ASSESSMENT OF PERFORMANCE OF A PASSIVE TREATMENT SYSTEM OVER A TWENTY YEAR PERIOD IN EAST CENTRAL TENNESSEE

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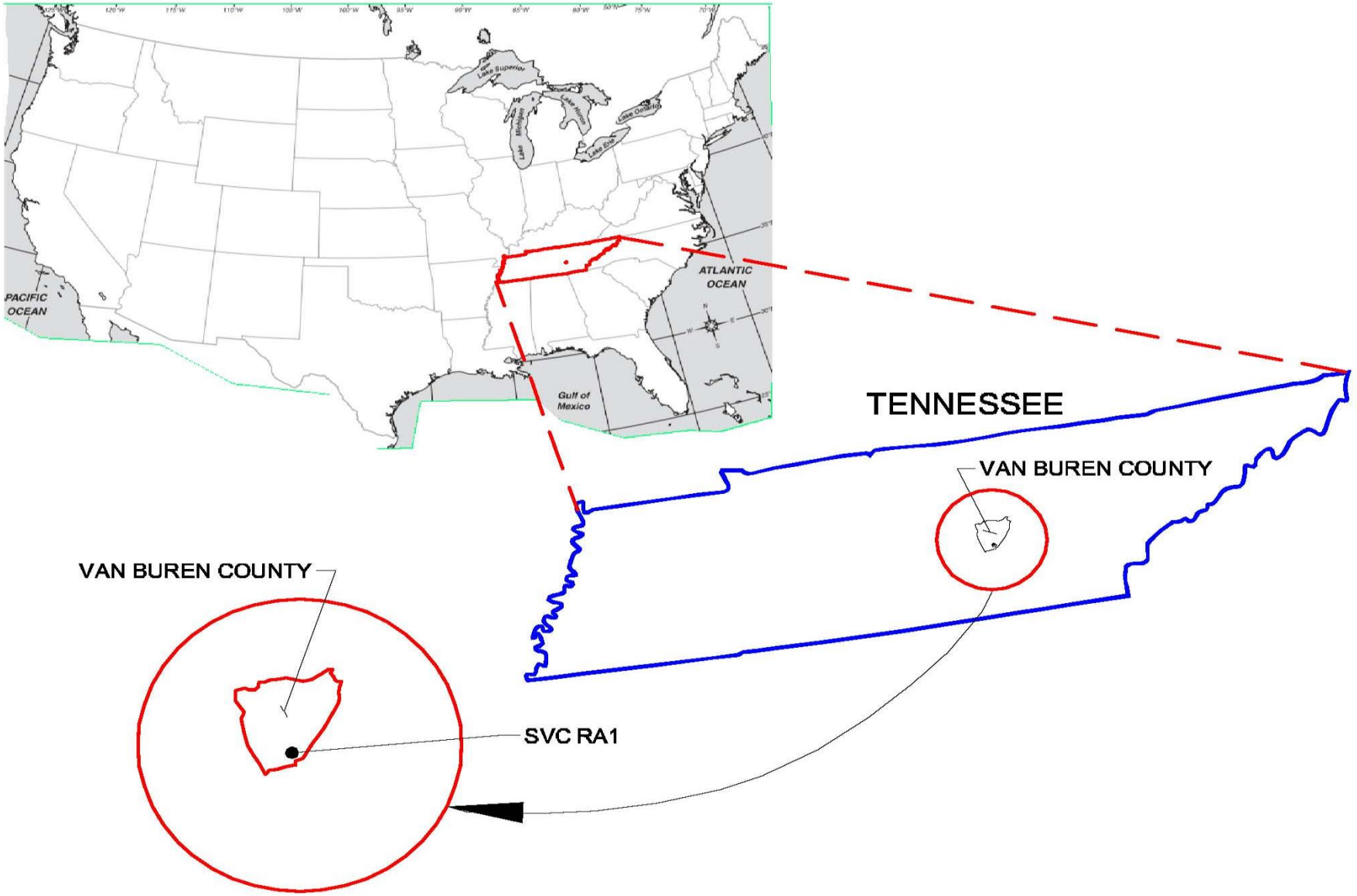
Project Location



Background

- Sequatchie Valley Coal Corporation (SVC)
- Extracted Sewanee coal 1978 to 1982
- Area mine using dragline for overburden
- Mining area covered about 175 acres
- Following reclamation, AMD developed
- Chemical treatment used for 10+ years
  - Over 100,000 gallons of NaOH (Caustic)

NPDES PERMITTING ASSESSMENT

- INITIATED IN 1992
- DETAILED STREAM SURVEY
- EVALUATION OF SITE HYDROLOGY
- REVIEW OF NPDES GUIDELINES
  - TECHNOLOGY BASED
  - REGULATORY BASED
  - WATER QUALITY BASED

NPDES PERMITTING ASSESSMENT

- WORKED WITH TDEC AND ATTORNEYS
- WHOLE EFFLUENT TOXICITY TESTS
- NPDES PERMIT NEGOTIATED
  - pH, IRON, SETTLEABLE SOLIDS
  - ACUTE AND CRONIC TOXICITY TEST

