Appendix

Tract:
Name:
Names:
Address: Box No.:
City: State: Zip Code:
Tax Map No.: Parcel:
Deed Book: Page:
Remarks:
State Project No.:
Description:

Person Contacted: Owner ☐ Renter ☐
By:
Date:

The following exists on the property:

Wells:
Septic Tanks:
Field Lines:
UG Fuel Tanks:
UG Utilities:
Graves:
Property Corners:

Make sketch of location of all above.

High Water Marks: Date:
Well Dug By: For: Date:
Building Types:

Comments:

Sketch:

Continue on back if necessary

Figure A-1
Property Owner Contact Form

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
REGION 3 SURVEY & DESIGN OFFICE
6601 Centennial Boulevard, 2nd Floor
Nashville, TN 37243-0360
February 11, 2009

John Doe
1234 Doe Road
Example, TN 12345

Re: Project Identification Number: xxxxxx.00
SR 123
OVER EXAMPLE CREEK L.M. 1.23
XXXXX County

Dear John Doe:

As you may have heard, TDOT is continuing its public involvement process for the above mentioned project, and we want to alert you about activities you may be seeing shortly in your neighborhood.

In order to insure that we have the most accurate, complete, and current information possible, TDOT survey crews will begin gathering data to supplement existing aerial photographs of the area. This will involve ground surveys, which will investigate property lines, underground utilities, detailed stream information, environmental surveys, and more.

These ground surveys will begin within the next one (1) to four (4) weeks, and will continue for twelve (12) to eighteen (18) months.

The survey crews may need to gain access to your property, located on this project, in order to gather the necessary information, and we will appreciate your cooperation in that effort. The surveyors will attempt to contact you personally prior to entering your property. If there are specific times during the work week we should avoid, please let us know. Surveys will not be required on all properties.

If you have specific questions, you may contact Ms. Melissa Portell (phone: (615) 350-4485, email: melissa.portell@state.tn.us), or Mr. Dave Marshall at (615) 350-4252, or Mr. Larry Binion at (615) 350-4254. TDOT thanks you in advance for your cooperation.

Very truly yours,
David Marshall
David Marshall

cc: Mr. J. Kelly Henshaw
Ms. B J Doughty
Mr. Dave Marshall
Mr. Larry Binion
File

Figure A-2
Property Owner Contact Letter – Survey

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
REGION 3 SURVEY & DESIGN OFFICE
6601 Centennial Boulevard, 2nd Floor
Nashville, TN 37243-0360
February 11, 2009

John Doe
1234 Doe Road
Example, TN 12345

Re: Project Identification Number: xxxxxx.00
SR 123
OVER EXAMPLE CREEK L.M. 1.23
XXXXX County

Dear John Doe:

As you may have heard, TDOT is continuing its public involvement process for the above mentioned project, and we want to alert you about activities you may be seeing shortly in your neighborhood.

In order to insure that we have the most accurate, complete, and current information possible, TDOT survey crews will begin staking the Geotechnical boring locations on the project. A representative from TDOT's Geotechnical Engineering Section of the Materials and Tests Division will be contacting you to discuss Geotechnical needs on your property.

These ground surveys will begin within the next one (1) to four (4) weeks, and will continue for twelve (12) to eighteen (18) months.

The survey crews may need to gain access to your property, located on this project, in order to gather the necessary information, and we will appreciate your cooperation in that effort. The surveyors will attempt to contact you personally prior to entering your property. If there are specific times during the work week we should avoid, please let us know. Surveys will not be required on all properties.

If you have specific questions, you may contact Ms. Melissa Portell (phone: (615) 350-4485, email: melissa.portell@state.tn.us), or Mr. Dave Marshall at (615) 350-4252, or Mr. Larry Binion at (615) 350-4254. TDOT thanks you in advance for your cooperation.

Very truly yours,
David Marshall
David Marshall

cc: Mr. J. Kelly Henshaw
Ms. B J Doughty
Mr. Dave Marshall
Mr. Larry Binion
File

Figure A-3
Property Owner Contact Letter – Geotechnical Staking

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
REGION 3 SURVEY & DESIGN OFFICE
6601 Centennial Boulevard, 2nd Floor
Nashville, TN 37243-0360
February 11, 2009

John Doe
1234 Doe Road
Example, TN 12345

Re: Project Identification Number: xxxxxx.00
SR 123
OVER EXAMPLE CREEK L.M. 1.23
XXXXX County

Dear John Doe:

As you may have heard, TDOT is continuing its public involvement process for the above mentioned project, and we want to alert you about activities you may be seeing shortly in your neighborhood.

In order to insure that we have the most accurate, complete, and current information possible, TDOT survey crews will begin staking the proposed right-of-way and easements on the project. A representative from TDOT's ROW Division will be contacting you in the near future regarding the proposed right-of-way and easements.

These ground surveys will begin within the next one (1) to four (4) weeks, and will continue for twelve (12) to eighteen (18) months.

The survey crews may need to gain access to your property, located on this project, in order to gather the necessary information, and we will appreciate your cooperation in that effort. The surveyors will attempt to contact you personally prior to entering your property. If there are specific times during the work week we should avoid, please let us know. Surveys will not be required on all properties.

If you have specific questions, you may contact Ms. Melissa Portell (phone: (615) 350-4485, email: melissa.portell@tn.gov), or Mr. Dave Marshall at (615) 350-4252, or Mr. Larry Binion at (615) 350-4254. TDOT thanks you in advance for your cooperation.

Very truly yours,
David Marshall
David Marshall

cc: Mr. J. Kelly Henshaw
Ms. B J Doughty
Mr. Dave Marshall
Mr. Larry Binion
File

Figure A-4
Property Owner Contact Letter – ROW Staking

Project Name: EMORY

Geodetic Survey Control Data

County: KNOX | Year: 1998 | Point Name: EM-1

Latitude(N): 36° 02' 58.471849" | Longitude(W): 84° 00' 04.022711"

	(m)	(Ft)
D.A. Northing(m):	192273.601	630817.6396
D.A. Easting(m):	780167.616	2559599.9201
Elevation(m):	313.965	1030.07

Horz. Datum: NAD83(1995) | D.A. Factor: 1.00009538

Vert. Datum: 1988 | Scale Factor: 0.99995545

Vertical Order: GPS | Geoid Model:

Ellipsoid Ht: 0

Party Chief: H.Garland | Described By: B.Solomon

Backsights

EM-2	N85-01-08.6E	248.224	meter
			meter

Type of Monument: DISK ATOP 5/8" REBAR STAMPED "EM-1", "1998", AND DRIVEN FLUSH WITH GROUND.

Route Description: Beginning at Emory Road I-75 Interchange, LOCATED ON I-75 NORTH OF THE BRIDGE OVER EMORY ROAD.

References: 72.54 m NORTH OF THE NORTHEAST CORNER OF BRIDGE 1.83 m EAST OF THE EDGE OF PAVEMENT ON NORTHBOUND LANE 0.55 m WEST OF WITNESS POST.

Tennessee Dept. of Transportation - Geodetic Survey Offices

7366 Region Lane, Knoxville, TN 37914

4004 Cromwell Road, Chattanooga, TN 37422

6601 Centennial Blvd, Nashville, TN 37243

300 Benchmark Place, Jackson, TN 38302

Note: These points have been set for the express use of the Tennessee Department of Transportation and its agents. No warranty, either express or implied, is granted to any individual and/or entity that makes use of this data for any other purpose.

Figure A-5
Example of Control Point Description Sheet

CONTROL POINTS					
POINT	NORTH	EAST	ELEV.	STATION	OFFSET
S1	460,512.0120	1,417,231.8940	520.7730	100+76.50	253.5824
S2	461,350.7600	1,417,172.0970	538.4500	108+74.06	-12.8205
S3	462,446.8280	1,417,446.0830	557.0590	120+03.83	-19.8765
S4	462,785.4470	1,417,328.7590	557.8100	123+02.66	-217.6868
S5	462,218.7960	1,417,385.1590	558.8310	117+67.82	-22.2078
S56	462,724.3300	1,417,773.8720	555.1660		
S101	462,751.2340	1,417,834.9240	552.9990		
S168	462,768.3990	1,417,518.0770	558.9040	123+33.21	-30.0730
S598	462,098.0210	1,417,360.0870	553.1960	116+44.60	-16.4726
S702	461,969.7530	1,417,435.2430	542.8950	115+39.04	88.2074
S703	461,965.0580	1,417,341.7330	544.0990	115+11.25	-1.2008
S755	461,813.7480	1,417,314.5920	535.6530	113+57.94	10.1202
S756	462,509.1290	1,417,461.4790	556.6760	120+68.01	-20.4495
S770	462,613.5110	1,418,737.5120	497.9230		
S771	462,823.9260	1,417,066.7250	554.6490	122+74.80	-481.0615
S776	461,372.5600	1,416,845.3620	536.6770	108+13.96	-334.7197
S779	461,156.6620	1,417,186.8740	530.0850	106+89.73	49.7386
S780	461,310.9110	1,417,479.7350	511.2280	109+11.93	295.0675
S802	461,555.6070	1,417,260.3260	530.9610	110+94.41	21.7219
S808	461,635.7310	1,417,281.4760	531.0160	111+77.28	22.2922
S978	460,968.0820	1,417,155.1260	524.0090	104+99.18	65.8612
S988	460,671.4170	1,417,149.4370	521.9000	102+10.41	134.0909
S996	460,638.7590	1,416,905.0140	525.9170	101+18.02	-94.5433
S1119	461,156.6490	1,417,186.8490	530.0850	106+89.71	49.7176
S1120	461,310.8250	1,417,479.7280	511.2000	109+11.85	295.0821
S1195	461,595.0120	1,417,330.5160	527.8030	111+50.03	79.9144

Table A-1
Control Points (Tabular Format)

NAVIGABLE WATERS OF THE UNITED STATES

Pursuant to the Rivers and Harbor Act of 1899, the U.S. Corps of Engineers has declared certain waters to be Navigable Waters of the United States.

The Nashville District

Regulates waters in the Cumberland River and Tennessee River watersheds. For further information, call the Corps Permit Section at 615-251-5181.

The Memphis District

Regulates waters in the Mississippi River watershed. For further information call the Corps Regulatory Control Branch at 901-521-3468.

The Nashville District, Corps of Engineers, has declared the following waterways to be "Navigable Waters of the United States".

CUMBERLAND RIVER AND TRIBUTARIES

I. *Cumberland River (CR)--Mouth* to Mile 694.2 (head of river, confluence of Poor Fork and Clover Fork, at Harlan, Kentucky).

  A. *Little River* (CRM 59.0)--Mouth to Mile 25.0.

  B. *Red River* (CRM 125.3)--Mouth to Mile 50.8 (Tennessee-Kentucky State Line).

  C. *Harpeth River* (CRM 152.9)--Mouth to Mile 88.9 (Franklin, Tennessee at Highway 96).

  D. *Stones River* (CRM 205.6)--Mouth to Mile 38.7 (Confluence of East and West Fork, Stones River).

    1. *East Fork, Stones River--Mouth* to Mile 10.0 (Waterhill Dam).

    2. *West Fork, Stones River--Mouth* to Mile 14.5 (US Highways 41 and 70-S bridge near Murfreesboro, Tennessee).

  E. *Caney Fork River* (CRM 308.9)--Mouth to Mile 111.1.

  F. *Obey River* (CTM 380.9)--Mouth to Mile 58.2 (Confluence of East Fork and West Fork Obey River).

    1. *East Fork Obey River* (Obey River Mile 58.2)--Mouth to Mile 47.2.

    2. *West Fork Obey River* (Obey River Mile 58.2)--Mouth to Mile 4.9.

    3. *Wolf River* (Obey River Mile 31.1)--Mouth to Mile 24.0.

  G. *Big South Fork Cumberland River* (CRM 516.0)--Mouth to Mile 77.0 (Confluence of Clear Fork River and New River).

    1. *New River--Mouth* to Mile 36.0 (Mouth of Smokey Creek).

    2. *Clear Fork River--Mouth* to Mile 19.9 (at Peter's Bridge).

  H. *Rockcastle River* (CRM 546.4)--Mouth to Mile 13.1

I. *Laurel River* (CRM 552.1)--Mouth to Mile 21.5.

J. *Poor Fork of Cumberland River* (CRM 694.2)--Mouth to Mile 30.6 (Letcher-Harlan County Line).

K. *Clover Fork of Cumberland River* (CRM 694.2)--Mouth to Mile 10.8 (Mouth of Yocum Creek).

1. *Martins Fork of Cumberland River* (Clover Fork of Cumberland River Mile 1.6)--Mouth to Mile 19.5.

TENNESSEE RIVER AND TRIBUTARIES

II. *Tennessee River* (TR)--Mouth to Mile 652.1 (head, confluence of French Broad and Holston Rivers).

A. *Clarks River* (TRM 4.3)--Mouth to Mile 13.0.

B. *Blood River* (TRM 50.7)--Mouth to Mile 9.7.

C. *Big Sandy River* (TRM 67.0)--Mouth to Mile 15.1.

D. *Duck River* (TRM 110.8)--Mouth to Mile 210.3 (Warner Bridge, Fishing Ford Road).

1. *Buffalo River* (Duck River Mile 15.4)--Mouth to Mile 65.0 (Flatwoods, Tennessee).

E. *Beech River* (TRM 135.7)--Mouth to Mile 17.0.

F. *Yellow Creek* (TRM 215.1)--Mouth to Mile 32.1 (head, Tennessee Valley Divide).

G. *Bear Creek* (TRM 224.7)--Mouth to Mile 27.3 (Bishop Bridge at Maude, Alabama).

H. *Cypress Creek* (TRM 255.0)--Mouth to Mile 10.2 (Mouth of Little Cypress Creek).

I. *Shoal Creek (TRM* 264.3)--Mouth to Mile 13.5.

J. *Elk River (TRM* 284.3)--Mouth to Mile 153.6 (Boiling Fork Creek).

1. *Richland Creek* (Elk River Mile 42.6)--Mouth to Mile 24.3 (Mill Street Bridge).

K. *Flint River* (TRM 339.1)--Mouth to Mile 35.9 (L & N Railroad Bridge at Bell Factory, Alabama).

L. *Paint Rock River* (TRM 343.2)--Mouth to Mile 60.0 (Confluence of Estill Fork and Hurricane Creek).

M. *Town Creek* (TRM 360.8)--Mouth to Mile 14.0 (High Falls).

N. *Crow Creek* (TRM 401.1)--Mouth to Mile 20.4 (Confluence of Little Crow Creek).

O. *Sequatchie River* (TRM 422.7)--Mouth to Mile 80.0 (Pikeville, Tennessee).

P. *Hiwassee River* (TRM 500.3)--Mouth to Mile 42.5.

1. *Ocoee River* (Hiwassee River Mile 34.4)--Mouth to Mile 11.9 (Ocoee Dam No.1).

Q. *Clinch River* (TRM 567.7)--Mouth to Mile 317.3 (Bridge 0.35 mile above Town Hill Creek).

1. *Emory River* (Clinch River Mile 4.4)--Mouth to Mile 28.4 (Confluence of Obed River).

    a. *Obed River* (Emory River Mile 28.4)--Mouth to Mile 5.0

2. *Powell River* (Clinch River Mile 88.8)--Mouth to Mile 156.7.

    a. *North Fork Powell River* (Powell River Mile 156.7) Mouth to Mile 7.0.

R. *Little Tennessee River* (TRM 601.3)--Mouth to Mile 114.7 (Franklin, North Carolina).

1. *Tellico River* (Little Tennessee River Mile 19.2)--Mouth to Mile 28.0 (Tellico Plains).

2. *Tuckasegee River* (Little Tennessee River Mile 76.2)--Mouth to Mile 33.6 (mouth of Savannah Creek, two miles southwest of Sylva, North Carolina).

S. *Little River* (TRM 635.6)--Mouth to Mile 41.0 (Blount and Sevier County line).

T. *Holston River* (TRM 652.1)--Mouth to Mile 142.2 (head, confluence of North and South Fork Holston River).

1. *North Fork Holston River* (Holston River Mile 142.2)--Mouth to Mile 92.5 (Juncture of Laurel Creek).

2. *South Fork Holston River* (Holston River Mile 142.2--Mouth to Mile 74.0.

    a. *Watauga River* (South Fork Holston River Mile 19.9)--Mouth to Mile 53.0.

U. *French Broad River* (TRM 652.1)--Mouth to Mile 196.5 (Wilson Bridge crossing Highway 276).

1. *Little Pigeon River* (French Broad River Mile 27.4)--Mouth to Mile 9.6 (mouth of East Fork (Prong) Little Pigeon River).

2. *Nolichucky River* (French Broad River Mile 69.1)--Mouth to Mile 110.8 (Juncture of Cane Creek).

3. *Pigeon River* (French Broad River Mile 73.8)--Mouth to Mile 42.7.

In addition, embayments and tributary streams of all impounded reservoirs are considered navigable water of the United States to the extent of slack water, and jurisdiction will be exercised accordingly.

The Memphis District, Corps of Engineers, has declared the following waterways to be "Navigable Waters of the United States".

I. *Hatchie River--Mouth* to Bolivar.

II. *Forked Deer River,* North Fork--Mouth to Dyersburg.

III. *Forked Deer River--Mouth* to junction, North and South Forks.

IV. *Forked Deer River,* South Fork--Mouth to Jackson.

V. *Obion River--Mouth* to Obion, Tennessee.

VI. *Wolf River--Mouth* to Jackson Ave. Bridge in Memphis.

MAINSTREAM	FULL POOL CONTOUR ft (m)	MAXIMUM SHORELINE CONTOUR ft (m)
Kentucky	359 (109.4)	375 (114.3)
Guntersville	595 (181.4)	600 (182.9)
Nickajack	634 (193.2)	640 (195.1)
Chickamauga	682.5 (208.03)	690 (210.3)
Watts Bar	741 (225.9)	750 (228.6)
Fort Loudon	813 (247.8)	820 (249.9)

TRIBUTARY RESERVOIRS	FULL POOL CONTOUR ft (m)	MAXIMUM SHORELINE CONTOUR ft (m)
Boone	1385 (422.1)	1390 (423.7)
Cherokee	1073 (327.1)	1080 (329.2)
Douglas	1000 (304.8)	1007 (306.9)
Ft. Patrick Henry	1263 (385.0)	1268 (386.5)
Great Falls1	805.3 (245.46)	812 (247.5)
Melton Hill	795 (242.3)	800 (243.8)
Nolichucky	1241 (378.3)	1246 (379.8)
Normandy	875 (266.7)	885 (269.7)
Norris	1020 (310.9)	1044 (318.2)
Ocoee No. 1	837.65 (255.317)	842.6 (256.8)
Ocoee No. 3	1435 (437.4)	1440 (438.9)
South Holston	1729 (527.0)	1747 (532.5)
Tellico	813 (247.8)	820 (249.9)
Tims Ford	888 (270.7)	895 (272.8)
Watauga	1959 (597.1)	1980) (603.5)

[1] Outside Tennessee River drainage area. Section 26a does not apply. TVA land or landrights may be involved.

