# ADAPTIVE MANAGEMENT

## Stream Restoration Projects

Maryland
Stream Information Exchange
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Land Studies

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# ADAPTIVE MANAGEMENT

"An approach to natural resource management that emphasizes learning through management where knowledge is incomplete, and when, despite inherent uncertainty, managers and policymakers must act. Unlike a traditional trial and error approach, adaptive management has explicit structure, including a careful elucidation of goals, identification of alternative management objectives and hypotheses of causation, and procedures for the collection of data followed by evaluation and reiteration. The process is iterative, and serves to reduce uncertainty, build knowledge and improve management over time in a goal-oriented and structured process."

*Environmental Protection Agency*
*https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=310397*

# Definition of Adaptive Management (NRC 2004)

A decision process that promotes **flexible** decision making that can be adjusted **in the face of uncertainties** as outcomes from management actions and other events become better understood.

Careful **monitoring** of these outcomes both advances scientific understanding and assists in the **adjustment of policies and operations** in an **iterative** learning process.

Recognizes the importance of the contribution of **natural variability** to ecological resilience and productivity. It is **not** a **"trial and error"** process, but rather emphasizes "**learning while doing**." Adaptive management does not represent an end in itself, but is instead a means to more effective decisions and enhanced benefits.

The true measure of adaptive management, and its value to USACE, is in how well it **helps meet environmental, social, and economic goals**, increases scientific knowledge, and **reduces tensions** among **stakeholders**.

# ADAPTIVE MANAGEMENT - Practitioner:

Design changes in the field during or post-construction as a result of:

- changes in field conditions post-survey data/flood events during construction
- uncovering unknown features such as bedrock or hillside seeps/springs
- changes during flood events post construction or
- monitoring protocols do not meet intended objectives
- construction budget changes

The changes may be associated with both wetlands and streams or specific habitat. This presentation will focus primarily on stream restoration.

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# ADAPTIVE MANAGEMENT techniques may be required as a result of:

- Permitting - special conditions
- Mitigation - requirements or obligations
- TMDL – requirements
- Aesthetics or property owner preferences
- Infrastructure at risk
- Stakeholder or regulatory opinions

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# ADAPTIVE MANAGEMENT is typically associated with:

- Vertical Stability
- Horizontal Stability
- Ecological Uplift or Habitat Improvements
- Vegetation (Type and Density)
- Wetland Requirements (acreage or Type)
- Stream Type (DA or E)
- Constructability (Water management or bedrock/clay)

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# Integration of AM in Planning
## Key Tasks

- identification of risks and uncertainties;
- development of clearly defined goals and objectives;
- development of conceptual and assessment models;
- identification of performance metrics and monitoring plans, and
- development of range of alts (including some that lend themselves to AM and others that may not)
- Result in Monitoring and AM Plan

# Identification of Risks and Uncertainties:

The potential risks and uncertainties are different depending upon the stream restoration techniques: Natural Channel Design

- Horizontal Stability – Lateral Migration from Bank Erosion
- Vertical Stability – In-Stream structure failure or incision through bed material
- Ecological Uplift or Habitat Improvements – Loss of riffle substrate; fish passage blockage
- Vegetation – Upland vegetation dominates/invasives
- Wetland Requirements (Acreage or Type) – Lack of hydrology
- Stream Type (B/C to F or G) – Failure of in-stream structures may cause a change in stream type
- Constructability – Water management, bedrock/in-stream structures; maintenance usually requires additional stone.

# Identification of Risks and Uncertainties:

The potential risks and uncertainties are different depending upon the stream restoration techniques:  Floodplain Restoration

- Horizontal Stability – Avulsion or ana-branching
- Vertical Stability – Incision through bed material/coarse material aggradation at upper reaches
- Ecological Uplift or Habitat Improvements – Loss of riffle substrate
- Vegetation – Upland vegetation dominates/eroded on banks
- Wetland Requirements (Acreage or Type) – Lack of hydrology
- Stream Type (B/C to F or G) – Failure of in-stream structures may cause a change in stream type
- Constructability – Bedrock or Initial Floodplain Stabilization, maintenance usually requires vegetation or fabric

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# What are the benefits to AM?

