ATION OF Upper to Lower
y Pipe Line also Upper
Harvey Diverting Dam.
992

F.B. 992

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.

4- 5 × (D + (4 × ½"))

inches

38 + to weld

46 + 80 Knob

51 + 50 Knob

53 + 48 Knob

Index

9

8

7

6

5

+77° Alt. 70°00'Lt N68°00'E

4

3

2

1 +85° P.O.T. △

1 S12°00' S42°00E

0+00 △

20

19

18

17

16

15

14

Abandoned

+7.00 Rt. 53°00' Rt S45°20'E

13

12

11

N81°40'E

10+00.00 Rt. 13°40' Rt.

N68°00'E

End 2-23-161

+61 ≏ ALT. 22°30' LT S67°50E

31

30 +62 ≏ POT

30

29

28

27

26

25

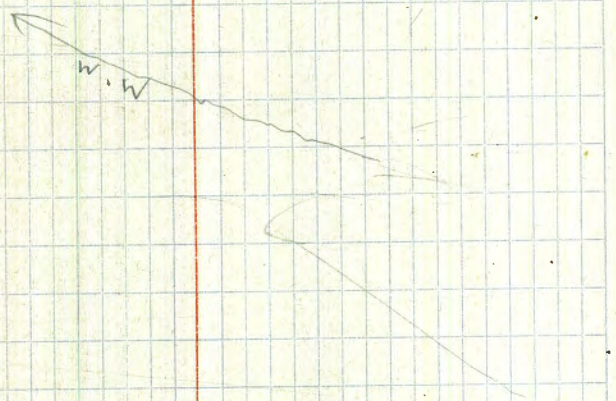
24

23

22

21 S45°20E

43
42
41
40
39
38
37
36
35
34
+75°00 A P.O.T.
33
32 S67°50'E



54

53+48

53

52

51+80

51

50

49

48

47

46

45

44

567°50E

50'

