Kingston Fossil Plant
Peninsula Site

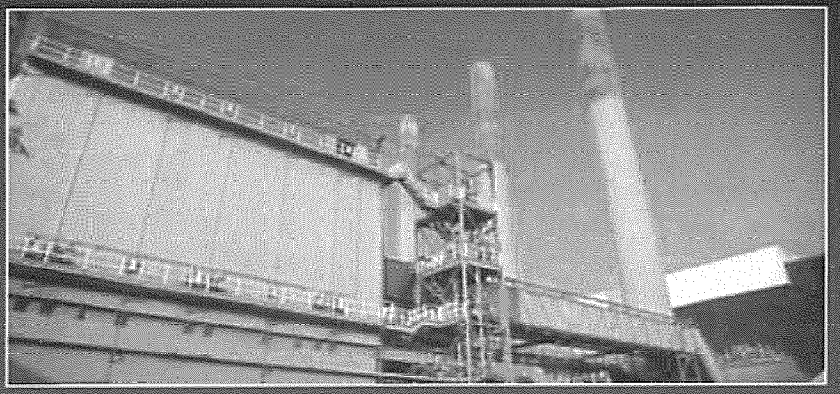
Presented by:

TVA

GeoSyntec Consultants

28 September 2006

Introduction



- Hydrogeology
- Landfill Design
- Groundwater Monitoring Plan
- Aesthetic Considerations
- Summary and Conclusion

Historical Data

- **Benziger and Kellberg (1951)**
  - 5 bedrock borings
- **Carpenter and Bohac (1988)**
  - 15 soil borings & seismic survey
- **TVA (2002)**
  - 5 piezometers
  - 31 Geoprobe holes
- **MACTEC (2003)**
  - 6 soil borings
  - 2 bedrock corings

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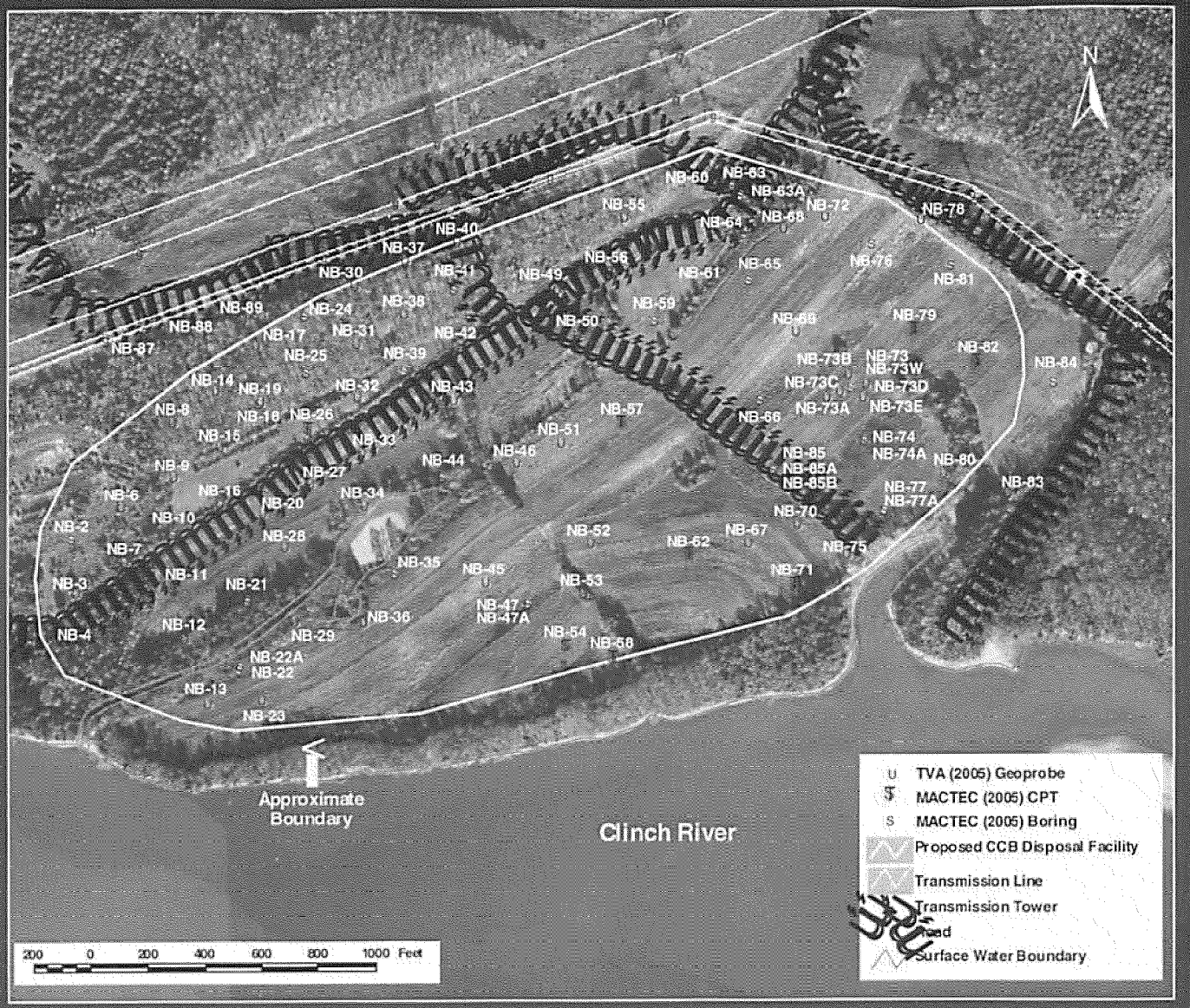
Recent Data

- MACTEC (2005)
  - 4 bedrock wells
  - 9 soil wells
  - 24 soil borings
  - 12 bedrock corings
  - 10 CPT holes
- TVA (2005)
  - 55 Geoprobe holes



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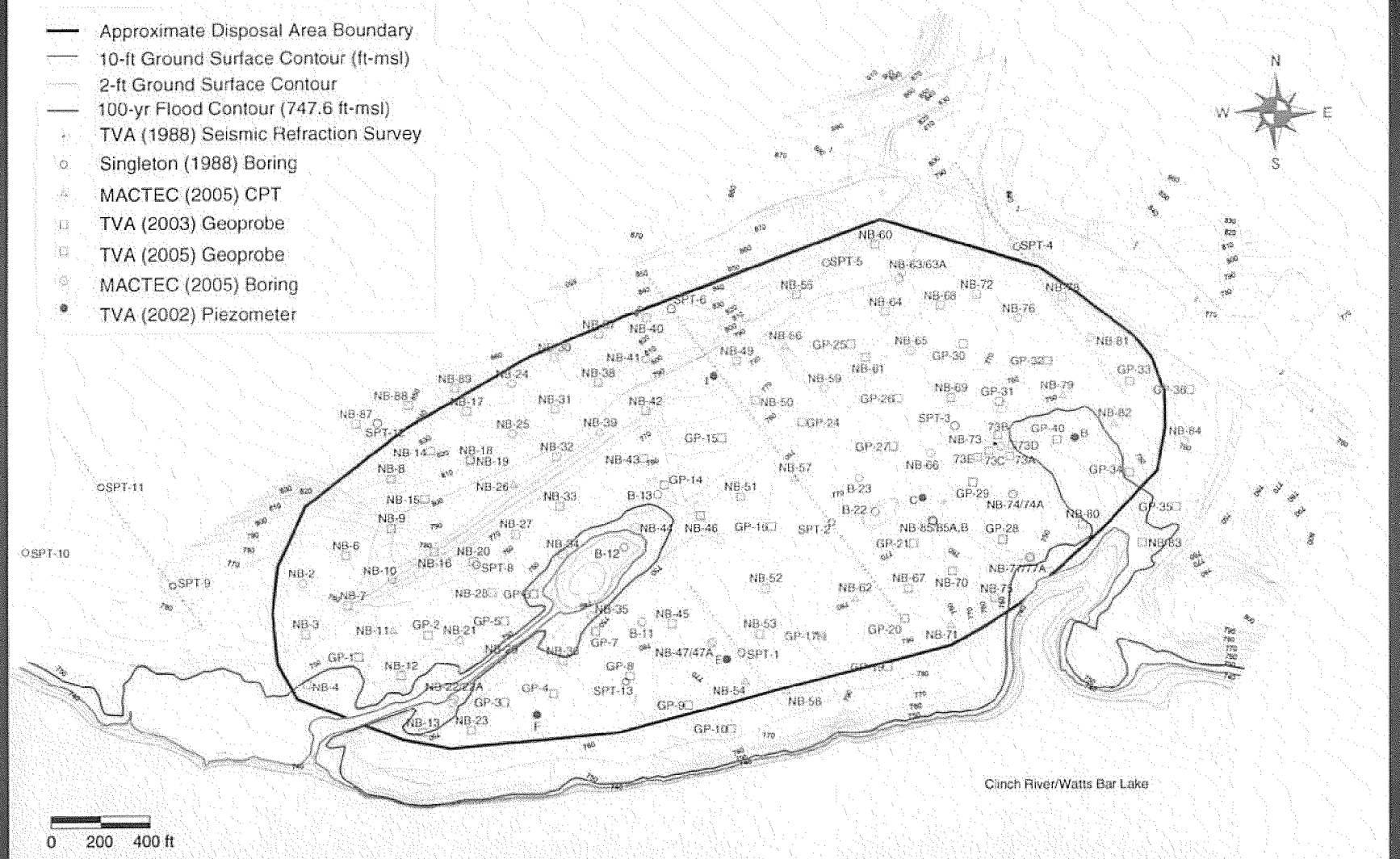
Topography



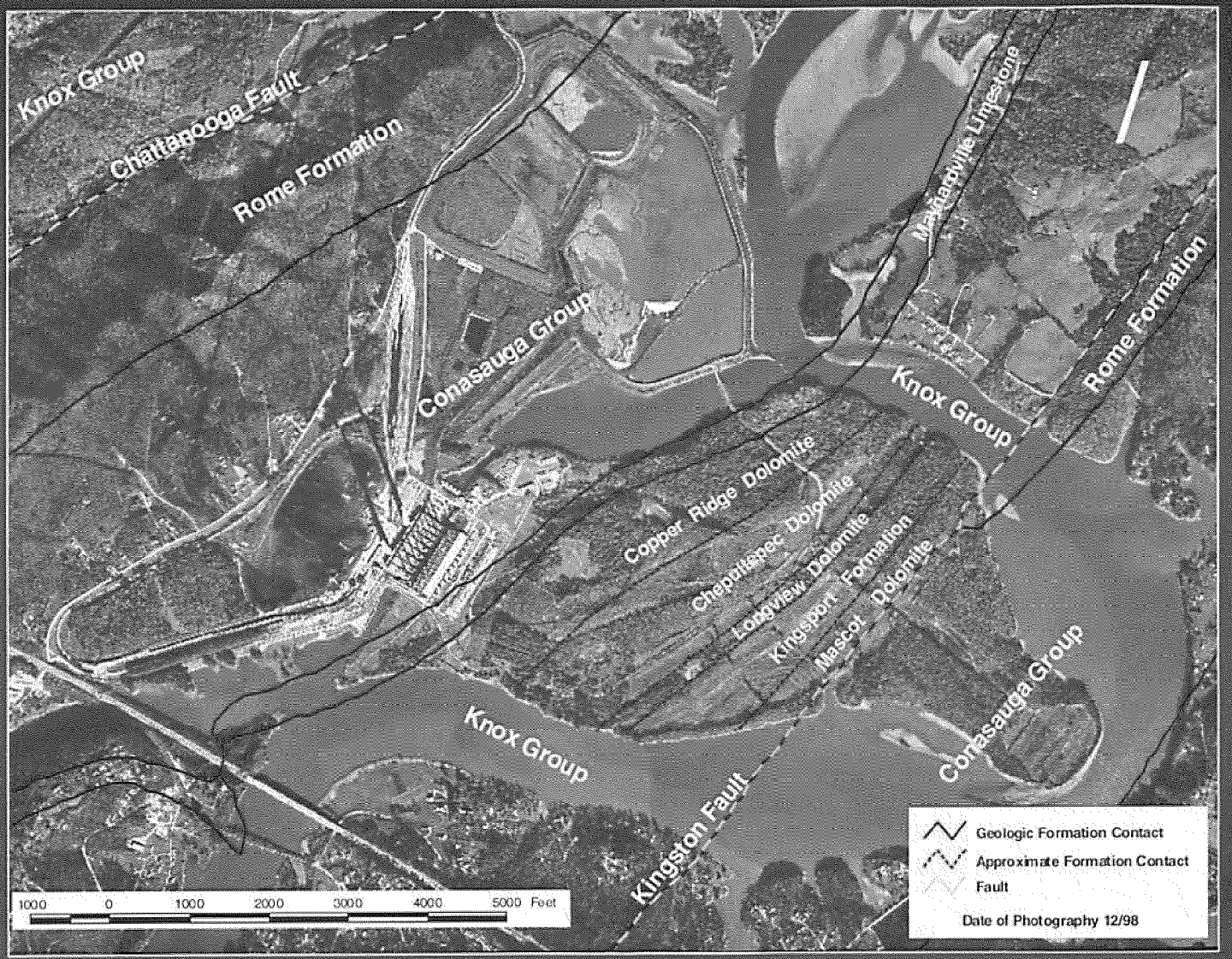
Geology

Bedrock

- Knox Group
- Strike ~N55°E
- Dip 45 – 50° SE

Soil

- Primarily silt & clay residuum
- 8.5 to 120-ft thick
- ave 40.5 ft thick
- 35.2 – 74.5-ft overlying depressions & dolines
- Some alluvium along drainage channel



