OPERATION, MAINTENANCE, and REPLACEMENT PLAN

Richards Passive System Rehabilitation

Project Information

System Components:	Mine Drain; Raw Water Pipeline; Flow Splitter Box; Jennings-type Vertical Flow Ponds 1, 2, & 3; Settling Pond; Wetland
Latitude/Longitude:	40°39’47.97” N/78°58’48.98” W
Municipality:	Cherryhill Twp., near Clymer, PA
Hydrologic Order:	Two Lick Creek→Blacklick Creek→Conemaugh R.→Kiskiminetas R.→Allegheny R. →Ohio R

Design Summary

Flow		Max Treatment Load	Average Treatment Load
Max Hydraulic Design	1,000 GPM	1,020 lb/day Acid	166 lb/day Acid
Max Treatment Design	747 GPM	148-296 lb/day Iron	23 lb/day Iron
Average Design	117 GPM	128 lb/day Aluminum	15 lb/day Aluminum
Design Life: 15-25 Years (Iron range represents 10-20 grams/m^2/day removal rate.)			

Overview

The Richards Passive System is located in Cherryhill Township near Clymer, PA adjacent to Iron Horse Salvage along State Route 403 (SR-403). The rehabilitated Richards Passive System was put online in June 2021. Flow from an abandoned underground coal mine drain (concrete riser) is piped to a three-way flow splitter box and proportionally distributed among three Jennings-type vertical flow ponds (JVFPs) that flow to either a settling pond or wetland as shown in Figure 1. A seep located between JVFP2 and JVFP3 is captured in a French drain and piped to the wetland. A flowing artesian corehole discovered during previous construction efforts contributes degraded water to the final 1/3 of the wetland. This OM&R Plan has been prepared as part of the final report documents prepared December 2021 and uploaded to [www.datashed.org.](http://www.datashed.org) Other final report documents include: One-page summary, Narrative, Photographs, Water Monitoring Data, and As-Built Drawings (2 sheets).

