Kiski-Conemaugh Basin Treatment System O&M Assessment Report

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Prepared by
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Introduction and Project Background

Approximately 5,600 miles of streams have been documented as being impacted by abandoned mine drainage (AMD) in Pennsylvania, making it one of the largest sources of pollution in the Commonwealth. Over the last 30 years, watershed groups, nonprofits and government agencies have constructed about 300 passive treatment systems, offering a more environmentally-friendly alternative to conventional chemical facilities. Many of the watershed groups that have made such a positive difference in our natural environment, however, are small grassroots organizations that depend on volunteer efforts. While these volunteer efforts have resulted in the substantial improvement of streams, technical knowledge relating to the effective maintenance of passive treatment systems, equipment, and monetary resources may not always be available.

To address this issue, Stream Restoration Incorporated (SRI) launched the Passive Treatment System Operation and Maintenance Technical Assistance Program (SRI O&M TAG) in July of 2011 through a partnership effort with BioMost, Inc (BMI) and with funding provided by the Pennsylvania Department of Environmental Protection (PADEP) Growing Greener Program and the Foundation for Pennsylvania Watersheds. The purpose of the program is to provide technical assistance to watershed groups, nonprofits, conservation districts and others related to the operation and maintenance of passive treatment systems where project partners evaluate treatment and maintenance issues, provide recommendations and perform maintenance to restore performance.

In 2011, the Foundation for Pennsylvania Watersheds was named as the benefactor of a $3.5 million-dollar settlement with GenOn, a coal-fired electric power producer. A stipulation of the settlement was that the funding be spent within the Kiski-Conemaugh River Basin. SRI applied for and received funding in the summer of 2012 to continue and enhance the Passive Treatment System Operation & Maintenance Technical Assistance Program with the understanding that all funds would be dedicated to treatment systems in the Kiski-Conemaugh Basin. The Foundation requested that the scope of work be changed to focus on providing a report which would include evaluations of those passive treatment systems located within the basin that had a known O&M issue or were not performing to expectation. Because a portion of the systems were not being regularly monitored or data was not available and therefore their condition unknown, SRI decided to take this one step further by trying to visit and evaluate every known publicly funded system within the Kiski-Conemaugh Basin. Whenever possible, the evaluations included gathering project related information and water quality data, conducting site investigations, performing various field tests, collecting water samples as necessary, and completing data analysis to determine if the systems were performing well or not. If not, the next step was to try to identify the potential reasons why the systems were not performing to desired expectations and then to provide recommendations as part of the evaluations. These evaluations were shared with the watershed group and/or other responsible organizations so that collective decisions could be made regarding the future of the treatment system. In some instances, maintenance activities were then conducted through the SRI O&M TAG program. In other cases, funding has or is being sought to repair/replace treatment systems.

The Kiski-Conemaugh River Basin (watershed management units 18-B, C, D, and E) is a major subwatershed of the Allegheny River Basin covering 1,887 square-miles in portions of Armstrong, Indiana, Cambria, Somerset and Westmoreland counties. The Kiskiminetas River, which flows into the Allegheny River near Freeport, Pennsylvania, forms at the confluence of the Conemaugh River and Loyalhanna Creek.

Coal mining has historically been a major industry in the watershed. Abandoned mine drainage (AMD) was listed in the Kiski-Conemaugh River Basin Conservation Plan (1999) as the greatest source of pollution. Numerous watershed groups, non-profit organizations, conservation districts, private industry, and government agencies such as the PA DEP have been working together within the basin to reclaim abandoned mine lands, install treatment systems, conduct water monitoring and engage the community to restore water quality. The combined efforts of these groups have made considerable progress as evidenced by those streams that were once orange and lifeless, but are now good quality and support aquatic life.

Based upon information stored in Datashed (www.datashed.org), approximately 60 passive treatment systems have been constructed within the basin and additional systems are planned. Due to the number of passive treatment systems and the size of the watershed, the evaluations have been grouped together within the six major sub-watersheds (See Figure 1) identified in the Conservation Plan. They are the Little Conemaugh River, Blacklick Creek, Stonycreek River, Conemaugh River, Loyalhanna Creek, and Kiskiminetas River.

It is important to note that this report contains evaluations and recommendations that were made based upon the information available and conditions at the time the site investigations were conducted. Due to numerous factors, the project was conducted over a period of several years. Treatment systems are dynamic and therefore the conditions and status of systems may have changed since evaluations were initially conducted. Systems that had been performing well, may no longer be functioning and systems that were performing poorly may have since been repaired, expanded, or rebuilt. This had occurred for several of the systems during the project and after becoming aware of the situation, new site visits were typically conducted and the evaluation was updated. Due to these potential fluctuations in status, it is always recommended to verify the current conditions of the treatment systems with the responsible party prior to seeking funding or going to the site to conduct maintenance.

Figure 1. Generalized Map and Major subwatersheds of the Kiski-Conemaugh River Basin (image courtesy of Kiski-Conemaugh SteamTeam and Conemaugh Valley Conservancy)

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List of Acronyms & Abbreviations

Throughout this report, many acronyms and abbreviations are utilized. While most readers of the report will be familiar, a list has been compiled for easy reference.

AFVFP	Auto-Flushing Vertical Flow Pond
AKA	Also Known As
Al	Aluminum
ALD	Anoxic Limestone Drain
AMD	Abandoned Mined Drainage or Acid Mine Drainage
BAMR	Bureau of Abandoned Mine Reclamation (PA DEP)
BCWA	Blacklick Creek Watershed Association
BMI	BioMost, Inc.
CFB	Circulating Fluidized Bed
CWRS	Center for Watershed Research and Service
Fe	Iron
GPM	Gallons per minute
JVFP	Jennings Vertical Flow Pond
Mn	Manganese
NRCS	Natural Resources Conservation Service
O&M	Operation & Maintenance
O&M TAG	Operation & Maintenance Technical Assistance Grant
OLD	Oxic Limestone Drain
PACD	Pennsylvania Association of Conservation Districts
PA DEP	Pennsylvania Department of Environmental Protection
SCRIP	Stoneycreek-Conemaugh River Improvement Project
SFU	Saint Francis University
SO_4	Sulfate
SP	Settling Pond
SRI	Stream Restoration Incorporated
T	Total
USSCS	United States Soil Conservation Service
VFP	Vertical Flow Pond
VFR	Vertical Flow Reactor
WL	Wetland

Little Conemaugh River

The Little Conemaugh River is approximately 29 miles long with a watershed of about 190 square miles. The Little Conemaugh River converges with the Stonycreek River at “The Point” in Johnstown to form the Conemaugh River. The watershed has a rich heritage of coal mining and steel production and as a result has until recent history been severely impacted. The Little Conemaugh Technical and Steering Committee has been working on a long-term plan to restore the Little Conemaugh River. A multi-million dollar active treatment plant is currently in the works, which would draw down the mine pools contributing to several major discharges in the watershed such as the Miller Shaft, Sonman mine and the infamous Hughes Borehole. The St. Michaels discharge, another large mine discharge is now being treated by the Rosebud Mining Company as part of a Consent Order and Agreement with the PA DEP to mine metallurgical grade coal. Shortly after the St. Michaels chemical treatment system went on-line, a noticeable difference in the watershed could be observed. In addition, there are several passive treatment systems within the watershed, which provide water quality improvements. It is important that these systems are maintained.

The following is a brief evaluation and discussion of the known publicly funded passive treatment systems located within the Little Conemaugh River Watershed. The systems are listed in alphabetical order. When available, site schematics have been included in Appendix A. The schematics vary in quality from scans of hand-drawings to auto-cad designs.

Bear Rock Run

Township/City: Washington Township
County: Cambria
Latitude/Longitude: 40° 25' 8.0004" N 78° 34' 57" W
Receiving Stream: Bear Rock Run
Watershed: Little Conemaugh River

The Bear Rock Run passive system is located in Washington Township, Cambria County near the town of Lilly. There are actually two separate AMD treatment systems located at the site called System 1 and System 2 (See Appendix A) that were installed by the Cambria County Conservation District and the County Conservation Recreation Authority to treat AMD from an underground clay mine. Both systems were designed by the US Soil Conservation Service (USSCS) and constructed around 1995.

A drawing by the USSCS completed in 1994 indicates only limited information about the treatment system. A final report obtained from the PA DEP provided some information related to the treatment systems. According to the report, System 1 consists of a series of four ponds. The first two ponds were designed to be shallow settling/oxidation ponds with rows of hay bale barriers to act as baffles. The third pond was designed to be an anaerobic wetland with about 12" of compost on the bottom and planted with a variety of plants including cattails. The fourth pond is reportedly a shallow basin lined with "3-4 inch diameter" limestone; however, thickness of the layer was not provided.

System 2 was reported to consist of a shallow oxidation basin followed by a "polishing pond to boost alkalinity". The report was unclear as to what the polishing pond contains. The report also mentioned the existence of a "semi-oxic limestone trench". Unfortunately, the final report was obtained after the site investigation was conducted and since there was no prior knowledge of the existence of this trench, it is unknown if the trench still exists. The trench was also not clearly shown on the USSCS drawings.

A site investigation was conducted on November 12, 2014. The System 1 discharge was flowing through the weir, but there appeared to be a large amount of sludge and debris accumulated behind the weir. Based upon observations made in the field, it appears that the first two ponds of System 1 are functioning as settling ponds/wetlands. There were indications of where the hay bale baffles were/are located. During the investigation it was unclear whether the ponds were filling with sludge or if they were designed to be that shallow. Based upon the final report and the design drawing obtained later, the ponds are only about 2.5 feet deep. The third pond, which had a bluish tint, looked as if there might have been compost in the pond, which would correspond to the final report. Since there did not appear to be an underdrain and piped outlet, this pond was likely meant to be an anaerobic or compost wetland. The fourth pond appeared to be a limestone bed, but most of the water looked as if it was flowing on top of the stone instead of through the stone. Water was flowing under and around the final effluent weir.

At System 2, the first pond appeared to be a settling pond/wetland. During the site investigation it was difficult to determine what the 2nd pond consisted of, but appeared to have at least a layer of limestone around, and possibly in, the pond.

Water Quality Data

A review was conducted of the available water quality data for the treatment system; however, there is very little data currently available over the life of the system. Data from a few sampling events shortly after the system was built were found in the final report. In addition, some sampling has been conducted over the last few years through the Passive Treatment Snapshots coordinated by Stream Restoration Inc. It is uncertain as to whether there are other historical data available somewhere. Average water quality data for select parameters from only the last 7 years are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org) as are the historical data collected 1994-1996. Historical data were not considered in the evaluation of the system due to the fact that the quality of the discharge appears to have drastically changed over the last 20 years and there were no data available from 1996 to 2009. Both of the discharges can currently be described as slightly acidic with elevated, but relatively low concentrations of metals. Except for the slightly depressed pH and net-acidic water, the discharges today would actually meet typical mining water quality effluent standards. The effluent water quality of System 1 can be described on average as possibly still net-acidic depending upon the date and the validity of the test results, but generally has a good pH and improved alkalinity and lower concentrations of metals. The effluent water quality of System 2 can be described on average as still net-acidic depending upon the date and the validity of the test results, but improved pH and alkalinity and lower concentrations of metals.

Bear Rock Run Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
BR1A1 (Influent)	17	5.8	5.0	4	8	2.2	0.6	0.4	19
BR1 Outflow	17	5.8	5.9	9	3	0.2	0.4	0.2	17
BR2A1 (Influent)	8	4.9	5.0	4	11	0.9	0.3	0.3	13
BR2 Outflow	8	6.5	6.4	15	1	0.2	0.2	0.2	12

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

The Bear Rock Run passive systems were designed over twenty years ago when passive treatment was still in its infancy. A system designed today for this discharge would likely utilize different technologies. Despite the age, treatment technology selection and assumed lack of maintenance, the system appears to still be functioning and improving the water quality, although not to the degree desired. System 1 could be improved by changing the technology being utilized. While additional excavation would be needed and more limestone purchased, one of the ponds could be converted to a flushable limestone bed. It would likely be possible to either utilize a siphon or SmartDrain to provide for automatic flushing. Alternatively, the final bed could be converted to a Horizontal Flow Limestone Bed (HFLB), which would also require additional excavation and purchase of limestone. System 2 would also benefit from having an HFLB or flushable limestone bed.

The following are additional recommendations:

- Clean the sludge, sediment & debris behind the influent water weir
- Repair effluent weir

Bear Rock Run System 1 Photos

The AMD flowing into the Bear Rock Run System 1 is sampled at a weir (Top Left) which has accumulated sludge, sediment and debris and needs to be cleaned out. The effluent weir (not shown) is leaking and needs to be repaired. System 1 consists of 2 Oxidation Ponds (Top Right), an Anaerobic Cell (Bottom Left), and a shallow limestone lined pond (Bottom Right). The amount of limestone is unknown. The water appears to be largely flowing on top of the limestone lined pond (Bottom Right) and much vegetation is growing in the bed as well.

Bear Rock Run System 2 Photos

At the Bear Rock Run System 2, a limestone channel (Top Left) conveys the mine drainage to the passive treatment system. The water flows into a shallow settling pond/wetland (Top Right) and then into a limestone lined pond (Left). The water is flowing on top of the limestone-lined pond, which may indicate that the stone is plugged and needs to be cleaned.

Mineral Point (aka Saltlick Run)

Township/City: Jackson
County: Cambria
Latitude/Longitude: 40° 24' 14.994" N 78° 49' 23.178" W
Receiving Stream: Little Saltlick Creek
Watershed: Little Conemaugh River

The Mineral Point (aka Saltlick Run) treatment system is located on the property of the Greater Johnstown Water Authority north of the Saltlick Reservoir in Jackson Township, Cambria County. The system was designed by the PA DEP BAMR Ebensburg office and constructed in 2009 by Ted Farabaugh. The site is currently maintained by Denny Steele of the PA DEP on at least a monthly basis and was monitored on a quarterly basis until 2013. The system was built to combine a discharge from a mine abandoned in the 1950s as well as the Ehrenfeld borehole, which is connected to the raw water line in a blockhouse located along the access road just before the system. The raw water including the Ehrenfeld borehole discharge is piped to an elevated step aeration trough which spans about 10 feet. The outfall of the step aerator continues into a baffled settling pond (Cell 1), through a thriving wetland (Cell 2) and through a final baffled settling pond (Cell 3). Rip rap spillways separate the three cells. The effluent of the final settling pond discharges through an Agri Drain box and is then piped to a flume and channel, which leads to Saltlick Run. Two large rock-lined spillways on the east side of the system were apparently designed to direct water into the system, but what water and the exact purpose was unknown at the time of writing this report.

The evaluation for this treatment system was part of a partnership effort with Saint Francis University's (SFU) Center for Watershed Research & Service (CWRS). A site investigation was conducted on 1/21/15 by SFU and on 5/3/16 by Cliff Denholm with Denny Steele of the PA DEP. During the site investigation the following issues were initially identified:

- According to Denny Steele, the step aerator clogs with iron precipitates quite quickly and he must spend significant time cleaning the aerator every 3-4 weeks.
- During the 1/21/15 site visit, water was going over the spillway rather than through the Agri Drain box, which pipes the final outfall of the system into Saltlick Run indicating plugging of the box or pipe. DEP had cleaned out the pipe and during the 5/3/16 site visit, this no longer appeared to be an issue.
- There are some signs of short-circuiting occurring in the rip-rap spillways.
- Significant sludge accumulation has occurred, especially in Cell 1. Eventually the sludge will need to be removed from the pond.
- Some signs of muskrat burrowing in berm.
- One of the baffles in Cell 3 needs to be fixed.
- Most of the numbers on the flume cannot be read due to iron staining and should be cleaned.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system is reported to be sampled by the PA DEP on an approximate quarterly basis; however, not all of the data was found. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). Sampling was also conducted on January 21, 2015 by SFU CRWS. Those results are provided in a separate table below.

The water quality of the discharge flowing into the system can be described as being net-alkaline with near neutral pH and elevated iron concentrations. Flow rate data was quite limited, but ranged from 100 to 450 GPM. In general, as the water flows through the system pH increases slightly with the alkalinity decreasing, but remains net-alkaline. On average about 93% of the total iron is removed. A comparison of iron concentrations from the first year with the last six years shows that initially the system had a higher removal rate than currently, which likely skews the average. Currently the system is discharging about 4 mg/L of iron, which still amounts to about 90% removal. Available ferrous iron concentrations indicate that Fe^{+2} in the effluent is, on average, about 0.3 mg/L indicating that most of the iron leaving the system is probably in the solid form. The solids can be seen entering & staining the receiving stream. A lack of field pH data prevents a good evaluation of the step aerator. Data collected by SFU does show an increase in field pH at the bottom of the aerator due to the degassing of CO_2. A lack of sampling within the system does not allow a determination of how the various parts of the system are performing.

Mineral Point Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	Fe+2	T. Mn	T. Al	SO_4
S8A (influent)	NA	NA	6.7	166	-102	38.0	35.7	0.6	0.2	482
S8D (Step Aerator)	NA	6.8	6.7	181	-124	39.1	34.4	0.6	0.2	526
S8C	180	7.1	7.4	141	-121	2.4	0.4	0.6	0.2	476
S8B (Effluent)	107	7.2	7.4	126	-110	2.6	0.3	0.5	0.2	438

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Saint Francis University Mineral Point 1/21/15 Water Quality Data

Sample Point	Field pH	Lab pH	Alkalinity Lab-	Field	Acidity	Field Cond.	Lab Cond.	T. Fe	T. Mn	T. Al	SO_4	TSS
Raw Discharge	6.1	6.4	138	186	-97	1613	1240	34.8	0.58	<0.05	625	29
End of Aeration Tray	6.4	6.6	121	168	-97	1607	913	37.7	0.66	<0.05	649	31
End of SP1	6.8	6.8	112	128	-94	1459	950	18.8	0.52	<0.05	684	45
Final Outfall	6.8	7.0	105	102	-86	1500	1020	4.84	0.46	<0.05	644	11

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Field and Lab Conductivity in uS/cm, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L, Sulfate and Suspended Solids in mg/L

Conclusions & Recommendations

Based upon available data and information, the Mineral Point system is utilizing appropriate treatment technologies and is working fairly well, removing about 90% of the total iron. There may be actions that could be taken to increase treatment efficiency. Site inspections as well as aerial photographs indicated that short-circuiting may be occurring, which could be affecting full utilization of the treatment area and thus reducing efficiency. A trompe with aeration could potentially be utilized to increase oxidation rates. Installing select windowed baffles to replace direction baffles in the final cell may help to settle solids. As this is a PA DEP BAMR system, it should already have access to their O&M fund.

The following are additional recommendations:

- Continue monitoring the system on a regular basis including flow rates.
- Continue to clean the step aerator as needed.
- Address short-circuiting pathways at spillways.
- Repair/replace baffle curtains as needed.
- Sludge removal will likely need to be conducted in the near future.
- Consider building a sludge dewatering pond if a location is available.
- Clean flume or develop another method to measure flow with look-up table.
- May need to address muskrats if they become a problem.

Mineral Point Photos





At the Mineral Point system, the Step Aerator (Top Left) quickly fills with iron precipitates that regularly need to be removed. Several maintenance issues may be reducing treatment efficiency including short-circuiting in the wetland as can be seen from the aerial photo (Top Right). This might be partially caused by uneven spillways (far side Middle Left). One of the baffle curtains needs to be repaired (Middle Right) although there may be a benefit to replacing a few of the directional curtains in cell 3 (Bottom Left) with windowed curtains to help settle solids. Removal of iron sludge may also help to improve treatment.

Puritan (aka Trout Run)

Township/City: Portage Township
County: Cambria
Latitude/Longitude: 40° 22' 0.5088" N 78° 38' 44.0016" W
Receiving Stream: Trout Run
Watershed: Little Conemaugh River

The Puritan (aka Trout Run) passive treatment system is located in Portage Township, Cambria County and receives mine drainage from the abandoned Puritan underground coal mine. The system was designed by Todd Stager of Penn Terra Engineering Inc., and constructed in 2012. The site is maintained by Dennis Beck and the Trout Run Watershed Association.

The evaluation for this treatment system was part of a partnership effort with Saint Francis University's (SFU) Center for Watershed Research & Service (CWRS). The CWRS has been evaluating the system and providing assistance to the Trout Run Watershed Association as part of a class project. In addition, Tim Danehy and Cliff Denholm met with Dr. Bill Strosnider of SFU on 6/16/15 to visit the site and provide additional input in the evaluation of the system with the intention of partnering to submit a Growing Greener Grant.

The passive system consists of a single, large, 3,500-ton limestone bed containing a series of nine (4 over & 5 under) wooden baffles. The bed discharges to a limestone channel outfall to Trout Run. Despite the current treatment system, the reach downstream of the system remains impacted. The treatment system was constructed with a flow splitter and bypass designed to allow a maximum of 100 gpm of the Puritan discharge to enter the limestone bed while the remaining flow, which can exceed 400 gpm during high-flow periods, bypasses directly to Trout Run. During these high-flow events, the untreated water significantly exceeds the treated water and can have a substantial negative impact regardless of the effectiveness of the treatment system.

In addition to the inability to fully treat the discharge, the following issues were initially identified:

- Within a few months of operation, the first two cells of the limestone bed became clogged with iron and aluminum solids requiring frequent cleaning and/or replacement of the limestone.
- Based upon flow measurements, it is believed that between 20% and 50% (average of 20%) of the influent flow to the system is leaking through the pond to Trout Run and therefore is likely not providing full treatment to the water that is leaking. The system was built within coal refuse and does not appear to be lined.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system is sampled at least quarterly by Dennis Beck of the Trout Run Watershed Association. Average water quality data for select parameters are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). Water quality data of the discharge have been split into pre- (1997-2010) and post-construction. The quality of the discharge appears to be improving over time with less measurable acidity, iron, aluminum and manganese over the last few years compared to the previous 13 years. This is not an uncommon occurrence. The TR4 post construction flow data are for the flow that is going into the system and do not include the bypassed flow. Despite the changes in quality, the discharge can still be described as acidic with elevated concentrations of iron and aluminum and relatively low concentrations of manganese. The final effluent can be described as net-alkaline and on average is removing 78% of the iron, 63% of the aluminum, and 33% of the manganese concentrations. Most of the remaining metals are likely in the solid form as further evidenced by the higher Total Suspended Solids.

Puritan Water Quality Data (Average Values)

Sample Point	Flow	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4	TSS
TR4 (Raw) (1997-2010)	190	3.0	0	290	25.7	3.6	20.9	774	5
TR4 (Raw) (2012-2015)	91	3.5	0	122	8.4	1.5	9.7	643	7
TR4.1 (Effluent)	72	6.4	84	-46	1.8	1.0	3.6	698	14

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Additional water sampling was conducted on January 20, 2015 by Saint Francis University's Center for Watershed Research and Service. The results are provided in the table below. This sampling event showed that the system was working well to remove metals and increase pH and alkalinity. Metals in the final outfall included ~1.4 mg/L of aluminum and less than 1 mg/L of iron and manganese. In addition, water samples were collected of Trout Run upstream and downstream of the system effluent. In this instance and in recent sampling events, it is visible that the water quality is affected by the raw discharge mix. It should be noted that the sampling on January 20th was during a time of low flow and therefore little water was actually bypassing the system. Also, it has been noted that about 25% of the inflow to the system is lost due either a compromised liner, or possibly lack of one, under the limestone, as the system was built within coal refuse.

1/20/15 Trout Run - Puritan Mine Discharge Water Quality Data

Sample Point	Lab pH	Alkalinity	Acidity	Lab Cond.	T. Fe	T. Mn	T. Al	SO_4	S.S.
TR4 (Raw)	3.3	0	91	949	4.65	1.26	7.02	680	14
TR4.1 (Effluent)	6.6	72	-50	951	0.30	0.70	1.41	653	12
Trout Run Up	6.4	13	2	170	0.31	0.44	0.20	51	14
Trout Run Dn	6.4	15	0	263	0.36	0.64	0.35	94	7

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

While the Puritan system generally provides significant treatment in terms of raising pH, neutralizing acidity and removing much of the metals from the mine drainage, the system only treats a portion of the drainage as it is undersized. In addition, the leaking pond further reduces the amount of water treated. The importance of treating this discharge has dramatically increased because once the proposed large Portage Active Treatment Plan is constructed for the major discharges in the basin, the Puritan discharge will be one of the last major impacts in the headwaters of the Little Conemaugh River. The system needs to be modified/rebuilt in order to treat the entire discharge, fix leaks and simultaneously reduce future maintenance needs.

A $538,944 Growing Greener Grant application was submitted in July 2015 by the Trout Run Watershed Association in cooperation with Stream Restoration Inc and SFU's CWRS. A new treatment system conceptual design (see Appendix B) was completed by BioMost, Inc., which consisted of significantly altering the treatment design. The new system would consist of 3,200-ton Auto-Flushing Vertical Flow Pond →Settling Pond with windowed baffle curtain → 3,300-ton Auto-Flushing Vertical Flow Pond →Settling Pond with windowed baffle curtain →Wetland. Existing limestone would be reused as possible. The estimated total cost of the new system is $785,168. The grant was awarded in April 2016. The partnership effort also obtained $100,000 in matching funds from the US Office of Surface Mining.

Puritan Photos

At times, a large portion of the AMD is bypassing the Puritan passive system (Top Left). The first two cells of the limestone bed are regularly clogged with metals (Top Right). At least once per year, the limestone in these cells is removed for cleaning and placed in a pile (Top Right) and then the cleaned stone from the year before is put in its place. The limestone bed uses wooden baffles (Bottom Left) to try to fully utilize the treatment media. Water monitoring indicates the treatment system is likely leaking which would probably be due to fact that the system was built in coal refuse material and does not appear to be lined (Bottom Right).

South Fork AMD50

Township/City: Summerhill Township
County: Cambria
Latitude/Longitude: 40° 18' 43.6464" N 78° 41' 25.5516" W
Receiving Stream: South Fork Little Conemaugh River
Watershed: Little Conemaugh River

The South Fork AMD50 passive treatment system is located on Highland Sewer and Water Authority property in Summerhill Township, Cambria County near the town of Beaverdale and is part of a larger initiative, which so far consists of several small projects, to help restore the South Fork Branch of the Little Conemaugh River. The system was designed by the Pennsylvania Association of Conservation Districts (PACD) and consists of a single limestone bed that is approximately 160’ long, 35’ wide and 5’ deep. The water flows horizontally through AASHTO #1 limestone and is collected on the opposite end by a perforated manifold system connected to an Agri Drain water control structure. The pond can be drained and somewhat flushed by removing stoplogs within the Agri Drain box, but there is not a flush pond on site to flush the solids.

A site investigation was conducted on May 3, 2016 with Jackie Ritko of the Cambria County Conservation District and the Little Conemaugh Watershed Association. According to Jackie, the system is currently working well. A coal refuse pile sits above the system to the west. Erosion of the pile had in the past caused the accumulation of sediment and plugging of the limestone bed. A WPCAMR Quick Response grant was previously used to stir the limestone and install a diversion channel which cuts across the bed utilizing geotextile material. It is uncertain as to whether there was ever stone placed on the geotextile or not. There may be a need to do so in the future. During the inspection, it was observed that the first 1/3 of the limestone bed (up to the diversion channel) showed evidence of being partially plugged with water existing up to the top of the stone (See photos). Algae was observed to be growing wherever there was water at the surface, which could compound the issue. Interestingly, the water appears to not be on top of the stone on the other side of the diversion channel; however, vegetation is growing within the bed.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. Average water quality data for select parameters are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with slightly elevated concentrations of aluminum and manganese. The average water quality of the effluent can be described as net-alkaline with significantly lower concentrations of metals.

South Fork AMD50 Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
AMD50 (Influent)	30	4.2	4.0	1	33	0.3	2.0	3.1	88
MD50F (Effluent)	25	6.4	7.3	38	-32	0.3	0.2	0.5	97

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

Based upon the available water quality data, the system appears to be working well. Water on top of the first 1/3 of the bed does indicate that permeability has decreased in that portion of the bed which is likely being caused by metal precipitates. Currently this does not appear to be a problem, but eventually the bed will need to be stirred and the stone washed.

The following are a list of recommendations:

- Continue to conduct regular inspections and water monitoring of the system including flow measurements whenever possible.
- Due to the passive system design, water quality characteristics, etc., the accumulation of metal sludge, sediment, and debris will decrease permeability and treatment effectiveness over time. There will be a need to periodically clean the bed. Pay particular attention to increases in water level and the accumulation of water on top of the limestone bed, which is an indicator of the bed becoming plugged. Once water is on top of the stone over a large portion of the bed or once water quality has decreased, the limestone in the bed will need to be stirred and washed.
- If possible, when the stone does need to be stirred and washed, make every effort to prevent the sediment and sludge from being flushed into the stream.
- It might be possible to find a location to either build a flush pond or to at least use a pumped filter bag during flushing events.
- Establishment of an O&M fund for future maintenance needs is also recommended.

South Fork AMD50 Photos




The South Fork AMD50 site consists of a single limestone bed, which appears to be partially plugged at the first 1/3 of the bed (Top Left) as evidenced by the standing water. Algae growing in the standing water could add to this problem. A coal refuse pile (Top Right) is situated above the system to the west and has in the past been a source of sediment and plugging. A WCPAMR Quick Response grant provided funding to stir the limestone and construct a diversion channel across the bed (Top & Bottom Left) to help keep the sediment out. There may be a need to add stone to the diversion channel. Vegetation is growing (Bottom Right) in places through the other 2/3 of the bed, but at the present time does not appear to be affecting treatment. The bed can be flushed, but there is no pond to flush the solids to due to limited room, public roads, and a stream.

South Fork AMD60

Township/City: Summerhill Township
County: Cambria
Latitude/Longitude: 40° 18' 39.7116" N 78° 41' 20.6808" W
Receiving Stream: South Fork Little Conemaugh River
Watershed: Little Conemaugh River

The South Fork AMD60 passive treatment system is located on Highland Sewer and Water Authority property in Summerhill Township, Cambria County near the town of Beaverdale and is part of a larger initiative, which so far consists of several small projects, to help restore the South Fork Branch of the Little Conemaugh River. The system was designed by the PACD and consists of a single limestone bed that is approximately 100' long, 20' wide and 3' deep. The mine drainage is collected by a 4" perforated pipe that is placed within a channel. Any water not collected by the pipe bypasses to the stream. The collected AMD is then conveyed around a pump house to a perforated distribution header that is situated on top of the limestone. The water then flows horizontally through AASHTO #1 limestone and is collected on the opposite end by a perforated manifold pipe connected to solid pipe and riser, which discharges the treated water to a channel.

A site investigation was conducted on May 3, 2016 with Jackie Ritko of the Cambria County Conservation District and the Little Conemaugh Watershed Association. The perforated collection pipe was covered over by leaves and other organic debris which was reducing the amount of AMD being collected and causing more water to bypass the system. The inlet distribution pipe was also covered in leaves and many of the perforations were plugged with debris preventing water from being conveyed to the system, compounding the problem. Both pipes and perforations were partly cleaned out during the site visit which resulted in an immediate increase in flow to the system. As the system is located in a wooded area, leaves and debris have been, and will continue to be, an on-going issue. At one point, geotextile was placed over top of the stone to help protect the bed from becoming plugged by leaves.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. Average water quality data for select parameters are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with high concentrations of aluminum and manganese. The average water quality of the effluent can be described as net-acidic with slightly lower concentrations of metals, but remains significantly impacted. The data indicates that the system has never fully functioned and is likely undersized.

South Fork AMD 60 Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
AMD60 (Influent)	37	3.7	3.7	0	126	0.4	13.5	14.2	324
MD60F (Effluent)	NA	4.8	4.6	3	55	0.3	9.4	8.5	249

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

While the AMD60 system does neutralize about half the acidity and removes a portion of the metals, overall the system does not perform well. This is likely due to being undersized. This is not the fault of the designer, but of the site conditions. An access road, pump house, buried water line at uncertain depth, and stream in close proximity significantly reduced the available area for construction. This is clearly a “do something or do nothing” situation. It might be possible to extend the length of the bed, but the impact would likely be minimal. Cleaning the stone periodically may help increase performance.

The following are a list of recommendations:

- Continue to conduct regular inspections and water monitoring of the system including flow measurements whenever possible.
- Pay particular attention to increases in water level and the accumulation of water on top of the limestone bed, which is an indicator of the bed becoming plugged.
- Regularly inspect the intake and flow distribution manifold for the accumulation of leaves and debris and remove as necessary.
- Due to the passive system design, water quality characteristics, etc., the accumulation of metal sludge, sediment, and debris will decrease permeability and treatment effectiveness over time. There will be a need to periodically clean the bed. It is recommended that the stone be stirred and washed and if possible that sediments and sludge are collected and removed from the site rather than being flushed into the stream.
- Establishment of an O&M fund for future maintenance needs is also recommended.

South Fork AMD60 Photos

The South Fork AMD60 discharge is collected by a white perforated PVC pipe (a portion visible Top Right) that was placed within a rock-lined channel (Top Left). Any water not collected by the pipe is bypassed to the stream by the black culvert pipe (Top Left and Right). The collection pipe is easily covered and plugged by leaves and debris. The collected AMD is conveyed around a pump house to the influent distribution pipe with bottom perforations (Bottom Left) which also can be easily clogged with leaves and debris. The water then flows through the limestone bed (Bottom Right) which has geotextile placed on top of the limestone to prevent clogging with leaves and debris.

South Fork AMD67

Township/City: Summerhill Township
County: Cambria
Latitude/Longitude: 40° 18' 28.9908" N 78° 41' 7.9872" W
Receiving Stream: South Fork Little Conemaugh River
Watershed: Little Conemaugh River

The South Fork AMD67 passive treatment system is located on Highland Sewer and Water Authority property in Summerhill Township, Cambria County near the town of Beaverdale and is part of a larger initiative, which so far consists of several small projects, to help restore the South Fork Branch of the Little Conemaugh River. The system was designed by the PACD and consists of a single narrow limestone trench that is approximately 140' long, 8' wide and 2' deep. Small AMD seeps flow into the trench. The size of the system was limited by available space because of the access road and stream.

A site investigation was conducted on May 3, 2016 with Jackie Ritko of the Cambria County Conservation District and the Little Conemaugh Watershed Association. The system is experiencing significant erosion of the cut slope. Reportedly, the erosion may have been caused by the installation of power lines from the windmill farm on top of the hill, but that has not been confirmed. There have been attempts to stabilize the hillside and a number of compost filter socks have been placed at the toe to help prevent sediment from entering the trench. The trench has been stirred a couple of times. At one point, geotextile was placed over top of the stone to help protect the bed from becoming plugged.

Water Quality Data

A review of the available water quality data for the treatment system was conducted, but the dataset appears to be very limited. Average water quality data for select parameters are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with elevated concentrations of aluminum and manganese. The average water quality of the effluent can be described as net-acidic with lower concentrations of metals, but remains impacted.

South Fork AMD 67 Water Quality Data (Average Data)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
AMD67 (Influent)	7	4.0	4.0	1	73	0.3	7.5	8.9	171
AMD67F (Effluent)	NA	4.9	4.8	2	16	0.3	3.8	3.1	120

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

While the AMD67 system does neutralize about 75% of the acidity and removes a portion of the metals, overall the system does not perform very well. This is likely due to being undersized. This is not the fault of the designer, but of the site conditions. An access road, buried water line at uncertain depth, and stream in close proximity significantly reduced the available area for construction. In addition, problems with slope stability and erosion may be contributors. This is clearly a “do something or do nothing” situation. It might be possible to extend the length of the trench, but the impact would likely be minimal. Cleaning the stone periodically may help increase performance.

The following are a list of additional recommendations:

- Continue to conduct regular inspections and water monitoring of the system including flow measurements whenever possible.
- Pay particular attention to increases in water level and the accumulation of water on top of the limestone trench, which is an indicator of the trench becoming plugged.
- Due to the passive system design, water quality characteristics, etc., the accumulation of metal sludge, sediment, and debris will decrease permeability and treatment effectiveness over time. There will be a need to periodically clean the trench. It is recommended that the stone be stirred and washed and if possible that sediments and sludge are collected and removed from the site rather than being flushed into the stream.
- Establishment of an O&M fund for future maintenance needs is also recommended.

South Fork AMD67 Photos




The South Fork AMD67 system consists of a long narrow limestone trench used to treat a small seep(s). Space was limited due to the hillside and access road (Top Left). The system is experiencing significant erosion of the cut slope and some large boulders are falling down (Top Left & Right). There have been attempts to stabilize the hill side and a number of compost filter socks have been placed at the toe (Bottom Left & Right) to help prevent sediment from entering the trench. The trench has been stirred a couple of times. At one point, geotextile was placed over top of the stone to help protect the bed from becoming plugged.

South Fork Brence (AMD85)

Township/City: Adams Township
County: Cambria
Latitude/Longitude: 40° 18' 1.6992" N 78° 41' 13.0848" W
Receiving Stream: South Fork Little Conemaugh River
Watershed: Little Conemaugh River

The South Fork Brence AMD85 passive treatment system is located on private property in Adams Township, Cambria County near the town of Beaverdale and is part of a larger initiative, which so far consists of several small projects, to help restore the South Fork Branch of the Little Conemaugh River. The system was designed by the Pennsylvania Association of Conservation Districts and consists of a limestone bed that is approximately 100' long, 65' wide and 5' deep, followed by a settling pond. The mine drainage is collected by a 6" perforated pipe that is then conveyed to the treatment system where a perforated distribution pipe along the width of the limestone bed is used to evenly distribute the AMD. The water flows horizontally through the limestone bed where it is captured by a "pipe tree" manifold system and then conveyed to a settling pond. An Agri Drain water control structure is used to control water level within the bed.

A site investigation was conducted on May 3, 2016 with Jackie Ritko of the Cambria County Conservation District and the Little Conemaugh Watershed Association. Much of the limestone bed had standing water on top of the stone indicating plugging of the bed was occurring. Jackie reported that recently water had been flowing across the whole length of the bed and was flowing over the emergency spillway. She removed one of the stoplogs from the Agri Drain box, which has resulted in lowering of the water level. Jackie also reported that when she does flush the bed, she leaves it for a week before returning.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system appears to be sampled on a somewhat regular basis since construction. Average water quality data for select parameters are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with high concentrations of aluminum and manganese with slightly elevated iron values. The average water quality of the effluent can be described as net-acidic with slightly lower concentrations of metals and remains significantly impacted. The data indicates that the system has never fully functioned.

South Fork Brence AMD 85 Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
AMD85 (Influent)	39	3.3	3.2	0	223	1.1	16.1	27.7	498
MD85F (Effluent)	NA	4.8	4.4	2	128	1.0	14.3	20.8	459

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

While the Brence system does neutralize about 40% of the acidity and removes a portion of the metals, overall the system does not perform well and based on the available data never really did. The design drawings indicate the limestone bed is approximately 100' long, 65' wide and 5' deep and is estimated to contain about 1200 tons of limestone. The actual amount is unknown. Based upon the available flow rate and chemistry, this is not an unreasonable amount of limestone. This may indicate that there has been an on-going short-circuiting issue. The first step to address this issue would be to stir and clean the stone. This could be completed utilizing the SRI O&M TAG program. If this is not successful, then there may be a need to change the treatment process. There are a variety of options depending upon funding and available construction area. If no additional land is available, one option would be to convert to an auto-flushing limestone bed utilizing a siphon or solar-powered SmartDrain. Either option would provide a flushing mechanism to help reduce plugging. The only problem is that the system does not have an underdrain. This would require cleaning and removing all of the stone, install an underdrain and then replace the cleaned stone. Due to the severity of the mine water, one single limestone-only alkalinity generator might not provide sufficient treatment. To address this concern, another option would be to convert the bed to a mixed media Jennings-style Vertical Flow Pond, which would be able to provide sufficient acid neutralizing capacity. If sufficient additional area can be obtained to expand the system, an ideal scenario would consist of an AFVFP→SP→JVFP→SP/WL and possibly adding an HFLB as the final component. Further evaluation is recommended which could be provided by the SRI O&M TAG program.

The following are a list of additional recommendations:

- Continue to conduct regular inspections and water monitoring of the system including flow measurements whenever possible.
- Pay particular attention to increases in water level and the accumulation of water on top of the limestone bed which is an indicator of the bed becoming plugged.
- Due to the passive system design, water quality characteristics, etc., the accumulation of metal sludge, sediment, and debris will decrease permeability and treatment effectiveness over time. There will be a need to periodically stir and wash the stone.
- Installing a directional baffle curtain in the settling pond may help to increase retention time and help to settle solids.
- Establishment of an O&M fund is also recommended.

South Fork Brence AMD85 Photos

At the South Fork Brence Pond (AMD 85), the limestone bed is becoming plugged with metal precipitates as evidenced by increasing water level (Top Left). In recent months stoplogs from the Agri Drain box have been removed to prevent water from exiting through the emergency spillway (Bottom Left). Water enters the system via a perforated distribution pipe (Top Left) and the effluent is collected by a “pipe tree” manifold system (Top Right). Flow enters the settling pond directly across from the outlet (Bottom Right) and likely could use a baffle curtain to prevent short-circuiting. The pond also contains a lot of algae and plants and may need to be cleaned in the near future.

Blacklick Creek

Blacklick Creek is a major tributary to the Conemaugh River. The Blacklick Creek Watershed is approximately 420 square miles in area and is located in Indiana and Cambria Counties in Western Pennsylvania. Blacklick Creek is formed by the confluence of the North and South Branches of Blacklick Creek near the town of Vintondale, PA and flows into the Conemaugh River near Blairsville, PA. Other major streams within the watershed include Two Lick Creek and Yellow Creek.

Coal mining has been a major industry within the watershed since at least the late 1800's and as a result the watershed has been severely impacted by abandoned mine drainage. According to the Blacklick Creek Watershed Assessment/Restoration Plan completed by L. Robert Kimball & Associates in 2005, there are over 490 mine discharges of varying flow and chemical composition within the watershed impacting about 40 miles of stream. The Blacklick Creek Watershed Association (BCWA) formed in 1993 with the primary goal of addressing abandoned mine drainage within the watershed. Other organizations that have installed treatment systems within the watershed include AMD & ART, U.S Army Corps of Engineers, Indiana County Conservation District, PA Department of Environmental Protection and Stream Restoration Incorporated. There are about a dozen known passive treatment systems and one active treatment system that have been constructed by these organizations. The PA DEP BAMR is currently in the design phase to install a large active treatment plant within the Blacklick Creek watershed similar to the one for the Little Conemaugh River with the intention of treating large mine pools that are the source water for mine discharges. Therefore, it will be important to make sure that the many publicly-funded passive systems within the watershed are properly maintained. Additional treatment systems may be located on permitted and bond forfeiture mine sites; however, those systems are beyond the scope of this project.

The following is a brief evaluation and discussion of the passive treatment systems located within the Blacklick Creek Watershed. The systems are listed in alphabetical order. When available, site schematics have been included in Appendix A. The schematics vary in quality from scans of hand-drawings to auto-cad designs.

AMD & ART

Township/City: Vintondale
County: Cambria
Latitude/Longitude: 40° 28' 49.0008" N 78° 54' 41.0004" W
Receiving Stream: South Branch Blacklick Creek
Watershed: Blacklick Creek

The AMD & ART site is located in the town of Vintondale in Cambria County. The site is one of the most interesting watershed restoration projects within Western Pennsylvania in that it attempted to combine water treatment, landscape reclamation, recreation, history, and art into a single community park. The AMD & ART park consists of approximately 35 acres of mine lands and includes educational signs, a beautiful and haunting mine portal scenery etching, litmus garden, hiking/biking trail, coal refuse pile and the passive treatment system. The passive treatment system was designed by EarthTech and initial construction was completed in 2001 with additional renovations completed in 2005. The system receives mine water from the Vinton Colliery Company Vintondale Mine #3 underground coal mine which began operation in 1899. After flowing out of the mine, the water is collected and then conveyed to the passive system via a pipe into the Acid Pool (aka Forebay aka Pond 1) → 3 wetland cells → a Vertical Flow Pond → Settling Pond → Wetlands → South Branch Blacklick Creek. The Vertical Flow Pond is a layered system reportedly with organic material placed on top of a four-foot thick bed of limestone.

An initial site visit was conducted on November 14, 2012 with Dennis Remy of the BCWA. Additional site visits were conducted on June 16, 2015 and July 2, 2015. During the site investigations, the following issues were initially identified:

- Currently the discharge emanates from the underground mine, flows down a hill, under the road, through a culvert, down another hill and then flows into a grate-covered catchment basin, which is connected to the piping system that conveys the water to the treatment system. This means that the treatment system receives road run-off and sediment during storm events and snow melts, road salt, etc. In addition, leaves, sediment from erosion, etc., collect on top of the grate and can prevent a portion, if not all, of the water from entering the system. On 6/16/15, while 200 gpm was flowing into the system, an estimated 50-100 gpm was bypassing because of the amount of material that had collected on top of the grate (See photos). This will continue to be a maintenance issue and will need to be regularly checked and cleaned unless the collection system is modified. In addition, due to the acidic nature of the discharge, the metal grate has been severely corroded so that larger holes now exist within the grate that allow larger sized material including rocks into the pipe. This could cause some plugging issues in the future if not fixed.
- Numerous holes (possibly from bullets) and/or breaks in the pipe that conveys the discharge to the system is another cause of water not getting to the system. According to Dr. Art Rose, a group of local teenagers have made an effort to “bandage” portions of the pipe by wrapping material around the pipe and using zip-ties to secure the material (See photos). These “bandages” are only partially working and the pipe is still

leaking in various locations. In addition, during installation of the pipe, a transition was made from an 8” to 12” pipe. The smaller pipe was inserted into the larger pipe and cemented together. Over time the cement has degraded and water is now leaking at the joint (See photos).

- The ponds were built in coal refuse and are leaking terribly. Even when all the flow was entering the system, the water reportedly did not usually get past Treatment Pond (Settling Pond) 6 (TP6), let alone the final outlet. (See photos)
- As most of the water is not getting to or through the system, evaluation of the treatment performance is not possible. The current condition of the treatment media in the VFP is also uncertain; however, based on existing water quality and flow data, additional alkalinity generating components are likely needed and have been recommended including the addition of auto-flushing limestone-only vertical flow ponds.

According to T. Allan Comp, an O&M account was established a number of years ago with the Community Foundation for the Alleghenies. Approximately $30,000 was initially established with the intention of using the interest to assist with O&M costs. The fund currently holds around $40,000.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The discharge has been sampled by StreamTeam on an approximately quarterly basis. A few samples of the effluent of the passive system have also been sampled by StreamTeam over the years, but typically the system does not appear to discharge due to leaking ponds. Average water quality data for select parameters are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with relatively high concentrations of iron and aluminum. A sample of the effluent was collected on 7-31-13; however, no flow data was provided to accurately compare treatment effectiveness. The water quality of the effluent on this date can be described as slightly net-acidic with significant reductions of iron and aluminum.

AMD & ART Water Quality Data

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
425 (Influent)	188	2.7	2.74	0	391	23.1	2.6	32.7	703
Effluent (7-31-13)	NA	5.71	6.0	16	2	1.4	3.7	0.5	619

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Water samples and field measurements were collected by BioMost, Inc. on 6/16/15. The data collected on this date is provided in the table below.

6/16/15 AMD & ART Water Quality Data

Sample Point	Flow	Lab pH	Alk mg/L	Acid mg/L	T. Fe mg/L	D. Fe mg/L	T.Mn mg/L	D. Mn mg/L	T. Al mg/L	D. Al mg/L	SO4 mg/L
425	204	2.81	0	264	14.1	12.0	4.0	3.9	26.4	21.5	986
TP4	75	2.88	0	348	20.8	17.4	3.1	3.1	41.0	34.8	921
VFP	5	6.40	157	-89	7.7	6.8	4.4	4.2	0.6	0.2	1671
TP6A	5	4.19	0	14	0.5	0.3	0.3	0.3	0.3	0.2	70
TP6	1	3.08	0	192	5.4	3. 7	2.9	2.9	23.5	20.9	964
WLA	5-10	3.04	0	91	15.1	13.6	2.6	2.5	21.4	19.6	707
Final	0										

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

As can be seen from the flow data collected on 6/16/15, most of the mine drainage that enters the treatment system leaks through the ponds and likely into the South Branch of Blacklick Creek. On 6/16/15, approximately 200 gpm entered the first pond of the system while only 75 gpm (36%) entered the VFP and only 5 gpm (2.5%) was flowing out of the Vertical Flow Pond (VFP). Even though an additional 5 gpm of surface runoff (TP6A) was flowing into Treatment Pond 6 (TP6) only about 1 gpm was flowing out. Additional flow was encountered in the following wetland, but at the final effluent, no water was discharging to the stream. Because the majority of the water does not flow through the system, it is difficult to evaluate the treatment effectiveness of the existing passive system. Based on the water quality of the lower portion of the system compared to the water quality flowing out of the VFP, it is likely that either additional AMD is flowing into the system, a portion of the water lost through the ponds at the beginning of the system is reentering lower in the system, or contact with coal refuse is degrading the treated water. What is clear is that in order to treat the AMD, all of the ponds will need to be lined.

Based upon the available water quality and flow data of the discharge, it is uncertain as to why several wetland cells were constructed after the first collection pond prior to the Vertical Flow Pond and why only one alkalinity-generating component was utilized. According to the AMD&ART website (www.amdandart.org), the Acid Pool (first pond) was lined with limestone. Not enough information is available to verify this. If true, the limestone probably did and may still today encourage some acid neutralization and low pH iron removal.

Conclusions & Recommendations

The treatment system is currently not working and needs to be repaired. In order to rehabilitate the AMD & ART site, the following tasks will need to be completed:

- Complete a design to rehabilitate and upgrade the existing system;
- Replace the existing collection and pipe conveyance system;
- Install liners (type to be determined) in all ponds;
- Reconfigure treatment ponds 1 through 6 to provide additional treatment capacity

Update #1

Working with the Blacklick Creek Watershed Association, a plan to rehabilitate the system was developed and a PA DEP Growing Greener grant application was submitted in 2015. A copy of the conceptual schematic has been included in Appendix B. As part of the proposed project, the mine discharge would be collected at the mine outflow and piped directly to the treatment system. An emergency overflow would be installed at the mine outflow to prevent backing water into the mine workings. A horizontal bore under the state road with steel casing and a HDPE insert would be installed to take the conveyance pipe under the road. Collecting the water at the mine will eliminate road runoff, sediment, leaves, etc. from entering the collection system and eliminate the problems with the grate-covered catchment basin. The existing broken SDR35 conveyance pipe would be replaced with 12" HDPE pipe that would be connected to the existing 12" Schedule 40 PVC that is still in good condition. Ponds 1 and 2 would be converted to 2 Auto-Flushing Limestone-Only Vertical Flow Ponds (AFVFPs) and ponds 3 and 4 would be combined into 1 large settling pond with a windowed baffle curtain. The existing Vertical Flow Pond (Pond 5) would be converted into a Jennings-type mixed media Vertical Flow Pond (JVFP). Pond 6 would also be converted into a JVFP. The purpose of the AFVFPs is to provide initial "pre-treatment" of the discharge by raising the pH to ~5 to promote the precipitation of aluminum and ferric iron. Approximately 1,500 tons of limestone would be placed in each AFVFP. The ponds would be designed to use siphon vaults and/or Agri Drain SmartDrains to allow for frequent flushing of metals from the treatment media. The ponds would flush into the settling pond with baffle curtains to settle solids prior to the water flowing into the Jennings Vertical Flow Ponds (JVFP). Each JVFP would consist of a mixture of 2,000 tons of limestone mixed with compost and woodchips to generate excess alkalinity and promote the removal of ferrous iron in the wetlands.

While the most time efficient and cost effective approach would consist of conducting the entire project at one time under one grant, the project partners realize that the scope of work and total cost may be prohibitive to this approach. Therefore, the work plan could be broken down into the following 4 phases:

Phase 1: Design, Permitting, and Collection System Upgrade
Phase 2: Reconfigure ponds 1 through 4 into 2 AFVFPs and a settling pond
Phase 3: Reconfigure ponds 5 and 6 into JVFPs
Phase 4: Install liners in the remaining wetlands

Update #2

Although a plan, conceptual design and grant application was developed, the grant was not approved. The PA DEP is currently investigating the possibility of capturing the mine water and directing it to the proposed large-scale active Blacklick Creek Treatment System. The proposed chemical treatment system will treat multiple mine discharges that currently impact the Blacklick Creek watershed including the "Three Sisters Boreholes". It is unlikely that the DEP will support the rehabilitation of the AMD & ART system until after they have tried to capture the discharge. If they are able to completely capture and treat the discharge, the passive system will no longer be needed and a decision about what to do with the O&M funds will need to be made.

AMD & ART Photos

The Vintondale #3 abandoned mine discharge flows out of the underground mine, over a hill, through a culvert under the road and is collected by a grate-covered catchment basin (Top Left). When the grate is covered by leaves and sediment or during high flows, a portion or all of the water can bypass the system. After cleaning the grate, the water flows into the basin and treatment system. As the photo demonstrates, the grate has been corroded by the water and pieces are now missing, allowing more debris, rocks, etc. to enter the system. A better collection system is needed. From the catchment basin, a pipe conveys the water to the treatment system. The pipe largely lies along the ground and is broken or leaking in various locations. Local teenagers have taken the initiative to try to "bandage" the pipe (Top Right) in places with limited success. All of the ponds within the treatment system were constructed within coal refuse (Bottom Left). Since the ponds were not lined, they leak very badly. Even when over 200 gpm was entering the system, no water was being discharged at the final effluent (Bottom Right). The ponds need to be lined in order for the water to be fully treated.

Coal Pit Run (Upper and Lower Systems)

Township/City: Blacklick Township
County: Cambria
Latitude/Longitude: 40° 29' 56.0004" N 78° 49' 58.0008" W
Receiving Stream: Coal Pit Run
Watershed: Blacklick Creek

The Coal Pit Run Upper and Lower Systems are located in Blacklick Township in Cambria County. The two passive treatment systems are located in close proximity to each other and treat two small abandoned mine discharges located along Coal Pit Run which is a headwaters tributary of the South Branch Blacklick Creek. The systems were designed by Vapco Engineering and constructed in 2005. As shown on the site schematic the upper passive treatment system consists of a vertical flow pond (reported to contain crushed limestone and manure) and a settling pond. The lower system consists of a vertical flow pond.

A site visit was conducted with Dennis Remy of BCWA on November 14, 2012. According to Dennis the systems were functioning well with no known maintenance issues. No obvious problems were observed during the site visit.

Water Quality Data

A review of the available water quality data for the treatment systems was conducted. The systems are sampled by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). Both systems are currently functioning well. The raw water quality for both discharges can be described as acidic with relatively low metal concentrations and flow. The effluent of both systems are net-alkaline with low metal concentrations.

Upper Coal Pit Run Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
462 (Influent)	25	3.7	3.7	0	55	0.6	0.7	5.7	228
463 (VFP)	27	6.7	6.8	77	-49	0.4	0.6	1.4	211
464 (Effluent)	27	7.0	7.4	75	-52	0.3	0.3	0.7	203

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Lower Coal Pit Run Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
465 (Influent)	NA	4.7	4.8	7	26	1.0	1.7	3.0	200
466 (Effluent)	19	7.1	7.5	113	-84	0.6	1.6	0.5	178

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Update

In January 2015, Missy Reckner of StreamTeam contacted SRI regarding problems at the site. Water was overtopping the berm of the Upper System's Vertical Flow Pond. There was also a problem with the accumulation of vegetation and sediment that was causing difficulties with sampling the Lower System. In June 2015, a new site visit was conducted and maintenance was performed under SRI's O&M TAG program. Maintenance included stirring the treatment media and installing a new valve at the Upper System and removing vegetation and sediment from around a pipe at the Lower System. The system is currently performing well.

Conclusions & Recommendations

As there are currently no known maintenance issues and the treatment systems are successfully treating the discharges, the primary recommendation at this time is to continue regular inspection and water monitoring of the system and complete maintenance as needed. Pay particular attention to increases in the water level of the Vertical Flow Ponds. As the media continues to age and accumulate metals, there may be a need to occasionally stir the treatment media every couple of years. In addition, establishment of an O&M fund for future maintenance needs is also recommended.

Coal Pit Run Upper and Lower Systems Photos





The permeability of the Coal Pit Upper Vertical Flow Pond had decreased and was flowing over the berm (Top Left). The pond was drained and stirred (Top Right). The valve for flushing the pond had broken and was replaced (Middle Left). Vegetation, sludge, and debris had accumulated around the influent pipe of the Lower system (Middle Right) which made sampling difficult. The material was removed (Bottom Left).

Laurel Run #1 (North)

Township/City: Brushvalley Township
County: Indiana
Latitude/Longitude: 40° 30' 29.6496" N 79° 6' 46.4112" W
Receiving Stream: Laurel Run
Watershed: Blacklick Creek

The Laurel Run #1 (North) passive system is located on PA State Gamelands #276 property in Brushvalley and Center townships, Indiana County in the headwaters of Laurel Run, a tributary to the main stem of Blacklick Creek. The system was designed by BioMost, Inc on behalf of Stream Restoration Incorporated and the BCWA and constructed in 2001 by Amerikohl Mining Inc. The original treatment system utilized a perforated piping system surrounded by non-reactive aggregate within an underground mine entry to capture the discharge. The collection system was designed to allow over 200 gpm to enter the treatment system while allowing the remaining flow to bypass the system to the stream. An approximately 300-foot long pipe with cleanouts every 100-feet conveys the mine discharge to the system. The treatment system consists of two Vertical Flow Ponds operating in parallel, which are followed by an aerobic wetland before discharging into Laurel Run. The Vertical Flow Ponds each have about 3,000-tons of high calcium carbonate limestone approximately 4 feet thick overlain by ~1/2-foot of spent mushroom compost. A two-tiered underdrain system with a total of eight zones collects the water and provides a mechanism for flushing into a separate flush pond.

A site visit was conducted with Dennis Remy of BCWA on November 12, 2012. During the site investigation the following issues were initially identified:

- The collection system and/or conveyance pipe appeared to be partially clogged as there was not much water flowing into the system, but significant flow bypassing the system.
- Because of site conditions, construction issues and size of the flush pond, the system has not been flushed in a long time and is essentially useless for conducting major flushing events.
- A number of the Vertical Flow Pond outlet peri-pipes were not flowing even though they were level, possibly indicating either partial plugging of media/bedding, stone/pipes, or gas traps within the underdrain.
- During the site visit, BCWA indicated that they thought that the treatment media needed to be replaced; however, due to the age of the system this should not be needed yet. There may be a need to rehabilitate the media.
- It was also noted during the visit that Amerikohl Mining was planning on mining coal in the area and that the water would be turned off to the system and additional treatment components may be built as part of the permit requirements. It was also noted that it would be advantageous to do any rehabilitation work to the existing passive treatment system at that time.

In the summer of 2013, Amerikohl Mining began operating a surface coal mine in the vicinity of the treatment system in which they planned to mine through existing underground mine workings and the mine water collection system. Amerikohl planned to shut off water to the passive system at some point during the mining operation and were to chemically treat the water during this time. As part of the mine permit, they were to build additional passive treatment components including a collection system for the discharge, conveyance piping, an additional vertical flow pond, etc.

On 8/22/13, a more in-depth investigation was conducted at the site. At that time, the conveyance pipe was snaked revealing that the pipe was not clogged, indicating that it was the collection system that was clogged. Since Amerikohl would be mining through the collection system in the near future it did not make sense to try to rehabilitate this portion of the system. The Vertical Flow Ponds were drained and small test pits were dug by hand to evaluate the treatment media. It was determined that only a thin (~ ¼" to ¾") layer of iron had been deposited on top of the compost since 2001. The condition of the compost and limestone was observed generally to be in good condition. However, it was noted that numerous voids existed in the compost layer where the water was observed to flow directly into the limestone layer indicating that short-circuiting is occurring to at least some extent. In addition, the 16 ball-valves used to flush the Vertical Flow Ponds are difficult for BCWA to open and should be replaced with Valterra-type valves that will be easier to operate.

A field meeting was held on August 30, 2013 with Amerikohl Mining, BioMost, Inc., SRI, and members of BCWA to discuss plans for the treatment system. BioMost reviewed the designs for the new treatment components and provided comments.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system is sampled by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as acidic with significant metal concentrations and flow rates that at times exceed 100 gpm. The system, on average, produces net-alkaline water with low metal concentrations indicating that the system is typically functioning well. However, there does not appear to be data available indicating how much water by-passes the system, preventing an accurate assessment of the functionality of the collection and treatment system especially under high flow conditions. For a few sampling events, the system did discharge net-acidic water with low metal concentrations although this typically occurred during high flow rates well over 100 gpm. Even during these events, the pH was always greater than 5 and metals significantly decreased. A review of the system should be conducted following completion of system expansion and other maintenance activities.

Laurel Run #1 (North) Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
458 (Influent)	NA	3.1	3.2	0	134	8.9	1.1	11.1	289
459 (VFP A)	51	5.5	6.4	59	-37	2.1	1.4	3.5	275
460 (VFP B)	50	5.9	6.4	41	-13	2.4	1.2	4.2	277
461 (Effluent)	NA	6.3	6.8	31	-10	0.7	0.8	0.7	257

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Original Conclusions & Recommendations

Since Amerikohl Mining was planning on mining through the current collection system, installing a new collection system and constructing a new Vertical Flow Pond, it would make the most sense in terms of timing, efficiency, and cost to conduct the needed maintenance in conjunction with the mining activities and construction of the new passive components. Amerikohl had been asked if they would be willing to assist with the maintenance activities as they will already have equipment on site. Amerikohl did agree.

The following are recommendations that were made for this site:

- Amerikohl is to remove the current collection system and install a new collection and distribution system as part of permit conditions.
- Amerikohl is to install an additional Vertical Flow Pond to add treatment capacity to the system as part of permit conditions.
- While Amerikohl has equipment on site and is constructing the new treatment system components, they will assist in the removal of 16 ball-valves used to flush the Vertical Flow Ponds and replace with Valterra-type valves that will be easier for BCWA to operate.
- There should be plenty of limestone within the existing VFPs for treatment for at least another 5-10 years. The treatment media should not be replaced at this time.
- To address potential short-circuiting within the treatment media of the existing VFPs, stir in top layer of compost into the top foot of limestone. It is important to be very careful to not exceed much more than 1-foot as the top tier of underdrain piping is located about 2-feet below the top of the stone. If desired and if funding is available, additional compost and possibly wood chips could be added, but may not be necessary. This could always be added in the future.
- Following installation of new treatment components and completion of maintenance items, it is recommended to conduct monitoring and reevaluate the system performance to determine if any other issues need to be addressed.
- Continue to conduct regular water monitoring and record and report flow measurements of the discharge, treatment components and by-passed water for future evaluations.

Update

Amerikohl Mining did complete changes to the system in 2014 including installing a new collection and distribution system. They constructed a third Vertical Flow Pond to increase treatment capacity. They also provided assistance to BioMost, Inc., during removal and installation of new flush valves. In addition, BioMost stirred the compost layer into the top foot of the limestone layer in order to eliminate short-circuiting pathways. Reportedly the water is now going through the system and recent water monitoring indicates the system is working well.

