

Form Follows Function: Lessons From Passive Mine Water Treatment Systems

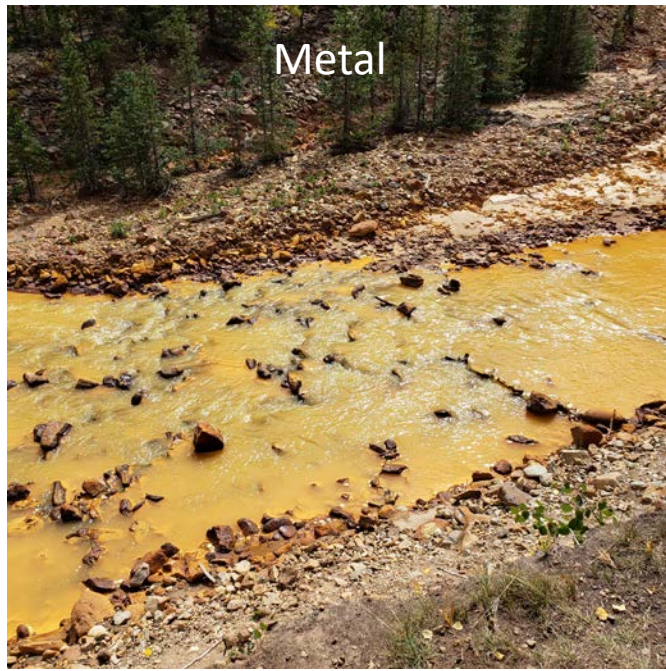
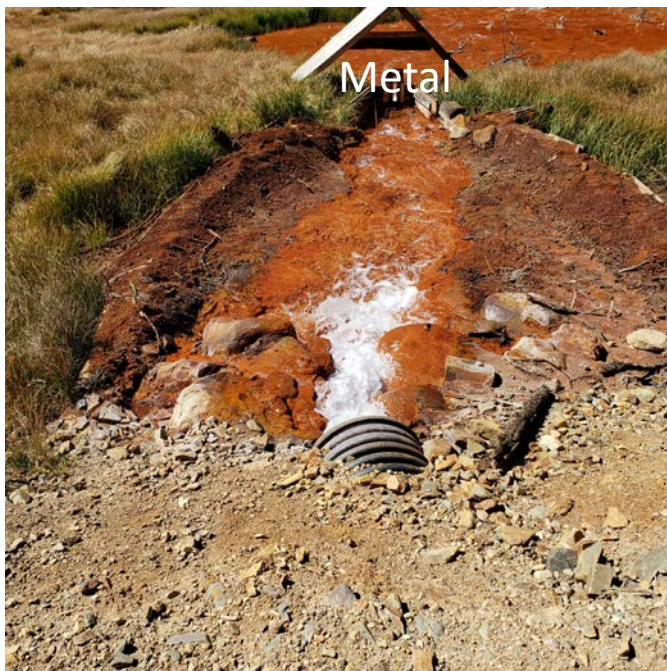
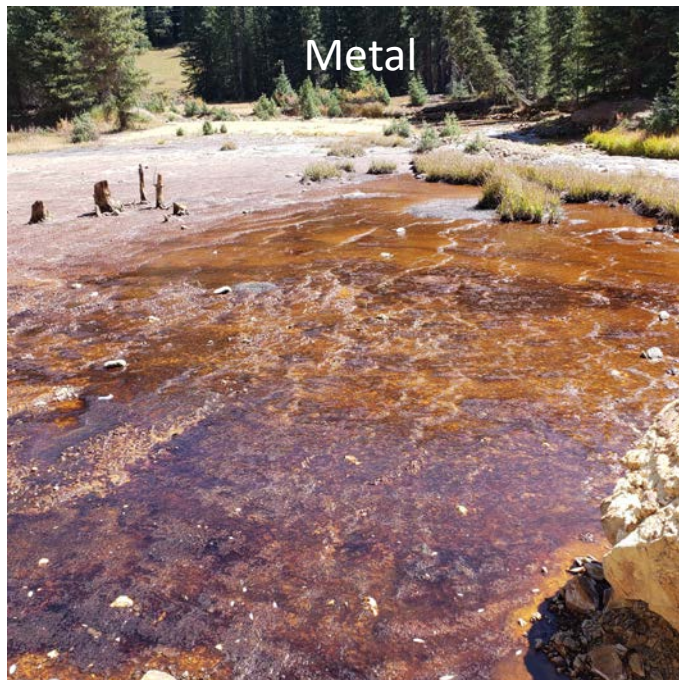
San Juan Mining and Reclamation Conference

