OFFICE OF
RAMSEY COUNTY ENGINEER

CONSTRUCTION NOTES

EAST CO. LINE ROAD

PROJ. 27-04

TABLES FOR EXCAVATIONS AND EMBANKMENTS.

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.
ROADWAY 18 FEET WIDE. SIDE SLOPES 1 TO 1.
FOR SINGLE TRACK EXCAVATION.

	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
0	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	0
1	10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.7	10.8	10.9	1
2	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9	2
3	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	3
4	13.0	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	4
5	14.0	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9	5
6	15.0	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9	6
7	16.0	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9	7
8	17.0	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9	8
9	18.0	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9	9
10	19.0	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9	10
11	20.0	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9	11
12	21.0	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9	12
13	22.0	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9	13
14	23.0	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	23.9	14
15	24.0	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9	15
16	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	16
17	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	17
18	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	18
19	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	19
20	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	20
21	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9	21
22	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7	31.8	31.9	22
23	32.0	32.1	32.2	32.3	32.4	32.5	32.6	32.7	32.8	32.9	23
24	33.0	33.1	33.2	33.3	33.4	33.5	33.6	33.7	33.8	33.9	24
25	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	25
26	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	26
27	36.0	36.1	36.2	36.3	36.4	36.5	36.6	36.7	36.8	36.9	27
28	37.0	37.1	37.2	37.3	37.4	37.5	37.6	37.7	37.8	37.9	28
29	38.0	38.1	38.2	38.3	38.4	38.5	38.6	38.7	38.8	38.9	29
30	39.0	39.1	39.2	39.3	39.4	39.5	39.6	39.7	39.8	39.9	30
31	40.0	40.1	40.2	40.3	40.4	40.5	40.6	40.7	40.8	40.9	31
32	41.0	41.1	41.2	41.3	41.4	41.5	41.6	41.7	41.8	41.9	32
33	42.0	42.1	42.2	42.3	42.4	42.5	42.6	42.7	42.8	42.9	33
34	43.0	43.1	43.2	43.3	43.4	43.5	43.6	43.7	43.8	43.9	34
35	44.0	44.1	44.2	44.3	44.4	44.5	44.6	44.7	44.8	44.9	35
36	45.0	45.1	45.2	45.3	45.4	45.5	45.6	45.7	45.8	45.9	36

Calculated by Julien A. Hall, M. Am. Soc. C. E.

For Keith's Railroad Curve Tabels see end of book.

179-60
54-14
B546

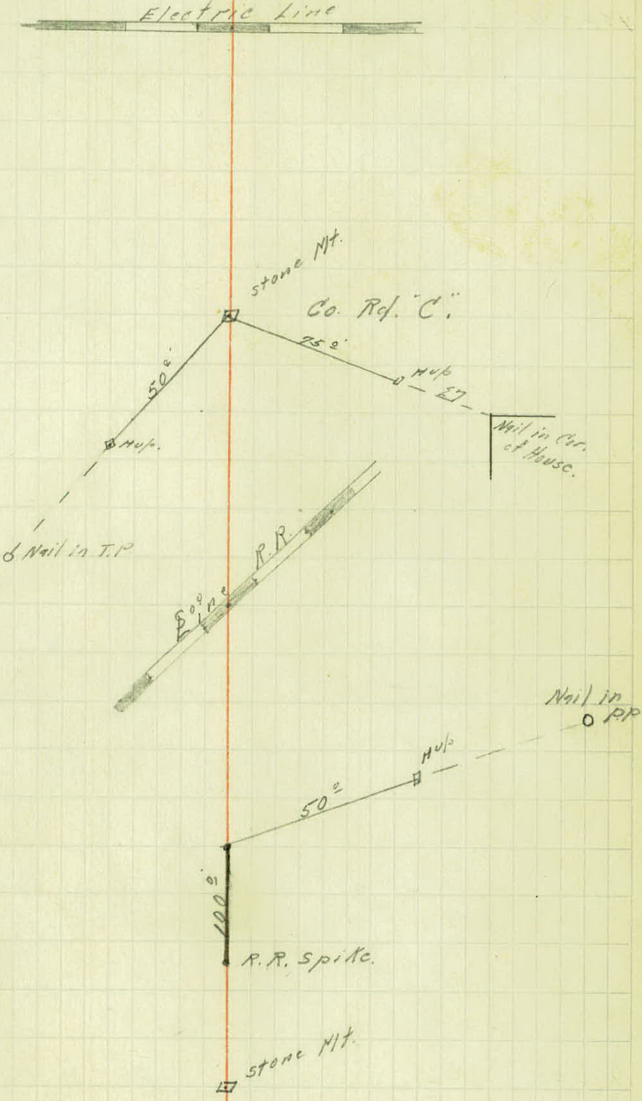
179-60
150-4c
99 14

Proj. # 27-04.

Sta.	to	Sta.	Description.	Page	to	Page
379		503	Alignment.	1		4
379		403+50	Original x Sections	9		13
404		451	Original x Sections	29		38
451		505	Original x Sections	15		25
			Original x Sec. Seventh St.	40		

Sta.	Point	Δ Lt.	Δ Rt.	
400+04.7	P.O.T.			
				N 1°29' E
396+39.40	P.I.		0°-09'	
389+93.30	P.O.T.			
379+08.0	P.O.T.	Beginning of Proj' 27-04		
377+00.0	P.O.T.			
370+08.5	P.O.T.			

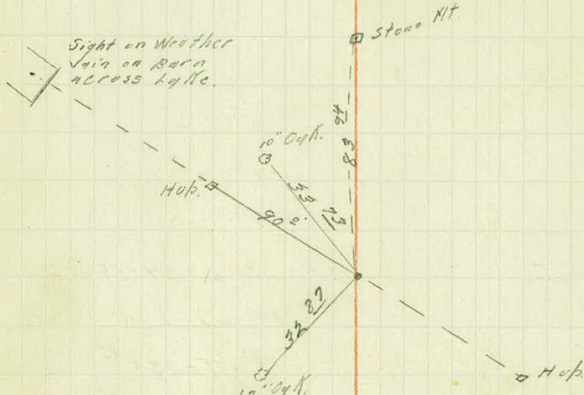
5-5-27


Electric Line
Stone Mt.
Co. Rd. "C".
75.0'
50.0'
Hub
Hub.
Nail in Cor. of House.
Nail in T.P.
R.R.
℄ of Line
Nail in P.P.
Hub
50.0'
100.0'
R.R. Spike.
Stone Mt.

Sta.	Point	Δ Lt.	Δ Rt.	
423+30.77	P.T.	27°-07'		
423		24°-48.4'		N 23°31' W
430		21°-03.4'		
422		17°-18.4'		
421+65.4	P.I.	54°-14'		Δ-54°-14'
450		13°-33.4'		D.-15° L.
421		9°-48.4'		T.-196.16
450		6°-03.4'		L.-361.55
420		2°-18.4'		R.-383.06
419+69.34	P.C.	0°-00'		
				N 30°43' E
417+35.16	P.T.		14°-57'	
417			12°-30.4'	
450			9°-30.4'	
416+16.3	P.I.		29°-14'	Δ-29°-14'
+15.76				
416			6°-30.4'	D.-12° R.
450			3°-30.4'	T.-124.75
415			0°-30.4'	L.-243.61
414+91.55	P.C.		0°-00'	R.-478.34

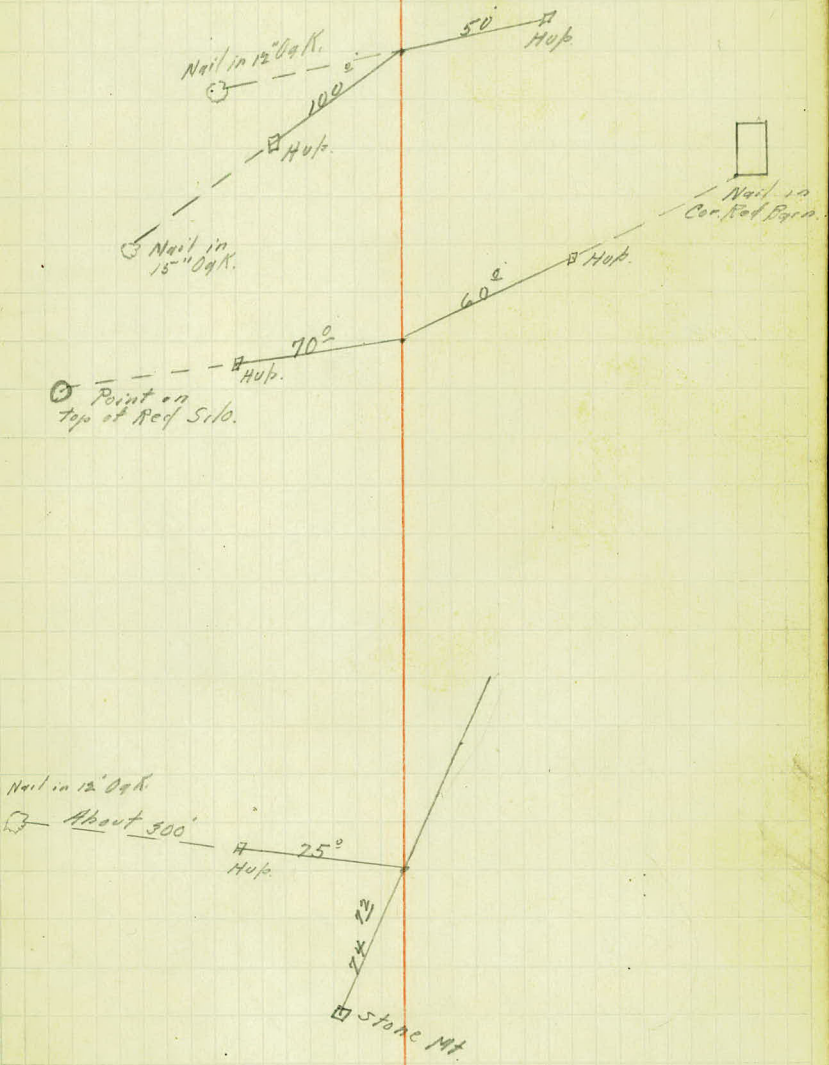
5-5-27


Nail in Cor. of Sign Board.
50°
Hub.


Stone Mt.
Sight on Weather Vain on Barn across Lake.
10" Oak.
Hub.
90°
12" Oak.
Hub.

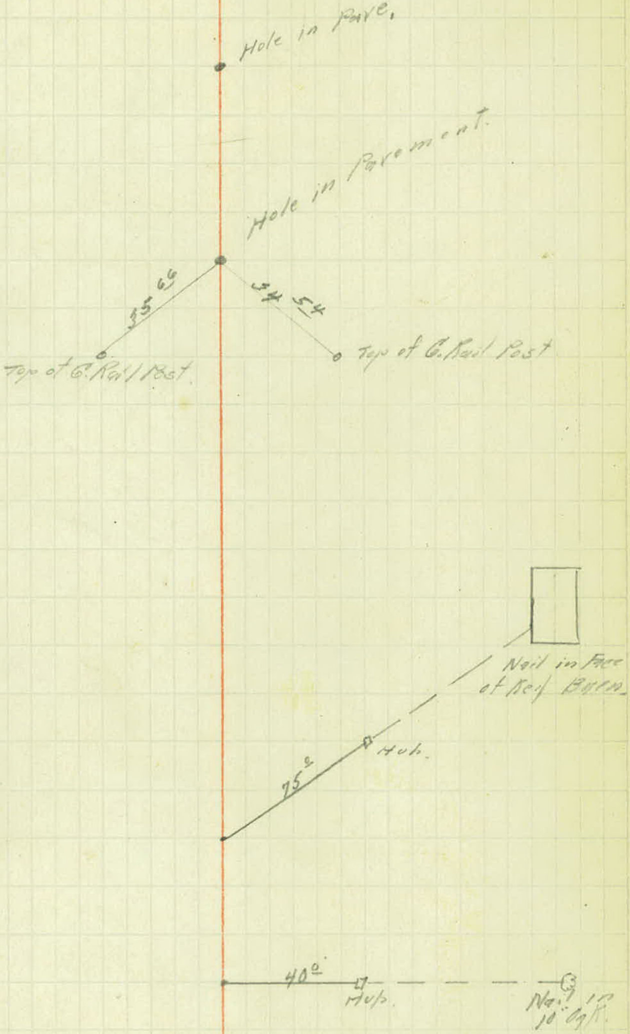
Sta.	Point	Δ Lt.	Δ Rt.	
476+84.7	P.I.	0°-02'		
450+46.5	P.I.		0°-02'	
429+33.8	P.T.		12°-29'	N 1°27' E.
429			11°-09'	
430			9°-09'	
428			7°-09'	
427+79.7	P.I.		24°-58'	Δ - 24°-58'
430			5°-09'	D. - 8° R.
427			3°-09'	T. - 158.70
430			1°-09'	L. - 312.08
426+21.0	P.C.		0°-00'	R. - 716.78

5-6-27


Nail in 12" Oak K.
50°
Hub
100°
Hub
Nail in 15" Oak K.
Nail in Cor. Ref Barn
Hub
60°
70°
Hub
Point on top of Ref Silo.
Nail in 12" Oak K.
About 300'
25°
Hub
12
24
Stone Mk

Sta.	Point	Δ Lt.	Δ Rt.	
504+85.77	P.T.		45°-05'	
+50			41°-30'	
504			86°-30'	
+50			31°-30'	
503+53.71	P.I.			Δ-90°-10'
503			26°-30'	D.-20° R.
+50			21°-30'	T.-288.76
502			16°-30'	L.-450.83
+50			11°-30'	R.-287.94
501			6°-30'	
+50			1°-30'	
500+34.94	P.C.		0°-00'	
500+33.94 =				
489+53.71	P.O.T.			
484+82.05	P.O.T.			
+81				

5-9-27


Hole in Pave.
Hole in Pavement.
35 66
34 54
Top of G. Rail Post
Top of G. Rail Post
Nail in Face
of Ref Barn.
75 2
Hub.
40 0
Hub.
Nail 1P
10" Og R.

Sta.	+	H.I.	−	Elev.	
B.M.	6.94	1002.38		995.44	
	4.34	999.13	7.59	994.79	
	5.73	997.74	4.92	994.21	
B.M.			5.57		
	4.91	996.27	6.58	991.36	
B.M.	5.08	996.25	5.08	991.19	991.17
B.M.			3.69	992.57	
	4.16	998.67	1.74	994.51	
	5.55	998.47	5.75	992.92	
B.M.			6.41		
	12.09	1009.83	0.73	997.74	
	1.00	1008.89	1.94	1007.89	
B.M.	7.84	1008.96	7.84	1001.05	1001.12
B.M.			4.09	1004.87	
	0.37	998.80	10.53	998.43	
	4.80	997.31	6.29	992.51	
	5.41	998.61	4.15	993.20	
			3.99		
	10.91	1009.04	0.48	998.13	
	6.97	1014.48	1.53	1007.51	
B.M.			6.40	1008.08	
	7.96	1019.40	3.04	1011.44	
	11.17	1029.78	0.79	1018.61	
	10.77	1039.84	0.69	1029.07	

5-12-26.

Spk. in R.R. 65 Lt. Sta. 378+85.

Spk in T.P. 100 Lt. Sta. 399+85.

Spk. in T.P. N.W. Cor. Co. Rd. C.
Top of Nut on Hyd. N.W. Cor. Co. Rd. C

Spk. in Tree Lt Sta. 407+15

Spk. in Twin Oak. Lt. Sta. 416+90.

Spk. in 12" Tree Lt. Sta. 429+90.

		1039.86			
B.M.	5.61	1039.83	5.61	1034.25	1034.22
B.M.	6.79	1040.62	6.63	1033.23	
	1.29	1035.31	6.00	1034.02	
	4.90	1034.64	5.57	1029.74	
B.M.			3.97	1030.67	
	6.72	1035.32	6.04	1028.60	
	6.93	1032.72	3.33	1031.99	
B.M.	3.21	1038.91	3.21	1035.71	1035.70
	7.00	1047.76	0.75	1038.16	
	10.46	1057.77	0.50	1047.26	
	4.90	1061.80	0.82	1056.90	
	1.21	1055.32	7.69	1054.11	
B.M.	1.34	1047.18	9.48	1045.84	
	0.61	1036.37	11.42	1035.76	
	0.45	1024.37	12.45	1023.92	
	0.22	1013.01	11.58	1012.79	
B.M.	6.01	1007.53	11.49	1001.52	
B.M	5.40	1051.19		1045.79	
B.M.			7.66	1041.53	
B.M.	5.41	1006.90		1001.49	
B.M.			4.29	1002.61	

Spk. in T.P. Lt. Sta. 450+35

Spk. in 18" Oak 40' Lt. Sta. 462+80.

Spk. in 12" Oak. 40' Lt. Sta. 476+05

Spk in 8" Oak. 33' Rt. Sta. 490+93.

Spk. in P.P. Rt. Sta. 492+39

Spk. in P.P. N.E. Cor. Int. Co. Rd. L. & E. Co. Line.