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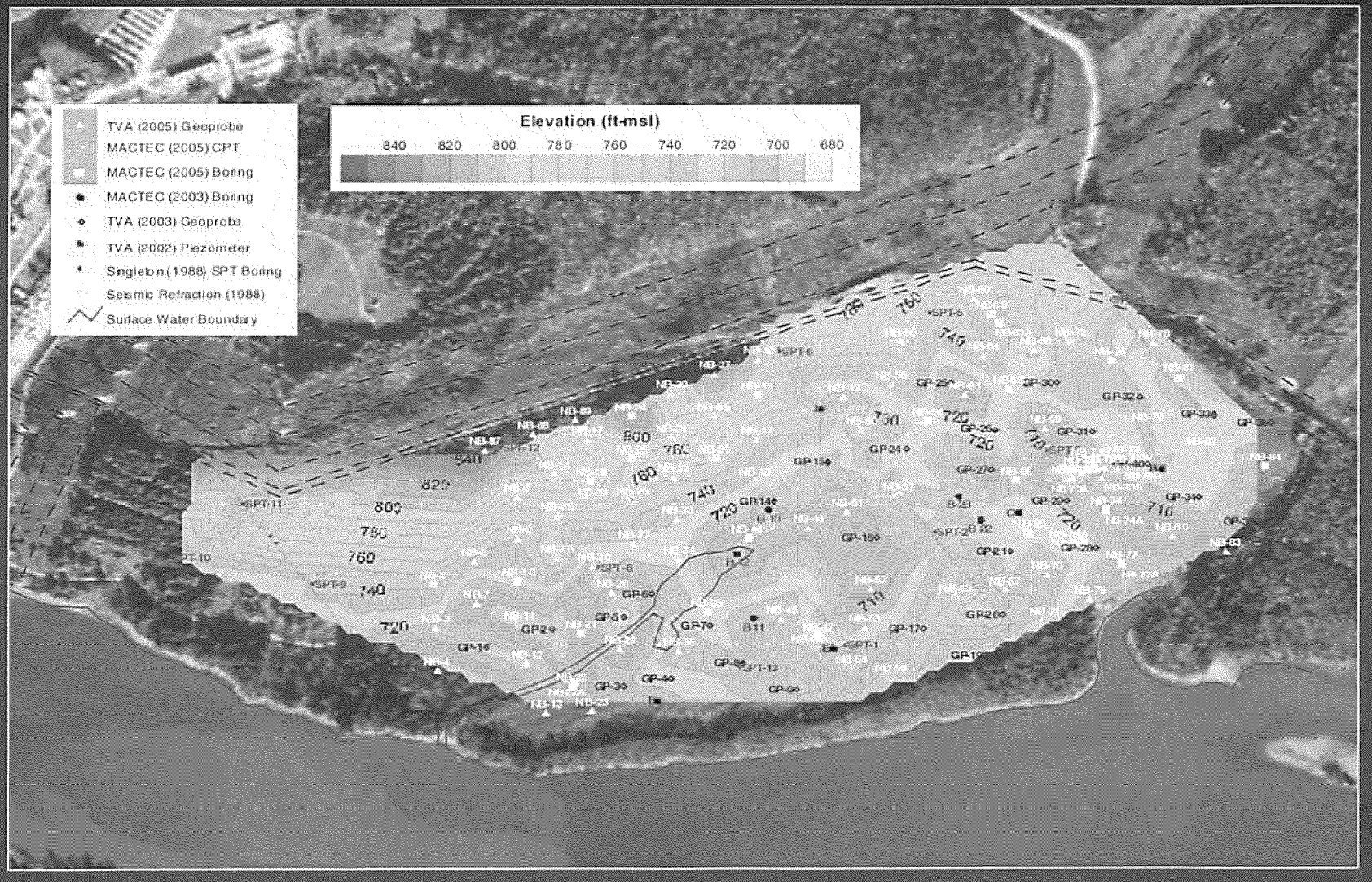
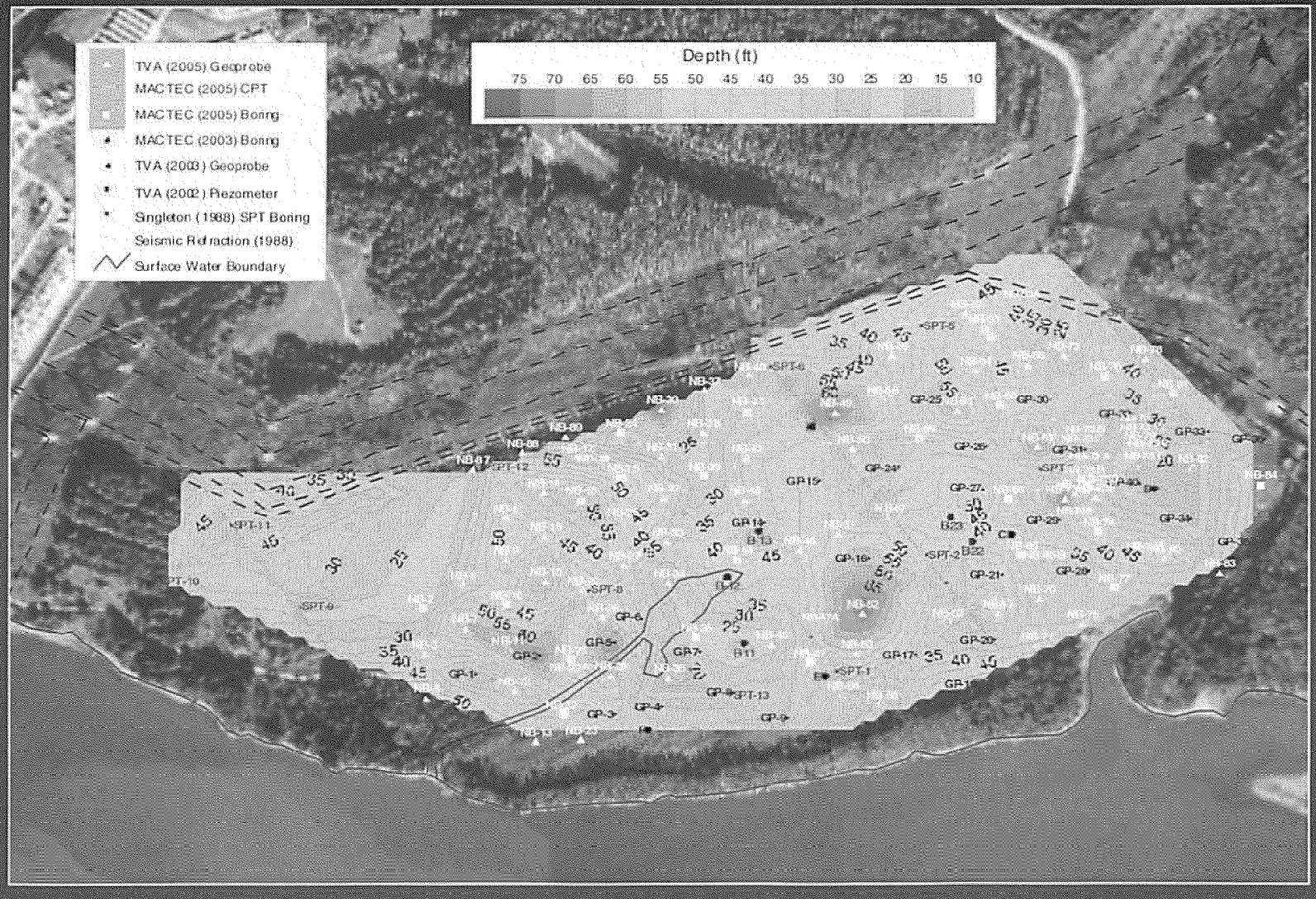
Top of Bedrock



Soil Thickness



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Soil Vertical Hydraulic Conductivity (K_v)

Summary of Constant-Head Permeability Tests (ASTM D5084)

Boring ID	Depth (ft)	Moisture (%)	K_v (cm/s)	Sample Type
NB-21A	33.0 - 35.0	26.6	1.5E-08	Shelby (undisturbed)
NB-44	16.5 - 18.5	28.2	4.6E-08	Shelby (undisturbed)
NB-44	21.5 - 23.5	25.7	1.6E-04	Shelby (undisturbed)
NB-47A	30.0 - 32.0	32.8	5.5E-08	Shelby (undisturbed)
NB-76	19.0 - 20.5	23.9	2.0E-07	Shelby (undisturbed)
NB-84	32.5 - 34.5	27.1	5.9E-08	Shelby (undisturbed)
NB-22	2.0 - 10.0	19.2	1.3E-06	bulk (remolded)
NB-76	5.0 - 15.0	23.0	2.5E-06	bulk (remolded)
NB-84	2.0 - 10.0	23.8	1.4E-07	bulk (remolded)
NB-59	5.0 - 15.0	22.4	1.1E-07	bulk (remolded)

undisturbed samples: 10^{-4} to 10^{-8} cm/s

remolded samples: 10^{-6} to 10^{-7} cm/s

Well Testing Bulk Hydraulic Conductivity (K)

