REINHOLD ENVIRONMENTAL Ltd.

2017 NOx-Combustion-CCR Round Table Presentation

February 27 & 28, 2017, in Cleveland, OH / Hosted by FirstEnergy

Case Studies for Compliance of Pond Closure

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February 27, 2017

Agenda

The presentation will cover the themes and trends of effective pond closure approaches ultimately transitioning into demonstrations of proven examples.

01 What are the Hard Trends (or Future Facts) of CCR Management

02 Compliance Actions

03 Industry Overview

04 Focus on Next Issues for Ponded CCPs

05 Case Studies in Pond Closure

06 Summary

07 Q+A

01

What are the Hard Trends (or Future Facts) of CCR Management

01 What are the Hard Trends (or Future Facts) of CCR Management

What does this mean for the future of CCR Market

CCR will continue to be produced and disposal will be necessary (tending toward dry disposal)

- "No" new impoundments
- Increase in landfills and beneficial use

Beneficial use is a focus, but not an offset to disposal (…yet)

Plant modifications

- Increase in dry conversions
- Improved water management

Surface Impoundments

- Surface impoundments will close
- There will be a major "surge" of impoundment closures over the next 5+ years

Groundwater remediation will be required (primary focus 2018)

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01 What are the Hard Trends (or Future Facts) of CCR Management

Where do we go from here?

Seize the opportunity!

- Anticipate and drive compliance
- Improve CCR management
- Effectively transition away from wet disposal

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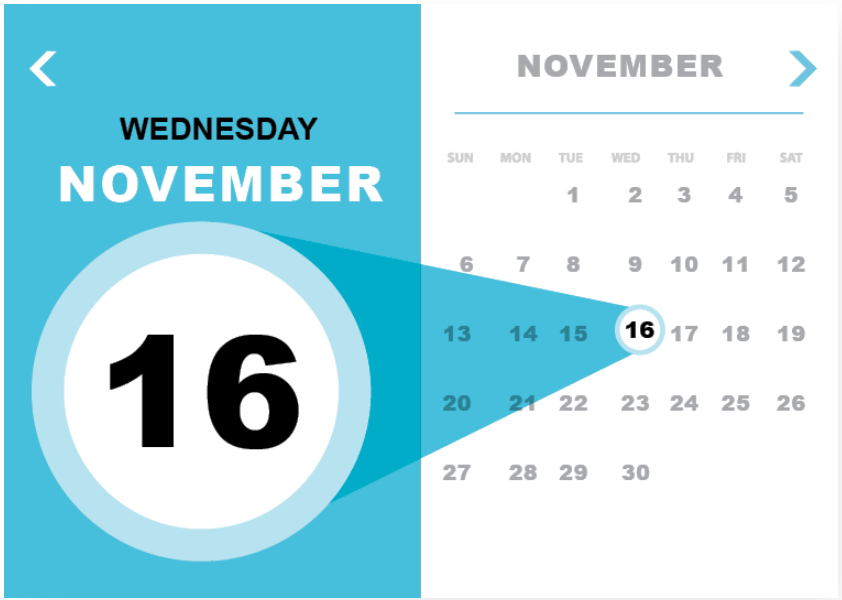
02
Compliance Actions

02 Compliance Actions

Compliance Calendar



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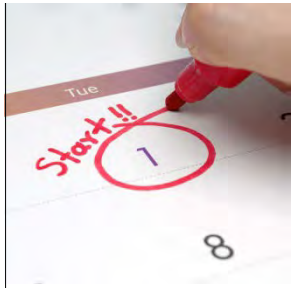
02 Compliance Actions

What's next for compliance?

Take a breath! A huge feat was accomplished



Prepare a 2017 compliance schedule

View Table >

Address reoccurring activities

Submittals resulting from changes to CCR units

Focus on groundwater

Address deficiencies or repairs to maintain compliance

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01 Compliance Actions

What's next for compliance?

< back

Compliance Date	Activity	Reference (40 CFR 257)	
November 16, 2016	For all certification and compliance reporting entered into the operating record, the information needs to be posted to the CCR website	257.107	30 days after posting to Operating Record (might be earlier)
December 19, 2016	Update Fugitive Dust Control Plan	257.80	14 months after the initial plan was posted to the operating record
January 19, 2017	Annual inspection report	257.83	One year after initially posted to the operating record
April 17, 2017	Prepare an emergency action plan	257.73	
October 17, 2017	− Investigate the hydrogeological setting − Install the groundwater monitoring system − Develop the groundwater sampling and analysis plan − Conduct baseline monitoring to establish background levels (8 events minimum) − Initiate the detection monitoring program and begin evaluating the groundwater monitoring data for statistically significant increases over background levels	257.90 – 257.98	
December 19, 2017	Update Fugitive Dust Control Plan	257.80	Annually
January 19, 2018	Annual inspection report	257.83 (certification not required)	One year after initially posted to the operating record

02 Compliance Actions

What's next for compliance?

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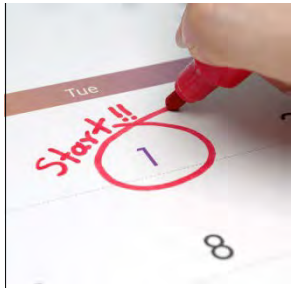

Prepare a 2017 compliance schedule

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03
Industry Overview

03 Industry Overview

How many are there?

Based on the 2009 Survey

- Based on revised data in 2012
- 653 Impoundments
- >32,000 acres or 50 square miles

- *Disney World is approx 47 mi^2*

Based on the 2017 Websites

- Based on publically available information
- 497 Impoundments
- >22,000 acres or 35 square miles
- *35 square miles is slightly bigger than St Thomas Island (31.2 mi^2)*
- Reduction of ~25% in number and ~30% in area
  - Definitions in final rule
  - Closed ponds

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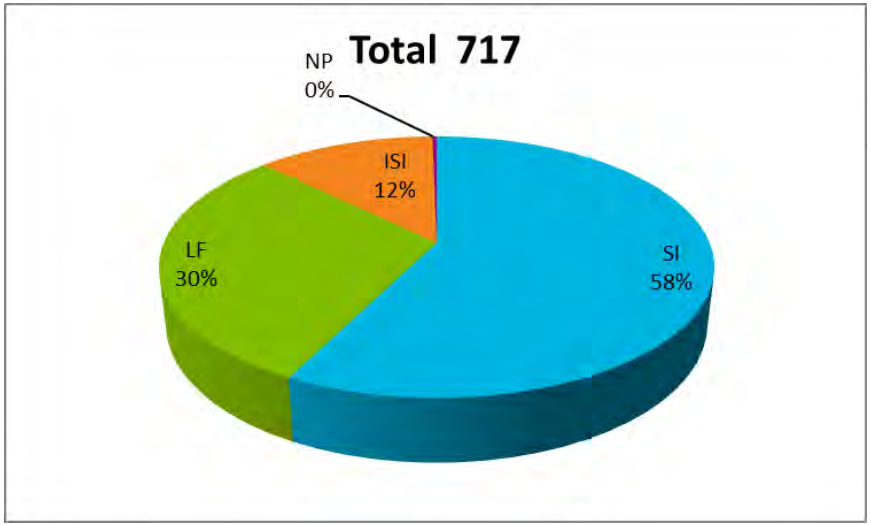
03 Industry Overview

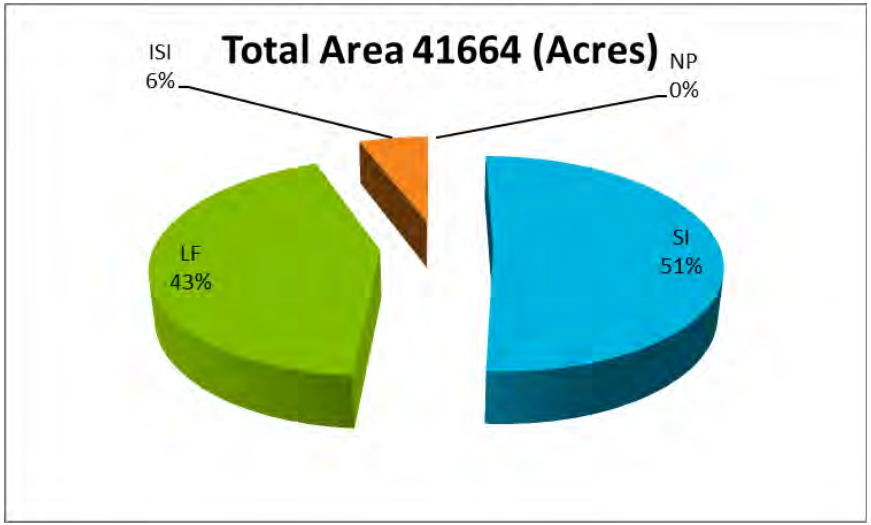
Types of Impoundments

But did you know…

- 82 Inactive SI (2,200 acres) … 415 Existing SI (20,000 acres) … 214 Landfills (17,800 acres)



Types of Impoundments reported



Total Area of Impoundments by type

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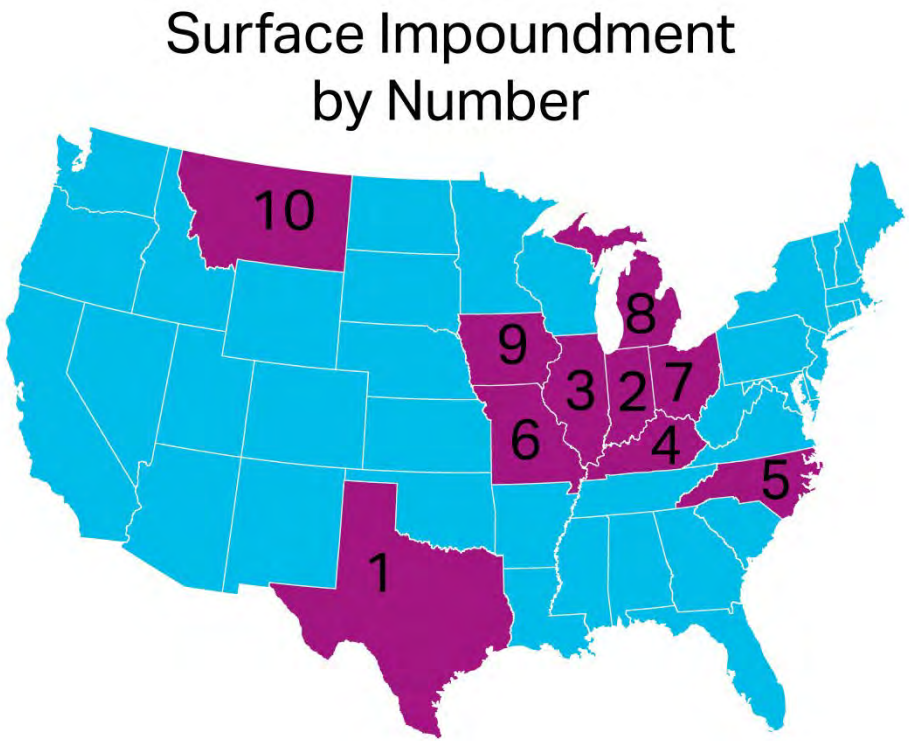
03 Industry Overview

How many are there?



Rank	State	Count
1	Texas	38
2	Indiana	35
3	Illinois	31
4	Kentucky	26
5	North Carolina	25
6	Missouri	22
7	Ohio	22
8	Michigan	21
9	Iowa	17
10	Montana	15

- Heavy focus in the Midwest based on number.

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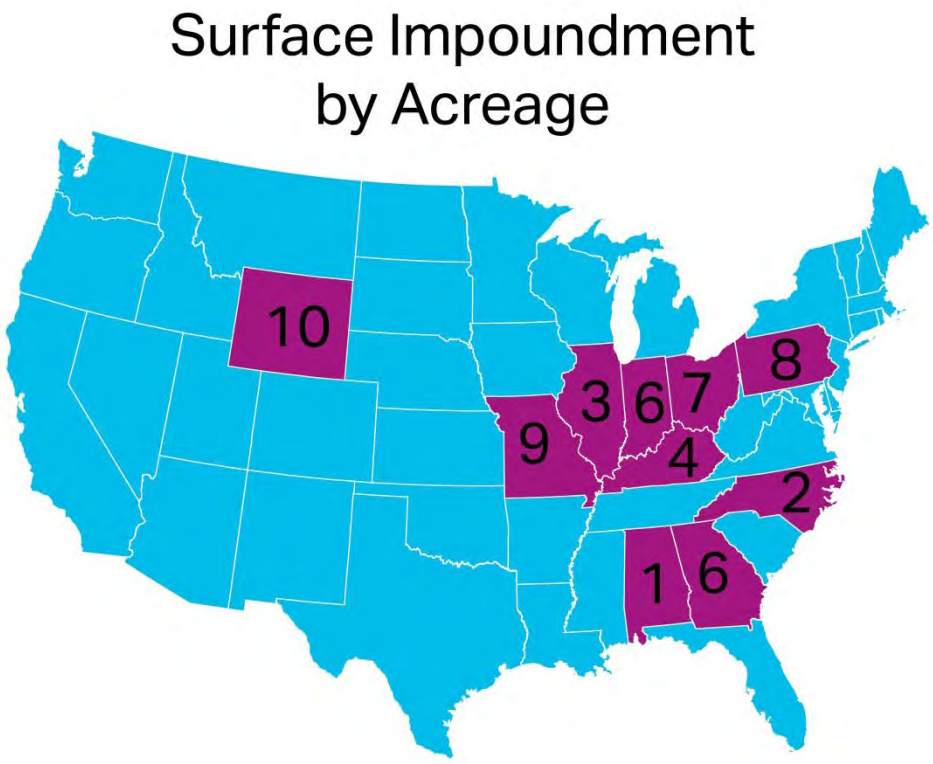
03 Industry Overview

How many are there?



