Integrated Mapping and Functional Assessment of Riverine and **Coastal Floodplains and Wetlands Project**

Finer Resolution

Higher Cost/Unit

Local Projects

Coarser Resolution

Lower Cost/Unit

Federal/State Policy & Programs

Field surveys and design-level modelling and mapping

Mike Kline & Andy Robertson, 2019

Agencies/organizations working on public and private lands implementing projects that restore and protect wetland and floodplain functions

Finer-scale remote sensing, field observation, and modeling data mapped and interpreted at the state and watershed scales

Routemenships for Integration Agencies and organizations engaged in detailed functional assessments to create policy and plans that identify optimal protection and restoration projects

Coarser-scale remote sensing and national inventory/regional data compilations/interpretations

National-regional-state mapping, assessment & planning using coarser-scale modelling and functional assessments to support policy development and the creation/delivery of programs

Programs = regulatory, technical, outreach, and funding assistance provided by government agencies and/or NGOs

Projects = restoration of wetland/floodplain functions and/or conservation / land use regulation that protects wetland/floodplain functions

Partnerships = agencies and organizations working together across organizational and geographic scales to co-develop data, functional assessments, science needs, technology, funding and continuity for watercourses that cross jurisdictional boundaries

Vermont's Functioning Floodplains Initiative

New Mapping, Assessment and Program Tracking





With climate change comes the urgency to create a community of practice and a social impetus to restore and protect resilient natural systems.



the social & economic values of wetland and floodplain functions to gain support for discretionary actions within local communities.



River Corridor

Inerable Settlements Incl People, Buildings and Facilities

Safer Area

A Community of Practice

Federal, State and Local Agencies National, State & Watershed Orgs **Research Institutions Private Foundations**

- \checkmark Supporting and conducting research
- Planning and coordination services \checkmark
- Technical assistance in assessment & mapping
- Conducting education and outreach \checkmark
- Administering funding pass-thru programs \checkmark
- Conducting regulatory oversight of practices
- Providing labor for implementing practices
- ✓ Providing public and donated funds
- Design and implementation of practices







Goal: A community of practice to restore and protect rivers, floodplains, and wetlands for the multitude of natural functions and societal values they provide.

Natural Functions and Ecosystem Services under 3 Overarching Values

Water Quality	Ecological Integrity	Flood Resiliency
Sediment/Nutrient Storage	Organics/Nutrient Exchange	Carbon Storage
Riverbank Stability	Organism movement	Channel Movement
Groundwater Exchange	Habitat Mosaics	Dispersing Energy
Organics/Nutrient Exchange	Carbon Storage	Mitigating Flood Stage
Water Supplies Contact Recreation Recreation Economy Natural Communities F & W Habitats Water Aesthetics	Aquatic Species Wetland Species Ag Soil & Forest Health Food Production Hunting & Fishing Nature Appreciation	Critical Facilities & Utilities Residential Communities Commercial & Industrial Agriculture Forest Products Roads & Bridges

Data framework needed to explain loss of function and ID optimal Protection & Restoration Practices

Floodplain	Fo	DCESS			
Functions	Floodplain Connectivity	Stream Connectivity	Flow Storage	Erosion/ Deposition	WSG*
Channel Movement	X	X		Х	Х
Dispersing Energy	X	X	x	X	
Stabilizing Riverbanks	X	X		X	Х
Connecting Organisms	X	X		Х	Х
Groundwater Exchange	X	X	X		X
Maintain Water Quality	X	X	X	X	X
Habitat Mosaics	X	X	X	X	X
Lat. Material Exchange	X		Х	X	
Carbon Storage	X		X	Х	X
Mitigating Flood Stage	X		X		X

(Vert./ Lat.) (Long. /Temp.) * WSG = Wetlands, Soils, and Geology

Physical Data to Construct Connectivity and Process Maps

Tier 1 and 2 – Large and Finer Scale Remote Sensing

- Soils and geology (incl. nat. grade controls)
- Channel and floodplain geometry (LIDAR)
- Land use/land cover (incl. encroachments, buffers and wetlands)
- Instream structures, including dams and stream/valley crossings
- Parcels and protected lands



