

# Silver Bow Creek – Balancing Competing Priorities and Lessons Learned

2013 Mine Design, Operations and Closure  
Conference

Presented By: Joel Gerhart. P.E.

# THANKS

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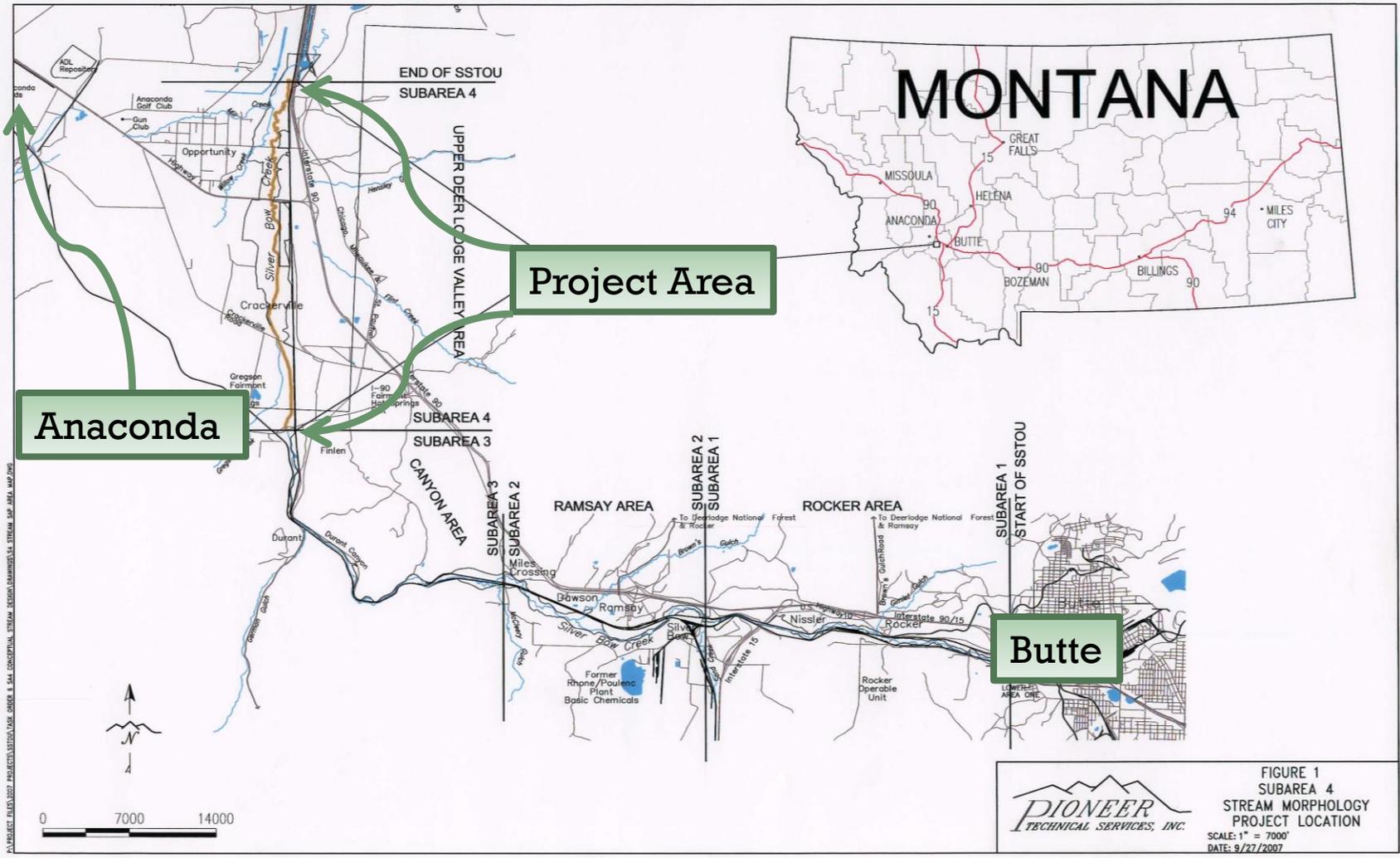
- ◉ DEQ
- ◉ NRDP
- ◉ EPA
- ◉ Greenway Services District
- ◉ Pioneer Technical Services

# WHATS IN STORE

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- ◉ Brief Streamside Project Overview
- ◉ Summarize Key Criteria/Constraints
- ◉ Lessons Learned in Construction
- ◉ Lessons Taught by 2010 and 2011 Floods
- ◉ Design Changes
- ◉ Summary

# PROJECT OVERVIEW MAP



**FIGURE 1**  
**SUBAREA 4**  
**STREAM MORPHOLOGY**  
**PROJECT LOCATION**  
 SCALE: 1" = 7000'  
 DATE: 9/27/2007

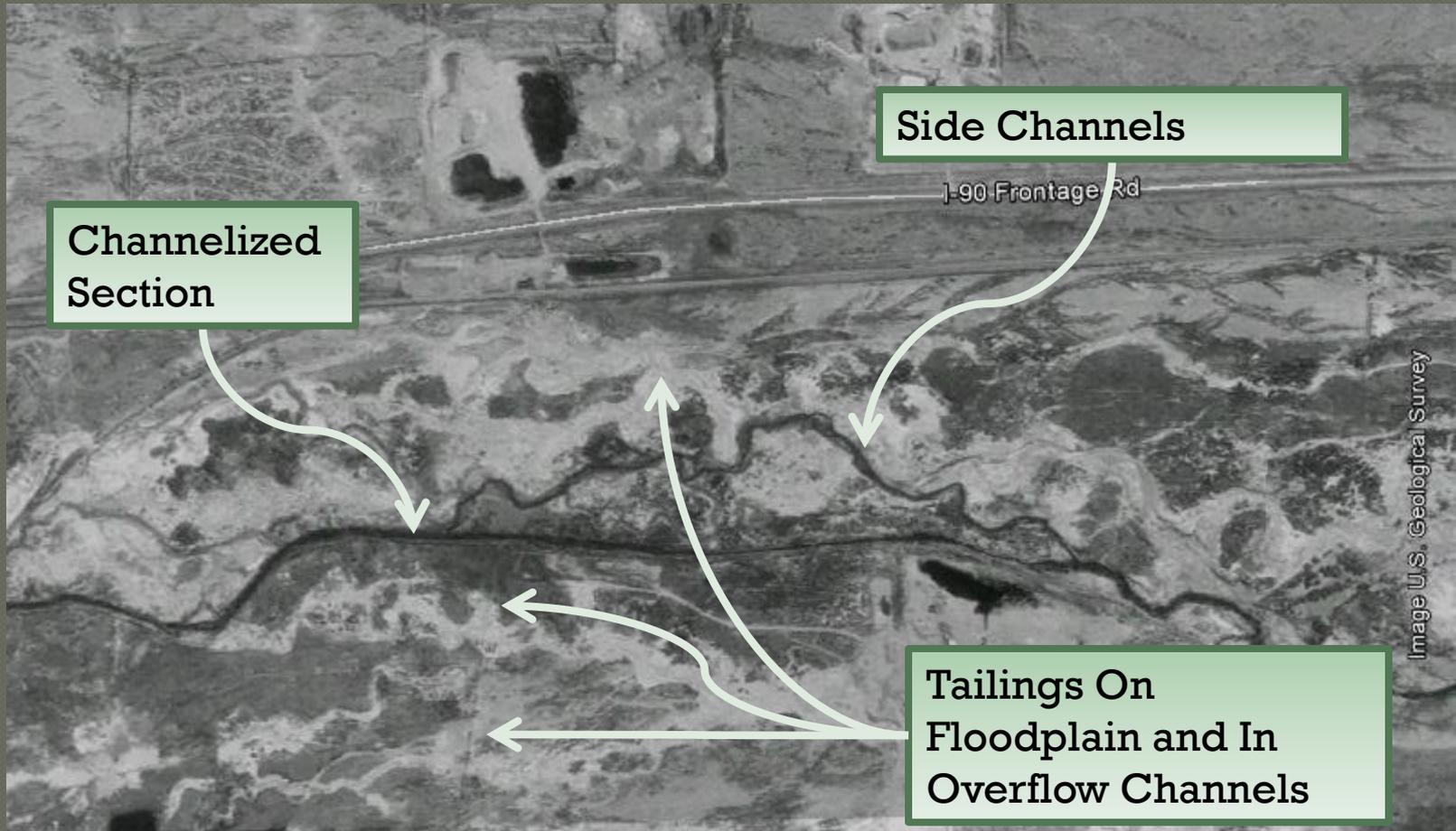


# SA4 PROJECT OVERVIEW

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- Approximately 9 Miles of Stream
- Approximately 1.8MM CY Tailings
- Approximately 1300 Acres of Floodplain
- Long Channelized Reaches
- Few Owners – Mostly DEQ
- Numerous Existing Grade and Flood Controls
- Alluvial Fan/Depositional Area
- Ice Jams and Overflow Channels

