

Location Survey

BENA -

FEDERAL DAM.

AUG. 1922

FIELD BOOK

C. J. BARK - ASST. ENGR.

147

147

DB5 BK 147

Loc Bline

$$\Delta = 93^\circ - 18'$$

$$7^\circ 30' CL$$

$$P.I. = 89 + 46.1$$

$$T = 809.8$$

$$Lofc = 1244'$$

$$179^\circ - 66'$$

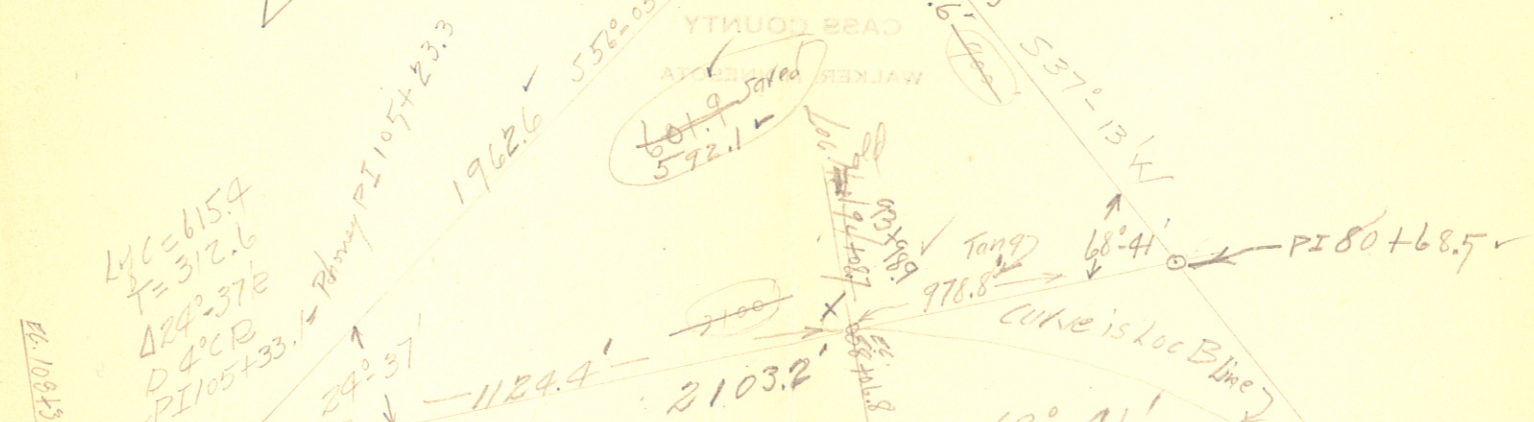
$$93^\circ - 18'$$

$$86^\circ - 42'$$

$$105^\circ - 33.1'$$

$$89^\circ - 7'$$

SMITHS
COUNTY ENGINEER
CASS COUNTY
WALKER MINNOTA



$$LWC = 615.4$$

$$T = 312.6$$

$$\Delta = 24^\circ - 37'$$

$$D = 4^\circ CR$$

$$PI 105 + 33.1$$

EC 108 + 35.9

531 - 28 E Z
24 - 37 R
Phoney Loc PI 105 + 23.3

601.9
572.1

$$\Delta = 68^\circ - 41'$$

$$PI = 80 + 68.5$$

$$4^\circ \text{ CURVE L.}$$

$$T = 978.8$$

$$Lofc = 1717.08$$

BC 70 + 89.7

$$BC = 70 + 89.7 = \text{old loc sta}$$

$$E.C. = 88 + 06.8 = 94 + 08.7 \text{ old sta (601.9)}$$

$$93 + 98.9$$

$$\frac{x}{\sin 86^\circ - 42'} = \frac{1962.6}{\sin 68^\circ - 41'}$$

$$x = \frac{1962.6 \times \sin 86^\circ - 42'}{\sin 68^\circ - 41'}$$

$$x = 2103.2'$$

$$\frac{y}{\sin 24^\circ - 37'} = \frac{1962.6}{\sin 68^\circ - 41'}$$

$$y = \frac{1962.6 \times \sin 24^\circ - 37'}{\sin 68^\circ - 41'}$$

$$y = 877.55$$

$$1124.4$$

$$312.6$$

$$1437.0$$

$$EC 108 + 35.9$$

$$14 \quad 37.0$$

$$93 + 98.9$$

$$+ \text{Log } 1962.6 = 3.2928318$$

$$\text{Log Sin } 86^{\circ} - 42' = 9.9992793$$

$$13.2921111$$

$$\text{Log Sin } 68^{\circ} - 41' = 9.9692227$$

$$3.3228884$$

$$x = 2103.2$$

$$\text{Log } 1962.6 = 3.2928318$$

$$\text{Log Sin } 24^{\circ} - 37' = 9.6196622$$

$$12.9124940$$

$$\text{Sin } 68^{\circ} - 41' = 9.9692227$$

$$2.9432713$$

$$y = 877.55$$

80+68.5
8+77.6

8946.1

$T_1 = 4 \frac{978.65}{36}$

31
28

978.65

18
978.83

1717.08
 $\frac{4}{16} 8.6833$

28
28

10533.1

8570.5
1962.6

17
68.6833

4 = 1717.08

3¹² 3.1
23.3

9.8

¹⁵¹⁷
80+68.5

9 78.8

108+35.9

3 12.6

105+23.3

11 24.4

70+89.7 BE ✓

17 17.1

93+98.9

88+06.8

88+06.8 EC 601.9

601.9
9.8

592.1

105+33.1

99+31.2
6+01.9

A. M. Moulster
PINE RIVER, MINN.

2103.2
978.8

1124.4

~~105+33.1
11+24.4
99+08.7
88+06.8
6+01.9~~

88+06.8

11 24.4
99+31.2

100.0
89.7

10.3

S. A. R. No. 8

JOB No. 3201

MINNESOTA HIGHWAY DEPARTMENT

SHEET No. 1

STATE AID HIGHWAY CONSTRUCTION

ESTIMATE No.

CONTRACTOR PERMANENT RECORD

BENA-FEDERAL DAM, CASS COUNTY

RETURN SHOWING PROGRESS TO 0 to

19 DIV. M TO M STA. TO STA. ENGR.

STATION TO STATION	Clearing		Excavation Cu. Yds.		GRADING ITEMS								SURFACING OR GRAVELING ITEMS									
	Acres	Grubbing Acres	Earth	Loose Rock Solid Rock	Hand Ditch Cu. Yds.	Over Haul Cu. Yds.	Guard Rail Lin. Ft.	12 in.	15 in.	18 in.	24 in.	30 in.	36 in.	42 in.	48 in.	Hauling Culverts Ton Miles	Stripping Pits Cu. Yds.	Screen & Load Cu. Yds.	Cu. Yd. Miles	Haul	Shaping & Compacting Mn.Hrs. Tm.Hr.	
Semi Tang P.I. = P.I.			Def. Angle	Distance	Cal Bearing	N Latitudes	S				E Departures	W				Coordinates			Mag. Bear.	Tang D	Le/c.	
291+84.4			43°-49'L	2616.2	535°-31'W														536°-30'W			
265+68.2	265+74.0		18°-49'R	2955.9	516°-42'W			2831.2				8.494			22910.2 +	345.5		518°-30'W	316.5	3°R	627.2	
236+18.1	236+18.9		6°-30'R	1914.5	510°-12'W			1884.2				339.0			20079.0 +	1194.9		511°-30'W	325.9	1°R	650.0	
217+04.4	217+22.6		27°-32'L	1704.5	537°-44'W			1348.0				1043.1			18194.0 +	1533.9		539°-00'W	41		917.8	
200+18.1	200+28.0		29°-32'R	1175.4	58°-12'W			1163.9				167.7			16846.0 +	2577.0		56°-45'W				
188+52.6	189+02.2		52°-08½'R	761.0	543°-56½'E			1268.0		1222.0					15683.4 +	2744.7		544°-45'E				
171+41.2	171+47.8		17°-17½'L	3355.1	526°-39'E			2998.7		1504.9					14415.4 +	1522.7						
137+98.7	137+93.2		4°-49'R	3269.7	531°-28'E			2788.9		1706.8					11416.7 +	17.8		530°-30'E				
105+23.3	105+33.1		24°-37'R	1962.6	556°-05'E			1095.1		1628.7					8627.8 -	1689.0		555°-15'E				
85+70.5	89+46.1		93°-18'L	3495.0	537°-13'W			2783.3				2113.9			7532.7 -	3317.7		538°-00'W				
54+57.1	54+53.5		12°-14'R	2024.3	524°-59'W			1834.9				855.0			4749.4 -	1203.8		525°-30'W				
34+29.2	34+80.8		56°-31'L	775.7	581°-30'W			114.7				767.2			2914.5 -	348.0		583°-30'W				
27+05.1	28+30.9		90°-00'R	2830.9	58°-30'E			2799.8		918.4					2799.8 +	418.4		57°-00'E				
0+00																						
Total To Date																						
Previous																						
Present																						
Unit Cost																						
Present Cost																						
34+80.8								1383.5				-577.6			-2914.5				348.8			
15+47.7			31°-38'R		523°-08'W			1531.0		228.8												
0+00					58°-30'E																	

S. A. R. No. _____

JOB No. _____

MINNESOTA HIGHWAY DEPARTMENT

STATE AID HIGHWAY CONSTRUCTION

SHEET No. _____

ESTIMATE No. _____

CONTRACTOR _____

CASS COUNTY

RETURN SHOWING PROGRESS TO _____

19____ DIV. _____ M _____ TO M _____

STA. _____ TO STA. _____

ENGR. _____

STATION TO STATION	GRADING ITEMS													SURFACING OR GRAVELING ITEMS										
	Clearing	Grubbing	Excavation Cu. Yds.			Hand Ditch	Over Haul	Guard Rail		Portable Culverts—Lin. Ft.						Hauling	Stripping	Screen & Load	Haul		Shaping & Compacting			
	Acres	Acres	Earth	Loose Rock	Solid Rock	Cu. Yds.	Cu. Yds.	Lin. Ft.	12 in.	15 in.	18 in.	24 in.	30 in.	36 in.	42 in.	48 in.	Ton Miles	Cu. Yds.	Cu. Yds.	Cu. Yd. Miles	Mn. Hrs. Tm. Hr.			
Sumitang P.I.	P.I.	Def. Angle	Distance	Cal. Bearing	+N	Latitudes	S-	E+Departures	-W	Coordinates	Mag. Bear.	Tang.	D	Lyc.										
	407+51.3																							
	371+32.2	371+43.5	34°-28'R			3789.1	53°-55'E														53°-00'E			
						1643.8	538°-23'E			1288.5	1020.7					32281.7	+1498.8				537°-30'E	178°-10'R	344.7	
	354+99.7	355+00.0	5°-19'R																					
						1339.1	543°-42'E			968.1	925.2					30993.2	+478.1				592°-45'E	266°-1'R	581.7	
	341+60.9	341+84.5	35°-24'L																					
						5038.2	58°-18'E			4985.4	727.3					30025.1	-447.1				57°-00'E	365.8	58L	708.0
	291+46.3	291+84.4	43°-49'L																					
						2616.2	535°-31'W			2129.5						1519.9								
	265+68.2	265+74.0	18°-49'R													25039.7	-1174.4				536°-30'W	384.2	6°CL	730.3
Total To Date																								
Previous																								
Present																								
Unit Cost																								
Present Cost																								

Var. 11643'E

Index

Page-1-3 = E+W Line - H.E. Co. 34 going west

" - 3-7 = "A" Line Location

" - 8-29 = Traverse Line

" - 30-32 = "L2" Location

" - 33-56 = "L1" Location

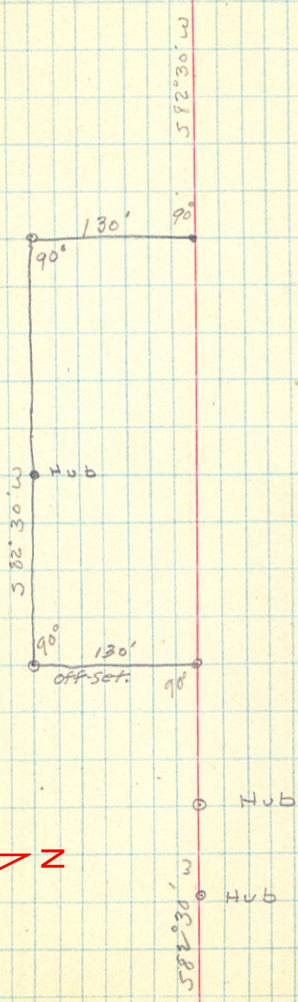
" - 58 = Sounding

Random Line on N. Boundary Sec 34.

E & West line
from T.E. Cor. 34
Running West

1

0 A Brq.
22
21
20
19
18
17
16+00
15
14
13
12
11 P.O.T.
10
9
8
7
6
5 S. 82°30' W.
+77.2 O.P.O.T.
4
+46.8 O.P.O.T.
3
2
1
0+00



East + West Line
from N.E. Cor. 34
Running West.

0	Δ	Targ.
3		
2		
1		
40		
39+265	P.O.T.	
39		
38		
37		
36+75	P.O.T.	
6		
5		
4		
3		
2		
1		
30		
29		
+65-	P.O.T.	
28		
27		
26+40	P.O.T.	
26		
25		
24		
23		

Hub

Hub

S 87° 30' W
Hub

Hub.
6.6'
30° 26'
1/4 Cor.

51468° Prot.

1

50

9.

8

7

6

45

44

Sec. Cor.
Wood Cor.

16' H

Sec. Cor.
Wood Cor.

"A" Line Location.

+53² Xing Track No 3. House Track.

+27⁵ Xing Main Passing Tr.

+102 4 RR Xing Main Line

5

4

+68.7

3

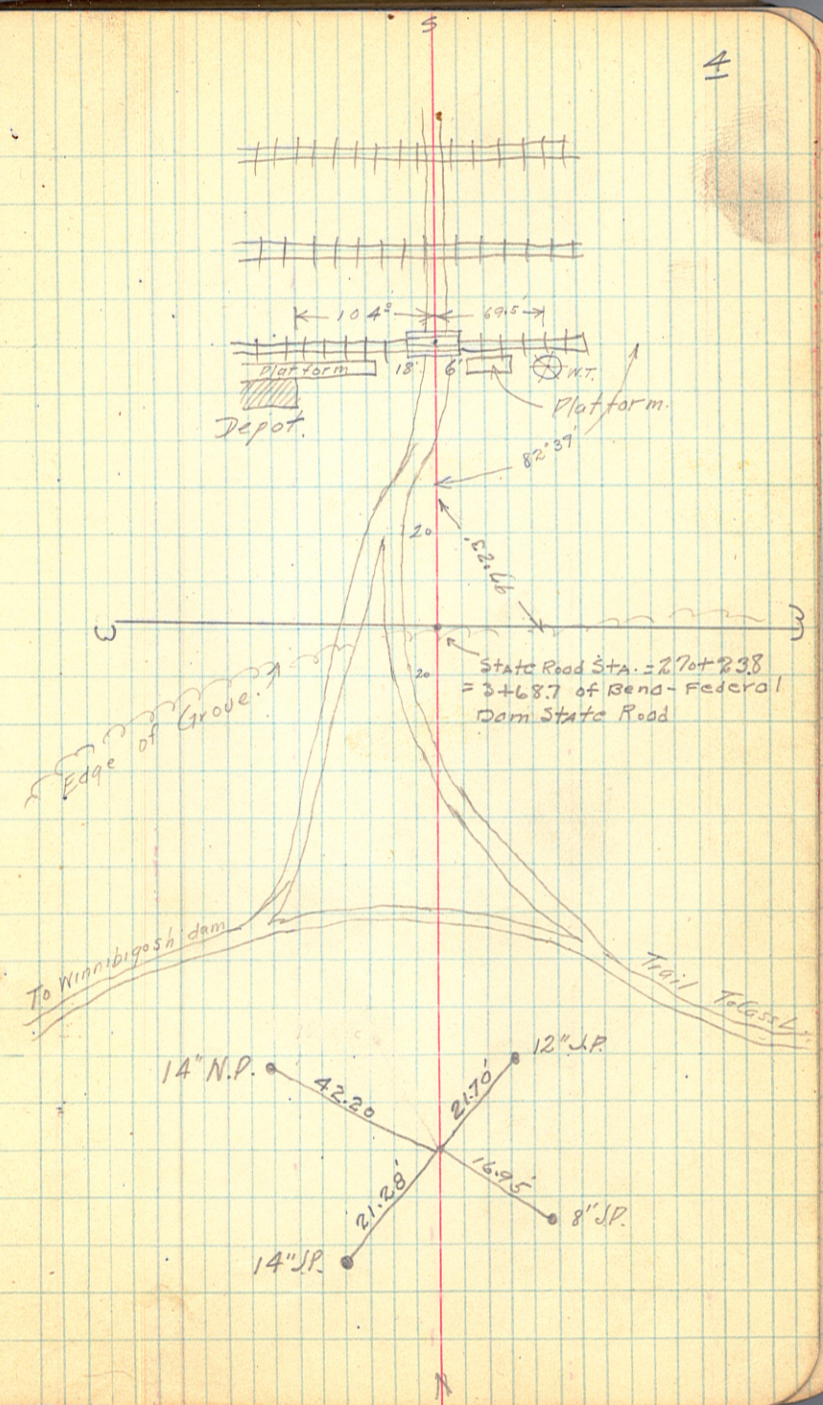
+40

2

+20

1

0+00 Jack Pine hub & Tack.



