Stream Project

Decision Analysis and Design Guidance for Stream Restoration

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PRRSUM
PARTNERSHIP FOR RIVER RESTORATION AND SCIENCE IN THE UPPER MIDWEST

JOHNS HOPKINS
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Questions we'll answer today...

- What is Stream Project?
- How can we frame decisions in a way that is easily understood by project proponents, regulators, and local citizens?
- How can we incorporate the uncertainties of natural stream systems in both design and decision making?
- How does this framework lend itself to adaptive management?

Overview

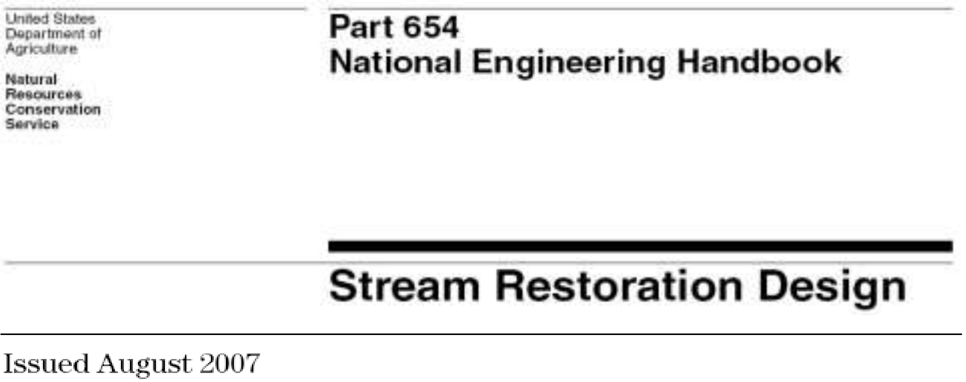
NCED Earth · Water · Life

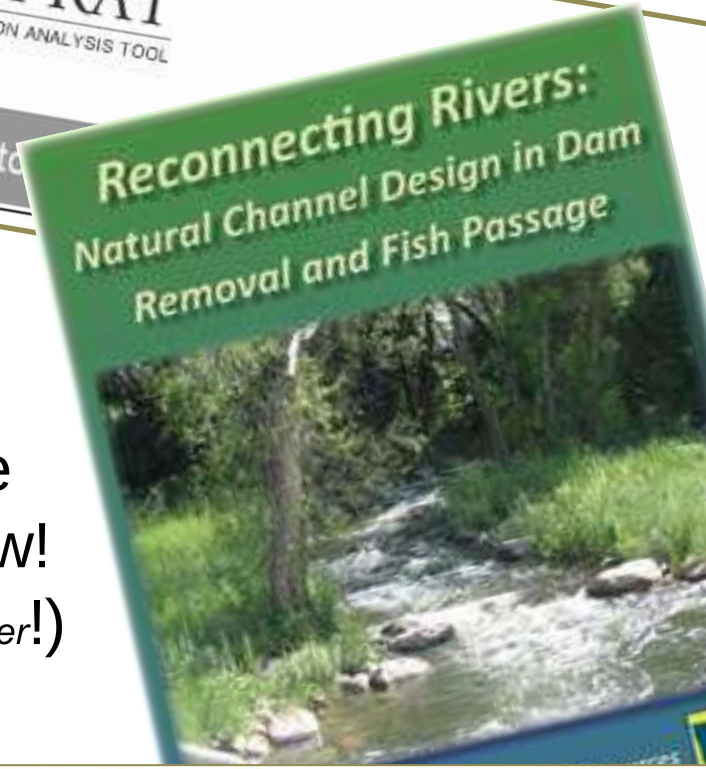
ICRRR Intermountain Center for River Rehabilitation and Restoration

US Army Corps of Engineers® Engineer Research and Development Center

<u>Project Intent</u>:

