

QB
275
.U35
no. 259
1952

U. S. Department of Commerce

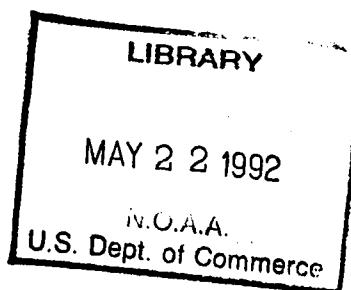
Charles Sawyer, Secretary

Coast and Geodetic Survey

Robert F. A. Studds, Director

Special Publication No. 259

**PLANE COORDINATE PROJECTION TABLES
INDIANA**



UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1952

National Oceanic and Atmospheric Administration

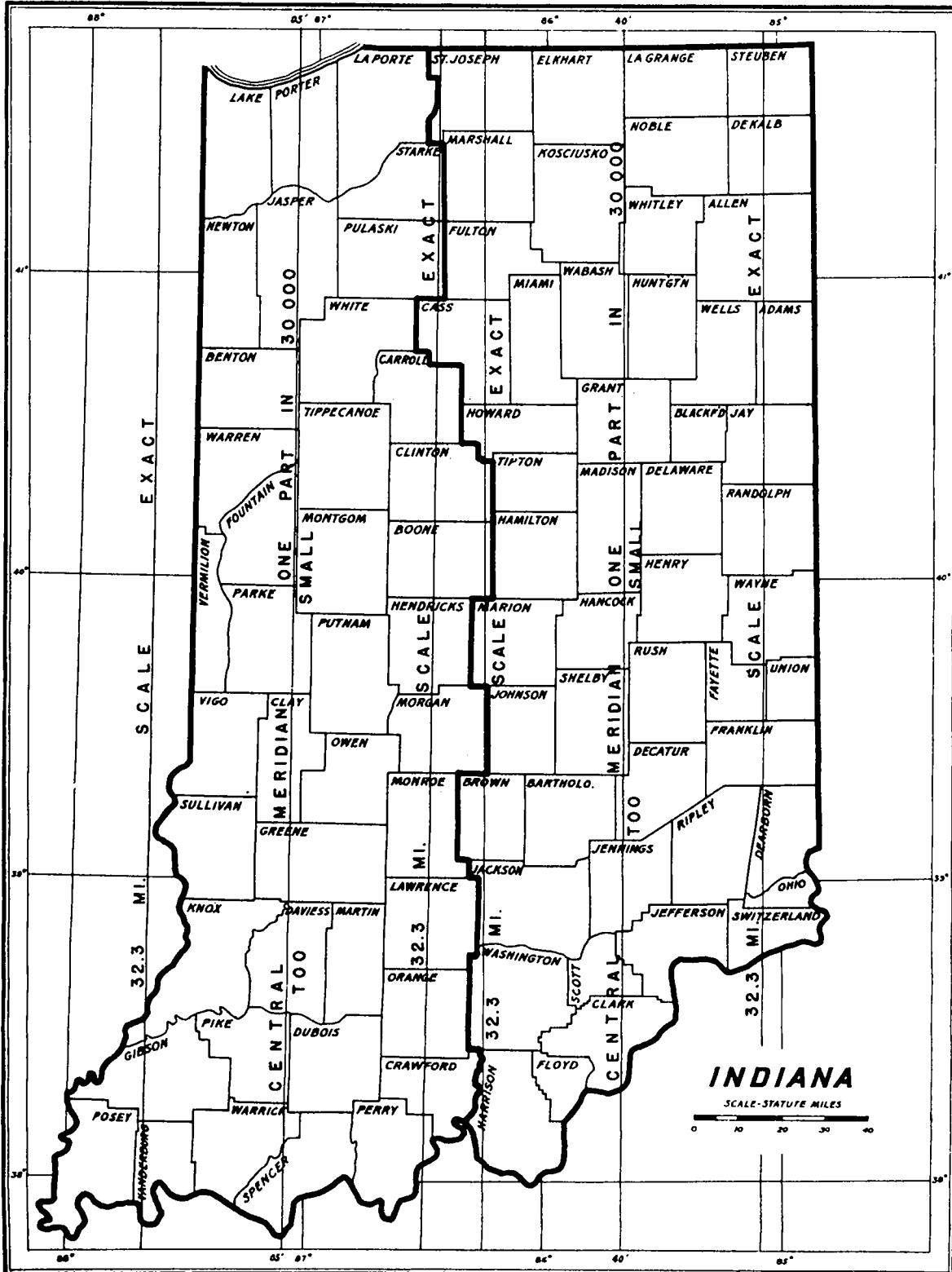
ERRATA NOTICE

One or more conditions of the original document may affect the quality of the image, such as:

Discolored pages
Faded or light ink
Binding intrudes into the text

This has been a co-operative project between the NOAA Central Library and the Climate Database Modernization Program, National Climate Data Center (NCDC). To view the original document, please contact the NOAA Central Library in Silver Spring, MD at (301) 713-2607 x124 or www.reference@nodc.noaa.gov.

LASON
Imaging Contractor
12200 Kiln Court
Beltsville, MD 20704-1387
January 1, 2006



Foreword

The plane coordinate system used in this State is based on the transverse Mercator projection using a reduced scale for the central meridian of the zone. The tables in this publication are to be used for the conversion of geographic positions to plane coordinates or plane coordinates to geographic positions. The constants of the projection are listed with the tables.

The methods of computation have been designed for machine calculation. All of the functions that are required are given in this publication.

The formulas and sample computations which follow show the general methods for computing either type of coordinates.

Plane coordinates from geographic positions

$$x = x' + 500,000$$

$$x' = H \cdot \Delta\lambda'' \pm a b$$

$$y = y_0 + v \left(\frac{\Delta\lambda''}{100} \right)^2 \pm c$$

Grid azimuth = geodetic azimuth - $\Delta\alpha$ - second term

$$\Delta\alpha'' = \Delta\lambda'' \sin \phi + g$$

where

y_0 , H , V , and a are based on the latitude
of the geographic position,

and

b , c , and g are based on $\Delta\lambda''$.

$$\Delta\lambda'' = \text{Central Meridian} - \lambda$$

and

$\Delta\alpha''$ is the convergence of the meridian at the station with respect to the Central Meridian.

The second term for the reduction of geodetic to grid azimuths may be neglected for most work. However, for lines five miles or more in length if the same degree of accuracy is desired as is obtained by geographic computations, this term should be evaluated and used.

$$\text{Second term} = \frac{(y_2 - y_1) (2x'_1 + x'_2)}{(6\rho_o^2 \sin l'') g}$$

Geographic positions from plane coordinates

$$P(x'/10,000)^2 + d = v(\Delta\lambda''/100)^2 + c$$

$$y_o = y - P(x'/10,000)^2 - d$$

Obtain the latitude from the table of y_o .

