RECONNECTING WATERWAYS

A WORKSHOP ON REMOVING DAMS & RIGHT-SIZING CULVERTS

(SLR, 2023)

Dam Removal & Culvert Design Demystified

December 25, 2024
Burlington, VT

SLRCONSULTING.COM

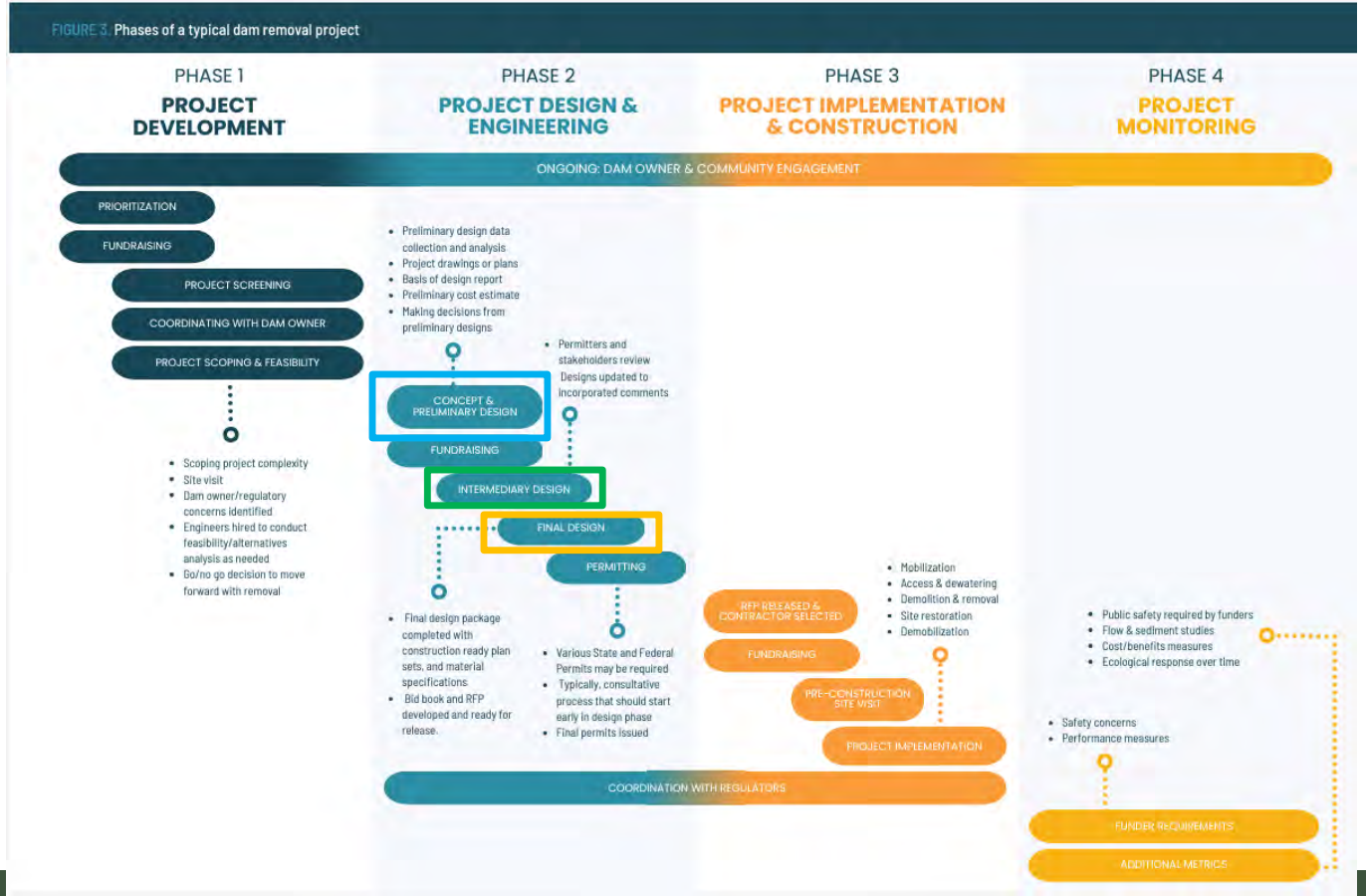
SLR

Design Steps – Clean Water Initiative Program (CWIP)

% Complete	Design Step	Description
60%	PRELIMINARY	Project partners, regulators, landowners, funders, public representatives, and consultants work together to identify and assess the **scientific and engineering challenges and conceptual approaches**. Data Collection, Conceptual (10%) Plans, Alternatives Analysis, Site Surveys and Mapping, Meetings, 30% Design Calculations and analyses on designs, Preliminary (30%) design report
100%	FINAL	BUILD PROJECT. 60/90/100% Design, Final (100%) Design Report.

(VTDEC, 2022)

Design Steps – VT Project Guide by TNC



Design Steps – WUV Grant Guidance

Project Type	***Definition***	***Performance measure***
Dam Removal – Preliminary Engineering Design	Preliminary design of a high priority dam removal project to restore hydrologic connectivity of surface waters. May involve alternatives analysis. Work must result in at least 30% design of project.	Number of preliminary (30%) designs completed
Dam Removal – Final Engineering Design	Final design of high priority dam removal project to restore hydrologic connectivity of surface waters. Work includes preparing permit application(s) and documentation of operation and maintenance plan(s).	Number of final (90%/100%) designs completed
Dam Removal – Implementation	Implementation of high priority dam removal project to restore hydrologic connectivity of surface waters. Permit(s), access license(s)/easement(s), and operation and maintenance plan(s) are in place prior to construction.	Acres of floodplain restored Linear feet of stream restored Stream miles reconnected for stream equilibrium/aquatic organism passage

(WUV, 2023)

Design Steps - Demystified

% Complete	Design Step	Description
10% (0-20)	SKETCH	• INITIAL IDEAS. Project feasibility. Limited knowledge.
30% (20-40)	CONCEPT	• CONSTRAINTS, FOOTPRINT, INITIAL COST. Key constraints. Project footprint. Primary dimensions. Initial river profile. Ballpark cost. Seek landowner support.
60% (40-70)	PRELIMINARY	• REFINE DESIGN VISION AND COST. Lock in design path forward. Information for stakeholder understanding. Initial regulator review. Detail footprint, profile, section, and sediment management. Guide construction funding. Seek community support.
90% (70-95)	FINAL	• FINAL LANDOWNER AGREEMENT AND PERMITS. Access, construction details, sequence, final quantities, and refine cost.
100% (95-100)	CONSTRUCTION	• BUILD PROJECT. Edits from regulatory process.

Design Step Selection

% Complete	Project	Description
90% Draft 100% Final	SIMPLE	• No constraints. • No risk to property and infrastructure. • Small river channel profile change anticipated. • Long-term, breached, obsolete dam. • Coarse sediment. • Minimal permitting.
30% Concept 90% Draft 100% Final	MEDIUM	• Some constraints. • Some potential short term instability influencing property or infrastructure requiring stabilization. • Profile change expected. • Larger dam with accumulated sediment. • Moderate permitting.
30% Concept 60% Preliminary 90% Draft 100% Final	COMPLEX	• Major constraints. • Channing instability potential for long term. • Long-distance profile change possible. • Large amount of accumulated sediment. • Sensitive receiving waters. • Complex permitting.

Sediment

- Volume (cubic yards)
- Toxics
- Nutrients
- Disposal
- Amount likely to move

Sediment

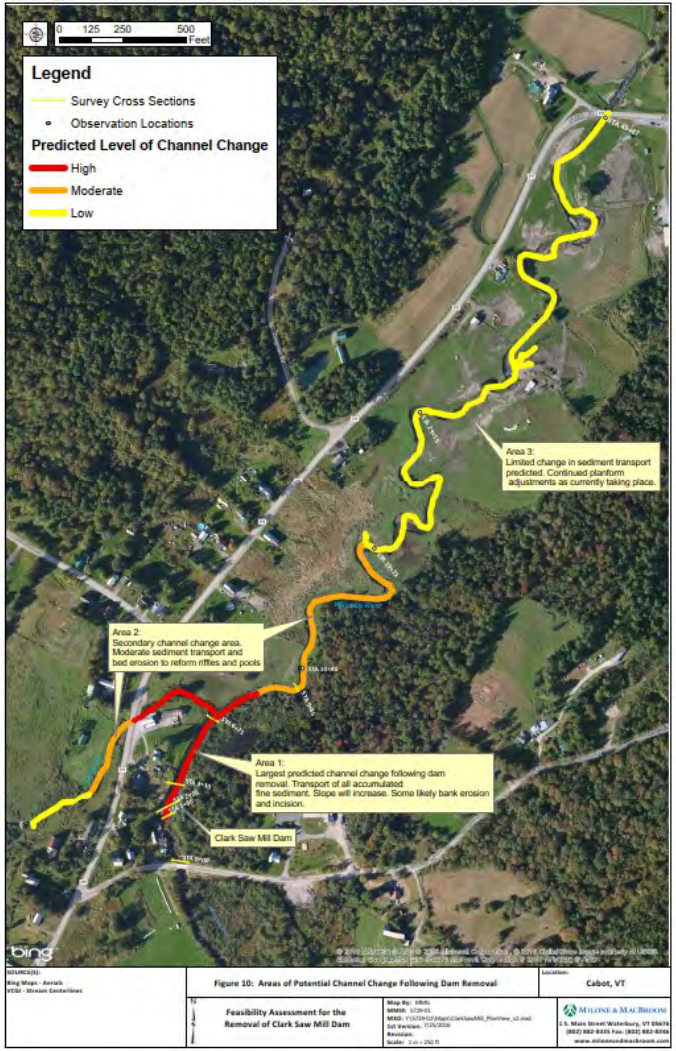
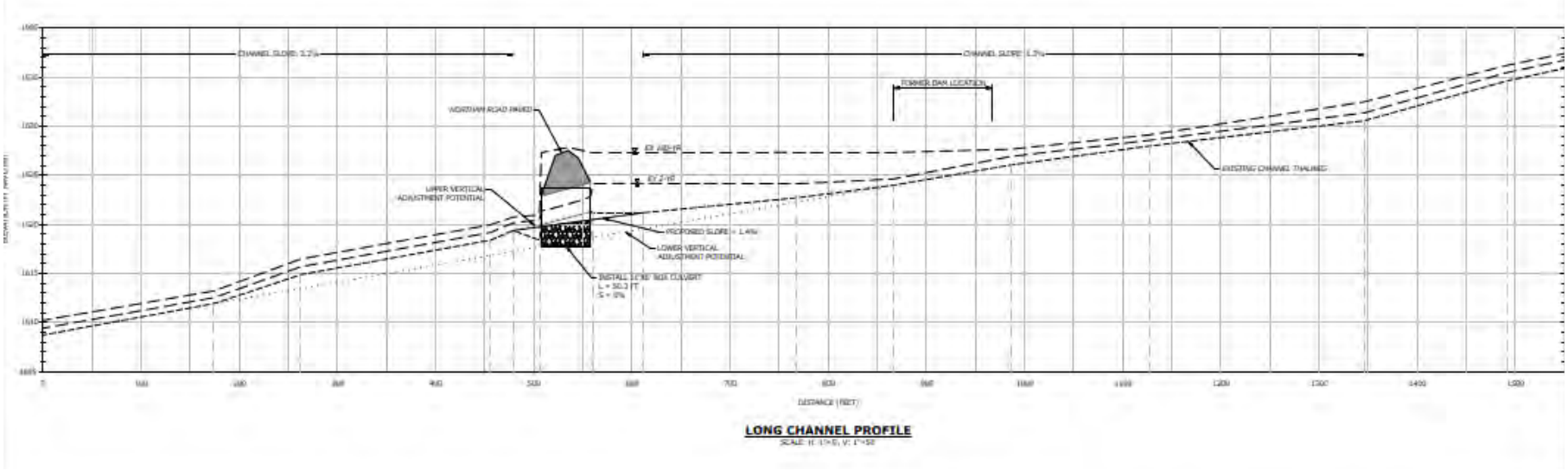


Figure 4: Breached Clark Saw Mill Dam (looking upstream on July 28, 2023)

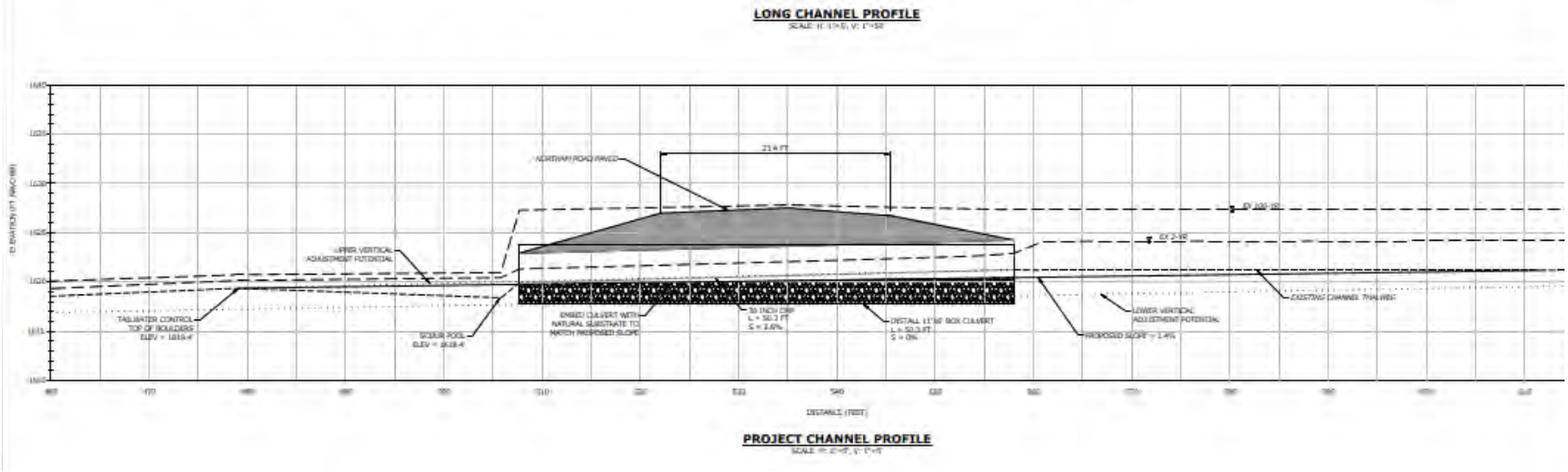
Hydraulics

- Profile
- Channel change
- Validation for flooding and normal flows
- Aquatic organism passage
- Flood reductions
- New hydraulic controls

Longitudinal Profile



Longitudinal Profile



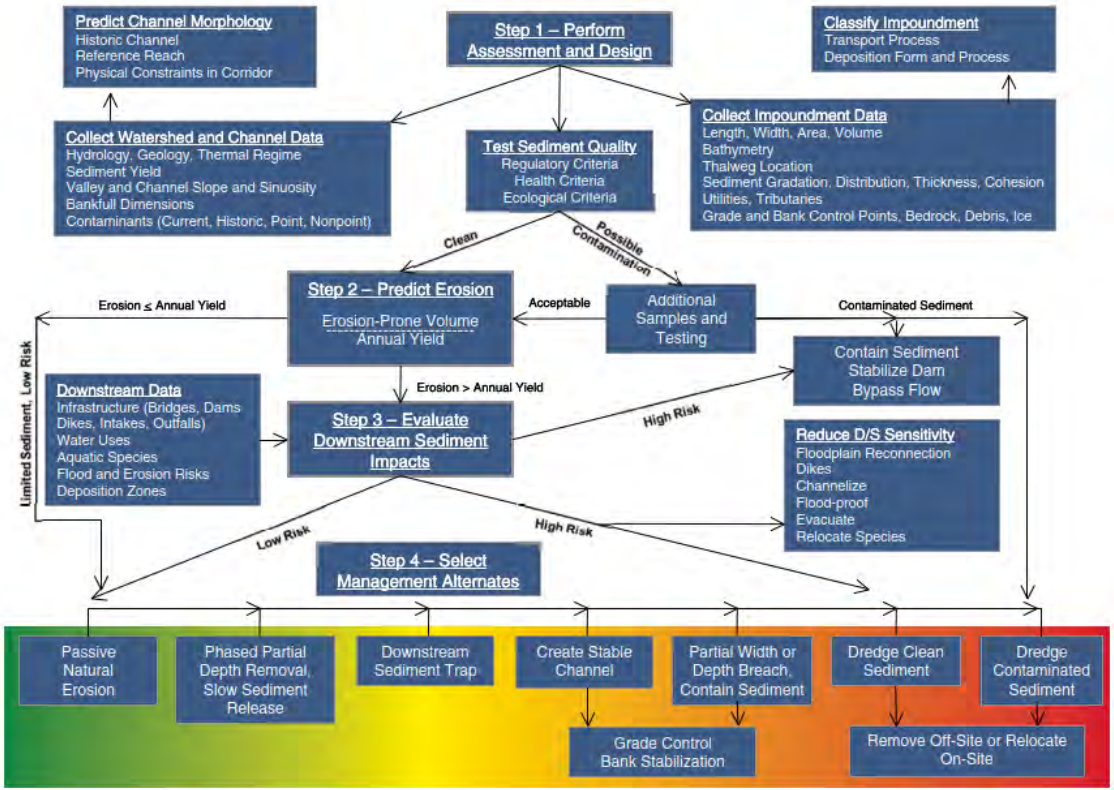
Alternatives Analysis – Dam Removal

1. None
   A. Safety risk
   B. Environmental risk
2. Partial removal
   A. Feasibility
3. Full removal
   A. Benefits

Alternatives Analysis – Sediment Removal

1. None
   A. Risk
2. Lower impoundment (limited)
   A. Approximately half of the sediment
   B. Would leave an over-steepened channel at bridge abutment to hold remaining sediment in place
   C. Risk of sedimentation and nutrient loading remains high
3. **Lower and middle impoundment (half)**
   A. Gets all the readily accessible sediment
   B. Slope transition more gently and natural
   C. Project limit is located at a more confined setting that is better to let adjust
   D. Easier to use large wood to hold grade and slowly release material at project limit
4. Lower, middle, and upper impoundment (all)
   A. Completely eliminate sediment and TP risk
   B. High per CY impacts for removal in upper impoundment
   C. Better to leave small amount and let it flow through system over next couple of larger floods

Alternatives Analysis – Sediment Removal



(MacBroom and Schiff, 2013)

Alternatives Analysis - Summary

	Alternative Description			Objectives				
ID	Dam	Sediment	Retaining Walls	Reduce flood and erosion risks to nearby property and infrastructure	Naturalize the river and floodplain to improve water quality and habitat	Minimize future maintenance needs	Minimize construction costs	Notes
1	No removal (retain breached structure)	No removal	No removal (retain existing)	NO	NO	NO	YES	Unsafe existing conditions that could be dangerous to nearby property and impact water quality and habitat.
2	Full removal	No removal (allow for passive erosion)	No removal (retain existing)	yes	no	NO	YES	Headcutting and excessive erosion would take place impacting water quality and habitat. Damaged retaining walls would likely fail soon.
3	Full removal	Partial removal (downstream of former bridge abutments)	No removal (retain existing)	YES	no	NO	yes	Sediment erosion will take place at the high-velocity area at the bridge abutments. Walls likely to fail.
4	Full removal	Partial (downstream of former bridge abutments)	Full (replace with slope)	YES	no	yes	yes	Sediment erosion will take place at the high-velocity area at the bridge abutments.
5	Full removal	Partial (downstream of former bridge abutments)	Replace with new wall	YES	no	YES	no	Sediment erosion will take place at the high-velocity area at the bridge abutments.
6	Full removal	Partial removal (downstream of wood jam at RS 8+36)	No removal (retain existing)	YES	yes	NO	yes	Good sediment removal option. Walls likely to fail.
7	Full removal	Partial removal (downstream of wood jam at RS 8+36)	Full (replace with slope)	YES	yes	YES	yes	Preferred. Removes most of sediment and uses heavy stone slope with joint plantings in place of wall.
7	Full removal	Partial removal - only in channel upstream of abutments (downstream of wood jam at RS 8+36)	No removal (retain existing)	YES	yes	NO	yes	Why not remove sediment on floodplain with invasives why in the area? Walls will fail.
	Full removal	Partial removal - only in channel upstream of abutments (downstream and upstream of former bridge abutments)	No removal (retain existing)	YES	yes	NO	yes	Why not remove sediment on floodplain with invasives why in the area? Walls will fail.
8	Full removal	Full removal (downstream and upstream of former bridge abutments)	No removal (retain existing)	YES	yes	NO	yes	Removal of sediment in upper channel seems like it will do more harm than good. No need for extra expense. Walls will fail.
10	Full removal	Full removal (downstream and upstream of former bridge abutments)	Full (replace with slope)	YES	YES	YES	no	Removal of sediment in upper channel seems like it will do more harm than good. No need for extra expense.
11	Full removal	Full removal (downstream and upstream of former bridge abutments)	Replace with new wall	YES	YES	YES	NO	Removal of sediment in upper channel seems like it will do more harm than good. No need for extra expense. Too expensive.