Summary of Single-Well Aquifer Test Results

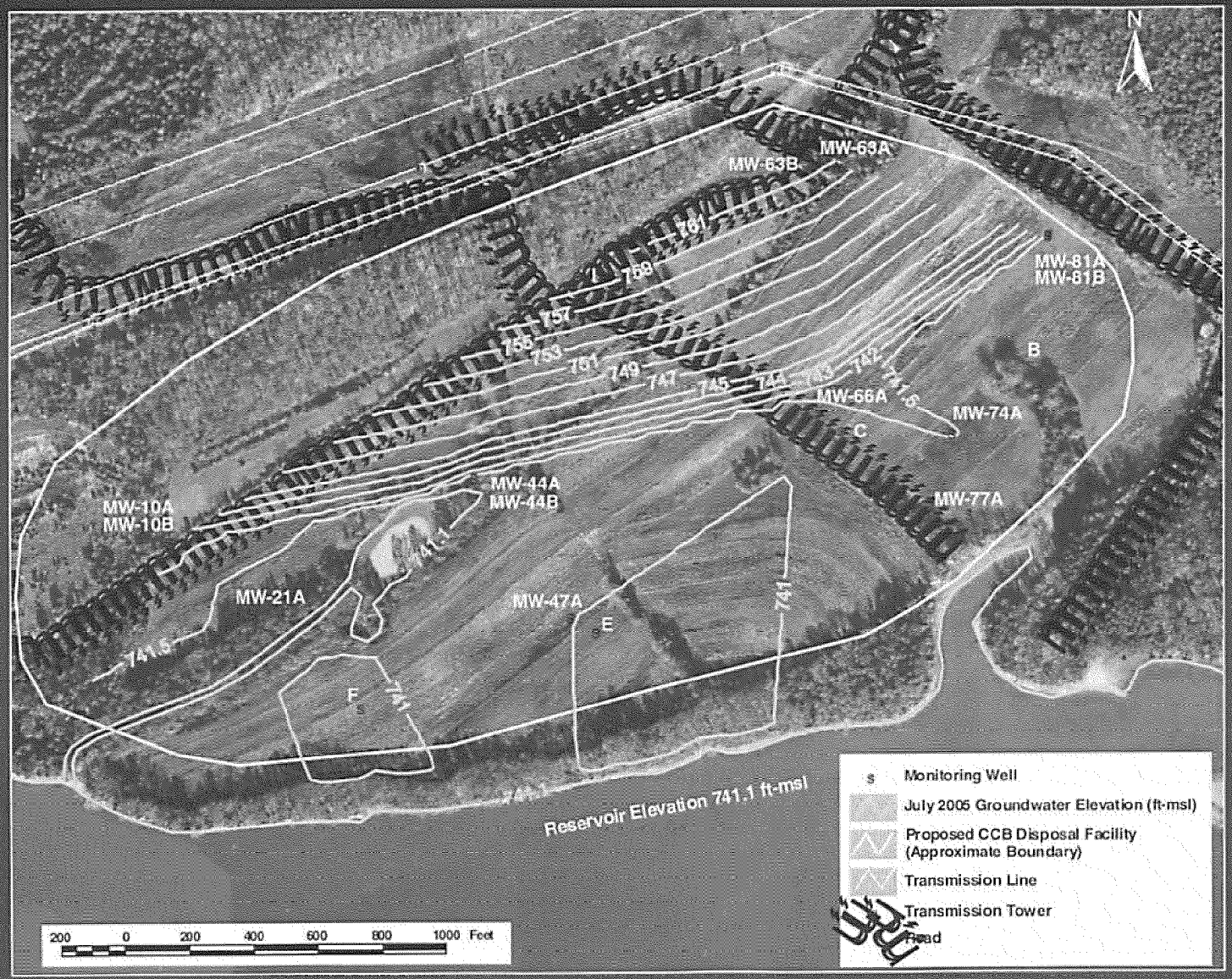
Well	Test Type	Q (gpm)	EMFM Test	Analytical Results	
				K (ft/s)	K (cm/s)*
MW-10A	*slug*	6 gallons		1.93E-06	**5.88E-05**
MW-10B	*slug*	3 gallons		2.34E-06	**7.13E-05**
MW-21A	*slug*	6 gallons		1.25E-06	**3.81E-05**
MW-21A	*pump*	0.18	X	1.86E-05	5.67E-04
MW-44A	*pump*	6.40 & 4.88	X	3.17E-04	**9.66E-03**
MW-44B	*pump*	18.6 & 4.90	X	6.03E-04	**1.84E-02**
MW-47A	*slug*	6 gallons		2.71E-05	8.26E-04
MW-47A	*pump*	4.17		1.25E-04	**3.81E-03**
MW-47A	*injection*	1.54		1.35E-03	4.11E-02
MW-63A	*slug*	3.5 gallons		2.64E-07	**8.05E-06**
MW-63B	*slug*	3 gallons		3.46E-07	1.05E-05
MW-63B	*injection*	0.20	X	2.10E-07	**6.40E-06**
MW-66A	*slug*	6 gallons		1.46E-05	4.45E-04
MW-66A	*pump*	0.35	X	2.13E-04	6.49E-03
MW-66A	*pump*	3.26		1.78E-05	**5.43E-04**
MW-66A	*injection*	0.76	X	8.14E-05	2.48E-03
MW-74A	*slug*	6 gallons		1.68E-06	5.12E-05
MW-74A	*pump*	0.28	X	1.02E-05	3.11E-04
MW-74A	*pump*	1.05		7.65E-06	**2.33E-04**
MW-77A	*slug*	3.5 gallons		1.14E-05	3.47E-04
MW-77A	*pump*	3.00	X	2.89E-05	8.81E-04
MW-77A	*pump*	2.50		3.89E-05	**1.19E-03**
MW-81A	*slug*	6 gallons		6.00E-06	**1.83E-04**
MW-81A	*injection*	0.65	X	2.00E-04	6.10E-03
MW-81B	*slug*	6 gallons		1.03E-04	**3.14E-03**

Test Types:
- single-well pumping tests
- injection tests
- slug tests
- electromagnetic borehole flowmeter (EBF) surveys

soil wells:
10^{-3} to 10^{-6} cm/s
geometric mean K = 3×10^{-4} cm/s

bedrock well estimates:
10^{-2} to 10^{-6} cm/s
geometric mean K is 4×10^{-4} cm/s

Potentiometric Surface – July 2005



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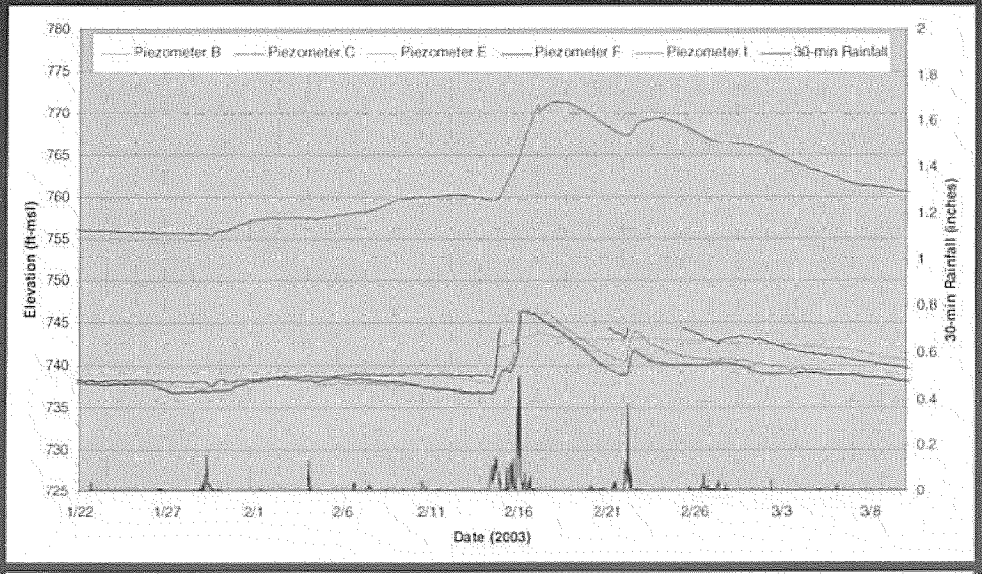
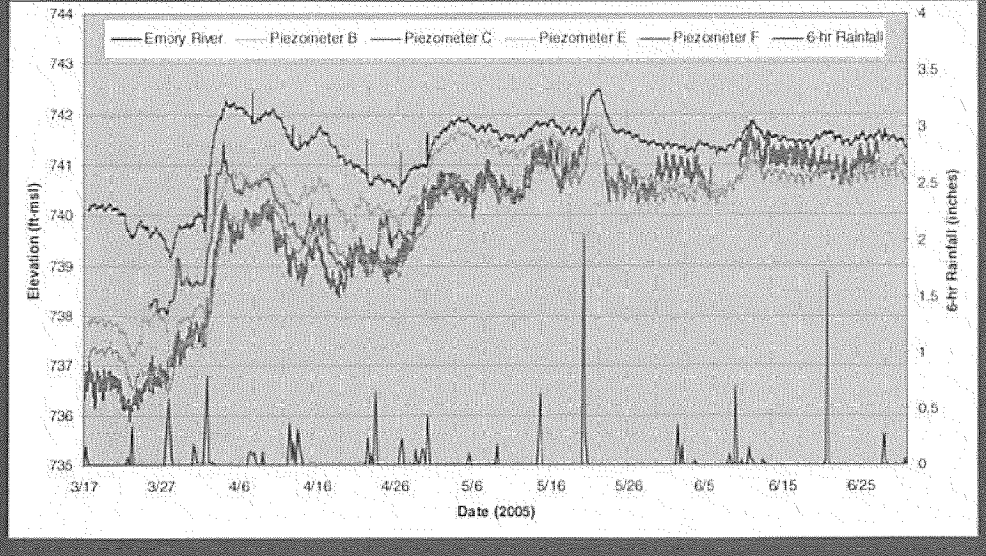
Time-Series Water Levels



January – March 2005



March – April 2005

Emory and Clinch Rivers influence groundwater levels in the lower elevations of the site

Summary

- A survey of water use in June 2005 indicates that there are no surface or groundwater supplies located within a one-mile radius of the site and no potential exists for offsite impacts to residential or municipal groundwater supplies.
- There is no evidence of Holocene-age faulting within the 200-ft facility exclusion zone.
- Although topographic expressions of dolines are exhibited at the site, these features do not possess open throats or avenues for reception of incipient recharge. Rather, the dolines are thickly mantled by soil thicknesses ranging from about 35 to 75 ft.
- Visual and laboratory classifications of these soils indicated that they are of residual origin except in the area of the site pond/channel where alluvial deposition has occurred.
- There were no voids detected immediately above bedrock that would indicate loss of soil into the deeper bedrock system.

Overview of Design and Operation of Facility

Objectives for Disposal Facility

- Provide a disposal facility capable of handling gypsum by-products from TVA's Kingston Fossil Plant
- Facility designed to handle 100 percent of anticipated gypsum production in the event that gypsum cannot be marketed
- Two-phase build out for operational flexibility and to minimize initial site disturbance with Phase 1 being of sufficient size to allow full build-out without disruption of operations in the event of marketing failure
- Permitted in accordance with TDEC Rule 1200-1-7

Site Layout and Features

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Key Facts and Figures

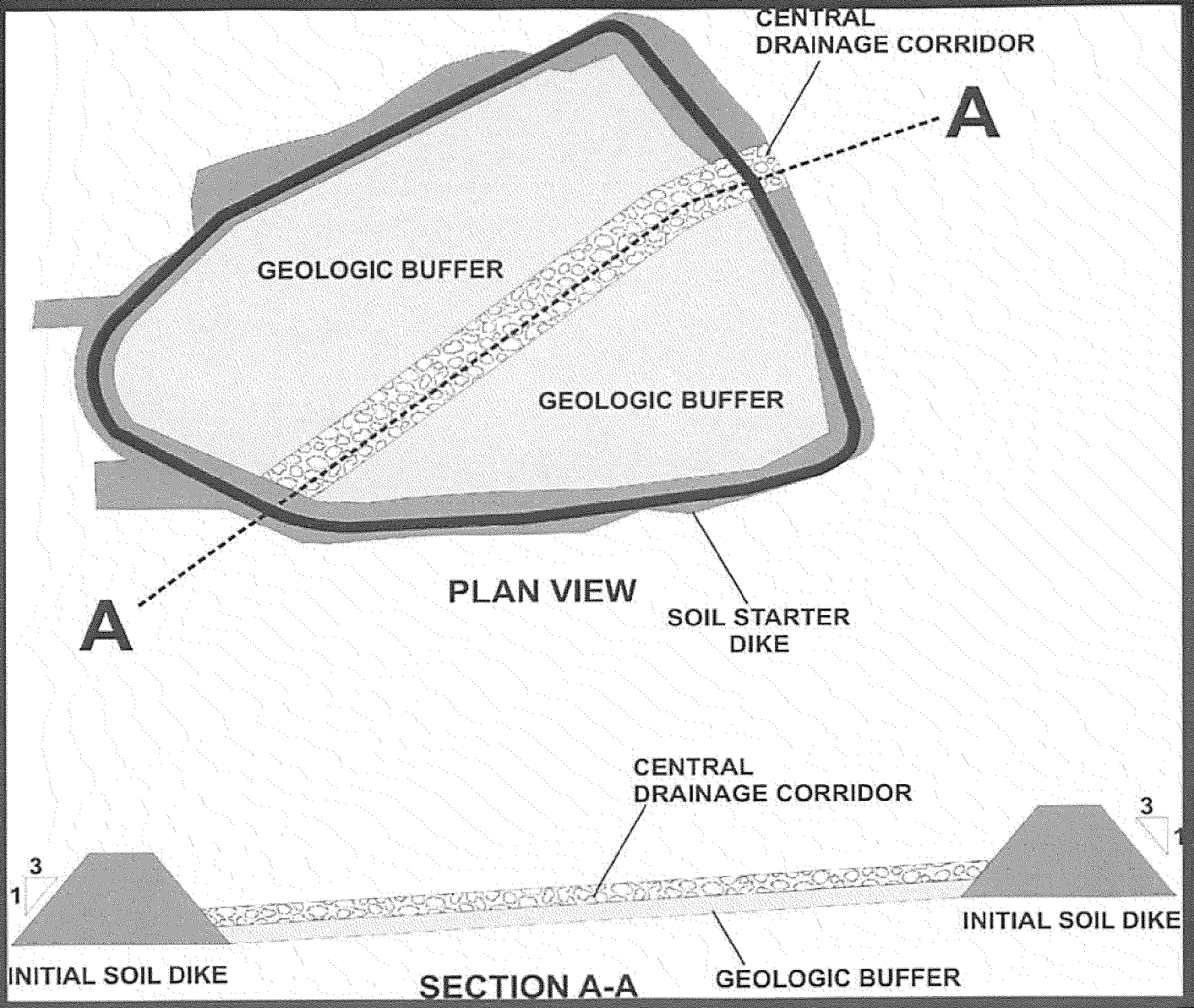
- Design Assumptions
  - Facility sized to handle 100 percent by-pass and a 3.2 # coal
  - Individual components sized to handle anticipated flow rates from a 5 # coal
- Capacities
  - Phase I – 6.9MM CY (wet) + 0.5MM CY (dry)
  - Phase I and II – 15MM CY (wet) + 2.6MM CY (dry)
  - Phase I and II provide > 30 years capacity

Development Sequence

- Construction Activities
  - Step 1 – Prepare Phase I Area, i.e., clearing, grubbing, erosion controls, access roads and parking areas, preparation of borrow area (if needed). Construct access roads and equipment parking areas.