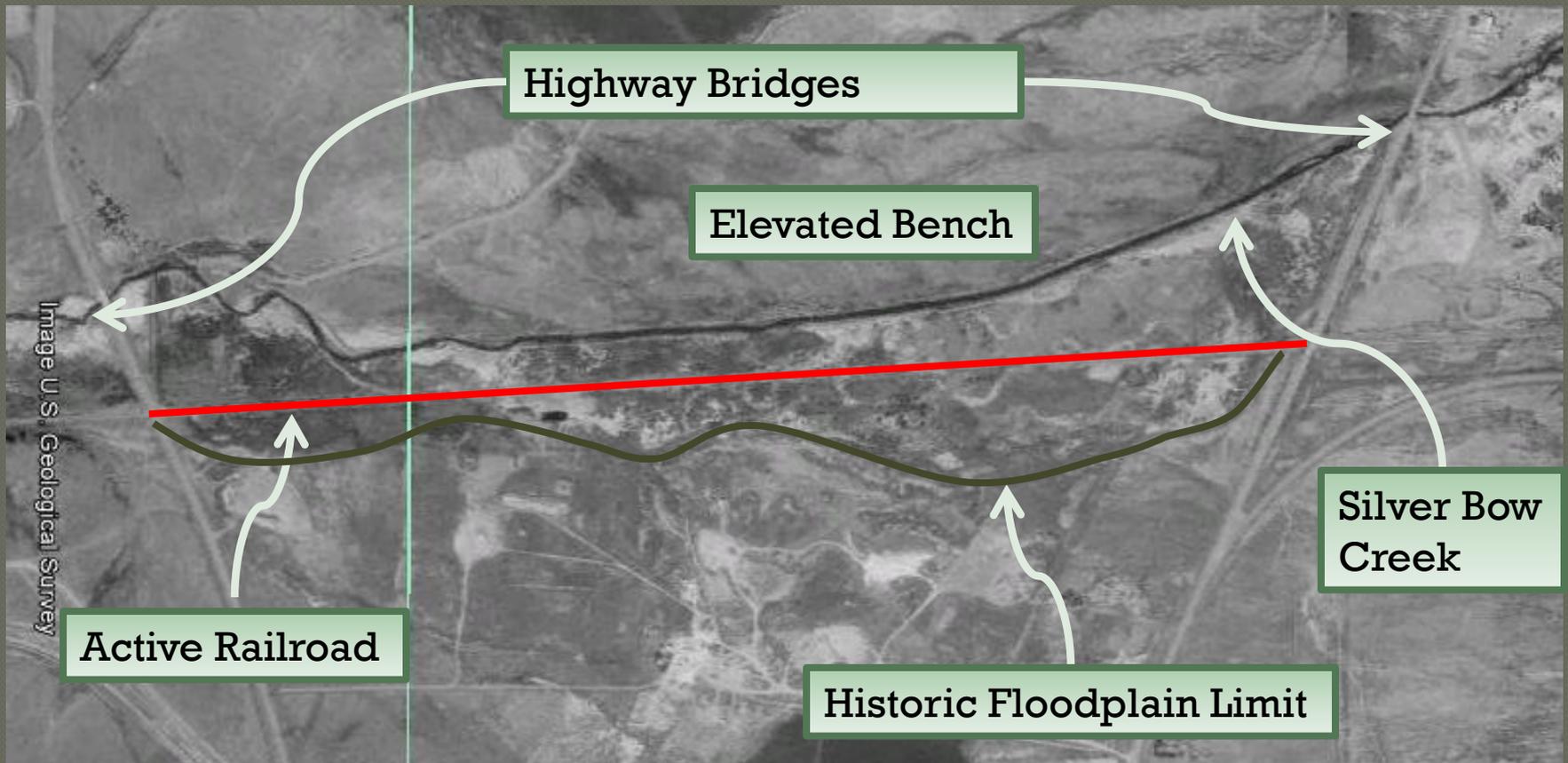
# HISTORICAL SATELLITE PHOTO



# TAILINGS IN FLOODPLAIN



# CONSTRAINTS AND CONTROLS



# CHANNELIZED REACH

Alluvium Berms to  
Contain the Channel

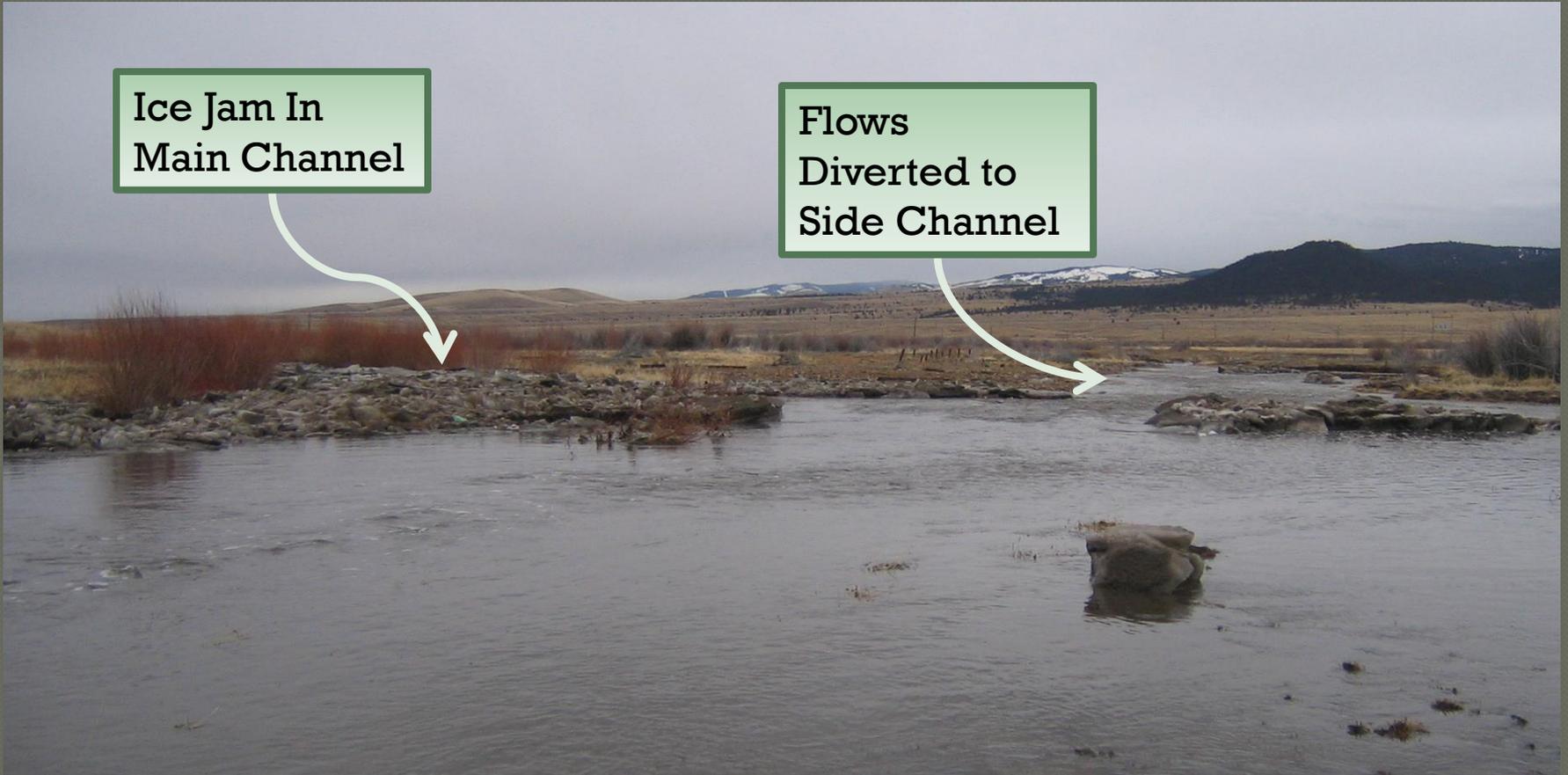
Channel With Limited  
Planform, Uniform  
Grade