Use latitude to obtain H from the table.

$$x' = x - 500,000$$

$$\text{approximate } \Delta\lambda'' = x' \div H.$$

Determine a from latitude and b from approximate $\Delta\lambda$ then

$$\Delta\lambda'' = (x' + a b) \div H$$

$$\Delta\alpha'' = Mx' - e$$

M is based on the y, and e on the x and y of the plane coordinates.

PLANE COORDINATES ON TRANSVERSE MERCATOR PROJECTION
(Condensed form for calculating-machine computation)

State Indiana Zone West Central meridian $87^{\circ} 05' 00.00''$

Station	<u>Day, 1939</u>	<u>Welborn, 1934</u>			
ϕ	<u>39 41 24.840</u>	<u>37 54 24.755</u>			
λ	<u>86 45 10.717</u>	<u>87 41 44.075</u>			
$\Delta\lambda = \text{Central mer.} - \lambda$	<u>$+0^{\circ} 19' 49.283$</u>	<u>$-0^{\circ} 36' 44.075$</u>			
$\Delta\lambda''$	<u>$+1,189.283$</u>	<u>$-2,204.075$</u>			
$\left(\frac{\Delta\lambda''}{100}\right)^2$	<u>141.439</u>	<u>485.795</u>			
H	<u>78.174 317</u>	<u>80.147 689</u>			
V	<u>1.210 428</u>	<u>1.193 847</u>			
a	<u>-0.692</u>	<u>+2.113</u>	<u>-0.941</u>	<u>+3.296</u>	
$x' = H \cdot \Delta\lambda \pm ab$	<u>$+92,969.92$</u>	<u>$-176,648.42$</u>			
$V \left(\frac{\Delta\lambda''}{100}\right)^2 \pm c$	<u>171.171</u>	<u>579.874</u>			
Tabular y	<u>797,635.91</u>	<u>148,152.80</u>			
x	<u>592,969.92</u>	<u>323,351.58</u>			
y	<u>797,807.08</u>	<u>148,732.67</u>			
$\Delta\alpha''$	<u>$+759.52$</u>	<u>$-1,354.17$</u>			
$\Delta\alpha$	<u>$+0 12 39.5$</u>	<u>$-0 22 34.2$</u>			
Geod. Az. to Az. Mk.	<u>81 53 36.4</u>	<u>335 23 02.6</u>			
Grid Az. to Az. Mk.	<u>81 40 57</u>	<u>335 45 37</u>			

$$x = x' + 500,000$$

$$y = \text{Tab. } y + V \left(\frac{\Delta\lambda''}{100} \right)^2 \pm c$$

$$\Delta\alpha'' = \Delta\lambda'' \sin \phi + g$$

$$\text{Grid Az.} = \text{Geod. Az.} - \Delta\alpha$$

$$H \text{ and } V = \text{Tab. } H \text{ and Tab. } V$$

When ab is $-$, decrease $H \cdot \Delta\lambda$ numerically.
 $+$ increase

g increases $\Delta\lambda'' \cdot \sin \phi$ numerically

6 GEODETIC POSITIONS FROM TRANSVERSE MERCATOR COORDINATES
(CALCULATING MACHINE COMPUTATION)

STATE - ZONE Indiana - West

Station Hall, 1939

X	654,071.70	Y	745,650.47
C	- 500,000.00	$P(\frac{X'}{10,000})^2 + d$	- 467.71
X'	+ 154,071.70	Y_0	745,182.76
P	1.97023	Approx. $\Delta\lambda = X' \div H$	+ 1,967
d	+ 0.02	$\Delta\lambda = (X' + ab) \div H$	+ 1,966.821
H	78.336 515	$\Delta\lambda$	+ 0° 32' 46.821
a b	- 0.711	Central Meridian	87° 05' 00.000
φ	39° 32' 46.419	$\lambda = C.M. - \Delta\lambda$	86° 32' 13.179

Station Harvey, 1934

X	402,398.08	Y	341,828.41
C	- 500,000.00	$P(\frac{X'}{10,000})^2 + d$	- 180.43
X'	- 97,601.92	Y_0	341,647.98
P	1.89391	Approx. $\Delta\lambda = X' \div H$	- 1,227
d	+ 0.01	$\Delta\lambda = (X' + ab) \div H$	- 1,226.675
H	79.567 780	$\Delta\lambda$	- 0° 20' 26.675
a b	- 0.867	Central Meridian	87° 05' 00.000
φ	38° 26' 17.646	$\lambda = C.M. - \Delta\lambda$	87° 25' 26.675

Station

X		Y	
C	-	$P(\frac{X'}{10,000})^2 + d$	-
X'		Y_0	"
P		Approx. $\Delta\lambda = X' \div H$	"
d		$\Delta\lambda = (X' + ab) \div H$	"
H		$\Delta\lambda$	° ′ ″
a b	.	Central Meridian	° ′ ″
φ	"	$\lambda = C.M. - \Delta\lambda$	° ′ ″

Station

X		Y	
C	-	$P(\frac{X'}{10,000})^2 + d$	-
X'		Y_0	"
P		Approx. $\Delta\lambda = X' \div H$	"
d		$\Delta\lambda = (X' + ab) \div H$	"
H		$\Delta\lambda$	° ′ ″
a b		Central Meridian	° ′ ″
φ	"	$\lambda = C.M. - \Delta\lambda$	° ′ ″

When ab is $\frac{+}{-}$, decrease X' numerically
 $\frac{-}{+}$, increase

Constants for Indiana

Constant	Zone	
	East	West
Central Meridian	85° 40' 00":000	87° 05' 00":000
log R	-144.8	-144.8
Scale reduction (Central Meridian)	1 : 30,000	1 : 30,000
$\log\left(\frac{1}{6\rho_0^2}\right)g$	4.581 0462 -20	4.581 0462 -20
$\log\left(\frac{1}{6\rho_0^2 \sin 1"}\right)g$	9.895 4713 -20	9.895 4713 -20
$\left(\frac{1}{6\rho_0^2 \sin 1"}\right)g$	0.7861×10^{-10}	0.7861×10^{-10}

