Laurel Run #1 Passive System Rehabilitation

Center Township, Indiana County, PA
40°30'29.7"N 79°06'46.4"W

A Blacklick Creek Watershed Association Project

Final Report

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Project Narrative:

I. Overview

The Blacklick Creek Watershed, located within Cambria and Indiana Counties in Western Pennsylvania, had extensive pre-act coal mining that began in the 1800's and therefore the main branch and many of the tributaries were impacted by acid mine drainage (AMD). 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 impacting about 40 miles of stream. To address the abandoned mine drainage within the watershed, the Blacklick Creek Watershed Association (BCWA) was formed in 1993. Through public-private partnership efforts, the BCWA and its partners have installed 13 passive treatment systems and one active system that are helping restore the Blacklick Creek Watershed today. Two treatment systems, Laurel Run #1 (2001) and Laurel Run #2 (2005) had previously been installed to address AMD issues in Laurel Run, a tributary to the mainstem of Blacklick Creek that enters just upstream of Josephine, PA. For nearly two decades, those two systems effectively neutralized acidity and removed metals, resulting in significant improvement to Laurel Run with only periodic maintenance needed for their upkeep. Based upon available data collected prior to rehabilitation, the Laurel Run #1 system alone neutralized 172 lb/day (62,900 lb/year) of acidity and removed 15 lb/day (5,560 lb/year) of iron and 10 lb/day (3,850 lb/year) of aluminum on average. Due to the system's immense benefits to Laurel Run and the watershed, BCWA partnered with Stream Restoration Incorporated (SRI) to rehabilitate the Laurel Run #1 Treatment System.

Stream Restoration Incorporated (SRI) received a Pennsylvania Department of Environmental Protection (PA DEP) Growing Greener grant in 2020 for this Laurel Run #1 Passive System Rehabilitation project to rehabilitate and to improve upon the design of the system using experience gained since its original construction in 2001. Additional funding was obtained from the US Office of Surface Mine Reclamation and Enforcement (OSMRE) Watershed Cooperative Agreement Program (WCAP) and the Foundation for Pennsylvania Watersheds (FPW). The funding was utilized for design, permitting, and reconstruction. Stream Restoration Incorporated acted as the fiscal agent and provided project management, outreach, and monitoring. BioMost, Inc., completed the design, permitting, bid documents, provided construction oversight and tree planting. Joseph C. Puryear Trucking & Excavating Inc. completed the construction work. A brief overview of the background, problems, and rehabilitation of the system is provided in the following sections.

Original Treatment System Information & Problems Encountered:
The Laurel Run #1 (aka North) Passive System is located on a mixture of public (PA State Game Lands #276) and privately-owned land in Center Township, Indiana County, PA within the headwaters of Laurel Run at the coordinates 40.508236, -79.112892. The site can be accessed from Aulds Run Road through a State Game Lands access road and gate. Laurel Run is listed as a Cold Water Fishery (CWF) in PA Code Title 25, Chapter 93. According to the 2018 Integrated Waters List, the entire four miles of Laurel Run (stream) are impaired by AMD.

The original Laurel Run #1 Passive Treatment System was funded by a PA DEP Watershed Restoration and Partnership Act grant. The system was designed by BioMost, Inc. and constructed by Amerikohl Mining in 2001 and had been initially designed to treat an average flow of 130 gpm and a maximum flow of 210 gpm. The original system utilized a perforated piping manifold surrounded by non-reactive aggregate at the outflow of an underground mine drain 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. The original system consisted of two vertical flow ponds (VFPs) operating in parallel, followed by a 0.6-acre aerobic wetland before discharging into Laurel Run. The VFPs were originally designed to have ~3,000 tons of high calcium carbonate limestone (4 foot thick) overlain by ½ foot thick spent mushroom compost, with a two-tiered underdrain system to provide a mechanism for flushing into a separate flush pond. The original shape of the VFPs were long, narrow, and rectangular, with the longer of the two being ~400 feet long and the shorter being ~315 feet long.

Prior to receiving funding for this rehabilitation project, Stream Restoration Incorporated (SRI), BioMost, Inc. (BMI), and the BCWA had been working together to evaluate and maintain passive treatment systems in the Blacklick Creek Watershed that began in 2012 as part of the Kiski-Conemaugh Basin Treatment System O&M Assessment project. Various maintenance activities were conducted between 2013 and 2018. During this time period, Amerikohl Mining Inc., conducted a surface remining operation. As part of the permit conditions, Amerikohl was to install a new pipe that conveyed flow from the underground mine drain to a new flow splitter box, conveyance piping, and a third layered VFP to provide additional treatment capacity during high flow events. Additionally, Amerikohl conducted maintenance on the existing system.

Starting in early 2018, the system once again began to show signs of decreased treatment performance including decreased permeability of the treatment media. While water going through the system was being treated well, portions of the flow were bypassing the VFPs even though they should have been able to handle the flow. There was some evidence of gas traps forming within the pipes as flushing would restore flow for a time. In addition, there appeared to be some issues with the new VFP. A broken pipe was suspected to be the cause; however, there was also concern about the pond being undersized. While it may have been possible to prolong the life of the system through stirring of the existing treatment media and performance of other maintenance in the short-term, a decision was made that the best course of action was to pursue funding to rehabilitate the system and potentially improve the design.

Laurel Run #1 Rehabilitation:
The Laurel Run #1 passive treatment system was redesigned by BioMost, Inc. Because BioMost designed the original system in 2001 and were involved with past maintenance events, they were already familiar with the project and able to improve upon the system's design using experience gained over the decades. The system was rebuilt by Joseph C. Puryear Trucking & Excavating Inc who was selected through a bid process. Construction began in late summer of 2024 and was essentially completed by March 2025.

During the early stages of the design process, it was discovered that the original mine drain, collection system, and piping distribution system were no longer functioning as intended (not conveying all the mine drainage) and that multiple seeps had formed along the hillside and therefore not entering the original passive system. It was uncertain when this change occurred, if it was sudden or gradual, or the exact cause, but likely did not occur until after the extremely wet year of 2018. It is possible that some of the seeps developed before 2018 but were not noticed or realized during sampling events. It is likely, although perhaps difficult to say with 100% certainty that the remining carried out by Amerikohl Mining, Inc., around 2012-2014 may have ultimately been responsible for this problem. There is concern that Amerikohl mined through the underground mine drain that had originally conveyed the AMD to the site and that the new pipe that they were supposed to install to convey the AMD had become separated or damaged afterwards. Since most of the length of the underground mine drain is likely still intact, AMD from the mine workings would still drain towards the project site, but then would suddenly end or be at least partially blocked, causing the AMD to build up and disperse within the backfill and ultimately find pathways to the surface forming the series of seeps. To address this issue, a collection channel (CC) and a terraced iron formation (TIF), were designed and installed to intercept as much of the multiple AMD seeps dispersed over the site as possible.

The newly rehabilitated system is designed to collect and treat 200 gpm on average with a max flow of 430 gpm. The following provides a description of the rehabilitation and maintenance efforts conducted at Laurel Run #1. Additional details are contained within the as-built drawings (Appendix 4) and O&M Plan (Appendix 3).

<u>Collection Channel (CC):</u>
The Collection Channel (CC) was added as a new component to the system as part of this project and is a 190-linear-foot rock-lined channel with a 2-foot bottom width that functions to collect the previously undiscovered and/or previously nonexistent northernmost discharge and convey the discharge to the terraced iron formation (TIF). The upper, flatter portion of the collection channel is AASHTO #1 rock-lined, and the lower, steeper portion is lined with R4 riprap.

<u>Terraced Iron Formation (TIF):</u>
The Terraced Iron Formation (TIF) was also added as a new component to the system as part of the rehabilitation project and functions to collect and convey diffuse discharges along the hillside as well as provide initial treatment through low pH iron removal. High Calcium AASHTO #1 limestone was used to line the TIF, acting as an alkaline buffer between acidic raw water and the underlying clay-bearing soil. The flow of water in the TIF will be maintained as a thin film to optimize treatment by promoting oxidation with atmospheric oxygen and facilitating biogeochemical processes at the water/solid interface, particularly on the surface of metal precipitates in the channel.

The TIF consists of three main sections: an inlet pool that collects raw water from the collection channel (CC), a 350-foot-long treatment channel with a 20-foot bottom width, and an outlet pipe leading to the flow splitter box. Approximately a quarter of the way down the TIF, two AMD seeps emanate from the upgradient hillside and flow into the TIF. To prevent erosion in these saturated areas, the seep zones are rock mulched with AASHTO #1 limestone. The combined drainage exits the TIF through an outlet pipe, which includes a twelve-inch SCH40 PVC pipe with an upward-facing tee to reduce clogging. The outlet pipe contains a stainless-steel bar guard inserted into the tee to block large debris. For maintenance, the bar guard is tied to a T-post, allowing personnel to pull on the rope to remove and clean the guard. The twelve-inch SCH40 PVC outlet pipe conveys water from the TIF into the flow splitter box. A 6” cleanout was installed approximately halfway between the inlet and the flow splitter box for future maintenance.

Flow Splitter Box:

The flow splitter box built by Amerikohl in 2012 was removed. A new splitter box was installed in a different location as part of this rehabilitation project with the purpose of distributing flow equally into the three Jennings-type vertical flow ponds (JVFP). It is a 10’x8.5’ concrete box with an aluminum grating cover and within it is a stainless-steel three-sided baffle with twelve-inch V-notch weirs cut into each side to split flow equally. Each weir is cut at a 90° angle. A weir lookup table can be found as Table 1 in the O&M Plan attached as Appendix 3 in this report. Both staff gauge and ‘measure down’ readings are included in the lookup table.

Jennings-type Vertical Flow Ponds 1, 2, and 3 (JVFP1, JVFP2, & JVFP3):

The area of the original passive system that consisted of two long rectangular vertical flow ponds and a flush pond were reconfigured into three square-shaped Jennings-style, mixed media vertical flow ponds. Limestone within the old original VFPs was washed and recovered as feasible. An estimated 3,100 tons of old limestone was recovered which was utilized as an aggregate filter envelope separating the mixed treatment media from the underdrain. The compost, sludge and other waste generated during the washing was placed in the fill placement area.

Each JVFP is designed to accept a third of raw inlet flow which is split evenly by the Flow Splitter Box. The JVFPs utilize a by-volume media mixture consisting of three parts limestone, two parts hardwood woodchips, and one part spent mushroom compost. Each JVFP contained approximately 2200 cubic yards of treatment media consisting of approximately 1,600 tons HI-CAL AASHTO #67 limestone aggregate, 400 cubic yards spent mushroom compost, and 800 cubic yards wood chips. This blend neutralizes acidity, generates alkalinity, and facilitates the precipitation of metals, particularly aluminum and iron.

Each JVFP includes a multi-cell underdrain system composed of four-inch SDR35 PVC perforated laterals connected to six-inch SDR35 PVC header pipes. The laterals are factory-perforated, while the headers are solid pipes with custom drilled ¼-inch perforations positioned midway between laterals and every five feet thereafter (within the pond footprint) to reduce air lock. These headers transition into solid six-inch SCH40 PVC pipes that pass through the embankment and discharge into a downstream treatment wetland. Each underdrain cell discharges through adjustable four-inch riser pipes, vertically connected to six-inch pipes using four-by-six-inch flexible rubber couplers. Riser heights can be manipulated to adjust water levels or direct flow through selected treatment zones. Each JVFP includes two potential outlets: the primary outlet via riser pipes and secondary overflow via rock-lined emergency spillways into the treatment wetland. All outlet pipes may also be drained to the wetland with the individual six-inch valves.

Treatment Wetland (WL):
The treatment wetland is the final stage in the system, receiving water from each of the JVFPs. The wetland was part of the original passive treatment system. During construction, treatment sludge and vegetation were removed and placed in the fill placement area identified on the as-built, but the original footprint of the wetland was left intact. An inlet pool near the VFP outlet traps solids and helps to spread the flow of water before it enters the wetland. A rock distribution berm placed perpendicular to the flow distributes water evenly, minimizing short-circuiting. The 25,200 square foot wetland is designed to remain free of standing water, with flow saturating the substrate. Overtime as organic matter, vegetation, and metal precipitates build up, the substrate is expected to thicken, and the water level is anticipated to gradually rise. The wetland has two primary functions: to re-aerate water that enters in a reduced state from the JVFPs and to provide surface area for iron to oxidize and precipitate. Treated water exits the wetland through a primary spillway to Laurel Run.

System Performance and Environmental Impact
Construction and rehabilitation of the Laurel Run #1 system was completed in early 2025. Due to the brief period between the construction end date and the grant end date, along with limited funding SRI was only able to conduct two monitoring events to assess the system performance on March 25th, 2025 and May 19th, 2025. In addition, sporadic site visits and assessments by SRI, BioMost, and the BCWA were carried out during the months of May through July 2025. Following this grant period, Laurel Run #1 will continue to be monitored by the BCWA, Stream Team, and SRI as feasible. Water quality results are presented for Laurel Run #1 in Appendix 2 - Water Monitoring Data and have been uploaded onto Datashed (www.datashed.org). In addition to the monitoring data collected post-rehabilitation, historic monitoring data for each system has been provided as a source of comparison. Site schematics provided in Appendix 3 can be referenced to help match the location of sample points to the data as can mapping available on Datashed. The water quality results are described in more detail below.

Laurel Run #1 Passive Treatment Performance – Post Construction
Post-construction monitoring of Laurel Run #1 took place on 3/25/2025 (Table 2, Appendix 2) and on 5/19/2025 (Table 3, Appendix 2), and the results demonstrated effective treatment of the acid mine drainage going through the system as well as improved water quality downstream. Early and late spring was chosen as the post-construction sampling time due to the expected high flow from March through May. At the northern end of the system, multiple diffuse discharges are collected, with the northernmost discharge being collected in the 190-foot-long collection channel (CC) that flows into the terraced iron formation (TIF). Two additional seeps were effectively captured in the TIF a quarter of the way down. The TIF is a long channel designed to remove low pH iron through the work of naturally occurring iron oxidizing bacteria. Low pH iron oxidation and precipitation was observed to be occurring as

evidenced by the accumulation of the hard, dense, red-orange colored iron solids coating the limestone along the entire reach of the TIF, and sampling results supported this observation. Water monitoring conducted during both sampling events demonstrated a 50% decrease in total iron concentration from the top of the TIF (sample point CC) to the end (sample point TIF), collected at the flow splitter box. The sample results from 3/25/2025 showed a decrease in iron from 18.4 mg/L to 10.2 mg/L (Table 2, Appendix 2), while the results from 5/19/2025 had a decrease from 10.80 mg/L to 5.86 mg/L (Table 3, Appendix 2).