Sept 22, 2021

Bob Hedin

Hedin Environmental, Pittsburgh PA





Theme of this talk

“Artfully transforming environmental liabilities into community assets” (AMD & Art Mission Statement)

Two examples of AMD remediation that have achieved this goal

Wingfield Pines, Allegheny Land Trust, Allegheny County, PA



Flow rate	1,308 gpm
pH	6.6
Alkalinity	404 mg/L
Acidity	-356 mg/L
Fe	14.1 mg/L
Mn	0.3 mg/L
Al	<0.1 mg/L
SO ₄	315 mg/L

Passive system design

Treatment Components

- Aerobic treatment of the net alkaline Fe-contaminated water
- Ponds where Fe^{2+} will be oxidized and settled
- Wetland for polishing (removal of Fe solids)

Auxiliary Components

- Ecological benefits
- Enable public access through the system
- Opportunities for education

Wingfield Pines System

Design Team

- Roy Kraynyk, landscape architect, landowner, project manager
- Bob Hedin, ecologist and design consultant
- Angelo Ciotti, environmental reclamation artist

Design goals

1. Develop treatment system plan that would eliminate pollution and was sustainable for 20+ years
2. Make it interesting

Design Process

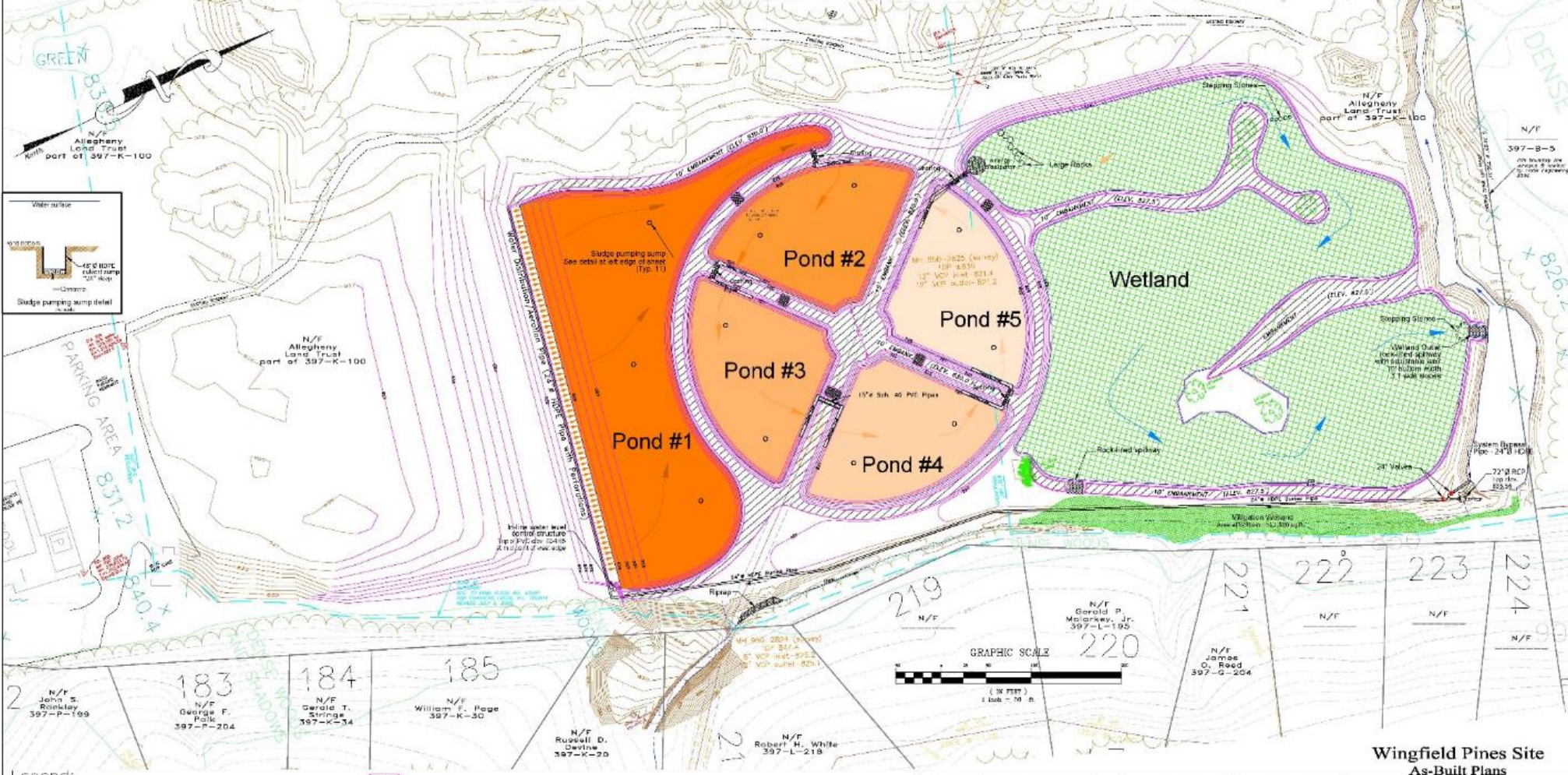
1. Design ideas proposed
2. Functionality assessed
3. Design idea revised or rejected
4. Functionality was always the primary concern





