How Many Discharge Flows are Enough: A Shade Creek Case Study

May 6, 2026

West Virginia Mine Drainage Task Force Symposium

Morgantown, West Virginia

KLEINFELDER
Bright People. Right Solutions.

Today’s Speakers

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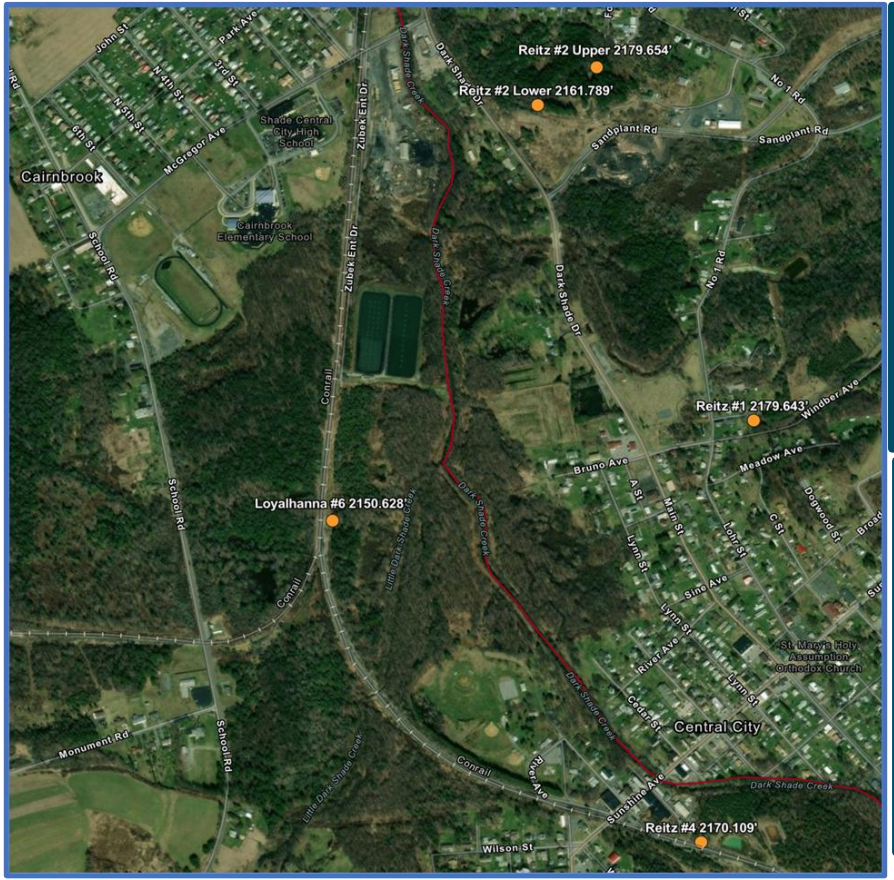
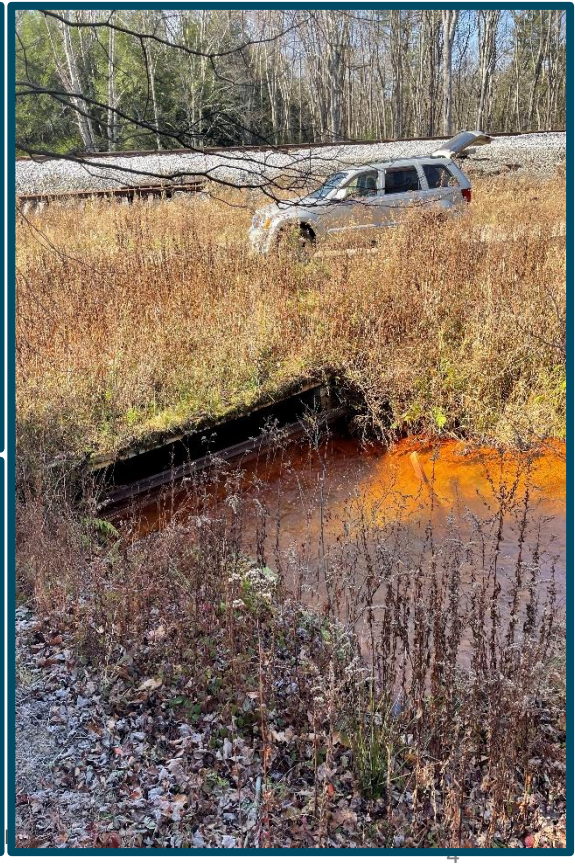
State College, PA

Shade Creek Active Treatment Plant Development Project

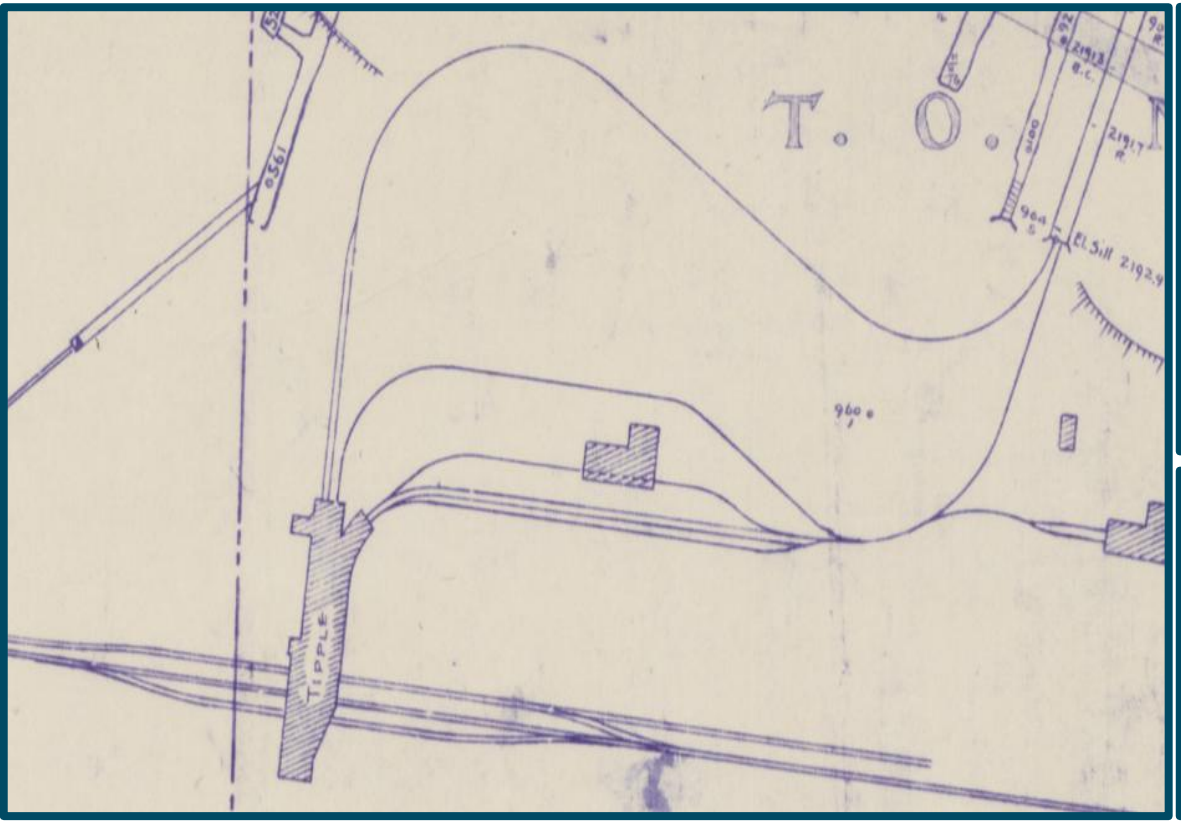
- Shade Creek at 98-square miles, is the second largest tributary and one of the largest sources of mine drainage to the Stonycreek River in Somerset County, PA.
- The Stonycreek River is a highly used river, particularly for paddling. Its confluence with the Little Conemaugh River in Johnstown forms the Conemaugh River. The Conemaugh River's confluence with Loyalhanna Creek forms the Kiskiminetas River which confluences with the Allegheny River near Freeport.
- Shade Creek has long been known to be impacted by four large flow deep mine discharges, The Big-4, all outfalling in Central City Borough or the surrounding Shade Township.
- Due to the significant expense of treating the Big-4 properly, no project progress occurred over decades, but this did allow for a large quantity / quality dataset to be compiled.
- This inability to fund a project all changed with the passing of IIJA and the Shade Creek Watershed Association obtained a 2024 AMD/AML Grant from BAMR to fund the Phase I: Development portion of a future active treatment plant

