

# PERFORMANCE OF A PASSIVE TREATMENT SYSTEM OVER 30 YEARS IN TENNESSEE

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Symposium, April 16, 2025, Charleston, West Virginia

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EARTHRES a Division of RESPEC

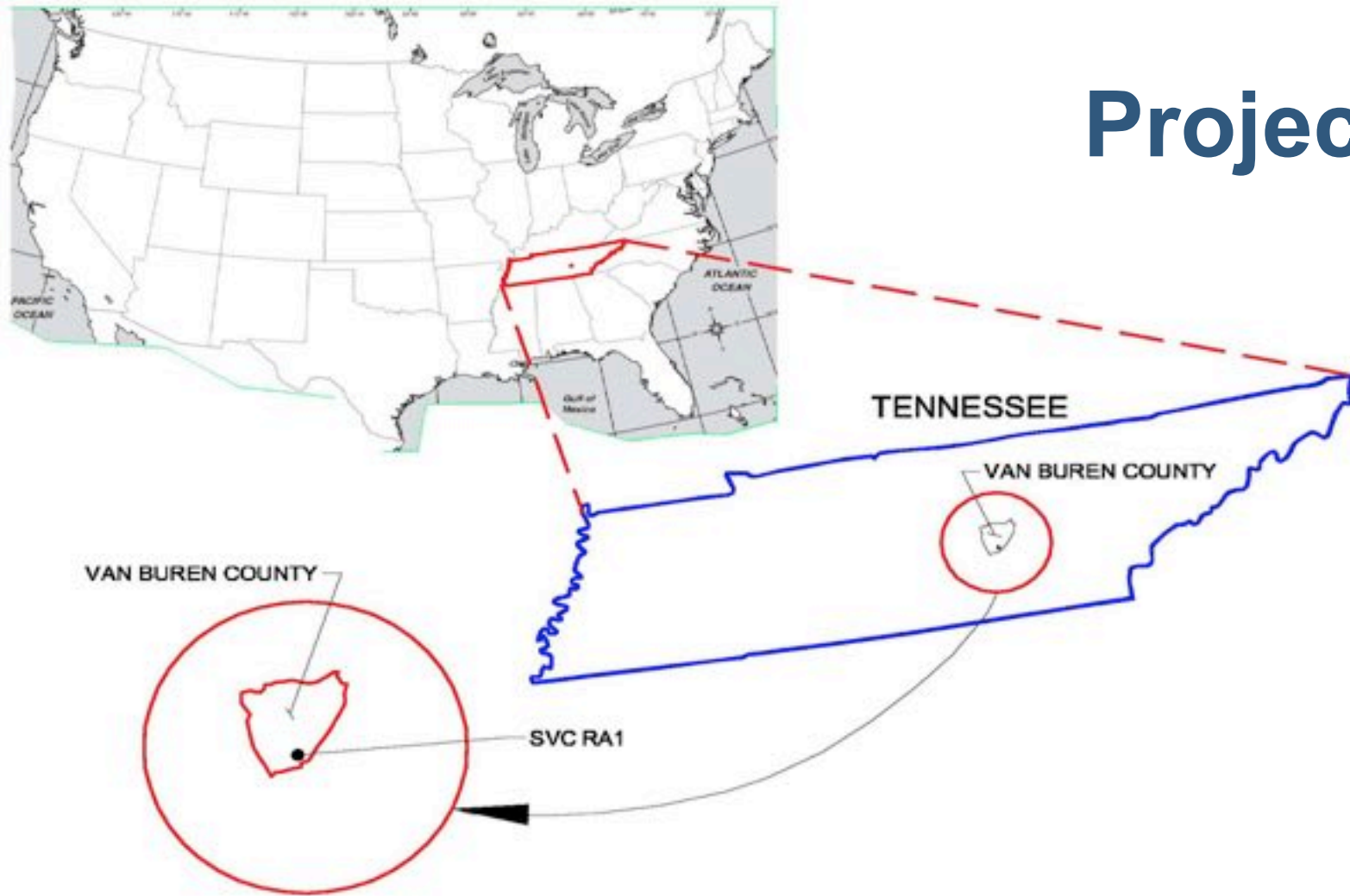
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# Project Location



