Baisbridge Road
Grand River Bridge
Chagrin River Bridge
Pettibone Road
Swine Creek Bridge
Chagrin River Bridge
Wilson Mills Rd

FIELD BOOK

364

KEUFFEL & ESSER CO.

DRAWING MATERIALS
AND
SURVEYING INSTRUMENTS.
NEW YORK.

CHICAGO. ST. LOUIS. SAN FRANCISCO. MONTREAL.

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.

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Chardon
Ohio
Geauga County

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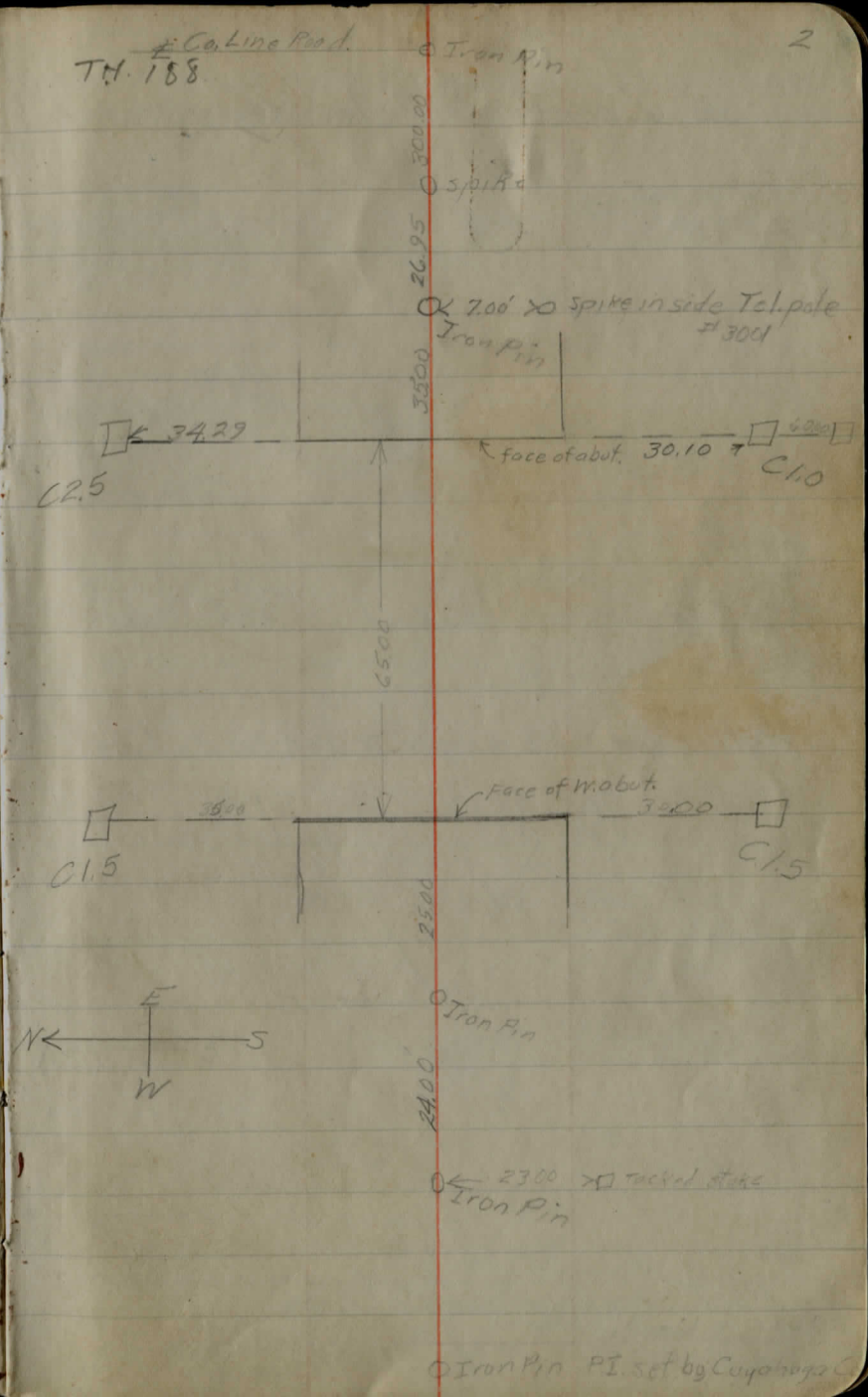
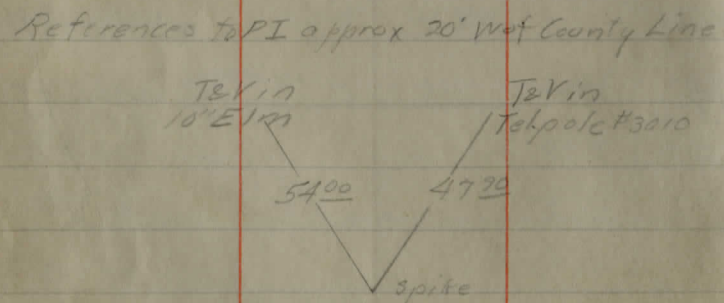
5/13/30

Solon Bunbridge Road Bridge

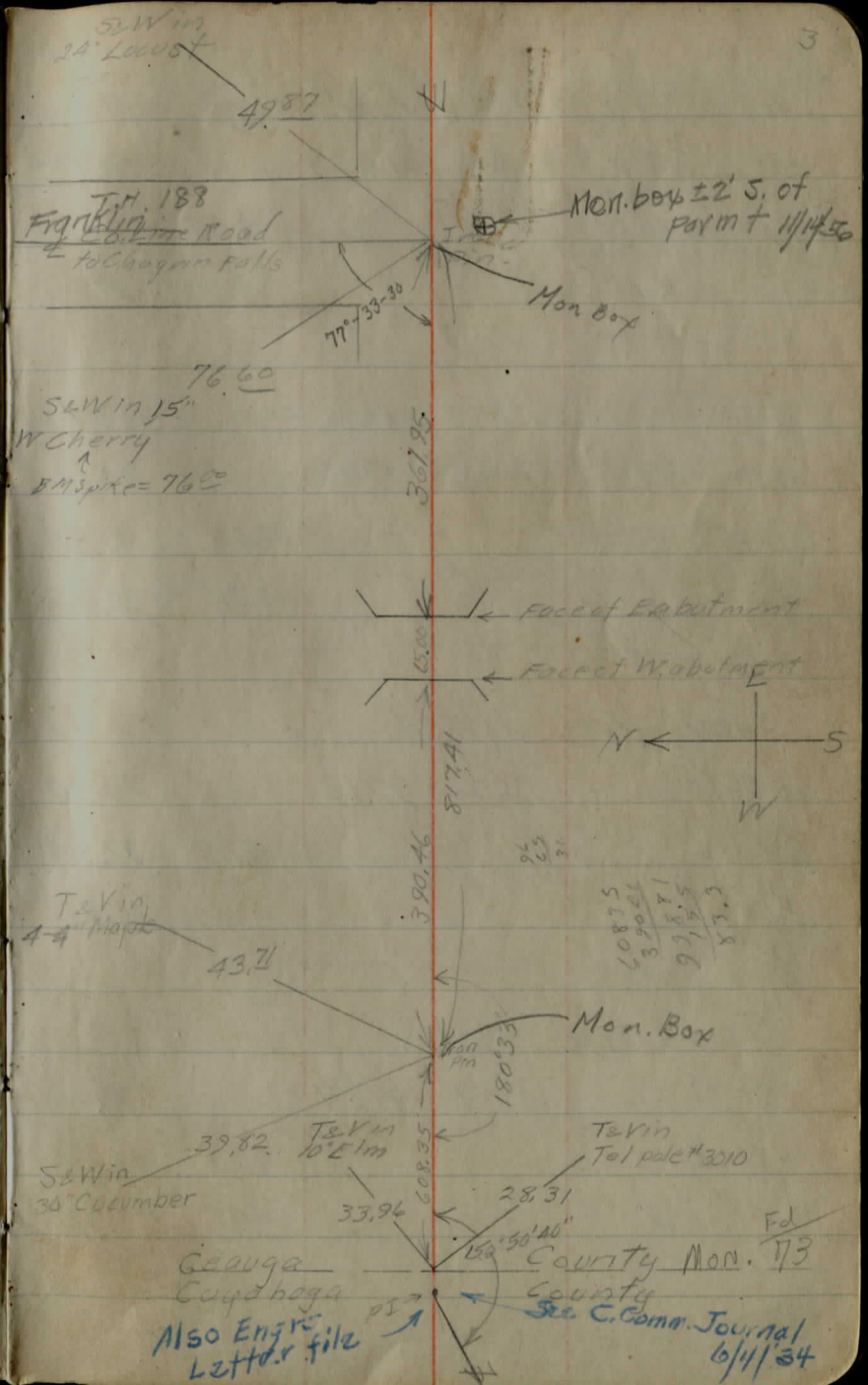
Location	65	111 I	FS	Elev
BM SW ∠ Bridge	6.88	106.88		100.00
Flow E			16.3	90.6
Flow W			17.8	89.1
Flow E			20.9	86.5
℄ Grade			5.38	101.50
Spring Line			16.38	90.50
New BM spike in 30" Willow 100' S of SW ∠ Bridge			10.98	95.90
New BM.	0.04	9594		9590
Spring Line			5.44	90.50
SE Cor			4.44	C1.0
SW Cor.			3.94	C 1.5
NW Cor			3.94	C1.5
NE Cor			2.94	C2.5



℄ Location Solon Bainbridge Road Bridge



POT on Cuyahoga Co. Line
PI approx 20' W of POT



Levels on W. Footer after pouring Wharf

BM new	1.09	96.99		95.90
Keel mark SE & wall				
on spring Line			4.07	92.92
Keel mark Center Nend				
wall above spring line			4.00	92.99

(level) Cuyahoga Co. BM N.W. & Wing 379.32

same levels after forms were removed

new BM	1.46	97.36		95.90
SE & wall			4.51	92.85
N end wall			4.44	92.92

Spike E side 36" Willow 75'S of Wendbridge
-.07 settlement
-.07 "

same levels 1/9/34

new BM	1.22	97.12		95.90
SE &			4.28	92.84
N end			4.20	92.92

-.01 settlement
-.00

Same Levels 9/13/35

BM	1.47	97.37		95.90
SE &			4.53	92.84
N end			4.45	92.92

Levels to the Cuyahoga BM Tooor

Oor new BM	10.72	10662		9590
Cuyahoga BM			4.57	10203

Cuyahoga Elev. - 379.32

Spike NE root 30" in low 75' S of Wood bridge

X cut Top NW ∠ W abt. Bridge

C H #2

℄ Location Grand River Bridge

Sta 75+08.66 PI = 76+79.02 Line A

Tan = 53.33

End Wall = 76+81.50 Line A

Extra Line = 20.90' on ℄

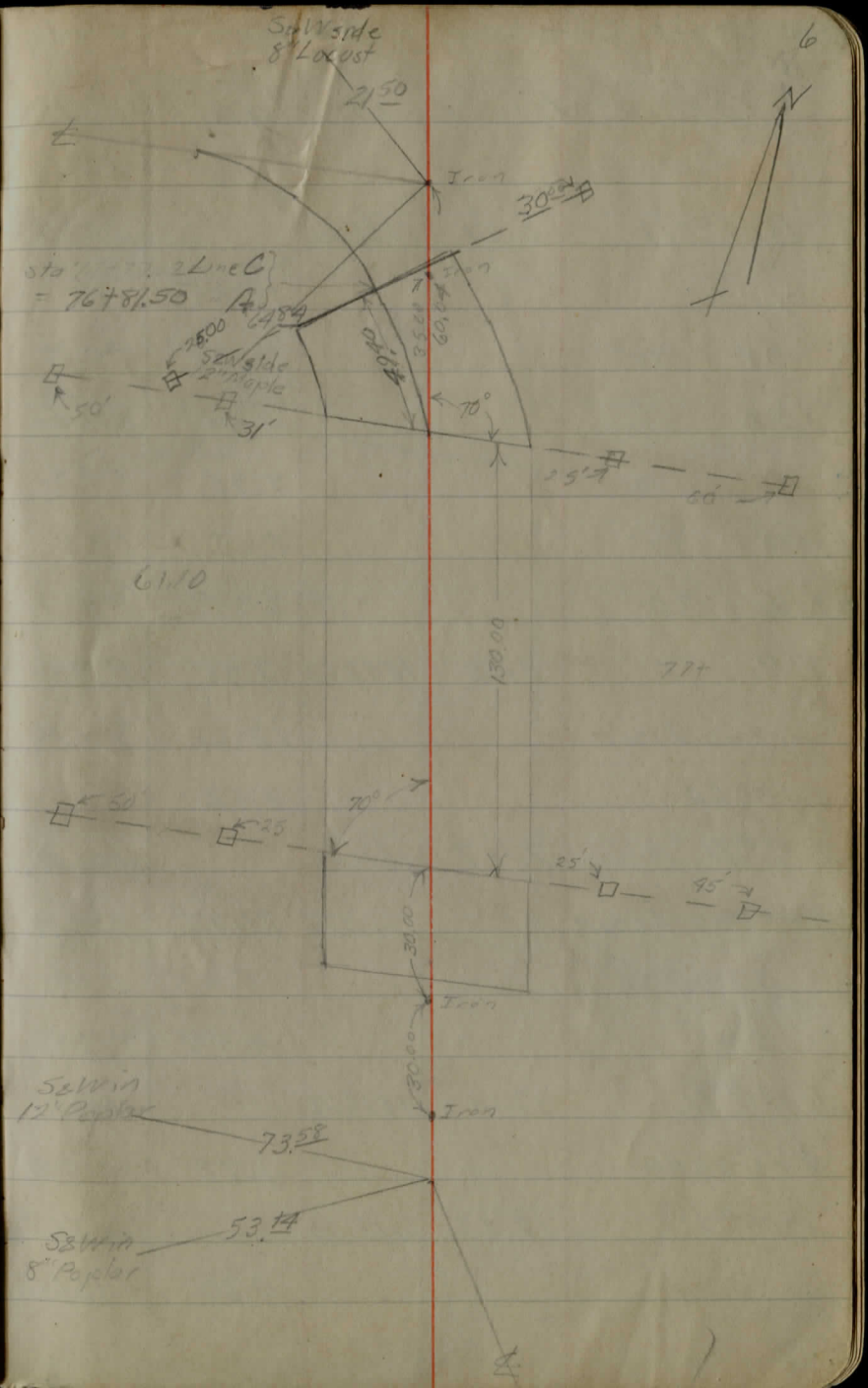
Spring Line = 76+39.10 Line A = 74+48.62 Line C

PT to Sta 76+81.50 = 20°25' = 51.05 ft.

PT to Sta 76+61.10 = 27°46' = 69.41 ft.

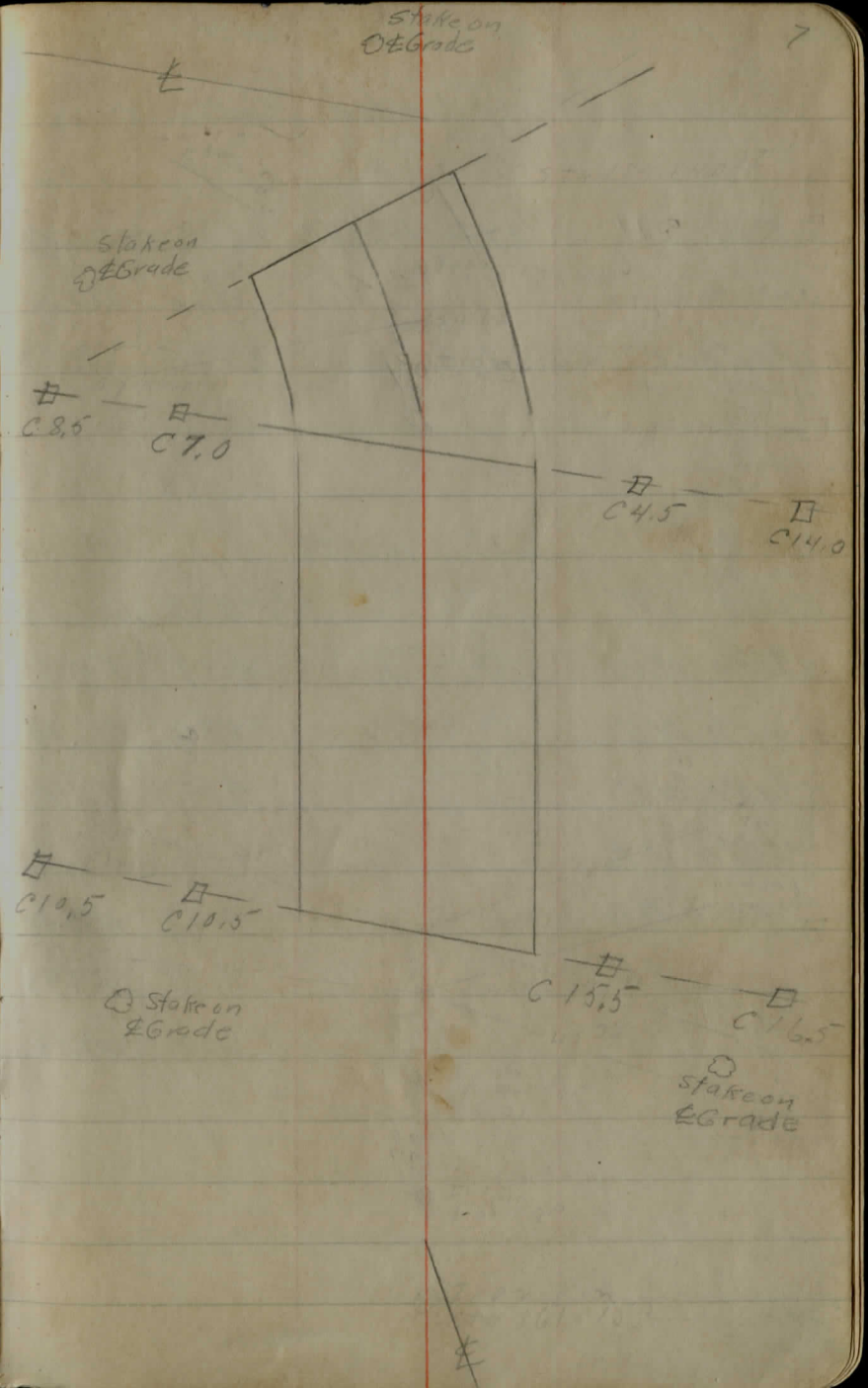
Spring Line = 73+18.62 Line C

Sta 72+26.46 PI



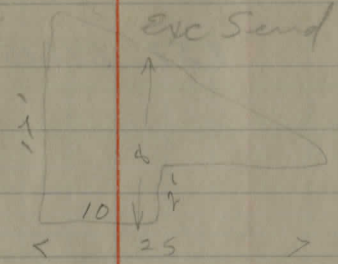
Grand River Bridge

	BS	HI	FS	Elev
BM # 11	0.87	1004.45		1003.58
Spring Line			14.45	990.00
SE 30°			9.95	C4.5
SE			0.45	C14.0
NE			5.95	C8.5
NE 30°			7.45	C7.0
NW 30			3.95	C10.5
T.P.	8.12	1008.62	3.95	1000.50
Spring Line			18.62	990.00
NW 60			8.12	C10.5
BM # 11	7.47	1011.05		1003.58
Spring Line			21.05	990.00
SW 30°			5.55	C15.5
SW			4.55	C16.5
BM # 11	13.14	1016.72		1003.58
℄ Grade			1.72	1015.00
BM # 11	12.12	1015.70		1003.58
			0.70	1015.00



Grand River Bridge Footer Elev.

	BS	HI	FS	Elev	
BM #11	1.92	100.550		1003.58	
Spring Line			15.50	990.00	
Footer Elev Sand			15.25	990.25	
BM #11	6.30	1009.88		1003.58	
curb NW			-5.70	1015.58	
stake NW			4.89	F10.59	
curb NE			-6.86	1016.74	
stake NE			4.54	F11.40	
Footer NE			4.46	1005.42	C 0.95
" NW			4.73	1005.15	C 1.11
" SE			8.30	1001.58	C 4.10
" SW			8.30	1001.58	C 3.61



curb NW - 1015.87
.29
stake = 1015.58

curb NE 1016.45
.29
stake = 1016.74

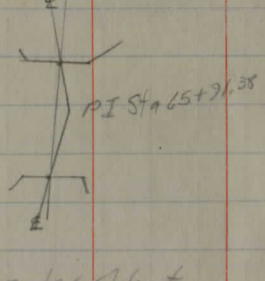
Elev of top of Footers Nend

	BS	HI	FS	Elev
BM #11	8.57	1012.15		1003.58
4 R			6.06	
3 R			6.78	
2 R			7.42	
1 R			7.29	
1 L			7.91	
2 L			7.05	
3 L			6.82	
4 L			6.60	

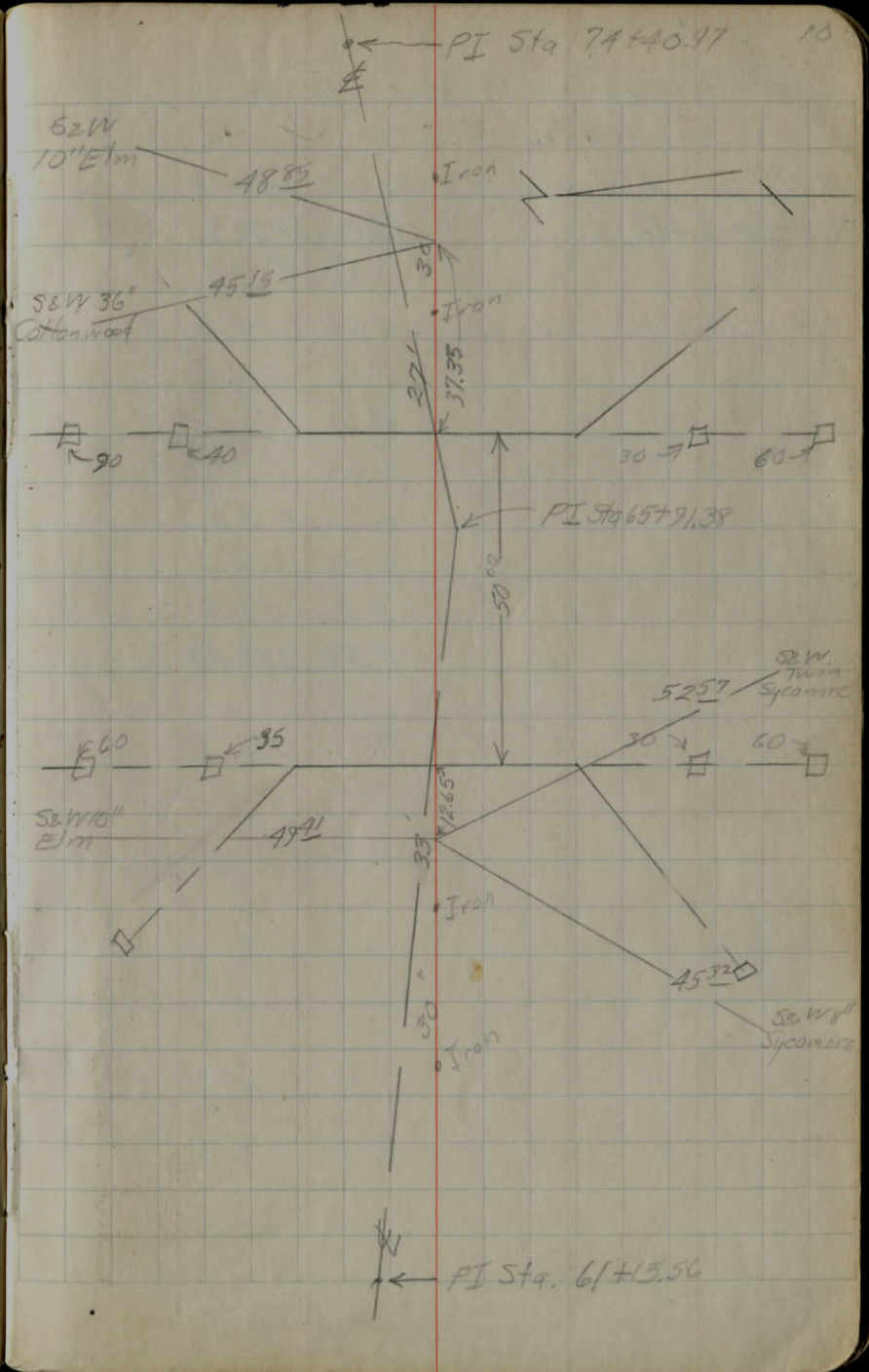
T.H.-185 9/9/30

Chagrin River Bridge
on the Pettibone Road

Sta	66+41.38	POT	Iron Found
Sta	66+09.03	Face E Abut.	