Table A-2
Tennessee Reservoirs

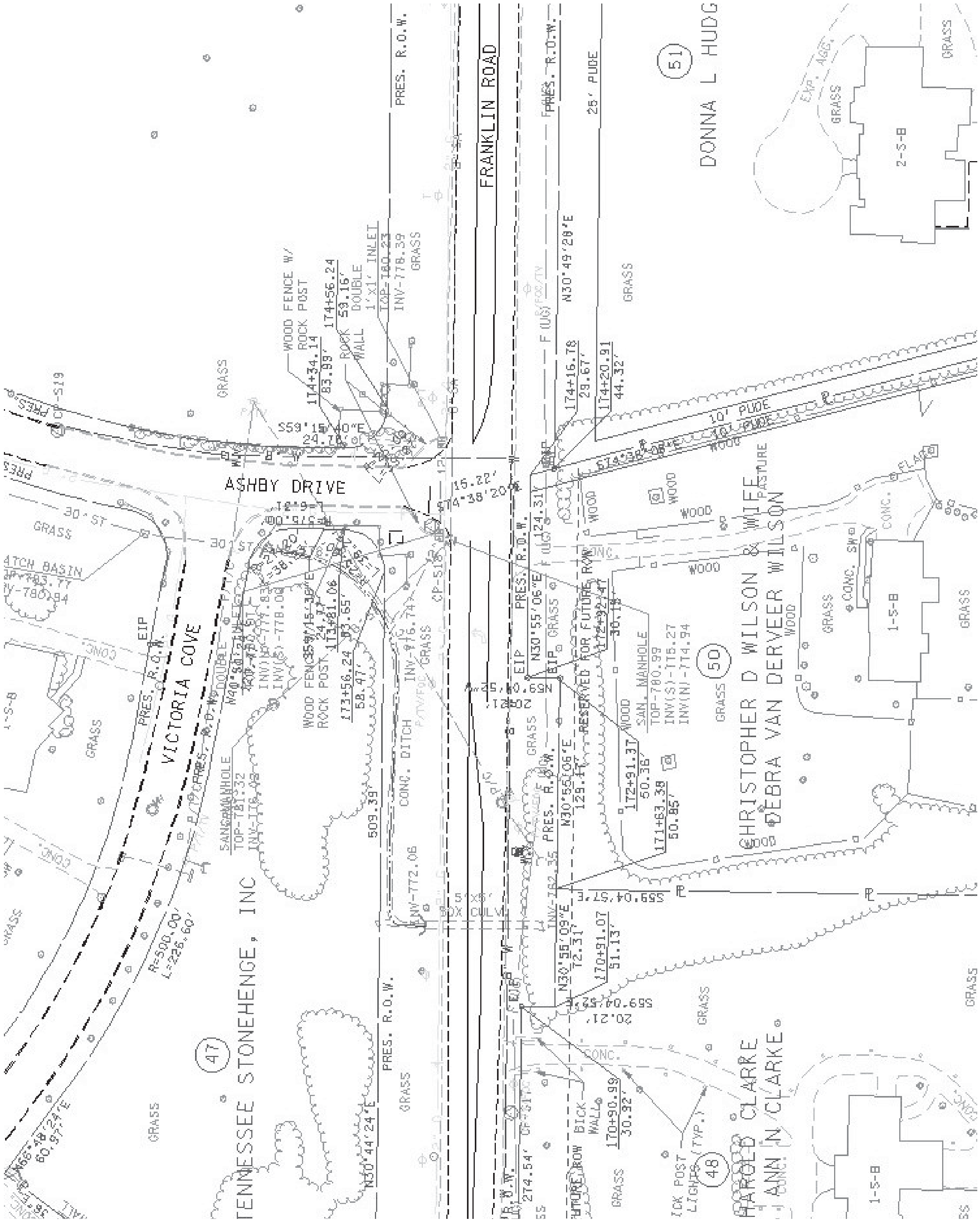


Figure A-6
Example of Present Layout Sheet

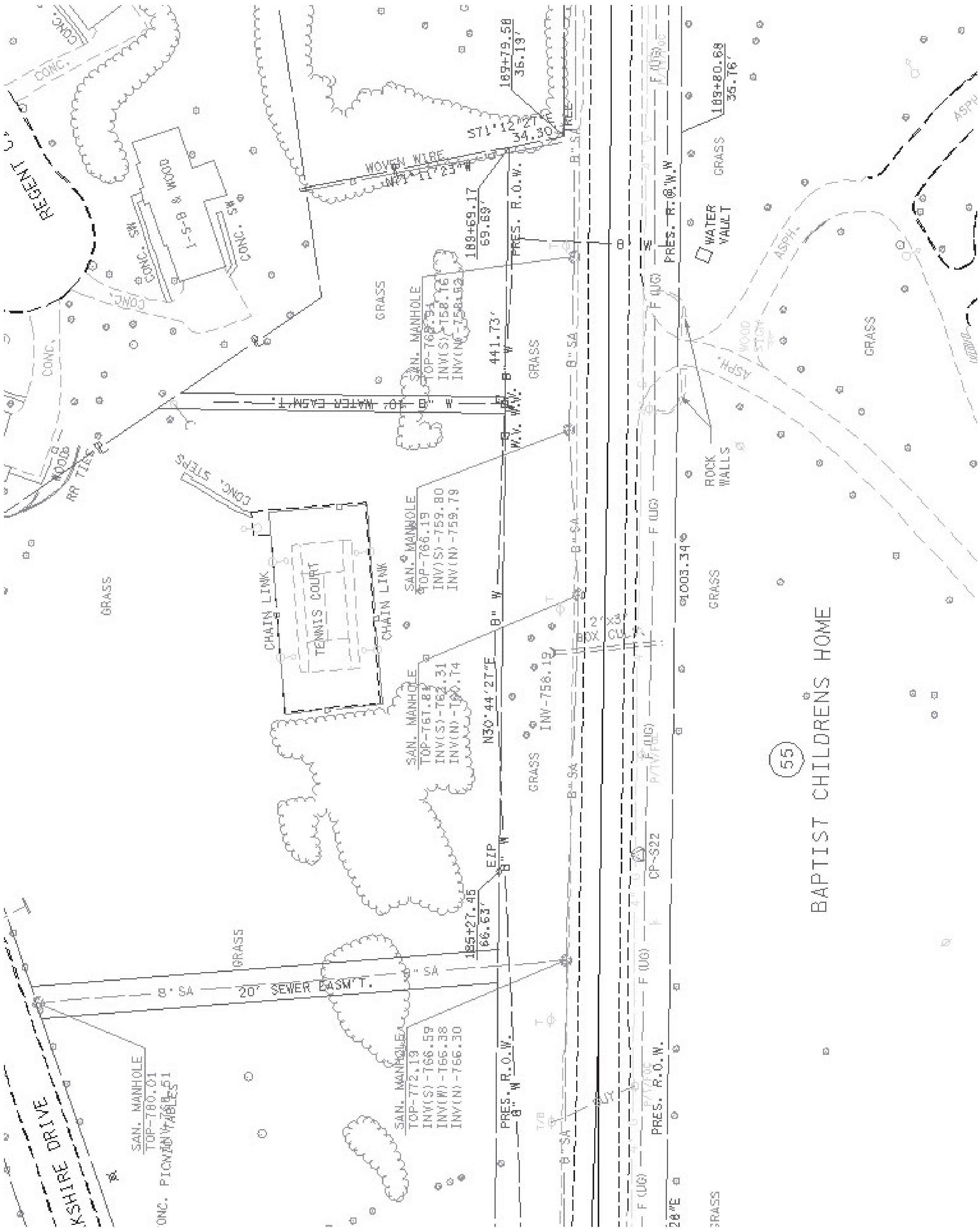


Figure A-7
Example of Present Layout Sheet

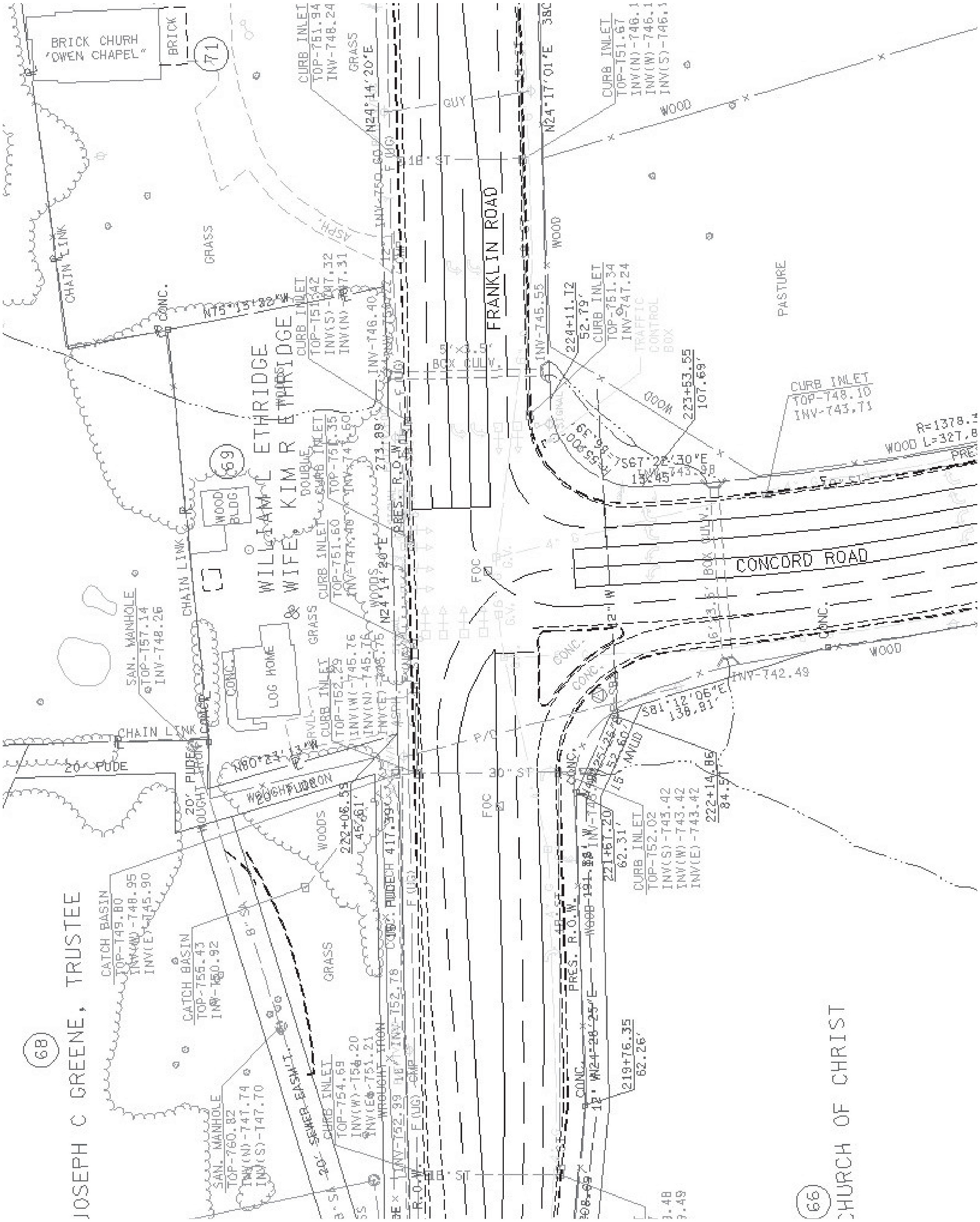


Figure A-8
Example of Present Layout Sheet

R.O.W. ACQUISITION TABLE

TRACT NO.	PROPERTY OWNERS	COUNTY RECORDS				TOTAL AREA ACRES			AREA TO BE ACQUIRED ACRES			AREA REMAINING ACRES		EASEMENT (SQUARE FEET)		
		TAX MAP NO.	PARCEL NO.	DEED DOCUMENT BK.	DEED DOCUMENT PAGE	LEFT	RIGHT	TOTAL	LEFT	RIGHT	TOTAL	LEFT	RIGHT	PERM. DRAINAGE	SLOPE	CONST.
1	BERT C. NICHOLSON	42	8	16	142											(1) 0.138 AC
2	GINGER BURCHETT	42	9	24	216											(2) 807 (3) 97
3	GLENN LADD	42	10	30	123	42.006		42.006	3.279		3.279	38.727				
4	IRENE S. MONK	42	11	77	289		52.098	52.098		2099 S.F.	2099 S.F.		52.052			
5	ROBERT L. BRYANT	42	12	83	352	36.699	58.966	95.665	10.146	9.244	19.39	26.553	49.721			

(1) FOR CONSTRUCTION OF DETOUR
(2) FOR CONSTRUCTION OF DRAINAGE DITCH
(3) FOR CONSTRUCTION OF RETAINING WALL

NOTE: EASEMENT AREAS SHOULD BE SHOWN IN ACRES AND NOTED AS SUCH WHEN GREATER THAN 0.1 ACRES AREAS ACQUIRED AND REMAINING SHOULD BE SHOWN IN SQUARE FEET AND NOTED AS SUCH WHEN LESS THAN 0.1 ACRES. IN URBAN PROJECTS THE PREDOMINANT UNITS FOR AREA ACQUIRED AND REMAINING SHOULD BE SHOWN IN SQUARE FEET.