Connolly Pond Dam Removal - Shrewsbury

Photo-Documentation
Connolly Pond Dam Removal Project, Shrewsbury, Vermont
Location B, Looking Downstream

Connolly Pond Dam Removal - Shrewsbury

Photo-Documentation
Connolly Pond Dam Removal Project, Shrewsbury, Vermont
Location E, Looking Upstream

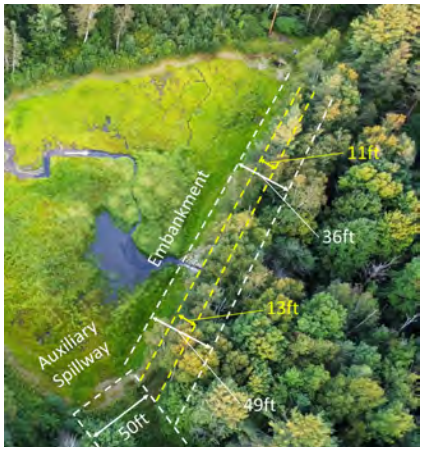
Connolly Pond Dam Removal - Shrewsbury

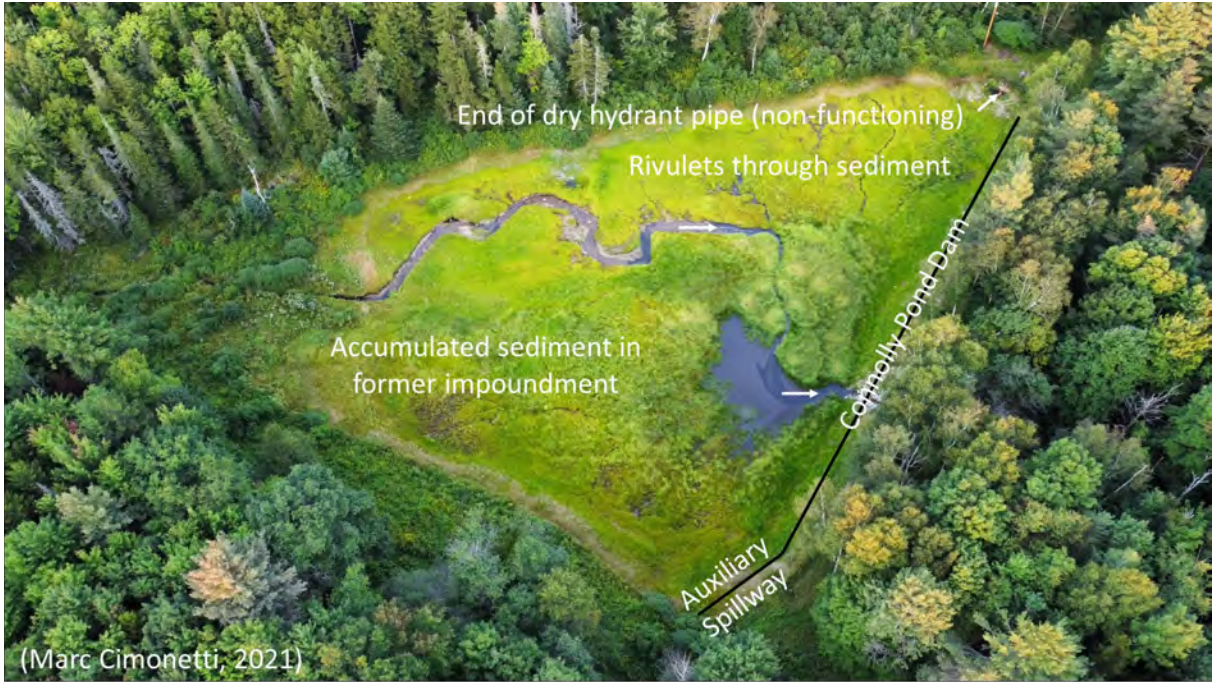
Photo-Documentation

Connolly Pond Dam Removal Project, Shrewsbury, Vermont

Location G, Looking West

Concept Design





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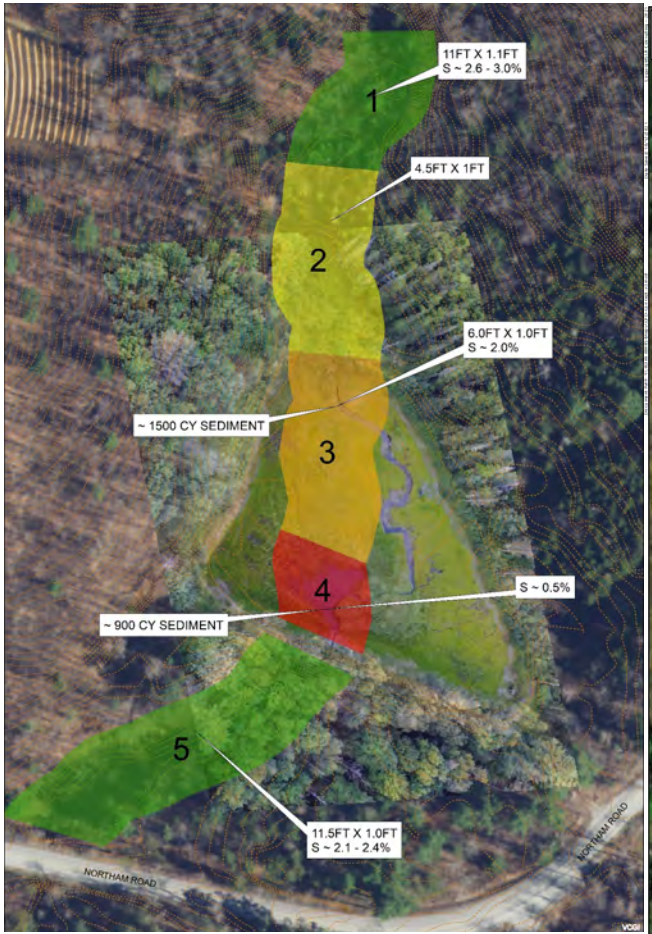
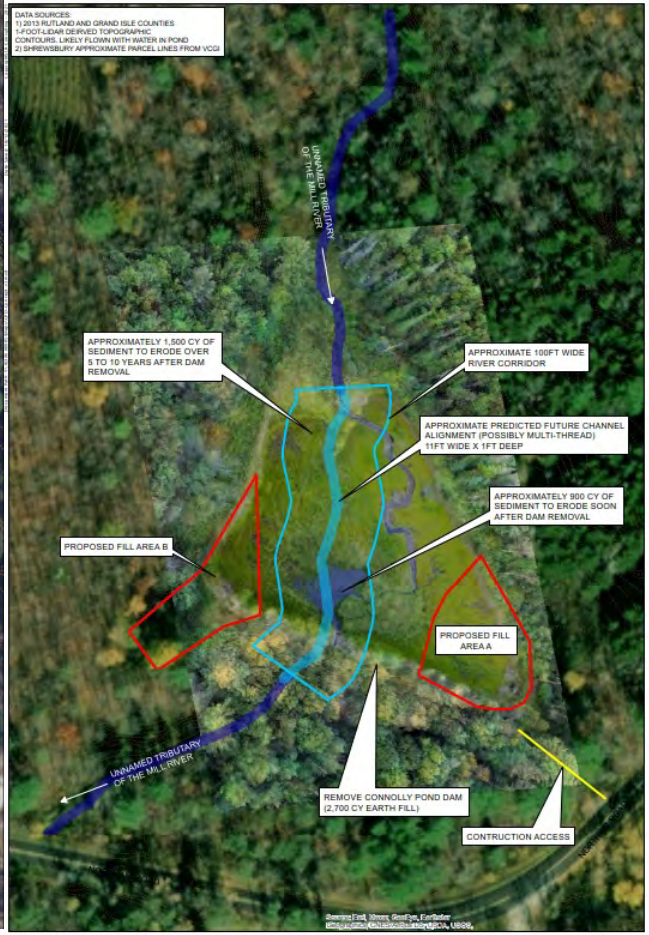




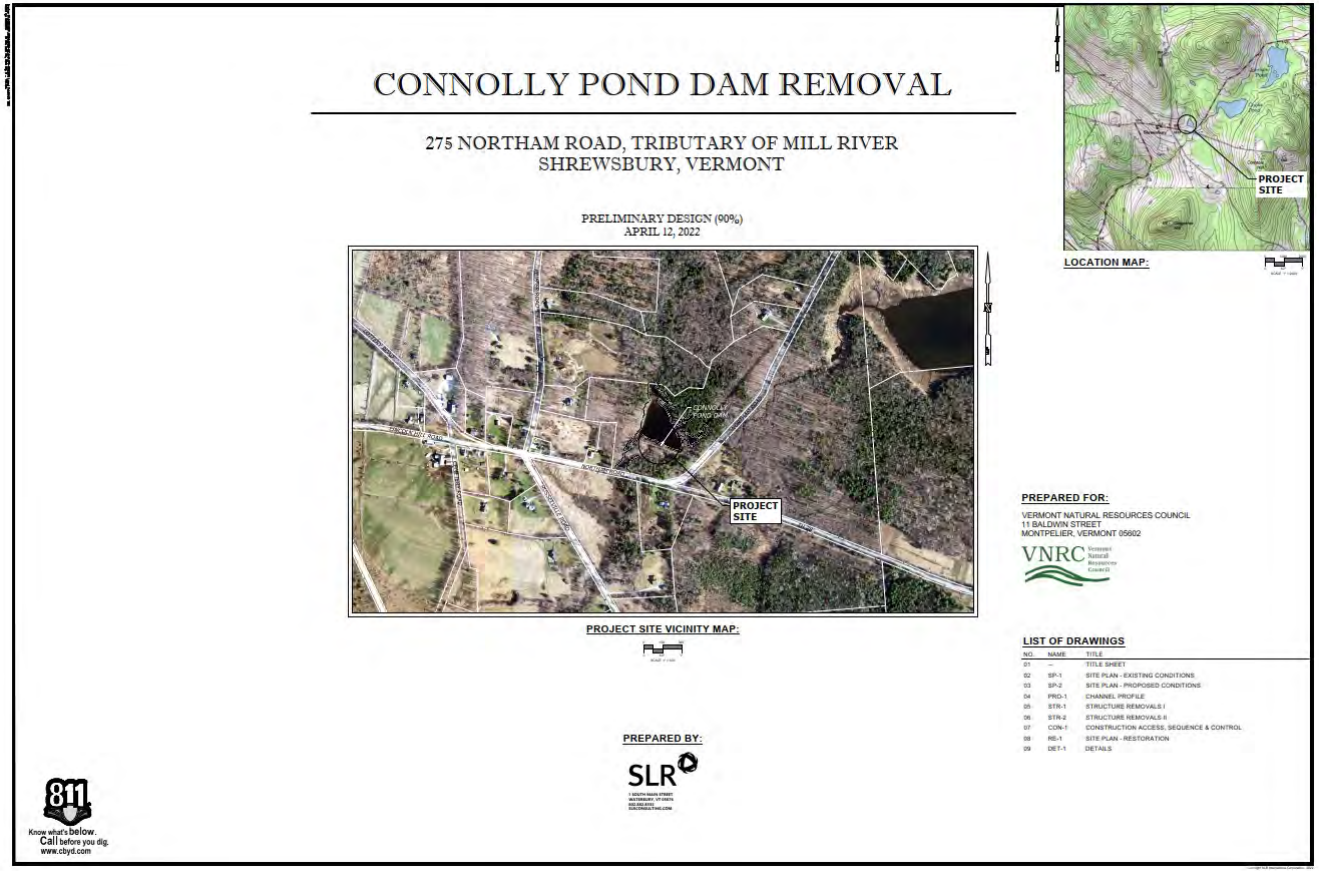
SKETCH CONCEPT PLAN
CONNOLLY POND DAM REMOVAL
VNRC

1 in = 70 feet

N

SLR
1 SOUTH MAIN ST
WATERBURY, VT 05676
802.882.8335

Preliminary Design (90%)



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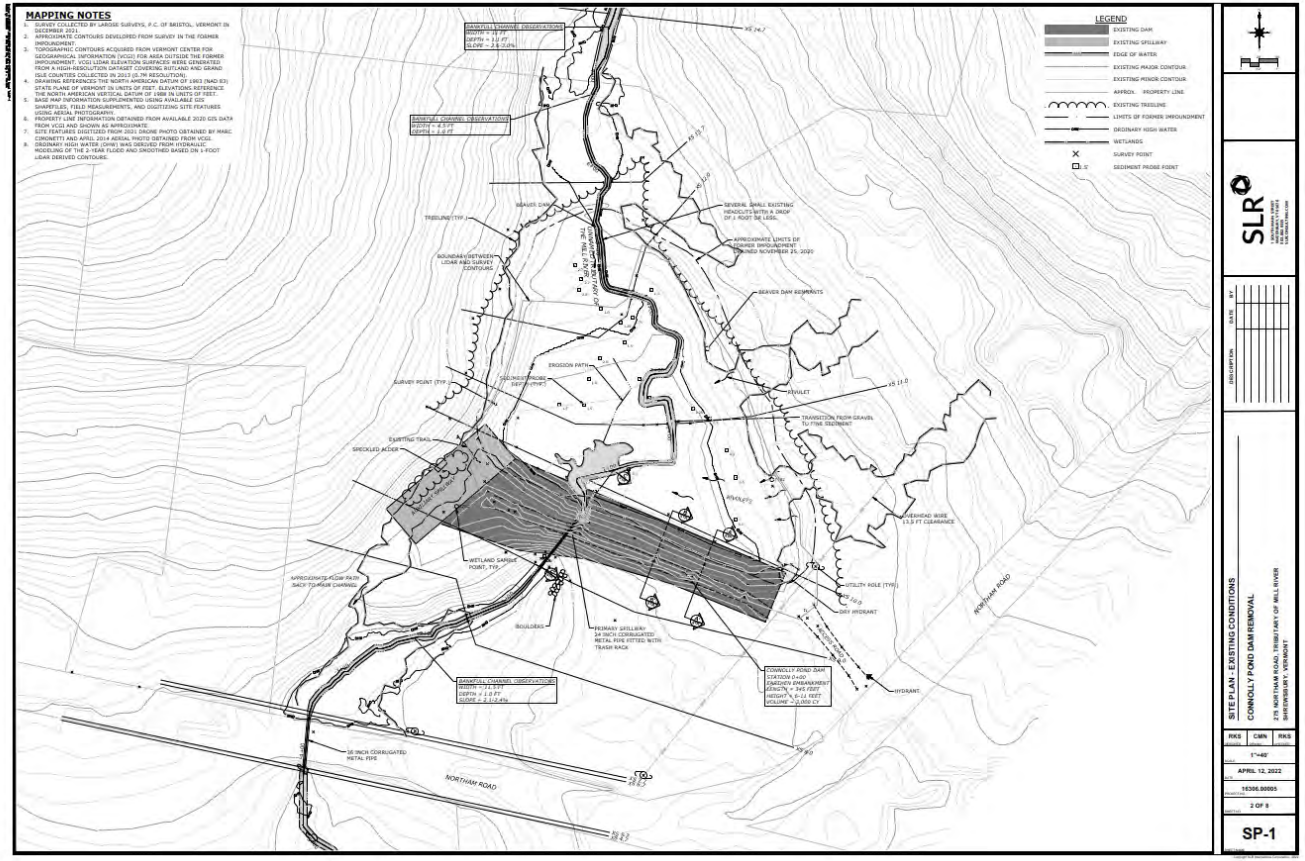

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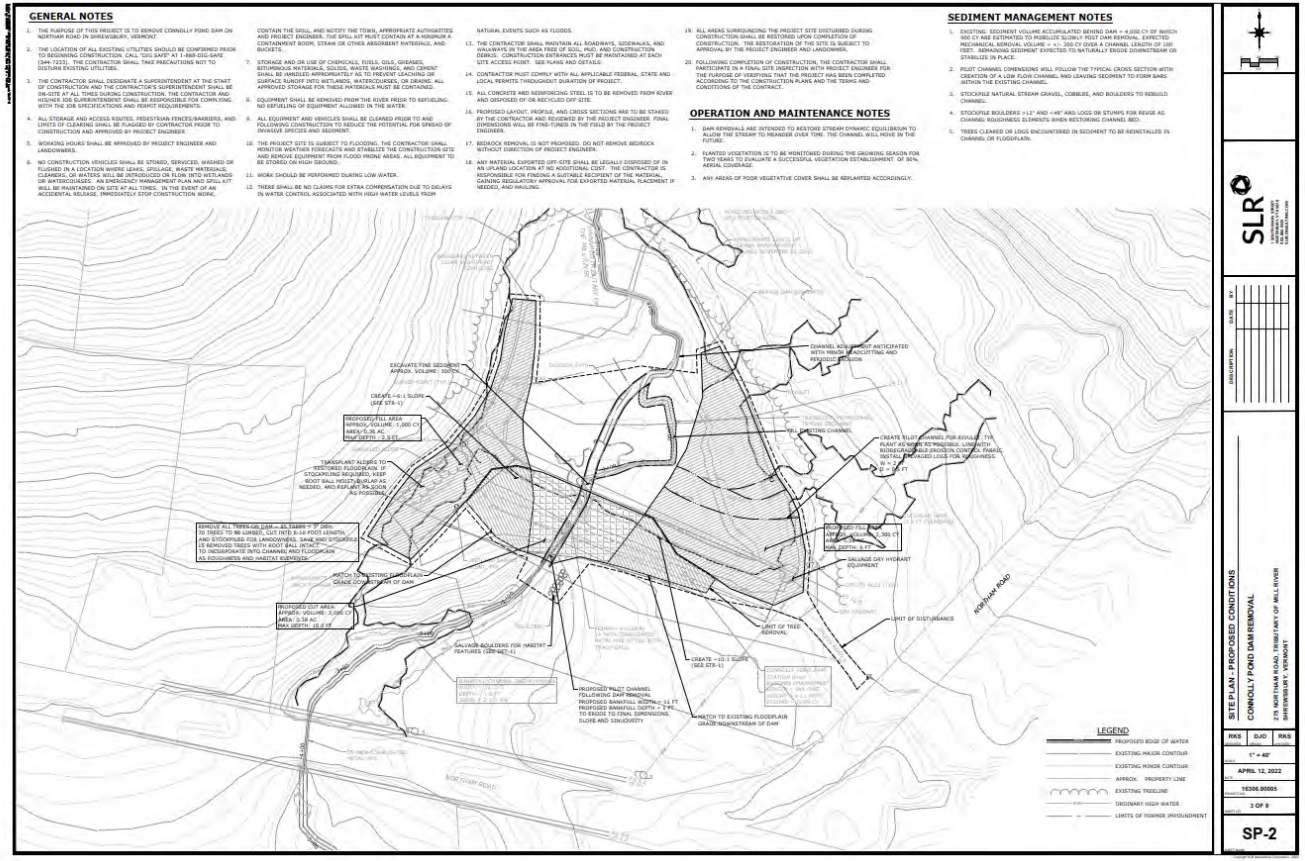


