Montour Run Watershed
Allegheny County, Pennsylvania

McCaslin Road Mine Drainage Treatment Operation, Maintenance & Replacement Plan

Prepared by

BioMost, Inc.

For

Montour Run Watershed Association

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OPERATION, MAINTENANCE & REPLACEMENT PLAN

This is the Operation and Maintenance Plan for the McCaslin Road Mine Drainage Treatment project located on Findlay Township property in Allegheny County, PA. This project is located along an unnamed tributary of West Fork of Enlow Run. The hydrologic order is: Unnamed Tributary → West Fork of Enlow Run → Enlow Run → Montour Run → Ohio River.

The passive treatment system consists of a 6" PVC Conveyance Pipe (with cleanouts) which conveys the water from the original/existing AMD discharge pipe to the passive system, an 800-Ton limestone only Automatic Flushing Vertical Flow Pond (AFVFP) with siphon, a 5,900 Square-foot Settling Pond, and a 2,300 Square-foot wetland.

The Montour Run Watershed Association (MRWA) 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. Design of all structures focused on minimal operation and maintenance compared to conventional chemical treatment systems. In order, however, for these facilities to effectively treat the mine drainage, periodic inspections and maintenance are required. This Operation and Maintenance Plan is site specific and written to be user friendly and easily implemented in order to ensure the long-term sustainable treatment of the abandoned mine drainage at McCaslin Road.

ACKNOWLEDGMENTS

This Operation and Maintenance Plan was completed through a public-private partnership effort coordinated by the Montour Run Watershed Association. Portions of this document were based upon an example provided by P.J. Shah of the Pennsylvania Department of Environmental Protection Bureau of Abandoned Mine Reclamation.

Public-Private Partnership Effort

Montour Run Watershed Association
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OVERVIEW OF AMD AND PASSIVE TREATMENT

Historical Mining Impacts

Coal has been mined in western Pennsylvania, as well as much of the Appalachian Coal Basin, for more than 200 years. During this time, this natural resource has played a pivotal role in the Industrial Revolution, resulting in the United States becoming a major world power. Despite the increasing development of alternative energy, coal continues to be vital to our way of life by generating over half of Pennsylvania's and our Country's electricity. Electricity production alone accounts for over 90% of all the coal consumed in the US today. In addition, coal is used in iron- and steel-making processes and in the manufacture of chemicals, cement, glass, and paper, and in food processing.

While this utilization of coal has fueled our homes, industries, and economy, the methods formerly used in coal extraction created a legacy of severe environmental impacts and public safety issues. Small towns and villages of western Pennsylvania and Appalachia, which were once bustling coal communities supporting the steel industry and electricity production for such cities as Pittsburgh (PA), Johnstown (PA), Wheeling (WV), New Castle (PA), and Youngstown (OH), are now often non-existent ghost towns left with only scarred landscapes characterized by dangerous highwalls, barren coal refuse piles, and, of course, degraded mine drainage.

The degraded drainage from abandoned coal mines is the largest nonpoint source (diffuse sources; not a permitted discharge point) of stream impairment in Pennsylvania. According to the 2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report over 4,600 miles of streams are degraded. In addition, 45 of Pennsylvania's 67 counties are impacted by over 250,000 acres of unreclaimed mine lands, including 2.6 billion cubic yards of coal refuse piles. Pennsylvania also has approximately 7,800 abandoned or inactive underground mines, which are typically the largest contributors of mine drainage. In many cases, entire watersheds have been completely decimated.

The majority of stream degradation, however, appears to be related to historical mining. With knowledge of the cause, documentation of long-term stream impacts, development of environmentally-focused mining methods, and requirement of comprehensive permitting and oversight by enactment of the PA Surface Mining Conservation & Reclamation Act, Clean Streams Law, etc. and 1977 federal Surface Mining Control & Reclamation Act, only about 1% of modern operations have post-mining discharges requiring treatment. (PA DEP, 1999, Evaluation of Mining Permits Resulting in Acid Mine Drainage 1987-1996: A Post Mortem Study)

AMD Formation and Selected Monitoring Parameters

The following brief overview may be helpful to those unfamiliar with terms and concepts that are important in learning about mine drainage and passive treatment systems. This, however, should not be considered a comprehensive, authoritative, or complete undertaking. There are several parameters that are used to describe and characterize mine drainage.

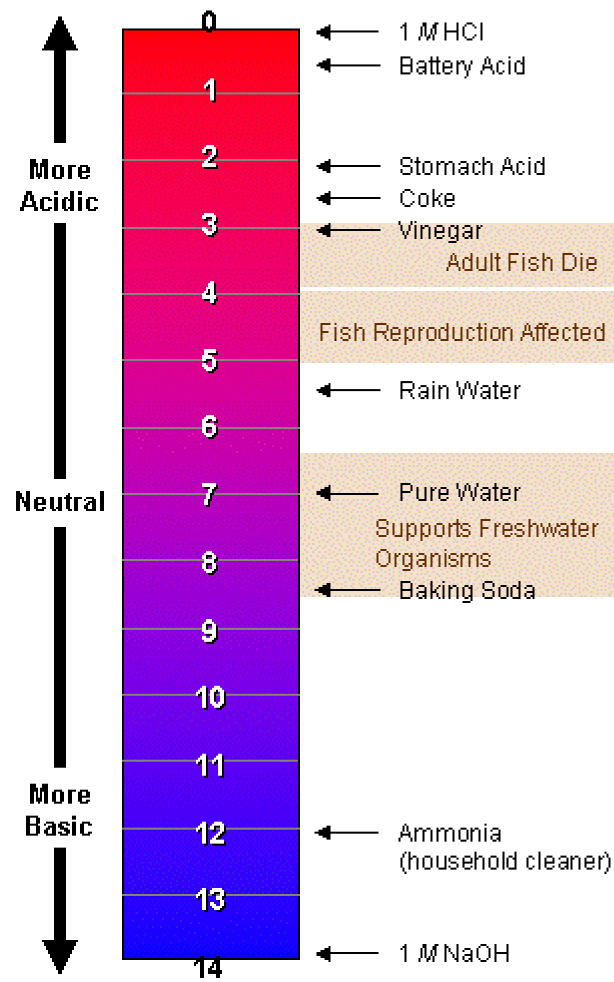
What is AMD? **AMD** is an acronym typically used for **Abandoned Mine Drainage** or **Acid Mine Drainage**, although AMD can be acidic or alkaline in nature and can emanate from abandoned or active mines. There are different names and acronyms for AMD that are used throughout the world such as Coal Mine Drainage (CMD), Mine Drainage (MD), Mining Influenced Water (MIW) and Acid Rock Drainage (ARD). In Pennsylvania, degraded coal mine drainage is usually referred to as AMD.

