The Association of State Wetland Managers Presents:

Improving Wetland Restoration Success
&
Natural Floodplain Functions Alliance
- Joint Webinar -

Stream-Wetland Restoration

Presenters:

Will Harman, Stream Mechanics

Matt Daniels, River Design Group

Moderators: Jeanne Christie & Marla Stelk

Supported by EPA Wetland Program Development Grant 83578301

If you have any technical difficulties during the webinar you can send us a question in the webinar question box or call Laura at (207) 892-3399 during the webinar.

HAVING TROUBLE WITH THE SOFTWARE?

Don't Panic -
we've got it covered!

Check your email from this morning:

1. You were sent a link to instructions for how to use the Go To Webinar software.
2. You were also sent a PDF of today's presentation. This means you can watch the PDF on your own while you listen to the audio portion of the presentation by dialing in on the phone number provided to you in your email.

AGENDA

- **Welcome and Introductions** (5 minutes)
  - **Restoration Webinar Schedule & Future Recordings** (5 minutes)
- **Stream-Wetland Restoration** (60 minutes)
  - Will Harman, Stream Mechanics
  - Matt Daniels, River Design Group
- **Question & Answer** (15 minutes)
- **Wrap up** (5 minutes)

WEBINAR MODERATORS

Jeanne Christie,
Executive Director

Marla Stelk,
Policy Analyst

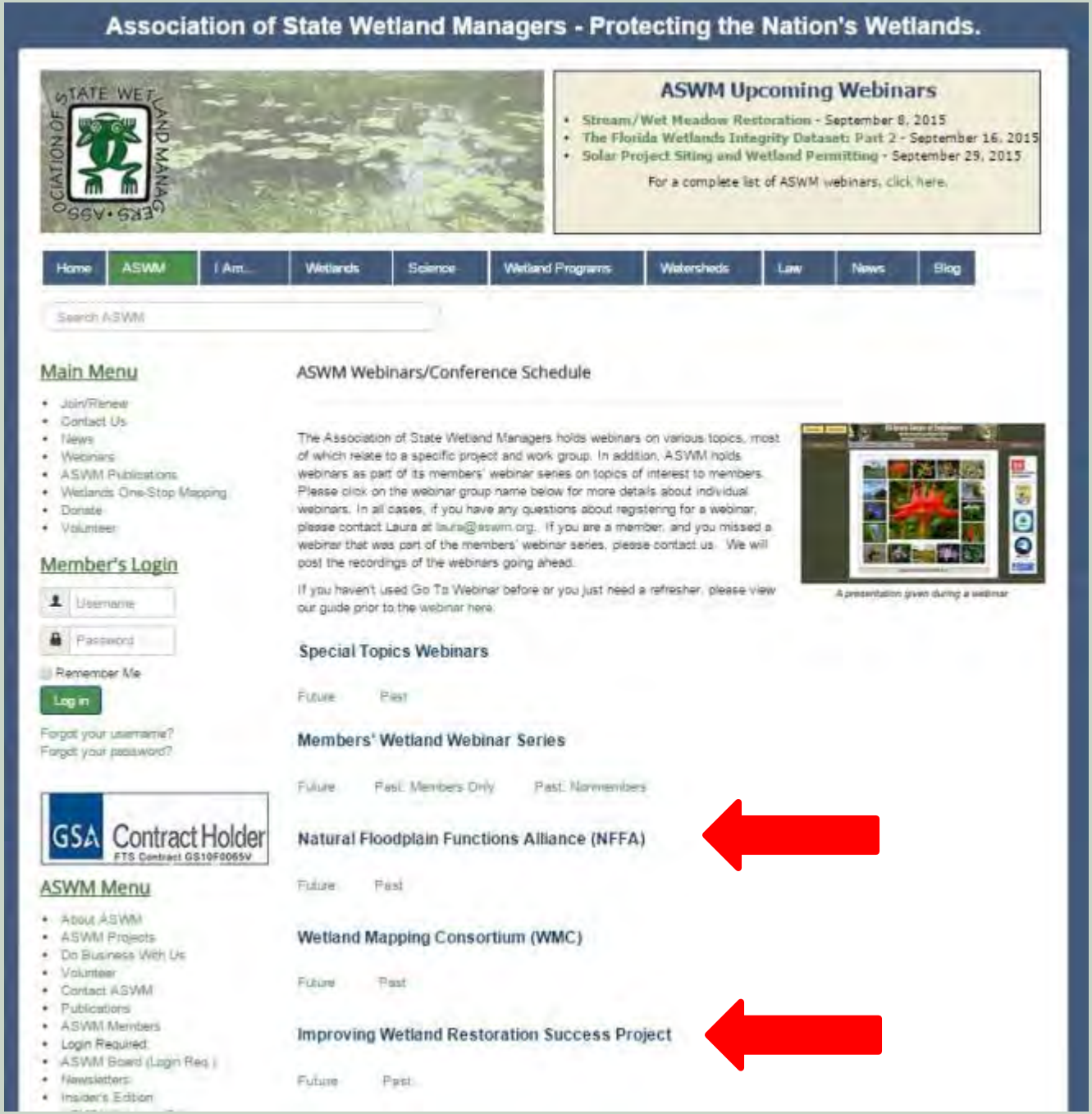
WETLAND RESTORATION PROJECT

- Interdisciplinary workgroup of 22 experts
- Monthly webinar series
- Draft white paper based on webinars, participant feedback, external review
- Pursuing strategies that:
  - Maximize outcomes for watershed management
    - Ecosystem benefits
    - Climate change
    - Invasive species
  - Improve permit applications and review
  - Develop a national strategy for improving wetland restoration success

ACTION PLAN ➡ IMPLENTATION

WEBINAR SCHEDULE & RECORDINGS

WEBINAR SCHEDULE & RECORDINGS



FUTURE RESTORATION WEBINARS

- **October 13th, 3pm eastern :**
  - **Restoration in Urban & Highly Disturbed Landscapes**
    - **Tom Ries, President and Founder of Ecosphere Restoration Institute**
    - **Steven I. Apfelbaum, Principal Ecologist, Chairman, Applied Ecological Services, Inc.**
    - **Alexander J. Felson, PhD RLA, Assistant Professor, Yale University School of Architecture & School of Forestry and Environmental Studies)**
- **November 19th, 3pm eastern (tentative date):**
  - **Novel Ecosystems & Restoration**
    - **Joy Zedler, Aldo Leopold Chair of Restoration Ecology, University of Wisconsin**
    - **Marilyn Jordan, Retired Senior Scientist, The Nature Conservancy**
- **December 15th, 3pm eastern:**
  - **Wetland Restoration: Contemporary Issues & Lessons Learned**
    - **Jeanne Christie, Executive Director & Marla Stelk, Policy Analyst, ASWM**

FOR FUTURE SCHEDULE & UPDATES, GO TO:
http://aswm.org/aswm/6774-future-webinars-improving-wetland-restoration-success-project

FUTURE NFFA EVENTS

- **Tuesday, October 6 at 3:00 p.m. ET – Conference Call**
- **Tuesday, November 3 at 3:00 p.m ET - Webinar**
  - **Overview of the MAST Tool to assist municipalities, state agencies, utilities and NGOs in developing adaptation projects that address their financial, social and environmental concerns**
    - **Dr. Samuel Merrill, Senior Practice Leader, GEI Consultants, Inc.**
- **Tuesday, December 1 at 3:00 p.m. ET – Conference Call**

Currently conference calls and webinars are usually held on alternating months on the second Tuesday of the month at 3:00 p.m. eastern, 2:00 central, 1:00 mountain, and 12:00 pacific.

FOR FUTURE SCHEDULE & UPDATES, GO TO:
http://www.aswm.org/watersheds/natural-floodplain-function-alliance/2783-future-webinarsconference-calls-schedule.html

INTERESTED IN RECEIVING CEUS?

Who can get CEUs?

- You must be a participant during the live webinar presentation.
- We are able to track webinar participation by registrants using our GoToWebinar software.
- **Documentation will state that you were a participant for X hours of a specific ASWM webinar.**

Receiving Documentation

*If you need CEUs for your participation in today's webinar, you **must request** documentation from ASWM.*

*Please note that we will send the documentation to you **for you to forward** to the accrediting organization.*

Please contact **Laura Burchill**
laura@aswm.org
(207) 892-3399

Provide:

- Your full name (as registered)
- Webinar date and Title

PRESENTERS

Will Harman, P.G.
Stream Mechanics

Matt Daniels, P.E.
River Design Group

A “COOKBOOK” APPROACH TO WETLAND RESTORATION WON’T WORK

There are too many variables.

- *Ingredients are always different*
- *Reason for ‘cooking’ varies*
- *Recipe isn’t always correct*
- *Inexperienced cooks*
- *Cooking time varies*
- *Poor inspection when “cooking”*
- *Additional ingredients may be needed*
- *Is it really done?*


MasterChef
FOX

WE NEED TO UNDERSTAND THE PLANNING PROCESS AND VARIABLES FROM SITE TO SITE THAT MUST BE STUDIED, UNDERSTOOD AND ADDRESSED

Major Reasons for Failure (examples)

Overarching

- Poorly Defined Outcomes/Performance Criteria
- Lack of Access to Expertise and Training
- Lack of Accountability and Enforcement
- Altered and Changing Landscapes/Climate
- Separation of Professions – The ‘Silo’ effect

Site-Specific

- Planning issues, i.e., Inadequate Assessment of landscape, hydrology & soils
- Construction issues, i.e., failure to implement design, no adaptive management
- Post construction issues, i.e., poor record keeping, limited follow up activity to address problems

How Do We Improve?