Table A-3
Example of R.O.W. Acquisition Table

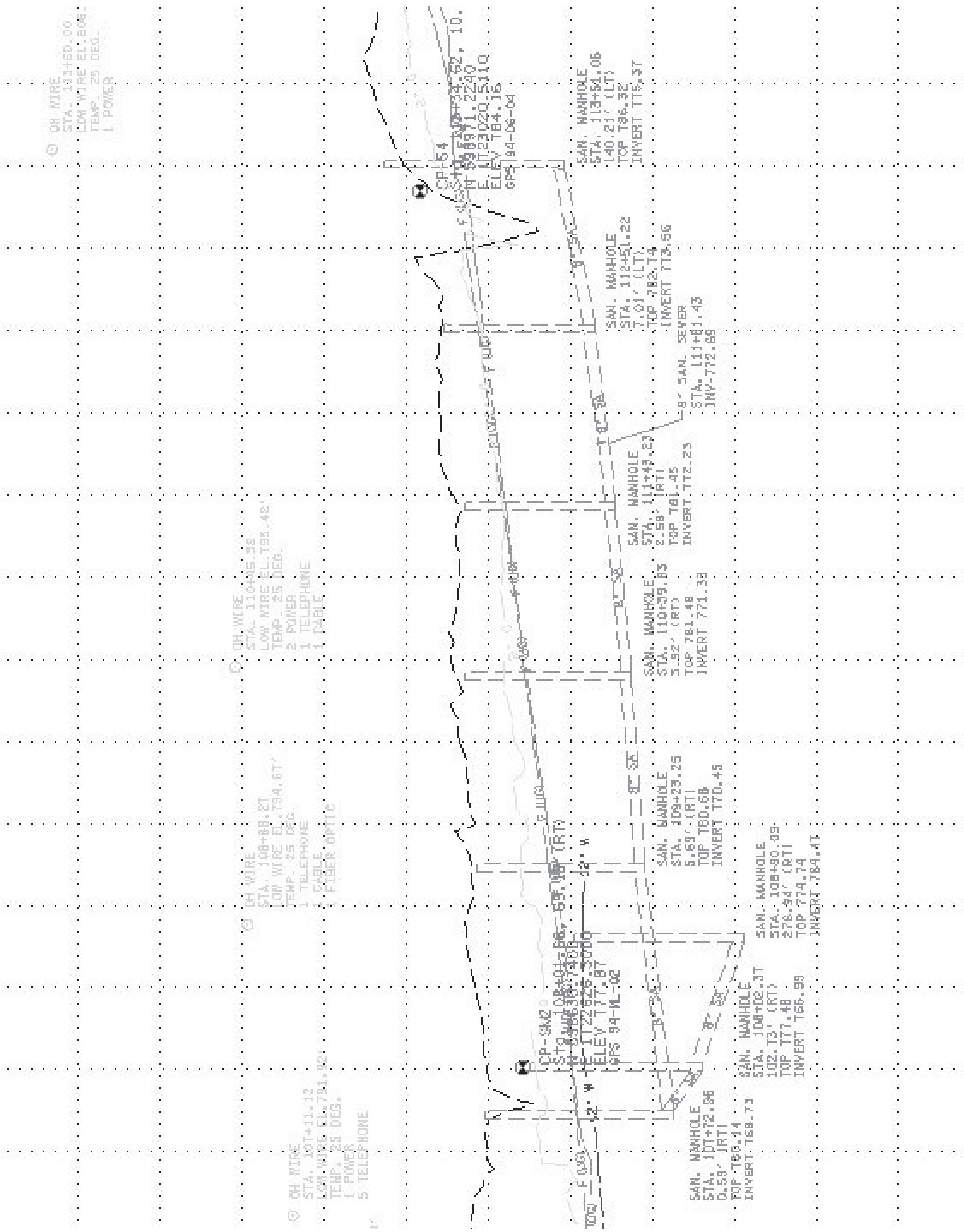


Figure A-9
Example of Profile

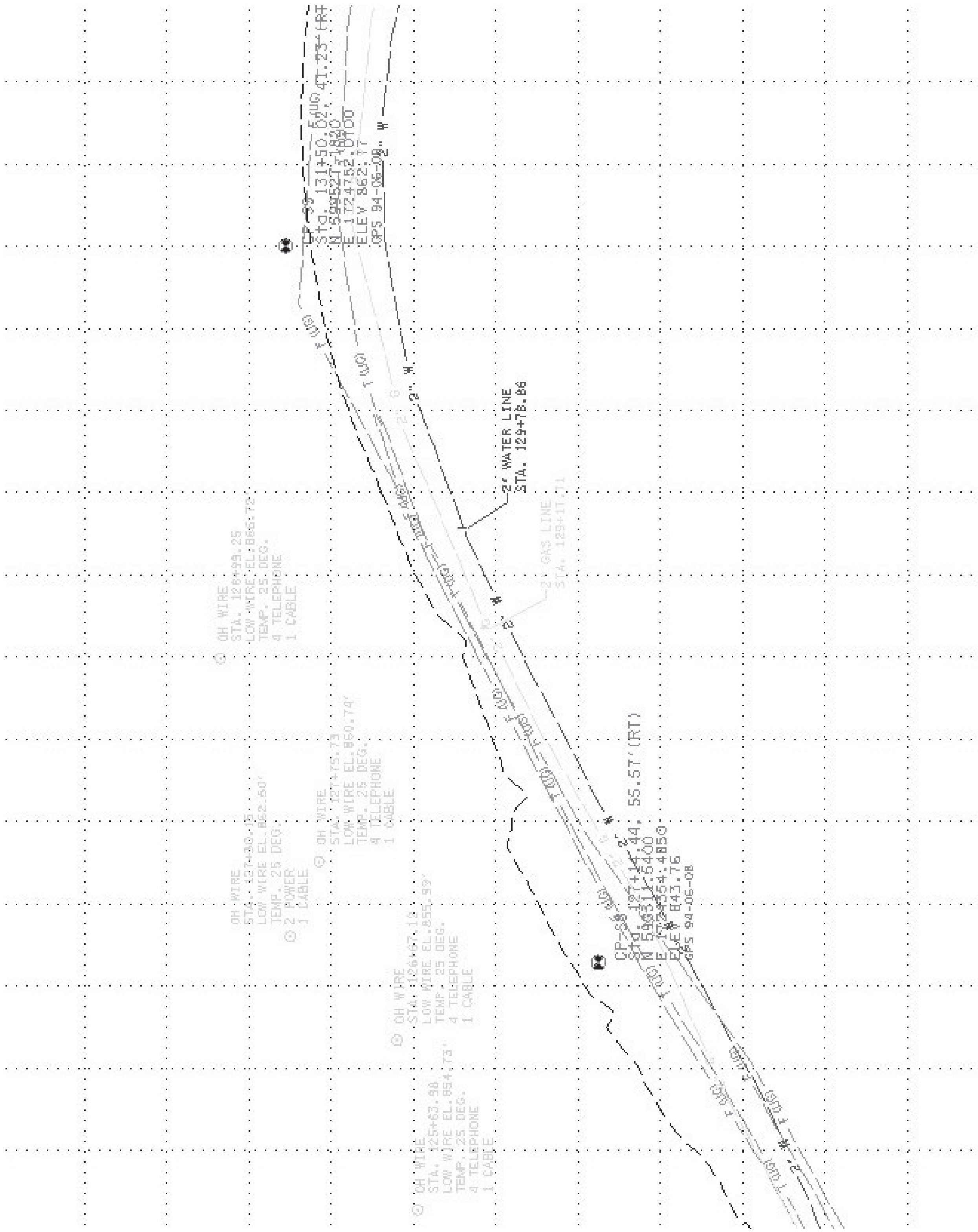


Figure A-10
Example of Profile

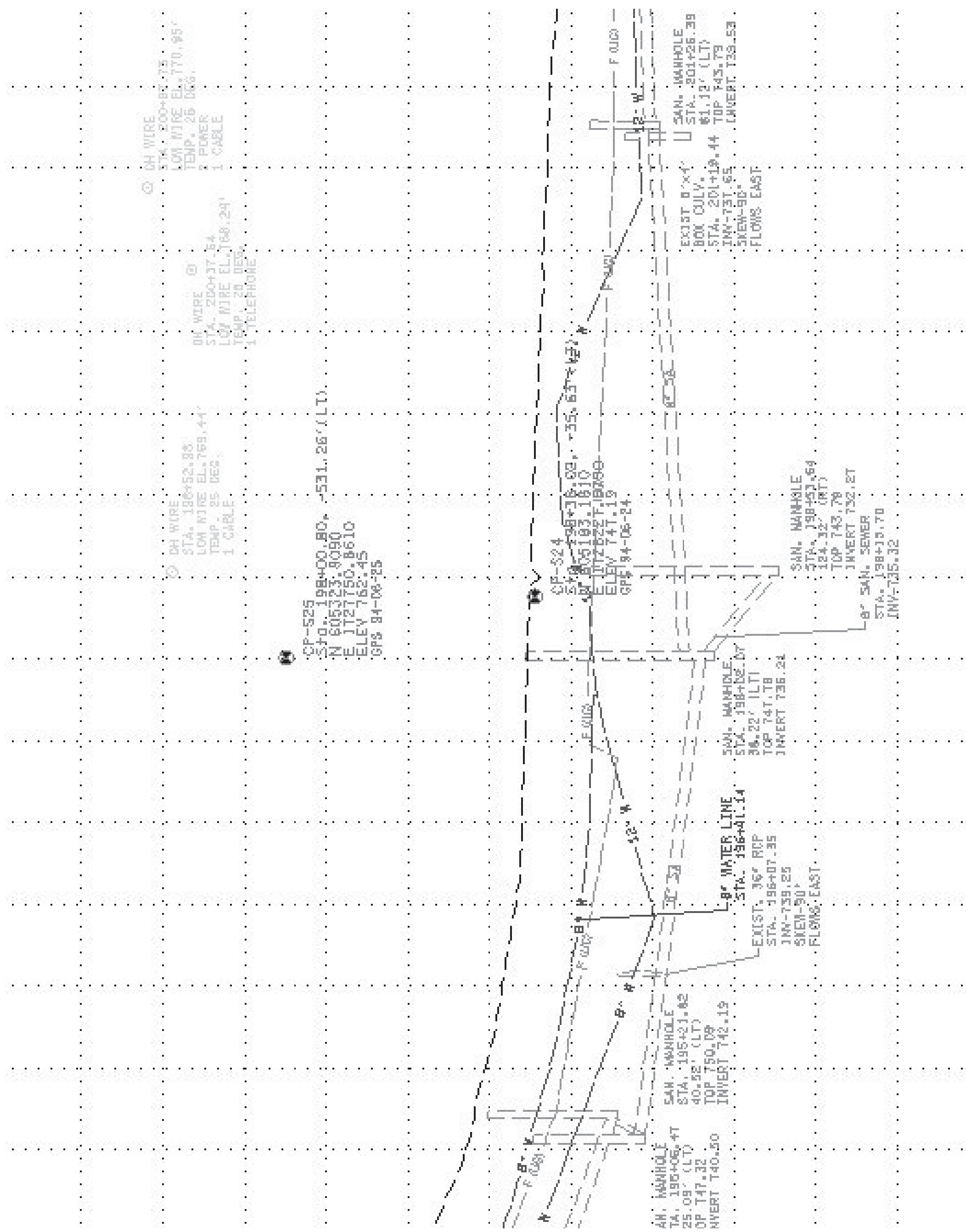


Figure A-11
Example of Profile

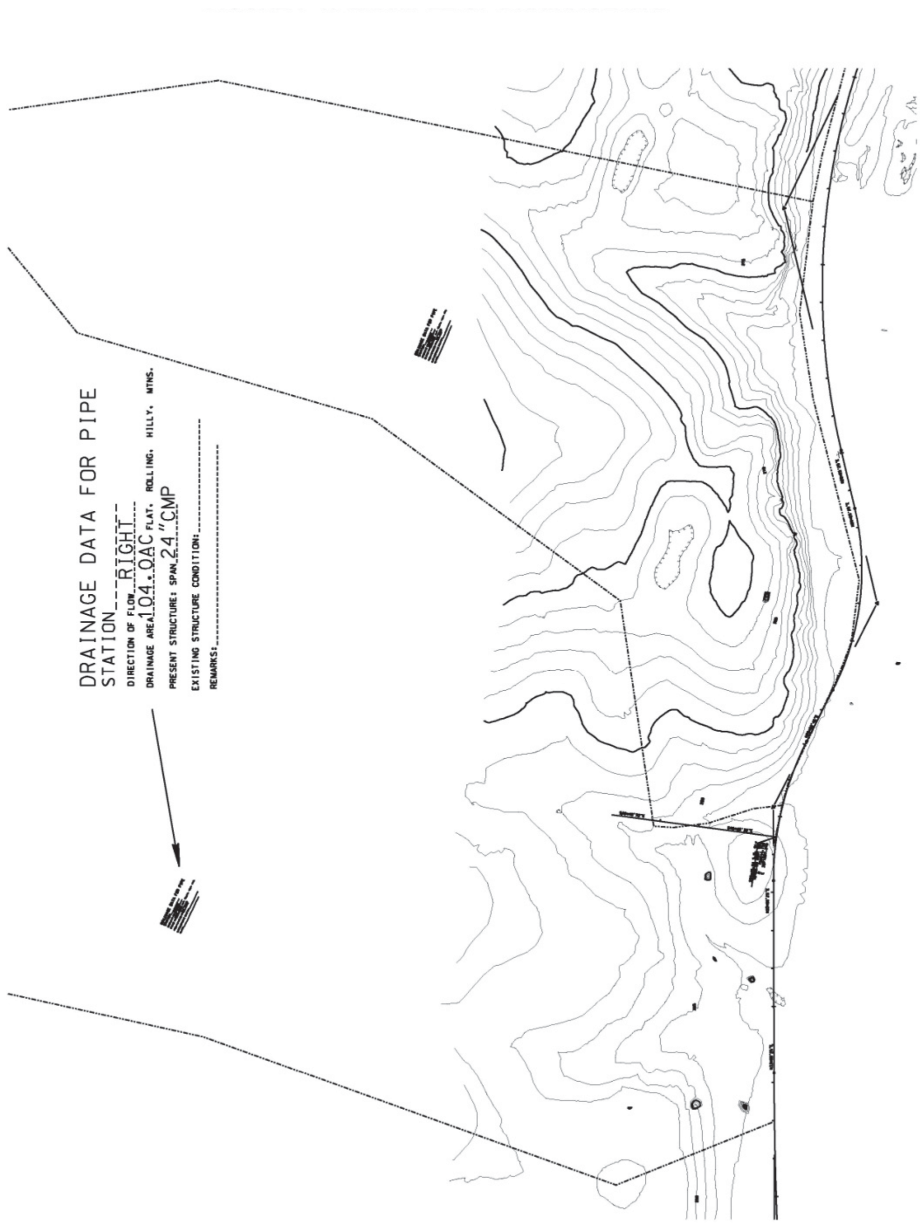


Figure A-12
Example of Drainage Map

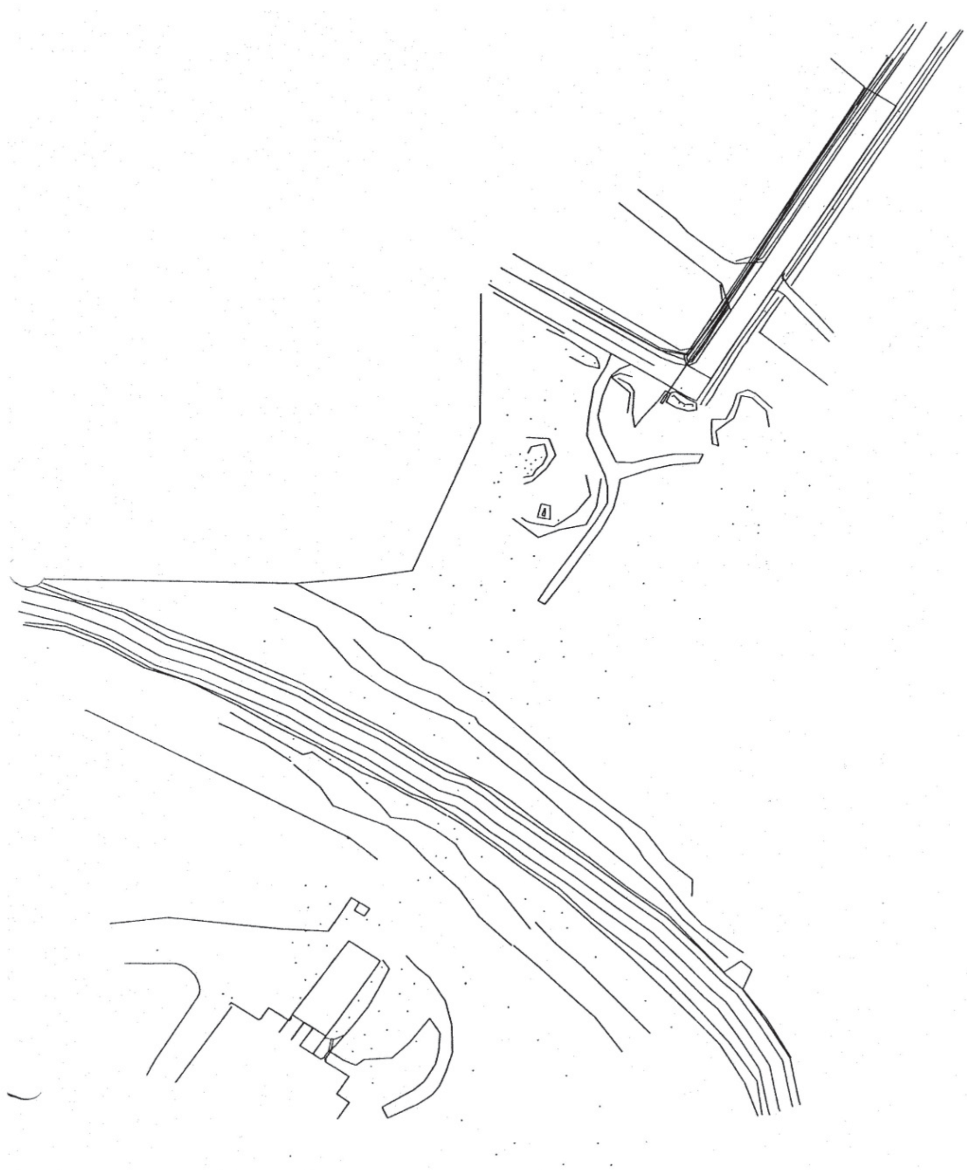


Figure A-13
Example of DTM (Aerial Surveys, MicroStation® Format)

SURVEY STANDARDS HORIZONTAL

	FIRST ORDER	SECOND ORDER		THIRD ORDER	
		Class I	Class II	Class I	Class II
POSITION CLOSURE	1:100,000 or 0.17 ft. $\sqrt{M}$	1:50,000 or 0.33 ft. $\sqrt{M}$	1:20,000 or 0.83 ft. $\sqrt{M}$	1:10,000 or 1.66 ft. $\sqrt{M}$	1:5,000 or 3.33 ft. $\sqrt{M}$
NUMBER OF COURSES BETWEEN AZIMUTH CHECKS	5-6	10-12	15-20	20-25	30-40
AZIMUTH CLOSURE AT AZIMUTH CHECKPOINT NOT TO EXCEED	1.0" per traverse point or 2" $\sqrt{N}$	1.5" per traverse point or 3" $\sqrt{N}$ Urban 2" per traverse point or 3" $\sqrt{N}$	2.0" per traverse point or 6" $\sqrt{N}$ Urban 4" per traverse point or 8" $\sqrt{N}$	3.0" per traverse point or 10" $\sqrt{N}$ Urban 6" per traverse point or 15" $\sqrt{N}$	8.0" per traverse point or 30" $\sqrt{N}$

N = The number of traverse points for carrying azimuth.
M= Distance in miles
In expressions for closing errors, use the formula that gives the smallest permissible closure.

Table A-4
Survey Standards Horizontal

SURVEY STANDARDS VERTICAL

	FIRST ORDER		SECOND ORDER		THIRD ORDER
	Class I	Class II	Class I	Class II	
Closure error not to exceed	0.017 ft.$\sqrt{M}$	0.021 ft.$\sqrt{M}$	0.025 ft.$\sqrt{M}$	0.035 ft.$\sqrt{M}$	0.050 ft. $\sqrt{M}$

M = Distance in miles

Table A-5
Survey Standards Vertical

STA.	FORWARD		BACK		ELEV.		
✓	+	-	+	-			
USC & GS BM K 212	4.94				618.41	✓	
TP	3.86	10.22					
TP	2.16	9.76					
TP	4.51	11.31					
TP	5.53	6.83					
TP	4.37	5.42					
BM NO. 1		5.51	5.47		594.70	✓	
			5.41	4.61			
			7.01	4.86			
			10.95	4.63			
			9.82	2.25			
			10.11	3.96			
				4.78			
USC & GS BM K 212	25.34 ✓	49.05 ✓	48.77 ✓	25.09 ✓			
		25.34	25.09				
		23.71 ✓ 23.68	23.68 ✓				
		0.03 DIFF.	✓				
		LINE APPROX. 1.1 MI. ✓					
		12.0√1.1 = 12.6 VS. 1			✓		
			CHECK ✓				

SETTING FIRST BENCH

11-5-09 2

FAIR & COLD
ASHMORE
SOLOMON
PARIS

MON & DISC. IN S.W. CORNER OF S.R. 22 & JONES ROAD ELEV.
OBTAINED FROM TN. DOT AERIAL SURVEY DIV. NASHVILLE. TN.

ALUMINUM DISK 75' RT. STA. 0+45

MON. & DISC. IN S. W. CORNER OF S.R. 22 & JONES ROAD

REDUCED BY R.A.J.
CHECKED BY S.M.R.

Figure A-14
Example of Field Notes

BENCH LEVELS

STA.	FORWARD		BACK		ELEV.			3
	+	-	+	-				
BM NO. 1	1.48				594.71 ✓	ADJUSTED		ALUMINUM DISK 75' RT. STA. 0+45
TP	3.22	11.36						
TP	2.91	10.55						
BM NO. 2	1.31	8.16						TAG BOLT FIRE HYDRANT 40' LT. 10+15
TP	2.65	6.43						
TP	2.01	5.85						
BM NO. 3	5.15	7.43						X ON CURB 22' LT. 20+07
TP	5.71	5.50						
TP	6.82	5.48						
BM NO. 4		7.12	10.05					NW CORNER OF BLDG. FOUNDATION 65 RT. 25+50
TP			11.66	7.41				
TP			8.21	6.20				
TP			10.95	7.08				
TP			9.92	2.31				
TP			11.48	3.57				
TP			7.82	4.81				
BM NO. 1				2.12				ALUMINUM DISK 75' RT. STA. 0+45
	31.26	67.88 ✓	70.09 ✓	33.50 ✓				
		31.26	33.50					
		36.62 ✓	36.59 ✓					
		0.03 DIFF.	✓					
		LINE APPROX. 0.5 MI. ✓						
		0.05√0.5 = 0.035 VS. 0.03 ✓						
			CHECK ✓					
								REDUCED BY R.A.J
								CHECKED BY S.M.R.

SETTING SUBSEQUENT BENCHES

Figure A-15
Example of Field Notes

ADJUSTED ELEVATIONS

BM	ELEV.
NO. 1	594.71
NO. 2	572.21
NO. 3	558.47
NO. 4	558.06

BENCH MARK LIST

4

ALUMINUM DISK 75' RT. STA. 0+45
TAG BOLT FIRE HYDRANT 40' LT. 10+15
X ON CURB 22' LT. 20+07
NW CORNER OF BLDG. FOUNDATION 65' RT. 25+50

REDUCED BY R.A.J.

Figure A-16
Example of Field Notes

ROADWAY PROFILE

STA.	+	HI	-	PRO.	ELEV.		
BM NO. 6	5.42	536.01✓			530.59✓		
30				6.1	529.9✓		
+22				8.2	527.8✓		
+50				5.8	530.2✓		
+81				4.7	531.3✓		
31				7.5	528.5✓		
+17				7.7	528.3✓		
+50				9.2	526.8✓		

PROFILE

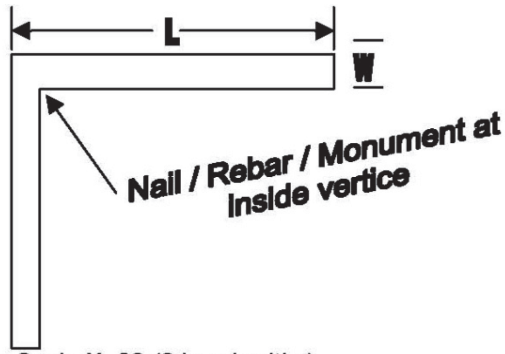
7

11-5-09
CLOUDY
SMITH
JONES
KELLY
WHITE

ALUMINUM DISK 75' RT. 29+50

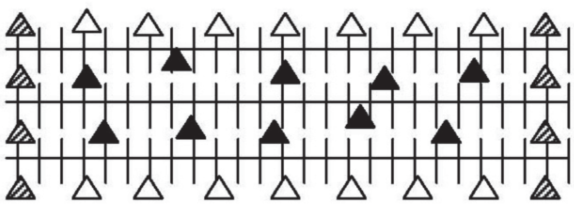
REDUCED BY M.G.D
CHECKED BY S.M.R.

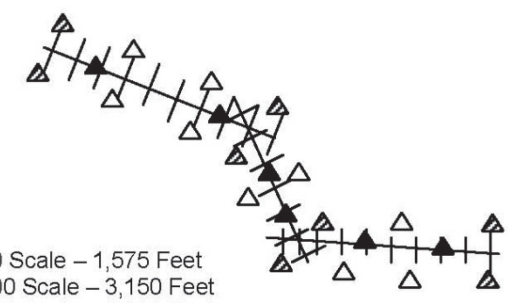
Figure A-17
Example of Field Notes



(L) Length of Leg = Photo Scale X .02 (2 hundredths)

(W) Thickness of Leg = 12 inches for below 1"=800' Photo Scale
18 inches for above 1"=800' Photo Scale





Distance between flight lines for block photography

50 Scale – 1,575 Feet
100 Scale – 3,150 Feet
200 Scale – 6,300 Feet

▲ Can be moved any direction a distance equal to the photo scale. Preference to be equal distance between flight lines on block photography. Move back and forth along flight line for strip photography.

△ Can be moved back and forth along the flight line a distance equal to one half of the photo scale. Can be moved away from the flight line a distance of one eight of the photo scale.

(hatched triangle) Can be moved back and forth along the flight line a distance equal to one half of the photo scale. Can be moved away from the flight line a distance of one eight of the photo scale.

Target spacing is 2,700 feet in the direction of the flight line and 750 feet from the centerline of flight for 1”=50’ scale mapping.

Target spacing is 5,400 feet in the direction of the flight line and 1,500 feet from the centerline of flight for 1”=100’ scale mapping.

Target spacing is 10,800 feet in the direction of flight line and 3,000 feet from the centerline of flight for 1”=200’ scale mapping.