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# Background

- Sequatchie Valley Coal Corporation (SVC)
- Extracted Sewanee coal 1978 to 1982
- Area mine using dragline for overburden
- Following reclamation, AMD developed
- Chemical treatment used for 10+ years

175

acres  
of mining area

100,000

gallons  
of NaOH (caustic)

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# NPDES Permitting Assessment

- Initiated in 1992
- Detailed stream survey
- Evaluation of site hydrology
- Review of NPDES guidelines
  - Technology based
  - Regulatory based
  - Water quality based

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# NPDES Permitting Assessment

- **Worked with TDEC and attorneys**
- **Whole effluent toxicity tests**
- **NPDES permit negotiated**
  - **Ph, IRON, SETTLEABLE SOLIDS**
  - **Acute and chronic toxicity test**



# Preconstruction Assessment

1993

Limestone  
incubation tests

- Prediction of 360 mg/l alkalinity
- Test ald of 65 tons constructed

1995

Pilot scale test

- Variable flow conditions applied
- Confirmed alkalinity generation

1996

- Documented in ASMR paper

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# Conversion to Passive Treatment

- **ALD and ponds installed in 1995**
- **Designed for 200 GPM and 100 mg/L Fe**
- **Other factors favorable (Al, DO, and site)**
- **Initial average flow exceeded 300 GPM**





# 1995 System ALD Discharge





# 1995 System Basin A





## 1995 System – Basin A





# 1995 System Basin A Discharge





# 1995 System Basin B Inflow





# 1995 System Basin B Discharge





# 1995 System Results 120 GPM

Cell	Alkalinity	pH	Iron
<b>ALD</b>	345	6.2	138
<b>Basin A</b>	175	6.5	42
<b>Basin B</b>	125	7.1	<1



# 1995 System Results 335 GPM

Cell	Alkalinity	pH	Iron
ALD	330	6.4	97
Basin A	240	6.7	52
Basin B	180	6.9	18

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# Passive Treatment System Enhancement

- Wetlands were added in 1996
- Planted with cattails



# 1996 Wetland 1 Added





## 1996 Wetland 2 Added





# 1995 System Results Post Wetland Construction

Cell	Alkalinity	pH	Iron	Mn
ALD	185	6.3	74	31
Basin A	170	6.2	24	33
Basin B	175	7.0	0.5	27
Wetland A	120	7.0	0.1	14
Wetland B	100	7.1	0.1	1.4

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# Supplemental ALD Added 1999

- **Hydraulically Activated - GW elevation**
- **Controlled by In-line water level structure**
- **Redirects and treats peak flow**
- **High flows split between systems**
- **Extends life of system constructed 1995**



# 1999 SYSTEM 2006 IMAGERY





# 1999 ALD and Basins





## 1999 Basin 1-C-005





## 1999 ALD Basin 1-C-005 (cont.)





# 1999 Wetland



# Basin A Sludge Operation and Maintenance

- Monitored at least 1 time per year
- Depth measurements taken at perimeter
- Estimated iron sludge volumes determined
- Average flow rates
- Average iron concentrations from ALD
- Average iron concentration discharging Basin
- Detailed measurements taken 2007