8

TRANSVERSE MERCATOR PROJECTION
INDIANA
BOTH ZONES

Lat.	y. feet	Δy . per second	H	ΔH per second	V	ΔV per second	a
37 30	0 00	101.141 67	80.587 069	298.63	1.189 415	3.10	-1.000
37 31	6 068.50	101.142 00	80.569 151	298.75	1.189 601	3.10	-.998
37 32	12 137.02	101.142 33	80.551 226	298.87	1.189 787	3.10	-.995
37 33	18 205.56	101.142 67	80.533 294	298.97	1.189 973	3.08	-.993
37 34	24 274.12	101.143 03	80.515 356	299.08	1.190 158	3.08	-.990
37 35	30 342.69	101.143 17	80.497 411	299.22	1.190 343	3.07	-.988
37 36	36 411.28	101.143 33	80.479 458	299.32	1.190 527	3.07	-.986
37 37	42 479.88	101.143 83	80.461 499	299.43	1.190 711	3.05	-.983
37 38	48 548.51	101.144 00	80.443 533	299.53	1.190 894	3.05	-.981
37 39	54 617.15	101.144 33	80.425 561	299.67	1.191 077	3.05	-.978
37 40	60 685.81	101.144 67	80.407 581	299.78	1.191 260	3.03	-.976
37 41	66 754.49	101.144 83	80.389 594	299.88	1.191 442	3.03	-.974
37 42	72 823.18	101.145 17	80.371 601	300.00	1.191 624	3.08	-.971
37 43	78 891.89	101.145 50	80.353 601	300.12	1.191 805	3.02	-.969
37 44	84 960.62	101.145 67	80.335 594	300.23	1.191 986	3.02	-.966
37 45	91 029.36	101.146 17	80.317 580	300.33	1.192 167	3.00	-.964
37 46	97 098.13	101.146 33	80.299 560	300.47	1.192 347	3.00	-.962
37 47	103 166.91	101.146 67	80.281 532	300.57	1.192 527	2.98	-.959
37 48	109 235.71	101.146 83	80.263 498	300.68	1.192 706	2.98	-.957
37 49	115 304.52	101.147 17	80.245 457	300.80	1.192 885	2.98	-.954
37 50	121 373.35	101.147 50	80.227 409	300.92	1.193 064	2.97	-.952
37 51	127 442.20	101.147 83	80.209 354	301.03	1.193 242	2.97	-.950
37 52	133 511.07	101.148 17	80.191 292	301.13	1.193 420	2.95	-.947
37 53	139 579.96	101.148 33	80.173 224	301.25	1.193 597	2.95	-.945
37 54	145 648.86	101.148 67	80.155 149	301.37	1.193 774	2.95	-.942
37 55	151 717.78	101.149 00	80.137 067	301.48	1.193 951	2.93	-.940
37 56	157 786.72	101.149 17	80.118 978	301.60	1.194 127	2.93	-.938
37 57	163 855.67	101.149 50	80.100 882	301.70	1.194 303	2.92	-.935
37 58	169 924.64	101.149 83	80.082 780	301.82	1.194 478	2.92	-.933
37 59	175 993.63	101.150 17	80.064 671	301.93	1.194 653	2.92	-.930
38 00	182 062.64		80.046 555		1.194 828		-.926

TRANSVERSE MERCATOR PROJECTION
INDIANA
BOTH ZONES

Lat.	y _o feet	Δy _o per second	H	ΔH per second	V	ΔV per second	a
38 00	182 062.64	101.150 50	80.046 555	302.05	1.194 828	2.90	-.928
38 01	188 131.67	101.150 67	80.028 432	302.15	1.195 002	2.90	-.926
38 02	194 200.71	101.151 00	80.010 303	302.28	1.195 176	2.88	-.923
38 03	200 269.77	101.151 17	79.992 166	302.38	1.195 349	2.88	-.921
38 04	206 338.84	101.151 67	79.974 023	302.48	1.195 582	2.88	-.919
38 05	212 407.94	101.151 83	79.955 874	302.62	1.195 695	2.87	-.917
38 06	218 477.05	101.152 17	79.937 717	302.72	1.195 867	2.87	-.914
38 07	224 546.18	101.152 50	79.919 554	302.83	1.196 039	2.85	-.912
38 08	230 615.33	101.152 67	79.901 384	302.95	1.196 210	2.85	-.910
38 09	236 684.49	101.153 00	79.883 207	303.07	1.196 381	2.85	-.907
38 10	242 753.67	101.153 33	79.865 023	303.17	1.196 552	2.83	-.905
38 11	248 822.87	101.153 67	79.846 833	303.28	1.196 722	2.83	-.903
38 12	254 892.09	101.153 83	79.828 636	303.40	1.196 892	2.82	-.900
38 13	260 961.32	101.154 17	79.810 432	303.52	1.197 061	2.82	-.898
38 14	267 030.57	101.154 50	79.792 221	303.63	1.197 230	2.80	-.896
38 15	273 099.84	101.154 83	79.774 003	303.73	1.197 398	2.80	-.894
38 16	279 169.13	101.155 00	79.755 779	303.85	1.197 566	2.80	-.891
38 17	285 238.43	101.155 33	79.737 548	303.97	1.197 734	2.80	-.889
38 18	291 307.75	101.155 67	79.719 310	304.08	1.197 902	2.77	-.887
38 19	297 377.09	101.156 00	79.701 065	304.18	1.198 068	2.78	-.884
38 20	303 446.45	101.156 17	79.682 814	304.30	1.198 235	2.77	-.882
38 21	309 515.82	101.156 50	79.664 556	304.43	1.198 401	2.77	-.880
38 22	315 585.21	101.156 83	79.646 290	304.52	1.198 567	2.75	-.877
38 23	321 654.62	101.157 17	79.628 019	304.65	1.198 732	2.75	-.875
38 24	327 724.05	101.157 33	79.609 740	304.75	1.198 897	2.75	-.872
38 25	333 793.49	101.157 67	79.591 455	304.88	1.199 062	2.73	-.870
38 26	339 862.95	101.158 00	79.573 162	304.98	1.199 226	2.72	-.868
38 27	345 932.43	101.158 33	79.554 863	305.08	1.199 389	2.73	-.865
38 28	352 001.93	101.158 50	79.536 558	305.22	1.199 553	2.72	-.863
38 29	358 071.44	101.158 83	79.518 245	305.32	1.199 716	2.70	-.860
38 30	364 140.97	101.159 17	79.499 926	305.43	1.199 878	2.70	-.858
38 31	370 210.52	101.159 50	79.481 600	305.55	1.200 040	2.70	-.856
38 32	376 280.09	101.159 67	79.463 267	305.67	1.200 202	2.68	-.853
38 33	382 349.67	101.160 00	79.444 927	305.77	1.200 363	2.68	-.851
38 34	388 419.27	101.160 33	79.426 581	305.88	1.200 524	2.67	-.848
38 35	394 488.89	101.160 67	79.408 228	306.00	1.200 684	2.67	-.846
38 36	400 558.53	101.160 83	79.389 868	306.10	1.200 844	2.67	-.844
38 37	406 628.18	101.161 17	79.371 502	306.22	1.201 004	2.65	-.841
38 38	412 697.85	101.161 50	79.353 129	306.33	1.201 163	2.65	-.839
38 39	418 767.54	101.161 83	79.334 749	306.45	1.201 322	2.63	-.836
38 40	424 837.25	101.162 17	79.316 362	306.55	1.201 480	2.63	-.834
38 41	430 906.98	101.162 33	79.297 969	306.67	1.201 638	2.62	-.832
38 42	436 976.72	101.162 67	79.279 569	306.78	1.201 795	2.62	-.829
38 43	443 046.48	101.162 83	79.261 162	306.90	1.201 952	2.62	-.827
38 44	449 116.25	101.163 33	79.242 748	307.00	1.202 109	2.60	-.824
38 45	455 186.05	101.163 50	79.224 328	307.12	1.202 265	2.60	-.822
38 46	461 255.86	101.163 83	79.205 901	307.23	1.202 421	2.60	-.820
38 47	467 325.69	101.164 17	79.187 467	307.33	1.202 577	2.58	-.817
38 48	473 395.54	101.164 33	79.169 027	307.45	1.202 732	2.58	-.815
38 49	479 465.40	101.164 67	79.150 580	307.57	1.202 887	2.57	-.812
38 50	485 535.28	101.165 00	79.132 126	307.68	1.203 041	2.57	-.810
38 51	491 605.18	101.165 33	79.113 665	307.78	1.203 195	2.55	-.808
38 52	497 675.10	101.165 50	79.095 198	307.90	1.203 348	2.57	-.805
38 53	503 745.03	101.165 83	79.076 724	308.02	1.203 502	2.55	-.803
38 54	509 814.98	101.166 17	79.058 243	308.13	1.203 654	2.55	-.801
38 55	515 884.95	101.166 50	79.039 755	308.23	1.203 807	2.52	-.799
38 56	521 954.94	101.166 83	79.021 261	308.35	1.203 958	2.53	-.796
38 57	528 024.95	101.167 00	79.002 760	308.47	1.204 110	2.52	-.794
38 58	534 094.97	101.167 33	78.984 252	308.57	1.204 261	2.52	-.792
38 59	540 165.01	101.167 67	78.965 738	308.68	1.204 412	2.50	-.789
39 00	546 235.07		78.947 217		1.204 562		-.787

