SITE BACKGROUND

The Deer Creek Passive Treatment System was constructed in 2017 to treat acidic discharges from abandoned surface mines. The system contains a series of vertical flow ponds and settling basins as well as a separate step pool treatment area. To make sure the system operates efficiently and effectively for decades to come, a regular operation and maintenance program should be implemented so problems are corrected before they impact system performance or become very expensive to fix. This OM&R Plan provides guidance for inspection, operation, and maintenance of the passive treatment system.

TREATMENT SYSTEM

The treatment system was constructed in 2017 with funding from the EPA Nonpoint Source Program. The entrance to the site is located at approximately 25607 Shawville Frenchville Hwy, Frenchville, PA, and can be accessed through a gated haul road. A key can be obtained from the Clearfield County Conservation District to access the gate.

System components/synopsis

The Deer Creek passive treatment system has a design flow of 150 gpm due to space availability and average inflow design parameters of 130 mg/L of acidity, 25 mg/L of alkalinity, 8 mg/L of iron, 10 mg/L of aluminum, 10 mg/L of manganese and a pH of 3.2. The treatment layout consists of:

1. Mixing Basin
2. Vertical Flow Pond 1
3. Settling Basin 1
4. Vertical Flow Pond 2
5. Settling Basin 2
6. Step Pool Treatment Cells: separate from primary treatment components

A more detailed description of the system components is documented below:

AMD seeps are intercepted by the Mixing Basin, which regulates the flow entering the treatment system. The mixing basin was constructed with a 10" overflow pipe to convey flow from the Mixing Basin to Vertical Flow Pond (VFP) 1. There is also an emergency spillway constructed approximately 6" above the overflow pipe. The Mixing Basin was sized to be 875 s.f. at the top of freeboard with an overall depth of 4'. The basin will convey flows of 150 gpm to the succeeding VFP 1 via a 10" PVC pipe. Flows over 150 gpm will exit the equalization basin via an emergency spillway on the western berm where a channel will convey flows to the unnamed tributary.

VFP 1 contains a mixture of approximately 280 tons of mushroom compost in the upper 2' of the basin underlain by 4' of high-purity limestone. VFP 1 has an overall depth of 10' and is lined with a 40 mil HDPE geomembrane. The bottom 1' of the cell contains a drainage system containing approximately 500' of 6" perforated pipe bedded in limestone with geotextile on the top and bottom to provide filtration draining through a 12" solid-walled pipe leading to the settling basin. An inline water level control structure is used to regulate the water elevation approximately at elevation 1242'. The bottom of the emergency spillway is approximately 1.5' below the berm.

Settling Basin 1 has been lined with a 40 mil HDPE geomembrane. An overflow spillway was installed at approximate elevation 1238.0', and a valved drainpipe has been installed to completely drain the basin for maintenance. The settling basin was sized at approximately 7,290 s.f. at the top of freeboard with an overall depth of 4'.

VFP 2 contains a mixture of approximately 290 tons of mushroom compost in the upper 3' of the basin underlain by 5' of high-purity limestone. VFP 2 has an overall depth of 16' and is lined with a 40 mil HDPE geomembrane. The bottom 1' of the cell contains a drainage system containing approximately 360' of 6" perforated pipe bedded in limestone with geotextile on the top and bottom to provide filtration draining through a 12" solid-walled pipe leading to the settling basin. An inline water level control structure is used to regulate the water elevation approximately at elevation 1236'. The bottom of the emergency spillway is approximately 1.5' below the berm.

Settling Basin 2 has been lined with a 40 mil HDPE geomembrane. A spillway was installed at approximate elevation 1236.0', and a valved drainpipe has been installed to completely drain the basin for maintenance. The settling basin was sized at approximately 5,650 s.f. at the top of freeboard with an overall depth of 12'.