Sta.	+	H. I.	−	Elev	Cr. Rod
B.M.	7.74	1003.18		995.44	
379+08				97.0	6.2
T.P.	7.91	1003.35	7.74	995.44	
+18				97.0	6.4
+25				97.0	8.1 6.4
+50				97.0	7.9 6.4
+60				97.0	6.4
380				97.0	7.4 6.4
+46				97.0	7.0 6.4
+60				97.0	6.4
381				97.0	6.5 6.4
T.P.	7.11	1002.55	7.91	995.44	
+50				96.7	5.9
382				96.2	6.4
+60				95.9	7.3

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Spk. in P.P. 65' Lt. Sta. 378+85

7.2/46 6.8/40 7.1/39 4.4/26 5.7/16 5.2/10 4.8/+1.4 4.5/9 4.0/18 0.6 3/3.3/+3.1 3.3/33

7.2/41 6.8/35 7.1/34 5.6/16 4.9 4.8/10 3.5/18 2.8/31 2.8/33

8.2/50 4.5 4/8.5/-0.4 8.3/40 7.2/36 7.1/31 6.5/22 5.4/11 4.9/+1.5 4.2/16 3.6/20 2.8 3/2.4/+4.2 2.3/33

6.9/50 4.1 3/7.8/+0.1 7.9/28 6.3/16 5.4/+1.0 5.2/9 3.0 3/1.7/+4.8

6.0/50 7.1/44 7.5/33 7.6/24 5.9/11 5.6 5.3/14 3.8/23 2.1/30 2.0/33

6.3/33 4.4 2/6.6/+0.8 6.2/14 6.0/+0.4 6.4/8 7.2/11 6.9/17 2.8/26 1.7/33

2.5/33 2.1 3/2.5/+4.5 2.6/30 6.1/26 6.1/24 6.6/19 6.0/12 5.8/+0.6 6.3/9 6.9/12 6.4/24 7.5 2/5.3/+1.0 4.2/32 4.0/33

2.4/33 2.6/30 6.2/24 6.5/21 6.0/12 5.8 6.4/9 7.6/13 7.3/24 5.9/28 3.3/29 3.3/33

3.4/33 0.5 3/3.5/+3.0 3.7/28 6.4/23 6.7/18 5.9/11 5.7/+0.7 6.4/10 8.4/14 0.0 2/8.8/-2.5 7.6/23 4.1/29 2.0/30 1.7/33

5.4/33 6.1 4/5.4/+0.5 5.5/22 5.5/13 5.7/+0.7 5.9/10 8.0/16 8.9 1/8.3/-2.4 7.2/25 4.1/32 3.1/33 0.4/35

6.9/33 5.5 2/6.7/-0.3 6.1/11 5.7/+0.7 6.2/11 8.0/15 8.4 1/8.3/-1.9 8.2/27 3.0/35

9.8/33 9.1/21 6.3 1/7.9/-0.6 7.1/14 6.5/+0.8 7.1/14 8.0 1/8.8/-1.5 8.9/27 5.2/34 4.4/38

Sta.	+	H.I.	−	Elev.	Cr. Rod
		1002.55			
+85				95.1	7.5
383				95.0	7.6
+50				94.4	8.2
T.P.	5.41	999.41	8.55	994.00	
384				94.0	5.4
385				93.6	5.8
+50				93.6	5.8
386				93.8	5.6
+50				94.0	5.4
387				94.1	5.3
+50				94.2	5.2
388				94.1	5.3
+35				94.0	5.4

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11.3/33 11.1/24 10.4/20 7.5/14 6.8 7.1/17 8.4/23 8.5/33

12.7/33 12.6/25 11.9/24 2.6/11.4/-3.8 11.1/21 7.8/14 7.1/+0.5 7.5/10 9.8/17 1.9 4/9.8/-3.2 10.1/26 8.8/33

14.0/33 2.5 8/13.6/-5.4 13.8/25 13.1/24 12.9/21 8.4/13 8.0/+0.2 8.3/10 12.6/17 3.5 2/13.3/-5.1 13.1/33

10.9/33 2.5 8/10.8/-5.4 11.0/24 10.4/23 10.4/21 6.0/14 5.4/0.0 5.7/10 10.0/18 2.4 4/10.1/-4.7 10.1/33

10.8/33 2.5 0/10.8/-5.0 10.4/23 10.0/21 6.0/14 5.7/+0.1 6.0/11 9.4/16 10.4/17 2.4 4/10.5/-4.7 10.2/33

10.0/33 9.9/23 2.2 2/9.4/-3.6 8.9/19 5.7/14 5.4/+0.4 5.7/7 6.2/11 8.0/13 9.3/18 9.5/19 2.4 4/7.5/-5.7 8.6/25 8.6/33

2.2/4 6.8/33 8.5/27 8.5/23 2.0 2/8.2/-2.6 8.0/18 5.7/14 5.1/+0.5 5.7/11 9.0/18 2.2 0/9.1/-3.5 8.7/25 5.6/28 5.3/33

2.1/37 6.4/30 7.1/25 1.8 2/7.0/-1.6 5.7/14 4.9/+0.5 5.5/11 7.5/17 7.7/22 6.6/25 2.3 9/6.8/-0.6 4.4/27 4.5/33

4.6/37 6.3/33 7.6/28 1.9 6/7.6/-2.3 5.3/14 4.8/+0.5 5.4/13 6.6/16 7.0/17 9.0/18 6.2/20 5.6/21 0.6/5.5/00 4.8/33

8.1/31 7.9/33

7.2/33 7.5/26 1.9 4/7.4/-3.2 7.0/17 5.4/13 5.1/+0.1 5.5/12 7.5/16 2.0 0/7.7/-2.5 7.2/24 7.7/27 9.3/29 9.5/30

7.5/33 1.9 8/7.7/-2.4 7.5/18 5.5/13 5.2/+0.1 (5.3) 5.4/13 8.1/17 2.4 8/8.7/-3.4 9.0/33

9/6.3/-0.9 6.2/29 7.1/28 6.9/24 6.0/22 5.8/20 6.0/16 5.3/14 5.0/+0.4 5.6/16 6.2/19 4.2 3/6.4/-1.0 6.3/33

Sta.	+	H. I.	−	Elev.	Br. Rod
		999.41			
+75				93.9	5.5
389				93.9	5.5
T.P.	4.14	998.22	5.33	994.08	
+50				93.7	4.5
B.M.			5.85	992.37	
+79				93.6	4.6
390				93.6	4.6
+25				93.5	4.7
+60				93.3	4.9
391				93.2	5.0
+50				92.9	5.3
392				92.6	5.6
+50				92.1	6.1
393				91.7	6.5

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1.6/34 5.4/30 6.9/26 6.8/19 5.8/16 5.0 5.7/13 6.5/16 6.6/23 4.0/27 3.6/33

3.2/35 3°/3 5.0/+0.5 6.9/30 7.2/24 6.8/21 5.8/14 5.0/+0.5 5.9/14 6.6/16 6.7/22 2.0/29 3°/3 1.4/+4.1

3°/3 5.7/-1.2 5.7/31 6.4/24 5.2/15 4.1/12 3.8/+0.7 4.3/13 5.8/16 5.2/24 2.8/27 1.9/30 3°/3 1.8/+2.7

Spk. in T.P. 100 Lt. Sta. 389+85.

5.3/33 4.5/12 4.2/7 5.8 3.9/13 5.1/17 5.0/25 4.3/27 4.2/33

7.8/33 7.4/21 1 5°/ 4.6/00 4.2/14 3.9/+0.7 4.0/14 4.1/24 3 8°/ 4.5/+0.1

7.3/33 6.3/22 4.4/12 5.8 4.0/12 4.9/15 5.0/25 4.4/27 4.5/33

8.2/33 4 0°/ 7.4/-2.5 7.0/18 4.5/13 3.9/+1.0 4.3/12 5.8/15 7.3/20 8.4/21 8.4/22 6.1/26 3 8°/ 5.5/-0.6

3 8°/ 6.5/-1.5 6.4/28 6.8/17 1 5°/ 5.0/00 4.3/+0.7 5.0/12 5.9/14 6.5/23 5.9/29 3 3°/ 5.9/-0.9

3 8°/ 3.5/+1.8 3.6/27 7.1/22 6.9/17 5.4/13 4.7/+0.4 5.7/14 6.3/16 6.8/24 5.9/31 3 3°/ 5.8/+1.5

3 3°/ 4.4/+1.2 5.0/26 7.3/24 7.3/18 5.8/13 5.1/+0.5 6.1/16 7.1/19 7.2/23 6.3/25 3 3°/ 6.3/-0.7

3 8°/ 6.6/+0.5 7.0/21 8.3/20 7.7/15 6.3/13 5.6/+0.5 6.5/17 8.0/21 8.3/33 1 5°4/ 6.3/-0.2

6.7/33 1 5°/ 6.5/-0.2 6.1/+0.4 1 5°/ 6.5/00 6.9/19 8.7/23 9.2/33

Sta.	+	H.I.	−	Elev.	Gr. Rod
		998.22			
+35				91.3	6.9
394				91.4	6.8
T.P.	4.38	996.30	6.30	991.92	
+50				90.9	5.4
B.M.	5.12	996.29	5.12	991.18	991.18
395				90.9	5.4
+50				90.9	5.4
396				91.1	5.2
+20				91.2	5.1
+37				91.2	5.1
+63				91.4	4.9
397				91.4	4.7
+50				91.9	4.4
398				92.3	4.0

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7.0	8.9	6.9	6.4	6.8	8.7	9.3
33	16	11	10.5	17	22	33

9.6	2 0/-2.5	9.3	9.0	7.0	6.4	6.6	6.8	8.9	9.0	10.1	10.1	8.7	8.5
33		16	11	10.4	15	18	23	24	25	27	27	33	

7.9	7.6	2 0/-2.6	8.0	7.2	5.8	4.7	5.1	5.1	6.6	6.9	3 0/-1.4	6.8
33	23		15	10	10.7	15	15	19.7	27			

Sp K in T.P. N.W. Cor. Co. Rd "C"

7.8	1 9/-2.2	7.6	7.3	5.7	4.8	5.3	7.0	7.1	3 0/-0.9	6.5
33		15	11	10.6	15	19	23			

3 0/-1.0	6.4	5.8	5.2	6.3	6.3	5.5	4.9	5.5	6.7	3 4/-1.7	7.1	7.0	5.8	5.2
	28	18	16	15	10	10.5	16	18	2		26	30	33	

3 0/-0.3	5.5	4.6	6.3	5.2	4.8	5.3	4 0/-1.3	6.5	6.5	5.7	2.9
	19	16	8	10.4	12	2		27	33	34	

6.0	6.4	5.0	4.7	5.2	6.3
33	28	11		19	33

5.3	5.1	4.6	4.8	4.6
33	20		21	33

7.1	6.4	5.2	4.6	5.0	5.8	5.5	5.8
33	18	10	10.3	12	23	164	33

(24)

8.5	1 3/-3.3	8.0	7.1	5.6	5.1	5.7	7.5	8 0/-2.9	8.0	7.4	5.7
33			15	11	-0.4	15	19	2	28	33	36

10.0	6 8/-5.4	9.8	10.2	9.1	5.8	5.0	5.5	8.0	3 8/-2.9	8.0
33	2		17	17	12	-0.6	13	17	2	33

8.3	4 7/-4.6	8.4	8.5	5.3	4.6	5.2	8.7	5.4 9.3/-5.3		10.4	10.5	9.8
33	2	4	17	12	-0.4	12	18	2		27	30	33

Sta.	+	H.I.	−	Elev.	Cr. Rod
		996.29			
+50				92.7	3.4
399				93.0	3.3
T.P.	5.35	999.25	2.39	993.90	
+50				93.4	5.9
400				93.7	5.6
+50				93.9	5.4
401				94.1	5.2
402				94.1	5.2
+30				94.0	5.3
403				93.8	5.5
+50				93.9	5.7
T.P.			5.81	993.44	

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5.0	4.7	4/5.3	6.1	6.1	4.4	3.7	4.2	6.2	7/6.7	6.4	5.4	5.3	
33	20	18/-1.7	14	15	11	+0.1	12	17	2/-3.1	28	31	33	
2.7	6/3.1	3.2	6.0	4.0	3.1	3.7	5.7	4/4.0	5.2	2.2	2.7		
33	2/+0.2	22	18	13	+0.2	12	16	2/-2.7	23	28	33		
6.1	0/5.9	6.2	6.2	5.5	6.2	8.1	8/8.5	8.3	5.3	5.5			
33	2/.00	24	13	+0.4	12	15	19/-2.4	22	26	33			
5.3	4/5.3	5.2	4.7	4.8	4.9	5.4	3/5.4	5.6					
33	2/+0.3	20	12	+0.8	14	24	2/+0.2	33					
4.8	5.8	6.7	2/8.9	2.3	7.6	5.1	4.7	5.3	6.5	6.4	5.8	5/5.7	6.1	5.0
33	25	23	2/-3.5	21	17	12	+0.7	12	16	24	25	2/-0.3	28	33
6	7.0	6.2	4/8.4	9.4	9.3	7.3	5.1	4.5	5.2	6.4	6.5	5.3	3/6.0	4.6
30	24	2/-3.2	21	18	17	13	+0.7	13	16	20	22	2/+0.2	33	
7.2	7.1	6/8.6	8.8	9.0	7.8	5.4	7.9	(5.2)	5.3	6.4	6.4	5.3	0/5.2	5.0
33	23	2/-3.4	21	19	17	12	+0.3	12	16	29	23	2/.00	33	
7.5	7.3	9.2	9.2	8.1	5.5	5.0	5.2	5.5	5.5					
33	23	21	19	18	12		12	24	33					
7.3	7.1	8/8.9	9.1	8.9	7.5	5.8	5.2	5.6	6.6	4/6.7	6.9			
33	23	2/-3.4	21	19	18	13	+0.3	13	15	2/-1.2	33			
7.1	7.0	4/6.6	6.2	5.6	5.4	6.0	6.5	4/6.8	6.5	6.7				
33	25	2/-0.9	20	12	+0.3	10	19	2/-1.1	27	33				

Nail in T.P. Lt. Sta 404+20.

Sta.	+	H. I.	−	Elev.	Gr. Rd.
B.M.	10.25	1043.34		1033.11	
451				1035.1	8.2
+50				35.3	8.0
452				35.1	8.2
+50				34.8	8.5
T.P.	4.44	1039.53	8.25	1035.09	
453				34.5	5.0
+50				34.3	5.2
454				34.0	5.5
+50				33.7	5.8
455				33.4	6.1
+40				33.0	6.5
456				32.3	7.2
T.P.	2.77	1035.12	7.18	1032.35	
+50				31.5	3.6

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pk. in T.P. Lt. Sta. 450+25

8.4/33 8.2/15 8.0/+0.2 (8.2) 8.4/14 8.6/23 7.3/25 7.0/+1.2

2.5/33 8.8/-0.8 8.4/26 8.5/21 8.3/15 8.1/-0.1 (8.0) 8.4/13 8.1/22 4.0/28 4.1/+3.9

5.8/+2.4 9.4/27 9.5/18 8.8/15 8.5/-0.1 (8.2) 8.7/11 8.5/19 8.8/20 8.1/28 5.4/+2.8

10.1/33 10.1/27 11.2/23 10.6/18 8.9/14 8.6/-0.1 (8.5) 9.1/15 11.3/-2.8 12.2/27 12.4/33

8.6/33 8.5/26 8.9/-3.9 8.4/19 5.0/13 5.1/-0.1 (5.0) 5.4/14 7.8/19 7.7/-2.7 8.2/25 8.3/33

4.3/33 4.4/27 3.2/00 5.9/24 6.2/18 5.4/15 5.1/+0.1 (5.2) 5.4/14 8.1/19 9.4/-4.2 10.2/28 10.2/33

7 3.5/+2.0 3.9/27 5.8/23 6.0/18 5.2/15 5.3/16 5.2/+0.3 (5.5) 5.5/14 8.0/20 8.1/24 7.4/28 7.5/33

5.9/33 5.8/0.0 6.7/24 6.8/18 5.6/15 5.5/11 5.8/9 5.5/+0.3 (5.8) 5.7/15 7.5/19 7.7/25 6.3/29 6.7/33

6.7/33 6.2/27 7.3/-1.2 7.0/19 6.1/16 6.1/10 5.8/+0.3 (6.1) 6.0/12 5.6/15 5.9/16 7.2/20 7.2/23 7.0/-0.9 6.4/28 3.6/33

.3/3 6.5/27 7.6/24 7.8/-7.3 7.7/18 6.3/15 6.4/10 6.0/+0.5 (6.5) 6.5/12 6.3/18 6.9/21 6.4/+0.1 5.9/28 0.4/35

4.4/33 4.3/29 7.8/-0.6 8.0/24 8.2/19 7.1/14 7.0/10 6.9/+0.3 (7.2) 7.3/12 7.1/16 8.7/21 8.7/-1.5 8.5/27 5.9/33

5.6/33 5.1/28 5.8/24 5.8/33 3.4/17 3.7/11 3.4/-0.2 (3.6) 3.7/11 3.3/13 3.6/00 3.7/16 7.1/24 7.4/33

Sta	+	H.I.	−	Elev.	Cr. R
		1035.12			
457				30.7	4.4
+50				30.0	5.1
T.P.	5.26	1035.05	5.33	1029.99	
458				29.6	5.5
+50				29.3	5.8
459				29.1	6.0
+50				29.2	5.9
460				29.4	5.7
+50				29.7	5.4
461				30.1	5.0
+50				30.2	4.9
462				30.2	4.9
B.M.	3.65	1034.20	4.50	1030.55	
+30				30.1	4.1

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9.6	5.0	9.4	9.3	4.8	4.6	4.4	4.4	4.5	4.0	4.4	8.0	7.3	7.5
33	2	-5.0	24	15	11	0	0	11	12	17	25	28	33

12.2	11.0	6.0	8	5.5	5.0	5.2	5.0	9.8	9.5			
33	24	17	1	-0.4	10.1	10	17	27	33			

13.4	11.5	7	6.1	5.3	5.5	5.4	10.0	10.2				
33	24	1	-0.6	10.2	7	19	25	33				

6.8	6.8	7.7	7.4	6	5.9	5.5	5.7	0	5.1	5.4	7.4	7.7	6.8	7.3
33	28	25	19	1	-0.1	10.3	10	3	+0.7	17	24	26	28	33

4.9	4.9	7.1	4	7.4	7.2	5.8	5	6.0	5.9	5.5	7.4	7.4	0	7.3	6.6	5.0
33	31	24	4	-1.6	19	15	10.4	10	16	21	23	2	4	7.3	27	33

5.6	5	6.9	6.8	6.0	5	6	5.9	6.0	6.1	7.1	7.3	4	7.2	6.8	5.7
33	2	-1.0	17	15	10.3	10	14	20	23	2	9	-1.3	27	33	

4.5	4.0	4	6.4	6.5	5.8	5.4	5.7	5.6	5.6	7.2	7	7.1	6.7	5.7
33	29	2	-0.7	18	16	10.3	10	15	19	2	4	-1.4	27	33

2.1	1.9	4	5.8	6.1	6.4	0	5.4	5.0	5.2	6.0	5.9	6	5.4	0.0
33	31	2	-0.4	24	18	1	0.0	+0.4	15	17	24	2	0.0	33

Have H.S.

2.0	6.2	3	6.8	6.6	5.7	4.9	5.0	6.1	9	5.7	0.2	+0.3
33	24	2	-1.8	19	15	+0.1	15	20	4	-0.7	33	34

5.4	6.0	7.0	9	6.9	6.8	6.0	5.1	5.0	4.9	5.2	5.1	6.4	4	6.6	6.3	5.0	4.9
33	30	28	1	-2.0	19	16	13	-0.1	12	17	22	2	-1.7	26	28	33	

7.3	7.5	4	7.6	7.6	7.0	5.7	5	4.9	5.4	5.4	7.9	7.4
33	29	2	-2.7	19	17	15	-0.2	11	17	22	33	

Sp K. in 18" Og K. 40 Lt. 5+9 462+80.

