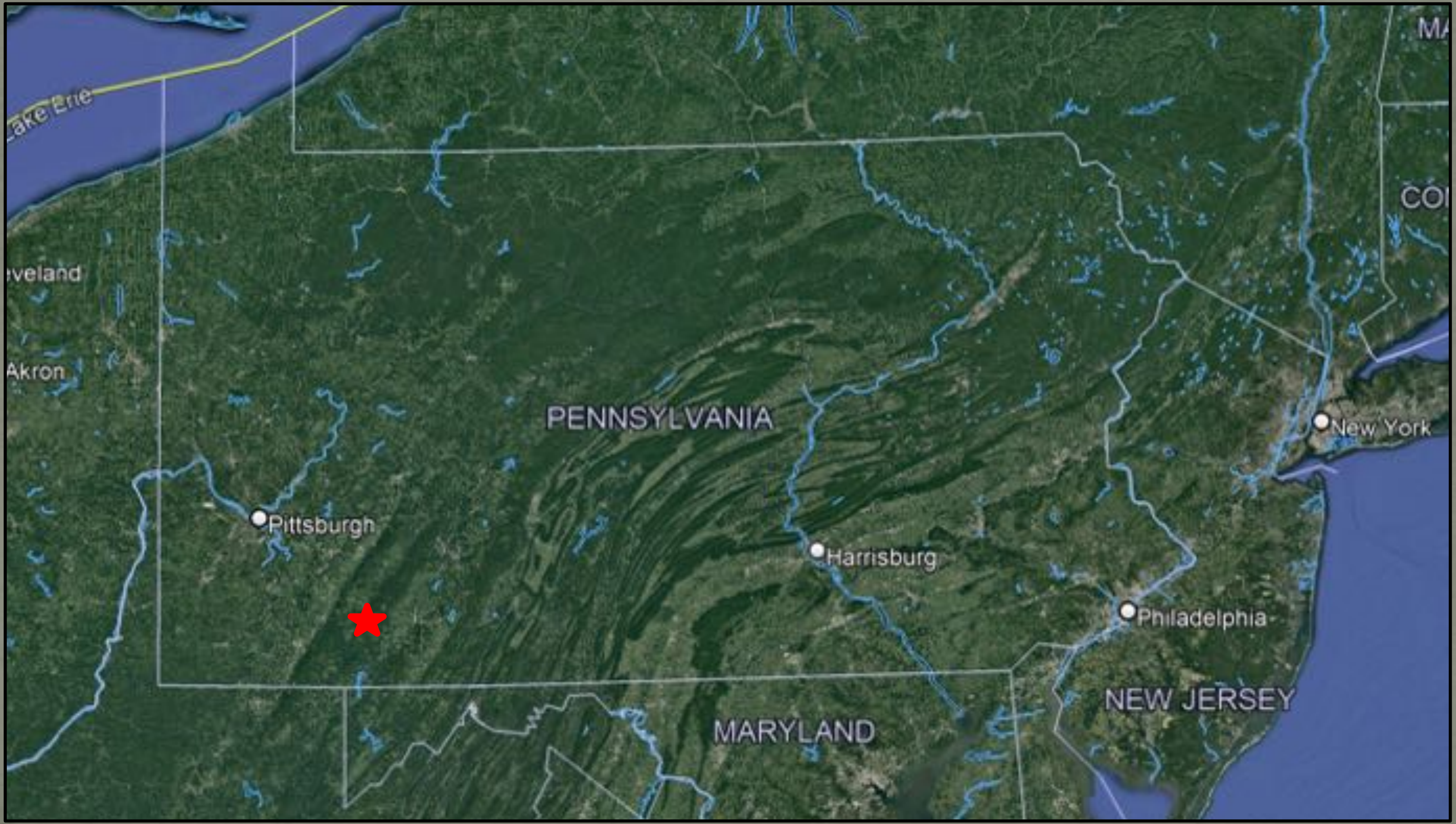
Oven Run B
Passive Treatment System

April 16, 2025

Presented by: Tim Danehy, BioMost, Inc.
Contributors:
Cliff Denholm, IV, Stream Restoration Incorporated
Cody “Buck” Neely, PE, Dan Guy, PG, BioMost, Inc.

2025 West Virginia Mine Drainage Task Force Symposium, Charleston, WV

Oven Run B – Stoystown, PA



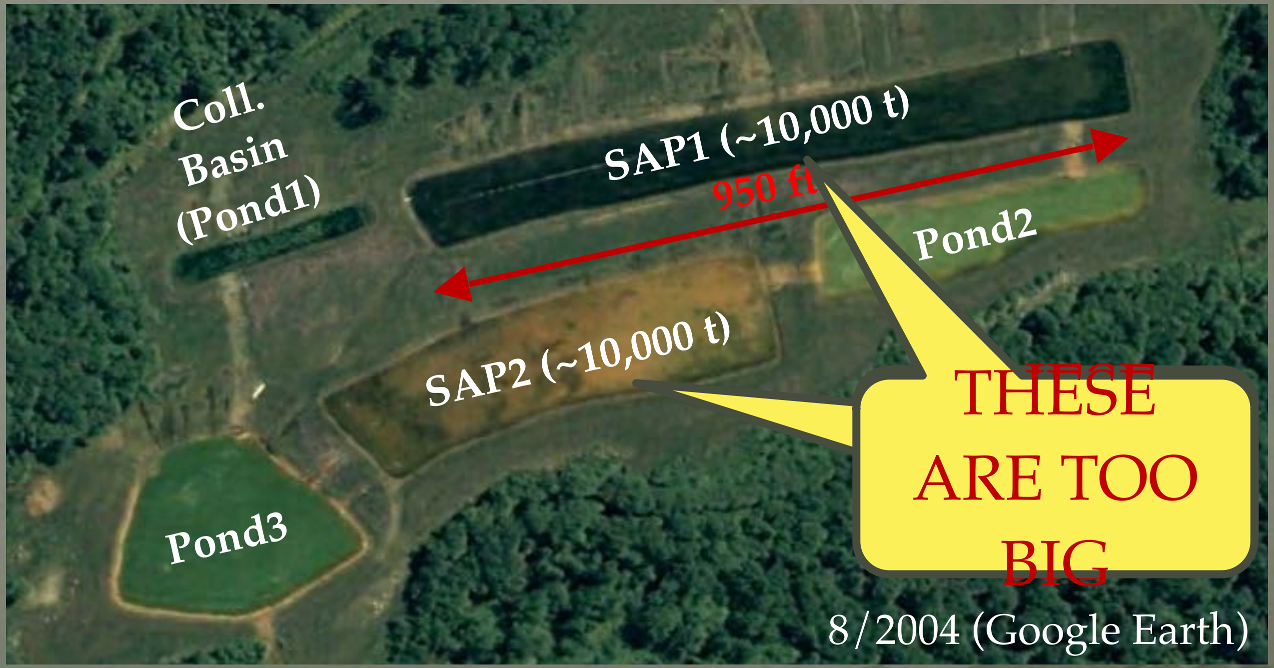
Why am I Talking?

- Never to criticize, but to think critically.
- Share experience and observations.
- Hope other can learn from us.
- Get feedback to do our work better.

Very appreciative to PADEP,
Bureau of Abandoned Mine Reclamation
for all their work and willingness
to work with us.

Oven Run B Passive System

- Information available on Datashed: datashed.org/project-oven-run-site-b
  - Water monitoring data from 1999 onward.
  - Design plans, O&M plan, as-built, water monitoring, reports, schematic, etc.
- Original system designed in 1998 and constructed in 1999.
  - Construction Cost: $1,101,948
- Worked Well first Two Years
  - Performance declined
  - Even with poor quality effluent, significant partial treatment was maintained

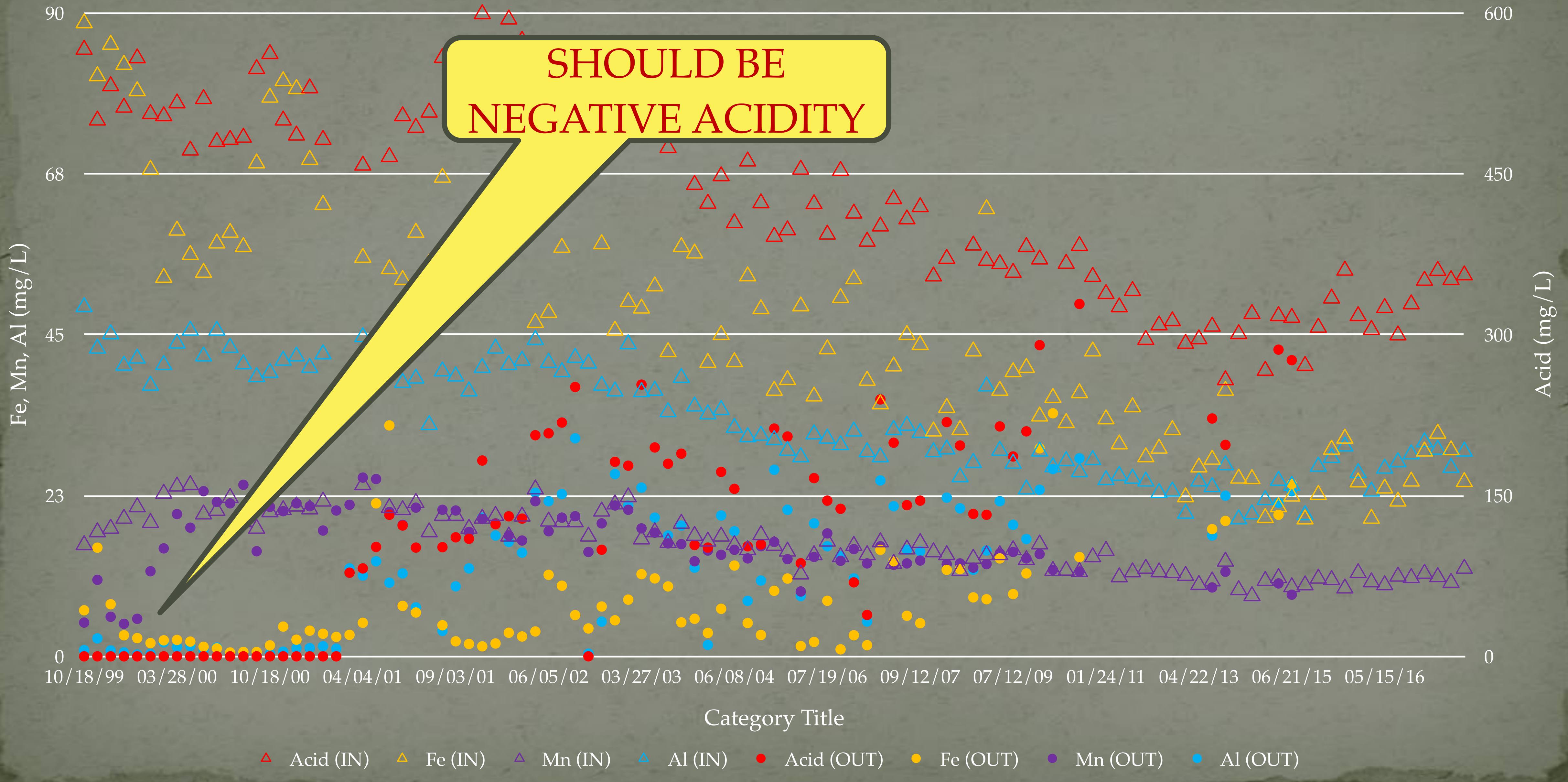


Oven Run B System Background


SAP1 2001 (BAMR)

- 1999-2010 monitored quarterly
- 1999-2008 flushed 2-3x/yr
- July 2001 distribution pipe added to SAP1
- October 2001 removed iron & added compost
- Nov. 2006 fixed Pond 3 HDPE liner
- June 2007 fix Pond 3 water level structure
- March 2008 System Evaluation by BAMR
- 2013-2017 System monitored and assessed
- December 2017 Evaluation by Stream Restoration Incorporated (SRI)
- July 2018 Stonycreek Conemaugh River Improvement & BAMR request SRI to develop rehabilitation treatment options and cost estimates

Original (1999) System Performance (Pre-Rehab)



2018 Site Investigation

- SRI, BioMost, St. Francis Univ. BAMR, SCRIP, PACD, SCC, SCCD


Collection Pond 9/9/18 (BioMost)

