SR 286 Passive Treatment System

"A Pennsylvania Growing Greener Initiative"

OPERATION AND MAINTENANCE PLAN

June 2005

Center Township, Indiana County, PA

"A Public-Private Partnership Effort"

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OPERATION AND MAINTENANCE PLAN

This is the operation and maintenance plan for the SR 286 Passive Treatment System located in Center Township, Indiana County, Pennsylvania. This project is constructed just south of the town of Aultman between PA State Route 286 and Aultmans Run, a Trout Stocked Fishery. Aultmans Run flows into the Conemaugh River (Warm Water Fishery), which is a tributary to the Kiskiminetas River (Warm Water Fishery). This passive treatment system consists of a forebay with level spreader, which intercepts the discharge from a pre-existing mine water conveyance pipe from an abandoned underground mine, and an aerobic wetland with riprap spillway and "drop" pool. The mine drainage is then returned to a pre-existing channel that is now a wetland, apparently constructed by PennDOT during roadwork on SR0286, for additional settling of solids prior to entering Aultmans Run. A pipe has been set in the outlet of the vegetated channel wetland for monitoring purposes.

The Aultman Watershed Association for Restoring the Environment (AWARE) will be responsible for the maintenance of all structures in order for the passive treatment system to continue to function properly. This AMD treatment system was designed, based on the best available knowledge and technology at the time, and implemented through a public-private partnership effort coordinated by AWARE (PA non-profit) and Stream Restoration Inc. (PA non-profit). It must be recognized that the technology of passively treating AMD is relatively new. All structures were designed focusing on minimal operation and maintenance compared to conventional treatment systems. In order, however, for these facilities to effectively treat the mine drainage, periodic inspections and maintenance are required. Inspection report forms, site plan schematic with monitoring points identified, and a location map are provided in sheet protectors within this report to allow for ease in copying for field use.

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PASSIVE TREATMENT SYSTEM PROJECT OVERVIEW

Passive systems use no electricity, require limited maintenance, and use environmentally-friendly materials for treatment, such as limestone aggregate and spent mushroom compost. These systems provide a cost-effective alternative to the harsh chemicals typically used for conventional treatment of mine drainage. Passive systems can be designed to neutralize acidity and add alkalinity while providing an environment suitable for beneficial chemical reactions and biological activity. Alkalinity encourages the metals dissolved in the mine drainage to form particulates, which are then retained in channels, settling ponds and/or constructed, naturally-functioning, wetlands. In some cases, the mine discharge contains sufficient alkalinity such that no alkalinity-generating processes are needed, which is the case at the SR286 Passive Treatment System.

There are several main types of passive treatment components that can be used, often in series, to treat degraded mine drainage. These components are chosen based upon the drainage characteristics (quality and flow rate), chemical or biological reaction preferred, and available construction space. The following is a brief description of the SR286 Passive Treatment components.

Collection Systems serve to collect, intercept, and/or combine discharges and seeps as well as to convey water. The SR 286 Passive Treatment System was designed and built to utilize the pre-existing mine water conveyance piping installed beneath SR 286. No details about the collection system are known at this time.

Forebays (right) can serve multiple purposes. They can be used to convey water, provide for settling of debris, and allow for oxidation, precipitation, and accumulation of metal solids. There is one forebay at the SR286 Passive Treatment System. The forebay captures the water from the pre-existing mine water conveyance piping. The forebay outlet spillway to the wetland agitates and aerates the drainage to further encourage formation of metal solids.

Wetlands (left) are typically used in passive treatment systems to allow for the oxidation, precipitation, and accumulation of metal solids that occur when alkaline drainage issues from a minesite or after acidic drainage has passed through an alkalinity-generating treatment component. Although many treatment wetlands are angular-shaped shallow ponds with predominantly cattails, the wetlands at this site have been designed, built, and planted to look and function as natural wetlands with high species diversity to provide not only treatment but also wildlife habitat. There is one aerobic wetland at the SR286 Passive Treatment System.

SITE SPECIFIC INSTRUCTIONS

Everyone who will be involved in the operation of the site should have an understanding of, and the ability to perform, basic routine duties, such as site inspections that include evaluating channels, spillways and passive treatment components as well as water sampling and measuring flows.