TRANSVERSE MERCATOR PROJECTION

INDIANA
BOTH ZONES

Lat.	y. feet	Δy. per second	H	ΔH per second	V	ΔV per second	a
39 00	546 235.07	101.167 83	78.947 217	308.80	1.204 562	2.50	.787
39 01	552 305.14	101.168 33	78.928 689	308.90	1.204 712	2.48	.785
39 02	558 375.24	101.168 50	78.910 155	309.02	1.204 861	2.48	.782
39 03	564 445.35	101.168 67	78.891 614	309.13	1.205 010	2.48	.780
39 04	570 515.47	101.169 17	78.873 066	309.23	1.205 159	2.47	.778
39 05	576 585.62	101.169 33	78.854 512	309.35	1.205 307	2.47	.776
39 06	582 655.78	101.169 67	78.835 951	309.47	1.205 455	2.45	.773
39 07	588 725.96	101.170 00	78.817 383	309.58	1.205 602	2.45	.771
39 08	594 796.16	101.170 33	78.798 808	309.68	1.205 749	2.45	.769
39 09	600 866.38	101.170 50	78.780 227	309.80	1.205 896	2.43	.766
39 10	606 936.61	101.170 83	78.761 639	309.92	1.206 042	2.43	.764
39 11	613 006.86	101.171 17	78.743 044	310.02	1.206 188	2.42	.762
39 12	619 077.13	101.171 50	78.724 443	310.13	1.206 333	2.42	.759
39 13	625 147.42	101.171 67	78.705 835	310.25	1.206 478	2.42	.757
39 14	631 217.72	101.172 00	78.687 220	310.37	1.206 623	2.40	.755
39 15	637 288.04	101.172 33	78.668 598	310.47	1.206 767	2.40	.753
39 16	643 358.38	101.172 67	78.649 970	310.58	1.206 911	2.38	.750
39 17	649 428.74	101.173 00	78.631 335	310.68	1.207 054	2.38	.748
39 18	655 499.12	101.173 17	78.612 694	310.80	1.207 197	2.38	.746
39 19	661 569.51	101.173 50	78.594 046	310.92	1.207 340	2.37	.743
39 20	667 639.92	101.173 67	78.575 391	311.02	1.207 482	2.37	.741
39 21	673 710.34	101.174 17	78.556 730	311.13	1.207 624	2.35	.739
39 22	679 780.79	101.174 33	78.538 062	311.25	1.207 765	2.35	.736
39 23	685 851.25	101.174 67	78.519 387	311.37	1.207 906	2.33	.734
39 24	691 921.73	101.175 00	78.500 705	311.47	1.208 046	2.35	.732
39 25	697 992.23	101.175 33	78.482 017	311.57	1.208 187	2.32	.730
39 26	704 062.75	101.175 50	78.463 323	311.70	1.208 326	2.33	.727
39 27	710 133.28	101.175 83	78.444 621	311.80	1.208 466	2.30	.725
39 28	716 203.83	101.176 17	78.425 913	311.92	1.208 604	2.32	.723
39 29	722 274.40	101.176 50	78.407 198	312.02	1.208 743	2.30	.720
39 30	728 344.99	101.176 67	78.388 477	312.13	1.208 881	2.30	.718
39 31	734 415.59	101.177 00	78.369 749	312.25	1.209 019	2.28	.716
39 32	740 486.21	101.177 33	78.351 014	312.35	1.209 156	2.28	.713
39 33	746 556.85	101.177 67	78.332 273	312.47	1.209 293	2.27	.711
39 34	752 627.51	101.177 83	78.313 525	312.58	1.209 439	2.27	.709
39 35	758 698.18	101.178 17	78.294 770	312.70	1.209 565	2.27	.707
39 36	764 768.87	101.178 50	78.276 008	312.80	1.209 701	2.25	.704
39 37	770 839.58	101.178 83	78.257 240	312.92	1.209 836	2.25	.702
39 38	776 910.31	101.179 17	78.238 465	313.02	1.209 971	2.23	.700
39 39	782 981.06	101.179 33	78.219 684	313.13	1.210 105	2.23	.697
39 40	789 051.82	101.179 67	78.200 896	313.25	1.210 239	2.23	.695
39 41	795 122.60	101.180 00	78.182 101	313.37	1.210 373	2.22	.693
39 42	801 193.40	101.180 17	78.163 299	313.47	1.210 506	2.20	.690
39 43	807 264.21	101.180 67	78.144 491	313.57	1.210 638	2.22	.688
39 44	813 335.05	101.180 83	78.125 677	313.70	1.210 771	2.20	.686
39 45	819 405.90	101.181 17	78.106 855	313.80	1.210 903	2.18	.684
39 46	825 476.77	101.181 33	78.088 027	313.90	1.211 034	2.18	.681
39 47	831 547.65	101.181 83	78.069 193	314.03	1.211 165	2.18	.679
39 48	837 618.56	101.182 00	78.050 351	314.13	1.211 296	2.17	.677
39 49	843 689.48	101.182 33	78.031 503	314.23	1.211 426	2.17	.674
39 50	849 760.42	101.182 67	78.012 649	314.35	1.211 556	2.15	.672
39 51	855 831.38	101.182 83	77.993 788	314.47	1.211 685	2.15	.670
39 52	861 902.35	101.183 17	77.974 920	314.57	1.211 814	2.15	.667
39 53	867 973.34	101.183 50	77.956 046	314.68	1.211 943	2.13	.665
39 54	874 044.35	101.183 83	77.937 165	314.78	1.212 071	2.13	.663
39 55	880 115.38	101.184 17	77.918 278	314.92	1.212 199	2.12	.661
39 56	886 186.43	101.184 33	77.899 383	315.00	1.212 326	2.12	.658
39 57	892 257.49	101.184 67	77.880 483	315.13	1.212 453	2.12	.656
39 58	898 328.57	101.185 00	77.861 575	315.22	1.212 580	2.10	.654
39 59	904 399.67	101.185 33	77.842 662	315.35	1.212 706	2.10	.651
40 00	910 470.79		77.823 741		1.212 832		.649

