

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



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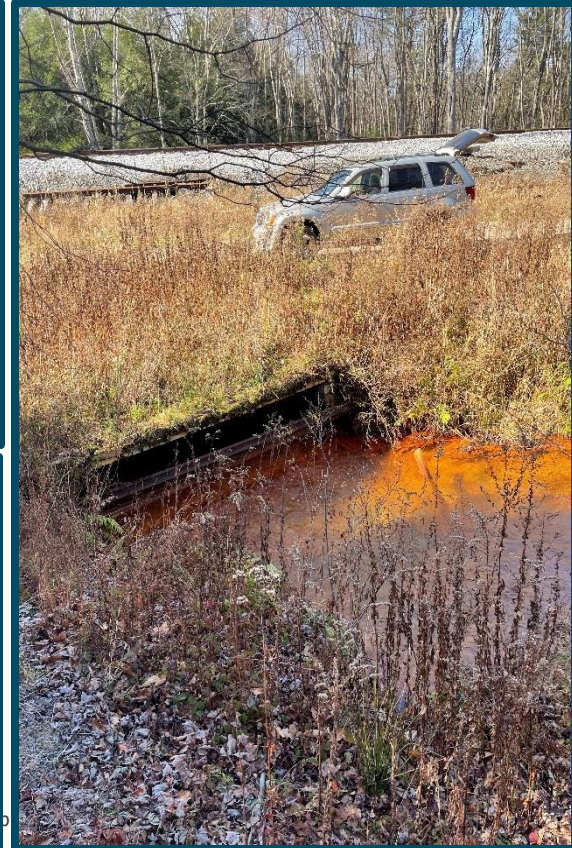
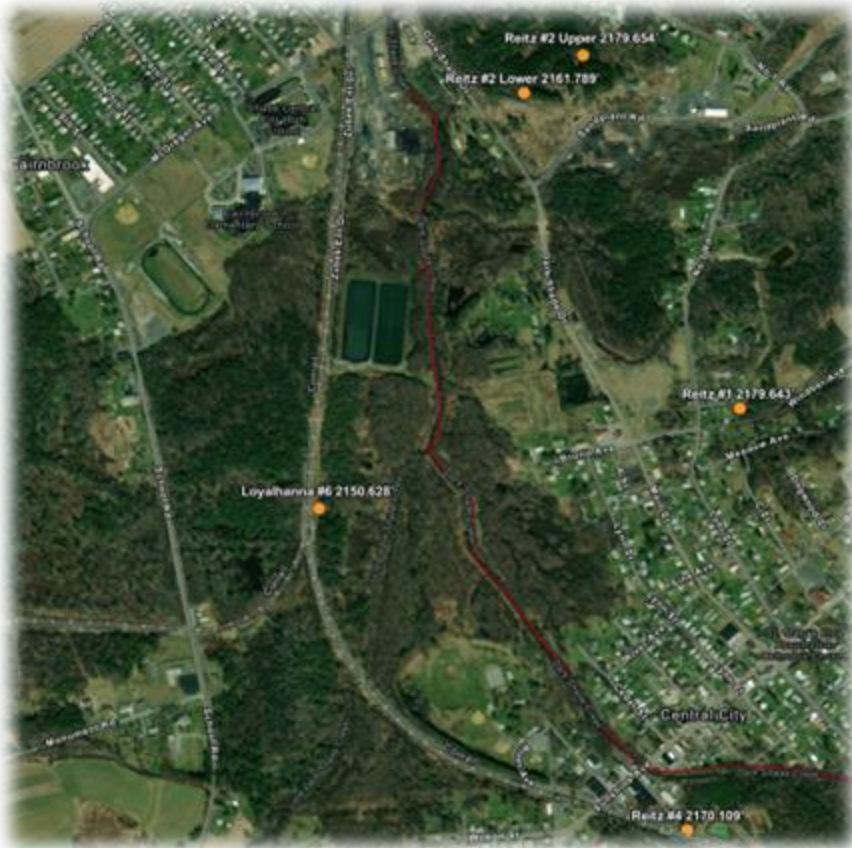
