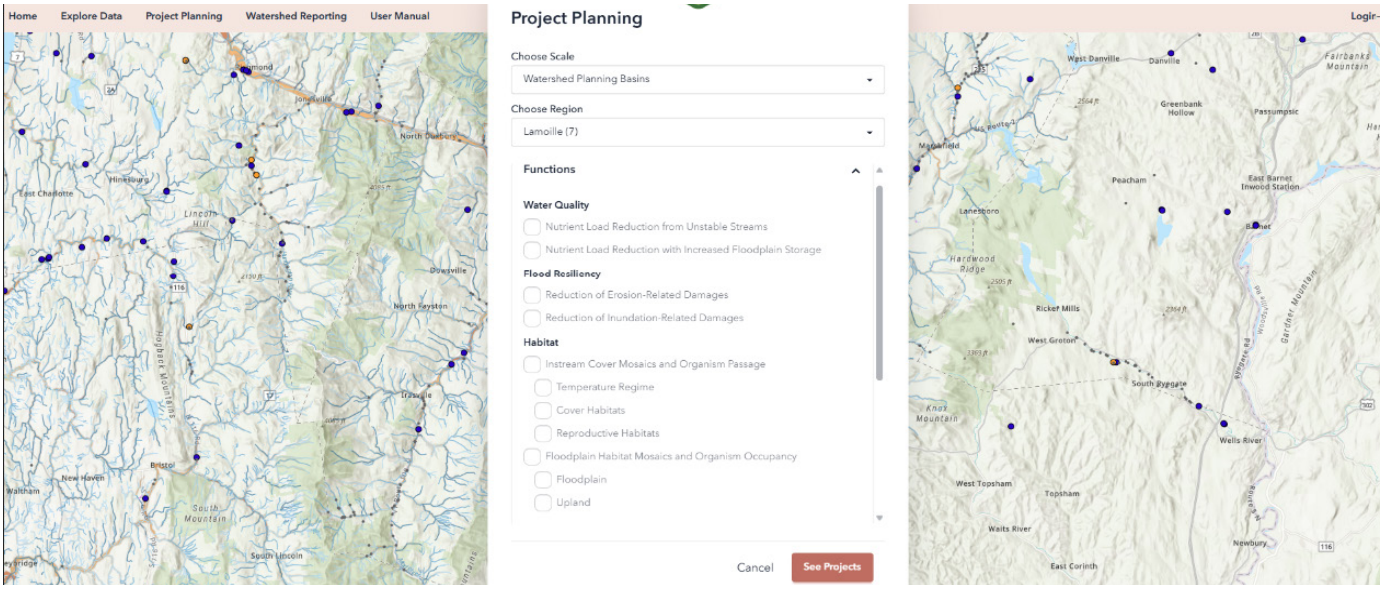
PATRICK LEAHY
Lake Champlain
Basin Program

TECHNICAL REPORT NO. 119

Expanding Vermont's Functioning Floodplain Initiative (FFI) to Advance the Science and Conservation of Healthy Stream, Riparian, Wetland, and Floodplain Ecosystems



July 2026

Prepared by: Roy Schiff, SLR Consulting, Liz Doran, University of Vermont, Jody Stryker, Stone Environmental, Mike Kline

For:
The Lake Champlain Basin Program and NEIWPCC

This report was funded and prepared under the authority of the Lake Champlain Special Designation Act of 1990, P.L. 101-596 and subsequent reauthorization in 2002 as the Daniel Patrick Moynihan Lake Champlain Basin Program Act, H. R. 1070, through the US EPA. Publication of this report does not signify that the contents necessarily reflect the views of the states of New York and Vermont, the Lake Champlain Basin Program, the US EPA or the Great Lakes Fishery Commission.

The Lake Champlain Basin Program has funded more than 100 technical reports and research studies since 1991. For complete list of LCBP Reports please visit:
https://www.lcbp.org/news-and-media/publications/technical-reports/

NEIWPCC Job Code: 0357-003-001
Project Code: L-2021-099

FINAL REPORT

NEIWPCC Job Cost Code:	0357-003-001
Project Code:	L-2021-099
Contractor:	SLR Consulting and Collaborators
Prepared By:	Roy Schiff, SLR Consulting, Liz Doran, University of Vermont, Jody Stryker, Stone Environmental, Mike Kline
Contract Execution Date:	2/11/2022
Contract End Date:	6/30/2026
Date Submitted:	3/13/2026
Date Approved:	3/20/2026

EXPANDING VERMONT'S FUNCTIONING FLOODPLAIN INITIATIVE (FFI) TO ADVANCE THE SCIENCE AND CONSERVATION OF HEALTHY STREAM, RIPARIAN, WETLAND, AND FLOODPLAIN ECOSYSTEMS

CONTACT INFORMATION

Roy Schiff, SLR Consulting

1 South Main Street, 2nd Floor, Waterbury, VT 05676

(802) 882-8335, rschiff@slrconsulting.com

This is a U.S. Environmental Protection Agency funded project.

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement (LC 00A00707-0) to NEIWPCC in partnership with the Lake Champlain Basin Program.