14

+35²

13

12

11

+85⁵

+35⁵

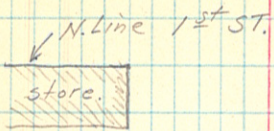
10

9

8

7

6



10 + 35⁴
3.68.7
6 + 6 6.8

47
13
80

26

25

+488

24

23

22

21

20

+15°

19

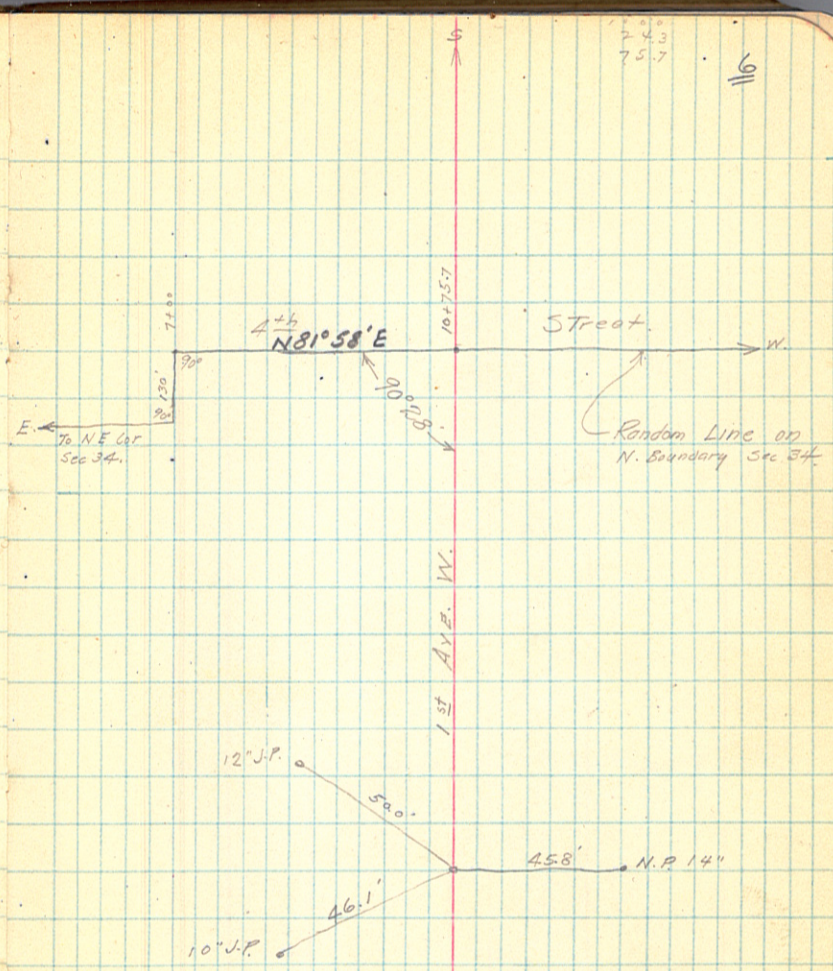
18

17

16

15

Hub on ridge



74.0
74.3
75.7

116

38

37

36+00 P.O.T. Hub.

35

34

33

32

+985 A 90°00' Rt. Turn West along 6th St. S.

31

30

29

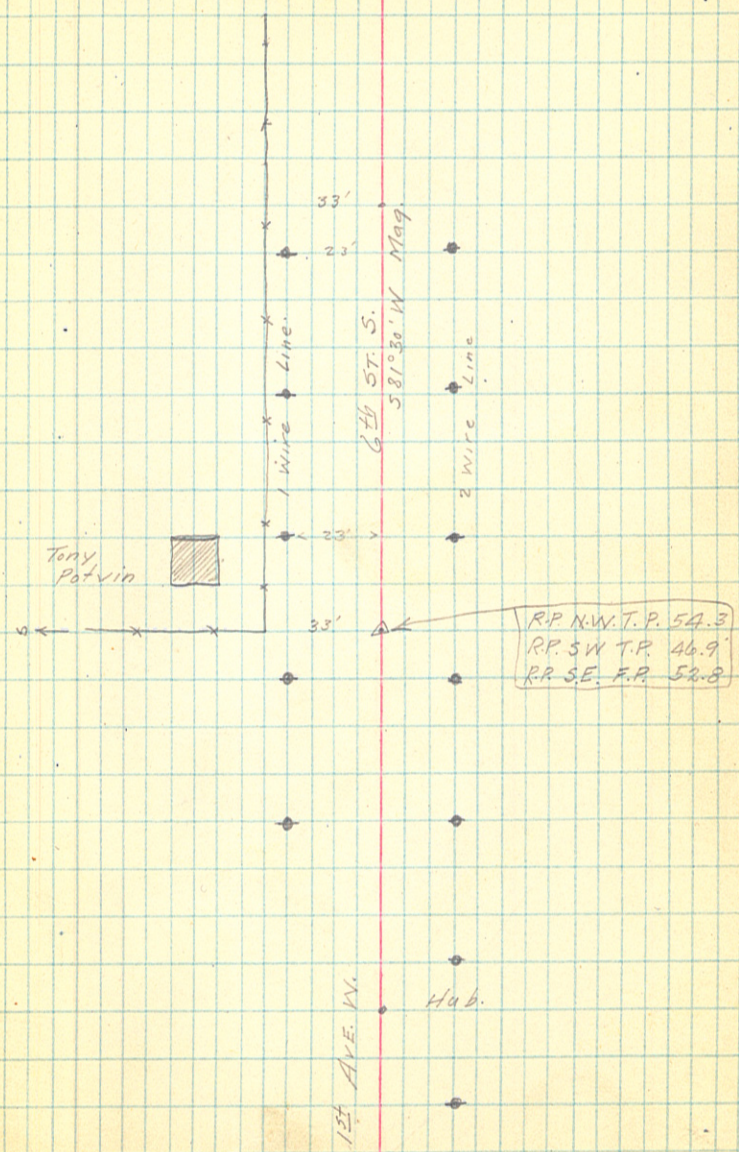
28+00

27

1800
385
2163

1800
385
2163

32 7 31498.5
10+35.5 10+35.5
21 64.5 21 63.0



51

Meadow

50

49+48.3 Δ 17°07' RT

49

48

47

46

Pot.

+86.7 Δ 14°07' RT

45

44

43

42

41

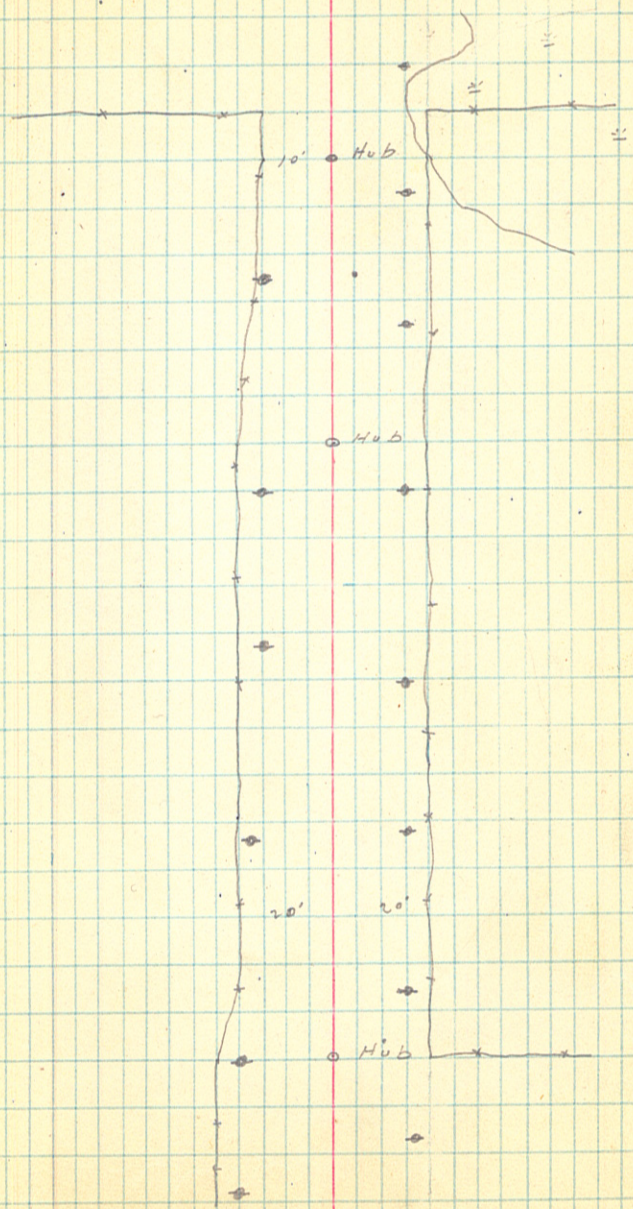
526°00' RT

40

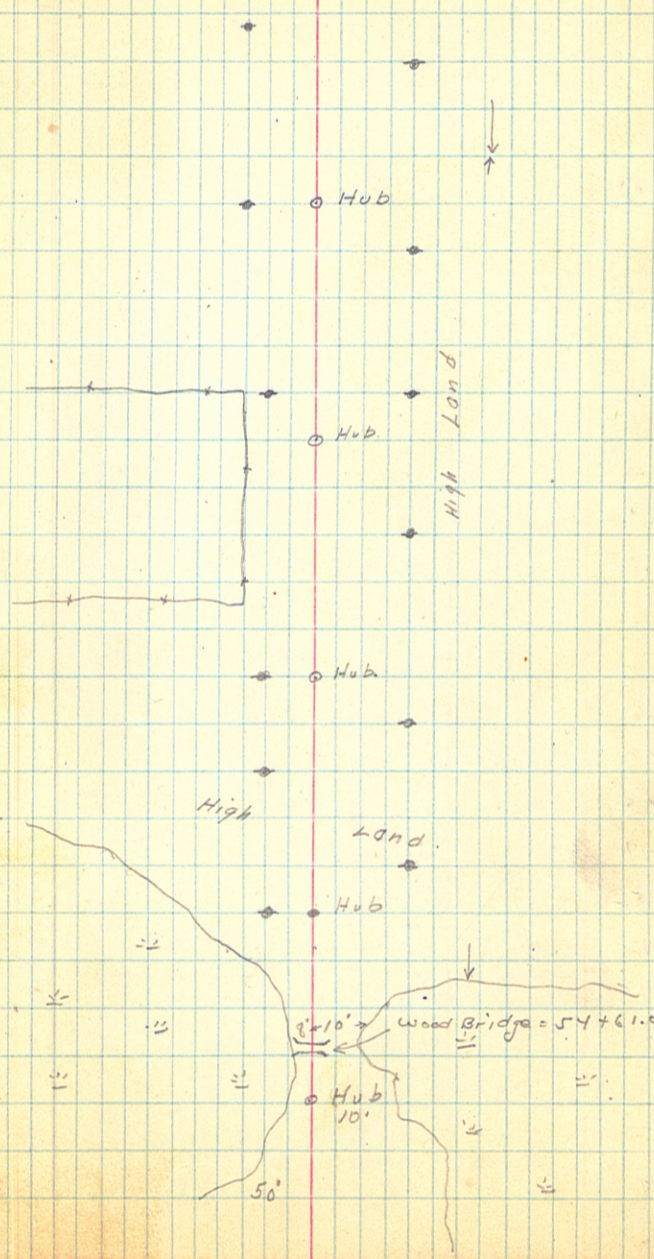
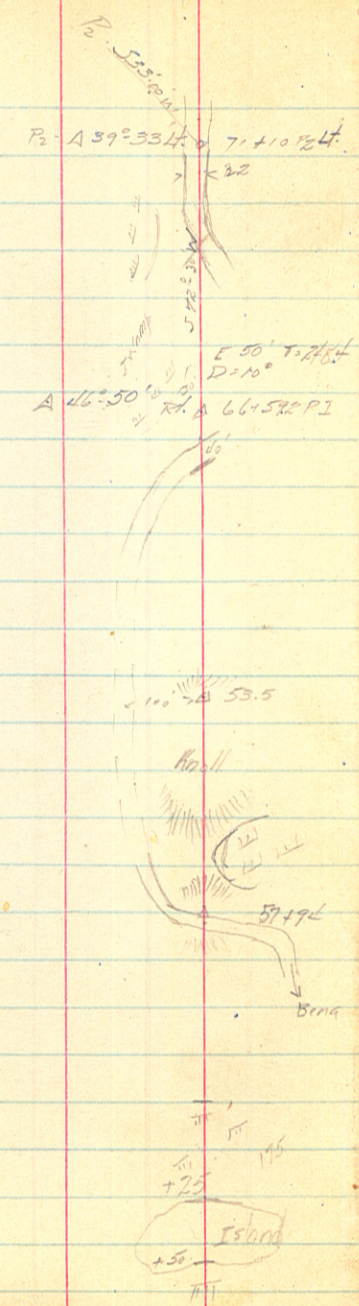
+74.8 Δ 55°12' LT

57-33' LT Δ 56°30' LT

39

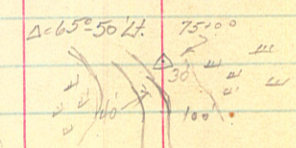


- 71
- 70
- 69
- +00.8 Δ 22°45' RT ✓
- 68
- 67
- 66
- 65
- +31.9 Δ 25°00' RT ✓
- 64
- 63
- 62
- 61
- +50.7 Δ 42°40' RT ✓
- 60
- 59
- 58
- 57
- 56+41.9 Δ 42°15' LT ✓
- 56
- 55
- 54
- 53+25.6 Δ 42°24' LT ✓
- 53
- 52

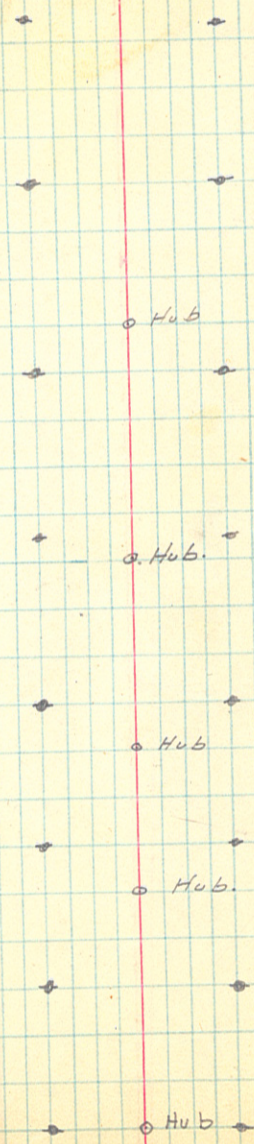


91
 90
 89
 88
 87
 86
 +54.7 $\Delta 13^{\circ} 23'$ RT. ✓
 85
 84
 83
 82
 +34.9 $\Delta 30^{\circ} 36'$ RT. ✓
 81
 80
 79
 +71.5 $\Delta 32^{\circ} 20'$ LT. ✓
 78
 77
 +88.0 $\Delta 46^{\circ} 44'$ LT. ✓
 76
 75
 74
 73
 +58.0 $\Delta 9^{\circ} 15'$ RT. ✓
 72

$P_1 = 60 + 64.4 = 79 + 16.7$
 $2^{\circ} 16'$
~~RT~~



1.00
 2.5
 6.5
 2.4



High Land

Low Poplar Land

+37.4 $\Delta 36^{\circ}27'$ Rt. ✓

1

110

9

+62.3 $\Delta 13^{\circ}46'$ Lt. ✓

8

7

6

+45.3 $\Delta 50^{\circ}03'$ Lt. ✓

105

4

3

2

1

100

99

98

+82.0 $\Delta 25^{\circ}47'$ Lt. ✓

97

96

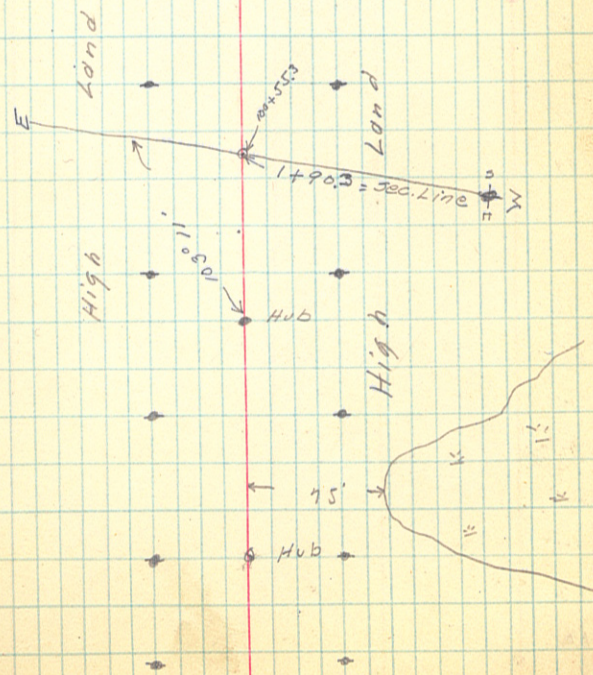
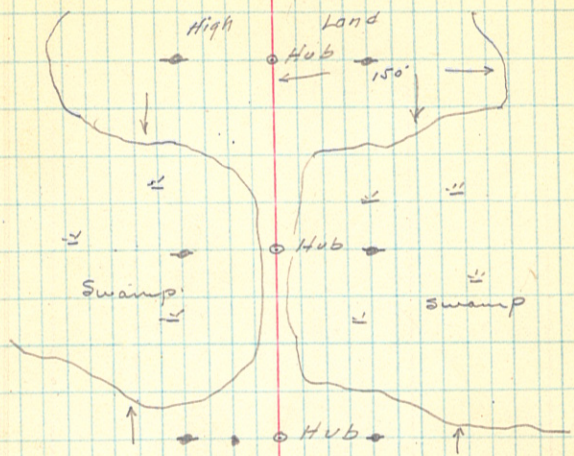
95