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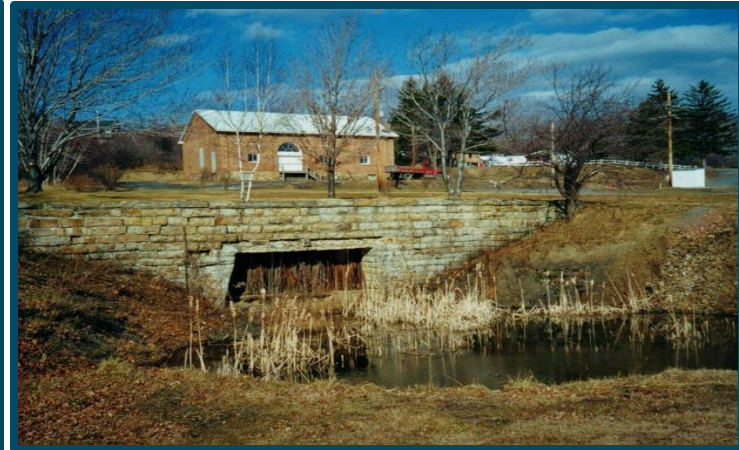
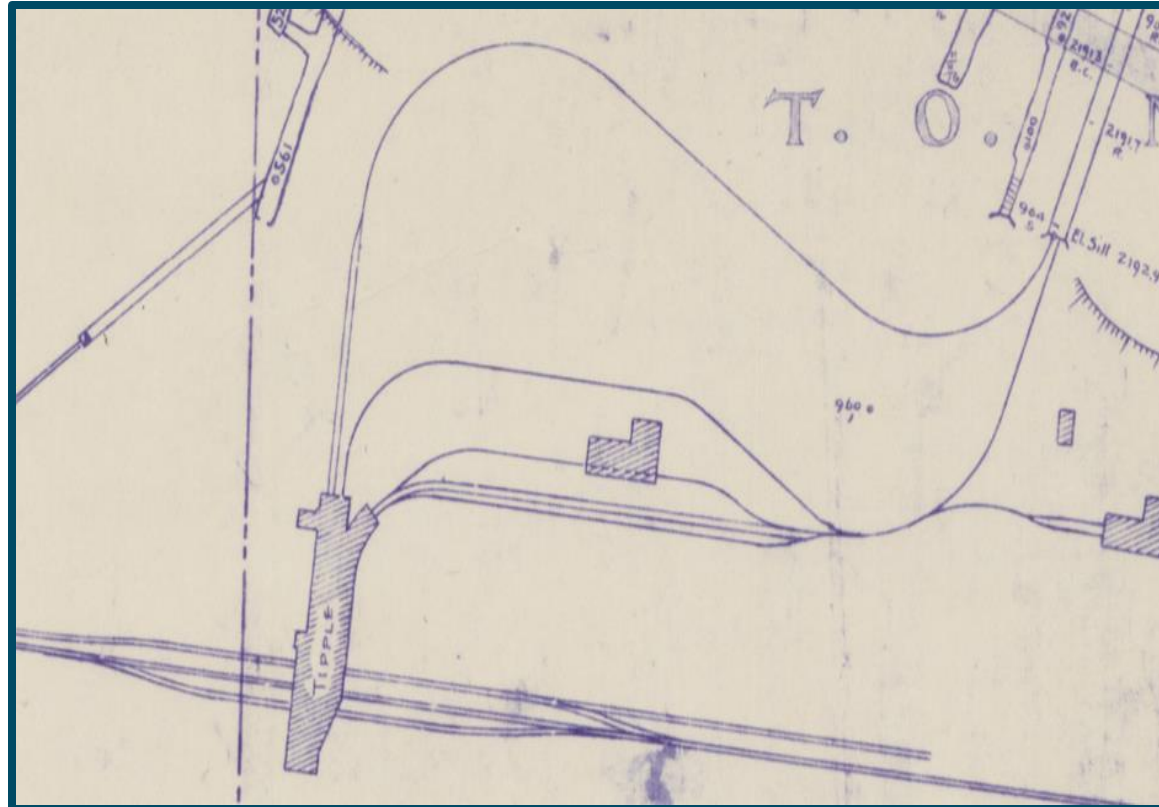
Introduction to Shade Creek ATP Development Project