5.7	5.7	6.7	2	6.7	4.8	4.4	4.1	4.6	4.5	5.5	5.6	4.7	5.0
33	29	25	2	-2.6	15	-0.9	11	14	19	21	24	33	

Sta.	+	H.I.	−	Elev.	Cr. Rd.
		1037.20			
463				29.7	4.5
+50				29.4	4.8
464				29.2	5.0
+27				29.1	5.1
+70				29.0	5.2
465				28.9	5.3
T.B.M.			4.95	1029.25	
T.P.	11.69	1045.43	0.46	1033.74	
464				29.2	10.2
+27				29.1	16.3
+70				29.0	16.4
T.P.	1.09	1034.41	12.11	1033.32	
T.P.	1.34	1030.59	5.16	1029.25	
466				28.9	1.7
467				29.0	1.6
T.P.	5.45	1034.70	1.34	1029.25	

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7.1	4.1	6.9	6.6	4.7	4.7	4.6	4.5	5.0	5.2	4/8.6	9.2	
33	32	27	21	16	18	-0.1	10	16	23	-4.1	33	

5.6	5.6	6.1	6.8	5.8	1.5/4.9	4.7	4.8	5.2	6.9	4/6.9	6.6	4.4	5.8
33	32	26	21	18	-0.1	10.1	14	18	19	-2.1	24	27	33

4.7	5.7	5.0	5.0	4.8	5.0	5.0	6.0	5.5	1.2	1.2	
24	18	15	12	10.2	11	15	19	24	32	33	

4.4	5.6	4.9	5.1	5.0	5.3	5.1	5.2	6.4	3/6.6	6.4	4.0	
25	19	15	12	10.1	11	15	16	19	2.3/-1.5	2.7	33	

2.7	6.9	7.3	5.7	5.5	5.1	5.4	6.0/5.7	7.0	8.8	
33	26	21	14	12	10.1	10	-0.5	22	33	

7.1	7.9	7.6	5.5	6.0/5.2	5.1	5.4	5.1	5.4	5.1	5.4	7.5	10.4
46	34	24	17	10.1	14	12	10.2	10	12	17	25	33

7.2	9/5.6	5.0
49.5	4/10.6	37

9/1.7	1.6
4/14.6	38

10.7	12.2
49.5	40

14.3	8.0/13.6	13.4	9.1	2.7	2.0	2.3	2.7	6.2	3.0/11.0			
49.5	3/-11.9	37	24	16	-0.3	10	16	22	3/-9.3			

12.6	11.4	8.5	6.6/2.4	2.4	1.7	2.0	1.6	7/6.3	7.9	9.2		
49.5	33	20	5/-6.8	15	-5.1	11	12	1.6/-1.7	2.7	33		

Sta.	+	H. I.	−	Elev.	Gr. Rod
		1034.70			
+45				29.2	5.5
468				29.4	5.3
+33				29.8	4.9
469				30.0	4.7
469 +50				30.3	4.4
T.P.	9.40	1042.28	1.82	1032.88	
468				29.4	12.9
468 +33				29.8	12.5
T.P.	3.83	1036.71	9.40	1032.88	
470				30.7	6.0
+50				31.0	5.7
471				31.2	5.5
+40				31.2	5.5
472				31.4	5.3

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5	7.6	7.6	8.2	7.9	6.0	5.7	5.4	5.7	5.4	5.7	9.0	8.5	9.2	
25	40	30	27	22	18	1 -0.2	+0.1	11	12	1 -0.2	24	28	33	

Above H.L.

4.3	5.5	5.0	4.9	5.3	5.1	5.5	6.6	6.0	6.3	10.2
24	17	14	+0.4	11	12	15	18	25	2 00	33

(4.9)

3.9	5.1	4.8	4.7	5.0	4.9	5.4	4.6
23	17	15	+0.2	9	1 00	16	23

(4.7)

8.8	8.1	7.0	6.6	4.7	4.9	4.5	4.7	4.2	5.0	4.8	3.3	2.1	1.5
49.5	40	31	21	15	12	+0.2	8	11	15	18	22	+2.6	33

(4.4)

4.7	5.6	5.9	4.9	4.5	4.4	4.6	4.3	4.7	4.3	4.5	6.6	5.3	4.4	4.0
46	2 -1.2	30	17	15	13	12	+0.1	10	10	13	15	2 -0.9	30	33

5.1	4.1	3.8
49.5	3 +8.8	34

3.9	2.2	1.3	1.3	1.7
49.5	4 +10.4	35	37	40

2	4.8	4.7	7.0	7.1	6.5	6.3	6.0	6.3	6.6	7.4	7.6	7.5
5	4 +1.2	27	22	18	17	12	00	11	14	16	2 -1.6	33

5.2	6.4	5.8	5.6	5.7	5.8	6.4	6.2	5.0	5.1	5.4
24	17	14	+0.1	11	15	17	21	24	2 +0.6	33

5.1	6.1	5.6	5.3	5.3	5.4	5.0
22	17	15	+0.2	14	2 +0.1	33

5.2	6.1	5.3	5.3	5.2	5.5	6.1	5.8
23	18	15	11	+0.3	1 00	18	24

5.1	5.7	5.3	5.0	5.3	5.0	5.6	4.2	3.5
21	17	15	+0.3	11	14	17	25	36

Sta.	+	H. I.	−	Elev.	Cr. R.
		1036.71			
426				31.4	5.3
463				31.4	5.3
473				31.4	5.3
474				31.9	4.8
450				32.5	4.2
T.B.M.			3.49	1033.22	
T.P.	11.60	1047.69	0.62	1036.09	
470+50				31.0	16.7
471				31.2	16.5
471+40				31.2	16.5
472				31.4	16.3
472+26				31.4	16.3
T.P.	4.61	1040.44	11.86	1035.83	
T.P.	7.22	1040.44	7.22	1033.22	
B.M.	4.84	1040.46	4.84	1035.58	1035.60
					1035.6

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9.8/33 9.0/29 4.5 2 6.3/-1.0 5.6/22 6.4/19 6.2/17 4.8/13 4.9/+0.4 5.2/16 6.1/18 6.0/20 5.4/22 0.8/27

5.3

12.3/33 11.6/29 5.0/16 4.9/14 5.2/11 4.9/+0.4 5.2/12 5.4/14 7.4/21 7.0/30 3.2/33

5.3

14.1/33 13.7/30 6.0/17 1 5.6 5.6/-0.3 5.0/+0.3 5.2/12 1 6 5.3/0.0 8.3/23 8.1/28 7.8/31 6.1/33

4.8

12.4/33 11.9/28 5.9/18 1 6 0 5.3/-0.5 5.2/15 4.8/0.0 5.0/11 1 5 8 5.2/-0.4 8.9/22 8.9/27 7.7/33

4.2

5.5/33 5.5/31 6.7/29 6.5/22 4.8/18 1 5 0 4.4/0.0 4.5/11 4.3/-0.1 4.5/11 4.3/12 1 6 4 4.6/-0.4 6.8/21 7.4/26 6.8/29 8.2/33

9.7/49.5 9.7/45 5 4.8 10.8/+5.9 11.5/30 16.7

6.4/49.5 8.7 3 8.0/+8.5 9.4/30 16.5

5.4/49.5 4 0.4 6.9/+9.6 8.6/32 16.5 3 3.9 11.2/+5.3 10.3/34

12.6/49.5 10.5/43 5 6.9 9.0/+7.3 6.2/31 16.3 8.9/30 3 3.0 6.8/+9.5 4.0/35 4.1/40

16.3 3 3.0 7.9/+8.4 1.9/38 2.1/43

Spk. in 12" Oak 40' Lt. Sta. 476+05.

Sta.	+	H. I.	−	Elev.	Gr. Rd.
		1040.46			
475				33.3	7.2
+50				34.3	6.2
476				35.3	5.2
+50				36.3	4.2
+80				36.9	3.6
477				37.3	3.2
T.P.	9.93	1048.96	1.43	1039.03	
+50				38.3	10.7
478				39.3	9.7
+60				40.5	8.5
T.P.	6.02	1048.88	6.10	1042.86	
479				41.3	7.4
+40				42.1	6.8
480				43.5	5.4

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1.4	5	7.7	8.2	8.0	7.2	7.1	7.5	7.2	7.4	7.5	9.9	10.1	9.7
33	2	-0.5	22	19	17	13	11	00	11	-0.3	21	27	28	33

1.8	2.2	7.3	4	7.4	7.8	6.6	6.6	6.2	6.6	6.1	6.2	6.6	9.2	9.4	9.6	7.5
33	32	24	2	-1.2	21	17	12	00	11	12	00	16	22	23	24	33

6.0	6.0	9.0	2	8.7	5.7	5.8	5.5	5.8	5.5	5	5.6	6.5	11.6	12.1
33	32	27	2	-3.5	15	12	-0.3	12	12		-0.9	18	24	33

11.2	11.1	10.4	6	4.8	4.8	4.5	4.8	4.9	6.4	8.0	10.2	10.7	11.1	11.2
33	30	27	1	-0.6	12	-0.3	11	16	19	22	25	8	-6.5	27	33

7.8	7.1	4.1	3.9	4.2	3.7	4.2	3.8	4.1	5.7	6.0	5.0	5.0
33	21	15	13	12		12	12	18	23	25	27	33

4.9	4.8	5.3	5.8	3.6	3.7	3.2	3.6	3.5	4.5	4	4.6	4.0	0.9
33	28	26	20	14	11	00	12	14	19	4	-1.5	27	33

5.2	11.3	11.7	10.6	10.8	10.5	10.7	10.9	10.4	11.0	10.2	3	2.9	2.8
33	25.1	19	15	12	10.2	12	13	18	23	3	-1.8	35

2.8	3	4.3	9.8	10.5	9.5	9.3	9.7	9.3	9.4	9.9	9.0	3	1.9	1.4
35	3	-5.4	24	19	16	13	12	10.4	12	17	24	3	-1.8	34

7.9	8.4	3	7.9	9.8	8.5	8.1	8.4	8.0	9.4	9.6	8.8	3	1.4	5.5
33	31	2	-1.4	18	15	10.4	11	14	18	21	24	3	-5.1	26

15.1	7.9	2	7.7	7.6	7.1	7.2	7.4	8.2	4	8.5	8.4	7.6	7.8
33	19	1.5	-1.1	12	10.5	13	17	22	4	-0.9	28	30	34

20.0	3	3.9	18.9	6.9	6.5	6.6	6.8	12.0	12.4
40	3	-12.1	14	10.3	10	16	24	33

21.0	20.8	3	16.1	6.2	5.7	5.4	5.5	5.2	4	5.4	10.0	10.1
48	40	3	-10.7	16	12	00	10	12	4	00	25	33

Sta.	+	H. I.	−	Elev.	Gr. No
		1048.88			
+50				44.7	4.4
T.P.	10.14	1052.56	2.46	1046.42	
481				46.1	10.5
+50				47.5	9.1
482				49.0	7.6
+50				50.7	5.9
483				52.3	4.3
+50				54.1	2.5
T.P.	10.50	1066.17	0.89	1055.67	
484				55.4	10.4
+50				56.7	9.5
485				57.4	8.8
+50				57.7	8.5
486				57.5	8.7

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15.3	13.5	4.9	5.4	4.4	4.2	4.6	4.1	4.3	4.4	4.0	4.1	5.5	4.5	5.2	3.4	2.9
40	32	17	15	-0.2	13	12	10.1		10	11	14	18	2.8	-1.7	26	27	33

13.1	11.3	12.4	12.2	10.4	10.2	10.6	10.1	10.5	10.3	9.8	10.2	11.5	5.9	10.8	5.8	4.0
33	24	22	17	16	13	13	10.4		10	11	15	19	2.5	-0.3	30	33

11.7	8.9	10.7	10.2	10.0	9.1	8.5	9.1	8.6	8.2	9.2	8.6	4.9	8.2			
33	2.8	-1.6	19	15.0	9.1	10.6		10	14	18	26	3.3	-15.7			

11.3	10.1	7.6	7.4	7.9	7.2	7.6	7.6	7.9	6.3		5.7					
33	23	18	13	12	10.4		12	2.4	+1.3		39					

11.7	11.5	6.3	6.3	5.7	5.9	6.2		5.5								
33	26	14	11			11		33								

2.0	8.3	4.4	4.5	4.7	4.3	4.7	4.3	5.5	4.6		4.8					
33	25	17	15	11	10.4	12	13	2.5	-0.3		31.5					

1.7	4.3	3.6	4.0	5.0	2.5	2.3	2.6	2.1	2.7	2.2	2.7	2.4				
33	2.1	-1.1	20	1.5	0.0	14	11	10.4	13	14	2.5	-0.2	32			

4.0	6.5	3.6	3.6	10.4	11.1	10.3	10.5	10.0	10.6	9.5	9.6	8.3				
40	3.1	+7.0	33	24	17	15	12	10.6	15	2.4	11.0	32				

3.3	4.6	2.6	3.4	9.2	9.6	8.7	8.5	9.5	8.5	4.8	7.9	6.5				
40	3.6	+6.9	34	24	17	13	11.2	14	2.4	11.6	32.4					

3.7	5.1	3.4	9.0	7.7	8.0	7.6	8.5	7.5	6.1		5.1					
40	34	2.6	10.2	21	16	12	11.2	15	3.0	12.7	32					

6.4	5.7	8.8	4.7	9.2	9.1	7.9	7.7	7.6	7.7	5.5	5.5	4.4				
40	33	27	2.6	-0.7	17	15	13	-0.8	16	3.3	13.0	32.5				

8.2	10.6	10.5	9.0	8.7	8.7	8.7	8.5	7.2	6.1							
33	27	19	15	0.0	1.5	10	23	2.8	+1.5	32						

Sta.	+	H. I.	−	Elev.	Gr. Rod
		1066.17			
+50				56.9	9.3
487				56.1	10.1
T.P.	3.73	1059.83	10.07	1056.10	
+50				55.3	4.5
488				54.5	5.3
+50				53.6	6.2
489				52.5	7.3
+53.2				51.1	8.7
490				49.6	10.2
T.P.	6.17	1057.36	8.64	1051.19	
+50				47.7	9.7
491				45.9	11.5
B.M.	3.93	1049.72	11.57	1045.79	
+60				43.3	6.4
492				41.3	8.4

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9.3

8.6 8.5 11.1 10.9 9.6 9.4 9.6 9.3 8.2
33 32 26 22 14 +0.1 15 0.0 32

10.1

7.8 10.5 11.6 11.4 10.5 10.4 10.3 10.4 9.9 9.6
33 29 -1.5 19 16 12 +0.2 15 +0.2 31

4.5

1.3 5.5 5.4 5.8 4.8 4.9 4.8 5.2 5.1 6.3 6.7 6.4
33 26 -1.4 18 15 11 -0.3 12 -0.6 21 27 32

5.3

1.7 5.4 6.5 6.5 5.3 5.6 5.3 5.7 6.3 11.6 12.3
33 28 -1.2 19 16 11 0.0 -0.4 19 27 33

6.2

2.8 6.7 7.4 7.3 5.9 6.1 6.0 6.4 6.4 11.9 12.3
33 28 -1.2 19 15 11 +0.2 12 -0.2 26 33

7.3

4.3 6.9 7.6 7.9 7.1 6.8 6.8 7.2 8.2 8.2
33 28 -0.3 17 14 14 +0.5 15 -0.9 33

8.7

1.3 1.2 1.2 8.9 9.6 8.4 8.4 7.9 10.4 10.4 8.3
40 +7.5 34 24 18 15 +0.3 14 17 -1.7 33

10.2

1.2 2.0 2.0 10.3 11.2 9.6 9.9 9.9 10.5 11.6 11.6 11.2 9.6 9.9
49.5 +8.2 32 23 17 14 13 +0.3 14 17 -1.4 24 29 33

9.7

2.0 1.2 9.1 9.4 8.9 8.8 7.3 9.2 9.6 10.7 10.7 9.0 10.0
+7.7 34 23 17 15 12 10 +0.5 14 16 -1.0 29 33

11.5

1.3 1.9 1.5 10.8 11.6 11.2 11.3 11.2 11.7 12.5 12.7 12.3 12.1
33 +9.6 33 23 20 14 12 +0.3 13 16 22 -0.8 33

Spk in 8" Oak 33' Lt. Sta. 490+93.