CALL BEFORE YOU DIG!
 FEDERAL AND STATE REGULATIONS FOR THE LOCATION OF UTILITIES AND DEEP EXCAVATIONS.
 CALL 811 TO LOCATE UTILITIES PRIOR TO ANY EXCAVATION.
 PA 3202A (08/04)
 10/01/08
 08/04/08-08/08/08

Contractor is responsible for placing PA OneCALL prior to excavation.



Legend:

dem
D.E.M. Surveying, P.C.
 Professional Land Surveying
 50 Industrial Park Road, Suite #1, Brookville, PA 15825
 (814) 846-8350 www.demasurveying.com

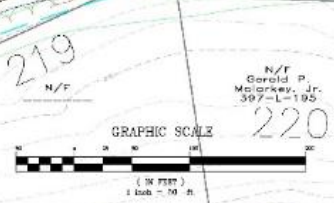
MedinEnvironmental
 www.medinenv.com

Notes:
 1. ALL NOTES ARE TO BE READ IN CONJUNCTION WITH THE DRAWINGS.
 2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPROPRIATE AGENCIES.
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No.	Date	Description	By	Check
1	02-21-05	As-Built	dem	dem
2	09-25-05	rough, pond 1, stepped	dem	dem
3	03-05-06	revisions for sewer line	dem	dem
4	09-09-07	make	dem	dem
5	05-06-07	make	dem	dem
6	02-27-07	added wetland data's.	dem	dem
7	09-07-04	make	dem	dem
8	05-29-04	revised rough locations	dem	dem
9	05-05-04	Site design	dem	dem

Wingfield Pines Site As-Built Plans
Wingfield Pines Passive Treatment System
 prepared for Allegheny Land Trust
 www.alleghenylandtrust.org
 prepared by: Upper St. Clair Township, October 2008
 prepared by: dem
 drawn by: As Shown

Point	Point 01	Point 02	Point 03	Point 04	Point 05	Point 06
Water Elev.	825.3	828.25	827.25	827.0	825.5	826.0
Bottom Elev.	815.0	815.0	815.0	815.0	815.0	815.0
Area of mainline (ft ²)	68.505	21.716	23.818	23.230	22.652	236.339