- 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 and eventually flowing to the Allegheny River near Freeport, PA.
- Shade Creek has long been known to be impacted by four large flow deep mine discharges, The Big-4, all located in Central City Borough or the surrounding Shade Township.
- Due to the significant expense of treating the Big-4 properly, while no project progress has occurred there is a large quantity / quality dataset that has been compiled.
- IJJA has allowed the Shade Creek Watershed Association to take advantage of a 2024 AMD/AML Grant from BAMR to fund the Phase I: Development Project for a future active treatment plant.

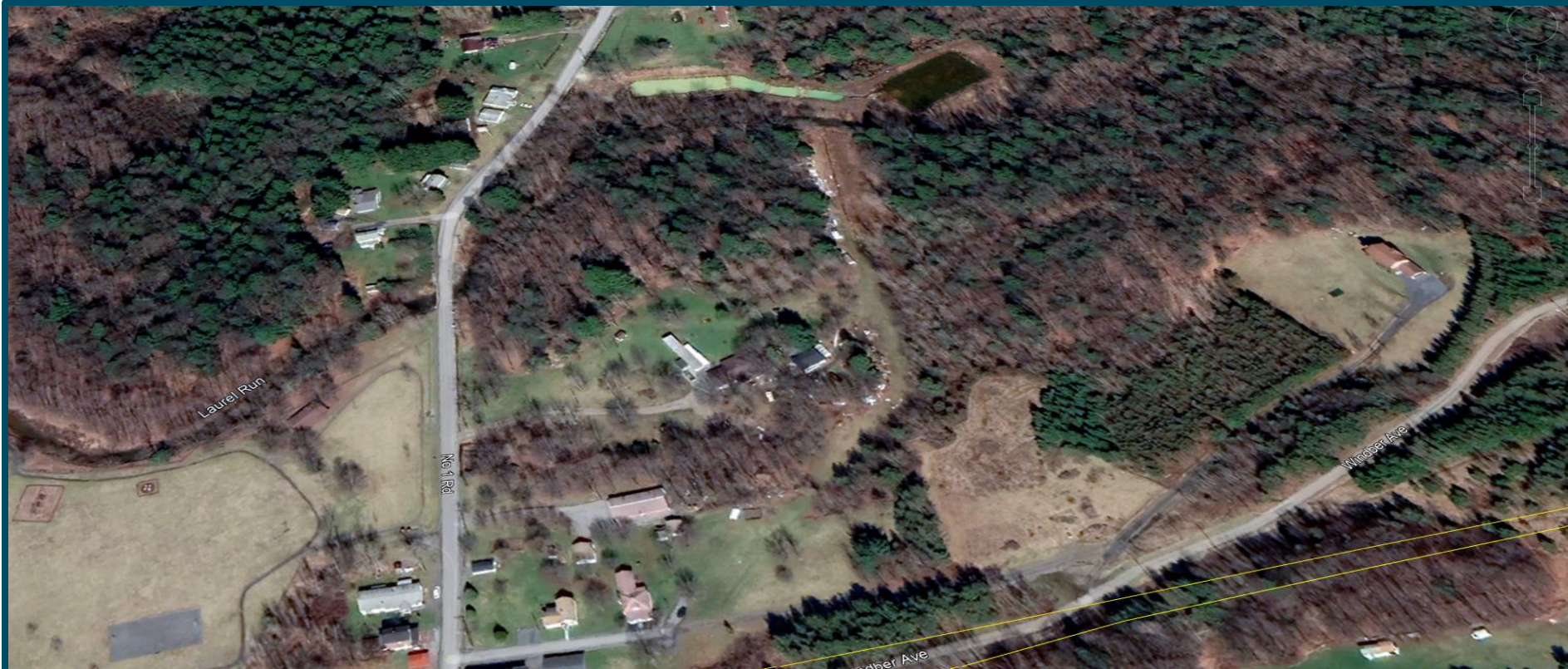