PASSIVE TREATMENT SYSTEM O&M INSPECTION REPORT

To maintain the effectiveness of the passive treatment facility, the site should be inspected at regular intervals and after major precipitation events or other natural/manmade occurrences that may affect the performance or integrity of the system. Regular site inspections should be conducted on a quarterly basis for the first two years and at least annually thereafter. A qualified person should perform the inspection and complete the appropriate report(s). (See attached inspection report forms.) The inspector should keep the paper copy of the report in permanent files in chronological order at a designated location. If desired, "Datashed" can be utilized to report and to store data on a GIS-enabled database online via the website www.datashed.org.

The report should include the inspection date, the inspector's name, the organization with which the inspector is affiliated, and the start and end time of the actual inspection. The following sections correspond with the attached Passive Treatment System O&M Inspection Report.

A. Site Vegetation (Uplands and Associated Slopes)

Vegetation (i.e. groundcover) is extremely important to provide wildlife habitat and to prevent erosion. Erosion can carry sediment into streams resulting in turbidity and siltation. Sediment entering the passive components can cause loss of capacity. During inspection, overall condition of the site vegetation should be observed and numerically rated from 0 to 5. If significant areas are barren, describe the action needed as well as the location. Normal husbandry practices (such as fertilizing, seeding, mulching, removing unwanted species, etc.) should be implemented, as necessary, to maintain a stable non-erosive groundcover and viable wildlife habitat on the site.

Rating	Description	Recommended Action
0	Site barren	Revegetate as soon as practicable; temporary seeding, installation of staked straw/haybales, filter fabric, etc. may be necessary until stabilization with permanent approved seed mix
1	Site mostly barren. Only small isolated areas of vegetation present	(Same as for "0" rating)
2	Large area(s) barren	Outline approximate area(s) on Site Schematic; revegetate as described for "0" rating
3	Revegetation spotty; erosion gullies present	Outline approximate area(s) on Site Schematic; on poorly vegetated areas, seed, mulch, apply soil amendments, as necessary; install staked straw/haybales, rip-rap, etc. in gullies to control erosion
4	Successful vegetation >70% groundcover; few, isolated, minor erosion features or areas with <70% groundcover	Identify potential problem areas; note changes on future Inspection Reports
5	Successful vegetation >70% groundcover	No remedial action required

B. Access and Parking Area

A "pull-off" area along SR286 is available for parking. In addition, there is a stabilized, graded area that may be used for activities relating to maintenance, monitoring, and educational/outreach programs. **THE SR 286 PTS SITE IS LOCATED ALONG A BUSY AND DANGEROUS HIGHWAY (SR 286). TAKE EXTREME CARE!!!!**

On the inspection sheet:

- Stabilized, graded area accessible (Yes or No): Is there debris or trash? Are significant erosion gullies present?
- Maintenance required: Do portions need to be stabilized with aggregate? If so, identify area on Site Schematic. Is machinery required to remove debris?

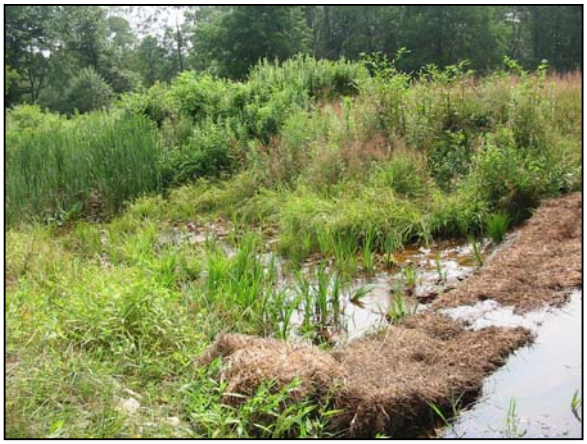
C. "Housekeeping"

The SR 286 Passive Treatment System is located on private property owned by the John Stilley. He has allowed this facility to be constructed on his property in order to help restore Aultmans Run. Please collect any litter you see during your inspection and dispose of it properly. Do not touch anything that you feel may be dangerous (such as, broken glass) or hazardous. Note these items and their location as a comment in the inspection report. Also report if the project or interpretive signs have been damaged by vandalism or other causes.