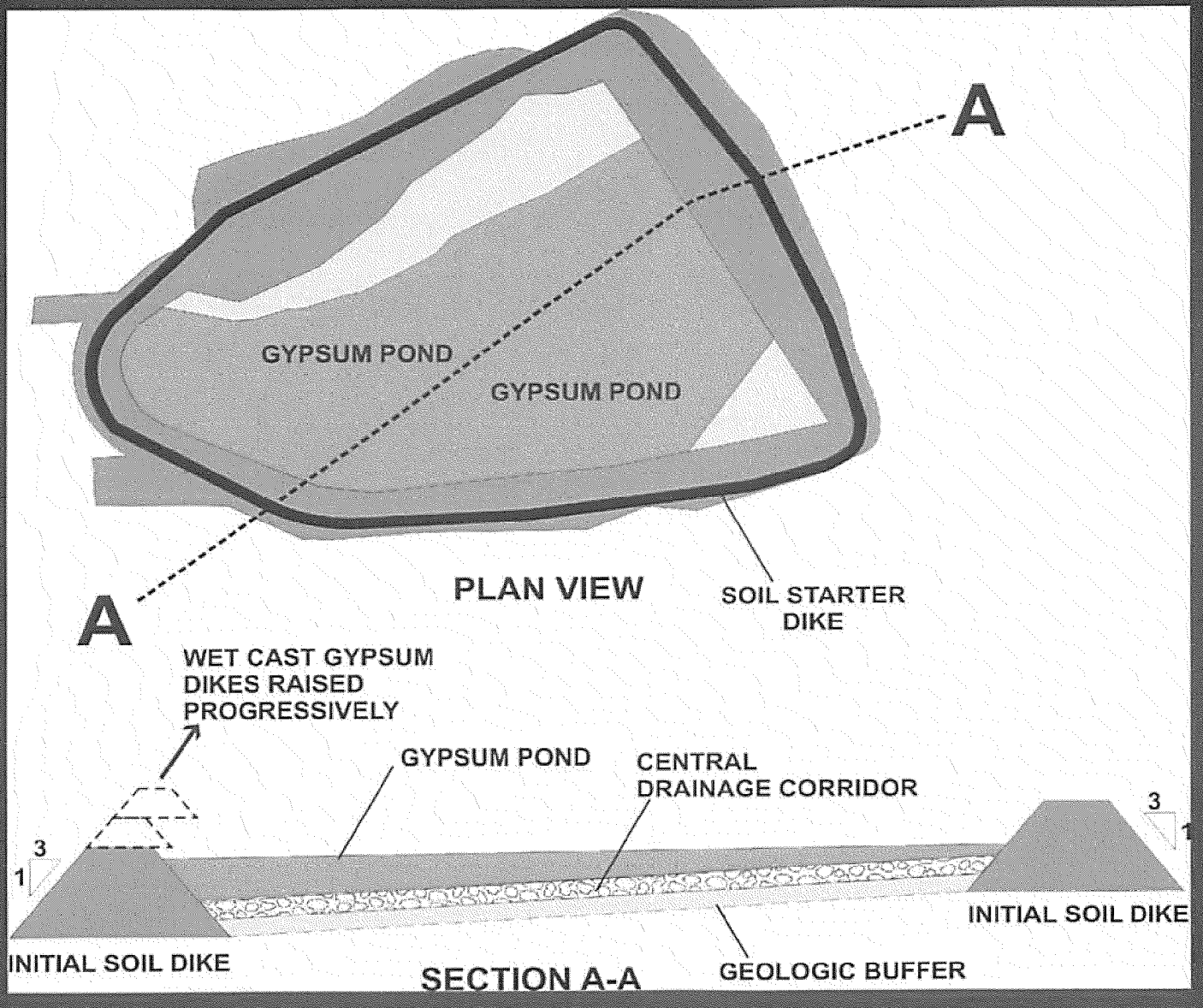
Development Sequence

- **Construction activities**
  - Step 2 – Earthwork for construction of geologic buffer, stormwater pond, and soil starter dikes, and surface water diversion ditches. Construct central drainage corridor, sump/lift station, and gypsum bypass pipeline
  - *Note: While most TVA disposal facilities are constructed with a geologic buffer of 3 feet of 10^{-6} clay in accordance with the "Teasler Memo", TVA is proposing a re-compacted buffer of 3 feet of 10^{-7} clay due to the karst nature of this site.*



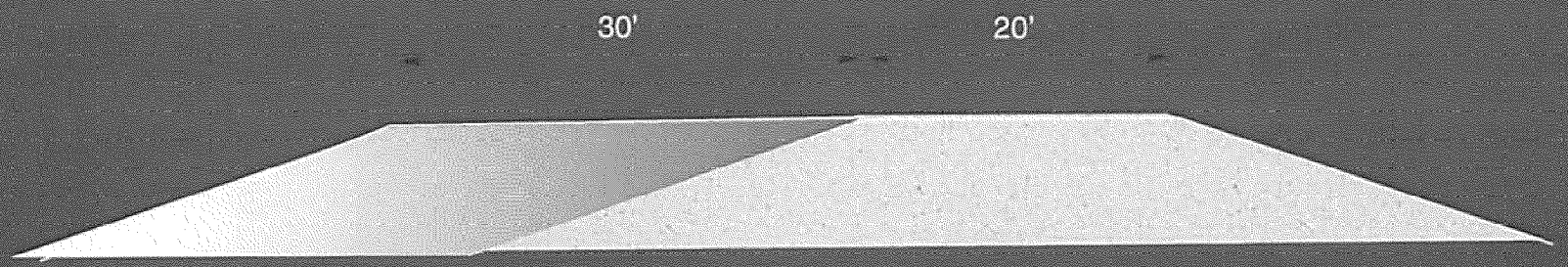
Development Sequence

- Construction Activities
  - Step 3 – Commence wet pond operations in Phase I; progressively raise elevation of soil starter dikes using wet cast gypsum



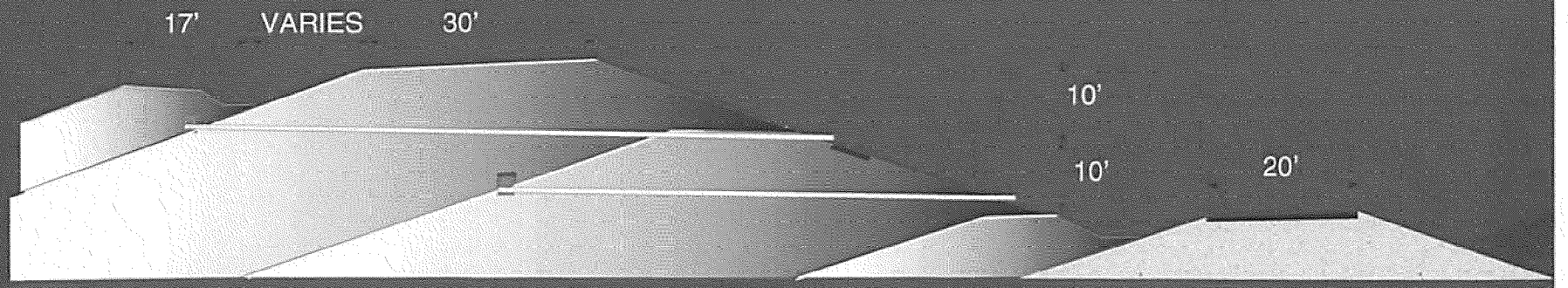
Procedure for Raising Dikes

- Construct initial starter dikes (soil)
- Increase width of working platform (gypsum from wet cast operations)



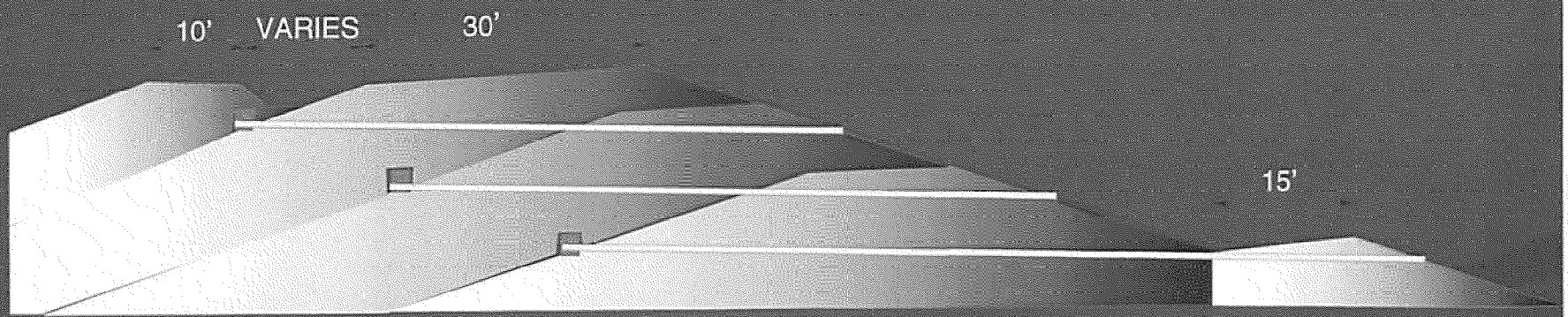
Procedure for Raising Dikes (Starter Dikes to first Bench)

- Cut in surface water perimeter ditch
- Raise using wet cast or Rim Ditch
- Cut in drains at 10 ft. height increments



Procedure for Raising Dikes (First Bench and Above)

- Back grade bench to form drainage swale
- Repeat dike raising procedure:
  - Raise using wet cast or Rim Ditch
  - Cut in drains at 10 ft. height increments

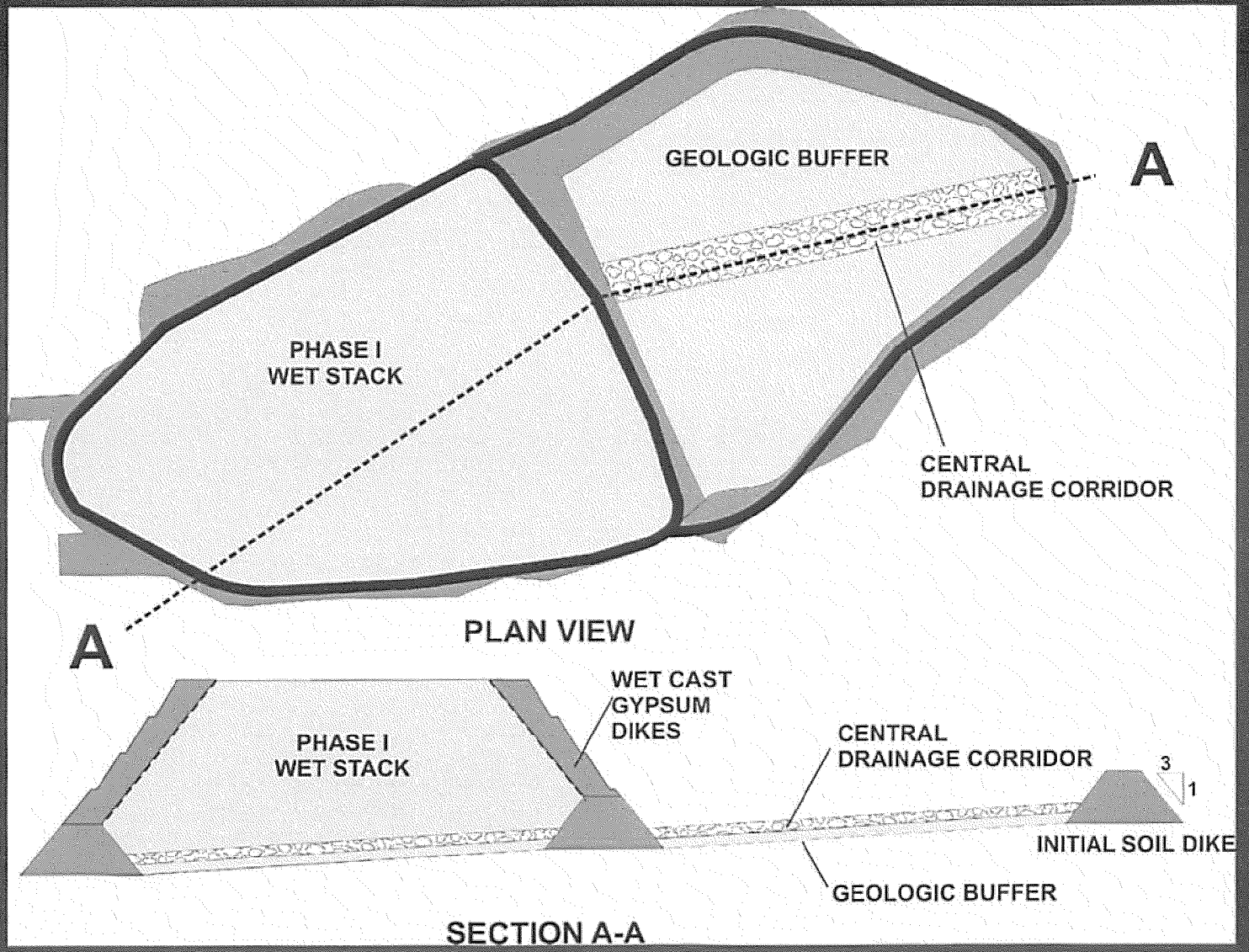


Development Sequence

- Construction Activities
  - Step 4 – Prepare Phase II Area, i.e., clearing, grubbing, erosion controls, access roads and parking areas, preparation of borrow area (if needed). Construct temporary access roads from Phase I area.
  - Note: Timing of Phase II selected by TVA based on operational needs – flexibility to occur early or later in operation of Phase I based on success of marketing

