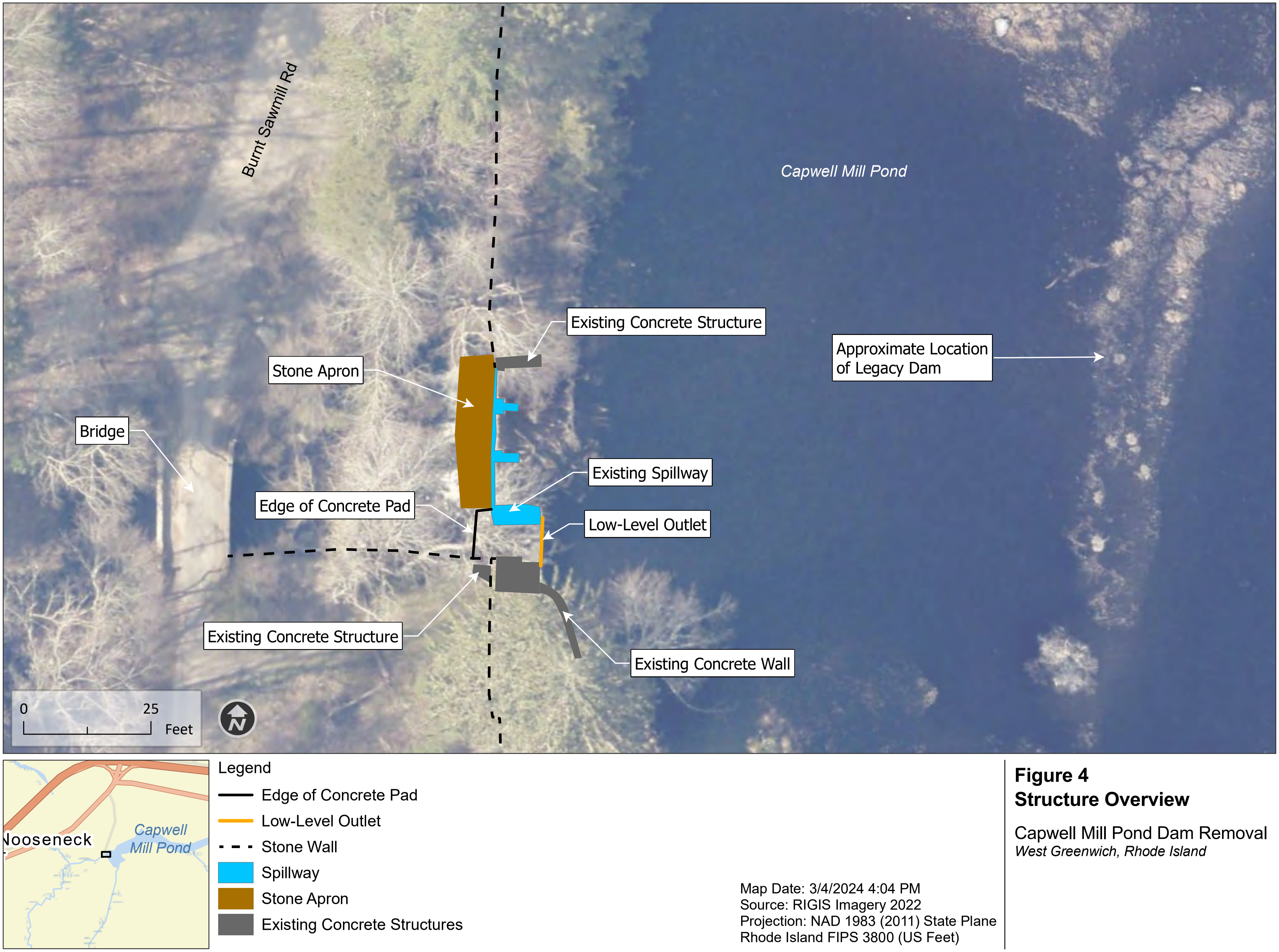
Legend

- 🟥 Area of Potential Effect
- ▨ High Value / High Vulnerability Habitat
- 🟩 Unfragmented Forest Blocks 2020 (500 acres or more)
- ▨ Natural Heritage Areas

Map Date: 3/6/2024
Projection: NAD 1983 (2011)
StatePlane Rhode Island
Sources: RIGIS 2023

Figure 3
Other Regulated Areas

Capwell Mill Pond Dam Removal
West Greenwich, RI



Map Date: 3/4/2024 4:04 PM
Source: RIGIS Imagery 2022
Projection: NAD 1983 (2011) State Plane
Rhode Island FIPS 3800 (US Feet)

Figure 4
Structure Overview

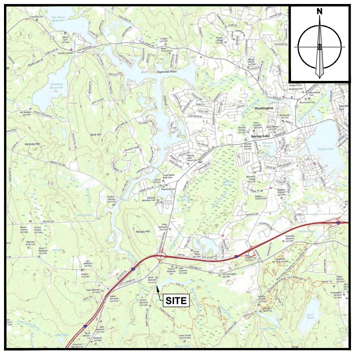
Capwell Mill Pond Dam Removal
West Greenwich, Rhode Island

Appendix B.

Capwell Mill Pond Dam Removal
35% Design Drawings

FILE PATH: \\WARWICKFP\WARWICKFP\CAD\PROJECTS\6364302 - RITU CAPWELL MILL POND DAM\CAD\PRODUCTION\DESIGN SET\6364302-CAPWELLMILLPONDDAM-PLANSET.DWG [G-001] TOWNE, ERIKA 3/6/2024 8:24 AM

CAPWELL MILL POND DAM REMOVAL
35% DESIGN DRAWINGS
WEST GREENWICH, RHODE ISLAND



VICINITY MAP
SCALE: 1" = 1 MILE

SITE LOCATION MAP
SCALE: 1" = 1,000'

SHEET LIST

DRAWING NO.	SHEET NO.	DRAWING TITLE
G-001	1	TITLE SHEET
G-002	2	GENERAL NOTES AND LEGEND
C-101	3	EXISTING CONDITIONS PLAN
C-102	4	PROPOSED CONDITIONS PLAN DAM AREA
C-103	5	PROPOSED CONDITIONS PLAN ACCESS AREA
C-301	6	PROFILE AND CROSS SECTIONS
C-501	7	DETAILS

EA®
EA Engineering, Science, and Technology, Inc., PBC
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Warwick, Rhode Island 02886
(401) 736-3440
www.eaest.com

HORIZONTAL DATUM:
RI83F

VERTICAL DATUM:
NAVD88

SCALE AS SHOWN

FULL SIZE PLOT: 24" x 36"

REVISIONS

SEAL

PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF RHODE ISLAND,
LICENSE NO. XXX
EXPIRATION DATE: XXX

PROJECT NAME
CAPWELL MILL POND
DAM REMOVAL

PROJECT ADDRESS
BURNT SAWMILL ROAD
WEST GREENWICH,
RHODE ISLAND

DRAWING TITLE
TITLE SHEET

DRAWING INFORMATION
DRAWN BY: DPA DESIGNED BY: EJT/NSD
CHECKED BY: LR PROJECT MANAGER: AEH
PROJECT NUMBER: 6364302

DRAWING NO.
G-001
DATE: FEBRUARY 2024 SHEET: 1 OF 7

35% DESIGN DRAWINGS - NOT FOR CONSTRUCTION

PROJECT INFORMATION

SITE LOCATION:
BURNT SAWMILL ROAD
WEST GREENWICH, RHODE ISLAND 02817
TAX ID #007-0002-00

CLIENT:
TROUT UNLIMITED, RHODE ISLAND CHAPTER 225
203 ARCADIA ROAD
HOPE VALLEY, RHODE ISLAND 02832

ENGINEER:
EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC
301 METRO CENTER BOULEVARD, SUITE 102
WARWICK, RHODE ISLAND 02886
401-736-3440

DATUM:

HORIZONTAL:
NORTH AMERICAN DATUM OF 1983 (NAD83) RHODE ISLAND STATE PLANE;
US SURVEY FOOT (RI83F)

VERTICAL:
NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

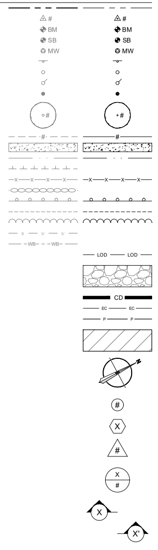
GENERAL NOTES

1. TO BE ADDED

ABBREVIATIONS

AC	ACRES
APPROX	APPROXIMATELY
BW	BOTTOM OF WALL
BGS	BELOW GROUND SURFACE
CL - C/L	CENTER LINE
CY	CUBIC YARDS
CONC	CONCRETE
DA	DRAINAGE AREA
DIA	DIAMETER
EL - ELEV	ELEVATION
EX - EXST	EXISTING
ESC	SOIL EROSION AND SEDIMENT CONTROL
FT	FEET
FEMA	FEDERAL EMERGENCY MANAGEMENT AGENCY
INV	INVERT
MHW	MEAN HIGH WATER
MLW	MEAN LOW WATER
NA	NOT APPLICABLE
NO.	NUMBER
NAD 83	NORTH AMERICAN DATUM OF 1983
NAVD 88	NORTH AMERICAN VERTICAL DATUM OF 1988
OH - OVHD	OVERHEAD
PR - PROP	PROPOSED
SF - SQ FT	SQUARE FEET
TW	TOP OF WALL
TYP	TYPICAL
W/	WITH
WSEL	WATER SURFACE ELEVATION

LEGEND



DESCRIPTION	EXISTING	PROPOSED
PROPERTY BOUNDARY		
SITE CONTROL POINT	#	#
SITE BENCHMARK	BM	BM
SITE SOIL BORING	SB	SB
SITE MONITORING WELL	MW	MW
SITE SIGN		
SITE FENCE POST	○	○
SITE GATE POST		
SITE BOLLARD	●	●
SITE TREE	#	#
SITE CONTOUR	#	#
SITE CONCRETE		
SITE EDGE OF WATER		
SITE FEMA FLOODPLAIN		
SITE FENCE	X X X X	X X X X
SITE STONEWALL		
SITE GUARD RAIL		
SITE GRAVEL		
SITE TREE/BRUSH LINE		
SITE WETLAND		
SITE WETLAND BUFFER	WB WB	
LIMIT OF DISTURBANCE		LOD LOD
CONSTRUCTION ACCESS ROAD		
SANDBAG COFFERDAM		CD
EROSION CONTROLS		EC EC
BYPASS PIPING		P P
DEWATERING BASIN		
PLAN NORTH ARROW		N
PLAN NUMBER CALLOUT		#
PLAN KEYNOTE CALLOUT		X
PLAN REVISION CALLOUT		#
PLAN STRUCTURE NAME/NUMBER		X #
PLAN SECTION CUT VIEW BEGIN		X
PLAN SECTION CUT VIEW END		X'

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www.eaest.com

HORIZONTAL DATUM:
RI83F

VERTICAL DATUM:
NAVD88

SCALE AS SHOWN

FULL SIZE PLOT: 24" x 36"

REVISIONS

SEAL

PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF RHODE ISLAND, LICENSE NO. XXX
EXPIRATION DATE: XXX

PROJECT NAME
CAPWELL MILL POND
DAM REMOVAL

PROJECT ADDRESS
BURNT SAWMILL ROAD
WEST GREENWICH,
RHODE ISLAND

DRAWING TITLE
GENERAL NOTES AND
LEGEND

DRAWING INFORMATION
DRAWN BY: DPA DESIGNED BY: EJT/NSD
CHECKED BY: LR PROJECT MANAGER: AEH
PROJECT NUMBER: 6364302

DRAWING NO.
G-002
DATE: FEBRUARY 2024 SHEET: 2 OF 7

35% DESIGN DRAWINGS - NOT FOR CONSTRUCTION

FILE PATH: \\WARWICKFP\WARWICKFP\CAD\PROJECTS\6364302 - RITU CAPWELL MILL POND DAM\CAD\PRODUCTION\DESIGN SET\6364302-CAPWELLMILLPONDDAM-PLANSET.DWG [G-002] TOWNE, ERIKA 3/6/2024 8:25 AM

FILE PATH: \\WARWICKFP\WARWICKFP\CAD\PROJECTS\6364302 - RITU CAPWELL MILL POND DAM\CAD\PRODUCTION\DESIGN SET\6364302-CAPWELLMILLPONDDAM-PLANSET.DWG [C-101] TOWNE, ERIKA 3/6/2024 8:25 AM

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N

HORIZONTAL DATUM:
RI83F

VERTICAL DATUM:
NAVD88

0 5 10 20
GRAPHIC SCALE IN FEET

FULL SIZE PLOT: 24" x 36"

REVISIONS

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LICENSE NO. XXX
EXPIRATION DATE: XXX

PROJECT NAME
CAPWELL MILL POND
DAM REMOVAL

PROJECT ADDRESS
BURNT SAWMILL ROAD
WEST GREENWICH,
RHODE ISLAND

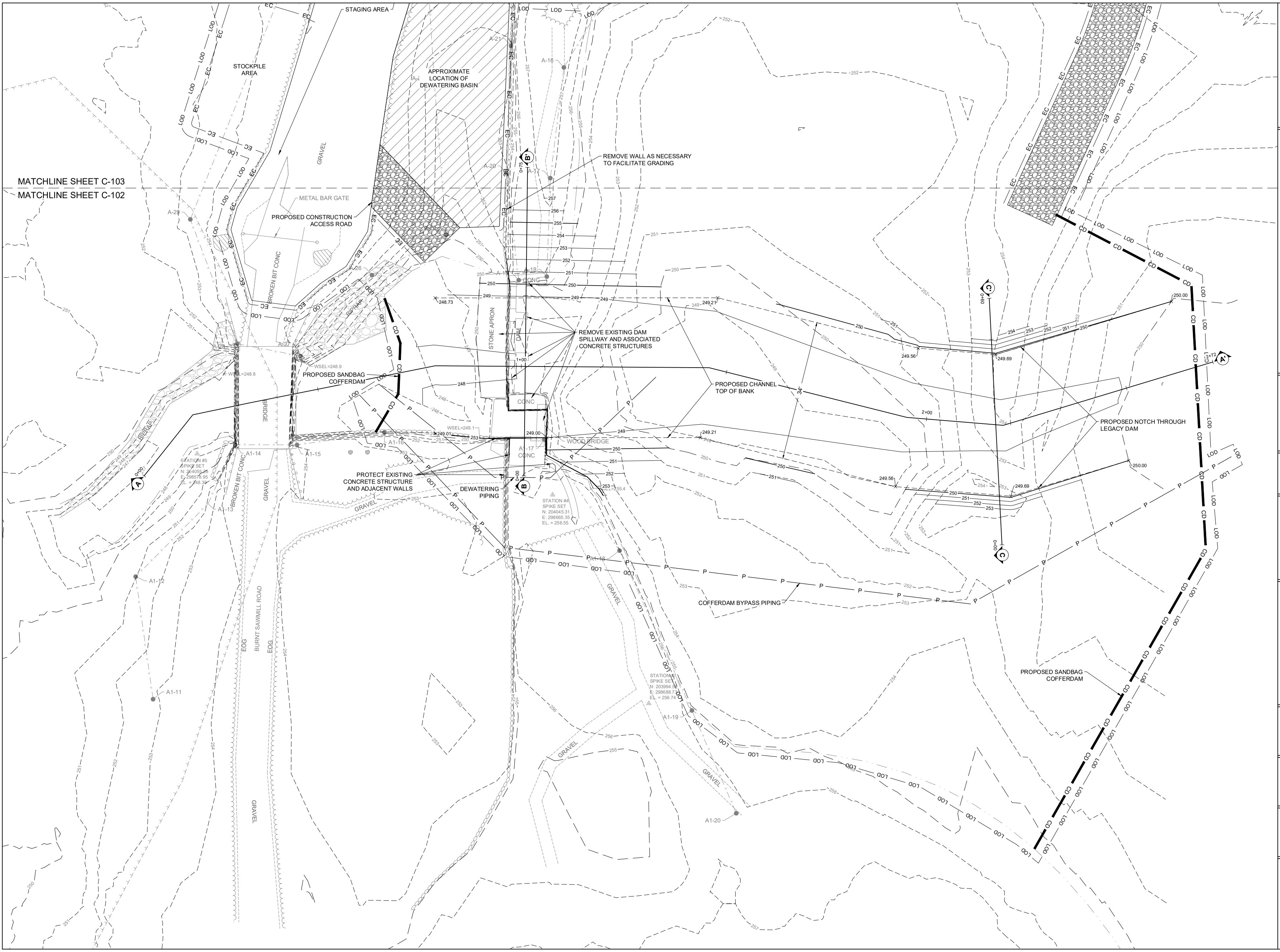
DRAWING TITLE
EXISTING CONDITIONS PLAN

DRAWING INFORMATION
DRAWN BY: DPA DESIGNED BY: EJT/NSD
CHECKED BY: LR PROJECT MANAGER: AEH
PROJECT NUMBER: 6364302

DRAWING NO.
C-101
DATE: FEBRUARY 2024 SHEET: 3 OF 7

35% DESIGN DRAWINGS - NOT FOR CONSTRUCTION

FILE PATH: \\WARWICKFP\WARWICKFP\CAD\PROJECTS\6364302 - RITU CAPWELL MILL POND DAM\CAD\PRODUCTION\DESIGN SET\6364302-CAPWELLMILLPONDDAM-PLANSET.DWG [C-102] TOWNE, ERIKA 3/6/2024 8:25 AM



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HORIZONTAL DATUM:
RI83F

VERTICAL DATUM:
NAVD88

0 5 10 20
GRAPHIC SCALE IN FEET

FULL SIZE PLOT: 24" x 36"

REVISIONS

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LICENSE NO. XXX
EXPIRATION DATE: XXX

PROJECT NAME
CAPWELL MILL POND
DAM REMOVAL

PROJECT ADDRESS
BURNT SAWMILL ROAD
WEST GREENWICH,
RHODE ISLAND

DRAWING TITLE
PROPOSED CONDITIONS PLAN
DAM AREA

DRAWING INFORMATION

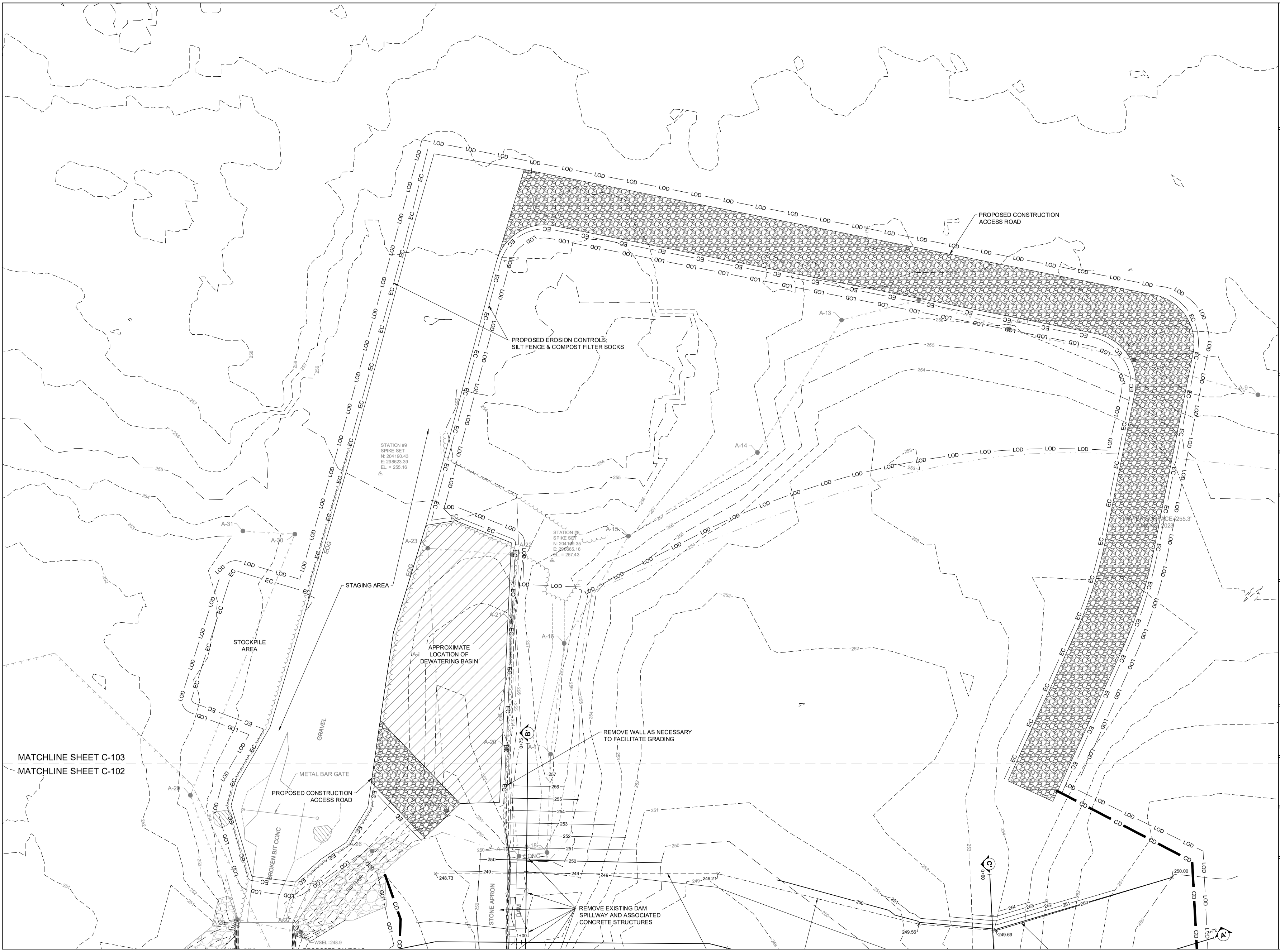
DRAWN BY: DPA	DESIGNED BY: EJT/NSD
CHECKED BY: LR	PROJECT MANAGER: AEH
PROJECT NUMBER: 6364302	

DRAWING NO.
C-102

DATE: FEBRUARY 2024 SHEET: 4 OF 7

35% DESIGN DRAWINGS - NOT FOR CONSTRUCTION

FILE PATH: \\WARWICKFP\WARWICKFP\CAD\PROJECTS\6364302 - RITU CAPWELL MILL POND DAM\CAD\PRODUCTION\DESIGN SET\6364302-CAPWELLMILLPONDDAM-PLANSET.DWG [C-103] TOWNE, ERIKA 3/6/2024 8:25 AM



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N

HORIZONTAL DATUM:
RI83F

VERTICAL DATUM:
NAVD88

0 5 10 20
GRAPHIC SCALE IN FEET

FULL SIZE PLOT: 24" x 36"

REVISIONS

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PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF RHODE ISLAND, LICENSE NO. XXX
EXPIRATION DATE: XXX

PROJECT NAME
CAPWELL MILL POND
DAM REMOVAL

PROJECT ADDRESS
BURNT SAWMILL ROAD
WEST GREENWICH,
RHODE ISLAND

DRAWING TITLE
PROPOSED CONDITIONS PLAN
ACCESS AREA

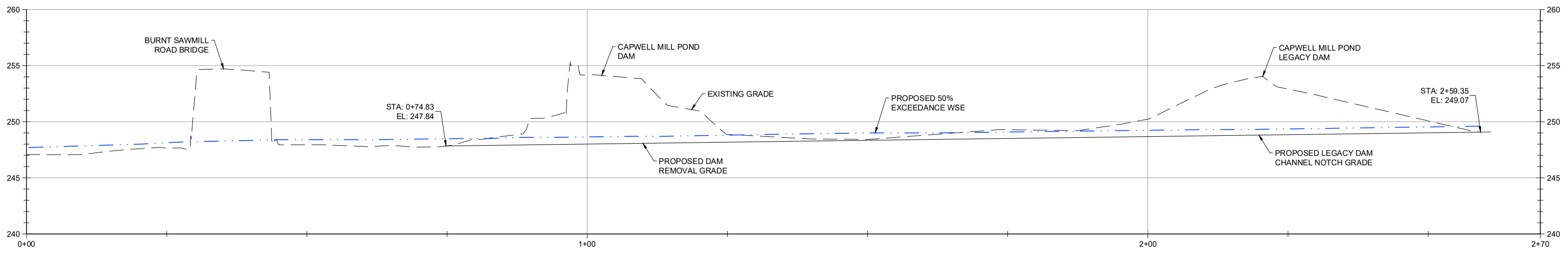
DRAWING INFORMATION

DRAWN BY: DPA DESIGNED BY: EJT/NSD
CHECKED BY: LR PROJECT MANAGER: AEH
PROJECT NUMBER: 6364302

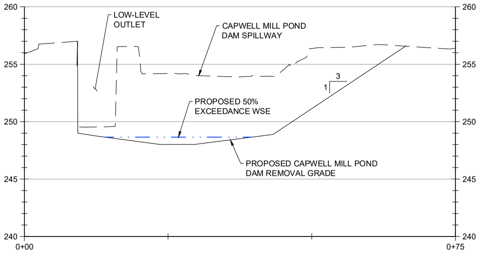
DRAWING NO.
C-103

DATE: FEBRUARY 2024 SHEET: 5 OF 7

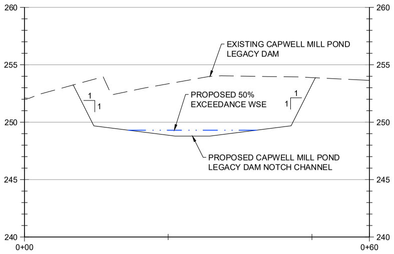
35% DESIGN DRAWINGS - NOT FOR CONSTRUCTION



A (C-102) PROFILE VIEW A-A'
HORIZ. SCALE: 1" = 10'
VERT. SCALE: 1" = 5'



B (C-102) CROSS SECTION VIEW B-B'
HORIZ. SCALE: 1" = 10'
VERT. SCALE: 1" = 5'



C (C-102) CROSS SECTION VIEW C-C'
HORIZ. SCALE: 1" = 10'
VERT. SCALE: 1" = 5'

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HORIZONTAL DATUM:
RI83F

VERTICAL DATUM:
NAVD88

SCALE AS SHOWN

FULL SIZE PLOT: 24" x 36"

REVISIONS

SEAL

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LICENSE NO. XXX
EXPIRATION DATE: XXX

PROJECT NAME
CAPWELL MILL POND
DAM REMOVAL

PROJECT ADDRESS
BURNT SAWMILL ROAD
WEST GREENWICH,
RHODE ISLAND

DRAWING TITLE
PROFILE AND
CROSS SECTIONS

DRAWING INFORMATION
DRAWN BY: DPA
DESIGNED BY: EJT/NSD
CHECKED BY: LR
PROJECT MANAGER: AEH
PROJECT NUMBER: 6364302

DRAWING NO.
C-301

DATE: FEBRUARY 2024
SHEET: 6 OF 7

35% DESIGN DRAWINGS - NOT FOR CONSTRUCTION

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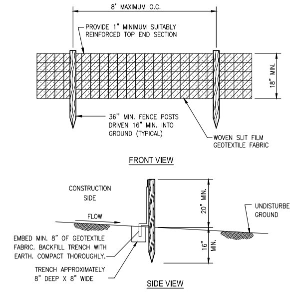
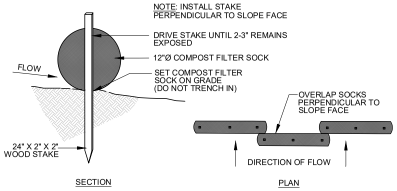


1 SILT FENCE
C-103
SCALE:NOT TO SCALE



2 COMPOST FILTER SOCK
C-103
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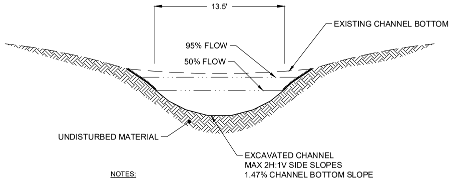


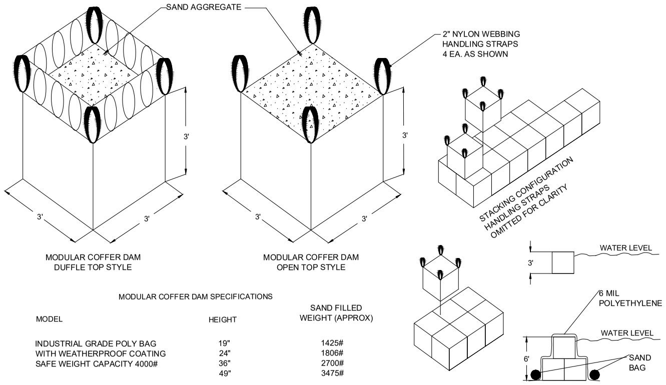
NOTES:

1. SECTION IS DEPICTED FACING DOWNSTREAM.

2. EXCAVATE CHANNEL FROM STATION 8+21 (94 FT UPSTREAM OF THE SPILLWAY) TO STATION 9+29 (11 FT DOWNSTREAM OF THE DAM).

3. CREATE 1.47% CHANNEL BOTTOM SLOPE, 3 FOOT WIDE THALWEG, AND A MAXIMUM OF 2 HORIZONTAL TO 1 VERTICAL SIDE SLOPES. MAINTAIN A CHANNEL TOP WIDTH OF 13.5 FT (APPROXIMATE BANKFUL WIDTH).

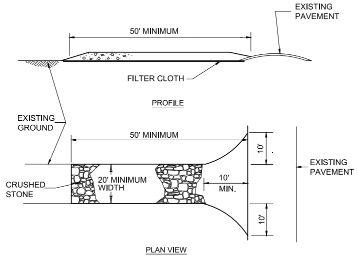
3 SEDIMENT EXCAVATION
C-102
SCALE:NOT TO SCALE



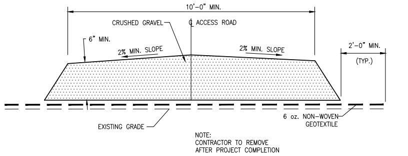
MODULAR COFFER DAM SPECIFICATIONS

MODEL	HEIGHT	SAND FILLED WEIGHT (APPROX)
INDUSTRIAL GRADE POLY BAG	19"	1425#
WITH WEATHERPROOF COATING	24"	1806#
SAFE WEIGHT CAPACITY 4000#	36"	2700#
	49"	3475#

4 SANDBAG COFFERDAM
C-102
SCALE:NOT TO SCALE



5 STABILIZED CONSTRUCTION ENTRANCE
C-103
SCALE:NOT TO SCALE



6 TEMPORARY CONSTRUCTION ACCESS ROAD
C-103
SCALE:NOT TO SCALE

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LICENSE NO. XXX
EXPIRATION DATE: XXX

PROJECT NAME
CAPWELL MILL POND
DAM REMOVAL

PROJECT ADDRESS
BURNT SAWMILL ROAD
WEST GREENWICH,
RHODE ISLAND

DRAWING TITLE
DETAILS

DRAWING INFORMATION
DRAWN BY: DPA DESIGNED BY: EJT/NSD
CHECKED BY: LR PROJECT MANAGER: AEH
PROJECT NUMBER: 6364302

DRAWING NO.
C-501

DATE: FEBRUARY 2024 SHEET: 7 OF 7

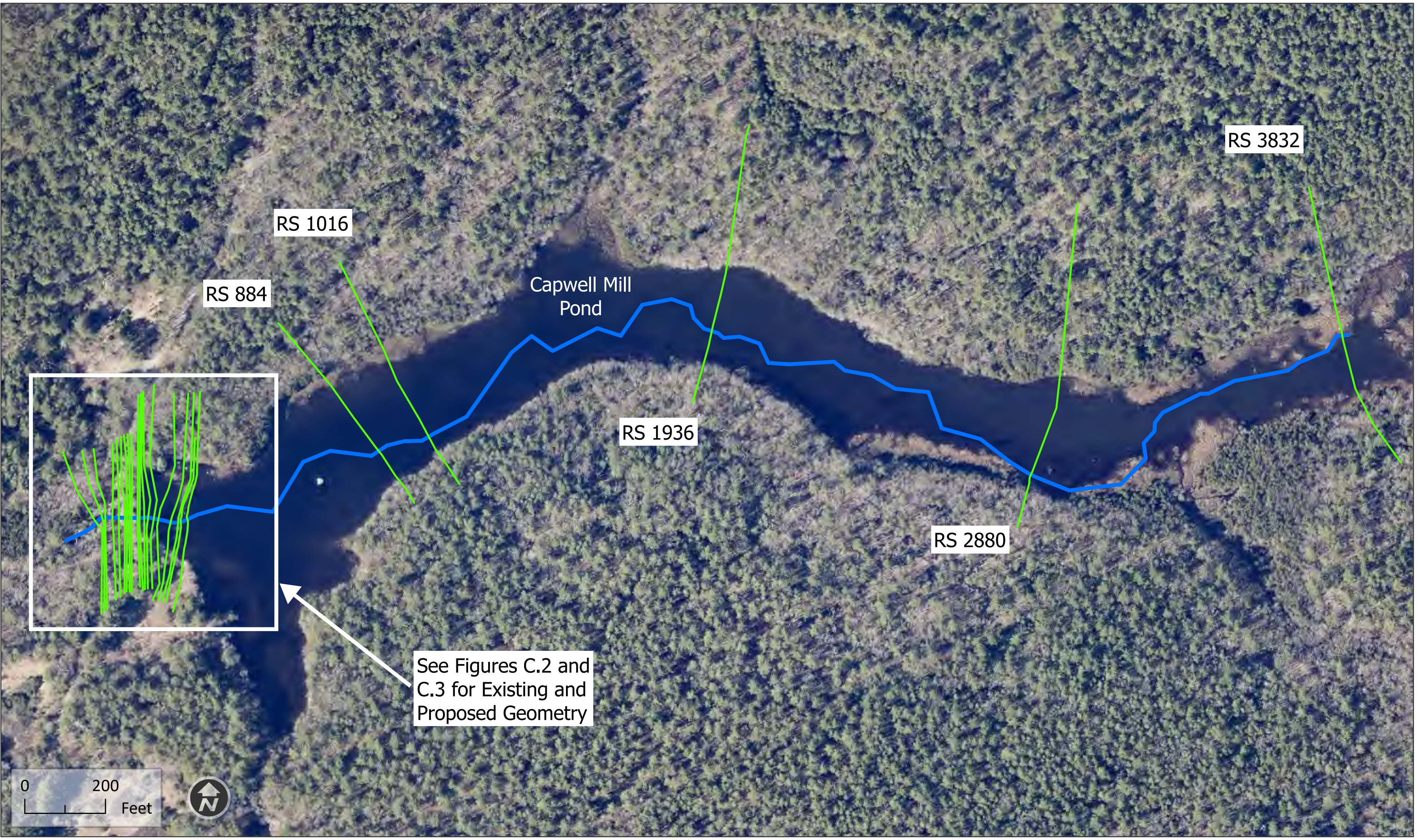
35% DESIGN DRAWINGS - NOT FOR CONSTRUCTION

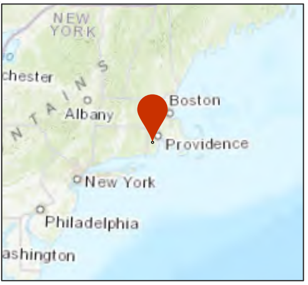
Appendix C.