From the TIF, AMD is conveyed via a pipeline to the flow splitter box, which splits the flow relatively evenly into the three Jennings-style vertical flow ponds (JVFPs). The reconfigured Jennings-style vertical flow ponds JVFP1, JVFP2, and JVFP3 are functioning as designed by increasing pH, neutralizing acidity, increasing alkalinity, and removing metals. The effluent from all three JVFPs were found on both sampling events to be net alkaline, with a pH right around 7.0, and with decreased aluminum concentrations to <0.1 mg/L. The alkalinity generated by all JVFPs in March were about 200 mg/L and close to 300 mg/L in May 2025. Additionally, water flowing into and out of each vertical flow pond were assessed during the May 2025 sampling event and indicated no loss or gain was occurring and flow evenly distributed. Flows will continue to be assessed and outlet piping adjusted as needed to balance the flow through the JVFPs. A mild hydrogen sulfide odor was noticed when standing directly next to the JVFP outlet risers and black precipitates were observed in the water exiting the JVFPs, indicating the JVFPs are working as intended by promoting biological activity by sulfur reducing bacteria that generate alkalinity. The odor does not linger far beyond the outlet of the JVFPs.

Following the JVFPs is the 0.6-acre wetland, which was part of the original passive system prior to the rehabilitation project and remains the final component of the Laurel Run #1 system. The wetland is intended to function to aerate the water and provide for the precipitation and settling of metals. The water appeared to be evenly dispersed across the wetland due to the rock distribution berm, which was added as part of this rehabilitation project. Sampling conducted on 3/25/2025 demonstrated a 50% decrease in iron and manganese concentrations from the VFP outlet to the end of the wetland; However, small concentrations of iron (2.55 mg/L and 2.37 mg/L) were still present in the wetland effluent during the March and May sampling events. It is possible that the iron concentrations remain slightly elevated due to the lack of wetland vegetation during those initial months following rehabilitation. We suspect that better established wetland vegetation will result in improved treatment performance. During a more recent site visit on 7/23/25, wetland plants were already observed to be populating the treatment wetland (Appendix 1 – Photolog, Page 15) and field iron measurements were below 1.0 mg/L.

Load Reduction Comparison to Pre-Rehabilitation Data
Acidity, metals, and alkalinity loading data for Laurel Run #1 collected post-rehabilitation in spring of 2025 was compared to the average loading data over the life of the system since its original construction in Table 4 of Appendix 2. Acid load neutralization achieved by Laurel Run #1 were somewhat similar prior to rehabilitation as after, with an average of 62,938 pounds of acidity neutralized per year prior to rehabilitation and a calculated 60,535 pounds of acidity

neutralized per year based on the two sample events in 2025. Alkalinity loading was calculated to be over three times as high following rehabilitation, with combined alkalinity load to Laurel Run being 24,662 lb/year averaged before the project and being 90,520 lb/year after rehabilitation in 2025. This considerable amount of excess alkalinity generated by the rehabilitated system may be due to being a new system but is incredibly beneficial as it will neutralize other sources of acidity entering Laurel Run. Though not originally intended, manganese load reductions greatly improved following rehabilitation, with an average of 82 lb/year manganese being removed prior to rehab and 1,059 lb/year being removed following rehabilitation. This is at least partly due to the higher manganese concentrations in the AMD itself compared to historical data. As for aluminum, 3,852 lb/year was removed prior to rehabilitation and 4,417 lb/year was removed after rehabilitation. Iron load reductions, however, were found to be slightly less following rehabilitation in spring of 2025 as compared to the iron load reductions averaged before the project. The average iron load reduction prior to rehabilitation was 5,560 lb/year, while post-rehabilitation was slightly less at 4,617 lb/year. This slight difference in the amount of iron loading removal at Laurel Run #1 following rehab could be due to a variety of factors including variability of flow and chemistry, long term water quality data vs two sample points, as well as potentially due to the wetland vegetation not yet being fully established. The comparison of the post-rehabilitation loading calculations to the historical average loadings demonstrates that the newly rehabilitated Laurel Run #1 system is working just as well if not better than the original system. Of course, two sampling events conducted shortly after construction are not sufficient indicators of long-term system performance. Stream Restoration Incorporated, the BCWA, and Stream Team will continue to monitor the system through different funds and programs to further evaluate its long-term effectiveness.

Overall, the post-construction water quality assessments conducted at Laurel Run #1 indicate the system components are functioning as designed to treat multiple AMD seeps and discharges onsite. The effluent of the treatment system can be characterized as circumneutral, net-alkaline water with low metal concentrations. Based upon the available data, the newly rehabilitated system is neutralizing 100% of the acidity, providing excess alkalinity and is removing about 85% of the iron, 99% of the aluminum, and about 70% of the manganese. The percentage of iron removal is expected to increase in future monitoring due to the re-establishment of wetland vegetation.

Effect of System Rehabilitation on Laurel Run
A brief comparison of available water quality data for Laurel Run was conducted. Unfortunately, little stream data related to the reach of Laurel Run was available on Datashed at the time of analysis. SRI is currently working to obtain and upload additional data to Datashed. A more thorough analysis will likely be possible while completing the design phase of the Laurel Run #2 rehabilitation project. In addition, there appears to be little downstream data prior to the original system being constructed in 2001. The downstream sample point (50-17) in relation to the Laurel Run #1 passive system is located at Aulds Run Road. In general, prior to any reclamation, water quality at 50-17 could be characterized as slightly acidic (pH ~5) and about 30 mg/L hot acidity with metal concentrations of about 1 mg/L Fe, 4 mg/L Al, and 1 mg/L of Mn. Immediately after the original passive system was constructed in late summer 2001, water

monitoring indicated a good pH around 7, net-alkaline and metal concentrations less than 1 mg/L. In March 2023, during the design process the system was in very poor condition with little water going through the treatment system during high flow conditions, and sample point 50-17 had a 4.3 pH in the field, was net-acidic at 15 mg/l hot acidity with Fe 2.2 mg/L, Al 1.5 mg/L and Mn 0.5 mg/L. Two samples were collected at 50-17 post-rehabilitation in 2025 (Table 3 and 4). On both dates, the stream was net-alkaline with a pH greater than 7 and metal concentrations all less than 1 mg/L. During the May 2025 sampling event, iron, aluminum, and manganese instream concentrations at 50-17 were all less than 0.5 mg/L. This monitoring indicates successful improvement to the water quality of Laurel Run. Additional stream monitoring is planned over the next year as part of the Laurel Run #2 design project which will further document stream improvements.

Additional AMD Seeps

As discussed throughout this report, problems associated with the underground mine drain resulted in the unexpected formation of a number of dispersed AMD seeps across the site rather than a single source emanating from the mine drain. While the collection channel and TIF are doing an excellent job of intercepting the vast majority of the AMD, there are a few small AMD seeps that emanate below the channels and some indication that AMD may be directly entering the streams themselves as “base flow.” It should be noted that these seeps may be intermittent and only occur during periods of high flow or following precipitation events. These seeps should continue to be monitored, but do not appear to have significant impacts on Laurel Run.

For example, a natural spring which emanates below and near the end of the TIF, forms an unnamed tributary labelled UNT15 (Appendix 3 - Schematic) that was intentionally avoided during construction of both the original and the newly rehabilitated system due to its good quality. Runoff collected by the diversion ditch is directed into this stream as well. UNT15 was assessed using field measurements during the March and May sampling events and contained a pH above 6.0 both times. The spring’s color was clear but showed evidence of iron staining on the substrate. During the sampling on 5/19/2025, a sample at UNT15 was collected for laboratory analysis, which had a pH above 6.0, alkalinity above 50 mg/L, negative acidity, and metal concentrations below 0.1 mg/L. The lab analysis suggests good quality of the water in UNT15, however, the BCWA reported the spring as having orange-colored water during high flow heavy rain and flood watches on 6/17/2025. There was concern by BCWA that the system was not collecting all of the AMD.

This concern identified by BCWA prompted further investigation by BioMost and SRI on 7/23/25 to assess the system and search for and document any AMD seeps that may be bypassing the treatment system. This included conducting a stream walk along Laurel Run and the tributaries that were located below the system. Field measurement results from 7/23/25 are presented in Table 5 of Appendix 2.

During the investigation of unnamed tributary 15 (UNT15), there was some evidence of a seep directly entering within the tributary about halfway between the start of the spring (UNT15-

Top) and the mouth (UNT15-DN) but the exact location was difficult to determine due to the large boulders and downed trees within the stream. Water quality at the formation of the spring just below the TIF had a pH of 7.2 and field Fe ~0.5 mg/L. Monitoring near the middle of UNT15 indicated a pH of 6.9 and field iron concentrations of ~2.5. Monitoring near the mouth of UNT15 had a pH of 7.1 and iron ~2.5. This indicates that while a seep appears to be present, it was not having a major impact on UNT15, at least on this date.

During the 7/23/25 investigation, SRI walked Laurel Run from near the new access road bridge past the Upstream monitoring point identified on the schematic, up towards the end of the surface mine. The stream segment above the Upstream monitoring point did not show any significant impacts with pH >6, clear water, and no visible iron staining. However, an approximately ~1,000-foot stretch of Laurel Run below the collection channel (CC) and TIF down to the access road bridge contained decreased pH and elevated levels of field iron concentrations. The investigation documented three small seeps located to the east and down gradient of the CC and TIF, which were not being captured and instead flowing directly into Laurel Run. Two of the three seeps contained extremely low flow (estimated to be less than 2 gpm) but had a pH of 3.0 and field iron concentration of ~7.0 mg/L. A slightly larger seep estimated to be less than 5 gpm (Seep 3, Appendix 2 – Table 5) was located below the collection channel and flowing into Laurel Run. This seep contained a field pH of 2.9 and field iron concentration of 5.5 mg/L. During the site investigation, BioMost collected elevation data of this seep and determined that this source of AMD could potentially be collected by a sump and then piped to the TIF but would require additional funding to implement.

Despite the presence of these identified AMD seeps bypassing the Laurel Run #1 system, the stretch of stream impacted is relatively small. The worst impact is about 500 feet in length. Laurel Run is then improved by UNT15 despite it having some potential AMD influence. Just upstream of the confluence with UNT15, the pH of Laurel Run was 3.8. By the time the stream reaches the site access bridge (LR POST-TIF, Appendix 2 – Table 5) the pH was measured to be 6.2 and the iron concentration <1.5 mg/L. Water quality continued to improve downstream. Laurel had a measured pH of 7.9 and field iron <1.0 mg/L just upstream of the system effluent, while having an alkalinity of 70 mg/L, pH of 7.6, and iron <1.0 mg/L directly downstream of the system effluent (Appendix 2 – Table 5). These downstream water quality findings are consistent with the previous March and May sampling events at Laurel Run #1 (Appendix 2 – Tables 2 & 3).

II. Operation & Maintenance Plan

BioMost, Inc., developed an O&M plan for the Laurel Run #1 passive treatment systems as part of this rehabilitation project. The plan explains site location and access, information on system components, how to perform operation and maintenance on specific system components, system monitoring requirements, and an anticipated O&M schedule. In short, the overall recommended O&M schedule is to visit the site on a monthly basis. During the site visit, the inspector should record flow at the flow splitter box, clear the splitter box and TIF bar guard of debris, visually inspect all components, check the pH at the system effluent (pH >6.0). The O&M plan recommends collecting water samples for laboratory analysis at the CC, TIF, JVFPs, and WL on an annual basis. All monitoring data should be uploaded to www.datashed.org. In addition, the annual O&M plan is also to flush solids out of the flow splitter box, exercise the JVFP inlet valves, and exercise the JVFP drain valves. The full O&M plan is attached as Appendix 3 in this report and is uploaded to Datashed.

III. Growing Greener Report Questions

a. What was the project supposed to accomplish?

The Laurel Run #1 Passive System Rehabilitation project was to redesign and rehabilitate (rebuild) the Laurel Run #1 passive system in the Blacklick Creek Watershed which was originally built in 2001 and no longer performing as desired. The goal was to sustain treatment achieved by the original construction, while accounting for AMD that bypassed the old system during high flow events and to ultimately improve stream water quality. An additional goal was to utilize knowledge of passive systems acquired over the past several decades to improve treatment effectiveness, reduce maintenance needs, and increase system longevity. Improved treatment performance was in turn expected to provide increased buffering capacity to Laurel Run. Another goal of the project was to utilize the existing pond structure as much as possible and to recover and reuse limestone that remained from the original system. As part of the project deliverables, as-built drawings and an updated O&M plan were also to be provided. Additional details regarding pre-existing conditions, plans, and actual implementation are provided within the overview section.

b. What you actually did and how it differs from your plan?

The Laurel Run #1 passive system was successfully redesigned and rehabilitated/rebuilt. In general, everything that was proposed in the 2019 grant application was completed through this project, despite some minor specification differences, although certain aspects from the conceptual system design needed to be changed in order to address changing field conditions as well as landowner requests. For example, in the original proposal, we were hoping to utilize or possibly improve the existing flow splitter box and potentially reuse the existing piping system to convey the AMD to the three JVFPs. However, as described above, during the design process it was discovered that the original mine drain, collection system, and piping distribution system were no longer functioning and that multiple seeps had formed along the hillside and no longer entering the original passive system To address this issue, a collection channel (CC) and a terraced iron formation (TIF), were designed and installed to intercept as much of the multiple AMD seeps dispersed over the site as possible. The added 190-foot-long CC is beneficial by intercepting the northern-most discharge for treatment in Laurel Run #1, while the 350 foot-long TIF provides immense benefits by collecting additional seeps while also promoting low-pH iron oxidation.

Another change that occurred from the conceptual provided in the grant application to the final design was that the private landowner did not want to have any ponds on his property. This required moving what was identified in the conceptual design as JVFP1 to be located on Pennsylvania Game Commission property with the other two JVFPS and reclaiming the old VFP that Amerikohl had built as part of their remine permit. This required changing the overall layout as well as the need for a new flow splitter box and distribution piping system.