2018 Sampling & Evaluation

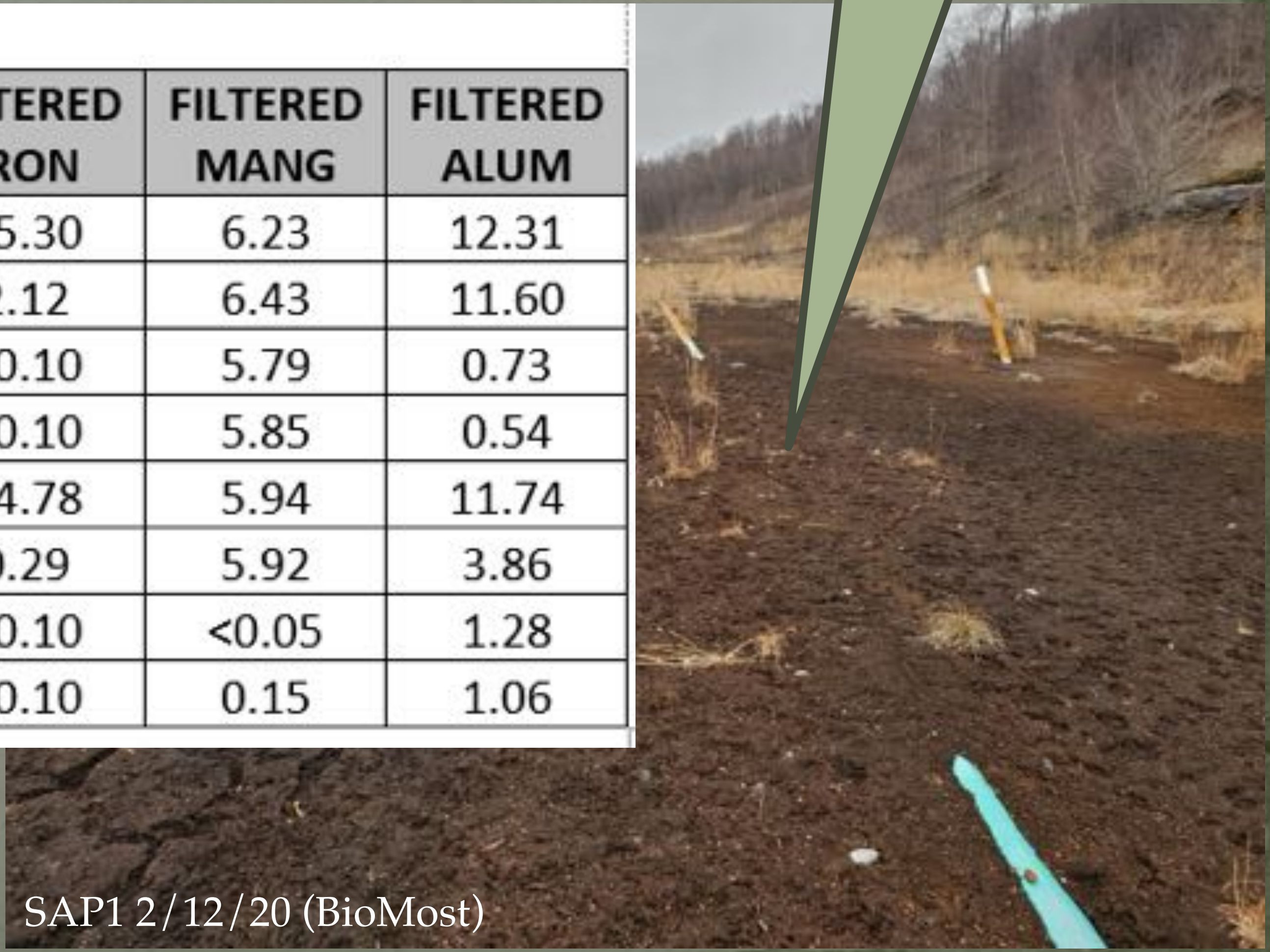
- St. Francis Water Sampling & Ferric / Ferrous Evaluation

Titration Test Data

Sample location	STARTING FIELD pH	ADJUSTED pH	FILTERED IRON	FILTERED MANG	FILTERED ALUM
ORBI	2.5	--	15.30	6.23	12.31
		3.5	2.12	6.43	11.60
		4.0	<0.10	5.79	0.73
		5.0	<0.10	5.85	0.54
ORBSAP1 Overflow	2.5	--	14.78	5.94	11.74
		3.4	0.29	5.92	3.86
		4.0	<0.10	<0.05	1.28
		5.9	<0.10	0.15	1.06

St. Francis Ferric Test 9/27/18
9/27/18 SFU Sample Data on datashed.org

Observation: Almost no Iron on Top of SAP 1 Compost



SAP1 2/12/20 (BioMost)

2019 Test Pits

- SRI, BioMost, St. Francis Univ.


SAP2 2/28/19 (BioMost)


SAP1 2/28/19 (BioMost)

2019 Limestone Analysis

- 92% Calcium Carbonate ($CaCO_3$) avg.
- 99% $CaCO_3$ Equivalent avg.

BIOMOST, INC.
434 SPRING ST. EXT.
MARS, PA 16046

SAMPLE MARKED	BIOMOST ST. FRANCIS UNI 151413
DATE SAMPLED:	05/08/19
SAMPLED BY	CLIENT
SAMPLE RECEIVED	05/08/19
SAMPLE REPORTED	05/21/19

PROCEDURE FOLLOWED: ASTM C 1271 (Modified)

TOTAL ANALY

INTENSITY OF FIZZ	STRONG	
CALCIUM CARBONATE	87.50	%
MAGNESIUM CARBONATE	12.35	%
CALCIUM CARBONATE EQUIVALENT	99.92	%

Approved by: Michael J. Chestnut, Water Lab Director

Date: 05/21/19

BIOMOST, INC.
434 SPRING ST. EXT.
MARS, PA 16046

SAMPLE MARKED	BIOMOST ST. FRANCIS UN 151412
DATE SAMPLED:	05/08/19
SAMPLED BY	CLIENT
SAMPLE RECEIVED	05/08/19
SAMPLE REPORTED	05/21/19

PROCEDURE FOLLOWED: ASTM C 1271 (Modified)

TOTAL ANAL

INTENSITY OF FIZZ	STRONG	
CALCIUM CARBONATE	91.99	%
MAGNESIUM CARBONATE	6.42	%
CALCIUM CARBONATE EQUIVALENT	99.06	%

Approved by: Michael J. Chestnut, Water Lab Director

Date: 05/21/19

BIOMOST, INC.
434 SPRING ST. EXT.
MARS, PA 16046

PA DEP Lab# 33-00325

SAMPLE MARKED	BIOMOST ST. FRANCIS UNIVERSITY 151414
DATE SAMPLED:	05/08/19
SAMPLED BY	CLIENT
SAMPLE RECEIVED	05/08/19
SAMPLE REPORTED	05/21/19

PROCEDURE FOLLOWED: ASTM C 1271 (Modified)

TOTAL ANALYSIS (Dry)

INTENSITY OF FIZZ	STRONG	
CALCIUM CARBONATE	95.12	%
MAGNESIUM CARBONATE	2.56	%
CALCIUM CARBONATE EQUIVALENT	98.33	%

Approved by: Michael J. Chestnut, Water Lab Director

Date: 05/21/19

Analysis by G&C Coal Analysis Lab.

2019 Bucket Tests

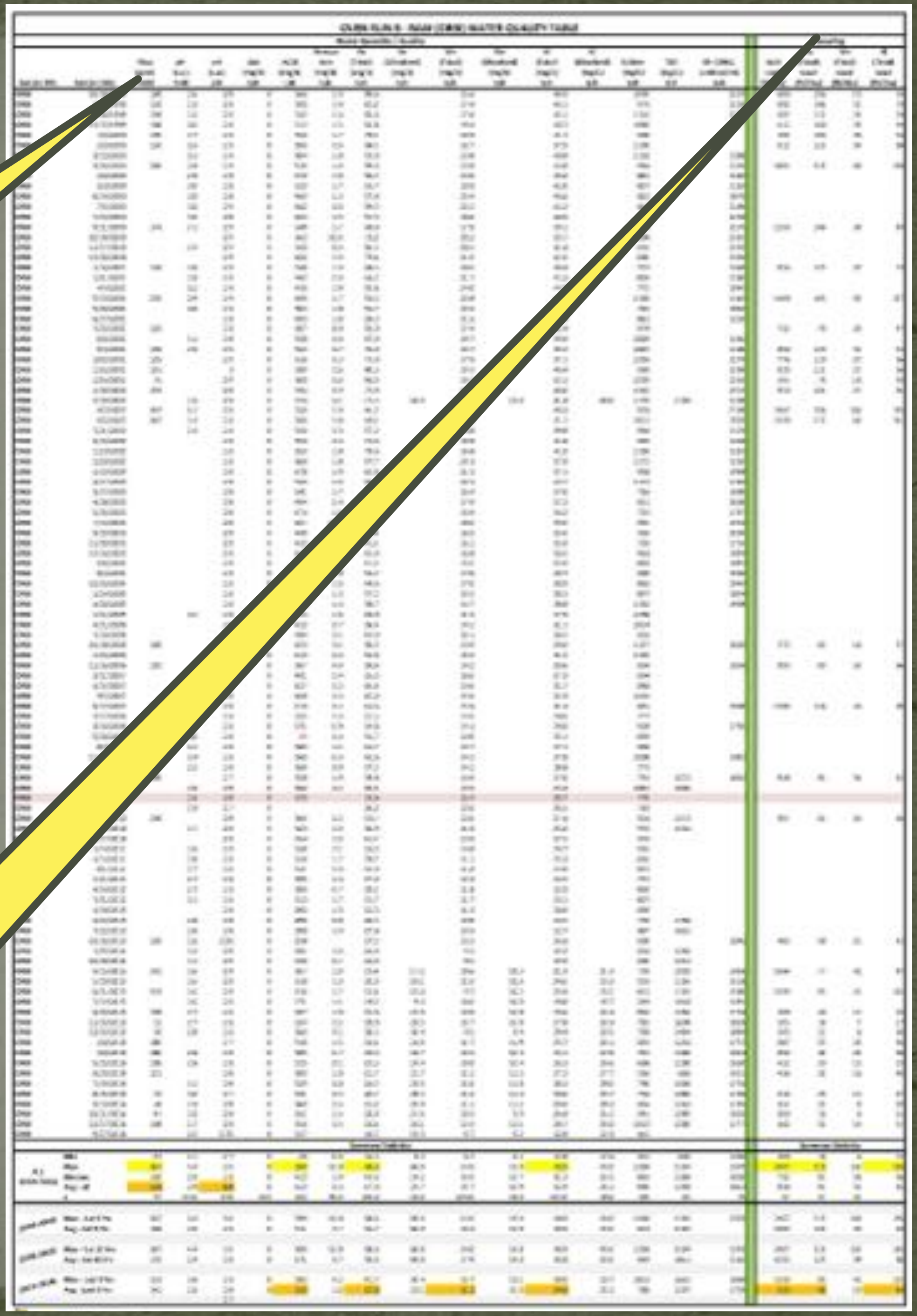
- St. Francis University
  - BioMost/SRI procedure
- Raw AMD
- Limestone from Test Pits
  - Washed prior to test
- 7-hr alkalinity ~125 mg/L
- 18-hr alkalinity ~135 mg/

Date	Time	Date + Time	Time elapsed	Bucket	pH	SPC	Alkalinity	Fe
4/8/2019	14:16	4/8/2019 14:16	0:00	1	2.77			33.3
4/8/2019	14:30	4/8/2019 14:30	0:14	1	4.93	1091	5	0
4/8/2019	15:00	4/8/2019 15:00	0:44	1	4.78	915	15	0.7
4/8/2019	15:30	4/8/2019 15:30	1:14	1	5.51	1052	35	
4/8/2019	16:00	4/8/2019 16:00	1:44	1	5.72	1109	51	
4/8/2019	17:00	4/8/2019 17:00	2:44	1	5.94	1074	77	
4/8/2019	21:00	4/8/2019 21:00	6:44	1	6.38	1227	127	
4/9/2019	8:00	4/9/2019 8:00	17:44	1	6.71	1203	135	1
4/8/2019	14:16	4/8/2019 14:16	0:00	2	2.77			33.3
4/8/2019	14:30	4/8/2019 14:30	0:14	2	6.01	992	53	0
4/8/2019	15:00	4/8/2019 15:00	0:44	2	5.18	1020	27	0
4/8/2019	15:30	4/8/2019 15:30	1:14	2	5.58	1050	49	
4/8/2019	16:00	4/8/2019 16:00	1:44	2	5.79	1119	58	
4/8/2019	17:00	4/8/2019 17:00	2:44	2	6.15	1165	76	
4/8/2019	21:00	4/8/2019 21:00	6:44	2	6.52	569.1	126	
4/9/2019	8:00	4/9/2019 8:00	17:44	2	6.67	1255	138	0
4/8/2019	14:16	4/8/2019 14:16	0:00	3	2.77			33.3
4/8/2019	14:30	4/8/2019 14:30	0:14	3	5.53	1025	12	0
4/8/2019	15:00	4/8/2019 15:00	0:44	3	4.49	937	6	0
4/8/2019	15:30	4/8/2019 15:30	1:14	3	4.1	1038	11	
4/8/2019	16:00	4/8/2019 16:00	1:44	3	5.48	1083	27	
4/8/2019	17:00	4/8/2019 17:00	2:44	3	5.94	1188	57	
4/8/2019	21:00	4/8/2019 21:00	6:44	3	6.49	564.7	115	
4/9/2019	8:00	4/9/2019 8:00	17:44	3	6.55	1254	124	0

Data Review – Design Basis

- 1999 through 2018
- 103 Samples of Raw Water
- 37 Flow Measurements
  - Only 37 load measurements
- Design Basis
  - Average water quality from last 8 years
  - Max design flow from all data (367 gpm)

MEASUR
E
FLOW



CALCULAT
E LOAD

Come On: Measure the Flow

I mean, come on, what can you really do with confidence, without accurate flow information?