The Big-4…maybe 5…no, its 3





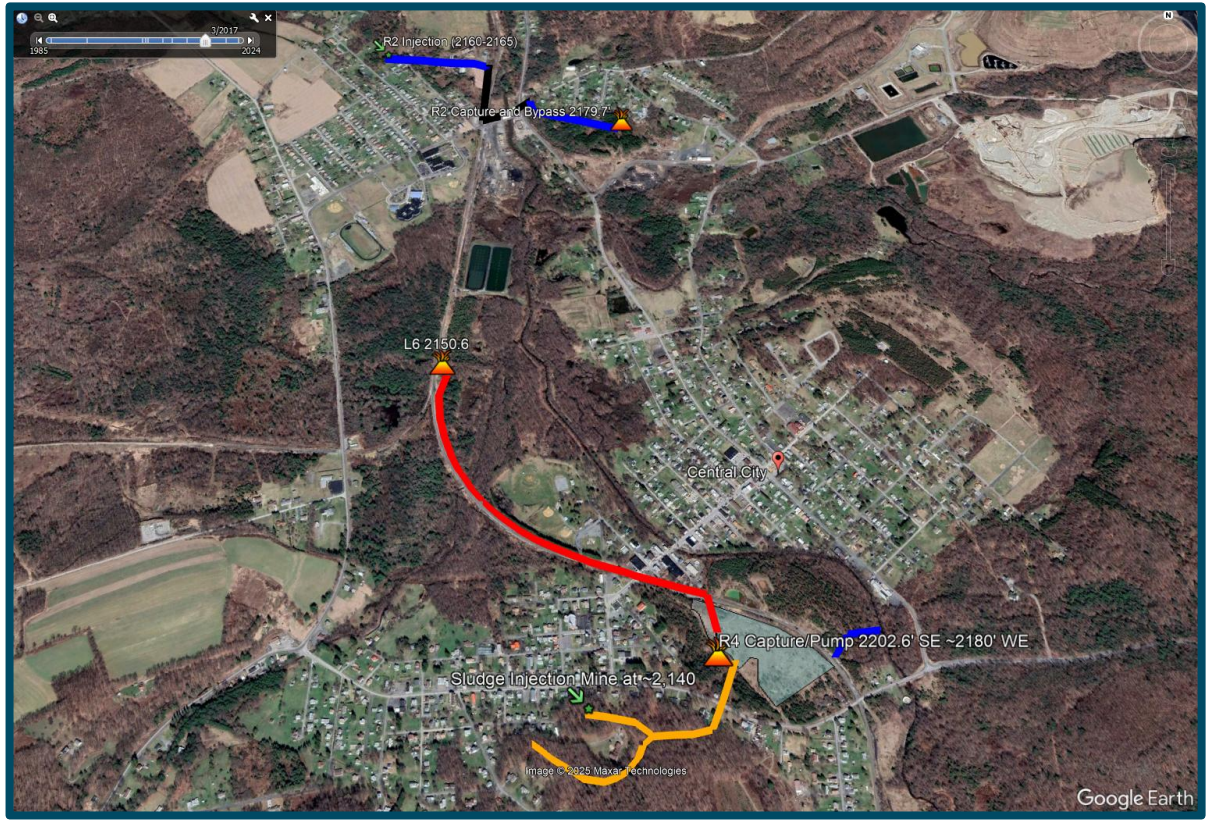
Why 5 to 3? Reitz 2 Findings



Why 5 to 3? Reitz 1 Passive Treatment System

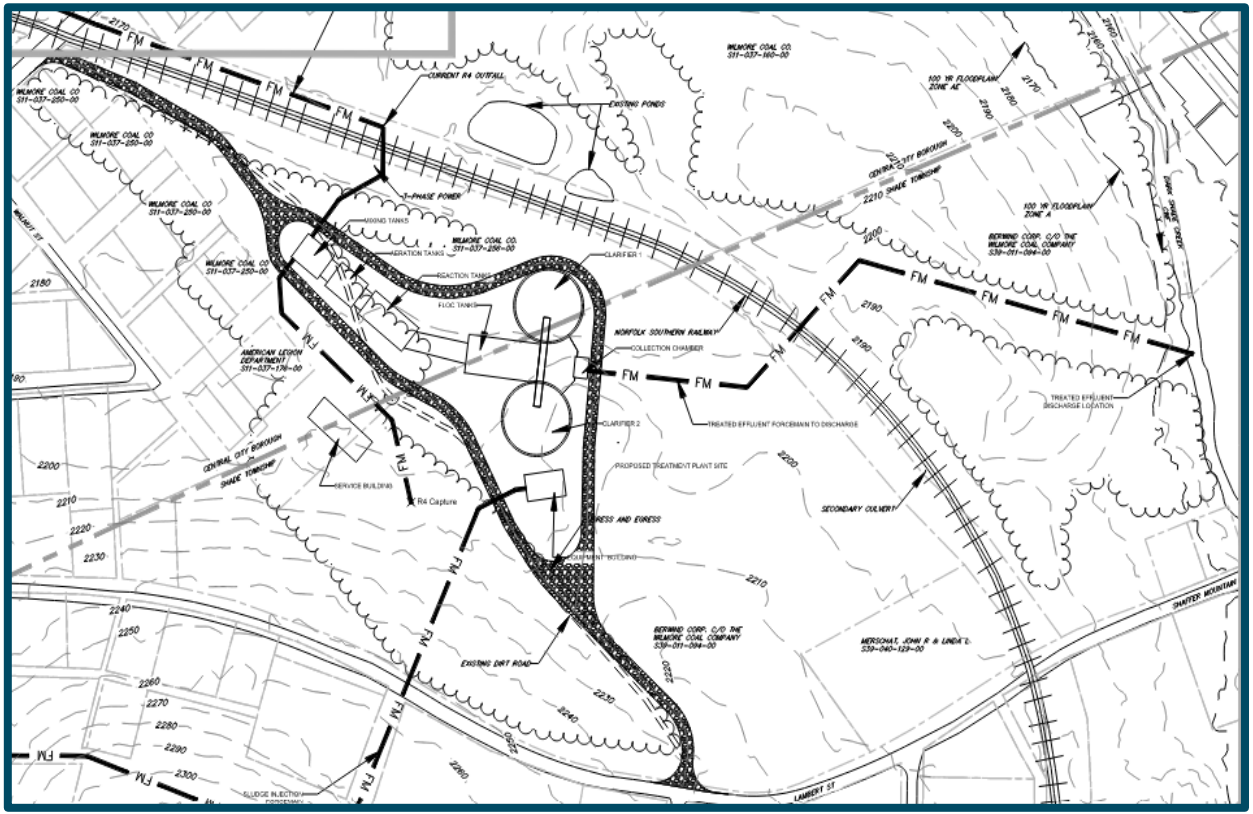
The Conceptual ATP….

- Collection of R2 and conveyance to L6 mine
- Capture of L6/R2 combined flow at L6 Shaft
- Pump L6/R2 to ATP Mix Tank by R4
- Capture and Pump R4 to ATP Mix Tank
- Aeration, Hydrated Lime, Polymer, Dual Clarifier ATP
- Treated water placed as far upstream as possible to maximize gains
- Restored Dark Shade through Central City Borough



The Conceptual ATP Continued……

- L6/R2 and R4 flows into Mix Tank.
- Aeration Tanks to decarbonate, decreasing lime need.
- Reaction Tanks where hydrated lime is added.
- Floc Tanks where polymer is added.
- Dual Clarifiers
- Sludge Pump and Disposal
- Treated Water Pump
- **Sized for 21-MGD Max, but not always so prior to transducer installs**