PROJECT SUMMARY

This project expanded the Vermont Functioning Floodplain Initiative (FFI) (https://dec.vermont.gov/rivers/ffi) to build out habitat quality components to allow for interactive web planning for the prioritization and tracking of projects to restore instream and floodplain habitat critical to maintaining the movement of organisms and biodiversity, especially in the presence of a changing climate. Methods are described in the revised FFI User Manual (Schiff et al., 2025) and are now available on the FFI web tool (https://ffi.stone-env.net/).

CONTENTS

1. PROJECT INTRODUCTION

Alluvial floodplains are valued for the ecosystem functions they perform including sediment and nutrient storage and transformation processes; groundwater recharge; and the creation and maintenance of aquatic and riparian habitats, including forms that enable plant and animal migrations and adaptation (Ward et al., 1999; Florsheim et al., 2008). The FFI has developed new assessment approaches to understand how departures in connectivity (i.e., physical breaks in vertical-lateral, longitudinal, and temporal flow patterns) are contributing to the loss of fluvial processes in the Lake Champlain basin in Vermont that support natural stream and floodplain functions (Wohl et al., 2018). The FFI also identifies opportunities to restore water quality and mitigate flood and fluvial erosion hazards. The FFI includes modeling to better define the geographic extents of stream equilibrium, channel evolution, and floodplain inundation (Underwood et al., 2020); and the frequency, duration and timing of flooding events that influence the water, sediment and nutrient storage potential of floodplains (Diehl et al., 2019).

This project expanded the Vermont Functioning Floodplain Initiative (FFI) (https://dec.vermont.gov/rivers/ffi) to build out habitat quality components to allow for interactive web planning for the prioritization and tracking of projects to restore instream and floodplain habitat critical to maintaining the movement of organisms and biodiversity, especially in the presence of extreme weather events. Methods are described in the revised FFI User Manual (Schiff et al., 2025) and are now available on the FFI web tool (https://ffi.stone-env.net/).

It is known that hydrologic and sediment connectivity influence instream and floodplain habitats. Vermont assessment protocols have been developed for instream habitat (Schiff et al., 2008; Kline et al., 2009), riparian corridors (Sorenson and Zaino, 2018), and natural community mapping (Thompson et al., 2019). This screening tool is needed to understand the variability in habitat functions across space and over time, and to identify highest priority habitat features for conservation and restoration. For example, the Vermont Conservation Design (Sorenson and Zaino, 2018) identifies all riparian corridors as highest priority landscape features, but limited financial resources require that we further prioritize riparian areas to maximize habitat benefit of reconnection projects.

We created the prioritization and mapping of habitat restoration and protection projects based on connectivity departure metrics that were incorporated into the web-based planning and tracking tools of the FFI. We performed the following three elements that draw upon previous Vermont instream habitat assessments and develop the first Vermont bio-geomorphic assessment of floodplain habitat:

1. Utilize existing Reach Habitat Assessment data (Schiff et al., 2008) to identify readily available proxy physical features to indicate habitat restoration opportunities in river corridor plans (Kline, 2010) via definition and assessment of patterns of instream habitat types using surrogate stream geomorphic assessment (SGA), hydrologic connectivity, and sediment regime departure data being developed in the ongoing FFI.
2. Create field methods and modeling to evaluate departures in natural processes that form floodplain and riverbank natural communities and riparian habitats important to wildlife.
3. Enhance the work being done to map and prioritize existing and potential habitat important to biodiversity and organism movements within and across the riverscape (Sorenson and Zaino, 2018) by evaluating and mapping predictions of stream, wetland, and floodplain habitat quality as indicated by river/floodplain form and process.

This project addressed several LCBP priorities, and Vermont's new Act 76 requirement for conservation and restoration research and the implementation of projects that support native species and achieve the co-benefits of habitat, water quality, and flood resilience. Incorporating habitat functions and restoration priorities into the FFI advanced the following objectives of the LCBP Opportunities for Action (LCBP, 2022).

- I.A.2.a – Support research to develop innovative management approaches likely to improve water quality. This project provides important habitat data in conjunction with water quality and resiliency data to restoration practitioners.
- II.C.1 – Work with Lake Champlain management partners to prioritize, protect and restore important riparian, shoreland and wetland habitat areas. This project helps assess instream and floodplain habitat and prioritize projects for protection and restoration.
- II.C.1.a – Fund and promote projects that protect and restore riparian corridors and floodplains. This project provides a systematic restoration strategy to protect biodiversity concentrated in rivers and floodplains.

2. TASKS COMPLETED AND METHODS

All project tasks in our approved work plan (Table 1) were completed during this project. Please refer to the Updated FFI User Guide (Schiff et al., 2025) that contains all of the new instream and floodplain habitat methods, along with screen shots of the FFI habitat outputs.