Rank	State	Approx Acres
1	Alabama	2300
2	North Carolina	2000
3	Illinois	1460
4	Kentucky	1410
5	Georgia	1390
6	Indiana	1250
7	Ohio	1200
8	Pennsylvania	1180
9	Missouri	890
10	Wyoming	870

- Heavy focus in the Midwest again.
- Note that Texas and other states dropped off…many but relatively small ponds.

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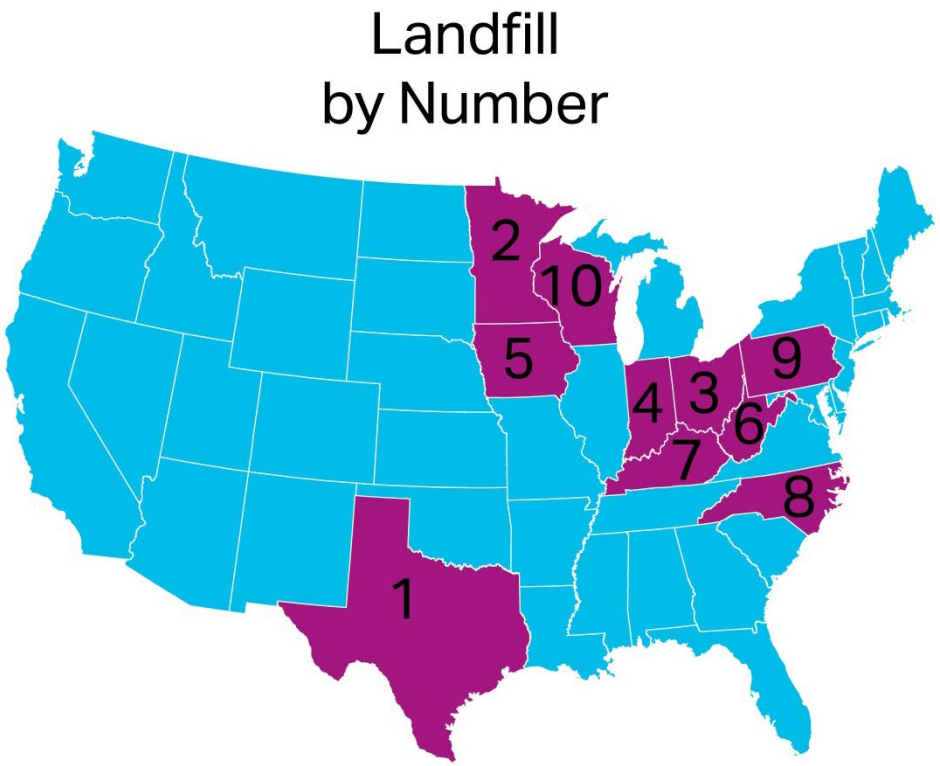
03 Industry Overview

How many are there?

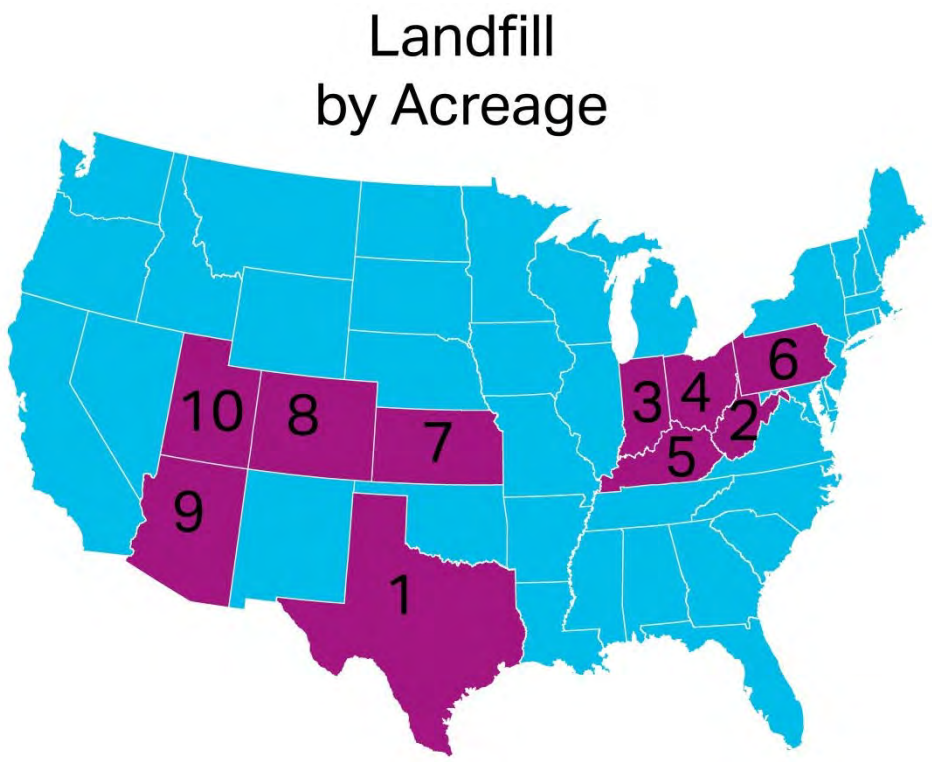


Rank	State	Count
1	Texas	14
2	Minnesota	11
3	Ohio	11
4	Indiana	9
5	Iowa	9
6	West Virginia	9
7	Kentucky	8
8	North Carolina	8
9	Pennsylvania	8
10	Wisconsin	8

- Heavy focus in the Midwest based on number and Texas.

03 Industry Overview

How many are there?



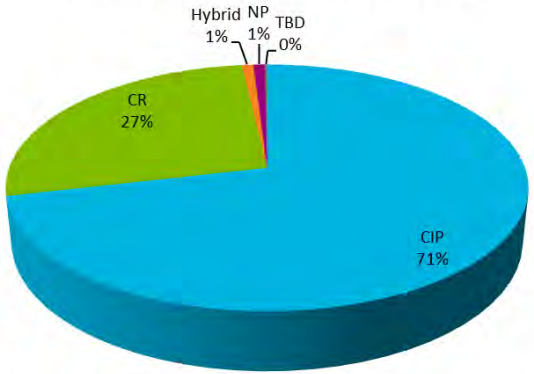
Rank	State	Approx Acres
1	Texas	2330
2	West Virginia	1430
3	Indiana	1250
4	Ohio	1060
5	Kentucky	970
6	Pennsylvania	920
7	Kansas	810
8	Colorado	750
9	Arizona	730
10	Utah	700

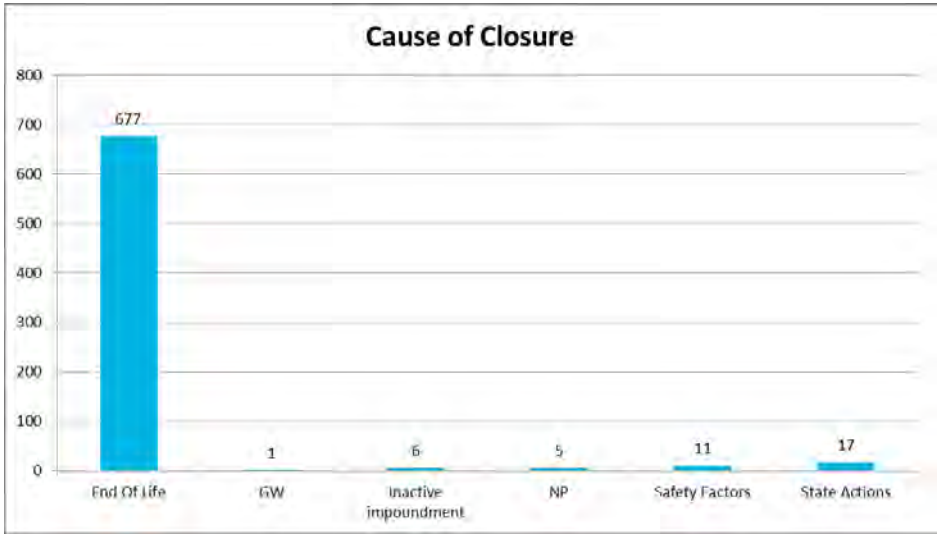
- Heavy focus in the Midwest again.
- But the southwest shows a strong landfill footprint.

03 Industry Overview

How many are there?

How are they closing?





Only 11 impoundments are closing due to missed safety factors!

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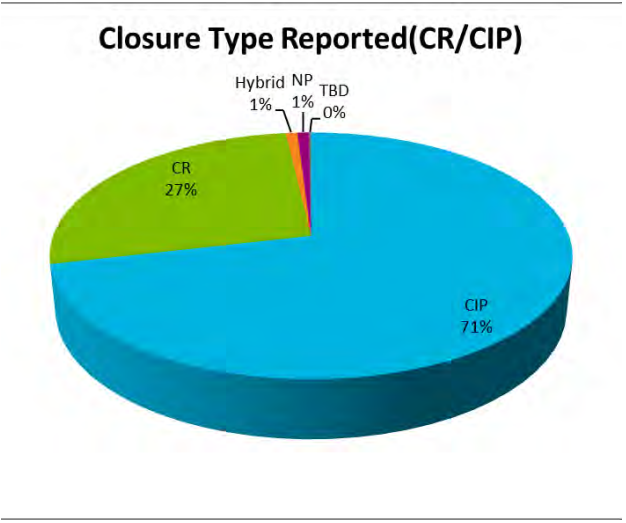
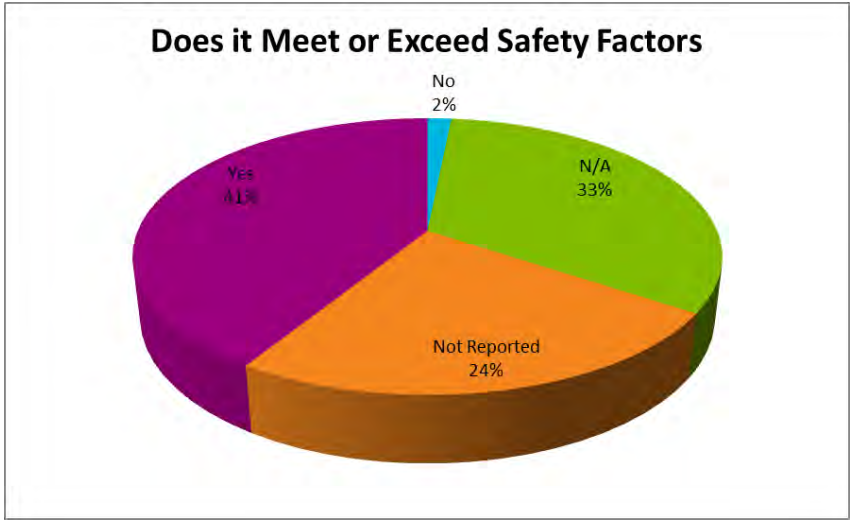
03 Industry Overview

How many are there?

How are they closing?





That is 2% of impoundments that are closing due to safety factors!