The reconfiguration of the three traditional layered VFPs into three square-shaped Jennings-style vertical flow ponds (JVFPs) was carried out as proposed. However, slight differences in treatment media specifications resulted. For instance, it was proposed in the grant application that each reconfigured JVFP would contain a treatment media mixture of about 2,000 tons high-calcium limestone, 470 cubic yards mushroom compost, and 930 cubic yards woodchips. The JVFPs were instead filled with a mixture of approximately 1,600 tons of high-calcium limestone, 400 cubic yards spent mushroom compost, and 800 cubic yards wood chips. In addition, as originally proposed, the AASHTO #1 limestone within the old VFPs was recovered and reused onsite after it was washed, but instead of it being crushed and resized to AASHTO #57 and utilized within the treatment media mix, it was instead used within the underdrain of each JVFP. Though there was slightly less mixed treatment media than proposed, the reconfigured JVFPs contain completely fresh limestone in the media and are still designed to treat a combined max flow of 430 gpm, which is well beyond the flow measured entering the system during 2025. In addition, the use of the 3,100 tons of recovered limestone as part of the underdrain, likely provides more overall tonnage of limestone and more neutralization capacity within the JVFPs.

An additional item that was added to the system during this rehabilitation project that was also not in the proposal is the rock distribution berm in the wetland. This is a small addition to the wetland that is expected to increase retention time and decrease channel formations.

c. What were your successes and reasons for your success?

Laurel Run #1 was successfully rehabilitated. Based on data collected in March and May of 2025 (Table 4, Appendix 2), the system is estimated to neutralize at least 60,000 pounds of acidity and prevent around 10,000 pounds of metals from entering Laurel Run each year. Furthermore, initial water monitoring results suggest the rehabilitated system provides over 90,000 pounds of alkalinity to Laurel Run each year. This shows that Laurel Run #1 is successfully treating the AMD entering the system as well as providing excess alkalinity for partial treatment of AMD and other sources of acidity that may be entering the stream in other locations.

Success of the project is due to the collective efforts and contributions of all project partners involved and the long-term dedicated commitment of the Blacklick Creek Watershed Association who have been working to improve the mainstem and the tributaries of Blacklick Creek for over 30 years. The project would not have been possible without the funding provided by the PA DEP Growing Greener program, OSMRE's WCAP program, and the Foundation for PA Watersheds. Without the ongoing and long-term support of the PA Game Commission, who owns much of the system property, as well as the support of the private landowner, the system would not exist. The professional expertise provided as well as the donated services and reduced fees of our various project partners, especially BioMost, Inc., was invaluable. The primary construction contractor Joseph C. Puryear Trucking & Excavating Inc. provided efficient quality work and were easy to work with.

d. What problems were encountered and how did you deal with them?

There were two main problems that were encountered during the grant period. As mentioned in other areas of this report, probably the most significant issue that was encountered was the unanticipated development of multiple dispersed AMD seeps that had formed after grant submission. This meant that the original collection system at the underground mine drain, flow splitter box and conveyance pipe could not be utilized, and we also had to develop another way to collect the multiple AMD sources dispersed over the site which was more difficult, less straightforward and more costly. This issue was addressed through the addition of the 190-foot-long collection channel (CC) and the 350-foot-long terraced iron formation (TIF), both of which collect and convey the vast majority of the AMD on site.

The second major issue was massive inflation that occurred due to the COVID-19 pandemic which began shortly after the grant was submitted in 2019. This significantly increased the cost of the project, especially related to materials for construction such as limestone, compost, pipe, valves, and fuel. This along with the need to install the collection channel and TIF significantly increased the overall cost of the project. To address this issue, we had to seek additional sources of funding as well as request an amendment to the grant contract which resulted in increasing the total grant amount. The additional funding made it possible to complete construction of the entire project as designed.

e. How your work contributed to the solution of the original problems?

Due to the extensive mining that had occurred throughout the Blacklick Creek Watershed, the BCWA and its partners have been working to restore many of the streams and tributaries impacted by AMD through land reclamation and the installation of numerous passive treatment systems. Despite the treatment systems' success over the years, the passive systems have a finite design life of 20-25 years. This project provided for the rehabilitation of the Laurel Run #1 passive system, which played an important role in treating AMD in a major tributary entering Blacklick Creek. This rehabilitation thereby continues to provide treatment and watershed restoration improvements that were accomplished through the original construction of the system. Laurel Run #1 not only neutralizes acidity and prevents metals from entering the watershed but also produces excess alkalinity to provide additional buffering compacity to the stream.

f. What else needs to be done?

The rehabilitation project has been completed. SRI and the BCWA will need to regularly inspect Laurel Run #1 and conduct maintenance as needed. The BCWA continues to monitor the performance of the other passive treatment systems in the watershed in partnership with Stream Team. Additionally, the BCWA is currently working together with SRI to rehabilitate the Laurel Run #2 passive treatment system located approximately one mile downstream from Laurel Run #1. SRI was awarded a grant through the Pennsylvania DEP AML/AMD Grant Program to complete the design work.

g. What are the plans for disseminating the project results?

Project information including water monitoring data, as-built drawings, O&M plan, and final report information will be posted online to Datashed (www.datashed.org) for free public access. Project information, updates, and successes will be shared at BCWA watershed meetings and through social media posts. In addition, the project will likely be discussed and/or presented at public events, tours, and conferences such as the annual Pennsylvania Abandoned Mine Reclamation, American Society of Reclamation Sciences, and West Virginia Mine Drainage Taskforce.

h. How well did spending align with the budget request?

Costs associated with this project, especially construction, were significantly higher than the original budget that was submitted in the 2019 grant application. This was largely due to massive inflation that occurred during and following the COVID-19 pandemic that began in 2020. Another factor that affected the cost of the project was the need to install a collection channel and TIF to capture the various discharges that had developed after the grant submission. These issues required SRI to seek a grant contract amendment that increased our grant budget by $100,000 as well as a $20,000 grant from the Foundation for Pennsylvania Watersheds. These additional funds allowed us to build the full-scale system as designed.

Appendix 1

Photographs

Top: Access road to the Laurel Run #1 system in 2023 (prior to rehab).

Middle & Bottom: Laurel Run (stream) flowing past the treatment system in 2023. The stream was impacted due to a large portion of the discharge bypassing the system.

Top: View of the Laurel Run #1 passive treatment system from the entrance at the bottom of the hill prior to rehab (2023).

Bottom Left: At some point, the original underground mine drain and collection system failed causing multiple AMD seeps to form across the site. One of the AMD discharges that had formed, bypassing the treatment system and entering directly into the stream prior to rehabilitation (2023).

Bottom Right: Another AMD seep that had formed at Laurel Run #1. An attempt was made to direct it into the flow splitter box of the system (2023).

Top: Flush pond of the original passive system in 2023. The flush pond was too small to be effective and not useful for Jennings style vertical flow ponds so was removed during rehab. The area was utilized for part of JVFP1.

Middle: The longer of the two original vertical flow ponds (VFPW aka VFRA) at Laurel Run #1 with the flush pond to the left. The photo taken in 2023 prior to rehab shows the long, rectangular shape which was potentially partly responsible for the cause of gas traps and short-circuiting issues within the VFPs.

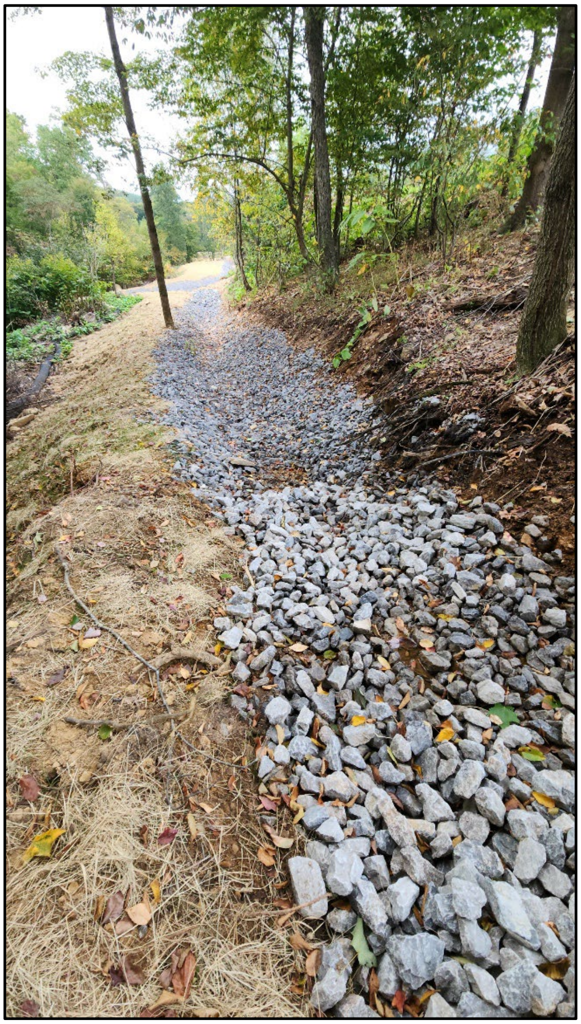
Bottom: View from the berm that separated the two original VFPs prior to rehab (2023).




Top Left: Laurel Run downstream at Aulds Run Road prior to rehab (2023).

Top Right: An unrelated AMD discharge found along the access road downstream of the system prior to rehab (2023).

Bottom: Laurel Run downstream at Aulds Run Road following rehab (May 2025).



All Above: Construction phase of the rehab project which started in late summer of 2024.

Left: Collection channel after initial construction.

Top Right: Terraced iron formation (TIF) after initial construction.

Bottom Right: Diversion ditch (right, on the upper slope) and the TIF (left, on the lower slope).

All Above: Construction of the rehab project which started in late summer of 2024.

Top Photo: During rehabilitation, the old treatment media was washed (background) to recover the limestone. The VFPs were reconfigured over time to have more of a square shape as opposed to the previous long, narrow shape. Portion of JVFP1 new berm constructed across VFPW but incomplete with the old flush pond still intact.

Bottom Left: Stone recovered from the original VFPW after being washed. The engineering ruler provides scale for stone size.

Bottom Right: Treatment sludge and vegetation were removed from the wetland. The wetland was also utilized for temporary sludge storage while washing and recovering the limestone from the VFPs.

All Above: Construction of Laurel Run #1 in late summer to fall of 2024.

Top Left: Raw discharge that was temporarily diverted during construction.

Top Right: Rock mulch was used to collect and convey some of the AMD discharges into the TIF while reducing erosion.

Bottom: Planted grass already growing next to the newly constructed TIF in fall of 2024.

All Above: Construction of Laurel Run #1 in late summer to fall of 2024.

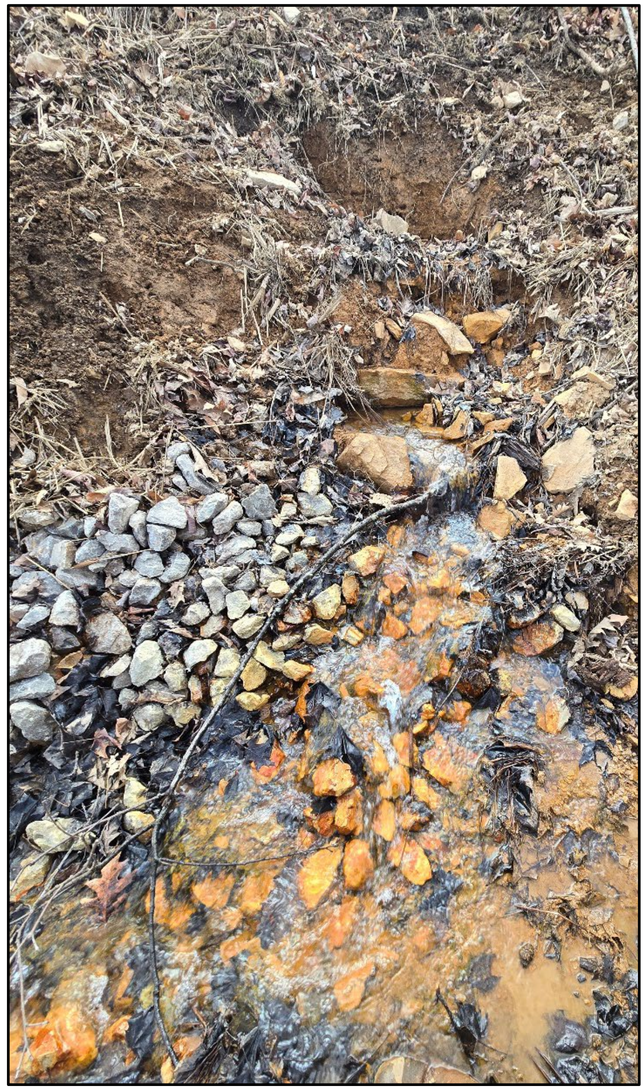
Top Left: Removal of piping and washing of limestone in one of the original VFPs.

Top Right: Installment of the underdrain system in JVFP1.

Bottom Left: Placement of mixed media into JVFP1.

Bottom Right: Pile of mixed media prior to being placed into a JVFP, which included a mix of compost, woodchips, and limestone.

All: Mixing and placement of treatment media in the new JVFPs in November 2024.



All Photos: Post-construction in March of 2025.

Left: Top of the Collection channel.

Right: Close-up of one of the AMD discharges that is captured by the collection channel and conveyed downhill to the TIF.

All Photos: Laurel Run #1 post-construction in March of 2025.

Top Left: Image of the end of the collection channel and another discharge entering the TIF.

Top Right: Terraced iron formation (TIF) after construction.

Bottom: End/bottom of the TIF where water pools and then flows into the pipe that conveys the AMD to the new flow splitter box.




All Photos: Newly installed flow splitter box post rehab.

Top Left: Inside of flow splitter box with drain valve open and drained.

Top Right: Flow splitter box filling back up after valve closed.

Bottom: Inside of new flow splitter box (left) showing one of the V-notch weirs and outside (right) with lightweight aluminum grate cover.

Top Left: JVFP1 after being online for over two months.

Top Right: Outlet risers of all three JVFPs discharging to the wetland.

Bottom: Final wetland shortly after construction before vegetation established. Note the dark color of the water is likely due to tannins and metals sulfides.

Above: Post-construction in May of 2025.

Top Left: Months after construction, the reconfigured JVFPs at Laurel Run #1 are working as intended. The white cloudy water on top of the JVFP1 is aluminum precipitating out of solution due to the increase in pH.