The Big-4...maybe 5...no, its 3



Taking it from 5 to 3 Discharges – Reitz 2

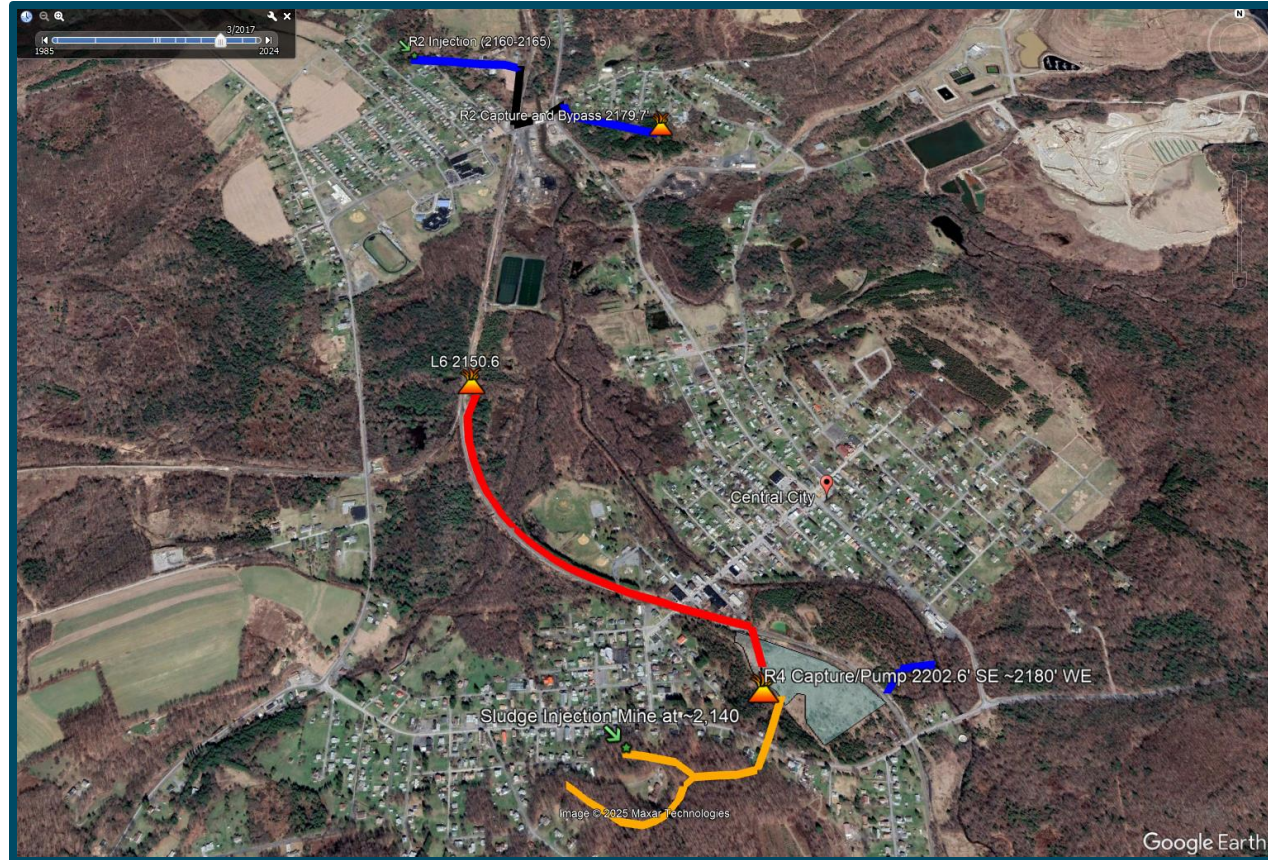


Taking it from 5 to 3 Discharges – Reitz 1 Passive System



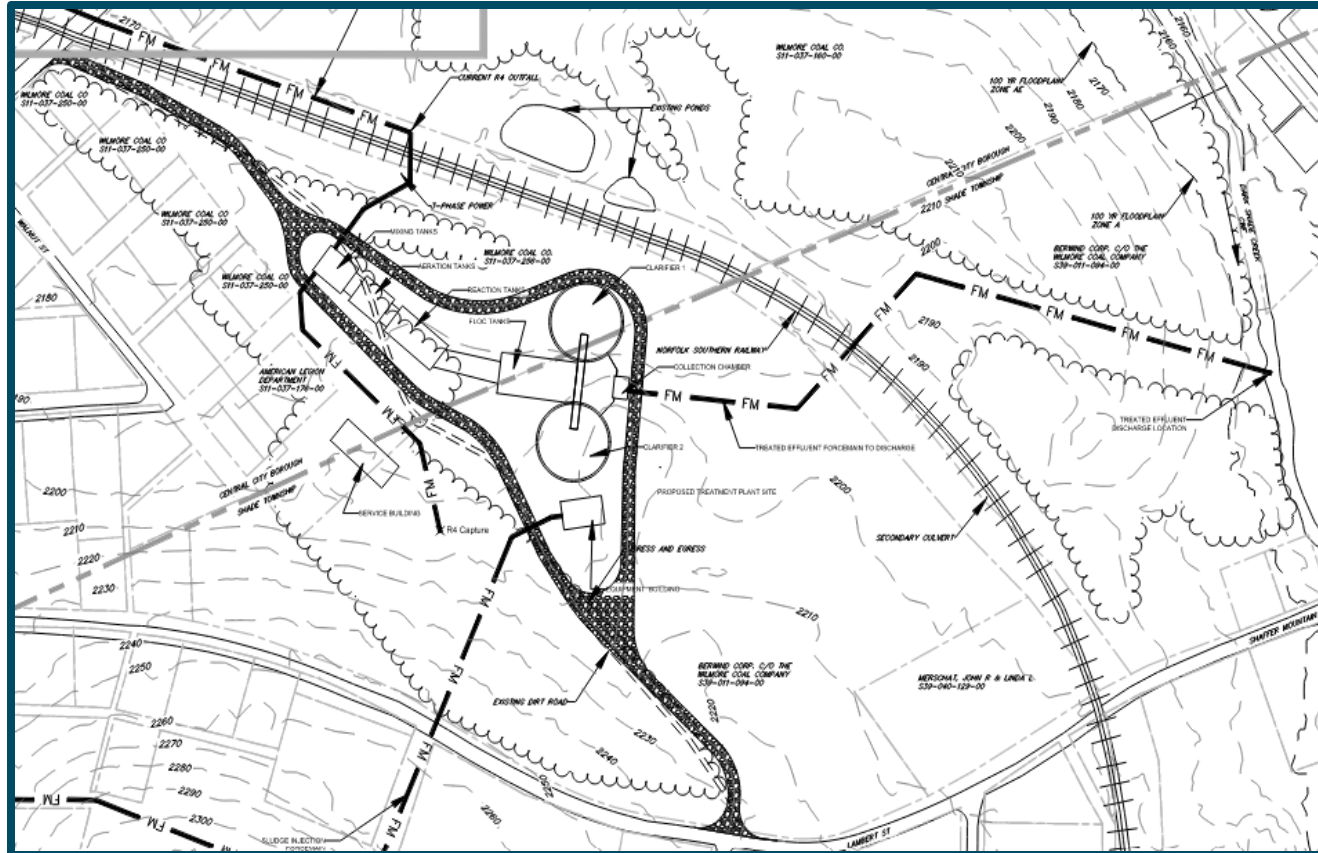
Phase 1: Conceptual ATP Development

- ✓ 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 and Restore Dark Shade through Central City



Phase 1: Conceptual ATP Development Continued

- ✓ Mix Tank for L6/R2 and R4
- ✓ Aeration Tanks to Decarbonate and Decrease Lime Usage
- ✓ Reaction Tanks for Hydrated Lime Addition
- ✓ Floc Tanks for Polymer Addition
- ✓ Dual Clarifiers / Redundancy
- ✓ Sludge Pump and Disposal
- ✓ Treated Water Pump
- ✓ **Sized for 21-MGD Max based on new transducer data**