219	N/F	220	N/F	221	N/F	222	N/F	223	N/F	224	N/F
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Function

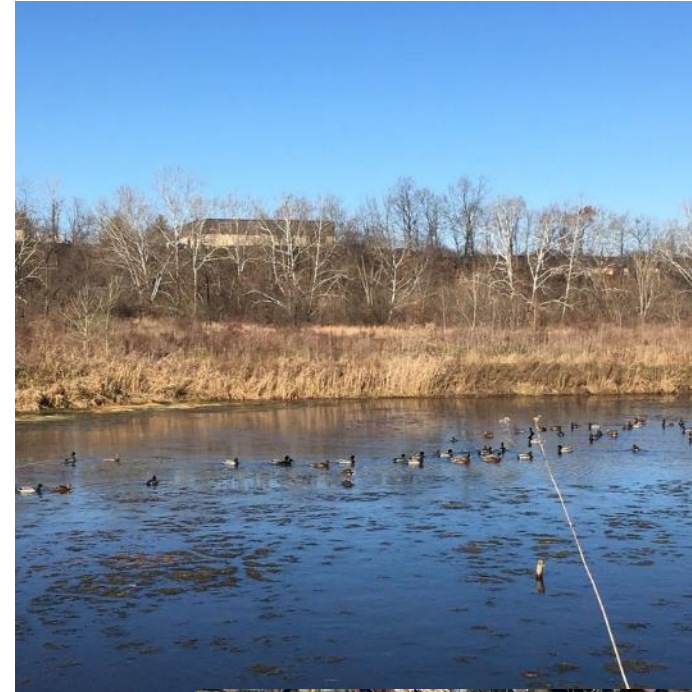


	Flow	pH	Alk	Acid	Fe	Mn	Al	SO ₄
2009-2021	gpm	s.u.	mg/L CaCO ₃		mg/L	mg/L	mg/L	mg/L
WP in	1,308	6.6	404	-356	14.1	0.3	<0.1	315
WP out	na	7.9	373	-375	0.4	<0.1	<0.1	305

Flora follows Function



Fauna follows Function





Change location ▾

Year-round, All years ▾

Wingfield Pines Allegheny County, Pennsylvania, US

Overview

Illustrated Checklist

VIEW MY...

- [My eBird](#)
 - [Life List](#)
 - [Target Species](#)
 - [Checklists](#)
- #### EXPLORE...
- [Hotspot Map](#)
 - [Bar Charts](#)
 - [Media](#)
 - [Printable Checklist](#)

194
Species observed

2090
Complete checklists

Sightings

Updated 10 sec ago.

- [Last seen](#)
[First seen](#)
[High counts](#)

[Show all details](#)

SPECIES NAME	COUNT	DATE ▾	OBSERVER
1. Cooper's Hawk	3	24 Jul 2021	Lauren Nagoda
2. Black-and-white Warbler	3	12 Jun 2021	Julie Cursi
3. Hooded Warbler	2	12 May 2021	Parker Bradley
4. Prothonotary Warbler	1	5 May 2021	John Flannigan
5. Bald Eagle	1	5 May 2021	Jacqueline Witwicki
Buteo sp.	1	30 Apr 2021	Chuck Jones
6. Northern Parula	1	19 Apr 2021	Daniel Muller
7. Northern Cardinal	30	18 Apr 2021	Brian Isett
Sharp-shinned/Cooper's Hawk	2	7 Apr 2021	Joe Papp
8. Hairy Woodpecker	6	4 Apr 2021	Molly Toth
9. Common Raven	3	21 Mar 2021	Greg Riggle
10. Common Goldeneye	1	25 Feb 2021	Ryan Tomazin
11. American Wigeon	13	23 Feb 2021	Joe Papp

Curiosity follows Function



People follow Function



Volunteers follow Function

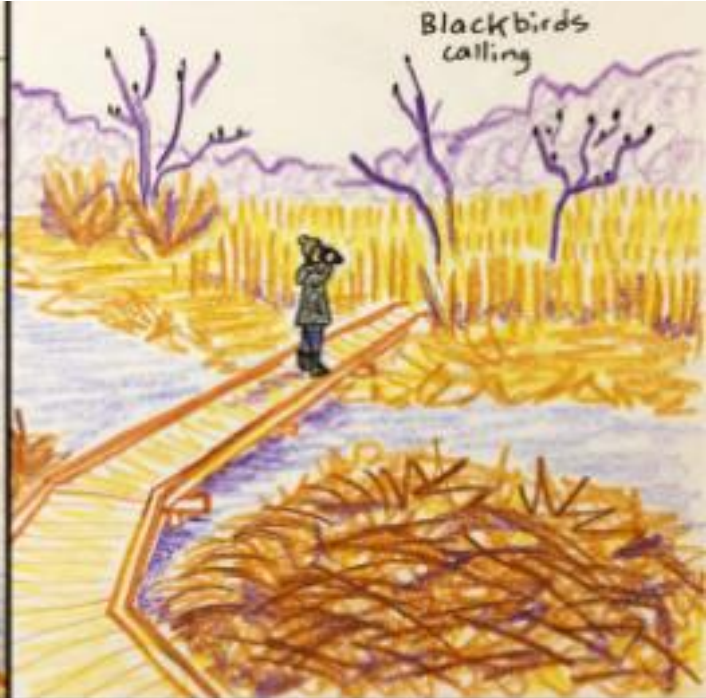


Recreation follows Function





WINGFIELD PINES PASSIVE ABANDONED MINE
REMEDIATION SYSTEM



Cartoons
follow
Function (!)

