Jennings Passive Treatment System Rehabilitation

Presenter: Cliff Denholm

Co-conspirators: M. H. Dunn, T. P. Danehy, C. A. Neely, R. M. Mahony, S. L. Busler, B. J. Page,
Slippery Rock Creek Watershed

Jennings Environmental Education Center

Pittsburgh
Jennings Background

- Special place
- Located within a PA State Park and Environmental Ed. Center
- One of the oldest, most monitored and successful passive treatment systems within Pennsylvania.
- Educational program for thousands of people every year who have an opportunity to learn about the culture and history of coal mining in Pennsylvania as well as AMD, water treatment, and land reclamation
- Mining professionals from South Africa, South Korea, Australia, Brazil, and Peru have also visited the site to view the technologies being demonstrated.
Brydon Mine

Operated Approximately 1935 to 1944
Middle Kittanning drift mine
Operation Scarlift

- Coal Refuse Removal
- Mine Seals
- Revegetation
### Original Wetlands System

** Constructed ~1988

<table>
<thead>
<tr>
<th>Point</th>
<th>Flow LPM (GPM)</th>
<th>pH</th>
<th>Alk mg/L</th>
<th>Acid mg/L</th>
<th>T. Fe mg/L</th>
<th>T. Al mg/L</th>
<th>T. Mn mg/L</th>
<th>SO4 mg/L</th>
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</thead>
<tbody>
<tr>
<td>In</td>
<td>129 (34)</td>
<td>2.9</td>
<td>0</td>
<td>258</td>
<td>22</td>
<td>19</td>
<td>6</td>
<td>516</td>
</tr>
<tr>
<td>Out</td>
<td>NA</td>
<td>3.3</td>
<td>0</td>
<td>154</td>
<td>15</td>
<td>14</td>
<td>6</td>
<td>519</td>
</tr>
</tbody>
</table>
ALD – Installed 1993
Plugged with Al within ~9 months

<table>
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<th>T. Fe mg/L</th>
<th>T. Al mg/L</th>
<th>T. Mn mg/L</th>
<th>SO4 mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>In</td>
<td>NA</td>
<td>3.3</td>
<td>0</td>
<td>NA</td>
<td>81</td>
<td>21</td>
<td>9</td>
<td>691</td>
</tr>
<tr>
<td>Out</td>
<td>92 (24)</td>
<td>6.3</td>
<td>177</td>
<td>NA</td>
<td>62</td>
<td>&lt;1</td>
<td>9</td>
<td>680</td>
</tr>
</tbody>
</table>
1997 VFP Built – Student Labor
Completed VFP with Overdrain

- 300 Tons (272 Metric Tons) mushroom compost
- 280 Tons (345 Metric Tons) #9 limestone aggregate
- 7-10 year design life of substrate
- 2004 – 2007 would be expected to fail
Jennings History Continued

• Occasional maintenance such as stirring the treatment media in 2004 (7 yrs) and 2007 (10yrs) is believed to have extended the life of the media.

• In 2011 (14 yrs), neither backflushing nor stirring events that were conducted were able to effectively increase sufficient permeability for significant time period.

• Rehabilitation necessary
Jennings Water Quality

Components: VFP, Bioswale, SP, WLs
Construction/maintenance to date: VFP stirring (7/2004, 7/2007, 2011) and revamp, channel cleanout (education site)
AMD Source: Underground
Watershed: Slippery Rock Creek
City: Brady Township
County: Butler
State: Pennsylvania
Primary Funding Partners: PA DEP, Foundation for PA Watersheds
Stream: Big Run

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Raw</th>
<th>Effluent</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>3.0</td>
<td>6.6</td>
</tr>
<tr>
<td>alkalinity</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>acidity</td>
<td>260</td>
<td>-4</td>
</tr>
<tr>
<td>Fe</td>
<td>40</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Mn</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Al</td>
<td>15</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

Total metals mg/L, acidity and alkalinity as CaCO3 mg/L
Jennings Rehab

- VFP drained to remove spent media – started April 18, 2012
- AMD diverted temporarily to AquaFix system for treatment
Jennings Rehab