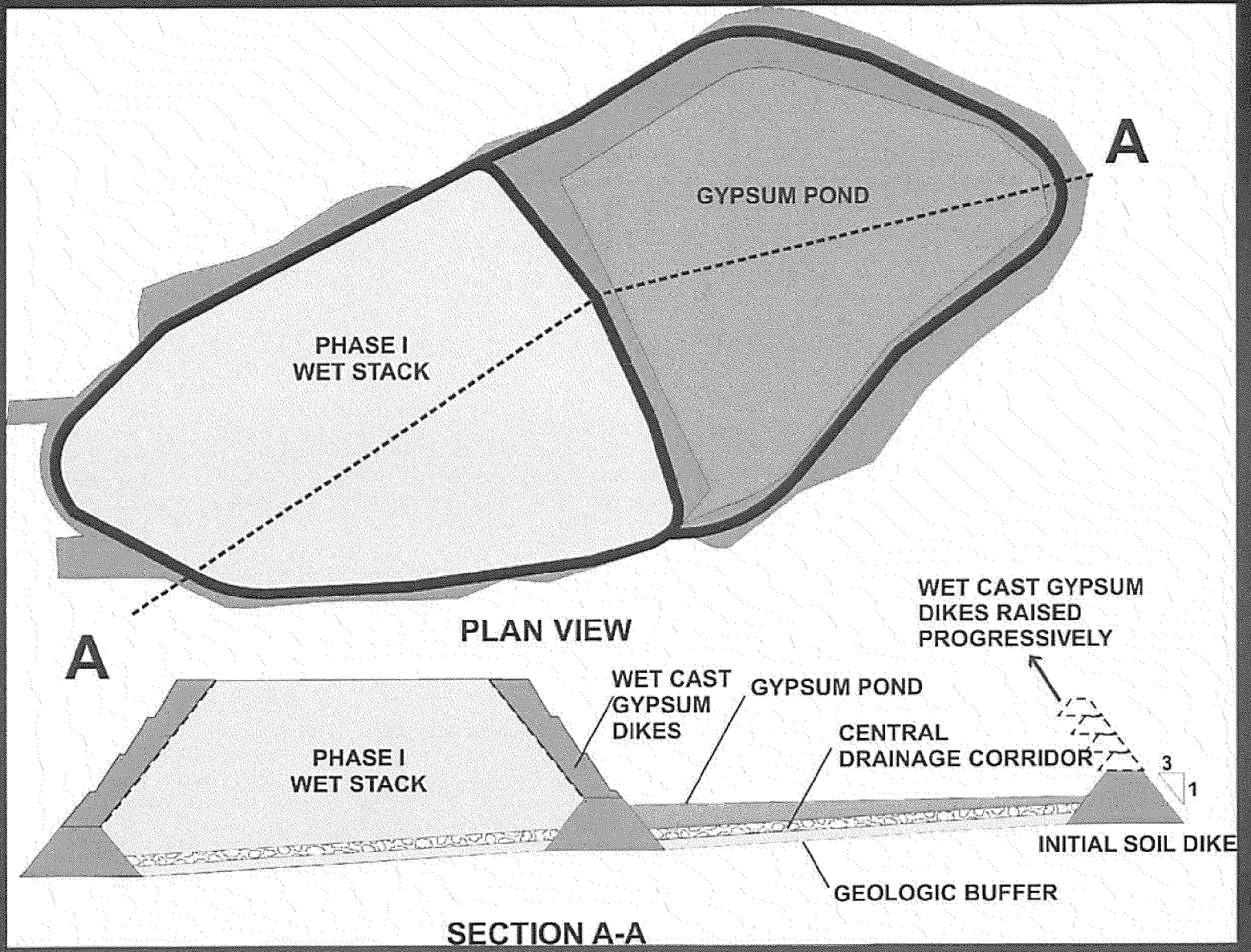
Development Sequence

- Construction Activities
  - Step 5 – Phase II earthwork for construction of geologic buffer, soil starter dikes, and surface water diversion ditches. Construct central drainage corridor, and extend gypsum bypass pipeline

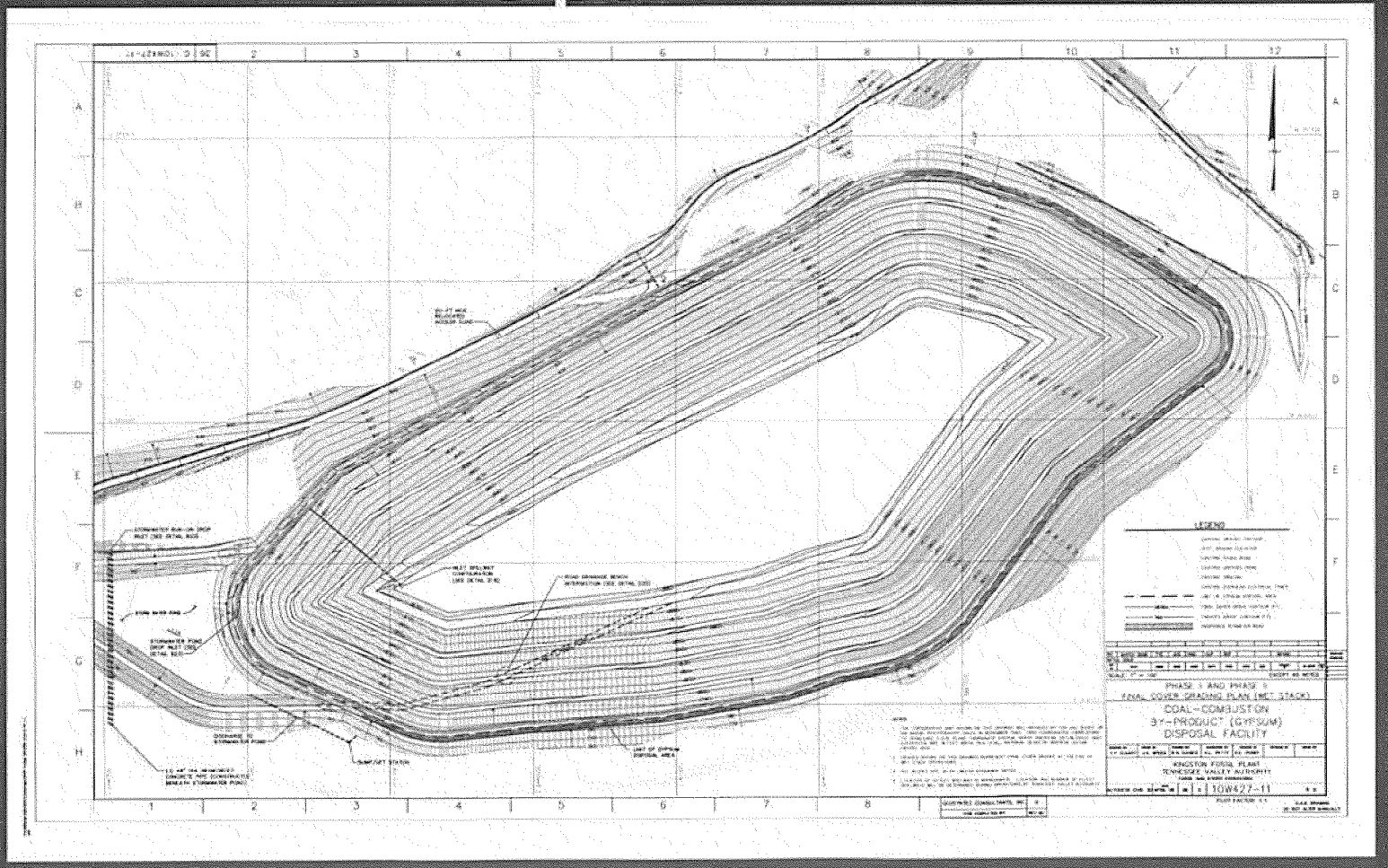


Development Sequence

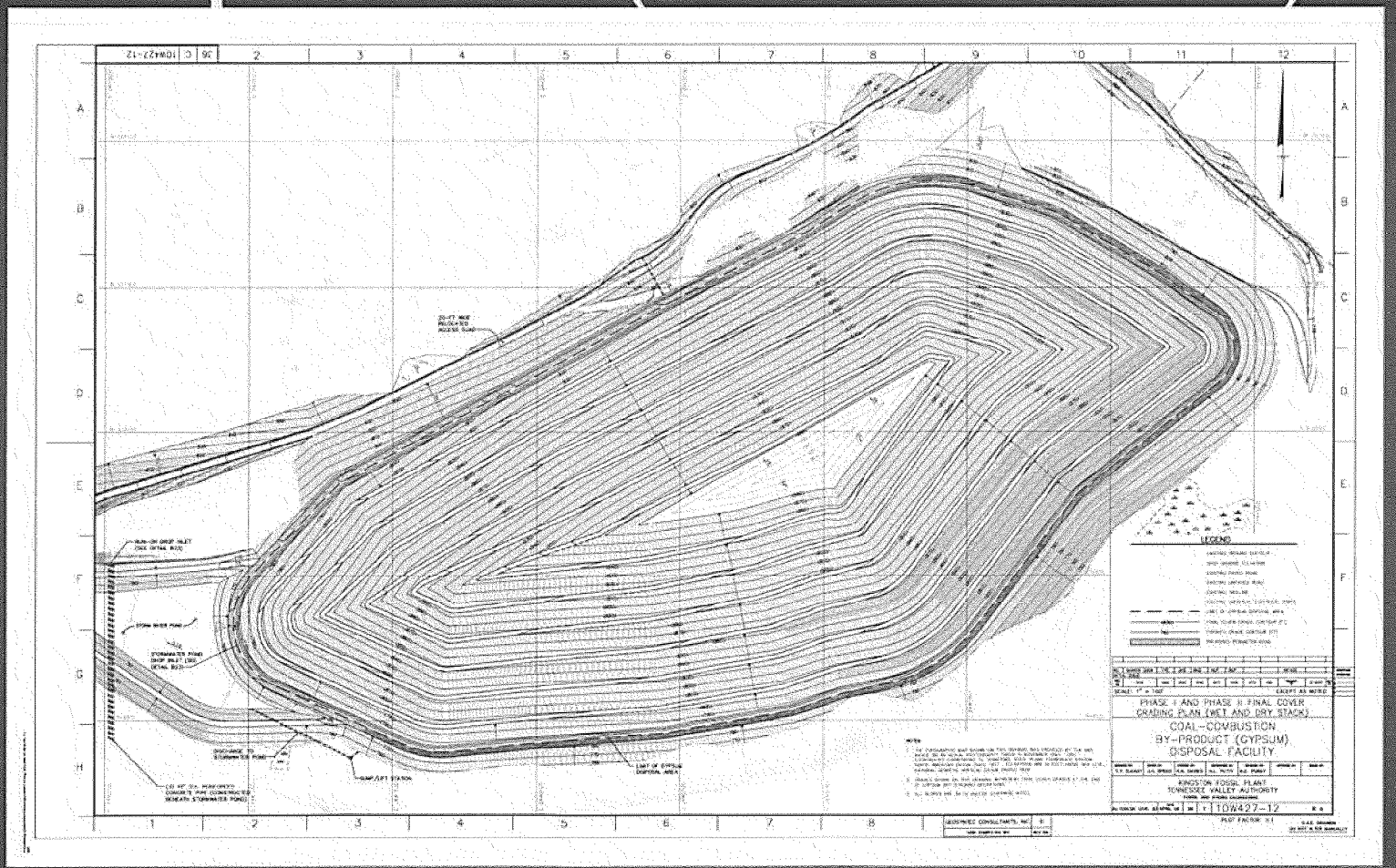
- **Construction activities**
  - Step 6 – Commence wet pond operations in Phase II; progressively raise elevation of starter dikes using wet cast gypsum [same procedure as Phase 1]