Remaining Recommendations:

- Continue to conduct regular water monitoring and record and report flow measurements of the discharge, treatment components and by-passed water for future evaluations.
- Reevaluate the system performance to determine if any other issues need to be addressed.
- At some point in time there may be a need to rehabilitate the media.

Laurel Run #1 (North) Photos

The underground collection system had become plugged causing AMD to upwell to the surface and bypass system (Top Left). A new collection and flow splitter system was installed by Amerikohl during mining (Top Right). After replacing the valves, a skid-loader and small excavator were used to stir the upper 2 to 3 feet of the treatment media of the existing Vertical Flow Ponds to increase permeability and promote better utilization of the treatment media. Compare before stirring the media (Middle Left) with after stirring (Middle Right). As part of the surface mine permit conditions, Amerikohl converted a settling basin to a third Vertical Flow Pond (Bottom Left) to provide greater treatment capacity especially during high flow periods.

Laurel Run #2 (South)

Township/City: Center Township
County: Indiana
Latitude/Longitude: 40° 29' 39.0012" N 79° 7' 18.9984" W
Receiving Stream: Laurel Run
Watershed: Blacklick Creek

The Laurel Run #2 (South) Treatment System is located in Center Township, Indiana County and was constructed to treat an abandoned underground mine discharge to Laurel Run, a tributary to Blacklick Creek. The system was designed by L. Robert Kimball and constructed in 2005. The treatment system consists of two vertical flow ponds in parallel, a settling pond, and a wetland. The mine discharge flows from the sealed mine entrance via a buried pipe and is then split between the two parallel VFPs. A site visit was conducted on November 12, 2012 with Dennis Remy of BCWA. According to Dennis, the system is working well and has no known maintenance issues. He did convey that the BCWA wants to know what should be done to maintain the current effectiveness of the treatment system.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. Up through 2012, the system was sampled by the PA DEP on an approximately quarterly basis. Around 2012, the StreamTeam began taking over sampling duties. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as having alkalinity, but net-acidic with significant metal concentrations and flow rates averaging about 60 gpm. The system is on average producing net-alkaline water with relatively low metal concentrations. In general, the water quality data indicates that the system is typically functioning well. For two sampling events (12-13-06 and 8-11-11), the data suggests the system did discharge net-acidic water and on 8-11-11 contained elevated metal concentrations. However, a closer look at the water quality data on 12-13-06 indicates that the acidity value may just be a typo. It is uncertain at this time why the 8-11-11 data shows net-acidic water and high metal concentrations. At this point in time, there does not appear to be a need to conduct maintenance.

Laurel Run #2 (South) Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
LR2 (Influent)	15	5.9	5.9	442	65	45.6	6.3	1.7	614
VFRA	21	7.2	6.8	122	-71	18.8	7.4	0.4	590
VFRB	17	6.7	6.9	135	-84	17.0	7.4	0.4	586
Outlet (Effluent)	64	7.2	7.1	90	-71	1.4	1.8	0.4	582

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Update

In April 2015, Dennis Remy contacted SRI to seek assistance. He reported that a build-up of cattails were acting like a dam and blocking the normal flow of water causing a large portion of the water to backup and flow out of the emergency spillway. In June 2015, the vegetation was removed using SRI's O&M TAG program. Normal flow operation was resumed.

Conclusions & Recommendations

The Laurel Run #2 (South) passive treatment system is currently working well, producing net-alkaline water with low metal concentrations. As there are currently no known maintenance issues and the treatment systems are successfully treating the discharges, the primary recommendation at this time is to continue regular inspection and water monitoring of the system and complete maintenance as needed. Pay particular attention to increases in the water level of the Vertical Flow Ponds. As the media continues to age and accumulate metals, there may be a need to occasionally stir the treatment media. Continue to keep an eye on the cattails as a similar problem will likely occur in the future. In addition, establishment of an O&M fund for future maintenance needs is also recommended.

Laurel Run #2 (South) Photos

A set of valves (Top Left) control the abandoned underground mine discharge to the Laurel Run #2 passive system. The Vertical Flow Ponds discharge to a settling pond (Top Right) followed by a wetland before discharging to the stream (Center Left). The vegetation within the wetland was so successful (Center Right) it caused the water to dam up and flow out of the emergency spillway therefore bypassing treatment. The SRI TAG program was utilized to clean out vegetation to open up pathways (Bottom Left) and restore flow through the system.

Lucerne 3A

Township/City: White Township
County: Indiana
Latitude/Longitude: 40° 35' 53.6676" N 79° 7' 20.6976" W
Receiving Stream: Two Lick Creek
Watershed: Blacklick Creek

The Lucerne 3A chemical treatment system was installed to treat a mine discharge from the Rochester & Pittsburgh (R&P) Coal & Iron Company Lucerne 3A underground coal mine which operated from 1907 until 1967. The system was constructed in 2008 within the 10-acre Indiana County Waterworks Conservation Area park in White Township, Indiana County. The Indiana County Conservation District (ICCD) currently maintains the system. Treatment consists of a water-powered “Swedish-Bucket” 75-ton silo lime doser, which systematically dumps hydrated lime into the discharge. The water then flows into a long, narrow, settling pond/wetland for metal removal. The treated water is discharged to Two Lick Creek. While the focus of this report was on passive systems, this active treatment system was included, as it is operated by the ICCD, was funded by public dollars, and is part of the effort to restore Blacklick Creek.

On November 25, 2014, a site visit was conducted with Adam Cotchen and Brooke Esarey of the Indiana County Conservation District to conduct a site visit. According to Adam, the system utilizes about 20 tons of hydrated lime per year costing about $3,000. During the site investigation the following issues were initially identified:

- Sludge and sludge handling was reported to be an issue. Depending upon available time the ICCD will typically pump sludge several times throughout the summer. The ICCD is currently using a 3” pump to place sludge back into the mine. The pump gets clogged with leaves and debris and has to be turned off and cleaned, slowing the operation down and increasing cost of labor.
- Unused lime was quite visible indicating the water is not mixing well and lime is being wasted. Unused lime could be contributing to a portion of the sludge.
- There was a broken valve controlling water flow to the lime doser. The valve was replaced shortly after through SRI’s O&M TAG program.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system is regularly sampled by StreamTeam. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as acidic with high concentrations of iron and aluminum. The discharge has relatively low concentrations of manganese. Flow rate of the discharge is variable ranging from 5 to nearly 400 gallons per minute. The water quality of the effluent has been quite variable over the life of the system. pH has ranged from 3.3 to 10.3 while acidity has ranged from 163 to -241. On average the effluent of the system has a circum-neutral pH and is net-acidic, which is a significant improvement, but typically still contains high concentrations of iron and aluminum. Based on the pH and the high suspended solids, most of the aluminum and iron is probably typically in the solid form and just needs further settling. However, there were a number of sampling events, especially in 2015 and 2016, when the pH of the effluent was low and therefore a portion of the metals were likely still dissolved.

Lucerne 3A Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4	TSS
467 (Influent)	NA	2.7	2.8	0	305	24.1	1.0	23.2	509	6
468 (Effluent)	87	6.4	6.4	70	5	17.4	0.9	19.9	533	138

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

The effectiveness of the Lucerne 3A treatment system is variable especially in terms of the neutralization of acidity. Typically, high concentrations of metal solids are being discharged to Two Lick Creek. This is largely due to the relatively small settling pond area. The treatment system should be expanded. One option would be to utilize the 2-acre constructed mitigation wetland at the park. This may not be popular with the county and there could be regulatory issues that would prevent its use. It may also be possible to expand the system to the east and south, which could significantly increase the amount of surface area for settling. It is uncertain at this time where the property lines are located or what permitting issues may be encountered. Adding windowed baffle curtains would also be beneficial for settling of solids. Active treatment systems require frequent inspections, adjustments, and maintenance, which is very time consuming and usually challenging for conservation districts and watershed groups to maintain. The site should be inspected at least once and ideally two or three times per week. The chemical dosage rate should be adjusted accordingly in order to consistently neutralize the acidity. At times, it may be necessary to increase the amount of chemical used. It may also be possible to install additional mixing, such as a Mixwell (patent pending), to improve lime utilization. Establishment of a trust fund or at least a dedicated long-term source of funding is important for any treatment system, but especially a chemical based system. Unfortunately, due to the flow rate, available area, elevation change, etc., a purely passive system is not really an option at this site. It might be possible to tap into the mine pool and treat the water at another location, but the feasibility of that option is unknown and beyond the scope of this report.

This system should probably have a more thorough evaluation conducted to determine what actions could be taken to improve treatment including expanding the size of the system, use of mixing, use of different chemicals, etc. If desired, SRI's O&M TAG program could provide these services free of charge.

Lucerne 3A Photos

The Lucerne 3A treatment system consists of a lime doser (Top Left) and settling pond/wetland (Center Left and Right). A broken valve (Top Right) was replaced through SRI's O&M TAG grant. The system could greatly benefit from having additional treatment pond area for settling of solids. Use of the large existing mitigation wetland (Bottom Left) would be ideal. It may be possible to expand the existing treatment system to the east and south. Adding windowed baffle curtains would also be beneficial to help settle solids.

Penn Hills #2

Township/City: Cherryhill Township
County: Indiana
Latitude/Longitude: 40° 38' 15" N 79° 2' 16.0008" W
Receiving Stream: Two Lick Creek
Watershed: Blacklick Creek

The Penn Hills #2 passive system was constructed around 2002 and treats an abandoned underground mine discharge from the Penn Hills #2 Mine. In order to reach the system, a long access road must be traveled. The access road has needed repairs several times. The Penn Hills #2 mine discharge is split between three Vertical Flow Reactors (VFRs) or Vertical Flow Ponds (VFPs). Often in the past, the three VFRs were named by the BCWA as if they were separate treatment systems and were called Penn Hills A, B, and C systems or Penn Hills 1, 2A, and 2B systems. There are two separate final effluent point locations which discharge into the Two Lick Creek reservoir. The reservoir was created by owners of the Homer City Power Plant for use at the plant. Having a clean reliable source of water is obviously important to the power plant. An initial site visit was conducted with Dennis Remy of the BCWA on November 14, 2012. According to Dennis Remy at that time, there were not any known serious issues at the site in terms of treatment. A second site visit was conducted with Dennis exactly one year later on November 14, 2013 and also accompanied by Malcolm Crittenden of PA DEP and Adam Cotchen of Indian County Conservation District. During the two site investigations the following issues were initially identified:

- The geotextile liners of the B system have been damaged due to sunlight exposure over time and are deteriorating. It is unknown at this point in time whether this is causing any issues such as leakage through the berm.
- Several of the VFRs do have vegetation growing in them. The BCWA is concerned about how this will affect the permeability of the media over time. It is unknown what the long-term effect will be, but currently does not appear to negatively affect treatment.
- VFRs have not been flushed in at least several years. The BCWA is concerned and wants to know what should be done.
- A small seep of unknown water quality is filling a small pond-like structure and is over-flowing across the access road. Dennis could not remember whether this pond had existed in the past or not. There is some evidence that a pipe may exist within the pond, which may be plugged or partially removed.
- A “ponded” area of water of unknown origin was flowing across the access road. There may be a pipe that is plugged or damaged.

There is an established treatment trust fund for the Penn Hills #2 system. The funds are managed by the PA DEP. The trust fund currently has a value of $87,000.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system is sampled by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as containing alkalinity, but net-acidic due to high concentrations of iron, which is the primary pollutant of concern at this site. The discharge has relatively low concentrations of aluminum and manganese. Both the effluent of system 1 and 2 can be characterized as net-alkaline with low concentrations of metals, indicating that the system is typically functioning well.

Penn Hills #2 Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
436 (Influent)	NA	6.4	6.2	62	55	51.4	1.1	0.6	364
438 (VFRA)	145	7.3	7.4	122	-67	0.9	0.9	0.4	296
437 (Effluent 1)	57	7.4	7.6	115	-69	0.8	0.9	0.4	298
439 (VFRB)	205	7.3	7.3	123	-68	2.3	1.1	0.5	295
440 (VFRC)	259	7.3	7.4	140	-89	0.4	1.1	0.5	288
441 (Effluent 2)	NA	7.6	7.7	96	-54	0.4	0.9	0.4	317

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

Overall the Penn Hills system is working well producing net-alkaline water with relatively low metal concentrations. The vegetation within the VFRs currently does not seem to be posing any problems. The vegetation may or may not be helpful to the system. As long as the VFRs are performing well, there is no need to try to remove the vegetation. If permeability begins to decrease, evidenced by increasing water levels within the ponds, then action would need to be taken. Since the system has continued to work well despite regular flushing, flushing is not necessary at this time. Flushing of some passive systems may actually do more harm than good by creating and encouraging the development of preferential pathways. Flushing can be used in the future as part of a treatment remediation practice; however, when flushing is conducted, the pond should be completely flushed. Flushing for 10-15 minutes or until water is clear is generally not a good method of flushing as typically only the pipes are being flushed and there is an increased risk in creating short-circuiting.

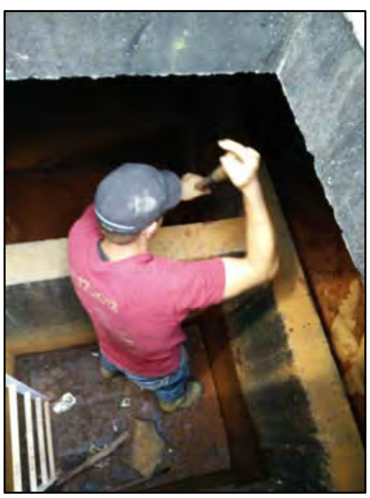
The following are additional recommendations:

- There is not really a good way to fix the liners at this point in time. It might be possible to cover the exposed liner with dirt and rock; however, there would be a potential risk of further damage. We recommend replacing the liners when the treatment media is replaced in the future. When replaced, care should be taken to limit exposure to sun.
- The pipe to the unnamed pond structure should be found, fixed and or replaced. It may be necessary to pump the water out of the pond in order to work effectively.

Update

In January of 2015, BCWA contacted SRI to receive assistance through the O&M TAG program. In addition to the clogged pipe in the unknown pond structure, another untreated AMD discharge was flowing over and eroding the access road. A culvert was installed to allow the AMD to flow underneath the road and the road was repaired. For the unknown pond structure, the pond was pumped down and existing capped pipes were discovered. The caps were removed which allowed the water to flow to the treatment system. A culvert pipe was also installed as a safety measure in case the other small pipes became plugged. In addition, iron was removed from the flow splitter box to allow even flow distribution to the various VFRs. Post maintenance water monitoring indicates that the system is still performing well.

Penn Hills #2 Photos



At the Penn Hills #2 system, the BCWA was concerned about vegetation growing within the Vertical Flow Reactors (Top Left) and the deterioration of pond liners (Top Right). An untreated mine discharge was flowing across and eroding the long access road (Center Left) to the system. A culvert was installed and the road repaired (Bottom Right) under SRI's O&M TAG program. An unknown pond structure which received AMD was overflowing and impacting the access road around the system (Center Right). This was also fixed through the O&M TAG program. Iron in the flow splitter box was also removed (Bottom Left) to return even flow distribution to the VFRs.

Richards Passive System Complex

Township/City: Cherryhill Township
County: Indiana
Latitude/Longitude: 40° 39' 48.9996" N 78° 58' 54.0012" W
Receiving Stream: South Branch Two Lick Creek
Watershed: Blacklick Creek

The Richards Passive Treatment system complex was designed by VAPCO Engineering and constructed in 1999 to treat an abandoned mine discharge from the sealed Egypt Mine, which was discharging to the South Branch Two Lick Creek. An inlet structure collects the mine drainage flowing out of the underground mine, which is then conveyed by pipe under SR-403 and split between two passive systems known as Richards 1 and Richards 2. Richards 1 contains a VFR followed by a settling pond. Richards 2 consists of two VFRs (2A and 2B) which both discharge into a settling pond and wetland complex. There is also a flush pond for VFR 2A and 2B. Sometimes the Richards treatment system has been considered as 3 separate passive systems known as Richards 1, Richards 2A, and Richards 2B. An initial site visit was conducted with Dennis Remy of the BCWA on November 14, 2012. During the site investigation, the following issues were initially identified:

- A large portion of the water was not being collected by the intake, which could not be seen and assumed to be partially plugged. The AMD was instead flowing through a culvert and bypassing the entire treatment system.
- Only 1 of 3 systems were receiving water.
- The flow splitter for the two systems did not appear to be functioning properly so there was essentially no flow going to Richards 1.
- Settling pond of Richards 1 was reported to be leaking due to poor building materials. Water entering the pond seeps through the berm into the stream.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system is sampled by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as acidic with elevated concentrations of iron and aluminum. Manganese concentrations are relatively low. The data provided for the passive treatment system can be somewhat misleading. While the average data indicates that the passive treatment system is functioning well, at times the system has produced water with pH less than 6. It is also difficult to conduct a full evaluation of the effectiveness of the system as a large portion of the water is bypassing all of or portions of the treatment system. A recommendation was made to monitor and reevaluate the system after maintenance was completed.

Richards Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
452 (influent)	NA	3.5	3.3	0	134	18.4	1.4	11.4	397
457 (VFR 1)	5	6.4	6.7	86	-36	12.3	1.5	4.4	403
453 (VFR 2A)	43	6.1	6.7	96	-54	6.5	1.6	3.6	410
456 (VFR 2B)	43	6.6	6.8	145	-118	7.7	1.8	1.8	440
454 (2A &2B Effluent)	NA	6.6	6.8	56	-27	1.6	1.4	0.7	387

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Update

In July 2015, repairs to the system were made through SRI's O&M TAG program. The system inlet box was found and drained to reveal a 12" inlet pipe which conveyed flow under SR-403 to the vertical flow ponds. Unfortunately, the pipe was clogged with iron precipitates as suspected. A portion of this material was removed with a shovel. A power snake was used to clear any blockages near the inlet of the pipe for approximately 80 additional feet. Shortly after the blockage was cleared, water began to back up within the pipe, hinting that an issue was occurring further into the pipe than the power snake could reach. The inlet pipes to VFP2A and VFP2B were connected to a section of corrugated pipe which extended into the ponds. These sections were also found to be clogged with iron precipitate. Once the corrugated pipes were removed from the end of the pond inlet pipes, water from the raw discharge began to flow freely into VFP2A and VFP2B. This solved the primary issues with flow from the raw discharge reaching the VFPs. Other minor maintenance such as removing vegetation from around pipes was conducted. A recommendation was made to review water quality data to determine if additional maintenance was necessary. Data is provided in table below.

Richards Post Maintenance Water Quality Data

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
452 (influent)	NA	3.5	3.5	2	118	10.9	1.1	10.2	517
457 (VFR 1)	NA	3.7	3.6	0	95	2.1	1.1	11.2	307
453 (VFR 2A)	18	6.1	6.4	57	-16	3.1	1.1	4.7	517
456 (VFR 2B)	36	6.6	6.8	113	58	1.3	1.0	2.4	681
454 (2A &2B Effluent)	NA	6.81	7.1	68	-45	2.8	1.1	0.5	524

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

Once the known major maintenance issues were completed, the Richards 2 system is treating the water as well if not better than prior to maintenance while receiving significantly more flow. The Richards 1 system is not performing as desired. There are seeps below the system and testing indicated that they are related to the same source of water. At least a portion of the seep water is believed to be caused by the leaking settling pond in Richards 1.

Due to the poor water quality now emanating from VFR1, further investigation is to be conducted under the SRI O&M TAG program. Based on our understanding, the original treatment media is still in place. VFR1 should be drained and stirred. The condition of the treatment media should be evaluated and evidence of short-circuiting and broken pipes should also be investigated. Once stirring is complete, additional water monitoring will be conducted to determine if the media needs to be replaced. As the system is about 17 years old, major rehabilitation of the system will likely need to be completed within the next 5 years.

The following are additional recommendations:

- Settling pond #1 should be repaired to stop leaking using some type of liner such as clay, geotextile, bentomat, Harsco Mineral CSA, etc. As the system is 17 years old, it may be more appropriate and cost efficient to wait until a major rehabilitation is needed, which may be sooner rather than later.
- There may be a need to stir the treatment media within the other VFRs in the near future. It is recommended that similar steps as VFR1 should be taken
- Continue to monitor & evaluate treatment system effectiveness. Complete maintenance as necessary.
- It may be prudent to begin planning for the rehabilitation of the Richards system within a few years. If stirring of VFR1 is not successful, those efforts will need to be conducted sooner.

Richards Systems #1 & #2 Photos

At the Richards Passive Treatment complex, the intake and conveyance pipe had become plugged (Top Left) causing most of the water to flow through a culvert and bypass the treatment system (Top Right). Additional plugged pipes from the flow splitter prevented water from getting to two of the VFR ponds (Center Left). An overgrowth of vegetation was causing difficulties for StreamTeam to sample, which needed to be removed (Center Right). After vegetation removal occurred, valve boxes were able to be located (Bottom Left).

Water within the drop inlet box had to be pumped in order to access and clean the box (Top Left). The conveyance pipe to the treatment system was plugged (Top Right) as well as the piping from the flow splitter box to two of the VFRs. These were cleaned out using a power snake (Center Left). Debris that had accumulated with the mine discharge pipe was also removed (Center Right). Seeps from the leaking Settling Pond and potential other sources flow into South Branch Two Lick Creek (Bottom Left).

Webster

Township/City: Nanty Glo Boro
County: Cambria
Latitude/Longitude: 40° 27' 55.0008" N 78° 50' 6" W
Receiving Stream: Pergrin Run ->South Branch Blacklick Creek
Watershed: Blacklick Creek

The Webster passive system is located in Nanty Glo Boro, Cambria County, PA and was designed to treat the Webster mine discharge, which is the largest impact to the South Branch of Blacklick Creek. This was a US Army Corps of Engineers Pittsburgh District project. The conceptual design was developed by Hedin Environmental with engineering design completed by GAI. The system was constructed in 2004 and consists of a long conveyance pipe, distribution manifold, two extremely large VFPs (~3.5 acres each) and a wetland.

Based upon available water quality data and personal communications, the system worked well for the first 2 years, but then the treatment effectiveness quickly and dramatically decreased sometime between October and December of 2006. Several individuals, companies, agencies, and organizations have evaluated the system since this time including Art Rose and Hedin Environmental. Reportedly DEP is considering abandoning the treatment system by conveying the water from one mine pool into another mine pool, which would then be treated at the Pristine Resources chemical treatment plant located in Ehrenfeld, PA.

Numerous sheets of design drawings were created as part of the original design and were available for review. The discharge is collected from the Webster mine and then piped under state route PA-271 and Pergrin Run (a tributary to South Branch of Blacklick Creek) to the treatment system where the AMD enters VFP1 through a 6 point distribution manifold system located along the western berm. From there, the water is then expected to simultaneously distribute itself evenly across the 3.5 acre pond with half of the water percolating down through the treatment media while the other half travels completely across the pond and through four equalization pipes located in the eastern berm into VFP2. Once entering VFP2, that portion of the water is once again expected to evenly distribute across a 3.5 acre pond before percolating down through the treatment media. The effluent of the two vertical flow ponds then flows into a wetland for oxidation and settling of metals before discharging to the receiving stream.

Considering the size of the VFPs and the short span of time the system was effective, the poor effluent quality would tend to indicate short circuiting and/or lack of sufficient contact time with the treatment media. Reviewing the design drawings indicated that the VFPs had a layered design, containing ~2.5 feet of AASHTO #1 limestone overlain with 1 foot of organic substrate consisting of a mixture of mushroom compost and AASHTO #57 limestone. A geogrid separation material was to be placed between the limestone and compost layers presumably to prevent the compost from migrating into the limestone bed. Considering the size of the VFPs, variability of the treatment media materials, and general construction difficulties, it is unlikely that exactly 2.5 feet of limestone and 1 foot of organic substrate was evenly spread throughout both ponds. Uneven distribution of materials and shallow treatment media to start with could easily lend to short-circuiting. Based upon the design drawings, the underdrain system consists of perforated 6" HDPE pipes that did not have any lateral "branches", were spaced about 50 feet apart and were each bedded in about 6" of AASHTO #57 stone that is assumed to be non-calcareous within the limestone layer. In VFP1 there are 5 perforated pipes, 3 of which combine and discharge at sample point W1W and 2 which combine and discharge at sampling point W1. In VFP2 there are 6 perforated pipes, which combine into 2 pipes at sampling points W2 and W2E. With the limestone thickness of only 2.5 feet and approximately 1 foot of pipe and bedding stone within that 2.5 feet, there is effectively only about 1 foot of limestone on top of the underdrain. This could be problematic as the water is more likely to short-circuit near the pipes and since there is not a branched piping system it is less likely for the water to travel down a few feet into the media and then laterally to reach the pipe. It is also possible that the bedding stone would act as a filter and become clogged with aluminum and iron solids, which would limit water entering that portion of the underdrain and force the water to another part of the system creating dead zones in one part of the media and short-circuiting in others.

Cliff Denholm met with Dee Columbus and Jack Bartok of the Cambria County Conservation and Recreation Authority on 12/4/12. Following the meeting, water samples were collected and a dye test of VFP1 and VFP2 was conducted. Conducting the dye test was difficult due to the size of the ponds, the design of the distribution system, and the inability to access the flow distribution system. For VFP1, six one-gallon jugs were mixed using raw water and about 100 tablets of fluorescent red tracer dye. The dye was dumped into the edge of VFP1 near the assumed locations of the distribution system. Unfortunately, the distribution system was discharging under the water several feet away from the berm which prevented the dye from being "caught by the current" of the incoming water. The dye tended to "hug" the berm and did not spread out over the pond. Most of the dye disappeared after about 1.5 hours except along certain sections of the pond where the dye clung to the berm, vegetation, etc. Dye was never detected in the effluent pipes of VFP1. For VFP2, four one-gallon jugs were mixed using raw water and about 100 tablets of the fluorescent red tracer dye. Again there was no way to access the pipes that distribute the flow from VFP1 to VFP2 therefore dye was dumped into the edge of VFP2 at the locations of the transfer pipes. While there was significantly better dispersal of dye within the pond, the dye did not travel more than 1/3 of the width of the pond and tended to move along the berm and began to flow out of the emergency spillway after about 1.5 hours. As most of the water entering VFP2 ended up flowing out through the emergency spillway instead of going through the treatment media, the dye test was probably an indication of the primary pathway of the water flow through this part of the system. Flow rates were measured throughout the treatment system and provided in the table below. As can be seen the treatment media and/or piping system is so plugged in VFP1 that only 20 gpm of flow was able to flow through the 3.5 acre pond whereas 150 gpm was flowing through VFP2. The water quality flowing through VFP2 was poor indicating short-circuiting or at least short contact time, however 100 gpm of flow was going over the emergency spillway indicating that at least a portion of the media and/or piping is plugged as well.

Webster Flow Rates (GPM) on 12/4/12

Sample Point	VFP1 W1W	VFP1 W1	VFP2 W2	VFP2 W2E	VFP2 Emergency	Wetland
Flow Rate	13	7	50	100	~100	260

During the site investigation, review of design drawings and discussions with other individuals who have been involved with the system, the following issues have been initially identified:

- Reportedly, one or more of the manholes including the distribution manifold system have “black damp” and may be dangerous. This has not been confirmed, but should be noted and appropriate safety precautions need to be taken when planning to enter.
- Poor water quality of the final effluent indicates the system is not performing to expectation and that short-circuiting, plugging, a lack of sufficient thickness of treatment media, or a combination of these is most likely the cause.
- The water elevation in VFP1 is above the influent distribution pipes, which may be further evidence of plugging of the treatment media or piping.
- Extreme differences in flow rates of the VFP pipes indicate that the media and/or piping system is at least partially plugged in VFP1 with most of the flow going through the transfer pipes to VFP2. Counter-intuitively the highest flow rate of the system comes from the farthest piping system within VFP2, which again indicates short-circuiting and/or plugging of the rest of the system. In addition, as a large portion of the flow is going over the emergency spillway of VFP2 as opposed through the treatment media and underdrain, this provides further evidence of plugging of treatment media or piping.
- While dye testing was not conclusive, evidence does suggest that short-circuiting is occurring, especially in VFP2.
- The VFPs are so large and the treatment media layer so thin that it would probably be difficult for short-circuiting not to occur.
- According to Dee Columbus, in 2011, the USACE had put cameras into the underdrain and visually determined that at least a portion of the VFP1 pipes were plugged with sludge, however to her knowledge nothing was ever done to clean out the pipes.
- Fencing placed along the berms around the perimeter of the system decreases the useable area for access, preventing vehicles and equipment from being able to reach critical parts of the system.
- Manholes between the two VFPs were constructed above ground, which prevents vehicles and equipment from traveling on top of the berm to reach critical parts of the system. This will significantly hinder if not prevent certain maintenance activities from occurring.
- Reportedly the USACE changed the original design of the system, eliminating valves, piping, and other features which would have allowed more control over water handling that would have potentially helped the system especially during maintenance activities. More specifically, there is not a flow splitter that evenly divides flow to each pond allowing for true parallel operation, which could allow for one of the VFPs to be overwhelmed. Also, while there are valves that could be used to shut off flow to VFP2 for maintenance, there is no way to bypass flow around VFP1 to VFP2 so that VFP1 could be maintained. Therefore, in order to conduct maintenance on VFP1, all of the flow would need to be bypassed directly to the stream without any level of treatment.
- Further complicating the ability to conduct maintenance is that the elevations of the VFP flush pipes are lower than the water level within wetlands, which prevents complete draining of the VFPs. The only option to drain the VFP would be pumping, which would be time consuming and expensive.
- The water level within the wetland is too high for establishment of vegetation. The weir has increased the water level within the wetland.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system is sampled by the PA DEP on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as acidic with relatively high concentrations of iron and aluminum and slightly elevated concentrations of manganese. A simple review of the average water quality of the passive system as shown in the table below can be confusing and even misleading due to the variable treatment performance. The system was successful for the first two years of operation, typically producing net-alkaline, circum-neutral pH water with significantly lower metal concentrations. However, treatment efficiency quickly decreased after this two-year period and now the effluent of the system is typically acidic with some reduction of acidity and metals, but still highly polluted.

Webster Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
Influent	262	2.9	2.9	0	340	23.0	5.0	35.2	584
W1 (VFP A)	56	4.6	3.5	59	122	18.4	5.5	18.9	643
W1W (VFP A)	72	5.1	4.8	60	68	23.3	5.6	14.5	622
W2 (VFP B)	74	3.8	4.3	58	113	18.1	5.4	17.9	599
W2E (VFP B)	75	3.1	4.4	40	130	19.0	5.6	19.2	594
Effluent	405	3.1	4.2	72	74	9.3	5.4	14.7	603

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

While the Webster system was successful for the first two years of operation, the effectiveness quickly and dramatically decreased. There may be a tendency to claim that the flow rate was too high or the chemistry too difficult for passive treatment, but it should be noted that other passive systems have been built with worse water quality and higher flow rates. The majority of the problems appear to be design and construction issues. There has been some indication that attempts to cut costs may have resulted in decisions being made that negatively impacted the final design and thus effectiveness. While it is difficult to say with absolute certainty the exact cause of the failure there are likely several main factors that contributed. They include:

- Lack of a flow distribution system.
- VFPs with extremely large surface area, which would likely encourage short-circuiting especially without a flow distribution system.
- Thin treatment media layer reducing contact/retention time, which is further exacerbated by the underdrain & bedding stone in the media.
- Undersized underdrain & lack of “branches” would likely encourage short-circuiting.

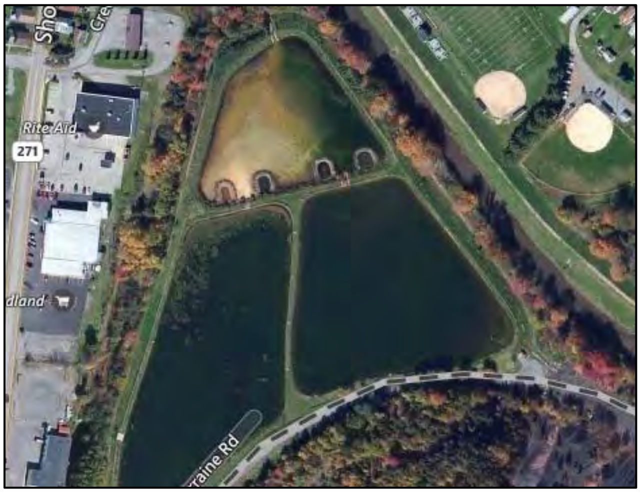
- Lack of maintenance and the design challenges that essentially discourage or even prevent maintenance from occurring.

Ultimately, the Webster treatment system needs to be redesigned and rebuilt. Ideally, the passive system would consist of more VFPs that are individually smaller in area, contain thicker treatment media, and possess a sufficient underdrain system. Also, a flow splitter and distribution system with a bypass should be installed to control flow and allow for maintenance activities to occur. The cost to complete this would likely be significantly less than the original cost of the treatment system. A conceptual design and cost estimate could be completed under SRI's O&M TAG program.

Another potential option would be to conduct major maintenance at the site. This would involve cleaning the underdrains and stirring the treatment media. One option could include removal of the treatment media from one VFP and adding it to the other VFP to create a thicker treatment media layer in one pond. Unfortunately, in order to do this, the AMD would need to be completely bypassed to the stream and the VFPs would need to be pumped. Also, these actions would not fix the structural design problems such as the lack of a distribution piping system or equipment access.

Unfortunately, at this time, the PA DEP does not appear to be interested in spending any more money on the passive treatment of the Webster discharge. They are instead focused on creating a deal with Pristine Resources to accept and treat the water at their active chemical system in Ehrenfeld, PA. If this approach were to fail, SRI and BioMost, Inc. would be happy to provide additional assistance to either conduct major maintenance or redesign and rebuild the treatment system.

Webster Photos



After two years of operation, the treatment effectiveness of the Webster passive treatment system (Top Left) suddenly and dramatically declined. The flow distribution piping system for VFP1 is currently underwater (Top Right) indicating the media or piping system may be plugged. A flow splitter device was not used at the site. Instead the AMD has to flow across the 3.5 acre VFP1 into VFP2 via valved pipes in manholes located in the berm between the ponds (Bottom Left). Unfortunately, these manholes were not built flush with the ground so trucks and equipment cannot easily reach critical parts of the system to conduct maintenance. Fencing around the outer perimeter (Bottom Right) causes similar problems in some locations.

Another design issue that impedes maintenance is that the water elevation in the wetland is higher than both the underdrain and the outlet of the flush pipe (Top Left), making draining the VFPs by gravity impossible. Adding to the problem is the weir (Top Right) which has increased the water level further. The water depth of the wetland is also too deep for wetland plants to survive, including cattails. Dye tests of both ponds were conducted, but were largely ineffective. In VFP2, the dye test (Bottom Left) did indicate that the water was not spreading out over the pond and was mostly flowing along the berm and over the emergency spillway (Bottom Right). Erosion at the emergency spillway indicates that at times much higher flow rates occur at this location.

Yellow Creek 1A

Township/City: Center Township
County: Indiana
Latitude/Longitude: 40° 34' 1.9992" N 79° 7' 36.9984" W
Receiving Stream: Yellow Creek
Watershed: Blacklick Creek

The Yellow Creek 1A passive treatment system is located on private property in Center Township, Indiana County, PA. The system was designed by L. Robert Kimball & Associates and constructed in 1998. A culvert conveys the Mecco abandoned mine discharge that is collected on the East side of PA-954 under the highway to the west side where the passive system is located. The water initially flows into a Collection Pond. The flow order is Collection Pond → Wetland → Vertical Flow Reactor → Settling Pond →Yellow Creek.

A field meeting was held on November 13, 2012 to investigate and discuss various issues of the Yellow Creek Systems. Those in attendance included Dennis Remy and Ted Pluchinsky of the Blacklick Creek Watershed Association (BCWA), Adam Cotchen of the Indiana County Conservation District, Jack Conrad retired from the PA DEP, and Cliff Denholm of Stream Restoration Incorporated and BioMost, Inc. Another field meeting was held on November 14, 2013 with Dennis Remy, Adam Cotchen, Cliff Denholm and Malcolm Crittenden of PA DEP. During the site investigation, the following issues were initially identified:

- A small dike had been constructed on the east side of PA-954 to separate the AMD from good quality springs. The dike is built beside a haul road for a coal mine. At some point, this dike has been damaged and needs to be repaired in order to separate the water sources. The dike may have been damaged during haul road maintenance. The pipe conveying the water may need to be reset and cleaned out.
- A portion of the AMD is bypassing the treatment system via the emergency spillway. The cause is believed to be a build-up of vegetation, debris, and/or sedimentation within the U-shaped wetland. At one point in time, the BCWA had a contractor breach several berms within the wetland to increase flow through the wetland. Despite the fact that the water is high enough to flow out of the emergency spillway of the Collection Pond, the water level within the wetland appears to be lower than the effluent spillway indicating there may be an issue with elevations.
- A pipe, possibly for overflow purposes was discovered and significant water was flowing out of the system. A riser and elbow was found nearby. This might need to be attached.
- It has been noted by StreamTeam that flow rates have been lower than in the past.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system is sampled by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as acidic with high concentrations of aluminum, elevated concentrations of manganese, and relatively low concentrations of iron. Treatment success has been quite variable over the life of the system with the final effluent quality varying from net-alkaline with low concentrations of iron and aluminum to acidic with high concentrations of aluminum. Manganese concentrations tend to remain about the same through the system although the system was not designed to remove manganese. In general, treatment performance based solely on water chemistry appears to be better over the last 5 years than in the past, however there has reportedly been significantly less water flowing through the system. Unfortunately flow data of the discharge is lacking, therefore it is unknown whether there is actually less water to be treated and/or just less water getting into the treatment system. If there is actually less water to be treated, it is possible that changes in the mine pool could be occurring or that the active underground Ondo Mine operating nearby could be intercepting and treating much of the discharge.

Yellow Creek 1A Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
443 (Influent)	NA	3.59	3.7	1	148	1.2	7.5	24.1	825
447 (1A VFR)	16	5.1	5.0	48	37.6	2.2	7.3	12.1	770
444 (Effluent)	45	4.6	4.7	26	58	1.9	7.2	9.7	763

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

Over the life of the system, the Yellow Creek 1A passive system has often not performed well, except for the last 5 years. This is likely due to a much lower flow rate now entering the system. The reason for the lower flow rate is not currently entirely known, but is at least partly due to water bypassing the system. There may be an issue with the collection pipe, which would need to be cleaned out and repaired. A more thorough investigation should probably be conducted. The change in performance at lower flow may indicate that the system was previously undersized, which may have been unavoidable due to the constraints of the access road, water line, gas line, stream, and wetlands. The age and condition of the treatment media is currently unknown. An attempt to stir the treatment media could be conducted to try to improve permeability and treatment effectiveness before or while trying to seek funding to rebuild the system. Other simple O&M tasks would include removing debris and vegetation from spillways and channels that are impeding water flow, adjusting spillway elevations, or installing elbows to control water elevations. Once the O&M is completed, additional monitoring should be conducted to evaluate the improvements and identify additional needs. A more thorough evaluation should be conducted to evaluate the existing design and potentially develop a different design before seeking funding to rebuild. During the evaluation, it is recommended to measure the elevations associated with the collection pond, wetland, VFR, and emergency spillways. SRI's O&M TAG program could be utilized to complete these tasks.

Yellow Creek 1A Photos

At the Yellow Creek 1A passive system, mine drainage is collected by a perforated pipe (Top Left) and then conveyed under the highway to the collection pond of the treatment system. A dike was also built to keep clean water out of the system. As lower flow rates are entering the system, the collection system probably needs to be repaired. Water from the collection system then flows into the wetland (Top Right). Accumulation of vegetation and debris possibly combined with elevation problems of the spillways are likely the cause of water flowing out of the emergency spillway of the collection pond (Bottom Left) causing more water to bypass the system. The treatment media within the VFR (Bottom Right) likely needs to be stirred and possibly replaced.

Yellow Creek 1B

Township/City: Center Township
County: Indiana
Latitude/Longitude: 40° 35' 59.0004" N 79° 7' 36.9984" W
Receiving Stream: Yellow Creek
Watershed: Blacklick Creek

The Yellow Creek 1B treatment system is located next to the 1A treatment system on private property in Center Township, Indiana County, PA. The system was designed by L. Robert Kimball & Associates and constructed around 1999. The mine drainage is collected by two collection ponds. There appears to be a pipe from the 1A system that flows into the collection pond. It is assumed that this pipe is an overflow. A pipe carries the AMD from Collection Pond #2 under the trail/access road to the 1B VFR. There are gas and water lines that run beside the trail, which could cause some difficulties if maintenance is needed. Reportedly, the VFR was originally a VFP, but then converted at some unknown point in time. The flow order is Collection Pond 1 → Collection Pond 2 → 1B VFR → 1B Settling Pond → Yellow Creek. The effluent of the 1A and 1B systems discharge to the same channel.

A field meeting was held on November 13, 2012 to investigate and discuss various issues of the Yellow Creek Systems. Those in attendance included Dennis Remy and Ted Pluchinsky of the Blacklick Creek Watershed Association (BCWA), Adam Cotchen of the Indiana County Conservation District, Jack Conrad retired from the PA DEP, and Cliff Denholm of Stream Restoration Incorporated and BioMost, Inc. Another field meeting was held on November 14, 2013 with Dennis Remy, Adam Cotchen, Cliff Denholm and Malcolm Crittenden of PA DEP. During the site investigation the following issues were initially identified:

- The primary problem identified at this site is that a large portion of the discharge is bypassing the system. Part of this problem may be a lack of head driving the water from the collection pond into the VFR through the media, which then causes the water to backup in the collection pond and flow out of the emergency outlet. Reportedly, the construction contractor may have made an error in relation to elevations. Part of the problem is likely to be that the media and/or underdrain is partially plugged.
- The effluent channel that the 1A & 1B systems share is clogged with cattails and needs to be cleaned.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system is sampled by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as acidic with high concentrations of iron, aluminum, and manganese. Treatment success has been quite variable over the life of the system with the final effluent quality varying from being net-alkaline with low concentrations of metals to acidic with high concentrations of metals. Manganese concentrations tend to remain about the same through the system although the system was not designed to remove manganese. At first glance, treatment performance based solely on water chemistry appears to be better over the last 4-5 years than in the past, however that is probably because much of the water appears to be bypassing the treatment system and there is an apparent lack of flow data to allow for accurate comparison. A review of the final effluent data indicates that overall, the system has not performed very well since it was constructed, but does neutralize about 50% of acidity and removes about 50% of the iron and aluminum.

Yellow Creek 1B Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
445 (Influent)	18	3.0	3.0	0	308	18.8	7.8	30.1	791
448 (1B VFR)	10	4.5	4.4	39	135	12.9	8.1	20.9	722
446 (Effluent)	12	4.6	4.3	18	156	7.8	8.7	17.6	700

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

Over the life of the system, the Yellow Creek 1B passive system has often not performed well except for the last several years. This is likely due to a much lower flow rate now entering the system while most of the water is bypassing the system. This would tend to indicate that the system may be undersized, which may have been unavoidable due to the constraints of the access road, water line, gas line, stream, and wetlands. The age and condition of the treatment media is currently unknown. An attempt to stir the treatment media could be conducted to try to improve permeability and treatment effectiveness before or while trying to seek funding to rebuild the system. A more thorough evaluation should be conducted to evaluate the existing design and potentially develop a different design before seeking funding to rebuild. During the evaluation, it is recommended to measure the elevations associated with the collection pond, VFR, and overflow pipe. SRI's O&M TAG program could be utilized to complete both of these tasks.

Yellow Creek 1B System Photos

At the Yellow Creek 1B passive system, the mine drainage is first collected in a series of ponds (Top Left) and then conveyed under the access road to the Vertical Flow Reactor (Center Right). A gas and water line run parallel with the road. A pipe found at the collection ponds (Top Right) is likely overflow from the 1A system. Permeability problems within the VFR are causing water to bypass the system through a culvert pipe (Center Left). The effluent of the 1A & 1B systems share an outlet channel to Yellow Creek that is clogged with cattails (Bottom Left).

Yellow Creek 2A & 2B

Township/City: Center Township
County: Indiana
Latitude/Longitude: 40° 33' 50.0004" N 79° 7' 33.9996" W
Receiving Stream: Yellow Creek
Watershed: Blacklick Creek

The Yellow Creek 2A & 2B passive system was constructed to treat mine drainage from the abandoned Judy #14 underground coal mine. Some of the following history and details of the treatment system are unclear and may not be completely accurate. The 2A portion of the system was designed by L. Robert Kimball & Associates and was constructed in either 2002 or 2004. The 2B portion of the system was designed by Jim Gusek when he worked for Knight Piésold and was constructed in 2002. The AMD emanates from collapsed mine entries. As part of the construction, these mine entries were temporarily opened and pipes installed. The AMD is then collected in a pond and conveyed by pipe under PA 954 ½ to ¾ mile to the treatment system. A flow splitter device splits the flow between the 2A and 2B portions of the system. Only a portion of the flow (up to about 10-20 gpm) is designed to enter the 2B system with the rest going to 2A. The 2A system originally consisted of another collection/settling pond, 2A Vertical Flow Reactor (VFR), and a settling pond in series. The system was designed to limit the amount of flow into the VFR with the remaining flow bypassing into the Settling Pond where it would mix with the effluent of the 2A & 2B VFRs. In 2004, a U-shaped polishing wetland was added to provide further treatment before discharging to Yellow Creek. The 2B portion of the system consists of a single bioreactor. The effluent of the bioreactor is directed to the Settling Pond. Reportedly sometime between 2009 and 2011, the 2A VFR was converted into a bioreactor. It is unclear if the 2B system was ever modified.

A field meeting was held on November 13, 2012 to investigate and discuss various issues of the Yellow Creek Systems. Those in attendance included Dennis Remy and Ted Pluchinsky of the Blacklick Creek Watershed Association (BCWA), Adam Cotchen of the Indiana County Conservation District, Jack Conrad retired from the PA DEP, and Cliff Denholm of Stream Restoration Incorporated and BioMost, Inc. Another field meeting was held on November 14, 2013 with Dennis Remy, Adam Cotchen, Cliff Denholm and Malcolm Crittenden of PA DEP. During the meeting it was reported that due to limited available space and money the system could not be built to the size needed and therefore, even when first built, the system could not fully treat the entire discharge. During the site investigation the following issues were initially identified:

- Flow rates from the lower mine entries were reported to have decreased in flow while those from higher mine entries increased in flow over time indicating that either something has happened within the mine itself or the pipes have become plugged with low pH iron.
- A portion of the AMD is flowing in a ditch that is bypassing the Collection System.
- Iron scale was observed to be peeling off the interior of a long conveyance pipe that extends from the collection pond to the splitter box.
- The pipe within the splitter box which directs flow to VFR 2B appeared to be broken, buried by sludge, plugged, etc., as no water is entering the system.

- VFR 2A does not appear to be able to handle much flow. According to Dennis only 5-10 gpm is flowing through the pond. The water is therefore backing up into the 2A Collection Pond and is bypassing the 2A VFR into the Settling Pond. This would tend to indicate that the treatment media is experiencing a permeability issue and/or the underdrain is plugged. As the VFR had been rebuilt not long before, it could be an indication that the media was accidentally compacted during placement.
- VFR 2A is also covered with aquatic vegetation, which may have an impact on permeability.
- The ditch from 2B VFR effluent pipe to the settling pond is dammed by cattails, which is causing the water to overflow the ditch to the Settling Pond causing the water to bypass the rest of the system.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system is sampled by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as very acidic with high concentrations of iron and aluminum and elevated manganese. Flow rate data for the system is generally lacking. Reportedly, the flow has ranged from 10-1000 gpm, but the highest measured flow available on Datashed is 75 gpm and a document found on Datashed indicated the total design flow was also 75 gpm. It is uncertain how much of the water may typically bypass the treatment system. Treatment success has been quite variable over the life of the system with the final effluent quality varying from being net-alkaline with low concentrations of metals to acidic with high concentrations of metals. Manganese concentrations tend to remain about the same through the system although the system was not designed to remove manganese. The average data for the VFRs indicate that they do a good job treating the water that is able to flow through the media, but then this water mixes with the untreated water within the Settling Pond and Wetland. The final effluent data indicates that overall, the system has not produced good quality water since constructed, but on average the system is still removing about 80% of the iron, 65% of the aluminum and neutralizing about 80% of the acidity.

Yellow Creek 2A & 2B Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
433 (Influent)	NA	2.8	2.8	0	525	46.9	3.9	46.7	760
442 (2B VFR)	12	6.3	6.6	178	-41	13.9	3.7	7.2	619
434 (2A VFR)	9	6.2	6.7	166	-53	18.86	3.4	8.8	604
435 (Effluent)	33	4.1	4	25	109.59	7.3	4.1	16.5	618

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

The Yellow Creek 2A & 2B system is neutralizing much of the acidity and removing a large portion of the metals; however, the effluent water quality is still degraded with low pH and elevated metals concentrations. While the system has been reported to be undersized due to a lack of funding and available room, there is not enough information at this time to confirm this claim. By completing some needed maintenance, it may be possible to significantly improve performance. A stepwise approach is therefore recommended where maintenance is completed and then the system is reevaluated to determine the next step. SRI's O&M TAG program could be utilized to complete both steps. The following maintenance items should be completed first:

- Both of the VFRs should be drained and the treatment media stirred to increase permeability. The media should be evaluated at that time to look for indications of plugging, short-circuiting, etc. It may be necessary to backflush the underdrain pipes as well if they are believed to be plugged.
- Cattails and other debris should be removed from the ditch located between 2B VFR and the Settling pond.
- The flow splitter to the 2B system needs to be repaired and cleaned out and may need to be excavated & replaced in order to direct flow to the system. If replaced, the system should provide the ability to increase the amount of flow to the 2B system.
- It may be necessary to snake portions of the various pipes on-site to make sure that the reason for water not entering the various components is not due to clogged pipes.
- Install a check dam or other structure and pipe or reroute the ditch into the AMD collection pond located on top of the hill. May need to do some additional work at the intake for the conveyance pipe to increase flow to the treatment system.

Once the initial maintenance is conducted, the system will need to be monitored and further evaluated to determine if the system is capable of fully treating the water, if additional maintenance is required, or whether a new design and/or rebuild is necessary. It may also be necessary to clean the pipes at the collapsed entries to the Judy #14 mine in order to increase the flow rate of the discharge.

Yellow Creek 2A & 2B Photos

Mine drainage from multiple entries of the Judy #14 mine is first collected in a pond (Top Left) before being conveyed to the 2A & 2B system. Some of the water is bypassing the system (Top Right). A flow splitter device (Center Left) is used to direct AMD into both parts of the system, but reportedly has some issues. VFR 2A (Center Right) is experiencing permeability issues. Dense cattails (Bottom Left) growing in a channel creates a dam that causes the water to overflow and bypass a portion of the treatment system.

Yellow Creek 2C

Township/City: White Township
County: Indiana
Latitude/Longitude: 40° 33' 43.9992" N 79° 7' 40.0008" W
Receiving Stream: Yellow Creek
Watershed: Blacklick Creek

The Yellow Creek 2C system was designed by L. Robert Kimball & Associates to treat mine drainage from the abandoned Tide Mine and was constructed in 2003. The mine discharge emanates from the underground mines into a collection pond and is then piped under the access road to the treatment system, which consists of a VFR followed by two Settling Ponds before discharging to Yellow Creek. A tributary carrying mine drainage from the Judy #14 mine that is not captured by the 2A & 2B system flows through the property, past the treatment system and into Yellow Creek. A dam with an intake was built within the tributary to provide the option of diverting the water into the treatment system. The Tide Mine coal refuse pile is located on the opposite side of the access road from the system. The mine water from the refuse does not appear to enter the treatment system.

A field meeting was held on November 13, 2012 to investigate and discuss various issues of the Yellow Creek Systems. Those in attendance included Dennis Remy and Ted Pluchinsky of the Blacklick Creek Watershed Association (BCWA), Adam Cotchen of the Indiana County Conservation District, Jack Conrad retired from the PA DEP, and Cliff Denholm of Stream Restoration Incorporated and BioMost, Inc. Another field meeting was held on November 13, 2013 with Dennis Remy, Adam Cotchen, Cliff Denholm and Malcolm Crittenden of PA DEP. During both investigations, the water level in the collection pond was below the effluent pipe so no water was able to discharge. Dennis Remy questioned whether something has happened inside the mine or if this was just due to low flow conditions. During the site investigations, the following issues were initially reported:

- Dennis reported that the valve controlling flow from the collection pond to the treatment system may be broken and/or the pipe may have also been cut during installation or maintenance of the water line that runs beside the road, but this could not be verified at the time of the investigations as no water was emanating from the mine.
- Erosion of the Tide coal refuse pile has washed refuse sediment into and accumulated in the settling ponds, which has greatly reduced the available settling capacity.
- As there is no water currently entering the treatment system, evaluating the current effectiveness is not possible.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system was regularly sampled from 2003 until at least 2009. A break in the data occurs for approximately 2 years and then two sample events were conducted in 2011. No more samples of the treatment system are known to have been collected of the system since April 2011; however, samples of the discharge have been collected approximately 10 times over the last 5 years. Average water quality data for select parameters of the available data is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as very acidic with high concentrations of iron and aluminum and elevated manganese. Flow rate data for the discharge is generally lacking, but has been reported to be highly variable ranging from 10-1000 gpm. It is uncertain if the 1000 gpm measurement is a typo, but it also appears to have been measured before the system was built. Flow measured at the VFR has a range of 5-100 gpm with an average of 34. It is uncertain if water was typically bypassing around the treatment system or not when it was fully functional. Treatment success has been quite variable over the life of the system with the final effluent quality varying from being net-alkaline with low concentrations of metals to acidic with high concentrations of metals. Manganese concentrations tend to remain about the same through the system although the system was not designed to remove manganese. After a few years of operation, the treatment effectiveness began to decline. Some of the effluent data does not make sense and may be spurious or may be an indication of influence from either the coal refuse or AMD from the pile entering the system. Unfortunately, there has not been a sample of the system in five years, due to a lack of water flowing through the treatment system.

Yellow Creek 2C Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
449 (Influent)	238	3.6	3.5	7	193	45.4	3.3	12.6	557
450 (2C VFR)	34	6.3	6.7	207	-70	22.8	3.7	1.7	548
451 (Effluent)	60	6.2	6.4	100	96	20.4	5.05	10.9	701

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

The Yellow Creek 2C passive treatment system has not been functioning for a number of years. Reportedly, there is either a broken valve or pipe, which prevents water from entering the system, but neither of these potential issues has been confirmed, as there was not water flowing at the time of the investigations. Even if water was flowing into the system, past water quality data indicate that there was some sort of issue with the effectiveness of the treatment system. It is not certain when the settling pond had become full of coal refuse, but this certainly could have been the cause of the poor water quality. In order to restore treatment capability, the following maintenance items would likely need to be completed:

- Install a diversion ditch to prevent further coal refuse from entering the system.
- Remove coal refuse from settling pond.
- Fix and/or replace the valve and pipe from collection pond to the system as needed.
- Since water has not been flowing through the system for many years, it would make sense to stir the VFR while equipment is on-site.

Once the system is repaired, additional monitoring should be conducted to evaluate the system performance in order to determine if other additional issues exist. Depending on the flow rate from the underground mine and treatment performance, it may be possible to direct water from the coal refuse pile or the “Judy 14” tributary to the system. In addition, if possible, the coal refuse pile should be removed and burned at a Circulating Fluidized Bed (CFB) coal plant and the ash brought back to reclaim the site.

Yellow Creek 2C Photos

At the Yellow Creek 2C system, the water emanates from the underground mine into the collection pond (Top Left). Reportedly, there is some sort of issue with the conveyance pipe and/or valve that prevents water from entering the passive system. At the time of the site investigations, the water level within the collection pond was below the discharge pipe so water was not able to flow and therefore could not be verified. The Tide coal refuse pile (Top Right) sits across from the system. Erosion of the pile has resulted in the accumulation of a large amount of coal refuse in the settling ponds (Bottom Left and Right). The coal refuse needs to be removed from the system and water directed to the Vertical Flow Reactor.

Stonycreek River

The Stonycreek River Watershed, located in Somerset and Cambria Counties is roughly 468 square- miles in area. The river itself is about 46 miles in length and converges with the Little Conemaugh River to form the Conemaugh River at the Point in Johnstown, PA. Major tributaries impacted by AMD include Shade Creek, Quemahoning Creek, Bens Creek, Paint Creek, Lamberts Run, Wells Creek, and Oven Run.

Coal mining has taken place within the Stonycreek River watershed since at least the late 1800's and therefore has been heavily impacted by abandoned mine drainage from pre-Act mining. A 1997 U.S. Geological Survey Report documented about 270 AMD discharges. The Stoneycreek-Conemaugh River Improvement Coalition (SCRIP) and other interested group have been working to improve the watershed for the last 20+ years, including the installation of numerous passive treatment systems that has resulted in the stream returning to a net-alkaline condition and the recovery of the aquatic fishery in 15-miles of the middle and lower sections of the river. It is therefore critical that these systems be monitored and maintained on a regular basis and rehabilitated as necessary.

The following is a brief evaluation and discussion of the known publicly funded passive treatment systems located within the Stonycreek River Watershed. The systems are listed in alphabetical order. When available, site schematics have been included in Appendix A. The schematics vary in quality from scans of hand-drawings to auto-cad designs.

Boswell

Township/City: Jennerstown
County: Somerset
Latitude/Longitude: 40° 9' 24.9984" N 79° 2' 31.9984" W
Receiving Stream: Beaverdam Creek
Watershed: Quemahoning Creek

The Boswell passive treatment system (AKA "Mallards Rest") is located near the towns of Boswell and Jennerstown in Somerset County, PA. The system was designed by Earthtech, Inc., and constructed in 2005 to treat alkaline mine discharges emanating from an abandoned deep mine that were impacting Beaverdam Creek and Quemahoning Creek. The project consisted of constructing a new stream channel and dike between the discharges and the Beaverdam Creek and enhancing the existing wetlands along the creek by building berms to increase retention time and to provide a location for iron to precipitate and settle. A site inspection was conducted on October 15, 2013. During the inspection, no issues were visible.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system effluent has been sampled quarterly by StreamTeam. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). Because the AMD was upwelling within the natural wetland, it appears that nobody conducted water monitoring of the actual discharge. Likewise, the discharges well up in the treatment system and are reportedly not able to be sampled. Data from the PA DEP was found, indicating flow measurements and chemical analyses were conducted upstream and downstream of the discharges between 1997 and 1999 and then that data was used to calculate discharge characteristics. These calculated values are provided in the table below. Based upon the available data, the discharges can be described as being a net-alkaline iron discharge. The effluent of the passive system has been regularly sampled; however, the sample point uses the same name as the original downstream point. Therefore, data before 2005 was removed prior to calculating statistical information. The effluent can be described as net-alkaline with low concentrations of metals.

Boswell Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
Discharges (calculated)	2700	6.6	6.4	120	0	22.6	1.1	0.2	NM
BCDS (Effluent)	1900	7.0	7.2	112	-84	1.5	0.5	0.4	338

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L; NM- not monitored

Conclusions & Recommendations

Based upon the available water quality data and site inspection, the Boswell passive treatment system appears to be functioning well and does not currently have any known maintenance issues. In the future, iron precipitates will need to be removed and may be able to be economically recovered.

Boswell Photos

At the Boswell passive system, a dike and channel were constructed to separate the AMD from Beaverdam Creek (Top Left and Right). The passive system (Center Left) largely utilized and enhanced existing wetlands to treat the discharges. The effluent of the system is sampled at a concrete structure (Center Right) which conveys the water down to the channel, which then discharges to the Quemahoning Creek (Bottom Left).

Cottagetown

Township/City: Shade Township
County: Somerset
Latitude/Longitude: 40° 7' 6.8016" N 78° 50' 35.9988" W
Receiving Stream: Miller Run
Watershed: Stoneycreek River

The Cottagetown passive treatment system was originally designed by the U.S. Soil Conservation Service and installed in 1988 through the Rural Abandoned Mine Program (RAMP). The treatment system consisted of 5 ponds. There is some indication that there was not an alkalinity-generating component. The AMD was collected and conveyed to the system via two separate pipes. The system was modified in 1998 by the Somerset County Conservation District and NRCS due to a lack of treatment. Two sets of two ponds each were combined so that there were only 3 ponds. Pond #2 was then converted into a Vertical Flow Pond to provide alkalinity generation. It is uncertain if anyone is currently inspecting, monitoring, or maintaining the system. A site inspection was conducted on October 1, 2013. The site was also visited on November 5, 2015 to collect samples for the statewide passive treatment snapshot. During the inspections, the following observations were made:

- The water level within pond #1 was very high and above the influent pipes. It was uncertain if water was flowing from both pipes or not.
- The stretch from the effluent pipe of pond #1 to the weir in the channel conveying flow to the VFP was clogged with iron, vegetation and debris, likely causing the water to back up in pond #1. The area around the pipe, weir and a small portion of the channel were cleaned out with a shovel, resulting in a significant increase in flow from pond #1. Additional vegetation removal will likely be needed.
- The site is overgrown with thick, tall vegetation, which makes it difficult to walk around the site and see important features that could be potentially hazardous.
- The VFP effluent pipe hangs out over the settling pond/wetland at a far distance making sampling essentially impossible without a sampler or getting into the pond.
- The effluent of the system combines with untreated AMD before entering the stream.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. Data from PA DEP SIS shows that the system was regularly monitored until about 2006. It is uncertain if there is any additional water monitoring data available from other sources. Occasional monitoring has been conducted through the passive treatment snapshots coordinated by SRI including 2009, 2010, 2013, and 2015. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as low flow and acidic, with high concentrations of iron and aluminum. Based on a few samples, the effluent can be described as net-alkaline with significantly lower concentrations of metals.

Cottagetown Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
MRCT1 (Influent)	24	3.8	3.5	0	96	17.7	2.0	6.2	279
MRCT2 (VFP)	41	6.4	6.8	61	-39	0.5	0.8	1.5	275
MRCT3 (Effluent)	14	6.6	7.1	70	-42	1.0	1.1	0.6	287

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

Based upon the available water quality data, the system appears to be functioning well despite the age, water quality and assumed lack of maintenance. It is unknown whether any organization is currently inspecting, monitoring, and/or maintaining the site. If there is currently no viable organization responsible for the site, the Somerset County Conservation District or Shade Creek Watershed Association would be the logical choice to take over responsibility. Current known maintenance issues include the site being overgrown with vegetation, making traveling around the site difficult and potentially hazardous. The site should be mowed. In addition, the accumulation of vegetation, sludge, and debris between the effluent pipe of pond #1 and the VFP will likely be an on-going problem and will need to periodically be removed to prevent water from becoming dammed up and bypassing the system. Also, as the VFP is now about 18 years old and the design life is unknown, there will likely be a need to replace the media in the near future.