- New culvert pipe installed for better truck access to bring in materials
Jennings Rehab

- Topsoil removed & stockpiled to create staging & encapsulation area
- Used Mineral CSA as pad to encapsulate old media/mix new media
- Mineral CSA Donated by Harsco Minerals
Jennings Rehab

- Spent media and clogged underdrain bedding stone was removed from VFP and placed on CSA pad – began May 9, 2012
- Removed clogged underdrain piping
- Spent media encapsulated within mineral CSA to prevent exposure to oxygen and to maintain an alkaline condition.
Jennings Rehab

- Topsoil placed on top of encapsulated spent media
- Seeded with warm season grasses
- Drainage ditch along toe of spent media to collect water and direct into the passive system
Jennings Rehab

- Non-reactive river gravel for underdrain bedding
- 2” underdrain piping installed
- New flush valve installed
Jennings Rehab

- Updated VFP water elevation control structure installed
- New valves & raw water conveyance/distribution system
Jennings Rehab

- New treatment media mixed by excavator and placed with loader
- 281 yds$^3$ single shredded wood chips
- 281 yds$^3$ spent mushroom compost
- 388 tons high CaCO3 Vanport #8 limestone
Jennings Rehab

• Iron, vegetation, & debris removed from Bioswale to address overtopping of the berm & short-circuiting into lower wetland
• Inlet pool created
Water turned in back in July 5\textsuperscript{th} ~ 3 months from start
Jennings Post-Rehab
## Jennings Post-Rehab Data June 2013

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>Flow (gpm)</th>
<th>Field pH</th>
<th>Field Alk</th>
<th>Hot Acid</th>
<th>T. Fe</th>
<th>D. Fe</th>
<th>T. Mn</th>
<th>D. Mn</th>
<th>T. Al</th>
<th>D. Al</th>
<th>SO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAW</td>
<td>25</td>
<td>3.5</td>
<td>0</td>
<td>162</td>
<td>26</td>
<td>26</td>
<td>15</td>
<td>15</td>
<td>16</td>
<td>16</td>
<td>614</td>
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<tr>
<td>VFP</td>
<td>21</td>
<td>7.4</td>
<td>312</td>
<td>-178</td>
<td>0.4</td>
<td>0.4</td>
<td>13</td>
<td>12</td>
<td>0.2</td>
<td>&lt;0.1</td>
<td>471</td>
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<tr>
<td>SP</td>
<td>21</td>
<td>7.5</td>
<td>250</td>
<td>-202</td>
<td>0.8</td>
<td>&lt;0.1</td>
<td>0.8</td>
<td>0.1</td>
<td>&lt;0.1</td>
<td>351</td>
<td></td>
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<tr>
<td>WL4</td>
<td>24</td>
<td>7.4</td>
<td>115</td>
<td>-84</td>
<td>0.4</td>
<td>0.1</td>
<td>0.3</td>
<td>0.4</td>
<td>0.1</td>
<td>&lt;0.1</td>
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Alkalinity, acidity, sulfates, and metals in mg/L; Flow in gallons per minute
## Jennings Post-Rehab Field Data

### 7-13-12 to 6-5-14

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<th>Field Alkalinity</th>
<th>Field Iron</th>
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<tr>
<td>VFP</td>
<td>18</td>
<td>6.6</td>
<td>291</td>
<td>3</td>
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<td>SP</td>
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n is variable 20-30; alkalinity and iron in mg/L; Flow in gallons per minute
Conclusions

• Acidic metal discharges can be successfully treated passively
• Maintenance (e.g., stirring & backflushing) can increase system life
• End of treatment media life is not a failure
• System performance can be restored through rehabilitation
• Encapsulation appears to be a valid option (at least so far = 2 years)
Acknowledgement

Project partners included:
• BioMost, Inc.
• Foundation for Pennsylvania Watersheds
• Harsco Mineral
• PA DEP’s Growing Greener Program
• PA DCNR Bureau of State Parks
• Slippery Rock Watershed Coalition
• Stream Restoration Incorporated
• U.S. Office of Surface Mining
• Western PA Coalition for Abandoned Mine Reclamation

Thank You to everyone who made this project a success!!!
Questions?
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