Top Right: Effluent of JVFPs flowing from the riser pipes and entering the wetland. JVFP drain valve boxes can be seen next to the wetland.

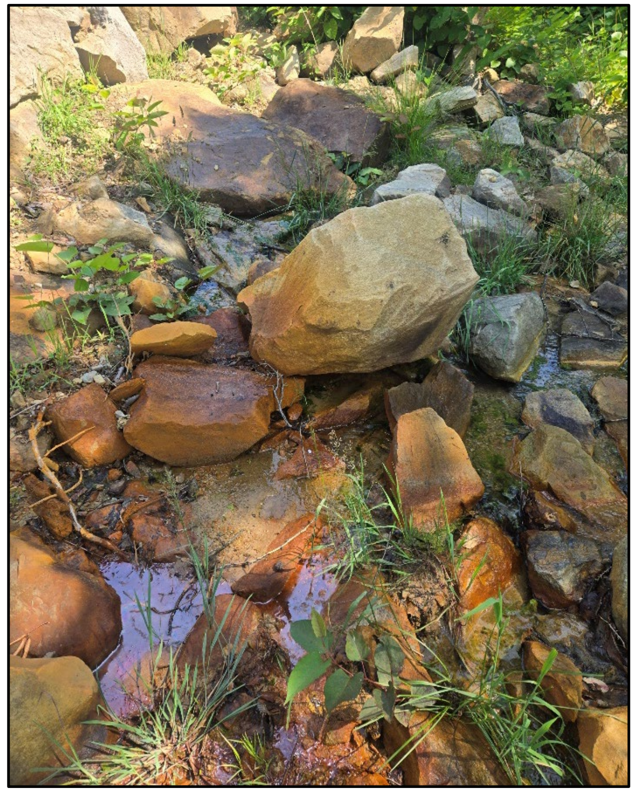
Bottom: JVFP outlet risers were easily adjusted to balance flow (left), with the balanced flow shown in the bottom right picture.

Above: Laurel Run #1 (LR#1) wetland, which is the final treatment component in the system, during the site assessment on 7/23/25.

Top: First portion of the LR#1 wetland before the rock flow distribution berm was intentionally designed to be deeper for settling of solids.

Middle: A rock distribution berm was installed to reduce channelization within the wetland. The second half of the wetland contains emerging wetland vegetation, such as cattails.

Bottom: The entire second half of the wetland now has wetland vegetation growing in it. This is expected to increase oxidation, precipitation and settling of iron.



Above: The unnamed tributary (UNT #15) was monitored during multiple site visits using field equipment and once with laboratory analysis between March and July of 2025. The water consistently contains neutral to circumneutral pH and contained low metal concentrations (<0.1 mg/L) when assessed in May 2025. The Blacklick Creek Watershed Association reported concerns of seeing AMD flowing in the channel in June 2025 which prompted investigations by BioMost and Stream Restoration Incorporated in July 2025. Iron staining is evidence of water containing high iron content flowing through this channel at times but could partly be due to when AMD was bypassing treatment prior to rehabilitation. Field monitoring did provide some evidence of a small AMD seep entering this tributary, but it was difficult to pinpoint the exact location.

Above: Stream photos taken during the site assessment on 7/23/25 to document seeps.

Top: Close up of Laurel Run (stream) located upstream near the beginning of the collection channel. Sections of the stream had significant sedimentation that had collected in small pools.

Middle: Portion of Laurel Run (stream) near the TIF that is impacted by three seeps that are not currently being captured in the LR#1 system. Iron is visible in this small reach of the stream (~1,000 ft reach) and a pH below 4.0 was measured near this location.

Bottom: Laurel Run where the LR#1 system effluent (shown on the right side with black coloration due to the VFP sulfide products) mixes with the stream. Circumneutral pH and low iron were measured at this location, despite evidence of iron staining, likely due to past conditions prior to rehabilitation.

Appendix 2

Water Monitoring Data

Table 1: Laurel Run No. 1 Average Water Quality Data Prior to Rehabilitation Project (2000 to 2020)

Point	Description	Flow (gpm)	pH Field	pH Lab	Cond. Field	Alk Lab	Acidity	T. Fe	T. Mn	T. Al	SO4	TSS	Alk Lab Load	Acidity Load	T. Fe Load	T. Mn Load	T. Al Load
RAW (458)	AMD raw influent to LR#1	115	3.32	3.21	899	0	144	13.05	1.19	10.93	310.1	7.1	0	172.2	16.4	1.4	12.2
VFP-W (459)	Outflow of VFP-West (aka VFRA)	57	5.58	6.46	901	62	-32	2.84	1.43	3.26	302.2	15.3	28.3	-5.8	1.1	0.7	2.6
VFP-E (460)	Outflow of VFP-East (aka VFRB)	54	5.97	6.36	886	75	-32	2.83	1.33	3.20	316.8	13.9	41.2	-11.6	1.3	0.6	2.0
WL (461)	Final Effluent of LR#1 from WL	115	6.30	6.90	1,173	52	-21	0.92	0.98	0.96	219.0	8.0	67.6	-25.7	1.1	1.2	1.6
LR-UP (50-9)	LR stream sample point upstream LR#1: Collected 2000-2002 and 2023	54	6.01	5.96	115	4	4	0.2	0.1	1.1	18.1	4.1	-	-	-	-	-
LR-DN (50-17)	LR stream sample point downstream LR#1 at Aulds Run Rd: Collected 2000-2002 and 2023	178	5.34	5.60	698	48	18	2.2	1.1	2.6	284	7.1	-	-	-	-	-

Units for specific conductivity are in µmhos/cm; and all units for alkalinity, acidity, metals, sulfate, and total suspended solids (TSS) are in mg/L. Units for loading are in lb/day. It should be noted that a portion of past historical water monitoring data wrongly reported hot acidity as a '0" rather than the negative number.

Table 2: Laurel Run No. 1 Water Quality Post Rehabilitation on 3/25/2025

Point	Description	Flow (gpm)	pH Field	pH Lab	Cond. Lab	Alk Field	Alk Lab	Acidity	Temp (°C)	T. Fe	T. Mn	T. Al	SO4	TSS	Alk Lab Load	Acidity Load	T. Fe Load	T. Mn Load	T. Al Load
CC	Sampled at end of the Collection Channel before flowing into the TIF	88*	2.91	2.94	1180	Na	< 10	190	10.4	18.4	3.55	13.1	420	< 2	0	200.9	19.5	3.8	13.9
TIF	Sampled after end of the TIF at the flow splitter box	88	3.41	3.12	1070	Na	< 10	130	11.5	10.2	3.61	12.9	490	7	0	137.5	10.8	3.8	13.6
VFPs	Composite (combined) sample of all VFP outlets	76	6.94	7.50	1030	201	199	-180	8.2	6.24	2.39	< 0.1	359	21	181.8	-164.4	5.7	2.2	≥0.0, ≤0.1
WL	Effluent of WL and final effluent of LR#1	76*	7.99	8.11	1020	183	195	-177	12.9	2.55	0.97	< 0.1	344	10	178.1	-161.7	2.3	0.9	≥0.0, ≤0.1
LR-UP	LR stream sample point upstream LR#1, but downstream from designated stream sample point for LR#1	-	4.05	4.22	280	Na	< 10	28	8.4	0.08	1.24	3.0	87	< 2	-	-	-	-	-
LR-DN	LR stream sample point downstream LR#1 at Aulds Run Rd	-	7.77	7.90	512	55	58	-45	9.7	0.8	0.59	0.7	149	8	-	-	-	-	-

Units for all temperature measurements are in degrees Celsius, specific conductivity are in µmhos/cm; all units for alkalinity, acidity, metals, sulfate, and total suspended solids (TSS) are in mg/L. Units for loading are in lb/day. Any flow measurement with an asterisk* in front is an estimated value based off flow measurements of other points within the system.

Table 3: Laurel Run No. 1 Water Quality Post Rehabilitation on 5/19/2025

Point	Description	Flow (gpm)	pH Field	pH Lab	Alk Field	Alk Lab	Acidity	Temp (°C)	T. Fe	T. Mn	T. Al	SO4	TSS	Alk Lab Load	Acidity Load	T. Fe Load	T. Mn Load	T. Al Load
CC	Sampled at end of the Collection Channel before flowing into the TIF	80*	2.88	3.14	Na	<20.0	136	12.7	10.80	3.87	10.90	622	<5	0	130.8	10.4	3.7	10.5
UNT15	Spring water bypassing LR#1 system and entering LR		6.04	6.22	58	51.8	-50	10.8	0.07	0.03	0.03	178	<5	-	-	-	-	-
TIF	Sampled after end of the TIF at the flow splitter box	80	3.19	3.31	Na	<20.0	94	19	5.86	3.36	8.69	382	<5	0	90.4	5.6	3.2	8.4
JVFP1	Composite sample from outlet risers for first JVFP	23	7.46	7.13	280	274	-254	15.5	4.11	2.33	0.05	142	14	75.7	-70.2	1.1	0.6	0.01
JVFP2	Composite sample from outlet risers for second JVFP	27	7.24	7.03	295	267	-270	17.9	1.11	1.81	0.08	135	<5	86.6	-87.6	0.4	0.6	0.02
JVFP3	Composite sample from outlet risers for third JVFP	28	7.25	7.02	350	300	-302	16.5	2.92	1.91	0.06	137	6	101.0	-101.6	1.0	0.6	0.02
WL	Effluent of WL and final effluent of LR#1	80*	6.69	7.64	310	258	-272	21.2	2.37	0.87	0.14	118	11	248.0	-261.5	2.3	0.8	0.1
LR-UP	LR stream sample point upstream LR#1	-	5.91	5.81	1	<20.0	-2	12.8	0.46	0.12	0.33	24	9	-	-	-	-	-
LR-DN	LR stream sample point downstream LR#1 at Aulds Run Rd	-	7.13	7.24	80	66.2	-60	13.5	0.36	0.09	0.19	128	<5	-	-	-	-	-

Units for all temperature measurements are in degrees Celsius, specific conductivity are in µmhos/cm; all units for alkalinity, acidity, metals, sulfate, and total suspended solids (TSS) are in mg/L. Units for loading are in lb/day. Any flow measurement with an asterisk* in front is an estimated value based off flow measurements of other points within the system.

Table 4: Load Reductions and Alkalinity Load to Stream Pre (Red) and Post (Blue) Rehab (lb/year)

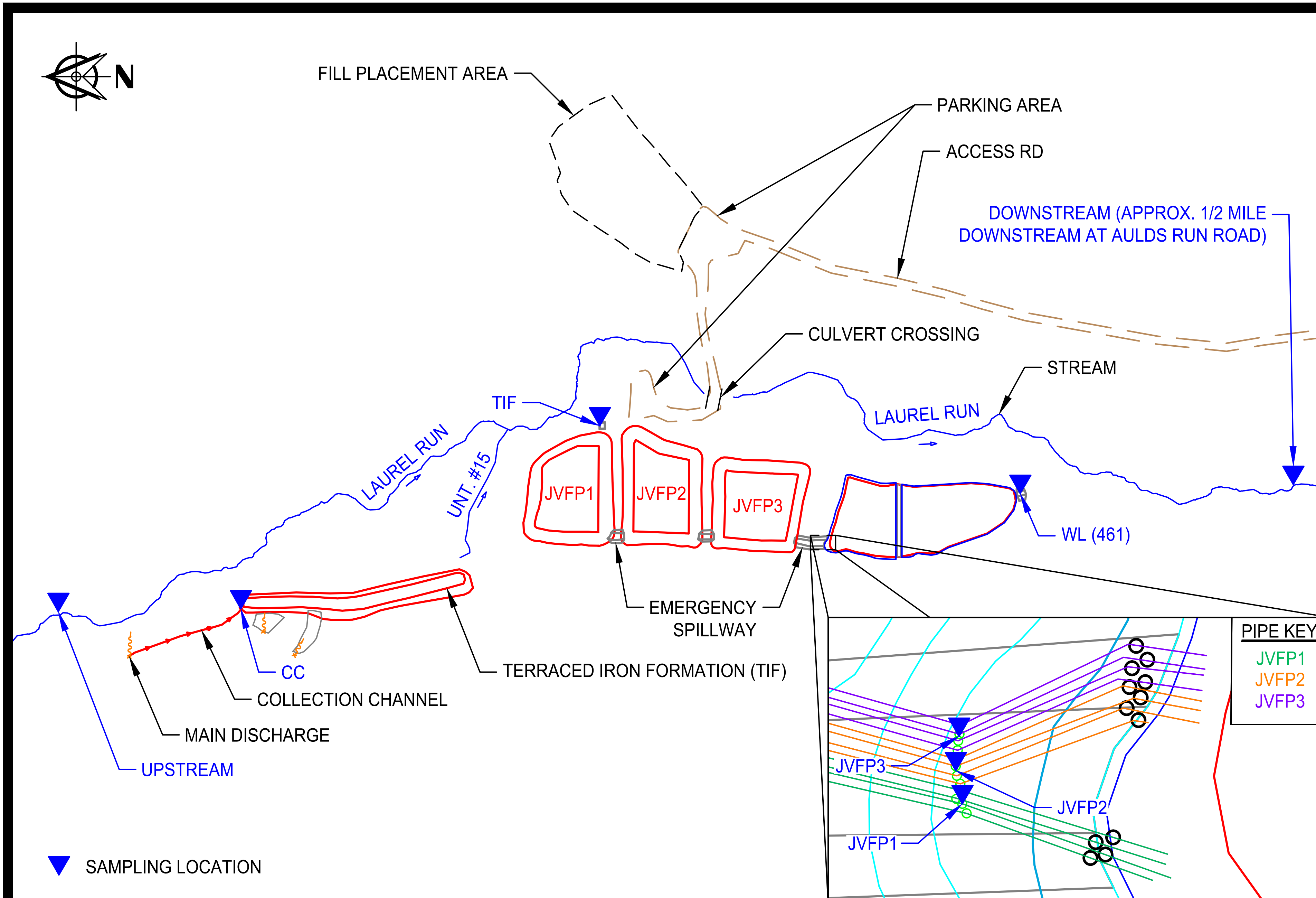
System	Acid Load Reduction (lb/year)	T. Fe Load Reduction (lb/year)	T. Mn Load Reduction (lb/year)	T. Al Load Reduction (lb/year)	Alkalinity Load to Stream (lb/year)
Laurel Run #1 (2000-2020)	62,938	5,560	82	3,852	24,662
Laurel Run #1 (2025)	60,535	4,617	1,059	4,417	90,520