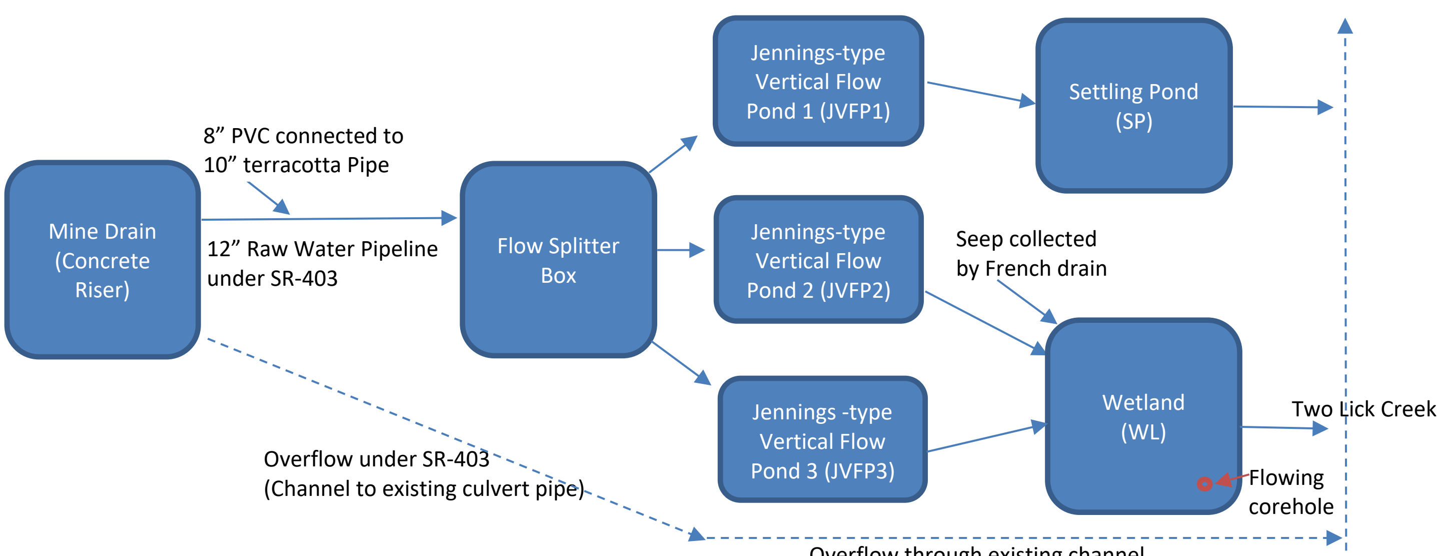

Figure 1. System Flow Diagram

System Components

Mine Drain and Raw Water Pipeline

Mine water flows from the underground coal mine through an existing vertical concrete riser (Mine Drain). A cover constructed of HDPE and stainless steel prevents unwanted access by animals and to exclude debris. A 12” SCH40 PVC pipe (Raw Water Pipeline) extends from a hole cut into the side of the Mine Drain, under SR-403, and into the Flow Splitter Box. The annulus of the hole in the concrete riser was not sealed around the PVC pipe so that other AMD that may be in the subsurface around the Mine Drain may flow into the Raw Water Pipeline and enter the treatment system. An overflow channel was installed near the mine drain to direct overflow and surface runoff to the 33” stainless steel corrugated metal culvert under SR-403.

The initial approximate 20’ of the Raw Water Pipeline is newly installed. The new pipe is connected to an existing 12” SCH40 PVC pipe with a flexible coupler (Fernco) installed in an existing concrete box. Both the pipe and concrete box have been covered with fill material. Downstream of the concrete box and prior to SR-403, an 8” pipe that extends from a 10” terracotta pipe, likely a historic mine drain, joins the 12” pipe. The existing 12” pipe runs under SR-403 in a 15” steel casing and to the north edge of the road right-of-way, then newly installed 12” SCH40 PVC pipe extends into the bottom of the flow splitter box via a 12” SCH40 PVC tee and riser pipe. Downstream of the flow splitter box a 12” Bypass Valve (Valterra gate valve) was installed to allow flow to bypass the Flow Splitter Box and discharge the full flow directly into JVFP2. The gate valve is located within a capped valve box and should typically be kept closed under normal operating conditions.

The Raw Water Pipeline should be evaluated on at least an annual basis or as needed. **If the depth of water above the 12” pipe in the Mine Drain is 0.3’ greater than reading on the staff gauge, the 12” pipe under Route SR-403 may need to be cleaned.** Note that the water in the Mine Drain is turbulent and a visual approximate average should be used for evaluation purposes. The elevation of top of the concrete riser is 1271.46, which is 0.27’ above the top of the stainless-steel baffle in the Flow Splitter Box. If water is flowing over the top of the stainless-steel baffle with all three weirs flowing at maximum capacity, the total flow would be in excess of 2,700 gpm. At no time should mine drainage exit the top of the Mine Drain, which would indicate that the 12” pipe should be cleaned immediately. The 12” pipe can be cleaned by flushing, achieved by opening the 12” Bypass Valve and allowing the pipe to flow full. Temporarily closing the Bypass Valve and allowing the water level to reestablish in the Flow Splitter Box and opening the valve again will allow the operator to repeatedly flush the pipe. If needed, the Raw Water Pipeline can be either snaked or jetted by accessing the pipe at the outlet in JVFP2, the bottom of the Flow Splitter Box, or at the Mine Drain. If cleaning the 12” pipe does not establish the desired conditions, the concrete riser may need to be extended, and the project designer or other qualified professional should be contacted.

The Mine Drain should be inspected during every site visit to ensure that the cover is in place and there is no overflow.

Flow Splitter Box

The flow splitter box is a 10’x8.5’ concrete box with a galvanized steel grate cover. Within the flow splitter box is a stainless-steel three-sided baffle with V-notch weirs cut into each side to proportionally direct flow to the three Jennings-type vertical flow ponds (JFVPs). Weirs that direct flow into JVFP1 and JVFP3 are cut at a 74° angle while the weir that feeds JVFP2 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 galvanized steel grate (within 1’ of the staff gauge). Both staff gauge and ‘measure down’ readings are included on the lookup table. Please note that the values presented in the lookup table for the 74° (VFP1/3) will be the flow rate for each JVFP1 and JVFP3 and is NOT a total value of the two. Also note that the Total Flow provided in the table for a given staff gauge reading is only valid for when all three JVFPs are flowing. When flow is not being directed to all 3 JVFPs, the individual values for the 90° and 74° weirs at a given staff gauge reading are still valid, but the total flow will need to be calculated. For example, if the staff gauge reading is 0.34 ft, but only VFP1 and VFP2 have flow and VFP3 is off line, the flow rates will be 57.5 gpm for JVFP1 and 75.6 gpm for JVFP2 for a total flow of 133.1 gpm.

