



Trout Brook Reservoir Dam Removal

Engineering Report

Franklin County Natural Resources Conservation District

50 South Main Street, Suite B-20, St. Albans, Vermont 05478

Prepared by:

SLR International Corporation

1 South Main Street, Waterbury, Vermont, 05676

SLR Project No.: 146.13528.00002

Client Reference No: 1414

March 26, 2025

Revision: 2

Executive Summary

Franklin County Natural Resources Conservation District (FCNRCD) and other project partners are designing the removal the Trout Brook Reservoir Dam. This dam removal design report includes a description of the current state of the dam, data collection, hydrology calculations, hydraulic modeling, alternatives analysis, and basis of design.

The Trout Brook Reservoir Dam is located on Trout Brook, a significant tributary that enters the Missisquoi River just above Enosburg Falls. The unmaintained dam is a legacy of the Village of Enosburg's former water supply system, which has been replaced by nearby wells. The dam is not currently serving a purpose and is no longer functional for its original purposes of a drinking water supply. The dam and surrounding property are owned by the Village of Enosburg Falls and located off of Reservoir Road in Berkshire, Vermont.

The dam is in poor condition, generally deteriorated, and no longer being used. It represents a public safety concern. The concrete is deteriorating on all sections of the dam with cracking, spalling, and chunks missing. Seepage is occurring under and through pour joints in the dam at multiple elevations. The joint approximately at the normal pool is severely corroded on upstream and downstream, and likely to detach. Portions of the primary spillway have detached, lowering the normal pool from the original elevation.

The drainage area above the dam is 1.8 square miles. The dam blocks the movement of fish and other aquatic organisms. If the dam is removed it will reconnect 4.8 miles of headwater habitat. The impoundment deteriorates water quality and habitat.

A range of alternatives were evaluated that consider both dam removal and accumulated sediment removal. This analysis suggests that Alternative 5 – Remove dam and sediment in river corridor to approximate upstream extent of maximum former impoundment (to RS 3640) – is recommended as a good balance between project cost and risk reduction via sediment removal. This alternative would remove the failing dam, remove the sediment most likely to move within the next few decades, and restore the channel and floodplain.

The concept design includes full dam removal, removal of impounded sediment within a 100-foot-wide river corridor, excavation to remove reed canary grass, protection of existing water infrastructure, and replacement of an undersized culvert on the access road. In summary, this concept design would naturalize hydraulic patterns, restore sediment transport, protect infrastructure, improve AOP, and increase public safety.

Preliminary and final design include the same extent of sediment removal as the concept design, with a 100-foot river corridor and reed canary grass removal area. Replacement of the access road culvert downstream is not included in preliminary or final design as this item will be completed in conjunction with the solar project development on the property, which is being designed and permitted separately from the dam removal and will also be implemented separately. Wood structures were added to the design between the concept design and preliminary design stages to provide additional resistance to erosion within the sediment removal area and the creation of instream habitat features once the dam is removed.



March 26, 2025

Table of Contents

Exe	cutive Summary	ii
1.0	Introduction	1
1.1	Purpose	1
1.2	Objectives	1
2.0	Background	1
3.0	Trout Brook Reservoir Dam	3
3.1	Dam Safety	3
3.2	Structural Evaluation	6
3.3	Dam Repair Estimate	7
4.0	Trout Brook	8
4.1	Geomorphology	8
4.2	Habitat	9
4.3	Impoundment	13
4.4	Temperature Data	15
5.0	Infrastructure	16
5.1	Culverts	16
5.2	Water Supply	18
5.3	Solar Field	19
6.0	Sediment	20
6.1	Sediment Quantity	20
6.2	Approximate Sediment Yield	20
6.3	Sediment Stability	20
6.4	Sediment Quality	21
7.0	Natural Resources Assessment	21
7.1	Wetlands	21
7.2	Invasive Species	22
7.3	Rare, Threatened, and Endangered Species	23
8.0	Hydrology	23
8.1	Flow Estimation	23
9.0	Hydraulics	25
9.1	Model Geometry	25
9.2	Model Validation	27
9.3	Existing Conditions Model Results	28



10.0 Dai	m Removal Alternatives Analysis	30
10.1 Alte	ernative 1 – Do nothing	32
10.2 Alte	ernative 2 – Remove dam and no sediment	32
10.3 Alte	ernative 3 – Remove dam and sediment adjacent to dam	33
	ernative 4 – Remove dam and sediment in river corridor in normal pool (to RS	33
	ernative 5 – Remove dam and sediment in river corridor in full former oundment (to RS 3680)	34
	ernative 6 – Remove dam and sediment full width in normal pool (to 2696) and er corridor width in full former impoundment (to RS 3680)	35
10.7 Alte	ernative 7 - Remove dam and all sediment in former impoundment	35
10.8 Alte	ernative 8 – Partial dam removal (no sediment)	36
10.9 Alte	ernative 9 - Replace dam and remove all sediment in former impoundment	36
11.0 Alt	ernative Considerations and Implementation Notes	37
11.1 Nat	rural Resources Conflicts and Restoration Potential	37
11.1.1	Wetland and Floodplain Restoration	37
11.1.2	Resource Conflicts	37
11.1.3	Aquatic Organism Passage Potential	37
11.2 Pot	ential Infrastructure Conflicts	38
11.2.1	Culverts	38
11.2.2	Water Supply	38
11.2.3	Solar Field	39
11.3 Co	nstruction and Access	39
11.3.1	Wetland and Floodplain Restoration	40
12.0 Bas	sis of Design	40
12.1 Coi	ncept Design	40
12.2 Pre	liminary Design	41
12.3 Fin	al Design	42
12.4 Per	mitting Needs	42
12.4.1	US Army Corps of Engineers Vermont General Permit	42
12.4.2	Vermont Dam Safety Permit	42
12.4.3	Vermont Stream Alteration Permit	42
12.4.4	Vermont Wetlands	42
12.4.5	Vermont Public Water System	43
12.4.6	Construction General Permit	43



12.4.7	Berkshire Zoning Permit	43	
12.4.8	Vermont Division of Historic Preservation		
13.0 Refe	erences	43	
Tables	s in Text		
Table A:	Bankfull Channel and Floodprone Dimension Measurements	9	
Table B:	Peak Flow Estimates for Trout Brook at the dam	23	
Table C:	Fish passage flow estimates for Trout Brook at the dam	24	
Table D:	Hydraulic model input flows	24	
Table E:	Manning's N Coefficients Used in the Hydraulic Model	25	
Figure	s in Text		
•	Location Map (USGS)	2	
-	FEMA Flood Insurance Rate Map (FIRM) (1983)		
	Dam viewed from upstream in impoundment		
	Dam viewed from the right bank		
Figure E:			
Figure F:	Dam spillway and downstream left training wall and foundation of gatehouse		
J	Dam downstream right face weeping		
_	Upstream channel		
Figure I:	Former impoundment, dominated by reed canary grass		
Figure J:	Impoundment just upstream of dam		
Figure K:	Channel downstream of dam		
Figure L:	Aerial imagery at dam and reservoir from May 1995 (left) and September 2021 (right). (Google Earth, 2023)	14	
Figure M:	Berm visible in LiDAR topography along southeastern side of impoundment		
Ū	Access road crossing viewed from upstream		
	Reservoir Road crossing, viewed from downstream		
	Water supply infrastructure from Village of Enosburg dated 1989		
•	Wetland complex at upstream end of impoundment		
-	Hydraulic model extent and cross sections		
_	Existing conditions modeled profile		
Figure T:	Existing conditions model at dam		
Figure U:	Alternatives Analysis Summary		



Appendices

Appendix A Dam Volume

Appendix B Dam Inspection

Appendix C Sediment Data

Appendix D Resource Maps

Appendix E Existing Hydraulic Modeling Results

Appendix F Alternatives Analysis

Appendix G Concept Design Plans

Appendix H Proposed Hydraulic Modeling Results

Appendix I Final Design Plans & Opinion of Probable Cost



March 26, 2025

1.0 Introduction

The Franklin County Natural Resources Conservation District and other project partners are working towards the removal of Trout Brook Reservoir Dam in Berkshire, Vermont. This poor condition dam is obsolete and breached. The dam is not currently serving a purpose and is no longer functional for its original purposes of a drinking water supply. The dam impacts water quality, habitat, public safety, and aquatic organism passage.

1.1 Purpose

This project generally includes a dam removal feasibility analysis and concept design for dam removal including data collection, hydraulic modeling, alternatives analysis, and engineering design.

1.2 Objectives

The objectives of the project are to:

- Naturalize the river and floodplain to restore dynamic equilibrium;
- Improve water quality;
- Restore aquatic organism passage (AOP);
- Restore wildlife habitat in the stream corridor;
- Restore connectivity of habitat blocks;
- Reduce flood and erosion risks;
- Balance sediment removal and ecosystem benefits;
- Minimize future maintenance needs at the site;
- Improve site safety;
- Consider impacts to infrastructure;
- Meet landowner desires for site; and
- Minimize construction costs.

2.0 Background

The Trout Brook Reservoir Dam is located on Trout Brook, a significant tributary that enters the Missisquoi River just above Enosburg Falls (Figure A). The unmaintained dam is a legacy of the Village of Enosburg Falls's former water supply system, which has been replaced by nearby wells. The dam and surrounding property are owned by the Village of Enosburg Falls and located off of Reservoir Road in Berkshire, Vermont.

The dam is in poor condition, generally deteriorated, and no longer being used. It represents a public safety concern. The drainage area above the dam is 1.8 square miles. The dam blocks the movement of fish and other aquatic organisms. If the dam is removed it will reconnect 4.8 miles of headwater habitat according to The Nature Conservancy Vermont Dam Screening Tool.



March 26, 2025

Figure A: Location Map (USGS)

1 Miles

0 0.25 0.5

The FEMA Flood Insurance Rate Map (FIRM) shows that a FEMA zone A (i.e., approximate) floodplain exists at the project site (Figure B). This area was not studied with detailed methods and no BFE exists at the site.

Franklin County Natural Resources Conservation District (FCNRCD) is designing the removal the Trout Brook Reservoir Dam. This dam removal design report includes a description of the current state of the dam, data collection, hydrology calculations, hydraulic modeling, alternatives analysis, basis of design and an engineer's opinion of probable project cost.



March 26, 2025

SLR Project No.: 146.13528.00002

Copyright: 2013 National Geographic Society, i-cubed

Figure B: FEMA Flood Insurance Rate Map (FIRM) (1983)

3.0 Trout Brook Reservoir Dam

Brief dam safety and structural evaluations were done in the field by SLR in spring 2023 and by reviewing existing information.

3.1 Dam Safety

No dam safety inspection reporting is on file with Vermont Dam Safety. The Vermont Agency of Natural Resources Dams Inventory lists the dam under primary name Trout Brook Reservoir and secondary name Enosburg Reservoir (VT# 19.02). Hazard Potential Classification as Minimal in the state database but based on field observations would be classified as at least Low due to impoundment size and possibly Significant due to possible negative impacts to downstream infrastructure and habitat. A normal pool surface area of 4.2 acres and max storage is 54 acre-feet, which is above the threshold of requiring a Dam Order for work at the dam (Appendix A).



March 26, 2025

No plans or early photos of the dam were available for review. The dam appears on the USGS topographic maps between the 1943 and 1944 datasets. The Village has not reported any issues with the dam to date.

Visual observations of Trout Brook Reservoir dam were performed May 5, 2023. The dam is a concrete gravity dam 128 feet long and 16 feet high (Figure C). The dam is 3 feet wide at the top and buttressed at 1:4 on the downstream side (Figure D). Upstream of the dam a riprap slope starts approximately 4 feet below the dam top (1 foot below normal pool water surface) and slopes at a 2:1 slope. Presence of concrete below the riprap was not able to be confirmed. A wood and concrete gatehouse sits downstream of the dam to the left of the primary spillway. There is no emergency spillway, only the primary spillway and dam top. The dam is showing common signs of decay such as cracked concrete, buried outlet pipe, and seepage.

The concrete volume has been estimated to be 288 CY (Figure E, Appendix A). The concrete may extend upstream under the riprap slope, but this was not able to be confirmed with probing. The riprap volume has been estimated to be 370 CY, but may be covering another material.

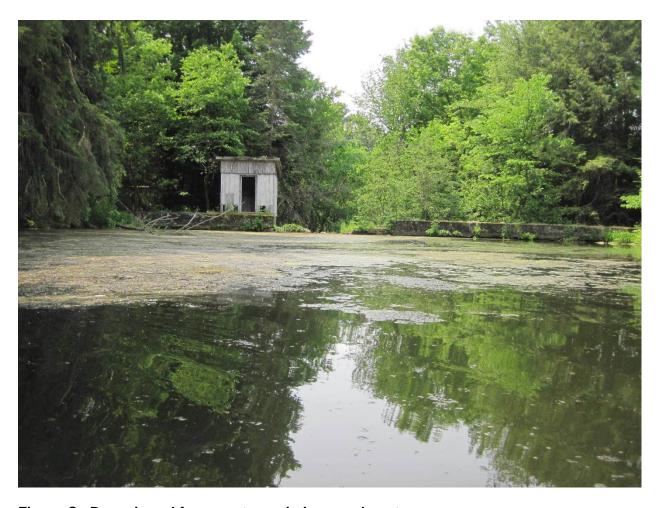


Figure C: Dam viewed from upstream in impoundment





Figure D: Dam viewed from the right bank

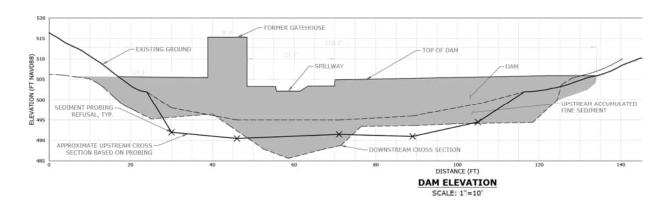


Figure E: Dam elevation with upstream and downstream sections



March 26, 2025

3.2 Structural Evaluation

The dam is in poor condition. Conditions of sections of the dam were documented in an observation report (Appendix B). The concrete is deteriorating on all sections of the dam with cracking, spalling, and chunks missing (Figures F & G). Seepage is occurring under and through pour joints in the dam at multiple elevations. The joint approximately at the normal pool is severely corroded on upstream and downstream, and likely to detach. Portions of the primary spillway have detached, lowering the normal pool from the original elevation.

The downstream training walls are deteriorating and have large trees growing out of them. Grass and other plants are growing on the dam top.

The upstream riprap slope appears to be intact, but turbid water and algae made visual observation impossible, so probing with a rod was used to observe presence.

A large scour hole is present in the downstream channel below the spillway. Undermining of the dam at the scour hole was not confirmed due to unsafe water flow conditions below the spillway.

The gatehouse is deteriorating and the concrete foundation has been separated and is partially missing. The outlet valves have not been serviced in decades and it is unknown if the low level outlet works. The possible location of the outlet pipe upstream of the dam was found by probing but could not be visually observed.



Figure F: Dam spillway and downstream left training wall and foundation of gatehouse



March 26, 2025



Figure G: Dam downstream right face weeping

3.3 Dam Repair Estimate

The dam is in a poor condition that is likely to continue to deteriorate, becoming a higher risk to public safety over time. Given the poor structural integrity of the dam, significant design, permitting, and construction costs would be necessary to bring the dam back to safe working order with the structural integrity needed to ensure public safety.

New dam safety regulations at the state have increased the level of analysis and design required to obtain permits for new dams and dam repairs. Analysis would include a dam break



March 26, 2025

analysis, detailed operation & maintenance plans, geotechnical analysis, and structure analysis. Engineering plans would need details on dimensions, materials, and construction methods.

Based on the poor condition of the dam and unknown foundation it is likely that a new dam would be required for the design team to feel comfortable with the structural integrity.

Construction would likely require some level of sediment removal to restore the impoundment, water control and cofferdams to dewater the construction area, removal of the existing dam, concrete and forming, and an outlet structure.

Costs could for this level of design, permitting, and construction for a dam of this size is in the \$1,000,000 range and could be significantly higher depending on replacement size and foundation requirements.

The maintenance costs have been extremely low in recent years. This historic dam has not had a maintenance program in place for the Village to follow, resulting in no maintenance and no cost. A new or repaired dam would be required to have an Operation & Maintenance program approved and on file with the Dam Safety Program. Recent O & M plans for permitted repair projects have required inspection annually and after large storms, frequent debris clearing and removal of vegetation, repairs to components every few years, and documentation of all inspections and repairs. These programs typically cost owners \$3,000 to \$5,000 annually, along with the dam annual fees.

4.0 Trout Brook

Trout Brook is a small headwater stream (drainage area at dam ~ 1.8 square miles) that generally flows south before entering the Missisquoi River. The subject dam is located about 2.3 miles from the confluence, which enters just above Enosburg Falls.

Trout Brook was included in a Phase 1 stream geomorphic assessment of the Missisquoi River watershed, but phase 2 data do not exist. The Phase 1 reach R14T5.04 is located upstream of the dam and included mention of the drinking water well, dam, and impoundment for a previous reservoir. Reach R14T5.03 is located downstream of the dam. Abbreviated geomorphic and habitat assessments were completed by SLR geomorphologists in June 2023 to understand the setting of the dam.

4.1 Geomorphology

The Vermont Hydraulic Geometry curves (VTDEC, 2006) predict the channel bankfull width at the dam to be 17 feet and the bankfull depth to be 1.2 feet. A stream walk was conducted to perform a rapid geomorphic assessment to identify the likely reference channel form and estimate the bankfull and floodprone dimensions that would exist following dam removal. The stream walk covered approximately 5,000 feet (0.9 miles) – 3,500 feet upstream of the existing dam and 1,500 feet downstream of the dam. Twelve cross sections were investigated. Two sections were surveyed with a tape measure, level, and rod to measure bankfull and floodprone dimensions. Bankfull dimensions were measured at ten sections based on field indicators using a rod and laser range finder.

Bankfull channel width ranges from 5 to 18 feet, and the bankfull channel depth ranged from 1.5 to 3.3 feet (Table A). A riffle-pool channel exists upstream of the impoundment near the start of the stream walk. The channel has a compound shape and is connected to its floodplain having



moderate to low incision. The bankfull width in the upstream riffle-pool channel is between 11 and 17 feet.

Table A: Bankfull Channel and Floodprone Dimension Measurements

Section ID	Bankfull Width (feet)	Bankfull Depth (feet)	Floodprone Width (feet)	Notes
1	12	2.8	N/M	Upstream start of walk.
2	17	2.0	46	
3	11	2.5	N/M	Valley width ~ 90 feet.
4	10	3.0	N/M	More incised. Valley width ~ 130 feet.
5R	9	2.3	N/M	Split channel with dense vegetated buffer.
5L	6	2.0	N/M	Split channel with dense vegetated buffer.
6	5	3.0	N/M	Incised (type E) reed canary grass area.
7	8	3.3	N/M	Incised (type E) reed canary grass area.
8	10	3.0	N/M	Incised (type E) reed canary grass area.
9	14	1.5	N/M	Downstream of dam.
10	12	1.8	N/M	Downstream of dam.
11	17	1.8	85	Downstream of dam.
12	18	2.2	N/M	Downstream end of walk.
Min	5	1.5	46	
Max	18	3.3	85	
Average	11	2.4	66	
DESIGN	12	2.0	50-100	Floodprone width varries with valley width.

Approaching the impoundment, the meadow channel flattens and becomes narrower and more incised. This condition is partially a function of the dam lowering the channel slope, the accumulation of fine sediment, and the thick vegetation consisting mostly of reed canary grass. The channel is essentially a vegetated, incised trough with limited hydraulic and habitat diversity. Bankfull width is between 5 and 10 feet in this location; that is too small to be used as a reference dimension.

Downstream of the dam the riffle-pool channel type exists again and the bankfull width varies between 12 and 18 feet. Side channels exist in the floodplain. The bankfull dimensions near the downstream limit of the stream walk become larger than near the dam and thus are not suitable for design.

Based on the field observations, the reference stream type is a riffle-pool channel that will likely contain gravel and have pockets of sand and silt. The design bankfull channel width is 12 feet and the design bankfull channel depth is 2.0 feet.

Floodprone width is 50 to 100 feet depending on the width of the valley. A floodprone width of approximately 100 feet will be used for design.

4.2 Habitat

Upstream of the impoundment Trout Brook has good, almost reference, habitat (Figure H). The habitat assessment started within the confined valley downstream of the agricultural fields, 3,500 feet upstream of the dam. This section has a forested riparian buffer with no encroachments. Most areas have good vegetated cover of trees, shrubs including alder elderberry and willows, and herbaceous species such as ferns and rushes. Sections dominated by reed canary grass are mixed into the floodplain areas along with sections of good mixed vegetation. Vegetation provides good cover, shading, and undercut banks provide shelter. Refuge is present in the form of adjacent seeps, wetlands, connected floodplain areas, side channels, and diverse areas around current and former beaver dams. Large woody debris, debris jams, and CPOM are common. Some filamentous algae is present in open canopy



areas. There is a well-defined riffle-run-pool-glide pattern, with most flow combinations, but little deep-fast water. Beaver dams have provided shelter, diversity, and increased sinuosity. Some fine deposition is occurring around beaver dams. Cobble and boulder riffles and gravel bars are present.



Figure H: Upstream channel

The former impoundment has reduced habitat value. The habitat assessment of the now dewatered former impoundment reach started at the top of the former impoundment, 2,000 feet upstream of the dam and ended 960 feet upstream of the dam at the current normal pool edge. This section appears to have been degraded by the former impoundment and vegetation and channel features have not recovered naturally. This area has no trees and very few shrubs that would provide shade, cover, and direct LWD recruitment. Reed canary grass dominates the vegetation with a few isolated patches of alder (Figure I). Only minor large woody debris and CPOM were observed. Some bed features are present but riffles are all or partially covered with fines. Significant algae growth exists. Pools dominate the channel and are long and deep, with very little hydraulic variation. Thicker fine sediment deposits exist in pools and cover all features in the lower portion of this reach as the river approaches the impoundment normal pool. The only refuge is located at an abandoned beaver dam.

The impoundment has smothered habitat with deep slow water filling the former channel and floodplains. Fine sediment has accumulated, covering the bottom. Thick algae was covering



the lower third of the impoundment surface when observed in spring 2023 (Figure J). The edges of the impoundment have good tree cover on the adjacent steep valley walls.



Figure I: Former impoundment, dominated by reed canary grass





Figure J: Impoundment just upstream of dam

Downstream of the dam Trout Brook has good habitat. The assessment started at the dam and extended to Reservoir Road, 528 feet. This section has good vegetation cover with 100% canopy of mixed coniferous and deciduous trees, thick shrub layer of alder and other shrubs, and a diverse native herbaceous and forb layer (Figure K). A wide riparian buffer exists with little encroachment other than the culvert crossings. Vegetation provides good cover, shading, and provides wood and CPOM to the channel. Large Woody Debris is significant in the channel. There is good refuge in side channels, flood chutes, and low floodplain areas. Bed features are defined riffle-run-pool-glide patterns with a large number of pools. Finer deposition is in pools and along margins. Embeddedness and fining are low. Cobble and boulder riffles and gravel bars are clean. Bank vegetation and many undercut banks provide shelter.

Both the access road culverts and Reservoir Road culvert block sediment transport, constrict the channel, and limit aquatic organism passage at some flows.



March 26, 2025

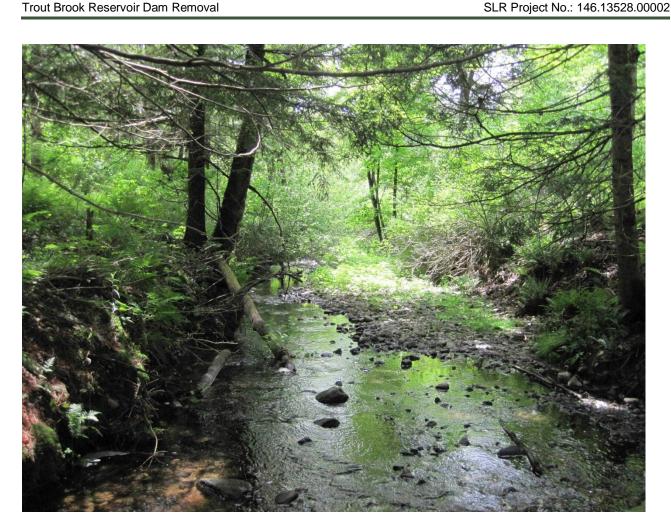


Figure K: Channel downstream of dam

4.3 Impoundment

The impoundment, known as Trout Brook Reservoir, is not a naturally occurring pond. It is estimated that the dam was built in the early 1900's and the pond had been created by settlers who used horses to excavate a large depression and construct the dam (FCNRCD, 2022). Much of the excavated material was spoiled as a berm on the southeastern side of the impoundment.

The reservoir was previously the drinking water supply for Enosburg up until the 1940s but was abandoned in favor of the two wells near the dam that are currently used as the Village water supply.

The upstream extent of the reservoir retreats between the 1995 and 2021 aerial imagery (Figure L). This indicates that the observed spillway damage likely occurred during this time period. Field observations of disturbed type vegetation (reed canary grass dominated) and sediment accumulated on floodplains up to river station 3680 indicate that the impoundment extended approximately 1,000 feet beyond the existing normal pool which ends at river station 2696.

The current normal pool footprint is 4.24 acres with a volume (water and sediment) of 33.7 acrefeet. The maximum impoundment volume is 53.6 with a footprint of 8.23 acres (Appendix A).



March 26, 2025

Topography shows that a large linear berm exists along the east side of the impoundment. This is likely the excavated spoil pile from when the impoundment was created. A review of LiDAR shows that the berm is approximately 90,000 CY, approximately 160% of the current normal pool volume.



Figure L: Aerial imagery at dam and reservoir from May 1995 (left) and September 2021 (right). (Google Earth, 2023)



Figure M: Berm visible in LiDAR topography along southeastern side of impoundment.

4.4 Temperature Data

Vermont Fish and Wildlife Department (VFWD) have collected temperature data above and below the dam impoundment to determine the impact of the dam on in-stream water temperatures between June and September 2023. The temperatures upstream of the dam are ideal for brook trout (max temps stay at or below 65 degrees), but the temperatures downstream of the dam are in a range that cannot support a healthy brook trout population (max temps are above 72 degrees repeatedly). Lee Simard with VFWD and Dave Minkoff with USFWS described the situation as: brook trout are interested in being in this stream and going upstream further than the dam and if the temperatures came down by removing the dam, then maybe instead of finding two brook trout below the dam, we could instead end up with a healthy population.



March 26, 2025

5.0 Infrastructure

5.1 Culverts

Trout Brook passes under the Well #2 access road 520 feet downstream of the dam (Figure N). This structure is privately owned by the Village of Enosburg Falls on their land to access their Well #2 and associated infrastructure. There is also access to #1524 Water Tower Road where a solar display is under development on that property and on Village land. The structure is two round culverts, one 36-inch diameter concrete pipe and one 30-inch diameter steel corrugated pipe. The road surface is a 12-foot wide single travel lane of dirt and gravel with grass shoulders. The steel pipe is deformed, catching debris, and backwatered. A scour pool exists at the culvert ends. Scour exists at the culvert and armoring is failing. A large culvert sits downstream on the floodplain that appears to have been washed out at a previous time. The Village reports that this culvert has washed out multiple times in their memory.

Aquatic organism passage is likely under most conditions considering that the structure is short, entirely backwatered and has no outlet drop. Low flows would be concentrated in the small diameter culvert and depth would be assisted by the backwatering. High flows may be a velocity barrier.

Trout Brook passes under Town of Berkshire owned Reservoir Road 1,220 feet downstream of the dam (Figure O). The structure is one round culvert with a 7.8-foot diameter steel plate structure with a poured concrete invert throughout the culvert. The culvert is 80 feet long and has 5 feet of cover. The road embankment top is 28-foot wide with a two-lane gravel road with grass shoulders. The high road embankment completely fills the floodplain and in the case of a large flood would overtop the road to the east. A very large scour pool exists at the culvert downstream end. Scour exists at the culvert ends, upstream footings, and armoring is failing. A large breached beaver dam is on top of the downstream tailwater control riffle and may at times cause backwatering at the culvert. The Village has not seen flood damage at this structure.

Aquatic organism passage is likely limited under both low and high flow conditions. Low flows are likely spread out on the concrete flat bottom, becoming a depth barrier. High flows may be a velocity barrier.



March 26, 2025



Figure N: Access road crossing viewed from upstream



Figure O: Reservoir Road crossing, viewed from downstream



5.2 Water Supply

Downstream of the dam along the access road is the location of Well #1 and its pumphouse. Well #2 and pumphouse are located just upstream of the dam, high on the right bank, near the parking area (Figure P). There is a water line that crosses across the river downstream of the dam and connects the two wells to the water storage tank that pressurizes the Village's water system. The exact location and depth of the water pipe is not known, but has been estimated based on the design plans and the location of a valve on the downstream left floodplain.

Village of Enosburg Falls staff helped estimate the depth of the pipe to be 5.25 feet below the top of the valve casing, with 3.5 feet to the top of the valve and an estimate 1 foot valve height and an 8-inch pipe diameter. SLR estimated that the pipe was located 2.1 feet below the channel thalweg where it crossed at approximately river station 1510, 67 feet downstream of the dam.

Modeling was used to assess the impacts on both wells and pipeline to determine if mitigation is needed to maintain functionality of the water district's system as part of the design.

A source water protection plan was created in July 2021 (Denton, 2021). Zone 1 includes a 200-foot radius around the dam where "only activities that are related to the water system should occur". Activities in this area are governed by the Village of Berkshire via Wellhead Protection Overlay District. A brief review of the zoning restrictions shows that most of the prohibited uses do not apply. The project has been reviewed by state regulators and the Town of Berkshire due to proposed work in the vicinity of drinking water infrastructure.



March 26, 2025

Figure P: Water supply infrastructure from Village of Enosburg dated 1989

5.3 Solar Field

The Village of Enosburg Falls may install a large solar array on the field to the west of the pond to provide power to residents. Design and analysis are currently underway. Wetland and archaeological data were collected as part of this project in the vicinity of the dam. Coordination of this solar project with a potential dam removal should be considered as this project is implemented.



March 26, 2025

6.0 Sediment

Sediment probing was conducted within the impoundment of the dam on June 6, 2023.

6.1 Sediment Quantity

Probing of the accumulated sediment took place through the impoundment using 14-foot and 8-foot-long rebar rods. The rod was pushed through fine, soft sediment until firm refusal was encountered likely on compacted gravel. Texture of accumulated sediment is silt and sand. The sediment thickness varied from 1 foot to 6 feet. Sediment depths were greatest near the dam and in the lower portion of the impoundment (4 to 6 feet), with hard refusal found in the vicinity of the dam likely on gravel. In the middle impoundment areas, a thinner layer of fine sediment (1 to 2 feet) has a higher silt content. In the upper part of the normal pool thick submerged and floating vegetation is growing. Upstream of the normal pool the accumulated sediment is dry and 1.5 to 3.5 feet thick. Most of the accumulated sediment is vegetated with reed canary grass upstream of the normal pool. The total volume of impounded sediment is estimated to be 27,600 cubic yards (Appendix C). Sediment probe sections have been plotted to see the distribution of sediment. A large portion of the sediment is refilling areas that were historically dug out in creation of the reservoir and located outside the meander belt.

6.2 Approximate Sediment Yield

The risk of a sudden sediment release from dam failure or allowing accumulated sediment to erode and pass downstream following dam removal can be estimated by comparing the amount of trapped sediment with the amount of sediment that is produced in a watershed and transported downstream by a river channel over a year (i.e., the mean annual sediment yield) (MacBroom and Schiff, 2013). Long-term measurements of sediment yield or load do not exist on Trout Brook, so sediment yield has been approximated based on sediment gauges throughout New England that indicate a mean yield of 50 tons per year per square mile of watershed (range is 25 to 150 tons per square mile). Based on a watershed size of 1.8 square miles, the annual watershed yield of sediment is roughly 90 tons per year.

At a typical density of 75 pounds per cubic foot for loose sandy sediments, each ton of sediment is estimated to occupy a volume of 1 cubic yard of material. The total sediment volume generated by the watershed on an annual basis is thus 93 cubic yards. Based on the estimated 27,600 cubic yards of impounded sediment, the existing material is estimated to be the product of 200-300 years assuming a trap efficiency of 100 percent. Reservoir trap efficiency is typically lower than 100 percent, so the amount of material present could have built up over a longer period of time. The agricultural operations upstream may have contributed a larger amount of sediment per year than the estimated 93 cubic yards per year.

Sediment removal will be required prior to dam removal since the release of a large amount of accumulated sand and silt into a channel with a coarse bed downstream will lead to long-term habitat and water quality impacts.

6.3 Sediment Stability

If left in place following dam removal, all the impounded sand and silt that currently sits upstream of Trout Brook Reservoir Dam will likely mobilize and be transported downstream over several years. The sand and silt material that makes up a larger portion the impounded sediment can mobilize under low velocity – less than 1 foot per second (Fischenich, 2001).



March 26, 2025

Other similar Vermont dam removals have shown us that an upstream erosion face (i.e., a headcut) will travel up the channel if sediment is not removed. Hydraulic modeling results indicate a flow velocity of 2 to 6 feet per second during small floods following dam removal and thus finer sediment is likely to erode. Head-cutting would eventually take place over the full channel width during larger floods where the velocity ranges between 5 to 7 feet per second mid-impoundment. Removal of sediment should be considered at different levels as part of the alternatives analysis.

6.4 Sediment Quality

Sediment quality testing was not requested by project partners and has not been completed. The rural nature of the watershed and previous usage as a water supply reservoir, reduce likelihood of contamination.

7.0 Natural Resources Assessment

Assessments and reviews were performed for wetlands; invasive species; and rare, threatened, or endangered species.

7.1 Wetlands

Jurisdictional wetlands were delineated at the project site by scientists at VHB during the 2022 field season as part of a contract with Encore Renewable Energy to evaluate the proposed solar array adjacent to the reservoir independent of this dam removal feasibility study. Wetlands and waterways were delineated for the entire 88-acre parcel owned by the Village of Enosburg Falls, as well as a sliver of the parcel to the west to capture the entire field where the solar array is proposed. Methods for wetland delineation followed those outlined in the US Army Corps of Engineers Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region. Wetland boundaries were flagged in the field and points collected using a GPS unit. Data plots were collected to document hydrology, vegetation, and soils within the wetlands. A map of wetlands and waterways prepared by VHB is included in Appendix D.

A large palustrine emergent/palustrine scrub-shrub Class II wetland complex was mapped at the fringe of the upper end of the reservoir and on the floodplain of Trout Brook upstream of the reservoir (Figure Q). This complex is large in size and extends up the floodplains of several tributaries to Trout Brook. The indicators of wetland hydrology noted for this wetland at the time of delineation were saturation and geomorphic position. The vegetative community was noted to be dominated by reed canary grass (*Phalaris arundinacea*) and speckled alder (*Alnus incana*) with ginger mint (*Mentha arvensis*), giant goldenrod (*Solidago gigantea*), and fowl blue grass (*Poa palustris*) also present. Wetland soils had the characteristics of a histic epipedon with a thick organic layer over fine sandy loam.





Figure Q: Wetland complex at upstream end of impoundment

Additional smaller areas of wetland were mapped by VHB and include a small palustrine emergent floodplain wetland downstream of the dam on the eastern side of the brook (Class II), a depressional wetland on the western side of the brook downstream of the dam (Class II), and two palustrine forested wetlands in forested land east of the reservoir (one Class II and one Class III). The larger of these forested wetlands contains a potential vernal pool (function not confirmed through vernal pool survey).

7.2 Invasive Species

A formal invasive plant survey was not conducted at the site, but observations of invasive plant species were noted during field data collection. The most prevalent invasive species at the site is reed canary grass, which forms a monoculture on the floodplain of the brook upstream of the reservoir. Other invasive species noted were common buckthorn (*Rhamnus cathartica*), Morrow's honeysuckle (*Lonicera morrowii*), and garlic mustard (*Alliaria petiolata*). Scattered plants of these three species were observed throughout the project site.



March 26, 2025

7.3 Rare, Threatened, and Endangered Species

The project site was reviewed for historic occurrences of rare, threatened, endangered, and uncommon species. No occurrences are reported through the Vermont Natural Heritage Inventory (VNHI) program within a 1-mile radius of the dam.

The rare four-toed salamander has been documented two miles north of the dam along Mineral Brook Road. The rare brassy minnow and uncommon fantail darter have been historically observed (1990s) in a nearby tributary to the Missisquoi River, Samsonville Brook. Fisheries monitoring was conducted on Trout Brook by the Vermont Department of Environmental Conservation (DEC) in 2018 0.5 miles upstream of confluence with the Missisquoi. No RTE or uncommon fish species are reported in the VNHI database from this 2018 monitoring. According to the DEC reporting, the fisheries community was ranked in poor condition based on the Vermont Index of Biotic Integrity.

The rare creek heelsplitter mussel is known to occur in the reach of the Missisquoi river that Trout Brook flows into. During field data collection, scientists from SLR observed an empty mussel shell along the banks of the brook downstream of the reservoir and a couple of live mussels in the silty/sandy substrate at the upper end of the reservoir. Mussel identification was not conducted thus species is not known. FCNRCD consulted with Vermont Fish and Wildlife Department (VFWD) about RTE mussels. Mark Ferguson, Zoologist with VFWD, made a site visit to look for mussels and examine mussel habitat. Following the site visit, Ferguson stated that he does not have any concerns in regards to rare, threatened, and endangered mussels for the dam removal project and that he believes dam removal could improve mussel habitat.

No nearby occurrence of rare or threatened bat species are reported in the VNHI database, however, there are protected species that are known to occur statewide that could have implications for construction at the project site, specifically in regards to tree clearing. According to data provided on the Agency of Natural Resources Atlas, the Town of Berkshire is outside of the summer range for state and federally protected Indiana Bat (*Myotis sodalis*), Northern Long-Eared Bat (*Myotis septentrionalis*), Tricolored Bat (*Perimyotis subflavus*), and outside of areas of concern for Indiana Bat hibernacula.

8.0 Hydrology

8.1 Flow Estimation

Peak flows were estimated for the Trout Brook Dam site with USGS StreamStats (Olson, 2014, Table B) for flows with recurrence intervals of 2, 5, 10, 25, 50, 100, and 500 years. A local flood that occurred on November 1, 2019, referred to as the Halloween flood, was also included in the model. Flows for this event were calculated by prorating real-time streamflow data for a USGS gauge near the project site.

Table B: Peak Flow Estimates for Trout Brook at the dam

Return Interval (Years)	Flow (cfs)
2	87
5	141
10	183



March 26, 2025

Return Interval (Years)	Flow (cfs)
25	247
50	302
100	363
500	534

Fish passage flows were estimated at the Trout Brook dam to evaluate fish passage in the channel (Bates and Kirn, 2009) (Table C).

Table C: Fish passage flow estimates for Trout Brook at the dam

Return Interval (Years)	Flow (cfs)
April Q2-20	47
Nov Q2-20	13
7Q2	0.3

Flows from StreamStats were used in conjunction with additional data to develop input flows for the hydraulic model for the site (Table D). The model accounts for flow changes at the largest tributary within the study reach, which flows into Trout Brook between the access road culvert and the Reservoir Road culvert.

Table D: Hydraulic model input flows

	Flow (cfs)		
Return Interval	Upstream Limit of Model 5109	Downstream of Tributary <i>816</i>	
2-Year	87.3	119	
5-Year	141	191	
10-Year	183	248	
25-Year	247	332	
50-Year	303	405	
100-Year	364	485	
500-Year	535	707	
April Q2-20	47	71	
Nov Q2-20	13	19	



March 26, 2025

SLR Project No.: 146.13528.00002

	Flow (cfs)		
Return Interval	Upstream Limit of Model 5109	Downstream of Tributary 816	
7Q2	0.3	0.4	
Halloween 2019	125.3	181.8	

9.0 Hydraulics

A hydraulic model was created to represent river flood conditions including depth, velocity, water surface elevations, and inundation extents. The model was used to approximate existing conditions and evaluate potential alternatives at the dam and impoundment.

HEC-RAS and RAS Mapper (USACE, 2018) were used to create a one-dimensional, steady flow river and floodplain hydraulic model for Trout Brook upstream and downstream of the Trout Brook Reservoir Dam.

9.1 Model Geometry

Button Professional Land Surveyors, PC conducted a boundary retracement survey at the dam property which included spot elevations on the dam and culverts in December 2021. Button conducted additional survey in the vicinity of the dam, including measurement of five cross sections, in June and July 2024. SLR collected field survey of cross sections in the vicinity of the structures tying into the 2021 survey using an engineers level. LiDAR elevation surfaces were generated from a high-resolution dataset covering Franklin County, VT collected during 2017 (0.7-meter resolution). The DEM elevation units were converted from meters to feet.

The hydraulic model consists of a single river reach with a length of 5,109 feet (Figure R). The stream centerline was digitized from the survey data, field GPS points, high resolution imagery, and a LiDAR-derived digital elevation model. Cross sections were cut through the LiDAR terrain and adjusted with topographic survey in the channel where available or field measurements of channel dimensions. Channel roughness and floodplain values (i.e., Manning's N values) were assigned based on land cover from aerial imagery and field observations. Roughness values ranged from 0.025 (gravel drive) to 0.12 (forest) (Chow, 1959; Arcement and Schneider, 2006, Table E).

Table E: Manning's N Coefficients Used in the Hydraulic Model

Site Feature	Mannings's N Value
Gravel drive	0.025
Short grass	0.03
Reservoir	0.03
Channel above impoundment	0.035
High grass, crop	0.035



March 26, 2025

SLR Project No.: 146.13528.00002

Site Feature	Mannings's N Value
Channel below dam	0.04
Floodplain herbaceous wetland	0.06
Developed, low intensity	0.1
Floodplain scrub-shrub	0.1
Forest	0.12

The dam was included in the model as an inline structure with the elevations collected during the survey. The downstream culverts were included in the hydraulic model as culvert crossings using data the survey and supplemented with dimensional measurements.

The downstream extent of the model is 310 feet downstream of the Reservoir Road culvert. The downstream boundary condition is normal depth with a slope of 0.005 feet per foot (0.5%) at the downstream section. The upstream extent of the model is at the upper end of the narrow valley containing Trout Brook, downstream of the wider valley containing a farm. The estimated peak flood flows were input at the upstream extent of the model, with a model flow change at a tributary located just upstream of model section 816.

The steady flow model was run using a mixed flow regime.



March 26, 2025

SLR Project No.: 146.13528.00002

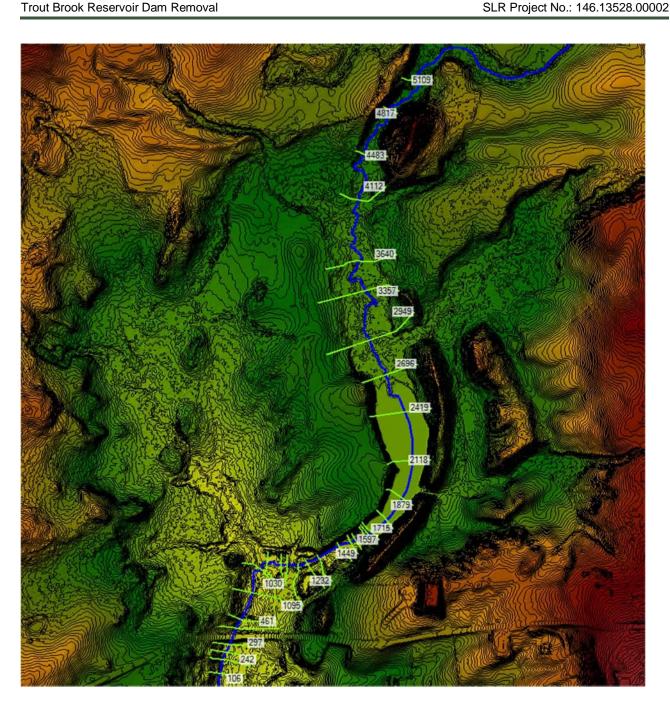


Figure R: Hydraulic model extent and cross sections

9.2 Model Validation

The Village reports that flooding in the area occurred in 2012, 2017 or 2018, and the Halloween storm of 2019. Each of these storms brought the water levels up in streams, but were not to flood stage. At least twice in the last 7 years the access road to well #2 was plugged with debris and washed out. The Halloween storm of 2019 was modeled. Flows were estimated to be 125.3 cfs (181.8 cfs downstream of tributary) using a ratio of drainage areas from nearby Jewett Brook USGS Gauge 04292810. This flow is approximately the 5-year flow.



March 26, 2025

opening which was not included in the model.

During the Halloween 2019 flood the modeling shows 0.2 to 0.8 feet of water over the well #2 access road surface and velocities of 4 to 6.9 feet per second. This depth of water and velocity could be expected to wash out the road, especially when combined with debris clogging the

Low flows were also reviewed using flows equivalent to conditions observed during field work conducted in June 2023. Flows were estimated to be 0.3 cfs (0.4 cfs downstream of tributary) using a ratio of drainage areas from nearby Jewett Brook USGS Gauge 04292810. This flow is similar to conditions aquatic species may encounter during summer months.

During the June 2023 conditions the modeling shows shows 0.05 feet of water over the dam spillway and velocities of almost zero feet per second. These match depths of less than one inch observed over the spillway. At an upstream measured cross section located at model section 1597 a depth of 7 feet was observed and a depth of 7.26 feet is modeled.

The qualitative model validation indicates good agreement that is suitable for exploring dam removal alternatives.

9.3 Existing Conditions Model Results

The existing conditions hydraulic model estimates depth, velocity, and inundation extent for all modeled flows (Appendix E). The existing conditions model results show increased flood depths and slower velocities in the impoundment approaching the Trout Brook reservoir dam. The water surface elevation shows a flat impoundment upstream of the dam to section 2696 under low flow conditions (Figure S). Under the highest flow conditions modeled, this flat impounded water surface extends upstream to section 3640. The 100-year flow is over the dam top (Figure T).

For the 10-year flood, maximum water depth through the impoundment ranges from 4.7 to 11 feet at the model sections, with the deepest areas in the lower and middle impoundment. For the 2-year flood, the range of maximum water depths through the impoundment is 4.4 to 10.2 feet. Downstream of the dam, maximum section water depths range from approximately 1.2 to 2.4 feet and 1.8 to 3.1 feet for the 2 and 10-year flood respectively. Velocity ranges from 0 to 0.15 feet per second through the reservoir (normal pool) for the 2-year and 0.01 to 0.28 for the 10-year. Downstream of the dam, maximum water velocity in the channel at the model sections ranges from 3.4 to 5.1 feet per second for the 2-year flood and 4.8 to 6.4 feet per second for the 10-year.

