Wheeler_Surface_Areas_gdb_eek_rev0

NOTE: "gdb.txt" and "timestamps.txt" were renamed to aid retrieval from PDF electronic attachment storage. Remove ".txt" extension for use.

1. Purpose

The USACE provided data to TVA that represent the bottom of the Tennessee River at various locations. This data was used to verify and validate the river section geometry below the water surface for use in preparation of SOCH model input. The linear, cross-section orientation of these data present problems for the triangulation algorithms used in modern GIS software. This Appendix describes an alternate method of inspecting and using the source data without triangulation or interpolation.

2. Methodology

The USACE bathymetric survey data contains series of points generally perpendicular to the river channel flow, describing cross sections at roughly 500 foot intervals along the river. At any given SOCH model section location, a series of USACE data points should be no more than 250 feet away, shown by example in Figure J-1. These data points can be taken to describe an underwater section very nearly approximating the section that would be observed at the SOCH model section location.

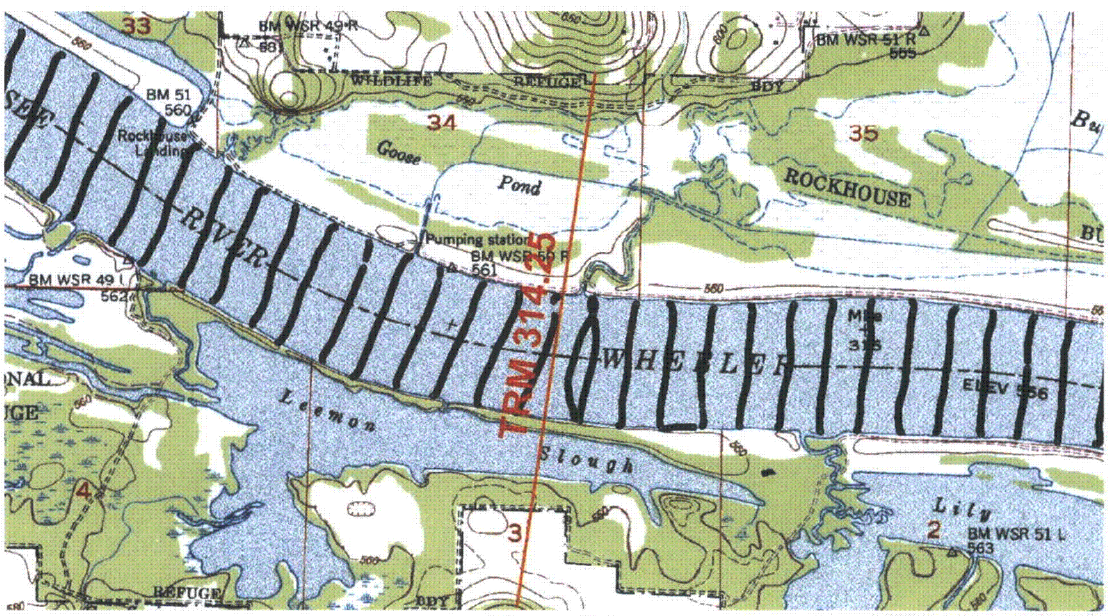


Figure J-1

For two section locations along the Tennessee River in Wheeler Reservoir, TRM 309.44 and TRM 314.25, where triangulation anomalies were suspected in the observed cross-section extracted from USACE TINs (Att. D-1), two or three nearby USACE data point series were selected. Considering each series individually, the station of a data point along the section location line was defined as the intersection of a line perpendicular to the section location line and passing through the data point. This was accomplished in CAD software by plotting the 3D data points, then defining a view of the data with the

X-axis oriented along the section location line, and the Y-axis corresponding to elevation, and the coordinate plane origin on the left bank. Using these stations paired with the elevations of the original data points, a section was defined. Each series defined a section, and these multiple underwater sections were compared to other data sources for verification and validation in Appendix D.

1. Purpose

The purpose of this part of the calculation was to meet the requirements of NEDP-2 for the use of non-QA software in a QA application, specifically to confirm the acceptability of area measurements and cross-section profiles extracted using MicroStation and ArcGIS software.

2. Methodology

The elevations for the cross-sections came from two sources: digital elevation model data (DEM) from the USGS, and from underwater survey data collected by the USACE.

Using ArcGIS software, under water TIN surfaces were created from USAC data, and a raster mosaic of the above water DEM data was created. Using ArcGIS add-on tool EZ Profiler, a vertical section was then cut at the selected TRM stations from the two surfaces, producing a cross-section. Additionally, selected contour lines were generated from the DEM data using ArcGIS extension Spatial Analyst. These contours were subdivided into a polygonal area per contour elevation for each river reach between cross-section locations. The area of the generated polygons was calculated with ArcGIS "Calculate Geometry" tool.

In order to verify that the cross-sections and measured areas were correct, a similar procedure was followed using alternate software. DEM data were converted to MicroStation GeoPak TIN surfaces using the GeoPak Survey "Geodetic Coordinate Conversion" tool (Figure K-1). USACE point data was converted to a GeoPak TIN surface using the GeoPak "Extract XYZ" tool (Figure K-2). Cross-sections were extracted from these surfaces using the GeoPak Road "Ground Profile" tool and compared to the cross-section generated in ArcGIS by plotting both data sets into an Excel spreadsheet chart for visual comparison. Comparison plots are included at the end of this appendix.

Contours were generated from the DEM TIN using the GeoPak "Load TIN Features" tool. These contours were visually compared to contours generated in ArcGIS and exported to CAD in UTM Zone 16N projection. No significant differences were observed. Additionally, the contours generated in ArcGIS were projected into Albers Equal Area projection and exported to CAD for confirmation of area measurements. Table K-1 summarizes the differences in area measurements for the sample of areas used to verify software operation.

3. Conclusion

Based on the results of this comparison, the procedure to produce cross-sections and calculate contour surface areas at selected TRM stations is verified.

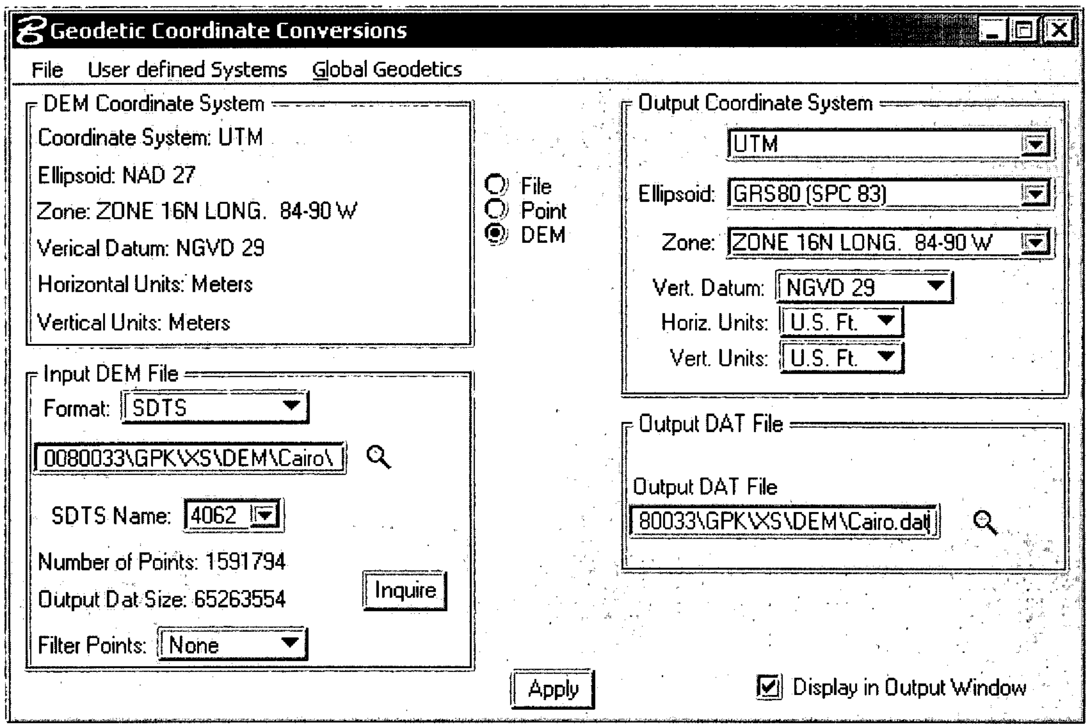


Figure K-1 GeoPak Geodetic Coordinate Conversions

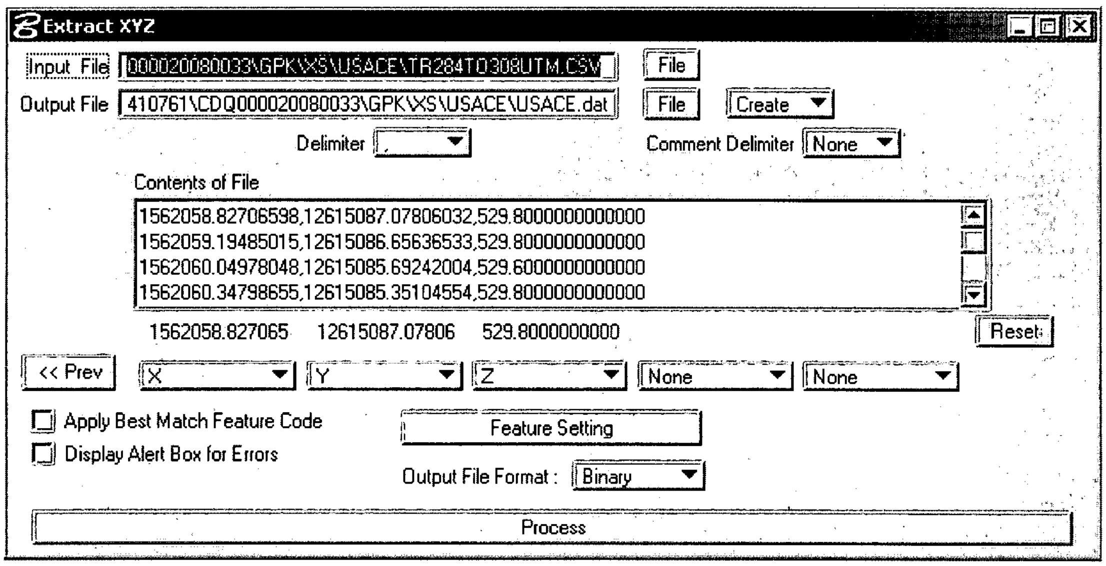


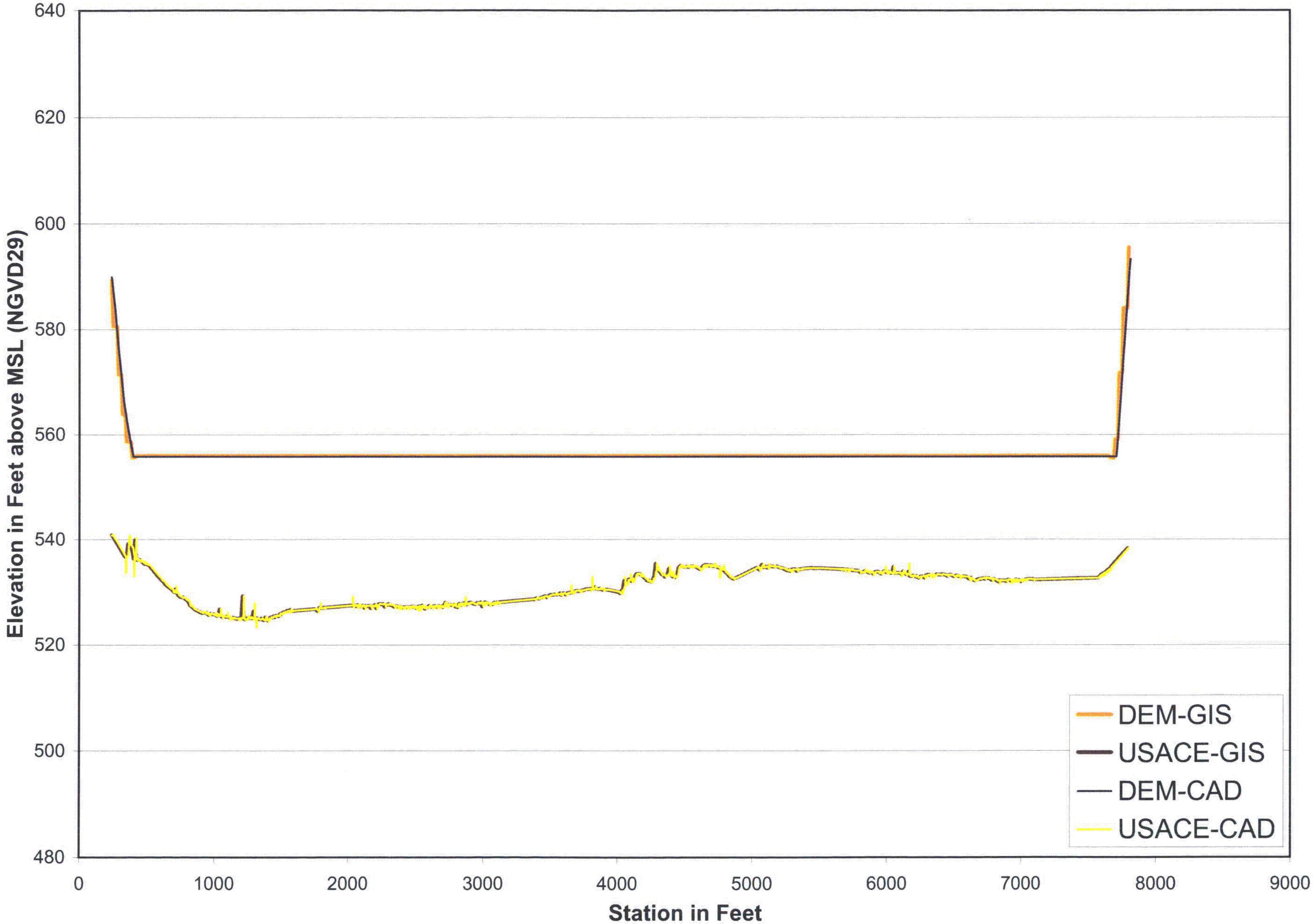
Figure K-2 GeoPak Extract XYZ

Table K-1 Area Measurement Summary

(strikethrough indicates revised areas not matching final table in Attachment I-2)

Section_Name	Portion	RvMi_Range	*GIS* 630	*CAD* 630	*Difference*
Section 1 - 2	Wheeler	TRM 349.00 - 346.94	2923.710	2923.713	-0.0001%
Section 2 - 3	Wheeler	TRM 346.94 - 344.88	2698.022	2698.025	-0.0001%
Section 3 - 4	Wheeler	TRM 344.88 - 342.83	51049.249	51049.304	-0.0001%
Section 4 - 5	Wheeler	TRM 342.83 - 340.94	1665.030	1665.032	-0.0001%
Section 5 - 6	Wheeler	TRM 340.94 - 338.71	41781.828	41781.873	-0.0001%
Section 6 - 7	Wheeler	TRM 338.71 - 336.90	2066.295	2066.297	-0.0001%
Section 7 - 8	Wheeler	TRM 336.90 - 334.59	4163.830	4163.835	-0.0001%
Section 8 - 9	Wheeler	TRM 334.59 - 332.53	6575.907	6575.914	-0.0001%
Section 9 - 10	Wheeler	TRM 332.53 - 330.02	7646.590	7646.598	-0.0001%
Section 10 - 11	Wheeler	TRM 330.02 - 328.47	962.037	962.038	-0.0001%
Section 11 - 12	Wheeler	TRM 328.47 - 326.36	4014.447	4014.451	-0.0001%
Section 12 - 13	Wheeler	TRM 326.36 - 324.20	25558.863	25558.891	-0.0001%
Section 13 - 14	Wheeler	TRM 324.20 - 322.24	12195.790	12195.804	-0.0001%
Section 14 - 15	Wheeler	TRM 322.24 - 320.18	17703.199	17703.218	-0.0001%
Section 15 - 16	Wheeler	TRM 320.18 - 317.83	~~38606.798~~	~~38606.840~~	-0.0001%
Section 16 - 17	Wheeler	TRM 317.83 - 316.07	8640.429	8640.438	-0.0001%
Section 17 - 18	Wheeler	TRM 316.07 - 314.25	4314.443	4314.448	-0.0001%
Section 18 - 19	Wheeler	TRM 314.25 - 312.57	3190.804	3190.807	-0.0001%
Section 19 - 20	Wheeler	TRM 312.57 - 309.44	49081.135	49081.188	-0.0001%
Section 20 - 21	Wheeler	TRM 309.44 - 307.73	~~107164.502~~	~~107164.618~~	-0.0001%
Section 21 - 22	Wheeler	TRM 307.73 - 305.78	6130.018	6130.025	-0.0001%
Section 22 - 23	Wheeler	TRM 305.78 - 303.72	3498.041	3498.045	-0.0001%
Section 23 - 24	Wheeler	TRM 303.72 - 301.66	15284.321	15284.338	-0.0001%
Section 24 - 25	Wheeler	TRM 301.66 - 299.60	19986.638	19986.659	-0.0001%
Section 25 - 26	Wheeler	TRM 299.60 - 297.54	14642.868	14642.884	-0.0001%
Section 26 - 27	Wheeler	TRM 297.54 - 295.62	16577.498	16577.516	-0.0001%
Section 27 - 28	Wheeler	TRM 295.62 - 293.75	5703.526	5703.532	-0.0001%
Section 28 - 29	Wheeler	TRM 293.75 - 291.37	25752.454	25752.482	-0.0001%
Section 29 - 30	Wheeler	TRM 291.37 - 289.80	2559.416	2559.418	-0.0001%
Section 30 - 31	Wheeler	TRM 289.80 - 287.16	5757.108	5757.114	-0.0001%
Section 31 - 32	Wheeler	TRM 287.16 - 285.19	3617.952	3617.956	-0.0001%
Section 32 - 33	Wheeler	TRM 285.19 - 283.13	61689.902	61689.969	-0.0001%
Section 33 - 34	Wheeler	TRM 283.13 - 281.08	16835.307	16835.325	-0.0001%
Section 34 - 35	Wheeler	TRM 281.08 - 278.60	3382.194	3382.198	-0.0001%
Section 35 - 36	Wheeler	TRM 278.60 - 276.80	5284.482	5284.488	-0.0001%
Section 36 - 37	Wheeler	TRM 276.80 - 274.90	6165.399	6165.399	0.0000%
		Total	**604870**	**604871**	**-0.0001%**