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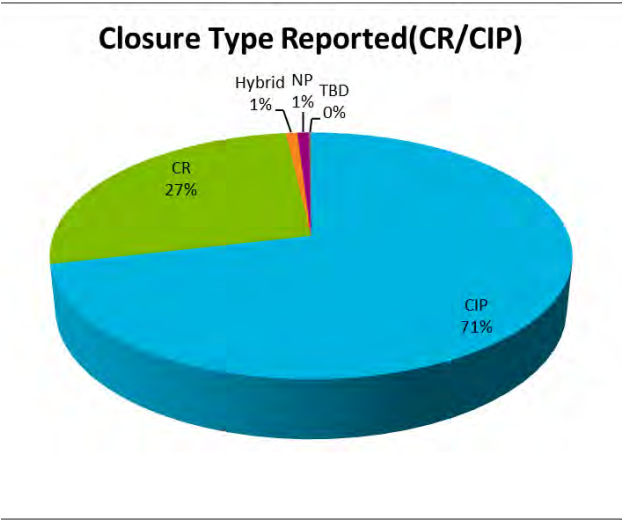
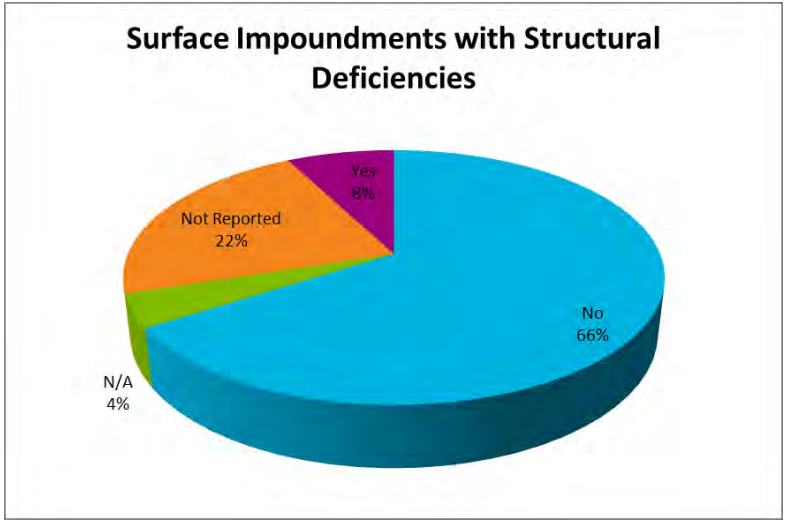
03 Industry Overview

How many are there?

How are they closing?





Only 8% of surface impoundments have noted deficiencies!

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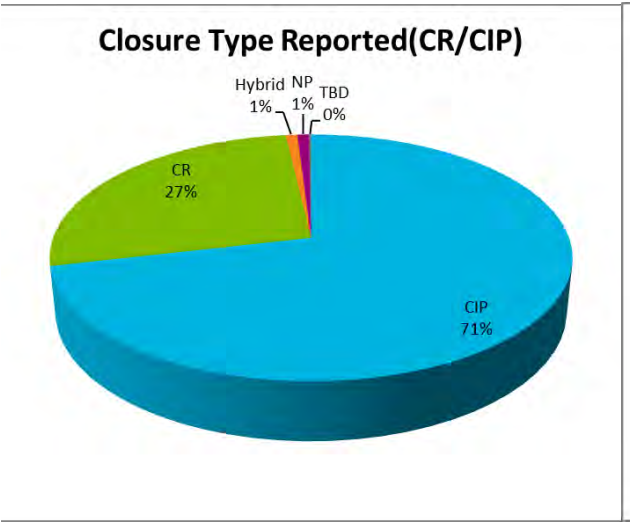
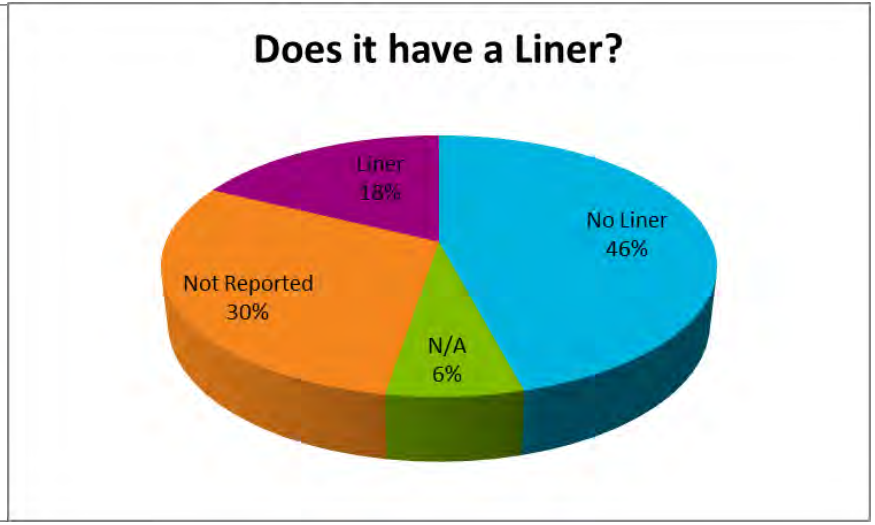
03 Industry Overview

How many are there?

How are they closing?



But are they lined?



Only 18% of surface impoundments are certified as lined!

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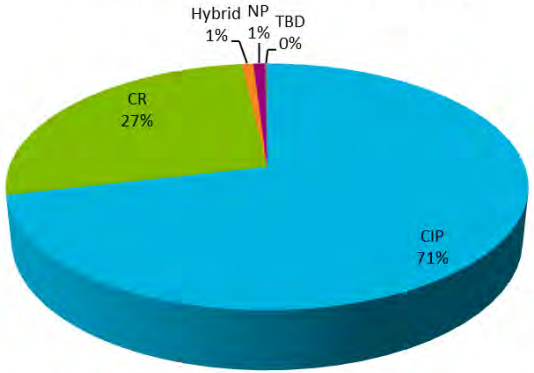
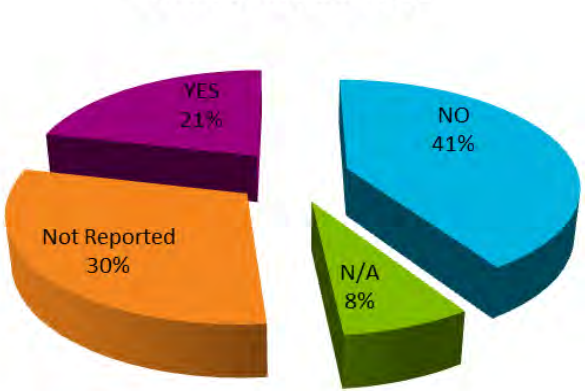
03 Industry Overview

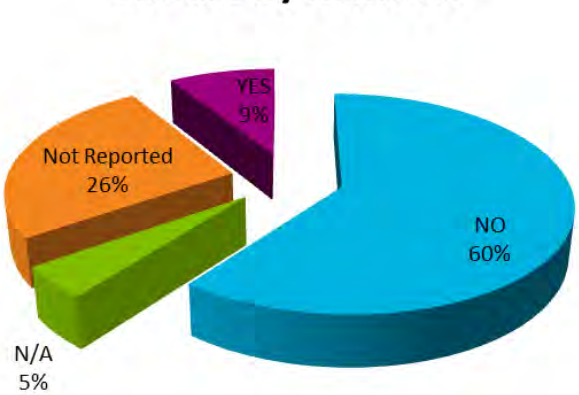
How many are there?

How are they closing?



But are they lined?





Majority of the closure by removal units are for unlined ponds.

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04

Focus on Next Issues for Ponded CCPs

04 Focus on Next Issues for Ponded CCPs

Closure of Existing Surface Impoundments (I) & Landfills (L)

(L) (I) 1 Known final receipt of waste or final removal of CCR for beneficial use

- Owner must initiate closure of the CCR unit within 30 days

(L) (I) 2 Two years after most recent receipt of CCR or removal of CCR for beneficial use for idled CCR units with remaining capacity

- Owner must initiate closure of the CCR unit within 2 years

3 CCR unit fails to meet any of the following technical criteria:

- (I) Within 18 months of publication date - owner cannot demonstrate minimum factors of safety regarding structural integrity of CCR unit
- (I) Within 30 months of publication date - **unlined** CCR unit is found to contaminate groundwater in excess of a ground water protection standard; or
- (L) (I) Within 42 months of publication date – it is determined the CCR unit cannot meet the applicable location criteria (i.e., has been sited inappropriately)

- Owner must initiate closure of the CCR unit within 6 months

Timing

Impoundments – 5 years to complete closure with 2-year extensions possible

Landfills – 6 months to complete closure with up to two, 1-year extensions possible

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04 Focus on Next Issues for Ponded CCPs

Overview of the process

Key Considerations

What is the goal?

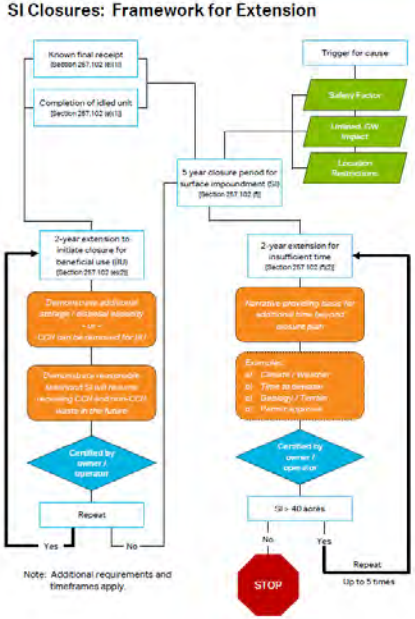
- Prolong operating life
- Extend closure period

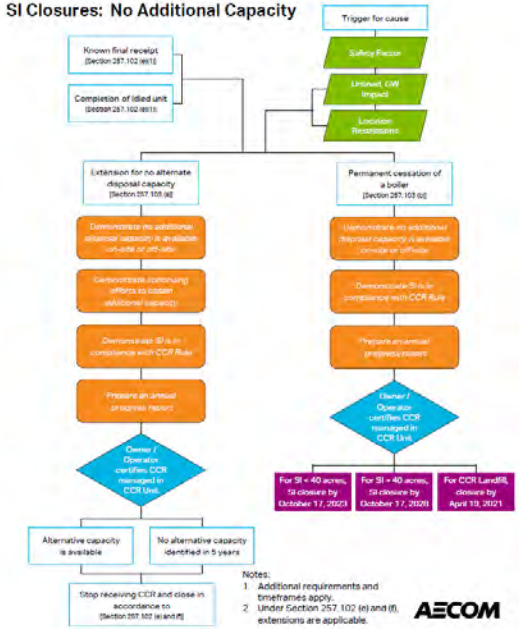
Is the impoundment operating?

- Non-CCR waste streams
- Beneficial use

What is the cause for closure (with respect to the closure triggers)?

- End of life
- Closure for cause (which one)





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04 Focus on Next Issues for Ponded CCPs

Review overall approaches and seek ways to improve

Review compliance calendar

Review approach to closure (contractor)

Consider interaction with ELG rules

Operational improvements

Review overall approaches and seek ways to improve

Review compliance calendar

Review approach to closure (contractor)

Consider interaction with ELG rules

Operational improvements

04 Focus on Next Issues for Ponded CCPs

Value Engineering

Costs
- Evaluate Costs
- Reassess Cash Flow

Schedules
- Accelerate closure
- Consider impact to other activities

Innovative and creative solutions
- Assess different cap systems
- Evaluate grading and closure approach
- Evaluate alternative below cap fill materials
- Consider moving ash before or during operations
- Operate to close
- Stockpile material for later beneficial use

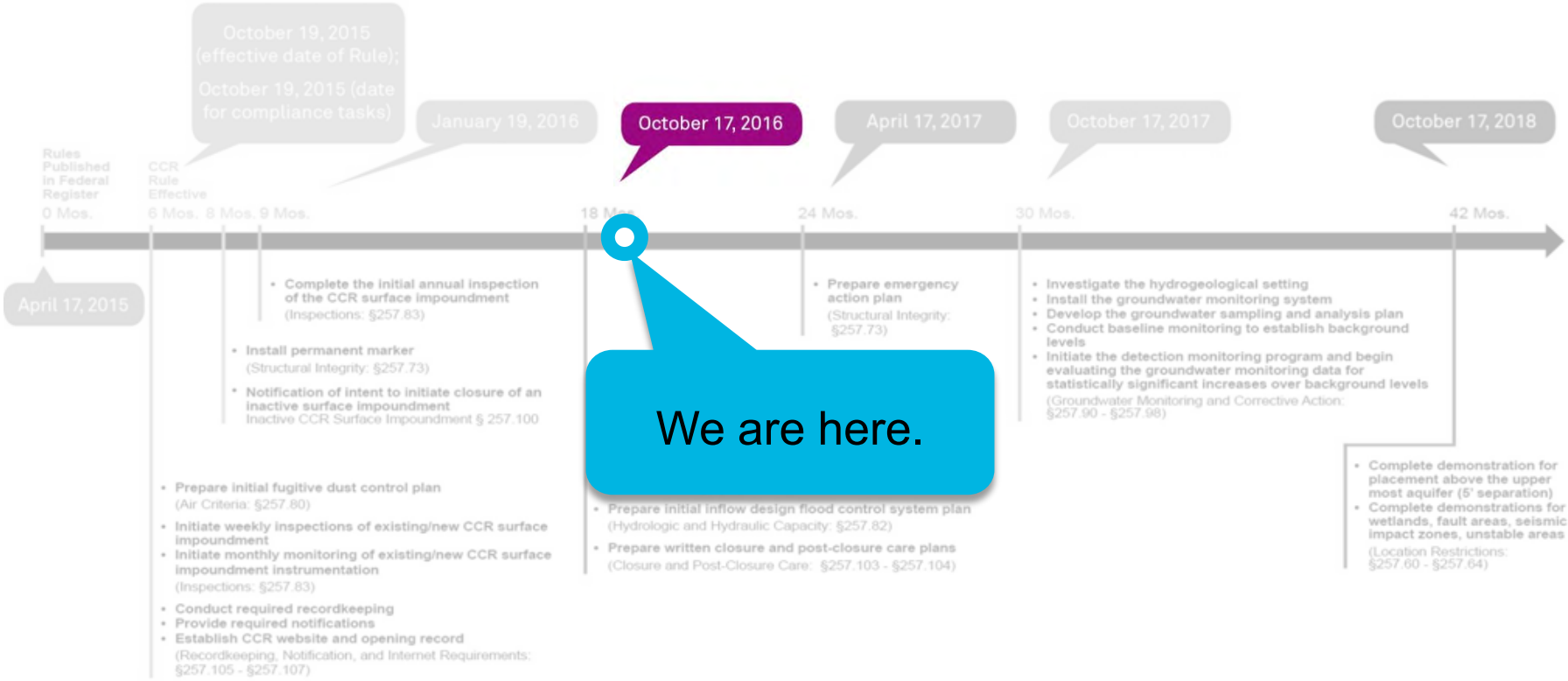
(Re)Assess Strategy

Evaluate other compliance requirements with other agencies

Save money – beneficiate and increase ash marketing
- Assess new applications
- Consider beneficiation
- Measurable goals through corporate policies
- Subsidize beneficial use