- Improved probability of project/program success - formal science-based approach
- Precautionary approach to act in the face of uncertainty
- Forum for dialogue between scientists and managers
- Forum for interagency collaboration and conflict resolution - consultation required
- Incorporates flexibility and robustness into project/program design, implementation, and operations

# Adaptive Management Issues – Shobers Run at Bedford Springs

- Horizontal Stability – Formation of secondary channels and open water areas during and immediately after construction.
- Vertical Stability – Although not an issue in this project, valley wide base controls are being implemented to reduce the risk of vertical degradation if secondary channels form.
- Ecological Uplift or Habitat Improvements – Increased floodplain connectivity and hyporheic exchange set the stage for improved physicochemical and biological functions.
- Vegetation – Areas where clay was encountered delayed vegetation growth. Tree plantings were not preferred in many locations.
- Wetland Requirements (Acreage or Type) – Secondary channels and other inundated areas in the floodplain reduced designated wetland mitigation acreage.
- Stream Type (B/C to F or G) – Stream type E4 changed to D4 in some locations after flood
- Constructability – Clay layer delayed vegetation establishment; flood removed topsoil and initial plantings of plugs.

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# Bedford Springs

## Stream and Floodplain Restoration 2006

**Adaptive Management: "Breach"**

- Defining breach
- Stability issues vs. The nature of stream systems
- Reporting language and communicating with agencies