TRANSVERSE MERCATOR PROJECTION

INDIANA
BOTH ZONES

Lat.		y. feet	Δy. per second	H	ΔH per second	V	ΔV per second	a
40 00		910 470.79	101.185 50	77.823 741	315.45	1.212 832	2.08	-.649
40 01		916 541.92	101.185 83	77.804 814	315.57	1.212 957	2.08	-.647
40 02		922 613.07	101.186 17	77.785 880	315.67	1.213 082	2.08	-.644
40 03		928 684.24	101.186 50	77.766 940	315.78	1.213 207	2.07	-.642
40 04		934 755.43	101.186 67	77.747 993	315.88	1.213 331	2.07	-.640
40 05	940	826.63	101.187 17	77.729 040	316.00	1.213 455	2.05	-.638
40 06	946	897.86	101.187 33	77.710 080	316.12	1.213 578	2.05	-.635
40 07	952	969.10	101.187 50	77.691 113	316.22	1.213 701	2.05	-.633
40 08	959	040.35	101.188 00	77.672 140	316.33	1.213 824	2.03	-.631
40 09	965	111.63	101.188 17	77.653 160	316.45	1.213 946	2.03	-.628
40 10	971	182.92	101.188 50	77.634 173	316.55	1.214 068	2.02	-.626
40 11	977	254.23	101.188 83	77.615 180	316.68	1.214 189	2.03	-.624
40 12	983	325.56	101.189 17	77.596 179	316.77	1.214 311	2.00	-.622
40 13	989	396.91	101.189 50	77.577 173	316.88	1.214 431	2.00	-.619
40 14	995	468.28	101.189 67	77.558 160	317.00	1.214 551	2.00	-.617
40 15	1 001	539.66	101.190 00	77.539 140	317.10	1.214 671	2.00	-.615
40 16	1 007	611.06	101.190 33	77.520 114	317.22	1.214 791	1.98	-.613
40 17	1 013	682.48	101.190 50	77.501 081	317.33	1.214 910	1.97	-.611
40 18	1 019	753.91	101.190 83	77.482 041	317.42	1.215 028	1.97	-.608
40 19	1 025	825.36	101.191 17	77.462 996	317.55	1.215 146	1.97	-.606
40 20	1 031	896.83	101.191 50	77.443 943	317.65	1.215 264	1.95	-.604
40 21	1 037	968.32	101.191 83	77.424 884	317.75	1.215 381	1.95	-.602
40 22	1 044	039.83	101.192 17	77.405 819	317.88	1.215 498	1.93	-.600
40 23	1 050	111.36	101.192 33	77.386 746	317.97	1.215 614	1.93	-.597
40 24	1 056	182.90	101.192 67	77.367 668	318.10	1.215 730	1.92	-.595
40 25	1 062	254.46	101.193 00	77.348 582	318.20	1.215 845	1.92	-.593
40 26	1 068	326.04	101.193 17	77.329 490	318.30	1.215 960	1.92	-.591
40 27	1 074	397.63	101.193 50	77.310 392	318.42	1.216 075	1.92	-.589
40 28	1 080	469.24	101.193 83	77.291 287	318.53	1.216 190	1.88	-.586
40 29	1 086	540.87	101.194 17	77.272 175	318.63	1.216 303	1.90	-.584
40 30	1 092	612.52	101.194 50	77.253 057	318.75	1.216 417	1.88	-.582
40 31	1 098	684.19	101.194 67	77.233 932	318.87	1.216 530	1.88	-.580
40 32	1 104	755.87	101.195 00	77.214 800	318.97	1.216 643	1.87	-.578
40 33	1 110	827.57	101.195 33	77.195 662	319.08	1.216 755	1.87	-.575
40 34	1 116	899.29	101.195 67	77.176 517	319.18	1.216 867	1.87	-.573
40 35	1 122	971.03	101.196 00	77.157 366	319.30	1.216 979	1.85	-.571
40 36	1 129	042.79	101.196 17	77.138 208	319.40	1.217 090	1.85	-.569
40 37	1 135	114.56	101.196 50	77.119 044	319.52	1.217 201	1.83	-.567
40 38	1 141	186.35	101.196 83	77.099 873	319.62	1.217 311	1.83	-.564
40 39	1 147	258.16	101.197 00	77.080 696	319.73	1.217 421	1.82	-.562
40 40	1 153	329.98	101.197 50	77.061 512	319.83	1.217 530	1.82	-.560
40 41	1 159	401.83	101.197 67	77.042 322	319.95	1.217 639	1.80	-.558
40 42	1 165	473.69	101.198 00	77.023 125	320.07	1.217 747	1.80	-.556
40 43	1 171	545.57	101.198 33	77.003 921	320.17	1.217 855	1.80	-.553
40 44	1 177	617.47	101.198 50	76.984 711	320.27	1.217 963	1.78	-.551
40 45	1 183	689.38	101.198 83	76.965 495	320.38	1.218 070	1.78	-.549
40 46	1 189	761.31	101.199 17	76.946 272	320.50	1.218 177	1.77	-.547
40 47	1 195	833.26	101.199 50	76.927 042	320.60	1.218 283	1.77	-.545
40 48	1 201	905.23	101.199 83	76.907 806	320.72	1.218 389	1.77	-.542
40 49	1 207	977.22	101.200 00	76.888 563	320.82	1.218 495	1.75	-.540
40 50	1 214	049.22	101.200 50	76.869 314	320.93	1.218 600	1.75	-.538
40 51	1 220	121.25	101.200 67	76.850 058	321.03	1.218 705	1.73	-.536
40 52	1 226	193.29	101.200 83	76.830 796	321.15	1.218 809	1.73	-.534
40 53	1 232	265.34	101.201 33	76.811 527	321.25	1.218 913	1.73	-.531
40 54	1 238	337.42	101.201 50	76.792 252	321.37	1.219 017	1.72	-.529
40 55	1 244	409.51	101.201 83	76.772 970	321.47	1.219 120	1.72	-.527
40 56	1 250	481.62	101.202 17	76.753 682	321.58	1.219 223	1.70	-.525
40 57	1 256	553.75	101.202 50	76.734 387	321.70	1.219 325	1.70	-.523
40 58	1 262	625.90	101.202 67	76.715 085	321.80	1.219 427	1.70	-.520
40 59	1 268	698.06	101.203 00	76.695 777	321.90	1.219 529	1.68	-.518
41 00	1 274	770.24		76.676 463		1.219 630		-.516

