

KINGSTON RCA



Kingston Dredge Cell Failure

Root Cause Failure Analysis

6/25/09

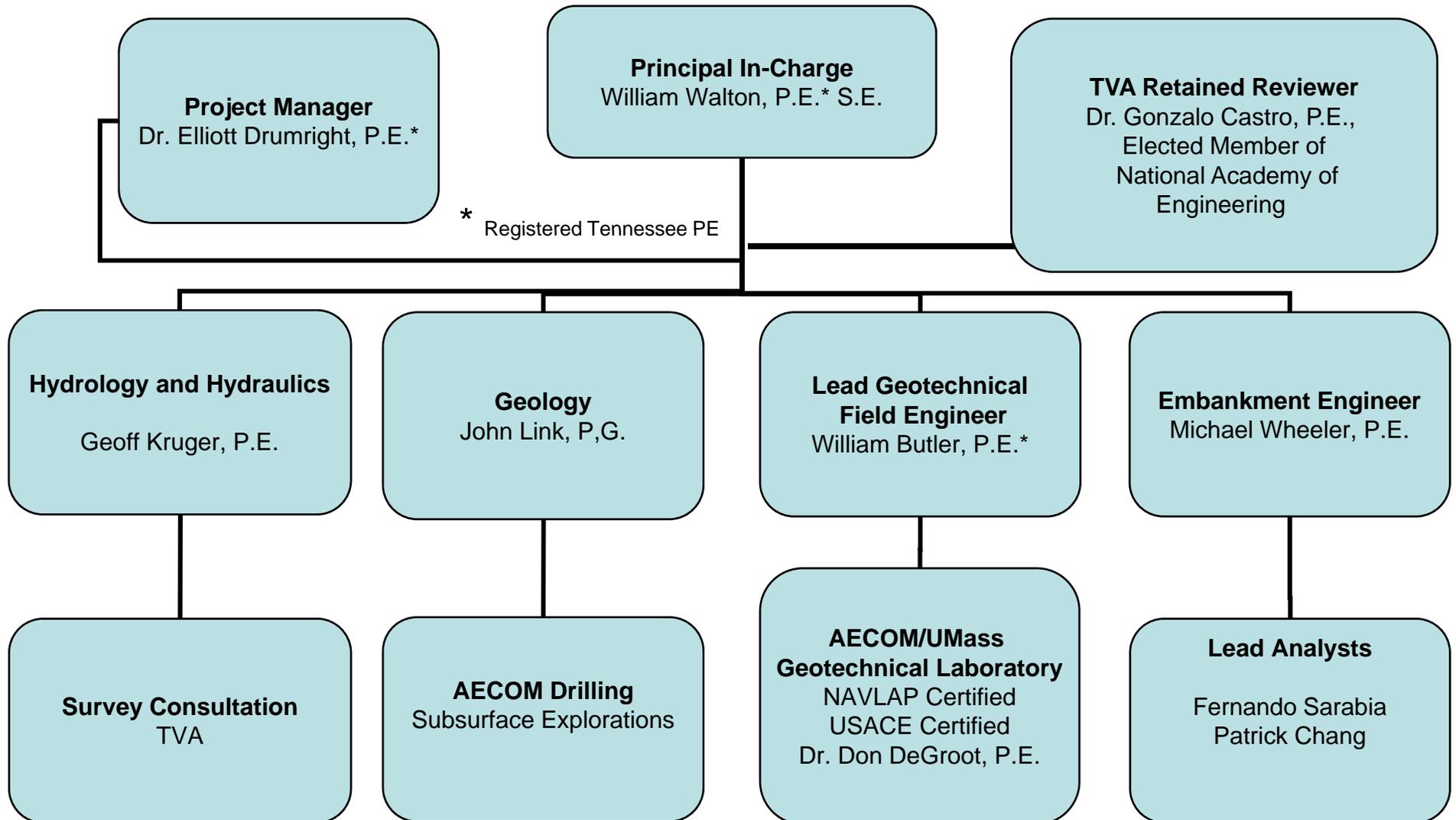
AECOM

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Independent Peer Review by

Dr. Gonzalo Castro, P.E., NAE

RCA AECOM Project Team



AECOM RCA 2009 Schedule

- Site Visit & Flyover January 8
- Signed Agreement January 16
- Data Review Jan. 10 to May 1
- Field Explorations Jan. 17 to April 3
- Laboratory Testing Feb 10 to June 8
- Analyses March 15 to June 13
- Preliminary Findings May 21
- Final RCA Report June 25
- Peer Review of Remedial Designs Ongoing

Root Cause Analysis

- **Define the problem**
- **Gather physical data/evidence**
- **Ask why and identify technical issues**
- **Perform testing and analyses**
- **Identify causes (most probable failure mode)**
- **Review effective solutions**
- **Implement restoration program (TVA)**
- **Institute performance monitoring to ensure effectiveness (TVA)**

AECOM RCA Activities

- Greater than 20 staff in TN for 3 months
- 147 Sampling Borings (4 to 5 rigs)
 - 59 Standard Penetration Test Borings
 - 8 of the 59 Included Rock Coring
 - 25 of the 59 Included Inclinometers
 - 21 Piezometer Locations & 54 Piezometers Installed
 - 48 Vane Shear/ 2" Shelby Tube Test Borings
 - 40 Osterberg/Shelby Tube Sampling Holes
- 87 Cone Penetrometer CPTu Test Probes (1 rig)
- Drilled and Installed Cross-hole Geophysical



AECOM

RCA Activities - Continued

- Located, Surveyed, and Logged Identifiable Relics
 - Survey monument, Spillway, Cell Tower, Outlet Piping, etc.
- Observed Two Test Trenches for Location of Outfall Piping
- Conducted Interviews to Establish Timelines
- Reviewed TVA Records
 - Established Filling and Flooding History
- Completed Test Trench on South Cell 1 Dike
- Reviewed Potential Failure Modes
- Performed Seepage Analyses
- Performed Stability Analyses
- Reporting to Multiple Agencies and Governing Bodies