- Better defined goals and performance criteria
- Improve Access to Knowledge and Training
- Require Accountability
- Require Documentation of Credentials
- Develop a Common Taxonomy
- Adopt New Science and Technology into Regulations and Guidance
- Engage Multi-Disciplinary, Integrated Teams
- Regional Data Depositories to Document Reasons for Success and Failure

EACH WETLAND RESTORATION PROJECT IS UNIQUE:

- *Consider both historic and current landscape setting*
- *Analyze how water moves into and out of the site*
- *Evaluate soils present and identify any onsite drainage*
- *Focus first on hydrology and soil first, last on plants*
- *Develop a plan that is achievable for the site*
- *Develop comprehensive cost estimates*
- *Ensure plan is followed*
- *Hire experienced and knowledgeable contractors*
- *Adapt plan as needed during construction*
- *Determine if monitoring criteria will measure progress*
- *Keep good records and share with others*

ASWM's White Paper Available to Today's Webinar Participants

- See document to download in Go To Webinar 'handouts' box
- Please Review the White Paper
- Contact us if you have ideas about opportunities to present the findings of the paper and explore ways to improve wetland restoration
- Join us for a Webinar providing an overview of the White Paper on December 15th at 3pm ET
- Forward Your Ideas and Recommendations to jeanne.christie@aswm.org or marla@aswm.org

Stream-Wetland Restoration

IT WILL TAKE US A FEW MOMENTS TO MAKE THE SWITCH…

StreamMechanics

Determining Functional Lift of Stream/Wetland Restoration Projects

Will Harman, PG

Stream Mechanics

StreamMechanics

Love of Channelization

- From 1820 to 1970, more than 200,000 miles of streams and rivers were channelized to reduce flooding, provide drainage for agriculture, and improve navigation
  - (*Disconnected Rivers* By Ellen Wohl)

StreamMechanics

Functions Lost from Channelization

- Less Flooding
- Less water and sediment storage on previous floodplain
- Loss of bed form diversity (habitat)
- Increased incision and widening (erosion)
- Loss of fish species and biomass

Darby, S.E. and C.R. Thornes, 1992. Impact of Channelization on the Mimmshall Brook, Hertfordshire, UK. Regulated Rivers 7:193-204.

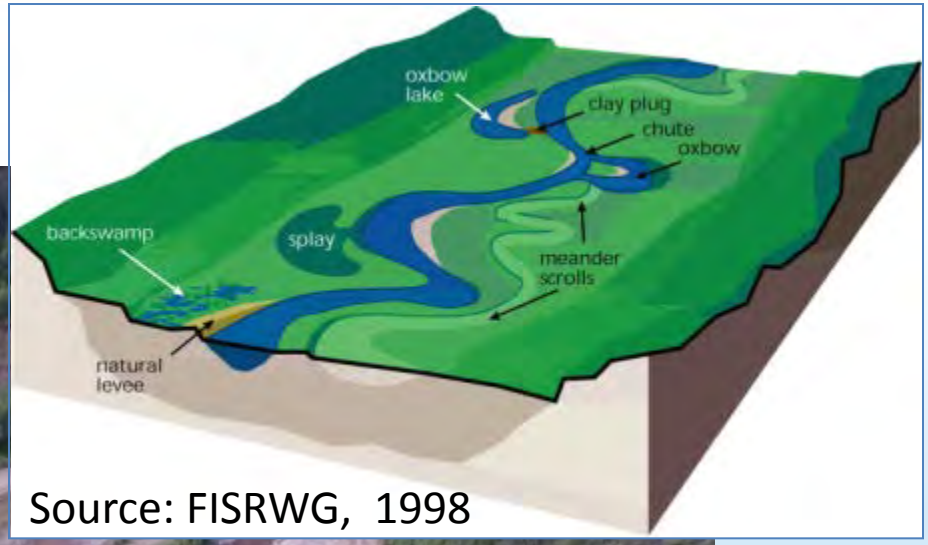
Hupp, C.R., 1992. Riparian Vegetation Recovery Patterns Following Stream Channelization: A Geomorphic Perspective. Ecology 73:1209-1226.

Kroes, D.E. and C.R. Hupp, 2010. The Effect of Channelization on Floodplain Sediment Deposition and Subsidence Along the Pocomoke River, Maryland. Journal of the American Water Resources Association 46(4):686-699.

StreamMechanics

StreamMechanics

Streams and Floodplains



Source: FISRWG, 1998

Splay

Slough

Reverse Slope

Floodplain Pools

StreamMechanics

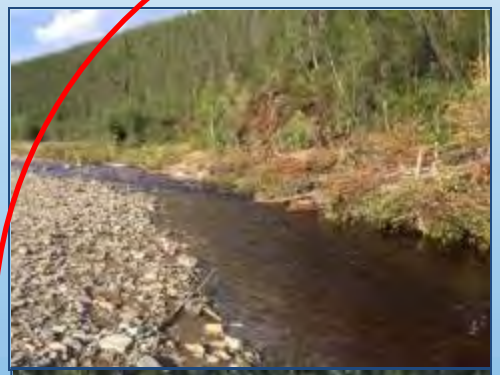
www.stream-mechanics.com

StreamMechanics

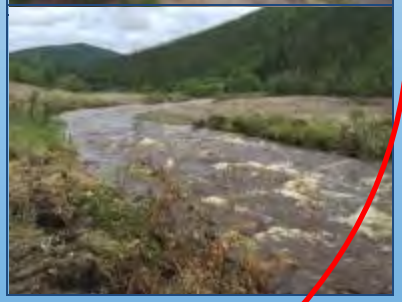
Biology

Physicochemical

Geomorphology



Hydraulics



Restoration Activities

Hydrology

StreamMechanics

Stream / Wetland Complex

Functional Category	Questions to Answer
Hydrology	Does the watershed support a stream/wetland complex? Is the stream connected to the water table?
Hydraulics	Do small flood events inundate the floodplain? Does the floodplain store flood waters?
Geomorphology	Is there bedform diversity (riffle-pool sequence, depth var.)? Is there an appropriate amount of large woody debris? Is there riparian vegetation providing channel and floodplain stability that also supports physicochemical functions.
Physicochemical	Does the reach retain good organic matter (leaves)? Does the temperature regime support biological functions? Is nutrient loading a problem?
Biology	Are macroinvertebrate and fish communities representative of reference condition?

StreamMechanics

Function-Based Parameters for showing Functional Lift

Functional Category	Parameter
Hydrology	Depth to Water Table Flow Duration
Hydraulics	Floodplain Connectivity
Geomorphology	Bed Form Diversity Lateral Stability Riparian / Wetland Vegetation Large Woody Debris (if applicable)
Physicochemical	Organic Matter (Percent Shredder)
Biology	Macroinvertebrate and Fish Communities

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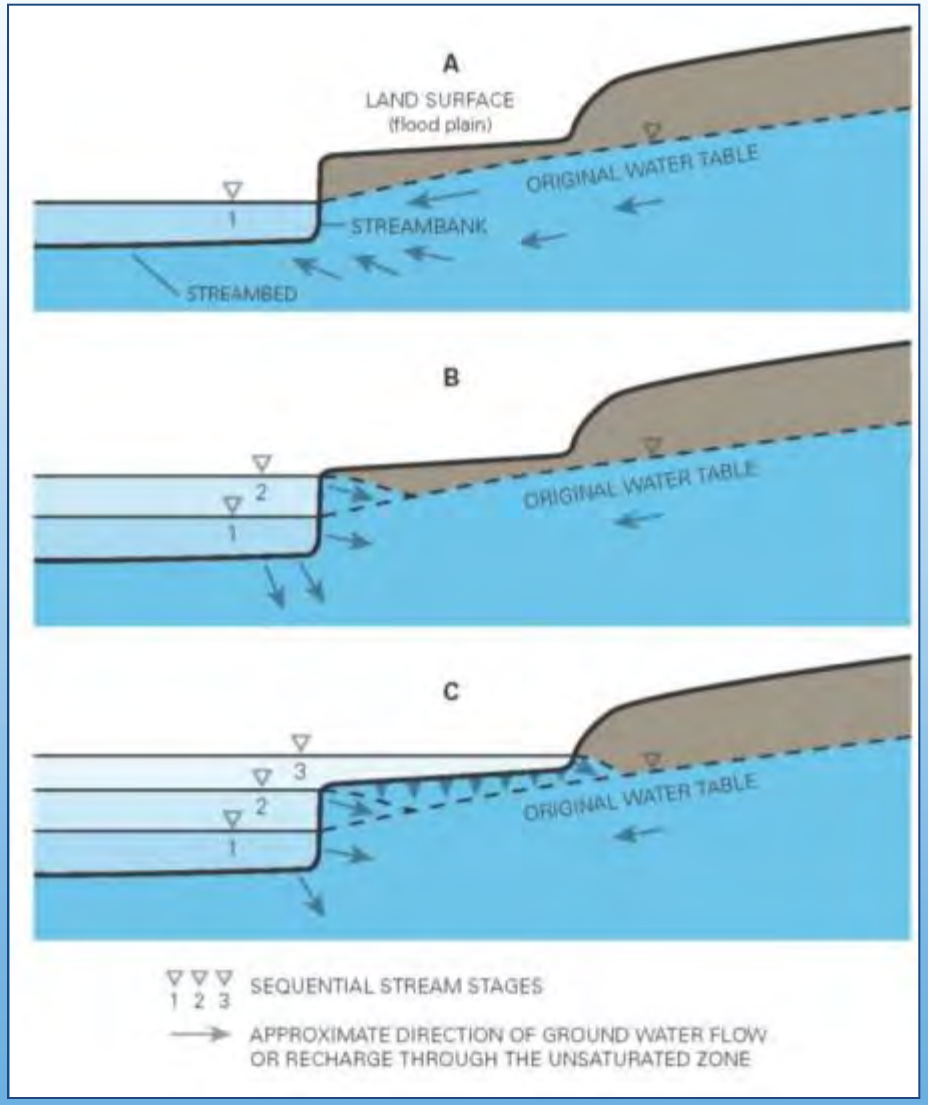
Hydrology:
Depth to Water Table