6.4

+0.6 +0.2 2.0 7.4 7.8 6.6 6.5 6.9 7.5 7.5 6.7 4.6
49.5 +6.6 31 23 20 14 -0.1 13 15 21 -0.3 33

8.4

5.5 6.7 6.7 9.4 9.4 9.0 8.8 8.4 8.7 8.6 9.6 9.2 8.2 6.3 5.4
+2.9 40 32 27 21 16 12 0.0 11 15 18 21 23 +2.1 33

Sta.	+	H. I.	−	Elev.	Cr. Rod
		1049.72			
+50				38.8	10.9
T.P.	2.68	1042.80	9.60	1040.12	
493				36.3	6.5
+50				33.8	9.0
T.P.	5.42	1040.36	7.86	1034.94	
494				31.3	9.1
T.P.	2.07	1035.20	7.23	1033.13	
+60				28.3	6.9
495				26.3	8.9
T.P.	0.49	1026.65	9.04	1026.16	
+17				25.4	1.3
T.P.	0.51	1021.07	6.09	1020.56	
496				21.3	−0.2
497				16.4	4.7
+50				14.2	6.9
498				12.2	8.9
T.P.	2.22	1013.94	9.35	1011.72	
+50				11.4	3.5

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9.5	7.1	8.3	12.2	12.5	11.4	11.9	10.9	10.9	11.2	11.5	12.9	11.9	8.1	8.2
4	+1.8	34	28	18	15	12	0.0		12	17	20	26	33	34
8.1	6.2	7.2	7.9	9.6	9.1	8.1	6.6	7.3	6.5	6.3	6.9	6.8	8.1	8.5	8.2	10
34	34	27	24	23	20	19	14	13	0.0		11	15	21	3 -2.0	24	33
4.1	6.8	10.7	11.7	11.6	10.0	9.0	9.6	8.9	9.0	9.5	8.8	10.0	10.1	10	3	11.8
49	41	37	35	28	19	14	13	+0.1		11	13	18	23	32	3	+7.2
5	7.2	8.5	8.6	9.9	11.7	11.6	10.5	9.4	8.9	9.1	9.6	8.8	9.8	9.7	1.5	3	11.5
	11.9	52	45	30	20	17	17	13	+0.2		12	15	16	22	31	3	+7.6
4	6.6	3.6	8.2	10.3	10.2	8.1	7.2	6.9	6.9	7.4	6.8	8.4	8.7	10	3	11.1
4	10.3	48	42	30	17	17	12	0.0		12	15	18	21	30	3	+4.8
	10.9	9.9	10.1	13.7	13.2	9.6	9.1	8.8	9.5	9.0	9.4	10.9	10.8	8.3	3	11.1
5	48.9	39	25	21	20	18	14	13	-0.4		12	19	18	22	25	3	+1.8
4	5.6	5.4	3.8	2.2	3	1.6	1.8	2.5	1.8	1.3	2.3	1.9	3.2	4.0	4.0	3.2	3.4
	25	23	21	18	1	-0.3	14	13	-0.5		11	13	20	22	24	27	33
	8.4	8.3	8.4	0.0	0.0	0.5	0.5	0.2	1.0	1.7	11.4	3	11.4	11.6	
	35	33	30	17	14	13	-0.7		14	16	32	3	-11.6	35	
	9.9	9.4	4.8	3	4.7	4.7	4.7	4.3	4.9	3	4.7	8.1	8.6	7.9	8.8
	33	25	17	1	0.0	13	0.0		11	1	0.0	21	25	28	33
	10.2	9.3	6.9	6.7	7.0	6.7	6.9	7.0	8.1	8.2	5.8	5.7	5	5.2	6.0
	33	24	17	15	12	+0.2	13	17	22	24	27	8	+1.7	33
	10.2	11.2	11.8	11.1	3	8.9	8.4	8.9	8.0	10.8	10.9	10.5	11.2
	33	30	24	20	1	0.0	+0.5	12	15	17	22	27	33
	4.0	4.0	5.9	6.0	3.3	3.0	3.4	3.0	3.5	3	3.5	8.3	9.2
	33	32	30	21	15	13	12	+0.5	12	3	0.0	24	33

Sta.	+	H. I.	−	Elev.	Cr. Rod
		1013.94			
499				08.7	5.2
B.M.	11.50	1013.01	12.43	1001.51	
+50				07.1	5.9
500				05.7	7.3
T.P.	1.49	1005.98	8.52	1004.49	
+50				04.4	1.6
501				03.4	2.6
+34				02.7	3.3
+50				02.5	3.5 3.1
T.P.	3.36	1004.86	4.48	1001.50	
502				01.8	3.1
+50				01.1	3.8
+78				00.7	4.2
503				00.3	4.6
+44				99.5	5.4

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4.1	6.4	1	7.1	6.4	4.5	7.4	7.9	4.5	5.2	4.9	6.4	4	6.4	7.7					
32	29	2	-1.9	20	16	12	11	10.7	15	21	28		-1.2	33					
4.0	7.6		7.8	7.6	7.2	5.2	5.1	5.7	5.2	5.9	5.5	7.1	3	5.9	5.1	5.8			
28	25	3	-1.9	22	21	15	12	11	10.7	14	19		-1.0	27	33				
2.5	7.7	4	8.1	8.2	6.7	6.7	7.2	6.8	7.3	7.1	7.4	8.2	6.3	5	7.8	9.4			
33	28	2	-0.8	21	14	12	11	10.5	15	17	19	23	4	-0.3	35				
Above H.I																			
14.4	10.7	2.7	2.7	1.3	1.1	1.5	1.2	1.6	1.8	4.8	5.4	6	6.2	7.3	8.0				
33	31	27	22	18	14	12	10.4	15	21	24	28		-7.4	30	33				
Above H.I.																			
14.4	16	4.7	2.7	2.5	2.3	2.5	2.6	2.9	5.1	5.3	5.5	2.8	2	4.1	5.0				
42	33	29	25	21	8	10.1	8	13	17	18	21	28		-0.9	33				
8.0	7.4	5.4	5.3	2.9	3.2	3.3	5.9	5.6	2.7	5.3	5.2								
50	44	37	32	18			4	8	13	24	33								
11	10.1	5.5	4.3	3.4	3.1	3.7	7.8	3.5	7.5	4.8	5.2	3	4.7	4.5					
57	50	46	43	38	26	7	-4.7	4	9	23	28		-0.8	30					
10.4	9.5	2.5	2.4	2.9	11.6	12.2	9.7	3.1	7.7	5.9									
90	84	73	58	40	20	-9.1	14	23	-3.4	33									
2.8	2.5	11.5	12.7	12.8	3.8	11.1	9	10.4	10.0										
88	83	66	50	-9.0	25	29	-5.6	33											
2.7	2.5	12.4	12.8	12.5	12.2	11.1													
77	74	54	37		21	33													
3.1	3.2	11.6	12.2	10.2	10.8	1	10.6	10.7											
65	59	38	23	-5.4	21	28	-5.0	33											
4.2	4.2	5.0	8.5	5.4	5.0	7.5													
28	27	15	8		17	33													

Sta.	+	H. I.	-	Elev.	Gr. Ro
		1004.86			
+50				99.3	5.4
+64				99.0	5.9
5+04				98.4	4.9
+50				97.0	
+85				95.7	9.
B.M.			3.36	1001.50	

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(5.6)

4.4	4.3	4.9	9.1	9.1	7.8	5.7	4.4	5.9	4	6.1 x	6.5
26	24	19	10	4	-2.2	5	19	28	0. 3	+0.5	33

(5.9)

4.9	4.8	4.7	9.1	9.8	9.2	6.2	4.5	5.4
17	16	11	4		7	13	28	33

(6.7)

5.9	5.8	5.7	5.9	9.8	9.6	6.4	4	5.6 x	5.6
4	3	+1.0	3	10	20	26	2. 3	+1.8	33

7.4	7.4	7.5	7.2	9.0	9.0	5	9.0 x	8.9
	7	8	13	18	27	8. 2	-0.7	33

8.5	8.5	8.3	8.4	11.2	11.0	6	8.0 x	8.4
	9	10	14	19	23	9. 2	+12	33

Sta.	+	H.I.	−	Elev.	Cr. Rd
B.M.	4.51	997.95		993.44	
404				93.5	4.5
405				93.2	4.8
406				92.9	5.1
+45				~~93.0~~	~~5.0~~
407				92.9	5.1
+45				93.0	5.0
408				92.3	4.7
T.P.	5.70	998.69	5.16	992.99	
409				94.1	4.9
B.M.			6.61	992.08	
410				95.6	3.1
+50				96.7	2.0
+90				97.1	T.C
T.P.	8.91	1006.54	1.04	997.63	
411				97.9	8.7

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Nail in R.R. Lt. Sta. 404+20.

4.9 5.7 7.6 7.6 5.9 4.7 1.9/4.6 4.1 4.7 5.0 4.8/5.3 5.3
33 25 24 22 20 14 1/00 10.4 11 15 2/-0.8 33

5.8 6.0 7.8 7.8 6.3 5.8 1.7/4.9 4.3 4.6 4.4 1.0/4.9 6.2 6.2
33 24 22 21 20 18 5/00 10.5 9 15 7/00 20 33

7.6 1.9/7.5 7.2 5.7 4.8 5.2 1.0/5.2 5.6 6.8 7.6 7.8
33 1/-2.3 17 15 10.3 10 5/00 17 19 26 33

~~8.0 8.0 8.6 1.0/8.0 7.5 5.3 4.8 1.8/5.4 5.5 7.4 8.0 8.3~~
~~33 24 22 2/-3.0 17 14 10.2 5/-0.4 17 22 26 33~~

8.4 7.9 8.5 7.4 1.6/5.4 5.2 4.9 5.2 1.2/5.2 5.3 7.3 7.9 8.0
33 25 24 19 1/-0.3 15 10.2 13 5/-0.1 18 22 26 33

6.8 1.0/5.5 4.9 5.3 5.0 1.0/5.0 5.0 7.1 7.3 7.5
33 6/-0.5 10.1 9 11 6/00 19 22 26 33

6.7 7.1 9.1 8.8 7.3 5.9 1.8/5.1 4.7 5.0 1.9/4.7 4.9 7.1 7.4 7.6
33 27 24 22 21 18 5/-0.4 00 10 5/00 17 22 26 33

9.3 9.0 3.4/8.8 8.8 6.5 5.3 4.8 5.0 1.6/4.9 5.1 7.8 8.4
33 27 2/-4.2 22 17 15 -0.4 12 5/-0.3 17 24 33

Spk. in Tree Lt. Sta. 407+15.

10.0 9.9 5.7 5.3 3.8 5.9 7.0 6.8/9.0 9.6
26 23 15 -0.2 15 20 23 2/-5.9 33

9.7 9.4/9.3 9.1 8.1 2.6 2.0 2.5 1.4/2.3 3.1 7.1 7.8
33 2/-7.3 28 26 16 00 10 5/-0.3 18 24 33

7.8 6.0 1.6 0.9 1.3 1.1 2.9 5.0 5.1
33 22 15 11 18 22 24 33

11.4 10.5 6.0/7.2 8.9 8.5 8.7 6.3/8.7 12.0 12.1 12.5
33 25 1/-0.5 14 10.7 13 1/00 23 25 33

Sta.	+	H. I.	−	Elev.	Gr. Rd
		1006.54			
+35				98.9	7.7
+40				97.1	7.5
412				1000.9	5.7
+50				02.5	4.1
413				04.0	2.6
T.P.	8.38	1013.33	1.61	1004.95	
+50				05.6	7.6 7.7
414				07.0	6.0 6.3
+50				07.7	5.2 5.6
415				07.9	4.7 5.4
+50				07.8	4.4 5.5
416				07.0	5.4 6.3
+50				05.7	6.7 7.4
T.P.	11.85	1021.94	3.24	10 10.09	

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11.8	11.1	8.8	7.7	7.4	8.0	7.4	
33	22	17	10		21	33	

11.7	10.6	8.5	7.6	7.3	7.7	7.6	8.3	5.7	4.9
33	22	17	11	10	12	1 -0.1	22	25	33

7.5	7.0	7.0	6.3	5.4	5.6	6.3	6.2	0.6
33	2 -1.3	20	10	8	15	18	22	27

4.8	4.6	5.0	4.9	4.4	3.8	4.2	3.5
33	2 -0.9	23	20	10	3	4	17

2.8	3.9	3.1	2.6	2.3	2.4	2.2	
33	31	2 -0.3	15	7	0.3	7	17

7.5	8.8	7.0	8.4	8.2	7.8	7.6	7.6	7.8
33	31	29	2 -0.8	21	13	10.1	8	15

5.4	5.4	7.7	7.5	7.1	6.7	6.5	6.6	6.6	6.3
33	31	28	3 -1.5	22	14	10.2	10	1 0.0	17

6.3	6.4	6.0	5.6	5.7	5.6	5.1	
33	2 -1.2	15	0.0	12	15	29	

7.0	6.4	6.1	5.3	5.0	7.9	4.5	4.0	1.7	1.0	
33	2 -1.7	21	12	10.4	1 +1.3	24	26	29	3 +5.2	

7.0	6.1	6.9	6.9	5.3	5.1	5.1	5.6	5.7	5.3	0.0
33	27	24	24	19	1 -0.3	10.4	14.1	+0.9	26	29

8.2	9.2	8.9	6.0	5.8	5.9	6.2	6.4	5.9	3.0	
33	32	27	22	1 -0.4	10.4	13	15	17 +1.5	26	

8.9	7.8	6.9	6.0	6.7	6.6	7.2	7.2	7.9	6.7	3.8
40	33	29	2 0.0	15	10.4	10	14	1 +2.0	20	3 +6.0

Sta.	+	H. I.	−	Elev.	Gr. R
		1021.94			
412				1000.9	21.0
+50				02.5	19.4
413				04.0	17.9
+50				05.6	16.3
414				07.0	14.9
+50				07.7	14.2
415				07.9	14.0
+50				07.8	14.1
416				07.0	14.9
T.P.	0.07	1010.16	11.85	1010.09	
B.M.			9.09	1001.07	
B.M.			5.35	1004.81	
417				04.2	52.60
+50				02.7	6.9 7.5

02.7

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3°/3 13.4/+7.6 12.1/34

7.5/31 3°/3 6.9/+12.5 6.5/35

3°/3 8.3/+9.6 5.5/35 1.5/45 1.9/50

6.2/31 3°/3 3.8/+12.6 2.1/35 2.4/40

3°/3 3.9/+11.3 4.3/36 4.0/40

3°/3 9.0/+5.6 5.4/35 5.2/40

5.9/35 5.5/40

5.9/31 3°/3 5.7/+9.5 5.2/40

8.3/26 3°/3 7.6/+8.4 7.3/40

Spk. in Twin Oak Lt sta. 416+90.

8.1/43 6.4/37 5.4/33 6'/2 5.1/+0.1 5.1/14 5.9/+0.1 5.5/12 6.5/15 5/1 6.2/+0.8 6.1/20 3.0/23 3/3 3.1/+3.9 2.7/40

7.3/37 7.2/24 6°/6 6.9/00 6.9/15 7.4/+0.1 8.0/13 7.6/14 5.6/1 7.5/+0.6 7.6/18 8.1/21 8.5/22 5.0/25 0/3 5.3/+2.8 5.5/50

Sta.	+	H.I.	−	Elev	Cr.	No
		1010.14				
418				101.2	8.7	9.0
T.P.	8.88	1009.94	9.10	1001.06		
+50				99.7		10.2
419				98.2	12.0	11.7
T.P.	2.77	1000.64	12.07	997.87		
418+50				99.7		− 0.9
419				98.2	2.7	2.4
+65				96.3	3.0	4.3
420				95.4	6.2	5.2
+50				94.8	7.4	6.8
421				93.6	8.1	7.0
T.P.	4.18	997.25	7.57	993.07		
+50				93.0	5.4	4.8
422				92.7	5.7	4.4
+50				92.6	5.8	4.7

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11.8	7.6	9.5	4/9.1	8.2	8.6	8.8	5/9.1	9.7	9.7	8.3	6/8.1	8.3	
33	30	27	2/-0.4	24	16	+0.2	1/+0.2	20	24	27	2/+1.2	33	

10.5	2/10.3	10.4	10.2	10.7	11.0	10.9	3.5	9/4.6			
17.5	1/-0.1	14	0.0	13	15	20	31	3/+0.2			

12.2	12.0	12.0	12.0	12.6	12.6	11.7	9/6.1	1.6		
11	-0.3	15	19	20	21	24	3/+5.3	36		

11.5	11.3
33	30

3.0	12.3	10.8	5.7
3/-9.6	25	13	

11.5	4/11.2	10.8	9.7	5.1	5.0	5.5	5.2	4.7	4.8	5.0	9/4.7	4.5	5.7
33	2/-6.2	27	18	11	8	6	-0.9	12	16	20	4/-0.7	27	33

11.6	6/11.1	10.1	8.1	6.8	6.3	5.8	4/6.1	5.7	5.7	9.7
33	2/-4.7	21	17	13	7.1	9	1/-1.7	21	25	33

11.6	4/10.6	9.9	7.8	6.6	7.0	6.8	12.5	2/12.5	12.5	
33	2/-3.2	21	17	-0.3	11	16	27	2/-7.1	33	

7.0

10.5	8/8.9	7.6	7.3	7.3	7.5	7.7	12.6	6/14.4	14.4	
33	2/-0.8	25	11	-0.3	4	9	17	3/-8.3	33	

4.3

6.0	9/5.0	4.1	4.5	4.4	6.2	9.1	2/10.5	10.6		
33	2/+0.4	13	-0.2	4	9	14	2/-7.1	33		

4.6

5.5	9/5.4	4.3	4.5	4.8	8.7	6/7.4	9.7		
33	2/-0.3	15	+0.1	4	14	2/-5.7	33		

4.7

6.0	9/5.8	4.8	4.9	5.1	7.6	4/8.5	8.8		
33	2/0.0	14	-0.2	7	12	2/-4.7	33		

Sta.	+	H. I.	−	Elev.	Gr. N
		997.25			
423				92.6	3.7 4.7
+50				92.6	3.3 4.7
424				92.5	3.1 4.8
+50				92.5	4.7 4.8
425				92.4	4.7 4.7
+50				92.4	4.6 4.9
T.P.	4.44	996.75	4.94	992.31	
426				92.3	4.0 4.5
+50				92.3	3.7 4.5
427				92.2	3.7 4.4
+50				92.4	3.5 4.4
428				92.8	3.1 4.0
+50				93.7	2.2 3.1
B.M.	7.58	1100.70	3.63	993.12	

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	5.7	4/6.0	5.6	5.0	4.7	4.8	4.7	5.0	6.6	2/7.5	7.7	
33	2	09	24	1.78	10	0.1	6	11	2	-36	33	

5.5	5.9	6.6	4/6.7	6.4	5.4	5.1	4.8	4.7	5.7	9/6.2	6.9	
33	28	27	2/-1.3	22	19	15	-0.1	15	1	-2.0	33	

4.9	4/4.8	4.8	5.8	5.7	5.4	4.9	4.8	5.4	5.4	1/6.4	6.0	6.1
33	2	10.3	24	20	15	12	-0.1	14	21	-1.9	26	33

4.5	3/4.7	4.9	5.2	5.6	5.3	5.1	4.9	5.1	8/5.6	6.8	6.5	5.7	5.7
33	2	10.2	17	15	14	7	-0.3	10	15	-2.8	28	31	32	33

	5.0	7/5.1	4.7	4.9		4.8	5.4	7/5.2	5.4	6.5		
33	2	-0.2	15	0.0		15	26	2	-0.2	27	33	

4.6	4.3	6.5	4/5.8	4.9	5.2	5.2	4.8	5.4	6/5.2	5.5	6.4	
33	30	22	1.7/-1.2	13	9	-0.3	16	24.2	0.0	30	33	

	9.0	3/8.0	7.9	4.8	4.5	5.1	5.2	5.6	5/5.9	7.7	8.2	
33	2	-4.0	22	15	0.0	15.4	20	24	2	-0.7	29	33

	5.9	5.2	6/4.7	4.3	5.0	5.9	5.5	8/5.9	7.4	10.0		
33	21	4	-1.0	15	-0.5	13	14	1.7	-0.5	26	33	

4.8	6/5.0	5.0	6.0	6.4	6.7	7.4	9.9	2/10.8	11.4			
33	1.7	-1.3	15	-1.4	9	14	17	21	2	-5.1	33	

4.4	5.0	5.0	6.5	7.9	11.5	6/11.9	12.3					
33	1.8	-1.5	19	-1.9	15	22	2.7	-6.4	33			

6.7	6.5	4.4	4/4.4	5.2	5.8	5.9	10.8	0/11.1	11.4			
33	30	26	1.7/-1.3	-1.2	10	15	26	2.9	-6.0	33		

9.0	9.0	7.4	5.9	3.6	6/5.5	3.7	4.9	6.1	10.2	4/10.4	10.7	
33	31	29	27	23	1.7/-1.3	-0.6	14	17	24	2.9/-6.2	33	

Sta.	+	H.I.	−	Elev.	Cr. Ro
		1000.70			
429				94.7	5.0 5.8
B.M.			6.16	994.54	
+50				96.3	3.9 4.4
+74				97.0	3.7
T.P.	8.39	1006.27	2.82	997.88	
430				97.7	3.3 3.6
+50				99.1	7.2
431				00.5	5.8
+50				01.8	4.5
432				03.0	3.3
+50				04.0	2.8
T.P.	7.40	1011.70	1.97	1004.30	
430+50				99.1	12.6
431				00.5	11.7
431 +50				01.8	9.9

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10.5/33 10.7/27 4.4/4 9.8/-4.6 9.2/21 6.3/16 6.1/-0.3 6.9/13 7.5/16 12.4/25 9.6/4 13.1/-6.4 13.5/33

Spk in 12" Tree Lt. Sta. 429+30

1.9/33 1.9/31 5.8/25 9.6/1 6.2/-2.3 4.7/15 4.4/00 5.0/14 5.9/1 5.1/-0.2 5.6/18 10.5/29 10.9/33

Above H. I.