- Tiff Hilton (The Elder), 1999

Tiff Hilton et al., 1999. "Did you Call me a SAPS!". *In Proceedings:* West Virginia Mine Drainage Task Force Symposium, Morgantown, WV . April 13-14, 1999.
https://wvmdtaskforce.com/wp-content/uploads/2016/01/99-hilton.pdf

2019 Design Options & Cost Report

- Design Options and Cost Estimates developed by BioMost
- Passive & Active Options Considered
- Target Effluent Quality:
  - pH 6 – 8
  - Negative Acidity
  - Fe & Al < 1 mg/L (Mn not targeted)

Influent Water Characteristics

Sample ID	Flow (gpm) *[Avg/Design/Max]*	Avg Acidity (mg/L)	Avg Diss. Fe (mg/L)	Avg Diss. Al (mg/L)	Avg Diss. Mn (mg/L)	Avg Acid Load (lb/day)	Avg Diss. Fe Load (lb/day)	Avg Diss. Al Load (lb/day)	Avg Diss. Mn Load (lb/day)
ORBI	161/200/367	320	23.1	25.2	10.5	533	37	42	18

2019 Design Options & Cost Report

- Considered reuse and purchase new limestone
- Four different passive configurations
- One active configuration
- 20-Year Cost not adjusted for inflation (2019 dollars)

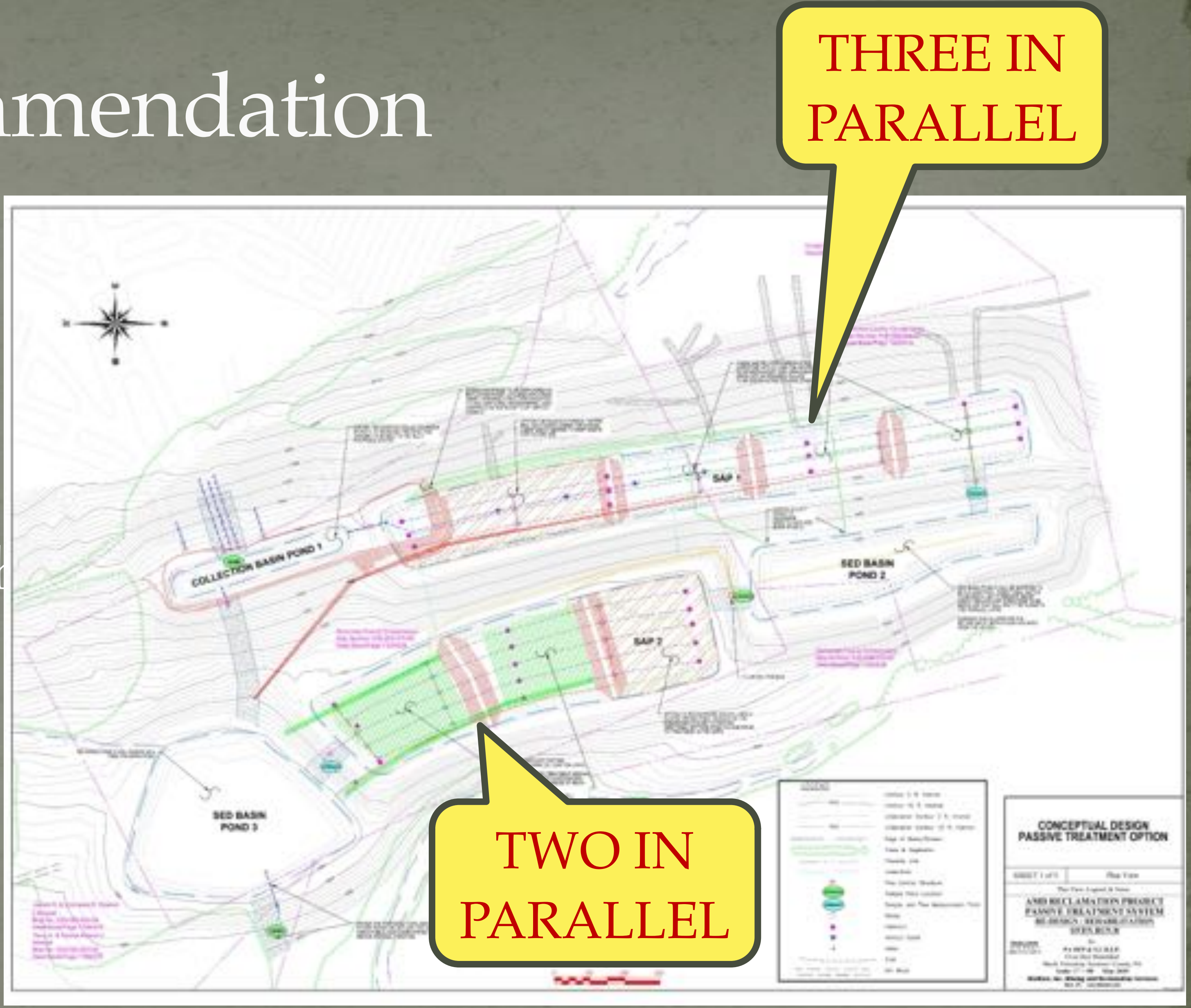
Construction Cost Estimates Summary

Type of Treatment	Construction Cost (Estimate)	Annual Cost (Estimate)	20-Yr Cost (Estimate)
Passive Treatment System Rehab (existing stone) - 5 AFVFPs	$1,300,000	$10,000	$1,500,000
Passive Treatment System Rehab (existing stone) – 3 AFVFPS + 2 JVFPs	$1,500,000	$10,000	$1,700,000
Passive Treatment System Rehab (new stone) 5 AFVFPS	$1,800,000	$10,000	$2,000,000
Passive Treatment System Rehab (new stone) 3 AFVFPS + 2 JVFPs	$2,000,000	$10,000	$2,200,000
Active Treatment System	$1,200,000	$65,000	$2,500,000

Full report on Datashed

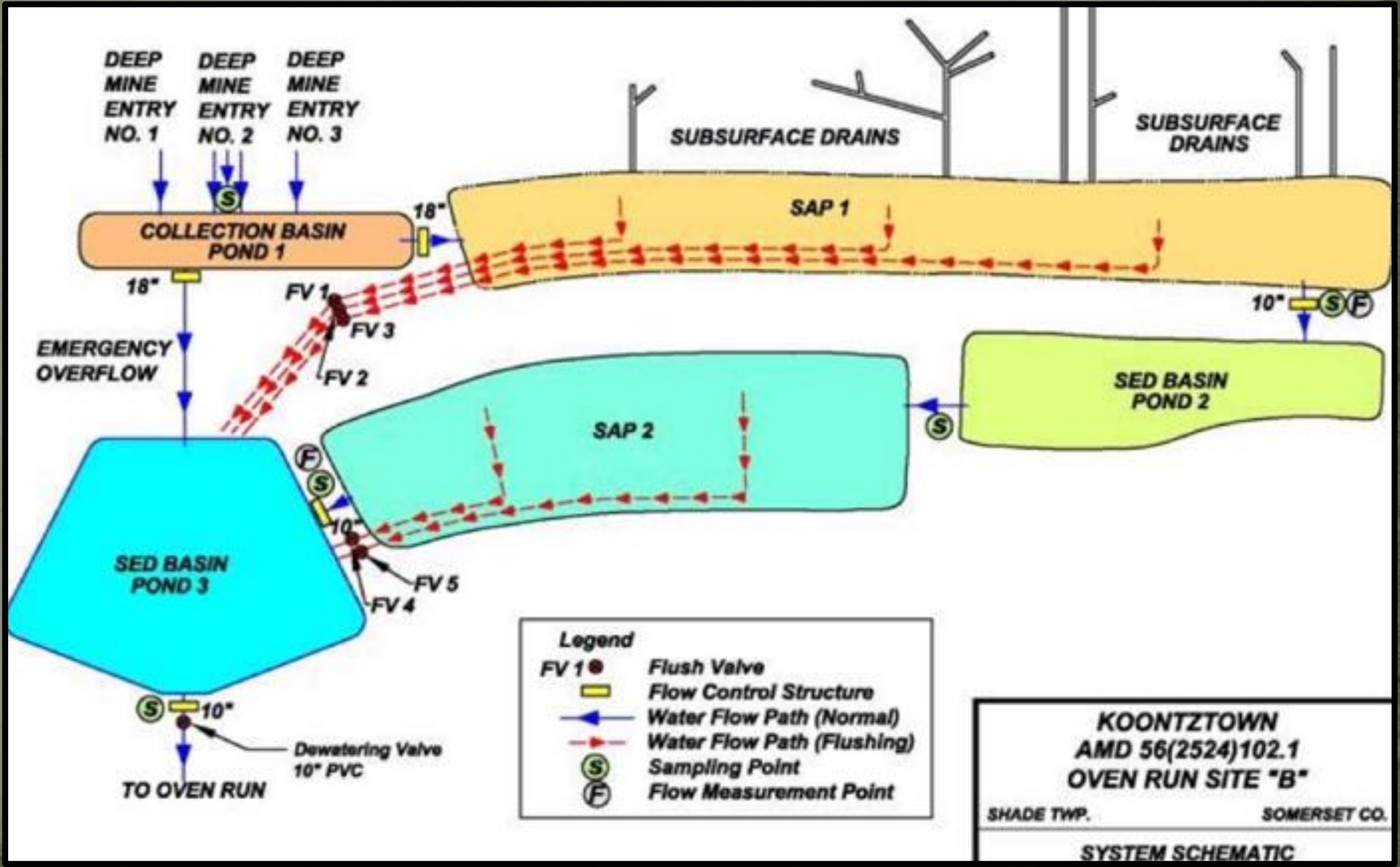
2019 Design Recommendation

- Rehab passive system
  - Three 3,000-ton AFVFPs
  - Two 2,800-ton JVFPs
- Reuse ~20,000 t limestone
- Use new "BOLTS" approach
  - Modified (not full fill)
  - Using Agri Drain Smart Drain
- Include sludge pond
- Utilize existing footprint



