SOVEREIGN CONSULTING INC.
AN ENVIRONMENTAL SERVICES FIRM

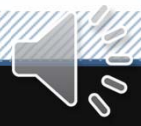
A Semi-Passive Approach to Treating AMD at a Reclaimed Coal Mine

- ❑What is Acid Mine (Rock) Drainage?
- ❑Background Information
- ❑Characterization – Data Collection/Analyses
- ❑Water Treatment Approach
- ❑Questions

Presented by:

Tyler Chatriand, PE

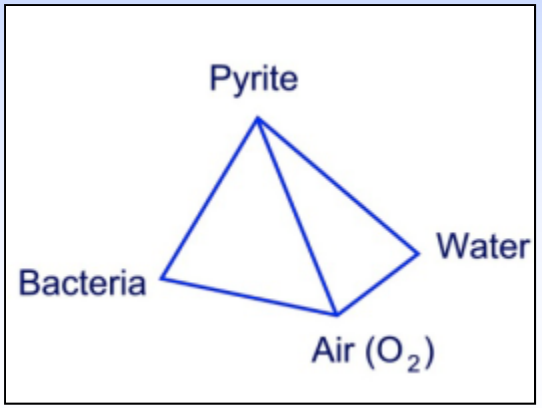
Sovereign Consulting Inc



What is Acid Mine Drainage (AMD)?

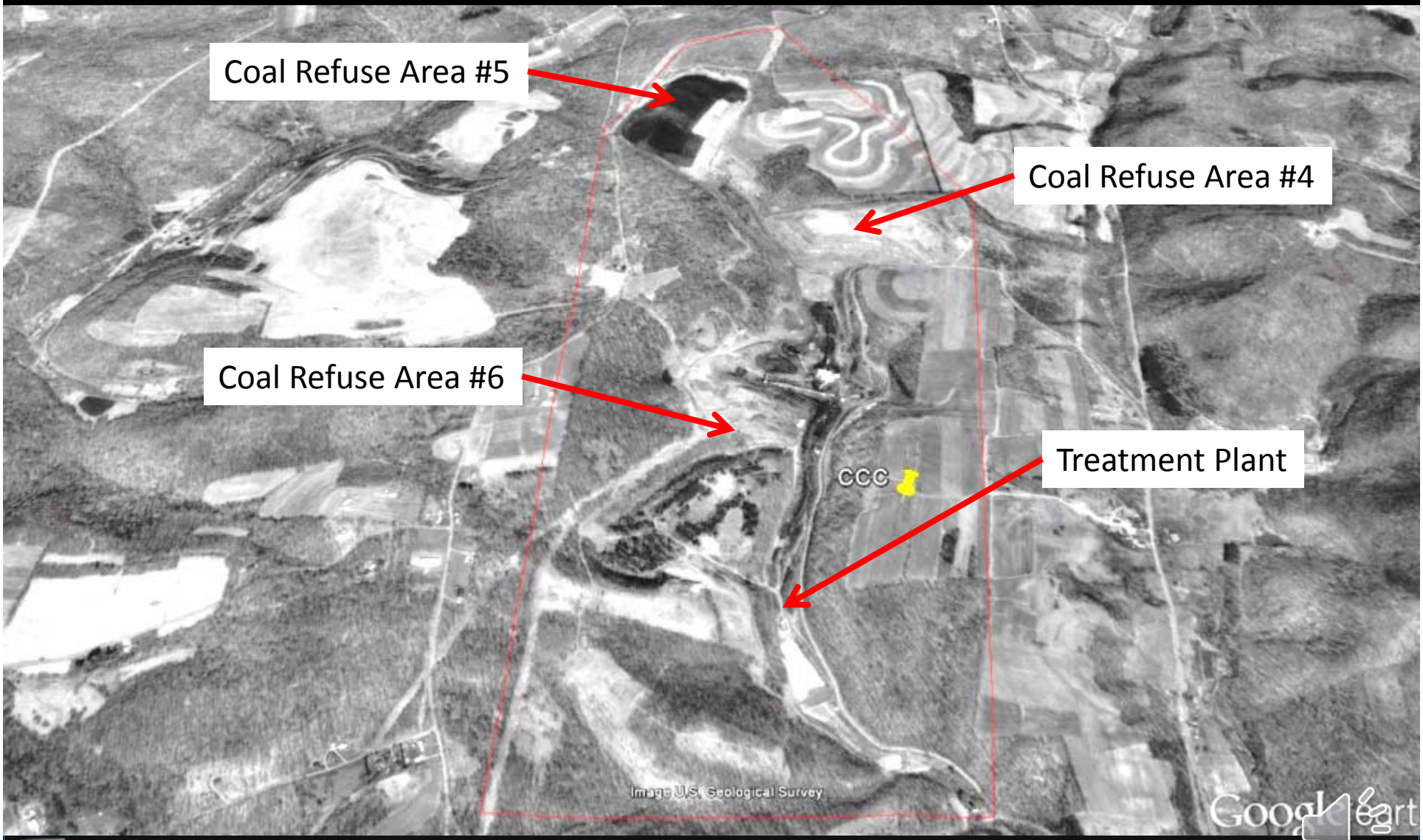
- AMD refers to the acidic water that is formed when sulfide minerals are exposed to air and water
  - Catalyzed by bacteria (Acidithiobacillus) – metabolize iron and sulfur to produce sulfuric acid