TRM 287.16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620
600
580
560
540
520
500
480
Elevation in Feet above MSL (NGVD29)
0
1000
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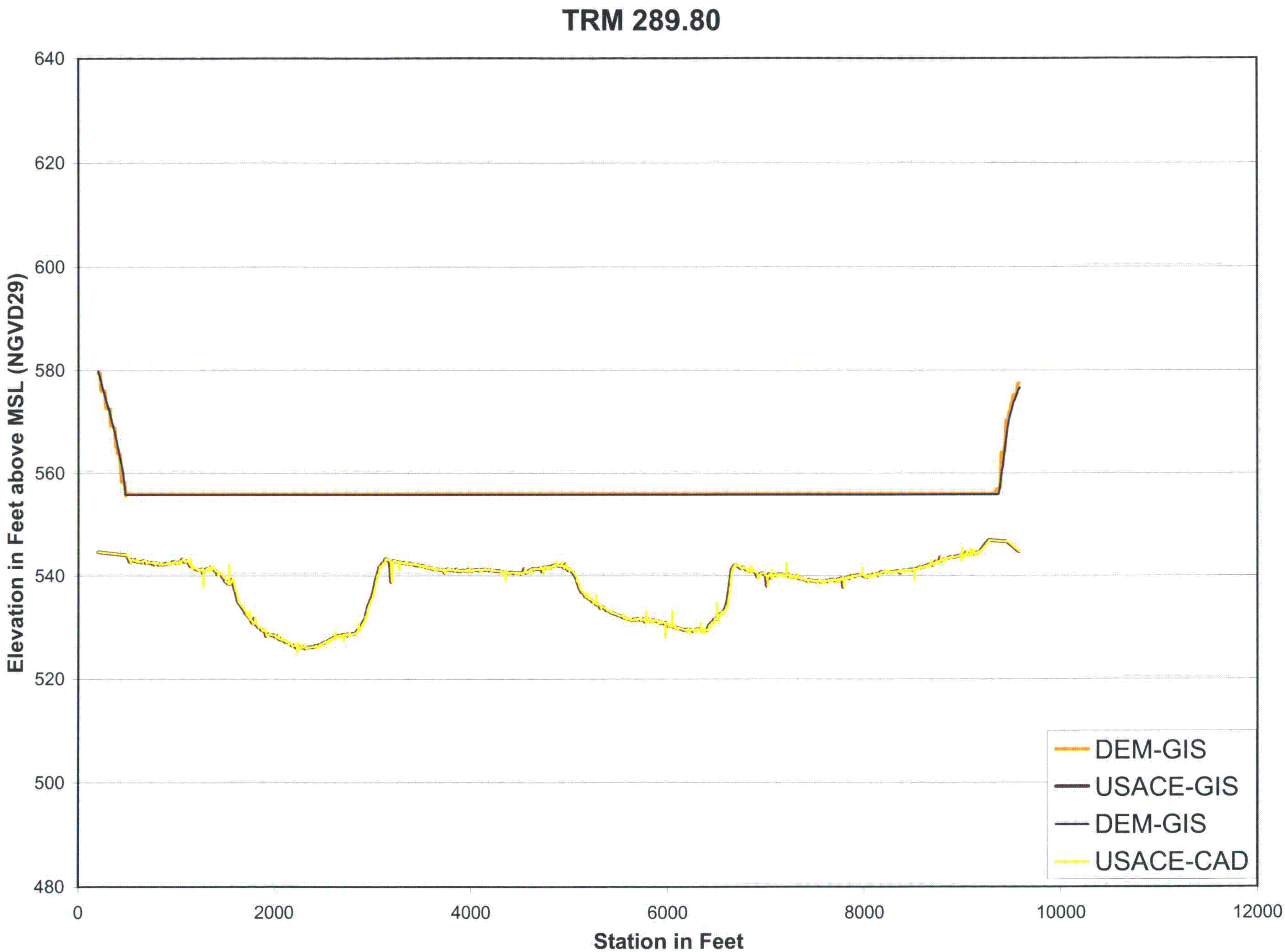
3000
4000
5000
6000
7000
8000
9000
Station in Feet
DEM-GIS
USACE-GIS
DEM-CAD
USACE-CAD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USACE-GIS
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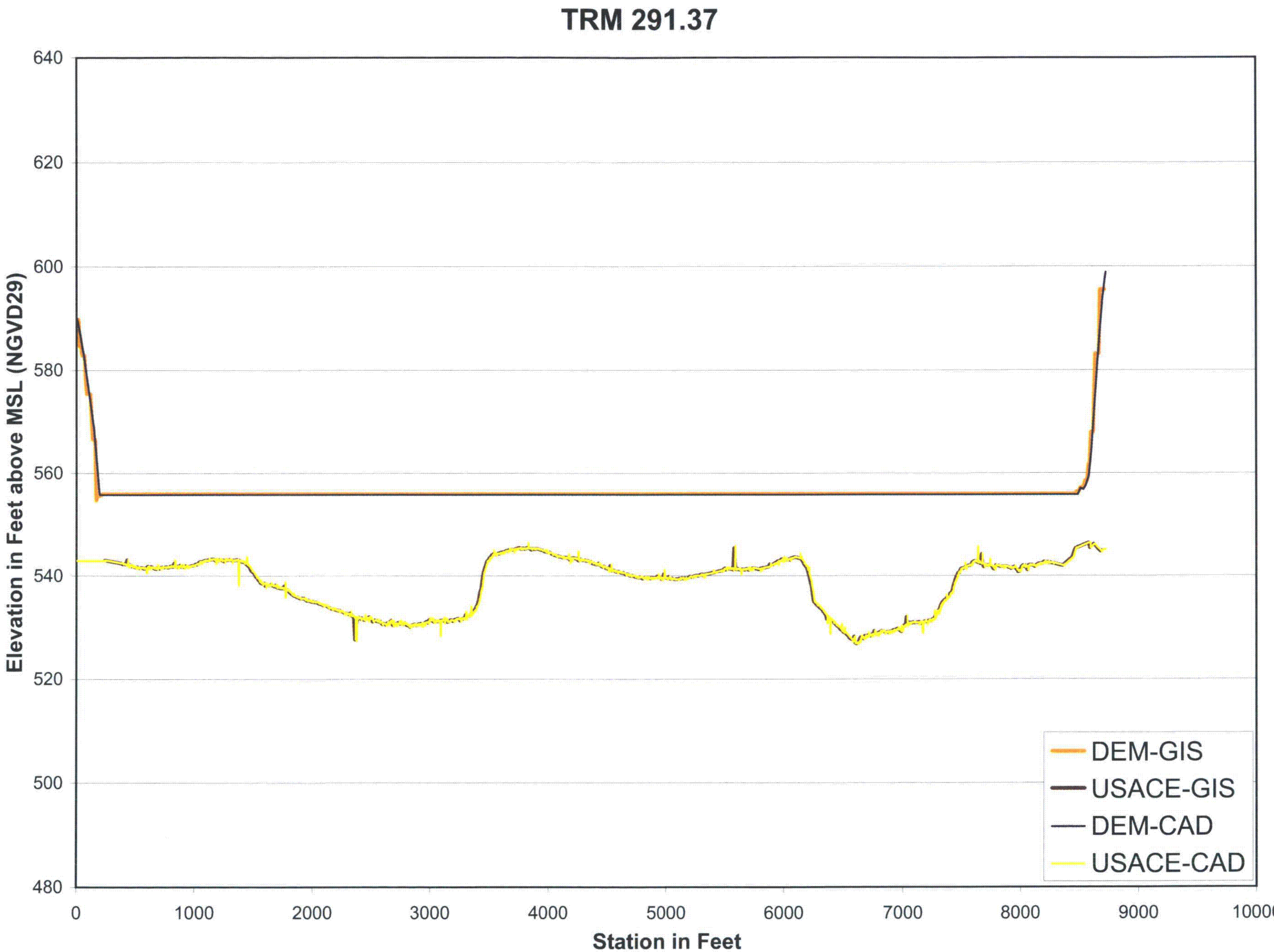
USACE-CAD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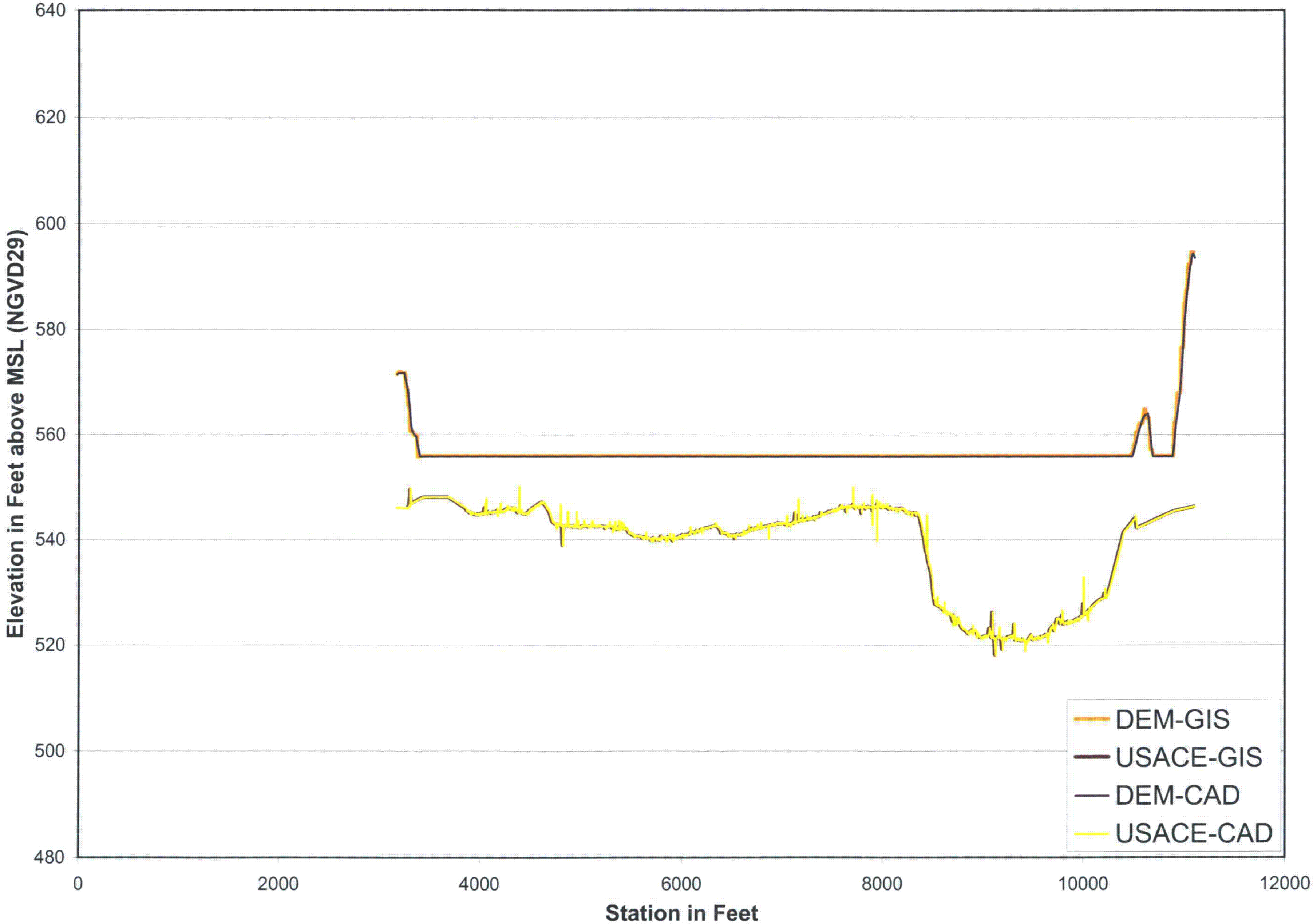
10000
DEM-GIS
USACE-GIS
DEM-CAD
USACE-CAD

TRM 293.75



640
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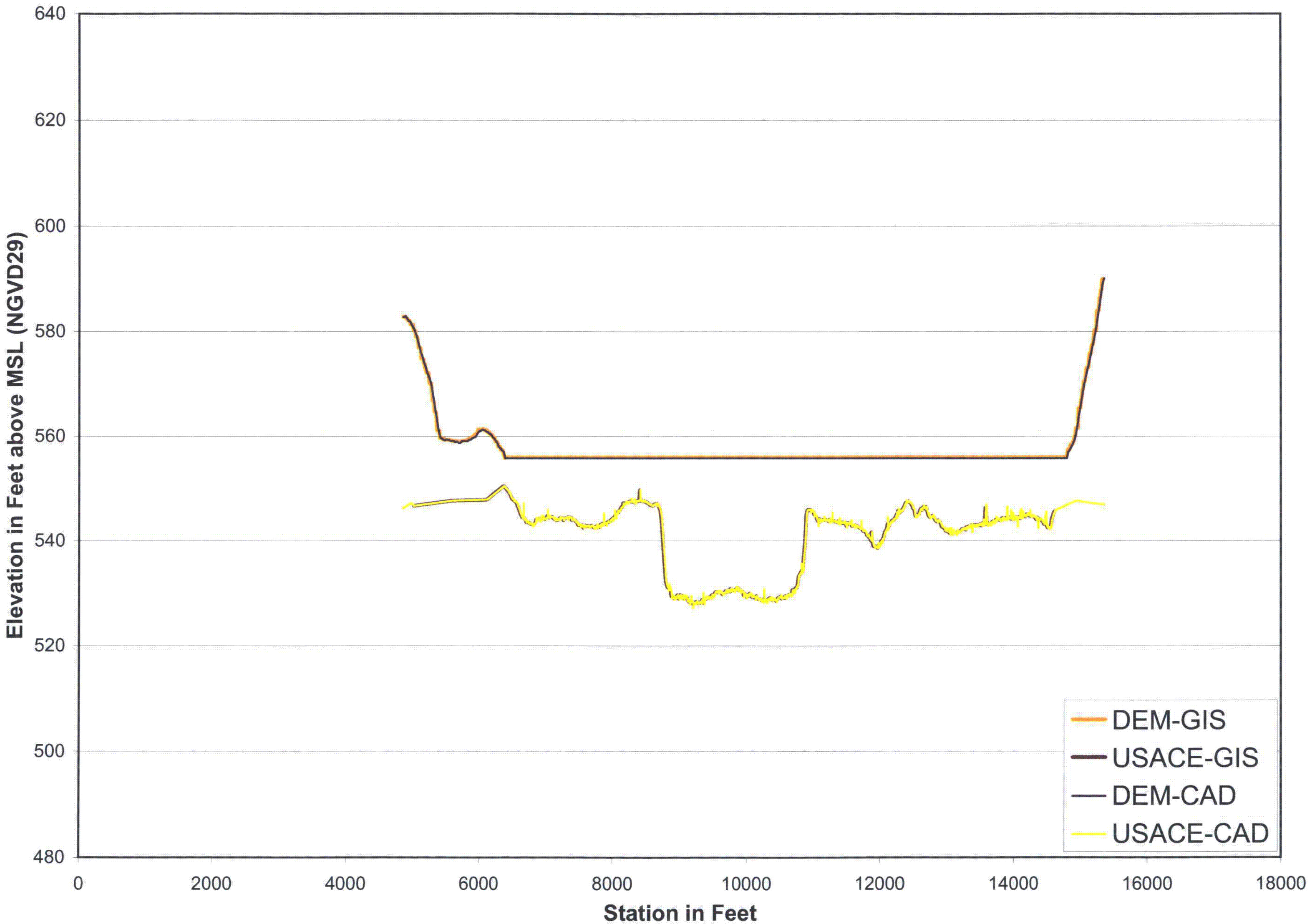
8000
10000
12000
Elevation in Feet above MSL (NGVD29)
Station in Feet
DEM-GIS
USACE-GIS
DEM-CAD
USACE-CAD

TRM 295.62



Elevation in Feet above MSL (NGVD29)
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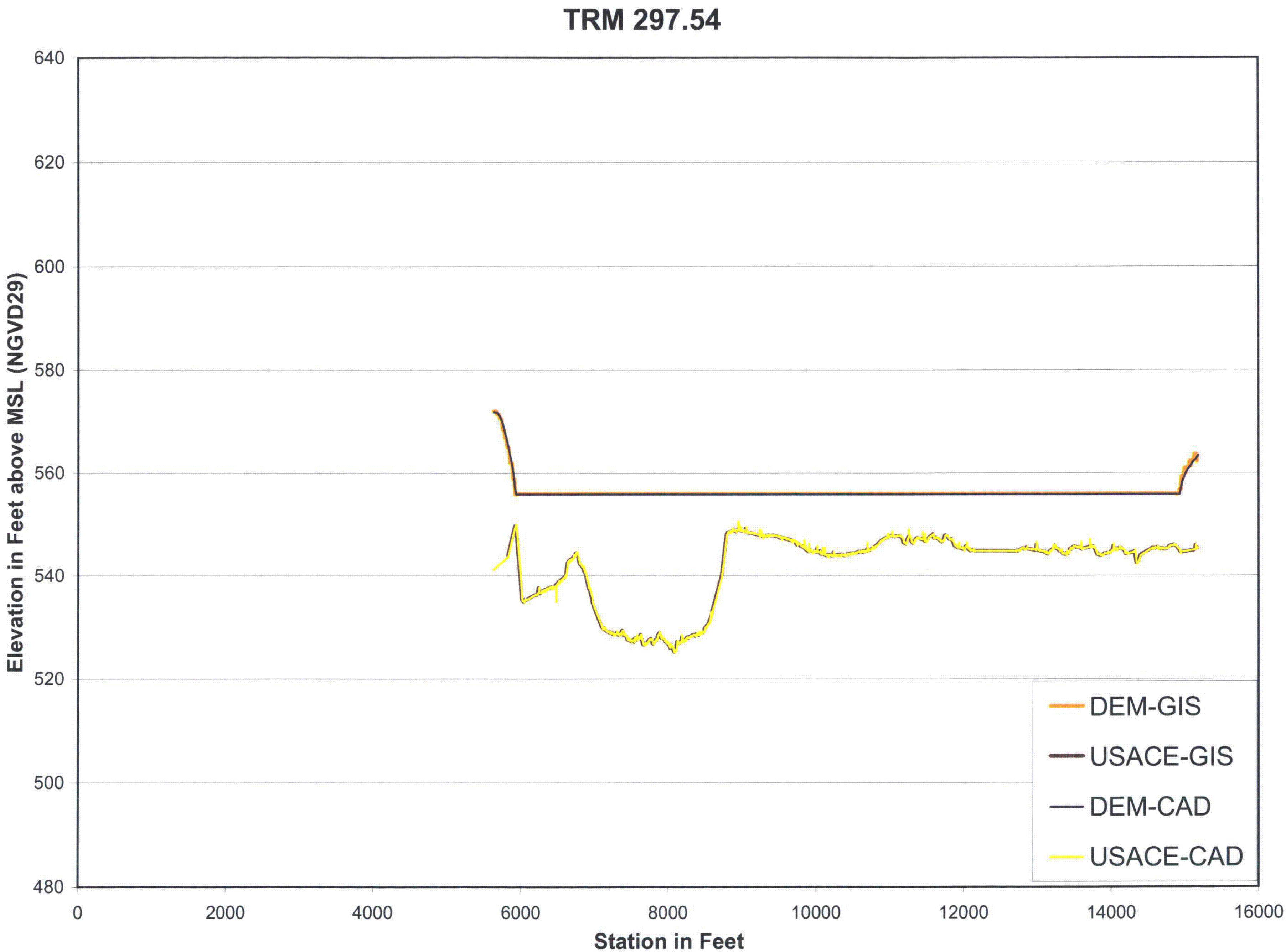
14000
16000
18000
Station in Feet
DEM-GIS
USACE-GIS
DEM-CAD
USACE-CAD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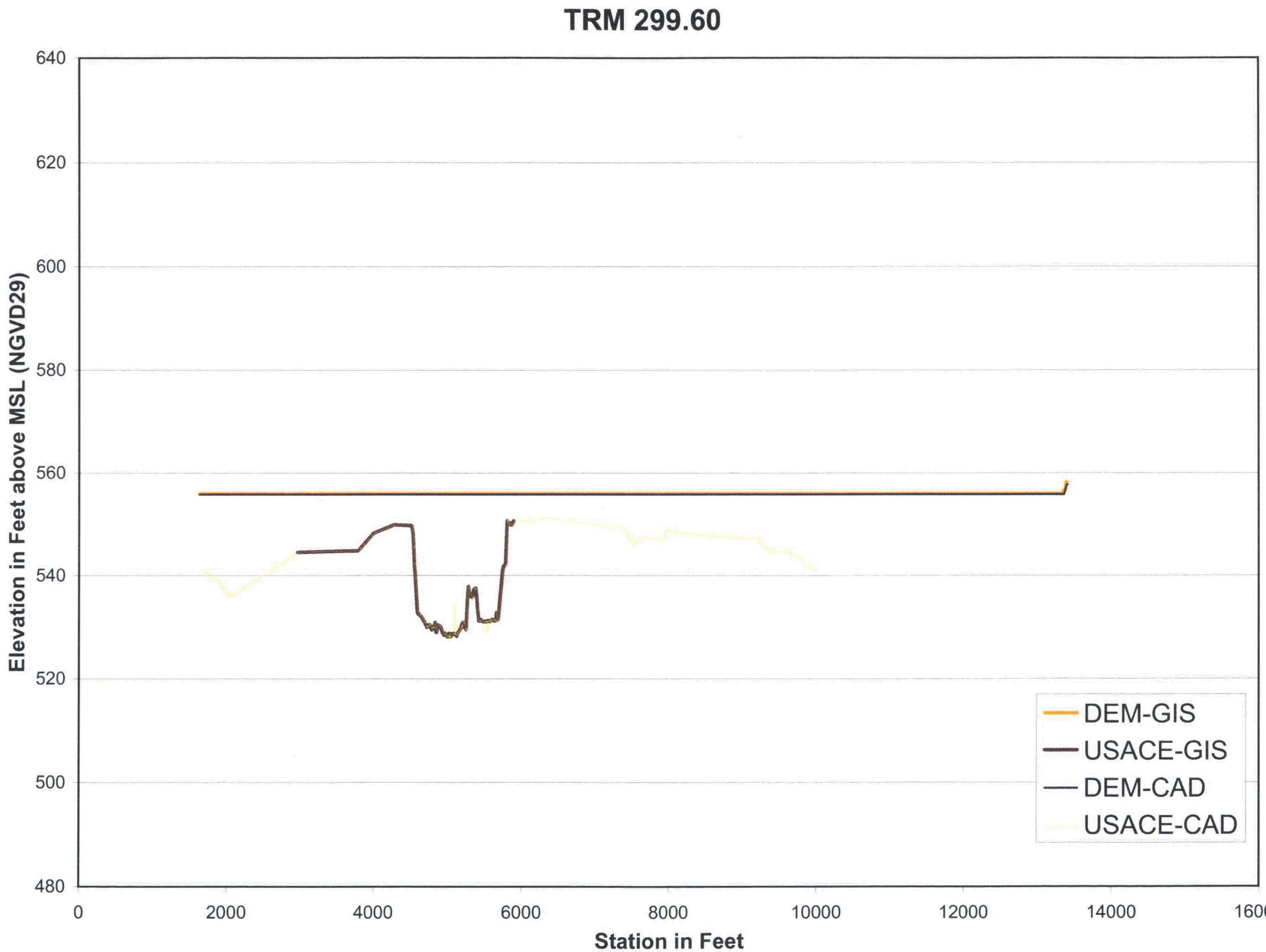
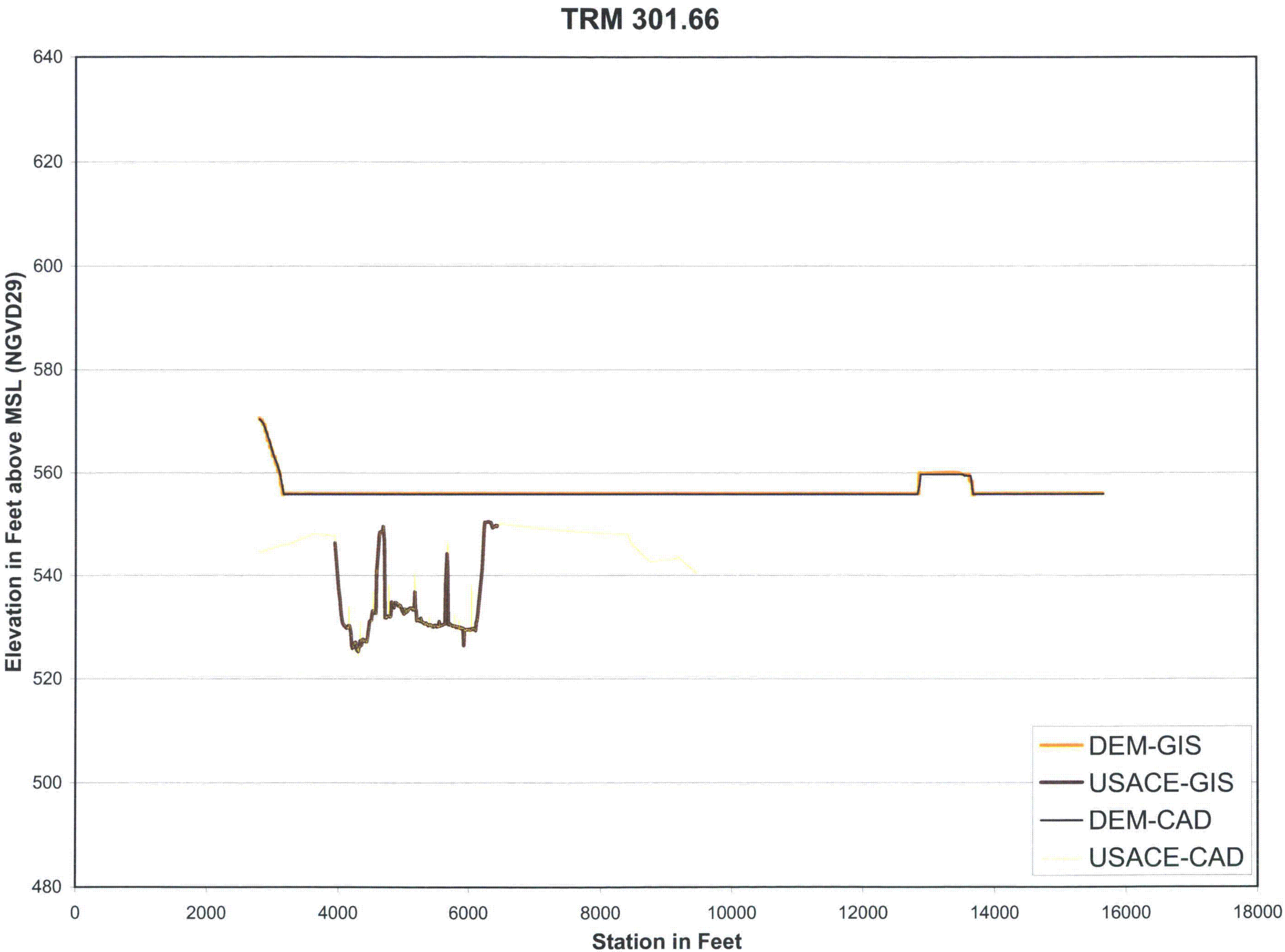
16000
DEM-GIS
USACE-GIS
DEM-CAD
USACE-CAD

TRM 299.60



TVA / BLN Project
SOCH Geometry Verification for Wheeler Reservoir

Calc. No.: CDQ 000020080033 Rev. 0
Appendix K



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6000
8000
10000
12000
14000
16000
18000
Station in Feet
DEM-GIS
USACE-GIS
DEM-CAD
USACE-CAD

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPS AND SURVEYS BRANCH

WHEELER DAM QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 53-SW

Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by USC&GS, USGS, and TVA

Revised by TVA in 1968 by photogrammetric methods using aerial photographs taken 1967 and by reference to TVA-USGS quadrangle dated 1952. Map field checked by TVA 1971

Polyconic projection. 1927 North American datum
10,000-foot grid based on Alabama (West) rectangular coordinate system
1000-meter Universal Transverse Mercator Grid ticks, Zone 16, shown in blue

Fine red dashed lines indicate selected fence and field lines visible on aerial photography. This information is unchecked

UTM GRID AND 1971 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
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A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ROAD CLASSIFICATION

Heavy-duty — Poor motor road
Medium-duty — Wagon and jeep track
Light-duty — Foot trail
U. S. Route — State Route

In developed areas, only through roads are classified

QUADRANGLE LOCATION

(TVA 53-SW)

WHEELER DAM, ALA.
N3445-W8722.5/7.5

1971

AMS 3553 IV SW-SERIES V844

1

UNITED STATES
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TENNESSEE VALLEY AUTHORITY
MAPS AND SURVEYS BRANCH

ROGERSVILLE QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 53-SE

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Polyconic projection, 1927 North American datum
10,000 foot grid based on Alabama (West) rectangular coordinate system
1000 metre Universal Transverse Mercator Grid ticks, Zone 16, shown in blue

Fine red dashed lines indicate selected fence and field lines visible on aerial photography. This information is unchecked

UTM GRID AND 1974 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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QUADRANGLE LOCATION

ROAD CLASSIFICATION

Heavy-duty		Poor motor road	
Medium-duty		Wagon and jeep track	
Light-duty		Foot trail	
U. S. Route		State Route	