94

+88.0 $\Delta 33^{\circ}16'$ Lt. ✓

93

92

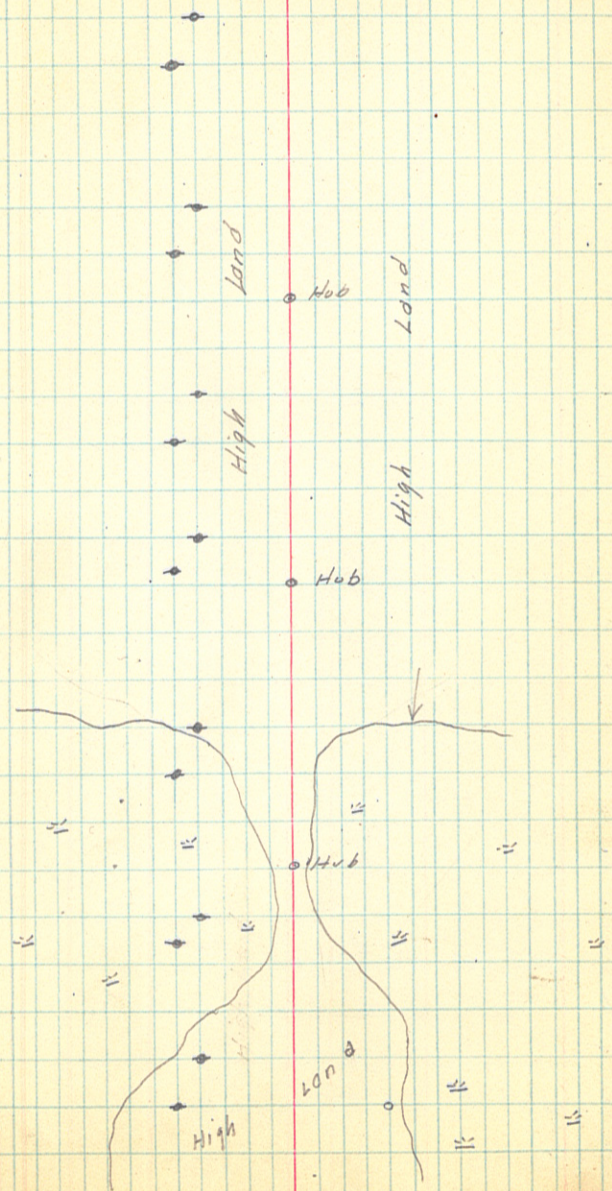


- 33
- 32
- 31
- 30
- 29
- 28
- +63.9
- 27
- 26
- 125
- 24
- 23
- +77.8
- 22
- 21
- 120
- 19
- 18
- +58.3
- 17
- 16
- 115
- 14
- 113
- 112

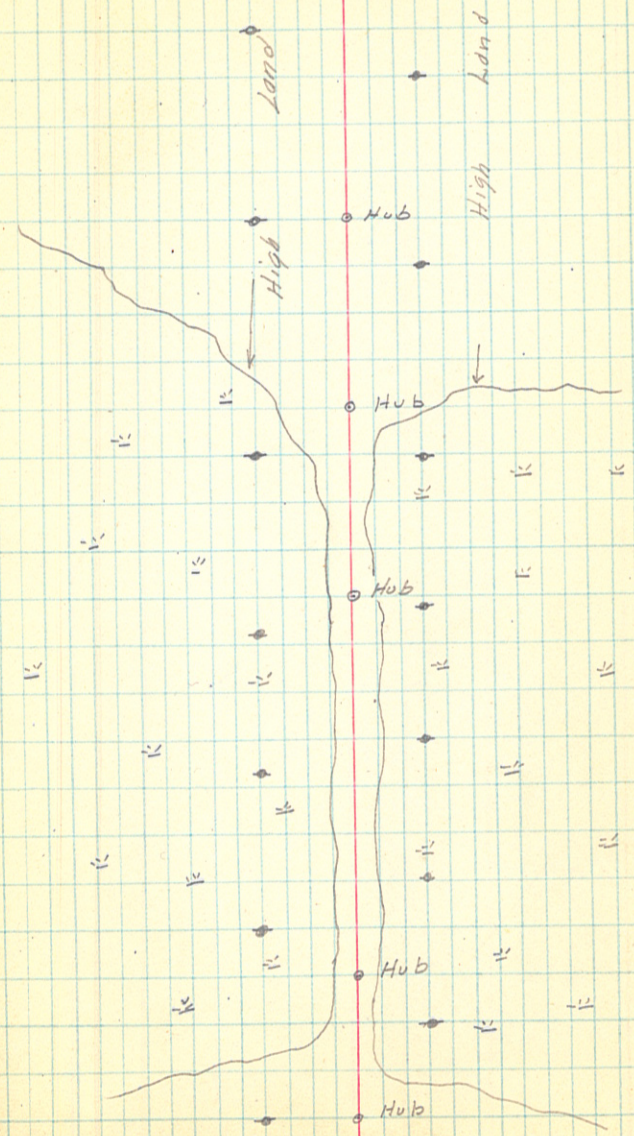
o P.O.T.

A 1° 14' Lt ✓

A 18° 00' Rt. ✓

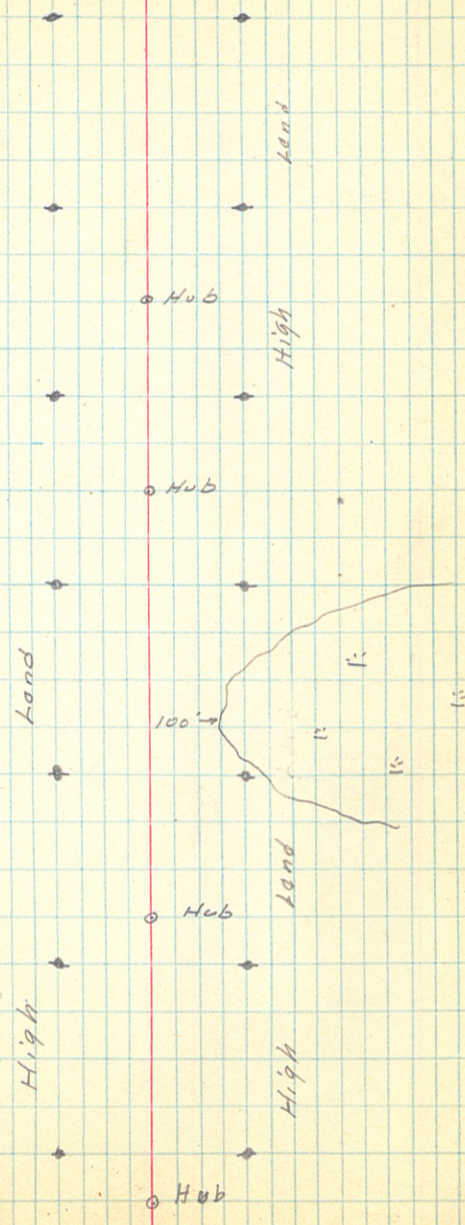


3
 2
 1
 150
 +60.7 Δ 8° 27' RT ✓
 9
 8
 7
 +62.5 Δ 48° 10' RT ✓
 6
 145
 4
 +346 Δ 37° 15' LT ✓
 3
 2
 1
 140
 39
 38
 37
 +87.2 Δ 9° 56' RT ✓
 136
 135
 +30.0 Δ 4° 22' LT ✓
 134



0 Angle
 4
 3
 2
 +80.3 $\Delta 25^{\circ} 09'$ Lt. ✓
 1
 170 \odot P.O.T.
 9
 8
 7
 +77.9 $\Delta 19^{\circ} 06'$ Rt. ✓
 6
 165
 4
 3
 2
 1
 160
 9
 +88.7 \odot P.O.T.
 8
 7
 6
 155
 4
 153+65.6 $\Delta 23^{\circ} 06'$ Lt. ✓

Note: Phone lines out 20'



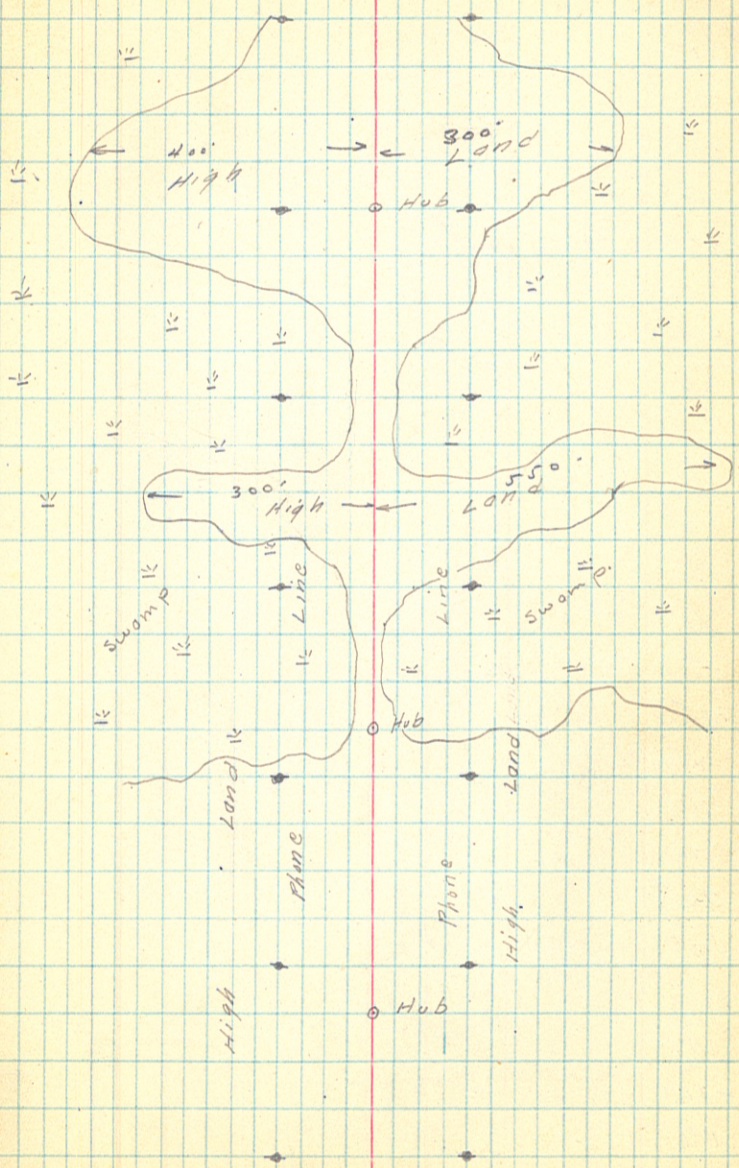
0 Angle
 6
 5
 4
 +66.9 Δ 18°33' LT ✓

193
 2
 1
 190
 9
 8

7
 6
 185
 4
 +97.4 Δ 17°08' H. ✓

183
 2
 1
 180
 9
 +34.3 Δ 11°52' RT ✓

178
 7
 6
 175



0 Angle
 217
 16
 215
 14
 213+00 $\Delta 28^{\circ}20'$ RT ✓

212

+21.9 O.P.A.T.

211

210

9

8

7

6

+80.8 $\Delta 9^{\circ}43'$ RT ✓

205

4

3

2

201

+90.7 $\Delta 26^{\circ}56'$ RT ✓

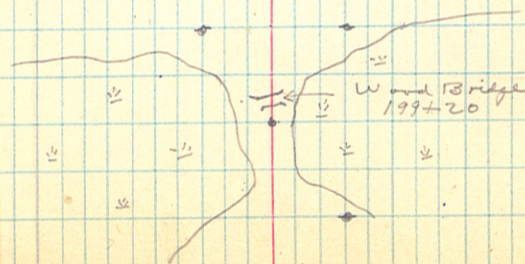
200

9

+80.9 $\Delta 18^{\circ}32'$ RT ✓

198

197



o Angle

- 240
- 39
- 38
- 37
- 36
- 235
- 34
- 33
- 232
- +51.7
- 231
- 230
- 29
- 28
- 27
- +39.8
- 226
- 225
- 24
- 23
- 222
- 221
- 220
- 19
- 218

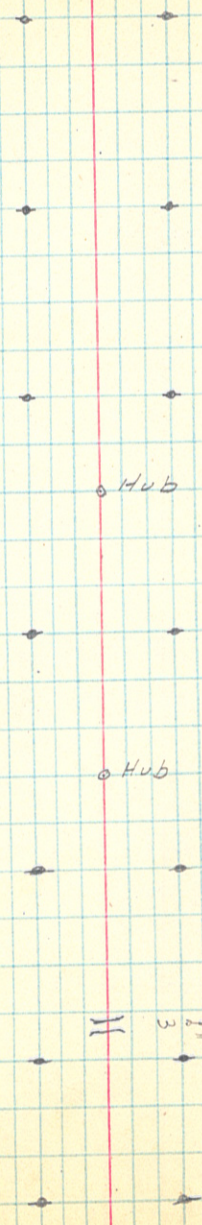
$\Delta 13^{\circ}36'$ Lt ✓

$\Delta 15^{\circ}43'$ Lt ✓

o Hub

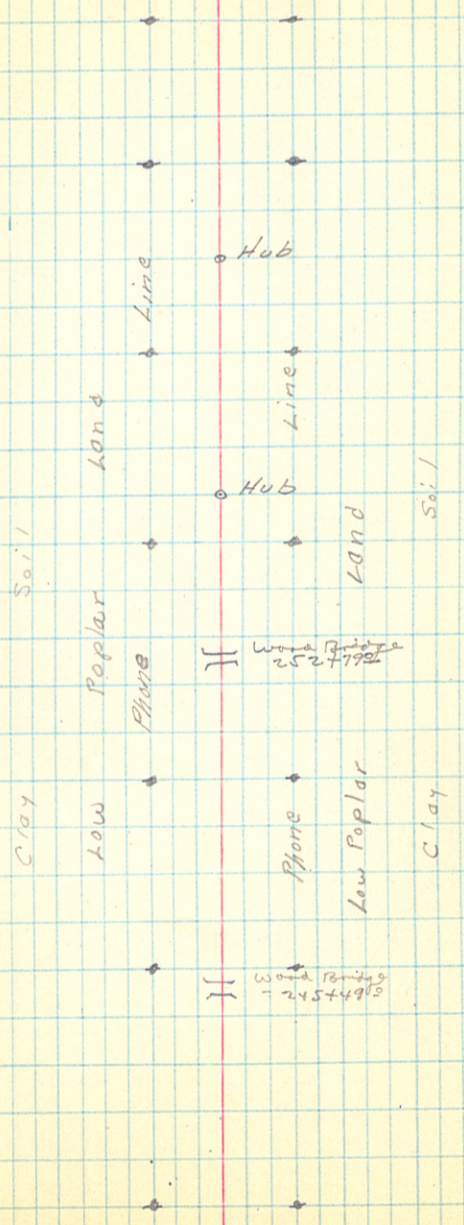
o Hub

||
Wald-Fänge
= 221 + 760



0 Angle
 3
 2
 1
 260
 +17.7 $\Delta 6^{\circ}40'$ Lt. \checkmark
 259
 8
 7
 6
 +45.5 $\Delta 8^{\circ}10'$ Rt. \checkmark
 255
 4
 3
 2
 1
 250
 49
 +48+00 $\Delta 5^{\circ}11'$ Rt. \checkmark
 47
 46
 245
 44
 43
 42
 241