# Bedford Springs

## Stream and Floodplain Restoration

*"Breach" A*


October 2007

May 2008

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# Bedford Springs

## Stream and Floodplain Restoration

*Repairs – August 2008*




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# Bedford Springs

## Stream and Floodplain Restoration

*"Breach" A*

October 2008

June 2009

Land Studies

# Bedford Springs

## Stream and Floodplain Restoration

*"Breach" A*

September 2010

August 2011

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# Bedford Springs

## Stream and Floodplain Restoration

*"Breach" A*

September 2012

August 2013

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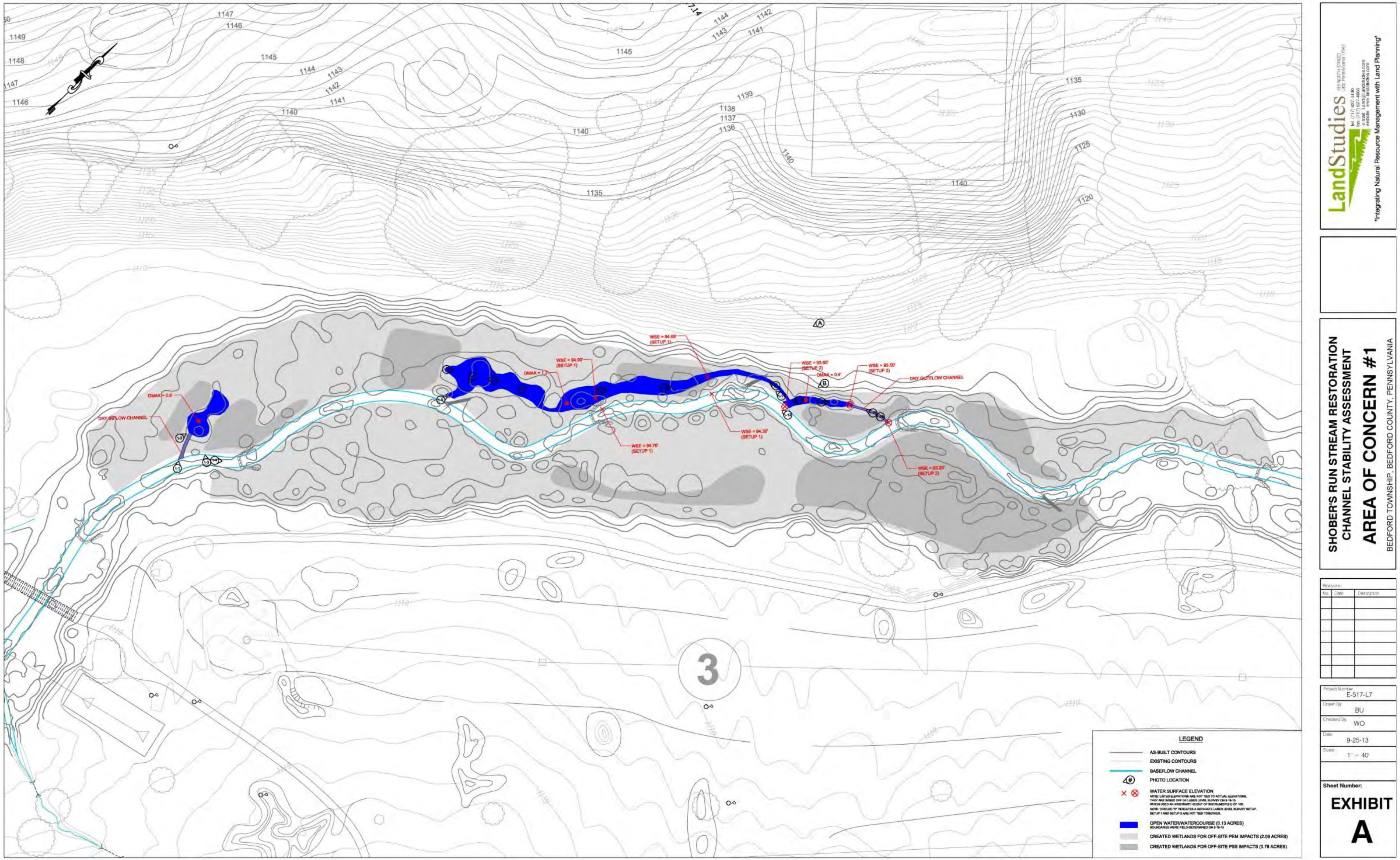
# Bedforc Springs