During maintenance events it may be necessary to block flow to one or more JVFP. To divert flow away from both JVFP1 and JVFP3 at the same time, the 12" Bypass Valve downstream of the flow splitter box may be opened to direct all flow into JVFP2. To divert water away from just JVFP2 a removeable insert, specially fabricated for a 90° weir, can be installed into the weir opening, therefore blocking water from entering the pipeline feeding water into JVFP2. All flow would then be split to JVFP1 and JVFP3. A second removable insert was fabricated to block flows through either of the 74° weirs. Flows can then be diverted away from either JVFP1 or JVFP3 without the entire flow going into JVFP2. These inserts are to be kept in the Bypass Valve box.

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.

French Drain Seep Collection (SEEP)
A mine drainage seep that appeared to be emanating from an existing 6" terracotta pipe and likely served as some sort of mine drain was found. The seep was at an elevation that prevented the mine drainage from being directed into any of the JVFPs. The seep was collected in a 6" French drain that extends from the western side of JVFP3, across the north side of JVFP3 and then outlets into the western side of the wetland. A riser was installed on the outlet to allow for flow measurements and water sampling.

Jennings-type Vertical Flow Pond 1 (JFVP1)
Jennings Vertical Flow Pond 1 lies farthest to the west and is the only JVFP to discharge into the Settling Pond (SP). JVFP1 contains a mixture of limestone, wood chips, and mushroom compost (treatment media). There are four separate underdrain cells that flow through the west side of the pond and into the SP. Riser pipes can be individually raised or lowered to control the amount of treatment media being used and the overall level of treatment provided by JVFP1. Drainpipes are located adjacent to the riser pipes and are controlled via four 6" Valterra valves located in individual valve boxes (N-12 pipes) with red metal caps. Opening these valves will drain the entirety of JVFP1 into the SP.

Jennings-type Vertical Flow Pond 2 (JVFP2)
Jennings Vertical Flow Pond 2 lies to the southeast of JVFP1 parallel to SR-403 and discharges into the Wetland (WL). JVFP2 contains a treatment media mixture similar to JVFP1. The pond has 5 separate underdrain cells that flow through the northeast side of the pond and into the WL. Riser pipes can be individually raised or lowered to control the amount of treatment media being used and the overall level of treatment provided by JVFP2. Drainpipes are located adjacent to the riser pipes and are controlled via five 6" Valterra valves located in a single concrete valve box with a red metal lid. Opening these valves will drain the entirety of JVFP2 into the WL.

Jennings-type Vertical Flow Pond 3 (JVFP3)

Jennings Vertical Flow Pond 3 lies to the north of JVFP2 parallel to Two Lick Creek and discharges into the WL. JVFP3 contains a treatment media mixture similar to JVFP1. The pond has 4 separate underdrain cells that flow through the northeast side of the pond and into the WL. Riser pipes can be individually raised or lowered to control the amount of treatment media being used and the overall level of treatment provided by JVFP3. Drainpipes are located adjacent to the riser pipes and are controlled via four 6” Valterra valves located in individual black valve boxes with red metal caps. Opening these valves will drain the entirety of JVFP3 into the WL.

Settling Pond

JVFP1 flows to an existing pond, around a newly installed earthen baffle, and discharges through a corrugated N-12 culvert pipe to Two Lick creek. An auxiliary outlet is located approximately five feet above the primary outlet if needed during extreme flooding or if the primary outlet becomes inoperable. Prior to construction and after system startup, it was noted that this pond leaks up to about 50 gpm. This does not seem to result in any known stability issues and the leaking water will be alkaline.