Sta	65+54.03	Face W Abut	
Sta	65+41.38	POT	Iron Found
Sta	61+15.56	PI	Iron Found

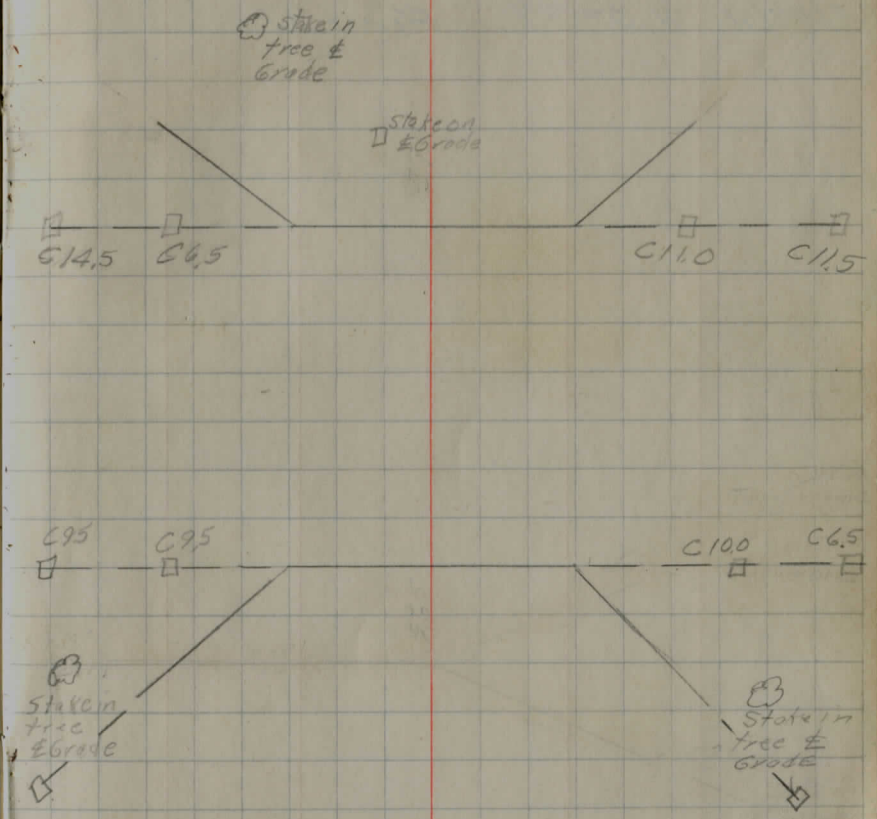


9/12/30

Chagrin River Bridge

BM#10	2.61	951.49		948.88
Footer Grade			1.616	935.33
NE 30			9.66	C 6.5
NE 60			1.66	C 14.5
SE 30			5.16	C 11.0
SE 80			4.66	C 11.5
NW 30			6.66	C 9.5
NW 60			6.66	C 9.5
SW 30			6.16	C 10.0
SW 60			9.66	C 6.5
℄ Grade			0.99	950.50
Flow			11.3	940.2

X cut in top wabutment old bridge Send



Water level Observations
below ℄ of Top N curb.

Nov. 30 Flow 100

4/27/31 H_2O = 8.7 Flow = 97

C.H. #38

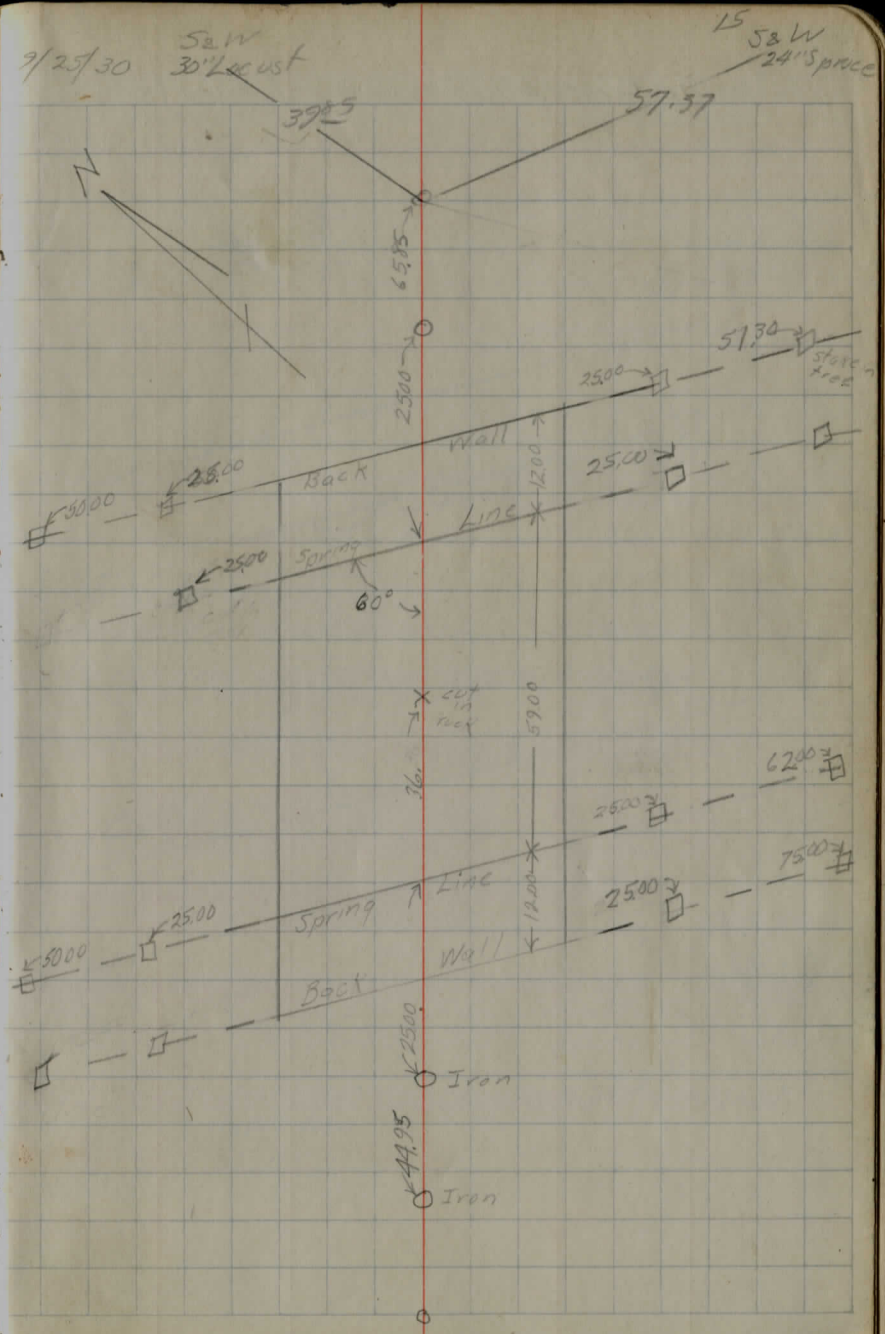
Swine Creek Bridge Location

Sta 164+73.30 PI Iron Found

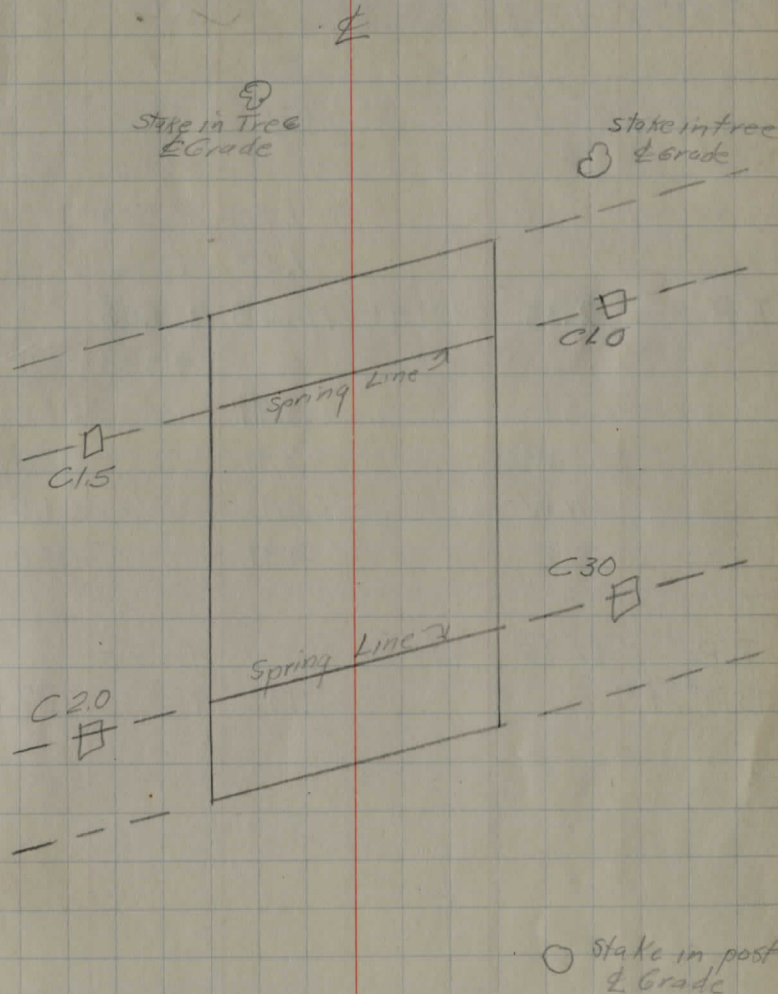
Sta 164+07.45 = Spring Line

Sta 163+48.45 = Spring Line

Sta 159+60.00 PI Iron Found



Swine Creek Bridge Levels



Swine Creek Bridge Levels

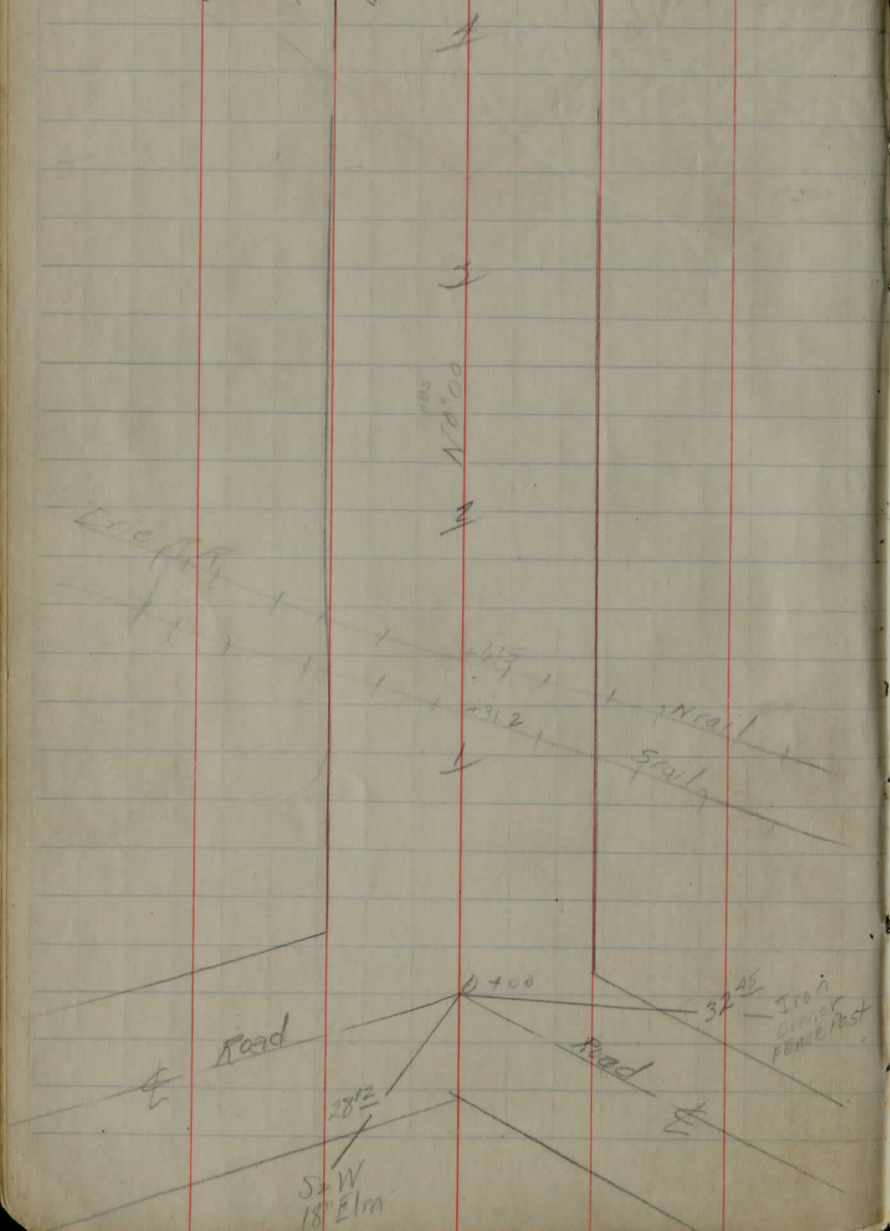
BM #21	1.73	929.69			927.96
Channel ℄			15.2	914.5	
Channel NE			16.1	913.6	
℄ Grade N			1.86	927.83	
℄ Grade S			1.03	928.66	
T.P.	2.35	921.41	10.63	919.06	
			5.91	915.50	
Springline	SE		2.91		C 3.0
	SW		3.91		C 2.0
	NW		4.41		C 1.5
	NE		4.91		C 1.0
T.P	12.78	929.28	4.91	916.50	
BM #21			1.32	927.96	927.96

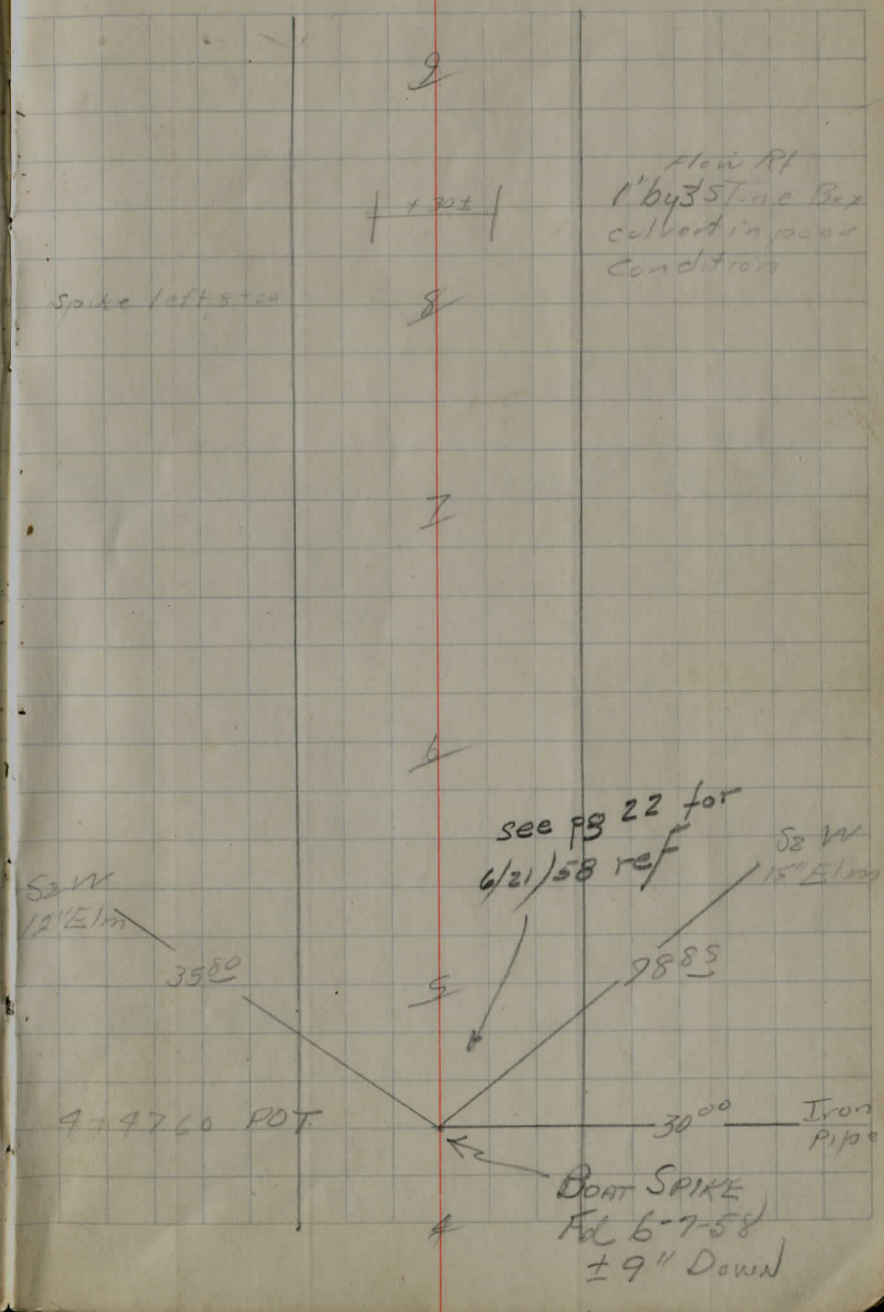
x cotton bridge seat SW ℄ old bridge

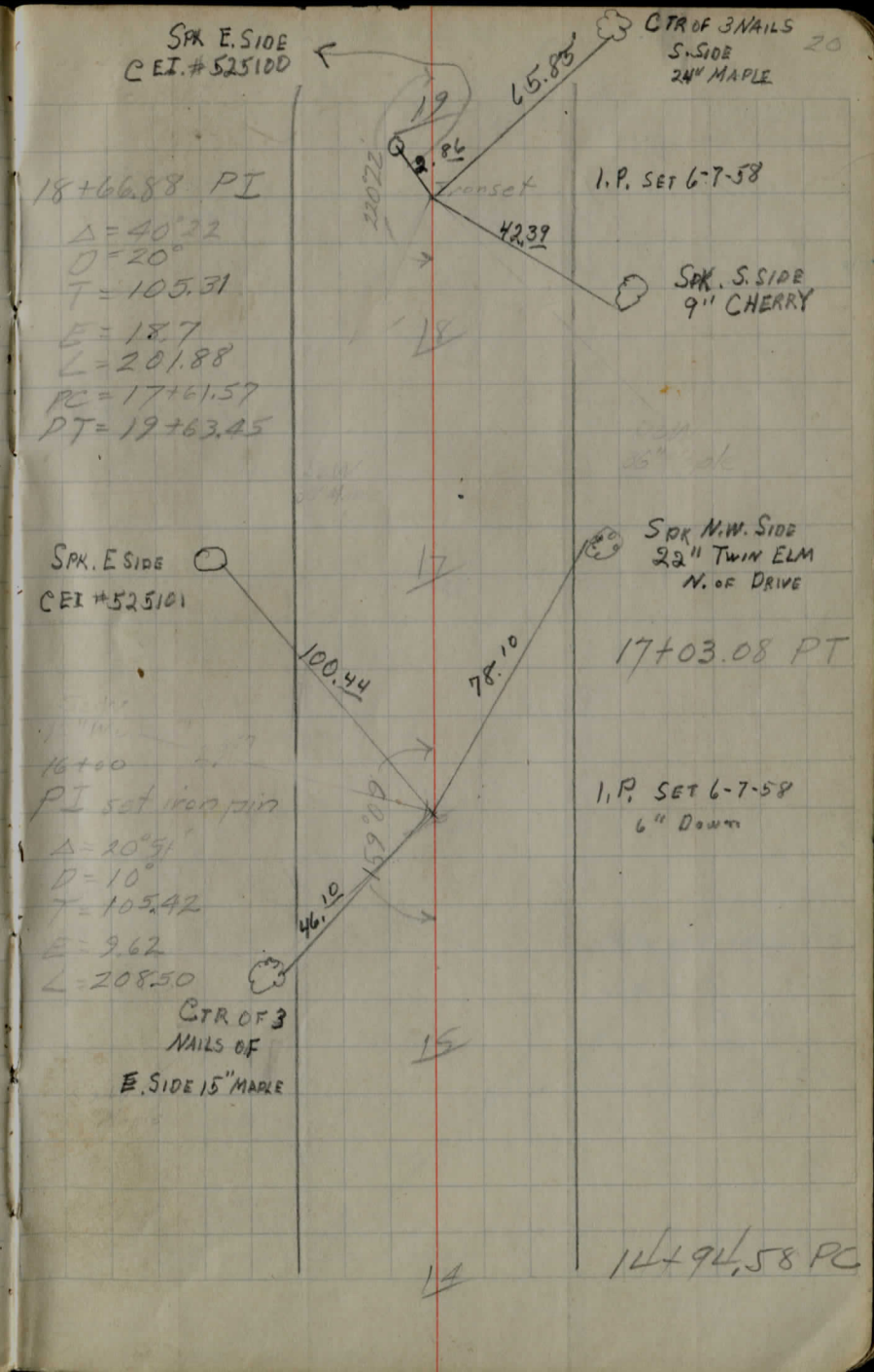
Geauga Lake - Bainbridge Road

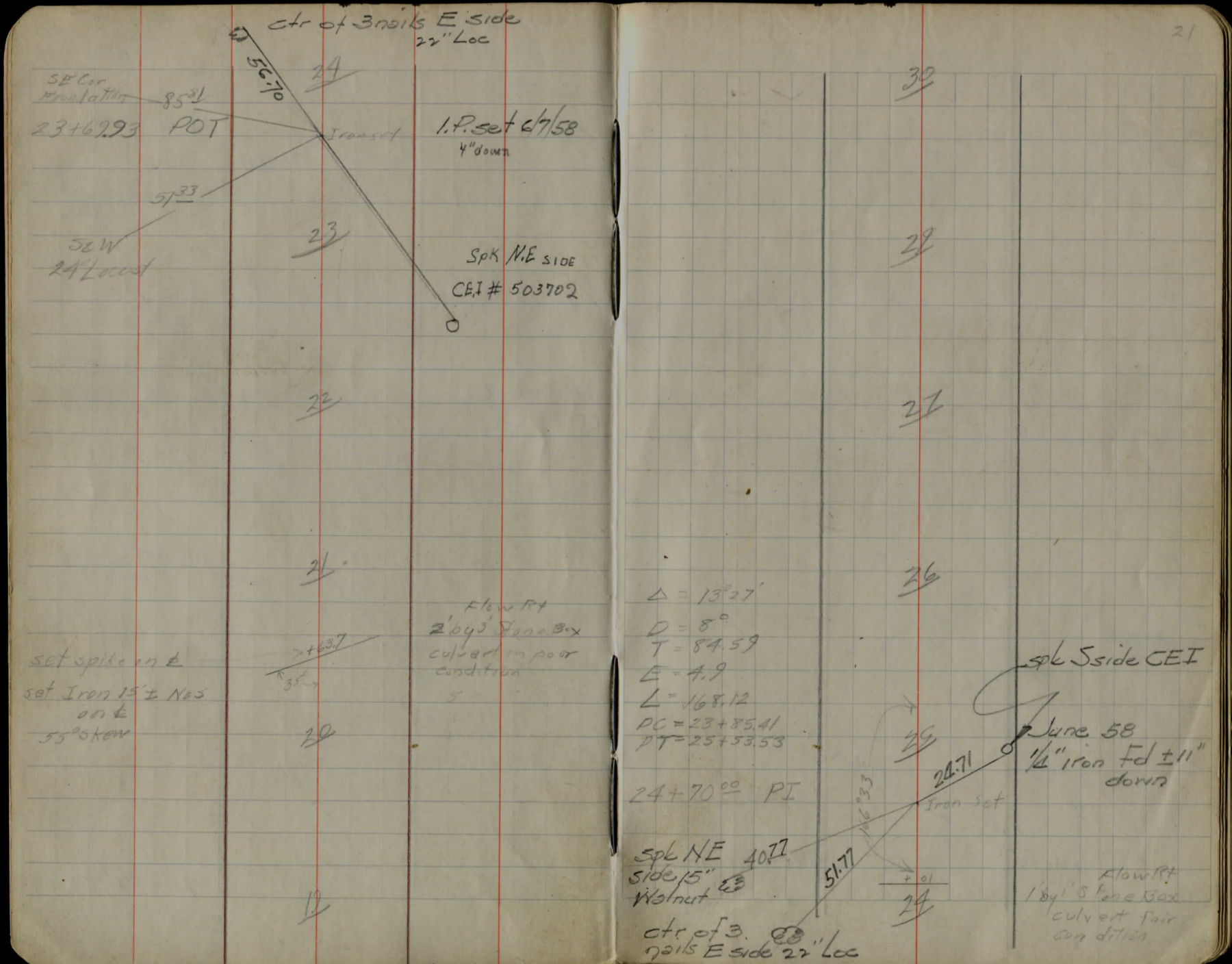
Road Location Sec A.