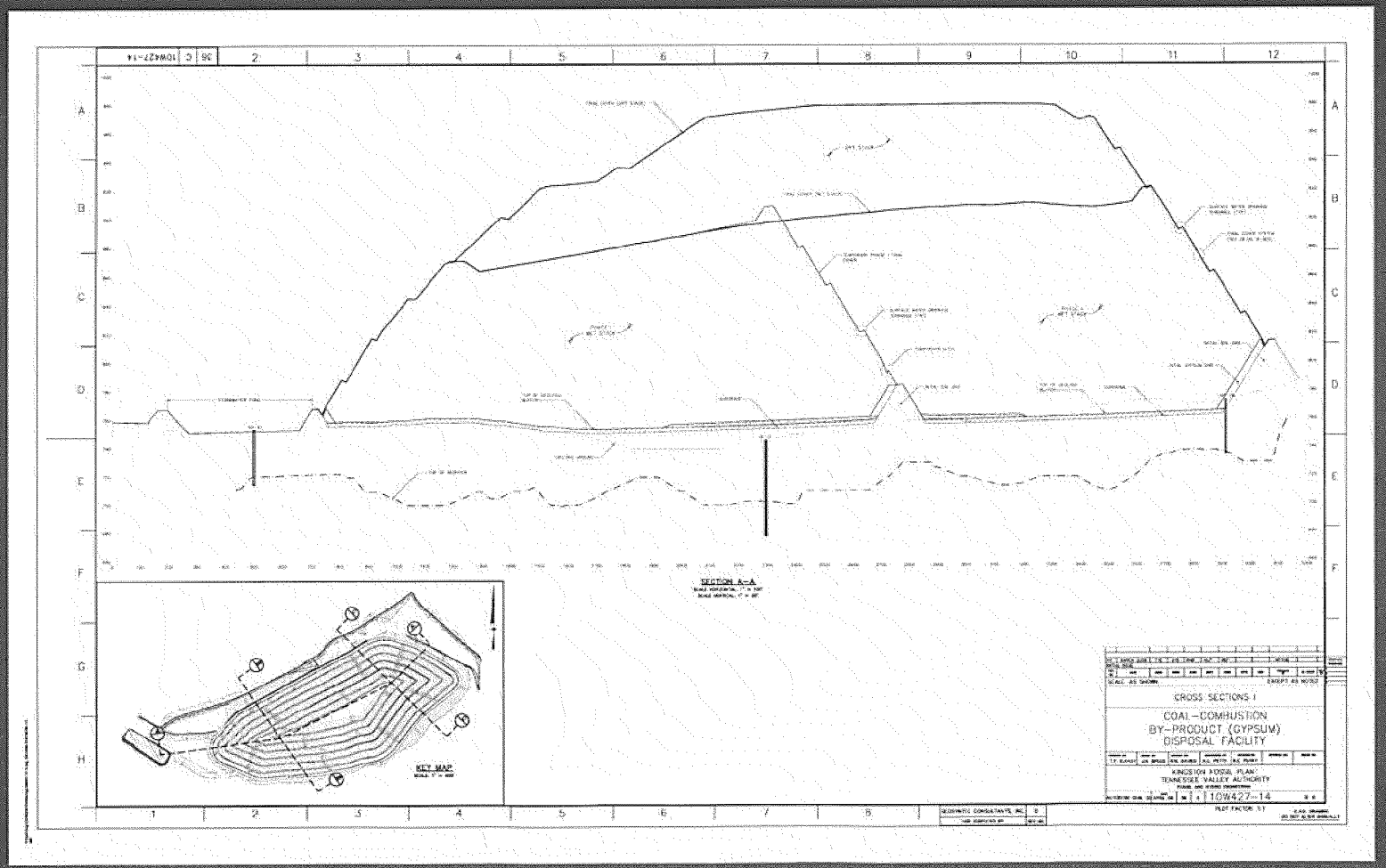
Completion of Wet Stack Operations



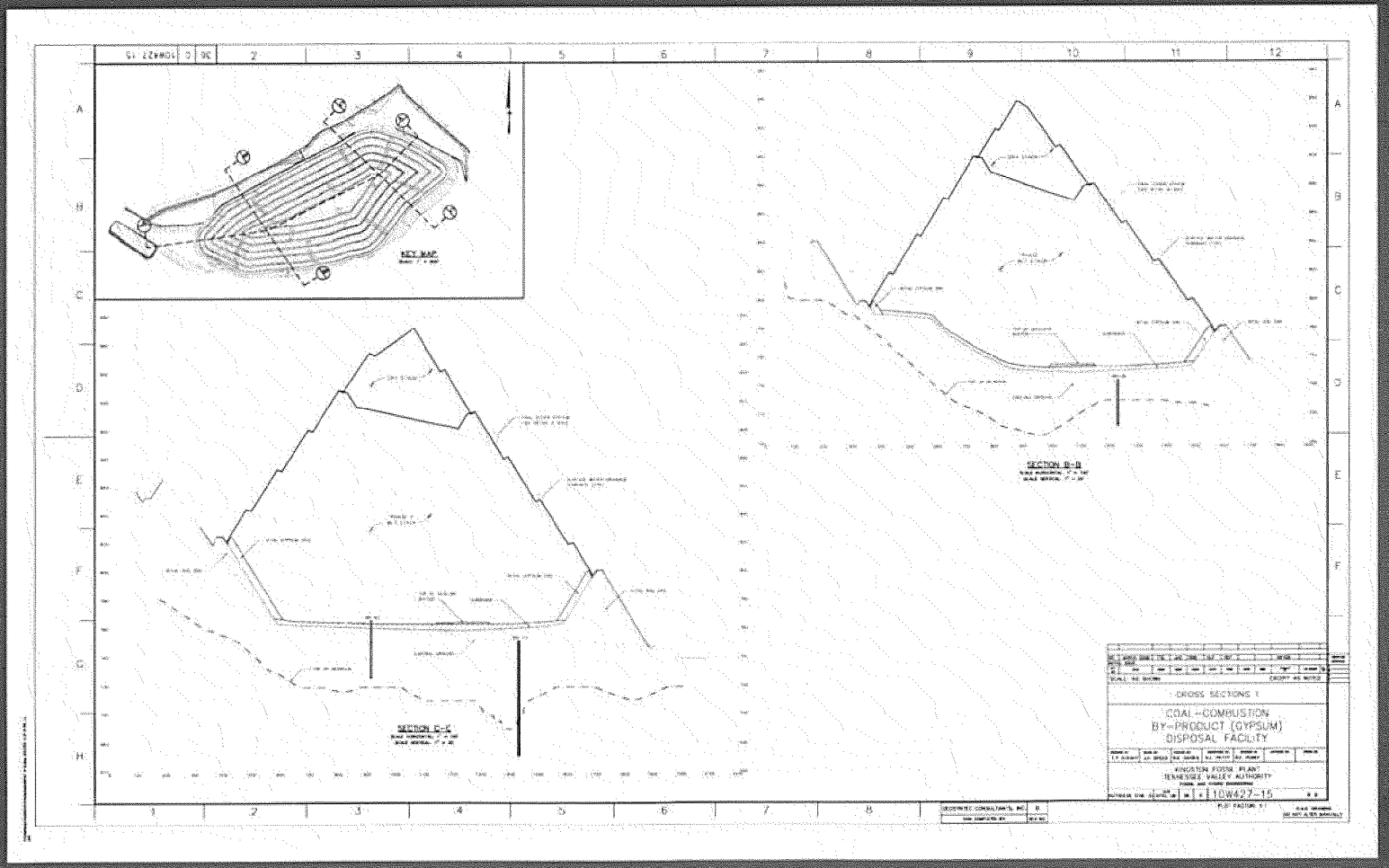
Completion of Dry Stack Operations (Full Build Out)



Cross Sections (1 of 2)



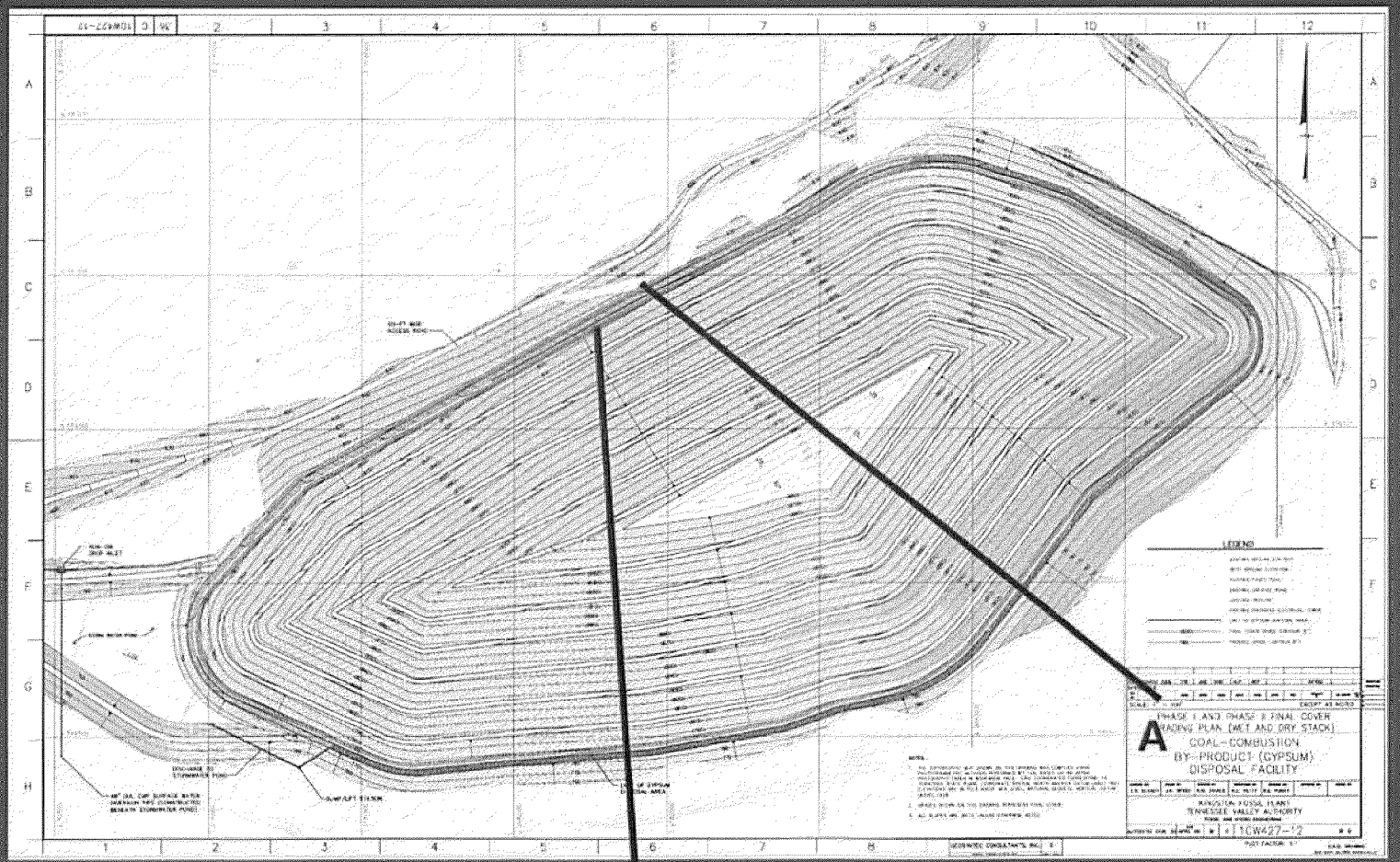
Cross Sections (2 of 2)