Wetland

An existing wetland was reconfigured and receives water from both JVFP2 and JVFP3 and discharges to Two Lick Creek via a rock-lined spillway. The wetland also receives the seep what is collected by the French drain. Seven Z-pile baffles have been installed to increase retention times and maximize the use of the wetland by utilizing stagnant areas and eliminated preferential flow paths. Wetland depth varies between one and two feet which should allow for good variability in wetland plant biodiversity. During previous construction efforts, it was reported that an artesian flowing corehole was discovered near the eastern end of the wetland and reportedly contributes degraded water to the last 1/3 of the wetland. The flowing corehole as well as the Seep and other sources reported to emanate within the Wetland likely impact the final water quality, however, the excess alkalinity generated by JVFP2 and JVFP3 should be more than sufficient to overcome the acid load associated with the corehole water.

Types of Maintenance

System Startup and Odor Control

The rehabilitated Richards Passive System is rated to treat up to about 1,000 pounds per day of acidity using a treatment media mixture of limestone and organic material. The biological activity in the treatment media will produce both alkalinity and hydrogen sulfide gas. Depending on flow, temperature, and the age of the treatment media, nuisance odors may occur. After the system was first turned on in June 2021, the system created odor that was reported to be noticeable in Clymer, PA. The inserts were placed in the weirs feeding JVFP2 and JVFP3 to direct all the flow to JVFP1 and the riser for JVFP1 cell 1 was lowered to force all the flow through a single underdrain cell. This proved to be an effective means to control odor; However, in the future, either JVFP2 or JVFP3 should be utilized when only using one of the JVFPs in order to provide treatment for the corehole, Seep, and other in-wetland sources. In December 2021, the weir inserts were removed and both Cell 1 risers in JVFP2 and JVFP3 were lowered to split the flow among the three JVFPs and utilize only one underdrain cell per JVFP. It is recommended that the treatment media be ‘burned in’ by changing which cell is used in each JVFP on a monthly basis through the colder months. As the weather warms and the flow potentially decreases, one or more of the JVFPs may need to be taken off line to control odor. Over time, which may be several years, the odor should abate as the treatment media ages. Eventually all the JVFPs should be operated year-round utilizing all of the underdrain cells (i.e., no weir inserts and all riser pipes set at equal elevations in each JVFP). There should always be a noticeable odor near the outlets of the JVFPs, which indicates they are functioning as designed; However, as long as the treatment goals are being met, the level of treatment should be adjusted as needed to control nuisance odors. To provide mixing in the wetland to help overcome pollutant loads from the seep and corehole, it is preferred that sufficient flow be directed through JVFP2 and/or JVFP3 at all times.

Routine Inspection/Operation/Maintenance (Quarterly)

Routine inspections and regular maintenance should be performed on a Quarterly basis by the Blacklick Creek Watershed Association to ensure that the mine drainage flows through all components of the system and that the treatment goals for the final effluent are being met. These efforts are intended to be suitable for completion by one individual.

- Check the Mine Drain to ensure that the entire discharge is being conveyed to the Flow Splitter Box and that no AMD is entering the emergency overflow channel.
- Clean debris and buildup from weirs and from around the inlets to the 10” pipelines in the Flow Splitter Box and take a flow reading. Verify no water is leaking around the stainless-steel baffle (weir structure) and repair as needed.
- Exercise 12” Bypass Valve.
- Remove debris and unwanted vegetation from any ditches or channels as needed.
- Check embankments, channels, ditches, and overall site for erosion or unstable conditions. Fill and stabilize with onsite material.
- In order to generally characterize the performance of the passive treatment system, field water monitoring of at least the SP and WL effluent should be measured on a quarterly basis including pH, alkalinity, and flow rates where feasible. Ideally, flow rates should be determined and reported for all influent sources of AMD (Raw and Seep) and both the SP and WL. When flow cannot be directly measured, an assumed estimated value based on other flow measurements should be calculated and reported. Excessive reducing conditions from the JVFPs may inhibit oxidation and settling of iron in the WL or SP. If this occurs flows may need to be consolidated or cells of a pond may need turned off to increase the oxidation potential and increase settling rates.
    - The Settling Pond and Wetland should have pH above 6 and field alkalinity greater than 20 mg/L
    - If samples are collected, the Settling Pond and Wetland should always have negative acidity
        - Aluminum should always be less than 1 mg/L
        - Iron should always be less than 3 mg/L (though the influence of the corehole and seeps may cause the total iron to be up to 7 mg/L at the outlet of the Wetland)
        - Manganese was not a targeted parameter as the raw concentration is about $\leq$2 mg/L

Long-Term Maintenance (~5 to 10-Year Projected Need)

Stir JVFP Treatment Media

Over time, compaction of the treatment media and accumulation of metals may reduce permeability to the point where water can no longer readily pass through the treatment media. Water level in the pond will increase and eventually discharge through the emergency spillway, significantly reducing treatment. Stirring of the treatment media can often address this issue.