Massive Datasets Prior to Feb 25 Shade Transducer Installs

- Reitz 4 = 449 flows
- Loyalhanna 6 = 67 flows
- Reitz 2 = 83 flows

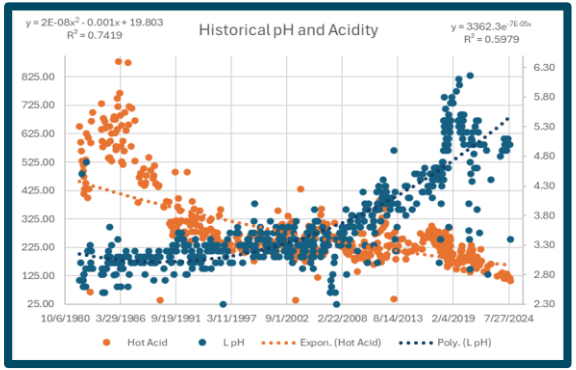
- Reitz 4 95% CI = 3,050-GPM
- Loyal. 6 95% CI = 4,250-GPM
- Reitz 2 95% CI = 2,925-GPM

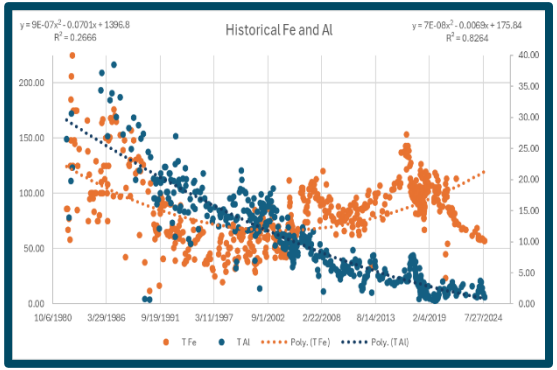
- Total flow 10,225-GPM
- Total Size 15-MGD

- Transducers installed in Feb 25 and Somerset County got 10-in of rain in May and decent amount in June.

Table 2. *Historical quantity and quality statistics for the R4 outfall. Elevation 2,170.109-ft.*

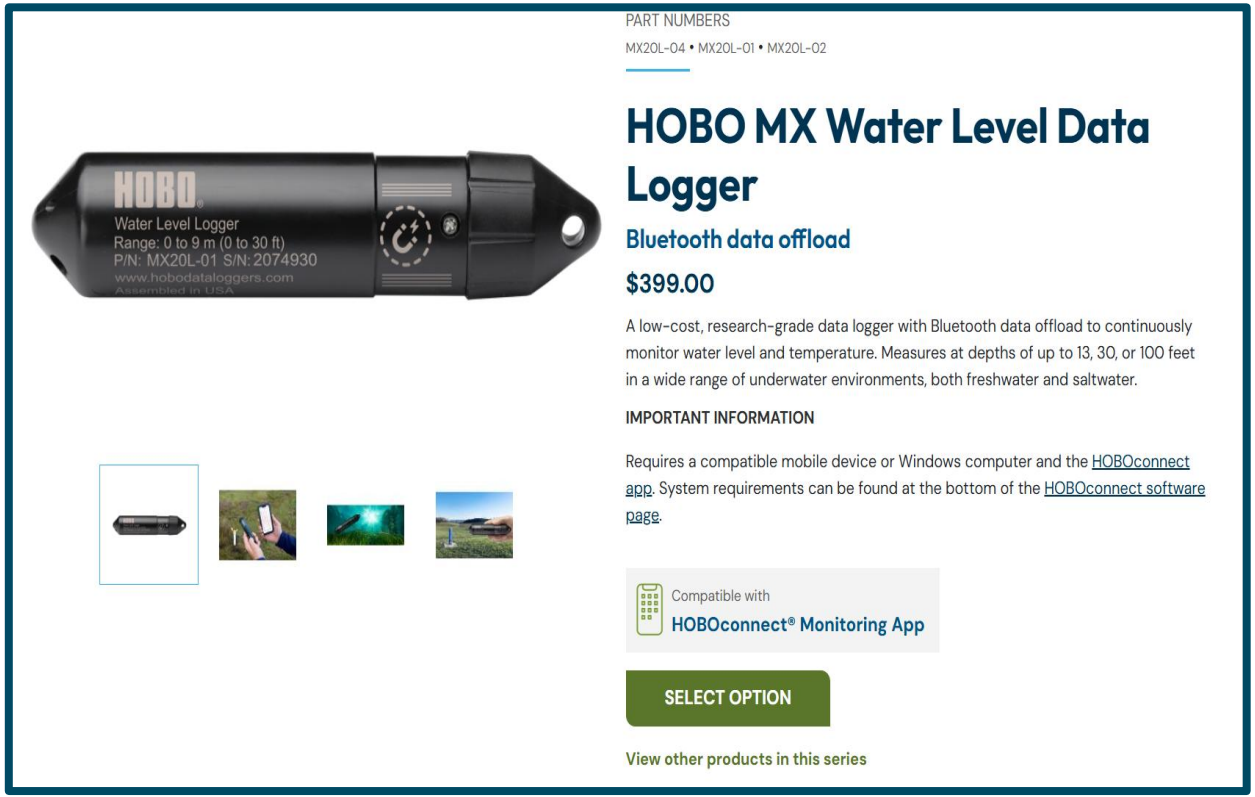
Stat	Q (GPM)	Lab pH	Lab Acid.	Lab T Fe	Lab F Fe	Lab T Al
n	449	587	586	587	13	526
Min	100	2.30	39.20	12.00	53.24	0.47
Med	1,424	3.50	243.60	83.50	58.40	7.59
Ave	1,605	3.77	283.62	83.99	71.36	9.51
75% CI	2,247					
90% CI	2,800					
95% CI	3,053					
99% CI	3,675					
Max	4,280	6.16	880.00	225.00	125.21	38.50
St Dev	802	0.82	134.34	30.78	23.67	7.20