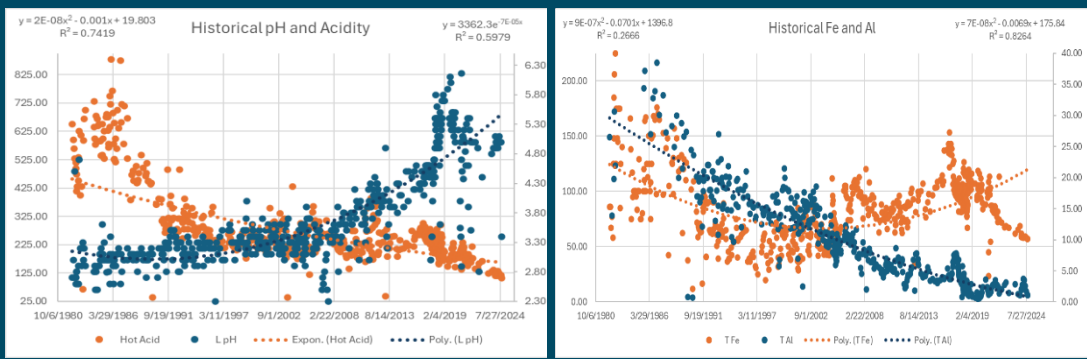


Massive Datasets Prior to Feb '25 Shade Transducer Installs

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

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

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





Water Level Logger
Range: 0 to 9 m (0 to 30 ft)
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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

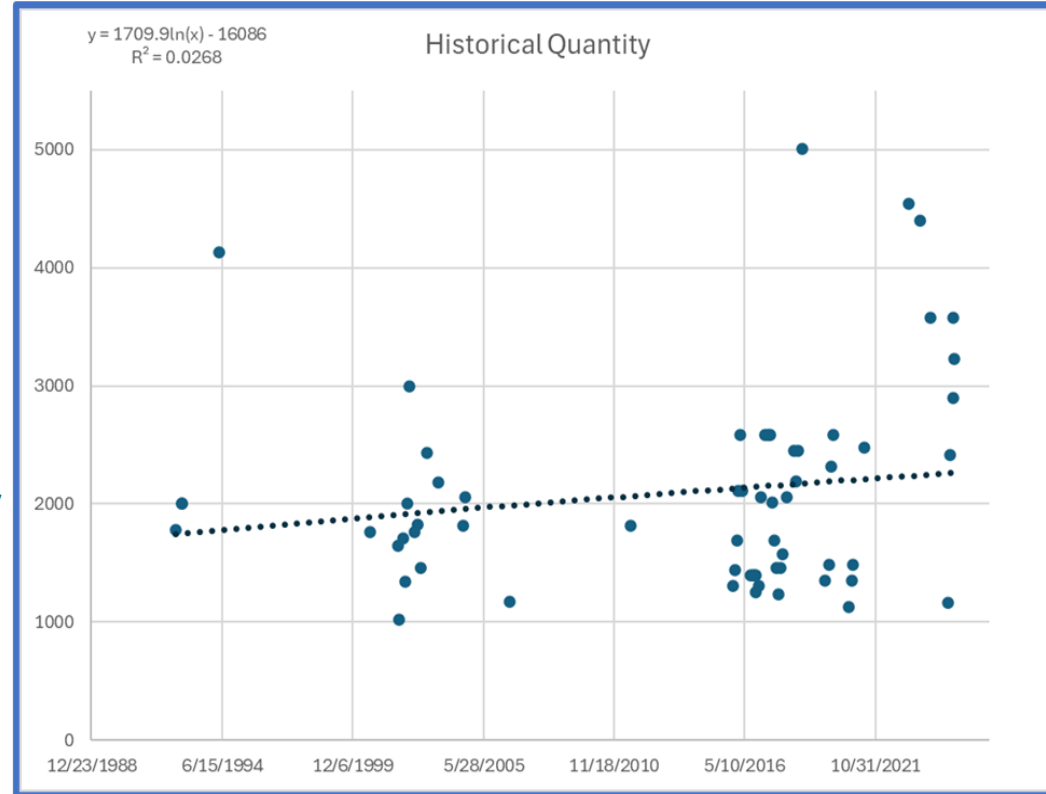
Why did R2/L6 Increase, but not R4?

- 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 seam to L6.