# Basin A Sludge Measurement 2007





# Basin A Sludge Measurement 2007



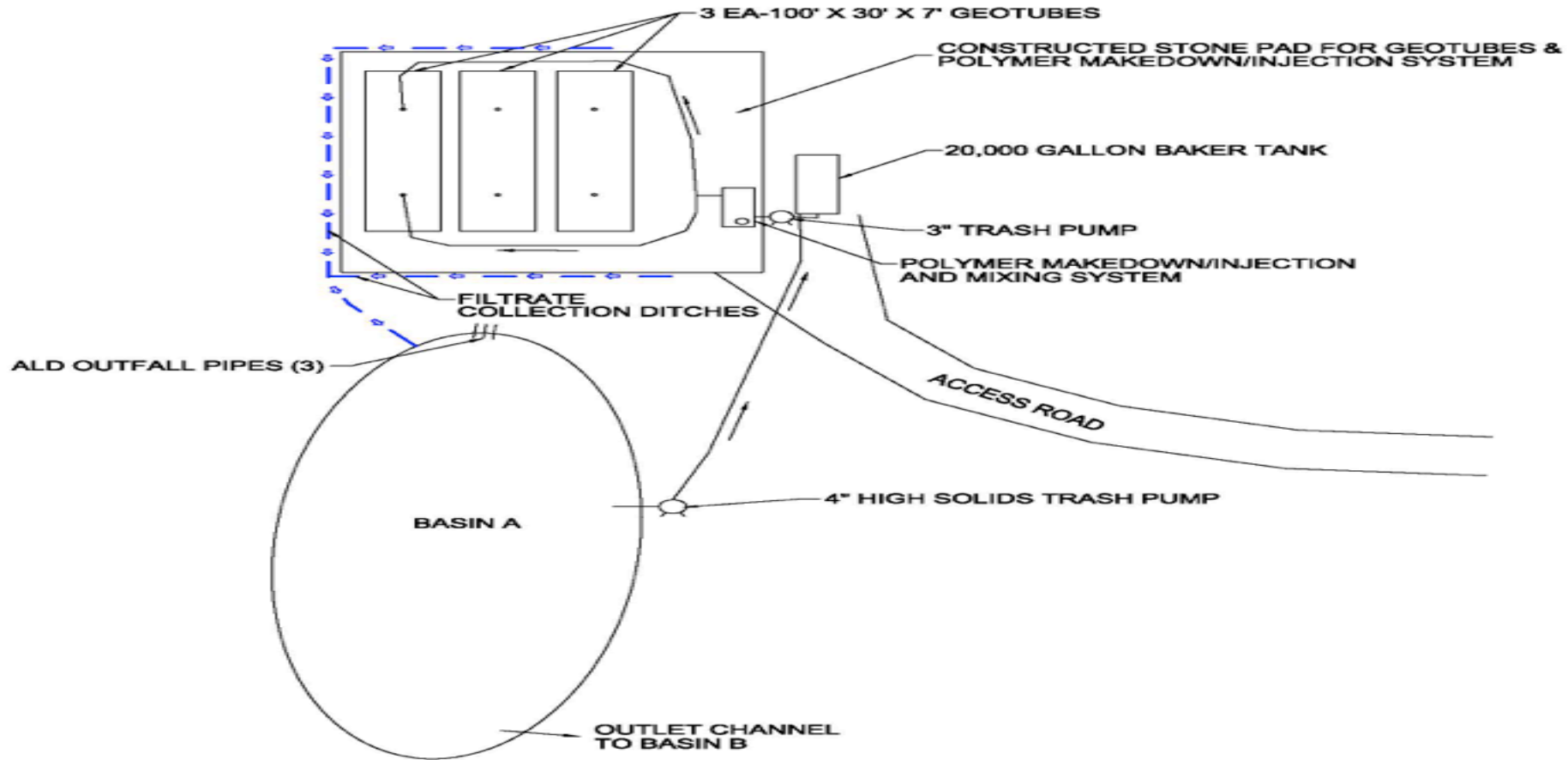


# Sludge Measurements

- Depths of 2 – 8 feet measured
- Average depth of 3 feet - Basin A
- Removal recommended
- Capture for potential reuse
- Restore storage capacity
- Restore retention time



# Sludge Capture System Schematic



# Sludge Dewatering System





# 2010 Photos





## 2010 Photos (Continued)





## 2010 Photos (Continued)



# 2011 PHOTOS





# 2011 PHOTOS



# Sludge Recycling

- All sludge removed from Basin A was recycled and trucked to Hoover Color Corporation. SVC covered the cost to ship the material, then Hoover compensated SVC for the material as it was consumed in their pigment process.





# 2010 - NEW NPDES PERMIT LIMITS BASED ON TMDL

- TMDL completed in Rocky River
- New NPDES limits planned
- Proposed Manganese limits required new system enhancements (toxicity limits replaced by numeric limits)



# 2012 SYSTEM ENHANCEMENTS

- **Elimination of one NPDES point**
- **Combining 1999 and 1995 systems**
- **Manganese reduction channels**
- **Raising berms to increase freeboard**
- **Settling Ponds**
- **Solar powered aeration**