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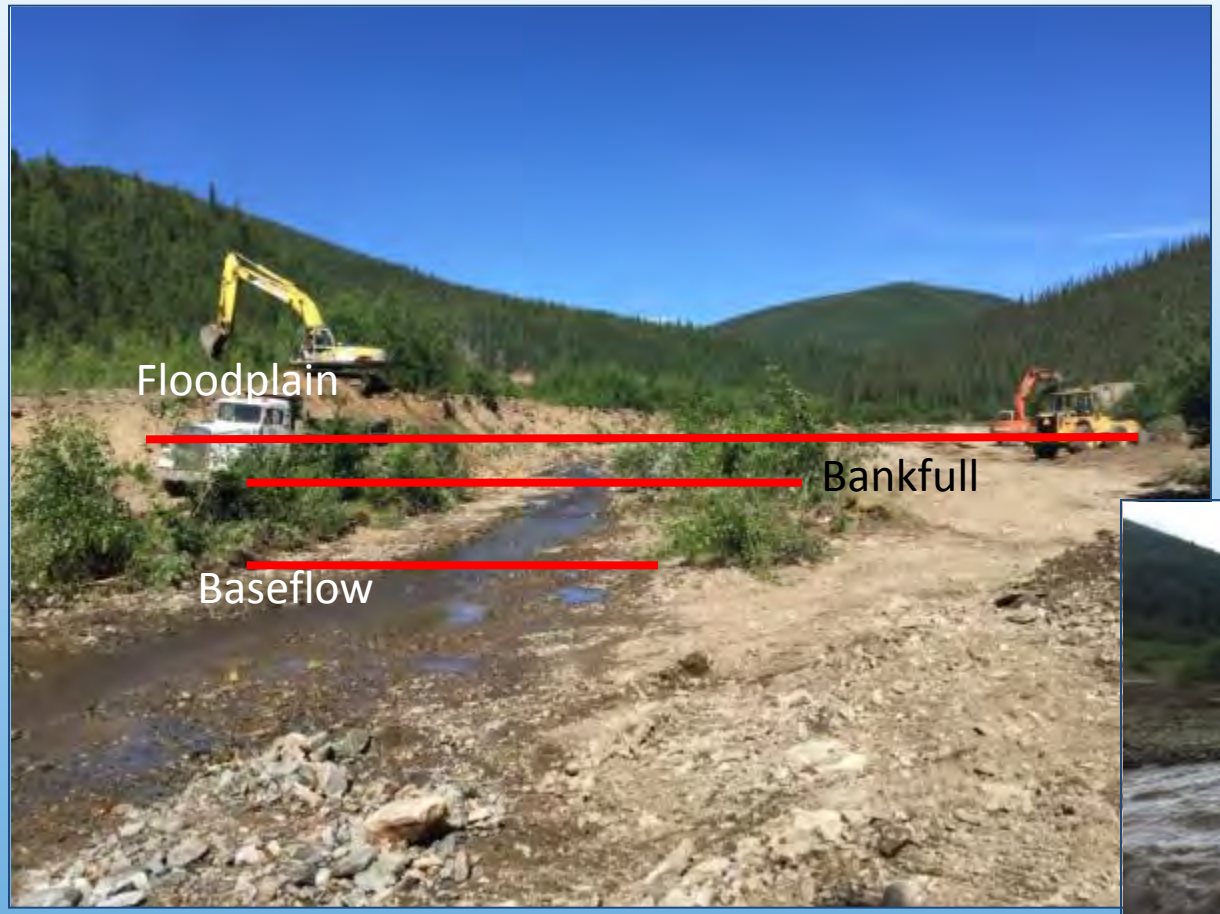
Hydraulics: Floodplain Connectivity



StreamMechanics

Elevated Channel

Source: Michael Baker Corporation

StreamMechanics

Source: Michael Baker Corporation

StreamMechanics

Excavated Floodplain


Source: Michael Baker Corporation

StreamMechanics

Geomorphology: Bed Form Diversity

Riffle

Pool

Riffle

StreamMechanics

Geomorphology: Lateral Stability

StreamMechanics

Geomorphology: Riparian Vegetation

StreamMechanics

Floodplain / Wetland Vegetation

StreamMechanics

Geomorphology: Large Woody Debris

StreamMechanics

Functional Lift Project Example

Source: Michael Baker Corp

StreamMechanics

Functional Lift

Level and Category	Parameter	Measurement Method	Pre-Restoration Condition		Post-Restoration Condition	
			Value	Rating	Value	Rating
1 - Hydrology	**Groundwater Connection**	Depth to Water Table (ft)	3	**Not Functioning**	<1	**Functioning**
2 - Hydraulics	**Floodplain Connectivity**	Bank Height Ratio	3.0	**Not Functioning**	1.0	**Functioning**
		Entrenchment Ratio	1.1		20	
3 – Geomorphology	**Bed Form Diversity**	Pool-to-pool spacing Ratio	>6.0	**Not Functioning**	4 to 5	**Functioning**
		Pool Depth Ratio	<1.1		>1.2	
	Lateral Stability	BEHI/NBS	High/High	**Not Functioning**	Low/Low	**Functioning**
	Riparian Vegetation	USFWS SAR	No zones of vegetation represented	**Not Functioning**	All three zones represented	**Functioning**

StreamMechanics

Level and Category	Parameter	Measurement Method	Pre-Restoration Condition		Post-Restoration Condition	
			Value	Rating	Value	Rating
4 - Physicochemical	**Water Quality**	Temperature	Meets WQ stds. Not rep of ref cond.	**Functioning-At-Risk**	Meets WQ stds. Meets ref condition	**Functioning**
		Organic Matter	25% of reference condition		80% of reference condition	
5 – Biology	**Fish Communities**	Upstream / downstream monitoring	Does not meet upstream reference condition	**Not Functioning**	Does meet upstream reference condition	**Functioning**

StreamMechanics

Thank You

Use of an Ecosystem-based Approach for Stream and Wetland Restoration

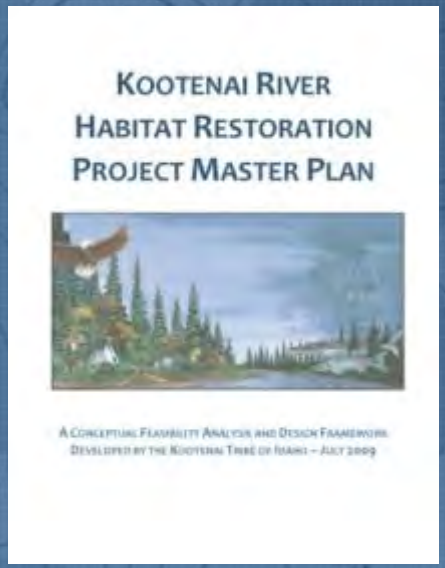
Milltown Dam Restoration Site
Near Missoula, Montana

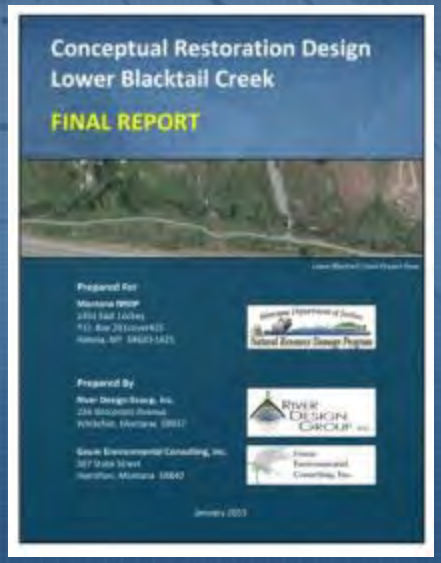
RIVER DESIGN GROUP, INC.

Matt Daniels, PE
riverdesigngroup.com
September 8, 2015

Components of an Ecosystem-based Restoration Plan

- Purpose and Need
- Site Assessment & Limiting Factors
- Restoration Objectives & Design Criteria
- Restoration Strategies & Treatments
- Restoration Alternatives & Prioritization
- Design & Implementation Considerations
- Cost Estimate





Restoration Challenges

Beaver trapping

Floodplain diking

Non native species

Commercial fish harvest

Infrastructure development

Climate change

T&E species listing

1800s

1900s

1950s

1960s

1990s

Mining

Logging

Conversion of wetlands to agriculture

Dam construction & Hydropower operations

Restoration Purpose and Need

Project Goals – Examples

- Improve **aquatic habitat** conditions (i.e., woody debris availability, spawning gravels, pool quality and quantity, off-channel habitat) for native fish.
- Improve floodplain and **riparian function** by establishing a dynamic, succession driven mosaic of plant communities capable of supporting a wide range of ecological functions.
- Establish sustainable **river and floodplain morphology** that supports aquatic habitat and vegetation goals within the context of constraints.