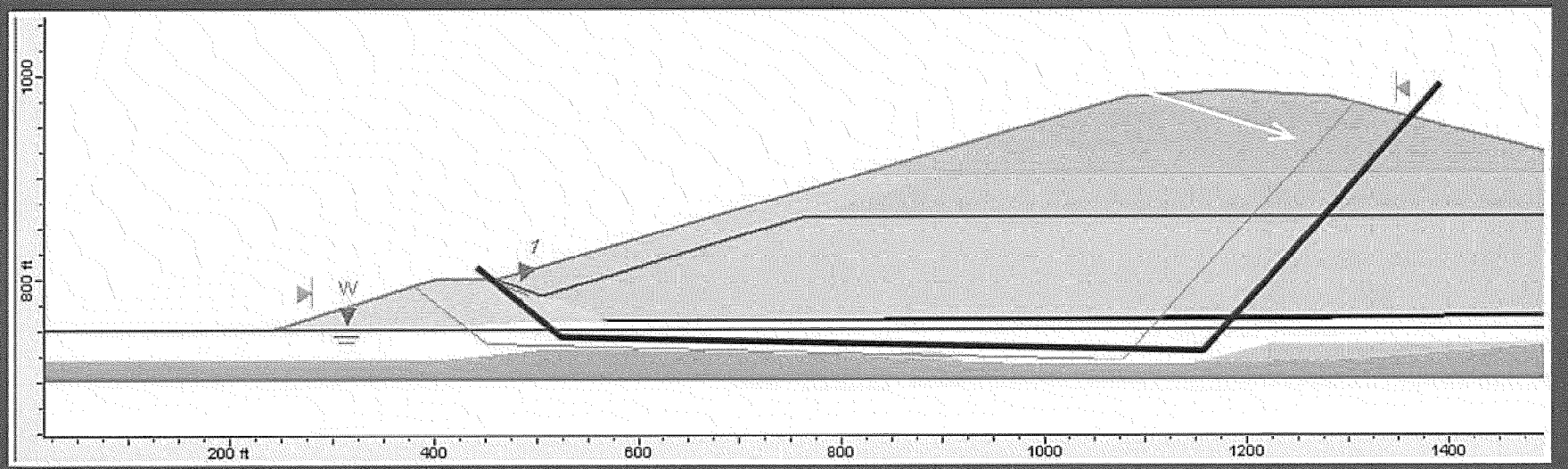
TDEC Waivers Requested

- Construction within buffer area
  - Only soil dikes will be within the 200ft. buffer
  - Waste footprint always outside of buffer
- Hydraulic head on liner
  - Since this is essentially a "wet pond" operation, a waiver will be required to allow a head greater than 1 ft. on geologic buffer during facility operation
- Free Liquids
  - Wet Pond operation will require waiver of "no free liquids" requirement

Slope Stability
Critical Section Locations



Short-term Analysis (Example)



Conclusions (Slope Stability)

- Analyses indicate gypsum stack is stable under anticipated short-term and long-term conditions:
  - Top of Wet Stack Operation
  - Top of Dry Stack Operation
  - Seismic conditions

Groundwater Monitoring Program

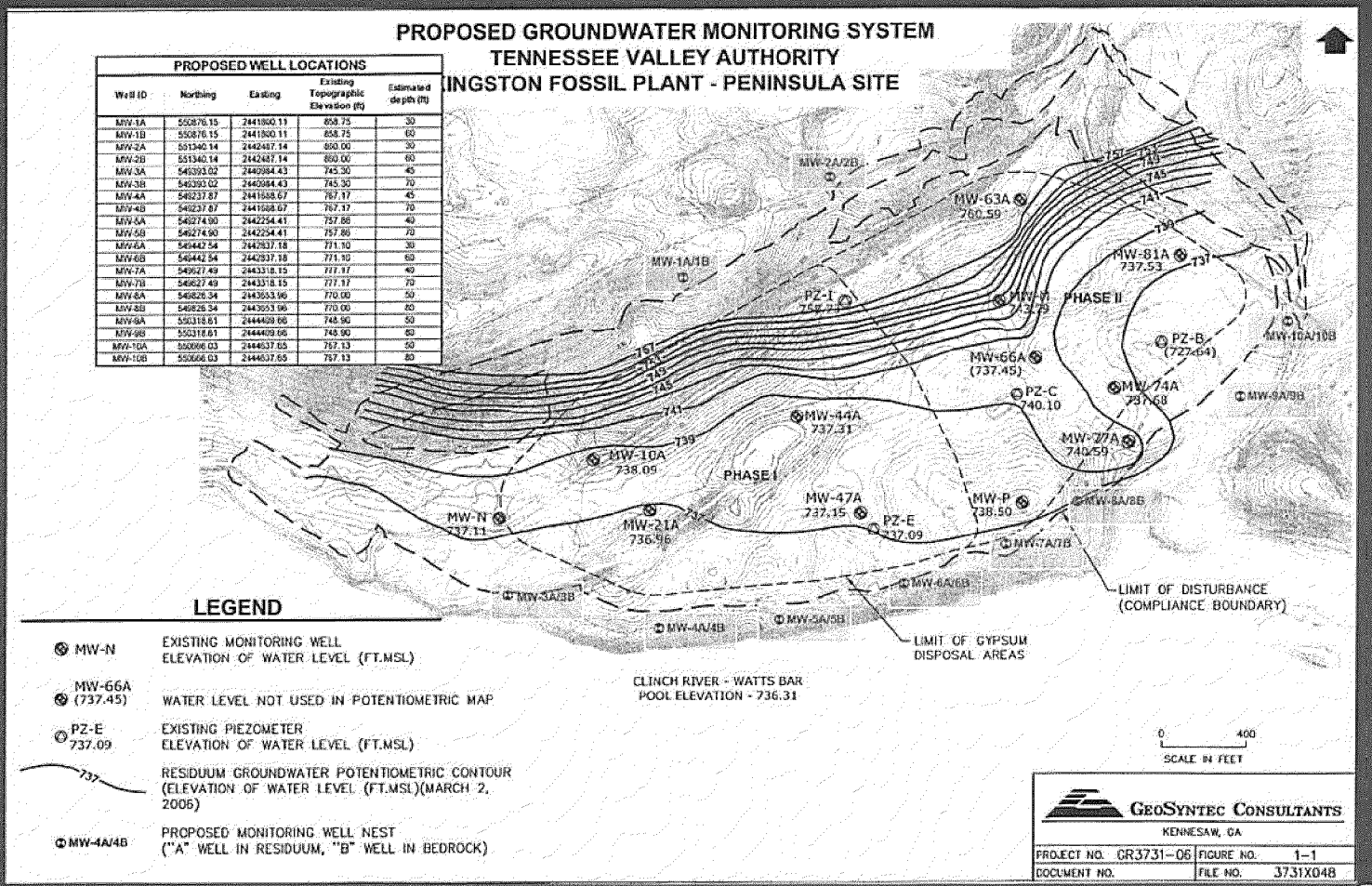
Summary of Proposed Groundwater Monitoring

- Existing wells are within Facility Footprint and will be abandoned
- Monitoring proposed for 2 hydrogeologic units Residuum and bedrock)
  - Both units are hydraulically connected with downward potential
  - Both units discharge to Clinch River
- Upgradient Monitoring
  - Phase 1 – MW-1A/1B
  - Phase 2 – MW-2A/2B
- Downgradient (along river)
  - MW-3A/3B through MW-10A/10B

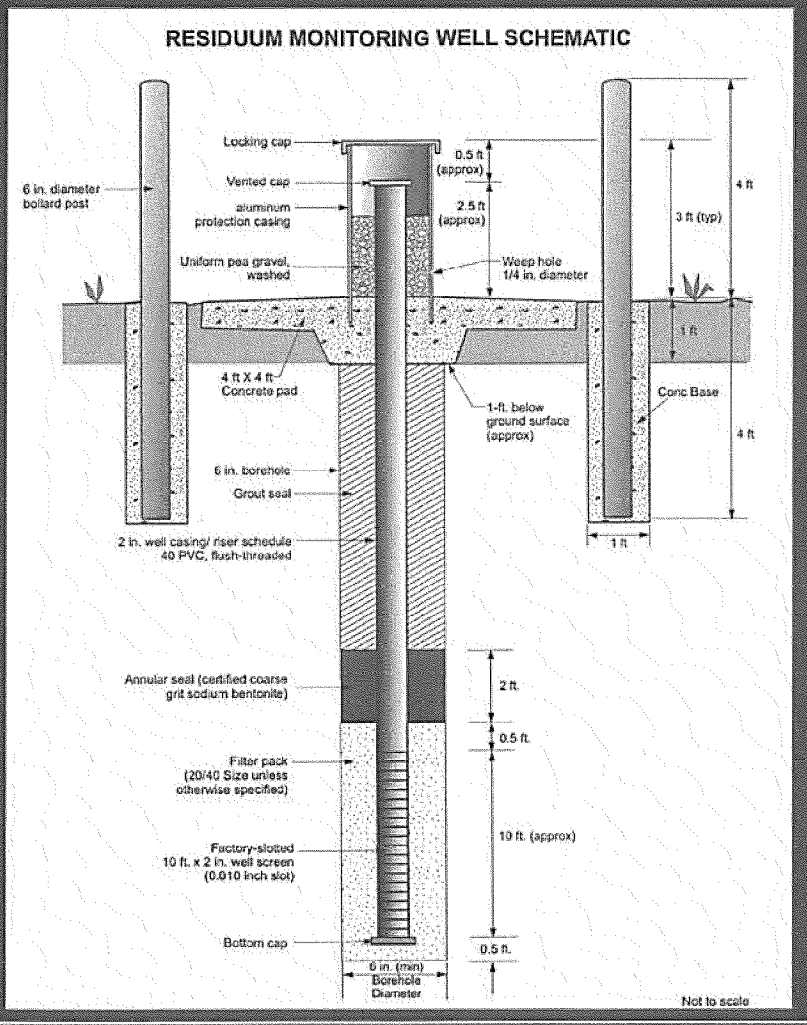
Groundwater Monitoring Program

- Detection monitoring program per Rule 1200-1-7-.04
- 17 inorganic constituents
- Statistical data evaluation of semi-annual data to assess for statistically significant increase (SSI)
- SSI event will trigger notification and establishment of an Assessment Monitoring Program (3 Phase Approach)
  - Phase 1 – initial assessment sampling and background sampling
  - Phase 2 – two semi-annual events
  - Phase 3 – develop/submit Groundwater Quality Assessment Plan (GWQAP)

Groundwater Monitoring Network



Monitoring Well Detail - Residuum



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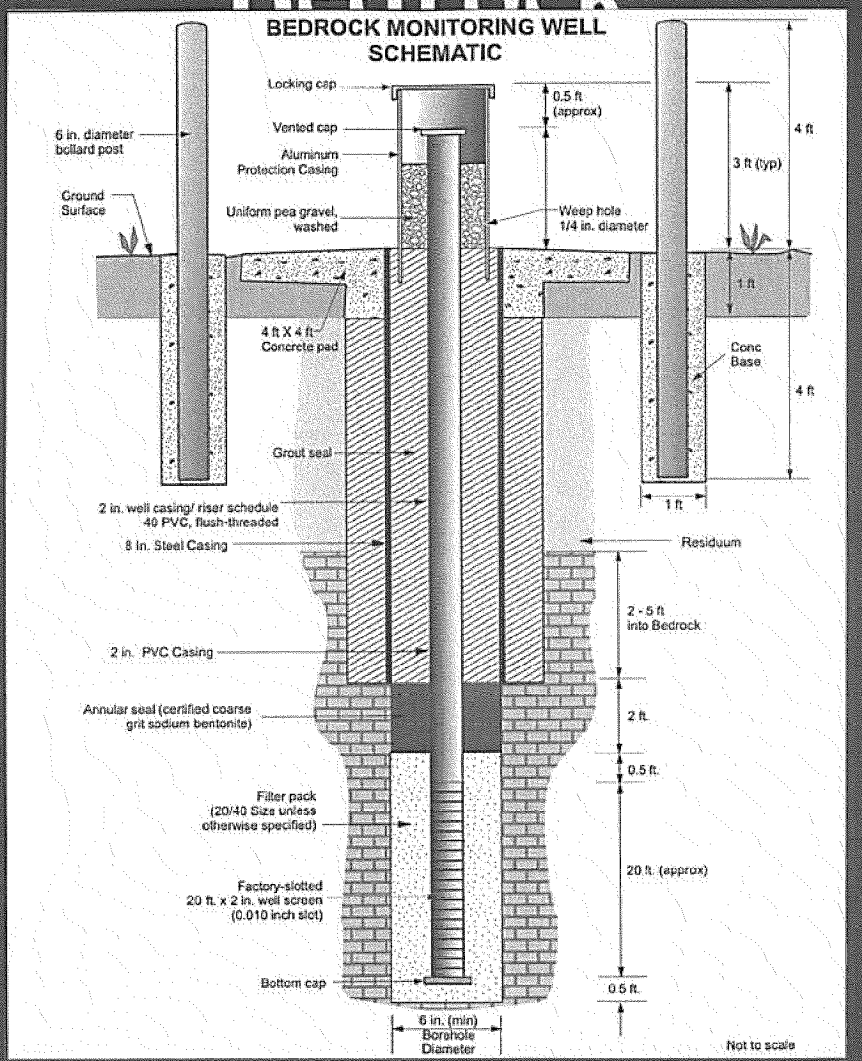
Monitoring Well Detail - Bedrock