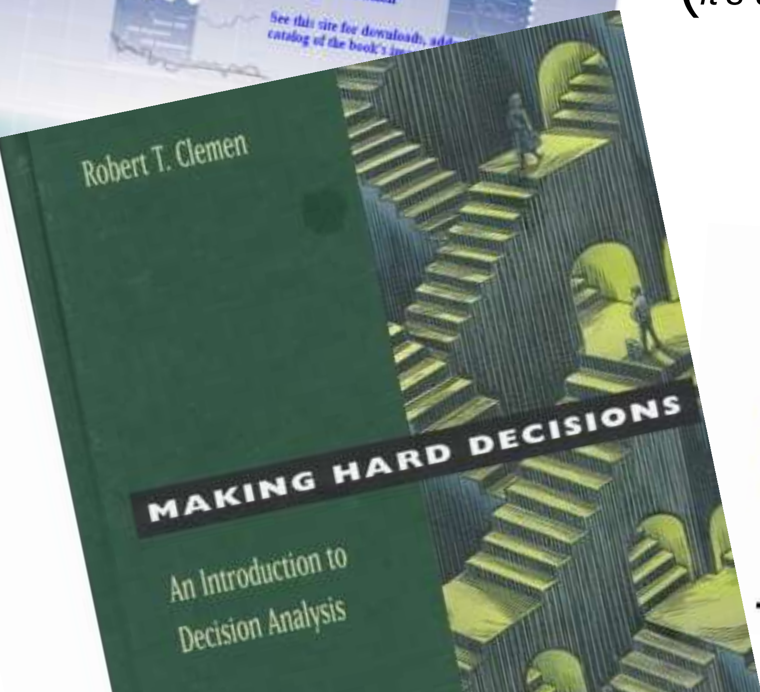
- Link stream restoration goals, objectives, and actions in transparent and predictive decision-analysis framework
  - Bring all restoration goals to the table
  - Evaluate uncertainty and risk
  - Incorporate stakeholder preferences and social benefits

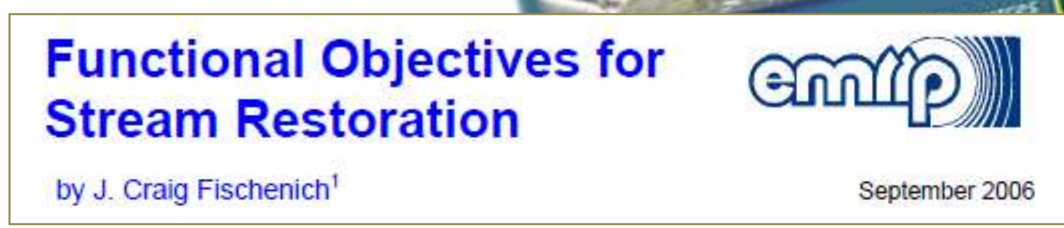


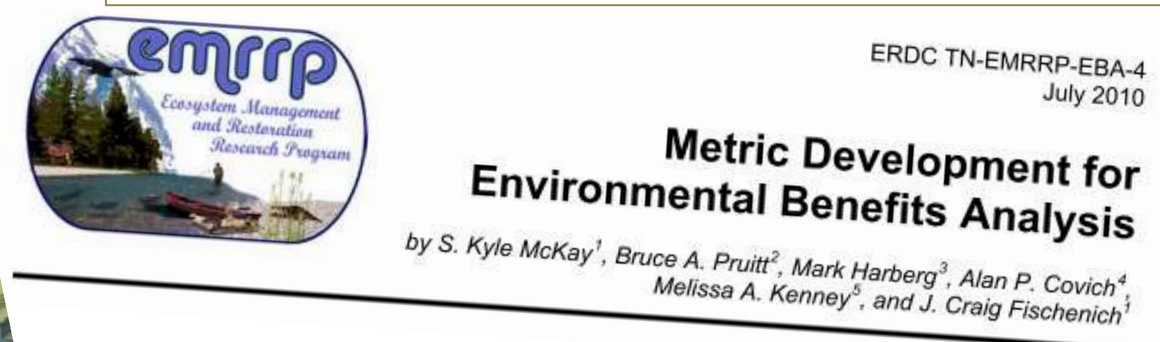


Much of what we propose is not new!

(*it's a matter of pulling it together*!)