Flow is typically subcritical, with a few locations locally supercritical at steeper sections such as downstream of access road culvert. For larger floods these smaller bed features do not affect the flow regime as much and all locations are subcritical.



March 26, 2025

Figure S: Existing conditions modeled profile

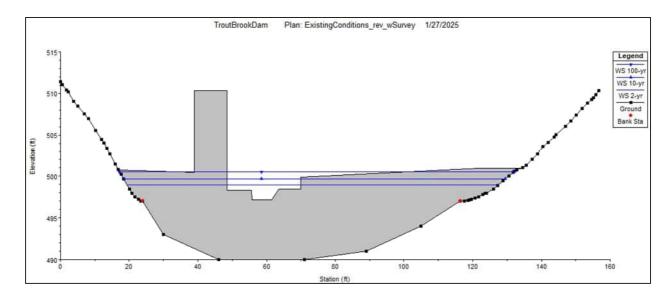


Figure T: Existing conditions model at dam

The access road and Reservoir Road culverts were included in the model. Under existing conditions, floodwaters are shown to overtop the roadway at the access road culverts beginning at the 2-year event. The roadway is very low and there is little cover over the culverts. Average in-channel velocity upstream of the culverts is 1.4 feet per second during the 2-year flood and 2.27 feet per second during the 10-year event. The undersized structure creates a constriction, leading to increased velocities and streambed scour downstream. Average in-channel velocity downstream of the culverts is 4.4 feet per second and 6.5 feet per second for the 2-year and 10-year events respectively. In the 100-year event the average channel velocity increases to 8 feet per second downstream of the access road. Based on modeling, the depth of water over the roadway is approximately 0.5 feet, 1.2 feet, and 2.1 feet for the 2-year, 10-year, and 100-year events respectively.

The Reservoir Road culvert is larger in size and has a much higher roadway surface than the access road. Based on modeling, floodwaters only overtop the roadway for the highest flow



March 26, 2025

out Brook Reservoir Dam Removal SLR Project No.: 146.13528.00002

modeled, the 500-year flood. Depth of water over the roadway is approximately 0.8 feet in this scenario. The culvert is undersized and creates a constriction point. This has led to excessive scour on the streambed at the outlet of the culvert, creating a large pool. Upstream of the culvert average instream channel velocity decreases slightly with increasing flow from 2.1 feet per second at the 2-year flood to 1.7 feet per second at the 10-year. Downstream of the culvert, modeled velocity is 3.1 feet per second, 4.9 feet per second, and 7.4 feet per second for the 2-year, 10-year, and 100-year events respectively.

Model results were also analyzed for calculated fish passage flows at the two culverts. A spring fish passage flow (April Q2-20), fall fish passage flow (November Q2-20) and a low summer flow (7Q2) were run through the model. For the April Q2-20, approximately 1.7 feet of water is shown to flow through the access road culvert. The November Q2-20 has 0.9 feet of water and 7Q2 0.2 feet through the culvert. According to Bates and Kirn (2009), these depths could support the passage of juvenile brook trout. Adult brook trout passage would likely not be supported for the 7Q2 flow due to depth. Average in-channel velocities upstream of the access road culvert were 1.1 feet per second for the April Q2-20, 0.9 feet per second for November Q2-20, and 1.7 feet per second for 7Q2. Downstream velocities ranged from 3.5 feet per second (April Q2-20) to 3.1 feet per second (November Q2-20) and 1.0 feet per second for 7Q2. Velocities downstream of the culvert for the April and November flows are unsuitable for passage of adult brook trout. Similarly, all velocities for April, November, and 7Q2 are unsuitable for the passage of brook trout juvenile (Bates and Kirn, 2009).

Downstream at the Reservoir Road culvert, water depth in the culvert is shown to be 1.8 feet for the April fish passage flow, 0.8 feet for the November flow, and 0.2 feet for the summer low flow. Similar to the findings for the upstream culvert, water depth could support juvenile brook trout passage for each of these three flows, but adult brook trout passage would likely not be supported for the 7Q2 flow due to depth (Bates and Kirn, 2009). Model velocities were also analyzed and the following were reported for the Reservoir Road culvert: April Q2-20 2.3 feet per second upstream and 2.1 feet per second downstream, November Q2-20 2.4 feet per second upstream and 1.1 feet per second downstream, and 7Q2 1.4 feet per second upstream and 0.4 feet per second downstream. According to Bates and Kirn, water velocity through the culverts is approaching the limit for what is suitable for adult brook trout (2.4 feet per second maximum) for the April and November flows. Velocities are unsuitable for juvenile brook trout passage at all flows except for 7Q2 downstream of the culvert (maximum 0.8 feet per second) (Bates and Kirn, 2009).

10.0 Dam Removal Alternatives Analysis

An alternatives analysis was performed to evaluate different levels of dam and sediment removal. Each of the alternatives has been evaluated against the following project objectives:

- Naturalize the river and floodplain to restore dynamic equilibrium:
- Improve water quality;
- Restore aguatic organism passage (AOP) and connectivity of habitat blocks;
- Restore wildlife habitat in the stream corridor;
- Reduce flood and erosion risks:
- Balance sediment removal and ecosystem benefits;



March 26, 2025

- Minimize future maintenance needs at the site;
- Consider impacts to infrastructure;
- Improve site safety; and
- Minimize construction costs.

The following alternatives were considered:

- 1 Do nothing
- 2 Remove dam and no sediment
- 3 Remove dam and sediment adjacent to dam
- 4 Remove dam and sediment in river corridor in normal pool (to RS 2696)
- 5 Remove dam and sediment in river corridor in full former impoundment (to RS 3680)
- 6 Remove dam and sediment full width in normal pool (to 2696) and river corridor width in full former impoundment (to RS 3680)
- 7 Remove dam and all sediment in former impoundment

	Alternative Objectives										
ID	Description	Naturalize the river and floodplain to restore dynamic equilibrium	Improve water quality	Restore aquatic organism passage (AOP)	Restore wildlife habitat in the stream corridor	Reduce flood and erosion risks	Balance sediment removal and ecosystem benefits	Minimize future maintenance needs	Consider impacts to infrastructure	Improve site safety	Ballpark construction costs
1	Do nothing	NO	NO	NO	NO	NO	No	NO	No	NO	\$0
2	Full dam removal (no sediment)	Maybe	NO	Better	Maybe	No	NO	No	No	Maybe	\$300,000 - \$400,000
3	Remove full dam and sediment adjacent to dam	Maybe	No	Better	Maybe	No	NO	Να	No	Better	\$300,000 - \$400,000
4	Remove full dam and sediment in river corridor in normal pool (to RS 2696)	Better	Maybe	BEST	Better	Maybe	Better	Maybe	Maybe	Better	\$400,000 - \$500,000
5	Remove full dam and sediment in river corridor in full former impoundment (to RS 3680)	Better	Better	BEST	Better	Better	BEST	BEST	BEST	Better	\$500,000 - \$600,000
6	Remove full dam and sediment full width in normal pool (to 2696) and river corridor width in full former impoundment (to RS 3680)	BEST	Better	BEST	Better	Better	Better	BEST	BEST	Better	\$500,000 - \$700,000
7	Remove full dam and all sediment in former Impoundment	BEST	BEST	BEST	BEST	BEST	No	BEST	BEST	Better	\$800,000 - \$1,200,000
8	Partial dam removal (no sediment)	Maybe	NO	Better	Maybe	No	NO	No	No	Maybe	\$300,000 - \$400,000
9	Replace dam and remove all sediment in former impoundment	Maybe	NO	Better	Maybe	Maybe	NO	No	Maybe	Maybe	\$1,500,000-2,000,000

Figure U: Alternatives Analysis Summary



March 26, 2025

SLR Project No.: 146.13528.00002

31

A range of alternatives were evaluated that consider both dam removal and accumulated sediment removal (Figure U and Appendix F). This analysis suggests that Alternative 5 – Remove dam and sediment in river corridor in full former impoundment (to RS 3680) – is

recommended as a good balance between project cost and risk reduction via sediment removal.

Many alternatives consider different levels of sediment removal over a different footprint within the impoundment as mapped (Appendix F). Sediment removal areas generally assume that a pilot channel would be created with an adjacent floodplain with an incision ration of 1 to 1.5 to create a hydraulicly connected floodplain. The concept design refines the width and depth of the pilot channel to allow the 2-year flood to spill out onto the floodplain for each section. Sinuosity would be higher than schematically shown in the alternatives map.

10.1 Alternative 1 – Do nothing

The do nothing alternative would allow the dam to continue to deteriorate. The dam has uncontrolled seepage, failing concrete, and would eventually fail releasing excessive sediment downstream. Such an uncontrolled sediment release would impact water quality and habitat over the long term. This alternative is not recommended.

PROS

- No construction impacts.
- No construction cost.

CONS

- Unsafe, failing dam remains.
- Potential for long-term water quality and habitat impacts.

10.2 Alternative 2 – Remove dam and no sediment

The removal of the full dam and no sediment removes the threat of the unsafe dam, yet leaves the accumulated fine sediment exposed to erode downstream during future floods. This alternative would likely lead to excessive sediment downstream that would impact water quality and habitat over the long term.

Modeling of this alternative suggests that water surface elevations would be lowered by 1 to 8.5 feet throughout the extent of the normal pool and would be lowered slightly throughout the entire former impoundment upstream (to RS 3680). Water levels would remain unchanged toward the upper limit of the model and downstream of the dam. Instream channel velocities are also shown to increase throughout the extent of the normal pool and slightly upstream under all flow conditions. Removal of the dam would no longer impound water, leading to decreased water depths and increased velocities upstream of the dam. These velocities would erode the fine sediment in the impoundment.

This alternative is not recommended.

PROS

- Unsafe, deteriorating dam removed.
- Control construction impacts since not leaving dam area.
- Control construction cost.



March 26, 2025

CONS

- Potential for long-term water quality and habitat impacts.
- Sediment and debris clogging downstream infrastructure.

10.3 Alternative 3 – Remove dam and sediment adjacent to dam

The removal of the full dam and limited sediment near the structure removes the threat of the unsafe dam, and the accumulated fine sediment near the dam that is certainly going to get transported downstream if left in place. This alternative would reduce the amount of sediment transport that would reduce the impact to water quality and habitat over the long term. Nonetheless, ongoing downstream sediment transport is likely to continue.

Modeling of this alternative suggests that water surface elevations would be lowered by 1.5 to 10.5 feet throughout the extent of the normal pool and would be lowered slightly throughout the entire former impoundment upstream (to RS 3680). Water levels would remain unchanged toward the upper limit of the model and downstream of the dam. Similarly to alternative 2, instream channel velocities are shown to increase throughout the extent of the normal pool and slightly upstream under all flow conditions. This effect is most pronounced for model sections immediately upstream of the dam. Channel incision and transport of fine sediment would likely occur with this increase in velocity. Channel slope would be increased upstream of the dam to approximately 1% through the proposed cut area.

This alternative is not recommended.

PROS

- Unsafe, deteriorating dam removed.
- Control construction impacts since not leaving dam area.
- Begin to remove most mobile sediment.
- Access to sediment straight forward near dam.

CONS

- Potential for long-term water quality and habitat impacts.
- Sediment and debris clogging downstream infrastructure.

10.4 Alternative 4 – Remove dam and sediment in river corridor in normal pool (to RS 2696)

The removal of the full dam, sediment near the structure, and sediment up the river corridor removes the threat of the unsafe dam, and the accumulated fine sediment that is most likely going to get transported downstream. This alternative would reduce the amount of sediment transport that would reduce the impact to water quality and habitat over the long term.

Changes in water surface elevation with this alternative are similar to those observed for alternative 3. Proposed channel slope would be approximately 0.4% in the lower former normal pool and increase to approximately 1.3% in the upper portion of the normal pool to tie into the existing streambed upstream. Modeling shows a pronounced increase in channel velocities in this steeper slope section that would likely be high enough to result in channel incision and transport of fine sediment downstream.



March 26, 2025

March 26, 2025 SLR Project No.: 146.13528.00002

This alternative is not recommended.

PROS

- Unsafe, deteriorating dam removed.
- Remove most of the mobile sediment.
- Reduced potential for long-term water quality and habitat impacts.

CONS

- Accessing sediment up impoundment complicated.
- Construction cost increases with increased sediment removal.
- Sediment and debris clogging downstream infrastructure.

10.5 Alternative 5 – Remove dam and sediment in river corridor in full former impoundment (to RS 3680)

The removal of the full dam, sediment near the structure, and sediment up the river corridor in the former impoundment removes the threat of the unsafe dam, and the accumulated fine sediment that is most likely going to get transported downstream. This alternative would reduce the amount of sediment transport that would reduce the impact to water quality and habitat over the long term. This alternative appears to balance sediment removal and construction cost where the highest risk of transport is removed.

Changes in water surface elevation with this alternative are similar to those observed for alternatives 3 and 4. Proposed channel slope is more consistent throughout the cut area, averaging approximately 0.7%. Increased velocities are also observed through the cut area. however, incision would likely be less severe due to most of the fine sediment from the former impoundment being removed from the river corridor. For this alternative, floodprone width would be restored to approximately 75 feet, near reference width, throughout the entire former impoundment. For alternatives that only include sediment removal through the normal pool, floodprone width would remain the width of the channel upstream of the normal pool due to the severely incised channel present under existing conditions.

This alternative is recommended.

PROS

- Unsafe, deteriorating dam removed.
- Remove most of the mobile sediment.
- Limited potential for long-term water quality and habitat impacts.
- Treats some of the meadow channel with reed canary grass

CONS

- Accessing sediment up impoundment during construction complicated.
- Construction cost increases with increased sediment removal.



10.6 Alternative 6 – Remove dam and sediment full width in normal pool (to 2696) and river corridor width in full former impoundment (to RS 3680)

The removal of the full dam, sediment in the full impoundment, and sediment up the river corridor in the former impoundment removes the threat of the unsafe dam, and the accumulated fine sediment that is most likely going to get transported downstream. This alternative would reduce the amount of sediment transport that would reduce the impact to water quality and habitat over the long term. This alternative removes most of the sediment and thus may not be required as some downstream transport is acceptable.

The proposed profile is the same for alternative 6 as it is for alternative 5. Potential for incision and sediment transport is further reduced by the removal of additional sediment through the normal pool.

This alternative is not recommended.

PROS

- Unsafe, deteriorating dam removed.
- Remove most of the sediment.
- Restore upstream channel where reed canary grass exists.
- Limited potential for long-term water quality and habitat impacts.

CONS

- Accessing sediment up impoundment during construction complicated.
- Construction cost increases with increased sediment removal.

10.7 Alternative 7 – Remove dam and all sediment in former impoundment

The removal of the full dam and all of the sediment would eliminate the amount of sediment transport that would reduce the impact to water quality and habitat over the long term. This alternative removes all of the sediment that may not be required as some downstream transport is acceptable.

The proposed profile for alternative 7 is the same as it is for alternatives 5 and 6. This alternative includes the most sediment removal and substantial incision and sediment transport are unlikely.

This alternative is not recommended as it is too expensive and removes more sediment than is likely to go in the coming decades.

PROS

- Unsafe, deteriorating dam removed.
- · Remove all of the sediment.
- Restore upstream channel where reed canary grass exists.
- No potential for long-term water quality and habitat impacts.



March 26, 2025

CONS

- Accessing sediment up impoundment during construction complicated.
- Construction cost at a maximum for accessing and removing all of the sediment.

10.8 Alternative 8 – Partial dam removal (no sediment)

The removal of part of the dam to achieve aquatic organism passage while reducing construction costs. This alternative does not include any sediment removal and would likely result in significant transport of fine sediment from above the dam to downstream reaches. A wall of sediment would be formed behind the dam without a transition between upstream and downstream reaches and a highly incised channel would likely form through the former impoundment. Due to the deteriorated condition of dam and requirements from Dam Safety, it may be difficult to obtain a dam order for the remaining portion of the dam. This alternative is not recommended.

PROS

- Unsafe, deteriorating dam partially removed.
- Control construction impacts since not leaving dam area.
- Control construction cost.

CONS

- Potential for long-term water quality and habitat impacts.
- Sediment and debris clogging downstream infrastructure.
- Potential challenge to obtain dam order for remaining structure

10.9 Alternative 9 – Replace dam and remove all sediment in former impoundment

Due to the deteriorated condition of the dam, repair of the dam to restore its full usage is infeasible. Full removal and reconstruction would be required. Removal of all sediment through the former impoundment would also be required to restore the impoundment function. Construction costs would be significantly higher than most of the other alternatives and the new dam would require a dam order from Dam Safety.

PROS

- Unsafe, deteriorating dam replaced.
- · Remove all of the sediment.
- Limit potential for long-term water quality and habitat impacts.

CONS

- Accessing sediment up impoundment during construction complicated.
- Construction cost at a maximum for accessing and removing all of the sediment.
- Dam order required for new dam



March 26, 2025

11.0 Alternative Considerations and Implementation Notes

Once an alternative was chosen, additional details were compiled to move the chosen alternative closer to implementation. A few of these design and implementation items are discussed here at the alternatives level for initial feedback from the project team.

11.1 Natural Resources Conflicts and Restoration Potential

11.1.1 Wetland and Floodplain Restoration

Removal of the dam and sediment has the potential to restore upstream floodplain, some of which may be wetlands. Areas proposed for sediment removal would become connected restored floodplains with targets for either wetlands, shrub-scrub, or forested vegetation types. Alternatives include varying footprints of restoration and connectedness.

Site revegetation is a critical part of the project to restabilize exposed fine-grained sediments and limit the potential for spread of reed canary grass in the area. Plantings will need to take place incrementally as final grades are achieved to allow for as much vegetation to become established as possible during the growing season. Existing native woody vegetation such as alder and dogwood shrubs should be saved and immediately replanted on lowered floodplains. All wood encountered such as old beaver dams should be stockpiled for reinstallation in the channel and floodplains to provide roughness, profile stability, build sinuosity, and habitat to match reference conditions.

Treatment to reduce reed canary grass at the project site is recommended as part of the design either during or before dewatering the impoundment and removal of the dam. Reed canary grass (*Phalaris arundinacea*) forms a thick monoculture in the upper historic impoundment, bordering the edge of the existing impoundment. It is extremely likely that following dam removal the reed canary grass will move into what is currently the normal pool footprint. There is ongoing current research in Vermont on reed canary monoculture treatment that can be applied to this project. Treatment options were discussed by the project team during the design process and remain nimble to adopting new ideas as more research results are shared. Treatments discussed included excavation to remove reed canary plants and roots, mowing, till and tree seed planting, or other options currently under research.

11.1.2 Resource Conflicts

The existing wetlands at the site are currently impacted with reed canary grass and the impoundment and are recommended to be restored as part of the project.

Regulators for the dam removal project may impose time-of-year restrictions for tree clearing at the site to protect bat species of concern.

Alternatives for dam removal that remove minimal to no sediment upstream of the dam, including the no action alternative, have the potential for long-term impacts to aquatic habitat and water quality downstream of the dam. Fine sediment upstream of the dam could readily be mobilized and deposited downstream, smothering instream habitat.

11.1.3 Aquatic Organism Passage Potential

Observations around the dam and probing upstream of the dam was used to investigate the likelihood of fish passage in the restored channel. No dam design plans were available for review to provide information on the historic channel makeup.



March 26, 2025

Trout Brook Reservoir Dam Removal

SLR Project No.: 146.13528.00002

Many dams are founded on bedrock and therefore have bedrock falls underneath that may

block aquatic organism passage. Trout Brook Reservoir dam does not have any visible bedrock downstream or around the dam. No bedrock was encountered during probing. Probe refusal upstream of the dam felt like compacted gravel, indicating no grade control. No step in the channel profile was detected based on probing.

A short section of the channel under the dam and under the upstream riprap face was not able to be checked with rod probing techniques.

Aquatic organism passage is likely post-dam removal.

11.2 Potential Infrastructure Conflicts

11.2.1 Culverts

Trout Brook passes under the Well #2 access road 520 feet downstream of the dam and under Town of Berkshire owned Reservoir Road 1,220 feet downstream of the dam. Modeling shows no changes to water depths or velocity in the vicinity of either of these structures due to removal of the Trout Brook dam and upstream sediment removal. The alternatives that leave the most sediment in place upstream of the dam – alternative 1 (no action), alternative 2 (dam removal only), and alternative 3 (dam removal and limited sediment removal) pose a potential risk to the downstream culverts. Leaving large amounts of fine sediment in the channel would likely lead to transport of this sediment downstream over time. Sediment could clog the culverts and cause damage to the structures and roadways.

Given the frequency of overtopping of the access road culvert and anecdotal evidence of it washing out in the recent past, we recommend this structure be replaced with a new structure that spans at least bankfull width. Modeling suggests that this culvert is both a depth and velocity barrier to brook trout under varying flow conditions. Replacement with a larger structure that incorporates natural substrate on the bottom would facilitate fish passage and reduce likelihood of washout during high flows. According to the Village of Enosburg Falls, replacement of the access road culvert is being designed, permitted, and implemented in conjunction with the solar project on the property.

Similarly, the Reservoir Road culvert is likely a low flow depth barrier and high flow velocity barrier for brook trout. This culvert has not been washed out in recent history and does not have anecdotal evidence of damage from high flows. This structure could be retrofitted to better support fish passage under varying flow conditions through practices such as the installation of baffles within the culvert to slow and deepen water.

11.2.2 Water Supply

Downstream of the dam along the access road is the location of Well #1 and its pumphouse. Well #1 is located outside the 500-year floodplain for both existing conditions and alternatives and considered to be outside the influence of the dam removal.

Well #2 and pumphouse are located just upstream of the dam, high on the right bank, near the parking area. Velocities in this area are very low in existing conditions and will be increased to 5 feet per second for the 2-year flood and 6 feet per second for the 50-year flood, which could cause bank erosion on the steep bank below Well #2. Bank stabilization measures are recommended on the west river bank.

There is a water line that crosses across the river approximately 67 feet downstream of the dam and connects the two wells to the water storage tank that pressurizes the Village's water



March 26, 2025

system. SLR estimated that the pipe was located 2.1 feet below the channel thalweg where it crossed at approximately river station 1510. Hydraulic modeling shows locally increased

changes in velocity between existing conditions and Alternative 5 at the model cross sections upstream and downstream of this pipe. Additional checks on model velocities and profile were performed as the design progressed to confirm the design of bed stabilization measures to hold the profile at the pipe.

Well #2 is near the impoundment. Well data was reviewed to see if removal of the impoundment was likely to affect the well production capacity (Denton, 2021). Well #2 is 78 feet deep and testing in November 1993 showed that there is no direct influence of surface water on the groundwater at the well. The removal of the impoundment is not expected to influence the well.

The dam and therefore also the access to the dam is within the Source Water Protection Zone 1 for Well #2. Coordination and review from the state and Town were part of the design and permitting process to make sure that the design was completed in accordance with acceptable practices.

11.2.3 Solar Field

Coordination of this solar project with a potential dam removal should be considered as this project is implemented. The dam and impoundment area where work would be completed do not overlap with the solar project area and therefore are not expected to be in conflict.

11.3 Construction and Access

The dam could be accessed for deconstruction from either side of Trout Brook. Currently a maintained road and parking area for accessing Well #2 are located at the top of a steep bank on the west side of Trout Brook. Construction activities in this area may be limited due to the Source Water Protection Plan.

A now overgrown road exists on the east side of Trout Brook from the dam to the gate just off of Reservoir Road, with possible access directly to the east part of the property which should also be considered for site access.

The site has fine sediment, which when saturated can be very difficult to maneuver machinery within the impoundment. Access to and across the impoundment would be necessary with each of the alternatives which include sediment removal to both reach and remove excess sediment. Saturated sediments complicate construction and sometimes require temporary access roads reinforced with rock or bog mats that can "float" on top of the sediment, which are not standardly owned by construction companies.

To reduce the water content of the sediments and allow them to consolidate, dewatering of the impoundment prior to deconstruction of the dam is recommended. Dewatering could be accomplished with an approved phasing plan that considers possible sediment migration during this time period. A dewatering plan would need to be part of design and permitting and come with assurances that the removal and restoration phases will be completed.

Sediment disposal locations in the area were considered as part of the design process. Identifying a local haul location can potentially reduce construction costs and be included in permitting efforts as part of the design approvals.



March 26, 2025

11.3.1 Wetland and Floodplain Restoration

Removal of the dam and sediment has the potential to restore upstream floodplain, some of which may be wetlands. Areas proposed for sediment removal would become connected restored floodplains with targets for either wetlands, shrub-scrub, or forested vegetation types. Alternatives include varying footprints of restoration and connectedness.

12.0 Basis of Design

12.1 Concept Design

A concept design was prepared for the Trout Brook Dam removal project for Alternative 5. Based on feedback from the project team during evaluation of the preferred alternative, modifications were made to the selected alternative. The concept design includes sediment removal within a 100-foot-wide river corridor throughout the length of the maximum impoundment. This approach will target the area in which the most adjustment and sediment loss would likely occur in the years following dam removal and will give the restored channel ample space to adjust laterally over time.

The design also includes sediment removal for the entire floodplain in the reed canary grass monoculture area. This will involve removal of reed canary grass plants and their rhizomes through excavation of one foot of sediment across the floodplain. The volume of sediment proposed for removal from the 100-foot river corridor is 12,600 cubic yards. Excavation of the reed canary grass will involve removal of an additional 2,400 cubic yards of sediment for a project total of 15,000 cubic yards of sediment removed.

The proposed profile as designed will tie into points of firm refusal identified during sediment probing upstream of the dam. Excavation of accumulated fine sediment will extend from the location of the dam (station 15+77) to the upstream extent of the maximum impoundment (station 36+80). Reference geomorphic channel and floodplain geometry will be recreated within the river corridor. Accumulated sediment will be removed and a pilot channel created that is approximately 12 feet wide and 2 feet deep. Adjacent to the pilot channel approximately 4,400 CY of the accumulated sediment will remain in the meander belt to create floodplain areas where original soils were removed during excavation of the reservoir when the dam was constructed. Floodplains are configured to achieve an incision ratio in the range of 1 to 1.5 with a cross slope of 1 to 2 percent.

Large wood will be incorporated into the restored channel and floodplain to increase roughness and provide resistance to erosion. The pilot channel will be approximately 1,900 feet in length, with the assumption that the stream will create a more sinuous alignment over time following dam removal.

Downstream of the dam, a large scour pool has formed where water flows over the spillway. When the dam is removed, the streambed will be raised in this location to tie into the natural expected profile for the reach.

The concept design was evaluated in the hydraulic model. Water surface elevations are lower than existing conditions through the project area. Velocities are normalized so that the impoundment area is no longer expected to have excessive aggradation and sediment transport will be naturalized. Downstream of the dam, a localized increase in water velocities is shown due to the elimination of the large scour hole at the foot of the dam.



March 26, 2025

March 26, 2025 SLR Project No.: 146.13528.00002

The design includes protection of the existing water pipe where the water line crosses below Trout Brook downstream of the dam due to the modeled increase in water velocities in this location. Streambed stabilization is called out on the plans which would include armoring the river bed with riprap and covering with native stream bed material. Rather than stabilizing the streambed, the Village of Enosburg Falls also considered lowering the water line to a depth great enough eliminate erosion risk.

The design includes slope stabilization in the vicinity of drinking water well #2 to avoid any potential impacts as the restored stream channel adjusts following dam removal. Project partners agreed that leaving the portion of the concrete dam along the right bank in place would minimize impacts to the water line that is located approximately twelve feet from the corner of the dam. Saw cutting may be used for dam removal rather than hydraulic hammering to further reduce the risk of impacting drinking water infrastructure during construction.

Sediment probing and visual observations in the vicinity of the dam suggest that removal of the dam will likely restore aquatic organism passage to upstream reaches. No bedrock was observed on the streambed or banks in the vicinity of the dam.

Replacement of the access road culvert is included due to its vulnerability to clogging and overtopping. Replacing this culvert will further restore aquatic organism passage, though the downstream culvert at Reservoir Road will still be limiting for some species and life stages under some flow conditions.

The proposed approach to dam removal maximizes naturalization of the river channel and public safety. The proposed bankfull dimensions at the dam removal site would match the reference dimensions. In summary, this alternative would naturalize hydraulic patterns, restore sediment transport, improve AOP, and increase public safety.

The design includes removal of the concrete dam (288 CY) and riprap ramp along the upstream face of the dam (370 CY). Excavation would include removing sediment from the impoundment upstream of the dam (12.600 CY) and reed canary grass sediment (2.400 CY). Note that sediment further up the channel and outside of the river corridor would not be removed and allowed to pass downstream during floods following dam removal. Dewatering the impoundment ahead of dam removal would allow for drier sediments and easier access in the impoundment.

The project area will be fully revegetated to accelerate site recovery. All disturbed areas will be planted with native seed for wet areas or slopes, including pollinator species. Seed mixes will be specified for remaining exposed soils based on slope.

Concept design plans have been prepared (Appendix G).

12.2 **Preliminary Design**

A preliminary (60%) design was prepared for the Trout Brook Dam removal project. Based on feedback from the project team and regulators, there were no substantial changes to major design elements from the concept design to preliminary design stage.

Sediment removal volumes are unchanged from the concept design. The preliminary design includes wood structures to aid in the stabilization of the site and provide habitat in the restored system. Twelve wood structures – 6 post-assisted log structures (PALS) and 6 beaver dam analogs (BDAs) will be installed at roughly even spacing in the pilot channel throughout the limits of excavation. The structures will span the limits of excavation laterally within the 100-foot river corridor where most of the sediment will be removed.

A site restoration and planting plan was developed as part of the preliminary design.



12.3 Final Design

Onsite disposal of fill was selected by project partners over hauling fill offsite. There is open upland space on the southeastern portion of the property with existing access. Grading for fill disposal was added based on feedback from the Town on slopes and maximum desired cover over existing utility pipes. Additional details on construction sequence, erosion control, and restoration were added to support permit review. Notes related to the protection of the Water Source Protection Area were added based on comments from the VTDEC Public Drinking Water program.

An evaluation of hydraulic effects was completed and determined to have no adverse impact (Appendix H).

The final design includes the removal of the dam and outlet works and excavation of 15,700 CY of impounded sediment. Large wood and wood structures are included throughout the pilot channel and in two tributaries that flow into the impoundment. The final design opinion of probable project cost is \$770,000 that includes construction, a construction contingency of 10%, bid phase services, and construction phase services. Final design plans and opinion of probable cost are included in Appendix I.

12.4 Permitting Needs

The following permits are needed for the removal of Trout Brook Reservoir Dam. Site visits were conducted with many of the regulatory agencies on September 19, 2023 and June 18, 2024 and to gain initial feedback on the design and insight into the permitting process needed. Regulatory comments collected have been incorporated into the final design.

12.4.1 US Army Corps of Engineers Vermont General Permit

The USACE reported during the September 2023 site visit that the project is likely to be covered under a general permit for this restoration activity. The permit will allow for fill associated with accessing the dam for removal and possible stabilization measures. The permit will also allow for dredging of accumulated sediment that is anticipated as part of the channel restoration. This permit may be triggered if dewatering the impoundment, even if no construction activities are proposed. Fill sites will also need to be reviewed.

12.4.2 Vermont Dam Safety Permit

The Vermont Dam Safety Section reported during the September 2023 visit that it is likely to issue a Dam Order for this project to remove the obsolete and breached dam that is creating an unnecessary public hazard. Dewatering of the impoundment is recommended and can be implemented at any time without a permit.

12.4.3 Vermont Stream Alteration Permit

A stream alteration permit is likely to be obtained, as the design is moving the channel toward dynamic equilibrium. Initial feedback from the Vermont River Scientist to restore the 100-foot wide river corridor has already been incorporated into the design. An Individual Stream Alteration Permit is required.

12.4.4 Vermont Wetlands

The Vermont Wetlands Program reported during the September 2023 visit that it is likely to issue necessary approvals. The removal of the dam and restoration of the impoundment would



March 26, 2025

March 26, 2025 SLR Project No.: 146.13528.00002

need to be reviewed, but likely authorized as an allowed use not requiring a permit. An Individual Wetlands Permit is necessary for construction access that crosses wetland buffer.

12.4.5 **Vermont Public Water System**

The Drinking Water and Groundwater Protection Division reported during the September 2023 site visit that the dam removal will need to be reviewed by the Division to determine what would be needed for construction activities. This would not need a permit unless there is alteration of the drinking water system. Lowering of the water main between Well #2 and the reservoir would require this permit. The Drinking Water Program reviewed the final design plans and confirmed that no permit is required for the project. The Program provided language that was added to the design plans for protection of the Source Water Protection Area

12.4.6 **Construction General Permit**

This permit is needed if the project disturbs 1 acre or more above ordinary high water. The project has a total of 9.4 acres of disturbance above OHW including the fill site. Due to its location within a Class A watershed and the sloped setting of areas of the site, an Construction Stormwater Individual Permit is required. The Class A watershed status is based on the reservoir being used as a drinking water source, which is no longer the case.

12.4.7 **Berkshire Zoning Permit**

The Flood Hazard Area Regulations exempt the need for development review, but do need a zoning permit for removal of part or all of a building or other structure, however channel management is subject to conditional approval. Through the lowering of flood levels with dam removal, we should be able to obtain a permit under the Flood Hazard Area Regulations.

The dam and therefore also the access to the dam is within the Source Water Protection Zone 1 for Well #2. Coordination and review from the state and Town will be required to make sure that the design is completed in accordance with acceptable practices. Review of project will be necessary with the Town of Berkshire and state regulators to make sure that the dam removal design would be allowed within the source water protection plan.

A conditional use zoning permit is required for work within the Flood Hazard Overlay District and Wellhead Protection Overlay District.

12.4.8 **Vermont Division of Historic Preservation**

The Vermont Division of Historic Preservation will review this project for the Army Corps and is a confirmation process NOT a permit. It does require review and possibly additional assessment work. An archeological resources assessment and historic resource review and archaeological phase 1 site assessment were completed for the project site. The studies found no archaeological sites and recommended a determination of No Historic Properties Affected.

References 13.0

Investigation and Remediation of Contaminated Properties Rule (I Rule) Environmental Protection Rules Sec.35, Effective July 6, 2019.)



- Arcement, G. J. J. and V. R. Schneider, 2006. Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains (Metric Version) USGS Water-supply Paper 2339 United States Geological Survey, Reston, VA.
- Chow, V. T., 1959. Open-Channel Hydraulics, McGraw-Hill Book Company, New York, NY.
- Clesceri, L. S., A. E. Greenberg, and A. H. Eaton (Editors), 1998. Standard Methods for the Examination of Water and Wastewater (20th Edition), APHA, AWWA, and WEF, Washington, DC.
- Denton, 2021. Source Protection Plan Enosburg Falls Water System (WSID 5116), Enosburg Falls, Vermont, July 2021.
- Fischenich, J. C., 2001. Stability Thresholds for Stream Restoration Materials. ERDC TN-EMRRP-SR-29. U.S. Army Engineer Research and Development Center, Vicksburg, MS.
- FCNRCD, 2022. Request for Proposals, Dam Removal Feasibility Study at Trout Brook Reservoir Dam, Missisquoi River Watershed. Franklin County Natural Resources Conservation District.
- Jacobs, J., 2010. Estimating the Magnitude of Peak Flows for Steep Gradient Streams in New England. New England Transportation Consortium Report NETC81, Project No. NETC 04-3. New England Transportation Consortium in cooperation with the Federal Highway Administration, Burlington, VT.
- Kline, M., C. Alexander, S. Pytlik, S. Jaquith, and S. Pomeroy, 2009. Vermont Stream Geomorphic Assessment Protocol Handbooks: Remote Sensing and Field Surveys Techniques for Conducting Watershed and Reach Level Assessments (Http://Www.Anr.State.Vt.Us/Dec/Waterq/Rivers/Htm/Rv_Geoassesspro.Htm). Vermont Agency of Natural Resources, Department of Environmental Conservation, Division of Water Quality, River Management Program, Waterbury, VT.
- MacBroom, J. G. and R. Schiff, 2013. Sediment Management at Small Dam Removal Sites. In: The Challenges of Dam Removal and River Restoration: Geological Society of America Reviews in Engineering Geology, 67-79. J. V. DeGraff and J. E. Evans (Editors). The Geological Society of America, Boulder, CO.
- MacDonald, D. D., C. G. Ingersoll, and T. A. Berger, 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Archives of Environmental Contamination and Toxicology 39(1):20-31.
- Olson, S., 2014. Estimation of Flood Discharges at Selected Annual Exceedance Probabilities for Unregulated, Rural Streams in Vermont. Scientific Investigations Report 2014–5078. U.S. Geological Survey in cooperation with the Federal Emergency Management Agency, Reston, VA.
- USACE, 2018. Hydrologic Engineering Center River Analysis System (HEC-Ras) (V. 5.0.6). U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, CA.
- VTDEC, 2006. Vermont Regional Hydraulic Geometry Curves. Appendix J of the Vermont Stream Geomorphic Assessment Protocol Handbooks: Remote Sensing and Field Surveys Techniques for Conducting Watershed and Reach Level Assessments. Vermont Agency of Natural Resources, Department of Environmental Conservation, Division of Water Quality, River Management Program, Waterbury, VT.





Appendix A Dam Volume

Trout Brook Reservoir Dam Removal

Engineering Report

Franklin County Natural Resources Conservation District

SLR Project No.: 146.13528.00002

March 26, 2025



Trout Brook Reservoir Dam Dam Measurements and Quantities July 05, 2023

Dam Concrete Structure Volume

Measured	See CAD plot for Dam Face Measurements	
	Avg. Dam Width (ft) 3 ft at top, buttressed 1:4	5
Calculated	Dam Face Total Area (sqft)	1260
	Dam Concrete Volume (CY)	233

Concrete Training Wall Volume - parallel to river

	Width (ft)	2.0
Measured	Height (ft)	12
	Length (ft)	20
Concrete Training Wall Volume (CY) x 2 walls		36

Gatehouse Concrete Structure Volume

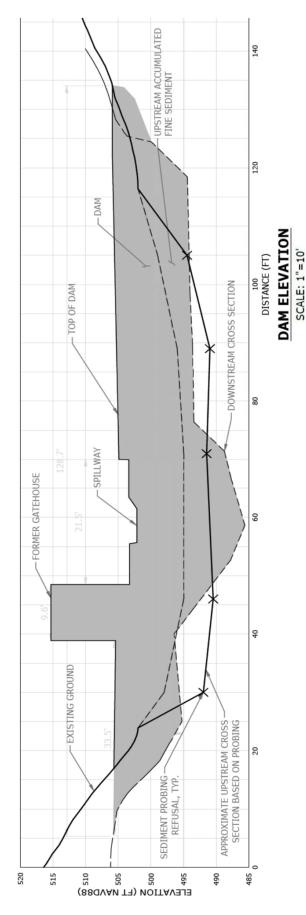
	Structure Height (ft)	14
Measured	Width (wall length) (ft)	18
	Structure Wall Thickness (ft)	2
	Gatehouse Concrete Structure Volume (CY)	19

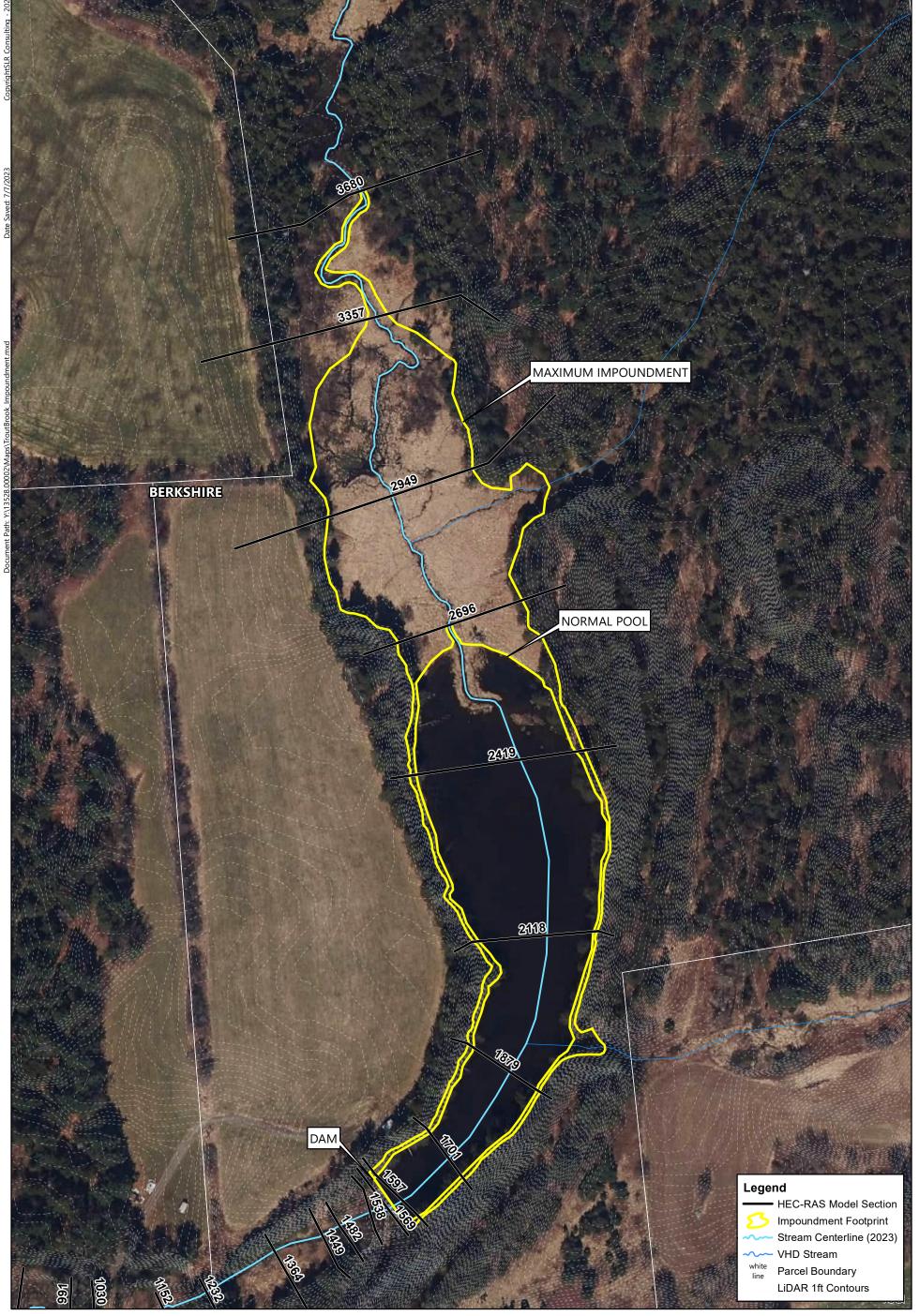
TOTAL CONCRETE (CY):	288

Riprap Upstream slope**

	Width (ft)	100.0
Measured	Length (ft)	20
	Depth (ft) - assumed average between 11 and 1	5
	Riprap Volume (CY)	370

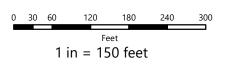
^{**} Riprap slope may have another material below assumes here that it is all riprap





TROUT BROOK DAM IMPOUNDMENT

TROUT BROOK DAM REMOVAL FEASIBILITY STUDY FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT





SSLR

1 SOUTH MAIN ST
WATERBURY, VT 05676
802.882.8335

MAXIMUM IMPOUNDMENT WATER VOLUME - EXISTING

	WSE Section	Area		
RS	Section	Average	D/S Dist	Volume
RS	(SF)	(SF)	(FT)	(CF)
1569	0			
1597	906.7431	453.4	28.0	12,694
1701	936.5008	921.6	104.0	95,849
1879	1352.9461	1144.7	178.0	203,761
2118	1750.7406	1551.8	239.0	370,891
2419	1631.6045	1691.2	301.0	509,043
2696	356.7608	994.2	277.0	275,389
2949	209.5910	283.2	253.0	71,644
3357	16.0514	112.8	408.0	46,031
3680	4.1763	10.1	323.0	3,267
4112	0	2.1	432.0	902

Total Water Volume (CF) =	1,589,469
Total Volume (AC-FT) =	36.5
Total Volume (CY) =	58,869

TOTAL IMPOUNDMENT VOLUME (AC-FT)

53.6

NORMAL POOL IMPOUNDMENT WATER VOLUME - EXISTING

	WSE Section	Area		
RS	Section	Average	D/S Dist	Volume
K3	(SF)	(SF)	(FT)	(CF)
1569	0			
1597	502.4552	251.2	28.0	7,034
1701	569.5345	536.0	104.0	55,743
1879	815.7221	692.6	178.0	123,288
2118	1001.1740	908.4	239.0	217,119
2419	579.2464	790.2	301.0	237,853
2696	7.1283	293.2	277.0	81,213
2949	0	3.6	253.0	902

Total Water Volume (CF) =	723,153
Total Volume (AC-FT) =	16.6
Total Volume (CY) =	26,783

TOTAL IMPOUNDMENT VOLUME (AC-FT)

33.7



Appendix B Dam Inspection

Trout Brook Reservoir Dam Removal

Engineering Report

Franklin County Natural Resources Conservation District

SLR Project No.: 146.13528.00002

March 26, 2025



DAM INSPECTION REPORT



Weather overcast Conditions: Project Name: Reservoir **Trout Brook** Location: Berkshire, VT J. Louisos, A. 13528.00002 5/5/2023 Project No.: Date: Marcucci Dam ID. 19.02 Physical Properties Impoundment Area Freeboard: 2.7 feet to the dam top Dam Height: 12 feet Embankment Material: concrete with river gravel and cobble aggregate, 1/8" metal pins, 2" metal straps Embankment Width: 3 feet at top, buttressed at 1:4 Dam/Embankments **General Conditions:** poor Vegetative Cover: grass on top of concrete dam top Erosion/Burrows Settlement/Alignment/Move upper part of dam on right shifting ment Seepage/Foundation seeping at bottom and the concrete joint 4 feet off of the ground on the left side, major seep along upper joint on right side Drainage: present upstream of dam, ramping down at 2"1 starting 1 foot below normal pool water Riprap: surface Stone Masonry: Concrete Condition: surface eroding and crumbling, chunks missing, seams eroded up to 12 inches deep Cracks: small cracks upstream corroded seam 0.3 - 0.6 feet deep at water surface, upper 3 feet of dam is Other detatched and unstable Spillway/Training Walls/Apron **General Conditions:** Settlement/Align./Movemen large center piece missing, 8 feet wide, most of left wall is gone Stone Masonry: Concrete Condition: poor, cracking & spalling, large chunks missing, slabs loose Cracks: multiple cracks, 6" gap at dam top Scouring/Undermining width of spillway has been eroded, water flowing across, large trees growing on left training Other D/S Channel Scouring: yes, at dam toe and outlet channel Debris: Riprap: riprap and concrete pieces on channel bed extending 40 feet from dam, displaced No Emergency Spillway **Emergency Spillway** General Conditions: Vegetative Cover: Erosion/Burrows:

DAM INSPECTION REPORT



Settlement/Align./Movemen t	
Seepage/Foundation	
Drainage:	
Riprap:	
Stone Masonry:	
Concrete Condition:	
Cracks:	
Other:	
	_
Outlet Structure(s)	poor
General Conditions:	
Vegetative Cover:	
Erosion/Burrows:	
Settlement/Align./Movemen t	lower part of concrete wall detatched
Seepage/Foundation	
Drainage:	
Riprap:	
Stone Masonry:	
	corner of concrete gone/ eroded, 1/3 of building not sitting on anything
Cracks:	large cracks througout
Other:	18" ductile iron outlet pipe partially buried downstream, not found upstream, valve underwater in gatehouse reportedly not used in decades - unknown if it works
Intake Structure	
General Conditions:	
Vegetative Cover:	
Erosion/Burrows:	
Settlement/Align./Movemen t	
Seepage/Foundation	
Drainage:	
Riprap:	
Stone Masonry:	
Concrete Condition:	
Cracks:	
Other:	
Miscellaneous Features	
Access - Roads, Bridges, etc.	
Safety - Fencing, Railing, etc.	