HISTORIC MAPPING & PHOTOS

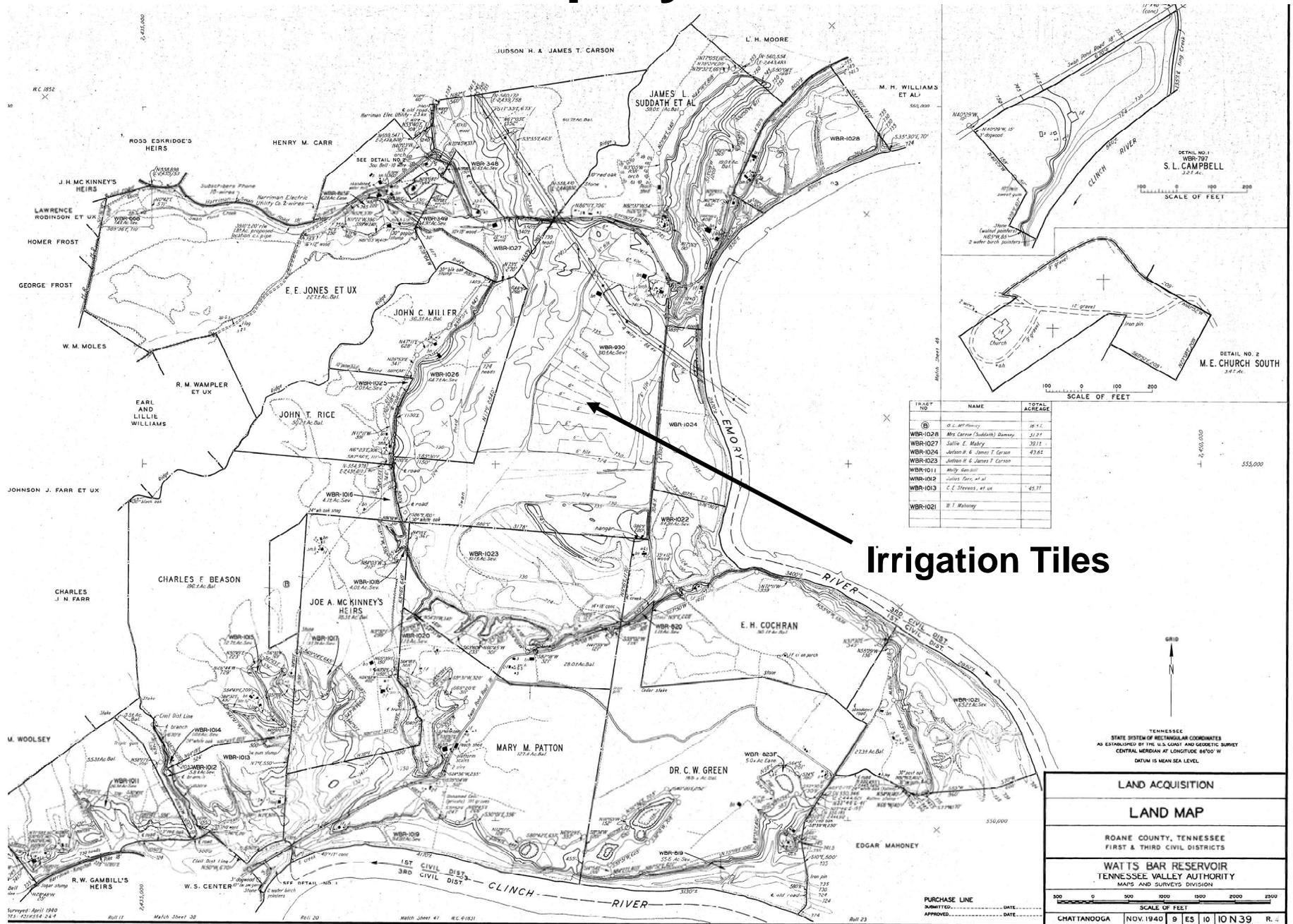
Chronology at Swan Pond Creek

- 1924 Swan Pond Creek Flows into Emory
- 1942 Watts Bar Reservoir Filled
- 1954 Initial Ash Pond Operational
- 1958 Dike C for Full Ash Pond Completed
- 1965 Initial Ash Pond Filled
- 1978 Settling Pond Constructed, Original Spillway Out
- 1984 Begin Filling Dredge Cells No. 1 & 2
- 1987 Filling in Cells 1 and 3
- 1994 Completed Dike D, Filling Cells 1, 3 and 2
- 1996 Began Re-Filling Cell 2 with 200' Setback Dike A
- 2004 Began Filling Phase I Interim Dredge Cell
- 2008 Failure of Cells 2, 3 and the Phase I Cell

1924 Aerial and Plane Table Survey by War Department



1940 Land Map by TVA



Irrigation Tiles

TRACT NO	NAME	TOTAL ACREAGE
①	J. L. McKinney	16.11
WBR-1028	Mrs. Corra (Suddath) Ramsey	21.27
WBR-1027	Sullivan E. Mabry	32.11
WBR-1024	Judson H. & James T. Carson	43.61
WBR-1023	Judson H. & James T. Carson	43.61
WBR-1011	Emily Carson	43.61
WBR-1012	Sullivan E. Mabry, et al	45.11
WBR-1013	C. E. Stevens, et al	45.11
WBR-1021	W. T. Mahoney	

STATE SYSTEM OF RECTANGULAR COORDINATES
AS ESTABLISHED BY THE U. S. COAST AND GEODETIC SURVEY
CENTRAL MERIDIAN AT LONGITUDE 84°00' W
DATUM IS MEAN SEA LEVEL.