Cottagetown Photos

At the Cottagetown passive treatment system, two pipes (Top Left) convey AMD to pond #1 (Top Right). Those pipes were not visible during the inspection due to the high water level within the pond, which was caused by the buildup of iron sludge, vegetation and debris in the channel from the pipe to the weir (Center Left). The effluent pipe of the VFP hangs out over the third pond (Center Right) so much that sampling is very difficult. The effluent of the system (Bottom Left) flows in a channel into a "wetland" and mixes with other sources of mine water before discharging to the stream.

Hinemyer (aka Heinemeyer)

Township/City: Stonycreek Township
County: Somerset
Latitude/Longitude: 40° 4' 13.8576" N 78° 53' 27.9888" W
Receiving Stream: Lambert Run Creek
Watershed: Stonycreek River

The Hinemyer (aka Heinemeyer) passive system is located on private property bordering the Flight 93 National Memorial in Somerset County, Pa. The system was designed by Eric Robertson of the NRCS to treat the A-1 Heinmeyer Deep Mine discharge. The system was originally constructed in 2012 and consisted of one settling pond with baffle curtains, but contained 2 outlet points (H2 and H3). Water leaving the two outlet points flow into two separate previously existing wetlands. An initial brief site visit was conducted with Greg Shustrick of the Somerset County Conservation District on November 20, 2012 who did not indicate there were any O&M problems at the site. Sometime in 2013, a pipeline was constructed to convey a small portion of the alkaline water from the PBS Coals, Inc. treatment system located on Flight 93 property to the Hinemyer system to provide a source of alkalinity to the net-acidic discharge. The site was revisited on October 15, 2013. Water leaving the settling pond had an obvious bright orange color potentially indicating significant concentrations of iron solids in the water. Water samples were collected.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. As this was a newly constructed system, water quality data was limited. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as net-acidic with relatively high concentrations of iron and manganese. Only one sample of the pipe from the PBS system was available, which was collected on 10-15-13. The water on that date can be characterized as net-alkaline with low concentrations of iron and aluminum, but elevated concentrations of manganese. Prior to the installation of the PBS pipe conveying alkaline water to the system, the discharge effluent of the Hinemeyer system could have been described as net-acidic with decreased, but elevated iron and manganese concentrations. Since the installation of the pipe from the PBS system, the water can be described as net-alkaline, but still containing elevated iron and manganese concentrations. Although the data set may be too limited to state with certainty, there is indication that iron removal has improved since the installation of the PBS pipe. As flow data was not available, it is difficult to state whether the improvement is due to the alkaline source of water or to increased retention during low flow periods. A CO_2 agitation test of sample point H2 conducted on 10-15-13 demonstrated that sufficient CO_2 remains in the water to depress the pH, as the pH quickly rose from 6.8 to 8.0 with only about 90 seconds of agitation.

Hinemyer Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
A-1 (H1) (Influent)	62	NA	5.5	50	74	32.2	14.6	0.3	1130
PBS Pipe (10-15-13)	NA	8.1	7.9	152	-130	0.7	9.1	0	1544
H2 (Effluent 1)	NA	NA	6.7	86	-15	11.0	8.0	0	1065
H3 (Effluent 2)	NA	NA	6.8	87	-13	11.4	8.3	0	1116

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L; NA- Not available

Conclusions & Recommendations

With a limited data set, uncertainty of when the PBS pipe was installed, and no flow data of the effluent points, a complete review of the system is not possible at this time. Based on the available data, the system does appear to be removing on average about 2/3 of the iron content and after the PBS pipe was installed is now producing net-alkaline water, but iron and manganese concentrations still remain elevated at times. The two separate effluent points do flow from the system into existing wetlands where additional treatment likely occurs before entering the stream, but no data is available to evaluate the extent. It is assumed that the system was not designed/constructed to be larger due to either a lack of landowner permission or permitting concerns of impacting the existing wetlands that the system discharges. If additional treatment is desired, there is the potential to expand the system, but permitting issues could increase cost or even prevent the expansion. As the system is relatively new, significant O&M issues are not expected in the near future. Eventually there will be a need to remove sludge and a disposal site will be needed.

The following are additional recommendations for the system:

- Measure and report flow during every sampling event for the influent and effluent sample points;
- If possible, try to collect effluent samples of the existing wetland to determine if additional treatment may be needed.
- The system should be reevaluated after additional data is obtained;
- There is probably sufficient elevation change to install a trompe for additional aeration

Hinemeyer Photos

At the Hinemyer passive system, alkaline water was conveyed from the nearby PBS Coals, Inc. treatment system via pipe to mix with acidic H1 (A-1) discharge (Top Left). The water then mixes and flows into a single baffled settling pond (Top Right). Under normal flow conditions, the system discharges through 2 different grate covered inlet boxes (Center Left). One outlets to a wetland area next to the treatment system via a pipe (Center Right). The other outlets to another wetland area on the opposite side of the road via a perforated PVC pipe (Bottom Left.)

Jenners

Township/City: Jenner Township
County: Somerset
Latitude/Longitude: 40° 8' 40.9992" N 79° 2' 48.99874" W
Receiving Stream: Quemahoning Creek
Watershed: Stonycreek River

The Jenners passive system is located on Jenners Township Municipal Authority property in Somerset County and was originally constructed in 1997. Reportedly the well from which the AMD flows was originally the township's water supply until mining from a nearby underground Upper Kittanning coal mine polluted the water source and caused the well to become artesian flow. The brick wall and other structures at the site are related to the water supply system and were built around the 1930's. In 2005, the system was rehabilitated. The current system is maintained by the Southern Alleghenies Conservancy and the Somerset Conservation District and monitored by the Kiski-Conemaugh StreamTeam. A fence surrounds the treatment system. The untreated mine water emerges from the well and flows into an aeration pond with baffles. From the aeration pond, a spillway leads into a long VFP, which discharges through three 6-inch standpipes in parallel to a long, baffled settling pond. The outfall of the system flows through a flume on the outer side of the fencing and through brush to the receiving stream adjacent to residences. A site investigation was conducted by the Saint Francis University's Center for Watershed Research and Service on November 18, 2014. During the site investigation, the following issues were initially identified:

- The baffles in both the first aeration pond and the final settling pond have been over-topped. The wooden structures are failing and allowing short-circuiting to occur in both sections of the system.
- A large amount of sludge has accumulated in the spillway between the aeration pond and the VFP. This may also be causing water to back up in the first pond.
- The flume at the final outfall is both hard to access and is difficult to measure flow.
- StreamTeam volunteers have noted an active bee nest reoccurring in the brick box and metal pipes that make up the raw-discharge housing.

Water Quality Data

Sampling was completed by SFU's CWRS at the time of the inspection. Those results are provided in the table below. The system is sampled by the StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org) for historical sampling. The raw discharge water quality can be described as net-acidic with high concentrations of iron and manganese, but essentially no aluminum with an average flow rate of about 30 gpm. The average final effluent data would characterize the water as net-alkaline with elevated iron and manganese concentrations; however, this is somewhat misleading because iron concentration in the effluent is typically less than 3 mg/L, but a couple spurious samples since 2005 and historical data associated with the original treatment system skew the average results. The system was not designed to remove manganese. The November sampling conducted by SFU also showed that the VFP seems to be working well with significant reduction of metals (iron from ~100 to ~5 mg/L), low D.O. concentrations (~1.5% at end of standpipes), addition of alkalinity and lack of water flow along the surface. Because the system has not been historically sampled at the effluent of the first pond, it is uncertain how the degradation of the baffles is affecting overall treatment.

Jenner Treatment System SFU CWRS Water Quality Data

Sample Point	Field pH	Lab pH	Alkalinity Lab-	Field	Acidity	Field Cond.	Lab Cond.	T. Fe	T. Mn	T. Al	SO_4	S.S.
Raw Discharge	5.2	6.1	29	36	265	1303	1260	126.0	12.27	<0.05	688	23
Oxidation Pond Outfall	3.1	3.1	0	0	217	1406	1280	101.0	12.10	<0.05	673	44
VFP Outfall	6.6	7.1	105	102	-77	1340	1320	6.49	11.53	0.08	656	9
VFP Outfall (Duplicate)	NA	7.1	115	NA	-86	NA	1330	4.77	11.15	0.06	687	7
Final Outfall	6.8	7.7	91	106	-68	1347	1300	2.45	7.41	<0.05	656	16

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Field and Lab Conductivity in uS/cm, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L, Sulfate and Suspended Solids in mg/L

Jenners Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
USGS176 (Influent)	25	5.8	5.9	31	257	157.4	12.8	0.1	691
USGS176A (VFP)	26	6.6	6.6	88	-41	21.0	12.5	0.1	700
USGS176X (Effluent)	35	6.7	6.7	56	-22	5.2 (2.7)	10.2	0.2	571

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

Overall the Jenners system appears to be working well by neutralizing all of the acidity and removing 98% of the iron. The following are recommendations for the system:

- Baffles should be replaced or repaired; however, the effluent water quality does not currently appear to be impacted. The wooden baffles could be replaced with directional curtain baffles.
- Iron sludge and debris should be removed from the spillways which are contributing to increased water levels within the ponds.
- A large amount of iron is being deposited on the surface of the VFP. Eventually the accumulation may reduce permeability, which could cause water to back up and bypass the system. This iron may need to be removed before the design life of the VFP is reached.
- Access to the flume should be improved

- Capturing and removing the bees from the site would be helpful to the volunteers. Removing the brick structure could be an option, but was apparently left in place due to the historical nature.
- Access is limited due to a 7-foot tall locked fence surrounding the system. Prior to visiting the system, arrangements must be made to have the gate unlocked.
- On Datashed, there are two different sample points listed for the VFP outfall. These should be verified as the same point and then combined into one.

Jenners Photos

At the Jenners passive system, the AMD emanates from an old municipal water supply well (Top Left). A build up of iron sludge and failing wooden baffles may be causing short-circuiting within the first settling/aeration pond (Top Right and Bottom Left). The wooden baffles could be replaced with directional curtain baffles. Iron precipitates within the spillway between the first settling/ aeration pond and the vertical flow pond (Bottom Right) are likely increasing water levels within the ponds.

Lamberts Run

Township/City: Stonycreek Township
County: Somerset
Latitude/Longitude: 40° 4' 6.9996" N 78° 53' 38.0004" W
Receiving Stream: Lamberts Run
Watershed: Stonycreek River

The Lamberts Run passive treatment system was originally designed by the NRCS and constructed in 1998 by PBS Coals Inc., through a PA DEP Reclamation In-lieu of Penalty on land secured by the Somerset County Conservancy. The property lies within the Flight 93 National Memorial property. The original system included a channel that conveyed the discharge to the system, which consisted of a Settling Pond → Vertical Flow Pond → Settling Pond → Lamberts Run.

During the Hinemyer site investigation on November 20, 2012, Greg Shustrick of the Somerset County Conservation District informed Cliff Denholm that the Lamberts Run system was not functioning, but funding was in place to rehabilitate the system. Rehabilitation was scheduled for the 2013 construction season. The new design was completed by the NRCS based upon recommendations made by Hedin Environmental. The rehabilitation included revamping the existing Vertical Flow Pond and adding an Auto-flushing upflow limestone-only pond. A site visit was conducted on October 15, 2013 shortly after construction was completed. New grass growth was observed providing further indication the system was only recently completed. It appears that the compost was removed from the VFP, which might now be functioning more like a Horizontal Flow Limestone Bed. No obvious maintenance issues were observed. Water samples of the untreated AMD and the final effluent were collected for laboratory analysis.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. Almost all of the data was associated with the original treatment system. The data has been separated and placed into pre- and post- rehabilitation tables below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with high concentrations of aluminum and manganese, but low concentrations of iron. On average, the system effluent pre-rehabilitation can be described as net-acidic with reduced, but still high concentrations of aluminum and manganese. Only one post-rehabilitation sampling event was available; however, the data indicates that the system was working well, with the final effluent being net-alkaline for the first time in over 10 years and iron, aluminum and manganese concentrations less than 0.5 mg/L.

Lamberts Run Water Quality Data Prior to Rehabilitation

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
Raw	25	3.9	3.8	0	243	1.3	26.5	25.6	1076
VFP	22	5.3	5.2	35	89	3.4	25.0	12.1	1134
Final	25	5.3	5.1	20	95	0.5	23.0	8.8	1078

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Lamberts Run Water Quality Data Post Rehabilitation

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
Raw	15	3.7	3.5	0	138	1.6	25.3	26.0	1028
Final	15	7.3	7.7	68	57	0.1	0.4	0.2	815

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

The original passive treatment system functioned well for the first couple of years and then performance quickly and dramatically declined. This would tend to indicate development of short-circuiting pathways. The rehabilitated system now appears to be working well; however, this conclusion is based upon one sampling event shortly after the rehabilitation was completed. The design drawings indicated that an up-flow, auto-flushing limestone bed was utilized in the new system. The up-flow systems have been known to experience major maintenance problems, especially in relation to plugging of the treatment media at the bottom of the pond near where the water enters the stone, which can cause the water to backup and even bypass the system. It is recommended that the system be regularly inspected at least once per quarter to ensure proper function. If the up-flow system becomes a problem, the system could be modified to an auto-flushing VFP by eliminating the inlet box and extending the channel to the limestone pond so that the water enters at the top of the stone.

Lamberts Run Photos

The Lamberts Run passive treatment system was rehabilitated and expanded in 2013. The AMD is conveyed by a channel to an inlet box where the water then enters an auto-flushing, up-flow limestone bed (Top Left) which flushes into a baffled settling pond (Top Right). Water then flows into the original settling pond/wetland (Center Left) which then flows into the Vertical Flow Pond (Center Right) where the compost had been removed and which may have been converted into Horizontal Flow limestone bed. The water then flows through a settling pond/wetland before discharging to the stream (Left).

Oven Run A

Township/City: Shade Township
County: Somerset
Latitude/Longitude: 40° 6' 6.0012" N 78° 54' 47.0016" W
Receiving Stream: Oven Run
Watershed: Stonycreek River

Oven Run is a small tributary that flows into the Stonycreek River near the town of Kantner and is reportedly named from an old stone and clay bake oven that was used by troops commanded by General Forbes to provide bread for the soldiers during the French and Indian War. According to the SCRIP website, AMD from the stream effectively killed all aquatic life in the Stonycreek from that point downstream, making it one of the most impacted areas within the watershed. The Oven Run Project is a series of five separate passive treatment systems that were completed from about 1995 to 2004 for about $5 million. The passive systems improved water quality and Stonycreek's fishery for seven miles, greatly improved the water supply of Hooversville, and provided measurably cleaner water as far downstream as Johnstown.

The Oven Run A passive system was constructed in 2001 and was designed to treat 200 to 300 gpm. The system consists of a dam and stream intake, which is designed to capture and pipe a portion of Oven Run 800 to 900 feet to the treatment system, which consists of a number of ponds in series including SAPS, settling basins, and wetlands. On November 20, 2012, the site was visited with Greg Shustrick of the Somerset County Conservation District. The site was revisited on October 2, 2013. The design schematic does not appear to match the actual system that is present. Therefore, it is difficult to know what the actual treatment components are. At the time of the site investigations, most of the water was bypassing the treatment system and therefore the effectiveness of the system could not be properly evaluated. It was suspected that either the intake structure and/or the conveyance pipe had become plugged with debris, sediment, and metal solids, possibly even low pH iron. The area in front of the dam looked to be quite shallow and is filled with sediment and debris, which could also decrease the amount of water able to enter the intake. The wood cover of the intake system was observed to be weak and rotting and in need of replacement. During the initial site visit, the following observations and recommendations were made:

- Clean sediment and debris from intake structure.
- Replace the cover on the intake structure for safety considerations.
- Clean conveyance pipe with a power snake, water jetter, or similar equipment.
- Consider removing sediment and deepening the area in front of the dam.
- In the future, evaluate and consider moving the intake closer to the system if possible. (Landowners, elevation change, construction conditions, etc. may be potential issues preventing relocation.)
- Potentially increase the height of the dam.
- Re-evaluate the system after water is returned to the system

In 2014 the SCCD received $704,000 grant to address O&M issues within the Oven Run watershed. At this site, the SCCD has cleaned debris from the intake box and installed a new grate to reduce debris entering the box. Flow rates have since been reported to have increased to over 100 gpm. Additional work may be completed in the future.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The Somerset Conservation District and StreamTeam have been working together to visit and sample the site on an approximately quarterly basis. Average water quality data for select parameters are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with high concentrations of iron, aluminum and manganese. Based on available historical water quality data, the water that has gone through the system has been typically net-alkaline with low concentrations of metals except manganese, which remains elevated. At initial first glance, this demonstrates that the system is quite successful in treating water; however, that is only the water that goes through the treatment system. As there appears to be little flow data available, it is uncertain how much of the water typically goes into and how much bypasses the system. The system was designed to treat 200-300 gpm. Even since the intake was repaired/replaced in 2014, flow rates measured at the final effluent have been quite low, indicating additional issues.

Oven Run A Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
ORARAW (Influent)	205	3.9	3.7	9	134	9.4	23.2	12.0	1165
ORAWWOUT (Effluent)	43	7.0	7.2	48	14	0.3	8.4	0.7	897

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

While the AMD that flows through the system is effectively being treated, there is indication that additional problems remain following changes made to the intake system in 2014. As additional investigations have not been completed by SRI and BMI nor sufficient updated information obtained, it is uncertain as to whether the small amount of flow being treated is due to additional/remaining problems with the intake and conveyance pipe or problems with the treatment system itself, which may be inhibiting water flowing through the system and causing the water to bypass the system. Further investigation is recommended. SRI's O&M TAG program could be utilized to complete the investigations. Additional work may be needed at the intake to improve capturing the water. The conveyance pipe may also need to be cleaned. Once sufficient flow is being captured and conveyed to the system, if water is bypassing the system, then that would provide evidence of issues such as plugged pipes, water being dammed by vegetation/debris, and/or reduced permeability of treatment media.

Oven Run A Photos




At the Oven Run A Passive Treatment System, a stream intake structure (Top Left) was built to divert up to 200 to 300 gpm of the stream to the passive system, but the flow rate entering the treatment system was significantly less, which may be in response to several issues. It is possible that the conveyance pipe from the intake to the system is plugged and needs to be cleaned by a power-snake, water jetter, etc. Several cleanout manholes can be utilized to provide access to the conveyance pipe. A build-up of sediment and debris in front of the dam (Top Right) may be limiting the flow entering the intake. In addition, the sediment and debris inside the intake structure (Bottom Left) may also be limiting the flow into the system. Also, consider replacing the compromised wooden covers on the intake structure (Bottom Right) as part of general site maintenance and safety.

Oven Run B

Township/City: Shade Township
County: Somerset
Latitude/Longitude: 40° 6' 50.0004" N 78° 54' 47.9988" W
Receiving Stream: Oven Run
Watershed: Stonycreek River

The Oven Run B passive treatment system was constructed by the PA Department of Environmental Protection in 1999 to treat mine drainage emanating from three sealed deep mine entries. The system was designed by Gwin, Dobson and Foreman, Inc., with modifications by BAMR. The treatment system consists of a collection pond → SAPS→ Settling Pond → SAPS→ Settling Pond. According to a Passive Treatment System Evaluation report prepared by the PA DEP in May of 2008, the system was designed based on an average flow of 350 gpm, but capable of handling a maximum flow of 1,100 gpm. In October 2001, a flow distribution pipe was installed on top of SAP1. In October 2001, iron sludge and compost was removed from SAP1 and SAP2 and new compost was added.

A site visit was conducted on October 17, 2013. Water samples were collected and field testing, including pH, DO, temperature, ORP, alkalinity, and flow, was conducted as possible. In addition, raw untreated water was collected from sample point ORBI to perform a bucket test. During the inspection, the flow rate through the system was approximately 200 gpm. No water was flowing through the underdrain of SAP1. Instead, the water was flowing over the emergency spillway indicating either a portion of the undrain is plugged or the treatment media itself has become impermeable, most likely due to low pH iron precipitation. Water was flowing through SAP2; however, water emanating from the primary outlet pipe was of poor quality indicating that there is probably significant short-circuiting within the pond. Interestingly water flowing out of what appears to be a flush pipe was of significantly better quality water.

An initial short-lived dye test of SAP2 was conducted to see if short-circuiting could be easily observed. Due to time constraints and the size of the pond, the dye test could only be observed for a short period of time. During the approximately 1.5 hours, no dye was observed in the effluent pipe. Observations of the dye plume on the surface of the pond indicated that the flow was moving towards the western 1/2 of the pond and not flowing through the eastern ½ of the pond. This may be due to the location of the flushing pipe, which is also located on the same side of the pond. In addition, water from the final settling pond (Pond 3) was flowing out of both the emergency spillway and the effluent pipe indicating that the pipe may be partially plugged with low pH iron and/or debris or the valve is broken.

A bucket test utilizing just limestone was conducted on October 22, 2013 utilizing raw untreated water collected several days earlier to assess the possibility of converting SAP1 into an auto-flushing limestone only VFP. With just 4 hours of retention time, the pH had risen to 6.1 with 64 mg/L of alkalinity and after 6 hours the pH was 6.5 with 100 mg/L of alkalinity. The results were very encouraging, but also questionable. It is unusual for a limestone only bucket test to exceed 80 mg/L of alkalinity due to the limits of limestone dissolution in an open environment. Also, during the test a strange odor resembling hydrogen sulfide was noticed.

After the test was completed, the bucket and stone were examined and a dead mouse, nest, and stored food were discovered. The decaying organic matter would likely have caused an increase in alkalinity production. Unfortunately, there was not enough water left to conduct another test. While the results are inconclusive, based upon other sites, it is believed that an auto-flusher could be successfully used as the first stage of treatment.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The PA DEP has sampled the site on a quarterly basis through about 2010 after which point monitoring was conducted more sporadically. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as very acidic with high concentrations of iron, aluminum and manganese. Based on available data, on average, the water quality of the effluent remains acidic with reduced, but still high concentrations of metals. The system appears to have treated the discharge well for the first year and a half after which the treatment suddenly and dramatically decreased. A closer evaluation of the SAP data indicates that SAP1 worked exceptionally well for only about 4 months and SAP2 for about 18 months before treatment decreased. Considering the amount of media present, the sudden decrease in treatment would tend to indicate short-circuiting to the underdrain.

Oven Run B Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
ORBI (Influent)	175	2.8	2.8	0	424	47.5	15.8	33.0	901
SAP1	174	3.7	3.5	11	234	36.7	15.8	23.1	994
Pond 2	186	3.4	3.2	11	240	21.0	15.5	23.2	986
SAP2	137	5.1	4.4	37	138	15.8	15.2	14.7	1003
ORBO (Effluent)	172	4.8	4.2	31	126	8.4	15.9	12.9	992

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

The Oven Run B system quickly began to develop operational problems within a few months of construction with good treatment results ending within about 18 months. Over a dozen years later, the system is still providing treatment. On average the system has been neutralizing about 70% of the acid and removing about 80% of the iron and 60% of the aluminum, which considering the flow rate is still providing quite a significant improvement to the Oven Run watershed. As there is most likely significant treatment media still remaining within the system, the primary problems is likely to be related to short-circuiting and potentially plugged pipes and/or loss of treatment permeability. Underdrain cleanouts extending through the treatment media would be a potential cause of short-circuiting. There is also indication that significant amounts of low-pH iron is accumulating on top of the compost of SAP1 and potentially SAP2, which could be the cause of permeability problems. There may be the potential to install an

Oxidation Precipitation Channel to remove a portion of low-pH iron prior to entering SAP1. Ideally, if possible, the collection pond could be modified into a large limestone channel that would convey the flow to SAP1. Due to the large size of the SAPS ponds at the site and the high flow rate, there is greater risk and greater impact of short-circuiting. To address the issue, an Agri Drain Smart Drain or automatic flushing siphon system could be installed to replace the existing Agri Drain control structures for at least SAP1 and possibly SAP2, which would provide for batch treatment of the mine drainage and regular flushing of the media. Baffle curtains should probably be added to the settling basins if the Smart Drain or siphons are installed to help settle solids. There may be a need to remove the compost and clean the treatment media. The piping throughout the treatment system should be cleaned or possibly replaced. If an extensive rehabilitation is conducted, it may be possible to effectively divide SAP1 into two auto-flushing systems. One potential problem with utilizing the auto-flushing system that needs to be considered is whether there is enough capacity within the settling pond to handle the flushing event. It may be necessary to utilize less stone or perhaps turn part of SAP1 into a flush pond. A more thorough engineering evaluation should be conducted. SRI's O&M TAG program could be utilized to complete the evaluation. In addition, as this is a BAMR project, BioMost, Inc. is currently on BAMR's list of approved contractors to provide services in which design improvements could be completed.

Oven Run B Photos




At the Oven Run B system, AMD enters through three sealed deep mine entries (Top Left) which flows into a collection pond (Top Right). It may be possible to convert a portion of the collection pond into an OPC for low pH iron removal, which might be able to be extended along the eastern side of SAP1 (Bottom Left), but the length and width would likely be limited by a rock outcropping (Bottom Right).

SAP1 (Top Left) is a huge pond which is susceptible to short-circuiting, especially along cleanouts that extend through the treatment media. The permeability of the media is now so low (likely due to low pH iron) that the water discharges to Pond 2 through the emergency spillway instead of the outlet (Top Right). A dye test of SAP2 was attempted (Center Left) but not conclusive; however, it indicated that the water appeared to flow along western side (Center Right) where the flush header was located. Final effluent of the system is currently discharging mainly over the emergency spillway with some flow through the pipe, indicating the outlet pipe is partially plugged or valve is broken.

Oven Run D (aka Oak Trail)

Township/City: Shade Township
County: Somerset
Latitude/Longitude: 40° 6' 52.9992" N 78° 55' 35.0004" W
Receiving Stream: Oven Run
Watershed: Stonycreek River

The Oven Run D (aka Oak Trail) passive treatment system was constructed in 1995 to treat an abandoned mine discharge and consists of Settling Pond → Wetland → SAPS → Settling Pond → Wetland → SAPS → Settling Pond → stream. The system was likely designed by the NRCS. A site inspection was conducted on October 2, 2013. It is uncertain if the system has ever been rehabilitated. If not, the system is now over 20 years old. During the inspection, the system appeared to be mostly functioning well with little concerns. A buildup of vegetation and debris (possibly caused by an animal) was found in the spillway of Settling Pond #2, which was causing some water to bypass a portion of the system. Once the inspection was completed, debris was removed by shovel to allow the water to flow as normal. An additional item of concern was that untreated AMD was mixing with the effluent of the system. It was unknown whether this was a separate source of AMD or if it was a portion of the discharge bypassing the system.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The Somerset Conservation District and StreamTeam have been working together to visit and sample the site on an approximately quarterly basis. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). Flow data of the system is limited and not consistent as can be seen by comparing the average flow of the various sample points. This makes evaluating the dynamics of the system difficult especially in terms of whether at times significant amount of flow may be bypassing the system or not. The discharge can be described as net-acidic with high concentrations of iron and manganese, but low aluminum. The effluent water quality has been variable over the years. Data for several sampling dates associated with this sample point are believed to be possibly incorrect and may actually be for a different sample point all together, which may be skewing the average data. Based on available data, on average the water quality of the effluent remains slightly net-acidic with low concentrations of iron and aluminum, but elevated concentrations of manganese, which the system was probably not designed to remove. The effluent water quality appears to have declined some since the initial inspection was completed. The reason for this decline is currently not known, but may be an indication of the media becoming spent.

Oven Run D Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
ORDRAW (Influent)	35	5.5	5.3	11	97	28.3	19.5	1.0	1190
Pond1	110	5.2	5.2	10	92	27.9	19.0	0.9	1200
SAP1	13	5.3	5.4	14	42.1	1.1	15.5	0.8	1156
Pond2	54	5.3	5.6	16	26	1.3	15.0	0.7	1122
SAP2	16	6.3	6.6	32	-8	0.3	9.1	0.5	1133
Pond3 (Effluent)	22	6.2	6.6	27	3	0.3	10.9	0.5	1121

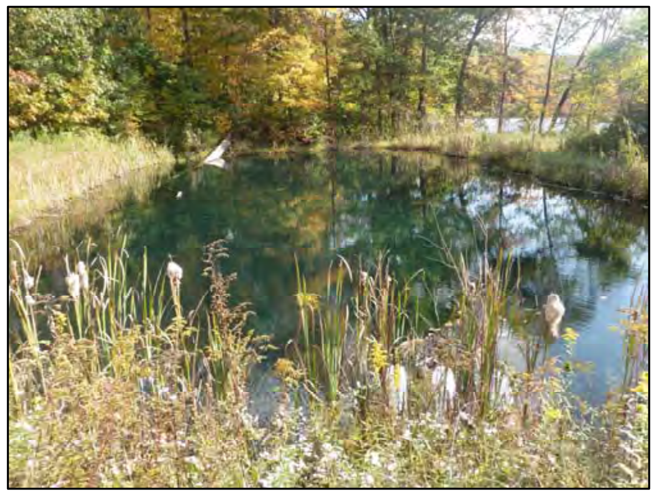
Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

Based upon the available information, the Oven Run D passive system itself has performed fairly well since installation, but this may not account for water that is potentially bypassing the system. During the site inspection, no major issues were observed and historical data indicated the system was working well. A buildup of vegetation and debris (possibly caused by an animal) was found in the spillway of Settling Pond #2, which was causing some water to bypass a portion of the system, but this was removed that day. Untreated AMD was mixing with the effluent of the system. It was unknown whether this was a separate source of AMD or if it was a portion of the discharge bypassing the system. Water sampling conducted after the site inspection indicates there has been a decrease in performance the last couple of years. As the system is now 20 years old, this may just be an indication of the treatment media being spent. Flushing and/or stirring of the treatment media could be conducted prior to replacement and potentially extend the life of the system. Further investigation is recommended. SRI's O&M TAG program could be utilized to conduct maintenance or complete further investigations.

Oven Run D Photos






AMD is conveyed by a channel (Top Left) to the Oven Run D System (Top Right). A buildup of debris, vegetation, etc., was causing water to flow over the berm of Settling Pond #2 (Center Left). This was fixed during the inspection. Water flowing out the system from Settling Pond #3 (Center Right) is generally of good quality, but then mixes with untreated AMD (Bottom Left) before flowing into an unknown body of water and eventually discharging to the Stonycreek River.

Oven Run E

Township/City: Shade Township
County: Somerset
Latitude/Longitude: 40° 7' 5.9988" N 78° 54' 20.9988" W
Receiving Stream: Oven Run
Watershed: Stonycreek River

The Oven Run E passive treatment system was designed by the NRCS and constructed in 1997 to treat an abandoned mine discharge that consists of Pond 1 → SAP 1→ Pond 2 → SAP 2 → Pond 3→ stream. A site visit was conducted on October 17, 2013. During the site visit, it was discovered that no water was flowing through the system. The water level in many of the ponds looked below normal and SAP2 was dry. Water with a low pH was discovered flowing in a channel on the eastern side of the system. As there was no water flowing through the system, a thorough evaluation could not be completed at that time. Both Missy Reckner and Greg Shustrick of the Somerset Conservation District were contacted. Greg went out to the site and found that the intake valves controlling flow to the system had been closed. According to Greg the system was doing fine, he regularly flushes the SAPS and the system did not need any maintenance.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The Somerset Conservation District and StreamTeam have been working together to visit and sample the site on an approximately quarterly basis. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). Flow is typically only monitored at the end of the system and ranges from 1-400 gpm with an average of 95 gpm. It is uncertain if the flow of the discharge is that variable or if the amount of water entering the system is variable or both. There are valves that control flow into the system and it has been reported that the flow rate is intentionally set to produce good quality water from the system and therefore, at least at times, a portion of the water may be bypassing the system. How much water bypasses the system is unknown. The discharge can be described as acidic with relatively high concentrations of iron, manganese, and aluminum. The effluent water quality of the system is typically net-alkaline with low concentrations of metals. There are several sampling dates associated with the effluent sample point that are believed to be possibly incorrect and may actually be for a different sample point altogether, which may be skewing the average data. Therefore, median data was reported.

Oven Run E Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
ORERAW (Influent)	NA	3.3	3.2	0	136	5.0	7.3	10.8	790
Pond1	NA	3.7	3.6	0	90	3.8	6.7	11.5	824
SAP1	NA	6.0	6.3	41	-5	1.2	5.8	5.3	873
Pond2	NA	7.0	6.8	34	1	0.8	5.6	2.9	821
SAP2	NA	7.0	7.2	48	-24	0.4	2.3	1.2	818
Pond3 (Effluent)	95	7.1	7.4	45	-23	0.3	0.8	0.5	770

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L;

Conclusions & Recommendations

Based upon the very limited site inspection, water quality data, and information from Greg Shustrick, the Oven Run E system appears to be working well. One potential concern is the use of valves to control flow into the system, which limits the amount of water that can be treated. Always adjusting the valves to reduce/increase flow to produce good water quality could potentially hide the actual treatment effectiveness and initiate needed maintenance. In addition, using valves to control flow in a passive system is difficult. It can lead to instances when more flow could be going into the system and being effectively treated, but because of how the valve is set, less flow enters the system. Or, as during the site inspection, in generally low flow conditions, no water was entering the system when all of it could have been treated. If a there is a desire to control flow into the system, other methods are available to better control flow including flow splitter boxes with a weir like structure and overflow. A new method to capture and introduce flow to the system is recommended.

Oven Run E Photos

At the Oven Run E passive system, water was not flowing (Top Left) which made evaluating the system in the field difficult. While some ponds still had water such as SAP1 (Top Right) and Pond 2 (Center Left), SAP2 was completely dry (Center Right). Low pH water was found flowing in a channel located on the east side of the system. Later, it was discovered that intake valves had been closed.

Oven Run F (aka Hawk View)

Township/City: Shade Township
County: Somerset
Latitude/Longitude: 40° 8' 3.9984" N 78° 55' 30" W
Receiving Stream: Oven Run
Watershed: Stonycreek River

The Oven Run F (aka Hawk View) passive system was designed by the NRCS and constructed in 2000 to treat an abandoned underground mine discharge. The system, which was reportedly designed to treat up to 350 gpm, consists of two SAPS and two settling ponds alternating in series. On November 20, 2012, a site visit was conducted with Greg Shustrick of the Somerset County Conservation District. According to Greg, the system was functioning fairly well and has been flushed on a quarterly basis since about 2010. Greg was primarily concerned that the treatment media and/or piping system within the SAPS are possibly becoming plugged as the time to completely flush the ponds was taking about 2-3 days. He was wondering if there was a need to replace the media; however, he noted that he had not observed flow through the SAPS emergency spillways. Based on this initial field visit the following preliminary recommendations were made:

- Continue to completely flush the system on a quarterly basis,
- Continue monitoring the system, and
- If treatment begins to decline or permeability decreases within the system, first try to back-flush or stir the treatment media before replacing the media.

After the initial field visit was completed, a review of available data did appear to show some improvement in water quality especially in terms of pH, alkalinity, and acidity since regular flushing of the system began. The data also suggested, however, that a much lower flow rate was entering the system than the design flow of 350 gpm, including a flow of 26 gpm in January 2013 and 73 gpm in April of 2012, which are both typically higher flow periods, especially when compared to the influent flow rate of 125 gpm measured in September of 2009, which is typically a lower flow period. There were no effluent flow measurements provided on these dates to compare to the influent flow rates, but the average flow rate of the effluent from all available data was about 200 gpm. On October 2, 2013, the site was revisited and a large source of water was found to be flowing in a channel between SAP2 and Settling Pond 2 that did not enter the system. It was uncertain if the water had been flowing there during the initial site visit. The water was traced back to the source, which was a pipe in close proximity to the influent pipe and believed to be either an overflow or by-pass pipe. The SCCD was contacted to report this finding.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The Somerset Conservation District and StreamTeam have been working together to visit and sample the site on an approximately quarterly basis. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). Flow data of the discharge compared to the treatment system is not available, which makes evaluating the system's true effectiveness difficult, especially in terms of whether significant amount of flow may be bypassing the system. The discharge can be described as acidic with high concentrations of iron and aluminum and slightly elevated manganese. The effluent water quality has been variable over the years, although some of the data may be spurious or even different data that belongs to a different sample point. As noted above, the overall water quality does seem to be improved over the last several years since regular flushing was initiated; however, less flow appears to be entering the system. Based on available data, on average the water quality of the effluent has been net-alkaline with low concentrations of metals.

Oven Run F Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
ORFAW (Influent)	65	3.0	3.0	0	221	12.8	3.1	18.8	734
SAP1	NA	4.76	4.7	19	62	4.8	2.6	11.7	777
Pond1	NA	4.9	4.6	14	63	1.8	2.5	8.9	736
SAP2	NA	6.2	6.4	44	-4	0.6	1.4	4.8	740
Pond2 (Effluent)	187	6.6	6.8	48	10	0.4	1.3	2.0	748

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

Overall, the Oven Run F passive system has produced good quality water for the water that has flowed through it. During the 2013 inspection, water was found to be bypassing the treatment system. It was uncertain how long this was occurring or if this was typical or not. The SCCD was notified. In 2014, the SCCD received $704,000 grant to address O&M issues within the Oven Run Watershed including making repairs to the system. At a minimum, a clogged pipe and a gate valve at the inlet has already been fixed which has increased flow to the system. It is uncertain if other measures have been taken to improve treatment effectiveness. Once maintenance has been completed, additional monitoring should be conducted to determine if additional action is needed. As the system is now over 15 years old, there may be a need to replace the treatment media. Stirring the treatment media and/or washing the limestone could be conducted as an attempt to improve existing treatment and/or extend the life of the treatment before trying to obtain funding for a complete rebuild or while waiting.

Oven Run F Photos

During the initial site visit on 11/20/12, the Oven Run F Passive Treatment System *(*Top Left and Right*)* appeared to be functioning well. Greg Shustrick expressed concerns about the media becoming plugged; however, there were no obvious signs of decreased water treatment or water overtopping the berms. After reviewing available water quality data, BMI revisited the site to further investigate the apparent reduction in effluent flow rates. During the site visit, mine water was found to be flowing in a channel between SAPS2 and Settling Pond 2 *(*Bottom Left*)*. The water was traced *(*Bottom Right*)* to the source, which was a pipe located near the influent pipe. This was believed to be an overflow or by-pass pipe. The Somerset County Conservation District was contacted and they have since acquired funding to complete repair work.

Reitz #1

Township/City: Shade Township
County: Somerset
Latitude/Longitude: 40° 7' 4.0008" N 78° 48' 11.0016" W
Receiving Stream: Laurel Run
Watershed: Dark Shade Creek

The Reitz #1 (aka Laurel Run Reitz #1) passive treatment system receives mine drainage from the Reitz #1 underground mine discharge located near Central City in Shade Township, Somerset County. The system was designed by Eric Robertson of the NRCS and constructed in 2004. The system is maintained by Larry Hutchinson of the Shade Creek Watershed Association. This site hosts an educational display board and trail for public viewing and understanding of the passive system.

The abandoned underground mine discharge is captured and piped underneath Laurel Run, emanates from a grate and then flows in a short channel into a layered-style VFP. The underdrain piping system collects the water from the VFP and connects to two Agri Drain boxes, which then convey the water via pipe to a settling pond followed by a Bioreactor. Reportedly, the hydrogen sulfide smell from the Bioreactor was so strong that the local citizens complained. The Bioreactor is now essentially bypassed as the water only flows on the surface, transforming the pond into more of a settling pond or wetland. Logs that had been placed within the media of the Bioreactor were mostly floating on the surface. The outfall of the settling pond/ wetland flows under a small walkway bridge and down a short limestone channel, discharging into Laurel Run.

Maintenance had previously been conducted under the SRI O&M TAG program in fall of 2012 after being contacted by the Shade Creek Watershed Association. The system was reported as having poor performance, likely due to short-circuiting being caused by a displacement of compost to the far side of the pond. First, the VFP was drained and the compost material was re-distributed across the pond. Then the compost was mixed into the top layer of the limestone to help reduce short-circuiting. The VFP emergency spillway outlet height was lowered and a ramp was installed into the VFP to provide easier access in the future. Logs that were floating were removed from within the settling pond and Bioreactor. Access points were installed for future maintenance activities to the settling pond. Water samples collected at the final effluent shortly after the maintenance was conducted indicated the system performance was significantly enhanced and produced net-alkaline water; however, total iron concentrations even though decreased by about 60%, remained elevated. The dissolved iron concentration is expected to be substantially lower as significant iron solids were observed in the effluent. The large amount of iron solids may have been due to the recent stirring event as this has been seen at other systems.

The site was visited again on October 1, 2013 due to concerns of the Shade Creek Watershed Association in relation to high iron solids entering Laurel Run. Field water monitoring conducted at the time, as well as visual observations, confirmed significant iron entering the stream. Monitoring indicated that additional oxidation and settling of solids may be needed.

The SCWA stated that the VFP was being flushed on about a weekly basis. Frequent flushing could be contributing to the high iron solids especially if the system is not able to effectively settle the solids. The settling ponds are largely full of material and may be reducing the ability to settle solids. SRI recommended that the flushing frequency be decreased in order to evaluate if flushing was contributing to the significant iron solids content within the final effluent. Once monitoring has been conducted, the system can be further evaluated to determine if additional actions can be taken.

A site inspection was also conducted under this project by the Saint Francis University's Center for Watershed Research and Service on November 13, 2014. During the site investigation, the following issues were identified:

- The settling pond appears to have significant sludge, especially at the outflow of the VFP.
- The raw water discharge into the VFP is directly next to the spillway into the settling pond/wetland. In times of high flow or if the VFP clogged, water could short-circuit.
- The Agri Drain boxes required some unclogging; however, this may be performed regularly as it was not terminally affecting the system.

Water Quality Data

The Reitz #1 system is sampled by the Shade Creek Watershed Association through StreamTeam on a periodic basis. Available data was limited. The most recent lab data available was 2013. It is uncertain if the system is not being sampled or if there is an issue with orphaned samples within the SIS database. Individual sample dates and additional parameters are available on Datashed (www.datashed.org) for historical sampling. The raw water quality can be described as acidic with significant metal concentrations and flow rates at times in excess of 75 gpm.

Sampling was conducted on November 13, 2014 by Saint Francis University's Center for Watershed Research and Service; the results are provided in the table below. The November sampling event showed that the VFP seems to be working well with significant reduction of metals, low D.O. concentrations (2.7 and 7.7 % in BOX/Woods and BOX/Stream respectively), addition of alkalinity and the distinct sulfide smell. The wetland/settling pond portion of the system is removing yet more metals and suspended solids; however, water entering Laurel Run still contains metals, confirmed visibly and by the data (5.6 Fe, 8.4 Mn mg/L). Starting in the spring of 2009, total iron and total aluminum concentrations exiting the system increased, indicative of the sludge effect on the retention time and lack of precipitation. The highest flow recorded on Datashed (120 gpm) shows that treatment still occurs in high flow; unfortunately, this is the only time high flow is documented.

Reitz #1 Water Quality Data 11-13-14

Sample Point	Field pH	Lab pH	Alkalinity Lab	Alkalinity Field	Acidity	Field Cond.	Lab Cond.	T. Fe	T. Mn	T. Al	SO_4	S.S.
DLR2 (Influent)	3.6	3.7	0	0	193	1160	1150	42.90	10.93	13.06	651	<5
BOX/Stream	6.5	6.4	148	170	-82	1372	1330	11.81	9.24	1.36	585	12
BOX/Woods	6.6	6.4	171	184	-111	1395	1350	11.21	9.45	0.37	602	9
WET/BIO	6.6	6.6	140	158	-94	1427	1300	8.75	8.13	0.51	638	16
BIO/ OUT Final Effluent	6.7	7.3	135	137	-97	1331	1260	5.60	8.36	0.20	654	13

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Field and Lab Conductivity in uS/cm, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L, Sulfate and Suspended Solids in mg/L

Reitz #1 Average Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4	TSS
DLR2 (Influent)	77	3.7	3.5	0	113	26.7	8.4	7.1	490	9
BOX/Stream	27	5.9	6.1	118	-63	10.2	7.0	3.8	466	18
BOX/Woods	NA	6.3	6.7	145	-102	10.6	6.9	2.5	440	20
WET/BIO	NA	5.7	6.7	124	-52	12.4	6.2	2.6	410	14
BIO/ OUT Final Effluent	57	6.0	6.7	150	-74	10.0	6.4	1.8	451	16

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L, Sulfate and Suspended Solids in mg/L

Conclusions and Recommendations

Overall, the Reitz #1 system has worked fairly well in terms of neutralizing acid and removing metals, but treatment has been variable and at times high concentrations of iron are still entering the stream. A lack of flow data and dissolved metal data further complicates the evaluation. It is quite possible that most if not all of the remaining iron and aluminum is in the particulate form, which would mean increasing the ability of the system to settle solids could significantly improve treatment performance. The following are recommendations to improve the treatment system:

- VFP water level may need to be lowered in order to prevent overtopping berms or flowing over emergency spillway. This should be able to be accomplished by removing stoplogs within the Agri Drain box. Alternatively, the berm elevation could be increased.
- The VFP does not need to be flushed on a regular basis unless water quality issues begin to develop. In some cases, regular flushing has been known to create short-circuiting pathways, which reduce treatment effectiveness.
- Remove sludge from settling pond. Pumped filter bags will likely need to be used. It may be possible to utilize a vacuum truck, but a location needs to be identified where the sludge can be taken.
- Installing windowed baffle curtains within the settling pond could help settle solids and reduce short-circuiting.
- Additional aeration may be beneficial. This might be able to be accomplished by building up riprapped spillways in the settling pond and lowering water elevation. It might be

possible to install a trompe, but there might not be sufficient elevation change to accomplish this task. Further evaluation would be needed.

- A vegetated wetland could probably be created at the end of the system utilizing the existing bioreactor to help remove more total iron and total manganese from the outflow. It could especially improve iron removal because iron is likely mostly particulate by that point.
- Alternatively, a portion of the Bioreactor could be converted into a Horizontal Flow Limestone Bed (HFLB), which would act as a filter for solids, as well as promote additional hydrolysis of metals, and provide additional alkalinity generation.
- Trimming of brush to allow for educational paths to be visible and open for public.
- Conduct regular water monitoring including flow measurements.

Reitz #1 Photos

At Reitz #1, portions of the compost layer had been disturbed and transported across the pond (Top Left) by a large flow event or possible high winds resulting in the compost layer being significantly thinner near the inlet (Center Right) which was likely leading to short-circuiting. In addition, a large quantity of logs (Center Left) from the Bioreactor had floated up out of the media and needed to be removed. The compost was leveled and mixed into the top layer of limestone aggregate (Top Right) and logs removed. There is concern about the water level in the VFP and the potential of the AMD overflowing and bypassing treatment (Center Right). In addition, at times, high iron content is still being discharged to the stream (Bottom Left). Installing baffle currents in the settling pond and better use of the Bioreactor space could be helpful.

Rock Tunnel

Township/City: Conemaugh Township
County: Somerset
Latitude/Longitude: 40° 13' 23.9988" N 78° 59' 21.9984" W
Receiving Stream: South Fork Bens Creek
Watershed: Bens Creek

The Rock Tunnel passive treatment system is located along the South Fork of Bens Creek in Somerset County. The system, originally constructed in 1994, was the first passive treatment system built by SCRIP in the Stonycreek Watershed and consisted of a single pond. The system was designed to treat a high-flow, net-alkaline, underground mine discharge with relatively low concentrations of iron and aluminum. As the pH of the discharge is typically between 6 and 7, the aluminum was believed to mainly be in the solid form and only requires settling. The system was undersized due to construction limitations of the stream, roads on each side of the stream valley, and wetlands. In 2002, the treatment system was reconfigured by installing wooden baffles within the pond in an attempt to reduce short-circuiting and maximize retention. A site investigation was conducted with Greg Shustrick of the Somerset County Conservation District on 10/16/13. Field testing was conducted and water samples collected. During the site inspection, the following initial recommendations were made:

- Expand the existing treatment area if possible. It may be possible to convey water to the other side of the stream for additional treatment area.
- The wooden baffles could be replaced with directional baffle curtains.
- Planting with wetland plants may be beneficial to helping remove solids.
- Significant CO_2 still exists in the final effluent. Shake test increased pH from 6.5 to 8.0. Increasing aeration and degassing of CO_2 will increase pH, which should lead to increased iron oxidation rates.
- Installing a trompe could be useful for aeration and CO_2 degassing.

The Somerset County Conservation District had applied for and acquired funding to rehabilitate the treatment system. The Pennsylvania Association of Conservation Districts developed a new design within the existing footprint. The newly constructed system included level spreaders and aeration troughs as well as converted most of the available area into a well-established wetland. In addition, BioMost, Inc. designed and installed 3 trompes as part of the project. A sludge bed was also installed. The site was revisited on November 4, 2015. Utilization of the treatment area was greatly improved and the water appeared to visibly have less iron solids in the effluent.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The discharge has been sampled by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as a high-flow, net-alkaline underground mine discharge with relatively low concentrations of iron and aluminum. As the pH of the discharge is typically between 6 and 7, the aluminum is believed to mainly be in the solid form and only requires settling. Final effluent data has been separated into pre-rehabilitation and post-rehabilitation data. As shown in the table below, on average very little metal removal was taking place in the system prior to rehabilitation. During the site inspection on 10/16/13, water samples were collected. In addition, an agitation test of the final effluent caused the pH of the sample to quickly increase from 6.5 to 8.0 indicating that a significant amount of $CO_{2\ was}$ dissolved in the water which is depressing the pH and likely reducing iron oxidation rates. Water monitoring of the final effluent since rehabilitation indicates that the system is performing much better.

Rock Tunnel Pre- and Post- rehabilitation Water Quality Data (Average Values)

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L, Sulfate and Suspended Solids in mg/L

Sample Point	Flow	pH field	pH lab	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO4	TSS
Raw	1629	6.0	6.6	200	-164	3.1	0.4	1.5	495	16
Treated (Pre-rehab)	NA	6.5	6.8	192	-161	2.8	0.4	1.3	492	13
Treated (Post-rehab)	814	6.6	7.0	214	-164	1.0	0.3	0.7	483	11
Bypass (Post-rehab)	321	6.2	6.7	221	-176	2.4	0.3	1.2	514	14

Conclusions and Recommendations

The original treatment system was undersized for the flow and loading of the discharge due to the various construction limitations related to the stream, roads, wetlands, etc. The Somerset County Conservation District received funding to rehabilitate the system, which included level spreaders, aeration troughs, and 3 trompes as well as converting most of the available area into a well established wetland. Treatment effectiveness has increased as a result; however, a large portion of the water bypasses the system most of the year and does not receive treatment. The system would still benefit by expanding the available area for treatment. Further evaluation would be needed to determine if there is additional land available to expand the system. One option may be to pipe the effluent and/or the bypassed water to the other side of the stream and/or further downstream.

Rock Tunnel Photos

The Rock Tunnel system was undersized and utilized wooden baffles (Top Left) resulting in poor iron removal. The Somerset Conservation District acquired funding to rehabilitate the system, which included converting most of the pond into wetlands (Top Right). Level spreaders and aeration troughs were added (Center Left) as well as three trompes (Center Right) to improve iron oxidation. A sludge pond was also added to provide on-site sludge storage capacity.

Shingle Run

Township/City: Shade Township
County: Somerset
Latitude/Longitude: 40° 4' 50.0016" N 78° 46' 0.0012" W
Receiving Stream: Shingle Run
Watershed: Shade Creek

The Shingle Run passive system is located on State Game Lands No. 228 near Central City, Somerset County and was constructed around 2002. An approximately 2-mile access road is used to reach the site, which is controlled by a locked gate. A concrete storm drain intake was installed along Shingle Run to intercept a portion of the stream flow and direct the water to a limestone diversion drain, which is similar in design to an Oxic Limestone Drain. Large mesh chicken wire screen is attached to the intake to allow flow from Shingle Run to enter the drain while preventing large rocks, leaves and debris from entering. A wooden board acting as a small dam-like structure downstream of the inlet was installed to encourage water to enter the intake. From the inlet, the water is piped under the game lands access road, through the limestone diversion drain and out a pipe to return to Shingle Run further downstream. The system is maintained by the Shade Creek Watershed Association.

A site investigation including water monitoring was conducted on November 20, 2014 by Saint Francis University's Center for Watershed Research and Service. During the site investigation, the mesh screen at the inlet box was almost completely blocked with leaves, wooden debris and ice allowing for a very small portion of Shingle Run to flow through the system. The inlet area was cleared of ice, debris, and leaves after water sampling was completed which significantly increased flow to the system.

Water Quality Data

Water sampling was conducted by SFU during the site investigation. Results are shown in the table below. The system is occasionally sampled by the Shade Creek Watershed Association or Kiski-Conemaugh StreamTeam. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The sample set collected by SFU closely matched the existing data set. The water quality of Shingle Run (Inlet to the system) can be described as slightly acidic with low concentrations of metals. The low acidity, metal concentrations and especially the low sulfate concentrations indicate that the stream may not be acidic due to AMD, but could potentially be caused by other reasons/sources such as the lack of carbonate minerals within the local bedrock, acid deposition, organic acids, etc. The effluent of the limestone drain typically has a higher pH and is on average net-alkaline with low metal concentrations. During the SFU investigation, they noted that the performance at the time of sampling may not be indicative of the system's capability because of the very small portion of Shingle Run flow actually entering the system at the time the sample was collected. Unfortunately, there was no historical flow data available to provide a comparison nor downstream samples to understand the impact to the stream. Therefore, it is uncertain if the system is able to successfully treat higher flow rates.

Shingle Run SFU Water Quality Data Sampled 11-20-14

Sample Point	Flow	Field pH	Lab pH	Alkalinity Lab-	Alkalinity Field	Acidity	Field Cond.	Lab Cond.	T. Fe	T. Mn	T. Al	SO_4	S.S.
Inlet	4.0	4.5	4.8	5	0	13	20.6	24	<0.05	0.07	0.23	6	<5
Outfall	7.5	7.6	6.9	32	30	-16	68.3	74	<0.05	<0.02	0.12	6	<5

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Field and Lab Conductivity in uS/cm, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L, Sulfate and Suspended Solids in mg/L

Shingle Run Water Quality Data (Average Values)

Sample Point	Flow	pH field	pH lab	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO4	TSS
SR3 (Inlet)	NA	4.4	4.4	5	16	0.3	0.07	0.6	25	5
SR4 (Outfall)	NA	7.3	7.7	36	-14	0.3	0.06	0.5	20	5

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L, Sulfate and Suspended Solids in mg/L, NM- Not Monitored

Conclusions and Recommendations

Based upon the available information, the water that flows through the limestone drain is significantly improved, but a lack of flow data and design information, etc. makes a full assessment difficult and incomplete. The following are recommendations for the site:

- During the site investigation, the mesh guarding the inlet box to the system along the bank of Shingle Run was covered by debris and ice, reducing flow to the system. Once cleared, the flow into the box increased visibly by an estimated ten-fold. These are well known problems that stream intakes often have. The site needs to be inspected at least on a quarterly basis and ideally monthly. During the inspection, the intake screen should be cleaned.
- If maintenance becomes a problem, it might be possible to design and install a different intake. This could be completed utilizing SRI's O&M TAG program.
- Flow rate should be measured and reported during each sampling event in order to document performance of the limestone drain.
- As the system is trying to treat a portion of the stream, downstream monitoring should be conducted in order to document whether the system is improving the stream.
- Contact the Shade Creek Watershed Association or Kiski-Conemaugh StreamTeam to gain vehicular access to the site.

Shingle Run Photos




A concrete inlet box with a mesh screen is used to capture a portion of the water flowing in Shingle Run (Top Left) and then is conveyed to a buried limestone drain (Bottom Left). The effluent then discharges back to Shingle Run further downstream (Bottom Right). The mesh screen is designed to prevent rock and debris from entering the system, but at times becomes clogged (Top Right). Regular inspections and cleaning are necessary to ensure sufficient water is entering the system.

Swallow Farm (aka Reels Corner)

Township/City: Shade Township
County: Somerset
Latitude/Longitude: 40° 3' 8.2116" N 78° 47' 43.7064" W
Receiving Stream: Coal Run
Watershed: Shade Creek

The Swallow Farm passive system (aka Reels Corner) was designed by the PA DEP BAMR and constructed in 2005 to treat a mine discharge impacting Coal Run in Shade Township, Somerset County, PA. AMD seeps are collected by ditches, which convey the water to a settling pond. From the settling pond, the water flows into a flushable limestone bed with plywood baffles. Under normal flow conditions water from the limestone bed flows into a settling pond followed by a wetland before discharging to Coal Run. A site inspection was conducted on October 1, 2013 with Larry Hutchinson of the Shade Creek Watershed Association. Water samples were collected. During the inspection, the following issues were discussed/identified:

- The settling pond and wetland following the limestone bed were reported to be leaking.
- A number of small seeps emanate along the stream bank and flow directly into Coal Run. DEP has suggested collecting the seeps and piping the water into the limestone bed.
- Since the water is mostly treated by the limestone bed, the SCWA would like to install a valve on the limestone bed and direct the effluent directly to the stream.

Water Quality Data

The Swallow Farm system is periodically sampled by the Shade Creek Watershed Association. Available data was limited. It appears that the effluent of the limestone bed is treated as the effluent of the system. The only known sample of the final wetland (SFO) was collected by SRI during the site investigation. It is possible that more data exists and there may be some problems related to the PA DEP SIS database, especially in relation to orphaned data. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The raw water quality can be described as very acidic with significant metals. Aluminum concentrations are very high. On average, the effluent of the limestone bed is good quality with net-alkaline water and low metal concentrations. Flow data is lacking, which makes a thorough evaluation difficult. During the inspection, the flow rate of the influent water and effluent of the limestone bed were measured at 5 gpm, while only 2 gpm were measured at the final effluent of the wetland. While one measurement cannot be conclusive, it does provide an indication that the settling pond and wetland following the limestone bed are leaking water.

Swallow Farm Average Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
DCR1 (Influent)	NA	3.2	3.0	0	376	8.0	7.5	29.1	313
DCR1.5	6	6.9	7.4	64	-43	0.4	0.4	1.4	157

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L, Sulfate and Suspended Solids in mg/L, NM- Not Monitored

Conclusions and Recommendations

While the Swallow Farm passive system is obviously experiencing problems with leaking ponds, overall the system is effectively treating the mine drainage that is entering the system. The system would likely perform better in terms of settling metal solids if the entire system was utilized. Without flow measurements and water quality data of the entire system, a complete evaluation is not actually possible. The following are recommendations for the Swallow Farm system:

- Capturing the seeps along Coal Run and conveying them to the treatment system would provide further improvement to the stream. Additional monitoring of the seeps and an evaluation of the system should be conducted to determine if the existing system can effectively treat all of the flow.
- Regular complete water monitoring and flow measurements of the system are needed, including the final effluent of the wetland, in order to assess the true value of the existing system.
- Lining the settling pond and wetland with clay, geotextile liner, BENTOMAT, or Mineral CSA could be completed to allow flow through the entire system.
- The water level within the limestone bed may be too high. Typically, horizontal flow type limestone beds are designed to keep the water level below the top of the limestone in order to provide maximum treatment. The water level is being kept higher than the stone by the weir and effluent spillway. As long as water treatment remains effective, this is not an issue.
- Eventually treatment will likely decline and there may be a need to wash the stone.

Swallow Farm Photos




At the Swallow Farm passive system, mine drainage is collected and then directed into a limestone bed with wooden baffles (Top Left). A weir and effluent spillway maintains a water level above the top of the stone (Top Right). The effluent of the limestone bed is considered the effluent of the system even though there is settling pond and wetland (Bottom Left) which are reported to leak and despite water still flowing out of the system (Bottom Right). As the system has been successful, it may be possible to collect additional seeps and direct them into the limestone bed.

Weaver Run D8A

Township/City: Paint Township
County: Somerset
Latitude/Longitude: 40° 12' 36.2988" N 78° 49' 26.6016" W
Receiving Stream: Weaver Run
Watershed: Paint Creek

The Weaver Run D8A passive treatment system is one of three systems built along Weaver Run to treat AMD from underground coal mines. The D8A & D8B systems are referred to as the "Twins" because they have the exact same design. The mine drainage is collected using a basin with two perforated 6" PVC pipes that are connected to a 6" solid Schedule 40 PVC pipe to convey the flow to the treatment system. The treatment system consists of a single 50' X 90' open limestone bed that is about 4.5' thick where the water flows horizontally through the treatment media. At the inlet side of the bed there is a 6" perforated pipe that extends most of the width of the bed to evenly distribute flow across the inlet. A "pipe tree manifold" with perforated vertical pipes is located at the opposite end of the bed to collect the treated water. It is connected to a control structure to control water level within the bed.

A site visit was conducted on December 17, 2015 with Missy Reckner of the Paint Creek Regional Watershed Association and Kiski-Conemaugh StreamTeam. According to Missy, the system is not currently experiencing any known maintenance issues. During the site visit, no known maintenance issues were observed.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system has been sampled by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as mildly acidic with slightly elevated concentrations of iron, aluminum, and manganese. The water quality of the effluent can be described as net-alkaline with low concentrations of metals indicating the system is working well.

Weaver Run D8A Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
KSTWRD8A (Influent)	18	3.3	3.4	0	40	2.9	3.4	0.6	198
KSTWR8AUE (Effluent)	21	6.4	8.0	40	-25	0.4	0.3	0.5	116

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

As there are currently no known maintenance issues and the system is successfully treating the discharge, the only recommendation at this time is to continue regular inspections and water monitoring of the system and to complete maintenance as needed. Eventually the limestone bed will become plugged with metals and the stone will need to be cleaned and metals removed. As there is no structure to flush into, flushing of the bed is not recommended at this time.

Weaver Run D8A Photos

View of the inlet distribution pipe (Top) and of the entire Weaver Run D8A limestone bed (Bottom).

Weaver Run D8B

Township/City: Paint Township
County: Somerset
Latitude/Longitude: 40° 12' 33.6996" N 78° 49' 30.9" W
Receiving Stream: Weaver Run
Watershed: Paint Creek

The Weaver Run D8B passive treatment system is one of three systems built along Weaver Run to treat AMD from underground coal mines. The D8A & D8B systems are referred to as the "Twins" because they have the exact same design. The mine drainage is collected using a collection basin with two perforated 6" PVC pipes that are connected to a 6" solid Schedule 40 PVC pipe to convey the flow to the treatment system. The treatment system consists of a single 50' X 90' open limestone bed that is about 4.5' thick where the water flows horizontally through the treatment media. At the inlet side of the bed there is a 6" perforated pipe that extends most of the width of the bed to evenly distribute flow across the inlet. A "pipe tree manifold" with perforated vertical pipes is located at the opposite end of the bed to collect the treated water. It is connected to a control structure to control water level within the bed.

A site visit was conducted on December 17, 2015 with Missy Reckner of the Paint Creek Regional Watershed Association and Kiski-Conemaugh StreamTeam. According to Missy, the system is not currently experiencing any known maintenance issues. During the site visit, no known maintenance issues were observed.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The system has been sampled by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as mildly acidic with slightly elevated concentrations of iron, aluminum, and manganese. The water quality of the effluent can be described as net-alkaline with low concentrations of metals indicating the system is working well.