GENERAL NOTES

1. THE PURPOSE OF THIS PROJECT IS TO REMOVE CONNOLLY POND DAM ON NORTHAM ROAD IN SHREWSBURY, VERMONT.
2. THE LOCATION OF ALL EXISTING UTILITIES SHOULD BE CONFIRMED PRIOR TO BEGINNING CONSTRUCTION. CALL "DIG SAFE" AT 1-888-DIG-SAFE (344-7233). THE CONTRACTOR SHALL TAKE PRECAUTIONS NOT TO DISTURB EXISTING UTILITIES.
3. THE CONTRACTOR SHALL DESIGNATE A SUPERINTENDENT AT THE START OF CONSTRUCTION AND THE CONTRACTOR'S SUPERINTENDENT SHALL BE ON-SITE AT ALL TIMES DURING CONSTRUCTION. THE CONTRACTOR AND HIS/HER SUB SUPERINTENDENT SHALL BE RESPONSIBLE FOR COMPLYING WITH THE SOB SPECIFICATIONS AND PERMIT REQUIREMENTS.
4. ALL STORAGE AND ACCESS ROUTES, PEDESTRIAN FENCES/BARRIERS, AND LIMITS OF CLEARING SHALL BE FLAGGED BY CONTRACTOR PRIOR TO CONSTRUCTION AND APPROVED BY PROJECT ENGINEER.
5. WORKING HOURS SHALL BE APPROVED BY PROJECT ENGINEER AND LANDOWNERS.
6. NO CONSTRUCTION VEHICLES SHALL BE STORED, SERVICED, WASHED OR FLUSHED IN A LOCATION WHERE LEAKS, SPILLAGE, WASTE MATERIALS, CLEANERS, OR WATERS WILL BE INTRODUCED OR FLOW INTO WETLANDS OR WATERCOURSES. AN EMERGENCY MANAGEMENT PLAN AND SPILL KIT WILL BE MAINTAINED ON SITE AT ALL TIMES. IN THE EVENT OF AN ACCIDENTAL RELEASE, IMMEDIATELY STOP CONSTRUCTION WORK, CONTAIN THE SPILL AND NOTIFY THE TOWN, APPROPRIATE AUTHORITIES AND PROJECT ENGINEER. THE SPILL KIT MUST CONTAIN AT A MINIMUM A CONTAINMENT BOOM, STRAW OR OTHER ABSORBENT MATERIALS, AND BUCKETS.
7. STORAGE AND OR USE OF CHEMICALS, FUELS, OILS, GREASES, HYDRAULIC FLUIDS, CONCRETE, MASTIC SEALANTS, AND CEMENT SHALL BE HANDLED APPROPRIATELY AS TO PREVENT LEACHING OR SURFACE RUNOFF INTO WETLANDS, WATERCOURSES, OR DRAINS. ALL APPROVED STORAGE FOR THESE MATERIALS MUST BE CONTAINED.
8. EQUIPMENT SHALL BE REMOVED FROM THE RIVER PRIOR TO REFUELING. NO REFUELING OF EQUIPMENT ALLOWED IN THE WATER.
9. ALL EQUIPMENT AND VEHICLES SHALL BE CLEANED PRIOR TO AND FOLLOWING CONSTRUCTION TO REDUCE THE POTENTIAL FOR SPREAD OF INVASIVE SPECIES AND SEDIMENT.
10. THE PROJECT SITE IS SUBJECT TO FLOODING. THE CONTRACTOR SHALL MONITOR WEATHER FORECASTS AND STABILIZE THE CONSTRUCTION SITE AND REMOVE EQUIPMENT FROM FLOOD PRONE AREAS. ALL EQUIPMENT TO BE STORED ON HIGH GROUND.
11. WORK SHOULD BE PERFORMED DURING LOW WATER.
12. THERE SHALL BE NO CLAIMS FOR EXTRA COMPENSATION DUE TO DELAYS IN WATER CONTROL ASSOCIATED WITH HIGH WATER LEVELS FROM NATURAL EVENTS SUCH AS FLOODS.
13. THE CONTRACTOR SHALL MAINTAIN ALL ROADWAYS, SIDEWALKS, AND WALKWAYS IN THE AREA FREE OF SOIL, MUD, AND CONSTRUCTION DEBRIS. CONSTRUCTION ENTRANCES MUST BE MAINTAINED AT EACH SITE ACCESS POINT. SEE PLANS AND DETAILS.
14. CONTRACTOR MUST COMPLY WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL PERMITS THROUGHOUT DURATION OF PROJECT.
15. ALL CONCRETE AND REINFORCING STEEL IS TO BE REMOVED FROM RIVER AND DISPOSED OF OR RECYCLED OFF SITE.
16. PROPOSED LAYOUT, PROFILE, AND CROSS SECTIONS ARE TO BE STAKED BY THE CONTRACTOR AND REVIEWED BY THE PROJECT ENGINEER. FINAL DIMENSIONS WILL BE FINE-TUNED IN THE FIELD BY THE PROJECT ENGINEER.
17. BEDROCK REMOVAL IS NOT PROPOSED. DO NOT REMOVE BEDROCK WITHOUT DIRECTION OF PROJECT ENGINEER.
18. ANY MATERIAL EXPORTED OFF-SITE SHALL BE LEGALLY DISPOSED OF IN AN UPLAND LOCATION AT NO ADDITIONAL COST. THE CONTRACTOR IS RESPONSIBLE FOR FINDING A SUITABLE RECIPIENT OF THE MATERIAL, OBTAINING REGULATORY APPROVAL FOR EXPORTED MATERIAL PLACEMENT IF NEEDED, AND HAULING.
19. ALL AREAS SURROUNDING THE PROJECT SITE DISTURBED DURING CONSTRUCTION SHALL BE RESTORED UPON COMPLETION OF CONSTRUCTION. THE RESTORATION OF THE SITE IS SUBJECT TO APPROVAL BY THE PROJECT ENGINEER AND LANDOWNER.
20. FOLLOWING COMPLETION OF CONSTRUCTION, THE CONTRACTOR SHALL PARTICIPATE IN A FINAL SITE INSPECTION WITH PROJECT ENGINEER FOR THE PURPOSE OF VERIFYING THAT THE PROJECT HAS BEEN COMPLETED ACCORDING TO THE CONSTRUCTION PLANS AND THE TERMS AND CONDITIONS OF THE CONTRACT.

OPERATION AND MAINTENANCE NOTES

1. DAM REMOVALS ARE INTENDED TO RESTORE STREAM DYNAMIC EQUILIBRIUM TO ALLOW THE STREAM TO MEANDER OVER TIME. THE CHANNEL WILL MOVE IN THE FUTURE.
2. PLANTED VEGETATION IS TO BE MONITORED DURING THE GROWING SEASON FOR TWO YEARS TO EVALUATE A SUCCESSFUL VEGETATION ESTABLISHMENT OF 80% AERIAL COVERAGE.
3. ANY AREAS OF POOR VEGETATIVE COVER SHALL BE REPLANTED ACCORDINGLY.

SEDIMENT MANAGEMENT NOTES

1. EXISTING SEDIMENT VOLUME ACCUMULATED BEHIND DAM = 4,000 CY OF WHICH 900 CY ARE ESTIMATED TO MOBILIZE SLOWLY POST DAM REMOVAL. EXPECTED MECHANICAL REMOVAL VOLUME = +/- 350 CY OVER A CHANNEL LENGTH OF 100 FEET. REMAINING SEDIMENT EXPECTED TO NATURALLY ERODE DOWNSTREAM OR STABILIZE IN PLACE.
2. PILOT CHANNEL DIMENSIONS WILL FOLLOW THE TYPICAL CROSS SECTION WITH CREATION OF A LOW FLOW CHANNEL AND LEAVING SEDIMENT TO FORM BARS WITHIN THE EXISTING CHANNEL.
3. STOCKPILE NATURAL STREAM GRAVEL, COBBLES, AND BOULDERS TO REBUILD CHANNEL.
4. STOCKPILE BOULDERS >12" AND <48" AND LOGS OR STUMPS FOR REUSE AS CHANNEL ROUGHNESS ELEMENTS WHEN RESTORING CHANNEL BED.
5. TREES CLEARED OR LOGS ENCOUNTERED IN SEDIMENT TO BE REINSTALLED IN CHANNEL OR FLOODPLAIN.

EXCAVATE FINE SEDIMENT APPROX. VOLUME = 300 CY

CREATE 4-6:1 SLOPE (SEE STR-1)

PROPOSED FILL AREA APPROX. VOLUME = 1,000 CY AREA = 0.36 AC MAX DEPTH = 2.5 FT

TRANSPLANT ALDERS TO RESTORED FLOODBACKS. IF STOCKPILING REQUIRED, KEEP ROOT BALL MOIST/SEALED AS NEEDED, AND REPLANT AS CLOSE AS POSSIBLE TO ORIGINAL POSITION

REMOVE ALL TREES ON DAM — 43 TREES > 9" DBH; 70 TREES TO BE LIMBED, CUT INTO 9-14 FOOT LENGTH AND STOCKPILED FOR LANDOWNERS. SAVE AND STOCKPILE 15 REMOVED TREES WITH ROOT BALL INTACT TO INCORPORATE INTO CHANNEL AND FLOODPLAIN AS ECOSYSTEM AND HABITAT ELEMENTS

PATCH TO EXISTING FLOODPLAIN GRADE DOWNSTREAM OF DAM

PROPOSED CUT AREA APPROX. VOLUME = 3,000 CY AREA = 0.58 AC MAX DEPTH = 10.0 FT

SALVAGE BOULDERS FOR HABITAT FEATURES (SEE DET-1)

PROPOSED PILOT CHANNEL FOLLOWING DAM REMOVAL PROPOSED BANKFULL WIDTH = 11 FT PROPOSED BANKFULL DEPTH = 1 FT TO ERODE TO FINAL DIMENSIONS, SLOPE AND SINUOSITY

CHANNEL ADJUSTMENT ANTICIPATED WITH MINOR AGGRADATION AND RESIDUAL EROSION

CREATE PILOT CHANNEL FOR EVASIVE TYP PLANT AS NEEDED TO PROVIDE LONGEVITY BIODEGRADABLE EROSION CONTROL FABRIC INSTALL SALVAGED LOGS FOR ROUGHNESS W = 5 FT D = 0.5 FT

PROPOSED FILL AREA APPROX. VOLUME = 300 CY MAX DEPTH = 0.7 FT

SALVAGE DRY HYDRANT EQUIPMENT

LIMIT OF TREE REMOVAL

LIMIT OF DISTURBANCE

NORTHAM ROAD

CREATE ~10:1 SLOPE (SEE STR-1)

MATCH TO EXISTING FLOODPLAIN GRADE DOWNSTREAM OF DAM

LEGEND

- PROPOSED EDGE OF WATER
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- APPROX. PROPERTY LINE
- EXISTING TREELINE
- ORDINARY HIGH WATER
- LIMITS OF FORMER IMPOUNDMENT

SLR

SITE PLAN - PROPOSED CONDITIONS

CONNOLLY POND DAM REMOVAL

175 NORTHAM ROAD, TRIBUTARY OF MILL RIVER

SHREWSBURY, VERMONT

RKS	DJO	RKS
DESIGNED	DRAWN	CHECKED

1" = 40'

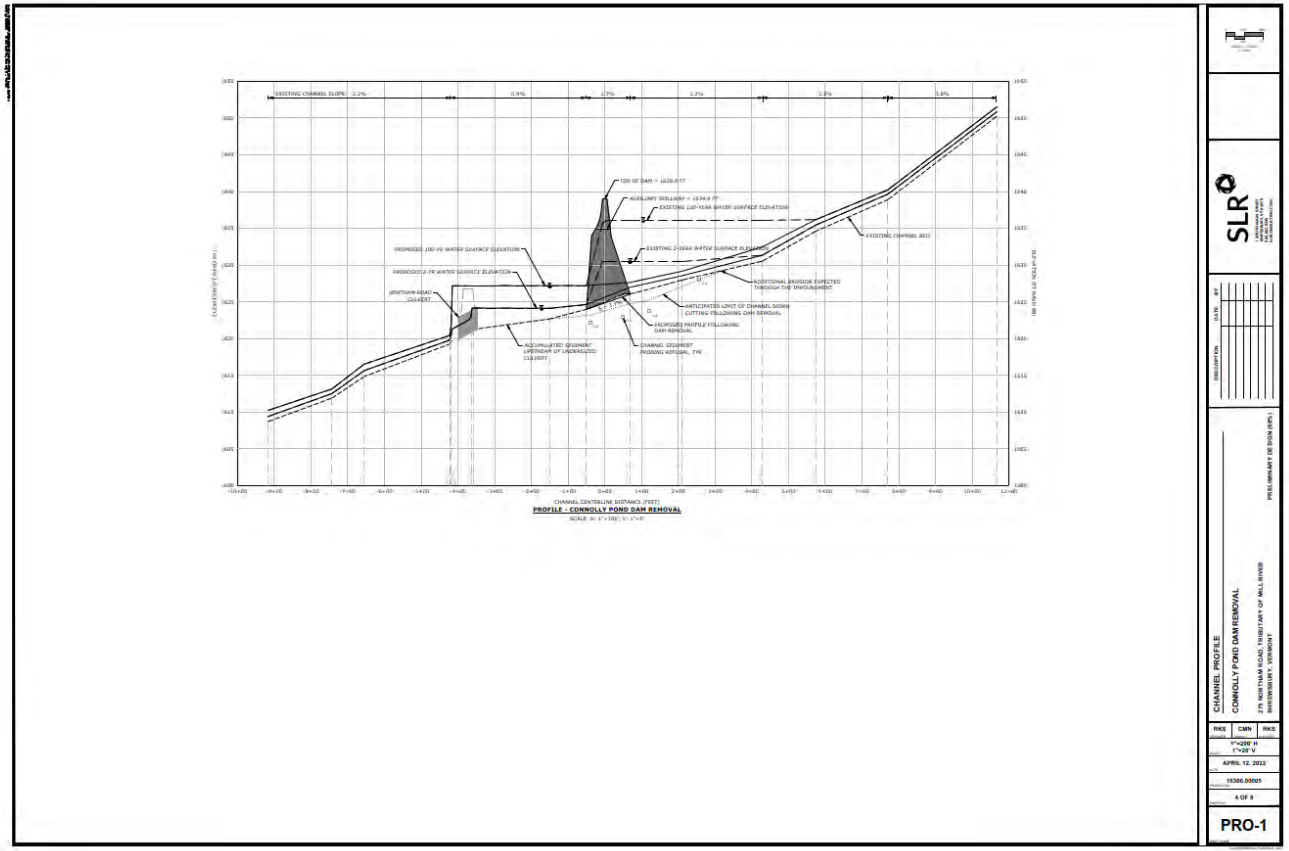
APRIL 12, 2022

16306.00005

3 OF 8

SP-2

Preliminary Design (90%)



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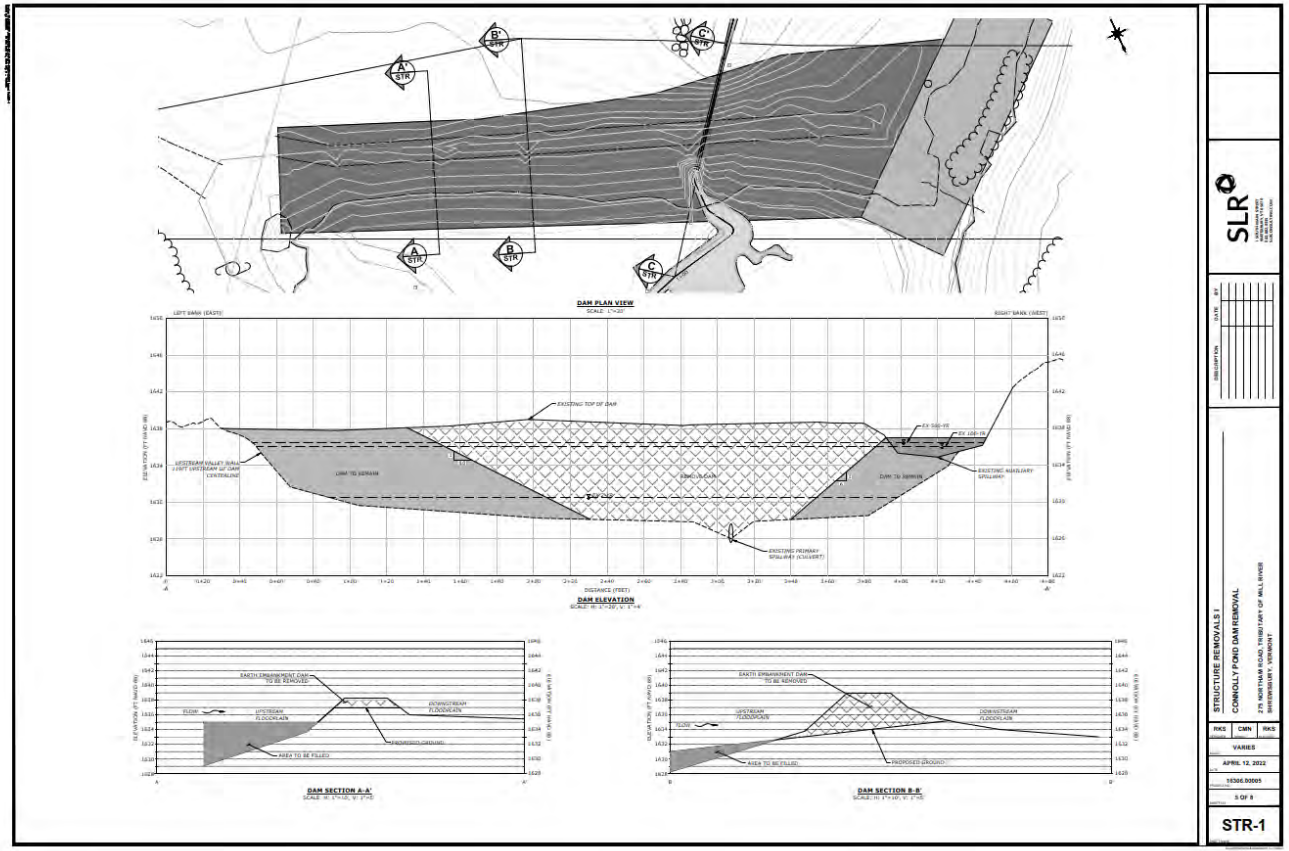
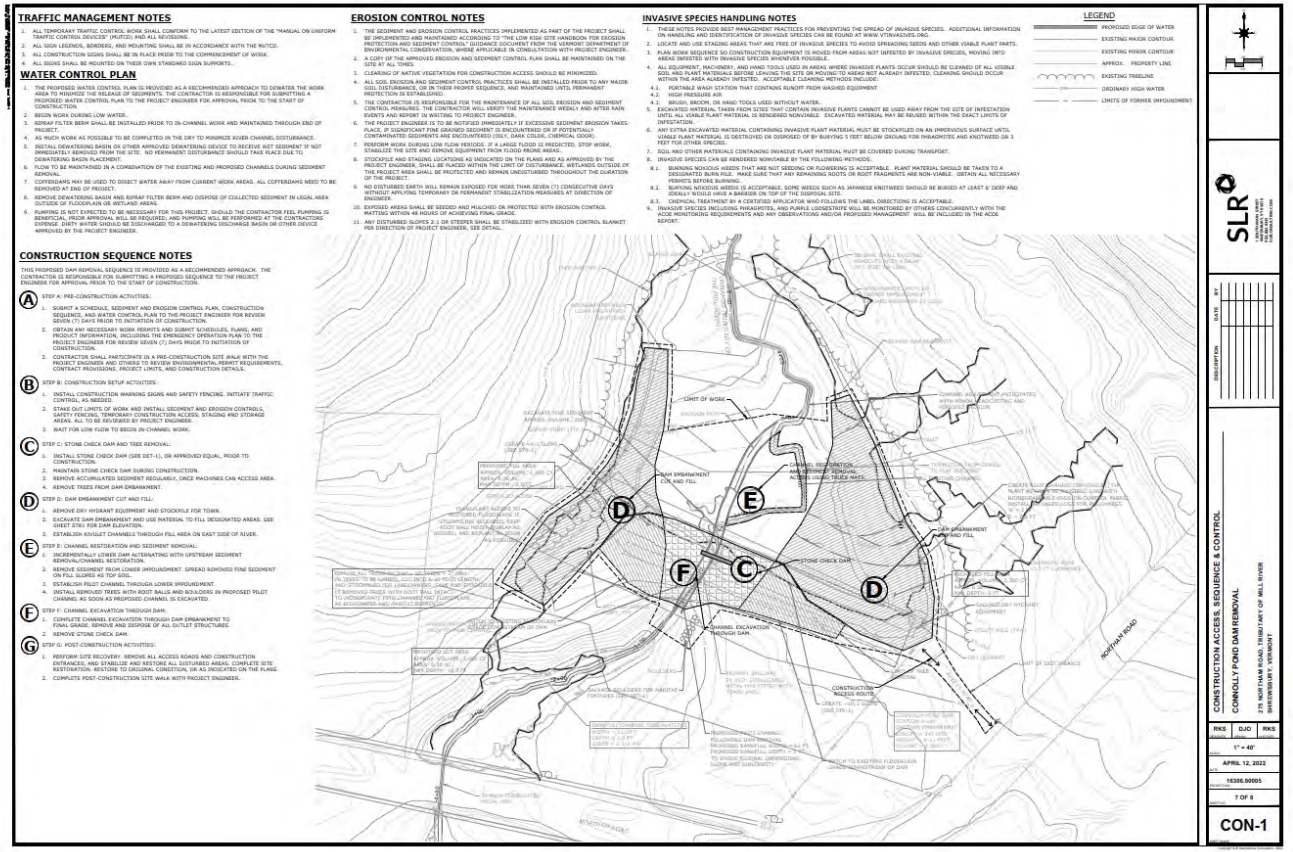


