

23-A  
Poppe's Corners Road, Troy  
Location

100

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FIELD BOOK

302 T

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1. 11/10/1900  
2. 11/10/1900  
3. 11/10/1900

TR 204 WINGLE - ALIGNMENT

78

21

20

22

19

23

18

24

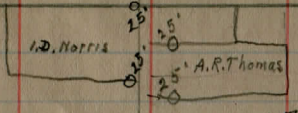
17

25

16

Hiram

Twp.



B.M. 1183.83 N.E. Root  
 36" Maple, S. side of Main Market Rd  
 460ft. W. of Popes Corners.

B.M. 1137.43 N. Root, 24" Maple  
 N. Side of M.M. Rd. 1280 ft ± E. of Popes Cor.

Arbuton Twp.

# TROY

Pl. #22

13A. 199-2337 A. Vahrouh

143+61  
192-114 Geauga Co

208-361 13A.  
R. Anderson et al

L 13A.  
M. & M. Sopjack  
218-172  
427A

188-156 A.

195-120  
A. J. & M. J. Soika  
28.97A.

217-369 J. & H. Ell

220-600 F. & M. TORAK <sup>680 Ac.</sup>

100.54 A.  
115+25  
Δ=0-11-30R

210-403 19.50 A.  
Wilma Kusma

100+98  
I.P.=25  
6822 AC.

1925 Ac. 167-2  
Cit

208-163  
J. & L. Gaspar  
79+10.5  
I.P.=25 ft  
217-319

es Yuhasz

ROAD

3305 Ac.  
A. & A. JONES  
70+87

27.75

84+81  
Δ=0-29 1/6 AC.  
Vera A. Sager  
195-382

RAPIDS

200-2  
Stuart B. Hull

SPK HIRAM

68+99  
John Koscelnik

orkowski et al 19.27A. 1A.

60+54  
58+05.75  
Δ=0-04R  
? hub?

16 Ac. ROAD  
Z

55+46  
212-580 Wm TUR

41 Ac. culvert

50 Ac. BETH KOSCELNIK culvert

46+71  
208-311 10 AC.  
W. E. Koscelnik

E.C. Grove  
5 Ac.  
188-277

Anderson 60 Ac.

35+58  
206-421 Eugen  
52 99

217-284 W. Bride  
150 AC.

ank E. Taylor  
100 Ac.

187-266 City of A.

17+00  
208-282 Anna Tieg

Edge

13+36  
10+36 7650

aylor 45 Ac.

0+00

See pg 61, '51  
Ref AUG

0+00

Brush  
+ Swamp 15" Hemlock  
8+48 30.5

7+71 21

P.L. 7+46

6+03 T 21.

4+44 T 21

2+72 T 21.5

1+01 T 21.5

Revised Location 0.8 ft.

1.P. Sec

25.5 @ 8+78 10" Apple  
W. Chertys  
23 @ 30"  
11"  
28 @ 8+45  
26 @ 8+0 12" Walnut  
26 @ 7+70 10" Maple  
26.5 @ 7+37 10" Maple  
27 @ 7+09 10" Maple  
27 @ 6+78  
12" Maple  
33 @ 6+50 6" Hemlock  
6+38  
39  
6+30  
H  
5+36  
100'  
39' 5"  
35.5 @ 20" Maple  
5+72  
5+70  
250 x x  
26 @ 5+32 12" Maple  
28 @ 4+86 12" Maple

33.00 15" Maple  
25.00 15" Maple  
Gegusa Co  
Portage Co.  
45.5 20" Maple  
S.W. Root

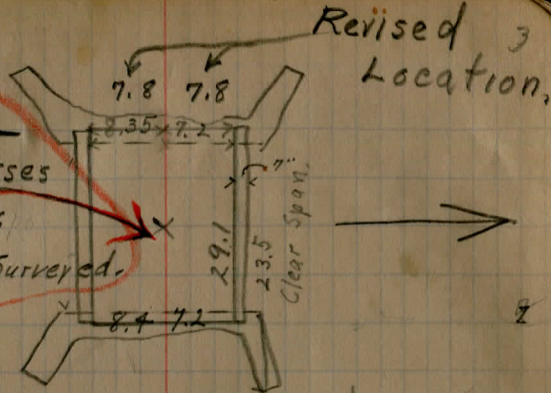
13 + 35.8

9-I beams, fair  
Poor Floor Plank

10 + 36.3 Middle  
I beam Bridge, Fair Condition

10 + 21.8 Spike, s. end

NOTE: -  
Revised E passes  
0.6 ft. West of  
line as first Surveyed.



Swamp + Brush

12 + 88

25.5

12 + 75 15" Maple

12 + 24

25 6" Oak 11 + 75

31' 11 + 47

29 11 + 37 15" Ash

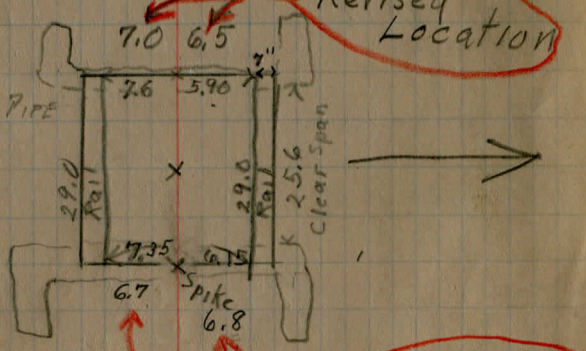
25 10" Oak 11 + 20

11 + 17 8" Ash 24

11 + 11 24.5

Revised Location

REPLACED WITH PIPE  
1952



Swamp + Brush

9 + 36 T 22.5

Revised Location

27+18 T 27.5

25+30 T 27

23+54 T 25.0

21+78 T 24.5

40" K. cherry 21+09 30

o spike 23+00  
o 10 o stake 22+00

20+10 T 24.5

18+26 T 24.5

Meadow  
17+92

Swamp  
+ Brush

16+50 T 24.5

19.0 X 19+95

15.55, Revised Location

90° spike X 25' Hub 25' Hub o

18.5 X X R.L. 2 16+15

16 23.5 X 15+94 12" Oak  
15+87 24" E/W

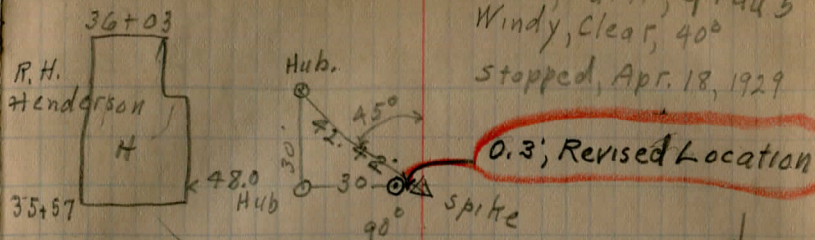
14+75 T 25

saplings  
o o o

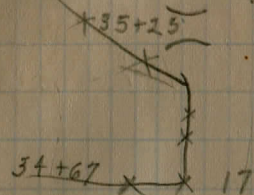
17+00 0°00'

35+58.05 A 0°00'

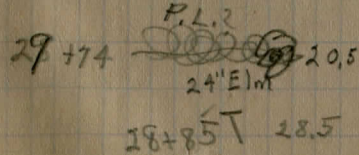
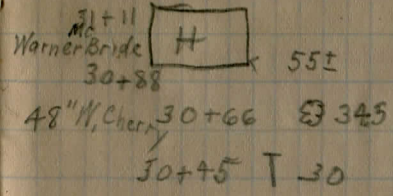
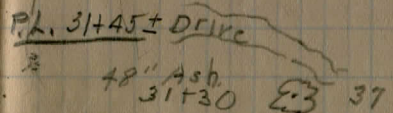
32+00 0°00'



Marks, Parks, Graus  
Windy, Clear, 40°  
stopped, Apr. 18, 1929

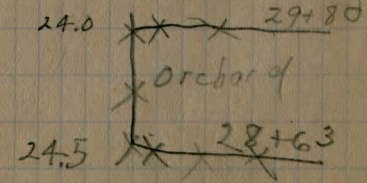
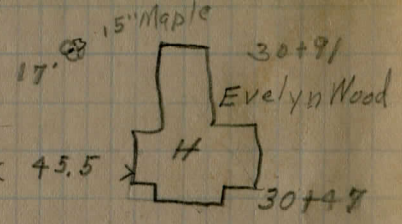
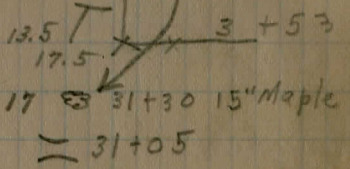


Revised Location, 0.35



0.3; Revised Location

15.5 T 35+33  
17' X  
15' T 33+35  
25.0  
Carry Water to east  
North of this Tree



Ravin<sup>2</sup> Marsh  
42" Maple  
41+18

40+70 Saplings

19 T 41+16

26 40+38  
15" Butternut

28.8 24" Chestnut  
40+03

saplings

39+85.5 27.8

P.L. 20" Hickory 31.5  
39+75 48" Chestnut

39+27 28  
8" Hickory

29.5 39+30  
30" Chestnut

18.5 T 39+17

8" Butternut 26  
38+85

28.5 X 38+91  
P.L.

8" Elm 24  
38+45

Gravel Bank ← 100±

Requires Side Hill Culvert  
12" Pipe  
X 38+00

30" Hickory 29  
37+54

18" Maple 28  
37+24

Locust  
Saplings

18 T 37+21  
Locusts

X 37+00

36+82 31  
36" Maple

36+60

40" Maple 32.  
36+37

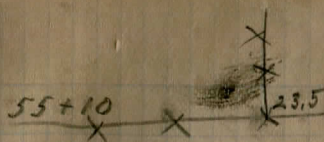
20± 28±  
Locusts

15± 36+20

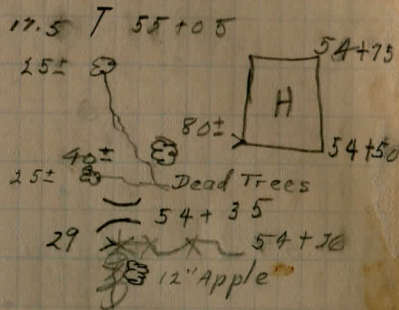
X 36+00

46 +71.2 Culvert, 7' span. Stone Walls good  
 Concrete slab good.  
 Pipe Rail 2" Outside diameter  
 27" above Parapet, W. side, 5' upright, 14'8" long to  
 28" " " E " " 5 " " 14'8"

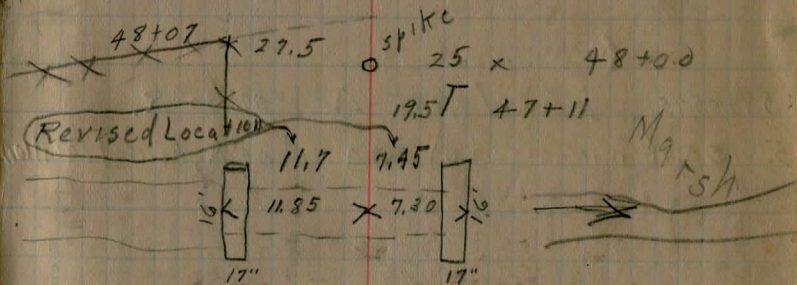
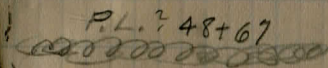
43+00  $\Delta = 0^{\circ}00'$



32.5  $\odot$  55+32 7  
 24" Ash  
 28  $\odot$  55+18  
 36" Elm



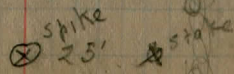
18.5 T 53+06  
 19 T 51+06  
 20 T 49+06



18 T 45+12



19 T 43+14



60+54.2

6.9' Concrete Culvert, Good,

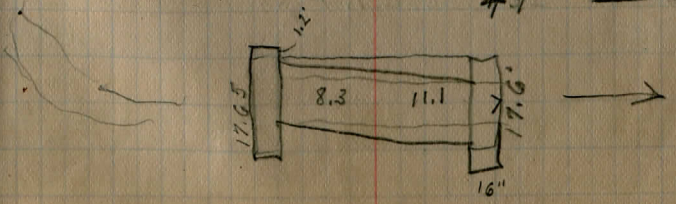
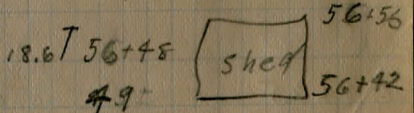
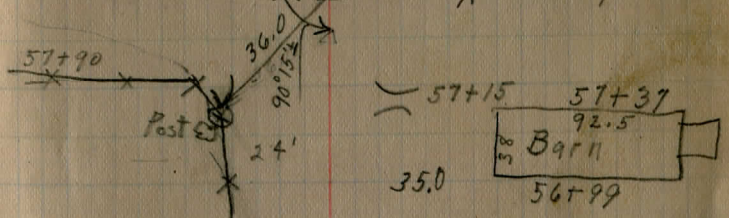
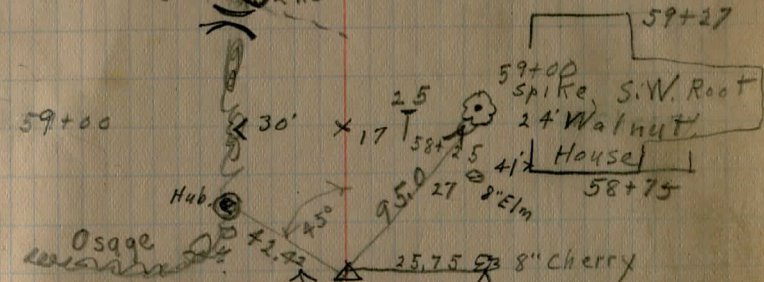
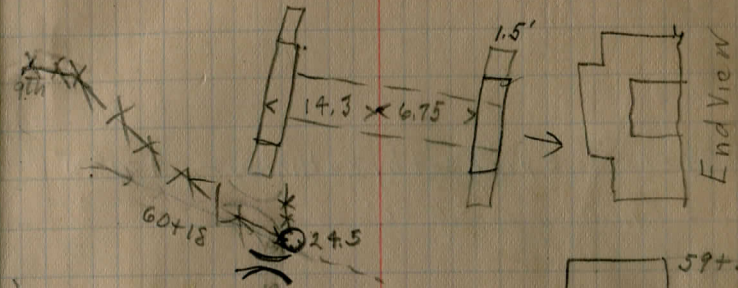
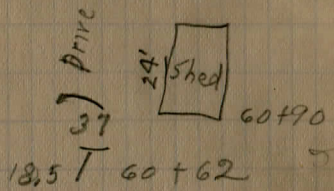
skew 1.5' in total Len

58+05.75 ♀ Road West  $\Delta = 0^{\circ}04'30'' R.$

58+05.75 (WINAGLE RD)  $\Delta = 0^{\circ}04' R.$  Revised Location

55+46.7 Culvert, span 7.5' Stone Walls } good  
Concrete slab }  
Pipe Rail 2" Outside Diarn  
Esides 29" High, 5 uprights, 15' 4" Long  
11" 29" 5" 15' 4"

61+99 Milk House 8



71+15 Requires 15" Pipe

68+99.00 Spike set by Zethmayr,  $\Delta = 0^{\circ}00'$

~~68+99.00  $\Delta = 0^{\circ}00'$~~

62+75 10" Sec. C.I. Pipe

71+15

10.55.5 10" C.I. Pipe

18.5 70+98

27 70+67

70+36

69+74

69+58  $\frac{21}{25}$

Stopped, Apr. 19, 1929  
Marks, Parks, Grau.  
Fair, 50°

32.85 69+20  
18.52 R.P. Spike 68+98

52.46  
27.5 68+54

68+23

67+94

67+32

x 28 67+00

19 T 66+88

22.2 25.0 66+46.6 P.L.  
Iron Pipe

18.5 T 64+75

x 26' x 64+00

20'  
19

62+45

32.8

T 62+73

30' Barn 62+12

10  
30.0  $\text{\textcircled{P}}$   $\times 80+25.5$  PL

26  $\text{\textcircled{P}}$  80+24

26  $\text{\textcircled{P}}$  80+00

$\text{\textcircled{P}}$  79+69

$\text{\textcircled{P}}$  79+35

18 T  $\text{\textcircled{P}}$  79+02

27  $\text{\textcircled{P}}$  78+74

vit. corr  
13.354

77+76  
12" Pipe

77+80

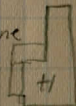
17.5 T 77+65

25  $\text{\textcircled{P}}$  77+46 36" Maple

77+32

33.5 77+28  $\text{\textcircled{P}}$  12" Pine

55



76+80

34  $\text{\textcircled{P}}$  76+69  
12" Pines

34  $\text{\textcircled{P}}$  76+55 30' Locust

25  $\text{\textcircled{P}}$  76+33 12" Maple

17.5 T 76+28

17.5 T 74+99

28  $\text{\textcircled{P}}$  74+34  
30" Maple

27  $\text{\textcircled{P}}$  73+45  
30" Maple

27  $\text{\textcircled{P}}$  73+12

17.5  $\text{\textcircled{P}}$  72+91

18" cherry  $\text{\textcircled{P}}$  32  
73+02

~~P.L. 72+51~~  
~~X X X X X~~ 21.8



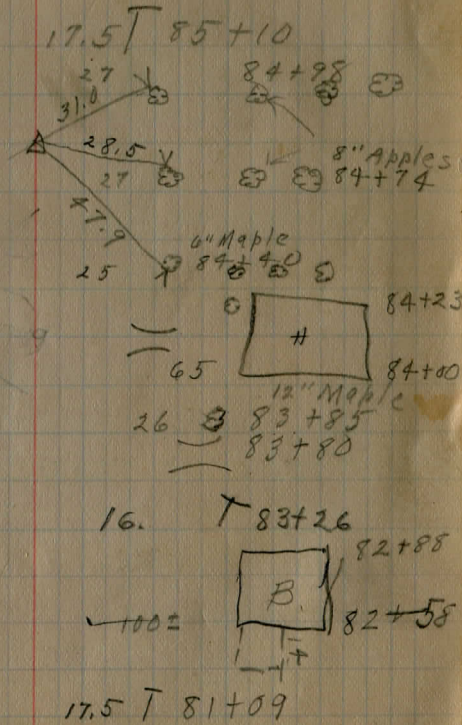
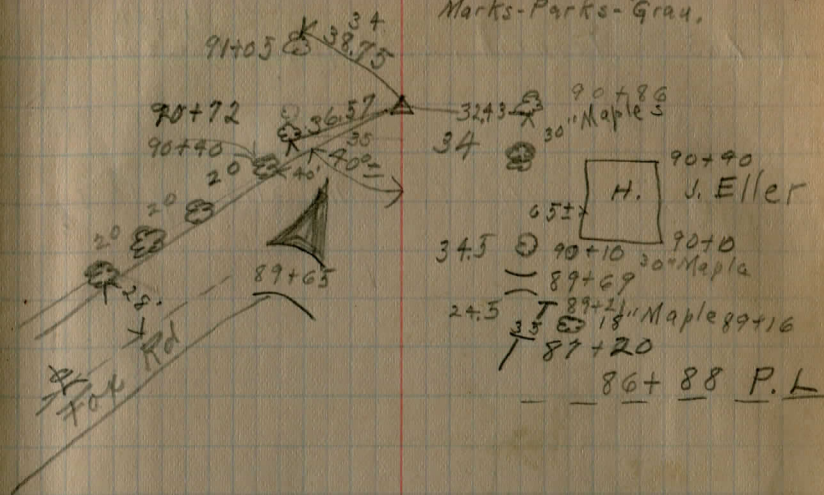
90+86.9

$\Delta = 0^{\circ}00'$

86 Str set  $\angle 18'$

84+81.1  $\Delta = 0^{\circ}29'6''$

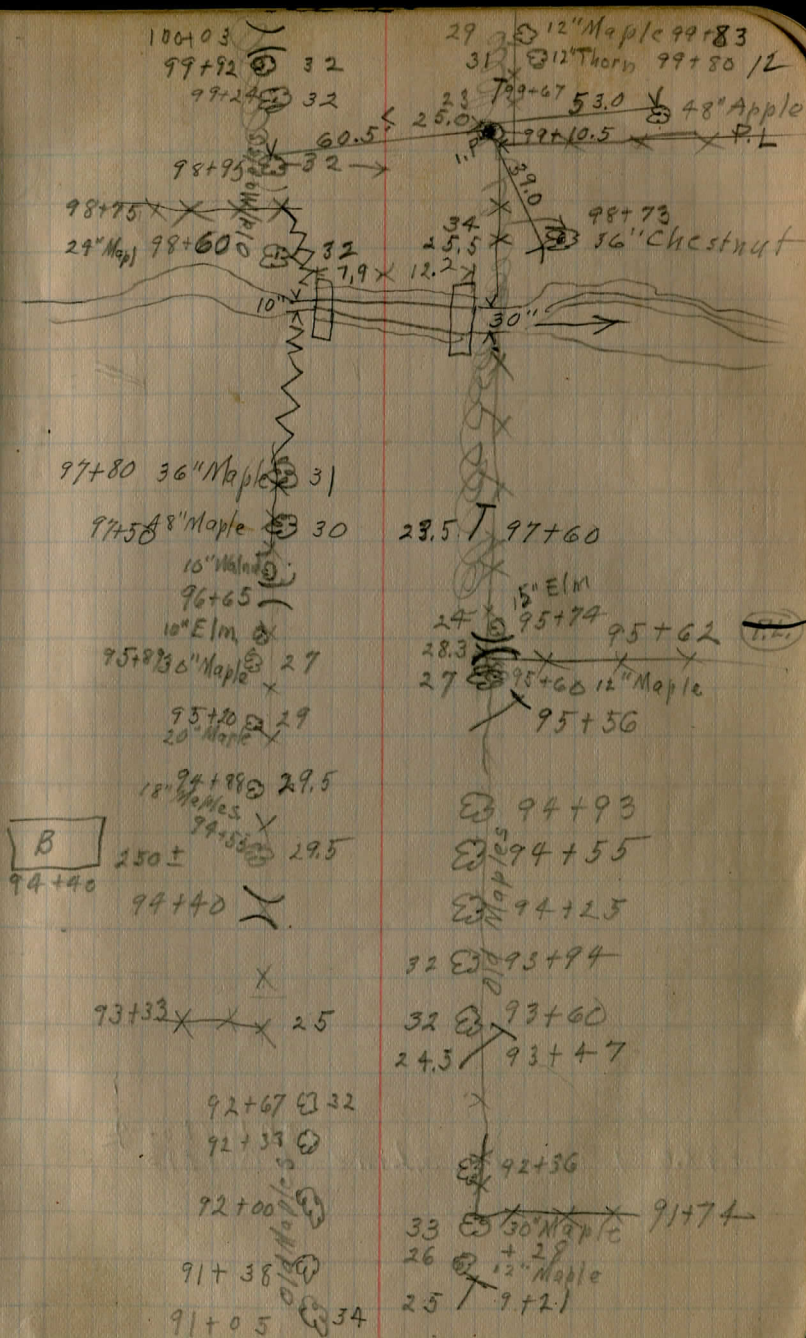
Stopped, Apr. 29, 1929  
Fair, NW. Wind.  
Marks-Parks-Grau.