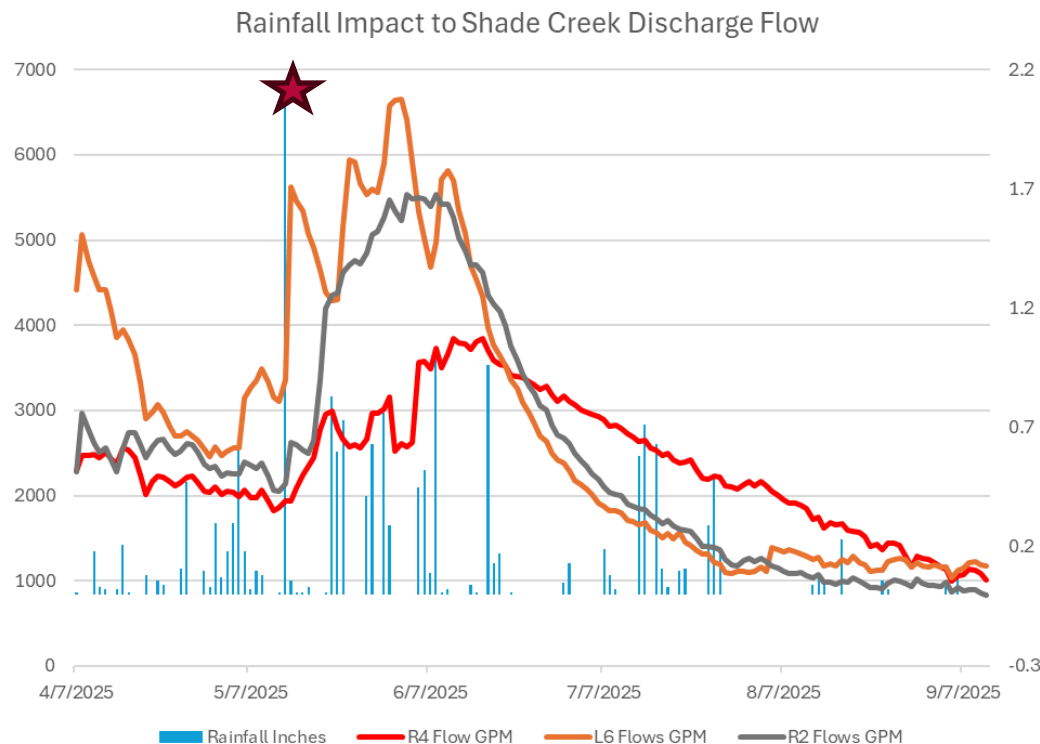
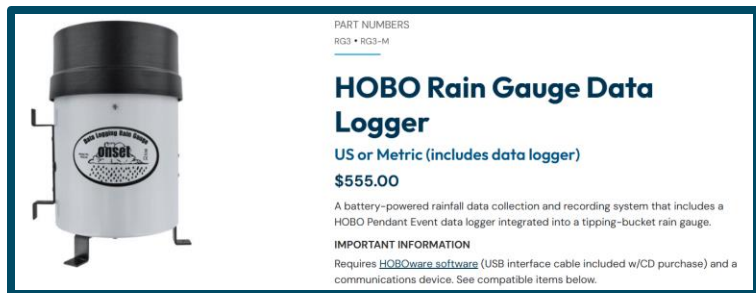
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Add in a Digital Rain Gage for Extra Fun

- 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.



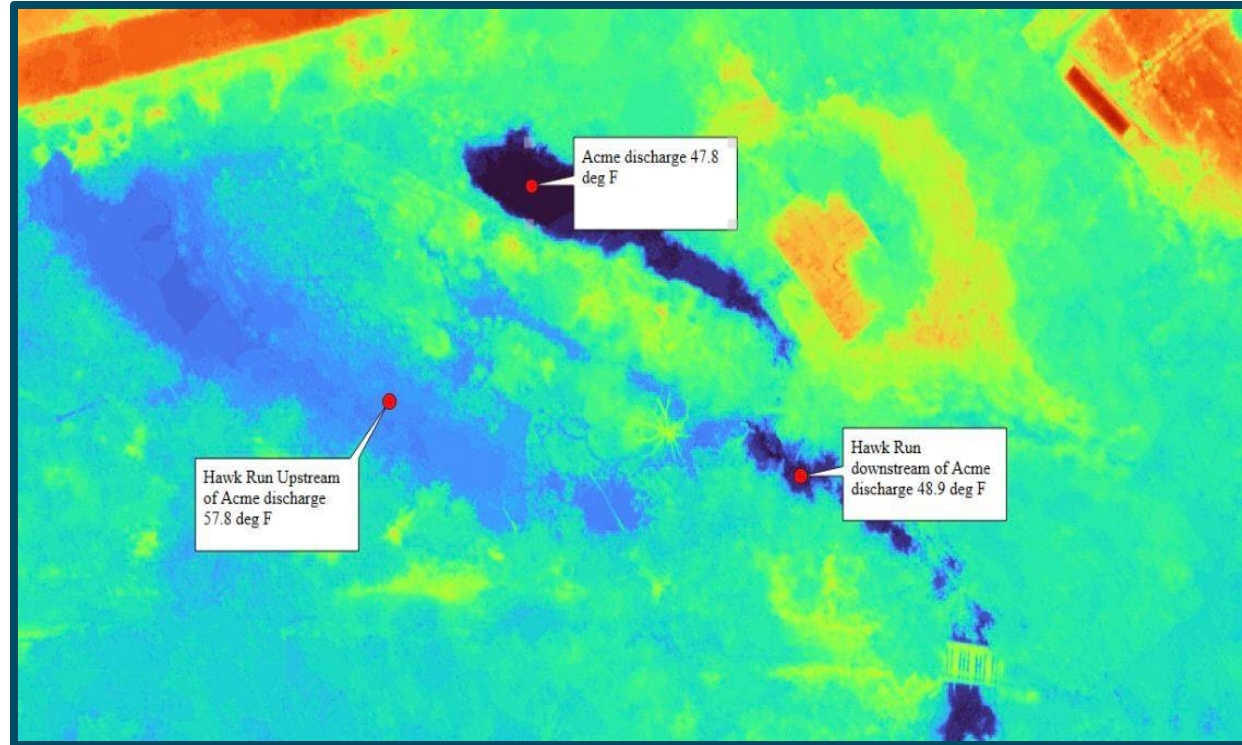
Find someone that isn't me to fly it.....