In addition to the AMD Passive Treatment System this project also included a Step-Pool type treatment system for existing impacted stormwater drainage that could not be included in the primary treatment area due to elevation differences. The Step-Pool system is constructed at the east end of the AMD treatment system and consists of three step pools with berm elevations of approximately 1238', 1236', and 1232'. The depths of the pools range from 2'-3' and water overflows through a spillway into the next pool. Each step pool is filled to the spillway elevation with a limestone and organic media mixture. This system offers some treatment to the impacted run-off waters that flow through the site into the Unnamed Tributary to Deer Creek.

The treatment system is anticipated to provide for a 90% reduction in acid load and an 80% reduction in both iron and aluminum load.

SYSTEM INSPECTION

The system should be inspected at least twice per year and following significant rain events. An inspection form is attached to this plan. This form can be used "as-is" or adapted for use by the inspection personnel. Use the "Notes" column to record any other relevant information about the site, such as signs of vandalism, sample numbers if lab samples are taken, or other information.

A system inspection involves visual observations, flow measurements, and simple water sampling. The entire process should require about two hours. The inspector can drive directly into the treatment system area.

The inspection forms provide inputs for some key observations. If no problems are apparent, then the inspection is complete. A record of the inspection, even if no problems are found, should be made. If problems exist, then additional investigation should occur as discussed in "Troubleshooting" and in the Narrative.

SAMPLING AND FLOW MEASUREMENTS

During each inspection the flow rate and pH should be measured at each sampling station. Flow can be measured using a bucket and stopwatch at the various piped outfalls of the system or with a flow meter at the final outfall. Alkalinity is also a valuable field measurement but requires a titrating device. If this is available, measure alkalinity at each sampling location. These data should be recorded on the inspection form so that changes in the system's performance over time can be recognized.

pH measurements are good indicators of the performance of the system. The system influent (Raw) has a pH between 3 and 4. All treatment system stations should have pH between 6 and 8. If stations have pH less than 6, which is verified after checking the pH meter's accuracy, then troubleshooting should occur for the poorly functioning treatment unit.

The periodic collection of water samples for laboratory analysis is recommended. The samples should be analyzed by a qualified laboratory for standard AMD parameters (pH, alkalinity, acidity, iron, manganese, aluminum, and sulfate). The laboratory should provide bottles and reagents necessary to properly collect the samples.

Deer Creek Passive Treatment System Inspection Form

Inspector _____ Date _____

Recent weather (wet, dry, cold, hot) _____

Refer to Figure 1 for the location of the inspection and sampling points included on this form

General Inspection Activities		**Response and Action**
Location	**What To Look For**	
Mixing Basin	Is the structure overflowing?	No: OK Yes: if flow is high, OK Yes: flow is not high, troubleshoot
VFPs	Discharge over the emergency spillways? Is vegetation growing in VFPs?	No: OK Yes: If flow is high, OK Yes: flow not high, adjust WLCS (troubleshoot) No: OK Yes: document and monitor
Settling Basins	Discharge over the emergency spillway?	No: OK Yes: Yes: If flow is high, OK Yes: flow not high, investigate cause and correct
Step Pool	Vegetation growth? Is water backing up near highway pipe?	No: OK Yes: document, monitor, remove if necessary No: OK Yes: If so, likely caused by vegetation growth, remove if possible, call Penn Dot if unable to fix
Berms	Signs of settling, slumping or seepage?	No: OK Yes: document and monitor
Animal Problems	Beaver or muskrat activity?	No: OK Yes: document and monitor

Problems or miscellaneous observations (continue of back of this sheet)

