The Association of State Wetland Managers Presents:

Improving Wetland Restoration Success
2014 — 2015 Webinar Series

Riverine/Riparian Wetland Restoration

Presenters:

Richard Weber, NRCS Wetlands Team

Lawrence Urban, Montana DOT

Moderators: Jeanne Christie & Marla Stelk

Supported by EPA Wetland Program Development Grant 83541601

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Don't Panic -
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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 & Past Recordings** (5 minutes)
- **Riverine/Riparian Wetland Restoration** (60 minutes)
- **Question & Answer** (15 minutes)
- **Wrap up** (5 minutes)

WEBINAR MODERATORS

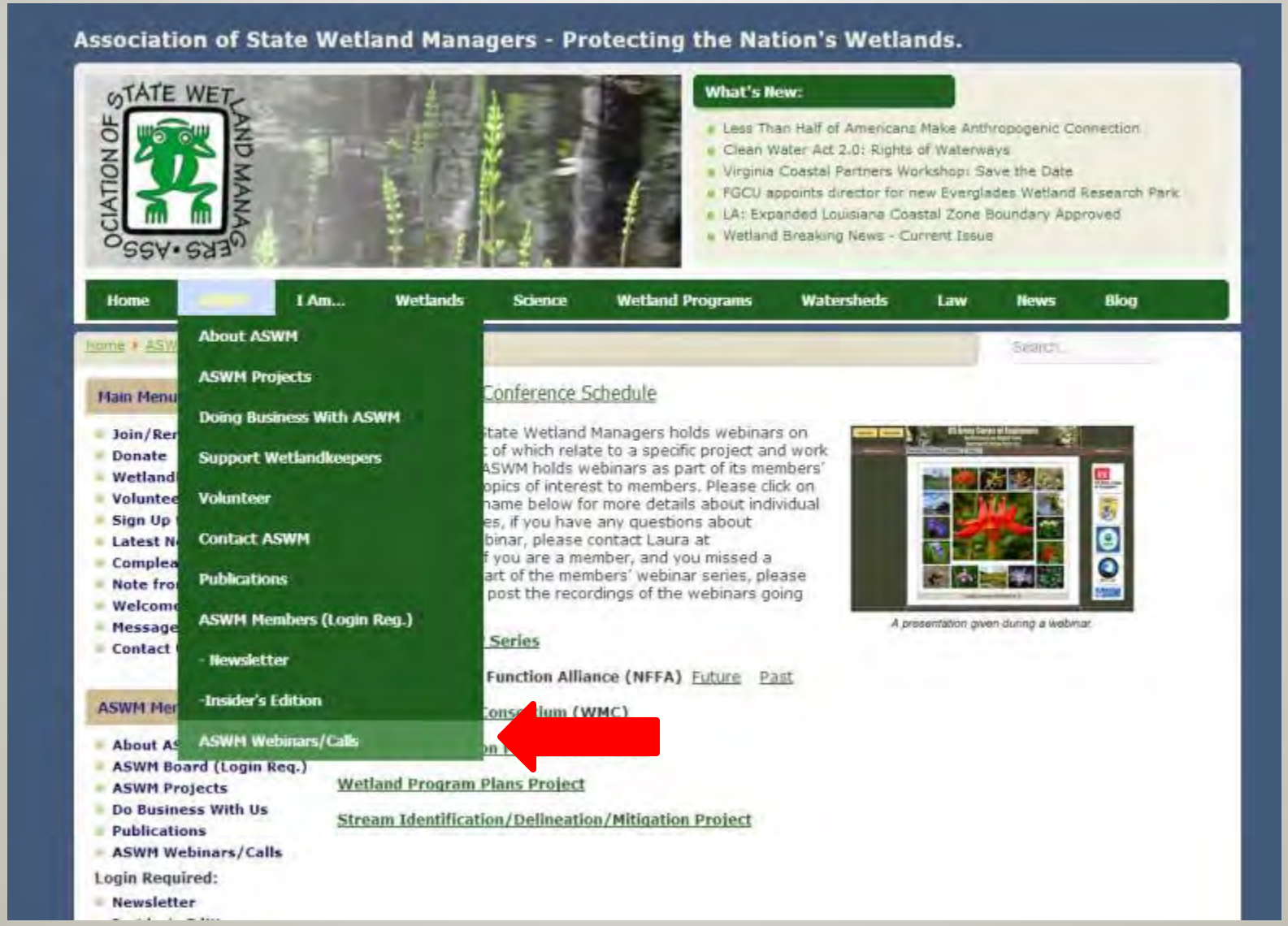
Jeanne Christie,
Executive Director

Marla Stelk,
Policy Analyst

WETLAND RESTORATION PROJECTS

- Convened interdisciplinary workgroup of 25 experts
- Developing monthly webinar series to run through September 2015
- Developing a white paper based on webinars and participant feedback
- To be continued through 2016 in an effort to pursue strategies that:
  - Maximize outcomes for watershed management
    - Ecosystem benefits
    - Climate change
  - Improve permit applications and review
  - Develop a national strategy for improving wetland restoration success

WEBINAR SCHEDULE & RECORDINGS



WEBINAR SCHEDULE & RECORDINGS

FUTURE SCHEDULE - 2015

- **Tuesday, July 14, 3:00pm eastern:**
  - **Peat Land Restoration**

    Presented by:

    - Norman Famous & Marcia Spencer-Famous, Spencer-Famous Environmental Consultants
    - Richard Weber, NRCS Wetlands Team
    - Larry Urban, Montana Department of Transportation

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

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- 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.**

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*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

Richard Weber
NRCS Wetland Team, CNTSC

Larry Urban
Montana Department of Transportation

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?*

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

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*

Riverine/Riparian Wetland Restoration

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

Photo Credit: Laura Hubers, USFWS

Riverine / Riparian Wetland Restoration

Richard Weber, USDA – NRCS Fort Worth, Texas

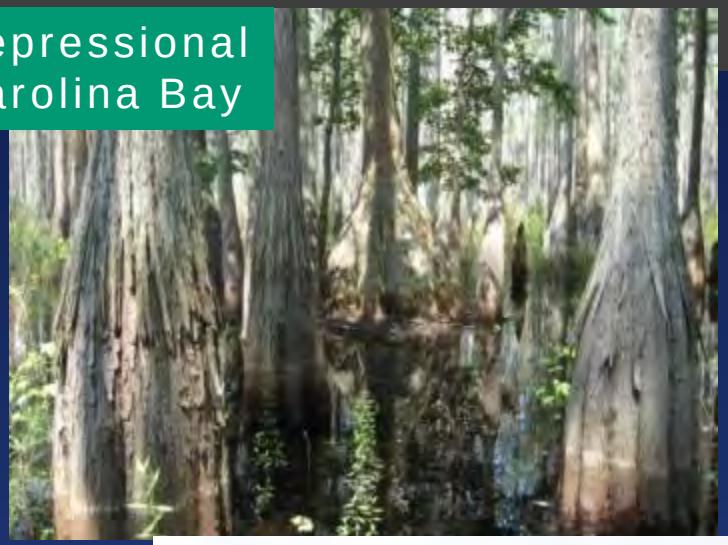
And

Lawrence Urban, Montana Department of Transportation

The 7 HGM Wetland Classes

- RIVERINE
- SLOPE
- MINERAL SOIL FLAT
- ORGANIC SOIL FLAT
- ESTUARINE FRINGE
- LACUSTRINE FRINGE
- DEPRESSION

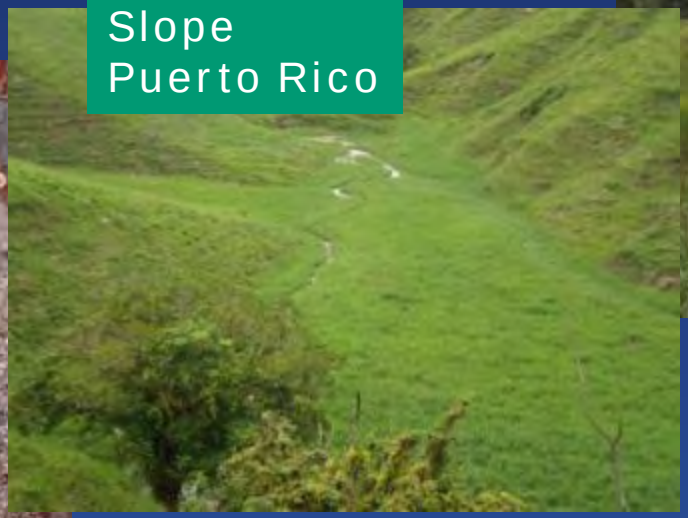
Depressional
Carolina Bay



Estuarine Fringe
Oregon

Mineral Flats
Indiana Flatwoods

Slope
Puerto Rico



RIVERINE Wetlands

Landscape Position
Floodplains
Dominant Water Source
Stream Hydrographs (Surface and Groundwater)
Hydrodynamics
Horizontal, Bi-Directional

- Geomorphic Channels
- Hydrologically Connected to a Floodplain
- Formed and Maintained by Flow and Sediment

Floodplain Oxbow -Wyoming

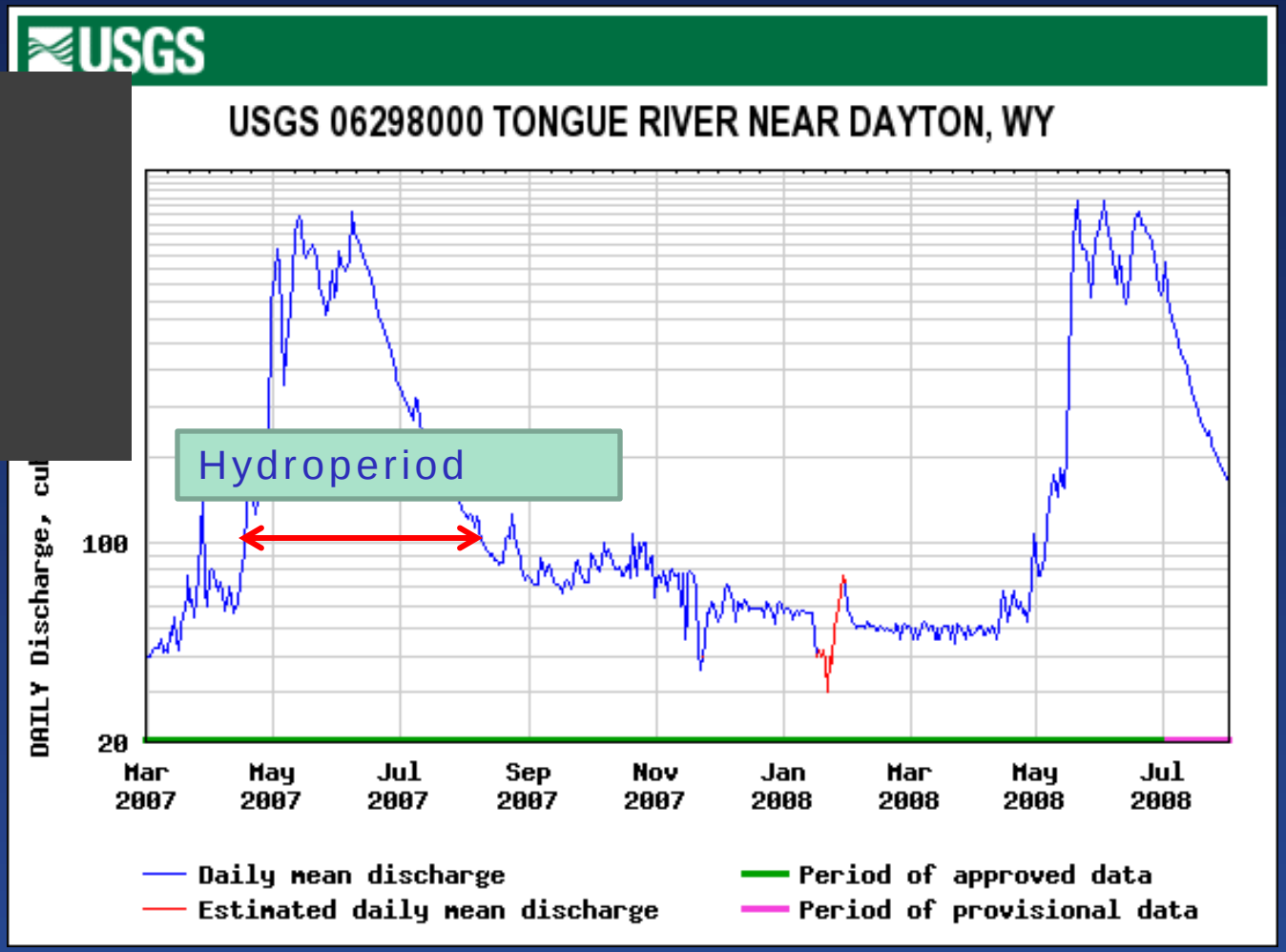
Geomorphic position of riparian wetlands – Big Hole River, MT