HEC-RAS Output Files
Existing and Proposed Conditions

Appendix C.1

Model Geometry Overview





- River Centerline
- Cross-Section Location

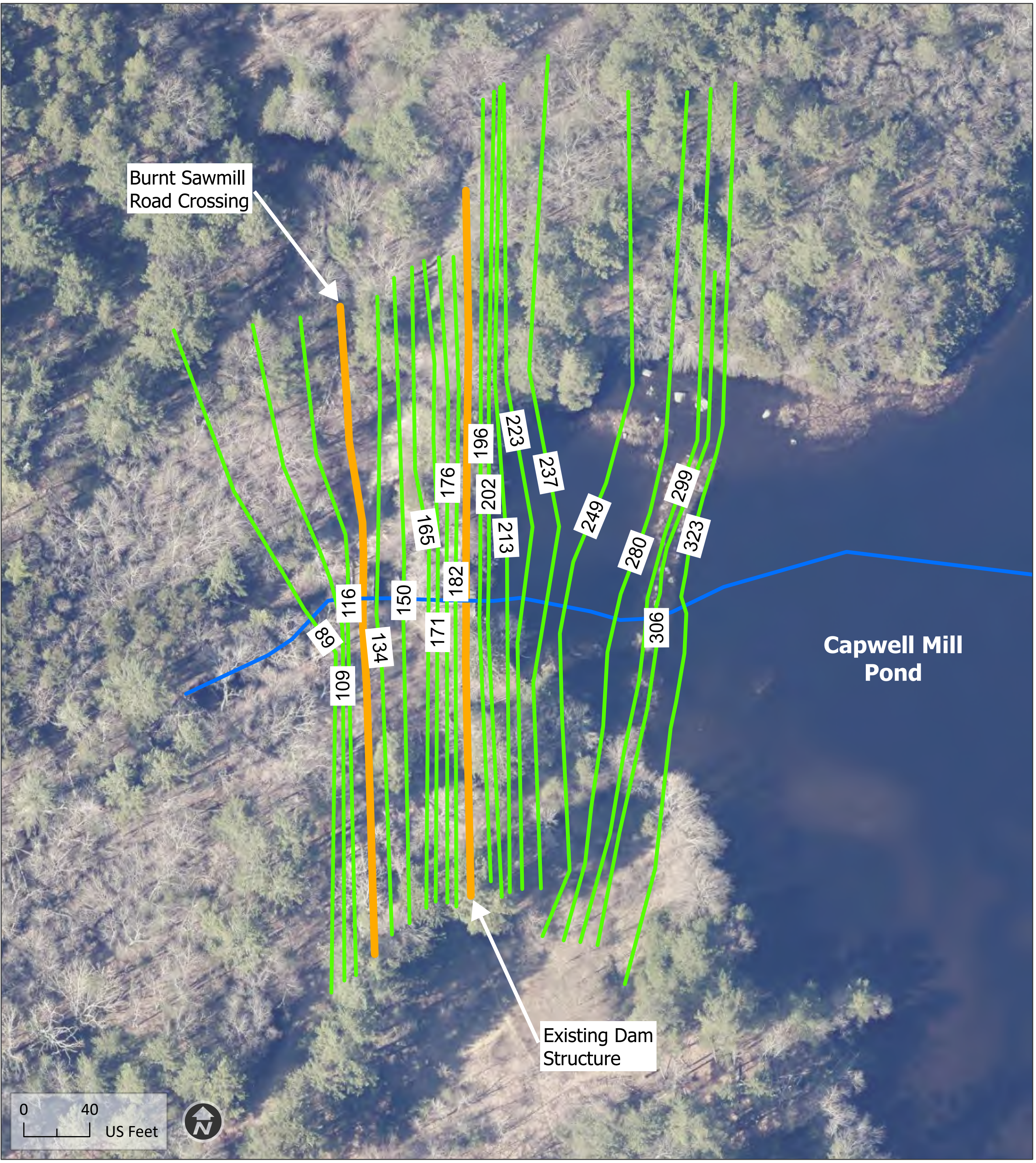
Appendix C.1
Model Geometry Overview

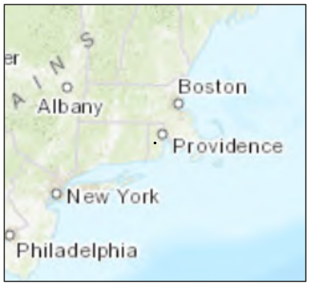
Project Name
Project Location

Map Date: 3/8/2024
Projection: NAD 1983 (2011)
StatePlane Rhode Island

Appendix C.2

Existing Model Geometry at Dam Site





🟩 Cross-Section Location
🟦 River Centerline
🟧 Existing Structure

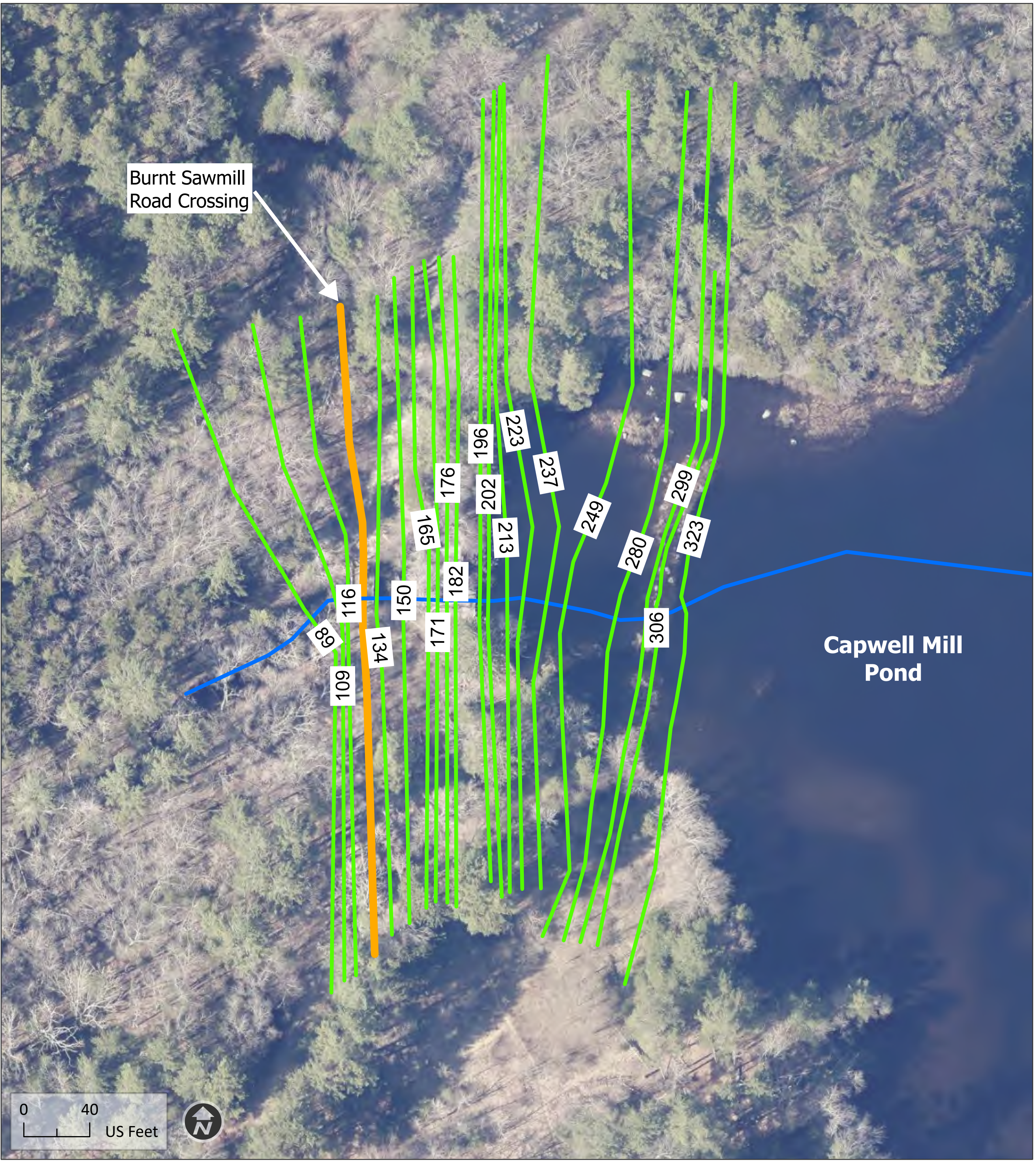
Appendix C.2 Existing Model Geometry

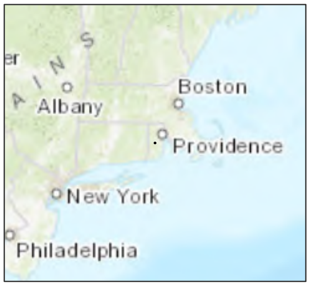
Capwell Mill Pond Dam Removal
West Greenwich, RI

Path: \\warwickfp\Warwickfp\GIS_Warwick\StateandLocal\Northeast\RhodeIsland\6364302_CapwellMillPondDamRemoval\PROJECTS\Capwell_HECRAS_Figures\Capwell_HECRAS_Figures.aprx | 3/8/2024 | etowne

Appendix C.3

Proposed Model Geometry at Dam Site





- Cross-Section Location
- River Centerline
- Existing Structure

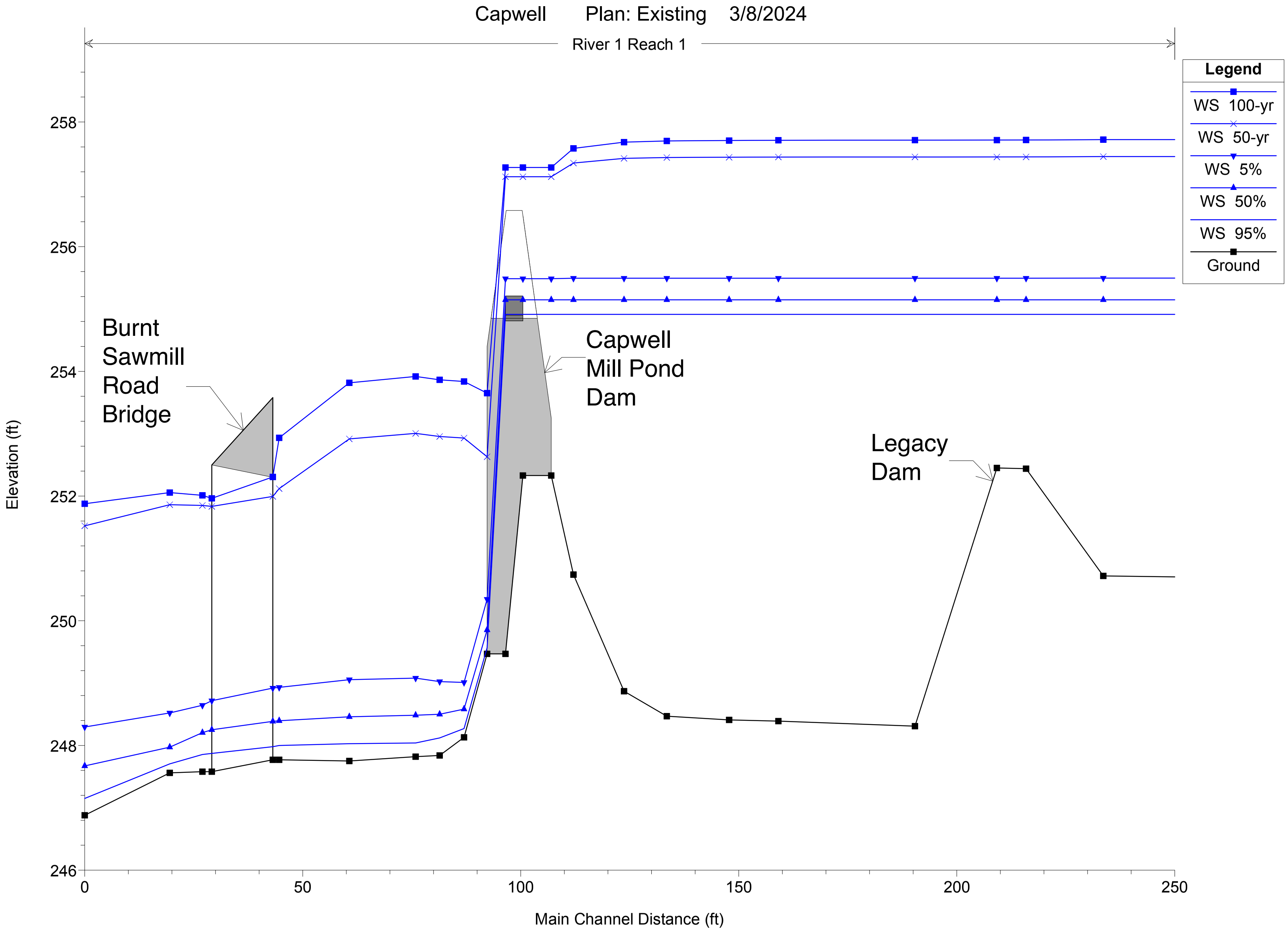
Appendix C.3
Proposed Model
Geometry

Capwell Mill Pond
Dam Removal
West Greenwich, RI

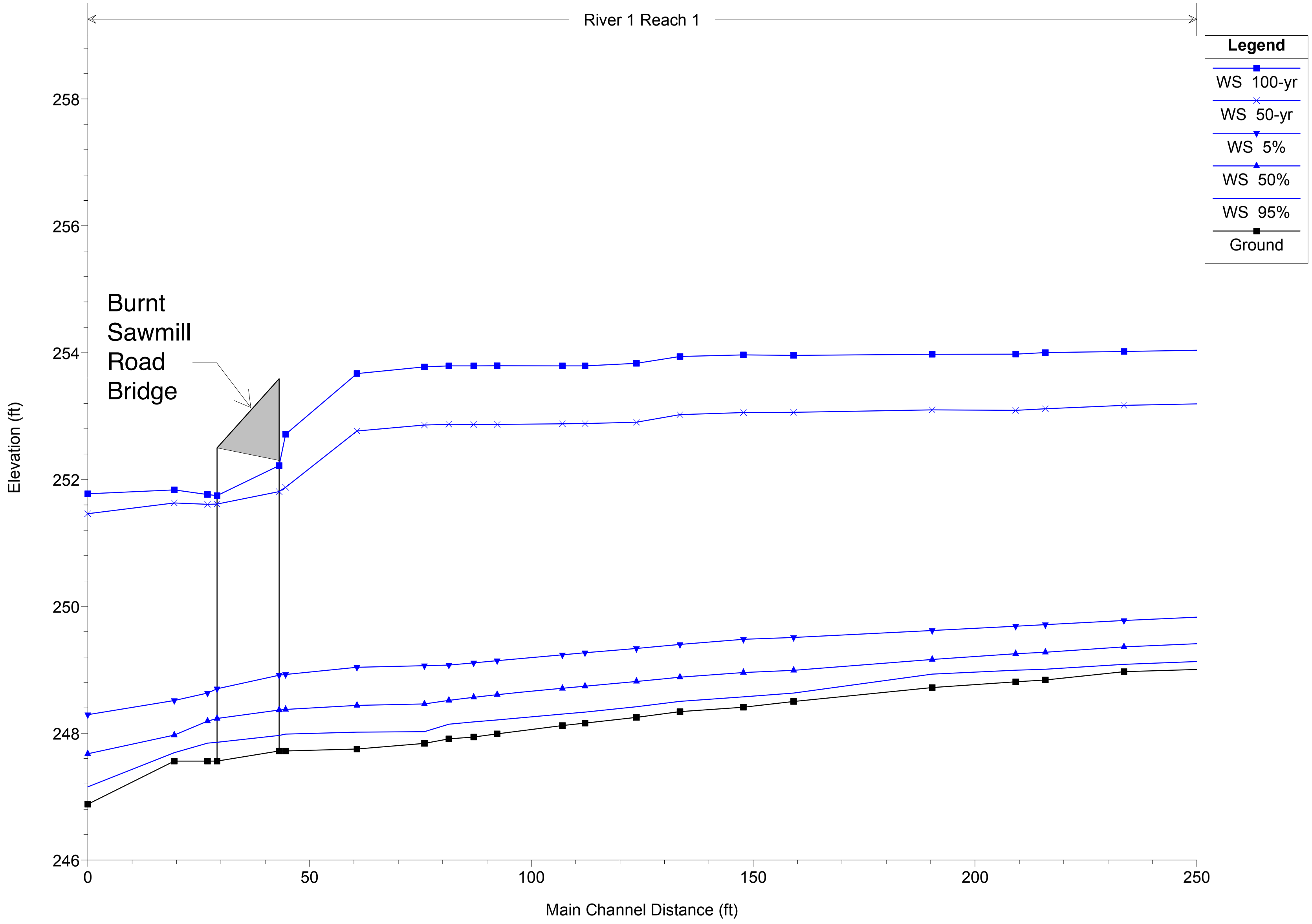
Path: \\warwickfp\Warwickfp\GIS_Warwick\StateandLocal\Northeast\RhodeIsland\6364302_CapwellMillPondDamRemoval\PROJECTS\Capwell_HECRAS_Figures\Capwell_HECRAS_Figures.aprx | 3/8/2024 | etowne

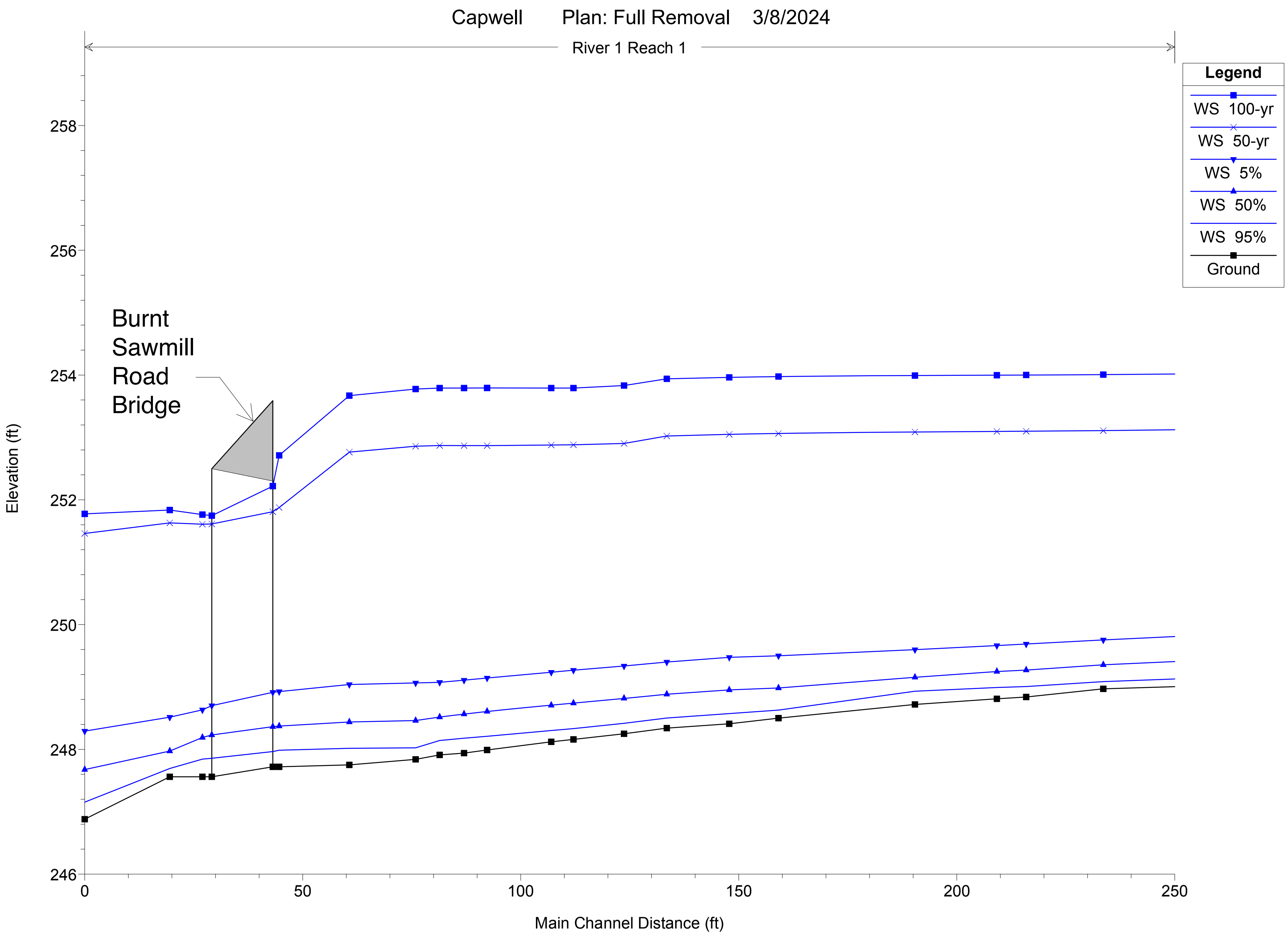
Appendix C.4

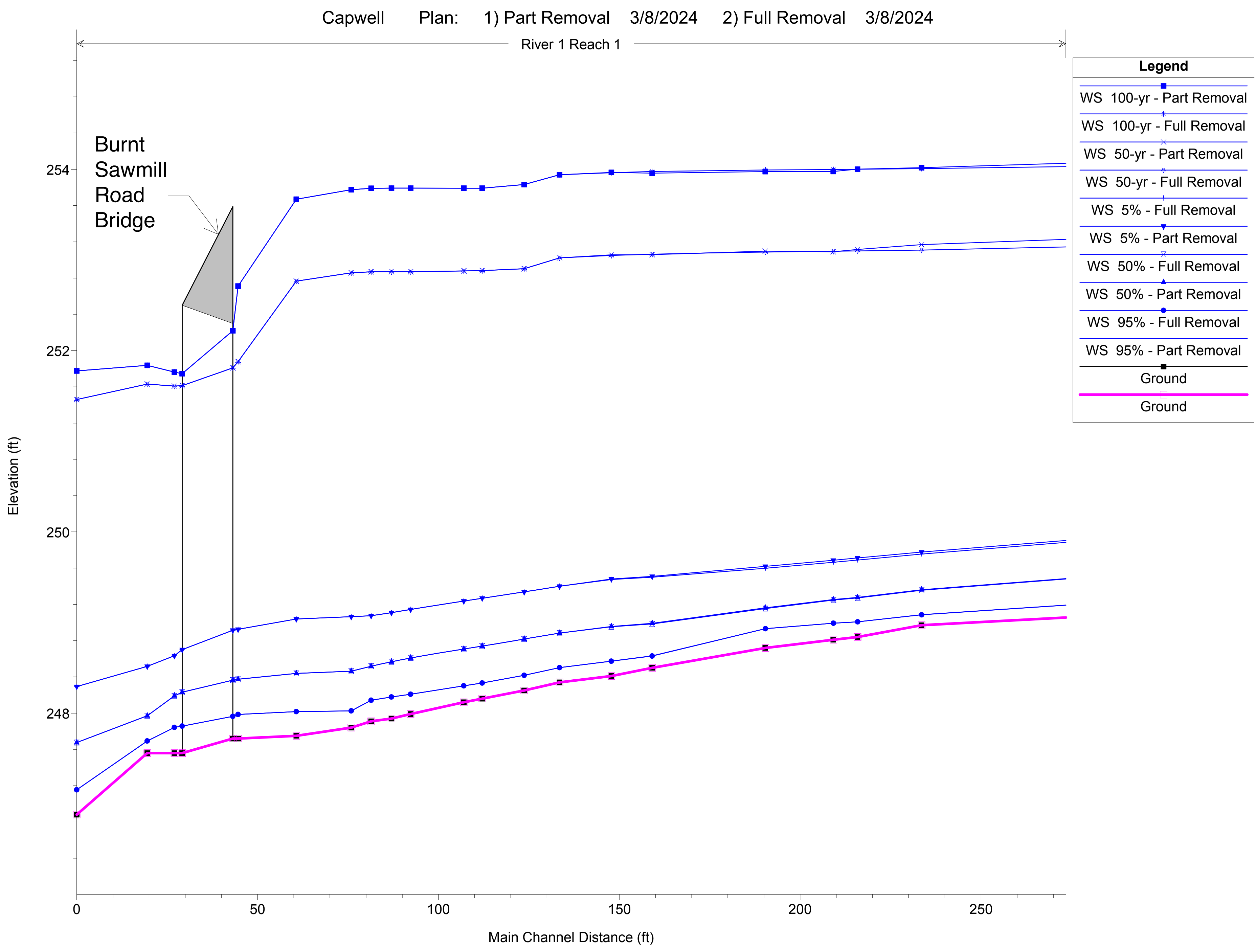
Water Surface Elevation Profiles


Capwell Plan: Existing 3/8/2024
River 1 Reach 1
Legend
WS 100-yr
WS 50-yr
WS 5%
WS 50%
WS 95%
Ground
Burnt Sawmill Road Bridge
Capwell Mill Pond Dam
Legacy Dam
Elevation (ft)
258
256
254
252
250
248
246
Main Channel Distance (ft)
0
50
100
150
200
250

Capwell Plan: Part Removal 3/8/2024




Capwell Plan: Full Removal 3/8/2024
River 1 Reach 1
Legend
WS 100-yr
WS 50-yr
WS 5%
WS 50%
WS 95%
Ground
Burnt Sawmill Road Bridge
Elevation (ft)
258
256
254
252
250
248
246
0
50
100
150
200
250
Main Channel Distance (ft)


Capwell Plan: 1) Part Removal 3/8/2024 2) Full Removal 3/8/2024
River 1 Reach 1
Burnt
Sawmill
Road
Bridge
Elevation (ft)
254
252
250
248
Main Channel Distance (ft)
0
50
100
150
200
250
Legend
WS 100-yr - Part Removal
WS 100-yr - Full Removal
WS 50-yr - Part Removal
WS 50-yr - Full Removal
WS 5% - Full Removal
WS 5% - Part Removal
WS 50% - Full Removal
WS 50% - Part Removal
WS 95% - Full Removal
WS 95% - Part Removal
Ground
Ground

Appendix C.5

HEC-RAS Results Tables

HEC-RAS Plan: EX   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	3832	95%	1.00	252.03	254.91	252.31	254.91	0.000000	0.02	119.47	178.70	0.00
Reach 1	3832	50%	11.00	252.03	255.15	252.74	255.15	0.000008	0.12	165.06	212.01	0.02
Reach 1	3832	5%	41.00	252.03	255.51	253.33	255.51	0.000037	0.30	246.09	241.25	0.04
Reach 1	3832	50-yr	533.00	252.03	257.64	255.08	257.65	0.000158	1.01	1035.00	457.03	0.09
Reach 1	3832	100-yr	689.00	252.03	257.97	255.24	257.97	0.000184	1.15	1188.55	479.70	0.10
Reach 1	2880	95%	1.00	251.12	254.91		254.91	0.000000	0.01	349.88	285.58	0.00
Reach 1	2880	50%	11.00	251.12	255.15		255.15	0.000001	0.05	418.42	299.06	0.01
Reach 1	2880	5%	41.00	251.12	255.50		255.50	0.000005	0.15	527.11	318.05	0.02
Reach 1	2880	50-yr	533.00	251.12	257.56		257.57	0.000066	0.76	1303.94	436.60	0.06
Reach 1	2880	100-yr	689.00	251.12	257.88		257.88	0.000084	0.89	1442.72	455.35	0.07
Reach 1	1936	95%	1.00	252.19	254.91		254.91	0.000000	0.00	417.32	261.01	0.00
Reach 1	1936	50%	11.00	252.19	255.15		255.15	0.000000	0.04	478.82	264.50	0.00
Reach 1	1936	5%	41.00	252.19	255.50		255.50	0.000003	0.11	572.21	269.96	0.01
Reach 1	1936	50-yr	533.00	252.19	257.51		257.51	0.000060	0.72	1203.37	356.90	0.06
Reach 1	1936	100-yr	689.00	252.19	257.80		257.81	0.000080	0.86	1310.10	368.45	0.07
Reach 1	1016	95%	1.00	250.89	254.91		254.91	0.000000	0.00	616.62	313.30	0.00
Reach 1	1016	50%	11.00	250.89	255.15		255.15	0.000000	0.03	690.92	322.71	0.00
Reach 1	1016	5%	41.00	250.89	255.50		255.50	0.000001	0.09	807.65	349.73	0.01
Reach 1	1016	50-yr	533.00	250.89	257.47		257.47	0.000032	0.60	1612.78	458.80	0.04
Reach 1	1016	100-yr	689.00	250.89	257.75		257.75	0.000043	0.72	1743.69	474.19	0.05
Reach 1	884	95%	1.00	250.19	254.91		254.91	0.000000	0.00	753.47	318.47	0.00
Reach 1	884	50%	11.00	250.19	255.15		255.15	0.000000	0.02	828.76	325.26	0.00
Reach 1	884	5%	41.00	250.19	255.50		255.50	0.000001	0.07	943.82	338.25	0.01
Reach 1	884	50-yr	533.00	250.19	257.46		257.47	0.000022	0.53	1724.79	440.82	0.04
Reach 1	884	100-yr	689.00	250.19	257.74		257.75	0.000030	0.64	1849.42	452.17	0.04
Reach 1	323	95%	1.00	250.72	254.91		254.91	0.000000	0.00	483.00	252.58	0.00
Reach 1	323	50%	11.00	250.72	255.15		255.15	0.000000	0.04	542.71	258.37	0.00
Reach 1	323	5%	41.00	250.72	255.50		255.50	0.000002	0.12	633.96	267.17	0.01
Reach 1	323	50-yr	533.00	250.72	257.44		257.45	0.000051	0.78	1257.72	404.44	0.06
Reach 1	323	100-yr	689.00	250.72	257.72		257.72	0.000070	0.93	1370.58	425.41	0.06
Reach 1	306	95%	1.00	252.44	254.91		254.91	0.000000	0.01	158.63	243.27	0.00
Reach 1	306	50%	11.00	252.44	255.15		255.15	0.000004	0.09	216.67	251.46	0.01
Reach 1	306	5%	41.00	252.44	255.49		255.50	0.000020	0.25	304.48	254.85	0.03
Reach 1	306	50-yr	533.00	252.44	257.44		257.45	0.000179	1.11	891.90	385.25	0.09
Reach 1	306	100-yr	689.00	252.44	257.71		257.72	0.000224	1.30	999.21	407.63	0.11
Reach 1	299	95%	1.00	252.45	254.91		254.91	0.000000	0.01	197.38	245.77	0.00
Reach 1	299	50%	11.00	252.45	255.15		255.15	0.000002	0.08	255.13	248.36	0.01
Reach 1	299	5%	41.00	252.45	255.49		255.50	0.000014	0.21	341.93	252.35	0.02
Reach 1	299	50-yr	533.00	252.45	257.44		257.45	0.000149	1.03	906.38	376.71	0.09
Reach 1	299	100-yr	689.00	252.45	257.71		257.72	0.000190	1.21	1011.12	399.02	0.10
Reach 1	280	95%	1.00	248.31	254.91		254.91	0.000000	0.00	569.27	243.78	0.00
Reach 1	280	50%	11.00	248.31	255.15		255.15	0.000000	0.03	624.75	246.77	0.00
Reach 1	280	5%	41.00	248.31	255.50		255.50	0.000001	0.10	707.12	250.85	0.01
Reach 1	280	50-yr	533.00	248.31	257.44		257.44	0.000035	0.75	1253.50	371.58	0.05
Reach 1	280	100-yr	689.00	248.31	257.71		257.72	0.000050	0.90	1357.12	394.59	0.06
Reach 1	249	95%	1.00	248.39	254.91		254.91	0.000000	0.00	654.21	243.80	0.00
Reach 1	249	50%	11.00	248.39	255.15		255.15	0.000000	0.02	698.50	245.63	0.00
Reach 1	249	5%	41.00	248.39	255.50		255.50	0.000001	0.08	764.24	248.20	0.01
Reach 1	249	50-yr	533.00	248.39	257.44		257.44	0.000029	0.68	1253.62	368.26	0.04
Reach 1	249	100-yr	689.00	248.39	257.71		257.72	0.000041	0.82	1356.44	393.32	0.05
Reach 1	237	95%	1.00	248.41	254.91		254.91	0.000000	0.00	523.92	186.98	0.00
Reach 1	237	50%	11.00	248.41	255.15		255.15	0.000000	0.02	552.22	188.35	0.00
Reach 1	237	5%	41.00	248.41	255.50		255.50	0.000001	0.08	594.23	203.63	0.01
Reach 1	237	50-yr	533.00	248.41	257.43		257.44	0.000039	0.80	961.08	353.53	0.05
Reach 1	237	100-yr	689.00	248.41	257.70		257.71	0.000056	0.98	1057.24	366.56	0.06
Reach 1	223	95%	1.00	248.47	254.91		254.91	0.000000	0.00	437.45	181.14	0.00
Reach 1	223	50%	11.00	248.47	255.15		255.15	0.000000	0.03	459.95	189.46	0.00
Reach 1	223	5%	41.00	248.47	255.49		255.50	0.000001	0.10	493.35	223.44	0.01
Reach 1	223	50-yr	533.00	248.47	257.43		257.44	0.000052	0.92	856.91	356.72	0.06
Reach 1	223	100-yr	689.00	248.47	257.70		257.71	0.000073	1.12	953.10	367.01	0.07
Reach 1	213	95%	1.00	248.87	254.91		254.91	0.000000	0.00	285.58	192.25	0.00
Reach 1	213	50%	11.00	248.87	255.15		255.15	0.000000	0.05	303.36	202.54	0.00
Reach 1	213	5%	41.00	248.87	255.49		255.50	0.000002	0.16	329.74	217.63	0.01
Reach 1	213	50-yr	533.00	248.87	257.42		257.44	0.000129	1.40	604.92	356.79	0.09
Reach 1	213	100-yr	689.00	248.87	257.68		257.71	0.000184	1.71	697.20	368.34	0.11
Reach 1	202	95%	1.00	250.74	254.91		254.91	0.000000	0.01	116.51	122.27	0.00
Reach 1	202	50%	11.00	250.74	255.15		255.15	0.000002	0.10	129.28	145.14	0.01
Reach 1	202	5%	41.00	250.74	255.49		255.49	0.000019	0.32	148.21	178.33	0.03
Reach 1	202	50-yr	533.00	250.74	257.34		257.43	0.000668	2.51	345.84	353.36	0.19
Reach 1	202	100-yr	689.00	250.74	257.58		257.70	0.000893	2.98	406.56	367.11	0.22

HEC-RAS Plan: EX   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	196	95%	1.00	252.33	254.91	252.59	254.91	0.000000	0.02	51.57	93.35	0.00
Reach 1	196	50%	11.00	252.33	255.15	253.04	255.15	0.000020	0.21	60.92	108.36	0.03
Reach 1	196	5%	41.00	252.33	255.49	253.50	255.49	0.000149	0.64	75.08	131.29	0.08
Reach 1	196	50-yr	533.00	252.33	257.12	255.55	257.37	0.003530	4.29	207.08	317.60	0.41
Reach 1	196	100-yr	689.00	252.33	257.27	255.90	257.62	0.004780	5.14	240.46	330.03	0.48
Reach 1	189 Dam		Inl Struct									
Reach 1	182	95%	1.00	249.47	249.57	249.57	249.61	0.082545	1.57	0.64	9.10	1.05
Reach 1	182	50%	11.00	249.47	249.85	249.85	250.03	0.046597	3.35	3.28	9.45	1.00
Reach 1	182	5%	41.00	249.47	250.35	250.35	250.74	0.037082	5.06	8.10	10.06	0.99
Reach 1	182	50-yr	533.00	249.47	252.63	252.58	253.59	0.024480	9.81	92.41	63.27	0.99
Reach 1	182	100-yr	689.00	249.47	253.65	252.97	254.36	0.012995	8.66	135.27	181.04	0.76
Reach 1	176	95%	1.00	248.13	248.27	248.36	248.63	0.633935	4.79	0.21	2.58	2.97
Reach 1	176	50%	11.00	248.13	248.58	248.82	249.44	0.303024	7.43	1.48	5.36	2.49
Reach 1	176	5%	41.00	248.13	249.01	249.40	250.27	0.205761	9.02	4.77	15.91	2.25
Reach 1	176	50-yr	533.00	248.13	252.93	251.17	253.18	0.004302	5.52	178.02	121.05	0.46
Reach 1	176	100-yr	689.00	248.13	253.84	251.52	254.09	0.003547	5.68	225.04	194.21	0.43
Reach 1	171	95%	1.00	247.84	248.12	248.05	248.14	0.013851	1.08	0.93	6.11	0.49
Reach 1	171	50%	11.00	247.84	248.50	248.41	248.59	0.021042	2.42	4.55	12.24	0.70
Reach 1	171	5%	41.00	247.84	249.02	248.85	249.17	0.012693	3.23	16.70	35.00	0.62
Reach 1	171	50-yr	533.00	247.84	252.96	250.76	253.14	0.002258	4.34	213.01	116.17	0.35
Reach 1	171	100-yr	689.00	247.84	253.87	251.11	254.06	0.001946	4.52	269.57	193.67	0.33
Reach 1	165	95%	1.00	247.82	248.04	247.98	248.05	0.015822	0.99	1.01	8.30	0.50
Reach 1	165	50%	11.00	247.82	248.48	248.30	248.51	0.006924	1.26	8.74	27.20	0.39
Reach 1	165	5%	41.00	247.82	249.08	248.58	249.11	0.002738	1.35	30.32	42.10	0.28
Reach 1	165	50-yr	533.00	247.82	253.01	250.07	253.10	0.000910	2.46	217.38	76.34	0.21
Reach 1	165	100-yr	689.00	247.82	253.92	250.39	254.02	0.000778	2.59	275.47	160.76	0.20
Reach 1	150	95%	1.00	247.75	248.03	247.81	248.03	0.000483	0.25	3.95	18.54	0.10
Reach 1	150	50%	11.00	247.75	248.46	248.04	248.47	0.001216	0.72	15.27	29.56	0.18
Reach 1	150	5%	41.00	247.75	249.05	248.34	249.08	0.001374	1.23	33.43	31.55	0.21
Reach 1	150	50-yr	533.00	247.75	252.92	250.08	253.08	0.001448	3.21	166.00	40.95	0.26
Reach 1	150	100-yr	689.00	247.75	253.82	250.44	254.00	0.001313	3.44	211.86	150.70	0.26
Reach 1	134	95%	1.00	247.77	248.00	247.91	248.01	0.007781	0.68	1.47	12.47	0.35
Reach 1	134	50%	11.00	247.77	248.40	248.17	248.43	0.005275	1.37	8.03	17.36	0.35
Reach 1	134	5%	41.00	247.77	248.93	248.49	249.02	0.006007	2.35	17.45	17.78	0.42
Reach 1	134	50-yr	533.00	247.77	252.12	250.98	252.85	0.010981	6.87	77.53	23.22	0.63
Reach 1	134	100-yr	689.00	247.77	252.93	251.53	253.76	0.009888	7.29	94.49	24.92	0.61
Reach 1	125		Bridge									
Reach 1	116	95%	1.00	247.58	247.86	247.76	247.87	0.007668	0.80	1.24	8.18	0.36
Reach 1	116	50%	11.00	247.58	248.21	248.08	248.27	0.015181	2.10	5.23	13.53	0.60
Reach 1	116	5%	41.00	247.58	248.65	248.49	248.83	0.018260	3.42	12.00	17.09	0.72
Reach 1	116	50-yr	533.00	247.58	251.85	250.80	252.50	0.007518	6.47	82.39	26.66	0.60
Reach 1	116	100-yr	689.00	247.58	252.01	251.28	253.01	0.010866	8.01	86.05	26.80	0.72
Reach 1	109	95%	1.00	247.56	247.70	247.70	247.74	0.067221	1.47	0.68	9.23	0.96
Reach 1	109	50%	11.00	247.56	247.97	247.95	248.09	0.037412	2.74	4.02	13.80	0.89
Reach 1	109	5%	41.00	247.56	248.52	248.33	248.70	0.015876	3.35	12.22	15.99	0.68
Reach 1	109	50-yr	533.00	247.56	251.86	250.85	252.38	0.006890	5.83	103.81	98.26	0.56
Reach 1	109	100-yr	689.00	247.56	252.06	251.36	252.80	0.009355	7.06	113.21	130.79	0.66
Reach 1	89	95%	1.00	246.88	247.15	247.07	247.17	0.010014	0.98	1.02	5.98	0.42
Reach 1	89	50%	11.00	246.88	247.67	247.45	247.73	0.010002	2.00	5.51	11.00	0.50
Reach 1	89	5%	41.00	246.88	248.30	247.94	248.45	0.010011	3.09	13.28	13.54	0.55
Reach 1	89	50-yr	533.00	246.88	251.52	250.85	252.19	0.010006	6.72	111.10	138.30	0.66
Reach 1	89	100-yr	689.00	246.88	251.88	251.82	252.59	0.010009	7.20	158.88	150.58	0.67