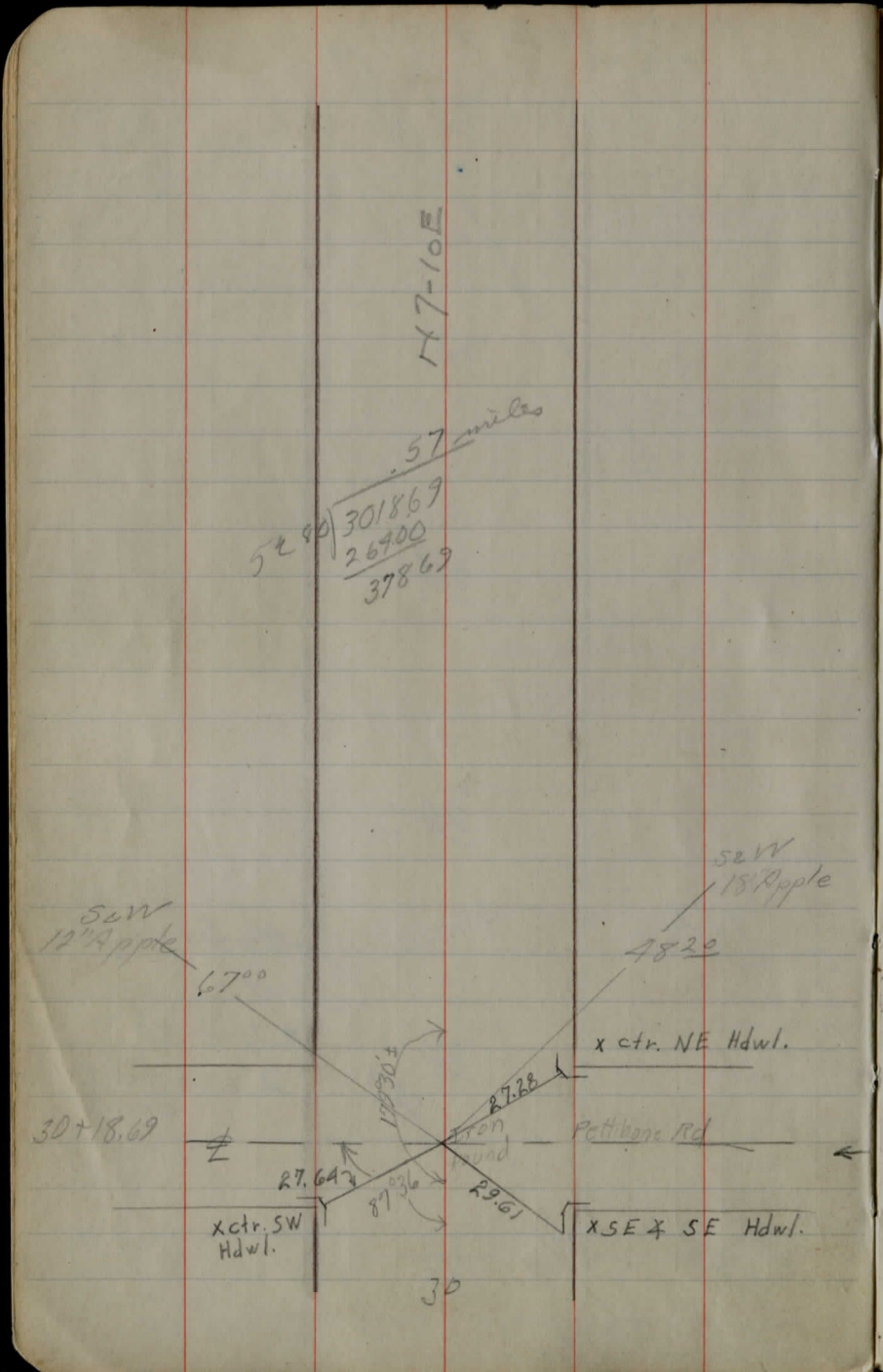
(Judge Henry Road)

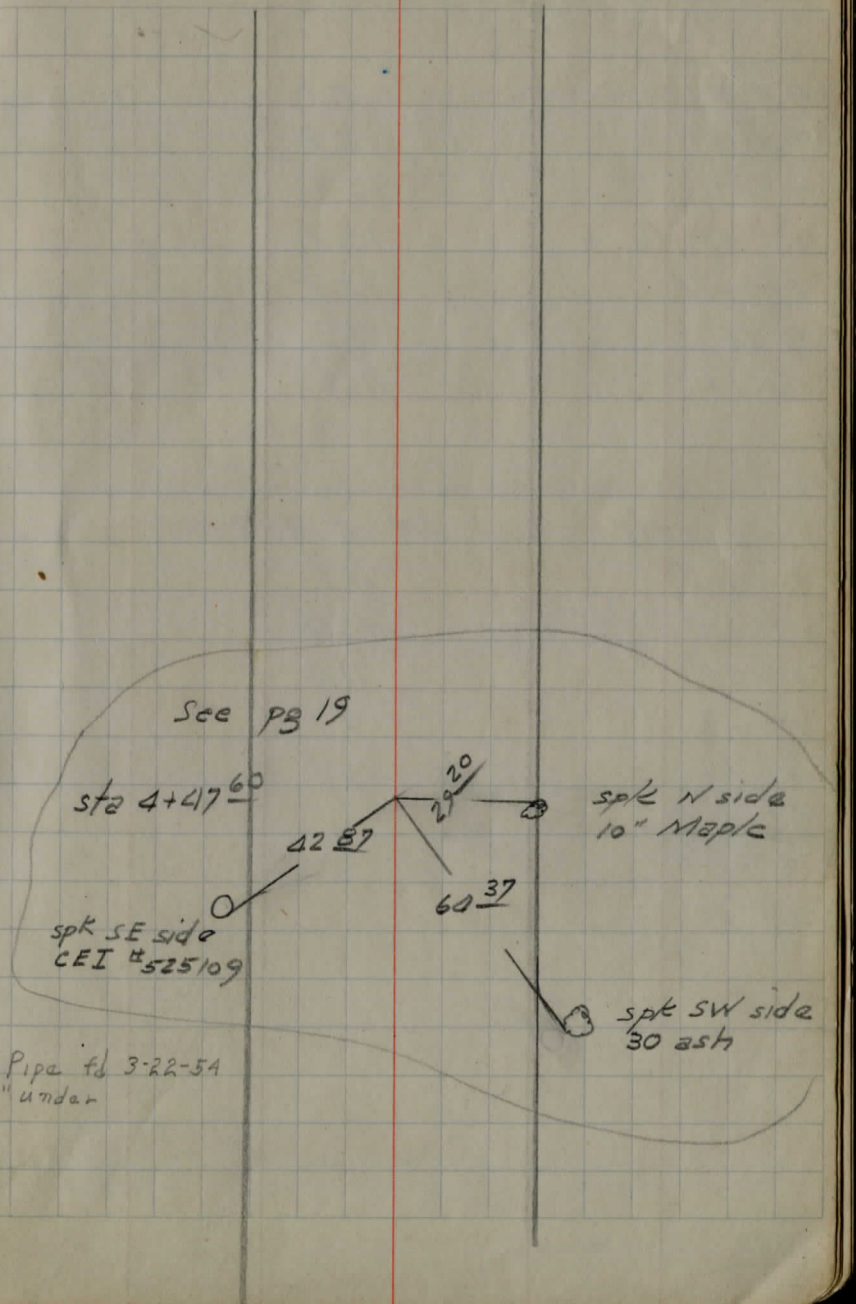





SPK E. SIDE
CEI. #525100
CTR OF 3 NAILS
S. SIDE
24" MAPLE
65.85
19
2.86
220°22'
Transet
I.P. SET 6-7-58
42.39
SPK. S. SIDE
9" CHERRY
18+66.88 PI
Δ = 40°22
D = 20°
T = 105.31
E = 15.7
L = 201.88
PC = 17+61.57
PT = 19+63.45
SPK. E SIDE
CEI #525101
SPK N.W. SIDE
22" TWIN ELM
N. OF DRIVE
17+03.08 PT
100.44
78.10
16+00
PI set iron pin
Δ = 20°51'
D = 10°
T = 105.42
E = 9.62
L = 208.50
I.P. SET 6-7-58
6" Down
46.10
CTR OF 3
NAILS OF
E. SIDE 15" MAPLE
14+94.58 PC


ctr of 3 nails E side
22" Loc
SE Cor
Evolation
23+62.93
POT
85.31
56.70
Iron set
51.33
SE W
24" Loc set
24
23
22
21
20
19
1.P. set 6/7/58
4" down
Spk N.E side
CE.I # 503702
set spike on ℄
set Iron 15' ± Nos
on ℄
55° skew
23+63.7
35°
Flow Rt
2' by 3' Stone Box
culvert in poor
condition
5
Δ = 13°27'
D = 8°
T = 84.59
E = 4.9
L = 168.12
PC = 23+85.41
PT = 25+53.53
24+70 ± PI
Spk NE 40.77
side 15"
Walnut
51.77
106°33
ctr of 3.
nails E side 22" Loc
+01
24
39
29
27
26
25
24.71
Iron set
Spk S side CE.I
June 58
½" iron Fd ±11"
down
Flow Rt
1' by 1' Stone Box
culvert Fair
condition


N 7-10 E
.57 miles
5+80
301869
26400
37869
SeW 12" Apple
6.70
SeW 18" Apple
48.20
x ctr. NE Hdwl.
100.30±
27.38
30+18.69
Pettibone Rd
Iron found
27.64
87°36
29.61
x ctr. SW Hdwl.
x SE & SE Hdwl.
30


See pg 19
sta 4+47.60
29.20
spk N side 10" Maple
42.87
60.37
spk SE side CEI #525109
spk SW side 30 ash
I Pipe fd 3-22-54 6" under

Cayuga Lake Road

Levels on culvert at Sta 20+69

℄ Road	2.1
Flow Rt	12.7
50' Rt	13.3
100' Rt	13.7
Flow Lt	12.7
75' Lt	11.3
150' Lt	11.2

12.7
2.1
10.6
5.3
10
25.9
14
10.36
25.9
36.2

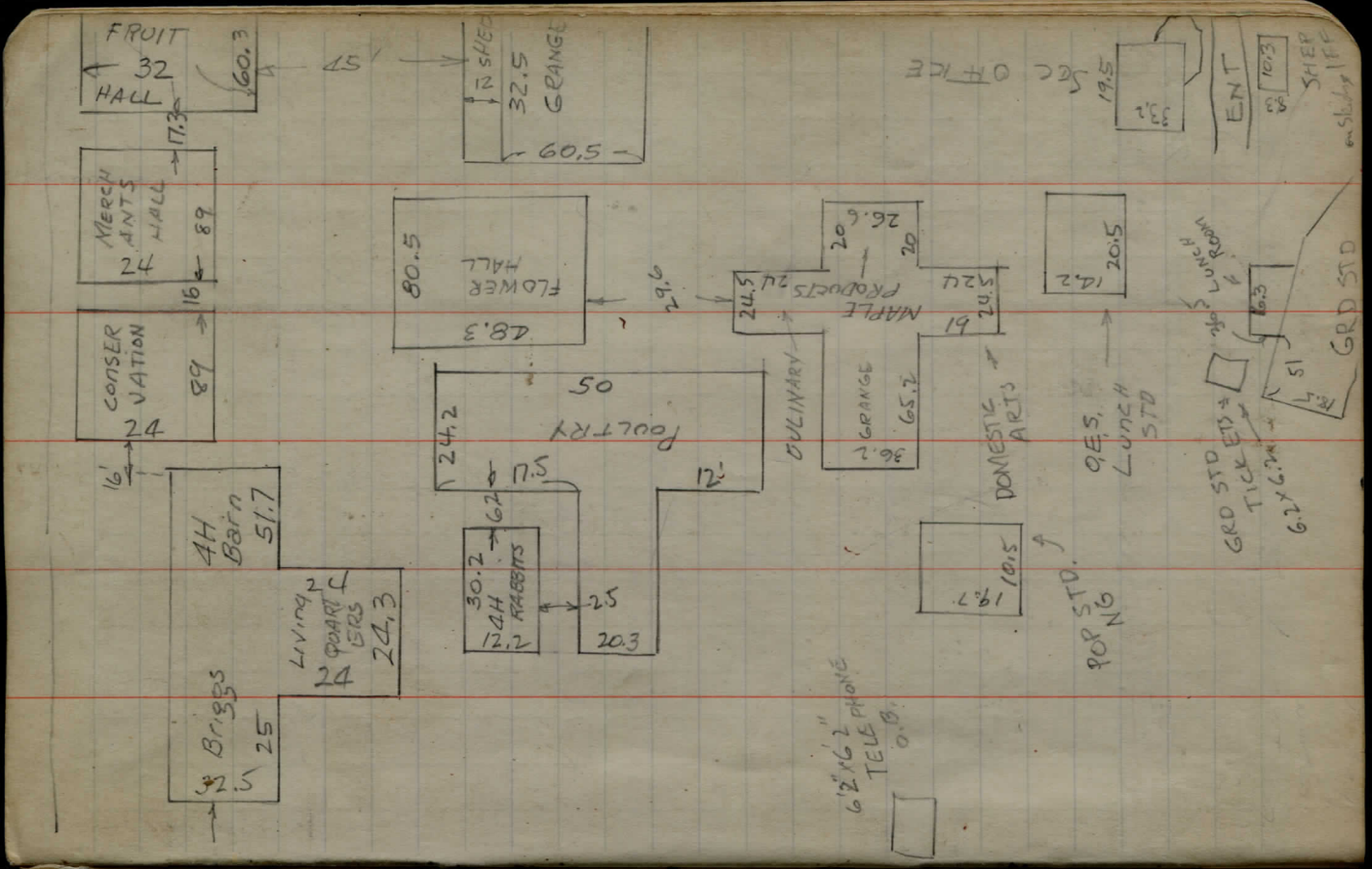
36" pipe required 72' long

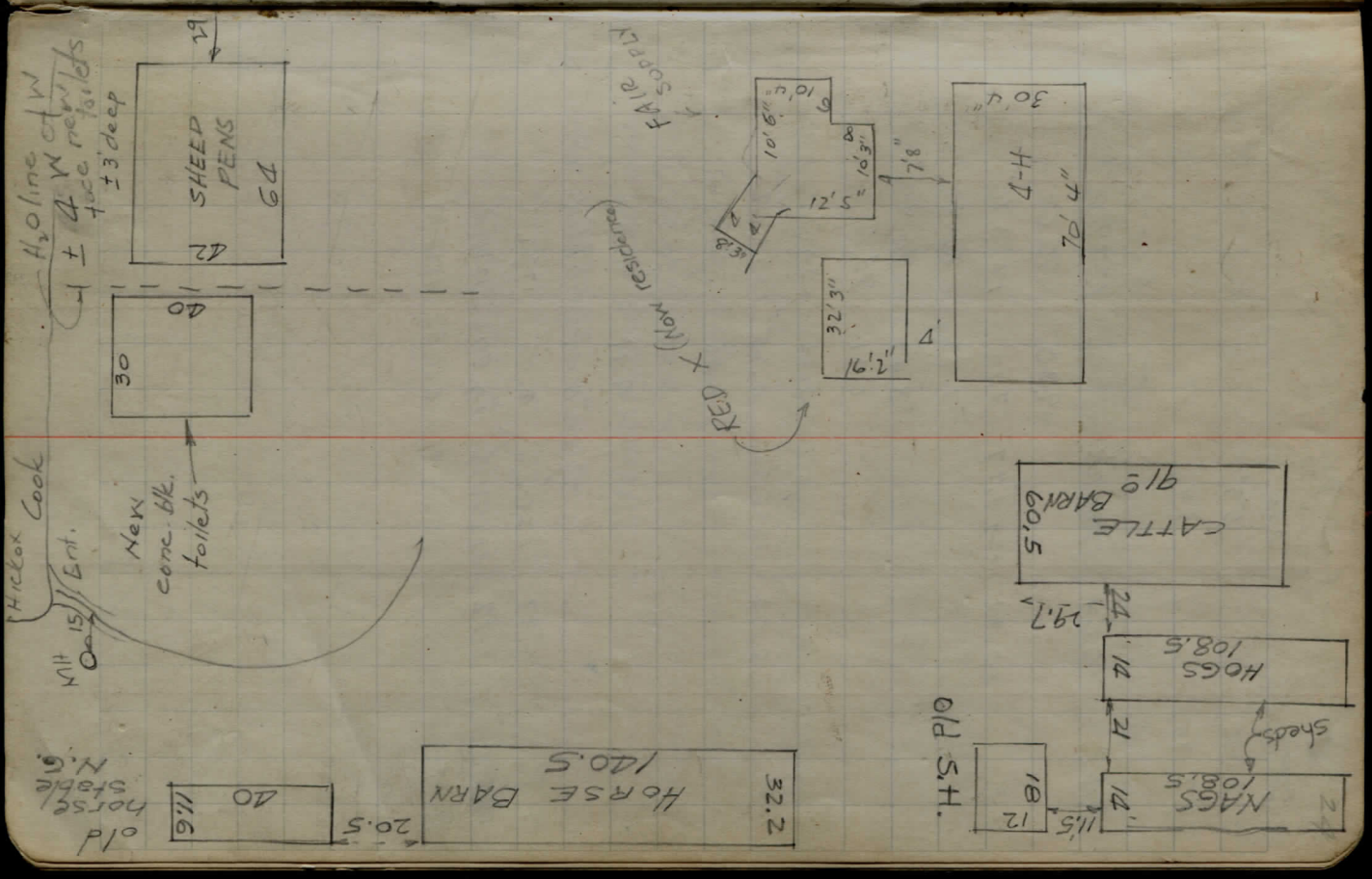
Levels on culvert at Sta 8+30

℄ Road	4.2
Flow R	10.0
50' Rt	11.4
Flow L	9.9
50' Lt	9.3

10.0
4.2
5.8
2.9
10
18.7

15" pipe required 38 long


FRUIT HALL
32
60.3
45
SHED
12
32.5
GRANGE
60.5
MERCH ANTS HALL
24
89
17.3
16
CONSER VATION
24
89
80.5
FLOWER HALL
48.3
29.6
24.5
22
20
26.6
MAPLE PRODUCTS
22
24.5
19
GRANGE
36.6
65.2
CULINARY
POULTRY
50
24.2
17.5
12
62
4H Barn
51.7
Living
Quart
Girls
24
24.3
Briggs
25
30.2
4H RABBITS
12.2
25
20.3
DOMESTIC ARTS
19.7
10.5
POP STD. NO
G.E.S. LUNCH STD
14.2
20.5
LUNCH ROOM
GRD STD
TICKETS
6.2 x 6.2
GRD STD
ENT
SHEEP
OFFICE
19.5
33.2
10.3


SHEEP PENS
42
29
H2O line with 4 ± 4 W ctrl's
4 ± new toilets
±3' deep
30
40
Hitch Cook
Ent.
New conc. blk. toilets
HWY
15
(residential)
(NOW)
FED
FAIR BOARD
10'6" = 3.01
6
8
12'5" = 10'3"
7'8"
32'3"
16'2"
4'
4-H
30'4"
70'4"
CATTLE BARN
90
50.9
29.7
24
HOGS
10'8.5
14
21
shades
HOGS
10'8.5
14
11.5
12
18
P.I.S.H.
Old
horse stable
N.G.
40
11.6
20.5
HORSE BARN
40.5
32.2

Cont from Book 76 Page 70½

Set on D Loot at B

Sta

318-45		53' ✓		
337-35		34'		
	+	H.I.	−	Elv
B.M.	6.64	1285.86 ✓		1279.22
			9.30	76.6
T.P.	10.51	1294.27 ✓	2.10	1283.76 ✓
			7.43	86.8
			3.43	90.8
			0.91	93.1
			5.35	88.9
T.P.	2.04	1295.66 ✓	0.65	1293.62 ✓
			1.50	94.2
			5.20	90.5
			4.11	91.5
			6.19	89.5
T.P.	0.98	1290.64 ✓	6.00	1289.66 ✓
T.P.	1.12	1281.26 ✓	10.50	1280.14 ✓
B.M.			6.05	1275.21 ✓

NW & Culinary Bldg

SW " "

Spk NW & Cattle Barn

NW & Horse Barn

NE & 4H Hall

SE & Rabbit

NE & New Toilet

M.H. Cover E. End Cook St.

℄ Cook St. Hi Point Pavement opposite E. End Sheep

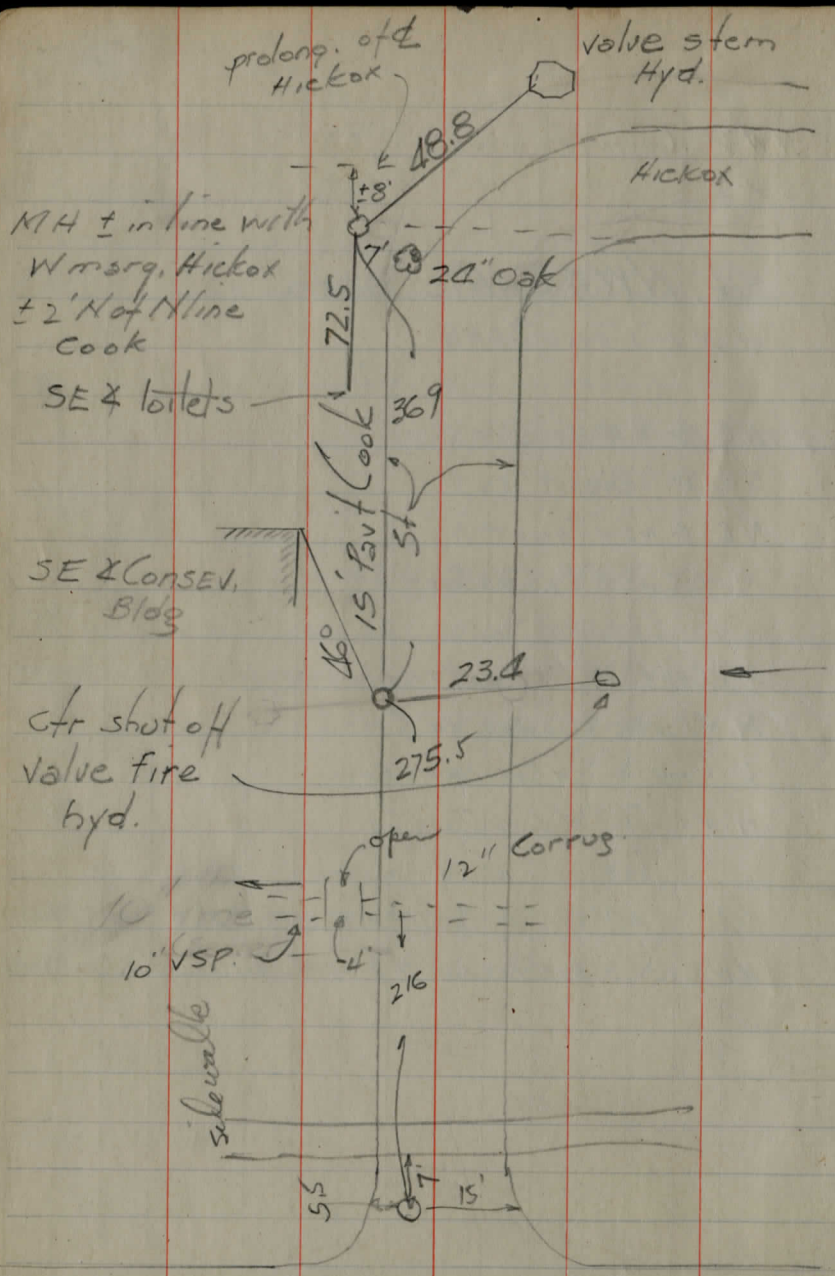
M.H. Cover Midway on Cook St.

℄ Cook St W. End Fruit Hall

M.H. Cover W. End Cook St.

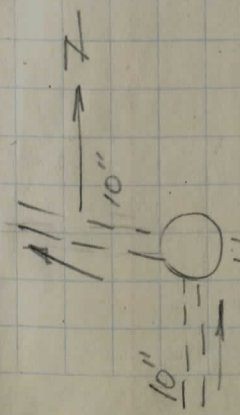
Old C&E R-O-W Entrance ± 15 E of E Edge N. Chosire

NW Bolt Fire Hydrant W. Side N. Chosire ± 25' S. Corp Line.



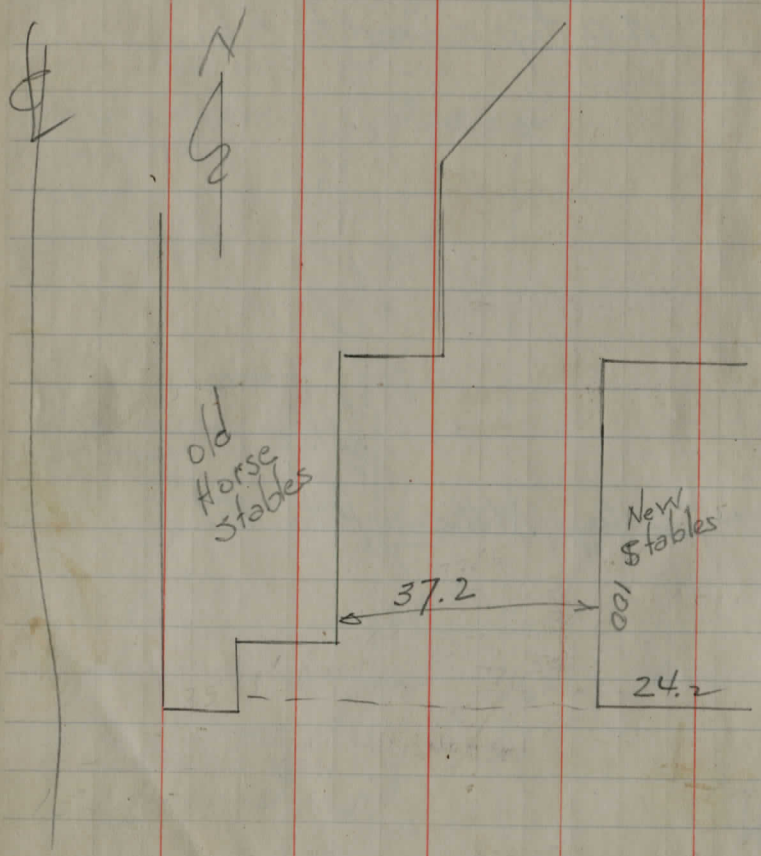
4.0 top cover to F.L.