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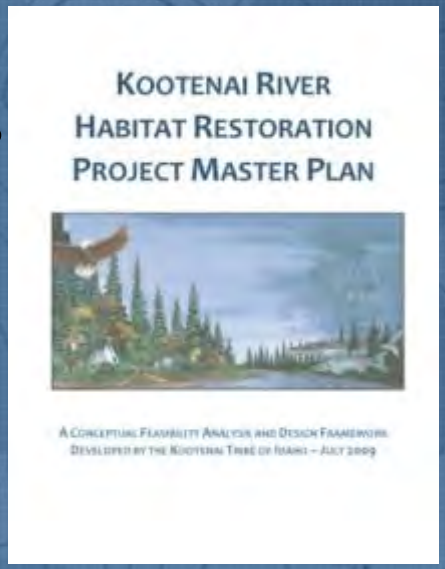
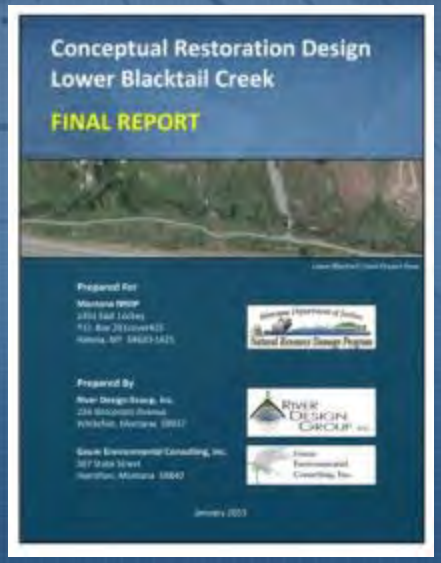
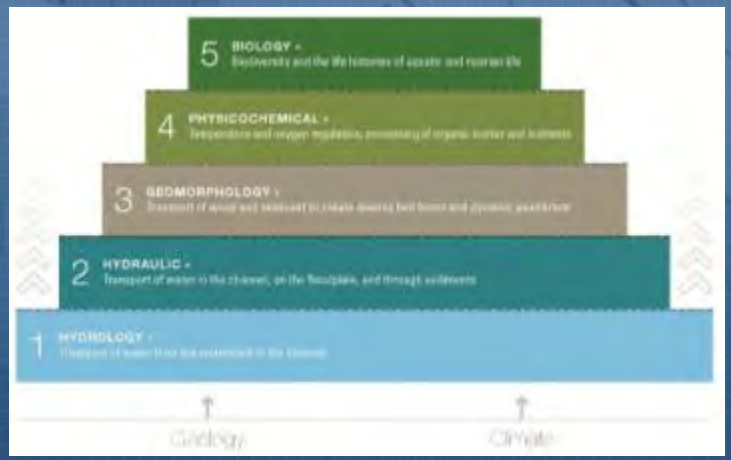




Limiting Factors and Constraints

- Limiting factors are the conditions affecting ecosystem functions and preventing the desired future condition.
- Limiting factors can be organized into a hierarchy or pyramid to help link observed problems to restoration goals
- Constraints are the limiting factors that we can't change.
- Requires data collection and analysis

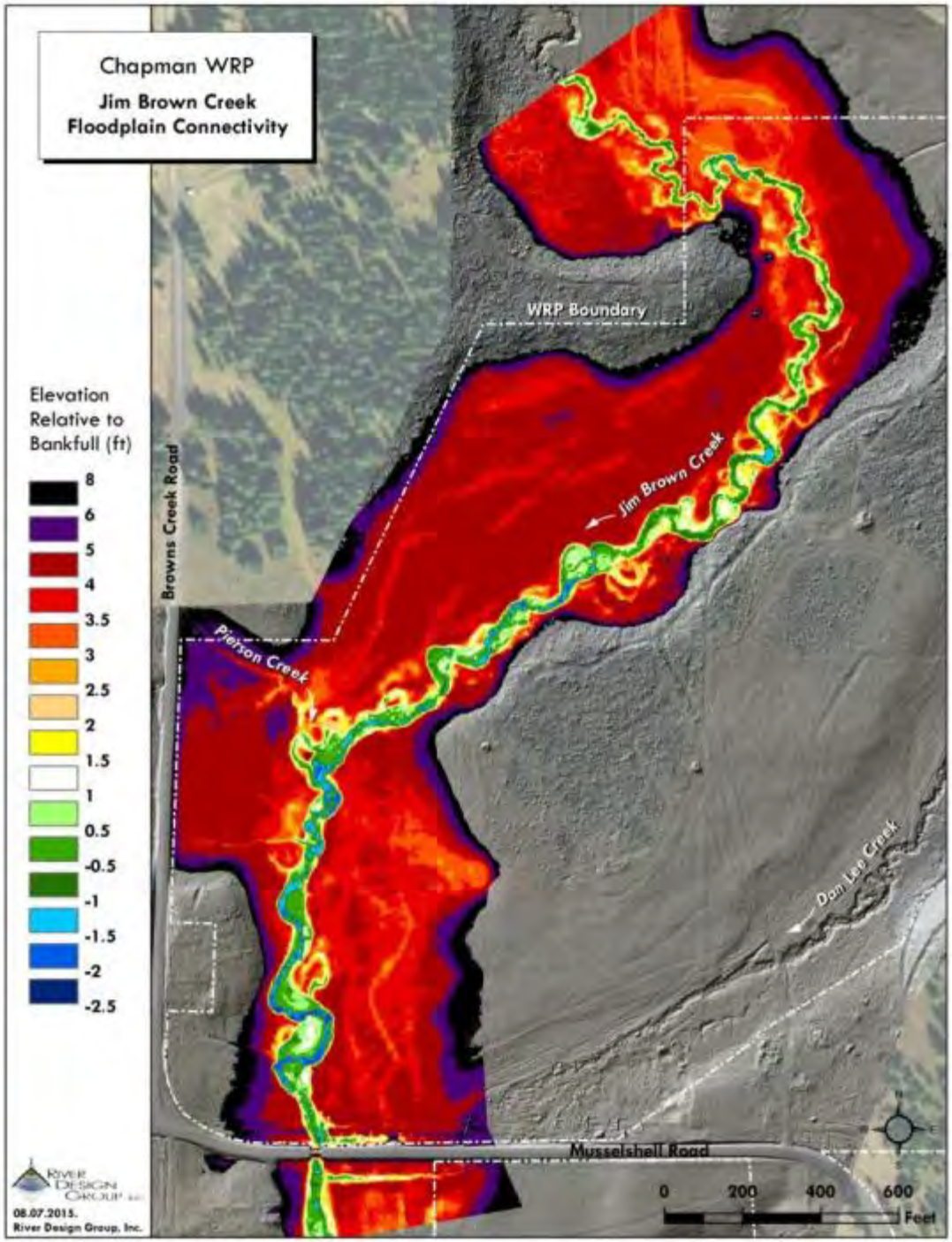


Project Example

Evaluating floodplain connection

<u>Jim Brown Creek</u>

- NRCS project
- Wetland Reserve Program
- Floodplain connection



Project Example

Evaluating floodplain connection

Data Needs

- Bankfull profile
- LiDAR

Methods

- Field survey
- Mapping of elevations relative to indicators with GIS or CAD

Results/Conclusions

- Entrenchment – 5 feet
- Inset floodplain

Components of an Ecosystem-based Restoration Plan

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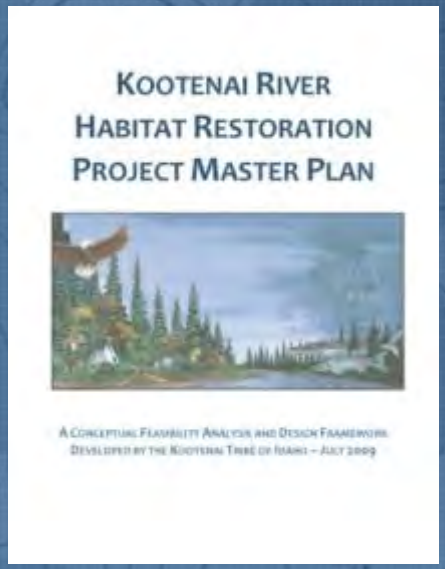
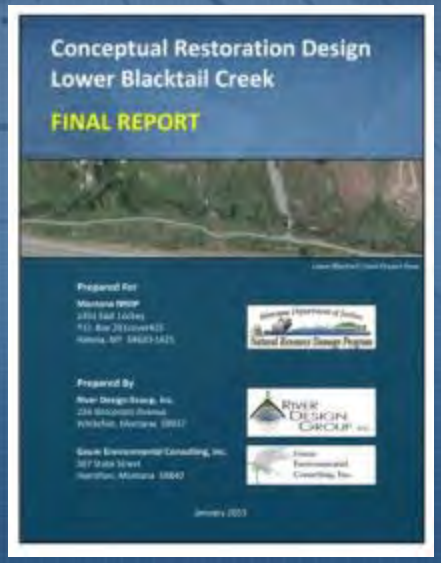




Restoration Objectives and Design Criteria

- Objectives describe how limiting factors will be addressed
- Objectives are quantified with design criteria
- Objectives and design criteria provide the guidance for the development of restoration strategies and treatments