Table 5: Field Assessment of Stream Points and Potential Seeps after Reconstruction (7/23/2025)

Point	Description	Coordinates	Field pH	Field DO (mg/L)	Field DO (%)	Field Temp (°C)	Field T. Fe (mg/)
Upstream	Designated upstream sample point on Laurel Run (LR) that is shown on updated as-built and sampling schematic.	40.512029, -79.113995	6.25				
Northern Raw	Northern raw discharge entering the collection channel where it first emanates from the ground.	40.510658, -79.114492	2.78	1.62	16.2	13.3	7.0
CC	LR#1 system sampling point. Sampled at end of collection channel before flowing into the TIF.	40.509800, -79.114164	2.95	9.41	104.7	13.9	7.0
Seep 1	Small AMD seep (likely <1 gpm) found coming out of the ground on the east side of the TIF and entering Laurel Run.	40.5094632, -79.113312	3.02	4.98	54.2	-	7.0
Seep 2	Another small, though slightly larger, AMD seep (likely <2 gpm) found directly next to Seep 1 and entering Laurel Run.	40.509597, -79.113509	3.02	9.11	101.7	-	7.0
Seep 3	Largest AMD seep (~5 gpm) not being collected. Located below and about 1/3 the way down the collection channel and flows directly into LR stream. Much of the seep is hidden by knotweed.	40.510197, -79.113924	2.91	4.18	51.4	23.3	5.5
LR BY-TIF	LR stream point alongside system approximately near the end of the TIF, and upstream of confluence with UNT15.	40.509252, -79.112728	3.77	9.10	99.3	17.3	0.5
UNT15 – Top	Top of boulder area where the spring and Unnamed Trib 15 begins.	40.508914, -79.113831	7.20	7.70	75.3	12.3	
UNT15 – Bottom	Bottom of boulder area in the middle of Unnamed Trib 15.	40.508914, -79.113831	6.86	7.68	73.4	11.4	<2.5
UNT15-DN	Mouth of UNT15 before confluence with Laurel Run.	40.508456, -79.112552	7.08	9.86	96.3	12.3	<2.5
LR POST-TIF	LR stream point downstream from TIF and downstream from confluence with UNT15-DN.	40.508556, -79.112560	6.20	9.67	98.4	14.2	<1.5
WL	Effluent of WL and final effluent of LR#1.	40.506748, -79.113230	7.56	4.19	59.9	31.6	1.0
US-Effluent	LR stream sampled just upstream of the system effluent.	40.506892, -79.112914	7.89	8.99	99.0	18.8	<1.0
DS-Effluent	LR stream sampled ~50 feet downstream of the system effluent.	40.505628, -79.113229	7.56	8.71	96.8	18.3	<1.0

Appendix 3

O&M Plan for Laurel Run #1



BioMost, Inc.
434 Spring Street Ext.
Mars, PA 16046
www.biomost.com

SCALE:
0 — 100' — 200'

COORDINATES:
N40.50785782
W79.11369619

LAUREL RUN #1 PASSIVE SYSTEM REHABILITATION

CENTER TOWNSHIP — INDIANA COUNTY/PA

SITE SCHEMATIC

DRAWING NUMBER:
1 of 1

Laurel Run #1 Passive Treatment System Rehabilitation

White Township, Indiana County, Pennsylvania

Operation & Maintenance Plan

May 2025

Prepared by:

BioMost, Inc.
Mining & Reclamation Services
434 Spring Street Ext., Mars, PA 16046
www.biomost.com

Prepared for:

Stream Restoration Incorporated
PO Box 837, Slippery Rock, PA 16057
www.streamrestorationinc.org

Operation & Maintenance Plan

Section 1 – Project Information

Project Name	**Laurel Run #1 Passive System Rehabilitation**
Location (Site Access)	40.509078, -79.113444 (40.500486, -79.112941)
Site Access	Aulds Run Rd., Indiana, PA
Hydrologic Order	Laurel Run → Blacklick Creek → Conemaugh R. → Kiskiminetas R. → Allegheny R. → Ohio R.
Landowners	State Game Lands No. 276 and William and Shirley Wensell
Project Designer	BioMost, Inc., Mars, PA, www.biomost.com
Project Contractor	Joseph C. Puryear Trucking & Excavating Inc.

Design Summary	
Max Hydraulic Design Flow	1,600 GPM
Max Treatment Design Flow	430 GPM
Average Design Flow	200 GPM

Raw Loading Rates		
Treatment Load	**Max**	**Average**
Acid Load	660 lb/day	203 lb/day
Iron Load	20 lb/day	8 lb/day
Aluminum Load	32 lb/day	15 lb/day
Design Life: 15-25 Years		

Section 2 – Overview

The Laurel Run #1 Treatment System is located in White Township, Indiana County, Pennsylvania. The existing site has multiple acid mine drainage (AMD) sources that emanate from the hillside on the western side of Laurel Run. Due to hydrologic issues of the previous treatment system, the two southern raw sources were not being treated and were bypassing the treatment system and discharging into Laurel Run. The furthest north AMD source was not previously collected and was flowing directly into Laurel Run. Access to the site is obtained from Aulds Run Road (SR-2014) through the State Game Lands Number 276 access gate. The 2025 passive treatment system described herein is designed to collect and treat the AMD sources with a Collection Channel, followed by a Terraced Iron Formation (TIF) that is piped to a Flow Splitter Box that evenly splits the flow among three Jennings-type Vertical Flow Ponds (JVFPs) that work in parallel. Each JVFP outlets to the existing Treatment Wetland, which finally discharges into Laurel Run.

Section 3 – System Components

3.1 – Previous Treatment System

The original design system was installed in 2001 and consisted of a collection system that conveyed an underground mine discharge via a pipeline to two vertical flow ponds operating in series. In about 2014, Amerikohl Mining, Inc. operated a surface mine that intercepted the underground mine discharge and installed a new collection system, third vertical flow pond, and a concrete three-way flow splitter box and piping. Issues with the effectiveness of the new collection system, splitter box, all three vertical flow ponds were experienced resulted in the need to rehabilitate the entire system.

3.2 – Collection Channel (CC)

3.2.A – Purpose and Description

The CC is a 190 linear foot rock-lined channel with a 2-foot bottom width and collects the previously undiscovered northernmost discharge and conveys the discharge to the Terraced Iron Formation (TIF). The upper, flatter portion of the collection channel is AASHTO #1 rock-lined, and the lower, steeper portion is lined with R4 riprap.

3.2.B – Maintenance

Inspect the collection channel (CC) and remove any debris that obstructs flow. Since the CC is not designed for treatment, cleaning the stone or replacing the rock lining is not expected.

3.3 – Terraced Iron Formation (TIF)

3.3.A – Purpose and Description

The TIF collects and conveys diffuse discharges along the hillside, providing initial treatment primarily for iron removal. High Calcium AASHTO #1 limestone was used to line the TIF, acting as an alkaline buffer between acidic raw water and the underlying clay-bearing soil. Maintaining the flow of water in the TIF as a thin film optimizes treatment. This approach promotes oxidation with atmospheric oxygen and facilitates biogeochemical processes at the water/solid interface, particularly on the surface of metal precipitates in the channel.

The TIF consists of three main sections: an inlet pool that collects raw water from the collection channel (CC), a 350-foot-long treatment channel with a 20-foot bottom width, and an outlet pipe leading to the Flow Splitter Box. Approximately a quarter of the way down the TIF, two AMD seeps emanate from the upgradient hillside and flow into the TIF. To prevent erosion in these saturated areas, the seep zones are rock mulched with AASHTO #1 limestone. The combined drainage exits the TIF through an outlet pipe, which includes a twelve-inch SCH40 PVC pipe with an upward-facing tee to reduce clogging. Each opening features a bar guard inserted into the tee to block large debris. For maintenance, each bar guard is tied to a T-post, allowing personnel to pull on the rope to remove and clean the guard.

3.3.B – Maintenance

Over time, precipitates and debris will accumulate on the bottom of the TIF, leading to channelization and potentially causing overflow. Channelization reduces treatment effectiveness and increases the pollutant load on downstream components. To maintain optimal performance, clean the TIF using an excavator or compact track loader (skid steer) to remove accumulated precipitates and vegetation.

Remove the accumulated material to expose the original rock surface and re-level the rock to ensure even distribution of flow across the entire width of the channel. Place vegetation and other debris removed from the TIF on the downgradient side of the facility or in other locations to ensure any runoff is captured by the passive system.

3.4 – Flow Splitter Box

3.4.A – Purpose and Description

The flow splitter box is a 10'x8.5' concrete box with an aluminum grating cover. Within the flow splitter box is a stainless-steel three-sided baffle with V-notch weirs cut into each side to distribute flow equally to the three Jennings-type vertical flow ponds (JFVPs). Each weir is cut at a 90° angle. A weir lookup table can be found below as Table 1. A copy of this table is to be kept in the valve box of the 12" bypass valve. Water elevations should be read directly from the staff gauge mounted on the inside wall of the concrete splitter box. Alternatively, the flow can be determined by measuring down from the aluminum grating (within 1' of the staff gauge). Both staff gauge and 'measure down' readings are included on the lookup table.

3.4.B – Maintenance

During maintenance events it may be necessary to direct flow to one or more JVFP. Valves for each JVFP inlet can be opened or closed to achieve desired water handling. To ensure accurate flow measurement, the weirs should be kept free of debris or buildup. The staff gauge should be cleaned as needed. The seams between the box and stainless-steel weirs should be inspected to ensure no leaks have developed. Leaks can be addressed by cleaning the affected area and coating with Flex Seal or similar coating. The inlets to the pipes extending to the JVFPs should be cleaned as needed to ensure free flow. The 12" bypass can be opened as needed to drain the box to facilitate maintenance activities. After opening the bypass valve, please allow sufficient time for the Flow Splitter Box, Raw Water Pipeline, and Mine Drain to fill prior to taking a flow measurement.

3.5 – Jennings-type Vertical Flow Ponds 1, 2, and 3 (JVFP1, JVFP2 & JVFP3)

3.5.A – Flow Distribution

Each JVFP is designed to accept a third of the raw inlet flow which is split evenly by the Flow Splitter Box. A cleanout along the twelve-inch inlet pipe to the flow splitter box is positioned approximately halfway between the TIF and the splitter box for maintenance if required.

3.5.B – Purpose and Description

The JVFPs utilize a by-volume media mixture consisting of three parts limestone, two parts hardwood woodchips, and one part spent mushroom compost. This blend neutralizes acidity, generates alkalinity, and facilitates the precipitation of metals, particularly aluminum and iron.

Each JVFP includes a multi-cell underdrain system composed of four-inch SDR35 PVC perforated laterals connected to six-inch SDR35 PVC header pipes. The laterals are factory-perforated, while the headers are solid pipes with custom-drilled ¼-inch perforations positioned midway between laterals and every five feet thereafter (within the pond footprint) to reduce air lock. These headers transition into solid six-inch SCH40 PVC pipes that pass through the embankment and discharge into a downstream treatment wetland.

Each underdrain cell discharges through adjustable four-inch riser pipes, vertically connected to six-inch pipes using four-by-six-inch flexible rubber couplers. Operators can manipulate riser heights to adjust water levels or direct flow through selected treatment zones. Each JVFP includes two potential outlets: the primary outlet via riser pipes and secondary overflow via rock-lined emergency spillways into the treatment wetland. All outlet pipes also may be drained to the wetland with the individual 6" valves.

3.5.C – Treatment Process and Odor Management

The treatment media's biological activity produces both alkalinity and hydrogen sulfide gas. During startup or early operation, and under conditions of low temperature or high flow, nuisance odors may be deemed problematic. Operators can mitigate these odors by restricting flow to a single cell and rotating usage monthly during colder months.

During warmer weather or periods of lower influent flow, further reduction of flow may be necessary. To assist in this, operators can install flow-reduction assemblies using dry-fit bushings and one-inch PVC ball valves at the four-inch riser elbows. This allows fine-tuned flow control without cell rotation. If odors persist, further restrict or temporarily halting flow, forcing ponded water to discharge via the emergency spillways. This partially treated water will mix with fully treated effluent in the wetland. Over time, typically several years, odor issues diminish as the media matures. A persistent mild odor near outlet pipes signals proper system function, but operators should adjust treatment as needed to meet performance targets and minimize odor.

3.5.D – Treatment Media Stirring

Over time, the treatment media may compact and accumulate metals, reducing permeability to a point where water no longer passes through effectively. This condition can cause the pond water level to rise and overflow via the emergency spillway, thereby significantly diminishing treatment efficiency. Stirring the treatment media typically restores permeability. To facilitate maintenance and maintain continuous operation, the JVFP units are installed in parallel, allowing two units to remain online while the other undergoes servicing. The maintenance procedure is outlined below:

1. Divert flow from the JVFP scheduled for maintenance.
2. Open the drain valves to fully dewater the selected JVFP.
3. Allow the treatment media to dry—typically one week or more, depending on weather conditions—to enable access by a mini-excavator or other low-ground-pressure equipment.
4. If solids have accumulated on top of the media to a depth that can be effectively removed, excavate the solids as feasible and remove before subsequent steps.
5. Stir the full depth of media until loose and uncompacted, stopping at the underdrain stone. Avoid and repair any damage to underdrain piping. Close the drain valves and allow the pond to refill.
6. Reopen the drain valves to flush the stirred JVFP and remove fine materials from the piping system.
7. Close the drain valves once more, allow the pond to refill, and adjust the outlet risers to the normal operating elevation as needed.

3.5.E – Media or Underdrain Replacement
If stirring fails to restore flow, replace the treatment media and, if needed, underdrain stone and piping:

1. Divert flow from the targeted JVFP.
2. Fully dewater and allow the media to dry.
3. Remove spent media and underdrain components as necessary.
4. Transport and place of old media appropriately, then revegetate placement areas.
5. Install new stone, piping, and mixed treatment media per the original specifications or updated designs.
6. Before replacement, reassess system performance needs and water quality trends.