Figure A-18
Example Aerial Survey Target, Block Photography, and Strip Photography

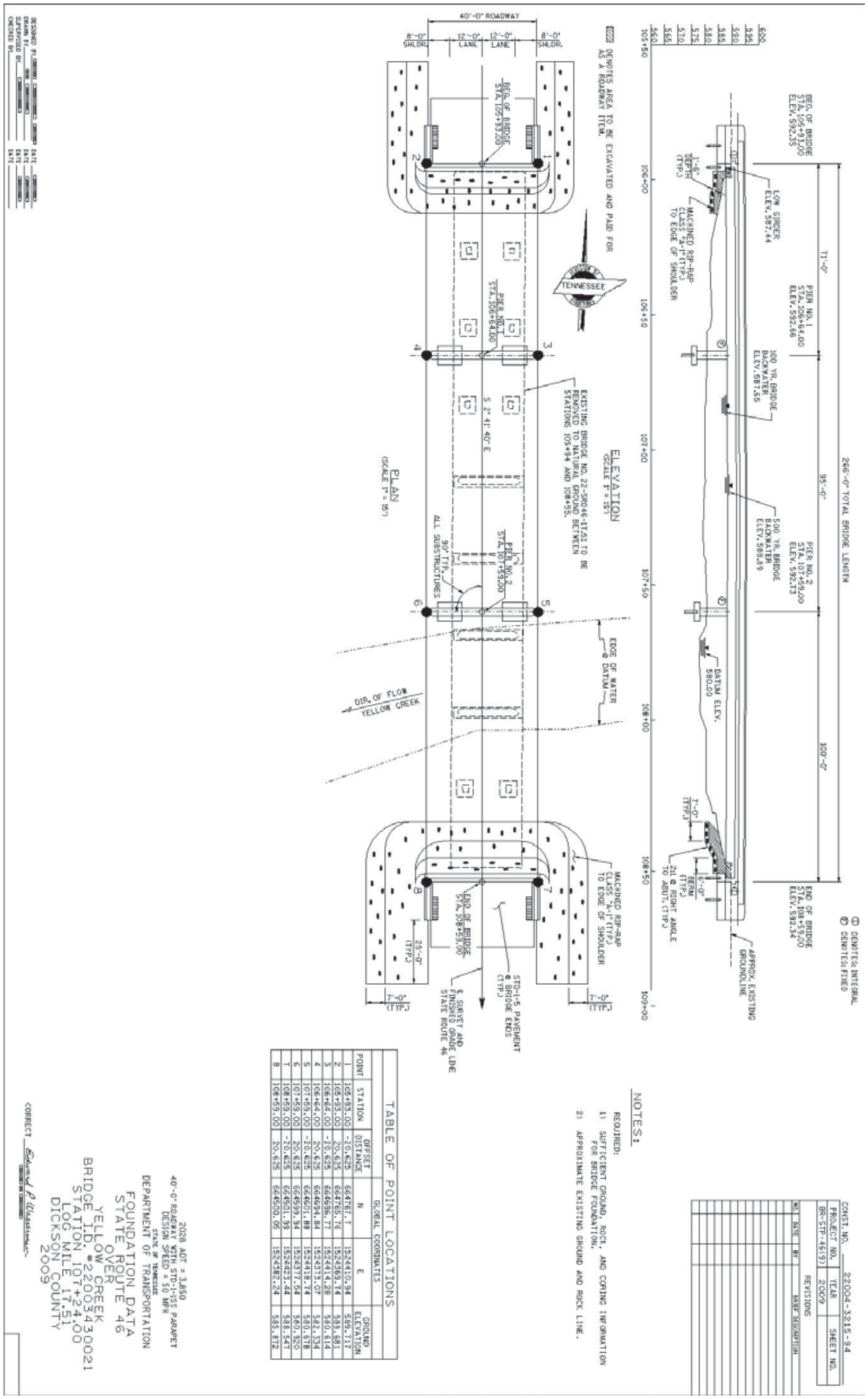


Figure A-19
Example of Preliminary Bridge Drawing

DT – 0108
F – 108
Z – 84

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

CLAIM FOR INCIDENTAL AND EMERGENCY EXPENSES

(LIMITED TO UNDER $10.00)

This form is to be completed when an employee of the Department of Transportation personally incurs the following incidental/emergency expenses while performing official State business: gasoline, oil, minor vehicular repair, ice, etc.

This form will be prepared by the employee incurring the incidental/emergency expense. The original and two copies of this form must be submitted along with the supporting paid receipts attached. (The supporting paid receipts must show the name and address of the vendor and must be marked Paid. The employee will sign and date the forms. The employee's authorized supervisor will approve these expenses by signing and dating these forms.

The forms will be submitted to: DOT FINANCE - ACCOUNTING
SUITE 800
JAMES K. POLK BUILDING
NASHVILLE, TENNESSEE 37219

QUANTITY	DESCRIPTION	AMOUNT	VENDOR	REASON FOR PURCHASE
	TOTAL	$		

I CERTIFY THAT THIS CLAIM IS TRUE AND CORRECT

CLAIMANT ADDRESS DATE

TITLE

APPROVED DIVISION HEAD DATE

TITLE

FOR DOT ACCOUNTS USE ONLY

NAME

DATE

CO.	SECTION	JOB OR DOT NUMBER	FUND F	FUND S	*	ACCOUNT NUMBER CONTROL	ACCOUNT NUMBER REG	ACCOUNT NUMBER FUNC.	* OBJECT	APPROP. CODE	AMOUNT	* CLAIMANT NUMBER

*TO BE CODED BY DOT ACCOUNTING ONLY.

DT-0302
Rev 02/04

Tennessee Department of Transportation

TR 000001

Transfer of Fixed Assets

__/__/__
(Document Date)

Send the white copy of this form to:
TDOT Finance
Attn: Fixed Asset Accountant
Suite 800, J.K. Polk Bldg
Nashville, TN 37243-0329

Distribution:
White - TDOT Finance Office
Canary - Releasing Unit Files
Pink - Receiving Unit Files

Please record the permanent transfer of the Fixed Asset(s) identified below to the unit number(s) shown. The Section Head or Unit Supervisor receiving the items(s) has acknowleged receipt below.

TDOT Tag Number	Serial Number	Cnty	Standard Description
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			
F 0			

Remarks:

Signature of Section Head or Unit Supervisor Releasing Item(s)	Date	Releasing Unit Number:	
Signature of Section Head or Unit Supervisor Receiving Item(s)	Date	Receiving Unit Number:	

TENNESSEE DEPARTMENT OF TRANSPORTATION
FINANCIAL PROCEDURES MANUAL

DESCRIPTION TRANSFER of FIXED ASSETS FORM INSTRUCTIONS

PURPOSE To provide instructions for the proper completion of form DT-0302. This form is used to report the reassignment of fixed assets from one unit to another.
NOTE: Send the completed DT-0302 form to:

TDOT Finance Office
Attn: Fixed Asset Accountant
Suite 800 James K. Polk Building
505 Deaderick Street
Nashville, TN 37243-0329

ITEM NO.	NAME	REQ	INSTRUCTION / VALUE
1	Document Number	N/A	Use only forms of the 02/04 revision, or later, in sets of three, with preprinted document numbers.
2.	Document Date	R	Enter the date the document is prepared, using mm/dd/yy format.
3.	Mail To Address	R	When form is complete, to include both signatures, mail the white copy to DOT Finance.
4.	Distribution	R	Separate the sheets of the completed form; mail the **white** copy to Finance, provide the **pink** copy to the receiving unit, and retain the **canary** copy in the releasing unit files. Retain completed forms for not less than three years.
5.	Fixed Asset Tag Number	R	Enter the last five digits of the tag number of the fixed asset to be transfered.
6.	Serial Number	R	If the asset has a serial number, enter the last 8 digits of that serial number.
7.	County	R	Enter the two digit county number where the item will be located after the transfer.
8.	Standard Description	R	Enter the description of the item.
9.	Remarks	O	Use this space to provide any additional explanation considered necessary.
10.	Releaser's Signature	R	The Section Head or Unit Supervisor of the unit releasing the listed item(s) MUST sign the form. The form is not complete without this signature.
11.	Releasing Unit Number	R	Enter the six-digit unit number of the unit releasing the item(s).
12.	Receiver's Signture	R	The Section Head or Unit Supervisor of the unit receiving the item(s) listed MUST sign the form. The form is not complete without this signature.
13.	Receiving Unit Number	R	Enter the six-digit unit number of the unit receiving the item(s).

DT – 0125
F – 125
Z – 74

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

NO. 50362

REQUISITION TO GARAGE STOCKROOM

DATE ____________, 19____

STOCK NUMBER OR LICENSE NUMBER	PART NUMBER OR SIZE	STD. UNIT	STANDARD DESCRIPTION	QUANTITIY ORDERED	QUANTITY SHIPPED	NUMBER BACK-ORDERED

COST DISTRIBUTION							
CO.	SEC.	JOB NO.	FUND F	FUND S	CONTROL	R	FUNCTION

DELIVER TO ______________________ (LOCATION)

DISTRIBUTION: WHITE, PINK, BLUE COPIES TO STOCKROOM

YELLOW COPY IS RETAINED BY ORIGINATOR

REQUESTED BY ______________________ (NAME AND TITLE)

APPROVED ______________________ (DRE OR AUTHORIZED PERSONNEL)

ORDER FILLED BY ______________________

REQUISTION FOR OFFICE & ENGINEERING SUPPLIES

CREDIT ACCOUNT	NUMBER	
1510		9909

STATE OF TENNESSEE

DEPARTMENT OF TRANSPORTATION

REQUISITION FOR OFFICE & ENGINEERING SUPPLIES 28141

______________ DATE

______________ REQUESTED BY   FROM DIVISION OF ______________   APPROVED ______________   REGION ______________

DELIVER TO D.O.T. IN CARE OF ______________ NAME ______________ SHOW EXACT LOCATION OF DELIVERY

COST DISTRIBUTION								STANDARD DESCRIPTION	STD. UNIT	QUANTITY ORDERED	QUANTITY ISSUED	STOCK NUMBER
CO.	SEC.	DOT-JOB	FUND	C	CONTROL	R	FUNCT					

FILLED BY: ______________

DATE		
MO.	DAY	YR

RECEIVED BY: ______________ DATE: ______________

DT-0607
F-607
REVISION 9-74

State of Tennessee
Department of Transportation

MATERIALS AND SUPPLIES RETURNED TO INVENTORY

DATE_________________________, 19_____

LOCATION

THE MATERIALS AND SUPPLIES LISTED BELOW HAVE BEEN RECEIVED INTO THIS INVENTORY LOCATION.

____
STOREKEEPER

DEBIT ACCOUNT	NUMBER	
15	06371	1 9 9 0 9

PROJECT NUMBER						ACCOUNT								
		JOB OR DOT	FUND		C									
CO.	SEC.		F	S	B	CONTROL	R	FUNCT	STANDARD DESCRIPTION	QUANTITY	STD. UNIT	UNIT PRICE	AMOUNT	STOCK NUMBER

Tennessee Department of Transportation

DT-0308
Rev 02-04

LSR 000001

LOST OR STOLEN PROPERTY REPORT

Distribution:

White - TDOT Finance Office
Canary - TDOT Finance Office
Blue - Unit File (permanent)
Green - Region or Division File
Pink - Unit File (suspense)

TO BE COMPLETED IMMEDIATELY UPON DISCOVERY OF LOSS BY PERSON TO WHOM PROPERTY IS ASSIGNED

DOT TAG NUMBER ______________________ DATE ______________

SERIAL NUMBER ______________________ COMPLETED BY:

PROPERTY DESCRIPTION ______________________ NAME ______________

______________________ TITLE ______________

______________________ UNIT LOC & SUB-LOC ______________

ESTIMATED VALUE $ ______________________ SUPERVISOR:

DATE OF LOSS ______________________ NAME ______________

PLACE OF LOSS ______________________ TITLE ______________

DETAILS OF LOSS (CIRCUMSTANCES, CAUSE, ETC.): ______________________

____

____

____

____

IF STOLEN, WHAT LAW ENFORCEMENT AGENCIES WERE NOTIFIED? ______________________

DOES TDOT HAVE A CLAIM AGAINST ANY EMPLOYEE OR OTHER PERSON FOR LOSS OF THIS ITEM (DUE TO NEGLIGENCE, ETC.)? __________ *IF YES, GIVE NAME, ADDRESS AND BASIS FOR CLAIM ON SEPARATE MEMORANDUM ATTACHED.*

APPROVED ______________________ (REGIONAL DIRECTOR OR DIVISION HEAD)

TO BE COMPLETED BY FIXED ASSET ACCOUNTANT

DOT TAG NUMBER	STANDARD DESCRIPTION	SERIAL NUMBER
F 0		

ORIGINAL COST $ ______________________ DATE PURCHASED ______________

REVIEWED BY ______________________ DATE ______________
INTERNAL AUDITOR

FORM NOT VALID WITHOUT REGIONAL DIRECTOR or DIVISION HEAD'S SIGNATURE

TENNESSEE DEPARTMENT OF TRANSPORTATION
FINANCIAL PROCEDURES MANUAL

DESCRIPTION	LOST OR STOLEN PROPERTY REPORT INSTRUCTIONS
PURPOSE	To provide instructions for the proper completion of form DT-0303. This form is used to report the loss of fixed assets, sensitive items, mobile equipment and inventory items. (Inventory lost as result of normal shrinkage need not be reported in this manner.) This form may also be used to report the loss or theft of "untagged assets."

NOTE: Send the white and yellow copies of the completed DT-0303 form to:

TDOT Finance Office
Cost Accounting Section
Suite 800 James K. Polk Building
505 Deaderick Street
Nashville, TN 37243-0329

ITEM NO.	NAME	REQ	INSTRUCTION / VALUE
1.	Document Number	N/A	Use only forms of the 02/04 revision, or later, printed in sets of five and with preprinted document numbers.
2.	Distribution Director	N/A	From the back of the packet to the front, the **pink** copy is retained in the unit as a suspense item, while the rest of the document is sent to the Regional or Division Head for signature; Once signed, the **green** copy is retained at the Region or Division level for file, and the rest of the signed packet is returned to the originating unit; At the unit, the **blue** copy is retained for permanent file and the remainder of the packet (**white** and **canary** copies) are mailed to DOT Finance, at the address above.
3.	DOT Tag Number	R	Enter the fixed asset tag number (or license number of mobile equipment). Use one form per tag number.
4.	Serial number	R	Serial number or VIN.
5.	Property Description	R	List a detailed description of item. Include manufacturer name and model if known.
6.	Estimated Value	O	Best estimate of the item's value at time of loss.
7.	Date of Loss	R	Date item was discovered missing.
8.	Place of Loss	R	Enter where the loss occurred.
9.	Date	R	Date report is filled out.
10.	Name	R	Signature of person reporting loss.
11.	Title	R	Job title of person reporting loss.

EXCERPT FROM NOAA MANUAL NOS NGS 5

This discussion is taken from NOAA Manual NOS NGS 5, "State Plane Coordinate System of 1983". References to the tranverse Mercator and oblique Mercator projections have been omitted. Any cross references printed in this section refer only to Sections and Tables from NOAA Manual NOS NGS 5, not to other sections in the Survey Manual.

3. CONVERSION METHODOLOGY

This chapter addresses both "manual" and "automated" methods for performing "conversions" on any Lambert conformal conic projections. Included is conversion from NAD 83 latitude/longitude to SPCS 83 northing/easting, plus the reverse process. For these processes this manual uses the term "conversion," leaving the term "transformation" for the process of computing coordinate values between datums, for example, transforming from NAD 27 to NAD 83 or transforming from SPCS 27 to SPCS 83. In addition to converting point coordinates, methods for conversion of distances, azimuth, and angles are also given.

The "automated" methods for conversions given in Section 3.1 are equations that have been sequenced and structured to facilitate programming. "Manual" methods are generally a combination of simple equations, tables, and intermediate numerical input, requiring only a calculator capable of basic arithmetic operations. Section 3.4 provides such a manual method for the Lambert projection where the intermediate numerical input is polynomial coefficients. Table 3.0 summarizes the conversion computational methods that were used for SPCS 27 and the methods discussed in this manual for SPCS 83.

TABLE 3.0 Summary of Conversion Methods

Datum	Mode	Projection	Method
SPCS 27	Manual	Lambert and Transverse Mercator	Projection tables
		Oblique Mercator	Intersection tables
	Automated	Lambert, transverse Mercator, and Oblique Mercator	Equations and constants described in C&GS Publication 62-4 (Claire 1968)
SPCS 83	Manual	Lambert	Polynomial coefficients (Sec. 3.4)
		Tranverse Mercator	New projection tables (future)
		Oblique Mercator	Automated only
	Automated	Lambert	Polynomial coefficients or new mapping equations (Sec. 3.1)
		Tranverse Mercator	New mapping equations (Sec. 3.2)
		Oblique Mercator	New mapping equations (Sec. 3.3)

The mapping equations given in Section 3.1 are not really "new" and may differ little from equations found in geodetic literature. However, they are new in the sense that they are not in the same form as the equations published or programmed by NGS or its predecessors in connection with SPCS 27. Whereas the SPCS 27 equations given in C&GS Publication 62-4 were designed to reproduce exactly the numerical results of an earlier manual method using logarithmic computations and projection tables, the equations here were designed for accuracy and computational efficiency.

Because the mapping equations of the automated approach apply equally to mainframe computers and programmable hand-held calculators, the availability of sufficient significant digits warrants consideration. For the Lambert projection, the method of polynomial coefficients (Sec. 3.4) was developed for machines with only 10 significant digits. With less than 12 digits, the general mapping equations could not guarantee millimeter accuracy in all Lambert zones, particularly in Florida, Louisiana, Texas, South Carolina, Nebraska and Montana. However, the polynomial coefficient method may also prove to be the most efficient for any machine. The general mapping equations will produce submillimeter accuracy when adequate significant digits are available for the computation.

Since the equations are not difficult, the polynomial coefficient method also fills the requirement for a manual method for the Lambert projection.

While it is easy to visualize map projections by considering them a perspective projection of the meridians and parallels of the datum surface onto a surface that develops into a plane, in this age of coordinate plotters a graticule is generally not constructed by these means. Although a set of mechanical procedures can sometimes be defined by which meridians and parallels can be geometrically constructed on the grid using a ruler, compass, and scale, a pair of functions, $N = f_1(\phi,\lambda)$ and $E = f_2(\phi,\lambda)$, always exist. That is, for a point of given latitude (ϕ) and longitude (λ), there exist equations to yield the northing coordinate and equations to yield the easting coordinate when ϕ and λ are substituted into the equations. Likewise, equations must exist to compute the convergence angle, $\gamma = f_3(\phi,\lambda)$, and grid scale factor, $k = f_4(\phi,\lambda)$. These four functions, or equations, comprise the direct conversion process.

Furthermore, it must be possible to perform the inverse computation, requiring another pair of formulas, latitude (ϕ) = f_5 (N,E) and longitude (λ) = f_6 (N,E). Similarly needed are convergence and grid scale factor as a function of the plane coordinates, $\gamma = f_7(N,E)$ and $k = f_8(N,E)$. Because these are one-to-one mappings, the inverse computation must reproduce the original values.

This chapter provides these eight "mapping equations" for the Lambert conformal conic projection (Sec. 3.1). The definition of the adopted symbols will be given first. Two sets of symbols are listed, the conventional set which incorporates the Greek alphabet and a set available on standard keyboards. The equations in this chapter will use the conventional notation. The entries in the notation section flagged with an asterisk are the constants required to uniquely define one specific zone of that general type of map projection. The values of those zone-defining constants as adopted and legislated by the States are listed in Appendix A.