The formation of mine drainage is essentially a weathering process that is a function of the geology, chemistry, biology, hydrology, and mining methods used at the site. Although the specific process may vary, AMD forms through a series of complex geochemical and, at times, microbial reactions that occur when water and oxygen contact sulfide minerals such as pyrite (FeS_2) which is typically present within coal and/or surrounding rock. The iron sulfide minerals "breakdown" (not unlike a nail rusting) in the presence of water and oxygen releasing iron and forming sulfuric acid. (Without the presence of water, oxygen, and sulfide minerals, AMD will most likely not form.) When the iron is further oxidized and hydrolyzed, iron compounds form and settle in ponds, wetlands, and streams. Due to the yellow, orange, and/or red color, these iron solids are often referred to as "Yellowboy". Although there are a number of steps in the process, these reactions can be represented by the following general chemical equation:

(1) $4\ FeS_2 + 15\ O_2 + 14\ H_2O \rightarrow 4\ Fe(OH)_3 + 8\ H_2SO_4$
Pyrite + Oxygen + Water → "Yellowboy" + Sulfuric Acid

The iron and sulfuric acid then reacts with other surrounding material to dissolve and release iron, aluminum, manganese, and other metals that might be present, such as zinc, nickel, cadmium, calcium, magnesium, etc. As the water becomes oxygenated and/or gains alkalinity some of the metals form solids (**precipitates**) that can also accumulate in ponds, wetlands, and streams. When streambeds become coated, the habitat of aquatic insects may be destroyed. As benthic macroinvertebrates are critical to the food chain, loss of this habitat may prevent fish from living and/or reproducing in the stream. In addition, AMD often causes the stream to be acidic with a low pH, which many organisms cannot tolerate.

pH is a measured value that indicates whether a solution is acidic, neutral, or basic (alkaline). pH is a way to express the hydronium (H_3O^+)-ion [a.k.a., hydrogen(H^+)-ion] concentration. The pH scale ranges from 0-14 with 0 being the most acidic, 7 being neutral, and 14 being the most basic. Note on the scale that vinegar has a pH of around 3 while household ammonia has a pH of around 12 and blood around 7.4. As pH is a negative log of the hydrogen-ion concentration, a change in one unit represents a 10-fold increase or decrease in hydrogen ions. For example, a solution with a pH of 4.0 has 10 times more hydrogen ions than a solution with a pH of 5. pH can be measured by using litmus paper, a color



The pH Scale
Source: http://www.jacksonbottom.org

indicator solution (used in field kits), or with a calibrated, electronic pH meter.

Alkalinity is typically defined as the acid neutralizing or buffering capacity of a given volume of water. This refers to the ability of water (such as a stream) to neutralize acid (such as acidic mine drainage). Depending on how much alkalinity is present in the water, when an acid is added the pH will either decrease or remain the same. The pH of water with no or little alkalinity can change dramatically with the addition of a small quantity of acid while the pH of water containing significant alkalinity can maintain the same pH when a larger quantity of acid is added. The reason the pH does not change is because of the alkalinity present. In other words, the alkalinity neutralizes (buffers) the acid, similar to taking an antacid to neutralize stomach acid. As additional acid is added the pH will begin to be lowered. If enough acid is added, eventually all alkalinity will be consumed.

Laboratory Titration
Source: www.dartmouth.edu

To measure alkalinity in most mine water, a relatively weak solution of sulfuric acid (H_2SO_4) is added "drop-by-drop" to a specified volume of water in order to lower the pH to 4.5. At pH 4.5, all bicarbonate alkalinity (HCO_3^-) has been consumed. (Bicarbonate alkalinity may be generated by natural processes including the weathering of limestone or other carbonate rock and/or bacterial reactions with sulfate and organic material.) The endpoint of pH 4.5 may be determined by a meter/kit or by a color change from green to pink after dissolving bromcresol green (an indicator powder) in the water. Alkalinity is usually expressed in milligrams of calcium carbonate per liter (mg $CaCO_3$/L). Calcium carbonate is the primary constituent of limestone and Tums© stomach antacid.

Acidity is typically defined as the ability of a solution to neutralize alkalinity (base) of a given volume of water. Like alkalinity, acidity is usually expressed as mg $CaCO_3$/L. There are three types of acidity of interest. Proton acidity is associated with free H^+ ions and is measured by pH. Organic acidity is associated with dissolved organic compounds such as tannic acid. Mineral acidity is generated as dissolved metals form solids. The transformation of metals from a dissolved phase to a solid phase [When table salt (solid phase) is dissolved in tap water, sodium and chloride ions are in the dissolved phase.] will be discussed in more detail in the "Generalized AMD Treatment Chemistry" section. The mineral acidity is only generated during the transformation process meaning that as long as the metals are dissolved, the acidity has not actually been generated. Mineral acidity, therefore, is sometimes viewed as "potential" acidity.

While acidity can be measured in the field by titrating with sodium hydroxide (NaOH), this measurement does not take into consideration all of the potential mineral acidity. To measure most, if not all, of the mineral acidity associated particularly with dissolved iron, manganese, and aluminum, a laboratory method called "Hot Acidity" is conducted.

While the pH measurement only takes into account free H^+ ions without indicating the neutralizing capacity of acidity or alkalinity, the hot acidity measurement conducted by laboratories accounts for several types of acidity as well as any existing alkalinity to provide a value that may indicate, in general, whether the water sample is net-acidic (positive acidity value) or net-alkaline (negative acidity value). If the hot acidity measurement indicates the sample is net-acidic, the value provides an idea of how much additional alkalinity would be required to neutralize all of the potential acidity that could be generated by the oxidation and hydrolysis of most of the metals of concern.

For instance, while a mine drainage sample could have a pH of 7, which would indicate that the water was neutral with no acidity, conducting a hot acidity test may reveal that metals dissolved in the water most likely to precipitate (given enough time and proper conditions) will produce acidity and actually result in the water being identified as a net-acidic.

Dissolved Oxygen (DO) is the measurement of the amount of oxygen dissolved in the water. It is determined either chemically (Winkler or iodometric methods) or with an electronic meter and is expressed in mg/L. DO is very important for several reasons. DO is important to aquatic organisms within a body of water. If no oxygen is present, fish and other aquatic life will die. Different species require different levels. Trout, for example, need relatively high concentrations. DO is also important in the treatment of AMD, which will be discussed later. Several factors can affect DO concentrations including the physical environment (lake or stream, shaded or open, temperature, aeration) as well as chemical and biological processes that consume (chemical reactions, decomposition of organic material, respiration) or add (photosynthesis) dissolved oxygen within the body of water. Temperature is very important due to the major role in the solubility of oxygen within water. For example, more oxygen can be dissolved in cold water than warm water. Field experience suggests, however, that water capped by ice (such as, a frozen pond) may have much less oxygen.

Sulfate (SO_4^{-2}) is measured through a variety of laboratory techniques and instrumentation. Although commonly present in acid rain, concentrations of the dissolved sulfate ion of >50 mg/L usually indicate coal mine drainage in western Pennsylvania. As discussed earlier, the sulfate ion is present in mine water typically by the weathering (dissolving) of sulfide minerals. The sulfates may, in turn, be used to generate alkalinity as a by-product of the decomposition of organic material (such, as compost) by anaerobic (without oxygen) bacteria (known as sulfate-reducing bacteria). High sulfate and calcium concentrations may also result in the precipitation of the mineral gypsum ($CaSO_4 \cdot 2H_2O$) which may cause plugging problems within certain treatment components.

Specific Conductivity is used to measure the ability of water to carry an electrical current. This ability is dependent on several factors including the presence of ions and the temperature during measurement. Specific conductivity readings are automatically normalized to 25 ºC to essentially eliminate the variability related to temperature. Specific conductivity is typically measured by an electronic meter and is expressed in micromhos per centimeter (μmho/cm). Low values indicate fewer dissolved ions while larger values indicate a higher number of dissolved ions. Although a large value does not necessarily mean pollution or a specific type of pollution, larger values do indicate that any pollutants present may be dissolved as opposed to solids floating in the water or sediment in the sample from disturbing the streambed.

Temperature, typically measured in either degrees Fahrenheit (ºF) or Celsius (ºC), is an important parameter affecting various physical as well as chemical processes. As previously discussed, temperature affects the solubility of dissolved oxygen and also the activity of certain organisms such as reptiles. Temperatures can even be used to indicate the source of pollution.

For instance, a groundwater source can be distinguished from a surface water source as the groundwater is typically warmer in winter and cooler in summer compared to surface water.

Oxidation/Reduction Potential (ORP) is measured in millivolts (mV) using an ORP meter. The higher the value above zero, the more oxidizing the water, while the closer the value is to zero the more reducing. A value below zero is reducing. In AMD, high ORP values in water having a pH <3.5 may reflect the presence of high concentrations of dissolved ferric iron (Fe^{+3}). In passive treatment, certain components are designed to create reducing conditions in order to promote bacterial sulfate reduction.