# 2012 SYSTEM ENHANCEMENTS





# Construction 2011





# Construction 2011





# Settling Basin 2012





# Basin & Limestone Channel 2012





# Beaverator 2012





# Solar Aerator and Baffles 2012



# Open Limestone Channel 2012





# Limestone Channel Mn 2014





# 2012 Monitoring Stations





# 2012 System Results Snapshot

• Cell	pH	FeT	FeD	MnT	MnD
• 1999 Out	7.3	1.6	0.9	13	4.7
• LS Channel	8.1	ND	ND	ND	ND
• Basin A	7.0	2.3	1.2	26	15
• Basin B	7.2	ND	ND	5.2	2.6
• Wetland A	7.6	0.1	ND	4.4	1.8
• Wetland B	7.5	0.1	ND	0.5	0.1

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# 2013 System Results Snapshot

• Cell	pH	FeT	FeD	MnT	MnD
• 1999 ALD	6.7	26	8.8	11	6.5
• 1999 Out	7.2	2.1	1.1	9.1	5.0
• LS Channel	7.5	ND	ND	0.2	0.2
• Basin A	7.5	1.2	0.6	4.1	2.1
• Basin B	7.6	0.9	0.4	3.6	1.9
• Wetland A	7.8	0.7	0.4	3.6	2.0
• Wetland B	7.7	0.2	ND	0.5	0.2

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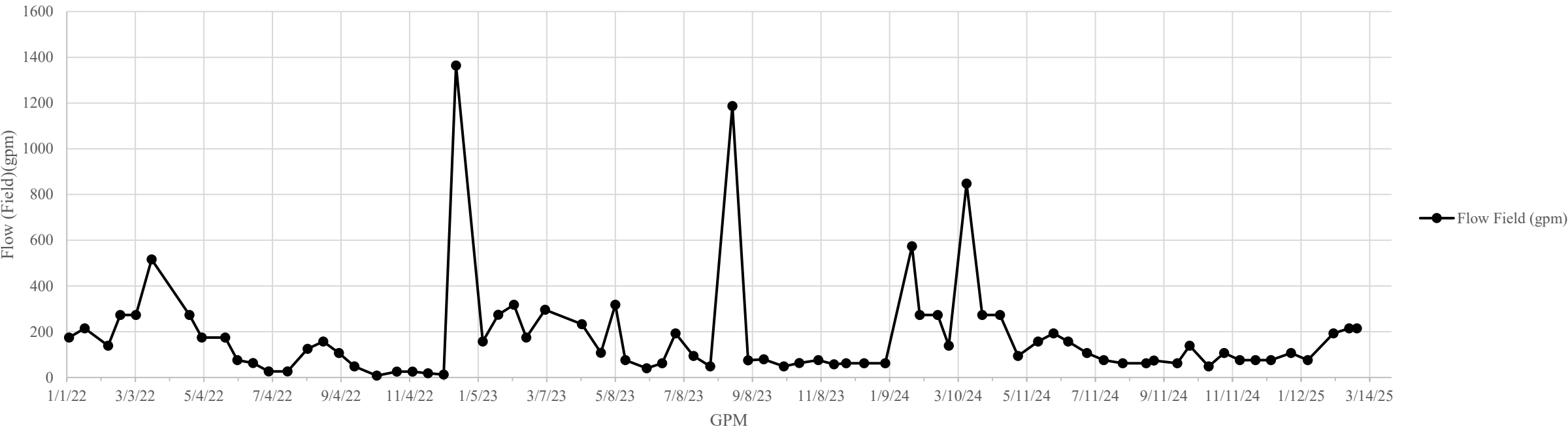
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# 1995 System Flow Rates 2022-2025

Discharge Flow Gallons Per Minute (GPM)



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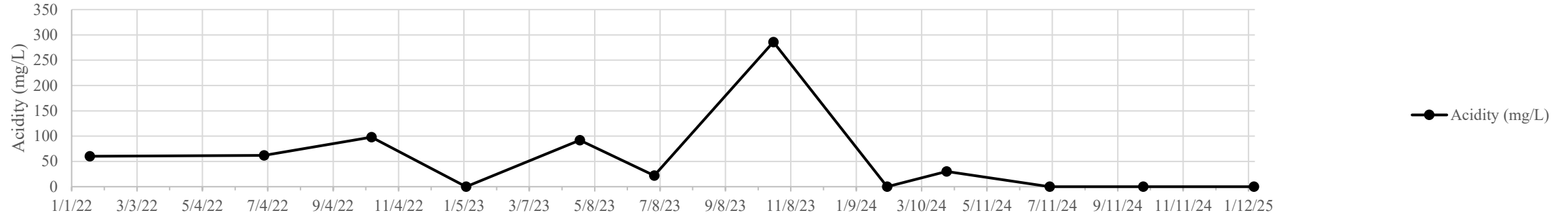