Weaver Run D8B Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
KSTWRD8B (Influent)	29	3.5	3.6	0	29	2.6	2.4	0.7	141
KSTWR8BLE (Effluent)	22	6.3	7.8	49	-24	0.4	0.6	0.5	179

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

As there are currently no known maintenance issues and the system is successfully treating the discharge, the only recommendation at this time is to continue regular inspections and water monitoring of the system and to complete maintenance as needed. Eventually the limestone bed will become plugged with metals and the stone will need to be cleaned and metals removed. As there is no structure to flush into, flushing of the bed is not recommended at this time.

Weaver Run D8B Photos

View of Missy Reckner of the Kiski-Conemaugh StreamTeam collecting water samples at the inlet distribution pipe (Top) and of the entire Weaver Run D8B limestone bed (Bottom).

Weaver Run D10

Township/City: Paint Township
County: Somerset
Latitude/Longitude: 40° 12' 43.9596" N 78° 49' 21.9468" W
Receiving Stream: Weaver Run
Watershed: Paint Creek

The Weaver Run D10 passive treatment system was the first and largest of the three systems built along Weaver Run to treat AMD from an underground coal mine. The mine drainage flows out of the underground mine and into a collection basin with three perforated 12" PVC pipes that are connected to a 12" solid Schedule 40 PVC pipe to convey the flow to a 12' deep pre-cast concrete inlet box connected to another 12" PVC pipe that then conveys the water to the treatment system. The AMD first enters the southeastern corner of the Forebay. A cement level spreader about 6" thick sits on top of the limestone. The intention of the Forebay is likely to settle leaves and debris and to spread the water across the width of the pond while the level spreader is intended to evenly distribute the water within the treatment media. The actual treatment component consists of a single 75' X 180' open limestone bed that is about 7' thick where the water flows horizontally through the treatment media. A "pipe tree manifold" with perforated vertical pipes is located at the opposite end of the bed to collect the treated water and is connected to an Agri Drain water control structure.

An initial site visit was conducted on October 17, 2013 with Missy Reckner of the Paint Creek Regional Watershed Association and Kiski-Conemaugh StreamTeam to see the newly constructed system. During the site visit, Missy discussed her concern with cracks on top of the berm, a seep zone that had developed on the steep outer slope of the berm as well as some minor signs of slumping. The pH of the seep water was about 5.6 indicating that it was likely partially treated water from the system. Water quality from the treatment system appeared to be good. A recommendation was made to monitor the seep zone and slumping over time to see if there are any signs of continual movement or if it was stable.

In November of 2015, Missy Reckner requested Technical Assistance related to the treatment system. Her primary concerns were decreased treatment performance, difficulty flushing, differences in flow rates in and out of the system, potential short-circuiting, continued leakage, and possible slope instability of the outer berm. Missy also questioned the quality of the limestone that was being used at the site. A site visit with Missy was conducted on December 17, 2015. The group had placed stakes in the ground and were periodically measuring the distance between them to see if the ground has been moving. Measurements so far are somewhat inconclusive, but may indicate some slight movement. She had also pointed out locations along the concrete level spreader that were cracked/broken and places where repairs had been attempted. Very little water was actually flowing over the level spreader. Most of the water was flowing underneath.

During the site visit, a dye test was conducted to try to assess whether short-circuiting was occurring. The dye test was somewhat inconclusive because much of the dye stuck to the algae growing within the Forebay; nonetheless, certain information was revealed. The dye plume initially and quickly went towards the middle and northern end of the Forebay and began to make its way into the limestone bed within about 20 minutes, but then the dye stopped moving forward and developed a very discernible line across the Forebay. This point is believed to represent the approximate location of where the water is entering the stone and where the algae is growing on top of the stone, thus absorbing the dye. No dye was ever observed in the effluent before leaving the site. However, this was not necessary to determine short-circuiting. While waiting for the dye test to progress, pH measurements of the water within the 8 ports of the "pipe tree" were measured where possible. The ports were numbered 1-8 from the south to north with 8 being closest to the outlet of the bed. As can be seen in the table below, ports 1-4 all had good pH values, but port 8 had a very low pH value. Unfortunately the caps on ports 5, 6, and 7 were stuck and could not be removed for monitoring. Assuming that ports 1-4 are receiving flowing water, this indicates that the water entering in port 8 has much shorter retention time and is likely short-circuiting.

12/17/15 pH values from the Weaver D10 "Pipe Tree Ports"

Port #	1	2	3	4	5	6	7	8
pH	6.71	7.22	7.11	7.03	-	-	-	4.89

Water Quality Data

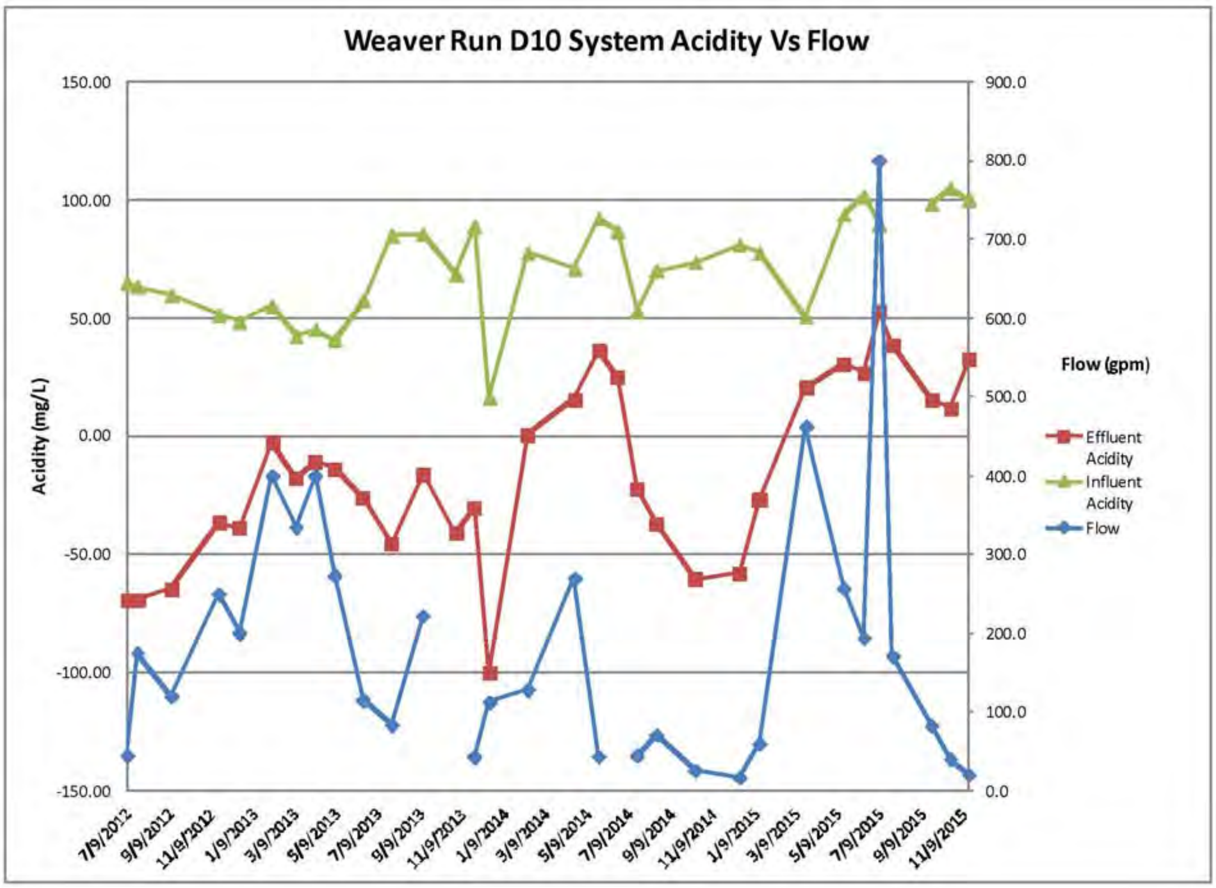
A review of the available water quality data for the treatment system was conducted. The system has been sampled at least quarterly by StreamTeam. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with elevated concentrations of aluminum and manganese. The water quality of the effluent on average can be described as net-alkaline with lower, but still slightly elevated concentrations of aluminum.

Weaver Run D10 Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
KSTWRT10I (Influent)	163	3.3	3.4	0	71	0.3	2.8	5.6	256
KSTWRT10E (Effluent)	182	6.1	6.6	31	-15	0.3	1.3	1.6	267

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Upon a closer evaluation of the data, it can be seen that the water monitoring indicates variable treatment over much of the short life of the system. Hot acidity values of the effluent range from -100 to 52 and those samples collected since March 2015 have all been net-acidic, indicating a change in treatment effectiveness. A few additional interesting aspects of the data were observed. A graph of the influent and effluent acidity values compared to flow is provided below. In general, the acidity of the effluent of the system appears to be related to the flow rate. As the flow rate increases, the effluent tends to be more acidic while when the flow rate decreases, the water tends to becomes more net-alkaline. This would tend to make sense as alkalinity generation is closely tied to retention time within the limestone bed. That was until a large flow spike occurred in July 2015. After the flow spike, the flow rate quickly drops down, but the effluent acidity remains high. The extremely high flow event may have caused or enhanced any short-circuiting that was already occurring. Another interesting observation is that towards the second half of 2015, the acidity of the influent AMD tends to be higher, which could also be impacting the overall performance of the system. It is difficult to say whether the higher acidity values are a long-term trend or just a temporary change in water quality due to a disturbance in the mine pool.



Conclusions and Recommendations

There are a variety of problems occurring at the Weaver Run D10 treatment system. In order to address these issues, the following recommendations are grouped together based upon the issue.

Water Quality

- As it currently does not function as designed and is not serving a real purpose, remove the concrete level spreader.
- Remove algae, sludge, and other accumulated debris from the Forebay.
- Fill in the Forebay with limestone by either purchasing additional stone or shifting stone from other areas of the bed.

- Add a perforated flow distribution pipe across the width of the bed similar to the ones used at the Weaver Run D8A & D8B systems.
- Stir/wash the limestone to clean off accumulated metal solids and disrupt short-circuiting pathways.
- Periodically measure the pH values within the pipe tree ports as an indicator of short-circuiting.

Flushing

- Currently, there is not a pond to direct the flush water from the limestone bed. Unless absolutely necessary, it is not recommended to flush to the stream as this partly defeats the purpose of the treatment system. We recommend that an additional pond be constructed for the purpose of flushing as well as for the settling of metals during normal operation. Alternatively, it may be possible to utilize filter bags during flushing events, but these are often difficult to use and sometimes are not very effective.
- If flushing must be conducted without using a method to capture the metal solids then it would be best to conduct the flushing during high flow periods or events.

Berm Stability

- It has now been a couple of years since the seeps and initial slumping were discovered. More than likely, there is not any significant risk of failing. Fixing the berm would likely be quite expensive and would require seeking a larger grant source. At this point in time, it is recommended to continue to monitor the berm for signs of movement.
- Installation of a rock drain could be a viable alternative to rebuilding the entire berm.

Flow Measurements

- The difference in flow measurements between the influent and effluent may simply be due to the difference is how the flow is measured. The influent is measured with a rectangular weir that is not completely level while the effluent is measured using the bucket and stopwatch method with a 10 gallon tote. When using a 10 gallon tote, a 0.1 second difference in time is equal to a measurement difference of 60 gpm. The inaccuracies of both methods could lead to significant differences.
- There is also the possibility of differences due to time lags associated with the retention time of the system and variable flow rates of the discharge.
- Completing a tracer study might help to identify if other leakage is occurring.

Once the treatment performance is restored, it will be important to continue regular inspections and water monitoring of the system and to complete maintenance as needed. Eventually the limestone bed will become plugged with metals and the stone will need to be cleaned and metals removed. In addition, establishment of an O&M fund for future maintenance needs is also recommended.

Update

In May of 2017, maintenance was conducted through the SRI O&M TAG program to address the water quality issue. The level spreader was removed. The limestone was stirred, washed and redistributed to eliminate the Forebay. A perforated flow distribution pipe was installed. The system will need to be re-evaluated after several water monitoring events are completed.

Weaver Run D10 Photos

The Weaver Run D10 limestone bed is experiencing a variety of issues. Dye testing (Top Left) and monitoring at the pipe tree (Top Right) indicated that short-circuiting was occurring and the level spreader was not functioning. Without a settling pond there is no place to settle aluminum solids (Center Left) during normal operation or flushing events. Installing a settling/flush pond is recommended. Wooden stakes were installed along the steep outer berm (Center Right) to monitor the seeps and potential slumping. Disparity in flow data may be due to the condition of the weir (Bottom Left) and/or differences in flow measuring techniques.

Wells Creek Adams #6 (aka Skeria #6)

Township/City: Somerset Township
County: Somerset
Latitude/Longitude: 40° 2' 4.956" N 78° 59' 50.1252" W
Receiving Stream: Wells Creek
Watershed: Wells Creek

The Adams #6 (aka Skeria #6) passive system was designed by Earthtech on behalf of the Wells Creek Watershed Association and constructed in 2003 to treat a large underground mine discharge. The system consists of a 2,200-ton Anoxic Limestone Drain with a flushing system followed by two settling ponds that have a combined designed retention time of over 30 hours. The treated water then flows in a 200' long limestone channel before entering the stream. The system was designed based upon an average flow of 360 gpm and maximum flow of 700 gpm. Reportedly, in the spring of 2004, a high flow event created excessive water pressure which caused some damage to the ALD and an adjacent pond. An 18" bypass was then installed to prevent future problems. The ALD is reported to be flushed on a quarterly basis. A site inspection was conducted on October 16, 2013. Field parameters were measured and sample of the effluent was collected for laboratory analysis. A series of about 15-20 capped riser pipes stick out of the ground near the ALD. It is uncertain if these pipes are for ports for monitoring water quality or water level or if used for cleanouts or some other purpose. One had a coffee container for a lid.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. Very little data was able to be obtained. Most of the data was collected in 2004 with only a few sampling events after. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge is currently able to be sampled at the A6ByPass point and can be described as mildly acidic with slightly elevated concentrations of iron, aluminum, and manganese. The water quality of the effluent of the treatment system can be described on average as net-acidic with low concentrations of metals. The last four effluent samples collected from 2009-2013 were actually net-alkaline, but the flow through the system was quite low around 50-60 gpm. The limited historic data indicates that in the past an average of 600 gpm and at times over 1000 gpm would flow through the system. During the October 16, 2013 site inspection, about 300 gpm was bypassing the system even though only 50 gpm was flowing through it. As the system was designed to treat an average of 360 gpm, this would tend to indicate that there is likely plugging of the treatment media. During the site investigation, relatively high dissolved oxygen concentrations and ORP values were measured both at the bypass and the effluent of the ALD. While it is possible, the instrument was not functioning properly, this is an indication that the bed is actually functioning more like an Oxic Limestone Drain (OLD). Average data does indicate that metals are being retained by the ALD.

Adams #6 Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
A6ByPass	340	4.0	3.7	0	50	1.0	0.8	2.2	190
A6ALDE	NA	6.2	6.0	27	15	0.3	0.5	1.2	171
A6SP2E	620	6.8	6.4	29	14	0.4	0.5	0.8	177

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

The Adams #6 passive system has been somewhat successful in treating the mine discharge by neutralizing about 70% of the acidity and significantly reducing metals concentrations that flow through the system, especially considering that on average it has been treating twice the design flow rate. It is uncertain how much water is typically bypassing the system and what the impact is to the overall water quality of the discharge and stream after the treated and bypassed water mix. As the treated water typically contains low alkalinity, it would be easily overwhelmed by the acidity of the untreated water and metal solids would be produced from the reactions of the two different water sources. While the primary alkalinity generator used at this system is called an Anoxic Limestone Drain, it is functioning more like an Oxic Limestone Drain as the water entering contains oxygen and the system was being regularly flushed. Regular flushing of the bed may prevent CO_2 levels from increasing to a point where limestone dissolution rates are significantly increased.

Most of the available water quality data was collected during the first two years after construction. During that time, the system was treating a large quantity of water. The limited water monitoring conducted over the last several years indicates a small amount of water is being treated while a significant amount of water is still bypassing the system. This indicates that the media or at least the portion of the media where the water first enters the component has become plugged. The reduction in permeability prevents water from flowing through the system, therefore causing the water to bypass the system. It is possible that if the overflow is not connected to the ALD influent pipes that something has happened within the underground mine such as a roof collapse that could affect flow rate to the system. The following actions could be completed to improve performance either separately in a stepwise approach or several could be combined at the same time.

- One of the caps on the riser pipes was missing and a coffee container was in place instead. It is unknown if any of the others are loose as they were not checked. All should be on tight and any missing should be replaced. This could be the source of oxygen into the system and could be causing CO_2 to escape, reducing limestone dissolution and alkalinity generation.
- If the system has not been regularly flushed for the last few years, a cheap initial effort could consist of flushing the ALD completely down for a few days then closing the valves to allow the water to refill the ALD and then repeat. Repeating this process several times over a period of a month or two may flush the metals, increase permeability, and rejuvenate the limestone. Water monitoring should be conducted in between each step to see if treatment improves. If treatment improves and the system

can once again treat higher flow rates without bypassing the water then there may not be a need to do anything else.

- If flushing the system does not appear to significantly improve treatment effectiveness, steps could be taken to stir and clean the limestone within the ALD especially in the areas where the water first enters the bed. The limestone should be evaluated at this time to determine if any of the media needs to be removed or if more limestone needs to be added.
- As the ALD was designed with a flushing system, it could be converted into an auto-flushing limestone bed by either installing a siphon vault to batch treat the water or using a solar powered Agri Drain SmartDrain to control how often the bed is flushed.
- Installing windowed baffle curtains within the settling ponds could assist with settling of metal solids.

Update

In December 2016, SRI received an update from the Wells Creek Watershed Association that in 2014, the WCWA placed high quality limestone in an existing small pond located below the bypass to provide some treatment of that water. In addition, a collection pipe header was installed in the bypass pond to handle flows of 4,000 to 5,000 gpm during max flow events. Further investigation is needed to determine if the increase in bypassed flows is due to problems with the influent distribution header or other causes. If the ALD is converted to an auto-flushing limestone bed, the complex influent header system could likely be removed and may help to eliminate some future problems. SRI's O&M TAG program may be able to provide further assistance.

Adams #6 Photos

At the Adams #6 passive system capped riser pipes with unknown purpose are associated with an ALD (Top Left). One of the pipes has a coffee can instead of a cap, which could be allowing oxygen to enter and CO_2 to escape. Despite being designed to treat over 350 gpm, more water was bypassing the system (Top Right) than the 50 gpm flowing through (Bottom Left). Aluminum solids were visible in the spillways and ponds (Center Left). Windowed baffle curtains could help settle solids in the long ponds (Center Right).

Wells Creek Adams #7 (aka Moore No. 7)

Township/City: Somerset Township
County: Somerset
Latitude/Longitude: 40° 2' 9.408" N 78° 59' 34.0332" W
Receiving Stream: Wells Creek
Watershed: Stonycreek River

The Wells Creek Adams #7 (aka Moore No. 7) passive treatment system was designed by Earthtech on behalf of the Wells Creek Watershed Association and constructed in 2003. The treatment system consists of a layered VFP containing approximately 8" compost layer on top of 3,800 tons of limestone with a two-tiered underdrain with numerous (over 30) cleanouts. The VFP discharges to a Settling Pond before flowing to the stream. The system is reported to be flushed quarterly. A site inspection was conducted on October 16, 2013. Field parameters were measured and water samples were collected. The following issues and observations were identified:

- The mine water enters the system at the southeastern corner of the VFP and directly across from the emergency spillway. During the inspection, approximately half of the water was flowing over the emergency spillway instead of flowing through the treatment media. As the effluent pipes of the VFP were not flowing full, this is an indication that the permeability of the treatment media has likely decreased. It is uncertain how much role the location of the emergency spillway may play as it might just be easier for the water to flow out than through the media.
- An unusually large number of cleanouts were installed for the VFP.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. Very little data was able to be obtained. Most of the data was collected in 2004 with only a few sampling events after. It is uncertain whether the system is being sampled on a regular basis or not. Average water quality data for select parameters are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with elevated concentrations of iron, aluminum, and manganese. The water quality of the effluent can be described on average as net-acidic with reduced concentrations of metals.

Adams # 7 Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
AS7	276	3.4	3.3	0	95	8.6	4.2	4.4	340
A7VFRE	NA	6.4	6.3	46	-8	1.4	2.4	1.5	318
A7SPE	500	5.8	6.1	24	17	1.5	2.8	1.5	316

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

The Adams #7 has been fairly successful treating the abandoned mine discharge by neutralizing about 95% of the acidity and removing a large portion of the metals. The water that actually flows through the VFP appears to be of good quality, but then mixes and helps to treat the bypassed flow. It is uncertain how much water is designed to go through the system and how much is meant to be bypassed; however, during the site inspection about half the flow was bypassing the VFP despite the pipes not flowing full indicating the permeability of the VFP treatment media has decreased. Based upon experience with other VFPs, the cause of the decreased permeability may be the accumulation of iron precipitates on top of the compost layer. Removing the iron layer off the top of the compost and fluffing the compost layer may be enough to increase permeability. There may be a need to stir and wash the limestone. Another option to improve treatment is eliminate the use of the top tier of the underdrain by capping the outlet. This will force more water through the entire treatment media.

Update

In December 2016, SRI received an update from the Wells Creek Watershed Association that in 2014, Adams #7 was rehabilitated due to low infiltration rate into the VFP treatment. They replaced the top 12” of high quality limestone and mushroom compost with 12 to 18” of high quality limestone and 12” of mushroom compost. The work has reportedly improved the permeability and water quality of the effluent is improved and more consistent throughout the year.

Adams #7 Photos

At the Adams #6 passive system, a large flow underground mine discharge (Top Left) has pooled and then flows into a VFP. Much of the water is flowing over the emergency spillway, which is located directly across from where the AMD enters the VFP (Top Right). Water bypassing the VFP through the emergency spillway mixes with the effluent of the VFP (Center Left) before flowing into the Settling Pond (Bottom Left) helping to treat the bypassed flow. The VFP has an unusually large number of cleanout pipes (Center Right). Work has been conducted by the WCWA to improve treatment.

Wells Creek Onstead

Township/City: Somerset Township
County: Somerset
Latitude/Longitude: 40° 0' 49.1292" N 79° 0' 36.3168" W
Receiving Stream: Wells Creek
Watershed: Wells Creek

The Wells Creek Onstead passive system was constructed in 2004 and was designed to capture and treat three discharges known as #5, 5A, and #11. The discharges are piped to a VFP that was designed to treat about 100 gpm. From the VFP the water flows into a polishing pond before discharging to the stream. A site inspection was conducted on 10-16-13. A sample of the final effluent was collected. A lot of algae and vegetation was growing within the VFP. There appeared to be a stone baffle or barrier of some type built within the polishing pond that is assumed to have been built to help settle solids, but the water was significantly higher, which could limit the effectiveness

Water Quality Data

A review of the available water quality data for the treatment system was conducted. Very little data was able to be obtained. Most of the data was collected in 2004 with only a few sampling events after. It is uncertain whether the system is being sampled on a regular basis or not. Average water quality data for select parameters are provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with slightly elevated concentrations of iron, aluminum, and manganese. The water quality of the effluent can be described on average as net-alkaline with low concentrations of metals. The water sample collected of the effluent confirmed the system was still performing well on that date although the flow rate was only about 30 gpm.

Onstead Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
OS	160	4.0	3.9	0	38	1.0	1.9	2.7	244
OSVFRE	160	6.3	6.4	44	-8	0.4	1.2	1.0	244
OSSPE	187	6.8	6.8	42	-11	0.2	0.7	0.5	235

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

Based upon the limited data available and the site inspection, the system appears to be functioning well, producing net-alkaline water with low metal concentrations. The purpose of the stone baffle is not completely certain. Depending on the intended purpose, the use of a windowed baffle curtain might accomplish the same thing. The influent pipe was covered by water indicating that the water level within the VFP may be a little high, but the designed elevation was unknown. Algae and vegetation growing within the VFP along with treatment media issues may be causing permeability issues, but at the time of the inspection, all of the water appeared to be flowing through the media. If permeability does become a problem, remove the algae and stir the treatment media. Regular water monitoring should be conducted.

Onstead Photos




At the Onstead passive system, the influent piping carrying the AMD to the system was under water (Top Left) which may be an indication of hydraulic issues which could be caused by plants and algae growing in the Vertical Flow Pond (Top Left and Right) or may be an indication of reduced permeability of the treatment media. From the VFP, the water flows into a settling pond (Bottom Left) which contains a rock baffle (Bottom Right), which the purpose of is not clearly known. The water level may be too high. If intended to help settle solids, the use of windowed baffle curtains could achieve similar and likely better

Conemaugh River

The Conemaugh River is about 70 miles long and is formed at Johnstown, Pennsylvania at "The Point" by the confluence of the Little Conemaugh River and the Stonycreek River. Loyalhanna Creek (separate section) confluences with the Conemaugh River in Saltsburg, PA to form the Kiskiminetas River. Many of the passive systems within the Conemaugh River Watershed are addressed in other sections of this report such as Blacklick Creek and Stonycreek River. This section focuses on the four treatment systems in the Aultmans Run watershed and one system along Gray Run. The systems are listed in alphabetical order. When available, site schematics have been included in Appendix A. The schematics vary in quality from scans of hand-drawings to auto-cad designs.

Gray Run

Township/City: Lower Yoder Township
County: Cambria
Latitude/Longitude: 40° 20' 26.2428" N 78° 58' 25.3632" W
Receiving Stream: Saint Clair Run
Watershed: Conemaugh River

The Gray Run passive system was designed by the NRCS and constructed in 1997. According to design drawings obtained from the Cambria County Conservation and Recreation Authority (CCCRA), the mine water is collected in two different locations utilizing trenches filled with AASHTO #57 sandstone and perforated pipe. The collected AMD is piped to a SAP with a half-foot of compost on top of three feet of limestone, which then flows into a settling basin. On November 12, 2014, a site inspection was conducted with Dee Columbus of the CCCRA and Jackie Ritko of the Cambria County Conservation District. According to Dee, the landowner who agreed to the system died and the family members who inherited the property changed the location and amount of land that could be used, therefore a smaller system had to be constructed. They also required a fence be built around the SAP to keep their horses out. The fencing, downed trees, and thick vegetation made traveling around the site, seeing, and sampling extremely difficult. A sample of the effluent was collected.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. Very little data was available. No historical data appeared to be available and only a few samples from the snapshot events were found. It is uncertain if additional data exists or not. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The water quality of the discharge flowing into the system can be described as being acidic with elevated concentrations of iron, manganese, and aluminum. All three samples of the effluent indicate the system is producing net-acidic water with significantly lower concentrations of iron and aluminum. As the system is nearly 20 years old and there is a lack of historical data, it is uncertain whether the system has always produced similar quality water or if this is indication of needed maintenance or possibly even new treatment media.

Gray Run Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
Influent	14	3.0	3.3	0	135	3.4	16.4	12.8	500
Effluent	10	3.9	4.1	2	34	0.9	13.5	2.8	289

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

Based upon limited information, the Gray Run passive system is not satisfactorily treating the water, but is neutralizing about 75% of the acidity and is removing a large portion of the iron and aluminum. As the system is nearly 20 years old and there is a lack of historical data, it is uncertain whether the system has always produced similar quality water or if the lack of full treatment is an indication of needed maintenance or possibly even new treatment media. Based upon the design plans there was only about 3 feet of limestone used in the SAP. When it is time to replace the treatment media, the system should be evaluated to determine if there is enough space available to increase the amount of treatment media and whether an Auto-flushing Vertical Flow Pond can be utilized. As it appears that the system is not currently being monitored, an effort should be made to find an organization to take over the O&M at the site. In addition, an effort should be made to clean up the site in order to allow easy travel around the system for inspections, monitoring, and maintenance.

Gray Run Photos

At the Gray Run passive system, fencing, downed trees, thick thorny vegetation, etc., made traveling around and seeing the system difficult. The system which is nearly 20 years old consists of a SAP or VFP (Top) and a settling pond (Bottom) which are not fully treating the water.

Neal Run

Township/City: Young Township
County: Indiana
Latitude/Longitude: 40° 34' 1.8732" N 79° 17' 40.3116" W
Receiving Stream: Neal Run
Watershed: Aultmans Run

The Neal Run passive system is only partially constructed and helps to treat the worst discharge in the entire Aultmans Run Watershed. The AMD emanates from a large coal refuse pile in McIntyre, PA that was reclaimed by PA DEP BAMR as part of the McIntyre East Refuse Piles project [Contract No. OSM 32 (3825) 101.1]. In 2011 and 2012, approximately 37,600 tons of acid-producing coal refuse was recovered from the site for power generation at the Seward Generating Station, a circulating fluidized-bed power plant capable of cleanly burning poorer quality coal refuse. As part of the project, three oxidation and precipitation channels (OPCs**)** were constructed to remove iron from the severely degraded mine drainage by encouraging the formation and storage of iron solids at low pH. Funding is currently being sought by SRI and the Aultman Watershed Association for Restoring the Environment (AWARE) to put in additional treatment components. A site inspection was conducted on November 25, 2014. The site was well vegetated and the OPCs appeared visually to be removing iron at low pH. No O&M issues were observed at this time.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The StreamTeam is sampling the site on an approximately quarterly basis, but only a portion of the data is available as there is a problem with the PA DEP SIS database. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The water quality of the D2 discharge is probably one of the worst quality discharges in the Kiski-Conemaugh basin with extremely acidic water and very high concentrations of metals. The OPCs that were installed have removed 64% of the iron concentration by sample point D7 and 80% by sample point NLO-D3. While a portion of the reduction is likely due to dilution by other seeps, a large portion is due to low pH iron removal.

Neal Run Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
D2	8	3.2	3.0	0	6560	2270	26.7	518	8680
D7	9	3.2	2.8	0	4855	810	23.8	406	6740
NLO-D3	24	3.5	3.0	0	2607	419	14.3	286	3685

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

While the OPCs at Neal Run are removing a large portion of the iron, the water quality is still extremely degraded and is severely impacting the stream. Additional treatment is needed. In March 2016, SRI completed the Aultmans Run Watershed AMD Assessment & Implementation Plan that proposed additional treatment components including an Auto-flushing Vertical Flow Pond, settling pond, and Jennings-type mixed media Vertical Flow Pond. SRI and AWARE are currently seeking funding to install the treatment system. Due to the severity of the water quality, a long-term O&M fund should be obtained if possible. In addition, the orphaned data in the SIS database needs to be fixed.

Neal Run Photos

At the Neal Run site, three OPCs (Top Left) were installed as part of a coal refuse removal project to treat an extremely polluted mine discharge. While the OPCs have been very successful at removing a lot of iron in a short period of time (Top Right and Bottom Left) the water is still extremely polluted and significantly impacts Neal Run (Bottom Right). Additional treatment is needed. SRI and AWARE are currently seeking funds to expand the treatment system.

Reeds Run

Township/City: Armstrong Township
County: Indiana
Latitude/Longitude: 40° 34' 39.6336" N 79° 16' 33.8016" W
Receiving Stream: Reeds Run
Watershed: Aultmans Run

The Reeds Run passive system was designed by BioMost, Inc and constructed in 2011 as part of a coal refuse removal project. This project addresses the RD0-D1 discharge, which was identified as being the second highest contributor of iron, manganese, and acidity to the 28-square mile Aultmans Run Watershed. The restoration strategy involved the removal of 72,647 tons of acid-producing coal refuse, which was taken to Seward Generating Station. The remaining non-fuel grade (NFG) refuse was mixed with 6,967 tons Mineral CSA, donated by Harsco Minerals, Sarver, PA. Within the footprint of the original refuse pile, a 0.75-acre wetland and 0.60-acre open water habitat were constructed to help ameliorate any lingering degraded seepage from the NFG refuse. The project eliminated most of the mine drainage at the site. Dramatic improvements in water quality have been documented in the stream, with fish being observed in the stream probably for the first time in over 50 years. A site inspection was conducted on November 25, 2014. No obvious maintenance issues were observed during this time.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The StreamTeam is sampling the site on an approximately quarterly basis, but only a portion of the data is available from Datashed as there is a problem with the SIS database. This issue needs to be addressed. Some data was able to be obtained from StreamTeam for the purpose of this report, but have not yet been uploaded to Datashed. Some individual sample dates and additional parameters are available on Datashed (www.datashed.org). As the main discharge (RD0-D1) into Reeds Run was essentially eliminated by the coal refuse removal and land reclamation project, water monitoring is being conducted of the wetland constructed within the project area built next to the remaining coal refuse that was left on site. The “influent” to the wetland can be described as net-alkaline with low concentrations of metals. The effluent of the wetland, which discharges to Reeds Run, can also be described as net-alkaline, but has slightly higher concentrations of iron and sulfate and less alkalinity. Interestingly, field pH data for the effluent averages about 5.8 while the lab pH averages about 7.0. If these values are assumed to be correct, this may indicate the effect of CO_2 suppressing the pH in the field and then degassing. The increase in metals and sulfate and decrease in alkalinity would indicate some level of influence from the remaining coal refuse left on site, but as of right now is not significantly degrading the water. This further demonstrates the success of the coal refuse removal and land reclamation project.

Reeds Run Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
Influent	20	6.3	7.7	65	-49	0.4	0.4	0.5	88
Effluent	20	5.8	7.0	30	-12	1.4	0.5	0.5	123

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

Water monitoring has indicated that the Reeds Run land reclamation project was very successful in improving water quality. The effluent of the wetland does indicate slight degradation from remaining coal refuse, but overall water quality is good with just slightly elevated iron concentrations. Water monitoring should continue to make sure that the alkaline material mixed with the remaining coal refuse is not consumed. If this happens, there may be a need in the future to add an alkalinity-generating component such as a limestone bed, but currently this is not necessary. Problems with orphaned data within the SIS database made obtaining and evaluating water quality data time consuming and difficult and should be fixed as soon as possible.

Reeds Run Photos

At the Reeds Run project, any remaining coal refuse that was not marketable was covered and revegetated (Top). In addition, a wetland was constructed including vegetated areas (Top) and open water habitat (Bottom). The wetland was to provide water treatment of seeps located within the project area before discharging to Reeds Run.

SR286

Township/City: Center Township
County: Indiana
Latitude/Longitude: 40° 33' 23.0004" N 79° 15' 33.0012" W
Receiving Stream: Aultmans Run
Watershed: Conemaugh River

The SR286 passive treatment system was designed by BioMost, Inc. and constructed in 2003. The project was the first AMD discharge addressed by AWARE in the Aultmans Run watershed and is highly visible along PA State Route 286. While originally believed to be a borehole (#8 borehole), according to PennDOT, the discharge actually emanates from a pipe installed by PennDOT. The pipe conveys mine drainage underneath Route 286 to Aultmans Run, but the discharge originates from a gravity drain from the R&P #4 abandoned underground coal mine. The passive system consists of a small forebay and a rip-rap level spreader designed to distribute flow evenly into an approximately ½-acre aerobic wetland. From the wetland, the water then flows into an existing channel wetland before entering Aultmans Run. During dry periods of the year, the effluent of the system is the primary source of flow to this section of the stream.

In July 2012, AWARE contacted SRI to obtain assistance through the SRI O&M TAG program. The following issues were identified;

- Preferential flow paths had formed within the treatment wetland over time, partly due to channels within the forebay level spreader. These channels were created by both vegetation growing within the forebay and from riprap being removed from several areas of the level spreader, most likely by local children.
- The water level within the treatment wetland had lowered due to the deterioration of hay bales placed at the outlet in 2004 in order to increase the storage capacity of iron solids and to reduce short-circuiting.
- The water level in the existing channel wetland had also been lowered due to erosion at the effluent end of the component. In addition, the outlet pipe, installed by hand in order to take flow measurements, was also missing due to erosion forces.
- The Kiski-Conemaugh Stream Team had also requested a path be cleared to the outlet of the treatment system for monitoring efficiency.

On 9/21/12, BioMost, Inc., and a group of AWARE volunteers performed the maintenance at the passive system. A trail was blazed to the outlet of the treatment wetland. To raise the water level in the treatment wetland, approximately 50 feet of 8” compost filter sock was installed by hand at the outlet to replace the deteriorated hay bales. The compost filter sock, a readily-available product used for erosion control, was selected as the longevity is typically greater than for hay bales. In addition, riprap was rearranged and vegetation removed within the forebay level spreader in order to re-establish the water level and to distribute the flow across the entire level spreader.

A replacement pipe was installed at the outlet of the existing wetland channel on 9/21/12; however, high flows within Aultmans Run again carried the pipe downstream. On 4/9/13, with the help of Indiana University of Pennsylvania (IUP) students, concrete bags were carried to the outlet and stacked carefully within the channel in order to help protect the current outlet pipe from being dislodged by erosive forces. Void spaces between the concrete bags noted during placement were sealed with bentonite chips. A subsequent monitoring event on 4/16/13 indicated that the channel wetland had returned to the design water level and that water was flowing through the outlet pipe.

Site inspections were conducted on November 21, 2013 and November 25, 2014.
During the site inspections, the following items were noted:

- The concrete bag "dam" installed to protect the outlet pipe was leaking, but may seal itself over time.

- Channels within the wetland could be observed. It was uncertain if short-circuiting was still taking place or if they were a remnant of the past issues. There may be a need to conduct additional work.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. AWARE and the StreamTeam are sampling the site on an approximately quarterly basis, but only a portion of the data is available as there is a problem with the SIS database. This issue needs to be addressed. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The water quality of the 286 discharge can be characterized as a net-alkaline iron discharge with low concentrations of aluminum and manganese. The effluent of the system has been variable, but can be described as net-alkaline with significantly reduced, but still elevated iron concentrations. Due to a lack of dissolved or ferrous iron data, it is uncertain whether the iron that is remaining is mostly in the dissolved or solid form, although the average total suspended solids for the final effluent is 12 mg/L, which does indicate a fairly high amount of solids.

SR286 Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
SR286 (Influent)	230	6.1	6.4	87	-27	17.8	0.7	0.3	150
WL	133	6.8	7.0	75	-58	6.3	0.6	0.4	145
85-16 (Effluent)	120	7.0	6.9	71	-41	5.7	0.6	0.3	140

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

While more recent water quality was not available, over the life of the system, SR286 is removing about 70% of the iron on average. It is uncertain how much of the remaining iron is in the solid form and just needs additional settling/filtration. During the site inspection, channels were observed within the wetland, which would indicate short-circuiting. It may be possible to improve treatment performance by disrupting the channels or taking other measures to help distribute flow to better utilize the wetland area. Compost filter socks, haybales or even baffle curtains could be used to help accomplish this task. It is recommended that AWARE/StreamTeam continue to monitor the raw discharge, the treatment wetland effluent, and the wetland channel effluent on at least a quarterly basis to document the effectiveness of the system. Problems with orphaned data within the SIS database made obtaining and evaluating water quality data time consuming and difficult and should be fixed as soon as possible.

SR286 Photos

At the SR286 passive treatment system, a discharge enters the system via a pipe installed by PennDOT conveying mine drainage under Route 286 into a small Forebay with level spreader (Top Left). The AMD then flows into a constructed aerobic wetland, which has become channelized (Top Right and Bottom Left). From the wetland, the water flows through a channel wetland that discharges to Aultmans Run. A berm made out of bags of concrete was created to house the effluent pipe (Bottom Right) used to measure flows, which kept getting washed away.

Loyalhanna Creek

The Loyalhanna Creek Watershed is approximately 300 square miles in area with about 2,500 miles of stream and is located entirely within Westmoreland County in Western Pennsylvania. Loyalhanna Creek confluences with the Conemaugh River near the town of Saltsburg to form the Kiskiminetas River. Coal mining has been a major industry within the watershed since at least the late 1800's and as a result, the watershed has been impacted by abandoned mine drainage. The Loyalhanna Watershed Association (LWA) formed in 1971 to address the various impacts to the watershed and to preserve natural areas. The LWA is one of the oldest watershed organizations within Pennsylvania.

The following is a brief evaluation and discussion of the passive treatment systems located within the Loyalhanna Creek Watershed. The systems are listed in alphabetical order. When available, site schematics have been included in Appendix A. The schematics vary in quality from scans of hand-drawings to auto-cad designs.

Friedline

Township/City: Cook
County: Westmoreland
Latitude/Longitude: 40° 8' 3.5052" N 79° 16' 46.434" W
Receiving Stream: Laurel Run
Watershed: Loyalhanna Creek

The Friedline Passive Treatment System, located in Cook Township, Westmoreland County, was originally constructed in 1997 to address a discharge from the abandoned Friedline Mine that had been previously identified as the primary source of pollution impacting Laurel Run, a designated High Quality-Cold Water Fishery in the Loyalhanna Creek Watershed. The Friedline Mine is reportedly a small "house coal", 600-foot upslope drift, deep mine on the Lower Kittanning coal seam that was operated by the Friedline family from the 1920's through the 1950's to supply fuel for the family farm and neighbors.

The original passive treatment system consisted of SAPS1 (Vertical Flow Pond 1) → PND1 (Settling Pond 1) → WL1 (Wetland 1) → PND2 (Settling Pond 2) → SAPS2 (Vertical Flow Pond 2) → PND3 (Settling Pond 3) → WL2 (Wetland 2) → PND4 (Settling Pond 4). According to the PADEP, the discharge is conveyed to the system via an 8" PVC drainpipe inserted through a sandstone mine seal. The system reportedly worked well for a few years before showing signs of degraded water quality. According to the O&M Plan completed by Skelly & Loy, a portion of the system was rebuilt in 2001. Rehabilitation included replacing the limestone aggregate, compost and underdrain of Vertical Flow Pond 1 and replacing the compost and a portion of the limestone aggregate in Vertical Flow Pond 2. In addition, emergency spillways were installed in several locations and a French drain was installed to capture seeps. According to the O&M Plan, an aluminum capture-and-recovery system was also installed at that time that included a tank and sludge drying bed. Around 2004, PADEP BAMR installed a steel-slag bed, which used diverted water from Laurel Run to produce alkaline water that was added to the treatment system in Settling Pond 3. Improvements to the final effluent were reported for about 2 to 3 years; however, the effluent was not net-alkaline.

A site visit was conducted on November 19, 2013 with Josh Penatzer of the Loyalhanna Watershed Association (LWA). During the inspection, the following observations were made:

- The water level was very high within SAPS1 to the point where a portion of the water was flowing out of an emergency spillway and bypassing most of the system and then flowing into PND4. This indicates a reduction in permeability of the treatment media and/or a plugged underdrain. The high water level also made collecting a sample of the raw water difficult and flow could not be measured. Low pH iron could be observed on top of the treatment media, which could be the cause of low permeability.
- Josh noted that during storm and other high flow events that Pond 1 also sometimes overflows. There was quite a bit of vegetation in the spillway between PND2 and SAPS2 that could be causing the water to back up.

- The water level within SAPS2 also appeared high, which would likely be due to decreased permeability of the treatment media and/or clogged underdrain. The water might be backing up into PND2 causing the higher water level in that pond.
- Vegetation in the final effluent spillway should be removed.
- Josh also reported that there were problems with the effluent flow pipe and that the LWA wanted to replace the pipe with a weir.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The discharge and treatment system has been regularly sampled by the PA DEP and LWA. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with high concentrations of iron and aluminum and slightly elevated manganese values. The water quality of the effluent can be described as acidic with significantly lower concentrations of iron and aluminum. The effluent quality indicates the system is not working well, but on average 92% of the acidity is being neutralized and 98% of the iron and 88% of aluminum are being removed. Therefore, the system is doing quite good. Interestingly, a sample collected in July of 2015 was the first sample collected in many years that had a pH greater than 6, although it was still net-acidic. This may be due to some initial work being conducted by PA DEP in which they lowered the spillway of SAPS1, which lowered the water level and prevented water from bypassing most of the system.

Friedline Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
F1 (Influent)	12	2.7	2.8	0	763	208.2	3.3	44.6	775
WL1	NA	2.9	3	0	192	15.0	1.8	13.2	398
SAPS2	18	3.4	3.6	4	111	6.7	1.6	9.9	360
F2 (Effluent)	21	4.2	4.2	19	60	3.0	2.1	5.1	322

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

The passive treatment system has not been performing as desired, but has demonstrated to be largely effective. Recent sampling may indicate that there is still life to the system and that potentially only maintenance may be necessary. On the other hand, the system is over 15 years old and replacement/rehabilitation should be at least considered. A phased stepped approach where maintenance is conducted prior to rehabilitation in order to extend the life of the system is a reasonable approach, but has a risk of not being effective.

If maintenance is conducted first, then the following should be completed:

- Remove the top layer of iron accumulated on top of SAPS1 and then stir the treatment media.
- Remove any metals off the top layer of SAPS2 and then stir the treatment media.
- Remove vegetation, sediment, and debris from spillways to allow for the free flow of water.
- Assess and remove sludge as necessary.
- Potentially stir and clean the slag bed.

Following maintenance, water monitoring should be conducted to determine if the system is functioning properly. If the system is to be rebuilt/rehabilitated, additional monitoring should be completed and a potential new design developed that would consider the following:

- Install an Oxidation Precipitation Channel (aka Terraced Iron Formation) that would capture the AMD further uphill and would utilize natural biogeochemical processes to remove iron at low pH. This will allow more of the iron to be removed in a channel as opposed to accumulating on top or within a Vertical Flow Pond. This should reduce maintenance needs and potentially increase the life of the system.
- Install an Auto-Flushing Limestone-Only Vertical Flow Pond that would utilize either a siphon or solar powered SmartDrain to allow frequent flushing of the limestone pond.
- Install a Jennings mixed media Vertical Flow Pond for high alkalinity production.
- Install a Horizontal Flow Limestone Bed as the last component for additional alkalinity production and manganese removal.

Friedline Photos




The Friedline discharge flows into SAPS1 (Top Left) where low pH iron is accumulating on top of the treatment media and may be responsible for the low permeability conditions that are causing the water to overflow through the emergency spillway. Vegetation in the spillways (Top Right) needs to be removed as it causes the water to backup and overflow the berm. The water level in SAPS2 (Bottom Left) is also high (probably due to low permeability) and may be causing water to back up into PND2. The slag bed (Bottom Right) may be plugged and may need to be stirred and cleaned.

Keystone Phase 1 & 2 (McCune Run)

Township/City: Derry
County: Westmoreland
Latitude/Longitude: 40° 22' 30.6912" N 79° 23' 53.9664" W
Receiving Stream: McCune Run
Watershed: Loyalhanna Creek

The Keystone passive treatment system is located in Keystone State Park in Derry Township, Westmoreland County. The treatment system was part of a public-private partnership effort to treat AMD from the abandoned underground Salem #2 coal mine that was impacting the water quality of McCune Run, a tributary to Loyalhanna Creek. The treatment system was designed by the PA DEP BAMR. The project was constructed in two phases. Phase 1 was completed in 2002 and consisted of removing the old leaking mine seal and replacing with a new seal as well as installing twin 10" PVC pipes to collect and convey the mine water about 1,500 ft to the area where the treatment system was to be constructed during Phase 2. The treatment system, constructed in 2004, consists of an Auto-flushing Limestone Upflow Pond (LUP) to provide for regular scheduled flushing of the pond. Originally, the flushing system used a siphon, but was later replaced with an Agri Drain SmartDrain. At one point, the limestone within the LUP was replaced with larger aggregate. The water then flows into a settling pond and then an aerobic wetland. An Open Limestone Channel was installed to increase pH and alkalinity and remove manganese while conveying the water to McCune Run. In addition, a flush pond was installed to assist with maintenance activities and provides for manual flushing of the Upflow Pond or settling pond as needed.

A site visit was conducted on 11/17/2014. Water samples were collected of the raw mine water and the final effluent. Field testing of each treatment component was also conducted at this time. During the inspection, the following observations were made:

- The top of the LUP was heavily coated with metal sludge.
- Water was sitting on top of the limestone of the LUP even though the system was not flushing which could indicate plugging issues.
- There was some confusion as to what mode the LUP was currently operating.
- Water looked like it may be entering the top of the LUP through a potential clean out, but this was not certain what the pipe was.
- The Open Limestone Channel was overgrown with wetland vegetation, although this did not seem to be causing any problems at the time of the visit.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The discharge and treatment system has been regularly sampled by the PA DEP. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with high concentrations of iron and aluminum and slightly elevated manganese values. The water quality of the effluent can be described on average as net-alkaline with significantly lower concentrations of iron and aluminum. However, the water quality of the effluent has been quite variable over the life of the system, especially in terms of metal removal. A very distinct change in water quality did seem to take place in the spring of 2007, when the data indicates the effluent of the treatment system went from being typically net-alkaline to net-acidic with only some sample dates being net-alkaline. Unfortunately, there does not appear to be much flow data on Datashed after the system was constructed to assess whether there is a connection between decreased treatment efficiency and high flow conditions. Reportedly the system has had a long history of maintenance issues related to the Limestone Upflow Pond. This could very well be a cause of water quality fluctuations, but without knowing what and when maintenance activities took place it would be difficult to correlate.

Keystone Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
D1 (Influent)	60	3.7	3.3	0	141	61.9	4.9	8.2	645
MP7 (LUP)	NA	4.5	5.3	66	-10	8.6	3.8	3.5	625
MP8 (WL)	422	4.5	4.2	71	-21	4.1	3.6	2.6	617
MP6 (Effluent)	NA	4.3	6.9	63	-22	3.3	3.1	2.2	577

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

Recommendations were going to be made for this system, but during the project it was discovered that the PA DEP had already redesigned the Keystone treatment system with construction anticipated to be completed in 2017. The new mine seal and conveyance system has already been completed. The new treatment system will consist of a settling pond, flushable limestone bed, settling pond, wetland, and manganese removal bed in series. The system should be re-evaluated after construction is completed.

Keystone Phase 1 & 2 Photos




The Limestone Upflow Pond (LUP) (Top Left and Right) receives AMD from the Salem #2 mine. A solar powered SmartDrain (Top Left) was installed to replace a siphon based auto-flushing system. Metal accumulation within the LUP (Top Right) is observable and may be inhibiting proper function of the pond. The LUP flushes into a settling pond/wetland (Bottom Left). A baffle curtain is used to help settle solids before entering the wetland. Treated water discharges to McCune Run via a long Open Limestone Channel (Bottom Right) that is currently over grown with wetland vegetation.

Laurel Run Pyrolusite® System

Township/City: Cook
County: Westmoreland
Latitude/Longitude: 40° 7' 46.1172" N 79° 16' 35.8176" W
Receiving Stream: Laurel Run
Watershed: Loyalhanna Creek

The Laurel Run Pyrolusite® passive treatment system was constructed in 1997 on Forbes State Forest property to treat AMD from the abandoned Kreger Middle Kittanning coal deep mine complex. The Laurel Run and the Friedline passive systems treat the two main discharges within Laurel Run, a tributary to Loyalhanna Creek. The treatment system consists of a single Pyrolusite® limestone bed inoculated with cultured microbes. This site was chosen as the initial trial site for assessment of the technology developed by Allegheny Mineral Abatement, Inc. The bed is 150 ft long by 40 ft wide and is 5 ft deep and filled with ASSHTO No. 57 limestone. Four baffles made from mine conveyor belt were embedded within the limestone and alternate between being placed at the top and bottom of the bed to direct the flow up and down within the bed. Due to reported access road and landowner issues, the site was not visited as part of the project, but the following information was obtained from the PA DEP.

Uneven stone and clogging of the limestone at the influent end of the bed was causing the discharge to short-circuit along the eastern edge while remaining on the surface instead of spreading out and flowing through the entire bed, thereby significantly reducing treatment effectiveness. Water samples of the effluent indicated elevated metals and acidity concentrations and decreasing pH and alkalinity. On February 6, 2012, O&M was performed by the PA DEP BAMR BD Crew. During the maintenance, they discovered that only a small top layer of about 6” of iron precipitates and leaves coated the stone, but this layer was obviously reducing the permeability of the treatment media. The first 2 ft of the limestone was stirred. There was evidence of short-circuiting, as well as dead zones within the limestone. The stone was leveled and an infiltration trench was excavated to encourage better utilization of the bed. It is uncertain if the baffles were left in place or not.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The discharge and treatment system has been regularly sampled by the PA DEP. Because of access issues, the system is only being sampled about once per year now. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with elevated concentrations of iron, manganese and aluminum. The water quality of the effluent can be described on average as net-alkaline with very low concentrations of metals. Sometime between November 2008 and July 2009, the water quality of the system began to deteriorate due to the short-circuiting and plugging issues described above. Reduced treatment occurred until maintenance was conducted in February 2012. Samples collected in March 2012 indicate that the maintenance was successful in restoring treatment, which has continued through at least 2014. This is another example demonstrating the ability of passive treatment media to be rejuvenated through maintenance activities that require relatively little time and thus save money and natural resources by not needing to remove, discard and replace the treatment media. This option should always be considered prior to replacing the media.

Laurel Run Pyrolusite® Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
LR1 (Influent)	13	3.6	3.6	0	82	4.1	10.0	6.6	229
LR2 (Effluent)	13	6.9	7.1	106	-11	0.1	0.5	0.5	278

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

Currently the system is working well; therefore the only recommendation is to continue monitoring the system on a regular basis and conduct maintenance as needed. The bed will likely need to be stirred again in the future. This passive system has been included in the O&M trust fund established by the PA DEP.

Laurel Run Pyrolusite® System Photos

After many years of operation, the AMD flowing into the Laurel Run Pyrolusite® bed (Top Left) began to flow in a channel on top of the limestone in a lower portion of the bed short-circuiting towards the outlet of the bed (Top Right). Uneven stone caused the channelization, but the accumulation of iron and debris prevented the water from entering the bed. The iron was removed. The limestone bed was stirred and leveled and an infiltration trench was excavated at the inlet of the bed (Bottom Left and Right). The maintenance activities restored the proper pathways and rehabilitated the bed's ability to treat the water. (Photos provided by the PA DEP)

Monastery Run Improvement Project (Wetland #1, 2, and 3)

Township/City: Unity
County: Westmoreland
Latitude/Longitude: 40° 17' 53.9988" N 79°24' 47.0016" W
Receiving Stream: Fourmile Run
Watershed: Loyalhanna Creek

The Monastery Run Improvement Project is located at Saint Vincent College on property owned by the Wimmer Corporation near the town of Latrobe, PA and consists of a 20-acre passive treatment complex containing three interconnected treatment systems known as Wetland #1, Wetland #2 and Wetland #3. The passive system reportedly treats between 500 and 6,000 gpm of AMD from numerous mine discharges and seeps and removes more than 260 pounds of iron per day; however, due to the lack of available data for the numerous seeps, these numbers could not be verified. In addition to water treatment, the system is used for environmental education purposes.

Wetland #1 was constructed by the PA DEP BAMR in 1998 in an existing wetland area that had been created by at least 10 known seeps and discharges. The 8.5-acre system consists of an up-flow limestone pond and 3 aerobic wetland cells that contain internal berms to prevent short-circuiting. In 1999, an inverted siphon was installed to convey flow from Wetland #1 under Fourmile Run to Wetland #2 to provide additional treatment which is needed during high flow in the winter and spring. In 2011, an approximately 1-acre sludge basin was installed to dry and store treatment sludge.

Wetland #2 which consists of 3 cells and is 7.5 acres is size was designed by the USDA Natural Resource Conservation Service and constructed in 1998. Wetland #2 receives water from Wetland #1. Originally, Wetland #2 had only 2 cells, but in 2001 a berm was installed to split the last cell into 2 cells with the purpose of increasing aeration and retention time. In addition, a pipe was installed to carry water from “The Bubbler” discharge to Wetland #2 during periods of high flow. An overflow pipe is located in cell 3 that discharges to cell 1 of Wetland #3 during high flow events.

Wetland #3, which consists of 5 cells and is 3.1 acres in size, was designed by the USDA Natural Resource Conservation Service and constructed in 1997 to treat the “Bubbler” discharge. The “Bubbler” is a borehole that was drilled to relieve basement flooding in the 1960’s as part of Operation Scarlift. In 2002, the “Bubbler” was relocated to bring the water closer to the treatment system. During periods of high flow, a portion of the discharge is also piped to Wetland #2. Adjacent to Wetland #3 is the Mesocosm outdoor laboratory that consists of four cells that are equal in size and used for research related to passive treatment and mine drainage.

On 11/17/2014, a site visit was conducted with Beth Bollinger and Jean Keene of Saint Vincent College. According to Beth, the system functions fairly well most of the time, but there are some O&M issues that need or will need to be addressed. Beth indicated that St. Vincent has been working with Hedin Environmental to identify problems at the site and to acquire funding through the PA DEP and US Office of Surface Mining to conduct the maintenance. Maintenance activities had been completed in 2012 which consisted mostly of removing iron solids that had accumulated in the Wetland #1 system. During the visit, the following issues were identified:

- Iron solids have been accumulating within Wetland #2 and #3 systems and will need to be removed.
- Low berms, the build-up of vegetation and the accumulation of iron has resulted in water overflowing the berms in the Wetland #2 system.
- Some of the valves need to be replaced.

Since the site visit was conducted, Saint Vincent College has continued to pursue funding and conduct maintenance. A sludge line was installed along Wetland #2 & Wetland #3 to the sludge drying bed. Sludge from Wetland #3 was pumped to the sludge drying bed. The northwest berm of Wetland #2 was repaired and built up to increase the elevation and cattails were removed from ponds to prevent overflowing of berms and potentially improve treatment.

Water Quality Data

A review of the water quality data for the treatment system provided by Saint Vincent College was conducted. The discharge and treatment system has been regularly sampled by Saint Vincent College and other organizations. Average water quality data for select parameters and sample points is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The numerous discharges are not (or possibly cannot be) monitored, but in general can be described as alkaline iron discharges that are typical of flooded Pittsburgh coal seam mines. Sample point W1O is the effluent of Wetland #,1 which is one of the sources of flow to Wetland #2. W2O is the effluent of Wetland #2, which discharges to Fourmile Run and is considered one of two final effluent points. W3I is the influent to Wetland #3. W3O is the effluent of Wetland #3 and is the other Final Effluent point.

The primary pollutant of concern for this treatment complex is iron. As can be seen in the table, the average concentration leaving the system at W2O is 7 mg/L and at W3O is 4 mg/L. While a lower concentration would be ideal, overall, the system is doing a good job in providing iron removal. The average data may be somewhat skewed due to periods of high loading and more recently because the sludge level within wetland 3 was quite high, reducing treatment effectiveness. In addition, the data set was not complete with about 7 years of data missing between 2007 and 2014. Depending on how well the system was functioning during this period, the average data could be significantly better or worse.

Monastery Run Improvement Project Water Quality Data (Average Values)

Sample Point	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
W1O	6.6	99	-35	31.7	2.7	0.4	636
W2O (Effluent)	7.0	84	-49	7.1	2.4	0.3	673
W3I (Influent)	6.4	209	-30	77.8	3.3	0.4	827
W3O (Effluent)	6.8	112	-65	4.4	2.6	0.4	785

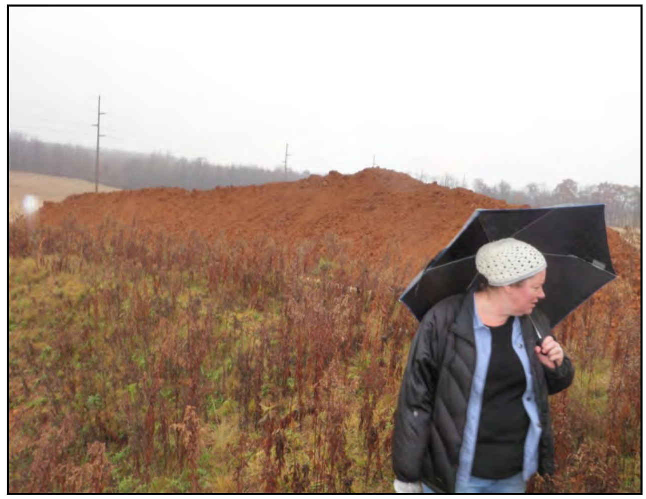
pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

Overall, the Monastery Run Improvement Project is working fairly well. Based on the available data provided by Saint Vincent College, at times, especially during periods of high flow, the treatment system is less effective. The recent removal of sludge from Wetland #3 is expected to improve treatment for that portion of the system. Sludge from Wetland #2 should also be pumped to the sludge drying bed. Once completed, the system should be re-evaluated to determine if sludge removal from Wetland #2 and #3 has resulted in sufficient improvement in treatment. If sludge removal does not provide the level of improved performance desired, then the system should be evaluated for opportunities to degas CO_2 through aeration. In particular, aeration towards the beginning of the system will provide the biggest impact.

In addition, Saint Vincent College has reported that the Mesocosm used for research and student projects needs to be cleaned and the piping repaired in order for flow from Wetland #3 to be restored to the Mesocosm. While not necessarily needed for treatment purposes, the Mesocosm is important to Saint Vincent College and the students who utilize the facility for research.

Monastery Run Improvement Project Photos



At the Monastery Run Improvement Project (Top), the Wetland #1 system (Middle Left) had maintenance conducted around 2012, including removing iron solids. Because there was not a market for the material, the iron oxide has been stockpiled (Middle Right) for future use. Recently acquired funds will be utilized to conduct additional maintenance, including removing accumulated iron solids (Bottom Left), replacing valves as needed, and raising berms to prevent overflowing and short-circuiting (Bottom Right).

Upper Latrobe AMD Treatment Project

Township/City: Unity
County: Westmoreland
Latitude/Longitude: 40° 18' 18" N 79° 23' 2.0004" W
Receiving Stream: Loyalhanna Creek
Watershed: Loyalhanna Creek

The Upper Latrobe passive treatment system is located in the city of Latrobe, PA. The project was conducted through a multi-phased approach. In 2004, L. Robert Kimball Associates completed a study that examined the hydrology, hydrogeology, connectivity, chemistry and flow of three mine discharges impacting Loyalhanna Creek in Latrobe. The study determined that the discharges were emanating from the same mine pool. Based upon the findings of the study, the PA DEP drilled a borehole into the mine pool that was located in an area large enough to construct the treatment system. A temporary treatment pond was installed. Once funding was obtained, a large passive treatment system was designed by Hedin Environmental and constructed in 2010 to treat the 500 gpm flow. The AMD is initially split between Pond 1 and Pond 2, which each have a perforated inlet pipe that spreads the water out across the ponds and provides some aeration. The water from Ponds 1 & 2 discharge into Pond 3, which then flows into a large constructed wetland. Water is conveyed from one pond to the next via metal troughs. A sludge basin was also constructed for sludge placement, drying, and potential recovery.