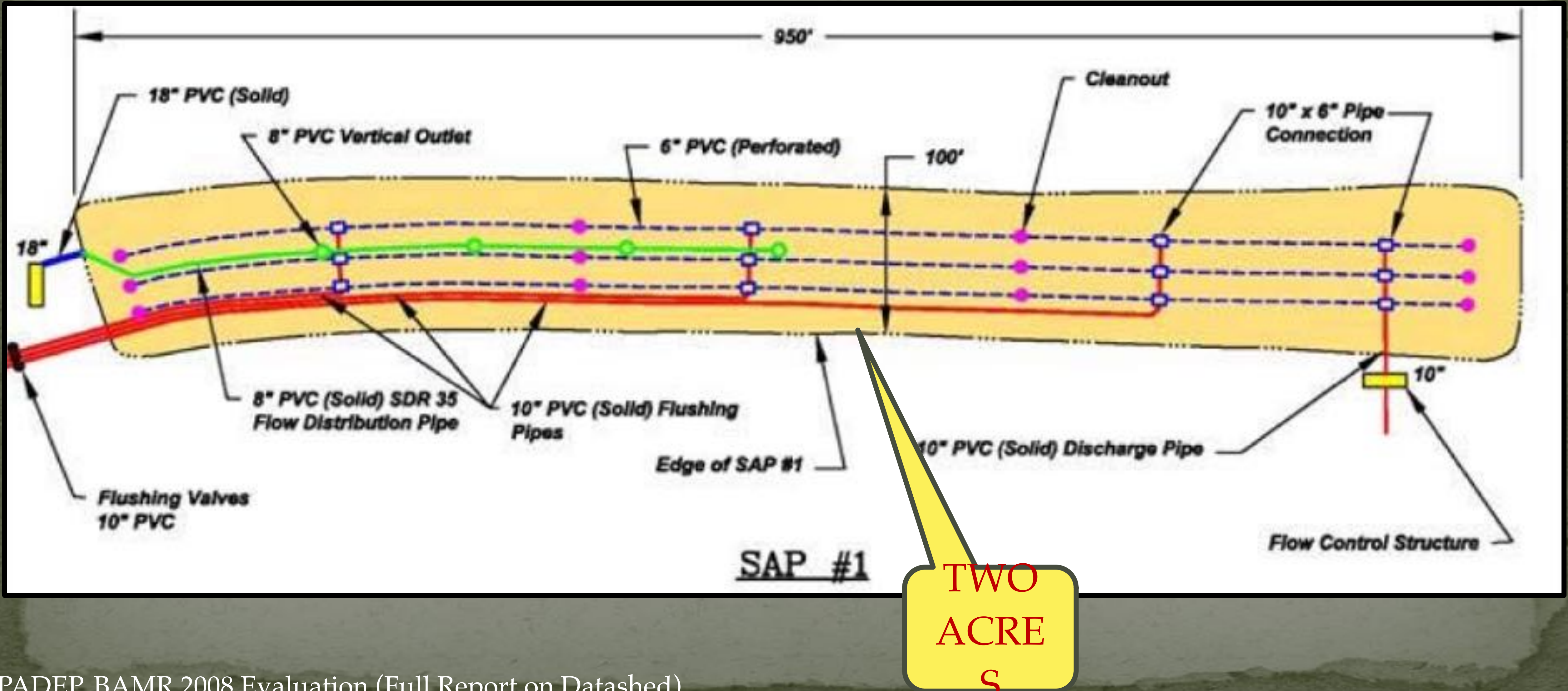
Full report on Datashed

1998 Design Schematic (Starting Point)



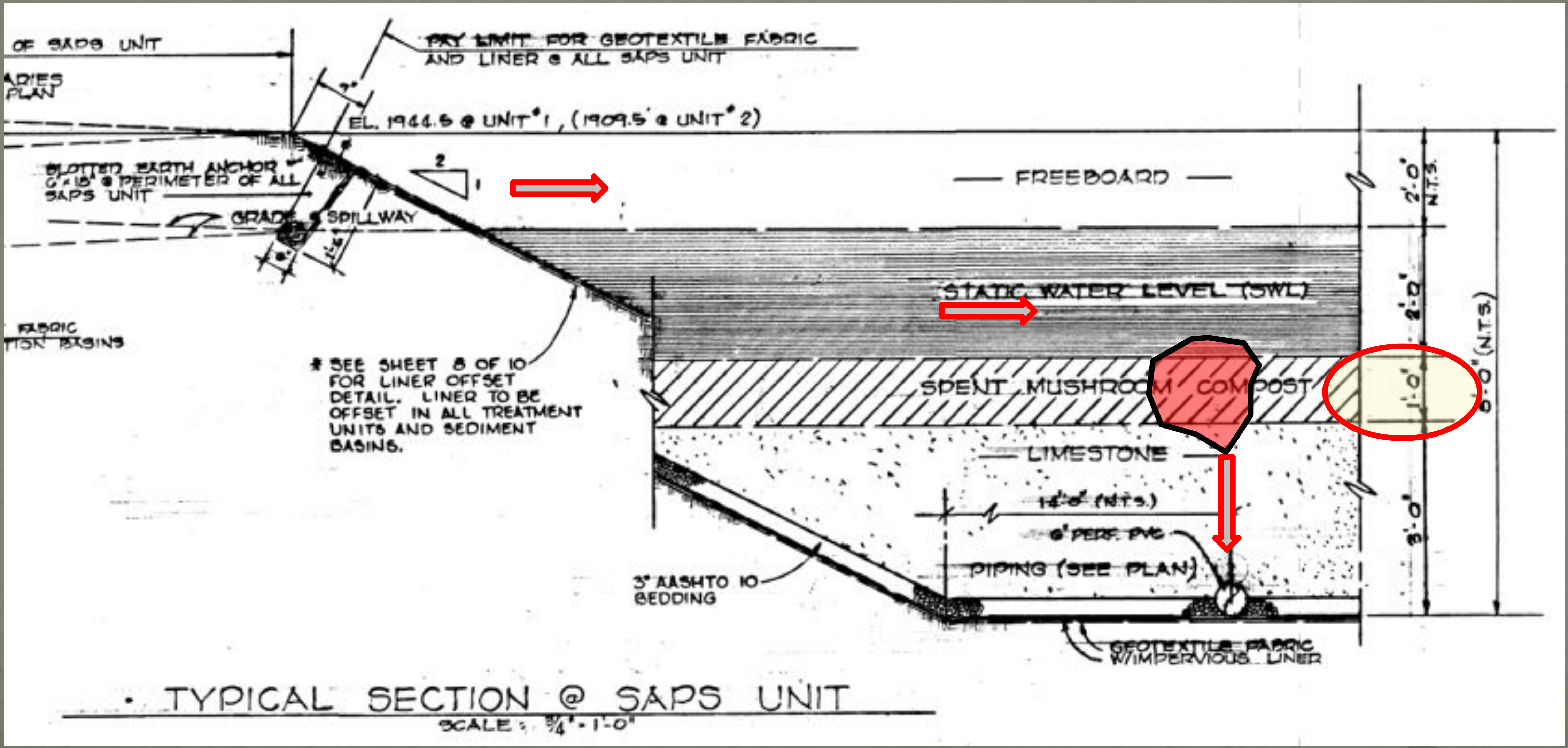
PADEP, BAMR 2008 Evaluation

1998 Design – SAP 1 Potential Issues



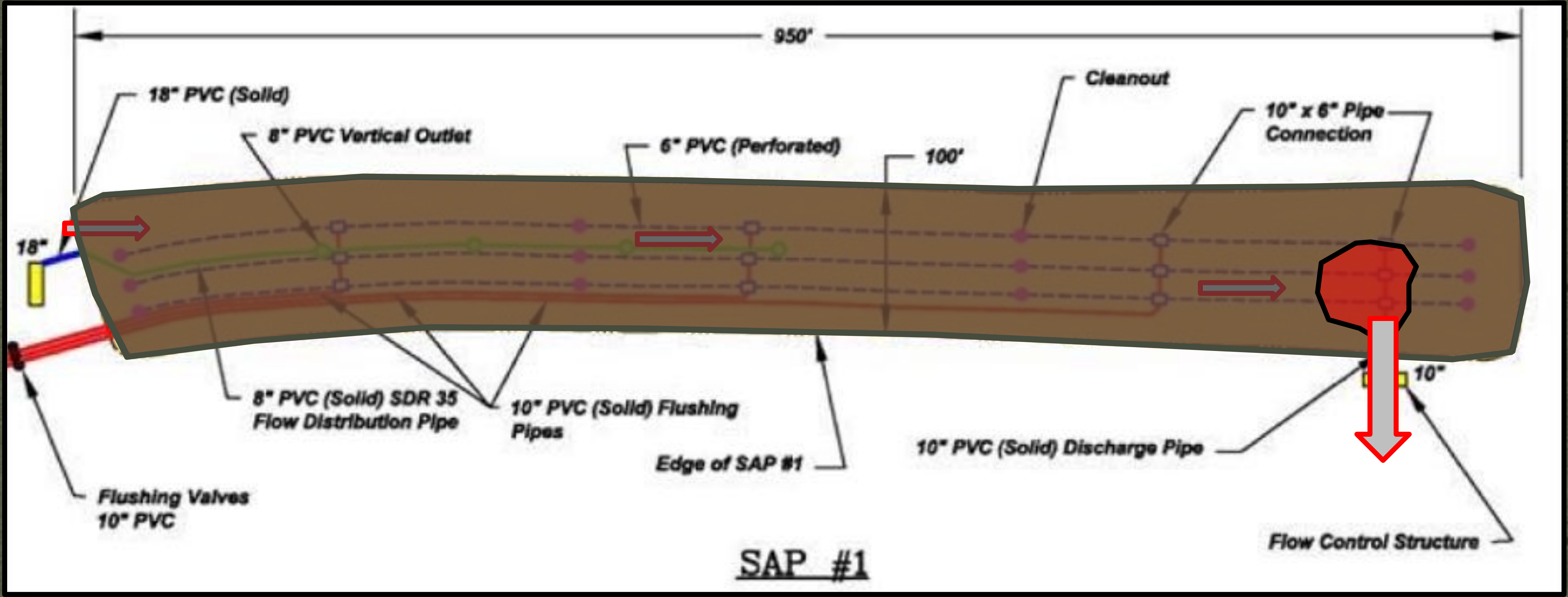
PADEP, BAMR 2008 Evaluation (Full Report on Datashed)

1998 Design – SAP 1 Potential Issues



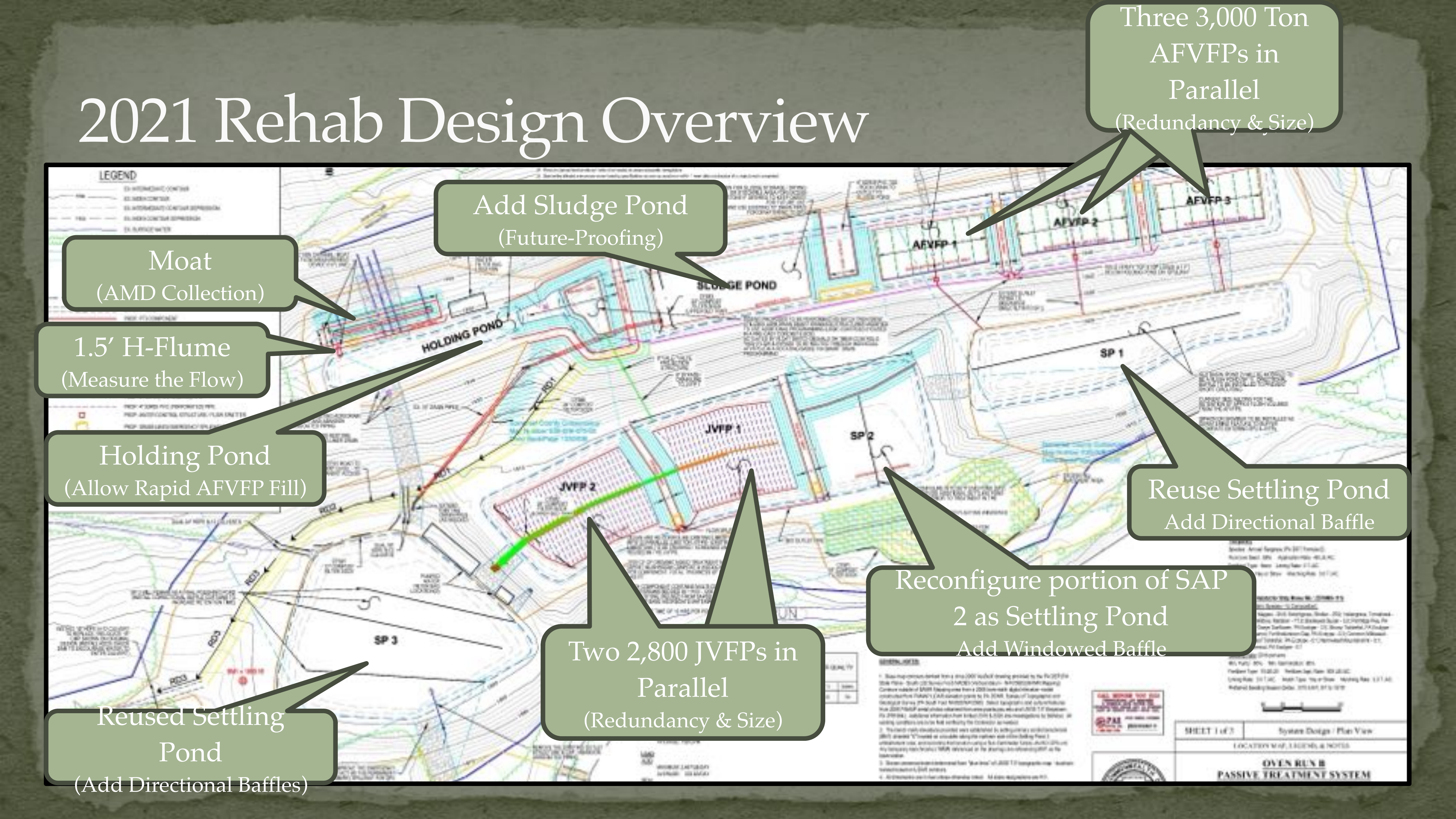
Gwin, Dobson and Foreman, Inc. Altoona, PA. May 1998. Full design available on Datashed.

1998 Design – SAP 1 (Two Acres & 10,000 Tons)



PADEP, BAMR 2008 (Full Report on Datashed)

2021 Rehab Design Overview

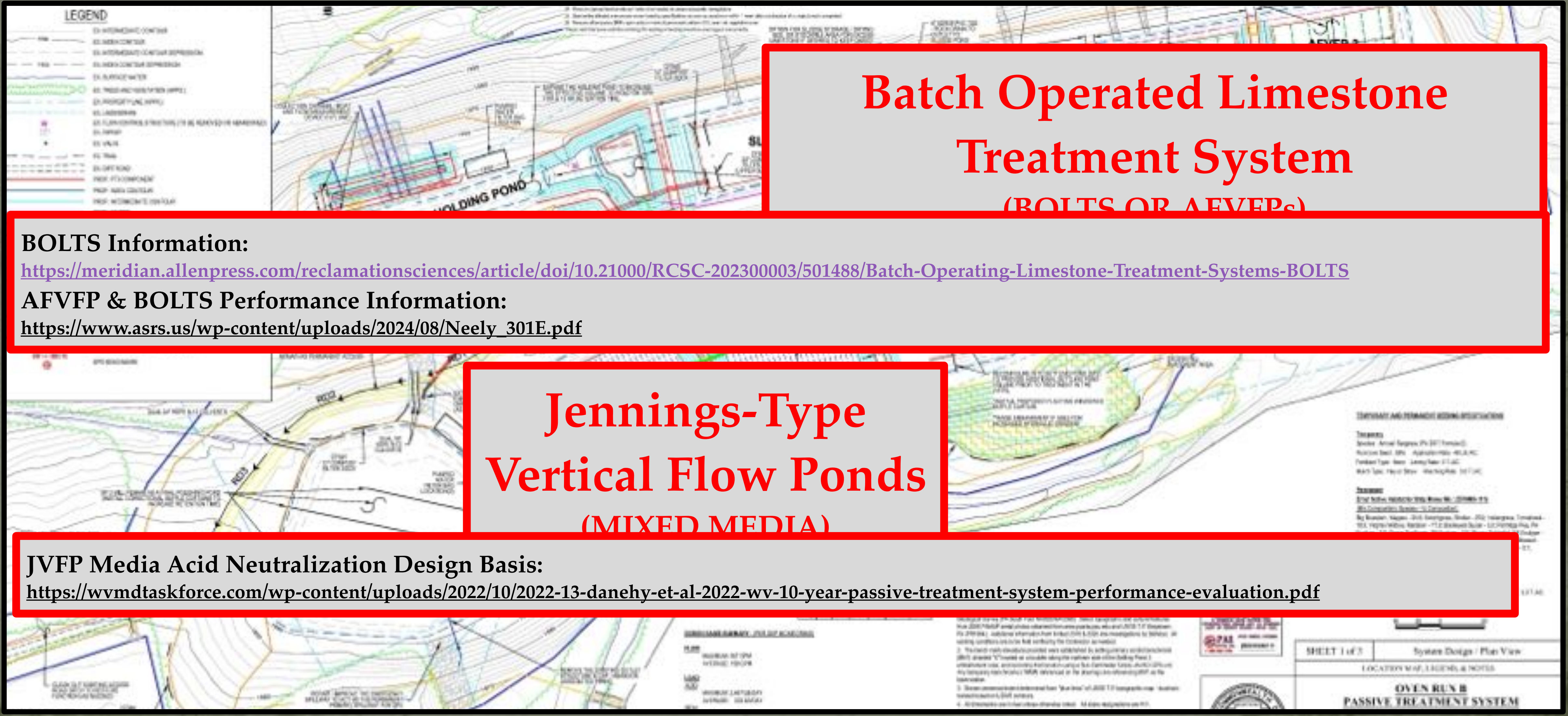


AutoFlushers – Use HDPE Pipe!

