Transforming Abandoned Mine Lands into a Botanic Garden

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1988 - Horticultural Society of Western Pennsylvania formed – World-Class Outdoor Botanic Garden
1998 – Settlers Cabin Park – Allegheny County leased 460 acres for 99 years
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Mining History

• Underground Coal Mining
  • Room and pillar
  • Early 1900s
  • Pittsburgh seam

• Surface Mining
  • Contour mining
  • 1930s and 40s
  • Pittsburgh seam plus rooster
  • Resulted in 6 miles of flat bench area and highwalls
Issues

• Acid mine drainage
• Subsidence holes
• Highwalls
• Mine spoil
• Coal refuse
2004 – Hurricane Ivan

• Flooded abandoned underground mines
• Treatment → Remediation
• Remining
Many AML problems - 4 areas

• Remining/Reclamation
  • 2010 – present
  • ~30 Acres

• Woodlands AMD
  • 2012
  • Treat AMD with Drainable Limestone Bed (DLB)
  • Reestablish pond (Lotus Pond)
  • Separate flush pond

• Abandoned Mine Land Economic Revitalization (AMLER) Pilot Program
  • Reclaim highwalls, subsidence pits, shafts

• Kentucky Hollow AMD
  • Treat AMD with Drainable Limestone Bed (DLB)
  • Stream recovery
Remining/Reclamation

- Reduce AMD
- Eliminate existing highwalls and subsidence pits
- Provide stable ground for visitors center
Woodlands AMD

• Treat AMD
  • Q = 4 – 12 gpm, pH = 3.2, Acidity = 143 mg/L, Aluminum = 16.3 mg/L
  • Ideally suited for a DLB

• Reestablish pond with good WQ

• Educational opportunities
  • Visible but not intrusive

• Minimize site disturbance
  • Concrete tank
  • AASHTO #3 LS topped with #9, boardwalk and “removable” landscaping
Concrete tank (filled with 450 tons of limestone)

Perforated influent pipe (4 inch dia)

Perforated drainage pipe (8 inch dia)

Agridrain box

To solids basin (during DLB drainage)

To Asian pond (treated water)

Solar panel, battery and computer - to open and close valve in Agridrain box

Original terracotta pipe
DLB treatment effectiveness has been excellent for over 4 years of operation

<table>
<thead>
<tr>
<th></th>
<th>Flow</th>
<th>pH</th>
<th>Alk</th>
<th>Acid</th>
<th>Al</th>
<th>Fe</th>
<th>Mn</th>
<th>SO₄</th>
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<tbody>
<tr>
<td></td>
<td>gpm</td>
<td>mg/L CaCO₃</td>
<td>-----</td>
<td>mg/L</td>
<td>-----</td>
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<tr>
<td>Influent</td>
<td>4-12</td>
<td>3.2</td>
<td>0</td>
<td>143</td>
<td>16.3</td>
<td>0.6</td>
<td>0.8</td>
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<td>Effluent</td>
<td>4-12</td>
<td>6.7</td>
<td>209</td>
<td>-188</td>
<td>0.7</td>
<td>0.1</td>
<td>0.2</td>
<td>508</td>
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</table>

![DLB Effluent Graph]

Alkalinity, mg/L
Where’s the DLB?
Measured water level in DLB during flushing event to determine the flow profile.
Flushed removed 71% of the aluminum solids that were retained in the past week of treatment. This test was repeated and showed similar results with 70% of aluminum solids flushed out.

### Al, Fe, and Mn Mass Balances for the Woodlands DLB (April 2014)

<table>
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<tr>
<th></th>
<th>units</th>
<th>Al</th>
<th>Fe</th>
<th>Mn</th>
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<tr>
<td><strong>Normal operations</strong></td>
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<tr>
<td>Influent</td>
<td>pounds/week</td>
<td>13.80</td>
<td>0.44</td>
<td>0.93</td>
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<tr>
<td>Effluent</td>
<td>pounds/week</td>
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<td>0.09</td>
<td>0.14</td>
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<tr>
<td>Retained</td>
<td>pounds/week</td>
<td>13.42</td>
<td>0.35</td>
<td>0.79</td>
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<td><strong>Draining Event</strong></td>
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<tr>
<td>Total removed</td>
<td>pounds</td>
<td>9.49</td>
<td>0.35</td>
<td>0.10</td>
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<tr>
<td>% removed</td>
<td>pounds</td>
<td>71%</td>
<td>99%</td>
<td>13%</td>
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<tr>
<td>% retained</td>
<td>pounds</td>
<td>29%</td>
<td>1%</td>
<td>87%</td>
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Abandoned Mine Land Economic Revitalization (AMLER) Pilot Program

• proposes to accelerate the disbursement of $1 billion, over 5 years, from unappropriated balances in the Abandoned Mine Reclamation Fund (Fund) to States and Tribes to build new development opportunities and new jobs in communities impacted by abandoned mine lands. This $1 billion of AML funding is in addition to the AML grants already provided to States under existing law. The accelerated AML funding would be used by States and Tribes for the reclamation of abandoned coal mine land sites and associated polluted waters in a manner that promotes economic diversification and development in economically distressed coal country communities.
- Total area with AML features: ~66 acres
- Subsidence is common behind highwalls from only one strip cut.
- Subsidence is not common behind highwalls from two strip cuts. But highwalls at these locations are higher and steeper.

Legend

DEM
Slope (%)
- 0
- 10
- 20
- 30
- 40
- 50

Mining Features
- Unreclaimed AML features
- Reclaimed AML Features
- AML Features
- Surface mine extent (approximate)
- Sediment Ponds

Misc.
- Roads
- Streams
- PBG Boundary (approximate)
Funding granted to address:

- 7,100 linear feet of highwall
- 27 acres of spoil
- 2 coal refuse piles
- 30 subsidence pits
- 3 vertical shafts
- Enlarge/Relocate Woodlands flush pond
Identified AML features overlain on Pittsburgh Botanic Garden Plans
Kentucky Hollow AMD

• Treat AMD from two discharges
  • Q = 40 gpm, pH = 3.3, Acidity = 140 mg/L, Aluminum = 19.2 mg/L
  • Ideally suited for a DLB

• Recover > 6000 feet of steam

• Educational opportunities
PVC pipe (8" ID) installed

Stone aggregate

Existing wetland

Existing clay pipe (8" ID) from mine

Fernco connecting clay pipe to PVC