PRECONSTRUCTION ASSESSMENT

- LIMESTONE INCUBATION TESTS 1993
  - PREDICTION OF 360 MG/L ALKALINITY
- PILOT SCALE TEST 1995
  - TEST ALD OF 65 TONS CONSTRUCTED
  - VARIABLE FLOW CONDITIONS APPLIED
  - CONFIRMED ALKALINITY GENERATION
  - DOCUMENTED IN 1996 ASMR PAPER

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
ALD	345	6.2	138
Basin A	175	6.5	42
Basin 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

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

- Documented in ASMR Paper 2001

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

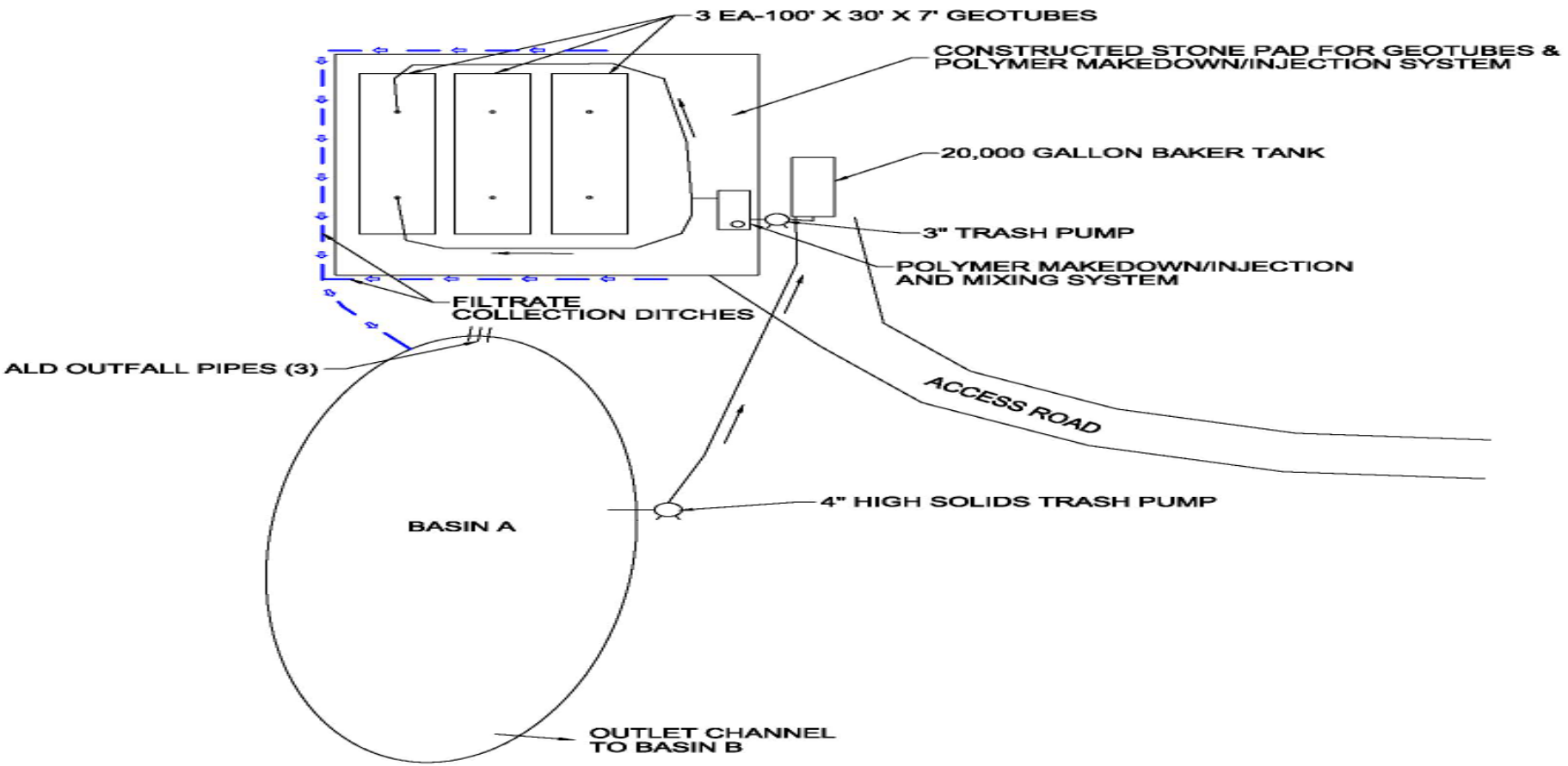
Basin A Sludge Measurement 2007

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

2012 SYSTEM ENHANCEMENTS

- Elimination of one NPDES point
- Combining 2009 and 2005 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
2009 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

2013 System Results Snapshot

Cell	pH	FeT	FeD	MnT	MnD
2009 ALD	6.7	26	8.8	11	6.5
2009 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

Conclusions

- Passive treatment has proven an effective and reliable means of treatment for 20 years
- NPDES permit limits may change and treatment strategy may require adjustment
- NPDES permit limits were continuously met throughout the 20 year period
- O&M including sludge removal is critical to maintaining effectiveness

Questions ?