D. Vandalism

Please record any type of vandalism and evidence of trespassing on the inspection report. Note any damage to the passive treatment system. Also report any damage to the kiosk.

E. Diversion Ditches and Spillways



All diversion ditches and spillways should be inspected and maintained to minimize erosion and insure proper water handling. The channels should be kept free of obstructions that would restrict water flow. Any debris/obstructions should be removed. Vegetation should be removed from spillways if it causing significant water level increase in the component that it drains. If disturbed or eroded areas are present, then these areas should be stabilized as soon as possible with riprap or noninvasive plant species, as appropriate. Channels or ditches that carry mine drainage should be cleaned when precipitate reduces the capacity by one half.

Hay bales were placed in front of the spillway to raise the water elevation of the wetland to encourage uniform flow distribution throughout the wetland. The water elevation of the wetland is dependent upon condition of the hay bales.

On the inspection sheet, for each identified channel or spillway note:

- Significant erosion present (Yes or No): Is the riprap or vegetative lining impaired or absent? Has the berm been overtopped and/or breached? Is there significant sedimentation as a result of erosion?
- Significant debris present (Yes or No): Are there tree limbs, leaves, trash, etc. that would "dam" the water in the diversion ditches and collection channels? Are there

vegetation and/or debris in the riprap-lined spillways that would cause the water level to rise in the passive components?

- Maintenance performed: Have the plants been removed from the riprap-lined spillways? (Removal of plants from riprap-lined spillways on a regular basis as part of "general housekeeping" prevents overtopping of berms and loss of function of the facility.) Have tree limbs, leaves, trash, etc. been removed? Has the erosion been addressed (rocks placed in erosion features; sediment cleaned from ditches, dirt placed and compacted on berms of ditches and channels, etc.)?
- Maintenance remaining: Describe additional maintenance needed. Indicate areas for additional maintenance on the Site Schematic.

F. Passive Treatment System Components

All passive treatment components need to be inspected for erosion, berm (slope) stability, vegetation, siltation, leaks, etc. Any problem should be noted and corrected as soon as practicable.

During site monitoring, the area of the pre-existing mine water conveyance pipe should be inspected. Normally, the pipe is covered with iron precipitate and not visible. If, however, the flow rate is observed to be substantially decreased or no flow is present, board members of AWARE should be contacted immediately.

Also during site inspection, the condition of the vegetation and the presence of any disturbed or eroded areas should be noted. Significantly disturbed or eroded areas should be stabilized as soon as possible with staked straw/haybales, riprap, plantings with accepted species, etc., whichever is appropriate. For instance, if erosion of the lower wetland berm occurs from flooding of Aultmans Run, it may be necessary to place riprap along the bank for stabilization.

On the inspection sheet, for each identified passive treatment component note:

- Significant erosion present (Yes or No): Are erosion gullies on the inside and/or outside of the berms?
- Features relating to berm instability present (Yes or No): Is there any slumping noted? Are tension cracks visible?
- Successful vegetation (Yes or No): Are there significant areas on the inside and/or outside berms that need to be revegetated? Overall, does the vegetation appear healthy?
- Significant siltation/sedimentation present (Yes or No): Is there significant sediment from erosion of berms or upland areas accumulating in the passive component?
- Significant change in water level (Yes or No): Is the water level rising or lowering in the passive component? Is the water level appropriate (not too high or too low) for the plants in the wetlands?
- Maintenance required: Do portions of the berms need to be stabilized with riprap and/or reconstructed? Does supplemental reseeding and mulching need to be completed? Do any passive components need to be cleaned of sediment? Has there been vandalism to the project sign? Does the 6-inch, SCH40, PVC pipe installed at the end of the pre-existing vegetated channel wetland for monitoring purposes need to be cleaned, repaired, or replaced?