HEC-RAS Plan: Part Removal 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	3832	95%	1.00	252.03	252.71	252.31	252.71	0.000451	0.35	2.82	7.30	0.10
Reach 1	3832	50%	11.00	252.03	253.94	252.73	253.95	0.000641	0.80	13.73	13.00	0.14
Reach 1	3832	5%	41.00	252.03	254.59	253.31	254.60	0.001102	1.12	65.46	154.94	0.19
Reach 1	3832	50-yr	533.00	252.03	256.44	255.12	256.47	0.000982	2.02	538.58	372.29	0.21
Reach 1	3832	100-yr	689.00	252.03	256.80	255.27	256.82	0.000921	2.10	674.91	398.21	0.20
Reach 1	2880	95%	1.00	251.12	252.65		252.65	0.000023	0.13	7.50	8.94	0.03
Reach 1	2880	50%	11.00	251.12	253.49		253.50	0.000363	0.62	17.62	16.96	0.11
Reach 1	2880	5%	41.00	251.12	254.02		254.03	0.000429	0.88	111.74	250.27	0.12
Reach 1	2880	50-yr	533.00	251.12	255.87		255.88	0.000565	1.69	646.77	337.64	0.16
Reach 1	2880	100-yr	689.00	251.12	256.25		256.27	0.000550	1.79	779.75	359.33	0.16
Reach 1	1936	95%	1.00	252.19	252.59	252.35	252.59	0.000464	0.24	4.97	30.54	0.09
Reach 1	1936	50%	11.00	252.19	253.09		253.09	0.000549	0.45	32.18	81.94	0.12
Reach 1	1936	5%	41.00	252.19	253.53		253.54	0.000688	0.77	87.83	192.71	0.15
Reach 1	1936	50-yr	533.00	252.19	255.25		255.28	0.000864	1.79	506.08	266.24	0.20
Reach 1	1936	100-yr	689.00	252.19	255.67		255.70	0.000776	1.87	619.39	273.35	0.19
Reach 1	1016	95%	1.00	250.88	251.07	251.07	251.11	0.066716	1.76	0.57	5.82	1.00
Reach 1	1016	50%	11.00	250.88	251.47		251.54	0.021729	2.14	5.18	19.08	0.69
Reach 1	1016	5%	41.00	250.88	251.96		252.01	0.007398	1.87	29.92	78.56	0.44
Reach 1	1016	50-yr	533.00	250.88	254.14		254.18	0.001572	2.46	401.22	249.48	0.27
Reach 1	1016	100-yr	689.00	250.88	254.79		254.83	0.001061	2.34	577.40	308.46	0.23
Reach 1	884	95%	1.00	250.17	250.57	250.34	250.57	0.000794	0.32	3.16	15.39	0.12
Reach 1	884	50%	11.00	250.17	251.09		251.10	0.001216	0.67	16.36	35.42	0.17
Reach 1	884	5%	41.00	250.17	251.57		251.59	0.001663	1.08	41.57	74.18	0.22
Reach 1	884	50-yr	533.00	250.17	253.98		254.02	0.000774	1.89	475.79	273.33	0.19
Reach 1	884	100-yr	689.00	250.17	254.69		254.72	0.000506	1.75	683.06	310.94	0.16
Reach 1	323	95%	1.00	248.97	249.09	249.08	249.11	0.073118	1.31	0.76	13.04	0.96
Reach 1	323	50%	11.00	248.97	249.36		249.40	0.016863	1.63	6.75	27.89	0.58
Reach 1	323	5%	41.00	248.97	249.78		249.84	0.007976	1.97	20.86	35.41	0.45
Reach 1	323	50-yr	533.00	248.97	253.17		253.32	0.002282	3.26	184.81	138.44	0.29
Reach 1	323	100-yr	689.00	248.97	254.02		254.20	0.002060	3.54	247.72	193.10	0.29
Reach 1	306	95%	1.00	248.84	249.01		249.01	0.001834	0.31	3.27	30.92	0.17
Reach 1	306	50%	11.00	248.84	249.28		249.29	0.003030	0.87	12.70	35.61	0.26
Reach 1	306	5%	41.00	248.84	249.71		249.74	0.003164	1.45	28.37	36.49	0.29
Reach 1	306	50-yr	533.00	248.84	253.12		253.28	0.002704	3.24	164.68	63.99	0.29
Reach 1	306	100-yr	689.00	248.84	254.00		254.16	0.002055	3.24	249.84	124.29	0.27
Reach 1	299	95%	1.00	248.81	248.99		248.99	0.002965	0.34	2.92	33.77	0.21
Reach 1	299	50%	11.00	248.81	249.25		249.27	0.003569	0.92	12.01	35.17	0.28
Reach 1	299	5%	41.00	248.81	249.69		249.72	0.003463	1.50	27.42	36.01	0.30
Reach 1	299	50-yr	533.00	248.81	253.09		253.26	0.002768	3.30	161.50	64.12	0.30
Reach 1	299	100-yr	689.00	248.81	253.98		254.14	0.002271	3.33	238.48	116.94	0.27
Reach 1	280	95%	1.00	248.72	248.93		248.93	0.003581	0.42	2.37	23.31	0.23
Reach 1	280	50%	11.00	248.72	249.16		249.18	0.006316	1.06	10.43	37.51	0.35
Reach 1	280	5%	41.00	248.72	249.62		249.65	0.003985	1.44	28.39	41.10	0.31
Reach 1	280	50-yr	533.00	248.72	253.10		253.20	0.001626	2.61	215.13	104.76	0.23
Reach 1	280	100-yr	689.00	248.72	253.97		254.10	0.001442	2.81	275.02	222.54	0.23
Reach 1	249	95%	1.00	248.50	248.63		248.65	0.048805	0.99	1.01	19.21	0.76
Reach 1	249	50%	11.00	248.50	248.99		249.01	0.004904	1.02	10.83	33.04	0.31
Reach 1	249	5%	41.00	248.50	249.51		249.54	0.003137	1.44	28.40	34.57	0.28
Reach 1	249	50-yr	533.00	248.50	253.06		253.14	0.001934	2.34	251.57	167.00	0.22
Reach 1	249	100-yr	689.00	248.50	253.96		254.04	0.001456	2.37	345.93	233.16	0.20
Reach 1	237	95%	1.00	248.41	248.57		248.58	0.002180	0.36	2.75	22.19	0.18
Reach 1	237	50%	11.00	248.41	248.96		248.97	0.002468	0.83	13.20	32.15	0.23
Reach 1	237	5%	41.00	248.41	249.48		249.51	0.002698	1.32	30.99	36.30	0.25
Reach 1	237	50-yr	533.00	248.41	253.06		253.11	0.001304	1.90	322.55	149.23	0.18
Reach 1	237	100-yr	689.00	248.41	253.97		254.01	0.000901	1.85	452.34	172.25	0.16
Reach 1	223	95%	1.00	248.34	248.50		248.51	0.009576	0.71	1.40	13.04	0.38
Reach 1	223	50%	11.00	248.34	248.88		248.91	0.006667	1.35	8.17	22.36	0.39
Reach 1	223	5%	41.00	248.34	249.40		249.45	0.005784	1.80	22.72	35.74	0.40
Reach 1	223	50-yr	533.00	248.34	253.02		253.09	0.000868	2.19	296.95	125.47	0.21
Reach 1	223	100-yr	689.00	248.34	253.94		254.00	0.000593	2.11	418.37	172.18	0.18
Reach 1	213	95%	1.00	248.25	248.42		248.42	0.006999	0.66	1.51	12.33	0.34
Reach 1	213	50%	11.00	248.25	248.82		248.85	0.006548	1.37	8.01	20.96	0.39
Reach 1	213	5%	41.00	248.25	249.34		249.40	0.005265	1.94	21.18	27.82	0.39
Reach 1	213	50-yr	533.00	248.25	252.90		253.07	0.001912	3.31	177.99	67.94	0.30
Reach 1	213	100-yr	689.00	248.25	253.83		253.98	0.001370	3.25	269.89	132.48	0.26

HEC-RAS Plan: Part Removal   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	202	95%	1.00	248.16	248.33		248.34	0.006724	0.67	1.50	11.85	0.33
Reach 1	202	50%	11.00	248.16	248.74		248.77	0.006452	1.42	7.73	18.96	0.39
Reach 1	202	5%	41.00	248.16	249.27		249.33	0.005680	2.00	20.51	27.20	0.41
Reach 1	202	50-yr	533.00	248.16	252.88		253.05	0.001919	3.26	168.42	52.32	0.30
Reach 1	202	100-yr	689.00	248.16	253.79		253.96	0.001519	3.35	218.53	71.74	0.27
Reach 1	196	95%	1.00	248.12	248.30		248.31	0.006522	0.66	1.51	11.70	0.33
Reach 1	196	50%	11.00	248.12	248.71		248.74	0.006403	1.44	7.66	18.46	0.39
Reach 1	196	5%	41.00	248.12	249.24		249.30	0.005834	2.02	20.26	26.91	0.41
Reach 1	196	50-yr	533.00	248.12	252.88		253.03	0.002006	3.14	170.00	49.05	0.30
Reach 1	196	100-yr	689.00	248.12	253.79		253.95	0.001576	3.19	218.17	68.04	0.27
Reach 1	182	95%	1.00	247.99	248.21		248.22	0.005911	0.66	1.51	10.87	0.31
Reach 1	182	50%	11.00	247.99	248.61		248.64	0.006813	1.46	7.51	18.39	0.40
Reach 1	182	5%	41.00	247.99	249.14		249.21	0.006248	2.08	19.75	26.73	0.43
Reach 1	182	50-yr	533.00	247.99	252.87		252.99	0.001438	2.80	198.05	107.63	0.26
Reach 1	182	100-yr	689.00	247.99	253.79		253.91	0.001057	2.79	296.68	193.79	0.23
Reach 1	176	95%	1.00	247.94	248.18		248.19	0.005929	0.68	1.47	10.32	0.32
Reach 1	176	50%	11.00	247.94	248.57		248.60	0.007579	1.52	7.23	18.06	0.42
Reach 1	176	5%	41.00	247.94	249.11		249.17	0.007417	2.05	20.02	31.55	0.45
Reach 1	176	50-yr	533.00	247.94	252.87		252.98	0.001180	2.66	212.10	109.78	0.24
Reach 1	176	100-yr	689.00	247.94	253.79		253.90	0.000916	2.69	302.62	193.45	0.22
Reach 1	171	95%	1.00	247.91	248.14		248.15	0.006701	0.70	1.43	10.50	0.33
Reach 1	171	50%	11.00	247.91	248.52		248.56	0.008625	1.59	6.90	17.78	0.45
Reach 1	171	5%	41.00	247.91	249.07		249.13	0.006855	1.91	21.51	35.64	0.43
Reach 1	171	50-yr	533.00	247.91	252.87		252.97	0.001005	2.53	218.32	107.24	0.22
Reach 1	171	100-yr	689.00	247.91	253.79		253.89	0.000818	2.61	296.62	191.77	0.21
Reach 1	165	95%	1.00	247.84	248.02		248.06	0.049981	1.51	0.66	6.96	0.86
Reach 1	165	50%	11.00	247.84	248.46		248.50	0.011530	1.60	6.87	21.83	0.50
Reach 1	165	5%	41.00	247.84	249.06		249.10	0.003538	1.46	28.04	41.97	0.32
Reach 1	165	50-yr	533.00	247.84	252.86		252.96	0.001001	2.58	207.33	57.80	0.22
Reach 1	165	100-yr	689.00	247.84	253.78		253.89	0.000847	2.70	274.46	155.62	0.21
Reach 1	150	95%	1.00	247.75	248.02		248.02	0.000595	0.27	3.72	18.70	0.11
Reach 1	150	50%	11.00	247.75	248.44		248.45	0.001366	0.74	14.82	29.91	0.19
Reach 1	150	5%	41.00	247.75	249.04		249.06	0.001407	1.23	33.34	31.76	0.21
Reach 1	150	50-yr	533.00	247.75	252.77		252.94	0.001594	3.31	160.96	39.75	0.27
Reach 1	150	100-yr	689.00	247.75	253.67		253.86	0.001445	3.54	204.28	140.95	0.27
Reach 1	134	95%	1.00	247.72	247.99	247.89	247.99	0.008285	0.67	1.48	13.47	0.36
Reach 1	134	50%	11.00	247.72	248.37	248.14	248.40	0.005259	1.36	8.09	17.82	0.36
Reach 1	134	5%	41.00	247.72	248.93	248.47	249.01	0.005489	2.27	18.05	18.25	0.40
Reach 1	134	50-yr	533.00	247.72	251.88	250.91	252.69	0.012243	7.22	73.79	19.74	0.66
Reach 1	134	100-yr	689.00	247.72	252.71	251.45	253.60	0.011173	7.58	90.95	24.18	0.64
Reach 1	125		Bridge									
Reach 1	116	95%	1.00	247.56	247.84	247.73	247.85	0.006051	0.74	1.35	8.41	0.33
Reach 1	116	50%	11.00	247.56	248.19	248.05	248.26	0.013603	2.05	5.38	13.30	0.57
Reach 1	116	5%	41.00	247.56	248.63	248.46	248.82	0.017332	3.46	11.84	15.82	0.71
Reach 1	116	50-yr	533.00	247.56	251.61	250.88	252.39	0.010233	7.09	75.13	26.17	0.69
Reach 1	116	100-yr	689.00	247.56	251.76	251.36	252.96	0.014692	8.76	78.63	26.31	0.83
Reach 1	109	95%	1.00	247.56	247.69	247.69	247.73	0.076356	1.60	0.63	8.29	1.02
Reach 1	109	50%	11.00	247.56	247.97	247.94	248.08	0.036394	2.70	4.07	13.92	0.88
Reach 1	109	5%	41.00	247.56	248.52	248.32	248.69	0.015756	3.34	12.27	16.02	0.67
Reach 1	109	50-yr	533.00	247.56	251.63	250.88	252.22	0.008978	6.24	95.36	87.41	0.63
Reach 1	109	100-yr	689.00	247.56	251.84	251.39	252.68	0.011782	7.47	105.38	122.55	0.73
Reach 1	89	95%	1.00	246.88	247.15	247.07	247.17	0.010004	0.98	1.02	6.02	0.42
Reach 1	89	50%	11.00	246.88	247.68	247.45	247.74	0.010005	1.98	5.55	11.27	0.50
Reach 1	89	5%	41.00	246.88	248.29	247.94	248.44	0.010008	3.09	13.28	13.56	0.55
Reach 1	89	50-yr	533.00	246.88	251.46	251.30	252.01	0.010002	6.26	132.65	146.86	0.65
Reach 1	89	100-yr	689.00	246.88	251.78	251.64	252.36	0.010009	6.71	175.55	153.70	0.66

HEC-RAS Plan: Full Removal 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	3832	95%	1.00	252.03	252.71		252.71	0.000450	0.35	2.82	7.30	0.10
Reach 1	3832	50%	11.00	252.03	253.94		253.95	0.000641	0.80	13.73	13.00	0.14
Reach 1	3832	5%	41.00	252.03	254.59		254.60	0.001102	1.12	65.46	154.94	0.19
Reach 1	3832	50-yr	533.00	252.03	256.44		256.47	0.000984	2.02	538.03	372.19	0.21
Reach 1	3832	100-yr	689.00	252.03	256.78		256.81	0.000941	2.12	669.20	397.25	0.21
Reach 1	2880	95%	1.00	251.12	252.65		252.65	0.000023	0.13	7.51	8.94	0.03
Reach 1	2880	50%	11.00	251.12	253.49		253.50	0.000363	0.62	17.62	16.96	0.11
Reach 1	2880	5%	41.00	251.12	254.02		254.03	0.000429	0.88	111.75	250.27	0.12
Reach 1	2880	50-yr	533.00	251.12	255.86		255.88	0.000568	1.70	645.33	337.51	0.16
Reach 1	2880	100-yr	689.00	251.12	256.21		256.23	0.000576	1.82	767.44	357.23	0.17
Reach 1	1936	95%	1.00	252.19	252.59	252.35	252.59	0.000462	0.24	4.97	30.58	0.09
Reach 1	1936	50%	11.00	252.19	253.09		253.09	0.000548	0.45	32.19	81.96	0.12
Reach 1	1936	5%	41.00	252.19	253.53		253.54	0.000689	0.77	87.81	192.70	0.15
Reach 1	1936	50-yr	533.00	252.19	255.24		255.27	0.000875	1.80	504.01	266.09	0.20
Reach 1	1936	100-yr	689.00	252.19	255.59		255.62	0.000867	1.95	597.35	271.87	0.20
Reach 1	1016	95%	1.00	250.88	251.07	251.07	251.11	0.066716	1.76	0.57	5.82	1.00
Reach 1	1016	50%	11.00	250.88	251.46		251.54	0.021959	2.15	5.16	18.98	0.69
Reach 1	1016	5%	41.00	250.88	251.96		252.01	0.007427	1.87	29.88	78.50	0.44
Reach 1	1016	50-yr	533.00	250.88	253.85		253.92	0.002623	2.95	331.26	234.25	0.34
Reach 1	1016	100-yr	689.00	250.88	254.47		254.53	0.001548	2.65	488.29	266.56	0.27
Reach 1	884	95%	1.00	250.17	250.57	250.34	250.57	0.000789	0.32	3.17	15.41	0.12
Reach 1	884	50%	11.00	250.17	251.09		251.10	0.001205	0.67	16.42	35.48	0.17
Reach 1	884	5%	41.00	250.17	251.58		251.59	0.001621	1.07	42.05	74.66	0.22
Reach 1	884	50-yr	533.00	250.17	253.59		253.65	0.001301	2.23	375.53	219.95	0.24
Reach 1	884	100-yr	689.00	250.17	254.32		254.36	0.000818	2.08	569.81	294.51	0.20
Reach 1	323	95%	1.00	248.97	249.09	249.08	249.11	0.078321	1.35	0.74	12.87	0.99
Reach 1	323	50%	11.00	248.97	249.36		249.40	0.017988	1.67	6.60	27.67	0.60
Reach 1	323	5%	41.00	248.97	249.76		249.81	0.008944	1.94	21.19	41.94	0.48
Reach 1	323	50-yr	533.00	248.97	253.11		253.16	0.000648	1.86	378.88	191.91	0.18
Reach 1	323	100-yr	689.00	248.97	254.01		254.05	0.000411	1.73	566.23	218.39	0.15
Reach 1	306	95%	1.00	248.84	249.01		249.01	0.001808	0.31	3.26	30.99	0.17
Reach 1	306	50%	11.00	248.84	249.27		249.28	0.003032	0.86	12.82	38.21	0.26
Reach 1	306	5%	41.00	248.84	249.69		249.72	0.003135	1.34	30.65	48.07	0.30
Reach 1	306	50-yr	533.00	248.84	253.10		253.15	0.000561	1.82	384.70	190.75	0.17
Reach 1	306	100-yr	689.00	248.84	254.00		254.04	0.000373	1.71	572.29	218.47	0.14
Reach 1	299	95%	1.00	248.81	248.99		248.99	0.002963	0.34	2.92	33.84	0.21
Reach 1	299	50%	11.00	248.81	249.25		249.26	0.003560	0.90	12.19	37.95	0.28
Reach 1	299	5%	41.00	248.81	249.66		249.69	0.003380	1.39	29.60	46.59	0.31
Reach 1	299	50-yr	533.00	248.81	253.10		253.14	0.000562	1.82	382.94	189.01	0.17
Reach 1	299	100-yr	689.00	248.81	254.00		254.04	0.000372	1.71	574.11	221.65	0.14
Reach 1	280	95%	1.00	248.72	248.93		248.94	0.003553	0.42	2.38	23.32	0.23
Reach 1	280	50%	11.00	248.72	249.15		249.17	0.006522	1.07	10.26	38.87	0.37
Reach 1	280	5%	41.00	248.72	249.60		249.63	0.003620	1.40	29.25	47.67	0.32
Reach 1	280	50-yr	533.00	248.72	253.09		253.13	0.000522	1.75	388.88	187.18	0.16
Reach 1	280	100-yr	689.00	248.72	253.99		254.03	0.000351	1.66	582.33	228.55	0.14
Reach 1	249	95%	1.00	248.50	248.63		248.65	0.054847	1.04	0.96	19.01	0.81
Reach 1	249	50%	11.00	248.50	248.98		249.00	0.004690	1.04	10.62	33.11	0.32
Reach 1	249	5%	41.00	248.50	249.50		249.53	0.002801	1.37	29.93	41.59	0.28
Reach 1	249	50-yr	533.00	248.50	253.06		253.11	0.000615	1.88	354.29	167.63	0.17
Reach 1	249	100-yr	689.00	248.50	253.98		254.02	0.000406	1.78	549.41	233.66	0.15
Reach 1	237	95%	1.00	248.41	248.57		248.58	0.002101	0.37	2.73	22.15	0.18
Reach 1	237	50%	11.00	248.41	248.95		248.96	0.002244	0.84	13.09	32.09	0.23
Reach 1	237	5%	41.00	248.41	249.47		249.50	0.002163	1.29	31.81	39.86	0.25
Reach 1	237	50-yr	533.00	248.41	253.05		253.10	0.000657	1.93	338.82	149.15	0.18
Reach 1	237	100-yr	689.00	248.41	253.96		254.01	0.000449	1.85	484.87	172.16	0.15
Reach 1	223	95%	1.00	248.34	248.50		248.51	0.009576	0.71	1.40	13.04	0.38
Reach 1	223	50%	11.00	248.34	248.88		248.91	0.006667	1.35	8.17	22.36	0.39
Reach 1	223	5%	41.00	248.34	249.40		249.45	0.005784	1.80	22.72	35.74	0.40
Reach 1	223	50-yr	533.00	248.34	253.02		253.09	0.000868	2.19	296.99	125.47	0.21
Reach 1	223	100-yr	689.00	248.34	253.94		254.00	0.000593	2.11	418.40	172.18	0.18
Reach 1	213	95%	1.00	248.25	248.42		248.42	0.006999	0.66	1.51	12.33	0.34
Reach 1	213	50%	11.00	248.25	248.82		248.85	0.006548	1.37	8.01	20.96	0.39
Reach 1	213	5%	41.00	248.25	249.34		249.40	0.005265	1.94	21.18	27.82	0.39
Reach 1	213	50-yr	533.00	248.25	252.90		253.07	0.001912	3.31	177.99	67.94	0.30
Reach 1	213	100-yr	689.00	248.25	253.83		253.98	0.001370	3.25	269.89	132.48	0.26

HEC-RAS Plan: Full Removal   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	202	95%	1.00	248.16	248.33		248.34	0.006724	0.67	1.50	11.85	0.33
Reach 1	202	50%	11.00	248.16	248.74		248.77	0.006452	1.42	7.73	18.96	0.39
Reach 1	202	5%	41.00	248.16	249.27		249.33	0.005680	2.00	20.51	27.20	0.41
Reach 1	202	50-yr	533.00	248.16	252.88		253.05	0.001919	3.26	168.42	52.32	0.30
Reach 1	202	100-yr	689.00	248.16	253.79		253.96	0.001519	3.35	218.53	71.74	0.27
Reach 1	196	95%	1.00	248.12	248.30		248.31	0.006522	0.66	1.51	11.70	0.33
Reach 1	196	50%	11.00	248.12	248.71		248.74	0.006403	1.44	7.66	18.46	0.39
Reach 1	196	5%	41.00	248.12	249.24		249.30	0.005834	2.02	20.26	26.91	0.41
Reach 1	196	50-yr	533.00	248.12	252.88		253.03	0.002006	3.14	170.00	49.05	0.30
Reach 1	196	100-yr	689.00	248.12	253.79		253.95	0.001576	3.19	218.17	68.04	0.27
Reach 1	182	95%	1.00	247.99	248.21		248.22	0.005911	0.66	1.51	10.87	0.31
Reach 1	182	50%	11.00	247.99	248.61		248.64	0.006813	1.46	7.51	18.39	0.40
Reach 1	182	5%	41.00	247.99	249.14		249.21	0.006248	2.08	19.75	26.73	0.43
Reach 1	182	50-yr	533.00	247.99	252.87		252.99	0.001438	2.80	198.05	107.63	0.26
Reach 1	182	100-yr	689.00	247.99	253.79		253.91	0.001057	2.79	296.68	193.79	0.23
Reach 1	176	95%	1.00	247.94	248.18		248.19	0.005929	0.68	1.47	10.32	0.32
Reach 1	176	50%	11.00	247.94	248.57		248.60	0.007580	1.52	7.23	18.06	0.42
Reach 1	176	5%	41.00	247.94	249.11		249.17	0.007417	2.05	20.02	31.55	0.45
Reach 1	176	50-yr	533.00	247.94	252.87		252.98	0.001180	2.66	212.10	109.78	0.24
Reach 1	176	100-yr	689.00	247.94	253.79		253.90	0.000916	2.69	302.62	193.45	0.22
Reach 1	171	95%	1.00	247.91	248.14		248.15	0.006701	0.70	1.43	10.50	0.33
Reach 1	171	50%	11.00	247.91	248.52		248.56	0.008627	1.59	6.90	17.78	0.45
Reach 1	171	5%	41.00	247.91	249.07		249.13	0.006855	1.91	21.51	35.64	0.43
Reach 1	171	50-yr	533.00	247.91	252.87		252.97	0.001005	2.53	218.32	107.24	0.22
Reach 1	171	100-yr	689.00	247.91	253.79		253.89	0.000818	2.61	296.62	191.77	0.21
Reach 1	165	95%	1.00	247.84	248.02		248.06	0.049981	1.51	0.66	6.96	0.86
Reach 1	165	50%	11.00	247.84	248.46		248.50	0.011540	1.60	6.87	21.83	0.50
Reach 1	165	5%	41.00	247.84	249.06		249.10	0.003538	1.46	28.04	41.97	0.32
Reach 1	165	50-yr	533.00	247.84	252.86		252.96	0.001001	2.58	207.33	57.80	0.22
Reach 1	165	100-yr	689.00	247.84	253.78		253.89	0.000847	2.70	274.46	155.62	0.21
Reach 1	150	95%	1.00	247.75	248.02		248.02	0.000595	0.27	3.72	18.70	0.11
Reach 1	150	50%	11.00	247.75	248.44		248.45	0.001367	0.74	14.81	29.91	0.19
Reach 1	150	5%	41.00	247.75	249.04		249.06	0.001407	1.23	33.34	31.76	0.21
Reach 1	150	50-yr	533.00	247.75	252.77		252.94	0.001594	3.31	160.96	39.75	0.27
Reach 1	150	100-yr	689.00	247.75	253.67		253.86	0.001445	3.54	204.28	140.95	0.27
Reach 1	134	95%	1.00	247.72	247.99	247.89	247.99	0.008285	0.67	1.48	13.47	0.36
Reach 1	134	50%	11.00	247.72	248.37	248.14	248.40	0.005267	1.36	8.09	17.82	0.36
Reach 1	134	5%	41.00	247.72	248.93	248.47	249.01	0.005489	2.27	18.05	18.25	0.40
Reach 1	134	50-yr	533.00	247.72	251.88	250.91	252.69	0.012243	7.22	73.79	19.74	0.66
Reach 1	134	100-yr	689.00	247.72	252.71	251.45	253.60	0.011173	7.58	90.95	24.18	0.64
Reach 1	125		Bridge									
Reach 1	116	95%	1.00	247.56	247.84	247.73	247.85	0.006051	0.74	1.35	8.41	0.33
Reach 1	116	50%	11.00	247.56	248.19	248.05	248.26	0.013691	2.05	5.37	13.30	0.57
Reach 1	116	5%	41.00	247.56	248.63	248.46	248.82	0.017332	3.46	11.84	15.82	0.71
Reach 1	116	50-yr	533.00	247.56	251.61	250.88	252.39	0.010233	7.09	75.13	26.17	0.69
Reach 1	116	100-yr	689.00	247.56	251.76	251.36	252.96	0.014692	8.76	78.63	26.31	0.83
Reach 1	109	95%	1.00	247.56	247.69	247.69	247.73	0.076356	1.60	0.63	8.29	1.02
Reach 1	109	50%	11.00	247.56	247.97	247.94	248.08	0.035766	2.69	4.09	13.93	0.87
Reach 1	109	5%	41.00	247.56	248.52	248.32	248.69	0.015756	3.34	12.27	16.02	0.67
Reach 1	109	50-yr	533.00	247.56	251.63	250.88	252.22	0.008978	6.24	95.36	87.41	0.63
Reach 1	109	100-yr	689.00	247.56	251.84	251.39	252.68	0.011782	7.47	105.38	122.55	0.73
Reach 1	89	95%	1.00	246.88	247.15	247.07	247.17	0.010004	0.98	1.02	6.02	0.42
Reach 1	89	50%	11.00	246.88	247.68	247.45	247.74	0.010005	1.98	5.55	11.27	0.50
Reach 1	89	5%	41.00	246.88	248.29	247.94	248.44	0.010008	3.09	13.28	13.56	0.55
Reach 1	89	50-yr	533.00	246.88	251.46	251.30	252.01	0.010002	6.26	132.65	146.86	0.65
Reach 1	89	100-yr	689.00	246.88	251.78	251.64	252.36	0.010009	6.71	175.55	153.70	0.66

Appendix D.

Probable Construction Cost Estimate

Trout Unlimited
Capwell Mill Pond Dam Removal
Engineer's Construction Cost Estimate - 35% Design

March 2024
EA Engineering, Science, and Technology Inc., PBC
EA Proj. No. 6364302

ITEM	COMPONENT DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL	Comments
1	Site Access and Prep	LS	1	$152,600.00	$152,600.00	
2	Water Control	LS	1	$92,300.00	$92,300.00	
3	Erosion and Sediment Control	LS	1	$53,000.00	$53,000.00	
4	Earthwork	LS	1	$43,200.00	$43,200.00	
5	Spillway Removal	LS	1	$17,600.00	$17,600.00	
6	Site Restoration	LS	1	$8,600.00	$8,600.00	
Subtotal					**$367,300.00**	
	Mob/Demob			**15%**	$55,100.00	15% of subtotal
	Contingency			**20%**	$73,500.00	20% of subtotal
	Inflation (2-years)			**12.36%**	$45,400.00	12.36% of subtotal (6% each year)
	Insurance and Bonds			**4%**	$2,300.00	4% of subtotal
TOTAL					**$544,000.00**	
				-30%	**$381,000.00**	
				+50%	**$816,000.00**	

Assumptions

Excavated sediment will be dewatered and left on site
Assume plantings will be done by Trout Unlimited
Burnt Sawmill Road will be used for the staging area
The notch in the Legacy Dam will be approximately 34 feet wide
Stones will be used from the demo of the notch in the Legacy Dam to stabilize slopes
Inflation is approximately 6% per year

Appendix E.

Alternatives Analysis Report

Alternatives Analysis
Capwell Mill Pond Dam Removal
West Greenwich, Rhode Island

Prepared for

Trout Unlimited, RI Chapter 225
203 Arcadia Road
Hope Valley, Rhode Island 02832

Partnership with

Rhode Island Water Resources Board
235 Promenade Street, Suite 230
Providence, Rhode Island 02908

Prepared by

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March 2024
Version: PRELIMINARY
EA Project No. 6364302

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LIST OF ACRONYMS AND ABBREVIATIONS

CADD	Computer-aided design and drafting
cfs	Cubic feet per second
cm	Centimeter(s)
EA	EA Engineering, Science, and Technology, Inc., PBC
FEMA	Federal Emergency Management Agency
ft	Foot (feet)
ft/s	Foot (feet) per second
ft^3/s	Cubic foot (feet) per second
GZA	GZA GeoEnvironmental Inc.
HEC-RAS	Hydrologic Engineering Centers River Analysis System
in	Inch(es)
Mgal/d	Million gallon(s) per day
NAVD	North American Vertical Datum
NRCS	Natural Resources Conservation Service
RIDEM	Rhode Island Department of Environmental Management
RITU	Rhode Island Trout Unlimited
RIWRB	Rhode Island Water Resources Board
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

1. INTRODUCTION

The Rhode Island Chapter of Trout Unlimited (RITU), partnered with the Rhode Island Water Resources Board (RIWRB), has contracted EA Engineering, Science, and Technology, Inc., PBC (EA) to provide engineering and design services as part of their efforts to restore aquatic passage in the Big River Management Area. As part of these design services, EA is providing RITU with this alternatives analysis to assist with the selection of the alternative that best meets the following project goals:

- Maximize restoration effectiveness and remove barriers to aquatic organisms.

- Eliminate stagnated water and increased water temperatures in the impoundment that are currently isolating thermally dependent species, and genetically isolating populations of aquatic organisms.

- Open the now closed fluvial river system to thermally restricted species (i.e., brook trout) and assist them in their ability to seek and successfully reach thermal refugia, which are critical to species and population survival through species fitness, genetic diversity, and population resiliency throughout the upper Pawtuxet River Watershed.

- Reduce liability to the dam owner from damages or injuries as a result of a future dam failure.

Three options for dam removal alternatives are evaluated in the alternatives analysis:

- No Action
- Removal of Capwell Mill Pond Dam only
- Removal of the Capwell Mill Pond Dam and upstream Legacy Dam

This report presents the results of the surveys and observations and summarizes EA’s assessment of the aquatic passages alternatives. Based on the information reviewed and analyses conducted as part of the analysis, EA recommends the removal of the Capwell Mill Pond Dam and Legacy Dam be reviewed in the feasibility study.

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2. EXISTING CONDITIONS

2.1 WATER QUALITY AND WETLAND RESTORATION TEAM REQUIREMENTS

No known contaminants of concern are present in Capwell Mill Pond or in the sediment behind the impoundment. There is no record that the pond has ever been drained or that sediment has been removed from behind the dam structure. The watershed upstream of the dam is primarily rural and forested areas, with no known sources of chemical contamination that would flow downstream into the water or sediment. No additional precautions associated with water quality are expected to be required at the site. Additionally, further impoundments that are present downstream of the dam would capture any nutrient rich sediment that is released downstream.

There are no current issues regarding permitting requirements that appear to be controversial or pose a cost or scheduling hurdle to the project. The Big River Management Area is a protected water quality area, set aside as a potential future drinking water source for Rhode Island.

2.2 GROUNDWATER AND WELLS

As part of the alternatives analysis, EA gathered information about groundwater wells in the project area to determine any potential impacts of the dam removal on groundwater levels. This consisted of reviewing U.S. Geological Survey (USGS) reports, contacting the Town of West Greenwich, and reviewing soils data from the Natural Resources Conservation Service (NRCS). The following sections describe the findings of this review. Based on the findings described below, it is likely that the removal of Capwell Mill Pond Dam would impact groundwater elevations due to the loose, gravelly nature of the surrounding soils and the connection between surface and groundwater. However, the area also has a naturally high groundwater table, and EA did not identify any local well sources that are near enough to the site to likely be significantly impacted. For a more intensive review of groundwater levels, EA recommends installing groundwater monitoring wells at the project site and monitoring the groundwater level before, during, and after construction.

2.2.1 USGS Reports

USGS, in cooperation with the RIWRB, investigated the potential to increase groundwater withdrawals in the Big River Management Area due to an increase in water demands in Rhode Island. This investigation included field data collection to determine the existing hydrogeologic conditions and modeling different groundwater withdrawal scenarios to determine the impact to nearby wetlands and waterbodies. The modeling used data from 1964 to 1998 at two Kent County wells in the Big River Management area and the model extents include the Carr River, which flows through Capwell Mill Pond. The findings were published in Water-Resources Investigations Report 03-4222 Hydrogeology and the Simulated Effects of Ground-Water Withdrawals in the Big River Area, Rhode Island in 2003 (USGS 2003) **Figure 2-1** shows the model extents, the location of the two wells, and model-calculated water-table contours.

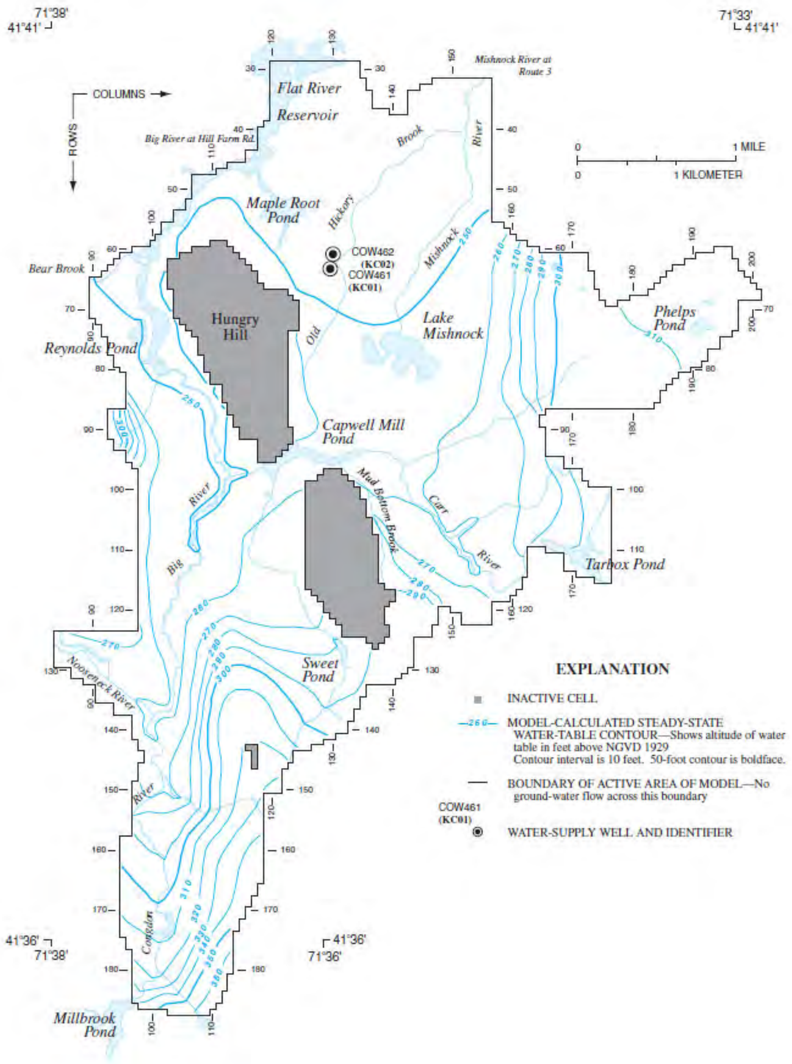

Figure 2-1. Model-Calculated Steady-State Water Table, Big River Study Area, Rhode Island

The two wells that were used in the model are located approximately 1.4 miles from Capwell Mill Pond. The combined average annual rate of withdrawal from these two wells was 1.4 million gallons per day (Mgal/d) (2.15 cubic feet per second [ft^3/s]) during the 1964–1998 simulation period. The simulation results showed that this caused a streamflow depletion of 0.01 ft^3/s in the Carr River; however, the report mentions that this "is about 0.1 percent of the average annual streamflow and probably is attributable to numerical-simulation error. Therefore, the Carr River and its tributaries are not affected by withdrawals at the Kent County wells" (USGS 2003). **Figure 2-2** shows the reach of the Carr River that was modeled (river mile 0 being the most upstream point) and the calculated streamflow depletion; the project site is located just downstream of the western unnamed tributary.

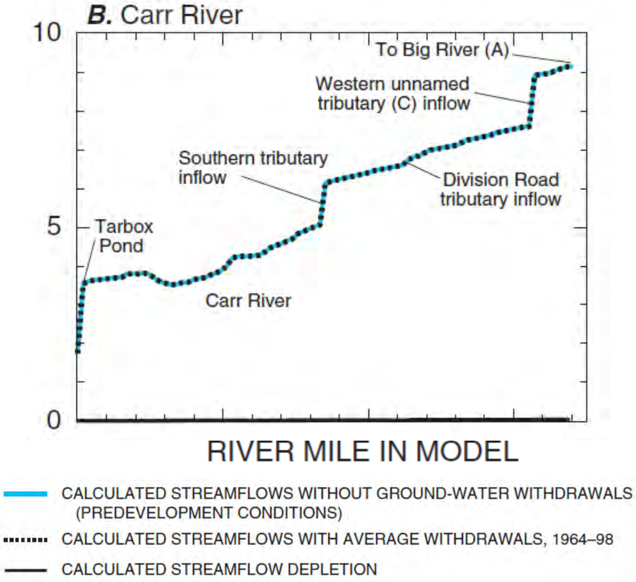

Figure 2-2. Carr River Calculated Streamflow Depletion from Groundwater Withdrawal

Table 2-1 shows the streams that were modeled and the streamflow depletion as a result of groundwater withdrawals from 1964–1998.