Table 1. Completed Deliverables from Approved Workplan

Task #	Task title	Objective	Deliverable or Output	Timeline
1.1	Develop and gain approval of project QAPP	Describe quality assurance procedures that will maintain project performance at start of project.	Approved QAPP.	Contact start – September 2022
1.2	Define reference conditions and construct models	Develop methods in the Vermont sector of the Lake Champlain Basin to define and map floodplain habitat reference and departure conditions, and prioritize projects.	Text, chart, and visual of floodplain screening approach.	Jan 2022-May 2025
1.3	Expand on the existing FFI assessment of longitudinal habitat connectivity	Develop methods in the Vermont sector of the Lake Champlain Basin to define and map instream habitat reference and departure conditions, and prioritize projects.	Text, chart, and visual of instream screening approach.	September 2022-May 2024

1.4	Field-Validate Instream and Floodplain Habitat Models	Perform field trips to review initial results of floodplain and instream habitat departure.	Documentation of field validation and proposed method changes.	October 2022 – August 2024
1.5	Define screening methods to prioritize practices for enhancing, restoring, and protecting instream and floodplain habitat	Create methods for habitat project identification and prioritization.	Text, chart, and visual of project screening approach.	Sept-Oct 2025
1.6	Attribute the instream habitat elements to the FFI maps for the Lake Champlain Basin in Vermont	Add habitat components to mapping to view initial results and initiate app development.	Habitat project prioritization in ArcGIS online mapping.	Oct-Nov 2025
2.1	Integrate habitat data into the FFI web application	Expand the FFI web-based mapping to include habitat elements.	New FFI web application mapping extents.	Jan-Dec 2025
2.2	Replicate water quality/flood resilience web application planning and tracking tools	Update FFI web application planning and tracking functionality for instream and floodplain habitat condition and project prioritization.	New FFI web application habitat planning and tracking features.	Mar-Dec 2025
2.3	Refine application habitat interface/functions based on stakeholder feedback	Update FFI web application appearance and menus to include habitat elements developed during this project.	New FFI web application habitat functionality.	Mar-Dec 2025
3.1	Add a habitat module to the FFI trainings and User Guide	Create final report / user manual for community of users to understand the habitat components of the FFI.	User manual/final report and training session.	Oct-Dec 2025
3.2	Test and refine user guide with stakeholders	Update the user manual after stakeholder input.	Revised user manual.	Oct-Dec 2025
3.3	Develop at least two habitat outreach information sheets	Create FFI habitat information sheets.	Two information sheets on FFI habitat.	Dec-25

3.4	Create a storyboard or blog content and Approved Final Report	Create web content for DEC/DFW on the FFI habitat components.	Story board or blog on FFI habitat and approved LCBP final report	June 30, 2026

A QAPP was developed and followed for the project. Quarterly progress reports were submitted to LCBP.

Following literature reviews, habitat methods were initially developed in spreadsheets (Figure 1 and Figure 2). Instream habitat methods were refined and validated by reviewing data distributions and by comparison to Vermont Reach Habitat Assessment field data. Floodplain methods were refined and validated by reviewing data distributions and comparison to natural community field data collected as part of this project (Figure 3).

Temperature Refugia Function based on Connectivity Scores

		Floodplain Connectivity				Stream Connectivity	
Steep Headwaters		**Lateral-MBW**	**Lateral-Protect**	**Lateral-Rip Veg**	**Vertical**	**Longitudinal**	**Temporal**
Cascade	**Near Natural**	76-100 Full	76-100 High	91-100 High		91-100 Connected	91-100 Connected
Step-Pool	**Good Habitat**	51-75 Moderate	51-75 Moderate	76-90 Moderate	Not a Factor	76-90 Min.Disconnect	76-90 Min.Disconnect
Planebeds	**Fair Habitat**	26-50 Low	26-50 Limited	51-75 Limited		51-75 P.Fragmented	51-75 P.Fragmented
DA < 2 Sq.Miles	**Poor Habitat**	0-25 Constrained	0-25 Mostly Absent	0-50 Mostly Absent		0-50 Fragmented	0-50 Fragmented
S > 3%	**Weight %**	10	5	40	0	20	25
Narrow--Semi-Confined							
Low-Gradient Headwaters		**Lateral-MBW**	**Lateral-Protect**	**Lateral-Rip Veg**	**Vertical**	**Longitudinal**	**Temporal**
	Near Natural	76-100 Full	76-100 High	91-100 High		76-100 Connected	91-100 Connected
Riffle-Pool	**Good Habitat**	51-75 Moderate	51-75 Moderate	76-90 Moderate	Not a Factor	51-75 Min.Disconnect	76-90 Min.Disconnect
Ripple-Dune	**Fair Habitat**	26-50 Low	26-50 Limited	51-75 Limited		26-50 P.Fragmented	51-75 P.Fragmented
Braided	**Poor Habitat**	0-25 Constrained	0-25 Mostly Absent	0-50 Mostly Absent		0-25 Fragmented	0-50 Fragmented
Beaver flowages	**Weight %**	15	5	40	0	15	25
Plane Beds							
DA < 2 Sq.Miles							
S < 3%							
Narrow-Broad							
Lower Valley Streams		**Lateral-MBW**	**Lateral-Protect**	**Lateral-Rip Veg**	**Vertical**	**Longitudinal**	**Temporal**
	Near Natural	91-100 Full	76-100 High	91-100 High	≤1.25 Minor	76-100 Connected	76-100 Connected
Riffle-Pool	**Good Habitat**	76-90 Moderate	51-75 Moderate	76-90 Moderate	>1.25-1.5 Moderate	51-75 Min.Disconnect	51-75 Min.Disconnect
Ripple-Dune	**Fair Habitat**	51-75 Low	26-50 Limited	51-75 Limited	>1.5-1.75 High	26-50 P.Fragmented	26-50 P.Fragmented
Braided	**Poor Habitat**	0-50 Constrained	0-25 Mostly Absent	0-50 Mostly Absent	>1.75 Severe	0-25 Fragmented	0-25 Fragmented
(anabranched)	**Weight %**	20	15	30	10	15	10
DA ≥ 2 Sq.Miles	**No IR Weight %**	25	15	30	0	20	10
Narrow-Broad Valley							