Total Suspended Solids (TSS) is the measurement of the amount of solids within a given volume of water, retained when passed through a certain pore-size filter. Typically, a 0.45-µm pore-size filter is used. **Total Dissolved Solids (TDS)** are the portion that passes through the filter. **Total Solids**, which includes both TSS and TDS, are usually measured by evaporating a water sample and then drying and weighing the remaining residue.

Metals, most commonly monitored in mine drainage are **iron** (Fe), **manganese** (Mn), and **aluminum** (Al). Measurements are often performed by an analytical laboratory using Atomic Absorption (AA), Spectrophotometry, or Inductively Coupled Plasma (ICP). While not necessarily as accurate as the laboratory methods, iron, manganese, and aluminum concentrations can also be measured using certain field kits. Iron solids give mine drainage that typical red or orange color while aluminum solids are white in color. Aluminum solids can also give water a bright aquamarine blue color. Manganese solids have a dark brown or black color. Iron often coats the streambed suffocating the benthic macroinvertebrates resulting in the destruction of the food chain. Aluminum can clog the gills of fish and macroinvertebrates. Of the three, aluminum generates more mineral acidity per unit concentration. Manganese at typical concentrations has not been demonstrated to have significant ecological impact. Manganese can cause discoloration or impart a bad taste to drinking water.

AMD Treatment Chemistry

To make site inspections and water monitoring more meaningful, a brief review of some applicable chemical processes is helpful. Passive treatment of net-acid mine drainage essentially revolves around imparting alkalinity to mine drainage and then allowing (and possibly enhancing) natural chemical, biological, and physical processes to occur.

Limestone is commonly used when passively treating acid mine drainage. Limestone, which occurs in many areas of western Pennsylvania, is rock that has at least 50% calcium carbonate ($CaCO_3$). In reaction (2), the calcium carbonate (usually in the mineral form as calcite) reacts with the hydrogen ion (H^+) and produces bicarbonate alkalinity (HCO_3^-) and calcium (Ca^{+2}).

(2) $CaCO_3 + H^+ \rightarrow Ca^{+2} + HCO_3^-$
Limestone + Acidity (proton) → Calcium + Bicarbonate Alkalinity

Not only is acidity consumed, but alkalinity is generated. The bicarbonate ion then goes on to neutralize additional hydrogen ions (H^+) in reaction (3), which results in the production of water and carbon dioxide (CO_2). This is basically the same reaction that occurs in your stomach when you take an antacid such as the Tums©, which has calcium carbonate as the main ingredient. In an enclosed environment, the CO_2 cannot escape (similar to a carbonated beverage in a can or bottle) and forms carbonic acid which makes the water more reactive resulting in more limestone being dissolved; thereby, allowing for more alkalinity to be generated.

(3) $HCO_3^- + H^+ \rightarrow H_2O + CO_2$
Bicarbonate Alkalinity + Acidity (proton) → Water + Carbon Dioxide

Another potential source of alkalinity commonly used in passive treatment systems is bacterial sulfate reduction illustrated in reaction (4). As discussed previously, mine drainage contains sulfate ions. When the mine drainage comes into contact with organic matter in an **anaerobic** (no or very little oxygen present) environment certain bacteria can decompose or oxidize the organic matter using sulfates as an electron sink to form hydrogen sulfide gas (H_2S) and bicarbonate (HCO_3^-) alkalinity. (Iron and other metal sulfides may also be formed.) Hydrogen sulfide gas is a gas that has a rotten-egg smell which is often noticeable in wetlands and vertical flow ponds with compost or other organic matter that are under anaerobic conditions. In this reaction 2 moles of bicarbonate are created for every mole of sulfate consumed.

Sulfate-reducing bacteria
(4) $2CH_2O + SO_4^{-2} \rightarrow H_2S + 2HCO_3^-$
Organic Matter + Sulfates → Hydrogen Sulfide + Bicarbonate Alkalinity

As the alkalinity generated by the passive treatment components begins to neutralize the acidity, the pH begins to increase and other chemical reactions begin to take place. Besides pH and acidity the major contaminants that are of concern are metals. During the formation of mine drainage, metals exist in a dissolved state. To remove the metals, solids are formed. The design of a passive treatment system is based upon considering the various biogeochemical and physical processes that remove these metals. As previously mentioned, the three major metals of concern in coal mine drainage are iron, manganese, and aluminum.

<u>Iron:</u> The removal of iron can occur under multiple conditions and pathways. Dissolved iron may also exist in multiple valence states. (Valence deals with behavior of electrons; i.e., ferrous iron (Fe^{+2}) is the reduced form of iron while ferric iron (Fe^{+3}) is the oxidized form of iron with one less electron.) The most common state of dissolved iron in mine drainage is ferrous iron (Fe^{+2}). Typically, except in the case of sulfides where sulfate-reducing bacteria are active, ferrous iron needs to be oxidized to ferric iron to be removed from the water. The oxidation of dissolved ferrous to dissolved ferric iron can occur with or without bacterial activity. Bacterial activity is important in mine water with low pH ($\leq$3.5) while dissolved oxygen (1 mg/L DO needed to oxidize 7 mg/L ferrous iron) is important in mine water at higher pH. Once oxidized, ferric iron may be hydrolyzed (generally meaning reacts with water) to form the yellow to red-brown iron solids. At low pH, iron minerals may form that typically feel silty or are “crusty”. As these minerals do not need oxygen to form, plugging is a consideration when designing a passive system. Iron solids forming at a higher pH are amorphous and are typically “gooey” or slippery feeling. These solids are commonly collected in settling ponds and wetlands.

Reaction rates appear to be strongly influenced by pH. The higher the pH, the faster the reactions take place. If alkalinity is present in the water, often the pH of the water can be raised by agitating the water to degas dissolved CO_2 which suppresses pH. Agitating the water can be accomplished with step aerators, splashing, steep rock-lined spillways, etc. Also consider that when treating discharges with high concentrations of ferrous iron, dissolved oxygen is consumed; therefore, additional aeration steps are often required. Acidity is created as a result of the precipitation of iron.

Manganese: The removal of manganese is also challenging. Historically, removal of manganese has been difficult and for a period of time was thought to only be accomplished through chemical treatment by raising the pH above ~9. With the development of passive technology, dissolved manganese has been observed to form solids at a much lower pH (~6). The exact mechanism is not completely understood at this time, but biogeochemical factors such as low dissolved iron concentrations, high dissolved oxygen concentrations, available surface area, sufficient alkalinity, presence of certain microorganisms, and autocatalytic processes appear to play a significant role.

Aluminum: As the solubility of aluminum is strongly dependant on the pH, once the pH is raised to about 4.5, aluminum begins to form solids and precipitate out of solution. [Dissolve aluminum (Al^{+3}) is in the oxidized form; therefore, oxygen is not necessary to form solids.] By a pH of about 5, there is generally < 1 mg/L of dissolved aluminum present. The solids can then be collected in a settling pond or wetland. Recognizing this process becomes very important in choosing which passive component to use. Remember from the acidity discussion that the precipitation of dissolved metals, including aluminum, results in the release of hydrogen ions and thus the creation of acidity which can decrease pH. Sufficient additional alkalinity will need to be generated either prior to or after this reaction in order to neutralize the mineral acidity.