Table 2-1. Groundwater Impact to Streamflow

Modeled Area	Streamflow Depletion (ft^3/s)
Old Hickory Brook	0.88
Mishnock River upstream of confluence with Old Hickory Brook	0.53
Big River Basin south of Hill Farm Road	0.24
Maple Root Pond stream reach	0.23
Outfall of Lake Mishnock	0.21
Carr River	0.01*
Western unnamed tributary to Carr River	0

Notes:
*Attributed to numerical-simulation error

Modeled areas that are closer to the wells were impacted more by the groundwater withdrawal. The study also modeled hypothetical ground-water withdrawal scenarios. Two hypothetical scenarios (9A and 9B) looked at withdrawing 1 Mgal/day (1.5 ft^3/s) and 2 Mgal/day (4.6 ft3/s), respectively from the Carr River Basin. The report states that “withdrawals… in scenarios 9A and 9B cause substantial streamflow depletion in the western unnamed tributary to Carr River, and therefore, cause streamflow depletion in the Carr River downstream of Capwell Mill Pond” (USGS 2003).

Figure 2-3 shows this streamflow depletion.

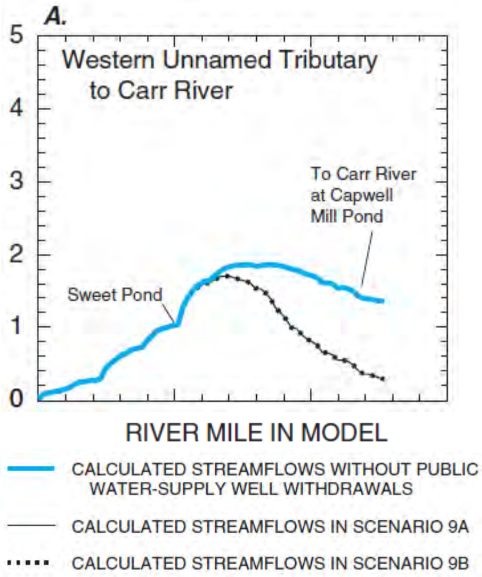

Figure 2-3. Carr River Tributary Calculated Streamflow Depletion from Groundwater Withdrawal

Additionally, there was a section of the investigation focused on groundwater fluctuations in wells. The study describes a "damping effect of surface-water bodies on ground-water levels"; namely, if groundwater elevations are close in elevation to surface waterbodies, there will be less groundwater level fluctuations. The surface waterbodies therefore "[exert] a control on the magnitude of water-level fluctuations". The report specifically mentions that one of the wells in the vicinity of Capwell Mill Pond had less fluctuation in groundwater levels than other wells in the study. This effect includes streams as well; the study found that there is a "narrow range of ground-water level fluctuations in streambed piezometers" (USGS 2003).

Overall, the USGS report indicates that there is a connection between the groundwater levels and the water levels of the surface water bodies. This connection decreases as distance away from the surface water body increases.

2.2.2 Location of Groundwater Wells in West Greenwich

The Town of West Greenwich was contacted regarding locations of groundwater wells near the project site, and EA was told to assume that every property has a well. The closest properties are a residence at 233 Nooseneck Hill Road and a pre-school (Greenwich Village School) also on Nooseneck Road, approximately 0.3 miles northwest of the site. Both properties are tenants of the RIWRB. Based on the groundwater contours in Figure 2-1, the residence at 233 Nooseneck Hill Road and preschool are located down-gradient of the project site and it is expected that any wells at these properties would not be impacted by the removal of the dam. There is also a residential neighborhood approximately 0.6 miles north of the project site; however, as the groundwater is flowing from east to west in this area, EA would not anticipate the removal of the Capwell Mill Pond Dam to impact these wells located north of the site.

2.2.3 NRCS Soils Data

EA examined soils data downloaded from the Natural Resources Conservation Service (NRCS) Web Soil Survey. The data shows that most of the surrounding soils are categorized as hydrologic soil group A or B. Soils that are hydrologic soil group A or B are loose soils that water can flow through unimpeded (NRCS, National Engineering Handbook, Part 630 Hydrology, Chapter 7 Hydrologic Soil Groups).

Theoretically, if the dam at Capwell Mill Pond is removed, water levels within the impoundment will decrease. As such, it is likely that the groundwater levels in the immediate vicinity of the pond will also decrease due to the relationship between surface water bodies and groundwater levels discussed in the USGS reports and the presence of loose sandy/gravely soils in the area. However, it is not anticipated that impacts on groundwater levels will be significantly impacted because of the high water table in the Big River Management Area. Additionally, the impacts to the groundwater levels will lessen as distance from the pond increases. It is also likely that once the water levels in this area come to an equilibrium, the groundwater levels around the surface waterbody will stay relatively consistent. Based on other dams in Big River Management Area which have breached (e.g. Sweet Pond Dam) and the aerial photos of the existing Capwell Mill Pond Dam impoundment, it is anticipated that once the dam is removed, the upstream impoundment will revert to an expansive wet meadow, which will help maintain elevated groundwater levels within the impoundment area.

2.3 TOPOGRAPHIC SURVEY

EA subcontracted Dawood Engineering, Inc., a Rhode Island Professional Licensed Surveyor, to complete a topographic survey of Capwell Mill Pond Dam and a bathymetric survey of the river immediately upstream and downstream of the dam.

In addition to the dam structures and topography, the bridge just downstream of the dam; the existing gravel path; roadway; and riprap embankments were defined and depicted on an existing conditions plan. The survey included topographic conditions 50 feet (ft) upstream and 50 ft downstream of the Legacy Dam, 50 ft upstream and downstream of the Capwell Mill Pond Dam abutments, and cross sections up to approximately 3,100 ft upstream of the dam. Five additional transects across the pond were also measured to capture the general topography of the impoundment. Measurements in the pond and downstream channel defined the pond and stream waterline and bathymetry. Elevations are in North American Vertical Datum 1988 (NAVD88). The existing conditions plan is included as **Appendix A**.

A historical Legacy Dam is still partially in place upstream of the Capwell Mill Pond Dam, identified in the topographic survey. This structure is not a registered dam and no longer impounds water due to the presence of the existing Capwell Mill Pond Dam; however, it is visible as an elevated area within the impoundment.

2.4 WETLANDS FLAGGING

EA's wetlands scientist delineated the boundary of the wetlands adjacent to the Capwell Mill Pond and surrounding area on 5 June 2023. The wetlands were flagged, and each flag was marked with an indicator letter using a sequential numbering system along the wetland boundary. The wetland boundary map is included in **Appendix B**. These wetlands flags were located during the topographic survey.

EA delineated the wetlands according to the 1987 U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual (USACE 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (USACE 2011) as well as the Rules and Regulations Governing the Administration and Enforcement of the Freshwater Wetlands Act (Rhode Island Department of Environmental Management [RIDEM] 2010), which are the accepted delineation methods for USACE and RIDEM, respectively.

The wetlands delineation was conducted to assure that the data were available for preparation of any necessary permit applications. Data was collected regarding the presence or absence of hydrophytic vegetation, hydric soils, and hydrology in the wetland and abutting upland areas. Photographs of the wetland and upland areas were taken during the delineation and are included in **Appendix B**.

EA delineated three areas under the jurisdiction of the RIDEM at the site: (1) a forested swamp system, which includes a deciduous forested swamp greater than 10 acres and an evergreen forested swamp greater than 1 acre, which runs through the site from east to west (Wetland A), (2) a deciduous forested swamp less than 1 acre (Wetland B), and (3) Capwell Mill Pond. All freshwater wetlands have an associated 100-ft jurisdictional area, and the Carr River has an associated 200-ft jurisdictional area. The deciduous forested swamp greater than 10 acres has an associated 75-ft buffer zone where it is not within 50-ft of another resource area and an associated 100-ft buffer zone where it is within 50-ft of another resource area. The evergreen forested swamp greater than 1 acre has an associated 100-ft buffer zone. The Carr River located within Wetland A has an associated 200-ft buffer zone. The western portion of Wetland A is located within Federal Emergency Management Agency (FEMA) Flood Zone A, which is considered an Area Subject to Flooding pursuant to 250-RICR-150-15-3.4(A)(6). Wetland A is also presumed to be a jurisdictional Water of the United States under the Clean Water Act.

Additional information on wetlands at the site and wetland delineation practices are described in the Wetland Delineation Letter dated 5 September 2023 provided in **Appendix B.**

2.5 SEDIMENT TESTING

Sediment sampling was not conducted for this site due to the lack of potential pollutant sources. The watershed draining to Capwell Mill Pond is primarily forested and rural land, with no industry or sources of concern for chemical pollutants. Due to the lack of potential sediment contaminant sources, it was determined that sediment testing was not required for an alternatives analysis. However, the regulatory agencies may require sediment testing for permit applications. This will be discussed at the pre-permitting meeting in a future task. There is no data available on the concentration of metals in the soil at the dam site or in the surrounding area.

2.6 CAPWELL MILL POND DAM

The Capwell Mill Pond Dam is located on the Carr River in the Big River Management Area in West Greenwich, Rhode Island. It is owned by the State of Rhode Island. The dam was last inspected in 2007 by GZA; the inspection report (provided as Appendix C) lists the date built as unknown and the purpose of the dam and its impoundment as recreation and conservation (GZA GeoEnvironmental Inc. [GZA] 2007). The dam is 150 ft long with earthen embankments, a 35 ft long broad crested concrete spillway divided into three bays, and a low-level outlet on the river left side. At the downstream face of the embankments, there are stone masonry walls on either side. The upstream face of the left embankment is concrete. The dam is approximately 7 ft tall from the downstream ground surface.

During minimum operating flows of the upstream aquatic migration period, the difference between the head pond and tailwater is approximately 4.3 ft. Capwell Mill Pond drains an area of approximately 6.75 square miles. Additionally, it is common during the summer months for the Capwell Mill Pond Dam to completely cut off flow from Capwell Mill Pond and the Carr River flowing to the Big River.

2.6.1 Structural Observations

The dam is classified as a Low Hazard dam in RIDEM’s 2022 Dam Safety Annual Report (Office of Compliance and Inspection 2022). GZA reports the dam as being a Significant Hazard Dam in their inspection report, which is consistent with RIDEM’s 2007 Annual Dam Safety Report where the dam is listed as a Significant Hazard dam, pending a classification change to Low Hazard (Office of Compliance and Inspection 2007). In RIDEM’s 2008 Annual Dam Safety Report, the dam is classified as a Low Hazard dam (Office of Compliance and Inspection 2008). GZA found the dam to be in poor condition on the 2007 inspection.

EA completed a site visit on 13 December 2021 at the Capwell Mill Pond Dam and noted the following observations during the site visit.

Spillway

The spillway is composed of concrete and stone masonry. Two concrete structures are installed on the dam and split the flow over the spillway into three bays. Both sidewalls and both concrete structures were observed to be heavily eroded. No flashboards were observed to be present at the spillway. Additional observations are below:

- Severe spalling was observed on vertical faces of the sidewalls.
- A network of large cracks is visible on the left face of the left sidewall and on the top faces of the concrete structures.

- The upstream portion of the left sidewall is eroded away and has exposed supporting rebar. Bolts and steel supports are exposed on the concrete structures and right sidewall.

- The concrete mortar has eroded to reveal the aggregate underneath at all concrete structures interfacing with flowing water.

- Two steel pipe outlets were observed in the downstream face of the left concrete training wall:

    - The upper pipe was approximately 2 inches (in.) in diameter with a steady stream of water flowing out of the pipe.

    - The lower pipe was approximately 3 inches (in.) in diameter with no water observed flowing out of the pipe.

- Thick phragmite vegetation and woody beaver debris are present along the entire upstream face, partially blocking the spillway.

Photograph 2-1. Capwell Mill Pond Dam concrete and masonry spillway. Deterioration of concrete structures and vegetation on right bank of dam evident. Looking north.

Photograph 2-2. Spalling at top of left concrete sidewall and exposed rebar protruding from concrete. Looking north.

Low Level Outlet Structure

Water flow and vegetation prevented a complete examination of the low-level outlet, but the outlet appeared to be composed of timber, which has been secured with bolts into two vertical timber posts. These two timber posts also support the timber pedestrian bridge providing access to the left spillway sidewall from the left embankment. The low-level outlet condition could not be examined in detail due to debris and water volume on the day of inspection. The pedestrian bridge timber decking and supporting timber posts appear to be in good condition. Thick and woody vegetation and loose vegetation are present along the upstream face of the low-level outlet, partially blocking the spillway. It has been observed that during the summer months the low-level outlet structure does not flow, resulting in the Capwell Mill Pond Dam completely cutting off hydraulic flow downstream.

Photograph 2-3. Downstream side of timber low-level outlet at spillway. Flow overtopping timber planks which are secured to vertical timber posts. Pedestrian bridge, spalling of concrete, and accumulation of beaver debris within outlet are shown. Looking east.

Left Embankment

The left embankment is an earthen embankment surrounded by a concrete wall along the leftmost and upstream face, and stone masonry along the downstream face of the embankment. The left bank past the concrete wall is lined with stone. The earthen embankment, concrete wall, and stone masonry wall are all observed to be in disrepair:

- Horizontal cracks were observed spanning across the top of the left concrete embankment wall.

- A large and deep scour hole was observed on the downstream side of the concrete embankment wall.

- Several large gaps were visible along the stone masonry wall where stones were missing. Dislodged stones were visible on the ground surrounding the wall at several locations along the length of the wall.

- Fallen trees obstructed the stone masonry wall in some locations. Roots from large trees were observed to be seen within the wall and behind dislodged stones.

- Partial to complete wall collapse was observed in and around the center of the left embankment.

- Two saturated muddy areas were observed at the downstream toe of the left embankment wall approximately 50 ft from the spillway. No other signs of seepage were observed.

- A large and deep scour hole is present at the end of the retaining wall on the left bank.

- The river left downstream retaining wall appears to be bulging outward toward the stream channel just downstream of the location of the scour hole. Several trees are present just behind the retaining wall at this location.

Photograph 2-4. Horizontal cracking across top of concrete portion of left embankment wall at the impoundment and large scour hole in bottom center of photograph. Looking southeast.

Photograph 2-5. Missing stones/gaps in downstream side of masonry left embankment wall near spillway. Looking east.

Right Embankment

Similar to the left embankment, the right embankment is a stone and earthen embankment surrounded by the right concrete spillway sidewall at the rightmost side and a stone masonry wall along the downstream face. The upstream face could not be observed. Some structural issues were observed along the stone masonry wall and footpath:

- A bulge was observed toward the downstream direction. Multiple large trees were observed to be growing on the earth upstream of the wall.

- Portions of the footpath along the upstream face of the impoundment are experiencing erosion, likely resulting from recreational foot traffic. Standing water was observed at two points along the footpath.

- Muddy tire rutting was observed at the northernmost side of the right embankment abutting Burnt Sawmill Road.

Photograph 2-6. Outward bulge of downstream side of right embankment wall. Large tree in top left corner of photograph. Looking south.

Summary

Despite deterioration of the dam structure, there is no indication of immediate danger or dam failure, but EA would still assess many of the structural components as “Poor” at this time because that is the lowest ranking that can be given during a visual inspection based on R.I. Gen. Laws Chapter 46-19, Inspection of Dams and Reservoirs.

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3. HYDROLOGIC AND HYDRAULIC ANALYSIS

3.1 HYDROLOGIC ANALYSIS

EA used appropriate, commonly accepted methodology to define flow conditions and develop a Hydrologic Engineering Centers River Analysis System (HEC-RAS) model of the existing conditions at the Capwell Mill Pond Dam.

3.1.1 FEMA Flood Study

A review of FEMA documents was performed to identify any pertinent flood studies performed for Capwell Mill Pond. No previous flood studies were identified.

3.1.2 Daily Exceedance Flow

The USGS stream gage located at Carr River near Nooseneck, Rhode Island (No. 01115770) is located at the project site just downstream of the dam. This gage recorded flow data directly at the project site, so it was used to calculate an annual flood exceedance curve for the site. Operating flows of minimum (95 percent daily exceedance), normal (50 percent daily exceedance), and maximum (5 percent daily exceedance) rates were calculated to represent varying flow events throughout the year, shown in **Table 3-1**. The design species for aquatic passage (trout) require passage through much of the year, so daily maximum flow rate data throughout the calendar year was analyzed to determine design flows. These exceedance values represent the percent likelihood of the flow magnitude exceeding the listed values on a day, based on historical flow data. Operating aquatic passage flows were calculated using methodology described in the Fish Passage Engineering Design Criteria (U.S. Fish and Wildlife [USFWS] NE Region 2019).

Table 3-1. Annual Flow Duration Curve

Flow Event	Flow (cfs) for Percent Time Exceeded
95 percent Exceedance	1
50 percent Exceedance	11
5 percent Exceedance	41

Notes:
cfs = Cubic foot (feet) per second

3.1.3 Peak Flow Recurrence Intervals

Flood conditions were estimated using data from a different gage than the one used for exceedance flows. The period of record for stream flow at the Carr River gauge at the project site is too short for annual recurrence analysis, as the Fish Passage Engineering Design Criteria dictate that no less than 10 years be available for flood flow events up to and including the 100-year flood, and the Carr River gauge only includes 6 years of data. The gage at Nooseneck River was determined to be an appropriate comparison to the Carr River gage because the topography, slope, and land cover of the contributing watersheds are similar. An area-ratio based approximation was used to estimate flow intervals for the project site based on methodology in the Fish Passage Engineering Design

Criteria (USFWS NE Region 2019). Flow data was available from 2007 to 2023 at the Nooseneck gauge location, providing a large enough sample size that is recent enough to reflect current climatic conditions for the area.

The 50-year and 100-year recurrence flow was calculated to represent flood conditions at the project site. A Log-Pearson Type III distribution curve was used to extrapolate data from the gage and calculate flood flows. This is standard practice for predicting flow recurrence intervals, and the methodology described in USGS guidelines. The existing historical annual maximum flow data was fit to the flow distribution curve, and flow intervals for 50 and 100 years were calculated and are presented in **Table 3-2**.

Table 3-2 . Peak Flow Intervals

Storm Event	Peak Discharge (cfs)
100-year	689
50-year	533

3.2 EXISTING RIVER HYDRAULIC ANALYSIS

EA developed a HEC-RAS model of the Carr River at the Capwell Mill Pond Dam to evaluate existing water levels and velocities in the river over the range of aquatic passage flows and flood event flows. Results of the HEC-RAS model are presented in **Tables 3.3** and **3.4**.

The HEC-RAS model was developed to represent localized flows under existing conditions near the Capwell Mill Pond Dam. The model incorporates cross sectional data obtained from the topographic survey and lidar data supplied by USGS. Cross sections from the survey extend approximately 3,643 ft upstream and 100 ft downstream of the dam. The model has 24 sections, 9 of which are downstream of the dam and 15 of which are upstream of the dam.

Manning's n, a roughness coefficient to describe how water will flow over the surface was calculated for three different surface types: main channel, submerged vegetated areas in the pond, and forested overbank. Manning's n was calculated using Cowan's method, which categorizes various surface and river characteristics and calculates a value. In the existing conditions model, a Manning's n of 0.046 was used for the channel, 0.069 was used for the submerged vegetated areas, and 0.101 was used for left and right forested overbanks. Bridge shape and dimensions, and dam spillway dimensions were based on survey data and analyzed in Civil3D CADD software. HEC-RAS output files are included in Appendix D.

Flow was modeled through the existing channel at the three operating flows, and at the two flood events calculated. Results of the modeling up and downstream of the dam are displayed in **Tables 3-3 and 3-4**. For reference, the elevation of the bottom of the bridge at the top of its arch is 252.3 ft, the elevation of the top of the bridge is 254.8 ft, and the elevation of the spillway crest is 256.6 ft.

Table 3-3. Existing Water levels and Channel Velocities Immediately Upstream of Dam

Flow Condition	Water Surface Elevation (ft)	Channel Velocity (ft/s)
Minimum Operating Flow	254.91	0.02
Normal Operating Flow	255.15	0.21
Maximum Operating Flow	255.49	0.64
50-Year Storm Event	257.12	4.29
100-Year Storm Event	257.27	5.14

Notes:
ft/s = Foot (feet) per second

Table 3-4. Existing Water levels and Velocities Immediately Downstream of Dam

Flow Condition	Water Surface Elevation (ft)	Channel Velocity (ft/s)
Minimum Operating Flow	249.57	1.57
Normal Operating Flow	249.85	3.35
Maximum Operating Flow	250.35	5.06
50-Year Storm Event	252.63	9.81
100-Year Storm Event	253.65	8.66

Flow is overtopping the spillway during the 50-year and 100-year storm event.

3.3 AQUATIC PASSAGE OPERATING CRITERIA

Flow conditions necessary for passage of brook trout, including water depth and velocity, were considered for this analysis. Design considerations for passage during the brook trout run season, which is year-long, were adapted from the 2019 Fish Passage Engineering Design Criteria (USFWS 2019) and include:

- Maximum fishway channel slope of 1:20 (vertical: horizontal)
- Depth of flow greater than or equal to three times the maximum fish's body depths
    - Brook trout has maximum body depth of 11.5 centimeters (cm), so depth of flow must be greater than 34.4 cm (1.12 ft)
- Maximum opening velocity of 3.25 ft/s

These considerations will be utilized in the feasibility study to analysis the preferred alternative.

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4. EVALUATION OF ALTERNATIVES

4.1 ALTERNATIVES

EA prepared three alternative conceptual engineering designs of aquatic passage alternatives for the Capwell Mill Pond Dam. The alternatives include: (1) No Action, (2) removal of Capwell Mill Pond Dam only, and (3) removal of Capwell Mill Pond Dam and the Legacy Dam. The two removal alternatives would include removal of the concrete dam structure and excavation of impounded sediment upstream of the dam. Alternatives 2 and 3 would both provide for aquatic passage at the Capwell Mill Pond Dam, if implemented. The primary difference in outcomes between Alternatives 2 and 3 is the effect of the Legacy Dam after the existing dam removal, and the potential for it to impound water. **Table 6-1** provides a summary of the costs, and advantages and disadvantages of each alternative.

4.2 ALTERNATIVE 1 – NO ACTION

4.2.1 Introduction/Description

The Alternative 1 – No Action would leave the Capwell Mill Pond Dam in its current state, with no removal of existing dam infrastructure. Under Alternative 1, the dam would remain an obstruction to aquatic passage, and benefits to the State's fisheries, wetlands, and water quality associated with the Capwell Mill Pond Dam Removal Project would not be realized.

4.2.2 Level of Achievement of Project Goals

The Alternative 1 – No Action would leave the Capwell Mill Pond Dam in its current state and would continue to impact the essential upstream and downstream migration of trout to the Capwell Mill Pond.

4.2.3 Design Considerations and Concerns

There are no design considerations and/or concerns associated with the Alternative 1 – No Action. The Capwell Mill Pond Dam would remain in its current state.

4.2.4 Cost Estimate

There are no direct costs associated with the Alternative 1 – No Action. The Capwell Mill Pond Dam would remain in its current state. Due to the condition of the existing dam, ongoing maintenance might be needed in future years to maintain the structural integrity of the dam and reduce the potential for failure.

4.3 ALTERNATIVE 2 – REMOVAL OF CAPWELL MILL POND DAM ONLY

4.3.1 Introduction/Description

Alternative 2 – Removal of Capwell Mill Pond Dam only would include the removal of the concrete structure of the existing Capwell Mill Pond dam and spillways, excavation of the left and right embankments to natural conditions, and possibly excavation of sediment impounded behind the dam. With the removal of the concrete dam and a portion of the earthen embankments, it is likely that the flow of the Carr River would carve a channel through the impounded sediment naturally, removing the need for soil excavation behind the dam and moving it downstream.

4.3.2 Level of Achievement of Project Goals

Alternative 2 would achieve the project goals of restoring trout aquatic passage at Capwell Mill Pond on the Carr River by removing the current impediment to aquatic passage. It is possible that this alternative would not fully achieve project goals however, as the upstream Legacy Dam could begin to impound water after the dam is removed and could be a barrier to aquatic passage.

4.3.3 Design Considerations and Concerns

One concern for Alternative 2 is the possibility of the Legacy Dam becoming a flow barrier after the existing dam is removed. If this structure were to impound water, it would need to be registered with the Office of Dam Safety. Due to the poor condition of the Legacy Dam, it would likely not receive approval as a licensed dam from the Office of Dam Safety in its existing poor condition.

4.4 ALTERNATIVE 3 – REMOVAL OF THE CAPWELL MILL POND DAM AND LEGACY DAM

4.4.1 Introduction/Description

Alternative 3 – Removal of the Capwell Mill Pond Dam and Legacy Dam includes removal of the Capwell Mill Pond Dam and the Legacy Dam located upstream of the existing dam. This would include removal of all concrete infrastructure, spillways, and left and right overbanks extending beyond the existing dam structure, and excavation of remaining stone, soil and sediment from the Legacy Dam. Some additional excavation of impounded sediment upstream of the existing dam may also be necessary for channel re-establishment.

4.4.2 Level of Achievement of Project Goals

The design of Alternative 3 would most likely remove all current impediments to aquatic passage and re-establish the ability for trout to travel up and down stream to access spawning habitat.

4.4.3 Design Considerations and Concerns

The current dam in place is a run-of-river dam, so removal of the dam should not significantly impact the flows of the Carr River below the dam. However, the bridge located just downstream of the Capwell Mill Pond Dam may act as a new impounding structure following the removal of the existing dam.

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6. EVALUATION OF ALTERNATIVES

Order-of-magnitude opinions of cost (-30%/+50%) associated with a conceptual level of design for the presented alternatives are provided below. These costs are presented in 2023 dollars and include a range typically associated with order-of-magnitude costs. These costs also include approximate amounts for engineering design and environmental permitting.

Cost estimates were calculated using a tool for estimating order of magnitude costs for dam removal, based on a comprehensive analysis of previous dam removal projects of comparable size and complexity (Duda, et al. 2023). For this level of estimation, the following parameters were used:

- Dam height: 7 ft
- Dam material: masonry/concrete/steel
- Project complexity: 0.1 (on a scale of 0–1)
- Average discharge: 11 cfs
- Drainage area: 6.75 square miles
- Location: Rhode Island

Table 6-1. Alternatives Summary

Alternative	Advantages	Disadvantages	Costs
Alternative 1 – No Action	• Maintains recreation fishing from dam	• Would not achieve the project goals of providing aquatic passage and reducing stagnant water • Increases risk to community downstream • Increases recreational safety risks • Requires repairing existing dam	Insufficient information available to estimate repair and maintenance costs. Most recent dam inspection dated 2007. Estimated cost of a dam inspection is ~$15,000.
Alternative 2 – Removal of the Capwell Mill Pond Dam	• Reduces risk to community downstream • Improves aquatic passage • Improves water quality • Establishes and enhances wetlands and water filtration	• Does not remove Legacy Dam (potential incomplete aquatic passage) • Elimination of existing recreational space	$388,500 – $832,000
Alternative 3 – Removal of the Capwell Mill Pond Dam and Legacy Dam	• Removes risk to community downstream • Would achieve aquatic passage • Improves water quality • Establishes and enhances wetlands and water filtration	• Additional complexity to construction (Legacy Dam access) • Slightly higher construction cost • Elimination of existing recreational space	$402,500 – $862,500

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7. SUMMARY AND CONCLUSIONS

EA has evaluated three alternatives to provide effective year-round aquatic passage at the Capwell Mill Pond Dam, located in West Greenwich, Rhode Island. The existing dam does not currently provide upstream aquatic passage into Capwell Mill Pond and is significantly increasing water temperatures downstream to lethal levels for cold-water fish species.

Alternative 1 would include a do-nothing approach. This approach would minimize wetland and sediment disturbance but would not meet the project goals of aquatic passage, reducing stagnated water and reducing water temperatures in the impoundment. This alternative would also leave the State with the liability of a structurally deficient dam in poor condition, which the State would need to improve and be responsible for regular inspections and maintenance.

Alternative 2 would include removal of Capwell Mill Pond Dam. This would provide aquatic passage but could create a new impoundment with the Legacy Dam in place.

Alternative 3 would include the removal of the Capwell Mill Pond Dam and the upstream Legacy Dam. This would provide aquatic passage and reduce the risk of creating a new impoundment after construction is complete.

Alternatives 2 and 3 would consist of relatively similar construction approaches, would have similar operational requirements, and would require approximately three months to complete. Alternative 3 would require more time for completion and more stone/soil removal. The cost estimates indicate that removing only the Capwell Mill Pond Dam is the most cost-effective option, while removal of both the existing and Legacy Dam is the option recommended due to the greater chance of it being permitted by RIDEM and USACE, and the increased effectiveness of removing both dam features.

Although not immediately necessary for aquatic passage, EA recommends addressing the condition of the existing Capwell Mill Pond Dam as this section is in relatively poor condition and could potentially pose a hazard should the dam reach a state of impaired structural integrity. EA also recommends addressing the condition of the downstream bridge, as it currently has a large crack on the upstream face. Repair to this structure during demolition of the dam would require additional construction access and a change in design scope to design the repair.

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8. REFERENCES

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Appendix A.

Existing Conditions

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FILE PATH: \\WARWICKFP\WARWICKFP\CAD\PROJECTS\6364302 - RITU CAPWELL MILL POND DAM\CAD\PRODUCTION\DESIGN SET\6364302-CAPWELLMILLPONDDAM-PLANSET.DWG [C-101] ALLEN, DANIEL 9/23/2023 7:37 PM

EA Engineering, Science, and Technology, Inc., PBC

301 Metro Center Blvd, Suite 102
Warwick, Rhode Island 02886
(401) 736-3440
www.eaest.com

N

HORIZONTAL DATUM:
RI83F

VERTICAL DATUM:
NAVD88

0 5 10 20
GRAPHIC SCALE IN FEET

FULL SIZE PLOT: 24" x 36"

REVISIONS

SEAL

PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF RHODE ISLAND. LICENSE NO. XXX
EXPIRATION DATE: XXX

PROJECT NAME
CAPWELL MILL POND DAM
REMOVAL FEASIBILITY
STUDY AND DESIGN

PROJECT ADDRESS
BURNT SAWMILL ROAD
WEST GREENWICH,
RHODE ISLAND

DRAWING TITLE
EXISTING CONDITIONS PLAN

DRAWING INFORMATION
DRAWN BY: DPA
DESIGNED BY: XXX
CHECKED BY: XXX
PROJECT MANAGER: AEH
PROJECT NUMBER: 6364302

DRAWING NO.
C-101

DATE: SEPTEMBER 2023
SHEET: 1 OF 1

CONCEPT DESIGN PLANS - NOT FOR CONSTRUCTION

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Appendix B.

Wetland Delineation Technical Memorandum

EA Engineering, Science,
and Technology, Inc., PBC

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Warwick, Rhode Island 02886
Telephone: 401-736-3440
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September 5th, 2023

Mr. Glenn Place
President
Trout Unlimited, Rhode Island Chapter 225
203 Arcadia Road
Hope Valley, RI 02832

RE: Wetland Delineation Technical Memorandum
Capwell Mill Pond Dam
Burnt Sawmill Road, West Greenwich, Rhode Island 02882
EA Project No. 6364302

Dear Mr. Place,

EA Engineering, Science, and Technology, Inc., PBC (EA) is pleased to provide you with this wetland delineation technical memorandum for the Capwell Mill Pond Dam located off Burnt Sawmill Road in West Greenwich, Rhode Island (the site). EA completed a delineation of jurisdictional wetland resource areas at the site on June 5, 2023. The area of review for the wetland delineation was an approximately seven-acre area surrounding the dam both upstream and downstream.

SITE DESCRIPTION

Capwell Mill Pond Dam is located in the Big River Management Area in West Greenwich, Rhode Island. The dam impounds the Carr River, thus creating Capwell Mill Pond. The Carr River continues approximately 1,000 feet downstream of the dam to its confluence with the Big River. The entirety of the site is within a forested swamp (see description of Wetlands A and B) and upland. The site contains numerous hiking and mountain biking trails as well as a semi-paved road for the enjoyment of the public. The area immediately surrounding the dam itself attracts many fishermen interested in the pond's warmwater fishery.

Freshwater wetlands at the site are not located within the vicinity of the coast and therefore are expected to be regulated at the state level pursuant to 250-RICR-150-15-3, *Rules and Regulations Governing the Administration and Enforcement of the Freshwater Wetlands Act*.

Based on a review of the Freshwater Wetlands Buffer Regions Map provided at 250-RICR-150-15-3.24, the site is located entirely within River Protection Region 2 and is not located within a Public Drinking Water Supply Reservoir Watershed. River Protection Regions 1 and 2 are defined at 250-RICR-150-15-3.23(B)(1) as "*watershed areas that are high priorities for conservation of fish and wildlife habitat, including rivers which rank highest on a Rhode Island stream condition index, as well as areas of the State that exhibit a mix of land uses and watershed characteristics and settings.*"

DESKTOP DATA REVIEW

EA completed a review of publicly-available desktop data sources prior to conducting the field delineation to determine the general extent of wetlands on the site and evaluate overall site conditions. A summary of the desktop data sources reviewed is provided below.

State Wetlands Mapping

EA reviewed publicly-available geospatial data from Rhode Island Department of Environmental Management (RIDEM) to determine the extent of wetlands mapped by the RIDEM located on the site. RIDEM wetlands mapping data indicates the presence of two wetland systems located on or in the immediate vicinity of the site: forested wetland, coniferous and forested wetland, deciduous.

Federal Wetlands Mapping

EA reviewed publicly-available geospatial data from the United States Fish and Wildlife Service (USFWS) to determine the extent of wetlands mapped under the National Wetlands Inventory (NWI) located on the site. NWI mapping data indicates the presence of four NWI-mapped wetlands on the site:

- A 2.57-acre freshwater forested/shrub wetland classified as PFO1E.
- A 5.24-acre freshwater forested/shrub wetland classified as PFO1E.
- A 17.20-acre riverine habitat classified as R2UBH.
- A 21.14-lake habitat classified as L1UBHh.

Flood Zones

EA reviewed Federal Emergency Management Agency (FEMA) flood mapping data available from RIDEM to determine whether any portion of the site is located within a mapped flood zone. A small part of the western portion of the site intersects Flood Zone A which is defined as *Areas subject to inundation by the 1-percent-annual-chance flood event*. Flood Zone A is associated with the Big River and the Carr River as one of its tributaries.

Soils

EA reviewed soils mapping data for the site provided by the Natural Resources Conservation Service (NRCS). NRCS data indicates the presence of four soil map units at the site, as described below.

Canton and Charlton fine sandy loams, 0 to 8 percent slopes, very stony (ChB): This well drained soil is derived from coarse-loamy melt-out till from granite, gneiss, and/or schist. The depth to water table and restrictive feature is more than 80 inches. This soil map unit is not considered a hydric soil.

Hinckley loamy sand, 0 to 3 percent slopes (HkA): This excessively drained soil is derived from sandy and gravelly glaciofluvial deposits from gneiss and/or granite and/or schist. The depth to water table and restrictive feature is more than 80 inches. This soil map unit is not considered a hydric soil.

Merrimac fine sandy loam, 3 to 8 percent slopes (MmB): This somewhat excessively drained soil is derived from loamy glaciofluvial deposits from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss. The depth to water table and restrictive feature is more than 80 inches. This soil map is not considered a hydric soil.

Swansea muck, 0 to 1 percent slopes (SwA): This very poorly drained soil is derived from highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits. The depth to water table is approximately 0 to 6 inches. The depth to restrictive feature is more than 80 inches. This soil map unit is considered a hydric soil.

Other Regulated Areas

EA reviewed publicly-available geospatial data from RIDEM to determine whether any of the following features have been identified on or in the immediate vicinity of the project site:

- Natural Heritage Area (NHA)
- Critical or Uncommon Habitat
- Unfragmented Forested Blocks
- Environmental Justice Area
- High Value/ High Vulnerability Habitat

Based on this review, the site is located within NHA 154, High Value/ High Vulnerability Habitat area, and an Unfragmented Forest Block over 500-acres. None of the other above-referenced features are currently identified on or in the immediate vicinity of the project site.

FIELD DELINEATION

The field delineation of wetland resource areas at the site was completed in accordance with the procedures identified in 250-RICR-150-15-3, *Specific Criteria for Identifying Freshwater Wetlands and Floodplain Edges*; the *Corps of Engineers Wetlands Delineation Manual* (USACE 1987); and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region Version 2.0* (USACE 2012). The field delineation was completed through an evaluation of three parameters to determine the location of the wetland boundary: (1) predominance of hydrophytic vegetation, (2) presence of hydric soils, and (3) presence of wetland hydrology. A summary of each of these parameters is provided below.

Hydrophytic Vegetation: The hydrophytic vegetation parameter is met if more than 50% of the dominant plant species present have a wetland indicator status of obligate (OBL), facultative wetland (FACW), or facultative (FAC). Wetland indicator statuses of plant species have been categorized regionally in the *National Wetland Plant List v3.4* (USACE 2018). Each plant species is classified into one of five categories as follows:

- Obligate (OBL) = Almost always occurs in wetlands.
- Facultative Wetland (FACW) = Usually occurs in wetlands but may occur in non-wetlands.
- Facultative (FAC) = Occurs in wetlands and non-wetlands.
- Facultative Upland (FACU) = Usually occurs in non-wetlands but may occur in wetlands.
- Upland (UPL) = Rarely occurs in wetlands.

Hydric Soils: The hydric soil parameter is met if soils can be inferred or observed to have a high groundwater table, if there is evidence of prolonged soil saturation, or if there are indicators suggesting a long-term reduced environment in the upper 18 inches of the soil profile. Hydric soil indicators from the *Regional Supplement* were used to determine whether soils in a particular location met the hydric soil parameter.

Wetland Hydrology: The wetland hydrology parameter is met at a location based on conclusions inferred from field observations that indicate that an area has a high probability of being inundated or saturated (flooded, ponded, or tidally influenced) long enough during the growing season to develop anaerobic conditions in the surface soil environment, especially within the root zone.

Wetlands were identified in the field by marking the wetland boundary with consecutively-numbered pink flagging labeled “WETLAND BOUNDARY.” Flags were tied such that each flag was visible from the flag tied both before and after. The location of wetland flags was recorded using a real-time kinematic (RTK) global positioning system (GPS) or a sub-meter-accurate Trimble Geo7x GPS. Flags A-1 O/S through A-30 and A1-10 through A1-20 were recorded using RTK. Flags A-31 through A-37 O/E, A1-1 O/S through A1-10, A1-21 through A1-32 O/E, and B-1 C/S through B-9 C/E were recorded using the Trimble Geo 7x. Indicators of wetland vegetation, soils, and hydrology were observed throughout the site to help determine the location of the wetland boundary. A Wetland Edge Delineation Form was completed for Wetland A.