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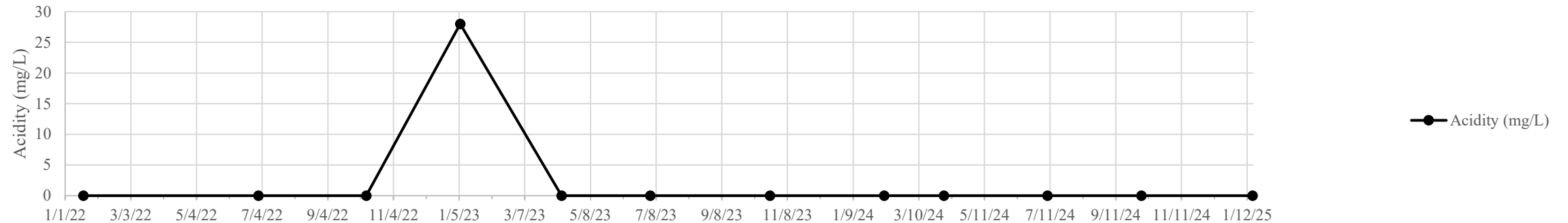
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# 1995 System Acidity 2022-2025

Well Acidity



ALD Acidity



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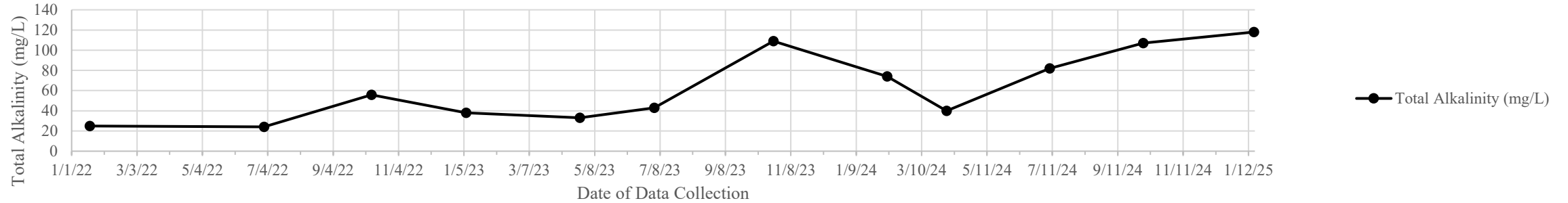
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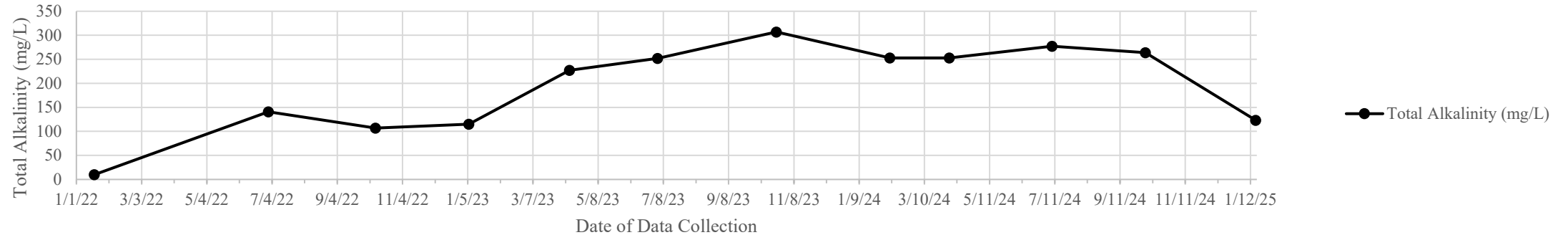