7.0 top MH cover to FL

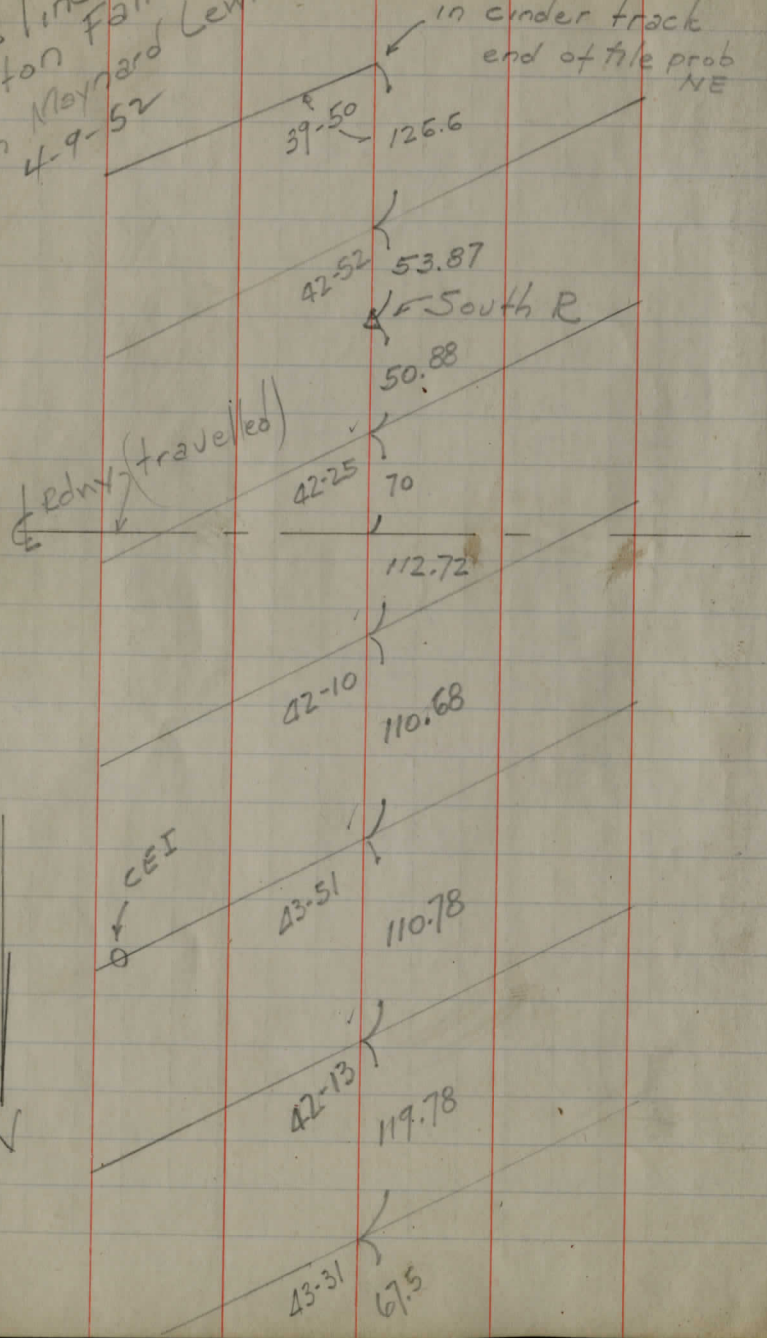


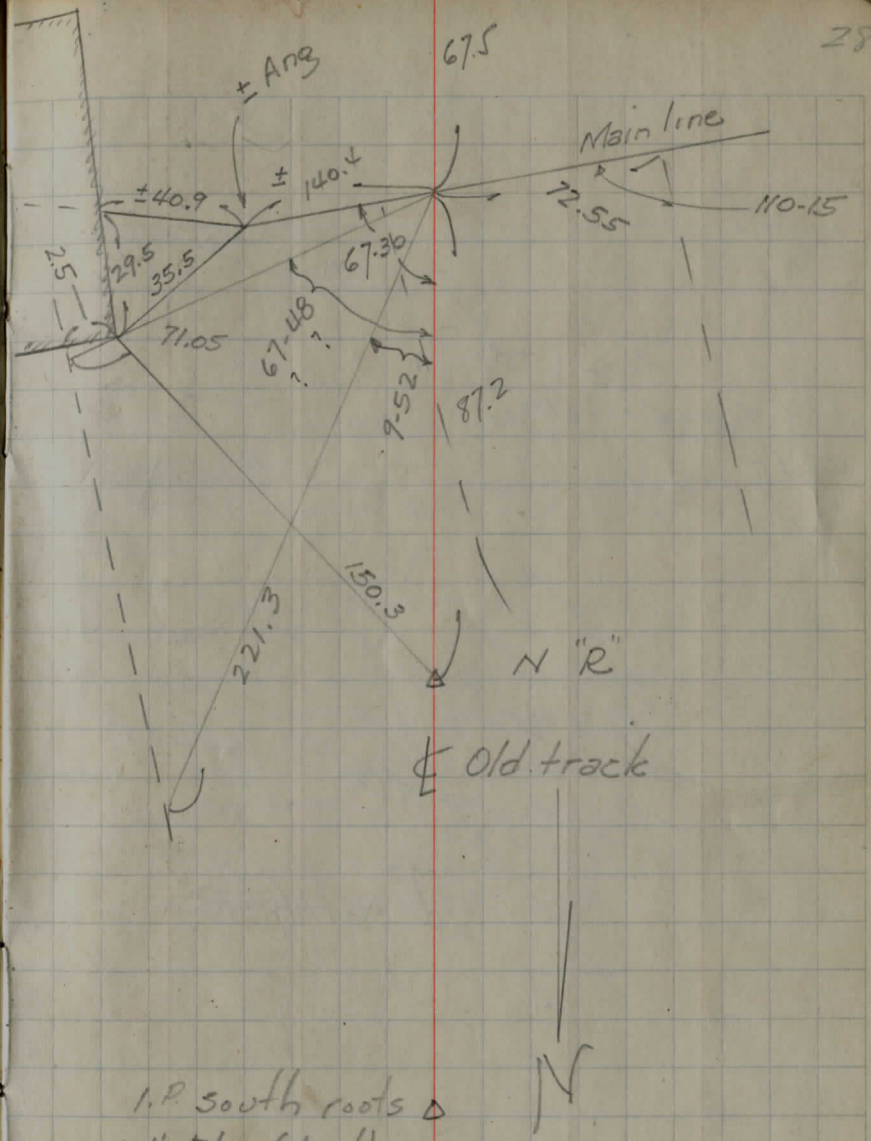
7.1 top cover to FL

FAIR GDS Contd

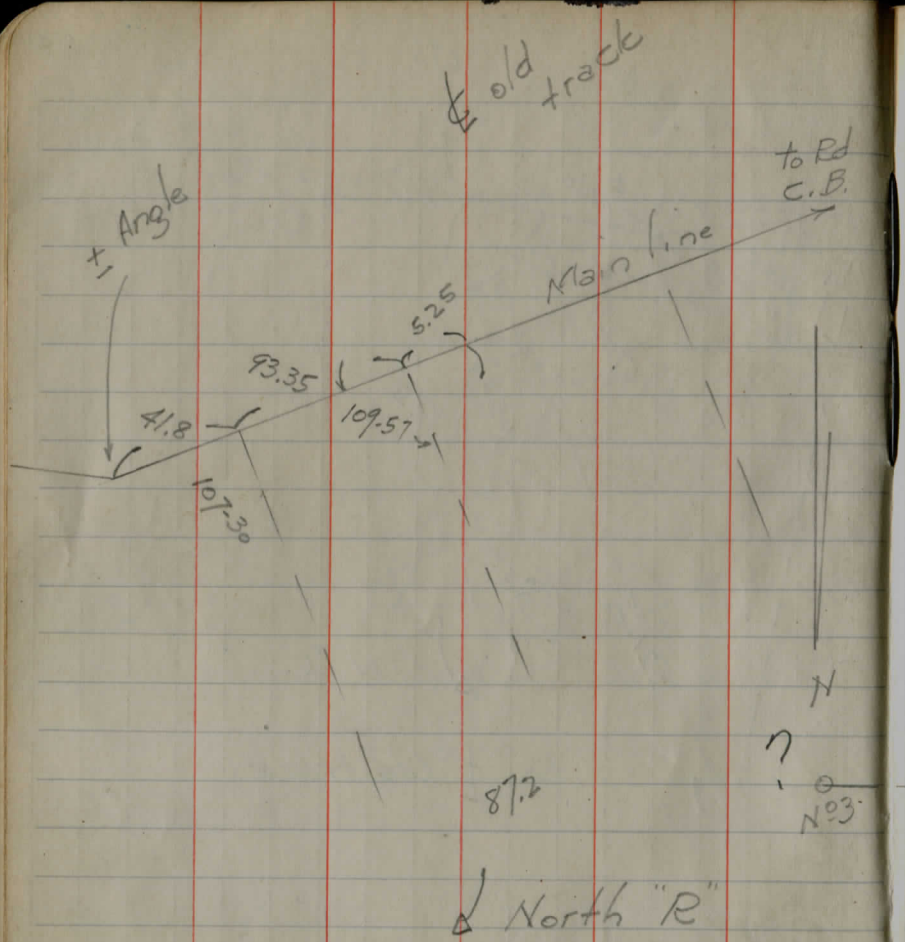


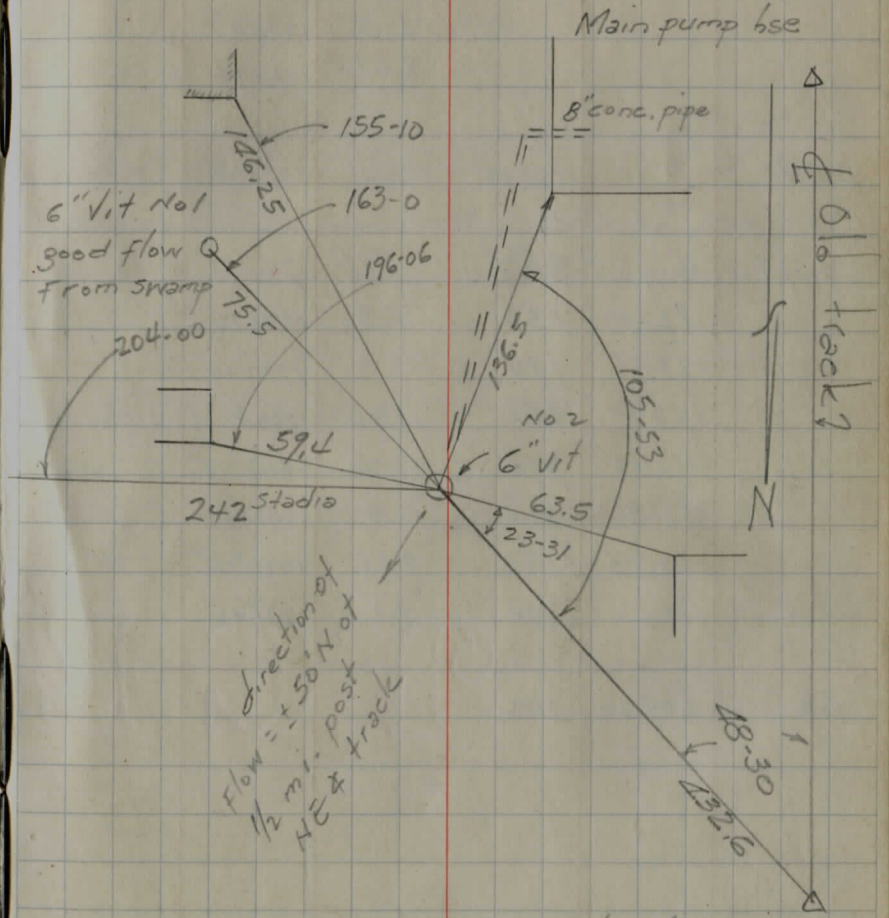
Tile lines
Burton Fair Gds.
Pom Maynard Lewis
4-9-52





1. P. South roots △
10" Elm (dead)
Spk on line 6' up
both fd


℄ old track
to Rd C.B.
Angle
+1
Main line
5.25
93.35
109.57
41.8
107.30
87.2
North "R"
N
?
No 3


Main pump bse
8" conc. pipe
℄ old track
155-10
146.25
163-0
6" V.t No 1
good flow
from swamp
196.06
75.5
204.00
136.5
105-53
No 2
6" Vit
59.L
242 Stadia
63.5
23-31
48-30
232.6
direction of
flow = ± 50° N of
1/2 mi. post
NE℄ track
North "R"

				Elev	
B.M.	3.78	1276.91		1273.13	
			6.73	1270.58	
Set over #2		B S on	north	R	
left	165-18	148'	6.3	1270.6	
"	126-47	132'	3.9	1273.0	
			5.0	1271.9	
			8.07	1268.84	
BM	7.43	1280.56		1273.13	
Set on #3 B.S. ±					
left	Long	Stad	Rod		
	96-00	132'	9.8	1270.76	1
	123-15	175'	9.8	1270.76	2
	145-00	258	11.16	1269.4	3
	142-10	310	11.65	1268.91	4
	155-30	210	11.4	1269.16	5
	163-30	185	9.85	1270.71	6
	182-16	154'	9.1	1271.46	7
tank	204-00	242.			

Spk N root 16" Elm
F/c 6" Tile ±1

± lowest point swamp
roadway
ground at 6" pipe ± 2
F/c " " "

Spk N root 16" Elm

See P 34

Junction Ditch N and W
Good fall to SE.
N.E.D. dug ch. ground ± 2.5 higher all around
Trapped H_2O

FAIRGDS DRAINAGE

S. S. SV
S. M.
J. M.
F. C. P.

Set on south "R" existg track
BS on I.P 400' S on continuation of track

℄ ± 10" VSP THRU INFIELD NEW TRACK

L's all to ℄	Stadia	deduct 1½' per 100'			
26-13	86'				
74-40	100'			Bayless	NG
112-04	237	∄ 6" ø	10" VSP	"	"
346-25-30	138'	Probable	stoppage	"	"
330-18	221'	INSIDE	TRAIN	"	" ?
324-43	275	OUTSIDE	TRACK	"	" ?

Set on I.P at Send W fang inside fence new track BS NEly on I.P 79.84 (A) Nof "R"

323-57	15½'	∄ 6" & 10"	VSP	"	"
156-29	106½'	6" VSP			
154-56	138'	6" VSP			
153-16	178	L. H. IN	6" VSP	} ± OK 5-10-52	
150-06	313	NEX CONC	Pump House		

6/10/31 Goodrich Merritt Barton

Profile Levels CH No 45

B.M. 1	2.94	1141.53		1138.59
Water Level.			10.10	1131.43
	11.61	1152.76	0.68	1140.85
	2.44	1154.70	0.20	1152.26
B.M.# 2			4.20	1150.50
	5.61	1150.03	10.28	1149.42
Culvert	Sta. 7+72		5.6	1144.4
	2.66	1142.93	9.76	1140.27
BM#3			3.95	1138.98
Culvert	Sta 10+45		4.10	
	3.25	1138.19	7.99	1134.94
Culvert Cont. to Right				
"3	4.19	1143.17		1138.98
Culvert	14+45			
	4.06	1142.45	4.78	1138.39
Cont to Left				
BM#3	4.33	1143.31		1138.98
	6.66	1145.93	4.04	1139.27
BM#4	5.70	1150.38	1.25	1144.68
22+75			4.9	
	7.22	1156.65	0.95	1149.43
BM#5			3.25	1153.40
	7.84	1159.52	4.97	1151.68
30+20			7.0	

X on S side E Abutment

Spike in W root 14" Maple 35' Rt. & Sta. 6+40

13.5/100 10.6/50 7.5/Fl. 7.4/Fl. 6.9/50

Spike in W root 18" Maple 22' Rt & Sta. 12+95

6.3/Fl. 6.6/50 7.1/100 7.4/200 8.0/300

4.1/400 4.4/500 5.4/600 5.9/700

4.9/300 4.2/200 4.1/100 4.4/50 6.3/Fl.

8.2/1100 7.9/900 7.3/800 6.5/700 5.2/600 4.3/500 3.9/400

11.9 Fl. on Culvert Manfield

Spike in SW Root 24" Maple 30' Rt & 21+30

6.3/60 7.3/Fl. 7.6/Fl. 7.9/50 8.2/100

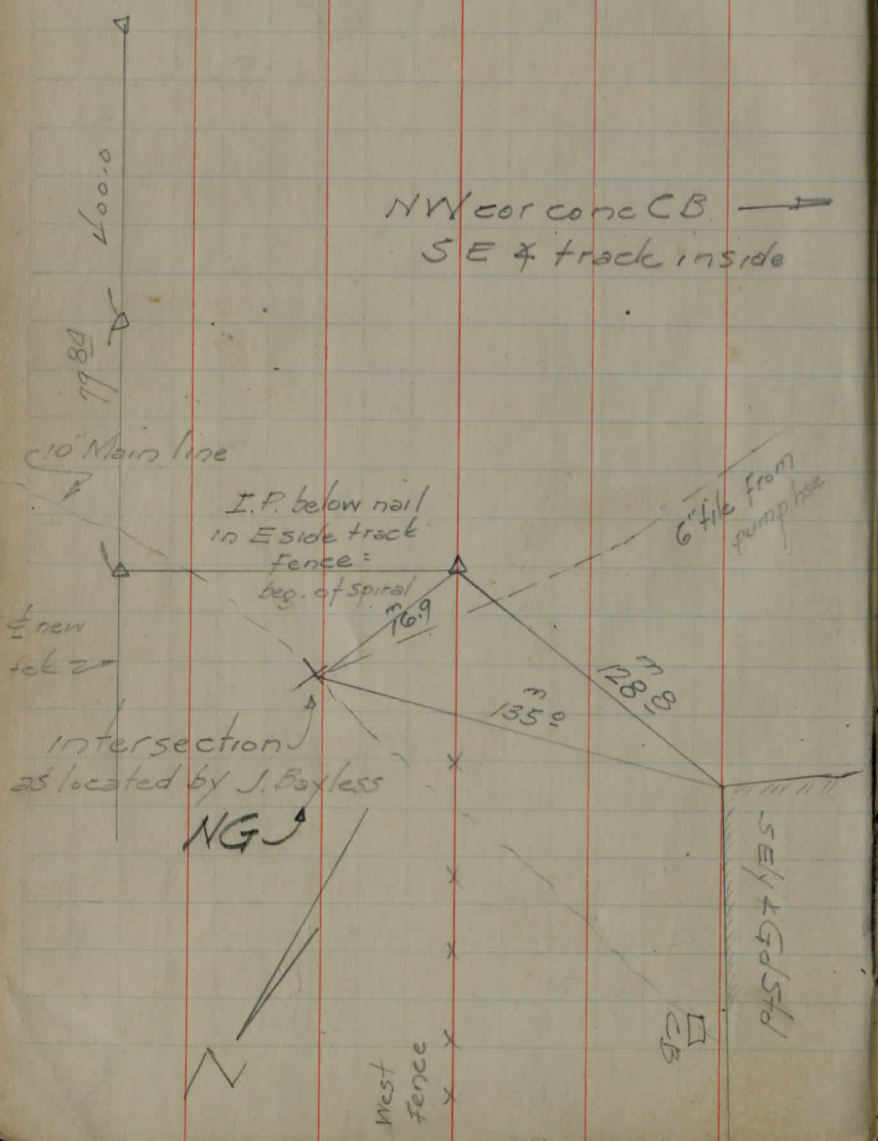
Spike in N Root 20" Elm 22' Lt. & 23+70

12.7/50 11.6/Fl. 11.6/Fl. 10.7/50

		1157.52			
	10.50	1169.12	0.92	1158.60	
BM.			1.90	1167.20	1167.45

Fair Gds from p. 31

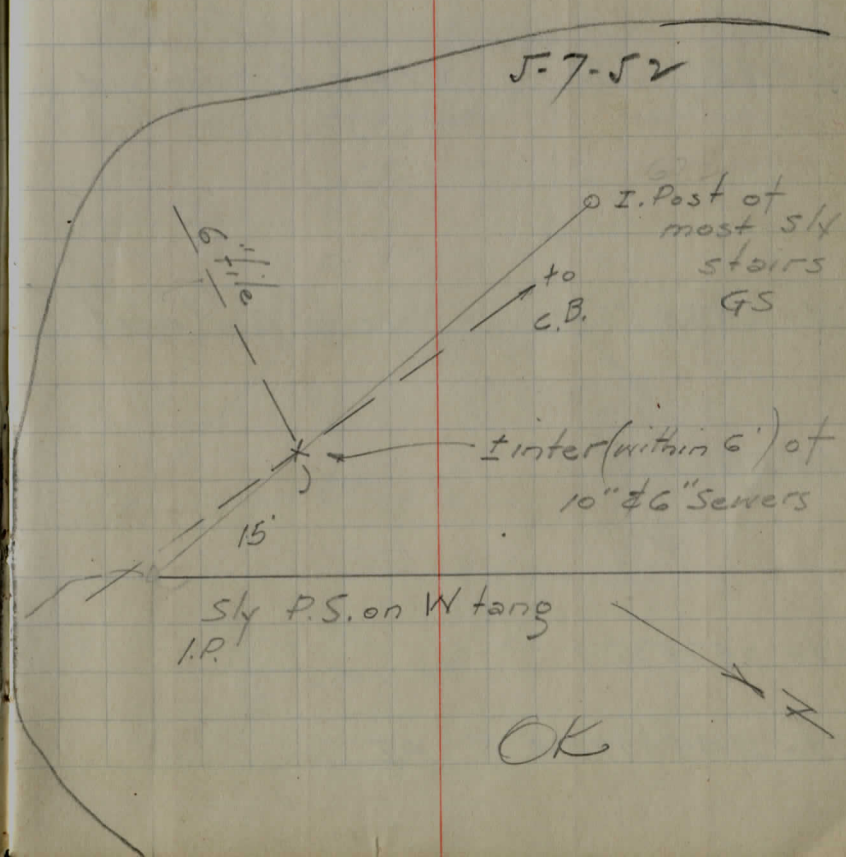
5-5-52



To Locate 10" Sewer

FL at MH			67.2
BM	4.77	1277.90	1273.13
FL at L Hole		9.00	
Grd in Hole #1		11.47	66.4
Top C.B. at Front GS		recorded	73.4
Gd ± over C.B		2.84	75.06
Hole #2		13.2	64.7
T.P.	3.95	1274.18	7.67	1270.23
FL outlet 10" tile			15.27	1258.31

5-7-52



C.H. #8 8/21/31

Wilson Mills Bridge

Sta 257+34.50 PI

Sta 248+75.99

Sta 248+45.99

Sta 248+25.99 = Face E Abutment

Sta 247+85.99 = Face W Abutment

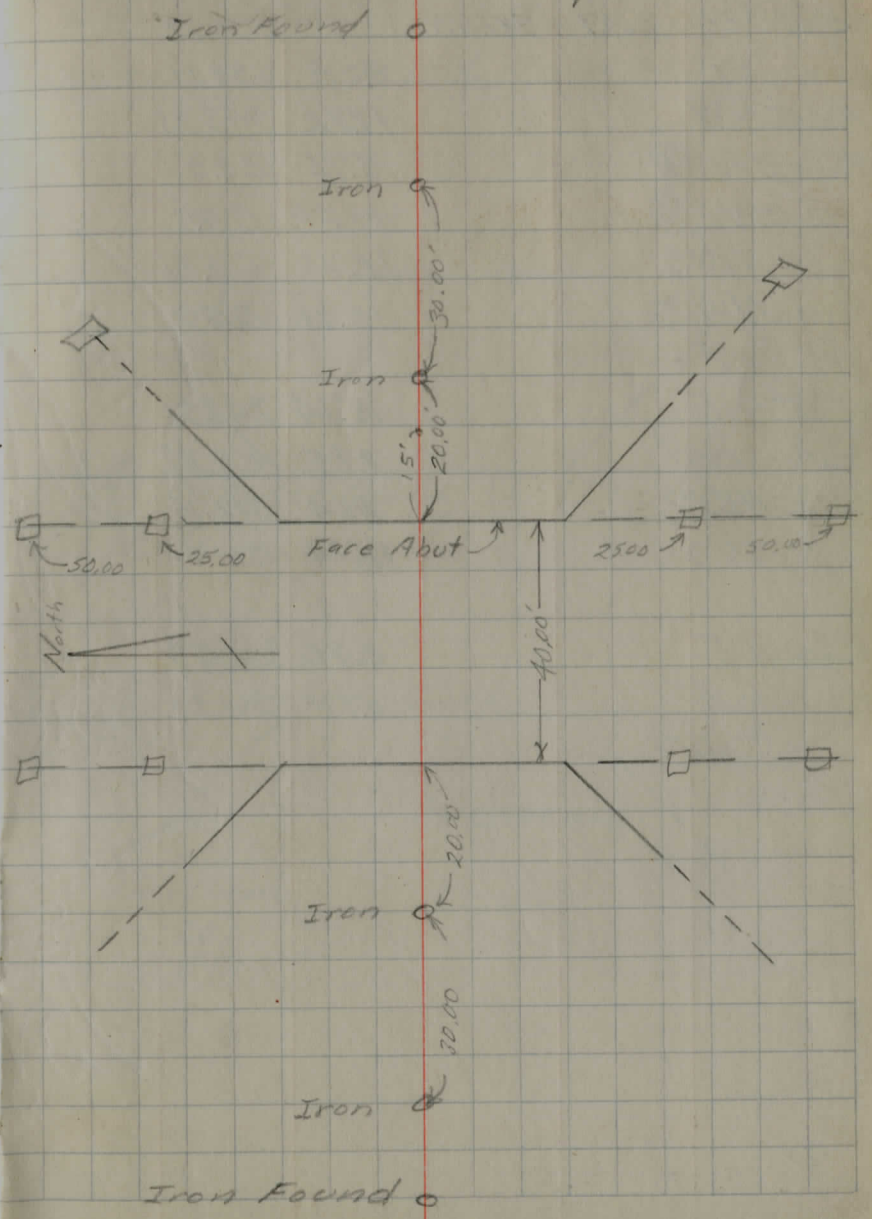
Sta 247+65.99

Sta 247+35.99

35.99
50
85

Sta 245+17.24 PI

Location Chester Twp.