Restoration Objectives and Design Criteria - Examples

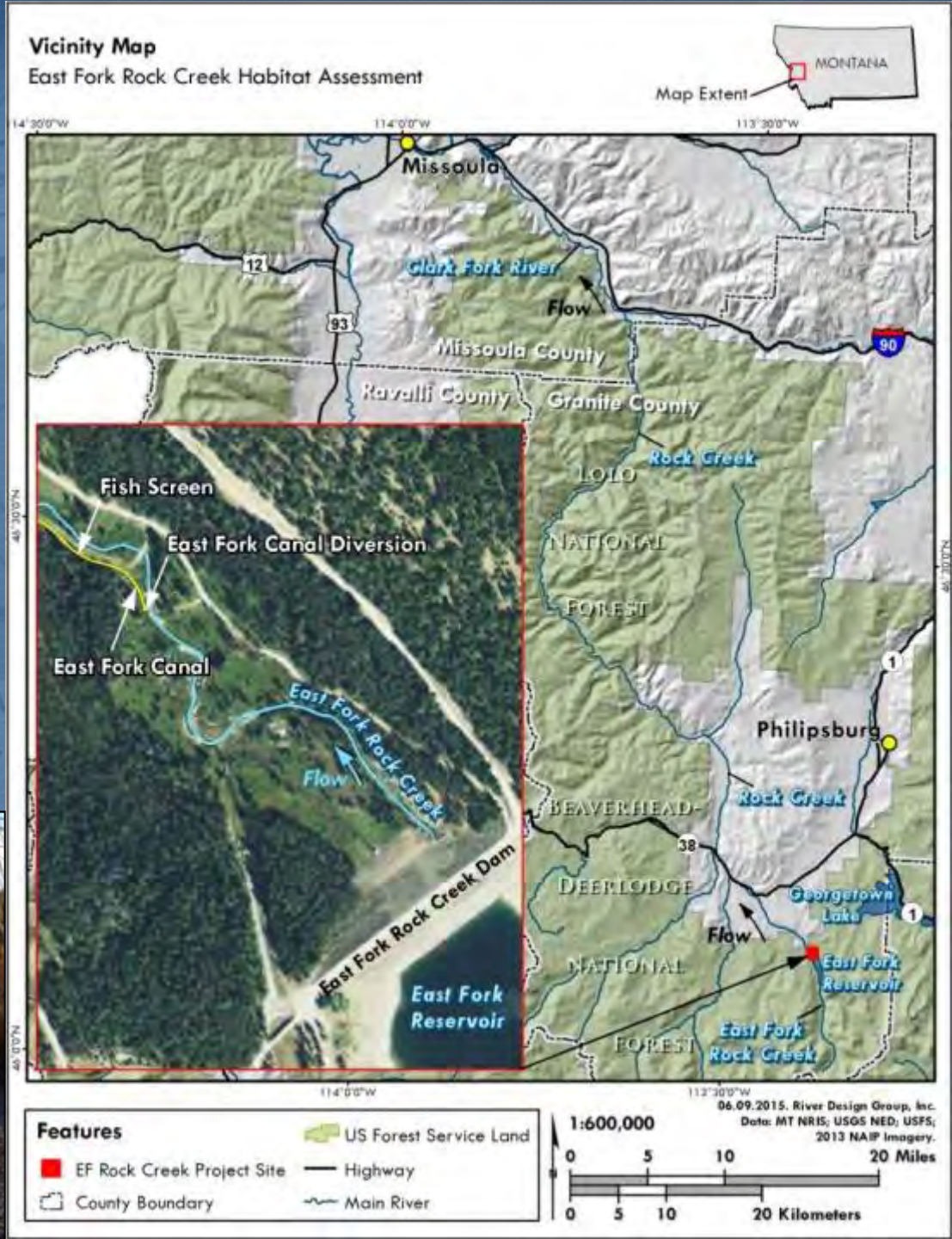
Limiting Factor	Objective	Design Criteria
Lack of juvenile rearing habitat	Create or enhance off channel habitat	Provide areas that are shallow, have low velocity and cover
Insufficient riparian buffer	Increase width of connected floodplain	Provide 150-foot wide areas on both sides of the channel that that are within one foot of the baseflow water table during the growing season
Fine sediment supply	Address severely eroding banks	Less that 10% of the banks are eroding at rates greater than one foot per year

Project Example

Quantifying restoration objectives with biological design criteria

<u>East Fork Rock Creek</u>

- Instream flow study
- Below a dam
- Bull trout habitat



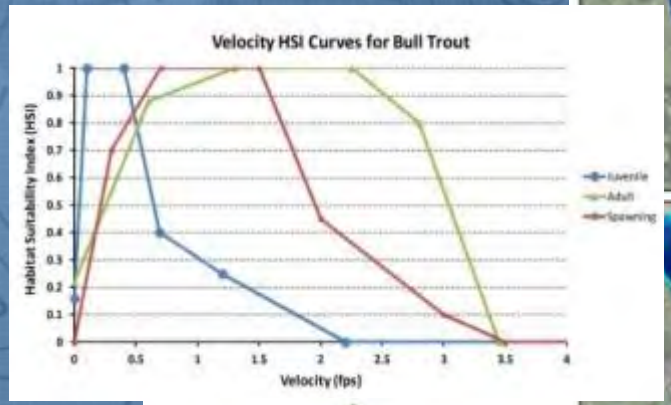
Project Example

Data Needs

- Topography
- Discharge & water surface profiles
- Habitat suitability indices

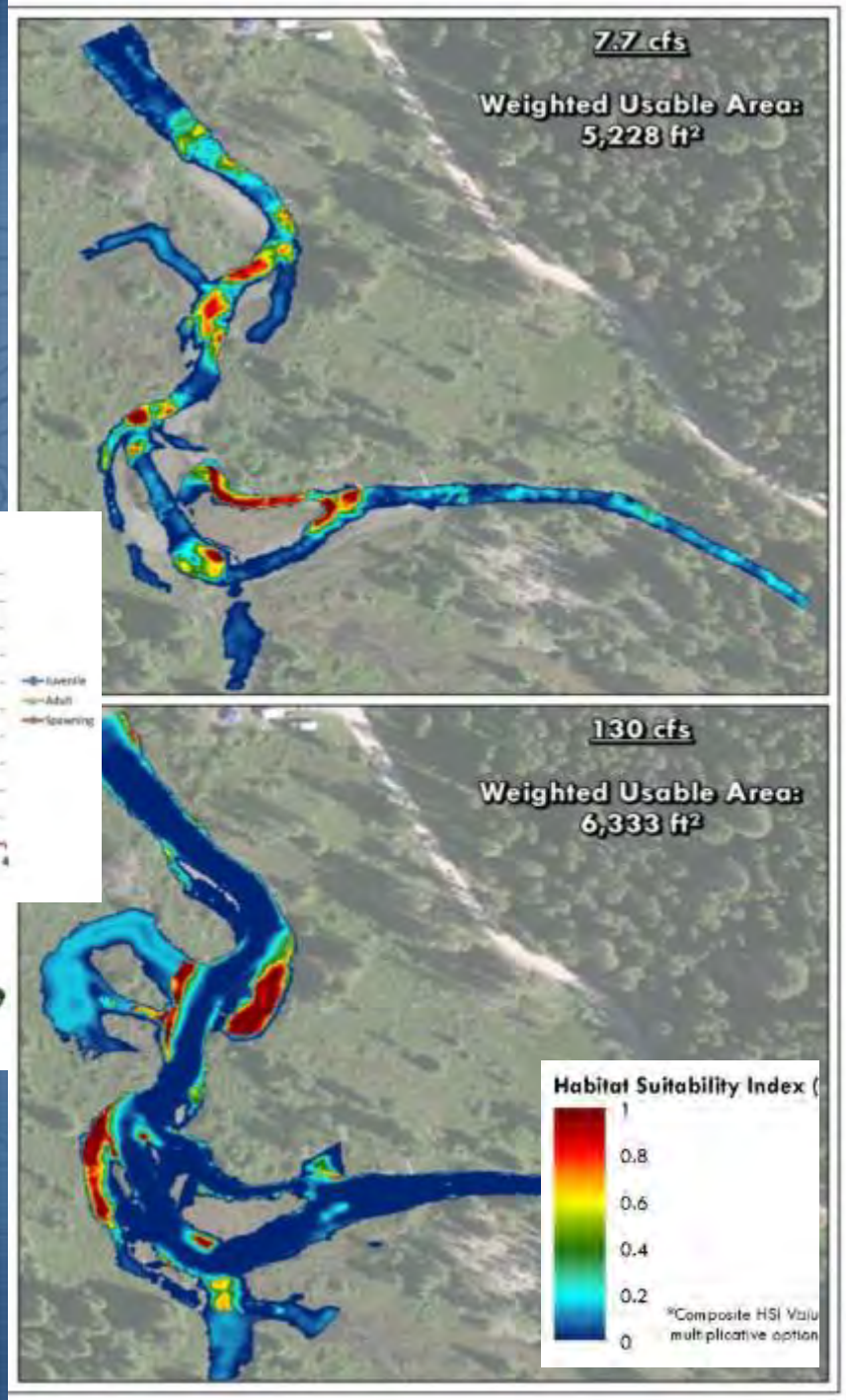
Methods

- Field survey
- 2D model
- GIS mapping



Results

- Quantity of habitat
- Spatial distribution
- Optimal flow



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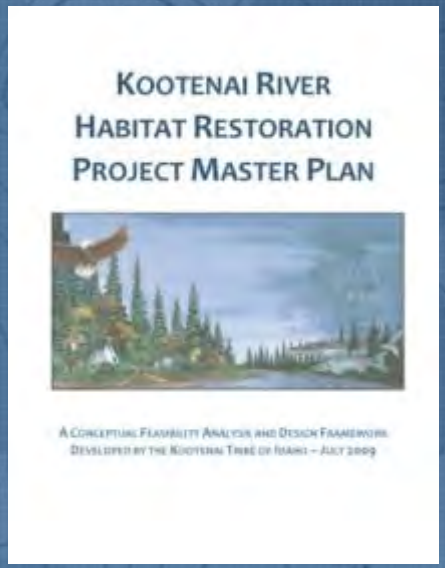
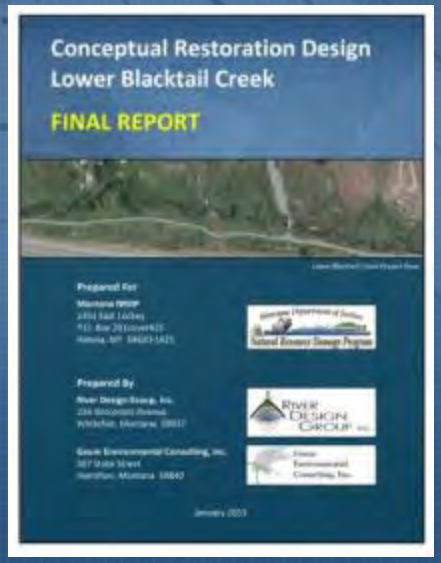




