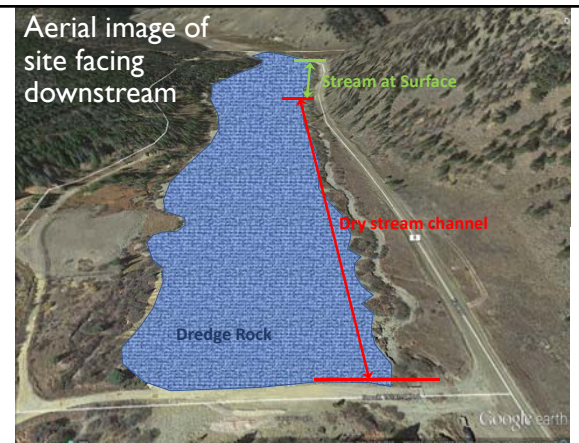


Project Location

Swan River Valley
Unincorporated Summit County



Aerial image of
site facing
downstream



The Swan River

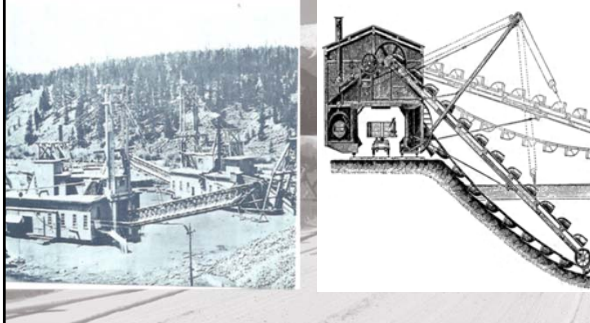
Then...
(late 19th/early 20th century)



...fall 2015.



Dredge Boat on the Swan River – early 1900's







Project Overview & Goals

- Create a natural, stable channel.
- Improve water quality and water conservation.
- Protecting and enhance existing wetlands.
- Restore, stream, riparian, and floodplain function and habitat.
- Natural treatment of surface water and groundwater.
- In-stream aquatic habitat for metapopulation of Colorado River cutthroat trout and diverse macroinvertebrates populations.



Project Overview & Goals

- Enhance local economy by creating public open space and opportunities for water-based recreation activities.
- Educational opportunities demonstrating stream restoration techniques for other reaches degraded by historic dredge mining.
- Benefit multiple stakeholder groups and objectives.



Blue River Restoration at Fourmile Bridge Open Space



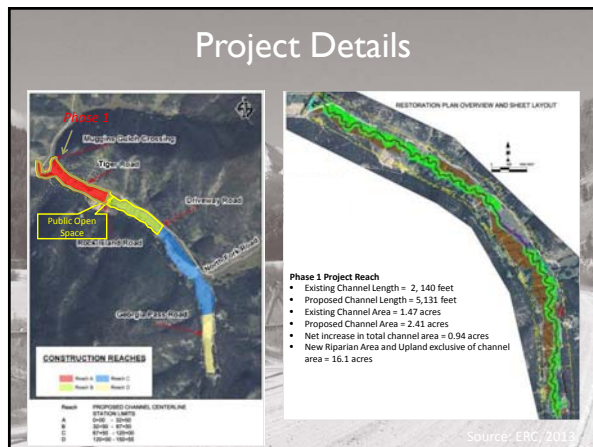
Before (2004)



After (2007)