Figure 1. Example Instream Habitat Methods – Weighting for Temperature Refugia Score

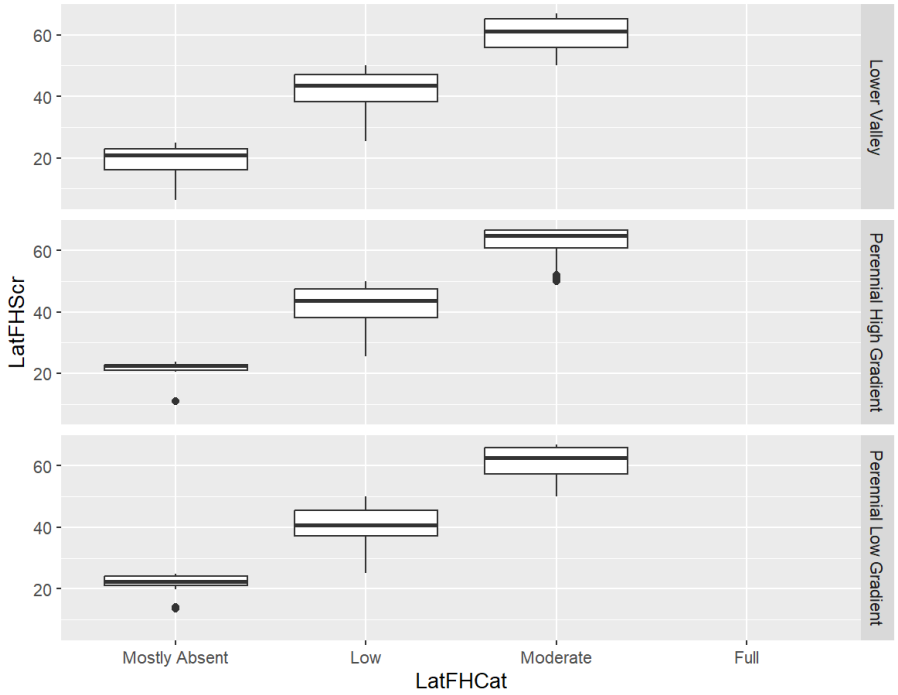


Figure 2. Example Floodplain Habitat Methods – Lateral Floodplain Habitat Score

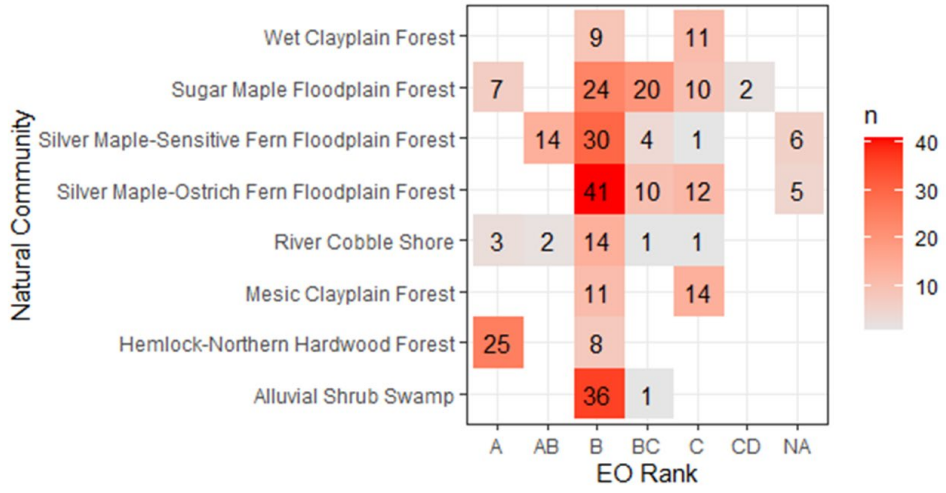


Figure 3. Example Floodplain Natural Community Data

Initial instream and habitat data sets were initially reviewed in in GIS mapping (Figure 4). Once review and necessary edits were completed, the habitat data sets were entered into the FFI database for continued review in the development version of the FFI web tool (Figure 5). A

series of reviews and quality control checks took place using the development platform to finalize the habitat data layers.