- Metal and coal deposits are often rich in sulfide minerals
  - Poor waste and water management can result in AMD
  - High dissolved metals, low pH (2-6)
  - Perpetual water treatment
  - Source control efforts



Gusek, 2004

Active Mining - 1993



Existing AMD Treatment

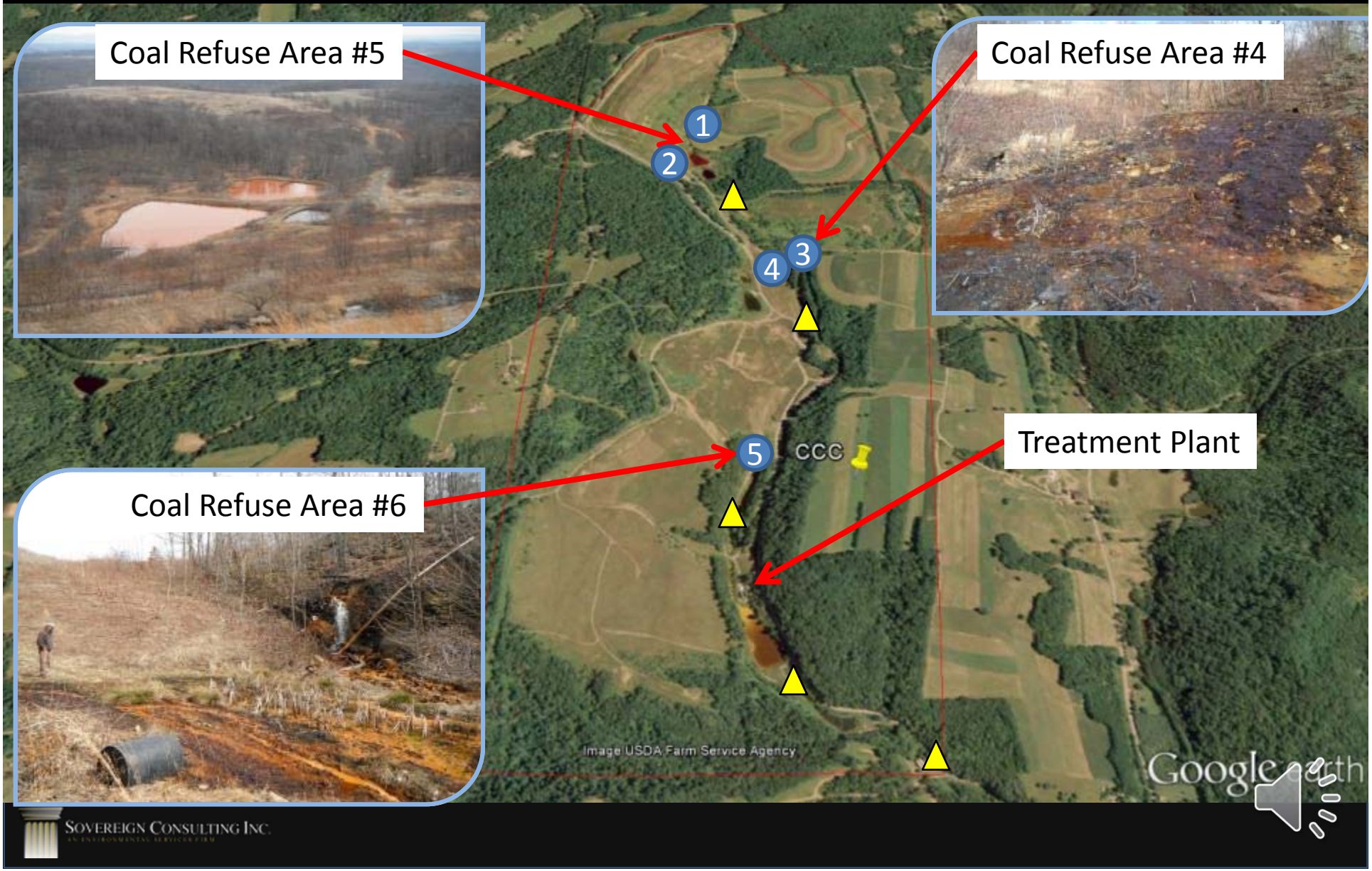
- Hydrated Lime Feed Plant
  - Mix alkaline media to neutralize pH and precipitate metals
- 25+ yrs old
- Weak structural integrity
- Inadequate pump system
- Remote – Power Outages
- Single stage treatment
  - Insufficient Mn/Al removal