Overview of Passive Treatment System Components

Passive systems use no electricity, require limited maintenance, and use environmentally-friendly materials, such as limestone aggregate and spent mushroom compost in a series of constructed ponds, beds, ditches and wetlands to provide a cost-effective alternative to the conventional treatment of mine drainage which is labor and energy intensive and typically uses harsh chemicals. Passive systems add alkalinity to neutralize acidity while providing an environment suitable for beneficial chemical reactions and biological activity. For instance, dissolving limestone neutralizes the acidity and raises the pH after which dissolved metals, through chemical, biological, and physical processes, form particulates (solids) that are then retained in settling ponds and constructed wetlands. In some cases, however, there is sufficient alkalinity naturally in the mine discharge in which case only settling ponds and constructed wetlands are needed.

When designing a passive system, the goal is to include components that provide long-term effective treatment, are economical to install, and require minimal maintenance. There are several main types of passive treatment components that can be used, often in series and/or in parallel, to treat degraded mine drainage. These components are chosen based upon the mine drainage characteristics (quality and flow rate), preferred chemical or biological process, and available construction space. The following is a brief description of the passive treatment components at the McCaslin Road site.

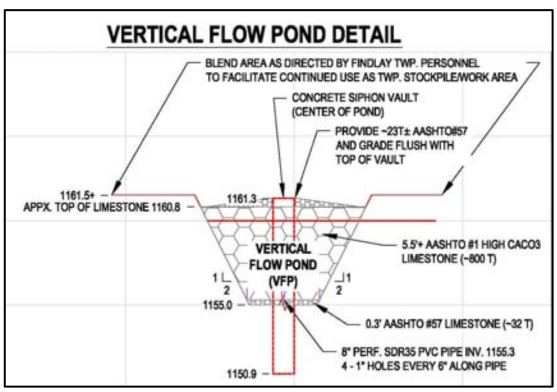
Design Parameters

Design parameters considered for the McCaslin Road passive treatment system were based upon the available water quality data for the MP5 abandoned mine discharge.

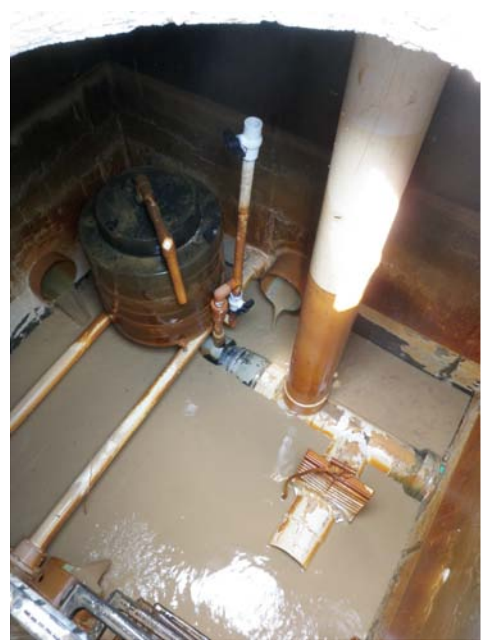
Flow:	2-38 gpm
pH:	3.0 – 3.5 s.u.
Alk:	0 – 3 mg/L ($CaCO_3$)
Acid:	176 – 326 mg/L ($CaCO_3$)
Fe:	2 – 9 mg/L
Mn:	6 – 16 mg/L
Al:	21 - 30 mg/L

Notes: n = 70 samples (05/1996 – 02/2003); Majority of the samples were collected by PA DEP.

A 6" Schedule 40 PVC **Conveyance Pipe** was installed in order to convey the abandoned mine discharge from the original 6" PVC AMD discharge pipe to the passive system. The conveyance pipe runs beneath Moon-Clinton Road (SR-3089) through a 12" steel casing installed by boring under the road. The conveyance pipe contains seven cleanout locations along the entire length of the pipe.



The water is conveyed into an **Automatic Flushing Vertical Flow Pond** (AFVFP). Untreated mine water enters the AFVFP through a perforated inlet manifold fills the pond to the maximum water elevation ~4' above the bottom of the pond. A Fluid Dynamics, Inc. Model 648 Automatic Dosing siphon then triggers a flushing event that drains the water to the approximate bottom of the pond. The siphon has no moving parts. The treatment medium consists of a six-foot layer of approximately 800 Tons of AASHTO #1 limestone (>90% $CaCO_3$). The acidic water dissolves the limestone and generates alkalinity and neutralizes acidity; thereby, increasing pH and encouraging the precipitation of metals especially aluminum. Within the approximate center of the Vertical Flow Pond is a siphon vault accessible via a 24" manhole. The purpose of the flushing is to maintain permeability of the treatment media. If permeability begins to decrease the treatment media can also be stirred. It is anticipated that the limestone will need to be stirred at least every five years. Eventually the treatment media will need to be replaced.



The effective design life of the limestone treatment medium is about 20 years. Because of the siphon the Vertical Flow Pond is either filling or flushing. There should not be a steady flow of water from the AFVFP. This also means that flow measurements from the Vertical Flow Pond (as well as the subsequent settling pond and wetland) will not be representative of actual flow rate of the discharge.

From the AFVFP, the water flushes into a 5,900 Square-foot **Settling Pond** that is designed to both settle aluminum solids and provide long term (20+ years) storage of accumulated sediment. Eventually the metal solids that accumulate in this pond will need to be removed and either recovered or disposed of properly. From the Settling Pond, the water flows into a 2,300 Square-foot **Wetland**. The plants in the wetland help to filter out solids that my still be suspended in the treated mine drainage. Eventually the metal solids and organic material that accumulate in the settling pond and wetland (SPWL) will need to be removed and either recovered or disposed of properly.

GENERAL INSTRUCTIONS FOR MONITORING AND MAINTENANCE

Everyone involved in monitoring and maintenance should have a general understanding of, and the ability to perform, routine duties, such as site inspections that include evaluating channels, spillways, and passive treatment components. Training should be provided to those not experienced in conducting inspections, water monitoring, and simple maintenance tasks.

Field Equipment & Supplies

In order to successfully conduct a site inspection and complete tasks, a variety of field equipment, supplies, and tools will be necessary. At a minimum, the following field equipment should be taken on every site inspection:

Clipboard	Site Schematic	Calibrated Flow Bucket(s)	pH kit or pH meter
Inspection Sheets	Pencil	Stopwatch	Shovel
Crow bar*		**Large screw driver***	

***hand tools need to remove cast iron manhole cover in siphon vault**

In addition, the following field equipment and supplies are highly recommended if available:

Dissolved Oxygen meter	Alkalinity kit (i.e., Hach Digital Titrator or "drops")	Filter Syringe & 0.45µm filters	Folding Engineer's Rule
Iron kit	100 ml graduated cylinder	Sample bottles	Backpack
Manganese kit	Reagents and titrants	Wash bottle	
Thermometer	Volumetric flask	Safety goggles	
ORP meter	Sunblock/Insect Repellant	Digital Camera	

Passive Treatment System O&M Inspection Report

In order to maintain the integrity of a 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 structure. Regular site inspections should be conducted at least quarterly. A qualified person should perform the inspection and complete the appropriate report(s). (See attached inspection report form.) The inspector should keep the paper copy of the report in permanent files in chronological order. In addition, prior to filing the reports the data and other pertinent information is encouraged to be entered into the online, GIS-enabled, database via the website www.datashed.org. Passwords to the site as well as instructions and training can be obtained by contacting Stream Restoration Incorporated. (See the Datashed section.)

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 in general with the attached individual Passive Treatment System and Land Reclamation O&M Inspection Reports.

A. Site Vegetation

Vegetation (i.e. groundcover) is extremely important to provide wildlife habitat and to prevent erosion. Erosion can carry sediment into streams resulting in decreased water quality, turbidity, and siltation. Sediment entering passive components such as the Vertical Flow Pond or Settling Pond can cause loss of capacity and shorten the lifespan of the system. During the 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 ground cover and viable wildlife habitat on the site. A large portion of the passive system at McCaslin Road site is located in the working/stock pile area of the Findlay Township Public Works facility, certain areas may be covered with gravel or other materials used by the Township and full vegetative cover may be affected by these activities.