_____
_____
_____
_____
_____
_____
_____
_____
_____

Deer Creek Passive Treatment System Sampling Form

Inspector _____ Date _____

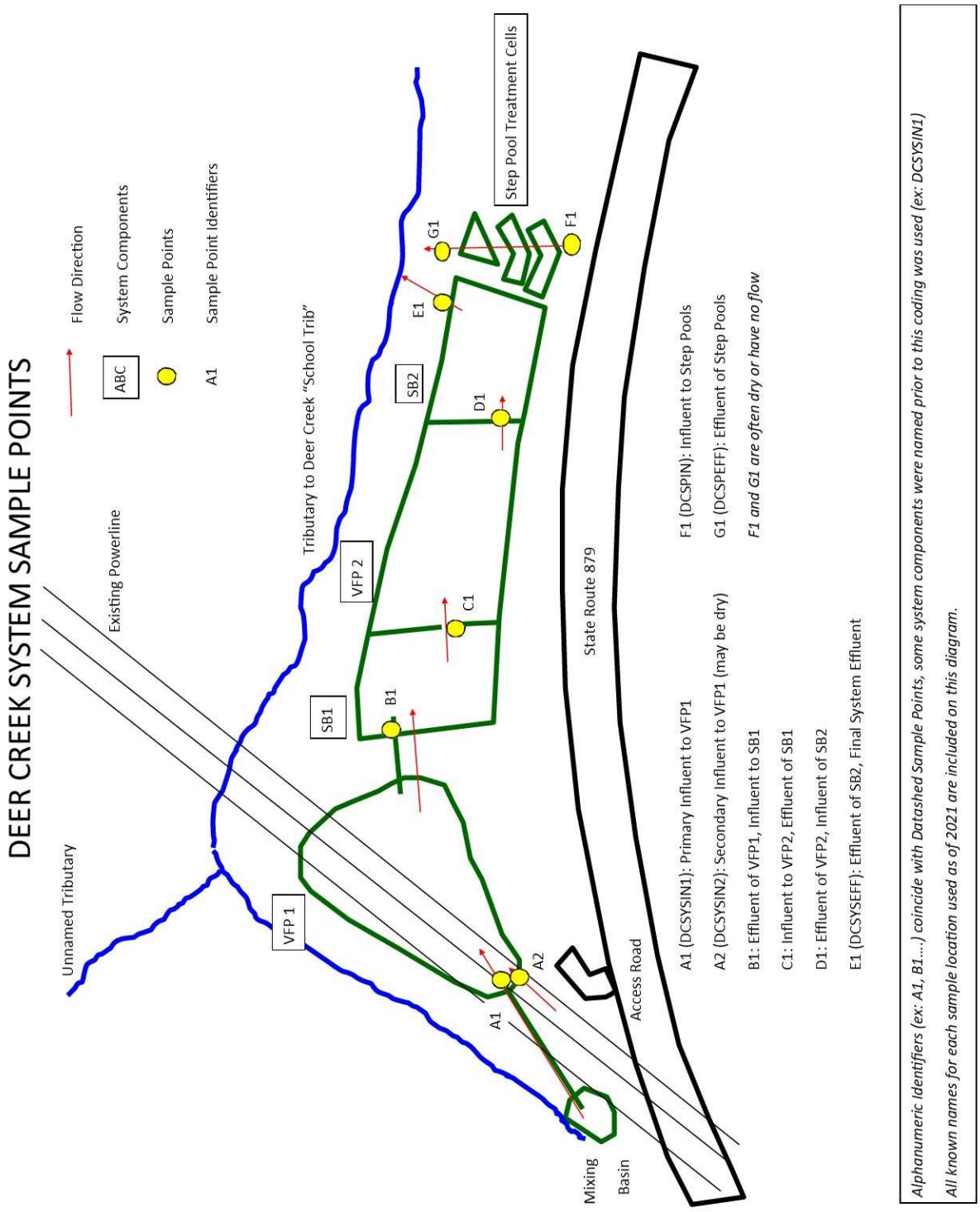
Recent weather (wet, dry, cold, hot) _____

Refer to Figure 1 for the location of the inspection and sampling points included on this form

Flow and water sampling information					
Location	**Flow (gpm)**	**pH**	**Temp**	**Alkalinity**	**Notes**
A1: VFP 1 Primary Influent					
A2: VFP 1 Secondary Influent (doesn't always flow)					
B1: VFP 1 Effluent					
C1: VFP 2 Influent					
D1: VFP 2 Effluent					
E1: Final System Effluent					
G1: Influent to Step Pools (doesn't always flow)					
F1: Effluent of Step Pools (doesn't always flow)					

Additional notes and diagrams below

Figure 1:


DEER CREEK SYSTEM SAMPLE POINTS
Flow Direction
System Components
ABC
Sample Points
A1
Sample Point Identifiers
Existing Powerline
Unnamed Tributary
Tributary to Deer Creek "School Trib"
State Route 879
Access Road
Mixing Basin
VFP 1
VFP 2
SB1
SB2
Step Pool Treatment Cells
A1
A2
B1
C1
D1
E1
F1
G1
A1 (DCSYSIN1): Primary Influent to VFP1
A2 (DCSYSIN2): Secondary Influent to VFP1 (may be dry)
B1: Effluent of VFP1, Influent to SB1
C1: Influent to VFP2, Effluent of SB1
D1: Effluent of VFP2, Influent of SB2
E1 (DCSYSEFF): Effluent of SB2, Final System Effluent
F1 (DCSPIN): Influent to Step Pools
G1 (DCSPEFF): Effluent of Step Pools
F1 and G1 are often dry or have no flow
Alphanumeric Identifiers (ex: A1, B1....) coincide with Datashed Sample Points, some system components were named prior to this coding was used (ex: DCSYSIN1)
All known names for each sample location used as of 2021 are included on this diagram.

Troubleshooting

The following table describes how to recognize, diagnose, and fix potential problems with the treatment system.

Problem	Potential Cause	Solution
Water is not reaching the system	Highway pipe could be clogged	Major problem not related to system, Penn Dot should be notified immediately
	10” pipe from Mixing Basin to VFP 1 clogged	Remove obstruction
VFPs performance (pH, alkalinity) declines over time	Organic Substrate is becoming less effective	Mix and add more limestone-amended spent mushroom compost
	Head loss evident by raising of water level	Remove boards from the water level control structure (WLCS) to increase amount of head to drive water through VFP. If problem persists, replace organic substrate.
Step Pool performance (pH, alkalinity) declines over time	Limestone and organic substrate is becoming less effective	Mix and add more limestone-amended spent mushroom compost
	Vegetation is overtaking the step pools	Remove vegetation by hand as soon as excess growth is detected
Pond integrity (animal activity is affecting system)	Muskrat activity is apparent from the presence of uprooted wetland plants and small huts made of mud and vegetation	Contact the PA Game Commission and request that the animals be removed
	Beaver activity is apparent from dams constructed in channels and sticks wedged in pipes	Contact the PA Game Commission and request that the animals be removed
	Vandalism	Repair damage, restrict access to site

Deer Creek Treatment System Maintenance Narrative

The following is a description of the system components and instructions for their monitoring and maintenance.

Water Level Control Structures

Description

A water level control structure (WLCS) is a PVC box with inlet and outlet pipes connected to its base and a series of boards that divide the interior of the box in half. Water backs up on one side of the boards in order to flow over and out the other side. Adding or removing boards raises or lowers the water level upstream of the WLCS. These boards are either 5" or 7" in height permitting various combinations of board heights to be used to achieve the desired water level. Each board has attached hooks that can be used to remove the boards. A rod made for removing boards is available on-site.

The WLCSs provide 2 functions for the treatment system. 1) They control water levels in the treatment unit immediately upstream 2) They allow the treatment unit immediately upstream to be drained manually. The treatment system utilizes 2 WLCSs. One is located at the effluent of VFP 1 and one is located at the effluent of VFP 2.

Operation and Maintenance

WLCSs installed on VFPs should be inspected for accumulation of iron. Thick accumulations of iron are difficult to remove so preventing excessive accumulation is the best strategy. If iron solids are visible on the boards, then they should be removed and cleaned. A stick or shovel may be needed to scrape some iron from the inside of the box.

WLCSs should also be inspected for blockage, tampering/vandalism.

Intake Structure

Description

Abandoned mine drainage (AMD) is directed into the treatment system by an intake structure that restricts flow to the system. This is a simple device involving a 10" pipe with a downward facing elbow in the Mixing Basin. There is a valve to limit the flow going into the VFP to 150 gpm. If the flow is greater than the maximum design flow, the excess will exit the equalization basin via an emergency spillway on the western berm where a channel will convey flows to the unnamed tributary. The maximum flow to the system should not exceed 150 gpm. During base and low flow conditions there should not be water in the channel. During high flow events, water is intentionally bypassed so the channel should contain flow.