TRANSVERSE MERCATOR PROJECTION
INDIANA
BOTH ZONES

Lat.		y _o feet	Δy _o per second	H	ΔH per second	V	ΔV per second	a
41 00	1	274 770.24	101.203 33	76.676 463	322.02	1.219 630	1.68	.516
41 01	1	280 842.44	101.203 67	76.657 142	322.13	1.219 731	1.67	.514
41 02	1	286 914.66	101.204 00	76.637 814	322.23	1.219 831	1.67	.512
41 03	1	292 986.90	101.204 17	76.618 480	322.35	1.219 931	1.65	.509
41 04	1	299 059.15	101.204 50	76.599 139	322.45	1.220 030	1.65	.507
41 05	1	305 131.42	101.204 83	76.579 792	322.55	1.220 129	1.65	.505
41 06	1	311 203.71	101.205 17	76.560 439	322.68	1.220 228	1.63	.503
41 07	1	317 276.02	101.205 33	76.541 078	322.77	1.220 326	1.63	.501
41 08	1	323 348.34	101.205 67	76.521 718	322.88	1.220 424	1.62	.498
41 09	1	329 420.68	101.206 00	76.502 339	323.00	1.220 521	1.62	.496
41 10	1	335 493.04	101.206 33	76.482 959	323.10	1.220 618	1.62	.494
41 11	1	341 565.42	101.206 67	76.463 573	323.22	1.220 715	1.60	.492
41 12	1	347 637.82	101.206 83	76.444 180	323.32	1.220 811	1.58	.490
41 13	1	353 710.23	101.207 17	76.424 781	323.43	1.220 906	1.60	.487
41 14	1	359 782.66	101.207 50	76.405 375	323.53	1.221 002	1.58	.485
41 15	1	365 855.11	101.207 83	76.385 963	323.65	1.221 097	1.57	.483
41 16	1	371 927.58	101.208 17	76.366 544	323.75	1.221 191	1.57	.481
41 17	1	378 000.07	101.208 33	76.347 119	323.85	1.221 285	1.57	.479
41 18	1	384 072.57	101.208 67	76.327 688	323.97	1.221 379	1.55	.476
41 19	1	390 145.09	101.209 00	76.308 250	324.08	1.221 472	1.55	.474
41 20	1	396 217.63	101.209 17	76.288 805	324.18	1.221 565	1.53	.472
41 21	1	402 290.18	101.209 67	76.269 354	324.30	1.221 657	1.53	.470
41 22	1	408 362.76	101.209 83	76.249 896	324.40	1.221 749	1.53	.468
41 23	1	414 435.35	101.210 17	76.230 432	324.52	1.221 841	1.52	.465
41 24	1	420 507.96	101.210 50	76.210 961	324.62	1.221 932	1.52	.463
41 25	1	426 580.59	101.210 67	76.191 484	324.72	1.222 023	1.50	.461
41 26	1	432 653.23	101.211 17	76.172 001	324.83	1.222 113	1.50	.459
41 27	1	438 725.90	101.211 33	76.152 511	324.95	1.222 203	1.48	.457
41 28	1	444 798.58	101.211 67	76.133 014	325.05	1.222 292	1.48	.454
41 29	1	450 871.28	101.212 00	76.113 511	325.15	1.222 381	1.48	.452
41 30	1	456 944.00	101.212 17	76.094 002	325.27	1.222 470	1.47	.450
41 31	1	463 016.73	101.212 50	76.074 486	325.37	1.222 558	1.47	.448
41 32	1	469 089.48	101.212 83	76.054 964	325.48	1.222 646	1.45	.446
41 33	1	475 162.25	101.213 17	76.035 435	325.58	1.222 733	1.45	.443
41 34	1	481 235.04	101.213 50	76.015 900	325.70	1.222 820	1.45	.441
41 35	1	487 307.85	101.213 67	75.996 358	325.80	1.222 907	1.43	.439
41 36	1	493 380.67	101.214 00	75.976 810	325.90	1.222 993	1.43	.437
41 37	1	499 453.51	101.214 33	75.957 256	326.02	1.223 079	1.42	.435
41 38	1	505 526.37	101.214 67	75.937 695	326.13	1.223 164	1.42	.432
41 39	1	511 599.25	101.215 00	75.918 127	326.23	1.223 249	1.42	.430
41 40	1	517 672.15	101.215 17	75.898 553	326.35	1.223 334	1.40	.428
41 41	1	523 745.06	101.215 50	75.878 972	326.45	1.223 418	1.40	.426
41 42	1	529 817.99	101.215 83	75.859 385	326.55	1.223 502	1.38	.424
41 43	1	535 890.94	101.216 17	75.839 792	326.67	1.223 585	1.38	.421
41 44	1	541 963.91	101.216 50	75.820 192	326.78	1.223 668	1.38	.419
41 45	1	548 036.89	101.216 83	75.800 585	326.88	1.223 751	1.37	.417
41 46	1	554 109.90	101.217 00	75.780 972	326.98	1.223 833	1.35	.415
41 47	1	560 182.92	101.217 33	75.761 353	327.10	1.223 914	1.37	.413
41 48	1	566 255.96	101.217 50	75.741 727	327.20	1.223 996	1.35	.410
41 49	1	572 329.01	101.218 00	75.722 095	327.30	1.224 077	1.33	.408
41 50	1	578 402.09	101.218 17	75.702 457	327.42	1.224 157	1.33	.406
41 51	1	584 475.18	101.218 50	75.682 812	327.52	1.224 237	1.32	.404
41 52	1	590 548.29	101.218 83	75.663 161	327.62	1.224 316	1.33	.402
41 53	1	596 621.42	101.219 00	75.643 504	327.75	1.224 396	1.30	.399
41 54	1	602 694.56	101.219 50	75.623 839	327.83	1.224 474	1.32	.397
41 55	1	608 767.73	101.219 67	75.604 169	327.95	1.224 553	1.30	.395
41 56	1	614 840.91	101.220 00	75.584 492	328.05	1.224 631	1.28	.393
41 57	1	620 914.11	101.220 33	75.564 809	328.17	1.224 708	1.28	.391
41 58	1	626 987.33	101.220 50	75.545 119	328.27	1.224 785	1.28	.388
41 59	1	633 060.56	101.221 00	75.525 423	328.38	1.224 862	1.27	.386
42 00	1	639 133.82		75.505 720		1.224 938		.384