In developed areas, only through roads are classified

ROGERSVILLE, ALA.
N3445-W8715/7.5
1974
AMS 3553 IV SE-SERIES V844

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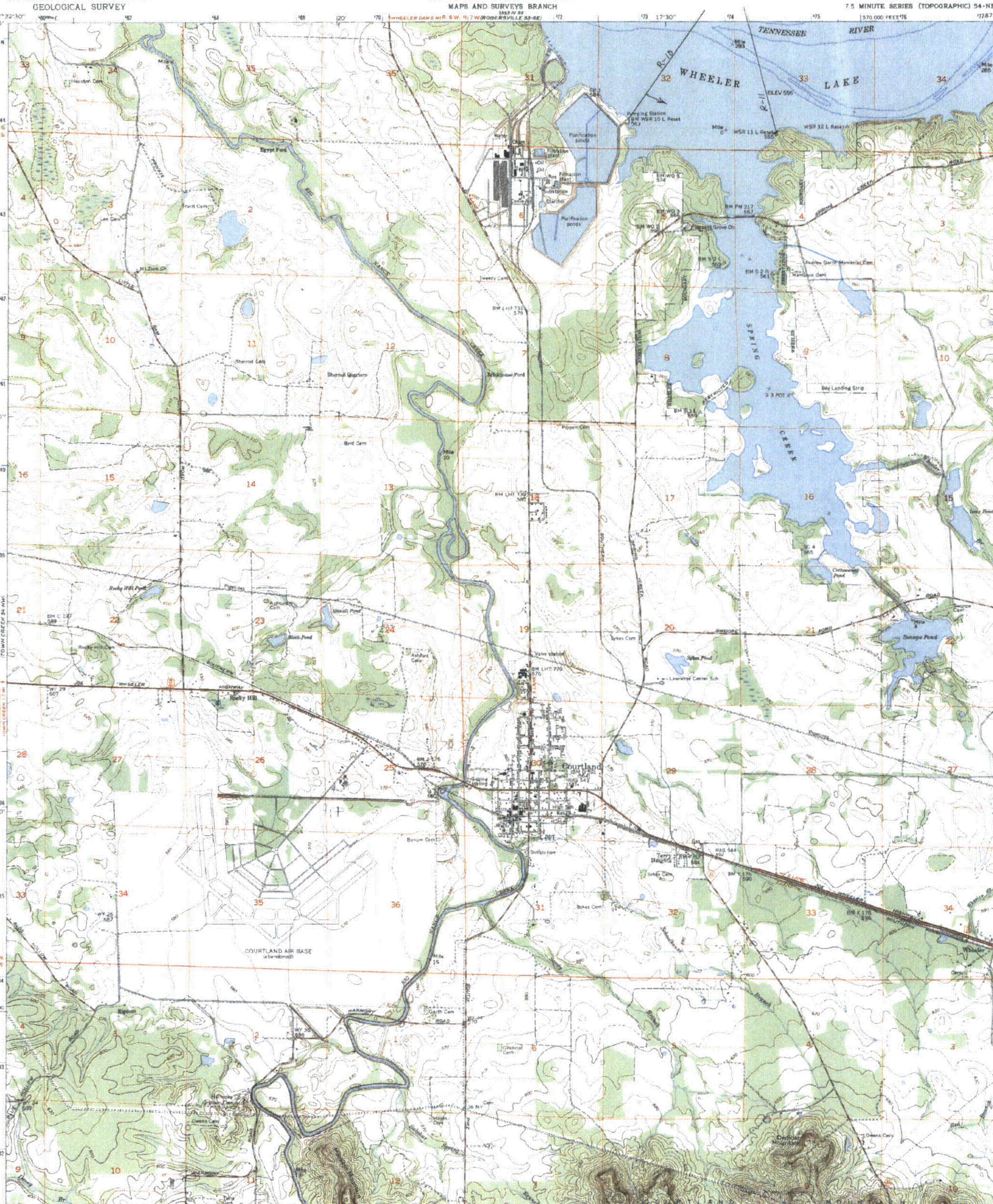
COURTLAND QUADRANGLE
ALABAMA - LAWRENCE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC) 54-NE



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Revised by TVA in 1973 by photogrammetric methods using aerial photographs taken 1972 and by reference to TVA-USGS quadrangle dated 1948. Map field checked by TVA, 1974

Polyconic projection. 1927 North American datum
10,000 foot grid based on Alabama (West) rectangular coordinate system
1000 metre Universal Transverse Mercator Grid ticks, Zone 16, shown in blue

Fine red dashed lines indicate selected fence and field lines visible on aerial photography. This information is unchecked

UTM GRID AND 1974 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Heavy-duty — Poor motor road
Medium-duty — Wagon and jeep track
Light-duty — Foot trail
U. S. Route — State Route

In developed areas, only through roads are classified

COURTLAND, ALA.
N3437.5-W8715/7.5

1974

AMS 3553 III NE-SERIES V844

3

UNITED STATES
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UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPS AND SURVEYS BRANCH

CAIRO QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 60-SW

Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Basic control by USC&GS, USGS, and TVA

Topography by USGS and TVA by multiplex and planetable methods from aerial photographs taken 1947
Field examination by TVA, 1948

Polyconic projection. 1927 North American datum
10,000-foot grid based on Alabama (West) rectangular coordinate system

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION 1949

SCALE 1:24000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

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CAIRO, ALA.
N3445-W8707.5/7.5

60-SW

PRINTED 1950

4

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UNITED STATES
TENNESSEE VALLEY AUTHORITY
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HILLSBORO QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 81-NW

Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by USC&GS, USGS, and TVA

Revised by TVA in 1974 by photogrammetric methods using aerial photographs taken 1972 and by reference to TVA-USGS quadrangle dated 1948. Map field checked by TVA, 1974

Polyconic projection. 1927 North American datum
10,000-foot grid based on Alabama (West) rectangular coordinate system
1000 metre Universal Transverse Mercator Grid ticks, Zone 16, shown in blue

Fine red dashed lines indicate selected fence and field lines visible on aerial photography. This information is unchecked

UTM GRID AND 1974 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ILL. MO. KENTUCKY VA. TENNESSEE N.C. MISS. ALA. GA. S.C.

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Heavy duty	Poor motor road
Medium duty	Wagon and jeep track
Light duty	Foot trail
U. S. Route	State Route

In developed areas, only through roads are classified

HILLSBORO, ALA.
N3437.5-W8707.5/7.5

1974

AMS 3563 II NW-SERIES V844

5

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPPING SERVICES BRANCH

JONES CROSSROADS QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 61-NE

Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by NOS/NOAA, USGS, and TVA

Revised by TVA in 1976 by photogrammetric methods using aerial photographs taken 1975 and by reference to TVA USGS quadrangle dated 1947. Map field checked by TVA, 1976.

Polyconic projection. 1927 North American datum
10,000 foot grid based on Alabama (West) rectangular coordinate system
1000 meter Universal Transverse Mercator Grid ticks, Zone 16, shown in blue

Fine red dashed lines indicate selected fence and field lines visible on aerial photography. This information is unchecked

UTM GRID AND 1976 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
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AND U.S. TENNESSEE VALLEY AUTHORITY, CHATTANOOGA, TENN. 37401
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Heavy-duty		Poor motor road	
Medium-duty		Wagon and jeep track	
Light-duty		Foot trail	
U. S. Route		State Route	

In developed areas, only through roads are classified

JONES CROSSROADS, ALA.
N3437.5—W8700/7.5
1976
AMS 3559 II NE—SERIES V844

6

UNITED STATES
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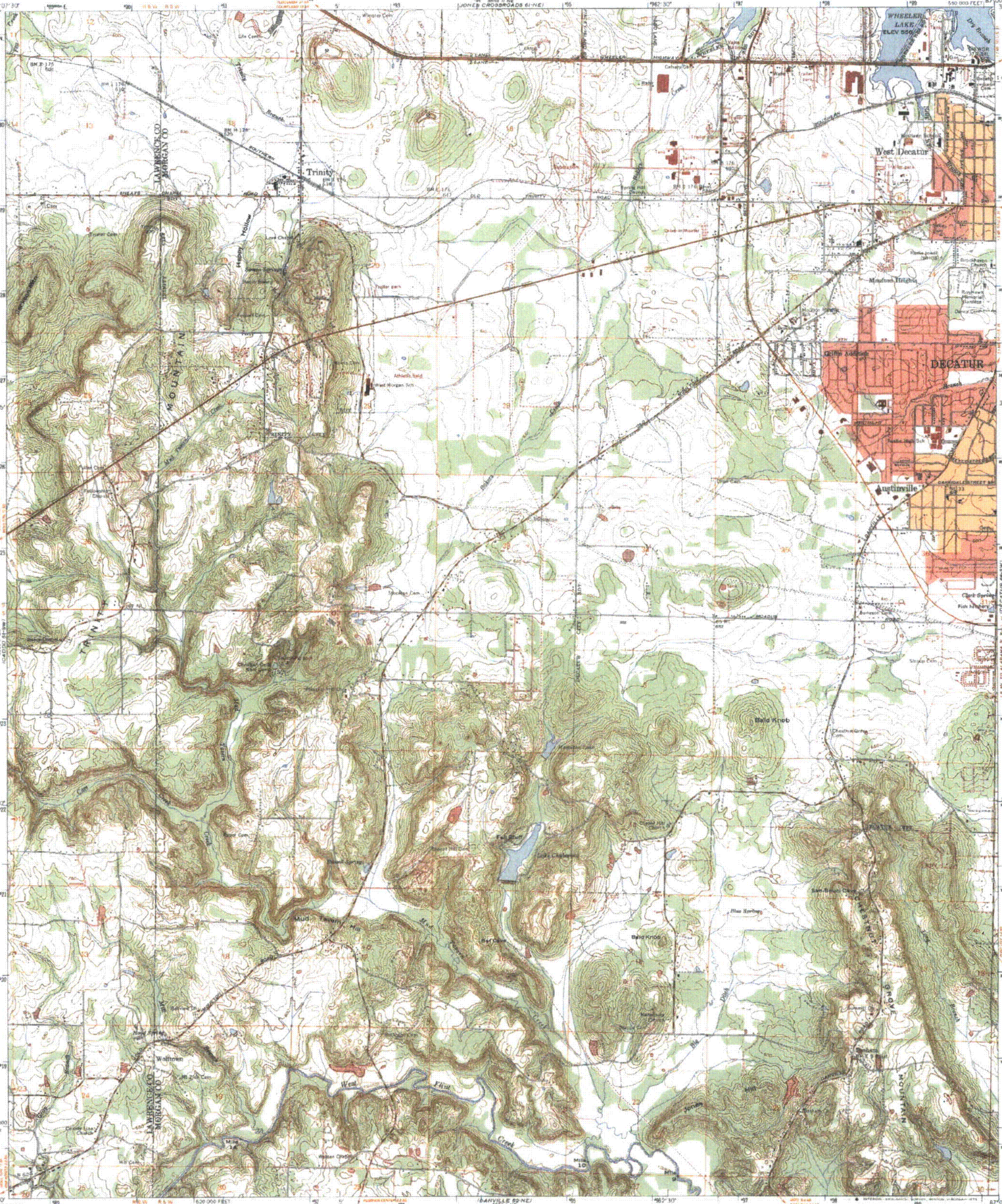
UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPS AND SURVEYS BRANCH

TRINITY QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 61-SE



Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by USC&GS, USGS, and TVA

Revised by TVA in 1961 by photogrammetric methods using aerial photographs taken 1961 and by reference to TVA-USGS quadrangle dated 1948. Map field checked by TVA, 1963

Polyconic projection. 1927 North American datum
10,000-foot grid based on Alabama (West) rectangular coordinate system
1000-metre Universal Transverse Mercator Grid ticks, Zone 16, shown in blue

Fine red dashed lines indicate selected fence and field lines visible on aerial photographs. This information is unchecked

Red tint indicates areas in which only landmark buildings are shown

UTM GRID AND 1974 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

Revisions shown in purple and recompilation of woodland areas compiled by the Tennessee Valley Authority from aerial photographs taken 1974. This information not field checked

Purple tint indicates extension of urban areas

SCALE 1:24 000

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 MILE — KILOMETRE

CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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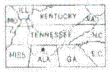
AND BY U.S. TENNESSEE VALLEY AUTHORITY, CHATTANOOGA, TENN. 37401 OR KNOXVILLE, TENN. 37902
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST



QUADRANGLE LOCATION

(TVA 61-SE)

ROAD CLASSIFICATION

Heavy-duty		Poor motor road	
Medium-duty		Wagon and jeep track	
Light-duty		Foot trail	
U. S. Route		State Route	

In developed areas, only through roads are classified

TRINITY, ALA.
N3430—W8700/7.5

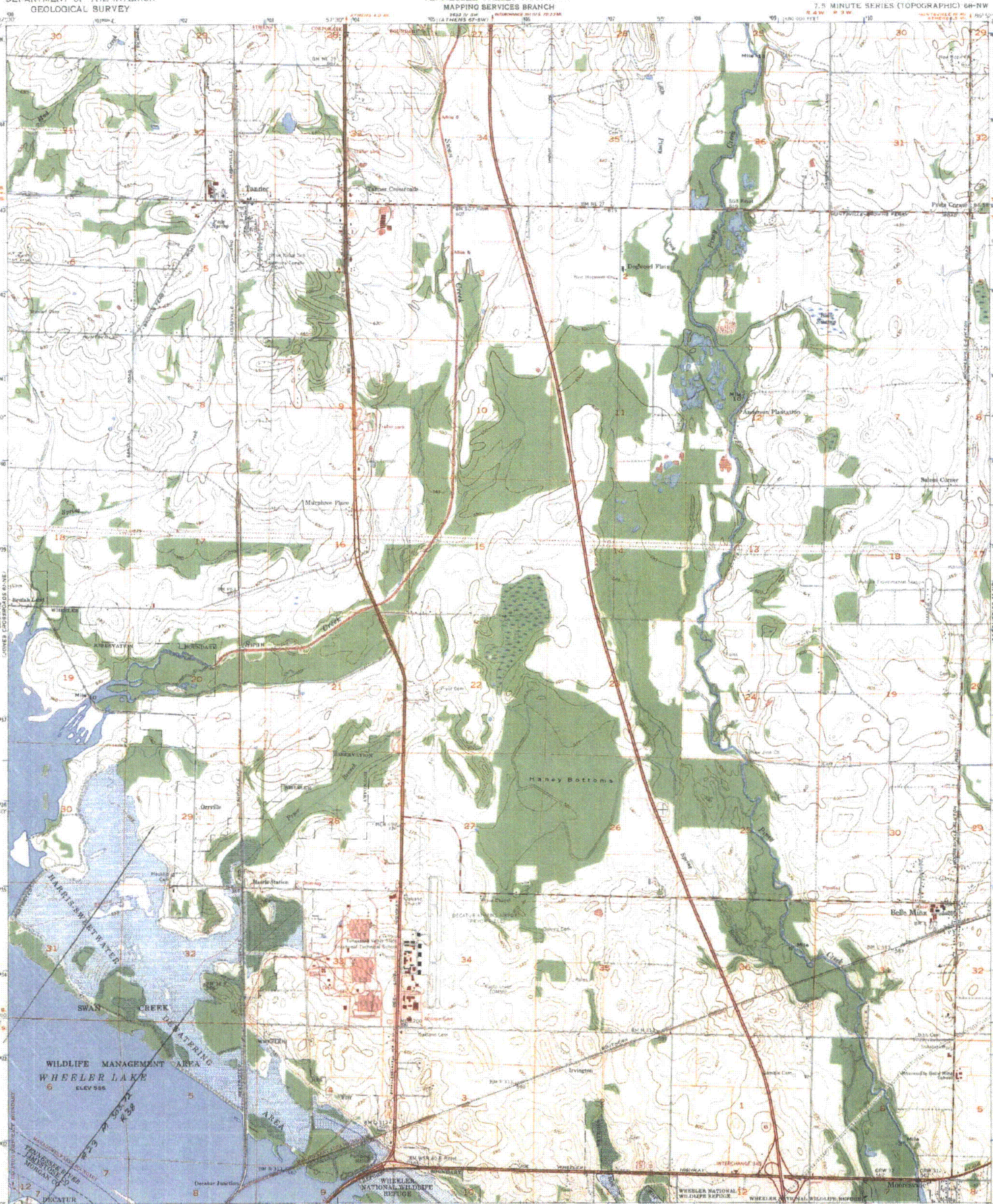
1963
PHOTOREVISED 1974
AMS 3563 II SE-SERIES V844

7

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPPING SERVICES BRANCH

TANNER QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC)



Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by NOS/NOAA, USGS, and TVA

Revised by TVA in 1961 by photogrammetric methods using aerial photographs taken 1961 and by reference to TVA USGS quadrangle dated 1938. Map field checked by TVA, 1963

Polyconic projection. 10,000-foot grid ticks based on Alabama coordinate system, west zone. 1000-meter Universal Transverse Mercator grid ticks, zone 16, shown in blue. 1927 North American Datum. To place on the predicted North American Datum 1983 move the projection lines 8 meters south as shown by dashed corner ticks

Fine red dashed lines indicate selected fence and field lines where generally visible on aerial photographs. This information is unchecked

There may be private inholdings within the boundaries of the National or State reservations shown on this map

UTM GRID AND 1982 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Revisions shown in purple and woodland compiled by the Tennessee Valley Authority from aerial photographs taken 1981 and other sources. This information not field checked. Map edited 1982

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, RESTON, VIRGINIA 22092
AND BY U.S. TENNESSEE VALLEY AUTHORITY, CHATTANOOGA, TENN. 37401 OR KNOXVILLE, TENN. 37902
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, all weather, hard surface	Light-duty road, all weather, improved surface
Secondary highway, all weather, hard surface	Unimproved road, fair or dry weather

Interstate Route · U. S. Route · State Route

TANNER, ALA.
N3437.5—W8652.5/7.5

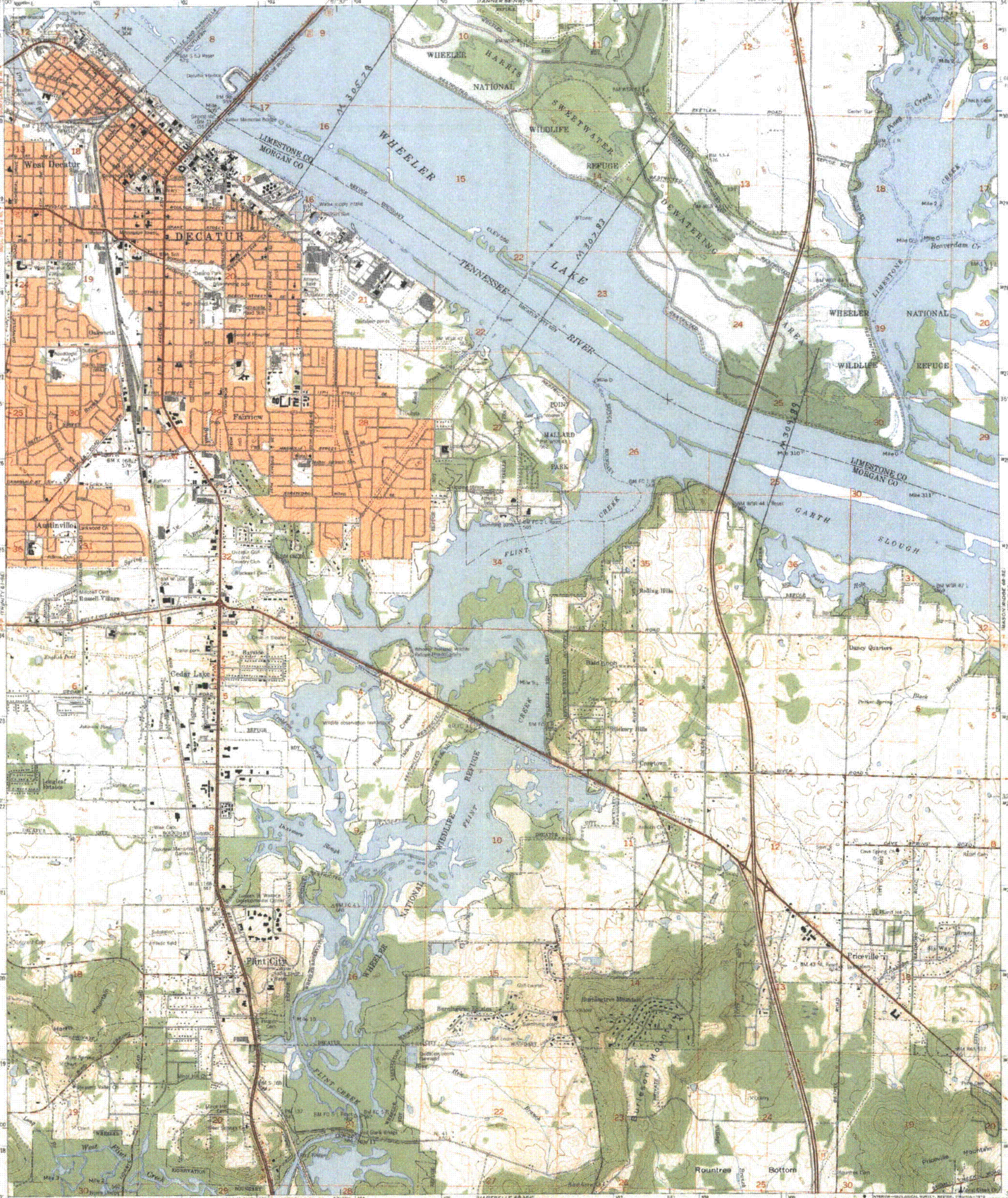
1963
PHOTOREVISED 1982
DMA 3653 III NW—SERIES V844

8

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPPING SERVICES BRANCH

DECATUR QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 68-SW



Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by NOS/NOAA, USGS, and TVA

Revised by TVA in 1975 by photogrammetric methods using aerial photographs taken 1974 and by reference to TVA-USGS quadrangle dated 1950. Map field checked by TVA, 1975

Polyconic projection. 1927 North American datum
10,000 foot grid based on Alabama (West) rectangular coordinate system
1000 metre Universal Transverse Mercator Grid ticks, Zone 16, shown in blue

Fine red dashed lines indicate selected fence and field lines visible on aerial photographs. This information is unchecked

Red tint indicates areas in which only landmark buildings are shown

UTM GRID AND 1975 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, RESTON, VIRGINIA 22092
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A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Heavy-duty · Poor motor road
Medium-duty · Wagon and jeep track
Light-duty · Foot trail
Interstate Route · U. S. Route · State Route

In developed areas, only through roads are classified

(TVA 68-SW)

DECATUR, ALA
N3430—W8652.5/7.5

1975

AMS 3652 III SW—SERIES V844

9

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPS AND SURVEYS BRANCH

MASON RIDGE QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 68-SE

10 Joins 11

Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by USC&GS, USGS, and TVA

Topography by USGS and TVA by photogrammetric and planetable methods using aerial photographs taken 1946
Map field checked by TVA, 1949

Polyconic projection. 1927 North American datum
10,000 foot grid based on Alabama (West) and Alabama (East) coordinate systems
1000 meter Universal Transverse Mercator Grid ticks, Zone 16, shown in blue

Revisions shown in purple and recompilation of woodland areas compiled by the Tennessee Valley Authority from aerial photographs taken 1973. This information not field checked

UTM GRID AND 1973 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Fine purple dashed lines indicate selected fence and field lines visible on aerial photographs. This information is unchecked

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, WASHINGTON, D.C. 20242,
AND BY U.S. TENNESSEE VALLEY AUTHORITY, CHATTANOOGA, TENN. 37401 OR KNOXVILLE, TENN. 37902
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ROAD CLASSIFICATION

Heavy-duty		Poor motor road	
Medium-duty		Wagon and jeep track	
Light-duty		Foot trail	
U. S. Route		State Route	

QUADRANGLE LOCATION

MASON RIDGE, ALA.
N3430—W8645/7.5

1949
PHOTOREVISED 1973
AMS 3653 II SE-SERIES V844

FLOODWAY MAP - WHEELER RESERVOIR
MADISON AND MORGAN COUNTY, ALABAMA
TVA FEBRUARY 1993

1 of 5

10

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPPING SERVICES BRANCH

TRIANA QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 75rSW

Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by NOS/NOAA, USGS, and TVA

Revised by TVA in 1963 by photogrammetric methods using aerial photographs taken 1961 and by reference to TVA-USGS quadrangle dated 1951. Map field checked by TVA, 1964