Preliminary Design (90%)



TRAFFIC MANAGEMENT NOTES

1. ALL TEMPORARY TRAFFIC CONTROL WORK SHALL CONFORM TO THE LATEST EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) AND ALL REVISIONS.
2. ALL SIGN LEGENDS, BORDERS, AND MOUNTING SHALL BE IN ACCORDANCE WITH THE MUTCD.
3. ALL CONSTRUCTION SIGNS SHALL BE IN PLACE PRIOR TO THE COMMENCEMENT OF WORK.
4. ALL SIGNS SHALL BE MOUNTED ON THEIR OWN STANDARD SIGN SUPPORTS.

WATER CONTROL PLAN

1. THE PROPOSED WATER CONTROL PLAN IS PROVIDED AS A RECOMMENDED APPROACH TO DEWATER THE WORK AREA TO MINIMIZE THE RELEASE OF SEDIMENTS. THE CONTRACTOR IS RESPONSIBLE FOR SUBMITTING A PROPOSED WATER CONTROL PLAN TO THE PROJECT ENGINEER FOR APPROVAL PRIOR TO THE START OF CONSTRUCTION.
2. BEGIN WORK DURING LOW WATER.
3. RIPRAP FILTER BERM SHALL BE INSTALLED PRIOR TO IN-CHANNEL WORK AND MAINTAINED THROUGH END OF PROJECT.
4. AS MUCH WORK AS POSSIBLE TO BE COMPLETED IN THE DRY TO MINIMIZE RIVER CHANNEL DISTURBANCE.
5. INSTALL DEWATERING BASIN OR OTHER APPROVED DEWATERING DEVICE TO RECEIVE WET SEDIMENT IF NOT IMMEDIATELY REMOVED FROM THE SITE. NO PERMANENT DISTURBANCE SHOULD TAKE PLACE DUE TO DEWATERING BASIN PLACEMENT.
6. FLOW TO BE MAINTAINED IN A COMBINATION OF THE EXISTING AND PROPOSED CHANNELS DURING SEDIMENT REMOVAL.
7. COFFERDAMS MAY BE USED TO DIRECT WATER AWAY FROM CURRENT WORK AREAS. ALL COFFERDAMS NEED TO BE REMOVED AT END OF PROJECT.
8. REMOVE DEWATERING BASIN AND RIPRAP FILTER BERM AND DISPOSE OF COLLECTED SEDIMENT IN LEGAL AREA OUTSIDE OF FLOODPLAIN OR WETLAND AREAS.
9. PUMPING IS NOT EXPECTED TO BE NECESSARY FOR THIS PROJECT. SHOULD THE CONTRACTOR FEEL PUMPING IS BENEFICIAL, PRIOR APPROVAL WILL BE REQUIRED, AND PUMPING WILL BE PERFORMED AT THE CONTRACTORS EXPENSE. DIRTY WATER SHOULD BE DISCHARGED TO A DEWATERING DISCHARGE BASIN OR OTHER DEVICE APPROVED BY THE PROJECT ENGINEER.

CONSTRUCTION SEQUENCE NOTES

THIS PROPOSED DAM REMOVAL SEQUENCE IS PROVIDED AS A RECOMMENDED APPROACH. THE CONTRACTOR IS RESPONSIBLE FOR SUBMITTING A PROPOSED SEQUENCE TO THE PROJECT ENGINEER FOR APPROVAL PRIOR TO THE START OF CONSTRUCTION.

A. STEP A: PRE-CONSTRUCTION ACTIVITIES:
   1. SUBMIT A SCHEDULE, SEDIMENT AND EROSION CONTROL PLAN, CONSTRUCTION SEQUENCE, AND WATER CONTROL PLAN TO THE PROJECT ENGINEER FOR REVIEW SEVEN (7) DAYS PRIOR TO INITIATION OF CONSTRUCTION.
   2. OBTAIN ANY NECESSARY WORK PERMITS AND SUBMIT SCHEDULES, PLANS, AND PRODUCT INFORMATION, INCLUDING THE EMERGENCY OPERATION PLAN TO THE PROJECT ENGINEER FOR REVIEW SEVEN (7) DAYS PRIOR TO INITIATION OF CONSTRUCTION.
   3. CONTRACTOR SHALL PARTICIPATE IN A PRE-CONSTRUCTION SITE WALK WITH THE PROJECT ENGINEER AND OTHERS TO REVIEW ENVIRONMENTAL PERMIT REQUIREMENTS, CONTRACT PROVISIONS, PROJECT LIMITS, AND CONSTRUCTION DETAILS.

B. STEP B: CONSTRUCTION SETUP ACTIVITIES:
   1. INSTALL CONSTRUCTION WARNING SIGNS AND SAFETY FENCING. INITIATE TRAFFIC CONTROL, AS NEEDED.
   2. STAKE OUT LIMITS OF WORK AND INSTALL SEDIMENT AND EROSION CONTROLS, SAFETY FENCING, TEMPORARY CONSTRUCTION ACCESS, STAGING AND STORAGE AREAS. ALL TO BE REVIEWED BY PROJECT ENGINEER.
   3. WAIT FOR LOW FLOW TO BEGIN IN-CHANNEL WORK.

C. STEP C: STONE CHECK DAM AND TREE REMOVAL:
   1. INSTALL STONE CHECK DAM (SEE DET-1), OR APPROVED EQUAL, PRIOR TO CONSTRUCTION.
   2. MAINTAIN STONE CHECK DAM DURING CONSTRUCTION.
   3. REMOVE ACCUMULATED SEDIMENT REGULARLY, ONCE MACHINES CAN ACCESS AREA.
   4. REMOVE TREES FROM DAM EMBANKMENT.

D. STEP D: DAM EMBANKMENT CUT AND FILL:
   1. REMOVE DRY HYDRANT EQUIPMENT AND STOCKPILE FOR TOWN.
   2. EXCAVATE DAM EMBANKMENT AND USE MATERIAL TO FILL DESIGNATED AREAS. SEE SHEET ST-1 FOR DAM ELEVATION.
   3. ESTABLISH KNICKET CHANNELS THROUGH FILL AREA ON EAST SIDE OF RIVER.

E. STEP E: CHANNEL RESTORATION AND SEDIMENT REMOVAL:
   1. INCREMENTALLY LOWER DAM ALTERNATING WITH UPSTREAM SEDIMENT REMOVAL/CHANNEL RESTORATION.
   2. REMOVE SEDIMENT FROM LOWER IMPOUNDMENT. SPREAD REMOVED FINE SEDIMENT ON FILL SLOPES AS TOP SOIL.
   3. ESTABLISH PILOT CHANNEL THROUGH LOWER IMPOUNDMENT.
   4. INSTALL REMOVED TREES WITH ROOT BALLS AND BOULDERS IN PROPOSED PILOT CHANNEL AS SOON AS PROPOSED CHANNEL IS EXCAVATED.

F. STEP F: CHANNEL EXCAVATION THROUGH DAM:
   1. COMPLETE CHANNEL EXCAVATION THROUGH DAM EMBANKMENT TO FINAL GRADE. REMOVE AND DISPOSE OF ALL OUTLET STRUCTURES.
   2. REMOVE STONE CHECK DAM.

G. STEP G: POST-CONSTRUCTION ACTIVITIES:
   1. PERFORM SITE RECOVERY. REMOVE ALL ACCESS ROADS AND CONSTRUCTION ENTRANCES, AND STABILIZE AND RESTORE ALL DISTURBED AREAS. COMPLETE SITE RESTORATION. RESTORE TO ORIGINAL CONDITION, OR AS INDICATED ON THE PLANS.
   2. COMPLETE POST-CONSTRUCTION SITE WALK WITH PROJECT ENGINEER.

EROSION CONTROL NOTES

1. THE SEDIMENT AND EROSION CONTROL PRACTICES IMPLEMENTED AS PART OF THE PROJECT SHALL BE IMPLEMENTED AND MAINTAINED ACCORDING TO "THE LOW RISK SITE HANDBOOK FOR EROSION PROTECTION AND SEDIMENT CONTROL" GUIDANCE DOCUMENT FROM THE VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION, WHERE APPLICABLE IN CONSULTATION WITH PROJECT ENGINEER.
2. A COPY OF THE APPROVED EROSION AND SEDIMENT CONTROL PLAN SHALL BE MAINTAINED ON THE SITE AT ALL TIMES.
3. CLEARING OF NATIVE VEGETATION FOR CONSTRUCTION ACCESS SHOULD BE MINIMIZED.
4. ALL SOIL EROSION AND SEDIMENT CONTROL PRACTICES SHALL BE INSTALLED PRIOR TO ANY MAJOR SOIL DISTURBANCE, OR IN THEIR PROPER SEQUENCE, AND MAINTAINED UNTIL PERMANENT PROTECTION IS ESTABLISHED.
5. THE CONTRACTOR IS RESPONSIBLE FOR THE MAINTENANCE OF ALL SOIL EROSION AND SEDIMENT CONTROL MEASURES. THE CONTRACTOR WILL VERIFY THE MAINTENANCE WEEKLY AND AFTER RAIN EVENTS AND REPORT IN WRITING TO PROJECT ENGINEER.
6. THE PROJECT ENGINEER IS TO BE NOTIFIED IMMEDIATELY IF EXCESSIVE SEDIMENT EROSION TAKES PLACE, IF SIGNIFICANT FINE GRAINED SEDIMENT IS ENCOUNTERED OR IF POTENTIALLY CONTAMINATED SEDIMENTS ARE ENCOUNTERED (OILY, DARK COLOR, CHEMICAL ODOR).
7. REMOVAL WORK DURING LOW FLOW PERIODS. IF A LARGE FLOOD IS PREDICTED, STOP WORK, STABILIZE THE SITE AND REMOVE EQUIPMENT FROM FLOOD PRONE AREAS.
8. STOCKPILE AND STAGING LOCATIONS AS INDICATED ON THE PLANS AND AS APPROVED BY THE PROJECT ENGINEER, SHALL BE PLACED WITHIN THE LIMIT OF DISTURBANCE. WETLANDS OUTSIDE OF THE PROJECT AREA SHALL BE PROTECTED AND REMAIN UNDISTURBED THROUGHOUT THE DURATION OF THE PROJECT.
9. NO DISTURBED EARTH WILL REMAIN EXPOSED FOR MORE THAN SEVEN (7) CONSECUTIVE DAYS WITHOUT APPLYING TEMPORARY OR PERMANENT STABILIZATION MEASURES AT DIRECTION OF ENGINEER.
10. EXPOSED AREAS SHALL BE SEEDED AND MULCHED OR PROTECTED WITH EROSION CONTROL MATTING WITHIN 48 HOURS OF ACHIEVING FINAL GRADE.
11. ANY DISTURBED SLOPES 2:1 OR STEEPER SHALL BE STABILIZED WITH EROSION CONTROL BLANKET PER DIRECTION OF PROJECT ENGINEER, SEE DETAIL.

INVASIVE SPECIES HANDLING NOTES

1. THESE NOTES PROVIDE BEST MANAGEMENT PRACTICES FOR PREVENTING THE SPREAD OF INVASIVE SPECIES. ADDITIONAL INFORMATION ON HANDLING AND IDENTIFICATION OF INVASIVE SPECIES CAN BE FOUND AT WWW.VTINVASIVES.ORG.
2. LOCATE AND USE STAGING AREAS THAT ARE FREE OF INVASIVE SPECIES TO AVOID SPREADING SEEDS AND OTHER VIABLE PLANT PARTS.
3. PLAN WORK SEQUENCE SO CONSTRUCTION EQUIPMENT IS MOVED FROM AREAS NOT INFESTED BY INVASIVE SPECIES, MOVING INTO AREAS INFESTED WITH INVASIVE SPECIES WHENEVER POSSIBLE.
4. ALL EQUIPMENT, MACHINERY, AND HAND TOOLS USED IN AREAS WHERE INVASIVE PLANTS OCCUR SHOULD BE CLEANED OF ALL VISIBLE SOIL AND PLANT PARTS BEFORE LEAVING THE INFESTED AREA (INCLUDING NOT ALREADY INFESTED). CLEANING SHOULD OCCUR WITHIN THE AREA ALREADY INFESTED. ACCEPTABLE CLEANING METHODS INCLUDE:
   4.1. PORTABLE WASH STATION THAT CONTAINS RUNOFF FROM WASHED EQUIPMENT
   4.2. HIGH PRESSURE AIR
   4.3. BRUSH, BROOM, OR HAND TOOLS USED WITHOUT WATER.
5. EXCAVATED MATERIAL TAKEN FROM SITES THAT CONTAIN INVASIVE PLANTS CANNOT BE USED AWAY FROM THE SITE OF INFESTATION UNTIL ALL VIABLE PLANT MATERIAL IS RENDERED NONVIABLE. EXCAVATED MATERIAL MAY BE REUSED WITHIN THE EXACT LIMITS OF INFESTATION.
6. ANY EXTRA EXCAVATED MATERIAL CONTAINING INVASIVE PLANT MATERIAL MUST BE STOCKPILED ON AN IMPERVIOUS SURFACE UNTIL VIABLE PLANT MATERIAL IS DESTROYED OR DISPOSED OF BY BURYING 5 FEET BELOW GROUND FOR PHRAGMITES AND KNOTWEED OR 3 FEET FOR OTHER SPECIES.
7. SOIL AND OTHER MATERIALS CONTAINING INVASIVE PLANT MATERIAL MUST BE COVERED DURING TRANSPORT.
8. INVASIVE SPECIES CAN BE RENDERED NONVIABLE BY THE FOLLOWING METHODS:
   8.1. BURNING NOXIOUS WEEDS THAT ARE NOT SEEDING OR FLOWERING IS ACCEPTABLE. PLANT MATERIAL SHOULD BE TAKEN TO A DESIGNATED BURN PILE. MAKE SURE THAT ANY REMAINING ROOTS OR ROOT FRAGMENTS ARE NON-VIABLE. OBTAIN ALL NECESSARY PERMITS BEFORE BURNING.
   8.2. BURYING NOXIOUS WEEDS IS ACCEPTABLE. SOME WEEDS SUCH AS JAPANESE KNOTWEED SHOULD BE BURIED AT LEAST 6' DEEP AND IDEALLY WOULD HAVE A BARRIER ON TOP OF THE DISPOSAL SITE.
   8.3. CHEMICAL TREATMENT BY A CERTIFIED APPLICATOR WHO FOLLOWS THE LABEL DIRECTIONS IS ACCEPTABLE.
9. INVASIVE SPECIES INCLUDING PHRAGMITES, AND PURPLE LOOSESTRIFE WILL BE MONITORED BY OTHERS CONCURRENTLY WITH THE ACOE MONITORING REQUIREMENTS AND ANY OBSERVATIONS AND/OR PROPOSED MANAGEMENT WILL BE INCLUDED IN THE ACOE REPORT.