LAND ACQUISITION

LAND MAP

ROANE COUNTY, TENNESSEE
FIRST & THIRD CIVIL DISTRICTS

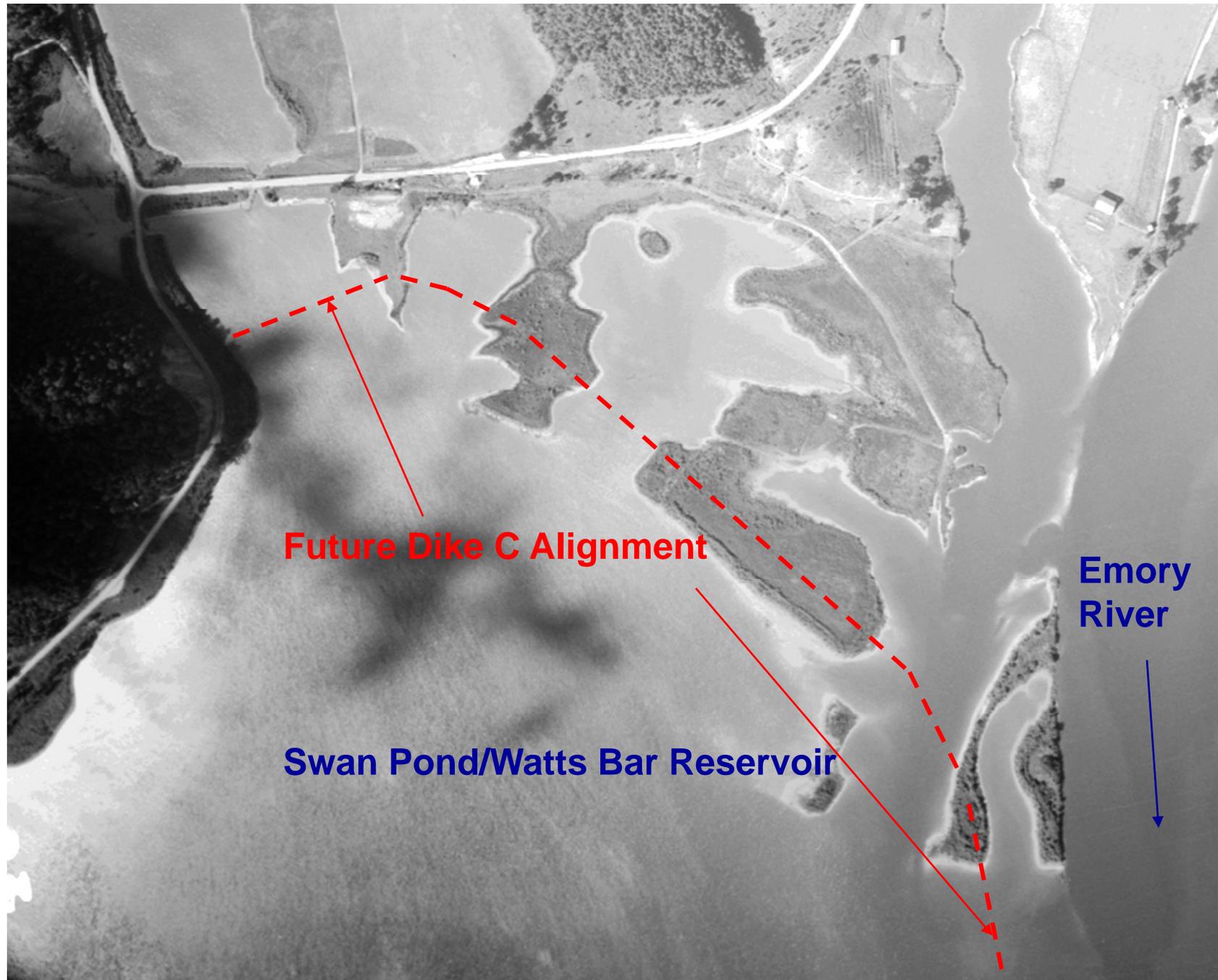
WATTS BAR RESERVOIR
TENNESSEE VALLEY AUTHORITY
MASS AND SURVEYS DIVISION

SCALE OF FEET
0 500 1000 1500 2000 2500

PURCHASE LINE