Appendix C Sediment Data

Trout Brook Reservoir Dam Removal

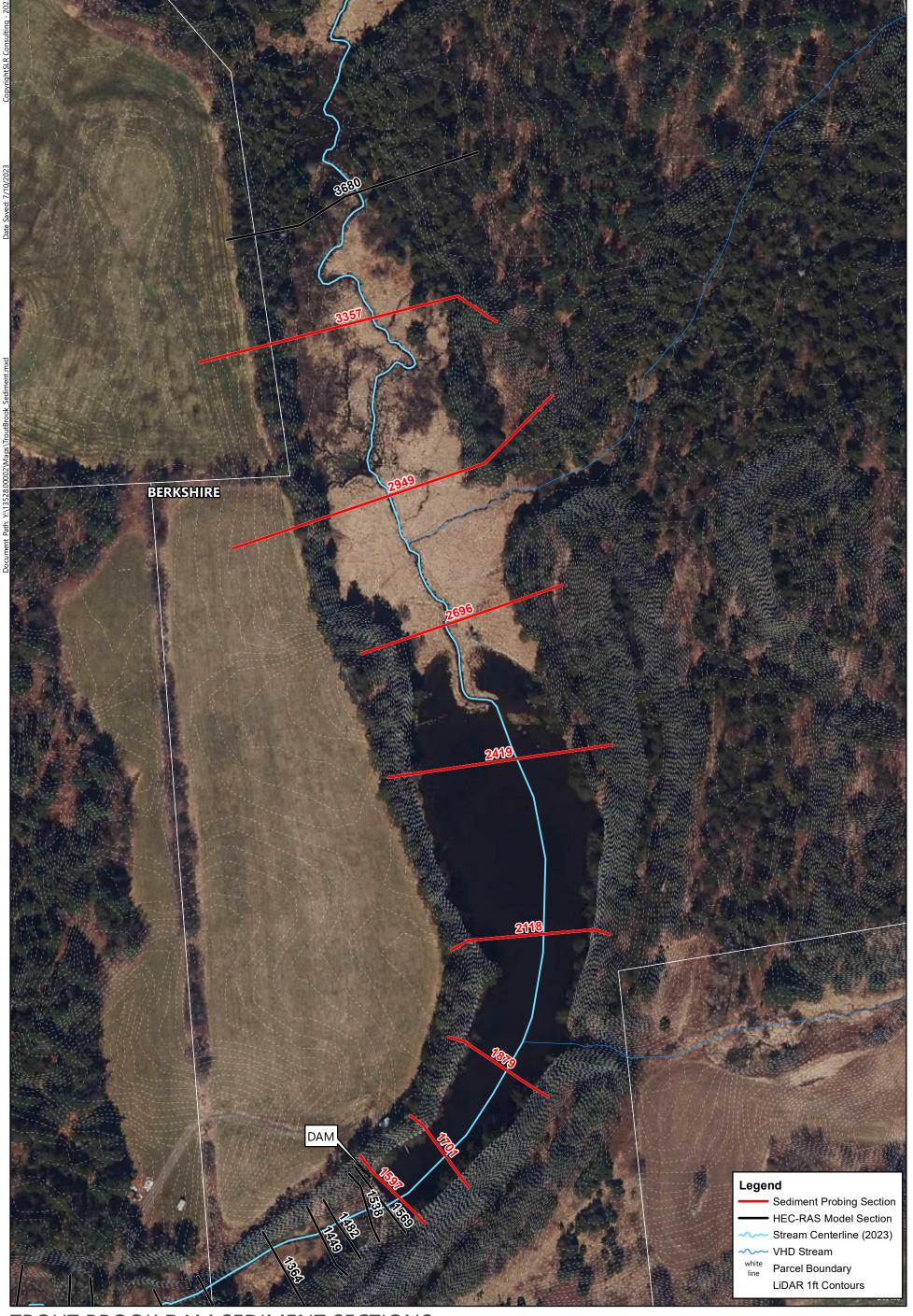
Engineering Report

Franklin County Natural Resources Conservation District

SLR Project No.: 146.13528.00002

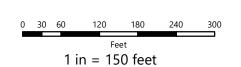
March 26, 2025





TROUT BROOK DAM SEDIMENT SECTIONS

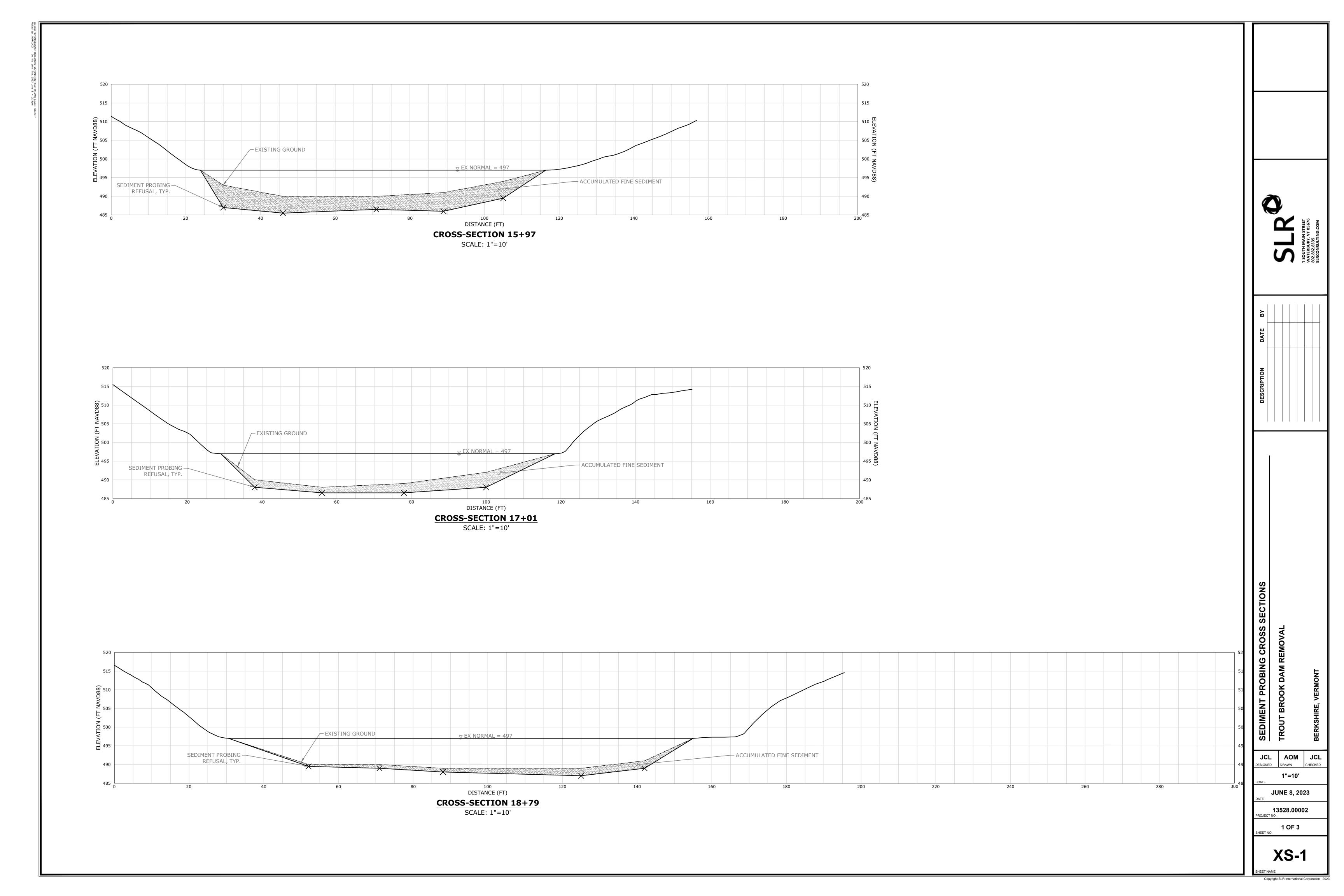
TROUT BROOK DAM REMOVAL FEASIBILITY STUDY FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT

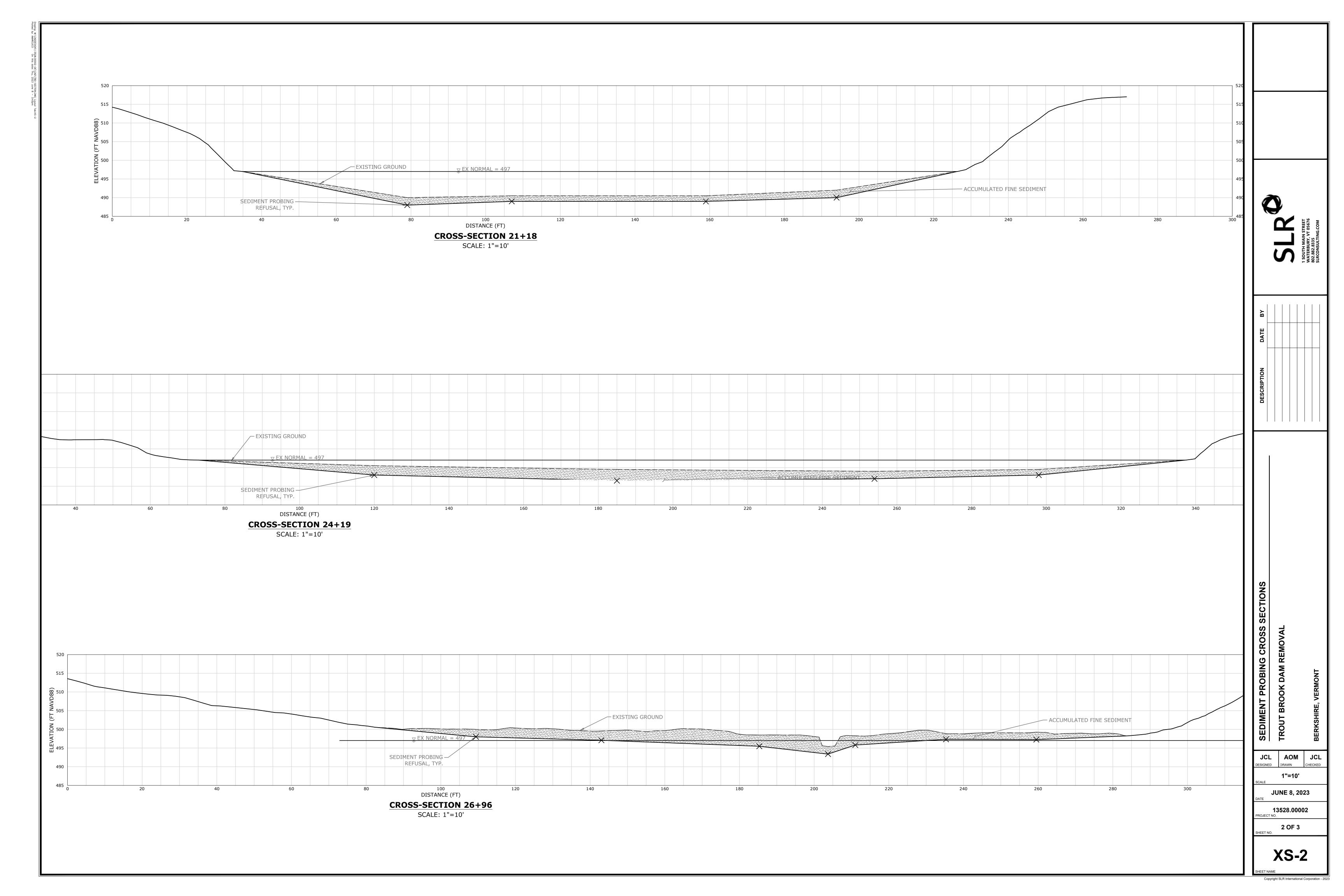


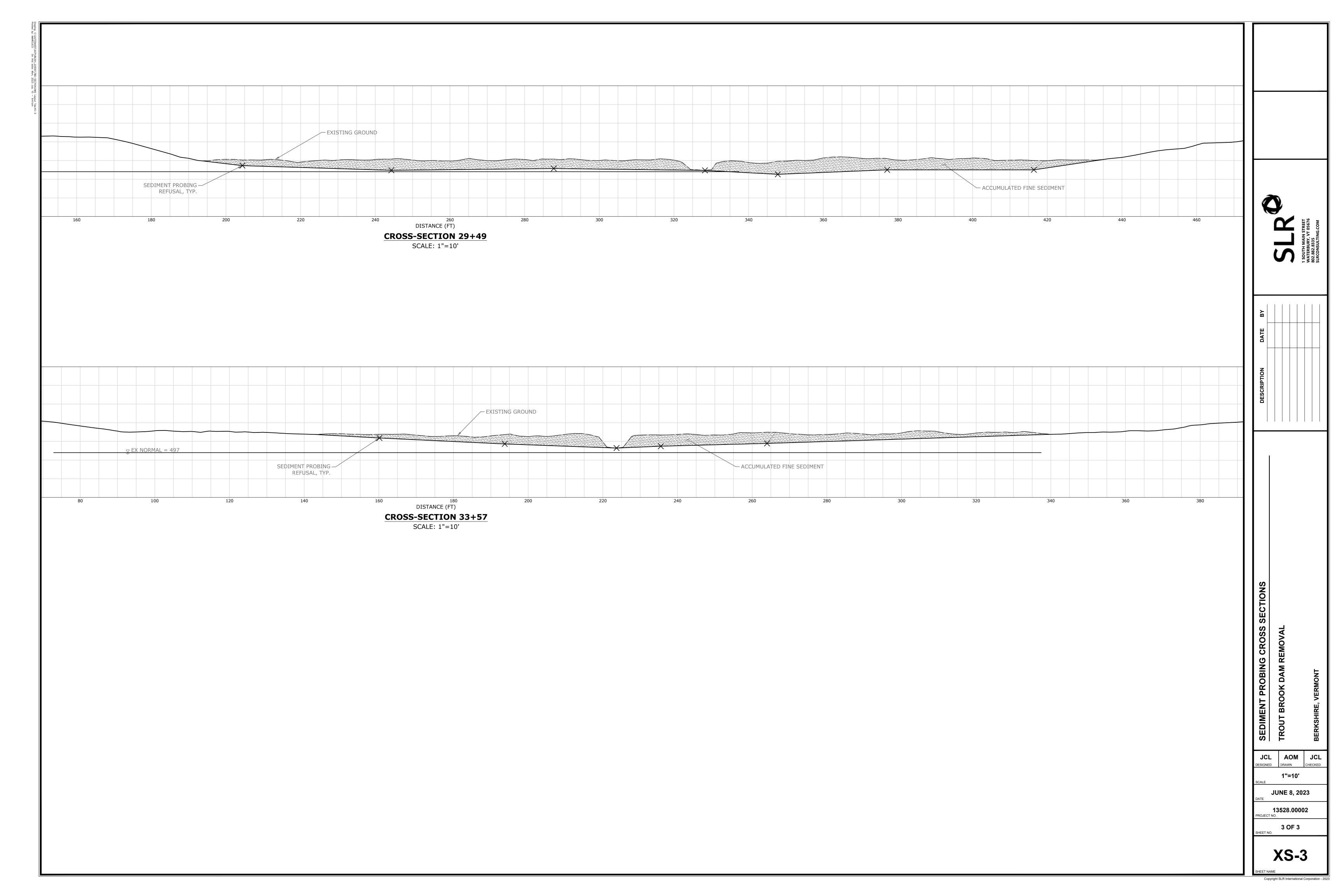


SSLR

1 SOUTH MAIN ST
WATERBURY, VT 05676
802.882.8335







TOTAL SEDIMENT VOLUME - EXISTING

	Sediment Sed	tion Area		
RS	Section	Average	D/S Dist	Volume
KS	(SF)	(SF)	(FT)	(CF)
1569	0			
1597	380.45	190.2	28.0	5,326
1701	193.10	286.8	104.0	29,825
1879	139.1000	166.1	178.0	29,566
2118	264.650	201.9	239.0	48,248
2419	516.675	390.7	301.0	117,589
2696	460.673	488.7	277.0	135,363
2949	577.766	519.2	253.0	131,363
3357	357.875	467.8	408.0	190,871
3680	0.0	178.9	323.0	57,797

Total Sediment Volume (CF) =	745,947			
Total Volume (AC-FT) =	17.1			
Total Volume (CY) =	27,628			



Appendix D Resource Maps

Trout Brook Reservoir Dam Removal

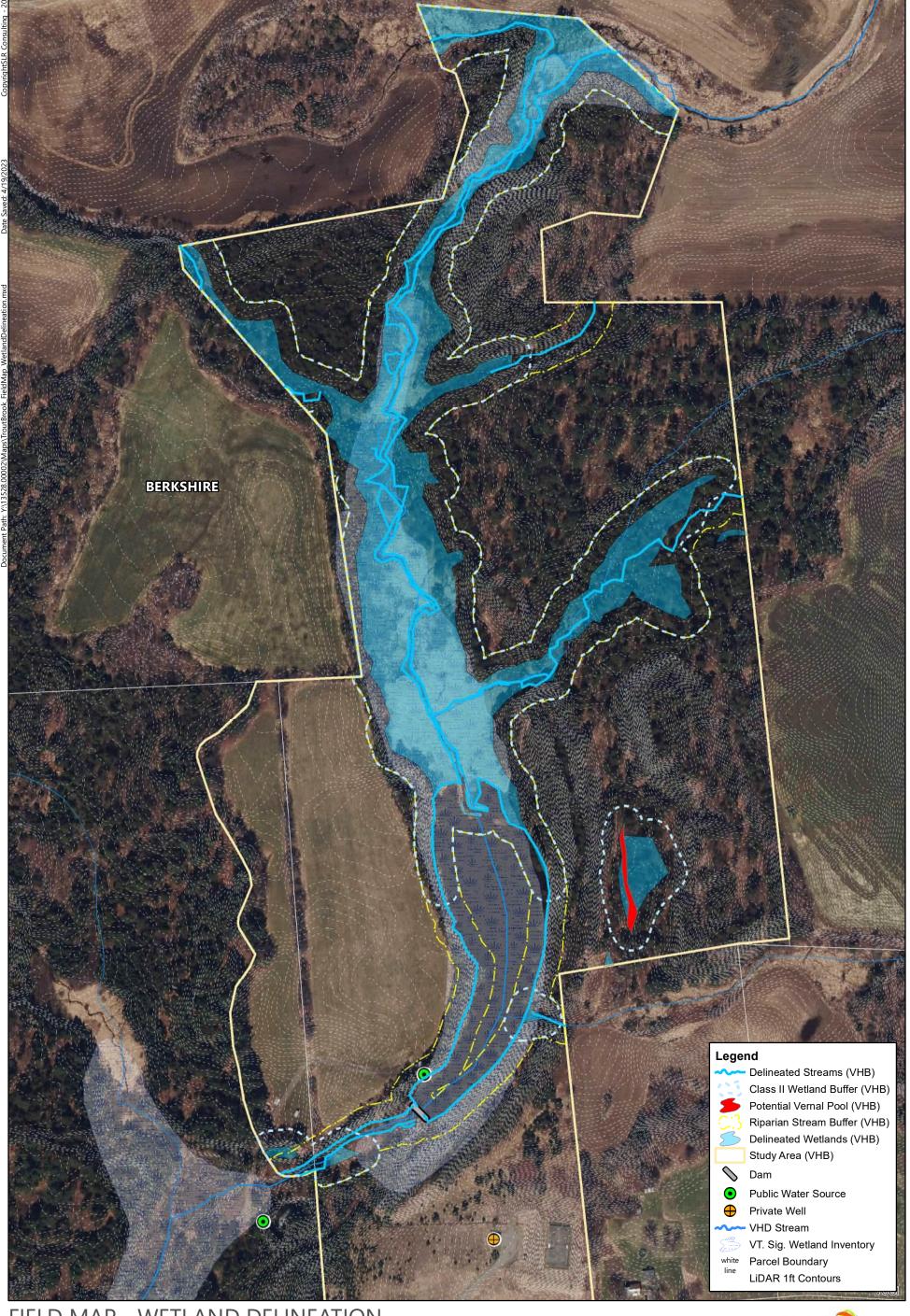
Engineering Report

Franklin County Natural Resources Conservation District

SLR Project No.: 146.13528.00002

March 26, 2025

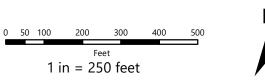




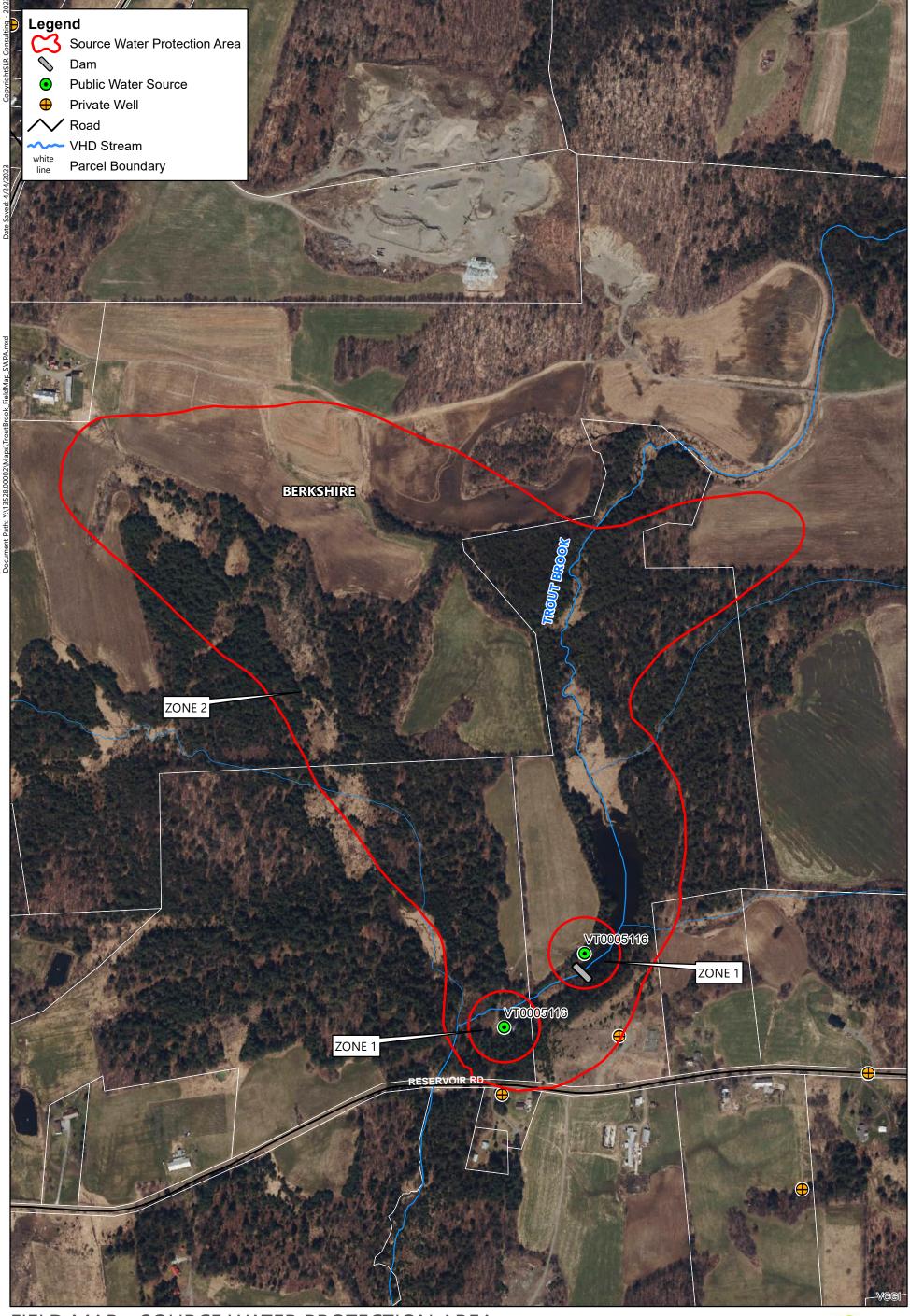
FIELD MAP - WETLAND DELINEATION

TROUT BROOK DAM REMOVAL FEASIBILITY STUDY FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT

Wetland delineation performed by VHB.

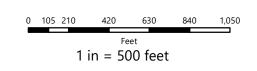






FIELD MAP - SOURCE WATER PROTECTION AREA

TROUT BROOK DAM REMOVAL FEASIBILITY STUDY FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT









Appendix E Existing Hydraulic Modeling Results

Trout Brook Reservoir Dam Removal

Engineering Report

Franklin County Natural Resources Conservation District

SLR Project No.: 146.13528.00002

March 26, 2025



	n: ExistingConditions_rev_wSur											
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
Decel 4	5400	0	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft) 0.004705	(ft/s)	(sq ft)	(ft)	0.54
	5109 5109	2-yr 5-yr	87.30 141.00	510.61 510.61	513.19 513.60	512.42 513.18	513.42 513.86		3.86 4.42	28.06 53.50	39.94 86.03	0.51 0.55
	5109	10-yr	183.00	510.61	513.79	513.57	514.09		4.89	72.91	110.39	0.58
	5109	25-yr	247.00	510.61	514.05	513.89	514.35		5.22	102.88	122.25	0.58
	5109	50-yr	303.00	510.61	514.23	514.07	514.53		5.39	126.16	128.37	0.58
	5109	100-yr	364.00	510.61	514.45	514.20	514.73		5.47	154.30	134.34	0.57
Reach 1	5109	500-yr	535.00	510.61	514.97	514.52	515.22	0.004024	5.52	226.02	136.90	0.53
Reach 1	5109	Halloween2019	125.30	510.61	513.52	512.79	513.77	0.004877	4.20	47.43	75.34	0.53
	5109	7Q2	0.30	510.61	510.75	510.70	510.76		0.92	0.33	2.97	0.49
	5109	AprilQ2-20	47.00	510.61	512.58	511.93	512.73		3.12	15.04	10.61	0.46
Reach 1	5109	NovQ2-20	13.00	510.61	511.74	511.36	511.80	0.003312	1.91	6.81	9.10	0.39
Reach 1	4817	2 1/2	87.30	508.57	510.43	510.43	510.91	0.019915	5.56	15.69	16.72	1.01
	4817	2-yr 5-yr	141.00	508.57	510.43	510.45	510.91		6.06	24.32	30.26	0.94
	4817	10-yr	183.00	508.57	511.13	510.65	511.42		6.25	33.79	37.06	0.94
	4817	25-yr	247.00	508.57	511.43	511.43	512.08		6.71	45.62	40.58	0.86
	4817	50-yr	303.00	508.57	511.67	511.63	512.35		7.01	55.73	42.93	0.85
Reach 1	4817	100-yr	364.00	508.57	511.87	511.84	512.62	0.010811	7.48	64.35	44.83	0.87
Reach 1	4817	500-yr	535.00	508.57	512.32	512.32	513.29	0.011538	8.69	85.36	49.16	0.92
Reach 1	4817	Halloween2019	125.30	508.57	510.71	510.71	511.28	0.018002	6.06	20.77	20.01	1.00
	4817	7Q2	0.30	508.57	508.86	508.78	508.87		0.80	0.37	2.56	0.37
	4817	AprilQ2-20	47.00	508.57	510.02	510.02	510.39		4.89	9.62	13.33	1.01
Reach 1	4817	NovQ2-20	13.00	508.57	509.47	509.47	509.68	0.026464	3.69	3.52	8.67	1.02
Desert 1	4400	0		E0 : -	=0			0.00				_
	4483	2-yr	87.30	504.91	508.05	506.68	508.25		3.61	26.70	22.82	0.41
	4483 4483	5-yr 10-yr	141.00 183.00	504.91 504.91	508.67 509.00	507.28	508.91	0.003521 0.003425	4.19 4.43	59.47 90.30	79.54 102.02	0.43
	4483	25-yr	183.00 247.00	504.91	509.00	507.88 508.76	509.25 509.49		5.50	102.95	102.02	0.43
	4483	50-yr	303.00	504.91	509.12	509.08	509.49		6.09	119.35	103.42	0.52
	4483	100-yr	364.00	504.91	509.20	303.00	509.70		6.36	143.69	103.29	0.57
	4483	500-yr	535.00	504.91	510.07	509.67	510.50		6.88	206.64	115.08	0.58
	4483	Halloween2019	125.30	504.91	508.52	507.12	508.76		4.06	48.70	69.24	0.43
	4483	7Q2	0.30	504.91	505.02	505.02	505.05		1.42	0.21	3.87	1.07
Reach 1	4483	AprilQ2-20	47.00	504.91	507.10	506.13	507.24	0.003245	3.03	15.50	8.00	0.38
Reach 1	4483	NovQ2-20	13.00	504.91	505.80	505.49	505.89	0.005160	2.33	5.58	7.28	0.47
	4112	2-yr	87.30	502.55	504.78	504.78	505.54		6.97	12.53	8.37	1.00
	4112	5-yr	141.00	502.55	505.42	505.42	506.29		7.48	18.90	11.83	1.01
	4112	10-yr	183.00	502.55	505.79	505.79	506.76		7.92	23.89	15.03	0.97
	4112 4112	25-yr 50-yr	247.00 303.00	502.55 502.55	506.63 506.93	506.63 506.93	507.22 507.44		6.61 6.52	59.88 87.25	72.51 100.95	0.68
	4112	100-yr	364.00	502.55	500.93	507.10	507.44		6.87	104.79	100.95	0.64
	4112	500-yr	535.00	502.55	507.44	507.44	508.05		7.91	140.54	110.37	0.72
	4112	Halloween2019	125.30	502.55	505.28	505.28	506.09		7.22	17.36	10.98	1.01
	4112	7Q2	0.30	502.55	502.72	502.63	502.72		0.51	0.59	4.23	0.24
	4112	AprilQ2-20	47.00	502.55	504.05	504.05	504.66	0.022446	6.28	7.48	6.11	1.00
Reach 1	4112	NovQ2-20	13.00	502.55	503.55		503.67	0.006952	2.84	4.58	5.40	0.54
	3640	2-yr	87.30	499.88	502.66	501.59	502.71	0.001584	2.26	55.53	100.07	0.29
	3640	5-yr	141.00	499.88	503.00	501.97	503.06		2.73	102.40	157.26	0.32
	3640	10-yr	183.00	499.88	503.19	502.19	503.25		3.01	131.96	162.32	0.34
	3640	25-yr	247.00	499.88	503.41	502.60	503.49		3.38	169.72	173.61	0.36
	3640 3640	50-yr	303.00 364.00	499.88 499.88	503.58 503.74	502.80 502.96	503.67 503.84		3.65 3.91	200.56 232.90	193.68 205.62	0.38
	3640	100-yr 500-yr	535.00	499.88	503.74	503.23			4.50	312.15	213.89	0.40
Reach 1	3640	Halloween2019	125.30	499.88	502.91	501.87	502.96		2.64	87.80	152.43	0.31
	3640	7Q2	0.30	499.88	500.00	500.00	500.04		1.61	0.19	2.37	1.01
	3640	AprilQ2-20	47.00	499.88	502.14	501.24	502.18		1.80	29.05	26.78	0.25
	3640	NovQ2-20	13.00	499.88	501.00		501.05		2.07	7.02	13.26	0.44
						-						
	3357	2-yr	87.30	498.24	502.12	500.42	502.17		2.10	76.71	157.53	0.21
	3357	5-yr	141.00	498.24	502.26	501.09			2.73	100.42	174.12	0.27
	3357	10-yr	183.00	498.24	502.41	502.05			2.87	127.87	198.61	0.28
	3357	25-yr	247.00	498.24	502.63	502.18			2.85	177.04	240.41	0.27
	3357	50-yr	303.00	498.24	502.77	502.30			2.95	210.29	258.41	0.27
	3357 3357	100-yr 500-yr	364.00 535.00	498.24 498.24	502.92 503.10	502.36 502.61	502.97 503.18		2.98 3.56	250.50 302.66	277.21 282.42	0.27
	3357	Halloween2019	125.30	498.24	503.10	502.61	503.18		2.14	115.14	185.25	0.31
	3357	7Q2	0.30	498.24	498.60	498.38			0.28	1.09	4.54	0.21
	3357	AprilQ2-20	47.00	498.24	501.62	499.78			1.98	29.37	42.91	0.10
	3357	NovQ2-20	13.00	498.24	500.22	498.99	500.25		1.23	10.56	7.13	0.18
Reach 1	2949	2-yr	87.30	497.37	499.29	499.29	500.00	0.018849	6.76	13.01	11.51	0.98
	2949	5-yr	141.00	497.37	500.28	500.28			4.83	63.48	168.22	0.55
	2949	10-yr	183.00	497.37	500.44	500.44	500.69		4.97	93.44	207.31	0.55
	2949	25-yr	247.00	497.37	500.55	500.55	500.83		5.64	117.18	223.25	0.61
	2949	50-yr	303.00	497.37	500.66	500.66	500.93		5.83	143.42	236.93	0.62
	2949	100-yr	364.00	497.37	500.74	500.74	501.03		6.25	162.35	241.88	0.65
	2949	500-yr	535.00	497.37	501.14	400.70	501.31		5.55	262.12	254.79	0.54
	2949 2949	Halloween2019 7Q2	125.30 0.30	497.37 497.37	499.79 497.51	499.79 497.51	500.47 497.53		6.82 1.28	22.09 0.23	26.24 3.45	0.87 0.86
Ponch 4		AprilQ2-20	47.00	497.37	497.51	497.51			5.84	8.04	7.73	1.01
	12949		1 47.00									1.01
Reach 1	2949		13.00	497 37	498 US	498 N2	498 27	().0250571			h aki	
Reach 1	2949 2949	NovQ2-20	13.00	497.37	498.02	498.02	498.27	0.025057	4.05	3.21	6.46	1.01
Reach 1 Reach 1		NovQ2-20	13.00 87.30	497.37	498.02 498.92	498.02	498.27 498.97		2.05	82.17	122.16	0.22
Reach 1 Reach 1 Reach 1	2949							0.000779				

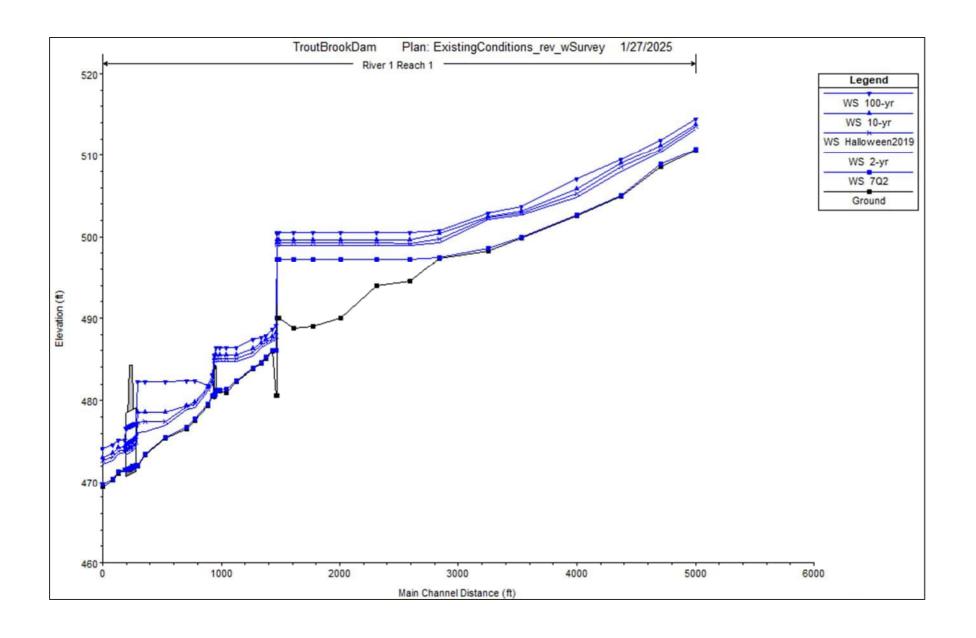
HEC-RAS Pla	an: ExistingConditions_rev_wSu											
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
Danah 4	0000	05	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	0.40
Reach 1	2696 2696	25-yr	247.00 303.00	494.51 494.51	500.00 500.28	498.86 499.08	500.03 500.31	0.000532 0.000470	2.11	281.41 341.02	213.53 216.09	0.19
Reach 1	2696	50-yr 100-yr	364.00	494.51	500.28	499.08	500.51	0.000470	2.07	392.53	220.44	0.18
Reach 1	2696	500-yr	535.00	494.51	500.95	433.27	500.98	0.000519	2.41	488.99	224.33	0.19
Reach 1	2696	Halloween2019	125.30	494.51	499.22	497.53	499.27	0.000776	2.19	124.03	168.02	0.22
Reach 1	2696	7Q2	0.30	494.51	497.25	494.74	497.25	0.000000	0.02	14.21	8.95	0.00
Reach 1	2696	AprilQ2-20	47.00	494.51	498.55	496.39	498.58	0.000486	1.47	48.35	69.41	0.17
Reach 1	2696	NovQ2-20	13.00	494.51	497.85	495.55	497.85	0.000131	0.65	20.09	11.30	0.08
Reach 1	2419	2-yr	87.30	494.00	498.95		498.95	0.000000	0.08	1065.71	282.61	0.01
Reach 1	2419	5-yr	141.00	494.00	499.36		499.37	0.000001	0.12	1182.38	283.84	0.01
Reach 1	2419 2419	10-yr	183.00 247.00	494.00 494.00	499.64 500.02		499.64 500.02	0.000001 0.000002	0.15 0.19	1261.36	284.63	0.01
Reach 1	2419	25-yr 50-yr	303.00	494.00	500.02		500.02	0.000002	0.19	1369.36 1447.95	285.71 286.50	0.01
Reach 1	2419	100-yr	364.00	494.00	500.53		500.53	0.000002	0.25	1515.45	287.47	0.02
Reach 1	2419	500-yr	535.00	494.00	500.97		500.97	0.000004	0.34	1641.00	289.32	0.02
Reach 1	2419	Halloween2019	125.30	494.00	499.25		499.25	0.000001	0.11	1150.81	283.51	0.01
Reach 1	2419	7Q2	0.30	494.00	497.25		497.25	0.000000	0.00	592.12	271.43	0.00
Reach 1	2419	AprilQ2-20	47.00	494.00	498.57		498.57	0.000000	0.05	958.74	280.97	0.00
Reach 1	2419	NovQ2-20	13.00	494.00	497.85		497.85	0.000000	0.02	757.49	276.50	0.00
Reach 1	2118	2-yr	87.30	490.00	498.95		498.95	0.000000	0.07	1348.69	200.45	0.00
Reach 1	2118	5-yr	141.00	490.00	499.36		499.36	0.000000	0.10	1431.57	201.97	0.01
Reach 1	2118 2118	10-yr	183.00 247.00	490.00 490.00	499.64 500.02		499.64 500.02	0.000000	0.12 0.16	1487.82	202.92 203.78	0.01
Reach 1	2118	25-yr 50-yr	303.00	490.00	500.02		500.02	0.000001	0.16	1564.82 1620.87	203.78	0.01
Reach 1	2118	100-yr	364.00	490.00	500.53		500.53	0.000001	0.19	1668.98	204.36	0.01
Reach 1	2118	500-yr	535.00	490.00	500.97		500.97	0.000001	0.22	1758.33	205.86	0.02
Reach 1	2118	Halloween2019	125.30	490.00	499.25		499.25	0.000000	0.09	1409.11	201.56	0.01
Reach 1	2118	7Q2	0.30	490.00	497.25		497.25	0.000000	0.00	1011.41	194.91	0.00
Reach 1	2118	AprilQ2-20	47.00	490.00	498.57		498.57	0.000000	0.04	1272.83	199.29	0.00
Reach 1	2118	NovQ2-20	13.00	490.00	497.85		497.85	0.000000	0.01	1129.81	197.26	0.00
Reach 1	1879	2-yr	87.30	489.00	498.95		498.95	0.000000	0.08	1061.40	144.36	0.01
Reach 1	1879	5-yr	141.00	489.00	499.36		499.36	0.000000	0.13	1121.05	145.31	0.01
Reach 1	1879 1879	10-yr	183.00 247.00	489.00 489.00	499.64 500.02		499.64	0.000001	0.16 0.21		145.96 146.83	0.01
Reach 1	1879	25-yr 50-yr	303.00	489.00	500.02		500.02 500.30	0.000001 0.000001	0.21	1216.89 1257.27	146.83	0.01
Reach 1	1879	100-yr	364.00	489.00	500.53		500.53	0.000001	0.29	1291.97	148.00	0.02
Reach 1	1879	500-yr	535.00	489.00	500.96		500.97	0.000002	0.41	1356.41	148.87	0.02
Reach 1	1879	Halloween2019	125.30	489.00	499.25		499.25	0.000000	0.12	1104.90	145.06	0.01
Reach 1	1879	7Q2	0.30	489.00	497.25		497.25	0.000000	0.00	820.98	129.49	0.00
Reach 1	1879	AprilQ2-20	47.00	489.00	498.57		498.57	0.000000	0.05	1006.79	143.39	0.00
Reach 1	1879	NovQ2-20	13.00	489.00	497.85		497.85	0.000000	0.01	904.25	140.59	0.00
Reach 1	1715	2-yr	87.30	488.74	498.95		498.95	0.000000	0.12	736.67	100.83	0.01
Reach 1	1715	5-yr	141.00	488.74	499.36		499.36	0.000001	0.18	778.27	101.32	0.01
Reach 1	1715 1715	10-yr	183.00 247.00	488.74 488.74	499.64 500.02		499.64 500.02	0.000001 0.000002	0.23	806.44 844.95	101.65 102.09	0.01
Reach 1	1715	25-yr 50-yr	303.00	488.74	500.02		500.02	0.000002	0.29	872.97	102.09	0.02
Reach 1	1715	100-yr	364.00	488.74	500.53		500.53	0.000003	0.33	897.01	102.42	0.02
Reach 1	1715	500-yr	535.00	488.74	500.96		500.97	0.000007	0.57	941.53	103.20	0.03
Reach 1	1715	Halloween2019	125.30	488.74	499.25		499.25	0.000001	0.16	767.02	101.19	0.01
Reach 1	1715	7Q2	0.30	488.74	497.25		497.25	0.000000	0.00	567.00	98.07	0.00
Reach 1	1715	AprilQ2-20	47.00	488.74	498.57		498.57	0.000000	0.07	698.50	100.38	0.00
Reach 1	1715	NovQ2-20	13.00	488.74	497.85		497.85	0.000000	0.02	626.49	99.19	0.00
		_										
Reach 1	1597	2-yr	87.30	490.00	498.95	490.65	498.95	0.000001	0.13	681.55	108.17	0.01
Reach 1	1597 1597	5-yr	141.00 183.00	490.00 490.00	499.36 499.64	490.86 491.00	499.36 499.64	0.000001 0.000002	0.20 0.25		109.80 111.00	0.01
Reach 1	1597	10-yr 25-yr	183.00 247.00	490.00	499.64 500.02	491.00 491.18	499.64 500.02	0.000002	0.25		111.00	0.02
Reach 1	1597	50-yr	303.00	490.00	500.02	491.16	500.02	0.000003	0.32		113.82	0.02
Reach 1	1597	100-yr	364.00	490.00	500.53	491.46	500.53	0.000005	0.45		114.82	0.03
Reach 1	1597	500-yr	535.00	490.00	500.96	491.82	500.96	0.000009	0.63	907.20	117.64	0.04
Reach 1	1597	Halloween2019	125.30	490.00	499.25	490.80	499.25	0.000001	0.18		109.36	0.01
Reach 1	1597	7Q2	0.30	490.00	497.25	490.02	497.25	0.000000	0.00		97.43	0.00
Reach 1	1597	AprilQ2-20	47.00	490.00	498.57	490.45	498.57	0.000000	0.07	640.83	106.49	0.01
Reach 1	1597	NovQ2-20	13.00	490.00	497.85	490.20	497.85	0.000000	0.02	565.45	102.27	0.00
Reach 1	1577 TroutBrookDam		Inl Struct									
Peach 1	1560	2.10	87.30	400.00	487.45		407 45	0.000060	0.71	400 50	29.51	0.06
Reach 1 Reach 1	1569 1569	2-yr 5-yr	87.30 141.00	480.62 480.62	487.45 487.87		487.45 487.89	0.000063 0.000124	1.03	123.53 136.25	29.51 30.58	0.06
Reach 1	1569	10-yr	183.00	480.62	487.87		487.89	0.000124	1.03	136.25	30.58	0.10
Reach 1	1569	25-yr	247.00	480.62	488.15		488.17	0.000177	1.26	156.83	38.33	0.10
Reach 1	1569	50-yr	303.00	480.62	488.79		488.84	0.000322	1.83		49.33	0.14
Reach 1	1569	100-yr	364.00	480.62	489.07		489.13	0.000389	2.08		57.27	0.16
Reach 1	1569	500-yr	535.00	480.62	489.71		489.82	0.000564	2.70		76.19	0.19
Reach 1	1569	Halloween2019	125.30	480.62	487.75		487.77	0.000106	0.94	132.76	30.29	0.08
Reach 1	1569	7Q2	0.30	480.62	486.03		486.03	0.000000	0.00	84.23	25.91	0.00
Reach 1	1569	AprilQ2-20	47.00	480.62	487.05		487.06	0.000024	0.42		28.51	0.04
Reach 1	1569	NovQ2-20	13.00	480.62	486.55		486.55	0.000003	0.13	98.06	27.23	0.01
		-										
Reach 1	1538	2-yr	87.30	485.93	487.16		487.42	0.016529	4.14	21.11	25.68	0.80
Reach 1	1538	5-yr	141.00	485.93	487.52 487.77		487.84	0.013419	4.55 4.79		33.05 37.60	0.76
Reach 1	1538 1538	10-yr 25-yr	183.00 247.00	485.93 485.93	487.77		488.12 488.49	0.011919 0.010555	5.07	40.46 54.06	44.29	0.74 0.71
. LOUGHT I	1.330	ZU yı	241.00	400.93	400.10		400.49	0.010005	5.07	34.00	44.29	0.71