Don’t Break Pipe Washing Stone

6” DR17
HDPE
AFTER
NINE
ANNUAL
WASHES

General Design Basis and Sizing Information



Batch Operated Limestone Treatment System

(BOLTS OR AFVFPs)

BOLTS Information:
https://meridian.allenpress.com/reclamationsciences/article/doi/10.21000/RCSC-202300003/501488/Batch-Operating-Limestone-Treatment-Systems-BOLTS

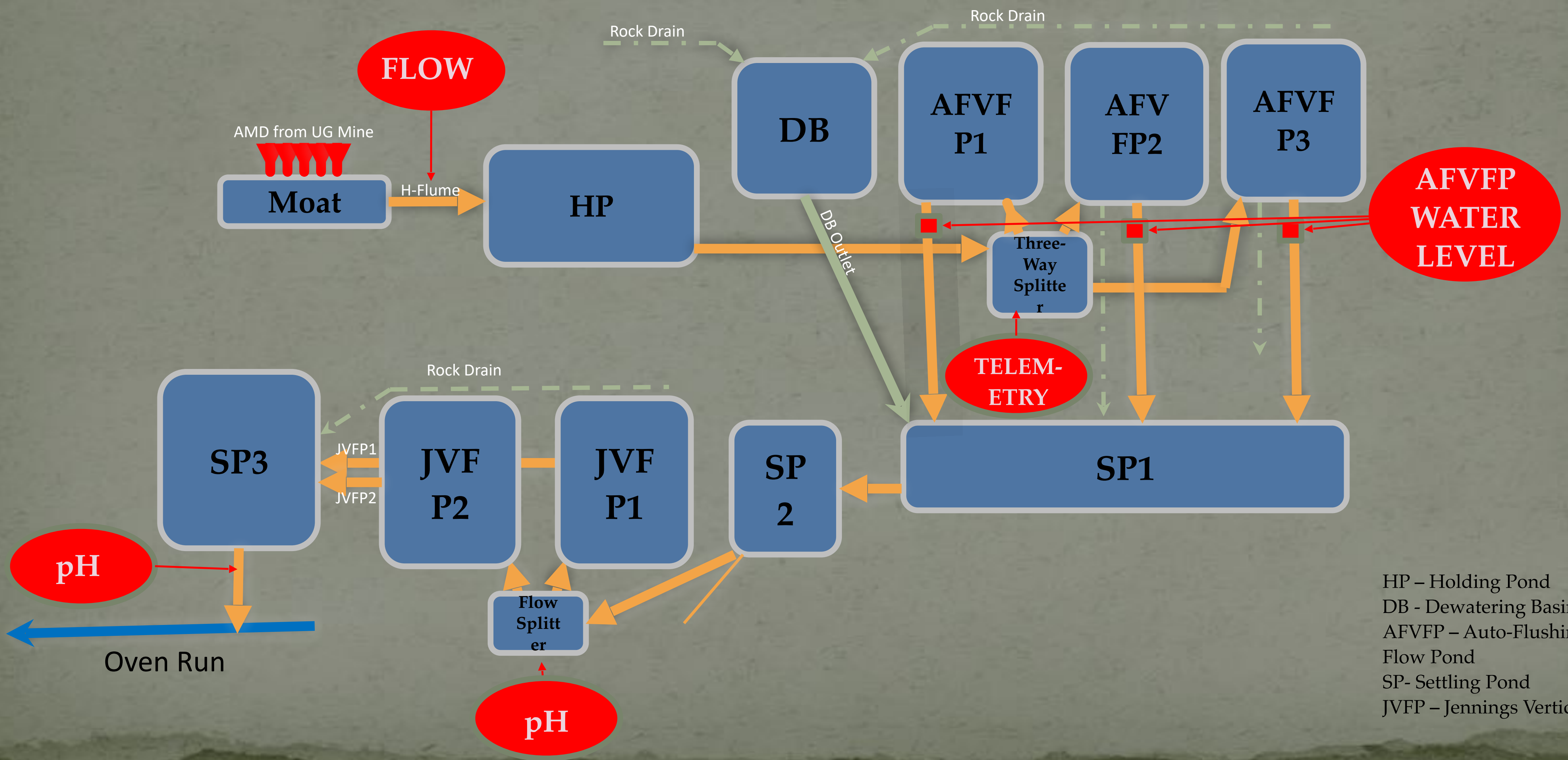
AFVFP & BOLTS Performance Information:
https://www.asrs.us/wp-content/uploads/2024/08/Neely_301E.pdf

Jennings-Type Vertical Flow Ponds

(MIXED MEDIA)

JVFP Media Acid Neutralization Design Basis:
https://wvmdtaskforce.com/wp-content/uploads/2022/10/2022-13-danehy-et-al-2022-wv-10-year-passive-treatment-system-performance-evaluation.pdf

System Schematic – With Telemetry

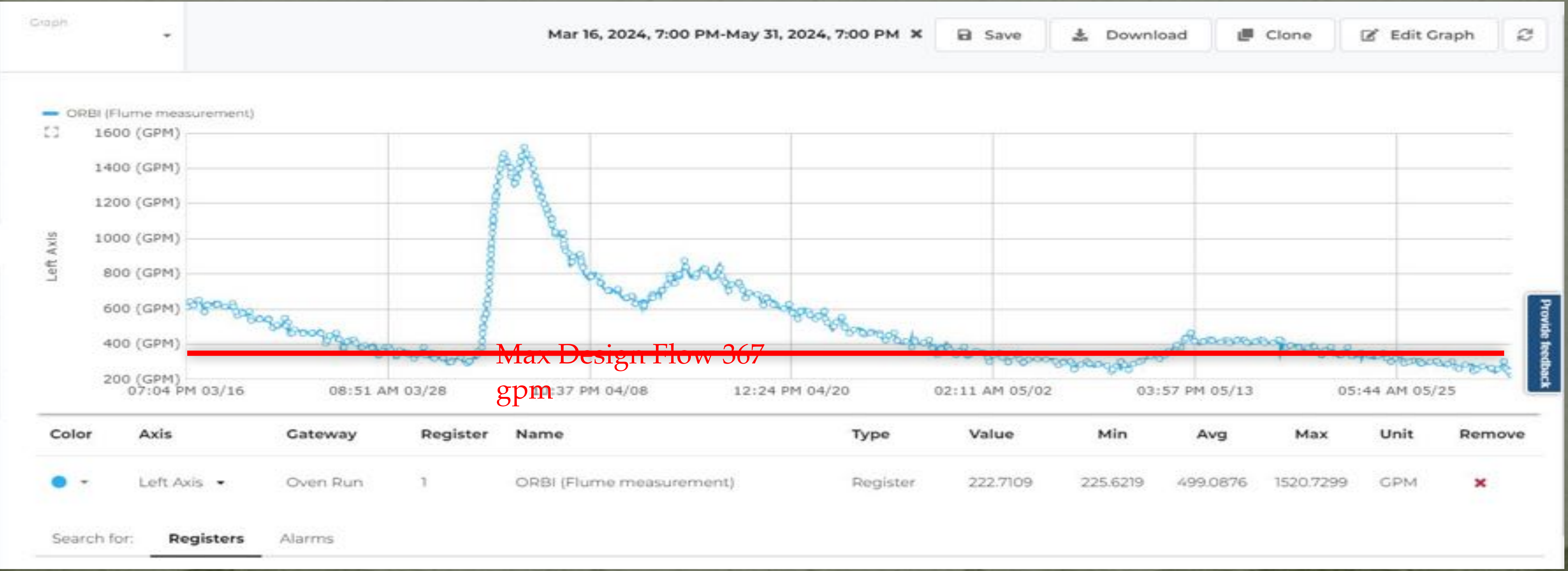


HP – Holding Pond
DB - Dewatering Basin
AFVFP – Auto-Flushing Vertical Flow Pond
SP- Settling Pond
JVFP – Jennings Vertical Flow Pond

USE RADAR, NOT ULTRASONIC

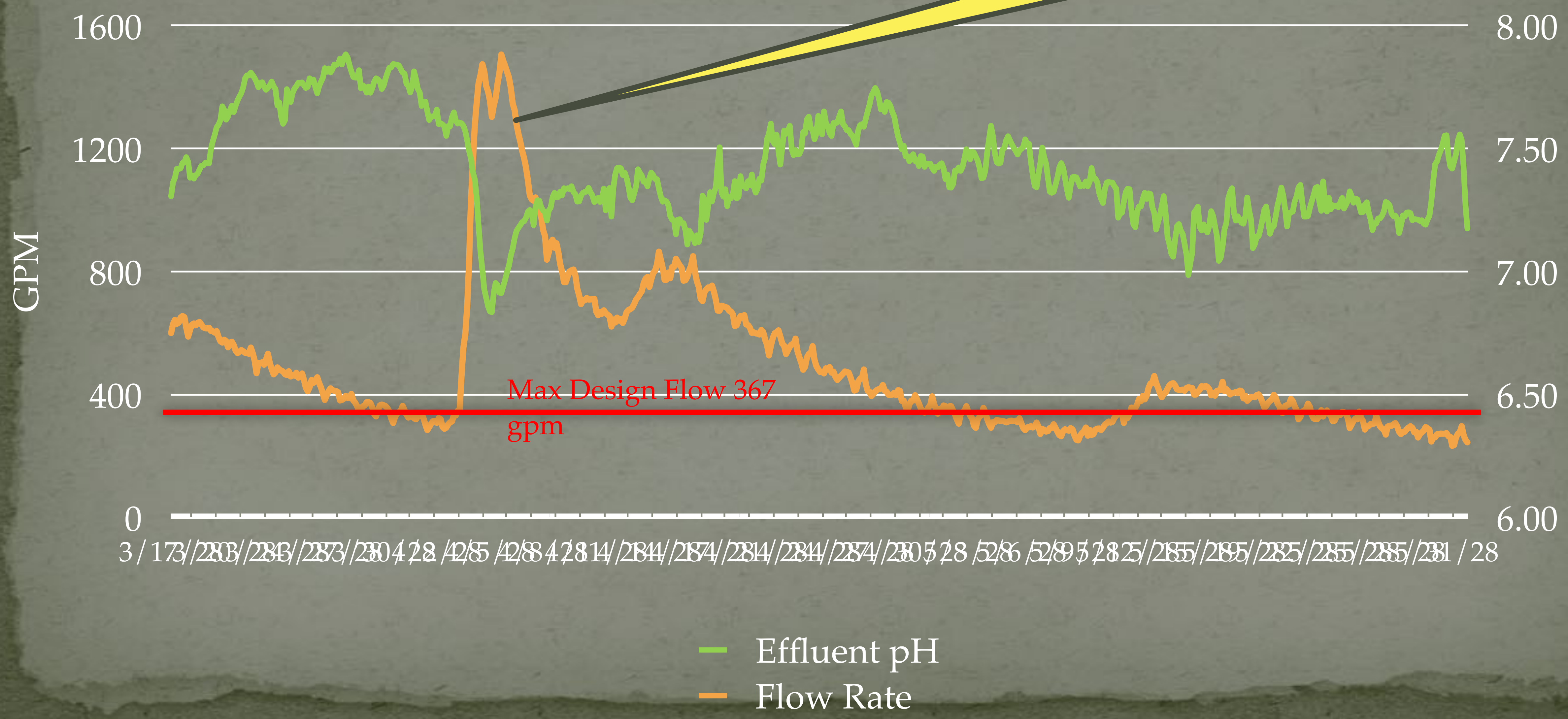
Flow

(Spring 2024)



Flow & Effluent pH (Spring 2024)

ONE WEEK AT UPTO 4X MAX DESIGN



Beyond O&M – We can Science!

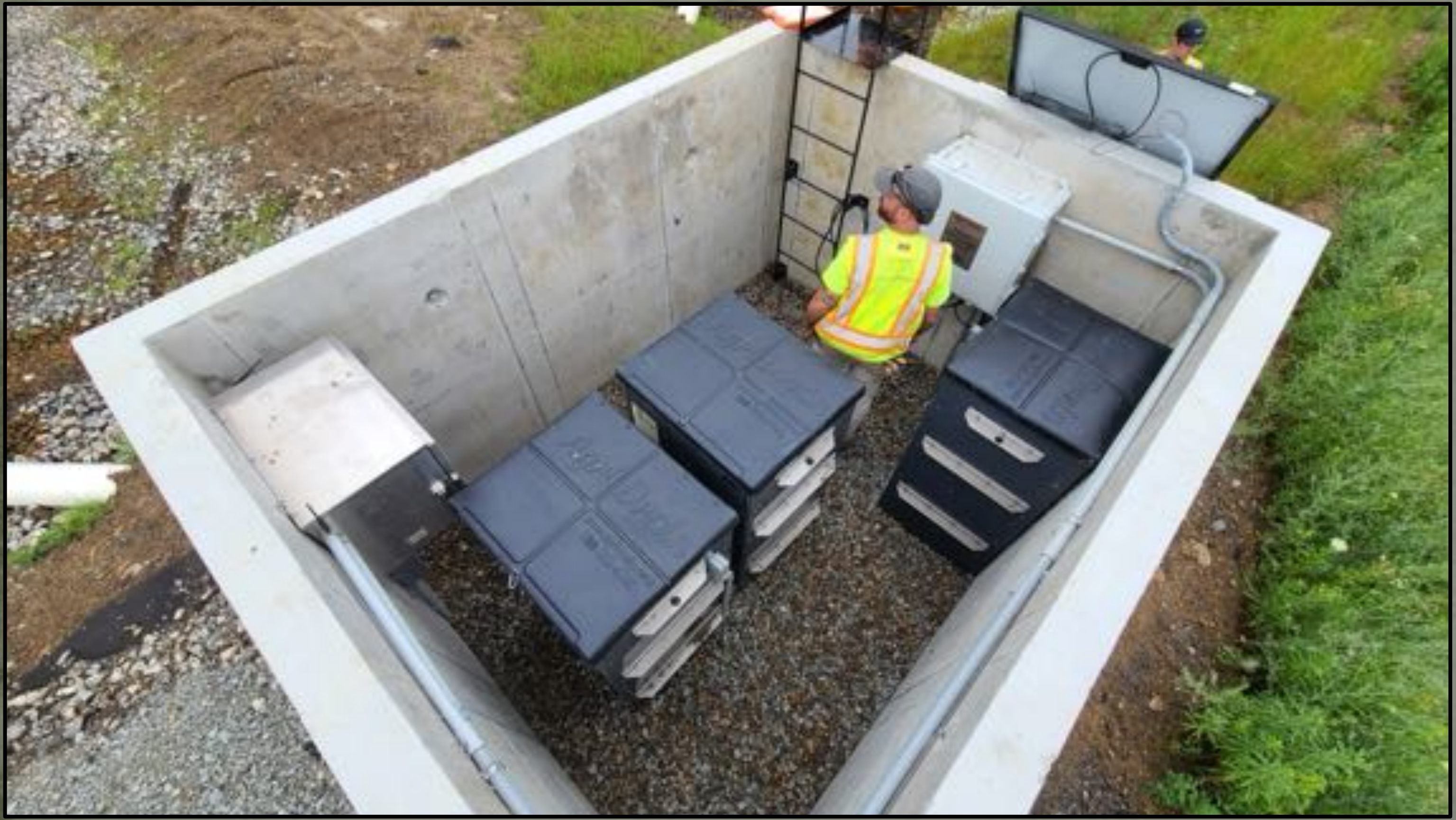
American Society of Reclamation Sciences