NOTE:
 From Sta. 227 To 346
 Leave Sandy Soil and Enter
 Clay Soil



o Angle

285

84

283

+26.1 Δ 19°34' Rt ✓

282

81

280

78

78

77

76

275

74

73

72

71

+14.5 Δ 19°05' Lt ✓

270

69

68

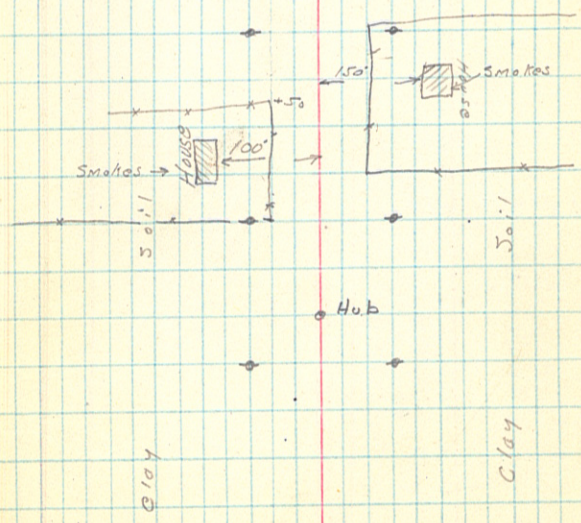
67

66

265

+73.8 Δ 17°35' Rt ✓

264



8

7

6

305

4

3

2

+ 92.5 $\Delta 26^{\circ} 20' 17''$

301

300

9

8

7

6

295+00 $\Delta 2^{\circ} 35' RT$

4

3

2

1

290

289

+19.4 $\odot POT.$

288

87

286

Hub

Hub

330

9

8

7

6

325

4

3

2

1

320

19

319

+38.0 $\Delta 0^{\circ} 45'$ Lt

317

16

315

14

+63.9 $\Delta 5^{\circ} 13'$ Rt ✓

13

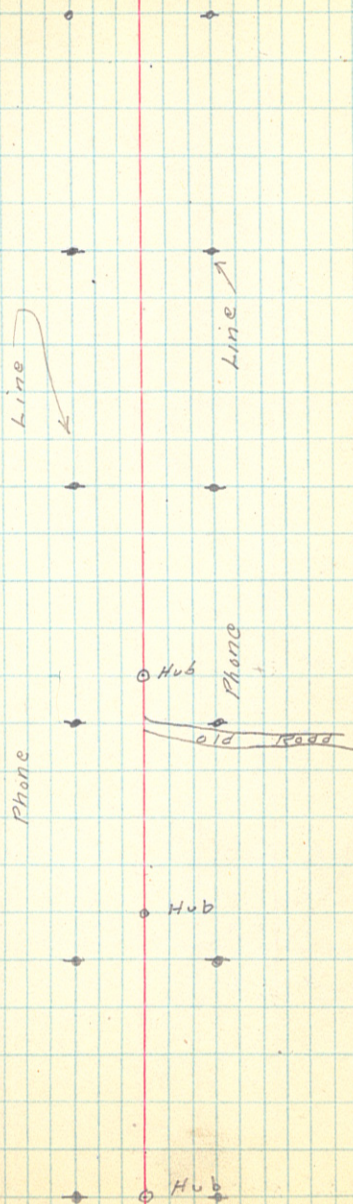
12

11

310

9

308+638 $\Delta 25^{\circ} 51'$ Lt ✓



+57.4 Δ 9°14' Lt ✓

350

49

48

47

46

345

4

3

2

1

340

39

+51.3 Δ 24°49' Rt ✓

338

37

36

+71.6 Δ 22°48' Lt ✓

335

34

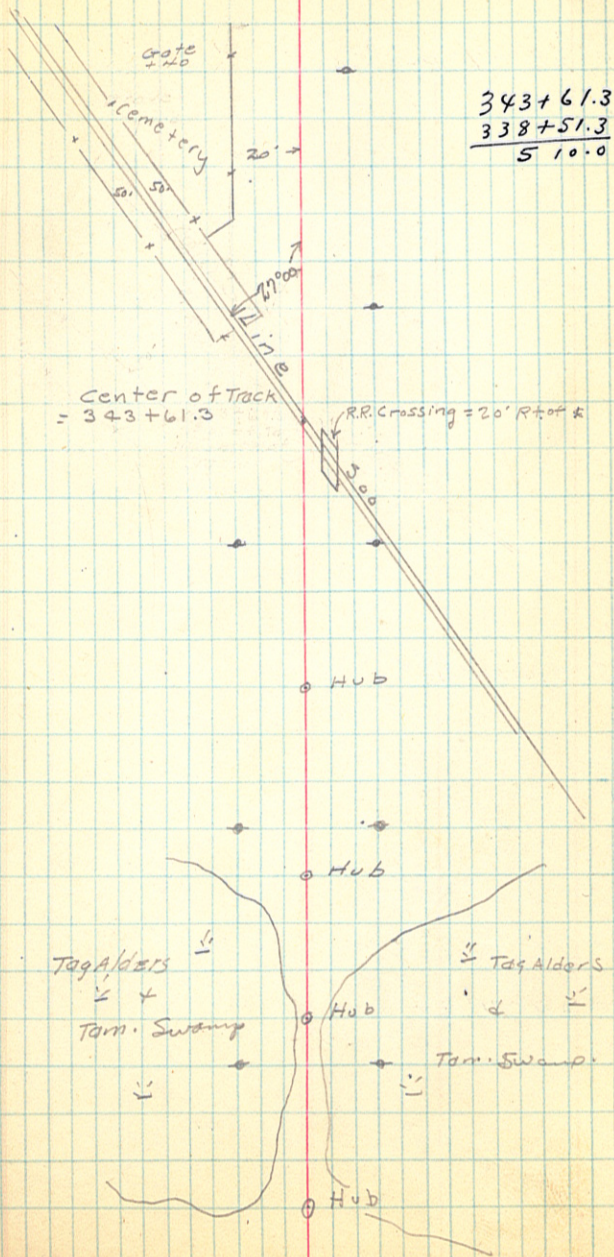
+38.7 Δ 19°06' Lt ✓

333

32

331

330+19.1 Δ 21°36' Rt ✓



+82.4 Δ 6° 07' Rt. ✓

372

71

370

69

368

+51.6 Δ 8° 08' Rt. ✓

367

66

365

64

63

362

+62.5 Δ 19° 34' Lt. ✓

361

360

59

58

57

56

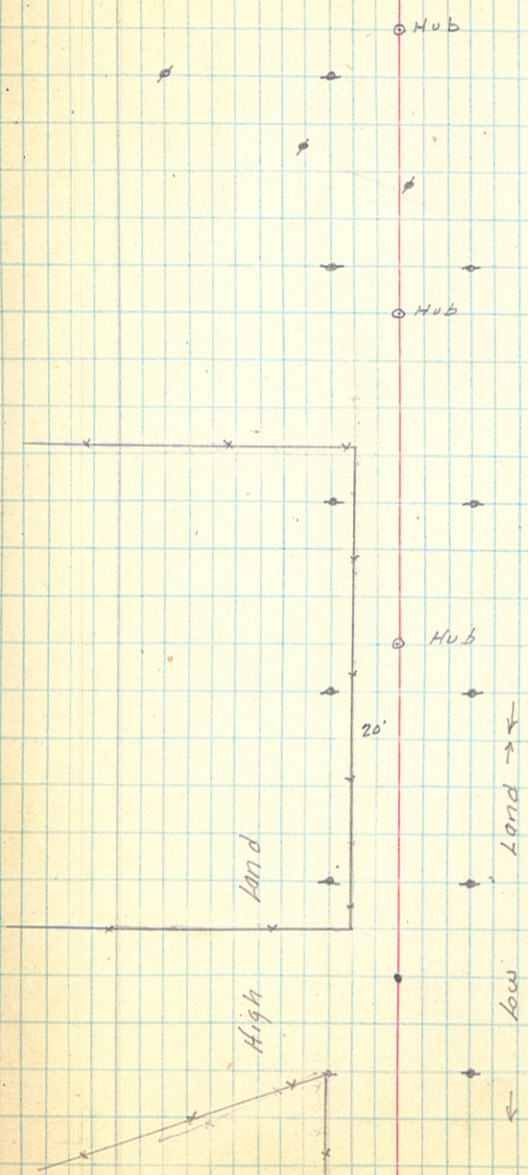
355+00 Δ 16° 31' Lt. ✓

54

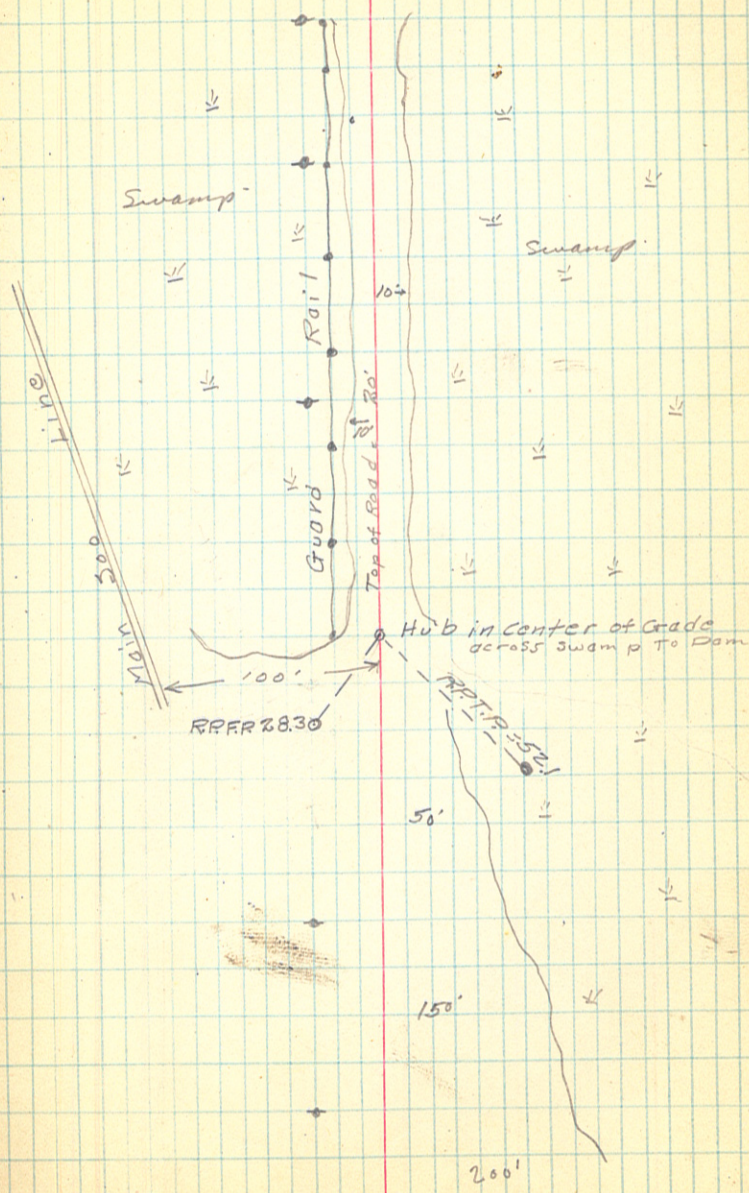
53

52

351



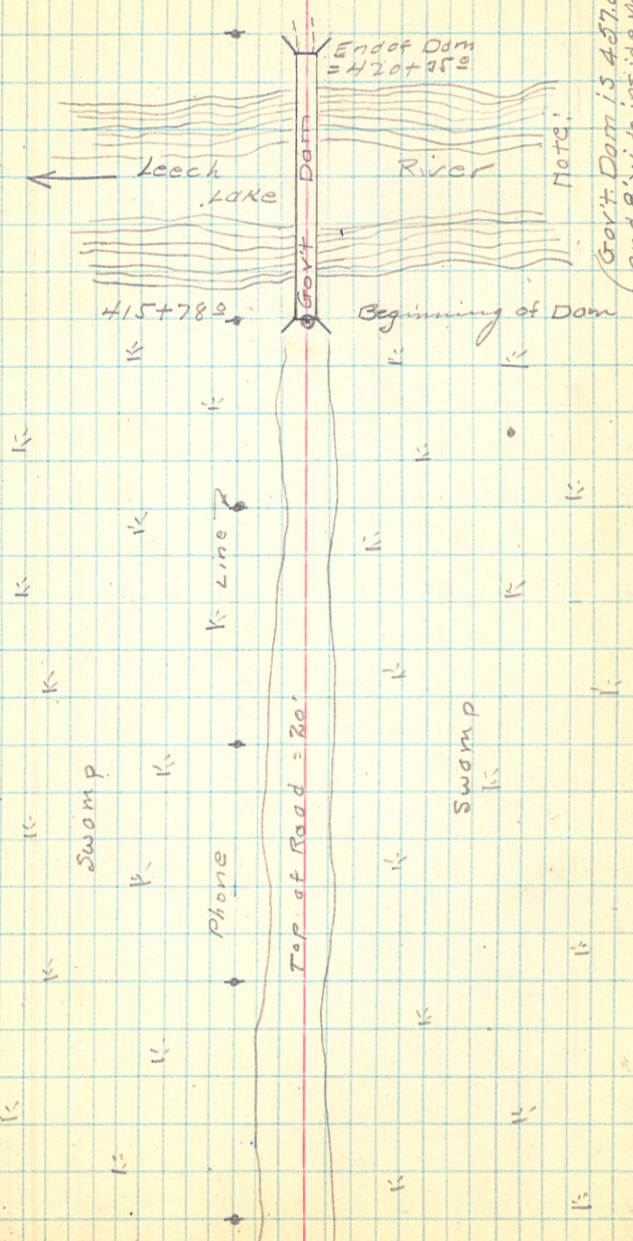
- 96
- 395
- ...4
- 3
- 2
- 1
- 390
- 89
- 88
- 87
- 86
- 385
- +65.1 $\Delta 33^{\circ}21'$ Rt. ✓
- 384
- 83
- 82
- 81
- 380
- 79
- 78
- 77
- 76
- 375
- 74
- 373



420
19
18
17
16
+78 = 0 P.O.T.
415
14
13
12
11
410
9
8
7
6
405
4
3
2
1
400
99
98
397

420 + 35.0
415 + 78.0
457.0

Note
Beginning of Tie Line
at Sta 415+78.2 To Sta 416 Road 1704



Govt Dam is 457.0 long
and 8' wide inside measure

42

41

440

39

+51.2 $\Delta 90^{\circ}50'$ Lt

438

37

36

35

+69.8 $\Delta 92^{\circ}26'$ Rt

434

3

2

1

430

29

28

27

26

425

24

23

422 $\Delta 63^{\circ}39'$ Lt

+10.1 $\Delta 30^{\circ}28'$ Lt

421

2nd Ave

Church Street

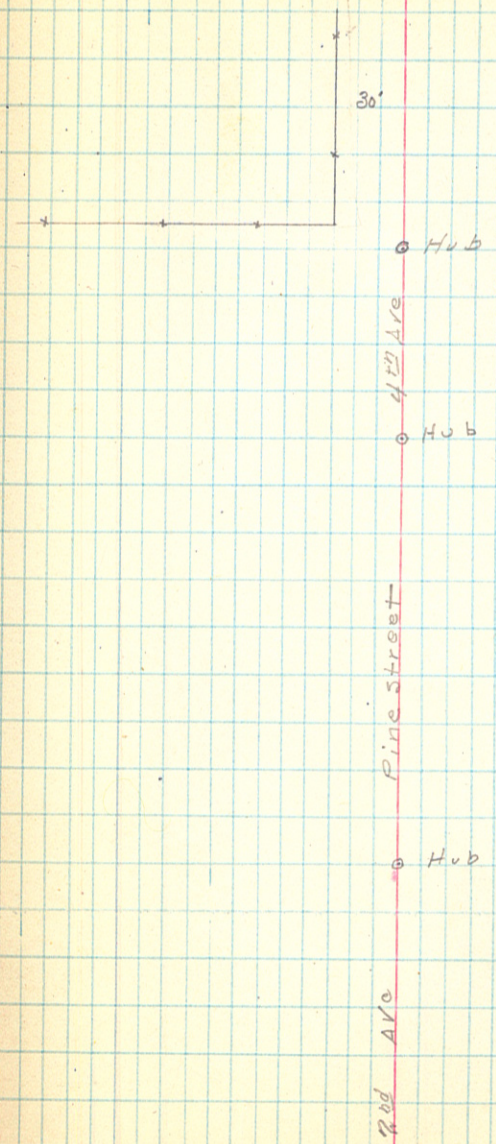
Hub

Hub. Cor. 1st. Street
Cedar Ave.

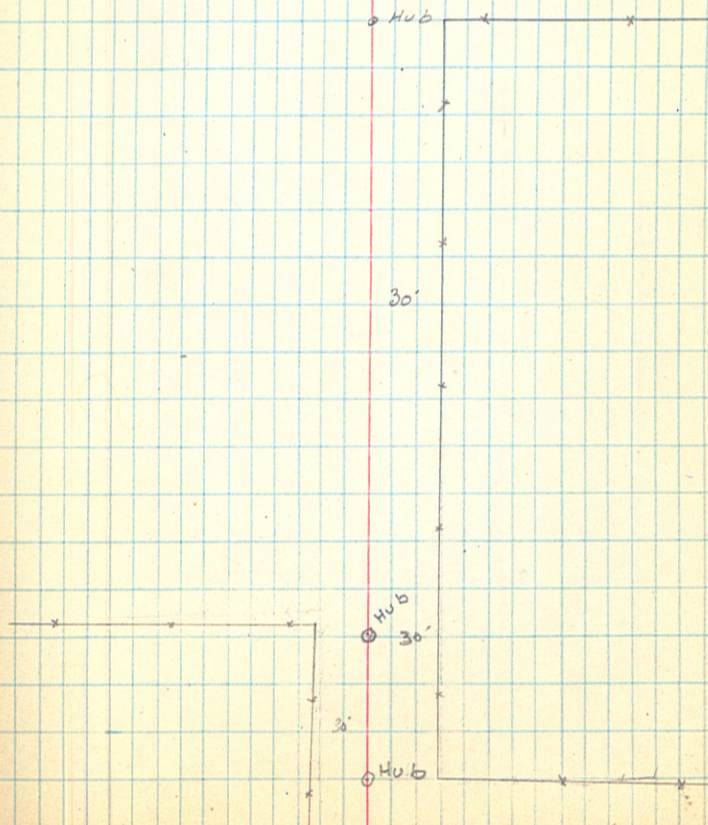
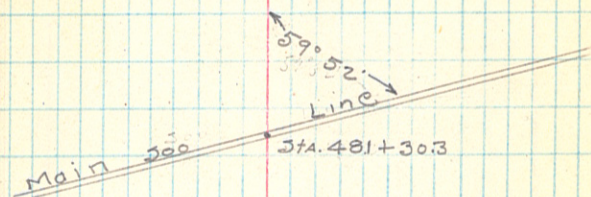
Hub

Hub

467
 63
 62
 61
 + 68.9 $\Delta 91^{\circ}40'$ Rt.
 460
 59
 458
 + 06.0 $\Delta 90^{\circ}00'$ H
 457
 56
 455
 54
 53
 52
 51
 450
 + 76.8 $\Delta 90^{\circ}00'$ Rt.
 449
 48
 47
 46
 445
 44
 443



86
 485
 84
 83
 482
 81
 480
 79
 +58.9 $\Delta 60^{\circ}05'$ Lt.
 478
 7
 6
 475
 4
 3
 2
 1
 470
 69
 68
 67
 +66.2 $\Delta 61^{\circ}57'$ Rt.
 466
 465
 464+24.5 $\Delta 93^{\circ}23'$ Lt.