Polyconic projection. 10,000-foot grid ticks based on Alabama coordinate system, east and west zones. 1000-meter Universal Transverse Mercator grid, zone 16. 1927 North American Datum. To place on the predicted North American Datum 1983 move the projection lines 8 meters south and 1 meter west as shown by dashed corner ticks

Fine red dashed lines indicate selected fence and field lines where generally visible on aerial photographs. This information is unchecked

UTM GRID AND 1982 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Revisions shown in purple and woodland compiled by the Tennessee Valley Authority from aerial photographs taken 1981 and other sources. This information not field checked. Map edited 1982

SCALE 1:24000

CONTOUR INTERVAL 10 FEET
DOTTED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, RESTON, VIRGINIA 22092
AND BY U.S. TENNESSEE VALLEY AUTHORITY, CHATTANOOGA, TENN. 37401 OR KNOXVILLE, TENN. 37902
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, all weather hard surface	Light-duty road, all weather, improved surface
Secondary highway, all weather hard surface	Unimproved road, fair or dry weather

Interstate Route U.S. Route State Route

There may be private inholdings within the boundaries of the National or State reservations shown on this map

TRIANA, ALA.
N3430—W8637.5/7.5
1964
PHOTOREVISED 1982
DMA 3483 II SW—SERIES V844

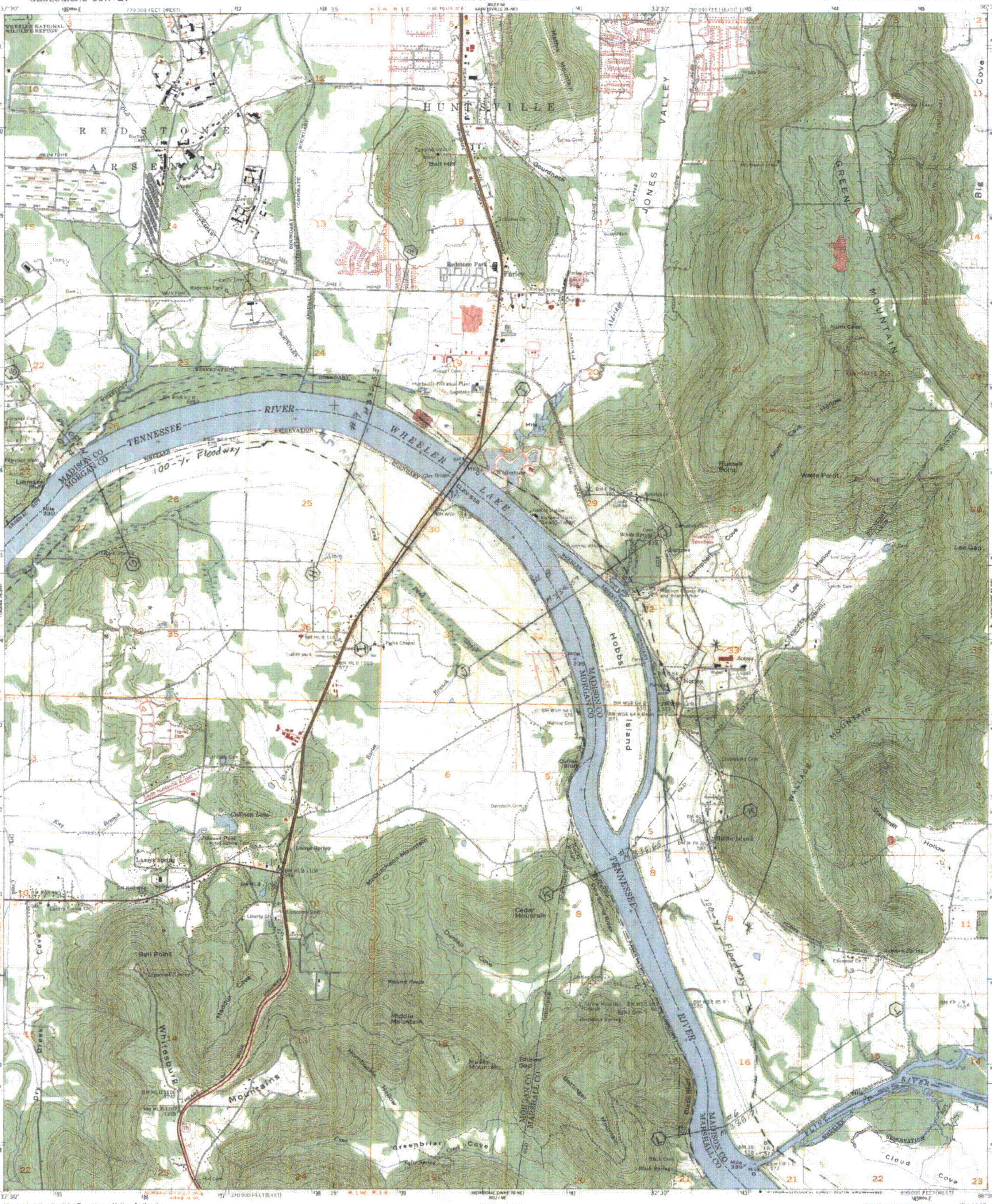
FLOODWAY MAP - WHEELER RESERVOIR
MADISON AND MORGAN COUNTY, ALABAMA
TVA FEBRUARY 1993 2 of 5

11

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPPING SERVICES BRANCH

FARLEY QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 75 SE



12 JOINS 11

* Fwy. revised by DED-see published FW

Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by NOS/NOAA, USGS, and TVA

Revised by TVA in 1964 by photogrammetric methods using aerial photographs taken 1961 and by reference to TVA-USGS quadrangle dated 1947. Map field checked by TVA 1964

Polyconic projection. 10,000-foot grid ticks based on Alabama (East) and Alabama (West) coordinate systems. 1000-meter Universal Transverse Mercator grid ticks, zone 16, shown in blue. 1927 North American Datum. To place on the predicted North American Datum 1983 move the projection lines 8 meters south and 1 meter west as shown by dashed corner ticks

Fine red dashed lines indicate selected fence and field lines where generally visible on aerial photographs. This information is unchecked

UTM GRID AND 1982 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

There may be private inholdings within the boundaries of the National or State reservations shown on this map

SCALE 1:24000

CONTOUR INTERVAL 20 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
AND U.S. TENNESSEE VALLEY AUTHORITY, CHATTANOOGA, TENN. 37401
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

FLOODWAY MAP - WHEELER RESERVOIR
MADISON AND MORGAN COUNTY, ALABAMA
TVA FEBRUARY 1993

3 of 5

QUADRANGLE LOCATION

Revisions shown in purple and woodland compiled by the Tennessee Valley Authority from aerial photographs taken 1981 and other sources. This information not field checked. Map edited 1982

12 JOINS 13

ROAD CLASSIFICATION

Primary highway, all weather, hard surface
Light-duty road, all weather, improved surface
Secondary highway, all weather, hard surface
Unimproved road, fair or dry weather
Interstate Route
U. S. Route
State Route

FARLEY, ALA.
N3430-W8630/7.5

1964
PHOTOREVISED 1982
DMA 3653 II SE-SERIES V844

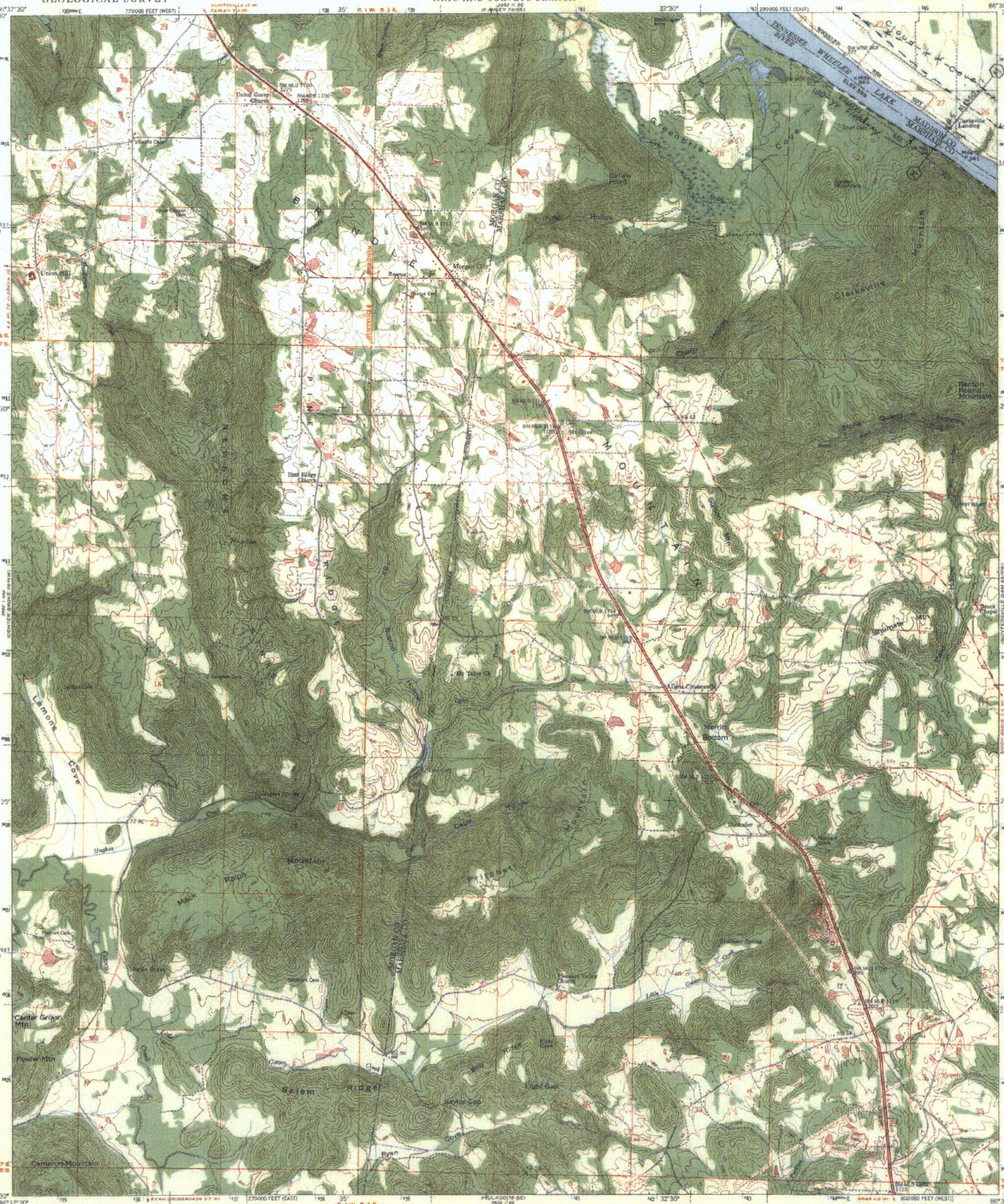
12

13 JOINS 12

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPS AND SURVEYS BRANCH

NEWSOME SINKS QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 76-NE



13 JOINS 14

Revised 6/29/94

Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by USC&GS, USGS, and TVA

Topography by USGS and TVA by photogrammetric and planetable methods using aerial photographs taken 1946.
Map field checked by TVA, 1947

Polyconic projection. 1927 North American datum
10,000-foot grid based on Alabama (East) and Alabama (west) rectangular coordinate systems
1000-meter Universal Transverse Mercator Grid ticks, Zone 16, shown in blue

Revisions shown in purple and recompilation of woodland areas compiled by the Tennessee Valley Authority from aerial photographs taken 1973. This information not field checked

UTM GRID AND 1973 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Fine purple dashed lines indicate selected fence and field lines visible on aerial photographs. This information is unchecked

SCALE 1:24000

CONTOUR INTERVAL 20 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
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AND BY U.S. TENNESSEE VALLEY AUTHORITY, CHATTANOOGA, TENN. 37401 OR KNOXVILLE, TENN. 37902
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Heavy-duty		Poor motor road	
Medium-duty		Wagon and jeep track	
Light-duty		Foot trail	
U. S. Route		State Route	

FLOODWAY MAP - WHEELER RESERVOIR
MADISON AND MORGAN COUNTY, ALABAMA
TVA FEBRUARY 1993

4 of 5

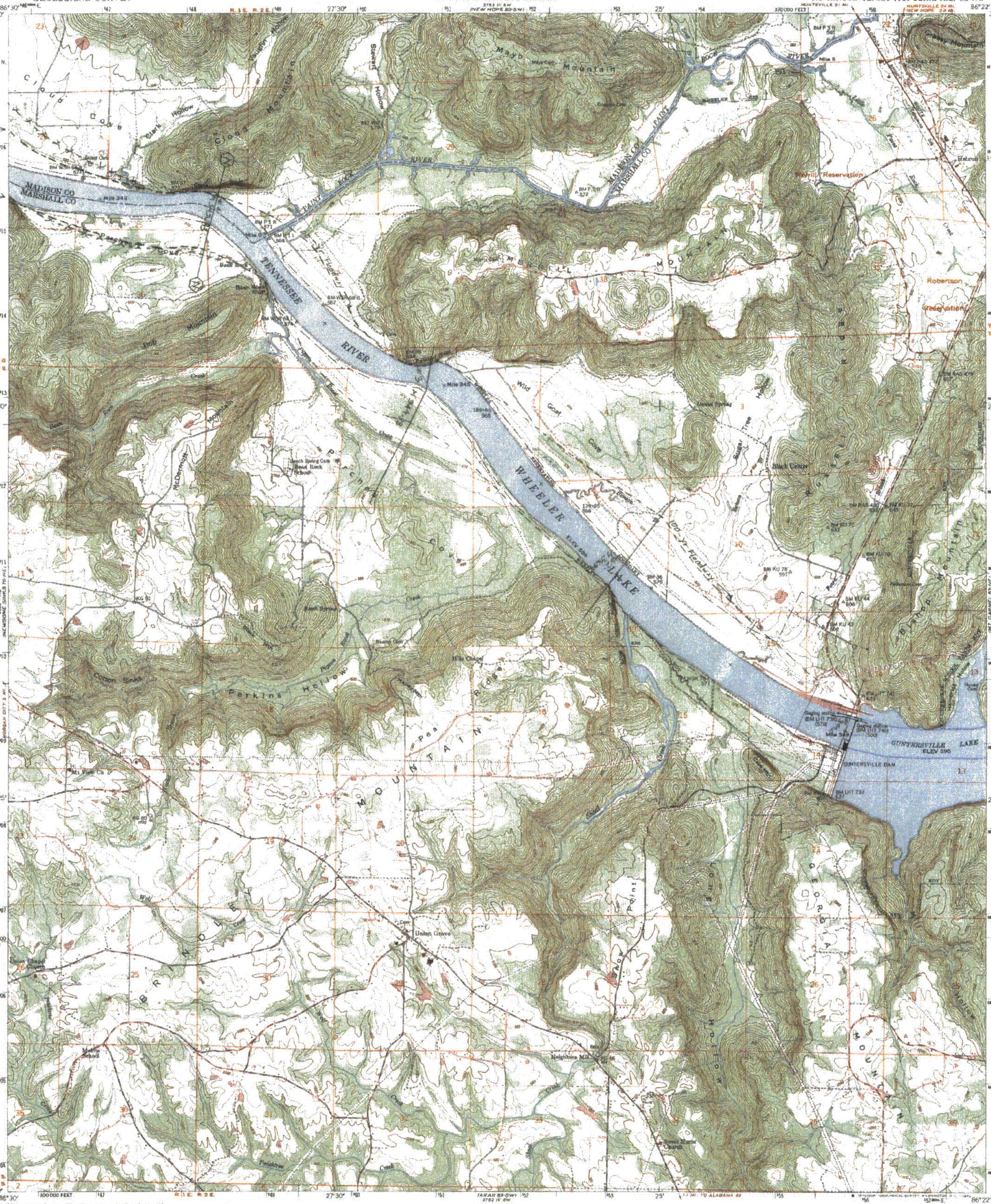
NEWSOME SINKS, ALA.
N3422.5—W8630/7.5
1947
PHOTOREVISED 1973
AMS 3852 I NE-SERIES V844

13

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
TENNESSEE VALLEY AUTHORITY
MAPS AND SURVEYS BRANCH

GUNTERSVILLE DAM QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 83-NW



Mapped and edited by Tennessee Valley Authority
Published by the Geological Survey

Control by USC&GS, USGS, and TVA

Topography by USGS and TVA by photogrammetric methods using aerial photographs taken 1946
Map field checked by TVA, 1948

Polyconic projection. 1927 North American datum
10,000 foot grid based on Alabama (East) rectangular coordinate system
1000 meter Universal Transverse Mercator Grid ticks, Zone 16, shown in blue

Revisions shown in purple and recompilation of woodland areas compiled by the Tennessee Valley Authority from aerial photographs taken 1970. This information not field checked

UTM GRID AND 1970 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Fine purple dashed lines indicate selected fence and field lines visible on aerial photography. This information is unchecked

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY
DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
AND U.S. TENNESSEE VALLEY AUTHORITY, CHATTANOOGA, TENN. 37401
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Heavy-duty — Poor motor road
Medium-duty — Wagon and jeep track
Light-duty — Foot trail
U. S. Route — State Route

In developed areas, only through roads are classified

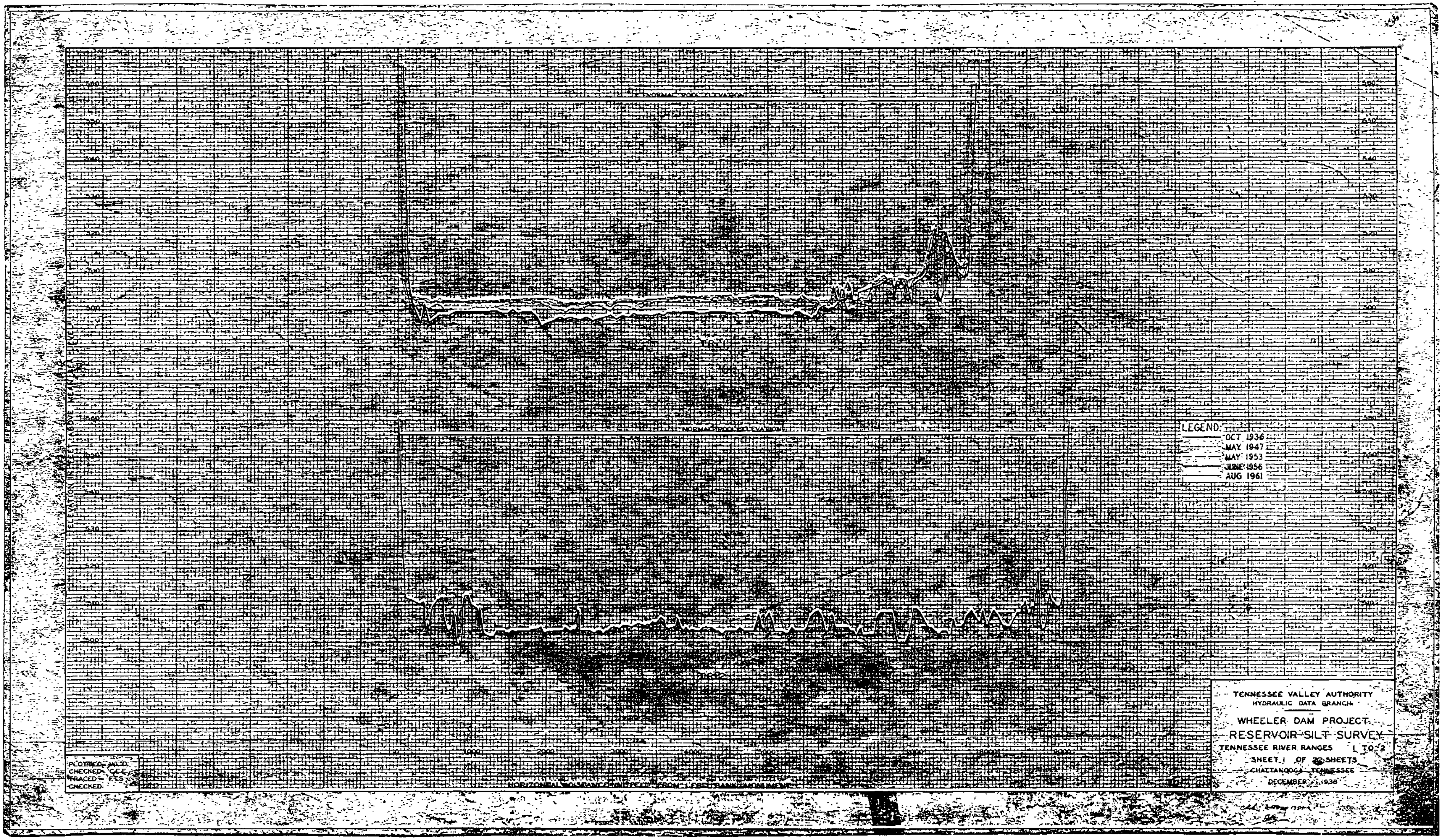
(TVA 83-NW)

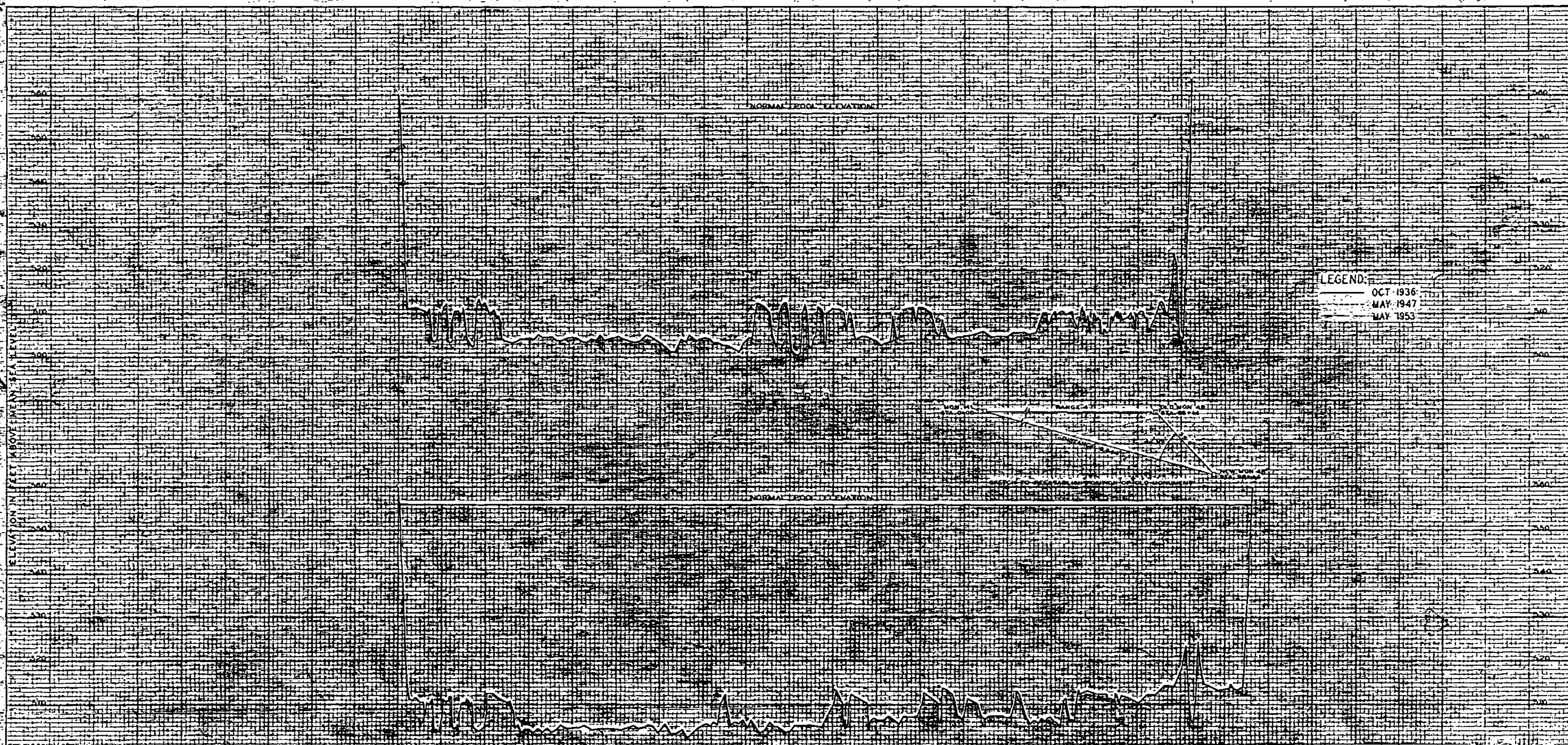
GUNTERSVILLE DAM, ALA.
N3422.5—W8622.5/7.5
1948
PHOTOREVISED 1970
AMS 3752 IV NW-SERIES V844