A site visit was conducted on November 19, 2013 with Josh Penatzer of the Loyalhanna Watershed Association (LWA). Josh indicated that for the most part, the system was working well, but noted that they have been having problems with short-circuiting issues within the wetland. They are currently using haybales to address the issue, but they break down over time and need to be replaced. During the site visit, a recommendation was made to consider compost socks, custom made baffle curtains, or possibly using plastic z-piling instead of haybales if constant replacement becomes difficult. These options could also be employed in other parts of the wetland to encourage full utilization of the treatment area. While the site investigation was conducted in mid-November, there was little evidence of wetland vegetation present within the wetland, which could also affect treatment performance.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The discharge and treatment system has been regularly sampled by the LWA. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). Data related to the partial temporary treatment system was not included in the average data for evaluation purposes. Flow data was often lacking. Aluminum data is somewhat questionable. Based upon the pH of the water, it is likely that the 0.5 mg/L of aluminum that is provided in every analysis indicates that this is probably <0.5 mg/L. The discharge can be described as net-alkaline with high concentrations of iron and slightly elevated manganese. The water quality of the effluent can be described on average as net-alkaline with significantly lower concentration of iron. On average, more than 90% of the iron is being removed.

Upper Latrobe Passive System Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
LFPPIN (Influent)	NA	6.3	6.5	145	-78	34.4	2.8	0.5	352
LFPPOUT (Effluent)	400	7.2	7.3	98	-81	2.2	1.9	0.5	340

Flow in gpm, pH in standard units, Alkalinity and Hot Acidity in mg/L as $CaCO_3$, Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

Overall the treatment system appears to be doing well. At times, slightly elevated concentrations of 2-5 mg/L of total iron remain; however, available ferrous iron and Total Suspended Solids values indicate these concentrations are due to suspended iron solids. Whether the increased iron solids are due to short-circuiting or not is difficult to state with certainty at this time, especially since there was little data with flow measurements available. Compost socks, custom made baffle curtains, or possibly plastic z-piling could be used within the wetland to discourage short-circuiting from occurring and encourage the settling of iron solids. If vegetation within the wetland is not successful there may be a need to conduct additional plantings. Planting more persistent vegetation may also be helpful to provide better year-round solids removal. In addition, the system should be regularly inspected and water monitoring, including flow measurements, should be conducted. The existing O&M plan should be followed and maintenance should be conducted as needed.

Upper Latrobe System Photos




At the Upper Latrobe passive treatment system, the discharge is split between two settling ponds. A perforated influent pipe stretches across the width of each pond (Top Left) to distribute and aerate the flow. Metal troughs (Top Right) spaced within the berms are intended to convey water evenly from one pond to the next. Haybales (Bottom Left) were strategically placed within the wetland to help address short-circuiting that was occurring, but they need to be periodically replaced. Installing baffle curtains, plastic z-piling, compost filter sock or utilizing persistent vegetation in the wetland (Bottom Right) would likely improve treatment performance.

Kiskiminetas River

The Kiskiminetas River forms at Saltsburg, Pennsylvania by the confluence of the Conemaugh River and Loyalhanna Creek. The "Kiski" is a major tributary to the Allegheny River joining near the town of Freeport, PA. The Kiski had long been severely impacted, especially by AMD, but has made tremendous improvements. Tributaries of the Kiskiminetas include Carnahan Run, Roaring Run, Wolford Run, and Blackleggs Creek. The primary watershed groups working in this section of the basin are the Blackleggs Creek Watershed Association, Roaring Run Watershed Association and the Kiskiminetas Watershed Association. Most of the passive treatment systems discussed in this section are located in the Blackleggs Creek watershed. The passive systems are listed in alphabetical order. When available, site schematics have been included in Appendix A. The schematics vary in quality from scans of hand-drawings to auto-cad designs.

Big Run #2

Township/City: Conemaugh Township
County: Indiana
Latitude/Longitude: 40° 32' 53.9988" N 79° 24' 56.9988" W
Receiving Stream: Big Run
Watershed: Blackleggs Creek

The Big Run #2 passive system is part of a larger AMD treatment system complex within the Blackleggs Creek Watershed located in Conemaugh Township, Indiana County. The treatment system was designed by Skelly & Loy and constructed in 2004. The #2 system treats water from an abandoned underground mine. The system consists of a limestone bed and aerobic wetland. The system was visited on several occasions during the project time period for various meetings and site inspections including November 21, 2013, July 2, 2014 and May 29, 2015. Art Grguric of the Blackleggs Creek Watershed Association was on-site during each meeting to discuss the current status of the system and any issues that were occurring. The following issues were initially identified:

- The limestone bed has required periodic stirring/cleaning of the limestone due to the accumulation of metals, especially aluminum.
- A perforated pipe had been installed in order to spread the influent across the limestone bed and provide for some aeration.
- In order to flush the limestone bed, all of the stoplogs must be removed.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The discharge has been sampled by StreamTeam on a regular basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge on average can be described as slightly acidic with elevated, but relatively low concentrations of iron, manganese, and aluminum. Interestingly, samples of the discharge collected over the last several years indicate that the discharge has become net-alkaline. Whether this change is temporary or not remains to be seen. Flow data is limited but indicates that the flow rate is quite high averaging about 600 gpm with a max flow of about 1300 gpm. The water quality of the effluent is typically net-alkaline with variable metal concentrations. As the available data typically only contains total metals, it is uncertain whether the chemical reactions have taken place and the metals just need to be settled or if the reactions have not occurred. It is quite possible that both situations occur at various times. A sample collected on 11/21/13 included both total and dissolved metals. While the dissolved was typically less than total, a significant portion was able to pass through the filter. Surprisingly, even with a pH of 6.5, there was still 1.1 mg/L of dissolved aluminum. It is suspected that the aluminum may have been in a colloidal form. The treatment variability is most likely related to how well the limestone bed is functioning as well as flow and loading. It is possible that the large flow is inhibiting the ability of the solids to settle.

Big Run #2 Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
531 (Influent)	625	5.4	5.4	25	8	3.1	1.8	3.7	600
549 (Effluent)	480	6.1	6.5	71	-48	1.6	1.5	2.8	588

Flow in gpm; pH in standard units; Alkalinity and Hot Acidity in mg/L as $CaCO_3$; Iron (Fe), Ferrous Iron (Fe+2), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Big Run #2 Water Quality Data on 11/21/13

Sample Point	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	D. Fe	T. Mn	D. Mn	T. Al	D. Al	SO_4
531 (Influent)	6.1	5.7	38	-13	6.2	4.6	1.4	1.4	2.5	1.2	604
549 (Effluent)	6.5	6.5	69	-47	3.5	2.0	1.1	1.0	1.4	1.1	547

pH in standard units; Alkalinity and Hot Acidity in mg/L as $CaCO_3$; Iron (Fe), Ferrous Iron (Fe+2), Manganese (Mn) and Aluminum (Al) as total (T) and dissolved (D) metal concentrations in mg/L

Conclusions and Recommendations

The Big Run #2 system has consistently improved the overall water quality despite only removing a small percentage of the iron and aluminum load. Fortunately, the metal concentrations in the untreated water are not too high. The primary reason for insufficient treatment is likely that there was limited land area and lack of elevation change to build the system that would be needed to fully treat the discharge. In addition, because the flow rate is so high, the water moves quickly through the system, which reduces retention time and, therefore, treatment. The following recommendations may be able to improve treatment effectiveness.

- If possible, retrofit the limestone bed with either a siphon or Agri Drain SmartDrain (solar powered) to create an auto-flushing limestone bed. It would be beneficial to improve or replace the existing underdrain system. The retrofit will allow for more frequent flushing to occur without the need for a person to complete the task and may increase treatment by potentially increasing retention time. An Agri Drain SmartDrain will provide more control of the frequency of flushing events. A siphon flushing mechanism will be controlled by flow rate.
- If a siphon or SmartDrain is not installed, the current Agri Drain box could be replaced with a valve that could easily be opened to simplify flushing of the bed as opposed to removing/replacing the stoplogs.
- Clean/wash the stone by turning and washing during retrofit and afterwards as needed. The frequent flushing will hopefully decrease the frequency of cleaning.
- Install baffle curtains and/or filtering media to assist removing solids in wetland.
- The system would greatly benefit from additional settling capacity, but there does not appear to be room to do so.

Big Run #2 Photos





At the Big Run #2 passive system, a perforated pipe (Top Left) was installed to evenly distribute water across the width of the limestone bed. The limestone bed accumulates iron and aluminum solids (Top Right), which periodically need to be removed (Center Left) in order to maintain treatment effectiveness. The limestone bed discharges to a wetland (Center Right). The limestone bed can be flushed by removing stoplogs (Bottom Left), but could be converted into an auto-flusher by installing a siphon or SmartDrain device.

Big Run #7

Township/City: Conemaugh Township
County: Indiana
Latitude/Longitude: 40° 32' 49.9272" N 79° 25' 0.3072" W
Receiving Stream: Big Run
Watershed: Blackleggs Creek

The Big Run #7 passive system is part of a larger AMD treatment system complex within the Blackleggs Creek Watershed located in Conemaugh Township, Indiana County. The treatment system was designed by Skelly & Loy and constructed in 2006. The #7 system treats water from an abandoned underground mine. The system consists of a flushable limestone bed follow by a settling pond/channel wetland. From the settling pond, the water is combined with the effluent of the #8 system and the Big Run #7A discharge and then further treated by the Big Run #3 system, which consists of a “Sweedish” hydrated lime doser and a large settling pond/wetland. The system was visited on several occasions during the project time period for various meetings and site inspections including November 21, 2013, July 2, 2014 and May 29, 2015. Art Grguric of the Blackleggs Creek Watershed Association was on-site during each meeting to discuss the current status of the system and any issues that were occurring. The following issues were initially identified:

- The limestone bed has required periodic stirring/cleaning of the limestone due to the accumulation of metals, especially aluminum.
- In order to flush the limestone bed, all of the stoplogs must be removed.
- The #7 and #8 discharges are believed to be hydrologically connected. If flow at #8 is restricted, flow will increase at #7.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The discharge has been sampled by StreamTeam on a regular basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with high concentrations of aluminum and relatively low concentrations of iron and manganese. Flow data is very limited, but flow measurements average 400-500 gpm, with a max flow of nearly 1000 gpm. The water quality of the effluent can be described as quite variable ranging from net-alkaline with low metals to net-acidic with decreased, but significant concentrations of aluminum. The variability is most likely related to how well the limestone bed is functioning. In addition to flow rates and influent water chemistry, the functionality appears to be affected by plugging of the limestone, which needs to be cleaned on a regular basis.

Big Run #7 Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
535 (Influent)	414	3.3	3.2	0	160	2.9	2.9	17.6	526
552 (Effluent	574	4.7	4.8	49	11	0.9	2.4	8.5	520

Flow in gpm; pH in standard units; Alkalinity and Hot Acidity in mg/L as $CaCO_3$; Iron (Fe), Ferrous Iron (Fe+2), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

The effectiveness of the Big Run #7 system has been variable over the life of the system. The most common factors affecting the system appear to be the condition of the limestone bed (plugging/coating of the treatment media) and potentially high flow rates. The limestone bed has required frequent cleanings. The following recommendations may help to increase treatment performance and should reduce O&M needs.

- Retrofit the limestone bed with either siphon or Agri Drain SmartDrain (solar powered) to create an auto-flushing limestone bed. It would likely be beneficial to improve or replace the existing underdrain system. The retrofit will allow for more frequent flushing to occur without the need for a person to complete the task. An Agri Drain SmartDrain will provide more control of the frequency of flushing events. A siphon flushing mechanism will be controlled by flow rate.
- Clean/ wash the stone by turning and washing during retrofit and afterwards as needed. The frequent flushing will hopefully decrease the frequency of cleaning.
- It may be possible to add limestone to the pond to increase contact time.
- While it currently does not seem to be causing a problem, during the retrofit, it may be beneficial to move the influent flow distribution pipe to be above the stone instead of within the stone. There is the possibility of the stone becoming plugged around the perforations and preventing water from flowing into the system, which would then cause the water in the mine to back up and flow out in a different location.
- There may be a benefit to overall water quality by regularly removing sludge from the settling pond/channel wetland to increase storage capacity, which may help to settle solids.

Big Run #7 Photos




The Big Run #7 mine discharge emanates from an abandoned underground mine entry (Top Left). A pipe (Top Right) was inserted into the mine to collect and convey the discharge to the treatment system. The AMD is directed into a flushable limestone bed (Bottom Left) that is flushed by removing stoplogs inside of an Agridrain box. Due to the accumulation of iron and aluminum, the limestone has to be regularly stirred and cleaned. Converting the limestone bed to an auto-flusher may help to improve treatment and reduce maintenance. Water from the limestone bed flows into a settling pond/channel wetland (Bottom Right). The water is then conveyed to the Big Run #3 system.

Big Run #8

Township/City: Conemaugh Township
County: Indiana
Latitude/Longitude: 40° 32' 44.0016" N 79° 24' 51.9984" W
Receiving Stream: Big Run
Watershed: Blackleggs Creek

The Big Run #8 passive system is part of a larger AMD treatment system complex within the Blackleggs Creek Watershed located in Conemaugh Township, Indiana County. The treatment system was designed by Skelly & Loy and constructed in 2010. The #8 system treats water from an abandoned underground mine. The system consists of a horizontal flow limestone bed followed by a settling pond. From the settling pond, the water flows into another limestone bed (pond 3). The effluent of the limestone bed then mixes with the #7A discharge before being combined with the effluent of the #7 system. It is then further treated by the Big Run #3 system, which consists of a "Sweedish" hydrated lime doser and a large settling pond/wetland. The system was visited on several occasions during the project time period for various meetings and site inspections, including November 21, 2013, July 2, 2014 and May 29, 2015. Art Grguric of the Blackleggs Creek Watershed Association was on-site during each meeting to discuss the current status of the system and any issues that were occurring. The following issues were initially identified:

- The #8 drainage tunnel bypass valve is broken and needs repaired.
- The limestone beds regularly plug due to the accumulation of low pH iron and aluminum precipitates and require periodic stirring/cleaning of the limestone.
- The limestone beds do not have an underdrain and currently cannot be flushed.
- The #7 and #8 discharges are believed to be hydrologically connected. When the flow out of #8 is restricted due to permeability problems of the first limestone bed, flow is reported to back up in the mine and significantly increase at the #7 discharge.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The discharge has been sampled by StreamTeam on a regular basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as acidic with relatively high concentrations of iron and aluminum and relatively low concentrations of manganese. Flow data is lacking and measurements range from 1 gpm to almost 900 gpm. The effluent of pond 3 (553), which is the true effluent of the #8 system, was good for the first couple of months of monitoring and then treatment quickly declined. The water from the #8 system then is mixed with the untreated #7A discharge (monitored at point 563), which is then piped to the #3 system. Point 563 can be described as acidic with reduced but still high concentrations of metals.

Big Run #8 Water Quality Data (Average Values)

Sample Point	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
536 (Influent)	3.1	3.1	0	228	14.2	3.9	22.5	650
553 (Pond 3)	3.4	3.3	26	131	6.7	3.7	16.5	680
563 (Effluent	3.5	3.5	2	105	3.0	2.6	12.3	535

pH in standard units; Alkalinity and Hot Acidity in mg/L as $CaCO_3$; Iron (Fe), Ferrous Iron (Fe+2), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

While the Big Run #8 treatment system is not performing as desired, on average it is still removing about 80% of the iron (probably as low pH iron) and 45% of the aluminum. Based on the flow rate and severity of the water chemistry, the system is likely undersized, which is due to various construction limits, such as steep terrain, nearby stream and wetland, mine workings, etc., that reduced the amount of area to build a passive system. It might not be possible to fully treat all of the water passively at this particular site, but the following recommendations may help to improve treatment effectiveness and reduce maintenance needs.

- Fix broken valve. This could be difficult with the amount of water at the site.
- It may be possible (depending on current design, elevation, room, etc) to convert Limestone Bed #1 to an Oxidation Precipitation Channel (OPC) to promote iron removal at low pH. Might be able to move stone to create terraces or, preferably, remove a large portion of the stone and add to one of the other Big Run limestone ponds. May be able to enlarge the surface area of the OPC to maximize iron removal.
- There may be the potential (depending on funds, current design, elevation, room, etc) to convert the second Limestone Bed (Pond 3) into a flushable limestone bed using either a siphon or Agri Drain SmartDrain system. An underdrain system would need to be installed as part of the retrofit. The retrofit will allow for frequent flushing to occur without the need for a person to complete the task. An Agri Drain SmartDrain will provide more control of the frequency of flushing events. A siphon flushing mechanism will be controlled by flow rate.
- It may be possible (depending on funds, current design, elevation, room, etc) to expand Pond 3 by utilizing a portion of the settling pond/wetland (Pond 2) and adding limestone.
- Clean the limestone by turning and washing during retrofit and afterwards as needed. The frequent flushing will hopefully decrease the frequency of cleaning.
- Establish an O&M fund to pay for frequent maintenance activities.
- Measure flow rates whenever possible.
- Alternatively, the limestone beds could be converted to settling ponds and the limestone removed from Ponds 1 & 3 could be added to other Big Run ponds. There may be the possibility of either moving the Big Run #3 lime doser or adding additional chemical treatment closer to the beginning of the system to make it a completely chemical system

Big Run #8 Photos

A large collection pipe and valve (Top Left) was needed to capture the AMD for the Big Run #8 system. The valve is leaking and should be repaired. The AMD enters a limestone bed with no underdrain and plugs quickly due to low pH iron and aluminum requiring frequent cleaning (Top Right and Center Left). The water then flows into a settling pond/wetland (aka Pond 2) (Bottom Left) and then into another limestone bed (Center Right) which also frequently plugs. Plugging became such a problem that a trench was cut through the treatment media. Converting the first bed to an OPC and the second bed to a flushable limestone bed may help to improve treatment and reduce maintenance.

Big Run #3

Township/City: Conemaugh Township
County: Indiana
Latitude/Longitude: 40° 32' 50.4996” N 79° 24' 56.7" W
Receiving Stream: Big Run
Watershed: Blackleggs Creek

The Big Run #3 system is part of a larger AMD treatment system complex within the Blackleggs Creek Watershed located in Conemaugh Township, Indiana County. The treatment system was designed by Skelly & Loy and constructed in 2013. The Big Run #3 system consists of a “Sweedish” hydrated lime doser and a large settling pond/wetland and receives partially treated water from the Big Run #7 and #8 passive systems along with the untreated #7A discharge. The system was visited on several occasions during the project time period for various meetings and site inspections including November 21, 2013, July 2, 2014 and May 29, 2015. Art Grguric of the Blackleggs Creek Watershed Association was on-site during each meeting to discuss the current status of the system and any issues that were occurring. The BCWA is concerned about the long-term O&M needs and costs of the chemical system and is looking for recommendations especially in terms of potentially reducing lime usage, decreasing the amount of unreactive lime and sludge, and how best to deal with sludge storage and disposal.

Water Quality Data

A review of the limited available water quality data for the treatment system was conducted. Sampling has been conducted by StreamTeam on an approximately quarterly basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The influent to the Big Run #3 system consists of the effluent of the #7 system along with the effluent of the #8 system mixed with the untreated #7A discharge. On average, all of these sources of water are typically acidic with high concentrations of aluminum and slightly elevated concentrations of iron and manganese. The effluent of the #3 system has been on average acidic with reduced metal concentrations, but still containing significant aluminum concentrations. As dissolved samples are not typically taken, it is uncertain whether the aluminum is dissolved or solid; however, the pH of the effluent is typically less than 5, which would indicate that the aluminum is likely in the dissolved form. As this is a chemical treatment system, it is uncertain whether the system was always operational and consistently dosing lime during the sampling events. Flow data is extremely limited which also hinders further analysis of the treatment effectiveness, but available data does suggest flow at this site can exceed 1000 gpm.

Big Run #3 Water Quality Data (Average Values)

Sample Point	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
563 (#8 & 7A (influent)	3.5	3.5	2	105	3.0	2.6	12.3	535
552 (#7) (influent)	4.7	4.8	49	11	0.9	2.4	8.5	520
566 (Effluent)	4.4	4.5	3	77	0.7	2.7	10.1	550

pH in standard units; Alkalinity and Hot Acidity in mg/L as $CaCO_3$; Iron (Fe), Ferrous Iron (Fe+2), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions and Recommendations

Based on the limited data set, the Big Run #3 treatment system does not appear to be working well. It is uncertain whether lime was being dosed to the water around the time of the sampling events. One of the problems the group is facing is paying for the ongoing cost of lime, frequent site visits and maintenance. It is possible that no lime was being used during much of this time period, which would skew the evaluation. If the efficiency of Big Run #7 and #8 treatment systems can be significantly improved, it may be possible to reduce the amount of chemical used, maybe only run for a portion of the year or possibly even turn off the Big Run #3 doser permanently. One potential drawback of increasing the performance of the #7 and #8 passive systems while continuing to use the lime doser is that increasing alkalinity generation through limestone dissolution increases both bicarbonate alkalinity and dissolved calcium content within the water. Once this water contacts the lime, the alkalinity can be "destroyed" and calcium can be precipitated thereby increasing sludge without real benefit. The following recommendations may help to improve treatment effectiveness and reduce O&M needs.

- While further evaluation is needed, it may be possible to install additional passive treatment components that would reduce or eliminate the need for lime. A Jennings VFP prior to the wetland and/or a horizontal flow limestone bed at the end of the wetland could provide additional alkalinity generation and remove solids prior to discharging to the stream.
- Depending on site conditions, BioMost may be able to install a MixWell or trompe powered Air Mixer to improve lime utilization, which will result in less sludge.
- Potentially add an additional windowed baffle curtain to assist in settling solids.
- Construct a pond for sludge dewatering and storage. There may be potential to utilize a sediment basin installed at a recent nearby surface mine operation.
- There may be the potential to pump sludge into the underground mine workings, but further evaluation would be necessary.

Big Run #3 Photos

The Big Run #3 system (Top Left) receives partially treated mine water from the #7 and #8 passive systems and untreated discharge #7A. The chemical based system consists of a lime silo (Top Left) containing a "Sweedish" tipping bucket lime doser (Top Right), a mixing channel (Center Left), a settling pond with baffle curtain (Center Right) and a constructed wetland (Bottom Left). The #3 system faces a variety of O&M challenges, some of which may be addressed by improving the #7 and #8 systems as well as adding additional passive components.

Booker

Township/City: Parks Township
County: Armstrong
Latitude/Longitude: 40° 37' 5.772" N 79° 34' 18.5412" W
Receiving Stream: Carnahan Run
Watershed: Kiskiminetas River

The Booker passive treatment system is located along Carnahan Run near Vandergrift, PA in Parks Township, Armstrong County. The treatment system was designed by the Armstrong County Conservation District and was constructed in 2008. The system treats water from an abandoned underground coal mine that was emanating as a diffuse seep zone. A collection system consisting of perforated 10" PVC pipe in gravel was installed along with an open limestone channel and three ponds. A site visit was conducted on November 6, 2014 with John Linkes of the Kiskiminetas Watershed Association who provided background information. John visits the treatment system on an approximately quarterly basis to inspect the site and collect water samples for StreamTeam. A phone call was also made to Dave Beale of the Armstrong County Conservation District regarding the project. According to John Linkes and Dave Beale, the system is performing well and very little maintenance has been needed. Iron precipitates and debris were removed from the open limestone channel once. The ponds were possibly designed to be wetlands, but there are currently few, if any, plants growing in the ponds. During the conversations, it was revealed that the first pond is 3-4 feet deep while the third pond is 8-10 feet deep. Wetland plants would not be expected to flourish in that depth of water. The second pond was said to be shallow. Plantings or seeding of the second pond could be conducted.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. Flow data was not available. The discharge has been sampled by StreamTeam on a regular basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The data appears to have a few outliers that may not be related to this discharge or system. This data had been excluded from the evaluation. The discharge can be described as net-alkaline with a high concentration of iron and relatively low concentrations of manganese and aluminum. As shown in the table below, the system is removing about 85% of the total iron content. Available ferrous iron data indicates that 1 mg/L or less of the average 3.5 mg/L of total iron remaining is dissolved, meaning that typically most of the iron at the final effluent point is in the solid form and additional filtering or settling could be used to improve the water quality from the system to Carnahan Run.

Booker Water Quality Data (Average Values)

Sample Point	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	Fe+2	T. Mn	T. Al	SO_4
557 (Raw)	6.4	6.4	102	-60	22.6	21.1	0.6	0.5	397
558 (OLC)	6.6	6.7	90	-60	16.8	15.3	0.5	0.5	397
559 (Pond 1)	6.6	6.8	88	-60	13.8	11.4	0.5	0.5	388
560 (Pond 2)	6.8	6.9	81	-58	6.8	3.6	0.6	0.5	377
561 (Pond 3)	6.9	7.2	81	-61	3.5	1.1	0.7	0.5	373

pH in standard units; Alkalinity and Hot Acidity in mg/L as $CaCO_3$; Iron (Fe), Ferrous Iron (Fe+2), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

Overall the system appears to be functioning well and there are currently no known maintenance or significant treatment issues. Due to the shapes of the ponds and locations of inlets and outlets, short-circuiting may be occurring, especially during high flow events. Continue regular inspection and water monitoring of the system and complete maintenance as needed. In addition, establishment of an O&M fund for future maintenance needs is recommended. The following recommendations could be completed to try to improve treatment effectiveness.

- Planting of Pond 2 with wetland plants or seed to establish a wetland if desired. This would likely help to filter solids from the water and improve treatment.
- Installing directional baffle curtains in Ponds 1 and 3 may help reduce short-circuiting, lengthen retention time and assist in oxidation of iron and settling of solids.
- Installing windowed baffle curtains in Pond 3 may help to settle additional solids.
- Installation of a trompe or other aeration device may help to improve treatment; however, the other recommendations should be completed first as they are cheaper and easier to implement.

Booker Photos

Volunteer John Linkes regularly inspects and samples the Booker Discharge (Top Left) passive treatment system. The only maintenance needed since construction was cleaning out the limestone channel (Top Right) that conveys the discharge to treatment system. Overall the system is working well. Due to the shape of the ponds and the location of inlet and outlets, Pond 1 (Center Left) and Pond 3 (Bottom Left) may be short-circuiting. Installing directional baffle curtains to disrupt short-circuiting and windowed baffle curtains to assist with settling solids could help improve treatment. Pond 2 (Center Right) is shallow enough that wetland plants could be planted if desired, which could help with removal of iron solids.

Jamison (aka Novosel) (aka Wolford Run)

Township/City: Bell Township
County: Westmoreland
Latitude/Longitude: 40° 31' 12.756” N 79° 29' 37.932" W
Receiving Stream: Wolford Run
Watershed: Kiskiminetas River

The Jamison passive treatment system is also known as the Novosel RAMP site or the Wolford Run site. The system is located in Bell Township, Westmoreland County near Salina, PA. The system is believed to have been designed by the US Soil Conservation Service and constructed in 1994 as part of the Rural Abandoned Mineland Program (RAMP). The treatment system was designed to consist of a very small Anoxic Limestone Drain and 3 settling ponds to treat a discharge from the Jamison Mine Borehole which impacts Wolford Run, a direct tributary to the Kiskiminetas River.

A site visit was conducted on November 6, 2014 with John Linkes of the Kiskiminetas Watershed Association (KWA), who provided background information. During the site visit, Ted Weaver of Hedin Environmental also stopped by and provided information about the project. Hedin Environmental has been working on evaluating the various problems with this site since about 2005. Copies of two reports completed by Hedin Environmental regarding previous work were provided by John Linkes for review.

Reportedly, the borehole drains AMD from two connected Upper Freeport Coal underground mines. It is believed that the Jamison Mine is flooded and the Truxall Mine is unflooded. Both the ALD and the treatment ponds are significantly undersized, which is likely the primary cause of inadequate treatment. The system was likely undersized because there was little construction area available, although there were little if any design criteria available at that time. The discharge often contains aluminum, which was also likely problematic for the ALD. It appears that the ALD is no longer in use so there is currently no alkalinity-generating component.

Around 2005, the borehole was cleaned out, as it had become partially plugged and leakage was occurring. In 2012, the borehole was rehabilitated by S&T Service and Supply Inc., by installing a new 8” Schedule 40 PVC pipe within the existing 10” steel pipe and grouting around the 8” pipe. Once the pipe was fixed, head tests were conducted to determine how high the discharge could be raised in order to capture and treat the discharge at a different location to provide additional land available for construction. A sludge pond was also constructed and sludge from the three ponds was pumped and dewatered. After dewatering, the material was shipped to the Iron Oxide Recovery processing facility in Clarion County.

Jamison Water Quality Data

A review of the available water quality data for the treatment system was conducted. Very little data was found considering the system is over 20 years old. For the borehole, there were 5 samples collected in 2006, 1 in 2007, 5 in 2013, 1 in 2014, and 1 in 2015. All 8 samples for

Pond In, which is probably the effluent of the ALD, were collected in 2002 and 2003. There were only 2 samples (2014 & 2015) collected for the effluent of the system and both were collected for Stream Restoration Incorporated projects. There were 5 samples of the Airshaft, located upstream of the system, collected in 2013.

The average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The mine discharge can be described as containing alkalinity, but is net-acidic and contains high concentrations of iron with slightly elevated concentrations of manganese and aluminum. Currently the effluent of the system can be described as acidic with high concentrations of iron and slightly elevated concentrations of manganese and aluminum. The two samples of the effluent were collected under very different circumstances. The 11/6/14 sampled was collected when most of the discharge was emanating from the airshaft and therefore most of the water was bypassing the system while the 5/28/15 sample was collected under "normal" flow through conditions. Therefore, the data is skewed and likely appears to be better than actual conditions. Due to the lack of data, it is uncertain if the system was ever successful and if so, for how long.

Jamison Water Quality Data

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	T. Mn	T. Al	SO_4
Borehole	260	5.6	5.7	43	154	112.6	2.4	1.7	915
Pond In	354	5.2	5.5	54	220	124.5	2.5	3.4	1052
Pond 3	216	3.4	4.4	8	86	50.8	2.0	1.2	738
Airshaft	NA	NA	5.7	35	143	91.2	2.5	3.3	721

Flow in gpm; pH in standard units; Alkalinity and Hot Acidity in mg/L as $CaCO_3$; Iron (Fe), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

The current treatment system is not sufficient and needs to be redesigned & expanded. At the time the original system was designed there were not design criteria for ALDs and it was uncertain at that time what effect aluminum would have.

Hedin Environmental has been involved in evaluating the Jamison system since at least 2005. As part of their project, Hedin Environmental has provided the Kiskiminetas Watershed Association a preferred conceptual design consisting of a 7,821 ton ALD, 1.7 acres of settling ponds and 2 acres of wetlands with the total footprint consisting of about 7.5 acres. Three different treatment options were then developed:

- Option 1 consists of raising the water elevation of the mine pool to force the discharge to occur at a nearby airshaft at a higher elevation that would allow for the utilization of more land. This still would probably not provide the sufficient land area necessary for full treatment, but would likely provide significantly better treatment. The owner was not interested in donating the property, but at the time was willing to consider selling it.

- Option 2 would consist of piping the water by gravity flow about 5,800 feet to a 20-acre undeveloped property that would provide suitable area for a full sized passive system. Unfortunately, the landowners were not receptive.
- Option 3 proposed pumping the water to a nearby property that would provide sufficient land for a full-scale system, but the cost of pumping was estimated to be $25,000 per year. Since there is not an O&M fund available to cover these long-terms costs, this option is probably not likely. In addition, dealing with the multiple landowners could be difficult.

According to the Hedin report, Option 1 was the preferred option of the KWA and was likely the only option available due to unwilling landowners. Unfortunately, since the writing of that report, the landowner for Option 1 has died and those who are now in charge of the estate are not currently interested. The future of the project is uncertain.

If Option 1 were to occur, there would be a need to closely monitor the system and the mine pool elevation. Even if a good initial water level is established within the mine at the time of construction, plugged pipes and reduced permeability of the treatment media could result in increasing the water elevation of the mine pool. We would encourage the installation of at least one monitoring well that would allow for the monitoring of the mine pool to make sure that the water elevation of the pool is not raised to the point that would cause a “blow out” or for the mine water to discharge at a different location.

Hedin Environmental is proposing an ALD due to the limited construction area, high iron concentrations, and alkalinity production needed. There is concern that the aluminum could pose a potential problem, which may result in increased maintenance compared to a typical ALD. The Hedin design did acknowledge this concern and recommended that 2 ALDs be installed, which would allow for one to operate while the other one is rehabilitated. Since the aluminum concentrations are not that high (max ~4 mg/L), and available options are lacking, this seems to be a reasonable approach. Including the ability to flush the system may also be beneficial. Due to the current landowner situation, it may not be possible to expand the existing passive system at all. A chemical treatment system could potentially be installed; however, a long-term maintenance fund and a dedicated person to maintain the system would be needed. No calculations were performed under this evaluation to determine if the existing ponds would provide enough capacity for a chemical system.

Jamison Photos




The Jamison Borehole discharge (Top Left) on this day was being controlled and the flow rate significantly reduced, which caused most of the flow to emanate at an old airshaft (Bottom Right). Under normal flow conditions, the AMD enters three settling ponds (Top Right and Bottom Left) which are undersized and do not have an alkalinity-generating component, allowing for little treatment to occur.

Kolb

Township/City: Young Township
County: Indiana
Latitude/Longitude: 40° 34' 45.9984" N 79° 20' 21.9984" W
Receiving Stream: Blackleggs Creek
Watershed: Kiskiminetas River

The Kolb passive treatment system is located in Young Township, Indiana County and is part of the Blackleggs Creek Memorial Park, which was dedicated to the memory of Blackleggs Creek Watershed volunteers. The park includes a pavilion, picnic tables, trail and access to fishing. The treatment system was designed by Skelly & Loy and constructed in 2001 to treat an underground mine discharge before flowing into Blackleggs Creek. The system consists of a collection and piping system which conveys the water to the system and then out through a very large cascading aeration fountain that is followed by 2 settling ponds with baffle curtains. A site inspection of the Kolb treatment system was conducted on November 6, 2014. No obvious major issues were noted. The system did appear to be too small for such a large flow. In addition, a field pH at the end of the system with high alkalinity along with a difference between field and lab pH data indicates that the pH is being suppressed by dissolved CO_2, which can inhibit iron oxidation rates.

Water Quality Data

A review of the available water quality data for the treatment system was conducted. The discharge has been sampled by StreamTeam on a regular basis. Average water quality data for select parameters is provided in the table below. Individual sample dates and additional parameters are available on Datashed (www.datashed.org). The discharge can be described as net-alkaline with slightly elevated iron concentrations and relatively low manganese and aluminum concentrations; however, due to the high flow rate there is a high loading of almost 40 lbs/day of iron. The effluent of the system is on average the same, but with reduced iron concentrations. On average, the system is removing about 45% of the total iron load. While dissolved (filtered) samples were not typically collected, available ferrous iron (Fe^{+2}) indicates that about 60% of the remaining iron in the final effluent is likely to be in the solid form and needs additional settling or filtering. A sample of the effluent was collected on 11/6/14, which included both total and dissolved metals. In that sample, total iron was 1.8 mg/L and dissolved iron was 0.1 mg/L. This also indicates that at least on that date, the system had enough retention time for the chemical reactions to take place, but needed additional settling or filtering to remove the solids.

Kolb Water Quality Data (Average Values)

Sample Point	Flow	Field pH	Lab pH	Alkalinity	Acidity	T. Fe	Fe^{+2}	T. Mn	T. Al	SO_4
514 (Influent)	815	6.5	6.9	254	-154	4.4	4.2	0.6	0.4	380
515 (Effluent)	800	6.7	7.4	248	-160	2.8	1.2	0.6	0.4	350

Flow in gpm; pH in standard units; Alkalinity and Hot Acidity in mg/L as $CaCO_3$; Iron (Fe), Ferrous Iron (Fe^{+2}), Manganese (Mn) and Aluminum (Al) as total metal concentrations in mg/L

Conclusions & Recommendations

While the Kolb system is removing a large amount of iron, a significant iron load is still entering the stream. In order to improve treatment, the system could likely be expanded into the neighboring field to provide additional iron precipitation and settling/filtration of solids. Constructing a wetland utilizing persistent vegetation such as cattails is recommended to provide filtering capabilities throughout the year. Haybales and/or filter fence could also be potentially used in places. Installing a trompe may be helpful in providing additional aeration and CO_2 degassing to increase iron oxidation rates, especially if the system cannot be expanded into the adjacent field. Installing additional windowed baffle curtains in strategic locations may also help to promote settling of solids. As flow data is generally lacking, an effort should be made to measure flow every time samples are collected in at least one location.

Update

The BCWA has applied for and received funding to expand the treatment system.

Kolb Photos

At the Kolb passive system, a large underground mine discharge has been collected and conveyed by pipe to two aerobic settling ponds in series. A large fountain (Left) was installed to provide aeration and degassing of CO_2 to promote oxidation of dissolved iron, while baffle curtains (Right) were installed to help settle solids. The treatment system would benefit from being expanded to include a constructed wetland and using persistent vegetation.

General Conclusions and Recommendations

One of the project deliverables desired by the Foundation for Pennsylvania Watersheds was for Stream Restoration Incorporated to develop generalized conclusions and recommendations regarding and based upon the passive systems within the Kiski-Conemaugh Basin. The following generalized conclusions and recommendations are those of the author(s) and do not necessarily reflect the views and opinions of the Foundation for Pennsylvania Watersheds.

Conclusions

1. Passive treatment systems can be a very effective tool for the treatment of acid mine drainage and the restoration of AMD impacted streams **IF** properly designed, constructed, and maintained.
2. Passive treatment systems are not “no maintenance” solutions to AMD, but generally have much lower maintenance needs than conventional active or “semi-active” chemical based systems.
3. Passive treatment will continue to be a developing technology. Some of the systems that have “failed” are systems that were constructed during the early stages of technological development when there were fewer options and less knowledge and understanding of the complex physical and biogeochemical processes. In addition, much experimentation took place where treatment system designs that “looked good on paper” were not as successful in practice. These lessons learned have resulted in a much better understanding of passive treatment, which in turn has led to better designs.
4. Poor water quality from a passive treatment system is not necessarily indicative of a “failure” of passive treatment, but is often an indicator of needed maintenance and spent treatment media.
5. Another common cause of poor water quality is an undersized treatment system. This is often due to one of several reasons such as: lack of representative chemistry and **flow** data used in the design; site conditions that limit the amount of land area available for construction such as streams, roads, wetlands, steep terrain, property lines; a lack of elevation change that prevents the appropriate technology being used; and lack of sufficient funding that leads to building smaller systems or taking “short-cuts” to meet a smaller-than-needed budget.
6. In some cases the systems do not work properly because of poor design and/or construction issues.
7. In many instances, passive systems that have “failed” or that have stopped performing as desired, can be rehabilitated through maintenance activities. Activities such as removing precipitates & debris off the top or inlet side of the system, unclogging pipes, eliminating short-circuiting pathways, fixing broken pipes, stirring and/or washing/cleaning the treatment media, etc., are all techniques that can be utilized to restore treatment performance. In other cases, the treatment media may be spent and in need of replacement.
8. Rehabilitating treatment media saves money and natural resources by eliminating the need to remove, discard and replace the treatment media.
9. Maintenance needs will vary from system to system depending upon water quality, flow, treatment technology, design, etc. Some systems may need yearly or even quarterly

maintenance to maintain treatment effectiveness while others may function for many years with little to no maintenance.

10. While the AMD Passive Treatment Risk Matrix used by the PA DEP & US OSM is correct in the assumption of identifying mine discharges that have higher metal concentrations and flow rates as being more difficult to treat and likely requiring increased maintenance, the matrix does not accurately predict the likelihood of success or the ability of a specific passive system design to treat a particular mine discharge. Much of what determines the success of the system depends upon being properly designed, constructed and maintained. There have been many successful passive systems built throughout Pennsylvania that would be determined by this matrix to be a high risk and possibly not funded.
11. Often it is not necessary to obtain 100% treatment and produce net-alkaline water to make a substantial improvement in the watershed. There is a need to recognize that in relation to watershed restoration that doing something is usually better than doing nothing. Or to put it another way, do not let the perfect get in the way of the good.
12. The removal of coal refuse for use as fuel in Circulating Fluidized Bed(CFB) power plants is an excellent strategy for addressing AMD issues especially when the alkaline CFB ash is then used to help reclaim the site. In some instances, AMD discharges have been nearly eliminated or at the very least greatly diminished.
13. There are numerous orphaned samples (water sample laboratory data that has not been linked to its named sample point) within the Pennsylvania DEP SIS database, which prevents people from easily finding the data, which was a hindrance to completing this project. This has also caused a problem with importing the data into Datashed. Well-managed and readily available data helps to develop more effective restoration strategies.

Recommendations

1. It is important that AMD treatment systems be designed by professionals who possess the necessary knowledge, background and experience.
2. Treatment systems need to be fully funded whenever possible to ensure that the complete system is properly constructed to provide optimal treatment and avoid budget-driven “short-cuts”.
3. Treatment systems should be regularly monitored and inspected in order to document water treatment effectiveness and identify maintenance needs. An O&M plan should be created for every passive treatment system. Ideally, passive treatment systems should be inspected and monitored on a monthly basis, but at least quarterly at a minimum. “Semi-active” chemical treatment systems including lime dosers, Aquafix wheels, etc., should be monitored & inspected at least twice per week if not more frequently.
4. The most sustainable option to conduct monitoring and inspection of passive treatment systems is the use of dedicated, well-trained, locally-based watershed organization volunteers. Supervision of these volunteers by an individual experienced with water monitoring and inspection of passive treatment systems and who can evaluate the data is also recommended. However, a reliable volunteer program is not always available. In those cases, nonprofit organizations with paid professional staff or contracted consultants may, in the long run be more efficient, reliable, consistent, and produce better results.

5. Water monitoring should at a minimum consist of the use of field kits and other equipment to measure pH, alkalinity, iron, and flow. Ideally water samples should be collected for laboratory analysis on a regular basis (2-4 times per year). Funding for monitoring should be made available.
6. Flow rates are critical to both designing and evaluating passive systems. Flow should be measured during every monitoring event wherever possible.
7. Water monitoring data needs to be compiled, made easily accessible, and reviewed on a regular basis. Ideally the data and treatment system should be placed in an on-line database such as Datashed (www.datashed.org) to provide easy public access and a permanent record/history of the site.
8. Passive treatment systems must be properly maintained to ensure long-term treatment.
9. Technical Assistance and capacity building programs like WPCAMR's Quick Response and Stream Restoration Incorporated's Operation & Maintenance programs should continue to be funded to provide much-needed assistance to watershed groups. A number of systems within the Kiski basin have directly benefited from these various programs.
10. Operation, Maintenance and Rehabilitation (OM&R) funds need to be made available to watershed groups, nonprofits, and conservation districts to maintain their existing passive treatment systems. We further recommend creating OM&R trust funds for both existing and new passive treatment systems. OM&R trust funds should be sufficiently funded to pay for field kits, laboratory water analyses, monitoring and inspection labor costs when necessary, travel expenses, maintenance costs, and replacement costs. Ideally, when a system is constructed, the funding agency should provide additional funds that can be set-aside and invested without restrictions to perpetually fund OM&R. Through an investment plan, there will be significant savings if the money is set-aside at time of construction as opposed to waiting till the funds are needed.
11. The OM&R funds should be placed in privately held accounts that are dedicated to a specific site or watershed and managed by stable nonprofit organizations whose missions are dedicated to watershed restoration and who have knowledge of both design and maintenance of passive treatment systems. Stable watershed groups could manage/control their very own trust funds so that they would have access to their funds for their systems when they need it.
12. Prior to replacement of treatment media, an attempt should first be made to rehabilitate the media by removing layers of precipitates & debris off the top of the media as well as stirring, washing/cleaning, etc. as appropriate. This is important in order to both reduce the use of natural resources as well as save money.
13. Whenever feasible, metals from mine drainage treatment sludge should be recovered and used.
14. Funding should continue be made available to assist in research and development of methods to recover and use metals from mine drainage treatment sludge.
15. When building a treatment system in coal refuse, it is recommended that the system be properly lined with appropriate materials such as on-site clay, bentonite, or synthetic liners.
16. Remove and reclaim coal refuse piles whenever possible to eliminate/decrease the source of AMD preventing or at least decreasing the need for additional treatment.
17. Fix the SIS orphaned data problem and take actions to prevent orphaned data from occurring in the future.

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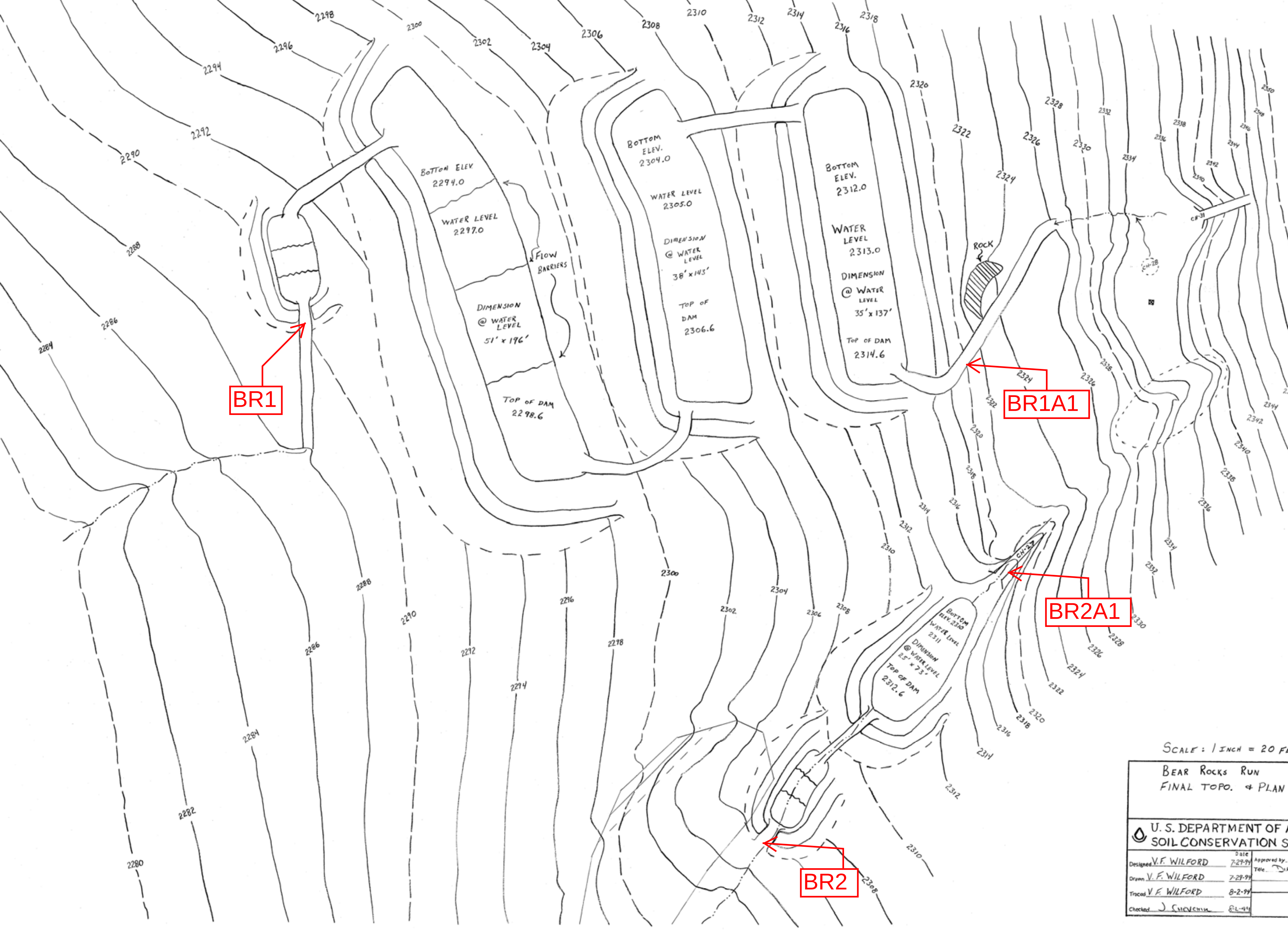
The Stonycreek, www.thestonycreek.com

Appendix A: Site Schematics

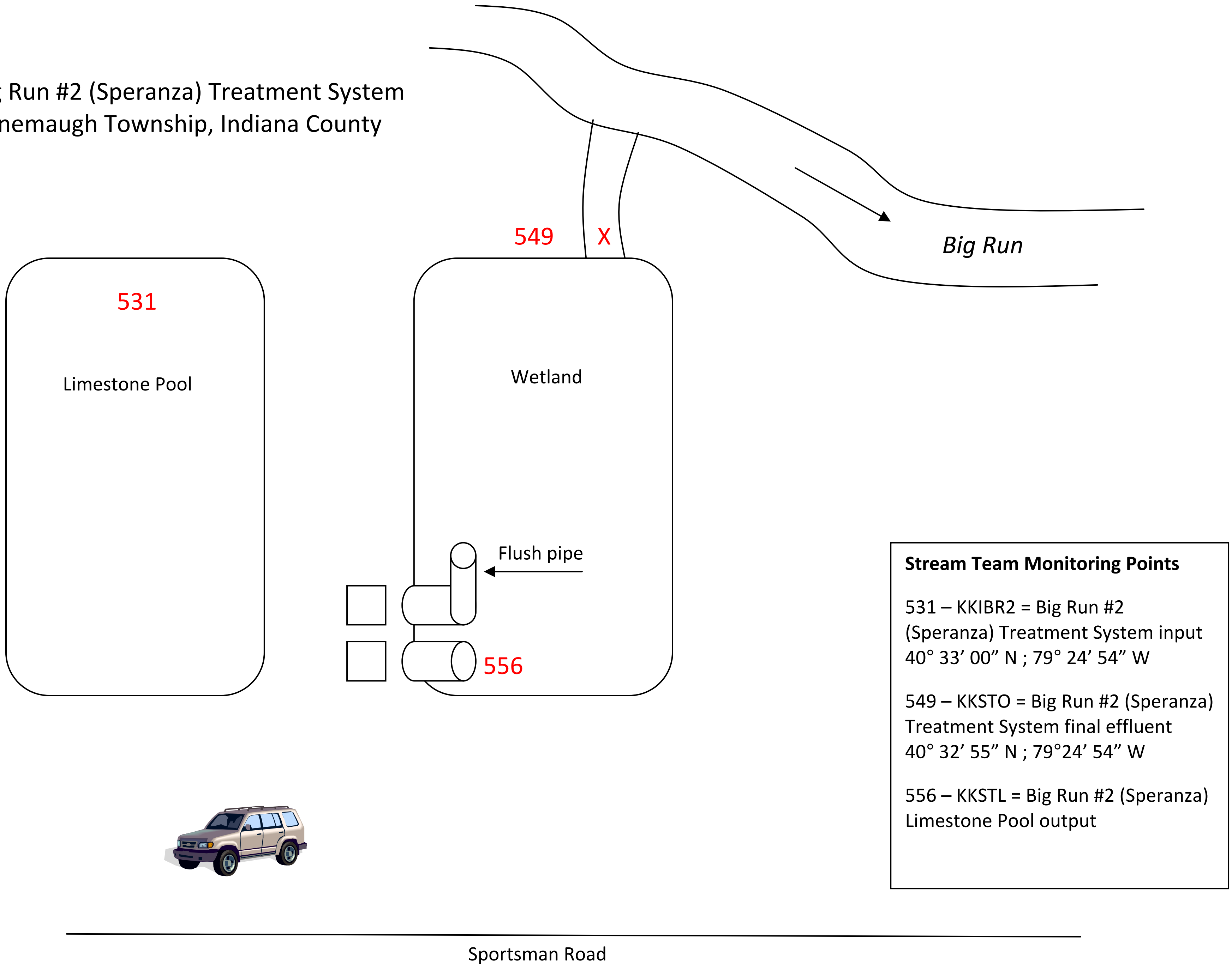
AMD & ART
VINTONDALE PASSIVE TREATMENT SYSTEM

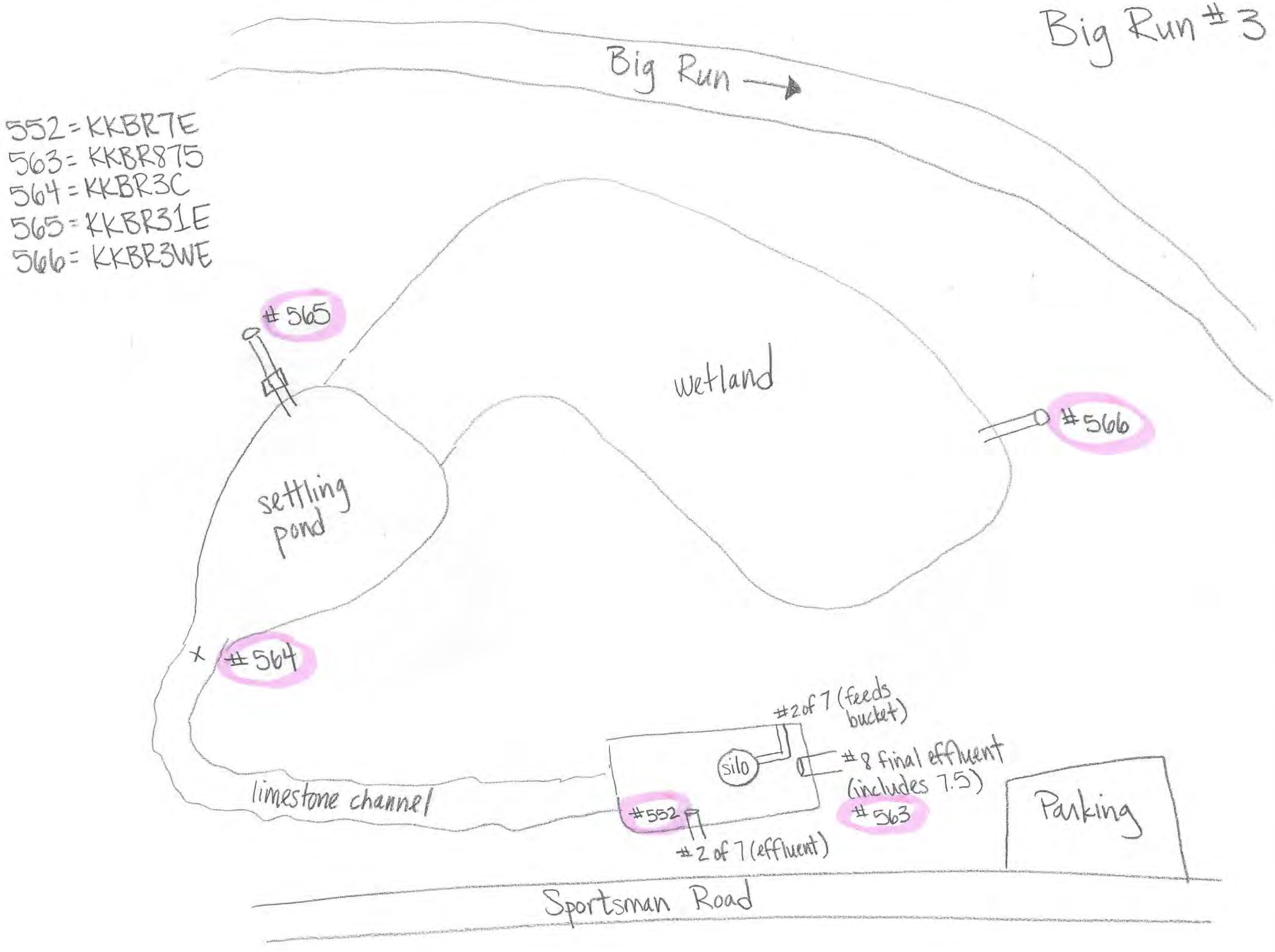
Prepared By The Blacklick Creek Watershed Association, 09/09

Bear Rock Run



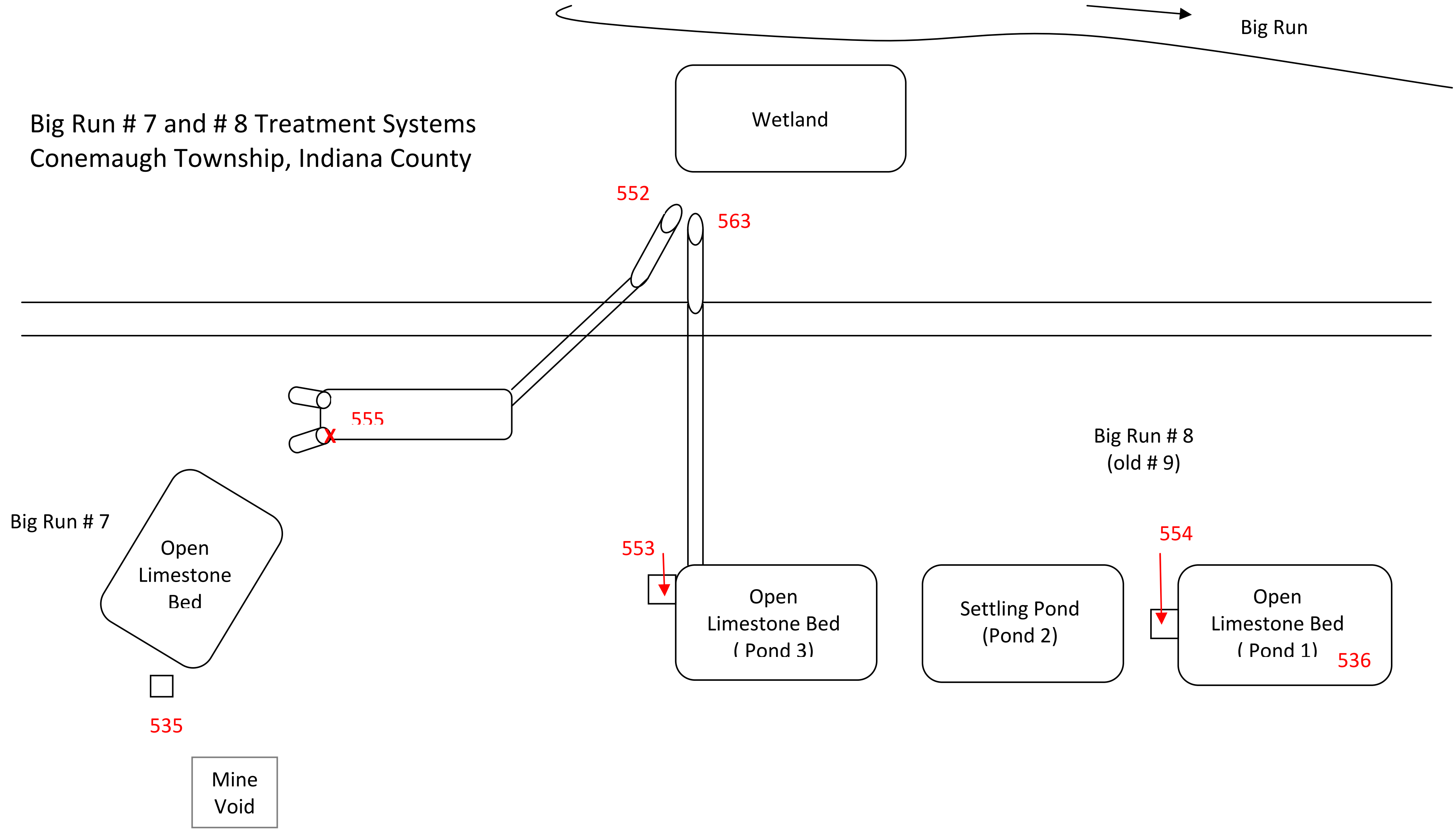
Big Run #2 (Speranza) Treatment System
Conemaugh Township, Indiana County





Big Run #3
Big Run
552 = KKBR7E
563 = KKBR875
564 = KKBR3C
565 = KKBR31E
566 = KKBR3WE
#565
wetland
#566
settling pond
#564
#2 of 7 (feeds bucket)
silo
#8 final effluent (includes 7.5)
limestone channel
#552
#563
Parking
#2 of 7 (effluent)
Sportsman Road

Big Run # 7 and # 8 Treatment Systems
Conemaugh Township, Indiana County



Stream Team Monitoring Points

535 – KKIBR7 = Big Run Discharge # 7
40° 32’ 50” N ; 79° 25’ 04” W

555 – KKBR7L = Output of Big Run # 7 limestone pool
40° 32’ 49.6” N ; 79° 24’ 58.8” W

552 – KKBR7E = Big Run # 7 Treatment System final effluent
40° 32’ 48” N ; 79° 24’ 58” W

Stream Team Monitoring Points

536 – KKIBR9 = Big Run Discharge # 9 (new #8)
40° 32’ 44” N ; 79° 24’ 52” W

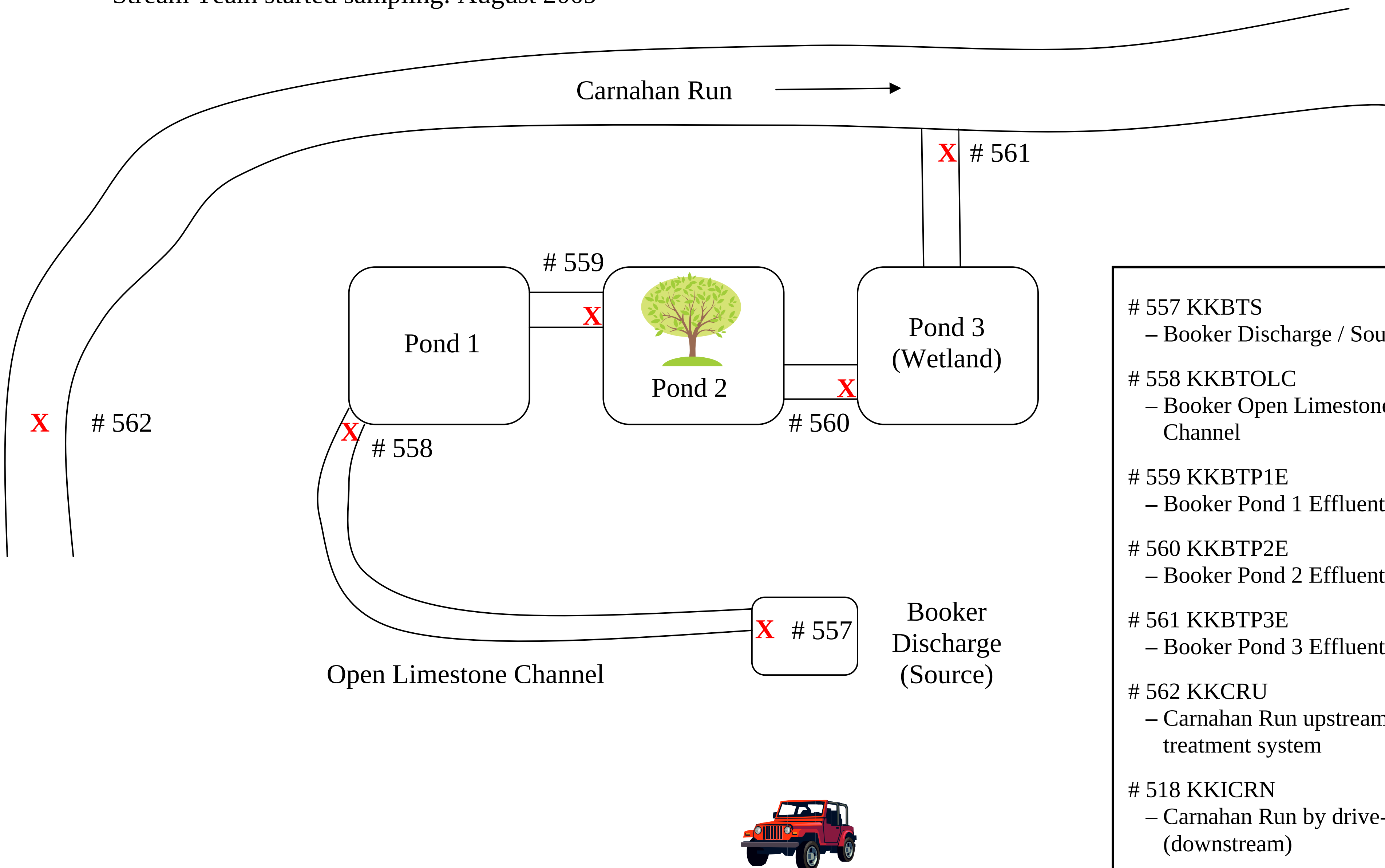
554 – KKBR9L = Output of Big Run #8 limestone pool
40° 32’ 41.6” N ; 79° 24’ 51.5” W