Restoration Strategies & Treatments

- Conservation (easements, fencing, acquisition)
- Flow modification
- Wood or gravel augmentation
- Migration barrier removal (dams and culverts)
- Revegetation (soil amendments and planting)
- Instream and streambank habitat structures
- Wetland enhancement and creation
- Remediation and pollution cleanup
- Channel and floodplain reconstruction

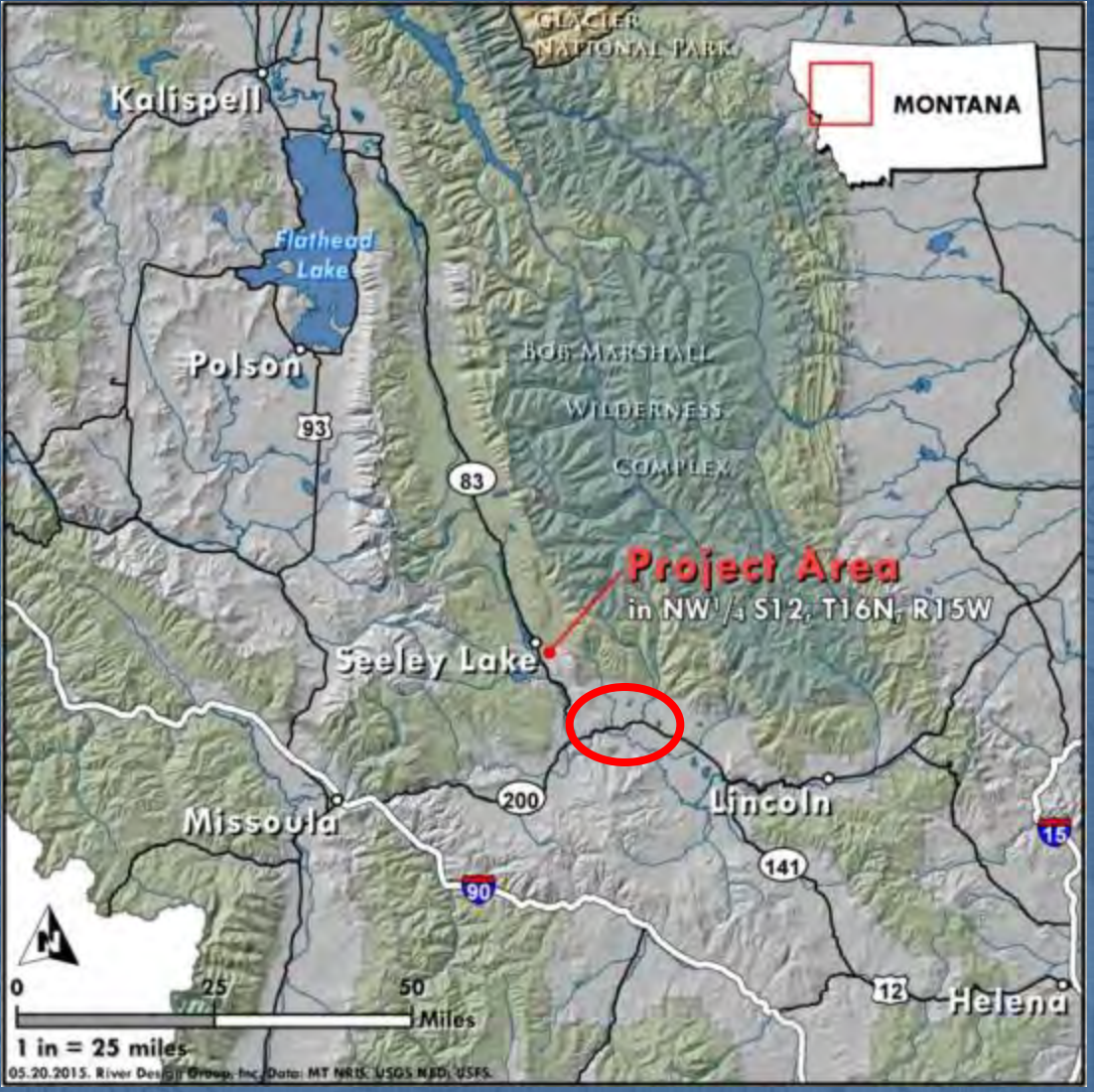
Restoration Strategy	Limiting Factors Addressed	Limitations
Conservation	Land use	Conservation does not directly address most limiting factors; however, conservation may improve riparian conditions in the long term. Success is dependent on selection of sites with high natural recovery potential. May provide opportunities for future restoration.
Revegetation	Altered pool development Bank erosion Lack of habitat diversity Warm water temperatures	Revegetation does not directly address limiting factors related to channel geometry such as channel entrenchment, straightened planform, or floodplain connection. Success is dependent upon routine maintenance and adaptively managing site conditions. Revegetation may improve aquatic habitat conditions in the long term.
Streambank Structures	Altered pool development Bank erosion Shallow, infrequent pools Lack of habitat diversity Warm water temperatures	Streambank structures do not directly address limiting factors related to channel geometry such as channel entrenchment, straightened channel planform, or floodplain connection. Success is dependent upon reach-scale stability and inclusion of vegetation components.

Project Example

Selecting appropriate strategies and treatments

<u>Blackfoot River</u>

- Recreation site
- Bank erosion



Design Approach

- Survey of reference bank
- Mapping of plant communities relative to streambank position

Treatments

- Planting
- Floodplain roughness
- Bioengineering
- Fencing and browse protection


Reference


As-built - 2010


Pre Project - 2009


June 2015

Project Example

Selecting appropriate strategies and treatments

Crooked River

- Placer mining
- Steelhead trout habitat
- Extensive berms and ponds
- Disturbed soils – fines removed
- Static channel and with low potential for disturbance and natural recovery