- October 2024 Telemetry Webinar (www.asrs.us/events/webinars) – Dan Guy, PG
- Use of Telemetry at a Passive Treatment System to Monitor Flow, pH, and Water Level
  - 2024 Knoxville: https://www.asrs.us/wp-content/uploads/2024/08/Guy_301A.pdf - Dan Guy, PG
- Fill Type & Hold Time Impacts to Limestone-Only Automatic Vertical Flow Ponds
  - 2024 Knoxville: https://www.asrs.us/wp-content/uploads/2024/08/Neely_301E.pdf - Buck Neely, PE

Scientific Advancements

- Void space of seasoned/washed/reused limestone: ~25%
  - www.asrs.us/wp-content/uploads/2024/08/Guy_301A.pdf
  - See also:
    - Reclamation Sciences "Batch Operating Limestone Treatment System (BOLTS): Greater Efficiency and Cost Savings". https://doi.org/10.21000/RCSC-202300003
  - Established Passive References use 49% void.
    - www.asrs.us/wp-content/uploads/2021/09/0262-Watzlaf.pdf (49%)
  - See also:
    - www.asrs.us/wp-content/uploads/2024/08/Danehy_301E.pdf
- Can use the same volume of limestone multiple times per day.
  - Potentially a game changer – Double or triple treatment capacity.
    - Need to evaluate if additional complexity is worth it.
    - Possible inexpensive retrofit to existing systems.

Utilizing Flume Ultrasonic and BOLTS Radar Monitoring to Perform Void Space Analysis



BOLTS System Reconfiguration

Color	Axis	Gateway	Register	Name	Type	Value	Min	Avg	Max	Unit	Remove
● ▾	Left Axis ▾	Oven Run	4	ORBAF 3	Register	1940.8667	1935.2543	1940.474	1941.1538	FT	✖

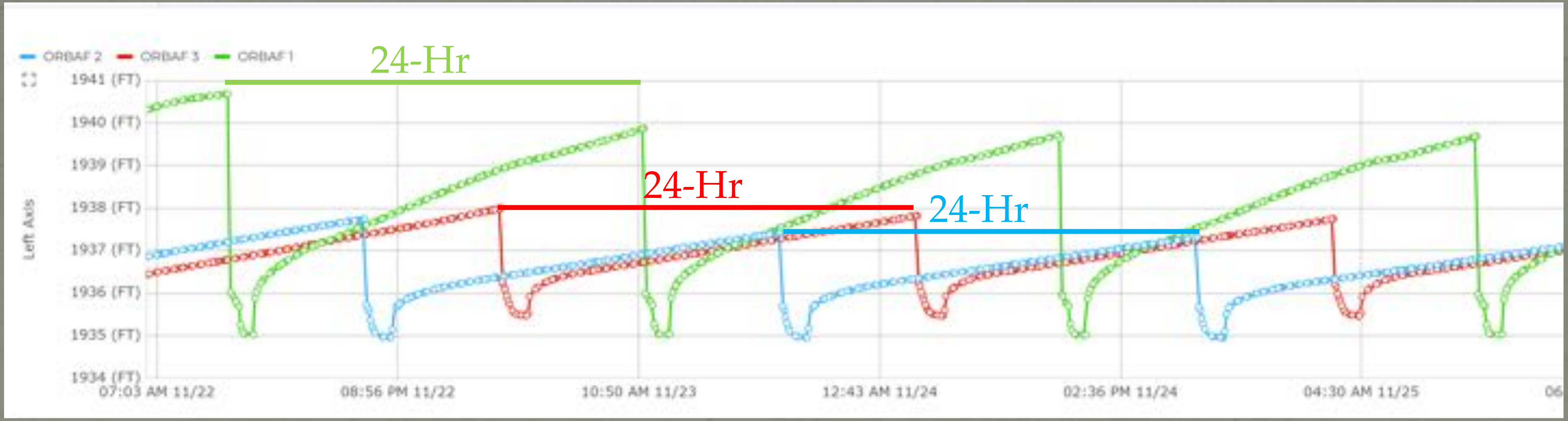
Turned off all three fill valves, added stop logs to AFVFP1 and AFVFP2 fill valves to force all water into AFVP3. Monitored how long it took to fill AFVP3 and flow measured at flume.

Hold Time Analysis

- Full Scale Science on a Seasoned Passive System
- Experimental setups
  - #1: 24-hr gradual fill / 12-hour average hold
  - #2: Rapid fill / 12-hr hold
  - #3: Rapid fill / 9-hr hold
  - #4: Rapid fill / 6-hr hold
- Each testing condition was allowed to run for 2 weeks prior to sampling (Nov 2023 – Jan 2024)
  - No instances of overflow were observed (telemetry)
  - Compare acid load reductions in SP1 effluent

(#1) 24- HR Gradual Fill (12-Hr Avg Hold)

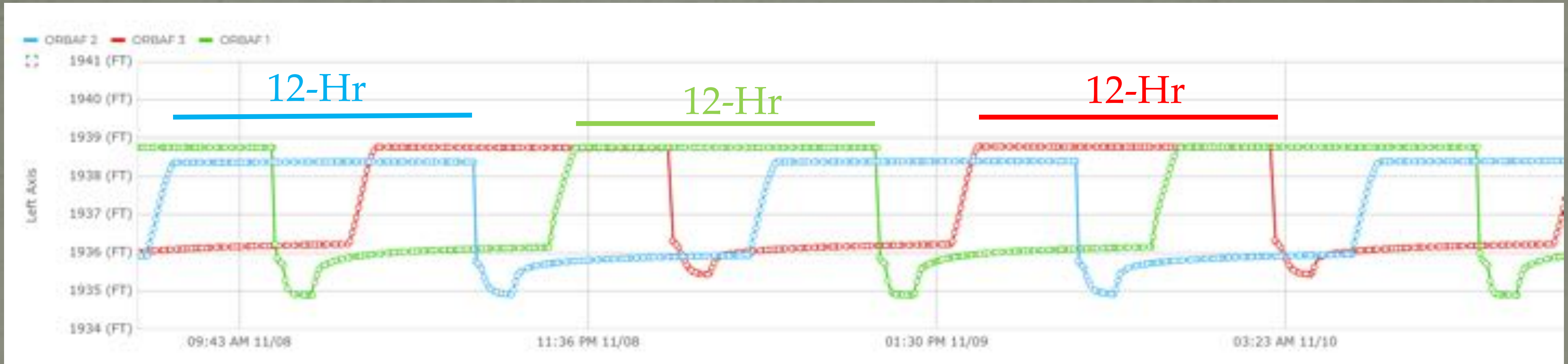
- Rapid Drain initiates 24-hr apart
  - ~1-hr to drain (11.5-hr avg retention)
  - 24-hr cycle
  - 23-hr fill & 1-hr drain



ID	pH	Flow (gpm)	Cond (μmhos/cm)	D. Al (mg/L)	D. Fe (mg/L)	D. Mn (mg/L)	ACID (mg/L)	ACID LOAD (lb/d)
SP1 out	4.14	99.7	1260	15.7	0.7	4.9	100	120

(#2) Rapid Fill (12-Hr Hold)

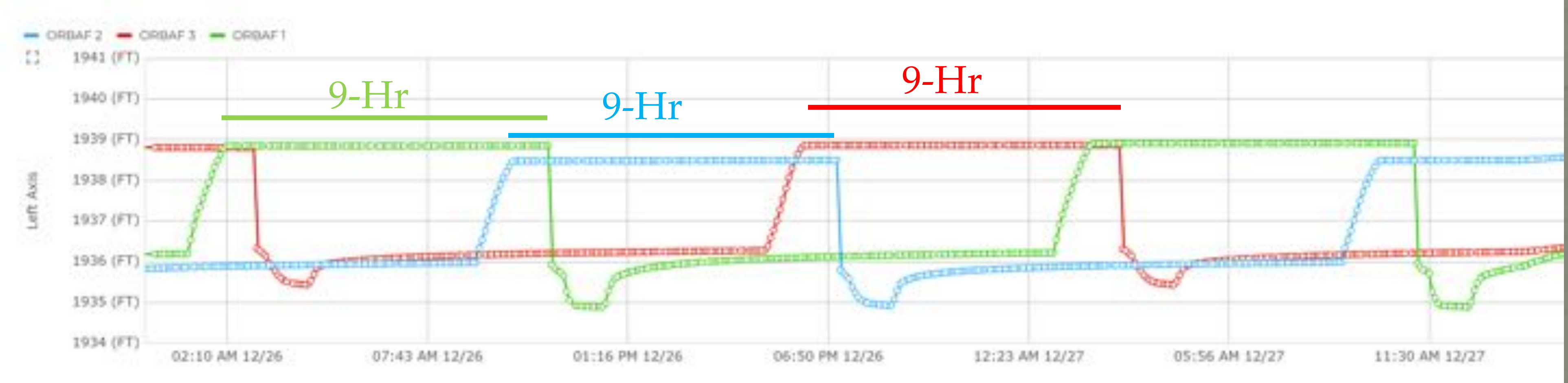
- True Hold Times
  - 14-hr cycle
  - 1-hr fill & 1-hr drain



ID	pH	Flow (gpm)	Cond (μmhos/cm)	D. Al (mg/L)	D. Fe (mg/L)	D. Mn (mg/L)	ACID (mg/L)	ACID LOAD (lb/d)
SP1 out	4.63	87.2	1220	7.9	0.2	3.5	61	64

(#3) Rapid Fill (9-Hr Hold)

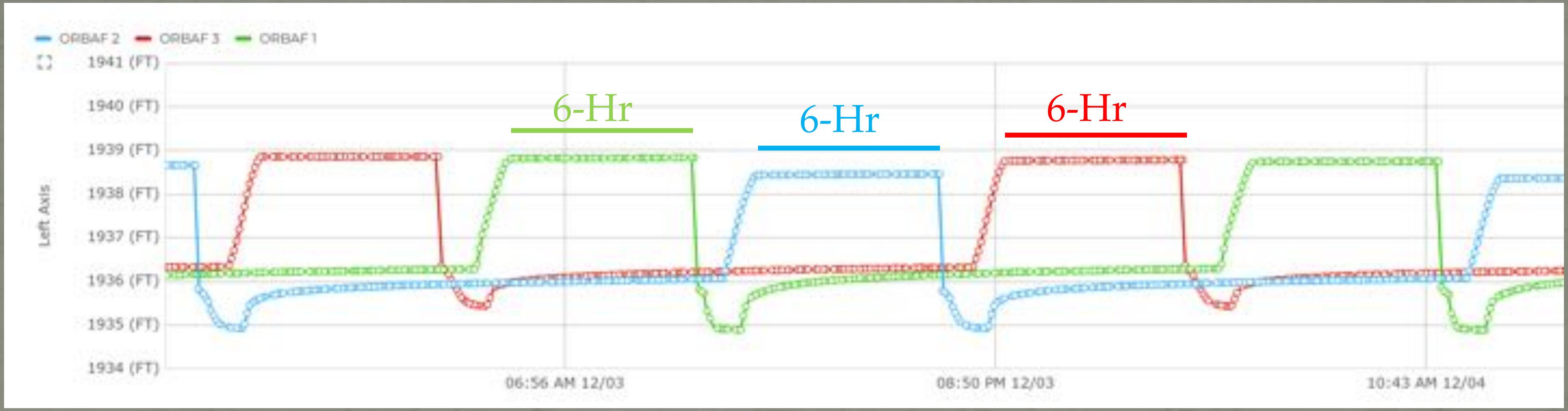
- True Hold Times
  - 11-hr cycle
  - 1-hr fill & 1-hr drain



ID	pH	Flow (gpm)	Cond (µmhos/cm)	D. Al (mg/L)	D. Fe (mg/L)	D. Mn (mg/L)	ACID (mg/L)	ACID LOAD (lb/d)
SP1 out	4.29	112.4	1240	12.7	0.5	4.5	84	114