EXCERPT FROM APPENDIX A - Zone Defining Constants

State/Zone/Code		Projection	Central Meridian And Scale Factor (T.M.) or Standard Parallels (L.)	Grid Origin Longitude Latitude	Grid Origin Easting Northing
Tennessee TN					
	4100	L	35 15	86 00	600000
			36 25	34 20*	0

* This represents a change from the defining constant used for the 1927 State Plane Coordinate System. All metric values assigned to the origins also are changes.

Included within the notation section are the symbols and definitions of ellipsoid constants. Although several geometric ellipsoid constants are used within the mapping equations, only two geometric constants are required to define an ellipsoid. The SPCS 83 uses the GRS 80 ellipsoid. Those constants are discussed in Section 1.7. All other geometric ellipsoid constants are then derived from the two defining constants, usually for the purpose of eliminating repeated computations.

A section on computation of zone constants follows each section on notation and definitions. Within this section are equations to compute intermediate quantities derived from the zone-defining constants of Appendix A. These need only to be derived once. The derived "intermediate computing constants" of this section that need to be saved for future computations are flagged with an asterisk. The advantage of segmenting the general mapping equations is to eliminate repeated computations.

Subsequent sections list the equations of the direct and inverse coordinate conversion process. The solution of the ultimate mapping equations will require the values of the asterisked terms of the first two sections (defining constants plus intermediate constants).

3.1 Lambert Conformal Conic Mapping Equations

3.11 Notation and Definitions

For some terms an optional symbol appears in parentheses. This optional symbol available on all keyboards is used exclusively in Section 3.4 and Appendix C. Asterisked terms define the projection. Their values are listed in Appendix A. These terms are the "zone defining constants" included within State SPCS legislation where enacted.

	ϕ	(B)	Parallel of geodetic latitude, positive north
*	ϕ_s	(B_s)	Southern standard parallel
*	ϕ_n	(B_n)	Northern standard parallel
	ϕ_o	(B_o)	Central parallel, the latitude of the true projection origin
*	ϕ_b	(B_b)	Latitude of the grid origin
	λ	(L)	Meridian of geodetic longitude, positive west

*	λ_o	(L_o)	Central meridian, longitude of the true and grid origin
	k		Grid scale factor at a general point
	k_{12}		Grid scale factor of a line (between point 1 and point 2)
	k_o		Grid scale factor at the central parallel ϕ_o
	γ	(C)	Convergence angle
	δ	(t-T)	Arc-to-chord or second-term correction
	N		Northing coordinate (formerly y)
*	N_b		The northing value for ϕ_b at the central meridian (the grid origin). Sometimes identified as the false northing.
	N_o		Northing value at the intersection of the central meridian with the central parallel (the true projection origin)
	E		Easting coordinate (formerly x)
*	E_o		The easting value at the central meridian λ_o. Sometimes identified as the false easting.
	R		Mapping radius at latitude ϕ
	R_b		Mapping radius at latitude ϕ_b
	R_o		Mapping radius at latitude ϕ_o
	K		Mapping radius at the equator
	Q		Isometric latitude
*	a		Semi-major axis of the geodetic ellipsoid
	b		Semi-minor axis of the geodetic ellipsoid
*	f		Flattening of the geodetic ellipsoid = (a-b)/a
	e		First eccentricity of the ellipsoid = $(2f-f^2)^{1/2}$

3.12 Computation of Zone Constants

In this section the zone defining constants, ellipsoid constants, and parts of the Lambert mapping equations are combined to form several intermediate computing constants that are zone specific. These intermediate constants, flagged with an asterisk, will be required within the working equations of Sections 3.13 through 3.15. All angles are in radian measure where 1 radian equals 180/π degrees. Linear units are identical to the units of the ellipsoid (a and b) and grid origin (N_b and E_o).

$$Q_s = \tfrac{1}{2}\left[\ln \frac{1 + \sin \phi_s}{1 - \sin \phi_s} - e \ln \frac{1 + e \sin \phi_s}{1 - e \sin \phi_s}\right]$$

$$W_s = (1 - e^2 \sin^2 \phi_s)^{1/2}$$

Similarly for Q_n, W_n, Q_b, Q_o and W_o upon substitution of the appropriate latitude

$$* \quad \sin\phi_o = \frac{\ln\left[W_n \cos\phi_s / (W_s \cos\phi_n)\right]}{Q_n - Q_s}$$

$$* \quad K = \frac{a \cos\phi_s \exp(Q_s \sin\phi_o)}{W_s \sin\phi_o} = \frac{a \cos\phi_n \exp(Q_n \sin\phi_o)}{W_n \sin\phi_o}$$

NOTE: $\exp(x) = \in^x$

where $\in$ = 2.718281828... (the base of natural logarithms)

$$* \quad R_b = K / \exp(Q_b \sin\phi_o)$$

$$* \quad R_o = K / \exp(Q_o \sin\phi_o)$$ (R_o used in δ computation)

$$* \quad k_o = (W_o \tan\phi_o R_o) / a$$

$$* \quad N_o = R_b + N_b - R_o$$

3.13 Direct Conversion Computation

This computation starts with the geodetic coordinates of a point (ϕ,λ) from which the Lambert grid coordinates (N, E) are to be computed, with convergence angle (γ), and grid scale factor (k).

$$Q = \tfrac{1}{2}\left[\ln\frac{1 + \sin\phi}{1 - \sin\phi} - e \ln\frac{1 + e\sin\phi}{1 - e\sin\phi}\right]$$

$$R = K / \exp(Q \sin\phi_o)$$

$$\gamma = (\lambda_o - \lambda) \sin\phi_o$$

$$N = R_b + N_b - R \cos\gamma$$

$$E = E_o + R \sin\gamma$$

$$k = (1 - e^2 \sin^2\phi)^{1/2} (R \sin\phi_o) / (a \cos\phi)$$

3.14 Inverse Conversion Computation

In this computation the Lambert grid coordinates of a point (N, E) are given and the geodetic coordinates (ϕ,λ), convergence (γ), and grid scale factor (k) are to be computed.

$$R' = R_b - N + N_b$$

$$E' = E - E_o$$

$$\gamma = \tan^{-1} (E'/R')$$

$$\lambda = \lambda_o - \gamma / \sin \phi_o$$

$$R = (R'^2 + E'^2)^{½}$$

$$Q = [\ln (K/R)] / \sin \phi_o$$

Computation of latitude is iterative. Starting with the approximation

$$\sin \phi = \frac{\exp (2Q) - 1}{\exp (2Q) + 1}$$

solve for sin ϕ three times, as follows:

$$f_1 = ½ \left[\ln \frac{1 + \sin \phi}{1 - \sin \phi} - e \ln \frac{1 - e \sin \phi}{1 + e \sin \phi} \right] - Q$$

$$f_2 = \frac{1}{1 - \sin^2 \phi} - \frac{e^2}{1 - e^2 \sin^2 \phi}$$

Add a correction of ($-f_1 / f_2$) to sin ϕ and iterate two times before obtaining ϕ.

$$k = (1 - e^2 \sin^2 \phi)^{1/2} (R \sin \phi_o)/(a \cos \phi)$$

If only k is desired from the grid coordinates, an approximate ϕ will suffice and its computation shortened. After computing Q, compute

$$\sin \theta = \frac{\exp (2Q) - 1}{\exp (2Q) + 1}$$

$$\phi = \theta + (A \sin \theta \cos \theta) (1 + B \cos^2 \theta)$$

in which $A = e^2 (1 - e^2 / 6)$ and $B = 7e^2 / 6$. For the GRS 80 ellipsoid A = 0.0066869 and B = 0.0078.

The grid scale factor may be approximated by the equation

$$k = k_o + (N-N_o)^2 / 2r_o^2 + (N-N_o)^3 (\tan \phi_o) / 6r_o^3$$

The quantity r_o is defined in Section 3.15. Values of r_o, k_o and N_o are given in Appendix C.

A further approximation is given by the equation:

$$k = k_o + (N-N_o)^2 (1.231 \times 10^{-14}) + (N-N_o)^3 (\tan \phi_o) (6.94 \times 10^{-22})$$

These approximations may not be sufficiently accurate in the States with a single Lambert zone, such as Tennessee.

To derive the grid scale factor at a point directly from the grid coordinates, the method given in Section 3.4, the method of polynomial coefficients, also warrants consideration.

3.15 Arc-to-Chord Correction "δ" (alias "t-T")

The relationship among grid azimuth (t), geodetic azimuth (α), convergence angle (γ), and arc-to-chord correction (δ) at any given point is

$$t = \alpha - \gamma + \delta$$

To compute δ requires knowledge of the coordinates of both ends of the line to which δ is to be applied. If geodetic coordinates of the endpoints are available (ϕ_1, λ_1 and ϕ_2, λ_2), the δ from point 1 to point 2 can be computed from

$$\delta_{12} = (\sin \phi_3 - \sin \phi_o) (\lambda_1 - \lambda_2) / 2$$

where $\phi_3 = (2 \phi_1 + \phi_2) / 3$ and ϕ_o is the computed constant for the zone. In normal practice, however, δ is desired as a function of the grid coordinates. To that end the following sequence of equations will produce the best possible determination of δ_{12}, given points N_1, E_1 and N_2, E_2:

$$p_1 = N_1 - N_o \qquad p_2 = N_2 - N_o$$
$$q_1 = E_1 - E_o \qquad q_2 = E_2 - E_o$$
$$R'_1 = R_o - p_1 \qquad R'_2 = R_o - p_2$$
$$\Delta N = N_2 - N_1$$

$$M_o = k_o a (1 - e^2) / (1 - e^2 \sin^2 \phi_o)^{3/2}$$

NOTE: M_o is the scaled radius of curvature in the meridian at ϕ_o scaled to the grid. The value of M_o for each zone appears in Appendix 3 as a "computed constant."

$$u_1 = p_1 - q_1^2 / 2R'_1$$

$$\phi_3 = \phi_o + (u_1 + \Delta N/3) / M_o$$

$$\delta_{12} = (\sin \phi_3 / \sin \phi_o - 1) (q_2/R'_2 - q_1 / R'_1) / 2 \qquad (1)$$

For most applications a less accurate determination of ϕ will suffice. For example, the original Coast and Geodetic Survey formula (Adams and Claire 1948) should be adequate for all applications except the most precise surveys in the largest Lambert zones.

$$\delta_{12} = (p_1 + \Delta N/3) \Delta E / 2r_o^2 \qquad (2)$$

where

$$p_1 = N_1 - N_o$$

$$\Delta N = N_2 - N_1 \qquad \Delta E = E_2 - E_1$$

$$r_o = k_o a(1 - e^2)^{½} / (1 - e^2 \sin^2 \phi_o)$$

The quantity r_o is the geometric mean radius of curvature at ϕ_o scaled to the grid and is constant for any one zone. The value of r_o has been included with the computed constants in Appendix C. A single value of $1 / (2r_o^2)$ is often used and combined with the constant to convert radians to seconds (1 radian = $648000/\pi$ seconds).

Hence, $\delta_{12} = 25.4\ (p_1 + \Delta N / 3)\ (\Delta E)\ 10^{-10}$ seconds, where the coordinates are in meters. Sometimes the notation (ΔN) replaces $(p_1 + \Delta N/3)$. Then the above equation is analogous to the expression often used in connection with NAD 27:

$$\delta_{12} = 2.36\ \Delta x\ \Delta y\ 10^{-10} \text{ seconds}$$

where the coordinates are in feet. This expression also serves for NAD 83 coordinates that have been converted to feet.

For the SPCS 27 Lambert systems NGS suggested two other appropriate methods that provided more accurate (t-T) corrections at the zone extremities. One was similar to Equation 3.15 (1) and gave essentially the same results. Since the computing effort was somewhat greater than for 3.15 (1) it is not given here. The second, while not as accurate as 3.15 (1), may be simpler for manual calculations because it uses the SPCS 83 zone constants and readily understood rotation and translation formulas.

$$\delta_{12} = (e_2 - e_1)\ (2n_1 + n_2) / 6r_o^2 \qquad \text{(in radian measure)}$$

where

$n = D + E' \sin \gamma + N' \cos \gamma$
$e = E' \cos \gamma - N' \sin \gamma$

" γ " is the average convergence angle for the survey area and is considered positive. γ to minutes is sufficient.

$D = 2R_o \sin^2 \gamma / 2$
$N' = N - N_o$
$E' = E - E_o$

The size of δ varies linearly with the length of the ΔE $(\Delta\lambda)$ component of the line and with the distance of the standpoint from the central parallel. It does not vary with distance of standpoint from the central meridian. Hence the size of δ depends on the direction of the line, varying from a zero value between points on the same meridian to maximum values over east-west lines.

Table 3.1 gives an overview of the true numeric value of the arc-to-chord correction (δ) and of the computational errors expected from Equations (1) and (2). The examples were computed for a hypothetical zone with central parallel of approximately 42° (standard parallels 41° and 43°), on the GRS 80 ellipsoid. Two cases, 1° and 2°, are illustrated for the distance of the standpoint from the central parallel ϕ_o. Two cases, 5° and 10°, are given for the distance of the standpoint from the central meridian. Although the magnitude of δ is not a function of the distance of the standpoint from the central meridian, Equation (2) becomes less accurate as this distance increases. Table 3.1 also gives three cases for the orientation of the line, in azimuths of 90°, 135°, and 180°. Again note that although the true δ equals zero in an azimuth of 180°, the equations only approximate zero.

The final assumption in Table 3.1 is that the length of the line for which δ is being computed is 20 km. Dividing the line into several traverse legs results in a proportional decrease in the required correction to a direction. It does nothing to diminish the closure error in azimuth because errors due to omission of δ are cumulative.

From data given in Table 3.1 the persons performing the computing must decide which reduction formula is appropriate for their needs, remembering that the accuracy of the formula should exceed the expected accuracy of the field work by one order of magnitude and that an error of 1" direction corresponds to a linear error of about 1:200 000, or 5 ppm.

TABLE 3.1 True Values of (t-T)

And Computational Errors in Their Determination (in seconds of arc)

$\phi_1 - \phi_o$	1°	2°	1°	2°
$\lambda_1 - \lambda_o$	5°	5°	10°	10°
Azimuth	90°	90°	90°	90°
True δ	5.67	11.44	5.67	11.44
Error by (1)	0.00	0.02	0.03	0.11
Error by (2)	0.53	0.38	2.28	2.07
Azimuth	135°	135°	135°	135°
True δ	3.83	7.91	3.83	7.91
Error by (1)	0.00	0.01	0.02	0.08
Error by (2)	0.14	-0.20	0.99	0.38
Azimuth	180°	180°	180°	180°
True δ	0.00	0.00	0.00	0.00
Error by (1)	0.00	0.00	0.00	0.00
Error by (2)	-0.34	-0.67	-0.90	-1.55

3.4 Polynomial Coefficients for the Lambert projection

Conversion of coordinates from NAD 83 geodetic positions to SPCS 83 plane coordinate positions, and vice versa, can be greatly simplified for the Lambert projection using precomputed zone constants obtained by polynomial curve fitting. NGS developed the Lambert "polynomial coefficient" approach as an alternative to the rigorous mapping equations given in Section 3.1. For many zones the solution of the textbook mapping equations for the Lambert projection requires the use of more than 10 significant digits to obtain millimeter accuracy, and in light of the programmable calculators generally in use by surveyors/engineers, an alternative approach was warranted. For the polynomial coefficient method of the Lambert projection, 10 significant digits will produce millimeter accuracy in all zones.

Given the precomputed polynomial coefficients, the conversion process by this method reduces to the solution of simple algebraic equations, requiring no exponential or logarithmic functions. It is therefore very efficient for hand calculators and small computers. In addition, the conversion is not too difficult to apply manually without the aid of programming. For this reason, the polynomial coefficient approach has also been listed as a manual approach in Table 3.0. When programmed, this approach may be more efficient than the mapping equations of Section 3.1.

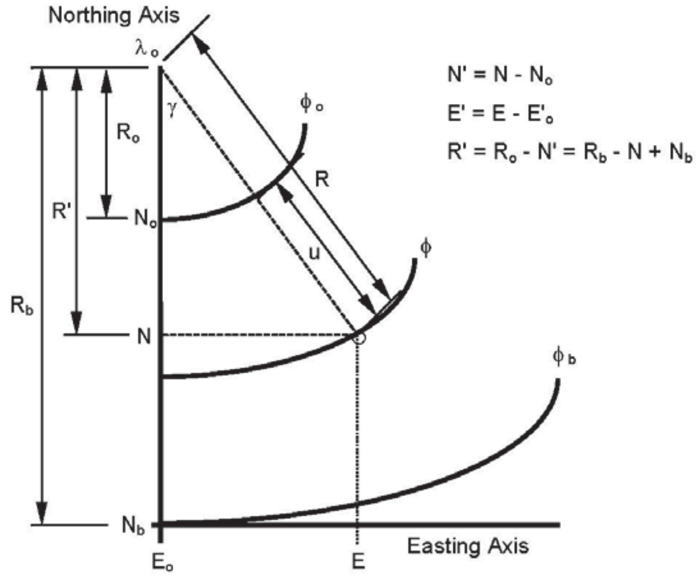


FIGURE 3.4 The Lambert Grid

The equations in this section are similar to those in Section 3.1, with the symbols representing the same quantities. Four new symbols are introduced, three of which are for polynomial coefficients--L's, G's, and F's--and the fourth is the symbol "u". From the equations and Figure 3.4, it will be discovered that "u" is a distance on the mapping radius "R" between the central parallel and a given point. The "L" coefficients (L_1, L_2, L_3, etc.) are used in the forward conversion process (Section 3.41), the "G" coefficients (G_1, G_2, G_3, etc.) are used in the inverse conversion process (Section 3.42), and the "F" coefficients are used in the computation of grid scale factor. For the computation of (t-T), the methods in Section 3.15 are applicable.

The fundamental polynomial equations of this method are

$$u = L_1 \Delta\phi + L_2 \Delta\phi^2 + L_3 \Delta\phi^3 + L_4 \Delta\phi^4 + L_5 \Delta\phi^5 \quad \text{(forward conversion)}$$

$$\Delta\phi = \phi - \phi_o = G_1 u + G_2 u^2 + G_3 u^3 + G_4 u^4 + G_5 u^5 \quad \text{(inverse conversion)}$$

The determination of "u" in meters on a plane by a polynomial, given point (ϕ,λ) in the forward conversion, and the determination by a polynomial of $\Delta\phi$ in radians on the ellipsoid given point (N,E) in the inverse conversion, is the unique aspect of this method. The L-coefficients perform the functions: (1) computing the length of the meridian arc between ϕ and ϕ_o, and (2) converting that length to (R_o - R) which is its equivalent on the mapping radius. The G-coefficients serve the same two-stage process, but in reverse. The polynomial coefficients of these equations, L's and G's, were separately determined by a least squares curve fitting program that also provided information as to the accuracy of the fit. Ten data points were used for each Lambert zone and the model solved for the fewest number of coefficients possible that provided 0.5 mm coordinate accuracy in the conversion. Consequently, some small zones required only three coefficients, three L's and three G's, whereas a few large zones required five coefficients for each the forward and inverse conversion.