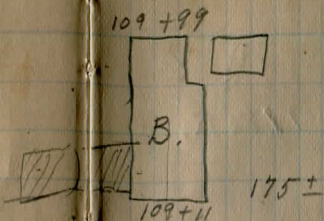
83+15  $\angle 12$   
82+90

99+10.5 Iron Pin, 25' Right, on ~~Elm's~~ S. Line  
Vondrasek's

78+06.5 Stone Culvert, Walls slid together



20 T 110+10



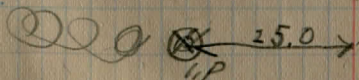
~~107+81~~ x

~~107+69~~ x x x 34  
30" Hickory

106+75 x 29

Black Walnuts.

101+44 20" Walnut 29.5



36" Dead Tree  
100+71 35

100+61 30" Apple 31.5

100+98.0 Iron Pipe, S. Line of Norris 25.0 Left of

108+30

20 T 108+02

31 106+85 60" Dead Chestnut snag  
106+55

x 106 T 105+92  
21  
x 105

x 104  
21 103+85  
x 103

x 102

22 T 101+70

29.0 x 101+32

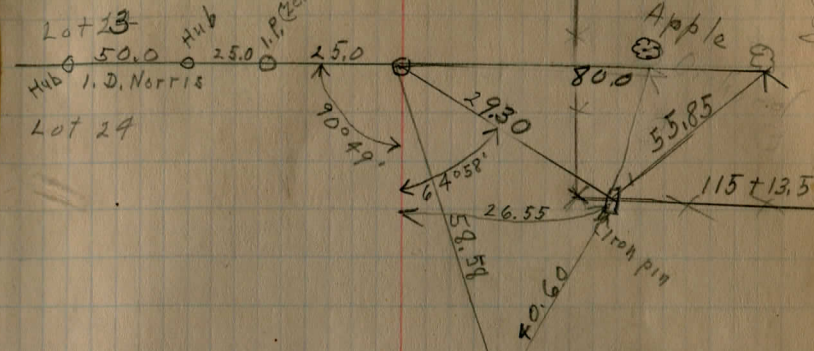
33 100+88 20" Thorn apple

100+38

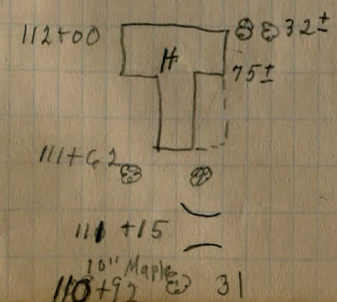
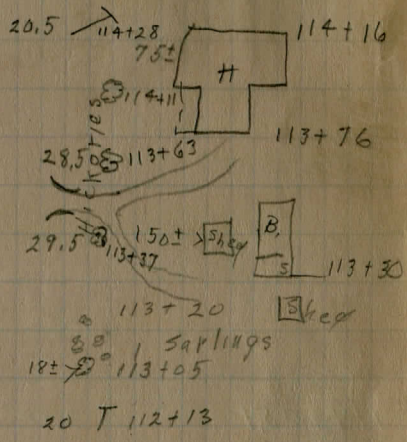
115+25.0

Lot Line.  $\Delta = 0^\circ 11' 1/2'' R.$

115+29.75 Point Set by Zethmayr.



25.6 @ 114+70 "Maples  
26.5 @ 114+49



119+051

$\Delta = 0^{\circ}00'$

100  
100  
100

21 X 122+99

15

28.0 S 122+60 18" B. Walnuts

28.5 S 122+97

30 X S 121+92 27"

29.6 S 121+67 Maples

29.5 X S 121+28

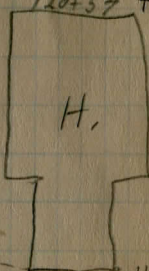
spike X 121+00

21.6 T X 120+98

24 X X 120+83

36 S 120+70 20" Buckeye  
120+57

B  
75±



X 118+90

21 T 118+69

23 X 118+00

21 T X 116+35

24 X 116+00

140+00

137+30.5 - Culvert Concrete Slab, Stonewalls, good Span 3.3

129+60, Requires 24" Pipe  
Carry Water across Road

16

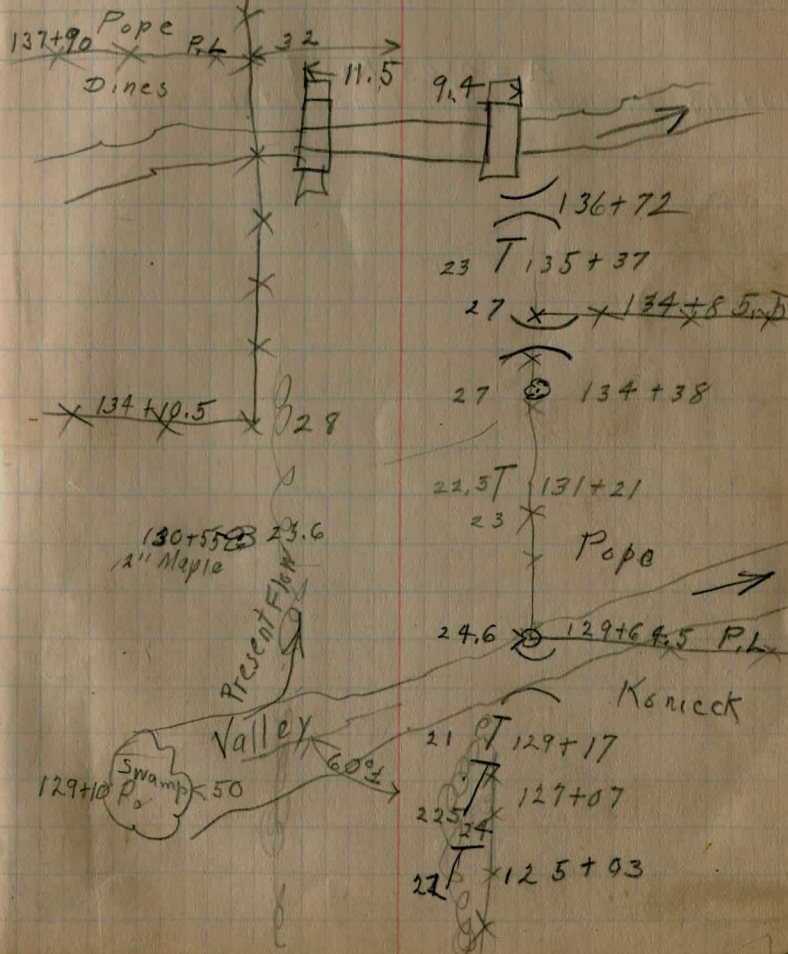
(Clyde)

Marks, Parks, Grau, Munn

Fair, S. W. <sup>Area</sup> 550  
stopped, Apr. 30, 1929

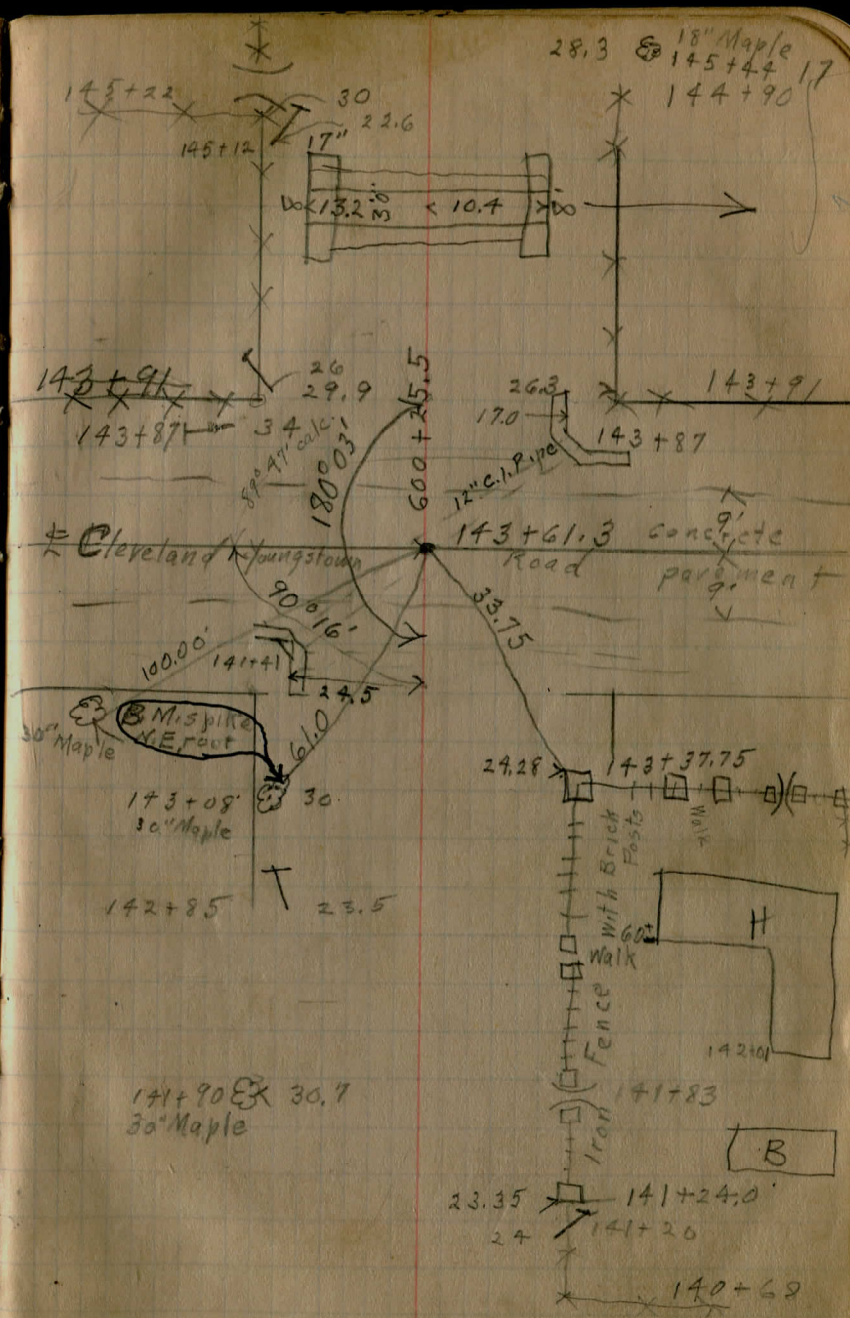
spike 25' stake

23 T 139+54



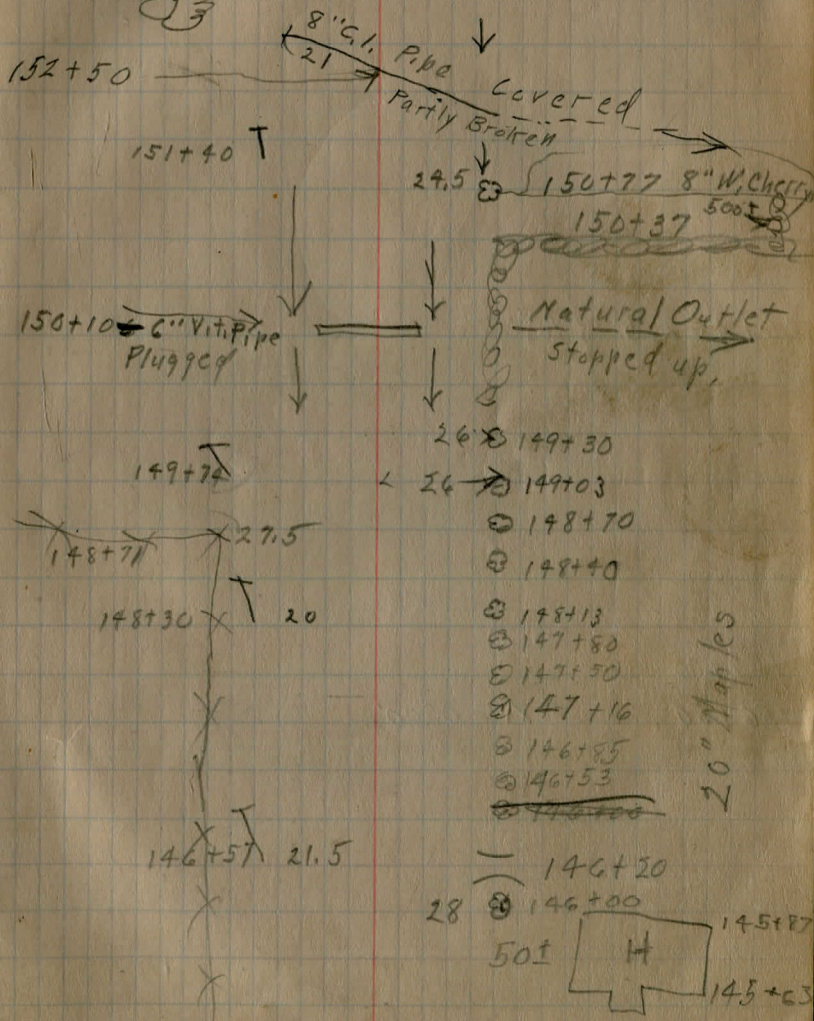
144+56.9 3.8' 2" ± Good Condition  
Concrete Culvert

$\Delta = 0^{\circ}03' \text{ Right}$   
143+61.3 E. Cleveland Youngstown Road at Sta. 600+25.5



153+96  
24" Apple 34.5  
153+70

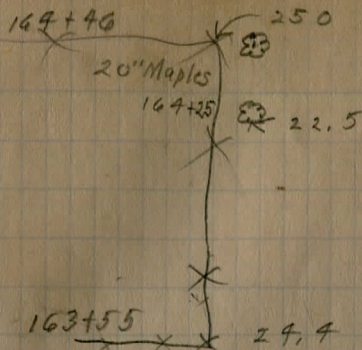
153+19 T  
Spring



161+62.5

156+50

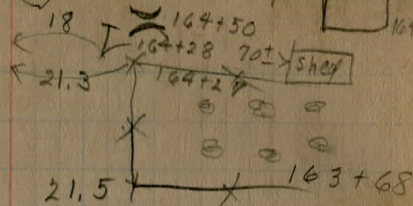
$\Delta = 0^{\circ}00'$



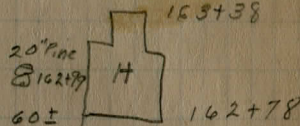
12" Vit. Pipe

10.1 11.0

90± B 19 164+50



163+50



T 162+60

T 160+93

T 159+37

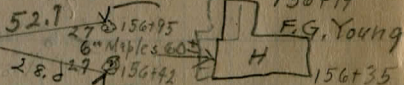
18.2 T 157+82 157+48.5

27.5 18" Maple 157+47

58 42" Oak 157+19

156+50

11.P July Fd 1956



34 156+25 48" Oak

156+09 T 16.3

23 155+50

23 154+84 15" Maples

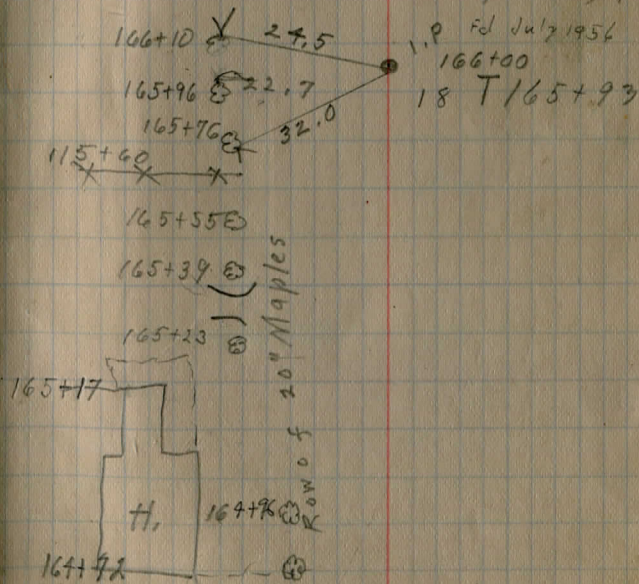
23 154+50

P.L. 154+43

166+00  $\Delta = 0^{\circ}00'$

1717  
~~170+86.5~~ X X 27.6 19.5 T 170+85  
Cemetery X X 170+00  
169+50  
~~169+23~~ X X 28.0 19.5 T 169+20  
X 169+00  
28 @ 168+95  
19.5 T 167+55

stopped, May 1, 1929  
SW. Wind, 55°, storm at 4:30  
Marks, Parks, Grau, Munn.



176+00

A = 0°00'

28.5 @ 182+25 "Apples"  
20.5 T 181+55 21

20 T 180+60  
180+25

X 180

X 179

19 T 178+80 178+80  
30'

X 178

20 T 177+15 177+15  
31

32 @ 176+95  
35 @ 176+98 H.  
12' Buckeye 176+92

88

36 @ 176+55 176+40  
38 @ 30' Maple

Spike Δ

25'

Hubbs ↗

∠ 90°

175+87

T 175+41

174+52

X 23.8

29.6 @ 174+55

19.2 T 174+09

X 174

X 173

20.5 T 172+49

X 172

X 171

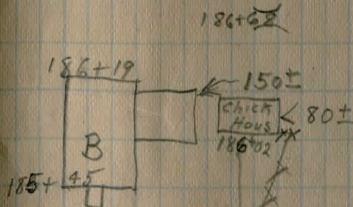
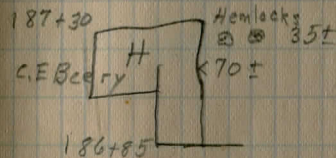
12" Apples

188+00  $\Delta = 0^{\circ}00'$

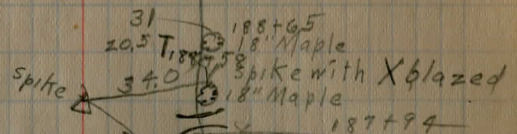
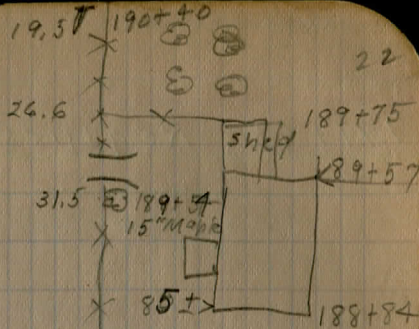
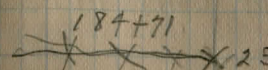
184+92.5

Requires Larger Culvert, about 6'x4'  
2 1/2' x 2' Stone Culvert, Walls, good, Slab, partly

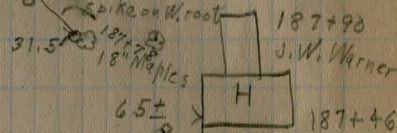
188+78



Broken swale 40'



187+95 28.5  
12" Apple



32' 18" Maples 187+30  
20.5 T 187+16

29.6 186+86 18" Apple

36 186+20  
48" Elm

21 T 185+36 184+94

26  
13.4

20.7 T 182+80 182+83 P.L.  
29

199+43, Requires 15" Pipe

200+0 + T 23.8

200+11

23

199+43-10" C.I. Pipe (Solid) 10.1  
8.2

PL 198+94.5 26.2

18" Apple Orchard  
196+08

195+50 22.4

195+39 Bert Kidd 65±

194+96

Granary 194+42 100±

194+24

B 194+15 100±  
193+84

17.8 T 198+39

T 196+72

195+72.5 P.L.  
22.4

19 T 195+19

19.5 T 193+56

12" corr. pipe 10" Vit. Pipe  
193+23 200±  
8.2 10.3

192+80

192+80 Build 3' X 3' Concrete Culvert,  
36" Vit. Pipe culvert.