Stream Team Monitoring Points

553 – KKIBR9E = Effluent of Big Run #8 Treatment (Pond 3 effluent)
40° 32’ 45.1” N ; 79° 24’ 54.2” W

563 – KKBR875 = Big Run #8 Treatment System effluent and discharge 7.5
40° 32’ 40.8” N ; 79° 24’ 45.3” W

Booker Treatment System
Parks Township, Armstrong County
Vandergrift Quad
Stream Team started sampling: August 2009



557 KKBTS
– Booker Discharge / Source

558 KKBTOLC
– Booker Open Limestone Channel

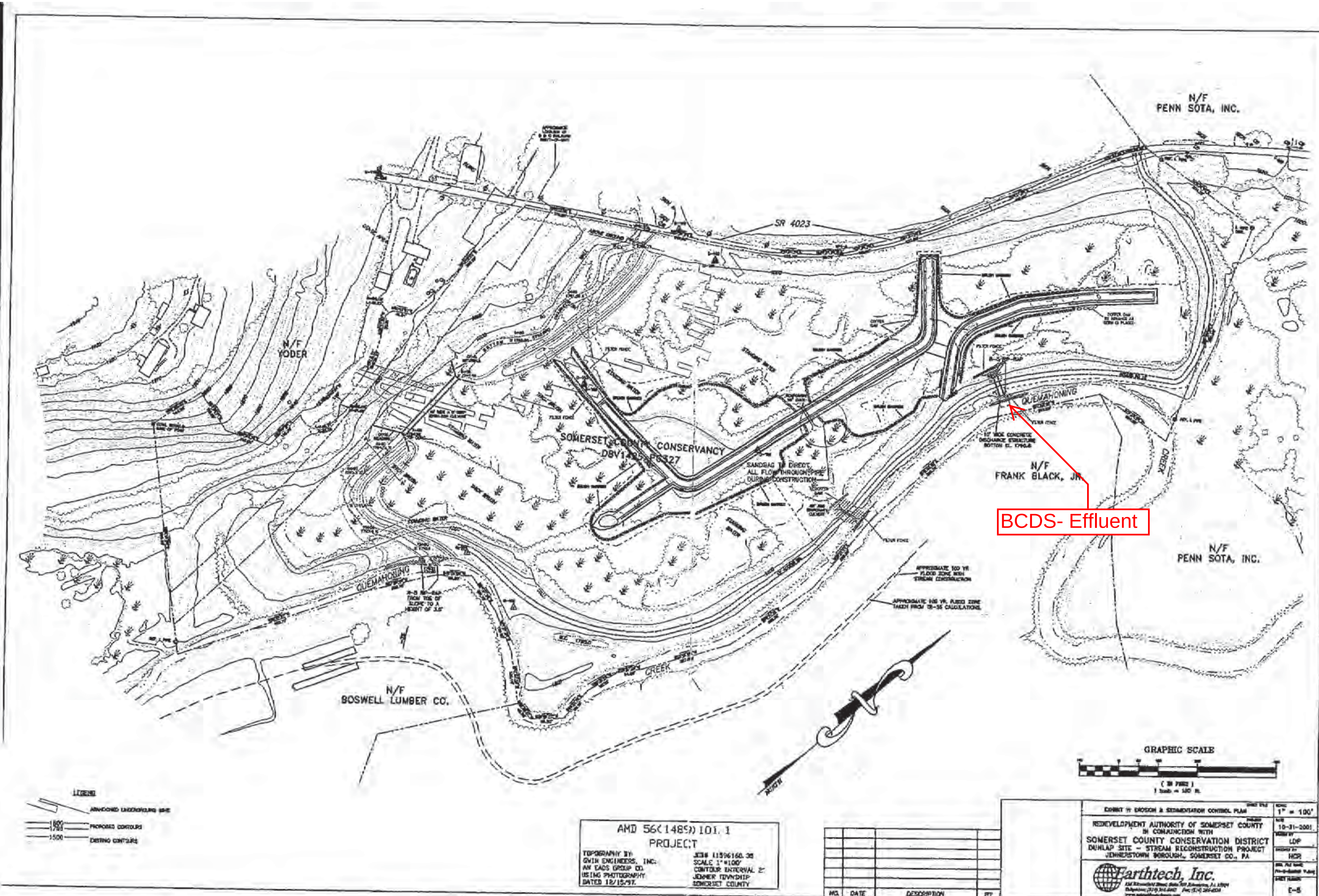
559 KKBTP1E
– Booker Pond 1 Effluent

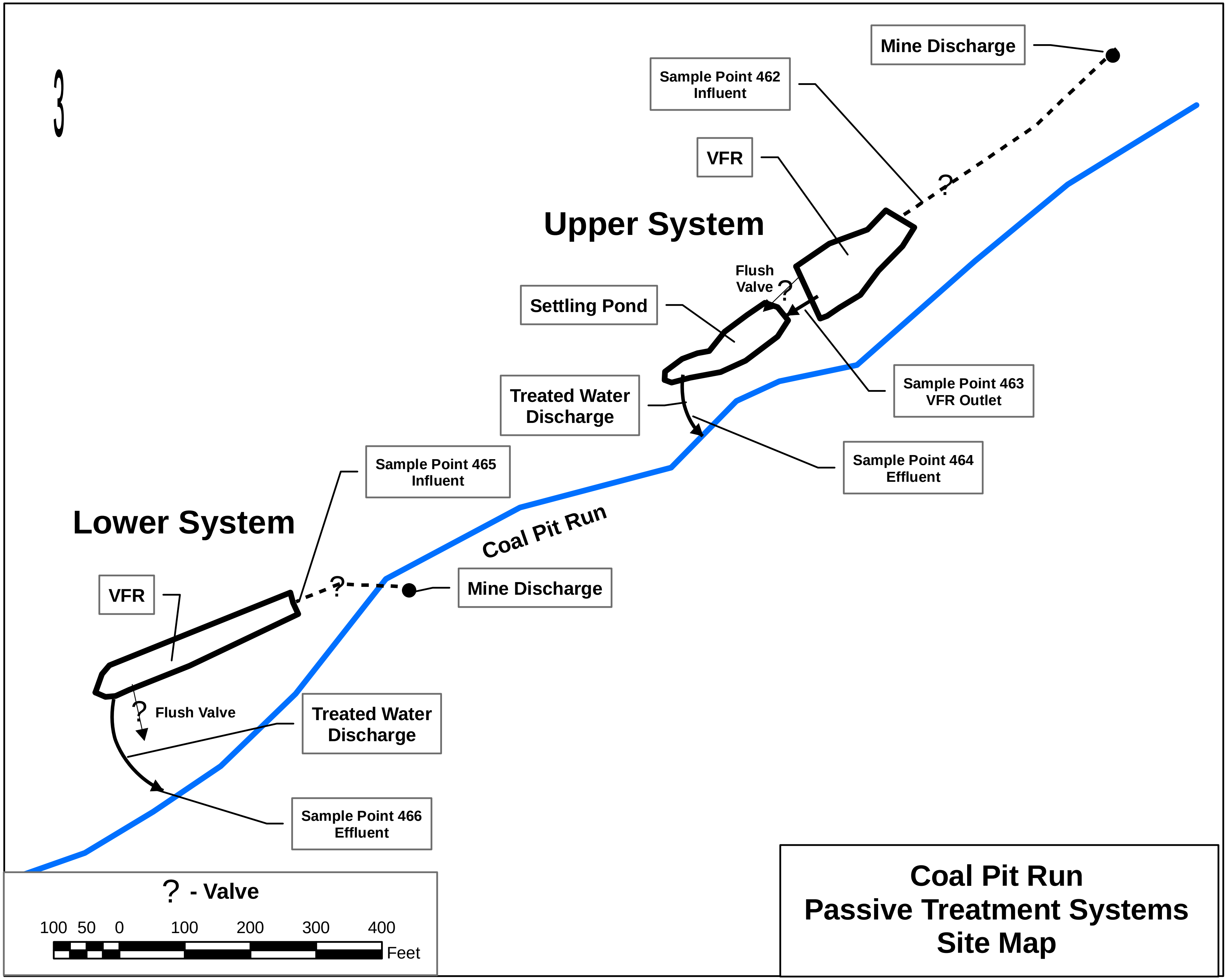
560 KKBTP2E
– Booker Pond 2 Effluent

561 KKBTP3E
– Booker Pond 3 Effluent

562 KKCRU
– Carnahan Run upstream of treatment system

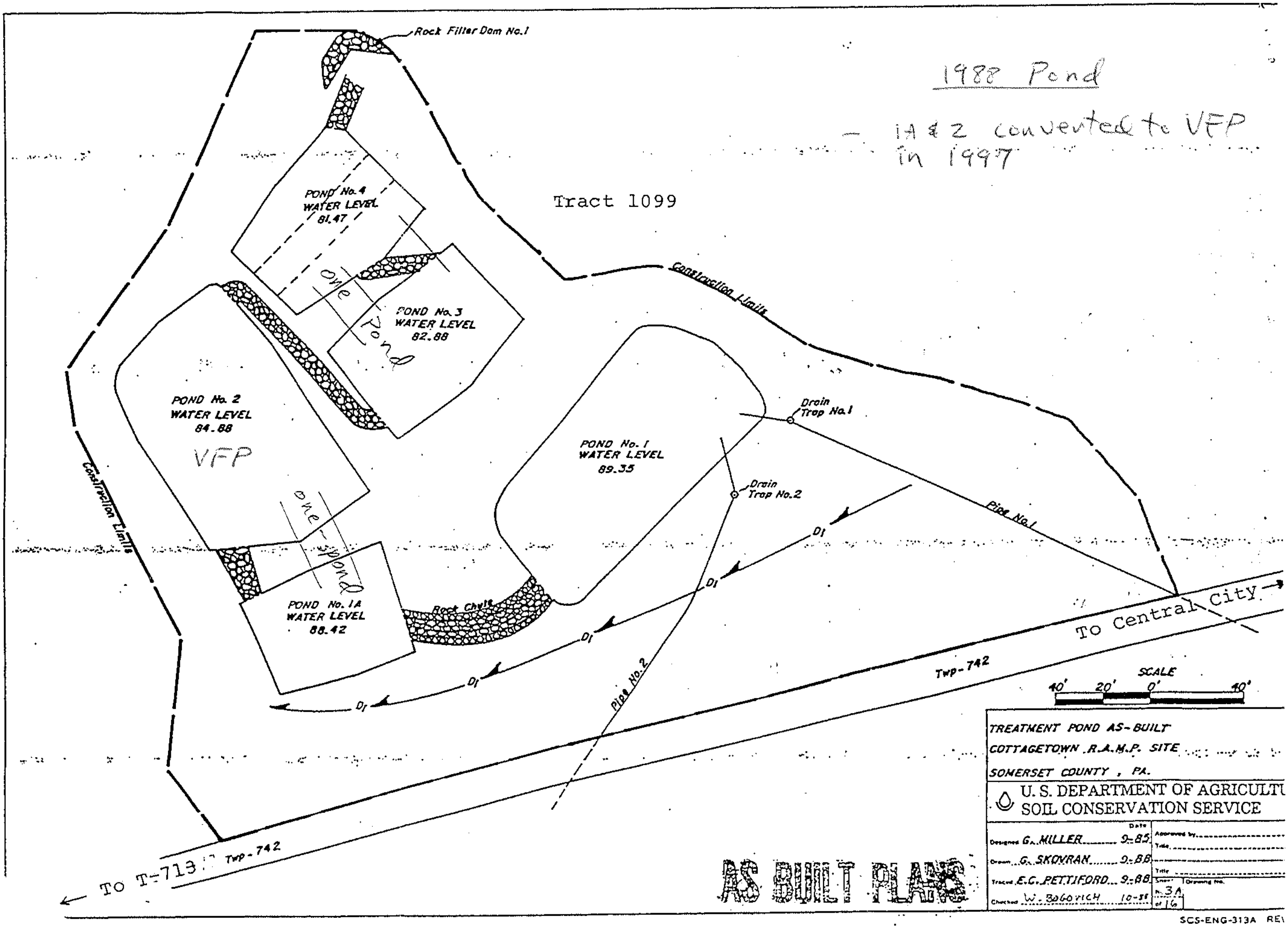
518 KKICRN
– Carnahan Run by drive-in (downstream)

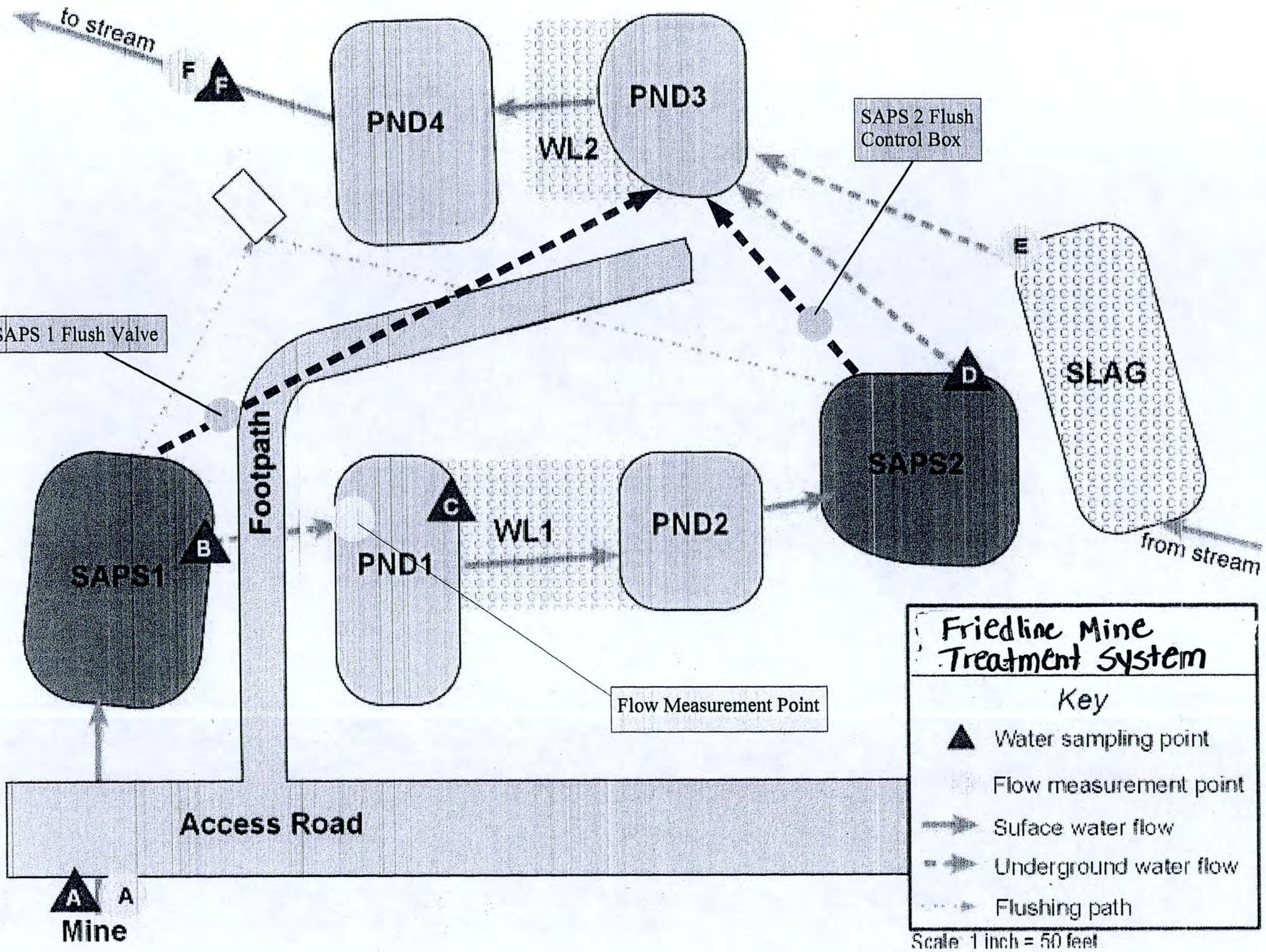

N/F
PENN SOTA, INC.
SR 4023
N/F
YODER
SOMERSET COUNTY CONSERVANCY
SANDBAG TO DIRECT ALL FLOW THROUGH PIPE DURING CONSTRUCTION
QUEMAHONING
N/F
FRANK BLACK, JR.
BCDS- Effluent
N/F
PENN SOTA, INC.
CREEK
QUEMAHONING
CREEK
N/F
BOSWELL LUMBER CO.
GRAPHIC SCALE
AMD 56(1489)101.1
PROJECT
TOPOGRAPHY BY:
GWIN ENGINEERS, INC.
AN EADS GROUP CO.
USING PHOTOGRAPHY
DATED 12/15/97.
JOB# 11596160.38
SCALE 1"=100'
CONTOUR INTERVAL 2'
JENNER TOWNSHIP
SOMERSET COUNTY
NO.
DATE
DESCRIPTION
BY
REDEVELOPMENT AUTHORITY OF SOMERSET COUNTY
IN CONJUNCTION WITH
SOMERSET COUNTY CONSERVATION DISTRICT
DUNLAP SITE - STREAM RECONSTRUCTION PROJECT
JENNERSTOWN BOROUGH, SOMERSET CO., PA
Earthtech, Inc.
1" = 100'
10-31-2001
LDP
HCR
E-5



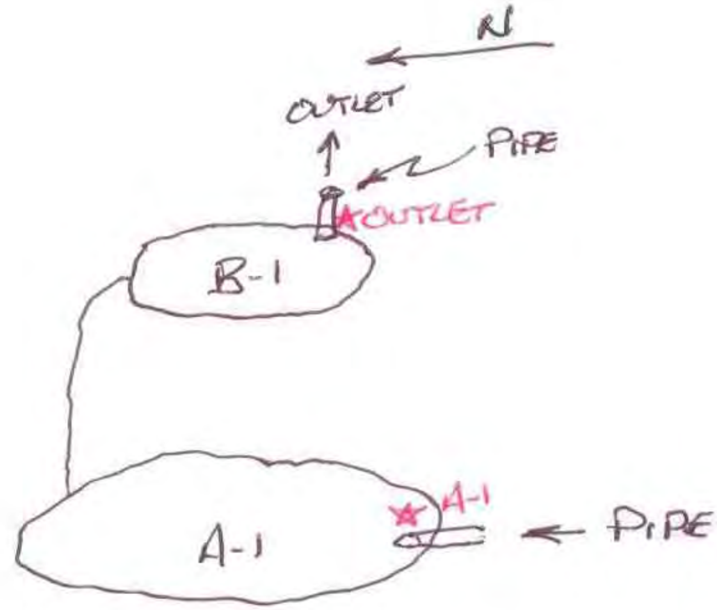
Coal Pit Run
Passive Treatment Systems
Site Map

Prepared by the Blacklick Creek Watershed Association, 08/09


1988 Pond
- 1A & 2 converted to VFP in 1997
Tract 1099
Rock Filter Dam No. 1
POND No. 4 WATER LEVEL 81.47
POND No. 3 WATER LEVEL 82.88
one Pond
POND No. 2 WATER LEVEL 84.88
VFP
one pond
POND No. 1A WATER LEVEL 88.42
POND No. 1 WATER LEVEL 89.35
Construction Limits
Drain Trap No. 1
Drain Trap No. 2
Pipe No. 1
Pipe No. 2
Rock Chute
To Central City
Twp-742
To T-713
SCALE
40' 20' 0' 40'
TREATMENT POND AS-BUILT
COTTAGETOWN R.A.M.P. SITE
SOMERSET COUNTY, PA.
U. S. DEPARTMENT OF AGRICULTU
SOIL CONSERVATION SERVICE
Designed G. MILLER 9-85
Drawn G. SKOVRAN 9-88
Traced E.C. PETTIFORD 9-88
Checked W. BOGOVICH 10-88
Approved by
Sheet 3A of 16
AS BUILT PLANS
SCS-ENG-313A REV


to stream
F
F
PND4
WL2
PND3
SAPS 2 Flush
Control Box
E
SAPS 1 Flush Valve
SLAG
D
SAPS2
Footpath
C
B
SAPS1
PND1
WL1
PND2
from stream
Flow Measurement Point
Access Road
A
A
Mine
Friedline Mine
Treatment System
Key
Water sampling point
Flow measurement point
Suface water flow
Underground water flow
Flushing path
Scale 1 inch = 50 feet

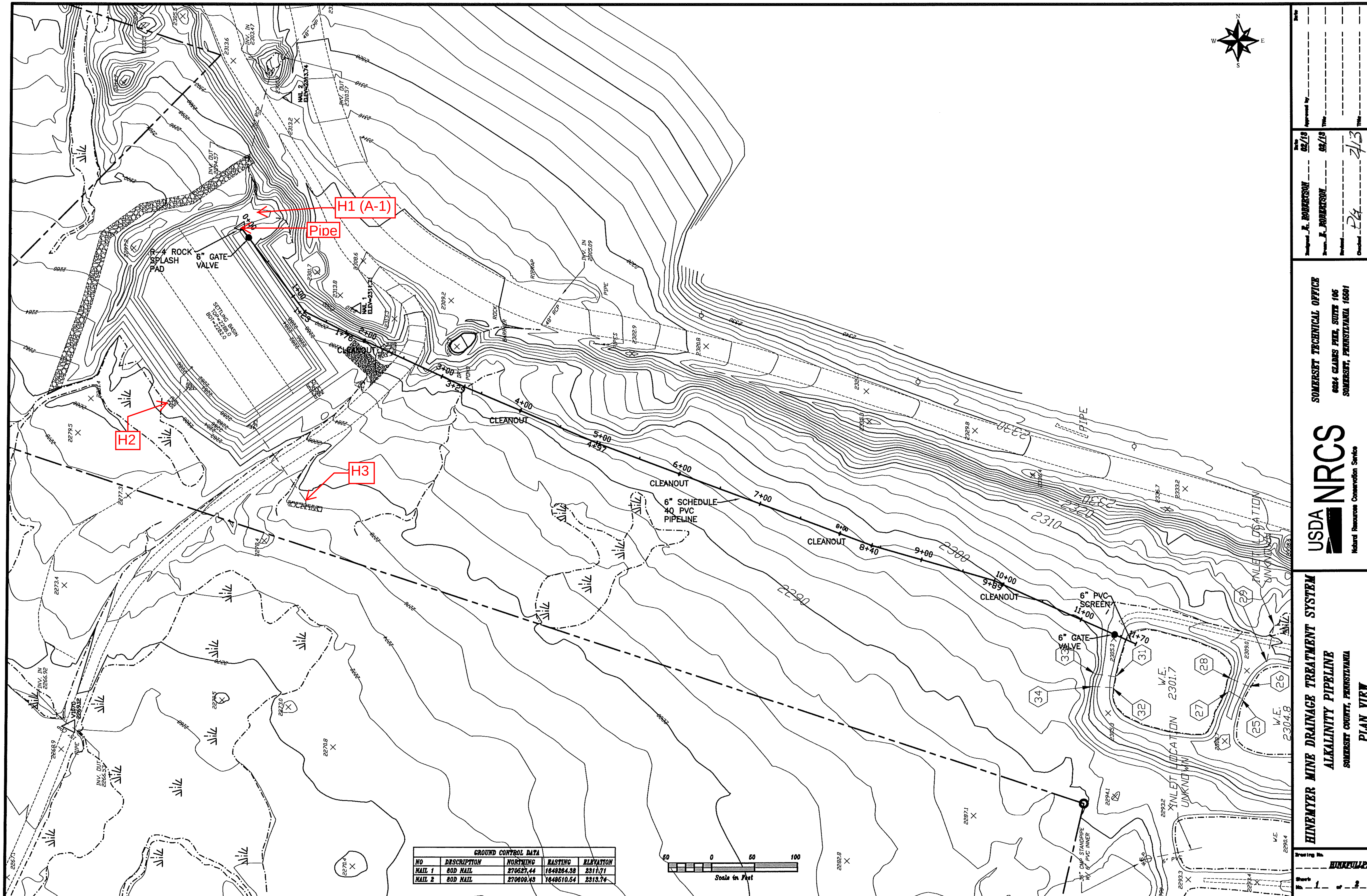
GREY RUN



★ SAMPLE POINT

N 40° 20' 27.2"
W 78° 58' 26.3"

JOHNSTOWN TURN RIGHT OFF ST. CLAIR ROAD ONTO SONS OF ITALY RD. PARK AT PROJECT SIGN. GO THRU GATE ON LEFT APPROX. 100 YDS. FENCE AROUND POND A-1



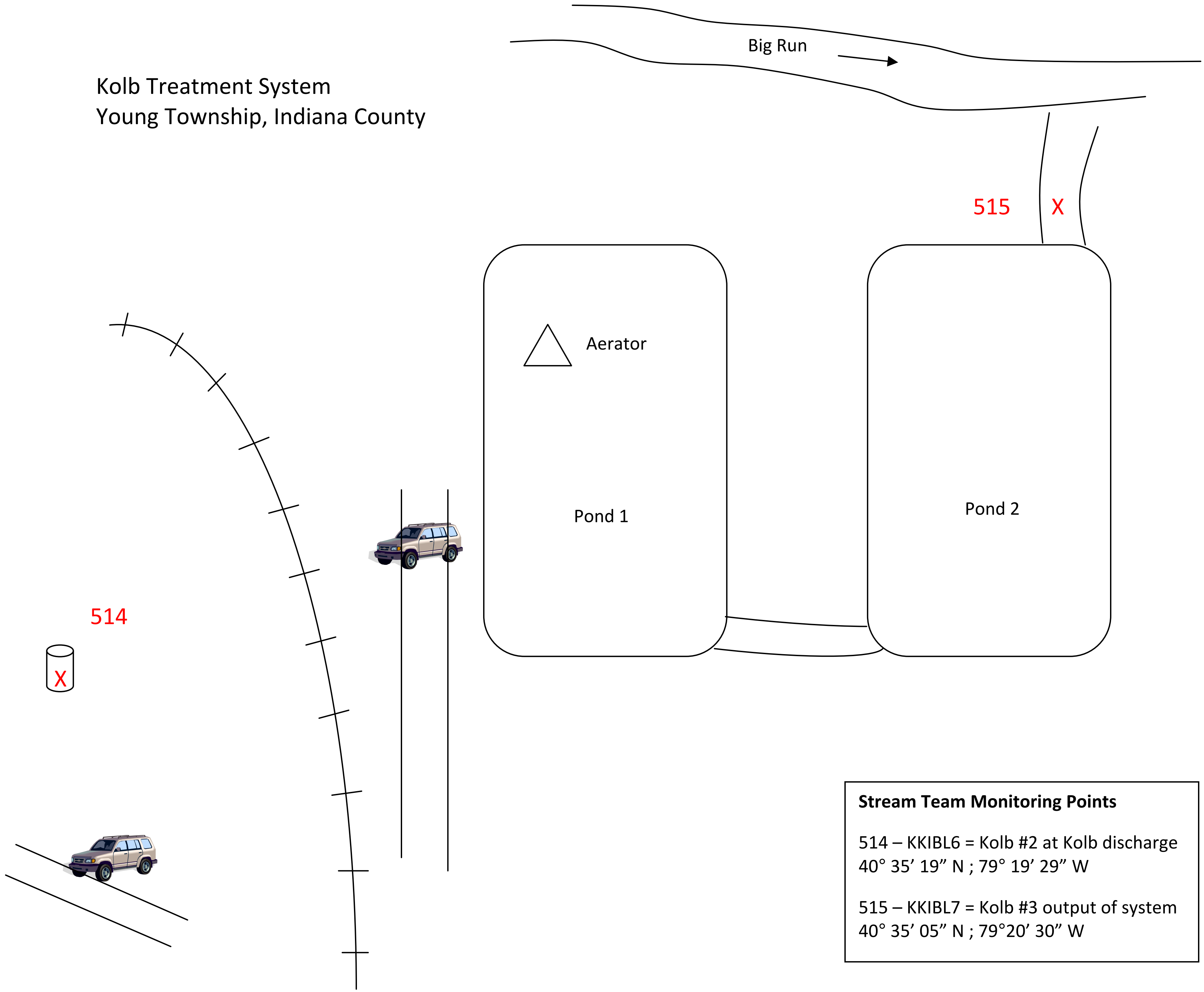
GROUND CONTROL DATA				
NO	DESCRIPTION	NORTHING	EASTING	ELEVATION
NAIL 1	80D NAIL	270527.44	1649264.38	2311.71
NAIL 2	80D NAIL	270609.43	1649510.54	2313.74

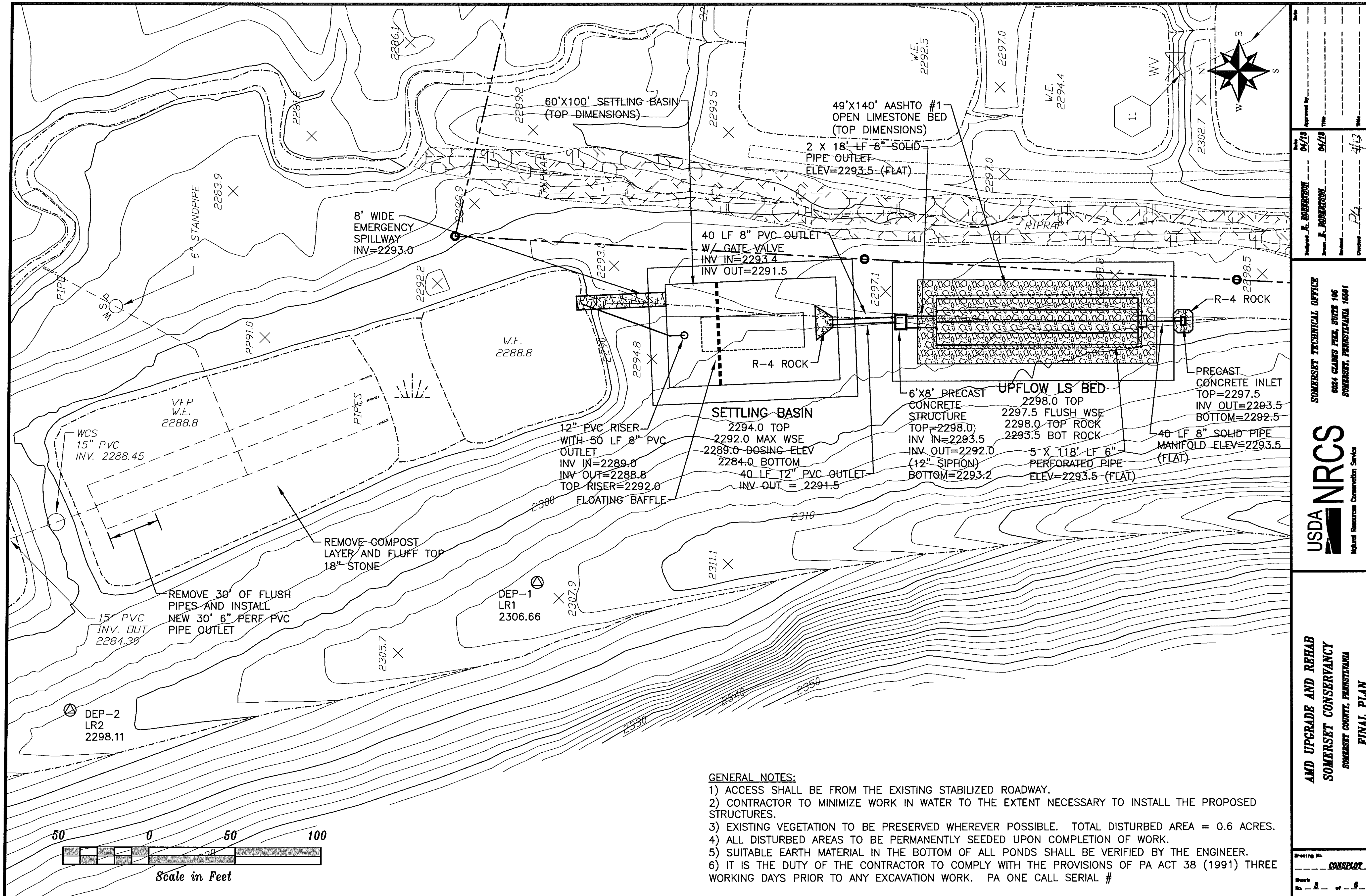
Jamison Mine (Novassel Ramp) (Wolford Run) Passive System

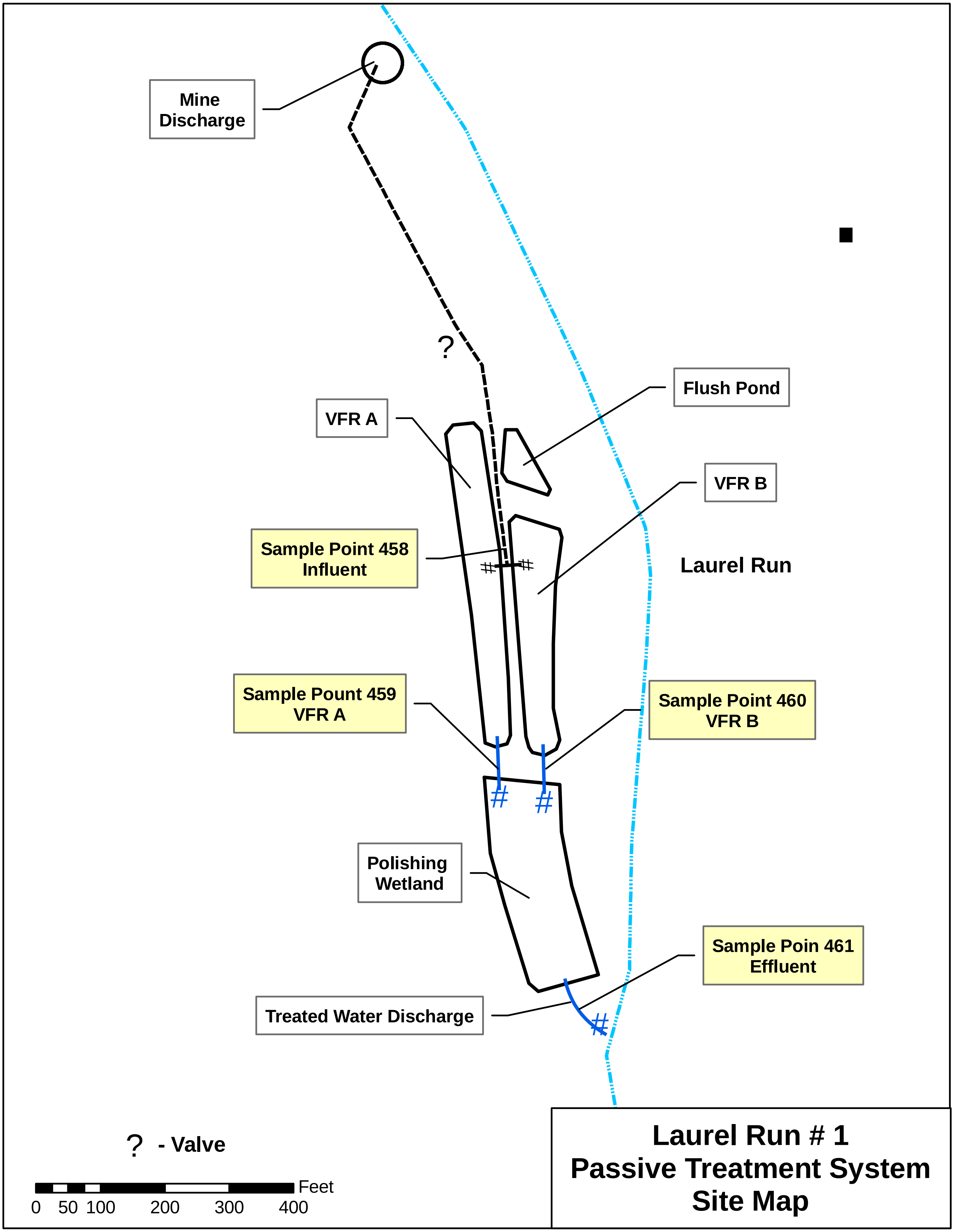
Jenners Passive System Sample Point Location Map

Keystone Passive System

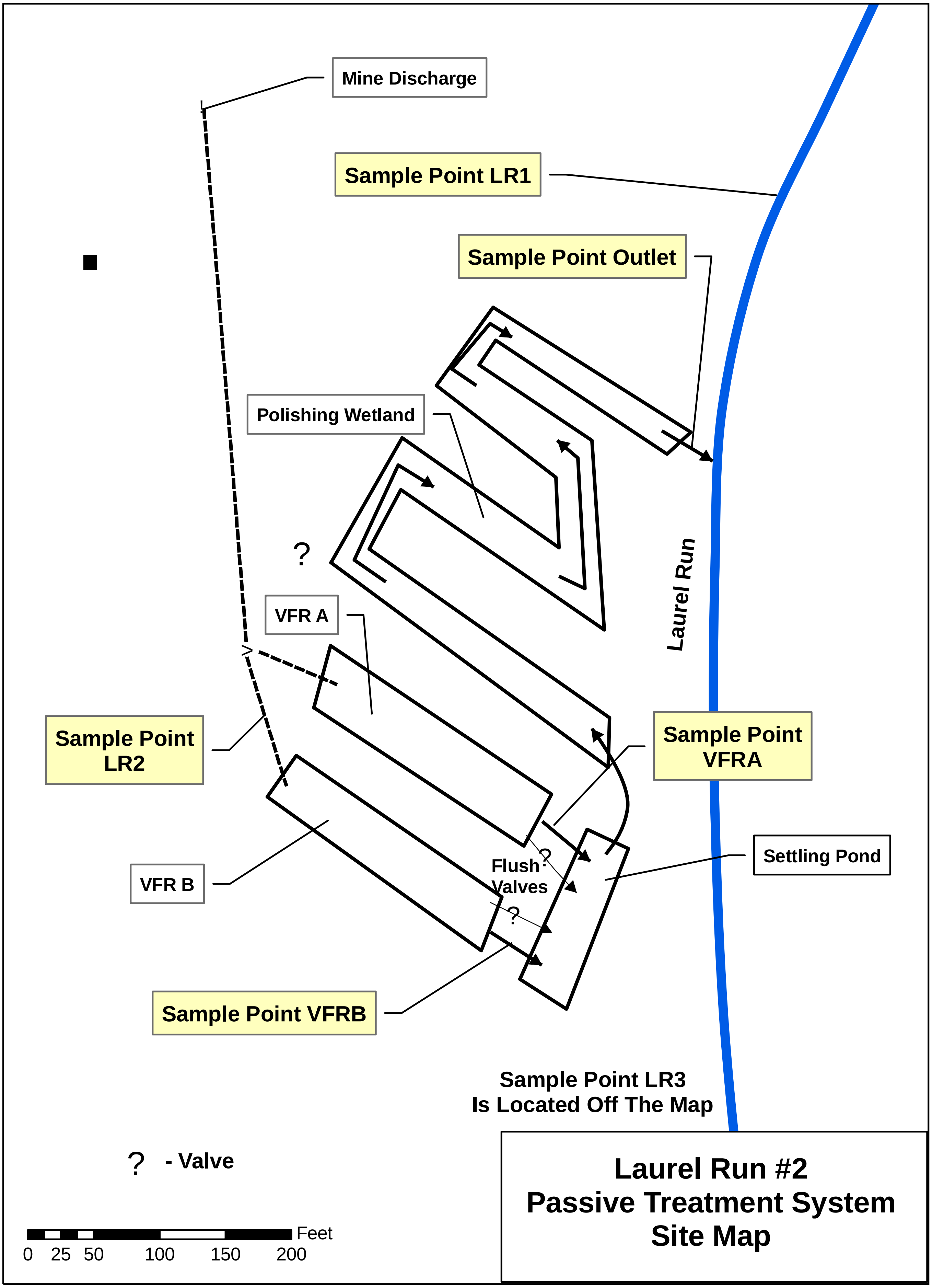
Kolb Treatment System
Young Township, Indiana County




60'X100' SETTLING BASIN (TOP DIMENSIONS)
49'X140' AASHTO #1 OPEN LIMESTONE BED (TOP DIMENSIONS)
2 X 18' LF 8" SOLID PIPE OUTLET ELEV=2293.5 (FLAT)
8' WIDE EMERGENCY SPILLWAY INV=2293.0
6" STANDPIPE
40 LF 8" PVC OUTLET W/ GATE VALVE INV IN=2293.4 INV OUT=2291.5
RIPRAP
R-4 ROCK
R-4 ROCK
W.E. 2292.5
W.E. 2294.4
W.E. 2288.8
VFP W.E. 2288.8
WV
PIPES
PIPE
W S/P
WCS 15" PVC INV. 2288.45
12" PVC RISER WITH 50 LF 8" PVC OUTLET INV IN=2289.0 INV OUT=2288.8 TOP RISER=2292.0
FLOATING BAFFLE
SETTLING BASIN
2294.0 TOP
2292.0 MAX WSE
2289.0 DOSING ELEV
2284.0 BOTTOM
40 LF 12" PVC OUTLET INV OUT = 2291.5
6'X8' PRECAST CONCRETE STRUCTURE TOP=2298.0 INV IN=2293.5 INV OUT=2292.0 (12" SIPHON) BOTTOM=2293.2
UPFLOW LS BED
2298.0 TOP
2297.5 FLUSH WSE
2298.0 TOP ROCK
2293.5 BOT ROCK
5 X 118' LF 6" PERFORATED PIPE ELEV=2293.5 (FLAT)
40 LF 8" SOLID PIPE MANIFOLD ELEV=2293.5 (FLAT)
PRECAST CONCRETE INLET TOP=2297.5 INV OUT=2293.5 BOTTOM=2292.5
REMOVE COMPOST LAYER AND FLUFF TOP 18" STONE
REMOVE 30' OF FLUSH PIPES AND INSTALL NEW 30' 6" PERF PVC PIPE OUTLET
15" PVC INV. OUT 2284.39
DEP-1 LR1 2306.66
DEP-2 LR2 2298.11
2286.1
2289.2
2293.5
2297.0
2302.7
2283.9
2289.9
2293.0
2292.2
2291.0
2294.8
2297.1
2298.5
2311.1
2307.9
2305.7
2300
2310
2330
2340
2350
50 0 50 100
Scale in Feet
GENERAL NOTES:
1) ACCESS SHALL BE FROM THE EXISTING STABILIZED ROADWAY.
2) CONTRACTOR TO MINIMIZE WORK IN WATER TO THE EXTENT NECESSARY TO INSTALL THE PROPOSED STRUCTURES.
3) EXISTING VEGETATION TO BE PRESERVED WHEREVER POSSIBLE. TOTAL DISTURBED AREA = 0.6 ACRES.
4) ALL DISTURBED AREAS TO BE PERMANENTLY SEEDED UPON COMPLETION OF WORK.
5) SUITABLE EARTH MATERIAL IN THE BOTTOM OF ALL PONDS SHALL BE VERIFIED BY THE ENGINEER.
6) IT IS THE DUTY OF THE CONTRACTOR TO COMPLY WITH THE PROVISIONS OF PA ACT 38 (1991) THREE WORKING DAYS PRIOR TO ANY EXCAVATION WORK. PA ONE CALL SERIAL #
Designed R. ROBERTSON 04/13
Drawn R. ROBERTSON 04/13
Checked 4/13
SOMERSET TECHNICAL OFFICE
6024 GLADES PIKE, SUITE 106
SOMERSET, PENNSYLVANIA 15501
USDA NRCS
Natural Resources Conservation Service
AMD UPGRADE AND REHAB
SOMERSET CONSERVANCY
SOMERSET COUNTY, PENNSYLVANIA
FINAL PLAN
Drawing No. CONSPLOT
Sheet No. 3 of 6

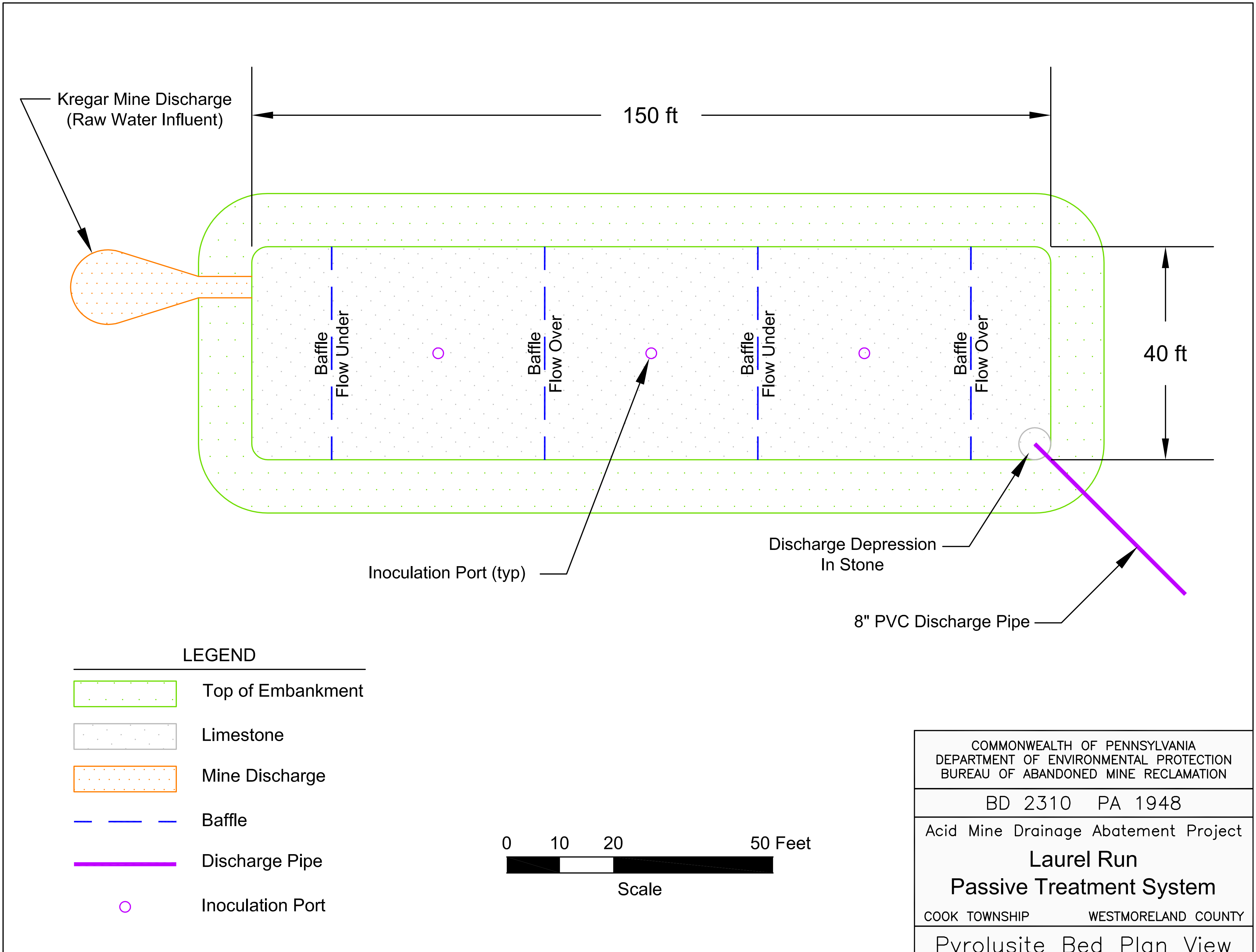


Prepared By The Blacklick Creek Watershed Association, 08/09



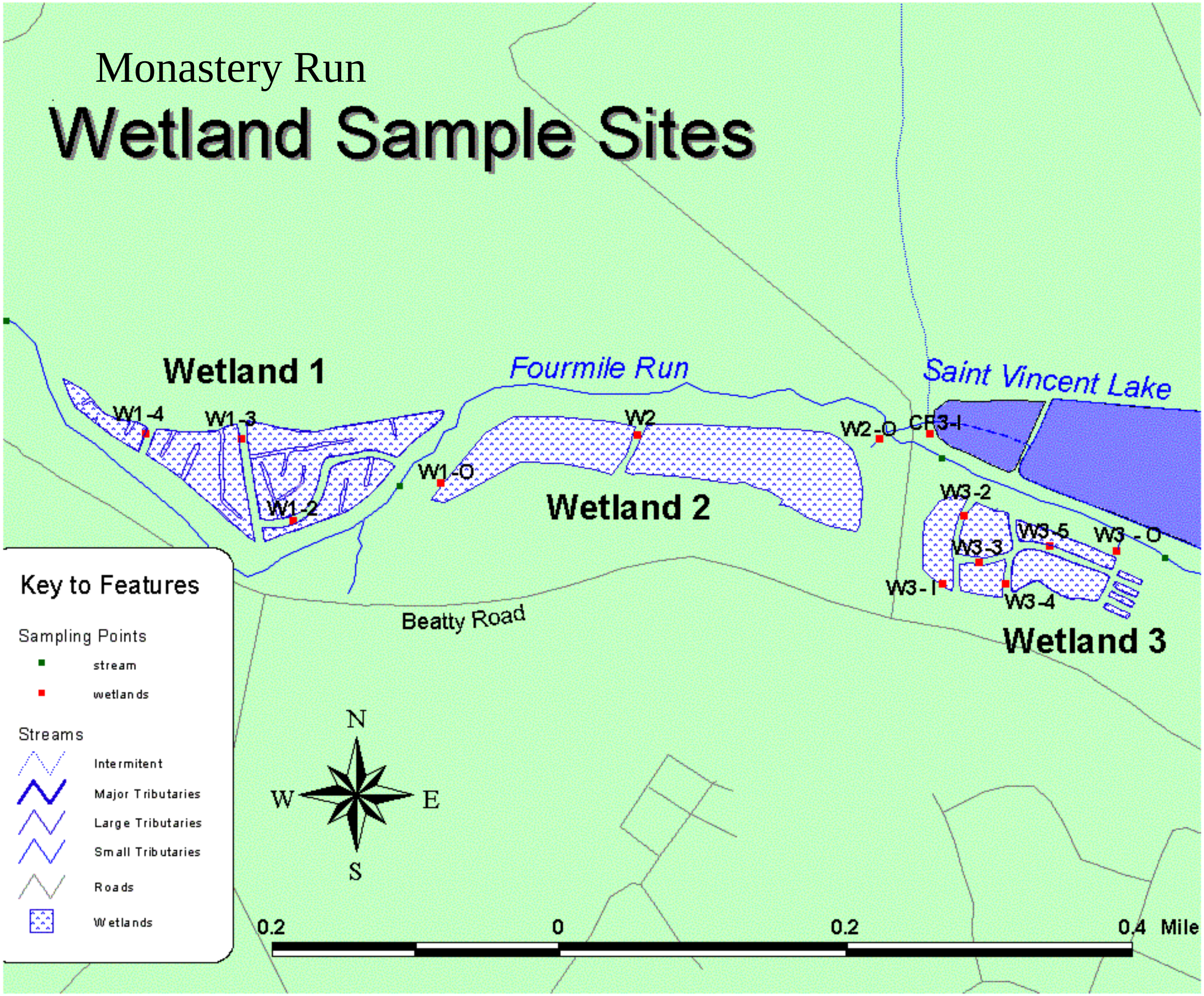
Laurel Run #2
Passive Treatment System
Site Map

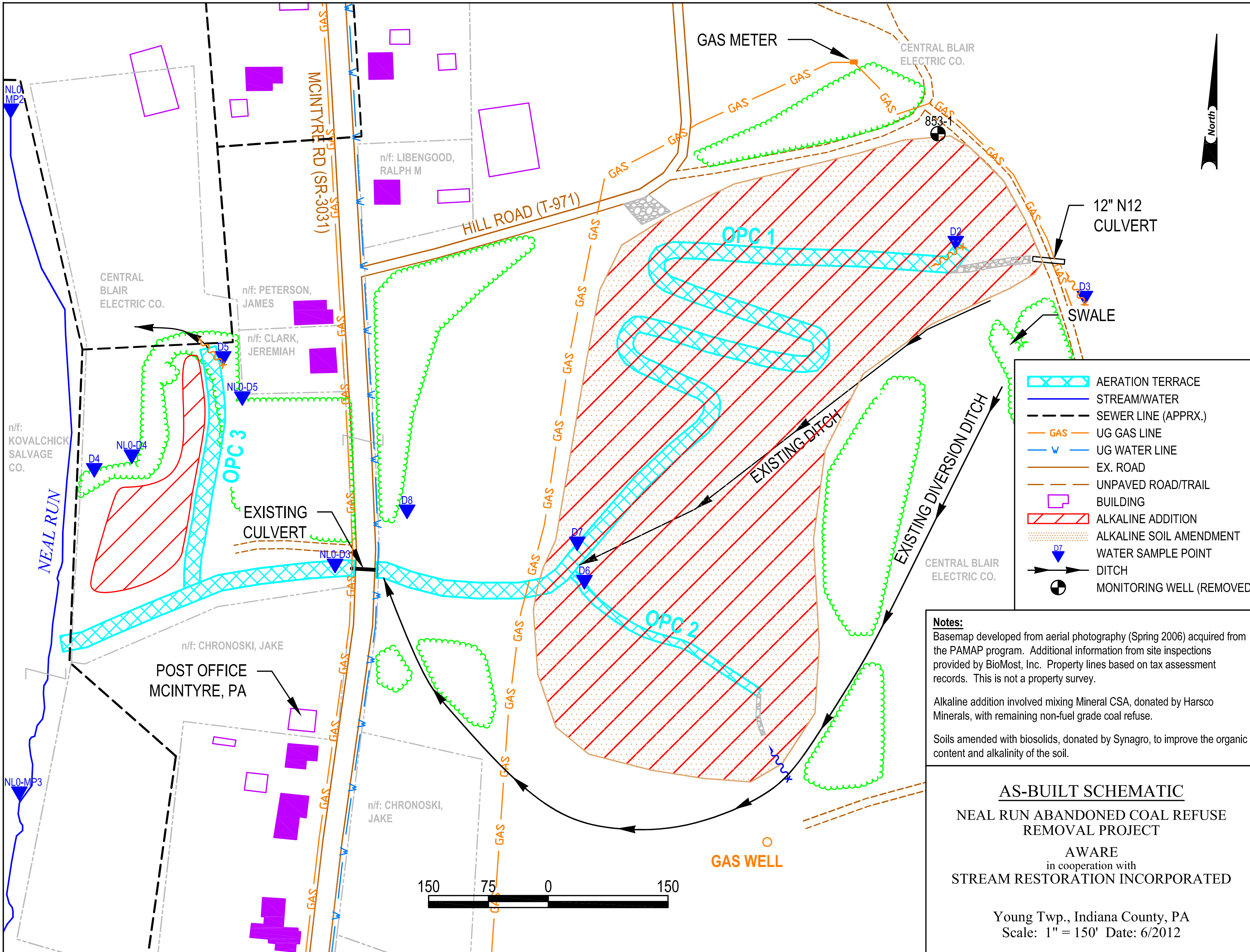
Prepared By The Blacklick Creek Watershed Association, 5/9/08


Kregar Mine Discharge
(Raw Water Influent)
150 ft
40 ft
Baffle
Flow Under
Baffle
Flow Over
Baffle
Flow Under
Baffle
Flow Over
Inoculation Port (typ)
Discharge Depression
In Stone
8" PVC Discharge Pipe
LEGEND
Top of Embankment
Limestone
Mine Discharge
Baffle
Discharge Pipe
Inoculation Port
0
10
20
50 Feet
Scale
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ABANDONED MINE RECLAMATION
BD 2310 PA 1948
Acid Mine Drainage Abatement Project
Laurel Run
Passive Treatment System
COOK TOWNSHIP
WESTMORELAND COUNTY
Pyrolusite Bed Plan View

Lucerne 3A Treatment System

Mineral Point Passive System


Monastery Run
Wetland Sample Sites
Wetland 1
Fourmile Run
Saint Vincent Lake
W1-4
W1-3
W1-2
W1-O
W2
W2-O
CF3-I
Wetland 2
W3-2
W3-5
W3 - O
W3-3
W3 - I
W3-4
Wetland 3
Beatty Road
Key to Features
Sampling Points
stream
wetlands
Streams
Intermitent
Major Tributaries
Large Tributaries
Small Tributaries
Roads
Wetlands
N
W
E
S
0.2
0
0.2
0.4 Mile



Notes:

Basemap developed from aerial photography (Spring 2006) acquired from the PAMAP program. Additional information from site inspections provided by BioMost, Inc. Property lines based on tax assessment records. This is not a property survey.

Alkaline addition involved mixing Mineral CSA, donated by Harsco Minerals, with remaining non-fuel grade coal refuse.

Soils amended with biosolids, donated by Synagro, to improve the organic content and alkalinity of the soil.