Old oxbows & meander scars within floodplain of Milk River near Chinook, MT

RIVERINE – Dominant Water Source – Stream Hydrograph

Hydrograph Supports -

- **Flooding**
- **Ponding**
- **Groundwater**

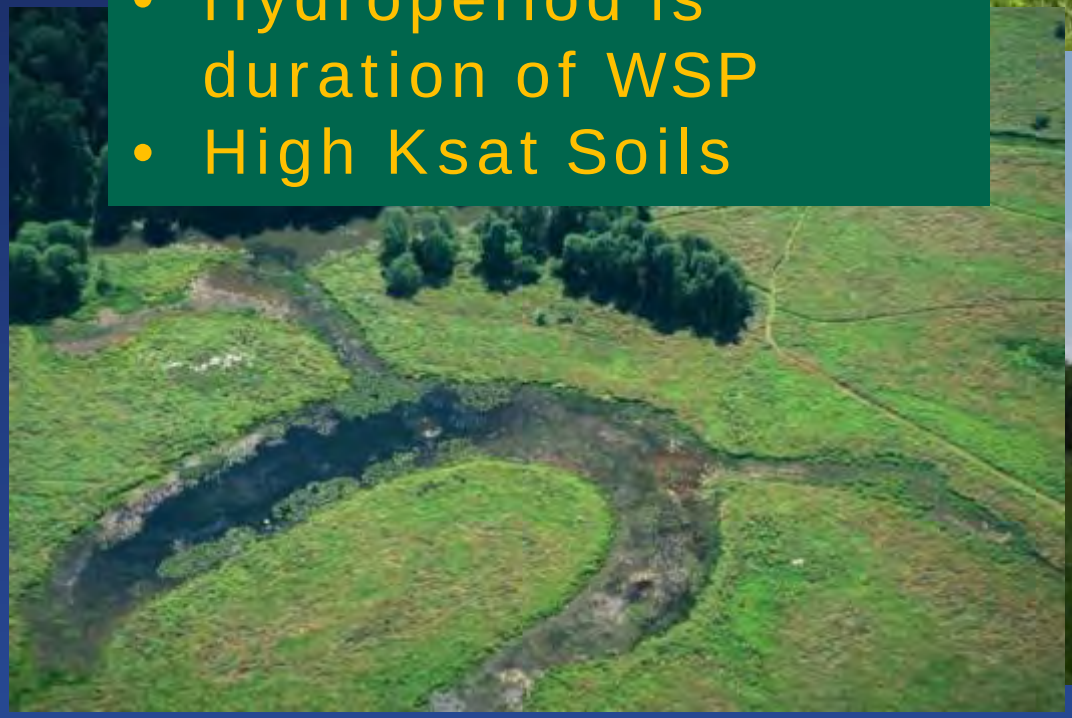


RIVERINE Wetlands

"Endosaturated"

Floodplains

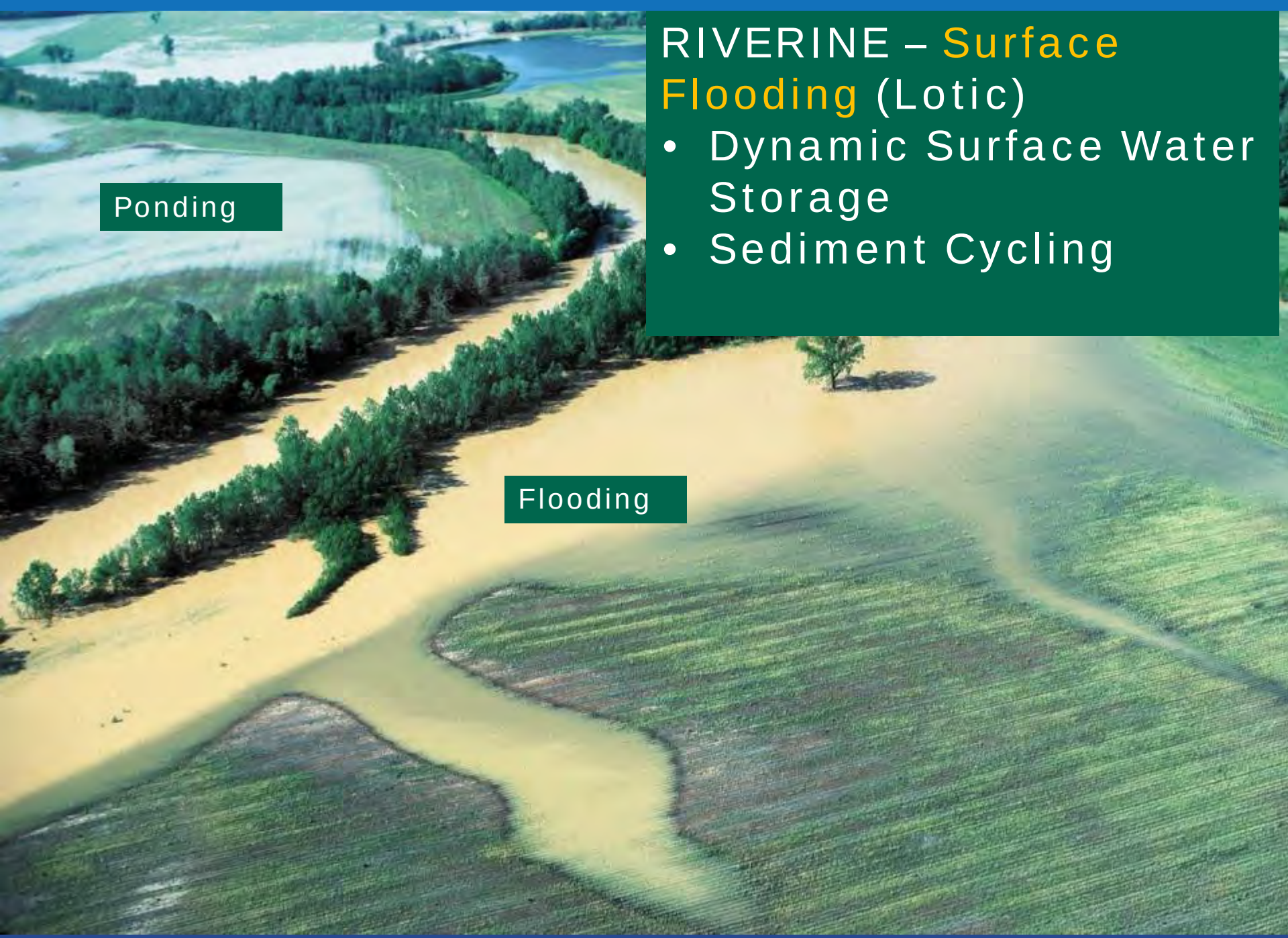
- Strong Groundwater Connection
- Hydroperiod is duration of WSP
- High Ksat Soils



RIVERINE Wetlands

"Episaturated" Floodplains

- Surface Flooding from Peak Discharges
- Weak Groundwater Connection
- Hydroperiod is Flood Duration + Ponding
- Low Ksat Soils



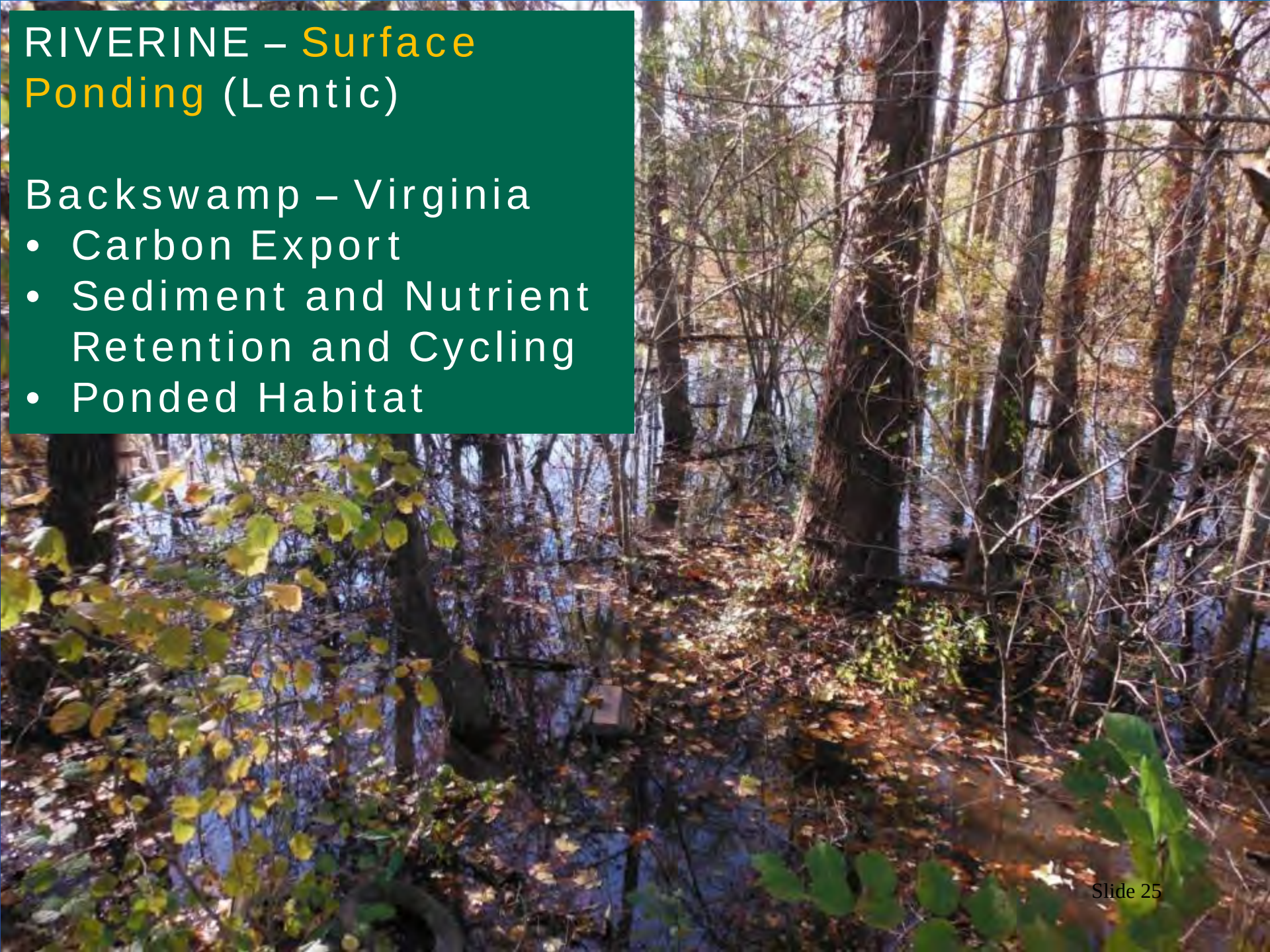
RIVERINE – Surface Flooding (Lotic)

- Dynamic Surface Water Storage
- Sediment Cycling

RIVERINE – Surface Ponding (Lentic)

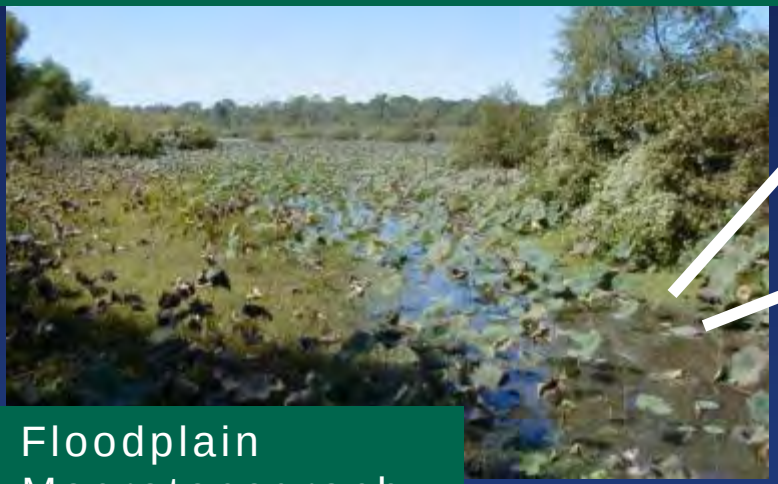
Backswamp – Virginia

- Carbon Export
- Sediment and Nutrient Retention and Cycling
- Ponded Habitat




RIVERINE – Floodplain
Groundwater
• Base flow Maintenance
• Alluvial Aquifer Storage

Floodplain Landforms

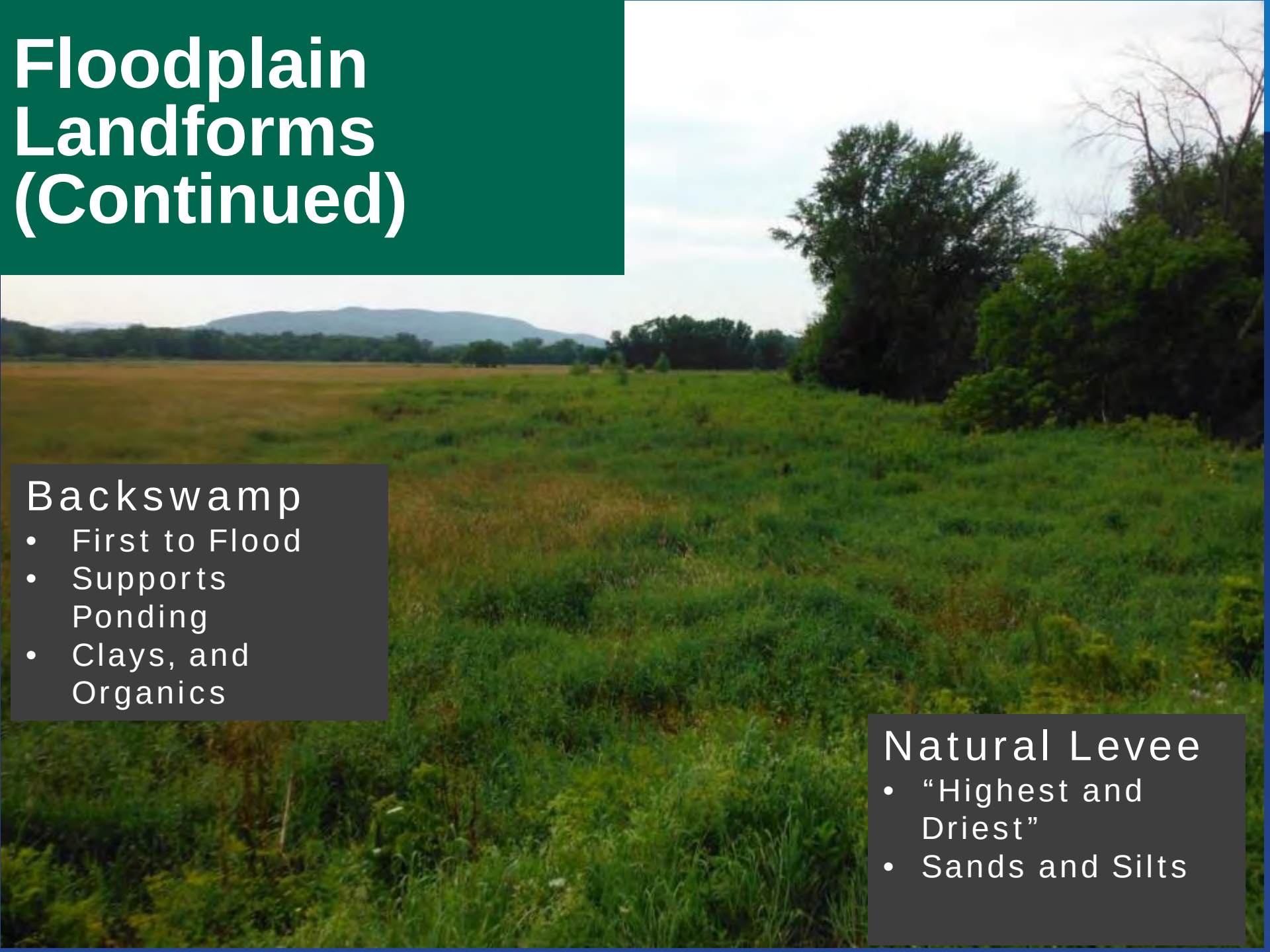


Floodplain Macrotopography – Abandoned Oxbow

The Bankfull Channel

Wetland Vegetation – Floodplain Flat

Floodplain Landforms (Continued)