1. Open drain valves (4 valves for JVFP1 and JVFP3, 5 valves for JVFP2).
2. Allow the JVFP to drain below the treatment media elevation.
3. Allow media to dry to facilitate use of mini-excavator or other small equipment with relatively low ground pressure to run on the media.
4. Stir entire volume of treatment media, leaving behind loose uncompacted material. Take care not to damage underdrain piping, repair piping as needed. Stirring should stop at the underdrain stone/treatment media interface.
5. Close drain valves and allow pond to fill.
6. Open drain valves to flush JVFP in order to wash fine material from piping system.

7. Close drain valves and allow pond to fill. Reset, as needed, the adjustable outlet risers to the normal operating elevation.

Raw Water Pipeline
Although not expected, cleaning of the Raw Water Pipeline may be necessary, especially if quarterly maintenance is not completed and metal precipitates are allowed to build within the pipe.

1. Open bypass valve.
2. Using a pipe snake or a jetter, start clearing the pipeline from the JVFP2 side of the pipeline working upstream.
3. Once cleaned, flush one or two volumes of water through the pipeline to clear any remaining debris.
4. Close valve and return system to normal operation

Rehabilitation (~15- to 25-Year)

Flow Splitter Box and Raw Water Pipeline
Rehabilitation of the Flow Splitter Box and Raw Water Pipeline will generally be dependent on any vandalism that may happen. If debris is removed from the box and the weirs are kept clean on a quarterly basis there are not any foreseen wear items within the box, though the staff gauge may need to be replaced. Ensure that the '0' mark be set at the exact same elevation, which is level with the elevation of the weir crests (bottom of 'V').

Replace JVFP Treatment Media/Underdrain System
The complete replacement of treatment media will most likely be done in phases to continue treatment of the raw water by diverting water to JVFP2 during replacement of JVFP1 and/or JVFP3, then diverting water to JVFP1 and/or JVFP3 during replacement of the other JVFPs.

1. Divert flow away from the JVFP to be rehabilitated.
2. Open all drain valves and completely drain the subject JVFP
3. Allow media to dry to facilitate removal.
4. Remove spent treatment media and, if needed underdrain bedding stone and piping.
5. Spread and level spent treatment media and bedding stone onsite and cover with ~1' soil, revegetate with grass-legume seed mix. Alternatively, material can be disposed of off-site in accordance with all federal, state, and local regulations.
6. Replace underdrain stone and piping if needed and thoroughly mix and place fresh treatment media. The existing system quantities can be found on the as-built drawing or within the pond descriptions within this document. New developments in water treatment technologies, as well as potential changes in water quality and flow should be evaluated prior to replacing the treatment media.
7. Repeat steps 1 – 6 as needed for the two other JVFPs

Triggers to Initiate Maintenance Activities

Several maintenance triggers have been developed to help assist in identifying needed maintenance. The following is a listing of selected action items (numbered) with a brief description of suggested maintenance activities.

Trigger #1: Final Effluent of Wetland or Settling Pond pH below 6
The system is designed to discharge at a pH ≥6 from the Wetland and Settling Pond during normal flow conditions. Routine inspections are recommended to include measuring the pH of the effluent flows in the field using a colorimetric kit or a pH meter. Effluent water with a pH <6 when the flow rate is <747 gpm typically

indicates that a JVFP is not functioning optimally. The decrease in treatment by the JVFP could be caused by insufficient hydraulic conductivity, short-circuiting of the treatment media, worse-than-designed-for influent water chemistry, exhausted treatment media, and/or other factors.