26.8 192+35

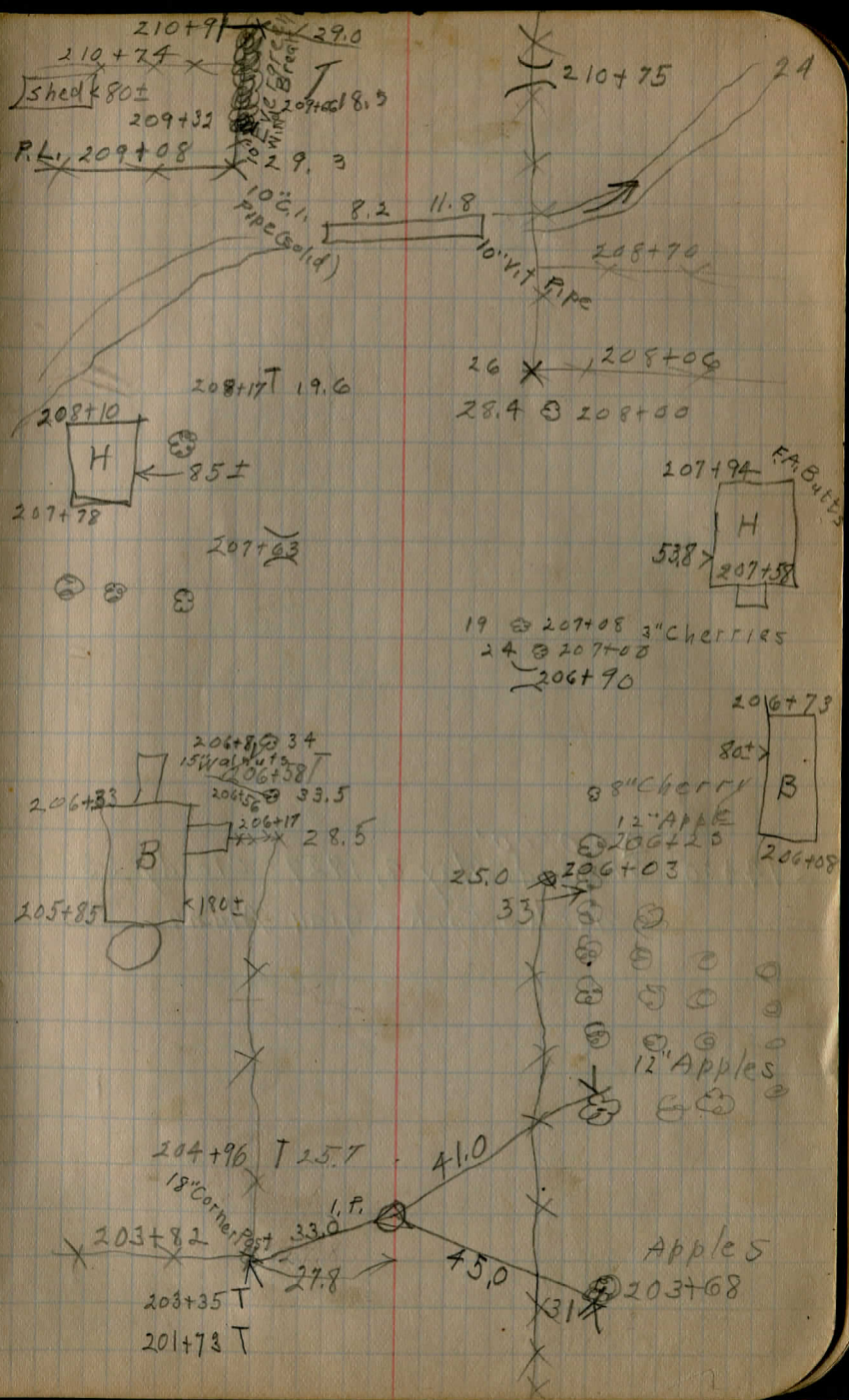
PL 192+08 25.6  
Post

Apple Orchard

20.4 T 191+99

208+90 Requires 18" Pipe

204+00  $\Delta = 0^{\circ}17'$  Left

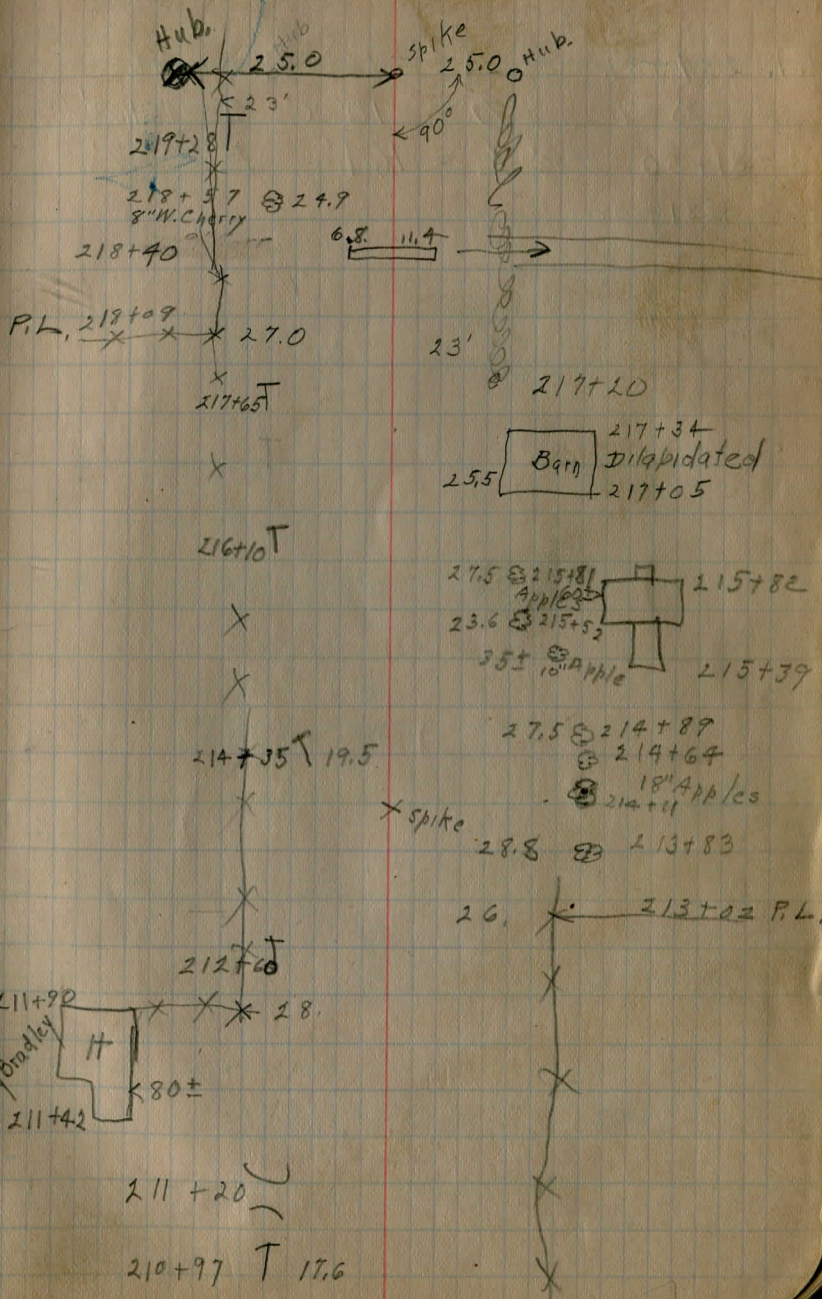


220+00

$\Delta = 0^{\circ}00'$

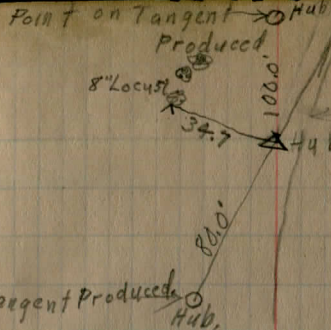
9" Corr. Pipe

214+00  $\Delta = 0^{\circ}00'$   
Stopped, May 6, 1929 Cloudy 55°  
Marks, Parks, Gray Mund



P.I. 231+81.00  $\Delta = 16^{\circ}06'$  Right  
 $D = 10^{\circ}00'$   $T = 81.0'$   
 231+50  $2^{\circ}30'$   $L = 161'$   $E = 5.7'$

P.C. 231+00



Point on Tangent Produced Hub

230+49 T 19.3

228+88 T

227+30 T

225+60 22

P.L. 225+29

224.0

225+71 T

224+35

224+07 T 22.9

223+58 24.0

223+58

120±

223+46

223+40

223+16

223+12

B = 200±

16' of 10' C.I.P.

222+61

222+64

222+52

222+52

222+37

221+91

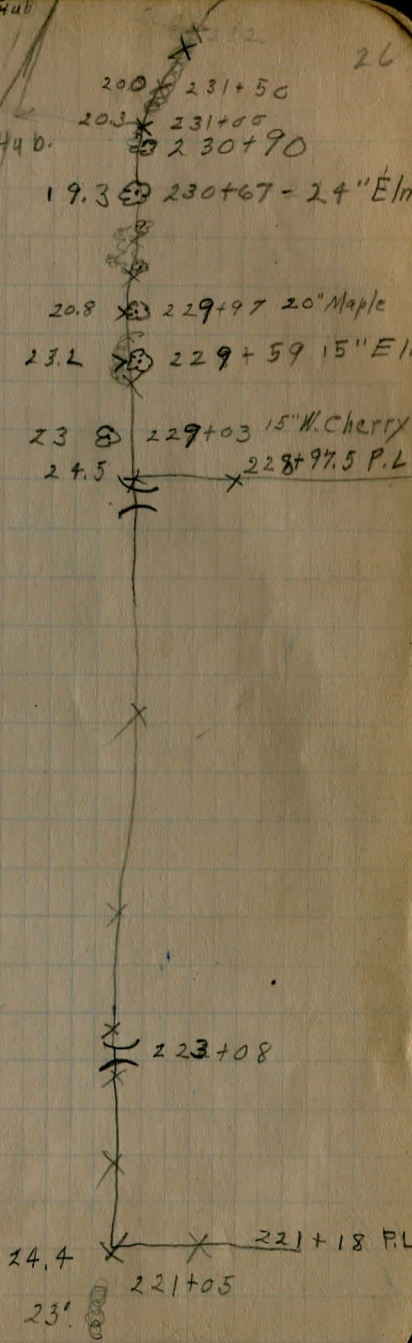
221+37

221+91

220+91 T

220+91 T

Magnetic N 4 1/2° E



238+99 18" Apple 26.3

23

239+00

27

238+71 T 18.9

237+42 15" Corr. Pipe 9.2 6.9

237+24 36" Elm. 18

156 8" Elms. 237+ { 21  
18

237+07 T 20.7

236+40

236+50

150' Swale

25.5 236+00

235+95

235+89 12" Maple. 22.5

235+38 T 21.4

27.7 235+33 18" W. Cherry

2359

28'

27.2 234+79 15" W. Ch.

25.8 234+65 6" Elm

26.8 18" Maple. 234+60

26.5 234+40 15" W. Ch.

18.4 234+14 20" W. Cherry

27.2 8" Elm 234+00

24 233+95 18" W. Cherry

27.0

27.0 233+74 18" W. Cherry

26.7 233+42 12" Elm

26.8 233+22 12" W. Cherry

26 233+04 8" W. Cherry

25 8" W. Cherry 232+87

24 12" Ash 232+70

← 90°

A 25.0

Hub

28.5 232+46 18" Apple

26.5 232+00

232+00 T 27.0

8" Locusts

P.T. 232+61 8°03'

232+50 7°30'

232+00 5°00'

24" Ash 250+50 26.2

Woods

250+15 24.2

250+05 T 14.4

248+56 T 14.6

15" Ash 247+99 24.5

246+99 T 15.3

20' 246+70

246+05

246+00 Δ = 0°00' Stopped, June 4, 1929 Fair-650  
Marks, Parks, Gray-Belding.

Tacked Stake 25.0 spike 25.0 Tacked Stake

245+34 T 15.8

30.0 245+08 30" W. cherry

243+76 T 16.1

242+10 P.L.

242+12 T 17.6

51.9 242+10  
25.2 T 241+90

242+00 T 31.1

13.7 241+89

241+84 6.9

10" solid c.l. pipe

15  
E. Road  
Stafford

74°40'±

T 22.0

241+58 T 16.7

240+32 T 17

28.7 239+35 18' Elm

$16^{\circ}22'$   
P.T. 259+49.5

259+00  $11^{\circ}25'$

P.I. 258+69.9

$\Delta = 32^{\circ}44'$  Right,  $E = 12.0$

$D = 20^{\circ}00'$   $T = 84.1$

$L = 163.7$

258+50  $6^{\circ}25'$

258+00  $1^{\circ}25'$

P.C. 257+85.8

179

147

1.6

$6^{\circ}30'$   
P.T. = 253+79.44

253+50  $5^{\circ}16'$

253+00  $4^{\circ}01'$

252+70 P.I.

$\Delta = 13^{\circ}00'$  R.  $E = 7.4$

252+50  $2^{\circ}46'$

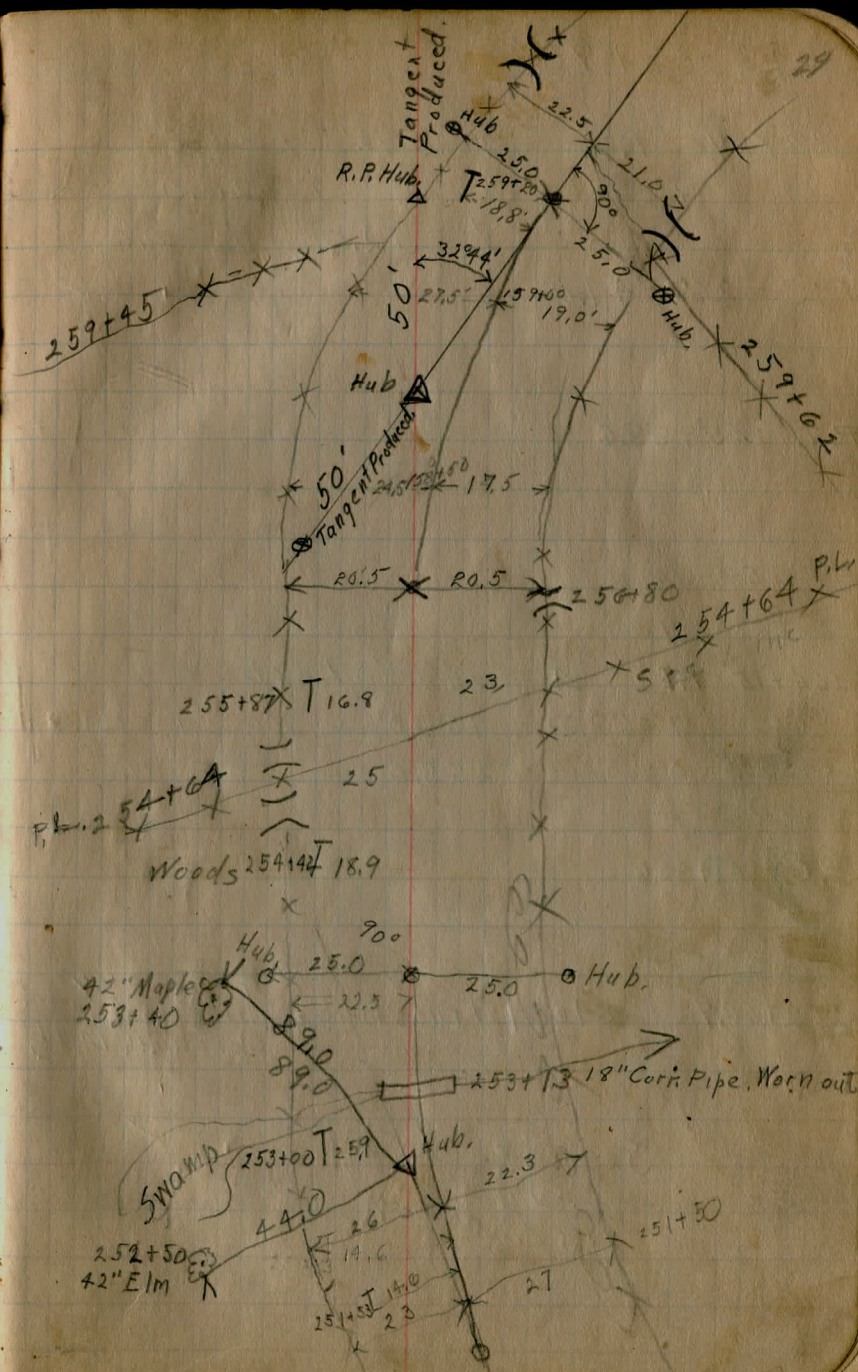
$D = 5^{\circ}00'$   $T = 130.56$

252+00  $1^{\circ}31'$

$L = 260.0'$

251+50  $0^{\circ}16'$

P.C. 251+39.44



P.T. = 267 + 96.0

267 + 70 P.I.  $\Delta = 5^{\circ}12'$  Left

267 + 42 6" Corr. P.  $D = 10^{\circ}$   $T = 16.0$   
 $L = 52.0$   $E = 0.6$

P.C. = 267 + 44.0

17000'

P.T. 265 + 38.6

265 + 00  $14^{\circ}26'$

267 + 50  $11^{\circ}06'$

264 + 15 P.I.  $\Delta = 34^{\circ}00'$  Left

264  $7^{\circ}46'$   $D = 13^{\circ}20' = 800'$   $T = 131.4$

263 + 50  $4^{\circ}26'$   $L = 255.0$   $E = 19.6$

263  $1^{\circ}06'$

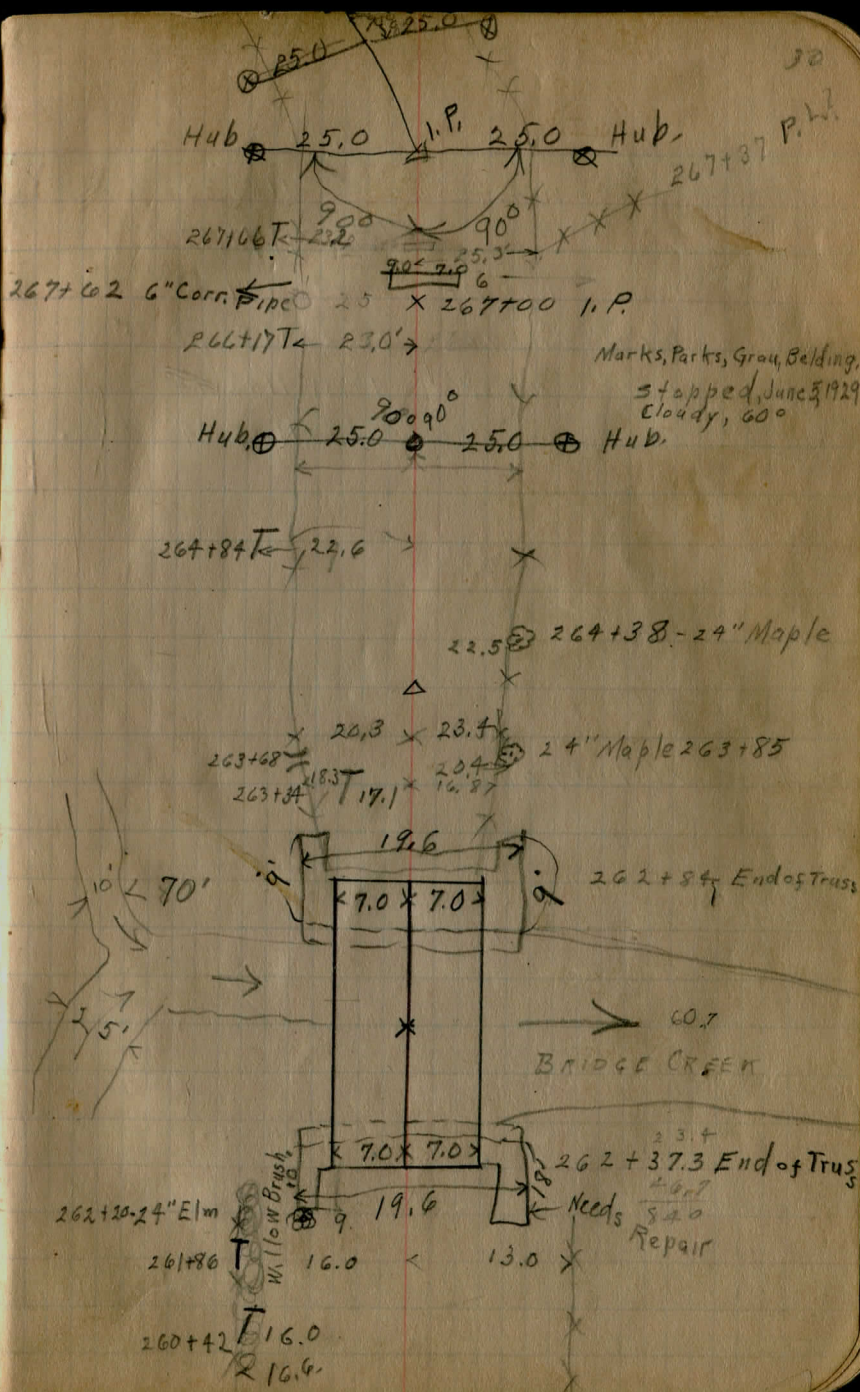
P.C. 262 + 83.6

262 + 60.7

Steel Truss Bridge

Truss  $46.7'$   
Clear Span  $44'$   
Clear Width  $14' \pm$

See pgs 56-57  
for margin notes.



0.59	1184.42		1183.83
		9.62	1174.80
0.80	1172.24	12.98	1171.44
0.06	1157.05	15.25	1156.99
1.09	1143.83	14.31	1142.74
		6.49	1137.34

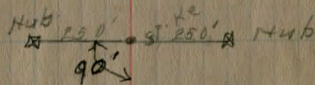
P.C. = 267+44.0

May 1, 1929  
Marks, Gray

31

B.M. Spike, N.E. Root 30" Maple, S. side M.M. Rd.  
+ 60' W. of Popes corners.  
B.M. Set, spike, N.E. root 30" Maple S.W. cor.  
Popes Corners

B.M. Rec, 1137.43 S. Root Tree, N. side M.M.  
1300± E. of Popes Cor.