Backswamp

- First to Flood
- Supports Ponding
- Clays, and Organics

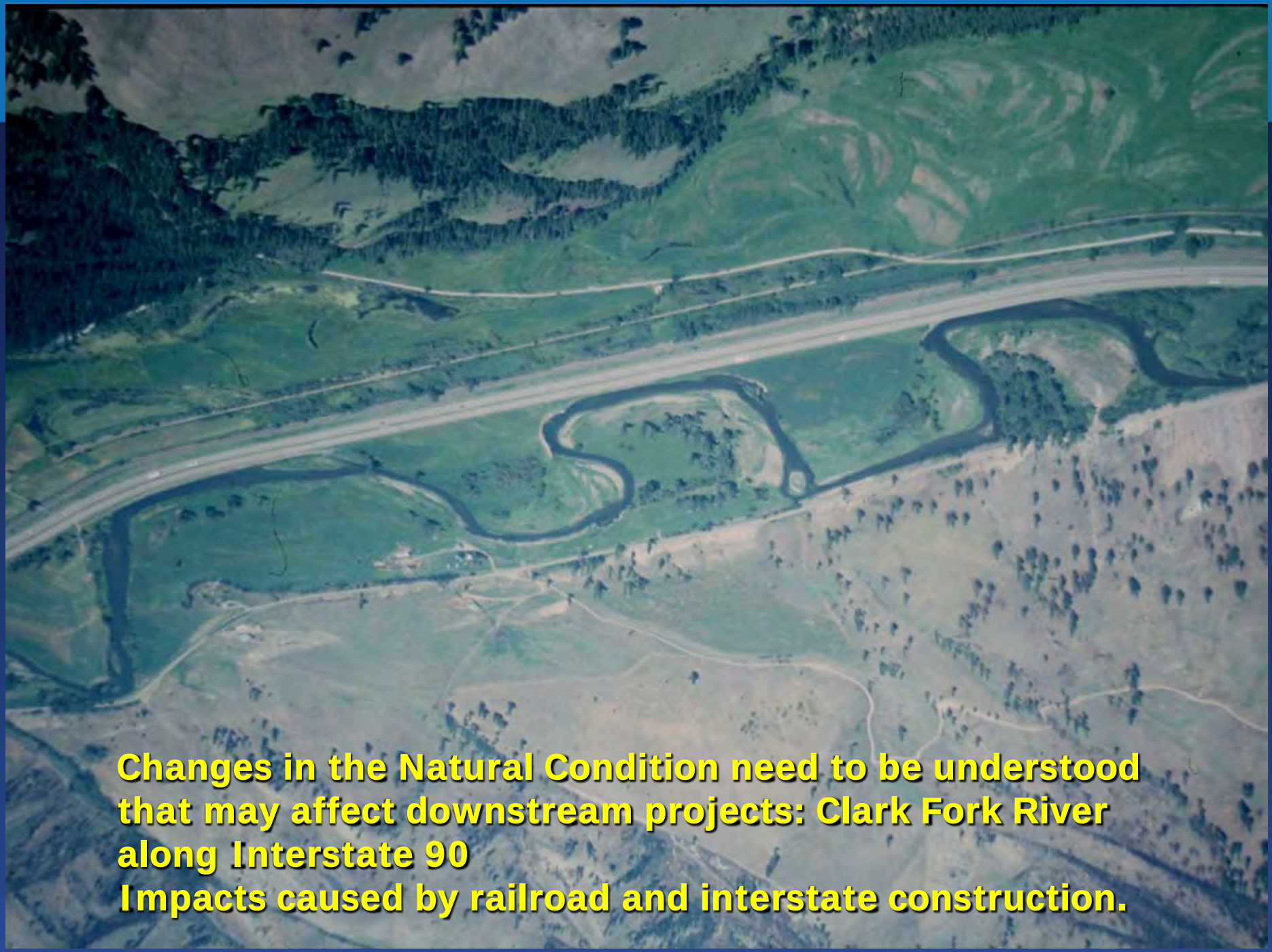
Natural Levee

- “Highest and Driest”
- Sands and Silts

Restoration Techniques

- Large Episaturated System

Levee Breach Restores Lateral Connectivity

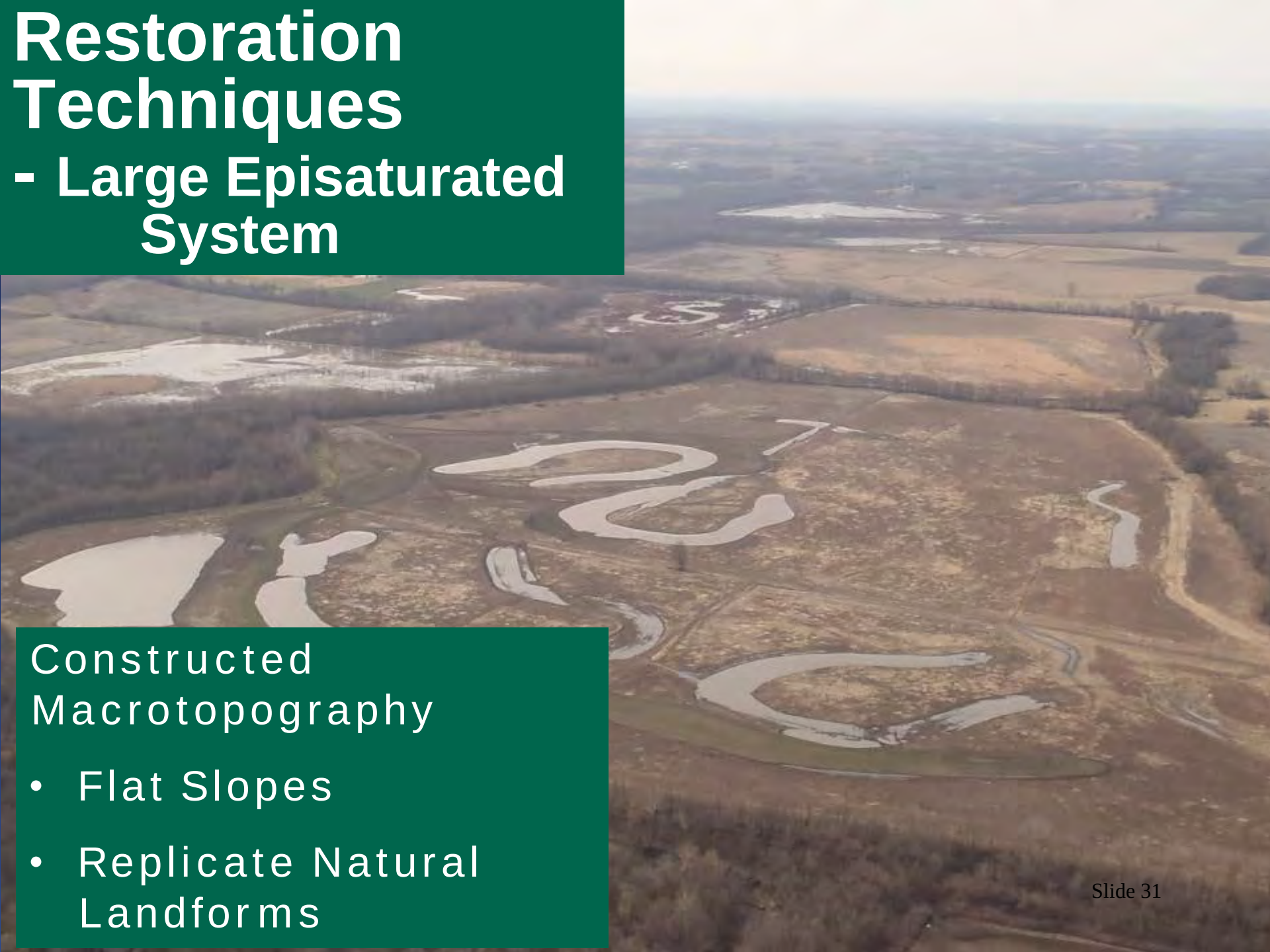


Changes in the Natural Condition need to be understood that may affect downstream projects: Clark Fork River along Interstate 90

Impacts caused by railroad and interstate construction.

Restoration Techniques

- Large Episaturated System



Constructed Macrotopography

- Flat Slopes
- Replicate Natural Landforms

Modified/Channelized Stream Restoration

- Designing new stream system to match historic system
- Restoring and reconnecting stream corridors
- Allowing for seasonal inundations of adjacent floodplains
- Understanding the geomorphic setting for placement

Restoration Techniques

- Small Endosaturated System
- Incised Channel

- Raise Channel WSP
- Floodplain GW Rises
- Structures in Series
- BE CAREFUL

Insure Grade Control Structures are designed and installed correctly for streambank soils and high flows to prevent channel down-cutting.

Properly installed grade control and log structures will:

- **Maintain higher water elevations within stream and wetlands**
- **Allows for vegetation to develop to stabilize stream banks**
- **Provides for higher quality fish habitat**
- **Provides opportunities for high flows to flood adjacent floodplain wetlands**

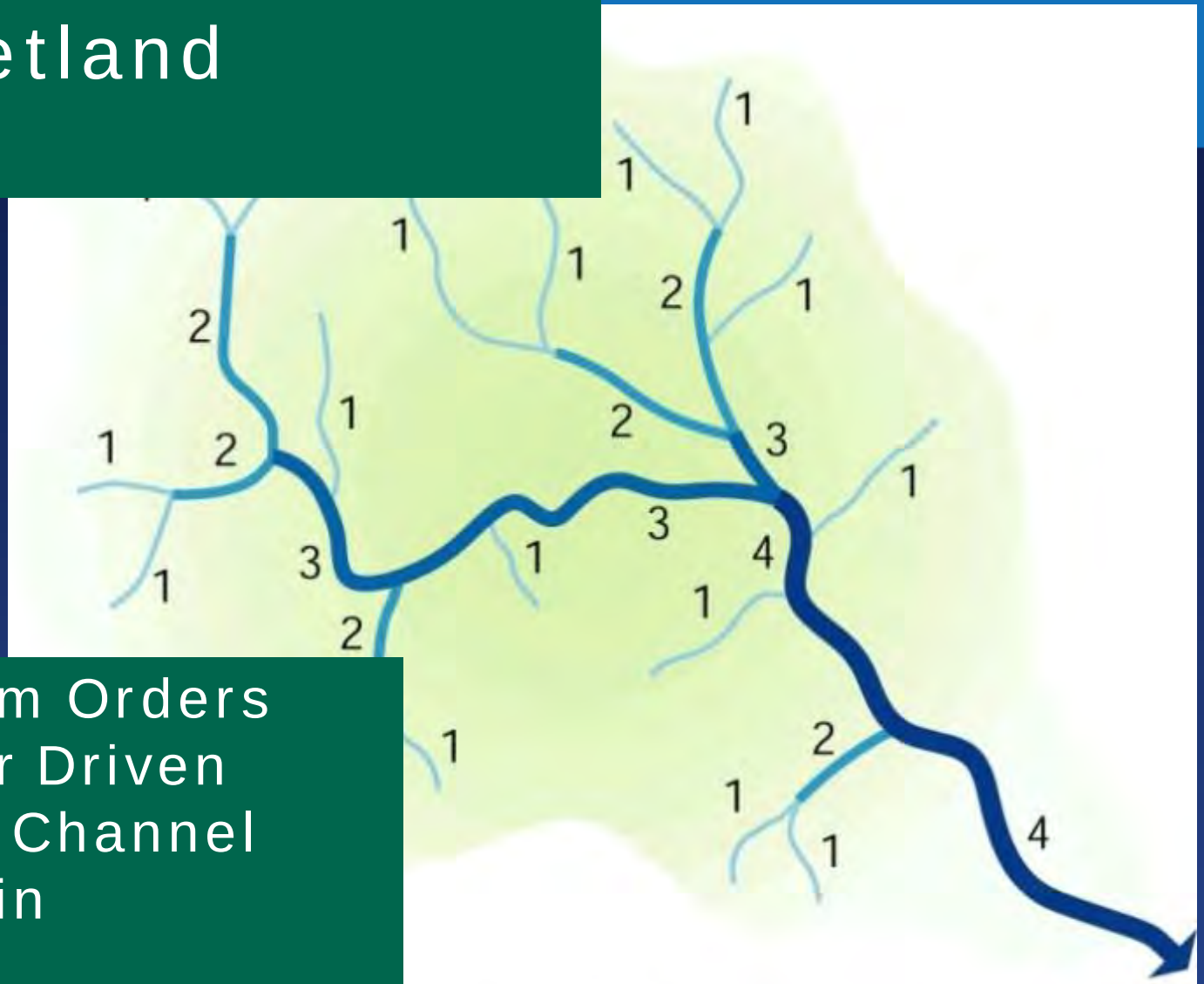
Stream Restoration Parameters

- ***Geomorphic bankfull discharge***
- ***Channel geometry***
  - ***Alluvial Channels***
  - ***Threshold Channels***
- ***Sediment Transport (in channel)***
  - ***Bedload***
  - ***Wash Load***