LEGEND

- PROPOSED EDGE OF WATER
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- APPROX. PROPERTY LINE
- EXISTING TREELINE
- 256 ORDINARY HIGH WATER
- LIMITS OF FORMER IMPOUNDMENT

CONSTRUCTION ACCESS, SEQUENCE & CONTROL

CONNOLLY POND DAM REMOVAL

215 NORTHAM ROAD, TRIBUTARY OF MILL RIVER
SHREWSBURY, VERMONT

SLR

RKS | DJO | RKS

1" = 40'

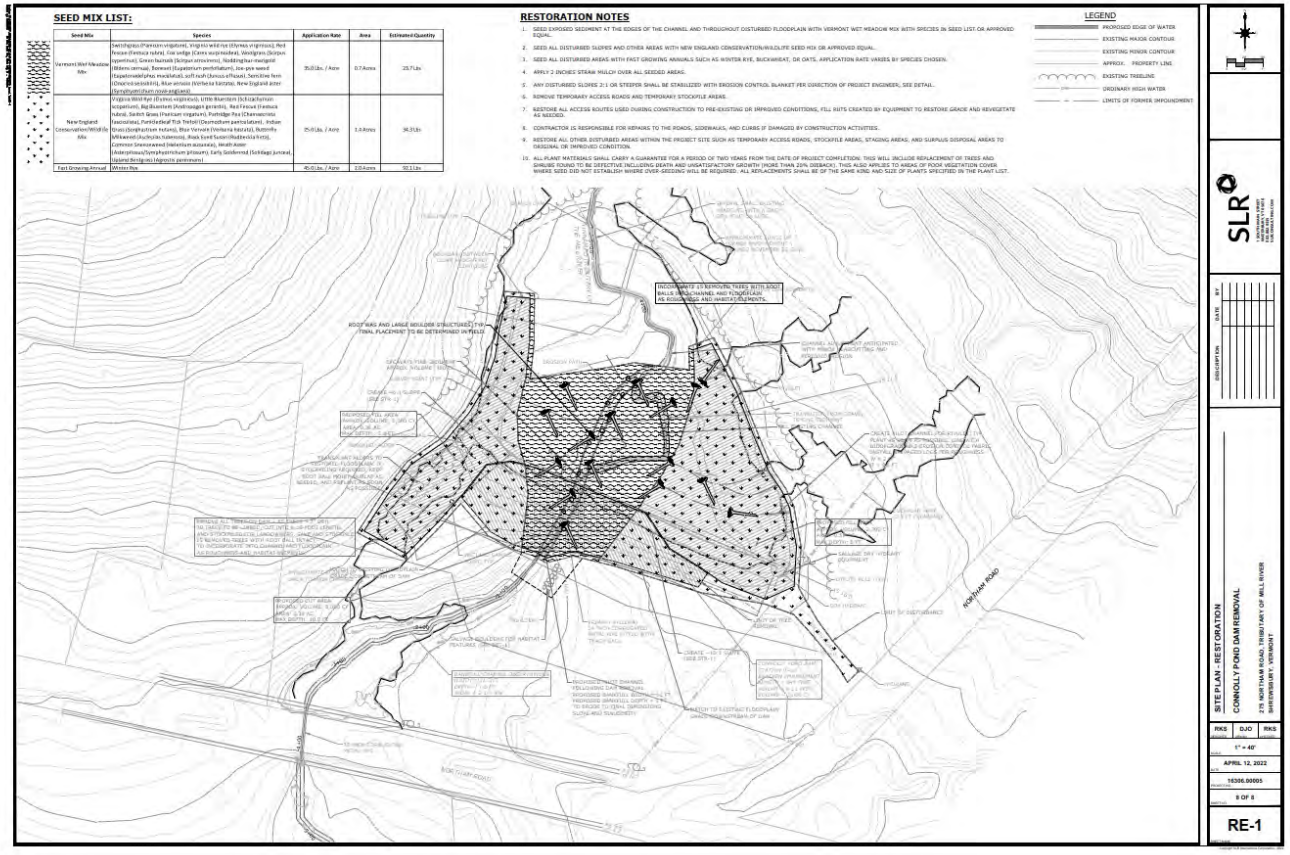
APRIL 12, 2022

16306.00003

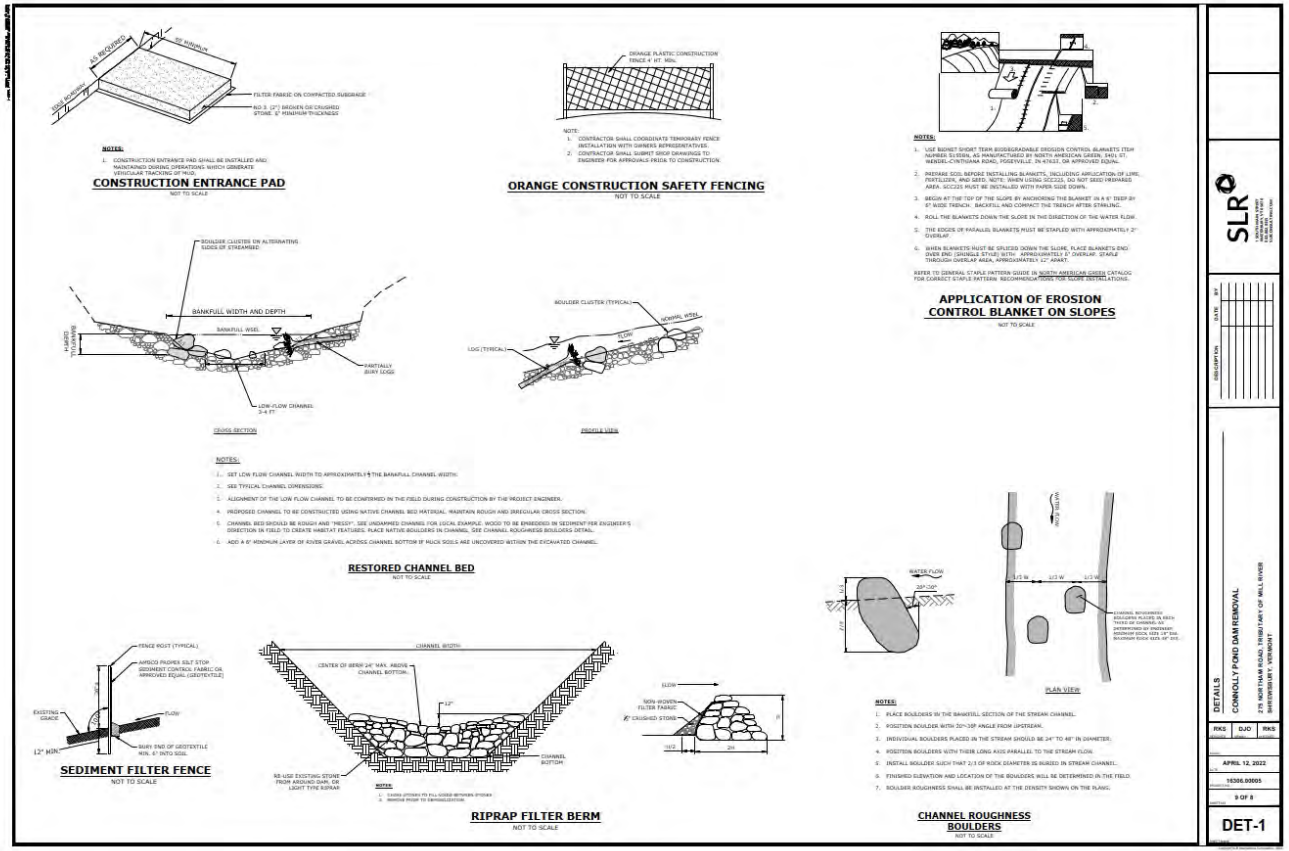
7 OF 8

CON-1

Preliminary Design (90%)



Preliminary Design (90%)



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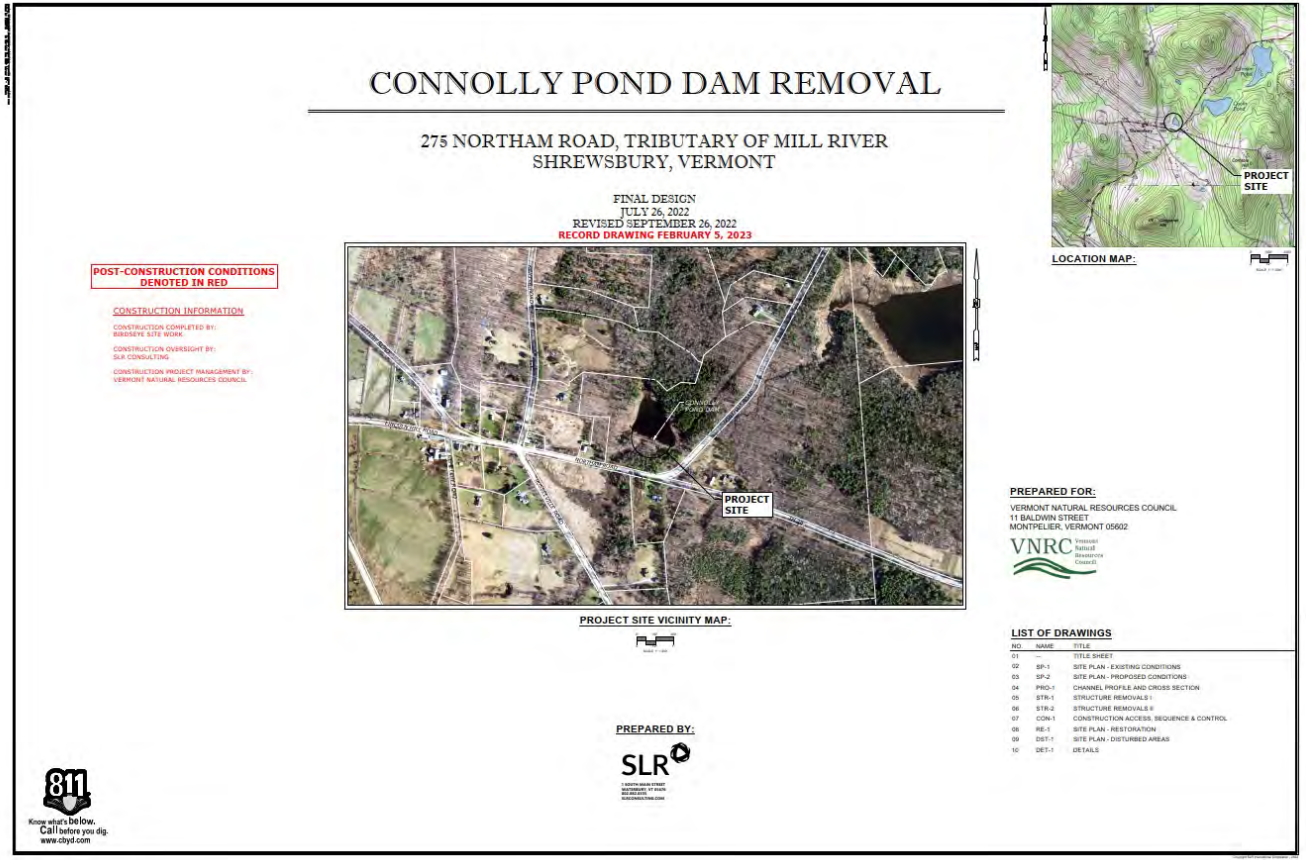


CONNOLLY POND DAM REMOVAL

275 NORTHAM ROAD, TRIBUTARY OF MILL RIVER
SHREWSBURY, VERMONT

FINAL DESIGN
JULY 26, 2022
REVISED SEPTEMBER 26, 2022
RECORD DRAWING FEBRUARY 5, 2023

POST-CONSTRUCTION CONDITIONS DENOTED IN RED

CONSTRUCTION INFORMATION

CONSTRUCTION COMPLETED BY:
BIRDSEYE SITE WORK

CONSTRUCTION OVERSIGHT BY:
SLR CONSULTING

CONSTRUCTION PROJECT MANAGEMENT BY:
VERMONT NATURAL RESOURCES COUNCIL

PROJECT SITE

PROJECT SITE VICINITY MAP:

LOCATION MAP:

PREPARED FOR:
VERMONT NATURAL RESOURCES COUNCIL
11 BALDWIN STREET
MONTPELIER, VERMONT 05602

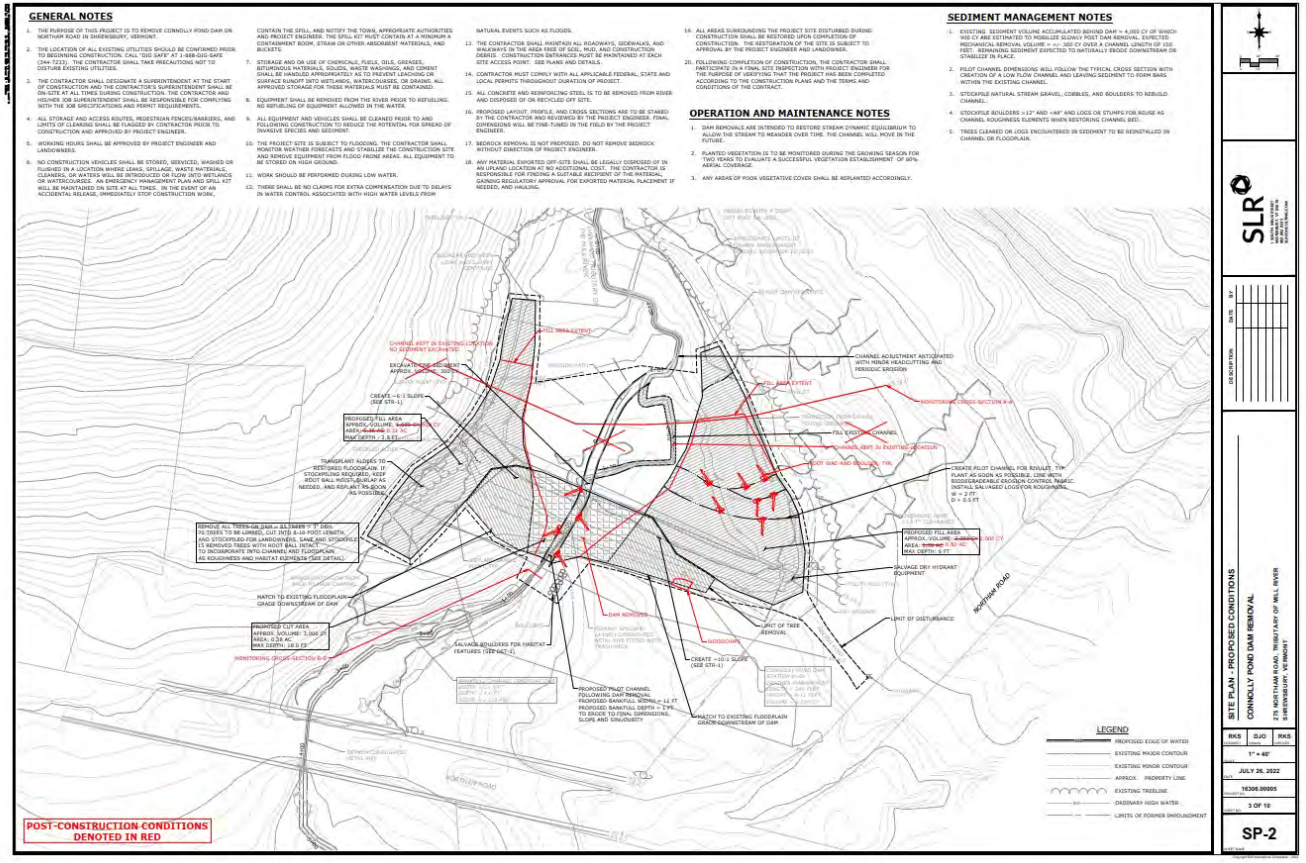
LIST OF DRAWINGS

NO	NAME	TITLE
01	—	TITLE SHEET
02	SP-1	SITE PLAN - EXISTING CONDITIONS
03	SP-2	SITE PLAN - PROPOSED CONDITIONS
04	PRO-1	CHANNEL PROFILE AND CROSS SECTION
05	STR-1	STRUCTURE REMOVALS I
06	STR-2	STRUCTURE REMOVALS II
07	CON-1	CONSTRUCTION ACCESS, SEQUENCE & CONTROL
08	RE-1	SITE PLAN - RESTORATION
09	DST-1	SITE PLAN - DISTURBED AREAS
10	DET-1	DETAILS

PREPARED BY:
SLR

811 Know what's below. Call before you dig. www.clvd.com

Record Drawing



GENERAL NOTES

1. THE PURPOSE OF THIS PROJECT IS TO REMOVE CONNOLLY POND DAM ON NORTHAM ROAD IN SHREWSBURY, VERMONT.
2. THE LOCATION OF ALL EXISTING UTILITIES SHOULD BE CONFIRMED PRIOR TO BEGINNING CONSTRUCTION. CALL "DIG SAFE" AT 1-888-DIG-SAFE (344-7233). THE CONTRACTOR SHALL TAKE PRECAUTIONS NOT TO DISTURB EXISTING UTILITIES.
3. THE CONTRACTOR SHALL DESIGNATE A SUPERINTENDENT AT THE START OF CONSTRUCTION AND THE CONTRACTOR'S SUPERINTENDENT SHALL BE ON-SITE AT ALL TIMES DURING CONSTRUCTION. THE CONTRACTOR AND HIS/HER JOB SUPERINTENDENT SHALL BE RESPONSIBLE FOR COMPLYING WITH THE JOB SPECIFICATIONS AND PERMIT REQUIREMENTS.
4. ALL STORAGE AND ACCESS ROUTES, PEDESTRIAN FENCES/BARRIERS, AND LIMITS OF CLEARING SHALL BE FLAGGED BY CONTRACTOR PRIOR TO CONSTRUCTION AND APPROVED BY PROJECT ENGINEER.
5. WORKING HOURS SHALL BE APPROVED BY PROJECT ENGINEER AND LANDOWNERS.
6. NO CONSTRUCTION VEHICLES SHALL BE STORED, SERVICED, WASHED OR FUELED IN A LOCATION WHERE LEAKS, SPILLAGE, WASTE MATERIALS, CLEANERS, OR WATERS WILL BE INTRODUCED OR FLOW INTO WETLANDS OR WATERCOURSES. AN EMERGENCY MANAGEMENT PLAN AND SPILL KIT WILL BE MAINTAINED ON SITE AT ALL TIMES. IN THE EVENT OF AN ACCIDENTAL RELEASE, IMMEDIATELY STOP CONSTRUCTION WORK, CONTAIN THE SPILL, AND NOTIFY THE TOWN, APPROPRIATE AUTHORITIES AND PROJECT ENGINEER. THE SPILL KIT MUST CONTAIN AT A MINIMUM A CONTAINMENT BOOM, STRAW OR OTHER ABSORBENT MATERIALS, AND BUCKETS.
7. STORAGE AND OR USE OF CHEMICALS, FUELS, OILS, GREASES, BITUMINOUS MATERIALS, SOLIDS, WASTE WASHINGS, AND CEMENT SHALL BE PROPERLY MANAGED AND USED TO PREVENT LEACHING OR DRAINAGE RUNOFF INTO WATERWAYS, WETLANDS OR FLOODPLAINS. ALL APPROVED STORAGE FOR THESE MATERIALS MUST BE CONTAINED.
8. EQUIPMENT SHALL BE REMOVED FROM THE RIVER PRIOR TO REFUELING. NO REFUELING OF EQUIPMENT ALLOWED IN THE WATER.
9. ALL EQUIPMENT AND VEHICLES SHALL BE CLEANED PRIOR TO AND FOLLOWING CONSTRUCTION TO REDUCE THE POTENTIAL FOR SPREAD OF INVASIVE SPECIES AND SEDIMENT.
10. THE PROJECT SITE IS SUBJECT TO FLOODING. THE CONTRACTOR SHALL MONITOR WEATHER FORECASTS AND STABILIZE THE CONSTRUCTION SITE AND REMOVE EQUIPMENT FROM FLOOD PRONE AREAS. ALL EQUIPMENT TO BE STORED ON HIGH GROUND.
11. WORK SHOULD BE PERFORMED DURING LOW WATER.
12. THERE SHALL BE NO CLAIMS FOR EXTRA COMPENSATION DUE TO DELAYS IN WATER CONTROL ASSOCIATED WITH HIGH WATER LEVELS FROM NATURAL EVENTS SUCH AS FLOODS.
13. THE CONTRACTOR SHALL MAINTAIN ALL ROADWAYS, SIDEWALKS, AND WALKWAYS IN THE AREA FREE OF SOIL, MUD, AND CONSTRUCTION DEBRIS. CONSTRUCTION ENTRANCES MUST BE MAINTAINED AT EACH SITE ACCESS POINT. SEE PLANS AND DETAILS.
14. CONTRACTOR MUST COMPLY WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL PERMITS THROUGHOUT DURATION OF PROJECT.
15. ALL CONCRETE AND REINFORCING STEEL IS TO BE REMOVED FROM RIVER AND DISPOSED OF OR RECYCLED OFF SITE.
16. PROPOSED LAYOUT, PROFILE, AND CROSS SECTIONS ARE TO BE STAKED BY THE CONTRACTOR AND REVIEWED BY THE PROJECT ENGINEER. FINAL DIMENSIONS WILL BE FINE-TUNED IN THE FIELD BY THE PROJECT ENGINEER.
17. BEDROCK REMOVAL IS NOT PROPOSED. DO NOT REMOVE BEDROCK WITHOUT DIRECTION OF PROJECT ENGINEER.
18. ANY MATERIAL EXPORTED OFF-SITE SHALL BE LEGALLY DISPOSED OF IN AN UPLAND LOCATION AT NO ADDITIONAL COST. THE CONTRACTOR IS RESPONSIBLE FOR FINDING A SUITABLE RECIPIENT OF THE MATERIAL, GAINING REGULATORY APPROVAL FOR EXPORTED MATERIAL PLACEMENT IF NEEDED, AND HAULING.
19. ALL AREAS SURROUNDING THE PROJECT SITE DISTURBED DURING CONSTRUCTION SHALL BE RESTORED UPON COMPLETION OF CONSTRUCTION. THE RESTORATION OF THE SITE IS SUBJECT TO APPROVAL BY THE PROJECT ENGINEER AND LANDOWNER.
20. FOLLOWING COMPLETION OF CONSTRUCTION, THE CONTRACTOR SHALL PARTICIPATE IN A FINAL SITE INSPECTION WITH PROJECT ENGINEER FOR THE PURPOSE OF VERIFYING THAT THE PROJECT HAS BEEN COMPLETED ACCORDING TO THE CONSTRUCTION PLANS AND THE TERMS AND CONDITIONS OF THE CONTRACT.