Operation and Maintenance

The downward facing elbow on the intake is designed to prevent debris from entering the pipe. However, if some leaves and other small debris do enter the pipe, it should be transported through the pipe and out into the VFP without completely clogging the pipe. Should it become clogged, water level in the VFP or Mixing Basin can be adjusted so the ends of the pipe can be accessed and cleaned.

Vertical Flow Ponds (VFP)

Description

VFP 1 contains a 4' thick layer of limestone aggregate covered with 2' of alkaline organic substrate and VFP 2 contains a 5' thick layer of limestone aggregate covered with 3' of alkaline organic substrate. Water flows downward through the organic substrate and limestone to a network of 6" perforated lateral pipes connected to a manifold and outlet pipe, which is connected to a WLCS.

Operation and Maintenance

If the water level in the VFP is near or above the elevation of the emergency spillway during normal flow conditions, then the permeability of the organic substrate is decreasing. Remove a board from the WLCS to lower the water level in the VFP.

Over time the organic substrate is consumed and requires maintenance and replacement. After five to seven years of operation, or if monitoring data indicate a problem with the VFP performance, the VFPs should be drained to permit inspection of the organic substrate layer. The organic substrate inspection process should proceed as follows:

1. Stop flow of water into the VFP by shutting the valve on the 10" intake pipe installing
2. Remove boards from the VFP WLCS to drain the VFP below the level of the compost. It will take at least a day to drain so plan to begin draining the VFP the day before the inspection.
3. Using a shovel, dig several holes in the organic substrate to expose profiles of the full thickness of the substrate. The organic substrate will be light brown to gray where it has been exhausted. Viable organic substrate will be dark brown to black. The relative thickness of the exhausted versus viable layers can be used to estimate how much time is remaining until the organic substrate is completely exhausted. The substrate should be replaced or rehabilitated when the viable thickness is less than 6 inches. Document the condition of the organic substrate with photos. Be sure to include a tape measure for scale.
4. Fill in the inspection hole carefully to avoid creating an easy path for water to flow through the organic substrate into the limestone below.
5. Repeat above steps for the each VFP.

VFP Minor Maintenance

Generally, minor maintenance is required after five to ten years of operation. The organic substrate will not be consumed uniformly across the VFP due to variations in flow rate through the organic substrate. As a result, the full column of organic substrate may be completely exhausted in one portion of the VFP while another portion is only partially exhausted. If inspections of the organic substrate indicate that this is the case, the organic substrate should be mixed to redistribute the viable organic substrate. Mixing can be accomplished with either an excavator or small dozer. Regardless of the equipment used, the organic substrate should be piled then redistributed uniformly.

VFP Major Maintenance

Major maintenance will likely be required after ten to fifteen years of operation. Before the organic substrate is completely exhausted, new compost should be added (the time to add compost should be determined using the inspection instructions above). Prior to adding new organic substrate, the existing organic substrate should be mixed following the "VFP Minor Maintenance" procedure. The amount of organic substrate required will depend on the amount of room in the VFP that's available to accept additional material. If permeability problems are encountered with the existing organic substrate even after it has been mixed it may require removal and disposal.

Step Pools

Description

The Step Pool treatment is intended to treat existing impacted stormwater drainage that crosses the site that could not be directed into the main treatment system due to its elevation. Each step pool contains 2'-3' of mixed limestone and organic media.

Operation and Maintenance

There are no WLCSs in intakes associated with the step pools so inspections should focus on making sure the water is flowing through the pools and vegetative growth. Vigorous vegetative growth in the step pools prevents water from efficiently flowing through them and can cause water to back up and impact a Penn Dot cross pipe under SR879. If vegetation starts to build up, it should be removed by hand as soon as possible after it starts to build up and early in the growing season. If allowed to grow uncontrolled, it may be necessary to bring in a backhoe to clean out the step pools. This was already done once by Penn Dot in 2020 and they may not be willing to provide that service for free in the future.