TRANSVERSE MERCATOR PROJECTION

INDIANA

Both Zones

$\Delta\lambda''$	b	Δb	c	$\Delta\lambda''$	b	Δb	c
0	0.000	+0.190	0.000				
100	+0.190	+0.188	0.000	3100	+3.428	-0.056	-0.133
200	+0.378	+0.188	-0.001	3200	+3.372	-0.071	-0.135
300	+0.566	+0.186	-0.002	3300	+3.301	-0.088	-0.136
400	+0.752	+0.185	-0.003	3400	+3.213	-0.104	-0.135
500	+0.937	+0.182	-0.005	3500	+3.109	-0.122	-0.133
600	+1.119	+0.179	-0.007	3600	+2.987	-0.140	-0.131
700	+1.298	+0.175	-0.010	3700	+2.847	-0.158	-0.128
800	+1.473	+0.172	-0.014	3800	+2.689	-0.178	-0.124
900	+1.645	+0.167	-0.018	3900	+2.511	-0.197	-0.120
1000	+1.812	+0.162	-0.022	4000	+2.314	-0.218	-0.115
1100	+1.974	+0.156	-0.027	4100	+2.096	-0.236	-0.109
1200	+2.130	+0.151	-0.032	4200	+1.860	-0.258	-0.101
1300	+2.281	+0.145	-0.038	4300	+1.602	-0.278	-0.091
1400	+2.426	+0.138	-0.043	4400	+1.324	-0.299	-0.078
1500	+2.564	+0.130	-0.049	4500	+1.025	-0.320	-0.063
1600	+2.694	+0.122	-0.055	4600	+0.705	-0.342	-0.045
1700	+2.816	+0.114	-0.061	4700	+0.363	-0.363	-0.025
1800	+2.930	+0.106	-0.067	4800	0.000	-0.387	0.000
1900	+3.036	+0.096	-0.073	4900	-0.387	-0.412	+0.026
2000	+3.132	+0.086	-0.079	5000	-0.799	-0.440	+0.053
2100	+3.218	+0.075	-0.085	5100	-1.239	-0.467	+0.084
2200	+3.293	+0.065	-0.091	5200	-1.706	-0.491	+0.117
2300	+3.358	+0.054	-0.096	5300	-2.197	-0.519	+0.153
2400	+3.412	+0.042	-0.101	5400	-2.716	-0.545	+0.191
2500	+3.454	+0.029	-0.106	5500	-3.261	-0.573	+0.232
2600	+3.483	+0.017	-0.111	5600	-3.834	-0.600	+0.275
2700	+3.500	+0.003	-0.116	5700	-4.434	-0.627	+0.321
2800	+3.503	-0.010	-0.121	5800	-5.061	-0.654	+0.371
2900	+3.493	-0.025	-0.125	5900	-5.715	-0.680	+0.426
3000	+3.468	-0.040	-0.130	6000	-6.395		+0.487

$$F = 7.38 \times 10^{-13}$$

TRANSVERSE MERCATOR PROJECTION

TABLE FOR g

$$\Delta\alpha'' = \sin \phi (\Delta\lambda'') + g$$

Latitude	$\Delta\lambda''$						
	0"	1000"	2000"	3000"	4000"	5000"	6000"
24°	0.00	0.00	0.02	0.07	0.17	0.33	0.58
25	0	0	0.02	0.07	0.17	0.34	0.59
26°	0.00	0.00	0.02	0.08	0.18	0.35	0.60
27	0	0	0.02	0.08	0.18	0.35	0.61
28	0	0	0.02	0.08	0.18	0.36	0.62
29	0	0	0.02	0.08	0.19	0.37	0.63
30	0	0	0.02	0.08	0.19	0.37	0.64
31°	0.00	0.00	0.02	0.08	0.19	0.37	0.64
32	0	0	0.02	0.08	0.19	0.38	0.65
33	0	0	0.02	0.08	0.19	0.38	0.65
34	0	0	0.02	0.08	0.19	0.38	0.65
35	0	0	0.02	0.08	0.19	0.38	0.65
36°	0.00	0.00	0.02	0.08	0.19	0.38	0.65
37	0	0	0.02	0.08	0.19	0.38	0.65
38	0	0	0.02	0.08	0.19	0.38	0.65
39	0	0	0.02	0.08	0.19	0.37	0.64
40	0	0	0.02	0.08	0.19	0.37	0.64
41°	0.00	0.00	0.02	0.08	0.19	0.37	0.63
42	0	0	0.02	0.08	0.18	0.36	0.63
43	0	0	0.02	0.08	0.18	0.36	0.62
44	0	0	0.02	0.08	0.18	0.35	0.61
45	0	0	0.02	0.08	0.18	0.35	0.60
46°	0.00	0.00	0.02	0.07	0.17	0.34	0.59
47	0	0	0.02	0.07	0.17	0.33	0.58
48	0	0	0.02	0.07	0.17	0.33	0.56
49	0	0	0.02	0.07	0.16	0.32	0.55
50	0.00	0.00	0.02	0.07	0.16	0.31	0.54

$$g = \left[\frac{C (\sin 1'') \cos^3 \phi}{2A^2} + F \right] (\Delta\lambda'')^3$$

A, C and F are position factors.