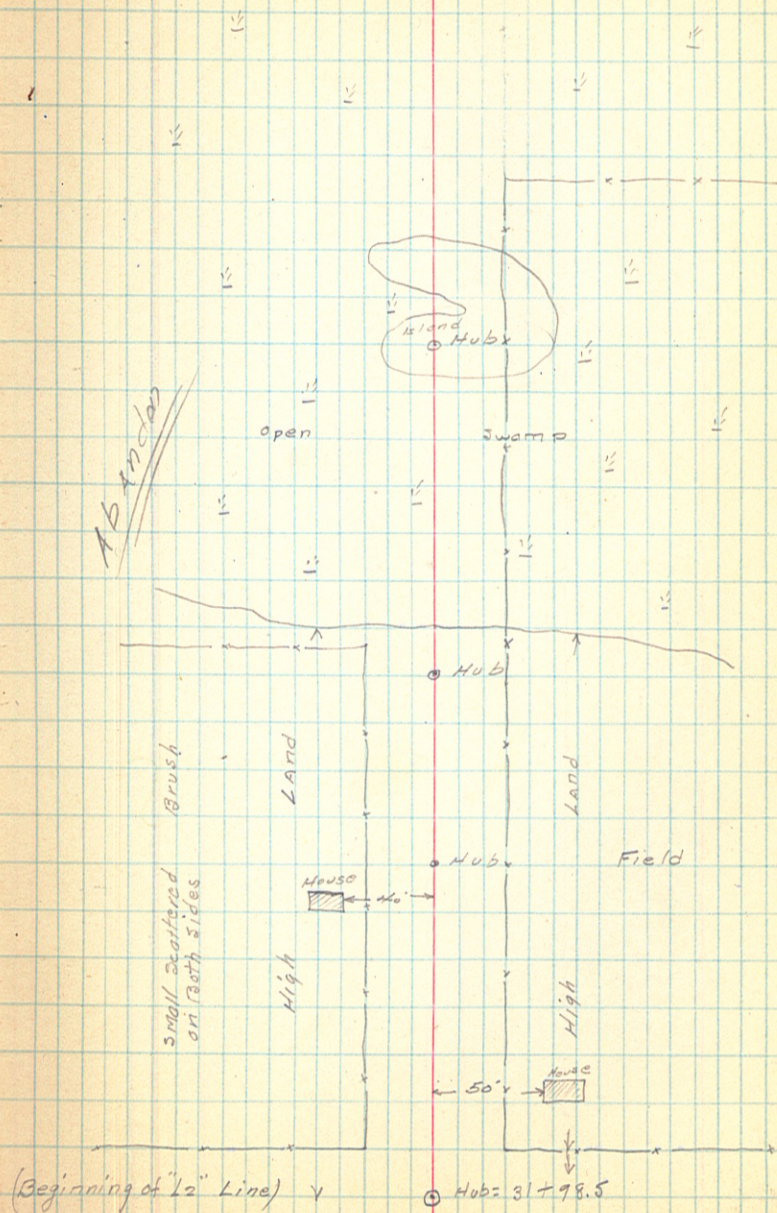
491 + 3/46 (End of Tie Line Joining)
491 State Road No 4 at 0700
490
89
88
487

52
 51
 50
 49
 48
 47
 +132.0 P.O.T.
 46
 45
 44
 43
 42
 41
 +62.9 P.O.T.
 40
 39
 38
 +61.1 P.O.T.
 37
 36
 35
 34
 33
 32
 31 +96.5

Abandon

(12" Line)

31

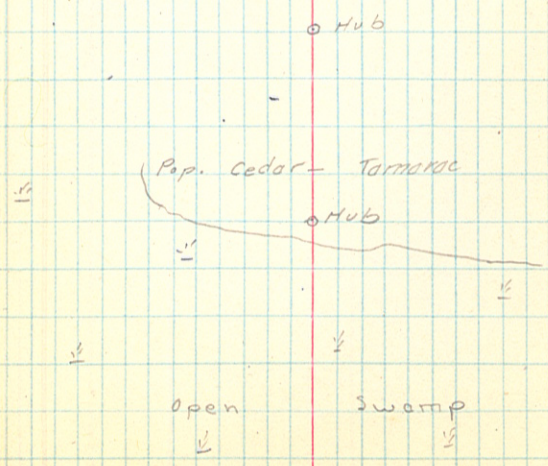


(Zelina)

32

62 O.P.O.T.
 61
 60
 59
 +50.3 O.P.O.T.
 58
 57
 56
 55
 54
 53

Abandon



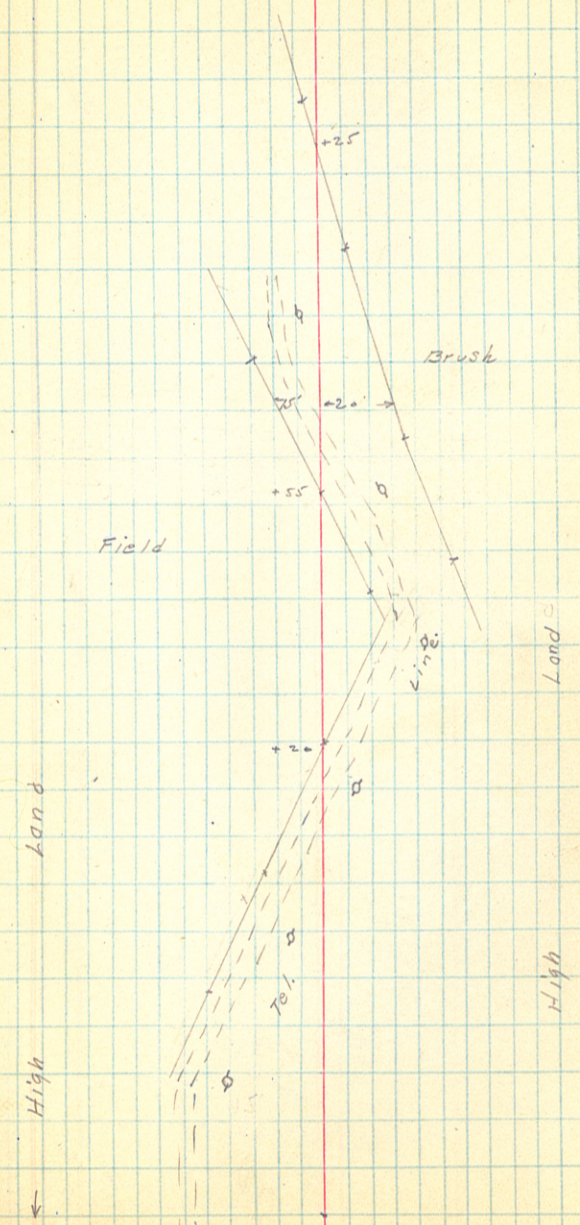
44	
43	
42+12.7 = EC.	25°40' ✓
42	25°02' ✓
+75	23°47' ✓
+50	22°32' ✓
+25	21°17' ✓
41	20°02' ✓
+75	18°47' ✓
+50	17°32' ✓
+25	16°17' ✓
40	15°02' ✓
+75	13°47' ✓
+50	12°32' ✓
+25	11°17' ✓
39	10°02' ✓
+75	8°47' ✓
+50	7°32' ✓
+25	6°17' ✓
38	5°02' ✓
+75	3°47' ✓
+50	2°32' ✓
+25	1°17' ✓
37	
36+99.4 = BC.	0°00'

Pl. = 39+74.8
 A 51°20' AT.
 D = 10°
 T 275.4
 L = 513.3

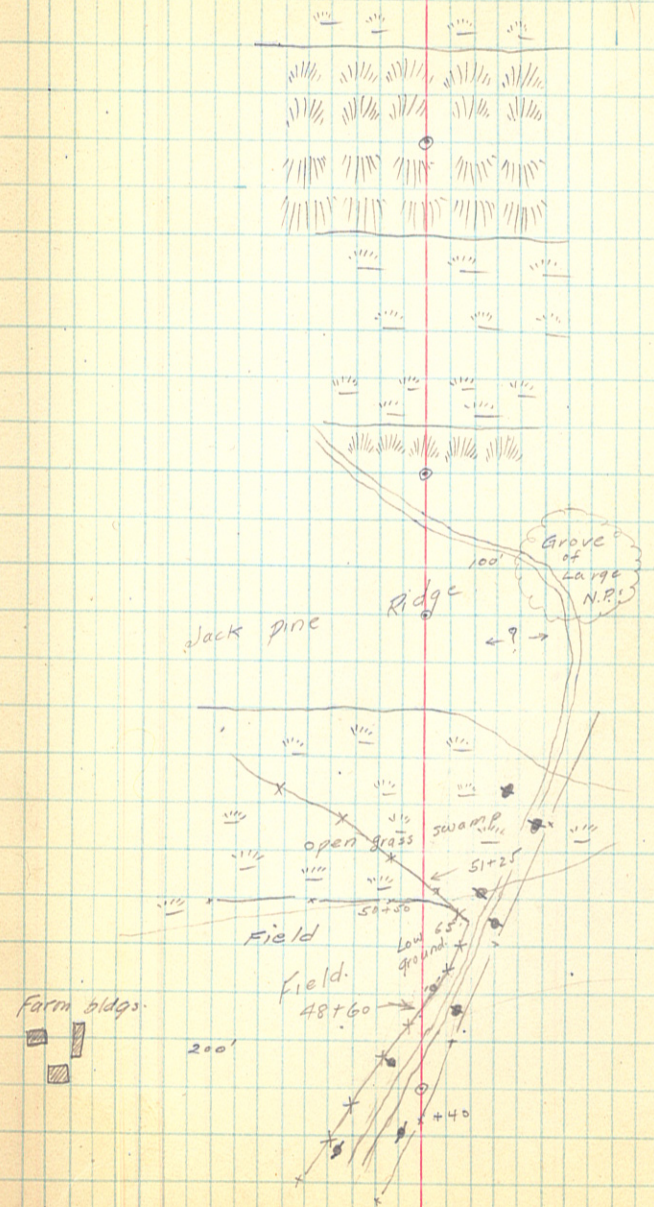
R.P.S.
 T.P. to N.E. = 23.6
 FIRST AX = 23.8

2. Line

33



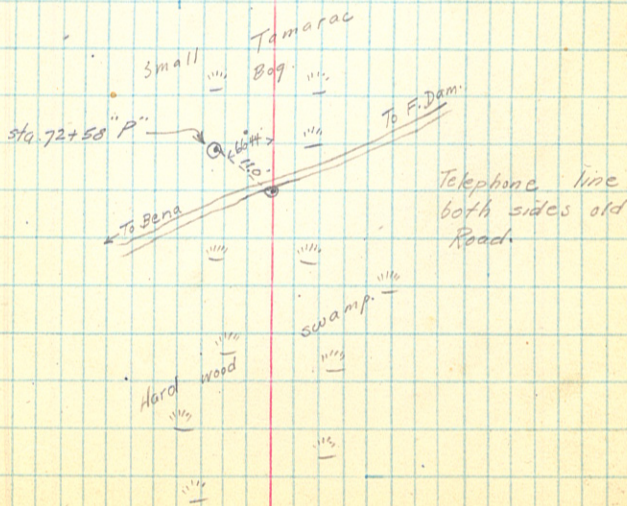
+25		Enter tog alder swamp.
62		
+76 ²	○ P.O.T.	on E+W Ridge.
61		
+75		Leave small bog.
60		
59		
58		
+50		Enter small bog.
57	○ P.O.T.	J.P. hub. 3 ^o on south edge of Ridge.
+20		
56		
+13 ¹	○ P.O.T.	
55		
+65		
54		
53		
52		
51		
50		
49		
48		
47+00	○ P.O.T.	
46		
45		



83
 82
 +12.3 O P.O.T. Birch Hub.
 81
 80
 79
 78
 77 O P.O.T. Balsam Hub.
 76
 +42.2 O P.O.T.
 +20 Leave swamp Enter High Land
 75
 74
 73
 72
 71
 70
 69
 +76.5 O P.O.T. Maple hub. on N. edge of old road.
 68
 67
 66
 65
 64
 63

High Land.
 Scattering Large N.P.s
 Small brush.

spruce Thicket



Line

36

941252

+25		20°40' ✓
93		19°25' ✓
+75		18°10' ✓
+50		16°55' ✓
+25		15°40' ✓
92		14°25' ✓
+75		13°10' ✓
+50		11°55' ✓
+25		10°40' ✓
91		9°25' ✓
+75	P.O.C.	8°10' ✓
+50		6°55' ✓
+25		5°40' ✓
90		4°25' ✓
+75		3°10' ✓
+50		1°55' ✓
+25		0°40' ✓

P.I. 91 + 886
 A 51' 45" L_A
 T 227.9
 Lc 517.5

89 + 11.7. B.C. 10° 6' L.

89
 88
 +658 O.P.O.T.

87
 86
 85
 84

P.I. in old Road
 "P"
 Sta. 97 + 82 = 9.8 L_A

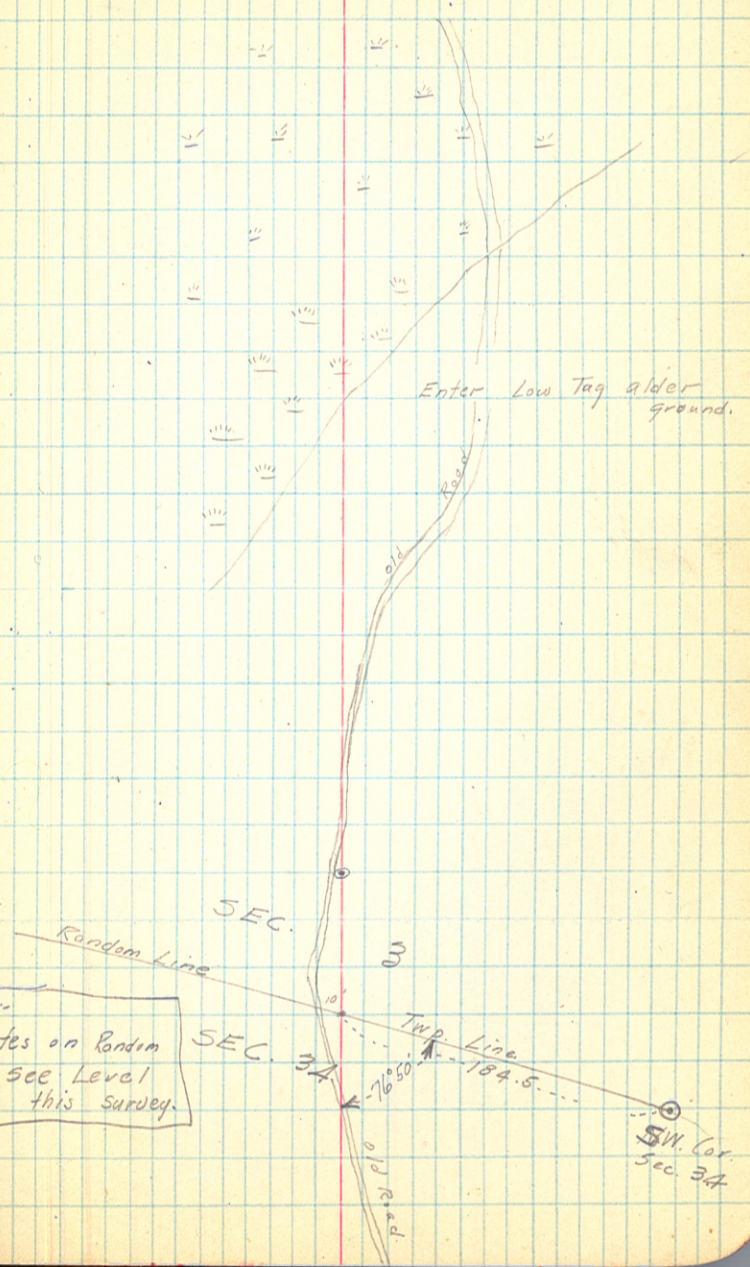
↑
 Low
 ↓
 Ground

+75	21°14'
+50	19°59'
+25	18°44'
100	17°29'
+75	16°14'
+50	14°59'
+25	13°44'
99	12°29'
+75	11°14'
+50	9°59'
+25	8°44'
98	7°29'
+75	6°14'
+50	4°59'
+25	3°44'
97	2°29'
+75	1°14'
+50 ±	B.C. 10°CL
96	
95	
+31 1/2	
+29 1/2	E.C. 25°52 1/2'
94	24°25' ✓
+75	23°10' ✓
+50	21°55' ✓

PI. 99+142
 Δ 49°31' LT
 D 10°
 T 264.3
 Lc 495.2

2" Line

37



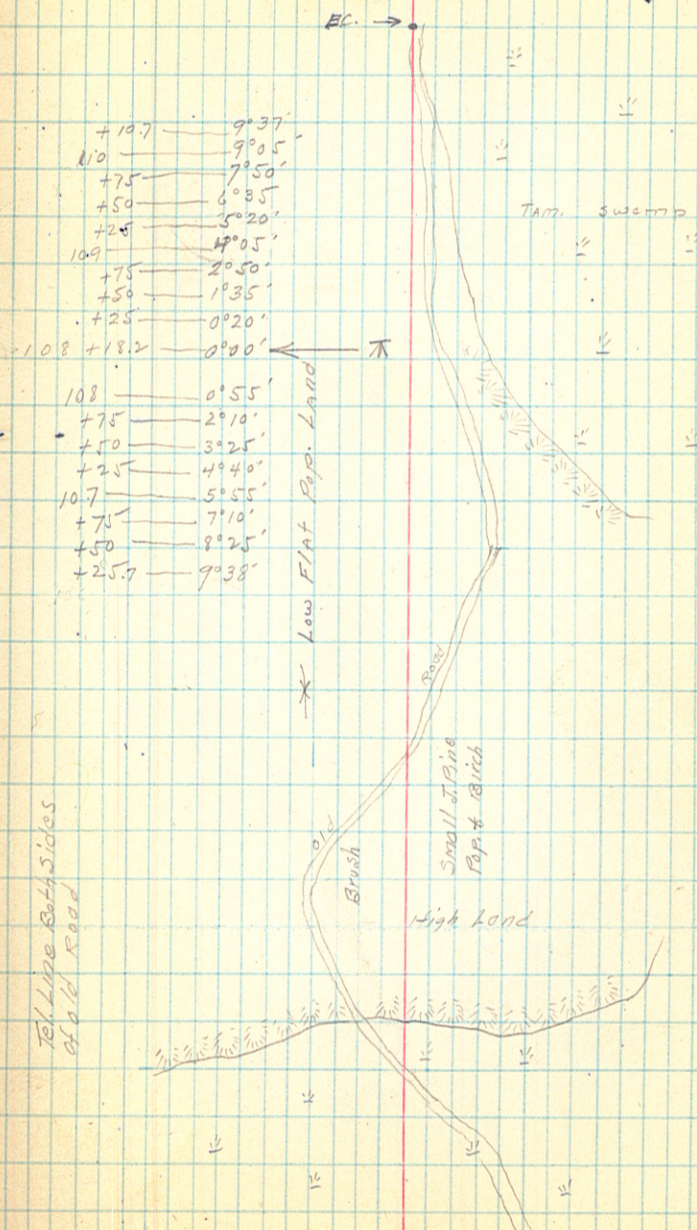
Notes:
 For notes on Random
 Line - see Level
 book this survey.