Rock weirs

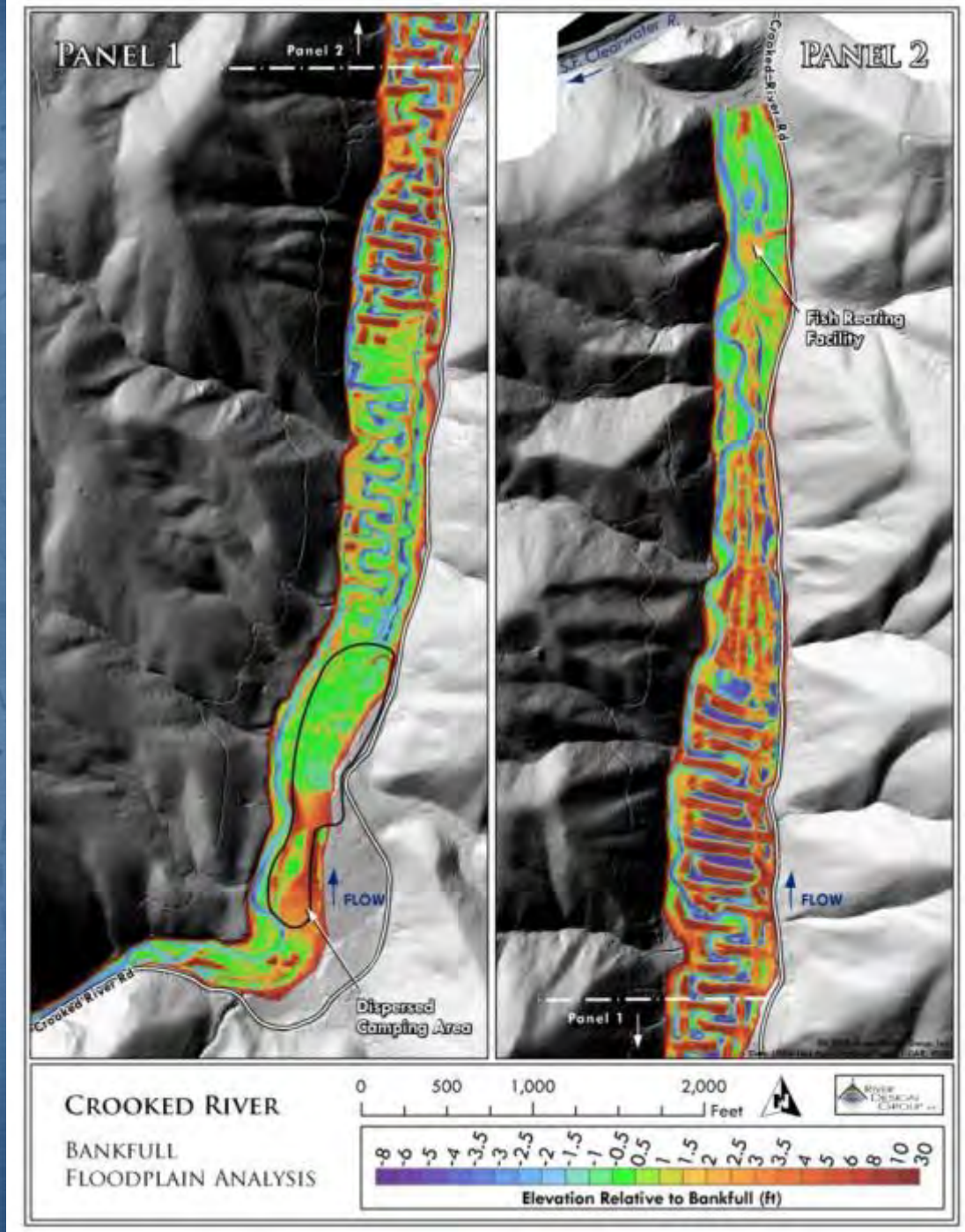

Rootwads


Log vanes


Boulders and woody debris

Crooked River

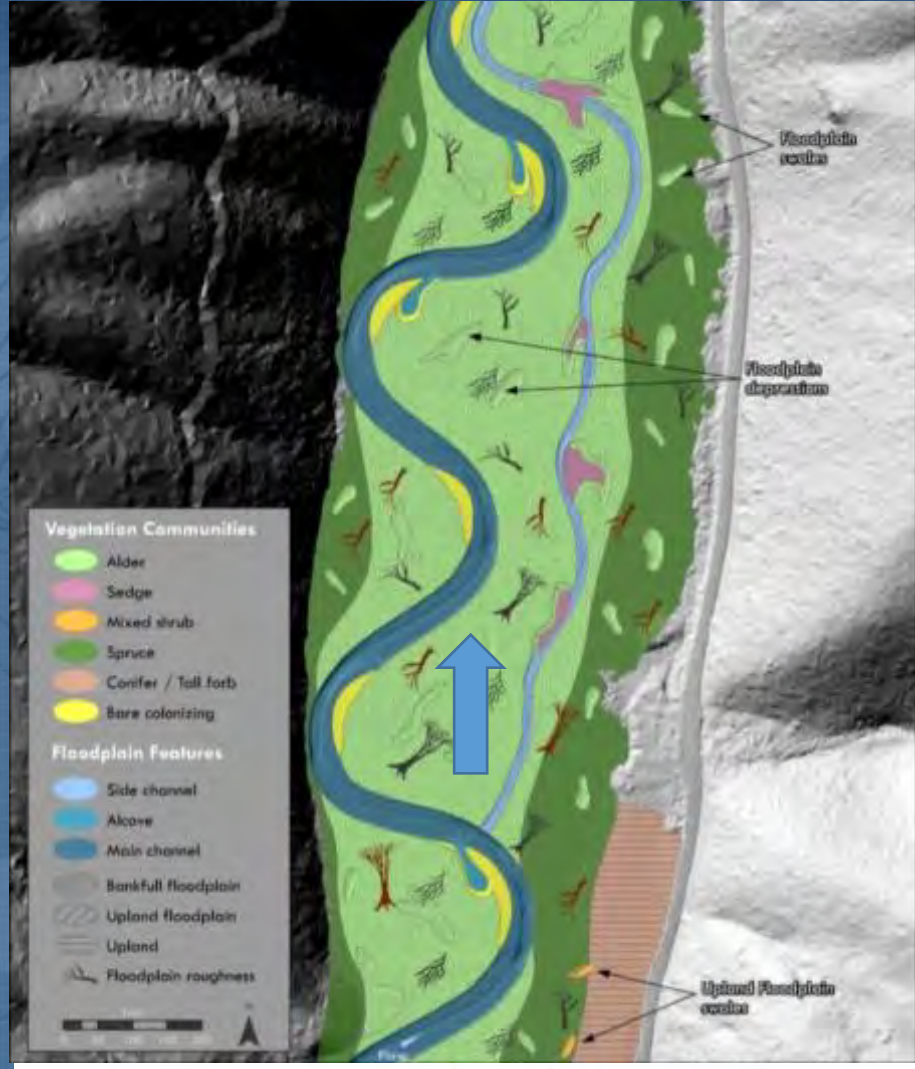
- 70 % of historical floodplain not suitable in elevation for riparian vegetation
- Off channel areas not connected

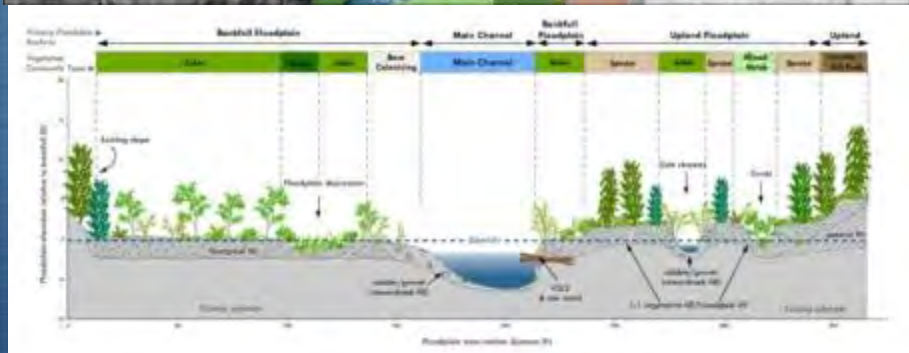


Project Example

Restoration Treatments

- Channel reconstruction
- Floodplain grading
- Side channels
- Wetland swales
- Alcoves and point bars
- Woody debris instream habitat structures and floodplain roughness elements
- Planting and seeding
- Upland restoration





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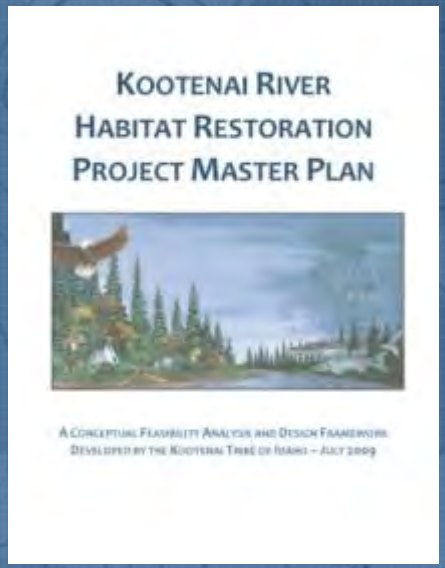
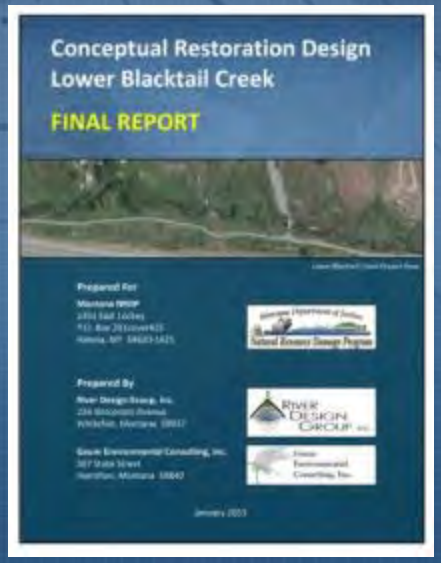
- Cost Estimate





Identification of Alternatives

Restoration Strategies	**Constraints**	**Limiting Factors Addressed**	**Feasibility Considerations**	**Relative Cost**
Conservation				
Revegetation				
Streambank structures				
Floodplain restoration				
Channel reconstruction				

Identification of Alternatives

Restoration Strategies	**Constraints**	**Limiting Factors Addressed**	**Feasibility Considerations**	**Relative Cost**
Conservation		Land use	Recovery	Low
Revegetation	Entrenchment	Lack of buffer	Browse	Moderate
Streambank structures	Infrastructure	Poor habitat	Stability	Moderate
Floodplain restoration	Houses	Connection	Flooding	High
Channel reconstruction	Floodplain regs	Entrenchment	Sediment	High

Example Site Selection and Prioritization of Projects

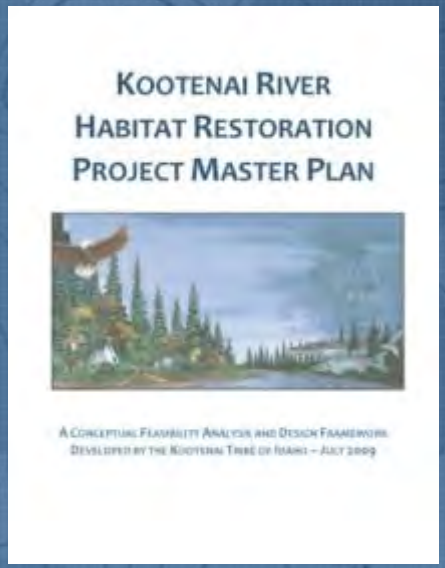
Project	Technical Complexity	Social Issues	Relationship to Other Projects	Ecological Uplift	Relative Cost
Site 1					
Site 3					
Site 6					