FLOODWAY MAP - WHEELER RESERVOIR
MADISON AND MORGAN COUNTY, ALABAMA
TVA FEBRUARY 1993

5 of 5

14

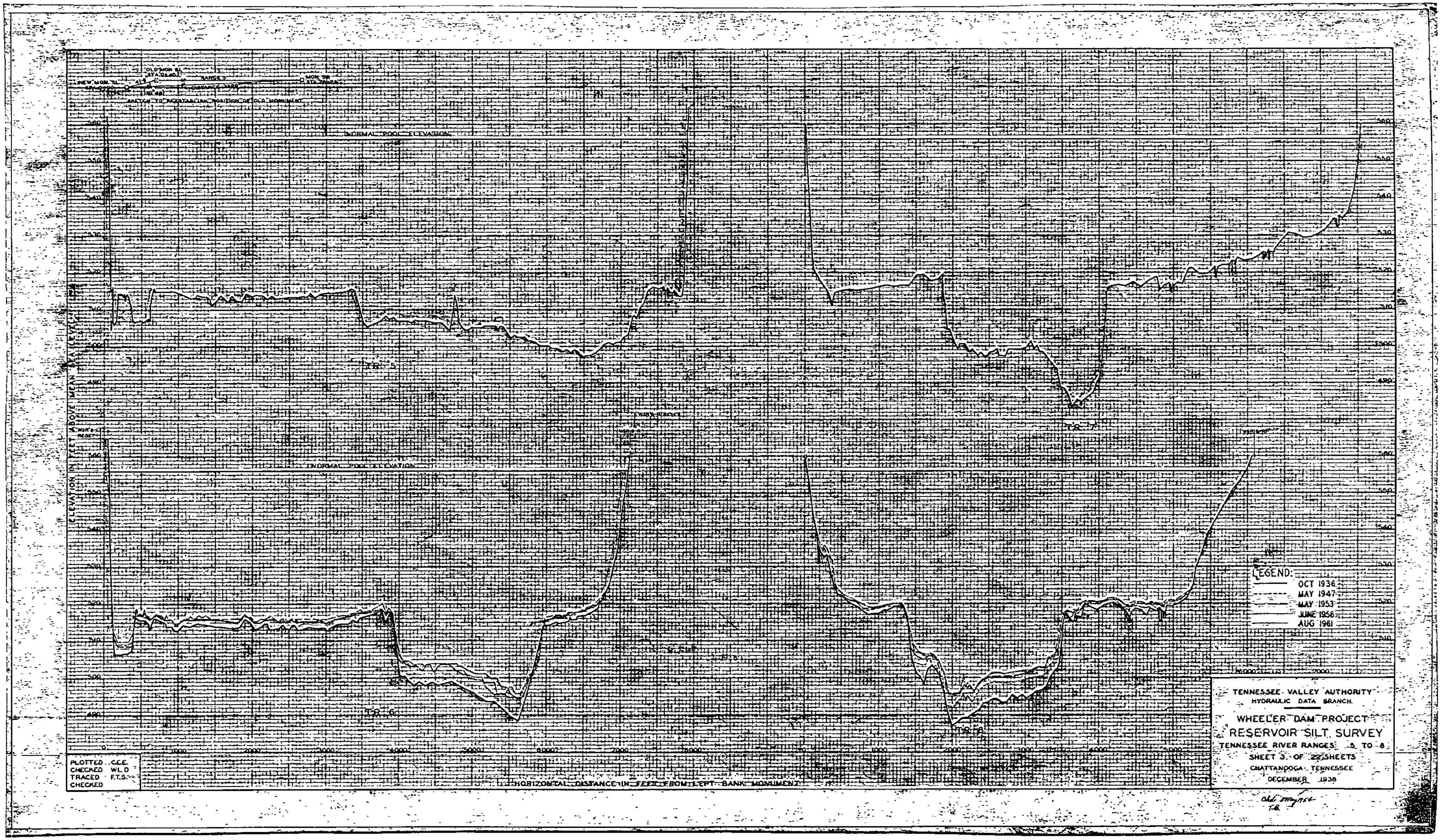

NORMAL POOL ELEVATION
LEGEND:
OCT 1936
MAY 1947
MAY 1953
JUNE 1956
AUG 1961
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH
WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES L TO 2
SHEET 1 OF 22 SHEETS
CHATTANOOGA TENNESSEE
DECEMBER 1938

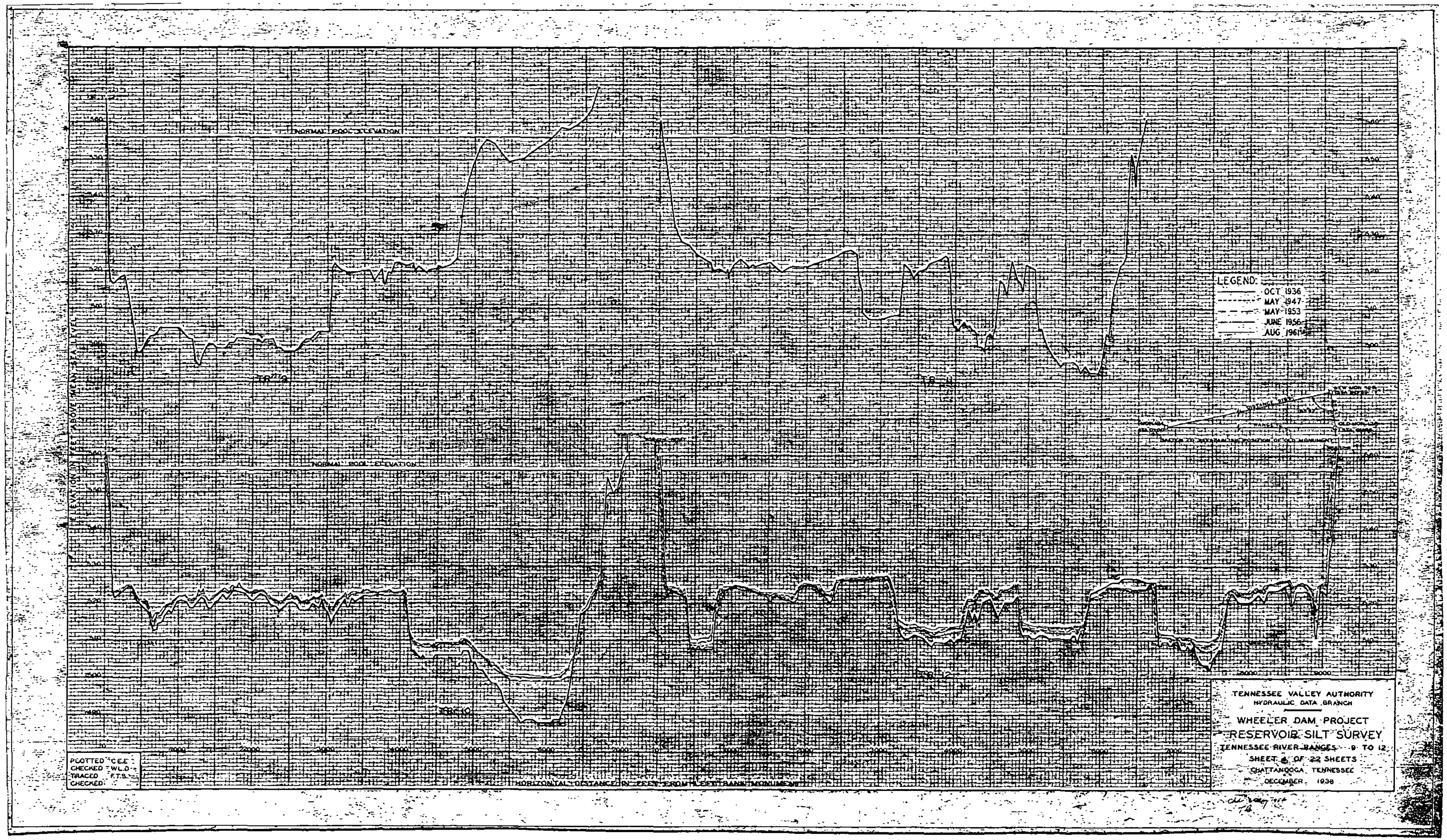


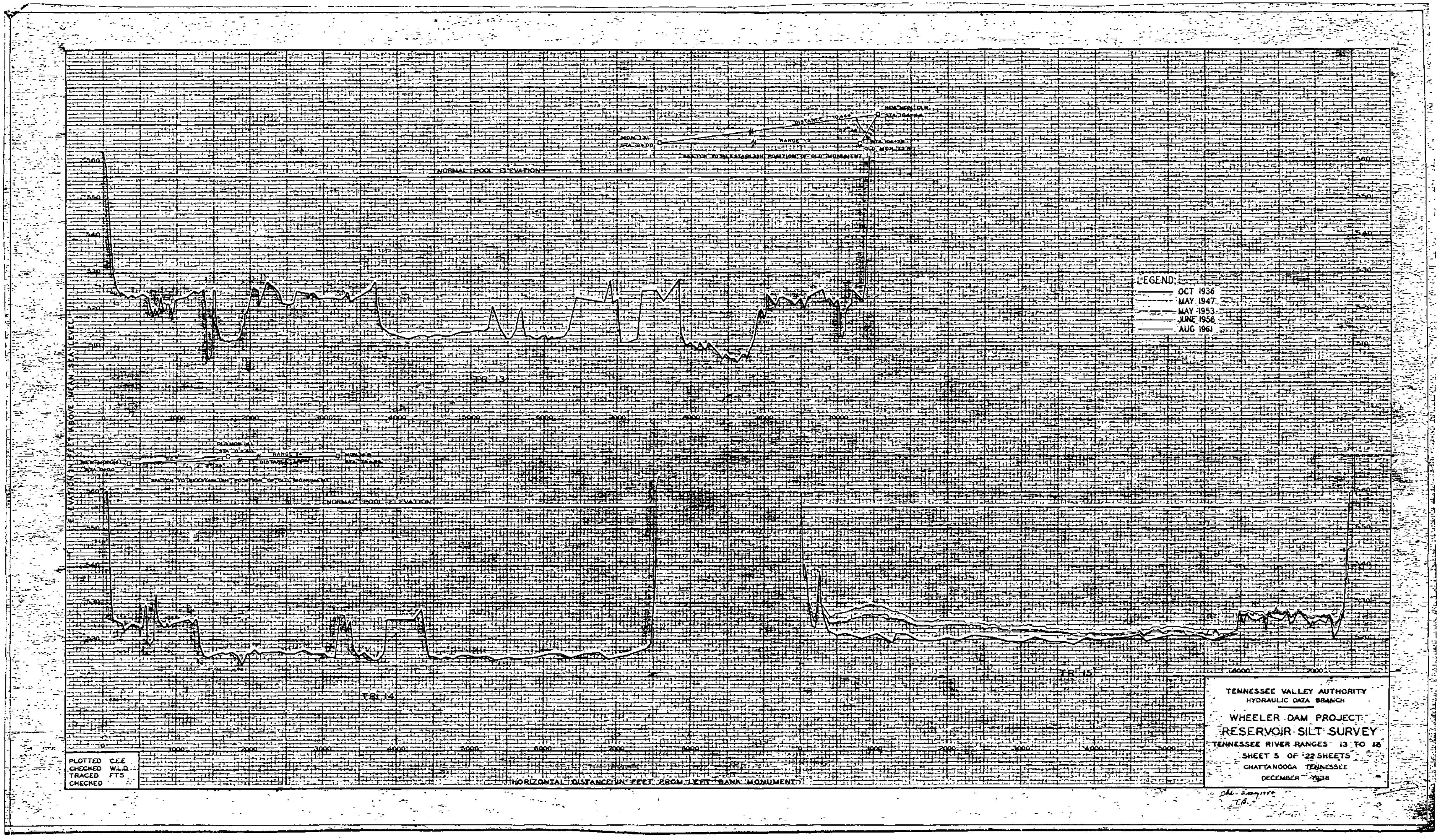
PLOTTED C.E.E.
CHECKED W.L.D.
TRACED F.T.S.
CHECKED

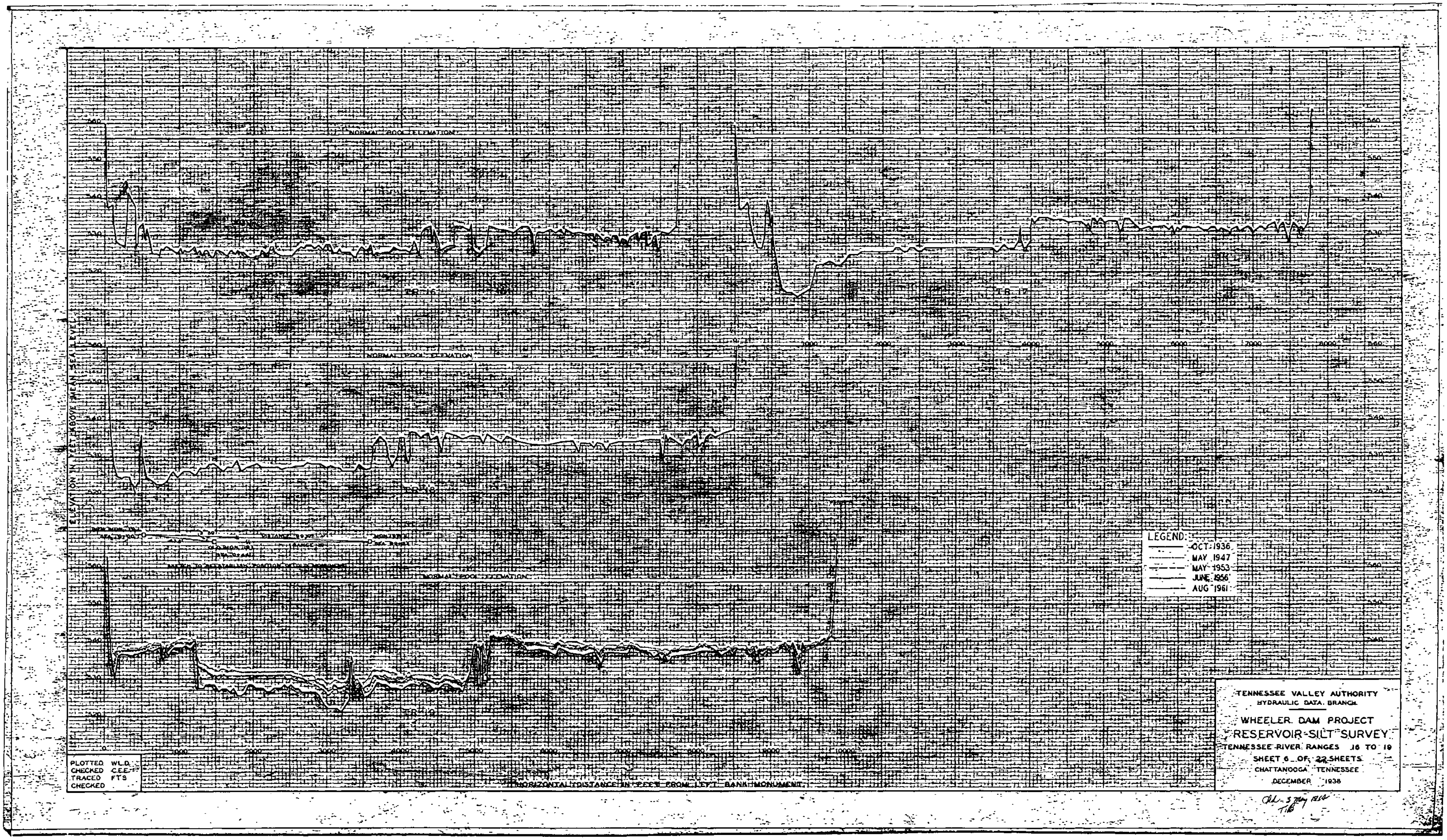
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH

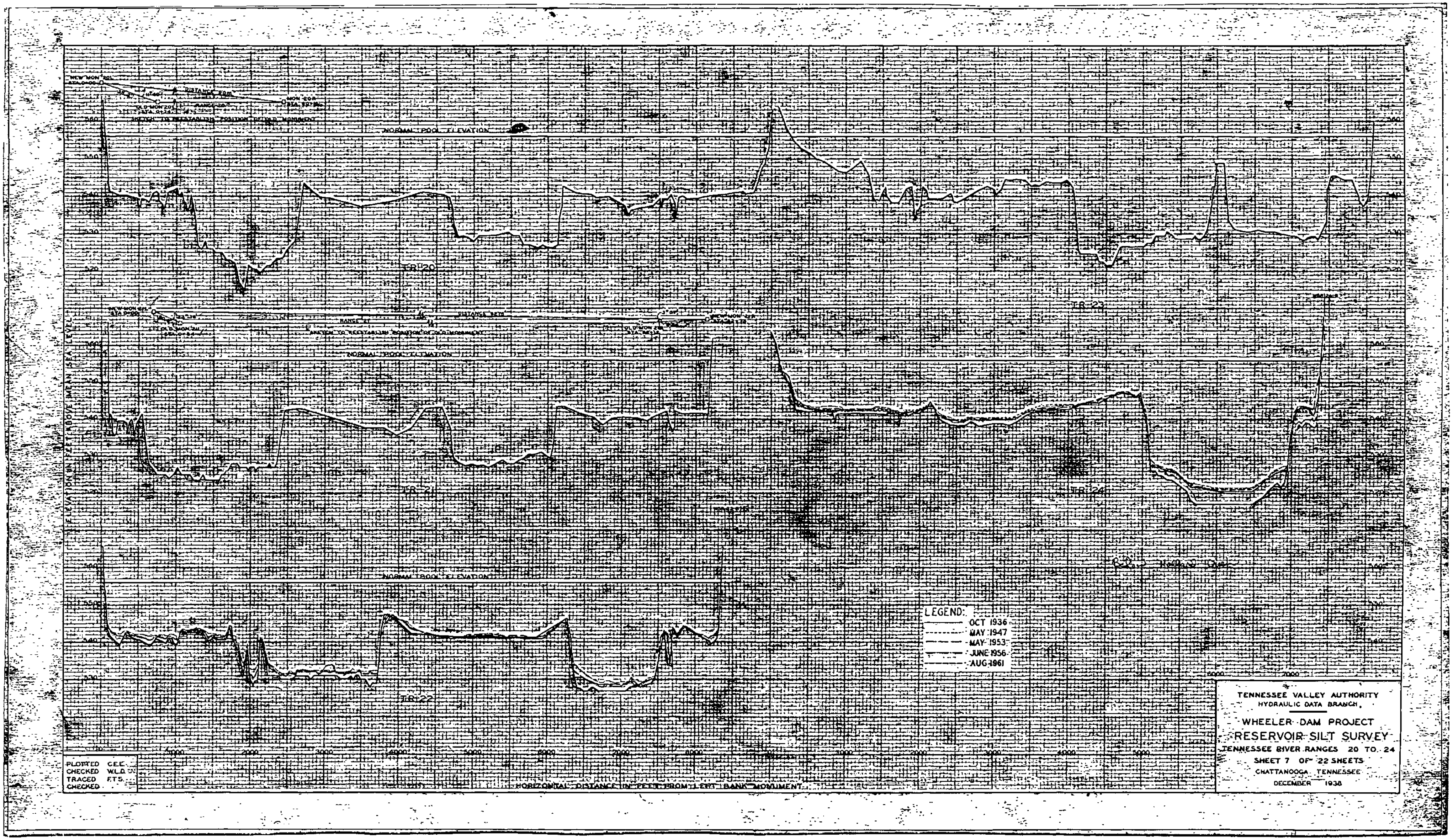
WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 3 TO 4
SHEET 2 OF 22 SHEETS
CHATTANOOGA TENNESSEE
DECEMBER 1938

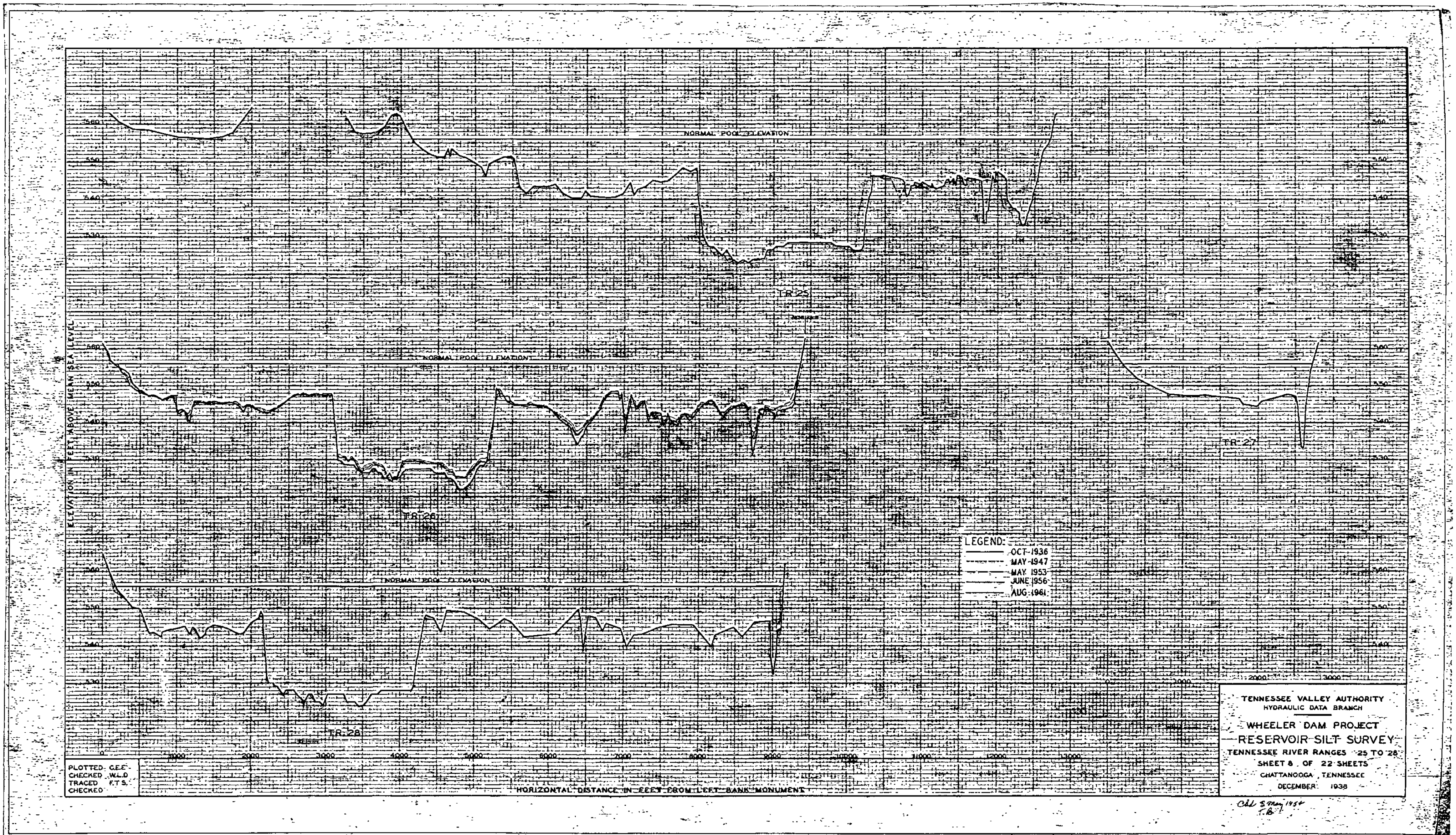

NORMAL POOL ELEVATION
T.R. 5
T.R. 6
T.R. 7
T.R. 8
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
HORIZONTAL DISTANCE IN FEET FROM LEFT BANK MONUMENT
LEGEND:
OCT 1936
MAY 1947
MAY 1953
JUNE 1956
AUG 1961
PLOTTED C.E.E.
CHECKED W.L.D.
TRACED F.T.S.
CHECKED
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH
WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 5 TO 8
SHEET 3 OF 22 SHEETS
CHATTANOOGA, TENNESSEE
DECEMBER 1938