+10.7	E.C.	19°15'
110		18°43'
+75		17°28'
+50		16°13'
+25		14°58'
109		13°43'
+75		12°29'
+50		11°13'
+25		9°58'
108		8°43'
+75		7°28'
+50		6°13'
+25		4°58'
107		3°43'
+75		2°28'
+50		1°13'
+25.7	BC 10° C.R.	0°00'
106		
105		
104		
103		
102		
+45 ^{1/2}	E.C.	24° 45 ^{1/2} '
+25		23° 44'
101		22° 29'

P.I. 108+25.8
 Δ 38° 30' R.
 Dc. 10° R.
 T- 200.1
 Lc. 385.0
 E. = 33.94
 Middle pt. 108+12.2

L'Line

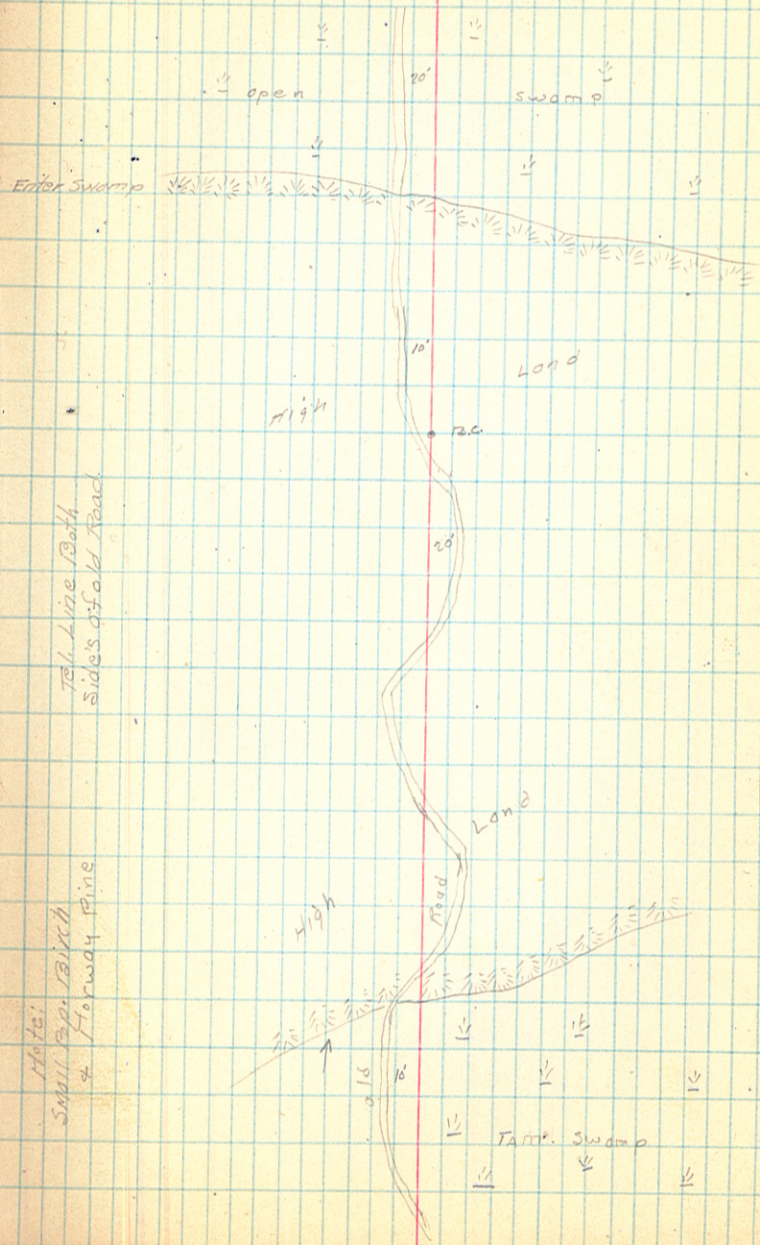
38



+50	1° 54 1/2
130	1° 39 1/2 ✓
+50	1° 24 1/2
129	1° 09 1/2 ✓
+50	0° 54 1/2 ✓
128	0° 39 1/2 ✓
+50	0° 24 1/2 ✓
127	0° 9 1/2 ✓
+683	B.C. Hub: 0° 00'
126	
125	
124	
123	
122	
121	
120	
119	
118	
117	0 Pot.
116	
115	
114	
113	
112	
111	

$R1 = 129 + 77.8$
 $A = 6^{\circ} 11' R$
 $D = 1^{\circ}$
 $T = 309.5$
 $L = 618.3$
 $Ext = 84'$

Line



151

150

149

148

147 0 Pot.

146

145

144

143

142

+771 0 Pot.

141

Leave Swamp

140

139

138

137

136

135

134

133

+866 - E.C.

$3^{\circ} 05' \frac{1}{2}$

+50

$2^{\circ} 54' \frac{1}{2}$

132

$2^{\circ} 39' \frac{1}{2}$

+50

$2^{\circ} 24' \frac{1}{2}$

131

$2^{\circ} 09' \frac{1}{4}$

21" line

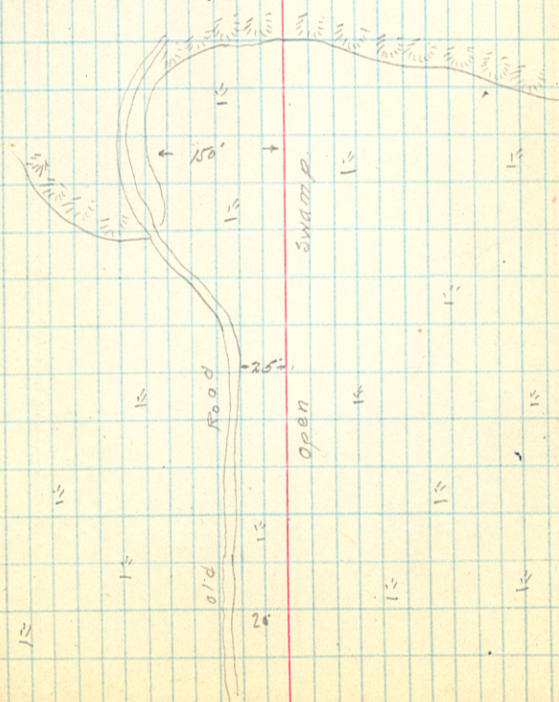
40

Small Pop. + Birch

land

sign

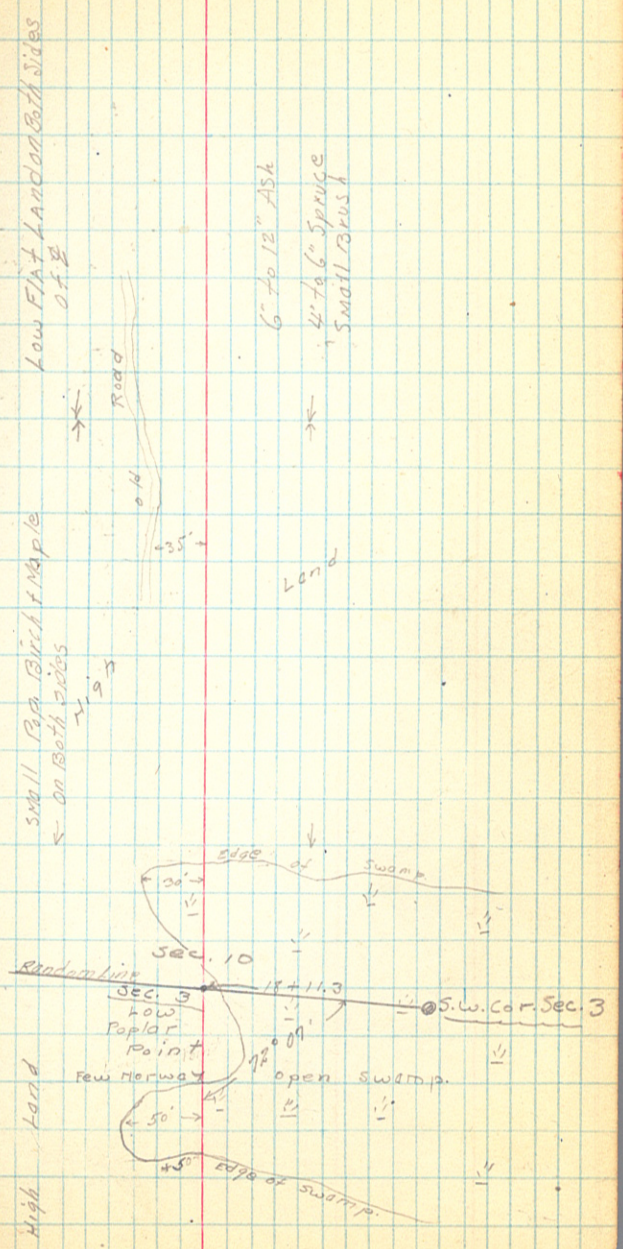
(21" line both side old Road)



170	1° 03' ✓
+50	0° 33' ✓
169	0° 03'
168 + 94.1 = 136.	0° 00'
168	
167	
+ 89.4	O.P.O.T.
166	
165	
164	
163	O.P.O.T.
162	
+ 74.2	O.P.O.T.
161	
160	
159	
158	
157	
156	
+ 10.4	Random Line
155	155 + 10.4 = 2i Line = 18 + 11.3 = on Sec. Line
154	
153	
152	
151 + 58.8	O.P.O.T.

2i Line

F 41



186			
185			
+966	O.P.O.T.		
184			
183			
182			
181			
180			
+200	O.P.O.T.		
179			
178			
177			
176+584	E.C.	7°35'	
176		7°03' ✓	
+50		6°33' ✓	
175		6°03' ✓	
+50		5°33' ✓	
174	P.O.C.	5°03' ✓	1°30'
+50		4°33' ✓	
173		4°03' ✓	
+50	P.O.C.	3°33' ✓	0°00'
172		3°03' ✓	
+50		2°33' ✓	
171	P.O.C.	2°03' ✓	
170+50		1°33' ✓	

$$P.H. = 172 + 75.5$$

$$\Delta = 15^\circ 10' 14''$$

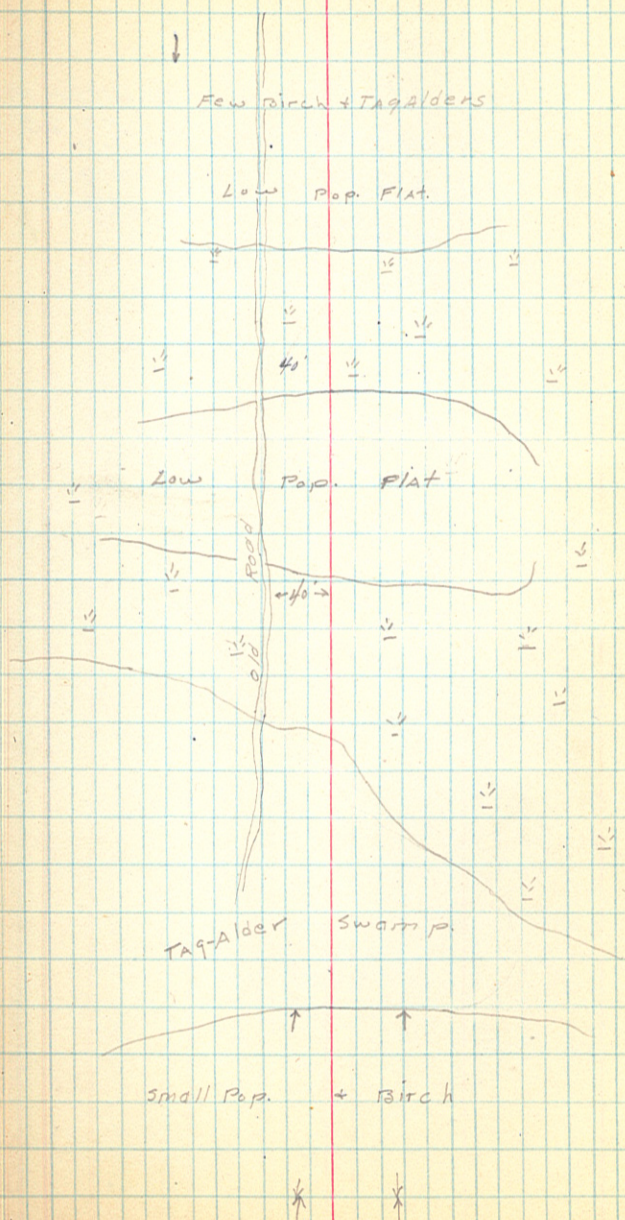
$$D.C. = 2^\circ$$

$$T = 381.7$$

$$L.C. = 758.3$$

"LiLine"

42



+50	P.O.C.	17°20'	6°15'	
+25		16°05'	5°00'	P.I. = 198 + 17.3
198		14°50'	3°45'	A = 57°25' R+
+75		13°35'	2°30'	D = 10°
+50		12°20'	1°15'	T = 313.8
+25	P.O.C.	11°05'	0°00'	L = 574.2
197		9°50'		
+75		8°35'		
+50		7°20'		
+25		6°05'		
196	P.O.C.	4°50'		
+75		3°35'		
+50		2°20'		
+25		1°05'		
195 + 0.35 = 136.		0°00'		
195				
194				
193				
192				
191				
190				
+84.4	O.P.O.T.			
189				
188				
187				

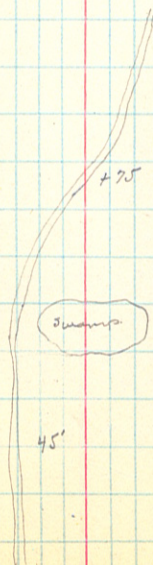
2. Line

43

Thick Birch - Poplar + willows
4" - 6" stuff

Plat. -
Lawn Raises slightly
from Sta. 193 to 196 that from
there on

Thick Tamaracs Pop + Small Birch



2.13 + 3.84 = "Li" Sta. = 32 + 9.6 on Random Line E+W.

+ 16.4 @ Pot.

13

12

11

210

+ 5.94 @ Pot.

209

8

7

6

205

4

3

2

1

200 + 77.7 = 28° 43' 5" 02'

+ 50 27° 20' 3" 45'

+ 25 26° 05' 2" 30'

200 Pot. 24° 50' 1" 15'

+ 75 Pot. 23° 35' 6" 15'

+ 50 22° 20' 5" 00'

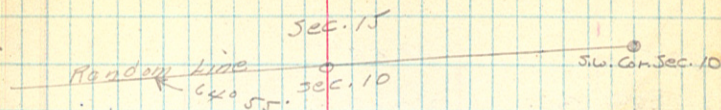
+ 25 21° 05' 3" 45'

199 19° 50' 2" 30'

198 + 75 18° 35' 1" 15'

"Li" Line

44



Few scattered 6" to 10" Paper

*

Thick 4" to 6" Pop. Birch - Maple

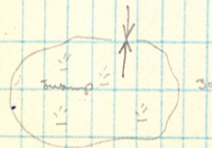
235 $0^{\circ} 25'$
 234+788=BC. $0^{\circ} 00'$
 234
 233 O.Pot.
 232
 231
 230
 229
 228
 +08.4 O.Pot.
 227
 226
 225
 224
 223
 +41.4 O.Pot.
 222
 221
 220
 219
 218
 217
 216
 215
 214

Note:
 Left Curve out
 at Sta 222+41.4 and
 Running on tangent.
 By turning A to left it
 would throw me to far
 from old Govt Trail
 C.S.B.

"21" Line

Page 45

Few scattered 6" to 10" Paper



Thick 4" to 6" Maple - Ash - Paper + Birch

+ 28.6 O.P.O.T.

251

250

249

248

+ 44.2 O.P.O.T.

247

246

245

+ 24.4 O.P.O.T.

243

+ 89.7 O.P.O.T.

242

241

+ 0.8° O.P.O.T.

240

239+500 E.C. 9° 25' 1/2"

239 8° 25' ✓

+50 P.O.C. 7° 25' ✓

238 6° 25' ✓

+50 5° 25' ✓

237 P.O.C. 4° 25' ✓

+50 3° 25' ✓

+23.6 2° 25' ✓

+50 1° 25' ✓

P.H. = 237 + 16.6
D 11° 51' R.H.
Dc = 4°
T = 237.8
Lc = 471.25
Ext = 19.6

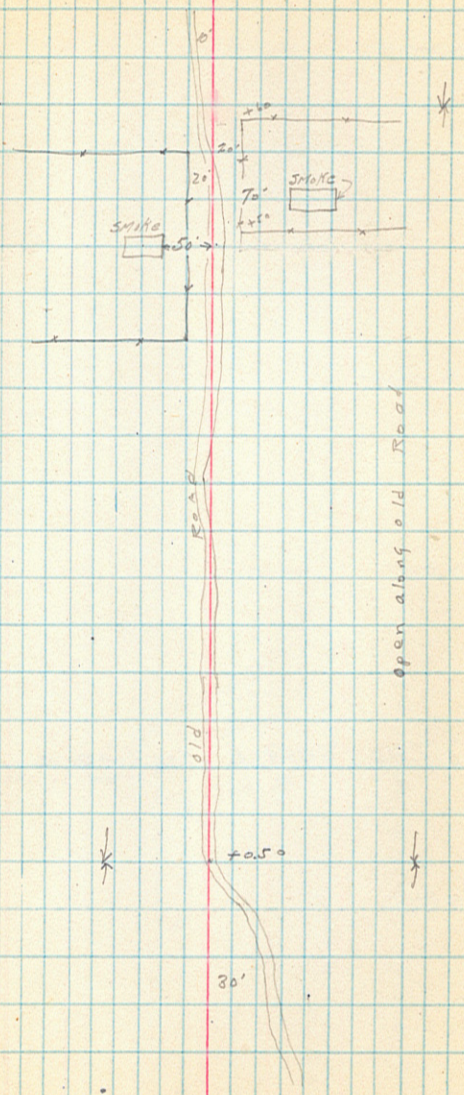
Thick 4" 46" Maple - Birch - Poplar - Ash

Few 8" 10 1/2" Ash

269		
268		
267		
266		
265+15.2	FC.	= 8° 40'
265		= 8° 22' ✓
+50		= 7° 22' ✓
264		= 6° 22' ✓
+50		= 5° 22' ✓
263	ROC.	= 4° 22' ✓
+50		= 3° 22' ✓
262		= 2° 22' ✓
+50		= 1° 22' ✓
261		= 0° 22' ✓
260+81.9	B.C.	= 0° 00'
260		
259		
258		
257		
+64.5	o Pat.	
256		
255		
254		
253		
252		

P.I. = 263+00
 Δ = 17° 19' Lt.
 D = 4°
 T = 218.1
 Lc = 433.3
 Ext. = 16.5

Tel. line both sides
 at a 16' Road



+ 954 O.P.O.T.

288

287

286

285

284

283

+ 494 O.P.O.T.

282

281

280

+ 476 O.P.O.T.

279

278

277

276 + 06.8 = Liline = 25 + 93.6 = Sec. Line

276

275

+ 162 O.P.O.T.