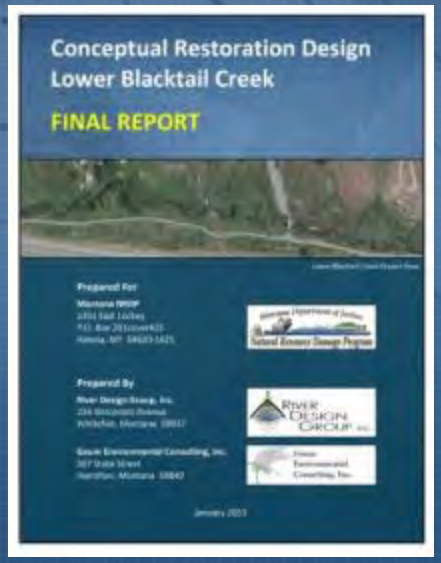
Example Site Selections and Prioritization of Projects

Project	Technical Complexity	Social Issues	Relationship to Other Projects	Ecological Uplift	Relative Cost
Site 1	Moderate	Moderate	Moderate	Moderate	Moderate
Site 3	High	Moderate	High	High	High
Site 6	Low	Low	Low	Low	Low

Components of an Ecosystem-based Restoration Plan

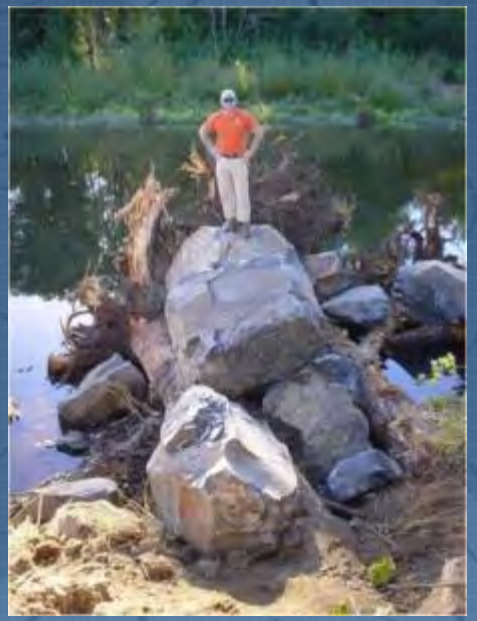
- Project Overview
- Site Assessment & Limiting Factors
- Restoration Objectives & Design Criteria
- Restoration Strategies & Treatments
- **Restoration Alternatives & Prioritization**
- **Design & Implementation Considerations**
- **Cost Estimate**



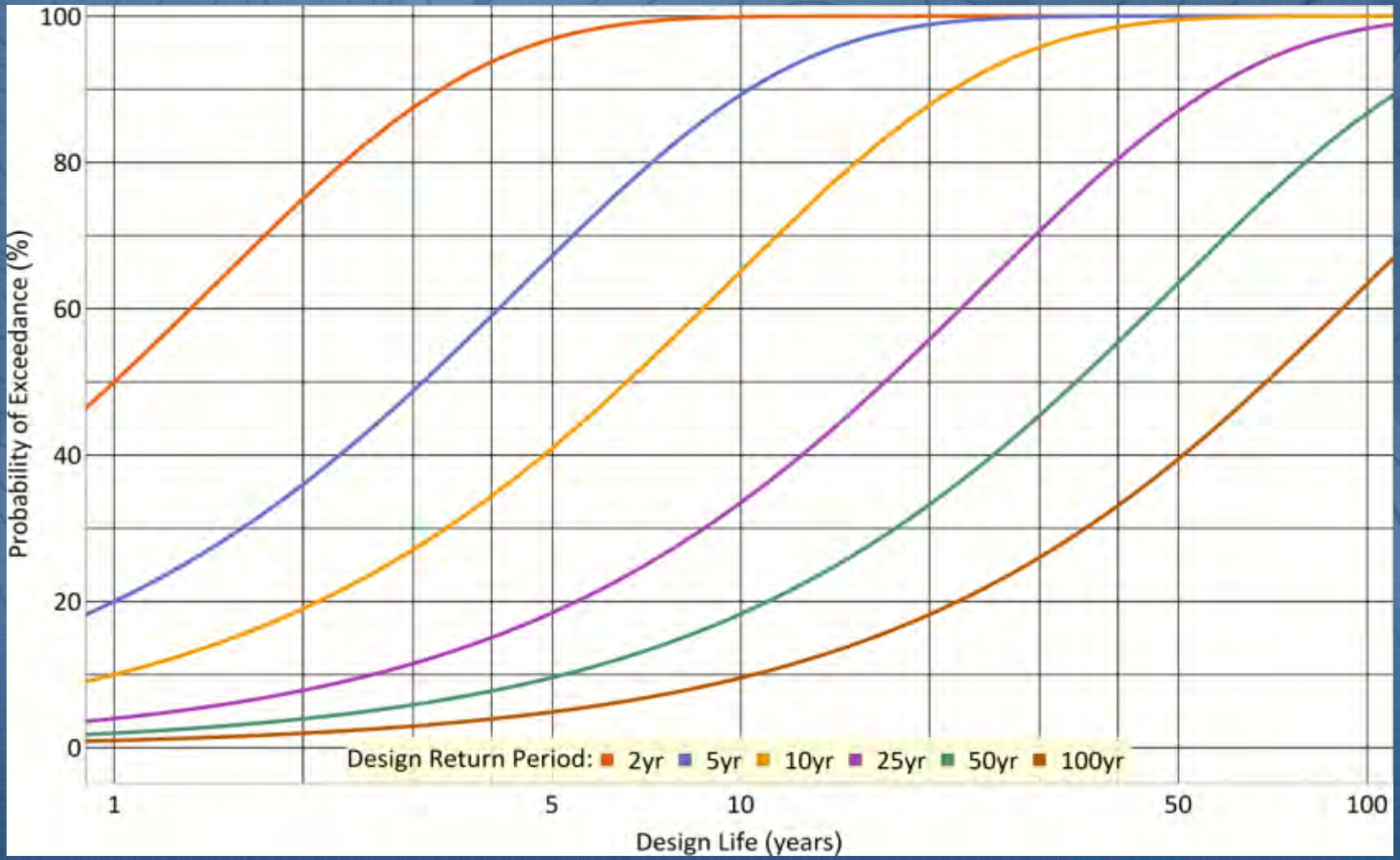


Design Considerations

- Performance expectations
- Risk management
- Data needs
- Permitting requirements
- Monitoring and adaptive management



Risk Management



Implementation Considerations

- Construction phasing
- Access and staging
- Water management
- Materials
- Contracting
- Oversight

Cost Estimates

- Construction
- Materials
- Design and construction oversight
- Permitting and environmental compliance
- Monitoring
- Maintenance
- Contingency

Are We Improving?

- Technology is your friend
  - Education (restoration –specific curricula)
  - Data collection (LiDAR)
  - Analysis (computational power)
  - Construction (GPS)
- Adaptive management is happening
  - Restoration industry is maturing
  - Learning from research and from monitoring projects
- Collaboration is key
  - Interdisciplinary design teams
  - Peer review and independent scientific review
  - Specialized construction contractors

Will Harman's Recommendations

Cause of Failure	Recommendation	Selected Measures
1. Credit determination methods generally do not exist for stream/wetland complexes.	Create a third category for mitigation debits and credits called stream/wetland complexes. Apply on debit and credit side.	Focus on groundwater connection, floodplain connectivity, bed form diversity, lateral stability, and riparian vegetation as a minimum.
2. Most credit determination methods are linked to changes in dimension, pattern, and profile.	Link restoration activities to changes in function-based parameters.	Same as above.
3. Projects over-promise success by not assessing restoration potential.	All projects should state the restoration potential as the highest level of restoration that can be achieved based on health of watershed, reach scale assessment and constraints.	Catchment assessment, function-based assessment using parameters above and a statement about the restoration potential. Level 3 (Geomorphology) = Stability Level 4 (Physicochemical) = Water Quality Level 5 = (Biology) = Biology to a reference condition

Matt Daniel's Recommendations

Cause of Failure	Recommendation	Selected Measures
Lack of monitoring and maintenance	Require monitoring and maintenance plans	Monitor projects for at least 5 years. Budget up to 10% of implementation costs for outyear maintenance.
Poor site selection and inability to overcome severe problems	Complete initial feasibility assessments prior to site selection	Collect data and complete analyses to document the limiting factors and constraints. Ensure that goals and objectives are appropriate and realistic. Assess the ability to overcome limiting factors.
Application of inappropriate restoration treatments	Clarify cause and effect pathways. Link treatments to limiting factors and objectives.	Peer review Enlist an interdisciplinary team to ensure that a broad range of issues are contemplated.
Inexperienced or unqualified construction contractor	Contractor selection must be based on more than low bid. Selection must also consider experience and qualifications	Require contractors to submit experience in the form of 5 restoration project examples. Require contractors to submit qualifications by describing components of past restoration work. Require use of GPS to improve implementation quality control, if applicable.
Lack of a project champion	All projects need a leader or dedicated team to see it through from start to finish and beyond.	Project designers need to be involved in all project aspects including planning, design, construction oversight and monitoring.

Questions?

Will Harman, Stream Mechanics
wharman@stream-mechanics.com
919-747-9448

Matt Daniels, River Design Group, Inc.
mdaniels@riverdesigngroup.net
406-862-4927


Thank you for your participation!
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