Rating	Description	Recommended Action
0	Site barren	Revegetate as soon as practicable; temporary seeding, installation of staked straw/hay bales, 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	Vegetation 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/hay bales, 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. Site Access and Parking

The Township of Findlay maintains the access road and parking area associated with this treatment system. The site is accessible via Public Works Drive which is located off of SR-3089 (Moon-Clinton Road) about 450 feet Southwest of the intersection with McCaslin Road (County Road #63436-01)

C. Vandalism and Housekeeping

The passive treatment system is located on Findlay Township property. The Township has **generously** allowed these facilities to be constructed on their property in order to help restore Montour Run. Please collect any litter you see during your inspection and dispose of it properly. Although vandalism has not been a problem at most sites, please record any type of vandalism or evidence of trespassing on the inspection reports. Note any damage to the passive treatment system or project site signs.

D. Ditches, Channels, and Spillways

The wetland outfall channel should be inspected and maintained to minimize erosion and insure proper water handling. The channel should be kept free of obstructions/debris that would restrict water flow as this can cause the water to back up and overflow the berm. Any debris/obstructions should be removed. If disturbed or eroded areas are present, then these areas should be stabilized as soon as possible with riprap or plantings. The channel should be cleaned when precipitates reduce the capacity by one half. .

On the inspection sheet**,** for the wetland outfall channel note:

- Significant erosion rills (Yes or No): Is the rip-rap lining impaired or absent? Has the berm been overtopped or breached? Are there erosion rills/gullies?
- Significant debris/vegetation (Yes or No): Are there tree limbs, leaves, trash, etc. that could "dam" the water? Is there vegetation or debris in the riprap-lined channel that would cause the water level to rise in the settling pond/wetland?
- Maintenance performed (Yes or No): In the appropriate column mark yes or no as to whether maintenance was performed.
- Maintenance performed and remaining: Note any maintenance that was performed. Was the vegetation removed from the riprap-lined channel? (Removal of plants from the riprap-lined channel may be needed on a regular basis as part of "general housekeeping" to prevent overtopping of the berm 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 channel, dirt placed and compacted on berms of ditches and channels, etc.)? Also describe additional maintenance that is still needed. Indicate areas for additional maintenance on the O&M Schematic.

E. Passive Treatment System Components

All the passive treatment components including the Automatic Flushing Vertical Flow Pond, Settling Pond, Wetland, and collection system should be inspected for erosion, berm (slope) stability, vegetation, siltation, leaks, etc. Any problem should be noted and corrected as soon as practicable.

The valve in the siphon vault should be monitored and maintained so the free-flow of water continues during normal operation. The valve also needs to be monitored to insure full operation (able to be completely opened & closed) and that no leakage is occurring. If the valve is broken, it will need to be replaced.

The condition of the vegetation and the presence of any disturbed or eroded areas should be noted. Disturbed or eroded areas (other than those areas affected by Township activities) will need to be stabilized as soon as possible with staked straw/hay bales, riprap, plantings, etc., whichever is appropriate.

Any signs of water overtopping or leaking through the berms should be noted and investigations conducted to determine the cause as soon as possible.

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

- Significant erosion (Yes or No): Do berms (inside & outside) have erosion gullies?
- Vegetation Problems (Yes or No): Are there significant areas on the berms (inside & outside) that need to be revegetated? Overall, does the vegetation appear unhealthy?
- Significant siltation/sedimentation (Yes or No): Is there significant sediment from erosion of berms or upland areas accumulating in the passive component?
- Are the embankments slumping/unstable (Yes or No): Is there any slumping? Are there cracks? Do the embankments or berms appear to be unstable?

- Significant change in water level (Yes or No): Is the water level rising or lowering in the Settling Pond/Wetland? Is there water discharging over any berm? Is the water level appropriate (not too high or too low) for the plants in the Wetland? Has a pond been drained that should not be?
- Valves broken/inoperable (Yes or No): Is the valve broken or leaking or unable to be opened and closed by hand? Is the valve otherwise inoperable? (The valve should be opened and closed during each inspection in order to maintain proper function – typically at the end of each inspection after water levels in the siphon vault are measured.)
- Pipes Broken or Plugged/Not Flowing (Yes or No): Are any of the pipes plugged (with vegetation or precipitates) or not flowing?
- Maintenance performed and needed: Describe any maintenance conducted or needed. Remember to identify the component. Do portions of the berms need to be stabilized with riprap and/or reconstructed? Does supplemental reseeding and mulching need to be completed? Do passive components or pipes need to be cleaned of sediment? Do valves need to be replaced? Are any pipes broken or plugged?

F. Field Water Monitoring and Sample Collection

In order to assess the efficiency and performance of a passive system, water monitoring of each component of the system should be completed. Water monitoring is perhaps the most important element of the O&M site inspection as it directly indicates whether the system is functioning properly and can help to identify problems that cannot be directly seen. If possible, water samples should be taken and analyzed by the PA State Lab or other approved laboratory using standard chemical testing procedures for the following water quality parameters.

Laboratory Water Quality Parameters

pH	Total Iron	Total Aluminum
Alkalinity	Dissolved Iron	Dissolved Aluminum
Acidity	Total Manganese	Sulfates
Specific Conductance	Dissolved Manganese	Total Suspended Solids

In addition to laboratory analyses, field tests should be completed including pH, temperature, and alkalinity. If water samples cannot be taken for laboratory analysis then, at a minimum, the following field tests should be completed: pH, alkalinity, and iron. Alkalinity is not completed when pH $\leq$ 4.5. For the McCaslin site, a field pH measurement of the final system monitoring point (1496-SPWL) will quickly indicate overall system performance (i.e. if the pH is ~6 or higher the system is most likely working as designed).

Water sampling and field testing should be completed at locations identified on the O&M Inspection Sheet and O&M Schematic. Water monitoring will enable evaluation of the degree of success of the passive components, individually and combined, in treating the mine drainage.

The monitoring program should include both the raw (MP5) as well as the final effluent (1496-SPWL) in order to provide a snapshot of the water quality through the passive treatment system at the time of sampling. These monitoring points are identified on the O&M Inspection Sheet, site schematic, and "As-Built" schematics.

In order to conduct laboratory analyses for pH, alkalinity, acidity, sulfates, conductivity, and total suspended solids, a 500-ml (or other volume specified by the laboratory), unfiltered, sample should be collected, stored in a cooler, and transported to the laboratory. In order to differentiate between dissolved and total iron, manganese, and aluminum 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 metals is not filtered. The sample for dissolved metals is filtered in the field using a 0.45-μm filter during sampling. At a minimum the filtering device should be rinsed three times with the water to be sampled. Each bottle should be labeled with a unique number.

A record of every sample taken should be made directly on the inspection sheet, such as sampler's name, sample location, sample date, field tests, and sample bottle identification. 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:

- <u>Monitoring point field measurements recorded:</u>
  Record readings to nearest whole number, except pH (record to nearest tenth).

Parameter	**Method**
pH	HACH pH kit, pH meter, etc.
Temperature	Field thermometer, pH meter, etc.
ORP (optional)	ORP meter
Total Alkalinity	HACH Digital Titrator, etc.
Iron	HACH iron, etc.
Dissolved oxygen (optional)	HACH DO kit, DO meter, etc.

- <u>Sample bottle data:</u> 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.
- <u>Comments:</u> Observations such as sample color may be recorded under "Comments".

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 settling pond and wetland. This sludge should be removed when the volume of the component is reduced by about one half (within about 1.5' of the berm elevation).

Safety Fence
A safety fence was installed around the Settling Pond and Wetland. The fence should be regularly inspected for damage and repaired as quickly as possible.