Riverine Wetland Restoration Parameters

- ***Flow duration and frequency***
  - ***Flow Duration - Probability***
- ***Floodplain macrotopography***
- ***Sediment Cycling (between channel and floodplain)***
  - ***Scour***
  - ***Deposition***
  - ***Vertical Accretion***

SLOPE Wetland Reaches

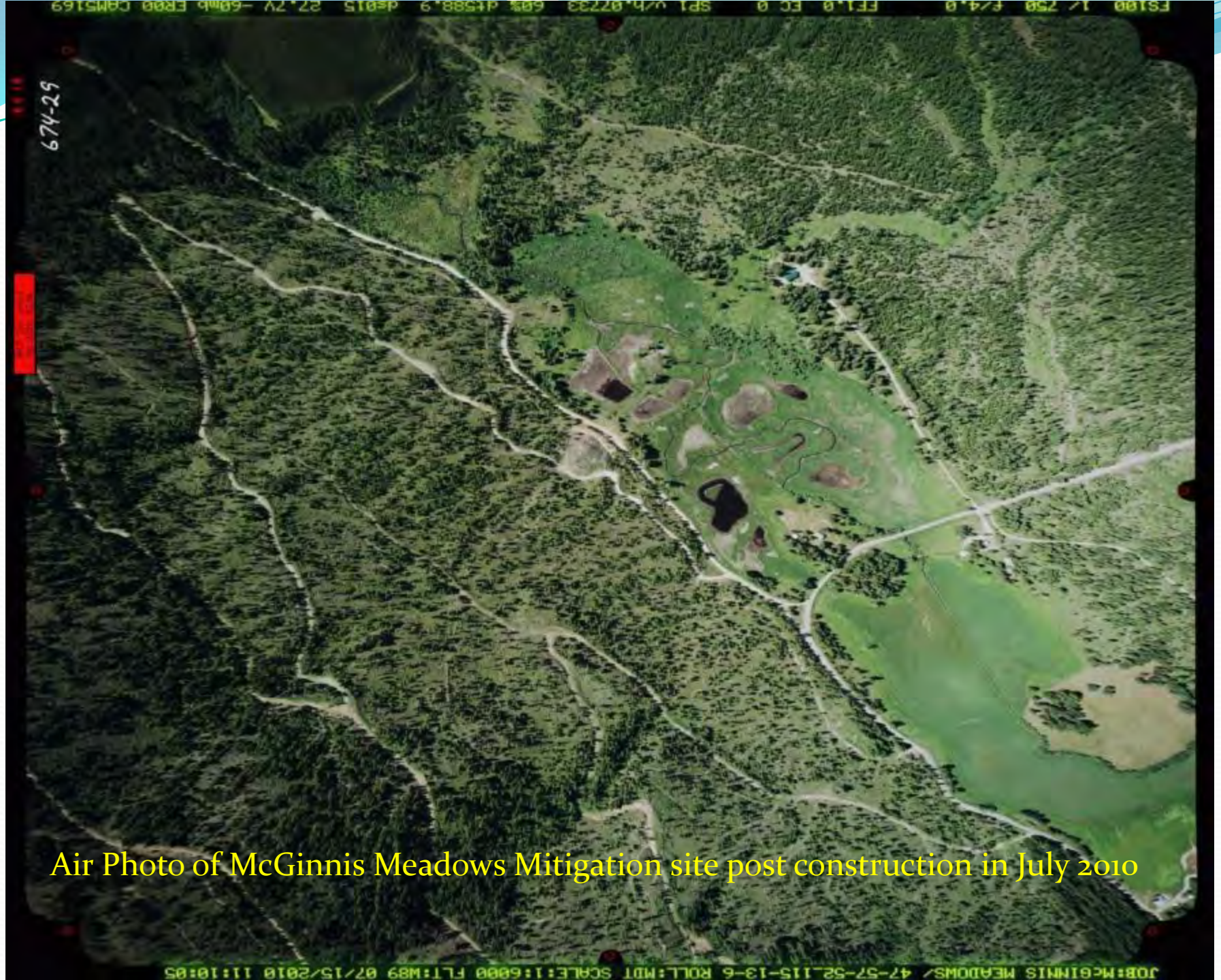


drainage network. "1" = first order stream; "2" = second order stream, etc.
Principles, Processes, and Practices (10/98).
Working Group (15 federal agencies)(FISRWG).

- Lower Stream Orders
- Groundwater Driven
- No separate Channel and Floodplain
- CHANNEL RESTORATION TECHNIQUES DO NOT APPLY!

Slope Wetland Reaches

- “Channels” are Signs of Degradation
- Lower GW Level
- Loss of D.S. Base flow
- “Stream” Restoration Does not Apply



Air Photo of McGinnis Meadows Mitigation site post construction in July 2010

Site Selection - Initial Evaluation

- Locate Potential Site – Office Component
- Research of existing data from databases:
  - USGS Topographic maps
  - Aerial photographs – current or historic
  - NRCS Web Soil surveys
  - DNRC Water rights
  - National Wetland Inventory Maps (if available)
  - Montana Natural Heritage Tracker system of State Listed Species of Concern
  - US Fish & Wildlife Service Threatened and Endangered Species Lists and Critical Habitat Designations

Historic 1947 USFS Aerial Photo of Schrieber Meadow and Lake Area

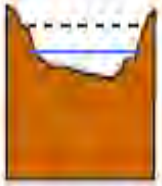
Site Evaluation Considerations

- Existing and adjacent land uses
- Landscape – identify man-made topographic alterations
- Existing vegetation communities
- Wetland delineations & Functional Assessments
- Soils & Geotechnical studies
- Historic aerial photos
- Cultural investigations
- Hydrologic studies including watershed basin
- Stream classification
- Water rights research

Classification of Stream Types (Rosgen one method)

Entrenchment ratio (ER) estimation – see User's Manual for additional guidance. Entrenchment ratio = (flood-prone width)/(bankfull width)
Flood-prone width = estimated horizontal projection of where 2 x maximum bankfull depth elevation intersects the floodplain on each side of the stream.

	/		=
Flood-prone width		*Bankfull width*	*Entrenchment ratio (ER)*

Slightly Entrenched ER = >2.2			Moderately Entrenched ER = 1.41 – 2.2	Entrenched ER = 1.0 – 1.4		
C stream type	D stream type	E stream type	B stream type	A stream type	F stream type	G stream type
						

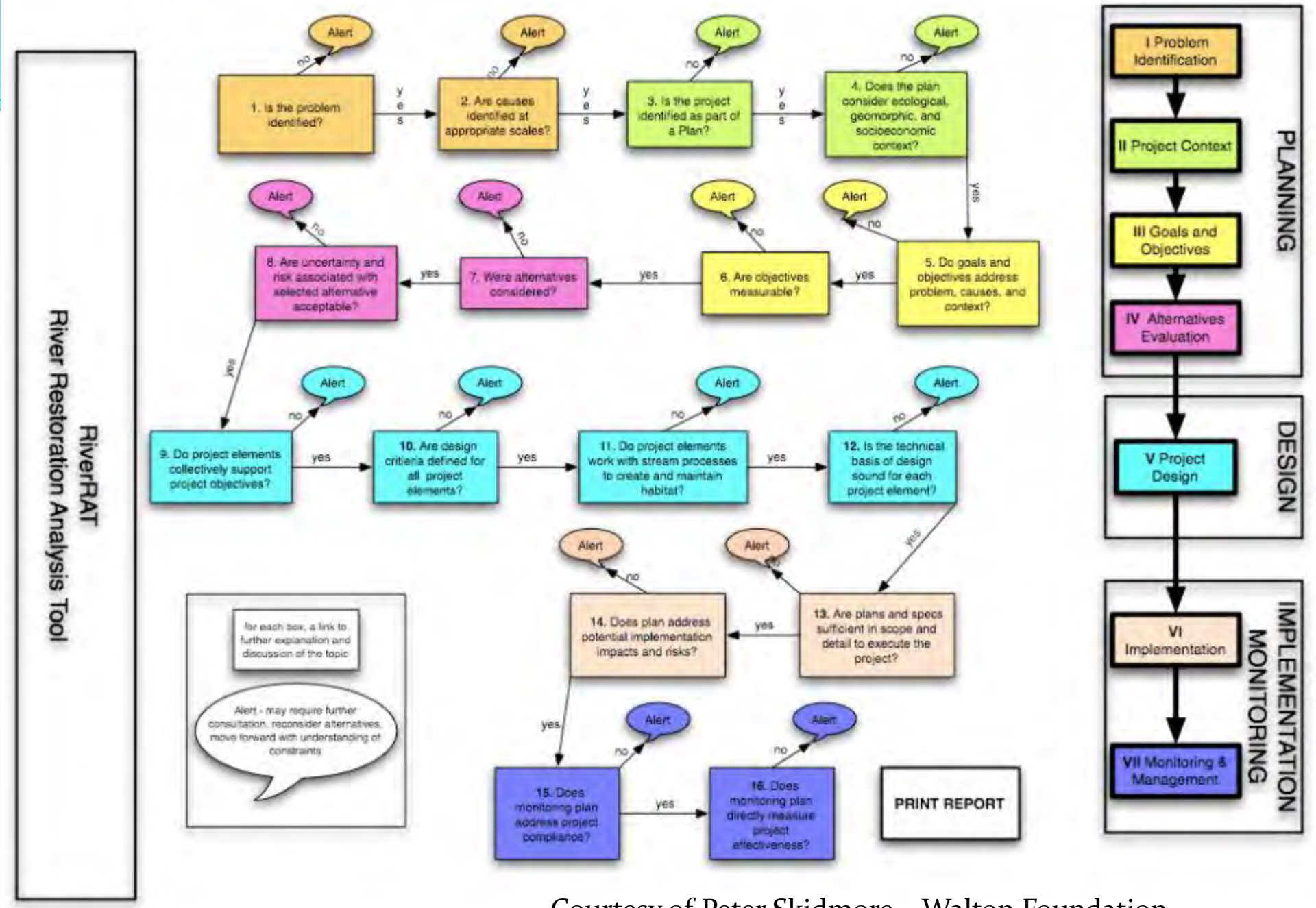
ii. Are ≥10 acres of wetland in the AA subject to flooding **AND** are man-made features which may be significantly damaged by floods located within 0.5 mile downstream of the AA (circle)? **Y N Comments:**

Determine Project Goals & Objectives:

- **Provide wetland mitigation acre credits to compensate for wetland impacts in advance of project impacts.**
- **Provide stream mitigation credits to compensate for stream impacts.**
- **Develop mitigation sites that provide a variety of habitat types – stream & wetland.**
- **Meet Federal, State and Tribal permit conditions and requirements.**
- **Provide a "No Net Loss" of wetlands – acre for acre.**

Mitigation Goals & Objectives:

- **Establishment, Restoration and enhancement of wetland ecosystems.**
- **Rehabilitation and Re-establishment of degraded stream channels and their associated riparian wetland floodplain habitat.**
- **Improve habitat for State-Listed species of concern and ESA listed fish, plant and wildlife species.**
- **Determine what types and kinds of wetland functions and values would be best suited for the proposed mitigation/restoration area such as flood control, improved water quality and enhanced fisheries & wildlife habitat.**
- **Utilize a planning analysis model such as RiverRAT or other Ecosystem models to determine goals and objectives.**



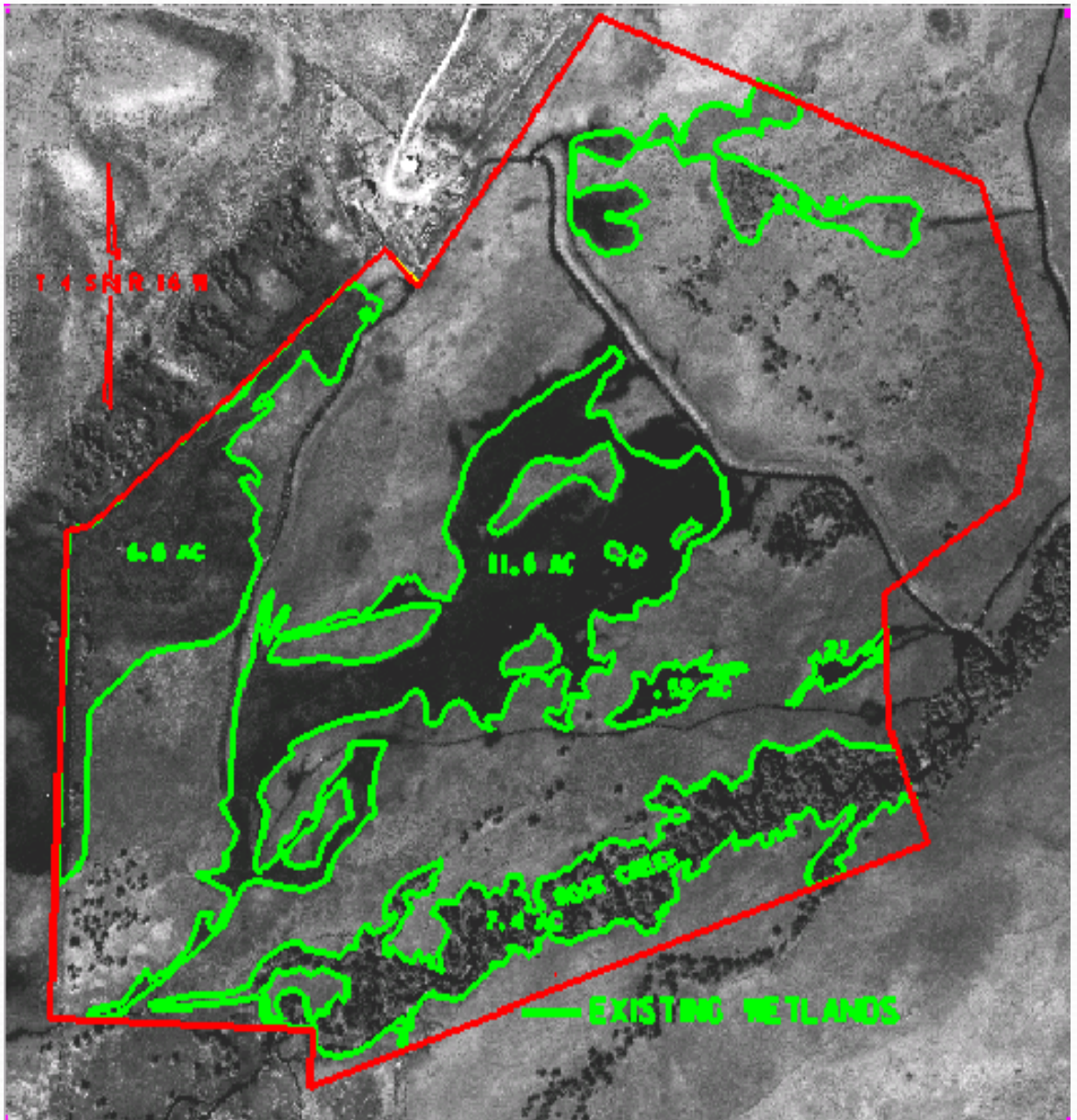
Courtesy of Peter Skidmore – Walton Foundation