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

STEP ONE: Determine that water chemistry and loading are not above the maximum design quantities. Flows or water chemistry above the design rate may cause depressed pH readings in the effluent making the treatment system appear to be underperforming when in fact it may be performing at or greater than designed on a load-basis.

STEP TWO: Reconfigure outlet risers to a higher elevation to increase the residence time within the JVFP to improve treatment. If increasing the residence time does not restore the effluent to a 6 pH, proceed to the third step. <u>*Note: Take care not to extend the outlet risers to the point that the water is bypassing the JVFP through its emergency spillway.*</u>

STEP THREE: Stir the treatment media in the JVFP as described above.

FINAL STEP: If stirring does not restore the desired pH and alkalinity, then the treatment media may need to be enhanced, increased, or replaced. Alternatively, the system may need to be otherwise evaluated and upgraded. Conferring with someone familiar with current passive treatment technology is advised before replacing the JVFP treatment media as described above.

<u>Trigger #2: JVFP Hydraulic Conductivity</u>
If water is flowing in the emergency spillway of the JVFP on a regular basis, this indicates that the actual flow rate is greater than the design flow rate, piping has plugged, and/or the hydraulic conductivity (permeability) of the treatment media has substantially decreased. If the influent flow rate is greater than 1000 gpm, check the system on a regular basis to ensure that the higher-than-maximum flow rate does not damage the spillways or embankments. If the flow rate is within the normal operating range and water is discharging through an emergency spillway, efforts to restore adequate flow through the treatment media or piping of the JVFP is needed. An initial first step is to lower the adjustable outlet riser of that JVFP, which will temporarily increase the driving head and potentially force the water through the treatment media until the water level stabilizes at the new outlet level. If lowering the outlet riser is not successful then additional action is required. Next drain the JVFP treatment media. As a loss in hydraulic conductivity may be caused by an accumulation of iron solids on the surface of the treatment media, draining the JVFP and allowing the iron solids to dry will encourage the formation of "cracks" that may be sufficient to restore adequate hydraulic conductivity. If draining and drying are not sufficient, the sludge may need to be removed prior to stirring the treatment media.

<u>Trigger #3: Sludge Accumulation</u>
If sludge has accumulated in the JVFPs, Wetland, or Settling Pond to a point where solids are (or about to be) carried out of the component during normal flow conditions, the recommendation is to remove the sludge. The material can be removed from the ponds and/or wetland and placed on-site, as feasible. There are a variety of mechanical means that can be provided by local companies including sludge pumping and/or excavation.

Rehabilitation/Replacement

Prior to initiating the previously discussed rehabilitation procedures for the passive components, an evaluation of any changes in raw discharge characteristics and advancements in technology is recommended. For instance, higher flow rates and poorer water quality can substantially affect future system performance; therefore, revisions to the size and/or design of the system may be applicable.

Rehabilitation/replacement considerations include, but are not limited to:

- Estimating Best Management Practice (BMP) design life;
- Determining replacement responsibility, including a successor, as necessary;
- Determining approximate costs for the following possible needs:
    - removing accumulated sediments;
    - replacing defective valves, water control structures, etc.;
    - replacing media in treatment components; and
    - re-sizing the system to accommodate changed water quality or quantity.

Table 1. Richards Flow Splitter Box Lookup Table.

Richards Flow Splitter Box Lookup Table

(Direct read staff guage or measure down from top of grate. Raw water sample may be collected in the box or at the pipes discharging to JVFP2 or JVFP3.)