Triggers to Initiate Maintenance Activities

Several maintenance triggers have been developed to help assist the Montour Run Watershed Association identify when maintenance is needed and what maintenance activity should be conducted.

Maintenance Action Item #1: Final Effluent pH below 6

The system is designed to discharge at a pH ≥6 during normal flow conditions. Due site constraints, only one alkalinity generating component could be installed (i.e. AFVFP). This can limit the ability to neutralize acidity especially during high flows. Therefore at times the system may not produce water with a pH ≥6. Routine inspections will include measuring the pH of the SPWL effluent in the field using a colorimetric kit or a pH meter. Effluent from the SPWL that has a pH <6 and when the flow rate is <40 gpm typically indicates that the AFVFP is not functioning optimally. (Note that due to site constraints, the McCaslin system does not provide a location suitable for flow measurements.) The decrease in treatment by the AFVFP could be caused by low hydraulic conductivity (i.e. limestone becoming plugged due to aluminum sediments), short-circuiting of the treatment media, worse-than-designed-for influent water chemistry, exhausted treatment media, broken siphon and/or other factors.

Improving the final effluent pH should be attempted in a step-wise manner starting with low-cost alternatives performed by a single person using only hand tools and proceed to activities requiring power equipment.

STEP ONE: Manually flush the AFVFP by pulling the rope attached to the valve located in the siphon vault (the top of the rope is tied to the top step). The AFVFP should completely drain in about ½ to 1 hour. Once the AFVFP has been completely drained close the valve. This can be accomplished by climbing down into the vault or by using a long stick or equivalent to push the valve closed. After manually flushing the AFVFP, allow the flow through the system to reestablish for approximately 1 week and then return to measure pH at SPWL. If draining is not sufficient to produce a ≥6 pH at the SPWL, repeat manually flushing at least two more times. If after repeating Step One at least two more times, the pH at the SPWL is still less than 6, proceed to the second step.

STEP TWO: If manually flushing of the AFVFP is not successful then the limestone will need to be stirred. This can be accomplished using a mini-excavator or standard backhoe. It is preferable to have the water as high in the pond as possible to assist in cleaning the stone. Water can be pumped into the AFVFP from the settling pond if necessary. Using the excavator, move and turn the stone as best as possible similar to turning a compost pile. It may be desired to have another person washing the stone (using a pump or hose) as this is occurring. Once the stirring is completed, manually flush the AFVFP until it is completely drained down and then close the valve. Stirring of the AFVFP may need to be completed every 1-5 years depending on a variety of factors. Each stirring event is expected to take approximately 1 day at an estimated cost of about $1,000 (in 2010 dollars) per event.

FINAL STEP: If stirring does not restore the desired pH, then the limestone may need to be enhanced, increased, or replaced and/or the system may need to be otherwise evaluated and upgraded. Changing limestone or upgrading the system should be completed with the assistance of someone familiar with current passive treatment technology.

Maintenance Action Item #2: Water level in siphon vault not changing

Since the AFVFP is controlled by a siphon, the water level within the siphon vault should always be either filling or flushing as long as there is a source of water entering the system. An easy way to determine if the siphon is properly functioning is to measure the water level within the siphon vault from the inner ring where the manhole cover sits. This should be part of the regular monitoring activities that occurs during EVERY site inspection. The first thing that should be conducted when arriving at the site is to remove the manhole cover and measure the depth to water. There is a place on the O&M inspection form for this information. Then continue the inspection. Once the rest of the inspection is completed, measure the depth to water again before leaving the site. Prior to leaving the site remember to put the manhole cover back on. Unless a flushing event occurred (which will be readily apparent by the 8" pipe discharging to the settling pond), the water level within the vault should increase. If not, the siphon may not be functioning properly and the following steps should be followed.

STEP ONE: If no change in water level is occurring during low flow conditions and the inspection visit was not very long, the change may be immeasurable. A second inspection should be conducted within 1 to 7 days. Water level should not be the same (could be higher or lower depending if a flush event occurred). If the water level is exactly the same, go to Step Two.

STEP TWO: During low flow conditions (that could include flows as low as 2 gpm or less), it is possible an equivalent volume of water that is entering the AFVFP is leaking out of the pond through a variety of pathways, which would keep the water level at about the same elevation. This has been observed to occur at about 3 feet above the bottom of the pond which is also about the same elevation as the 2nd step from the top. To address this, two ball valves were installed on the trigger mechanism to provide the option of two different maximum water elevations. During typical operation these valves should be closed which allows the most amount of limestone to be used (about 4 feet). If the water level is not rising to about top step (about 4 feet above the bottom of the pond) and idling around the 2nd step from the top (or about 3 feet above the bottom of the pond), open the two ball valves (the 6" drain valve will need to be opened to facilitate entering the vault).

If step two successfully restores flushing operations, leave both valves open through the low-flow period and close upon entering higher flow periods (e.g. open valves July-November and close valves December through June, or alternatively as needed depending on actual rainfall conditions).

STEP THREE: If the idling is occurring at a higher or lower elevation within the siphon vault or if opening the ball valves is unsuccessful, then contact BioMost, Inc.

Maintenance Action Item #3: Conveyance Pipe plugging or water backing up

The passive treatment system contains a conveyance pipe that collects and conveys the mine discharge to the passive system. The Conveyance Pipe contains multiple cleanouts. The Conveyance Pipe should be inspected at least once a year. This should be conducted by removing the caps of each cleanout and visually inspecting the pipe for accumulation of metal precipitates and debris. The pipe will need to be cleaned when the capacity is reduced by about

50%. An industrial power snake, typically available from most equipment rental stores, should be used (make sure the power snake is rated for 6” pipe).

In addition, the observation of water discharging from or backing up within the cleanouts is an indication that plugging is occurring either within the conveyance pipe, the inlet pipe, or the stone surrounding the inlet pipe, however, “stagnant” water can be expected to occur in the two cleanouts closest to the VFP during portions of the fill/flush cycle (cleanouts #6 and #7). If water is backed up to the other cleanouts, action should be taken. Start by cleaning out the Conveyance Pipe. If this does not solve the issue, then the inlet manifold may need to be cleaned. It will be necessary to utilize a mini excavator or backhoe to excavate the limestone around the inlet manifold to facilitate maintenance activities. Cut the intake manifold pipe as needed, clean with power snake or other device and glue back together when finished. The stone around the intake manifold may also need to cleaned or stirred.

Maintenance Action Item #4: Sludge Accumulation

If sludge has accumulated in the Settling Pond or Wetland to a point where solids are (or about to be) carried out of the spillway during normal flow conditions (or about 1.5’ below the berm elevation), the settling pond and/or wetland should be cleaned. Several companies are currently developing markets for materials recovered from mine drainage treatment systems. One or more of these companies should be contacted first to evaluate the potentially valuable commodities accumulating in the McCaslin Road system. If the material is determined not to be economically viable for recovery, then on-site placement is recommended. The material can be removed from the ponds and/or wetland and placed on-site as feasible. There are a variety of mechanical means available including sludge pumping and/or excavation. There are commercial companies specializing in these types of services. As the system is located on the Findlay Township Public Works property there may not be a suitable location. In addition, Findlay Township may not want this material disposed of on their property therefore permission must be obtained prior to disposal. Other offsite sludge disposal locations may need to be found including active surface mine operations and landfills.

As the Settling Pond/Wetland was constructed with significant freeboard, it is possible to raise the final effluent spillway by adding R4 or R5 riprap and/or moving stone within the spillway. This may help extend the capacity of the pond and eliminate sludge from being eroded away and carried out of the system and therefore lengthening the time before the pond will need to be cleaned out. It may be desirable to try this prior to removing the sludge.