< 100 >

65

64

63+00 P.O.T

62

61

+44

60

59

58

57

57+16.00 Δ P.O.T

56

55

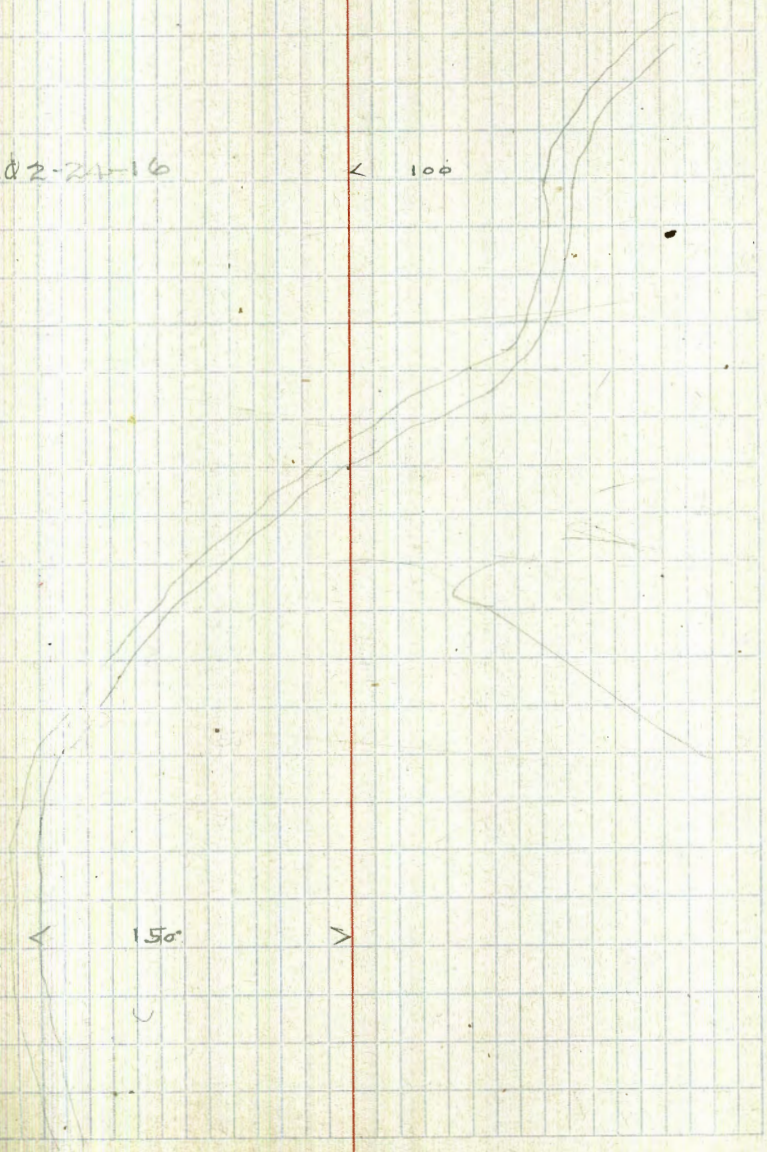
Abandoned

S67°50E

End 2-21-16

< 100

< 150 >



74+15 W

74+15

74

73

72

71

70

69+23

69

68

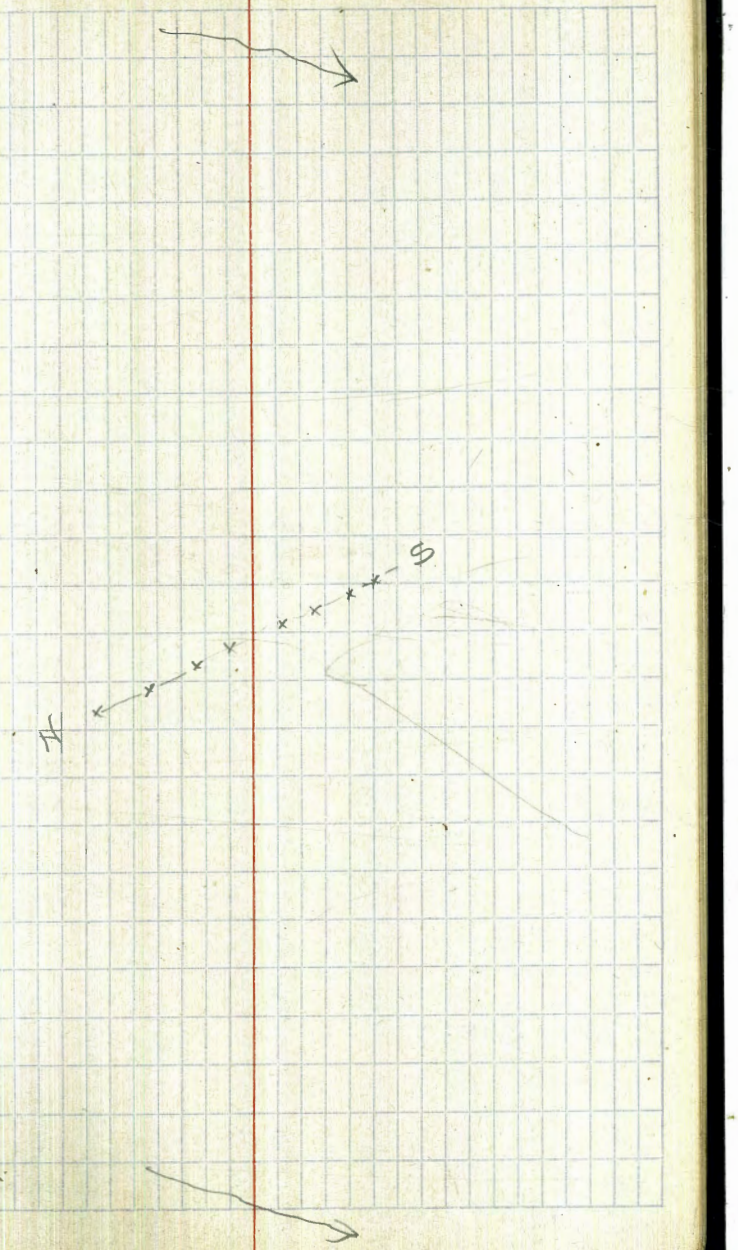
67+70 POT

67

66

65+50

S 67°50' E



+10 P.O.T.