Overall strategy improvements
- Optimize plant operations
- Seek major improvements with minor efforts

04 Focus on Next Issues for Ponded CCPs



Review overall approaches and seek ways to improve | **Review compliance calendar** | Review approach to closure (contractor) | Consider interaction with ELG rules | Operational improvements

04 Focus on Next Issues for Ponded CCPs

Prequalify contractors

Define overall approach

Contracting mechanism

(target price, integrated delivery, etc)

Integrate with design

(and incorporate construction reviews)

Ponded ash dewatering

Review overall approaches and seek ways to improve

Review compliance calendar

Review approach to closure (contractor)

Consider interaction with ELG rules

Operational improvements

04 Focus on Next Issues for Ponded CCPs

Review plans and verify they comply in scope and schedule

Assess for improved solutions

Consider if changes need to be documented in compliance documents

04 Focus on Next Issues for Ponded CCPs

Comply with the compliance requirements

Improve consistency in the fleet

Improve operations to avoid “mis-management of CCRs” (Site audits)

Develop O&M Manuals

Training of staff

Review overall approaches and seek ways to improve

Review compliance calendar

Review approach to closure (contractor)

Consider interaction with ELG rules

Operational improvements

04 Focus on Next Issues for Ponded CCPs

Surface water

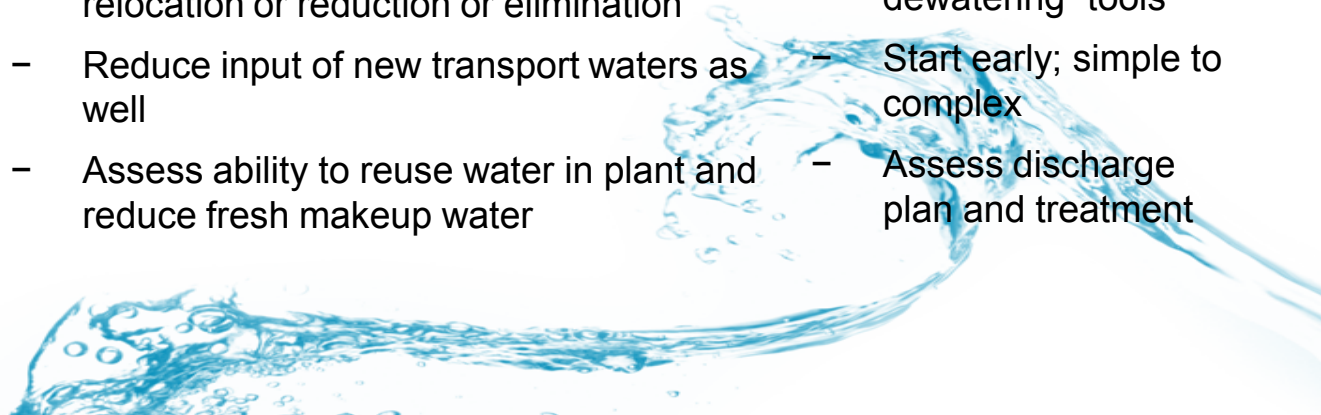
- Develop plans to reduce inflow of surface water
- Discuss methods to address
  - Redirect
  - Collect and discharge
  - Other

Free water

- Need to lower and remove
  - Optimize plant's water balance
  - Assess NPDES permit
  - Other means of removal (POTW, Treatment, etc.)
- Assess additional low volume waste water streams and begin plans for relocation or reduction or elimination
- Reduce input of new transport waters as well
- Assess ability to reuse water in plant and reduce fresh makeup water

Pore water

- Dewatering plans needed, develop an approach
- Assess site conditions and response to dewatering "tools"
- Start early; simple to complex
- Assess discharge plan and treatment



04 Focus on Next Issues for Ponded CCPs

Assess current practices (with on site visit)

- Identify/verify containerized CCR pile(s)
- Avoid storage of CCRs
- If CCR is a “product”, establish written guidelines to not invalidate the approach
- Establish procedures for dealing with off spec material

Explore new options

(ponded or new material)

- Improve the quality and consistency
- Assess market demand
- Evaluate other benefits (REE)

Complete the BU documentation as “required” by the rule

04 Focus on Next Issues for Ponded CCPs

Begin assessing anticipated results

Evaluate remediation alternatives

Consider early technical, legal and other factors

Get Prepared!

04 Focus on Next Issues for Ponded CCPs

Identify a core response team

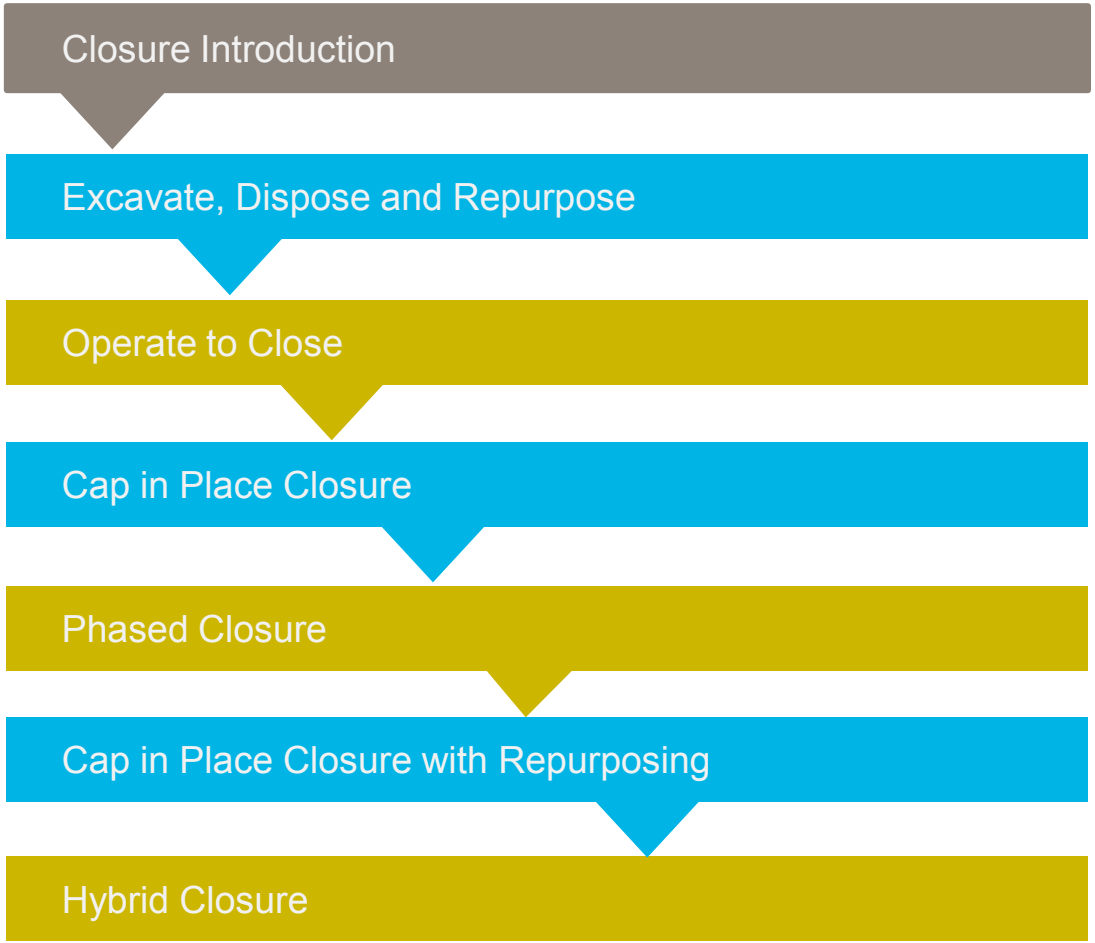
Assess risk to determine management approach

Monitor actions/activities of others

05

Case Studies in Pond Closure

Case Studies in Pond Closure



Focus on effective and efficient solutions that integrate innovative approaches to pond closure projects.

Ash is Unique

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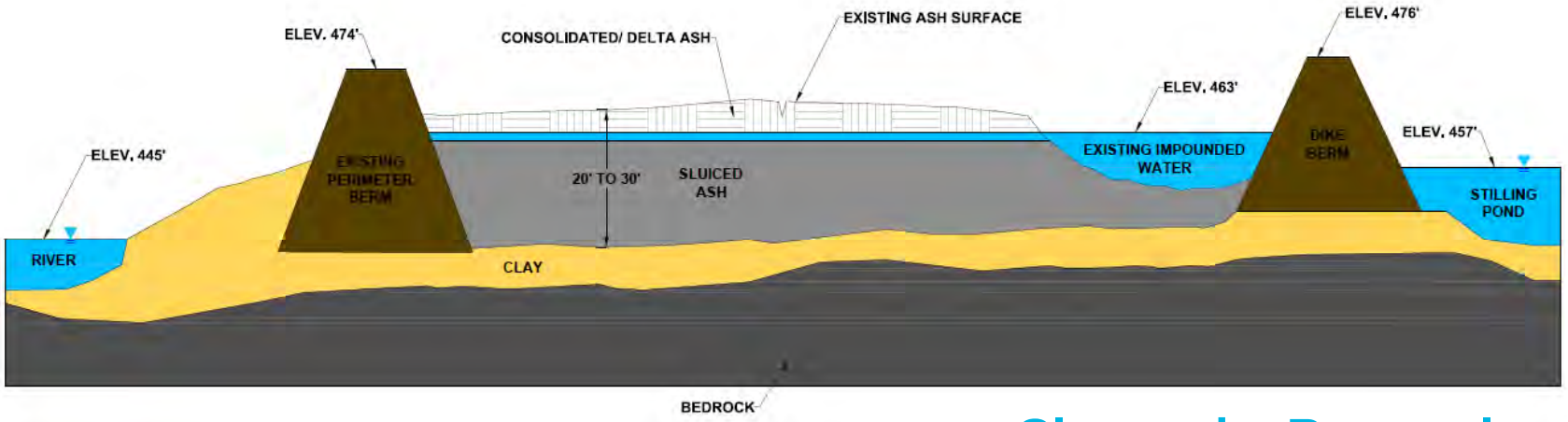
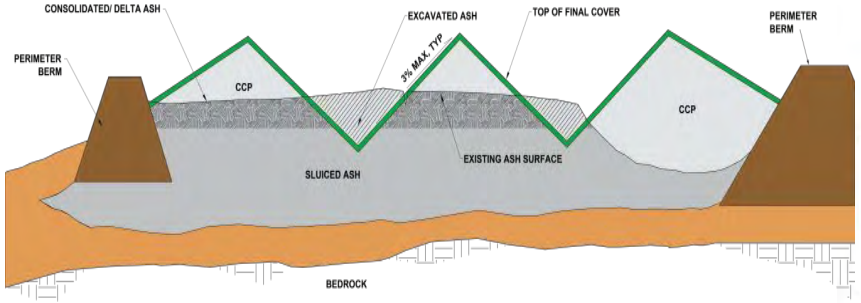
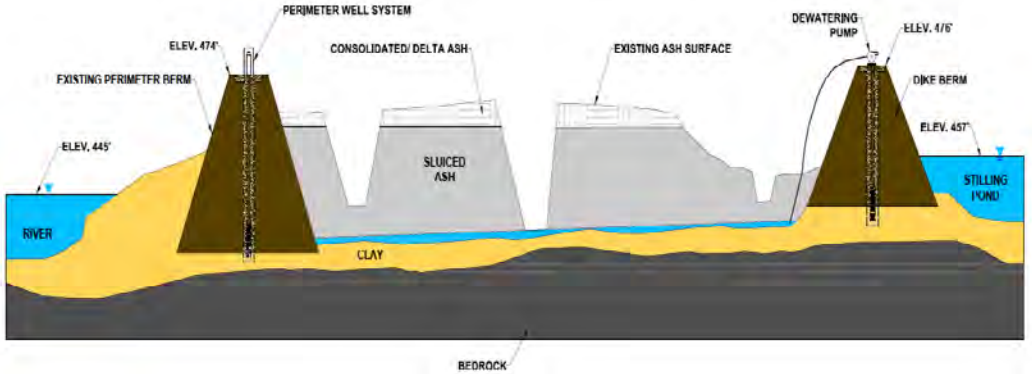
Cap in Place/Closure by Removal