274

273

272

271

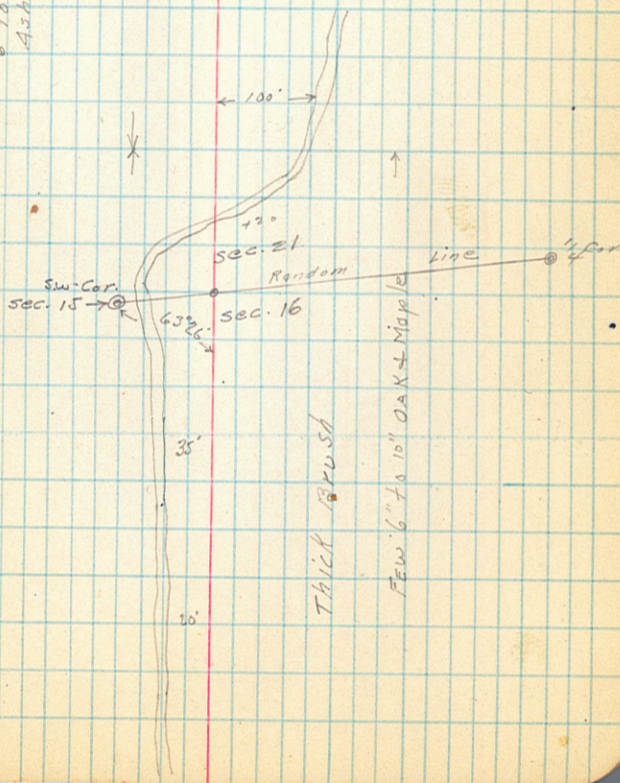
+ 152 O.P.O.T.

270

Liline

48

Thick Brush with
6" to 10" Poplar + Oak + Maple
434



Top line with
2063 at top

Thick Brush

Few 6" to 10" Oak + Maple

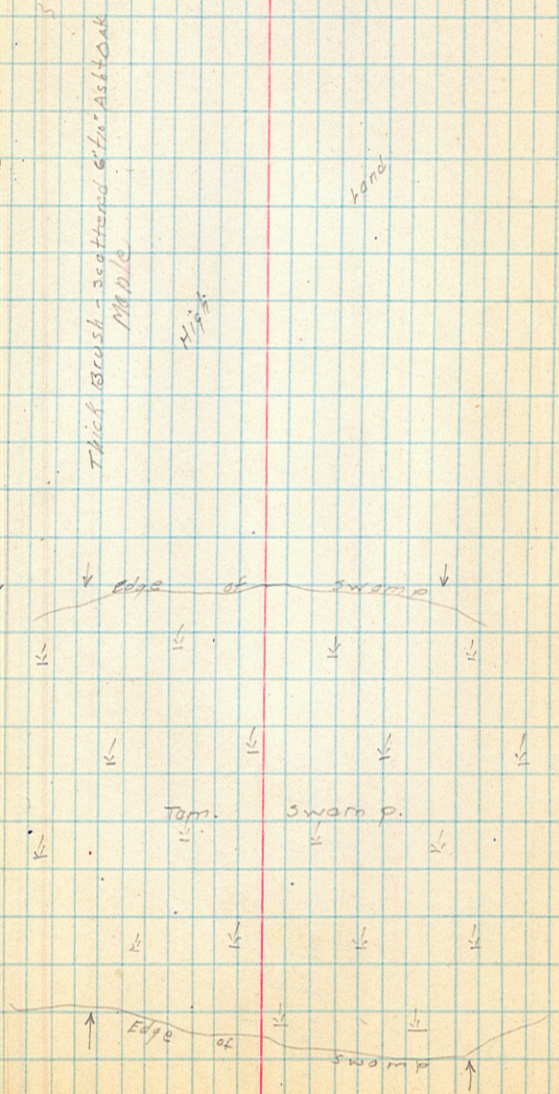
+50 6°07'
 306 5°22'
 +50 4°37'
 305 P.O.C. 3°52'
 +50 3°07'
 304 2°22'
 +50 1°37'
 303 0°52'
 302 +41.7 = B.C. = 0°00'
 302
 301
 +15.4 O.P.O.T.
 300
 299
 298
 297
 296
 +71.7 O.P.O.T.
 295
 294
 293
 292
 291
 290
 289

$P.L. = 306 + 11.5 = \frac{1}{16} \text{ Cor}$
 $\Delta = 21^\circ 55' \text{ LT.}$
 $D_c = 3^\circ$
 $T_c = 369.8$
 $L_c = 730.5$

Liline

49

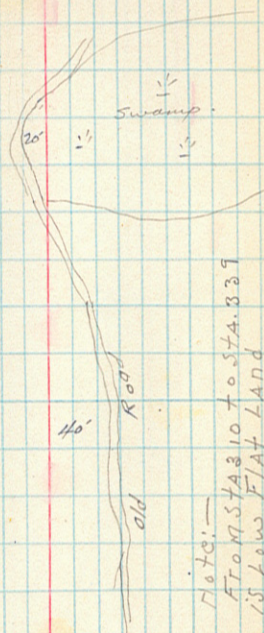
Note:
 This Top. Swamp is
 High Land - Dry.



+50		0°15'
+337	B.C. 3°C.L.	0°00'
325		
324		
323		
322		
321		
320		
319	O.P.O.T.	
318		
317		
316		
315		
+72.0	O.P.O.T.	
314		
313		
312		
311		
310		
309+72.2 = E.C.		10°57½'
+50		10°37' 1°30'
309		9°52' 0°45'
+50	P.O.C.	9°07' ✓ 2°15'
308		8°22' ✓ 1°30'
+50		7°37' ✓ 0°45'
307	P.O.C.	6°52' ✓

Zizine

50



Thick Brush - Scattered 6" to 10"
Oak - Ash - Maple

341

340

339

338

337

336

335

+94.8 EC.

14°25'

+50

13°45' 6°45'

334

P.O.C.

13°00' 5°15'

+50

12°15' 4°30'

333

11°30' 3°45'

+50

10°45' 3°00'

332

10°00' 2°15'

+50

9°15' 1°30'

331

8°30' 0°45'

+50

P.O.C.

7°45' P.I. = 330 + 24.7

330

7°00' Δ = 28°50'
Dc = 3°

+50

6°15' T = 491.0
Lc = 961.1

329

5°30'

+50

4°45'

328

P.O.C.

4°00'

+50

3°15'

+05.9 O Post.

Center old road.

327

2°30'

+50

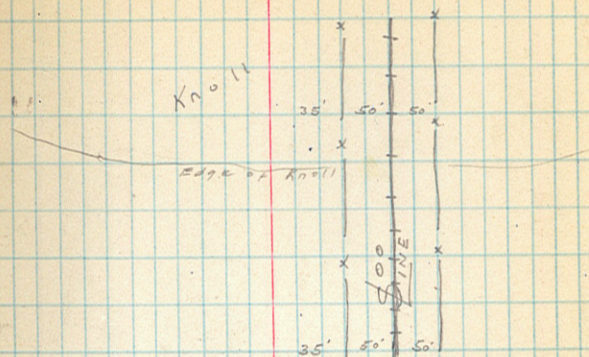
1°45'

326

1°00'

(1" line) 9/11/22 Rain. Quit 5:15 pm.

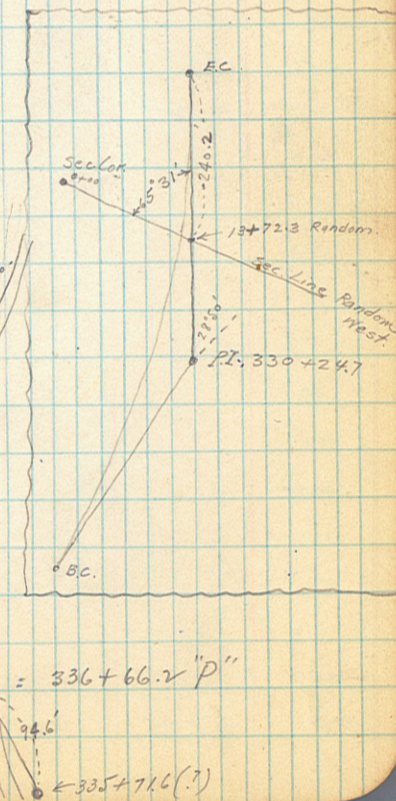
51



Few large trees
Oak - Maple - Ash - 6" to 10" tall

"P" Line

End Location 9/11/22



366
 365
 364
 363
 362
 361
 360
 359 © P.O.T.
 359
 357
 356
 355 © P.O.T.
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 342 © P.O.T.

2" Line

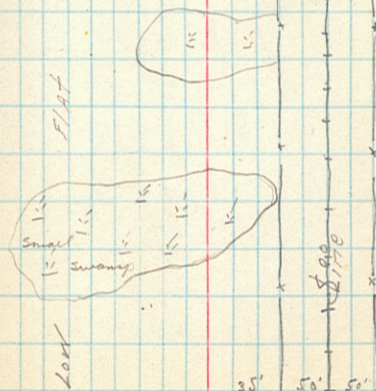
Page 2 = 52

Notes -
Need Culvert at Sta. 363

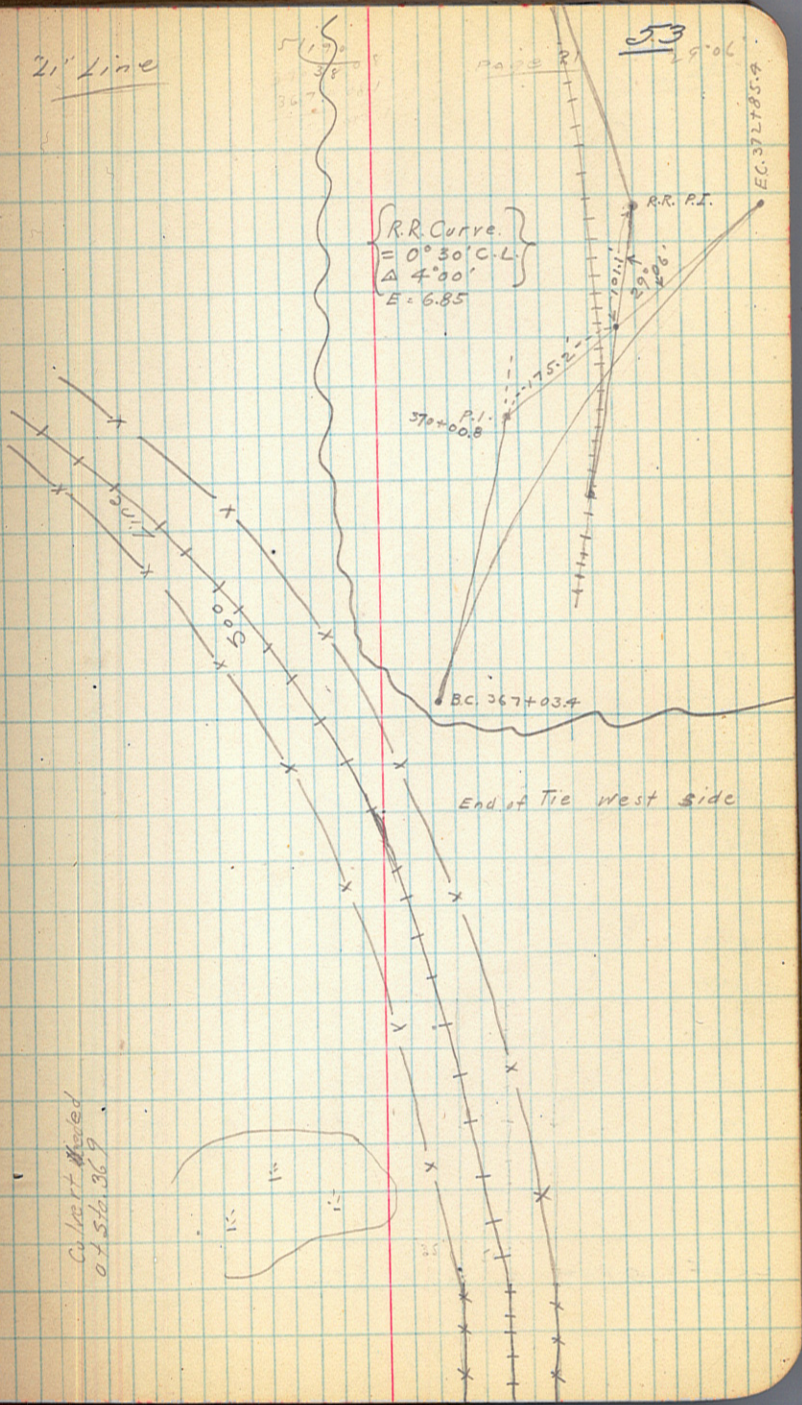
6" x 10" Maple Ash

High Load

Notes -
Culvert at Sta.
347+50



+66.2	P.O.T	= 384+65.1	"P" line
373			
+85.4	E.C.		14°33' ✓
+50			13°40' ✓
372			12°25' ✓
+50			11°10' ✓ P.I. 370+00.8
371			9°55' ✓ Δ 29°06' R.
+50			8°40' ✓ D. 5'
			7°25' ✓ T. 297.4
370			6°10' ✓ Lc 582.0
+50			6°10' ✓
369			4°55' ✓
+50			3°40' ✓
368			2°25' ✓
+50			1°10' ✓
+08.1	P.O.S.T.		
+03.4	BC. 5°-R.		0°00'
367			



394.
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 374
 +66 = O.P.O.T. = '384+654" P'
 373

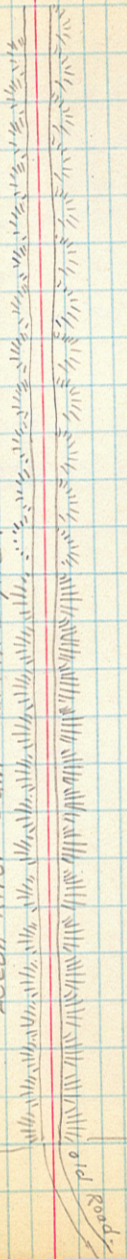
(2)

(Beginning of Guard Rail on Lt. = 378+77)
 (End of Line & outside of Guard Rail)

River Slough

Bottoms

Acad. River Dam Earth Dyke



Line.

9/2/22

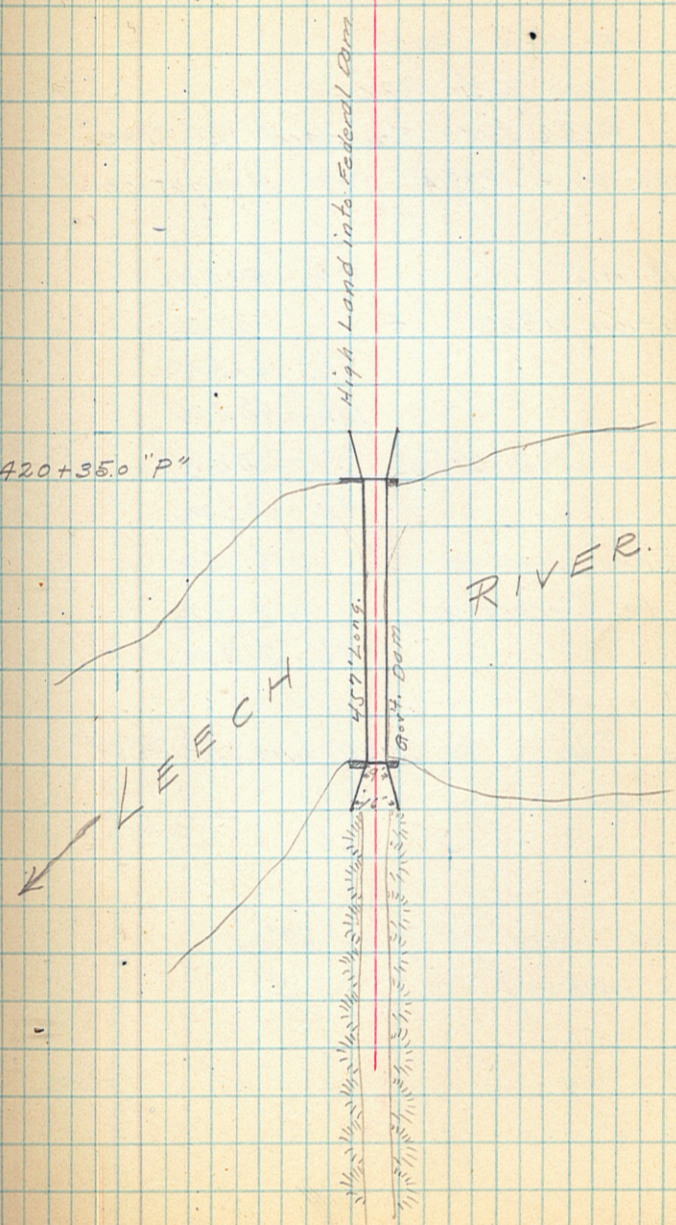
54

Tie Angles to connect
L^o Line to Meridian Base Line.

Point #1.	Pointing To.	Angle.	B. S.	True Bearing
409+38.2	Point #1.	77°05' L.	373+66.2	Base line
Point #1.	W. end Base line	75°11' R.	409+38.2	= 589°03' E.
W. end Base line	E. end Base line	91°00' L.	Point #1.	For observation Notes see next page.

- +54.2 End 3" Pipe railings.
- + 38.2 End Concrete driveway.
- 409
- 408
- 407
- 406
- 405
- +81.2 End Concrete driveway.
- +65.2 End Pipe railings.
- 404
- 403
- 402
- 401
- 400
- 399
- 398
- 397

= 420+35.0 "P"



P. 24.
Polaris Observation.

Place: Federal Dam.

Date: Aug. 30th 1922.

Time: 9:22 P.M. Standard 90° Time.

Azimuth: West. $1^{\circ}38'$ East Elongation.

Aug. 15, 1915 9h. 59.8m.

Correction 1922 + 3.1m.

9h. 62.9m.

= 10h. 02.9m.

Daily Correction 15th to 30th - 58.8m.

9h. 04.1m.

Longitude Correction + 16.68m

Latitude Correction + 1.16m

9h. 21.9m.

Angle: Polaris to Base line Rt. $89^{\circ}19'$
+ Azimuth $1^{\circ}38'$

 $90^{\circ}57'$

$179^{\circ}60'$ Less $90^{\circ}57' = 89^{\circ}03'$

True bearing S. $89^{\circ}03'$ E.