A description of the jurisdictional areas identified in the field is provided below.

Wetland A

Wetland A occupies a large portion of the site and on both the northern and southern sides of the dam. Wetland A was delineated in the field by flag series A-1 (open start) to A-37 (open end) and A1-1 (open start) to A1-32 (open end). Wetland A extends off site to the northeast, southeast, and west. In accordance with 250-RICR-150-15-3.23(E)(3-4), Wetland A is comprised of a deciduous forested swamp and an evergreen forested swamp; in accordance with 250-RICR-150-15-3.23(H)(3), deciduous forested swamps greater than or equal to ten (10) acres in size have an associated 75-foot wide buffer zone and evergreen forested swamps greater than or equal to one (1) acre have an associated 100-foot buffer zone.

Wetland A includes the Carr River which flows in a generally westerly direction downstream of the dam. The stream meets the definition of “river” pursuant to 250-RICR-150-15-3.4(A)(64). In accordance with 250-RICR-150-15-3.23(H)(5), the Carr River in River Protection Region 2 has an associated 200-foot wide buffer zone.

In addition to being a regulated area pursuant to 250-RICR-150-15-3, Wetland A is presumed to be jurisdictional under Section 404 of the federal Clean Water Act (CWA, 33 U.S.C. §1251 et seq.).

Vegetation: Wetland A is primarily a forested swamp. Vegetation observed in Wetland A included red maple (*Acer rubrum*), Atlantic white cedar (*Chamaecyparis thyoides*), yellow birch (*Betula alleghaniensis*), sweet pepperbush (*Clethra alnifolia*), highbush blueberry (*Vaccinium corymbosum*), poison sumac (*Toxicodendron vernix*), eastern poison ivy (*Toxicodendron radicans*), royal fern (*Osmunda spectabilis*), cinnamon fern (*Osmundastrum cinnamomeum*), skunk cabbage (*Symplocarpus foetidus*), three-leaf goldthread (*Coptis trifolia*), sensitive fern (*Onoclea sensibilis*), New York fern (*Parathelypteris noveboracensis*), and *Sphagnum* moss .

Plant species observed growing within Capwell Mill Pond included pickerelweed (*Pontederia cordata*), white water lily (*Nymphaea odorata*), bayonet rush (*Juncus militaris*), blue flag (*Iris versicolor*), and common reed (*Phragmites australis*).

Soils: The majority of Wetland A is located within the Merrimac fine sandy loam, 3 to 8 percent slopes soil map unit which is considered a hydric soil. Wetland A is also partially located within the Hinckley loamy sand, 0 to 3 percent slopes and Swansea muck, 0 to 1 percent slopes soil map units, neither of which is considered a hydric soil. At Wetland A data plot 1 (located between flags A-3 and A-4), soils were observed to be an organic duff to a depth of 3 inches below the surface, a very dark grey (10YR 2/1) fine sandy loam between 3 and 5 inches below the surface, a dark grey (10YR 3/2) fine sandy loam between 5 and 15 inches below the surface, and a greyish-brown (10YR 5/4) clayey loam between 15 and 25 inches below the surface.

Hydrology: Indicators of wetland hydrology observed in Wetland A included water-stained leaves and high water table at 6 inches.

Wetland B

Wetland B is an isolated deciduous swamp located on the northern downstream side of the dam. Wetland B was delineated by flag series B-1 (closed start) to B-9 (closed end). In accordance with 250-RICR-150-15-3.23(H)(3), any swamp less than one (1) acre in size have an associated 25-foot wide buffer zone.

Vegetation: Primary plant species observed within Wetland B included skunk cabbage, red maple, sweet pepperbush, highbush blueberry, cinnamon fern, *Sphagnum* moss, poison ivy, royal fern, three-leaf goldthread, sensitive fern, and New York fern.

Soils: Wetland B is located within the Merrimac fine sandy loam, 3 to 8 percent slopes soil map unit which is considered a hydric soil.

Hydrology: Hydrology indicators in Wetland B included water-stained leaves and saturation at the surface.

Adjacent Upland Areas

The upland areas adjacent to Wetlands A and B occupy a large portion of the area within the delineation boundary and generally extend to the north and south of the dam between the wetlands and Burnt Sawmill Road. Given that the area is primarily used for public recreation, the adjacent upland areas are primarily forested and undisturbed with the exception of Burnt Sawmill Road meant to allow access to the area for the public and administrative staff. Plant species observed in these areas included eastern white pine (*Pinus strobus*), red maple, Highbush blueberry, tree-clubmoss (*Dendrolycopodium sp.*), starflower (*Lysimachia borealis*), catbrier (*Smilax bona-nox*), Canada mayflower (*Maianthemum canadense*), lowbush blueberry (*Vaccinium angustifolium*), northern bayberry (*Morella pensylvanica*), eastern hemlock (*Tsuga canadensis*), poison ivy, black cherry (*Prunus serotina*), Indian cucumber-root (*Medeola virginiana*), hay-scented fern (*Dennstaedtia punctilobula*), Virginia creeper (*Parthenocissus quinquefolia*), trailing blackberry (*Rubus ursinus*), steeplebush (*Spiraea tomentosa*), Asian bittersweet (*Celastrus orbiculatus*), Japanese barberry (*Berberis thunbergii*), European buckthorn (*Rhamnus cathartica*), multiflora rose (*Rosa multiflora*), American chestnut (*Castanea dentata*), sweet pepperbush, and cinnamon fern.

SUMMARY

EA completed a delineation of jurisdictional wetland resource areas at Capwell Mill Pond dam on June 5, 2023. EA delineated three areas under the jurisdiction of the RIDEM at the site: a forested swamp system which includes a deciduous forested swamp greater than ten acres and an evergreen forested swamp greater than 1 acre which runs through the site from east to west (Wetland A), a deciduous forested swamp less than 1 acre (Wetland B), and Capwell Mill Pond. All freshwater wetlands have an associated 100-foot jurisdictional area, and the Carr River has an associated 200-foot jurisdictional area. The deciduous forested swamp greater than 10 acres has an associated 75-foot buffer zone where it is not within 50-feet of another resource area and an associated 100-foot buffer zone where it is within 50-feet of another resource area. The evergreen forested swamp greater than one acre has an associated 100-foot buffer zone. The Carr River located within Wetland A has an associated 200-foot buffer zone. The western portion of Wetland A is located within FEMA Flood Zone A, which is considered an Area Subject to Flooding (ASF) pursuant to 250-RICR-150-15-3.4(A)(6). Wetland A is also presumed to be a jurisdictional Water of the United States under the CWA.

EA appreciates the opportunity to provide Trout Unlimited with professional environmental consulting services. Should you have any questions or require additional information, please do not hesitate to contact me at qmilton@eaest.com or (401) 352-5740.

Sincerely,

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC

Quincy M III

Quincy Milton III
Ecologist

Attachments:
Photographic Log
Wetland Edge Delineation Form
Figures

Photographic Log

Photograph 1: Pond from north side of dam.

Photograph 2: Evergreen forested wetland.

Photograph 3: Evergreen forested wetland facing south.

Photograph 4: Facing east from top of dam.

Photograph 5: View from south side of dam.

Photograph 6: View of dam from Burnt Sawmill Road.

Photograph 7: View downstream of dam.

Photograph 8: Main dam area.

Photograph 9: Downstream of dam.

Photograph 10: Deciduous forested swamp.

Data Form

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RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER RESOURCES - Groundwater and Freshwater Wetlands Protection
FRESHWATER WETLANDS PROGRAM
235 Promenade Street, Providence, RI 02908
Telephone: 401-222-6820; Rhode Island Relay: 711
www.dem.ri.gov/wetlands

WETLAND EDGE DELINEATION FORM INSTRUCTIONS

Pursuant to § 3.9.3(E) of the Rules and Regulations Governing the Administration and Enforcement of the Freshwater Wetlands Act (Rules) [250-RICR-150-15-3], applicants must complete, and provide to RIDEM, documentation which describes the reasoning used to delineate wetland edges whenever requesting verification of a wetland edge. For this purpose, the applicant must complete the attached Wetland Edge Delineation Forms. These forms (see attached) are not meant to provide quantitative plot data, but rather to provide RIDEM with an outline of the reasoning used to delineate a particular **wetland edge**. While the vegetative community may change abruptly in some circumstances, other plant communities may transition very gradually to upland. In these cases, other hydrologic indicators, such as soil redoximorphic features, often must be considered in determining existing hydrological conditions. Completion of these data forms will provide RIDEM biologists with a clearer understanding of all the factors considered by an applicant or their consultant in delineating the boundary of a given wetland area.

At a minimum, one set of data forms (upland and wetland) must be completed for each wetland on the site. More than one set should be provided wherever changes in vegetative community composition, soil characteristics, topography, or other factor(s) might cause a change in reasoning for determination of the wetland edge. For example, if the edge of wetland "X" is located at the base of a steep slope with a clear vegetative break in one area (Flag Nos 1-27), but within a broad, transitional zone dominated by facultative vegetation in another area (Flag Nos. 28-56), at least two sets of data forms should be filled out for that wetland, since the reasoning behind the delineation (changes in vegetative species, topography and/or soil characteristics) is different in the two areas. If only one set of data forms is provided for a given wetland, it will be assumed that the same reasoning was used for determination of the entire wetland edge and the wetland flagging will be reviewed accordingly.

Properly completed forms which support an accurate edge only increase the speed by which RIDEM's verification can be completed. This in turn will get a quicker, less troublesome answer back to the applicant. Substantial inaccuracies can often be attributed to a lack of supporting data used to locate the wetland edge. In turn, these inaccuracies only increase delays and problems with verifying the wetland edge.

All wetland edge delineations are to be accomplished in accordance with § 3.21 of the Rules.

Wetland Edge Delineation Data Form (UPLAND)

Applicant: Rhode Island Trout Unlimited

Project Name: Capwell Millpond Dam Removal Feasibility Study

City/Town: West Greenwich

Wetland No. A

Flag No. Sequence: A-1 (o/s) to A-37 (c/s), A1-1 - A1-32

Delineation Date: June 5, 2023

Vegetation: List the three dominant species in each vegetative strata along with their NWI status:

Tree	Indicator Status	Herbs	Indicator Status
Eastern white pine (Pinus strobus)	FACU	Starflower (Lysimachia borealis)	NC
Black cherry (Prunus serotina)	FACU	Canada mayflower (Maianthemum canadense)	FACU
Eastern hemlock (Tsuga canadensis)	FACU	Hay-scented fern (Dennstaedtia punctilobula)	UPL

Saplings/Shrubs	Indicator Status	Woody Vines	Indicator Status
Coastal sweet-pepperbush (Clethra alnifolia)	FAC	Eastern poison ivy (Toxicodendron radicans)	FAC
Highbush blueberry (Vaccinium corymbosum)	FACW	Asian bittersweet (Celastrus orbiculatus)	FACU
Lowbush blueberry (Vaccinium angustifolium)	FACU	Virginia-creeper (Parthenocissus quinquefolia)	FACU

List other vegetative species noted which may have affected determination of the wetland edge:

Soil: SCS Soil Survey Mapping Unit: Hinckley loamy sand, 0 to 3 percent slopes

On Hydric Soils List? ☐ YES ☑ NO

Soil Profile (Note wetland flag no. nearest soil test pit): A-4

Horizon	Depth	Matrix Color	Mottling Description	Depth to Saturation	Depth to Free Water
O	0-3"	Organic Duff	Not encountered	Not encountered	Not encountered
A	3-5"	7.5YR 2.5/3			
B	5-16"	7.5YR 2.5/1			
B	16-28"	10YR 5/6			

Other indicators exhibiting an absence of wetland hydrology (e.g. absence of water marks, lack of redoximorphic features, lack of oxidized rhizospheres, etc.): No water-stained leaves, lack of high water table, lack of saturation

Landscape position:

Altered/atypical situation? (describe):

Comments: See attached delineation report for additional information.

Wetland Edge Delineation Data Form (WETLAND)

Applicant: Rhode Island Trout Unlimited

Project Name: Capwell Millpond Dam Removal Feasibility Study

City/Town: West Greenwich

Wetland No. A

Flag No. Sequence: A-1 (o/s) to A-37 (c/s), A1-1 - A1-32

Delineation Date: June 5, 2023

Vegetation: List the three dominant species in each vegetative strata along with their NWI status:

Tree	Indicator Status	Herbs	Indicator Status
Atlantic white cedar (Chamaecyparis thyoides)	OBL	Cinnamon fern (Osmundastrum cinnamomeum)	FACW
Red maple (Acer rubrum)	FAC	Skunk-cabbage (Symplocarpus foetidus)	OBL
Yellow birch (Betula alleghaniensis)	FAC	Sensitive fern (Onoclea sensibilis)	FACW

Saplings/Shrubs	Indicator Status	Woody Vines	Indicator Status
Coastal sweet-pepperbush (Clethra alnifolia)	FAC	Eastern poison ivy (Toxicodendron radicans)	FAC
Highbush blueberry (Vaccinium corymbosum)	FACW	N/A	N/A
N/A	N/A	N/A	N/A

List other vegetative species noted which may have affected determination of the wetland edge: Sphagnum moss present in some portions of Wetland A. Wetter areas also contain cattail (Typha latifolia) and common reed (Phragmites australis).

Soil: SCS Soil Survey Mapping Unit: Hinckley loamy sand, 0 to 3 percent slopes

On Hydric Soils List? ☐ YES ☐ NO

Soil Profile (Note wetland flag no. nearest soil test pit): A-4

Horizon	Depth	Matrix Color	Mottling Description	Depth to Saturation	Depth to Free Water
O	0-3"	Organic Duff	Not observed		
A	3-5"	10YR 2/1	Not observed		
B	5-15"	10YR 3/2	Not observed		6"
B	15-25"	10YR 5/4	Not observed		

Other indicators exhibiting an absence of wetland hydrology (e.g. water marks, drainage patterns, root rhizospheres, etc.; see § 3.21.1 (D) of the Rules): Water-stained leaves, water table at 6".

Landscape position: Floodplain

Altered/atypical situation? (describe):

Comments: See attached delineation report for additional information.

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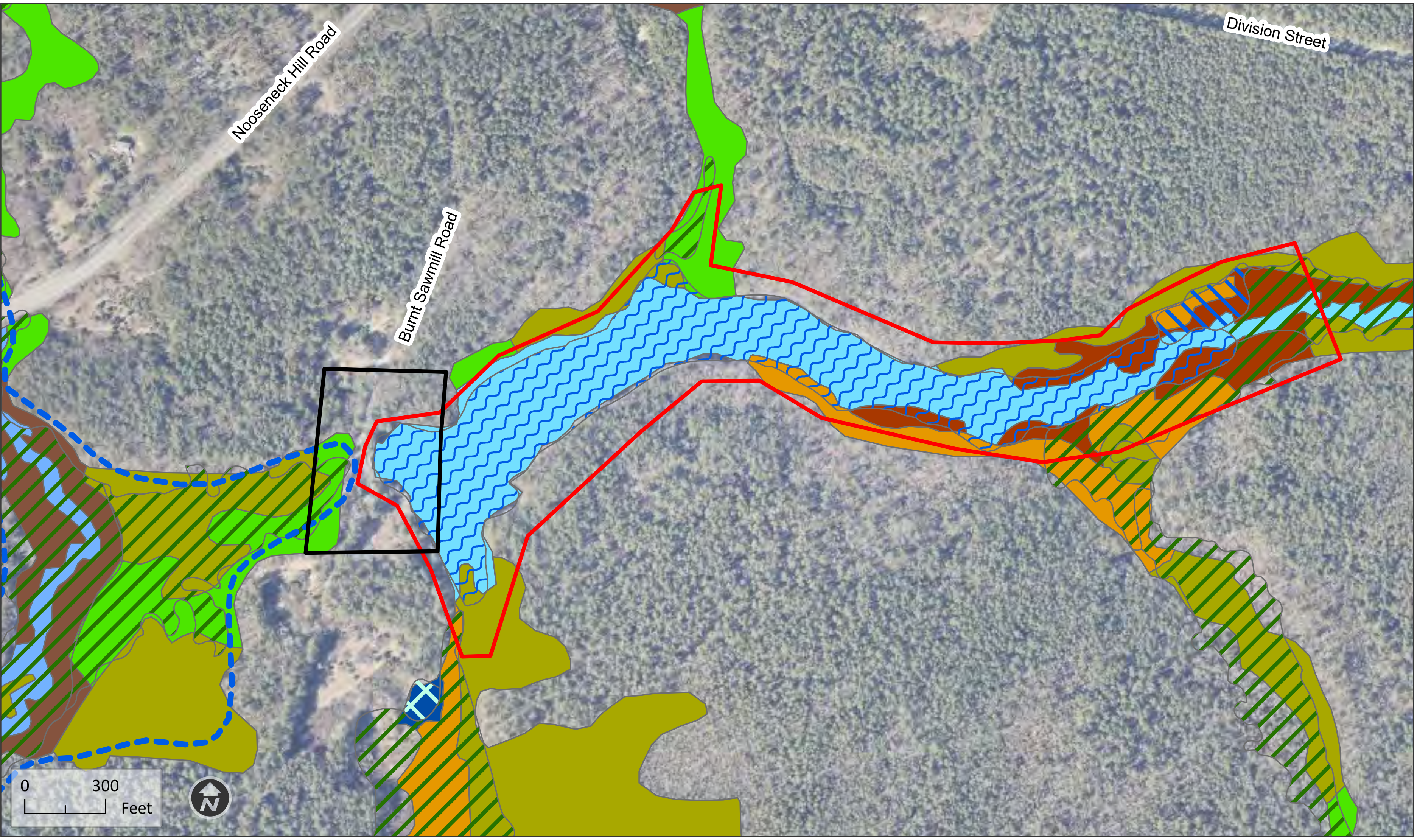
Figures

Path: \\WarwickFP\Warwickfp\GIS_Warwick\StateandLocal\Northeast\RhodeIsland\BigRiverManagementArea\PROJECTS\ArcGISPro\CapwellMillpond_DamFeasibility_6364302\CapwellWetDel\CapwellWetDel.aprx | 8/9/2023 | qmilton



Legend

- ⬛ Delineation Boundary
- 🟥 Area of Potential Effect
- ▭ Flood Hazard Area

NWI Wetlands

- ▨ Freshwater Emergent Wetland
- ▨ Freshwater Forested/Shrub Wetland
- ▨ Freshwater Pond
- ▨ Lake

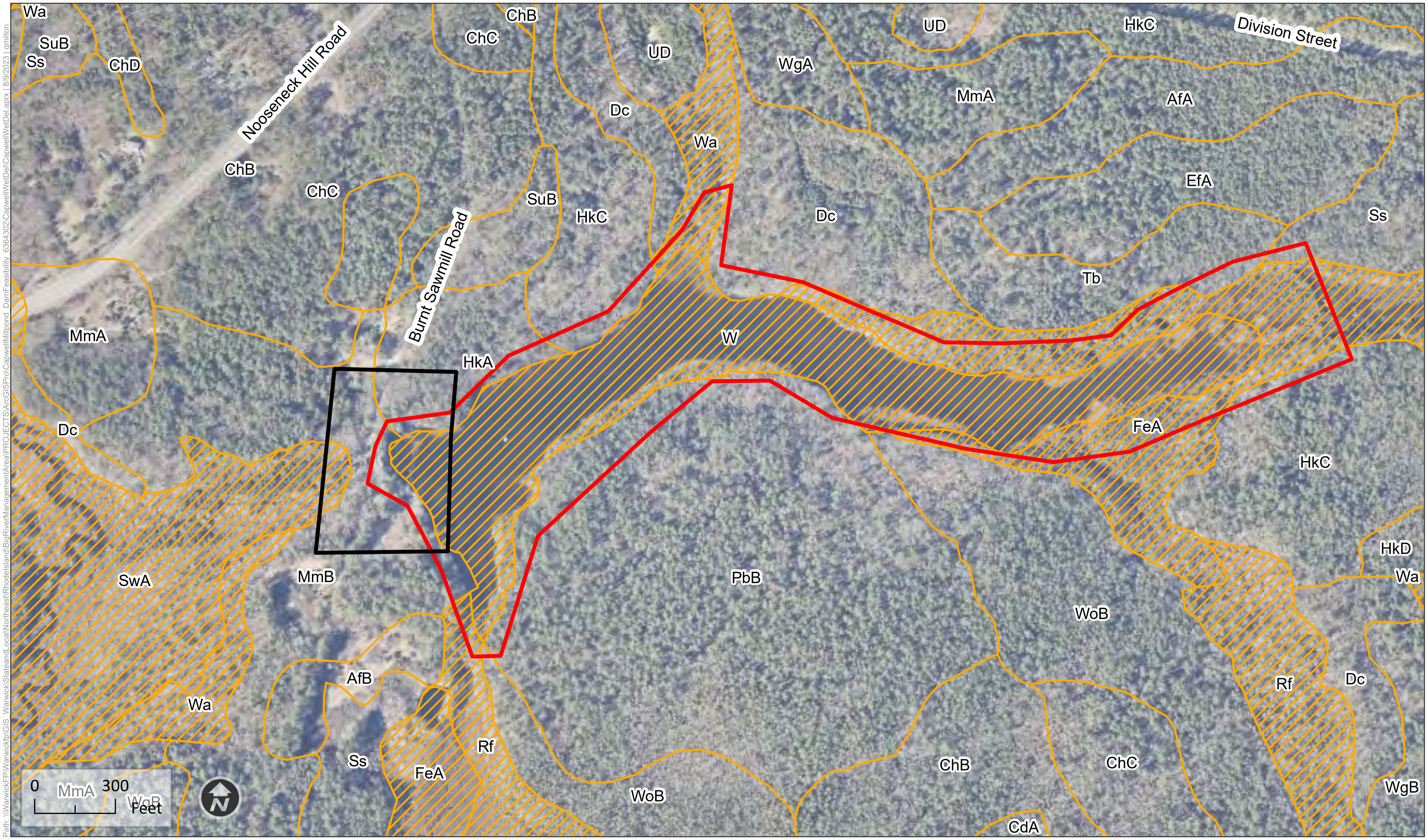
DEM Identified Wetlands

- 🟫 Emergent Wetland: Emergent Fen or
- 🟨 Forested Wetland: Coniferous
- 🟩 Forested Wetland: Deciduous
- 🟦 Lacustrine Open Water
- 🟦 Palustrine Open Water
- 🟦 Riverine Nontidal Open Water
- 🟫 Scrub-Shrub Swamp
- 🟧 Scrub-Shrub Wetland: Shrub Fen

Figure 1
Wetlands and Floodplains

Capwell Mill Pond
Dam Removal Feasibility Study
West Greenwich, RI

Map Date: 8/9/2023
Projection: NAD 1983 (2011)
StatePlane Rhode Island
Sources: DEM 1993, NWI 2021



Legend

- ⬛ Delineation Boundary
- 🟥 Area of Potential Effect
- ☐ Soil Map Units
- ▨ Hydric Soil Map Units

Soil Map Units Within APE and Delineation Boundary

Soil Map Unit Code	Soil Map Unit
Dc	Deerfield loamy fine Sand
FeA	Freetown, mucky peat, 0 to 2 % slopes
HkA	Hinckley gravelly sandy loam, 0 to 3 % slopes
HkC	Hinckley gravelly sandy loam, rolling
MmB	Merrimac sandy loam, 3 to 8 % slopes
PdB	Paxton very stony fine sandy loam, 0 to 8 % slopes
Rf	Ridgebury, Whitman, And Leicester extremely stony fine sandy loams
Ss	Sudbury sandy loam
SwA	Swansea mucky peat, 0 to 2 percent slopes
Tb	Tisbury silt loam
W	Water
Wa	Walpole sandy loam
WoB	Woodbridge very stony fine sandy loam, 0 to 8 % slopes

Figure 2
Soils

Capwell Mill Pond
Dam Removal Feasibility Study
West Greenwich, RI

Map Date: 8/9/2023
Projection: NAD 1983 (2011)
StatePlane Rhode Island
Sources: NRCS 2022

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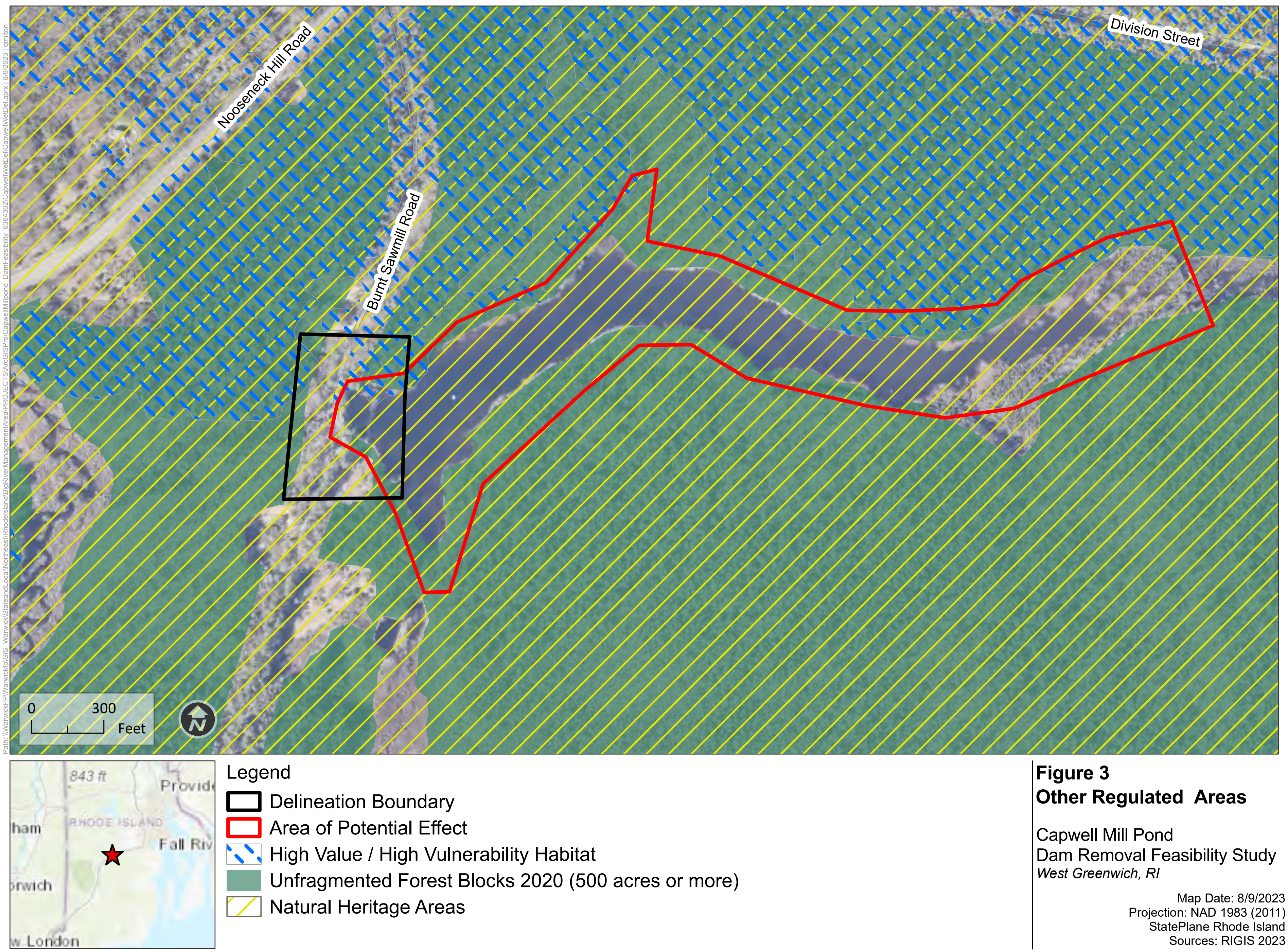

Figure 3
Other Regulated Areas

Capwell Mill Pond
Dam Removal Feasibility Study
West Greenwich, RI

Map Date: 8/9/2023
Projection: NAD 1983 (2011)
StatePlane Rhode Island
Sources: RIGIS 2023

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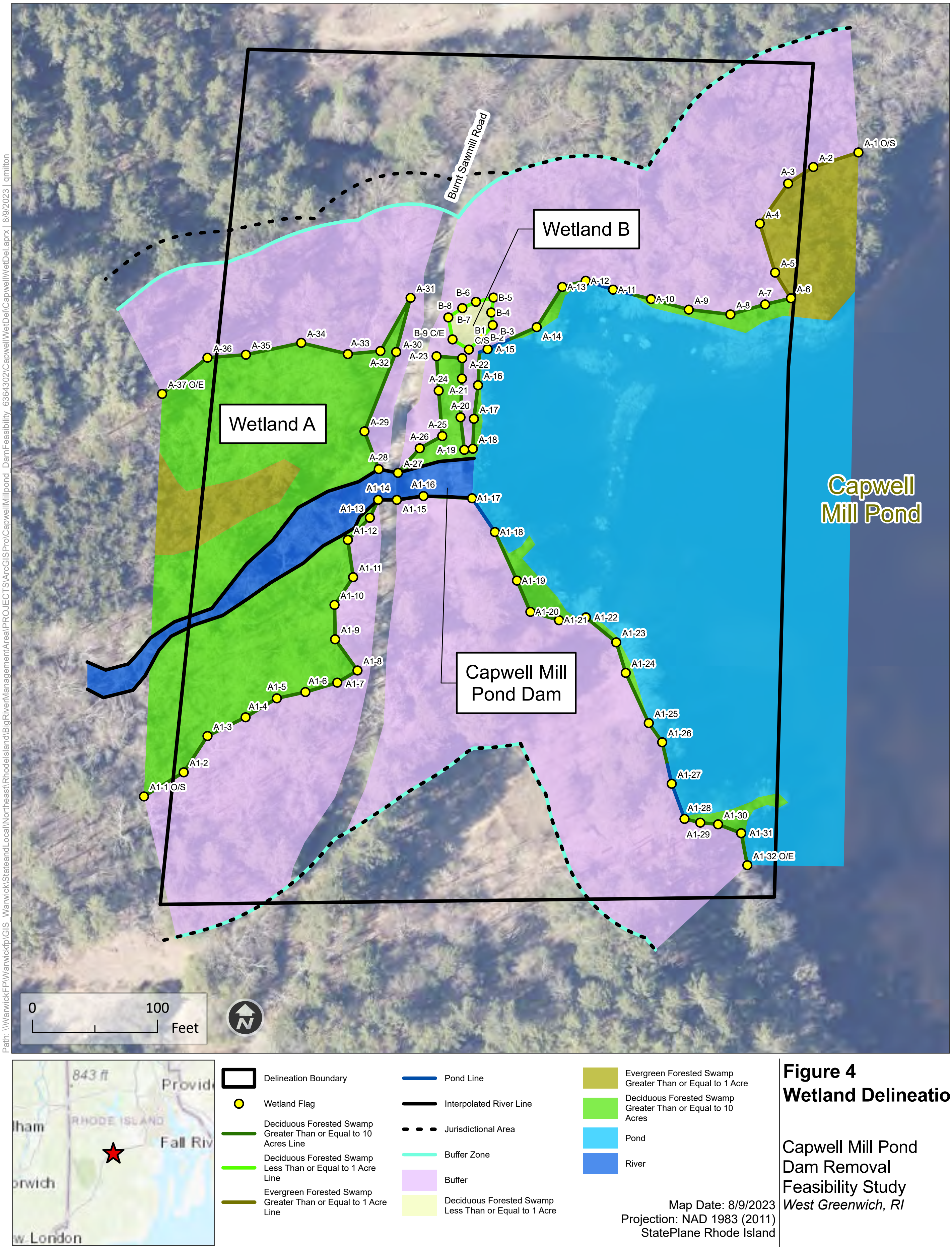

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Map Date: 8/9/2023
Projection: NAD 1983 (2011)
StatePlane Rhode Island

Figure 4
Wetland Delineation

Capwell Mill Pond
Dam Removal
Feasibility Study
West Greenwich, RI

Appendix C.

GZA Dam Inspection Report

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281
CAPWELL MILL POND DAM

CAPWELL MILL POND DAM (281), WEST GREENWICH

Capwell Mill Pond Dam (Figure 1) is classified by DEM as having a **Significant Hazard** potential. The following report summarizes GZA's evaluation of the dam's potential impact area due to failure of the dam.

1.00 SUMMARY OF SITE AND POTENTIAL DOWNSTREAM IMPACT AREA

In addition to compiling background information and GIS mapping data, GZA performed field reconnaissance of the dam and its associated downstream area (Figure 2). GZA representatives David M. Leone and Gregory W. Hunt visited the site and the downstream river valley on May 17, 2007. A field checklist from the reconnaissance is provided in **Attachment I** and selected photographs are provided in **Attachment II**.

1.10 Site Description

Capwell Mill Pond Dam is located on the Carr River in the Town of West Greenwich, Kent County, Rhode Island (See Locus Map, Figure 1). The following state and national identification numbers are associated with the dam:

- DEM ID Number 281
- NID Number RI04228

The dam has a total length of approximately 150 feet and a maximum height of approximately 8 feet. The dam consists of an earthen embankment with an approximately 35-foot long broad-crested concrete spillway. The spillway is divided into three bays, with a low-level outlet on the left side. The downstream portion of the dam consists of an approximately 3-foot high stone masonry wall above an earthen embankment slope. Pertinent engineering data, as obtained from the DEM dam information database, is provided in **Table 1**.

The dam and its impoundment are located within the Big River watershed protection area. The purpose of the dam and its impoundment is recreation and conservation.

TABLE 1: Pertinent Engineering Data

Dam	
Type	Earth Embankment
Length	Approximately 150 feet
Height	Approximately 8 feet
Drainage Area	± 7 mi^2
Elevation (feet above approximate MSL)	
Normal Pool	± 257 ft
Top of Dam	± 259 ft

TABLE 1 (Cont.): Pertinent Engineering Data

Storage (Acre-feet)	
Normal Pool	±32
Top of Dam	±48
Spillways	
Type	Broad-Crested Concrete Weir
Length	Approximately 35 feet

1.20 Downstream Description

Capwell Mill Pond Dam is located at the western end of the Capwell Mill Pond. Burnt Sawmill Road runs along the downstream toe of the dam, and crosses the Carr River on a concrete arch bridge about 50 feet downstream of the spillway. Downstream of Burnt Sawmill Road, the Carr River flows through a wooded conservation area for about 0.2 miles to its confluence with the Big River. About 0.5 miles downstream of the dam, Route 3 (Nooseneck Hill Road) crosses the Big River on a concrete arch bridge about 50 feet wide. Some residences are located along Route 3 near the river in the right overbank area. About 0.7 miles downstream of the dam, the Big River passes through a culvert under Interstate 95. Downstream of Interstate 95, the Big River flows into the Flat River Reservoir. Numerous residences are located along the shores of the Flat River Reservoir downstream of Harkney Hill Road.

1.21 Downstream Dams

The Flat River Reservoir Dam (167) is located about 5 miles downstream of the dam on the Flat River Reservoir. The Flat River Reservoir Dam is located beyond the anticipated impact area of a dam failure at the Capwell Mill Pond Dam.

1.22 Downstream Bridges

Several bridges and culverts are located downstream of the Capwell Mill Pond Dam. Burnt Sawmill Road crosses the Carr River on a concrete arch bridge about 50 feet downstream of the dam. Route 3 crosses the Big River on An approximately 50-foot wide concrete arch bridge about 0.2 miles downstream of the dam. The Big River passes through a culvert under Interstate 95 about 0.7 miles downstream of the dam. Harkney Hill Road and Hill Farm Road cross the Flat River Reservoir about 2.2 and 2.7 miles downstream of the dam, respectively, on concrete span bridges.

Failure of the Capwell Mill Pond Dam is anticipated to result in the overtopping of Burnt Sawmill Road immediately downstream of the dam. The failure of the dam is not anticipated to result in the overtopping of the Route 3, Interstate 95, Harkney Hill Road, or Hill Farm Road bridges.

1.23 Downstream Development

Development downstream of the dam primarily consists of the roadways mentioned above. A USGS streamflow gage is located just downstream of the Burnt Sawmill Road bridge on the Carr River. Additional downstream development consists of residences located near Route 3 and along the shores of the Flat River Reservoir downstream of Harkney Hill Road.

2.00 DAM BREAK FLOOD POTENTIAL ASSESSMENT

To further evaluate the extent of flooding due to a potential dam failure, GZA performed a limited hydraulic investigation of the hypothetical dam break flood. The analysis was performed with the National Weather Service (NWS) Simplified Dam Break (SMPDBK) model, which estimates the peak dam break flood outflow, peak water surface elevations, and the timing of the flood wave as it travels downstream, given breach characteristics specific to the dam and the geometry of the downstream channel and overbank. SMPDBK output summaries are provided in **Attachment III**.

Please note that the approximate extent of hypothetical dam break flooding generated with SMPDBK is not generally applicable for emergency planning or other hydraulic design purposes. Detailed hydraulic modeling using state-of-the-practice unsteady flow models such as the NWS DAMBRK or FLDWAV computer programs, which is not in the scope of this study, should be performed when generating inundation maps for Emergency Action Plans or for use in spillway design / inflow design flood (IDF) studies.

2.10 Potential Dam Failure Mechanisms and Breach Description

As specified by the DEM, the simplified hypothetical dam failure analysis assumed starting pool elevations in the impoundment coincident with the top of dam elevation and average stream flow conditions prevailing (i.e., assumed about 1 to 2 cfs per square mile of drainage area). Dam breach parameters such as time of breach formation, breach shape, and the average width of the breach were selected according to these conditions and based upon the type of materials used in constructing the dam, in accordance with the recommended range of values published in the Federal Energy Regulatory Committee (FERC) guidelines and based on engineering judgment. For Capwell Mill Pond Dam, it was assumed that the failure of the dam was along the earth embankment, with a time to failure of 30 minutes and a trapezoidal breach shape (0.5 H : 1.0 V) utilized. Because the breach was assumed to occur at the embankment section of the dam, the average breach width was assumed to be three times the height of the dam, about 24 ft.

2.20 Estimated Peak Outflow from Dam Break

The peak outflow from the hypothetical dam break was estimated using the breach outflow approximation equation developed by the National Weather Service as part of their SMPDBK computer model (see Attachment III), using the breach parameters described above and top-of-dam pool reservoir characteristics. The estimated peak breach outflow is approximately 1,200 cfs. Although there is no published FEMA 100-yr flood estimate for the Carr River, the peak dam break outflow is expected to be somewhat larger than the 100-yr flood, given the dam's contributory watershed area of approximately 7 square miles.