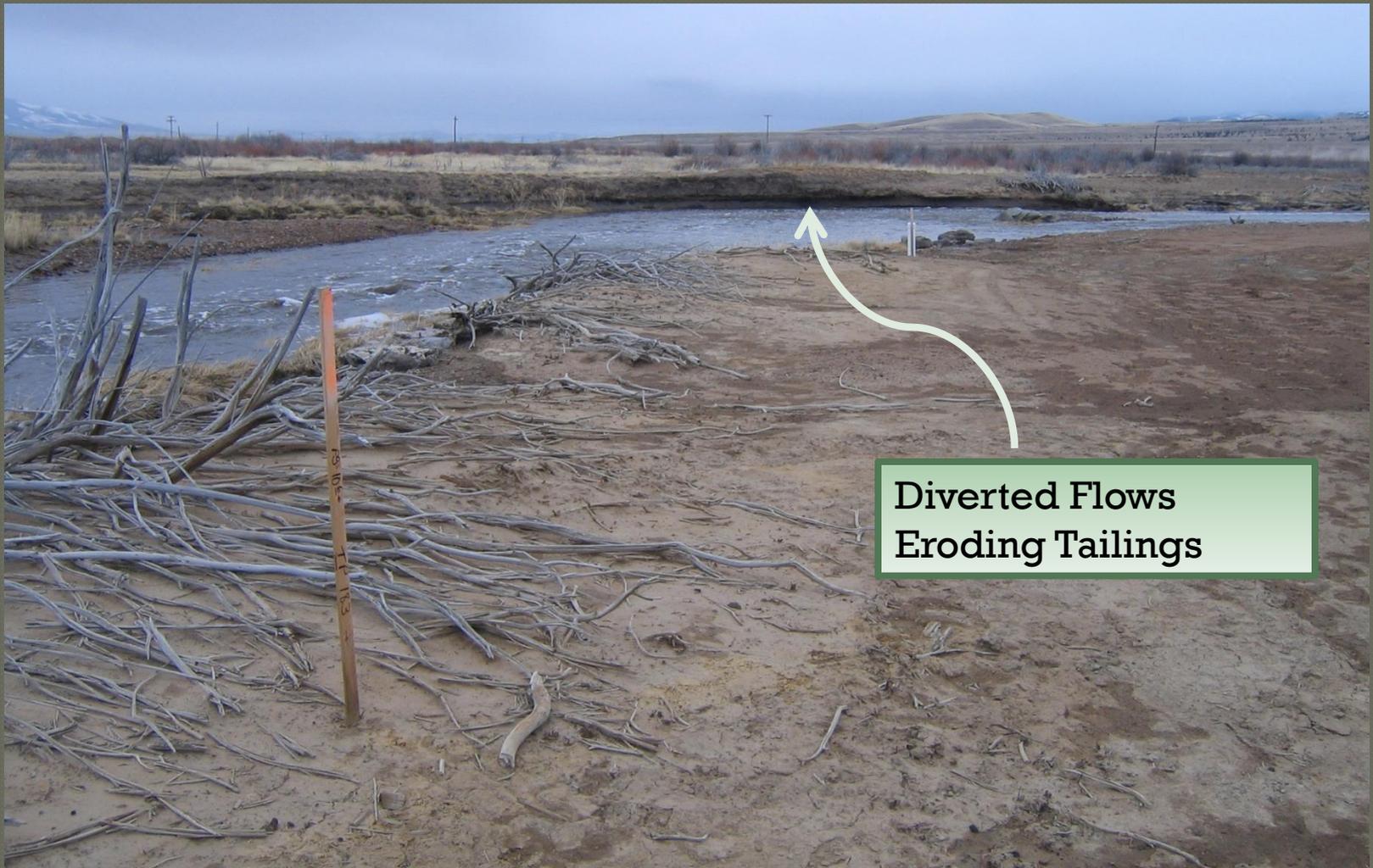
# ICE JAMS

Ice Jam In  
Main Channel

Flows  
Diverted to  
Side Channel



# SIDE CHANNEL EROSION



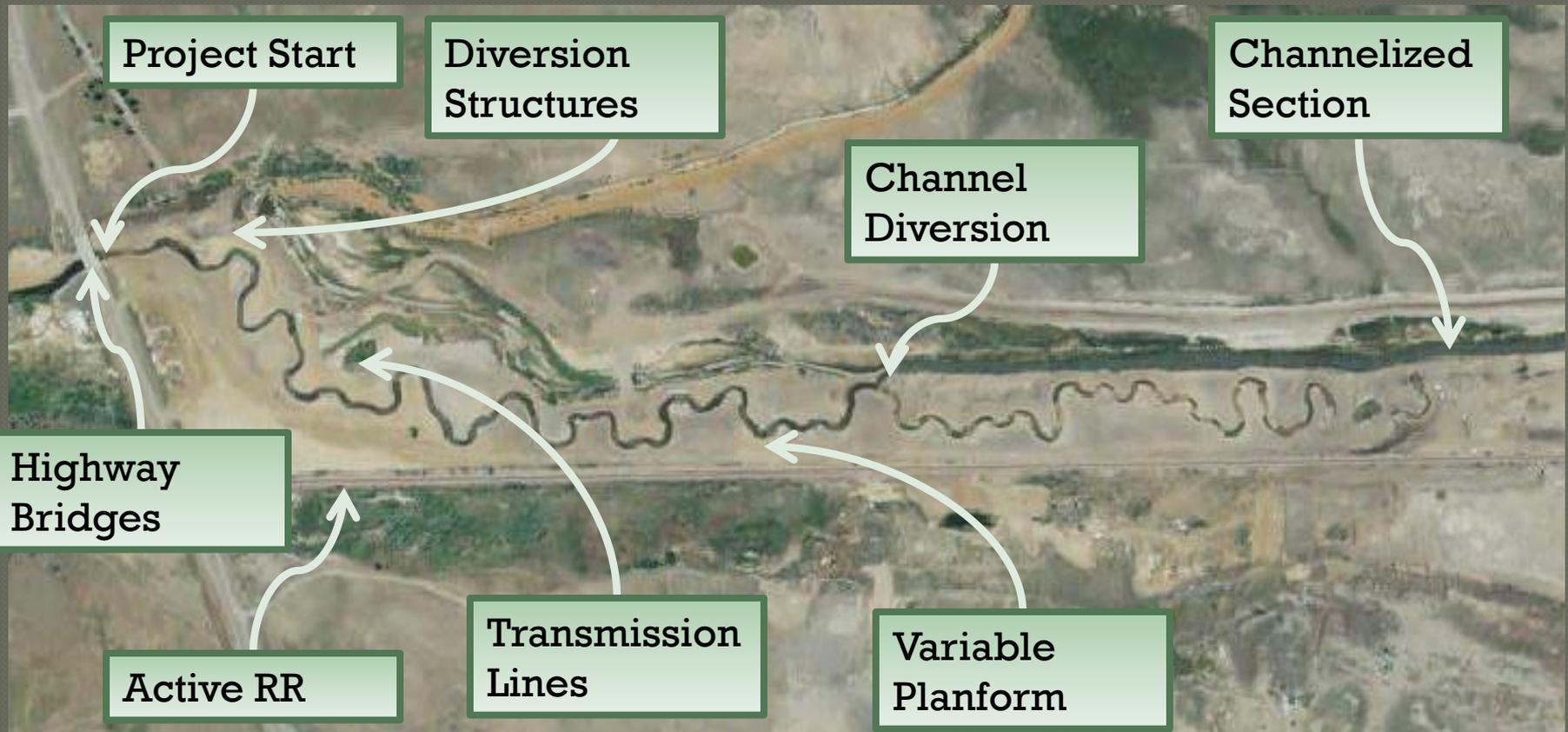
Diverted Flows  
Eroding Tailings

# KEY DESIGN CRITERIA

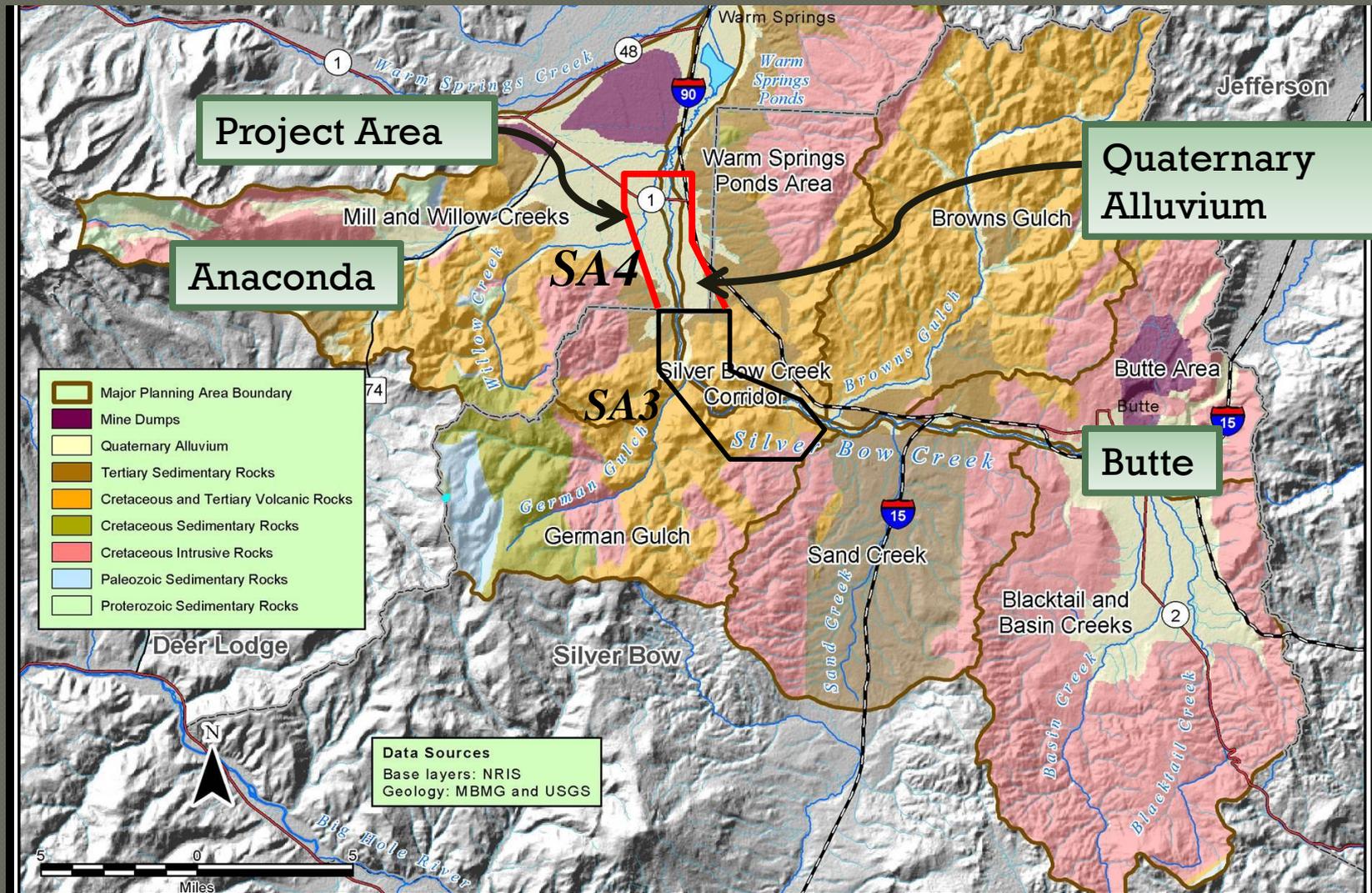
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- Coordinate Remedy/Restoration Actions
- Bankfull Flow – 210 CFS
- Floodplain Access/Flood-Prone Area
- Native Channel Substrate
- Sediment Transport Issues
- Infrastructure Protection/Constraints
- Variable Plan Form and Channel Width
- Minimal Existing Channel Crossings
- Flexible Floodplain Design
- Favorable Site Setting - Geology

# KEY DESIGN CONSTRAINTS



# STREAMSIDE GEOLOGIC MAP

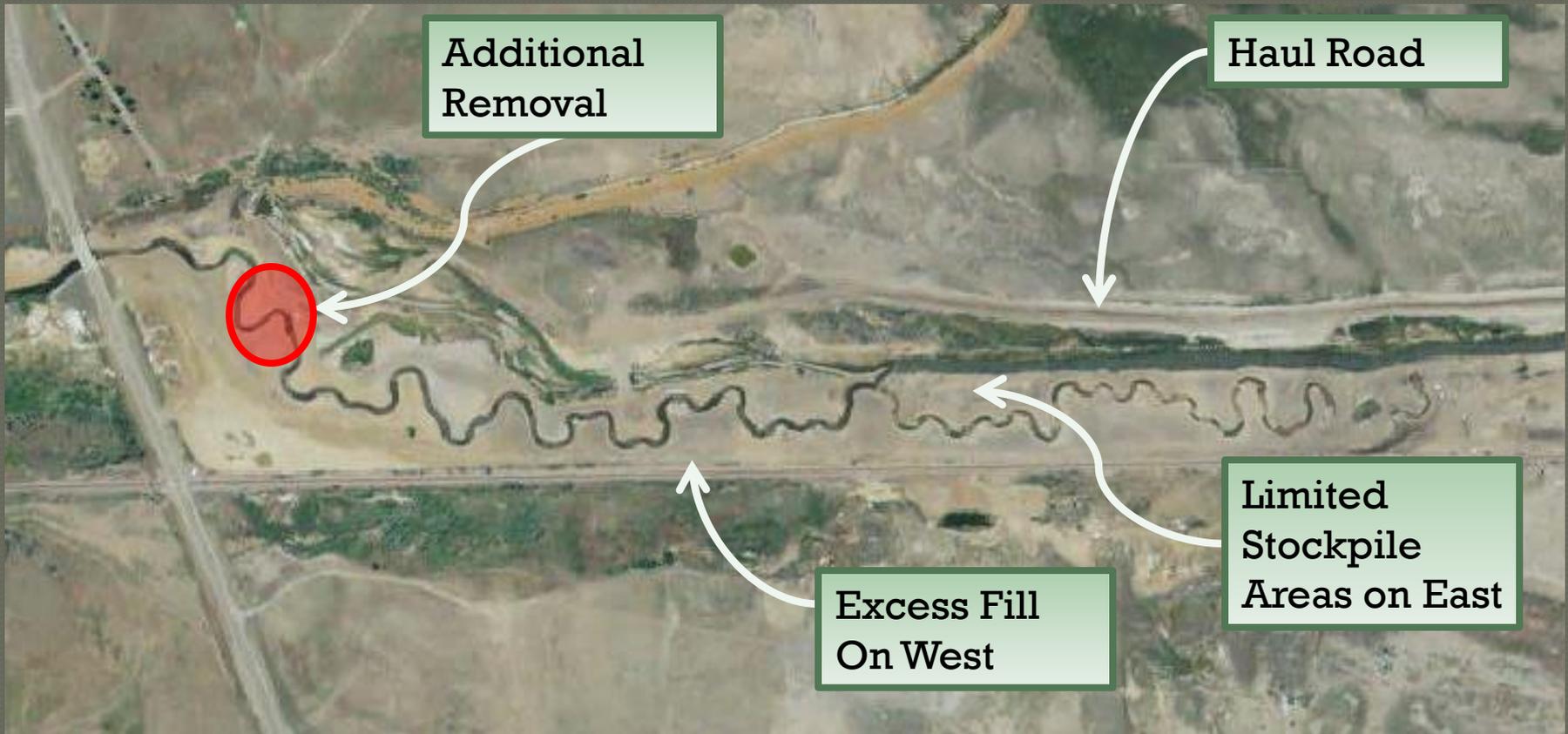


# LESSONS LEARNED IN CONSTRUCTION

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- Compaction of Fill In Channel Corridor
- Floodplain Grading and Fill Haul
- Point Bars/Bend Radii
- Tighter QA/QC
- Fabric Issues -
  - Reseeding
  - Ice Damage
- Channel Shelf