Replacement

All passive treatment systems are unique. The sludge storage capacity for passive components varies from component to component and over time with variable discharge characteristics. Design capacity is based upon available water quality monitoring data and published references. Higher flow rates and poorer water quality can substantially affect the design life. Prior to replacement, the system and water quality should be evaluated to determine if reconstruction 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 is advantageous.

Datashed

Datashed, www.datashed.org, is a fully-featured, GIS-enabled, internet database designed to assist watershed groups, academic institutions, private industry, and government agencies. Powered by open source software, this database provides a cost-effective and reliable solution to the management of data associated with environmental efforts. GIS capability allows users to easily view geographic data and directs users to additional content. Anyone with internet access can view the site and download information. This allows the website to function not only as a data management tool but also as part of the education/outreach effort associated with the project. Datashed was developed by Stream Restoration Incorporated, 241 Computer Services, and WPCAMR using the PHP programming language and open source software such as APACHE HTTP Server, MySQL database, and Map Server.

Datashed is incorporated as part of this O&M Plan. On Datashed, each restoration project has its own page within the website where users can not only view data but also download and print information needed to conduct O&M inspections such as site inspection sheets, site schematics, topographic maps, aerial photos, etc. In addition, those who conduct the inspections can be given passwords to allow direct online upload of collected field and laboratory data from the inspection. See: http://www.datashed.org/project.php?ProjectID=457

To view, download forms, or upload data onto the site use the following directions below:

Viewing, Downloading, and Uploading Data to Datashed

1. Go to Datashed (www.datashed.org). To view data or download forms go to step 2. To upload data such as completing the online O&M form, you will need to first login using your assigned email address and password. If you do not have a password, contact Stream Restoration Incorporated.
2. Select the "Projects" tab or "My Projects".
3. A Project Search Query should appear. This feature allows the user to search for projects based on a variety of selections criterion. Once the criteria has been selected, click on the "List Projects" button
4. A list of available projects matching the criteria with short descriptions should appear.
5. Select the project that you wish to view, download forms, or upload data. The "Project Details" report page will automatically open.
6. Select:
   - "Maps and Directions" located beneath the site photo to get directions to the site
   - "Sample Points" for information about Sample Points
   - "Downloads" to obtain O&M forms, site schematics, location map, "as-builts", etc
   - "View Data" to view O&M submissions, graphs, reports, and data
   - "View Pictures" for project photos
   - "Partners" to view a list of partners involved in the project
   - "Submit Data" to access and upload data via the on-line O&M form
7. If an O&M form exists, you can enter the data from the O&M field inspection sheet. When finished, click submit button. Note that other import mechanisms do exist. Stream Restoration Inc provides instructions when a user signs up for an account. S

MCCASLIN ROAD MINE DRAINGE TREATMENT
O&M INSPECTION REPORT

Inspection Date:	______________	Project Name:	**McCaslin Road Passive Treatment System**
Inspected by:	______________	Municipality:	**Findlay Twp**
Organization:	______________	County:	**Allegheny** State: **PA**
Time Start: ________	End: ________	Project Coordinates:	**40° 29' 31"** Lat **80° 17' 26"** Long
Receiving Stream:	**Unnamed Tributary**	Subwatershed: **West Fork of Enlow Run**	Watershed: **Montour Run**

Weather (circle one): Snow Heavy Rain Rain Light Rain Overcast Fair/Sunny **Temp(°F):** <32 33-40 41-50 51-60 60+

INSPECTION SUMMARY

A. Site Vegetation

Overall condition of site vegetation: 0 1 2 3 4 5 (0=poor, 5=excellent) Is any reseeding required? Yes/No Describe & identify on Schematic

B. Site Access and Parking

Is the access road and parking area accessible for operation and monitoring? Yes/No? Maintenance performed/needed?__________________

C. Vandalism and Housekeeping

Is there evidence of vandalism to the site? Yes/No? Is there litter around/in the passive system? Yes/No? If Yes, was the litter picked up? Yes/No?

D. Spillways (check if Yes)

Ditch	Erosion Rills	Debris/Vegetation Present	Maintenance Performed	Maintenance Needed	Describe Maintenance Performed or Needed:
SPWL					

E. Passive Treatment Components (Check if Yes)

Component	Erosion Rills	Vegetation Problems	Significant Siltation	Berm Slumping, Cracks or Unstable	Water level Change or Overtopping Berm	Valve Broken or Inoperable	Pipes Broken or Plugged
VFP							
SP/WL						**NA**	**NA**
Describe Maintenance Performed or Needed:							

F. Field Water Monitoring, Flow Measurements, and Sample Collection - <u>Remove Manhole Cover and measure depth to water before (upon arrival at site) and after water monitoring (before leaving site). If water level does not change there may be a problem with the siphon</u>**.** Water sample locations as marked on the site schematic. For passive components the sample point is at the effluent of the named component. The following table provides the opportunity to conduct full monitoring if/when desired, however at a minimum, field parameters should be conducted at the SPWL. <u>At a minimum the pH and field iron from the wetland (SPWL outfall channel) should be measured during every site visit. The system and stream should be monitored on at least a quarterly basis.</u>

Depth to Water in Siphon Vault.: _____ ft *Before* monitoring ______ feet *After* monitoring Did the Siphon Flush during inspection?___

Sampling Point	pH	Temp (°C)	Alkalinity (mg/L)	DO (mg/L)	ORP	Iron (mg/L)	Comments	Bottle #	Bottle # (total metals)	Bottle # (diss. metals)
MP5										
1496-VFP										
1496-SPWL*										
1496-UP										
1496-MID										
1496-DN										

O&M SCHEMATIC

MONTOUR RUN WATERSHED ASSOCIATION MCCASLIN ROAD MINE DRAINAGE TREATMENT

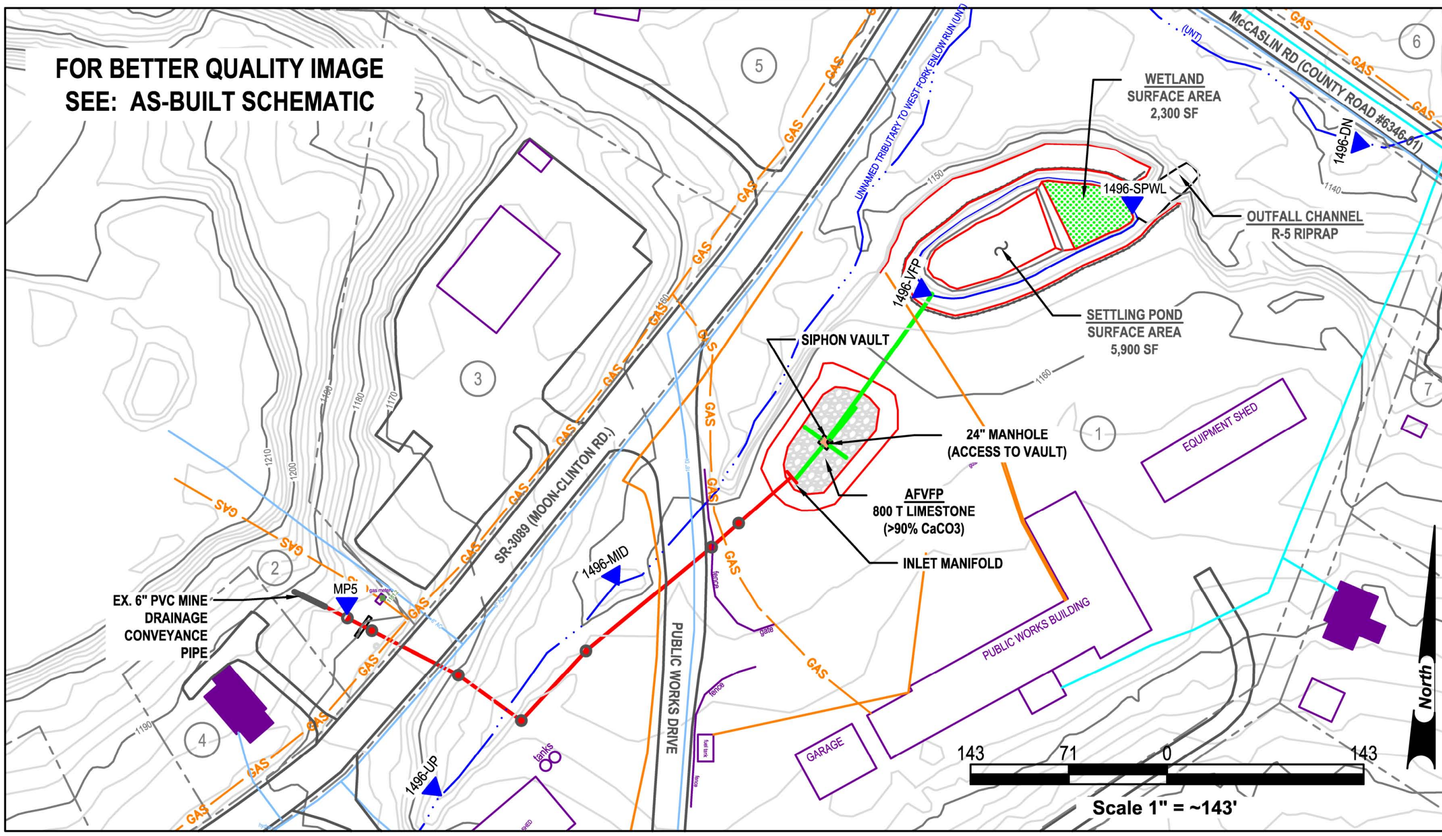
WEST FORK ENLOW RUN SUBWATERSHED
MONTOUR RUN WATERSHED
FINDLAY TOWNSHIP, ALLEGHENY COUNTY, PA
Scale: As Shown June 2010