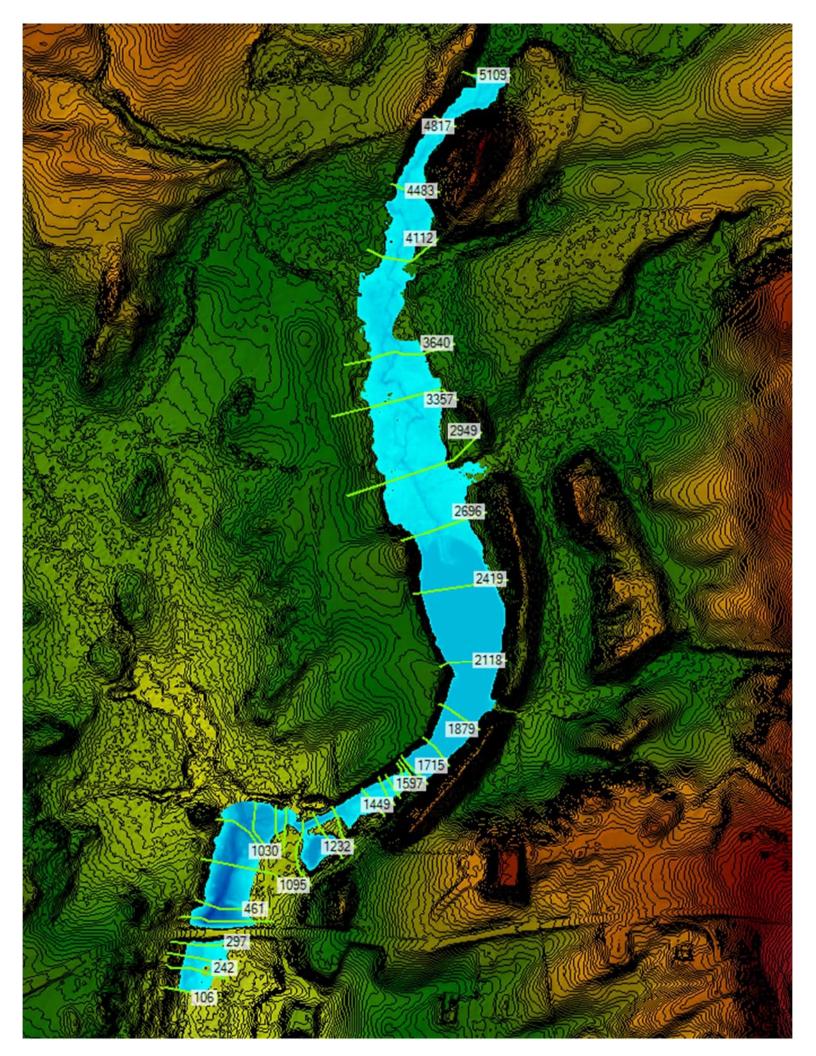
HEC-RAS Pla	an: ExistingConditions_rev_wS	Survey River: River 1	Reach: Reach 1	(Continued)								
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
Decel 4	4500	50	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	0.70
Reach 1	1538 1538	50-yr 100-yr	303.00 364.00	485.93 485.93	488.35 488.61		488.78 489.06	0.009724 0.008751	5.31 5.51	65.45 77.81	47.17 48.40	0.70
Reach 1	1538	500-yr	535.00	485.93	489.16		489.73	0.008206	6.26	107.28	57.22	0.68
Reach 1	1538	Halloween2019	125.30	485.93	487.42		487.73	0.014201	4.45	28.42	31.24	0.77
Reach 1	1538	7Q2	0.30	485.93	486.02	486.00	486.03	0.015759	0.66	0.45	8.48	0.50
Reach 1	1538	AprilQ2-20	47.00	485.93	486.84		487.03	0.020461	3.55	13.23	23.85	0.84
Reach 1	1538	NovQ2-20	13.00	485.93	486.44		486.54	0.016572	2.50	5.20	13.62	0.71
Reach 1	1482	2-yr	87.30	485.05	486.67		486.84	0.006617	3.29	26.56	23.40	0.54
Reach 1	1482	5-yr	141.00	485.05	487.11		487.34	0.005904	3.81	37.57	26.28	0.54
Reach 1	1482	10-yr	183.00	485.05	487.35		487.64	0.006136	4.28	44.15	28.02	0.56
Reach 1	1482	25-yr	247.00	485.05	487.66	487.04	488.03	0.006571	4.91	55.65	50.52	0.59
Reach 1	1482	50-yr	303.00	485.05	487.73	487.27	488.25	0.008818	5.82	59.79	66.07	0.69
Reach 1	1482	100-yr	364.00	485.05	487.84	487.52	488.51	0.010568	6.59	67.83	73.44	0.77
Reach 1	1482 1482	500-yr Halloween2019	535.00 125.30	485.05 485.05	488.23 487.00	488.23	489.14 487.21	0.012352 0.005958	7.90 3.65	97.87 34.70	78.37 25.49	0.85 0.53
Reach 1	1482	7Q2	0.30	485.05	485.19		485.20	0.014061	0.76	0.40	5.57	0.50
Reach 1	1482	AprilQ2-20	47.00	485.05	486.19		486.32	0.008272	2.90	16.21	20.14	0.57
Reach 1	1482	NovQ2-20	13.00	485.05	485.63		485.70	0.013438	2.18	5.95	16.41	0.64
Reach 1	1449	2-yr	87.30	484.43	486.35	400.04	486.59	0.008225	3.94	22.70	21.53	0.61
Reach 1	1449 1449	5-yr 10-yr	141.00 183.00	484.43 484.43	486.76 486.91	486.34 486.63	487.10 487.37	0.008176 0.010083	4.72 5.54	34.41 40.72	38.10 48.50	0.64 0.72
Reach 1	1449	25-yr	247.00	484.43	487.09	487.09	487.72	0.010663	6.58	50.63	62.41	0.72
Reach 1	1449	50-yr	303.00	484.43	487.40	487.40	487.94	0.009737	6.37	74.38	78.63	0.73
Reach 1	1449	100-yr	364.00	484.43	487.57	487.57	488.14	0.009910	6.73	87.78	80.11	0.75
Reach 1	1449	500-yr	535.00	484.43	488.29	487.93	488.71	0.006182	6.28	147.10	85.64	0.62
Reach 1	1449	Halloween2019	125.30	484.43	486.66		486.97	0.007988	4.48	30.97	32.76	0.62
Reach 1	1449 1449	7Q2	0.30 47.00	484.43 484.43	484.57 485.84		484.59 486.02	0.026786 0.009887	1.04 3.41	0.29	4.02 15.13	0.69
Reach 1	1449	AprilQ2-20 NovQ2-20	13.00	484.43 484.43	485.84 485.13		486.02 485.24	0.009887	2.70	13.77 4.81	15.13	0.63 0.70
. 1040111		1.0.42.20	15.50	101.10	400.13		100.24	0.014007	2.70	7.01	10.25	5.70
Reach 1	1372	2-yr	87.30	483.75	485.35		485.67	0.018350	4.54	19.27	15.88	0.70
Reach 1	1372	5-yr	141.00	483.75	485.92	485.48	486.28	0.014446	4.90	34.75	53.12	0.64
Reach 1	1372	10-yr	183.00	483.75	486.28	486.03	486.55	0.009693	4.53	64.14	98.35	0.54
Reach 1	1372	25-yr	247.00	483.75	486.76	486.39	486.90	0.005123	3.75	111.27	100.83	0.40
Reach 1	1372 1372	50-yr 100-yr	303.00 364.00	483.75 483.75	487.09 487.43	486.49 486.63	487.20 487.53	0.003802 0.002955	3.49	144.92 180.24	102.56 104.06	0.35 0.32
Reach 1	1372	500-yr	535.00	483.75	488.28	400.00	488.37	0.002333	3.10	270.44	107.42	0.32
Reach 1	1372	Halloween2019	125.30	483.75	485.77	485.35	486.13	0.015848	4.85	28.28	33.72	0.66
Reach 1	1372	7Q2	0.30	483.75	483.94	483.86	483.94	0.004046	0.49	0.61	6.49	0.28
Reach 1	1372	AprilQ2-20	47.00	483.75	484.99		485.16	0.012814	3.36	13.99	14.11	0.59
Reach 1	1372	NovQ2-20	13.00	483.75	484.53	484.25	484.57	0.005450	1.69	7.71	13.38	0.39
Reach 1	1232	2-yr	87.30	482.31	484.66		484.80	0.002838	3.02	31.62	21.36	0.38
Reach 1	1232	5-yr	141.00	482.31	485.14		485.36	0.002030	3.86	42.52	24.28	0.44
Reach 1	1232	10-yr	183.00	482.31	485.44		485.73	0.003887	4.41	50.25	26.48	0.47
Reach 1	1232	25-yr	247.00	482.31	485.81		486.21	0.004489	5.16	60.39	27.76	0.51
Reach 1	1232	50-yr	303.00	482.31	486.04		486.54	0.005234	5.84	66.89	28.54	0.56
Reach 1	1232	100-yr	364.00	482.31	486.32		486.92	0.005667	6.41	75.00	29.47	0.59
Reach 1	1232 1232	500-yr Halloween2019	535.00 125.30	482.31 482.31	486.93 485.01		487.82 485.21	0.007048 0.003309	7.92 3.63	93.44 39.50	31.67 23.55	0.68
Reach 1	1232	7Q2	0.30	482.31	482.41	482.41	482.44	0.003303	1.40	0.21	4.28	1.10
Reach 1	1232	AprilQ2-20	47.00	482.31	483.71		483.87	0.006984	3.15	14.90	13.98	0.54
Reach 1	1232	NovQ2-20	13.00	482.31	482.82	482.82	483.00	0.033957	3.43	3.79	10.54	1.01
Reach 1	1152	2-yr	87.30	480.90	484.67	482.26	484.71	0.000340	1.47	69.79	88.27	0.14
Reach 1	1152	5-yr	141.00	480.90	485.16	482.68	485.22	0.000545	2.04	83.43	92.65	0.19
Reach 1	1152 1152	10-yr 25-yr	183.00 247.00	480.90 480.90	485.47 485.86	482.93 483.25	485.56 485.99	0.000695 0.000919	2.43 2.96		95.28 98.58	0.21 0.25
Reach 1	1152	50-yr	303.00	480.90	486.11	483.54	486.27	0.000313	3.43		100.65	0.28
Reach 1	1152	100-yr	364.00	480.90	486.40	483.80	486.61	0.001331	3.85	122.82	103.19	0.30
Reach 1	1152	500-yr	535.00	480.90	487.05	484.48	487.40	0.001852	4.93	146.66	109.30	0.37
Reach 1	1152	Halloween2019	125.30	480.90	485.03	482.58	485.08	0.000486	1.88	79.72	91.38	0.17
Reach 1	1152	7Q2	0.30	480.90	481.37	481.00	481.37	0.000022	0.08		43.53	0.03
Reach 1	1152 1152	AprilQ2-20 NovQ2-20	47.00 13.00	480.90 480.90	483.74 482.44	481.85 481.40	483.76 482.45	0.000318 0.000367	1.13 0.72		79.93 62.62	0.13 0.12
. TOUGHT	. 102	110102-20	13.00	400.90	40∠.44	401.40	402.40	0.000367	0.72	17.99	02.02	0.12
Reach 1	1095	2-yr	87.30	481.15	484.66	482.53	484.69	0.000344	1.39	68.06	27.08	0.14
Reach 1	1095	5-yr	141.00	481.15	485.13	482.84	485.19	0.000536	1.91	81.47	29.20	0.18
Reach 1	1095	10-yr	183.00	481.15	485.44	483.05	485.52	0.000671	2.27	90.64	30.73	0.21
Reach 1	1095	25-yr	247.00	481.15	485.82	483.35	485.93	0.000874	2.76		32.56	0.24
Reach 1	1095	50-yr	303.00	481.15	486.05	483.58	486.21	0.001082 0.001248	3.19		33.64	0.27
Reach 1	1095 1095	100-yr 500-yr	364.00 535.00	481.15 481.15	486.34 486.98	483.83 484.43	486.53 487.28	0.001248	3.58 4.56	120.27 148.10	35.17 59.76	0.29 0.35
Reach 1	1095	Halloween2019	125.30	481.15	485.01	482.76	485.06	0.001713	1.77	77.82	28.56	0.33
Reach 1	1095	7Q2	0.30	481.15	481.32	481.32	481.36	0.054492	1.67	0.18	2.10	1.01
Reach 1	1095	AprilQ2-20	47.00	481.15	483.72	482.23	483.74	0.000370	1.11	43.85	24.59	0.14
Reach 1	1095	NovQ2-20	13.00	481.15	482.40	481.81	482.41	0.000982	0.91	14.22	20.05	0.19
Boook 4	1051 Appr Dd		0.4									
Reach 1	1051 AccessRd		Culvert									
Reach 1	1030	2-yr	87.30	480.52	481.89	481.73	482.19	0.014658	4.40	19.88	24.27	0.78
Reach 1	1030	5-yr	141.00	480.52	482.13	482.07	482.63	0.019043	5.70		24.90	0.92
Reach 1	1030	10-yr	183.00	480.52	482.29	482.29	482.95	0.021526	6.51	28.26	29.14	1.00
Reach 1	1030	25-yr	247.00	480.52	482.60	482.60	483.38	0.019704	7.08		40.82	0.98
Reach 1	1030	50-yr	303.00	480.52	482.84	482.84	483.72	0.018604	7.54	41.91	52.43	0.98

HEC-RAS Pla	n: ExistingConditions_rev_ws											
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
5 14	4000	400	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	0.00
Reach 1	1030	100-yr 500-yr	364.00 535.00	480.52 480.52	483.07 485.04	483.07 483.66	484.06 485.33	0.017922 0.002736	8.01 4.87	47.97 197.40	56.21 77.45	0.98
Reach 1	1030	Halloween2019	125.30	480.52	485.04	483.66	485.33	0.002736	5.39	23.35	24.71	0.43
Reach 1	1030	7Q2	0.30	480.52	480.60	480.60	480.61	0.054082	0.99	0.30	7.72	0.89
Reach 1	1030	AprilQ2-20	47.00	480.52	481.56	481.39	481.75	0.013319	3.49	13.46	18.08	0.71
Reach 1	1030	NovQ2-20	13.00	480.52	480.98	480.96	481.12	0.029804	3.05	4.26	12.92	0.94
Reach 1	991	2-yr	87.30	479.40	481.22	481.22	481.57	0.016249	4.99	27.50	58.60	0.83
Reach 1	991	5-yr	141.00	479.40	481.51	481.51	481.91	0.015546	5.67	45.81	65.99	0.84
Reach 1	991	10-yr	183.00	479.40	481.63	481.68	482.13	0.018004	6.45	53.96	66.84	0.91
Reach 1	991	25-yr	247.00	479.40	481.69	481.88	482.48	0.027603	8.19	58.01	67.22	1.14
Reach 1	991	50-yr	303.00	479.40	481.78	482.05	482.75	0.032869	9.26	63.85	67.76	1.26
Reach 1	991 991	100-yr	364.00	479.40 479.40	481.86 485.06	482.21	483.04 485.17	0.038056 0.001241	10.30	69.72 329.99	68.30 98.86	1.36
Reach 1	991	500-yr Halloween2019	535.00 125.30	479.40	481.44	481.44	481.82	0.001241	5.44	41.49	65.51	0.29 0.82
Reach 1	991	7Q2	0.30	479.40	479.56	479.51	479.57	0.009308	0.73	0.41	4.43	0.62
Reach 1	991	AprilQ2-20	47.00	479.40	480.88	480.72	481.14	0.016886	4.15	12.87	23.83	0.80
Reach 1	991	NovQ2-20	13.00	479.40	480.13		480.28	0.016328	3.11	4.18	7.53	0.74
Reach 1	886	2-yr	87.30	477.58	479.12	479.22	479.57	0.022647	5.67	23.78	54.81	0.96
Reach 1	886	5-yr	141.00	477.58	479.62	479.50	479.88	0.010593	4.92	60.41	96.47	0.70
Reach 1	886	10-yr	183.00	477.58	479.84	479.66	480.10		5.08	84.23	117.92	0.67
Reach 1	886	25-yr	247.00	477.58	480.44	479.91	480.57	0.003953	3.99	162.89	147.19	0.46
Reach 1	886	50-yr	303.00	477.58	481.35	480.06	481.40	0.001129	2.65	304.60	160.63	0.26
Reach 1	886	100-yr	364.00	477.58	482.46	480.19	482.49		1.96	489.24	174.46	0.16
Reach 1	886	500-yr	535.00	477.58	485.10	470.40	485.11	0.000116	1.41	980.66	195.54	0.09
Reach 1	886 886	Halloween2019 7Q2	125.30 0.30	477.58 477.58	479.57 477.74	479.42 477.74	479.81 477.77	0.009557 0.041971	4.59 1.29	56.44 0.23	93.06 3.29	0.66 0.85
Reach 1	886	AprilQ2-20	47.00	477.58 477.58	477.74	477.74	477.77	0.041971	4.82	10.36	20.01	0.85
Reach 1	886	NovQ2-20	13.00	477.58	478.78	4/0./4	479.14		3.03	4.29	9.39	0.91
. 100011 1		1.0.32 20	13.00	711.50	770.20		770.40	0.013024	3.03	4.29	3.38	0.79
Reach 1	816	2-yr	119.00	476.54	478.88	478.36	479.03	0.003962	3.52	67.58	86.03	0.45
Reach 1	816	5-yr	191.00	476.54	479.28	478.74	479.45	0.004083	4.06	106.34	106.71	0.47
Reach 1	816	10-yr	248.00	476.54	479.40		479.63	0.005235	4.76	119.76	107.70	0.54
Reach 1	816	25-yr	332.00	476.54	480.26		480.38	0.002144	3.73	219.08	125.52	0.36
Reach 1	816	50-yr	405.00	476.54	481.27		481.33	0.000892	2.87	354.43	141.43	0.24
Reach 1	816	100-yr	485.00	476.54	482.42		482.45	0.000427	2.33	534.29	167.37	0.18
Reach 1	816	500-yr	707.00	476.54	485.09		485.10	0.000152	1.81	1024.69	197.88	0.11
Reach 1	816	Halloween2019	181.80	476.54	479.23	478.70	479.40	0.004108	4.01	101.46	106.36	0.47
Reach 1	816	7Q2	0.40	476.54	476.77	476.68	476.77	0.004477	0.58	0.69	6.06	0.30
Reach 1	816	AprilQ2-20	71.00	476.54	478.46	477.97	478.59	0.004227	3.08	36.85	58.37	0.45
Reach 1	816	NovQ2-20	19.00	476.54	477.51		477.61	0.008114	2.52	7.54	11.20	0.54
Doodh 1	630	2 1/2	110.00	475.24	476.00	476.99	477.57	0.022052	6.10	10.46	1714	1.01
Reach 1	639 639	2-yr 5-yr	119.00 191.00	475.34 475.34	476.99 477.53	476.99	477.57	0.023853 0.015808	6.12 6.37	19.46 37.69	17.14 44.03	1.01 0.87
Reach 1	639	10-yr	248.00	475.34	477.55	477.55	478.81	0.004099	4.46	83.92	47.09	0.48
Reach 1	639	25-yr	332.00	475.34	479.92		480.07	0.004655	3.51	166.84	68.61	0.31
Reach 1	639	50-yr	405.00	475.34	481.08		481.18	0.000776	3.02	262.04	102.23	0.23
Reach 1	639	100-yr	485.00	475.34	482.31		482.37	0.000446	2.64	396.42	119.29	0.18
Reach 1	639	500-yr	707.00	475.34	485.03		485.07	0.000197	2.22	816.24	180.76	0.13
Reach 1	639	Halloween2019	181.80	475.34	477.48	477.48	478.07	0.016007	6.29	35.61	43.92	0.87
Reach 1	639	7Q2	0.40	475.34	475.55	475.48	475.56	0.012101	0.71	0.56	7.68	0.47
Reach 1	639	AprilQ2-20	71.00	475.34	476.59	476.59	477.04	0.025596	5.40	13.14	14.54	1.00
Reach 1	639	NovQ2-20	19.00	475.34	476.25	475.98	476.33	0.006534	2.22	8.55	13.02	0.48
	404		440.00	470.00	470.47	474.70	470.00	0.004040	0.40	0.4.00		0.07
Reach 1	461	2-yr	119.00	473.36	476.17	474.78	476.26	0.001340	2.40	64.60	57.14	0.27
Reach 1	461 461	5-yr 10-yr	191.00 248.00	473.36 473.36	477.55 478.54	475.19	477.61 478.59	0.000578 0.000378	2.13 2.02	158.89 246.91	80.19 96.58	0.19 0.16
Reach 1	461	25-yr	332.00	473.36			479.95		1.87	387.93	109.35	0.18
Reach 1	461	50-yr	405.00	473.36			481.10		1.80	524.43	124.13	0.13
Reach 1	461	100-yr	485.00	473.36	482.29		482.32		1.73	684.89	138.61	0.10
Reach 1	461	500-yr	707.00	473.36			485.04		1.70	1104.54	171.17	0.09
Reach 1	461	Halloween2019	181.80	473.36	477.39	475.14	477.45		2.16	145.80	77.10	0.20
Reach 1	461	7Q2	0.40	473.36	473.46		473.47		0.72	0.56	7.22	0.45
Reach 1	461	AprilQ2-20	71.00	473.36		474.43	475.23		2.65	26.96	21.05	0.40
Reach 1	461	NovQ2-20	19.00	473.36	473.89	473.89	474.09	0.032717	3.56	5.33	13.73	1.01
Decel 1	404	0		171.5-	470.4-	470.00	470 :-	0.00005-		0		
Reach 1	401	2-yr	119.00	471.96	476.12	473.86	476.19	0.000855	2.14	64.09	44.36	0.21
Reach 1 Reach 1	401	5-yr	191.00 248.00	471.96 471.96	477.54	474.56 475.02	477.58 478.57		1.79	121.13	109.57	0.15 0.12
Reach 1	401	10-yr 25-yr	332.00	471.96 471.96	478.53 479.90	475.02 475.61	478.57 479.94	0.000248 0.000169	1.68 1.60	161.55 217.41	130.84 170.73	0.12
Reach 1	401	50-yr	405.00	471.96	479.90	475.61	481.09		1.56	264.65	190.99	0.11
Reach 1	401	100-yr	485.00	471.96	482.28	476.29	482.32	0.000131	1.54	314.43	210.13	0.10
Reach 1	401	500-yr	707.00	471.96	485.03	476.85	485.04		0.53	1600.57	254.75	0.03
Reach 1	401	Halloween2019	181.80	471.96		474.48	477.41	0.000399	1.82	114.28	97.15	0.15
Reach 1	401	7Q2	0.40	471.96	472.08	472.08	472.11	0.063688	1.41	0.28	4.82	1.03
Reach 1	401	AprilQ2-20	71.00	471.96	475.00	473.35	475.08		2.25	32.09	19.09	0.27
Reach 1	401	NovQ2-20	19.00	471.96	473.00	472.65	473.08	0.005664	2.36	8.05	9.63	0.45
Reach 1	344 ReservoirRd		Culvert									
Reach 1	297	2-yr	119.00	471.50	473.73	472.65	473.87	0.002374	3.05	38.99	49.73	0.36
Reach 1	297	5-yr	191.00	471.50	474.12	473.07	474.39	0.003527	4.15	45.99	51.84	0.46
Reach 1	297	10-yr	248.00	471.50	474.40	473.36	474.77		4.88	50.86	58.82	0.51
Reach 1	297 297	25-yr	332.00 405.00	471.50 471.50	474.73 474.98	473.75 474.07	475.26 475.66		5.85 6.62	56.79 61.17	73.58 94.20	0.58 0.63
Reach 1	297	50-yr 100-yr	405.00 485.00	471.50 471.50		474.07	475.66		7.44	61.17 65.18	121.53	0.63
rveacht I	1201	100-yi	400.00	47 1.30	4/0.20	414.38	4/0.00	0.007110	1.44	00.18	121.03	0.69

HEC-RAS Plan: ExistingConditions_rev_wSurvey River: River 1 Reach: Reach 1 (Continued)

	: ExistingConditions_rev_wSurv	r'										
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)	
		500-yr	707.00	471.50	475.64	475.20	477.10	0.010382	9.69	72.95	153.88	0.84
	297	Halloween2019	181.80	471.50	474.07	473.02	474.32	0.003416	4.03	45.08	51.57	0.45
	297	7Q2	0.40	471.50	471.59	471.54	471.59	0.002772	0.36	1.12	17.66	0.23
	297	AprilQ2-20	71.00	471.50	473.41	472.33	473.48	0.001431	2.13	33.29	46.00	0.27
Reach 1	297	NovQ2-20	19.00	471.50	472.53	471.87	472.55	0.000846	1.08	17.67	34.82	0.19
		2-yr	119.00	471.10	473.44		473.63	0.010306	3.58	43.11	57.17	0.64
	242	5-yr	191.00	471.10	473.90		474.09	0.006748	3.76	71.55	65.08	0.56
Reach 1	242	10-yr	248.00	471.10	474.21		474.42	0.005571	3.90	92.51	68.46	0.52
Reach 1	242	25-yr	332.00	471.10	474.60		474.83	0.004954	4.20	121.21	87.11	0.51
Reach 1	242	50-yr	405.00	471.10	474.89		475.15	0.004704	4.47	149.97	105.20	0.51
Reach 1	242	100-yr	485.00	471.10	475.20		475.47	0.004295	4.62	185.43	126.05	0.49
Reach 1	242	500-yr	707.00	471.10	475.90		476.20	0.003683	4.99	293.47	168.41	0.48
Reach 1	242	Halloween2019	181.80	471.10	473.84		474.03	0.007152	3.75	67.62	64.41	0.57
Reach 1	242	7Q2	0.40	471.10	471.27		471.29	0.015752	1.03	0.39	3.66	0.56
Reach 1	242	AprilQ2-20	71.00	471.10	473.12		473.27	0.014465	3.24	26.63	46.76	0.71
Reach 1	242	NovQ2-20	19.00	471.10	472.02	471.99	472.33	0.026148	4.44	4.27	6.15	0.94
Reach 1	194	2-yr	119.00	470.25	472.73	472.49	473.10	0.011086	5.07	33.93	38.78	0.71
Reach 1	194	5-yr	191.00	470.25	473.23	472.96	473.68	0.010097	5.79	55.53	50.29	0.71
Reach 1	194	10-yr	248.00	470.25	473.54	473.16	474.04	0.009879	6.28	72.62	58.98	0.71
Reach 1	194	25-yr	332.00	470.25	473.95		474.49	0.009074	6.69	98.95	66.17	0.70
Reach 1	194	50-yr	405.00	470.25	474.26		474.83	0.008729	7.03	119.70	70.06	0.70
Reach 1	194	100-yr	485.00	470.25	474.55		475.16	0.008555	7.39	141.70	79.98	0.70
Reach 1	194	500-yr	707.00	470.25	475.25	474.76	475.91	0.008062	8.12	211.76	132.68	0.71
Reach 1	194	Halloween2019	181.80	470.25	473.18		473.61	0.010013	5.67	52.98	47.71	0.70
Reach 1	194	7Q2	0.40	470.25	470.45	470.41	470.46	0.019046	1.03	0.39	4.28	0.60
Reach 1	194	AprilQ2-20	71.00	470.25	472.23	471.95	472.56	0.015061	4.67	17.83	24.07	0.78
Reach 1	194	NovQ2-20	19.00	470.25	471.26		471.44	0.013159	3.33	5.70	7.69	0.68
Reach 1	106	2-yr	119.00	469.38	472.22	471.38	472.42	0.005000	3.62	38.02	33.86	0.48
Reach 1	106	5-yr	191.00	469.38	472.75	471.99	473.02	0.005000	4.28	60.39	52.25	0.50
Reach 1	106	10-yr	248.00	469.38	473.07	472.30	473.38	0.005005	4.68	77.79	58.68	0.51
Reach 1	106	25-yr	332.00	469.38	473.50	472.74	473.86	0.004998	5.18	106.15	76.61	0.53
Reach 1	106	50-yr	405.00	469.38	473.81	473.03	474.21	0.004992	5.53	130.73	80.87	0.54
Reach 1	106	100-yr	485.00	469.38	474.11	473.24	474.54	0.005002	5.86	156.79	89.40	0.54
Reach 1	106	500-yr	707.00	469.38	474.81	474.01	475.32	0.005004	6.60	229.35	112.52	0.56
Reach 1	106	Halloween2019	181.80	469.38	472.69	471.88	472.96	0.005008	4.21	57.39	51.70	0.50
Reach 1	106	7Q2	0.40	469.38	469.69	469.57	469.70	0.005002	0.74	0.54	3.46	0.33
	106	AprilQ2-20	71.00	469.38	471.64	470.95	471.80	0.005004	3.19	22.33	17.98	0.47
Reach 1	106	NovQ2-20	19.00	469.38	470.66	470.29	470.73	0.005002	2.12	8.96	11.73	0.43







Appendix F Alternatives Analysis

Trout Brook Reservoir Dam Removal

Engineering Report

Franklin County Natural Resources Conservation District

SLR Project No.: 146.13528.00002

March 26, 2025

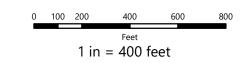


	Alternative Objectives												
ID	Description	Naturalize the river and floodplain to restore dynamic equilibrium	Improve water quality	Restore aquatic organism passage (AOP)	Restore wildlife habitat in the stream corridor	Reduce flood and erosion risks	Balance sediment removal and ecosystem benefits	Minimize future maintenance needs	Consider impacts to infrastructure	Improve site safety	Ballpark construction costs	Recommended	Notes
1	Do nothing	NO	NO	NO	NO	NO	No	NO	No	NO	\$0		Dam failing. Public safety risk and potential for long-term water quality and habitat impacts from failure.
2	Full dam removal (no sediment)	Maybe	NO	Better	Maybe	No	NO	No	No	Maybe	\$300,000 - \$400,000		Fine sediment immediately behind the dam will migrate downstream. A wall of sediment would be formed without a transition between the downstream and upstream sections. Potential for long-term water quality and habitat impacts.
3	Remove full dam and sediment adjacent to dam	Maybe	No	Better	Maybe	No	NO	No	No	Better	\$300,000 - \$400,000		Limited removal of channel material near dam. Long term release expected from river corridor. Potentials for long-term water quality and habitat impacts. Includes removal of approximately 700 CY of sediment.
4	Remove full dam and sediment in river corridor in normal pool (to RS 2696)	Better	Maybe	BEST	Better	Maybe	Better	Maybe	Maybe	Better	\$400,000 - \$500,000		Most mobile sediment removed. Long-term release expected from river corridor upstream of normal pool. Reduced long-term water quality and habitat impacts. Includes removal of approximately 3,600 CY of sediment.
5	Remove full dam and sediment in river corridor in full former impoundment (to RS 3680)	Better	Better	BEST	Better	Better	BEST	BEST	BEST	Better	\$500,000 - \$600,000	YES	Limited long-term sediment release; captures sediment most likely to move. Construction access may be complicated and excavation of material costly. Includes removal of approximately 9,600 CY of sediment.
6	Remove full dam and sediment full width in normal pool (to 2696) and river corridor width in full former impoundment (to RS 3680)	BEST	Better	BEST	Better	Better	Better	BEST	BEST	Better	\$500,000 - \$700,000		Limited long-term sediment release; captures sediment most likely to move. Construction access may be complicated and excavation of material costly. Includes removal of approximately 11,900 CY of sediment.
7	Remove full dam and all sediment in former impoundment	BEST	BEST	BEST	BEST	BEST	No	BEST	BEST	Better	\$800,000 - \$1,200,000		Obsolete dam in poor condition with many failing parts. Remove while still easy to access components in one place to naturalize corridor and restore AOP. Limited long-term sediment release; captures sediment likely to move. Construction access may be complicated and excavation of material costly. Includes removal of approximately 28,000 CY of sediment.
8	Partial dam removal (no sediment)	Maybe	NO	Better	Maybe	No	NO	No	No	Maybe	\$300,000 - \$400,000		Fine sediment immediately behind the dam will migrate downstream. A wall of sediment would be formed without a transition between the downstream and upstream sections. Potential for long-term water quality and habitat impacts. High velocities expected. May not receive dam order.
9	Replace dam and remove all sediment in former impoundment	Maybe	NO	Better	Maybe	Maybe	NO	No	Maybe	Maybe	\$1,500,000-2,000,000		Brings dam and impoundment back to full usage.



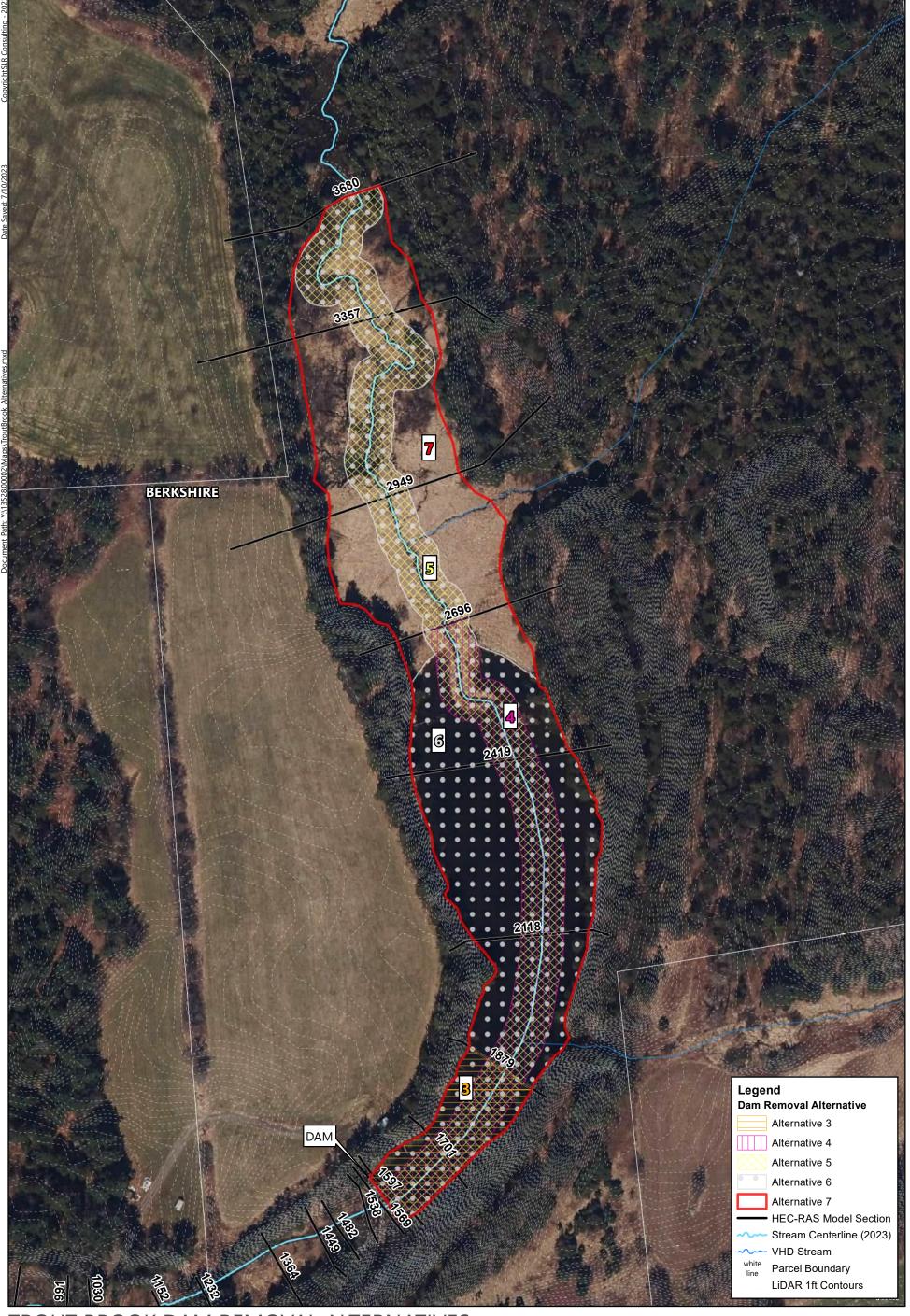
TROUT BROOK DAM REMOVAL ALTERNATIVES - LIMITS OF SEDIMENT REMOVAL

TROUT BROOK DAM REMOVAL FEASIBILITY STUDY FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT



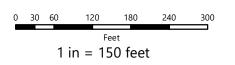


SUTH MAIN ST WATERBURY, VT 05676 802.882.8335



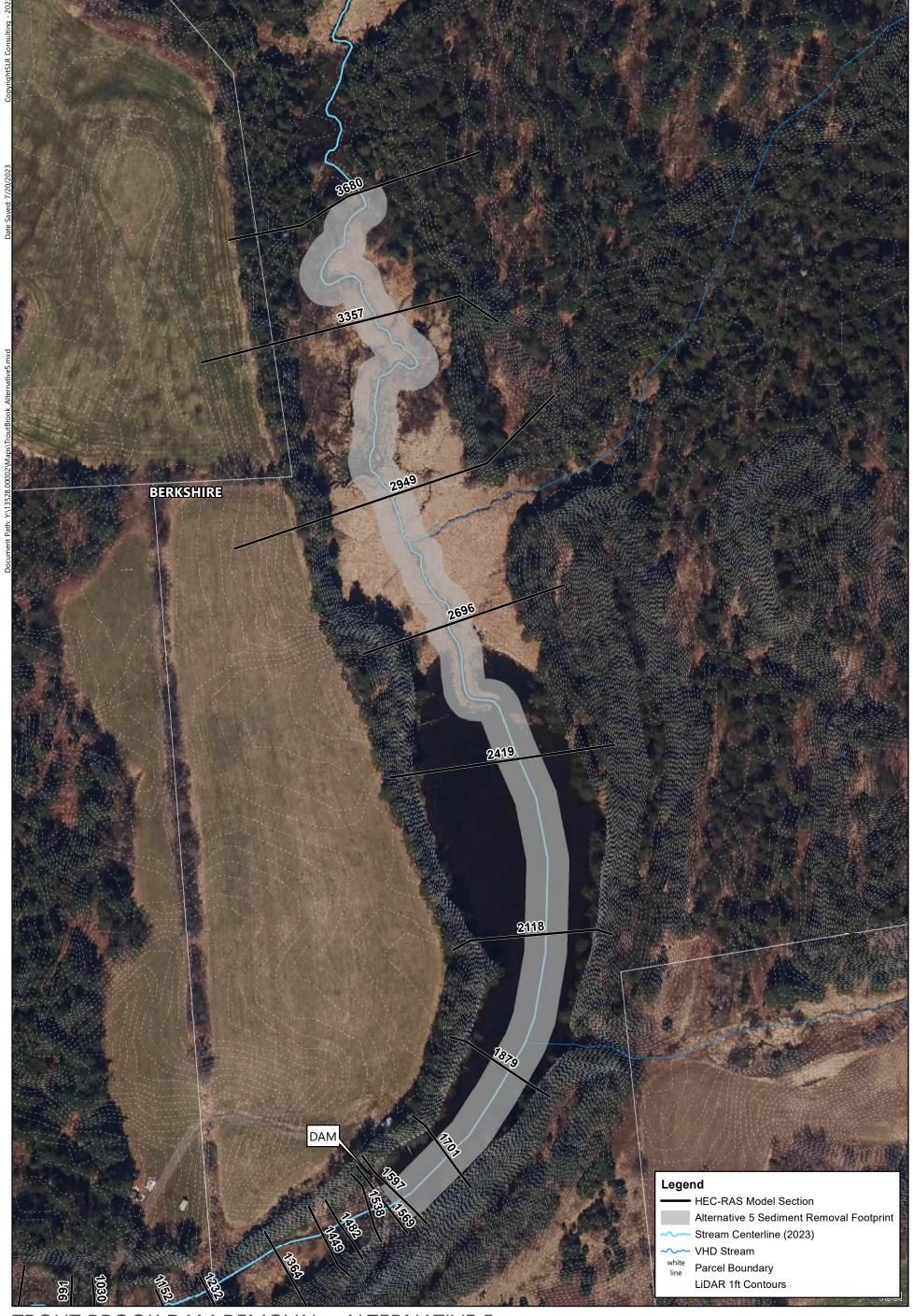
TROUT BROOK DAM REMOVAL ALTERNATIVES

TROUT BROOK DAM REMOVAL FEASIBILITY STUDY FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT



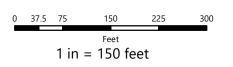


1 SOUTH MAIN ST WATERBURY, VT 05676 802.882.8335



TROUT BROOK DAM REMOVAL - ALTERNATIVE 5

TROUT BROOK DAM REMOVAL FEASIBILITY STUDY FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT





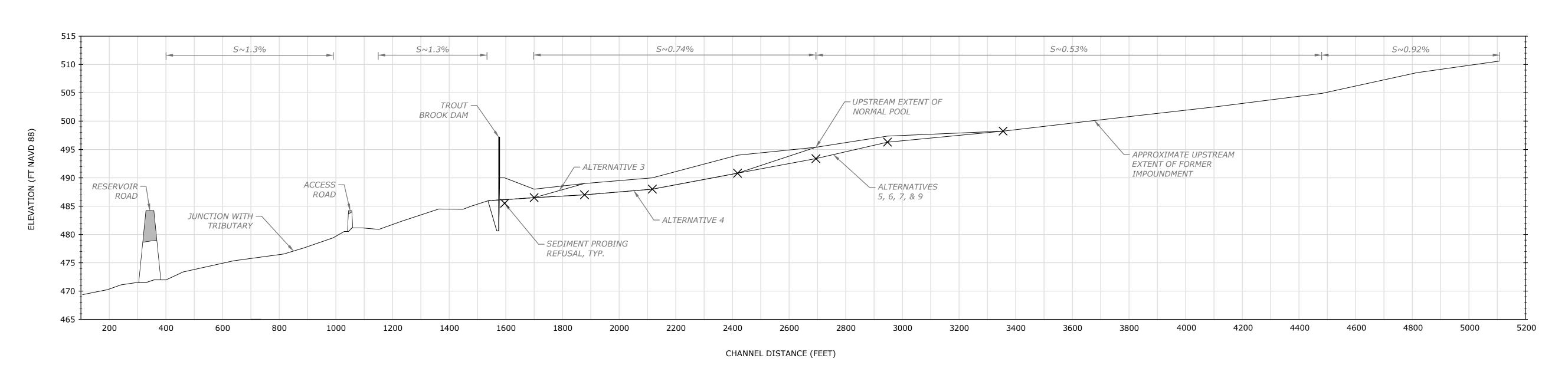
SSLR

1 SOUTH MAIN ST
WATERBURY, VT 05676
802.882.8335

Alternative		Sediment Re	emoval/Loss Volumes	(Cubic Yards)		
Description	ID	Active*	Passive	Total**	Footprint of Upstream Sediment Removal (Acres)	Notes
None	1	0	9,620	9,620	0	Not recommended as dam is in poor condition and poses a public safety risk. Potential for long-term water quality and habitat impacts.
Dam removal only	2	0	9,620	9,620	0	Near term channel incision. Long term erosion within the river corridor. Not recommended as too much sediment loss would lead to long-term water quality impacts and habitat.
Dam removal with limited sediment removal in vicinity of dam	3	701	8,919	9,620	0.7	Limited removal of channel material near dam. Long term release expected from river corridor. Potentials for long-term water quality and habitat impacts.
Dam removal with sediment removal in river corridor through normal pool	4	3,608	6,012	9,620	1.8	Long-term release expected from river corridor upstream of normal pool.
Dam removal with sediment removal in river corridor through extent of former impoundment	5	9,620	0	9,620	3.4	Limited long-term sediment release; captures sediment most likely to move. Construction access may be complicated.
Dam removal with full sediment removal in normal pool and upstream river corridor through extent of former impoundment	6	11,868	0	11,868	5.8	Limited long-term sediment release; captures sediment most likely to move. Construction access may be complicated.
Dam removal and full sediment removal	7	28,123	0	28,123	8.3	Limited long-term sediment release; captures sediment likely to move. Construction access may be complicated.
Partial dam removal and no sediment removal	8	0	9,620	9,620	0	Dam is in poor condition and poses a public safety risk. Potential for long-term water quality and habitat impacts. May be difficult to obtain dam order for remaining structure.
Dam replacement and full sediment removal	9	28,123	0	28,123	8.3	Limited long-term sediment release; captures sediment likely to move. Construction access may be complicated. Reconstruction of dam and sediment removal would be costly.

^{*}Active removal includes an estimated 10% loss downstream during construction.