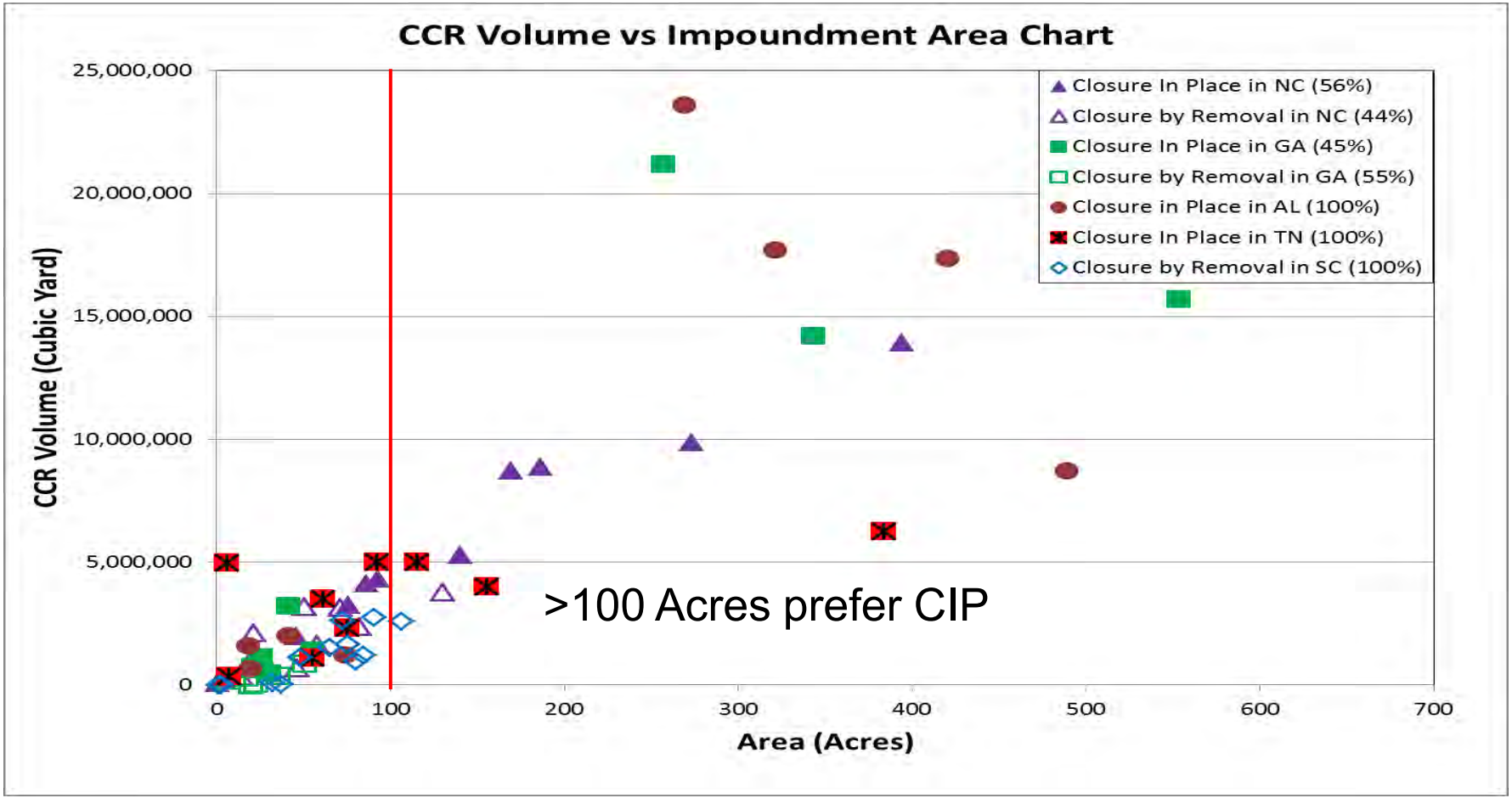
Cap In Place



Closure by Removal

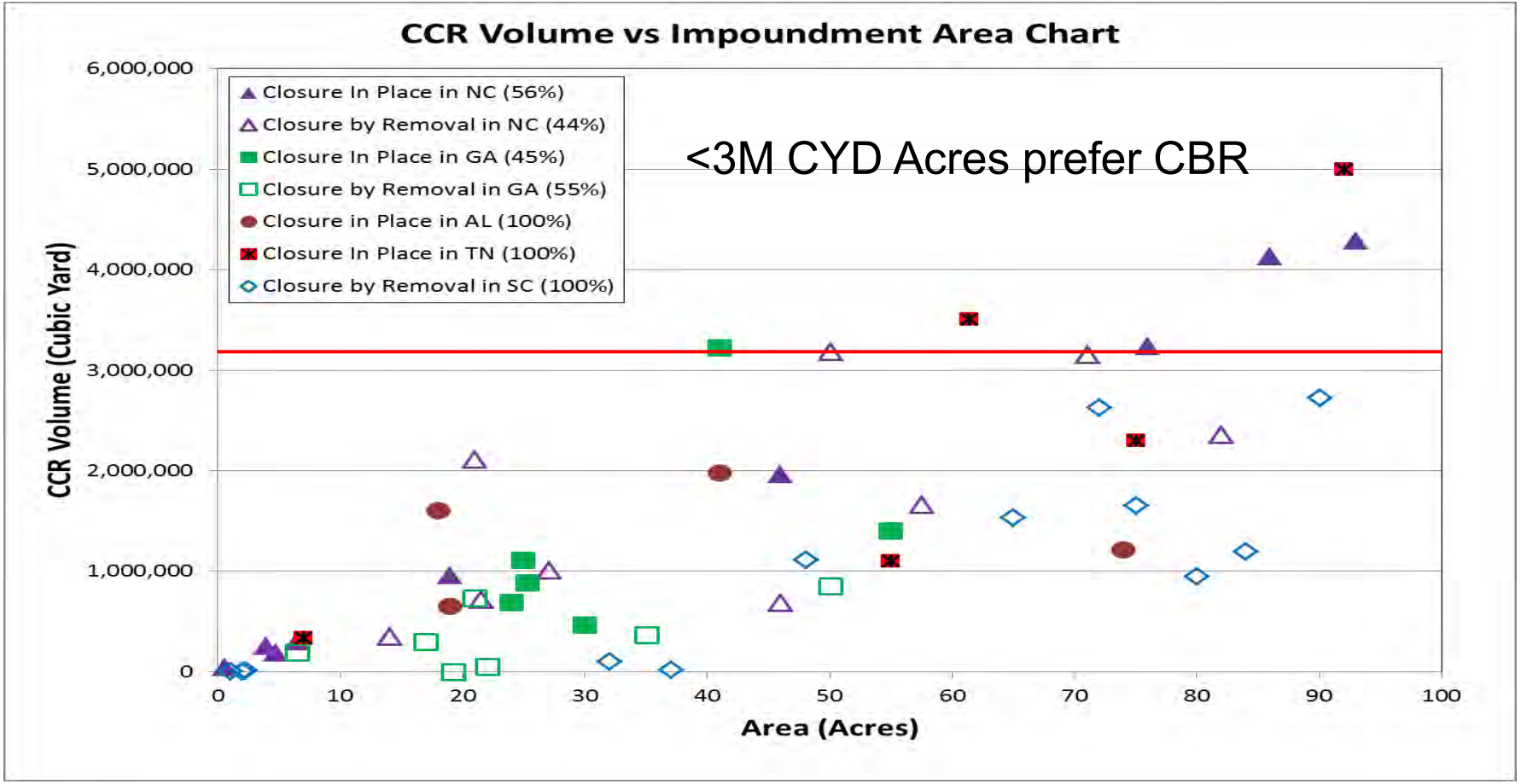


Cap in Place/Closure by Removal



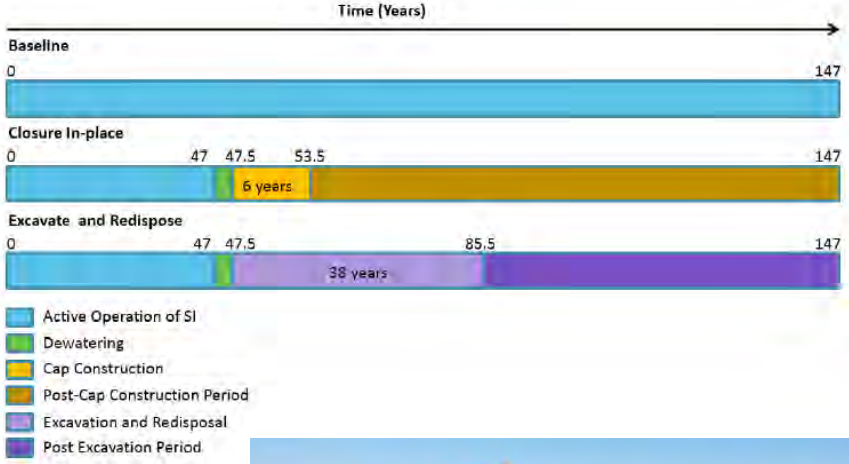
Cap in Place/Closure by Removal

Less Than 100 Acres



Closure Schedule Comparison

400 Acre Pond Typical Schedules



DESCRIPTION	ESTIMATED SCHEDULE
Excavation - Lined Onsite Disposal in Ponds	20 - 25 years
Excavation - Onsite Landfill Expansion	20-25 years
Excavation – Offsite Disposal	20 years
Footprint Reduction	10-15 years
Cap in Place Closure	7 - 10 years

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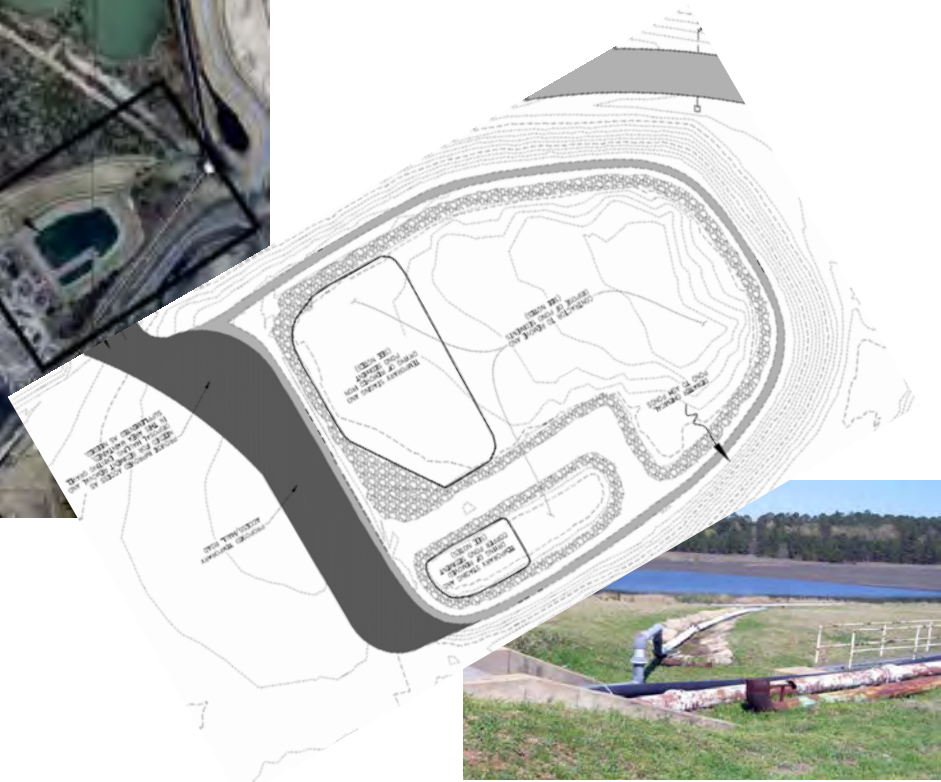
05 Case Studies in Pond Closure

Project Background

Pond Details
- Inactive Pond
- 3.5 Acre Chemical Pond
- 20 ft high dikes
- Shallow rock below pond

Pond Constituents
- Non-CCR waste streams
- Stormwater holding pond
- Metals impacted soils

Closure Drivers
- Reuse of footprint
- Inactive facility

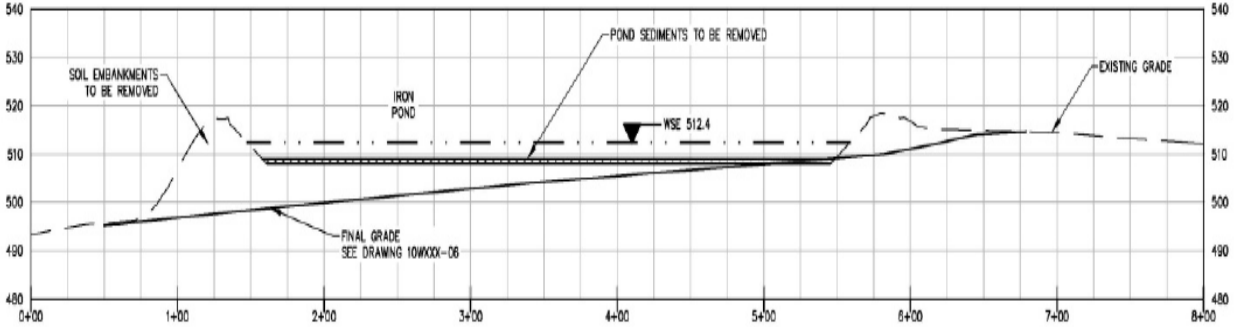


05 Case Studies in Pond Closure

Project Execution

How was it done?