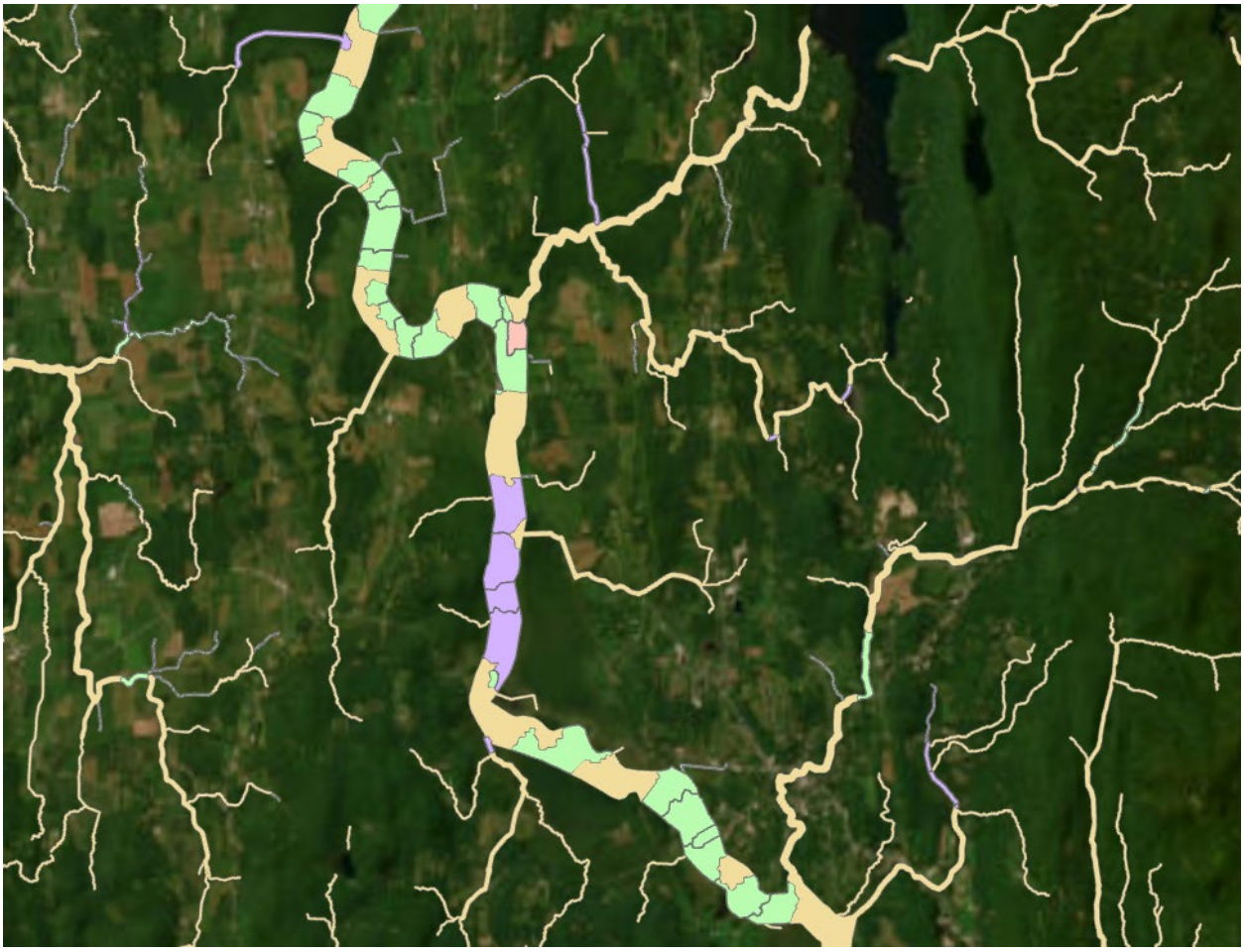


Figure 4. Example GIS Map of Floodplain Habitat Data

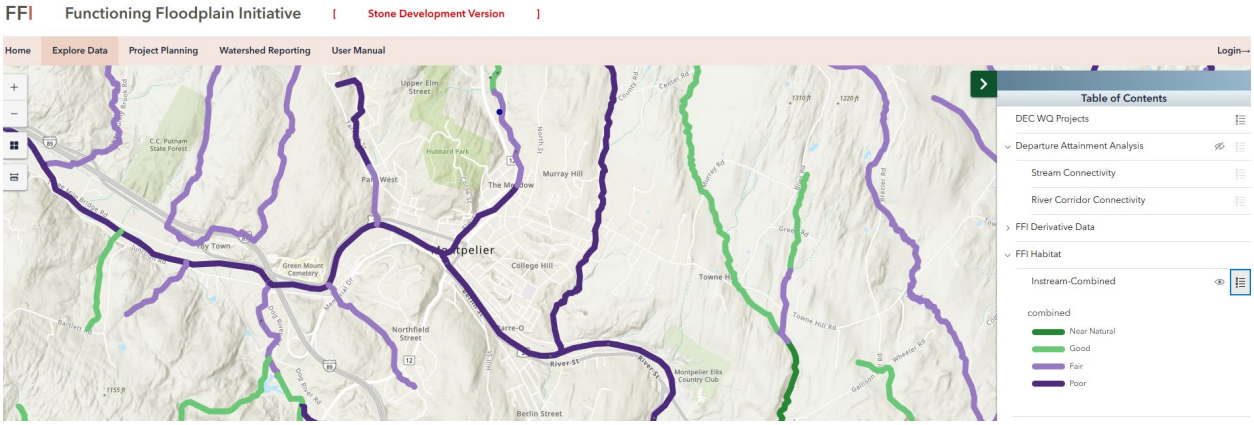


Figure 5. Example Instream Habitat Quality in the Development Version of the FFI Web Application

The FFI functionality for project prioritization and tracking habitat project benefits was then built out using the final habitat data sets. These functions were reviewed using past FFI project case studies and new project examples.