Transducers or Water Level Loggers

- Myriad of companies, styles, and costs.
- I am not an Onset Rep nor am I plugging their products, but this works at a pretty low price.
- Myriad of ways to install
  - Put them in cinder block behind weir
  - Stilling well / piezometer behind or beside weir
  - Housing….
  - Angled off bank



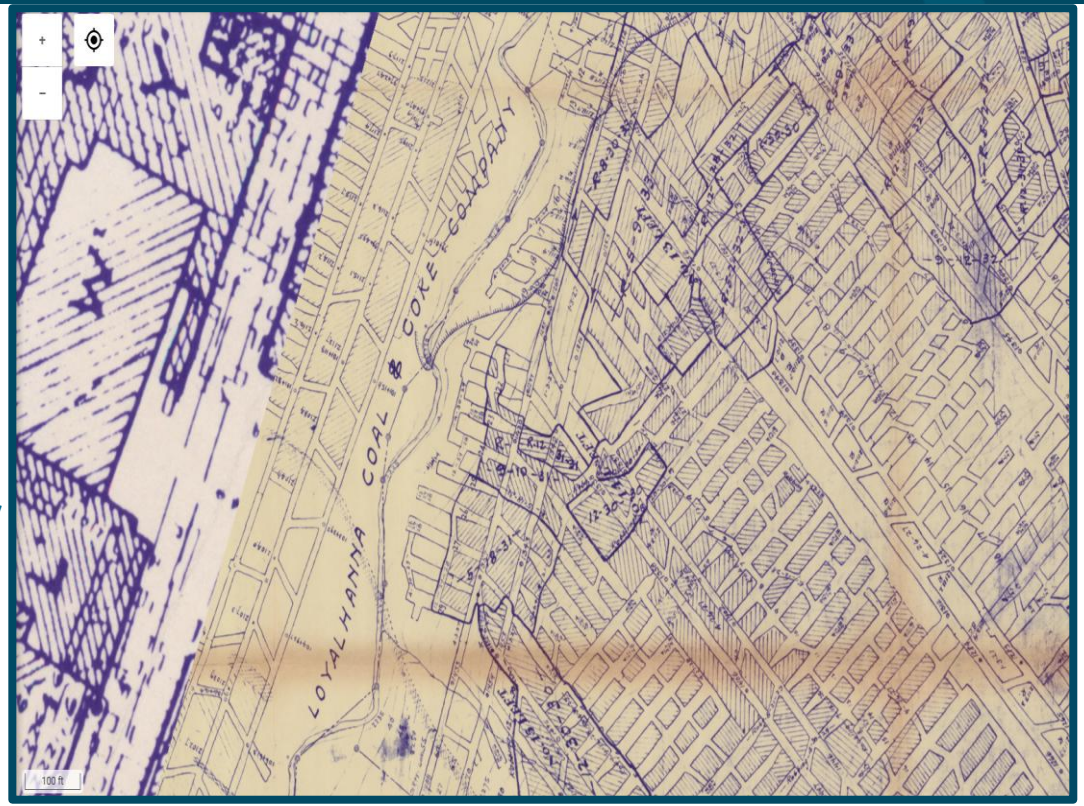
Big-3 Transducer Flows Post May / June Precipitation

- Total flows increased from 15-MGD to 21-MGD, a 40-percent increase.
- Influent to plant
  - L6/R2: 11,500-GPM 95% CI
  - R4: 3,000-GPM 95% CI from R4
  - Why did R4 not change? Next slide for theory.
- We believe we can use L6 pool to store the very infrequent and short duration max flows from L6/R2 that get more than 13,000-GPM.
- Even so, for double-redundancy, secondary bypass will be installed for extreme flows.
- Shade Creek high at same time with treated flow from plant upstream.

	R4	L6	R2	Total
n	2639	2267	8899	
Min	100	1016	68	1184
Ave	2078	3714	2717	8510
Med	2092	3448	2355	7895
75% CI	2422	4468	2728	9618
90% CI	2744	5637	4883	13264
95% CI	2933	6126	5223	**14282**
99% CI	3325	6879	5735	15938
Max	4280	7216	5991	17487
St Dev	550	1262	1092	2904

Why did R2/L6 Increase, but not R4?

- Barrier pillar right at the Berlin Syncline between R4 (to the right) and L6 (to the left)
- R4 pool elevation controlled by the outfall at 2,174-ft.
- L6 pool elevation controlled by the shaft elevation at 2,156-ft.
- Theorize that water is leaking / spilling from R4 to L6, partly causing the heavy flows at L6 and decreasing at R4.
- Mine mapping also shows evidence that L7 in the Upper Kittanning seam was intentionally drained down seem to L6.