** Assumes passive erosion of sediment outside of the river corridor will occur in a longer time period



TROUT BROOK CHANNEL PROFILE

SCALE: H: 1"=200', V: 1"=10'

*NOTE: PROFILE BASED ON LIDAR DATA, DECEMBER 2021 SURVEY, AND MAY/JUNE 2023 FIELD MEASUREMENTS

JCL AOM JCL

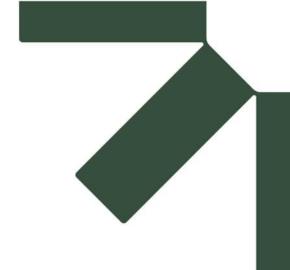
AS NOTED

JULY 20, 2023

13528.00002

1 OF 1

PRO



Appendix G Concept Design Plans

Trout Brook Reservoir Dam Removal

Engineering Report

Franklin County Natural Resources Conservation District

SLR Project No.: 146.13528.00002

March 26, 2025



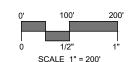
TROUT BROOK RESERVOIR DAM REMOVAL (VT ID 19.02)

RESERVOIR ROAD BERKSHIRE, VERMONT

> CONCEPT DESIGN OCTOBER 9, 2023

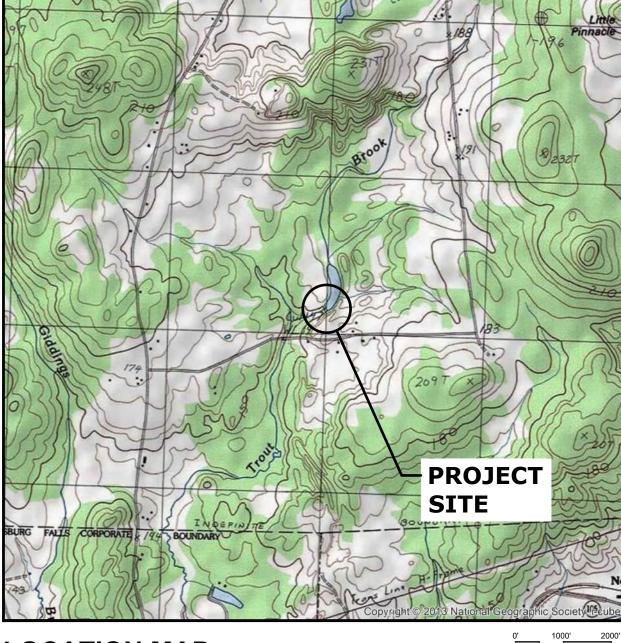


PROJECT SITE VICINITY MAP:

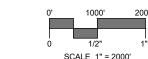


PREPARED BY:





LOCATION MAP:



PREPARED FOR:

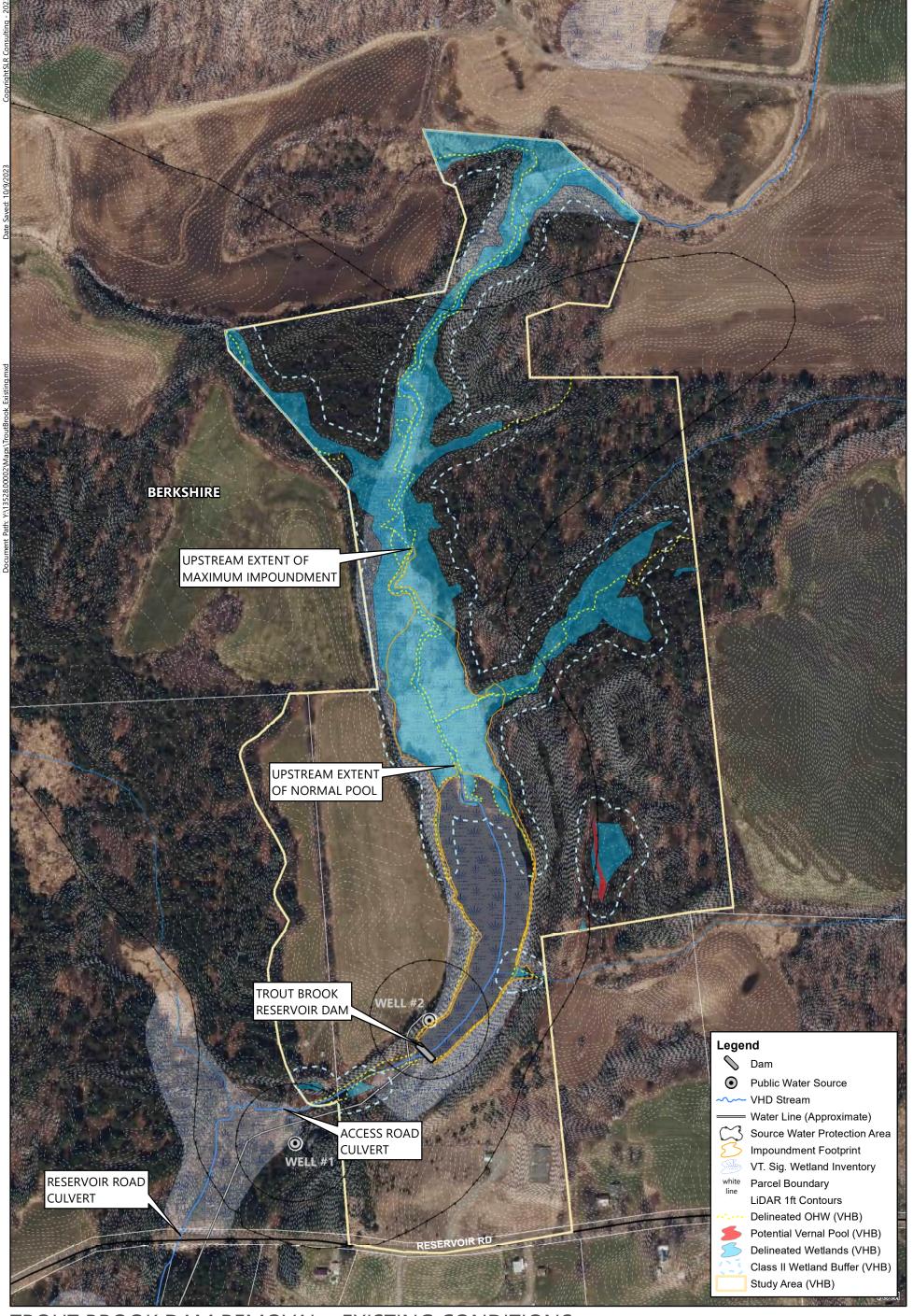
FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT 50 SOUTH MAIN STREET, SUITE B-20 SAINT ALBANS, VT 05478



LIST OF DRAWINGS

NO.	NAME	TITLE
1		TITLE SHEET
2	EX-1	SITE PLAN - EXISTING CONDITIONS
3	PR-1	SITE PLAN - PROPOSED CONDITIONS
4	PRO-1	CHANNEL PROFILE AND DAM ELEVATION
5	XS-1	TYPICAL SECTIONS
6	XS-2	TYPICAL SECTIONS
7	XS-3	TYPICAL SECTIONS
8	XS-4	TYPICAL SECTIONS





TROUT BROOK DAM REMOVAL - EXISTING CONDITIONS

TROUT BROOK DAM REMOVAL FEASIBILITY STUDY FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT

0 75 150 300 450 600

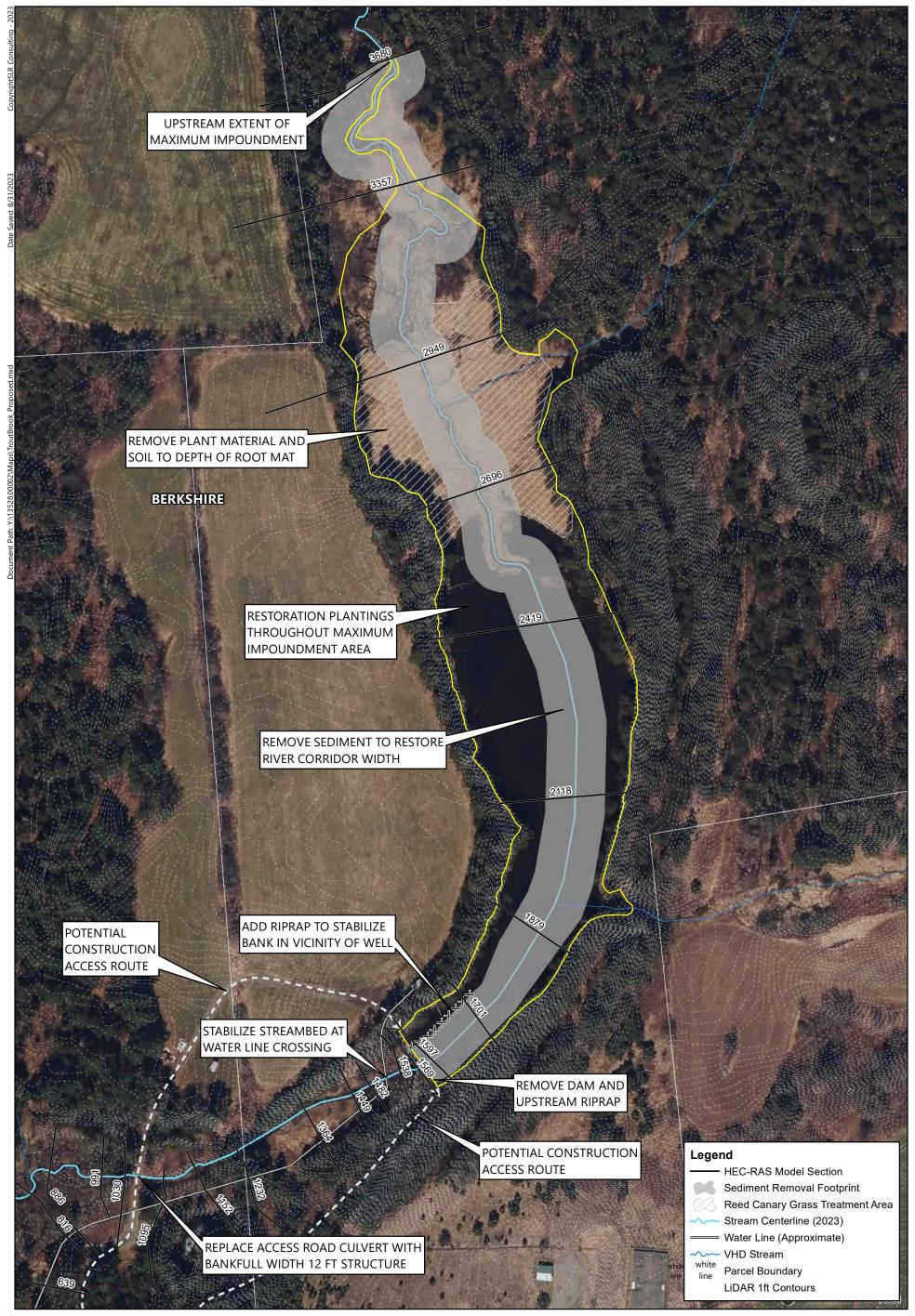
1 in = 300 feet

Wetland delineation performed by VHB.



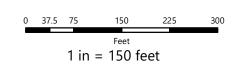
彩SLR

1 SOUTH MAIN ST WATERBURY, VT 05676 802.882.8335



TROUT BROOK DAM REMOVAL - PROPOSED CONDITIONS - 100-FOOT

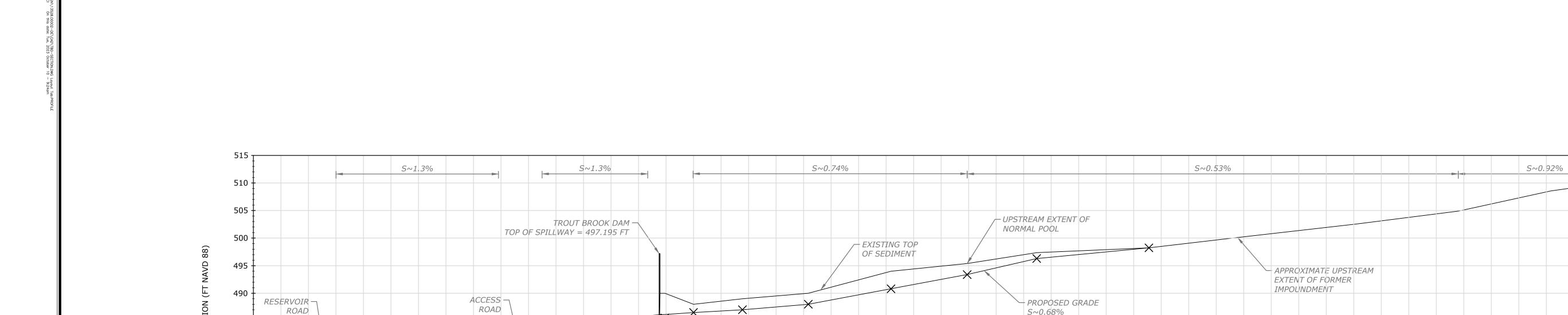
TROUT BROOK DAM REMOVAL FEASIBILITY STUDY FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT





SLR

1 SOUTH MAIN ST
WATERBURY, VT 05676
802.882.8335



- SEDIMENT PROBING REFUSAL, TYP.

TROUT BROOK CHANNEL PROFILE

S~0.68%

SCALE: H: 1"=200', V: 1"=10'

CHANNEL DISTANCE (FEET)

*NOTE: PROFILE BASED ON LIDAR DATA, DECEMBER 2021 SURVEY, AND MAY/JUNE 2023 FIELD MEASUREMENTS

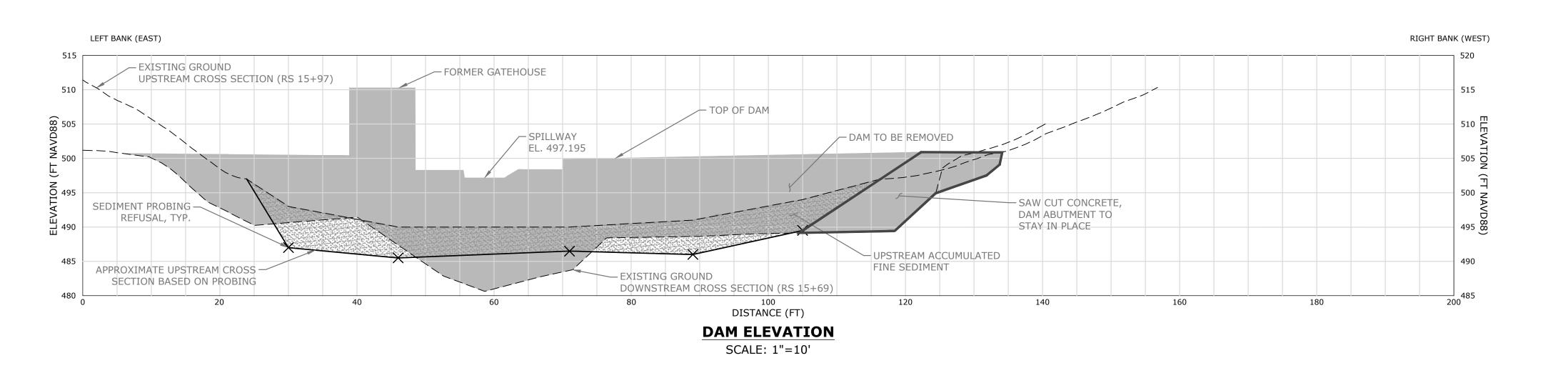
ROAD

200

475 -

JUNCTION WITH -TRIBUTARY

(SECTION VIEWED LOOKING DOWNSTREAM)

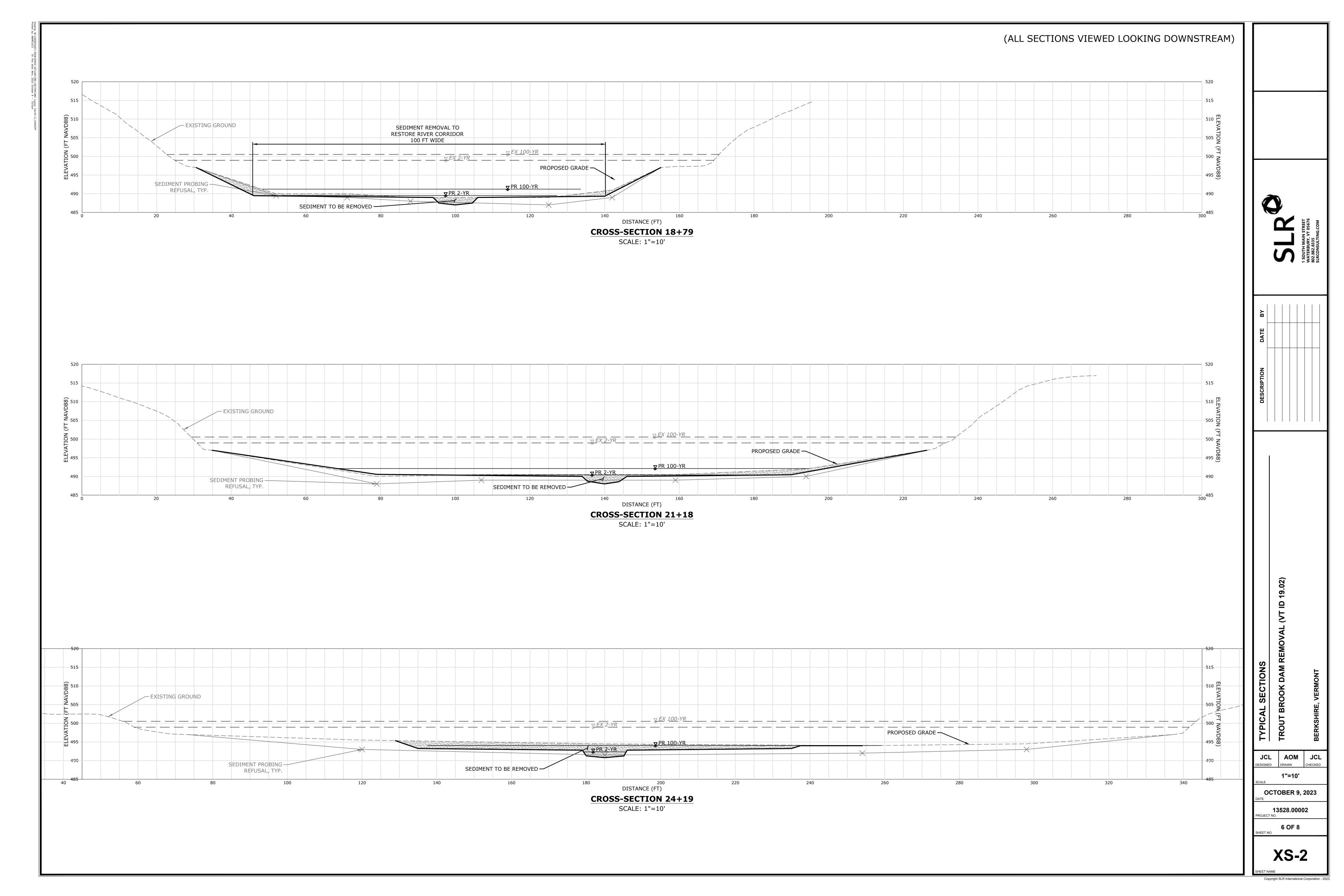


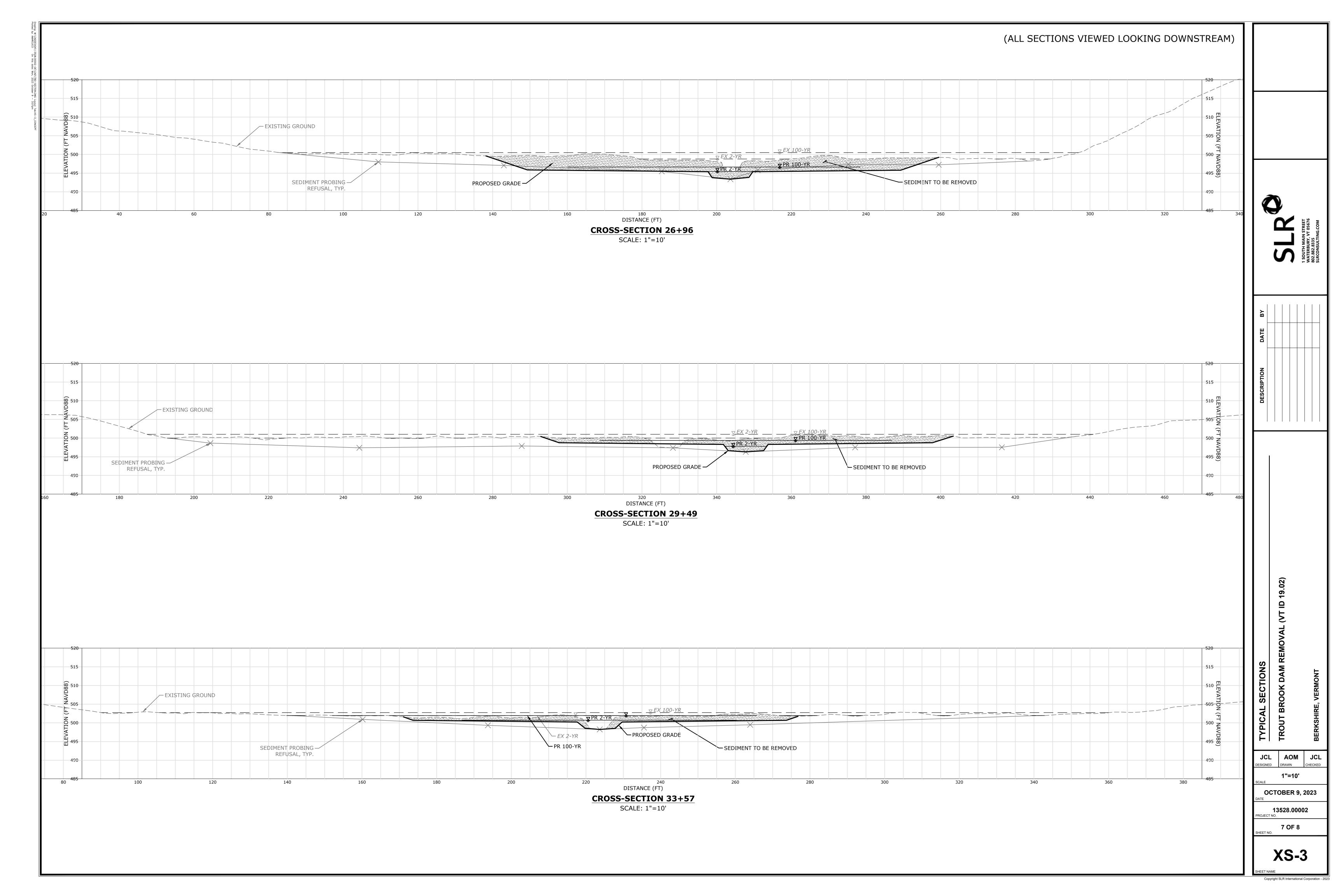
JCL AOM JCL **AS NOTED OCTOBER 9, 2023**

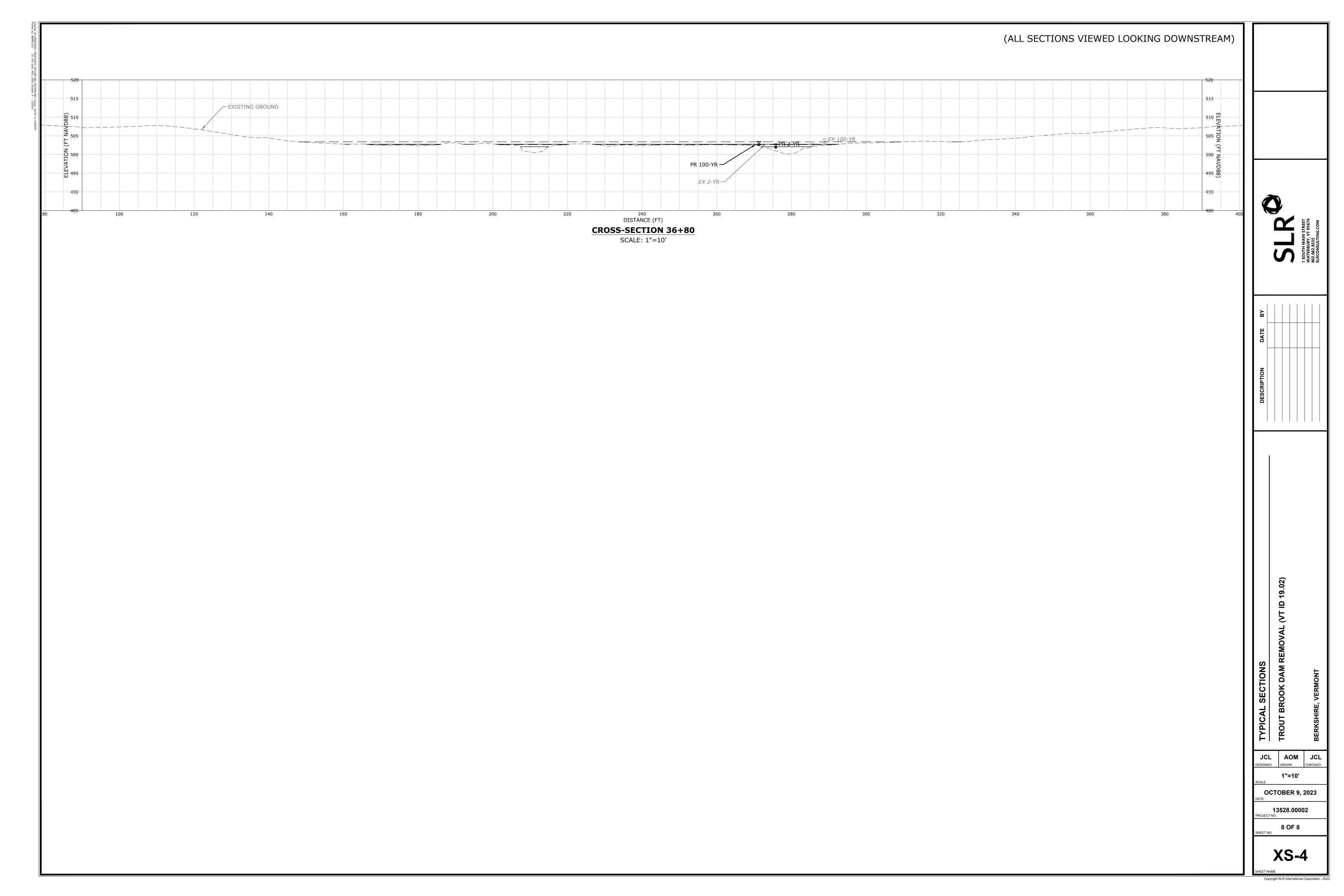
13528.00002 ROJECT NO.

4 OF 8

PRO-1









Appendix H Proposed Hydraulic Modeling Results

Trout Brook Reservoir Dam Removal

Engineering Report

Franklin County Natural Resources Conservation District

SLR Project No.: 146.13528.00002

March 26, 2025



Memorandum



To: Zoning Administrator, Town of Berkshire

Cc: Rebecca Pfeiffer, VT NFIP Coordinator

From: Jessica Louisos PE and Alex Marcucci

Date: 3/3/2025

Subject: Hydraulic Model Results and No Adverse Impact Certification



Project Overview

The Trout Brook Reservoir Dam (VTDEC# 19.01) on the Trout Brook in Berkshire, Vermont is slated for removal. The dam is obsolete, partially breached in the center, generally deteriorated, and blocks the movement of fish and other aquatic organisms. This dam removal is being led by the Franklin County NRCD. The goals of this project include improving aquatic organism passage, restoring the river channel, and reducing failure hazards.

The FEMA Flood Insurance Rate Map (FIRM) shows that a FEMA zone A (i.e., approximate) floodplain exists at the project site (Figure B). This area was not studied with detailed methods and no BFE exists at the site.

Our hydraulic model shows No Adverse Impact for this project. This project will improve public safety and improve aquatic and wildlife passage and connectivity.

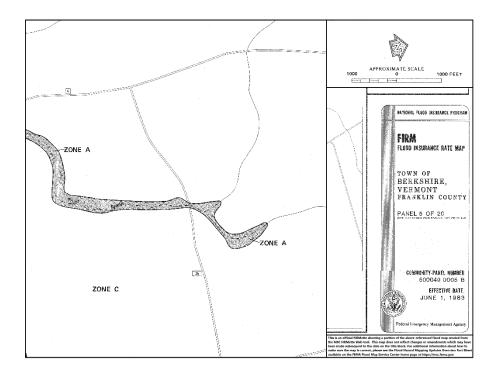


Figure 1: FEMA Flood Insurance Rate Map (2007)

Modeling and Results

Hydraulic modeling was completed at the project site to explore the hydraulic changes associated with the proposed project. A HEC-RAS (USACE, 2018) model was built using field survey of cross sections collected in 2023 and 2024. Design peak flows were developed from StreamStats for this small ungauged stream (drainage area ~ 1.8 square miles).

The results of the hydraulic analysis show that the 100-year flood level will decrease through the project area once the backwater at the dam and accumulated sediments are removed (Table 1, Figure 2).

Minor fluctuations in hydraulics are shown immediately downstream of the dam, showing a local rise in water surface elevation. In existing conditions, the water plunges into a deep scour hole at the dam face where hydraulic modeling fluctuates due to a hydraulic jump. There are no structures adjacent to this location and flow is contained entirely within the deep valley walls, with proposed water surface elevations 23 feet below the upstream well house and 20 feet below the upstream planned solar. No change occurs to flood levels downstream of the dam.

Discussion

The project does not increase the level of flood or erosion risk to any private property or infrastructure.

In Summary, the removal of the Trout Brook Reservoir Dam will not increase flood risk.

Table 1: Hydraulic Modeling Results – 100-Year Flood

Cross Section ID	Location	Existing WSE (ft)	Proposed WSE (ft)	Proposed WSE Rise (ft)
4112	US of project limit	507.10	507.10	0.00
3640	US project limit	503.74	503.33	-0.41
3357		502.92	501.60	-1.32
2949		500.74	499.21	-1.49
2696		500.52	496.56	-3.96
2419		500.53	494.05	-6.48
2118		500.53	491.94	-8.59
1879		500.53	490.78	-9.75
1715		500.53	490.72	-9.81
1597	US of dam	500.53	490.37	-10.16
1569	DS of dam	489.07	489.68	0.61
1538	US of water line	488.61	487.56	-1.05
1482	DS of water line	487.84	487.84	0.00
1449		487.57	487.57	0.00
1372	DS of project limit	487.43	487.43	0.00



SLR Project No.: 13528.00002

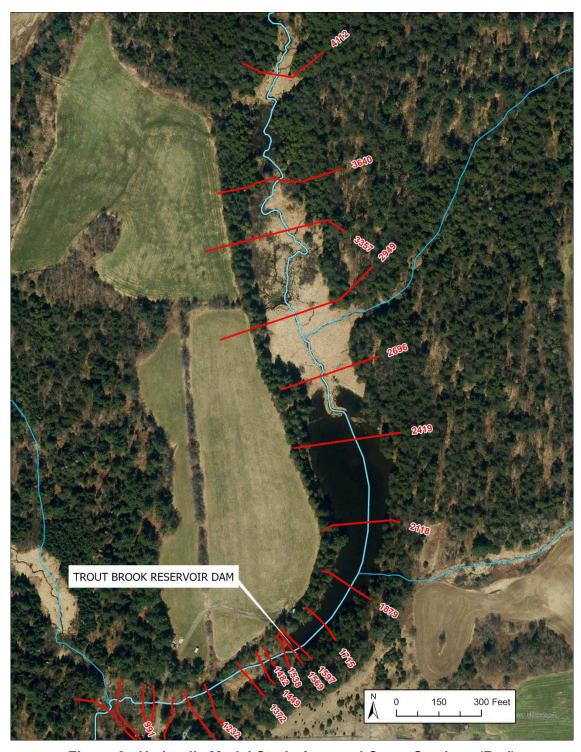


Figure 2: Hydraulic Model Study Area and Cross Sections (Red)



	: 90%Design_100ftRC_RCG											
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S.	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	5109	2-yr	87.30	510.61	513.15	512.42	513.39	0.005062	3.99	26.32	38.71	0.53
	5109	5-yr	141.00	510.61	513.54	513.18	513.84	0.005950	4.66	48.61	78.07	0.59
	5109	10-yr	183.00	510.61	513.79	513.57	514.09	0.005570	4.89	72.91	110.39	0.58
Reach 1	5109	25-yr	247.00	510.61	514.05	513.89	514.35	0.005490	5.22	102.88	122.25	0.58
Reach 1	5109	50-yr	303.00	510.61	514.23	514.07	514.53	0.005326	5.39	126.16	128.37	0.58
Reach 1	5109	100-yr	364.00	510.61	514.45	514.20	514.73	0.004954	5.47	154.30	134.34	0.57
Reach 1	5109	500-yr	535.00	510.61	514.97	514.52	515.22	0.004024	5.52	226.02	136.90	0.53
Reach 1	5109	Halloween2019	125.30	510.61	513.45	512.79	513.73	0.005857	4.48	42.19	66.46	0.58
Reach 1	5109	7Q2	0.30	510.61	510.80	510.70	510.80	0.002891	0.63	0.48	3.21	0.29
	5109	AprilQ2-20	47.00	510.61	512.57	511.93	512.73	0.004077	3.13	15.02	10.60	0.46
Reach 1	5109	NovQ2-20	13.00	510.61	511.68	511.36	511.75	0.004254	2.07	6.27	8.99	0.44
5 14	1017		07.00	500 57	540.40	540.40	540.04	0.040055	E 00	40.00	47.00	
Reach 1	4817	2-yr	87.30	508.57	510.49	510.43	510.91	0.016855	5.23	16.69	17.22	0.94
Reach 1	4817 4817	5-yr	141.00 183.00	508.57 508.57	510.94 511.13	510.85 511.13	511.42 511.71	0.012035 0.012625	5.60 6.25	27.24 33.79	32.51 37.06	0.84 0.88
Reach 1	4817	10-yr 25-yr	247.00	508.57	511.13	511.13	511.71	0.012625	6.71	45.62	40.58	0.86
Reach 1	4817	50-yr	303.00	508.57	511.67	511.63	512.35	0.010683	7.01	55.73	42.93	0.85
Reach 1	4817	100-yr	364.00	508.57	511.87	511.84	512.62	0.010811	7.48	64.35	44.83	0.87
Reach 1	4817	500-yr	535.00	508.57	512.32	512.32	513.29	0.011538	8.69	85.36	49.16	0.92
Reach 1	4817	Halloween2019	125.30	508.57	510.83	510.71	511.29	0.012692	5.45	23.89	29.91	0.85
Reach 1	4817	7Q2	0.30	508.57	508.78	508.78	508.82	0.030616	1.60	0.19	1.81	0.88
Reach 1	4817	AprilQ2-20	47.00	508.57	510.02	510.02	510.39	0.021731	4.89	9.62	13.33	1.01
Reach 1	4817	NovQ2-20	13.00	508.57	509.58	509.47	509.71	0.013507	2.90	4.49	9.56	0.75
Reach 1	4483	2-yr	87.30	504.91	507.75		508.02	0.005123	4.16	21.57	13.33	0.49
Reach 1	4483	5-yr	141.00	504.91	508.39	507.30	508.75	0.005583	4.94	40.06	58.94	0.53
Reach 1	4483	10-yr	183.00	504.91	508.89	507.88	509.18	0.004092	4.74	79.54	98.53	0.47
Reach 1	4483	25-yr	247.00	504.91	509.12	508.76	509.49	0.005030	5.50	102.96	103.43	0.52
Reach 1	4483	50-yr	303.00	504.91	509.28	509.08	509.70	0.005806	6.09	119.35	105.29	0.57
Reach 1	4483	100-yr	364.00	504.91	509.50		509.94	0.005824	6.36	143.69	108.17	0.57
Reach 1	4483	500-yr	535.00	504.91	510.07	509.67	510.50	0.005664	6.88	206.64	115.08	0.58
Reach 1	4483	Halloween2019	125.30	504.91	508.24	507.12	508.58	0.005527	4.73	32.65	41.22	0.52
Reach 1	4483	7Q2	0.30	504.91	505.09	505.02	505.10	0.003252	0.51	0.59	6.02	0.29
Reach 1	4483	AprilQ2-20	47.00	504.91	506.83	506.13	507.02	0.004996	3.52	13.34	7.85	0.48
Reach 1	4483	NovQ2-20	13.00	504.91	505.65		505.78	0.010258	2.91	4.47	7.19	0.65
5 14	4440		07.00	500.55	505.40	504.70	505.70	0.007004	4.00	40.00	44.00	
Reach 1	4112 4112	2-yr	87.30 141.00	502.55	505.43 506.04	504.78 505.42	505.76 506.48	0.007284 0.006653	4.60 5.39	19.03 29.03	11.89 26.33	0.62 0.62
	4112	5-yr		502.55				0.006653		29.03	26.33	
Reach 1	4112	10-yr	183.00 247.00	502.55 502.55	506.05	505.79 506.63	506.79 507.22	0.007442	6.97 6.61	59.88	72.51	0.80
Reach 1	4112	25-yr 50-yr	303.00	502.55	506.63 506.93	506.63	507.44	0.007442	6.52	87.25	100.95	0.64
Reach 1	4112	100-yr	364.00	502.55	507.10	507.10	507.63	0.006565	6.87	104.79	104.54	0.66
	4112	500-yr	535.00	502.55	507.10	507.10	508.05	0.000303	7.91	140.54	110.37	0.72
Reach 1	4112	Halloween2019	125.30	502.55	505.87	505.28	506.29	0.006877	5.21	25.19	18.61	0.62
	4112	7Q2	0.30	502.55	502.65	303.20	502.66	0.019625	1.02	0.30	4.13	0.67
Reach 1	4112	AprilQ2-20	47.00	502.55	504.82	504.05	505.03	0.005744	3.65	12.87	8.58	0.53
Reach 1	4112	NovQ2-20	13.00	502.55	503.83		503.90	0.002981	2.11	6.15	5.79	0.36
			70.00					0.00200				
Reach 1	3640	2-yr	87.30	499.88	501.89		502.12	0.008031	4.17	22.76	23.04	0.63
Reach 1	3640	5-yr	141.00	499.88	502.18		502.53	0.010640	5.23	30.08	27.35	0.73
Reach 1	3640	10-yr	183.00	499.88	502.74		502.93	0.005806	4.44	64.87	124.30	0.55
Reach 1	3640	25-yr	247.00	499.88	502.98	502.60	503.17	0.006106	4.89	98.41	155.92	0.57
Reach 1	3640	50-yr	303.00	499.88	503.16	502.80	503.35	0.005923	5.08	128.26	161.91	0.57
Reach 1	3640	100-yr	364.00	499.88	503.33	502.96	503.53	0.005882	5.30	156.13	166.80	0.58
Reach 1	3640	500-yr	535.00	499.88	503.80	503.23	503.98	0.005111	5.51	245.28	207.00	0.55
Reach 1	3640	Halloween2019	125.30	499.88	502.11		502.43	0.009731	4.91	28.28	26.35	0.70
Reach 1	3640	7Q2	0.30	499.88	500.11		500.12	0.002471	0.62	0.48	2.89	0.27
Reach 1	3640	AprilQ2-20	47.00	499.88	501.43		501.62	0.009349	3.77	13.69	16.81	0.66
Reach 1	3640	NovQ2-20	13.00	499.88	500.71	500.71	500.92	0.020760	3.79	3.78	9.47	0.91
D 1.	0057											
Reach 1	3357	2-yr	87.30	498.24	500.70	F00 =-	500.85	0.002781	3.30	45.10	100.12	0.41
Reach 1	3357 3357	5-yr	141.00 183.00	498.24 498.24	501.12 500.98	500.73 500.92	501.25 501.29	0.002323	3.43 5.14	87.62 72.95	102.52 101.70	0.39 0.60
Reach 1	3357	10-yr 25-yr	183.00 247.00	498.24	500.98	500.92	501.29	0.005657 0.005329	5.14	100.08	101.70	0.60
Reach 1	3357	50-yr	303.00	498.24	501.24		501.73	0.005329	5.69	117.78	103.22	0.60
Reach 1	3357	100-yr	364.00	498.24	501.41		501.73	0.005485	5.69	137.75	105.33	0.61
Reach 1	3357	500-yr	535.00	498.24	502.09		502.46	0.005604	6.67	198.12	169.16	0.64
Reach 1	3357	Halloween2019	125.30	498.24	501.01	500.20	501.15	0.003451	3.41	76.00	101.87	0.40
Reach 1	3357	7Q2	0.30	498.24	498.37	498.37	498.40	0.032309	1.26	0.24	3.56	0.86
Reach 1	3357	AprilQ2-20	47.00	498.24	500.16		500.27	0.002811	2.72	17.30	11.81	0.40
Reach 1	3357	NovQ2-20	13.00	498.24	499.27	498.82	499.31	0.002336	1.69	7.71	9.77	0.33
Reach 1	2949	2-yr	87.30	496.30	497.82	497.82	498.43	0.019179	6.31	13.84	11.26	1.00
Reach 1	2949	5-yr	141.00	496.30	498.29	498.29	499.11	0.018630	7.30	19.31	11.98	1.01
Reach 1	2949	10-yr	183.00	496.30	498.93	498.93	499.16	0.004727	4.60	97.62	221.17	0.54
Reach 1	2949	25-yr	247.00	496.30	499.04	499.04	499.30	0.005626	5.18	122.55	232.57	0.59
Reach 1	2949	50-yr	303.00	496.30	499.14	499.14	499.40	0.005903	5.45	144.75	234.77	0.61
Reach 1	2949	100-yr	364.00	496.30	499.21	499.21	499.49	0.006627	5.88	161.11	235.28	0.65
Reach 1	2949	500-yr	535.00	496.30	499.38	499.38	499.71	0.008165	6.82	201.39	236.54	0.73
Reach 1	2949	Halloween2019	125.30	496.30	498.16	498.16	498.93	0.018771	7.05	17.77	11.78	1.01
Reach 1	2949	7Q2	0.30	496.30	496.41	496.41	496.45	0.070170	1.65	0.18	3.23	1.23
Reach 1	2949	AprilQ2-20	47.00	496.30	497.38	497.37	497.80	0.020350	5.20	9.04	10.59	0.99
Reach 1	2949	NovQ2-20	13.00	496.30	496.85	496.85	497.04	0.026192	3.52	3.69	9.80	1.01
Booch 4	2606	2.15	07.00	400.00	405.70	40.4.00	405.74	0.000044	4.00	00.50	40.50	0.50
Reach 1	2696	2-yr	87.30	493.38	495.43	494.86	495.71	0.006011	4.28	20.58	19.56	0.58
Reach 1	2696	5-yr	141.00	493.38	495.91	495.33	496.22	0.005313	4.75	48.79	97.86	0.57
Reach 1	2696	10-yr	183.00	493.38	495.41	496.04	496.68	0.027286	9.05	20.29	16.91	1.23