G. Wildlife Utilization

One of the functions of a constructed wetland is to provide wildlife habitat for desired species. If, however, during inspections, signs of damage are noted, such as from muskrats, appropriate steps should be taken to continue the function of the passive system and general site restoration. Significant damage needs to be corrected by repairing berms, removing invasive species, replanting, and trapping (contact PA Game Commission).

On the inspection sheet:

- Animals observed: Although not an inventory, please record whether there were tracks or visual observations of wildlife utilizing the site. Describe any damage observed.
- Invasive plants observed: If invasive or undesirable plants are observed, please note and remove as soon as practicable.

H. Flow Measurements:

Flow rate can be measured at the 6", Sch 40, PVC pipe installed for this purpose at the outlet of the pre-existing channel wetland.

Bucket and Stopwatch

Flow measurements from pipes can be easily made using a bucket and stopwatch. The bucket and stopwatch method consists of timing (in seconds) the filling of a bucket of known volume (preferably calibrated in gallons). The flow rate in gallons per minute can then be calculated utilizing the following formula:

$$\text{Flow (gal/min)} = \left(\frac{\text{Gallons}}{\text{Seconds}} \right) \text{X} \quad 60$$

A large bucket (15- to 20-gallon capacity) may be calibrated and used for flow measurements. To calibrate a bucket, use another container of known volume to add metered amounts of water (i.e., 1-gallon increments). Mark on the bucket with a permanent marker, desired volume gradations. For example, on a 20-gallon bucket, gradations might be at 5, 10, 12, 15, 16,17,18, 19, and 20 gallons although any gradation scheme is acceptable as long as relatively accurate measurements can be made. Due to the awkwardness and weight of a filled 15- to 20-container, using a 5-gallon container may be more suitable. With a measured maximum flow of 200 gpm, however, a 5-gallon container would be filled quickly (1.5 seconds).

I. Water Monitoring and Sample Collection

In order to assess the efficiency and performance of this system and the impact to Aultmans Run, field tests should be completed including pH, temperature, alkalinity, and dissolved iron. Water samples, to confirm field analyses, may also be taken and analyzed by the PA State Lab or other approved laboratory using standard chemical testing procedures for pH, alkalinity, acidity, total iron, dissolved iron, sulfates, and total suspended solids. Field testing is recommended to be completed quarterly or biannually, with confirming lab tests conducted when possible.

Water sampling and field testing at the following locations will enable evaluation of the degree of success of the passive components, individually and combined, in treating the mine drainage:

1. **Raw (in forebay near existing mine drainage conveyance pipe)**
2. **Wetland (in outlet spillway)**
3. **85-16 (final effluent in existing vegetated channel wetland)**
4. **85-14 (Aultmans Run Upstream)**
5. **85-13 (Aultmans Run Downstream)**

The monitoring program should include points other than the final effluent from the wetland in order to provide a complete description of the water quality through the passive treatment system at the time of sampling. For instance, the untreated raw mine discharge (as close to the source as possible), components (at the effluent), and the stream (above and below the system) should be monitored. These monitoring point locations are identified on the O&M Inspection Sheet, site schematic, and "As-Built" plans.

In order to conduct laboratory analyses for pH, alkalinity, acidity, sulfates, and total suspended solids, a 500-ml (or other specified volume), unfiltered, sample should be collected, stored in a cooler, and transported to the laboratory. In order to differentiate between dissolved and total iron concentrations, the laboratory requires two, 125-ml (or other specified volume) samples that are preserved with trace metal-grade nitric acid to ensure that the pH is <2. The sample for total iron is not filtered. The sample for dissolved iron is filtered using a 0.45-μm filter in the field prior to placing the sample in the bottle. The filtering device should be rinsed with distilled or de-ionized water between each sample. Each bottle should be labeled with a unique number.

A record of every sample taken should be made directly on the inspection sheet. Information such as sampler's name, sample location, sample date, flow rate, field tests, and sample bottle identification is written on the inspection sheet. Pertinent information is then transferred from the inspection sheets to the laboratory's Record of Sample form or Chain of Custody form.