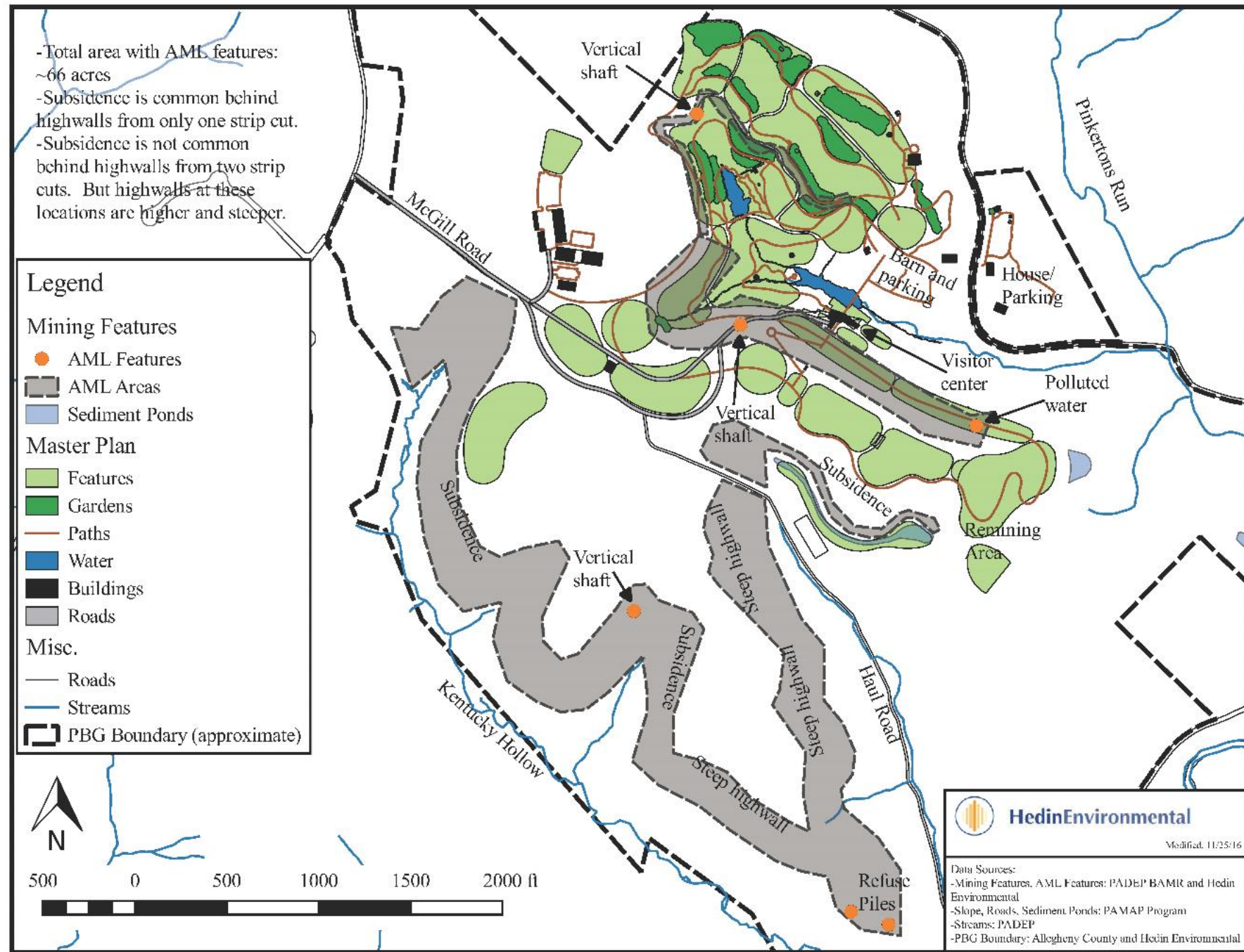
? Follows ?



Pittsburgh Botanic Garden: Lotus Pond

Pittsburgh Botanic Garden

Early plan with AML overlay





WELCOME CENTER
Begin and end your visit to the gardens and woodlands in our Welcome Center. This building opened spring 2021 and offers all the amenities for a beautiful day at the Garden, all year around.