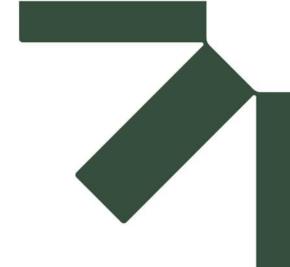
Sept Dec		an: 90%Design_100ftRC_F					0:1110	505	500	V 101 1	F	T 145 H	F 1 " 011
March 1 March 2 Marc	Reacn	River Sta	Profile										Froude # Chi
Sept Dec	Reach 1	2696	25-vr							. ,			1.03
March 1986													1.00
March Marc	Reach 1	2696		364.00	493.38	496.56	496.48	496.94	0.006607	6.30	115.79	106.04	0.66
Report 2006	Reach 1	2696	500-yr	535.00	493.38	496.91	496.77	497.33	0.006975	7.00	153.89	112.16	0.69
March 1986													0.58
March Marc							493.49						0.38
Table 1													0.59
Separt 2479	Reach 1	2696	NovQ2-20	13.00	493.38	494.12	493.90	494.19	0.005981	2.21	5.88	10.13	0.51
Separt 2479	Booch 1	2440	2 1/2	97.20	400.91	402.26	402.25	402.06	0.019709	6.21	14 OF	11.44	0.00
Search 1969													
Sept													
Sept 1989													
Manual M													0.76
Sept Sept					490.81					7.68			0.80
Report 2919	Reach 1	2419	500-yr	535.00	490.81	494.61	494.61	495.22	0.008274	7.98	210.67	168.61	0.76
Regard 2419	Reach 1	2419	Halloween2019	125.30	490.81	492.68	492.68	493.45	0.018956	7.04	17.79	11.84	1.01
Sept 198													0.63
Raugh 1 18													0.84
Regent 118	Reach 1	2419	NovQ2-20	13.00	490.81	491.47	491.41	491.61	0.016418	3.00	4.33	10.33	0.82
Regent 118	5 14	0440			100.00	400.44		400.40	0.004470	0.00	20.05	20.00	
Regard 1818							400.30						
Rech 118													
Rech 118													0.27
Report 118													0.23
New 1													0.22
Reach 2116													0.21
Reach 1879 1974 1970													0.35
Reach 1979 2-yr 87.30 489.00			7Q2										0.40
Reach 1 879 Syr													0.51
Repair 1879 Syr	Reach 1	2118	NovQ2-20	13.00	488.00	489.00		489.07	0.005047	2.17	5.98	9.41	0.48
Repair 1879 Syr													
Reach 1979													0.42
Reach 1 1879													
Reach 1 1879 50 yr 303.00 487.00 400.55 400.85 0.004322 5.46 146.64 98.47 0.58 Reach 1 1879 500-yr 585.00 487.00 401.30 491.74 0.001444 6.31 233.35 101.93 0.05 Reach 1 1879 Halkoweer0019 125.30 487.00 401.30 491.74 0.001444 6.31 233.35 101.93 0.05 Reach 1 1879 Halkoweer0019 125.30 487.00 449.67 449.90 0.0033165 0.55 0.52 4.27 0.00 Reach 1 1879 April 20 2.00 487.00 489.85 489.97 0.0033165 0.55 0.52 4.27 0.00 Reach 1 1879 April 20 487.00 488.85 489.97 0.0033165 0.55 0.52 4.27 0.00 Reach 1 1879 April 20 487.00 488.85 489.97 0.0033165 0.55 0.52 4.27 0.00 Reach 1 1879 April 20 487.00 488.85 489.97 0.003004 1.55 6.67 9.94 0.04 Reach 1 1879 April 20 487.00 488.55 489.97 0.003004 1.55 6.67 9.94 0.04 Reach 1 1715 5.77 141.00 486.55 489.94 489.55 0.003165 0.003004 1.55 6.67 9.94 0.04 Reach 1 1715 5.77 141.00 486.55 489.94 489.55 0.003165 0.003004 1.55 6.67 9.94 0.04 Reach 1 1715 5.77 141.00 486.55 489.94 489.55 0.003104 1.65 6.67 9.94 0.04 Reach 1 1715 5.77 141.00 486.55 489.94 489.55 0.003104 1.65 6.67 9.94 0.04 Reach 1 1715 5.97 9.94 0.04 486.55 489.94 0.003004 1.55 0.003004 1.55 0.003004 0.0030													
Reach 1979													
Reach 1879													
Reach 1979													
Reach 1979													0.50
Reach 1679													0.29
Reach	Reach 1	1879	AprilQ2-20	47.00	487.00	488.83		488.97	0.003588	2.94	15.96	11.66	0.44
Reach 1 775 5-yr	Reach 1	1879	NovQ2-20	13.00	487.00	487.97		488.03	0.003804	1.95	6.67	9.94	0.42
Reach 1 775 5-yr													
Reach 1715			2-yr										0.43
Reach 1 7715													0.33
Reach 1715													0.29
Reach 1715 100-yr													
Reach 1715													
Reach 1715													
Reach 1715													
Reach 1715													
Reach 1715													0.44
Reach 1 1597 5-yr 141.00 486.14 489.08 488.60 489.28 0.003208 4.01 70.83 69.84 0.44 Reach 1 1597 10-yr 183.00 486.14 489.43 489.62 0.002821 4.13 95.35 70.66 0.4 Reach 1 1597 25-yr 247.00 486.14 489.43 489.05 0.002821 4.13 95.35 70.66 0.4 Reach 1 1597 50-yr 303.00 486.14 490.37 490.62 0.002900 5.11 168.31 73.61 0.4 Reach 1 1597 100-yr 364.00 486.14 490.37 490.62 0.002900 5.11 163.31 73.61 0.4 Reach 1 1597 50-yr 555.00 486.14 489.93 488.37 489.12 0.003355 6.05 265.75 75.27 0.55 Reach 1 1597 AprilO2-20 47.00 486.14 487.82 488.02													0.38
Reach 1 1597 5-yr 141.00 486.14 489.08 488.60 489.28 0.003208 4.01 70.83 69.84 0.44 Reach 1 1597 10-yr 183.00 486.14 489.43 489.62 0.002821 4.13 95.35 70.66 0.4 Reach 1 1597 25-yr 247.00 486.14 489.43 489.05 0.002821 4.13 95.35 70.66 0.4 Reach 1 1597 50-yr 303.00 486.14 490.37 490.62 0.002900 5.11 168.31 73.61 0.4 Reach 1 1597 100-yr 364.00 486.14 490.37 490.62 0.002900 5.11 163.31 73.61 0.4 Reach 1 1597 50-yr 555.00 486.14 489.93 488.37 489.12 0.003355 6.05 265.75 75.27 0.55 Reach 1 1597 AprilO2-20 47.00 486.14 487.82 488.02													
Reach 1 1597 15-yr 13.00 486.14 489.43 489.62 0.002821 4.13 95.35 70.86 0.4 Reach 1 1597 25-yr 247.00 486.14 489.85 490.05 0.002835 4.40 125.64 72.10 0.4 Reach 1 1597 50-yr 303.00 486.14 490.37 490.62 0.002900 5.11 163.31 72.91 0.44 Reach 1 1597 100-yr 364.00 486.14 489.37 490.62 0.002900 5.11 163.31 73.61 0.4 Reach 1 1597 Halloween2019 125.30 486.14 488.90 488.37 489.12 0.00360 4.06 58.81 69.33 0.4 Reach 1 1597 70.22 0.30 486.14 488.99 486.40 0.003030 0.58 0.52 4.18 0.2 Reach 1 1597 Aprilo2-20 47.00 486.14 487.10 487.73 487.18 <t< td=""><td>Reach 1</td><td>1597</td><td>2-yr</td><td>87.30</td><td>486.14</td><td>488.41</td><td>487.87</td><td>488.68</td><td>0.005589</td><td>4.24</td><td>26.23</td><td>50.89</td><td>0.58</td></t<>	Reach 1	1597	2-yr	87.30	486.14	488.41	487.87	488.68	0.005589	4.24	26.23	50.89	0.58
Reach 1 1597 25-yr 247.00 486.14 489.85 490.05 0.002635 4.40 125.64 72.10 0.4 Reach 1 1597 50-yr 303.00 486.14 490.13 490.62 0.002708 4.72 145.60 72.91 0.4 Reach 1 1597 500-yr 535.00 486.14 490.94 491.28 0.003355 6.05 205.75 75.27 0.5 Reach 1 1597 Halloween2019 125.30 486.14 488.90 488.37 489.12 0.003355 6.05 205.75 75.27 0.5 Reach 1 1597 702 0.30 486.14 488.90 488.37 489.12 0.003030 0.56 0.52 4.18 0.22 Reach 1 1597 AprilC2-20 47.00 486.14 487.12 488.02 0.006041 3.53 13.30 11.13 0.5 Reach 1 1597 April/2-20 47.00 486.06 487.73 487.73	Reach 1						488.60			-			0.46
Reach 1 1597 50-yr 303.00 486.14 490.13 490.35 0.002708 4.72 145.80 72.91 0.44 Reach 1 1597 100-yr 364.00 486.14 490.37 490.62 0.002900 5.11 163.31 73.61 0.44 Reach 1 1597 500-yr 535.00 486.14 489.94 491.28 0.003355 6.05 205.75 75.27 0.55 Reach 1 1597 Halloween2019 125.30 486.14 488.90 488.37 489.12 0.003640 4.06 58.81 69.33 0.44 Reach 1 1597 702 0.30 486.14 486.39 486.40 0.003000 0.58 0.52 4.18 0.22 Reach 1 1597 NovQ2-20 13.00 486.14 487.10 487.18 0.004925 2.18 5.97 9.16 0.44 Reach 1 1569 2-yr 87.30 486.06 487.73 487.73 488.36 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.44</td></t<>													0.44
Reach 1 1597 100-yr 364.00 486.14 490.37 490.62 0.002900 5.11 163.31 73.61 0.43 Reach 1 1597 500-yr 555.00 486.14 490.94 491.28 0.003355 6.05 205.75 75.27 0.51 Reach 1 1597 7Q2 0.30 486.14 488.39 488.37 489.12 0.003340 4.06 6.88,18 69.33 0.44 Reach 1 1597 AprilQ2-20 47.00 486.14 487.82 488.02 0.006041 3.53 13.30 11.13 0.5 Reach 1 1597 AprilQ2-20 47.00 486.14 487.72 488.02 0.006041 3.53 13.30 11.13 0.5 Reach 1 1569 2-yr 87.30 486.06 487.73 488.36 0.024593 6.34 13.77 11.20 Reach 1 1569 5-yr 141.00 486.06 488.26 489.26 489.36 0.024593													0.44
Reach 1 1597 500-yr 535.00 486.14 490.94 491.28 0.003355 6.05 205.75 75.27 0.55 Reach 1 1597 Halloween2019 125.30 486.14 488.90 488.37 489.12 0.00340 4.06 58.81 69.33 0.48 Reach 1 1597 AprilQ2-20 47.00 486.14 487.82 488.02 0.006041 3.53 13.30 11.13 0.55 Reach 1 1597 NovQ2-20 13.00 486.14 487.82 488.02 0.006041 3.53 13.30 11.13 0.55 Reach 1 1597 NovQ2-20 13.00 486.06 487.73 487.73 488.36 0.04925 2.18 5.97 9.16 0.44 Reach 1 1569 2-yr 87.30 486.06 487.73 487.73 488.36 0.024593 6.34 13.77 11.20 1.0 Reach 1 1569 5-yr 141.00 486.06 489.26													0.45
Reach 1 1597 Halloween2019 125.30 486.14 488.90 488.37 489.12 0.003640 4.06 58.81 69.33 0.44 Reach 1 1597 7Q2 0.30 486.14 486.99 486.40 0.003030 0.58 0.52 4.18 0.22 Reach 1 1597 AprilQ2-20 47.00 486.14 487.10 487.18 0.006041 3.53 13.30 11.13 0.55 Reach 1 1597 NovQ2-20 13.00 486.14 487.10 487.18 0.004925 2.18 5.97 9.16 0.44 Reach 1 1569 2-yr 87.30 486.06 487.73 487.73 483.36 0.024593 6.34 13.77 11.20 1.0 Reach 1 1569 5-yr 141.00 486.06 488.26 488.26 489.03 0.024593 6.34 13.77 11.20 1.0 Reach 1 1569 10-yr 183.00 486.06 489.26 48													
Reach 1 1597 7Q2 0.30 486.14 486.39 486.40 0.003030 0.58 0.52 4.18 0.22 Reach 1 1597 AprilQ2-20 47.00 486.14 487.82 488.02 0.006041 3.53 13.30 11.13 0.57 Reach 1 1597 NovQ2-20 13.00 486.14 487.10 487.18 0.004925 2.18 5.97 9.16 0.44 Reach 1 1569 2-yr 87.30 486.06 487.73 487.73 488.36 0.024593 6.34 13.77 11.20 1.0 Reach 1 1569 5-yr 141.00 486.06 488.72 488.72 489.41 0.014096 6.84 37.69 47.59 0.8 Reach 1 1569 25-yr 247.00 486.06 489.05 489.45 499.41 0.014096 6.84 37.69 47.59 0.8 Reach 1 1569 50-yr 303.00 486.06 489.05 489.45							100 27						
Reach 1 1597 AprilQ2-20 47.00 486.14 487.82 488.02 0.006041 3.53 13.30 11.13 0.55 Reach 1 1597 NovQ2-20 13.00 486.14 487.10 487.18 0.004925 2.18 5.97 9.16 0.44 Reach 1 1569 2-yr 87.30 486.06 487.73 487.73 488.36 0.024593 6.34 13.77 11.20 1.0 Reach 1 1569 5-yr 141.00 486.06 488.26 488.26 489.03 0.024593 6.34 13.77 11.20 1.0 Reach 1 1569 5-yr 141.00 486.06 488.26 488.26 489.03 0.025531 7.03 21.14 23.33 0.99 Reach 1 1569 25-yr 247.00 486.06 488.75 489.05 489.84 0.013994 7.51 5.85 56.35 0.8 Reach 1 1569 50-yr 303.00 486.06 489.05<							488.37						
Reach 1 1597 NovQ2-20 13.00 486.14 487.10 487.18 0.004925 2.18 5.97 9.16 0.44 Reach 1 1569 2-yr 87.30 486.06 487.73 487.73 488.36 0.024593 6.34 13.77 11.20 1.0 Reach 1 1569 5-yr 141.00 486.06 488.26 489.03 0.020531 7.03 21.14 23.33 0.9 Reach 1 1569 10-yr 183.00 486.06 488.72 488.72 489.41 0.014096 6.84 37.69 47.59 0.8 Reach 1 1569 25-yr 247.00 486.06 489.05 489.45 0.014096 6.84 37.69 47.59 0.8 Reach 1 1569 50-yr 303.00 486.06 489.05 489.45 490.15 0.010899 7.34 81.81 75.53 0.7 Reach 1 1569 50-yr 335.00 486.06 489.68 489.68			_										
Reach 1 1569													0.48
Reach 1 1569 5-yr 141.00 486.06 488.26 488.26 489.03 0.020531 7.03 21.14 23.33 0.9 Reach 1 1569 10-yr 183.00 486.06 488.72 488.72 489.41 0.014096 6.84 37.99 47.59 0.8 Reach 1 1569 25-yr 247.00 486.06 489.05 489.45 40.01394 7.51 54.85 56.35 0.8 Reach 1 1569 50-yr 303.00 486.06 489.45 490.15 0.013994 7.51 54.85 56.35 0.8 Reach 1 1569 100-yr 364.00 486.06 489.48 490.15 0.010999 7.34 81.81 75.53 0.7 Reach 1 1569 500-yr 535.00 486.06 490.15 490.15 491.03 0.011999 8.90 134.70 77.30 0.8 Reach 1 1569 7Q2 0.30 486.06 488.09 488.09								,				20	2.10
Reach 1 1569 5-yr 141.00 486.06 488.26 488.26 489.03 0.020531 7.03 21.14 23.33 0.99 Reach 1 1569 10-yr 183.00 486.06 488.72 488.72 489.41 0.014096 6.84 37.69 47.59 0.88 Reach 1 1569 25-yr 247.00 486.06 489.05 489.45 40.01394 7.51 54.85 56.35 0.8 Reach 1 1569 50-yr 303.00 486.06 489.45 490.15 0.013994 7.51 54.85 56.35 0.8 Reach 1 1569 100-yr 364.00 486.06 489.48 490.15 0.010999 7.34 81.81 75.53 0.7 Reach 1 1569 500-yr 535.00 486.06 490.15 490.15 491.03 0.011990 8.90 134.70 77.30 0.8 Reach 1 1569 702 0.30 486.06 488.09 488.09 <td>Reach 1</td> <td>1569</td> <td>2-yr</td> <td>87.30</td> <td>486.06</td> <td>487.73</td> <td>487.73</td> <td>488.36</td> <td>0.024593</td> <td>6.34</td> <td>13.77</td> <td>11.20</td> <td>1.01</td>	Reach 1	1569	2-yr	87.30	486.06	487.73	487.73	488.36	0.024593	6.34	13.77	11.20	1.01
Reach 1 1569 25-yr 247.00 486.06 489.05 489.84 0.013994 7.51 54.85 56.35 0.88 Reach 1 1569 50-yr 303.00 486.06 489.45 489.45 490.15 0.010899 7.34 81.81 75.53 0.7 Reach 1 1569 100-yr 364.00 486.06 489.68 490.41 0.010957 7.74 98.62 76.10 0.7 Reach 1 1569 500-yr 535.00 486.06 489.05 491.03 0.011990 8.90 134.70 77.30 0.8 Reach 1 1569 Halloween2019 125.30 486.06 488.09 488.85 0.023468 6.99 17.95 13.85 1.0 Reach 1 1569 AprilQ2-20 47.00 486.06 487.35 487.27 0.020373 4.88 9.63 10.24 0.3 Reach 1 1569 NovQ2-20 13.00 486.06 487.35 487.27 487.72	Reach 1				486.06	488.26		489.03		7.03	21.14		0.96
Reach 1 1569 50-yr 303.00 486.06 489.45 489.45 490.15 0.010899 7.34 81.81 75.53 0.77 Reach 1 1569 100-yr 364.00 486.06 489.68 489.68 490.41 0.010957 7.74 96.62 76.10 0.77 Reach 1 1569 500-yr 535.00 486.06 489.01 490.15 491.03 0.011990 8.90 134.70 77.30 0.8 Reach 1 1569 Halloween2019 125.30 486.06 488.09 488.85 0.023468 6.99 17.95 13.85 1.0 Reach 1 1569 7Q2 0.30 486.06 486.28 486.20 486.29 0.005463 0.63 0.47 4.23 0.3 Reach 1 1569 AprilO2-20 47.00 486.06 487.35 487.27 487.72 0.020373 4.88 9.63 10.24 0.8 Reach 1 1569 NovQ2-20 13.00 <													0.83
Reach 1 1569 100-yr 364.00 486.06 489.68 489.68 490.41 0.010957 7.74 98.62 76.10 0.77 Reach 1 1569 500-yr 535.00 486.06 490.15 490.15 491.03 0.011990 8.90 134.70 77.30 0.88 Reach 1 1569 Halloween2019 125.30 486.06 488.09 488.09 0.023468 6.99 17.95 13.85 1.0 Reach 1 1569 702 0.30 486.06 487.25 487.27 0.005463 0.63 0.47 4.23 0.3 Reach 1 1569 AprilQ2-20 47.00 486.06 487.35 487.27 487.72 0.020373 4.88 9.63 10.24 0.88 Reach 1 1569 NovQ2-20 13.00 486.06 486.86 487.27 487.72 0.020373 4.88 9.63 10.24 0.88 Reach 1 1538 2-yr 87.30 485.93 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.85</td></t<>													0.85
Reach 1 1569 500-yr 535.00 486.06 490.15 490.15 491.03 0.011990 8.90 134.70 77.30 0.88 Reach 1 1569 Halloween2019 125.30 486.06 488.09 488.09 488.85 0.023468 6.99 17.95 13.85 1.0 Reach 1 1569 AprilQ2-20 47.00 486.06 487.27 487.72 0.020373 4.88 9.63 10.24 0.88 Reach 1 1569 NovQ2-20 13.00 486.06 486.86 487.27 487.72 0.020373 4.88 9.63 10.24 0.88 Reach 1 1569 NovQ2-20 13.00 486.06 486.86 487.27 486.97 0.011742 2.63 4.94 9.04 0.63 Reach 1 1538 2-yr 87.30 485.93 487.16 487.03 487.42 0.016527 4.14 21.11 25.68 0.8 Reach 1 1538 5-yr 141.00													0.77
Reach 1 1569 Halloween2019 125.30 486.06 488.09 488.09 488.85 0.023468 6.99 17.95 13.85 1.0 Reach 1 1569 7Q2 0.30 486.06 486.22 486.29 0.005463 0.63 0.47 4.23 0.33 Reach 1 1569 April02-20 47.00 486.06 487.25 487.27 487.72 0.02373 4.88 9.63 10.24 0.88 Reach 1 1569 NovQ2-20 13.00 486.06 486.86 486.97 0.011742 2.63 4.94 9.04 0.66 Reach 1 1538 2-yr 87.30 485.93 487.16 487.03 487.42 0.016527 4.14 21.11 25.88 0.88 Reach 1 1538 5-yr 141.00 485.93 487.05 487.31 487.96 0.066083 7.67 18.38 25.06 1.5 Reach 1 1538 10-yr 183.00 485.93 487.													0.78
Reach 1 1569 7Q2 0.30 486.06 486.28 486.20 486.29 0.005463 0.63 0.47 4.23 0.33 Reach 1 1569 AprilQ2-20 47.00 486.06 487.35 487.27 487.72 0.020373 4.88 9.63 10.24 0.88 Reach 1 1569 NovQ2-20 13.00 486.06 486.86 486.86 486.97 0.011742 2.63 4.94 9.04 0.66 Reach 1 1538 2-yr 87.30 485.93 487.16 487.03 487.42 0.016527 4.14 21.11 25.68 0.8 Reach 1 1538 5-yr 141.00 485.93 487.05 487.31 487.96 0.066083 7.67 18.38 25.06 1.58 Reach 1 1538 10-yr 183.00 485.93 487.10 487.52 488.45 0.090673 9.32 19.64 25.35 1.88 Reach 1 1538 25-yr 247.00 <td></td> <td>0.83</td>													0.83
Reach 1 1569 AprilQ2-20 47.00 486.06 487.35 487.27 487.72 0.020373 4.88 9.63 10.24 0.88 Reach 1 1569 NovQ2-20 13.00 486.06 486.86 486.97 0.011742 2.63 4.94 9.04 0.6 Reach 1 1538 2-yr 87.30 485.93 487.16 487.03 487.42 0.016527 4.14 21.11 25.68 0.8 Reach 1 1538 5-yr 141.00 485.93 487.05 487.31 487.96 0.066083 7.67 18.38 25.06 1.5 Reach 1 1538 10-yr 183.00 485.93 487.10 487.52 488.45 0.090673 9.32 19.64 25.35 1.8 Reach 1 1538 25-yr 247.00 485.93 487.28 487.78 488.88 0.085691 10.15 24.33 26.39 1.8 Reach 1 1538 50-yr 303.00 485.93<													1.01
Reach 1 1569 NovQ2-20 13.00 486.06 486.86 486.97 0.011742 2.63 4.94 9.04 0.66 Reach 1 1538 2-yr 87.30 485.93 487.16 487.03 487.42 0.016527 4.14 21.11 25.88 0.8 Reach 1 1538 5-yr 141.00 485.93 487.05 487.31 487.96 0.066083 7.67 18.38 25.06 1.58 Reach 1 1538 10-yr 183.00 485.93 487.10 487.52 488.45 0.090673 9.32 19.64 25.35 1.8 Reach 1 1538 25-yr 247.00 485.93 487.78 488.88 0.085691 10.15 24.33 26.39 1.80 Reach 1 1538 50-yr 303.00 485.93 487.99 489.30 0.090233 11.07 27.56 30.64 1.9													
Reach 1 1538 2-yr 87.30 485.93 487.16 487.03 487.42 0.016527 4.14 21.11 25.88 0.80 Reach 1 1538 5-yr 141.00 485.93 487.05 487.31 487.96 0.066083 7.67 18.38 25.06 1.58 Reach 1 1538 10-yr 183.00 485.93 487.10 487.52 488.45 0.090673 9.32 19.64 25.35 1.8 Reach 1 1538 25-yr 247.00 485.93 487.28 487.78 488.88 0.085691 10.15 24.33 26.39 1.8 Reach 1 1538 50-yr 303.00 485.93 487.99 493.90 0.090233 11.07 27.56 30.64 1.9							487.27						
Reach 1 1538 5-yr 141.00 485.93 487.05 487.31 487.96 0.066083 7.67 18.38 25.06 1.51 Reach 1 1538 10-yr 183.00 485.93 487.10 487.52 488.45 0.090673 9.32 19.64 25.35 1.8 Reach 1 1538 25-yr 247.00 485.93 487.78 488.88 0.085691 10.15 24.33 26.39 1.8 Reach 1 1538 50-yr 303.00 485.93 487.98 489.30 0.090233 11.07 27.56 30.64 1.9	INEAUTI T	1309	NUVQ2-20	13.00	480.06	486.86		480.97	0.011742	2.63	4.94	9.04	0.63
Reach 1 1538 5-yr 141.00 485.93 487.05 487.31 487.96 0.066083 7.67 18.38 25.06 1.51 Reach 1 1538 10-yr 183.00 485.93 487.10 487.52 488.45 0.090673 9.32 19.64 25.35 1.8 Reach 1 1538 25-yr 247.00 485.93 487.78 488.88 0.085691 10.15 24.33 26.39 1.8 Reach 1 1538 50-yr 303.00 485.93 487.98 489.30 0.090233 11.07 27.56 30.64 1.9	Reach 1	1538	2-vr	87.30	485 03	487 16	487 03	487 42	0.016527	4 14	21 11	25.68	0.80
Reach 1 1538 10-yr 183.00 485.93 487.10 487.52 488.45 0.090673 9.32 19.64 25.35 1.8 Reach 1 1538 25-yr 247.00 485.93 487.28 487.78 488.88 0.085691 10.15 24.33 26.39 1.8 Reach 1 1538 50-yr 303.00 485.93 487.39 487.98 489.30 0.090233 11.07 27.56 30.64 1.9													1.58
Reach 1 1538 25-yr 247.00 485.93 487.28 487.78 488.88 0.085691 10.15 24.33 26.39 1.88 Reach 1 1538 50-yr 303.00 485.93 487.39 487.98 489.30 0.090233 11.07 27.56 30.64 1.99													1.87
Reach 1 1538 50-yr 303.00 485.93 487.39 487.98 489.30 0.090233 11.07 27.56 30.64 1.9													1.86
													1.94
	Reach 1												1.88

	n: 90%Design_100ftRC_RC											
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
Doooh 1	4530	500 vr	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	1.75
Reach 1	1538	500-yr	535.00	485.93	487.97	488.65	490.19	0.064720	12.02	48.46	41.59	1.75
Reach 1	1538	Halloween2019	125.30	485.93	487.03	487.24	487.79	0.056611	7.00	17.90	24.95	1.46
Reach 1	1538	7Q2	0.30	485.93	486.02	486.00	486.03	0.015558	0.66	0.46	8.48	0.50
Reach 1	1538	AprilQ2-20	47.00	485.93	486.84		487.03	0.020457	3.55	13.23	23.85	0.84
Reach 1	1538	NovQ2-20	13.00	485.93	486.44		486.54	0.016589	2.50	5.20	13.62	0.71
Danah 4	1482	0	07.00	405.05	400.07		400.04	0.000000	2.00	00.50	22.40	0.54
Reach 1		2-yr	87.30	485.05	486.67	400.55	486.84	0.006620	3.29	26.56	23.40	
Reach 1	1482	5-yr	141.00	485.05	487.11	486.55	487.34	0.005906	3.81	37.56	26.28	0.54
Reach 1	1482	10-yr	183.00	485.05	487.35	486.77	487.64	0.006136	4.28	44.15	28.02	0.56
Reach 1	1482	25-yr	247.00	485.05	487.66	487.04	488.03	0.006571	4.91	55.65	50.52	0.59
Reach 1	1482	50-yr	303.00	485.05	487.73	487.27	488.25	0.008818	5.82	59.79	66.07	0.69
Reach 1	1482	100-yr	364.00	485.05	487.84	487.52	488.51	0.010568	6.59	67.83	73.44	0.77
Reach 1	1482	500-yr	535.00	485.05	488.23	488.23	489.14	0.012352	7.90	97.87	78.37	0.85
Reach 1	1482	Halloween2019	125.30	485.05	487.00	486.46	487.21	0.005960	3.65	34.69	25.49	0.53
Reach 1	1482	7Q2	0.30	485.05	485.19		485.20	0.014288	0.76	0.39	5.55	0.50
Reach 1	1482	AprilQ2-20	47.00	485.05	486.19		486.32	0.008274	2.90	16.21	20.14	0.57
Reach 1	1482	NovQ2-20	13.00	485.05	485.63		485.70	0.013417	2.18	5.96	16.41	0.64
Reach 1	1449	2-yr	87.30	484.43	486.35		486.59	0.008238	3.94	22.69	21.52	0.61
Reach 1	1449	5-yr	141.00	484.43	486.76	486.34	487.10	0.008188	4.72	34.39	38.06	0.64
Reach 1	1449	10-yr	183.00	484.43	486.91	486.63	487.37	0.010098	5.54	40.69	48.43	0.72
Reach 1	1449	25-yr	247.00	484.43	487.09	487.09	487.72	0.012604	6.58	50.63	62.41	0.81
Reach 1	1449	50-yr	303.00	484.43	487.40	487.40	487.94	0.009737	6.37	74.38	78.63	0.73
Reach 1	1449	100-yr	364.00	484.43	487.57	487.57	488.14	0.009910	6.73	87.78	80.11	0.75
Reach 1	1449	500-yr	535.00	484.43	488.28	487.93	488.71	0.006244	6.30	146.53	85.60	0.62
Reach 1	1449	Halloween2019	125.30	484.43	486.66		486.97	0.008000	4.49	30.95	32.73	0.62
Reach 1	1449	7Q2	0.30	484.43	484.57		484.59	0.026818	1.04	0.29	4.02	0.69
Reach 1	1449	AprilQ2-20	47.00	484.43	485.84		486.02	0.009901	3.42	13.76	15.13	0.63
Reach 1	1449	NovQ2-20	13.00	484.43	485.13		485.24	0.014899	2.70	4.81	10.29	0.70
Reach 1	1372	2-yr	87.30	483.75	485.35		485.67	0.018350	4.54	19.27	15.88	0.70
Reach 1	1372	5-yr	141.00	483.75	485.92	485.48	486.28	0.014447	4.90	34.75	53.11	0.64
Reach 1	1372	10-yr	183.00	483.75	486.28	486.03	486.55	0.009694	4.53	64.13	98.34	0.54
Reach 1	1372	25-yr	247.00	483.75	486.76	486.39	486.90	0.005123	3.75	111.26	100.83	0.40
Reach 1	1372	50-yr	303.00	483.75	487.09	486.49	487.20	0.003803	3.49	144.90	102.56	0.35
Reach 1	1372	100-yr	364.00	483.75	487.43	486.63	487.53	0.002955	3.31	180.23	104.05	0.32
Reach 1	1372	500-yr	535.00	483.75	488.28		488.36	0.001929	3.10	269.76	107.39	0.27
Reach 1	1372	Halloween2019	125.30	483.75	485.77	485.35	486.13	0.015848	4.85	28.28	33.72	0.66
Reach 1	1372	7Q2	0.30	483.75	483.94	483.86	483.94	0.004046	0.49	0.61	6.49	0.28
Reach 1	1372	AprilQ2-20	47.00	483.75	484.99		485.16	0.012813	3.36	13.99	14.11	0.59
Reach 1	1372	NovQ2-20	13.00	483.75	484.53	484.25	484.57	0.005450	1.69	7.71	13.38	0.39
Reach 1	1232	2-yr	87.30	482.31	484.66		484.80	0.002838	3.02	31.61	21.35	0.38
Reach 1	1232	5-yr	141.00	482.31	485.14		485.36	0.003482	3.86	42.52	24.28	0.44
Reach 1	1232	10-yr	183.00	482.31	485.44		485.73	0.003888	4.41	50.24	26.48	0.47
Reach 1	1232	25-yr	247.00	482.31	485.81		486.21	0.004491	5.16	60.38	27.76	0.51
Reach 1	1232	50-yr	303.00	482.31	486.04		486.54	0.005237	5.84	66.87	28.54	0.56
Reach 1	1232	100-yr	364.00	482.31	486.32		486.92	0.005671	6.41	74.98	29.47	0.59
Reach 1	1232	500-yr	535.00	482.31	486.91		487.81	0.007145	7.96	92.93	31.59	0.68
Reach 1	1232	Halloween2019	125.30	482.31	485.01		485.21	0.003312	3.63	39.48	23.55	0.42
Reach 1	1232	7Q2	0.30	482.31	482.41	482.41	482.44	0.076625	1.40	0.21	4.28	1.10
Reach 1	1232	AprilQ2-20	47.00	482.31	483.71		483.87	0.006985	3.15	14.90	13.98	0.54
Reach 1	1232	NovQ2-20	13.00	482.31	482.82	482.82	483.00	0.033957	3.43	3.79	10.54	1.01
Reach 1	1152	2-yr	87.30	480.90	484.67	482.26	484.71	0.000340	1.47	69.79	88.27	0.14
Reach 1	1152	5-yr	141.00	480.90	485.16	482.68	485.22	0.000545	2.04	83.42	92.65	0.19
Reach 1	1152	10-yr	183.00	480.90	485.47	482.93	485.56	0.000695	2.43	92.69	95.28	0.21
Reach 1	1152	25-yr	247.00	480.90	485.86	483.25	485.99	0.000920	2.96	104.79	98.58	0.25
Reach 1	1152	50-yr	303.00	480.90	486.10	483.54	486.27	0.001145	3.43	112.82	100.64	0.28
Reach 1	1152	100-yr	364.00	480.90	486.40	483.80	486.61	0.001143	3.85	122.81	103.19	0.30
Reach 1	1152	500-yr	535.00	480.90	487.04	484.48	487.38	0.001869	4.94	146.11	109.07	0.37
Reach 1	1152	Halloween2019	125.30	480.90	485.03	482.58	485.08	0.000487	1.88	79.70	91.38	0.17
Reach 1	1152	7Q2	0.30	480.90	481.37	481.00	481.37	0.000022	0.08	3.69	43.53	0.03
Reach 1	1152	AprilQ2-20	47.00	480.90	483.74	481.85	483.76	0.000318	1.13	45.61	79.93	0.13
Reach 1	1152	NovQ2-20	13.00	480.90	482.44	481.40	482.45	0.000367	0.72	17.99	62.62	0.12
				.55.50		.210	.52.10			50		
Reach 1	1095	2-yr	87.30	481.15	484.66	482.53	484.69	0.000344	1.39	68.06	27.08	0.14
Reach 1	1095	5-yr	141.00	481.15	485.13	482.84	485.19	0.000536	1.91	81.47	29.20	0.18
Reach 1	1095	10-yr	183.00	481.15	485.44	483.05	485.52	0.000671	2.27	90.64	30.73	0.21
Reach 1	1095	25-yr	247.00	481.15	485.82	483.35	485.93	0.000874	2.76	102.59	32.56	0.24
Reach 1	1095	50-yr	303.00	481.15	486.05	483.58	486.21	0.000874	3.19	110.40	33.64	0.24
Reach 1	1095	100-yr	364.00	481.15	486.34	483.83	486.53	0.001062	3.19	120.27	35.17	0.27
Reach 1	1095	500-yr	535.00	481.15	486.96	484.43	487.27	0.001248	4.58	147.21	58.20	0.29
Reach 1	1095	Halloween2019	125.30	481.15	485.01	482.76	485.05	0.001730	1.77	77.80	28.56	0.33
Reach 1	1095	7Q2	0.30	481.15	481.32	481.32	481.36	0.000462	1.67	0.18	2.10	1.01
Reach 1	1095	AprilQ2-20	47.00	481.15	483.72	482.23	483.74	0.000370	1.07	43.85	24.59	0.14
Reach 1	1095	NovQ2-20	13.00	481.15	483.72	482.23	483.74	0.000370	0.91	14.22	24.59	0.14
- touoll I	.333	110792-20	13.00	401.10	402.40	401.01	402.41	0.000962	0.91	14.22	20.05	0.18
Reach 1	1051 AccessRd		Culvert									
INCAUTT I	1001 ACCESSKO		Culvert									
Ponch 1	1020	2.11	07.00	480.52	404.00	404 70	400 40	0.044600	4.40	40.00	24.00	0.70
Reach 1	1030	2-yr	87.30		481.89	481.73	482.19	0.014696	4.40	19.86	24.26	0.78
Reach 1	1030	5-yr	141.00	480.52	482.13	482.07	482.63	0.019118	5.71	24.82	24.89	0.92
Reach 1	1030	10-yr	183.00	480.52	482.29	482.29	482.95	0.021526	6.51	28.26	29.14	1.00
Danie 1	13030	25-yr	247.00	480.52	482.60	482.60	483.38	0.019704	7.08	35.74	40.82	0.98
Reach 1			^^~!	****								
Reach 1	1030	50-yr	303.00	480.52	482.84	482.84	483.72	0.018604	7.54	41.91	52.43	0.98
			303.00 364.00 535.00	480.52 480.52 480.52	482.84 483.07 485.04	482.84 483.07 483.66	483.72 484.06 485.33	0.018604 0.017922 0.002743	7.54 8.01 4.88	41.91 47.97 197.20	52.43 56.21 77.44	0.98 0.98 0.43

		n: 90%Design_100ftRC_RC					C-it M/ C	F.O. Fl	F.O. 01	\/-I OhI	[] A	T \45-44	F
March 100	Reacn	River Sta	Profile										Froude # Chl
March 1 100	Reach 1	1030	Halloween2019							. ,			0.89
March 1986													0.89
	Reach 1												0.71
Second S	Reach 1	1030	NovQ2-20	13.00	480.52	480.98	480.96	481.12	0.029804	3.05	4.26	12.92	0.94
Second S													
Sept 1 10 10 10 10 10 10 10	Reach 1		2-yr			481.22				4.99	27.50		0.83
Search 10 10 10 10 10 10 10 1	Reach 1												0.84
Seach 10													0.92
Seeph 195													1.14
Seep 1 97													1.26
Search 197							482.21						1.36 0.29
Seep							491.44						0.29
Second 1991													0.42
Secret S													0.42
Second 196							100.72						0.74
Seage 1													
Seach Seac	Reach 1	886	2-yr	87.30	477.58	479.11	479.22	479.58	0.023666	5.79	23.01	53.60	0.98
Name		886		141.00	477.58	479.62	479.50	479.88	0.010593	4.92	60.41	96.47	0.70
Seach Seac	Reach 1	886	10-yr	183.00	477.58	479.84	479.66	480.10	0.009445	5.08	84.23	117.92	0.67
Search 186	Reach 1	886	25-yr	247.00	477.58	480.44	479.91	480.57	0.003953	3.99	162.89	147.19	0.46
Seach Sec	Reach 1	886	50-yr	303.00	477.58	481.35	480.06	481.40	0.001129	2.65	304.60	160.63	0.26
Reach 186	Reach 1	886	100-yr	364.00	477.58	482.46	480.19	482.49	0.000418	1.96	489.24	174.46	0.16
Resch 1 886 702 0.30 477.56 477.74 477.74 0.04477 1.20 0.022 3.20 1.20 0.000 1.20 0.000 0.	Reach 1												0.09
Report 1 196	Reach 1												0.66
Respir 1 895 No.GZ-20 13.00 477.50 479.5	Reach 1												0.85
Resent 1 816							478.74						0.91
Seach 186	reacn 1	886	NovQ2-20	13.00	477.58	478.26		478.40	U.019824	3.03	4.29	9.39	0.79
Seach 186	Ponch 1	916	2.10	110.00	A70 E A	470.00	470.00	470.00	0.000000	2.50	67.50	06.00	0.45
Reach 1 616													0.45
Reach 1 816							410.74						0.47
Resch 1 816													0.36
Respon 16 16 100 yr													0.24
Reach 166													0.18
Reach 816													0.11
Reach 816	Reach 1						478.70						0.47
Reach 1 816	Reach 1	816	7Q2	0.40	476.54	476.77	476.68	476.77	0.004477	0.58	0.69	6.06	0.30
Reach 639	Reach 1	816	AprilQ2-20	71.00	476.54	478.46	477.97	478.59	0.004227	3.08	36.85	58.37	0.45
Reach 639 Syr 19100	Reach 1	816	NovQ2-20	19.00	476.54	477.51		477.61	0.008114	2.52	7.54	11.20	0.54
Reach 639 Syr 19100													
Reach S9	Reach 1												1.01
Reach 1 639							477.53						0.87
Reach 1 639													0.48
Reach 1 639													0.31
Reach G39 S00-yr T07.00 475.34 485.03 485.07 0.00197 2.22 816.24 180.76 628 639 Hallowencotti 9 1818.00 475.34 477.48 478.07 0.00197 0.25 629 33.61 43.32 180.76 629 33.61 43.32 180.76 629 33.61 43.32 180.76 629 33.61 43.32 180.76 629 33.61 43.32 180.76 629 33.61 43.32 180.76 629 33.61 43.32 180.76 629 63.61 63.92 63.													0.23
Reach Sa9													0.18
Reach 1 639							477.40						0.13 0.87
Reach 1 639													0.47
Reach 639													1.00
Reach 1 461													0.48
Reach 461 5-yr													
Reach 1 461	Reach 1	461	2-yr	119.00	473.36	476.17	474.78	476.26	0.001340	2.40	64.60	57.14	0.27
Reach 1 461	Reach 1	461	5-yr	191.00	473.36	477.55	475.19	477.61	0.000578	2.13	158.89	80.19	0.19
Reach 1 461	Reach 1			248.00	473.36			478.59	0.000378	2.02	246.91	96.58	0.16
Reach 1 461 100-yr 485.00 473.36 482.29 482.32 0.000128 1.73 684.89 138.61 (Reach 1 461 500-yr 707.00 473.36 485.02 485.04 0.000086 1.70 1104.54 171.17 (Reach 1 461 Halloween2019 181.80 477.36 485.02 485.04 0.000087 2.16 145.80 77.10 (Reach 1 461 702 0.40 473.36 477.36 477.14 477.45 0.000627 2.16 145.80 77.10 (Geath 1 461 702 0.40 473.36 475.12 477.43 475.23 0.001329 0.72 0.56 7.22 0.6 7.22 0.05 7.22 0.05 7.22 0.05 7.22 0.05 7.22 0.56 7.22 0.05 7.22 0.05 7.22 0.05 7.22 0.05 7.22 0.05 7.22 0.05 7.22 0.05 7.22 0.05 7.22 0.05 7.22 0.05	Reach 1												0.13
Reach 1 461 500-yr 707.00 473.36 485.02 485.04 0.000068 1.70 1104.54 171.17 (Reach 1 461 Halloween2019 118.18 473.36 477.39 475.14 477.45 0.000627 2.16 145.80 77.10 (Reach 1 461 702 0.40 473.36 473.46 473.47 0.011239 0.72 0.56 7.22 0.05 7.2	Reach 1												0.12
Reach 1 461 Halloween2019 181.80 473.36 477.39 475.14 477.45 0.000827 2.16 145.80 77.10 (Reach 1 461 7Q2 0.40 473.36 473.46 473.46 473.47 0.011239 0.72 0.56 7.22 0.66 7.22 0.66 7.22 0.66 7.22 0.66 7.22 0.66 7.22 0.66 7.22 0.66 7.22 0.66 7.22 0.66 7.22 0.66 7.22 0.60 7.22 0.66 7.22 0.66 7.22 0.60 7.22 0.61 0.00 476.21 477.38 477.39 477.39 478.23 0.00380 2.66 5.33 13.73 Reach 1 401 2-yr 119.00 471.96 476.12 473.86 476.19 0.000855 2.14 64.09 443.66 6 68.86 1 79 121.13 109.97 6 476.12 473.86 477.59 477.59 477.50 477.50	Reach 1												0.10
Reach 1 461 7Q2 0.40 473.36 473.46 473.47 0.011239 0.72 0.56 7.22 0.68 Reach 1 461 April02-20 71.00 473.36 475.12 474.43 475.23 0.003500 2.65 26.96 21.05 0.003717 Reach 1 461 NovQ2-20 19.00 473.36 473.89 473.89 474.09 0.032717 3.56 6.93 13.73 Reach 1 401 2-yr 119.00 471.96 476.12 473.86 476.19 0.000885 2.14 64.09 443.66 0.00388 Reach 1 401 10-yr 248.00 471.96 478.53 475.02 478.57 0.000248 1.68 161.55 130.84 0 Reach 1 401 25-yr 332.00 471.96 481.09 0.000181 1.56 22.14 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00													0.09
Reach 1 461 AprilQ2-20 71.00 473.36 475.12 474.43 475.23 0.003500 2.65 26.96 21.05 (6 Reach 1 461 NovQ2-20 19.00 473.86 473.89 473.89 474.09 0.032717 3.56 5.33 13.73 Reach 1 401 2-yr 119.00 471.96 476.12 473.86 476.19 0.000365 2.14 64.09 443.66 (6 Reach 1 401 5-yr 191.00 471.96 476.12 473.86 476.19 0.000368 1.79 121.13 109.57 Reach 1 401 10-yr 248.00 471.96 476.53 475.02 476.59 0.000388 1.79 121.13 109.57 Reach 1 401 25-yr 332.00 471.96 479.90 475.61 479.94 0.000131 1.56 264.65 190.99 1.60 1.54 110.07 481.09 0.000131 1.56 264.65 190.99							475.14						0.20
Reach 1 461 NovQ2-20 19.00 473.36 473.89 474.09 0.032717 3.56 5.33 13.73 Reach 1 401 2-yr 119.00 471.96 476.12 473.86 476.19 0.000855 2.14 64.09 44.36 (Reach 1 401 5-yr 191.00 471.96 477.54 474.56 477.58 0.000368 1.79 121.13 109.57 (Reach 1 401 10-yr 248.00 471.96 478.53 475.02 478.57 0.000248 1.68 161.55 130.84 (Reach 1 401 50-yr 405.00 471.96 478.50 475.91 400.000169 1.60 217.41 170.73 (Reach 1 401 100-yr 485.00 471.96 481.09 476.91 481.09 0.000131 1.56 264.65 190.99 Reach 1 401 100-yr 485.00 471.96 482.28 476.29 482.32<							474.40						0.45
Reach 1 401													0.40
Reach 1 401 5-yr 191.00 471.96 477.54 474.56 477.58 0.000368 1.79 121.13 109.57 (Reach 1 401 10-yr 248.00 471.96 478.53 475.02 478.57 0.000248 1.68 161.55 130.84 (Q Reach 1 401 25-yr 332.00 471.96 479.99 475.61 479.94 0.000169 1.60 217.41 170.73 (Q Reach 1 401 50-yr 405.00 471.96 481.06 475.97 481.09 0.000131 1.56 264.65 190.99 (Q 475.61 479.94 0.000169 1.56 264.65 190.99 (Q 475.61 479.94 0.000131 1.56 264.65 190.99 (Q 475.01 481.09 0.000131 1.56 264.65 190.99 (Q 475.01 475.97 481.09 0.000160 1.54 314.43 210.13 (Q 471.96 482.28 476.29 482.32 0.000160 1.	rcaull I	101	14040/2-20	19.00	413.36	473.89	473.89	4/4.09	0.032/1/	3.56	5.33	13.73	1.01
Reach 1 401 5-yr 191.00 471.96 477.54 474.56 477.58 0.000368 1.79 121.13 109.57 (Reach 1 401 10-yr 248.00 471.96 478.53 475.02 478.57 0.000248 1.68 161.55 130.84 (Q Reach 1 401 25-yr 332.00 471.96 479.99 475.61 479.94 0.000169 1.60 217.41 170.73 (Q Reach 1 401 50-yr 405.00 471.96 481.06 475.97 481.09 0.000131 1.56 264.65 190.99 (Q 475.61 479.94 0.000169 1.56 264.65 190.99 (Q 475.61 479.94 0.000131 1.56 264.65 190.99 (Q 475.01 481.09 0.000131 1.56 264.65 190.99 (Q 475.01 475.97 481.09 0.000160 1.54 314.43 210.13 (Q 471.96 482.28 476.29 482.32 0.000160 1.	Reach 1	401	2-vr	119 00	471 96	476 12	473.86	476 10	0,000855	2 14	64.00	44.36	0.21
Reach 1 401 10-yr 248.00 471.96 478.53 475.02 478.57 0.000248 1.68 161.55 130.84 (Reach 1 Reach 1 401 25-yr 332.00 471.96 479.90 475.61 479.94 0.000169 1.60 217.41 170.73 (Reach 1 401 50-yr 405.00 471.96 481.06 475.97 481.09 0.000131 1.56 264.65 190.99 (Qertical 20) Reach 1 401 100-yr 485.00 471.96 482.28 476.29 482.32 0.000106 1.54 314.43 210.13 (Qertical 20) Reach 1 401 500-yr 707.00 471.96 485.03 476.85 485.04 0.000009 0.53 1600.57 254.75 (Qertical 20) Reach 1 401 Halloween2019 181.80 471.96 477.37 474.48 477.41 0.000399 1.82 114.28 97.15 (Qertical 20) 471.96 477.30 472.08 <td></td> <td>0.21</td>													0.21
Reach 1 401 25-yr 332.00 471.96 479.90 475.61 479.94 0.000169 1.60 217.41 170.73 (Reach 1 401 50-yr 405.00 471.96 481.06 475.97 481.09 0.000131 1.56 264.65 190.99 (Reach 1 401 100-yr 485.00 471.96 482.28 476.29 482.32 0.000166 1.54 314.43 210.13 (Image of the control of													0.13
Reach 1 401 50-yr 405.00 471.96 481.06 475.97 481.09 0.000131 1.56 264.65 190.99 (Reach 1 doll of 100-yr doll													0.11
Reach 1 401 100-yr 485.00 471.96 482.28 476.29 482.32 0.000106 1.54 314.43 210.13 (e Reach 1 401 500-yr 707.00 471.96 485.03 476.85 485.04 0.000009 0.53 1600.57 254.75 (e Reach 1 401 Halloween2019 181.80 471.96 472.08 472.08 472.11 0.003099 1.82 114.28 97.15 (e Reach 1 401 702 0.40 471.96 472.08 472.08 472.11 0.003088 1.41 0.28 4.82 Reach 1 401 AprilQ2-20 71.00 471.96 475.00 473.35 475.08 0.001680 2.25 32.09 19.09 (e Reach 1 344 ReservoirRd Culvert 473.00 472.65 473.87 0.002374 3.05 38.99 49.73 (e Reach 1 297 2-yr 119.00 471.50 <t< td=""><td>Reach 1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.10</td></t<>	Reach 1												0.10
Reach 1 401 500-yr 707.00 471.96 485.03 476.85 485.04 0.000009 0.53 1600.57 254.75 (0 Reach 1 401 Halloween2019 181.80 471.96 477.37 474.48 477.41 0.000399 1.82 114.28 97.15 (0 Reach 1 401 702 0.40 471.96 475.00 473.35 475.08 0.001680 2.25 32.09 19.09 (0 Reach 1 401 NovQ2-20 19.00 471.96 473.00 472.65 473.08 0.005664 2.36 8.05 9.63 (0 Reach 1 344 ReservoirRd Culvert	Reach 1												0.09
Reach 1 401 Halloween2019 181.80 471.96 477.37 474.48 477.41 0.000399 1.82 114.28 97.15 0.000399 Reach 1 401 702 0.40 471.96 472.08 472.08 472.11 0.063688 1.41 0.28 4.82 4	Reach 1												0.03
Reach 1 401 AprilQ2-20 71.00 471.96 475.00 473.35 475.08 0.001680 2.25 32.09 19.09 (Reach 1 Reach 1 401 NovQ2-20 19.00 471.96 473.00 472.65 473.08 0.005664 2.36 8.05 9.63 0.005664 Reach 1 344 ReservoirRd Culvert	Reach 1			181.80	471.96	477.37	474.48	477.41	0.000399	1.82	114.28	97.15	0.15
Reach 1 401 NovQ2-20 19.00 471.96 473.00 472.65 473.08 0.005664 2.36 8.05 9.63 (Reach 1 344 ReservoirRd Culvert	Reach 1												1.03
Reach 1 297 2-yr 119.00 471.50 473.73 472.65 473.87 0.002374 3.05 38.99 49.73 (Reach 1 297 5-yr 191.00 471.50 474.12 473.07 474.39 0.003527 4.15 45.99 51.84 (Reach 1 297 191.00 471.50 474.12 473.07 474.39 0.003527 4.15 45.99 51.84 (Reach 1 297 25-yr 332.00 471.50 474.40 473.36 474.77 0.004251 4.88 50.86 58.82 (Reach 1 297 25-yr 332.00 471.50 474.73 473.75 475.26 0.005276 5.85 56.79 73.58 (Reach 1 297 50-yr 405.00 471.50 474.98 474.07 475.66 0.006129 6.62 61.17 94.20 (Reach 1 297 50-yr 485.00 471.50 474.98 474.07 475.66 0.006110 7.44 65.18 121.53 (Reach 1 297 500-yr 707.00 471.50 475.64 475.20 474.38 476.06 0.007110 7.44 65.18 121.53 (Reach 1 297 500-yr 707.00 471.50 475.64 475.20 474.38 476.06 0.007110 7.44 65.18 121.53 (Reach 1												0.27
Reach 1 297 2-yr 119.00 471.50 473.73 472.65 473.87 0.002374 3.05 38.99 49.73 (Reach 1 297 5-yr 191.00 471.50 474.12 473.07 474.39 0.003527 4.15 45.99 51.84 (Reach 1 297 10-yr 248.00 471.50 474.40 473.36 474.77 0.004251 4.88 50.86 58.82 (Reach 1 297 25-yr 332.00 471.50 474.73 473.75 475.26 0.005276 5.85 56.79 73.58 (Reach 1 297 50-yr 405.00 471.50 474.98 474.07 475.66 0.006129 6.62 61.17 94.20 (Reach 1 297 100-yr 485.00 471.50 475.20 474.38 476.06 0.007110 7.44 65.18 121.53 (Reach 1 297 500-yr 707.00 471.50 475.64 475.20 477.10 0.010382 9.69 72.95 153.88 (Reach 1	401	NovQ2-20	19.00	471.96	473.00	472.65	473.08	0.005664	2.36	8.05	9.63	0.45
Reach 1 297 2-yr 119.00 471.50 473.73 472.65 473.87 0.002374 3.05 38.99 49.73 (Reach 1 297 5-yr 191.00 471.50 474.12 473.07 474.39 0.003527 4.15 45.99 51.84 (Reach 1 297 10-yr 248.00 471.50 474.40 473.36 474.77 0.004251 4.88 50.86 58.82 (Reach 1 297 25-yr 332.00 471.50 474.73 473.75 475.26 0.005276 5.85 56.79 73.58 (Reach 1 297 50-yr 405.00 471.50 474.98 474.07 475.66 0.006129 6.62 61.17 94.20 (Reach 1 297 100-yr 485.00 471.50 475.20 474.38 476.06 0.007110 7.44 65.18 121.53 (Reach 1 297 500-yr 707.00 471.50 475.64 475.20 477.10 0.010382 9.69 72.95 153.88 (044 5											
Reach 1 297 5-yr 191.00 471.50 474.12 473.07 474.39 0.003527 4.15 45.99 51.84 (c) Reach 1 297 10-yr 248.00 471.50 474.40 473.36 474.77 0.004251 4.88 50.86 58.82 (c) Reach 1 297 25-yr 332.00 471.50 474.73 475.26 0.005276 5.85 56.79 73.58 (c) Reach 1 297 50-yr 405.00 471.50 474.98 474.07 475.66 0.006129 6.62 61.17 94.20 (c) Reach 1 297 100-yr 485.00 471.50 475.20 474.38 476.06 0.007110 7.44 65.18 121.53 (c) Reach 1 297 500-yr 707.00 471.50 475.64 475.20 477.10 0.010382 9.69 72.95 153.88 (c)	Reach 1	344 ReservoirRd		Culvert									
Reach 1 297 5-yr 191.00 471.50 474.12 473.07 474.39 0.003527 4.15 45.99 51.84 (c) Reach 1 297 10-yr 248.00 471.50 474.40 473.36 474.77 0.004251 4.88 50.86 58.82 (c) Reach 1 297 25-yr 332.00 471.50 474.73 475.26 0.005276 5.85 56.79 73.58 (c) Reach 1 297 50-yr 405.00 471.50 474.98 474.07 475.66 0.006129 6.62 61.17 94.20 (c) Reach 1 297 100-yr 485.00 471.50 475.20 474.38 476.06 0.007110 7.44 65.18 121.53 (c) Reach 1 297 500-yr 707.00 471.50 475.64 475.20 477.10 0.010382 9.69 72.95 153.88 (c)	Booch 4	207	2 100	440.00	474 50	470 70	470.05	470.07	0.00007.1	0.05	00.00	40.70	0.00
Reach 1 297 10-yr 248.00 471.50 474.40 473.36 474.77 0.004251 4.88 50.86 58.82 6 Reach 1 297 25-yr 332.00 471.50 474.73 473.75 475.26 0.005276 5.85 56.79 73.58 6 Reach 1 297 50-yr 405.00 471.50 474.98 474.07 475.66 0.006129 6.62 61.17 94.20 6 Reach 1 297 100-yr 485.00 471.50 475.20 474.38 476.06 0.007110 7.44 65.18 121.53 Reach 1 297 500-yr 707.00 471.50 475.64 475.20 477.10 0.010382 9.69 72.95 153.88													0.36
Reach 1 297 25-yr 332.00 471.50 474.73 473.75 475.26 0.005276 5.85 56.79 73.58 0.005276 Reach 1 297 50-yr 405.00 471.50 474.98 474.07 475.66 0.006129 6.62 61.17 94.20 0.005276 Reach 1 297 100-yr 485.00 471.50 475.20 474.38 476.06 0.007110 7.44 65.18 121.53 0.005276 Reach 1 297 500-yr 707.00 471.50 475.64 475.20 477.10 0.010382 9.69 72.95 153.88 0.005276													0.46 0.51
Reach 1 297 50-yr 405.00 471.50 474.98 474.07 475.66 0.006129 6.62 61.17 94.20 0 Reach 1 297 100-yr 485.00 471.50 475.20 474.38 476.06 0.007110 7.44 65.18 121.53 0 Reach 1 297 500-yr 707.00 471.50 475.64 475.20 477.10 0.010382 9.69 72.95 153.88 0													0.51
Reach 1 297 100-yr 485.00 471.50 475.20 474.38 476.06 0.007110 7.44 65.18 121.53 0 Reach 1 297 500-yr 707.00 471.50 475.64 475.20 477.10 0.010382 9.69 72.95 153.88 0													0.63
Reach 1 297 500-yr 707.00 471.50 475.64 475.20 477.10 0.010382 9.69 72.95 153.88 (0.69
													0.84
	Reach 1	297	Halloween2019	181.80	471.50	474.07	473.02	474.32		4.03	45.08	51.57	0.45

