AHEAD OF THE STORM
EXISTING CONDITIONS SUMMARY
Location: Hollow Brook, Sugarhouse Lane, Starksboro, Vermont

Site Description

Hollow Brook has been historically altered near the Lazy Brook Mobile Home Park reducing river and floodplain functions (Existing Conditions Map). Flood water carrying sediment has occasionally spilled out of Hollow Brook and a steep tributary and caused damage and sediment deposition on a neighborhood road, around multiple homes, and on a farm field. This project evaluates channel and floodplain alternatives to improve water quality, habitat, and flood resiliency.

Drainage Patterns

Upstream of Lazy Brook Mobile Home Park Hollow Brook is in a narrowly confined channel with steep valley walls. Two mass failures and steep gullies exist. The mass failures were found to be naturally stabilizing and not contributing large amounts of sediment. A steep tributary immediately upstream of the mobile home park is receiving runoff collected in the road drainage network on Lincoln Hill Road. The tributary has deep gully erosion and is transporting large amounts of sediment to Hollow Brook. Sediment has been removed from the channel 2-3 times per year and is in need of removal again as it is currently accumulated high above a nearby home and filling the downstream channel creating increased flood risk.

Lazy Brook Mobile Home Park has encroached on the channel with development, roads, homes, and an informal rock berm on the east side of the channel (river left looking downstream). Abandoned bridge abutments are constricting the river and causing floodwaters to leave the channel and flow into the neighborhood. This area is the former location of an alluvial fan where the channel slope decreases and sediment deposits. Flow from the fan spilled into the downstream wetland complex before the river was channelized.

The double culvert passing under Sugarhouse Lane is perched – trapping sediment upstream and blocking fish passage. The landowner reports that they regularly remove wood caught at the culvert and that the culvert has been overtopped by flood waters. This is the only access over the river to private land. A home is located immediately upstream of the culvert and is at risk of flooding and erosion damage if the culvert is clogged.

Hollow Brook has been straightened and natural riparian vegetation has been reduced due to past and current agricultural fields downstream of Sugarhouse Lane. This area was likely a wetland with meandering channels prior to the channel being moved to the edge of the valley. The channel has filled with sediment and is dry during periods of low flow. Flow travels subsurface starting at the culvert and emerges in the middle of the field and downstream of the beaver dams during dry periods. The beaver dams may be capturing excess sediment. The agricultural field is no longer being actively used, but still does not have natural hydrology or riparian vegetation.

Site Constraints

Existing neighborhood land uses are likely to continue. Landowners may not want to give up potential agricultural land uses. Culvert upgrades will need to consider access during construction.

Possible Treatment Options Identified

1. Restore river channel and adjacent riparian areas downstream of culvert where Hollow Brook is full of accumulated sediment, has been historically straightened, and placed along field edge to make space for agriculture. Consider channel restoration, wetland restoration, river corridor easements, large wood additions, and plantings.
2. Replace driveway culverts with a new crossing structure that is geomorphically compatible and improves aquatic organism passage.
3. Remove remaining abutments and concrete in river at abandoned bridge crossing.
4. Discuss potential to reduce road swale runoff directed to the tributary on Lincoln Hill Road with Town.

EXISTING CONDITIONS

HOLLOW BROOK REFUGIA DESIGN

LEWIS CREEK ASSOCIATION

0 170 340

Feet

1 in = 208 feet

N

MILONE & MACBROOM
1 South Main St
Waterbury, VT 05676
802-882-8335

AHEAD OF THE STORM

Site: Hollow Brook

Location: Sugarhouse Lane, Starksboro, Vermont

EXISTING CONDITIONS PHOTO LOG

Figure 13: When flow backs up at the old abutment constriction, the water flows out onto nearby Elm Lane, damaging homes, and carrying sediment (October 9, 2020).

Figure 15: View of old bridge abutments looking upstream. There is a steep riffle and sediment deposit filling the river channel and contributing to flows leaving the channel (December 12, 2020).

Figure 14: A concrete sill crosses the river at an abandoned crossing. Abutments constrict channel to 12.5' wide. View of old bridge abutments looking upstream (December 6, 2020).

Figure 16: View of old bridge abutments looking downstream (October 2, 2020).