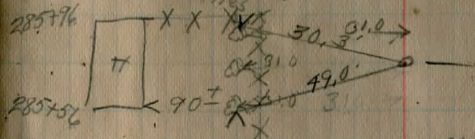




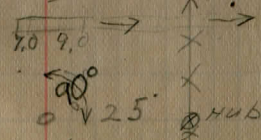
291+60 X X ← R6 →

← 28.5 → 10" APPLE  
 291+35  
 ← 17.0 → 291+10  
 ← 32.0 → 290+96  
 ← 32.5 → 290+62  
 ← 32.5 → 290+46  
 ← 32.5 → 290+30  
 ← 32.5 → 289+97  
 ← 32.5 → 289+70  
 ← 18.0 → 289+52  
 ← 35.5 → 288+95  
 ← 32.0 → 288+95  
 ← 19.5 → 288+12

← 19.0 → 286+52  
 ← 21.6 → 286+05  
 12" CORR. PIPE



← 20.0 → 285+20  
 ← 20.0 → 283+82  
 ← 20.0 → 282+62  
 ← 24.0 → 282+61



286+00 Δ = 0°00'

282+30.4 12" corr. pipe

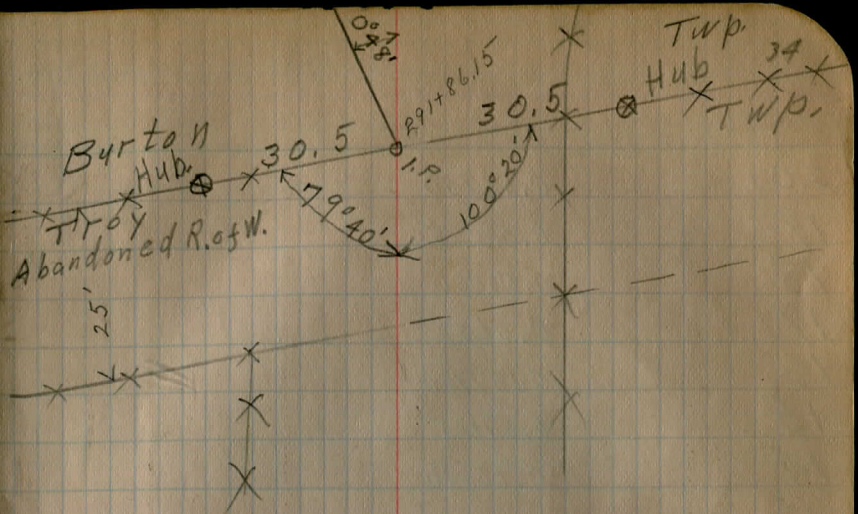
P. T. 281+26.83 60 2 1/2'

281 5°41'

June 7, 1925 D. Parks  
stopped F. Bran,  
Cloudy Warm 50° R. Goodrich

291+86.15

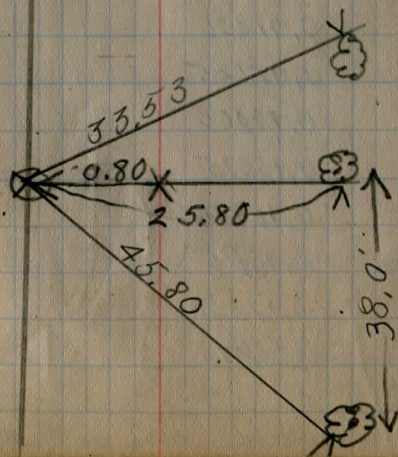
end of Project



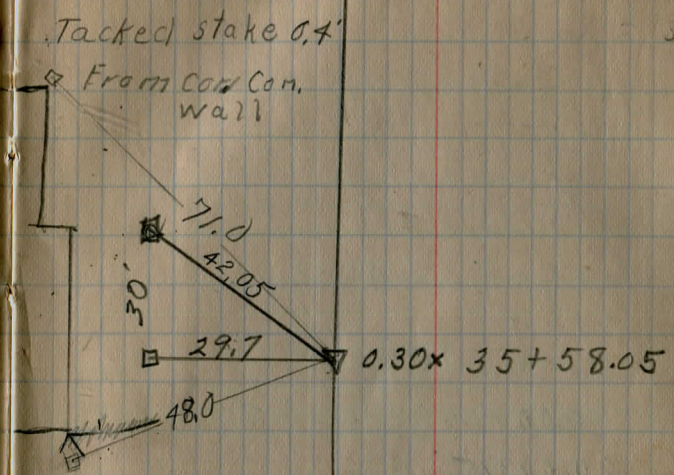
20	0.52250
19	0.53625
18	0.55000
17	0.56375
16	0.57750
15	0.59125
14	0.60500
13	0.61875
12	0.63250
11	0.64625
10	0.66000
9	0.67375
8	0.68750
7	0.70125
6	0.71500
5	0.72875
4	0.74250
3	0.75625
2	0.77000
1	0.78375
0 + 00	0.80750

July 16, 1929  
 Fair Warm 75°  
 Relocation of

D. Parks  
 R. Goodrich  
 line from Sta 0+00  
 to Sta 58+05.75



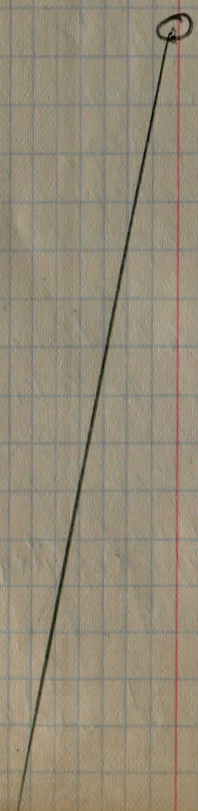
44	0.19250
43	0.20625
42	0.22000
41	0.23375
40	0.24750
39	0.26125
38	0.27500
37	0.28875
36	0.30250
35	0.31625
34	0.33000
33	0.34375
32	0.35750
31	0.37125
30	0.38500
29	0.39875
28	0.41250
27	0.42625
26	0.44000
25	0.45375
24	0.46750
23	0.48125
22	0.49500
21	0.50875



tack stake 6.6'  
from lower  
corner board  
of house.

58+05.75

58	0,00
57	0,01375
56	0,02750
55	0,04125
54	0,05500
53	0,06875
52	0,08250
51	0,09625
50	0,11000
49	0,12375
48	0,13750
47	0,15125
46	0,16500
45	0,17875



# Drainage Observations.

- 165+40 L. req. 8" D.W. Pipe.  
 163+50 Requires 8" D.W. pipe  
 161+62.5 Requires 18" Pipe Culvert,  
 157+07, R. 8" D.W. Pipe reqs.  
 152+30 Carry water from Spring down  
~~152+50 Requires 10" sidehill Culvert Outlet~~  
 146+20 R. Use present 12" seg. C.I. Pipe  
 145+30 L. 18" D.W. pipe req.  
 137+30.5 Extend with Slab Pipe  
 134+80 R. 10" D.W. Pipe Req.  
 129+60 Req. 24" Hillside Culvert across Rd.  
 120+75 R. 8" D.W. Pipe Req.  
 113+50 R. 12" D.W. Pipe Req.  
 111+15 L. 15" D.W. Pipe Req.  
 98+06.5 6' x 4' Slab, Top Culv. Req.  
 94+40 L. 24" D.W. Pipe Req.  
 89+~~20~~<sup>20</sup> to 90+40 12" Side Road Culv. Req.  
 89+70 R. 10" D.W. Pipe Req.  
 83+80 R. 8" D.W. Pipe Req.  
 76+45 R. 15" D.W. Pipe Req.  
 62+45 Left, 18" D.W. Pipe Req.  
 61+90 Right, 15" D.W. Pipe Required  
 33+30 Make Culvert at 33+30  
 6+40 Right Salvage 24' of 6" V.t.  
 0-10 Driveway East side,

July 29, 1929, Fair, 80° Marks + Hassel<sup>38</sup>

West side of road  
 into field to S.E.  
 20'


8" Pipe, Cur Pipe to be salvaged.

instead of 31+65  
 Pipe in Driveway  
 Requires open Ditch or 8" Pipe

VITRIFIED  
**DRAIN TILE**  
The E. BIGLOW COMPANY  
NEW LONDON, OHIO  
PHONE 78

*N of the bridge ± 500'*  
*S of bridge ± 1200'*

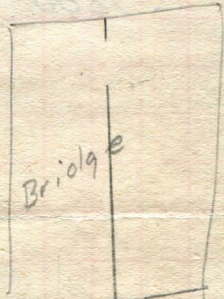
VERIFIED  
DRAIN TILE  
THE E. BLOW COMPANY  
NEW LONDON OHIO  
PHONE 24

spt  sta 93+0

27.7  
3.95  

---

81.65





saw NW side  
10" shag Hick

168.0

~~55.75~~

40.3

 spt N  
root 40" Oak

*Jorge*  
saw in  
S side tel pole  33.06

1P set 80' S of Sedge  
of sbridge seat  
Sta 91 ± 12.0

Date 7-30-51

- 291+00,
- 289+70 289+70 R req. 12" D.W. pipe,
- 186+05 L. req. 8" D.W. Pipe
- 282+30 Requires 18" Culvert 90° to E
- 276+85 requires 15" Culvert 90° to E
- 272 I R, 8" D.W. pipe req,
- 271+00 L, 8" D.W. pipe req,
- 267+62 12" Culv. req. 90° to E.
- 259, Both sides, no D.W. pipe req,
- 253+13 requires 18" culvert square with E
- 241+84 left. requires 15" side road
- 237+42. requires slab top Culv. 6' x 3' opening
- 223+08 R, Req. 10" D.W. Pipe
- 222+70 L. req. 12" D.W. Pipe
- 218+40 Req. 18" pipe culv. 90° to E. ✓
- 216+50 R. req. 12" D.W. Pipe
- 211+20 L. req. 12" D.W. Pipe
- 208+90 req. 18" pipe culv. 90° to E.
- 207+63 L. req. 15" D.W. pipe.
- 206+90 R. req. 12" D.W. Pipe
- 194+15 L. req. 12" D.W. Pipe
- 188+00 R. req. 8" D.W. Pipe
- 186+68 L req. 12 D.W. Pipe
- 179 +70 Requires 15" Culvert, 90° to E
- 175+85 R req. 8" D.W. Pipe
- 174+00 Requires 24" Culvert 90° to E.

Water runs both ways from road.

dig outlet 100'

Culvert 50' long -  
dig outlet 300'

Salvage + Relay <sup>16'</sup> present 10" C.I. Pipe

5.4	7.1	9.1	9.4	10.0
E	50	100	150	200

3.6	6.5	7.6
E	45	100

4.9	9.5	11.5
100	E 85	185

W.

E

# CULVERTS

Oct. 10, 1929, Marks, Belding, Barton

129+60

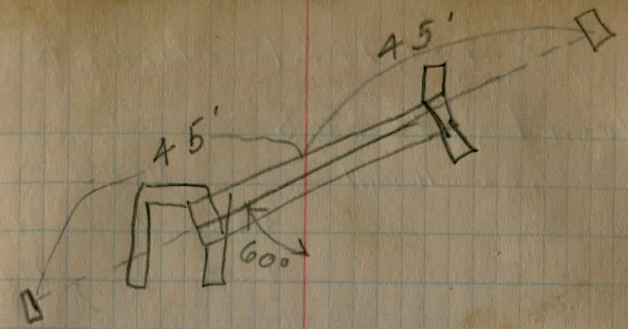
T.P.	5.14	1187.71		1182.57
			5.46	1180.25
			6.46	1179.25
	5.88	1188.05		1182.25
				1179.25
			6.30	

105+00

	1.03	1172.80		1171.83
			3.71	1165.15
			6.01	1163.11
				1163.95

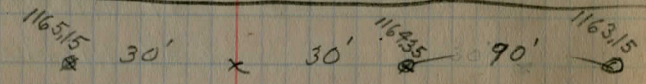
98+065

			1162.12	B.M.
	2.40	1164.52	1162.12	
				1153.00
			8.02	1156.50
			8.02	1156.50



Slope Hub, W. side, 129+00

7.46	Cut 2.0	Stake 45' Left
8.46	<del>Cut 2.0</del>	" 45' Right
		Grade stake, Left
		Oct. 19, 1929, Marks, Rand, Barton
8.80	Cut 2.5	



Left, 107+65

7.71	C 4.0'	Stake, 30' Left of E,
8.51	C 2.5'	" 30' Right " "
8.91		" 120' " " "



B.M.

11.52	Bottom of Footer	
	Cut 3.5' to bottom of footer	Stake 40' Left
	Cut 3.5' " " " "	40' Right

Oct. 21, 1921. Marks, Rand

Culvert, 90+05

B.M.	1.02	1190.17	1189.15
		4.32	1182.85
		12.32	1179.85

Culvert, 144+60, Slab Top, 6' Span

7.32	1176.97	1169.65	1170.00
			1171.50
			0.60
			1170.90
			4.00
			1166.90
6.57	1170.40	1166.90	
6.57	1170.40	1166.90	
9.70		1165.90	

71+15, 15" Pipe Culvert.

3.90	1167.51	1163.61
	4.35	1161.15
	7.16	1160.35

77+70 15" Pipe Culvert

1.78	1180.47	1178.69	B.M., 80+00
	3.65	1172.82	
	4.79	1172.18	

89+55  
1182.85

89+70  
1182.74

90+40  
1170.3

90+55  
1179.85

41

spike, W. Root, 24" Maple, Right	89+15
7.32	6.3.0
10.32	0.0
	Stake 89+55
	" 90+53

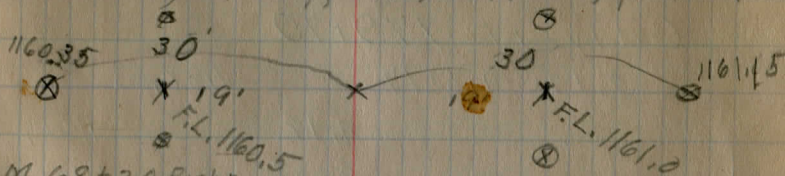
Oct. 26, 1929, Fair, 55° Marks+Goodrich,

slope stake, Right, 144+00	1181.92
5 yd. grade of road.	12.27
thickness of slab	1169.65
Top of Wall	

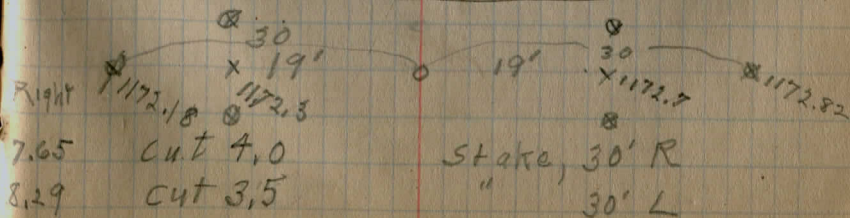
Bottom of Footer

10.07	Cut 3.5'	Stake, 25' Left of E
10.07	Cut 3.5'	" 25' Right " "
11.07	Cut 1.4	" 100' " "

Oct. 28, Cloudy, 45°, Marks, Goodrich



B.M., 68+20, Right.	6.36	Cut 2.0	Stake, 30' R.
	7.16	Grade	Stake 30' L.



Right	7.65	Cut 4.0	Stake, 30' R
	8.29	Cut 3.5	" 30' L

Culvert, 161+62.5

T.P. 4.24 1188.58 1184.32

4.78 1182.8

1.98 1183.6

Culvert 174+00

5.90 1146.91 1161.01

5.55 1158.36

4.27 1159.14

Culvert 179+70

5.14 1153.97 1150.83

4.12 1150.35

2.32 1151.15

Oct. 29, 1929 Cold rainy 40°

D. Parks, R. Goodrich

Slope peg, Sta. 162+00, Right

5.78 cut 1' Stake 30' R

4.98 cut 3' Stake 30' L

Slope stake RT 174+00 1166.42  
3.41  
1161.01

8.55 cut 3' Stake 30' R

7.77 cut 3' 6" Stake 30' L

Slope Hub RT Sta. 180+00 1158.24  
7.71  
1150.83

5.62 cut 1' 6" Stake 30' RT

4.82 cut 2' 6" Stake 30' LI

Culvert 38+00

B.M. 13.88 1162.07      1148.19

5.21      1157.34

0.43      1158.14

Side Road Culvert Sta. 58+05.75

B.M. 183 1136.81      1134.98

5.81      1125.5

5.81      1127.5

5.63      1172.35      1166.72

3.23      1166.15

8.00      1165.35

Nov. 2, 1929 Fair 65°

D. Barks, R. Goodrich, H. Barton

S. W. Root 24" Chestnut sta. 40+05 R

4.71      F 0.5      Stake 30' R

3.93      C 3.5      Stake 30' L

Spike S. W. Root R. Sta 59+00

11.31      05'6"      Stake 23.75 South E

9.31 \*      03'6"      Stake 24.25 North E

Nov. 4, 1929 Cloudy, W. Wind. Mark's, Goodrich

1166.5	o 1166.0				
o	19'	x	19'	o 1165.5	
	30'	x	30'		o 1165.35
	o 19'	x	19'	o	

B.M. 7' Ash, L. 31+25

6.20      C 3'      Stake 30' L

7.00      F 1.1      "      30 R.

42+65

1140.28

1.63

1135.15

4.13

1133.15

184+92.5 6' span slab top Culv.

1.10

1149.71

1148.61

1140.50

5.71

5.71

5.68

1149.17

1143.49

4.52

1140.65

5.32

1139.85

192+80, 36" Vit. Pipe Culv. Enc.

3.10

1149.30

1146.20

4.65

1140.65

9.45

1139.85

8.45

FL. 1135.15

5.13

C 3.5'

Stake 30' L.

5.13

C 3.0

" 30' R.

Nov. 5, 1929, Snow-clearing, Marks, Goodric

o 19'

19' x

o 30'

x 30' o

o 19'

19' x

B.M., Right, 187+30

Grade, Bottom of footer.

9.21 Cut 3.5' to Bottom of Footer

Stake 30' L.

9.21 Cut 3.5'

Stake 30' R.

1140.65

o 19'

19' o

o 30'

30' x

1139.85

o 19'

19' o 1140.0

Grade Hub, 193+00, Left.

8.52 C 4.0

Stake 30' L.

9.32 C 4.0

" 30' R.

Apr. 21, 1930 Marks, Belding

B.M., E. root, 15" Apple, 197+70, Left.

8.65 C 4.0

Stake, 30' L.

9.45 0.0

" 30' R.

7.45 C 1.0

" 30' R.

199+43

3.12 1149.32 1146.20

4.67 1142.65

5.47 1141.85

184+925 2.08 1150.69 1148.61

1140.50

6.75

7.25

208+90 18" Pipe Culv.

2.00 4.06 1144.36 1140.30

4.71 1136.65

5.51 1135.85

218+40 18" Pipe Culv.

B.M. 5.83 1134.81 1128.98

5.66 1127.15

6.46 1126.35

B.M. 197+70, L.

6.67 C 2' Stake 30' L.

7.47 C 2' " 30' R.

B.M., Right 187+50

grade, Bottom of Footer

10.79 C 3.5 Stake, 30' L.

10.19 C 3.0 " , 30' R.

Apr. 23, 1930, Cloudy, 30° Marks, Quiggle, Belding.

B.M. 208+00, R.

7.71 C 3.0 stake, 30' L.

8.51 C 3.0 stake, 30' R.

W. root, Wild Apple, 219+20, R.

7.66 C 2.0 stake 30' L.

8.46 C 2.0 stake 30' R.

May 6, 1930 D. Parks, L. Ernst, F. Ashcraft  
241+75 side road culvert

8.52 1114.33 1105.81

1107.25  
1105.60

253+13

1.32 1106.61

1105.29

1099.4  
1098.1

3.50 1109.31 1105.81

237+42 Concrete Culvert 1101.75

3.31 1106.00

3.31 1106.00

B.M. W. root 20" Elm right sta 237+40

7.08 2.08 C5.0 stake at 242+10  
8.83 3.33 C5.5 stake at 241+40

B.M. E. root 24" Maple Left sta 251+00

7.21 5.21 C2.0 stake 30' Lt  
8.51 5.51 C3.0 stake 30' Rt

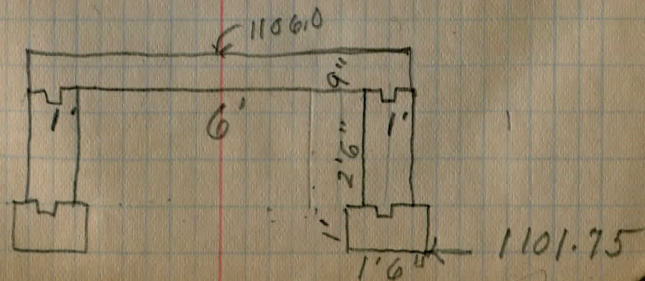
May 9, 1930, Fair, 80° Marks, Belding.

B.M. W. root 20" Elm, 239+40; R,

7.56 1101.75 Bottom of Footer

Top of Slab, Cut 4'3" to Bottom of Footer Stake 30' L,

same " 30' R,



267+62

8.45 1111.12

1102.67

1103.35

1104.15

276+85

0.16 1117.50

1117.34

1109.18

1109.57

282+30

3.00 1123.73

1120.73

1120.73

1113.15

1112.35

May 10, 1930 D. Parks, L. Ernst, F. Ashcraft

B.M. W. root 30" Maple right sta 263+80

7.77 5.77 C2.0 stake 30' Left

6.97 5.47 C1.5 stake 30' Right

May 14, 1930 D. Parks, L. Ernst, F. Ashcraft

B.M. R.P. spike N. side 48" Maple Pt. 271+98

8.32 6.82 C1.5 stake 30' Lt.

7.93 4.93 C3.0 stake 30' Rt.

May 10, 1930 D. Parks, L. Ernst, F. Ashcraft

B.M. R.P. spike N. root 20" pine Left sta. 285+95

10.58 9.08 C1.5 stake 30' L.

11.38 8.88 C2.5 stake 30' R.