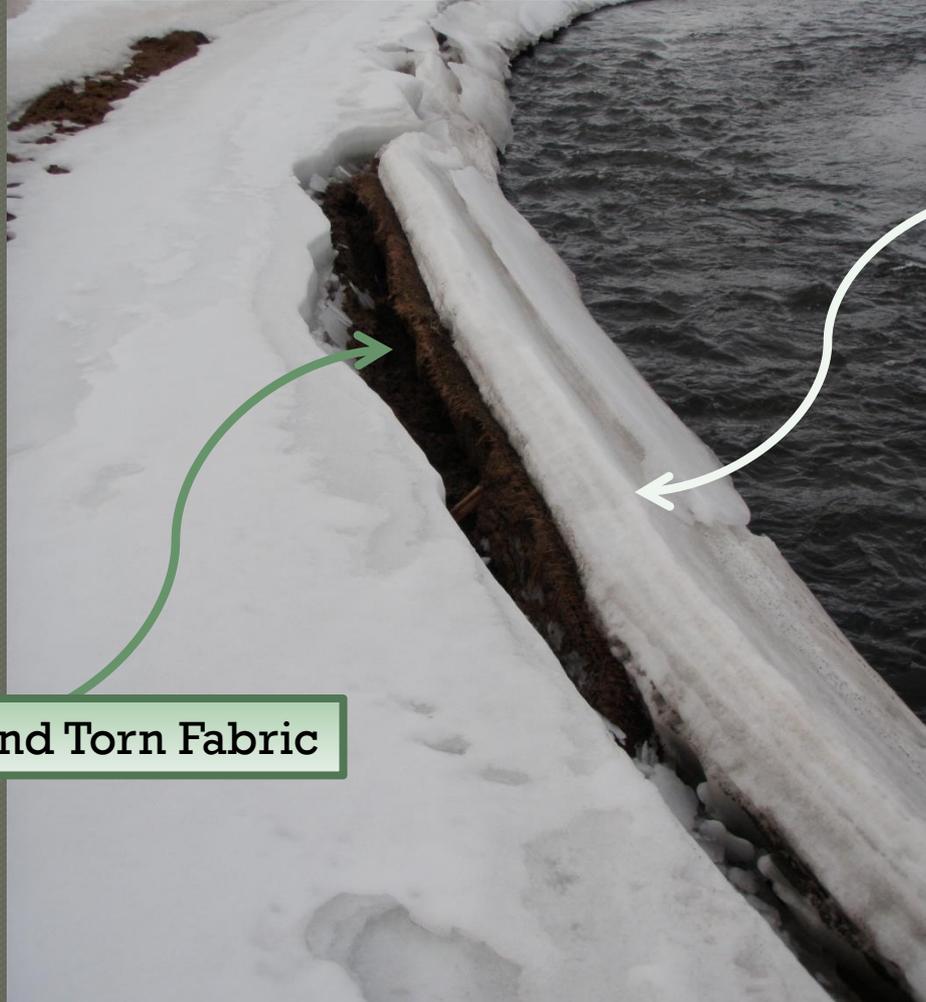
# CONSTRUCTION ISSUES



# SPACE CONSTRAINTS



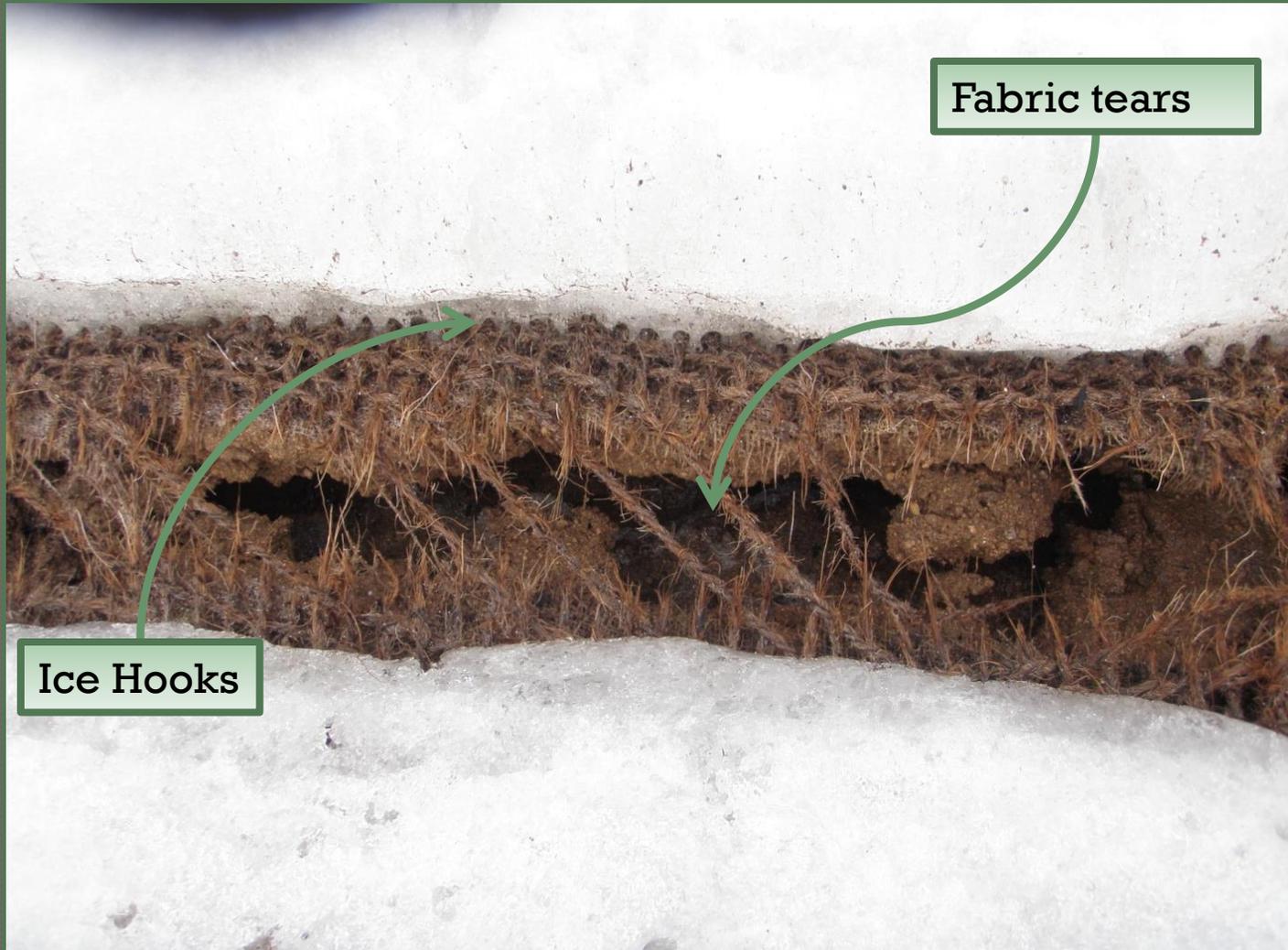
# ICE DAMAGE



Ice Shelf

Cracking and Torn Fabric

# ICE DAMAGE



Fabric tears

Ice Hooks

# ICE DAMAGE



Fabric tears

# 2010 AND 2011 FLOODS

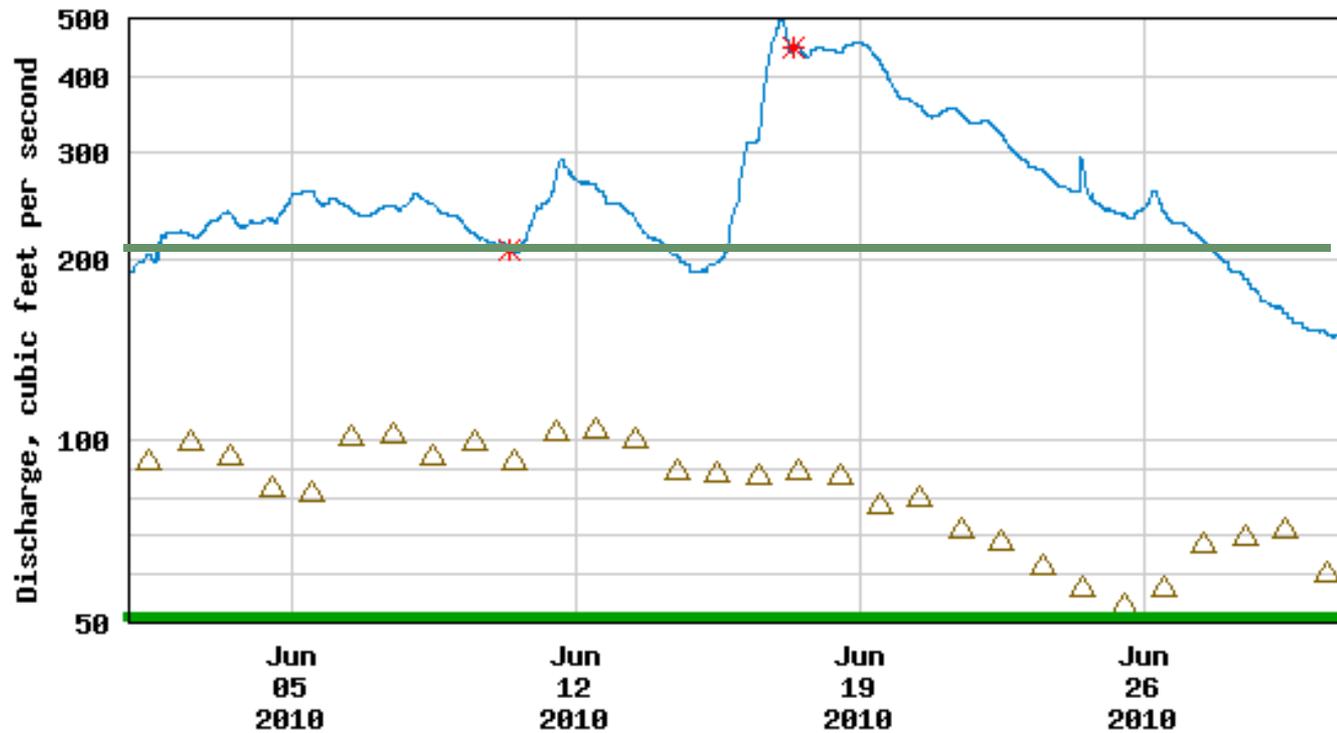
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- ◉ Summarize Flows Experienced
- ◉ Damage Areas and Repairs
- ◉ Aerial Photos
- ◉ Ground Photos
- ◉ Effects on the Bankfull Flow Estimates

# 2010 FLOOD FLOWS



USGS 12323600 Silver Bow Creek at Opportunity MT



- △ Median daily statistic (23 years)
- \* Measured discharge
- Discharge
- █ Period of approved data