SUBMITTED: _____ DATE: _____
APPROVED: _____ DATE: _____

CHATANOOGA NOV. 1940 9 ES 10 10 N 39 R. 11

09-23-1949

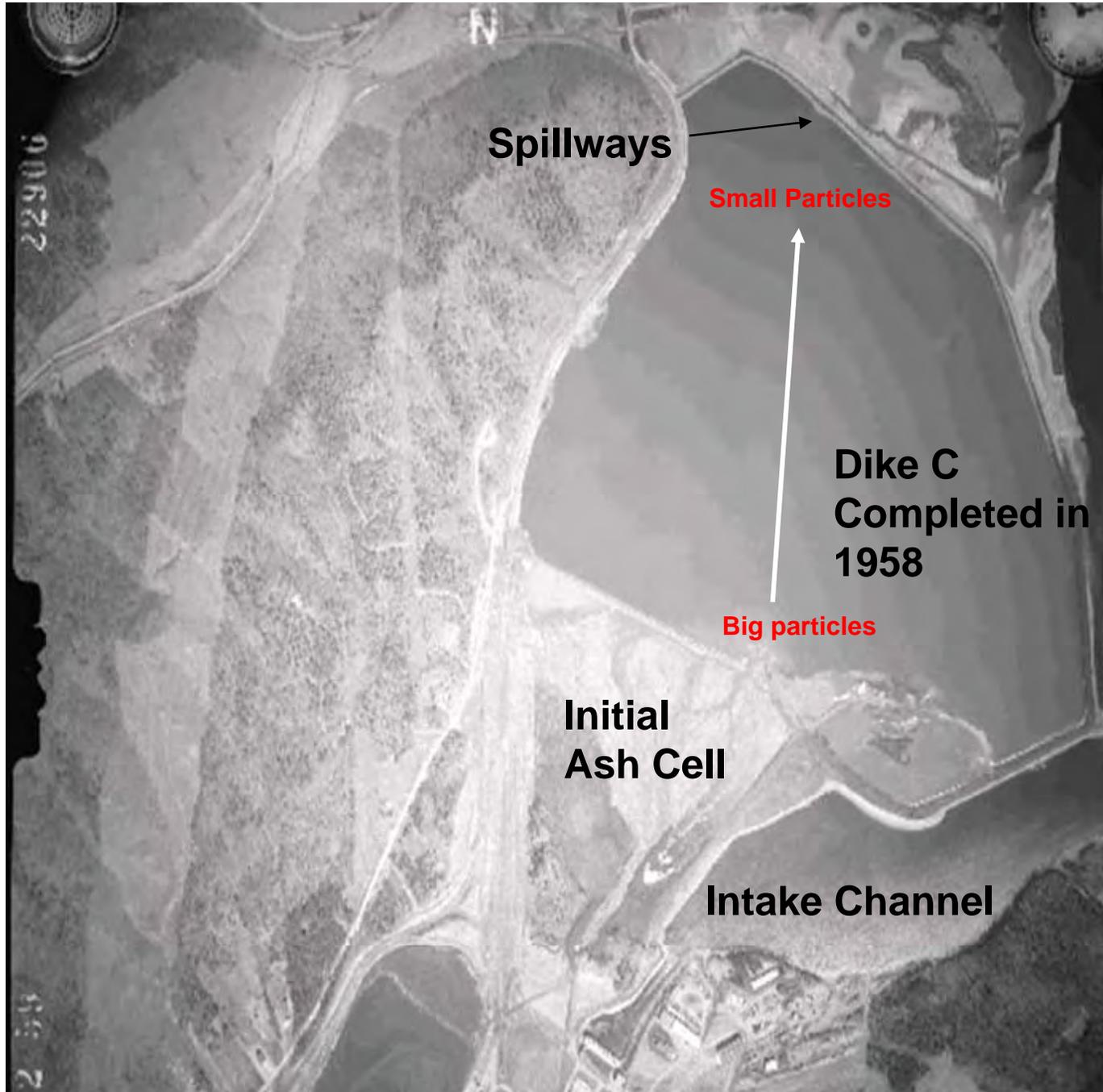


Future Dike C Alignment

**Emory
River**

Swan Pond/Watts Bar Reservoir

3-22-1959



04-21-1962



Reservoir