Example of a successful "Natural Stream Design" Project

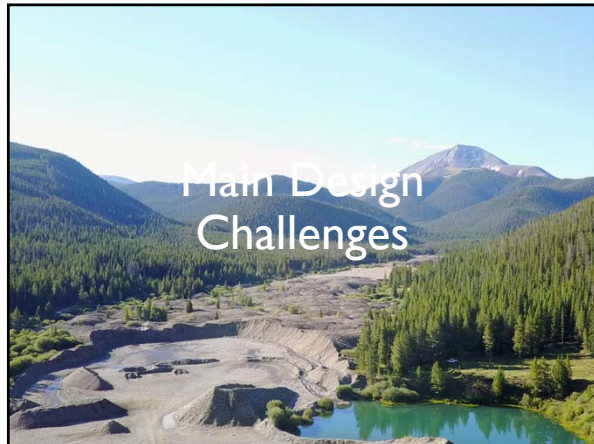


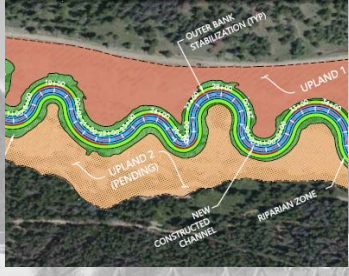


Project Funding and Support

Project Funding Sources


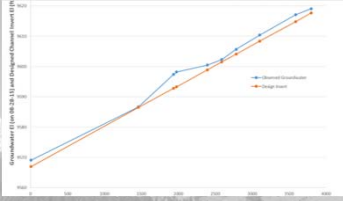
Organization	Type	Value (\$)
Summit County	Cash	568,055
US Fish and Wildlife Service	Cash	150,000
U.S. Forest Service	Cash	110,000
Colorado Parks and Wildlife (Fishing is Fun)	Cash	130,000
Colorado Parks and Wildlife (Wetlands and Riparian)	Cash	59,000
Town of Breckenridge	Cash	368,055
National Forest Foundation	Cash	100,000
Colorado Water Conservation Board (WSRA)	Cash	975,000
Colorado Water Conservation Board (Watershed)	Cash	40,000
Colorado Water Conservation Board (Monitoring)	Cash	31,395
Summit County	In-Kind	11,000
Friends of Dillon Ranger District	In-Kind	10,500
Blue River Watershed Group	In-Kind	5,250
Trout Unlimited	In-Kind	5,000
Total		2,563,255





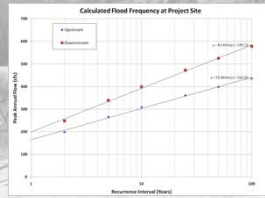
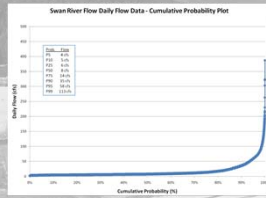
- Keep stream away from Tiger Road on the north and old mine workings at the southeast to minimize water quality impacts
- Locate new western road crossing to the south to eliminate one of the two existing crossings
- Resulting sinuosity = 1.58; average slope = 1.1%

Develop a Planform that Fits Constraints and Mimics Natural Stream System

Understand Groundwater Levels to Achieve Gaining Stream

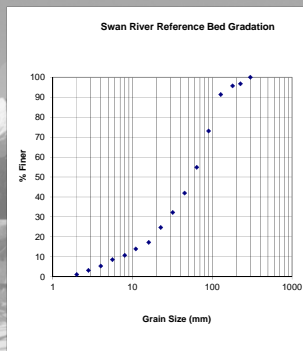
Define Flows for Subsurface Stream Bankfull Discharge (~230 cfs) & Flow Frequency



22

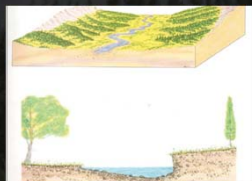
Design a Natural, Low Permeability Liner that Could be Manufactured from On-Site Materials

- Used Fuller-Thompson method and sediment sampling in reference section to define gradations for a natural, low permeability liner
- Calculations suggested 5% - 15% fines required in lower permeability layer
- Due to high permeability of dredge material and risk of water loss, 20% fines were specified.