3.6 – Treatment Wetland

3.6.A – Purpose and Description
The treatment wetland is the final stage in the system, receiving water from each of the JVFPs. An inlet pool near the outlet risers traps solids and helps spread the flow of water before it enters the wetland. A rock distribution berm placed perpendicular to the flow distributes water evenly, minimizing short-circuiting.
The wetland is designed to remain free of standing water, with flow saturating the substrate. Over time, as organic matter, vegetation, and metal precipitates build up, the substrate thickens and the water level gradually rises. The wetland has two primary functions:

1. Re-aerate water that enters in a reduced state from the JVFPs.
2. Provide surface area for iron to oxidize and precipitate.

Treated water exits the wetland through a primary spillway to Laurel Run.

3.6.B – Maintenance
As the wetland fills with accumulated material, cleanout is required when the buildup nears the top of the distribution berm or when outlet function is obstructed. Remove excess substrate and dispose of it in an approved location, following all state and federal regulations. Visually inspect the distribution berm for debris or erosion that could lead to uneven flow. Restore or replace rock as needed to maintain even water distribution across the wetland.

3.7 – General Maintenance
Inspections described in the O&M schedule should take place to check for erosion of embankments and associated slopes. Any erosion shall immediately be graded as needed and stabilized utilizing seed and mulch or, in cases of bad erosion due to flooding or vandalism, erosion control fabric may be needed. The embankments should be kept free of woody vegetation typically achieved by mowing on an annual basis where feasible and removing woody growth on at least a triennial basis. The Flow Splitter Box should be checked every visit and cleaned of all debris that could obstruct any of the outlet pipes. If the box fills with metal precipitates and needs to be cleaned, open the twelve-inch Valterra valve and drain all precipitates, manual agitation of precipitates may be required.

Section 4 – Monitoring

The passive treatment system is designed to neutralize acidity and remove iron and aluminum from raw water. Under design flow and load conditions, the system should consistently remove acid, iron, and aluminum, and generate excess alkalinity, indicated by negative acidity in lab results. Effluent pH should stay at or above 6. During high flows or pollutant surges, short-term drops in effluent quality may occur, but effluent quality typically recovers as conditions return to normal. Frequent exceedance of design limits may reduce system life and increase maintenance needs.

To verify performance, calculate acid load removal using total flow at each JVFP outlet riser and lab-determined acidity (via the hot-peroxide method). Since the wetland does not add alkalinity, evaluate each JVFP's effluent against its influent. Also analyze water quality at the wetland outlet to assess overall system output to Laurel Run. Field alkalinity tests can provide a quick check of system function.

Equation 1: Influent Acid Load
Instructions: Collect sample at any inlet pipe to a JVFP from the Flow Splitter Box, or within the box
Flow (GPM) X Acid Concentration (mg/L $CaCO_3$) X 0.01202 (conversion factor) = Acid Load lb/day

Equation 2: JVFP Effluent Acid Load
Instructions: Collect sample at JVFP outlet riser for each JVFP being evaluated, collect composite all the flowing pipes by holding a container under each pipe for an equal amount of time.
Flow (GPM) X Acid Concentration (mg/L $CaCO_3$) X 0.01202 (conversion factor) = Acid Load lb/day
Add acid loads calculated from each VFP.
Note: If JVFPs are functioning as intended, the acid load will be a negative number.

Equation 3: Acid Load Removed
Influent Acid Load (lb/d) minus Combined Effluent Acid Load (lb/d) = Acid Load Removed

Note that positive acid load minus a negative acid load will result in an acid load removed greater than the influent acid load. (e.g., 100 lb/day minus negative 10 lb/day = 110 lb/day total acid removed).

The acid load removed for the entire system may be calculated by using the chemistry measured at the Wetland outlet and using the total flow measured at the JVFPs.

To calculate the metal load removed, follow the above equations, substituting the metal concentration (mg/L) for acidity concentrations (mg/L $CaCO_3$). As manganese contributes a minor amount of the total acid load, the system was not designed to remove this metal, and no appreciable manganese removal is expected. However, manganese removal may still be observed.

Section 5 – O&M Schedule

Monthly (Frequency may be reduced based on system performance)

- Record flow by reading the staff gauge inside the flow splitter box.
  - Splitter box should be cleaned of debris and precipitates as needed
- Visual inspection of all components, channels, ditches, etc.
- Remove and clean TIF bar guards of vegetation and debris.
- Check pH at system effluent, WL
  - pH should always be >6.0
- Upload all monitoring data to www.datashed.org

Annually

- During typical high-flow (February – May) collect samples for laboratory analysis at:
  - CC, TIF (can be collected in flow splitter box or at inlet of any JVFP), and WL (See Attachment 1: Schematic). A composite sample from the four pipes discharging from each of the JVFPs should be taken.
    - Minimum parameters to include per sample point: pH, conductivity, acidity, alkalinity, iron, aluminum, manganese
      - At system effluent, WL, iron should be <3.0 mg/L
    - Measure flow at inlets and outlets of JVFP1, JVFP2 and JVFP3
      - Flow can be measured by taking the sum of each individual riser pipe outlet and combining for each respective JVFP total. There are four (4) outlets per JVFP. Large differences in flows into and out of the JVFP could be an early signal that the media may be losing permeability.
    - Upload all monitoring data to www.datashed.org
- Flush solids out of the flow splitter box by opening the 12” valve at the inlet of JVFP2.
- Exercise JVFP inlet valves along the eight-inch SCH40 PVC pipes following the flow splitter box.
- Exercise JVFP drain valves along six-inch SCH40 PVC underdrain pipes prior to the wetland; leave all valves in closed position, unless intentionally draining one of the JVFPs.

As Needed

- Remove unwanted vegetation from spillways, channels, pipes, etc.
- Remove woody vegetation from embankments.
- Maintain of ditches, level spreaders, etc. as described herein.
- Replace or stir treatment limestone or mixed media as described herein.

Section 6 – Weir Lookup Table

90-Degree V-Notch Weir Lookup Table (Per Weir and All Three Weirs)

From Top of Grate (GPM)	Staff Gauge Read (feet)	Flow Per JVFP (GPM)	Flow All 3 JVFPs (GPM)
0.68	0.20	20	60
0.69	0.21	23	68
0.70	0.22	25	76
0.71	0.23	28	85
0.72	0.24	32	95
0.73	0.25	35	105
0.74	0.26	39	116
0.75	0.27	43	128
0.76	0.28	47	140
0.77	0.29	51	152
0.78	0.30	55	166
0.79	0.31	60	180
0.80	0.32	65	195
0.81	0.33	70	211
0.82	0.34	76	227
0.83	0.35	81	244
0.84	0.36	87	262
0.85	0.37	93	280
0.86	0.38	100	300
0.87	0.39	107	320
0.88	0.40	114	341
0.89	0.41	121	362
0.90	0.42	128	385
0.91	0.43	136	408
0.92	0.44	144	432
0.93	0.45	152	457
0.94	0.46	161	483
0.95	0.47	170	510
0.96	0.48	179	537
0.97	0.49	189	566
0.98	0.50	198	595
0.99	0.51	208	625
1.00	0.52	219	656
1.01	0.53	229	688
1.02	0.54	240	721

From Top of Grate (GPM)	**Staff Gauge Read (feet)**	**Flow Per JVFP (GPM)**	**Flow All 3 JVFPs (GPM)**
1.02	0.54	240	721
1.03	0.55	252	755
1.04	0.56	263	790
1.05	0.57	275	826
1.06	0.58	287	862
1.07	0.59	300	900
1.08	0.60	313	939
1.09	0.61	326	978
1.10	0.62	340	1019
1.11	0.63	353	1060
1.12	0.64	368	1103
1.13	0.65	382	1147
1.14	0.66	397	1191
1.15	0.67	412	1237
1.16	0.68	428	1283
1.17	0.69	444	1331
1.18	0.70	460	1380
1.19	0.71	477	1430
1.20	0.72	494	1481
1.21	0.73	511	1533
1.22	0.74	529	1586
1.23	0.75	547	1640

Note: “From Top of Grate” column represents a lookup value for measurements taken by measuring down form the top of the grate near the staff gage to the water level in the Flow Splitter Box.

Appendix 4

As-Built Plans and Details

DESIGN BASIS SUMMARY: (Per Pre-Mining Water Monitoring July, 2012 - June, 2013)

FLOW
MAXIMUM: 430 GPM
AVERAGE: 200 GPM

LOAD

ACID
MAXIMUM: 660 LB/DAY
AVERAGE: 203 LB/DAY

IRON
MAXIMUM: 20 LB/DAY
AVERAGE: 8 LB/DAY

ALUMINUM
MAXIMUM: 32 LB/DAY
AVERAGE: 15 LB/DAY

MANGANESE
MAXIMUM: 3 LB/DAY
AVERAGE: 2 LB/DAY

NOTE: COMPONENTS DESIGNED TO REMOVE MANGANESE NOT INCLUDED.
MAX ACID LOAD BASED ON TOTAL MIXED MEDIA VOLUME USING DESIGN FACTOR OF 0.1 LB/DAY/CY.

REPRESENTATIVE RAW WATER QUALITY

	pH (S.U.)	Acid (mg/L)	T Fe (mg/L)	T Mn (mg/L)	T Al (mg/L)	Sulfates (mg/L)
AVERAGE	3.20	128	8	1	11	286

LEGEND

- INDEX CONTOUR (10')
- INTERMEDIATE CONTOUR (2')
- EXISTING ACCESS ROAD
- EXISTING WETLANDS
- STREAM / SURFACE WATER
- TREELINE
- AS-BUILT INDEX CONTOUR (10')
- AS-BUILT INTERMEDIATE CONTOUR (2')
- PASSIVE TREATMENT SYSTEM COMPONENT
- ROCK DIVERSION DITCH
- GRASS DIVERSION DITCH
- 4" SDR35 PVC PIPE
- 4" SDR35 PVC PIPE (PERF.)
- 6" SCH40 PVC PIPE
- 6" SDR35 PVC PIPE
- 8" SCH40 PVC PIPE
- 12" SCH40 PVC PIPE
- 18" HDPE N12 CULVERT PIPE
- 30" HDPE N12 CULVERT PIPE
- PROPERTY LINE (APPROXIMATE)
- EMERGENCY SPILLWAY
- AMD SOURCE
- BENCHMARK
- WL SAMPLING LOCATION

GENERAL NOTES

1. Base map contours derived from a bare-earth digital elevation model constructed from LiDAR data (QL2) collected in Fall 2019/Spring 2020 by US Geologic Survey [PA State Plane - South (US Survey Foot) NAD83, Vertical datum - NAVD88]. Select topographic and cultural features from 2018 Pennsylvania Emergency Management Agency (PEMA) 0.5-foot orthoimagery obtained from www.pasda.psu.edu. Additional information by BioMost, Inc. from limited 2023 site investigations. All existing conditions are to be field verified by the contractor as needed.
2. All dimensions are in feet unless otherwise noted. All slope designations are H:V.
3. Property line locations and surface ownership taken from the Indiana County online Geographic Information Systems (GIS) parcel viewer (accessed November 2023). **THIS IS NOT A PROPERTY SURVEY**

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NO.	BY	DATE	DESCRIPTION

REVISIONS

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER CODY A. NEELY PE085089

SUBMITTED BY:
CODY A. NEELY, P.E.
PROJECT DESIGNER - BioMost, Inc.

DATE: MAY 2025
LATITUDE: 40.508015
LONGITUDE: -79.112952
DRAWN BY: DMC/LVH
CHECKED BY: TPD
SCALE: 50' 25' 0 50' UNLESS OTHERWISE NOTED
ACAD FILE NAME: 502 AB.dwg

ALL EXISTING CONDITIONS SHALL BE CHECKED AND VERIFIED BY THE CONTRACTOR AT THE SITE AS APPLICABLE

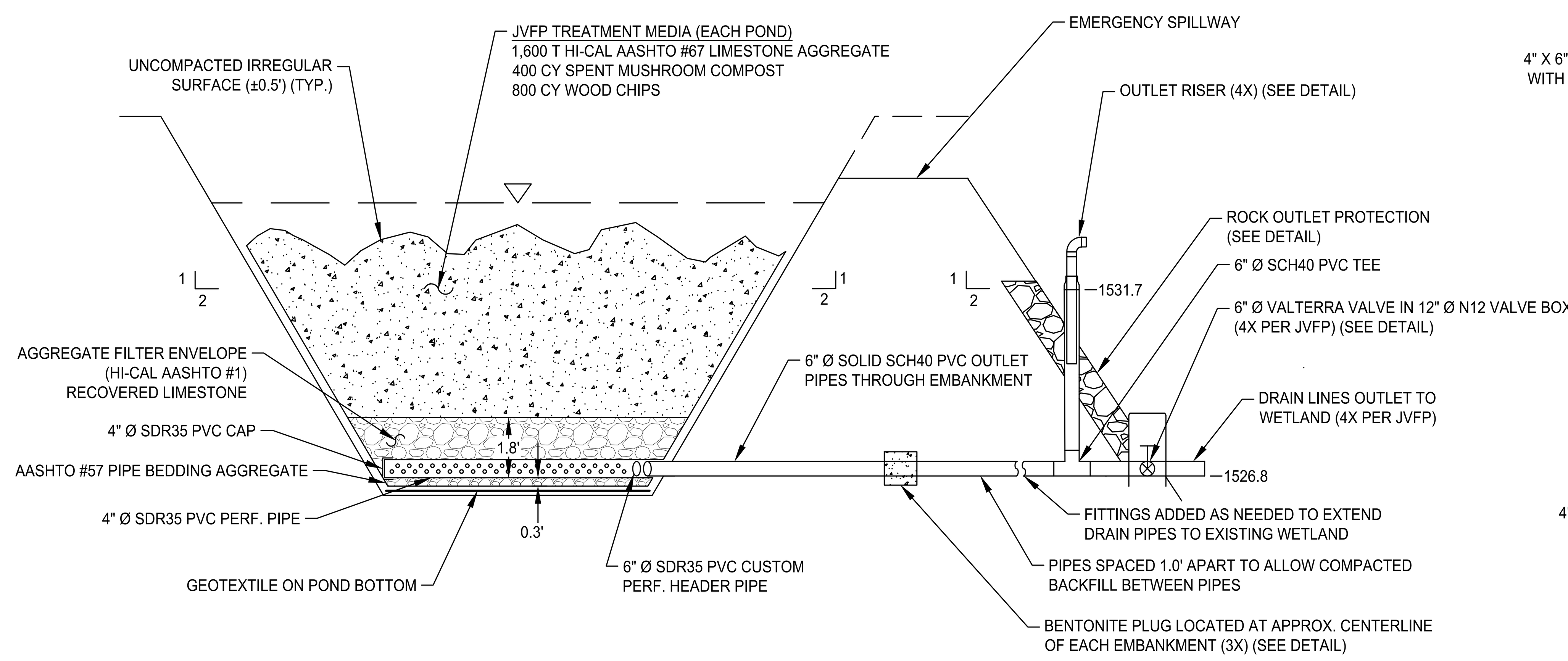
LAUREL RUN #1 PASSIVE SYSTEM REHABILITATION