+1.0/33 +1.0/32 0.0/31 5.1/25 5.3/19 3.8/16 3.5 4.4/14 5.4/18 7.8/27 8.3/33

4.9/33 9.9/26 10.5/22 9.9/18 5.4/1 8.5/-0.2 8.2/+0.4 8.7/13 6.6/1 9.7/-0.8 12.9/33

7.9/23 8.6/18 5.0/1 7.2/00 6.9/+0.3 7.5/14 10.0/19 0.6/4 10.1/-2.8 9.9/23 8.5/26 8.8/33

5.6/24 6.7/18 5.0/1 5.8/00 5.6/+0.2 6.2/13 8.0/17 9.8/1 8.2/-2.4 8.5/23 4.1/29 4.3/33

4.7/22 5.5/18 5.0/1 4.3/+0.2 4.3/+0.2 4.8/14 7.0/19 0.4/4 7.2/-2.7 6.9/25 4.0/29 4.2/33

4.5/24 4.8/18 5.2/1 3.4/-0.1 3.2/+0.1 3.6/13 6.0/19 1.2/4 6.4/-3.1 6.2/26 4.3/29 4.5/33

3.1/25 3.6/19 5.2/1 2.3/00 2.1/15 1.9/+0.4 2.5/14 1.2/4 5.4/-3.1 5.3/24 4.3/29 4.7/33

4.9/33 4.9/32

1.8/35 1.8/33

1.3/35 1.3/33

Sta.	+	H. I.	-	Elev.	Cr. Rd
		1011.70			
432				03.0	8.7
432+50				04.0	7.7
433				04.9	6.8
+50				05.4	6.1
434				06.2	5.5
+50				06.7	5.0
435				07.2	4.5
+50				07.6	4.1
436				08.1	3.6
+50				08.5	3.2
T.P.	5.63	1017.49	2.84	1008.84	
437				08.9	5.4
+50				09.3	5.7

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4.1	4.1
35	33

3.3	3.1
35	32

6.4	8.5	8.4	4	x 7.1	6.8	6.5	4	x 7.1	8.7	9.5	8.8	7.6	7.8
33	27	18	1.5	-0.3	14	+0.3	1.5	-0.3	19	24	24	28	33

8.8	7.8	8	x 6.5	6.3	5.7	9	6.1	7.1	7.7	4	x 7.7	7.3	6.1	6.7
33	24	1.5	-0.4	14	+0.4	1.5	00	18	22	2.3	-1.6	24	28	33

9.1	8.2	4	7.2	5.6	5.2	0	x 5.5	6.7	2	x 6.7	6.3	3.2	3.5
33	23	1.8	-1.7	14	+0.3	1.5	00	19	2.4	-1.2	27	30	33

8.8	4	x 7.3	5.6	5.2	4.6	4.9	6.1	9	x 5.7	5.5	1.5	1.4
33	1.9	-23	16	13	+0.4	15	18	2.4	-0.7	24	32	33

7.6	2	x 6.6	4.7	4.3	4.5	4.6	6.2	6.1	9	x 5.9	4.3	2.4	2.4
33	1.9	-21	12	+0.2		14	18	23	2.3	-1.4	28	32	33

6.3	4	x 5.8	5.8	4.3	4.2	4.1	4.5	5.6	7	x 5.6	5.3	3.3	3.2
33	1.4	-1.7	17	13	-0.1		15	18	2.3	-1.5	27	31	33

7.0	0	x 6.6	6.5	3.8	3.8	3.6	4.1	4.1	5.4	5.5	3.4	3.3
33	2.1	-3.0	19	13	-0.2		12	15	18	25	30	33

5.2	9	x 4.8	4.7	3.2	3.1	3.4	5.1	3	x 5.0	4.7	2.7	2.1
33	1.8	-1.6	19	14	+0.1	15	19	2.3	-1.8	25	28	33

5.4	4.9	7.7	7.3	0	x 5.6	5.4	6.0	7.1	4	x 7.2	7.0	4.6
33	27	23	20	1.6	00	+0.2	15	17	2.8	-1.6	27	33

3.0	3.0	7.2	7.2	9	x 5.2	5.0	5.1	6.4	6.2	8	x 5.6	3.1
33	31	24	20	1.5	00	+0.2	13	18	23	2.5	-0.4	33

Sta.	+	H. I.	−	Elev.	Gr. Rod
		1014.49			
438				09.7	4.8
+30				09.9	4.6
+70				10.3	4.2
439				10.5	4.0
+70				11.1	3.4
B.M.			6.51	1007.98	
440				11.3	3.2
	8.41	1020.14	2.74	1011.73	
+40				11.7	8.4
441				12.2	7.9
+50				12.7	7.4
442				13.2	6.9
+50				13.7	6.4
+43				14.2	5.9

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9	1.9	4.9	4	6.0	6.5	6.6	5.0	4.9	5.3	4	6.4	7.4	7.4
3	30	27	4	-1.2	22	19	17	-0.1	15	3	-1.6	30	33
	5.4	5.6	6.2	6.3	4.9	5.1	5.1		5.7	7.0	10.2	10.8	
	33	26	23	20	16	13			16	19	24	33	
	8.4	8.0	1	7.2	7.2	5.0	5.2	6.1	8.5	10.3	4	10.4	10.8
	33	24	4	-3.0	20	14	-1.0	16	22	25	2	-6.2	33
	8.7	7.6	4	6.7	6.3	5.0	5.0	5.9	10.4	2	11.1	11.6	
	33	25	2	-2.9	18	14	7.0	17	24	4	-7.1	33	
	6.9	6.1	1	4.6	4.2	3.8	4.5	8.0	2	0.0		10.3	
	33	25	7	-1.2	14	-0.4	16	24	8	-6.6		33	
	1.7	1.7	5.3	5.3	4	3.4	3.2	6	3.7	9.0		10.1	
	33	29	25	19	6	-0.2	00	1	-0.5	28		33	
5.4	4.9	10.3	10.3	8	8.8	8.6	8.4	8.7	9	6.1		11.1	12.4
33	27	23	20	5	-0.4	15	00	14	1	-2.1		21	33
3	7.7	8.5	8.7	9.6	9.4	8.1	7.9	8.2	9.3	9.7	8.5	3	1.0
3	7.8	26	21	20	18	14	00	15	18	21	26	3	33
	10.5	9.1	8	8.9	8.9	7.8	7.4	7.8	9.0	8.0	3	2.4	2.4
	33	24	1	-1.5	17	14	00	14	18	27	5	+5.0	33
	3	8.8	8.6	6.8	7.1	6.8	6.9	7.1	8.1	8.3	7.5	5	5.8
	3	-1.9	17	14	11	+0.1	14	14	17	25	30	3	33
3	7.1	6.6	7.9	7.6	6.2	6.4	6.2	6.4	6.5	7.5	7.6	6.8	3	3.9	4.0
3	-0.7	24	24	18	15	11	+0.2	13	18	23	29	3	+2.5	33
3	4.7	4.5	7.0	7.1	5.7	5.7	5.9	6.0	7.0	7.1	6.5	3	2.8	4.8
3	7.2	27	24	20	14	+0.2	14	18	22	28	3	+2.1	33

Sta.	+	H. I.	−	Elev.	Gr. Rd
		1020.14			
+32				14.5	5.6
+60				14.8	5.3
444				15.4	4.7
	8.32	1023.40	5.04	1015.08	
+50				16.4	7.0
445				17.7	5.7
+50				19.3	4.1
+77				20.3	3.1
T.P.	10.22	1031.87	1.75	1021.65	
446				21.1	10.8
+50				22.9	9.0
447				24.7	7.2
+50				26.5	5.4
448				28.1	3.8
T. P.	10.10	1040.02	1.95	1029.92	

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(5:16)

4.0	4.0	4.2	5.2	5.5	5.3	5.7	6.7	6.9	6.2	1.7
33	28	21	17	12		15	18	24	28	34

4.8	2 0/4.8	5.0	6.4	6.3	4.9	5.0	0/5.5	6.0	6.4	3 0/7.0	7.2
35	3 +0.5	27	24	18	15	+0.3	1 0.0	19	27	3 -1.7	35

9.7	9.7	8.7	7 0/5.7	4.8	10 0/4.7	5.2	9.3	10.0	10.2	
35	28	23	1 -1.0	-0.1	10 -0.5	17	25	28	33	

13.0	12.7	6 0/12.4	12.3	8.1	7.7	7.5	7.7	7 0/8.5	12.6	13.8
33	28	4 -5.4	24	16	12	-0.5	14	1 -1.3	26	33

12.4	12.2	6.9	3 0/6.1	6.2	5.8	6 0/6.5	12.5	13.1		
33	28	18	3 -0.4	11	-0.8	1 -0.8	27	33		

9.8	8.9	16 0/4.1	3.7	4.1	3.8	4.5	3.8	7 0/4.1	4.5	10.1	10.7
33	27	1 0.0	11	10	+0.3	12	13	1 0.0	18	27	33

5.5	5.0	4.8	2.9	2.7	5.1	2.6	3.0	2.7	2.7	4.0	4.2	3 0/3.5	3.5
33	28	19	13	11	10	+0.5	12	13	17	21	27	3 -0.7	33

5.9	3 0/5.4	5.0	11.1	12.3	10.8	10.2	10.6	10.3	11.3	10.9	0/3.8	2.8	2.8
35	3 +5.4	30	23	17	13	+0.4	12	15	20	25	2 +7.0	34	35

5.4	6 0/6.4	5.2	9.7	10.3	7.0	8.7	9.0	9.7	8.7	0/8.1	4.3	4.3
35	6 +13.6	29	23	17	14	+0.3	17	21	29	3 +12.9	34	35

5.2	3 0/5.3	5.4	8.1	8.7	7.0	7.4	6.9	15 0/7.2	7.4	8.4	8.2	6 0/8.1	7.1
33	3 +1.9	22	25	17	13	10	+0.3	00	14	20	24	3 -0.9	35

2	2 0/2.4	2.3	6.7	7.0	5.2	5.1	5.5	5.1	5.6	5.3	5.3	6 0/5.4	7.2	7.4	8.3
3	3 +3.0	27	23	16	12	11	9	+0.3	12	13	14	4 0.0	20	26	33

3.8	4.3	3.4	3.3	3.7	3.4	3.7	4.0	5.2	5.7	6.2	6.5
19	16	12	10	9	+0.4	14	17	19	24	33	35

Sta.	+	H.I.	-	Elev.	Cr.
		1040.02			
+50				29.8	10.2
449				31.3	8.7
+45				32.6	7.4
450				33.7	6.3
B.M.			6.91	1033.11	
+46.8				34.5	5.5
+70				34.7	5.3
B.M.	12.35	1046.48	5.89	1034.13	
448				28.1	18.4
+50				29.8	16.7
449.				31.3	15.2
B.M.			12.35	1034.13	

6-3-27

5.1/27 8.0/24 10.9/20 11.0/15 10.2/12 10.2/0.0 10.6/12 10.3/14 10.5/14 11.8/19 11.7/24 8.9/31 3°/3 8.9/+1.3

9.2/20 10.0/14 9.1/13 8.8/-0.1 9.1/15 9.8/18 9.0/23 1.9/31 3°/3 1.9/+6.8 1.9/35

7.0/35 3°/3 7.0/+0.4 6.2/27 9.2/22 9.3/17 7.7/13 7.6/-0.2 7.9/16 8.7/20 8.2/27 5.8/34 3°/3 5.6/+1.8 5.1/35

6.2/35 3°/3 6.1/+0.2 6.1/23 8.1/22 8.2/18 7.0/14 6.5/-0.2 6.7/19 3°/3 6.8/-0.5

Spk. in T.P. Lt. Stn. 450+25

4.4/33 4.8/15 5.1 5.4/15 5.6/33

4.9/33 4.9/17 4.8 5.2/15 5.8/24 3.7/31 3.8/33

7.7/49.5 8.1/3 9.0/+9.4 8.5/30

1.7/49.5 8.2/4 1.9/+14.8 2.9/41 2.3/39

5.2/49.5 8.9/3 6.6/+8.6 6.6/34 5.8/33 6.4/30

Sta.	+	H.I.	−	Elev.
B.M.	9.50	1004.94		995.44
0+33				01.1
				04.0
0+50				
	9.33	1013.75	0.52	1004.42
0+33				
0+50				
0+75				04.0
1+00				05.5
1+25				07.0
1+50				08.4
1+75				08.6
	1.40	1005.82	9.33	1004.42
2+00			10.38	995.44

Spk. in P.P. 65' Lt. Sta. 378+85.

	Lt.				℄	Rt.				
℄ Road 21' L.			5.7/33	5.4/9	3.8	4.0/12	3.7/21			
℄ Road 14' L.		5.6/33	4.8/19	0.8/4	0.9	2.5/4	2.7/12	3.0/19	1.4/23	
					12.6	5.6/33	5.5/45			
					9.8	5.5/32	4.9/42			
Road 8' L.	11.4/35	10.9/27	10.9/19	10.1/11	9.8	10.0/17	10.3/22	4.4/31	4.2/40	
Road 1' L.		10.4/33	9.6/24	8.8/10	8.3	8.1/9	8.3/18	8.8/22	4.2/30	3.5/38
Road 5' R.	10.5/33	8.6/20	7.3/14	7.1/4	6.8	6.4/7	6.6/17	6.6/25	2.8/30	3.3/35
Road 15' R.		7.9/33	7.9/20	6.1/7	5.4	5.0/14	5.2/29	2.8/39		
Road 27' R.		8.8/33	7.2/18	6.0/8	5.6	4.7/10	4.8/19	4.3/26	4.3/30	4.0/50
Road 40' R.										

	Cross Drains		Elev. Lt.	Elev. Rt.
384+38	24" X	48' RCP	24 989.67	24 987.47
390+51	24" X	42' RCP	21.5 989.28	20.5 989.68
394+06	24" X	42' RCP	21.5 988.00	20.5 988.40
397+82	24" X	48' RCP	24.3 985.30	23.7 985.50
409+47	24" X	60' RCP		
427+48	24" X			
444+27	24" X	56 54' RCP	27 1009.29	27 1007.79
457+75	24" X	54 RCP	28 1022.14	26 1024.56
466+00	24" X	60' RCP	34 1017.00	32 1018.20
479+72	24" X	72' RCP	1028.38	1035.88

85.47 Intake Co. Rd. C.

Inlet of Culv. C.
at Co. Rd. C.

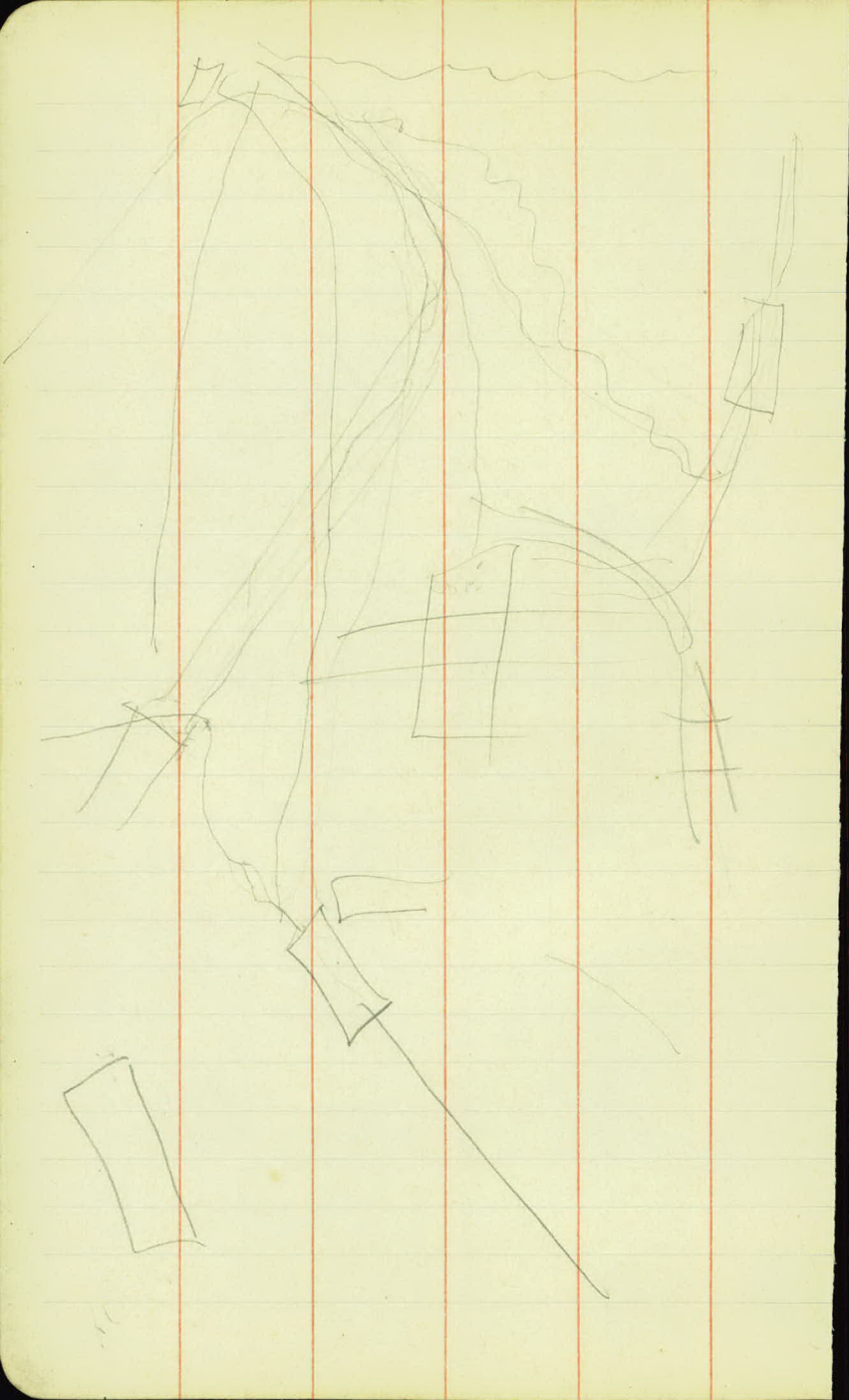
Elev. in Bottom of Ditch

84.9	85.9	85.5	85.8	85.5	85.1
200	100	50	0.0	0.0	50

85.42 85.42 Bottom of Old Culv.