- Treatment Alternatives Analysis
  - Identify and Characterize the source

Site Characterization

- Review Historical Data
- Inventory ARD Sources
- Establish Monitoring and Gaging Stations
- Evaluate Water Chemistry and Contaminant Loadings
- Identify Treatment Alternatives

Post Mining - 2013



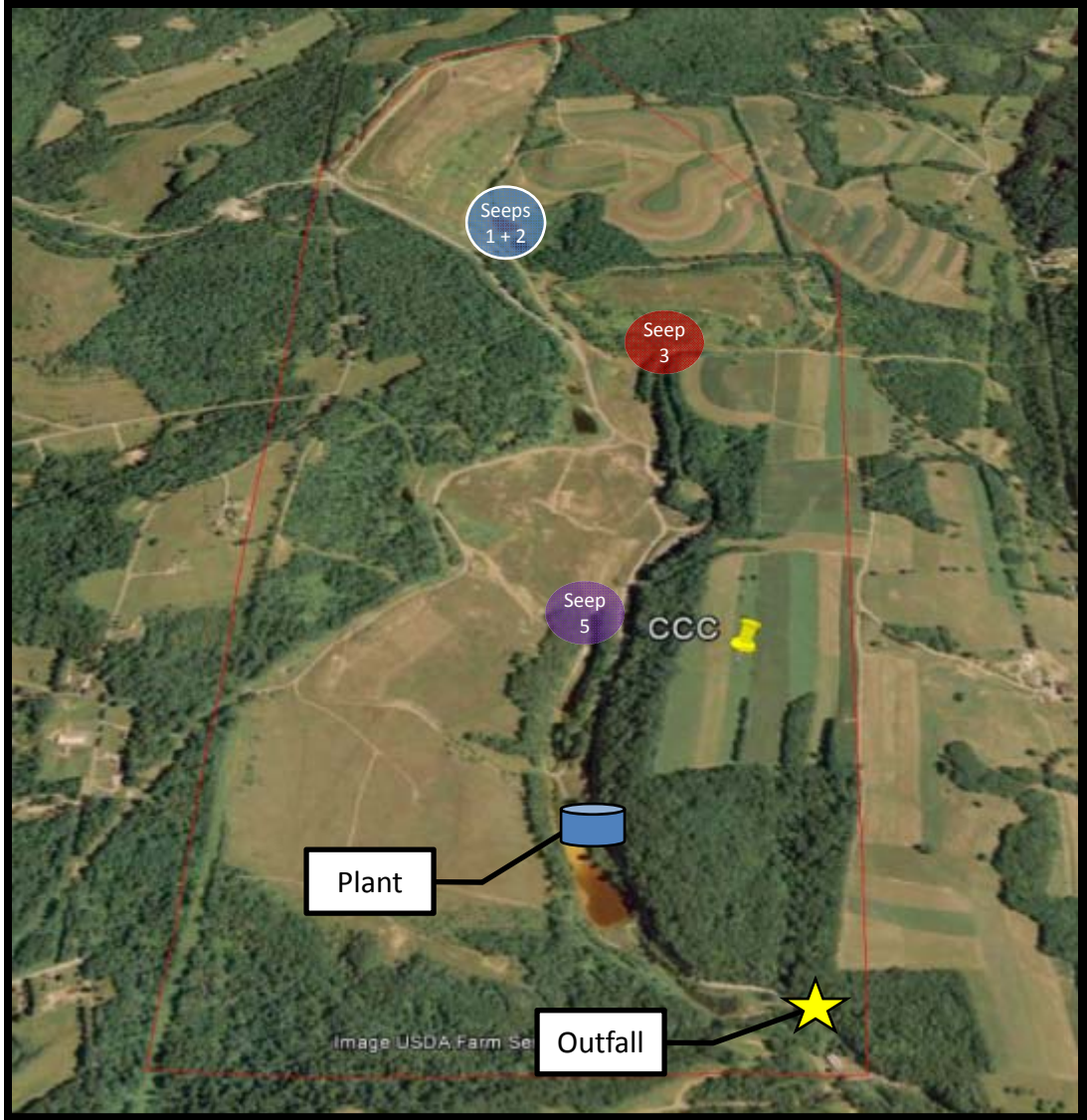
Sovereign Consulting Inc.