On the inspection sheet for each Sampling Point:

- Monitoring point field measurements recorded:

Parameter	**Method**
Flow	Bucket & Stopwatch (where pipe discharge), etc.
pH	HACH pH kit, pH meter, etc.
Temperature	Field thermometer, pH meter, etc.
Total Alkalinity	HACH Digital Titrator, etc.
Iron	HACH iron kit, etc.
Dissolved oxygen (optional)	HACH DO kit, DO meter, etc.

  Record readings to nearest whole number, except pH (record to nearest tenth).
- Sample bottle data: If water samples are collected, assign and record bottle numbers on the inspection sheet. You will need to transfer this information to the laboratory's Record of Sample or Chain of Custody form.
- Comments: Observations such as color of the sample or other information may be recorded in the "Comments" column.

J. SLUDGE ACCUMULATION

During the periodic O&M inspection, it is recommended that a Sludge Accumulation inspection be completed every year or every other year. The primary purpose of this inspection is to assess the type and amount of sludge that is accumulating within the passive treatment components. This can give an indication as to how the system is functioning and when action is needed to remove the sludge from the component.

On the inspection sheet for each component listed provide:

- Sludge Accumulation: Note the depth (estimated) of the sludge. Has the sludge filled the component to within about 1-2' of the primary spillway or top of berm in the Wetland?
- Sludge Description: Note the color of the sludge. Typically, white, red, and black colors indicate precipitate rich in aluminum, iron, and black, respectively.
- Comments: For example: Is there significant organic debris in the sludge?

K. SCHEMATIC

A site schematic has been provided to orient the inspector to the site and is keyed to the various sections of the inspection report. The schematic can also be used to identify specific locations where maintenance is needed, particularly for locations within the site that do not already have a specific identified name and location. For instance, if a section of the site was not well vegetated and experiencing erosion, that area could be circled on the schematic and then a copy or fax could be provided to the person(s) responsible for addressing the issue.

MISCELLANEOUS MAINTENANCE CONSIDERATIONS

All materials used in repairs should be of equal or better quality and have the same capacity and function as shown on the "As-Built" plans.

Removal and disposal of accumulated precipitate or sediment

Precipitates from chemical reactions and other solids will be retained within the forebay and wetlands. This sludge should be removed when the volume of the component is reduced by one half. Inlet and outlets should be kept clear of debris and obstructions. Sludge removal is planned for every fifteen years or as desired. Opportunities may be available to utilize the sludge for metal recovery or the sludge may be allowed to drain/dewater for disposal. At this time, the sludge from coal mine drainage does not require special permitting for disposal. Care, however, should be taken in order not to cause sediment problems in streams. (An Erosion and Sediment Pollution Control Plan should be completed for the placement area.)

WETLAND PLANT DIVERSITY REPORT

It is also recommended that a Wetland Plant Diversity Report be completed at least once per year. The primary purpose of this report is to assess the diversity of plant species within the constructed treatment wetland in order to determine if species diversity is increasing or decreasing. Species diversity is believed to optimize the health, productivity, and treatment capability of the wetland. In addition, increased plant species diversity should result in an increase in wildlife diversity. A secondary purpose is to identify if unwanted invasive plants have become established, such as common reed (*Phragmites australis*) and purple loosestrife

(*Lythrum salicaria*). (See pictures below.) These plants should be removed from the wetlands. On the report provide the common name and/or scientific name for each plant, the plot number, the location of the plot, and the population within that plot.

Common Reed

Purple Loosestrife

REPLACEMENT

All passive treatment systems are unique. The sludge storage capacity for a projected design life of 25 years was based upon background monitoring data and published references. Higher flow rates and poorer water quality can substantially affect the design life. When the storage capacity of the system has been diminished by approximately one half, the sludge should be removed. Prior to removal, the system and water quality should be evaluated to determine if reconstruction of the system is necessary. Advances in technology and changes in raw drainage quality and quantity should be considered to determine if revisions to the size and/or design of the system would be advantageous. Replacement considerations include:

(1) Estimating Best Management Practice (BMP) design life;
(2) Determining replacement responsibility, including a successor, as necessary;
(3) Determining approximate costs for removing accumulated sediments, replacing water control structures, re-sizing the system to accommodate changed water quality or quantity, and replanting wetlands.