# 2010 FLOOD PHOTO

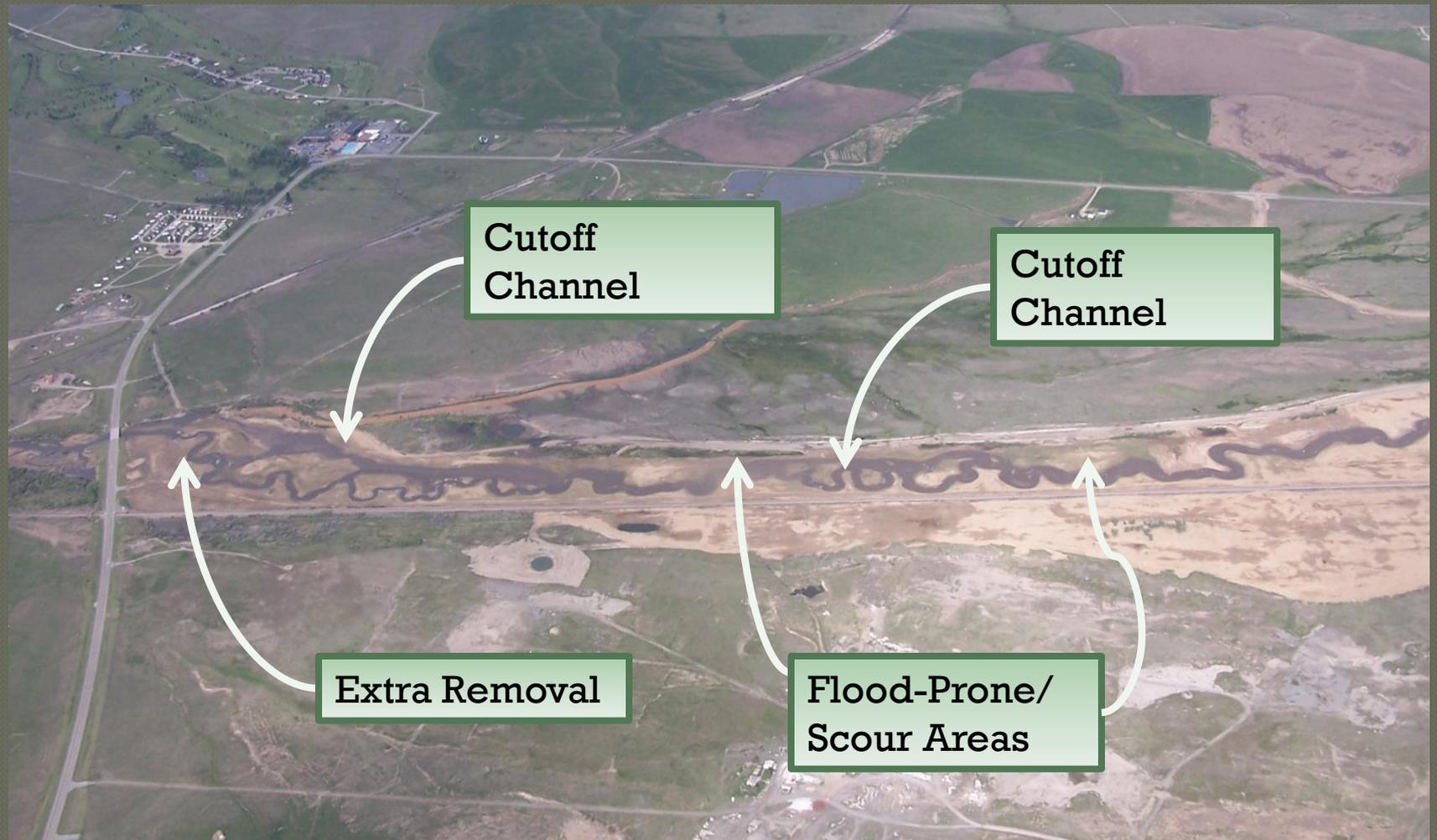


06/03/2010

# SA4 CHANNEL AT BANKFULL



# AERIAL FLOOD PHOTO



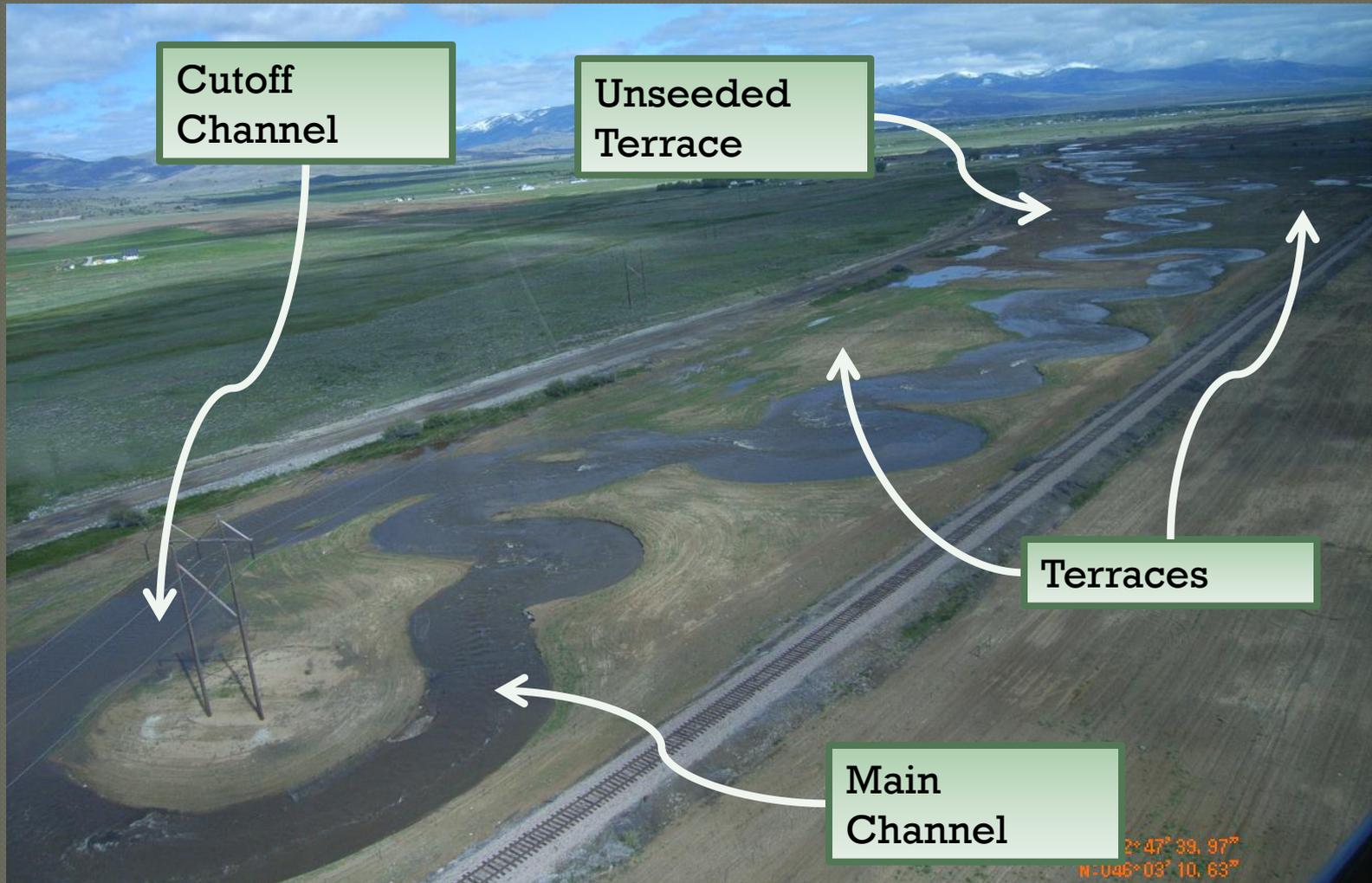
Cutoff  
Channel

Cutoff  
Channel

Extra Removal

Flood-Prone/  
Scour Areas

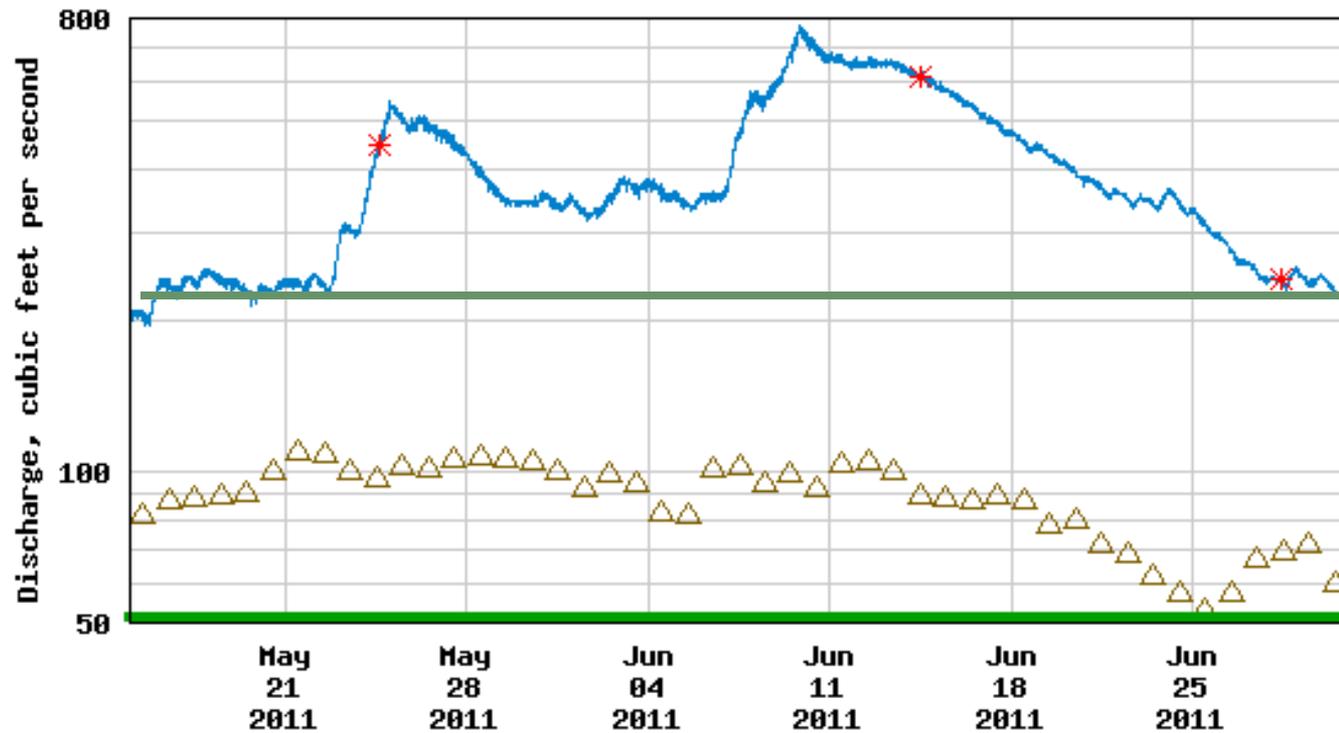
# AERIAL FLOOD PHOTO



# 2011 FLOOD FLOWS



USGS 12323600 Silver Bow Creek at Opportunity MT

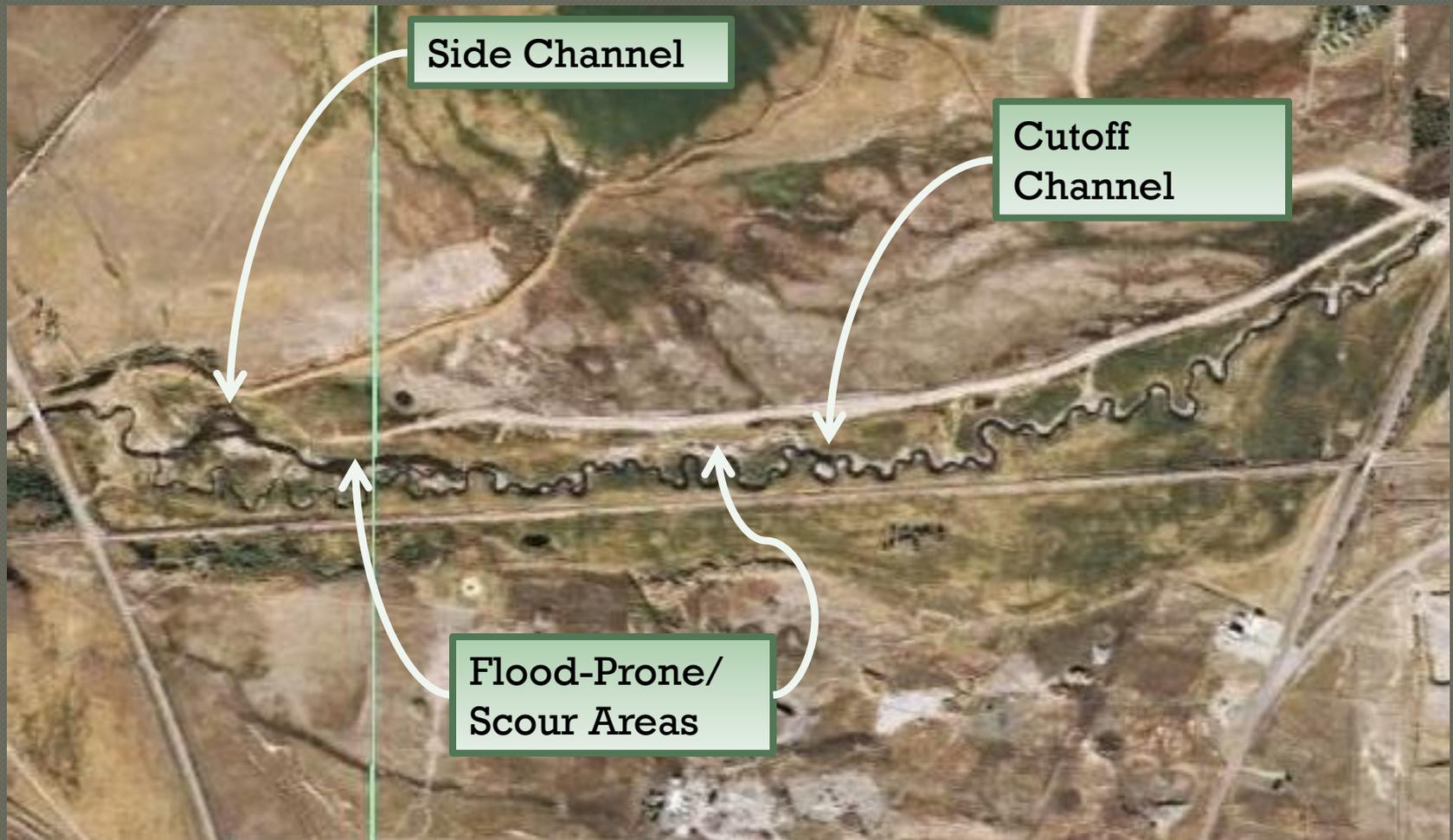


△ Median daily statistic (23 years) \* Measured discharge  
— Discharge — Period of approved data