OPERATION AND MAINTENANCE NOTES

1. DAM REMOVALS ARE INTENDED TO RESTORE STREAM DYNAMIC EQUILIBRIUM TO ALLOW THE STREAM TO MEANDER OVER TIME. THE CHANNEL WILL MOVE IN THE FUTURE.
2. PLANTED VEGETATION IS TO BE MONITORED DURING THE GROWING SEASON FOR TWO YEARS TO EVALUATE A SUCCESSFUL VEGETATION ESTABLISHMENT OF 80% AERIAL COVERAGE.
3. ANY AREAS OF POOR VEGETATIVE COVER SHALL BE REPLANTED ACCORDINGLY.

SEDIMENT MANAGEMENT NOTES

1. EXISTING SEDIMENT VOLUME ACCUMULATED BEHIND DAM = 4,000 CY OF WHICH 900 CY ARE ESTIMATED TO MOBILIZE SLOWLY POST DAM REMOVAL. EXPECTED MECHANICAL REMOVAL VOLUME = +/- 300 CY OVER A CHANNEL LENGTH OF 150 FEET. REMAINING SEDIMENT EXPECTED TO NATURALLY ERODE DOWNSTREAM OR STABILIZE IN PLACE.
2. PILOT CHANNEL DIMENSIONS WILL FOLLOW THE TYPICAL CROSS SECTION WITH CREATION OF A LOW FLOW CHANNEL AND LEAVING SEDIMENT TO FORM BARS WITHIN THE EXISTING CHANNEL.
3. STOCKPILE NATURAL STREAM GRAVEL, COBBLES, AND BOULDERS TO REBUILD CHANNEL.
4. STOCKPILE BOULDERS >12" AND <48" AND LOGS OR STUMPS FOR REUSE AS CHANNEL ROUGHNESS ELEMENTS WHEN RESTORING CHANNEL BED.
5. TREES CLEARED OR LOGS ENCOUNTERED IN SEDIMENT TO BE REINSTALLED IN CHANNEL OR FLOODPLAIN.

POST-CONSTRUCTION CONDITIONS DENOTED IN RED

LEGEND

PROPOSED EDGE OF WATER
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
APPROX. PROPERTY LINE
EXISTING TREELINE
ORDINARY HIGH WATER
LIMITS OF FORMER IMPOUNDMENT

SLR

SITE PLAN - PROPOSED CONDITIONS
CONNOLLY POND DAM REMOVAL
275 NORTHAM ROAD, TRIBUTARY OF MILL RIVER
SHREWSBURY, VERMONT

RKS | DJO | RKS

1" = 40'

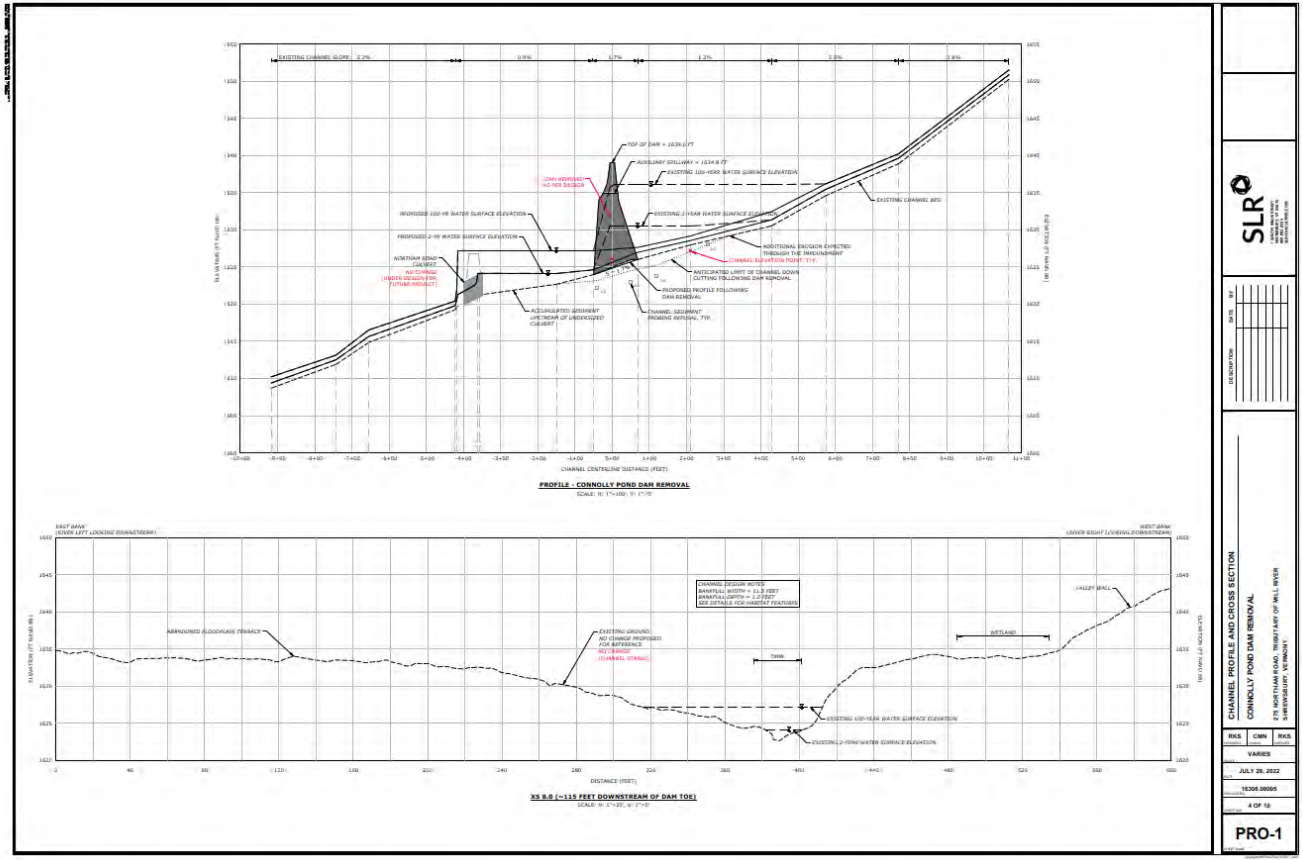
JULY 26, 2022

16306.00005

3 OF 10

SP-2

Record Drawing



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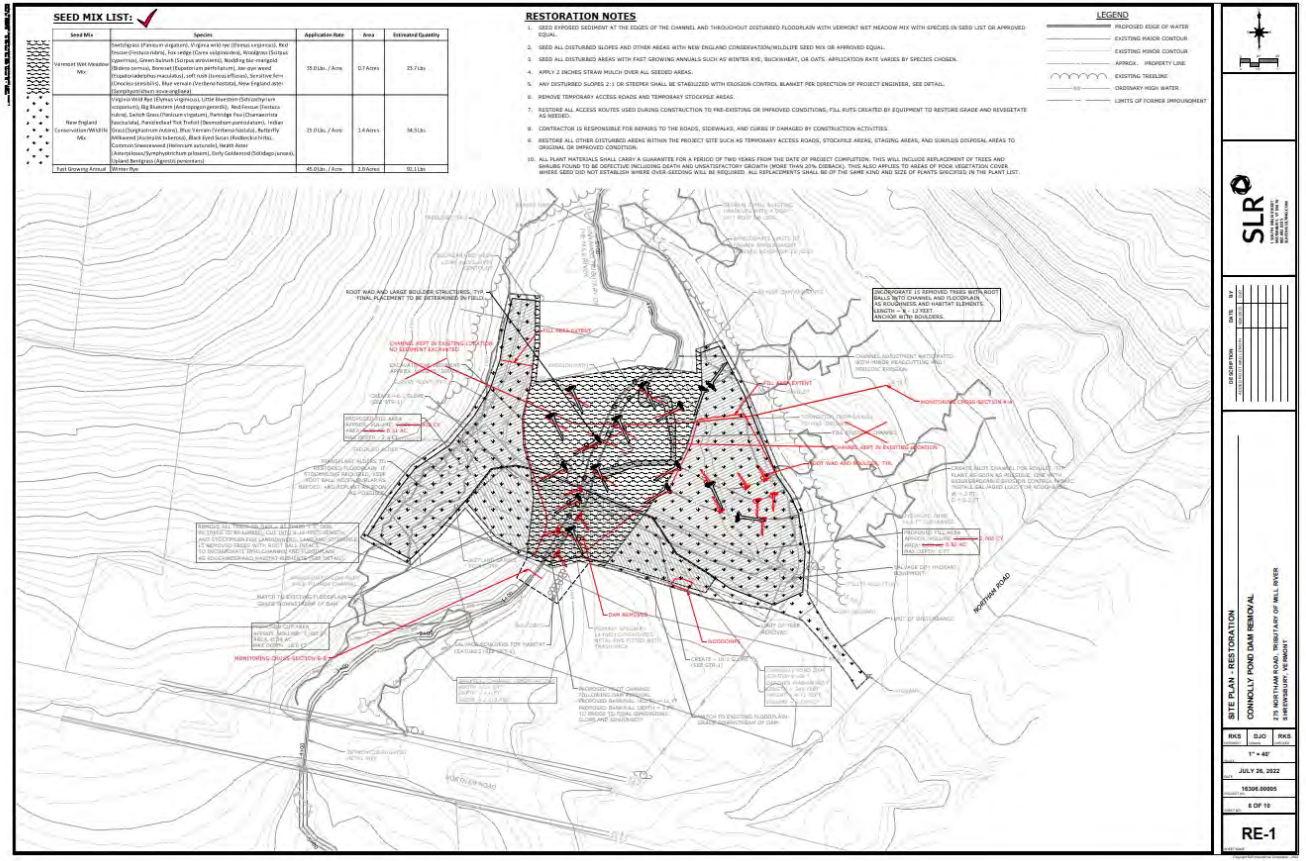
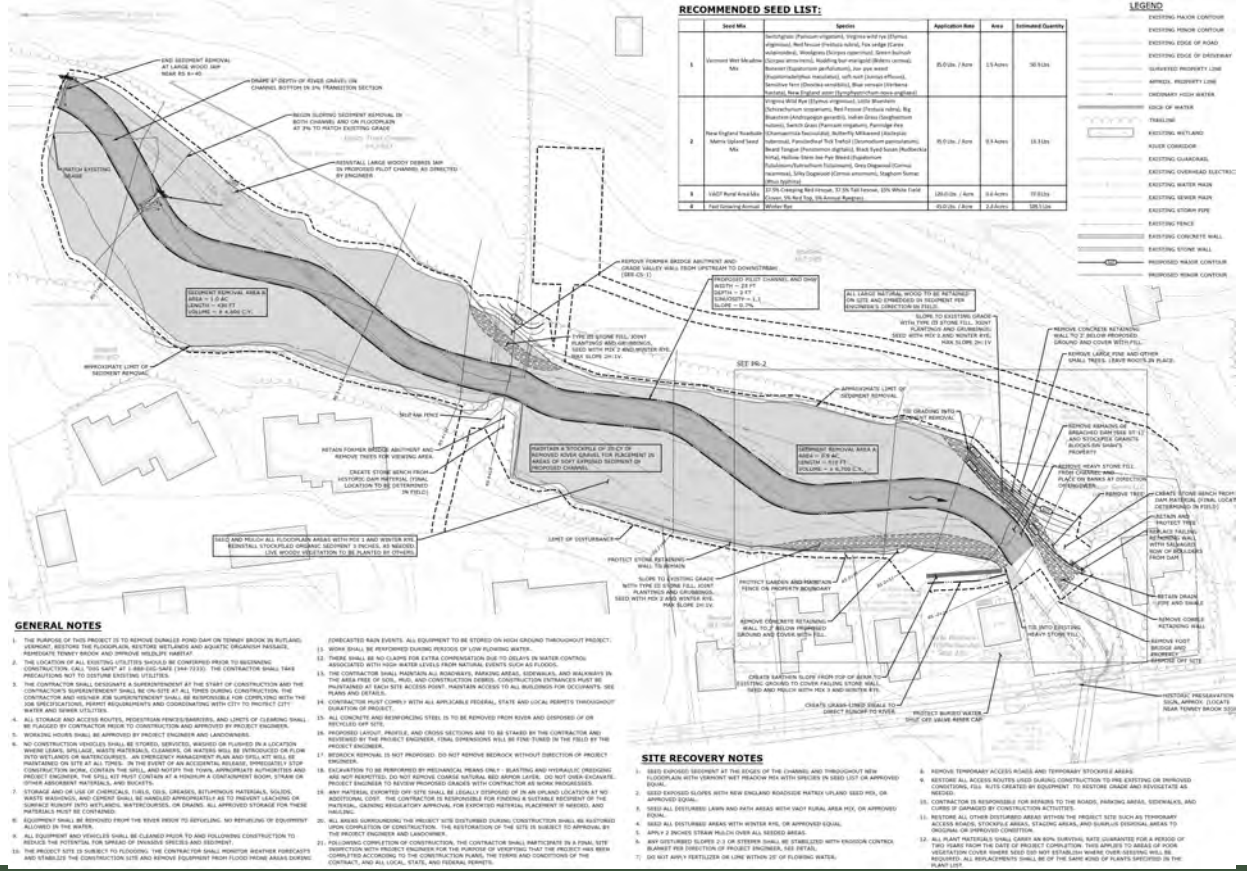
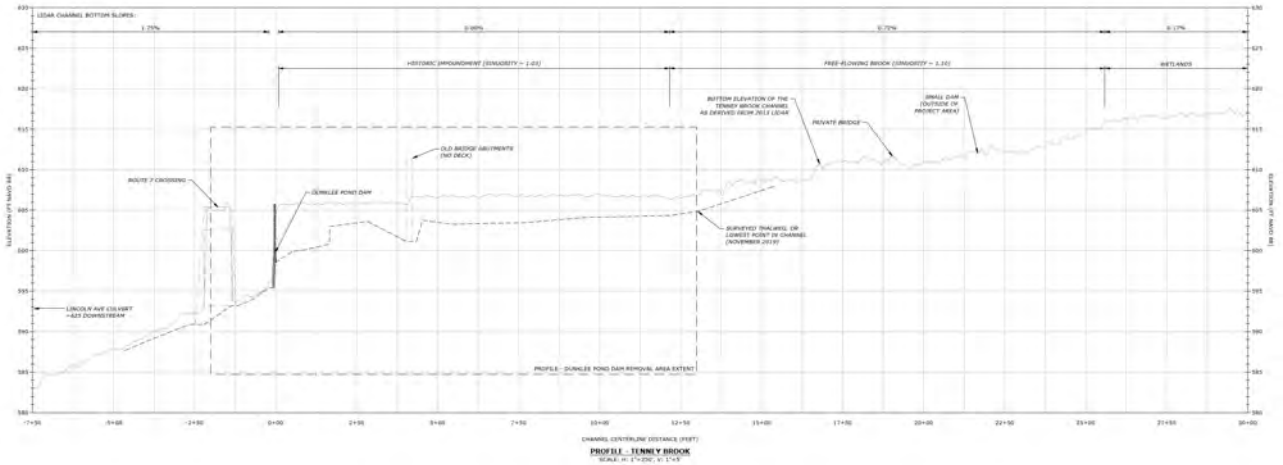
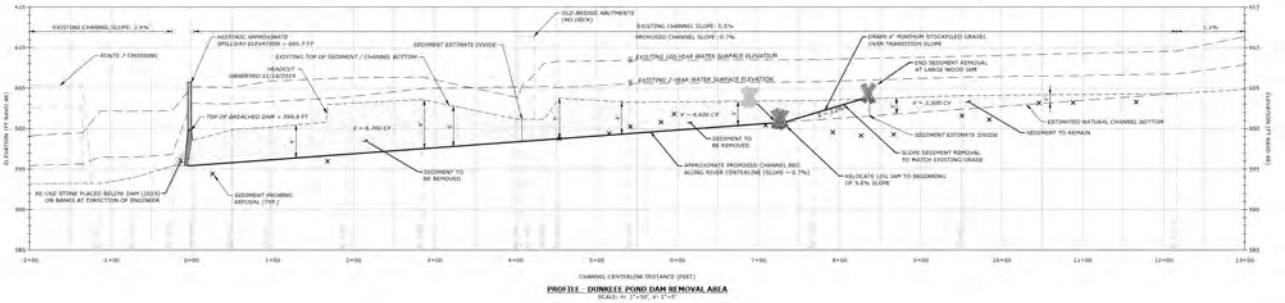


Complex Design – Dunklee Pond Dam Removal

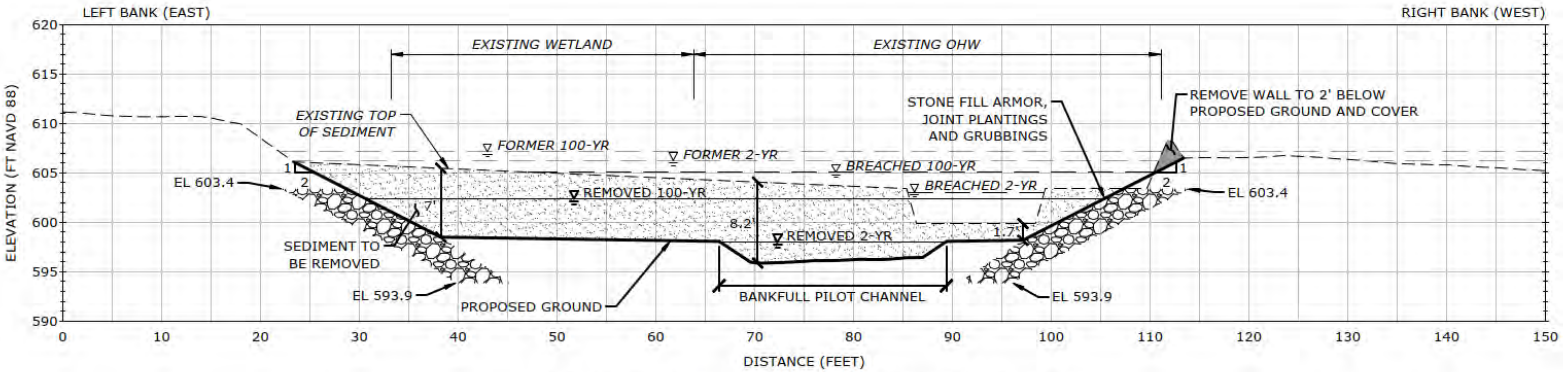


Complex Design – Longitudinal Profile





Complex Design – Stablize Section



RS 0+51 (51 FEET UPSTREAM OF DAM)