NORMAL POOL ELEVATION
NORMAL POOL ELEVATION
LEGEND:
OCT 1936
MAY 1947
MAY 1953
JUNE 1956
AUG 1961
PLOTTED C.E.E.
CHECKED W.L.D.
TRACED F.T.S.
CHECKED
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH
WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 9 TO 12
SHEET 4 OF 22 SHEETS
CHATTANOOGA, TENNESSEE
DECEMBER 1938

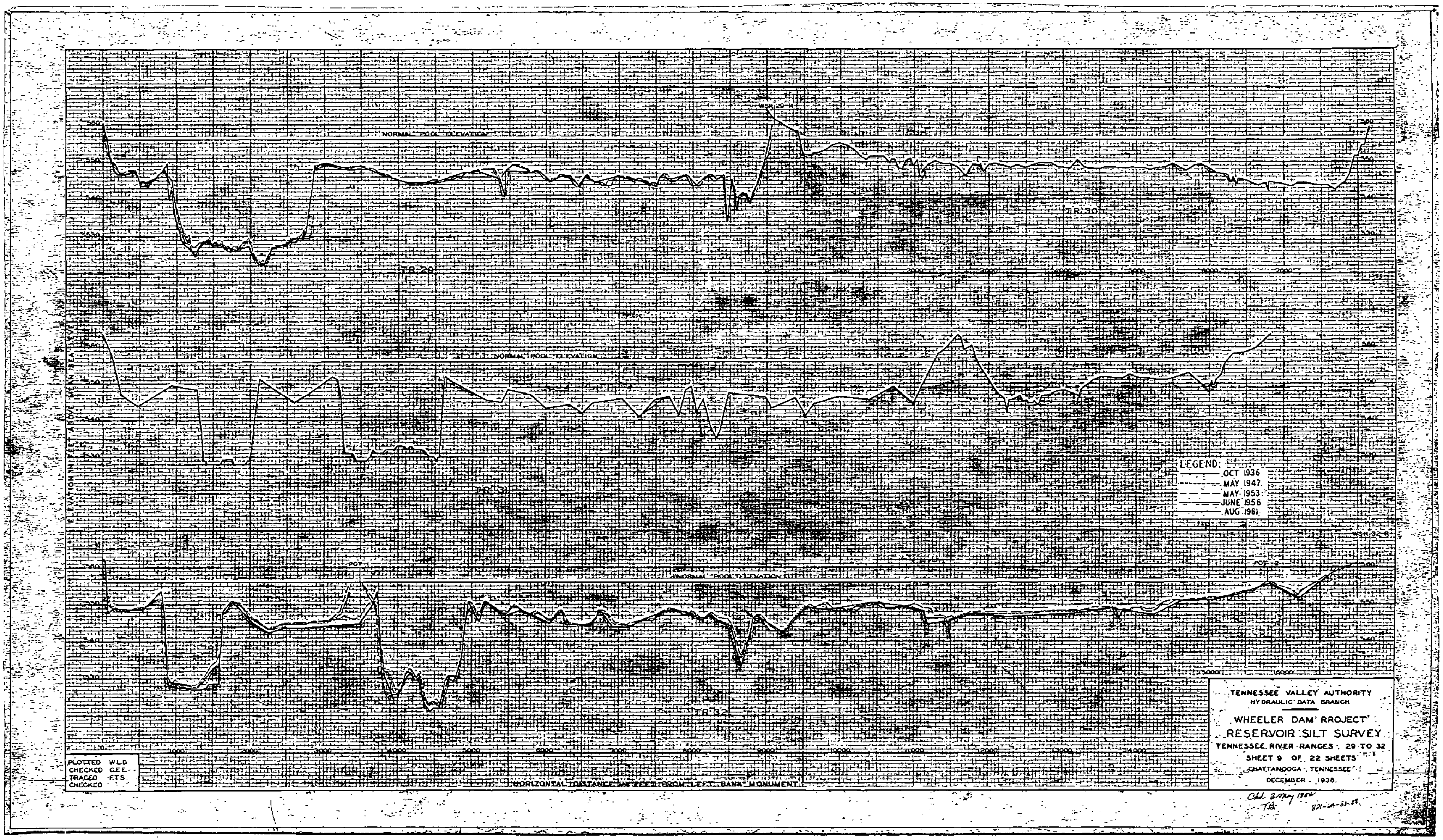

NORMAL POOL ELEVATION
SKETCH TO RE-ESTABLISH POSITION OF OLD MONUMENT
LEGEND:
OCT 1936
MAY 1947
MAY 1953
JUNE 1956
AUG 1961
T.R. 13
T.R. 14
T.R. 15
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
HORIZONTAL DISTANCE IN FEET FROM LEFT BANK MONUMENT
PLOTTED C.E.E.
CHECKED W.L.D.
TRACED F.T.S.
CHECKED
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH
WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 13 TO 15
SHEET 5 OF 22 SHEETS
CHATTANOOGA TENNESSEE
DECEMBER 1938

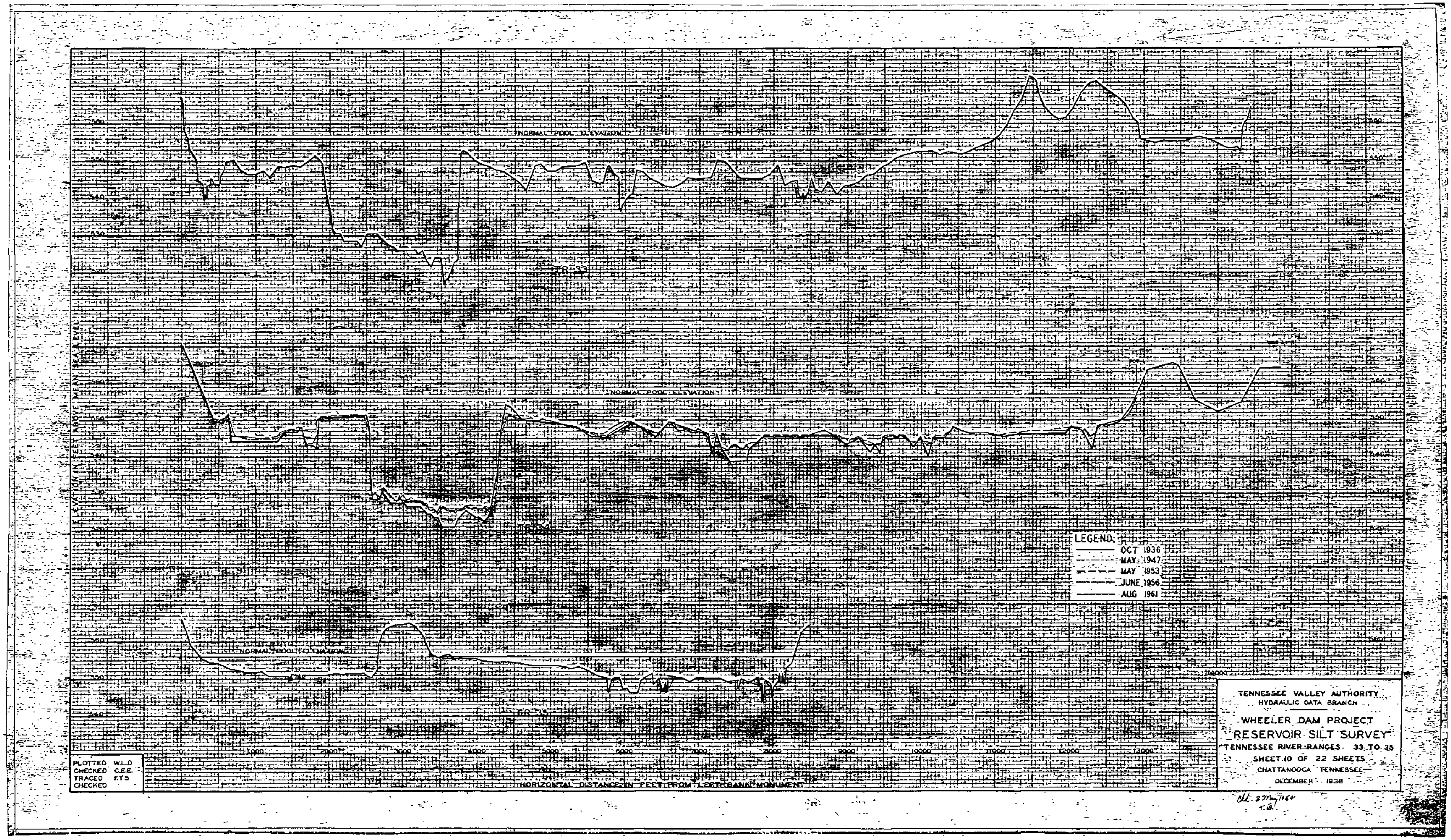

NORMAL POOL ELEVATION
TR 16
TR 17
NORMAL POOL ELEVATION
TR 18
NORMAL POOL ELEVATION
TR 19
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
HORIZONTAL DISTANCE IN FEET FROM LEFT BANK MONUMENT
LEGEND:
OCT. 1936
MAY 1947
MAY 1953
JUNE 1956
AUG 1961
PLOTTED W.L.D.
CHECKED C.E.E.
TRACED F.T.S.
CHECKED
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH
WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 16 TO 19
SHEET 6 OF 22 SHEETS
CHATTANOOGA TENNESSEE
DECEMBER 1938

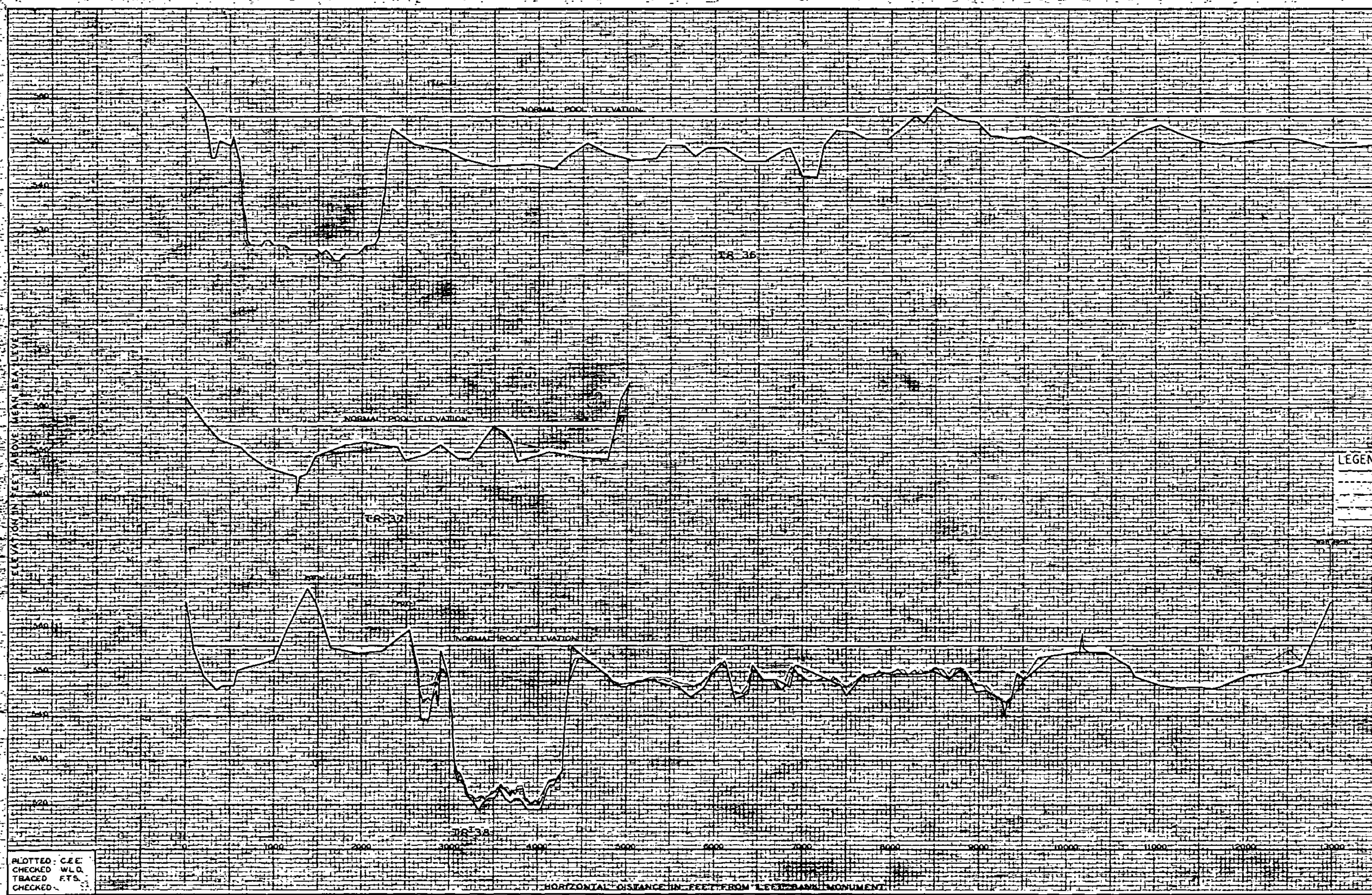

NORMAL POOL ELEVATION
T.R. 20
T.R. 21
T.R. 22
T.R. 23
T.R. 24
LEGEND:
OCT 1936
MAY 1947
MAY 1953
JUNE 1956
AUG 1961
HORIZONTAL DISTANCE IN FEET FROM LEFT BANK MONUMENT
PLOTTED C.E.E.
CHECKED W.L.D.
TRACED F.T.S.
CHECKED
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH.
WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 20 TO 24
SHEET 7 OF 22 SHEETS
CHATTANOOGA, TENNESSEE
DECEMBER 1938



NORMAL POOL ELEVATION
T.R. 25
T.R. 26
T.R. 27
T.R. 28
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
HORIZONTAL DISTANCE IN FEET FROM LEFT BANK MONUMENT
LEGEND:
OCT 1936
MAY 1947
MAY 1953
JUNE 1956
AUG 1961
PLOTTED C.E.E.
CHECKED W.L.D.
TRACED F.T.S.
CHECKED
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH
WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 25 TO 28
SHEET 8 OF 22 SHEETS
CHATTANOOGA, TENNESSEE
DECEMBER 1938

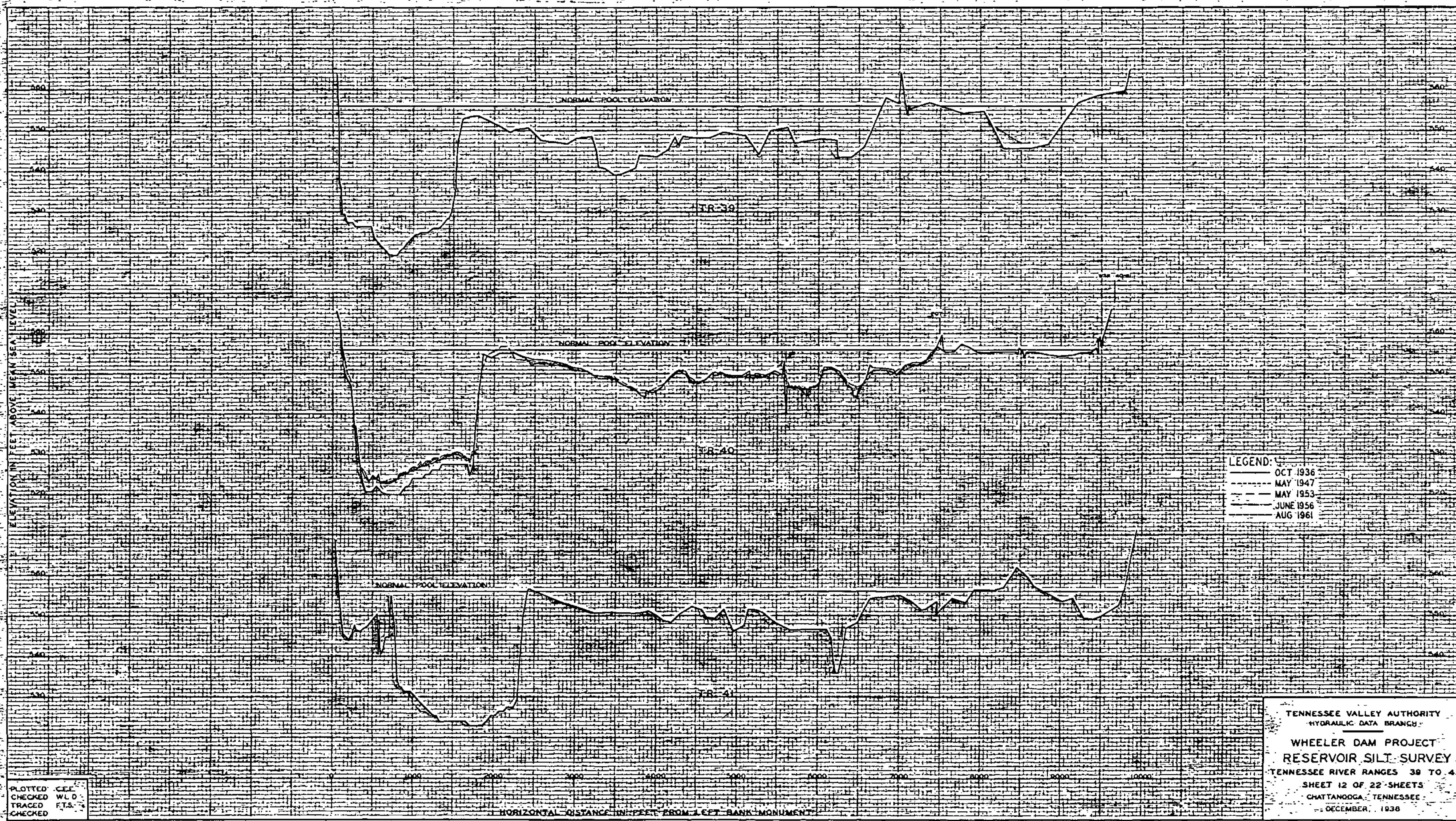

NORMAL POOL ELEVATION
T.R. 29
T.R. 30
T.R. 31
T.R. 32
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
LEGEND:
OCT 1936
MAY 1947
MAY 1953
JUNE 1956
AUG 1961
HORIZONTAL DISTANCE IN FEET FROM LEFT BANK MONUMENT
PLOTTED W.L.D.
CHECKED G.E.E.
TRACED F.T.S.
CHECKED
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH
WHEELER DAM RROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER - RANGES : 29 TO 32
SHEET 9 OF 22 SHEETS
CHATTANOOGA - TENNESSEE
DECEMBER - 1938.


NORMAL POOL ELEVATION
TR 33
NORMAL POOL ELEVATION
TR 34
NORMAL POOL ELEVATION
TR 35
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
HORIZONTAL DISTANCE IN FEET FROM LEFT BANK MONUMENT
LEGEND:
OCT 1936
MAY 1947
MAY 1953
JUNE 1956
AUG 1961
PLOTTED W.L.D
CHECKED C.E.E.
TRACED F.T.S.
CHECKED
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH
WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 33 TO 35
SHEET 10 OF 22 SHEETS
CHATTANOOGA TENNESSEE
DECEMBER 1938



TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH

WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 36 TO 38
SHEET 11 OF 22 SHEETS
CHATTANOOGA TENNESSEE
DECEMBER 1938



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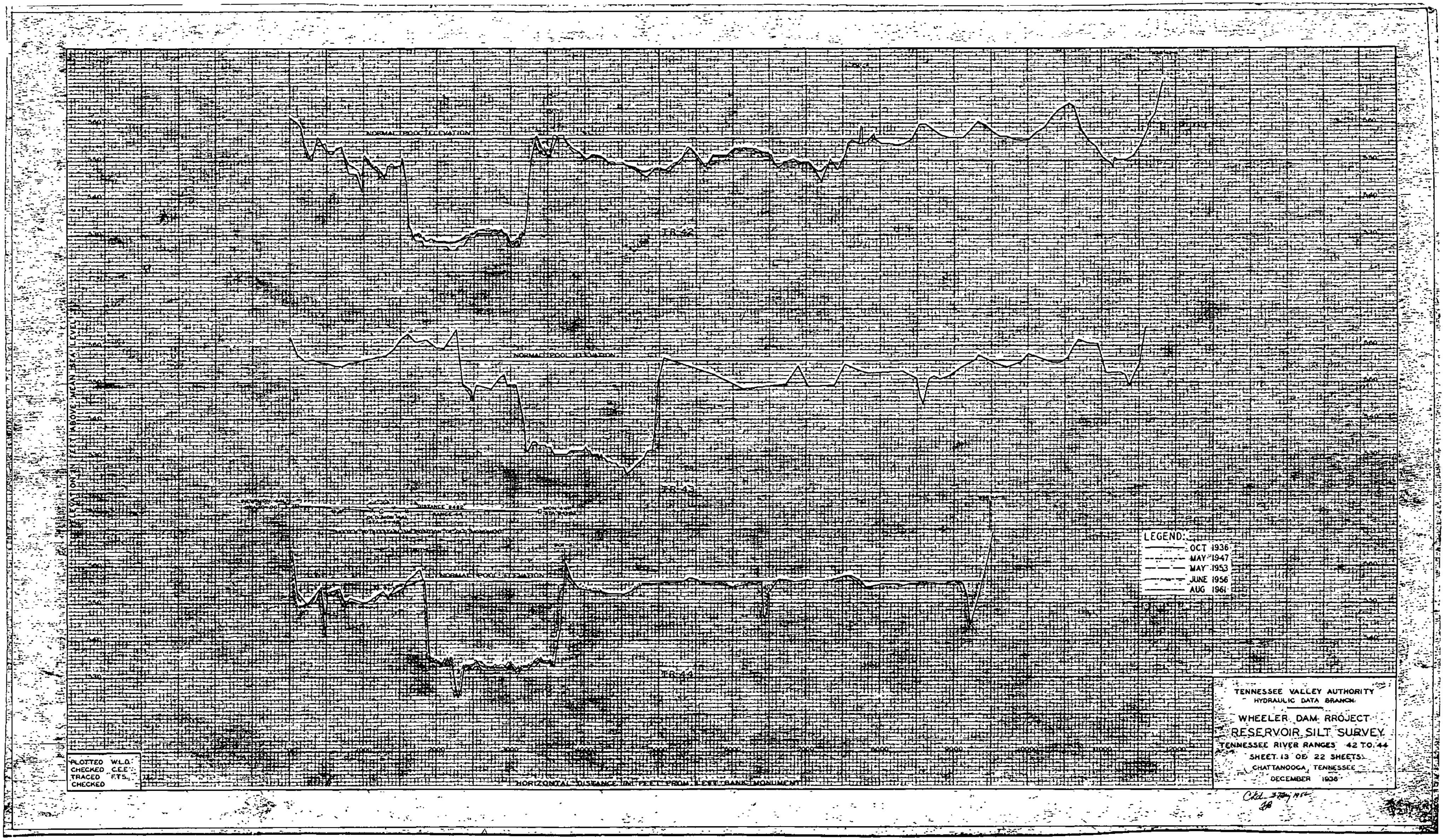
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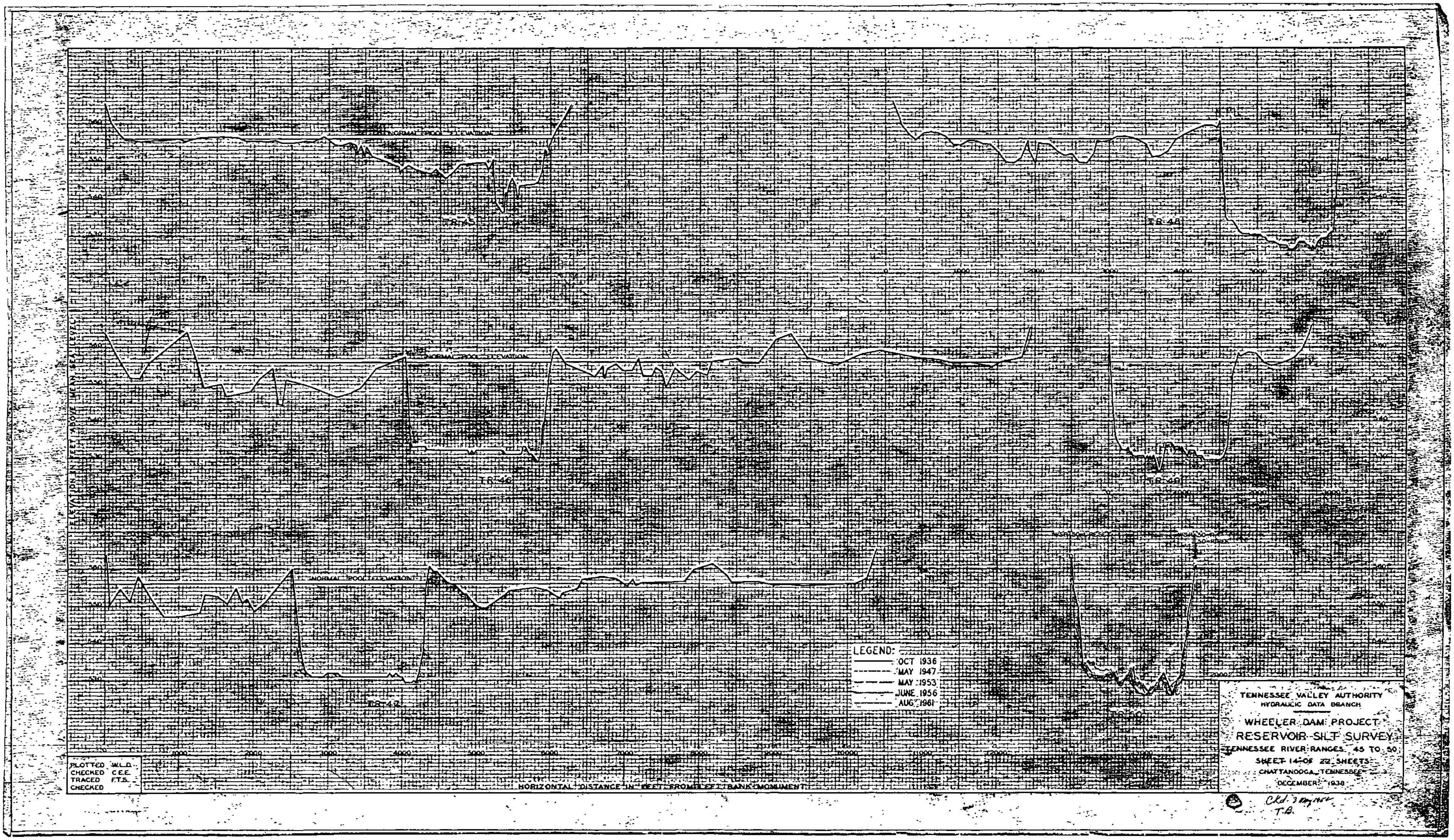
HYDRAULIC DATA BRANCH
WHEELER DAM RROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 42 TO 44
SHEET 13 OF 22 SHEETS
CHATTANOOGA, TENNESSEE
DECEMBER 1938