# 2011 FLOOD PHOTO



# POST FLOOD PHOTO



# POST FLOOD PHOTO

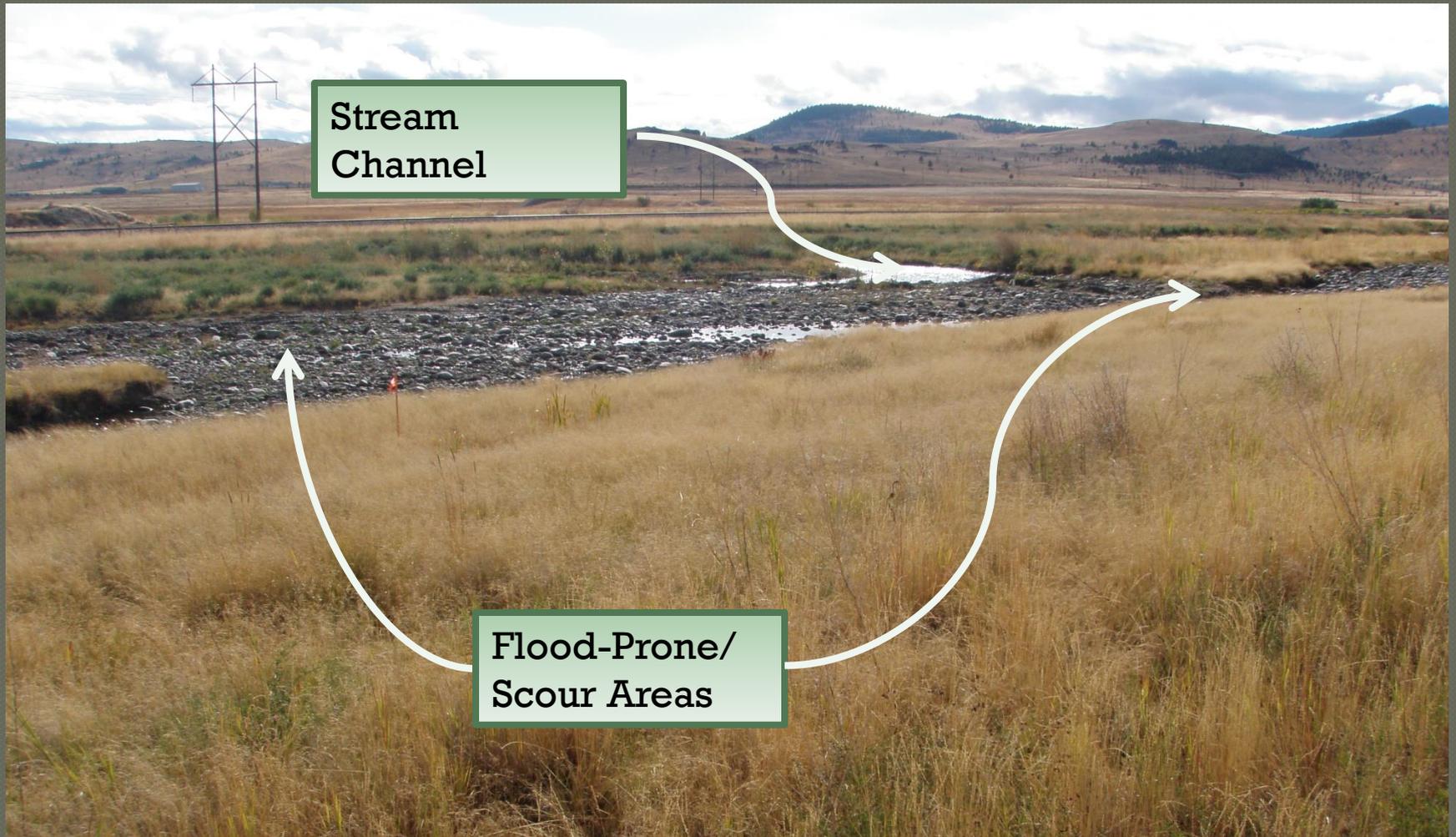


Flood-Prone  
Area

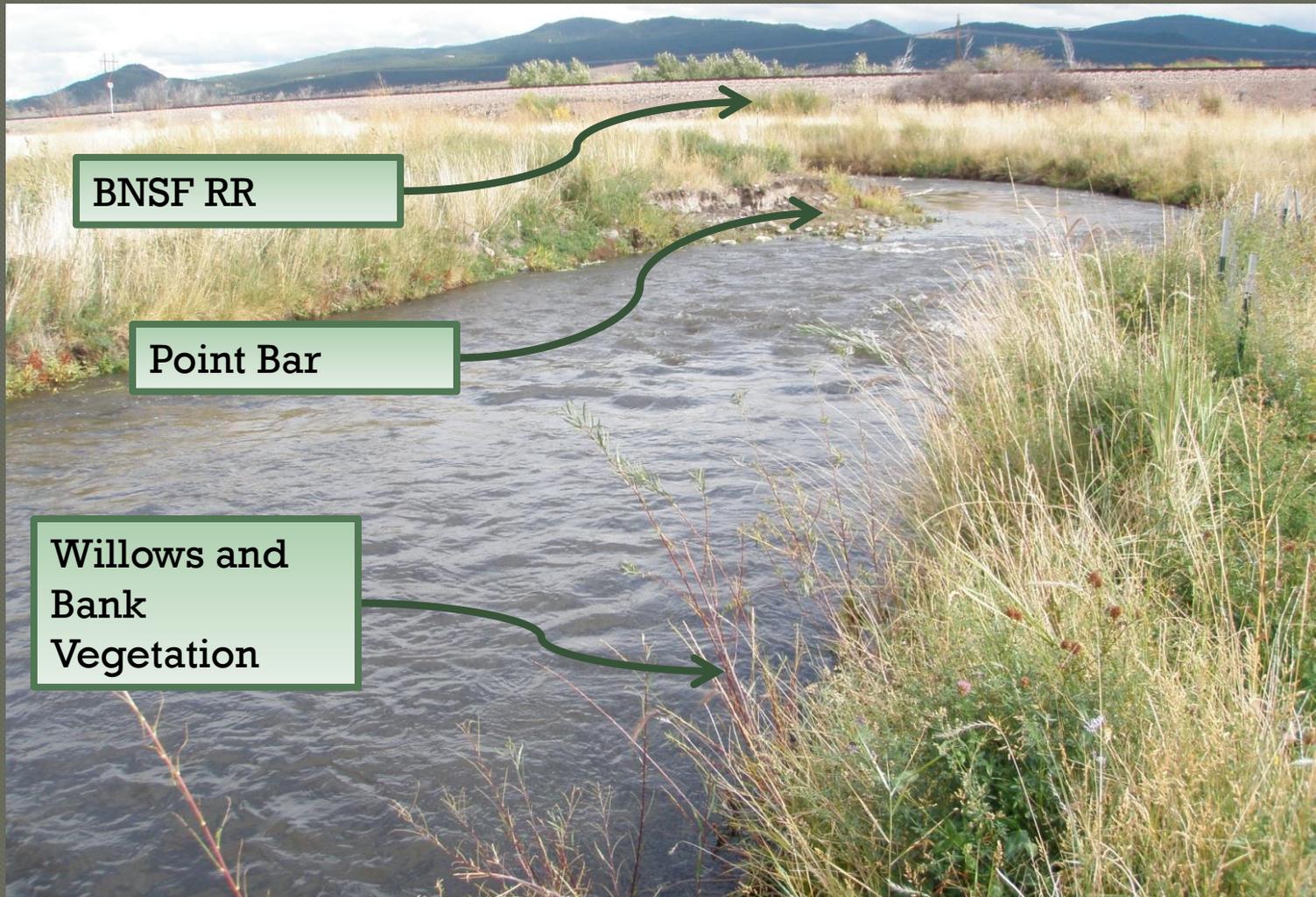
End of  
Reconstructed  
Channel

Cutoff  
Channels

# POST FLOOD PHOTO



# POST FLOOD PHOTO



BNSF RR

Point Bar

Willows and  
Bank  
Vegetation

# POST FLOOD PHOTO



# DAYS OF BANKFULL FLOW

<b>Years of Record</b>	<b>23</b>
Normal Range of Bankfull Days/Year	7-14
Bankfull Days Before 2010	115
Bankfull Days/Year Before 2010	5.5
Bankfull Days in 2010	24
Bankfull Days in 2011	47
Bankfull Days After 2011	186
Bankfull Days/Year After 2010	6.3
Bankfull Days/Year After 2011	8.1

# KEY CHANGES

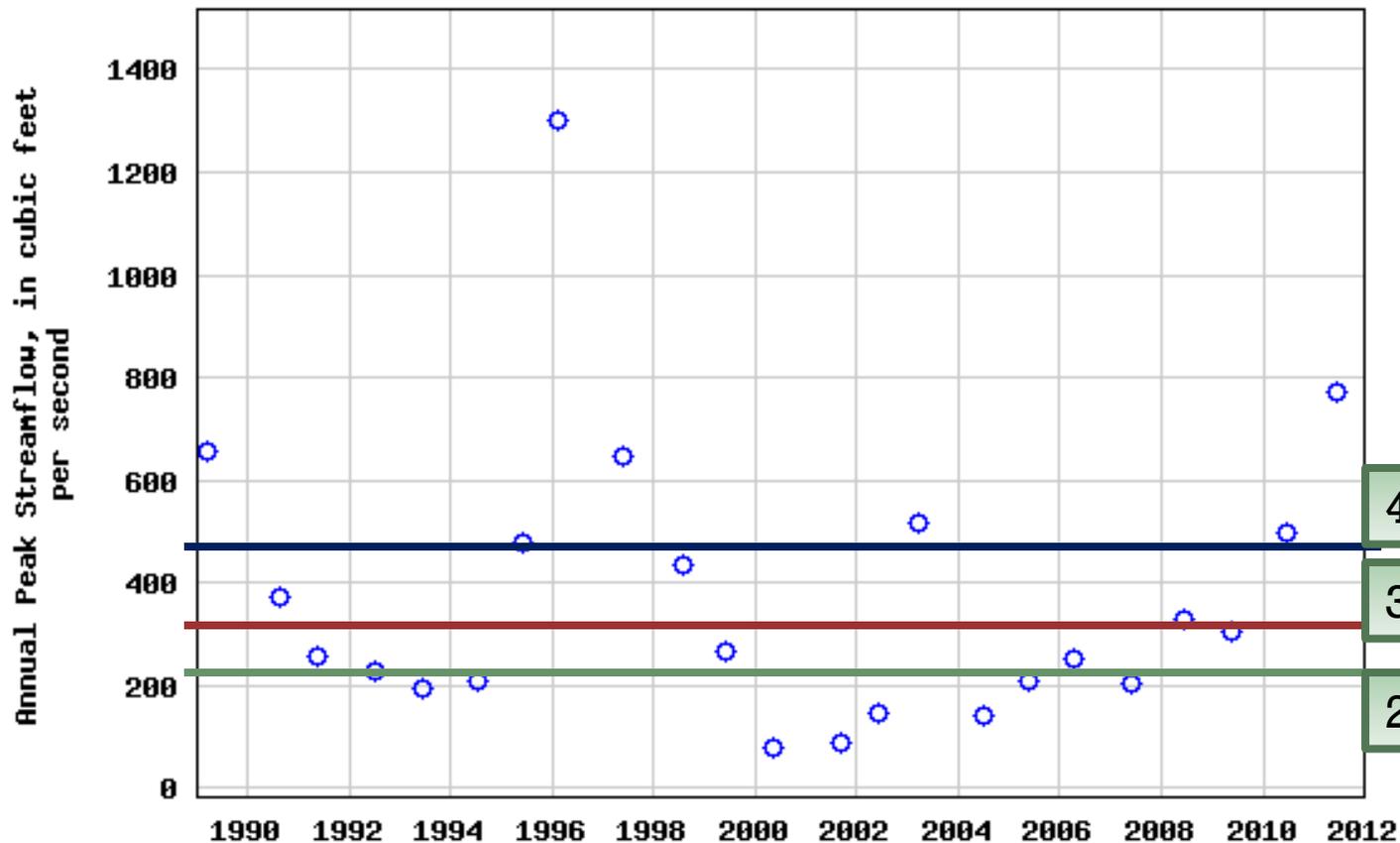
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- Larger Channel
- Coir Fabric/Coir Rolls
- Shallower Bank Slopes
- Floodplain Swales or Side Channels
- QA/QC
- Compaction in Fill Areas
- Minimum Channel Dimensions