85

84

83

82

81

80

79+50

79

78

77

76

75

S67°50'E

96+20

96

95

94

93+20° POT

92

91

90

89

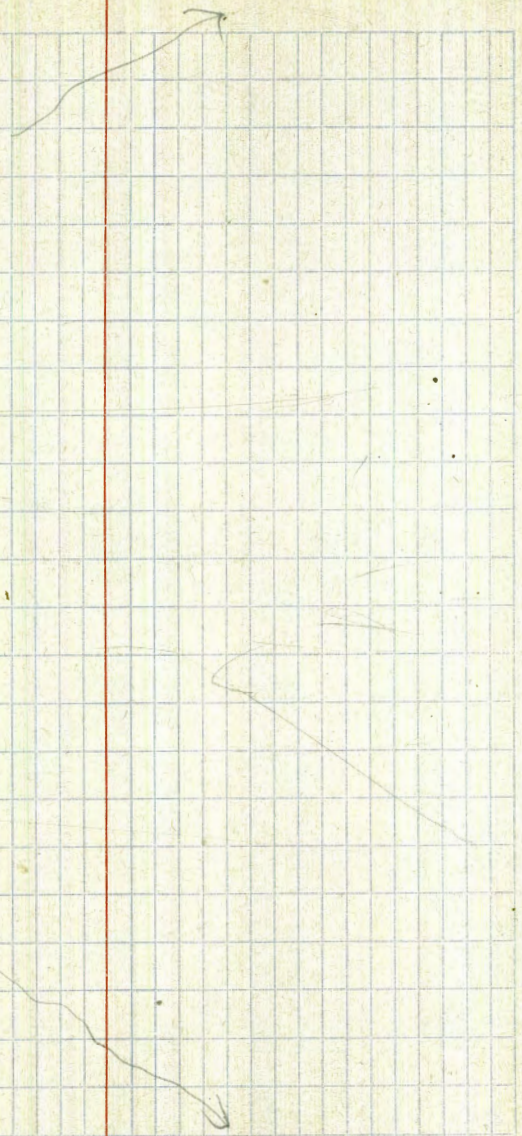
88

87+45

87

86

567°50'E



107

106

105+85 P.O.T

5

4

3

2

1

100

99

98+50 P.O.T

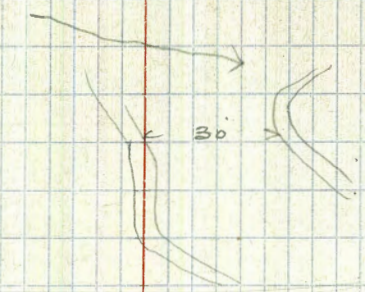
98

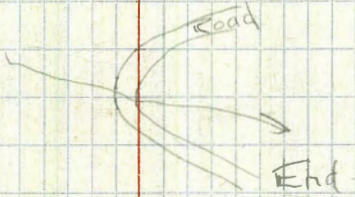
97

S67°50E

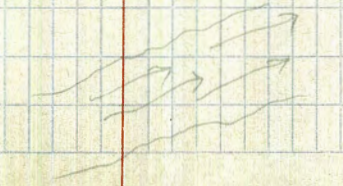
138+70	△Rt.	42°00' Rt	S60°10'E
135+80			
129+39	P.O.T		
124+70	△Lt.	34°20' Lt	N77°50'E
124+25	P.O.T.		
115+30			
111+35	P.O.T		
111			
110			
109			
108	Ft. of cliff		
107+75			
107+50			S67°50'E

End 2-28-16





End 2-25-16



152

151

150

149

148

147

146

145

144

143

142

141

140+15

S 60° 10' E

4

3

2

1

160

9

8

7

6

5

4

153

N40°10E

152+38= △Lt. 79°40 Lt

S60°10E

173+99	Δ Rt		9°00' Rt	N47°50' E
173				
172				
171+36	Δ Rt		22°50' Rt	N38°50' E
170				
169				
+98	Δ Rt		19°50' Rt	N16°00' E
168				
167				
+96	Δ Lt,		28°00' Lt	N08°50' W
166				
				N24°10' E
+86	Δ Lt		16°00 Lt	
165				
				N40°10 E