2.30 Estimated Approximate Flood Impact Area

Several riverine cross sections, developed by GZA from USGS 7.5 minute quadrangle maps, were input into the SMPDBK models to preliminarily estimate approximate peak water surface elevations. The results of the analysis are provided as the approximate inundation area depicted in **Figure 2**.

2.31 Downstream Extent of Flooding

The stream channel downstream of Capwell Mill Pond Dam has moderate slopes. Typical Manning's "n" roughness coefficients used in the analysis were 0.04 for the channel areas, and 0.08 for the overbank areas. These values are consistent with the range of values used in the FEMA Flood Insurance study for nearby communities.

2.32 Potential Effects of Dam Break

Results of the analysis indicate a peak flood depth of about 6 feet downstream of the dam on the Carr River and a peak depth of about 5 feet along the Big River upstream of the Flat River Reservoir. A peak flood depth of about 3 feet is anticipated along the upstream portion of the Flat River Reservoir.

The hypothetical failure of the dam would likely flood the low-lying valley along the Carr River, the Big River, and a portion of the Flat River Reservoir. Failure of the dam would likely overtop and wash out Burnt Sawmill Road just downstream of the dam. Failure of the dam may also destroy the USGS gaging station downstream of the bridge. Backwater on the Big River is anticipated within the FEMA 100-year flood zone upstream of the Carr River confluence. No residences are expected to be impacted along the Big River. Along the Flat River Reservoir, the dam break flooding is expected to be within 3 feet of the initial Reservoir level. The dam break flood wave is anticipated to dissipate within the Flat River Reservoir upstream of Hill Farm Road.

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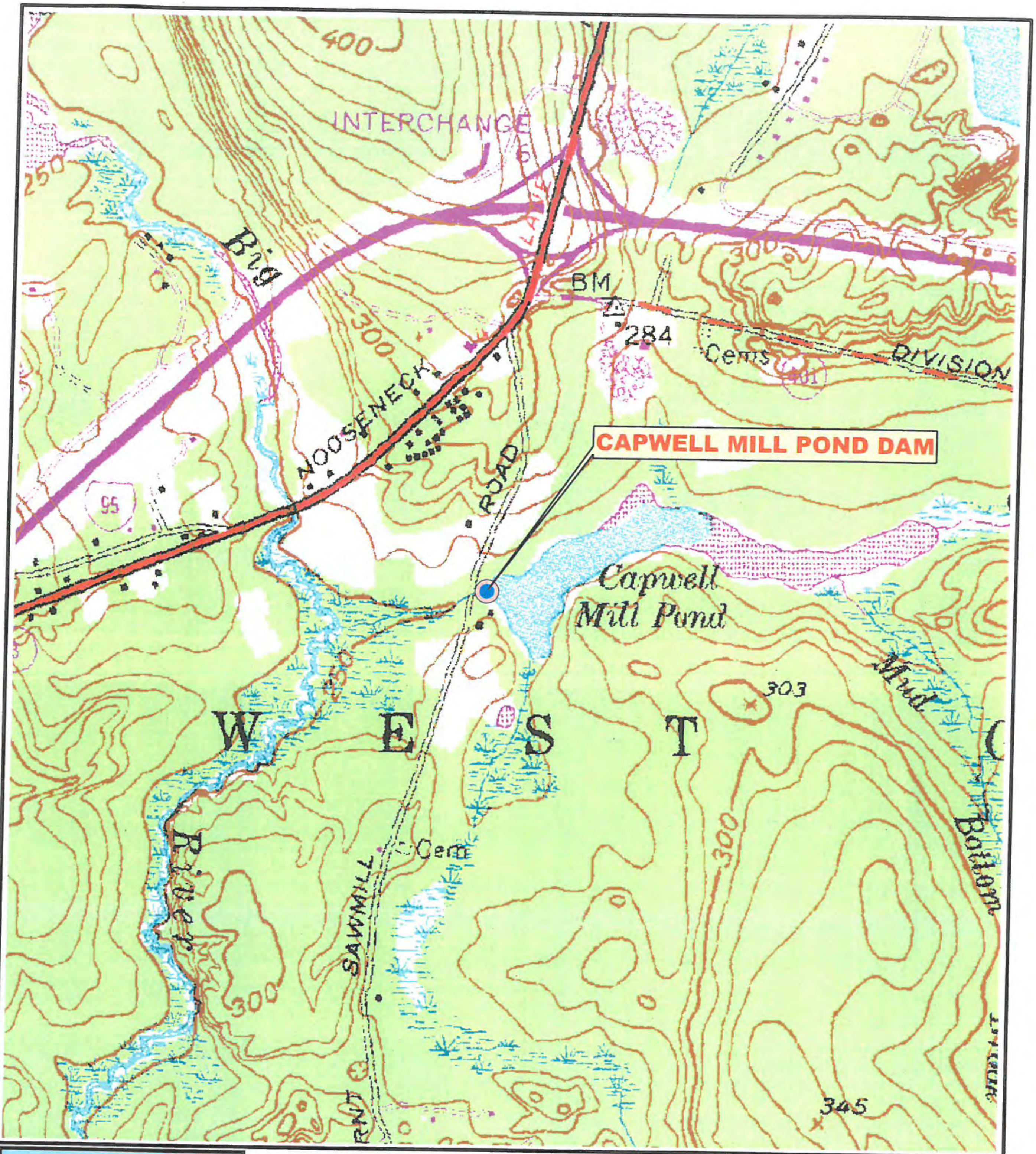
FIGURES



SOURCE : SCANNED USGS TOPOGRAPHIC QUADRANGLES DISTRIBUTED BY THE RHODE ISLAND GEOGRAPHIC INFORMATION SYSTEM, RIGIS.
DATA SET CREDIT: This DRG was produced through an Innovative Partnership agreement between The Land Information Technology Company, Ltd., of Aurora, CO and the USGS.

Data Supplied by : RIGIS

0 1,000 2,000 4,000 Feet

N
W E
S

GZA

PROJ. MGR.: DML
DESIGNED BY: GWH
REVIEWED BY: PHB
OPERATOR: GWH

DATE: 05-17-07

CAPWELL MILL POND DAM (281)

SITE LOCUS

JOB NO.
01.0017085.30

FIGURE NO.
1

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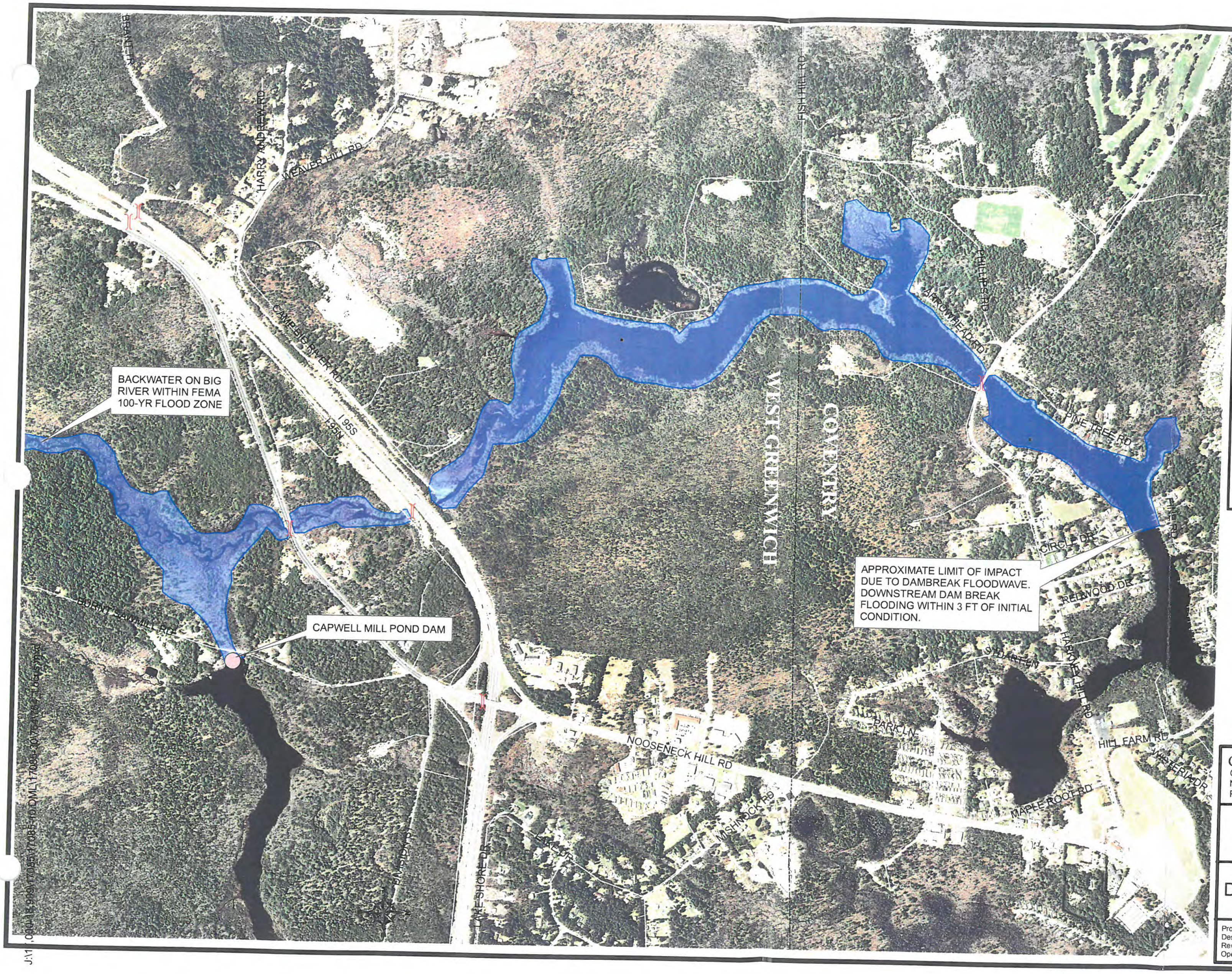


LEGEND

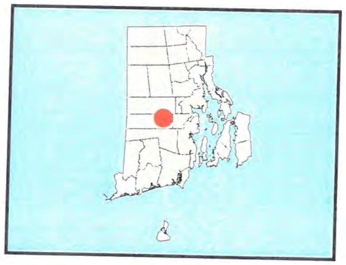
BRIDGE	▭ APPROX. FLOOD HAZARD AREA
SCHOOLS	▲ WATER SUPPLY WITHDRAWALS
★ PUBLIC SAFETY BUILDINGS (FIRE, POLICE, TOWN HALLS)	○ DAMS
✚ HOSPITALS	

SOURCE

DIGITAL AERIAL OTHOPHOTOGRAPHY PROVIDED BY THE RHODE ISLAND GEOGRAPHIC INFORMATION SYSTEM, (RIGIS) AND THE RHODE ISLAND DEPARTMENT OF TRANSPORTATION, (RIDOT). ORTHOPHOTO IMAGES WERE ORIGINALLY PRODUCED BY CHAS. H. SELLS UNDER CONTRACT TO THE (RIDOT). THE IMAGES WERE OBTAINED ON APRIL 14, 2003 AND WERE RELEASED IN NOVEMBER 2005.

RIGIS

0 250 500 1,000 1,500 2,000 Feet



GZA GeoEnvironmental, Inc.
One Edgewater Drive
Norwood, MA 02062
Phone: (781) 278-3700 Fax: (781) 278-5701

CAPWELL MILL POND DAM (281)
WEST GREENWICH, RHODE ISLAND

DAM FAILURE INUNDATION MAP

Proj. Mgr.: DML
Designed By: GWH
Reviewed By: PHB
Operator: GWH

Dwg. Date: 07-09-2007
Job No.: 17085.30
Figure No.: 2

ATTACHMENT I

FIELD RECONNAISSANCE CHECKLIST

DAM HAZARD POTENTIAL FIELD CHECKLIST

Name of Dam: CAPWELL MILL POND DAM

RI DEM ID NO. 281

Location:

Town: WEST GREENWICH

River or Stream: CARR RIVER

Downstream Communities: COVENTRY

Major Confluence: BIG RIVER TO REYNOLDS POND

Classification Data:

Size: Intermediate

Date Built: Unknown

PHYSICAL DATA:

Type of Dam: Earthen embankment

Height of Dam: ±8 FT

Length of Dam: 150

Type of Spillway: Broad-crested Concrete weir (3 bays)

Length of Spillway: 35

Purpose of Dam: Recreation

Pool at Inspection: 3 in over spillway crest

Normal Pool Storage Capacity: 32

Freeboard: Approximately 25 inches

Maximum Pool Storage Capacity: 48

Name	Title/Position	Representing
David M. Leone	Project Mgr / Hydrologist	GZA GeoEnvironmental, Inc.
Gregory W. Hunt	Project Engineer	GZA GeoEnvironmental, Inc.

DATE OF INSPECTION: 5/17/2007

WEATHER: Overcast

TEMPERATURE: Upper 40s

Name of Dam: CAPWELL MILL POND DAM D. No.: 281 Inspection Date: 17-M[illegible]-07

STRUCTURAL CONDITION	1	Concrete Condition	Poor. Scoured, deteriorated concrete at spillway sidewalls.
	2	Outlet Condition	Poor. Concrete deterioration at water line.
	3	Unusual Movement	Partial collapse of left downstream stone masonry wall
	4	Seepage / Wet Area	Wetness along right toe; standing water right of foot path.
	5	Embankment Slides/Erosion	Eroded footpath on right side, pedestrian access.
	6	Vegetation / Pest Control	Large trees, shrubs, low vegetation
DAM & IMMEDIATE DOWNSTREAM AREA	7	Vicinity Description	Gravel road just downstream of toe, gravel pull-off area along road.
	8	Dam Roads & Utilities	Burnt Sawmill Road passes along downstream road, crosses channel.
	9	Discharge Channel	Stone masonry walled rectangular channel.
	10	Structures (Gatehouses, etc.)	USGS gage on downstream side of arch bridge downstream.
	11	Adjacent Land Use	Primarily conservation, recreation. One house on left side above top of dam elevation.
	12	Adjacent Population Density	Low.
	13	Downstream Constrictions	Concrete arch bridge downstream (Burnt Sawmill Rd.)
	14	Downstream Access / Use	No formal access, Big River watershed protection area
	15	Property / Infrastructure / Utility Description & Distance	Road crossing downstream of dam with USGS gage.
GENERAL DOWNSTREAM AREA	17	Land Use Classification	Primarily conservation, low density residential.
	18	Population Density	Low.
	19	Property / Infrastructure	Nooseneck Hill Road (Route 3) crossing about 1/2 mi downstream Interstate 95 crossing about 3/4 mile downstream
	21	Downstream Dams	Flat River Reservoir Dam (135) about 5 miles downstream
	22	Downstream Bridges	Bridge at Route 3; Concrete arch culvert, about 50 ft wide Interstate 95 crosses Big River about 3/4 mile downstream of dam
	23	Upstream Dams	N/A
	24	Channel Description (depth, Manning's n, width, overbank)	3 to 4 foot deep, about 20 ft wide channel. Wooded overbank. Slow moving, silty/sandy bottom.

ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE

ATTACHMENT II

FIELD PHOTOGRAPHS

DAM 281 – CAPWELL MILL POND DAM

Photo 1. View along top of dam from right side.

Photo 2. View along downstream face of dam from right toe.

Photo 3. Overview of Capwell Mill Pond from top of dam.

Photo 4. View of Burnt Sawmill Road bridge downstream of dam. USGS streamflow gage #01115770 on downstream side of bridge.

DAM 281 – CAPWELL MILL POND DAM

Photo 5. View of Carr River channel downstream of Burnt Sawmill Road bridge.

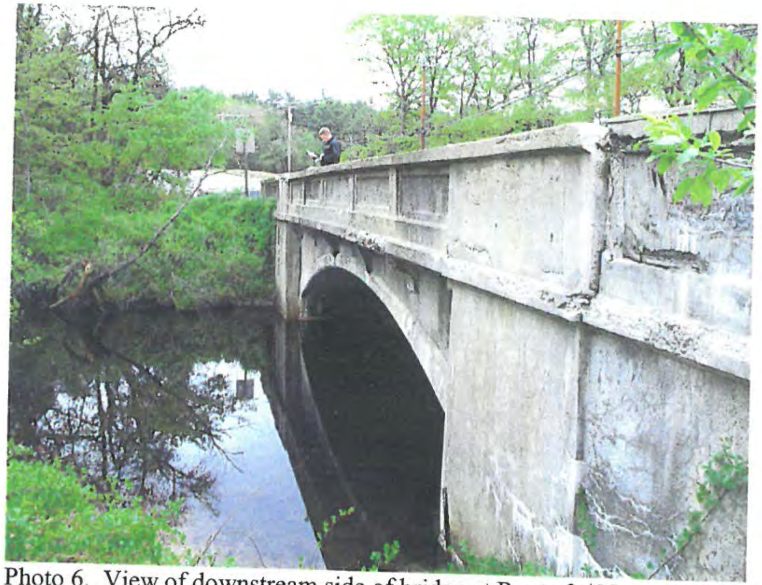


Photo 6. View of downstream side of bridge at Route 3 / Nooseneck Hill Road along Big River.

ATTACHMENT III

SMPDBK OUTPUT SUMMARY

```
SIMPLIFIED DAMBREAK MODEL (SMPDBK) VERSION: 9/91
BY D.L. FREAD, J.M. LEWIS, & J.N. WETMORE - PHONE: (301) 427-7640
NWS HYDROLOGIC RESEARCH LAB W/OH3, 1325 EAST-WEST HIGHWAY,
SILVER SPRING, MD 20910


***** DISTANCE TO PRIMARY POINT OF INTEREST MOVED TO THE CROSS SECTION
***** CLOSEST TO THIS LOCATION (MI    2.68)


THE DATA FOR THIS DAM IS AS FOLLOWS:

TYPE OF DAM      (IDAM)                EARTH
DAM BREACH ELEVATION   (HDE)                          259.00 FT
FINAL BREACH ELEVATION  (BME)                         251.00 FT
SURFACE AREA OF RESERVOIR  (SA)                        30.00 ACRES
FINAL BREACH WIDTH  (BW)                               24.00 FT
TIME OF DAM FAILURE   (TFM)                            30.00 MINUTES
NON-BREACH FLOW  (QO)                                   7.00 CFS
DISTANCE TO PRIMARY PT OF INTEREST (DISTTN)             2.68 MILES
DEAD STORAGE EQUIV. MANN. N (CMS)                        .50

CROSS SECTION NO.  1
FLOOD DEPTH  (FLD)           5.00 FT

ELEV.(FT) (HS)             251.0    254.0    259.0    260.0
TWIDTHS(FT) (BS)            24.0     24.0    150.0    465.0
INACTIVE TW(FT) (BSS)         .0       .0       .0       .0
MANNING N (CM)              .040     .040     .080     .080

CROSS SECTION NO.  2
REACH LENGTH  (D)             .01 MI
FLOOD DEPTH  (FLD)           5.00 FT

ELEV.(FT) (HS)             250.5    253.5    259.0    260.0
TWIDTHS(FT) (BS)            24.0     24.0    150.0    465.0
INACTIVE TW(FT) (BSS)         .0       .0       .0       .0
MANNING N (CM)              .040     .040     .080     .080

CROSS SECTION NO.  3
REACH LENGTH  (D)             .21 MI
FLOOD DEPTH  (FLD)           5.00 FT

ELEV.(FT) (HS)             246.5    249.5    250.0    260.0
TWIDTHS(FT) (BS)              .0     20.0    505.0   1410.0
INACTIVE TW(FT) (BSS)         .0       .0       .0       .0
MANNING N (CM)              .040     .040     .080     .080

CROSS SECTION NO.  4
REACH LENGTH  (D)             .45 MI
FLOOD DEPTH  (FLD)           5.00 FT

ELEV.(FT) (HS)             246.0    249.0    250.0    260.0
TWIDTHS(FT) (BS)              .0     20.0     80.0    555.0
INACTIVE TW(FT) (BSS)         .0       .0       .0       .0
MANNING N (CM)              .040     .040     .080     .080

CROSS SECTION NO.  5
REACH LENGTH  (D)             .74 MI
FLOOD DEPTH  (FLD)           5.00 FT

ELEV.(FT) (HS)             245.5    248.5    250.0    260.0
TWIDTHS(FT) (BS)              .0     20.0    290.0    595.0
INACTIVE TW(FT) (BSS)         .0       .0       .0       .0
MANNING N (CM)              .040     .040     .080     .080

CROSS SECTION NO.  6
REACH LENGTH  (D)            1.25 MI
FLOOD DEPTH  (FLD)           5.00 FT

ELEV.(FT) (HS)             245.0    248.0    250.0    260.0
TWIDTHS(FT) (BS)              .0    250.0    400.0    920.0
INACTIVE TW(FT) (BSS)         .0       .0       .0       .0
```

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MANNING N (CM)                .040     .040     .080     .080

CROSS SECTION NO.   7
REACH LENGTH   (D)             1.89 MI
FLOOD DEPTH   (FLD)            5.00 FT

ELEV.(FT) (HS)                244.5    247.5    250.0    260.0
TWIDTHS(FT) (BS)                 .0    310.0    580.0    890.0
INACTIVE TW(FT) (BSS)            .0       .0       .0       .0
MANNING N (CM)                 .040     .040     .080     .080

CROSS SECTION NO.   8
REACH LENGTH   (D)             2.22 MI
FLOOD DEPTH   (FLD)            5.00 FT

ELEV.(FT) (HS)                244.3    247.3    250.0    260.0
TWIDTHS(FT) (BS)                 .0     65.0    115.0    600.0
INACTIVE TW(FT) (BSS)            .0       .0       .0       .0
MANNING N (CM)                 .040     .040     .080     .080

CROSS SECTION NO.   9
REACH LENGTH   (D)             2.68 MI
FLOOD DEPTH   (FLD)            5.00 FT

ELEV.(FT) (HS)                244.0    247.0    250.0    260.0
TWIDTHS(FT) (BS)                 .0    260.0    390.0    545.0
INACTIVE TW(FT) (BSS)            .0       .0       .0       .0
MANNING N (CM)                 .040     .040     .080     .080

NAME OF DAM: CAPWELL MILL POND DA     NAME OF RIVER: CARR RIVER  COVENTRY

 RVR MILE  MAX FLOW  MAX ELEV  MAX DEPTH TIME(HR)  TIME(HR)  TIME(HR)   FLOOD
 FROM DAM   (CFS)    (FT-MSL)    (FT)   MAX DEPTH   FLOOD    DEFLOOD  DEPTH(FT)
 ********  ********  ********  ********  ********  ********  ********  ********
      .00     1182.    257.14      6.14       .50       .33      1.16      5.00
      .01     1037.    256.18      5.68       .50       .40       .99      5.00
      .21      747.    250.62      4.12       .68       .00       .00      5.00
      .45      723.    250.62      4.62       .99       .69      3.14      5.00
      .74      714.    250.62      5.12      1.33      1.19      2.39      5.00
     1.25      685.    247.83      2.83      1.55       .00       .00      5.00
     1.89      631.    247.10      2.60      1.80       .00       .00      5.00
     2.22      580.    247.10      2.85      2.41      2.31      3.30      5.00
     2.68      535.    246.85      2.85      2.92       .00       .00      5.00