# REVISED CHANNEL CAPACITY



USGS 12323600 Silver Bow Creek at Opportunity MT



450

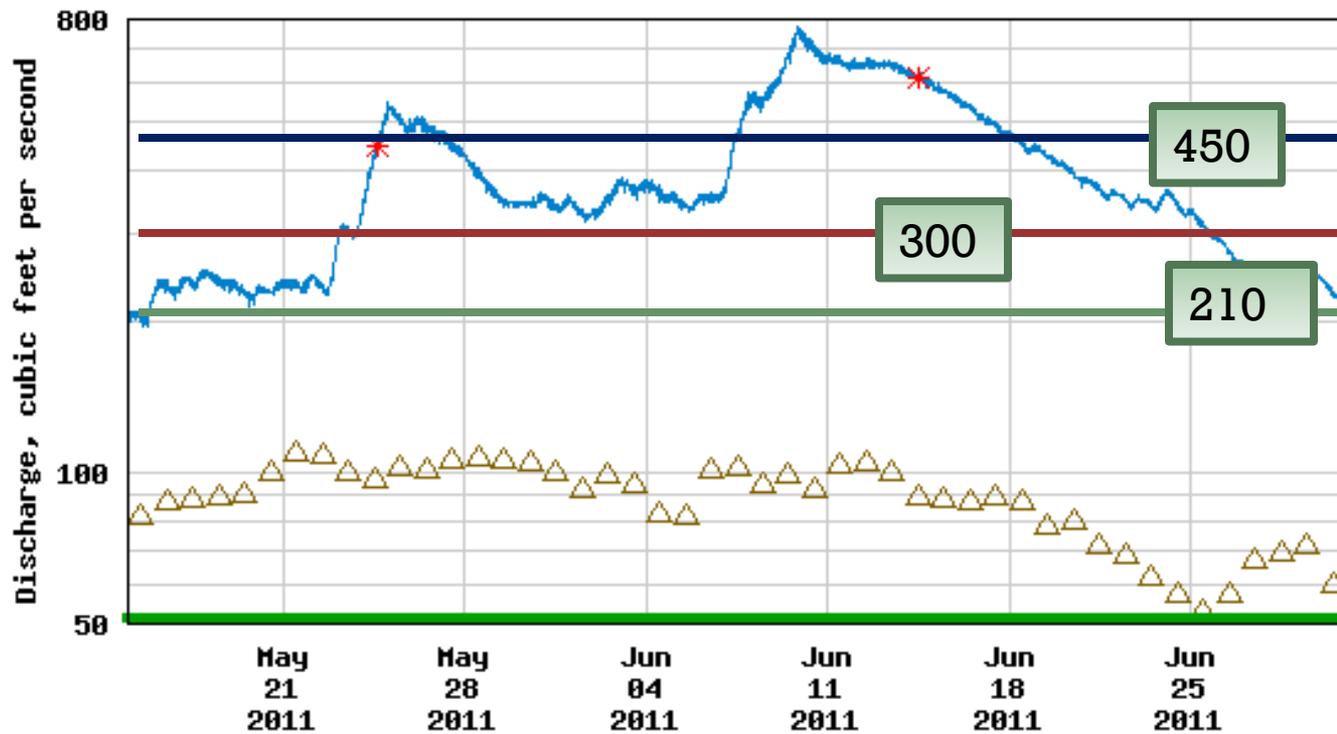
300

210

# 2011 FLOOD FLOWS



USGS 12323600 Silver Bow Creek at Opportunity MT

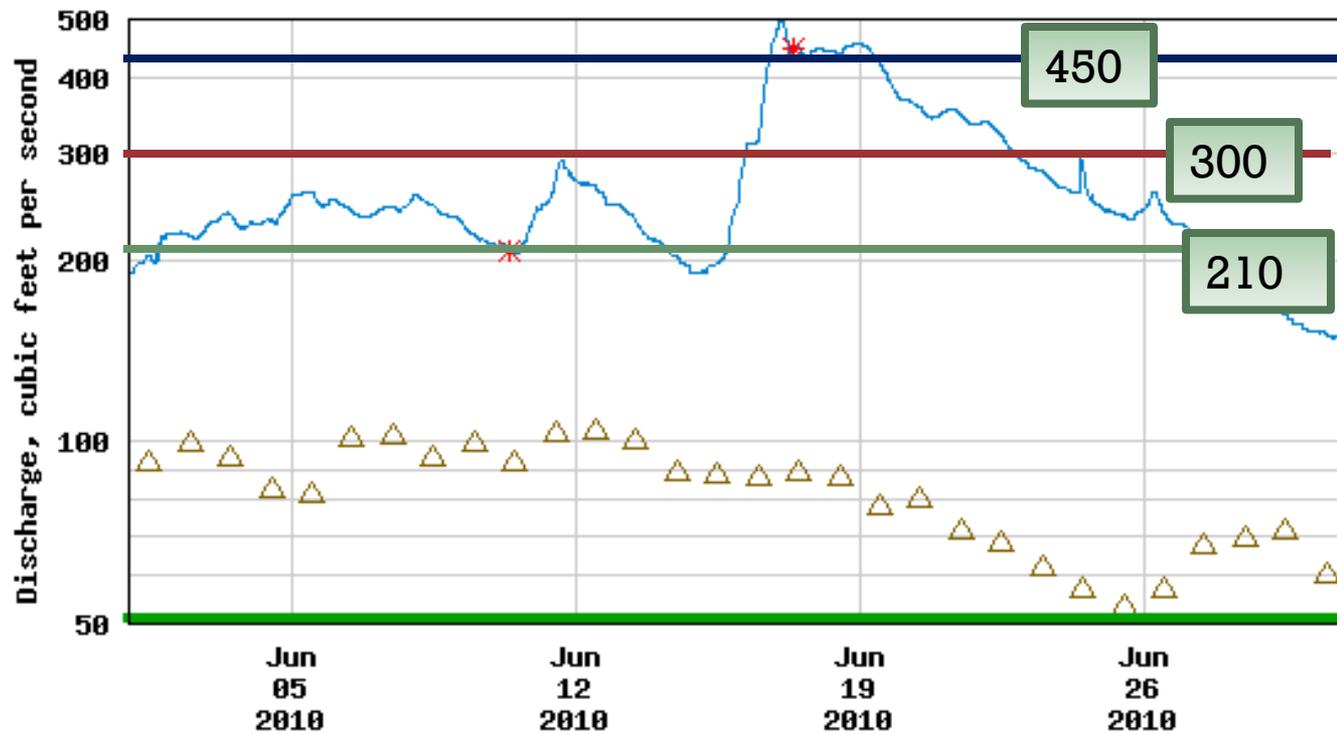


- △ Median daily statistic (23 years)
- \* Measured discharge
- Discharge
- Period of approved data

# 2010 FLOOD FLOWS

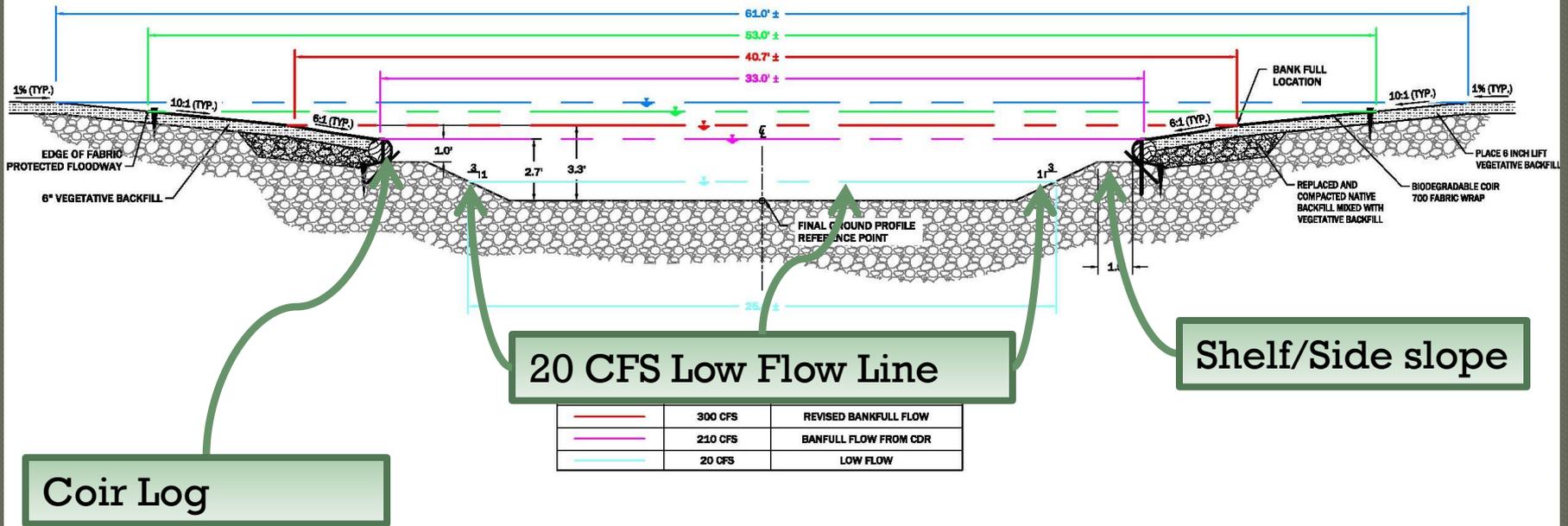


USGS 12323600 Silver Bow Creek at Opportunity MT

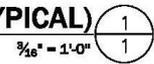


△ Median daily statistic (23 years) \* Measured discharge  
— Discharge — Period of approved data