Abandoned

End 3-1-16

End 3-2+16

+90 Δ Rt

182

181

180

179

178

177

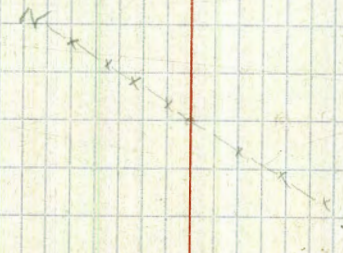
176

+95 773.5

+165 Δ Rt. 5°10' Rt N53°00E

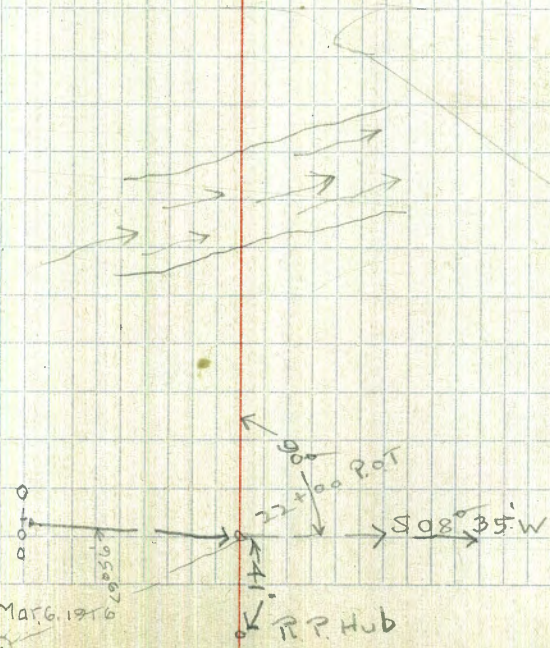
175

174 N47°50E



11
10
9
8
7
6
5
4
+40
3
+74
2
1 S81°25'E

0+00 Intake line
=22+00 Of Upper to Lower Dam line P.o.T.



Obs. Polaris Mar. 6. 1916
Star at Western Elongation at 8-12 P.M. Azth of Star 52½° N Lat 51°21'

Mag

20

19+00 P.O.T.

18

S66°25'E

+64.68 P.T. see opp. page 11°45' 23°30'

+50 R=200 PT=17+05

17 T=41.60

+82.60 P.C. see opp. page

+64

16

15

14

S89°55'E

+64.81 E.C. 4°15' 8°30'

+50 R=200 13+50 P.T.

+35.14 P.C. T=14.86

13

12

S81°25'E

Changes

19

Offset 3' Rt. from old line

18+63.83 P.T. <10'> New P.T. = 17+63.53

Change ~~to~~ fit P.T.
offset + 3' Rt.
R = 233.17
P.C. moved back 14.42'
T = 48.5 D = 24°57'
L = 95.65

8° New P.C. = 16+68.18

20

8° P.T.

30

29

+05 P.O.T.

Offset 3' Rt.

28

27

26

S32°55E

+48.22 E.C. 16/45 33/30

R=300

25

+50 E.D. 13:13 T=90.23

24

+72.81 B.C. Rt

23

+60 Washed out

22

21

S66°25

Changes

Offset 3' Rt. from old line

24' corr.

39

38

37

36

+78° P.O.T.

35

34

33

32

31

30 + 67

Line offset 3' Rt.

S32°55'E

changes

offset 3' Rt.

12" corr. pipe

S05°15'E

+73.53 P.T 12°00' 24°00

+50 Δ=4°00

46 I=85.02

+50 T=8.74

+05.38 P.C.

45

44

S18°45'W

+94.0 Δ Lt. 12°20 Lt.

43

42

S31°05'W

41+97.0 Δ Lt. 4°00 Lt

Fg. { 41+20 / =41+31

+11.09 P.T 34°00 68°00

41 31°05'02" R=150

+75 27°06'58"

+50 22°20.02 I=101.18

+25 17°33'56" 41+93.5 P.T.

40 12°47'02" Def=1°46

+75 8°00'05"

+50 3°14.02 S.=9°33'

39+33.07 P.C.R.T.

S32°55'E

17.9

4.207

41.2

13.4

8.4

9.6.6

1°37' 03

.72

Offset 3' Rt.

*Curve changed

E=370 D=32°22'

Δ=68° R=179.42

T=126.55 L=214.07

41+17.77 P.T.

39+07.70 P.C.

< 10'

< 10'

End 3-4-16

39+88

39+81 - W W

39+75

< 10

10° Curve

R=179.5'

60°

SIDEWALK

56

55

54

53

52

S65°35'E

+73 83 P.T. 38°55' 77°50'

+50 34°46.73' T=165

+25 30°26.28'

51 26°05.83' L=133.22

+75 21°45.35'

+50 17°24.93' Deg 1'=10.418' 50+83.62 P.I.