HEC-RAS Plan: 90%Design_100ftRC_RCG_wSurvey 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	297	7Q2	0.40	471.50	471.59	471.54	471.59	0.002772	0.36	1.12	17.66	0.23
Reach 1	297	AprilQ2-20	71.00	471.50	473.41	472.33	473.48	0.001431	2.13	33.29	46.00	0.27
Reach 1	297	NovQ2-20	19.00	471.50	472.53	471.87	472.55	0.000846	1.08	17.67	34.82	0.19
Reach 1	242	2-yr	119.00	471.10	473.44		473.63	0.010306	3.58	43.11	57.17	0.64
Reach 1	242	5-yr	191.00	471.10	473.90		474.09	0.006748	3.76	71.55	65.08	0.56
Reach 1	242	10-yr	248.00	471.10	474.21		474.42	0.005571	3.90	92.51	68.46	0.52
Reach 1	242	25-yr	332.00	471.10	474.60		474.83	0.004954	4.20	121.21	87.11	0.51
Reach 1	242	50-yr	405.00	471.10	474.89		475.15	0.004704	4.47	149.97	105.20	0.51
Reach 1	242	100-yr	485.00	471.10	475.20		475.47	0.004295	4.62	185.43	126.05	0.49
Reach 1	242	500-yr	707.00	471.10	475.90		476.20	0.003682	4.99	293.49	168.41	0.48
Reach 1	242	Halloween2019	181.80	471.10	473.84		474.03	0.007152	3.75	67.62	64.41	0.57
Reach 1	242	7Q2	0.40	471.10	471.27		471.29	0.015752	1.03	0.39	3.66	0.56
Reach 1	242	AprilQ2-20	71.00	471.10	473.12		473.27	0.014465	3.24	26.63	46.76	0.71
Reach 1	242	NovQ2-20	19.00	471.10	472.02	471.99	472.33	0.026145	4.44	4.27	6.15	0.94
Reach 1	194	2-yr	119.00	470.25	472.73	472.49	473.10	0.011086	5.07	33.93	38.78	0.71
Reach 1	194	5-yr	191.00	470.25	473.23	472.96	473.68	0.010097	5.79	55.53	50.29	0.71
Reach 1	194	10-yr	248.00	470.25	473.54	473.16	474.04	0.009879	6.28	72.62	58.98	0.71
Reach 1	194	25-yr	332.00	470.25	473.95		474.49	0.009073	6.69	98.95	66.17	0.70
Reach 1	194	50-yr	405.00	470.25	474.26		474.83	0.008729	7.03	119.70	70.06	0.70
Reach 1	194	100-yr	485.00	470.25	474.55		475.16	0.008555	7.39	141.70	79.98	0.70
Reach 1	194	500-yr	707.00	470.25	475.25	474.76	475.91	0.008060	8.12	211.78	132.69	0.71
Reach 1	194	Halloween2019	181.80	470.25	473.18		473.61	0.010013	5.67	52.98	47.71	0.70
Reach 1	194	7Q2	0.40	470.25	470.45	470.41	470.46	0.019046	1.03	0.39	4.28	0.60
Reach 1	194	AprilQ2-20	71.00	470.25	472.23	471.95	472.56	0.015061	4.67	17.83	24.07	0.78
Reach 1	194	NovQ2-20	19.00	470.25	471.26		471.44	0.013161	3.33	5.70	7.69	0.68
Reach 1	106	2-yr	119.00	469.38	472.22	471.38	472.42	0.005000	3.62	38.02	33.86	0.48
Reach 1	106	5-yr	191.00	469.38	472.75	471.99	473.02	0.005000	4.28	60.39	52.25	0.50
Reach 1	106	10-yr	248.00	469.38	473.07	472.30	473.38	0.005005	4.68	77.79	58.68	0.51
Reach 1	106	25-yr	332.00	469.38	473.50	472.74	473.86	0.004998	5.18	106.15	76.61	0.53
Reach 1	106	50-yr	405.00	469.38	473.81	473.03	474.21	0.004992	5.53	130.73	80.87	0.54
Reach 1	106	100-yr	485.00	469.38	474.11	473.24	474.54	0.005002	5.86	156.79	89.40	0.54
Reach 1	106	500-yr	707.00	469.38	474.81	474.01	475.32	0.005004	6.60	229.35	112.52	0.56
Reach 1	106	Halloween2019	181.80	469.38	472.69	471.88	472.96	0.005008	4.21	57.39	51.70	0.50
Reach 1	106	7Q2	0.40	469.38	469.69	469.57	469.70	0.005002	0.74	0.54	3.46	0.33
Reach 1	106	AprilQ2-20	71.00	469.38	471.64	470.95	471.80	0.005004	3.19	22.33	17.98	0.47
Reach 1	106	NovQ2-20	19.00	469.38	470.66	470.29	470.73	0.005002	2.12	8.96	11.73	0.43



Appendix I Final Design Plans & Opinion of Probable Cost

Trout Brook Reservoir Dam Removal

Engineering Report

Franklin County Natural Resources Conservation District

SLR Project No.: 146.13528.00002

March 26, 2025



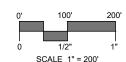
TROUT BROOK RESERVOIR DAM REMOVAL (VT ID 19.02)

RESERVOIR ROAD BERKSHIRE, VERMONT

> DRAFT FINAL DESIGN MARCH 25, 2025

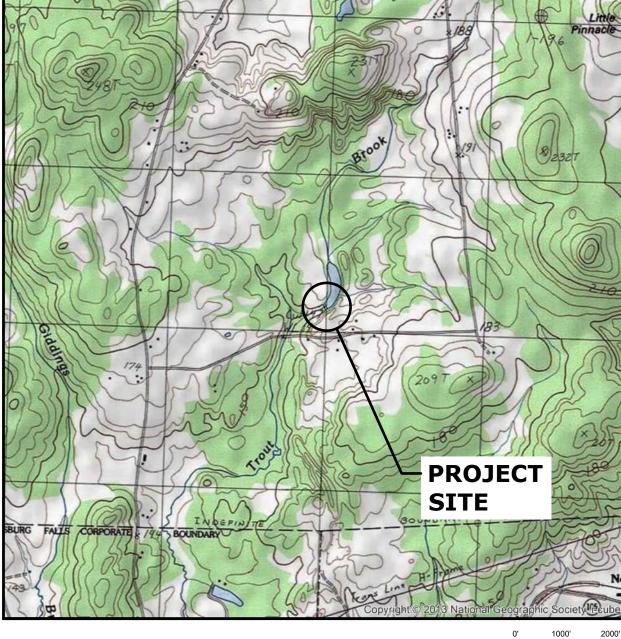


PROJECT SITE VICINITY MAP:

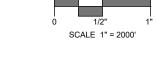


PREPARED BY:





LOCATION MAP:



PREPARED FOR:

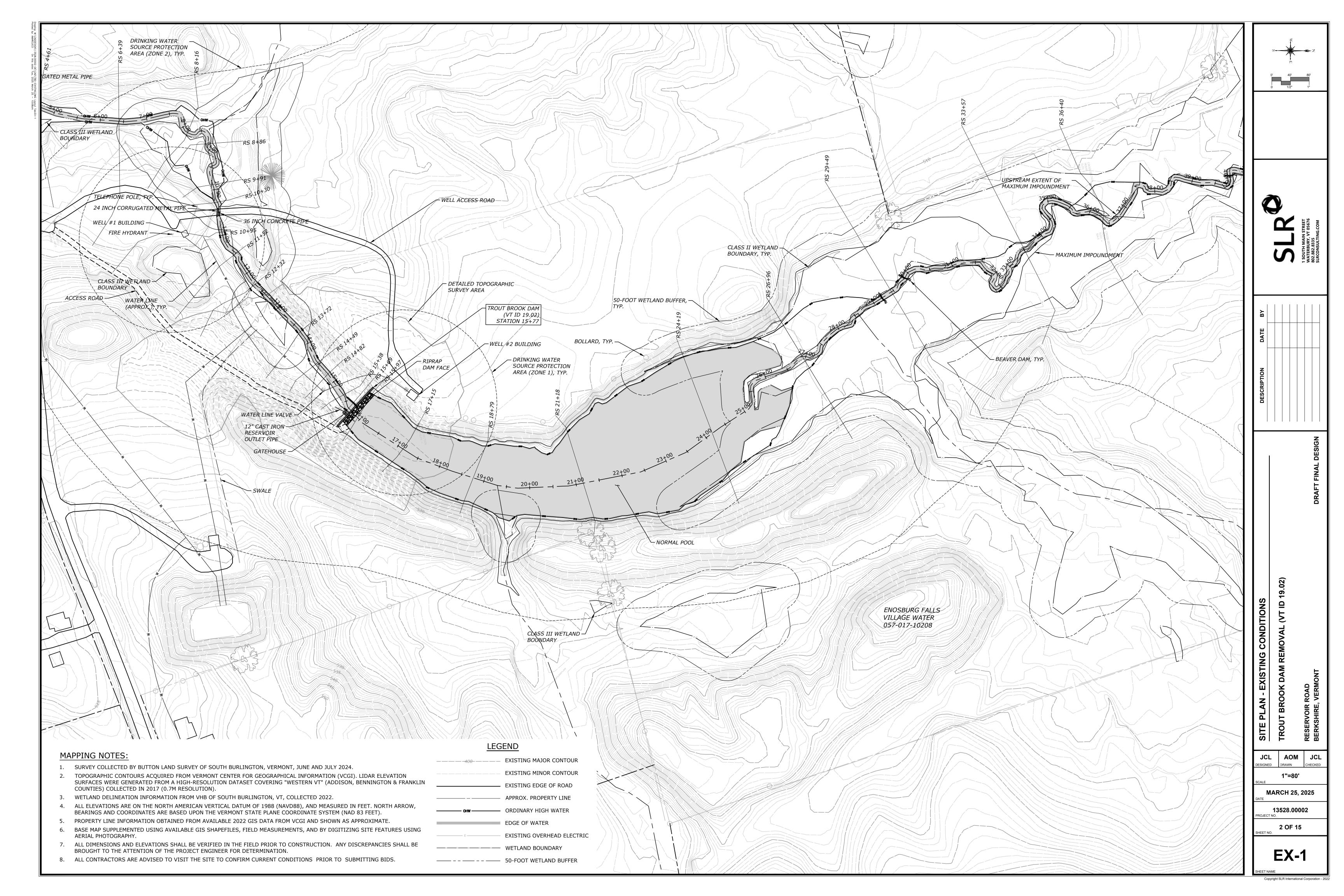
FRANKLIN COUNTY NATURAL RESOURCES CONSERVATION DISTRICT 50 SOUTH MAIN STREET, SUITE B-20 SAINT ALBANS, VT 05478

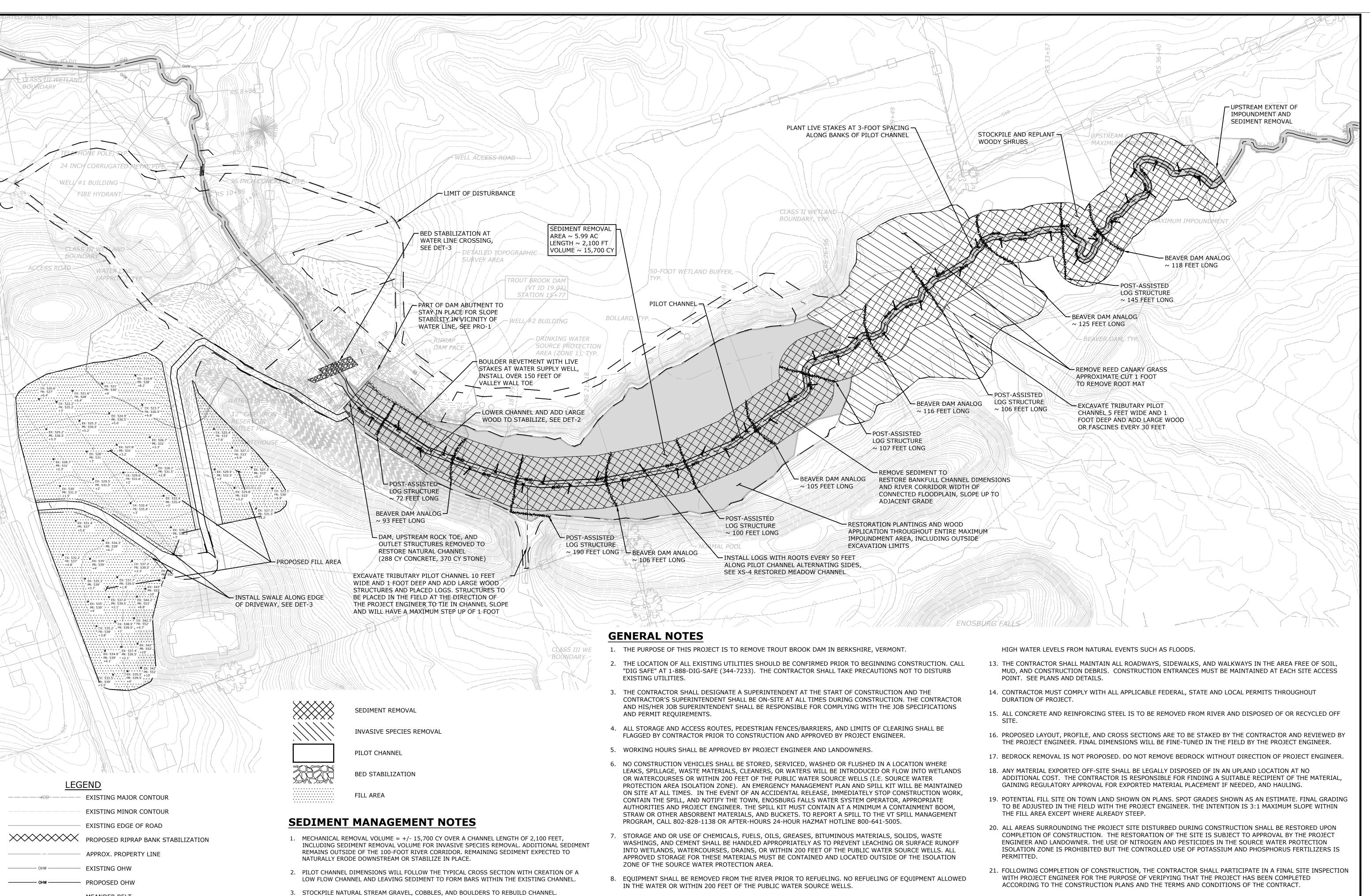


LIST OF DRAWINGS

NO.	NAME	TITLE
1		TITLE SHEET
2	EX-1	SITE PLAN - EXISTING CONDITIONS
3	PR-1	SITE PLAN - PROPOSED CONDITIONS
4	SE-1	SITE PLAN - SEDIMENT & EROSION CONTROLS
5	SE-2	SITE PLAN - SEDIMENT & EROSION CONTROLS
6	RE-1	SITE RESTORATION AND STABILIZATION PLAN
7	PRO-1	CHANNEL PROFILE AND DAM ELEVATION
8	XS-1	TYPICAL SECTIONS
9	XS-2	TYPICAL SECTIONS
10	XS-3	TYPICAL SECTIONS
11	XS-4	TYPICAL SECTIONS
12	DET-1	DETAILS I
13	DET-2	DETAILS II
14	DET-3	DETAILS III
15	DET-4	DETAILS IV







STOCKPILE BOULDERS >12" AND <48" AND LOGS OR STUMPS FOR REUSE AS CHANNEL ROUGHNESS

5. STOCKPILE WOODY SHRUBS AND KEEP MOIST IN SHADY LOCATION FOR REPLANTING.

6. TREES CLEARED OR LOGS ENCOUNTERED IN SEDIMENT TO BE REINSTALLED IN CHANNEL OR

7. LONG ARM EXCAVATOR RECOMMENDED TO LIMIT ACCESS PATH BUILDING ON SOFT SOILS.

ELEMENTS WHEN RESTORING CHANNEL BED.

FLOODPLAIN.

9. ALL EQUIPMENT AND VEHICLES SHALL BE CLEANED PRIOR TO AND FOLLOWING CONSTRUCTION TO REDUCE THE

STABILIZE THE CONSTRUCTION SITE AND REMOVE EQUIPMENT FROM FLOOD PRONE AREAS. ALL EQUIPMENT TO BE

10. THE PROJECT SITE IS SUBJECT TO FLOODING. THE CONTRACTOR SHALL MONITOR WEATHER FORECASTS AND

STORED ON HIGH GROUND AND OUTSIDE OF THE SOURCE WATER PROTECTION AREA ISOLATION ZONE, A

12. THERE SHALL BE NO CLAIMS FOR EXTRA COMPENSATION DUE TO DELAYS IN WATER CONTROL ASSOCIATED WITH

POTENTIAL FOR SPREAD OF INVASIVE SPECIES AND SEDIMENT.

11. WORK SHOULD BE PERFORMED DURING LOW WATER.

200-FOOT RADIUS CIRCLE CENTERED ON THE PUBLIC WATER SOURCE WELL.

MEANDER BELT

EXISTING WATER LINE

EXISTING OVERHEAD ELECTRIC

EDGE OF WATER

— WETLAND BOUNDARY

————— 50-FOOT WETLAND BUFFER

0' 40' 80' 0 1/2" 1"

SOUTH MAIN STREET
WATERBURY, VT 05676
302.882.8335

DESCRIPTION DATE BY

MONTH FOR OTHER PROPERTY.

REMOVAL (VT ID 19.02)

RESERVOIR ROAD BERKSHIRE, VERMONT

AOM JCL
CHECKED

1"=80'

JCL

OPERATION AND MAINTENANCE NOTES

SUCCESSFUL VEGETATION ESTABLISHMENT OF 80% AERIAL COVERAGE.

3. ANY AREAS OF POOR VEGETATIVE COVER SHALL BE REPLANTED ACCORDINGLY.

OVER TIME. THE CHANNEL WILL MOVE IN THE FUTURE.

1. DAM REMOVALS ARE INTENDED TO RESTORE STREAM DYNAMIC EQUILIBRIUM TO ALLOW THE STREAM TO MEANDER

2. PLANTED VEGETATION IS TO BE MONITORED DURING THE GROWING SEASON FOR TWO YEARS TO EVALUATE A

MARCH 25, 2025

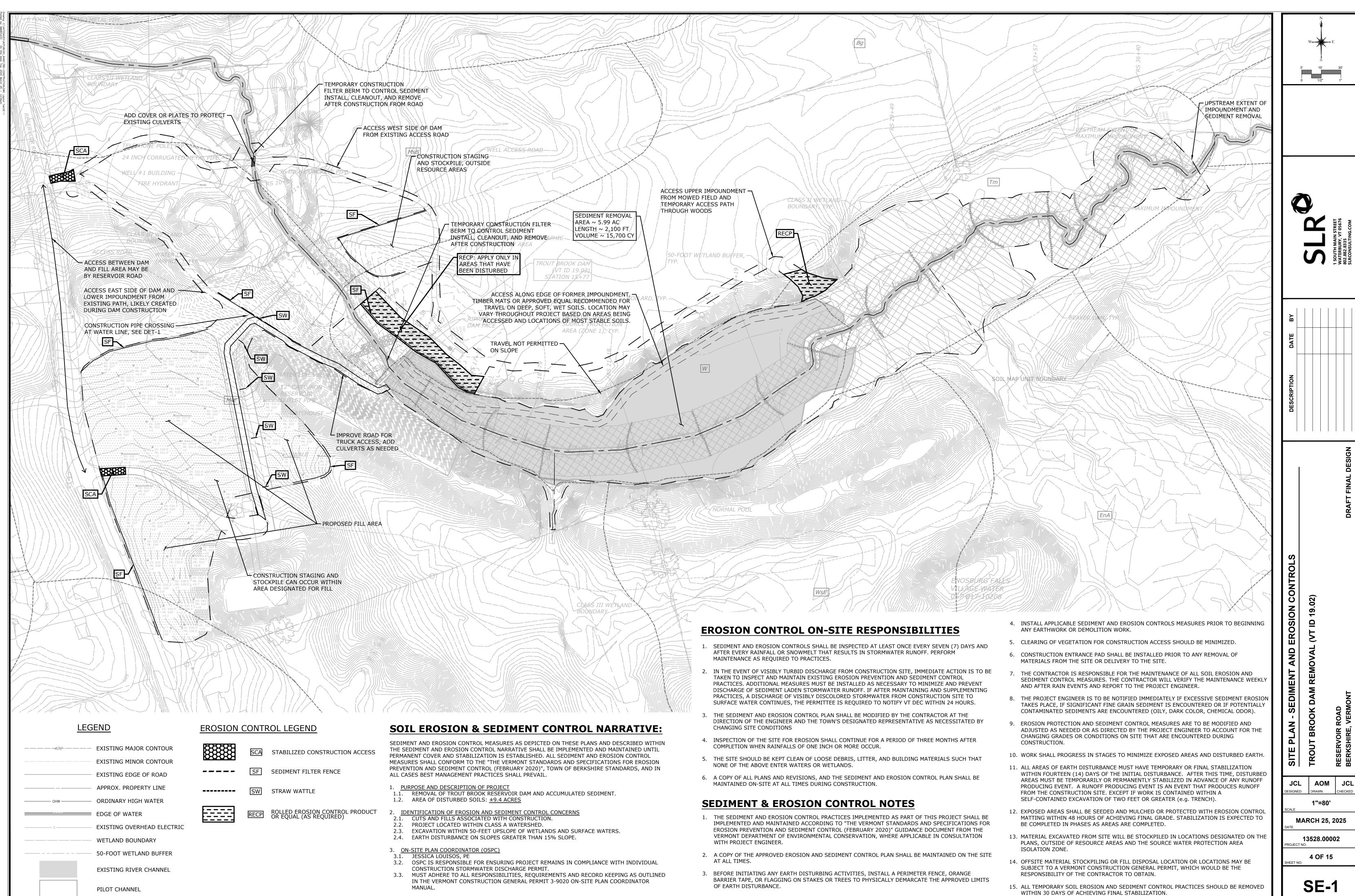
13528.00002 NO.

3 OF 15

PR-1

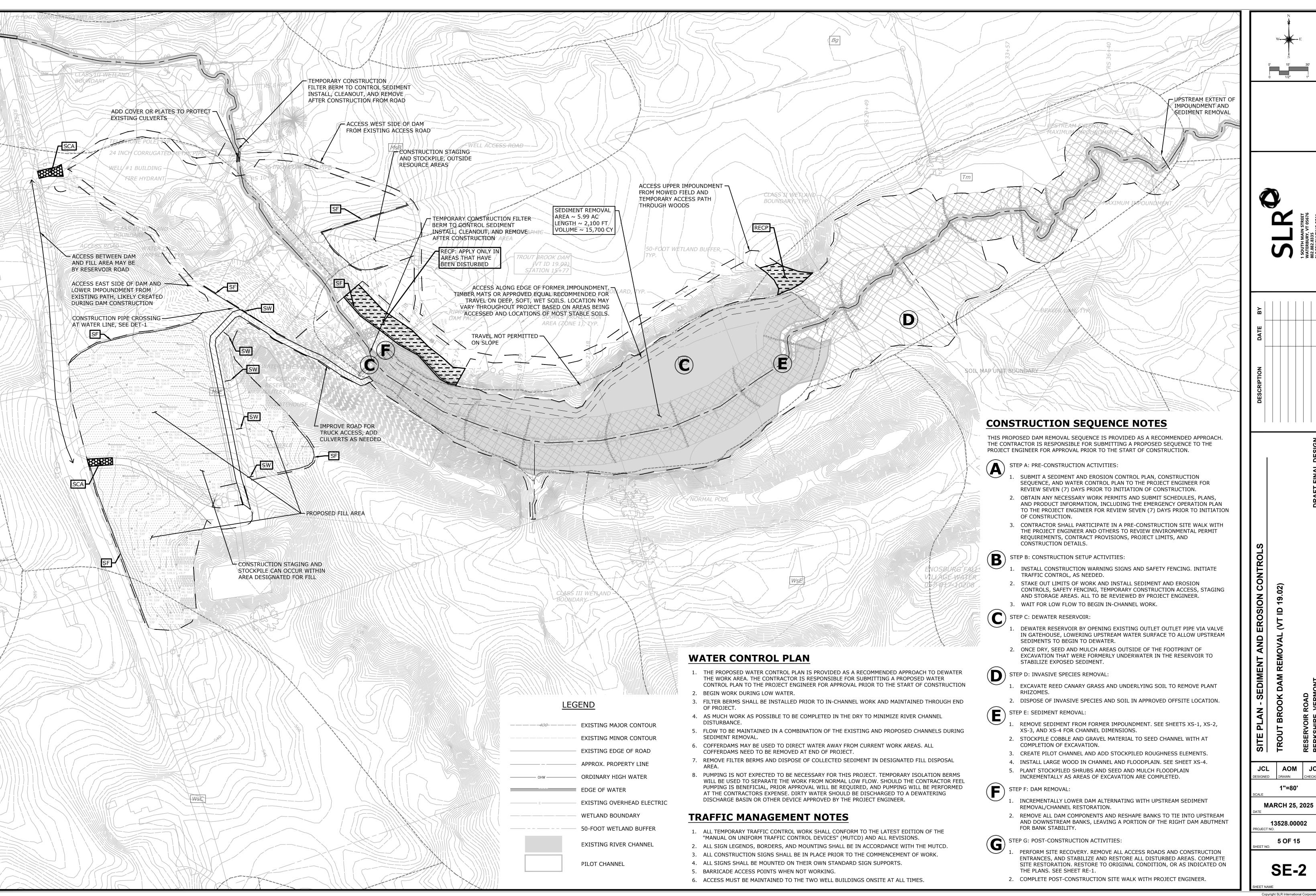
EET NAME

Copyright SLR International Corporation -

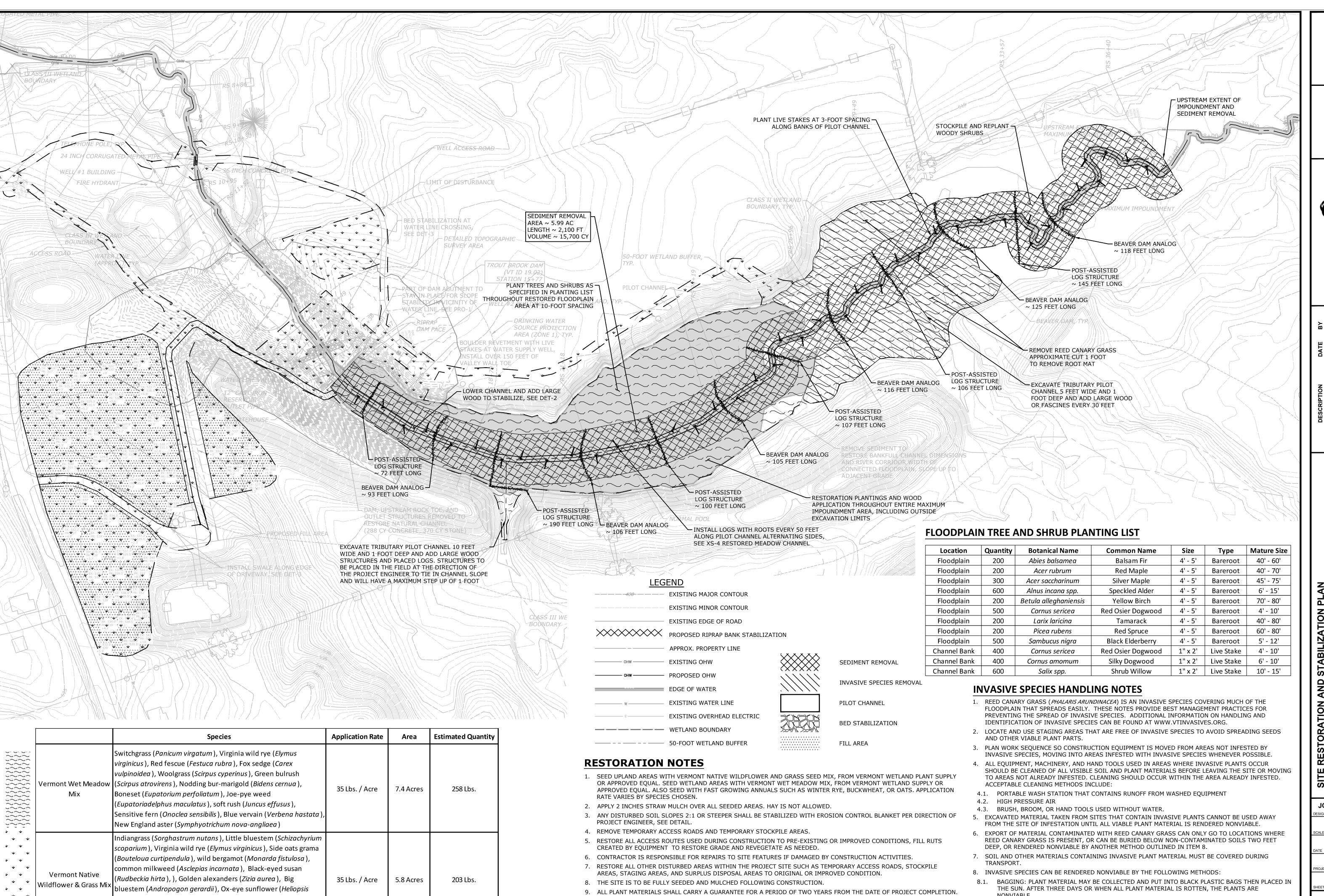


EET NAME

Copyright SLR International Corporation - 2



AOM JCL



helianthoides), Showy ticktrefoil (Desmodium canadense),

Lanceleaf tickseed (Coreopsis lanceolata), Sneezeweed (Helenium

autumnale), and Great St. Johnswort (Hypericum pyramidatum)

9. ALL PLANT MATERIALS SHALL CARRY A GUARANTEE FOR A PERIOD OF TWO YEARS FROM THE DATE OF PROJECT COMPLETION.

WHERE SEED DID NOT ESTABLISH WHERE OVER-SEEDING WILL BE REQUIRED. ALL REPLACEMENTS SHALL BE OF THE SAME

UNSATISFACTORY GROWTH (MORE THAN 20% DIEBACK). THIS ALSO APPLIES TO AREAS OF POOR VEGETATION COVER

THIS WILL INCLUDE REPLACEMENT OF TREES AND SHRUBS FOUND TO BE DEFECTIVE INCLUDING DEATH AND

KIND AND SIZE OF PLANTS SPECIFIED IN THE PLANT LIST.

NONVIABLE.

NECESSARY PERMITS BEFORE BURNING.

8.2. BURNING: PLANT MATERIAL SHOULD BE TAKEN TO A DESIGNATED BURN PILE. OBTAIN ALL

8.3. BURYING: REED CANARY GRASS MUST BE BURIED AT LEAST 2 FEET BELOW GROUND.

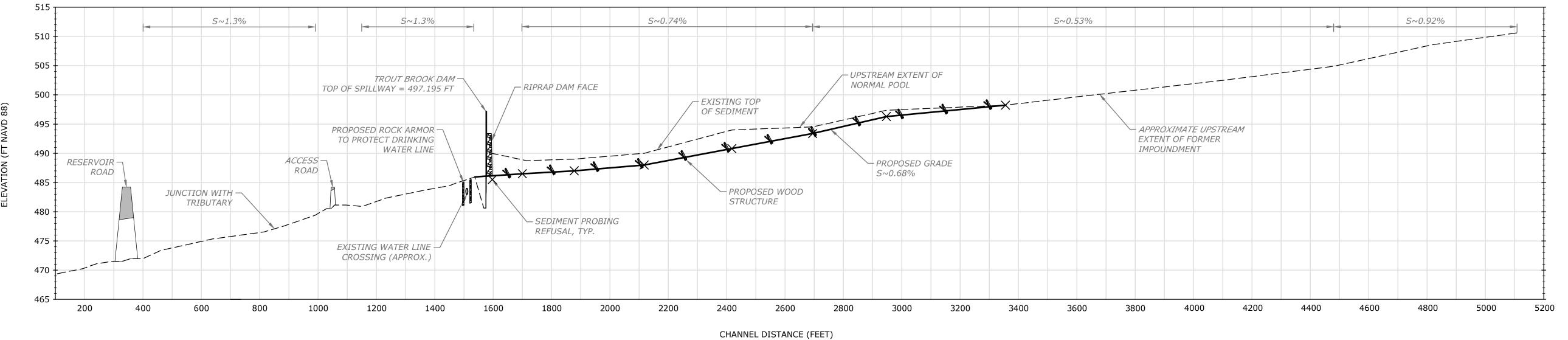
JCL AOM JCL 1"=80"

MARCH 25, 2025

13528.00002

6 OF 15

RE-1

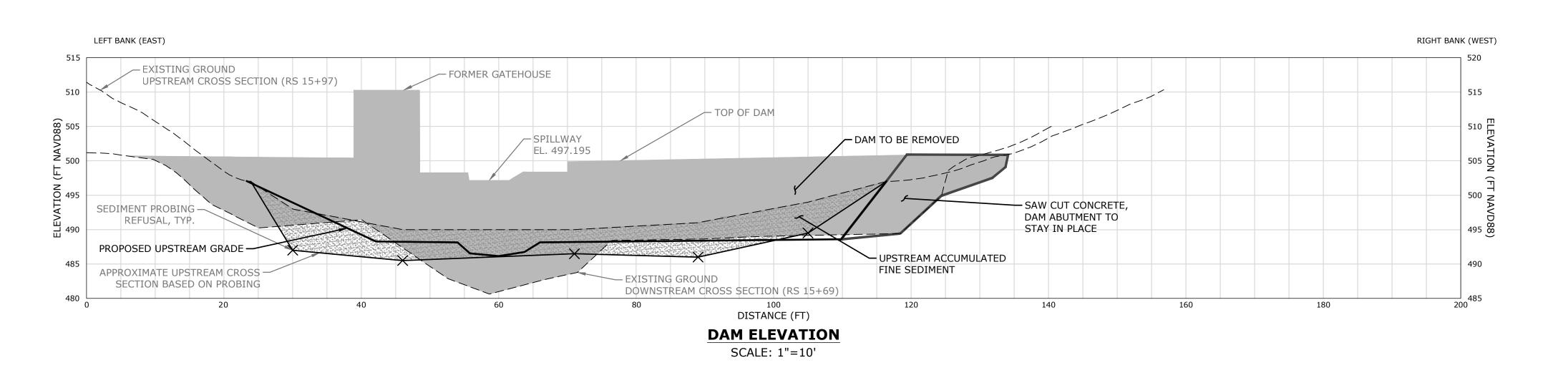


TROUT BROOK CHANNEL PROFILE

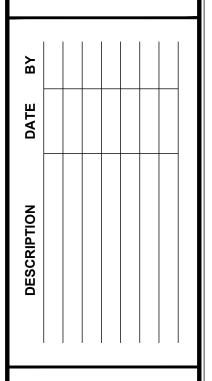
SCALE: H: 1"=200', V: 1"=10'

*NOTE: PROFILE BASED ON LIDAR DATA, DECEMBER 2021 AND JUNE/JULY 2024 SURVEY, AND MAY/JUNE 2023 FIELD MEASUREMENTS

(SECTION VIEWED LOOKING DOWNSTREAM)



S L SOUTH MAIN STREET WATERBURY, VT 05676 802.882.833



ROUT BROOK DAM REMOVAL (VT ID 19.02)

JCL DESIGNED DRAWN JCL CHECKED

AS NOTED

SCALE

MARCH 25, 2025

DATE

13528.00002

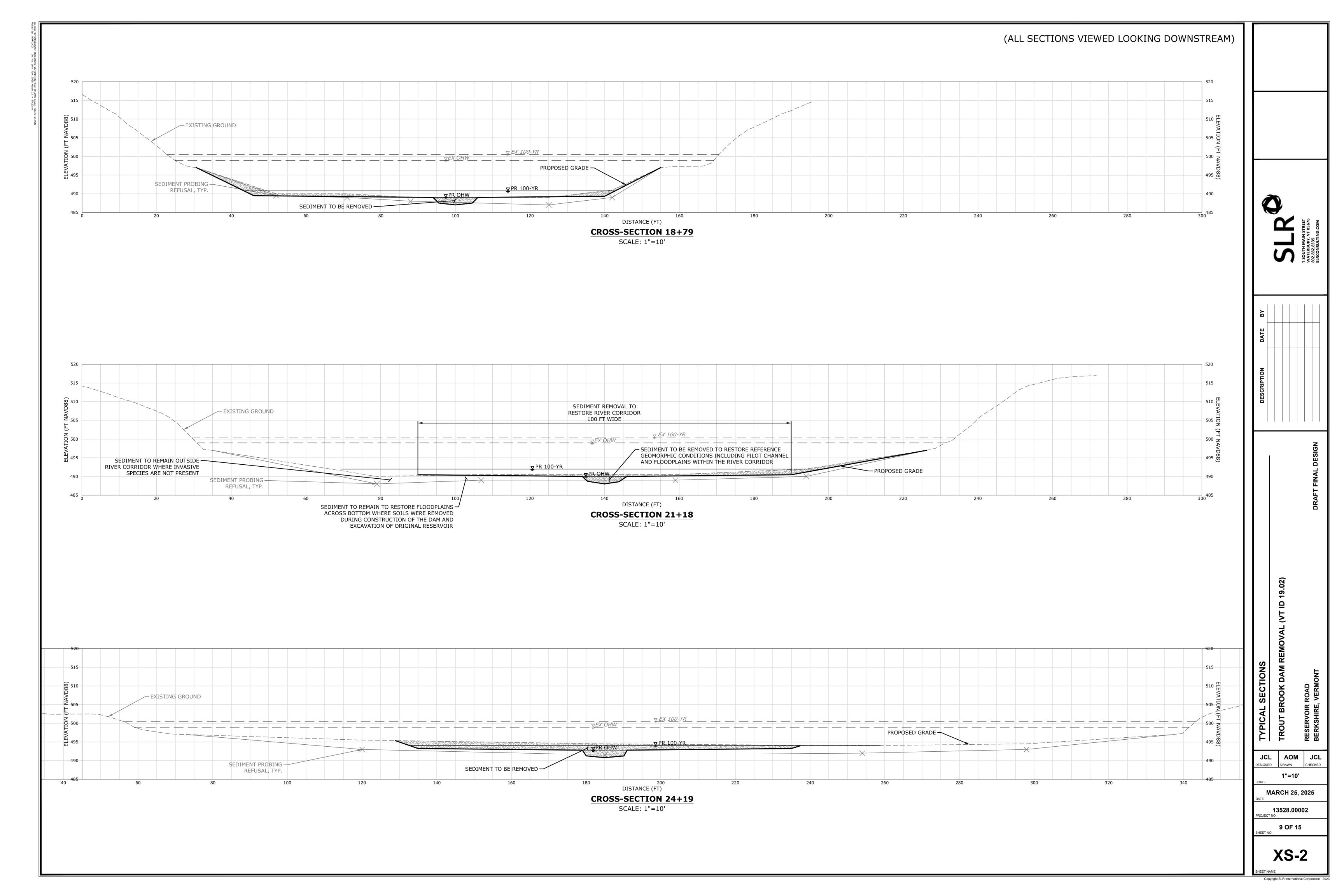
PROJECT NO.