Staff Reading	Staff Reading	Measure Down*	Measure Down*	90˚ (VFP2)	74˚ (VFP1/3)	TOTAL (3 VFPS)	Staff Reading	Staff Reading	Measure Down*	Measure Down*	90˚ (VFP2)	74˚ (VFP1/3)	TOTAL (3 VFPS)	Staff Reading	Staff Reading	Measure Down*	Measure Down*	90˚ (VFP2)	74˚ (VFP1/3)	TOTAL (3 VFPS)
Head (ft)	Head (in)	(ft)	(in)	(gpm)	(gpm)	(gpm)	Head (ft)	Head (in)	(ft)	(in)	(gpm)	(gpm)	(gpm)	Head (ft)	Head (in)	(ft)	(in)	(gpm)	(gpm)	(gpm)
0.01	1/8	1.32	15 7/8	0.0	0.0	0.0	0.34	4 1/8	0.99	11 7/8	75.6	57.5	190.6	0.67	8	0.66	8	412.3	309.9	1032.1
0.02	2/8	1.31	15 6/8	0.1	0.1	0.2	0.35	4 2/8	0.98	11 6/8	81.3	61.8	204.9	0.68	8 1/8	0.65	7 7/8	427.9	321.5	1070.9
0.03	3/8	1.30	15 5/8	0.2	0.2	0.5	0.36	4 3/8	0.97	11 5/8	87.3	66.2	219.7	0.69	8 2/8	0.64	7 6/8	443.8	333.4	1110.6
0.04	4/8	1.29	15 4/8	0.4	0.3	1.0	0.37	4 4/8	0.96	11 4/8	93.4	70.9	235.2	0.70	8 3/8	0.63	7 5/8	460.0	345.6	1151.2
0.05	5/8	1.28	15 3/8	0.6	0.5	1.7	0.38	4 4/8	0.95	11 4/8	99.9	75.7	251.4	0.71	8 4/8	0.62	7 4/8	476.6	358.0	1192.6
0.06	6/8	1.27	15 2/8	1.0	0.8	2.7	0.39	4 5/8	0.94	11 3/8	106.6	80.8	268.1	0.72	8 5/8	0.61	7 3/8	493.6	370.7	1234.9
0.07	7/8	1.26	15 1/8	1.5	1.2	3.9	0.40	4 6/8	0.93	11 2/8	113.5	86.0	285.6	0.73	8 6/8	0.60	7 2/8	510.9	383.6	1278.2
0.08	1	1.25	15	2.0	1.7	5.4	0.41	4 7/8	0.92	11 1/8	120.8	91.4	303.7	0.74	8 7/8	0.59	7 1/8	528.6	396.8	1322.3
0.09	1 1/8	1.24	14 7/8	2.7	2.2	7.1	0.42	5	0.91	11	128.3	97.1	322.4	0.75	9	0.58	7	546.6	410.3	1367.3
0.10	1 2/8	1.23	14 6/8	3.5	2.8	9.2	0.43	5 1/8	0.90	10 7/8	136.0	102.9	341.9	0.76	9 1/8	0.57	6 7/8	565.0	424.1	1413.2
0.11	1 3/8	1.22	14 5/8	4.5	3.6	11.7	0.44	5 2/8	0.89	10 6/8	144.1	109.0	362.0	0.77	9 2/8	0.56	6 6/8	583.8	438.1	1460.0
0.12	1 4/8	1.21	14 4/8	5.6	4.4	14.5	0.45	5 3/8	0.88	10 5/8	152.4	115.2	382.9	0.78	9 3/8	0.55	6 5/8	602.9	452.4	1507.8
0.13	1 4/8	1.20	14 4/8	6.8	5.4	17.6	0.46	5 4/8	0.87	10 4/8	161.0	121.7	404.4	0.79	9 4/8	0.54	6 4/8	622.4	467.0	1556.4
0.14	1 5/8	1.19	14 3/8	8.2	6.5	21.1	0.47	5 5/8	0.86	10 3/8	169.9	128.4	426.6	0.80	9 5/8	0.53	6 3/8	642.3	481.9	1606.0
0.15	1 6/8	1.18	14 2/8	9.8	7.6	25.1	0.48	5 6/8	0.85	10 2/8	179.1	135.2	449.6	0.81	9 6/8	0.52	6 2/8	662.6	497.0	1656.6
0.16	1 7/8	1.17	14 1/8	11.5	9.0	29.4	0.49	5 7/8	0.84	10 1/8	188.6	142.3	473.3	0.82	9 7/8	0.51	6 1/8	683.2	512.4	1708.1
0.17	2	1.16	14	13.4	10.4	34.2	0.50	6	0.83	10	198.4	149.7	497.7	0.83	10	0.50	6	704.2	528.1	1760.5