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TENNESSEE RIVER RANGES 45 TO 50
SHEET 14 OF 22 SHEETS
CHATTANOOGA, TENNESSEE
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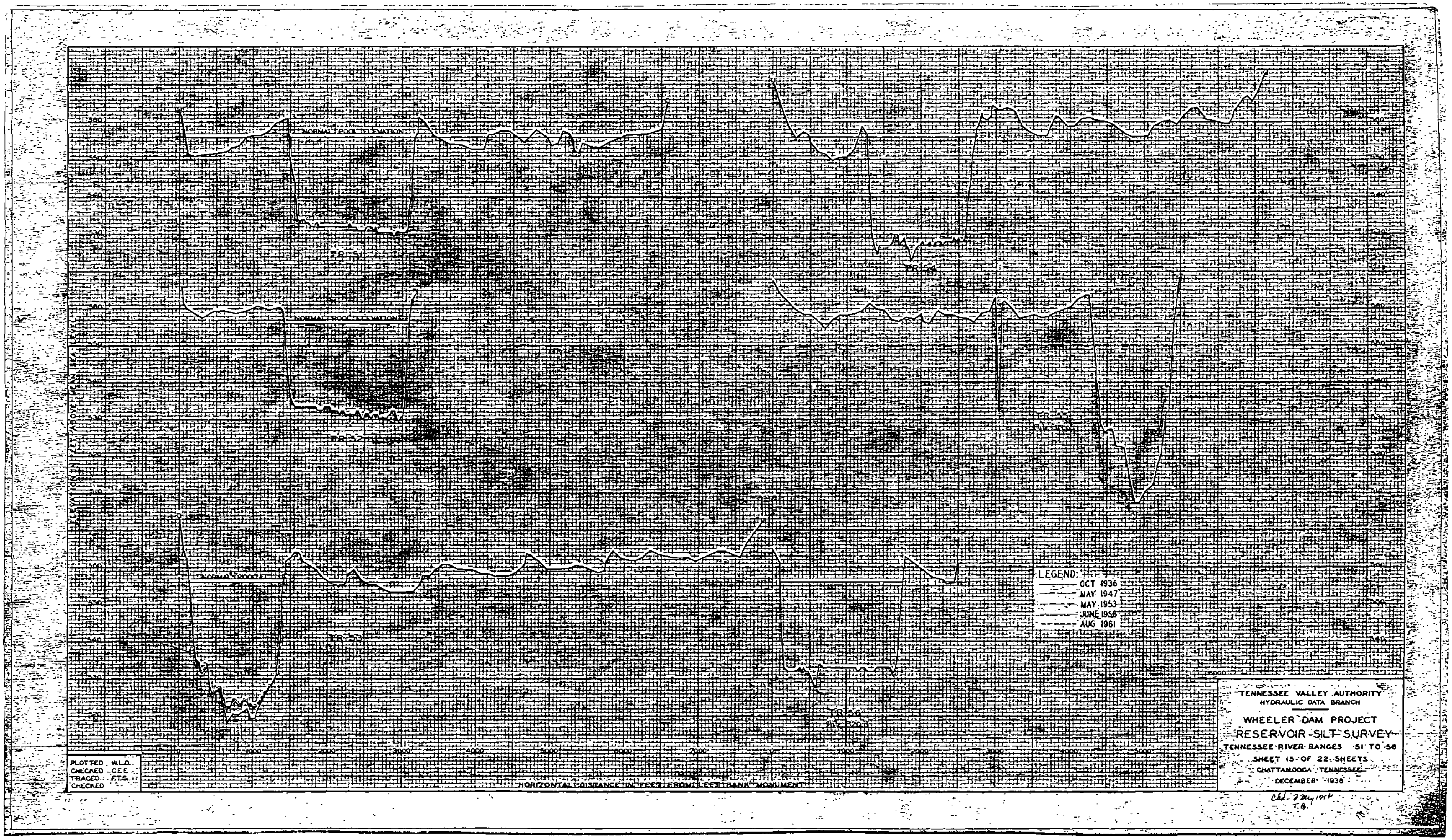

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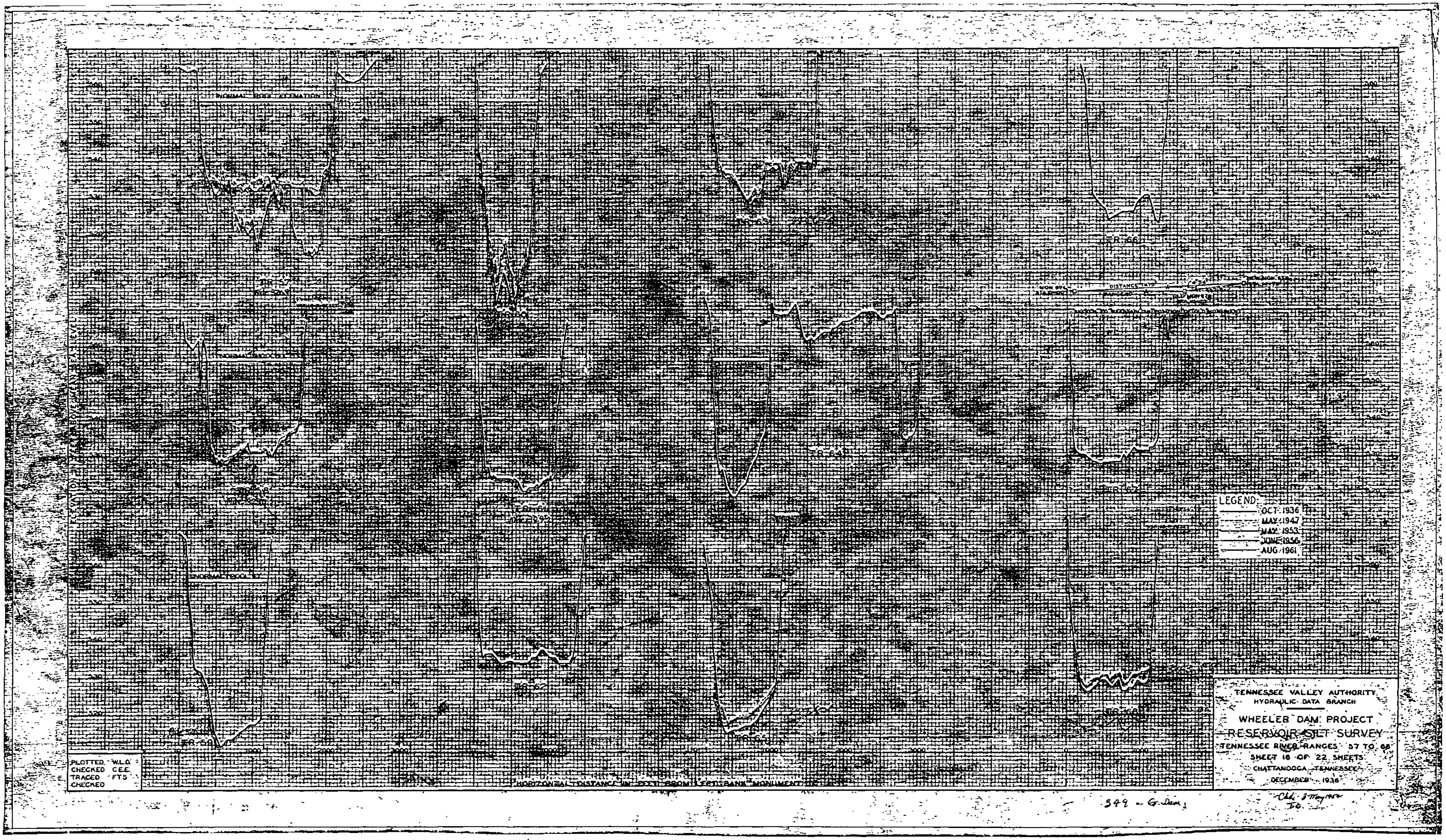
TENNESSEE RIVER RANGES 51 TO 56
SHEET 15 OF 22 SHEETS
CHATTANOOGA TENNESSEE
DECEMBER 1938



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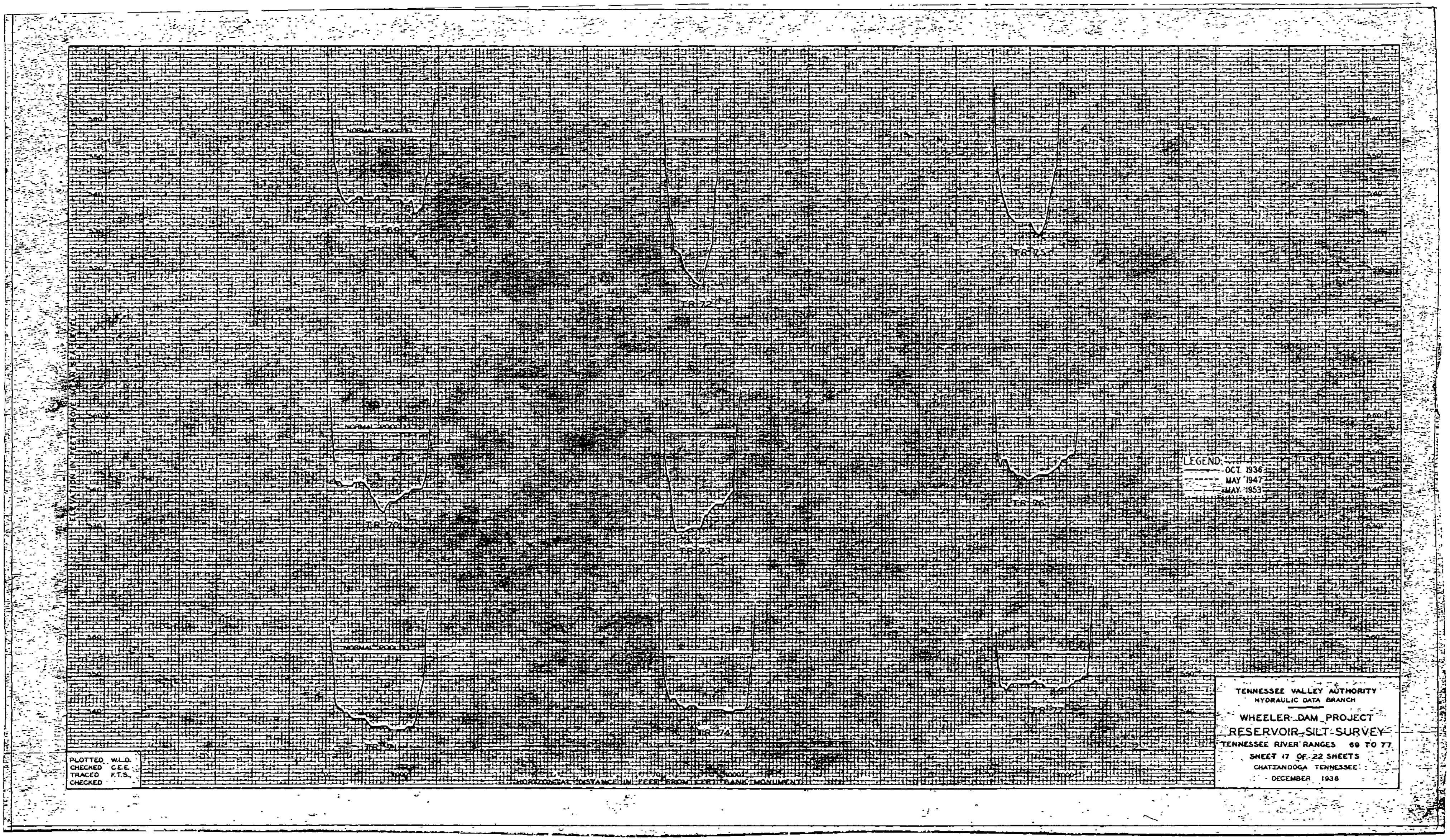
WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 57 TO 68
SHEET 16 OF 22 SHEETS
CHATTANOOGA, TENNESSEE
DECEMBER 1938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T.R. 73
T.R. 74
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T.R. 76
T.R. 77
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
HORIZONTAL DISTANCE IN FEET FROM LEFT BANK MONUMENT
LEGEND:
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MAY 1947
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PLOTTED W.L.D.
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TENNESSEE VALLEY AUTHORITY
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WHEELER DAM PROJECT
RESERVOIR SILT SURVEY
TENNESSEE RIVER RANGES 69 TO 77
SHEET 17 OF 22 SHEETS
CHATTANOOGA TENNESSEE
DECEMBER 1938

Original HEC-RAS Files from 1992 FEMA Flood Study

OPEN-CHANNEL HYDRAULICS

VEN TE CHOW, Ph.D.

Professor of Hydraulic Engineering
University of Illinois

A
McGRAW-HILL
CLASSIC
TEXTBOOK
REISSUE

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To

Humanity and Human Welfare

OPEN-CHANNEL HYDRAULICS

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ISBN 07-010776-9

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
C. EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
D. NATURAL STREAMS			
D-1. Minor streams (top width at flood stage <100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070
D-2. Flood plains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Dense willows, summer, straight	0.110	0.150	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. Same as above, but with flood stage reaching branches	0.100	0.120	0.160
D-3. Major streams (top width at flood stage >100 ft). The n value is less than that for minor streams of similar description, because banks offer less effective resistance.			
a. Regular section with no boulders or brush	0.025	.....	0.060
b. Irregular and rough section	0.035	.....	0.100

CHAPTER 6

COMPUTATION OF UNIFORM FLOW

6-1. The Conveyance of a Channel Section. The discharge of uniform flow in a channel may be expressed as the product of the velocity, represented by Eq. (5-1), and the water area, or

$$Q = VA = CAR^xS^y = KS^y \tag{6-1}$$

where

$$K = CAR^x \tag{6-2}$$

The term K is known as the *conveyance* of the channel section; it is a measure of the carrying capacity of the channel section, since it is directly proportional to Q.

When either the Chézy formula or the Manning formula is used as the uniform-flow formula, i.e., when $y = \frac{1}{2}$, the discharge by Eq. (6-1) becomes

$$Q = K\sqrt{S} \tag{6-3}$$

and the conveyance is

$$K = \frac{Q}{\sqrt{S}} \tag{6-4}$$

This equation can be used to compute the conveyance when the discharge and slope of the channel are given.

When the Chézy formula is used, Eq. (6-2) becomes

$$K = CAR^{1/2} \tag{6-5}$$

where C is Chézy's resistance factor. Similarly, when the Manning formula is used,

$$K = \frac{1.49}{n} AR^{2/3} \tag{6-6}$$

The above two equations are used to compute the conveyance when the geometry of the water area and the resistance factor or roughness coefficient are given. Since the Manning formula is used extensively, most of the following discussions and computations will be based on Eq. (6-6).

6-2. The Section Factor for Uniform-flow Computation. The expression $AR^{2/3}$ is called the *section factor for uniform-flow computation;* it is an important element in the computation of uniform flow. From Eq.

(6-6), this factor may be expressed as

$$AR^{2/3} = \frac{nK}{1.49} \tag{6-7}$$

and, from Eq. (6-4),

$$AR^{2/3} = \frac{nQ}{1.49\sqrt{S}} \tag{6-8}$$

Primarily, Eq. (6-8) applies to a channel section when the flow is uniform. The right side of the equation contains the values of n, Q, and S; but the left side depends only on the geometry of the water area. Therefore, it shows that, for a given condition of n, Q, and S, there is *only one* possible depth for maintaining a uniform flow, provided that the value of $AR^{2/3}$ always increases with increase in depth, which is true in most cases. This depth is the *normal depth.* When n and S are known at a channel section, it can be seen from Eq. (6-8) that there can be *only one* discharge for maintaining a uniform flow through the section, provided that $AR^{2/3}$ always increases with increase of depth.[1] This discharge is the *normal discharge.*

Equation (6-8) is a very useful tool for the computation and analysis of uniform flow. When the discharge, slope, and roughness are known, this equation gives the section factor $A_nR_n^{2/3}$ and hence the normal depth y_n. On the other hand, when n, S, and the depth, hence the section factor, are given, the normal discharge Q_n can be computed from this equation in the following form:

$$Q = \frac{1.49}{n} AR^{2/3} \sqrt{S} \tag{6-9}$$

This is essentially the product of the water area and the velocity defined by the Manning formula. The subscript n is sometimes used to specify the condition of uniform flow.

In order to simplify the computation, dimensionless curves showing the relation between depth and section factor $AR^{2/3}$ (Fig. 6-1) have been prepared for rectangular, trapezoidal, and circular channel sections. These self-explanatory curves will help to determine the depth for a given section factor $AR^{2/3}$, and vice versa. The $AR^{2/3}$ values for a circular section can also be found from the table in Appendix A.

[1] This is true for channels in which the value of $AR^{2/3}$ always increases with increase of depth, since Eq. (6-8) will give one value of $AR^{2/3}$, which in turn gives only one depth. In the case of a closed conduit having a gradually closing top, the value of $AR^{2/3}$ will first increase with depth and then decrease with depth when the full depth is approached, because a maximum value of $AR^{2/3}$ usually occurs in such a conduit at a depth slightly less than the full depth. Consequently, it is possible to have two depths for the same value of $AR^{2/3}$, one greater and the other less than the depth for the maximum value of $AR^{2/3}$. For further discussion on this subject see Art. 6-4.

UNITED STATES

TENNESSEE VALLEY AUTHORITY

SURVEYING, MAPPING AND RELATED ENGINEERING

Tennessee Valley Authority

TECHNICAL REPORT NO. 23

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1951

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price $2.25. Buckram.

TENNESSEE VALLEY AUTHORITY.
Knoxville, Tenn., August 4, 1950.

MR. GEORGE F. GANT, *General Manager,*
Tennessee Valley Authority, Knoxville, Tenn.

DEAR MR. GANT: Technical Report No. 23, *Surveying, Mapping and Related Engineering*, is the third of a series of special reports being prepared to cover certain phases of engineering and construction work common to all projects designed and constructed by TVA in the unified development of the water resources of the Tennessee River system.

These special technical reports have been planned as a companion series to technical reports on the individual projects and record the results of experience gained on TVA projects in specialized fields over a period of years. It is recommended that Technical Report No. 23 be printed as a public document.

Yours very truly,

C. E. BLEE, *Chief Engineer.*

Medium-scale topographic surveys

A large portion of the course of the Tennessee River and several of its tributaries had been mapped by the United States Corps of Engineers between 1923 and 1930. The maps were reproduced at an approximate scale of 1 inch=1,250 feet and show 5- and 10-foot contours (fig. 21). Planimetry was mapped to an elevation approximately equal to that reached by the greatest flood along the main river and from 100 to 300 feet, vertically, above the low water elevation on tributary streams. The maps were reproduced as a series of contiguous sheets, the majority with over-all dimensions of 27 by 40 inches. In all, the Corps of Engineers compiled some 250 of these maps. This survey was probably the first one of such magnitude on which single lens photographs were used for plane table sheets and many of the survey and compilation methods developed in connection with the undertaking are still used in spite of the substantial advances that have been made in the science of photogrammetry. While the series did not cover the entire river system, and considerable revision and remapping were required to extend the work to higher elevations, the maps were extensively used by the TVA in the earlier reservoirs for making studies and estimates, and for planning activities. A number of special topographic drawings prepared by the Corps of Engineers have also proved useful.

Before 1937, when the Valley-wide topographic mapping program was started, the methods employed by TVA to revise or extend the original flowage mapping and to work previously unmapped sections of the river system varied a great deal, being influenced by the type of source data immediately available, the cost, and the element of time involved. For instance, when it became necessary to extend the original contour mapping to a higher elevation along the reaches of the Tennessee River now included in the Kentucky Reservoir, because of the urgency of the work and the absence of newer photographs, the original photography, tracings, and work methods employed by the Corps of Engineers in 1926–27 were again used by the TVA in 1934. Through the use of the original source materials it was possible to prepare very economically maps satisfactory for many preliminary studies. However, the usefulness of these maps was limited because of position errors resulting from the lack of horizontal ground control in the original work; and the unit costs of the additional field surveys were increased as the result of having to work on old unratioed photographs in an area where considerable cultural change had taken place, making it both difficult and time-consuming to establish reliable bearings and scale ratios on the photographs in the field.