## Stream and Floodplain Restoration

*Areas of Concern Ma*

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# Bedford Springs

## Stream and Floodplain Restoration

*Channel Stability Assessment*


November 2007

September 2013

Land Studies

# Bedford Springs

## Stream and Floodplain Restoration

*Channel Stability Assessment*


November 2007

September 2013

Land Studies

# Bedford Springs

## Stream and Floodplain Restoration

*Channel Stability Assessment*


November 2007

September 2013

Land Studies

# Bedford Springs

## Stream and Floodplain Restoration

*Channel Stability Assessment*


November 2007

September 2013

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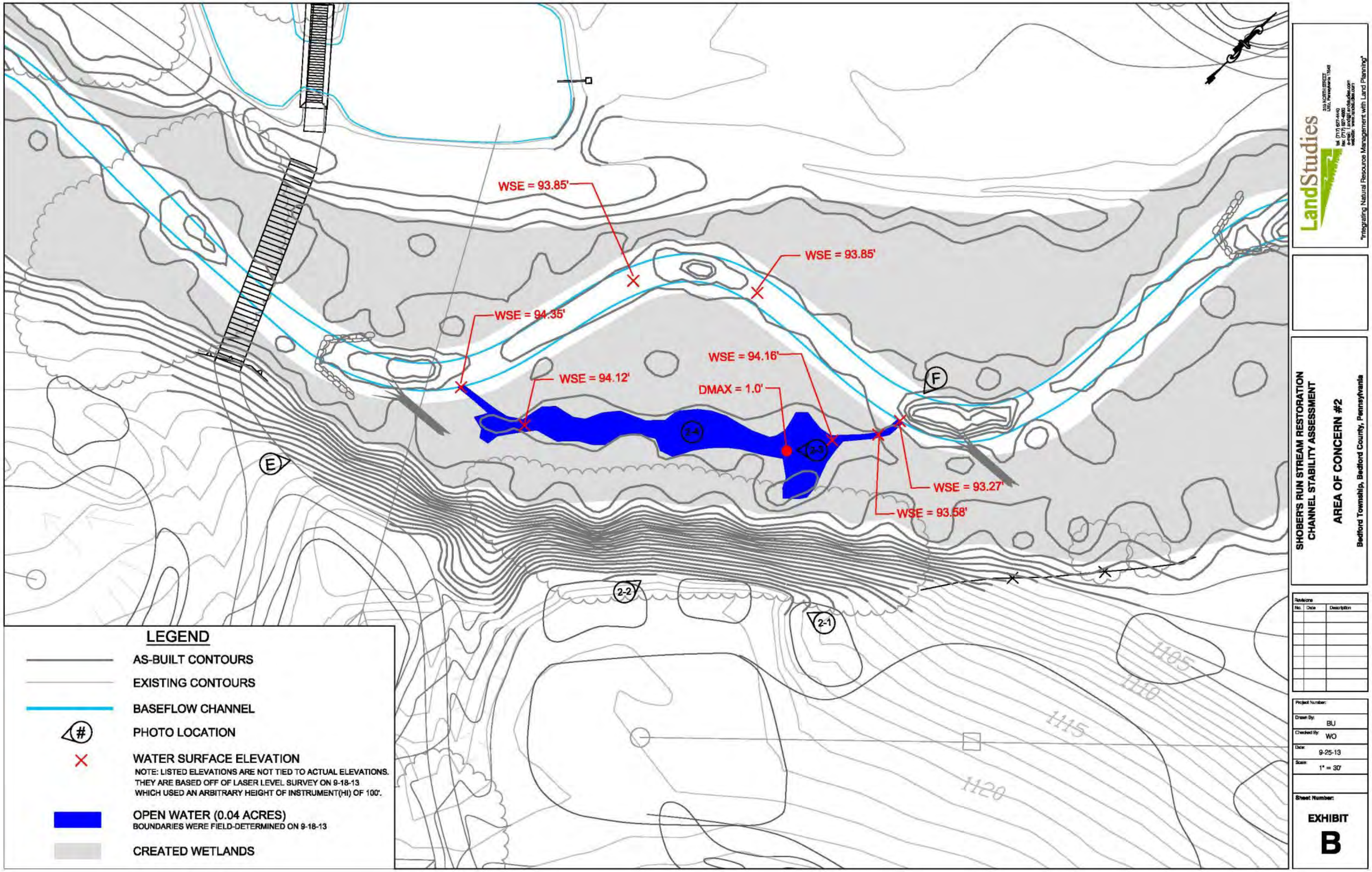
# Bedford Springs

## Stream and Floodplain Restoration

*Areas of Concern Map*



# Bedford Springs

## Stream and Floodplain Restoration

*"Breach" B*


October 2007

May 2008

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# Bedford Springs

## Stream and Floodplain Restoration

*Repairs – August 2008*




Land Studies

# Bedford Springs

## Stream and Floodplain Restoration

*"Breach" B*

August 2008

October 2008

Land Studies

# Bedford Springs

## Stream and Floodplain Restoration

*"Breach" B*

June 2009

September 2010

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# Bedford Springs

## Stream and Floodplain Restoration

*"Breach" B*

August 2011

September 2012

# Bedford Springs
## Stream and Floodplain Restoration

*Habitat – Large wood*
*Turtle in Secondary Channel*

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# The Formation of Secondary Channels and Open Water Areas Created a lot of Discussion between all of the Stakeholders

This was a sign of instability and thus had to be repaired.

The area is stable and was designed to accommodate new channel formation

The areas where the secondary channels and open water areas formed created non-typical micro-habitat that would not exist and provided variations such as substrate, vegetation and flow velocity within the areas. The entrance, middle and exit locations of these areas were different.

The Agencies required more detailed monitoring of the secondary channel water surface profiles compared to main channel. No signs of further headcutting, the secondary channels had the same substrate as the primary channel.