AHEAD OF THE STORM

Site: Hollow Brook Old Bridge Removal

Location: Sugarhouse Lane, Starksboro, Vermont

Primary Problem

Abandoned bridge abutments near Elm Lane are constricting the river and causing floodwaters to leave the channel and flow into the neighborhood. The former road bed is elevated with fill across the narrow valley, filling the floodplain. The remaining concrete constricts the river to only 12.5 feet, narrower than the 20 foot bankfull width (63% of the bankfull channel width). The concrete sill across the river bed prevents fish passage during low flows (Photo 1). Residents report that flood flows have left the channel immediately upstream of the constriction and flowed into the neighborhood depositing sediment, washing out the road, and damaging homes (Photo 2). A large steep sediment deposit is located immediately upstream of the constriction that is filling the channel.

Photo 1: View of old bridge abutments and concrete blocks from downstream (December 6, 2020).

Final Treatment Recommendation

Remove old bridge abutments, concrete blocks, and fill from the road embankment. This will open the channel to match bankfull width upstream and restore the potential for floodplain flow. Use deposited channel materials upstream to create uniform channel slope through former bridge location. Remove excess sediment from large upstream bar.

Site Setting

- Elm Lane can be used to access the removal site.
- Existing structures and known utilities are not constraints.
- The project is not located in the FEMA Special Flood Hazard Zone and will not impact wetlands.

Photo 2: Yellow arrow shows where water has exited the channel upstream of old bridge abutments and concrete blocks (October 10, 2020).

Project Benefits

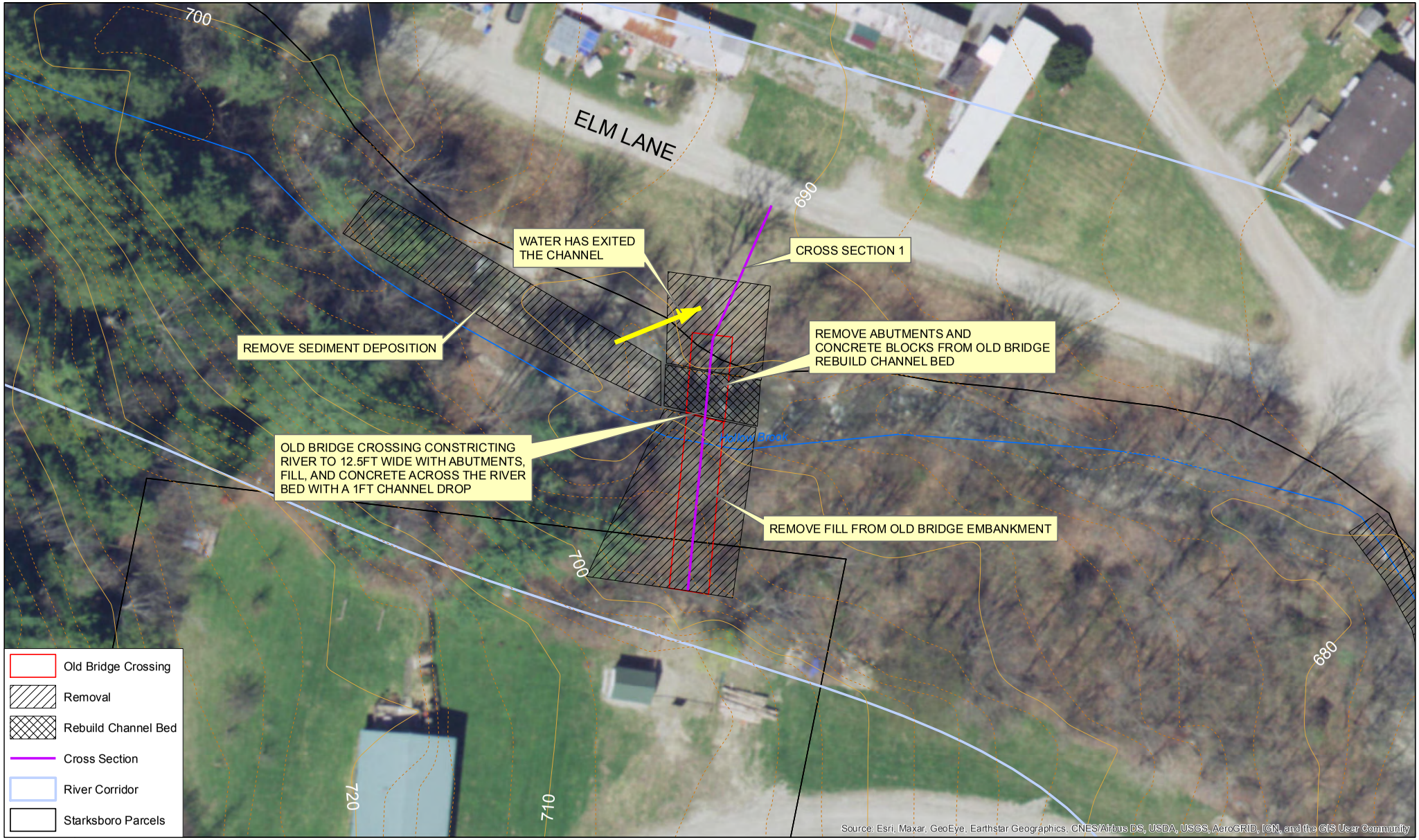
Restoring the river cross section at the constriction reduces risk of flood and erosion damage. The removal of the constriction will reduce the likelihood of high flows leaving the channel, as it will restore the larger flow cross section in both the bankfull channel and the floodplain that is lower than the neighborhood. Restoring the channel profile will improve aquatic organism passage by removing the barriers of the vertical drop and high velocities.