To Gardens & Woodlands

MAP KEY

- 1 Welcome Center
- 2 Davidson Event Center
- 3 Administration Building
- 4 White Pine Grove
- 5 Nature Play Picnic Area
- 6 Heritage Homestead
- 7 Pioneer Garden, Chicken Coop & Apple Orchard
- 8 Walker-Ewing-Glass Log House
- 9 Peirce Celebration Garden
- 10 Hillside Pollinator Garden
- 11 Garden of the Five Senses
- 12 Weisbrod Learning Pavilion
- 13 Maple Court
- 14 Highmark Gazebo
- 15 Margaret Lawrence Simon Dogwood Meadow
- 16 Meadows Edge
- 17 Apiary
- 18 Hermit Hut
- 19 Bookworm Glen
- 20 European Woodland
- 21 Giant Bird Nest
- 22 Allegheny Plateau Woodland
- 23 Stepping Stones
- 24 Lotus Pond
- 25 Asian Woodland
- 26 Exhibit Garden
- 27 Orientation Station
- 28 Parking
- X Pollinator Trail
- Ⓢ Tree Times

PATH KEY

- Gravel Path
- Grass Path
- Wood Chip Path
- Concrete Path

WELCOME CENTER KEY

- Welcome Desk
- Zappala Woodland Room
- Forage & Finds
- Canopy Cafe
- Art Gallery
- Comfort Room
- Peirce Education Rooms
- A Dogwood
- B Hemlock
- Peirce Courtyard Garden

PBG Lotus Pond water source





	Flow	pH	Alk	Acid	Fe	Mn	Al	SO ₄
	gpm	s.u.	mg/L CaCO ₃	mg/L	mg/L	mg/L	mg/L	mg/L
Lotus Pond inflow	9	3.3	0	144	0.6	0.9	17.9	512

PBG Lotus Pond Remediation

Design Goals

1. Develop treatment system plan that would eliminate pollution and was sustainable with minimal operation and maintenance by PBG
2. Fit the system into the developed plans for the Lotus Pond
3. Minimize impact on existing woodland

Lotus Pond Treatment Plan

Drainable limestone bed (DLB)

- 450 tons high Ca limestone aggregate in concrete tank
- Influent distributed on surface of one side; effluent collected on bottom on opposite side
- Routine discharge from bed directly to Lotus Pond
- Bed can drained by opening gate valve at the bottom of the bed
 - Solar powered gate valve and programable controller
- Draining water (high Al solids) piped to separate sediment pond