- Free water pumped to Ash Ponds
- Impacted sediment maintained in footprint
- Sediment treated with lime for hauling
- Sediment transported to on-site landfill (9K cyd)
- 20 ft excavation to remove pond
- Removal of earthen dikes (90K cyd)
- Controlled blasting to remove rock (50K cyd)



05 Case Studies in Pond Closure

Project Summary

What were the results?

- Site suitable for constructing future CCR related facility
- Project cost of $3M, $850K/Acre
- Without separate staging area, drying additives required for hauling

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05 Case Studies in Pond Closure

Project Background

Pond Details

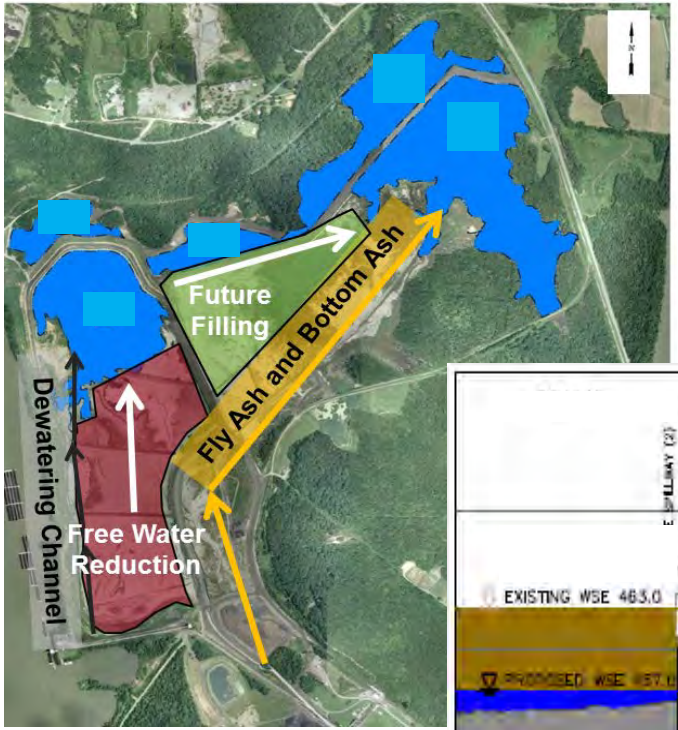
- Active Ash Pond
- 140 Acre Pond
- 20-30 ft high dikes

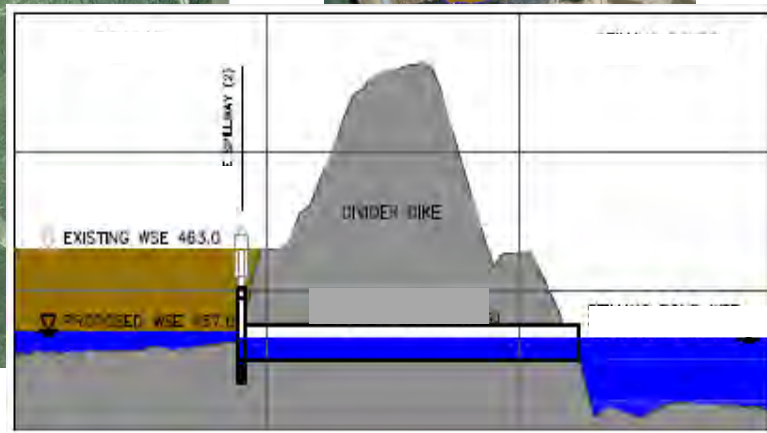
Pond Constituents

- 5M cyd Fly Ash and Bottom Ash
- 20+ Acres of ponded water
- Approximately 26M gallons

Closure Drivers

- Conversion to dry handling
- CCR Rule compliance



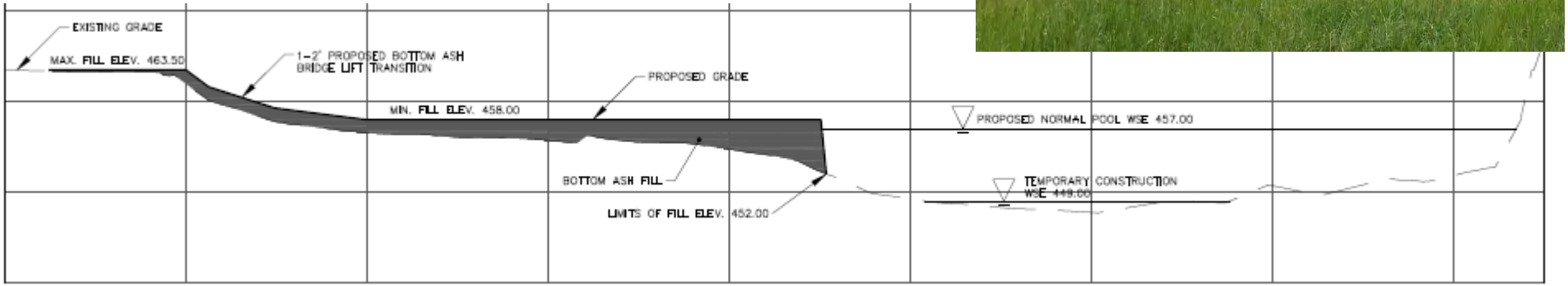


05 Case Studies in Pond Closure

Project Execution

How was it done?

- Free water pumped from Pond to current pond system
- Existing spillway modified for stormwater management
- Bottom ash access roads
- Erosion control measures

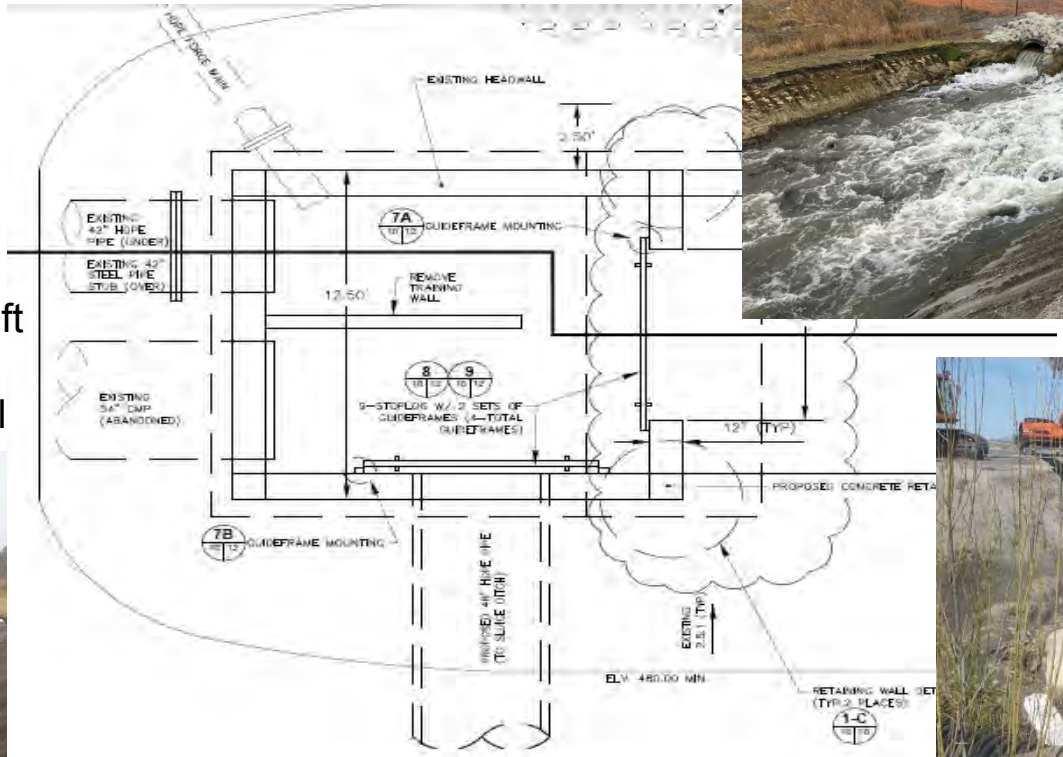


05 Case Studies in Pond Closure

Project Execution

How was it done?

- Existing flows diverted to ash pond
- Modified sluice trenches
- Pond pumped down at 1 ft per day
- Additional erosion control



05 Case Studies in Pond Closure

Project Summary

What were the results?

- Conducted as part of normal pond operations
- Bottom ash fill utilized to bridge soft ash areas
- Project cost of $1M, $7K/Acre
- Pond ready to initiate closure
- Effective stormwater management to prevent ash movement

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05 Case Studies in Pond Closure

Project Background

Pond Details

- Inactive Ash Ponds
- 68 Acres of Delta Ash
- 10 Acres of Open Pool

Pond Constituents

- Approx. 2M cyd Fly Ash
- 10-15 ft high dikes between active pond

Closure Drivers

- Conversion to dry handling
- Stormwater Management/ Maintenance

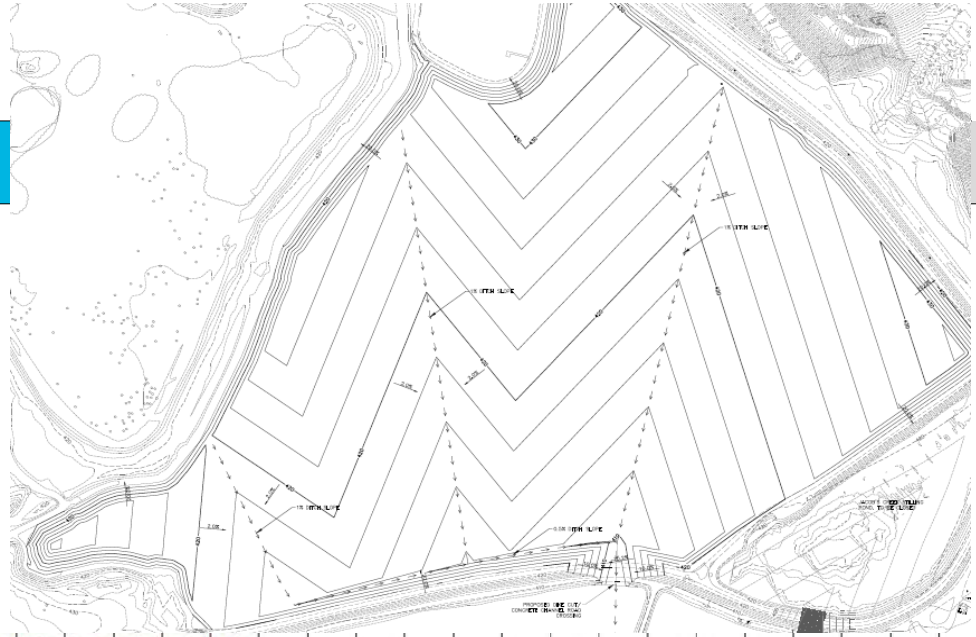
05 Case Studies in Pond Closure

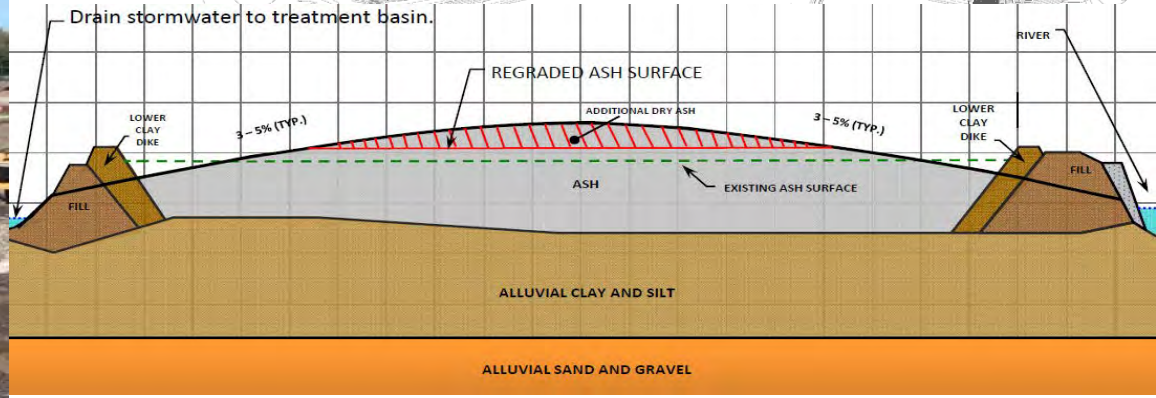
Excavate, Dispose and Repurpose	Operate to Close	**Cap in Place**

Project Execution

How was it done?