Spillway

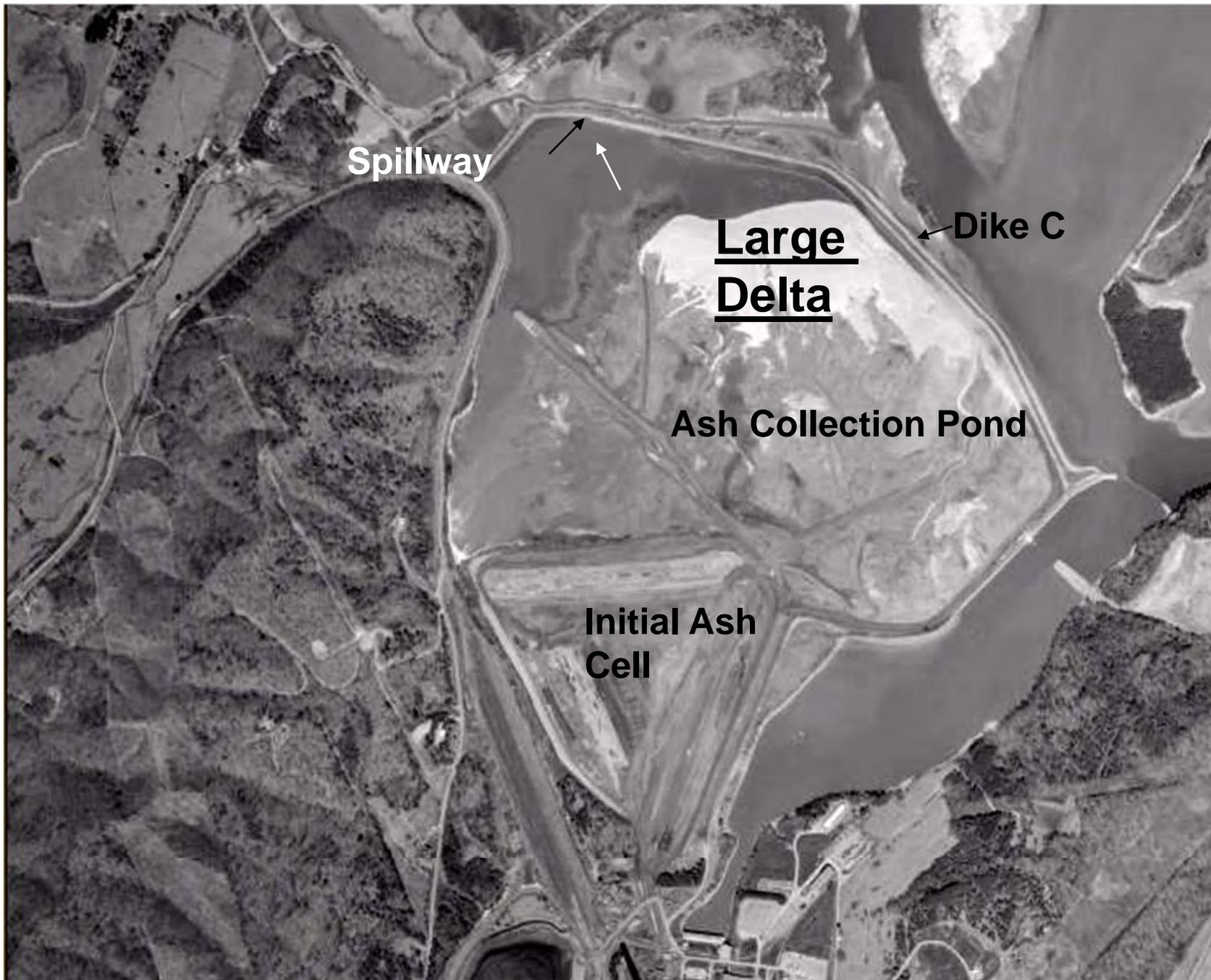
**Ash Collection
Pond**

Delta

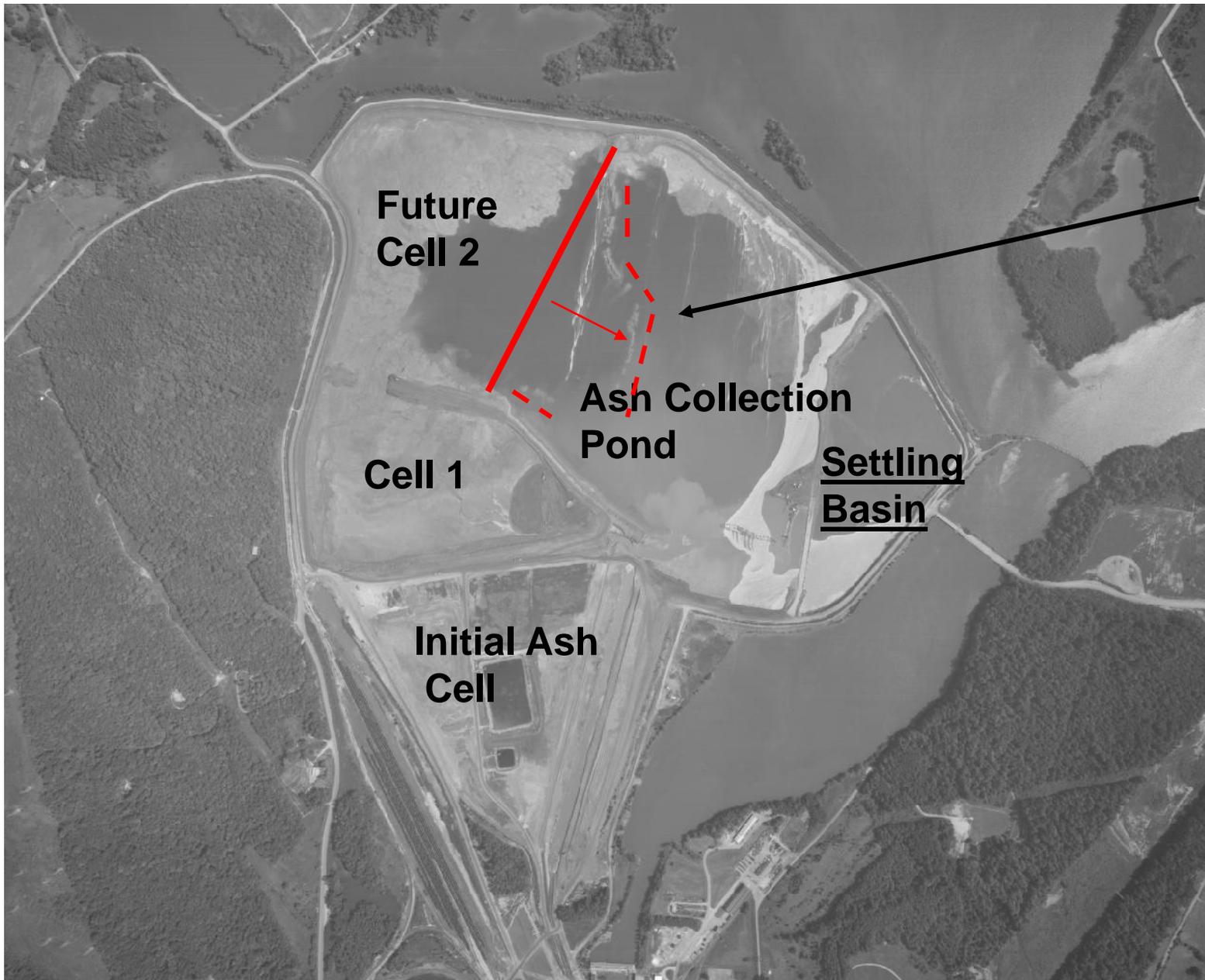
Initial Ash Pond

Intake Channel

1976

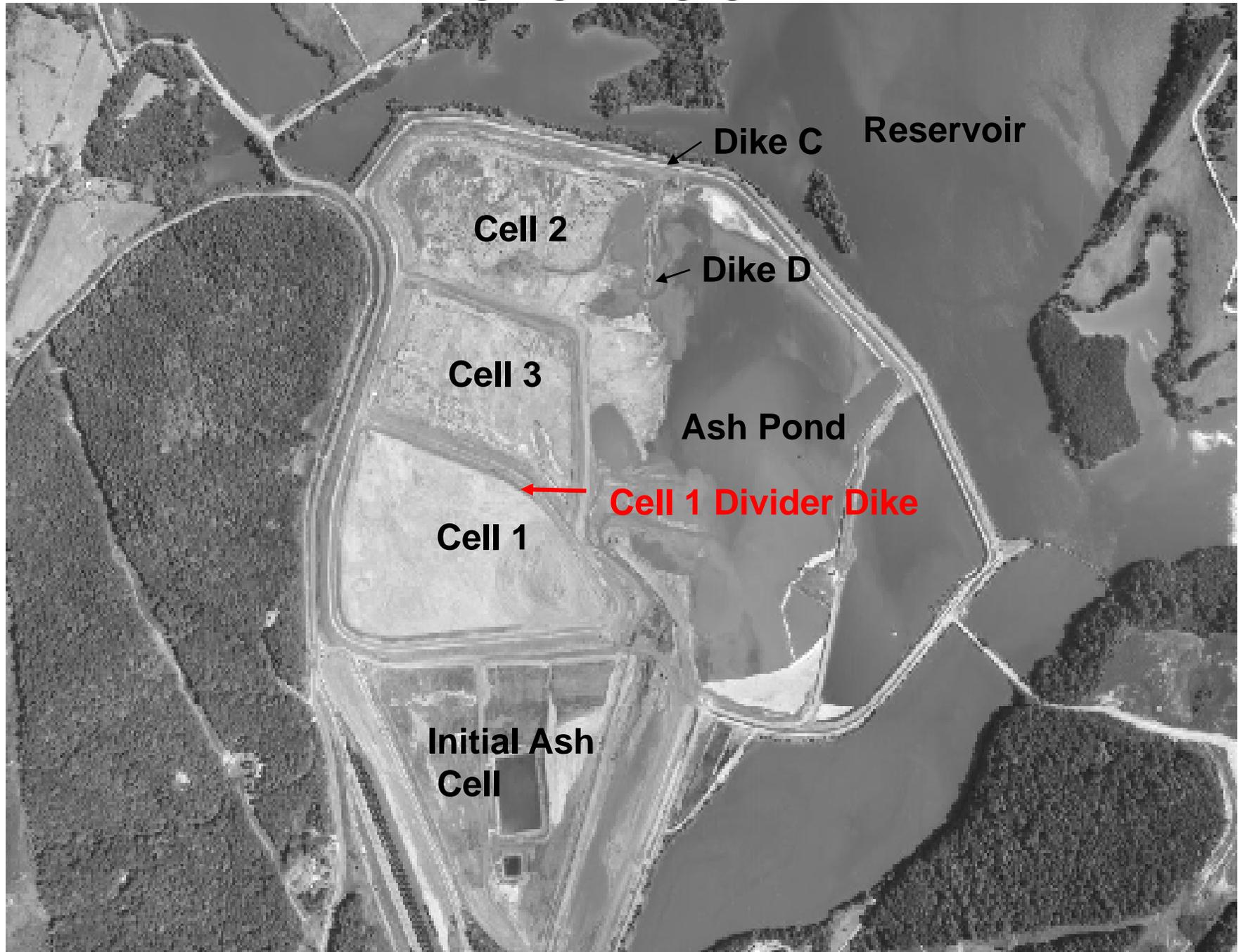


8-24-84

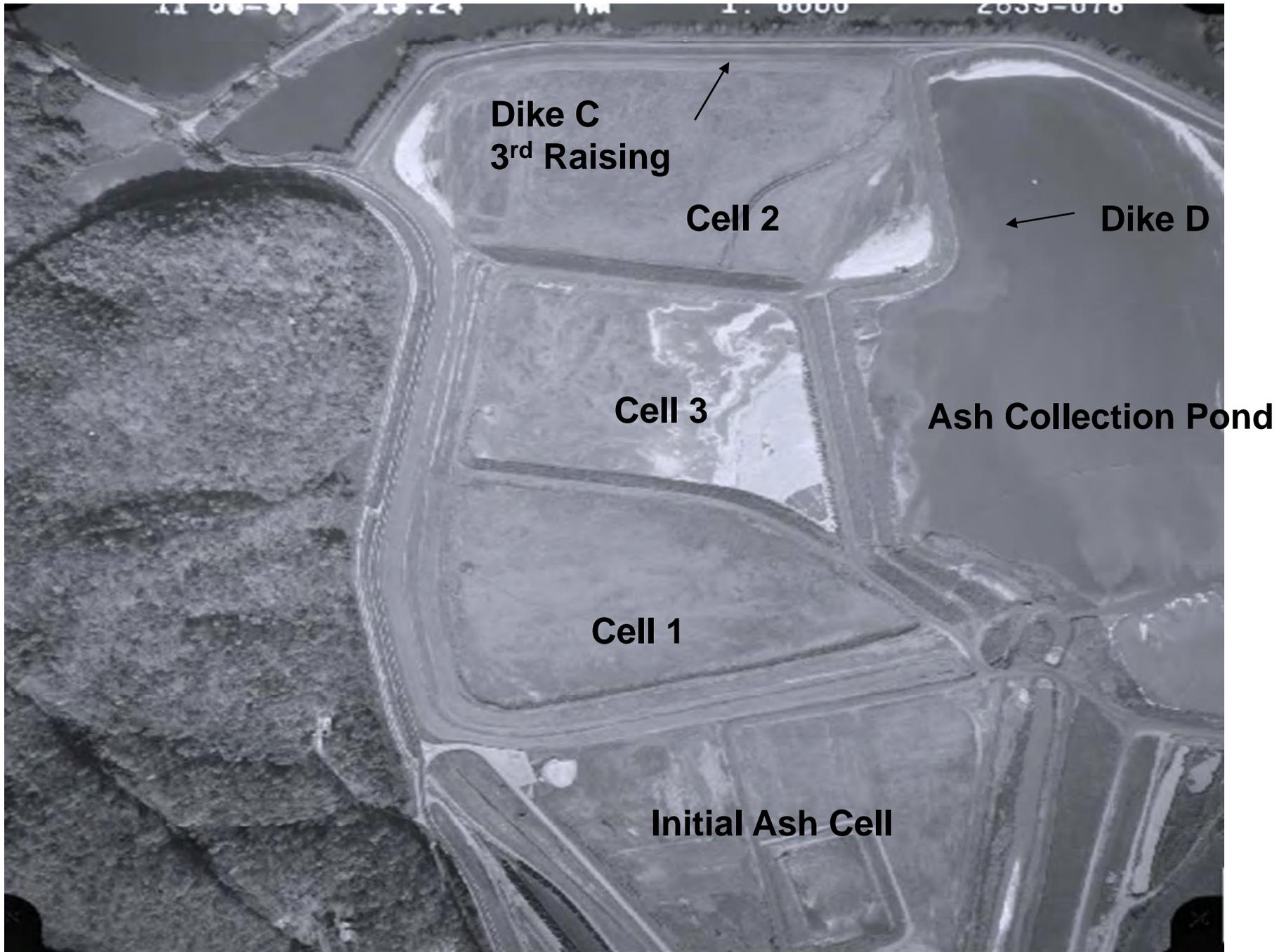


August 8,