CENTER TOWNSHIP
INDIANA COUNTY/PA

AS-BUILT PLAN

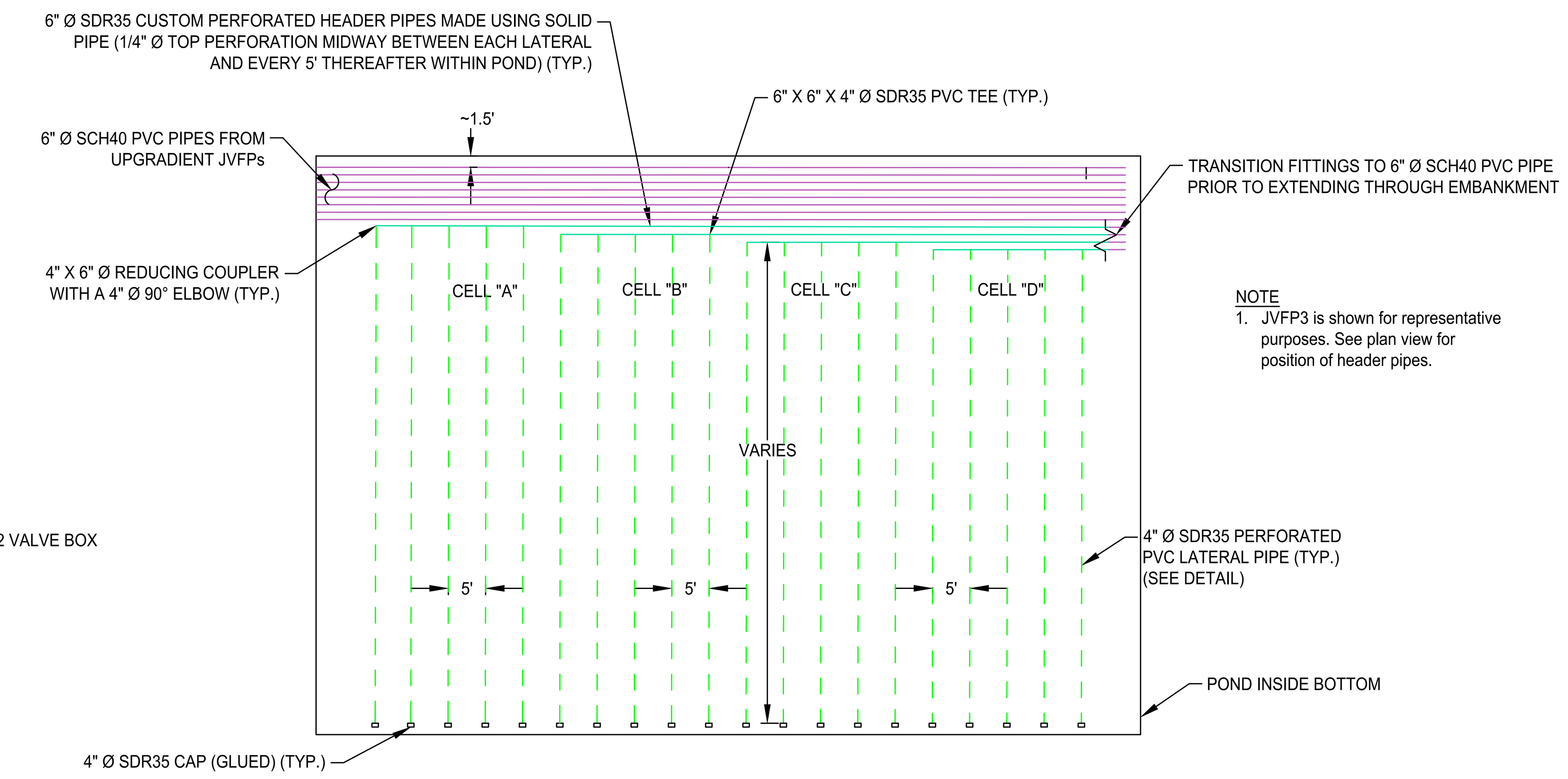
DRAWING NUMBER:

JENNINGS POND DATA TABLE			
COMPONENT	AVG. TOP MEDIA ELEV.	MIXED MEDIA VOLUME (CY)	LS ABOVE 4" PIPES (CY)
JVFP 1	1532.3	2200	600
JVFP 2	1532.1	2300	580
JVFP 3	1532.8	2100	580



JENNINGS VERTICAL FLOW POND (TYP.) (JVFP 1, JVFP 2 & JVFP 3)

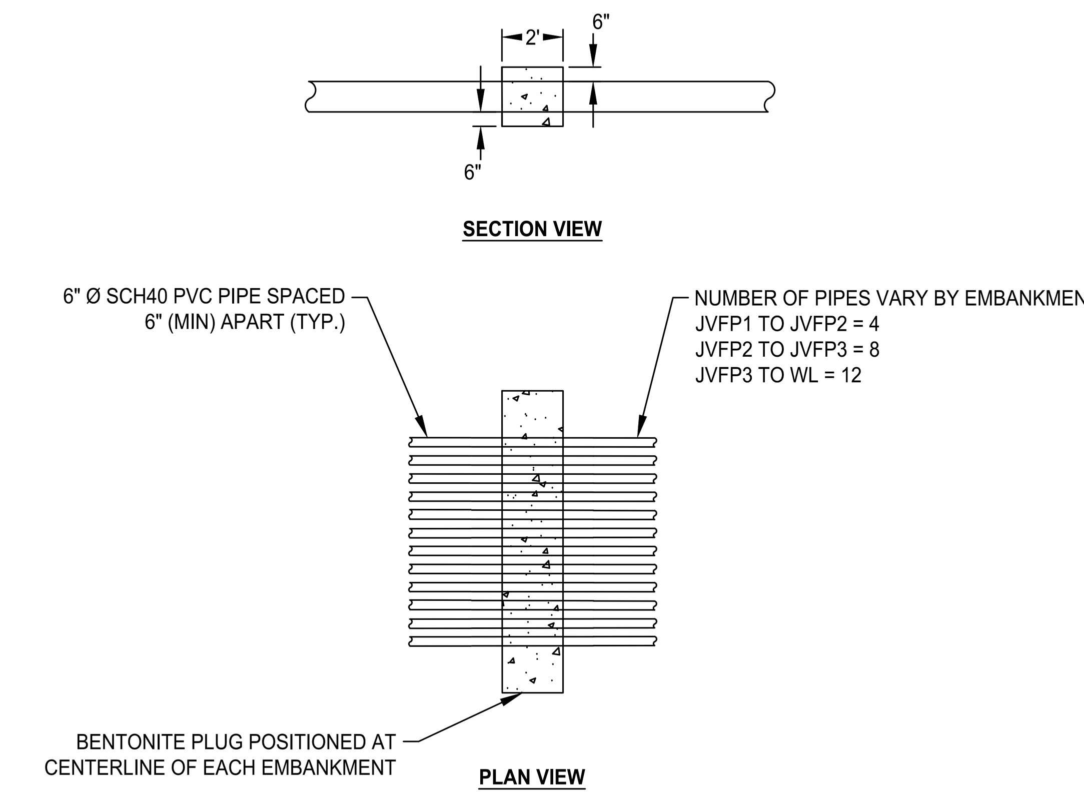
Horizontal Scale: None Vertical Scale: None



NOTE
1. JVFP3 is shown for representative purposes. See plan view for position of header pipes.

JENNINGS VERTICAL FLOW POND (JVFP) PIPE LAYOUT

Horizontal Scale: None Vertical Scale: None



BENTONITE PLUG

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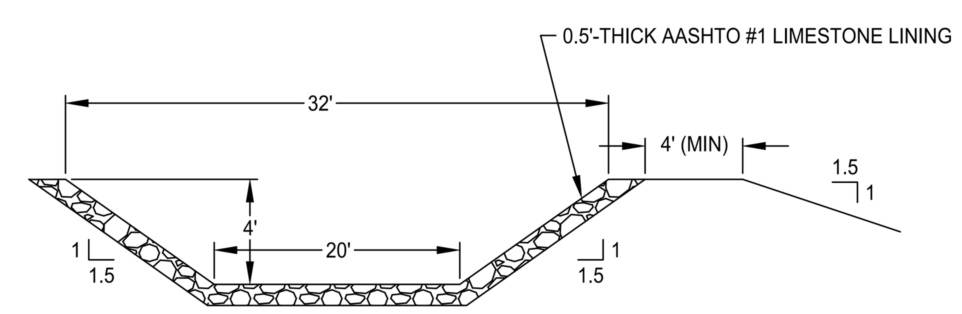

TERRACED IRON FORMATION (TIF)

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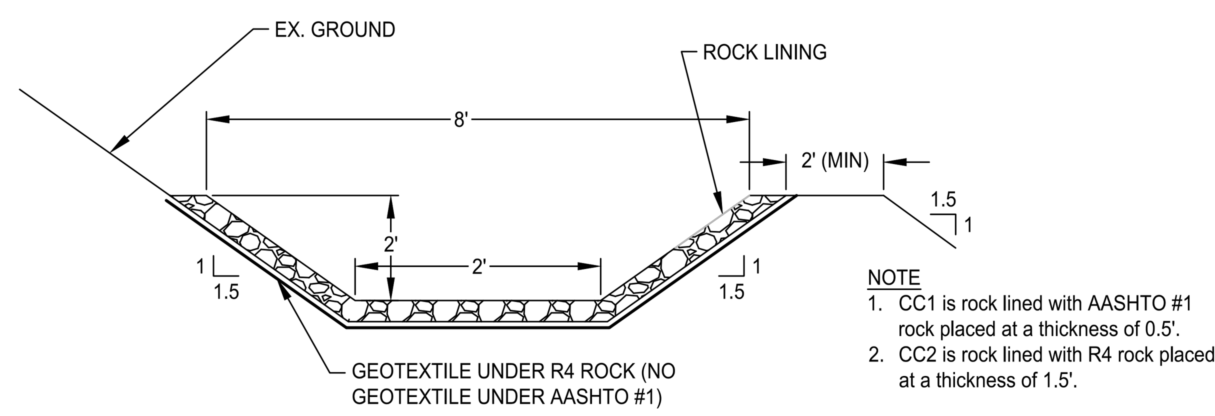

NOTE
1. CC1 is rock lined with AASHTO #1 rock placed at a thickness of 0.5'.
2. CC2 is rock lined with R4 rock placed at a thickness of 1.5'.

COLLECTION CHANNEL (CC)

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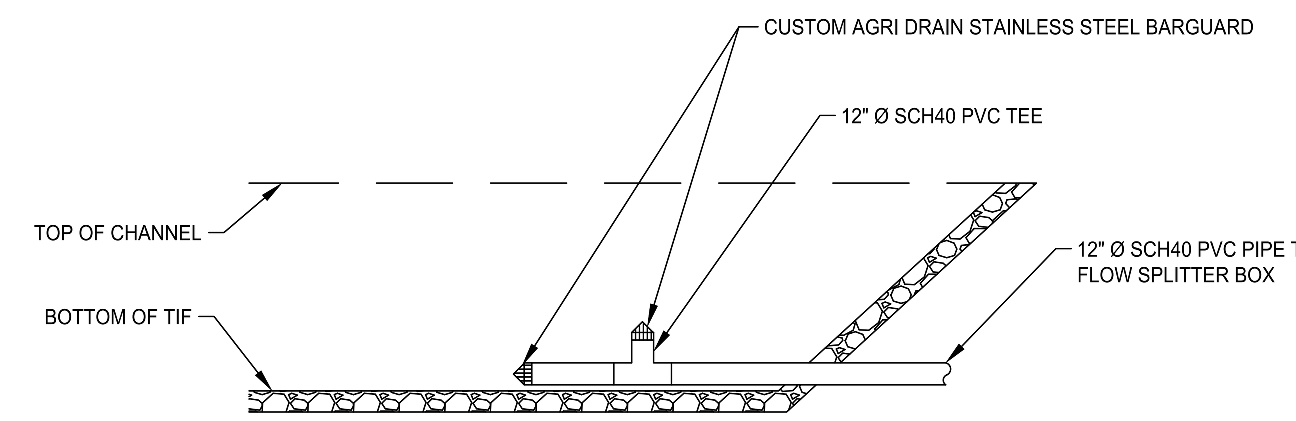

TIF OUTLET PIPE CONFIGURATION

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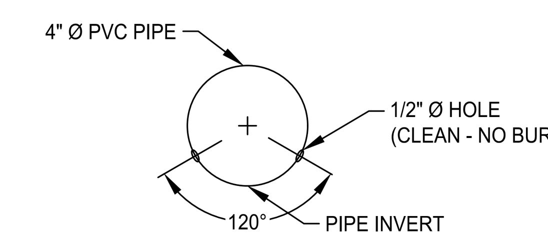
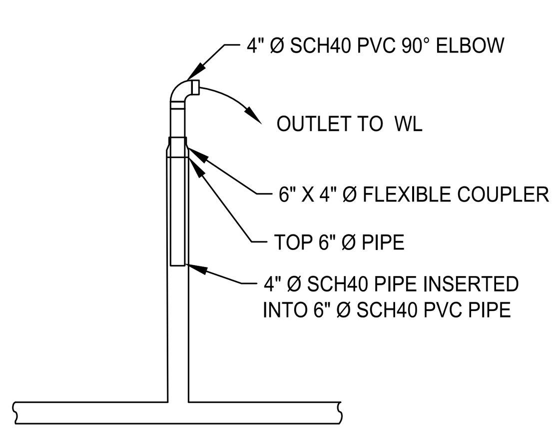


NOTE
1. Two 1/2" Ø perforations every 6" along length of pipe.
2. Standard SDR35 perforated pipe.