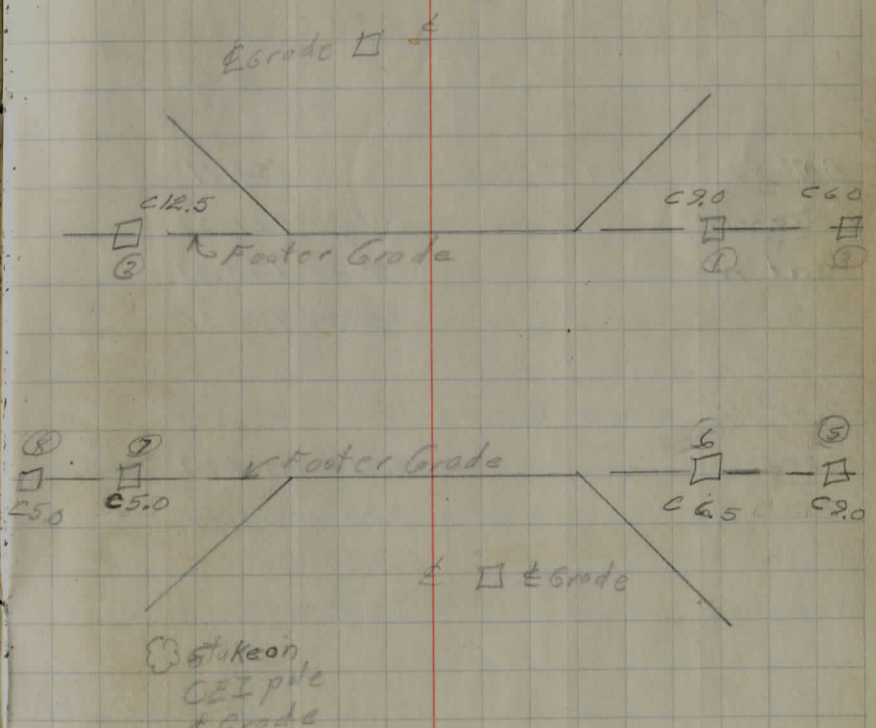


8/25/31

Wilson Mills Bridge Levels

B.M. #33	6.37	96.165		955.28
New B.M. #37			7.54	954.11
Footer W			17.72	943.93
Stake SW ⑤			8.72	C7.0
" SW ⑥			11.22	C6.5
NW ⑦			12.72	C5.0
NW ⑧			12.72	C5.0
Footer E			18.14	943.51
Stake SE ①			9.14	C9.0
NE ②			5.64	C12.5
SE ③			12.14	C6.0
℄ Grade E			0.76	960.89
℄ Grade W			0.34	961.31

Spike in 10" Elm 75' Lt ℄ Sta 247+75



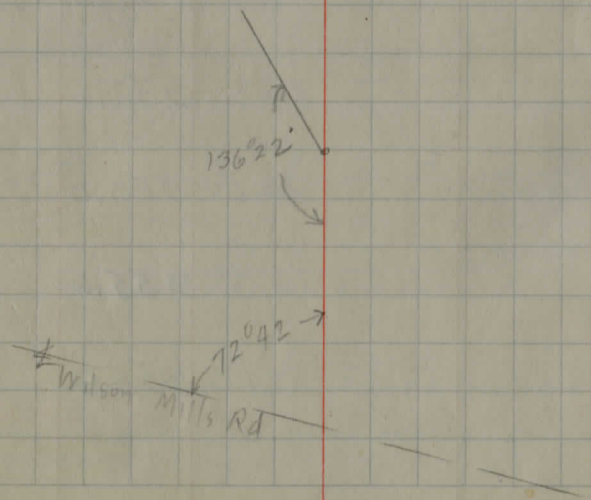
BM#37	7.71	961.82		954.11
Footer E			18.31	943.51
℄ Grade W			0.51	961.31
℄ Grade E			0.93	960.89
Seat E			3.93	957.89
Top curb E			0.31	961.51
BM#37	8.49	962.60		954.11
Seat E			4.71	957.89
℄ Grade W			1.29	961.31
Seat W			4.29	958.31
Spike Set at			12.29	950.31
BM#37	6.565	960.675		954.11
SW ℄ E Foot			12.828	947.847
SW Coping			5.737	954.938
NE ℄ Foot			12.664	948.011
NE Coping			5.507	955.168
SW ℄ Foot			12.390	948.285
SW Cop.			5.180	955.495
NW ℄ Foot			12.378	948.297
NW Cop.			5.286	955.389

Readings on Footers taken .1 one-tenth in from true intersection of Wing - Bluff

taken .5 in from true intersection

Location for Ditch to Southeast from Wilson Mills Bridge

0+62	Def. Lt.	43° 38'
0+00	℄ Road	



Wilson Mills Bridge X Sections

BM #33	2.86	958.14		955.28
0+00			8.9	949.2
+25			9.6	948.5
+50			9.2	948.9
+62			6.5	951.6
+82			6.6	951.5
1+00			6.2	951.9
	9.60	963.07	4.67	953.47
+18			11.6	951.5
+30			10.5	952.6
+50			10.1	953.0
+62			7.5	955.6
+64			7.2	955.9

18/3.7 12/8.9 9/9.8 — 3/9.8 6/10.1 15/13.6 18/8.9 — 25/4.8 21/5.5 (-7.2)

27/2.6 24/4.6 14/5.7 7/9.4 — 4/10.1 12/9.2 22/10.1 25/9.9 26/8.4 29/7.3 35/6.2

27/6.0 14/9.2 7/9.9 — 8/9.0 13/8.1 15/6.8 25/6.6

40/3.7 27/8.1 14/9.7 7/9.5 3/6.4 — 9/6.8 13/6.9 21/7.0 22/6.9

38/5.7 28/8.6 21/9.1 14/9.7 9/8.2 8/6.2 — 6/6.7 11/5.1 18/4.4 23/0.3 34/-4.8

28/9.6
27/8.9 23/7.8 20/6.2 17/6.3 15/5.3 12/8.2 8/6.3 — 7/5.0 16/4.1 21/1.6 27/0.9 37/-3.1

37/1.4 28/11.2 20/10.4 11/10.5 10/12.7 7/12.7 6/11.4 — 5/10.7 9/9.2 15/8.6 23/4.0 30/2.5 35/0.7

35/0.9

30/10.5 — 4/11.4 6/12.1 12/12.5 13/10.3 18/5.6 25/3.7

40/10.6 30/10.0 4/8.9 3/10.0 — 2/11.2 4/11.5 6/10.0 15/10.0 18/8.3 29/2.9 32/1.1

32/10.3 18/8.8 7/8.1 — 2/8.5 8/10.5 15/11.2 17/9.9 26/7.5 —

31/12.8 22/11.8 20/9.4 8/8.1 — 9/9.0 12/8.8 22/8.8 30/8.9

	963.07			
+80		8.8	954.3	
2+00		12.2	950.9	
+39		11.2	951.9	
+50		11.8	951.3	
3+00		11.6	951.5	
4		10.5	952.6	
5		10.4	952.7	
BM 33		7.81	955.26	955.28

40/11.1 26/11.8 20/12.5 13/12.9 7/10.5 6/8.3 9/8.9 15/8.0 20/8.2 31/7.7

32/10.3 25/10.2 21/11.0 8/12.1 2/12.0 3/11.2 7/9.1 9/8.5-7.0 18/6.1 31/3.7 31/4.1

35/8.8 28/10.1 12/10.0 3/11.7 9/11.8 13/12.7 15/12.1 17/10.4 20/9.2 24/2.5

6/21/31

Slope Stakes for Ditch

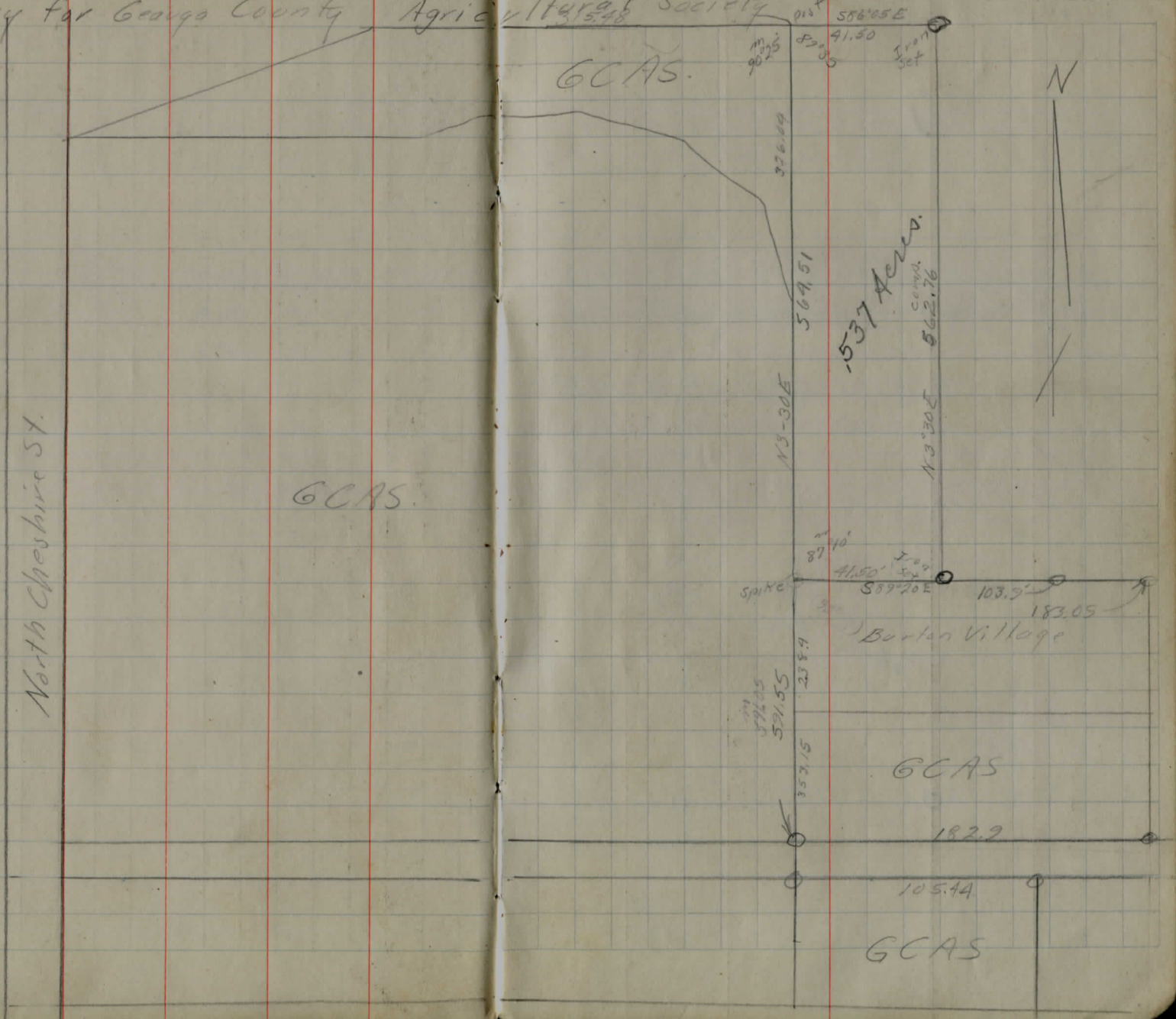
BM #33	2.65	957.93		955.28	
0+50			9.53	946.00	
	933	962.81	4.45	953.48	
1+00			14.31	948.50	
1+50			13.81	949.00	
2+00			13.31	949.50	
2+40			12.92	949.89	
BM 33			7.54	955.27	955.28

C 1.5 / 16.5	13.5	17.5	C 3.4 / 20.5
C 3.7 / 17.5	14.5	25.5	C 9.7 / 28.5
C 4.3 / 21.6	18.6	22.7	C 13.0 / 32.7
C 2.2 / 18.5	15.5	27.2	C 10.1 / 30.2
C 3.3 / 20.0	17.0	13.0	C 2.4 / 16.0

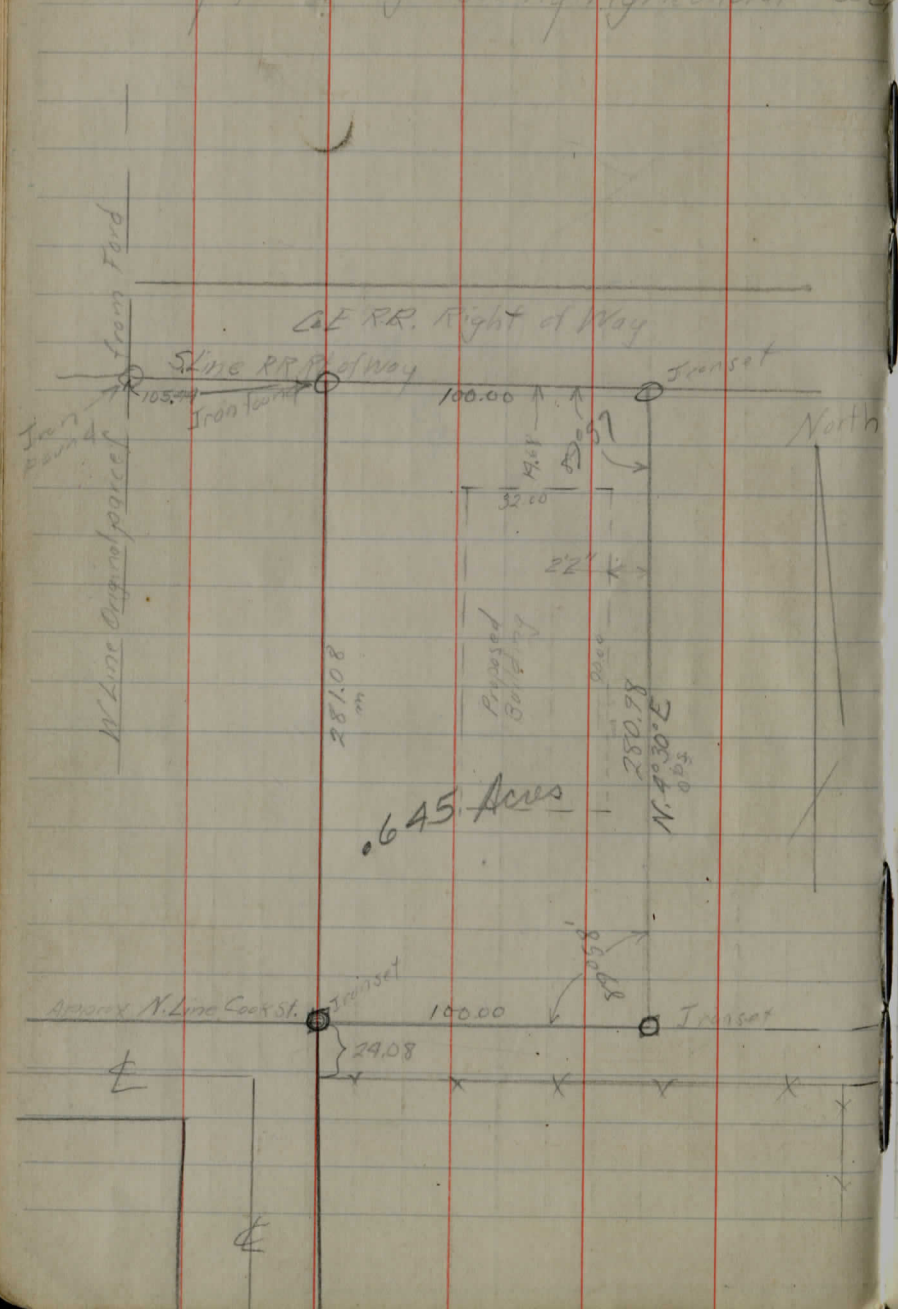
					9/28/31		
BM# 13		11.02	965.13		954.11		
N –	1			4.19	960.94		
	2			4.24	960.89		
	3			4.35	960.78		
S	4			4.20	960.93		
	5			4.13	961.00		
	6			4.03	961.10		
℄ Grade	E			4.24	960.89		5.03
	W			3.82	961.31		4.51
℄ Bridge.				4.61			
				4.72	960.41		
9/29/31 –							
BM# 13		11.02	965.13		954.11		
N	1			4.26	960.87	-07	
	2			4.31	960.82	-07	
	3			4.42	960.71	-07	
S	4			4.20	960.93	+0.0	
	5			4.13	961.00	+0.0	
	6			4.03	961.10	+0.0	
9/30							
BM# 13		11.07	965.18		954.11		
B	4			4.30	960.88	-06	
	5			4.23	960.95	-05	
	6			4.12	961.06	-04	

10/10/31					
BM# 37	11.69	965.80			954.11
NW Curb			3.93	961.87	
SW "			3.89	961.91	
NE "			4.34	961.46	
SE "			4.39	961.41	
℄ East			4.86	960.94	
℄ West			4.46	961.34	
℄ Rdwy Curb N			4.08	961.72	
E. Bridge					
" S			3.99	961.81	
10/12/31					
BM# 37	11.15	965.26		954.11	
NW Curb			3.39	961.87	
SW "			3.35	961.91	
NE "			3.80	961.46	
SE "			3.85	961.41	
℄ East			4.32	960.94	
℄ West			3.92	961.34	
℄ Bridge Curb N			3.54	961.72	
℄ " " S			3.45	961.81	

Survey for Geauga County Agricultural Society

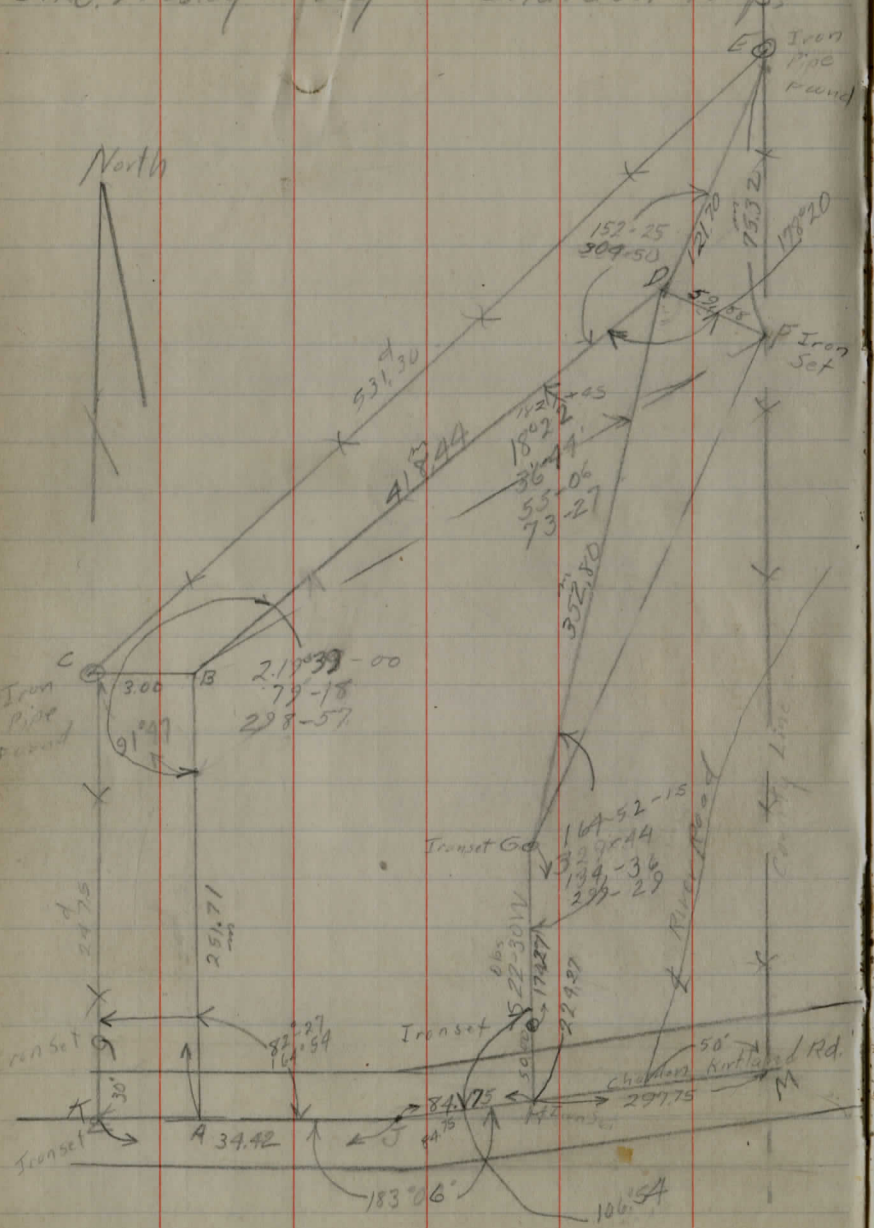


Survey for Orange County Agricultural Society

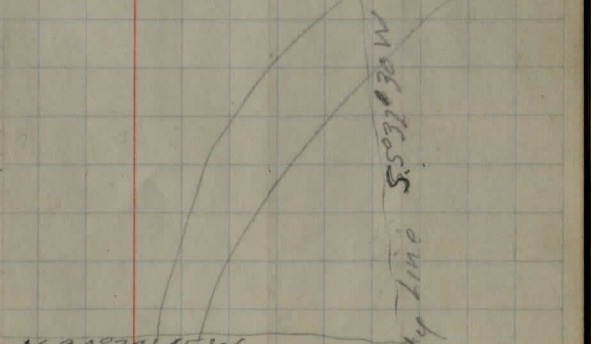


Note: South line of this survey is on the south fence line, as it is now occupied, produced, in an easterly direction. It is also approximately on the north line of Cook St produced.

Chas. Presley Survey Chardon Twp. Lot 155 Tr 3 Presley Goodrich 3-29-1932 46

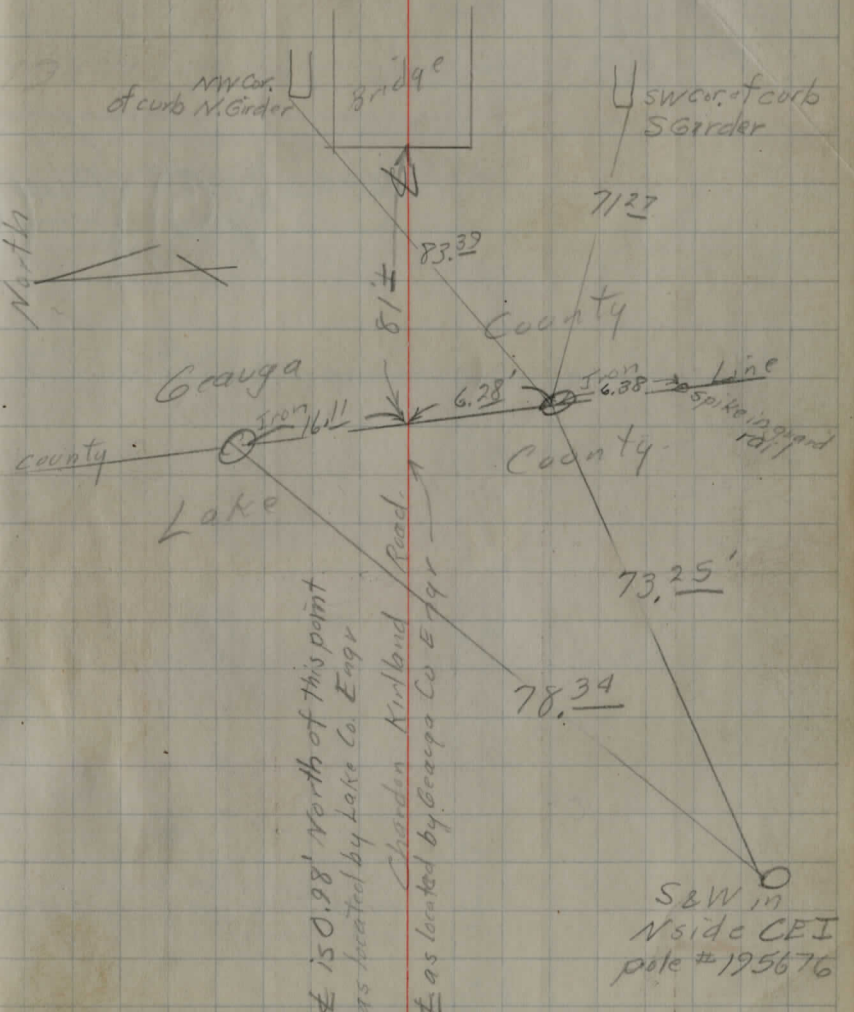


84-22-45
5 32 30
89-55-15



16.11
6.28
.63
23.77

References to Iron Pipe on County Line at intersection with Chardon Kirtland Road.