1984 Divider
Dike D
Failure

9-3-1987



11-08-1994



11-3-1996



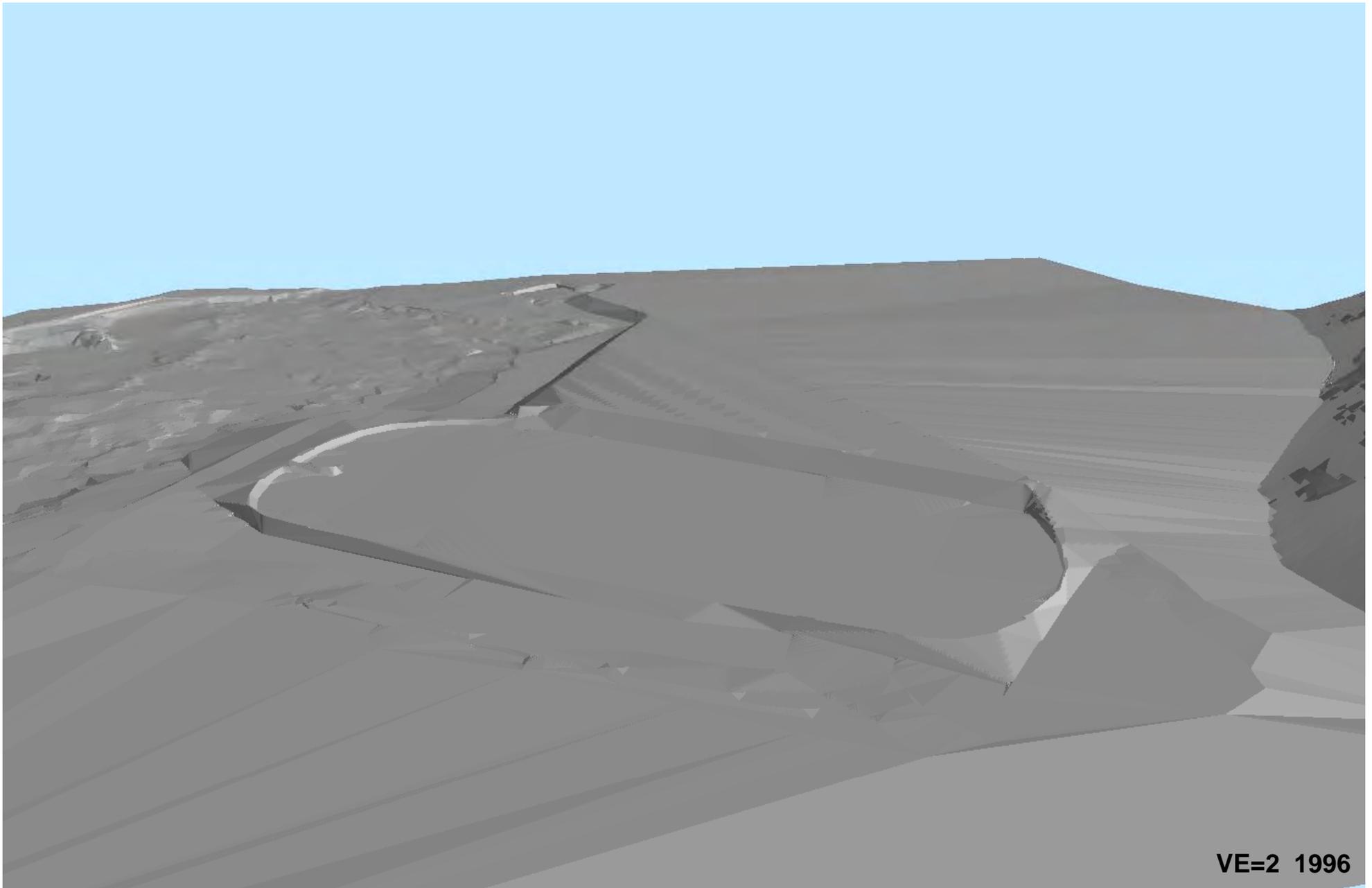
4-5-2005



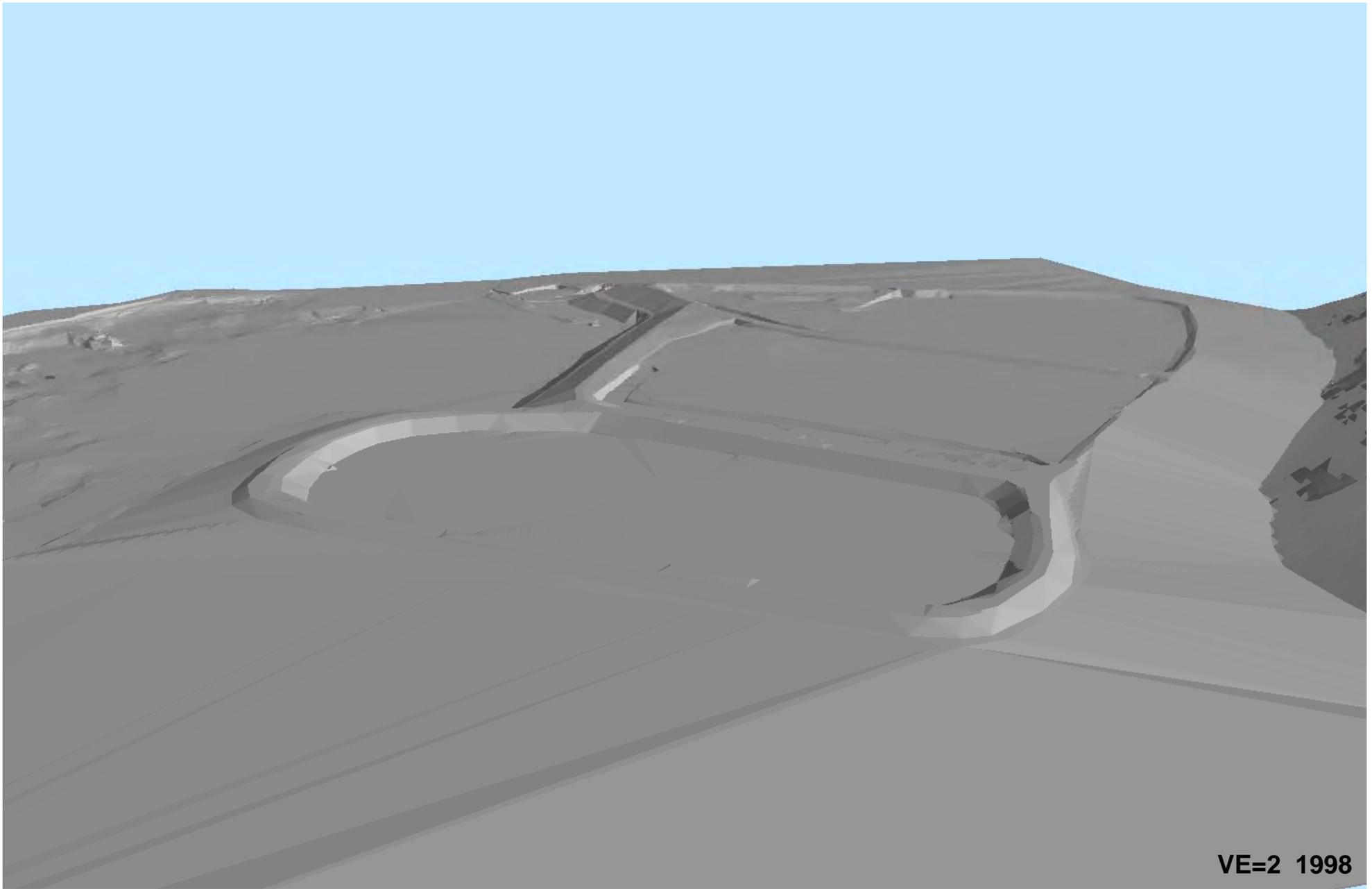
4-5-2008



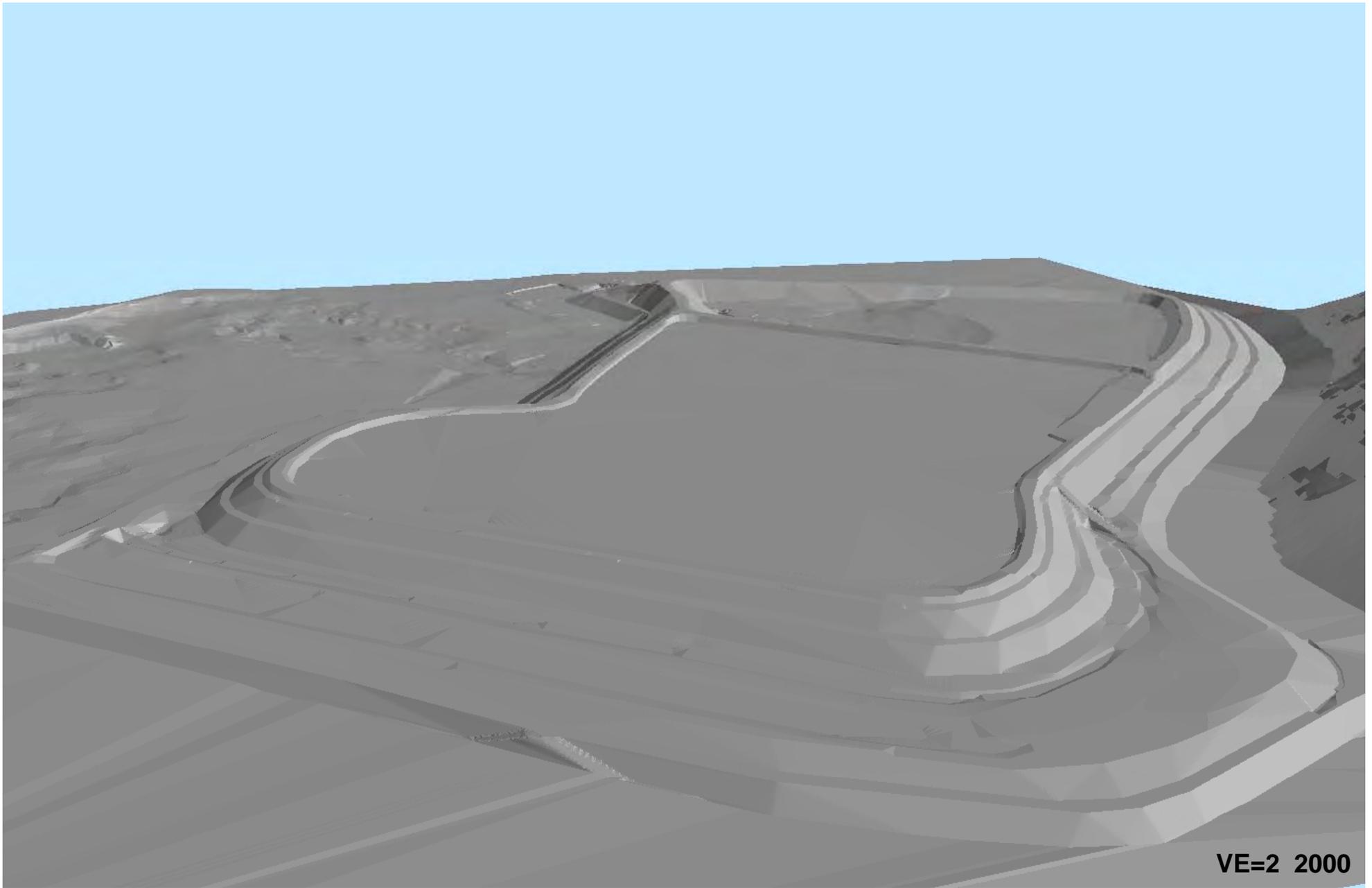
GIS Views of Dredge Cells Using TVA Surveys