Following development of the habitat methods, a training was conducted in coordination with Vermont Department of Environmental Conservation that manages the FFI. The training was recorded and will be posted on the FFI website.

Summary graphics were assembled for the instream (Figure 6) and floodplain (Figure 7) habitat methods for display on the VTDEC FFI website.

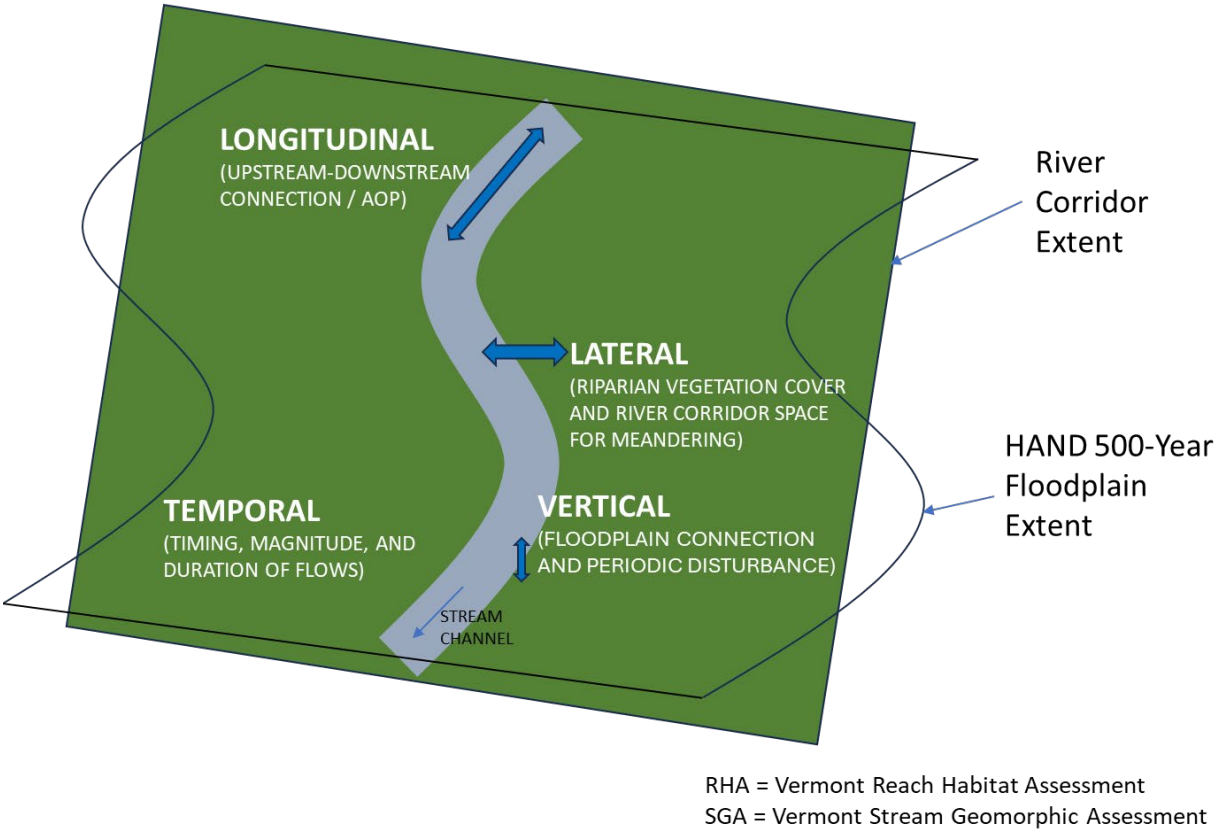


Figure 6. Instream Habitat FFI Summary Graphic

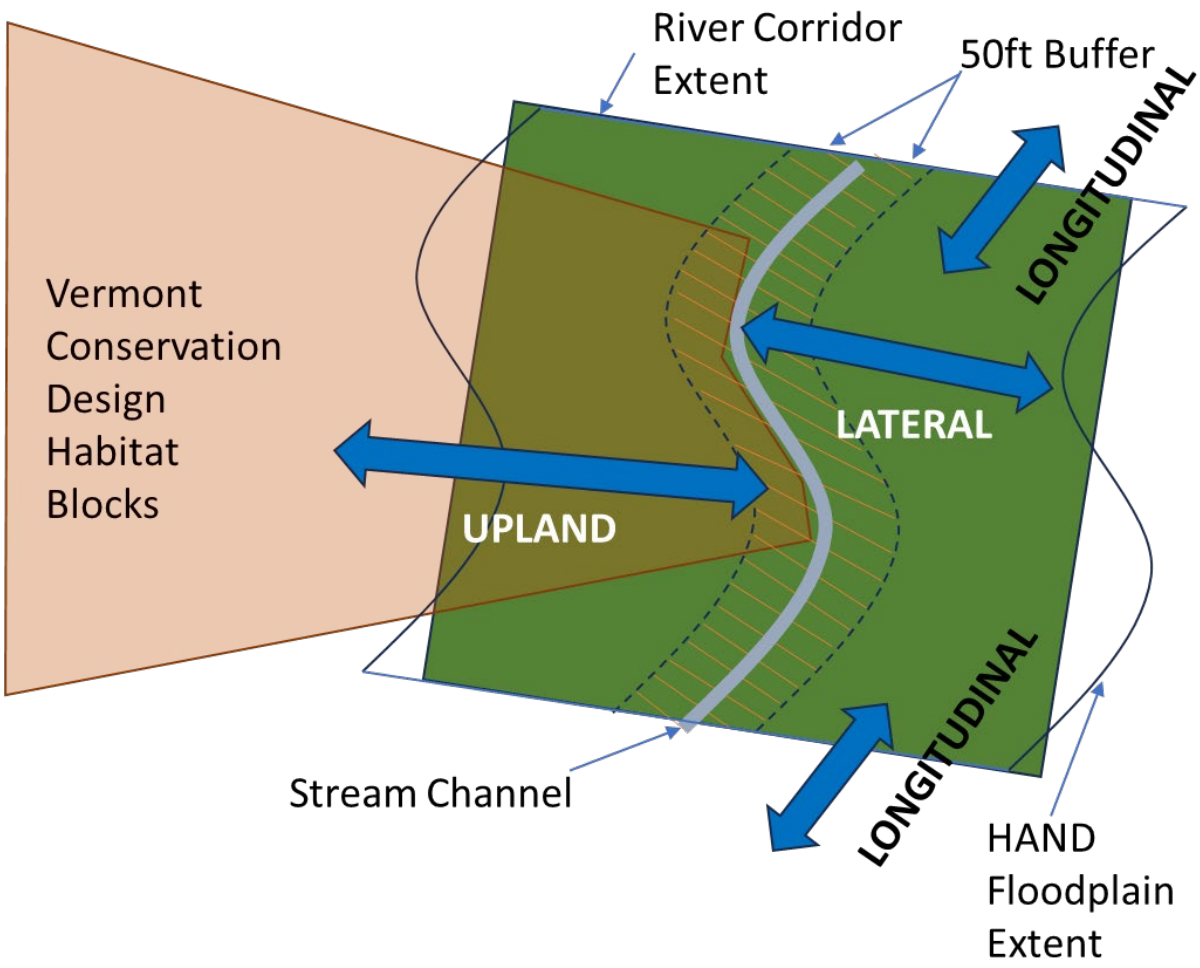


Figure 7. Floodplain Habitat FFI Summary Graphic

3. QUALITY ASSURANCE TASKS COMPLETED

All project tasks completed (QAPP objective A6). The data used for this project contained the anticipated accuracy and precision. All data were reviewed by more than one person prior to accepting it into use for the FFI (A7).

All data, files, and methods are documented electronically and safely stored. Project methods and deliverables reside on the SLR Consulting servers and are regularly backed up. The habitat data are now part of the FFI database and web application that are housed on Stone Environmental servers. The updated FFI User Manual summarizes all methods and project development (A9).

Field data collection progressed as anticipated with standard methods for observation and data collection (B4, B6).

All data (B9) and data review tracked methods used in the original FFI development. All data and methods received several rounds of internal review throughout the project, and external review during the trainings and follow-up. The web application and User Manual will be reviewed one final time by Vermont Department of Environmental Conservation (VTDEC) FFI managers after the conclusion of this award. Our project team worked closely with VTDEC throughout the project to be sure habitat methods fit existing FFI methods and would be useable by stakeholders (D2).