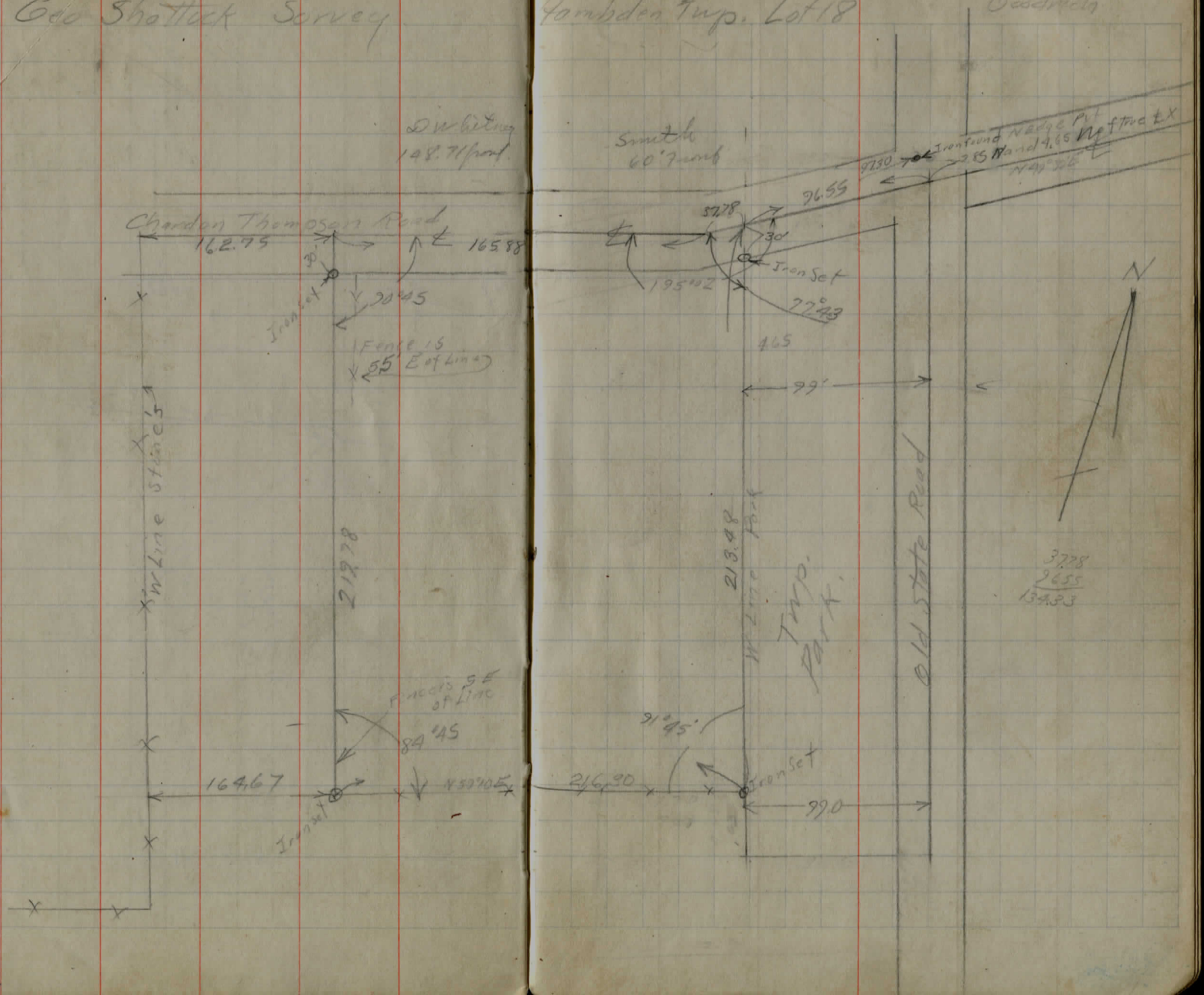
4-1-32

Geo Shattuck Survey

Richey Goodrich

48

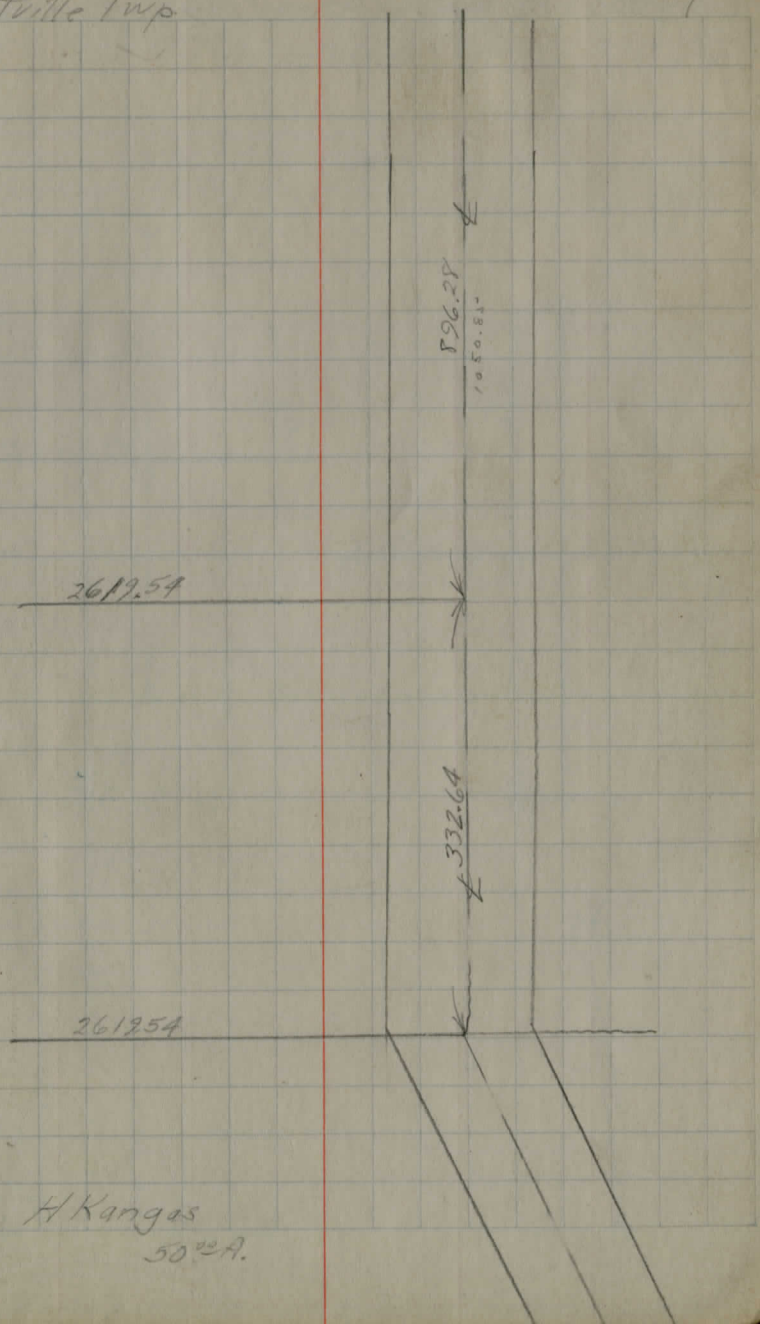
Yarmouth Twp. Lot 18



Gregory Survey

1/28/32 Gadwich Richey 50

Montville Twp



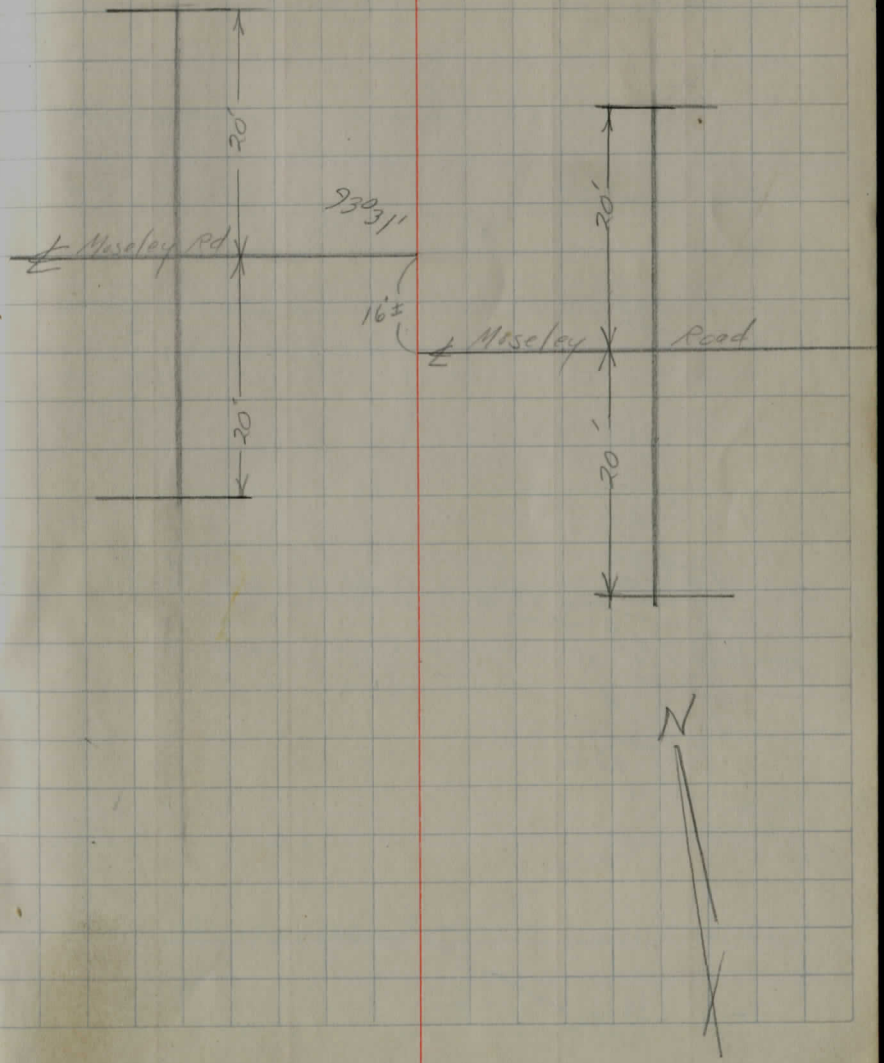
Culverts at intersection of Harden

Richey, Goodrich, 5/6/32

51

(SR525) Madison Road with Moseley Road

Thompson Twp.



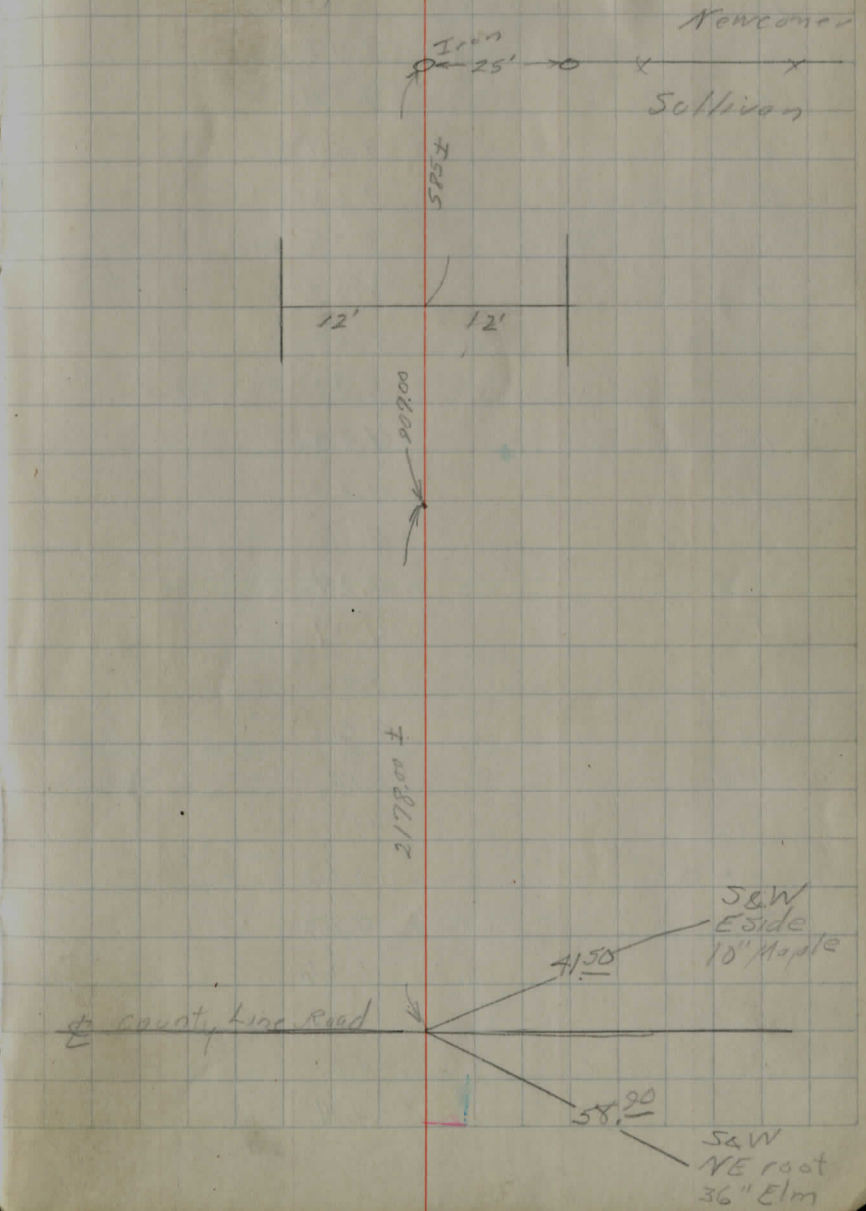
Culvert Location Cedar Road

907

3085
907
2178
4.8
17424
8708
10454 (3.38)
3085
9255
11954
9255
26990
2

5/13/32 Richey Goodrich 52

2500' East of County Line



B.M.		
⓪		3.33
①		3.40
②		3.47
③		3.54
④		3.61
⑤		3.68
⑥		3.75
⑦		3.82
⑧		3.89
⑨		3.96
⑩		4.03
⑪		4.10
⑫		4.17
⑬		4.24
⑭		4.31
⑨'		3.96
⑩'		4.03
⑪'		4.10
⑫'		4.17
Door to S		4.10
		4.17
		4.24
to N		4.16
		4.17
		4.24

	3.01 / L	3.92 / ℄	3.81 / R
	3.88	3.98	3.88
	3.96	4.06	3.96
	3.91	4.01	3.91
	3.98	4.08	3.98
	4.04	4.14 4.16	4.06
	4.10	4.20	4.10
	3.80	3.90	3.80 - 2.80
	3.87	3.97	3.87 - 2.87
3.08	4.08	4.18	4.08 3.08
3.15	4.15	4.25	4.15 3.15
2.94 - 3.94		4.04	3.94 - 2.94
3.01 - 4.01		4.11	4.01 - 3.01
3.08	4.08	4.18	4.08 3.08

FARMINGTON RD 9/13/32

County Highway No. 18 Location
Parkman, Imp.

Sta 8+00 PI Int Rt 1°09' Iron Set

Locate Ctr of Sta 6+86 ±

Sta 1+65.08 POT Iron Set

Sta 0+19.15 PI Sta at Main Track at Imp

Sta 0+00 Beginning of Imp Iron Set

our line 9½' to north of Ctr of track

Richey
Gorton
Pvt Rd

OK

3 x 3.5 Stone Box
Flow Lt

14+57
18 16

G Brown

Prop line 12+65

J Jana

S & W
14" Maple

38 48 C Gorber

Prop line 5+25 ±

F Vosbrough

181.20'

47 ½°

S & W
12" Apple

OK
12" CSP Concrete
Flow Rt

0+90 ±

S 89° E

Main Track

03+22

Prop

Pvt Rd

Sta 20+27.00 POT

Sta 17+35.85 POT

Sta 15+81.70 PI Def Lt 0°32' Iron Set

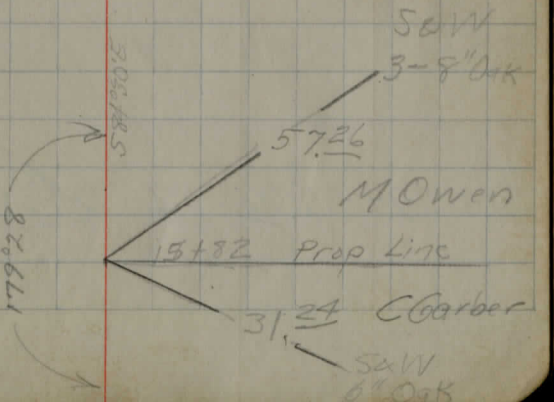
6 Owen

Ot
3x½ Stone box
Flow Lt.

26+00
13 9

Prop line (?)
25+80 ±

M Owen

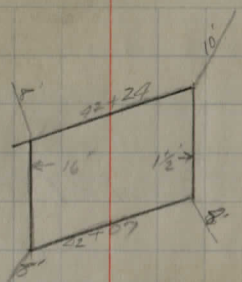


Sta 41 + 77.60 Def. Rt. 1°37' Iron Set

31+65 try to locate prop. Brown Owen

Sta 27+92.96 PI Def Lt 2°25' Iron Set

15° skew
Span 14' Height 4'
17½' Roadway
Conc slab stone
abut and wings
iron rail



X cut in NW ⌀ North
Conc. Headwall

29.88
S 25° 15' E
51.76
S & W
8" Willow

f.a.r
12 Cor. IP
45.93 from Lt Flow Lt

39.70
N 10° E
Owen
Pool line 32+29
Brown

S & W
14" Maple
48.82
S 5° 50' E
31.50
S & W
8" Maple

Sta 65+00 POT Spike Set

Sta 51 +77 74 Def Lt. 1° 22' Iron Set

Maple Hollow Co. E Harper

Roadline 67+50 Z Property
Lot line

F Owen F Owen

Ox.
12" C.I.P.

64+16
9' 9'

Ox.
10" Cor I P
45° Skew

60+67
9' 8'

Skew
15" Hickory

68 00

75 29

Spike Face of
36" Maple

F Owen

Side Road 50+42

5.8% Grade

M Owen

47+76 Creek line

2½ x 2½ Stone
Box OR

41+78
11 19

85 ± 85 Side Road

3 x 2 Stone Box
C.K.

81 + 50
12 12

S & W
15" Maple

39.40

S.76° E.

180°12'

67

S & W
NW root
15" Maple

15" Cor I P
Poor Condition

77 + 78
12 1

S & W
8" Maple

25.40

180°12'

29.38

S & W
8" Maple

81 50
80 14
1 36

Sta 80 + 14 12 Def. Lt. 0°43' Iron Set

proposline Harper Pintner = 7612 comp.

Sta 69+00 Def. Rt 0°12' Iron Set

J Thorpe 59

10369
9686
683

9686
9189
497

Sta 96+86.02 Def Rt 0°32' Iron Set

8545
1731
10331 prop line Dow comp.
747 Thorp.
11078 prop line Maple Ridge
Evans

103+69
Prop line

103+47
Lot line

M.M. Dow

Steel I beam bridge 12'
Span 29
Roadway 14
Lattice rail
E Abut. Conc. Fair
W Abut. Stone OK

102+62
15'
15'
102+36
12'
40'
8'

S&W
NW root
12" Maple

2635

180°32'

2904

S&W
NE root
18" Maple

10" Cor I P
O.K.

21+89
4 15

12" Cor I P
Poor Condition

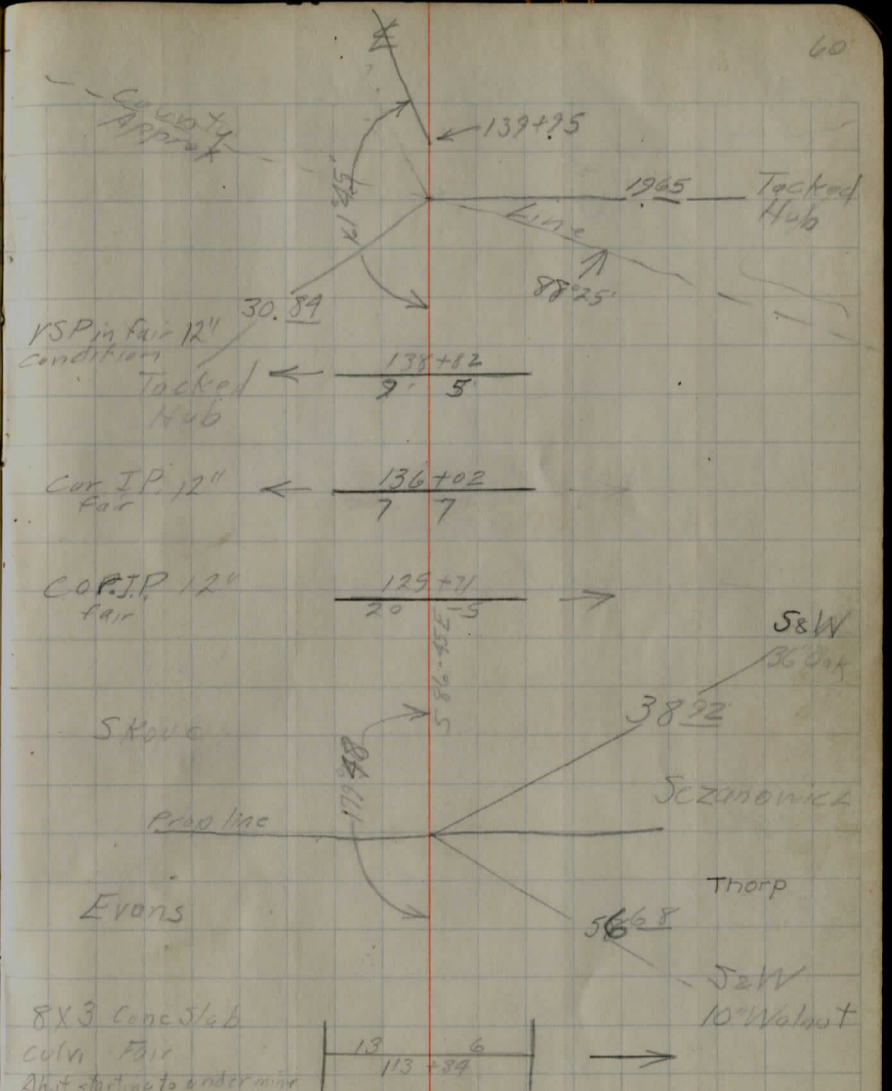
88+29
8 4

Sta 139 +61.20 End of Imp. Iron Set

2.64 miles

5280 | 13961.9
10560
3401.9
37080
31680
23390

Sta 127 +30.32 Def. Lt. 0° 12' Iron Set



TH 157

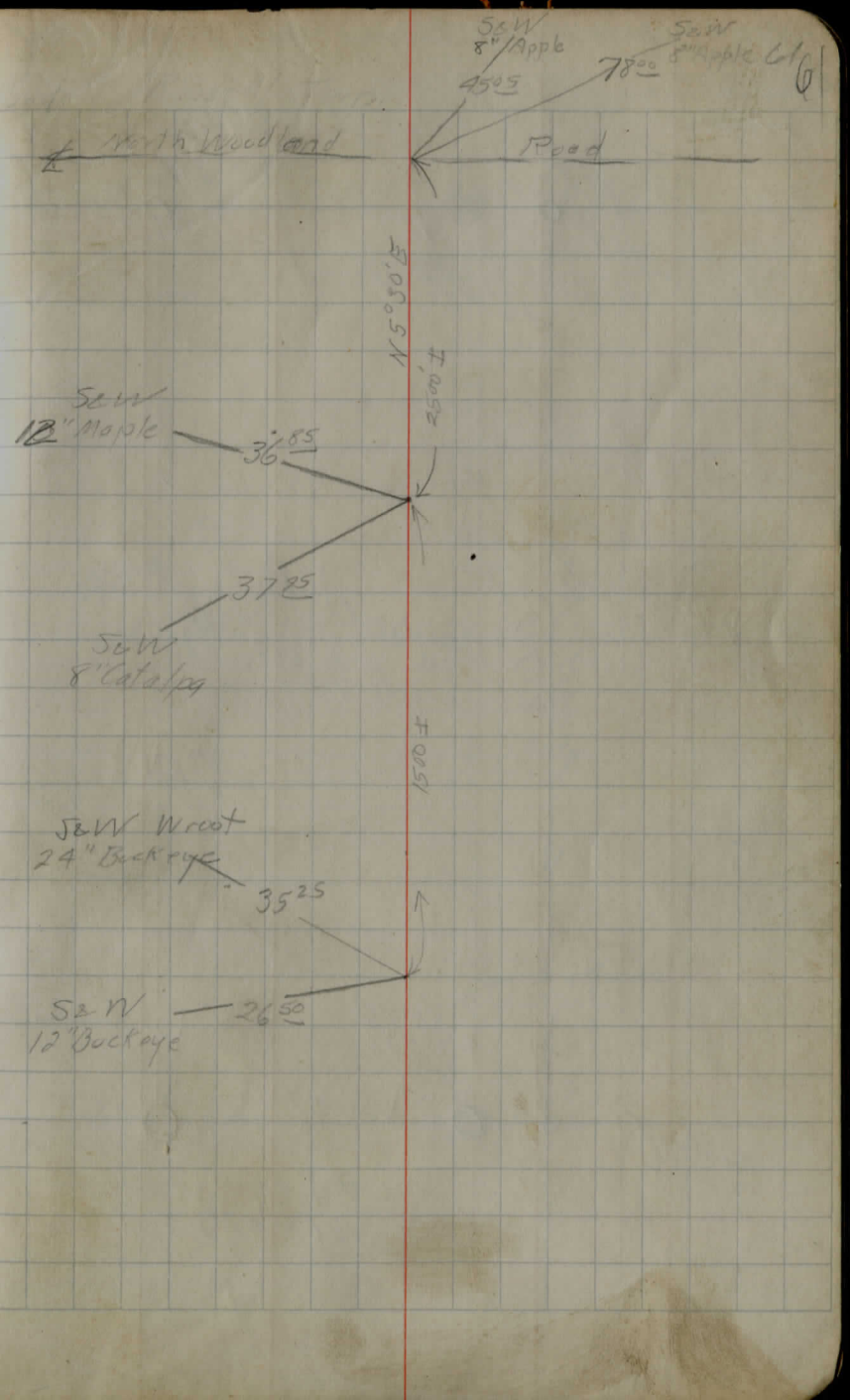
Goodrich Fisher 9/14/32

℄ Location Caves Road Russell Twp

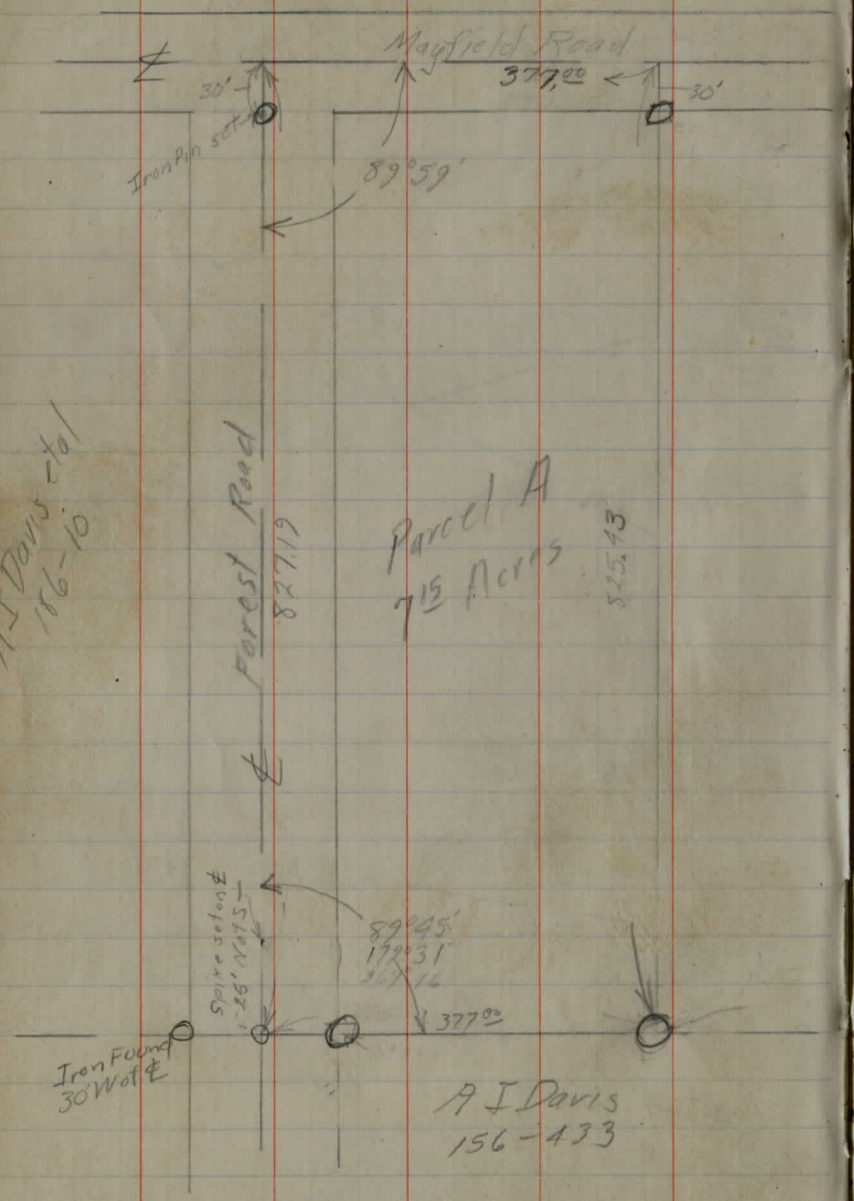
North end of Imp. Spike set in pvt.