Permitting Needs and Feasibility

A VTDEC Stream Alteration Permit and US Army Corp of Engineers Vermont General Permit will be required.

Cost

Construction and engineering services is estimated to cost in the range of $35,000 – $65,000. If combined with other identified project elements on the river reach, this project will share costs and fall closer to the low end of the cost range.



CONCEPT - OLD BRIDGE REMOVAL

HOLLOW BROOK REFUGIA DESIGN

LEWIS CREEK ASSOCIATION

0 35 70

Feet

1 in = 32 feet

N

MILONE & MACBROOM
1 South Main St
Waterbury, VT 05676
802-882-8335

MILONE & MACBROOM — Now part of SLR

MEMORANDUM

TO:	Lewis Creek Association
FROM:	Jessica Louisos, PE, Roy Schiff, Phd, PE, & Claire Nauman, SLR
RE:	Alternatives Analysis – Hollow Brook Refugia Design
DATE:	1/28/2021
MMI #:	3452-36

The upper reaches of Hollow Brook were identified to be important areas for restoration in *Increasing Aquatic Habitat Knowledge and Stewardship in the Lewis Creek Watershed* prepared by Milone & MacBroom for Lewis Creek Association in 2020. Existing conditions were evaluated, and potential improvement projects were identified to meet the following project objectives:

- Improve Water Quality – To improve water quality a practice might reduce sediment and nutrients entering the river system by filtering or removing sediment by settling on reconnected floodplains, reducing erosion, or filtering in a vegetated buffer before runoff reaches the channel.

- Improve Floodplain Connectivity – To improve floodplain connectivity a project would increase either the area of floodplain or the frequency that water from the channel would flow onto the adjacent floodplain. Floodplain reconnection could be achieved by reducing the elevation difference between the channel and the floodplain or by removing constraining berms.

- Improve Habitat or Aquatic Organism Passage – To improve aquatic organism passage a project might remove a physical barrier to organism movement along the channel such as an outlet drop at a culvert. To improve habitat a project might improve the temperature of water by increasing shading and installing large wood elements where organisms can shelter during flood and predation.

- Reduce Flood and Erosion Risk – To reduce flood and erosion risk projects may lower flood levels, reduce velocities, or provide more conveyance capacity within the river and floodplain for water, sediment, and debris. The more water spreads out, the slower it moves and less erosion takes place.

- Reduce Implementation Cost – The costs for additional design, permitting, and construction were evaluated in relationship with other alternatives and gives a sense of the scale of the financial commitment to implement each alternative.

- Reduce Maintenance Cost – Maintenance costs relative to other alternatives were evaluated and gives a sense of the ongoing need for actions at a location if the alternative is implemented. A good rating may be a natural project that is expected to function without intervention while a poor rating may be an alternative where removing sediment or debris is likely required annually.

- Avoiding Constraints – Location or project specific needs or constraints were also evaluated. These may include feasibility issues that may prevent a project from being successful.

A series of alternatives for each project area were evaluated against the project objectives (see the Alternatives Analysis Matrix). The following project elements are recommended for concept design:

1. River channel and floodplain restoration downstream of Sugarhouse Lane.

2. Replace Sugarhouse Lane river crossing culverts with a new crossing structure that is geomorphically compatible and improves aquatic organism passage and material transport.
3. Remove the remaining abutments and concrete in river at abandoned bridge crossing near Elm Lane.
4. Discuss potential to reduce road swale runoff directed to the tributary on Lincoln Hill Road with Town, evaluate the need to make changes at an at-risk home, and continue the periodic dredging of the lower channel.