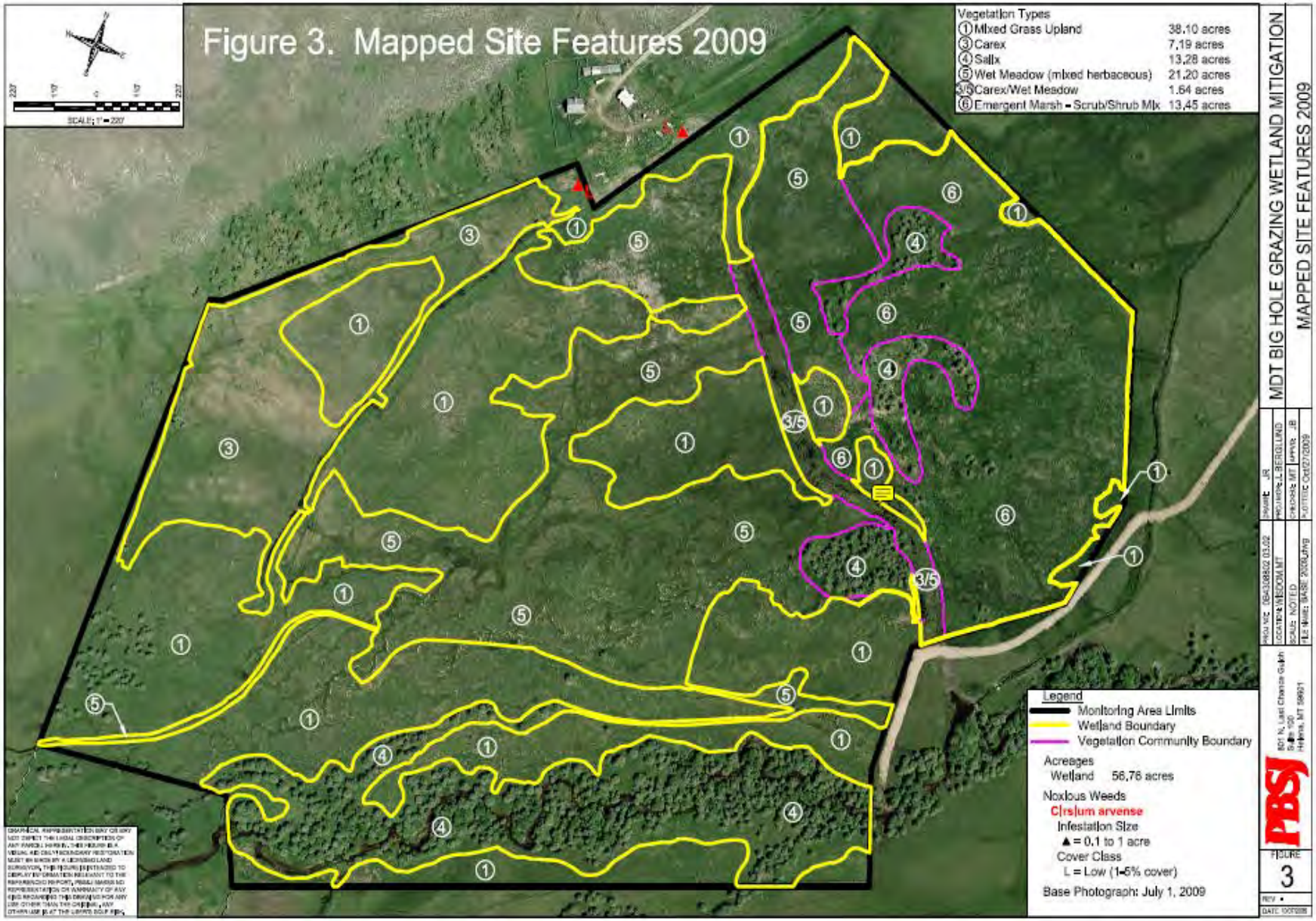
Project Development - Feasibility Studies

- Feasibility studies conducted on suitable potential sites.
- Feasibility studies evaluate and provide technical information:
  - Available ground and surface hydrology sources
    - Drainage ditches, tile drains, channelized streams, etc.
  - Topographic surveys
  - Water Rights – important in the Western US
  - Geology & Soils
  - Cultural Resources
  - Biological Resources (T&E)/ Wetland Delineations
  - Hazmat
  - Permits & regulatory requirements
  - Public Involvement
- Technical Studies utilized for NEPA/MEPA documents.

Map Existing or Degraded Wetlands

- Big Hole Grazing Association Wetland Delineation June, 2001 by MDT personnel.
- Approximately 29 acres of degraded wetlands identified.

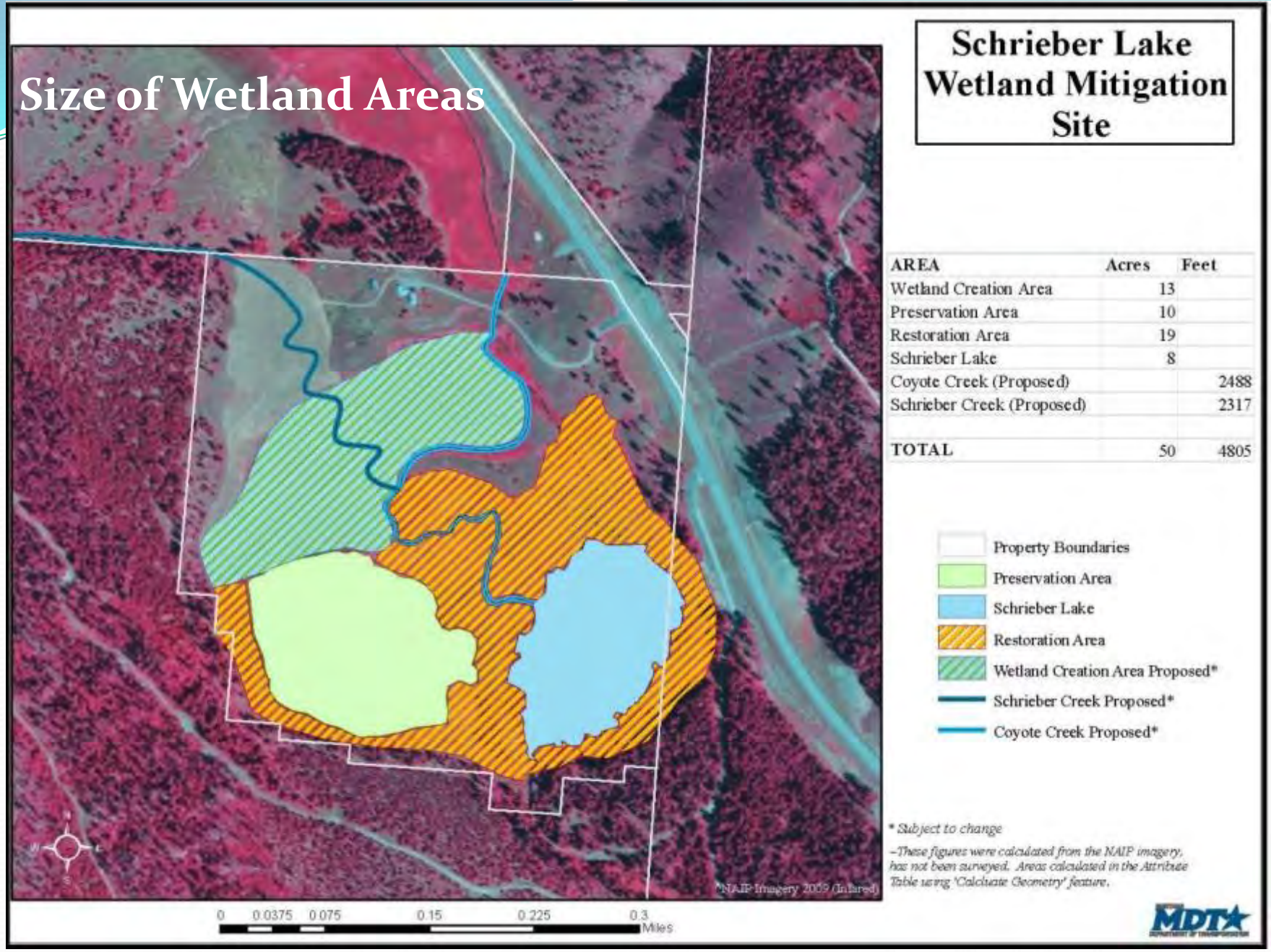




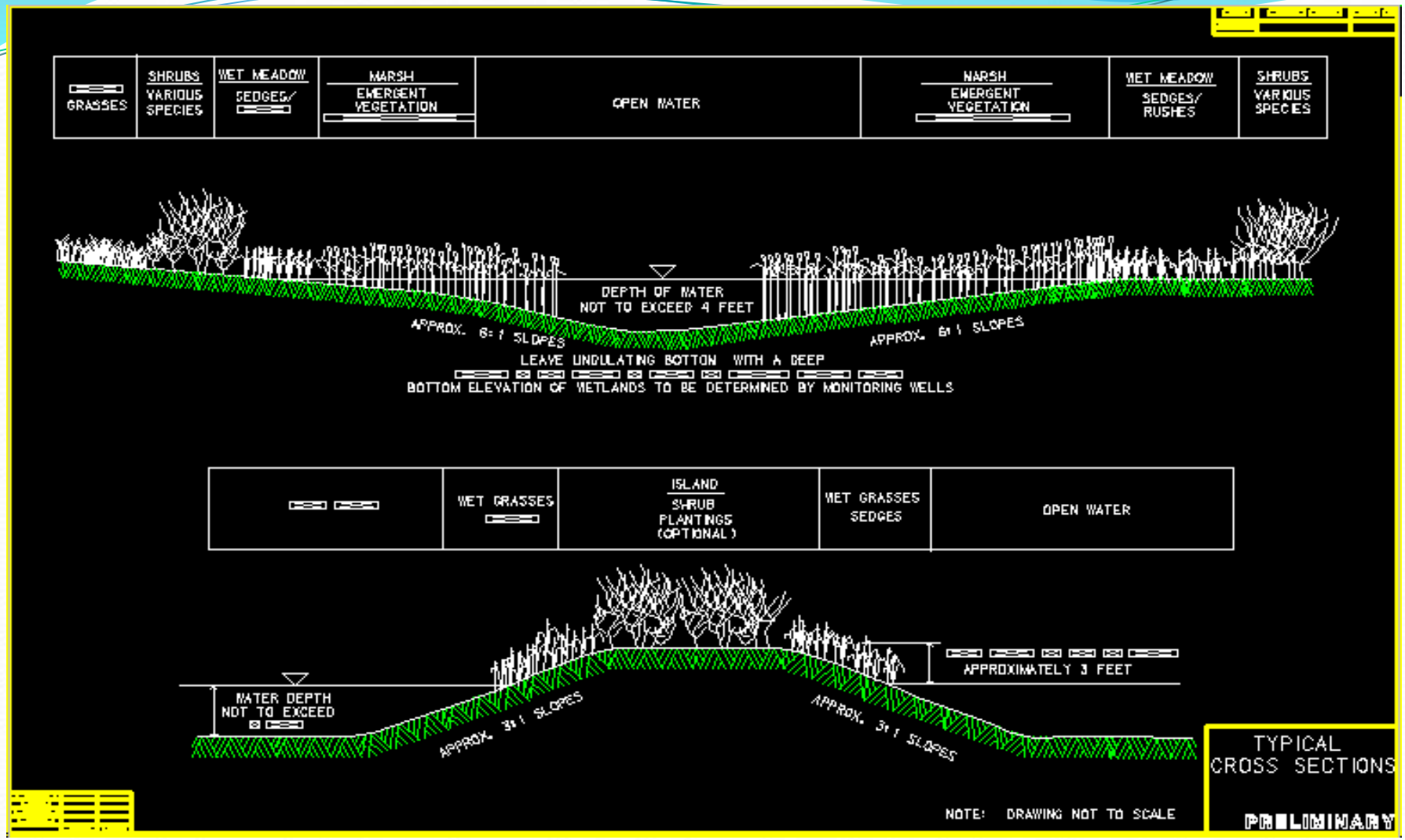
Big Hole Grazing Association - wetland delineation 57 acres in 2009

Conceptual Design Development

- Development of aquatic resource mitigation plan to meet mitigation goals and objectives within chosen site:
  - Restoration, creation, enhancement and preservation of wetlands to provide credit acres.
  - Increased stream length and sinuosity, pool/riffle, fish habitat, stream hydraulic modeling, etc.
  - Determine which stream/wetland functions are practical for development. (floodplains, water storage, wildlife habitat, etc.)
  - Utilize reference wetlands and streams in area (if available) as a basis for developing conceptual designs and for determining types of plants to re-establish within site.
- Work within the geomorphic setting of the site.
- Crediting scheme for wetland and stream mitigation credits for permitting agencies.