AS-BUILT SCHEMATIC

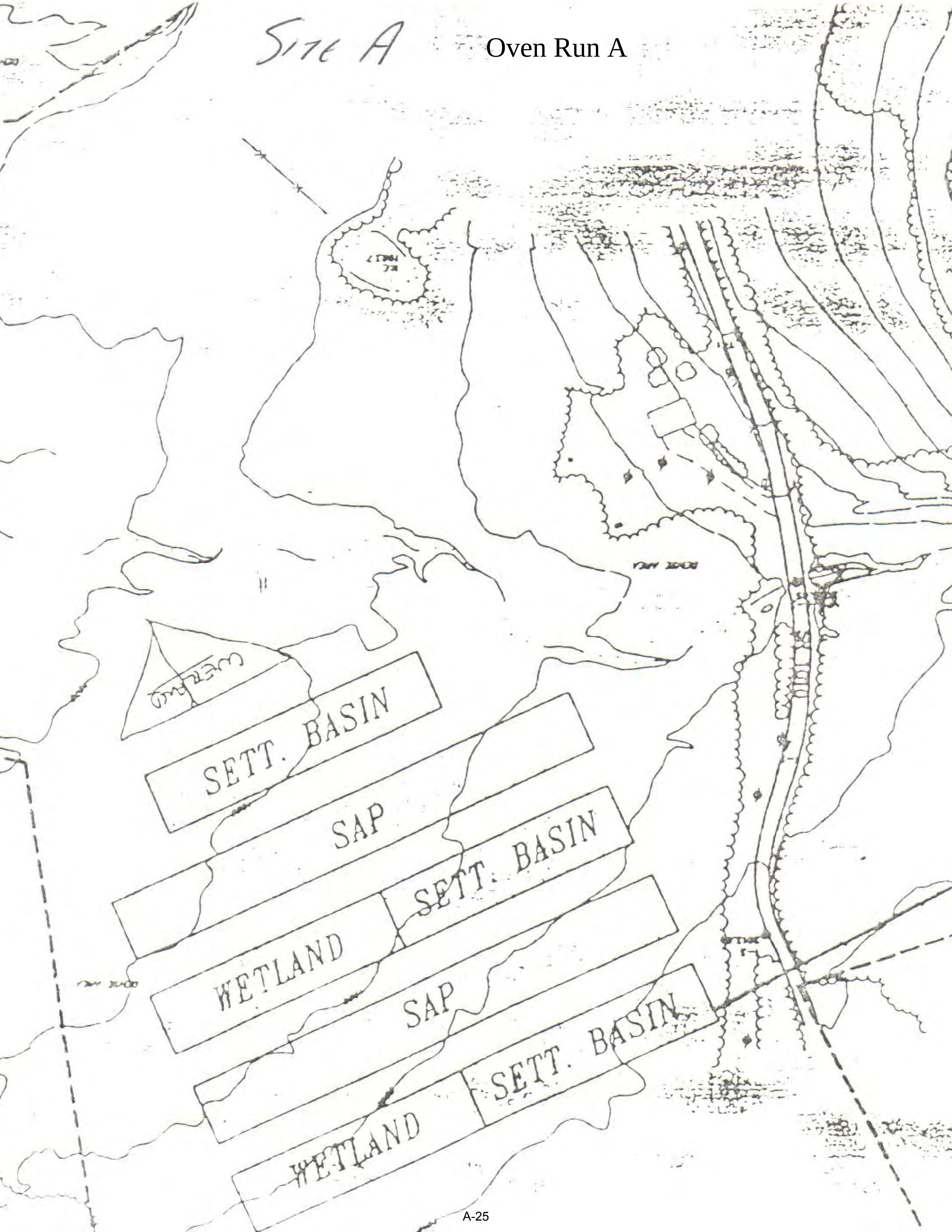
NEAL RUN ABANDONED COAL REFUSE REMOVAL PROJECT

AWARE
in cooperation with
STREAM RESTORATION INCORPORATED

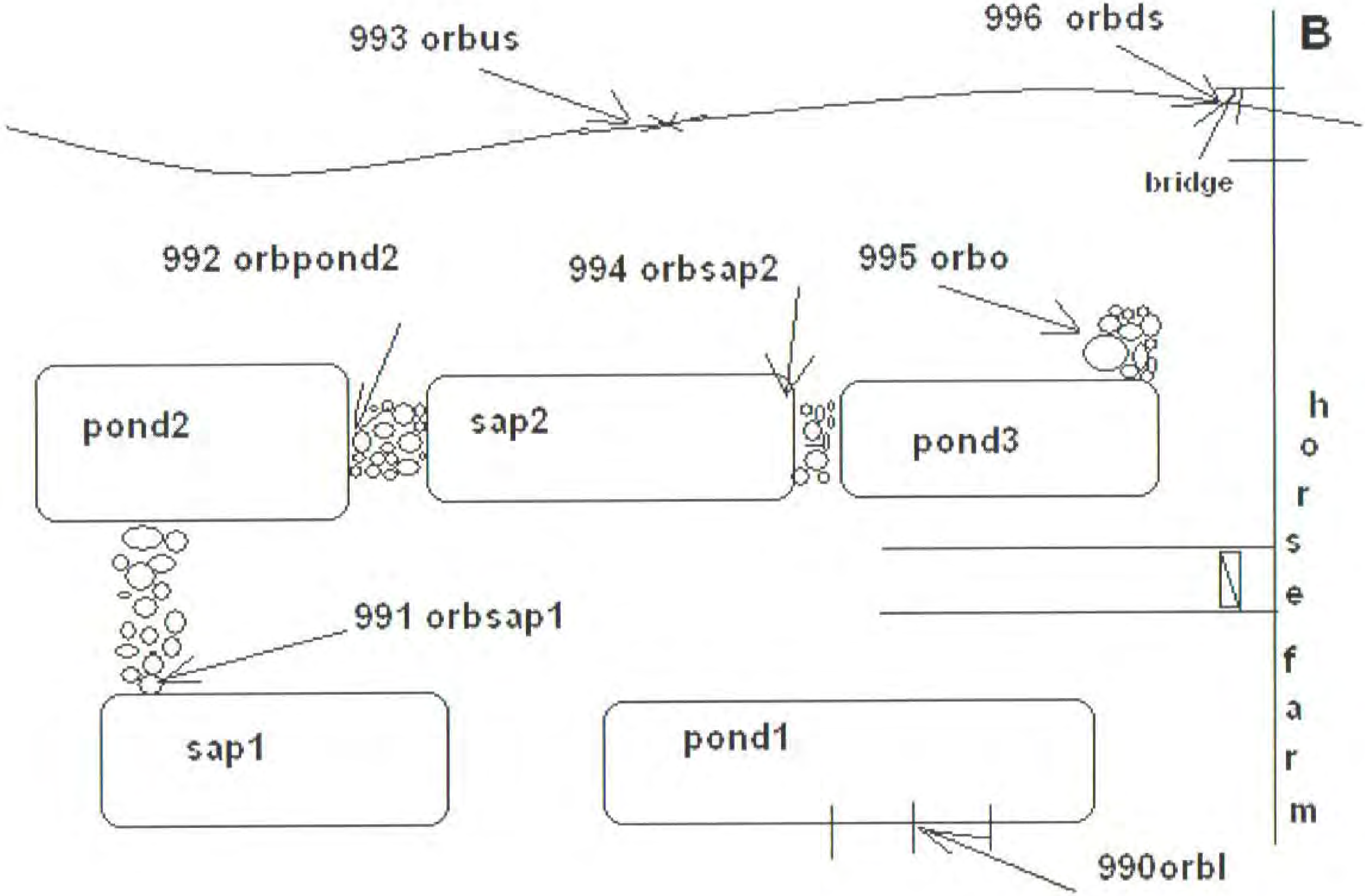
Young Twp., Indiana County, PA
Scale: 1" = 150' Date: 6/2012

853 AB.dwg

Oven Run A

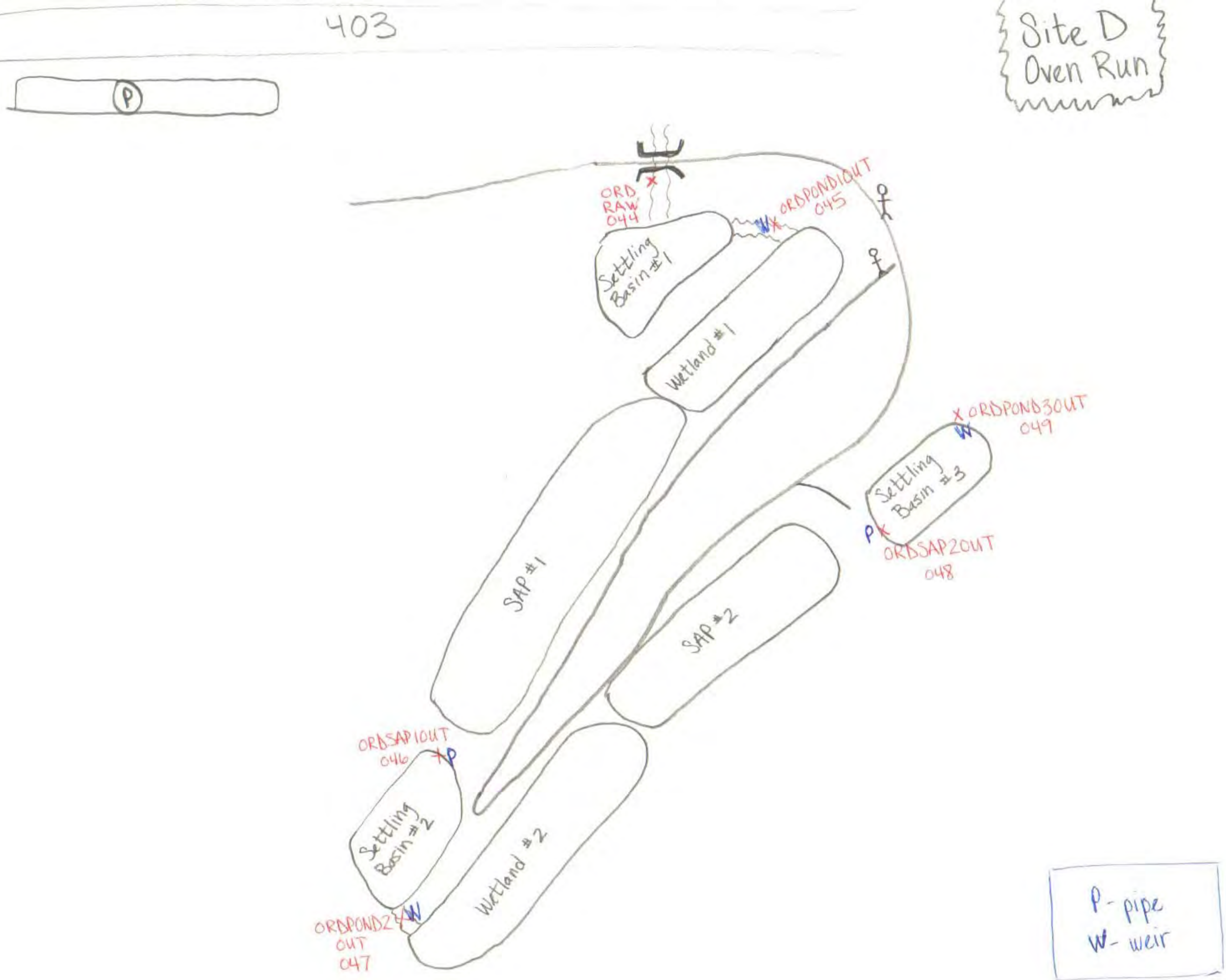

Site A
SETT. BASIN
SAP
SETT. BASIN
WETLAND
SAP
SETT. BASIN
WETLAND

Oven Run B



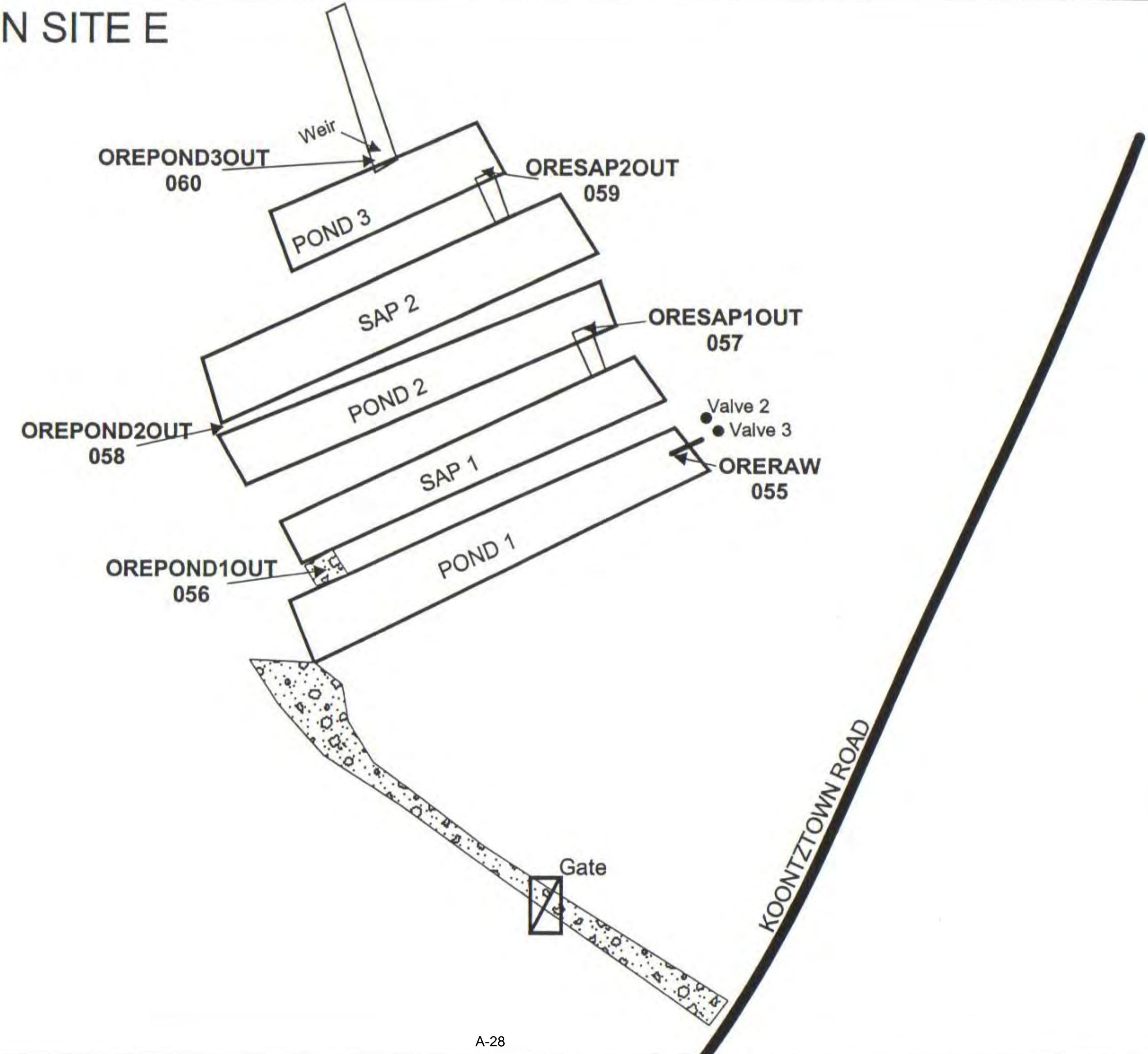
B
993 orbus
996 orbds
bridge
992 orbpond2
994 orbsap2
995 orbo
pond2
sap2
pond3
h
o
r
s
e
f
a
r
m
991 orbsap1
sap1
pond1
990orbl

403

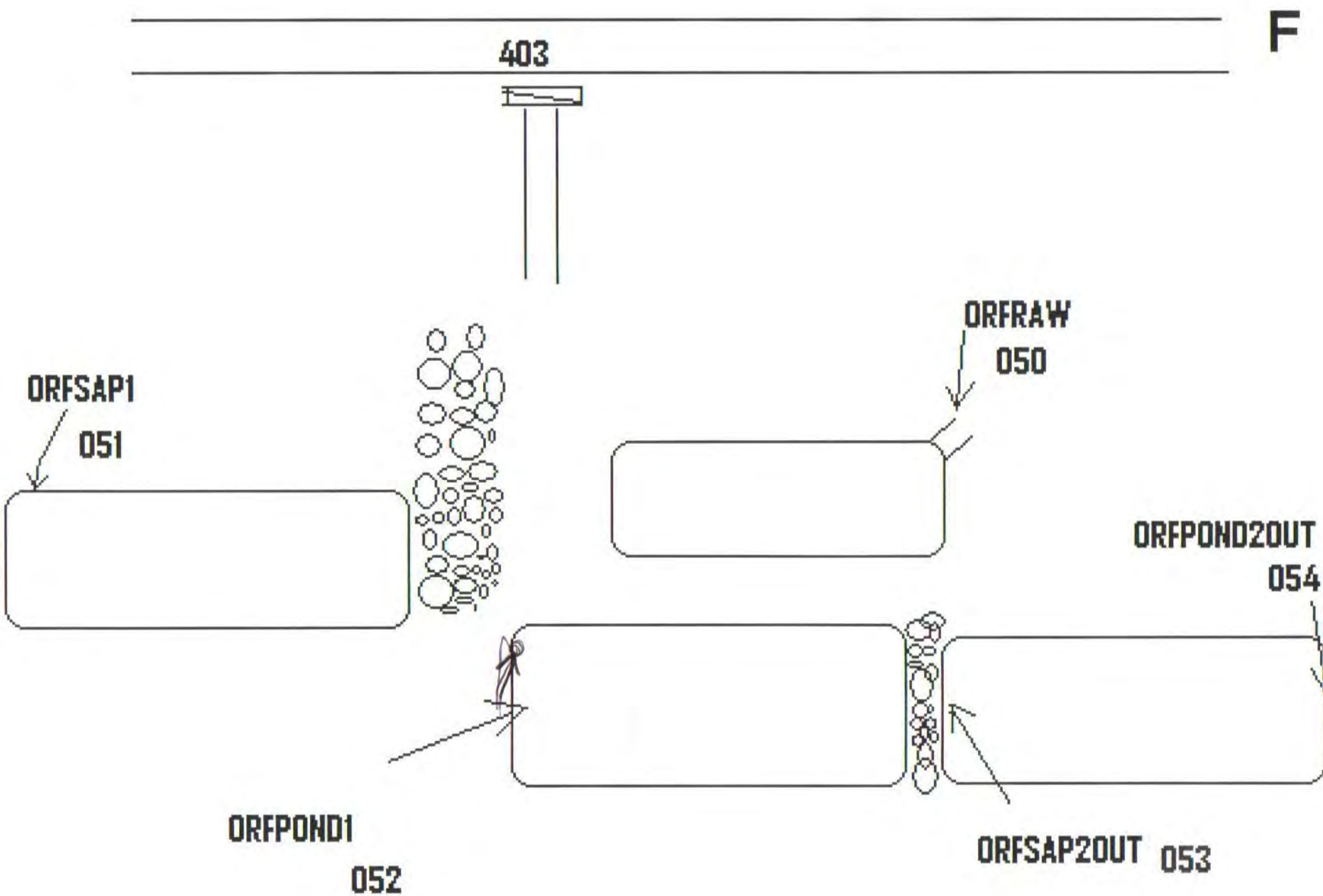


Site D
Oven Run
P
ORD RAW 044
ORDPOND1OUT 045
Settling Basin #1
Wetland #1
SAP #1
SAP #2
ORDPOND3OUT 049
Settling Basin #3
ORDSAP2OUT 048
ORDSAP1OUT 046
Settling Basin #2
Wetland #2
ORDPOND2 OUT 047
P - pipe
W - weir

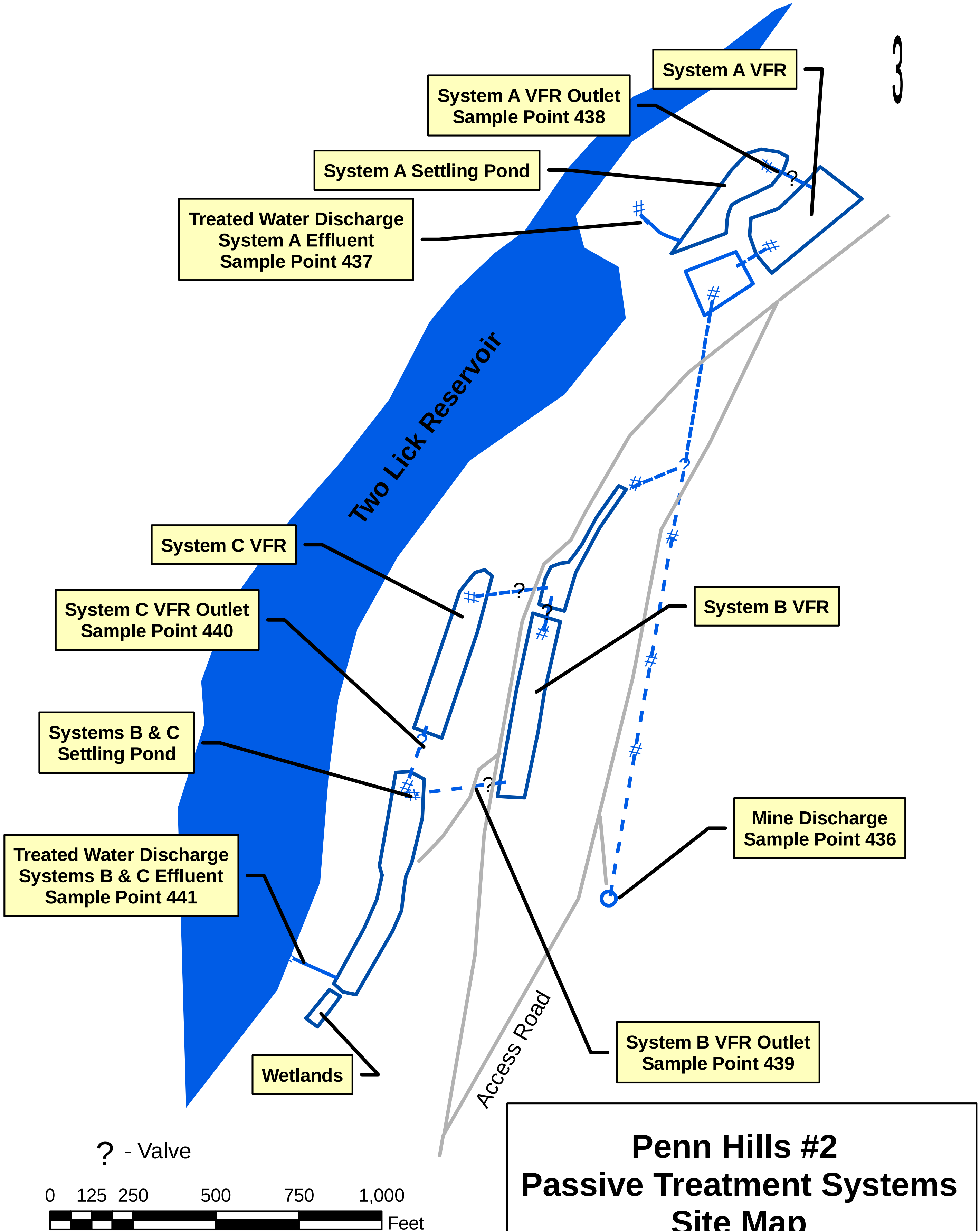
OVEN RUN SITE E



Oven Run F

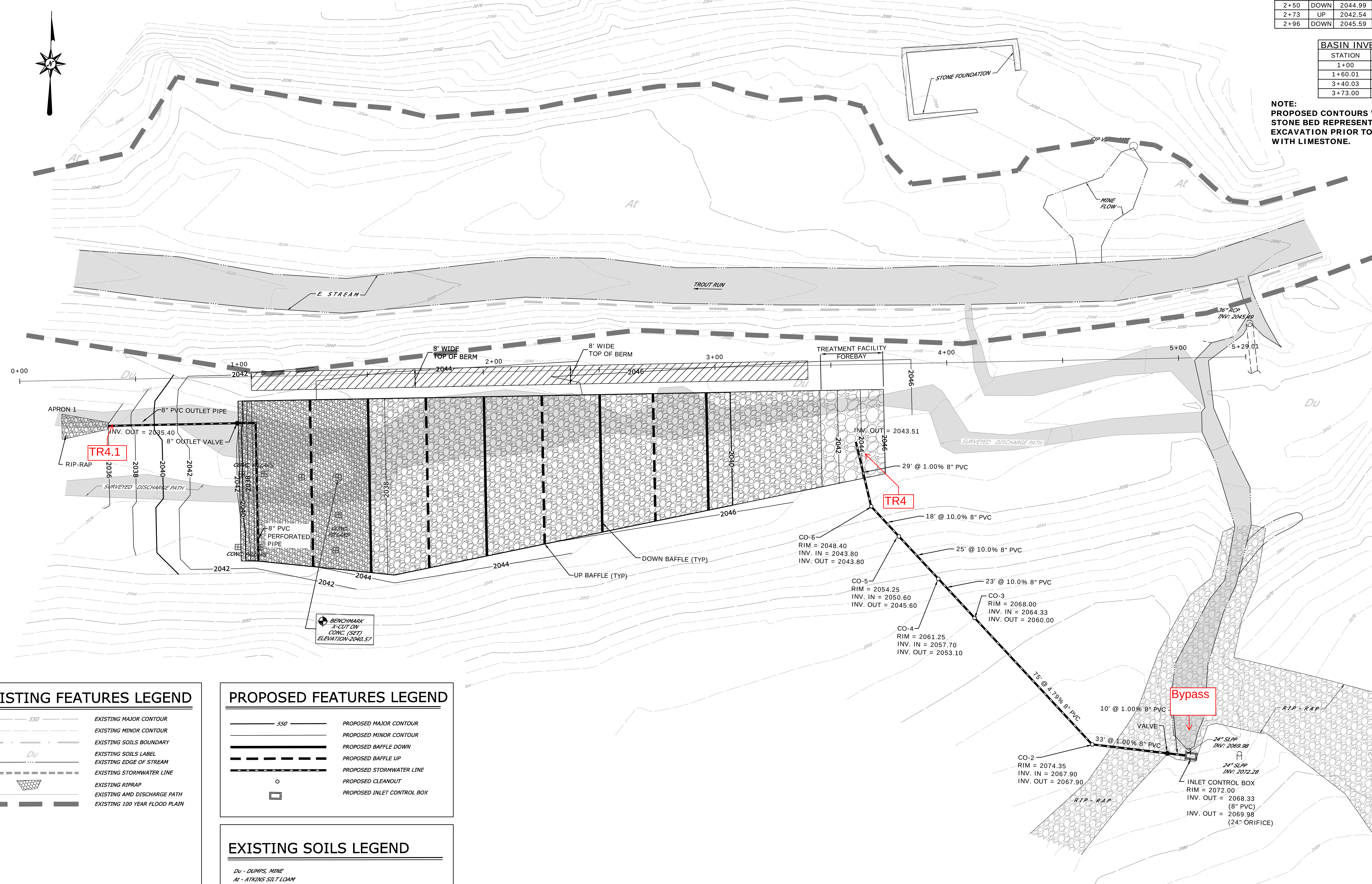


F
403
ORFRAW
050
ORFSAP1
051
ORFPOND2OUT
054
ORFPOND1
052
ORFSAP2OUT
053



Penn Hills #2
Passive Treatment Systems
Site Map

Prepared By The Blacklick Creek Watershed Association
revised 02/10



BAFFLE LOCATION TABLE			
STATION	TYPE	TOP ELEV.	BOTTOM ELEV.
1+25	UP	2039.85	2036.85
1+50	DOWN	2043.49	2039.49
1+75	UP	2041.27	2038.27
2+00	DOWN	2044.34	2040.34
2+25	UP	2041.92	2038.92
2+50	DOWN	2044.99	2040.99
2+73	UP	2042.54	2039.54
2+96	DOWN	2045.59	2041.59

BASIN INVERT WIDTH	
STATION	WIDTH
1+00	69'
1+60.01	76'
3+40.03	42'
3+73.00	36'

NOTE:
PROPOSED CONTOURS WITHIN STONE BED REPRESENT BOTTOM OF EXCAVATION PRIOR TO FILLING WITH LIMESTONE.

EXISTING FEATURES LEGEND

- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING SOILS BOUNDARY
- EXISTING SOILS LABEL
- EXISTING EDGE OF STREAM
- EXISTING STORMWATER LINE
- EXISTING RIPRAP
- EXISTING AMD DISCHARGE PATH
- EXISTING 100 YEAR FLOOD PLAIN

PROPOSED FEATURES LEGEND

- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED BAFFLE DOWN
- PROPOSED BAFFLE UP
- PROPOSED STORMWATER LINE
- PROPOSED CLEANOUT
- PROPOSED INLET CONTROL BOX

EXISTING SOILS LEGEND

Du - DUMPS, MINE
At - ATKINS SILT LOAM

GRAPHIC SCALE
20 0 10 20 40 80
(IN FEET)
1 inch = 20 ft.

PennTerra ENGINEERING INC.

CORPORATE OFFICE:
3075 ENTERPRISE DRIVE
SUITE 100
STATE COLLEGE, PA 16801
PH: 814-231-8285
Fax: 814-237-2308

CAPITOL REGION:
4909 LOUISE DRIVE
SUITE 105
MECHANICSBURG, PA 17055
PH: 717-691-8050
Fax: 717-795-1718

WWW.PENNTERRA.COM

Designer NRC
Draftsman JWM
Proj.Manager TNS
Surveyor N/A
Perimeter Ck.
Book Pg
Drive G: View/Snap
Acad 07012 Puritan Discharge

Date	Description
03/02/2011	PER INTERNAL REVIEW
09/21/2010	PER DEP COMMENT LETTER
03/15/2010	PER DEP COMMENT LETTER DATED 01/12/2010

REVISIONS

PURITAN DISCHARGE

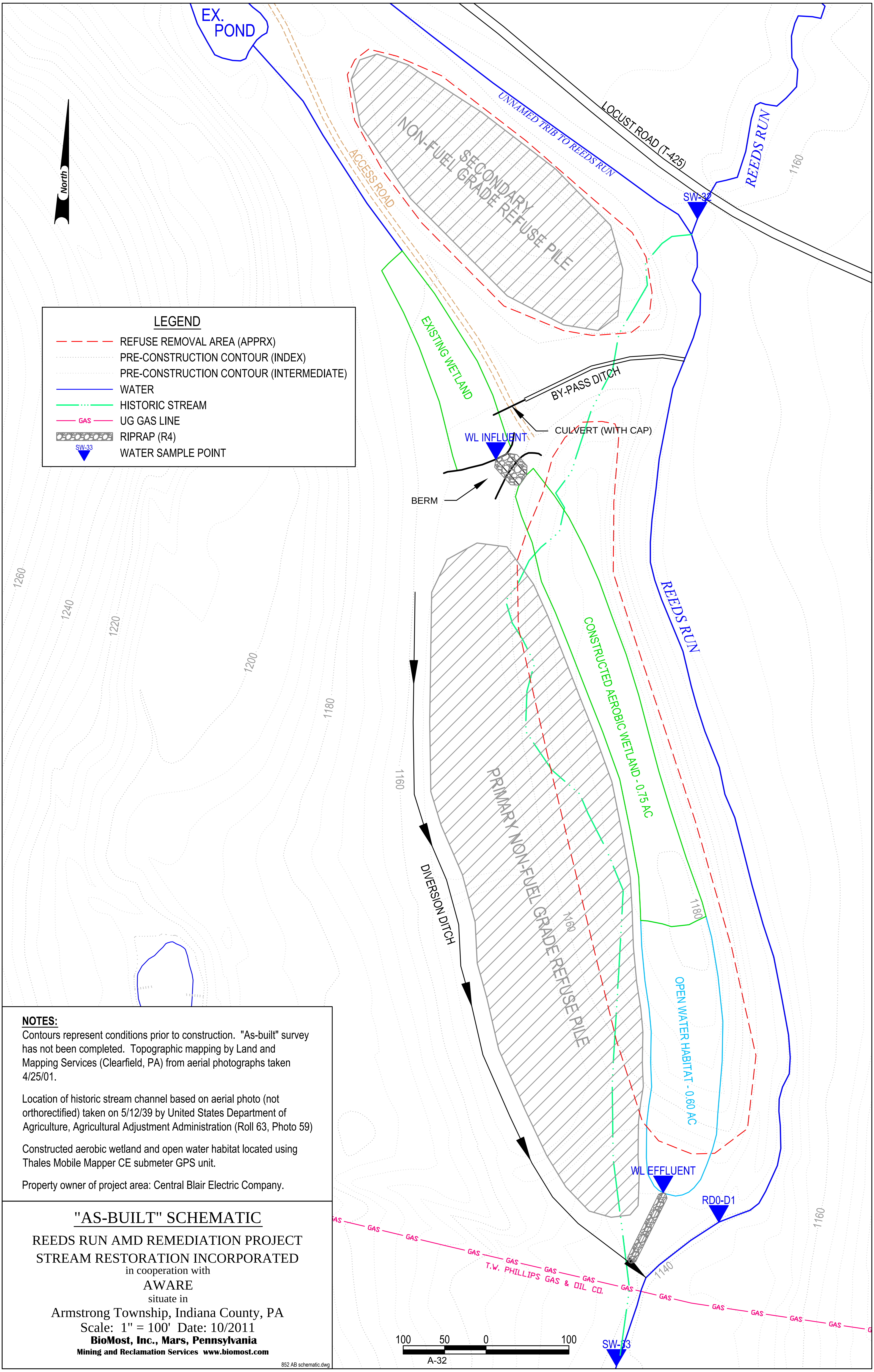
PROPOSED FeAlMn BED

PORTAGE TOWNSHIP
CAMBRIA COUNTY
PENNSYLVANIA

TROUT RUN WATERSHED ASSOCIATION, CAMBRIA COUNTY CONSERVATION DISTRICT, PA DEPARTMENT OF ENVIRONMENTAL PROTECTION

FINAL PLAN

PROJECT NO. C07012
DATE 2-23-2010
SCALE 1"=20'
SHEET NO. 3.00



NOTES:

Contours represent conditions prior to construction. "As-built" survey has not been completed. Topographic mapping by Land and Mapping Services (Clearfield, PA) from aerial photographs taken 4/25/01.

Location of historic stream channel based on aerial photo (not orthorectified) taken on 5/12/39 by United States Department of Agriculture, Agricultural Adjustment Administration (Roll 63, Photo 59)

Constructed aerobic wetland and open water habitat located using Thales Mobile Mapper CE submeter GPS unit.

Property owner of project area: Central Blair Electric Company.

"AS-BUILT" SCHEMATIC

REEDS RUN AMD REMEDIATION PROJECT

STREAM RESTORATION INCORPORATED

in cooperation with

AWARE

situate in

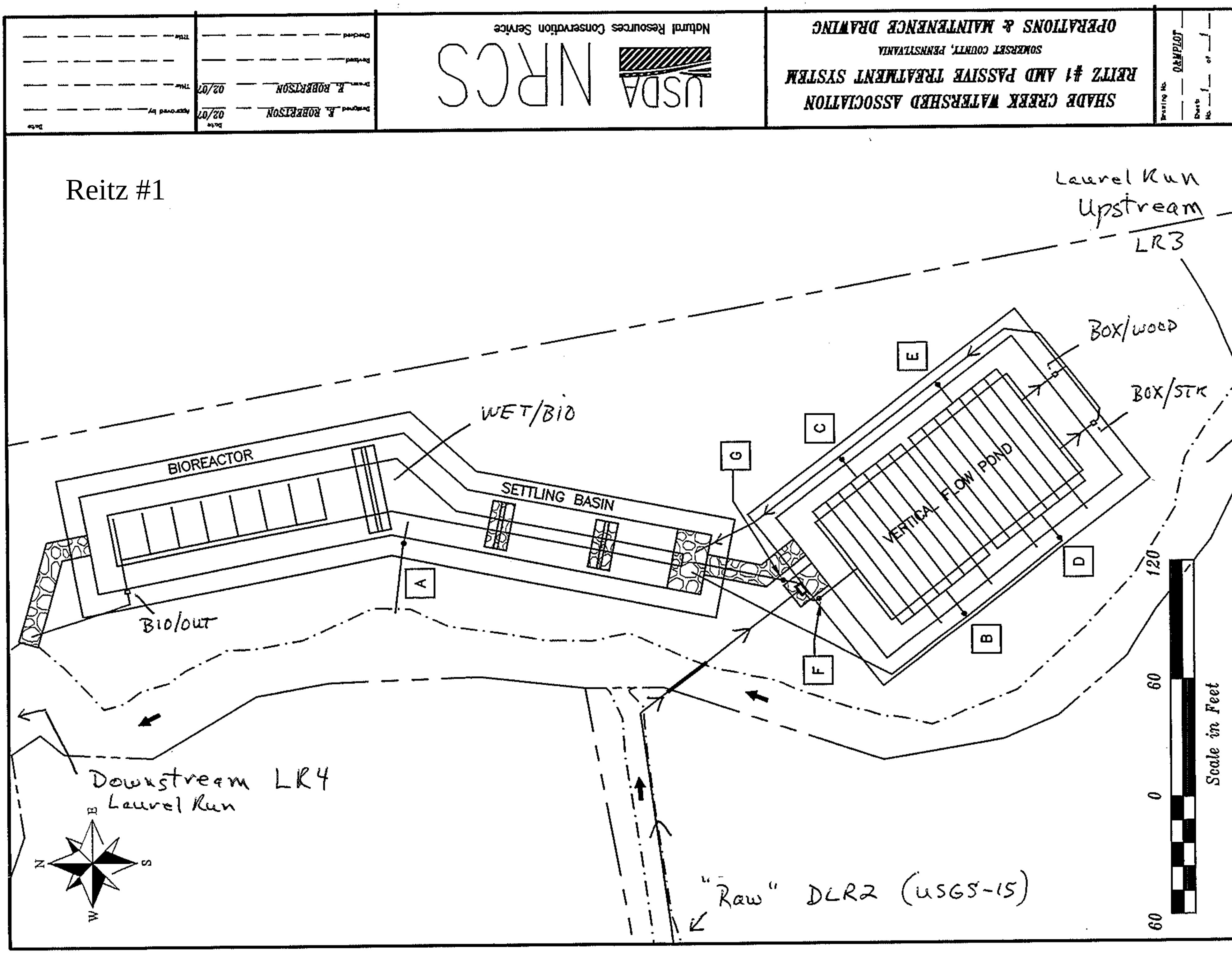
Armstrong Township, Indiana County, PA

Scale: 1" = 100' Date: 10/2011

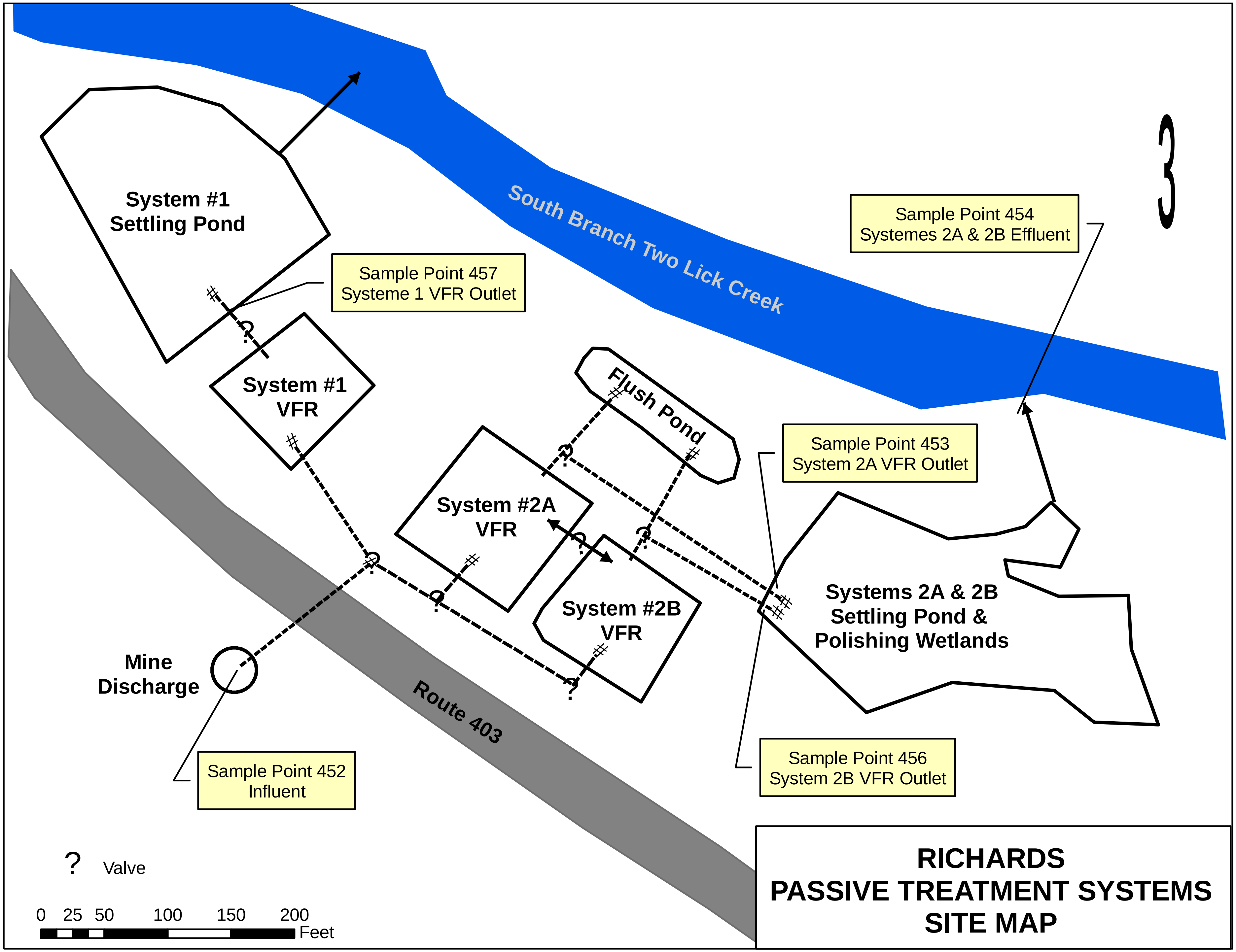
BioMost, Inc., Mars, Pennsylvania

Mining and Reclamation Services www.biomost.com

Reitz #1

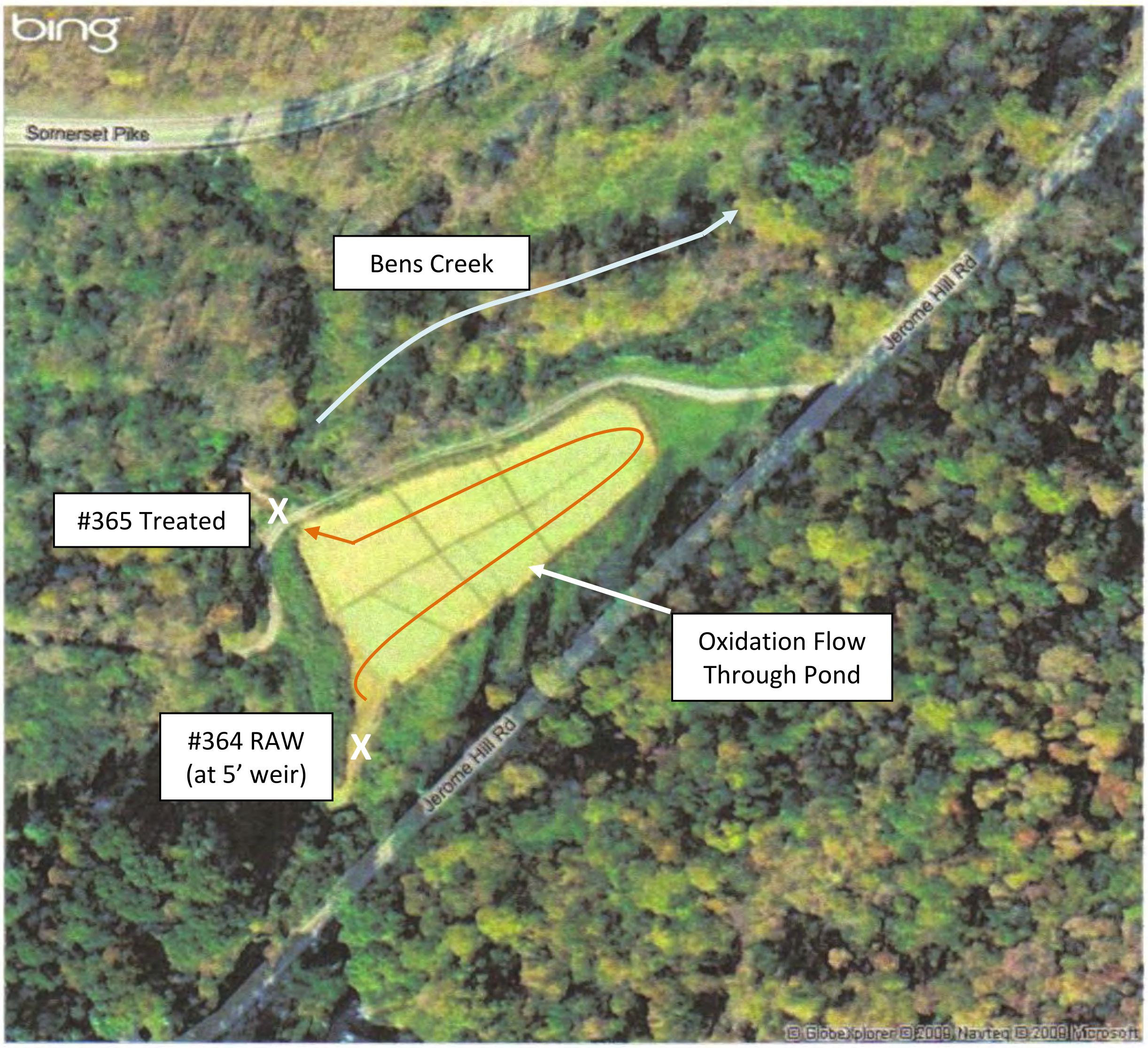


SHADE CREEK WATERSHED ASSOCIATION
REITZ #1 AMD PASSIVE TREATMENT SYSTEM
SOMERSET COUNTY, PENNSYLVANIA
OPERATIONS & MAINTENANCE DRAWING
USDA NRCS
Natural Resources Conservation Service
Designed E. ROBERTSON 02/07
Drawn E. ROBERTSON 02/07
Laurel Run Upstream LR3
BOX/WOOD
BOX/STK
WET/BIO
BIOREACTOR
SETTLING BASIN
VERTICAL FLOW POND
A
B
C
D
E
F
G
BIO/OUT
Downstream LR4 Laurel Run
"Raw" DLR2 (USGS-15)
E
N
S
W
120
60
0
60
Scale in Feet



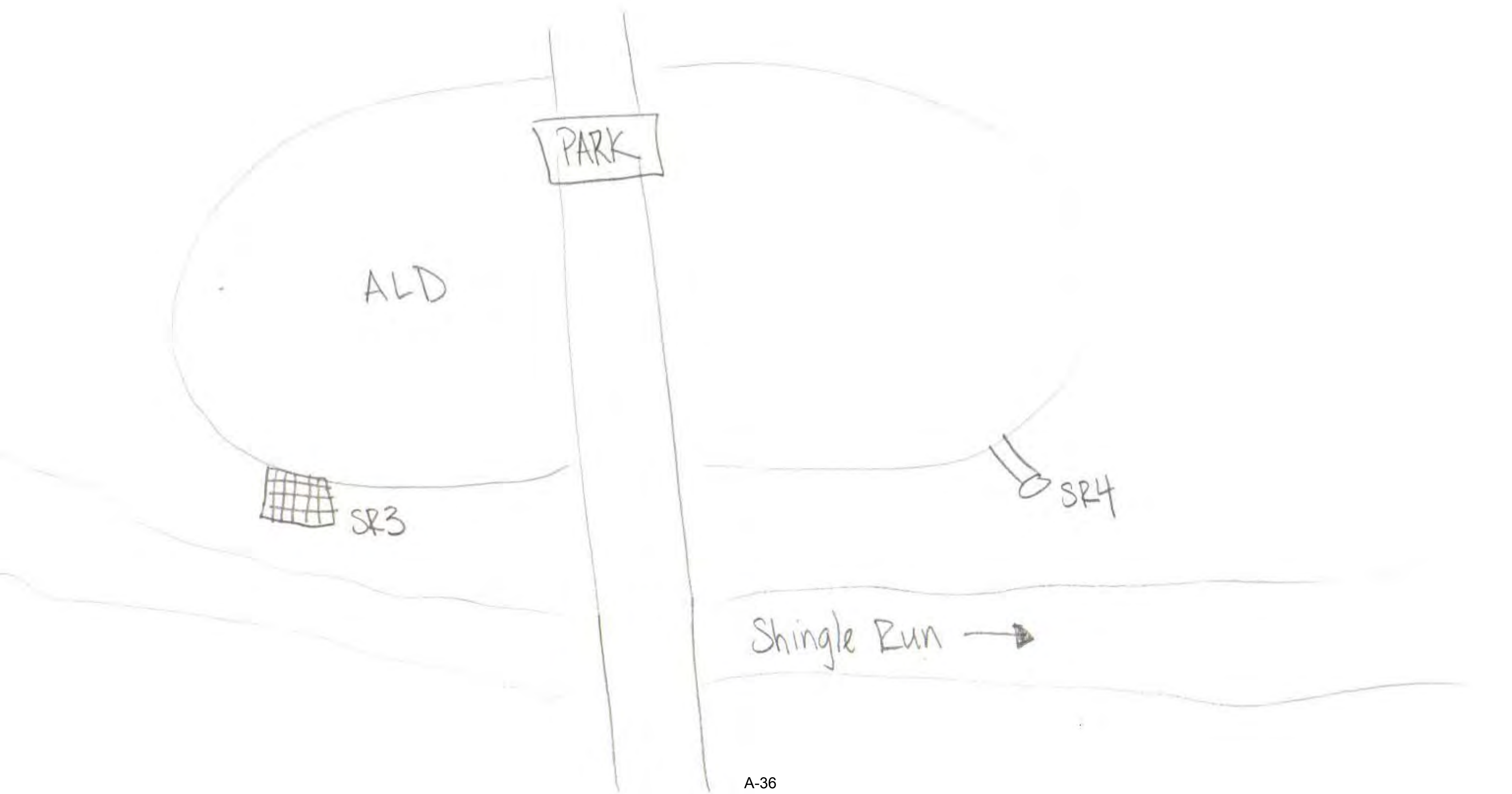
Prepared By Blacklick Creek Watershed Association, 08/09

Rock Tunnel Treatment System
Somerset County, PA
Hooversville Quad
Project ID: 175

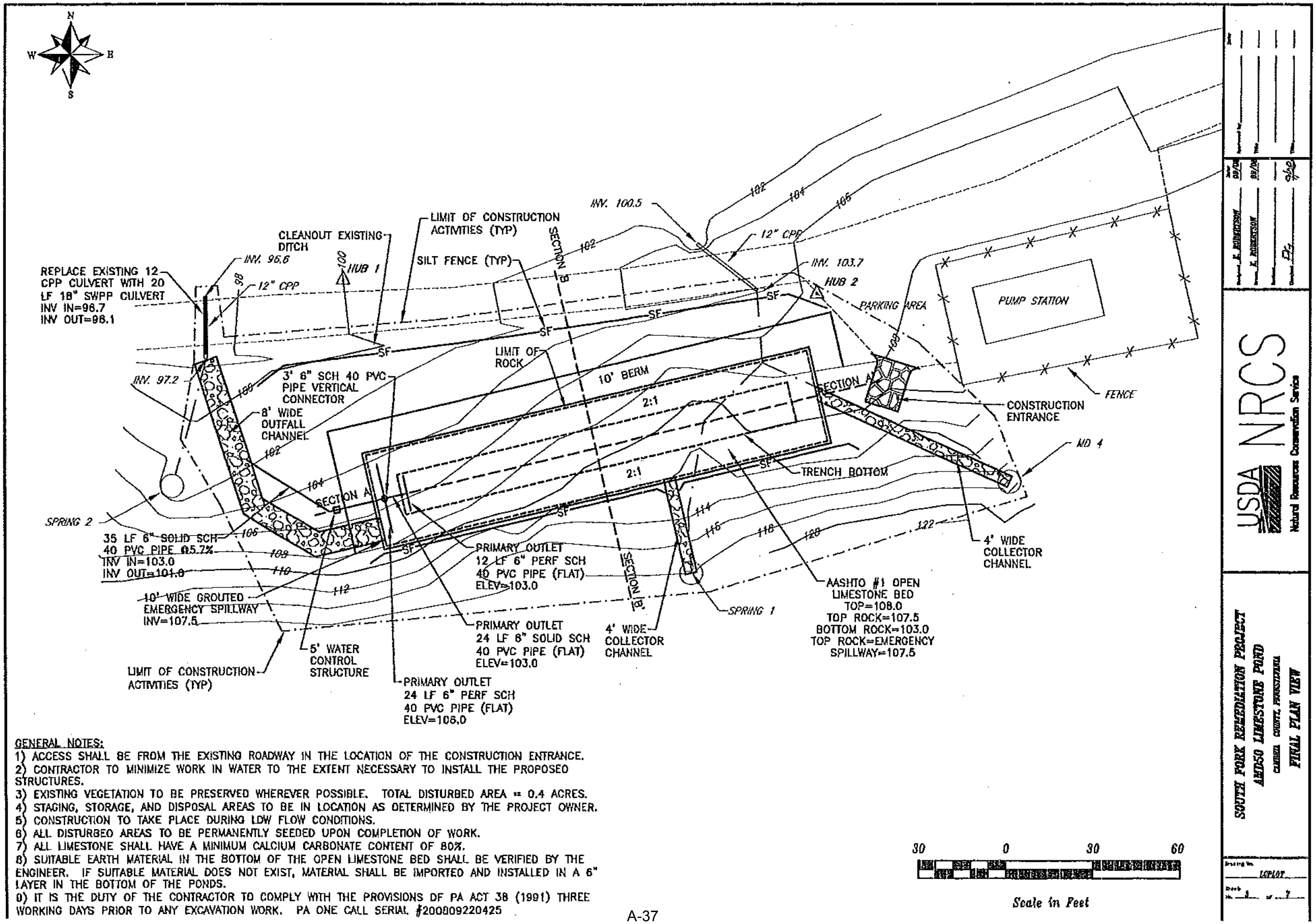


Shingle Run ALD
Shade Twp., Somerset Co.

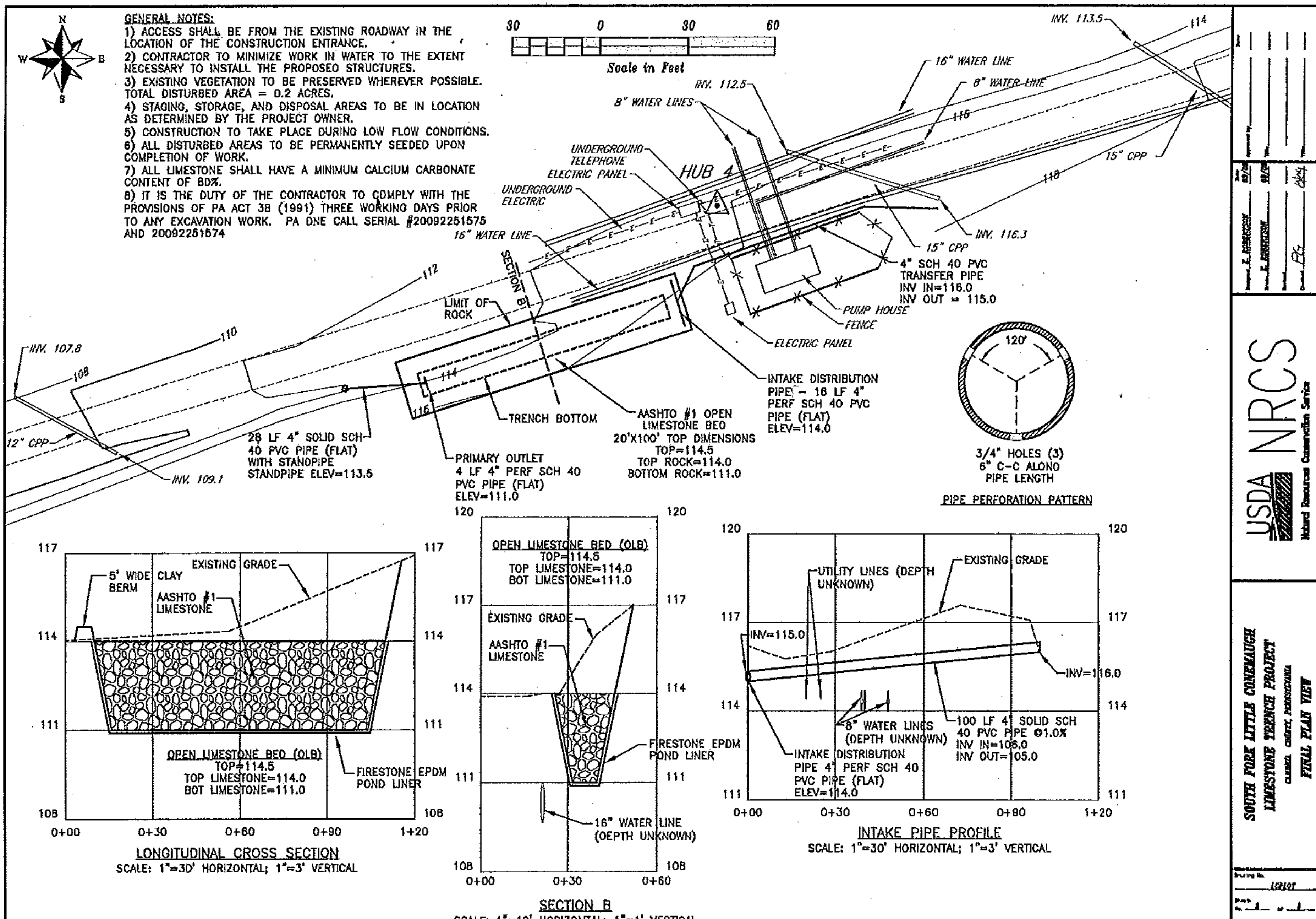
Monitoring Points (SCWA)
SR3 = Shingle Run ALD intake
SR4 = Shingle Run ALD effluent



AMD50

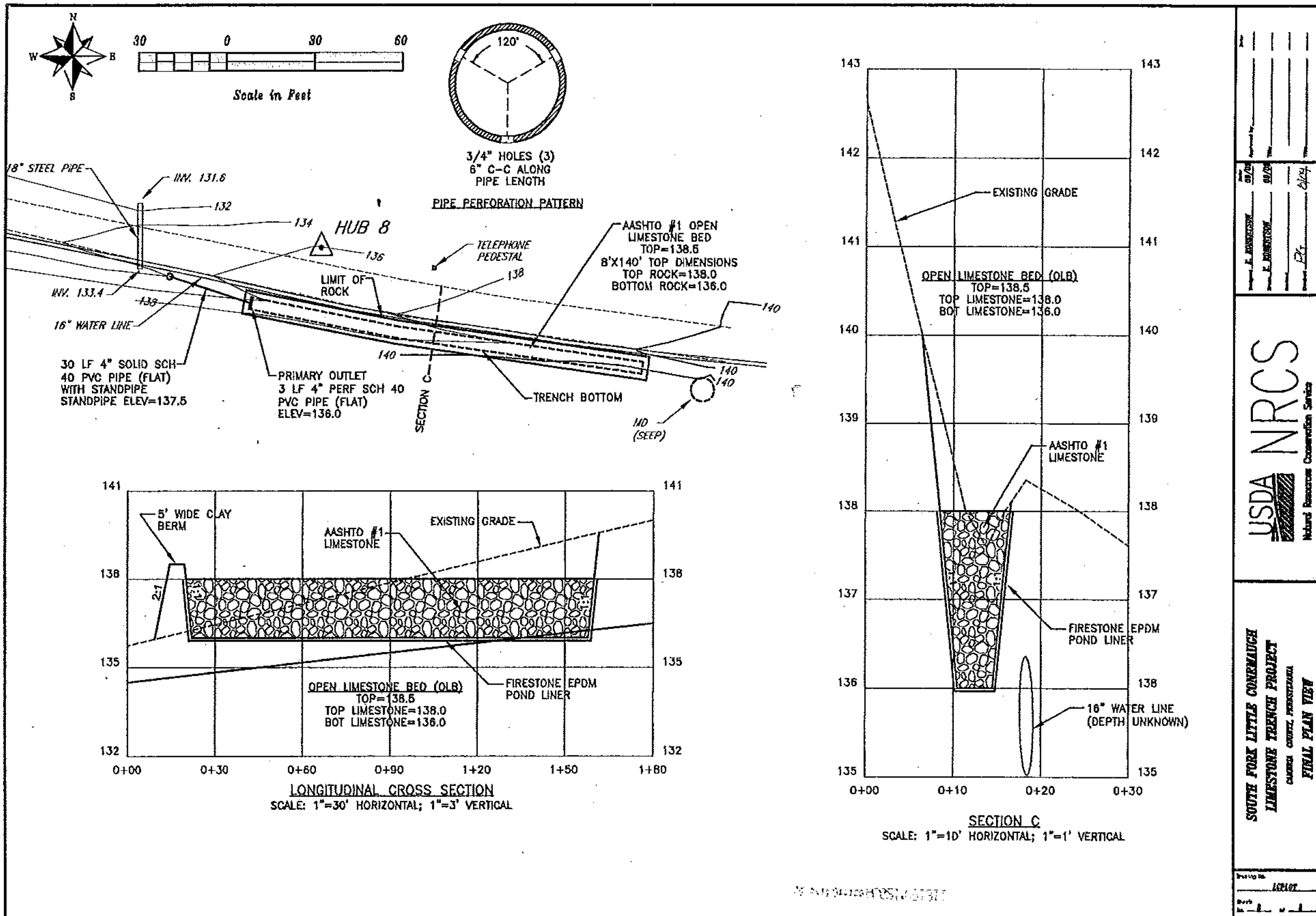

N
W
E
S
INV. 100.5
12" CPP
INV. 103.7
HUB 2
PARKING AREA
PUMP STATION
LIMIT OF CONSTRUCTION ACTIVITIES (TYP)
CLEANOUT EXISTING DITCH
SECTION B
INV. 96.6
HUB 1
SILT FENCE (TYP)
REPLACE EXISTING 12 CPP CULVERT WITH 20 LF 18" SWPP CULVERT
INV IN=96.7
INV OUT=96.1
12" CPP
SF
LIMIT OF ROCK
10' BERM
2:1
INV. 97.2
3' 6" SCH 40 PVC PIPE VERTICAL CONNECTOR
8' WIDE OUTFALL CHANNEL
SECTION A
CONSTRUCTION ENTRANCE
FENCE
MD 4
TRENCH BOTTOM
SPRING 2
35 LF 6" SOLID SCH 40 PVC PIPE @5.7%
INV IN=103.0
INV OUT=101.0
10' WIDE GROUTED EMERGENCY SPILLWAY
INV=107.5
PRIMARY OUTLET
12 LF 6" PERF SCH 40 PVC PIPE (FLAT)
ELEV=103.0
4' WIDE COLLECTOR CHANNEL
SPRING 1
AASHTO #1 OPEN LIMESTONE BED
TOP=108.0
TOP ROCK=107.5
BOTTOM ROCK=103.0
TOP ROCK=EMERGENCY SPILLWAY=107.5
PRIMARY OUTLET
24 LF 6" SOLID SCH 40 PVC PIPE (FLAT)
ELEV=103.0
4' WIDE COLLECTOR CHANNEL
LIMIT OF CONSTRUCTION ACTIVITIES (TYP)
5' WATER CONTROL STRUCTURE
PRIMARY OUTLET
24 LF 6" PERF SCH 40 PVC PIPE (FLAT)
ELEV=106.0
GENERAL NOTES:
1) ACCESS SHALL BE FROM THE EXISTING ROADWAY IN THE LOCATION OF THE CONSTRUCTION ENTRANCE.
2) CONTRACTOR TO MINIMIZE WORK IN WATER TO THE EXTENT NECESSARY TO INSTALL THE PROPOSED STRUCTURES.
3) EXISTING VEGETATION TO BE PRESERVED WHEREVER POSSIBLE. TOTAL DISTURBED AREA = 0.4 ACRES.
4) STAGING, STORAGE, AND DISPOSAL AREAS TO BE IN LOCATION AS DETERMINED BY THE PROJECT OWNER.
5) CONSTRUCTION TO TAKE PLACE DURING LOW FLOW CONDITIONS.
6) ALL DISTURBED AREAS TO BE PERMANENTLY SEEDED UPON COMPLETION OF WORK.
7) ALL LIMESTONE SHALL HAVE A MINIMUM CALCIUM CARBONATE CONTENT OF 80%.
8) SUITABLE EARTH MATERIAL IN THE BOTTOM OF THE OPEN LIMESTONE BED SHALL BE VERIFIED BY THE ENGINEER. IF SUITABLE MATERIAL DOES NOT EXIST, MATERIAL SHALL BE IMPORTED AND INSTALLED IN A 6" LAYER IN THE BOTTOM OF THE PONDS.
9) IT IS THE DUTY OF THE CONTRACTOR TO COMPLY WITH THE PROVISIONS OF PA ACT 38 (1991) THREE WORKING DAYS PRIOR TO ANY EXCAVATION WORK. PA ONE CALL SERIAL #200009220425
30 0 30 60
Scale in Feet
USDA NRCS
Natural Resources Conservation Service
SOUTH FORK REMEDIATION PROJECT
AMD50 LIMESTONE POND
CAMBRIA COUNTY, PENNSYLVANIA
FINAL PLAN VIEW