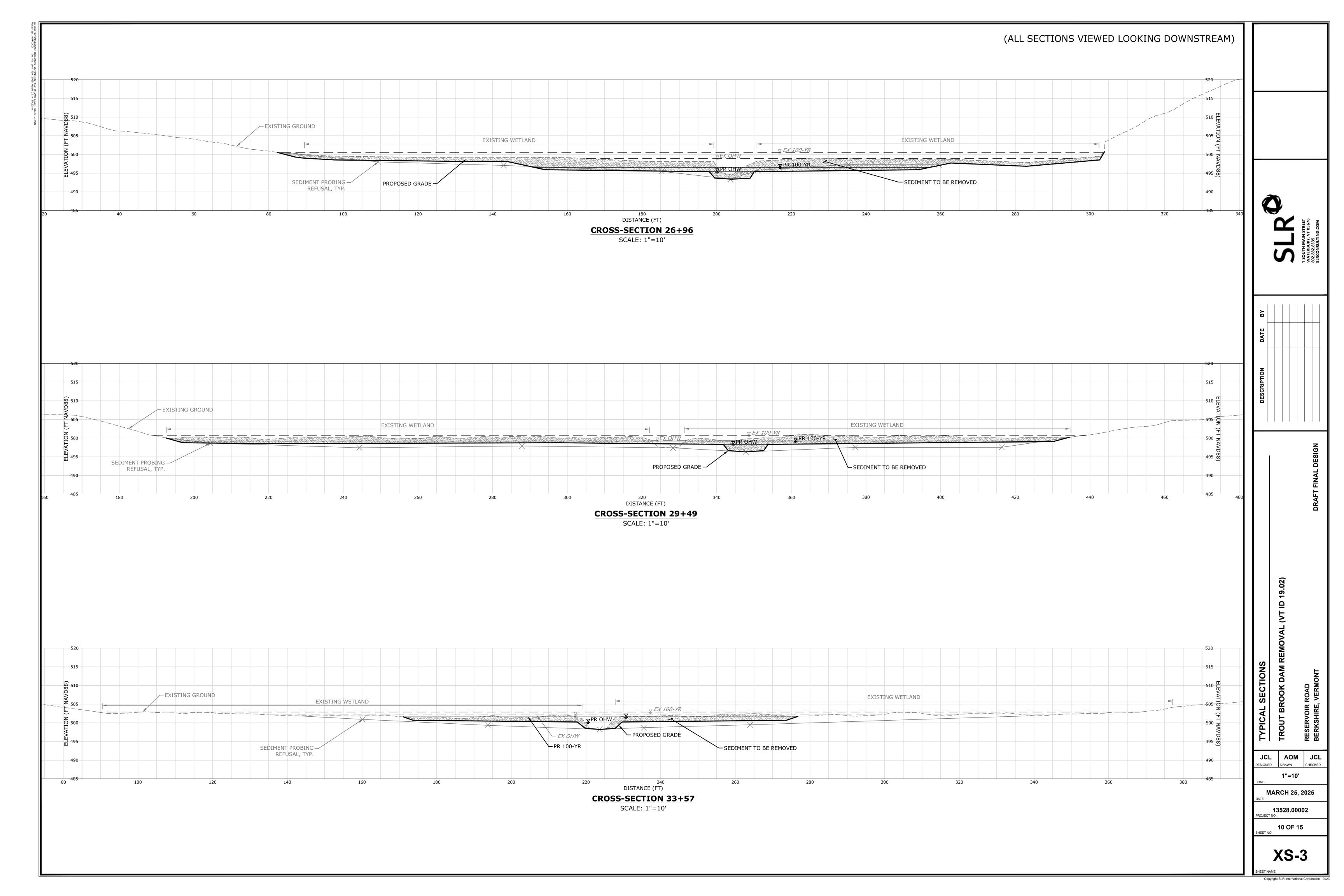
7 OF 15

PRO-1

T NAME

Copyright SLR International Corporation





CROSS-SECTION 36+40

SCALE: 1"=10'

CROSS SECTION NOTES

- 1. CROSS SECTIONS VIEWED LOOKING DOWNSTREAM.
- 2. CONSTRUCTED CHANNEL TO BE CONSTRUCTED USING NATIVE CHANNEL BED MATERIAL, OR BE COMPOSED OF EXISTING BEDROCK, WITH ROUGHNESS (SEE DETAILS).
- 3. CHANNEL TYPE (BEDROCK OR SEDIMENT) TO BE REFINED IN FIELD WITH PROJECT ENGINEER AFTER DEWATERING AND SEDIMENT REMOVAL.

4. BEDROCK CHANNEL SECTIONS

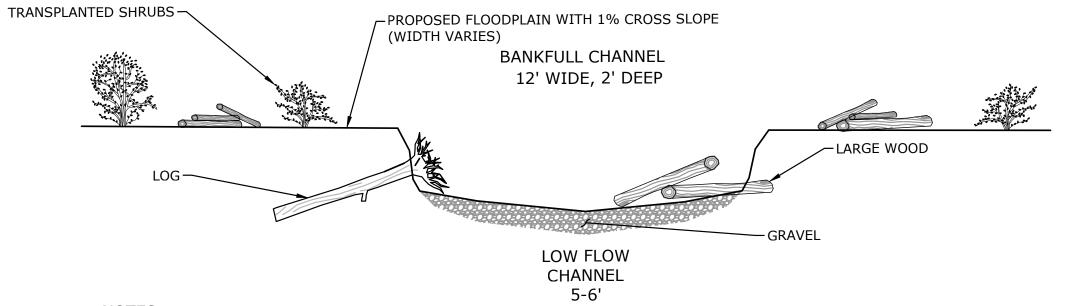
4A. DO NOT ATTEMPT TO MATCH PROPOSED GRADING IN AREAS WHERE BEDROCK IS **ENCOUNTERED**

- 4B. BEDROCK NOT TO BE REMOVED
- 4C. LOW-FLOW CHANNEL SET BY BEDROCK

5. RIVER SEDIMENT CHANNEL SECTIONS

5A. REFER TO RESTORED CHANNEL BED AND TYPICAL CHANNEL SECTION DETAILS

5B. ALIGNMENT OF THE LOW-FLOW CHANNEL TO BE LOCATED IN THE FIELD DURING CONSTRUCTION BY THE PROJECT ENGINEER.



NOTES:

- 1. SET LOW FLOW CHANNEL WIDTH TO APPROXIMATELY $\frac{1}{2}$ THE BANKFULL CHANNEL WIDTH.
- 2. SEE TYPICAL CHANNEL DIMENSIONS.
- 3. ALIGNMENT OF THE LOW FLOW CHANNEL TO BE LOCATED IN THE FIELD DURING CONSTRUCTION BY THE PROJECT ENGINEER.
- 4. PROPOSED CHANNEL TO BE CONSTRUCTED USING NATIVE CHANNEL BED MATERIAL. MAINTAIN ROUGH AND IRREGULAR CROSS SECTION.
- 5. SEED PROPOSED CHANNEL BED AND FLOODPLAIN WITH LARGE WOOD AS DIRECTED BY THE PROJECT ENGINEER.
- 6. CHANNEL BED SHOULD BE ROUGH AND "MESSY". SEE UNDAMMED CHANNEL FOR LOCAL EXAMPLE. WOOD TO BE EMBEDDED IN SEDIMENT PER ENGINEER'S DIRECTION IN FIELD TO CREATE HABITAT FEATURES. PLACE NATIVE BOULDERS IN CHANNEL.
- 7. ADD A 6" MINIMUM LAYER OF RIVER GRAVEL ACROSS CHANNEL BOTTOM IF MUCK SOILS ARE UNCOVERED WITHIN THE EXCAVATED

RESTORED MEADOW CHANNEL NOT TO SCALE

Β				
DATE				
DESCRIPTION				

JCL AOM JCL 1"=10' **MARCH 25, 2025** 13528.00002

XS-4

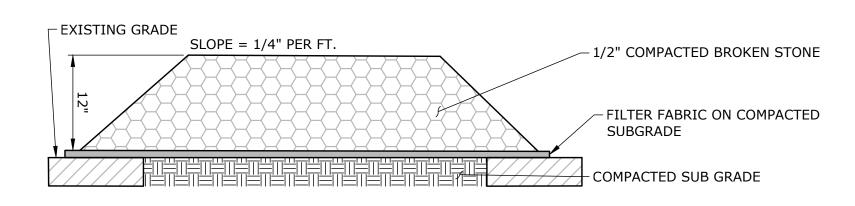
11 OF 15

NOTES:

 STRIP TOP SPOIL AND STORE FOR REUSE.
 WITHIN IMPOUNDMENT USE CLEAN TRACK MATS WITH NO INVASIVE SPECIES CONTAMINATION TO ACCESS OVER SOFT SOILS

CONSTRUCTION ACCESS ROAD

NOT TO SCALE



NOTES:

1. STRIP TOP SPOIL AND STORE FOR REUSE.

CONSTRUCTION PIPE CROSSING

NOT TO SCALE

Part 5 - Stabilized Construction Access

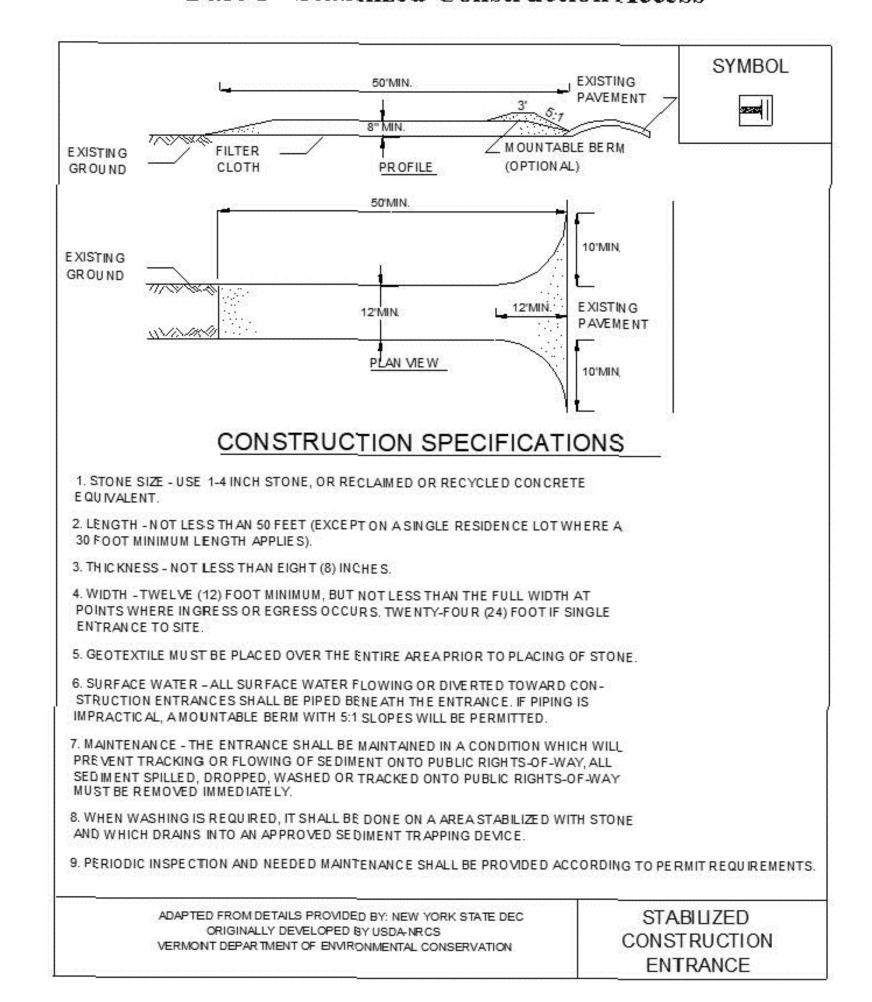


Figure 5.4 Stabilized Construction Access

STONE FILL TYPE II (D50 = 12")

SETTLING BASIN
BOTTOM

WIDTH=
8 FT MIN.

CROSS SECTION

STONE FILTER BERM

Part 5 - Silt Fence

NOT TO SCALE

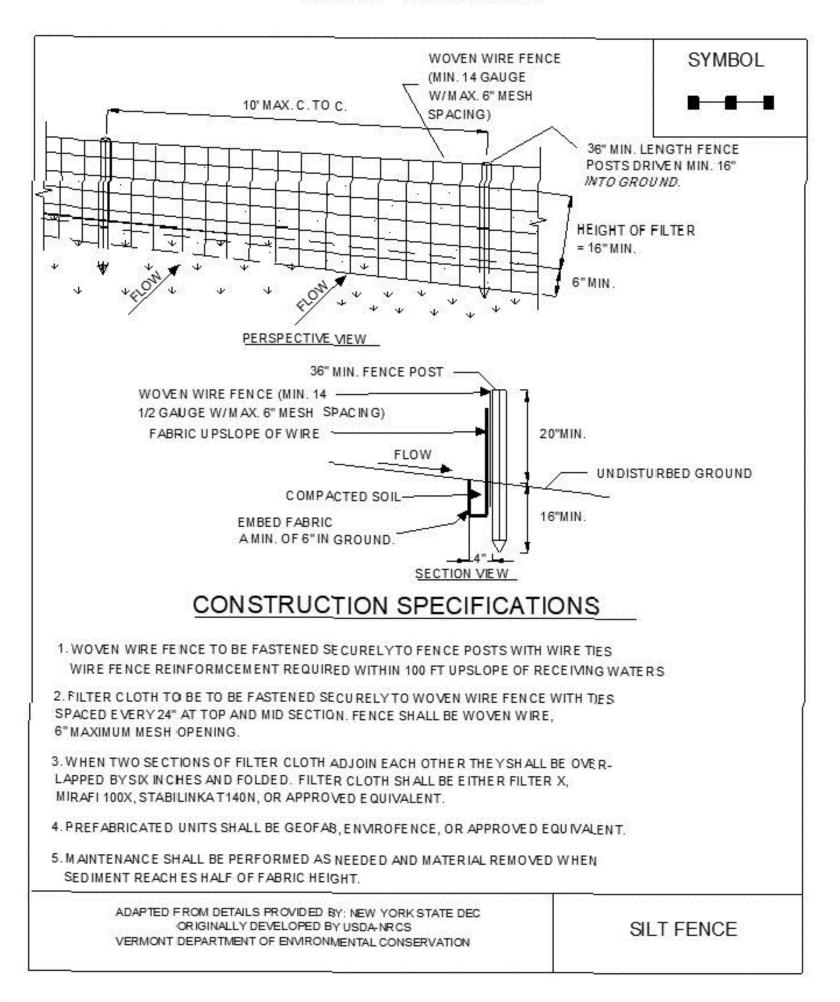
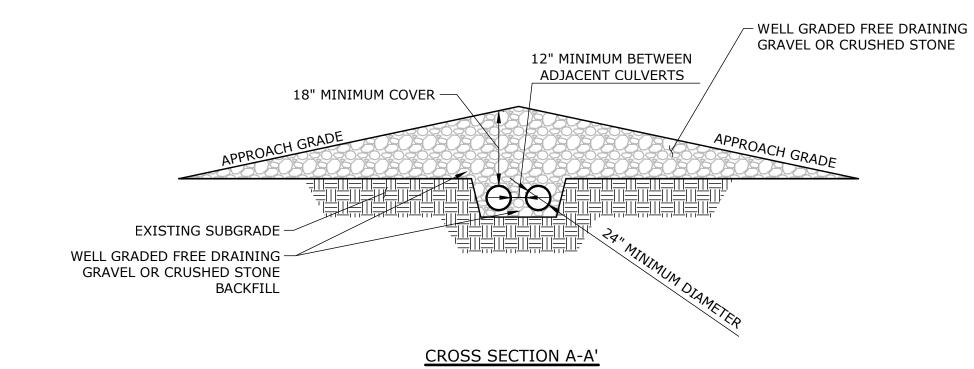
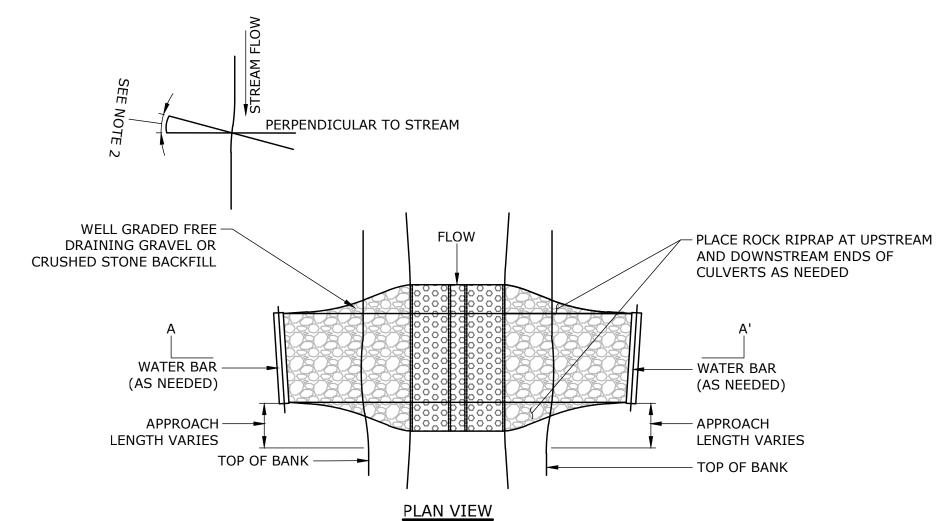


Figure 5.1 Silt Fence



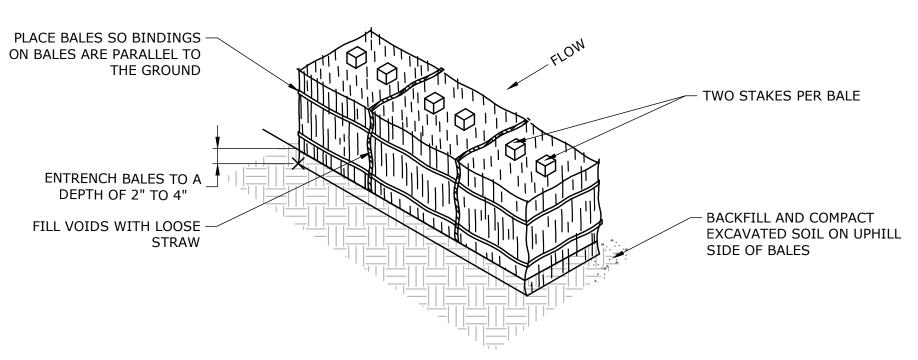


NOTES:

- 1. CULVERT LENGTH SHALL NOT EXCEED 40 FEET.
- 2. THE CENTER OF THE STREAM CROSSING SHALL BE ALIGNED SO THAT IT IS NO GREATER THAN 15° FROM A LINE PERPENDICULAR TO THE STREAM FLOW.
- 3. CULVERTS SIZED TO CONVEY AVERAGE JULY FLOW WITH HEADWATER/DEPTH=0.8.

TEMPORARY CULVERT CROSSING

NOT TO SCALE



NOTES:

- IDEALLY BALES SHOULD BE ENTRENCHED 2 TO 4 INCHES AND TIGHTLY BUTTED TOGETHER. BALES CAN BE SUCCESSFULLY PLACED WITHOUT A TRENCH IF GOOD GROUND CONTACT IS MADE. REMOVE HEAVY BRUSH AND FILL ALL VOIDS WITH LOOSE STRAW.
- 2. BALES SHALL BE ONLY USED AS A TEMPORARY BARRIER AND FOR NO LONGER THAN 60 DAYS
- 3. WHEN SEDIMENTATION DEPOSITS REACH WITHIN 3" OF THE TOP OF BALES, REMOVE THE SEDIMENTATION OR ADD ADDITIONAL BALES ON SEDIMENTATION DIRECTLY BEHIND FIRST ROW OF BALES AS DIRECTED BY THE ENGINEER.
- 4. UPON ESTABLISHMENT OF GROUND COVER ON DISTURBED AREAS AND WHEN DIRECTED BY THE ENGINEER, HAY BALES WILL BE REMOVED AND USED AS MULCH. ANY SEDIMENTATION WILL BE THINLY SPREAD UPON ESTABLISHED GROUND COVER.

STRAW BALE BARRIER PROTECTION

SERCONSULTING.COM

DESCRIPTION DATE BY

DRAFT FINAL DESIGN

OK DAM REMOVAL (VT ID 19.02)

JCL AOM JCL CHECKED

NOT TO SCALE

MARCH 25, 2025

13528.00002 NO. 12 OF 15

DET-1

X-SECTION VIEW

PLANFORM VIEW

WOOD STRUCTURE NOTES:

INSTALL ACROSS FLOODPLAIN

AREAS AS SHOWN ON SHEET PR-1

SET STRUCTURE TO BANKFULL

Lay branches in overflow mattress

parallel to flow paths.

- EXTEND ACROSS FLOODPLAIN

Lay branches parallel to flow on downstream side and build up a mattress to dissipate overflow

FINISHING STEP

Build up subsequent layer(s) in 6 to 12" lifts, packing well with

Bring dam up to desired design crest elevation. Make sure crest of

dam is perfectly level (so no preferential flow or weir exists). If

stream is flowing, water should be backed up and ponding, but flow over and through dam should equilibrate so that flow into pond

Figure 31 – Sequence for building postless BDAs, build up in 6" to 12" lifts, slowly, like beaver do. Make sure that your lifts are level, and wat is backed up sufficiently that is flowing over the crest evenly (as opposed to through or under the dam), and the base is broad, before building it

mud, turf, leaves, needles, sediment and other material until

ponding water to this next temporary crest elevation.

equals flow out lover and through leaky dam).

ELEVATION. SEE SHEETS XS-1, XS-2, XS-3, AND XS-4 FOR ELEVATIONS

- 1. FINAL LOCATION AND SHAPE OF WOOD STRUCTURES WILL BE DETERMINED DURING INSTALLATION. LOCATION SHOWN ON PLANS IS CONCEPTUAL AND EXPECTED TO BE ADJUSTED IN THE FIELD.
- . POSTS AT UPSTREAM STRUCTURES TO BE INSTALLED TO DEPTH BELOW POTENTIAL NATURAL RIVER CHANNEL SLOPE SHOWN ON SHEET PRO-1.
- . WOOD IS EXPECTED TO BE MESSY AND NATURAL LOOKING. MATERIALS
- 4. NO INVASIVE SPECIES WILL BE USED IN CONSTRUCTION OF WOOD

AND CONFIGURATION WILL VARY DUE TO NATURAL MATERIALS.

WOOD STRUCTURES ARE NOT PERMANENT AND WILL EVOLVE OVER TIME INCLUDING BREACHING AND NATURALIZATION INTO THE RIVER SYSTEM. THEY ARE EXPECTED TO ADD TEMPORARY RESISTANCE TO EROSION AND

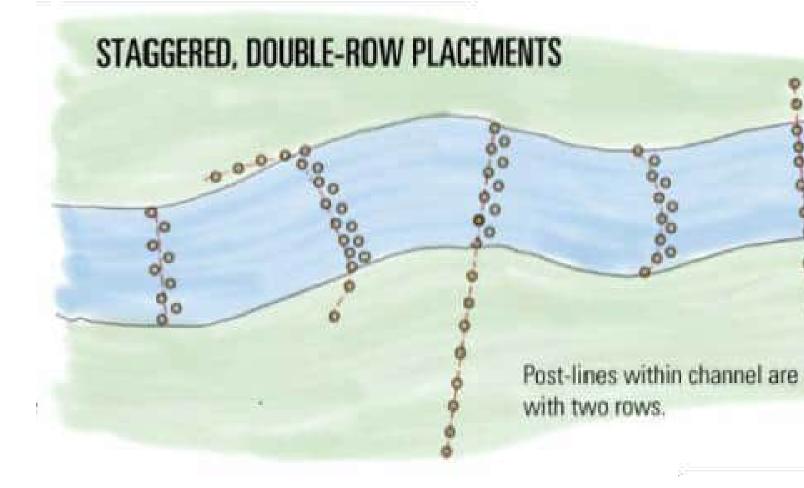
> MUD, BED MATERIAL, TURF, AND STICKS TO BE USED TO FILL IN AREAS BETWEEN POSTS AND LARGER PIECES OF WOOD

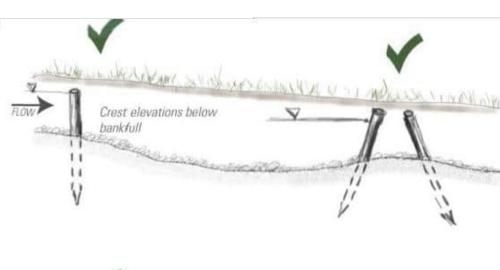
PROFILE VIEW Drive posts in to bed angled inwards to wedge wood pieces and prevent them Start with key pieces oriented stream-wise from rafting up and floating away in and face butt end or root wed upstream to high flows. maximize width that will create divergent. flow paths around it. Use a mix of sizes of wood and tengle together with branches. X-SECTION VIEW Design height for channel-spanning structures is important. If it is intended Structure can protrude above typical high flow stages

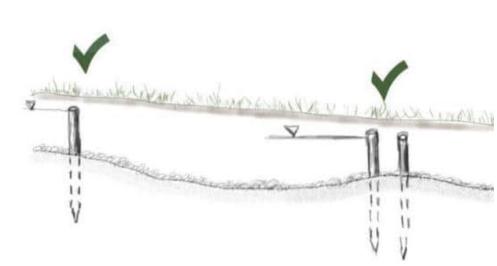


PLANFORM VIEW Take advantage of branches on key pieces to position posts as pins to temporarily anchor and wedge See XS View structure in place Floodplain or Terrace

Layout key pieces with butt ends (or root-wads, if to flow is fine. NOT-TO-SCALE







NOTES:

PROPOSED GRADE -

1. POST-ASSISTED BEAVER DAM ANALOGS TO BE INSTALLED IN PILOT CHANNEL THROUGHOUT ACTIVE EXCAVATION AREA. BDAS WILL SPAN THE BANKFULL CHANNEL AND EXTEND OUT ONTO THE FLOODPLAIN.

to your next layer.

2. IT IS ANTICIPATED THAT A VARIETY OF TECHNIQUES WILL BE USED AND ARE TO BE DETERMINED BY THE PROJECT ENGINEER.

DEPTH OF POSTS BELOW BED TO BE AT LEAST

1.5 FEET DEEP, EXCEPT WHERE BEDROCK MAY

PROFILE VIEW

riffles, but placing them on relative high spots does limit the height and material needed.

Build up first layer only to just above existing water surface

and make sure crest is level across bed and its pooling water

upstream to this temporary crest elevation

Use mud, bed material & turf sourced from backwater

area combined with sticks of various sizes to build wide base.

Make sure base is wide enough to accommodate designed height.

NOTE BDAs do not need to be positioned on bars or

STEP 1 Decide where to locate BDA along stream —

BE PRESENT AROUND FORMER DAM AND AS

SPECIFIED IN WOOD STRUCTURE NOTES

Floodplain or Terrace

- 3. SCHEMATICS FROM UTAH STATE DESIGN GUIDANCE DOCUMENT "LOW-TECH PROCESS-BASED RESTORATION OF RIVERSCAPES: DESIGN MANUAL" (SHAHVERDIAN ET AL., 2019). SECTION VIEW MODIFIED BY SLR.
- 4. TRENCH WOOD ACROSS FLOODPLAIN AREAS. GENERAL ELEVATION ACROSS FLOODPLAIN IS LEVEL WITH NATURAL VARIATION OF TOP ELEVATION.

POST-ASSISTED BEAVER DAM ANALOG

NOT TO SCALE

- POST-ASSISTED LOG STRUCTURES TO BE INSTALLED IN PILOT CHANNEL THROUGHOUT ACTIVE EXCAVATION AREA. PALS WILL SPAN THE BANKFULL CHANNEL AND EXTEND OUT ONTO THE FLOODPLAIN.
- 2. IT IS ANTICIPATED THAT A VARIETY OF TECHNIQUES WILL BE USED AND ARE TO BE DETERMINED BY THE PROJECT ENGINEER.
- 3. SCHEMATICS FROM UTAH STATE DESIGN GUIDANCE DOCUMENT "LOW-TECH PROCESS-BASED RESTORATION OF RIVERSCAPES: DESIGN MANUAL" (SHAHVERDIAN ET AL., 2019).

POST-ASSISTED LOG STRUCTURE NOT TO SCALE

JCL AOM JCL **NOT TO SCALE**

MARCH 25, 2025 13528.00002.00009

13 OF 15

DET-2

Post-lines within channel are staggered

DRINKING WATER LINE

- LIVE STAKES - EXISTING GRADE ADD TOPSOIL TO BOULDER REVETMENT AT 2:1 REVETMENT STONES VTRANS TYPE III MIN. ROCK=12" DIA. D50=18" DIA MAX. ROCK=24" DIA. COMPACTED EARTHEN FILL FOUNDATION STONES VTRANS 5' MIN. TYPE III NATIVE COMPACTED MATERIAL BASE

BOULDER REVETMENT NOTES:

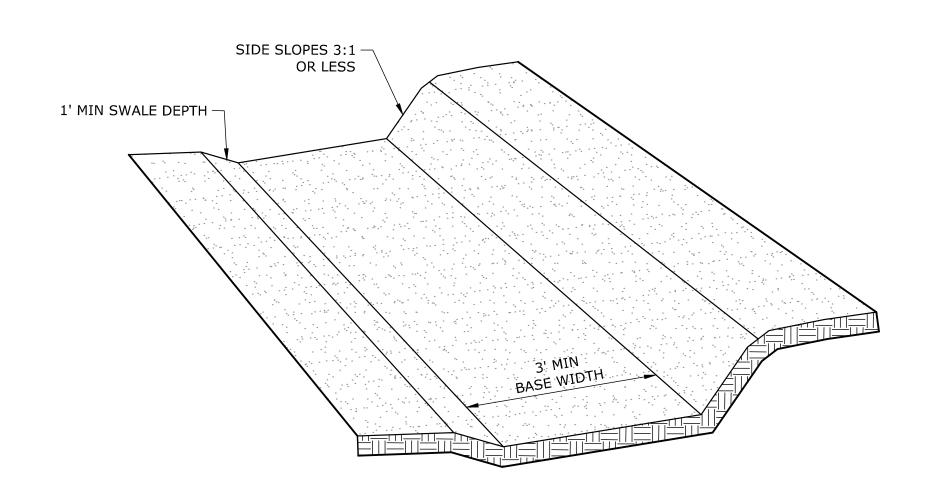
- 1. EMBED STONE A MINIMUM OF 4 FEET INTO THE STREAM BANK TO KEY INTO THE BANK.
- 2. FINISHED ELEVATION OF THE STONES AS SHOWN ON CROSS SECTIONS AND SUBJECT TO ADJUSTMENT BY PROJECT ENGINEER DURING CONSTRUCTION.
- 3. IF BEDROCK IS ENCOUNTERED THE FIRST COURSE OF ROCK SHALL BE PINNED A MINIMUM OF 2 TIMES PER ROCK UNLESS OTHERWISE DIRECTED BY THE ENGINEER. THE DRILLED HOLES SHALL BE A MINIMUM OF 1 ½ INCHES IN DIAMETER AND EXTEND A MINIMUM OF 12 INCHES INTO THE ROCK BELOW. A #8 REBAR SHALL BE USED AS THE PIN IN EACH HOLE. THE REBAR SHALL BE CUT SO THAT IT IS RECESSED 2 TO 6 INCHES DOWN INTO THE ROCK.

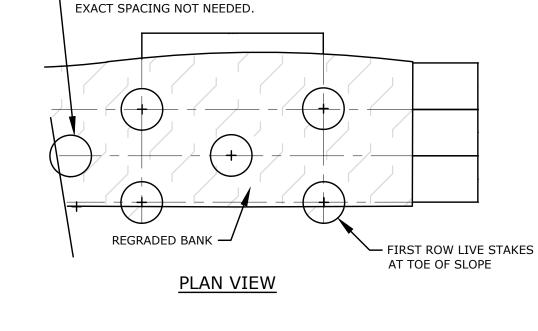
BOULDER REVETMENT KEY NOTES:

- 1. EMBED THE STONE A MINIMUM OF 4 FEET INTO THE FLOODPLAIN AND 8 FEET INTO THE SLOPE TO KEY.
- 2. FINISHED ELEVATION OF THE STONES AS SHOWN ON CROSS SECTIONS AND SUBJECT TO ADJUSTMENT BY PROJECT ENGINEER DURING CONSTRUCTION.

BOULDER REVETMENT WITH LIVE STAKES

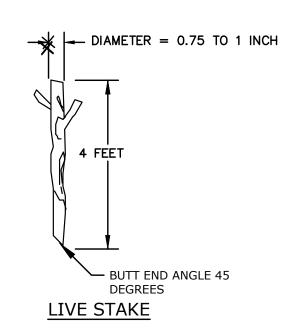
NOT TO SCALE



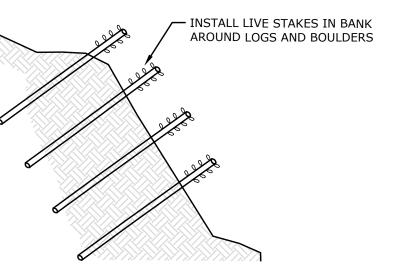


ATTEMPT 3 FOOT ON CENTER SPACING BASED ON

POSSIBLE PLANTING LOCATIONS BETWEEN RIPRAP.



GRASSED SWALE NOT TO SCALE



SECTION VIEW

LIVE STAKE PLANTING NOTES:

- USE ONSITE WILLOW AND DOGWOOD OR SIMILAR NATIVE SPECIES.
- WILLOW AND DOGWOOD BRANCHES MUST BE HARVESTED DORMANT. COLD STORAGE MUST BE MAINTAINED BEFORE PLANTING. 3. INSTALL 4' LONG LIVE STAKES SPACED 3' ON CENTER. THESE ARE TO BE INSERTED INTO
- PREDRILLED PILOT HOLES SLIGHTLY LARGER THAN THE STAKE DIAMETER AND BACKFILLED. STAKES SHOULD BE INSERTED TO 36" DEPTH.
- 4. LIGHTLY TAMP TOPSOIL AROUND EACH STAKE AND SATURATE WITH WATER. 5. SEED BANK WITH RIPARIAN AREA SEED MIX. THE SLOPE SHOULD BE HAND RAKED TO SCARIFY THE SOIL SURFACE, THEN HAND SEEDED, HYDROMULCHED OR HAND SPREAD
- WITH A STRAW MULCH, AND RAKED LIGHTLY TO ENSURE SEED TO SOIL CONTACT. 6. PLANT MATERIALS SHOULD BE PLANTED THE DAY THEY ARRIVE ON SITE. PLANTS AND CUTTINGS THAT CANNOT BE PLANTED THE DAY THEY ARRIVE SHALL BE STORED ON SITE UNDER A WET TARP TO PROTECT THEM FROM WIND, DIRECT SUNLIGHT, DRYING OR OTHER DAMAGE. CUTTINGS OR UNROOTED STOCK THAT IS NOT PLANTED WITHIN TWO DAYS AFTER ARRIVAL ON THE SITE SHALL BE DISCARDED UNLESS REFRIGERATED AT 40
- TO 50 DEGREES FAHRENHEIT. 7. WILLOW CUTTINGS FOR BIOENGINEERNIG SHOULD BE SOAKED 24 - 48 HOURS PRIOR TO INSTALLATION.

PLANTING NOTES:

- 1. THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL UNDERGROUND UTILITIES PRIOR TO EXCAVATING PLANT PITS.
- 2. PLANTINGS SHALL BE LIMITED TO THE PERIODS OF APRIL 15 JULY 15 OR SEPTEMBER 15 NOVEMBER 30. 3. BAREROOT TREES CAN ONLY BE PLANTED DURING EARLY SPRING OR FALL. POTTED STOCK MAY BE SUBSTITUTED WITH APPROVAL FROM PROJECT ENGINEER IF PLANTING PERIOD FALLS WHEN NOT SUITABLE FOR BAREROOT.
- 4. TREES SHOULD BE PLANTED ROUGHLY 10 FEET ON CENTER, FOR A DENSITY OF 400/ACRE DISTRIBUTED TO NOT IMPACT EXISTING VEGETATION. LIVE STAKES SHOULD BE GROUPED INTO AREAS OF 5-10 EACH AND CONCENTRATED NEAR THE LOWER PORTION OF THE BANK.
- ORGANIC MATTER (LEAF COMPOST). 6. THE LANDSCAPE CONTRACTOR SHALL PROVIDE A 4" MIN. DEPTH OF SHREDDED MULCH EXTENDING 1 FOOT BEYOND EACH PLANTING HOLE.

5. IN TREE PLANTING HOLES - TOPSOIL TO CONTAIN A MINIMUM OF 12% ORGANIC CONTENT (BY WEIGHT), AMEND SOIL WITH

- 7. QUANTITY AND PLACEMENT OF PLANTS ARE APPROXIMATE AND SHOULD BE ADJUSTED IN THE FIELD TO AVOID IMPACT TO EXISTING WOODY SHRUBS AND SMALL TREES ON THE SITE.
- WHERE A SIZE RANGE IS SPECIFIED AT LEAST 50% OF PLANTS PROVIDED SHALL BE OF THE LARGER SIZE. 9. MAINTENANCE SHALL BEGIN IMMEDIATELY AFTER PLANTING AND SHALL CONTINUE UNTIL AT LEAST 50% OF THE TREES HAVE REACHED 6 FEET TALL. MAINTENANCE SHALL INCLUDE WATERING, MULCHING, REPLACEMENT OF SICK OR DEAD PLANTS, AND
- ALL OTHER CARE NEEDED FOR PROPER GROWTH OF THE PLANTS. 10. WATER PLANTS SEVERAL TIMES A WEEK FOR THE FIRST FEW WEEKS IF NO SUBSTANTIAL RAIN FALLS. ALSO WATER DURING
- DRY SPELLS FOR THE FIRST SUMMER. 11. ALL PLANT MATERIALS SHALL CARRY A GUARANTEE FOR A PERIOD OF TWO YEARS FROM THE DATE OF PROJECT COMPLETION. THIS WILL INCLUDE REPLACEMENT OF TREES AND SHRUBS FOUND TO BE DEFECTIVE INCLUDING DEATH AND UNSATISFACTORY GROWTH (MORE THAN 20% DIEBACK). THIS ALSO APPLIES TO AREAS OF POOR VEGETATION COVER WHERE SEED DID NOT
- ESTABLISH WHERE OVER-SEEDING WILL BE REQUIRED. ALL REPLACEMENTS SHALL BE OF THE SAME KIND AND SIZE OF PLANTS SPECIFIED IN THE PLANT LIST. 12. THIS PLANTING PLAN HAS BEEN DEVELOPED TO ACHIEVE FULL REVEGETATION WITH 75% SURVIVAL.

BAREROOT TREE PLANTING NOTES:

- PRESOAK BAREROOT IN ITS ENTIRETY FOR UP TO 24 HOURS BEFORE PLANTING TO ENSURE 100% HYDRATION.
- BAREROOT SHALL BE STORED IN A COOL, DRY SPACE AND BE PLANTED WITHIN 48 HOURS OF RECEIVING. DIG HOLE TWICE THE DEPTH AND WIDTH OF THE ROOTS.

WHEN PLANTING, SUPPLEMENT BAREROOT WITH ADDITIONAL SOIL TO ACCOUNT FOR SOIL COMPACTION AND VOIDS. 5. ROOT FLARE SHALL BE VISIBLE WHEN PLANTED AND MULCH-FREE.

LIVE STAKE PLANTINGS

JCL AOM JCL **NOT TO SCALE MARCH 25, 2025** 13528.00002 14 OF 15

DET-3

Part 4 - Straw Wattle AT MAX SPACING NOTE: INSTALL STRAW WATTLES ALONG WATTLES ALONG WEEL CONTOUR INSTALL STRAW WATTLES WHERE SLOPE TRANSITIONS INTO STEEPER SLOPE TYPICAL STRAW WATTLE INSTALLATION STRAW WATTLE SLOPE VARIES ENTRENCHMENT INSTALLATION STRAW WATTLE DETAIL

Figure 4.15 Straw Wattle

Part 4 - Rolled Erosion Control Product (RECP)

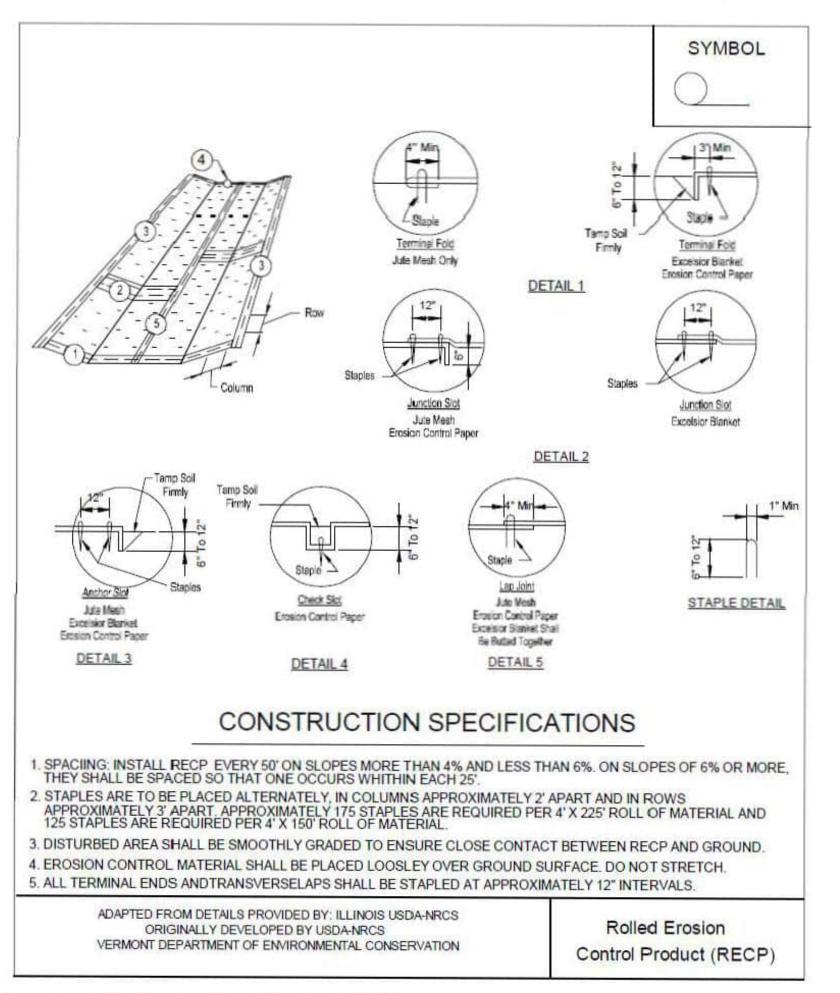


Figure 4.6 Rolled Erosion Control Product (RECP)

NOTES:

RECP MATERIAL TO BE NORTH AMERICAN GREEN BIONET C125BN. REFER TO GENERAL STAPLE PATTERN GUIDE IN NORTH AMERICAN GREEN CATALOG FOR CORRECT STAPLE PATTERN RECOMMENDATIONS FOR SLOPE INSTALLATIONS.

JCL

CL AOM JCL
GNED DRAWN CHECKED

NOT TO SCALE

MARCH 25, 2025

13528.00002

15 OF 15

DET-4

OPINION OF PROBABLE COST

Trout Brook Dam Removal - Preliminary Design Berkshire, Vermont

January 10, 2025 SLR# 13528.00002



Description	Unit	Unit Price (\$)	Quantity	Ar	nount (\$)			
			<u> </u>					
CONSTRUCTION SETUP								
MOBILIZATION / DEMOBILIZATION	LS	20,000	1	\$	20,000			
SITE ACCESS	LS	10,000	1	\$	20,000			
WATER CONTROL / DEWATERING	LS	20,000	1	\$	20,000			
DAM REMOVAL								
CONCRETE DAM AND OUTLET WORKS	CY	200	300	\$	60,000			
ROCK DAM FACE	CY	90	370	\$	33,300			
WOODEN OUTLET WORKS	LS	5,000	1	\$	5,000			
CHANNEL WORK								
INVASIVE SPECIES HANDLING	LS	1	5,000	\$	5,000			
RIVER SEDIMENT EXCAVATION AND HAUL	CY	20	15,000	\$	300,000			
CREATE CHANNEL	LS	15,000	1	\$	15,000			
INSTALL LARGE WOOD AND BDA'S	LS	25,000	1	\$	25,000			
DRINKING WATER PIPE PROTECTION								
ROCK STABILIZATION	CY	80	100	\$	8,000			
RIVER BED RIFFLE	CY	80	50	\$	4,000			
SITE RESTORATION								
RIPRAP STABILIZATION ON VALLEY TOE	CY	70	200	\$	14,000			
TRANSPLANT TREES AND SHRUBS	LS	5,000	1	\$	5,000			
NATIVE SEED AND MULCH	LS	35,000	1	\$	35,000			
RIPARIAN PLANTINGS	LS	75,000	1	\$	75,000			
SUBTOTAL (ROUNDED)				\$	644,000			
CONSTRUCTION CONTINGENCY (10%)				\$	64,400			
BID PHASE SERVICES								
CONSTRUCTION OVERSIGHT (PART TIME)								
POST-CONSTRUCTION REGULATORY COMPL	IANCE	(THREE YEARS)	\$	18,000			
TOTAL (ROUNDED)				\$	770,000			