Physical Data to Construct Connectivity and Process Maps

Tier 2

Field Measurement / Assessment

- Channel incision and entrenchment
- Confirmation of human structures that confine and obstruct channel
- Bridge, culvert, and dam inventories
- Boundary conditions (bed substrates & bank characteristics)
- Natural grade controls
- Channel evolution stage (dominate process – erosion/trans/dep)
- Habitat conditions



Physical Data to Construct Connectivity and Process Maps

Tier 2 and 3 Calculated (modelling), for example:

- Specific stream power signatures (hydraulic modelling)
- Existing and potential sediment regime (channel floodplain)
- Flood inundation and storage (at different flood frequencies)



Return Interval of Peak Storm (yrs)

Mapping used to evaluate restoration potential

Target practices to reconnect rivers, wetlands and floodplains by evaluating impediments.





Regain function, based on project feasibility and the ecosystem services provided by restored and protected fluvial processes.

Mapping to Identify Priority Reaches for Restoration and Protection



Landscape Features	Existing Flow Storage	Potential Flow Storage	Existing Sediment Storage	Potential Sediment Storage
River	Х	X	4	6
River Corridor	2	4	3	6
Wetlands	1	4	1	3
Floodplains	2	8	2	8

Mapping to Identify Priority Reaches for Restoration and Protection

Underhill



lats Village Center

Reach Priority Ranking determined by size and type of landscape feature coded with data concerning the adjacency of threats and the existing and potential:

- Stream and floodplain connectivity
- Fluvial processes: flow and sediment storage
- Social, technical, and cost impediments

Interactive web-based platform to explore an optimal set of practices for achieving the benefits of reconnect rivers, floodplains & wetlands

- Floodplain & Wetland Connectivity
- $\circ\,$ Conserve corridors and flood plains
- Remove wetland drainage structures
- \circ Remove berms and cut flood plains
- \circ Restore stream slope and depth
- Reshape banks & plant riparian areas

Stream Connectivity

- Remove derelict dams
- Lower road & rail fills
- Upsize culvert replacements
- Install grade controls & roughness
- $\circ~$ Slow and store stormwater
- Restore flows below diversions





Watershed scale tracking system for connectivity, fluvial processes, wetland / floodplain functions and socio-economic values

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Projects assigned credits – to track restoration and protection progress



Connectivity is an easily measured attribute for tracking the potential loss of and opportunity for functioning floodplains & wetlands

Tracking Connectivity at Different Scales



Funding programs key in on "practice credits" and progress towards restoring and maintaining connectivity and equilibrium process.

Reduce the Economic Fuzziness of Nature-Based Solutions Water Quality, Habitat, and Flood Resiliency Values Based on Contributing Weighted Functions and Ecosystem Services

Display existing support for functions/services and promote the potential values



Aggregate data to support state policies and a community of practice.



Floodplain Functional Assessments with Form & Process Mapping

Process-based mapping builds on form-based maps constructed with Tier 1 through 3 scaled remote sensing, field, and modeling data

Process

Restore and Protect

Field surveys and HEC-RAS modelling to design floodplain cuts

Agencies/organizations working on public and private lands implementing projects that restore and protect wetland and floodplain functions **Tier 2 Case Study** Vermont Functioning Floodplains Initiative

T3

One-meter land use/land cover and parcel data, conserved lands mapping, Phase 1 (remote) / Phase 2 (field) stream geomorphic assessments, and modelled hydraulic data correlated to valley measurements

Form

Vermont agencies and NGOs engaged in detailed floodplain function assessments to create local strategic plans that identify optimal protection and restoration projects

LIDAR data and mapping, large-scale hydrologic modelling, flood hazard area mapping, NWI+ mapping

EPA's TMDL program and the Lake Champlain project in Vermont; FEMA flood hazard mapping and mitigation programs; and the EPA and USFWS National Wetland Inventory programs.

Stream & Floodplain Connectivity, Wetlands, Soils, Geology