THE CLARK FORK RIVER REACH A REMEDIATION AND RESTORATION PROJECT

Bill Bucher, P.E.

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WATER + ENVIRONMENT + TRANSPORTATION + ENERGY + FACILITIES
The Clark Fork River Reach A Remediation and Restoration Project

- Project Background
- Design Approach
- Construction Status
- Results to Date (monitoring)
Introduction

- **Clients**
  - Montana Department of Environmental Quality
  - Montana Department of Justice
  - Department of Interior – Grant Kohrs Ranch
  - Environmental Protection Agency - Oversight

- **Engineers**
  - CDM Smith
  - TetraTech
  - TerraGraphics
  - Dowl

- **Other Consultants**
  - Applied Geomorphology - Geomorphology
  - Geum Environmental Consulting – Vegetation Design
  - RESPEC - Monitoring
Site Background

- Upper Clark Fork River Operable Unit
  - Part of the largest complex of Superfund Sites in the USA
  - Mine waste contamination from historic mining in the Butte - Anaconda region
  - Sites were listed in the early 1980s
  - Some sites are partially or largely remediated
  - Upper Clark Fork River remediation began in 2013
  - A 15 year remediation effort
Project Location
Project Objectives

- Remove tailings and contaminated soils from the floodplain
- Stabilize contaminated, eroding streambanks
- Reestablish vegetation appropriate to land use
- Meet applicable surface water and groundwater standards
Regulatory Guidance

- Record of Decision (2004)
- This is primarily a remediation project
- Restoration by DEQ is limited to what is necessary to produce a functioning stream and floodplain
- Additional restoration conducted by the Natural Resource Damage Program (Department of Justice)
Magnitude of Project

- 45 river miles between Warm Springs and Garrison
- Tailings removal volume on the order of 5,000,000 cy
- 15-year time frame for project
- Estimated cost of $137,000,000 (net present value 2013 dollars)
- Need for a coordinated design approach
Overview of Design Process

- Set remedial strategies based on project objectives
- Develop appropriate design criteria
- Develop design elements
- Present design for review by landowners, clients and Technical Review Committee
  - Landowner Plans
  - Preliminary Design
  - Draft Final Design
  - Bid Package
Remedial Design Strategies

- Tailings – Remove and dispose at central repository
- Where feasible, reconnect the floodplain and river subject to landowner constraints
- Reinforce floodplain areas subject to higher risk of erosion
- Preserve well vegetated streambanks that have low risk of accelerated erosion
- Stabilize actively eroding streambanks with bioengineered treatments
Typical Existing Banks
Preserve Vegetation
Brush Trench Bank Treatment

Drawing by Geum Environmental Consulting, Inc.
Brush Matrix Bank
Double Vegetated Soil Lift

Drawing by Geum Environmental Consulting, Inc
Double Vegetated Soil Lifts Installed
CONSTRUCTION TO DATE

- Four phases of 22 constructed

<table>
<thead>
<tr>
<th>Project</th>
<th>Year Completed</th>
<th>Removal Area (acres)</th>
<th>Tailings (cy)</th>
<th>Stream Length (mi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>2014</td>
<td>64</td>
<td>332,000</td>
<td>1.3</td>
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<tr>
<td>Phase 2</td>
<td>2016</td>
<td>131</td>
<td>472,000</td>
<td>1.9</td>
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<tr>
<td>Phases 5 &amp; 6</td>
<td>2016</td>
<td>136</td>
<td>539,000</td>
<td>4.5</td>
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<tr>
<td>Totals to Date</td>
<td></td>
<td>331</td>
<td>1,343,000</td>
<td>7.7</td>
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</tbody>
</table>
Phases 1 and 2
Tailings Removal
Tailings Dewatering

- Trenches or wellpoints
- Sediment ponds for settling solids
- Discharge to river after treatment
Tailings Dewatering
Alluvium Borrow Area
Backfill Materials
Bank Layout
Monitoring Program

- Perform Qualitative Rapid Assessments (QRA) for vegetation and geomorphology

- Objectives:
  - Evaluate a project phase to see if it is trending towards meeting goals and objectives
  - Determine effectiveness of required monitoring
  - Identify maintenance actions.

- Monitor geomorphology first year, monitor vegetation first and second years.