- Free water pumped to Ash Ponds
- 1M cyd fill
- Minimal excavations of 15K cyd
- 2% grades, 1% ditches
- Concrete/Rip rap spillways





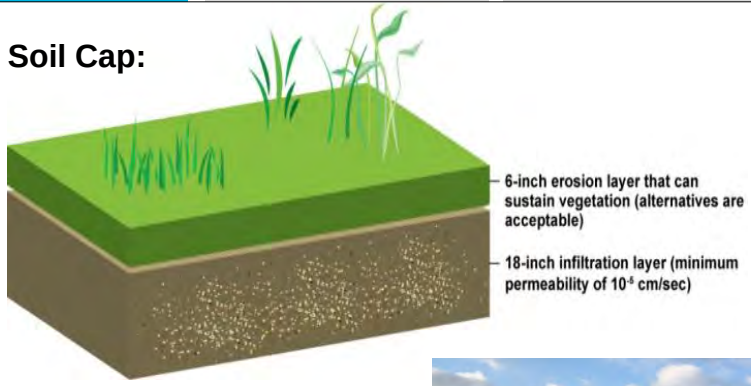
05 Case Studies in Pond Closure

Project Summary

What were the results?

- Addressed long-term maintenance needs
- Areas of concentrated flow required concrete lining over TRM
- Underdrains required at roadway crossings
- Project cost of $5.5M, $70K/Acre

Soil Cap:



05 Case Studies in Pond Closure

Project Background

Pond Details

- Inactive Pond
- 75 Acre Stack
- Up to 30 ft high dikes with slopes of 1.5:1 to 2.5:1

Pond Constituents

- Predominantly Fly Ash
- 115 ft high stack, 4:1 Slopes, terraces every 20 ft

Closure Drivers

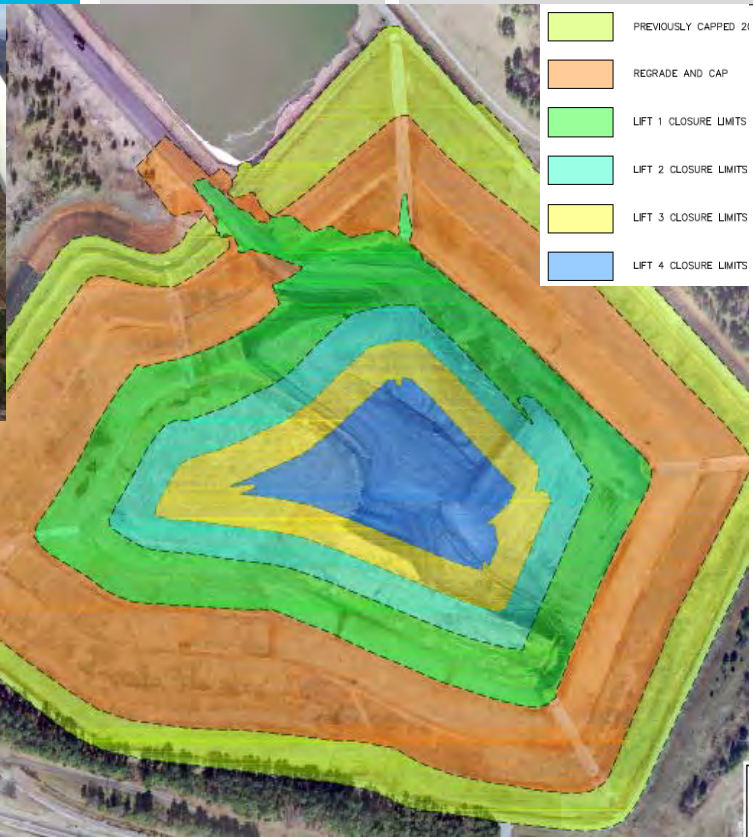
- Improve stability
- Facility closure
- Maintenance

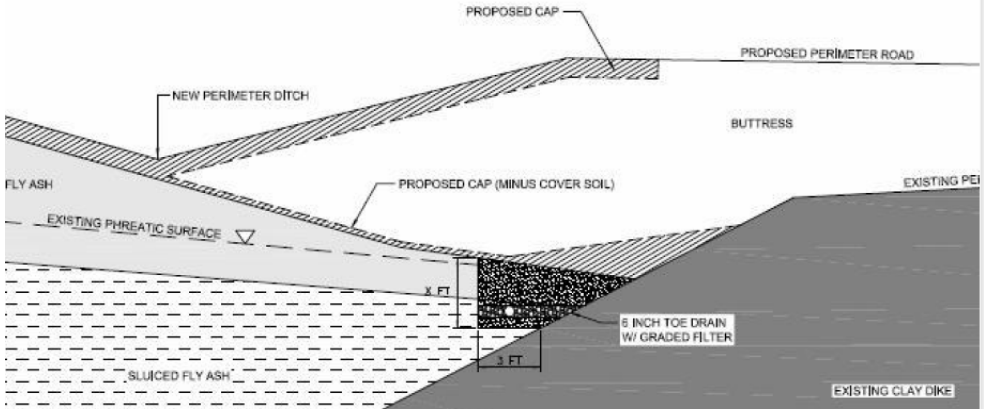
05 Case Studies in Pond Closure

Project Execution

How was it done?

- 3 construction seasons in 4 closure lifts
- Regrading of existing ash
- Seepage/drainage improvements prior to capping



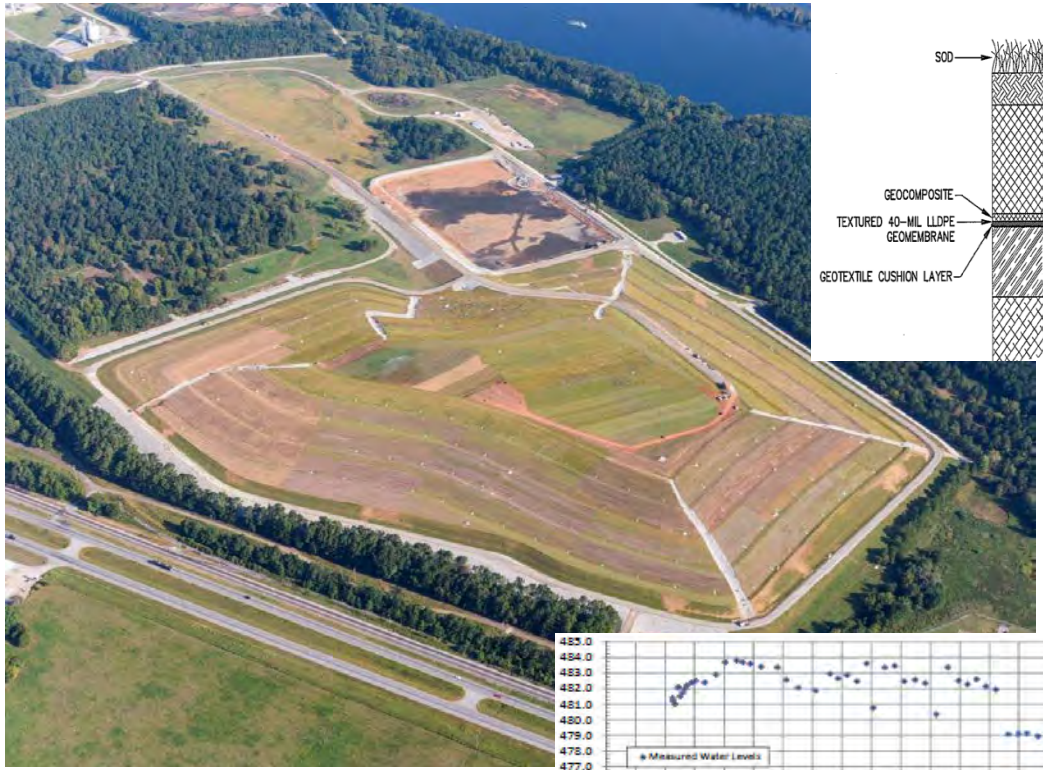


05 Case Studies in Pond Closure

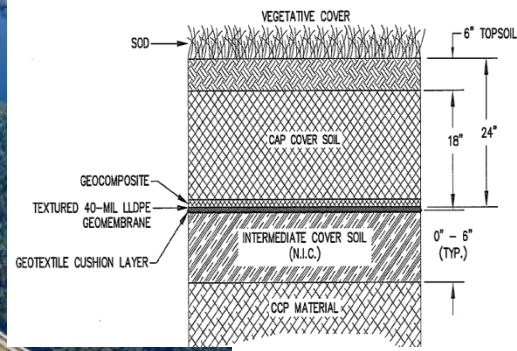
Project Summary

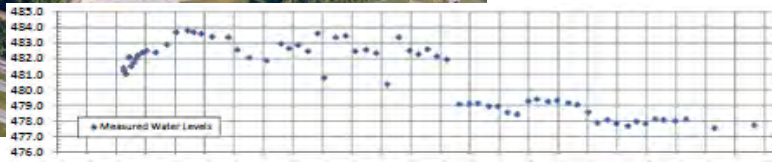
What were the results?

- Addressed long-term maintenance needs
- Reduced infiltration/phreatic levels
- Closure cost of $12M, $160K/Acre
- Seepage and Drainage Improvements $5M
- Several unique challenges associated with stack closure
  - Working bottom up
  - Soil entering liner
  - Extreme temperatures



Geomembrane Cap with Soil Cover:





04 Case Studies in Pond Closure

Project Background

Pond Details
- Inactive Pond
- 32 Acre Stack
- Sluicing channel
- No open pool in stack area

Pond Constituents
- Predominantly stockpiled Fly Ash

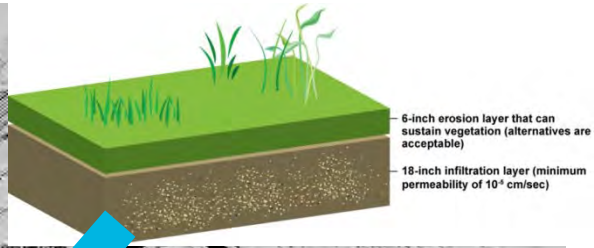
Closure Drivers
- Dry conversion
- Maintenance

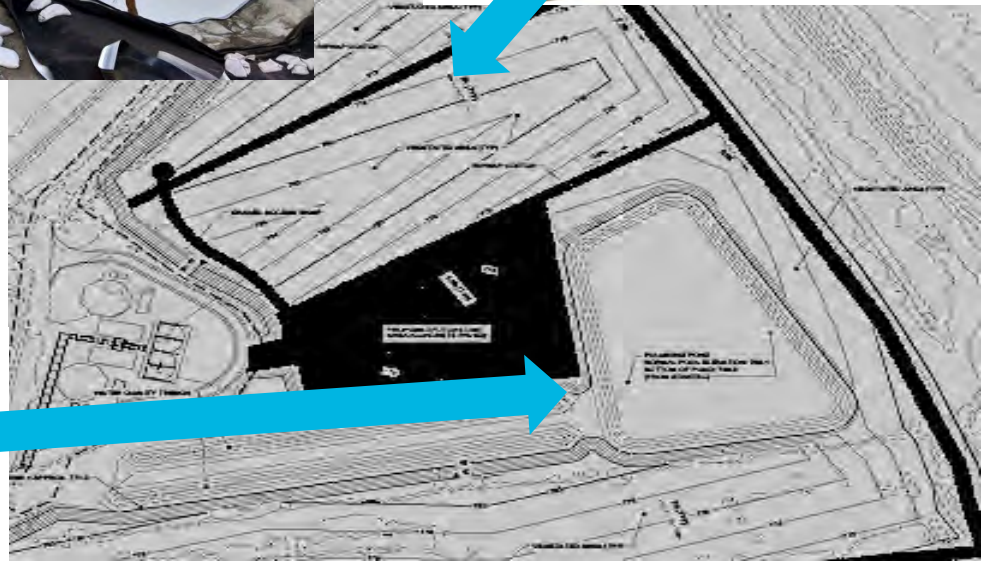
04 Case Studies in Pond Closure

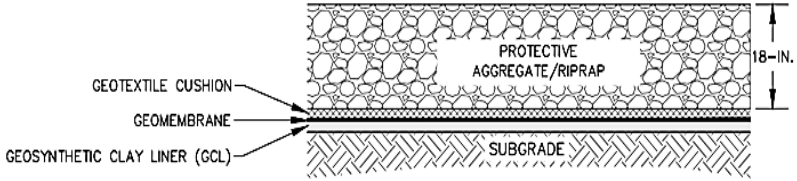
Project Execution

How was it done?