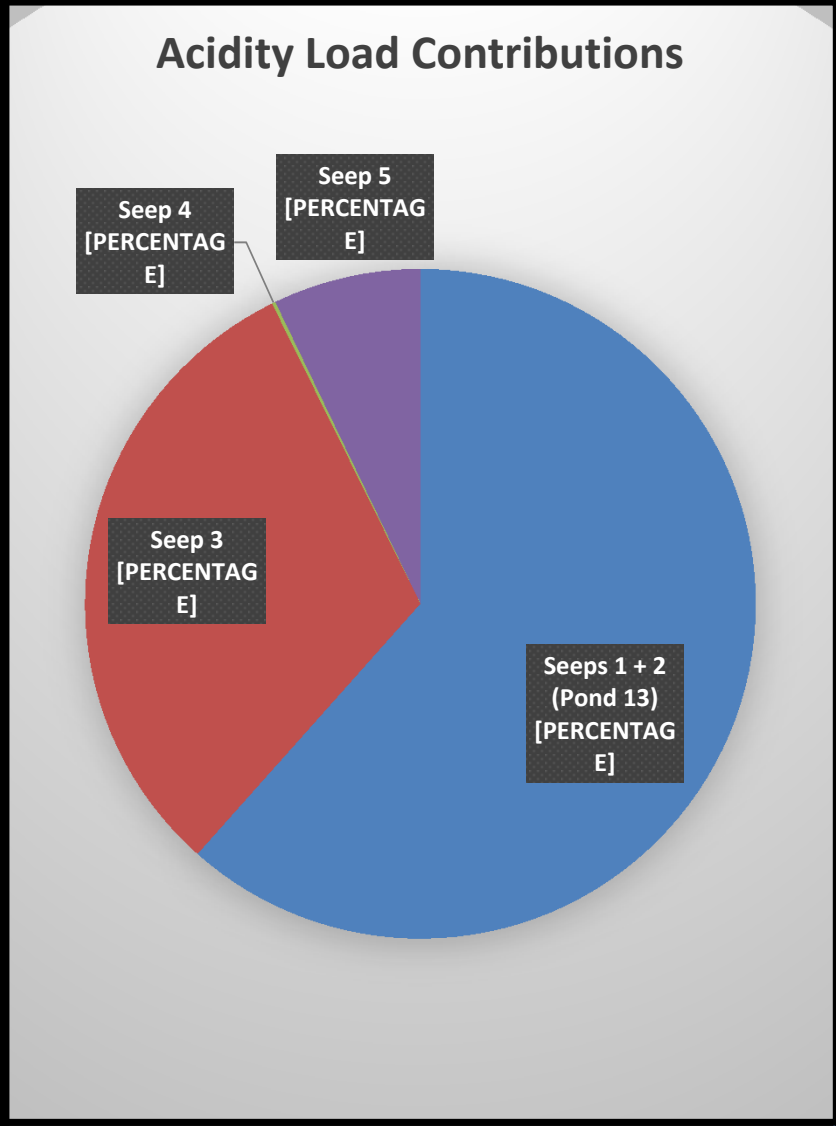
Data Analyses – Acidity Loadings

- Conceptual Site Model –
  - Acidity Loadings (pH, Fe, Al, Mn, flow rate)

- Compare acidity loadings from each source to the total acidity load observed at the treatment plant (as a percentage of the total loading at the site)
  - Identify data gaps
  - Prioritize treatment areas

Acidity Loadings Comparison





Water Treatment Alternatives

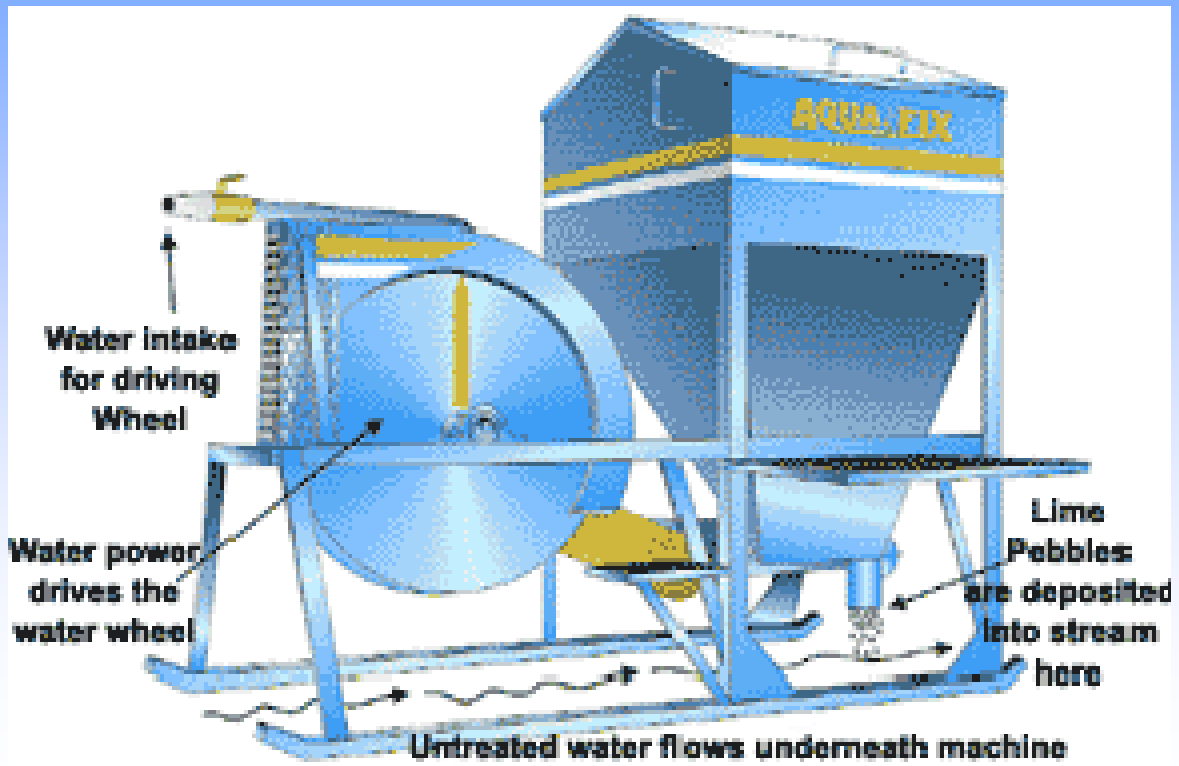
- Active Treatment
  - Uses chemicals, energy, labor, and infrastructure (high O&M)
  - Shortest HRT and smallest possible footprint