Tile Left & Right Sta. 35+50 to 36+70

B.M. 7.09 1173.81 1166.72

35+50 1170.07

36+00 1169.50

36+50 1168.74

36+70 4.07 1172.93 4.95 1168.86

36+50 1167.74

36+70 1167.24

E. root 4' Ash L, sta 31+25.0

stake L

stake RT

3.74 0.24 0 3'6" 1.74 0 2'0"

4.31 1.31 0 3'0" 2.81 0 1'6"

6.07 0.07 0 6'0"

5.19 4.19 0 1'0"

5.69 0.69 0 5'0" 5.69 0 0

Slope Stakes

B.M. 2.64 1123.39 1120.73

286			1117.75
287			1117.00
288			1116.00
289			1115.00
	2.64	1118.83	7.20 1116.19
290			1114.00
291			1113.15
291+86.15			1113.20

B.M. 3.39 1124.12 1120.73

285			1117.00
284			1116.00
283			1115.35
282			1115.40
	7.16	1122.74	8.54 1115.58
281			1115.50
280			1115.10
279			1113.95
	5.26	1116.76	11.24 1111.50
278			1112.63
277			1111.50
T.P			4.59 1112.17

R.P. spike N. Root 20" Pine Left sta 285+95

5.64	2.89	$\frac{02.8}{28.5}$	3.71	$\frac{01.9}{26.0}$
6.39	4.76	$\frac{01.6}{26.0}$	4.05	$\frac{00.3}{24.5}$
7.39	7.02	$\frac{00.4}{24.5}$	7.86	$\frac{F0.5}{24.5}$
8.39	7.23	$\frac{01.2}{25.5}$	8.42	$\frac{01.0}{24.0}$
4.83	4.38	$\frac{00.5}{25.0}$	4.55	$\frac{00.3}{25.0}$
5.68	6.08	$\frac{F0.4}{24.0}$	5.08	$\frac{00.6}{25.0}$
5.63	6.10	$\frac{F0.5}{24.5}$	6.17	$\frac{F0.6}{24.5}$

R.P. spike N. Root 20" pine Left sta 285+95

7.12	4.21	$\frac{02.9}{28.5}$	4.15	$\frac{03.0}{28.5}$
8.12	7.40	$\frac{00.7}{26.0}$	6.98	$\frac{01.1}{26.0}$
8.77	9.67	$\frac{F0.9}{24.0}$	9.94	$\frac{F1.2}{23.0}$
1115.40	8.72	$\frac{F1.4}{23.5}$	10.11	$\frac{F1.4}{24.5}$
1119.40	8.24	$\frac{02.3}{30.0}$	5.92	$\frac{00.6}{23.0}$
1114.10	8.64	$\frac{01.3}{28.0}$	7.31	$\frac{03.7}{27.5}$
8.79	9.46	$\frac{F0.7}{24.0}$	7.93	$\frac{00.9}{25.0}$
4.13	5.26	$\frac{F1.1}{23.5}$	3.43	$\frac{00.7}{25.0}$
5.26	4.71	$\frac{F1.5}{22.5}$	5.65	$\frac{F0.7}{23.5}$

X: N.E. Cor. E. Head wall

# Iron Pipes Set

35+58.0  $\Delta = 0^{\circ}00'$

32+00  $\Delta = 0^{\circ}00'$

17+00  $\Delta = 0^{\circ}00'$

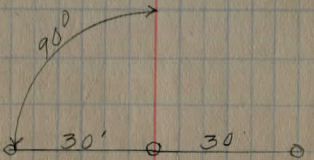
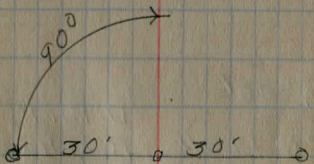
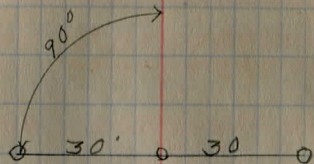
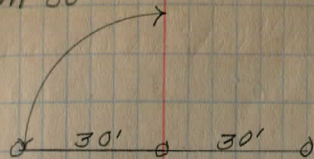
0+00  $\Delta = 0^{\circ}00'$

Aug. 18, 1930

D. Parks  
R. Hassel  
T. Snyder

50

Clear Warm 80°



90+86.9

$\Delta = 0^{\circ}00'$

For 1930

84+81.1

$\Delta = 0^{\circ}29' L$

68+99.0

$\Delta = 0^{\circ}00'$

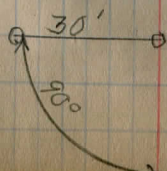
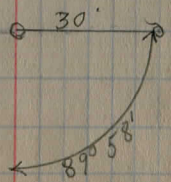
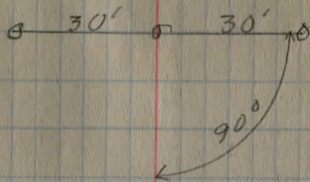
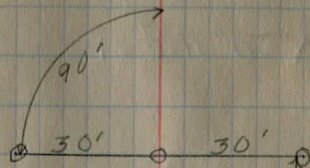
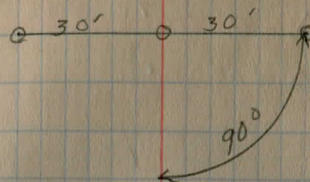
Aug. 26, 1930

D. Parks  
F. L. Hassel  
T. Snyder

58+05.75

$\Delta = 0^{\circ}4' R$  (W. INGLE R. S.)

48+67



117+25.1

$\Delta = 0^{\circ}00'$

$\Delta = 0^{\circ}00'$

115+25.0

$\Delta = 0^{\circ}11\frac{1}{2}' R$

100+98

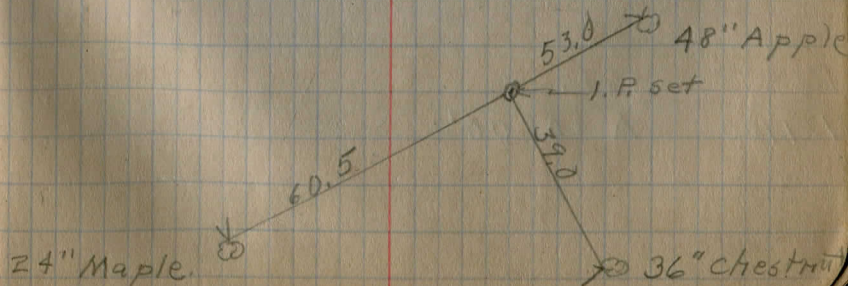
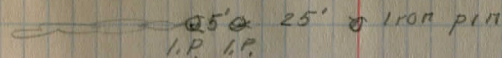
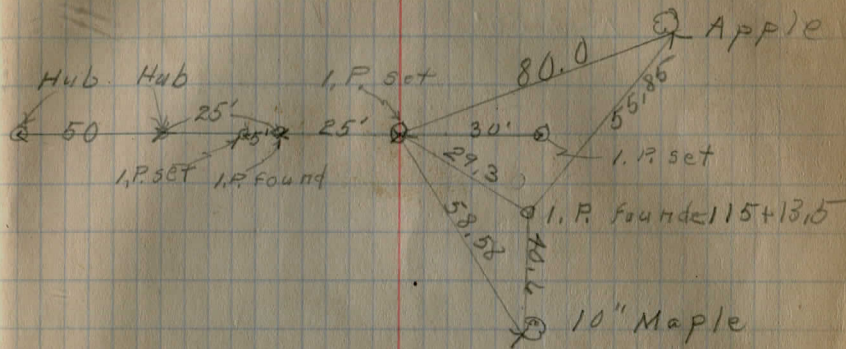
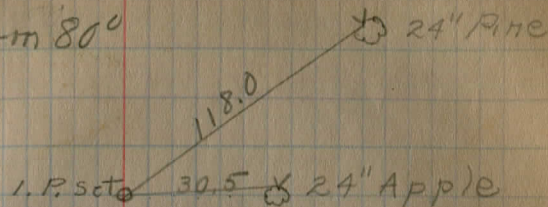
P.L.

99+10.5 P.L.

Sept. 4, 1930

D. Parks 52  
P.L. Hassel

Clear Warm 80°



156+50

$\Delta = 0^{\circ}00'$

143+61.3

$\Delta = 0^{\circ}03'$  RT.

121+00

$\Delta = 0^{\circ}00'$

Sept. 5, 1930

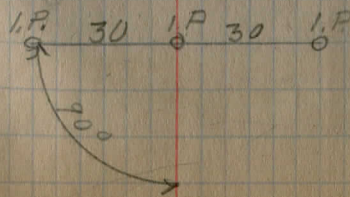
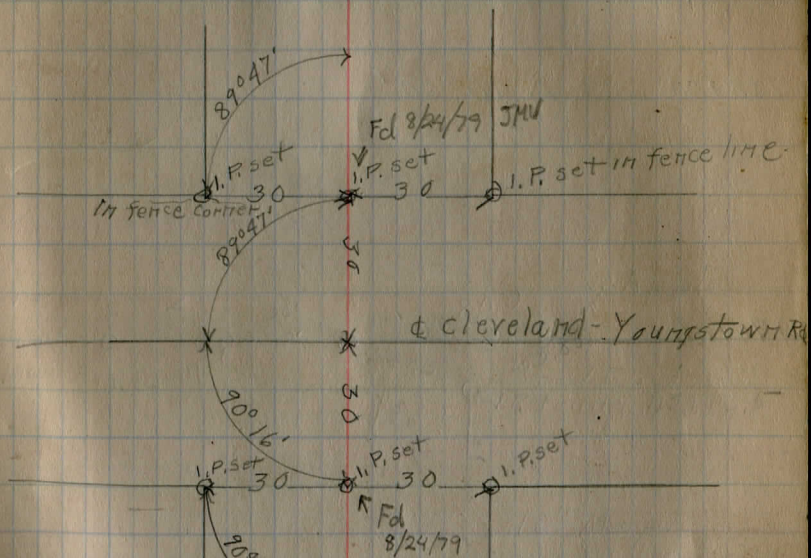
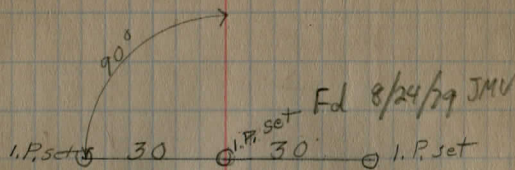
D. Parks

R. L. Hassel

53

Clear Warm 80°

T. Snyder



188+00

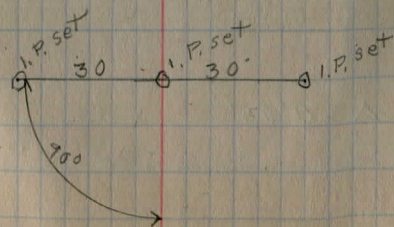
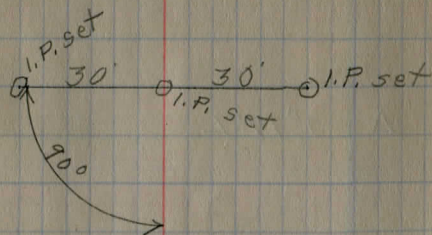
$\Delta = 0^{\circ} 00'$

176+00

$\Delta = 0^{\circ} 00'$

166+00

$\Delta = 0^{\circ} 00'$



220+00  $\Delta = 0^{\circ} 00'$

204+00  $\Delta = 0^{\circ} 17' L$

188+00  $\Delta = 0^{\circ} 00'$

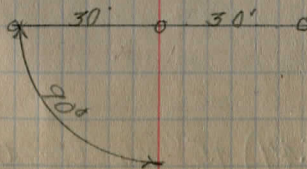
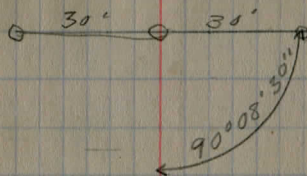
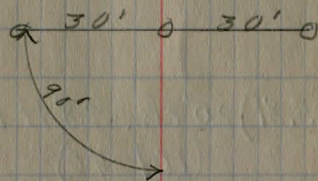
Sept. 15 1930

D. Parks

R. Hassel

T. Snyder

Cloudy 75°





265+38.6 P.T.

264+15.0  $\Delta = 34^{\circ}00'$  L P.I.

BM. (1102.67) = 36" maple = 25 ft E. y  
.. (V01-46) 263+80

262+83.6 P.C.

262+60.7 =  $\Phi$  bridge

259+49.5 P.T.

258+69.9  $\Delta 32^{\circ}44'$  R P.I.

257+85.8 P.C.

253+99.44 P.T.

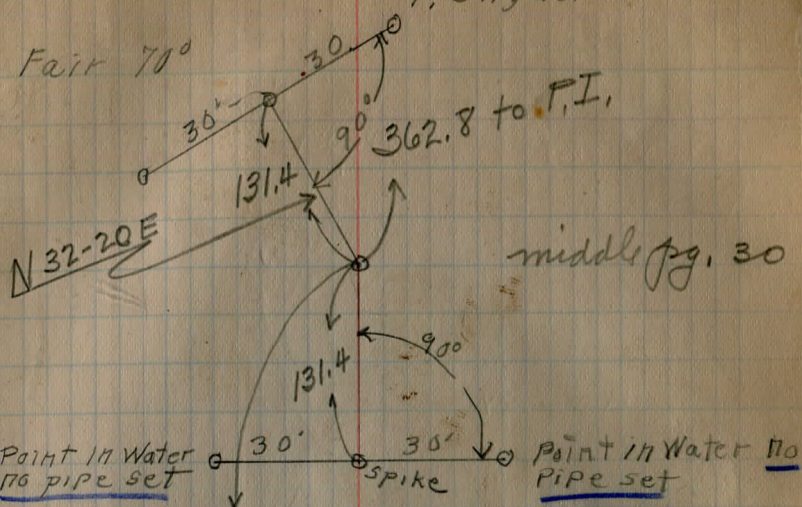
252+70 P.I.

Sept. 19, 1930

D. Parks  
T. Snyder

57

Fair  $70^{\circ}$

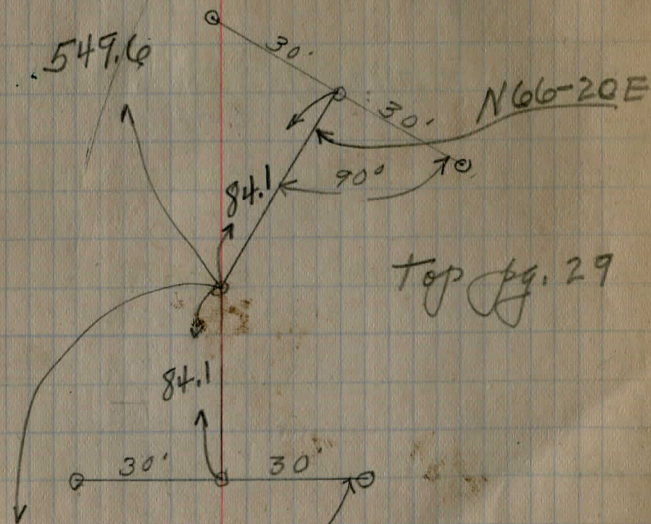


Point in Water  
no pipe set

Spike

Point in Water  
no pipe set

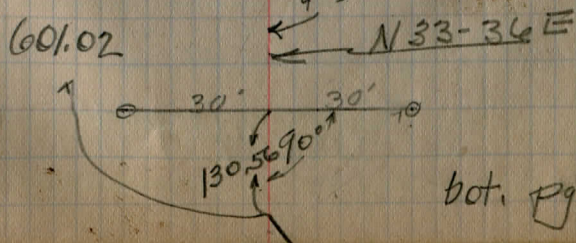
549.6



Top pg. 29

84.1

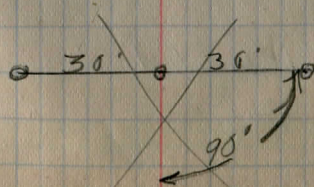
601.02



bot. pg. 29

267144.0 / P.C.

See next page



281+26.83 P.T.

280+00  $\Delta = 12^\circ 43' L$  P.I.

278+72.50 P.C.

B.M. (1117.34) 48" Maple = 35 ft E. of 271+75  
(101-48)

271+50  $\Delta = 0^\circ 00'$

267+96 P.T.

267+70.0  $\Delta = 5^\circ 12' L$  P.I.

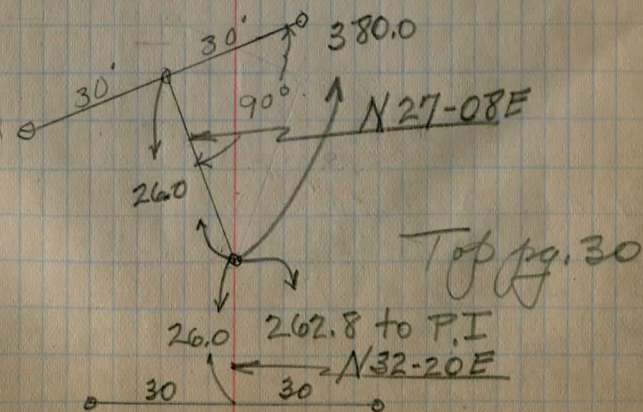
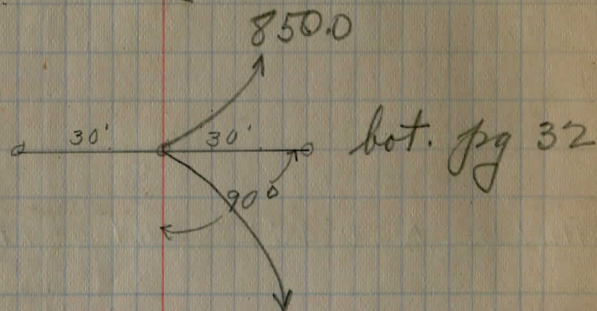
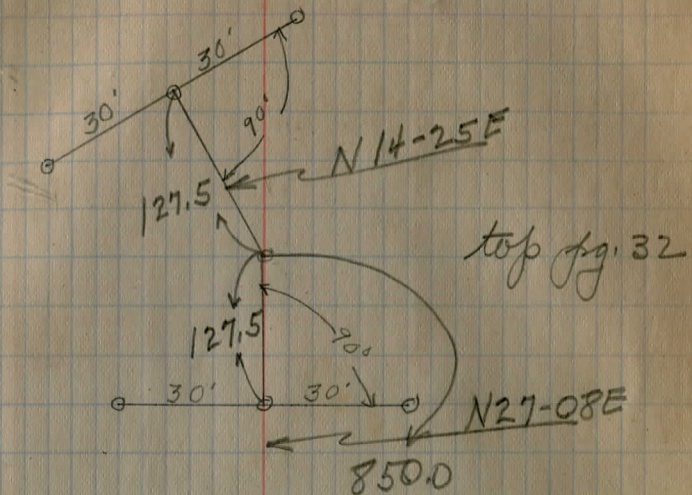
267+44 P.C.

Sept. 23, 1930

Cloudy 75°

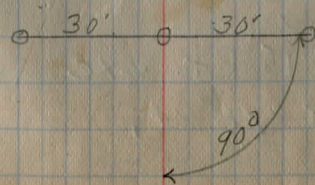
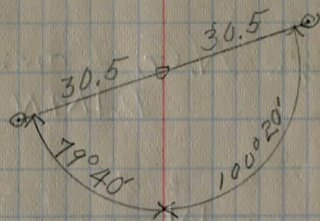
D. Parks  
T. Snyder  
R. Hassel

59



291+86.15  $\Delta = 0^{\circ}48' L$  end of Project

286+00  $\Delta = 0^{\circ}00'$



8-30 51  
P.M.  
Bender  
Temp

# RAPIDS RD. C.H. #1

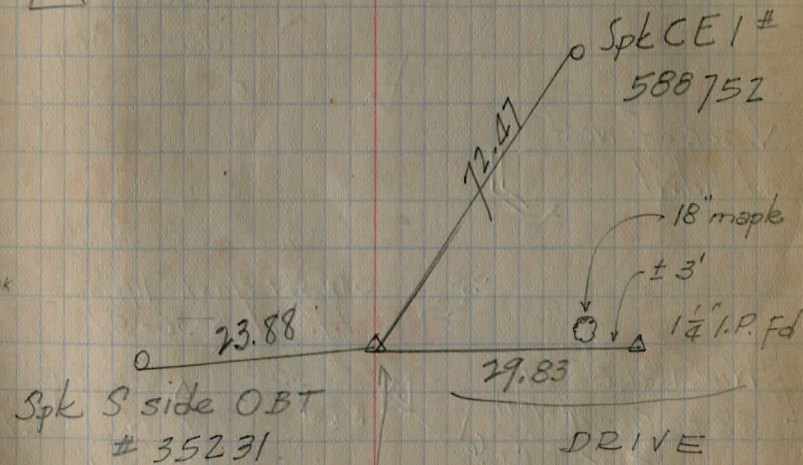
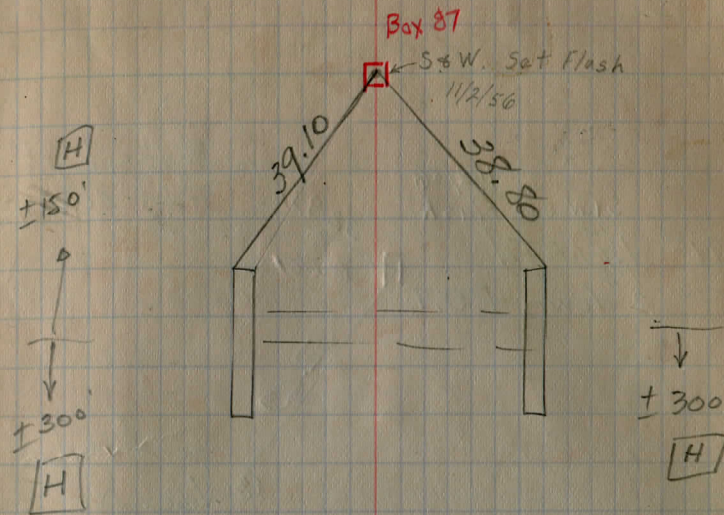
References OK-6-87

33+66.20 Spk set P.O.T.  
± 200' S of summit of hill

South bridge N.G. I mean NO  
DAMN GOOD!

0+0 ———— Box 87 ———— GEAUGA  
I.P. fd ± flush PORTAGE

Side stked 15' Rt exc  
48 to 58 = 18' Rt;  
86 to     = 18' Rt.  
105 to end = 16'



S&W set flush  
With Permitt.  
11/2/56

11/2/56  
S&W sat Flush  
68+99° 1 1/4" I.P. Fd  
2" down P.O.T.

32.85

Box 87

52.09

Bent spk SE  
Side 40" map

bent spk E  
Vee NE  
side 30" Map  
5<sup>th</sup> fm Send  
of row

N cor. of west  
end hdwl

33.29

S&W sat Flush 11/2/56  
I.P. Fd 8-30-51

30<sup>10</sup>

WINAGLE RD  
58+05.04 (1951)

+05.75 (1929)

Δ = 0-04' Rt

Box 87

I.P. Flush  
5' N of CE1  
#380004

S cor. of West hdwl

Spk NE side  
40" Map

vert. spk E  
root 36" map

90+86.9

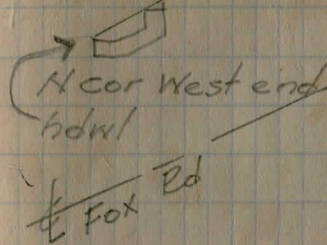
Δ = 0-0

I.P. Fd

34.82

53.0

S&W sat Flush  
11/2/56



Spk NE CE1 # 898687

84+81.1 I.P. Fd

Δ = 0-29' Lt

S&W sat Flush  
11/2/56

55.50

Spk 10" Apple

Box 87

48.03

77.08

Spk  
NE  
side 15"  
Map

Spk NE side 10"  
Map

H

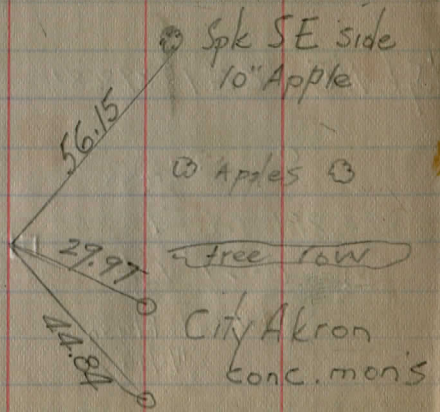
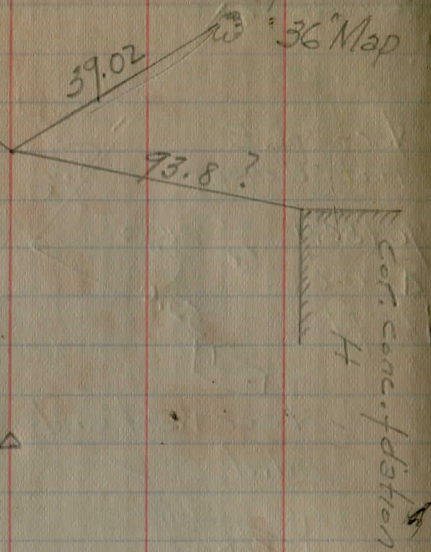
Spk SW side CEI  
± 898597

Spk W root  
36" Map

121+00 I.P. set  
P.O.T.  
SEW set Flush  
with Pmnt.  
11/2/56

119+05.1 I.P. Fd POT  
r under

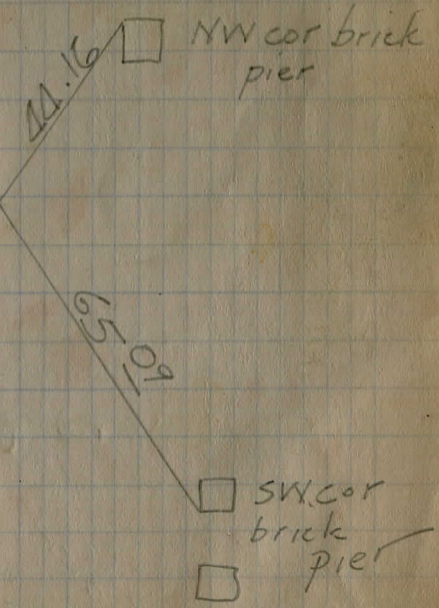
115+25 I.P. Fd  
SEW set Flush  
11/2/56  
Δ = 0-N-30 Rt.