Base line is approx. \perp of 2nd Ave.
from Birch St. to Pine St.

Soundings on "Li Line"

Sta	Water	Stiff Muck	Peet	Sand	Clay	Bottom
52		1'		3'		To Compact Sand Bottom
53+50		5' 1/2'		1'		To Compact Sand Bottom
58		4'		1'		To Compact Sand Bottom
59		6'		1'		To Compact Sand Bottom
60		4'		1'		To Compact Sand Bottom
63		3'				To Compact Sand Bottom
65		3'		1'		To Compact Sand Bottom
67		3'		1'		To Compact Sand Bottom
72+50		6'		1/2'		To Compact Sand Bottom
74		5'		1/2'		To Compact Sand Bottom
102+50		3'				To Compact Sand Bottom
129		2'				To Compact Sand Bottom
131		5'		1'		To Compact Sand Bottom
133		6'		1/2'		To Compact Sand Bottom
135		4'				To Compact Sand Bottom
138		6'		1/2'		To Compact Sand Bottom
139+50		4'		1/2'		To Compact Sand Bottom
153+50		5'		1/2'		To Compact Sand Bottom
156+250		3'				To Compact Sand Bottom
176		5'		1'		To Compact Sand Bottom
180+50		4'				To Compact Sand Bottom
182		4'				To Compact Sand Bottom
190+750		5'		1/2'		To Clay Bottom
289		3'				To Sand Bottom
298		7'				To Compact Sand Bottom
295+50		6'				To Compact Sand Bottom

Note: Soundings taken on Li line
 Sept. 13, 1922 - 1927 (part + new)

East Leg of Y

3+043 B.C. 0°00' Δ 97° 23'
 +25 5°10 1/2 D 50°
 +50 11°25 1/2 P.I. 3+68.7
 +75 17°40 1/2 T. 1 30.4
 A+00 23°55 1/2 E.C. 4+99.1
 +25 30°10 1/2 Lc 1 94.8
 +50 36°25 1/2 B.C. 3+04.3
 +75 42°40 1/2 I. 271+52.9
 5+991 E.C. 48°41 1/2

← 271+52.9

615
1230

615
1230

615
6015

50
130
6520.4
650
204

24.1
12016 1/2
333
203
1050'

1304
50) 6520.4
152
150
204
200
4

19476
50) 97.8833
473
450

50
333
150

5° 10 1/2

20.7
15
1035
207
310.5

238
200
383
350
333
300

25
15
125
25
375
360

6° 15"
5 10 1/2
11° 25 1/2
6 15
17 40 1/2
6 15

24.1
15
1205
241
321.5
6° 01 1/2
42 40 1/2
48 42

9684

23 55 1/2
6 15
29 70 1/2
30 10 1/2
6 15
36 25 1/2
6 15
40 1/2

9684

West Leg of Y to #8

2+86°	Bc	0°00'	Δ 82°31'
3+00		2°44'	D. 39°
+25		7°36 1/2	P.I. 3+68.7
+50		12°29	T 129.1
+75		17°21 1/2	EC. 4+97.8
4+00		22°14'	Lc 211.8
+25		27°06 1/2	Bc 2+86.0
+50		31°59'	R 197.6
+75		36°51 1/2	
+97 1/2	EC.	41°18 1/2	

268 + 93.4
state

2° 30 1/2			
3 37 1/2			
5 68			
6 08			
3 37 1/2			
9 45 1/2			
3 37 1/2			
12 83			
13 23			
3 37 1/2			
16 60 1/2			
17 00 1/2	29	6520.4	
3 37 1/2			
20 38			
3 37 1/2			
23 75 1/2			
24 15 1/2			
3 37 1/2			
27 53			
3 37 1/2			
30 90 1/2			
31 30 1/2			
3 3 1/2			
31 30 1/2			
3 37 1/2			
34 68			
35 08			
3 37 1/2			
38 45 1/2			
3 37 1/2			
41 83			
42 23			
3 37 1/2			
45 60 1/2			
96°			

130
17
22° 15'

77

50
6
300

22 24.8

58
58

140
116

244
232

75.0

57.7
17.3
9.7

121.1
1384
150.51

93.5
20
18.5
18.7

30

129.5
1480
1609.5

2° 41'
46 00 1/2
48° 41 1/2

33540

97.3833
87

103
87

168
145

233
232

13

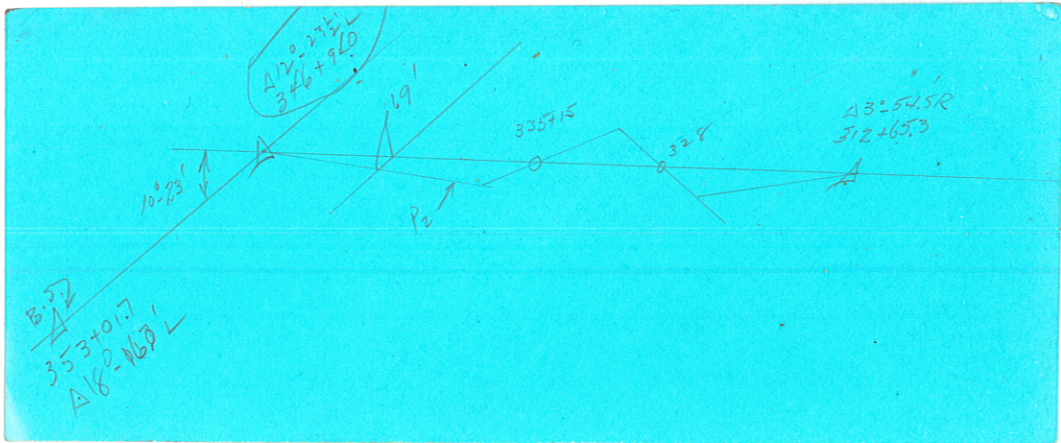
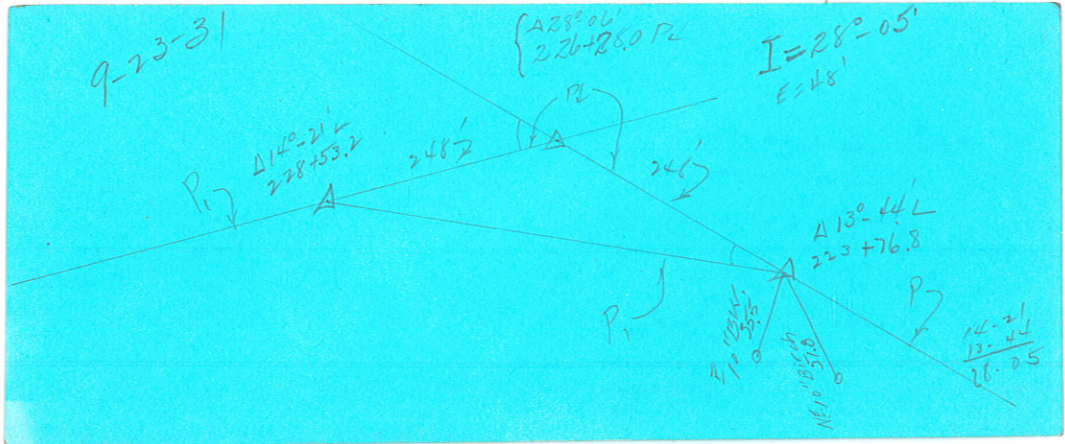
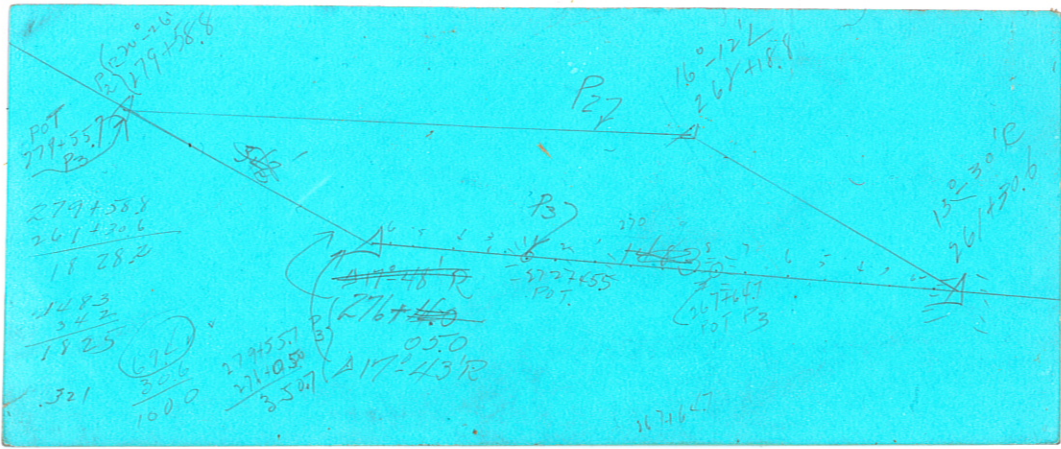
25
8.7

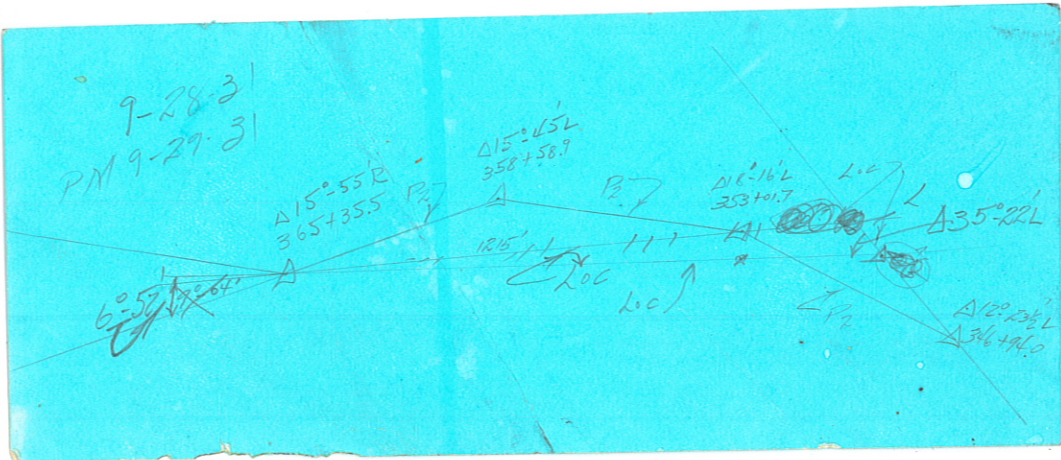
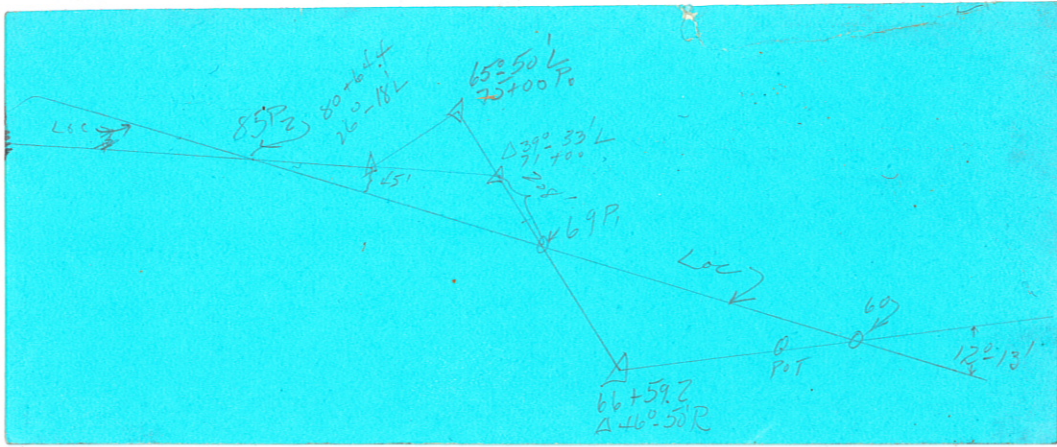
17.5
200

217.5
180

37.0

83"





$$\begin{array}{r} 380 + 99.0 \\ 365 + 55.5 \\ \hline 1563.5 \end{array}$$

$$\begin{array}{r} 411 + 76.6 \\ 380 + 99.0 \end{array}$$

S. A. R. No. _____

JOB No. _____

MINNESOTA HIGHWAY DEPARTMENT

SHEET No. _____

ESTIMATE No. _____

STATE AID HIGHWAY CONSTRUCTION

CONTRACTOR _____

CASS COUNTY

RETURN SHOWING PROGRESS TO _____ 19____ DIV. _____ M _____ TO M _____ STA. _____ TO STA. _____ ENGR. _____

STATION TO STATION	GRADING ITEMS													SURFACING OR GRAVELING ITEMS										
	Clearing Acres	Grubbing Acres	Excavation Cu. Yds.			Hand Ditch Cu. Yds.	Over Haul Cu. Yds.	Guard Rail		Portable Culverts—Lin. Ft.						Hauling Culverts Ton Miles	Stripping Pits Cu. Yds.	Screen & Load Cu. Yds.	Cu. Yd. Miles	Shaping & Compacting Mn. Hrs. Tm. Hr.				
			Earth	Loose Rock	Solid Rock			12 in.	15 in.	18 in.	24 in.	30 in.	36 in.	42 in.	48 in.									
EC. STA 70 0+00	28+30.9	2830.9			90°-00'R	58°-30'E																		
29+93.0	34+80.8	775.7	287.9		56°-31'L	58°-30'W				114.7				767.2										
37+37.6	54+53.5	2024.3	308.4		12°-14'D	524°-59'W				1835.0				855.0										
57+58.1	89+46.1	3495.0	307.0		93°-18'L	537°-13'W				2783.3				2113.9										
93+80.3	105+33.1	1962.6	809.8		24°-37'R	556°-05'E				1095.1		1628.7												
108+35.9	137+93.0	3269.7	312.6		4°-49'R	531°-28'E				2789.1		1706.8												
140+33.7	171+47.8	3355.1	241.2		17°-17½'L	526°-39'E				2998.6		1505.1												
175+76.8	187+54.2	1613.2	435.6		50°-21'R	543°-56½'E				1161.5		1119.3												
187+54.2	199+56.3	1202.1			31°-08'R	56°-24½'W				1194.6				134.2										
199+56.3	1 PT	1720.0			28°-06½'L	537°-32½'W				1363.8				1048.1										
1	2	1914.8			112°-42'L	59°-26'W				1888.9				313.8										
2	3	3085.0			17°-43'R	521°-08'W				2877.5				1112.3										
3	4	2914.4			43°-47'L	538°-51'W				1880.3				1514.5										
4	5	5025.0			35°-28'L	54°-56'E				5006.4		432.2												
5	6	1480.0			6°-35'R	540°-24'E				1127.1		959.2												
6	7	1563.5			32°-52'R	533°-49'E				1299.3		870.4												
7	8	3077.6				500°-57'E				3077.2		51.0												
Total To Date																								
Previous																								
Present																								
Unit Cost																								
Present Cost																								

$27.99.8$ $13.447.1278$ 1146.6 5 1146.6 $12.059.3959$ 1834.9 13.2636095
 $\cos 80^{\circ}30'E = 9.9952033$ $\cos 81^{\circ}30'W = 9.1697021$ $\cos 524^{\circ}59'N = 9.9573346$
 $2830.9 = 3.4519245$ $7757 = 2.8896938$ $2024.3 = 3.3062749$
 $\Sigma = 9.1697021$ $\Sigma = 9.9952033$ $\Sigma = 9.6256772$
 418.43 12.6216266 $W767.8$ 12.8848971 854.97 12.9319521

2783.3 13.4445534 1095.1 13.0394555 2788.7 13.4454284
 $\cos 37^{\circ}13'W = 9.9011062$ $\cos 56^{\circ}05'E = 9.7466237$ $\cos 531^{\circ}28'E = 9.9309205$
 $3495.0 = 3.5434472$ $1962.6 = 3.2928318$ $3269.7 = 3.5145079$
 $\Sigma = 9.7816339$ $\Sigma = 9.7189996$ $\Sigma = 9.7176725$
 2112.9 13.3250811 1628.7 13.2118314 1706.8 13.2321804

2998.7 13.4769279 1268.0 13.1031100 1163.4 13.0657227
 $\cos 26^{\circ}39'E = 9.9512224$ $\cos 43^{\circ}56'E = 9.8573606$ $\cos 8^{\circ}12'W = 9.9955370$
 $3355.1 = 3.5257055$ $1761.0 = 3.2457594$ $1175.4 = 3.0701857$
 $\Sigma = 9.6518004$ $\Sigma = 9.8413129$ $\Sigma = 9.1542076$
 1504.9 13.1775059 1222.0 13.0870723 1676.5 12.2243933

1348.0 13.1297008 1884.2 13.2751368
 $\cos 37^{\circ}44'W = 9.8981038$ $\cos 510^{\circ}12'W = 9.9930814$
 $1704.5 = 3.2315970$ $1914.5 = 3.2820554$
 $\Sigma = 9.7867424$ $\Sigma = 9.2481811$
 1043.1 13.0183394 339.03 12.5302365

2831.2 13.4519747 2129.5 13.3282668 4985.4 13.6977025
 $\cos 16^{\circ}42'W = 9.9812850$ $\cos 35^{\circ}31'W = 9.9105959$ $\cos 58^{\circ}18'E = 9.9954271$
 $2955.9 = 3.4706897$ $2616.2 = 3.4176709$ $5038.2 = 3.7022754$
 $\Sigma = 9.4584271$ $\Sigma = 9.7641311$ $\Sigma = 9.1594354$
 849.40 12.9291168 1519.9 13.1818020 727.30 12.8617108

968.13 12.9859316 1288.5 13.1100953 3491.8 13.5430525
 $\cos 543^{\circ}42'E = 9.8591186$ $\cos 538^{\circ}23'E = 9.8942463$ $\cos 53^{\circ}55'E = 9.9987845$
 $1339.1 = 3.1268130$ $1643.8 = 3.2158490$ $2500 = 3.5440680$
 $\Sigma = 9.8394041$ $\Sigma = 9.7930355$ $\Sigma = 8.8344557$
 975.16 12.9662171 1020.7 13.0088845 2390.7 12.3785257