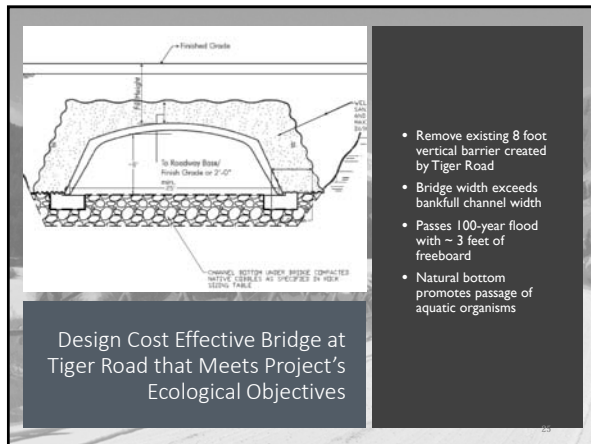
23

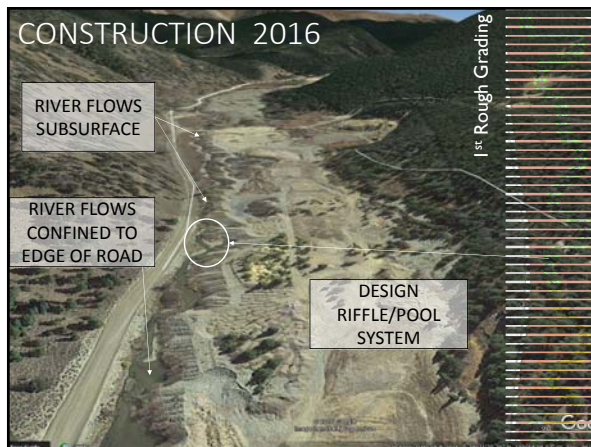
Obtain Floodplain Connectivity

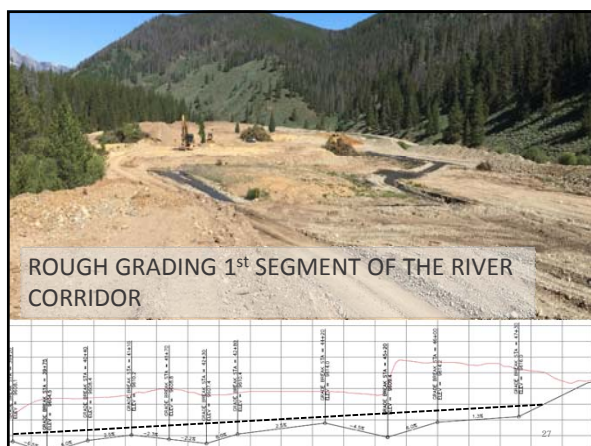



- Have flows access its riparian floodplain above bankfull
- Entrenchment ratio > 3
- Mimic a natural Montgomery-Buffington Pool/Riffle and Rosgen Type C stream

24









Use of Native Materials

- Materials Generated On-Site
- Larger Cobbles (6" +)
 - Grade control
 - Bank stabilization
 - Riffle heads
- Smaller Cobbles (3" – 6")
 - Riffles
 - Banks
- Gravels (3/4" – 3")
 - Pools and glides
 - Non-critical banks
 - Random fill
- Finer Material (<3/4")
 - Channel liner
 - Matrix for create planting soil
- Use of on-site material resulted in huge cost savings and makes sense from a true, natural restoration concept

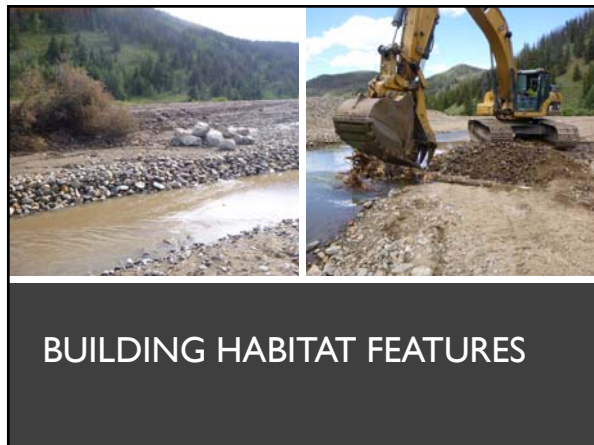


BEFORE AND AFTER INITIAL CHANNEL EXCAVATION


CONSTRUCTING RIFFLES & POOLS









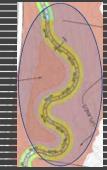
Encountered ~50,000 CY of mine tailings

Tested water and soils

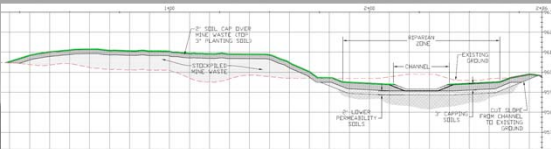
Mitigation involved project sponsors, DRMS, USFS, EPA, CWCB, CDPHE and design/build team

Devised remediation plan

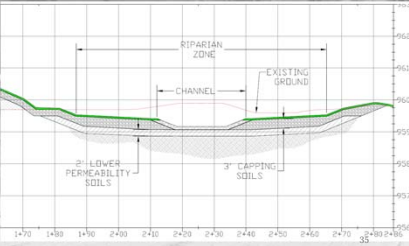
2nd Phase of Rough Grading



TAILINGS MITIGATION PLAN



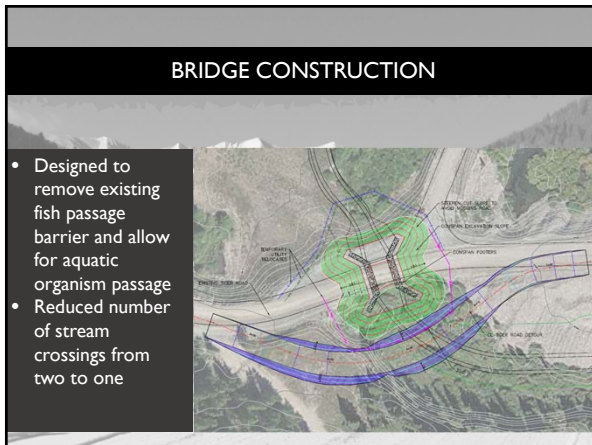
- Changed profile to straight grade to remove pool areas
- Raised stream profile to minimize hydrologic connection between stream and waste
- Armored stream to minimize lateral and vertical migration
- Consolidated and capped waste
- Changed construction sequencing to keep mine waste dry during construction