- Passive Treatment
  - Low-energy dynamics employed in natural biological and geochemical processes
    - No moving parts or power requirements
    - Long HRT and large footprint

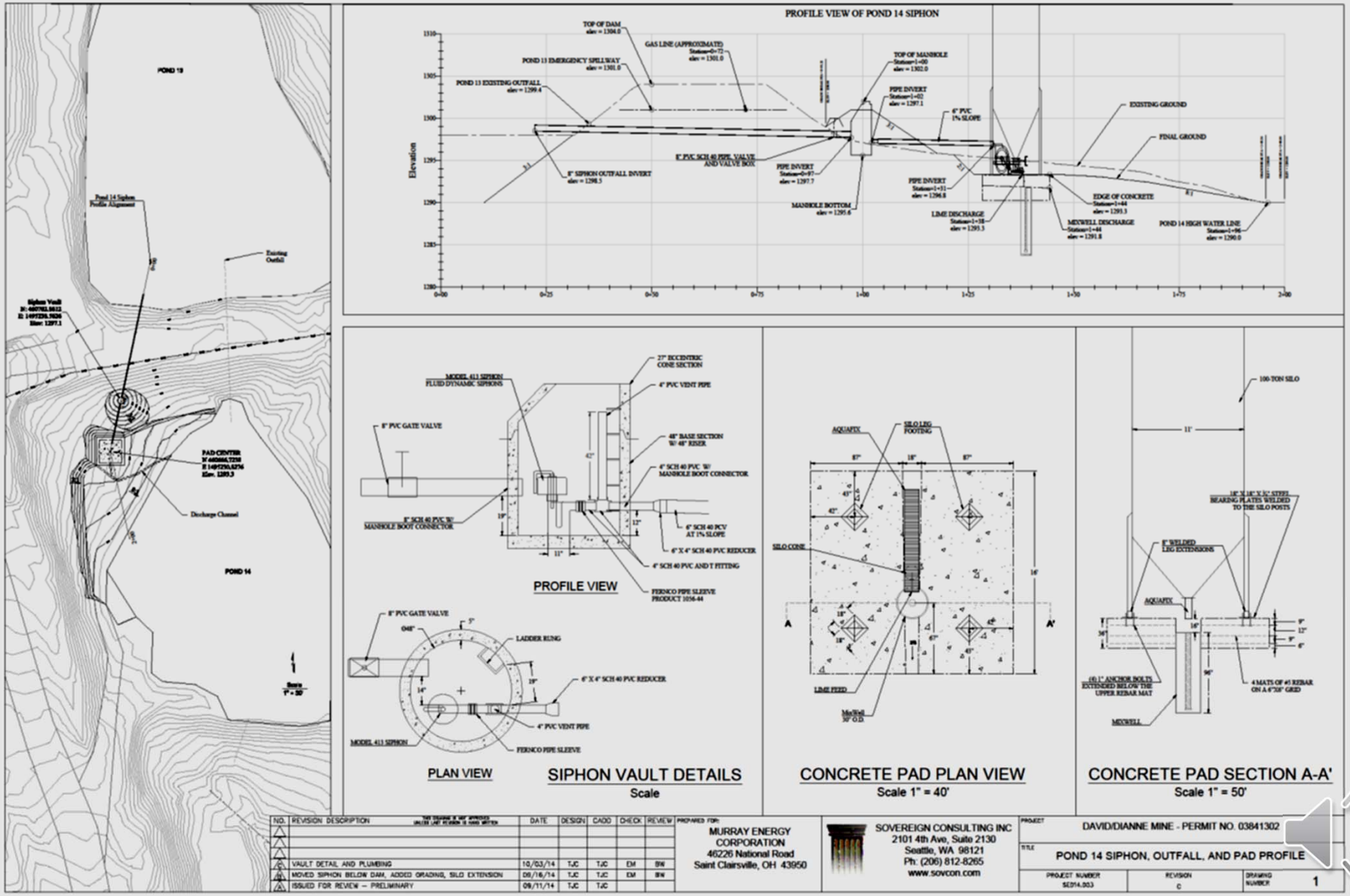
- **Semi-Passive Treatment**
  - Utilizes moving parts and chemicals WITHOUT continuous power and labor required for active systems.