         ANALYSIS IS COMPLETE
```

Appendix D.

HEC-RAS Attachments

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Appendix D-1. Existing Geometry

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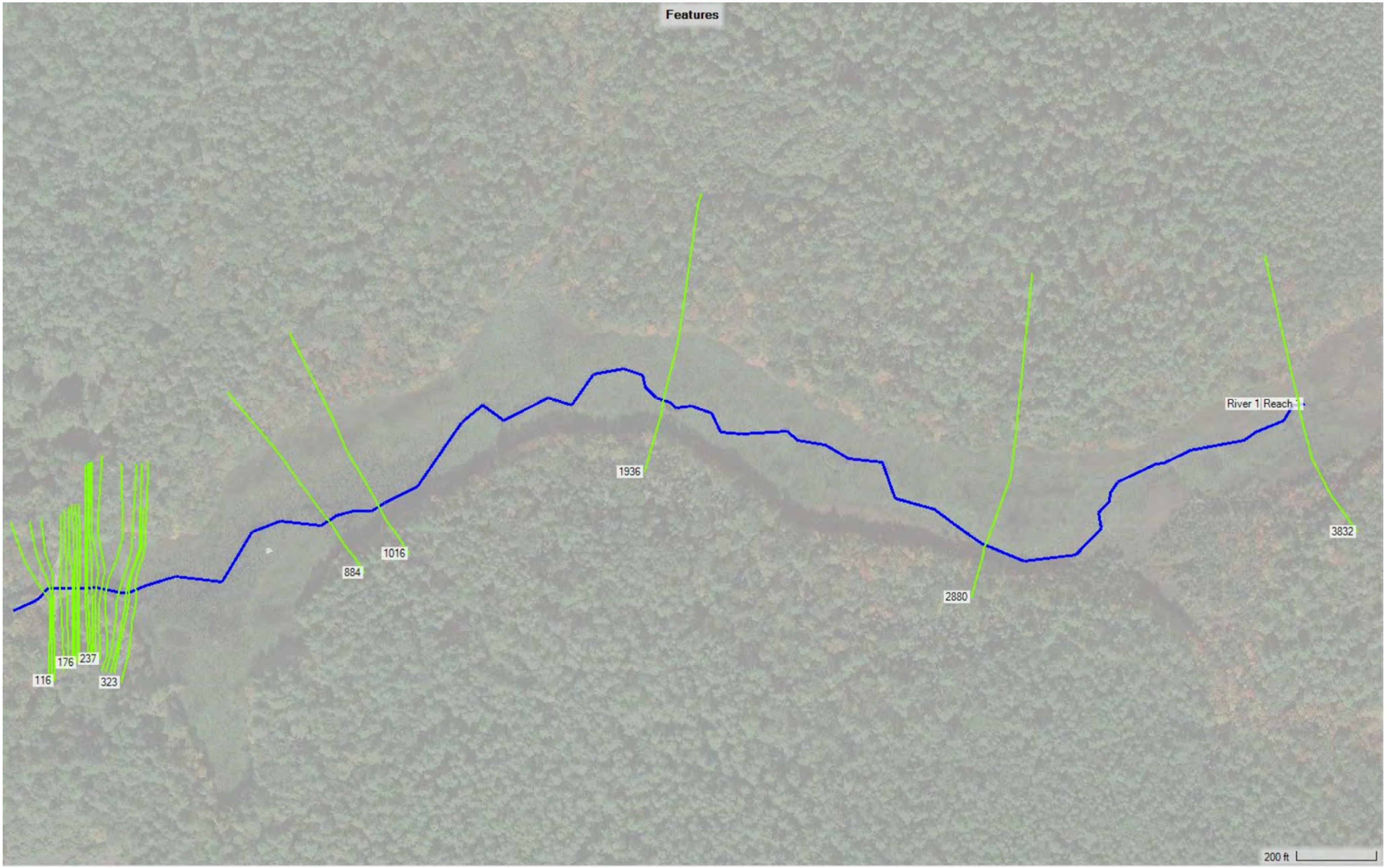
Features
River 1 Reach 1
116
176
237
323
884
1016
1936
2880
3832
200 ft

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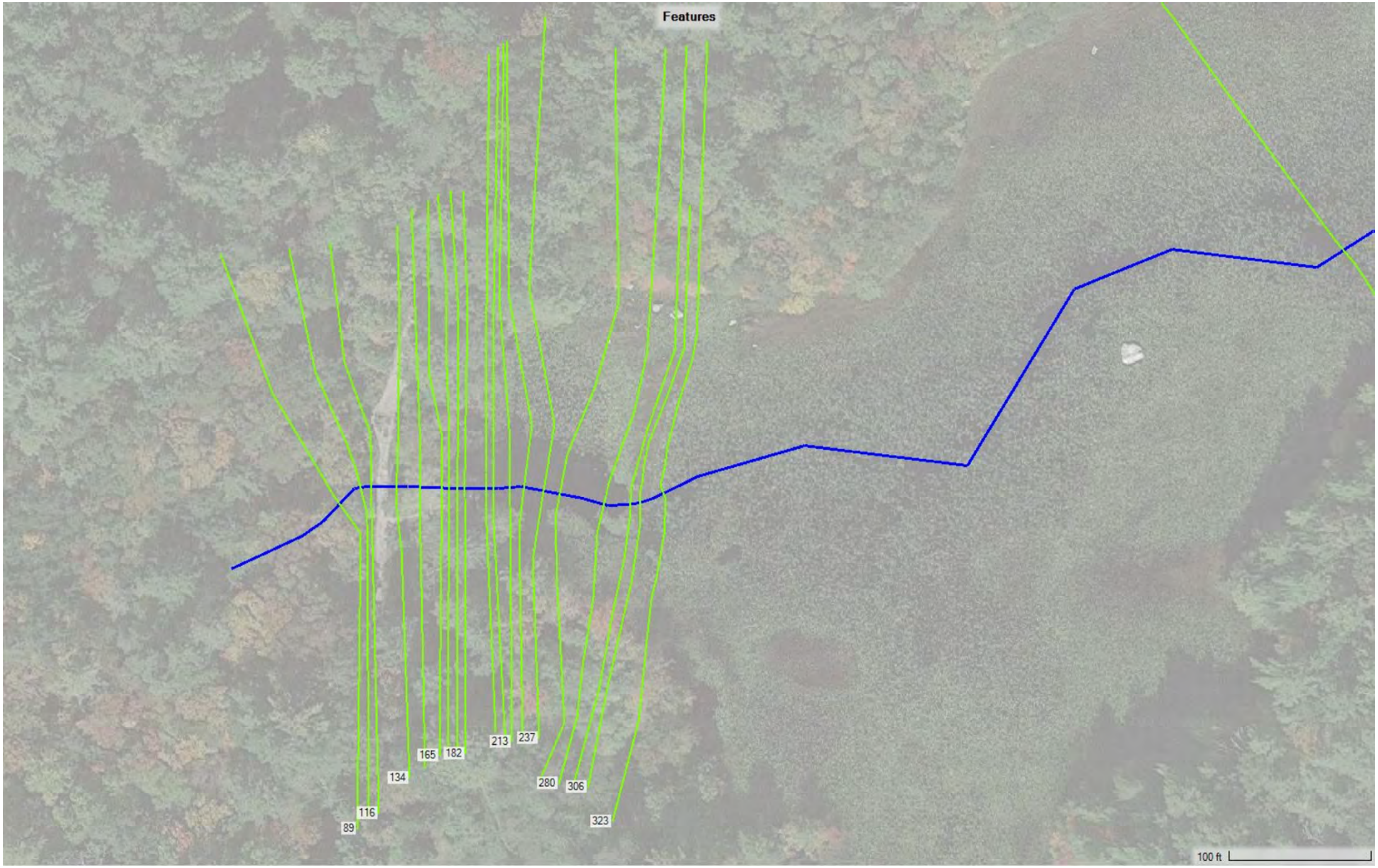
Appendix D-2. Dam Area Existing Geometry


Features
89
116
134
165
182
213
237
280
306
323
100 ft

Appendix D-3. Dam Area Water Surface Elevation Profile

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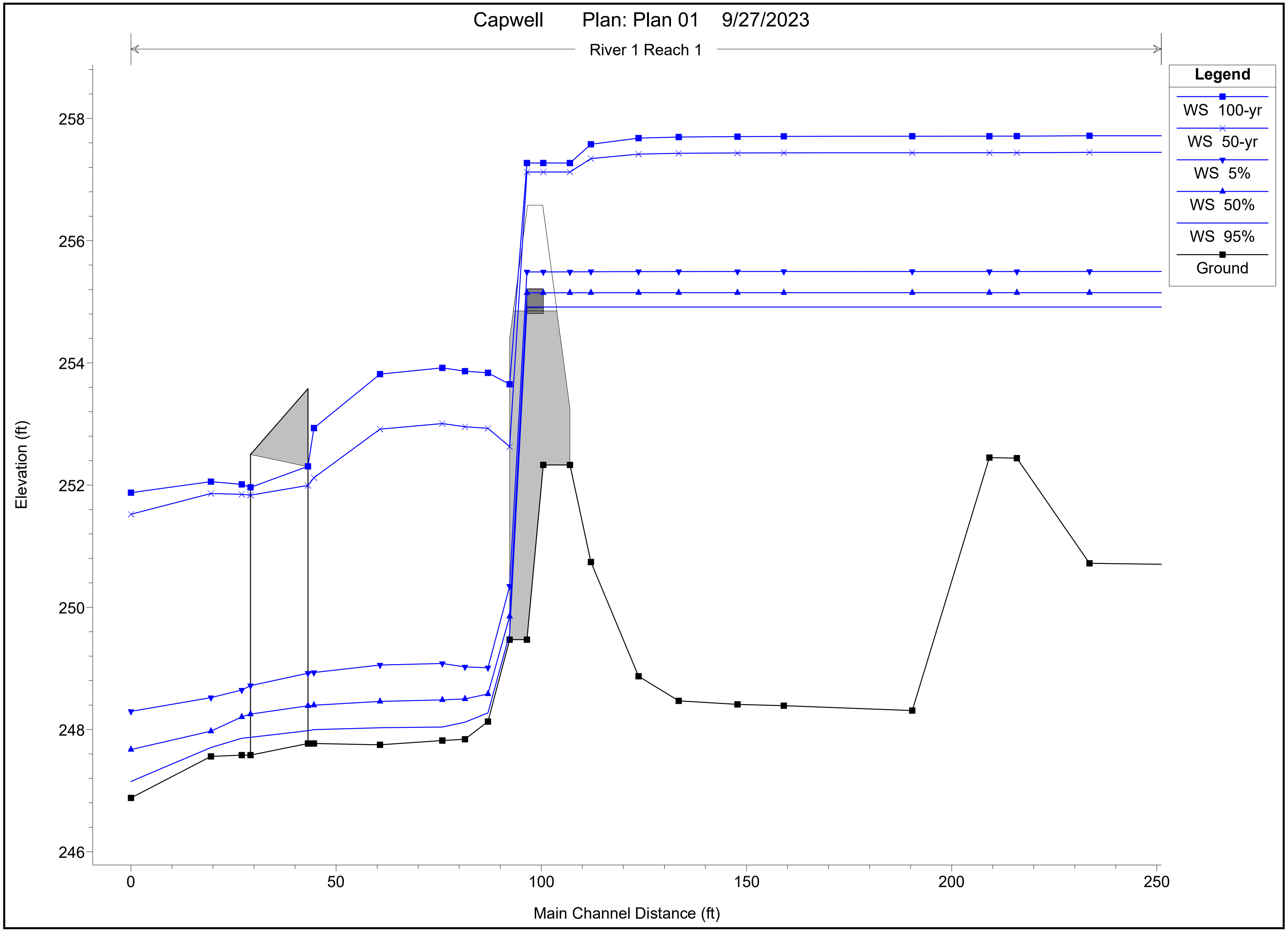
Capwell
Plan: Plan 01
9/27/2023
River 1 Reach 1
Legend
WS 100-yr
WS 50-yr
WS 5%
WS 50%
WS 95%
Ground
Elevation (ft)
246
248
250
252
254
256
258
Main Channel Distance (ft)
0
50
100
150
200
250

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Appendix D-4. Existing Conditions HEC-RAS

HEC-RAS Plan: EX 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	3832	95%	1.00	252.03	254.91	252.31	254.91	0.000000	0.02	119.47	178.70	0.00
Reach 1	3832	50%	11.00	252.03	255.15	252.74	255.15	0.000008	0.12	165.06	212.01	0.02
Reach 1	3832	5%	41.00	252.03	255.51	253.33	255.51	0.000037	0.30	246.08	241.25	0.04
Reach 1	3832	50-yr	533.00	252.03	257.64	255.08	257.65	0.000158	1.01	1035.00	457.03	0.09
Reach 1	3832	100-yr	689.00	252.03	257.97	255.24	257.97	0.000184	1.15	1188.56	479.70	0.10
Reach 1	2880	95%	1.00	251.12	254.91		254.91	0.000000	0.01	349.88	285.58	0.00
Reach 1	2880	50%	11.00	251.12	255.15		255.15	0.000001	0.05	418.42	299.06	0.01
Reach 1	2880	5%	41.00	251.12	255.50		255.50	0.000005	0.15	527.11	318.05	0.02
Reach 1	2880	50-yr	533.00	251.12	257.56		257.57	0.000066	0.76	1303.94	436.60	0.06
Reach 1	2880	100-yr	689.00	251.12	257.88		257.88	0.000084	0.89	1442.75	455.35	0.07
Reach 1	1936	95%	1.00	252.19	254.91		254.91	0.000000	0.00	417.32	261.01	0.00
Reach 1	1936	50%	11.00	252.19	255.15		255.15	0.000000	0.04	478.82	264.50	0.00
Reach 1	1936	5%	41.00	252.19	255.50		255.50	0.000003	0.11	572.21	269.96	0.01
Reach 1	1936	50-yr	533.00	252.19	257.51		257.51	0.000060	0.72	1203.37	356.90	0.06
Reach 1	1936	100-yr	689.00	252.19	257.80		257.81	0.000080	0.86	1310.12	368.45	0.07
Reach 1	1016	95%	1.00	250.89	254.91		254.91	0.000000	0.00	616.62	313.30	0.00
Reach 1	1016	50%	11.00	250.89	255.15		255.15	0.000000	0.03	690.92	322.71	0.00
Reach 1	1016	5%	41.00	250.89	255.50		255.50	0.000001	0.09	807.65	349.73	0.01
Reach 1	1016	50-yr	533.00	250.89	257.47		257.47	0.000032	0.60	1612.78	458.80	0.04
Reach 1	1016	100-yr	689.00	250.89	257.75		257.75	0.000043	0.72	1743.71	474.19	0.05
Reach 1	884	95%	1.00	250.19	254.91		254.91	0.000000	0.00	753.47	318.47	0.00
Reach 1	884	50%	11.00	250.19	255.15		255.15	0.000000	0.02	828.76	325.26	0.00
Reach 1	884	5%	41.00	250.19	255.50		255.50	0.000001	0.07	943.82	338.25	0.01
Reach 1	884	50-yr	533.00	250.19	257.46		257.47	0.000022	0.53	1724.79	440.82	0.04
Reach 1	884	100-yr	689.00	250.19	257.74		257.75	0.000030	0.64	1849.42	452.17	0.04
Reach 1	323	95%	1.00	250.72	254.91		254.91	0.000000	0.00	483.00	252.58	0.00
Reach 1	323	50%	11.00	250.72	255.15		255.15	0.000000	0.04	542.71	258.37	0.00
Reach 1	323	5%	41.00	250.72	255.50		255.50	0.000002	0.12	633.96	267.17	0.01
Reach 1	323	50-yr	533.00	250.72	257.44		257.45	0.000051	0.78	1257.72	404.44	0.06
Reach 1	323	100-yr	689.00	250.72	257.72		257.72	0.000070	0.93	1370.58	425.41	0.06
Reach 1	306	95%	1.00	252.44	254.91		254.91	0.000000	0.01	158.63	243.27	0.00
Reach 1	306	50%	11.00	252.44	255.15		255.15	0.000004	0.09	216.67	251.46	0.01
Reach 1	306	5%	41.00	252.44	255.49		255.50	0.000020	0.25	304.48	254.85	0.03
Reach 1	306	50-yr	533.00	252.44	257.44		257.45	0.000179	1.11	891.90	385.25	0.09
Reach 1	306	100-yr	689.00	252.44	257.71		257.72	0.000224	1.30	999.21	407.63	0.11
Reach 1	299	95%	1.00	252.45	254.91		254.91	0.000000	0.01	197.38	245.77	0.00
Reach 1	299	50%	11.00	252.45	255.15		255.15	0.000002	0.08	255.13	248.36	0.01
Reach 1	299	5%	41.00	252.45	255.49		255.50	0.000014	0.21	341.93	252.35	0.02
Reach 1	299	50-yr	533.00	252.45	257.44		257.45	0.000149	1.03	906.38	376.71	0.09
Reach 1	299	100-yr	689.00	252.45	257.71		257.72	0.000190	1.21	1011.12	399.02	0.10
Reach 1	280	95%	1.00	248.31	254.91		254.91	0.000000	0.00	569.27	243.78	0.00
Reach 1	280	50%	11.00	248.31	255.15		255.15	0.000000	0.03	624.75	246.77	0.00
Reach 1	280	5%	41.00	248.31	255.50		255.50	0.000001	0.10	707.12	250.85	0.01
Reach 1	280	50-yr	533.00	248.31	257.44		257.44	0.000035	0.75	1253.50	371.58	0.05
Reach 1	280	100-yr	689.00	248.31	257.71		257.72	0.000050	0.90	1357.12	394.59	0.06
Reach 1	249	95%	1.00	248.39	254.91		254.91	0.000000	0.00	654.21	243.80	0.00
Reach 1	249	50%	11.00	248.39	255.15		255.15	0.000000	0.02	698.50	245.63	0.00
Reach 1	249	5%	41.00	248.39	255.50		255.50	0.000001	0.08	764.24	248.20	0.01
Reach 1	249	50-yr	533.00	248.39	257.44		257.44	0.000029	0.68	1253.62	368.26	0.04
Reach 1	249	100-yr	689.00	248.39	257.71		257.72	0.000041	0.82	1356.44	393.32	0.05
Reach 1	237	95%	1.00	248.41	254.91		254.91	0.000000	0.00	523.92	186.98	0.00
Reach 1	237	50%	11.00	248.41	255.15		255.15	0.000000	0.02	552.22	188.35	0.00
Reach 1	237	5%	41.00	248.41	255.50		255.50	0.000001	0.08	594.23	203.63	0.01
Reach 1	237	50-yr	533.00	248.41	257.43		257.44	0.000039	0.80	961.08	353.53	0.05
Reach 1	237	100-yr	689.00	248.41	257.70		257.71	0.000056	0.98	1057.24	366.56	0.06
Reach 1	223	95%	1.00	248.47	254.91		254.91	0.000000	0.00	437.45	181.14	0.00
Reach 1	223	50%	11.00	248.47	255.15		255.15	0.000000	0.03	459.95	189.46	0.00
Reach 1	223	5%	41.00	248.47	255.49		255.50	0.000001	0.10	493.35	223.44	0.01
Reach 1	223	50-yr	533.00	248.47	257.43		257.44	0.000052	0.92	856.91	356.72	0.06
Reach 1	223	100-yr	689.00	248.47	257.70		257.71	0.000073	1.12	953.10	367.01	0.07
Reach 1	213	95%	1.00	248.87	254.91		254.91	0.000000	0.00	285.58	192.25	0.00
Reach 1	213	50%	11.00	248.87	255.15		255.15	0.000000	0.05	303.36	202.54	0.00
Reach 1	213	5%	41.00	248.87	255.49		255.50	0.000002	0.16	329.74	217.63	0.01
Reach 1	213	50-yr	533.00	248.87	257.42		257.44	0.000129	1.40	604.92	356.79	0.09
Reach 1	213	100-yr	689.00	248.87	257.68		257.71	0.000184	1.71	697.20	368.34	0.11
Reach 1	202	95%	1.00	250.74	254.91		254.91	0.000000	0.01	116.51	122.27	0.00
Reach 1	202	50%	11.00	250.74	255.15		255.15	0.000002	0.10	129.28	145.14	0.01
Reach 1	202	5%	41.00	250.74	255.49		255.49	0.000019	0.32	148.21	178.33	0.03
Reach 1	202	50-yr	533.00	250.74	257.34		257.43	0.000668	2.51	345.84	353.36	0.19
Reach 1	202	100-yr	689.00	250.74	257.58		257.70	0.000893	2.98	406.56	367.11	0.22

HEC-RAS Plan: EX 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	196	95%	1.00	252.33	254.91	252.59	254.91	0.000000	0.02	51.57	93.35	0.00
Reach 1	196	50%	11.00	252.33	255.15	253.04	255.15	0.000020	0.21	60.92	108.36	0.03
Reach 1	196	5%	41.00	252.33	255.49	253.50	255.49	0.000149	0.64	75.08	131.29	0.08
Reach 1	196	50-yr	533.00	252.33	257.12	255.55	257.37	0.003530	4.29	207.08	317.60	0.41
Reach 1	196	100-yr	689.00	252.33	257.27	255.90	257.62	0.004780	5.14	240.46	330.03	0.48
Reach 1	189 Dam		Inl Struct									
Reach 1	182	95%	1.00	249.47	249.57	249.57	249.61	0.082545	1.57	0.64	9.10	1.05
Reach 1	182	50%	11.00	249.47	249.85	249.85	250.03	0.046597	3.35	3.28	9.45	1.00
Reach 1	182	5%	41.00	249.47	250.35	250.35	250.74	0.037082	5.06	8.10	10.06	0.99
Reach 1	182	50-yr	533.00	249.47	252.63	252.58	253.59	0.024480	9.81	92.41	63.27	0.99
Reach 1	182	100-yr	689.00	249.47	253.65	252.97	254.36	0.012995	8.66	135.27	181.04	0.76
Reach 1	176	95%	1.00	248.13	248.27	248.36	248.63	0.633935	4.79	0.21	2.58	2.97
Reach 1	176	50%	11.00	248.13	248.58	248.82	249.44	0.303024	7.43	1.48	5.36	2.49
Reach 1	176	5%	41.00	248.13	249.01	249.40	250.27	0.205761	9.02	4.77	15.91	2.25
Reach 1	176	50-yr	533.00	248.13	252.93	251.17	253.18	0.004302	5.52	178.02	121.05	0.46
Reach 1	176	100-yr	689.00	248.13	253.84	251.52	254.09	0.003547	5.68	225.04	194.21	0.43
Reach 1	171	95%	1.00	247.84	248.12	248.05	248.14	0.013851	1.08	0.93	6.11	0.49
Reach 1	171	50%	11.00	247.84	248.50	248.41	248.59	0.021042	2.42	4.55	12.24	0.70
Reach 1	171	5%	41.00	247.84	249.02	248.85	249.17	0.012693	3.23	16.70	35.00	0.62
Reach 1	171	50-yr	533.00	247.84	252.96	250.76	253.14	0.002258	4.34	213.01	116.17	0.35
Reach 1	171	100-yr	689.00	247.84	253.87	251.11	254.06	0.001946	4.52	269.57	193.67	0.33
Reach 1	165	95%	1.00	247.82	248.04	247.98	248.05	0.015822	0.99	1.01	8.30	0.50
Reach 1	165	50%	11.00	247.82	248.48	248.30	248.51	0.006924	1.26	8.74	27.20	0.39
Reach 1	165	5%	41.00	247.82	249.08	248.58	249.11	0.002738	1.35	30.32	42.10	0.28
Reach 1	165	50-yr	533.00	247.82	253.01	250.07	253.10	0.000910	2.46	217.38	76.34	0.21
Reach 1	165	100-yr	689.00	247.82	253.92	250.39	254.02	0.000778	2.59	275.47	160.76	0.20
Reach 1	150	95%	1.00	247.75	248.03	247.81	248.03	0.000483	0.25	3.95	18.54	0.10
Reach 1	150	50%	11.00	247.75	248.46	248.04	248.47	0.001216	0.72	15.27	29.56	0.18
Reach 1	150	5%	41.00	247.75	249.05	248.34	249.08	0.001374	1.23	33.43	31.55	0.21
Reach 1	150	50-yr	533.00	247.75	252.92	250.08	253.08	0.001448	3.21	166.00	40.95	0.26
Reach 1	150	100-yr	689.00	247.75	253.82	250.44	254.00	0.001313	3.44	211.86	150.70	0.26
Reach 1	134	95%	1.00	247.77	248.00	247.91	248.01	0.007781	0.68	1.47	12.47	0.35
Reach 1	134	50%	11.00	247.77	248.40	248.17	248.43	0.005275	1.37	8.03	17.36	0.35
Reach 1	134	5%	41.00	247.77	248.93	248.49	249.02	0.006007	2.35	17.45	17.78	0.42
Reach 1	134	50-yr	533.00	247.77	252.12	250.98	252.85	0.010981	6.87	77.53	23.22	0.63
Reach 1	134	100-yr	689.00	247.77	252.93	251.53	253.76	0.009888	7.29	94.49	24.92	0.61
Reach 1	125		Bridge									
Reach 1	116	95%	1.00	247.58	247.86	247.76	247.87	0.007668	0.80	1.24	8.18	0.36
Reach 1	116	50%	11.00	247.58	248.21	248.08	248.27	0.015181	2.10	5.23	13.53	0.60
Reach 1	116	5%	41.00	247.58	248.65	248.49	248.83	0.018260	3.42	12.00	17.09	0.72
Reach 1	116	50-yr	533.00	247.58	251.85	250.80	252.50	0.007518	6.47	82.39	26.66	0.60
Reach 1	116	100-yr	689.00	247.58	252.01	251.28	253.01	0.010866	8.01	86.05	26.80	0.72
Reach 1	109	95%	1.00	247.56	247.70	247.70	247.74	0.067221	1.47	0.68	9.23	0.96
Reach 1	109	50%	11.00	247.56	247.97	247.95	248.09	0.037412	2.74	4.02	13.80	0.89
Reach 1	109	5%	41.00	247.56	248.52	248.33	248.70	0.015876	3.35	12.22	15.99	0.68
Reach 1	109	50-yr	533.00	247.56	251.86	250.85	252.38	0.006890	5.83	103.81	98.26	0.56
Reach 1	109	100-yr	689.00	247.56	252.06	251.36	252.80	0.009355	7.06	113.21	130.79	0.66
Reach 1	89	95%	1.00	246.88	247.15	247.07	247.17	0.010014	0.98	1.02	5.98	0.42
Reach 1	89	50%	11.00	246.88	247.67	247.45	247.73	0.010002	2.00	5.51	11.00	0.50
Reach 1	89	5%	41.00	246.88	248.30	247.94	248.45	0.010011	3.09	13.28	13.54	0.55
Reach 1	89	50-yr	533.00	246.88	251.52	250.85	252.19	0.010006	6.72	111.10	138.30	0.66
Reach 1	89	100-yr	689.00	246.88	251.88	251.82	252.59	0.010009	7.20	158.88	150.58	0.67

Appendix F.

Public Outreach Photos

ATTENTION

This dam is being studied for removal by the Rhode Island chapter of Trout Unlimited and Rhode Island Water Resources Board.

Removal of this structure will enhance habitat for fish and wildlife and improve water quality in the Big River Management Area, a protected source for drinking water for the state of Rhode Island.

You may provide feedback on this project at: CapwellDam@gmail.com

Photo 1: Informational sign posted at the Capwell Mill Pond Dam site.

Photo 2: Location of the informational sign relative to the Capwell Mill Pond Dam, looking east

Photo 3: Location of the informational sign relative to the Capwell Mill Pond Dam, looking north

Appendix G.

PAL Historic Property Report

Public Archaeology Laboratory

Report
Capwell Mill Pond and Sweet Pond Dams
West Greenwich, Rhode Island

Historic Architectural Property Reconnaissance Survey and Preliminary Effects Assessment

June 7, 2024

PAL No. 4688

Submitted to:
EA Engineering, Science and Technology, Inc.
Marlboro, NY 12542

This report presents the results of a historic architectural property reconnaissance survey and preliminary effects assessment conducted by The Public Archaeology Laboratory, Inc. (PAL) for the proposed removal of portions of the Capwell Mill Pond Dam and Sweet Pond Dam within the Big River Management Area (BRMA) in West Greenwich, Rhode Island (Figure 1).

The Project will require permits and will use funding from state and/or federal agencies and is, therefore, subject to review under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (54 USC 306108), and its implementing regulations (36 CFR 800), and under Rhode Island General Laws § 42-45 and 530-RICR-10-00-1. The survey was conducted to identify historic architectural properties that may be affected by the Project and provide recommendations to assist in complying with applicable state and federal historic preservation laws.

Project Description

The RI Chapter of Trout Unlimited (RITU), in partnership with the Rhode Island Water Resources Board (RIWRB), is proposing to remove portions of the Capwell Mill Pond and Sweet Pond dams (the Project) to restore aquatic organism passage in the BRMA. The Project will also reduce downstream water temperature and thermal impacts to the Big River downstream of Capwell Mill Pond. EA Engineering, Science and Technology (EA) is providing engineering and design services for the Project under contract with the RITU.

The Capwell Mill Pond Dam creates an impoundment on the Carr River a short distance from its confluence with the Big River to the west. EA previously completed an analysis of three alternatives for the dam. In its subsequent Engineer Design Report (EDR) prepared by EA evaluated the recommended preferred alternative, which consists of removing the concrete spillway and gate structure of the Capwell Mill Pond Dam and cutting a channel through the earthen berm of a legacy dam approximately 120 feet (ft) upstream of the Capwell Mill Pond Dam (Figure 2).

EA is currently conducting a similar study for the Sweet Pond Dam, which impounds an unnamed tributary about 950 ft north of the abandoned Sweet Mill Road. Design plans have not yet been developed, but the work likely will be limited to removing the remains of the dam's breached spillway section (Figure 3).

Methodology

The historic property reconnaissance survey involved research, delineation of a study area, a site visit, an evaluation of the historical significance of the dams, and an assessment of the Project's effects based on current plans.

Research

PAL reviewed the RI Historic Preservation & Heritage Commission's (RIHPHC's) inventory and relevant town survey reports to identify previously recorded historic resources in or adjacent to the Project areas (RIHPC 1978a and 1978b). Research was conducted at the Louttit Public Library in West Greenwich to gather pertinent information about the area's historical development and using the West Greenwich Registry of Deeds (WGRD) to identify property records relating to the Capwell Mill Pond and Sweet Pond dams. Additional research was done using online genealogical databases, newspapers, and historical map collections. Relevant cultural resource management investigations, including PAL's 1986 reconnaissance survey of the Big River Management Area (King and Ritchie 1986), were also reviewed for information about the history of the area and sites identified in the vicinity of the dams.

Study Areas/Recommended Area of Potential Effects

PAL reviewed the EA's EDR for the Capwell Mill Pond Dam and available information about proposed alterations to the Sweet Pond Dam to delineate study areas that defined the limits of the survey. Based on the current plans and the limited surrounding development, the study areas consisted of the dams and their associated features, which consist of the visible remains of the sawmills that they once served. The Capwell Mill Pond Dam study area includes the remains of the legacy dam that existed at the water privilege before it was replaced by the current dam. The study areas, as depicted in Figures 2 and 3, constitute PAL's recommendation for establishing the Area of Potential Effects (APE) for the Project pursuant to 36 CFR 800.4(1)(a) and 36 CFR 800.16(d).

Site Visits

In March 2024, PAL conducted site visits of the Capwell Mill Pond and Sweet Pond dams within the BRMA. The site visits included visual inspection of the dam structures and their surroundings. Notes on the appearance and integrity of the two dam sites, existing conditions, and the integrity of the immediate upstream and downstream banks and mill ponds were recorded. The existing conditions were documented with high-resolution digital photographs of the two dams and their landscapes.

National Register Evaluation

After completing the research and site visit, PAL evaluated the significance of the dams by applying the National Register of Historic Places (National Register) criteria for evaluation (36 CFR 60). The criteria state that the "quality of significance in American history, architecture, archaeology,engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and

A. that are associated with events that have made a significant contribution to the broad patterns of our history; or
B. that are associated with the lives of persons significant in our past; or
C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
D. that have yielded, or may be likely to yield, information important to prehistory or history" (NPS 1997).

The evaluation of National Register eligibility was conducted in two phases. The first phase involved the preparation of a historic context statement and developmental history of the dams to determine if they meet one or more of the National Register criteria for evaluation. A historic context provides the organizational framework for evaluating historic properties based on their associations with important themes, trends, events, and people important in local, state, or national history. The development history describes how and why the property was developed within its historic context. The second phase of the evaluation consisted of assessing the integrity of the dams by determining which aspects of integrity (location, design, setting, materials, workmanship, feeling, and association) they possess. A property must possess most or all aspects of integrity in order to convey its historical associations and be eligible for inclusion in the National Register.

Effects Assessment

An effects assessment was conducted by applying the criteria of adverse effect, as defined in the regulations governing Section 106 of the NHPA at 36 CFR 800.5(a)(1), to properties that were evaluated potentially eligible for inclusion in the National Register. The criteria state that an "adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register of Historic Places in a manner that would dimmish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association."

Report

The preparation of this report constituted the final phase of the survey. The report provides a historic context statement that was used as a framework for evaluating properties, provides a preliminary National Register evaluation of the properties, and assesses the potential effects of the Project, as currently designed, on properties that are listed or potentially eligible for listing in the National Register, and provides recommendations subsequent consultation under Section 106 of the NHPA.

Descriptions

The Capwell Mill Pond and Sweet Pond dams are in the eastern portion of West Greenwich in the BRMA, which encompasses 8,319 acres and primarily consists of second growth coniferous and deciduous forest and wetlands. The major streams that travel through the area are the Big River, Nooseneck River, Congdon River, and Carr River. The area was lightly settled during the historic period, and development today is limited to a few residential properties and about 230 acres of agricultural lands.

Capwell Mill Pond Dam

The Capwell Mill Pond Dam is an earthen berm gravity dam with a concrete spillway and sluicegate structure that was constructed about 1872. It is 35 ft east of Burnt Sawmill Road and 0.35 miles south of the intersection with Nooseneck Hill Road. There are no visible remains of the sawmill that was once associated with the dam. The dam stretches 150 ft north–south across the Carr River to impound the 23.75-acre Capwell Pond (Figures 2 and 4; Photos 1 and 2). The non-overflow earthen berm sections of the dam are 6.5 ft tall and have dry-laid rubble fieldstone retaining walls on their downstream (west) faces. The crests of the berm sections are overgrown with mature trees and underbrush (Photos 3–8). At the south abutment of the dam, the fieldstone wall of the downstream face curves to the west and gradually tapers (Photo 9).

The concrete spillway and sluicegate structure is near the center of the dam (Photo 10). It is 30 ft wide and has five concrete piers that create four bays. The sluicegate in the southernmost bay contained a manually operated wood gate that controlled flows to the river downstream (Photos 11 and 12). The piers of the three northern bays are slotted to accept flashboards that were used to raise the level of the impoundment (Photo 13). A stone block apron extends from the base of the spillway on the downstream face. The sluicegate is no longer operable, and the flashboards of the spillway are not extant.

Burnt Sawmill Road Bridge

The southern riverbank is lined with a dry-laid fieldstone training wall that extends from the spillway to a 35-ft-long, single-span, arched concrete bridge over the Carr River (Photos 14 and 15). The bridge was constructed in 1923 and shows signs of deterioration, including some significant cracks and spalled areas (Photos 16 and 17). The Carr River runs west from the spillway approximately 0.2 miles before it joins the Big River in West Greenwich.

Legacy Dam

The remains of a legacy earthen dam about 100 ft east of the Capwell Mill Pond Dam are visible at times of low water in the impoundment (Photo 18). The legacy dam extends 90 ft east from a point northeast of the existing Capwell Mill Pond Dam before turning south at a near 90-degree angle and extending an additional 160 ft to the bank of the pond. The crest of the dam that is visible at low water is approximately 18 ft wide. It is overgrown with reeds and wetland vegetation. A 4-by-8-ft concrete pad littered with displaced brick was southeast of the Capwell Mill Pond Dam and may have been associated with the icehouse once operated at the site (Photo 19).

Sweet Pond Dam

The Sweet Pond Dam is a stone-lined earthen gravity dam that was constructed at least as early as 1870. It extends approximately 150 ft east–west across an unnamed tributary stream to form Sweet Pond (Figure 5, Photos 20). Sweet Pond extends south about 950 ft from the dam to the abandoned Sweet Sawmill Road and covers 5.32 acres (Photo 21). The unnamed tributary stream flows north from the dam's spillway and runs approximately 1.3 miles to empty into the Capwell Mill Pond on the Carr River (Photo 22).

The Sweet Pond Dam has an overall height of 9.5 ft with the west abutment constructed into a sloping hillside and the eastern abutment constructed to meet a lower terrace. Its upstream (south) and downstream (north) faces are lined with dry-laid stone masonry (Photos 23–27). The earthen crest of the dam is overgrown with mature trees and underbrush. At the widest part of the dam east of the spillway, the crest is 26 ft wide (Photo 28). To the west of the spillway, the crest of the dam is 13 ft wide (Photo 29).

A breached 12-ft-wide dry-laid stone spillway is in the center of the dam (Photos 30 and 31). At some time in the twentieth century, a ceramic drainage pipe was installed within the spillway to control water levels in the impoundment (Photo 32). The downstream face of the dam to the west is badly overgrown and partially flooded (Photo 33). A dry earthen channel extends 34 ft from the western side of the dam and rejoins the stream below the dam (Photo 34).

The remains of a stone foundation of the former sawmill that straddled the raceway are immediately below the dam. East of the raceway is an 18-by-13-ft dry-laid stone foundation (Photos 35 and 36). The western wall of the foundation is 5 ft high and constructed adjacent to the eastern streambank. The eastern wall of the foundation where the wheel pit was likely locates has mostly collapsed and there is no visible north wall to the foundation (see Photo 33). To the east of the foundation, the northeast abutment wall extends 40 ft and curves to the north where it gradually meets the level of the eastern slope (Photo 37). Downstream of the dam, a small wood plank footbridge carries a walking trail across the stream (Photo 38).