88.24 = Tile Drain
87.6 Low spot on Rd.

x88.54 Intake of S Drain



KEITH'S RAILROAD CURVE TABLES.

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HOW TO USE KEITH'S TABLES.

EXAMPLE.

Wanted a Curve with an Ext. of about 12 ft. Angle of Intersection or I. P.=23° 20′ to the R. at Station 542+72.

Ext. in Tab. IV opposite 23° 20′=120.87
120.87÷12=10.07. Say a 10° Curve.

Tan. in Tab. IV opp. 23° 20′=1183.1
1183.1÷10=118.31.

Tab. V. correction for A. 23° 20′ for a 10° Cur.=0.16
118.31+0.16=118.47=corrected Tangent.

(If corrected Ext. is required find in same way)
Ang. 23° 20′=23.33°÷10=2.3333=L. C.

2° 19½′=def. for sta.	542	I. P.=sta.	542+72
4° 49½′= " " "	+50	Tan.=	1.18.47
7° 19½′= " " "	543	B. C.=sta.	541+53.53
9° 49½′= " " "	+50	L. C.=	2.33.33
11° 40′= " " "	543+	E. C.=sta.	543+86.86
	86.86		

100—53.53=46.47×3 (def. for 1 ft. of 10° Cur.)=139.41′=2° 19½″=def. for sta. 542.

Def. for 50 ft.=2° 30′ for a 10° Curve.

Def. for 36.86 ft.=1° 50½′ for a 10° Curve

(These tables are published in Field Books of KEUFFEL & ESSER Co., New York, N. Y.)

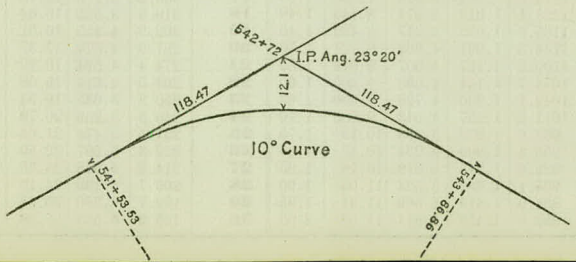

Table I. — Minutes in Decimals of a Degree.

1	.0167	**11′**	.1833	**21′**	.3500	**31′**	.5167	**41′**	.6833	**51′**	.8500
2	.0333	**12**	.2000	**22**	.3667	**32**	.5333	**42**	.7000	**52**	.8667
3	.0500	**13**	.2167	**23**	.3833	**33**	.5500	**43**	.7167	**53**	.8833
4	.0667	**14**	.2333	**24**	.4000	**34**	.5667	**44**	.7333	**54**	.9000
5	.0833	**15**	.2500	**25**	.4167	**35**	.5833	**45**	.7500	**55**	.9167
6	.1000	**16**	.2667	**26**	.4333	**36**	.6000	**46**	.7667	**56**	.9333
7	.1167	**17**	.2833	**27**	.4500	**37**	6167	**47**	.7833	**57**	.9500
8	.1333	**18**	.3000	**28**	.4667	**38**	.3333	**48**	.8000	**58**	.9667
9	.1500	**19**	.3167	**29**	.4833	**39**	.6500	**49**	.8167	**59**	.9833
10	.1667	**20**	.3333	**30**	.5000	**40**	.6667	**50**	.8333	**60**	1.0000

Table II. — Inches in Decimals of a Foot.

1-16	3-32	1/8	3-16	1/4	5-16	3/8	1/2	5/8	3/4	7/8
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729

1	2	3	4	5	6	7	8	9	10	11
.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167

Table III. — Radii, Ordinates and Deflections.

Deg.	Radius	Mid. Ord.	Tan. Def.	Chd. Def.	Def. for 1 Foot	Deg.	Radius	Mid. Ord.	Tan. Def.	Chd. Def.	Def. for 1 Foot
0° 10′	34377.	.036	.145	.291	0.05′	**7°**	819.0	1.528	6.105	12.21	2.10
20	17189.	.073	.291	.582	0.10	20′	781.8	1.600	6.395	12.79	2.20
30	11459.	.109	.436	.873	0.15	30	764.5	1.637	6.540	13.08	2.25
40	8594.4	.145	.582	1.164	0.20	40	747.9	1.673	6.685	13.37	2.30
50	6875.5	.182	.727	1.454	0.25	**8**	716.8	1.746	6.976	13.95	2.40
1	5729.6	.218	.873	1.745	0.30	20	688.2	1.819	7.266	14.53	2.50
10	4911.2	.255	1.018	2.036	0.35	30	674.7	1.855	7.411	14.82	2.55
20	4297.3	.291	1.164	2.327	0.40	40	661.7	1.892	7.556	15.11	2.60
30	3819.8	.327	1.309	2.618	0.45	**9**	637.3	1.965	7.846	15.69	2.70
40	3437.9	.364	1.454	2.909	0.50	20	614.6	2.037	8.136	16.27	2.80
50	3125.4	.400	1.600	3.200	0.55	30	603.8	2.074	8.281	16.56	2.85
2	2864.9	.436	1.745	3.490	0.60	40	593.4	2.110	8.426	16.85	2.90
10	2644.6	.473	1.891	3.781	0.65	**10**	573.7	2.183	8.716	17.43	3.00
20	2455.7	.509	2.036	4.072	0.70	30	546.4	2.292	9.150	18.30	3.15
30	2292.0	.545	2.181	4.363	0.75	**11**	521.7	2.402	9.585	19.16	3.30
40	2148.8	.582	2.327	4.654	0.80	30	499.1	2.511	10.02	20.04	3.45
50	2022.4	.618	2.472	4.945	0.85	**12**	478.3	2.620	10.45	20.91	3.60
3	1910.1	.655	2.618	5.235	0.90	30	459.3	2.730	10.89	21.77	3.75
10	1809.6	.691	2.763	5.526	0.95	**13**	441.7	2.839	11.32	22.64	3.90
20	1719.1	.727	2.908	5.817	1.00	30	425.4	2.949	11.75	23.51	4.05
30	1637.3	.764	3.054	6.108	1.05	**14**	410.3	3.058	12.18	24.37	4.20
40	1562.9	.800	3.199	6.398	1.10	30	396.2	3.168	12.62	25.24	4.35
50	1495.0	.836	3.345	6.689	1.15	**15**	383.1	3.277	13.05	26.11	4.50
4	1432.7	.873	3.490	6.980	1.20	30	370.8	3.387	13.49	26.97	4.65
10	1375.4	.909	3.635	7.271	1.25	**16**	359.3	3.496	13.92	27.84	4.80
20	1322.5	.945	3.718	7.561	1.30	30	348.5	3.606	14.35	28.70	4.95
30	1273.6	.982	3.926	7.852	1.35	**17**	338.3	3.716	14.78	29.56	5.10
40	1228.1	1.018	4.071	8.143	1.40	**18**	319.6	3.935	15.64	31.29	5.40
50	1185.8	1.055	4.217	8.433	1.45	**19**	302.9	4.155	16.51	33.01	5.70
5	1146.3	1.091	4.362	8.724	1.50	**20**	287.9	4.374	17.37	34.73	6.00
10	1109.3	1.127	4.507	9.014	1.55	**21**	274.4	4.594	18.22	36.44	6.30
20	1074.7	1.164	4.653	9.305	1.60	**22**	262.0	4.814	19.08	38.16	6.60
30	1042.1	1.200	4.798	9.596	1.65	**23**	250.8	5.035	19.94	39.87	6.90
40	1011.5	1.237	4.943	9.886	1.70	**24**	240.5	5.255	20.79	41.58	7.20
50	982.6	1.273	5.088	10.18	1.75	**25**	231.0	5.476	21.64	43.28	7.50
6	955.4	1.309	5.234	10.47	1.80	**26**	222.3	5.697	22.50	44.99	7.80
10	929.6	1.346	5.379	10.76	1.85	**27**	214.2	5.918	23.35	46.69	8.10
20	905.1	1.382	5.524	11.05	1.90	**28**	206.7	6.139	24.19	48.38	8.40
30	881.9	1.418	5.669	11.34	1.95	**29**	199.7	6.360	25.04	50.07	8.70
40	859.9	1.455	5.814	11.63	2.00	**30**	193.2	6.583	25.88	51.76	9.00

TABLE IV. — Tangents and Externals to a 1° Curve.

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
1°	50.00	.22	11°	551.70	26.50	21°	1061.9	97.57
10′	58.34	.30	10′	560.11	27.31	10′	1070.6	99.16
20	66.67	.39	20	568.53	28.14	20	1079.2	100.75
30	75.01	.49	30	576.95	28.97	30	1087.8	102.35
40	83.34	.61	40	585.36	29.82	40	1096.4	103.97
50	91.68	.73	50	593.79	30.68	50	1105.1	105.60
2	100.01	.87	12	602.21	31.56	22	1113.7	107.24
10	108.35	1.02	10	610.64	32.45	10	1122.4	108.90
20	116.68	1.19	20	619.07	33.35	20	1131.0	110.57
30	125.02	1.36	30	627.50	34.26	30	1139.7	112.25
40	133.36	1.55	40	635.93	35.18	40	1148.4	113.95
50	141.70	1.75	50	644.37	36.12	50	1157.0	115.66
3	150.04	1.96	13	652.81	37.07	23	1165.7	117.38
10	158.38	2.19	10	661.25	38.03	10	1174.4	119.12
20	166.72	2.43	20	669.70	39.01	20	1183.1	120.87
30	175.06	2.67	30	678.15	39.99	30	1191.8	122.63
40	183.40	2.93	40	686.60	40.99	40	1200.5	124.41
50	191.74	3.21	50	695.06	42.00	50	1209.2	126.20
4	200.08	3.49	14	703.51	43.03	24	1217.9	128.00
10	208.43	3.79	10	711.97	44.07	10	1226.6	129.82
20	216.77	4.10	20	720.44	45.12	20	1235.3	131.65
30	225.12	4.42	30	728.90	46.18	30	1244.0	133.50
40	233.47	4.76	40	737.37	47.25	40	1252.8	135.35
50	241.81	5.10	50	745.85	48.34	50	1261.5	137.23
5	250.16	5.46	15	754.32	49.44	25	1270.2	139.11
10	258.51	5.83	10	762.80	50.55	10	1279.0	141.01
20	266.86	6.21	20	771.29	51.68	20	1287.7	142.93
30	275.21	6.61	30	779.77	52.89	30	1296.5	144.85
40	283.57	7.01	40	788.26	53.97	40	1305.3	146.79
50	291.92	7.43	50	796.75	55.13	50	1314.0	148.75
6	300.28	7.86	16	805.25	56.31	26	1322.8	150.71
10	308.64	8.31	10	813.75	57.50	10	1331.6	152.69
20	316.99	8.76	20	822.25	58.70	20	1340.4	154.69
30	325.35	9.23	30	830.76	59.91	30	1349.2	156.70
40	333.71	9.71	40	839.27	61.14	40	1358.0	158.72
50	342.08	10.20	50	847.78	62.38	50	1366.8	160.76
7	350.44	10.71	17	856.30	63.63	27	1375.6	162.81
10	358.81	11.22	10	864.82	64.90	10	1384.4	164.86
20	367.17	11.75	20	873.35	66.18	20	1393.2	166.95
30	375.54	12.29	30	881.88	67.47	30	1402.0	169.04
40	383.91	12.85	40	890.41	68.77	40	1410.9	171.15
50	392.28	13.41	50	898.95	70.09	50	1419.7	173.27
8	400.66	13.99	18	907.49	71.42	28	1428.6	175.41
10	409.03	14.58	10	916.03	72.76	10	1437.4	177.55
20	417.41	15.18	20	924.58	74.12	20	1446.3	179.72
30	425.79	15.80	30	933.13	75.49	30	1455.1	181.89
40	434.17	16.43	40	941.69	76.86	40	1464.0	184.08
50	442.55	17.07	50	950.25	78.26	50	1472.9	186.29
9	450.93	17.72	19	958.81	79.67	29	1481.8	188.51
10	459.32	18.38	10	967.38	81.09	10	1490.7	190.74
20	467.71	19.06	20	975.96	82.53	20	1499.6	192.99
30	476.10	19.75	30	984.53	83.97	30	1508.5	195.25
40	484.49	20.45	40	993.12	85.43	40	1517.4	197.53
50	492.88	21.16	50	1001.7	86.90	50	1526.3	199.82
10	501.28	21.89	20	1010.3	88.39	30	1535.3	202.12
10	509.68	22.62	10	1018.9	89.89	10	1544.2	204.44
20	518.08	23.38	20	1027.5	91.40	20	1553.1	206.77
30	526.48	24.14	30	1036.1	92.92	30	1562.1	209.12
40	534.89	24.91	40	1044.7	94.46	40	1571.0	211.48
50	543.29	25.70	50	1053.3	96.01	50	1580.0	213.86

TABLE IV. — Tangents and Externals to a 1° Curve.

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
31°	1589.0	216.3	**41°**	2142.2	387.4	**51°**	2732.9	618.4
10′	1598.0	218.7	10′	2151.7	390.7	10′	2743.1	622.8
20	1606.9	221.1	20	2161.2	394.1	20	2753.4	627.2
30	1615.9	223.5	30	2170.8	397.4	30	2763.7	631.7
40	1624.9	226.0	40	2180.3	400.8	40	2773.9	636.2
50	1633.9	228.4	50	2189.9	404.2	50	2784.2	640.7
32	1643.0	230.9	**42**	2199.4	407.6	**52**	2794.5	645.2
10	1652.0	233.4	10	2209.0	411.1	10	2804.9	649.7
20	1661.0	235.9	20	2218.6	414.5	20	2815.2	654.3
30	1670.0	238.4	30	2228.1	418.0	30	2825.6	658.8
40	1679.1	241.0	40	2237.7	421.4	40	2835.9	663.4
50	1688.1	243.5	50	2247.3	425.0	50	2846.3	668.0
33	1697.2	246.1	**43**	2257.0	428.5	**53**	2856.7	672.7
10	1706.3	248.7	10	2266.6	432.0	10	2867.1	677.3
20	1715.3	251.3	20	2276 2	435.6	20	2877.5	682.0
30	1724.4	253.9	30	2285.9	439.2	30	2888.0	686.7
40	1733.5	256.5	40	2295.6	442.8	40	2898.4	691.4
50	1742.6	259.1	50	2305.2	446.4	50	2908.9	696.1
34	1751.7	261.8	**44**	2314.9	450.0	**54**	2919.4	700.9
10	1760.8	264.5	10	2324.6	453.6	10	2929.9	705.7
20	1770.0	267.2	20	2334.3	457.3	20	2940.4	710.5
30	1779.1	269.9	30	2344.1	461.0	30	2951.0	715.3
40	1788.2	272.6	40	2353.8	464.6	40	2961.5	720.1
50	1797.4	275.3	50	2363.5	468.4	50	2972.1	725.0
35	1806.6	278.1	**45**	2373.3	472.1	**55**	2982.7	729.9
10	1815.7	280.8	10	2383.1	475.8	10	2993.3	734.8
20	1824.9	283.6	20	2392.8	479.6	20	3003.9	739.7
30	1834.1	286.4	30	2402.6	483.8	30	3014.5	744.6
40	1843.3	289.2	40	2412.4	487.2	40	3025.2	749.6
50	1852.5	292.0	50	2422.3	491.0	50	3035.8	754.6
36	1861.7	294.9	**46**	2432.1	494.8	**56**	3046.5	759.6
10	1870.9	297.7	10	2441.9	498.7	10	3057.2	764.6
20	1880.1	300.6	20	2451.8	502.5	20	3067.9	769.7
30	1889.4	303.5	30	2461.7	506.4	30	3078.7	774.7
40	1898.6	306.4	40	2471.5	510.3	40	3089.4	779.8
50	1907.9	309.3	50	2481.4	514.3	50	3100.2	784.9
37	1917.1	312.2	**47**	2491.3	518.2	**57**	3110.9	790.1
10	1926.4	315.2	10	2501.2	522.2	10	3121.7	795.2
20	1935.7	318.1	20	2511.2	526.1	20	3132.6	800.4
30	1945.0	321.1	30	2521.1	530.1	30	3143.4	805.6
40	1954.3	324.1	40	2531.1	534.2	40	3154.2	810.9
50	1963.6	327.1	50	2541.0	538.2	50	3165.1	816.1
38	1972.9	330.2	**48**	2551.0	542.2	**58**	3176.0	821.4
10	1982.2	333.2	10	2561.0	546.3	10	3186.9	826.7
20	1991.5	336.3	20	2571.0	550.4	20	3197.8	832.0
30	2000.9	339.3	30	2581.0	554.5	30	3208.8	837.3
40	2010.2	342.4	40	2591.0	558.6	40	3219.7	842.7
50	2019.6	345.5	50	2601.1	562.8	50	3230.7	848.1
39	2029.0	348.6	**49**	2611.2	566.9	**59**	3241.7	853.5
10	2038.4	351.8	10	2621.2	571.1	10	3252.7	858.9
20	2047.8	354.9	20	2631.3	575.3	20	3263.7	864.3
30	2057.2	358.1	30	2641.4	579.5	30	3274.8	869.8
40	2066.6	361.3	40	2651.5	583.8	40	3285.8	875.3
50	2076.0	364.5	50	2661.6	588.0	50	3296.9	880.8
40	2085.4	367.7	**50**	2671.8	592.3	**60**	3308.0	886.4
10	2094.9	371.0	10	2681.9	596.6	10	3319.1	892.0
20	2104.3	374.2	20	2692.1	600.9	20	3330.3	897.5
30	2113.8	377.5	30	2702.3	605.3	30	3341.4	903.2
40	2123.3	380.8	40	2712.5	609.6	40	3352.6	908.8
50	2132 7	384.1	50	2722.7	614.0	50	3363.8	914.5

TABLE IV. — Tangents and Externals to a 1° Curve.