- Eric Oliver, licensed drone pilot, all around tech nerd.
- Joece Lynn and the MCWA boys as spotters.
- 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.

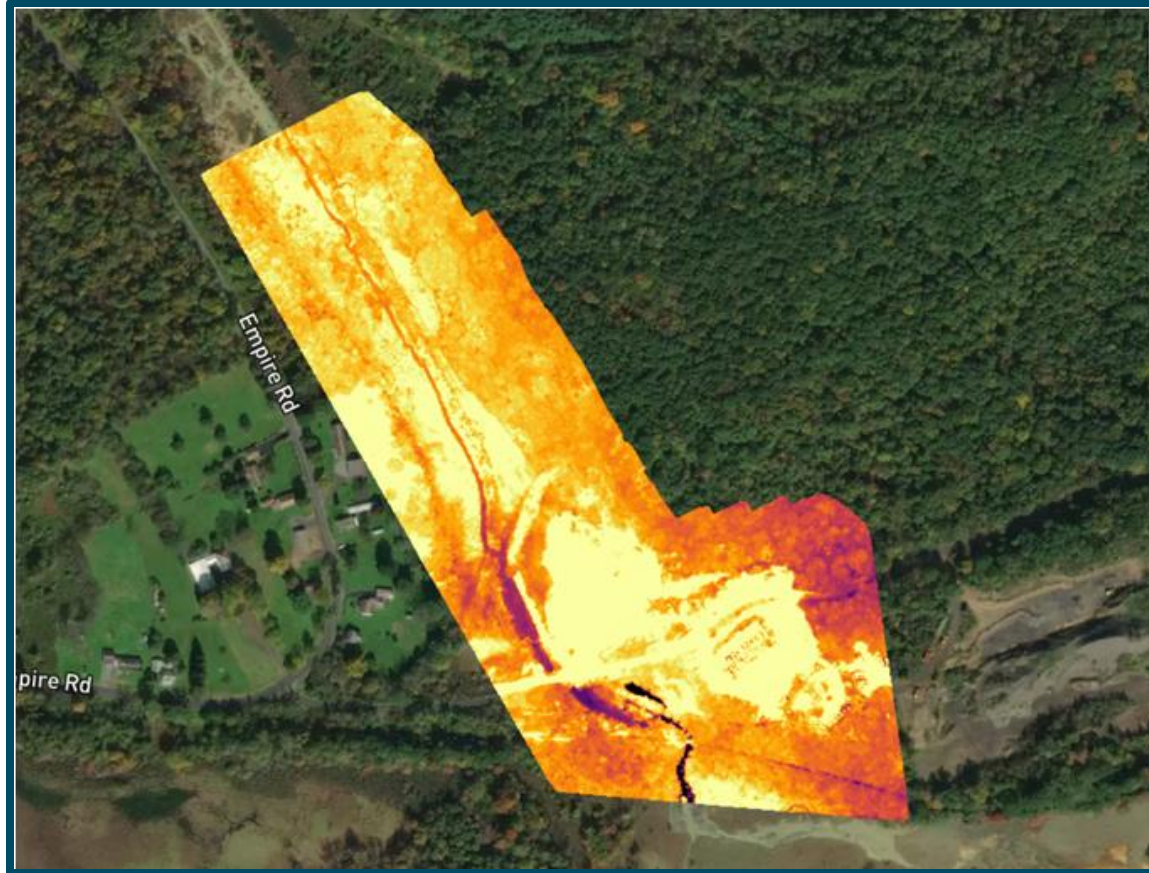


Section Between Acme and Morrisdale



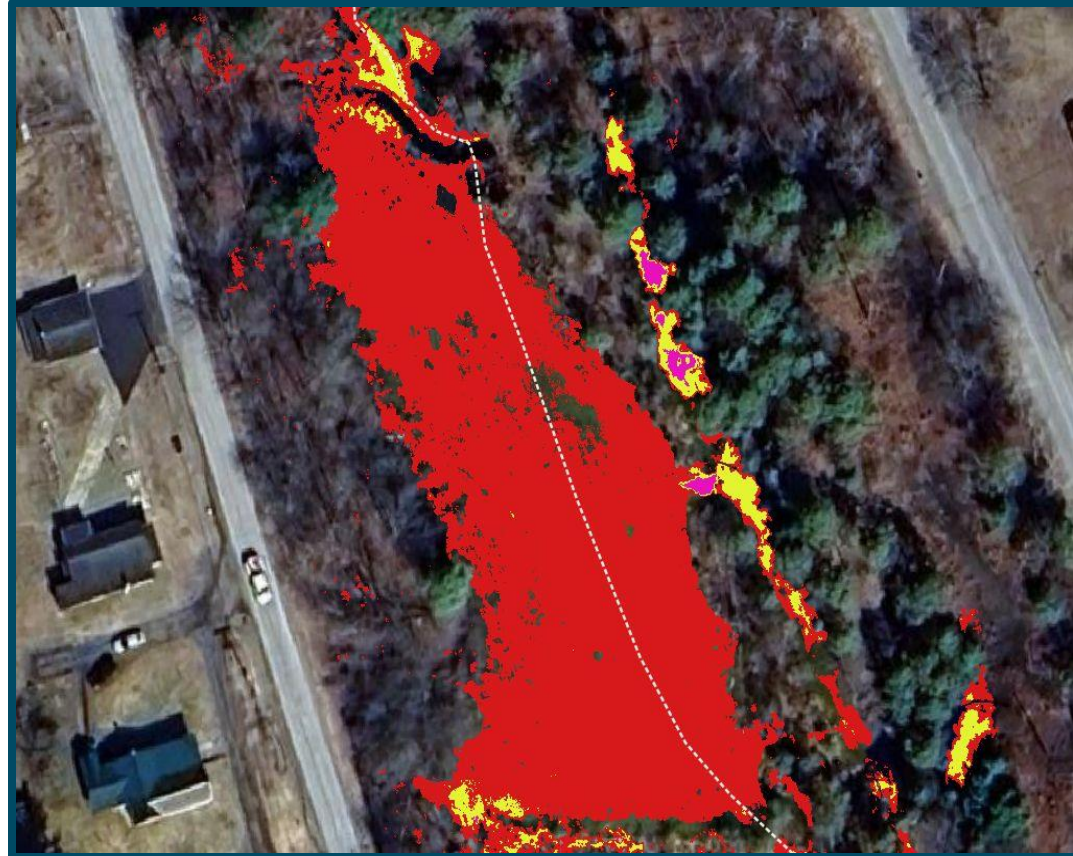
Section Between Acme and Morrisdale

- 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.