Construction of the DLB

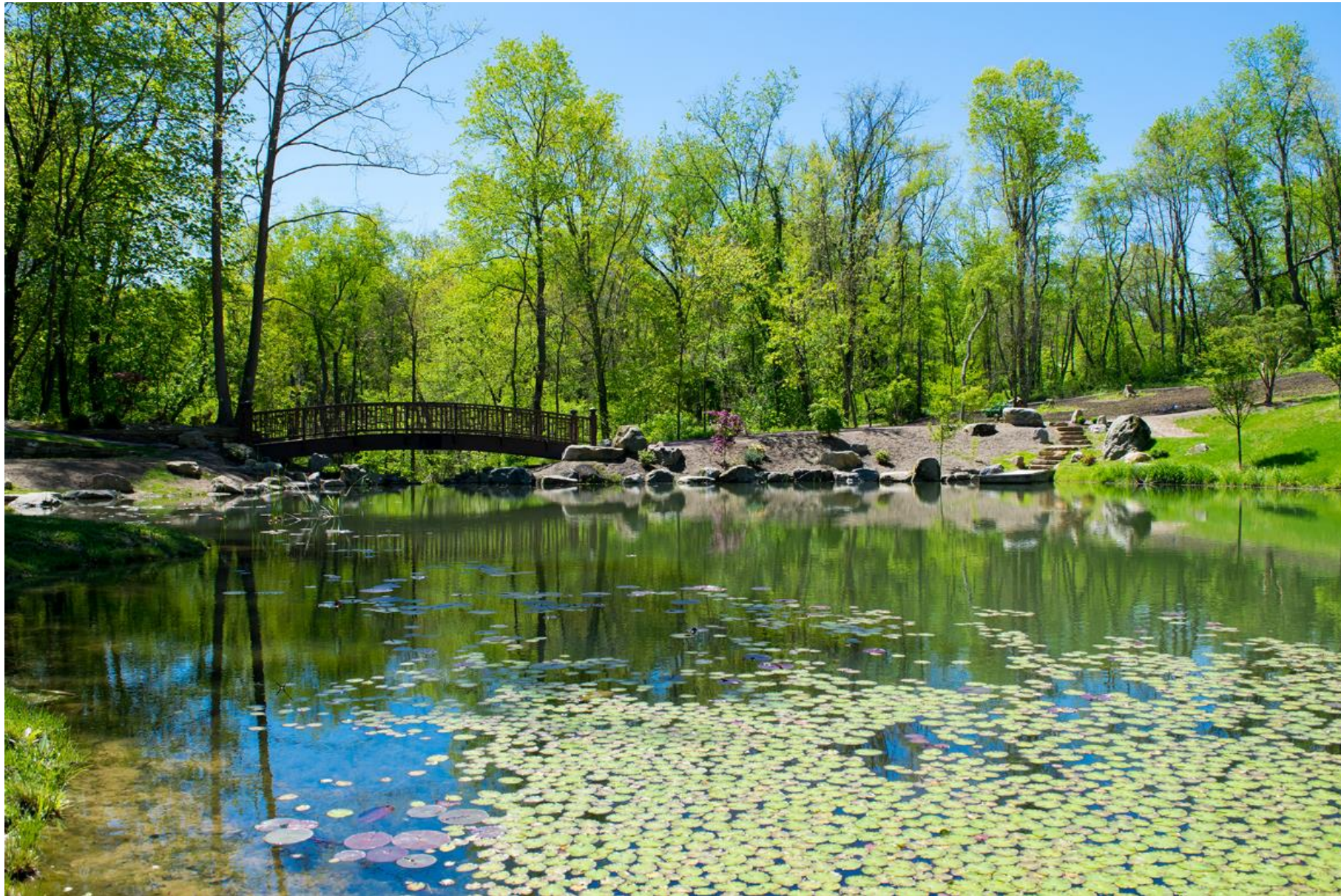


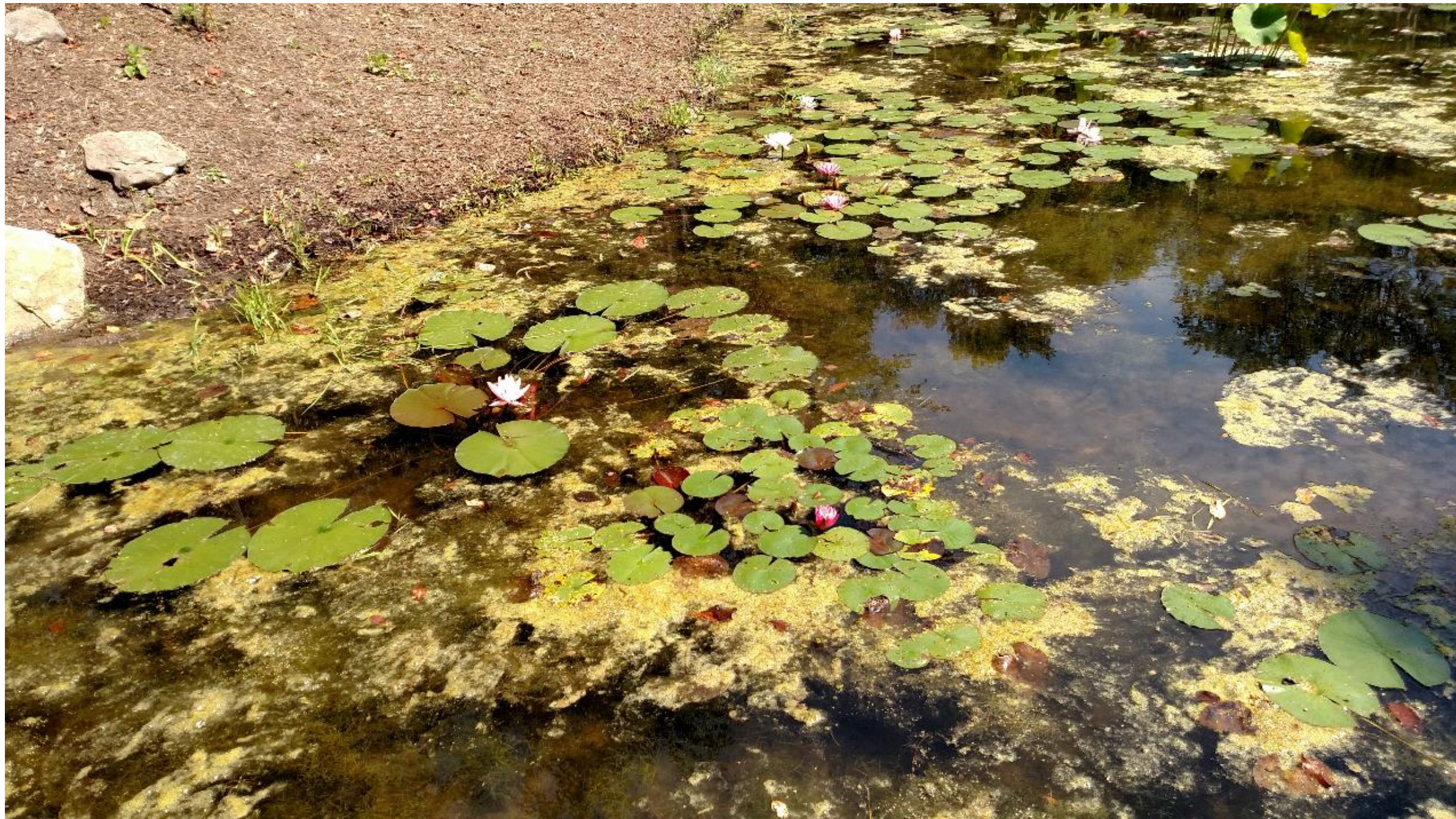
Performance of the Lotus Pond AMD Passive Treatment System, 2013 – 2021