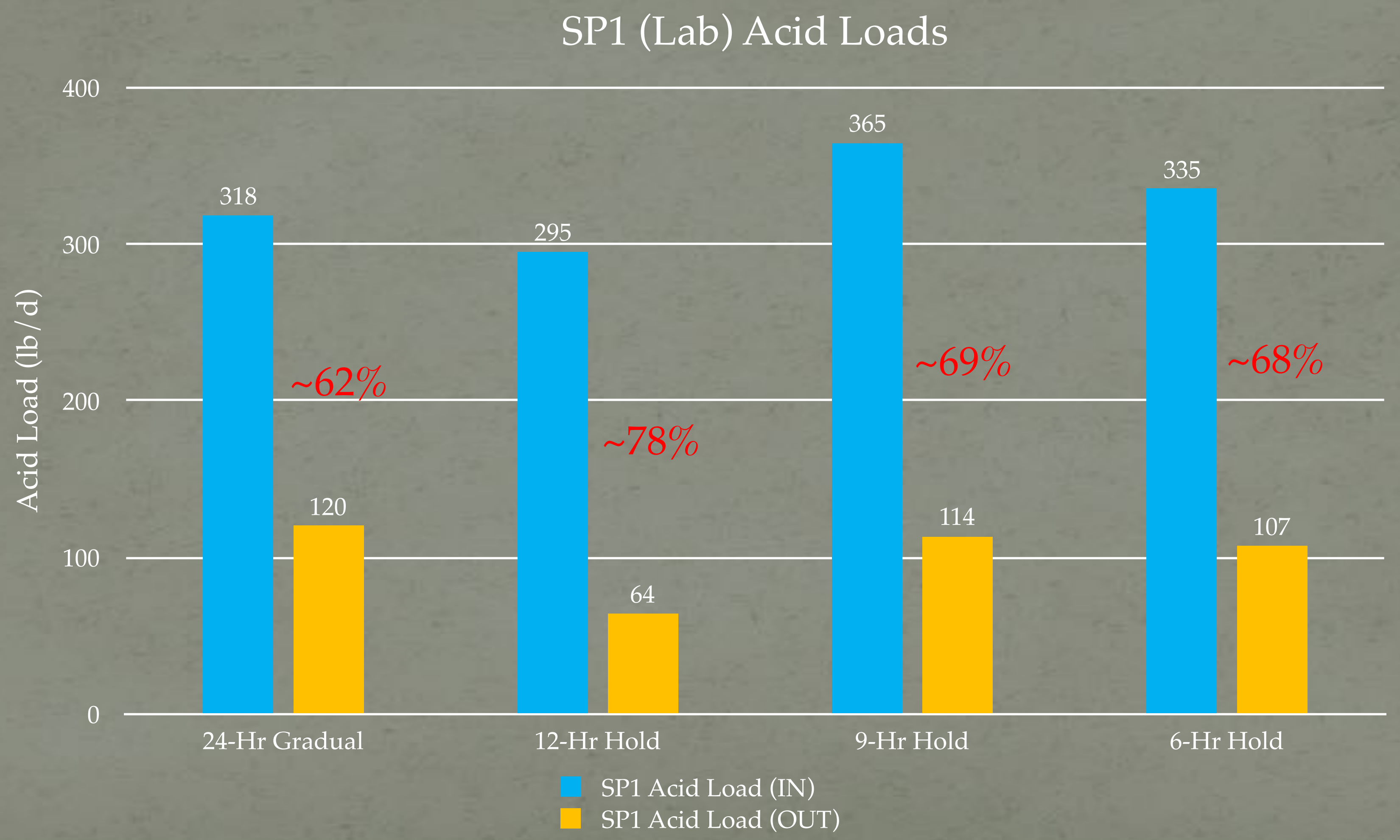
(#4) Rapid Fill (6-Hr Hold)

- True Hold Times
  - 8-hr cycle
  - 1-hr fill and 1-hr drain

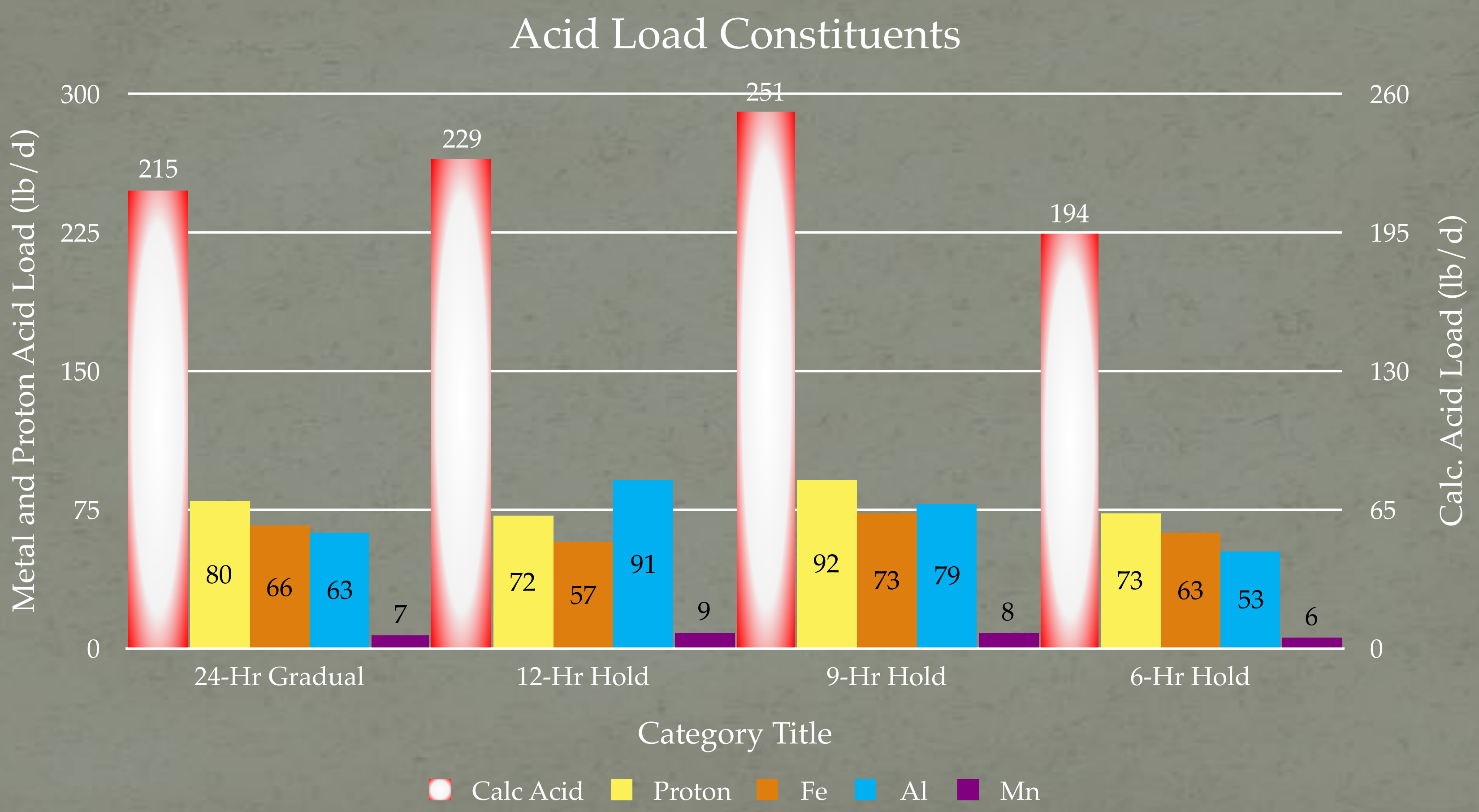


ID	pH	Flow (gpm)	Cond (µmhos/cm)	D. Al (mg/L)	D. Fe (mg/L)	D. Mn (mg/L)	ACID (mg/L)	ACID LOAD (lb/d)
SP1 out	4.26	97.9	1280	14.8	0.5	4.9	91	107

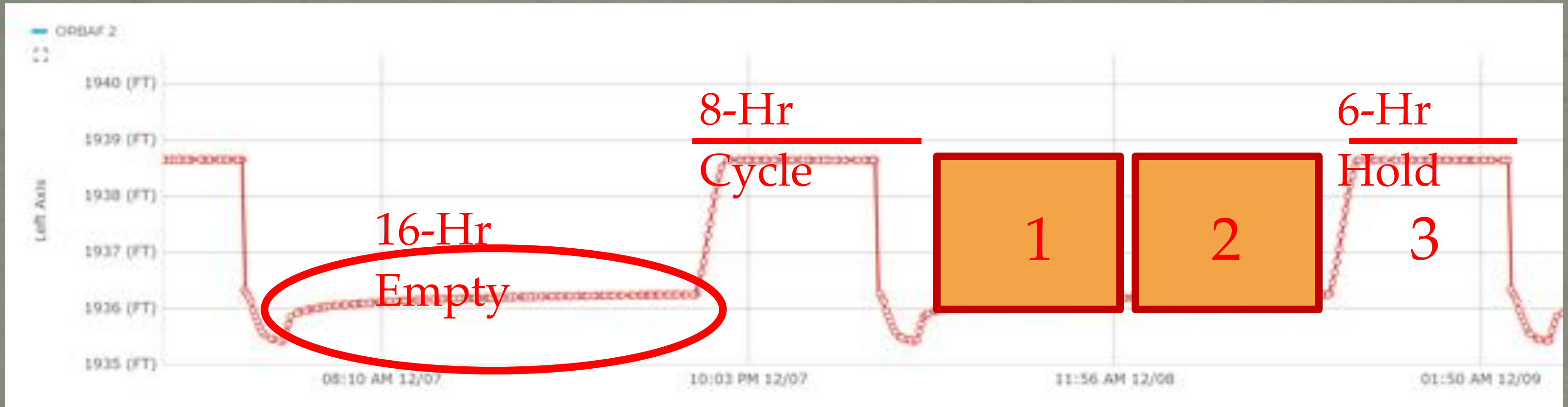
Acid Load Summary



ACID LOAD REMOVED



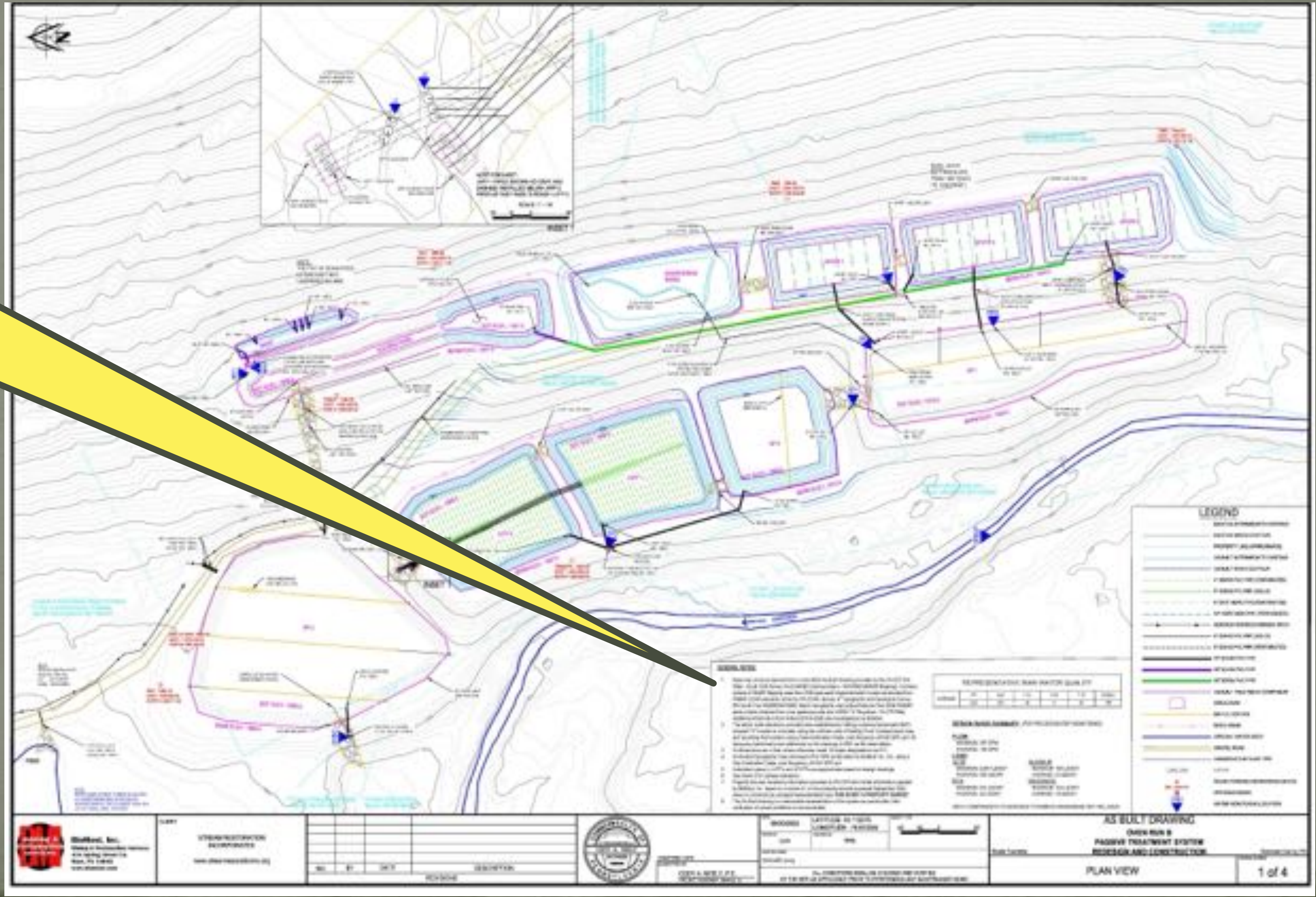
How Can We Use It?