Data created for this project will now be managed with the overall FFI database and web application (B10).

4. DELIVERABLES SUBMITTED

Project deliverables were submitted throughout the project electronically via email or uploaded to the LCBP deliverable document folder. Given the research nature of this project, the deliverables often included expanding spreadsheets and graphics illustrating methods progression. Deliverables are described in the workplan deliverable table (Table 1).

At the time of writing of this final report, the following deliverables have been submitted to LCBP (Table 2).

Table 2. Submitted Deliverables

Task	Deliverable	Date Submitted
1.1	PDF of QAPP.	December 2022
1.3, 1.4	PDF of charts with instream and floodplain methods.	July 2024
1.2, 2.1	PDF of refined methods charts. Data entered into web map.	October 2025
1.5, 2.2	PDF of habitat prioritization sheet and project selection guidance. Clips of FFI web tool output in the User draft User Manual.	February 2026
1.6	Screen shots of habitat prioritization project planning tools in the FFI web application in User Manual.	March 2026
2.3	Screen shots of updated FFI web application habitat interface and tables in User Manual.	March 2026
3.1	PDF of draft FFI User Manual.	March 2026
3.2	PDF of final FFI User Manual.	March 2026
3.3	PDF of habitat summary graphics.	March 2026
3.4	PDF of habitat information sheets for the FFI website and PDF of LCBP Report.	March 2026

5. PROJECT METRICS

Below are estimates of engagement metrics for this project.