# REVISED CHANNEL

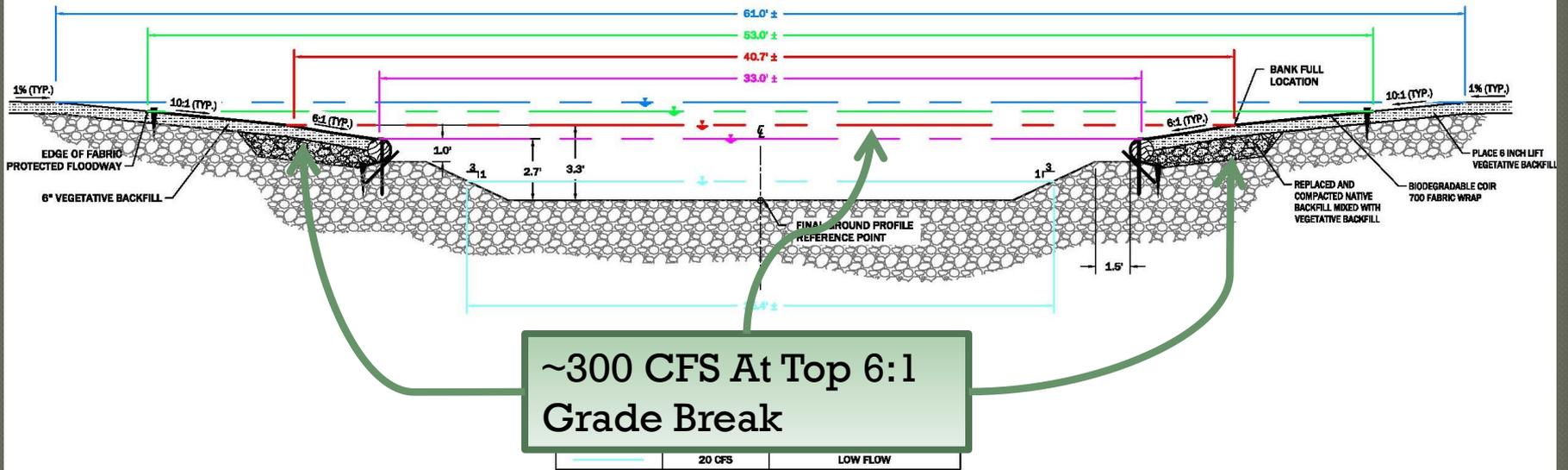


CONCEPTUAL DEFORMABLE CHANNEL WIDE RIFFLE SECTION (TYPICAL)





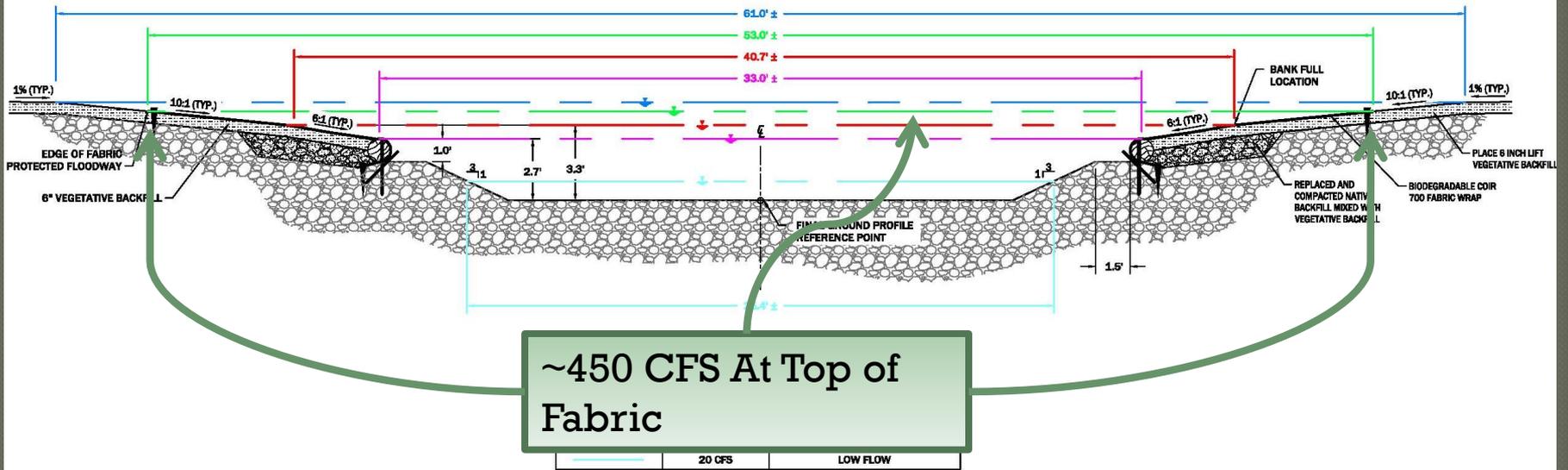
# REVISED CHANNEL



CONCEPTUAL DEFORMABLE CHANNEL WIDE RIFFLE SECTION (TYPICAL)



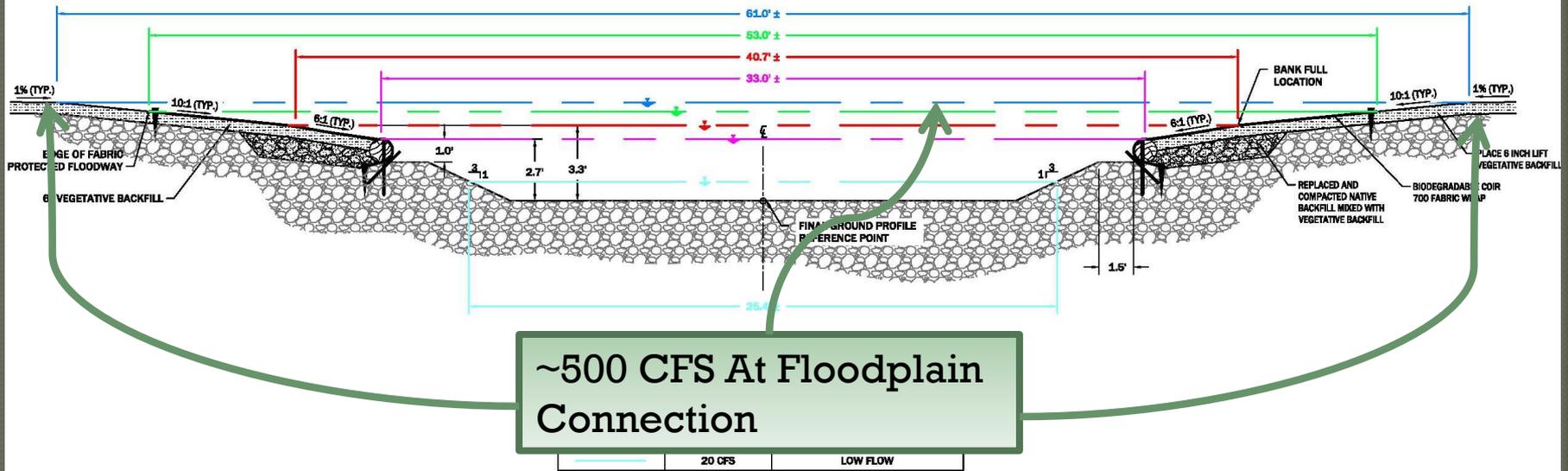
# REVISED CHANNEL



CONCEPTUAL DEFORMABLE CHANNEL WIDE RIFFLE SECTION (TYPICAL)



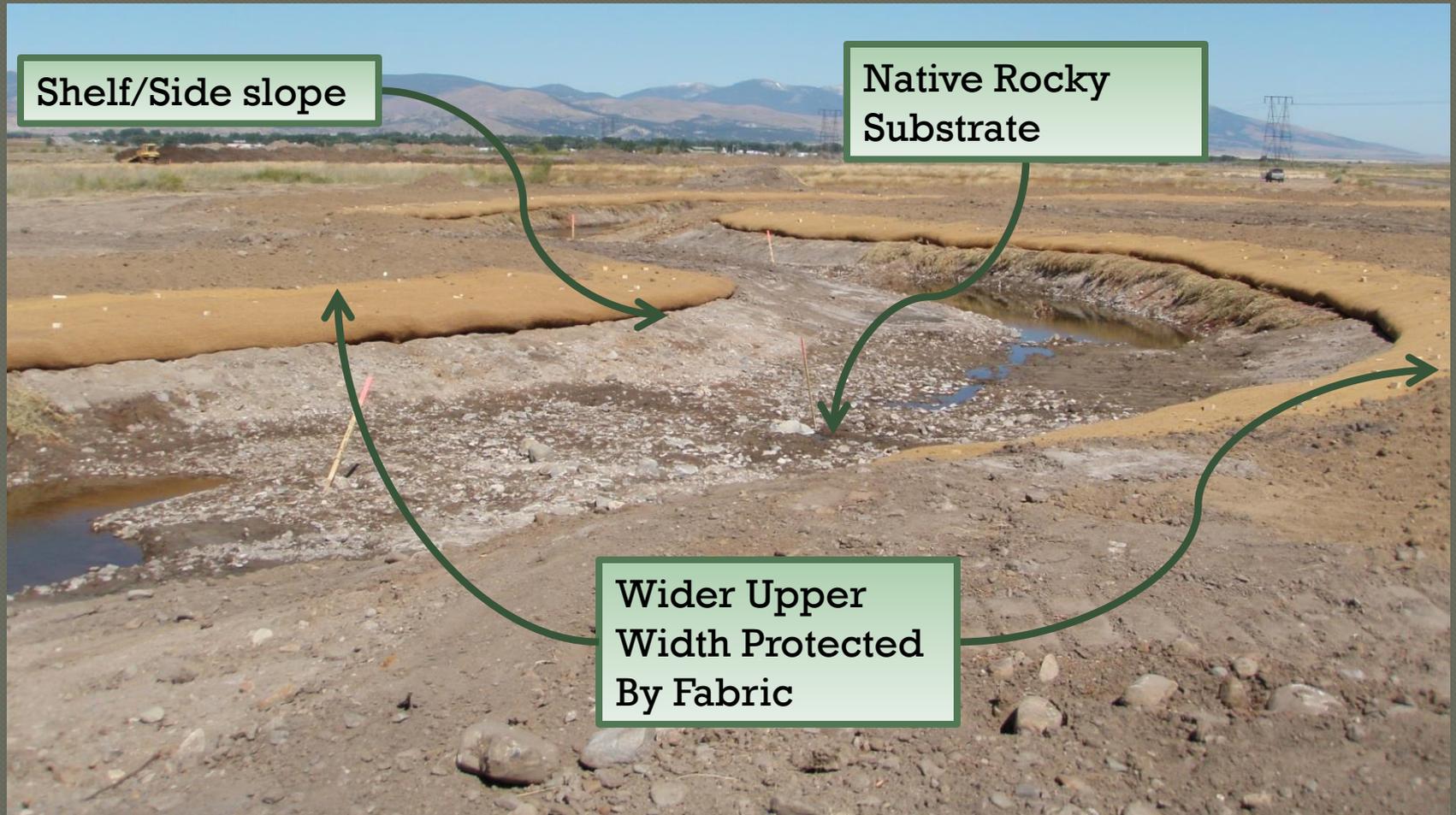
# REVISED CHANNEL



CONCEPTUAL DEFORMABLE CHANNEL WIDE RIFFLE SECTION (TYPICAL) 1

$\frac{3}{16}" = 1'-0"$

# REVISED CHANNEL



Shelf/Side slope

Native Rocky  
Substrate

Wider Upper  
Width Protected  
By Fabric

# SUMMARY

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- Larger Channel Capacity
- Enhanced Initial Stability
- Still Have Some Risk
- Side Channels/Terraces
- QA/QC Is Key
- Ice Jams Remain A Wildcard
- Expect and Budget for Some O&M/Repair

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QUESTIONS?

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**THANKS!**