143 + 49.75 = Sedge #422

Spk NE side Tel  
gde  
33.09  
~~37.09~~

143+0  
Spk set P.O.T.  
SEW set Flush  
With Pmnt.



Clear & Windy 80°

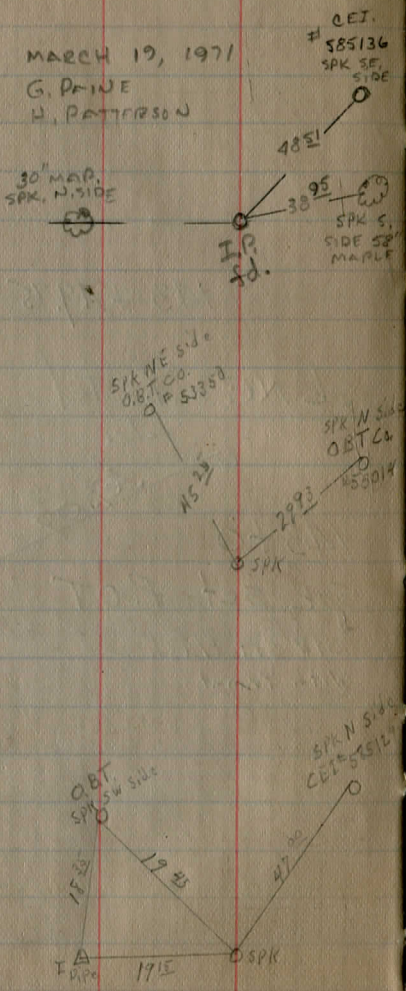
July 10 1956

Patterson  
Canfield

MARCH 19, 1971

G. PRINE  
W. PATTERSON

COLD  
WIND

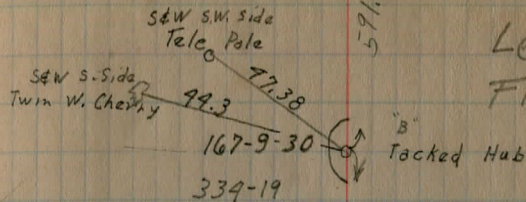


Sta 286100

20' Aves  
0-30.30  
0-49.0

64

See  
Levels @ Topo  
FB. 101 p 76

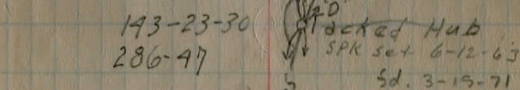
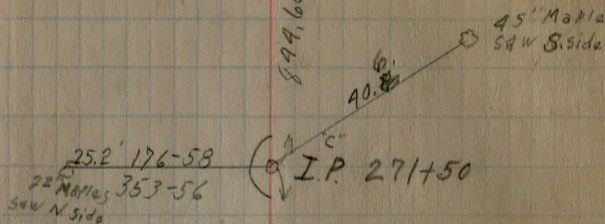


591.67'

844.60'

739.51'

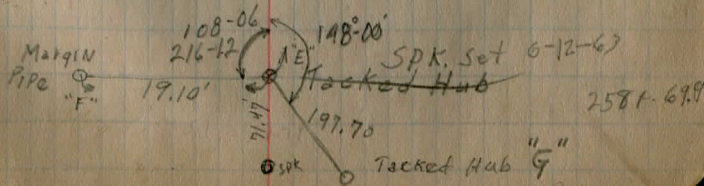
457.90'



264+15

River

Spk in 2nd guard Post Sth. of W. Truss



2581-67.9

(Fri. 13)

July 13, 1956

Rainy 75°

Patterson  
Centfield

65

Mar. Apr. 19, 10

α

103-59

207-48

1957.9

Tacked Hub

"E"

197.7

♂

Tacked Hub

"G"











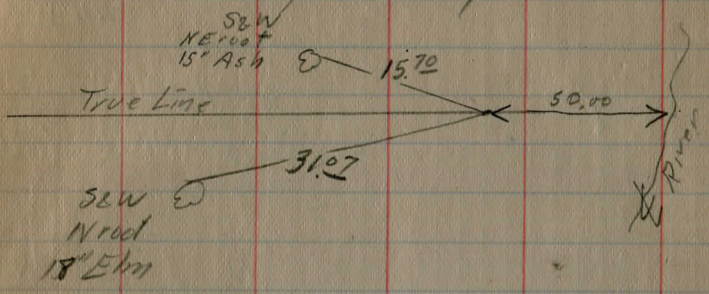








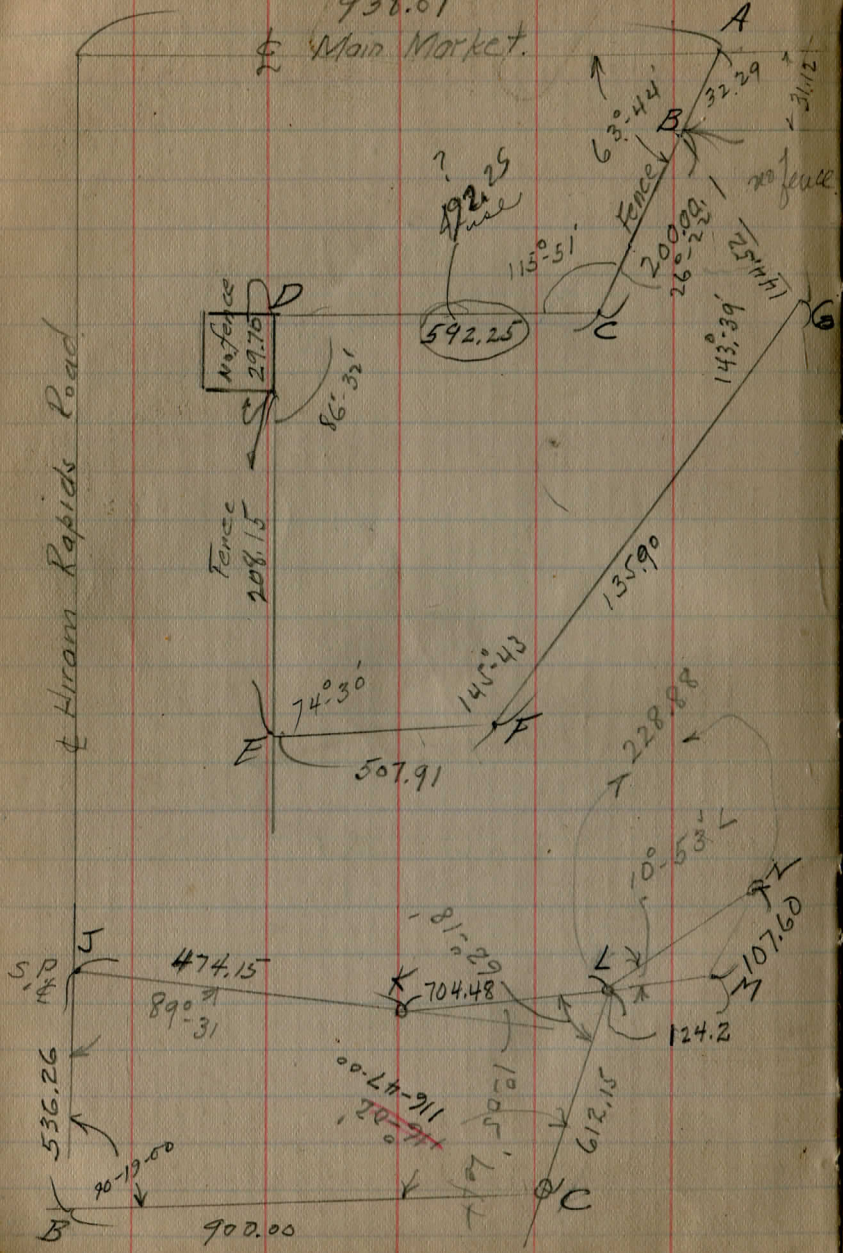
References to pipe set at SE Cor of  
Dope Survey



Data for fence at Pope Farm.

938.89

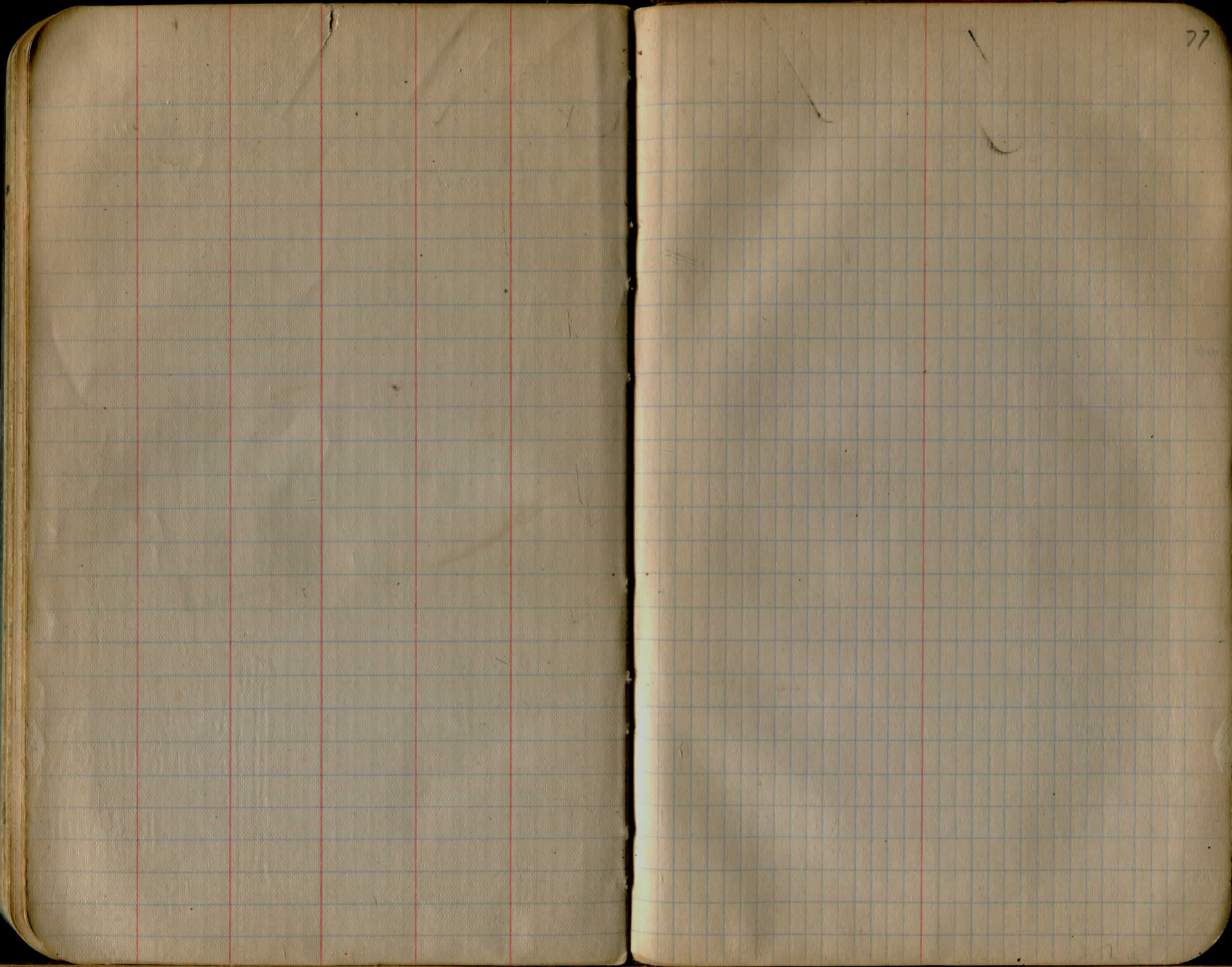
Main Market.



Fence  
834,57

30.71  
H.



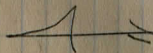
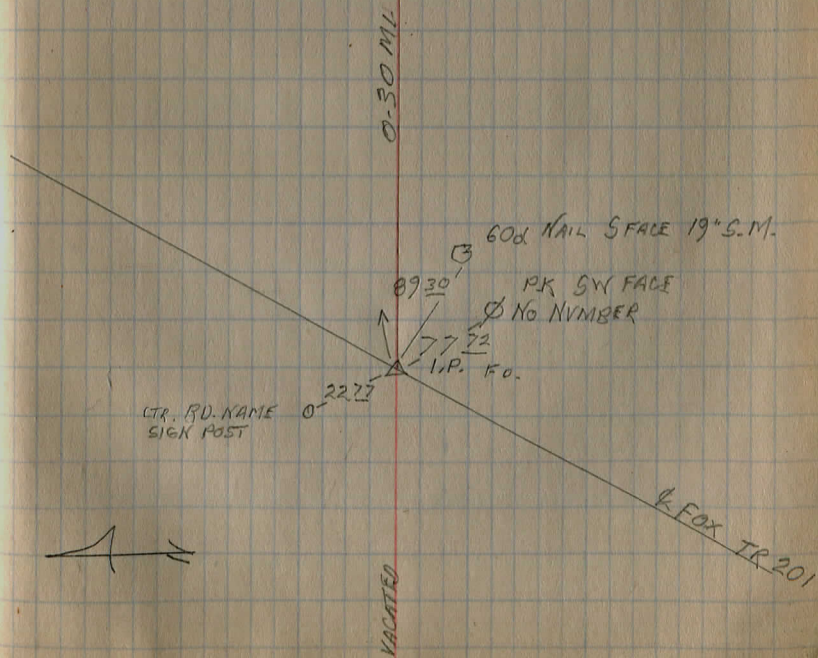
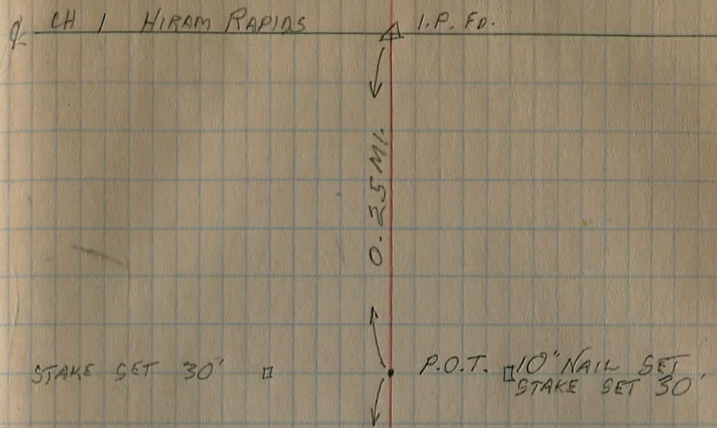


REH  
D-LAM.

WINAGLE  
TR 204

179

78



1871  
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DIRECTIONS FOR USE OF TABLES

TABLE No. 1.

Distance of slope stake from side or shoulder  
stake for any width roadway, slope 1/2 to 1.  
If ground is nearly level, the cut or fill at side  
stake is located by the double entry method in  
left column and top row. If the number is bold

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**IMPROVED TABLES**

AND

**INFORMATION**

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To find tangent and extension for curve of  
any other degree, divide by degree of curve by  
odd number found in column of constants.  
Degree of curve with a given  $T$  may be found  
by dividing tangent (or extension) by  
given tangent (or extension).  
The distance from a point on the tangent to  
the curve is very nearly the square of the tangent  
length divided by twice the radius.

## DIRECTIONS FOR USE OF TABLES

TABLE No. 1.

Distance of slope stake from side or shoulder stake for any width roadway, slope  $1\frac{1}{2}$  to 1. If ground is nearly level, the cut or fill at side stake is located by the double entry method in left column and top row. The number in body of table in same row and column gives distance from side stake to slope stake. If ground is not level estimate the difference in elevation between the side stake and slope stake, lower target by this amount if cut, elevate if fill. Add this amount to cut or fill and find distance in table. Set up rod at this point, and line of sight should cut target. If it does not make the slight adjustment necessary.

TABLE No. 9.

To find Tangent and External for curve of any other degree, divide by degree of curve and add correction found in column of corrections.

Degree of curve with a given I may be found by dividing tangent, (or external), opposite I by given tangent, (or external).

The distance from a point on the tangent to the curve is very nearly the square of the tangent length divided by twice the radius.

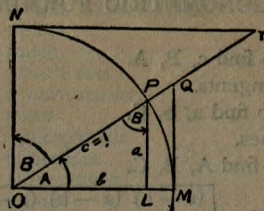


TABLE II  
TRIGONOMETRIC FORMULÆ.

$$\angle A = \angle MOP \quad \angle B = \angle PON = \angle OPL$$

$$R = OB = c = 1$$

$$\sin A = \frac{a}{c} = \frac{a}{1} = a = \cos B = LP$$

$$\cos A = \frac{b}{c} = \frac{b}{1} = b = \sin B = OL$$

$$\tan A = \frac{a}{b} = \frac{MQ}{OM} = \frac{MQ}{1} = MQ = \cot B = MQ$$

$$\cot A = \frac{NT}{ON} = \frac{NT}{1} = NT = \tan B = NT$$

$$\sec A = \frac{OQ}{OM} = \frac{OQ}{1} = OQ = \csc B = OQ$$

$$\csc A = \frac{OT}{ON} = \frac{OT}{1} = OT = \sec B = OT$$

$$\text{vers } A = \frac{LM}{OP} = LM = \text{covers } B \#$$

$$\text{covers } A = \frac{OP - LP}{OP} = OP - LP = \text{vers } B$$

$$\text{exsec } A = PQ = \text{coexsec } B$$

$$\text{coexsec } A = PT = \text{exsec } B$$

$$\sin \frac{1}{2} A = \sqrt{\frac{1 - \cos A}{2}} \quad \cos \frac{1}{2} A = \sqrt{\frac{1 + \cos A}{2}}$$

$$\sin 2A = 2 \sin A \cos A \quad \cos 2A = \cos^2 A - \sin^2 A$$

$$\text{Law of Sines} \quad \frac{\sin A}{a} = \frac{\sin B}{B} = \frac{\sin C}{C}$$

$$\text{Law of Cosines} \quad c^2 = a^2 + b^2 - 2ab \cos C$$

$$\text{Law of Tangents} \quad \frac{a+b}{a-b} = \frac{\tan \frac{1}{2}(A+B)}{\tan \frac{1}{2}(A-B)}$$

TABLE II—Continued  
TRIGONOMETRIC FORMULAE (continued)

In any triangle:

Given a, b, C; to find c, B, A.

Use Law of Tangents.

Given A, B, c; to find a, b, C.

Use Law of Sines.

Given a, b, c; to find A, B, C.

$$\text{Let } \frac{a+b+c}{2} = s, \sqrt{\frac{(s-a)(s-b)(s-c)}{s}} = r$$

$$\cos \frac{1}{2} A = \sqrt{\frac{s(s-a)}{bc}}$$

$$\tan \frac{1}{2} A = \frac{r}{s-a}$$

$$\tan \frac{1}{2} B = \frac{r}{s-b}$$

$$\tan \frac{1}{2} C = \frac{r}{s-c}$$

Area of a triangle:

$$\text{Area} = \frac{1}{2} ab \sin C$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

PRISMOIDAL FORMULA.

$$\text{Vol.} = \frac{h}{6} (B + b + 4M)$$

h = altitude; b, B = bases; M = midsection

TABLE III  
INCHES AND FRACTIONS OF AN INCH IN DECIMALS OF A FOOT

	0	1	2	3	4	5	6	7	8	9	10	11	
$\frac{1}{16}$	.0052	.0885	.1719	.2552	.3385	.4219	.5052	.5885	.6719	.7552	.8385	.9219	$\frac{1}{16}$
$\frac{1}{8}$	.0104	.0938	.1771	.2604	.3438	.4271	.5104	.5938	.6771	.7604	.8438	.9271	$\frac{1}{8}$
$\frac{3}{16}$	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323	$\frac{3}{16}$
$\frac{1}{4}$	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.6875	.7708	.8542	.9375	$\frac{1}{4}$
$\frac{5}{16}$	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427	$\frac{5}{16}$
$\frac{3}{8}$	.0313	.1146	.1979	.2813	.3646	.4479	.5313	.6146	.6979	.7813	.8646	.9479	$\frac{3}{8}$
$\frac{7}{16}$	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531	$\frac{7}{16}$
$\frac{1}{2}$	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583	$\frac{1}{2}$
$\frac{9}{16}$	.0469	.1302	.2135	.2969	.3803	.4635	.5469	.6302	.7135	.7969	.8802	.9635	$\frac{9}{16}$
$\frac{5}{8}$	.0521	.1354	.2188	.3021	.3854	.4688	.5521	.6354	.7188	.8021	.8854	.9688	$\frac{5}{8}$
$\frac{11}{16}$	.0573	.1406	.2240	.3073	.3906	.4740	.5573	.6406	.7240	.8073	.8906	.9740	$\frac{11}{16}$
$\frac{3}{4}$	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792	$\frac{3}{4}$
$\frac{13}{16}$	.0677	.1510	.2344	.3177	.4010	.4844	.5677	.6510	.7344	.8177	.9010	.9844	$\frac{13}{16}$
$\frac{7}{8}$	.0729	.1563	.2396	.3229	.4063	.4896	.5729	.6563	.7396	.8229	.9063	.9896	$\frac{7}{8}$
$\frac{15}{16}$	.0781	.1615	.2448	.3281	.4115	.4948	.5781	.6615	.7448	.8281	.9115	.9948	$\frac{15}{16}$
1	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167	1.0000	1
	0	1	2	3	4	5	6	7	8	9	10	11	

TABLE IV  
USEFUL RELATIONS.