Initial Conceptual design and wetland/stream crediting for Schrieber Lake Site.

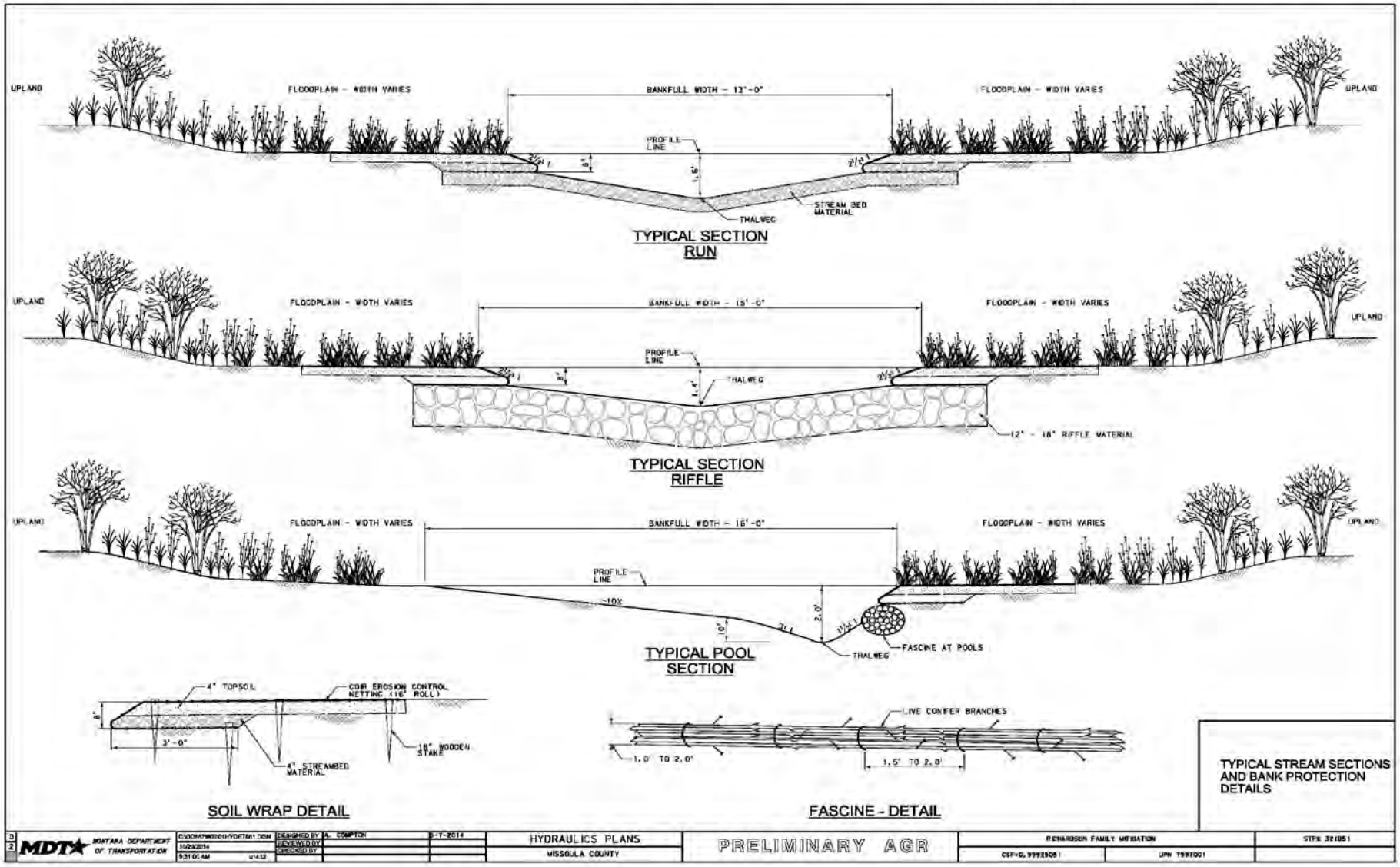


Development of typical wetland design cross-sections for agency review and comment.

Creating shallow (1-3 feet deep) wetland cells to mimic oxbow wetlands. Insure a small pocket of deeper water in cell (tied to groundwater) for aquatic life refugia during dry periods.

Wetland Cells

- Designed primarily for high groundwater elevations
- Allows for flood inundation during spring runoff from adjacent streams.
- Designed and setback to prevent capture by new stream channel



Development of typical design cross-sections for pool, riffle and run segments of the stream channel for agency review and comment.

Riffle Drop segment of stream with erosion occurring along one edge of channel. Coir blanket will need to be re-staked.

Insure the establishment of floodplain benches along new stream channels that allow for high flow events to inundate these areas. Insure roughness in floodplain as this promotes sediment deposition and seed dispersal for riparian plants to establish.

Natural vegetation establishment and sediment deposition on coir fabric streambank wrap within floodplain. Note passive wood in channel.

Design Plan Development

- Topographic surveys critically important for design
- Hydraulic design analysis:
  - Stream flow modeling for high gradient or low gradient channel designs including bedload analysis using software such as HEC-RAS, HEC-HMS, FISHPASS, HY-8, etc.
  - Groundwater elevations for depressional wetlands – installation of wells to monitor for several years if possible.
  - Water budget for wetlands to evaluate sources of water for wetlands (precip., surface flows, flood flows, irrigation, groundwater levels, evapo/transpiration,etc.)
- Design parameters for, wetland cells, islands, channel configuration, grade control and water diversion structures, channel plugs, root wads, bank treatments, borrow/fill/material quantities, construction costs, etc.
- Stream / Wetland Cross-sections
- Seeding/planting plans.

Channel designs must understand sediment load movement in streams containing decomposing granitic, sandy, organic and/or silty soils.

Conduct geotechnical borings along proposed stream channel locations to understand substrate of new channel location. Organic soil layers not identified early in the process leads to channel down-cutting and incising. Agency review - July 2014

Same organic soil channel bottom stabilizing with vegetation, but incised stream creating undercut banks. May 2015

Organic soils eroded away creating plunge pools due to more resilient clays and rock strata in portions of the streambed. Fish habitat structure by accident.

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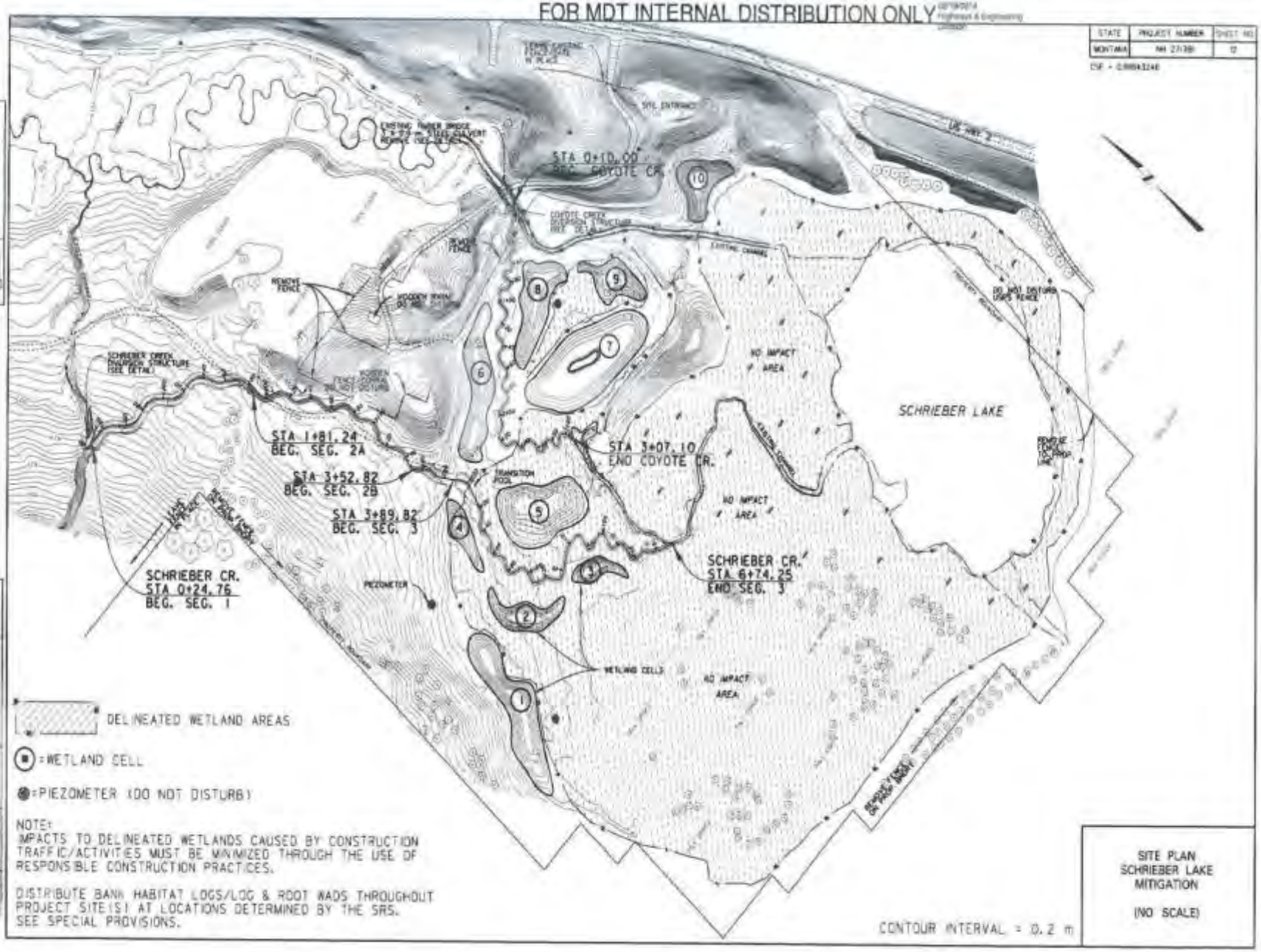

NOTE:
IMPACTS TO DELINEATED WETLANDS CAUSED BY CONSTRUCTION TRAFFIC/ACTIVITIES MUST BE MINIMIZED THROUGH THE USE OF RESPONSIBLE CONSTRUCTION PRACTICES.

DISTRIBUTE BANK HABITAT LOGS/LOG & ROOT WADS THROUGHOUT PROJECT SITE(S) AT LOCATIONS DETERMINED BY THE SRS. SEE SPECIAL PROVISIONS.

CONTOUR INTERVAL = 0.2 m

SITE PLAN
SCHRIEBER LAKE
MITIGATION

(NO SCALE)

High elevation view of Schrieber Lake aquatic resource mitigation project showing new stream channels and depressional wetlands created in a former hay field.