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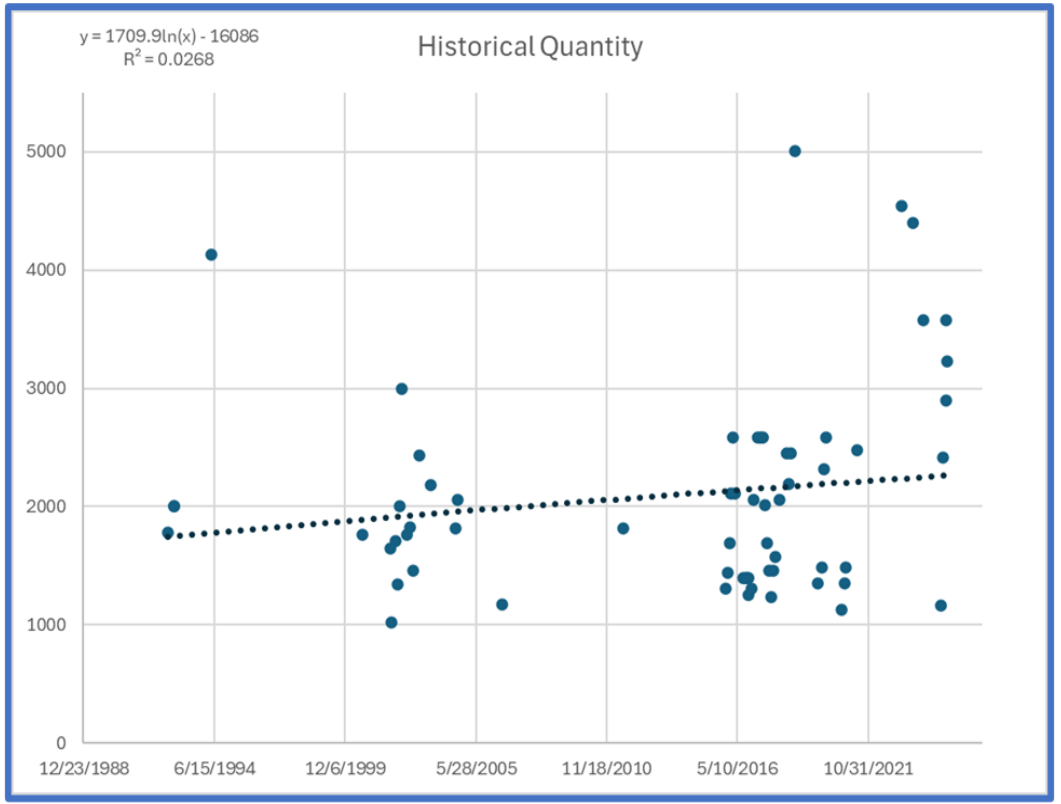
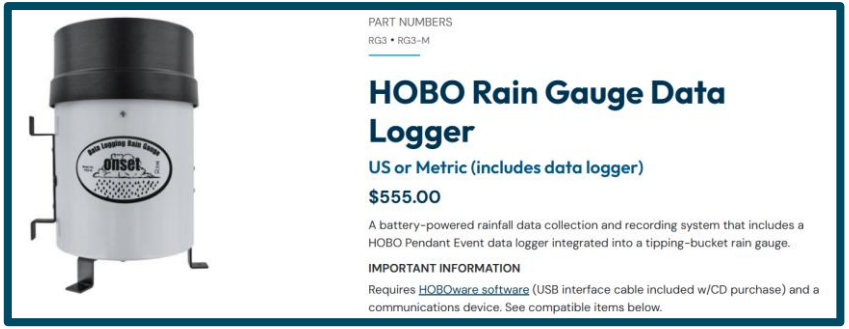
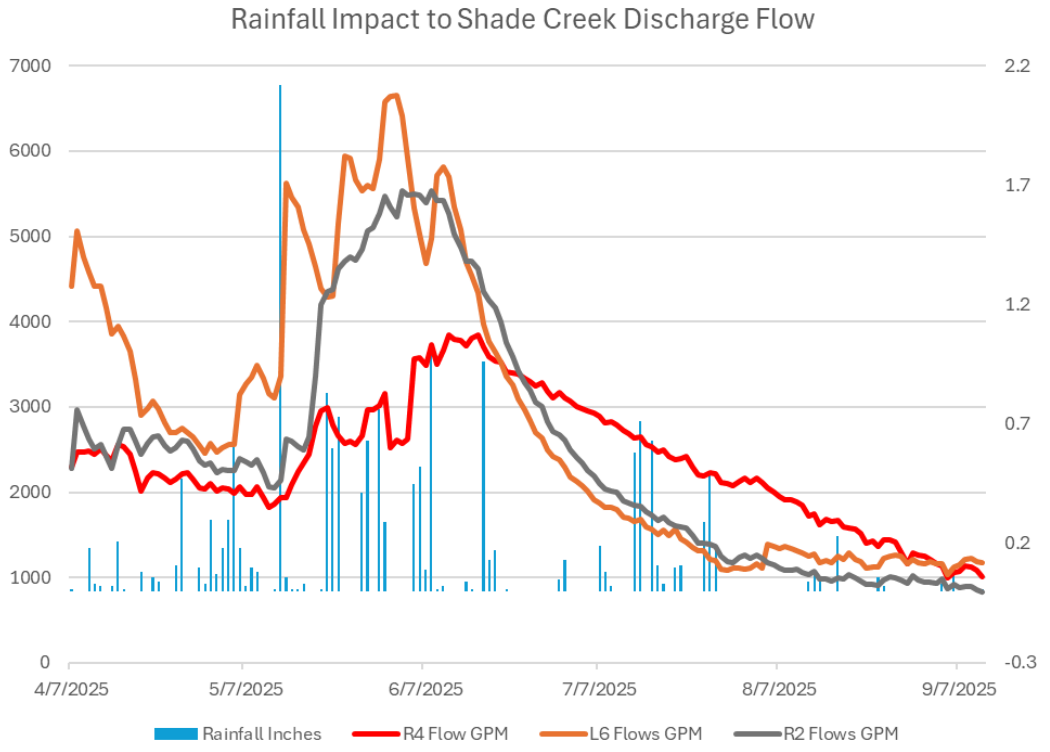


Add in a Digital Rain Gage for Extra Fun

- Transducer flow and rain gage data shows that R2 has a significant delay/lag.
- Heavy precip event on 5/13 and 5/14, but flows did not increase significantly until 5/20.
- Shows that this mine has storage and is valuable information for eventual plant operators.





Hydrologic year transducer flows tied to a local rain gage….

- In my opinion, it's a must.
- Without I would have designed a 15-MGD plant at Shade instead of the needed 21-MGD.
- Why are we missing high end flows and designing plants too small?
  - TC: "When does rainfall mainly occur in Pennsylvania, ChatGPT?"
  - ChatGPT: "Rain is most frequent in the afternoon and evening due to solar heating, which causes warm air to rise and form convection storms. That was a very insightful question, TC."
  - TC: "Oh, why thank you, Skynet. When do you plan to takeover?"
  - ChatGPT: …….
- The people collecting one-time flows are working from 8-4.
- High flows more than likely occurring in evening and overnight.
- 12 flows between the hours of 8-4 are not enough and is impacting proper sizing.
- Slap a weir, put a transducer behind it, and place a rain gage nearby. That's the solution.