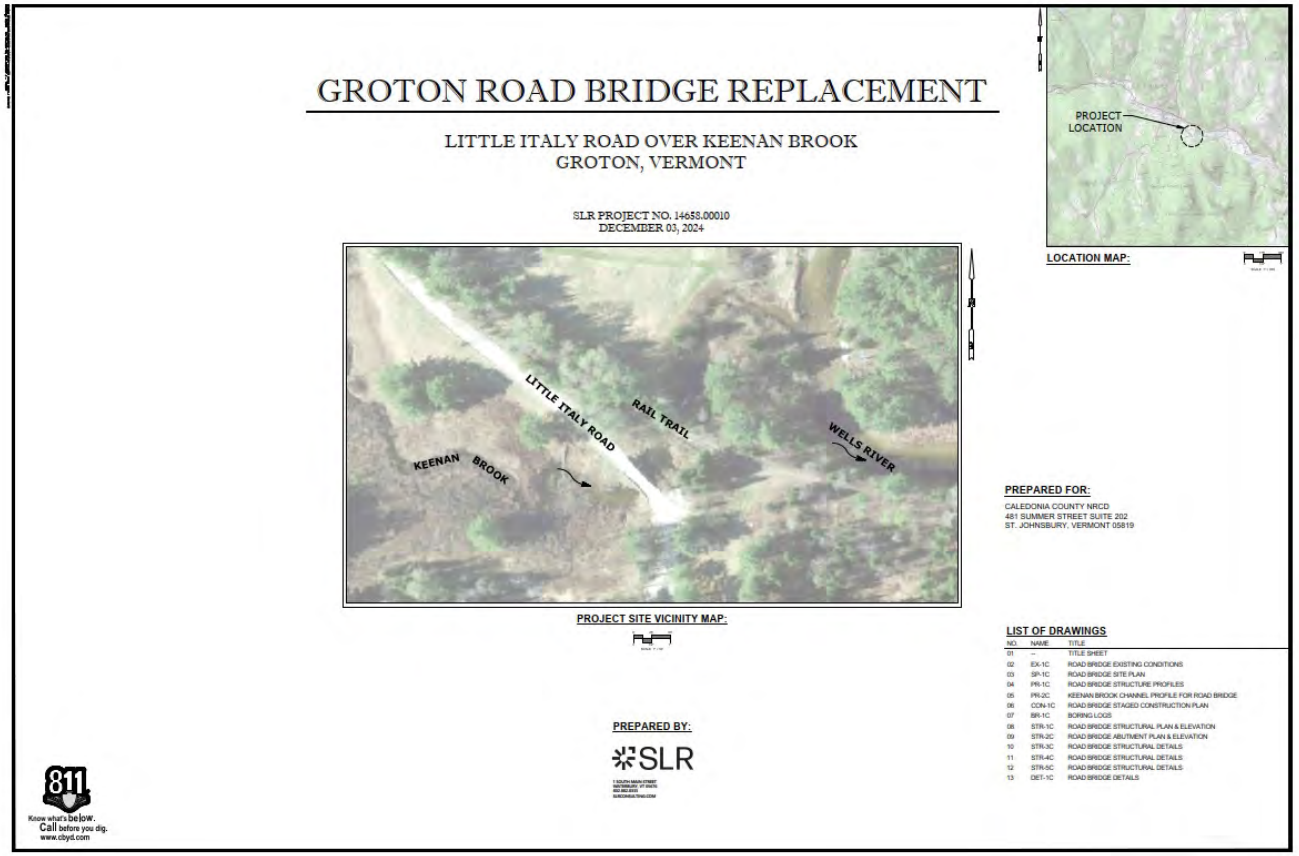
Design Demystified

Design Demystified

B VIEW LOOKING EAST

One Year Post-construction (Source: SLR)

Final Design (100%)



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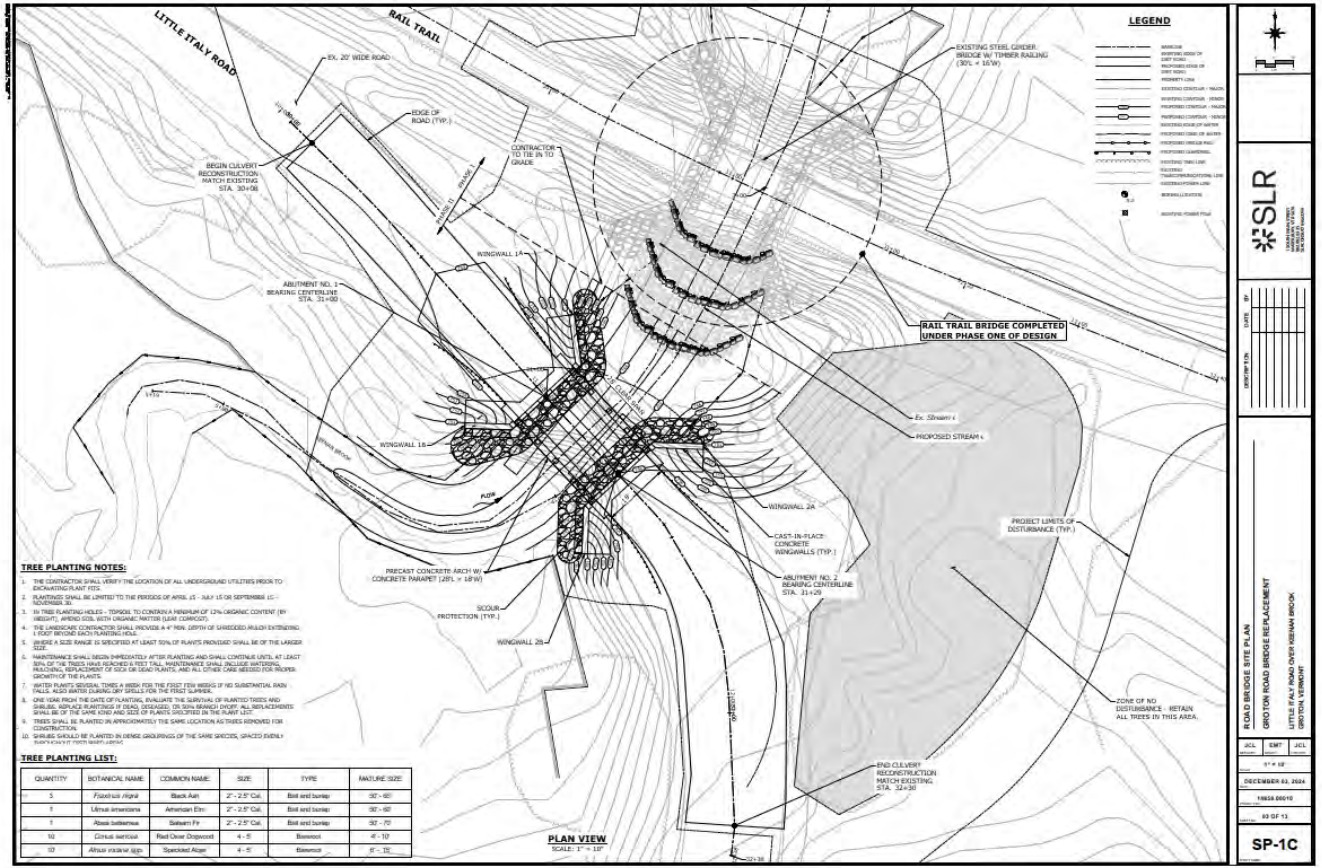

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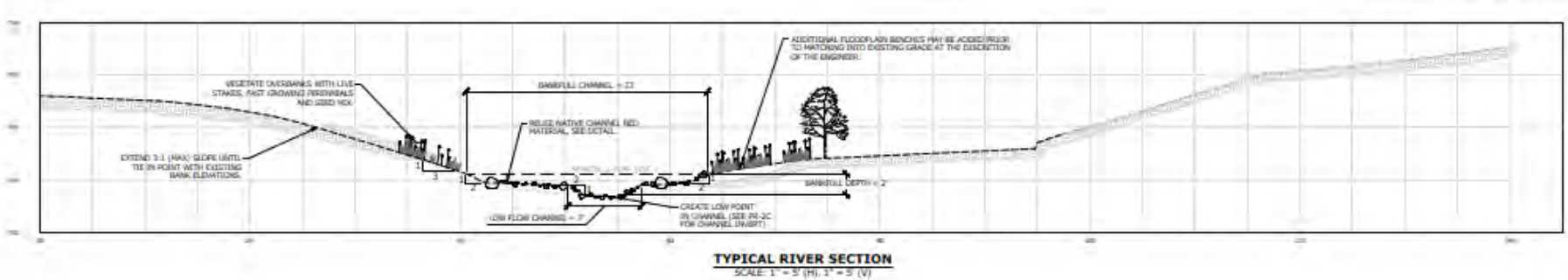
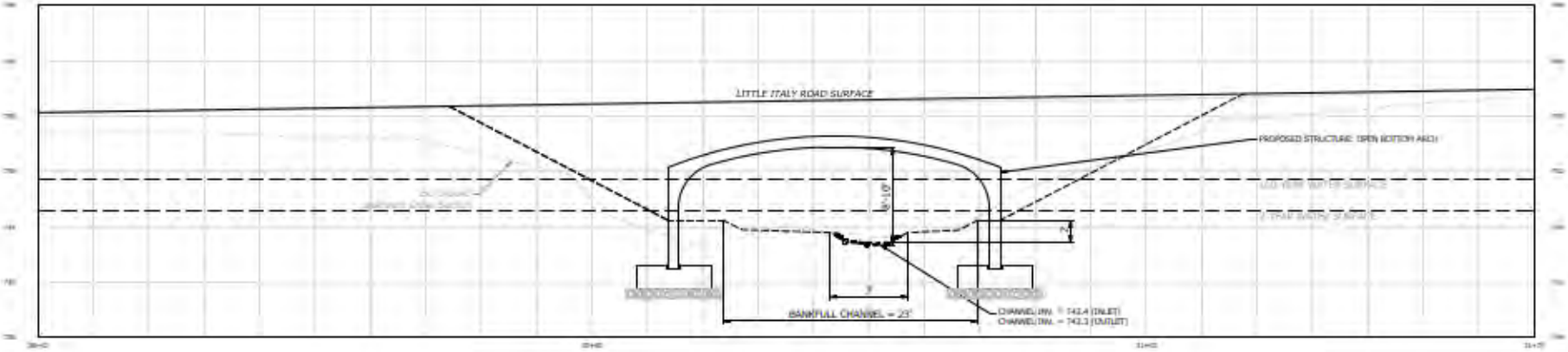
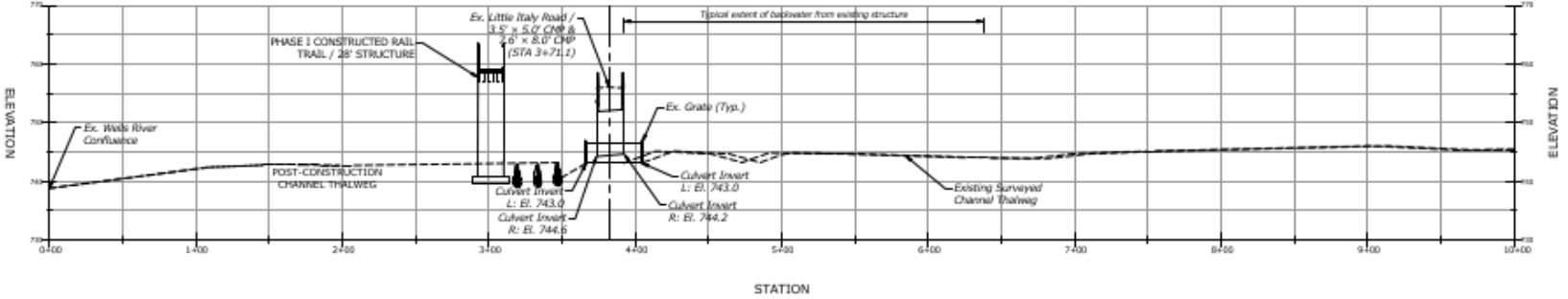


TYPICAL RIVER SECTION
SCALE: 1" = 5' (H), 1" = 5' (V)



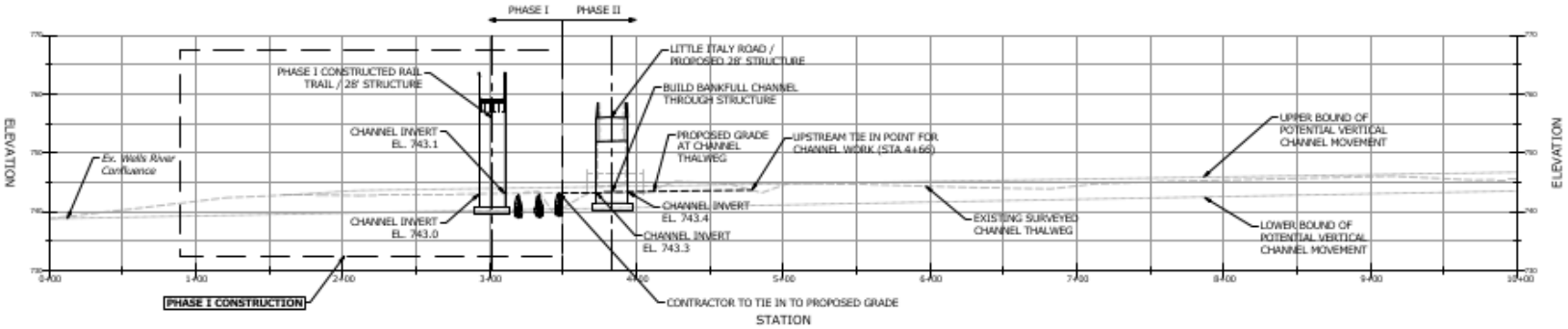
LITTLE ITALY ROAD PROPOSED STRUCTURE
SCALE: 1" = 5' (H), 1" = 5' (V)

Final Design (100%)



KEENAN BROOK EXISTING CHANNEL PROFILE

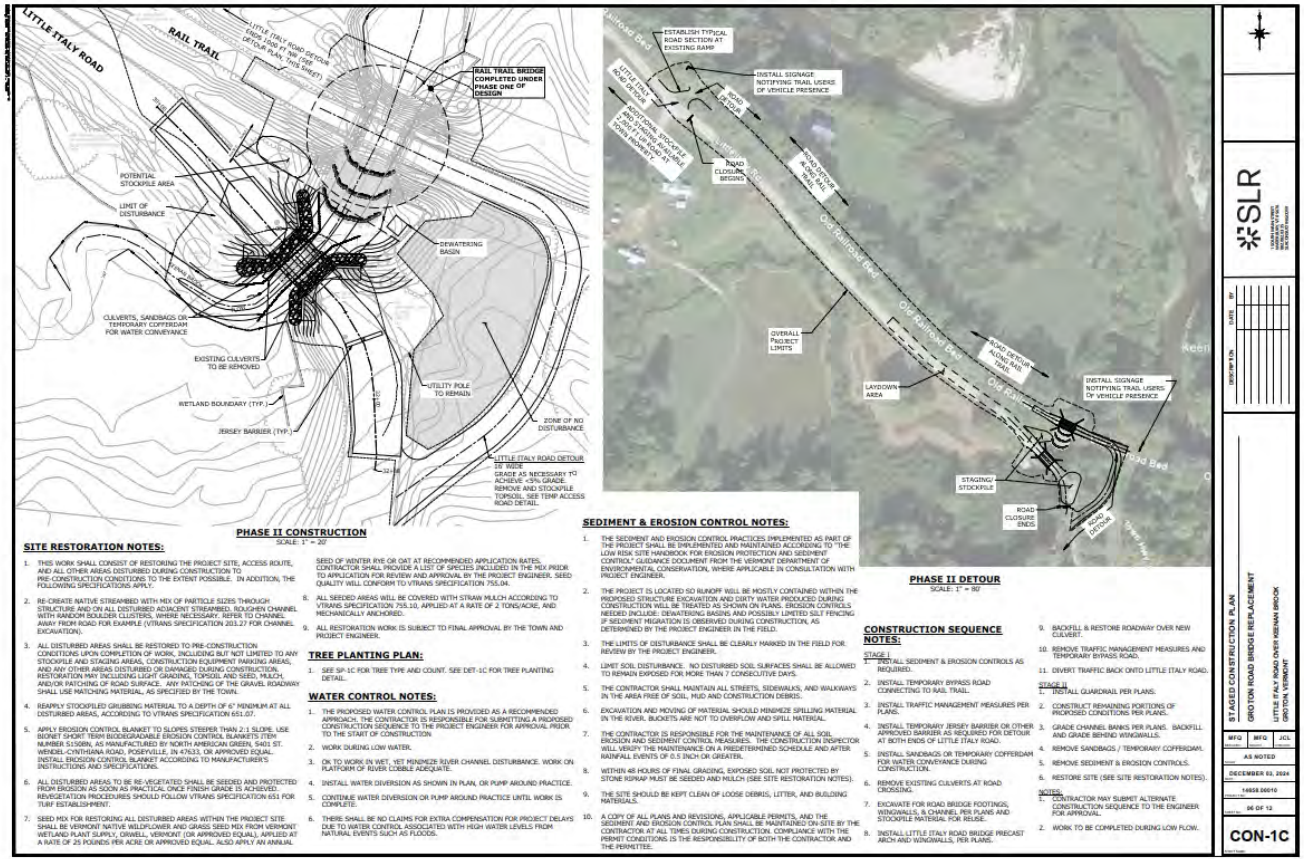
SCALE: 1" = 20' (H), 1" = 5' (V)



KEENAN BROOK PROPOSED CHANNEL PROFILE

SCALE: 1" = 20' (H), 1" = 5' (V)

Final Design (100%)



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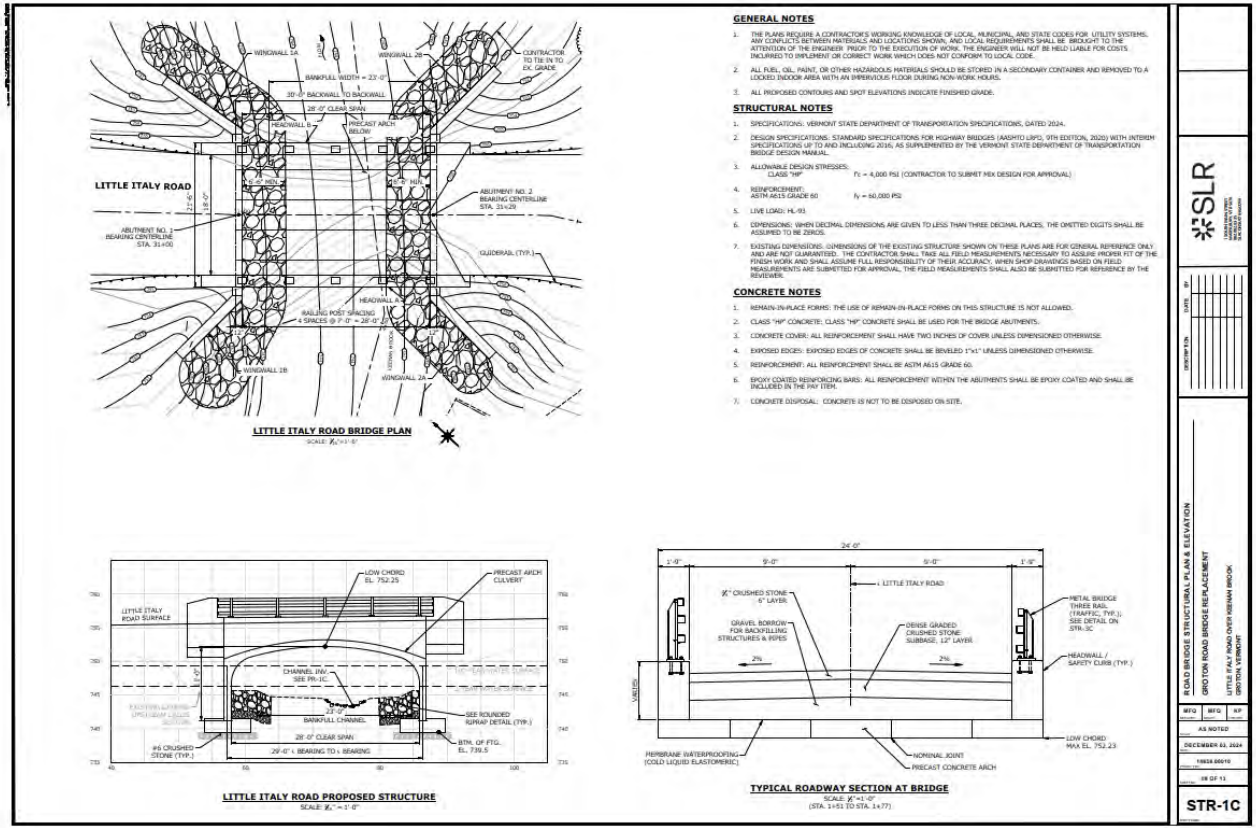