Appendix C discusses the computed constants and coefficients required for this method, which are defined as follows:

The Defining Constants of a Zone:

ϕ_s or B_s	Southern standard parallel
ϕ_n or B_n	Northern standard parallel
ϕ_b or B_b	Latitude of grid origin
λ_o or L_o	Central meridian - longitude of true and grid origin
N_b	Northing value at grid origin (B_b)
E_o	Easting value at grid and projection origin (L_o)

The Derived Constants:

ϕ_o or B_o	Central parallel - Latitude of the projection origin
N_o	Northing value at projection origin (B_o)
k_o	Grid Scale Factor at the central parallel
R_o	Mapping radius at (B_o)
R_b	Mapping radius at (B_b)
M_o	Scaled radius of curvature in the meridian at B_o used in Section 3.15

The Polynomial Coefficients:

L_1 through L_5 used in the forward conversion
G_1 through G_5 used in the inverse conversion
F_1 through F_3 used in the grid scale-factor computation

EXCERPT FROM APPENDIX C

Constants for the Lambert Projection By the Polynomial Coefficient Method

TN TENNESSEE **ZONE # 4100**

Defining Constants

B_s	=	35:15
B_n	=	36:25
B_b	=	34:20
L_o	=	86:00
N_b	=	0.0000
E_o	=	600000.0000

Coefficients for GP to PC

L(1)	=	110950.2019
L(2)	=	9.25072
L(3)	=	5.64572
L(4)	=	0.017374

Computed Constants

B_o	=	35.8340607459
sin B_o	=	0.585439726459
R_b	=	9008631.3113
R_o	=	8842127.1422
N_o	=	166504.1691
K	=	13064326.2967
k_o	=	0.999948401424
M_o	=	6356978.3321
r_o	=	6371042.

Coefficients for PC to GP

G(1)	=	9.013052490E-06
G(2)	=	-6.77268E-15
G(3)	=	-3.72351E-20
G(4)	=	-9.2828E-28

Coefficients for Grid Scale Factor

F(1)	=	0.999948401424
F(2)	=	1.23188E-14
F(3)	=	4.54E-22

3.41 Direct Conversion Computation

The computation starts with the geodetic position of a point (ϕ,λ), and computes the Lambert grid coordinates (N,E), convergence angle (γ), and grid scale factor (k).

$\Delta\phi = \phi - B_o$ ($\Delta\phi$ in decimal degrees)
$u = L_1 \Delta\phi + L_2 \Delta\phi^2 + L_3 \Delta\phi^3 + L_4 \Delta\phi^4 + L_5 \Delta\phi^5$

NOTE: The only required terms are those for which polynomial coefficients are provided in Appendix C. Either three, four, or five L's are required depending on the size of the zone.

Suggestion: Use nested form.

$u = \Delta\phi [L_1 + \Delta\phi \{ L_2 + \Delta\phi (L_3 + \Delta\phi (L_4 + L_5 \Delta\phi))\}]$
$R = R_o - u$
$\gamma = (L_o - \lambda) \sin (B_o)$ convergence angle
$E' = R \sin \gamma$

$N' = u + E' \tan(\gamma / 2)$

$E = E' + E_o$ — easting

$N = N' + N_o$ — northing

$k = F_1 + F_2u^2 + F_3u^3$ — grid scale factor

3.42 Inverse Conversion Computation

This computation starts with the Lambert grid coordinates (N,E) from which are computed the geodetic coordinates (ϕ,λ), convergence angle (γ), and grid scale factor (k):

$N' = N - N_o$

$E' = E - E_o$

$R' = R_o - N'$

$\gamma = \tan^{-1}(E' / R')$ — convergence angle

$\lambda = L_o - \gamma / \sin(B_o)$ — longitude

$u = N' - E' \tan(\gamma / 2)$

$\Delta\phi = \phi - B_o = G_1u + G_2u^2 + G_3u^3 + G_4u^4 + G_5u^5$ — ($\Delta\phi$ in decimal degrees)

NOTE: The only required terms are those for which polynomial coefficients are provided in Appendix C. Either three, four, or five G's are required depending on the size of the zone.

Suggestion: Use factored form.

$$\Delta\phi = u [G_1 + u \{ G_2 + u (G_3 + u (G_4 + G_5 u))\}]$$

$\phi = B_o + \Delta\phi$ — latitude

$k = F_1 + F_2u^2 + F_3u^3$ — grid scale factor

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
FIELD ENGINEERS PROJECT TIME REPORT IN MAN-DAYS

Project No.: ______________________ County: ______________
Route No.: ______________________ Length: ____________ Miles
Description: ____
____

Type of Survey: Urban ______ Rural ______
Function Code: __________

	MAN-DAYS		
	FIELD	OFFICE	TOTAL
Alignment			
B. M.'s and Cross Sections			
Topography and Utilities			
Drainage			
Property			
Lost Time (travel, weather, etc.)			
Control Traverses			
Grand Total			

Remarks: ____
____
____
____
____
____

This form will be turned in with each survey.

Prepared by: ______________________
Field Supervisor Date

TENNESSEE DEPARTMENT OF TRANSPORTATION

MANDAY ESTIMATE AND FEE PROPOSAL

For Survey Only

SR-22

from SR-314 to 0.75 Miles South of Old Bridge Road

Humphreys County

Project Identification Number (PIN): <100000.00>

General Comments:

Prepared By:
IMA Surveyor

Date prepared:
4/5/2011

Project No.:
43065-1241-04

ABC Engineering

Mr. Surveyor

2112 Benchmark Place

615-555-5555

615-555-5556

mrsurveyor@emailserver.net

TDOT
Version 2.22

Survey Summary

TDOT

Route: SR-22 4/5/2011
Description: from SR-314 to 0.75 Miles South of Old Bridge Road
County: Humphreys
Consultant: ABC Engineering
Prepared By: IMA Surveyor
Project No.: 43065-1241-04

Mainline Project Length: 4.00 (miles)
Number of Sideroads: 10 Length: 3500 (feet)
Office Travel Time per day (hrs): 2.00
Crew Travel Time per day (hrs): 1.00
Crew Work per day (hrs): 8

Number of Existing Lanes: 2 Proposed: 4
Number of Driveways/Ramps: 36

Location:
Existing Road: 100% Rural: 50%
New Alignment: 0% Urban: 50%
Business: 0%

Rural Land Character: Woods: 50% Terrain: Flat 50%
Pasture: 50% Rolling: 25%
Cultivated: 0% Hilly: 0%
Mountains: 25%

Distance to Nearest Benchmark: 0.6 miles
Number of Survey Updates: 0
R.O.W. Staking:
Iron Pins 0
1 Stake Points 0
2 Stake Points 0

Aerial Mapping Available: (●) YES ( ) NO

Approximate Obscured Area: 10% Use 100% if no mapping is available.
Proposed DTM Width: 300 (ft)

Geotechnical Staking:
Points 0

Drainage:
Approx. Number of Culvert Sites: 42
Number of Bridges: Small: 0 Medium 0 Large: 0

Approx. Number of Property Tracts: 30 Number of Railroad Crossings: 0

Indicate Utilities Present:
Elect.: ☑ Telephone: ☑ Cable TV: ☑
Water: ☑ Sewer: ☑ Gas: ☐
Fiber Optic: ☐ Petroleum Pipeline: ☐

Comments on Difficulty, Conditions or Other Considerations:

INPUT SIDEROADS LT & RT OF CENTERLINE

Sideroad Name	Length (feet)
Side Road 1	400
Side Road 2	400
Side Road 3	500
Side Road 4	300
Side Road 5	300
Side Road 6	300
Side Road 7	300
Side Road 8	1000
Total Length	3500

ESTIMATE FOR FIELD SURVEYS

PROJECT DESCRIPTION: Version 2.22

Route: SR-22
Description: from SR-314 to 0.75 Miles South of Old Bridge Road
County: Humphreys Prepared By: IMA Surveyor
Consultant: ABC Engineering Date Prepared: 4/5/2011
Project No.: 43065-1241-04
TOTAL LENGTH(miles): 4.38
OFFICE TRAVEL TIME PER DAY(hrs): 2.00
CREW TRAVEL TIME PER DAY(hrs): 1.00

TDOT

ACTIVITY	PROJECT MANAGER	OFFICE CADD TECH.	PARTY CHIEF	INSTRUMENT MAN	RODMAN	RODMAN	FLAGGER	FLAGGER	
	PM	O	P	I	R	R	F	F	Total
1.Establish & Stake Alignments	0.9	0.6	4.4	4.4	4.4	4.4			19.1
2. Update Survey									
3. Control Traverses	2.3	0.7	2.9	2.9	2.9	2.9			14.6
4. Set Aerial Control									
5. Bench Levels	0.7	0.7	2.3	2.3	2.3	2.3			10.6
6. Develop Digital Terrain Model	3.1	4.6	5.6	5.6	5.6	5.6			30.1
7. R.O.W.,Deed & Utility Research	1.5	1.0							2.5
8. Property Owner Contact	2.0		2.0						4.0
9. Locate Property & Pres. R.O.W. Lines	3.0	3.0	5.0	5.0	5.0	5.0			26.0
10. Obtain Topo/Verify Aerial	1.7	3.4	16.9	16.9	16.9	16.9			72.7
11. Drainage Surveys (Culverts)	2.8	2.8	10.6	10.6	10.6	10.6			48.0
12. Bridge Surveys (bridge details, stream alignment, topo, profile, flood plain sections, high water, etc.									
13. Railroad Surveys									
14. Utilities	0.7	1.8	11.7	11.7	11.7	11.7			49.3
15. Stake R.O.W. & Easements									
16. Stake Sounding Holes									
17. Note Reduction & other Calculations	4.4								4.4
18. Plot Plan, Profiles, Property Map, Drainage Map, Bridge Survey, Control Point Table, etc.	1.8	7.0							8.8
19. Supervision	4.4								4.4
20. Travel Time (8 HOUR MAN-DAYS)	0.8	0.3	8.8	8.5	8.5	8.5			35.4
TOTALS (8 HOUR MAN-DAYS)	30.1	25.9	70.2	67.9	67.9	67.9			**329.9**

Description: from SR-314 to 0.75 Miles South of Old Bridge Road
County: Humphreys
Consultant: ABC Engineering
Project No.: 43065-1241-04
TOTAL LENGTH(miles): 4.38
Date Prepared: 4/5/2011 Prepared By: IMA Surveyor

TDOT

	OFFICE DIFFICULTY	FIELD DIFFICULTY	REMARKS
Align.	0.5	0.5	
Update	1.0	1.0	0 Survey Updates
Control	1.0	1.0	
Aerial	0.0	0.0	0 0 NUMBER HORIZONTAL & NUMBER VERTICAL POINTS
Levels	1.0	1.0	ZERO IF NOT REQUIRED
DTM	1.3	1.3	10% PERCENT SKIPS 300 DTM WIDTH(feet)
Research	1.0	1.0	30 NUMBER OF TRACTS
Contacts	1.0	1.0	
Property	1.0	1.0	DO NOT EDIT THESE CELLS
Topo	1.2	1.2	
Culverts	1.0	1.0	
Bridges	1.0	1.0	0 0 0 NUMBER OF SMALL, MEDIUM, LARGE BRIDGES
RR	1.0	1.0	0 NUMBER OF RR CROSSINGS
Utilities	1.0	1.0	5 Number of Different Utilities Involved
R.O.W.	1.0	1.0	DO NOT EDIT THESE CELLS
Geotech.	1.0	1.0	
	1.0		0 0 0 Number of IP's, 1-stake, 2-stakes
Plotting	1.0		0 Number of Geotechnical Staking Points
	1.0		**73.6** 8 - Hr MD/MILE not including travel
	1.0	1.0	**82.5** 8 - Hr MD/MILE

SURVEY DIRECT LABOR COST

PROJECT DESCRIPTION:
ROUTE: SR-22
DESCRIPTION: from SR-314 to 0.75 Miles South of Old Bridge Road
COUNTY: Humphreys
CONSULTANT: ABC Engineering
TOTAL LENGTH (miles): 4.66

Prepared By: IMA Surveyor
Date Prepared: 4/5/2011

TDOT

	Abbrv.	Personnel Classification	8 - Hr Man-Days		Approved Hours	Rate Per Hr	Direct Labor	
1	PM	PROJECT MANAGER	30.1		8.0	$ 38.00	$ 9,150.40	
2	O	OFFICE CADD TECH.	25.9		8.0	$ 22.00	$ 4,558.40	
3	P	PARTY CHIEF	70.2		8.0	$ 20.00	$ 11,232.00	
4	I	INSTR. MAN	67.9		8.0	$ 15.00	$ 8,148.00	
5	R	RODMAN	67.9		8.0	$ 11.00	$ 5,975.20	
6	R	RODMAN	67.9		8.0	$ 11.00	$ 5,975.20	
7	F	FLAGGER	0.0		8.0	$ -	$ -	
8	F	FLAGGER	0.0		8.0	$ -	$ -	
		TOTALS	329.9				$ 45,039.20	

Direct Labor Cost Per 8 - Hour Man-Day	$ 136.52

Version 2.22

SURVEY DIRECT EXPENSES

PROJECT DESCRIPTION:
ROUTE: SR-22
DESCRIPTION: from SR-314 to 0.75 Miles South of Old Bridge Road
COUNTY: Humphreys
CONSULTANT: ABC Engineering
TOTAL LENGTH (miles): 4.66

Prepared By: IMA Surveyor
Date Prepared: 4/5/2011
Project No.: 43065-1241-04

TDOT

Reproduction Costs

Item Description	Number / Unit	Unit Price	Item Subtotal	Item Total Cost
Xerographic Bond	0	$ 0.25	$ -	
Blueline Fullsize	10	$ 0.25	$ 2.50	
Photo-Copies	60	$ 0.25	$ 15.00	
Deeds	30	$ 0.50	$ 15.00	
			Subtotal	$ 32.50

Travel

Survey Crew Travel Calculations

From:
To:

	Number of Trips	No. of Miles/No. of People	* RATE	Item Subtotal	Item Total Cost
Travel Day Per Diem	14.00 Man-Days	X 4.00 People X	$ 34.50 Per Day	= $ 1,932.00	
Non Travel Day Per Diem	57.00 Man-Days	X 4.00 People X	$ 46.00 Per Day	= $ 10,488.00	
Transportation	71.00 Man-Days	X 50.00 Miles X	$ 0.46 Per Mile	= $ 1,633.00	
Lodging	57.00 Nights	X 4.00 People X	$ 77.00 Per Person	= $ 17,556.00	
				Subtotal	= $ 31,609.00

Office Personnel Travel Calculations

From:
To:

	Number of Trips	No. of Miles/No. of People	* RATE	Item Subtotal	Item Total Cost
Travel Day Per Diem	2.00 Man-Days	X 1.00 People X	$ 34.50 Per Day	= $ 69.00	
Non Travel Day Per Diem	0.00 Man-Days	X 1.00 People X	$ 46.00 Per Day	$ -	
Transportation	1.00 Round Trips	X 130.00 Miles X	$ 0.46 Per Mile	= $ 59.80	
Lodging	1.00 Nights	X 1.00 People X	$ 77.00 Per Person	= $ 77.00	
				Subtotal	$ 205.80

Other Expenses

Item Description	Number / Unit	Unit Price	Item Subtotal	Item Total Cost
	0	$ -	$ -	
	0	$ -	$ -	
	0	$ -	$ -	
	0	$ -	$ -	
	0	$ -	$ -	
	0	$ -	$ -	
	0	$ -	$ -	
			Subtotal	$ -

TOTAL DIRECT EXPENSES	$ 31,847.30

FEE PROPOSAL

ROUTE:	SR-22	Project No.:	43065-1241-04
DESCRIPTION:	from SR-314 to 0.75 Miles South of Old Bridge R	PIN No.:	<100000.00>
COUNTY:	Humphreys		
CONSULTANT:	ABC Engineering		
Prepared By:	IMA Surveyor		
Date Prepared:	4/5/2011		

COMPLETE SURVEY SHEETS FIRST IF SURVEY IS INCLUDED IN THE CONTRACT.
PROCEED WITH FEE PROPOSAL IF SURVEY IS NOT INCLUDED.

This sheet computes percent net fee and performs fee proposal calculations for each phase of the project and total project.
Enter the appropriate overhead rate & fill in shaded boxes that apply for each phase.

Version 2.22

Data For Fee Calculations

Overhead Rate = **1.4500** **

** **(State Project Maximum overhead rate = 1.45)**
** **(Federal Project Maximum overhead rate per External Audit Report)**

Design Direct Labor =	$	-
Survey Direct Labor =	$	45,039.20
Total Direct Labor =	$	45,039.20
Cost for net fee basis =	$	110,346.04 *
Net Fee = (Rounded to Nearest Tenth)		**12.5%** *

NOTE: Net Fee for Supplements shall be the same as the original contract. It may be necessary to modify net fee calculated on supplement requests.

* Net fee is based on cost of contract not including direct cost and net fee as follows:

Survey & Design / Design Only Rates		Survey Only Rates	
$ 0 - $ 100,000 =	13.0%	$ 0 - $ 50,000 =	13.0%
$100000 - $ 500,000 =	12.5%	$ 50,000 - $ 200,000 =	12.5%
> $ 500,000 =	12.0%	> $200,000 =	12.0%

(Place X in adjacent box to remove instructions prior to printing.)

SURVEYS

1	Direct Labor	=	$	45,039.20
2	Overhead (Overhead Rate = 1.4500) (Overhead rate X direct labor)	=	$	65,306.84
3	**Subtotal 1 + 2**	=	$	110,346.04
4	Net Fee = 12.5% (Rounded to nearest $10.) (Direct labor X 2.35 X 0.NF)	=	$	13,230.00
5	**Subtotal 3 + 4**	=	$	123,576.04
6	Direct Expense	=	$	31,847.30
7	Premium Labor (Premium Labor is only eligible if the survey crew works greater than a 40 hour work week.)	=	$	-
8	**Total Survey** (Total 5 + 6 + 7)	=	$	155,423.34