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
61°	3375.0	920.2	**71°**	4086.9	1308.2	**81°**	4893.6	1805.3
10′	3386.3	925.9	10′	4099.5	1315.6	10′	4908.0	1814.7
20	3397.5	931.6	20	4112.1	1322.9	20	4922.5	1824.1
30	3408.8	937.3	30	4124.8	1330.3	30	4937.0	1833.6
40	3420.1	943.1	40	4137.4	1337.7	40	4951.5	1843.1
50	3431.4	948.9	50	4150.1	1345.1	50	4966.1	1852.6
62	3442.7	954.8	**72**	4162.8	1352.6	**82**	4980.7	1862.2
10	3454.1	960.6	10	4175.6	1360.1	10	4995.4	1871.8
20	3465.4	966.5	20	4188.5	1367.6	20	5010.0	1881.5
30	3476.8	972.4	30	4201.2	1375.2	30	5024.8	1891.2
40	3488.3	978.3	40	4214.0	1382.8	40	5039.5	1900.9
50	3499.7	984.3	50	4226.8	1390.4	50	5054.3	1910.7
63	3511.1	990.2	**73**	4239.7	1398.0	**83**	5069.2	1920.5
10	3522.6	996.2	10	4252.6	1405.7	10	5084.0	1930.4
20	3534.1	1002.3	20	4265.6	1413.5	20	5099.0	1940.3
30	3545.6	1008.3	30	4278.5	1421.2	30	5113.9	1950.3
40	3557.2	1014.4	40	4291.5	1429.0	40	5128.9	1960.2
50	3568.7	1020.5	50	4304.6	1436.8	50	5143.9	1970.3
64	3580.3	1026.6	**74**	4317.6	1444.6	**84**	5159.0	1980.4
10	3591.9	1032.8	10	4330.7	1452.5	10	5174.1	1990.5
20	3603.5	1039.0	20	4343.8	1460.4	20	5189.3	2000.6
30	3615.1	1045.2	30	4356.9	1468.4	30	5204.4	2010.8
40	3626.8	1051.4	40	4370.1	1476.4	40	5219.7	2021.1
50	3638.5	1057.7	50	4383.3	1484.4	50	5234.9	2031.4
65	3650.2	1063.9	**75**	4396.5	1492.4	**85**	5250.3	2041.7
10	3661.9	1070.2	10	4409.8	1500.5	10	5265.6	2052.1
20	3673.7	1076.6	20	4423.1	1508.6	20	5281.0	2062.5
30	3685.4	1082.9	30	4436.4	1516.7	30	5296 4	2073.0
40	3697.2	1089.3	40	4449.7	1524.9	40	5311.9	2083.5
50	3709.0	1095.7	50	4463.1	1533.1	50	5327.4	2094.1
66	3720.9	1102.2	**76**	4476.5	1541.4	**86**	5343.0	2104.7
10	3732.7	1108.6	10	4489.9	1549.7	10	5358.6	2115.3
20	3744.6	1115.1	20	4503.4	1558.0	20	5374.2	2126.0
30	3756.5	1121.7	30	4516.9	1566.3	30	5389.9	2136.7
40	3768.5	1128.2	40	4530.4	1574.7	40	5405.6	2147.5
50	3780.4	1134.8	50	4544.0	1583.1	50	5421.4	2158.4
67	3792.4	1141.4	**77**	4557.6	1591.6	**87**	5437.2	2169.2
10	3804.4	1148.0	10	4571.2	1600.1	10	5453.1	2180.2
20	3816.4	1154.7	20	4584.8	1608.6	20	5469.0	2191.1
30	3828.4	1161.3	30	4598.5	1617.1	30	5484.9	2202.2
40	3840.5	1168.1	40	4612.2	1625.7	40	5500.9	2213.2
50	3852.6	1174.8	50	4626.0	1634.4	50	5517.0	2224.3
68	3864.7	1181.6	**78**	4639.8	1643.0	**88**	5533.1	2235.5
10	3876.8	1188.4	10	4653.6	1651.7	10	5549.2	2246.7
20	3889.0	1195.2	20	4667.4	1660.5	20	5565.4	2258.0
30	3901.2	1202.0	30	4681.3	1669.2	30	5581.6	2269.3
40	3913.4	1208.9	40	4695.2	1678.1	40	5597.8	2280.6
50	3925.6	1215.8	50	4709.2	1686.9	50	5614.2	2292.0
69	3937.9	1222.7	**79**	4723.2	1695.8	**89**	5630.5	2303.5
10	3950.2	1229.7	10	4737.2	1704.7	10	5646.9	2315.0
20	3962.5	1236.7	20	4751.2	1713.7	20	5663.4	2326.6
30	3974.8	1243.7	30	4765.3	1722.7	30	5679.9	2338.2
40	3987.2	1250.8	40	4779.4	1731.7	40	5696.4	2349.8
50	3999.5	1257.9	50	4793.6	1740.8	50	5713.0	2361.5
70	4011.9	1265.0	**80**	4807.7	1749.9	**90**	5729.7	2373.3
10	4024.4	1272.1	10	4822.0	1759.0	10	5746.3	2385.1
20	4036.8	1279.3	20	4836.2	1768.2	20	5763.1	2397.0
30	4049.3	1286.5	30	4850.5	1777.4	30	5779.9	2408.9
40	4061.8	1293.6	40	4864.8	1786.7	40	5796.7	2420.9
50	4074.4	1300.9	50	4879.2	1796.0	50	5813.6	2432.9

TABLE IV. — Tangents and Externals to a 1° Curve.

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
91°	5830.5	2444.9	**101°**	6950.6	3278.1	**111°**	8336.7	4386.1
10′	5847.5	2457.1	10′	6971.3	3294.1	10′	8362.7	4407.6
20	5864.6	2469.3	20	6992.0	3310.1	20	8388.9	4429.2
30	5881.7	2481.5	30	7012.7	3326.1	30	8415.1	4450.9
40	5898.8	2493.8	40	7033.6	3342.3	40	8441.5	4472.7
50	5916.0	2506.1	50	7054.5	3358.5	50	8468.0	4494.6
92	5933.2	2518.5	**102**	7075.5	3374.9	**112**	8494.6	4516.6
10	5950.5	2531.0	10	7096.6	3391.2	10	8521.3	4538.8
20	5967.9	2543.5	20	7117.8	3407.7	20	8548.1	4561.1
30	5985.3	2556.0	30	7139.0	3424.3	30	8575.0	4583.4
40	6002.7	2568.6	40	7160.3	3440.9	40	8602.1	4606.0
50	6020.2	2581.3	50	7181.7	3457.6	50	8629.3	4628.6
93	6037.8	2594.0	**103**	7203.2	3474.4	**113**	8656.6	4651.3
10	6055.4	2606.8	10	7224.7	3491.3	10	8684.0	4674.2
20	6073.1	2619.7	20	7246.3	3508.2	20	8711.5	4697.2
30	6090.8	2632.6	30	7268.0	3525.2	30	8739.2	4720.3
40	6108.6	2645.5	40	7289.8	3542.4	40	8767.0	4743.6
50	6126.4	2658.5	50	7311.7	3559.6	50	8794.9	4766.9
94	6144.3	2671.6	**104**	7333.6	3576.8	**114**	8822.9	4790.4
10	6162.6	2684.7	10	7355.6	3594.2	10	8851.0	4814.1
20	6180.2	2697.9	20	7377.8	3611.7	20	8879.3	4837.8
30	6198.3	2711.2	30	7399.9	3629.2	30	8907.7	4861.7
40	6216.4	2724.5	40	7422.2	3646.8	40	8936.3	4885.7
50	6234.6	2737.9	50	7444.6	3664.5	50	8965.0	4909.9
95	6252.8	2751.3	**105**	7467.0	3682.3	**115**	8993.8	4934.1
10	6271.1	2764.8	10	7489.6	3700.2	10	9022.7	4958.6
20	6289.4	2778.3	20	7512.2	3718.2	20	9051.7	4983.1
30	6307.9	2792.0	30	7534.9	3736.2	30	9080.9	5007.8
40	6326.3	2805.6	40	7557.7	3754.4	40	9110.3	5032.6
50	6344.8	2819.4	50	7580.5	3772.6	50	9139.8	5057.6
96	6363.4	2833.2	**106**	7603.5	3791.0	**116**	9169.4	5082.7
10	6382.1	2847.0	10	7626.6	3809.4	10	9199.1	5107.9
20	6400.8	2861.0	20	7649.7	3827.9	20	9229.0	5133.3
30	6419.5	2875.0	30	7672.9	3846.5	30	9259.0	5158.8
40	6438.4	2889.0	40	7696.3	3865.2	40	9289.2	5184.5
50	6457.3	2903.1	50	7719.7	3884.0	50	9319.5	5210.3
97	6476.2	2917.3	**107**	7743.2	3902.9	**117**	9349.9	5236.2
10	6495.2	2931.6	10	7766.8	3921.9	10	9380.5	5262.3
20	6514.3	2945.9	20	7790.5	3940.9	20	9411.3	5288.6
30	6533.4	2960.3	30	7814.3	3960.1	30	9442.2	5315.0
40	6552.6	2974.7	40	7838.1	3979.4	40	9473.2	5341.5
50	6571.9	2989.2	50	7862.1	3998.7	50	9504.4	5368.2
98	6591.2	3003.8	**108**	7886.2	4018.2	**118**	9535.7	5395.1
10	6610.6	3018.4	10	7910.4	4037.8	10	9567.2	5422.1
20	6630.1	3033.1	20	7934.6	4057.4	20	9598.9	5449.2
30	6649.6	3047.9	30	7959.0	4077.2	30	9630.7	5476.5
40	6669.2	3062.8	40	7983.5	4097.1	40	9662.6	5504.0
50	6688.8	3077.7	50	8008.0	4117.0	50	9694.7	5531.7
99	6708.6	3092.7	**109**	8032.7	4137.1	**119**	9727.0	5559.4
10	6728.4	3107.7	10	8057.4	4157.3	10	9759.4	5587.4
20	6748.2	3122.9	20	8082.3	4177.5	20	9792.0	5615.5
30	6768.1	3138.1	30	8107.3	4197.9	30	9824.8	5643.8
40	6788.1	3153.3	40	8132.3	4218.4	40	9857.7	5672.3
50	6808.2	3168.7	50	8157.5	4239.0	50	9890.8	5700.9
100	6828.3	3184.1	**110**	8182.8	4259.7	**120**	9924.0	5729.7
10	6848.5	3199.6	10	8208.2	4280.5	10	9957.5	5758.6
20	6868.8	3215.1	20	8233.7	4301.4	20	9991.0	5787.7
30	6889.2	3230.8	30	8259.3	4322.4	30	10025.0	5817.0
40	6909.6	3246.5	40	8285.0	4343.6	40	10059.0	5846.5
50	6930.1	3262.3	50	8310.8	4364.8	50	10093.0	5876.1

Table V. Corrections for use with table IV,

For Tangents Add

Δ ANGLE	CURVE 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.03	.06	.09	.13	.16	.19	.22	.25	.28	.31	.34	.38	.42	.46
15°	.04	.10	.14	.19	.24	.29	.34	.39	.45	.51	.53	.58	.63	.68
20°	.06	.13	.19	.26	.32	.39	.45	.51	.58	.65	.72	.79	.84	.90
25°	.08	.16	.24	.33	.40	.49	.58	.67	.75	.83	.90	.99	1.06	1.14
30°	.10	.19	.29	.39	.49	.59	.69	.79	.89	.99	1.09	1.20	1.29	1.39
35°	.11	.22	.34	.47	.58	.69	.70	.81	.92	1.04	1.29	1.42	1.54	1.66
40°	.13	.26	.40	.53	.67	.80	.93	1.06	1.20	1.34	1.49	1.64	1.79	1.94
45°	.15	.30	.44	.60	.76	.91	1.06	1.21	1.37	1.52	1.70	1 87	2.04	2.21
50°	.17	.34	.51	.68	.85	1.02	1.19	1.36	1.54	1.72	1.91	2.10	2.29	2.48
55°	.19	.38	.57	.76	.95	1.14	1.32	1.52	1.72	1.92	2.14	2.35	2.56	2.77
60°	.21	.42	.63	.84	1.05	1.27	1.49	1.71	1.94	2.17	2.38	2.60	2.83	3.07
65°	.23	.46	.69	.93	1.16	1.40	1.64	1.88	2.13	2.38	2.63	2.88	3.13	3.39
70°	.25	.51	.76	1.02	1.28	1.54	1.80	2.06	2.33	2.60	2.88	3.16	3.44	3.72
75°	.27	.56	.83	1.12	1.40	1.69	1.98	2.27	2.57	2.87	3.16	3.47	3.78	4.09
80°	.30	.61	.91	1.22	1.53	1.84	2.15	2.46	2.78	3.10	3.44	3.78	4.12	4.46
85°	.33	.66	1.00	1.33	1.68	2.02	2.36	2.70	3.05	3.40	3.77	4.14	4.55	4.89
90°	.36	.72	1.09	1.45	1.83	2.20	2.57	2.94	3.32	3.70	4.10	4.50	4.91	5.32
95°	.39	.79	1.19	1.55	2.00	2.40	2.80	3.20	3.61	4.02	4.40	4.98	5.38	5.83
100°	.43	.86	1.30	1.74	2.18	2.62	3.06	3.50	3.95	4.40	4.88	5.37	5.85	6.34

For Externals Add

ANGLE	CURVE 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.001	.003	.004	.006	.007	.008	.009	.011	.012	.014	.015	.017	.018	.020
15°	.003	.007	.010	.014	.018	.023	.027	.029	.032	.035	.039	.043	.047	.051
20°	.006	.011	.017	.022	.028	.034	038	.045	.051	.057	.063	.070	.076	.083
25°	.009	.018	.027	.036	.046	.056	.065	.074	.083	.093	106	.120	.127	.135
30°	.013	.025	.038	.051	.065	.078	.090	.103	.116	.129	.149	.170	.179	.188
35°	.018	.035	.054	.072	.086	.109	.131	.153	.175	.197	.213	.230	.247	.264
40°	.023	.046	.070	.093	.117	.141	.172	.203	.234	.265	.277	.290	.315	.341
45°	.030	.060	.093	.119	.153	.184	.216	.254	.289	.325	.351	.378	.411	.445
50°	.037	.075	.116	.151	.189	.227	.266	.305	.345	.384	.425	.467	.508	.550
55°	.046	.093	.142	.188	.236	.283	.332	.381	.420	.479	.530	.582	.641	.700
60°	.056	.112	.168	.225	.283	.340	.398	.457	.516	.575	.636	.697	.774	.851
65°	.067	.135	.204	.273	.343	.412	.483	.554	.625	.697	.711	.845	922	1.01
70°	.080	.159	.240	.321	.403	.485	.568	.652	.735	.819	.906	.994	1.08	1.17
75°	.095	.182	.286	.383	.480	.578	.678	.777	.877	.977	1.07	1.18	1.29	1.39
80°	.110	.220	.332	.445	.558	.671	.787	.903	1.02	1.13	1 25	1.38	1 50	1.62
85°	.128	.259	.391	.524	.657	.790	.926	1.06	1.20	1.34	1.47	1 62	1.76	1.91
90°	.149	.299	.450	.603	.756	.910	1.07	1.22	1.38	1.54	1.70	1.87	2.03	2.20
95°	.174	.350	.522	.706	.985	1.06	1.25	1.43	1.62	1.80	1.99	2.18	2.38	2.58
100°	200	.401	.604	.809	1.01	1.22	1.43	1.64	1.85	2.06	2.28	2.50	2.73	2.96

Table VI. Deflections for Sub Chords for Short Radius Curves.

Degree of Curve	Radius 50 / sin. def. ang.	½ sub chord / R = sin of def. angle				Length of arc for 100 ft.
		12.5 Ft.	15 Ft.	20 Ft.	25 Ft.	
30°	193.18	1° 51′	2° 17′	2° 58′	3° 43′	101.15
32°	181.39	1° 59′	2° 25′	3° 10′	3° 58′	101.33
34°	171.01	2° 06′	2° 33′	3° 21′	4° 12′	101.48
36°	161.80	2° 13′	2° 41′	3° 33′	4° 26′	101.66
38°	153.58	2° 20′	2° 49′	3° 44′	4° 40′	101.85
40°	146.19	2° 27′	2° 57′	3° 55′	4° 54′	102.06
42°	139.52	2° 34′	3° 05′	4° 07′	5° 08′	102.29
44°	133.47	2° 41′	3° 13′	4° 18′	5° 22′	102.53
46°	127.97	2° 48′	3° 21′	4° 29′	5° 36′	102.76
48°	122.92	2° 55′	3° 29′	4° 40′	5° 50′	103.00
50°	118.31	3° 02′	3° 38′	4° 51′	6° 04′	103.24
52°	114.06	3° 09′	3° 46′	5° 02′	6° 17′	103.54
54°	110.11	3° 16′	3° 54′	5° 13′	6° 31′	103.84
56°	106.50	3° 22′	4° 02′	5° 23′	6° 44′	104.14
58°	103.14	3° 29′	4° 10′	5° 34′	6° 57′	104.43
60°	100.00	3° 35′	4° 18′	5° 44′	7° 11′	104.72

CURVE FORMULAS.

$$T = R \tan \tfrac{1}{2} I$$

$$T = \frac{50 \tan. \tfrac{1}{2} I}{\text{Sin. D}}$$

$$\text{Sin. D} = \frac{50}{R}$$

$$\text{Sin. D} = \frac{50 \tan. \tfrac{1}{2} I}{T}$$

$$R = T \cot. \tfrac{1}{2} I$$

$$R = \frac{50}{\text{Sin. D}}$$

$$E = R \text{ ex. sec. } \tfrac{1}{2} I$$

$$E = T \tan \tfrac{1}{4} I$$

$$\text{Chord def.} = \frac{\text{chord}^2}{R}$$

$$\text{No. chords} = \frac{\tfrac{1}{2} I}{D}$$

$$\text{Tan. def.} = \tfrac{1}{2} \text{ chord def.}$$

The square of any distance, divided by twice the radius, will equal the distance from tangent to curve, very nearly.