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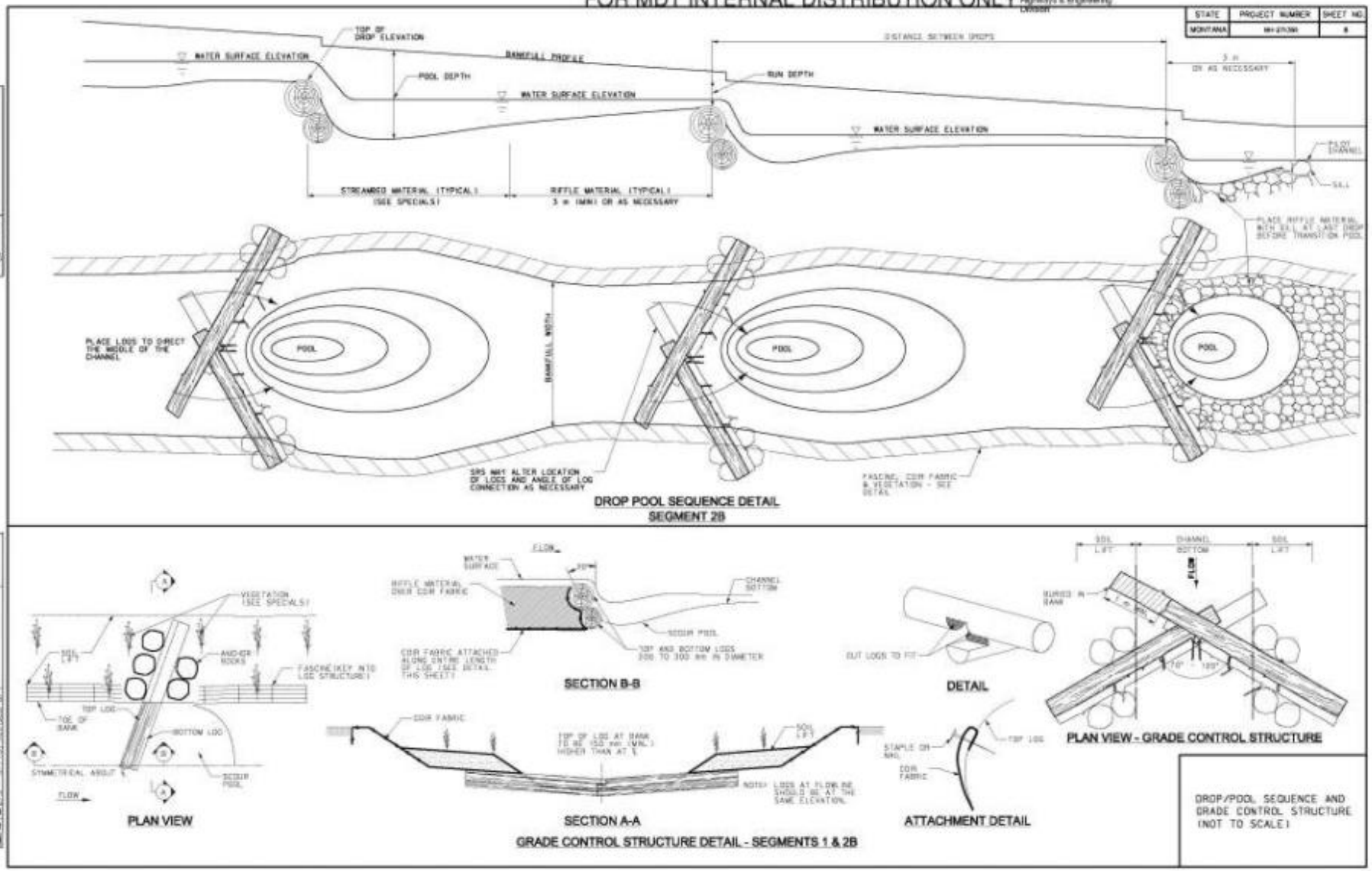
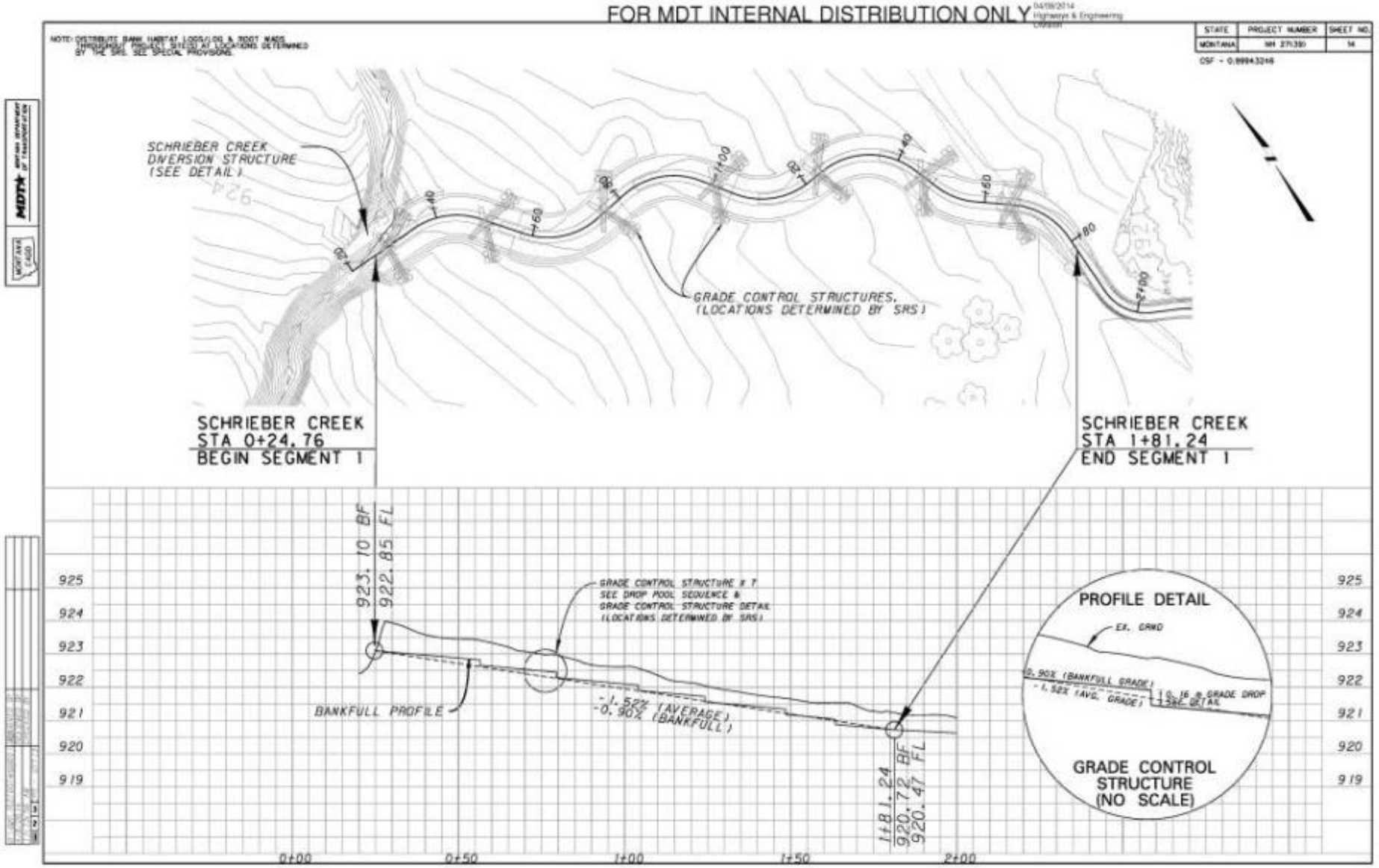


Log Drop Structures being constructed at Schrieber Creek. Note geotextile fabric tacked to upstream end of logs.

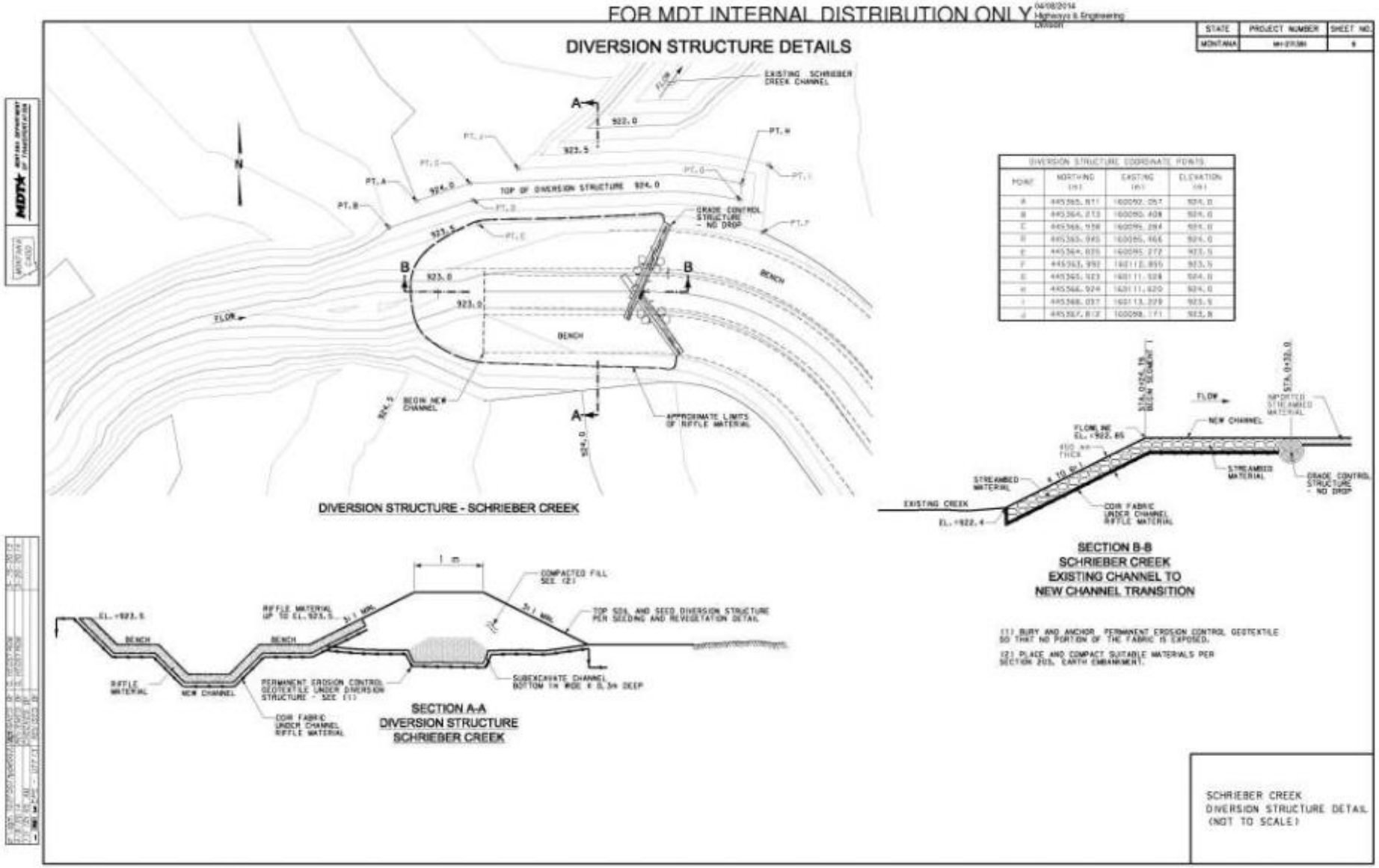
Log Drop Structures installed to mimic beaver dams that failed as they were undercut by stream flows. No geotextiles were installed although recommended and overruled by permitting agency.



Log Drop Pool Design for Schrieber Creek channel.

Completed log drop pool structures with coir fabric wrap and fascines on Schrieber Creek channel. Note flat floodplain areas and passive wood.

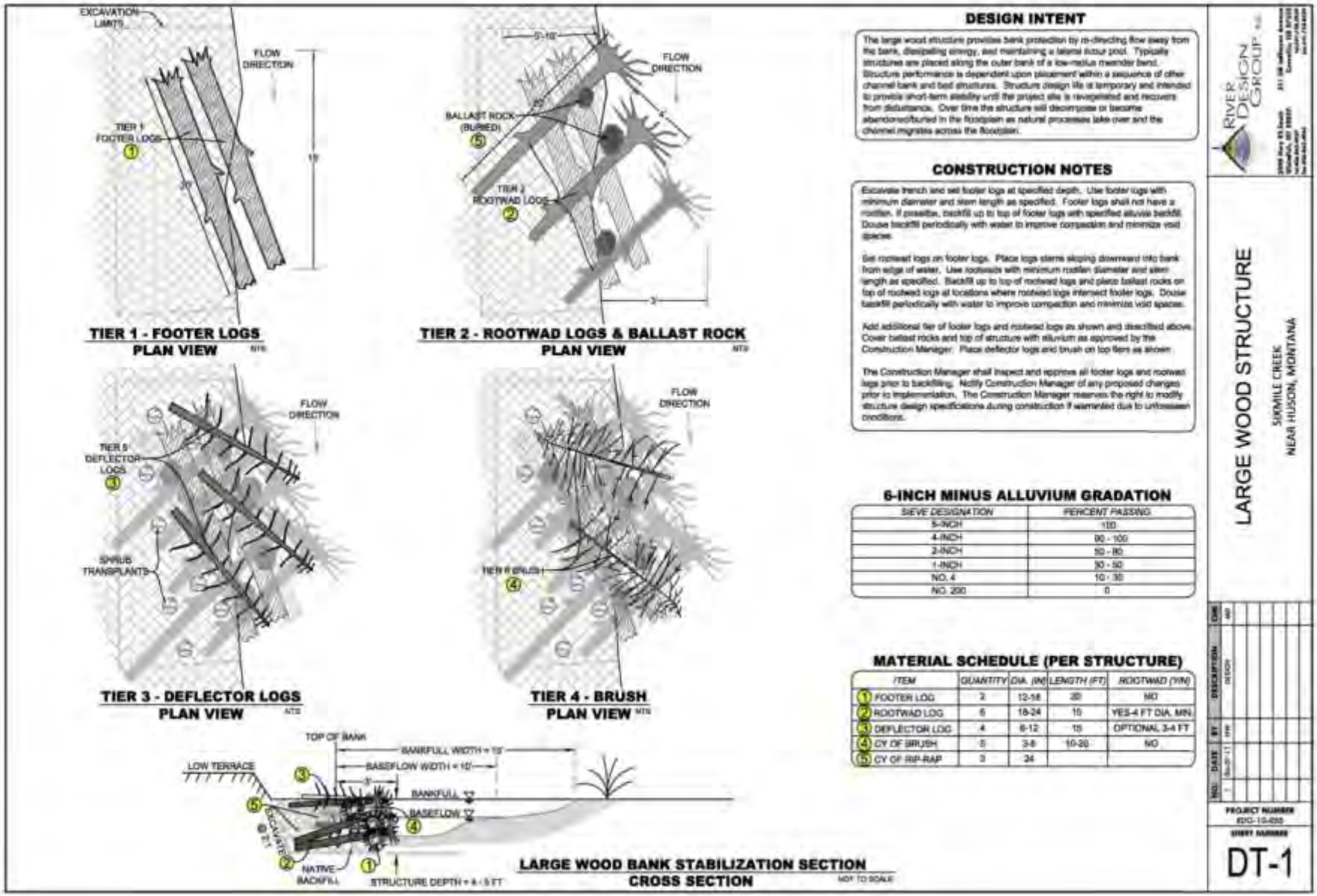
Completed log drop pool structures functioning during spring runoff March 2015.



Channel plug/diversion detail

Coyote Creek channel plug diverting stream into new channel. May 2015

Root wad ditch block installation at Schrieber Meadows – September 2011



Courtesy of Matt Daniels of River Design Group, Inc.

Stream Habitat Structures

Series of root wad bank structures to serve as flow deflectors and habitat structures in an ephemeral stream channel.

Streambank Treatments

Coir log installation over a rock toe with willow cuttings installed above and below the coir log.

Two coir log bank installation with a rock toe and willow cutting mat between coir logs sprigged with willow cuttings.