POT { in front of Newcomber house 1st on East North of Dines Car Road — Spike set

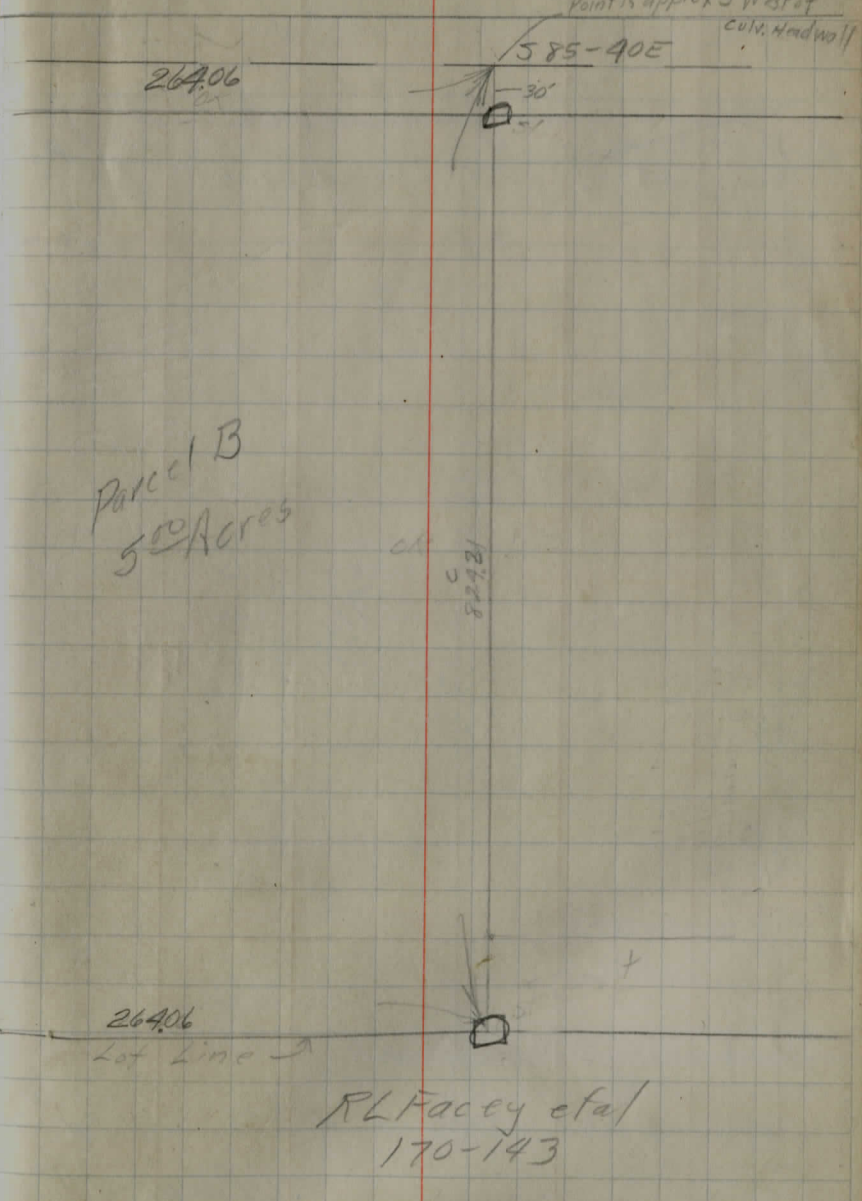
PI in front of Arbuckle House 1st South of Dines Car Rd on West — Spike set

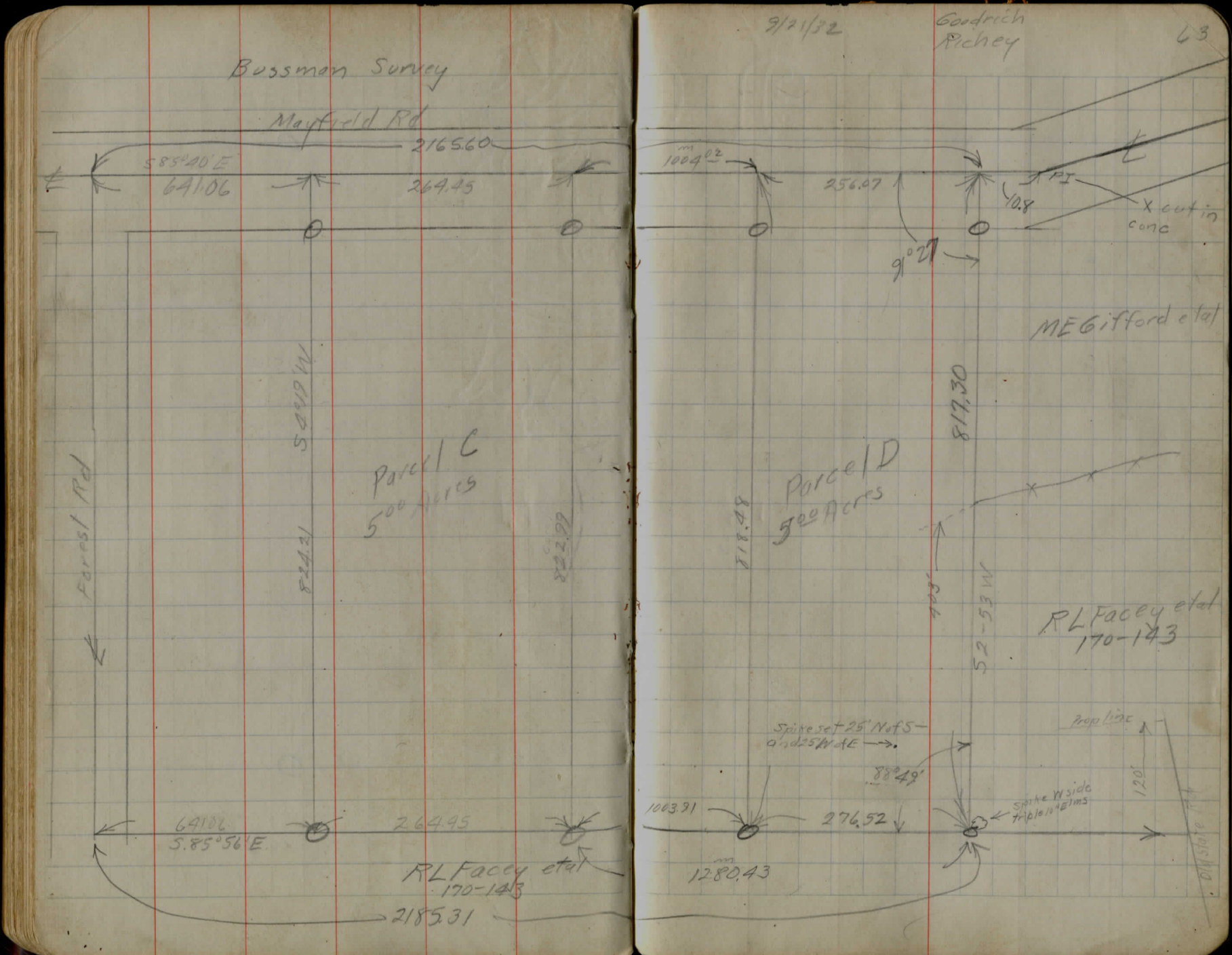


Walter Bozeman Survey Chariton Twp



1/19/32 Goodrich Pichey 62




Bussman Survey
Mayfield Rd
2165.60
S85°40'E
641.06
264.45
Forest Rd
S0°19'W
822.21
822.99
Parcel C
5.00 acres
641.06
S.85°56'E
264.45
RL Facey etal
170-143
2185.31
9/21/32
Godrich
Richey
C3
1004.02
256.07
PI
10.8
X cut in conc
9°27'
ME Gifford etal
817.30
718.48
Parcel D
5.00 Acres
S2-53W
RL Facey etal
170-143
Spike set 25' N of S- and 25' W of E
Top bank
88°49'
120'
1003.91
276.52
Spike W side triple 10" elms
1280.43
Old fence

℄ Location of CH. No 4 from Dunnings Xs North Munson Twp.

POT 30+95.85 S Line Pfander

Spike Set

Sta 27+02 ± PT Rt. 8' Iron Set

Found

Iron Pipe

Sta 0+00

Iron Set in spike hole Found

18" VSP good condition flow Lt 16' long

34 too

N 77 E

S & W 24" Maple

91.68

S & W 29" Maple

74.42

12" CIP good Fl. Lt.

28+76

Sta 23+40 ± culvert needed Flow Lt. 12" required

Sta 20 ± culvert needed Flow Lt. 12" required

Iron Pipe

30.86

30.93

Iron Pipe

8' cor I P Flow Rt in good condition 10' long

S & W in front 15" Maple

47.88

Wilson Mills Rd

9.7

Spike

To Chardon

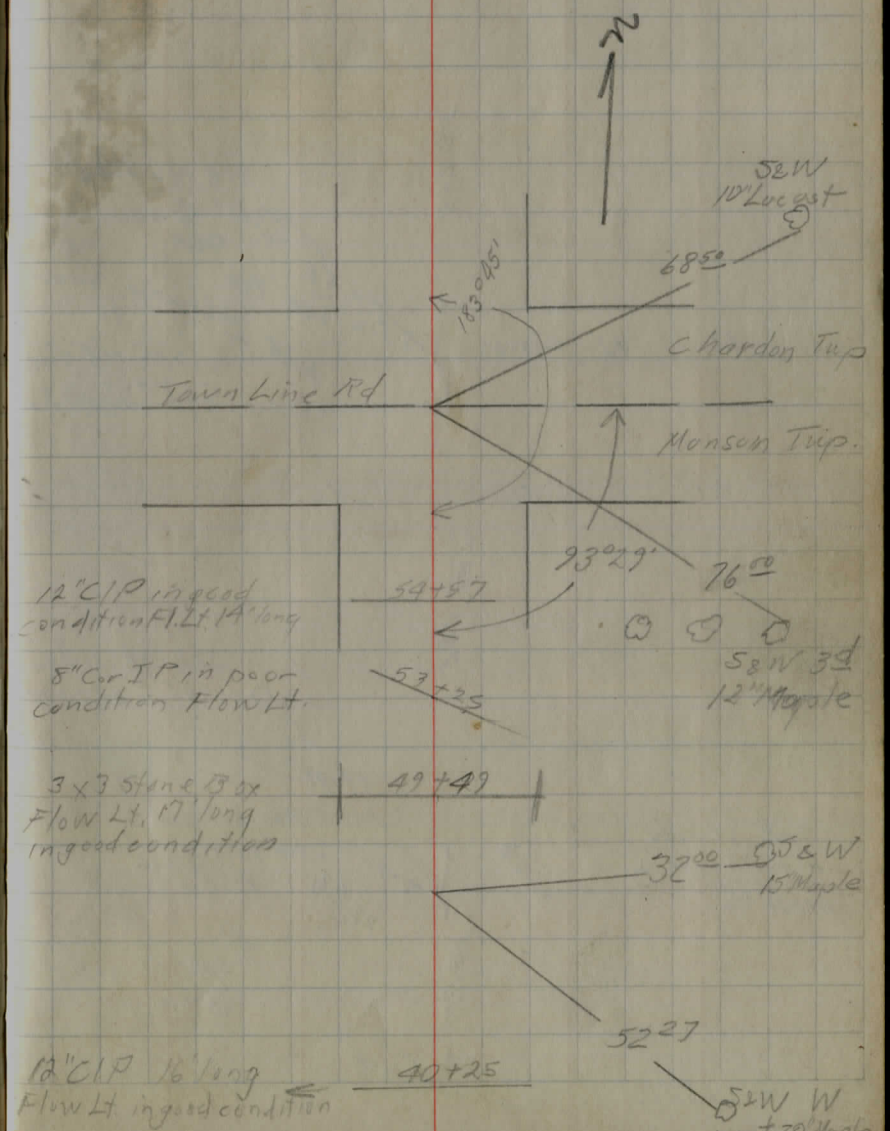
To Munson 4145

1.10 miles

5284 | 58130.0
5280
5330
5280
50.0

58+13.00 End of Imp. ℄ Town Line Rd. Iron found

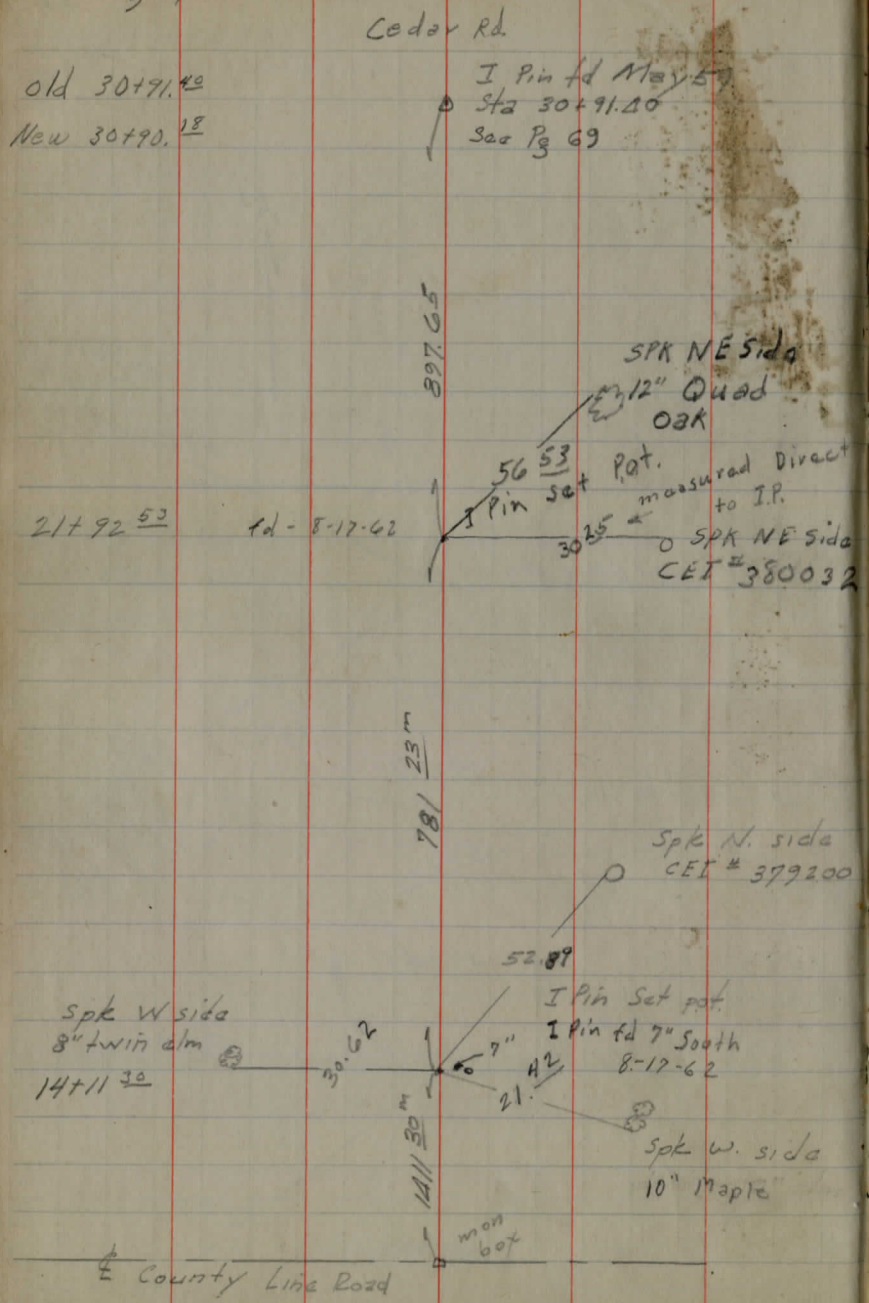
POT 43+60.02 100'± N of fence to West and 1200's of Town Line Iron Set



Pg 67 A

TH #98

Cedar Rd.



Cedar Road Location

Sidestakes are set 30' Right or L.

Sta 22+00 POT 2.13 N

Sta 15+00 POT 1.45 N

See pg 67

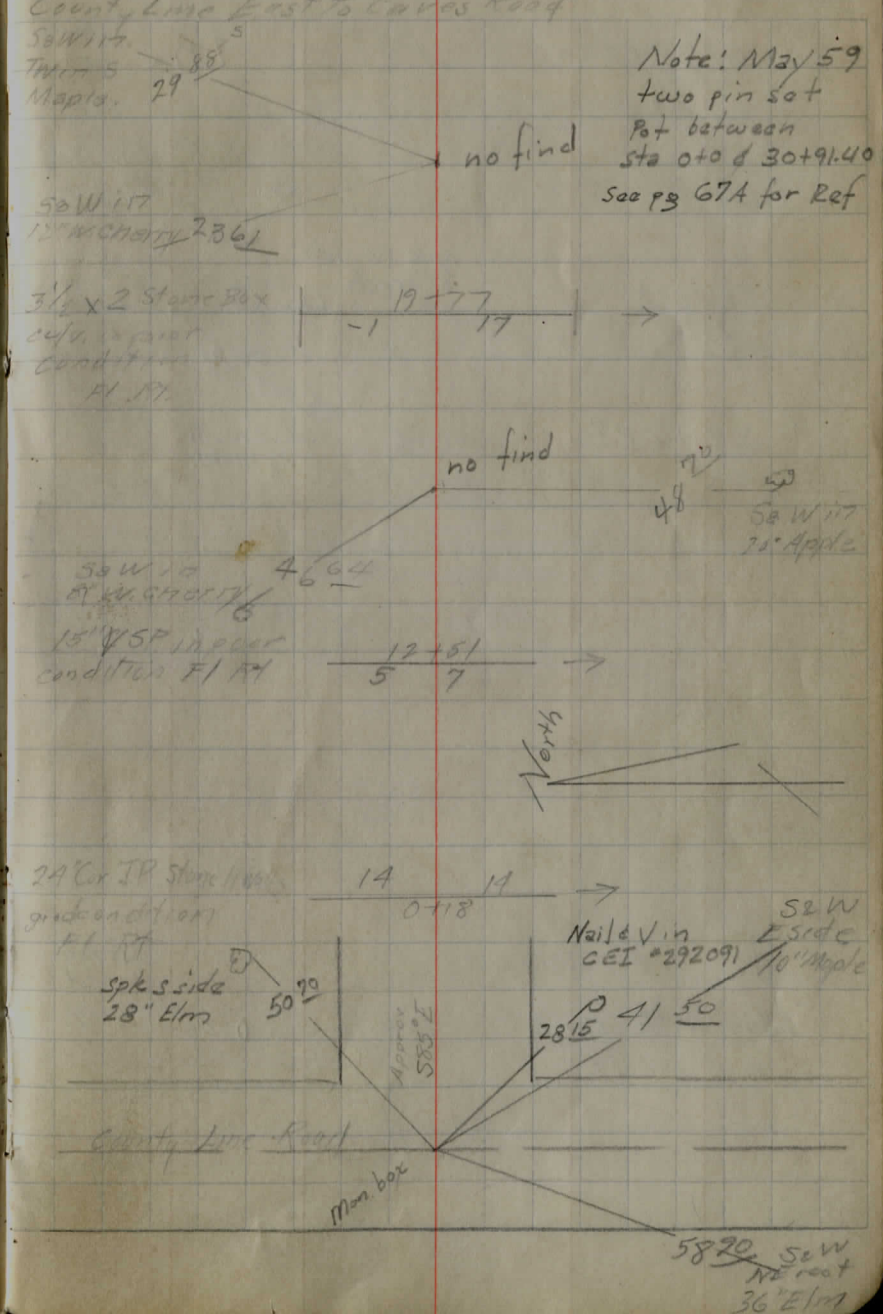
Note:

Sta 0+00 is 7.34 to North and .50 to East of ℄ as located by Zetlmayr

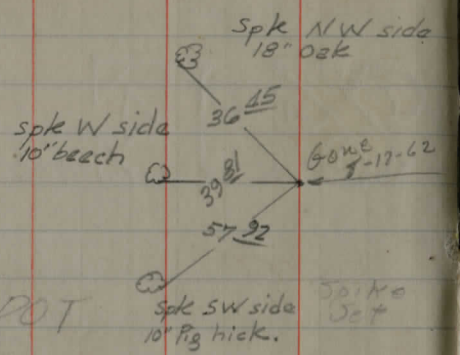
Sta 0+00 ℄ County Line Road Iron Set

Ramey Goodrich Date 1-6-33

County Line East to Cavers Road



Sta. 46+79.25 P.O.T. I Pin ~~SPKe Set~~

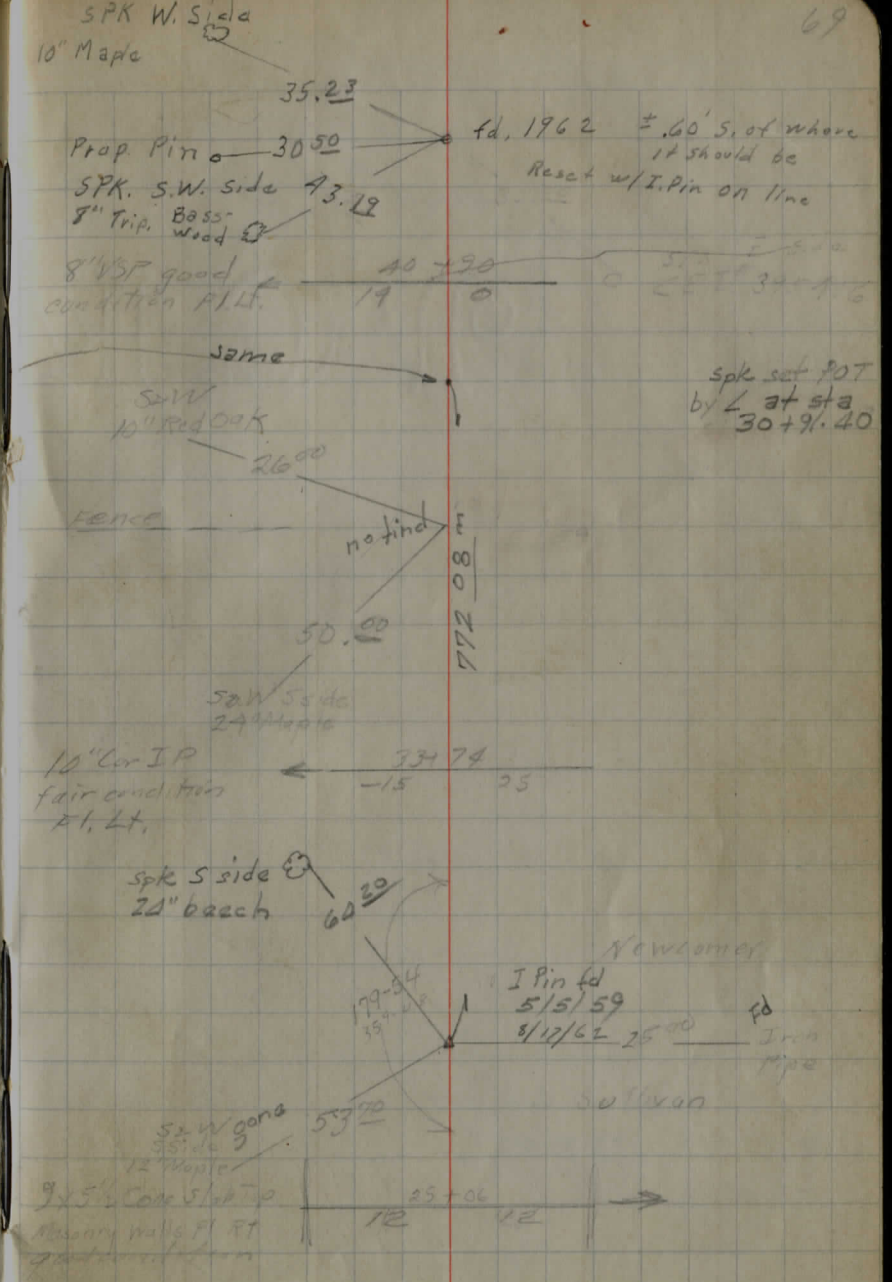


STa 38+63.53

M 41.35

Sta 30+91.40 PI Def Lt 0°06' Iron Pin found

(30+90.15 1962 Def Lt 0°00'20")



Sta 78+81.20 ℄ Caves Road Iron Found

1.97 miles

5280 | 7881.20
5280
2601.2
2112.0
489.20

69+40 3x3" Culvert.