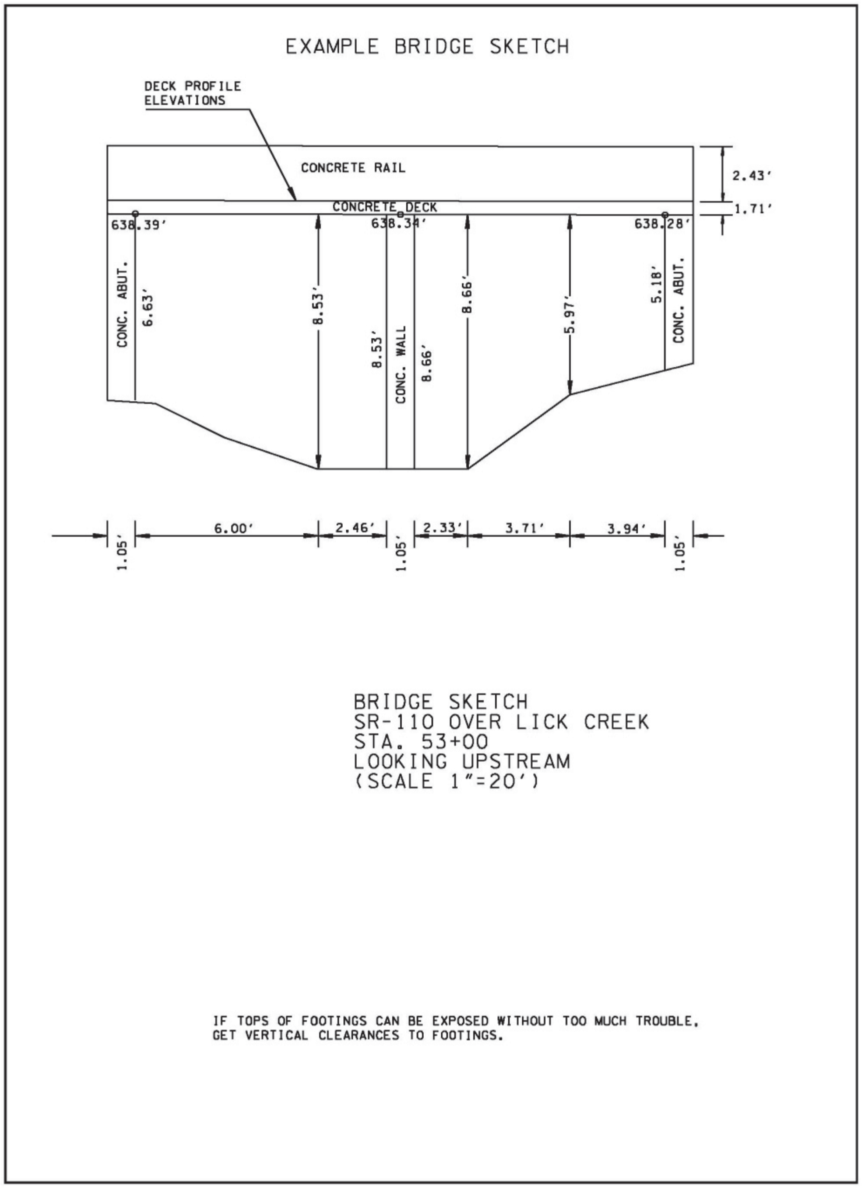


Figure A-20
Example Bridge Sketch

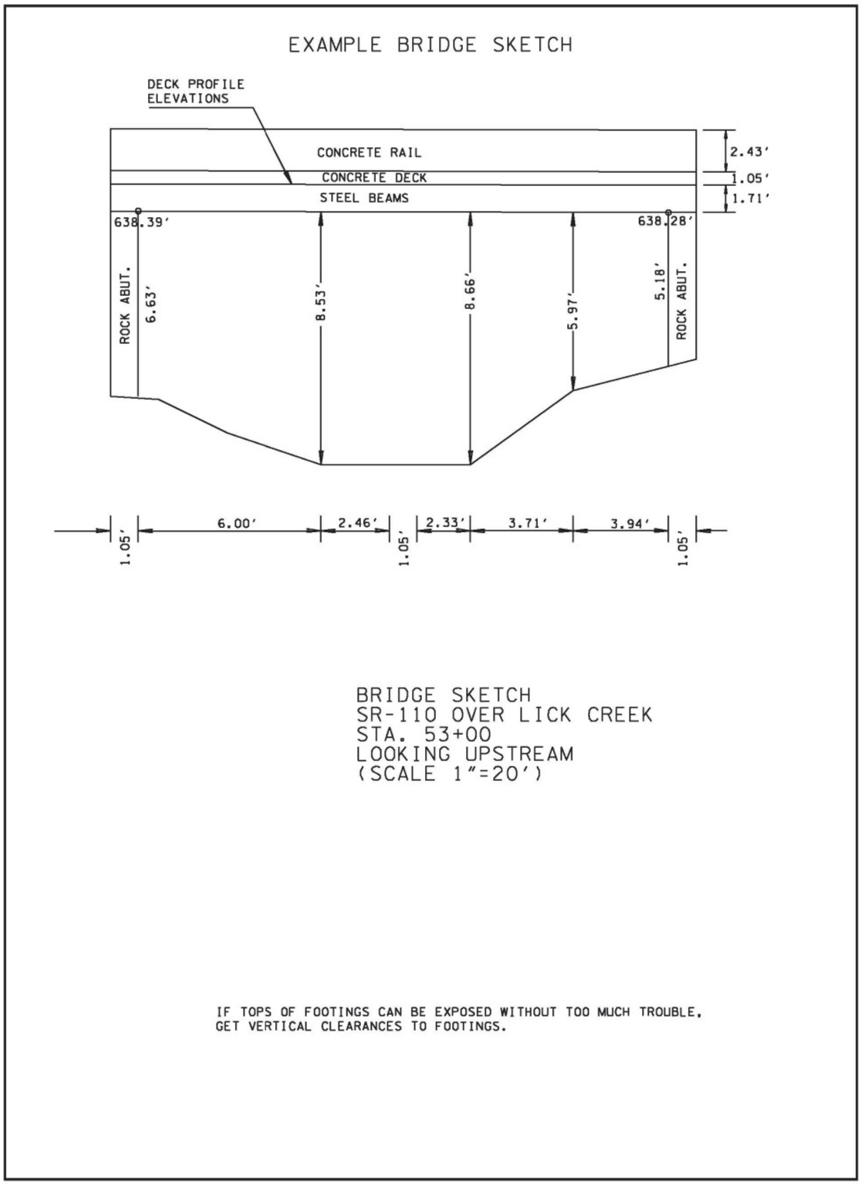


Figure A-21
Example Bridge Sketch

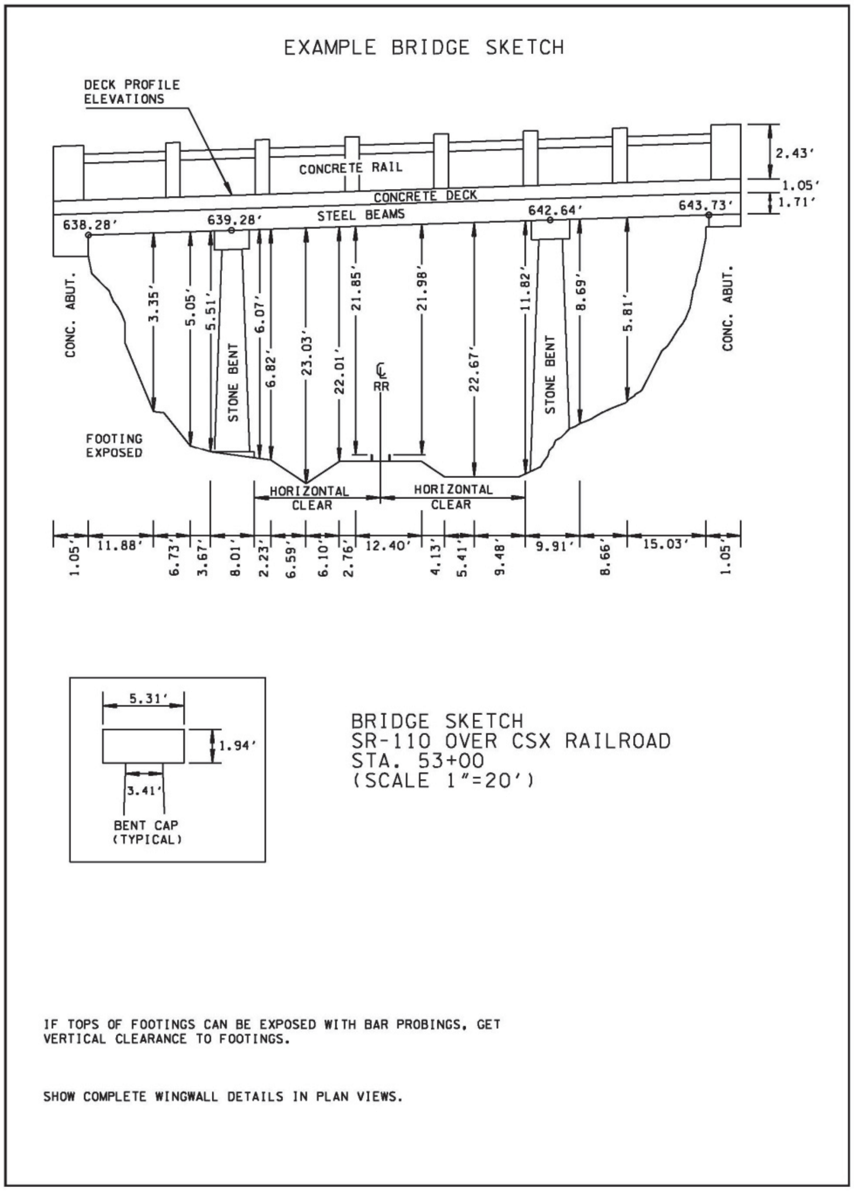


Figure A-22
Example Bridge Sketch

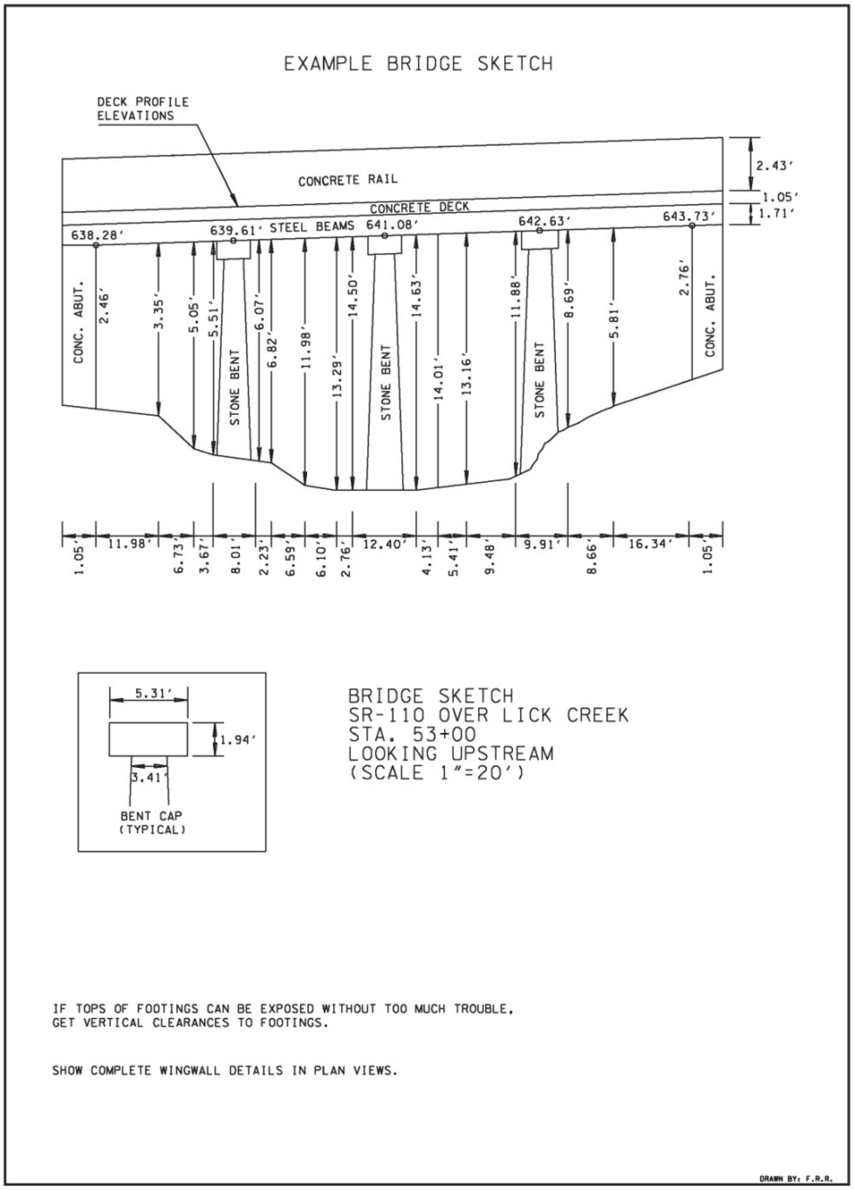


Figure A-23
Example Bridge Sketch

Tennessee Department of Transportation
Geodetic Survey Section

Project Name: ____________ Point Name: ______________Operator: _____________

Date: ____________________ County: _____________________

Project Description (Include Termini): ____

Setup Type: (Circle one): 5" data 15" data stop-go rover stop-go base

Receiver SN: _____________ Controller SN: _____________ Card No: _______________

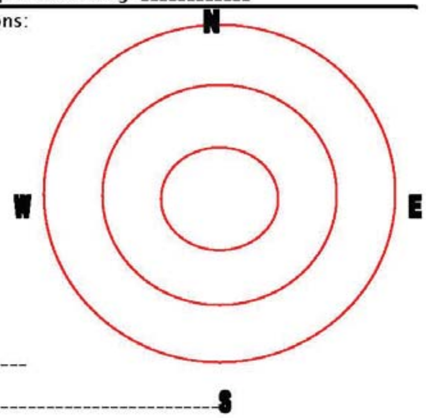
Antenna Offset = 0.441 m
Scale H.I. Reading = _____ m
Total Height = -____ m

Time Started Measuring: _____________

Time Stopped Measuring: ____________

Checklist:
Are tripod legs firm? ____
Is receiver head high? ____
Is Antenna oriented North? ____
Have you pressed measure? ____

Obstructions:



Comments: (Gdop, Errors, Etc.)

____
____
____
____
____
____
____
____
____

ALT KEYS

Alt-A = Audio Alarm on/off	Alt M = Message history	Alt L = Locks Keyboard
Alt B = Battery Status	Alt R = Help for alt keys	Alt U = Unlocks Keyboard
Alt I = Illumination on/off	Alt + = Increase contrast	Alt W = Warnings help
Alt K = Keyboard on/off	Alt - = Reduce contrast	