+25 13°02.48'

50 8°44.03' 50'=8°40.9'

+75 4°23.58'

+50 0°03.13 Ch.=4982

+49 69 P.C

49

S12°15'W

+45 45 P.T. 8°45' 17°30'

48 T=300 PI=48+00

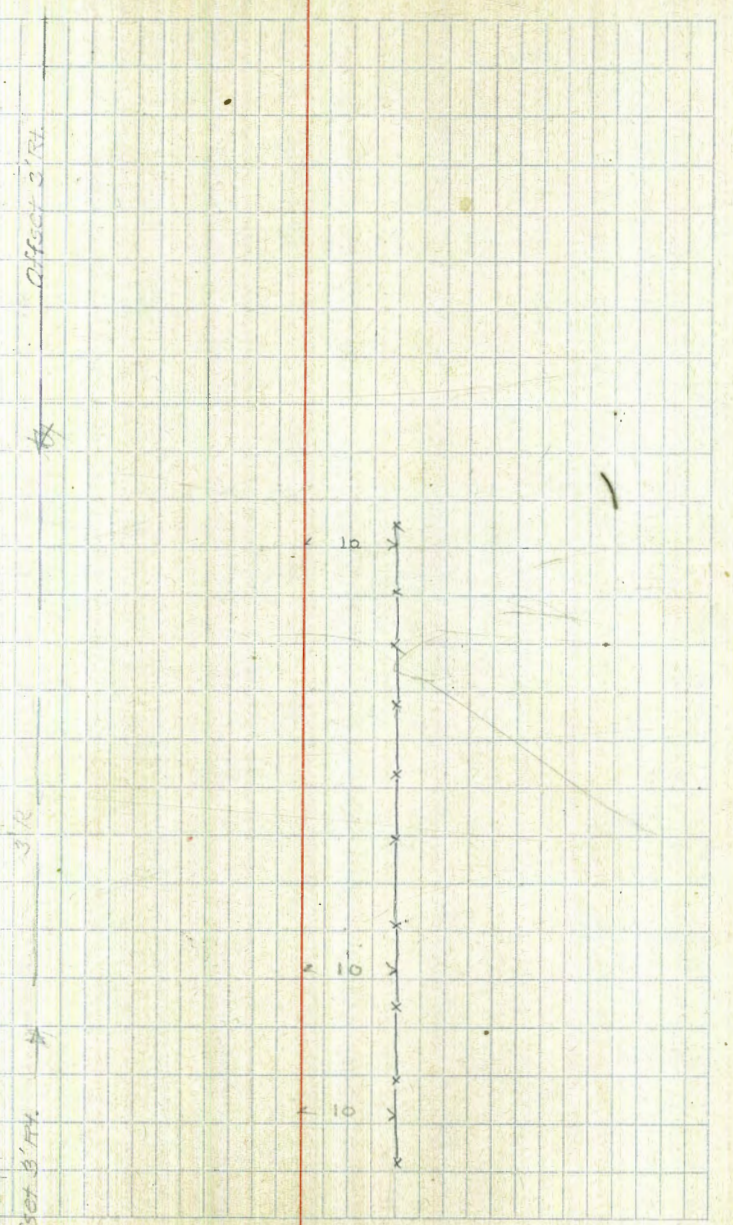
47+53 83 P.C

T=46.17

ED=3.49

47

S17°30'E



S82°35'E

61+17.35 ΔRt — 12°20' Rt.

61

N85°05'E

+58.14 EC — 18°35' — 37°10'

+50 — 17°44.90' R = 300

60 * — 12°58.42' l = 100.86

+50 — 8°11.24' Def l = 5°29.5'

59 — 3°25.46' 50 = 446.185

58+64.14 B.C.L.t

N85°05'E

+30.00 EC — 18°35' — 37°10'

+50 — 15°43' R = 400

60 — 12°08'26" l = 134.48

+50 — 8°53.40' Def l = 4°29.7' — 59+65 P.T.

59 — 4°58.55' 5 = 3°09.71

+50 — 1°23.70' CD = 49.90

+30.52 P.C.L.t.