In areas not previously mapped under the TVA-United States Geological Survey mapping program or by the Corps of Engineers, or where the cost of revising and extending the limits of earlier surveys exceeded the cost of complete remapping, new flowage maps were prepared by plane table methods. The new flowage map series differed from the earlier maps in that it included the appropriate State plane coordinate grid system and was rigidly controlled through the use of transit-tape traverse networks, previously established for control of the Valley planimetric map series. Incorporation of the accurate control made possible the scale determination of contact aerial

The harbor entrance is swept to its connection with the main channel and soundings taken with a depth recorder or a lead line. The size of the harbor is determined from sweep drawings, and dredge cut lines are laid out to reduce dredging to a minimum. Soundings and probings are then taken in strike areas within the dredge cut lines to determine the character of materials and quantities to be dredged.

For safety landing sites the area along the bank is swept by moving a barge out with the bars down the required depth. As the barge moves away from the bank each bar is checked to determine the approximate slope and to locate stumps, rock, boulders, or other obstructions which would prove disastrous to boats if the water was lowered or they were rammed against the bank by a storm while tied up. The entrance to the landing is swept also. In order to find 2,000 or 3,000 feet of area along river bank in one stretch suitable for a safety landing, 4,000 to 6,000 feet may be swept.

Soundings and probings are taken at 5- and 10-foot intervals to rock or to a depth of 2 feet below the proposed harbor bottom elevations and, normally, on ranges of 100 feet; however, the range interval is changed, if necessary, to accurately locate ledge rock, rock outcrop, and boulders along the submerged bank.

The navigation contours, cultural features, and navigation aids are mapped by plane table stadia methods. The contour interval above water is usually 5 feet and contours are mapped to an elevation 5 to 15 feet above normal pool. The contour interval below the water surface varies between 3 and 5 feet and contours are mapped to an elevation 10 to 15 feet below normal pool.

SILT RANGES

Purpose

The characteristics and amounts of siltation in a reservoir depend on such factors as the extent of forest cover and the type of soil in the drainage basin; the state of its cultivation; the gradient of the tributary streams and the slope of land adjacent to the reservoir; the number and type of reservoirs upstream; and the amount and peculiarities of rainfall in each reservoir basin. In some of the older reservoirs built before the creation of TVA and before much attention was given to terracing, contour plowing, and planting of cover crops, silt deposits had destroyed much of the storage capacity and had, in fact, almost completely filled one small reservoir. In order to estimate the useful life of storage reservoirs and cope with the problems of siltation in navigation channels, accurate base lines or silt ranges are established before impoundage in TVA reservoirs so that resurveys can be made from time to time to accurately measure the amount of silt deposits.

Preimpoundage surveys

Horizontal and vertical control.—Ranges are generally laid out at right angles to the direction of flow and are spaced about 1 mile apart in the upper half of the reservoir and on tributary streams. In the lower half of the reservoir, the spacing is generally greater, in some instances as much as 2 miles apart. Monuments are set to mark the ends of the ranges. They are standard precast concrete markers, measuring 8 inches square at the top, 10 inches square at the bottom, 40 inches long, and weighing about 200 pounds. Each monument has embedded in its top a standard cast-bronze tablet, in which is stamped the identifying range number. The markers are set well above and away from the reservoir shore line to ensure against being covered by silt in the upper reaches of the main river projects and from being disturbed by caving banks caused by wave action in other locations. A detailed description is recorded for each monument which includes the distance and bearing of the marker from a number of permanent and prominent features in the immediate vicinity to facilitate its recovery. Later, after it was found that some of the monuments were being destroyed by farm machinery, enamel-covered metal survey marker signs bolted to 1- by 1-inch by 7-foot angle iron fence posts were set adjacent to the markers to help preserve them.

The horizontal position and elevation of each monument was established by traverse and levels of third-order accuracy. The horizontal control was adjusted to the state plane coordinate grid system and the leveling to the mean sea level datum.

Field methods and procedures.—Distances along the ranges were measured by fourth-order transit and tape methods. Stations were established and marked on the ground at each change in grade along the range. Distances across bodies of water were established by triangulation. Underwater profiles were established by tag line distances from a station on the shore and underwater elevations obtained by conventional rod or lead line soundings.

Elevations of all breaks in grade along the land sections of the ranges on the main-river projects, where the land to be flooded was generally flat to rolling, were determined by spirit leveling with the errors of closure between monumented ends of ranges being limited to 0.2 foot. All turning points were read to 0.01 foot and profile elevations to the nearest 0.1 foot.

Elevations of breaks in grade along the steep mountain slopes in the storage type reservoirs were established by reciprocal trigonometric leveling over stations previously set by transit slope-taping methods, making ties to third-order reservoir control levels at the toes of the slopes. Errors of closure were limited to 1 foot. The profiles across the relatively flat flood plains (where later silt survey data would be most reliable) between the steep hills, were established by spirit leveling.

Silt range surveys are delayed until after clearing operations are completed in order to minimize the amount of line clearing. In the reservoirs where trees were left standing below the draw-down contour it is the practice to clear 20 feet on each side of the range line, primarily for the convenience in making resurveys after impoundage. In the case of large turbulent mountain streams, it has been found to be more economical and less hazardous to delay sounding the river bed until reservoir filling begins, then sound the river section of the ranges from a boat using a tag line for distance measurements from a station established on the bank. By starting shortly after filling operations begin, it is possible to work in shallow slack water throughout the entire length of the reservoir area. It has also been found that the notes should include detail sketches showing the recorder's view of the ground profile and the approximate location of features adjacent to the range that might be of use in analyzing the results of resurveys after impoundage. Large tree stumps, flat rocks, and abrupt changes in ground elevation to the side of the center line are shown.

Rod soundings have been found to be more satisfactory in water less than 20 feet in depth. A bell-shaped lead weight suspended by 1/16-inch wire cable or piano wire is used in deeper water. On the initial soundings the ground or bottom profile is dragged between soundings to avoid the omission of a change in ground profile. Also, at each recorded sounding the area immediately surrounding the point is felt out to locate abrupt changes that might be confusing in the resurveys should there be a small error in position of the sounding during resurveys. Since silt is usually laid down in wedge-shaped layers with the thickest section, usually a coarse material, in the narrow upper reaches of the reservoir and the thinnest portion, made up of a fine silt that will not support a heavy sounding weight, in the broad sections close to the dam, both the original profile and the resurveys are taken very carefully in the downstream ranges.

Postimpoundage soundings

Several methods or combinations of methods have been employed in making silt range resurveys. The ground above water level, including land exposed during draw-down (the time when resurveys are generally scheduled) is profiled using the same methods used in the initial work. In the upper reaches of some of the storage type projects where silt deposits are heaviest, satisfactory underwater results have been obtained using electronic depth sounding equipment from a boat equipped with a piano wire tag line device, reeled off from the boat, for measuring the distance from a known station on the shore line. When this method is employed spot check soundings with a lead line are made to detect any errors of adjustment in the electronic equipment. In making resurveys a five-man party can handle both the bank profiling above the water level and the reservoir sounding.

For taking soundings the boat crew is made up of a boat operator, tag-line man, a man to operate the electronic device, and the party chief who also keeps in communication with the transitman on the bank. The transitman keeps the boat on line. All five men take part in the bank surveys, making profile surveys above water on two ranges, and erecting signals on silt range monuments for back sights before alternating the bank operations to the other side of the reservoir.

Where more accurate results are required than can be obtained with the depth sounding equipment, the soundings in shallow water are made with a rod graduated to tenths of a foot and in deeper water with a lead line, using graduated piano wire and a bell-shaped lead sounding weight. Care is exercised to prevent the weight from sinking below the surface of the silt deposit. Alinement for the soundings on the silt range is maintained by short wave radio communication between the transitman on the monumented bank station and the boat crew. A graduated piano wire anchored to a station on the bank is unreeled from the boat to determine the distance from the shore station. The manual sounding party generally consists of four men in the boat and a transitman and, like the party using echo depth sounding equipment, also makes the bank profile surveys. The party chief, in the boat, maintains constant communication with the transitman and records the depth of water and registers distances from the station on the bank. One man takes the soundings, another operates the tag line distance measuring equipment, and the fourth man operates the boat. Depths are measured from water surface and converted to mean sea level elevation. Accurate sounding can only be taken when there are no wind tides or large waves.

Results of successive resurveys are all plotted on the same tracing on which the original silt range survey data was plotted for ease in measuring the total silt deposits as well as the deposits laid down between any two surveys.

SUBSURFACE EXPLORATIONS

Purpose and types

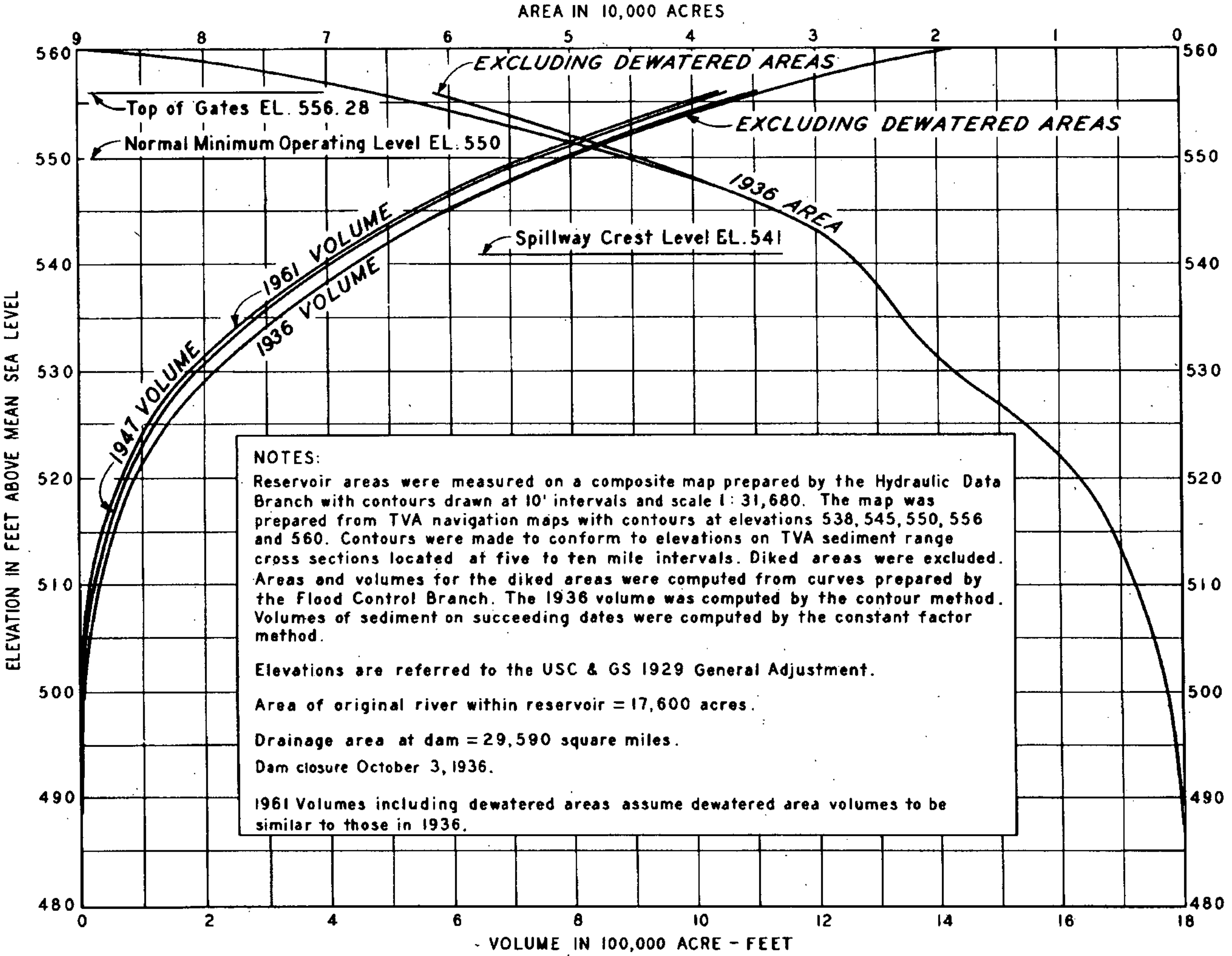
Subsurface investigations having to do with irregular earth and mineral deposits, stratified formations, and foundation studies for large structures usually involve the use of core drill and auxiliary equipment to obtain samples for laboratory tests and to establish the thickness and elevation of strata or deposits. The work includes the preparation of logs, columnar sections, topographic and geologic maps, the computation of quantities, and the investigation of ground water conditions. In general, test pits, rod soundings, wash borings, auger borings, core drilling, calyx drilling, or a combination of such methods are employed after surface geological investigations have been made to determine the structural conditions and to outline the area of interest.

Horizontal and vertical control

The initial points scheduled for subsurface explorations are usually established by plane table. A print of the site topography on which the geologist has spotted the location of points when tests are to be made is used as a plane table sheet. Standard third-order horizontal and vertical control methods are then used to establish positions and ground elevations for the location of additional holes if more intensive investigations are indicated. The local grid system or range lines are first laid out graphically on the plane table sheets. Traverse and level lines are then routed to the location by a series of rectangular loops following the predetermined range or grid lines. Oak hubs or angle iron station markers are set at each hole location and the station identification is stenciled on a guard stake driven in the ground adjacent to the station marker.

Field procedures and equipment

In the investigation of earth or mineral deposits, the type of equipment used is largely dependent upon the characteristics of the overburden materials and the deposit itself, and how deep the investigation is to go. In deposits of earth or other soft materials and when dry samples are required the earth auger is used. Where the overburden material has a tendency to cave or otherwise make auger



ELEV FT	INCLUDING DEWATERED AREAS 1936 AREA AC	INCLUDING DEWATERED AREAS 1936 VOLUME AC-FT	INCLUDING DEWATERED AREAS 1961 VOLUME AC-FT	EXCLUDING DEWATERED AREAS 1936 AREA AC	EXCLUDING DEWATERED AREAS 1936 VOLUME AC-FT	1947 VOLUME AC-FT	1953 VOLUME AC-FT	1956 VOLUME AC-FT	1961 VOLUME AC-FT
560	89,100	1,429,000	1,358,000						
556.28	68,000	1,142,000	1,071,000	62,000	1,122,000				
556	67,070	1,121,000	1,050,000	61,190	1,108,000	1,058,000	1,948,000	1,047,000	1,037,000
550	45,450	792,000	720,000	44,810	790,000	740,000	727,000	728,000	718,000
545	33,090	596,000	528,000	33,060	596,000	549,000	538,000	538,000	528,000
541	27,260	472,000		27,260	472,000	432,000	420,000		
538	24,870	393,000	335,000	24,870	393,000	355,000	344,000	343,000	335,000
530	18,600	220,000	171,000	18,600	220,000	190,000	178,000	177,000	171,000
520	8,080	88,600	65,600	8,080	88,500	74,400	67,800	67,300	65,600
510	3,680	31,300	18,100	3,680	31,300	22,200	19,800	19,100	18,100
500	1,220	7,140	800	1,220	7,140	1,810	1,240	1,040	800
490	138	344	0	138	344	0	0	0	0
483.8	0	0	0	0	0	0	0	0	0

TENNESSEE RIVER-MILE 274.9

RESERVOIR AREAS AND VOLUMES

WHEELER PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

SUBMITTED	RECOMMENDED	APPROVED
Edwin K. McCain	Paul C. [illegible]	[illegible]

KNOXVILLE | 12-28-62 | 3 | DA | 1 | 321G784 R1

THIS DRAWING SUPERSEDES 3-DA-1-321A14R1

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(615) 254 - 1500
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BWSC | BARGE WAGGONER SUMNER & CANNON, INC.

USACE HYDROGRAPHIC SURVEY DATE DOCUMENTATION

DATE OF ACQUISITION:	June 23, 2009
PROJECT:	TVA SOCH CHANNEL VERIFICATION
CC:	**Perry Maddux, TVA** **Greg Lowe, TVA** **PJ Nabors, TVA** **Carrie Stokes, BWSC** **Heather Smith-Sawyer, BWSC** **File**
BWSC FILE NO:	3410761

ITEMS RECEIVED:

On June 23, 2009 BWSC received an email from Bob Taphorn with the US Army Corps of Engineers in Nashville, Tennessee confirming the Tennessee River hydrographic survey collection dates within Wheeler Reservoir. Tennessee River miles 275 to 375 were surveyed between June 2006 and August 2006.

The survey horizontal and vertical datum is NAD83 and NGVD 29, respectively. The email indicated that survey points for Tennessee River miles 275 to 305 were provided in Alabama West State Plane coordinates, and survey points for Tennessee River miles 305 to 375 were provided in Alabama East State Plane coordinates. However, use and inspection of the data revealed the divide between Alabama East and West coordinate systems in the USACE hydrographic survey data coordinate files to occur at Tennessee River mile 308.

The original email from Bob Taphorn is enclosed.

Eric E. King, PE
BWSC

<u>USACE Contact Information:</u>
Bob Taphorn, Navigation Branch, CELRN-OP-N
PO Box 1070
Nashville, TN 37202-1070
Phone: 615.308.9742
Bob.Taphorn@usace.army.mil

-----Original Message-----
From: Taphorn, Bob LRN [mailto:Bob.Taphorn@usace.army.mil]
Sent: Tuesday, June 23, 2009 9:56 AM
To: Jeff Cundiff
Cc: Heather Smith Sawyer
Subject: RE: Wheeler - Bathymetric Data

Jeff
Data collected from June 06 to Aug 06. All xy's Al-west from 275 to 305. 305 to 375 are Al east NAD 83. All z values are NGVD 29.We use the Hwy 72 Bridge in Decatur to separate Al East and West.
Bob

-----Original Message-----
From: Jeff Cundiff [mailto:Jeff.Cundiff@bwsc.net]
Sent: Friday, June 12, 2009 9:17 AM
To: Taphorn, Bob LRN
Cc: Heather Smith Sawyer
Subject: Wheeler - Bathymetric Data

Bob,

Do you know anything about the bathymetric data for Wheeler?
Specifically were looking for the coordinate system (AL State Plane?), dates collected, any other pertinent information off hand.

Thank you,
Jeff

National Geodetic Survey (NGS) Height Conversion Methodology

This process is designed to provide datum shift between the NAVD 88 and NGVD 29 vertical datums at specified geographic position.

Dennis G. Milbert, Ph.D.

05/12/1999

METHOD

Program VERTCON computes the modeled difference in orthometric height between the North American Vertical Datum of 1988 (NAVD 88) and the National Geodetic Vertical Datum of 1929 (NGVD 29) for a given location specified by latitude and longitude.

The VERTCON 2.0 model was computed on May 5, 1994 using 381,833 datum difference values. A key part of the computation procedure was the development of the predictable, physical components of the differences between the NAVD 88 and NGVD 29 datums. This included models of refraction effects on geodetic leveling, and gravity and elevation influences on the new NAVD 88 datum. Tests of the predictive capability of the physical model show a 2.0 cm RMS agreement at our 381,833 data points. For this reason, the VERTCON 2.0 model can be considered accurate at the 2 cm (one sigma) level. Since 381,833 data values were used to develop the corrections to the physical model, VERTCON 2.0 will display even better overall accuracy than that displayed by the uncorrected physical model. This higher accuracy will be particularly noticable in the eastern United States.

It should be emphasized that VERTCON 2.0 is a datum transformation model, and can not maintain the full vertical control accuracy of geodetic leveling. Ideally, one should process level data using the latest reduction software and adjust it to established NAVD 88 control. However, VERTCON 2.0 accuracy is suitable for a variety of mapping and charting purposes.

Most horizontal positions of the bench marks used to generate VERTCON were scaled from USGS topographic maps. The estimated uncertainty of the scaled positions, 6", is greater than the differences between NAD 27 and NAD 83. Therefore, the latitude and longitude provided to VERTCON can be on either the NAD 27 or NAD 83 datum.

The VERTCON 2.0 model expresses datum differences between NAVD 88 and NGVD 29 due to removal of distortions in the level data, as well as due to the physical differences in the height systems. In some rare cases, these local NGVD 29 distortions could be 20 cm or more. If both ends of your old vertical survey were tied to one of these "problem" lines, then the datum difference of the problem line is appropriate to use to transform the survey data. If both ends of a vertical survey are tied to "undistorted lines", then it is appropriate

to use a slightly distant point to compute the transformation, no matter how close your survey data may approach a given problem line. The possible presence of a problem NGVD 29 line in the vicinity of your survey will become evident if dramatically different datum transformation values are computed within a small area.

It must also be emphasized that VERTCON 2.0 is not to be considered reliable beyond the boundaries of the lower 48 United States. Future versions of VERTCON may be extended into neighboring countries. The National Imagery and Mapping Agency (NIMA - previously the Defense Mapping Agency) has been of immense help in this endeavor. NIMA has provided a major portion of the NGS land gravity data set. NIMA has also been instrumental in the creation of the various 30" elevation grids in existence. Although the work of the NIMA generally precludes public recognition, their cooperation in this work is gratefully acknowledged.

National Geodetic Survey (NGS)

Height Conversion Algebraic Sign Convention

This process is designed to provide the datum shift between the NAVD 88 and NGVD 29 vertical datums at a specified geographic position. The correct use of algebraic signs to convert NGVD 29 heights to NAVD 88 heights, or NAVD 88 heights to NGVD 29 heights, is illustrated with examples.

Rudolf J. Fury M.S.,M.Eng.

05/12/1999

Data grids of (NAVD 88 - NGVD 29) height differences represent the datum shift model.

```
 ----------------------------------------------
| from    NGVD 29   ---->   NAVD 88 |
 ----------------------------------------------
```

If a NAVD 88 height is desired when a NGVD 29 height is given,
ADD the model value ALGEBRAICALLY to the NGVD 29 height.

FORMULA: height (NAVD 88) = height (NGVD 29) + datum shift (correction) value

Examples:

1. the NGVD 29 height is 500 meters (1640.420 feet) at

```
 36  10  35.0  latitude
098  40  10.0  longitude
```

After keying this position into VERTCON, the returned (NAVD 88 - NGVD 29) datum shift (correction) value is

+ 0.202 meter (+0.663 ft)

```
 --------
| ADD | this value ALGEBRAICALLY [ keep the sign ] to the NGVD 29 height:
 --------

                             500.000
                           +   0.202
                           ---------
the NAVD 88 height is        500.202  meters  (1641.083 feet).
```

2. the NGVD 29 height is 120 meters (393.701 feet) at

```
 36  10  35.0  latitude
078  40  10.0  longitude
```

After keying this position into VERTCON, the returned (NAVD 88 - NGVD 29) datum shift (correction) value is

- 0.267 meter (-0.876 ft)

```
 --------
```

| ADD | this value ALGEBRAICALLY [keep the sign] to the NGVD 29 height:

```
                    120.000
                  -   0.267
                  ---------
the NAVD 88 height is     119.733  meters  (392.825 feet).
```

- - - - - - - - - - - - - -

```
-------------------------------------------
| from    NAVD 88   ---->   NGVD 29 |
-------------------------------------------
```

If a NGVD 29 height is desired when a NAVD 88 height is given,
SUBTRACT the model value ALGEBRAICALLY from the NAVD 88 height.

FORMULA: height (NGVD 29) = height (NAVD 88) - datum shift (correction) value

Examples:

1. the NAVD 88 height is 500.202 meters (1641.083 feet) at

```
 36  10  35.0  latitude
098  40  10.0  longitude
```

After keying this position into VERTCON, the returned
(NAVD 88 - NGVD 29) datum shift (correction) value is

+ 0.202 meter (+0.663 ft)

|SUBTRACT| this ALGEBRAICALLY [flip the sign] from the NGVD 29 height:

```
                    500.202
                    - 0.202
                  ---------
the NGVD 29 height is     500.000  meters  (1640.420 feet).
```

2. the NAVD 88 height is 119.733 meters (392.825 feet) at

```
 36  10  35.0  latitude
078  40  10.0  longitude
```

After keying this position into VERTCON, the returned
(NAVD 88 - NGVD 29) datum shift (correction) value is

- 0.267 meter (-0.876 ft)

|SUBTRACT| this ALGEBRAICALLY [flip the sign] from the NGVD 29 height:

```
                    119.733
                  +   0.267
                  ---------
the NGVD 29 height is     120.000  meters  (393.701 feet).
```