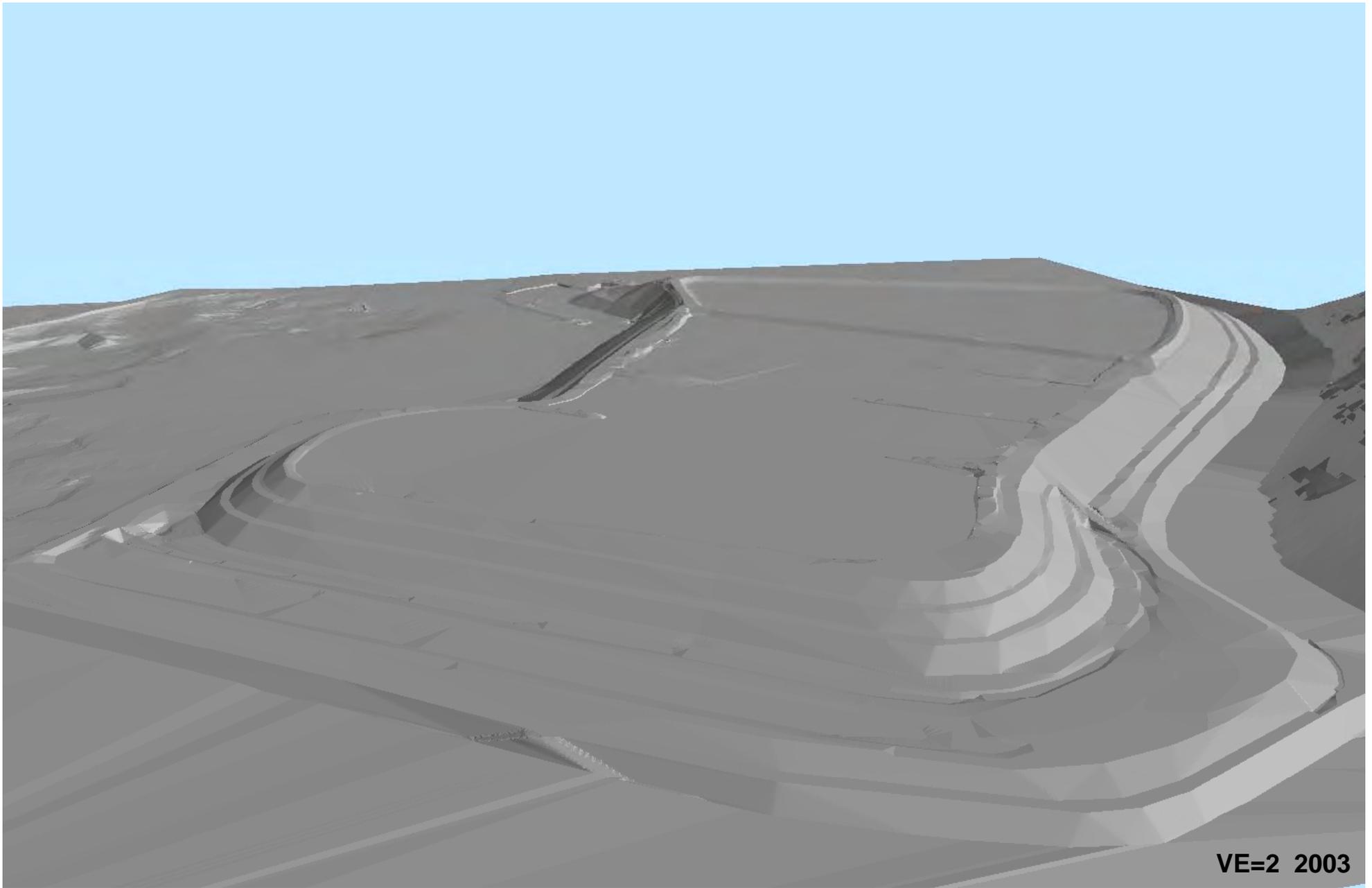
1996 Pre-failure Topography from TVA Surveys



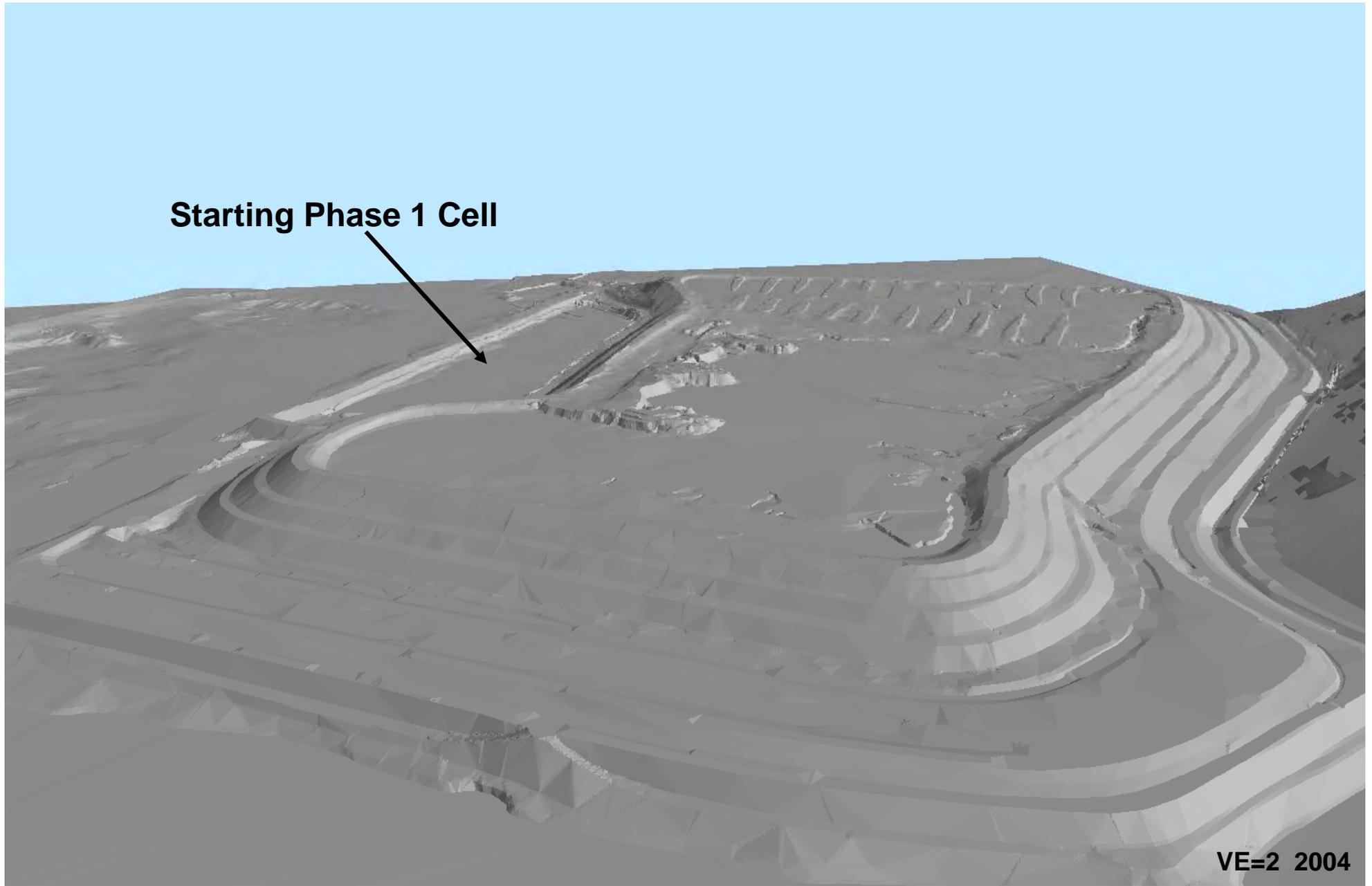
1998 Pre-Failure Topography from TVA Surveys