BioMost, Inc., Mining and Reclamation Services
Mars, Pennsylvania www.biomost.com

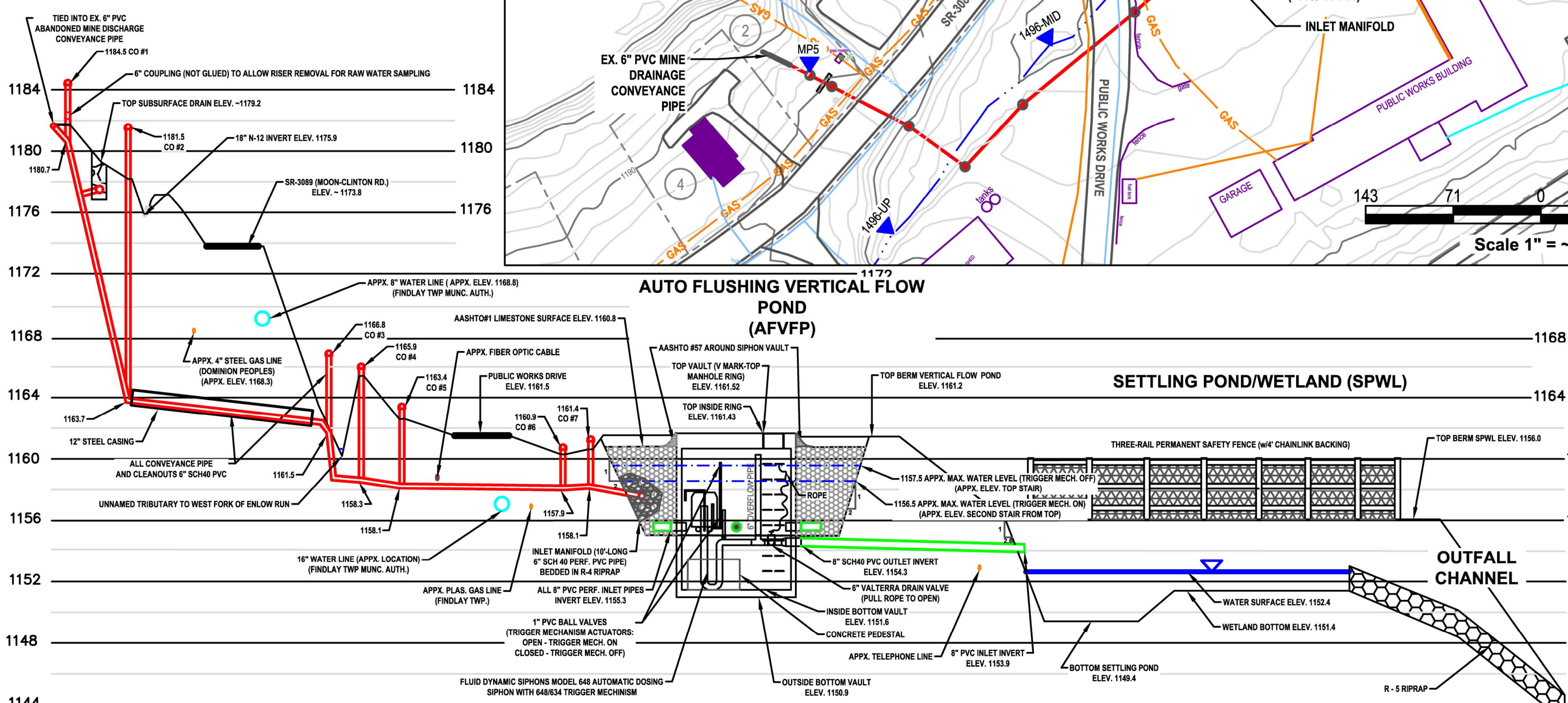
LEGEND

- CONTOUR (INDEX)
- CONTOUR (INTERMEDIATE)
- STREAM
- ROAD (PAVED)
- STRUCTURE (SHADED IF DWELLING)
- PROPERTY LINE (APPX.)
- 6" SCH40 PVC CLEAN OUT (CO #)
- 1181.2 TEMP. CONSTRUCTION BENCH MARK
- GAS UNDERGROUND GAS LINE
- UNDERGROUND UTILITY LINES (ELEC/CABLE/TELE)
- UNDERGROUND WATER LINE (FTMA)
- UNDERGROUND SEWER LINE (FTMA)
- PERMANENT SAFETY FENCE
- 8" SDR35 PVC PIPE
- 6" SCH40 PVC PIPE
- PASSIVE TREATMENT SYSTEM COMPONENT
- SURFACE WATER (POND EDGE)
- MP5 SAMPLING POINT LOCATIONS
- TREATMENT WETLAND AREA
- LIMESTONE TREATMENT MEDIUM (>90% CaCO3)

PLAN VIEW



ELEVATION SCHEMATIC



VERTICAL SCALE: AS SHOWN
HORIZONTAL SCALE: NONE

PROPERTY OWNERS

1. TOWNSHIP OF FINDLAY
2. PRECISION KIDD STEEL CO. INC.
3. INTERNATIONAL ASSOCIATION OF HEAT & FROST INSULATORS & ASBESTOS WORKERS
4. n/f LEONARD, Lawrence M. & Betty Lou
5. n/f NERNBERG, A. Richard & Susan
6. n/f MAFFEI, Charles W. & Dianne E.
7. n/f REPOS, Stanley J. Jr. & Patricia D.

NOTES:

As-built information from 06/24/10 field inspection by BioMost, Inc. using post-processed sub-meter rated GPS unit and laser level as well as design information. Information shown is a reasonable representation of actual field conditions.

Water elevations may vary due to outlet spillway, weather and other factors.

All dimensions are in feet unless otherwise noted.

Sizes listed include: T - Tons High Calcium Carbonate (>90% CaCO3) Limestone; SF - Square Feet (measured at water surface elevation).