- After initial monitoring, geomorphic and vegetation monitoring occurs on year 5 and continuing at 5-year intervals.
Monitoring Program

- Monitoring instituted at Phase 1 in 2015 and 2016 although some monitoring was also conducted in 2014.
- Monitoring at Phases 5 and 6 began in 2016 for geomorphology with limited vegetation monitoring primarily in Phase 5.
Phase 1 Geomorphic Evaluation – 2015 & 2016 QRA

- Conducted by Applied Geomorphology and RESPEC
- Channel Stability – largely stable
- Floodplain stability – No designed floodplain channels creating elevated avulsion risk
- Floodplain Elevation – Clear evidence of floodplain inundation with wood mobilization and fine sediment deposition.
Phase 1 Geomorphic Evaluation – 2015 & 2016 QRA

- Out-of-bank flow in 2014 caused small avulsion paths across one meander tab.
- Banks heights are design approximately to the height of the two year recurrence flood event.
- Flow in 2014 was about 40 cfs higher than 2-year recurrence event.
Phase 1 Geomorphic Evaluation

- Erosion due in part due to design and construction variance.
- Avulsion paths were backfilled and planted, upstream bank was elevated.
Phase 1 Geomorphic Evaluation

- Some slumping of Double Vegetated Soil Lifts but none requiring maintenance
- Fabric used for Double Vegetated Soil Lifts (high strength woven coir) is disintegrating faster than expected but not a concern as long as willows are establishing.
- Willow growth is generally very robust in stream banks.
Phase 1 Vegetation Evaluation 2015 & 2016

- Conducted by Geum and RESPEC
- Canopy Cover Woody Vegetation on Streambanks – trending towards 40% cover (5-year goal)
- Canopy Cover Woody Vegetation on Floodplain – Trending towards 30% cover (5-year goal)
Phase 1 Vegetation Evaluation 2015 & 2016

- Herbaceous Vegetation on Floodplain – Majority of plots meet 20% cover by year 1; trending towards 5-year performance goal of 80% cover.
- Planted Woody Vegetation Survival – Majority meet 80% survival in year 1 but fell below 80% in year 2; however, overall canopy cover is increasing.
Phase 1 Vegetation Evaluation 2015 & 2016

- Herbaceous plantings are meeting goals.
- Browse protection is helping woody plant establishment but is not entirely effective.
- Complete wildlife exclosures are most effective.
- Also recommend installation of browse protectors in outer bank planting units of Phase 1.
- Recommended repairing exclosures and browse protectors.
Phase 5 Vegetation Evaluation 2016

- Canopy Cover of Woody Cover on Streambanks – 42% of plots are meeting 5-year goal of 40% cover.
- Woody Vegetation survival – 71% of plots meeting 80% cover (5-year goal).
- Incomplete evaluation of floodplain cover for woody vegetation and herbaceous plants.
## Monitoring Summary

### Table from Qualitative Rapid Assessment 2015-2016 Status Report, Geum and Applied Geomorphology, 2017

<table>
<thead>
<tr>
<th>Related Monitoring Plan Metrics</th>
<th>Phase 1</th>
<th>Phases 5 and 6</th>
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<tbody>
<tr>
<td></td>
<td>2015 (Year 2)</td>
<td>2016 (Year 3)</td>
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<tr>
<td><strong>GEOMORPHOLOGY</strong></td>
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<tr>
<td>Channel Stability</td>
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<td>Channel dimensions</td>
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<td>Slope and Sinuosity</td>
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<td>Bedform complexity</td>
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<td>Bank erosion and channel migration</td>
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<tr>
<td><strong>Floodplain stability and secondary channel stability</strong>^2</td>
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<tr>
<td><strong>Floodplain connectivity</strong>^2</td>
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<tr>
<td><strong>VEGETATION</strong></td>
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<tr>
<td>Canopy cover woody vegetation on streambanks</td>
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<td>Canopy cover floodplain woody vegetation</td>
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<tr>
<td>Canopy cover of herbaceous vegetation</td>
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<tr>
<td>Woody vegetation survival</td>
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Table from *Qualitative Rapid Assessment 2015-2016 Status Report*, Geum and Applied Geomorphology, 2017
Summary

- The Clark Fork River project is a large-scale river and floodplain remediation project with restoration components
- Described the design approach
- Presented a summary of construction completed
- Presented monitoring results
- Project approach is on track to meet most remedial and restoration objectives.
Project Success - A Renewed River