IMPLEMENTING TAILINGS MITIGATION PLAN







2016



A ground-level photograph showing several people working on a large, cleared area of land. They appear to be planting or seeding the ground. The background shows a forested hillside.

- Seeding and site stabilization completed in 2016
- Plantings finished in 2017

Revegetation







Comparison Photos



Pre-Project

During Construction







Reach A Grand Opening

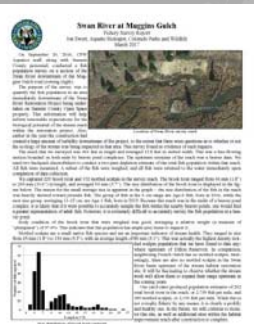
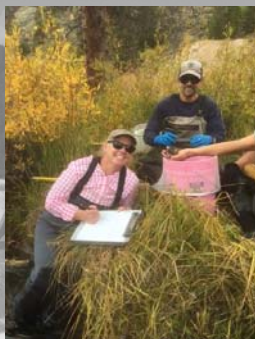


Lessons Learned (so far.....)

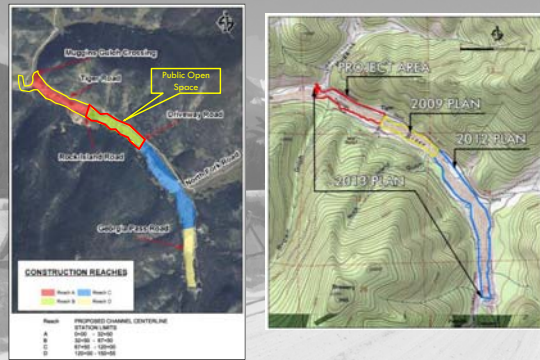
- Stream elevations relative to groundwater were of utmost importance and have worked well
- Alignment, cross sections and profiles have been stable through the first high flows
- Major challenges such as those necessary due to mine waste can be addressed with good teamwork, cooperation and flexibility in a design/build format
- Minor adjustments, particularly along the water line help to "naturalize" the stream's appearance
- Vegetation is extremely important in terms of stability, ecological benefits and aesthetics
- Design/build approach has major advantages for this type of a project



Fishery Survey



Reach B Project Planning



Reach B Implementation

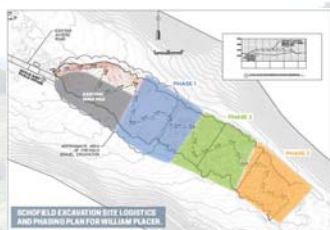
- In 2017, Summit county hired an outside contractor to continue rock removal under existing State Mining and County Conditional Use permits
- Follow same general approach and all permit requirements as Reach A



Reach B - Implementation

Per the terms of this lease agreement with Contractor:

- Collect **royalty payments** on all material leaving the site
 - dedicated towards the restoration of public Open Space in the Swan River Valley (Reach B)
- **Rough grade** the future stream channel, riparian, and upland areas
- **Produce material** required for constructing the future stream channel
- **Import and place suitable soil** for the riparian and upland restoration areas
- County and Town able to **purchase manufactured materials for things like road base at a reduced cost** compared to the open market



[illegible]

Reach B Channel Design

LEGEND:

- WEIR
- BANKLINE STABILIZATION
- POINT BAR
- BANK STABILIZATION
- WE FLAMES
- BANKLINE SHARPEN CLUSTERS
- LARGE WOODY DEBRIS
- BENTON ARMCHAIRING STRUCTURE

DATE: 10/1/2010

PROJECT: REACH B CHANNEL DESIGN

LOCATION: REACH B CHANNEL DESIGN

SCALE: 1" = 100'

0 100 200

02

Ongoing Swan River Restoration Goals



- Continue restoration of Stream Reach B (remainder of County/Town Open Space) based upon recent successes and lessons learned
- Work with partners and stakeholders to restore dredged areas on public and private properties
- Work with upstream private land owners to implement restoration work

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