- Regrading/removal of existing ash
- Soil cap over dry ash area (26 acres)
- Lining of process water ditch and pond (approximately 10 acres)







05 Case Studies in Pond Closure

Project Summary

What were the results?

- Area ready for conversion projects
- Long runs of large HDPE piping required flexible connections
- Test strips critical to clay cap placement

05 Case Studies in Pond Closure

Project Background

Pond Details

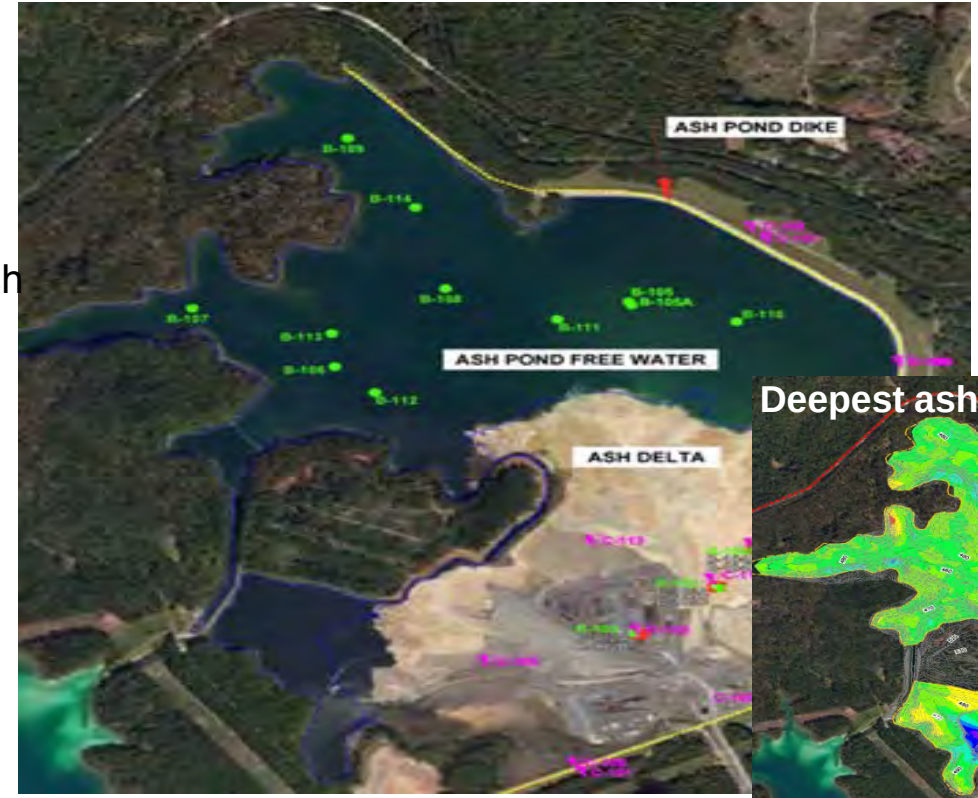
- Active Ash Pond
- Approx. 600 Acres
- ½ of pond contains delta ash

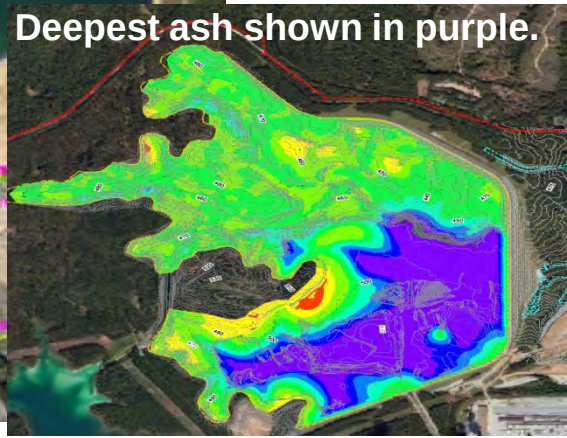
Pond Constituents

- Approx. 16M cyd of CCR

Closure Drivers

- CCR Rule compliance
- Dry conversion
- Maintenance



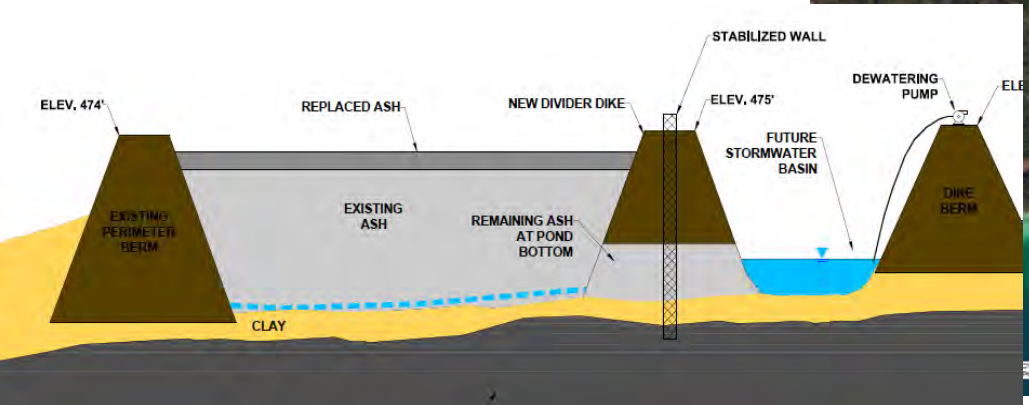


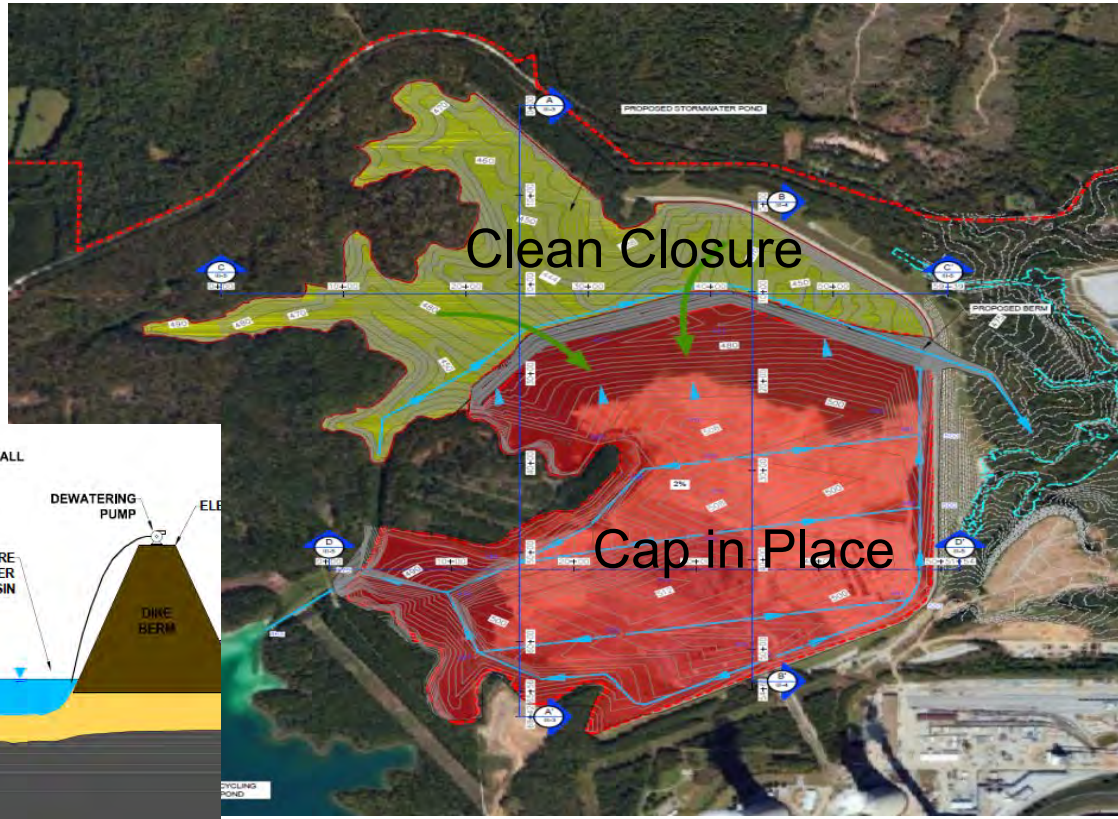
05 Case Studies in Pond Closure

Project Execution

How will it be done?

- Dewatering of open pool
- Relocation of ash from thinnest areas to thickest areas
- Construction of dike to divide clean closure and cap in place areas



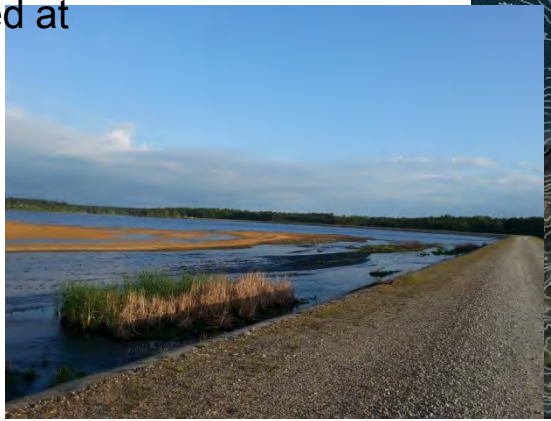


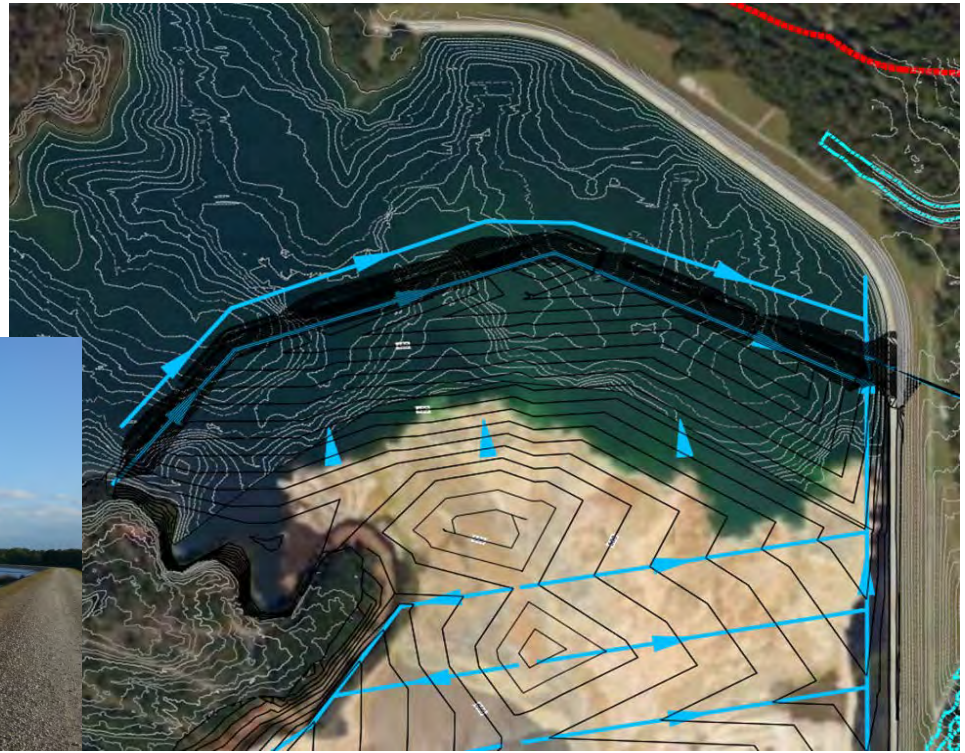
05 Case Studies in Pond Closure

Project Summary

What were the results?

- CCR Rule Compliance
- Footprint consolidation
- Geotech investigations defined the closure method
- Closure cost estimated at $100M, $160K/Acre





06
Summary

06 Summary

Seize the Opportunity

Opportunity to stay ahead of compliance

- Planning will lead to proactive behaviors
- Compliance requires continual focus
- Address areas of repairs or improvements

Opportunity to improve CCR management

- Reassess overall strategies and align
- Improve operations, beneficial use, water management, and more
- Anticipate and resolve issues…proactive behaviors

Opportunity to transition away from wet disposal

- Identify and plan for challenges in closure
- Planning ahead in fleet wide closure
- Push for cost savings, innovation, and improved delivery

Maximizing opportunity requires continual focus and effort

Questions?

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Thank you!