Lineal feet	×.00019	= miles
Lineal yards	×.0006	= miles
Square inches	×.007	= square feet
Square feet	×.111	= square yards
Square yards	×.0002067	= acres
Acres	×4840	= square yards
Cubic inches	×.00058	= cubic feet
Cubic feet	×.03704	= cubic yards
Links	×.22	= yards
Links	×.66	= feet
Feet	×1.5	= links

$$360^\circ = 21600' = 1296000''$$

$$\text{Radius} = \text{arc of } 57.2957790''$$

$$\text{Arc of } 1^\circ (\text{radius} = 1) = .017453292$$

$$\text{Arc of } 1' (\text{radius} = 1) = .000290888$$

$$\text{Arc of } 1'' (\text{radius} = 1) = .000004848$$

$$\pi = 3.141592654$$

$$\sqrt{\frac{1}{4}} = 0.564190$$

$$\frac{\pi}{4} = 0.785398163$$

$$\sqrt[3]{\frac{6}{\pi}} = 1.240700982$$

$$\frac{\pi}{6} = 0.523598776$$

$$\pi^2 = 9.869604401$$

$$\sqrt{\frac{4}{\pi}} = 1.128379167$$

$$\frac{1}{\pi^2} = 0.101321184$$

$$\frac{\pi}{6} = 0.523598776$$

$$\sqrt{\pi} = 1.772453851$$

$$\frac{4\pi}{3} = 4.188790205$$

$$\frac{1}{\pi} = 0.3183099$$

Curvature of Earth's surface = about 0.7 feet in 1 mile

Curvature in feet = 0.667 (Dist. in miles)<sup>2</sup>

Difference between arc and chord length, 0.05 feet in 11½ miles

$$\text{Probable error of a single observation} = 0.6754 \sqrt{\frac{Mv^2}{n-1}}$$

Error in chaining of 0.01 feet in 100 feet:

Due to—

1. Length of tape error of 0.01 feet
2. Alignment. One end 1.4 feet out of line
3. Sag of tape at centre of 0.61 feet.
4. Temperature difference of 15°
5. Difference of pull of 15 lbs.

STADIA REDUCTION FORMULAE.

$$\text{Horizontal Distance} = R - R \sin^2 a + C \cos a$$

$$\text{Vertical Distance} = R \frac{1}{2} \sin 2a + C \sin a$$

$$R = \text{Reading} \times \frac{\text{distance from Object glass to cross hairs}}{\text{distance between cross hairs}}$$

C = distance from Object glass to cross hairs + distance from Object glass to center of instrument.

a = angle of elevation for mid Reading



TABLE VI (continued)  
SINES, COSINES, TANGENTS, COTANGENTS (continued)

deg.	sin 0'	tan 0'	sin 10'	tan 10'	sin 20'	tan 20'	sin 30'	tan 30'	sin 40'	tan 40'	sin 50'	tan 50'	deg.
46	7193	1.0355	7214	1.0416	7234	1.0477	7254	1.0533	7274	1.0599	7294	1.0661	43
47	314	.0724	333	.0786	353	.0850	373	.0913	392	.0977	412	.1041	42
48	431	.1106	451	.1171	470	.1237	490	.1303	509	.1369	528	.1436	41
49	547	.1504	566	.1571	585	.1640	604	.1708	623	.1778	642	.1847	40
50	660	1.1918	7679	1.1988	7698	1.2059	7716	1.2131	7735	1.2203	7753	1.2276	39
51	771	2.349	790	.2423	808	.2497	826	.2572	844	.2647	862	.2723	38
52	880	.2799	898	.2876	916	.2954	934	.3032	951	.3111	969	.3190	37
53	986	.3270	8004	.3351	8021	.3452	8039	.3514	8056	.3597	8073	.3680	36
54	8090	.3764	107	.3848	124	.3934	141	.4019	158	.4106	175	.4193	35
55	192	4.281	208	.4370	225	.4460	241	.4550	258	.4641	274	.4733	34
56	290	.4826	307	.4919	323	.5013	339	.5108	355	.5204	371	.5301	33
57	387	.5399	403	.5497	418	.5597	434	.5697	450	.5798	465	.5900	32
58	480	.6003	496	.6107	511	.6212	526	.6319	542	.6426	557	.6534	31
59	572	.6643	587	.6753	601	.6864	615	.6977	631	.7090	646	.7205	30
60	660	1.7321	8675	1.7437	8689	1.7556	8704	1.7675	8718	1.7797	8732	1.7917	29
61	746	.8040	760	.8165	774	.8291	788	.8418	802	.8546	816	.8676	28
62	829	.8807	843	.8940	857	.9074	870	.9210	884	.9347	897	.9486	27
63	910	.9626	923	.9768	936	.9912	949	2.0057	962	2.0204	975	2.0353	26
64	988	2.0503	9001	2.0655	9013	2.0809	9026	.0965	9038	.1123	9051	.1283	25
65	9063	.1445	075	.1609	088	.1775	100	.1943	112	.2113	124	.2286	24
66	135	.2460	147	.2637	159	.2817	171	.2998	182	.3183	194	.3369	23
67	205	.3559	216	.3750	228	.3945	239	.4142	250	.4342	261	.4545	22
68	272	.4751	283	.4960	293	.5172	304	.5386	315	.5605	325	.5826	21
69	336	.6051	346	.6279	356	.6511	367	.6746	377	.6985	387	.7228	20
70	397	2.7475	9407	2.7725	9417	2.7980	9426	2.8239	9436	2.8502	9446	2.8770	19
71	455	.9042	465	.9319	474	.9600	483	.9887	492	3.0178	502	3.0475	18
72	511	3.0777	520	3.1084	528	3.1397	537	3.1716	546	.2041	555	.2371	17
73	563	.2709	572	.3052	580	.3402	588	.3759	596	.4124	605	.4495	16
74	613	.4874	621	.5261	628	.5656	636	.6059	644	.6470	652	.6891	15
75	659	.7321	667	.7760	674	.8208	681	.8657	689	.9136	696	.9617	14
76	703	4.0108	710	4.0611	717	4.1126	724	4.1653	730	4.2193	737	4.2747	13
77	744	.3315	750	.3897	757	.4494	763	.5107	769	.5736	775	.6382	12
78	781	.7046	787	.7729	793	.8430	799	.9152	805	.9894	811	5.0658	11
79	816	.1446	822	5.2257	827	5.3093	833	5.3955	838	5.4845	843	.5764	10
80	948	5.6713	953	5.7694	958	5.8708	963	5.9758	968	6.0844	972	6.1970	9
81	877	6.3138	881	6.4348	886	6.5606	890	6.6912	894	.8269	899	.9682	8
82	903	7.1154	907	7.2687	911	7.4287	914	7.5958	918	7.7704	922	7.9530	7
83	925	8.1443	929	8.3450	932	8.5555	936	8.7769	939	9.0098	942	9.2553	6
84	945	9.5144	948	9.7882	951	10.078	954	10.385	957	10.711	959	11.059	5
85	962	11.430	964	11.826	967	12.250	969	12.706	971	13.197	974	13.727	4
86	976	14.300	978	14.924	980	15.605	981	16.350	983	17.169	985	18.075	3
87	986	19.081	988	20.206	989	21.470	990	22.903	992	24.542	993	26.432	2
88	994	28.636	995	31.242	996	34.368	997	38.189	997	42.964	998	49.104	1
89	998	57.290	999	68.750	999	85.940	999	114.58	1.000	171.88	1.000	343.77	0
deg.	60'	60'	50'	50'	40'	40'	30'	30'	20'	30'	10'	10'	deg.
	cos	cot	cos	cot	cos	cot	cos	cot	cos	cot	cos	cot	

TABLE VII  
RODS IN FEET AND INCHES

Rods	Feet Inches	Rods	Feet Inches	Rods	Feet Inches	Rods	Feet Inches	Rods	Feet Inches
1	16-6	21	346-6	41	676-6	61	1006-6	81	1336-6
2	33-0	22	363-0	42	693-0	62	1023-0	82	1353-0
3	49-6	23	379-6	43	709-6	63	1039-6	83	1369-6
4	66-0	24	396-0	44	726-0	64	1056-0	84	1386-0
5	82-6	25	412-6	45	742-6	65	1072-6	85	1402-6
6	99-0	26	429-0	46	759-0	66	1089-0	86	1419-0
7	115-6	27	445-6	47	775-6	67	1105-6	87	1435-6
8	132-0	28	462-0	48	792-0	68	1122-0	88	1452-0
9	148-6	29	478-6	49	808-6	69	1138-6	89	1468-6
10	165-0	30	495-0	50	825-0	70	1155-0	90	1485-0
11	181-6	31	511-6	51	841-6	71	1171-6	91	1501-6
12	198-0	32	528-0	52	858-0	72	1188-0	92	1518-0
13	214-6	33	544-6	53	874-6	73	1204-6	93	1534-6
14	231-0	34	561-0	54	891-0	74	1221-0	94	1551-0
15	247-6	35	577-6	55	907-6	75	1237-6	95	1567-6
16	264-0	36	594-0	56	924-0	76	1254-0	96	1584-0
17	280-6	37	610-6	57	940-6	77	1270-6	97	1600-6
18	297-0	38	627-0	58	957-0	78	1287-0	98	1617-0
19	313-6	39	643-6	59	973-6	79	1303-6	99	1633-6
20	330-0	40	660-0	60	990-0	80	1320-0	100	1650-0

TABLE VIII  
LINKS IN FEET AND INCHES

Links	Feet Inches	Links	Feet Inches	Links	Feet Inches	Links	Feet Inches	Links	Feet Inches	Links	Feet Inches
1	0-7.92	18	11-10.56	35	23-1.20	52	34-3.84	69	45-6.48	86	56-9.12
2	1-3.84	19	12-6.48	36	23-9.12	53	34-11.76	70	46-2.40	87	57-5.04
3	1-11.76	20	13-2.40	37	24-5.04	54	35-7.68	71	46-10.32	88	58-0.96
4	2-7.68	21	13-10.32	38	25-0.96	55	36-3.60	72	47-6.24	89	58-8.88
5	3-3.60	22	14-6.24	39	25-8.88	56	36-11.52	73	48-2.16	90	59-4.80
6	3-11.52	23	15-2.16	40	26-4.80	57	37-7.44	74	48-10.08	91	60-0.72
7	4-7.44	24	15-10.08	41	27-0.72	58	38-3.36	75	49-6.00	92	60-8.64
8	5-3.36	25	16-6.00	42	27-8.64	59	38-11.28	76	50-1.92	93	61-4.56
9	5-11.28	26	17-1.92	43	28-4.56	60	39-7.20	77	50-9.84	94	62-0.48
10	6-7.20	27	17-9.84	44	29-0.48	61	40-3.12	78	51-5.76	95	62-8.40
11	7-3.12	28	18-5.76	45	29-8.40	62	40-11.04	79	52-1.68	96	63-4.32
12	7-11.04	29	19-1.68	46	30-4.32	63	41-6.96	80	52-9.60	97	64-0.24
13	8-6.96	30	19-9.60	47	31-0.24	64	42-2.88	81	53-5.52	98	64-8.16
14	9-2.88	31	20-5.52	48	31-8.16	65	42-10.80	82	54-1.44	99	65-4.08
15	9-10.80	32	21-1.44	49	32-4.08	66	43-6.72	83	54-9.36	100	66-.00
16	10-6.72	33	21-9.36	50	33-0.00	67	44-2.64	84	55-5.28	101	66-7.92
17	11-2.64	34	22-5.28	51	33-7.92	68	44-10.56	85	56-1.20	102	67-3.84

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=10°	I	T	E	I=20°	I	T	E	I=30°
1°	50.00	.218	+	11°	551.70	26.500	+	21°	1061.9	97.577	+
10'	58.34	.297	5° C.	10'	560.11	27.313	5° C	10'	1070.6	99.155	5° C
20'	66.67	.388	T	20'	568.53	28.137	T	20'	1079.2	100.75	T
30'	75.01	.491	E	30'	576.95	28.974	E	30'	1087.8	102.35	E
40'	83.34	.606	.03	40'	585.36	29.824	.06	40'	1096.4	103.97	.10
50'	91.68	.733	E	50'	593.79	30.686	E	50'	1105.1	105.60	E
2°	100.01	.873	.001	12°	602.21	31.561	.006	22°	1113.7	107.24	.013
10'	108.35	1.024	10° C.	10'	610.64	32.447	10° C.	10'	1122.4	108.90	10° C.
20'	116.68	1.188	T	20'	619.07	33.347	T	20'	1131.0	110.57	T
30'	125.02	1.364	E	30'	627.50	34.259	E	30'	1139.7	112.25	E
40'	133.36	1.552	.03	40'	635.93	35.183	.06	40'	1148.4	113.95	.10
50'	141.70	1.752	E	50'	644.37	36.120	E	50'	1157.0	115.66	E
3°	150.04	1.964	10° C.	13°	652.81	37.070	10° C.	23°	1165.7	117.38	10° C.
10'	158.38	2.188	T	10'	661.25	38.031	T	10'	1174.4	119.12	T
20'	166.72	2.425	.06	20'	669.70	39.006	.13	20'	1183.1	120.87	.19
30'	175.06	2.674	E	30'	678.15	39.993	E	30'	1191.8	122.63	E
40'	183.40	2.934	.03	40'	686.60	40.992	.06	40'	1200.5	124.41	.10
50'	191.74	3.207	E	50'	695.06	42.004	.11	50'	1209.2	126.20	.15
4°	200.08	3.492	15° C.	14°	703.51	43.029	15° C.	24°	1217.9	128.00	15° C.
10'	208.43	3.790	T	10'	711.97	44.066	T	10'	1226.6	129.82	T
20'	216.77	4.099	E	20'	720.44	45.116	E	20'	1235.3	131.65	E
30'	225.12	4.421	.03	30'	728.90	46.178	.06	30'	1244.0	133.50	.10
40'	233.47	4.755	.06	40'	737.37	47.253	.09	40'	1252.8	135.35	.15
50'	241.81	5.100	E	50'	745.85	48.341	.13	50'	1261.5	137.23	.20
5°	250.16	5.459	20° C.	15°	754.32	49.441	20° C.	25°	1270.2	139.11	20° C.
10'	258.51	5.829	T	10'	762.80	50.554	T	10'	1279.0	141.01	T
20'	266.86	6.211	E	20'	771.29	51.679	E	20'	1287.7	142.93	E
30'	275.21	6.606	.03	30'	779.77	52.818	.06	30'	1296.5	144.85	.10
40'	283.57	7.013	.06	40'	788.26	53.969	.09	40'	1305.3	146.79	.15
50'	291.92	7.432	E	50'	796.75	55.132	.13	50'	1314.0	148.75	.20
6°	300.28	7.863	30° C.	16°	805.25	56.309	30° C.	26°	1322.8	150.71	30° C.
10'	308.64	8.307	T	10'	813.75	57.498	T	10'	1331.6	152.69	T
20'	316.99	8.762	E	20'	822.25	58.699	E	20'	1340.4	154.69	E
30'	325.35	9.230	.03	30'	830.76	59.914	.06	30'	1349.2	156.70	.10
40'	333.71	9.710	.06	40'	839.27	61.141	.09	40'	1358.0	158.72	.15
50'	342.08	10.202	E	50'	847.78	62.381	.13	50'	1366.8	160.76	.20
7°	350.44	10.707	45° C.	17°	856.30	63.634	45° C.	27°	1375.6	162.81	45° C.
10'	358.81	11.224	T	10'	864.82	64.900	T	10'	1384.4	164.86	T
20'	367.17	11.753	E	20'	873.35	66.178	E	20'	1393.2	166.95	E
30'	375.54	12.294	.03	30'	881.88	67.470	.06	30'	1402.0	169.04	.10
40'	383.91	12.847	.06	40'	890.41	68.774	.09	40'	1410.9	171.15	.15
50'	392.28	13.413	E	50'	898.95	70.091	.13	50'	1419.7	173.27	.20
8°	400.66	13.991	60° C.	18°	907.49	71.421	60° C.	28°	1428.6	175.41	60° C.
10'	409.03	14.582	T	10'	916.03	72.764	T	10'	1437.4	177.55	T
20'	417.41	15.184	E	20'	924.58	74.119	E	20'	1446.3	179.72	E
30'	425.79	15.799	.03	30'	933.13	75.488	.06	30'	1455.1	181.89	.10
40'	434.17	16.426	.06	40'	941.69	76.869	.09	40'	1464.0	184.08	.15
50'	442.55	17.065	E	50'	950.25	78.264	.13	50'	1472.9	186.29	.20
9°	450.93	17.717	75° C.	19°	958.81	79.671	75° C.	29°	1481.8	188.51	75° C.
10'	459.32	18.381	T	10'	967.38	81.092	T	10'	1490.7	190.74	T
20'	467.71	19.058	E	20'	975.96	82.525	E	20'	1499.6	192.99	E
30'	476.10	19.746	.03	30'	984.53	83.972	.06	30'	1508.5	195.25	.10
40'	484.49	20.447	.06	40'	993.12	85.431	.09	40'	1517.4	197.53	.15
50'	492.88	21.161	E	50'	1001.7	86.904	.13	50'	1526.3	199.82	.20
10°	501.28	21.887	90° C.	20°	1010.3	88.389	90° C.	30°	1535.3	202.12	90° C.
10'	509.68	22.624	T	10'	1018.9	89.888	T	10'	1544.2	204.44	T
20'	518.08	23.375	E	20'	1027.5	91.399	E	20'	1553.1	206.77	E
30'	526.48	24.138	.03	30'	1036.1	92.924	.06	30'	1562.1	209.12	.10
40'	534.89	24.913	.06	40'	1044.7	94.462	.09	40'	1571.0	211.48	.15
50'	543.29	25.700	E	50'	1053.3	96.013	.13	50'	1580.0	213.86	.20

T = R tan 1/2 I

E = R exsec 1/2 I

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=40°	I	T	E	I=50°	I	T	E	I=60°
31°	1589.0	216.3	+	41°	2142.2	387.4	+	51°	2732.9	618.4	+
10'	1598.0	218.7	5° C.	10'	2151.7	390.7	5° C.	10'	2743.1	622.8	5° C.
20'	1606.9	221.1	T	20'	2161.2	394.1	T	20'	2753.4	627.2	T
30'	1615.9	223.5	E	30'	2170.8	397.4	E	30'	2763.7	631.7	E
40'	1624.9	226.0	.13	40'	2180.3	400.8	.17	40'	2773.9	636.2	.21
50'	1633.9	228.4	E	50'	2189.9	404.2	E	50'	2784.2	640.7	E
32°	1643.0	230.9	.023	42°	2199.4	407.6	.037	52°	2794.0	645.2	.056
10'	1652.0	233.4	10° C.	10'	2209.0	411.1	10° C.	10'	2804.9	649.7	10° C.
20'	1661.0	235.9	T	20'	2218.6	414.5	T	20'	2815.2	654.3	T
30'	1670.0	238.4	E	30'	2228.1	418.0	E	30'	2825.6	658.8	E
40'	1679.1	241.0	.06	40'	2237.7	421.4	.10	40'	2835.9	663.4	.14
50'	1688.1	243.5	E	50'	2247.3	425.0	E	50'	2846.3	668.0	E
33°	1697.2	246.1	10° C.	43°	2257.0	428.5	10° C.	53°	2856.7	672.7	10° C.
10'	1706.3	248.7	T	10'	2266.6	432.0	T	10'	2867.1	677.3	T
20'	1715.3	251.3	.26	20'	2276.2	435.6	.34	20'	2877.5	682.0	.42
30'	1724.4	253.9	E	30'	2285.9	439.2	E	30'	2888.0	686.7	E
40'	1733.5	256.5	.06	40'	2295.6	442.8	.10	40'	2898.4	691.4	.14
50'	1742.6	259.1	.10	50'	2305.2	446.4	.15	50'	2908.9	696.1	.19
34°	1751.7	261.8	15° C.	44°	2314.9	450.0	15° C.	54°	2919.4	700.9	15° C.
10'	1760.8	264.5	T	10'	2324.6	453.6	T	10'	2929.9	705.7	T
20'	1770.0	267.2	E	20'	2334.3	457.3	E	20'	2940.4	710.5	E
30'	1779.1	269.9	.03	30'	2344.1	461.0	.06	30'	2951.0	715.3	.08
40'	1788.2	272.6	.06	40'	2353.8	464.6	.10	40'	2961.5	720.1	.12
50'	1797.4	275.3	.10	50'	2363.5	468.4	.15	50'	2972.1	725.0	.16
35°	1806.6	278.1	20° C.	45°	2373.3	472.1	20° C.	55°	2982.7	729.9	20° C.
10'	1815.7	280.8	T	10'	2383.1	475.8	T	10'	2993.3	734.8	T
20'	1824.9	283.6	E	20'	2392.8	479.6	E	20'	3003.9	739.7	E
30'	1834.1	286.4	.03	30'	2402.6	483.4	.06	30'	3014.5	744.6	.08
40'	1843.3	289.2	.06	40'	2412.4	487.2	.10	40'	3025.2	749.6	.12
50'	1852.5	292.0	.10	50'	2422.3	491.0	.15	50'	3035.8	754.6	.16
36°	1861.7	294.9	30° C.	46°	2432.1	494.8	30° C.	56°	3046.5	759.6	30° C.
10'	1870.9	297.7	T	10'	2441.9	498.7	T	10'	3057.2	764.6	T
20'	1880.1	300.6	E	20'	2451.8	502.5	E	20'	3067.9	769.7	E
30'	1889.4	303.5	.03	30'	2461.7	506.4	.06	30'	3078.7	774.7	.08
40'	1898.6	306.4	.06	40'	2471.5	510.3	.10	40'	3089.4	779.8	.12
50'	1907.9	309.3	.10	50'	2481.4	514.3	.15	50'	3100.2	784.9	.16
37°	1917.1	312.2	45° C.	47°	2491.3	518.2	45° C.	57°	3110.9	790.1	45° C.
10'	1926.4	315.2	T	10'	2501.2	522.2	T	10'	3121.7	795.2	T
20'	1935.7	318.1	.03	20'	2511.2	526.1	.15	20'	3132.6	800.4	.25
30'	1945.0	321.1	E	30'	2521.1	530.1	E	30'	3143.4	805.6	E
40'	1954.3	324.1	.06	40'	2531.1	534.2	.10	40'	3154.2	810.9	.14
50'	1963.6	327.1	.10	50'	2541.0	538.2	.15	50'	3165.1	816.1	.18
38°	1972.9	330.2	60° C.	48°	2551.0	542.2	60° C.	58°	3176.0	821.4	60° C.
10'	1982.2	333.2	T	10'	2561.0	546.3	T	10'	3186.9	826.7	T
20'	1991.5	336.3	E	20'	2571.0	550.4	E	20'	3197.8	832.0	E
30'	2000.9	339.3	.03	30'	2581.0	554.5	.06	30'	3208.8	837.3	.08
40'	2010.2	342.4	.06	40'	2591.0	558.6	.10	40'	3219.7	842.7	.12
50'	2019.6	345.5	.10	50							