Table IV. contains Tangents and Externals to a 1° curve. Tan. and Ext. to any other radius may be found, nearly enough, by dividing the Tan. or Ext. opposite the given Central Angle by the given degree of curve.

To find Deg. of Curve, having the Central Angle and Tangent: Divide Tan. opposite the given Central Angle by the given Tangent.

To find Deg. of Curve, having the Central Angle and Tangent: Divide Ext. opposite the given Central Angle by the given External.

To find. Nat. Tan. and Nat. Ex. Sec. for any angle by Table IV.: Tan. or Ext. of twice the given angle divided by the radius of a 1° curve will be the Nat. Tan. or Nat. Ex. Sec.

To find angle for a given distance and deflection.

Rule 1. Multiply the given distance by .01745 (def. for 1° for 1 ft.), and divide given deflection by the product.

Rule 2. Multiply given deflection by 57.3, and divide the product by the given distance.

To find deflection for a given angle and distance: Multiply the angle by .01745, and the product by the distance.

Right Angle Triangles.—Square the altitude, divide by twice the base. Add quotient to base for hypotenuse.

Given Base 100, Alt. 10. $10^2 \div 200 = .5$. $100 + .5 = 100.5$ hyp.

Given Hyp. 100, Alt. 25. $25^2 \div 200 = 3.125$. $100 - 3.125 = 96.875 =$ Base.

Error in first example, .002; in last, .045.

To find Tons of Rail in one mile of track: multiply weight per yard by 11, and divide by 7.

Natural Sines

DEG.	0′	10′	20′	30′	40′	50′	DEG.	DEG.	0′	10′	20′	30′	40′	50′	DEG.
0	0000	0029	0058	0087	0116	0145	89	40	6428	6450	6472	6494	6517	6539	49
1	0175	0204	0233	0262	0291	0320	88	41	6561	6583	6604	6626	6648	6670	48
2	0349	0378	0407	0436	0465	0494	87	42	6691	6713	6734	6756	6777	6799	47
3	0523	0552	0581	0610	0640	0669	86	43	6820	6841	6862	6884	6905	6926	46
4	0698	0727	0756	0785	0814	0843	85	44	6947	6967	6988	7009	7030	7050	45
5	0872	0901	0929	0958	0987	1016	84	45	7071	7092	7112	7133	7153	7173	44
6	1045	1074	1103	1132	1161	1190	83	46	7193	7214	7234	7254	7274	7294	43
7	1219	1248	1279	1305	1334	1363	82	47	7314	7333	7353	7373	7392	7412	42
8	1392	1421	1449	1478	1507	1536	81	48	7431	7451	7470	7490	7509	7528	41
9	1564	1593	1622	1650	1679	1708	80	49	7547	7566	7585	7604	7623	7642	40
10	1736	1765	1794	1822	1851	1880	79	50	7660	7679	7698	7716	7735	7753	39
11	1908	1937	1965	1994	2022	2051	78	51	7771	7790	7808	7826	7844	7862	38
12	2079	2108	2136	2164	2193	2221	77	52	7880	7898	7916	7934	7951	7969	37
13	2250	2278	2306	2334	2363	2391	76	53	7986	8004	8021	8039	8056	8073	36
14	2419	2447	2476	2504	2532	2560	75	54	8090	8107	8124	8141	8158	8175	35
15	2588	2616	2644	2672	2700	2728	74	55	8192	8208	8225	8241	8258	8274	34
16	2756	2784	2812	2840	2868	2896	73	56	8290	8307	8323	8339	8355	8371	33
17	2924	2952	2979	3007	3035	3062	72	57	8387	8403	8418	8434	8450	8465	32
18	3090	3118	3145	3173	3201	3228	71	58	8480	8496	8511	8526	8542	8557	31
19	3256	3283	3311	3338	3365	3393	70	59	8572	8587	8601	8616	8631	8646	30
20	3420	3448	3475	3502	3529	3557	69	60	8660	8675	8689	8704	8718	8732	29
21	3584	3611	3638	3665	3692	3719	68	61	8746	8760	8774	8788	8802	8816	28
22	3746	3773	3800	3827	3854	3881	67	62	8829	8843	8857	8870	8884	8897	27
23	3907	3934	3961	3987	4014	4041	66	63	8910	8923	8936	8949	8962	8975	26
24	4067	4094	4120	4147	4173	4200	65	64	8988	9001	9013	9026	9038	9051	25
25	4226	4253	4279	4305	4331	4358	64	65	9063	9075	9088	9100	9112	9124	24
26	4384	4410	4436	4462	4488	4514	63	66	9135	9147	9159	9171	9182	9194	23
27	4540	4566	4592	4617	4643	4669	62	67	9205	9216	9228	9239	9250	9261	22
28	4695	4720	4746	4772	4797	4823	61	68	9272	9283	9293	9304	9315	9325	21
29	4848	4874	4899	4924	4950	4975	60	69	9336	9346	9356	9367	9377	9387	20
30	5000	5025	5050	5075	5100	5125	59	70	9397	9407	9417	9426	9436	9446	19
31	5150	5175	5200	5225	5250	5275	58	71	9455	9465	9474	9483	9492	9502	18
32	5299	5324	5348	5373	5398	5422	57	72	9511	9520	9528	9537	9546	9555	17
33	5446	5471	5495	5519	5544	5568	56	73	9563	9572	9580	9588	9596	9605	16
34	5592	5616	5640	5664	5688	5712	55	74	9613	9621	9628	9636	9644	9652	15
35	5736	5760	5783	5807	5831	5854	54	75	9659	9667	9674	9681	9689	9696	14
36	5878	5901	5925	5948	5972	5995	53	76	9703	9710	9717	9724	9730	9737	13
37	6018	6041	6065	6088	6111	6134	52	77	9744	9750	9757	9763	9769	9775	12
38	6157	6180	6202	6225	6248	6271	51	78	9781	9787	9793	9799	9805	9811	11
39	6293	6316	6338	6361	6383	6406	50	79	9816	9822	9827	9833	9838	9843	10
DEG.	60′	50′	40′	30′	20′	10′	DEG.	DEG.	60′	50′	40′	30′	20′	10′	DEG.

DEG.	0′	10′	20′	30′	40′	50′	DEG.
80	9848	9853	9858	9863	9868	9872	9
81	9877	9881	9886	9890	9894	9899	8
82	9903	9907	9911	9914	9918	9922	7
83	9925	9929	9932	9936	9939	9942	6
84	9945	9948	9951	9954	9957	9959	5
85	9962	9964	9967	9969	9971	9974	4
86	9976	9978	9980	9981	9983	9985	3
87	9986	9988	9989	9990	9992	9993	2
88	9994	9995	9996	9997	9997	9998	1
89	9998	9999	9999	9999	1.0000	1.0000	0
DEG.	60′	50′	40′	30′	20′	10′	DEG.

Natural Cosines

Natural Tangents

deg.	0′	10′	20′	30′	40′	50′	deg.	deg.	0′	10′	20′	30′	40′	50′	deg.
0	0000	0029	0058	0087	0116	0145	89	40	8391	8441	8491	8541	8591	8642	49
1	0175	0204	0233	0262	0291	0320	88	41	8693	8744	8796	8847	8899	8952	48
2	0349	0378	0407	0437	0466	0495	87	42	9004	9057	9110	9163	9217	9271	47
3	0524	0553	0582	0612	0641	0670	86	43	9325	9380	9435	9490	9545	9601	46
4	0699	0729	0758	0787	0816	0846	85	44	9657	9713	9770	9827	9884	9942	45
5	0875	0904	0934	0963	0992	1022	84	45	1.0000	1.0058	1.0117	1.0176	1.0235	1.0295	44
6	1051	1080	1110	1139	1169	1198	83	46	1.0355	1.0416	1.0477	1.0533	1.0599	1.0661	43
7	1228	1257	1287	1317	1346	1376	82	47	1.0724	1.0786	1.0850	1 0913	1.0977	1.1041	42
8	1405	1435	1465	1495	1524	1554	81	48	1.1106	1.1171	1.1237	1.1303	1 1369	1.1436	41
9	1584	1614	1644	1673	1703	1733	80	49	1.1504	1.1571	1.1640	1.1708	1.1778	1.1847	40
10	1763	1793	1823	1853	1883	1914	79	50	1.1918	1 1988	1.2059	1.2131	1.2203	1.2276	39
11	1944	1974	2004	2035	2065	2095	78	51	1.2349	1.2423	1.2497	1.2572	1.2647	1.2723	38
12	2126	2156	2186	2217	2247	2278	77	52	1.2799	1.2876	1.2954	1.3032	1.3111	1.3190	37
13	2309	2339	2370	2401	2432	2462	76	53	1.3270	1.3351	1 3452	1.3514	1.3597	1.3680	36
14	2493	2524	2555	2586	2617	2648	75	54	1.3764	1.3848	1.3934	1.4019	1.4106	1.4193	35
15	2679	2711	2742	2773	2805	2836	74	55	1.4281	1.4370	1.4460	1.4550	1.4641	1.4733	34
16	2867	2899	2931	2962	2994	3026	73	56	1.4826	1.4919	1.5013	1.5108	1.5204	1.5301	33
17	3057	3089	3121	3153	3185	3217	72	57	1.5399	1.5497	1.5597	1.5697	1.5798	1.5900	32
18	3249	3281	3314	3346	3378	3411	71	58	1.6003	1.6107	1.6212	1.6319	1.6426	1.6534	31
19	3443	3476	3508	3541	3574	3607	70	59	1.6643	1 6753	1.6864	1.6977	1.7090	1 7205	30
20	3640	3673	3706	3739	3772	3805	69	60	1.7321	1.7437	1.7556	1.7675	1.7797	1.7917	29
21	3839	3872	3906	3939	3973	4006	68	61	1.8040	1.8165	1.8291	1.8418	1.8546	1.8676	28
22	4040	4074	4108	4142	4176	4210	67	62	1.8807	1.8940	1.9074	1.9210	1.9347	1.9486	27
23	4245	4279	4314	4348	4383	4417	66	63	1.9626	1.9768	1.9912	2.0057	2.0204	2.0353	26
24	4452	4487	4522	4557	4592	4628	65	64	2.0503	2.0655	2.0809	2.0965	2,1123	2.1283	25
25	4663	4699	4734	4770	4806	4841	64	65	2. 1445	2. 1609	2. 1775	2 1943	2.2113	2.2286	24
26	4877	4913	4950	4986	5022	5059	63	66	2.2460	2.2637	2.2817	2.2998	2.3183	2.3369	23
27	5095	5132	5169	5206	5243	5280	62	67	2.3559	2.3750	2.3945	2.4142	2.4342	2.4545	22
28	5317	5354	5392	5430	5467	5505	61	68	2.4751	2.4960	2.5172	2.5386	2.5605	2.5826	21
29	5543	5581	5619	5658	5696	5735	60	69	2.6051	2 6279	2.6511	2.6746	2.6985	2.7228	20
30	5774	5812	5851	5890	5930	5969	59	70	2.7475	2.7725	2.7980	2.8239	2.8502	2.8770	19
31	6009	6048	6088	6128	6168	6208	58	71	2.9042	2.9319	2.9600	2.9887	3.0178	3.0475	18
32	6249	6289	6330	6371	6412	6453	57	72	3.0777	3 1084	3.1397	3.1716	3.2041	3.2371	17
33	6494	6536	6577	6619	6661	6703	56	73	3.2709	3 3052	3.3402	3.3759	3.4124	3.4495	16
34	6745	6787	6830	6873	6916	6959	55	74	3.4874	3.5261	3 5656	3.6059	3.6470	3.6891	15
35	7002	7046	7089	7133	7177	7221	54	75	3. 7321	3.7760	3.8208	3.8657	3.9136	3.9617	14
36	7265	7310	7355	7400	7445	7490	53	76	4.0108	4.0611	4.1126	4 1653	4.2193	4.2747	13
37	7536	7581	7627	7673	7720	7766	52	77	4. 3315	4.3897	4.4494	4.5107	4.5736	4.6382	12
38	7813	7860	7907	7954	8002	8050	51	78	4. 7046	4.7729	4.8430	4.9152	4.9894	5.0658	11
39	8098	8146	8195	8243	8292	8342	50	79	5. 1446	5. 2257	5,3093	5. 3955	5.4845	5.5764	10
deg.	60′	50′	40′	30′	20′	10′	deg.	deg.	60′	50′	40′	30′	20′	10′	deg.

deg.	0′	10′	20′	30′	40′	50′	deg.
80	5.6713	5. 7694	5.8708	5.9758	6.0844	6.1970	9
81	6.3138	6.4348	6.5606	6.6912	6.8269	6.9682	8
82	7.1154	7.2687	7.4287	7.5958	7. 7704	7.9530	7
83	8.1443	8.3450	8.5555	8.7769	9.0098	9.2553	6
84	9.5144	9.7882	10.078	10.385	10. 711	11.059	5
85	11.430	11.826	12.250	12.706	13.197	13.727	4
86	14.300	14.924	15.605	16.350	17.169	18.075	3
87	19.081	20.206	21.470	22.903	24.542	26.432	2
88	28.636	31.242	34.368	38.189	42.964	49.104	1
89	57.290	68.750	85.940	114.588	171.885	343.77	0
deg.	60′	50′	40′	30′	20′	10′	deg.

Natural Cotangents

10000
6924
10.76

10000
3079
6921

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

ROADWAY 14 FEET WIDE. SIDE SLOPES 1½ TO 1.

FOR SINGLE TRACK EMBANKMENT.

	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
0	7.0	7.2	7.3	7.5	7.6	7.8	7.9	8.1	8.2	8.4	0
1	8.5	8.7	8.8	9.0	9.1	9.3	9.4	9.6	9.7	9.9	1
2	10.0	10.2	10.3	10.5	10.6	10.8	10.9	11.1	11.2	11.4	2
3	11.5	11.7	11.8	12.0	12.1	12.3	12.4	12.6	12.7	12.9	3
4	13.0	13.2	13.3	13.5	13.6	13.8	13.9	14.1	14.2	14.4	4
5	14.5	14.7	14.8	15.0	15.1	15.3	15.4	15.6	15.7	15.9	5
6	16.0	16.2	16.3	16.5	16.6	16.8	16.9	17.1	17.2	17.4	6
7	17.5	17.7	17.8	18.0	18.1	18.3	18.4	18.6	18.7	18.9	7
8	19.0	19.2	19.3	19.5	19.6	19.8	19.9	20.1	20.2	20.4	8
9	20.5	20.7	20.8	21.0	21.1	21.3	21.4	21.6	21.7	21.9	9
10	22.0	22.2	22.3	22.5	22.6	22.8	22.9	23.1	23.2	23.4	10
11	23.5	23.7	23.8	24.0	24.1	24.3	24.4	24.6	24.7	24.9	11
12	25.0	25.2	25.3	25.5	25.6	25.8	25.9	26.1	26.2	26.4	12
13	26.5	26.7	26.8	27.0	27.1	27.3	27.4	27.6	27.7	27.9	13
14	28.0	28.2	28.3	28.5	28.6	28.8	28.9	29.1	29.2	29.4	14
15	29.5	29.7	29.8	30.0	30.1	30.3	30.4	30.6	30.7	30.9	15
16	31.0	31.2	31.3	31.5	31.6	31.8	31.9	32.1	32.2	32.4	16
17	32.5	32.7	32.8	33.0	33.1	33.3	33.4	33.6	33.7	33.9	17
18	34.0	34.2	34.3	34.5	34.6	34.8	34.9	35.1	35.2	35.4	18
19	35.5	35.7	35.8	36.0	36.1	36.3	36.4	36.6	36.7	36.9	19
20	37.0	37.2	37.3	37.5	37.6	37.8	37.9	38.1	38.2	38.4	20
21	38.5	38.7	38.8	39.0	39.1	39.3	39.4	39.6	39.7	39.9	21
22	40.0	40.2	40.3	40.5	40.6	40.8	40.9	41.1	41.2	41.4	22
23	41.5	41.7	41.8	42.0	42.1	42.3	42.4	42.6	42.7	42.9	23
24	43.0	43.2	43.3	43.5	43.6	43.8	43.9	44.1	44.2	44.4	24
25	44.5	44.7	44.8	45.0	45.1	45.3	45.4	45.6	45.7	45.9	25
26	46.0	46.2	46.3	46.5	46.6	46.8	46.9	47.1	47.2	47.4	26
27	47.5	47.7	47.8	48.0	48.1	48.3	48.4	48.6	48.7	48.9	27
28	49.0	49.2	49.3	49.5	49.6	49.8	49.9	50.1	50.2	50.4	28
29	50.5	50.7	50.8	51.0	51.1	51.3	51.4	51.6	51.7	51.9	29
30	52.0	52.2	52.3	52.5	52.6	52.8	52.9	53.1	53.2	53.4	30
31	53.5	53.7	53.8	54.0	54.1	54.3	54.4	54.6	54.7	54.9	31
32	55.0	55.2	55.3	55.5	55.6	55.8	55.9	56.1	56.2	56.4	32
33	56.5	56.7	56.8	57.0	57.1	57.3	57.4	57.6	57.7	57.9	33
34	58.0	58.2	58.3	58.5	58.6	58.8	58.9	59.1	59.2	59.4	34
35	59.5	59.7	59.8	60.0	60.1	60.3	60.4	60.6	60.7	60.9	35
36	61.0	61.2	61.3	61.5	61.6	61.8	61.9	62.1	62.2	62.4	36

Calculated by Julien A. Hall, M. Am. Soc. C. E.