Figure A-24
Site Log

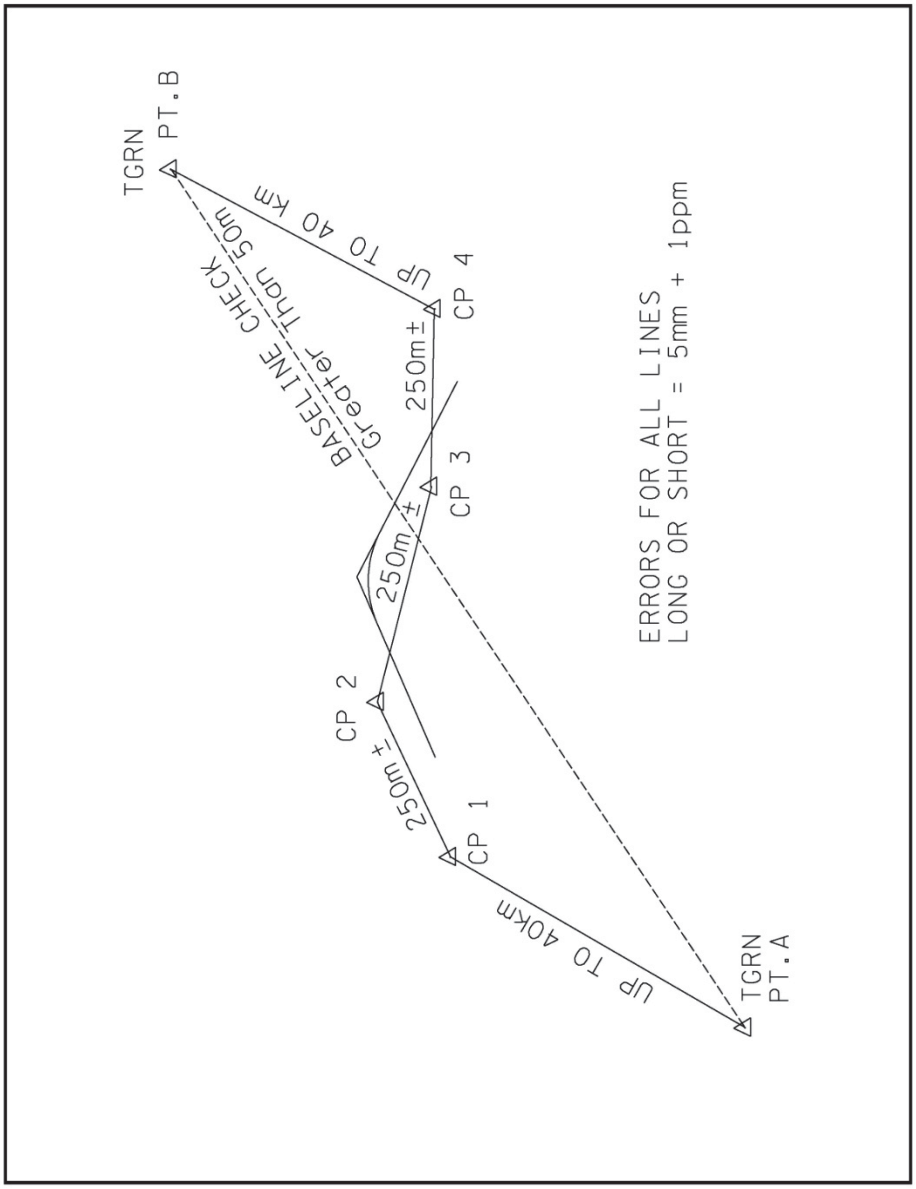


Figure A-25
Example of Traverse Method

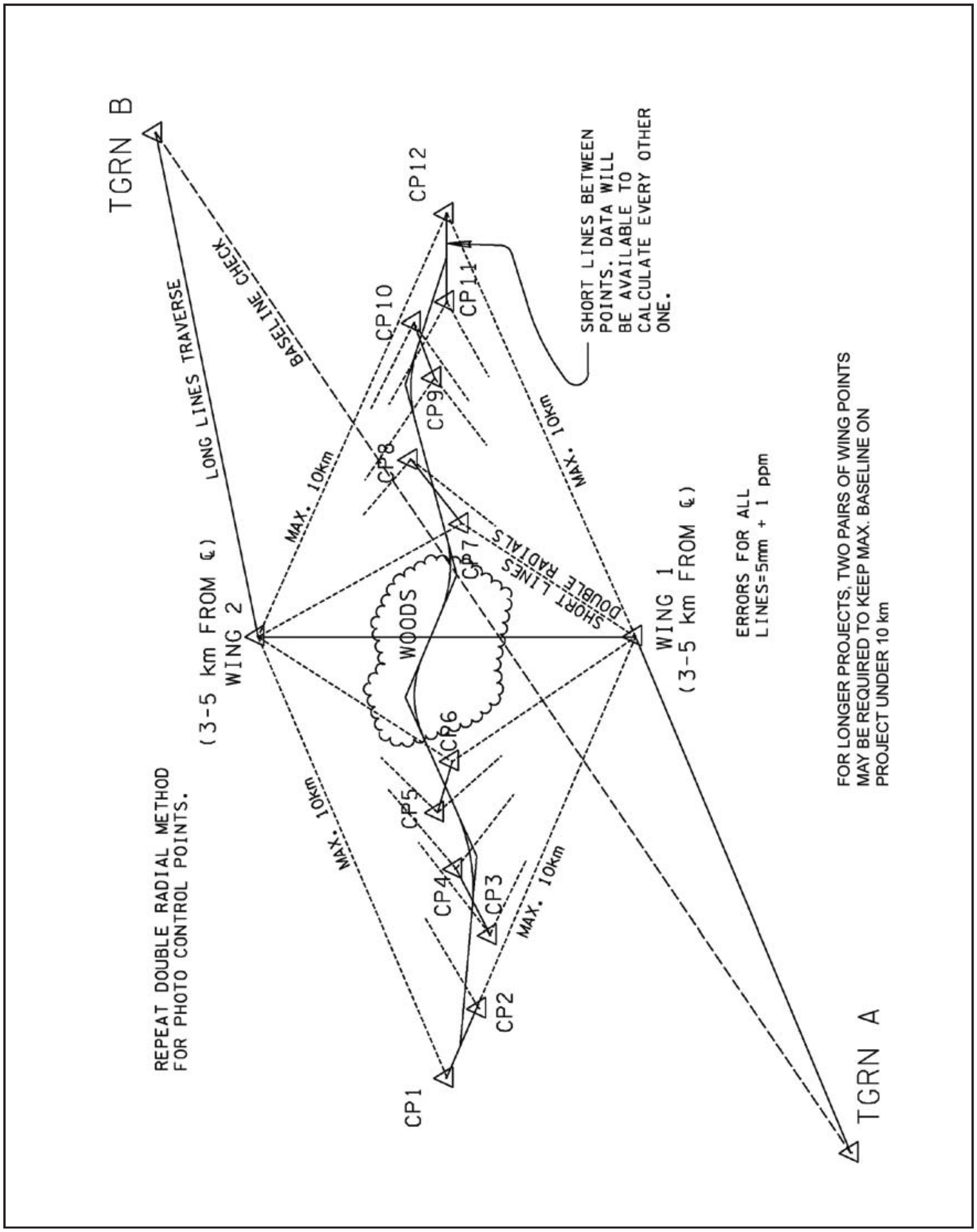


Figure A-26
Example of Wing Point Method

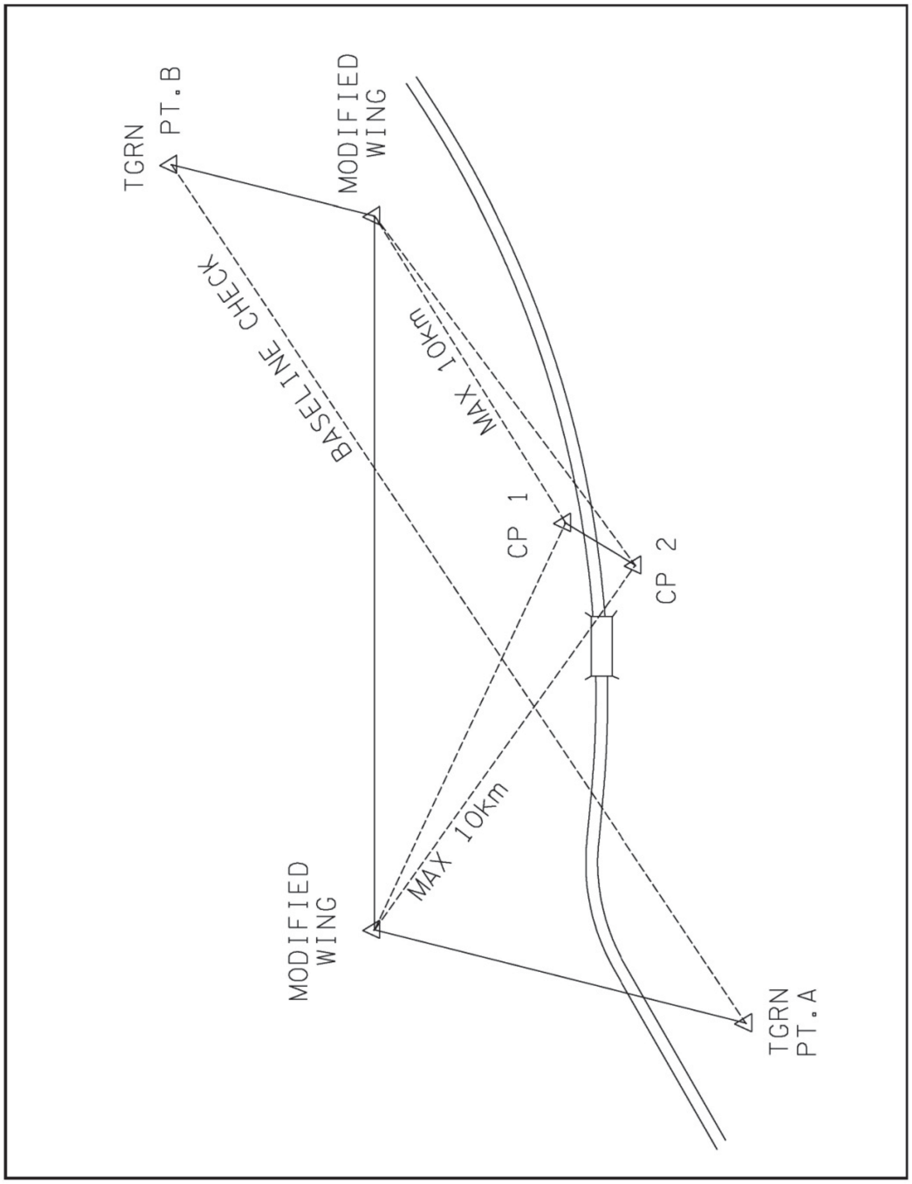


Figure A-27
Example of Modified Wing Point Method

COUNTY CODES			
REGION 1	REGION 2	REGION 3	REGION 4
ANDERSON – AN	BLEDSOE – BS	BEDFORD – BD	BENTON – BN
BLOUNT - BT	BRADLEY – BR	CHEATHAM – CT	CARROLL – CA
CAMPBELL - CM	CANNON - CN	DAVIDSON - DV	CHESTER - CH
CARTER - CR	CLAY - CL	DICKSON - DS	CROCKETT - CK
CLAIBORNE - CB	COFFEE - CF	GILES - GI	DECATUR - DE
COCKE - CO	CUMBERLAND -CU	HICKMAN - HI	DYER - DY
GRAINGER - GG	DEKALB – DK	HOUSTON – HO	FAYETTE – FA
GREENE - GR	FENTRESS - FE	HUMPHREYS - HU	GIBSON - GB
HAMBLEN - HB	FRANKLIN - FR	LAWRENCE - LW	HARDEMAN - HM
HANCOCKE - HC	GRUNDY - GD	LEWIS - LE	HARDIN - HD
HAWKINS - HK	HAMILTON - HT	LINCOLN - LI	HAYWOOD - HW
JEFFERSON - JF	JACKSON - JK	MACON - MC	HENDERSON - HS
JOHNSON - JN	McMINN - MM	MARSHALL - MS	HENRY – HY
KNOX - KN	MARION - MA	MAURY - MU	LAKE - LK
LOUDON - LO	MEIGS - ME	MONTGOMERY - MT	LAUDERDALE - LD
MONROE - MR	OVERTON - OV	MOORE - MO	McNAIRY - MN
MORGAN – MG	PICKETT - PI	PERRY - PE	MADISON - MD
ROANE - RO	POLK - PO	ROBERTSON - RB	OBION - OB
SCOTT - SC	PUTNAM – PU	RUTHERFORD – RF	SHELBY - SH
SEVIER - SE	RHEA – RH	SMITH - SM	TIPTON - TI
SULLIVAN – SL	SEQUATCHIE - SQ	STEWART - ST	WEAKLEY - WE
UNICOI - UC	VAN BUREN - VB	SUMNER - SU	
UNION – UN	WARREN – WR	TROUSDALE – TR	
WASHINGTON - WS	WHITE - WH	WAYNE - WA	
		WILLIAMSON - WM	
		WILSON – WI	

Table A-6
County Codes

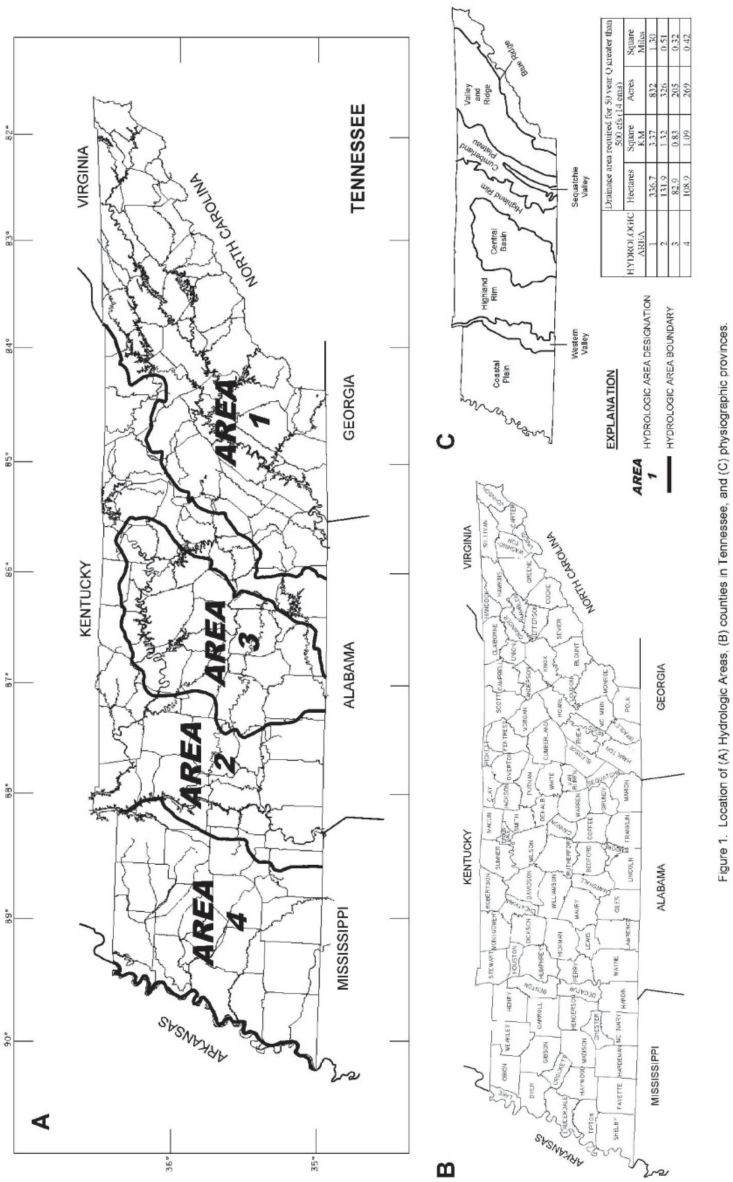


Figure 1. Location of (A) Hydrologic Areas, (B) counties in Tennessee, and (C) physiographic provinces.

Figure A-28
Hydrologic Areas

FIELD - SURVEY CHECKLIST

PROJECT NO.:	
COUNTY:	
ROUTE NO.:	
DESCRIPTION:	
SURVEY CHECKLIST SHALL BE COMPLETED BY TDOT REGIONAL SURVEY OFFICE AND PLACED IN THE PROJECT FOLDER	

GENERAL:
Note: When locating features, MOST of them will require a comment. Examples are:

Buildings: type & description	**1-S-F RES, 2-S-B BILL'S PIZZA**
Poles: utility lines on the poles	**P/T/C**
Streams, lakes, etc.: names	**LITTLE GOOSE CREEK, REELFOOT LAKE**
Pipes: size & type	**24" RCP, 30" CMP**
Roads: name & type of surface	**MAIN STREET (ASP.)**

____ Property owners contacted & contact forms filled out
____ Railroad right-of-entry obtained

CONTROL

____ Additional, main control points set & located. Traverse closures as needed.
____ Bench marks set and located (if applicable)

PROPERTY

____ Property corners (front, side, and back) located
____ Present R.O.W. monuments or other R.O.W. evidence located

TOPO

____ Comments added to all possible points
____ (no aerial) Topo located
____ (w/aerial) Topo that is not on the aerial survey located
____ (w/aerial) Label aerial survey topo on a paper plot
____ Septic tanks & field lines located
____ Wells located
____ Fuel tanks located and get size, owner ID #, and facility # of them
____ Historical features located
____ Environmental features located
____ Log mile posts located on state routes and interstates. Comment example: LM-8

DTM

____ (no aerial) DTM within the project length & width.
____ (w/aerial) DTM: obscure areas filled in, within the project width.
____ (w/aerial) DTM: densify around drainage structures and in ditches.
____ (w/aerial) DTM & Locate all pavement ties on mainline and sideroads (crown, edges of pavement, shoulders, ditches).

FIELD - SURVEY CHECKLIST

BRIDGE SURVEYS

____ Locate the existing bridge and wingwalls.
Comment example: 3-SPAN CONC. & STEEL BRIDGE.
____ Obtain ordinary water and high water elevations.
The very bottom flow-line of the stream, top of water, and top of bank located.
____ The length up and down stream is approx. 6 times the typical distance between top of banks.
Upstream and downstream flood plain sections, taken to above the high water elevation, perpendicular to the stream flow.
____ The location is approximately 4 times the typical distance between top of banks
____ Bridge sketch (put in a separate data collector file).
____ Existing roads located and DTM taken to above the high water elevation.
____ Locate a center line (feature code DECK) on bridge decks (abutment to abutment)

UTILITIES

____ All Poles located. Comment example: P/T/C
____ Water lines, valves, and meters located.
____ Gas lines, valves, and meters located.
____ UG Telephone lines and pedistals located.
____ UG Fiber Optic lines and pedistals located.
____ UG Cable and pedistals located.
____ UG Electric lines and junction boxes located.
____ Manholes located.
____ TVA towers located (get tower numbers).
____ Signal heads & span wires located
____ Traffic control devices located.
____ Low Wire crossings (locate the lines pole-to-pole).
____ Low Wire crossing point located (list numbers of each type of wire and temperature).
____ Sanitary Sewer lines and Manholes (top, bottom, inverts) located.

DRAINAGE

____ Pipes & Box Culverts located (size & type).
____ Storm Sewer lines and catch basins / manholes (top, bottom, inverts) located.
____ Floor elevations of buildings subject to flooding.
____ Wetlands (notify the office if wetlands are possible).
____ Wetlands (locate them after they are flagged).
____ Springs located.
____ Sink holes located.

RAILROADS

____ Tracks, and all features located 600' each way from centerline, within the RR Row.
____ Locate any evidence of railroad ROW.
____ For at grade crossings, DTM 200' each way from centerline, within the RR ROW width.
For grade separation crossing, DTM width is the same as the roadway's.
____ Distance to nearest mile post, and get the mile number.

FIELD - SURVEY CHECKLIST

COMMENTS:	

SIGNATURE OF PARTY LEADER

SIGNATURE OF FIELD SUPERVISOR

3

OFFICE - SURVEY CHECKLIST

PROJECT NO.:	
COUNTY:	
ROUTE NO.:	
DESCRIPTION:	
SURVEY CHECKLIST SHALL BE COMPLETED BY TDOT REGIONAL SURVEY OFFICE AND PLACED IN THE PROJECT FOLDER	

PRELIMINARY

____ Get copies of tax maps, owners' names & addresses & phone numbers.
____ Get copies of deeds and plats.
____ Property owner contact letters written and mailed.
____ Railroad right-of-entry obtained.
____ Get quad maps.
____ Get old railroad ROW plans, if required.
____ Get copies of old highway plans.
____ Utility companies contacted for marking.

PLANIMETRIC

GENERAL:
____ Mainline survey length (also starting and ending points) correct.
____ Sideroads' survey length (also starting and ending points) correct.
____ Project description.
____ Drawing scale.
____ North arrow, placed near the planimetrics area.
____ Ties to prior surveys.
____ Plot all field data.

CONTROL:
____ Reference Datum noted (Horizontal & Vertical).
____ Control points table (Point #, North, East, Elevation, Station, Offset).
____ Survey tied at the beginning to existing log mile marker (if available).

TOPO:
____ All topography located and labeled.
____ Septic tanks & field lines shown, or location noted, on tracts not served by a sanitary sewer.
____ Underground fuel tanks (size, owner ID #, facility #).
____ Historical features.
____ Environmental features.
____ Ground cover labeled.
____ Wells shown, or water source noted, on tracts not served by a public water utility company. List the name & address of driller, date drilled, depth, property owner at the time of drilling.

OFFICE - SURVEY CHECKLIST

CENTERLINES:

____ Alignment and Base Chains named descriptively, such as a road or stream name.
____ Stationing on the mainline is in the direction of increasing log mile. If no log mile is available, stationing is south-to-north and west-to-east.
____ Stationing on sideroads left-to-right looking forward on the mainline, except for Interstates or State Routes, which are stationed by their log mile direction.
____ Bearings on curve tangents agree with bearings on adjoining centerline tangent sections.
____ Centerlines shown.
____ Curve tangents, PI symbol, point circles.
____ Station tics shown correctly.
____ Full tics at 500' stations.
____ Even 5 stations shown in figures.
____ Bearings.
____ Complete curve data.
____ Side roads' centerline intersection station equations.
____ Coordinates for all centerline PI's.
____ Coordinates for all centerline begin & end points.

PROPERTY:

____ Property lines.
____ Each tract shown in its entirety (where scale will allow).
____ Property lines' metes & bounds.
____ If a centerline crosses a property line or curve, show station of intersection and divide the property line or curve, and metes & bounds, in two.
____ Property owners' names.
____ Property tracts numbered.
____ Use separate tract #'s if property is disconnected.
____ Tracts numbered consecutively from the beginning of the project, crisscrossing the centerline as necessary.
____ Property overlaps and unclaimed property noted.
____ City, County, & State boundary lines.
____ All access to properties.

PRESENT ROW AND EASEMENTS:

____ Present ROW shown.
____ Present ROW labeled as such, along mainline and along sideroads.
____ Present ROW metes & bounds.
____ If a centerline crosses a present ROW line or curve, show station of intersection and divide the ROW line or curve, and metes & bounds, in two.
____ Present easements shown.
____ Station/offset flags on present ROW (end & bend pts, curve points, property intersections).

2

OFFICE - SURVEY CHECKLIST

UTILITIES:

- ____ All utilities shown (sizes & types).
- ____ Utility owners' list (names, addresses, contact person, and phone).
- ____ Limits of service shown when 2 utility owners supply the same service.
- ____ Utility easements.
- ____ Easements shown for any utility line outside the present R.O.W.
- ____ Elevations (top) of manholes, plus bottom and inverts for sanitary sewer manholes.
- ____ TVA towers & tower numbers.
- ____ Signal heads.
- ____ Major utilities shown (sizes & types).

DRAINAGE:

- ____ Boundary lines shown completely for each area.
- ____ Drainage information blocks filled in for every area.
- ____ Copy of quad map used to mark boundary lines.
- ____ Size, type, & length of existing drainage structures.
- ____ Elevations (top, bottom, inverts) of catch basins and manholes.
- ____ Elevations (inverts) of pipes & boxes.
- ____ Floor elevations of buildings subject to flooding.
- ____ Wetlands (with areas).

RAILROAD SURVEYS

- ____ RR centerline geometry (labeled the same as a road centerline).
- ____ All railroad topography within RR ROW for 600' each direction
- ____ RR centerline intersection station equations.
- ____ Distance to nearest mile marker, and the milepost number.
- ____ Profile of tops of each rail of railroad crossing.
- ____ Add the railroad company to the utility owners' list.

BRIDGE SURVEYS

- ____ Stream baseline & flood plain section lines shown and labeled (like horizontal alignments).
- ____ Profile flood plain sections (plans scale) (show type vegetation and high water).
- ____ Profile of centerlines of existing roads, completely through the floodplain (show highwater).
- ____ Profile of stream bed, top-of-water, top-of-bank, (plans scale).
- ____ Sketch of existing bridge opening. (scale: 1"=10' or 1"=20')
- ____ Stream data block filled in.

3

OFFICE - SURVEY CHECKLIST

DIGITAL TERRAIN MODEL AND TIN

____ Mainline DTM length and width (also starting and ending points) correct.
____ Sideroads' DTM length and width (also starting and ending points) correct.
____ Non-ground-surface points and points off project limits removed from DTM.
____ Break line crossings resolved.
____ Obscure areas within limits of project filled in.
____ Check for elevation errors (by contouring or rendering).
____ (w/aerial) DTM: densify around drainage structures and in ditches where needed
____ (w/aerial) DTM & Locate all pavement ties on mainline and sideroads (crown, edges of pavement, shoulders, & ditches).

PROFILE

GENERAL:

____ Each separate profile labeled with the road name.
____ Stations & Elevations to proper scale.
____ Groundline profiles have "grn" in their names.

CENTERLINES:

____ All centerline ground line profiles plotted.
____ Bridge deck profile (when applicable).
____ Centerline intersection station equations.
____ Stations & elevations of each railroad rail crossing.
____ Bench marks.
____ Underground utilities profiles (parallel to centerline).
____ Underground utilities (crossing the centerline).
____ Low wires (station, elevation, type) shown (add temperature for high-tension lines).
____ Existing drainage structures that cross a centerline (bridges, pipes, box culverts) (show size, type, station, invert, direction of flow).
____ Storm & sanitary sewers profiles (parallel to centerline).
____ Storm & sanitary sewers (crossing the centerline).
____ High water & normal water elevations at stream crossings.

ROW ACQUISITION TABLE

____ Tract numbers agree with planimetrics.
____ Owners' names correct as taken from the deed.
____ All columns filled out properly.

FINALIZE

____ All features match TDOT features.
____ Text and other drafting element overlaps resolved
____ Text, lines, and symbols rotated to the mainline alignment.
____ Check each individual Microstation level for correct color, weight, linestyle & element type.
____ Detach all files that are not turned in with the survey.

OFFICE - SURVEY CHECKLIST

COMMENTS:	

SIGNATURE OF FIELD SUPERVISOR

SIGNATURE OF REGIONAL SUPERVISOR

5