Restoration alternative project sheets and overview maps are attached for the top three alternatives that are recommended to be included in the concept design. Project sheets provide additional detail on the primary problem to be addressed, treatment recommendations, information on the site setting and site constraints, a summary of project benefits, an overview of expected permitting needs and challenges, and a range of potential construction costs. Maps of each recommendation are included as an overview of project elements.

Additional evaluation of the recommended alternatives for the tributary upstream of Lazy Brook Mobile Home Park should be pursued in partnership with the Mobile Home Park Association and the Town. This gully is contributing excessive sediment to the stream and leading to high flood and erosion risk to the nearby homes.

Hollow Brook Refugia Design
Alternatives Analysis Matrix
Starksboro, Vermont
January 28, 2021

MILONE & MACBROOM — Now part of SLR

Location	Description	Improve Water Quality	Improve Floodplain Connectivity	Improve Habitat or Aquatic Organism Passage	Reduce Flood and Erosion Risk	Comparative Implementation Cost	Comparative Maintenance Cost	Recommend	Notes
Channel Downstream of Sugarhouse Lane	No Action	Poor	Fair	Poor	Poor	Good	Poor		Historically straightened channel altered from wetland meandering channel. Filled with sediment, blocking aquatic organism passage. Limited vegetation in buffer. Flooding outside the channel may extend to the west side of the channel where a barn, home, and driveway are located as well as additional locations in the field.
	Remove Beaver Dams	Poor	Poor	Fair	Fair	Fair	Poor		A series of recent beaver dams are slowing velocities and causing sediment to accumulate and fill the channel. Flow is going subsurface through sediment during some portions of the year and high flows and sediment are exiting onto the adjacent field. Beavers are likely to rebuild dams if removed.
	Remove Beaver Dams and Accumulated Sediment	Poor	Poor	Good	Good	Poor	Poor		Beavers are likely to build dams if removed, so this is likely not a long-term solution. Dredging may not be allowed by permits. Expensive solution to maintain historically altered channel.
	Plant Riparian Buffer Along Existing Channel	Good	Fair	Good	None	Good	Good		Woody riparian vegetation provides many benefits. Benefits of this solution alone are limited due to the current altered and sediment filled state of the channel. Combine with other alternatives to gain full benefits of riparian vegetation.
	Channel and Floodplain Restoration	Good	Good	Good	Good	Poor	Good	√	Eliminates future agricultural use. Currently straightened river would be relocated into field and reconnected to floodplain. Riparian area would be planted with woody species. Filled channel would be blocked and part of new floodplain.
Sugarhouse Lane River Crossing Structure	No Action	Poor	Poor	Poor	Poor	Good	Poor		The existing two 6-foot diameter culverts are perched, trap sediment and wood upstream, and block fish passage. The culverts are not large enough to pass floods safely (60% of bankfull width). Flows have overtopped the road and increase risk to adjacent home.
	Add Third Culvert	Poor	Poor	Poor	Fair	Fair	Poor		Hydraulic capacity would be increased. Clogging risk would stay the same because the capacity to pass large wood would not be increased. The perch would not be corrected and aquatic organism passage would not be improved.
	Remove Structure, Without Replacement	Good	Good	Good	Good	Fair	Good		This crossing is the only access to three residential and a maple surgar operation. No other access exists. A river crossing over Hollow Brook is necessary to access properties. No other more suitable river crossing location exists.
	Replace with Larger Open Bottom Single Span	Good	Good	Good	Good	Poor	Good	√	Replace with a 20 foot wide structure that fits the stream channel section and profile. Embed into the natural bed and remove perch will remove the aquatic organism block. The reach itself would still be a block during low flow periods when flows are subsurface without combining with other alternatives.
Abandoned Bridge Abutments near Elm Lane	No Action	Poor	Poor	Poor	Poor	Good	Poor		The remaining fill and concrete constrict the river. The constriction has accumulated sediment upstream filling the bankfull channel. The full channel and constriction both contribute to flood flows flowing out of the channel into the neighborhood. The concrete in the channel is a low flow fish passage block.
	Remove Concrete from River and River Banks	Fair	Fair	Good	Fair	Fair	Fair		Removing the concrete from the river would remove the artificial step in the channel that blocks fish passage. Removing the concrete blocks from the banks will reduce the bankfull channel constriction. The remaining earth fill across the floodplain on both sides still remains as a constriction and may continue to backwater flows, not fully eliminating the risk.
	Remove All Bridge Remains including Earth Fill	Good	Good	Good	Good	Fair	Good	√	Restoring the river and floodplain cross section reduces risk of flood and erosion damage and improves fish passage. Removing the sediment deposit will reduce flood risk and restore the native stream bed.