Questions Answered at Shade Via Transducers/Rain Gage

- We are designing the plant to proper size (i.e. 15-MGD to 21-MGD). Bypass would have ruined all our gains. No one wants fish kills AFTER plant construction.
- We now understand that flows are not very delayed at R4 and L6 (hours to a day) but are very delayed at R2 (up to a week). R2 could offer storage relief.
- We now have the timed and connected data to inform the eventual plant operator that flows may increase X-GPM with every Y-inches of precipitation. Operators can then plan accordingly or pump down a mine pool to accept oncoming amount to “cut off the peaks”.
- Transducers showing how R4 has actually decreased in flow over time, while L6 has increased, allowed us to theorize that a leaky barrier pillar between R4 and L6 and higher seam drainage to L6 may be the cause.
- With L6 being a vertical shaft artesian discharge, pool pumping to accept precip flow increases may offer flow management to plant.

Have Trouble ID'ing Where Your Discharges Are?

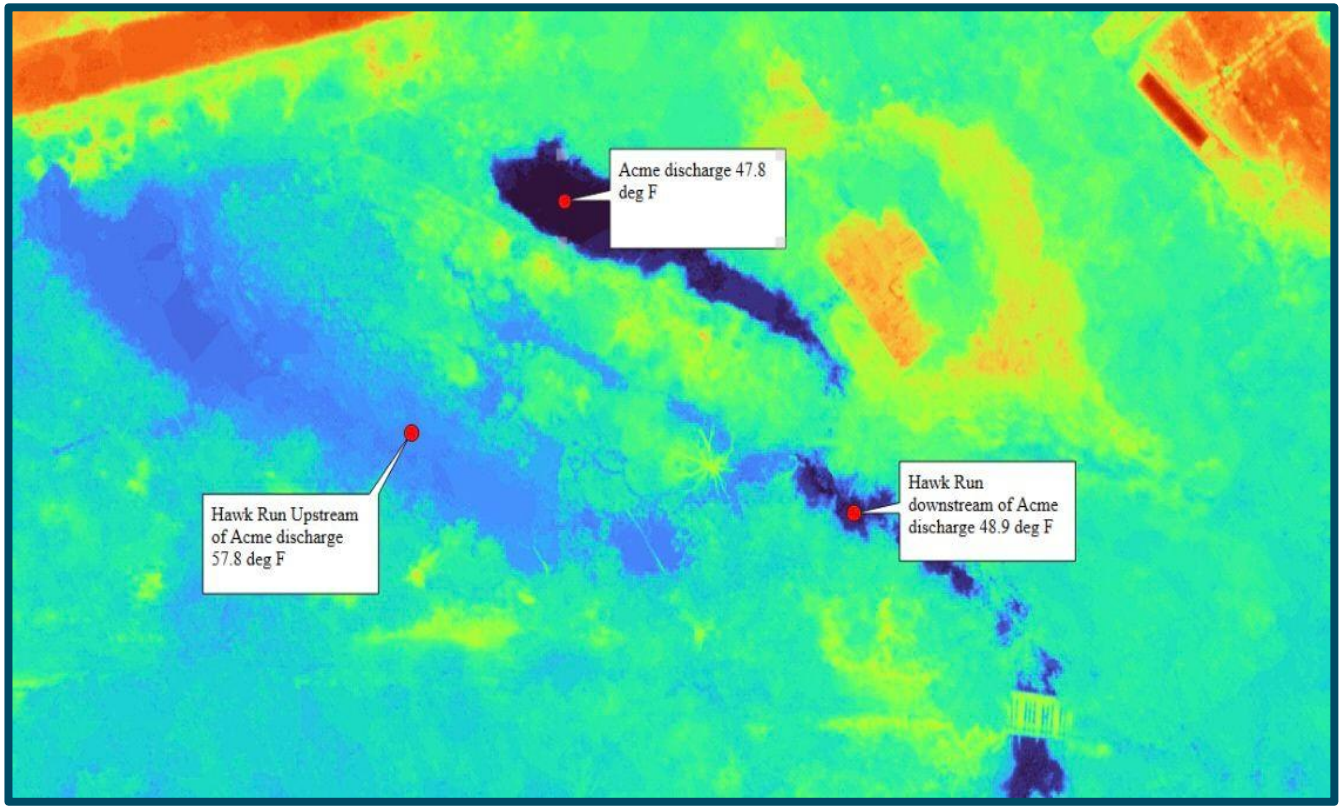
- Thermal drone technology
  - Can answer the "is that a discharge?" question quicker saving you/your client money.
  - Can also improve safety and limit risk.
- Hawk Run had unaccounted for sulfate loading beyond the two known shaft discharges.
- First of its kind use that I know of.

Find someone that isnt me to fly it…..

- Eric Oliver, licensed drone pilot, all around tech nerd, and good guy.
- Joece Lynn and the MCWA boys as spotters. Got to watch for those damn Bald Eagles.
- Divided the watershed into three stretches. Each stretch about 20-mins to fly with some prep. In/out in 3-hrs.
- Would have took days to walk and very dangerous.