# 1995 System Alkalinity 2022-2025

Well Alkalinity



2005 ALD Alkalinity



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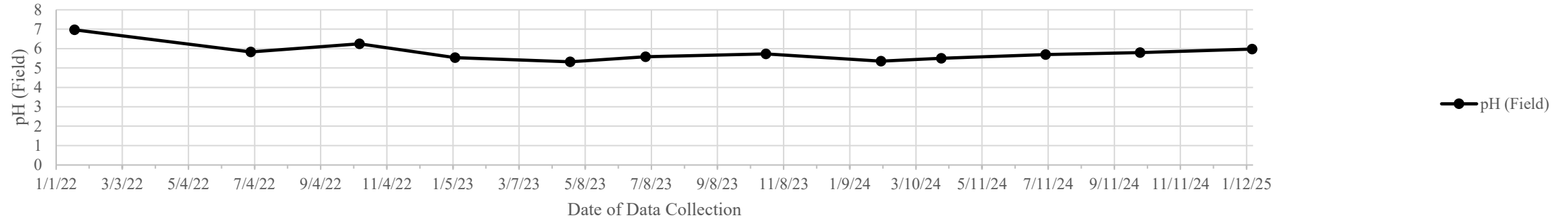


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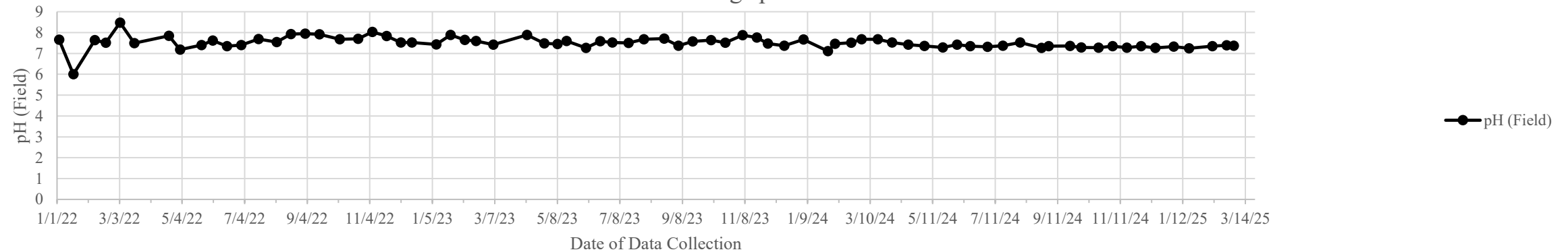
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# 1995 System pH 2022-2025

Well pH



Discharge pH



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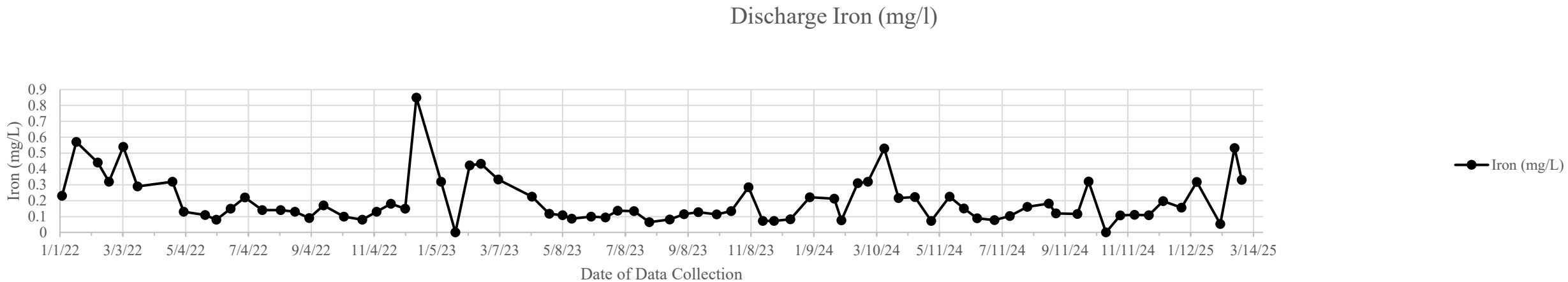
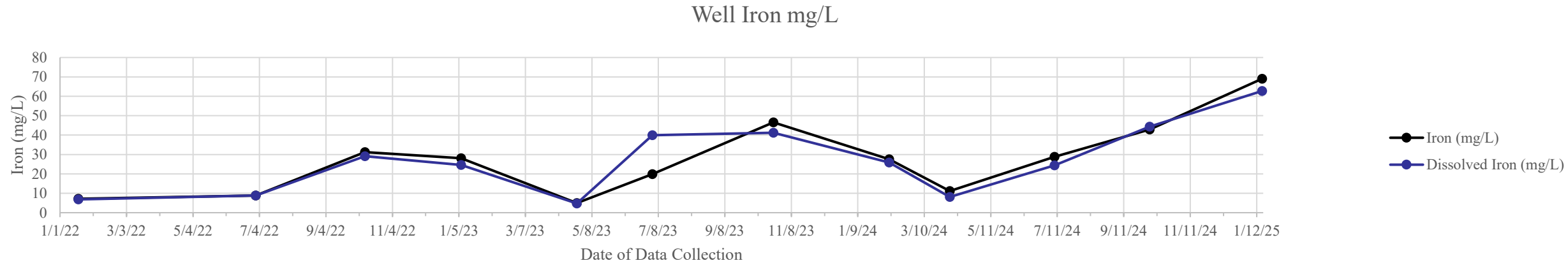