Pebble Quicklime at ARD Source

- Aquafix – water wheel driven chemical feed system



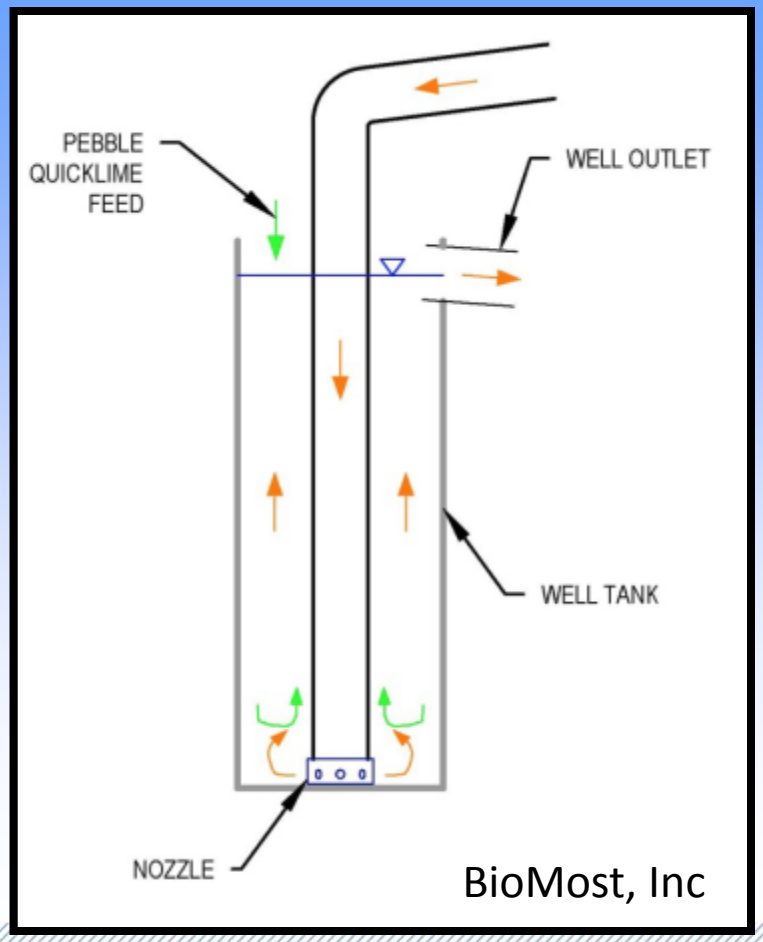
Seeps 1 & 2 Lime Dosing



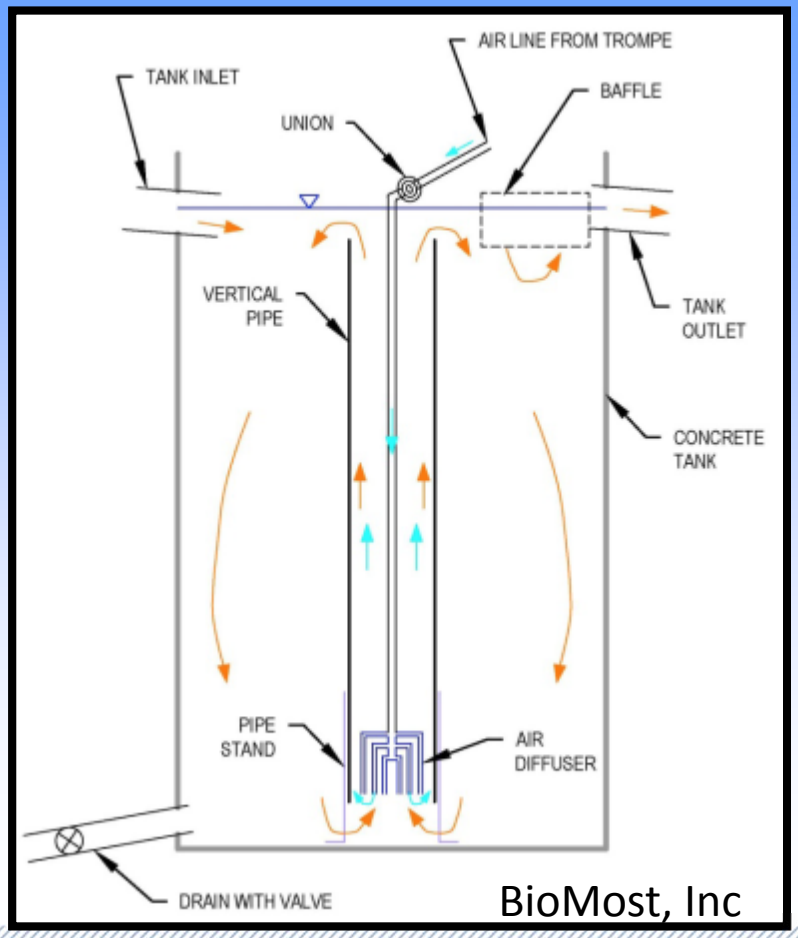
Seeps 1 & 2 Lime Dosing Footprint

Passive Mixing/Aeration – BioMost, Inc

MixWell

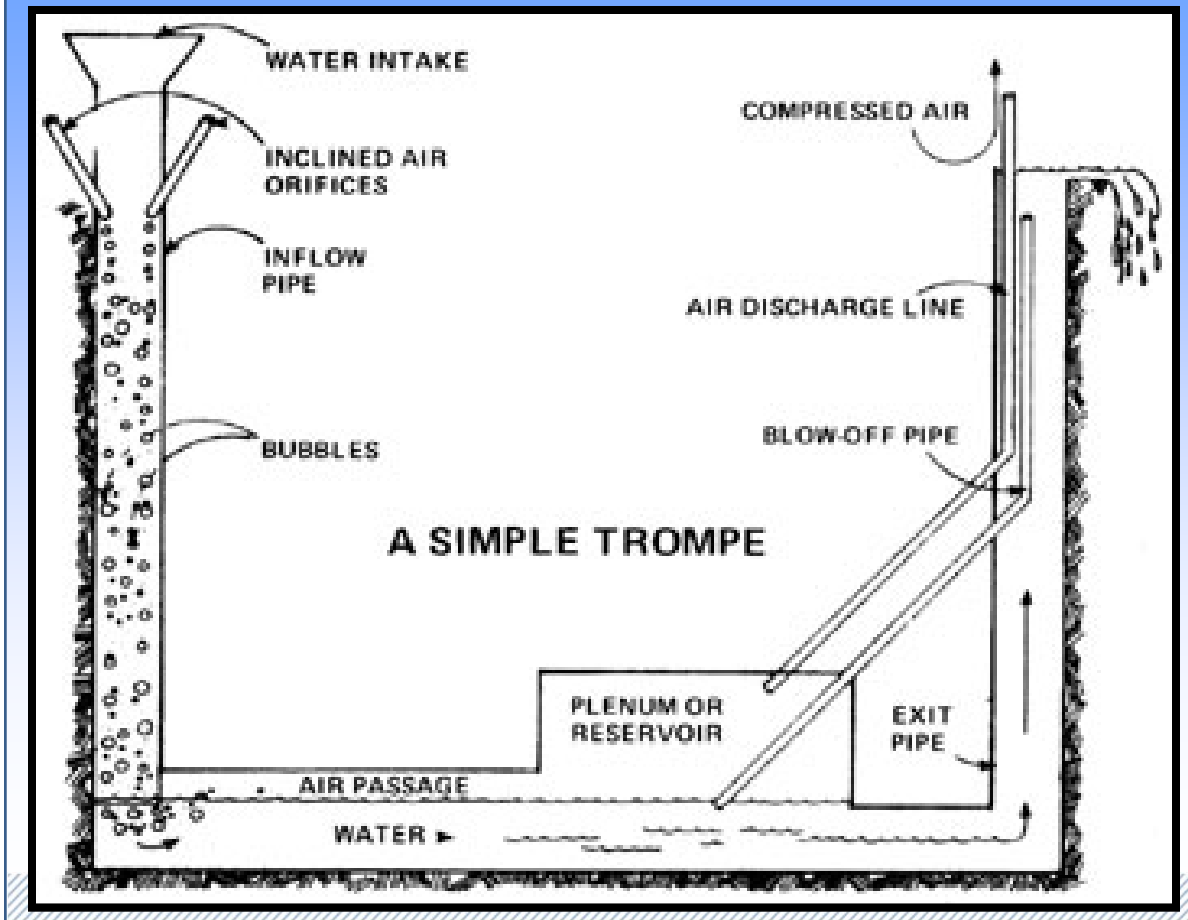


A-Mixer



Passive Aeration - Trompe

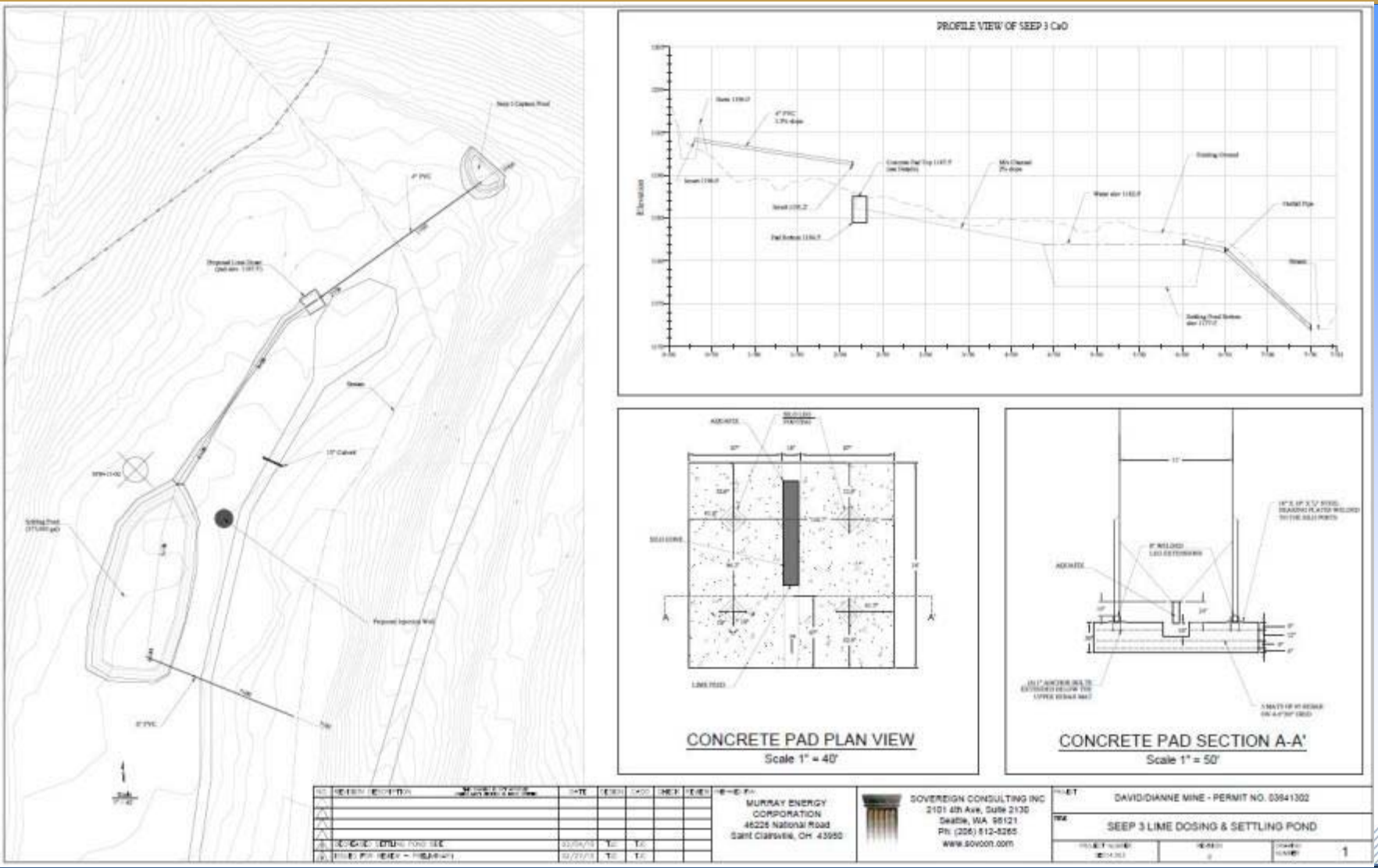
- Water-powered air compressor



- For every 4' TDH,
  = 1 cfm/25 gpm
- Pond 14 Outfall = 13'
- 3 Trompes in series
  = 4 CFM at base flow

Pond 14 Construction

Seep 3 Lime Dosing



Seep 5 Passive Treatment

- Added alkalinity from upper lime dosing systems
- “Clean” groundwater influx
- Controlled releases of stormwater ponds above the site
  - Currently piped to below permitted outfall
- Constructed Wetlands

Semi-Passive Treatment

- Capital costs << Completely Passive System
- Annual O&M costs << Active System
- No power = reliable treatment
- Treating at the source allows passive polishing systems to be installed downstream
  - Manganese removal beds
  - Open Limestone Channels
- Cost-effective bandage approach
  - Buys time to explore source control efforts

Questions?

Tyler Chatriand, PE, CFM

Environmental Engineer | email: tchatriand@sovcon.com

Sovereign Consulting Inc.

2101 Fourth Ave, Suite 2130

Seattle, WA 98121

www.sovcon.com

Phone: 206-812-8265