JVFP PIPE PERFORATION

Horizontal Scale: None Vertical Scale: None



OUTLET RISER

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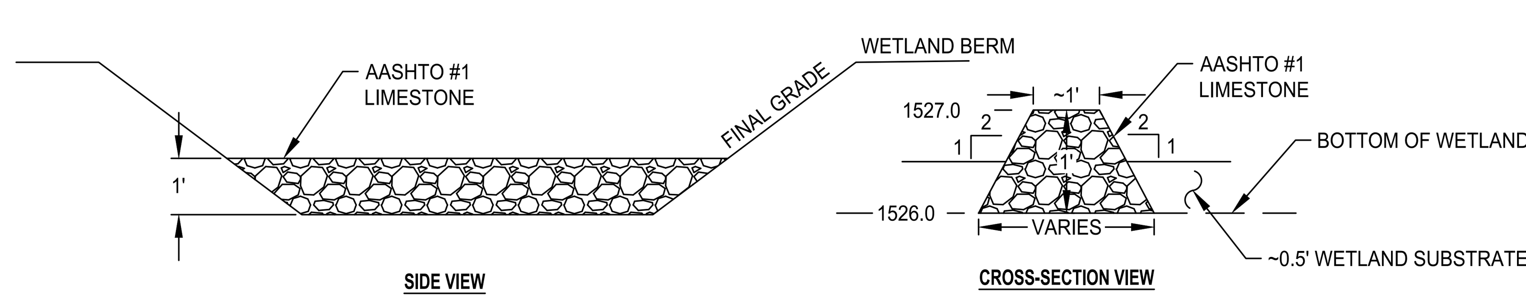

DISTRIBUTION BERM

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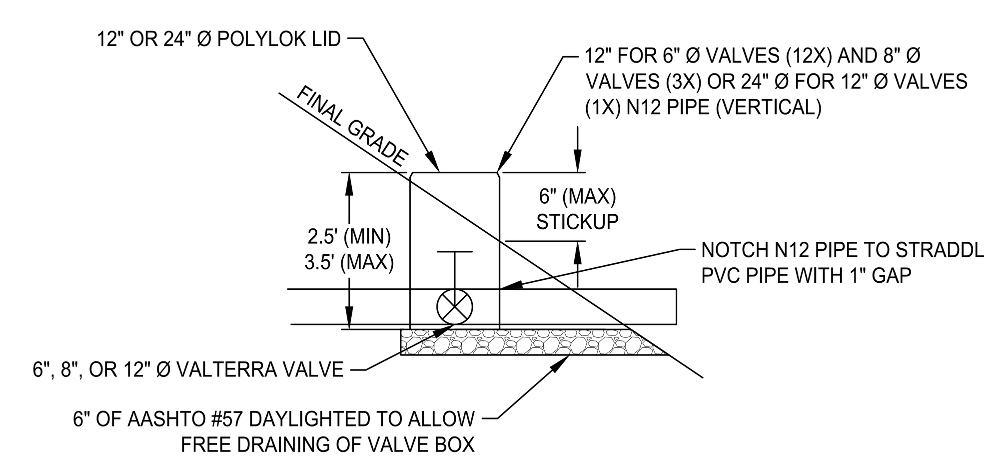

VALVE BOX

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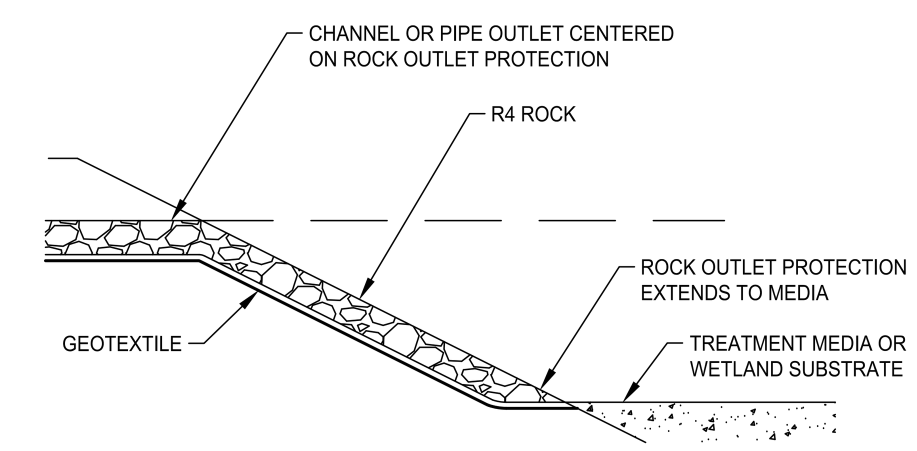

ROCK OUTLET PROTECTION

Horizontal Scale: None Vertical Scale: None

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NO.	BY	DATE	DESCRIPTION

REVISIONS

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
CODY A. NEELY
ENGINEER
PE085099

SUBMITTED BY:
CODY A. NEELY, P.E.
PROJECT DESIGNER - BioMost, Inc.

DATE: MAY 2025
LATITUDE: 40.508015
LONGITUDE: -79.112952
SCALE: NO SCALE
DRAWN BY: DMC/LVH
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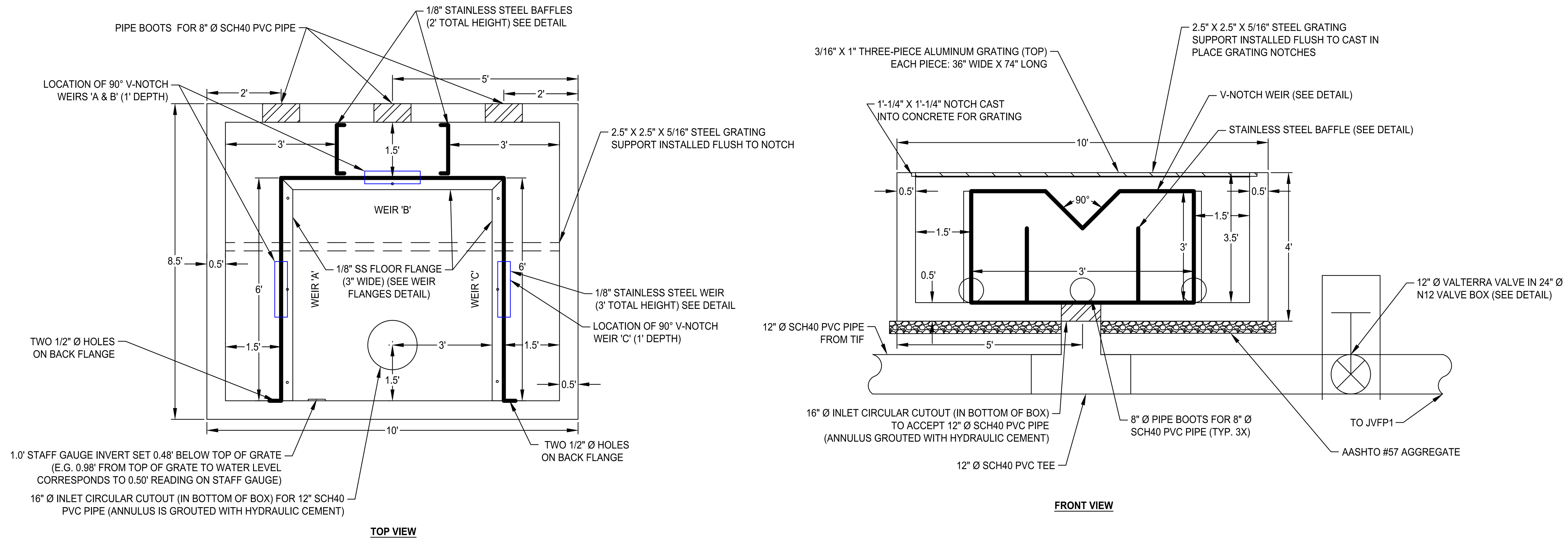
LAUREL RUN #1 PASSIVE SYSTEM REHABILITATION

CENTER TOWNSHIP INDIANA COUNTY/PA

AS-BUILT DETAILS

DRAWING NUMBER:
2 of 3



FLOW SPLITTER

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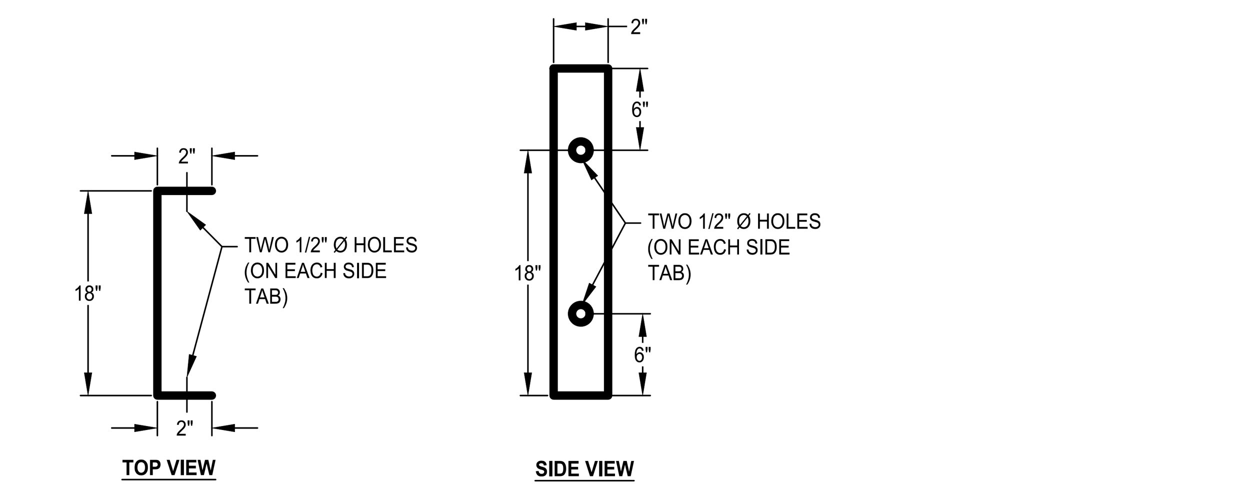

STAINLESS STEEL BAFFLES

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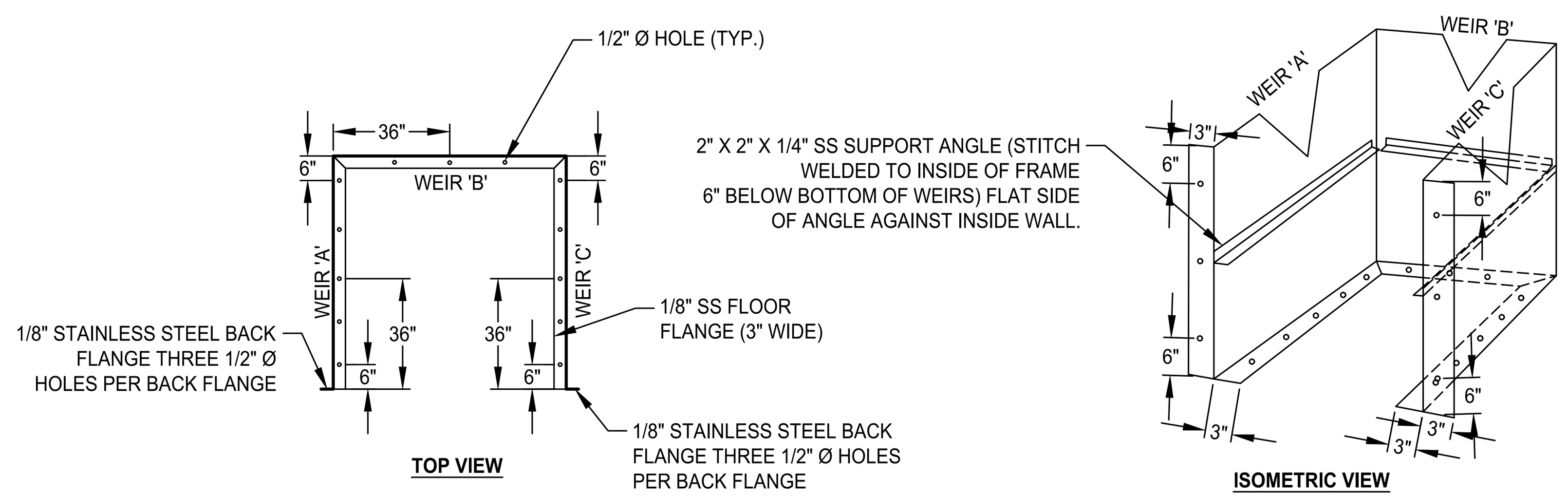

WEIR FLANGES

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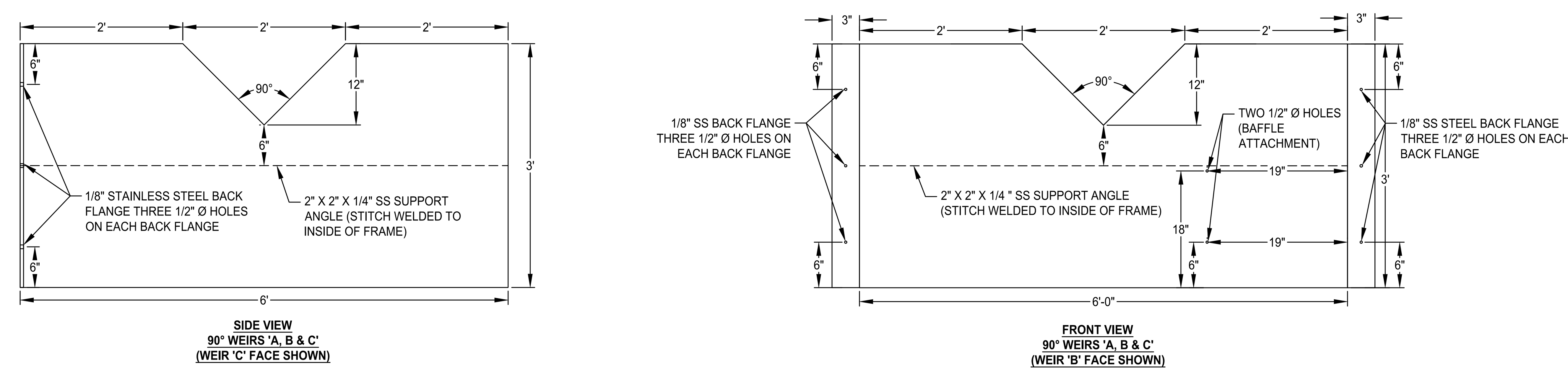

V-NOTCH WEIR CUTOUTS (90°)

Horizontal Scale: None Vertical Scale: None

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