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# Bedford Springs

## Stream and Floodplain Restoration

*Clay Layer with Vegetation Growth*


November 2007

October 2008

September 2012

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# Brubaker Run

## Floodplain Restoration
## (Under Construction)

*Meeting Stormwater Management requirements*

Adaptive Management: Bedrock

- Bidding challenges
- Planning for the unexpected
- Adapting the plan

# Adaptive Management Issues – Brubaker Run

- Horizontal Stability – Anticipate and encourage the formation of secondary channels
- Vertical Stability –
  - Valley-wide grade control (log) structures installed throughout project length
  - Bedrock vane was found near design elevation, providing additional vertical control
- Ecological Uplift or Habitat Improvements –
  - Increase acreage and length of stream and wetlands
  - Increase floodplain connectivity and groundwater connection
- Vegetation – increase quantity and diversity of wetland plant species in the floodplain
- Wetland Requirements (Acreage or Type) – none
- Stream Type (F to C to D) – Anticipate and encourage the formation of multiple secondary channels (outlined in design report submitted for permitting)
- Constructability – Bedrock constrained proposed alignment and was incorporated into grading

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# Brubaker Run

## Floodplain Restoration

*Bedrock*

# Brubaker Run

## Floodplain Restoration

*Bedrock*

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# Big Spring Run

## Stream and Floodplain Restoration

### Adaptive Management: Stabilization

- Storm event challenges – removal of topsoil main challenge
- Methods to deal with challenges

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# Adaptive Management Issues – Big Spring Run

- Horizontal Stability – Formation of secondary channels and open water areas during and immediately after construction, which was anticipated and encouraged by the design. Significant rill formation where excavating floodplain in down-valley direction displaced topsoil. Prolonged inundation delayed vegetation development. Additional woody material and straw bales installed following construction to limit further rill development.
- Vertical Stability – Numerous log grade control structures across the channel but were not valley-wide due to funding constraints. Localized scouring around individual log structures. No further issues.
- Ecological Uplift or Habitat Improvements – Increased floodplain connectivity and hyporheic exchange set the stage for improved physicochemical and biological functions.
- Vegetation – Vegetation establishment delayed by clay at upstream limits; construction occurred immediately after growing season. Undesirable water cress species within channel.
- Wetland Requirements (Acreage or Type) – None
- Stream Type (B/C to F or G) – Stream type changed from E to D.
- Constructability – Funding limitations reduced restoration length along headwater tributary and prevented valley-wide grade control structures (very little existing trees on site) and valley wide fabric stabilization. Construction ended well past growing season limiting vegetation establishment. Down valley ripping or excavating of floodplain increased rill formation.

# Big Spring Run

## Stream and Floodplain Restoration

*Stabilization*

Straw bales to create backwater and increase deposition and reduce further erosion

# Big Spring Run

## Stream and Floodplain Restoration

*Stabilization*

Small woody debris was used to help reduce erosion, collect sediment and more debris

# Big Spring Run

## Stream and Floodplain Restoration

### Adaptive Management: Stabilization

- Storm event challenges
- Methods to deal with challenges

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# Big Spring Run
## Stream and Floodplain Restoration

### Adaptive Management: Stabilization

It appears that either the

Adaptive Management measures worked

or

were not necessary!

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# Reducing the Potential for Adaptive Management:

Design Stage – Sufficient data collection such as subsurface data (bedrock) are outcrops visible along hillslope or in stream bed. How will debris affect design?

Construction Stages – Qualification of Contractor; Timing of Construction; Frequency of Designated Specialist On-Site; ease of making minor changes/costs or EWO's

Monitoring Stages – Are Objectives reasonable; are monitoring protocols suitable for restoration or objectives; expectations of ecological uplift and results (fish passage; macro-invertebrates)

Prevention or Implementation of Adaptive Management is directly related to cost – data collection, during construction or post construction.

Opinions – there are many opinions in both the client, designer, contractor and Regulatory Agency that affect all aspects of Adaptive Management. Expectations should be reasonable and also identify potential risks to all stakeholders in order to better understand when, where and how adaptive management measures are necessary.

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Questions?
Big Spring Run 2015
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