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=70°	I	T	E	I=80°	I	T	E	I=90°
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	5° C.	20'	4112.1	1322.9	5° C.	20'	4922.5	1824.1	5° C.
30'	3408.8	937.3	T	30'	4124.8	1330.3	T	30'	4937.0	1833.6	T
40'	3420.1	943.1	.25	40'	4137.4	1337.7	.30	40'	4951.5	1843.1	.36
50'	3431.4	948.9	E	50'	4150.1	1345.1	E	50'	4966.1	1852.6	E
62°	3442.7	954.8	.080	72°	4162.8	1352.6	.110	82°	4980.7	1862.2	.149
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	10° C.	73°	4239.7	1398.0	10° C.	83°	5069.2	1920.5	10° C.
10'	3522.6	996.2	T	10'	4252.6	1405.7	T	10'	5084.0	1930.4	T
20'	3534.1	1002.3		20'	4265.6	1413.5		20'	5099.0	1940.3	
30'	3545.6	1008.3	.51	30'	4278.5	1421.2	.61	30'	5113.9	1950.3	.72
40'	3557.2	1014.4	E	40'	4291.5	1429.0	E	40'	5128.9	1960.2	E
50'	3568.7	1020.5	.159	50'	4304.6	1436.8	.220	50'	5143.9	1970.3	.299
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	T	75°	4396.5	1492.4	T	85°	5250.3	2041.7	T
10'	3661.9	1070.2	.76	10'	4409.8	1500.5	.91	10'	5265.6	2052.1	1.09
20'	3673.7	1076.6	E	20'	4423.1	1508.6	E	20'	5281.0	2062.5	E
30'	3685.4	1082.9		30'	4436.4	1516.7		30'	5296.4	2073.0	
40'	3697.2	1089.3	.240	40'	4449.7	1524.9	.332	40'	5311.9	2083.5	.450
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	20° C.	40'	4530.4	1574.7	20° C.	40'	5405.6	2147.5	20° C.
50'	3780.4	1134.8	T	50'	4544.0	1583.1	T	50'	5421.4	2158.4	T
67°	3792.4	1141.4	1.02	77°	4557.6	1591.6	1.22	87°	5437.2	2169.2	1.45
10'	3804.4	1148.0	E	10'	4571.2	1600.1	E	10'	5453.1	2180.2	E
20'	3816.4	1154.7	.321	20'	4584.8	1608.6	.445	20'	5469.0	2191.1	.603
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	25° C.	20'	4667.4	1660.5	25° C.	20'	5565.4	2258.0	25° C.
30'	3901.2	1202.0	T	30'	4681.3	1669.2	T	30'	5581.6	2269.3	T
40'	3913.4	1208.9	1.28	40'	4695.2	1678.1	1.53	40'	5597.8	2280.6	1.83
50'	3925.6	1215.8	E	50'	4709.2	1686.9	E	50'	5614.2	2292.0	E
69°	3937.9	1222.7	.403	79°	4723.2	1695.8	.558	89°	5630.5	2303.5	.756
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	30° C.	80°	4807.7	1749.9	30° C.	90°	5729.7	2373.3	30° C.
10'	4024.4	1272.1	T	10'	4822.0	1759.0	T	10'	5746.3	2385.1	T
20'	4036.8	1279.3	1.54	20'	4836.2	1768.2	1.84	20'	5763.1	2397.0	2.20
30'	4049.3	1286.5	E	30'	4850.5	1777.4	E	30'	5779.9	2408.9	E
40'	4061.8	1293.6		40'	4864.8	1786.7		40'	5796.7	2420.9	
50'	4074.4	1300.9	.485	50'	4879.2	1796.0	.671	50'	5813.6	2432.9	.910

T = R tan ½ I

E = R exsec ½ I

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=100°	I	T	E	I=110°	I	T	E	I=120°
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	5° C.	20'	6992.0	3310.1	5° C.	20'	8388.9	4429.2	5° C.
30'	5881.7	2481.5	T	30'	7012.7	3326.1	T	30'	8415.1	4450.9	T
40'	5898.8	2493.8	.43	40'	7033.6	3342.3	.51	40'	8441.5	4472.7	.62
50'	5916.0	2506.1	E	50'	7054.5	3358.5	E	50'	8468.0	4494.6	E
92°	5933.2	2518.5	.200	102°	7075.5	3374.9	.268	112°	8494.6	4516.6	.360
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	10° C.	103°	7203.2	3474.4	10° C.	113°	8656.6	4651.3	10° C.
10'	6055.4	2606.8	T	10'	7224.7	3491.3	T	10'	8684.0	4674.2	T
20'	6073.1	2619.7		20'	7246.3	3508.2		20'	8711.5	4697.2	
30'	6090.8	2632.6	.86	30'	7268.0	3525.2	.103	30'	8739.2	4720.3	1.25
40'	6108.6	2645.5	E	40'	7289.8	3542.4	E	40'	8767.0	4743.6	E
50'	6126.4	2658.5	.401	50'	7311.7	3559.6	.536	50'	8794.9	4766.9	.721
94°	6144.3	2671.6		104°	7333.6	3576.8		114°	8822.9	4790.4	
10'	6162.2	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	15° C.	50'	7444.6	3664.5	15° C.	50'	8965.0	4909.9	15° C.
95°	6252.8	2751.3	T	105°	7467.0	3682.3	T	115°	8993.8	4934.1	T
10'	6271.1	2764.8	1.30	10'	7489.6	3700.2	1.56	10'	9022.7	4958.6	1.93
20'	6289.4	2778.3	E	20'	7512.2	3718.2	E	20'	9051.7	4983.1	E
30'	6307.9	2792.0		30'	7534.9	3736.2		30'	9080.9	5007.8	
40'	6326.3	2805.6	.604	40'	7557.7	3754.4	.806	40'	9110.3	5032.6	1.09
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	20° C.	40'	7696.3	3865.2	20° C.	40'	9289.2	5184.5	20° C.
50'	6457.3	2903.1	T	50'	7719.7	3884.0	T	50'	9319.5	5210.3	T
97°	6476.2	2917.3	1.74	107°	7743.2	3902.9	2.08	117°	9349.9	5236.2	2.52
10'	6495.2	2931.6	E	10'	7766.8	3921.9	E	10'	9380.5	5262.3	E
20'	6514.3	2945.9	.809	20'	7790.5	3940.9	1.08	20'	9411.3	5288.6	1.46
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	25° C.	20'	7934.6	4057.4	25° C.	20'	9598.9	5449.2	25° C.
30'	6649.6	3047.9	T	30'	7959.0	4077.2	T	30'	9630.7	5476.5	T
40'	6669.2	3062.8	1.18	40'	7983.5	4097.1					

TABLE X.  
MIDDLE ORDINATES OF RAILS  
Length of Rail (feet)

C o /	R Feet	30 Inch	28 Inch	26 Inch	24 Inch	22 Inch	20 Inch	C o	R Feet	30 Inch	28 Inch	26 Inch	24 Inch	22 Inch	20 Inch
0-20	17189	.08	.07	.06	.05	.04	.03	8	716.8	1.88	1.64	1.42	1.20	1.01	.84
0-40	8594	.16	.14	.12	.10	.08	.07	9	637.3	2.12	1.84	1.60	1.35	1.14	.94
1-0	5730	.24	.20	.18	.15	.13	.10	10	573.7	2.36	2.05	1.78	1.50	1.27	1.04
1-20	4297	.31	.27	.23	.20	.17	.13	11	521.7	2.59	2.26	1.95	1.65	1.39	1.15
1-40	3438	.39	.34	.29	.25	.21	.17	12	478.3	3.83	2.47	2.15	1.81	1.54	1.26
2-0	2865	.47	.41	.35	.30	.25	.20	13	441.7	3.05	2.66	2.30	1.96	1.66	1.36
2-20	2456	.55	.48	.41	.35	.29	.23	14	410.3	3.30	2.87	2.48	2.10	1.78	1.46
2-40	2149	.63	.55	.47	.40	.33	.27	15	383.1	3.54	3.08	2.68	2.26	1.91	1.57
3-0	1910	.71	.62	.53	.45	.38	.31	16	359.3	3.76	3.28	2.83	2.40	2.04	1.67
3-20	1719	.78	.68	.59	.50	.42	.35	17	338.3	4.00	3.48	3.02	2.57	2.16	1.78
3-40	1563	.86	.75	.65	.55	.46	.38	18	319.6	4.21	3.67	3.18	2.70	2.28	1.87
4-0	1433	.94	.82	.71	.60	.50	.42	19	302.9	4.45	3.89	3.36	2.86	2.41	1.98
4-20	1323	1.02	.89	.77	.65	.55	.45	20	287.9	4.70	4.09	3.55	3.00	2.54	2.09
4-40	1228	1.10	.96	.83	.70	.59	.48	22	262.0	5.16	4.44	3.84	3.30	2.80	2.29
5	1146	1.18	1.03	.89	.75	.63	.52	24	240.5	5.64	4.92	4.20	3.59	3.04	2.50
6	955.3	1.41	1.23	1.06	.90	.76	.62	26	222.3	6.07	5.29	4.58	3.88	3.29	2.70
7	819.0	1.65	1.44	1.24	1.05	.89	.73								

TABLE XI.  
SHORT RADIUS CURVES

Radius Feet	Chord Feet	Central Angle	Deflection Angle	Deflection for 1 Foot
35	10	16-26	8-13	49.3
45	10	12-46	6-23	38.3
50	15	17-16	8-38	34.5
60	15	14-22	7-11	28.8
75	15	11-30	5-45	23.0
100	20	11-30	5-45	17.3
120	20	9-34	4-47	14.3
150	20	7-39	3-49	11.5
190	25	7-32	3-46	9.15
200	25	7-10	3-35	8.6
225	25	6-25	3-12	7.7
240	25	5-58	2-59	7.2
250	25	5-44	2-52	6.9
275	25	5-12	2-36	6.2
288	50	9-58	4-59	6.0
300	50	9-32	4-46	5.7
350	50	8-12	4-06	4.9
376	50	7-40	3-50	4.6
400	50	7-10	3-35	4.3
410	50	7-00	3-30	4.2

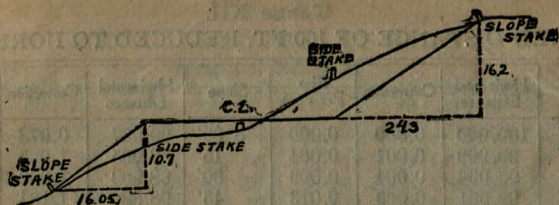
To find length of curve divide angle from P. C. to P. T. by central angle of chord, and multiply by length of chord.

TABLE XII.  
INCLINED DISTANCE OF 100 FT. REDUCED TO HORIZONTAL

Slope	Horizontal Distance	Correction	Rise Per Foot	Slope	Horizontal Distance	Correction	Rise Per Foot
0°00'	100.000	0.000	0.000	8°00'	99.027	0.973	0.139
15'	99.999	0.001	0.004	15'	98.965	1.035	0.143
30'	99.996	0.004	0.009	30'	98.902	1.098	0.148
45'	99.991	0.009	0.013	45'	98.836	1.164	0.152
1 00	99.985	0.015	0.017	9 00	98.769	1.231	0.156
15	99.976	0.024	0.022	15	98.700	1.300	0.161
30	99.966	0.034	0.026	30	98.629	1.371	0.165
45	99.953	0.047	0.031	45	98.556	1.444	0.169
2 00	99.939	0.061	0.035	10 00	98.481	1.519	0.174
15	99.923	0.077	0.039	15	98.404	1.596	0.178
30	99.905	0.095	0.044	30	98.325	1.675	0.182
45	99.885	0.115	0.048	45	98.245	1.755	0.187
3 00	99.863	0.137	0.052	11 00	98.163	1.837	0.191
15	99.839	0.161	0.057	15	98.079	1.921	0.195
30	99.813	0.187	0.061	30	97.992	2.008	0.199
45	99.786	0.214	0.065	45	97.905	2.095	0.204
4 00	99.756	0.244	0.070	12 00	97.815	2.185	0.208
15	99.725	0.275	0.074	15	97.723	2.277	0.212
30	99.692	0.308	0.078	30	97.630	2.370	0.216
45	99.657	0.343	0.083	45	97.534	2.466	0.221
5 00	99.619	0.381	0.087	13 00	97.437	2.563	0.225
15	99.580	0.420	0.092	15	97.338	2.662	0.229
30	99.540	0.460	0.096	30	97.237	2.763	0.233
45	99.497	0.503	0.100	45	97.134	2.866	0.238
6 00	99.452	0.548	0.105	14 00	97.030	2.970	0.242
15	99.406	0.594	0.109	15	96.923	3.077	0.246
30	99.357	0.643	0.113	30	96.815	3.185	0.250
45	99.307	0.693	0.118	45	96.705	3.295	0.255
7 00	99.255	0.745	0.122	15 00	96.593	3.407	0.259
15	99.200	0.800	0.126	15	96.479	3.521	0.263
30	99.144	0.856	0.131	30	96.363	3.637	0.267
45	99.087	0.913	0.135	45	96.246	3.754	0.271

TABLE XIII.  
MINUTES IN DECIMALS OF A DEGREE.

0 30"	.00833	10' 30"	.17500	20' 30"	.34167	30' 10"	.50833	40' 30"	.67500	50' 10"	.84167
1 00	.01667	11 00	.18333	21 00	.35000	31 00	.51667	41 00	.68333	51 00	.85000
30	.02500	30	.19167	30	.35833	30	.52500	30	.69167	30	.85833
2 00	.03333	12 00	.20000	22 00	.36667	32 00	.53333	42 00	.70000	52 00	.86667
30	.04167	30	.20833	30	.37500	30	.54167	30	.70833	30	.87500
3 00	.05000	13 00	.21667	23 00	.38333	33 00	.55000	43 00	.71667	53 00	.88333
30	.05833	30	.22500	30	.39167	30	.55833	30	.72500	30	.89167
4 00	.06667	14 00	.23333	24 00	.40000	34 00	.56667	44 00	.73333	54 00	.90000
30	.07500	30	.24167	30	.40833	30	.57500	30	.74167	30	.90833
5 00	.08333	15 00	.25000	25 00	.41667	35 00	.58333	45 00	.75000	55 00	.91667
30	.09167	30	.25833	30	.42500	30	.59167	30	.75833	30	.92500
6 00	.10000	16 00	.26667	26 00	.43333	36 00	.60000	46 00	.76667	56 00	.93333
30	.10833	30	.27500	30	.44167	30	.60833	30	.77500	30	.94167
7 00	.11667	17 00	.28333	27 00	.45000	37 00	.61667	47 00	.78333	57 00	.95000
30	.12500	30	.29167	30	.45833	30	.62500	30	.79167	30	.95833
8 00	.13333	18 00	.30000	28 00	.46667	38 00	.63333	48 00	.80000	58 00	.96667
30	.14167	30	.30833	30	.47500	30	.64167	30	.80833	30	.97500
9 00	.15000	19 00	.31667	29 00	.48333	39 00	.65000	49 00	.81667	59 00	.98333
30	.15833	30	.32500	30	.49167	30	.65833	30	.82500	30	.99167
10 00	.16667	20 00	.33333	30 00	.50000	40 00	.66667	50 00	.83333	60 00	1.00000



DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING.

SLOPE  $1\frac{1}{2}$  TO 1. ROADWAY OF ANY WIDTH.

	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
0	0 00	0 15	0 30	0 45	0 60	0 75	0 90	1 05	1 20	1 35	0
1	1 50	1 65	1 80	1 95	2 10	2 25	2 40	2 55	2 70	2 85	1
2	3 00	3 15	3 30	3 45	3 60	3 75	3 90	4 05	4 20	4 35	2
3	4 50	4 65	4 80	4 95	5 10	5 25	5 40	5 55	5 70	5 85	3
4	6 00	6 15	6 30	6 45	6 60	6 75	6 90	7 05	7 20	7 35	4
5	7 50	7 65	7 80	7 95	8 10	8 25	8 40	8 55	8 70	8 85	5
6	9 00	9 15	9 30	9 45	9 60	9 75	9 90	10 05	10 20	10 35	6
7	10 50	10 65	10 80	10 95	11 10	11 25	11 40	11 55	11 70	11 85	7
8	12 00	12 15	12 30	12 45	12 60	12 75	12 90	13 05	13 20	13 35	8
9	13 50	13 65	13 80	13 95	14 10	14 25	14 40	14 55	14 70	14 85	9
10	15 00	15 15	15 30	15 45	15 60	15 75	15 90	16 05	16 20	16 35	10
11	16 50	16 65	16 80	16 95	17 10	17 25	17 40	17 55	17 70	17 85	11
12	18 00	18 15	18 30	18 45	18 60	18 75	18 90	19 05	19 20	19 35	12
13	19 50	19 65	19 80	19 95	20 10	20 25	20 40	20 55	20 70	20 85	13
14	21 00	21 15	21 30	21 45	21 60	21 75	21 90	22 05	22 20	22 35	14
15	22 50	22 65	22 80	22 95	23 10	23 25	23 40	23 55	23 70	23 85	15
16	24 00	24 15	24 30	24 45	24 60	24 75	24 90	25 05	25 20	25 35	16
17	25 50	25 65	25 80	25 95	26 10	26 25	26 40	26 55	26 70	26 85	17
18	27 00	27 15	27 30	27 45	27 60	27 75	27 90	28 05	28 20	28 35	18
19	28 50	28 65	28 80	28 95	29 10	29 25	29 40	29 55	29 70	29 85	19
20	30 00	30 15	30 30	30 45	30 60	30 75	30 90	31 05	31 20	31 35	20
21	31 50	31 65	31 80	31 95	32 10	32 25	32 40	32 55	32 70	32 85	21
22	33 00	33 15	33 30	33 45	33 60	33 75	33 90	34 05	34 20	34 35	22
23	34 50	34 65	34 80	34 95	35 10	35 25	35 40	35 55	35 70	35 85	23
24	36 00	36 15	36 30	36 45	36 60	36 75	36 90	37 05	37 20	37 35	24
25	37 50	37 65	37 80	37 95	38 10	38 25	38 40	38 55	38 70	38 85	25
26	39 00	39 15	39 30	39 45	39 60	39 75	39 90	40 05	40 20	40 35	26
27	40 50	40 65	40 80	40 95	41 10	41 25	41 40	41 55	41 70	41 85	27
28	42 00	42 15	42 30	42 45	42 60	42 75	42 90	43 05	43 20	43 35	28
29	43 50	43 65	43 80	43 95	44 10	44 25	44 40	44 55	44 70	44 85	29
30	45 00	45 15	45 30	45 45	45 60	45 75	45 90	46 05	46 20	46 35	30
31	46 50	46 65	46 80	46 95	47 10	47 25	47 40	47 55	47 70	47 85	31
32	48 00	48 15	48 30	48 45	48 60	48 75	48 90	49 05	49 20	49 35	32
33	49 50	49 65	49 80	49 95	50 10	50 25	50 40	50 55	50 70	50 85	33
34	51 00	51 15	51 30	51 45	51 60	51 75	51 90	52 05	52 20	52 35	34
35	52 50	52 65	52 80	52 95	53 10	53 25	53 40	53 55	53 70	53 85	35
36	54 00	54 15	54 30	54 45	54 60	54 75	54 90	55 05	55 20	55 35	36
37	55 50	55 65	55 80	55 95	56 10	56 25	56 40	56 55	56 70	56 85	37
38	57 00	57 15	57 30	57 45	57 60	57 75	57 90	58 05	58 20	58 35	38
39	58 50	58 65	58 80	58 95	59 10	59 25	59 40	59 55	59 70	59 85	39
40	60 00	60 15	60 30	60 45	60 60	60 75	60 90	61 05	61 20	61 35	40
41	61 50	61 65	61 80	61 95	62 10	62 25	62 40	62 55	62 70	62 85	41
42	63 00	63 15	63 30	63 45	63 60	63 75	63 90	64 05	64 20	64 35	42
43	64 50	64 65	64 80	64 95	65 10	65 25	65 40	65 55	65 70	65 85	43
44	66 00	66 15	66 30	66 45	66 60	66 75	66 90	67 05	67 20	67 35	44
45	67 50	67 65	67 80	67 95	68 10	68 25	68 40	68 55	68 70	68 85	45
46	69 00	69 15	69 30	69 45	69 60	69 75	69 90	70 05	70 20	70 35	46
47	70 50	70 65	70 80	70 95	71 10	71 25	71 40	71 55	71 70	71 85	47
48	72 00	72 15	72 30	72 45	72 60	72 75	72 90	73 05	73 20	73 35	48
49	73 50	73 65	73 80	73 95	74 10	74 25	74 40	74 55	74 70	74 85	49
50	75 00	75 15	75 30	75 45	75 60	75 75	75 90	76 05	76 20	76 35	50

Computed by L. Leland Locke.

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Clyde Mann

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