Metric	Approximate Values
Total number of volunteers engaged in project	10
Total number of volunteer hours	100
Value of volunteer hours (Hourly rates: NY: $33.17; VT: $26.85; QC: $30.01)	$2,685
Number of grant-funded events	1
Number of people attending grant-funded events	20
Education: Number of students involved	5
Education: Number of teachers/specialists involved	3
Education: Number of field trips / work meetings	10
Hours of staff time funded by the grant	1,656

6. CONCLUSIONS

This project expanded the Vermont Functioning Floodplain Initiative (FFI) (https://dec.vermont.gov/rivers/ffi) to build out habitat quality components to allow for interactive web planning for the prioritization and tracking of projects to restore instream and floodplain habitat critical to maintaining the movement of organisms and biodiversity, especially in the presence of extreme weather events. Methods are described in the revised FFI User Manual (Schiff et al., 2025) and are now available on the FFI web tool (https://ffi.stone-env.net/).

This project went as planned, with the exception that the research and synchronization with the ongoing FFI work took longer than expected. In the future more time would be anticipated at the start of the project to complete tasks.

The FFI is a new screening tool in VT and its use is expanding. Beyond the habitat work completed here, some additional FFI needs that we encountered over the course of this project include updating water quality crediting for culvert replacement projects, expanding use of strategic wood additions for water quality and habitat improvement projects, and refinement of headwaters FFI crediting methods. These tasks could be future FFI component updates like the habitat work performed here.

7. REFERENCES

Diehl, R. M., B. Wemple, S. Drago, J. Gourevitch, K. Underwood, and D. Ross, 2019. Building an Understanding of Floodplain Functioning to Inform Effective Management in the Lake Champlain Basin (Poster). *Presented at the:* American Geophysical Union Fall Meeting, San Francisco, CA.

Florsheim, J. L., J. F. Mount, and A. Chin, 2008. Bank Erosion as a Desirable Attribute of Rivers. BioScience 58(6):519–529.

Kline, M., 2010. Vermont Anr River Corridor Planning Guide: To Identify and Develop River Corridor Protection and Restoration Projects, 2nd Edition. Vermont Agency of Natural Resources, Waterbury, 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.

LCBP, 2010. Lake Champlain Opportunities for Action (Online, Dynamic) Management Plan. Lake Champlain Basin Program, Grand Isle, VT.

Schiff, R., J. S. Clark, G. Alexander, and M. Kline, 2008. The Vermont Agency of Natural Resources Reach Habitat Assessment (Rha). Prepared by Milone & MacBroom, Inc. with the Vermont Agency of Natural Resources, Departments of Environmental Conservation and Fish and Wildlife, Waterbury, VT.

Schiff, R., E. Fitzgerald, M. Kline, K. Underwood, E. Boardman, J. Stryker, B. Patterson, R. Diehl, E. Roy, J. C. Louisos, B. Wemple, D. Rizzo, G. Alexander, and L. Doran, 2025. The Vermont Functioning Floodplain Initiative (Ffi) User Guide (Version 2.1). Prepared by SLR Consulting, Fitzgerald Environmental, Fluvial Matters, Stone Environmental, South Mountain Reserach & Consulting, and the University of Vermont in collaboration with the Vermont Department of Environmental Conservation and Others, Montpelier, VT.

Sorenson, E. R. and R. J. Zaino, 2018. Vermont Conservation Design: Maintaining and Enhancing an Ecologically Functional Landscape, Summary Report for Landscapes, Natural Communities, Habitats, and Species. , Vermont Fish and Wildlife Department, Montpelier, VT.

Thompson, E. H., E. R. Sorenson, and R. J. Zaino, 2019. Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont, 2nd Edition, Co-published by The Vermont Fish & Wildlife Department, The Nature Conservancy, and the Vermont Land Trust., Montpelier, VT.

Underwood, K. L., D. M. Rizzo, M.M.Dewoolkar, and M. Kline, 2020. Analysis of Reach-Scale Sediment Process Domains in Glacially-Conditioned Catchments Using Self-Organizing Maps. Geomorphology (In Press)

Ward, J. V., K. Tockner, and F. Schiemer, 1999. Biodiversity of Floodplain River Ecosystems: Ecotones and Connectivity1. Regulated Rivers: Research & Management 15(1-3):125–139.

Wohl, E., G. Brierley, D. Cadol, T. J. Coulthard, T. Covino, K. A. Fryirs, G. Grant, R. G. Hilton, S. N. Lane, F. J. Magilligan, K. M. Meitzen, P. Passalacqua, R. E. Poeppl, S. L. Rathburn, and L. S. Sklar., 2018. Connectivity as an Emergent Property of Geomorphic Systems. Earth Surface Processes and Landforms 3(1):350–373.

8. APPENDICES

See the Updated FFI User Manual (Version 2.2), February 2026