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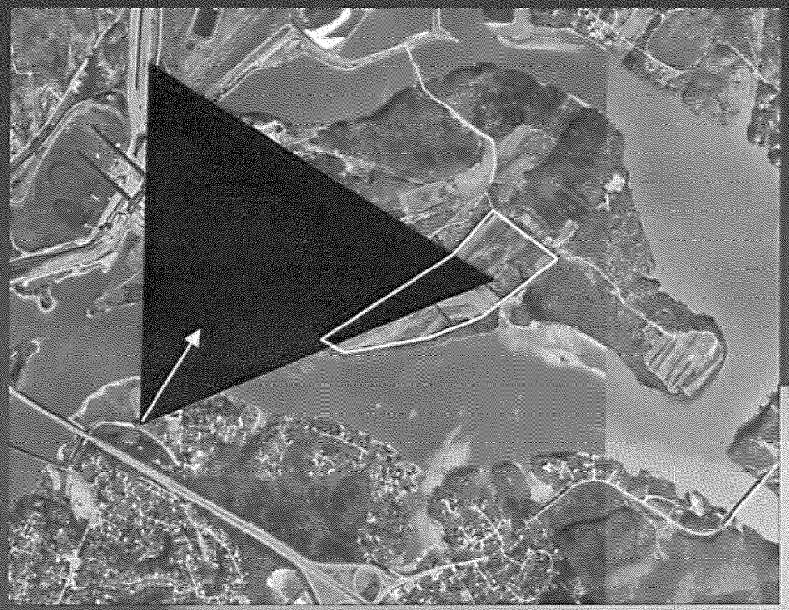
Aesthetic Considerations

Aesthetic Considerations

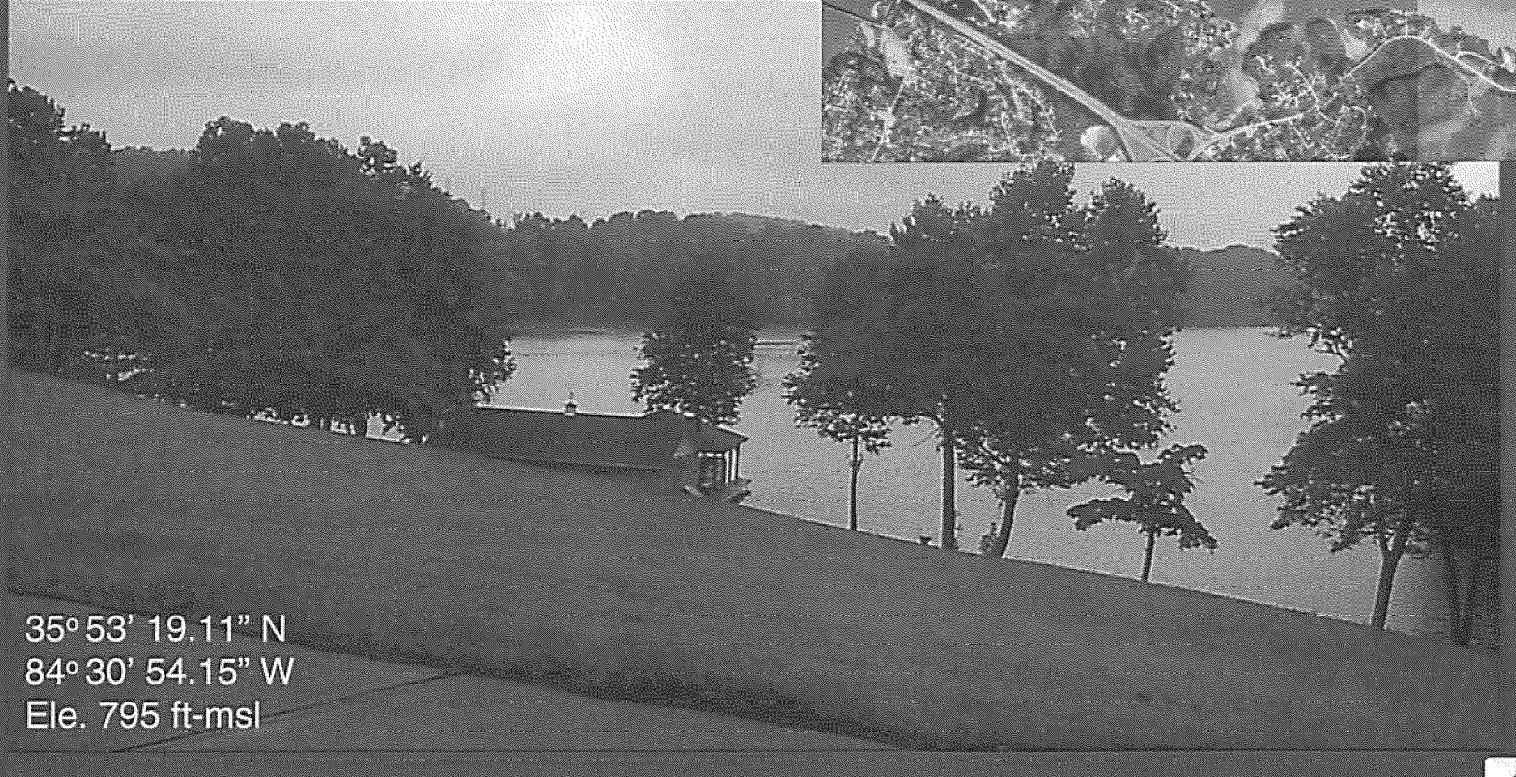
- The following slides consist of "before and after" renderings
- "Before" – recent photographs taken from viewpoints on the south side of the river, looking towards the TVA reservation
- "After" – rendering showing likely view after full development of gypsum byproducts disposal facility and re-establishment of vegetation

View 1 - Before



35° 53' 10.11" N
84° 31' 12.27" W
Ele. 790 ft-msl

View 2 - Before



35° 53’ 19.11” N
84° 30’ 54.15” W
Ele. 795 ft-msl

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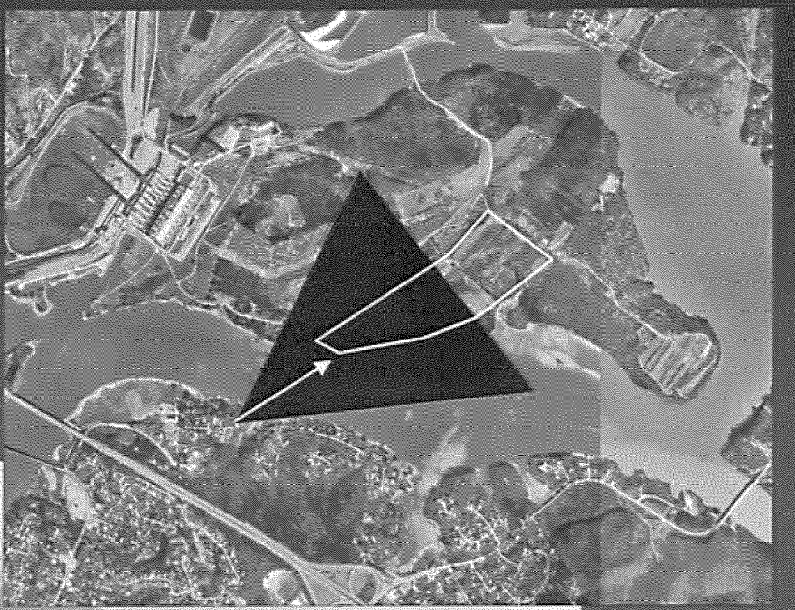
View 2 - After



35° 53’ 19.11” N
84° 30’ 54.15” W
Ele. 795 ft-msl

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View 3 - Before

35° 53' 18.63" N
84° 30' 41.56" W
Ele. 780 ft-msl

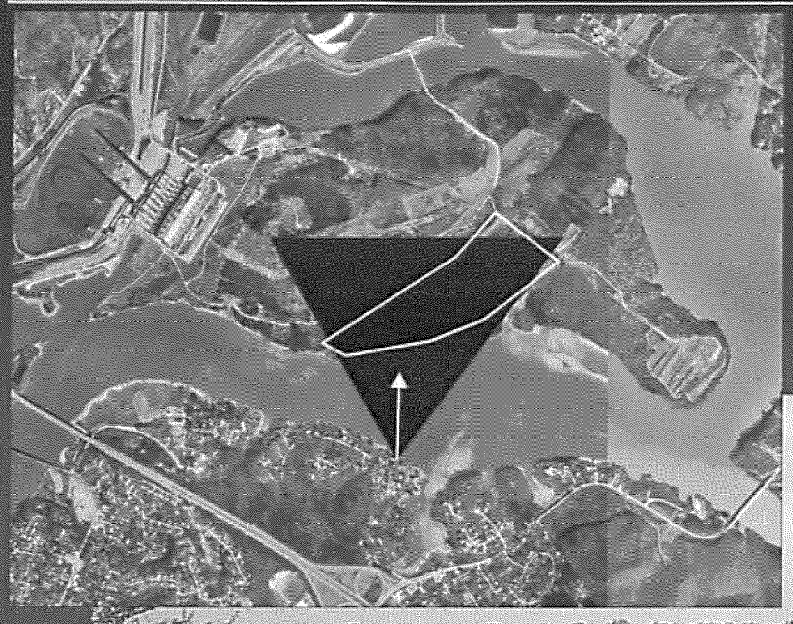
GeoSyntec

View 3 - After

35° 53' 18.63" N
84° 30' 41.56" W
Ele. 780 ft-msl

GeoSyntec

View 4 - Before



35° 53' 11.78" N
84° 30' 22.58" W
Ele. 750 ft-msl

View 4 - After

35° 53' 11.78" N
84° 30' 22.58" W
Ele. 750 ft-msl

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View 5 - Before

35° 52’ 55.25” N
84° 30’ 19.14” W
Ele. 770 ft-msl

GeoSyntec

View 5 - After

35° 52’ 55.25” N
84° 30’ 19.14” W
Ele. 770 ft-msl

GeoSyntec

View 6 - Before

35° 53' 10.75" N
84° 30' 09.87" W
Ele. 795 ft-msl

GeoSyntec

View 6 - After

35° 53' 10.75" N
84° 30' 09.87" W
Ele. 795 ft-msl

GeoSyntec

View 8 - Before

35° 53' 10.75" N
84° 30' 09.87" W
Ele. 795 ft-msl

GeoSyntec

View 9 - Before

35° 53' 03.34" N
84° 29' 50.97" W
Ele. 825 ft-msl

GeoSyntec

View 9 - After

35° 53' 03.34" N
84° 29' 50.97" W
Ele. 825 ft-msl

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To Summarize....

Rule 1200-1-7-.04(2)(q) requires the following demonstration by an applicant for a solid waste permit

- Karst Terrane - If a facility is proposed in an area of highly developed karst terrane (i.e., sinkholes, caves, underground conduit flow drainage, and solutionally enlarged fractures) the applicant must demonstrate to the satisfaction of the Commissioner that relative to the proposed facility siting:
  - There is no significant potential for surface collapse;
  - The groundwater flow system is not a conduit flow which would contribute significant potential for surface collapse or which would cause significant degradation to the groundwater; and
  - Location in the karst terrane will not cause any significant degradation to the local groundwater resource.
- *TVA Believes this pending application adequately addresses this demonstration*

Conclusion

TVA believes the Peninsula Site provides the optimum site for location of the disposal facility for the following reasons:

- Operations
  - TVA proposes to develop the site in a phased approach; if marketing activities are successful, site development and land disturbance will be minimized
- Location
  - The site is currently part of TVA Kingston Reservation (no land purchase or significant change of use)
- Suitability
  - Favorable hydrogeologcal conditions (low permeability soils, excellent geologic buffer, no evidence of Holocene-age faulting, no karst voids immediately above bedrock
- Aesthetics
  - With appropriate landscaping, existing vistas will not be negatively impacted

Thank You

Questions?