**Y CORRECTION FOR COMPUTATION OF GEOGRAPHIC
POSITIONS FROM PLANE COORDINATES**

TRANSVERSE MERCATOR PROJECTION, INDIANA-E-W ZONES

$$P(x'/10,000)^2 + d = v(\Delta y/100)^2 + c$$

P taken out for y-coordinate
d taken out for x'

y	P	ΔP	x'	d
0	1.83108	1822	0	0.00
100,000	1.84930	1834	50,000	0.00
200,000	1.86764	1848	100,000	+ 0.01
300,000	1.88612	1862	150,000	+ 0.02
400,000	1.90474	1877	200,000	+ 0.02
500,000	1.92351	1890	250,000	+ 0.02
600,000	1.94241	1906	300,000	- 0.01
700,000	1.96147	1920	350,000	- 0.09
800,000	1.98067	1936		
900,000	2.00003	1951		
1,000,000	2.01954	1967		
1,100,000	2.03921	1983		
1,200,000	2.05904	2000		
1,300,000	2.07904	2016		
1,400,000	2.09920	2032		
1,500,000	2.11952	2050		
1,600,000	2.14002			

TRANSVERSE MERCATOR PROJECTION

Indiana

Both zones

$$\Delta\alpha = Mx' - e$$

y	M	ΔM
0	0.007 5541	751
100,000	0.007 6292	757
200,000	0.007 7049	763
300,000	0.007 7812	768
400,000	0.007 8580	774
500,000	0.007 9354	780
600,000	0.008 0134	786
700,000	0.008 0920	793
800,000	0.008 1713	798
900,000	0.008 2511	805
1,000,000	0.008 3316	812
1,100,000	0.008 4128	818
1,200,000	0.008 4946	825
1,300,000	0.008 5771	831
1,400,000	0.008 6602	839
1,500,000	0.008 7441	846
1,600,000	0.008 8287	

e

y \ x'	100,000	200,000	300,000	400,000
0	0.0	0.0	0.2	0.5
500,000	0.0	0.0	0.2	0.6
1,000,000	0.0	0.1	0.2	0.6
1,500,000	0.0	0.1	0.3	0.7

TRANSVERSE MERCATOR PROJECTION

INDIANA

Both zones

x' (feet)	Scale in units of 7th place of logs	Scale expressed as a ratio	x' (feet)	Scale in units of 7th place of logs	Scale expressed as a ratio
0	-144.8	0.9999667	175,000	+ 7.3	1.0000017
5,000	-144.7	0.9999667	180,000	+ 16.1	1.0000037
10,000	-144.3	0.9999668	185,000	+ 25.1	1.0000058
15,000	-143.7	0.9999669	190,000	+ 34.4	1.0000079
20,000	-142.8	0.9999671	195,000	+ 44.0	1.0000101
25,000	-141.7	0.9999674	200,000	+ 53.8	1.0000124
30,000	-140.3	0.9999677	205,000	+ 63.9	1.0000147
35,000	-138.7	0.9999681	210,000	+ 74.2	1.0000171
40,000	-136.9	0.9999685	215,000	+ 84.7	1.0000195
45,000	-134.8	0.9999690	220,000	+ 95.5	1.0000220
50,000	-132.4	0.9999695	225,000	+106.6	1.0000245
55,000	-129.8	0.9999701	230,000	+117.9	1.0000271
60,000	-126.9	0.9999708	235,000	+129.4	1.0000298
65,000	-123.8	0.9999715	240,000	+141.2	1.0000325
70,000	-120.5	0.9999723	245,000	+153.2	1.0000353
75,000	-116.9	0.9999731	250,000	+165.5	1.0000381
80,000	-113.0	0.9999740	255,000	+178.0	1.0000410
85,000	-108.9	0.9999749	260,000	+190.8	1.0000439
90,000	-104.6	0.9999759	265,000	+203.9	1.0000469
95,000	-100.0	0.9999770	270,000	+217.2	1.0000500
100,000	- 95.2	0.9999781	275,000	+230.7	1.0000531
105,000	- 90.1	0.9999793	280,000	+244.5	1.0000563
110,000	- 84.7	0.9999805	285,000	+258.5	1.0000595
115,000	- 79.1	0.9999818	290,000	+272.8	1.0000628
120,000	- 73.3	0.9999831	295,000	+287.3	1.0000662
125,000	- 67.2	0.9999845	300,000	+302.1	1.0000696
130,000	- 60.9	0.9999860	305,000	+317.1	1.0000730
135,000	- 54.3	0.9999875	310,000	+332.3	1.0000765
140,000	- 47.5	0.9999891	315,000	+347.8	1.0000801
145,000	- 40.4	0.9999907	320,000	+363.6	1.0000837
150,000	- 33.1	0.9999924	325,000	+379.6	1.0000874
155,000	- 25.5	0.9999941	330,000	+395.9	1.0000912
160,000	- 17.7	0.9999959	335,000	+412.4	1.0000950
165,000	- 9.6	0.9999978	340,000	+429.2	1.0000988
170,000	- 1.3	0.9999997	345,000	+446.2	1.0001027
			350,000	+463.4	1.0001067

CORRECTIONS TO NATURAL SCALE RATIOS*

(in units of the 7th decimal place)

For Lambert Projection				For Lambert or transverse Mercator Projection		
<u>$\Delta\phi'$ as argument</u>				<u>Δy</u> or	<u>Δx</u>	<u>Corr'n</u> (Plus)
<u>$\Delta\phi'$</u>	<u>Corr'n</u> (Plus)	<u>$\Delta\phi'$</u>	<u>Corr'n</u> (Plus)			
1	0	31	34		10,000	0
2	0	32	36		20,000	0
3	0	33	38		30,000	1
4	1	34	40		40,000	2
5	1	35	43		50,000	2
6	1	36	45		60,000	3
7	2	37	48		70,000	5
8	2	38	51		80,000	6
9	3	39	53		90,000	8
10	4	40	56		100,000	10
11	4	41	59		110,000	11
12	5	42	62		120,000	14
13	6	43	65		130,000	16
14	7	44	68		140,000	19
15	8	45	71		150,000	21
16	9	46	74		160,000	24
17	10	47	77		170,000	27
18	11	48	81		180,000	31
19	13	49	84		190,000	34
20	14	50	88		200,000	38
21	15	51	91		210,000	42
22	17	52	95		220,000	46
23	19	53	98		230,000	50
24	20	54	102		240,000	55
25	22	55	106		250,000	59
26	24	56	110		260,000	64
27	26	57	114		270,000	69
28	27	58	118		280,000	74
29	29	59	122		290,000	80
30	32	60	126		300,000	86
$\Delta\phi'$ is the difference in latitude in minutes of the ends of the line.					310,000	91
					320,000	97
					330,000	103
					340,000	110
					350,000	116

*Scale ratio interpolated for mean latitude or mean x' of the ends of a line and corrected by the above table is a true mean value accurate to within one in the seventh decimal place.