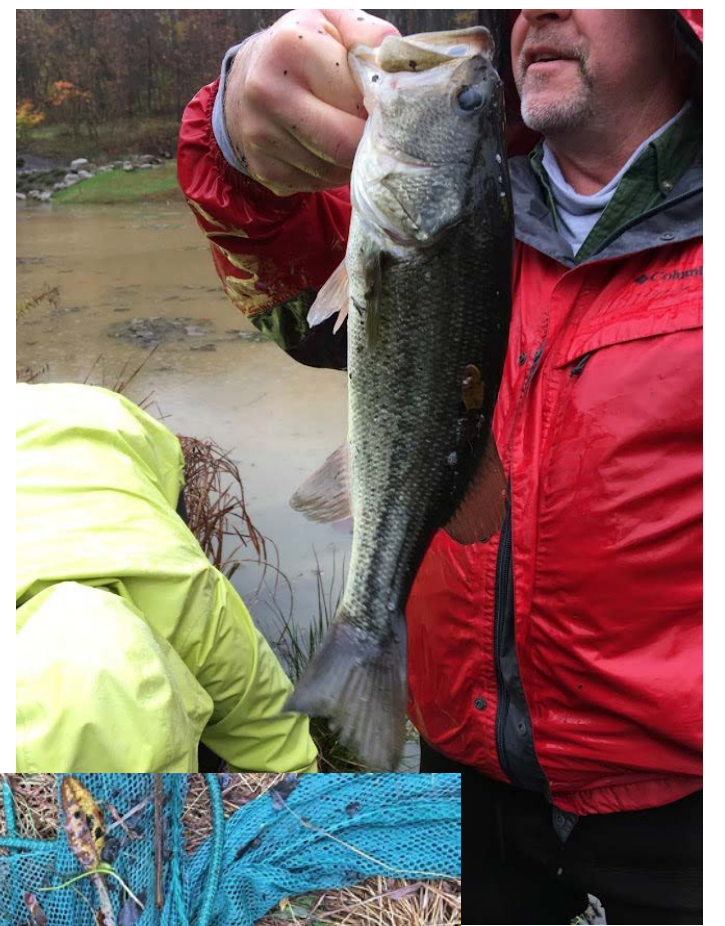
	Flow	pH	Alk	Acid	Fe	Mn	Al	SO4
	gpm	s.u.	mg/L CaCO ₃		mg/L	mg/L	mg/L	mg/L
DLB in	na	3.3	0	144	0.6	0.9	17.9	512
DLB out	9	6.7	204	-193	0.1	0.2	0.6	515
Pond out	na	7.4	na	na	<0.1	<0.1	<0.1	na























What is the take home message?

- Abandoned mine remediation sites can be special
- Sustainable functionality must be a primary concern in mine remediation projects
- Once a functional system is in place, the possibilities for benefits and growth are limitless
- Form, Ecology, Beauty, and Community Follow Function