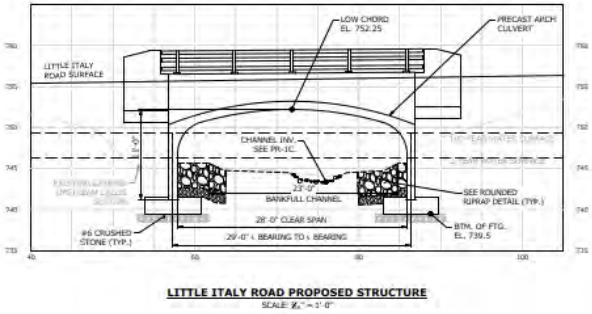

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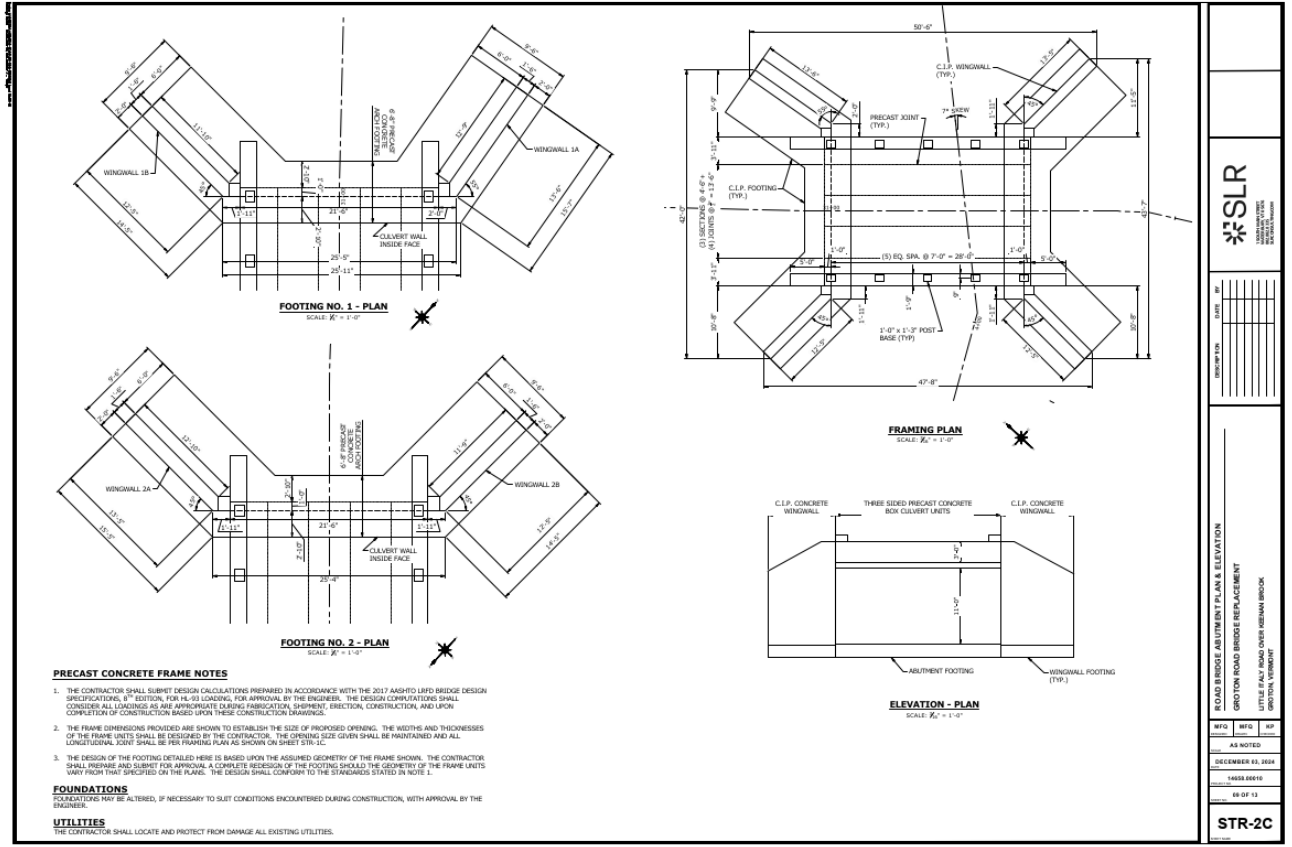

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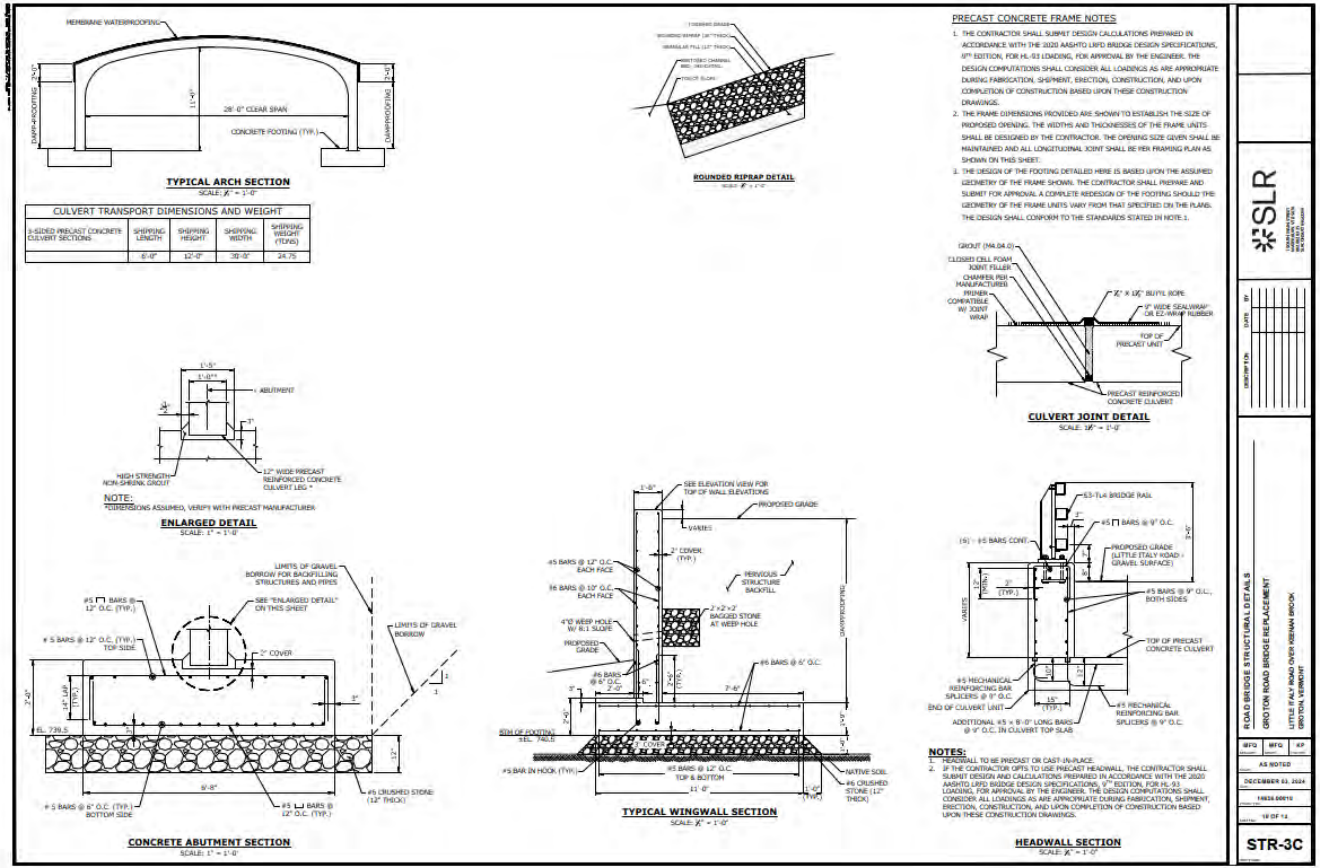

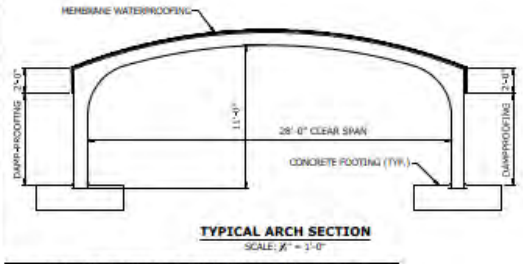

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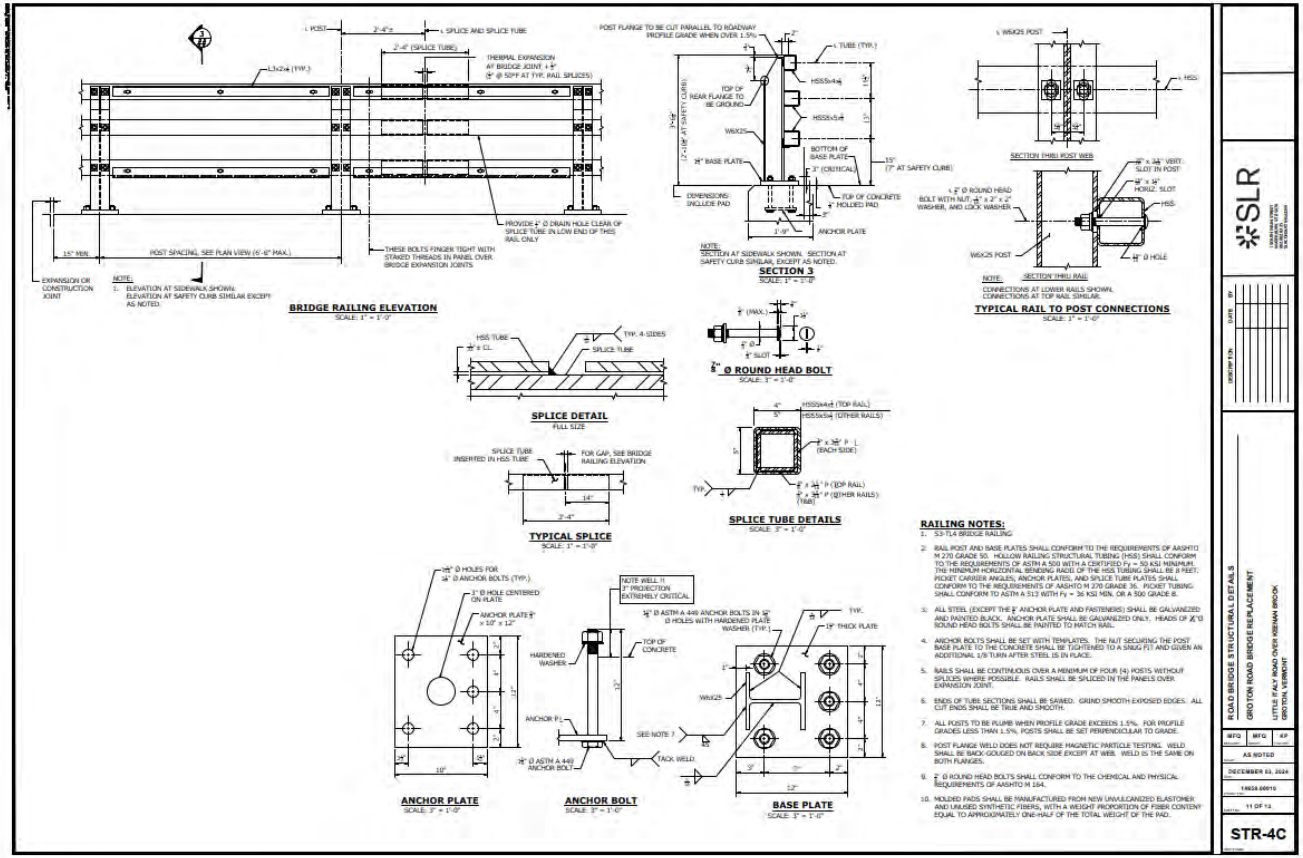

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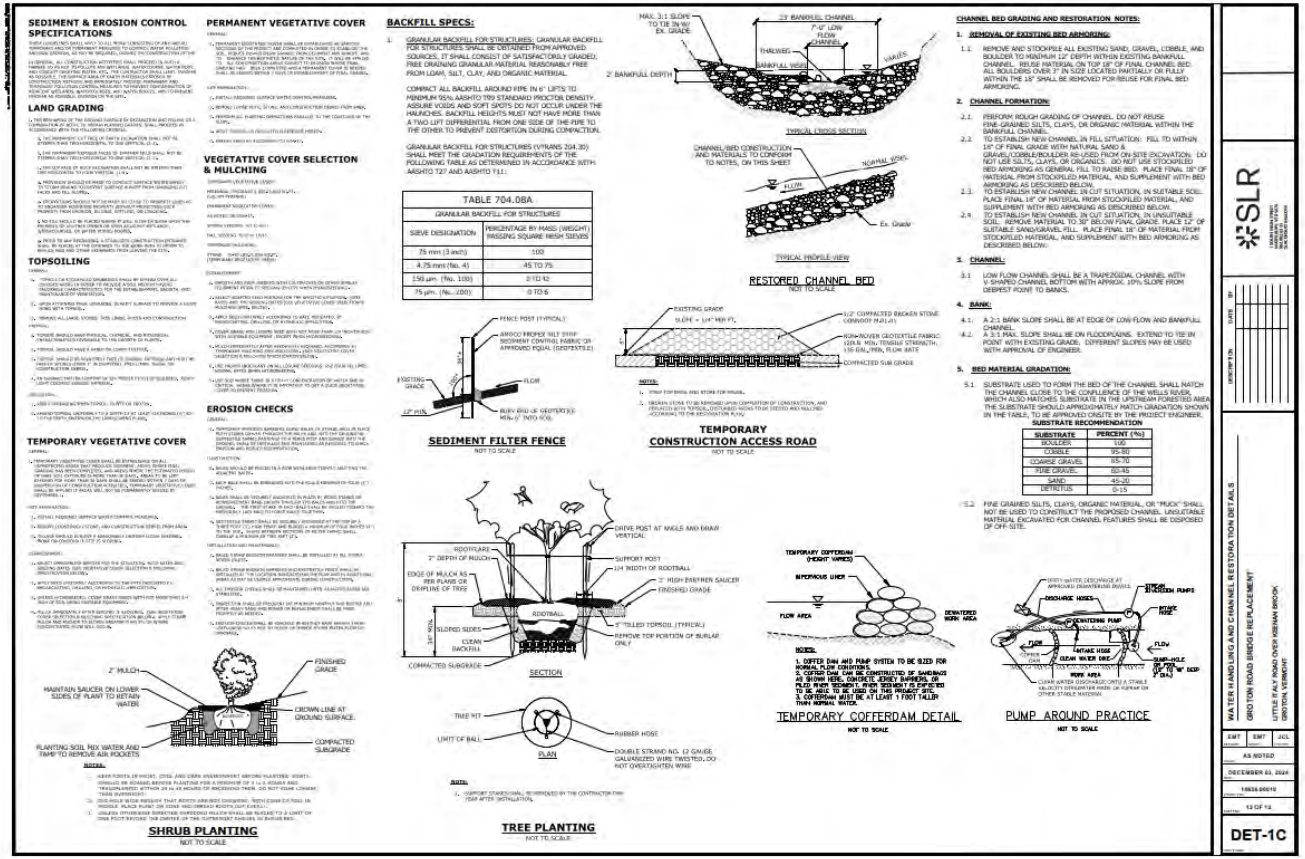
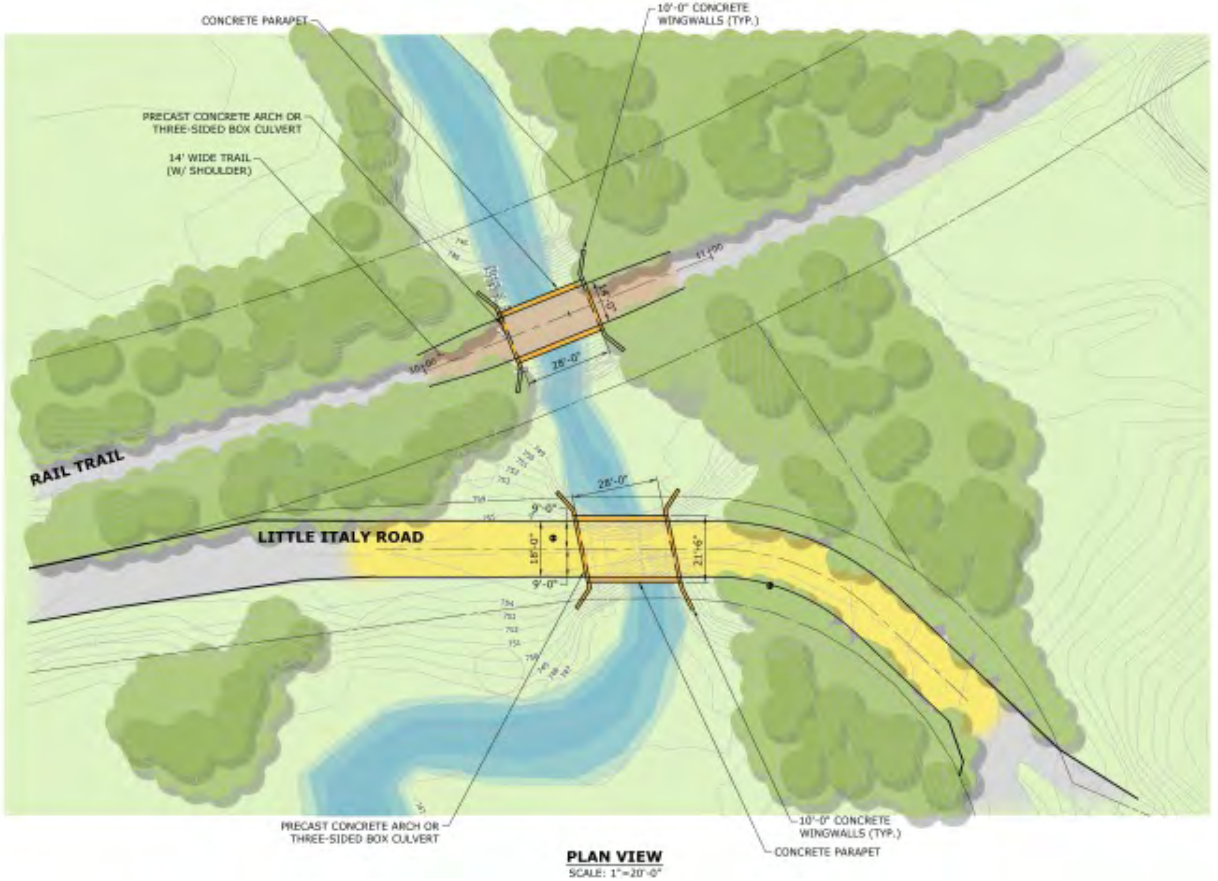


Design Demystified



Design Demystified

Design Recommendations

- Match the number of design levels to the complexity of the project, addressing all constraints.
- Naturalize channel morphology.
- Establish early communications with the landowner, abutters, and community.
- Share information with regulators prior to seeking permits.
- Be flexible to make field changes as new information becomes available during project.
- Form a cohesive project team to successfully design and build a project.

Thank You