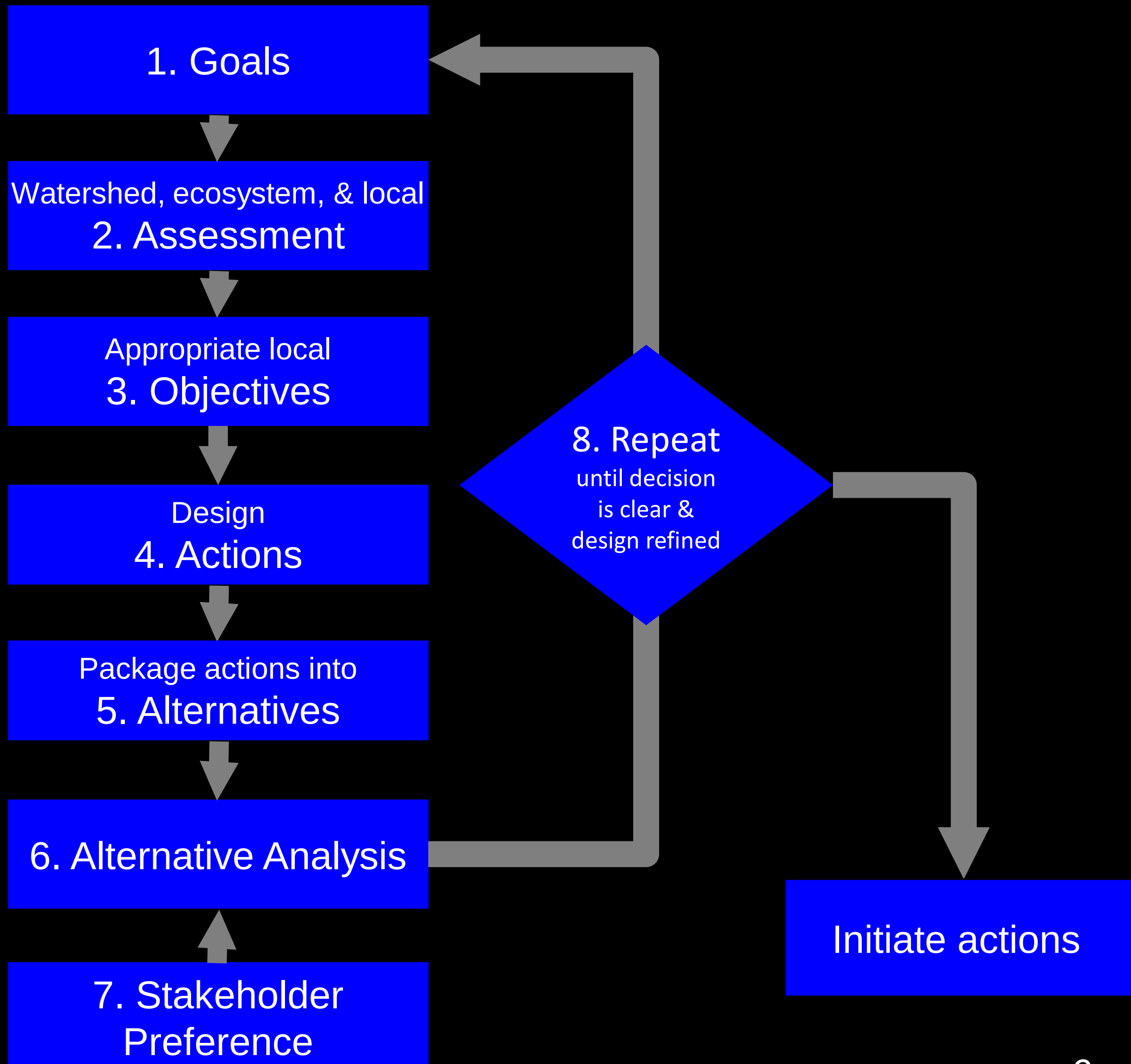




Why Now?

- Stream restoration is becoming a more ‘mature’ discipline
- Restoration context and objectives are evolving, but not necessarily more focused
- Expertise of restoration teams is increasing
- Linkages from goals to actions are weak

Basic Framework



Consider Typical Project Objectives

- Project will reduce sediment and nutrient loadings

  By how much? At what cost?

  Is there a cheaper alternative?

- Project will provide in-stream habitat

  Is habitat limiting?

  What are the odds of population recovery?

  What is it worth?