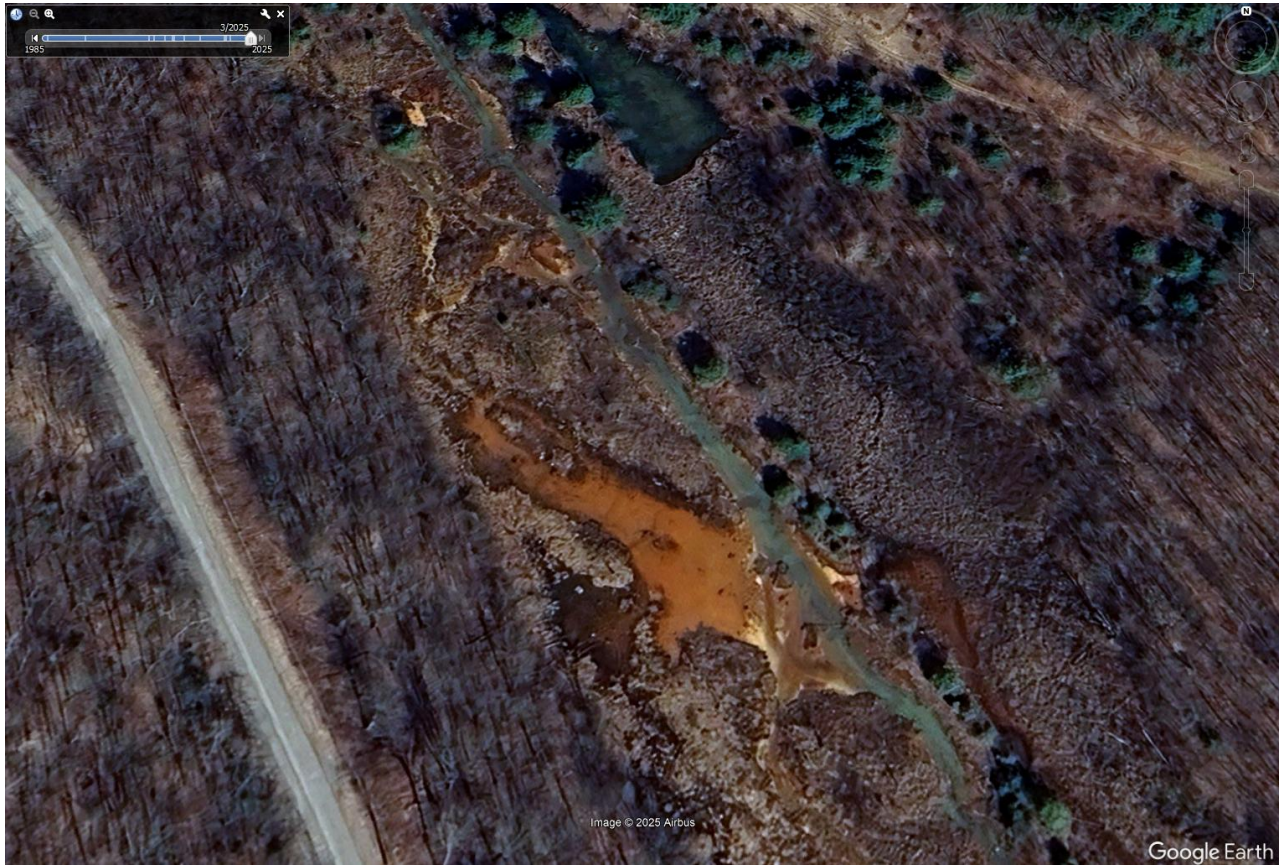
Known Discharge – Acme Shaft

- Hawk Run flowing from northwest to southeast running at 57.8 deg.
- Acme Shaft just north of channel outfalling at 47.8 deg.
- Mix of Hawk Run and Acme at 48.9 deg showing that a majority of the flow is Acme.
- This is the furthest downstream section. The two upstream sections are where there are questions.



Section Between Acme and Morrisdale

- Where there are visual cues of other possible discharges.
- The most significant of which is shown in the aerial to the right.
- Is that a discharge or is that a backflow or eddy within the flowing wetland?
- Could this be a part of our unaccounted for sulfate loading?
- I’m not going in there to fall in an unknown shaft.



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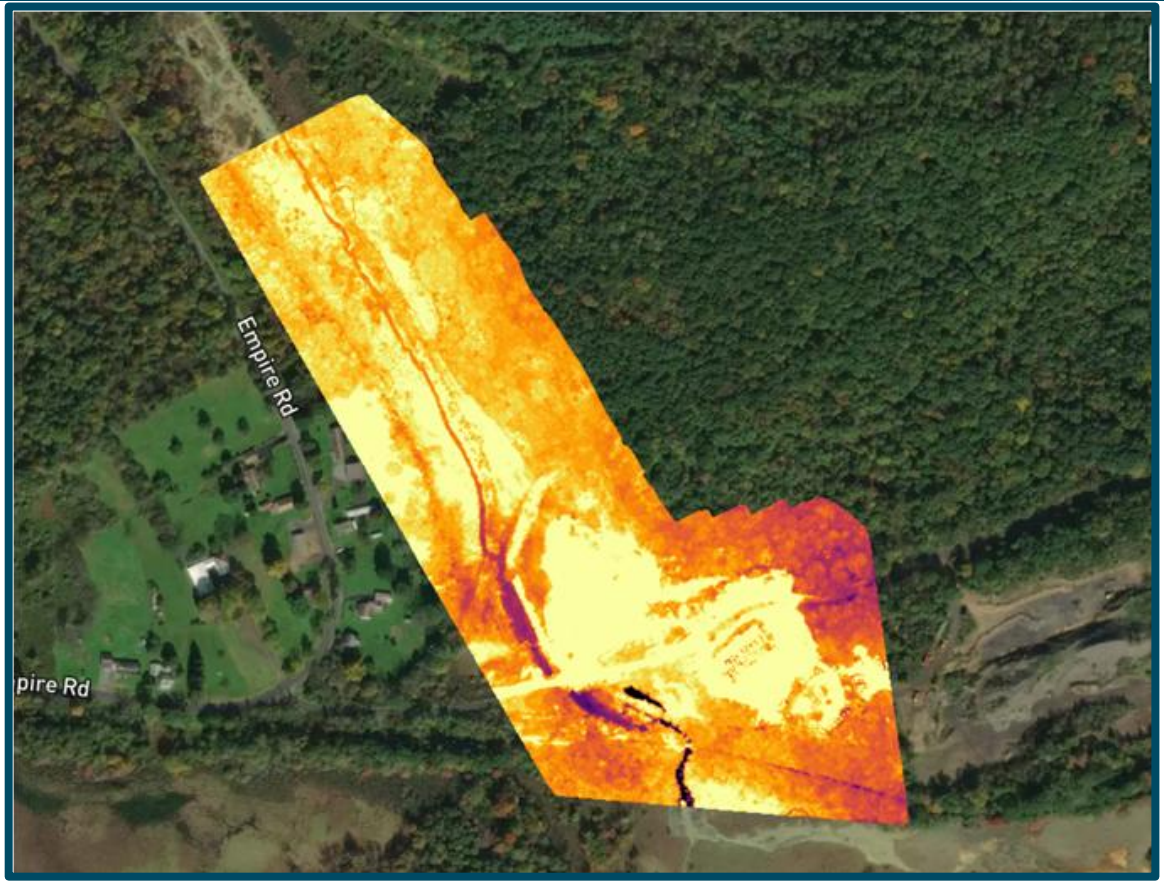
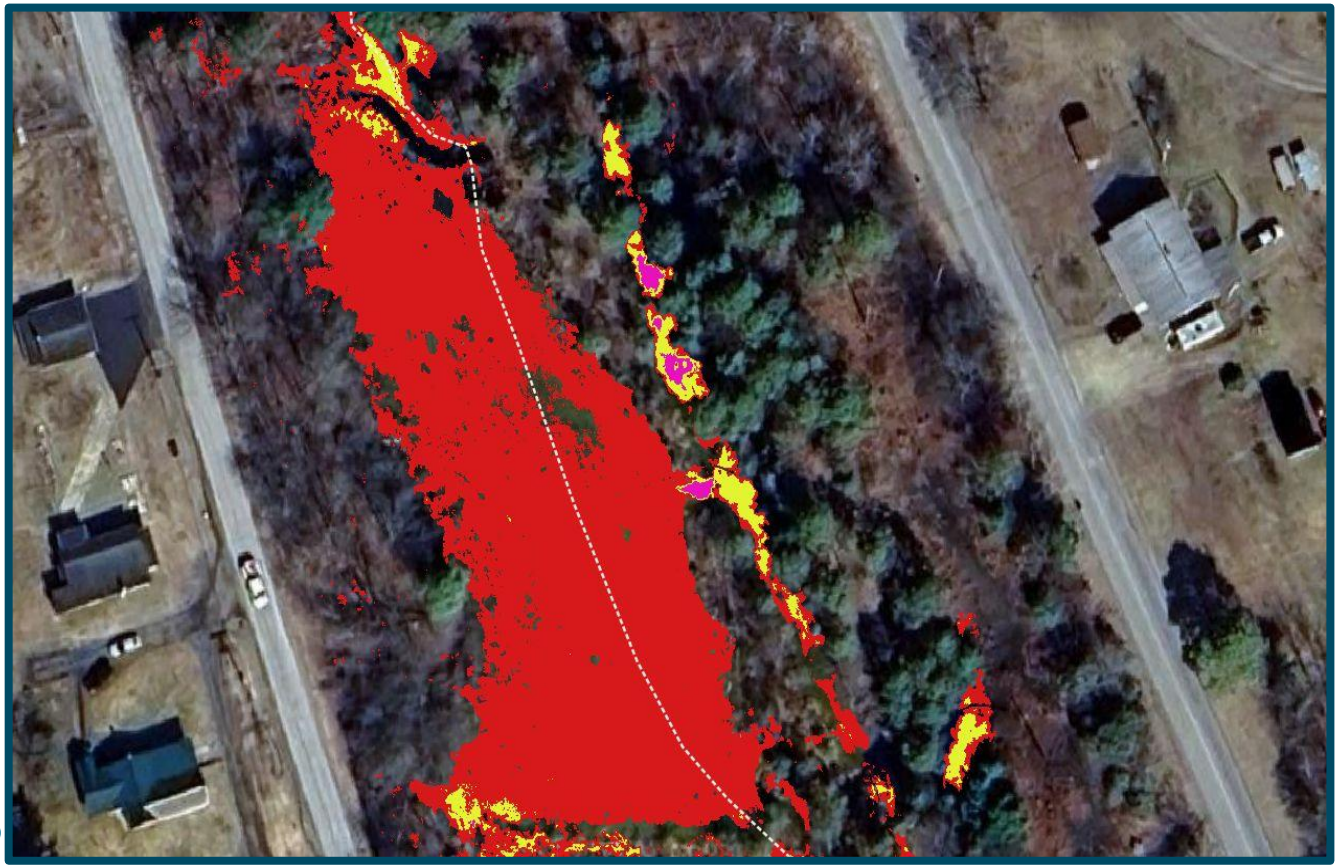