Sta. 62+78.85 P.O.T

Sta. 58+00 P.O.T Spike

12" Trip.

56+33 8" Vit. Tile Fl Left

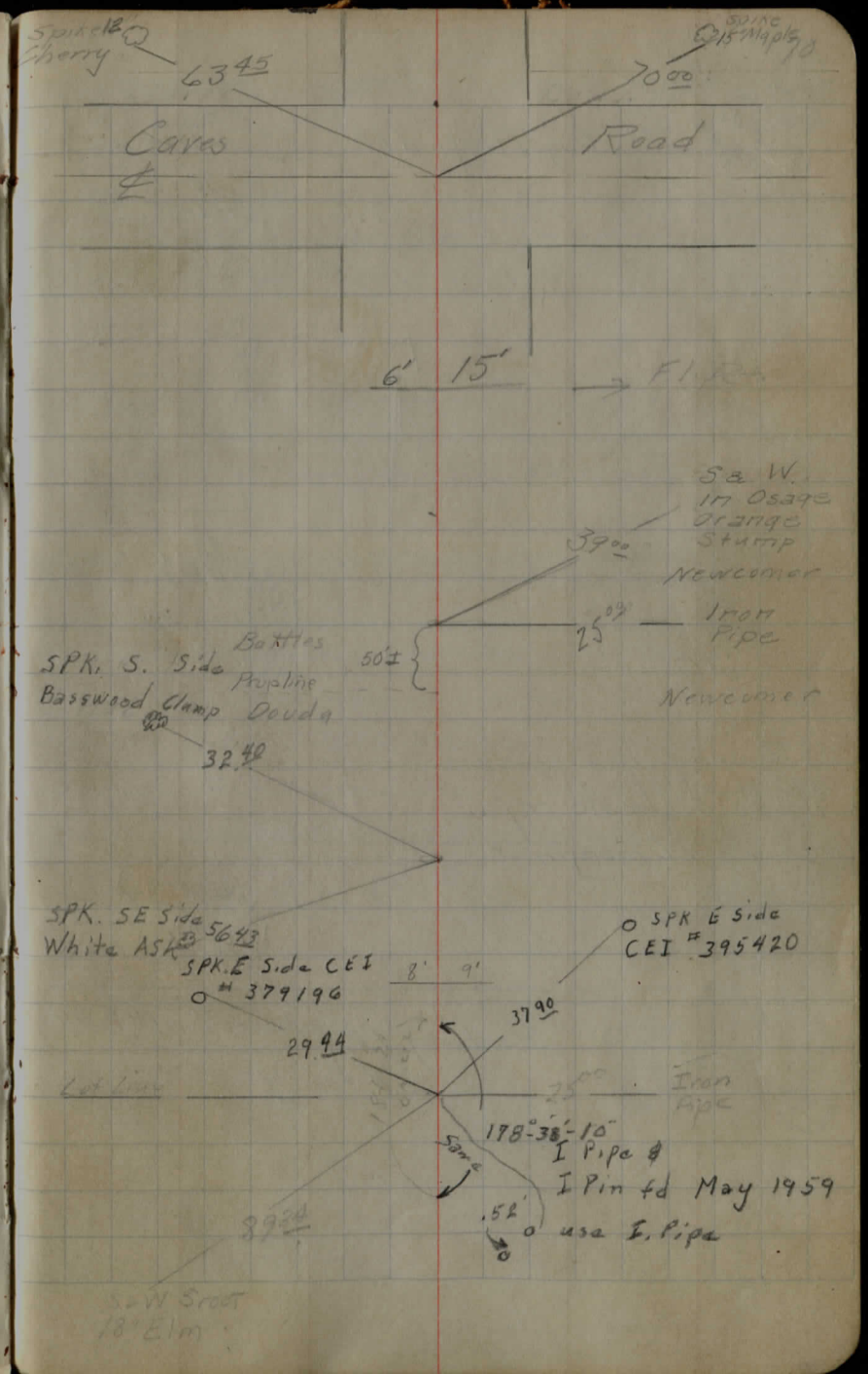
Sta. 52+39.58 Per 1959

~~Sta 52+41.55~~ PT Sta 52+1921' I. Pipe

30 91.4

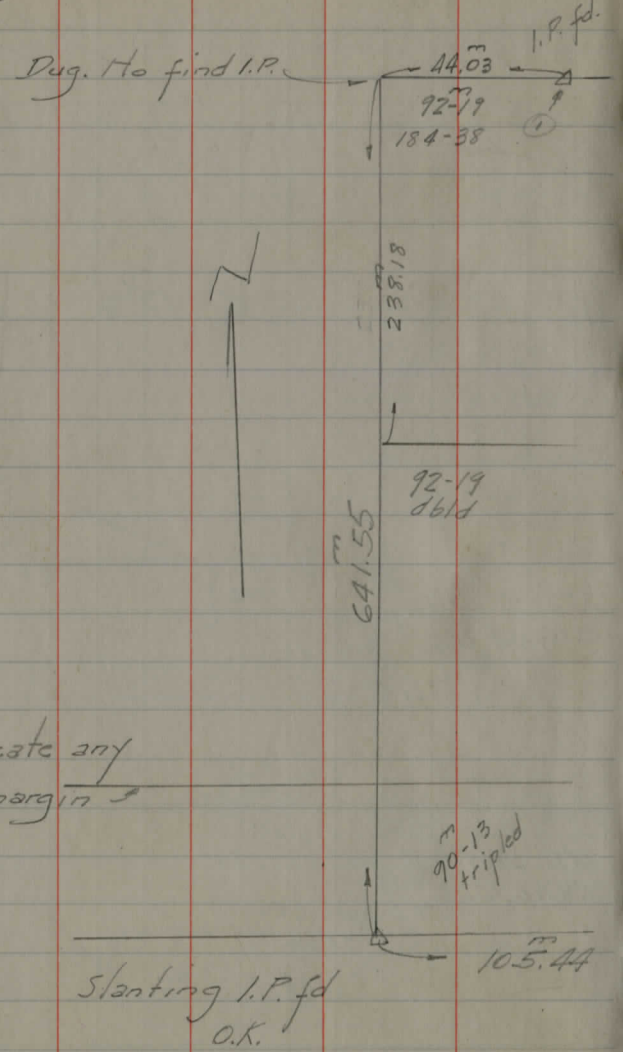
Def Rt 1°21'50"

1.50.1 5'



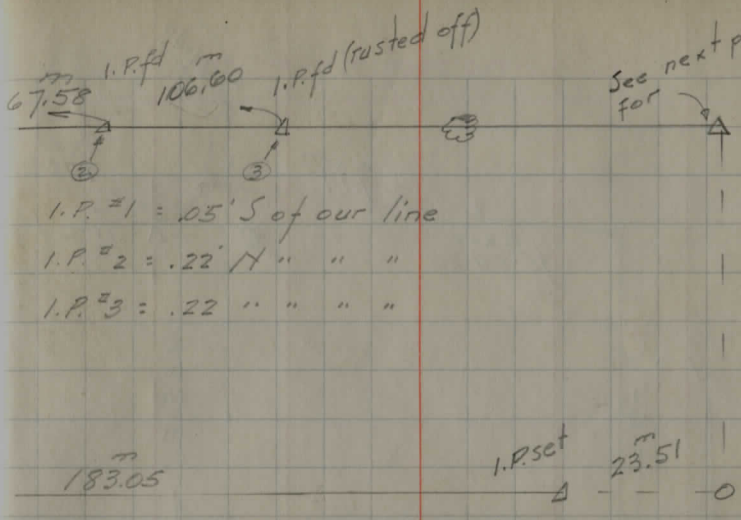
11-28-42
Form. Clark
Snow cold
12-12-42
Same as above

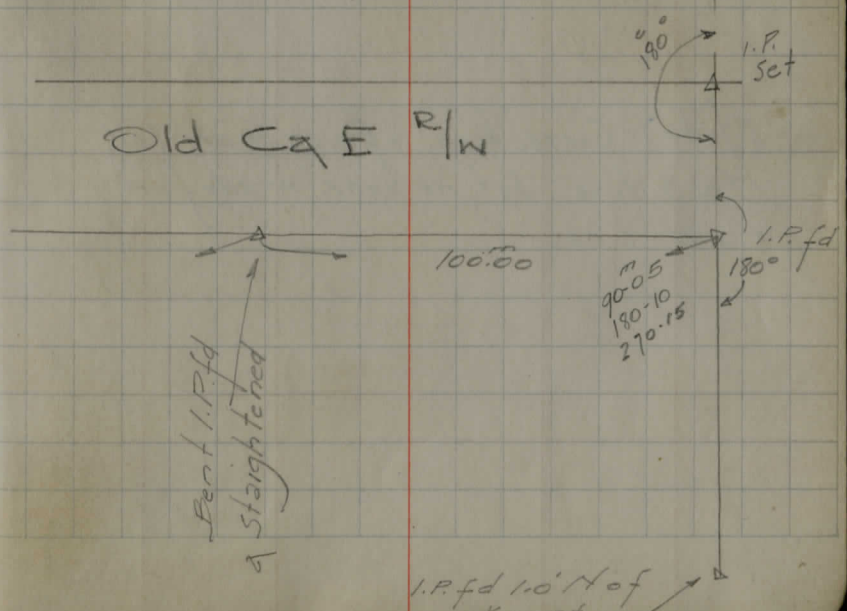
Dug. Ho find I.P.



Co. Fair gds

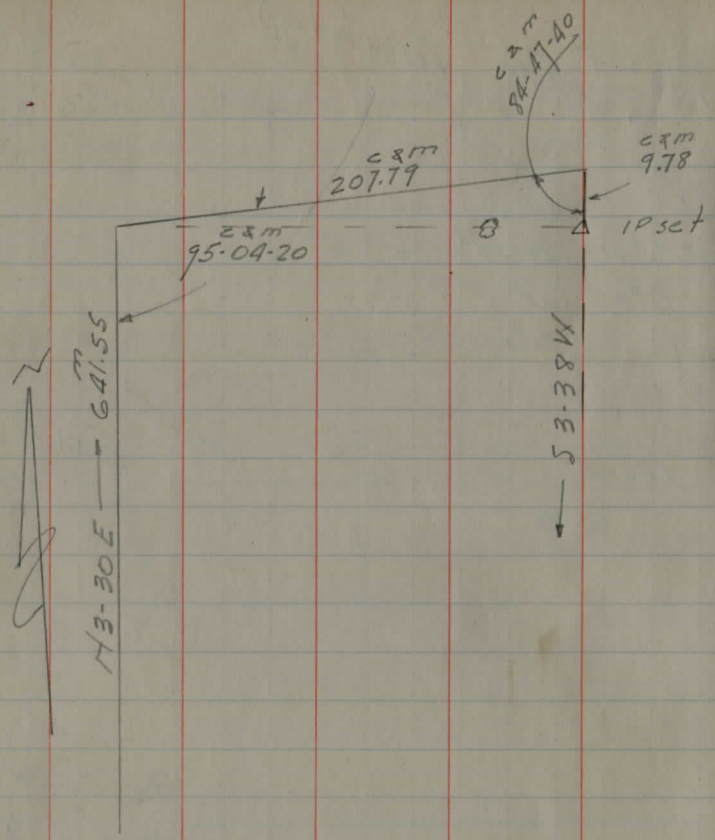
Unable to locate any mon. on N. margin





71

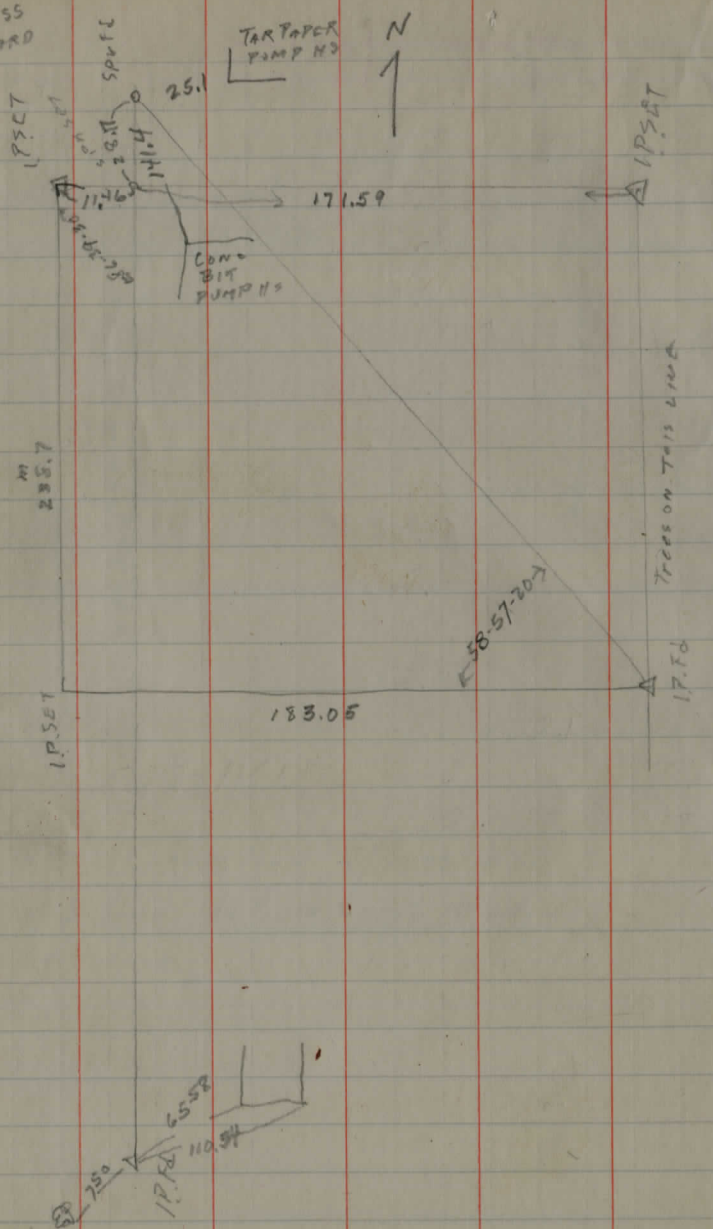
Fair Gds (cont'd)



Note: Correction of 0.22 made for N & S line but no corr. made for E & W line.

MAY 1, 1953 BURTON'S ACRE WELL LOT

SCHAUSS
MAYNARD



133
909

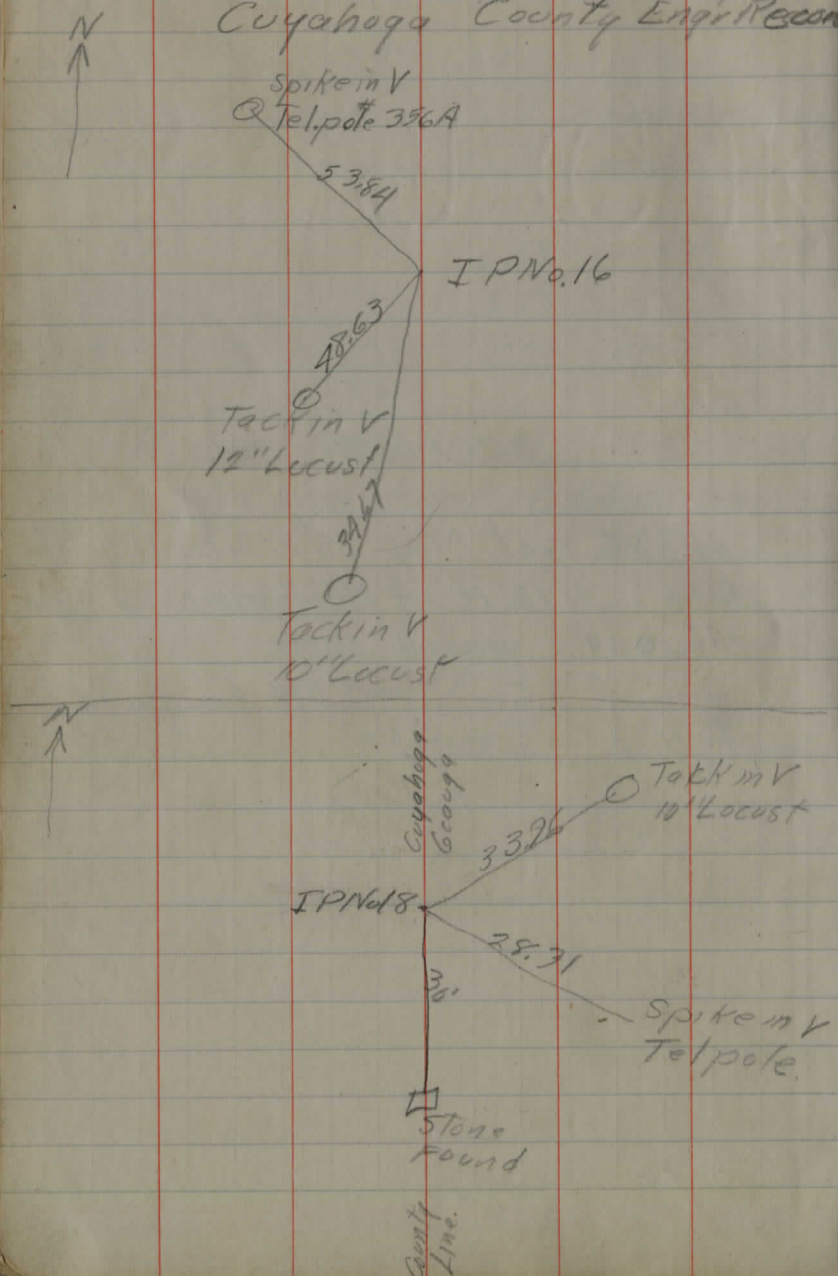
Low ground			5.85	
Grade		105.42	5.42	100.00
1st Tier			4.75	100.67
2nd Tier			4.09	101.33
	6.65	107.32	4.75	100.67
1st Tier			6.65	100.67
2nd Tier			5.99	101.33
3rd Tier			5.32	102.00

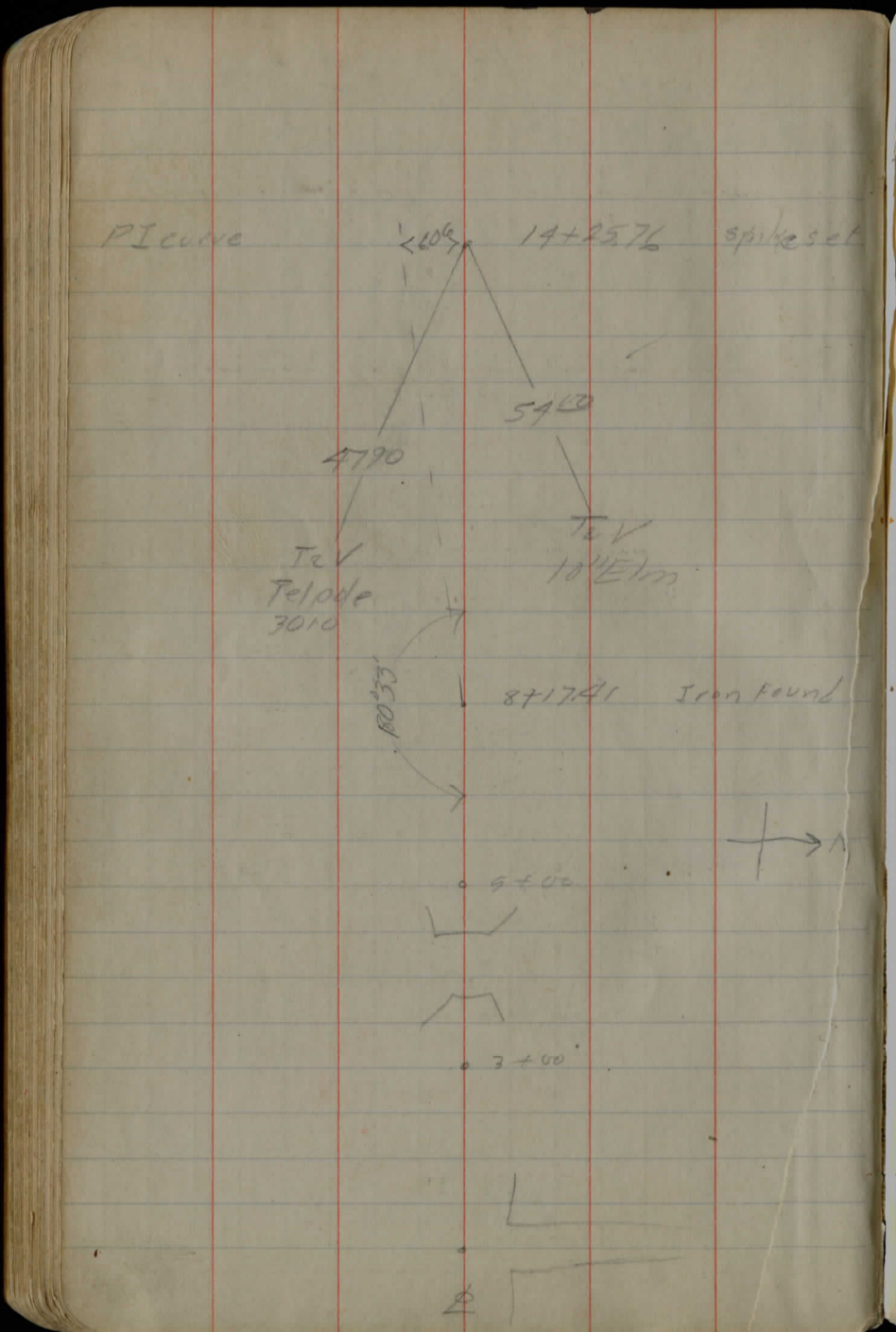
POLIO HOSPITAL
WELLS PROP CLARIDON

BM	3.29		100.00	
0+0				
+35	Bend south			
1+30		3.46 STATE	5.66	GROUND
2+0		2.9 "	4.9	"
3+0			7.5	"
3+50			9.8	"

Spk NE root N30 15' W of NW k house
0+0 : + 15 N of NE k main (2 St.) house
stk 0.59 ground 2.3
ground 3.6 use BM for grade stks
"

Solon Bainbridge Road & Survey
Cuyahoga County Engr Record





KEITH'S RAILROAD CURVE TABLES.

Published by KEUFFEL & ESSER CO., New York.

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.)

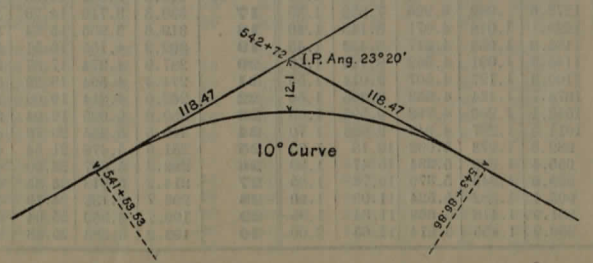


Table I. — Minutes in Decimals of a Degree.

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	.6333	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	3.781	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	483.4	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	2o31.1	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

△ 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	4.49	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. angle	½ sub chord / R = sin of def. angle 12.5 Ft.	15 Ft.	20 Ft.	25 Ft.	Length of arc for 100 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.

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

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

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

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

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

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

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

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

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

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

Tan. def. = ½ 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	1276	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	1.3432	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	3.8667	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

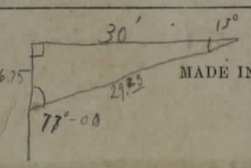
DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

ROADWAY 18 FEET WIDE. SIDE SLOPES 1½ to 1.

FOR LONG RACK 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.



MADE IN GERMANY.

R.