- Project will provide a stable, natural channel

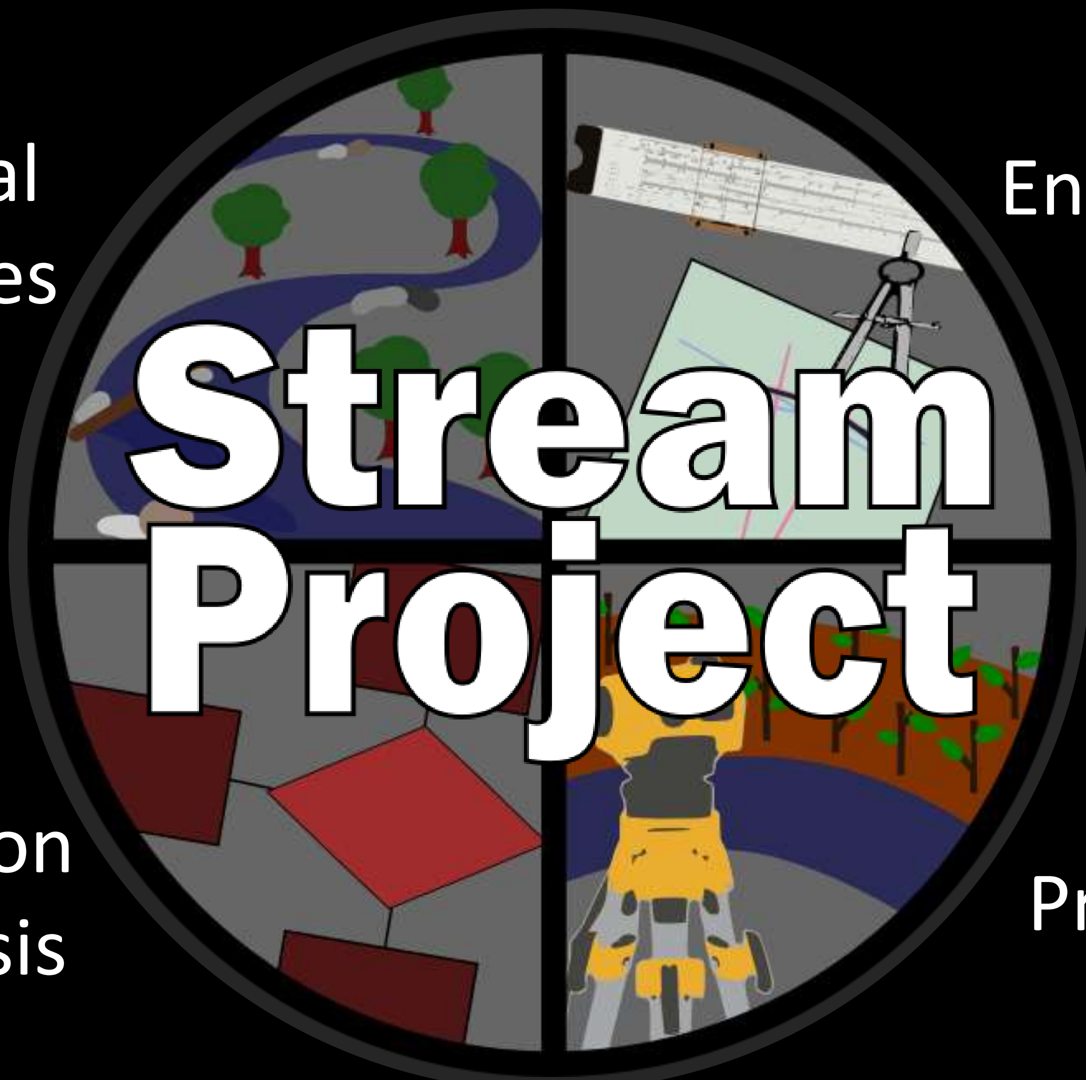
  What is that?

  Is it consistent with other objectives?