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# 1995 System Iron 2022-2025



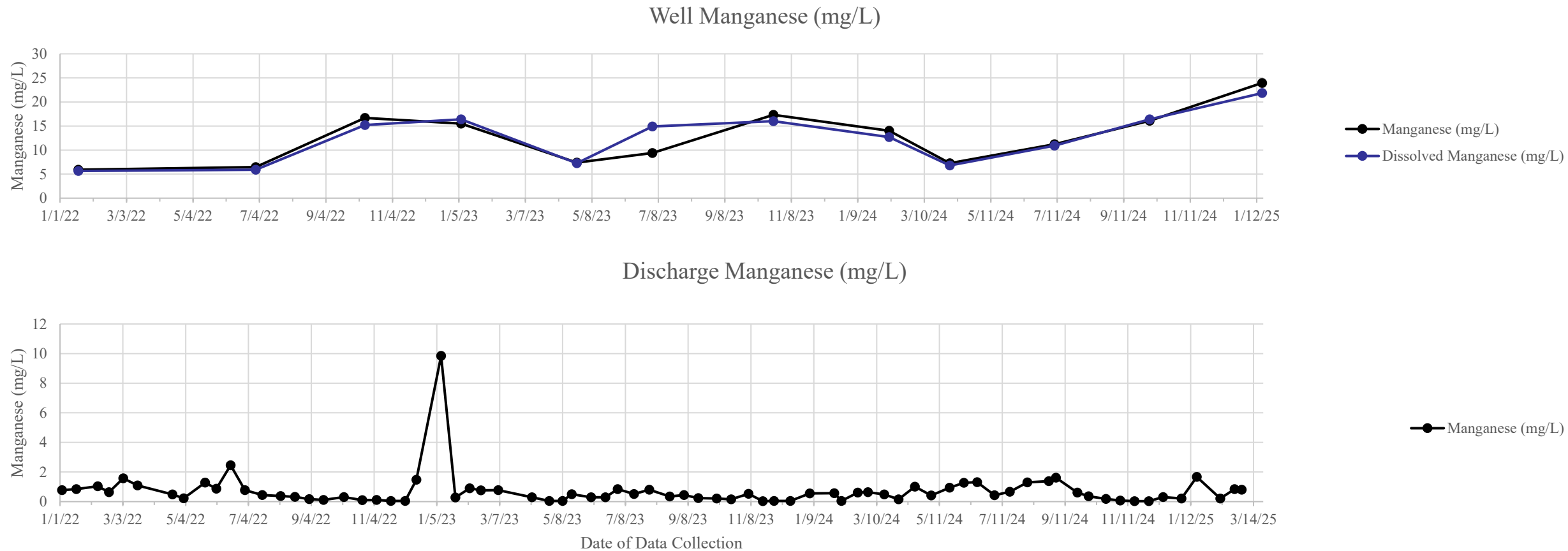
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# 1995 System Mn 2022-2025



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# Conclusions

- **Passive treatment has proven to be an effective and reliable means of treatment for over 30 years**
- **NPDES permit limits may change and treatment strategies may require adjustment**
- **NPDES permit limits were continuously met throughout the 30-year period**
- **O&M including sludge removal, beaver management, and wetland management has been critical to maintaining effectiveness**





# Questions ?