- Safety Concerns as it is an unknown shaft.



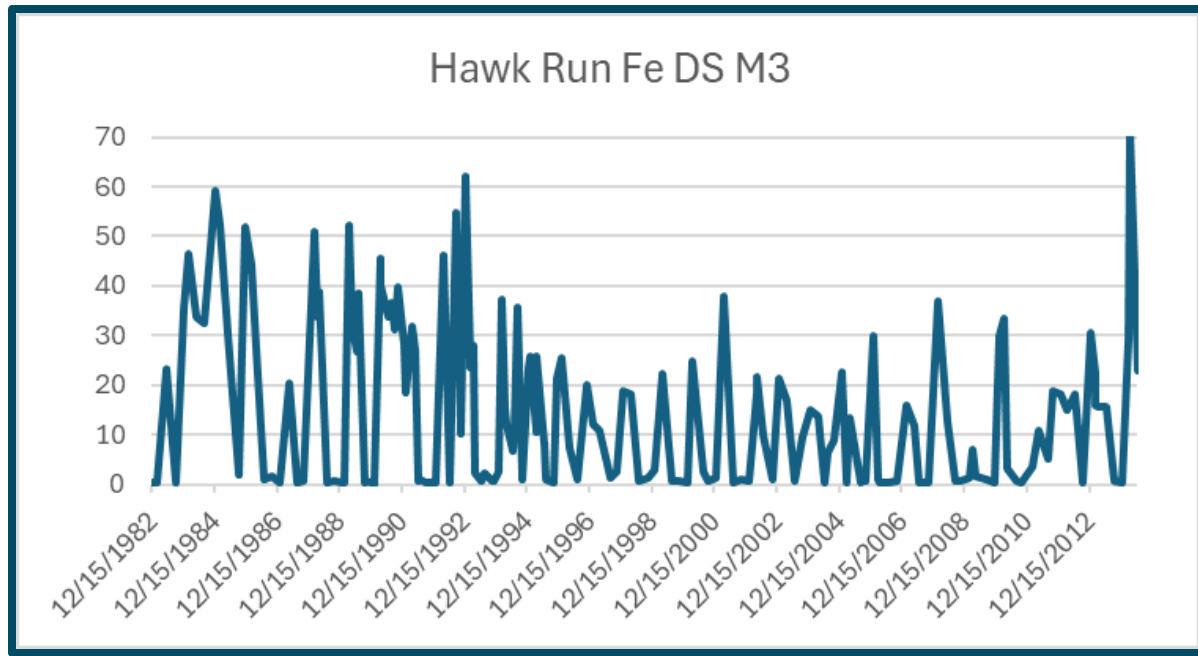
Morrisdale 3 Shaft Section

- 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.
- Transducers are planned to try and answer the questions.



Speaker Contact Information / Questions



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