0.18	2 1/8	1.15	13 7/8	15.4	12.0	39.3	0.51	6 1/8	0.82	9 7/8	208.4	157.2	522.9	0.84	10 1/8	0.49	5 7/8	725.6	544.1	1813.9
0.19	2 2/8	1.14	13 6/8	17.7	13.7	45.0	0.52	6 2/8	0.81	9 6/8	218.8	165.0	548.8	0.85	10 2/8	0.48	5 6/8	747.4	560.4	1868.2
0.20	2 3/8	1.13	13 5/8	20.1	15.5	51.1	0.53	6 3/8	0.80	9 5/8	229.5	173.0	575.5	0.86	10 3/8	0.47	5 5/8	769.6	577.0	1923.5
0.21	2 4/8	1.12	13 4/8	22.7	17.5	57.6	0.54	6 4/8	0.79	9 4/8	240.4	181.2	602.9	0.87	10 4/8	0.46	5 4/8	792.2	593.8	1979.8
0.22	2 5/8	1.11	13 3/8	25.5	19.6	64.7	0.55	6 5/8	0.78	9 3/8	251.7	189.7	631.1	0.88	10 4/8	0.45	5 4/8	815.1	611.0	2037.1
0.23	2 6/8	1.10	13 2/8	28.5	21.9	72.2	0.56	6 6/8	0.77	9 2/8	263.3	198.4	660.1	0.89	10 5/8	0.44	5 3/8	838.5	628.4	2095.3
0.24	2 7/8	1.09	13 1/8	31.7	24.3	80.3	0.57	6 7/8	0.76	9 1/8	275.2	207.3	689.8	0.90	10 6/8	0.43	5 2/8	862.2	646.2	2154.6
0.25	3	1.08	13	35.1	26.9	88.8	0.58	7	0.75	9	287.5	216.5	720.4	0.91	10 7/8	0.42	5 1/8	886.4	664.2	2214.8
0.26	3 1/8	1.07	12 7/8	38.7	29.6	97.9	0.59	7 1/8	0.74	8 7/8	300.0	225.9	751.7	0.92	11	0.41	5	910.9	682.5	2276.0
0.27	3 2/8	1.06	12 6/8	42.5	32.5	107.5	0.60	7 2/8	0.73	8 6/8	312.9	235.5	783.9	0.93	11 1/8	0.40	4 7/8	935.9	701.2	2338.2
0.28	3 3/8	1.05	12 5/8	46.5	35.6	117.7	0.61	7 3/8	0.72	8 5/8	326.1	245.4	816.9	0.94	11 2/8	0.39	4 6/8	961.3	720.1	2401.5
0.29	3 4/8	1.04	12 4/8	50.8	38.8	128.4	0.62	7 4/8	0.71	8 4/8	339.6	255.5	850.6	0.95	11 3/8	0.38	4 5/8	987.0	739.3	2465.7
0.30	3 5/8	1.03	12 3/8	55.3	42.2	139.7	0.63	7 4/8	0.70	8 4/8	353.5	265.9	885.3	0.96	11 4/8	0.37	4 4/8	1013.2	758.9	2531.0
0.31	3 6/8	1.02	12 2/8	60.0	45.7	151.5	0.64	7 5/8	0.69	8 3/8	367.7	276.5	920.7	0.97	11 5/8	0.36	4 3/8	1039.8	778.7	2597.3
0.32	3 7/8	1.01	12 1/8	65.0	49.5	163.9	0.65	7 6/8	0.68	8 2/8	382.2	287.4	957.0	0.98	11 6/8	0.35	4 2/8	1066.8	798.9	2664.6
0.33	4	1.00	12	70.2	53.4	177.0	0.66	7 7/8	0.67	8 1/8	397.1	298.5	994.1	0.99	11 7/8	0.34	4 1/8	1094.2	819.4	2733.0

Total flow is the 90˚ weir plus 2X the 74˚ weir reading. The 74˚ weir reading is for a single weir. If JVFP2 is turnd off with flow to both JVFP1 and JVFP3, the total flow is the flow for the 74˚ weir multipled by two.

*Measure within 1 foot of staff guage. (Distance measured from top of grate to 0.0 on staff gugage was 1.33' (16.0") on 7/2/21.

Note: '0' Mark (weir crest) elevation: 1270.19; Elevation at top of 12" PVC pipe in Mine Drain at inside wall of concrete riser: 1270.13