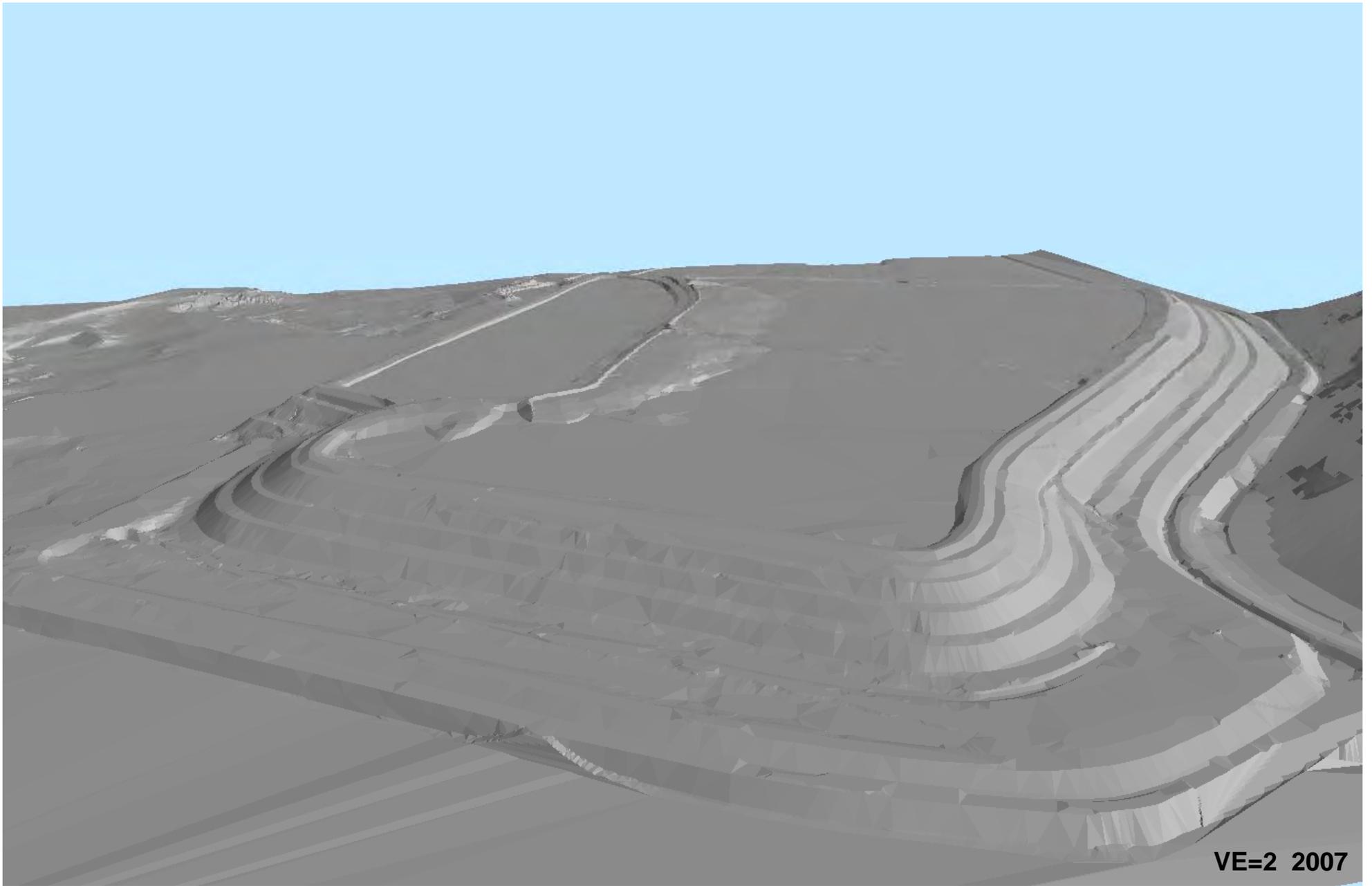
2000 Pre-Failure Topography from TVA Surveys



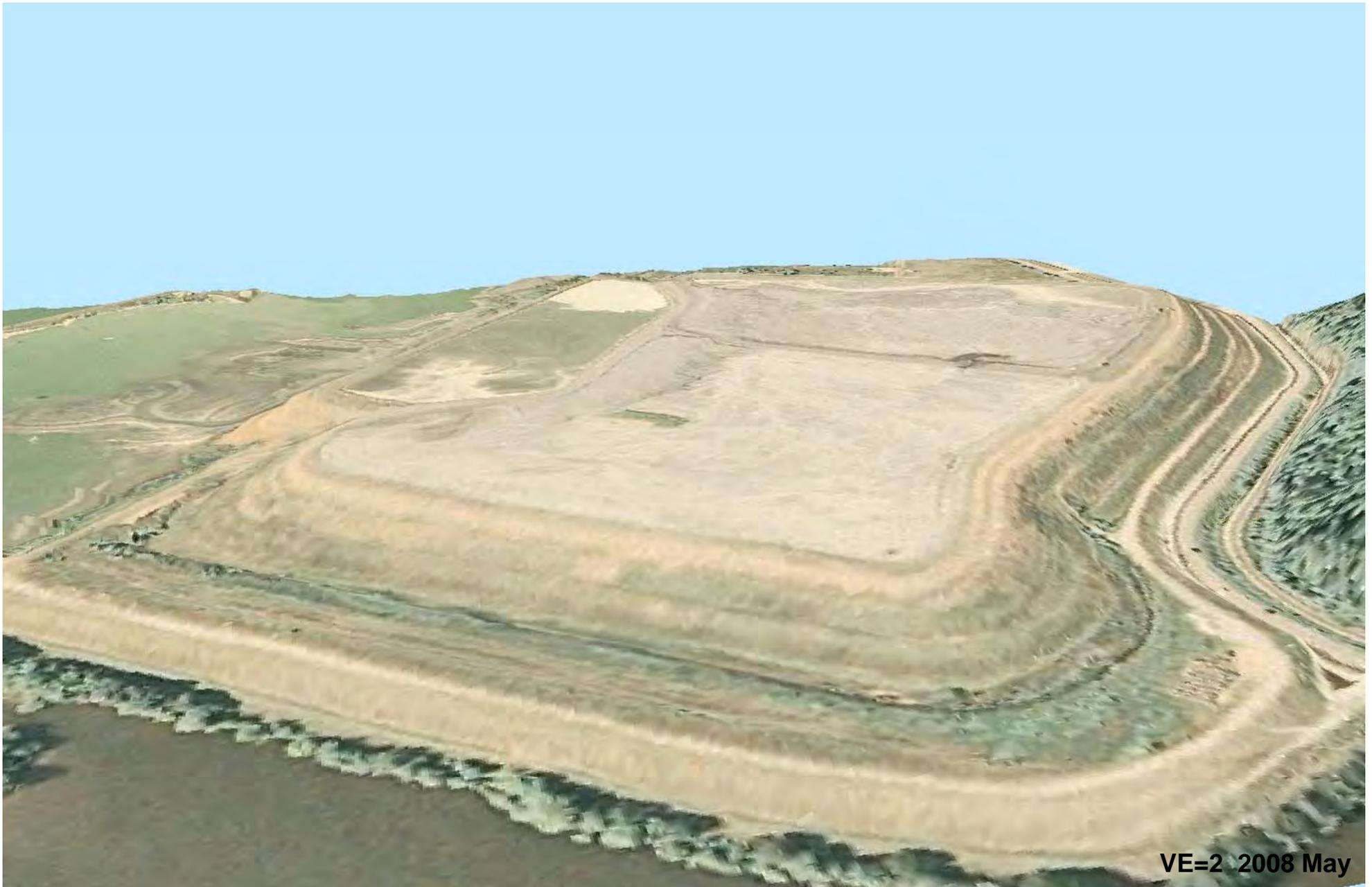
2003 Pre-Failure Topography from TVA Surveys



2004 Pre-Failure Topography from TVA Surveys



2007 Pre-Failure Topography from TVA Surveys



May 2008 Air Photo and Topography from Pre-Failure from TVA Surveys