- Triple Acid Load Neutralization Potential
- Design
  - More efficiently use smaller quantities of limestone
    - $ or space limited projects
  - How small can you make these ponds?
    - A lot depends on flow

2022 As-Built Drawing

DOCUMENT WHAT THE SYSTEM WAS DESIGNED TO DO



O&M Plan and As-Built available on Datashed

Design Basis Included on As-Built

REPRESENTATIVE RAW WATER QUALITY						
AVERAGE	pH	Acid	T Fe	T Mn	T Al	Sulfates
	2.80	320	28	11	25	799

DESIGN BASIS SUMMARY: (PER PRE-DESIGN DEP MONITORING)

FLOW
MAXIMUM: 367 GPM
AVERAGE: 158 GPM

LOAD

ACID
MAXIMUM: 2,467 LB/DAY
AVERAGE: 533 LB/DAY

IRON
MAXIMUM: 215 LB/DAY
AVERAGE: 42 LB/DAY

ALUMINUM
MAXIMUM: 195 LB/DAY
AVERAGE: 43 LB/DAY

MANGANESE
MAXIMUM: 103 LB/DAY
AVERAGE: 19 LB/DAY

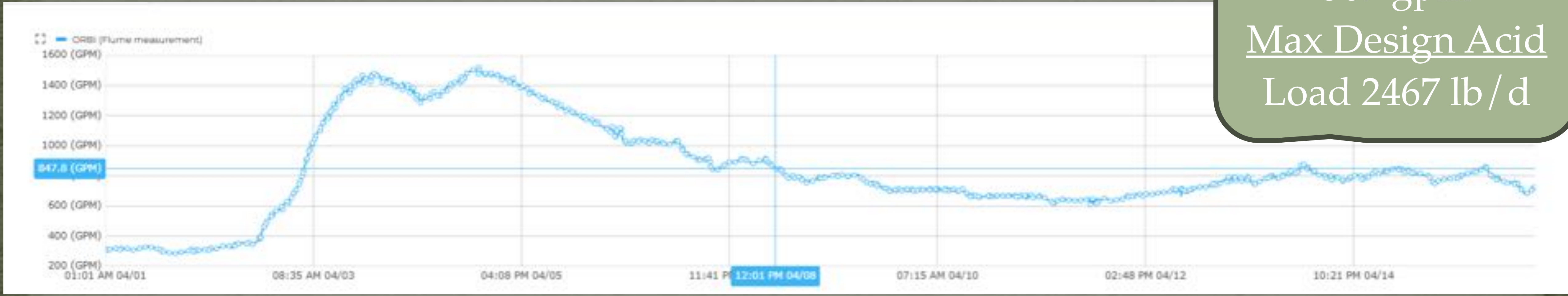
NOTE: COMPONENTS TO DESIGNED TO REMOVE MANGANESE NOT INCLUDED.

If the System is Flowing at 1,500 GPM with 3,000 lb/day influent acid load, should we expect 6+ pH effluent?

Probably Not. Let's be Reasonable

Pre- and Post- Construction Monitoring and O&M Plan with As-Built available on Datashed

Does it Work?
Sample 4/8/24 (after ~1.5 years)



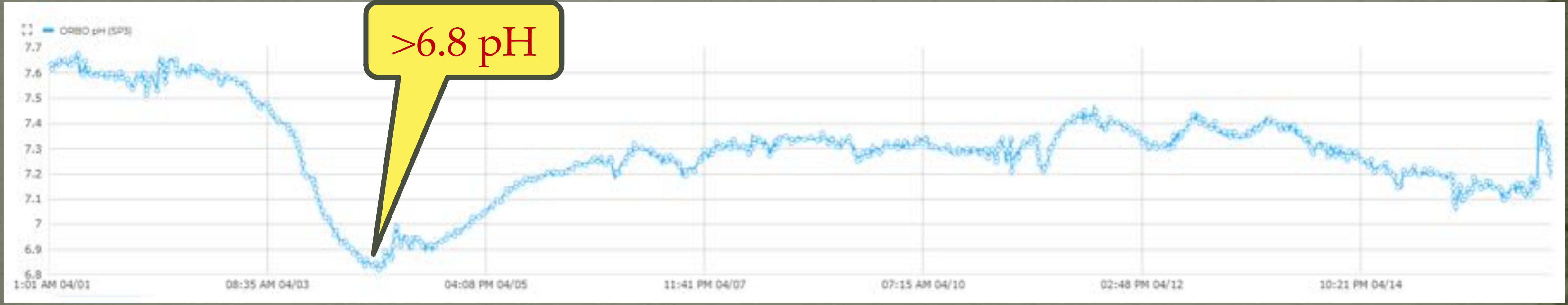
Max Design Flow
367 gpm
Max Design Acid
Load 2467 lb/d

ID	pH	Flow (gpm)	Sulfate (mg/L)	T. Al (mg/L)	T. Fe (mg/L)	T. Mn (mg/L)	ACID (mg/L)	ACID LOAD (lb/d)
Influent (ORBI)	2.9	848	558	16.5	12.7	6.8	216	2202
Effluent (ORBO)	6.6	848+	425	1.0	0.3	3.0	-65	-662
Total Acid Load (2467 lb/day acid is design):								2864

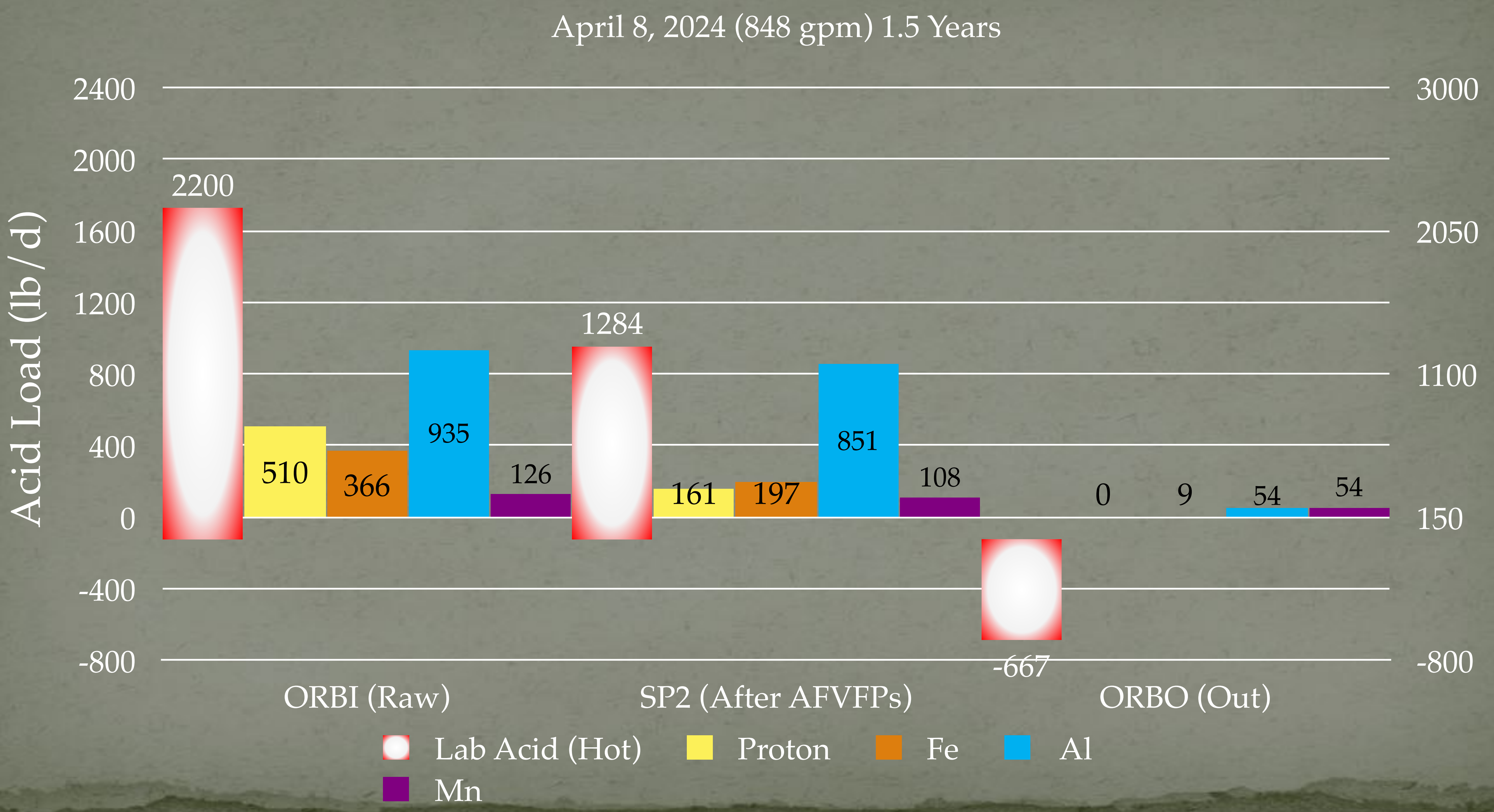
How Does it Work?
April 2024 (after ~1.5 years)

>4X DESIGN FLOW

>6.8 pH

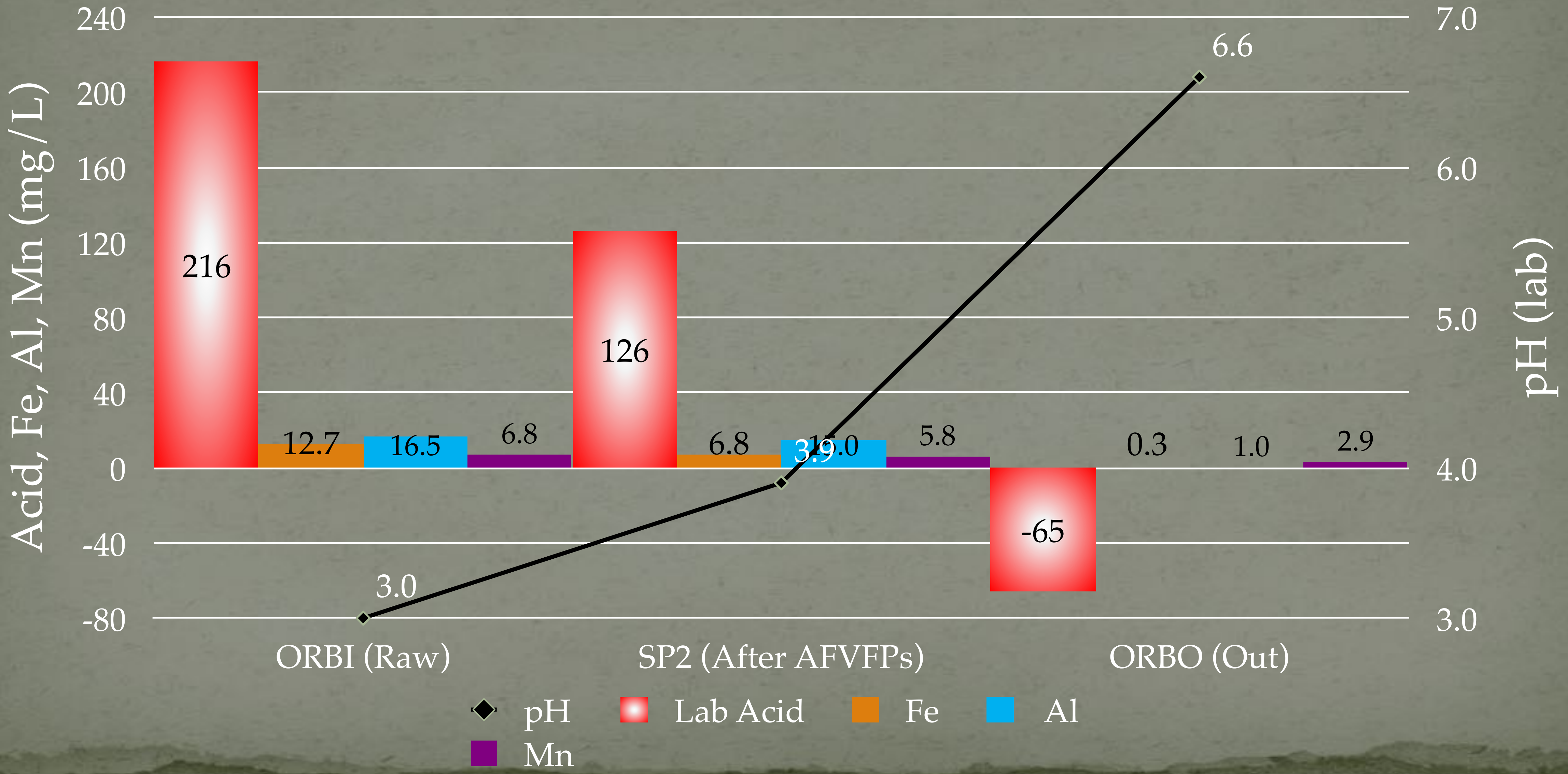


Acid Load Removal by Constituent

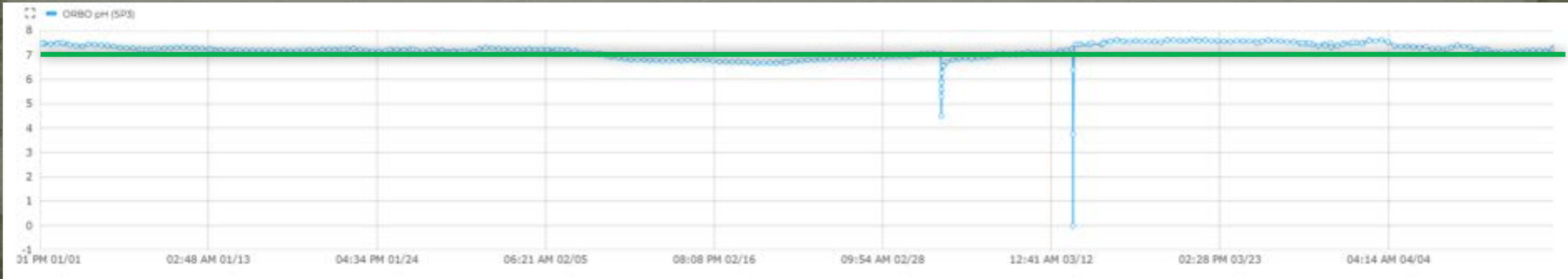


Pollutant Concentration

April 8, 2024 (848 gpm)



How Does it Work Now?
January 1 – April 15, 2025 (~2.5 years)



Biology is Cool – Holding Pond 8/2/22

Biology is Cool – SP3 pH Probe 7/7/22

Thank You

Acknowledgements

PA DEP BAMR

Foundation for Pennsylvania Watersheds

Stream Restoration Incorporated

BioMost, Inc.

Earth Shapers, LLC

Saint Francis University

Landowners

BioMost, Inc.

Mining & Reclamation Services

Mars, PA

www.biomost.com