Historic Context

In 1709, the area encompassing present-day East and West Greenwich, then known as the "Vacant Land Tract" because it was sparsely settled and not yet part of the Rhode Island Colony, was obtained by the Rhode Island General Assembly from Ninigret, Sachem of the Narragansetts. The area of West Greenwich was subsequently sold to 13 individuals from East Greenwich and Warwick for 1,100 pounds, but it remained part of East Greenwich until 1741, when the General Assembly granted a petition to incorporate West Greenwich as a separate town. During the ensuing 50 years, West Greenwich's population grew steadily and was 2,054 by 1790 (RIHPC 1978a).

West Greenwich's colonial period development pattern consisted of widely spaced homesteads along a rudimentary road system. There was no town center and only a few village clusters, the largest of which were at Nooseneck near the geographic center of the town, and Escoheag and West Greenwich Centre were in the southwest and northwest corners, respectively. The primary east–west running road was Division Street, a former Pequot Indian trail through the northern section of town leading to East Greenwich and Narragansett Bay. Most early settlers were farmers who eked a living out of the few areas of fertile land by growing subsistence crops and some marginal cash crops, including flax, barley, maize, rye, oats, and hay. The meager soils forced many farmers to supplement their incomes by exploiting other available natural resources, which included isolated deposits of granite that supported a limited quarrying industry, particularly in the area south of Carr Pond near the East Greenwich border (RIHPC 1978a).

More importantly, West Greenwich possessed large tracts of virgin white pine, birch, oak, and chestnut forest that farmers exploited to supplement their incomes. In 1740, Pasco Coon, who had learned to operate an up-and-down water-powered sawmill in York, Maine, built a sawmill on the Carr River at what became known as Potter's Pond. Coon's mill was the first of its kind in Rhode Island and he developed a thriving business in supplying products to ship builders in the region. He also taught local farmers how to build and operate sawmills and, by the end of the eighteenth century, numerous dams and mill buildings were constructed on the town's rivers and streams (Harpin and Albro 2003:76–77). The sawmills produced a variety of wood building products, including shingles clapboards, floorboards, and barrel staves and ends. Some of these mills also included gristmills that processed grains grown by local farmers (RIHPC 1978a). In 1889, there were about 12 saw and shingle mills "doing good business" in the town (Cole 1889).

The lack of good transportation routes to transport products to coastal markets was a problem that hindered West Greenwich's development into the twentieth century. The New London Turnpike, which was completed through West Greenwich in 1821, promised to be a significant improvement by providing a good overland route to the port cities of Providence and New London, Connecticut. The turnpike sparked the development of several taverns and inns along its route in West Greenwich, but soon became a financial failure and went into disrepair due to competition from steamboat lines and railroads that offered far more efficient and cheaper ways to transport goods.

West Greenwich was ultimately bypassed by the railroads that were constructed throughout the state. As a result, the town remained somewhat isolated and unable to participate in the types of large-scale industrial production that fueled development of many other towns during the nineteenth and early twentieth centuries (RIHPC 1978b). In his history of Washington and Kent counties published in 1889, J. R. Cole described West Greenwich as having "no important public enterprises…No telegraph nor railroad, nor any very extensive manufacturing; no secret societies…no post office until 1846, no stately town edifice in which the freemen assemble to exercise their inalienable rights, and no town asylum."

The most notable industrial development in West Greenwich during the nineteenth century occurred in the village of Nooseneck, which was along Big River. A succession of textile mills was constructed there during the first half of the century to manufacture cotton thread, wool yarn, and, later, braided sash cord, warp, and twine. By mid-century, David Hopkins was the most prominent mill owner and was responsible for the construction of a number of houses in the village that accommodated mill workers (RIHPC 1978b). By 1890, however, the small-scale mills at Nooseneck were no longer able to compete with larger manufactures and most were eventually destroyed by fire. Agricultural production also declined precipitously in the late nineteenth century, as many of the town's farmers abandoned the area in search of better lands. By 1880, the population of the town had declined to 1,000 and would eventually fall to a low of 367 in 1920 (Public Archaeology Laboratory 1978; RIHPC 1978a).

Although the introduction of the automobile and improved roads in the early twentieth century helped to attract some residential development in the town, the population remained low and did not surpass 2,000 recorded in 1790 until the 1980s. In the 1960s, the lightly settled area in the center of town along the Big River was targeted by the State of Rhode Island for the development of a 3,400-acre water supply reservoir. By 1966, the State had acquired through eminent domain about 8,500 acres in Coventry and West Greenwich, including the areas surrounding the Capwell Mill Pond and Sweet Pond dams (Moffitt 2014). However, the reservoir project was abandoned after substantial opposition by the U.S. Environmental Protection Agency, local environmental groups, and the general public. The area was ultimately set aside for conservation as the Big River Management Area (USEPA 1989).

History of the Capwell Mill Pond Dam

Development of the mill privilege on Carr River where the Capwell Mill Pond Dam is located appears to have begun during the 1830s. An 1831 map depicts the area as undeveloped forestland southeast of Ishmael's Bridge, which carried Division Street over what is now Big River (Figure 6). The first documentation of industrial development of the water privilege is an 1844 deed from John James, the Kent County deputy sheriff, to William Bailey Whitford (1796–1883), which describes Whitford's purchase at public auction of a parcel of property containing one-half acre "with an old mill thereon, standing or however otherwise." The property's previous owner was Oliver Matteson (1768–1842) (WGRD 1844; FamilySearch.org 2024c).

Whitford was born in 1796 in Rhode Island and was documented as living in West Greenwich with his family by 1830 (U.S. Census 1830). He listed his occupation as a farmer and, like others in town, supplemented his income by harvesting trees from several woodlots he owned in the vicinity and processing them into building materials at his sawmill to supplement to his farming income (U.S. Census 1840). An 1855 map of West Greenwich shows Whitford's Sawmill and the impoundment of the legacy dam that provided waterpower for the mill (Figure 7). Whitford's farmstead included two houses adjacent to the mill to the south along the east side of what is now Burnt Sawmill Road (Walling 1855).

In 1870, Searles Capwell (1839–1916) purchased Whitford's mill. Capwell was born in West Greenwich to Charles and Phebe (Asten) Capwell (Harpin and Albro 2003, 120). He began working in the lumber business at the age of 15 when he was employed at the Fry Sawmill, which was northwest of Nooseneck on a tributary to Big River. In 1856, Capwell married Susan Dawson Greene, and the couple eventually had two daughters, Evangeline and Nettie Capwell (Harpin and Albro 2003:120; U.S. Census 1870 and 1880). An 1870 map indicates by that time the Capwells lived in a house near the intersection of present-day Nooseneck Hill and Burnt Sawmill roads (Figure 8). The sawmill on the south side of the Carr River and east of Burnt Sawmill Road is identified on the map with Capwell's initials (Beers 1870).

Although Capwell's original deed to the property could not be identified, a series of three deeds recorded in 1872 detail Capwell's purchase of lands adjacent to the dam privilege that would be "flowed with water by the erection and maintenance of a dam or rollway sixteen inches higher than the present dam or rollway of Capwell's sawmill" from his neighbors Ephraim Howard, John Howard, and Whitman Harrington (WGRD 1872a, 1872b, 1872c). It is likely that the legacy earthen dam visible in Capwell Pond at times of low water was abandoned and the present stone-lined earthen dam was constructed at this time. Once constructed, Capwell used the new dam to provide power to a sawmill and shingle shop. Also recorded in these deeds was an obligation on the behalf of Capwell to erect and maintain a bridge at the outlet of the pond so that Whitman Harrington could pass by the dam and sawmill (WGRD 1872c). Presumably, the bridge mentioned was located where the existing concrete arch bridge was constructed to carry Burnt Sawmill Road over the river west of the dam in 1923.

In 1880, Searles Capwell's daughter Evangeline (Eva) Capwell (1861–1942) married Alanson Albro (1852–1940) (FamilySearch.org 2024b). Capwell then partnered with Albro, who took over management of the operations on Burnt Sawmill Road. With Albro taking over as chief sawyer, Capwell sought to expand their lumber milling business by purchasing additional properties throughout West Greenwich to use as woodlots (Harpin and Albro 2003:121). Eva was also involved in the business and acted as an accountant (Harpin and Albro 2003:122). As Capwell's share of the West Greenwich lumber industry grew, he rose to become a prominent figure in the town. In 1882–1884, he served as the Rhode Island State Senator from the town (Harpin and Albro 2003:125).

In 1884, the Capwell Mill Pond Dam was inspected by the Rhode Island Commissioner of Dams and Reservoirs. The dam, referred to as "Capwell's Saw Mill Privilege" was briefly described in the commissioner's annual report as a "dam two hundred feet in length and eight feet high, in poor condition." Capwell Pond was described as having a "very small area" and being "unimportant as a cause of danger in any event." A second dam, named "Searles Capwell's Saw Mill Privilege," also in West Greenwich, was described as larger than the other dam and discharging directly into the Quidnick Reservoir in Coventry to the northwest of the Capwell Mill Pond Dam (Rhode Island Office of the Commissioner of Dams and Reservoirs 1884:30–31).

The presence of a second dam attributed to Capwell testifies to the expansion of the family-run lumber business at that time. Also in 1884, he reportedly purchased a portable, gasoline-powered Lane sawmill that increased production at the Capwell Mill site on Burnt Sawmill Road by enabling Albro to produce lumber during the summer months when waterpower was limited. It also allowed him to easily move between the various other woodlots owned by Capwell in the area (Harpin and Albro 2003:123). During the winter months, the family used Capwell Pond to harvest ice for their personal use that they stored in an icehouse southeast of the dam (Harpin and Albro 2003:123).

In 1890, Capwell expanded the family lumber business with the purchase of a carriage shop in the village of Anthony in Coventry. He converted the carriage shop to serve as a headquarters for the S. Capwell Lumber Company. The building allowed him to grow the business by manufacturing windows, doors, blinds, and other architectural wood products crafted from the lumber that his son-in-law produced at Burnt Sawmill Road and the various other woodlots owned by Capwell (Harpin and Albro 2003:121). Capwell was appointed to the Rhode Island State Senate for a second term in 1891–1893, this time representing the Coventry (Harpin and Albro 2003:125).

By the time of Searles Capwell's death in 1916, his lumber company had grown to be one of the most prominent lumber businesses in Rhode Island. In 1919, Capwell's wife, Florence Capwell, and his daughter Nettie Northrup sold the Capwell Mill to Evangeline Albro (WGRD 1919). His other daughter, Eva, and her son Deck Albro continued to operate the S. Capwell Lumber Co. with Charles Northrup (husband of Nettie Northrup) (Harpin and Albro 2003:127). It is possible that the concrete spillway was added during Eva's ownership of the company. After Eva's death in 1942, the Capwell Mill was sold to the Providence Box Company in 1944 by Eva's son John Albro (WGRD 1944).

The Providence Box Company continued to use the property for a sawmill. It retained ownership of the mill until 1946, when it sold the property to Albert Jaeger (WGRD 1946), who is listed in the 1950 U.S. Census as a general manager of a dying company. Inspection of aerial imagery confirms that the Capwell Mill was demolished by 1963 (NETR 1963).

In 1965, the Capwell Mill was seized by eminent domain by the State of Rhode Island Board of Water Resources, along with hundreds of other properties in eastern West Greenwich for the creation of the Big River Reservoir. In 1986, an archaeological survey of the Big River Reservoir recorded the

Capwell Mill Pond Dam as the Whitford/Capwell Mill archaeological site (RI 312) (King and Ritchie 1986).

In 1990, the EPA ruled against issuing a permit to the Big River Reservoir, putting an end to decades of litigation involving the proposed reservoir project. Since 1990, the land owned by the Rhode Island Board of Water Resources has been managed as a conservation area. Today, Burnt Sawmill Road and Capwell Pond are popular destinations for outdoor recreation, with the Capwell Mill Pond Dam serving as a scenic reminder of West Greenwich's roots in the lumber industry.

History of the Sweet Pond Dam

The Sweet Pond Dam is on the north side of Sweet Pond to the north of the now abandoned Sweet Sawmill Road, which was probably laid out during West Greenwich's colonial period (King and Ritchie 1986:137). The Sweet family, namesake of the road, sawmill, and pond, was one of the first families to settle in eastern West Greenwich, and they occupied a farmstead near the Sweet Pond Dam (King and Ritchie 1986:69). Family gravestones in the nearby Sweet Family Burial Ground date from as early as 1759 (Stevens 1831; King and Ritchie 1986:69).

The first documentary evidence of the Sweet Pond Dam is an 1870 (Beers) that identifies a sawmill the pond, and a house nearby owned by E.O. Sweet (Figure 8). Enos Osborne Sweet (1819–1891) likely constructed the dam and sawmill during the late 1850s or early 1860s. He sold the property to Eben Sweet, possibly a distant cousin, in 1876 (WGRD 1891).

Eben Sweet and his wife, Dianthe Sweet, owned the Sweet sawmill until 1891, when they sold the property to Clinton Hopkins (1860–1924) and his wife, Ella May Tarbox (1870–1945). Clinton Hopkins and his brother-in-law, Elmer Tarbox operated another sawmill at Potters Pond (now Tarbox Pond) northeast of Sweet Pond and were already prominent figures in the West Greenwich lumber industry when Hopkins acquired the Sweet Sawmill (Harpin and Albro 2003:107).

Soon after Hopkins purchased sawmill, the nearby Sweet family residence was destroyed in a forest fire in 1895 (King and Ritchie 1986:178). The property is shown the 1895 (Everts and Richards) map of Coventry and West Greenwich as "Old Saw Mill," indicating that it may have been abandoned by that time (Figure 9). The sawmill There are no buildings depicted in the area on historical topographical maps, suggesting that the sawmill also may have been destroyed by the forest fire (NETR 1899–1943).

After Clinton Hopkin's death in 1924, the property then passed to his wife, Ella May Tarbox, and the Sweet Pond Dam fell into disrepair. Ella May passed the property and the Sweet Pond Dam to her late husband's niece and nephews Ardis Barbour, Clinton Barbour, and Howard Barbour, whom the couple had taken in after the death of the children's parents at an early age (Harpin and Albro 2003:108).

Ardis, Clinton, and Howard Barbour would retain ownership of the property until it was seized by eminent domain by the State of Rhode Island Board of Water Resources to create the Big River Reservoir in 1965. The 1976 archaeological survey of the Big River Reservoir recorded the dam as the Sweet Pond Dam archaeological site (RI 1468).

National Register Evaluation

Capwell Mill Pond and Legacy Dam

The Capwell Mill Pond and legacy dams are potentially eligible for inclusion in the National Register under Criterion A at the local level for their important associations with the history of West Greenwich's lumber industry. Together, the dams represent about 150 years of lumber processing at the privilege on the Carr River where they are located. The legacy dam is a vestige of West Greenwich's early lumber industry, which served as a supplementary source of income for settlers that practiced subsistence agriculture. The Capwell Mill Pond Dam is representative of the transition of the lumber industry into one of the few major drivers of West Greenwich's economy from the mid-nineteenth to early twentieth centuries. Constructed by Searles Capwell in 1872, the dam and former sawmill there formed the basis for founding the S. Capwell Lumber Company, one of the state's largest suppliers of wood building materials. The success of the company propelled Capwell's rise in state politics as he went on to serve as a two-time state senator for West Greenwich and Coventry.

The Capwell Mill Pond Dam conveys its historical associations through its location, design, setting, and materials. Concrete alterations made to the dam's spillway in the early twentieth century represent the dam's evolution during the period of ownership and use by the S. Capwell Lumber Company. The loss of the sawmill and shingle mill buildings associated with the dam have diminished the feeling and association aspects of the dam's integrity. The legacy dam retains integrity of its location, setting, and materials and is important to the understanding of the site's long history of lumber production.

Sweet Pond Dam

The Sweet Pond Dam is recommended to be ineligible for inclusion in the National Register. It was constructed about 1870 and, like the Capwell Mill Pond Dam, is a simple earthen berm gravity dam. The spillway has been breached, however, and in poor condition and lacks the important historical associations with the development of West Greenwich's lumber industry that the Capwell Mill Pond Dam possesses.

Effects Assessment

The Project, as currently designed, will cause an adverse effect on the Capwell Mill Pond Dam through the removal of the concrete spillway and sluicegate structure and portions of the earthen berm to create a free-flowing river channel. The impact to the legacy dam caused by the removal of a small portion of the earthen dam will not cause an adverse effect due to the dam's breached and deteriorated condition.

Recommendations

PAL recommends a more thorough effects assessment be conducted for the Project when design plans for the proposed modifications of the Capewell Mill Pond Dam and the legacy dam have advanced to a stage where all effects can be determined. PAL further recommends that the Section 106 consultation process be initiated by the Lead Federal Agency for the Project, once that agency is determined.

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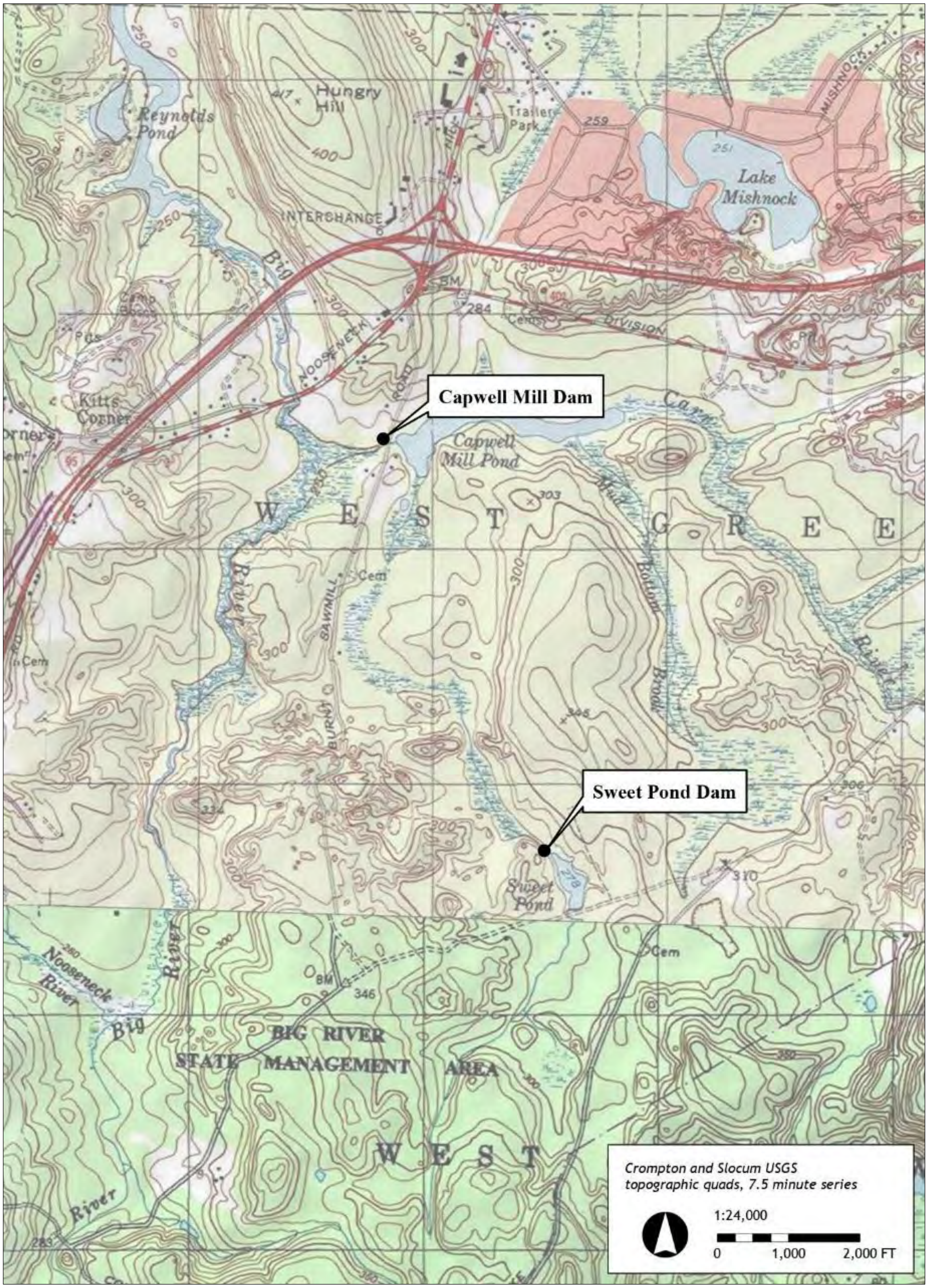

Figure 1. Locations of the Capwell Mill Pond Dam and the Sweet Pond Dam on the Crompton and Slocum USGS topographic quadrangles, 7.5-minute series.

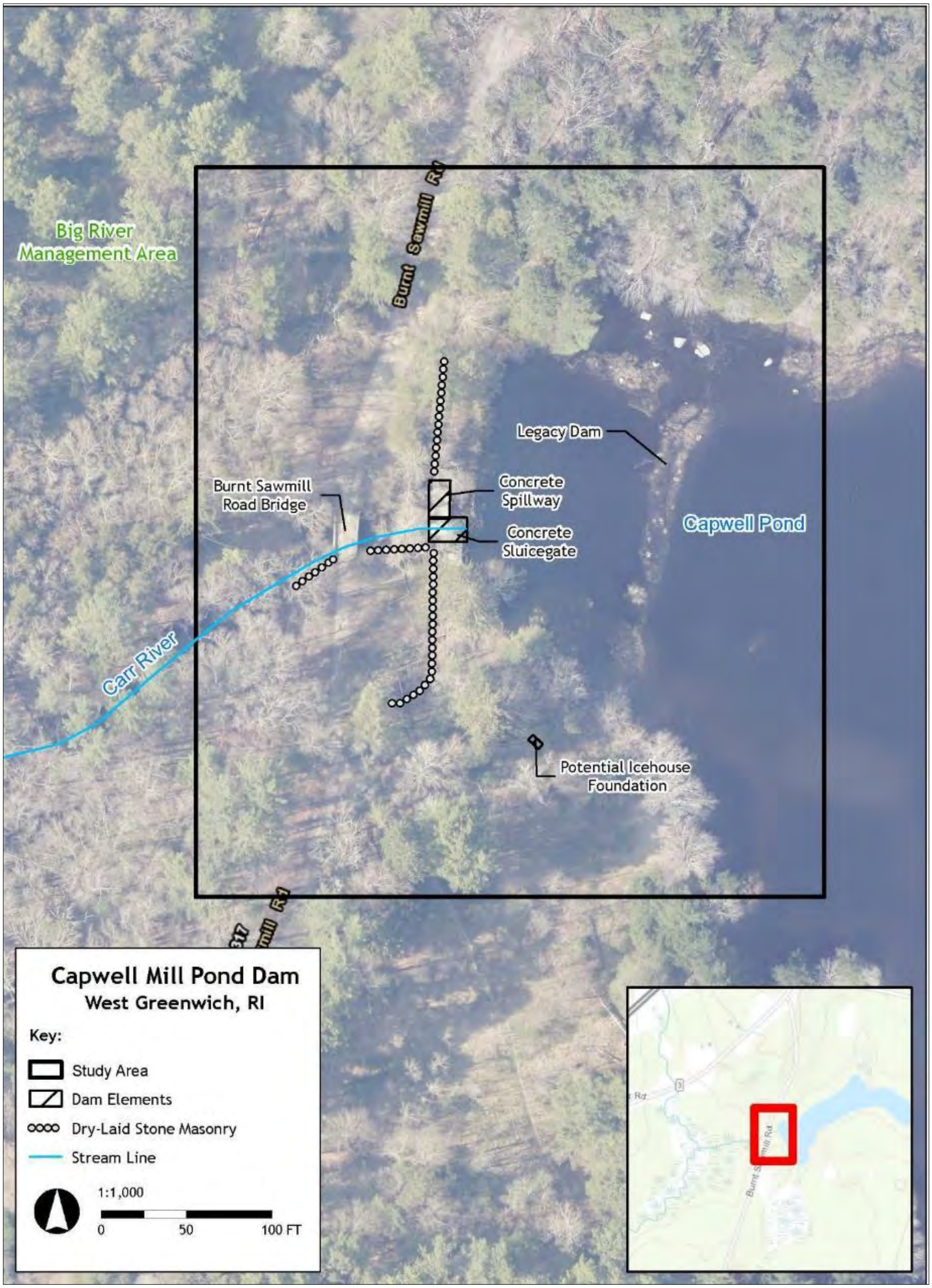

Figure 2. Capwell Mill Pond Dam Study Area/Recommended Area of Potential Effects.

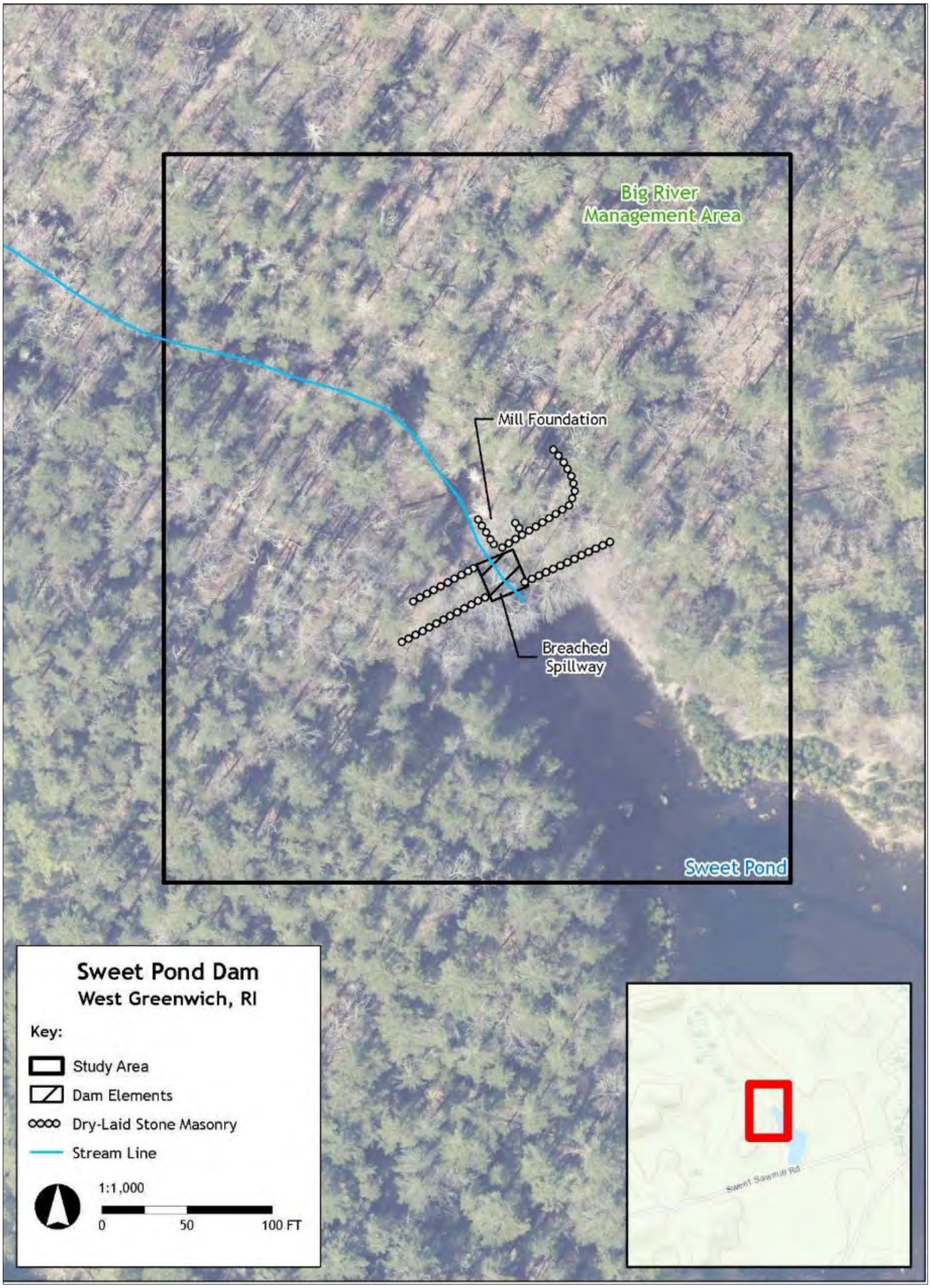

Figure 3. Sweet Pond Dam Study Area/Recommended Area of Potential Effects.

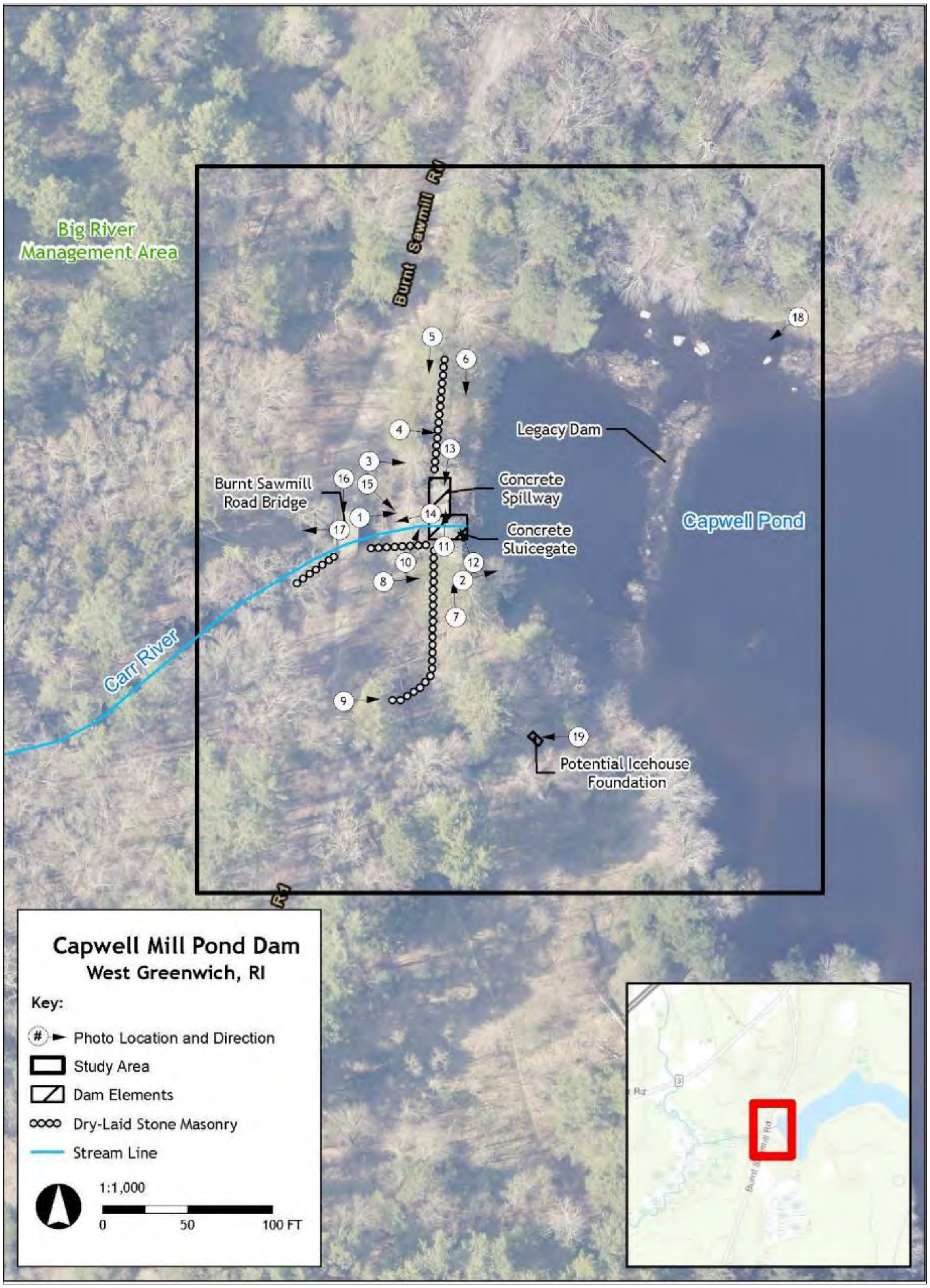

Figure 4. Photo locations and directions at the Capwell Mill Pond and legacy dams.

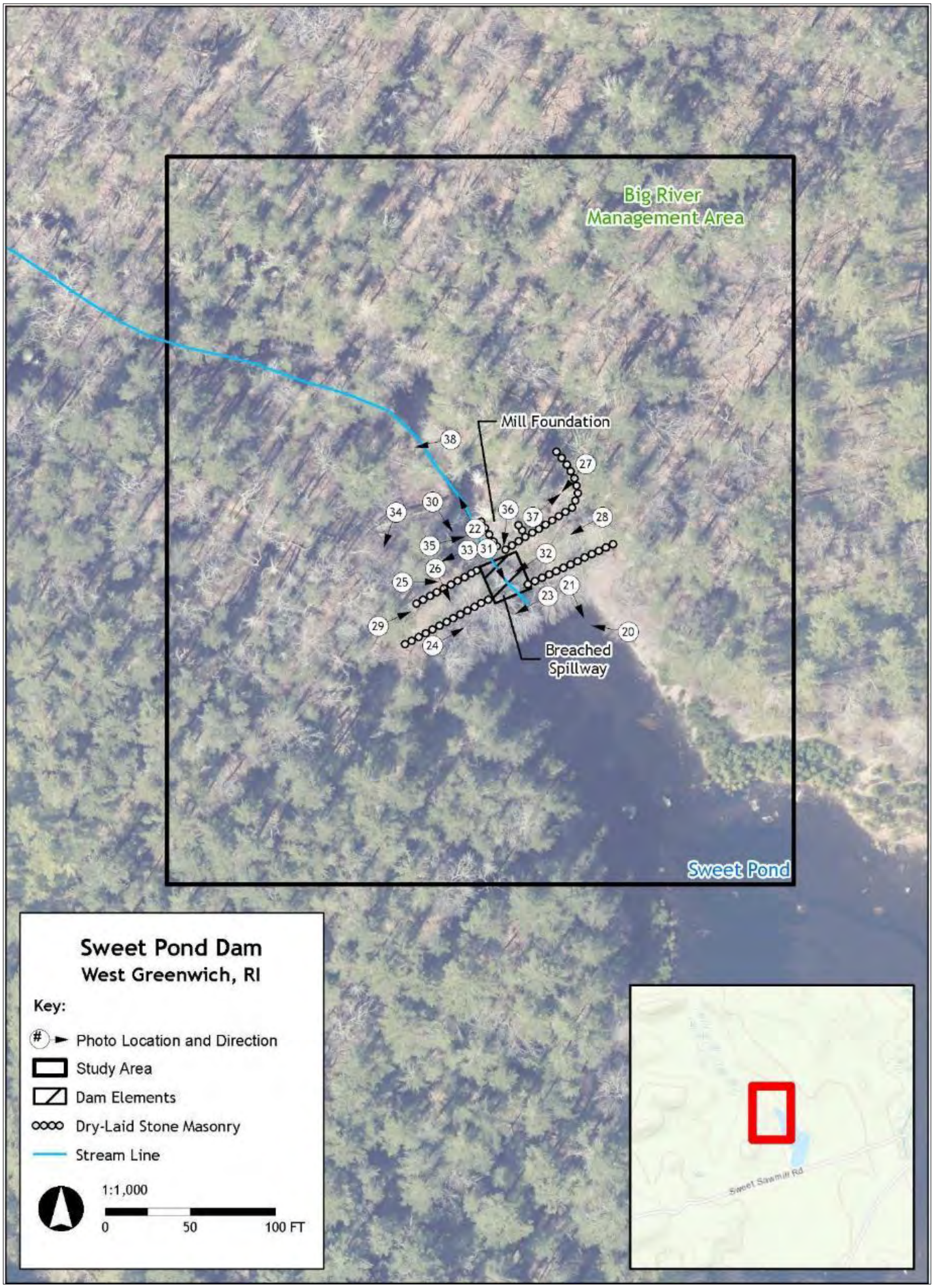

Figure 5. Photo locations and directions at the Sweet Pond Dam.

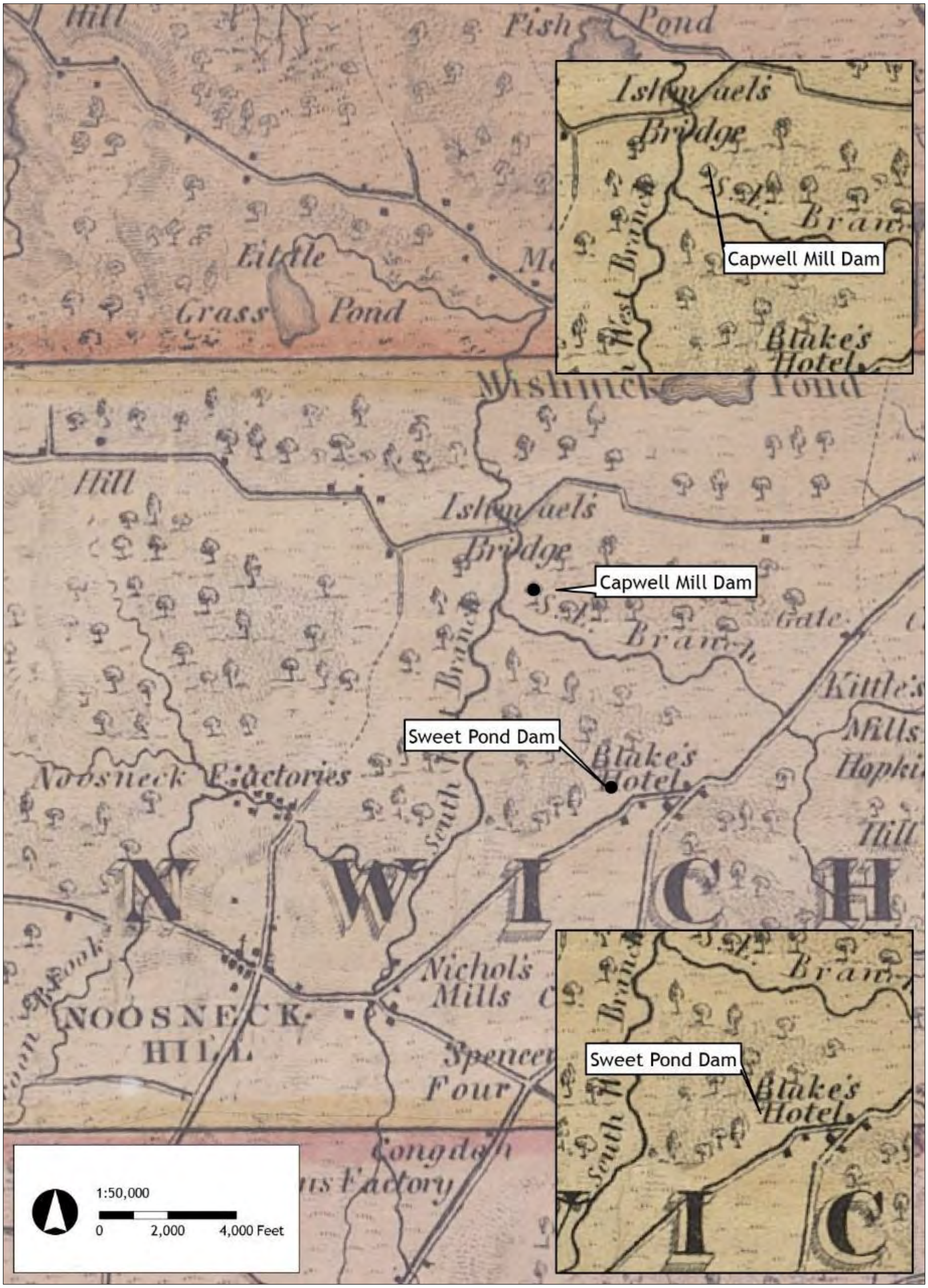

Figure 6. 1831 map showing the future locations of the Capwell Mill Pond and Sweet Pond dams (Stevens 1831).

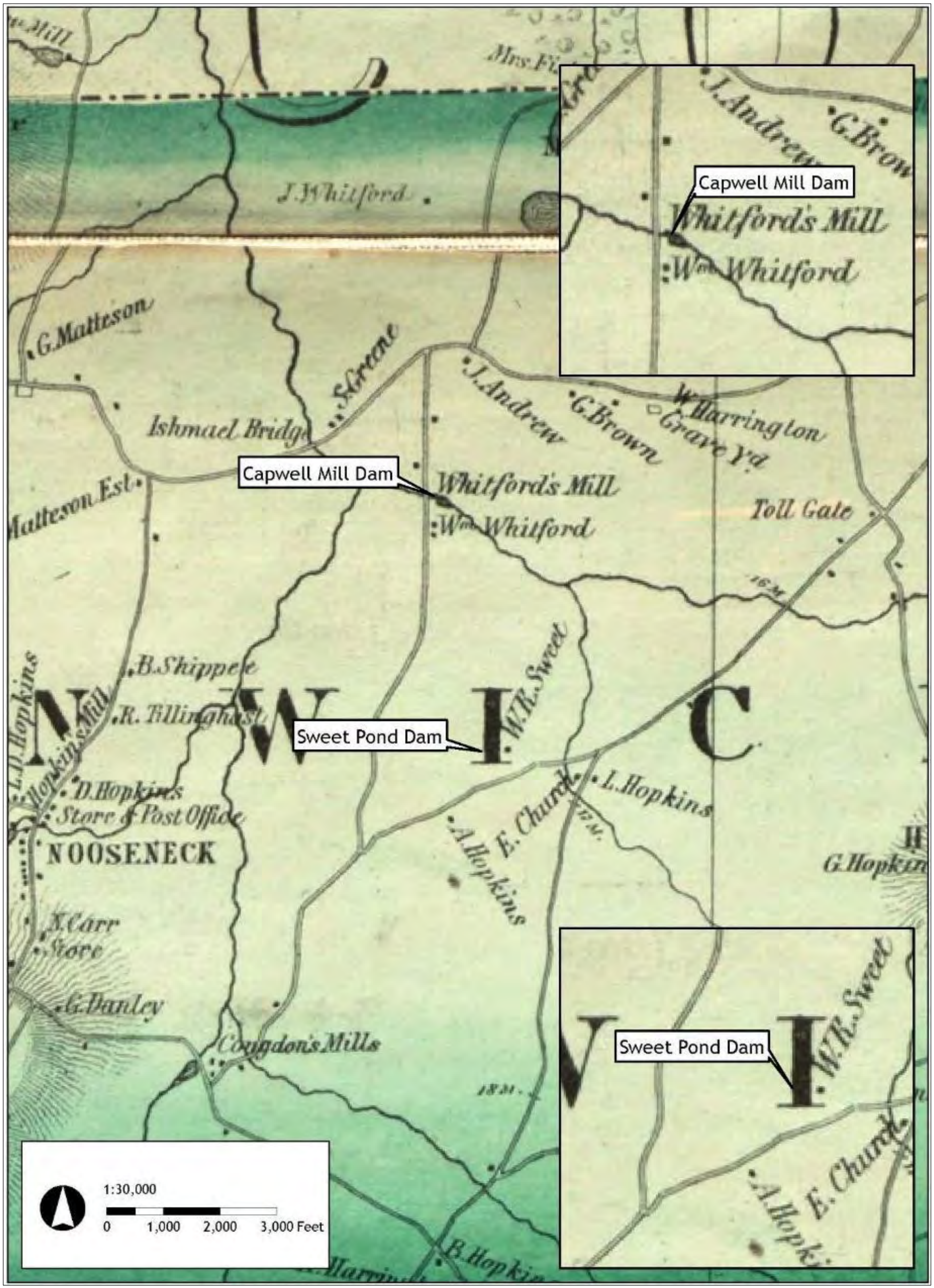

Figure 7. 1855 map showing the location of William Whitford's dam and sawmill at the legacy dam and the future location of the Sweet Pond Dam (Walling 1855).

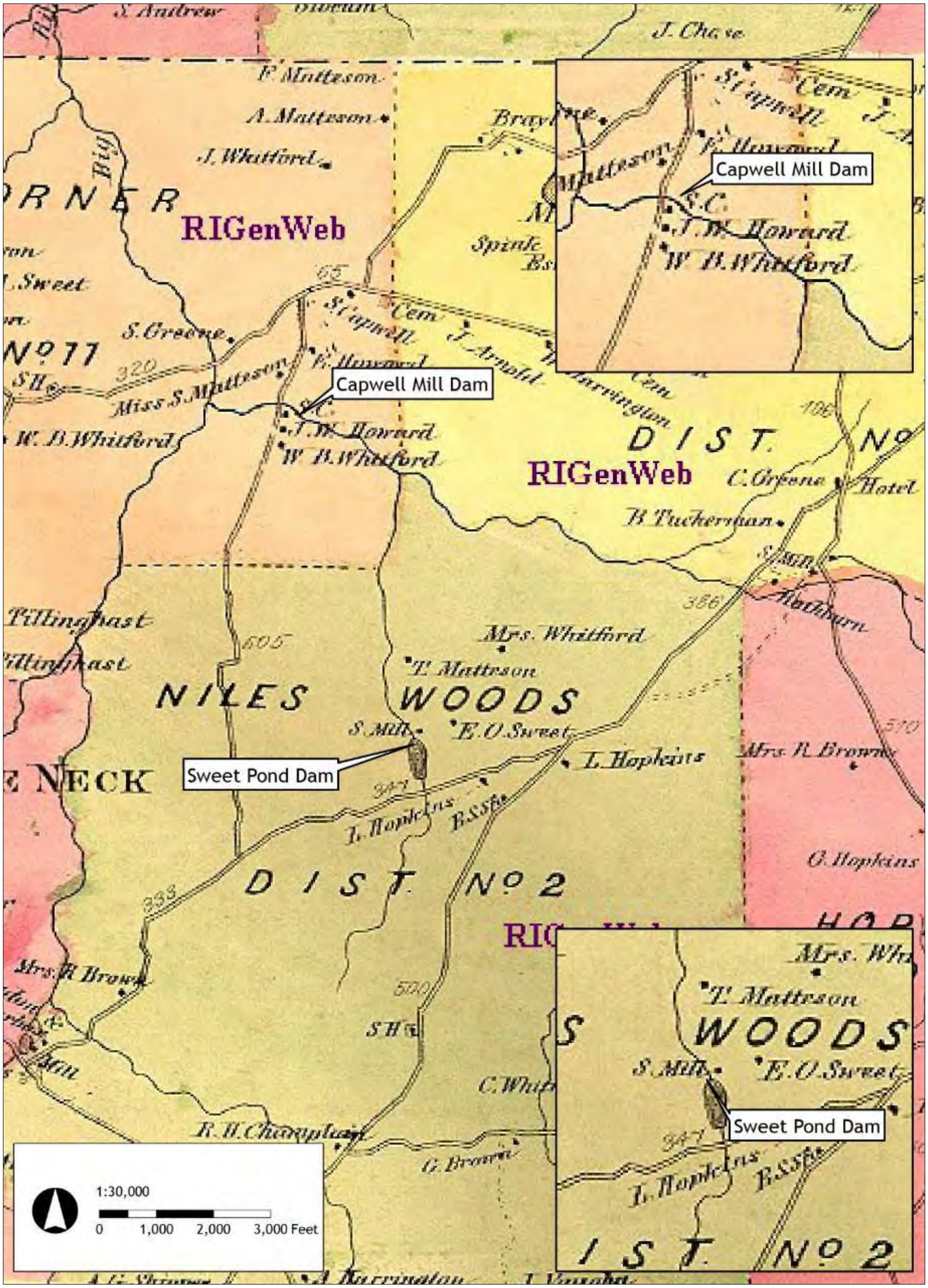

Figure 8. 1870 map showing the locations of the Capwell Mill Pond Dam and Sawmill and the Sweet Pond Dam and Sawmill (Beers 1870).

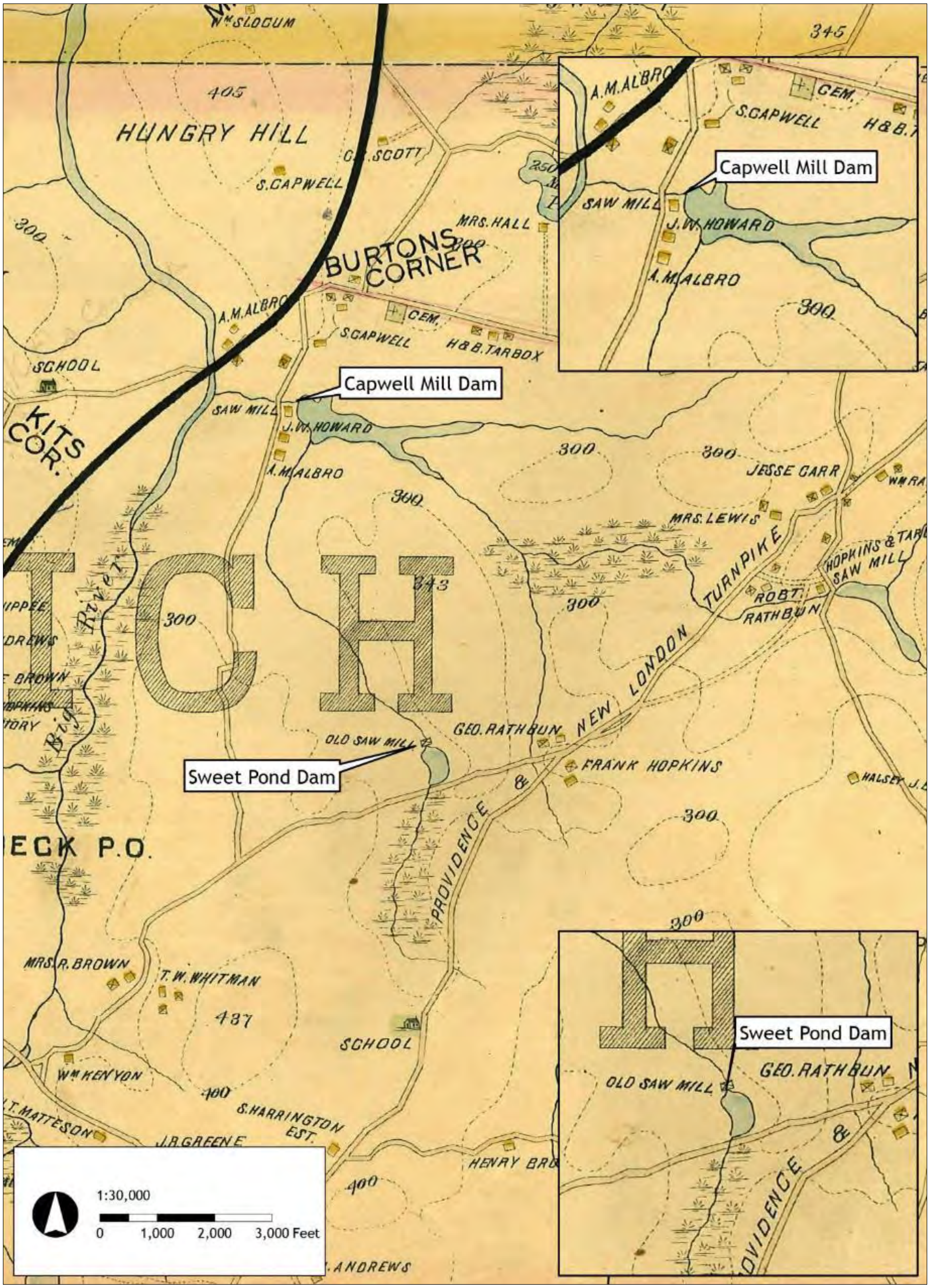

Figure 9. 1895 map showing the locations of the Capwell Mill Pond Dam and Sawmill and the Sweet Pond Dam and "Old" Sawmill (Everts and Richards 1895).

Photo 1. Capwell Mill Pond Dam, view east.

Photo 2. Capwell Mill Pond, view east.

Photo 3. Downstream (west) face of the Capwell Mill Pond Dam, view east.

Photo 4. Dry-laid stone masonry on the downstream face of the Capwell Mill Pond Dam, view east.

Photo 5. Dry-laid stone masonry on the downstream face of the Capwell Mill Pond Dam, view south.

Photo 6. Overgrown earthen crest of the Capwell Mill Pond Dam, view south.

Photo 7. Overgrown earthen crest of the Capwell Mill Pond Dam, view north.

Photo 8. Dry-laid stone masonry on the downstream face of the Capwell Mill Pond Dam, view east.

Photo 9. Low retaining wall at Capwell Mill Pond Dam's southern abutment, view southeast.

Photo 10. Capwell Mill Pond Dam spillway and sluice, view northeast.

Photo 11. Capwell Mill Pond Dam spillway and sluice with a small wooden footbridge.

Photo 12. Capwell Mill Pond Dam spillway and sluice with a water level meter on the upstream (east) face, view southwest.

Photo 13. Slatted concrete piers at the spillway of the Capwell Mill Pond Dam, view south.

Photo 14. Concrete arch bridge immediately downstream of the Capwell Mill Pond Dam on Burnt Sawmill Road, view west.

Photo 15. Stone-lined river wall on the south bank of the Carr River downstream from the Capwell Mill Pond Dam, view southeast.

Photo 16. Concrete arch bridge deck on Burnt Sawmill Road, view south.

Photo 17. Engraved "1923" dedication on the concrete arch bridge, view west.

Photo 18. Legacy dam remains in Capwell Pond, view south.

Photo 19. Concrete and brick pad to the southeast of the Capwell Mill Pond Dam, view west.

Photo 20. Sweet Pond Dam, view northwest.

Photo 21. Sweet Pond, view south.

Photo 22. Unnamed tributary stream extending north downstream from the Sweet Pond Dam, view north.

Photo 23. Upstream (south) face of the Sweet Pond Dam, view west.

Photo 24. Upstream (south) face of the Sweet Pond Dam, view east.

Photo 25. Downstream (north) face of the Sweet Pond Dam, view southeast.

Photo 26. Downstream (north) face of the Sweet Pond Dam, view south.

Photo 27. Downstream (north) face of the Sweet Pond Dam, view west.

Photo 28. Crest of the Sweet Pond Dam (east side of spillway), view west.

Photo 29. Crest of the Sweet Pond Dam (west side of spillway), view east.

Photo 30. Sweet Pond Dam spillway and upstream reach, view south.

Photo 31. Sweet Pond Dam spillway, view southwest.

Photo 32. Sweet Pond Dam spillway with ceramic drain pipes and collapsed masonry, view west.

Photo 33. Sweet Pond Dam wheel pit remains, view west.

Photo 34. Sweet Pond Dam channel, view southwest.

Photo 35. Foundation remains to the north of the Sweet Pond Dam, view east.

Photo 36. Foundation remains to the north of the Sweet Pond Dam, view southwest.

Photo 37. Sweet Pond Dam northeast abutment wall, view east.

Photo 38. Small footbridge extending over the unnamed tributary stream downstream from the Sweet Pond Dam, view west.