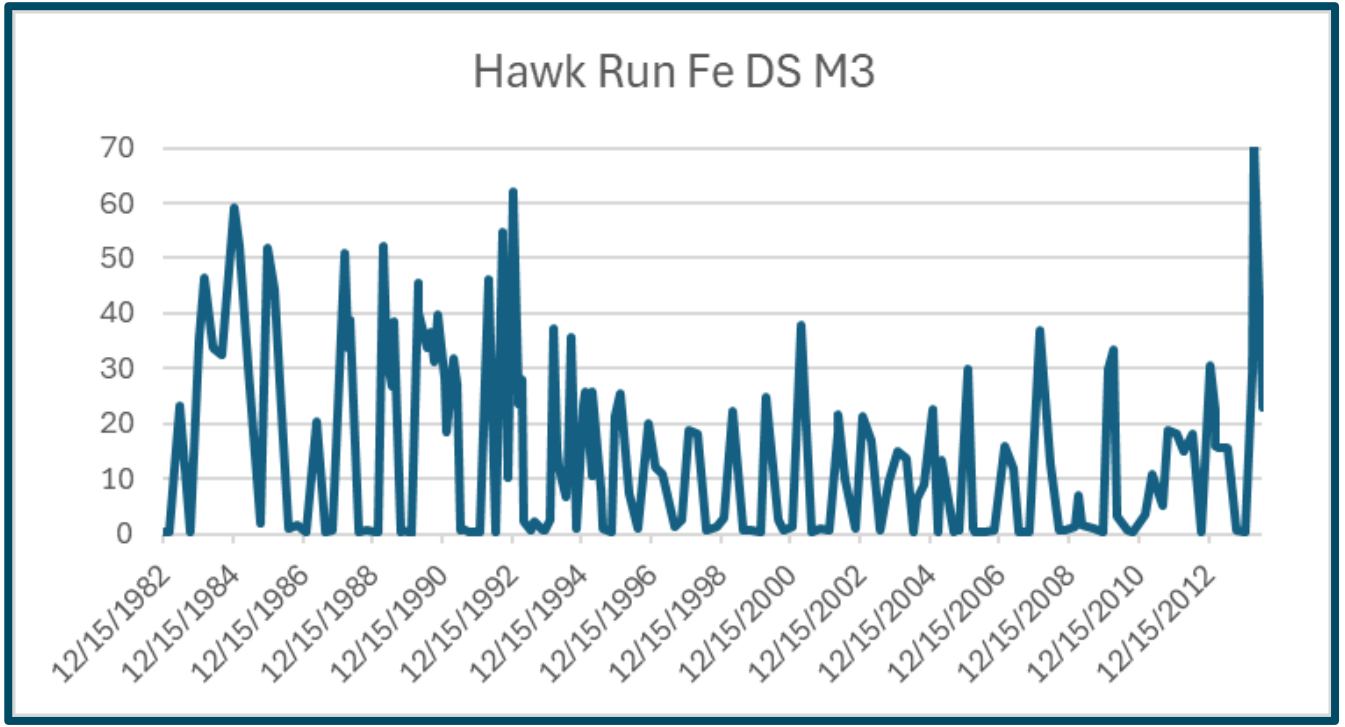
Morrisdale 3 Shaft Section

- Red on left is a beaver pond that Hawk Run is flowing through.
- Lower yellow is a discharge of relatively good quality discharging from an Upper Freeport Mine.
- Yellow and magenta flow, signifying colder temps, is the M3 Shaft.
- Could the M3 Shaft be flowing through fissures to the surface?
- Unaccounted for sulfate?



Morrisdale 3 ‘”Burping”

- Long term quality trends at Hawk Run DS of M3 are just strange.
- For example, Fe can be below detection or 70-mg/l.
- We believe that M3 is burping after precip events.
- No impact during low flows, large impact during high flows.
- Guess what is going to confirm that?
- A TRANSDUCER!



Speaker Contact Information / Questions

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