Key Element #1: Interdisciplinary Interaction

Natural Sciences

Engineering



Decision Analysis

Practice

Key Element #2: Objectives Linked to Actions

- Specific, quantifiable objectives explicitly linked to design choices
  - support tradeoff analysis
  - adaptive management
  - effective learning by doing
- Range of Objectives
  - Infrastructure protection
  - Improve water quality
  - Recover endangered aquatic population
  - Improve aesthetics or recreational opportunities

Key Element #3
Integrated Toolbox

- Quantify watershed sediment, hydrologic, and ecological drivers
- Predict physical, biological, and geochemical response to design manipulations
- Multi-Criteria Decision Analysis for evaluating design alternatives

Scalable Toolsets

Effort Level	Chair Base Level	Bike Minimal Level	Scooter Moderate Level	SUV Highest Level
Working Time on Project	hours	days	weeks	months-years
Duration of Data Collection	< 1 day	< 1 month	< 1 year	> 1 year
Total Cost	$0.1K	$1K	$10K	$100K

Scalable Toolsets: Example

Required Information	Chair Base Level	Bike Minimal Level	Scooter Moderate Level	SUV Highest Level
Stream temperature	Model averaged over reach and time	Model averaged over reach, but including time	1-D reach scale model: e.g. HEC-RAS temp model	2-D reach scale temp model OR Basin scale temp model
Sediment Assessment: History and Trends	Gage data, historic air photo analysis	Historic sedimentation rates; section calculations	Reach scale routing analysis	Watershed sediment budget with multiple lines of evidence

Do you have predictive tools you would like to share?

Send us your suggestions to info@streamproject.org

Key Element #4
Unifying Case Studies

- Apply framework and tools to diverse restoration projects
- Demonstrate the importance of the watershed context

Minebank Run, Baltimore County, MD

Stream Project: Chapters

1. Introduction
2. Objectives driven framework
3. Hydrology
4. Sediment
5. Fluvial geomorphology
6. Hydraulics
7. Sediment transport
8. Channel dynamics
9. Water quality
10. Energy and productivity
11. Physical habitat
12. Social value
13. Riparian vegetation
14. Decision analysis methods
15. Monitoring and adaptive management

Watershed Context

Site Dynamics: Assessment and Design

Making Decisions and Learning

Adaptive Management

- Process that promotes flexible decision making that can be adjusted as outcomes become better understood
- A complimentary extension to the Stream Project framework
  - Objective driven design
  - Actions that can be adaptive instead of singular
  - Modular toolset that can be improved over time

What the Stream Project will NOT do for you

- Provide a ‘cookbook’ approach to stream restoration
- Circumvent engineering analysis and judgment
- Provide <u>all</u> the background you need
- Recommend reach scale restoration if the problem is at the watershed scale
- Eliminate stream restoration failures

What the Stream Project can do for you

- Help set the appropriate objectives given the site / watershed attributes and constraints
- Predicatively and transparently link objectives → site attributes → restoration actions
- Provide a range of scalable tools that quantify uncertainty
- Provide a bases for tradeoffs among objectives and across project alternative

The Stream Project Team

Name	Affiliation(s)	Specialties
Peter Wilcock - Director	JHU, NCED, ICRRR	*sediment transport, channel dynamics*
Daniel Baker - Manager	JHU, NCED, ICRRR	*channel design, water quality*
Patrick Belmont	USU, NCED, ICRRR	*watershed analysis, water quality*
Phaedra Budy	USU, ICRRR	*fish biology, ecosystem restoration*
Jock Conyngham	USACE ERDC Env. Lab	*aquatic habitat, fishery restoration*
Martin Doyle	U. North Carolina	*channel design, restoration strategies*
Craig Fischenich	USACE ERDC Env. Lab	*environmental assessment, riparian ecology*
Richard Fischer	USACE ERDC Env. Lab	*riparian ecology*
Ben Hobbs	JHU, NCED	*environmental economics, decision analysis*
Meg Jonas	USACE ERDC Env. Lab	*hydraulics and channel design*
Gary Parker	UIUC, NCED	*sediment transport, channel dynamics*
Jack Schmidt	USU, ICRRR	*fluvial geomorphology, hydrology*
Dave Shepp	USACE Headquarters	*water quality, environmental restoration*
Barb Utley	USU, NCED, ICRRR	*fluvial processes, water quality monitoring*
Joe Wheaton	USU, ICRRR	*multi-dimensional modeling, instream habitat*

Questions?

Email us: info@streamproject.org