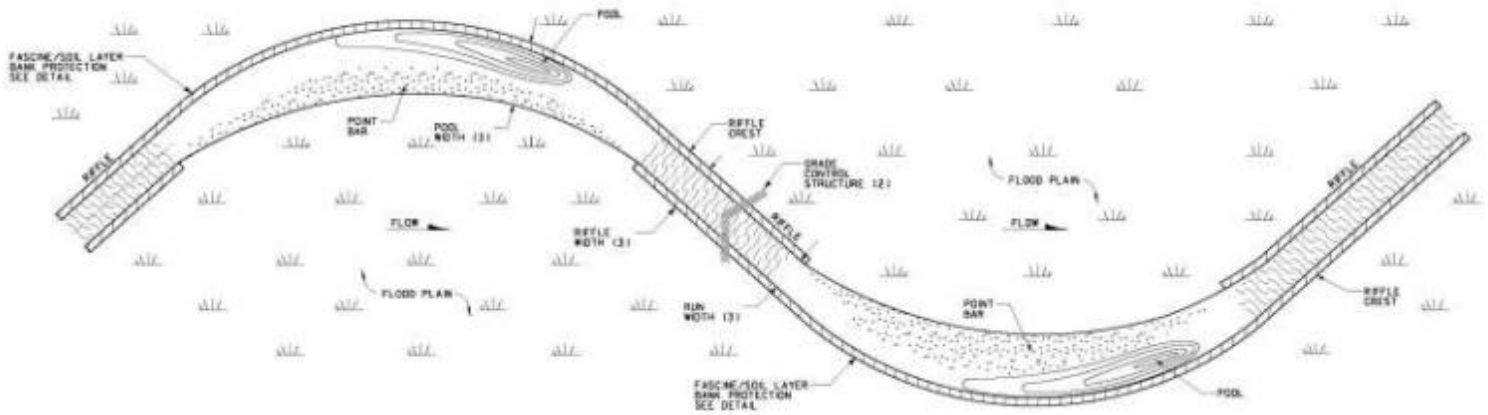
Insure that coir fabric wraps do not unravel or tear to prevent bank instability. Protect wraps with fascine installation below.

Coir fabric bank treatment underlain by evergreen/willow branch fascines. Note passive wood root wad in stream channel to create habitat and sediment deposition. Woody plantings have been made in point bar location at edge of channel.

Coir wraps will eventually sag and slough into channel as channel develops, which may add to bank stability and plant rooting success.

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	[illegible]	8

CHANNEL DETAILS



SCHEMATIC - CHANNEL BANK PROTECTION PLAN
SEGMENTS 1 AND 2A

NOTES

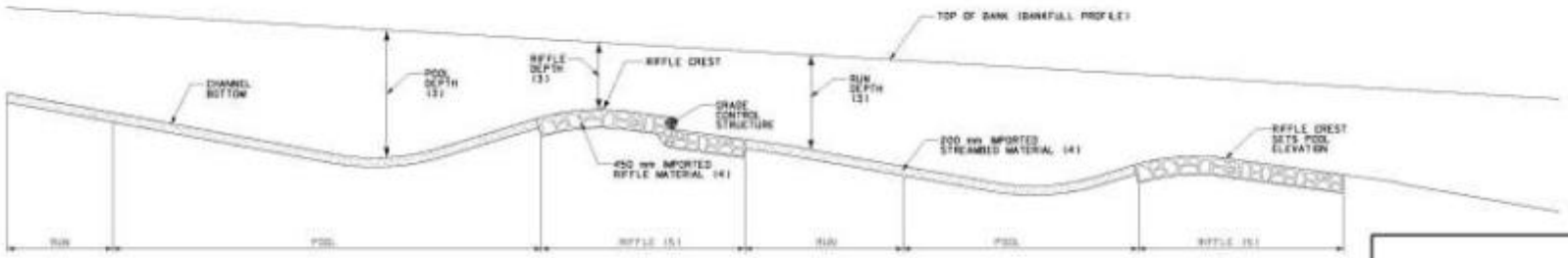
(1) THIS DETAIL SHOWS TYPICAL BANK PROTECTION INSTALLATION. SEE PLANS, SPECIALS, AND SUMMARIES FOR MORE INFORMATION.

(2) GRADE CONTROL STRUCTURES IN SEGMENT 1 WILL BE LOCATED PER PLANS OR AS DIRECTED BY THE SRS.

(3) SEE TYPICAL CHANNEL SECTION DIMENSIONS DETAIL FOR CHANNEL DEPTHS & WIDTHS.

(4) SEE SPECIAL PROVISIONS FOR MATERIAL AND CONSTRUCTION REQUIREMENTS FOR IMPORTED STREAMBED AND RIFFLE MATERIALS.

(5) RIFFLE LENGTH VARIES BUT IS APPROXIMATELY 2 TIMES THE BANKFULL WIDTH. THE EXACT LENGTH TO BE DETERMINED BY THE SRS.

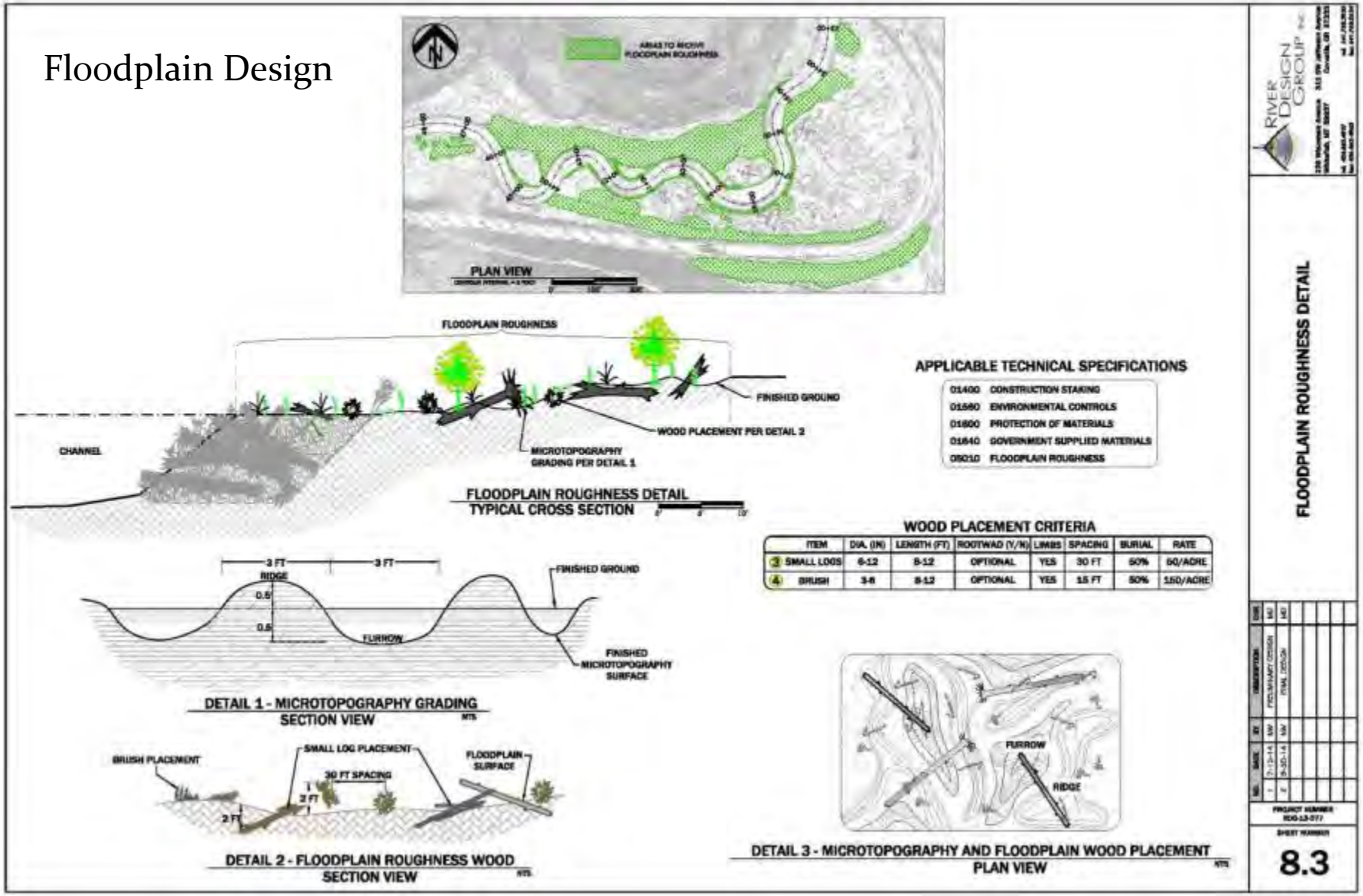


SCHEMATIC - CHANNEL PROFILE - SEGMENTS 1 AND 2A
NOT TO SCALE

BANK PROTECTION PLAN
(NOT TO SCALE)

Coir fabric bank treatment after vegetation has re-established.

Floodplain Design



Courtesy of Matt Daniels of River Design Group, Inc.

PASSIVE WOOD INSTALLATION:

For streams established in forested areas, habitat features such as the installation of passive wood in stream restoration is important for the overall health of the stream.

These are not stream structures, but rather simple installation of downed trees into the stream as would be found in a natural system.

Follow regulations for such wood installation as in some areas of the country, FEMA frowns upon the installation of passive wood that is un-anchored in the floodplain or extends into the stream. As it has the potential to wash out in large storm events and piles up against bridges and other infrastructure creating hazardous conditions.

Placement of passive wood in a newly constructed stream channel and floodplain.

Placement of new channel to naturally fit into the landscape.

New stream channels should be placed to minimize disturbance of existing vegetation communities and allow for natural plant colonization. Note passive wood into stream.

Construction Monitoring

- MDT Aquatic Resource Unit in conjunction with a Stream/Wetland Restoration Consultant conduct Project Oversight on all aquatic resource mitigation project sites under construction.
- Stream/Wetland Restoration Consultant assists Contractor, and MDT Construction personnel concerning design plans and construction issues onsite.
- Post Construction Reviews with Regulatory Agencies.

Before: East Bozeman Wetland Fall 2009

After: East Bozeman Wetland – April 2010

Monitoring: East Bozeman Wetland – August 2010

Post Construction Review with Regulators at East Bozeman site – Sept 2009

Post Construction Monitoring

- **Period of monitoring of each mitigation site minimum of 5 years. Could be longer if drought conditions persist, or shorter if site develops quickly.**
- **Monitoring requirements and durations are outlined in Corps 404 permits.**
- **Performance goals and objectives must be measurable and quantifiable in order to be considered complete and approved by agencies.**
- **Costs of monitoring are variable dependent upon mitigation requirements and size of sites.**
  - **Streams – Require transects at pools/riffles dependent upon channel length (every 100-500 feet), bank pins, longitudinal channel surveys, photo points, vegetation belt transects within the floodplain stream buffer, etc.**

Post Construction Monitoring Continued

- Wetland Monitoring includes: establishment of vegetation transects; assessment of woody planting survival; soil borings; photo points; wetland delineations and functional assessments; wildlife observations (birds, mammals, herpetiles), etc.
- Mitigation monitoring reports must be prepared annually for submission to the various permitting and natural resource agencies until the site is approved.
  - MDT Monitoring Reports can be viewed at this website: http://www.mdt.mt.gov/other/environmental/external/wetlands/
- Adaptive management and maintenance is required for all mitigation sites into perpetuity.

Channel cross-section transect

Wetland vegetation monitoring belt transects marked by T-posts and tapes across riverine wetland areas.


Established photo-points for monitoring: New Channel
Camp Creek – Winter 2001

Same Camp Creek channel showing migration after 2011 flood events. Channel migration in some instances is beneficial to riparian system.

Camp Creek Channel Spring 2006

Camp Creek channel Fall of 2011


Learning from our mistakes - Camp Creek, fall 2001.
Road contractor building a stream channel.

Qualified and experienced stream contractors and aquatic restoration professionals now hired for the construction and oversight of all stream/wetland projects.

Recommendations

Cause of Failure	Recommendation	Selected Measures
Problems encountered during construction due to lack of information.	Feasibility studies must address all technical aspects of a proposed project in enough detail to prevent problems from occurring during construction.	-Accurate topographic survey -Geotechnical information – soils, rock strata, groundwater elevations, etc. -Hydrologic analysis – modeling for the watershed
Inexperienced construction oversight personnel.	Contract specifications should require that an experienced Stream/Wetland Restoration Specialist provide oversight during the entire construction project.	Develop standard contract language requiring experienced Construction oversight personnel.
Undermined log drop structures in stream.	Install geotextile fabric on all log drop structures to prevent undermining by streams flows by tacking to logs	Develop a standard plan detail for construction plans showing the location of geotextile in relationship to log drop structure design.
Inexperienced construction contractors.	Hire only contractors experienced in stream and/or wetlands work.	Contract bid requirements should require experienced construction firms to construct the aquatic resource restoration projects, specifically for riverine systems. More efficient and knowledgable in building such systems, may reduce costs.
Post-construction reviews	Recommend separate post construction meetings with agencies and contractor /oversight professional.	Agency review may provide recommendations for future projects. Post con with contractor and oversight professional to discuss the good, bad and ugly for improvements to future plans, specifications and projects.
Hydrology Not Restored	Match Channel Water Surface Profile to Stream Corridor Groundwater Table, Flood frequency and Duration	Properly Identify System as Riverine or Slope. Design Channel Water Surface Profile to support system's groundwater and flooding frequency and duration

Important Website Links:

- MDT Mitigation Program website:
  - http://www.mdt.mt.gov/publications/datastats/wetlands.shtml
- Montana Wetland Assessment Methodology links:
  - MWAM Manual
    - http://www.mdt.mt.gov/other/environmental/external/wetlands/2008_wetland_assessment/2008_mwam_manual.pdf
  - Computerized MWAM Form:
    - http://app.mdt.mt.gov/wetlands/
  - RiverRAT – River Restoration Analysis Tool link:
    - http://www.restorationreview.com/
  - Rosgen Stream Classification System:
    - http://www.fgmorph.com/fg_4_16.php

Questions?

Richard Weber
richard.weber@ftw.usda.gov
(817)509-3576

Larry Urban
lurban@mt.gov
(406)444-6224


Thank you for your participation!
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www.aswm.org