AMD60



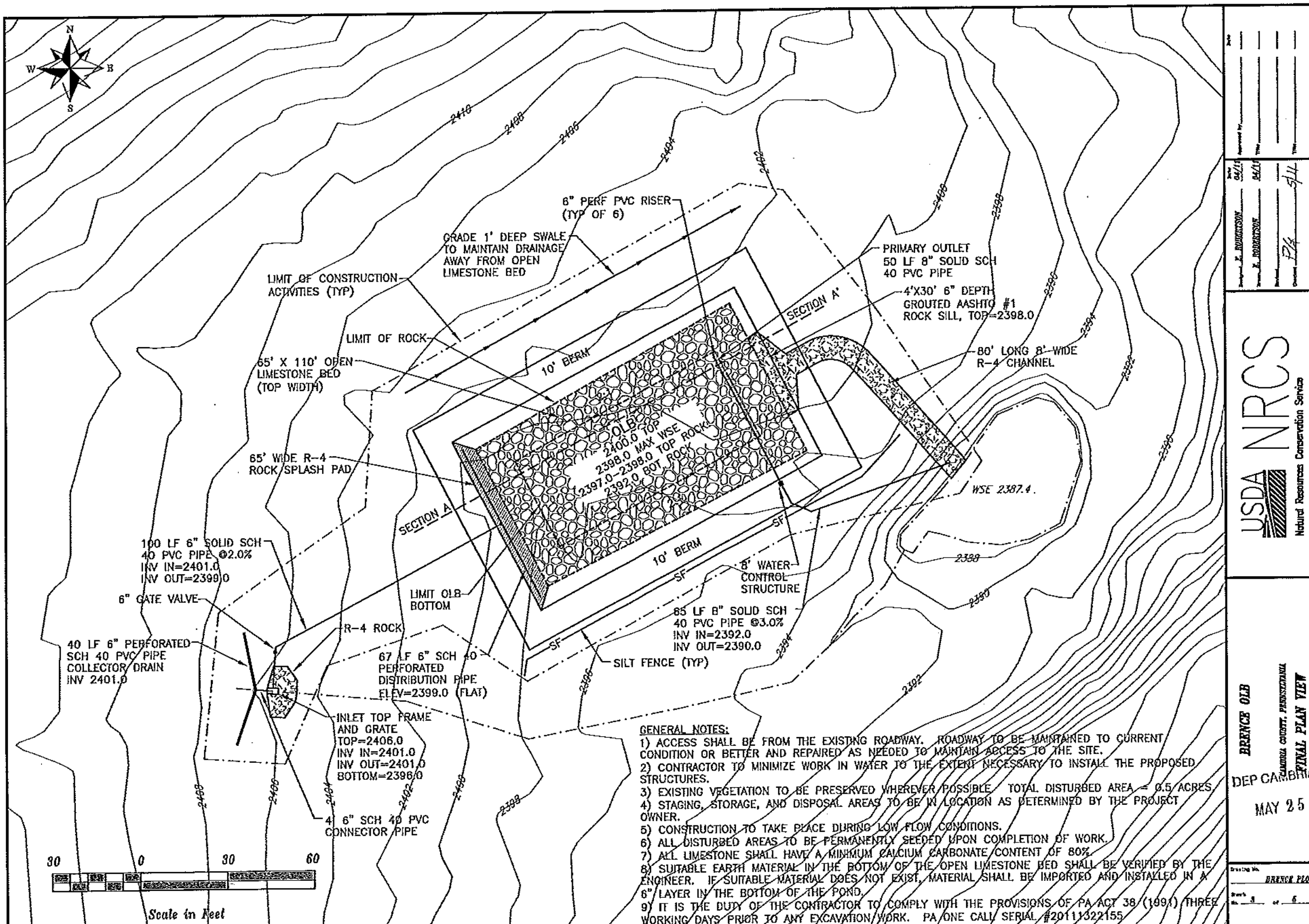
GENERAL NOTES:
1) ACCESS SHALL BE FROM THE EXISTING ROADWAY IN THE LOCATION OF THE CONSTRUCTION ENTRANCE.
2) CONTRACTOR TO MINIMIZE WORK IN WATER TO THE EXTENT NECESSARY TO INSTALL THE PROPOSED STRUCTURES.
3) EXISTING VEGETATION TO BE PRESERVED WHEREVER POSSIBLE. TOTAL DISTURBED AREA = 0.2 ACRES.
4) STAGING, STORAGE, AND DISPOSAL AREAS TO BE IN LOCATION AS DETERMINED BY THE PROJECT OWNER.
5) CONSTRUCTION TO TAKE PLACE DURING LOW FLOW CONDITIONS.
6) ALL DISTURBED AREAS TO BE PERMANENTLY SEEDED UPON COMPLETION OF WORK.
7) ALL LIMESTONE SHALL HAVE A MINIMUM CALCIUM CARBONATE CONTENT OF 80%.
8) IT IS THE DUTY OF THE CONTRACTOR TO COMPLY WITH THE PROVISIONS OF PA ACT 38 (1991) THREE WORKING DAYS PRIOR TO ANY EXCAVATION WORK. PA ONE CALL SERIAL #20092251575 AND 20092251574
Scale in Feet
16" WATER LINE
8" WATER LINE
8" WATER LINES
INV. 113.5
INV. 112.5
UNDERGROUND TELEPHONE
ELECTRIC PANEL
UNDERGROUND ELECTRIC
HUB 4
15" CPP
INV. 116.3
4" SCH 40 PVC TRANSFER PIPE INV IN=116.0 INV OUT = 115.0
PUMP HOUSE
FENCE
ELECTRIC PANEL
SECTION B
LIMIT OF ROCK
INV. 107.8
12" CPP
INV. 109.1
28 LF 4" SOLID SCH 40 PVC PIPE (FLAT) WITH STANDPIPE STANDPIPE ELEV=113.5
PRIMARY OUTLET 4 LF 4" PERF SCH 40 PVC PIPE (FLAT) ELEV=111.0
TRENCH BOTTOM
AASHTO #1 OPEN LIMESTONE BED 20'X100' TOP DIMENSIONS TOP=114.5 TOP ROCK=114.0 BOTTOM ROCK=111.0
INTAKE DISTRIBUTION PIPE - 16 LF 4" PERF SCH 40 PVC PIPE (FLAT) ELEV=114.0
3/4" HOLES (3) 6" C-C ALONG PIPE LENGTH
PIPE PERFORATION PATTERN
5' WIDE CLAY BERM
EXISTING GRADE
AASHTO #1 LIMESTONE
OPEN LIMESTONE BED (OLB) TOP=114.5 TOP LIMESTONE=114.0 BOT LIMESTONE=111.0
FIRESTONE EPDM POND LINER
LONGITUDINAL CROSS SECTION
SCALE: 1"=30' HORIZONTAL; 1"=3' VERTICAL
16" WATER LINE (DEPTH UNKNOWN)
SECTION B
SCALE: 1"=10' HORIZONTAL; 1"=1' VERTICAL
UTILITY LINES (DEPTH UNKNOWN)
INV=115.0
INV=116.0
8" WATER LINES (DEPTH UNKNOWN)
INTAKE DISTRIBUTION PIPE 4" PERF SCH 40 PVC PIPE (FLAT) ELEV=114.0
100 LF 4" SOLID SCH 40 PVC PIPE @1.0% INV IN=106.0 INV OUT=105.0
INTAKE PIPE PROFILE
SCALE: 1"=30' HORIZONTAL; 1"=3' VERTICAL
USDA NRCS
Natural Resources Conservation Service
SOUTH FORK LITTLE CONEMAUGH LIMESTONE TRENCH PROJECT
FINAL PLAN VIEW

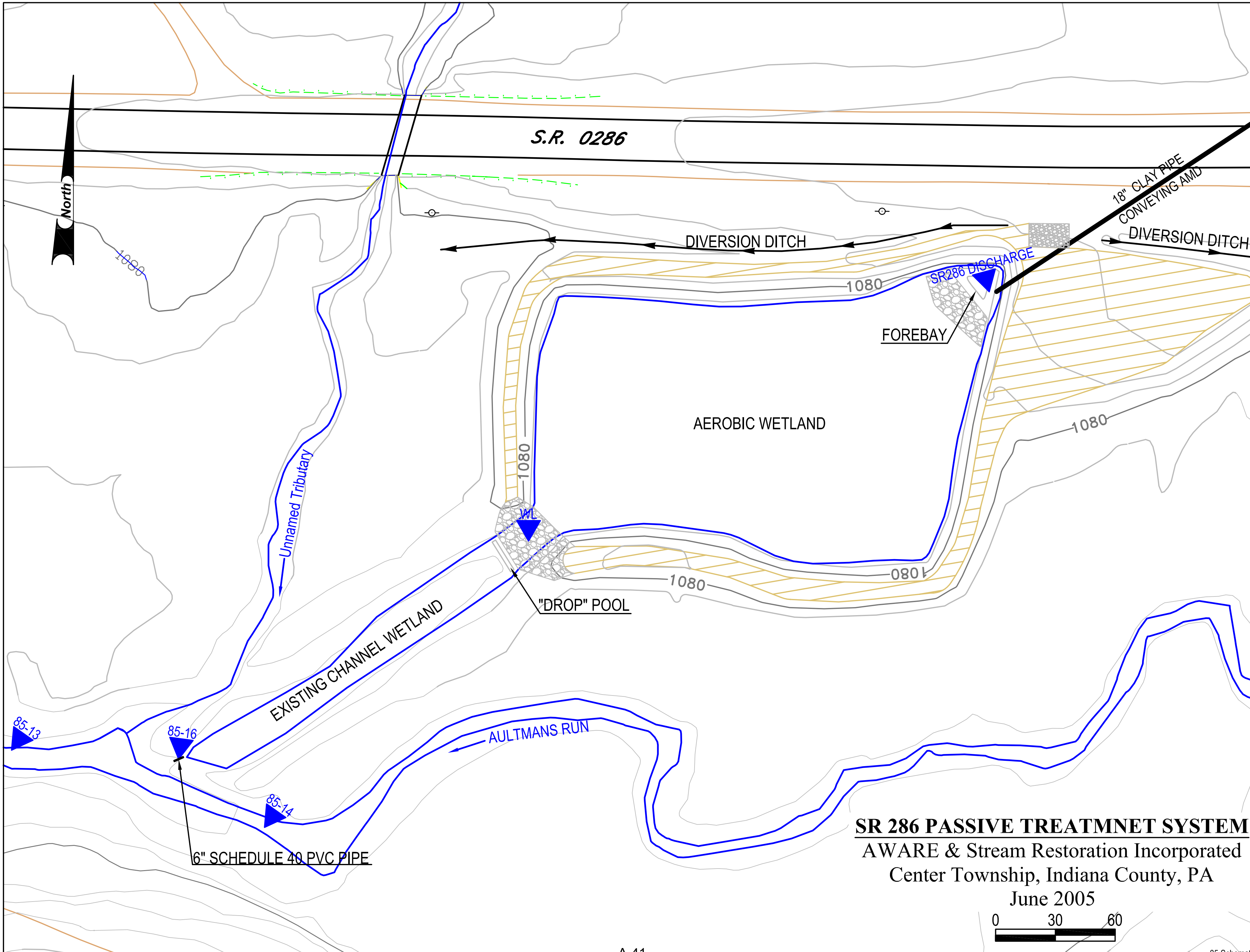
AMD67



Scale in Feet
3/4" HOLES (3)
6" C-C ALONG
PIPE LENGTH
PIPE PERFORATION PATTERN
18" STEEL PIPE
INV. 131.6
HUB 8
TELEPHONE PEDESTAL
LIMIT OF ROCK
AASHTO #1 OPEN LIMESTONE BED
TOP=138.5
8'X140' TOP DIMENSIONS
TOP ROCK=138.0
BOTTOM ROCK=136.0
INV. 133.4
16" WATER LINE
30 LF 4" SOLID SCH 40 PVC PIPE (FLAT) WITH STANDPIPE
STANDPIPE ELEV=137.5
PRIMARY OUTLET
3 LF 4" PERF SCH 40 PVC PIPE (FLAT)
ELEV=136.0
SECTION C
TRENCH BOTTOM
MD (SEEP)
5' WIDE CLAY BERM
AASHTO #1 LIMESTONE
EXISTING GRADE
OPEN LIMESTONE BED (OLB)
TOP=138.5
TOP LIMESTONE=138.0
BOT LIMESTONE=136.0
FIRESTONE EPDM POND LINER
LONGITUDINAL CROSS SECTION
SCALE: 1"=30' HORIZONTAL; 1"=3' VERTICAL
16" WATER LINE (DEPTH UNKNOWN)
SECTION C
SCALE: 1"=10' HORIZONTAL; 1"=1' VERTICAL
USDA NRCS
Natural Resources Conservation Service
SOUTH FORK LITTLE CONEMAUGH
LIMESTONE TRENCH PROJECT
FINAL PLAN VIEW

Brence (AMD85)





SR 286 PASSIVE TREATMNET SYSTEM
AWARE & Stream Restoration Incorporated
Center Township, Indiana County, PA
June 2005

Swallow Farm / Coal Run Treatment System

Monitoring Points

DCR1 = Swallow Farm Trx system raw water (USGS #27)
40° 03' 07.2" N
78° 47' 43.9" W

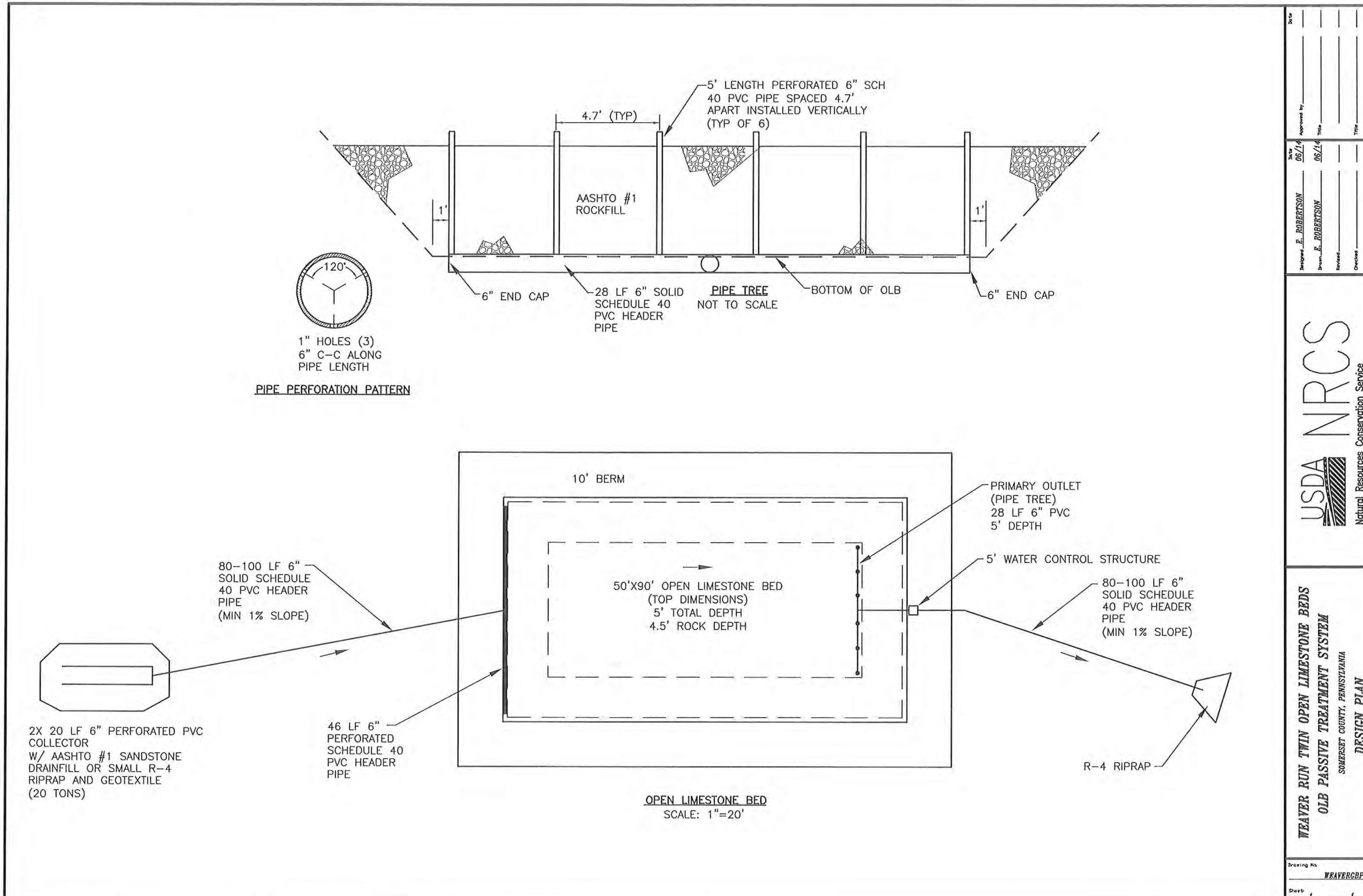
DCR1.5 = VFR effluent at weir
40° 03' 10.2" N
78° 47' 43.4" W

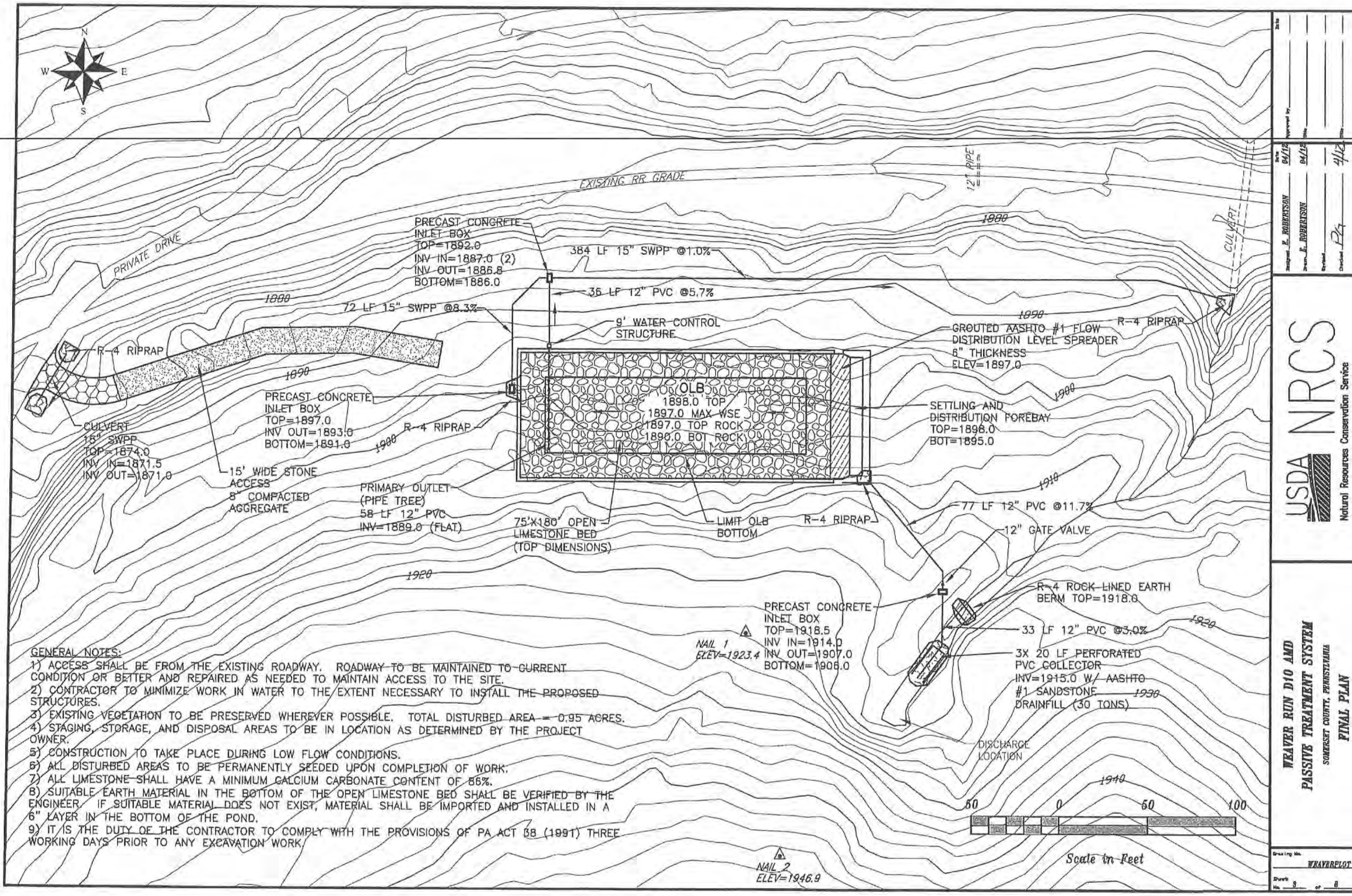
SFO = Trx system effluent after wetland
40° 03' 11.5" N
78° 47' 44.8" W

Upper Latrobe Passive System

Sample Point	Description
LFPPIN	Discharge
LFPP1	Pond 1 Outfall
LFPP2	Pond 2 Outfall
LFPP3	Pond 3 Outfall
LFPPOUT	Final Effluent of system to Loyalhanna Creek

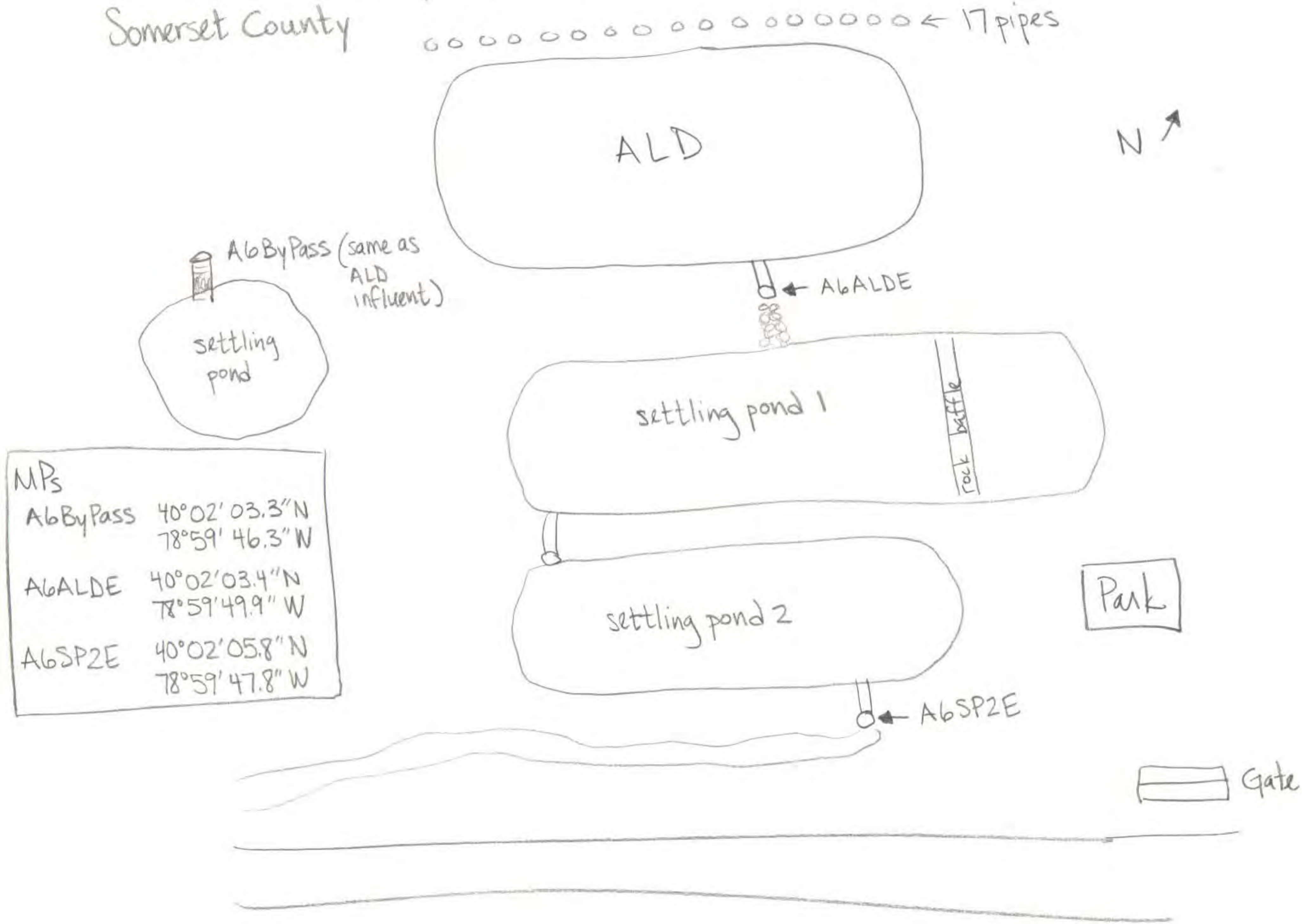
Weaver Run D8A & D8B




N
W
E
S
EXISTING RR GRADE
PRIVATE DRIVE
12" PIPE
CULVERT
1880
1890
1900
1910
1920
1930
1940
PRECAST CONCRETE INLET BOX
TOP=1892.0
INV IN=1887.0 (2)
INV OUT=1886.8
BOTTOM=1886.0
384 LF 15" SWPP @1.0%
36 LF 12" PVC @5.7%
72 LF 15" SWPP @8.3%
9' WATER CONTROL STRUCTURE
R-4 RIPRAP
GROUTED AASHTO #1 FLOW DISTRIBUTION LEVEL SPREADER
6" THICKNESS
ELEV=1897.0
OLB
1898.0 TOP
1897.0 MAX WSE
1897.0 TOP ROCK
1890.0 BOT ROCK
PRECAST CONCRETE INLET BOX
TOP=1897.0
INV OUT=1893.0
BOTTOM=1891.0
SETTLING AND DISTRIBUTION FOREBAY
TOP=1898.0
BOT=1895.0
CULVERT
15" SWPP
TOP=1874.0
INV IN=1871.5
INV OUT=1871.0
15' WIDE STONE ACCESS
8" COMPACTED AGGREGATE
PRIMARY OUTLET (PIPE TREE)
58 LF 12" PVC
INV=1889.0 (FLAT)
75'X180' OPEN LIMESTONE BED (TOP DIMENSIONS)
LIMIT OLB BOTTOM
77 LF 12" PVC @11.7%
12" GATE VALVE
R-4 ROCK-LINED EARTH BERM TOP=1918.0
PRECAST CONCRETE INLET BOX
TOP=1918.5
INV IN=1914.0
INV OUT=1907.0
BOTTOM=1906.0
33 LF 12" PVC @3.0%
NAIL 1
ELEV=1923.4
3X 20 LF PERFORATED PVC COLLECTOR
INV=1915.0 W/ AASHTO #1 SANDSTONE DRAINFILL (30 TONS)
DISCHARGE LOCATION
GENERAL NOTES:
1) ACCESS SHALL BE FROM THE EXISTING ROADWAY. ROADWAY TO BE MAINTAINED TO CURRENT CONDITION OR BETTER AND REPAIRED AS NEEDED TO MAINTAIN ACCESS TO THE SITE.
2) CONTRACTOR TO MINIMIZE WORK IN WATER TO THE EXTENT NECESSARY TO INSTALL THE PROPOSED STRUCTURES.
3) EXISTING VEGETATION TO BE PRESERVED WHEREVER POSSIBLE. TOTAL DISTURBED AREA = 0.95 ACRES.
4) STAGING, STORAGE, AND DISPOSAL AREAS TO BE IN LOCATION AS DETERMINED BY THE PROJECT OWNER.
5) CONSTRUCTION TO TAKE PLACE DURING LOW FLOW CONDITIONS.
6) ALL DISTURBED AREAS TO BE PERMANENTLY SEEDED UPON COMPLETION OF WORK.
7) ALL LIMESTONE SHALL HAVE A MINIMUM CALCIUM CARBONATE CONTENT OF 86%.
8) SUITABLE EARTH MATERIAL IN THE BOTTOM OF THE OPEN LIMESTONE BED SHALL BE VERIFIED BY THE ENGINEER. IF SUITABLE MATERIAL DOES NOT EXIST, MATERIAL SHALL BE IMPORTED AND INSTALLED IN A 6" LAYER IN THE BOTTOM OF THE POND.
9) IT IS THE DUTY OF THE CONTRACTOR TO COMPLY WITH THE PROVISIONS OF PA ACT 38 (1991) THREE WORKING DAYS PRIOR TO ANY EXCAVATION WORK.
NAIL 2
ELEV=1946.9
50 0 50 100
Scale in Feet
Designed E. ROBERTSON 04/12
Drawn E. ROBERTSON 04/12
Checked 4/12
USDA NRCS
Natural Resources Conservation Service
WEAVER RUN D10 AMD
PASSIVE TREATMENT SYSTEM
SOMERSET COUNTY, PENNSYLVANIA
FINAL PLAN
Drawing No. WEAVERPLOT
Sheet No. 8 of 8

Webster Passive System

Adams 6 Treatment System
Somerset County



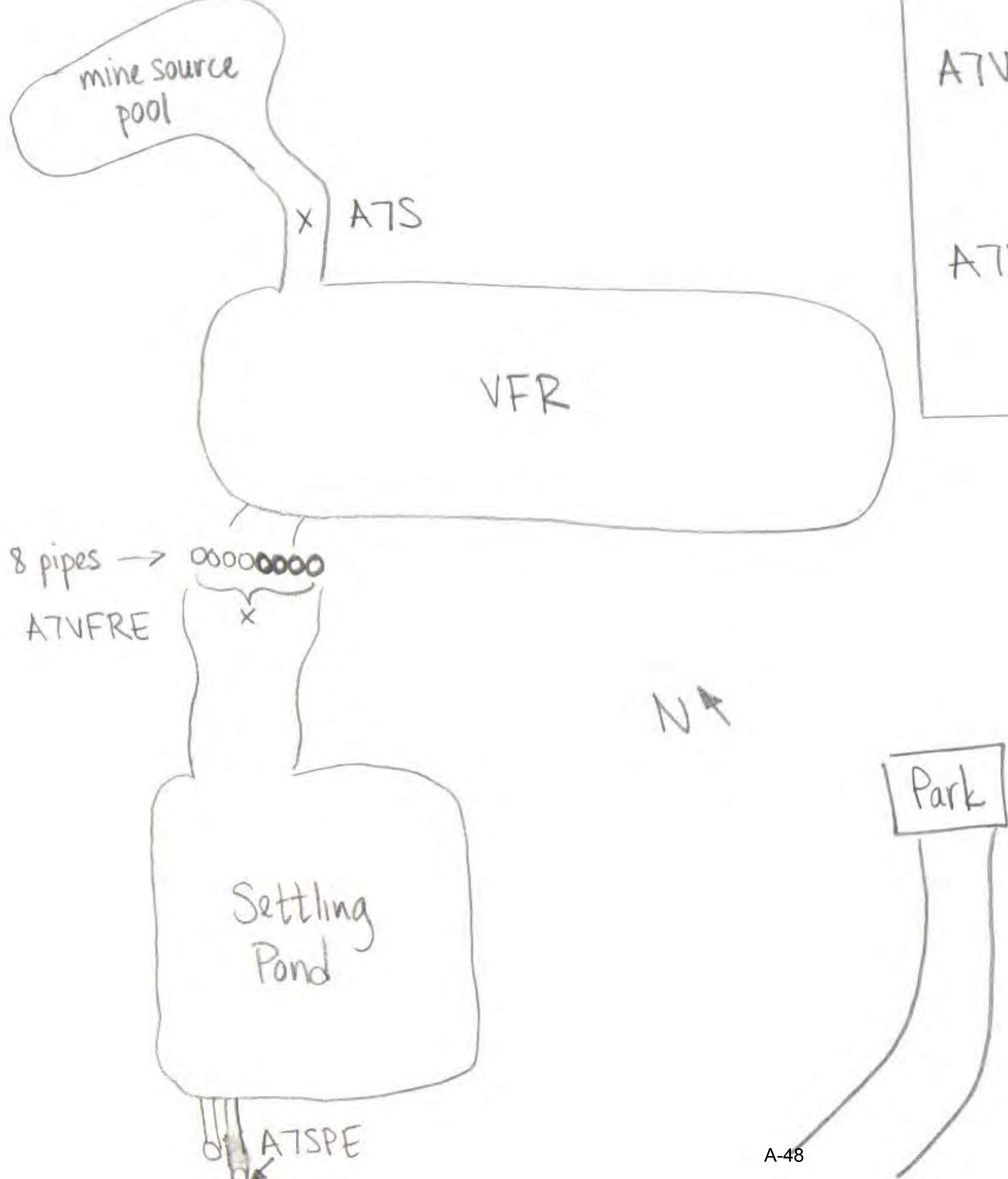
Adams 7
Somerset County

Monitoring Points

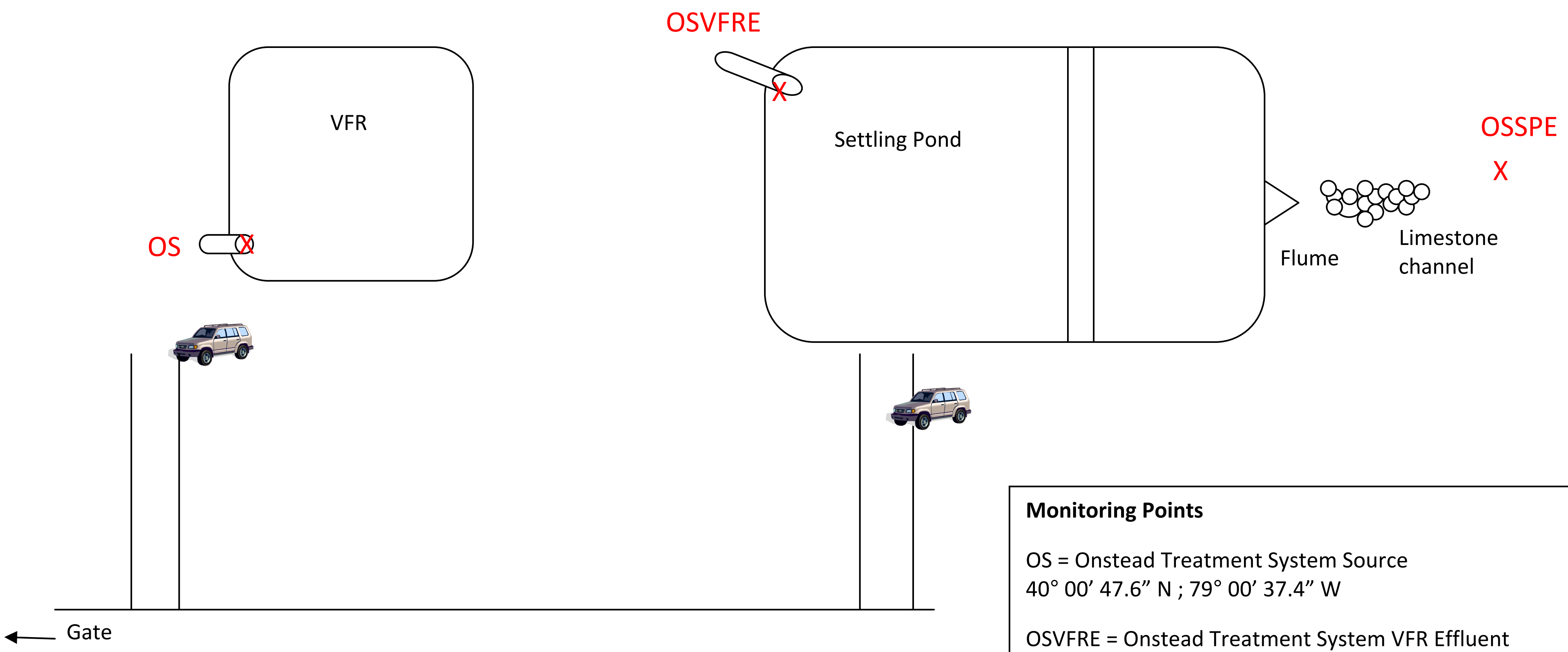
A7S = Adams 7 Treatment System Source
40° 02' 07.2" N ; 78° 59' 29.7" W

A7VFRE = Adams 7 Treatment System VFR Effluent
40° 02' 06.8" N ; 78° 59' 30.3" W

A7SPE = Adams 7 Treatment System Settling Pond Effluent
40° 02' 11.3" N ; 78° 59' 34.5" W



Onstead Treatment System
Somerset County

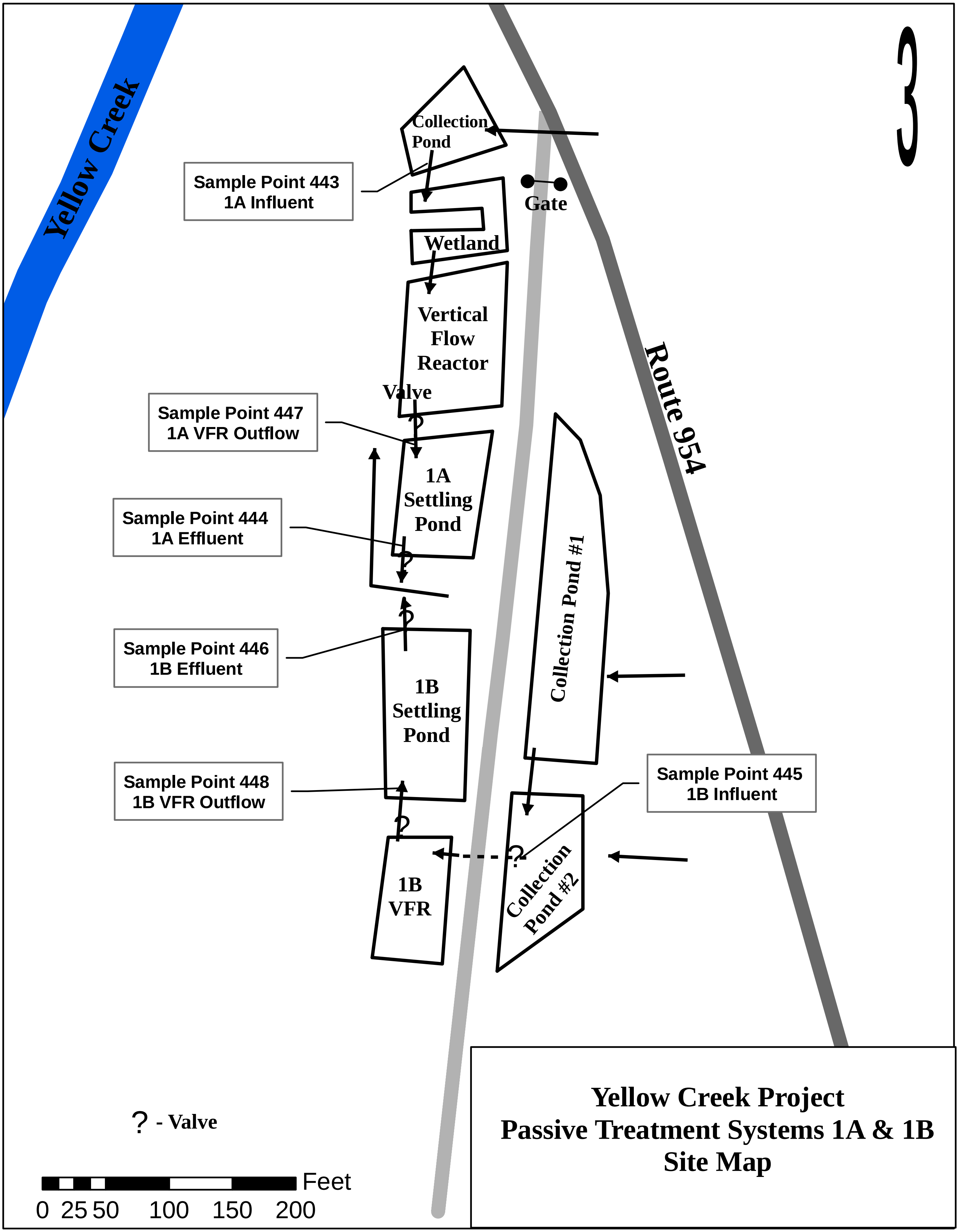


Monitoring Points

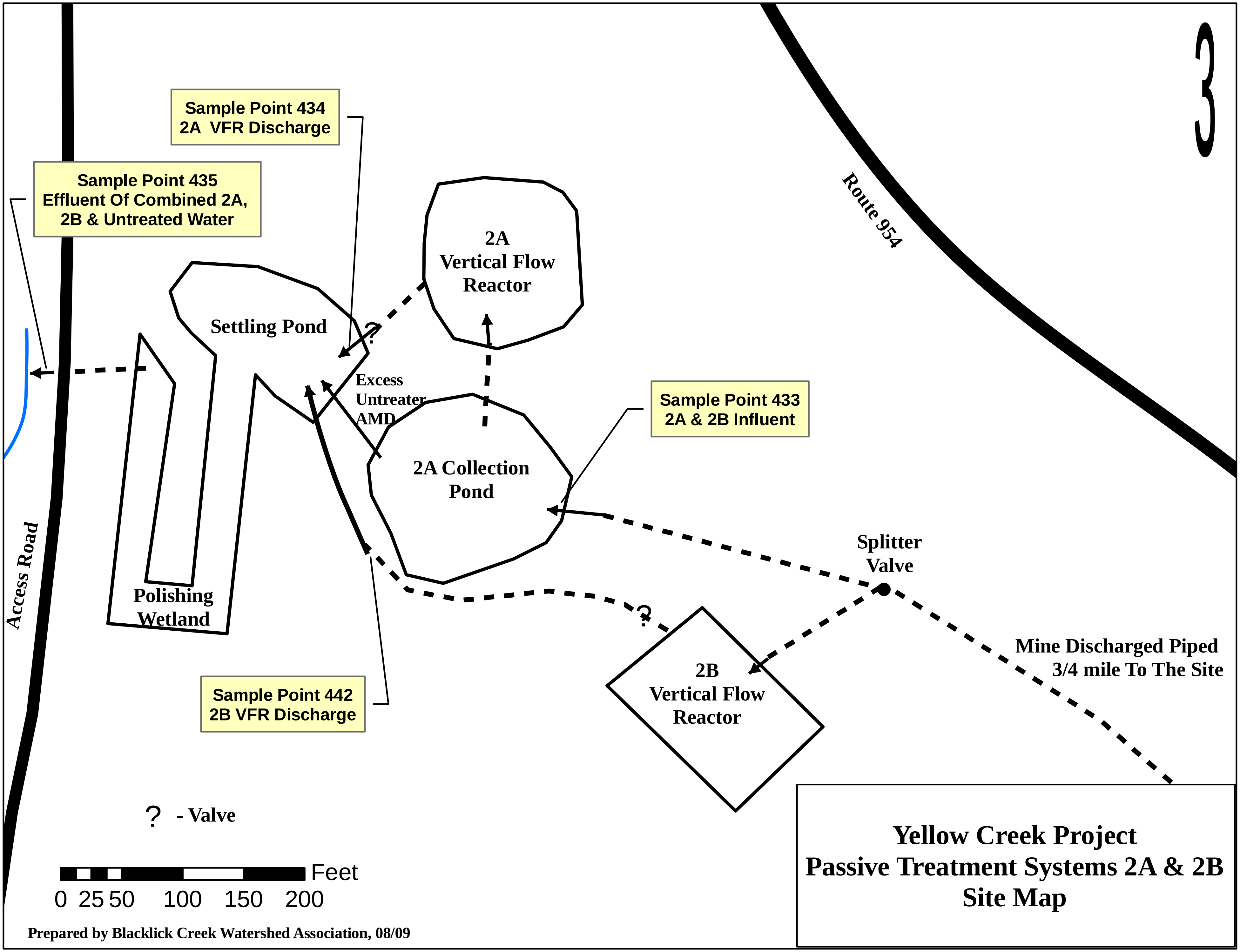
OS = Onstead Treatment System Source
40° 00’ 47.6” N ; 79° 00’ 37.4” W

OSVFRE = Onstead Treatment System VFR Effluent
40° 00’ 50.7” N ; 79°00’ 38.2” W

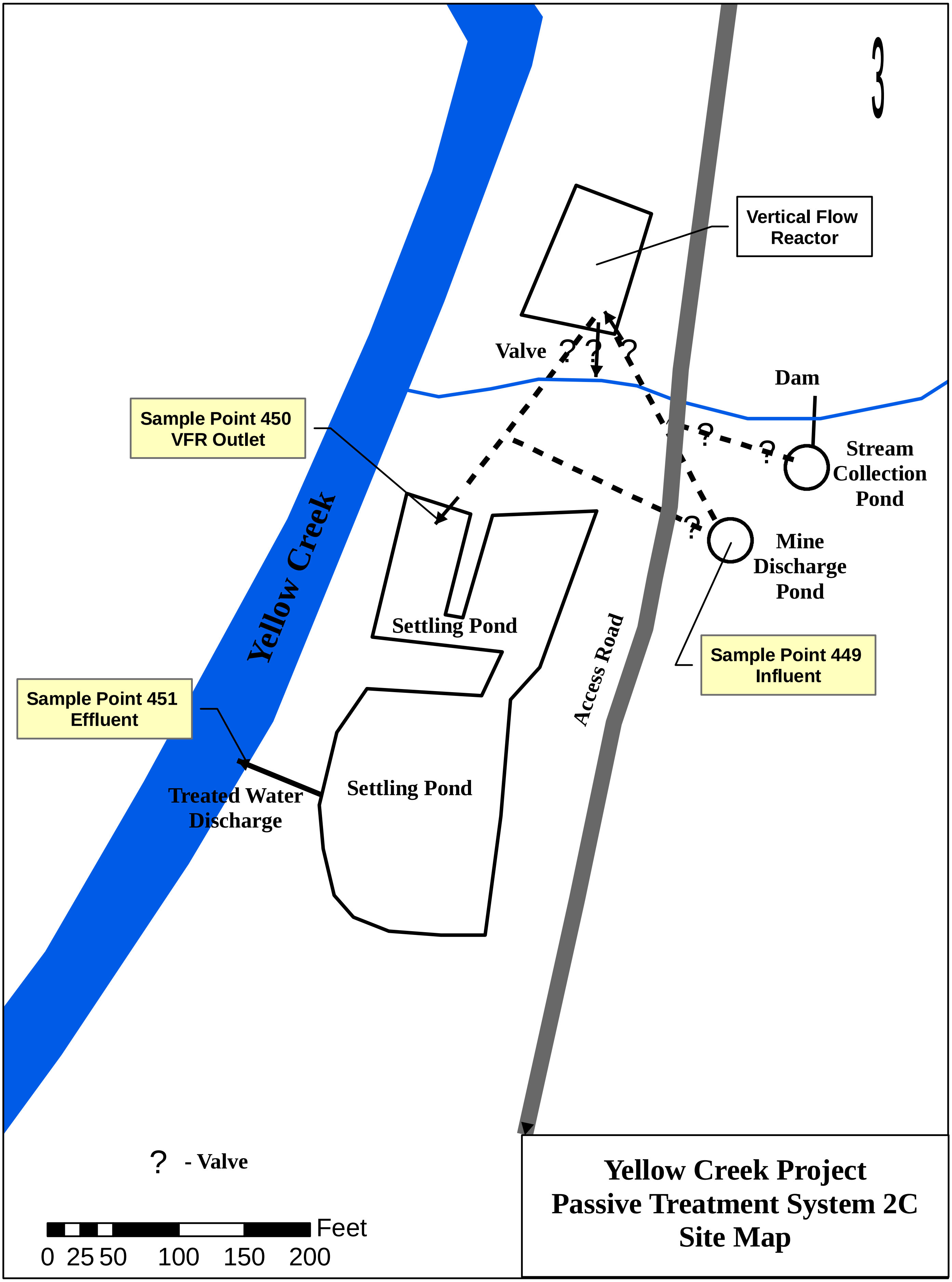
OSSPE = Onstead Treatment System Settling Pond Effluent
40° 00’ 52.8” N ; 79°00’ 37.3” W



Prepared by the Blacklick Creek Watershed Association, 08/09

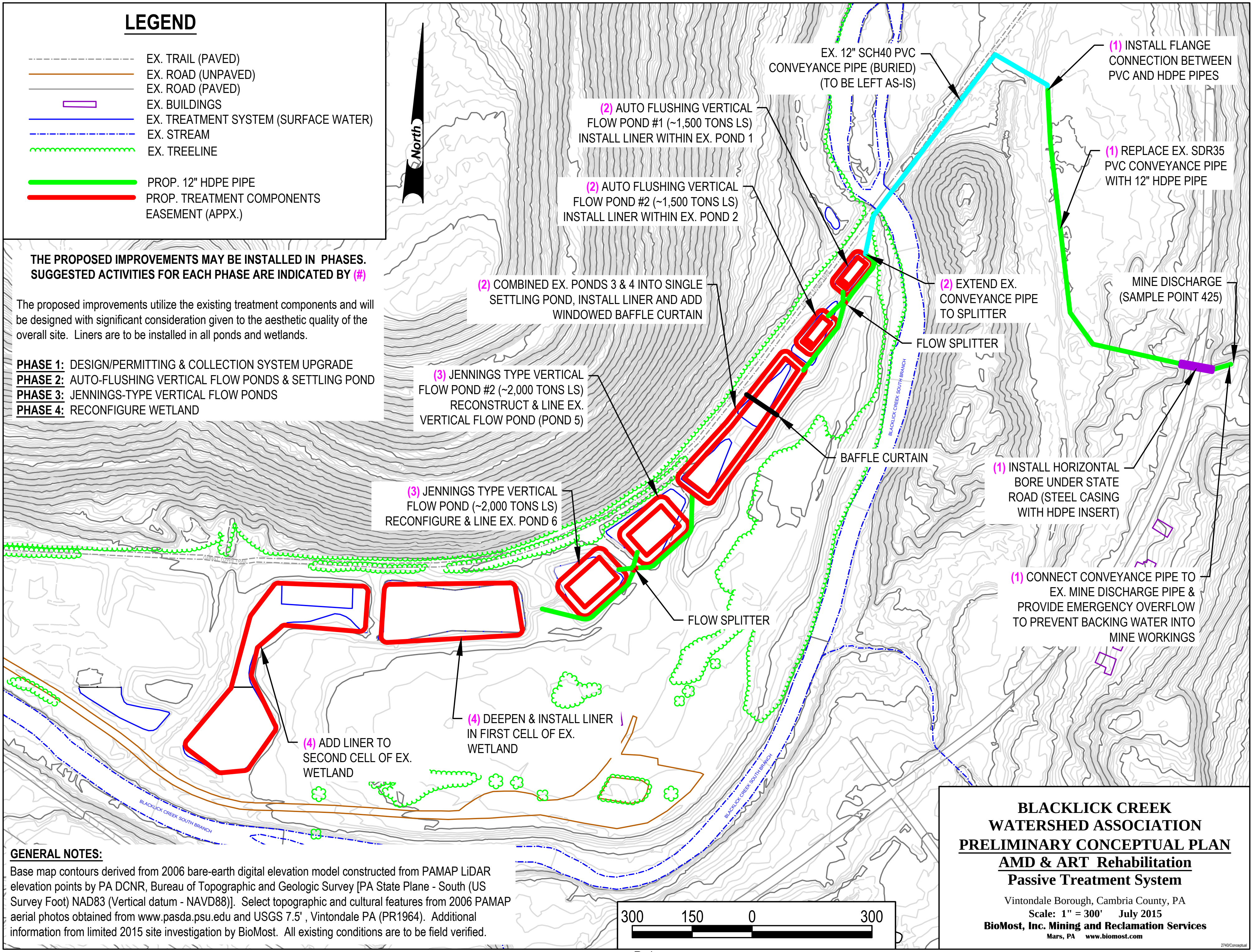


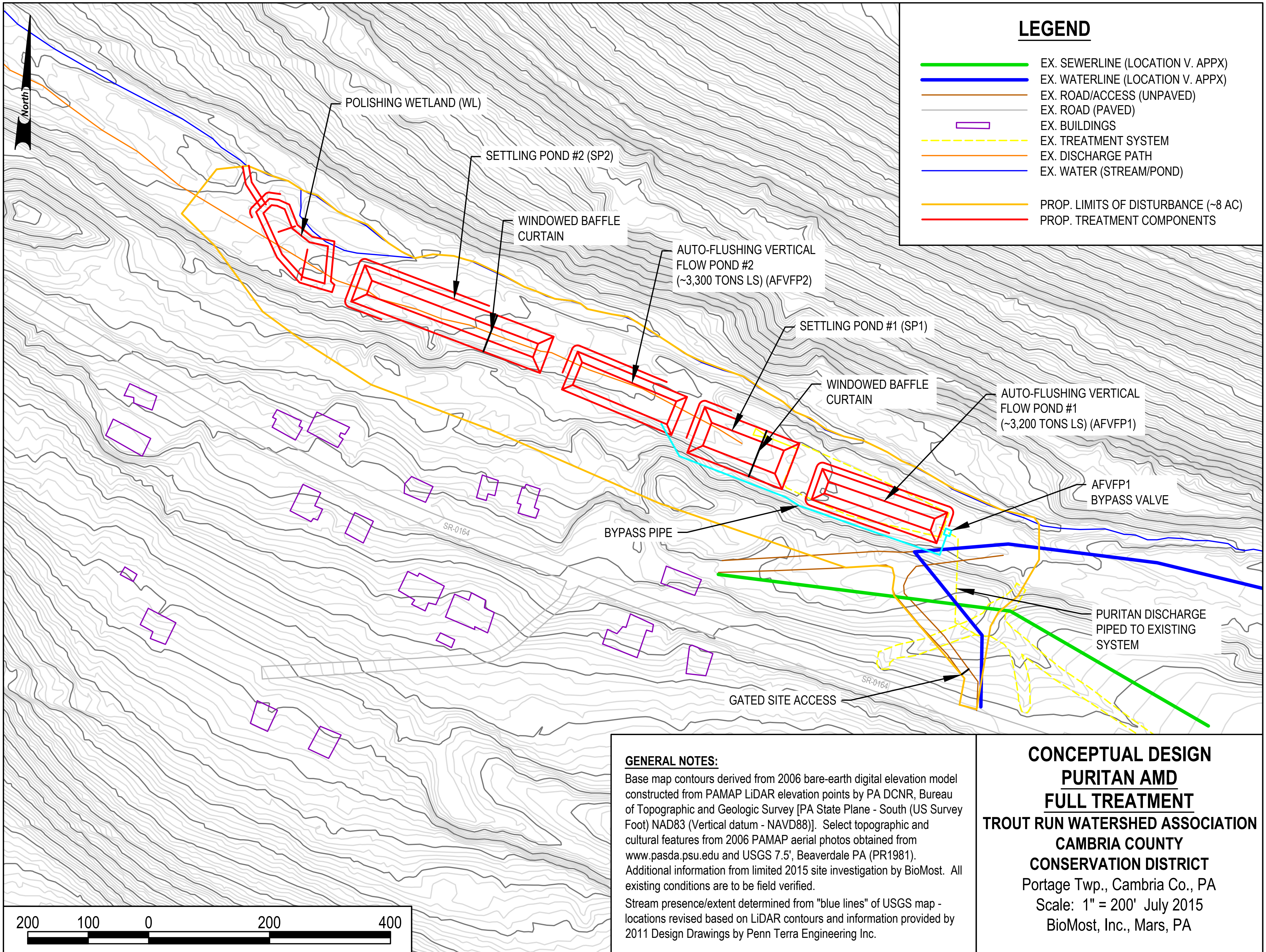
Yellow Creek Project
Passive Treatment Systems 2A & 2B
Site Map



Prepared by Blacklick Creek Watershed Association, 08/09

Appendix B: Conceptual Designs


LEGEND
EX. TRAIL (PAVED)
EX. ROAD (UNPAVED)
EX. ROAD (PAVED)
EX. BUILDINGS
EX. TREATMENT SYSTEM (SURFACE WATER)
EX. STREAM
EX. TREELINE
PROP. 12" HDPE PIPE
PROP. TREATMENT COMPONENTS
EASEMENT (APPX.)
North
THE PROPOSED IMPROVEMENTS MAY BE INSTALLED IN PHASES. SUGGESTED ACTIVITIES FOR EACH PHASE ARE INDICATED BY (#)
The proposed improvements utilize the existing treatment components and will be designed with significant consideration given to the aesthetic quality of the overall site. Liners are to be installed in all ponds and wetlands.
PHASE 1: DESIGN/PERMITTING & COLLECTION SYSTEM UPGRADE
PHASE 2: AUTO-FLUSHING VERTICAL FLOW PONDS & SETTLING POND
PHASE 3: JENNINGS-TYPE VERTICAL FLOW PONDS
PHASE 4: RECONFIGURE WETLAND
EX. 12" SCH40 PVC CONVEYANCE PIPE (BURIED) (TO BE LEFT AS-IS)
(1) INSTALL FLANGE CONNECTION BETWEEN PVC AND HDPE PIPES
(2) AUTO FLUSHING VERTICAL FLOW POND #1 (~1,500 TONS LS) INSTALL LINER WITHIN EX. POND 1
(1) REPLACE EX. SDR35 PVC CONVEYANCE PIPE WITH 12" HDPE PIPE
(2) AUTO FLUSHING VERTICAL FLOW POND #2 (~1,500 TONS LS) INSTALL LINER WITHIN EX. POND 2
(2) COMBINED EX. PONDS 3 & 4 INTO SINGLE SETTLING POND, INSTALL LINER AND ADD WINDOWED BAFFLE CURTAIN
(2) EXTEND EX. CONVEYANCE PIPE TO SPLITTER
MINE DISCHARGE (SAMPLE POINT 425)
FLOW SPLITTER
(3) JENNINGS TYPE VERTICAL FLOW POND #2 (~2,000 TONS LS) RECONSTRUCT & LINE EX. VERTICAL FLOW POND (POND 5)
BAFFLE CURTAIN
(1) INSTALL HORIZONTAL BORE UNDER STATE ROAD (STEEL CASING WITH HDPE INSERT)
(3) JENNINGS TYPE VERTICAL FLOW POND (~2,000 TONS LS) RECONFIGURE & LINE EX. POND 6
(1) CONNECT CONVEYANCE PIPE TO EX. MINE DISCHARGE PIPE & PROVIDE EMERGENCY OVERFLOW TO PREVENT BACKING WATER INTO MINE WORKINGS
FLOW SPLITTER
(4) DEEPEN & INSTALL LINER IN FIRST CELL OF EX. WETLAND
(4) ADD LINER TO SECOND CELL OF EX. WETLAND
BLACKLICK CREEK SOUTH BRANCH
GENERAL NOTES:
Base map contours derived from 2006 bare-earth digital elevation model constructed from PAMAP LiDAR elevation points by PA DCNR, Bureau of Topographic and Geologic Survey [PA State Plane - South (US Survey Foot) NAD83 (Vertical datum - NAVD88)]. Select topographic and cultural features from 2006 PAMAP aerial photos obtained from www.pasda.psu.edu and USGS 7.5' , Vintondale PA (PR1964). Additional information from limited 2015 site investigation by BioMost. All existing conditions are to be field verified.
300 150 0 300
BLACKLICK CREEK WATERSHED ASSOCIATION
PRELIMINARY CONCEPTUAL PLAN
AMD & ART Rehabilitation
Passive Treatment System
Vintondale Borough, Cambria County, PA
Scale: 1" = 300' July 2015
BioMost, Inc. Mining and Reclamation Services
Mars, PA www.biomost.com
2740/Conceptual

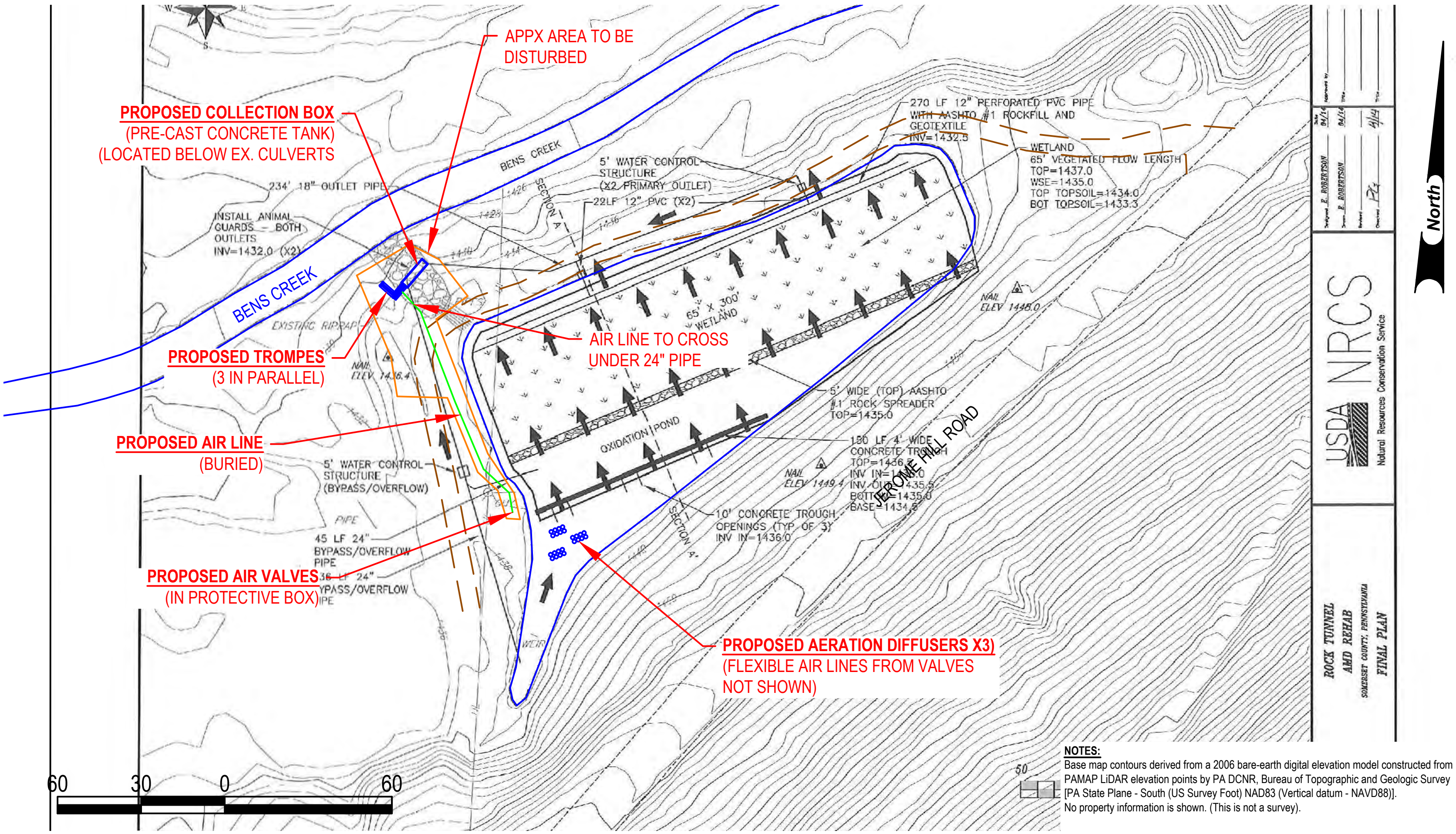


GENERAL NOTES:

Base map contours derived from 2006 bare-earth digital elevation model constructed from PAMAP LiDAR elevation points by PA DCNR, Bureau of Topographic and Geologic Survey [PA State Plane - South (US Survey Foot) NAD83 (Vertical datum - NAVD88)]. Select topographic and cultural features from 2006 PAMAP aerial photos obtained from www.pasda.psu.edu and USGS 7.5', Beaverdale PA (PR1981). Additional information from limited 2015 site investigation by BioMost. All existing conditions are to be field verified.

Stream presence/extent determined from "blue lines" of USGS map - locations revised based on LiDAR contours and information provided by 2011 Design Drawings by Penn Terra Engineering Inc.

CONCEPTUAL DESIGN
PURITAN AMD
FULL TREATMENT
TROUT RUN WATERSHED ASSOCIATION
CAMBRIA COUNTY
CONSERVATION DISTRICT
Portage Twp., Cambria Co., PA
Scale: 1" = 200' July 2015
BioMost, Inc., Mars, PA



NOTES:
Base map contours derived from a 2006 bare-earth digital elevation model constructed from PAMAP LiDAR elevation points by PA DCNR, Bureau of Topographic and Geologic Survey [PA State Plane - South (US Survey Foot) NAD83 (Vertical datum - NAVD88)].
No property information is shown. (This is not a survey).

BASE MAP PROVIDED BY NRCS/SCCD.
PROPOSED TROMPE-RELATED FEATURES SHOWN ARE APPROXIMATE AND ACTUAL LOCATIONS MAY CHANGE BASED ON FIELD CONDITIONS AND OTHER FACTORS.

LEGEND

EXISTING ROAD/TRAIL (GRAVEL)

EXISTING WATER

ROCK TUNNEL TROMPE AERATION

PRE-CONSTRUCTION LAYOUT PLAN
Somerset County Conservation District

Conemaugh Twp., Somerset Co., PA
Scale: 1" = 60' February 2015
BioMost, Inc. Mining and Reclamation Services
Mars, PA www.biomost.com