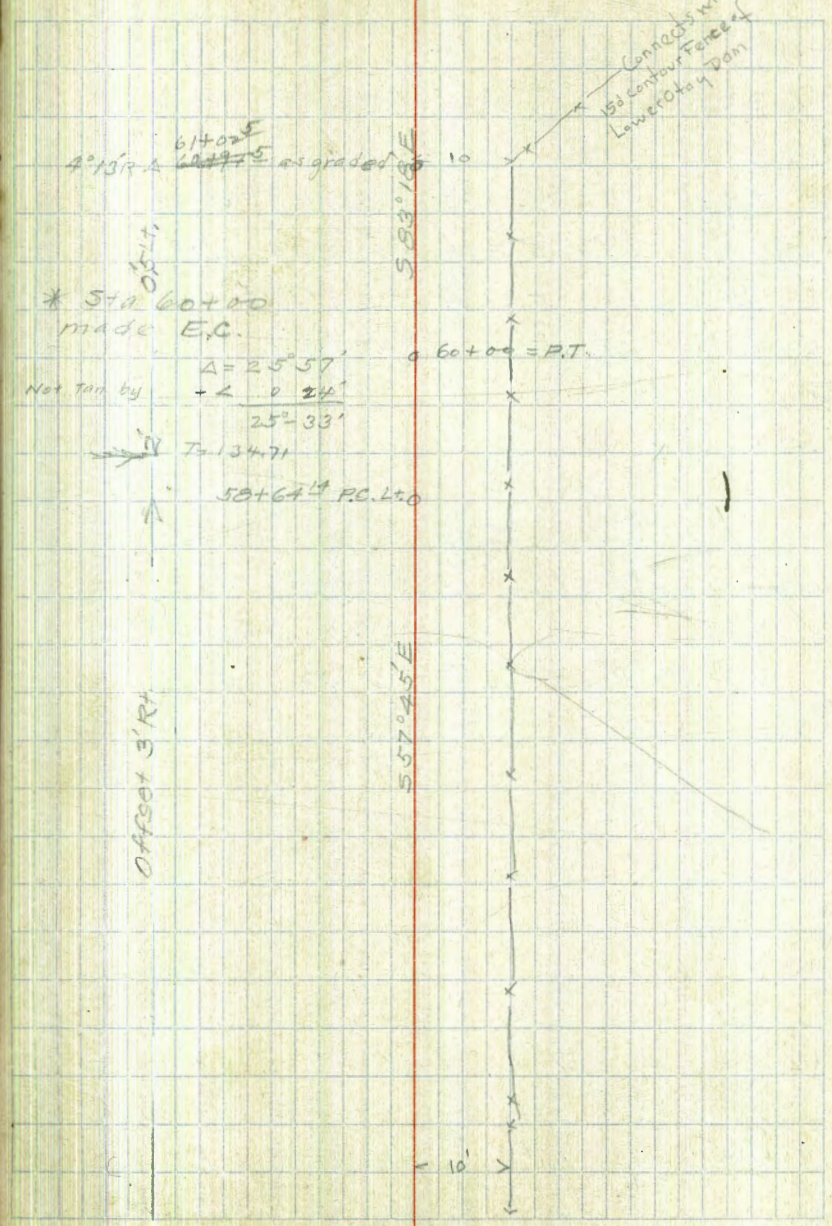
58

57

S57°45'E

56+14.0 ΔRt — 7°50' Rt

S65°35'E



S85°55'E

+10 56 P.T 9°40 19°20'

69 9°03.71' R=500

+50 6°11.83' T=85.16 PI=68+27

68 3°19.24' Def 1'=3.438

+50 0°28.05' Def 50'=2°51.89' 68+27

67+41 84 P.C. Lt. E.D.=7.10 (68+26.70)

67

S66°35'E

+07 84 P.T. 8°00' 16°00'

66 R=300

+50 T=42.16 65+66 PI.

+23 87 P.C. Rt E.D. 2.92

65

64

63

62

61+80

S82°35'E

changes

S83°57'E

Lower line 4 hr 3-7-16

End 3-6-16

D = 11°27.56'

T = 79.19 E = 6.3

R = 500

Δ = 18°

68+26 P.I. (new)

L = 158.32

P.T. 69+05 12 3' L

offset

3' L

188' offset Rt

2' L

1 offset 1' L

P.C. = 67+46 8 Lt 2' L

S65°57'E

1' L

L = 90.73'

T = 45.73'

R = 300

Δ = 17°21'

65+66 new P.I. 13' offset Rt

P.T. = 66+08 59

36" corr. pipe 65+82. ℄ runs at outer face of head wall

P.C. 65+18 32 Rt

S83-18'E

24" corr. pipe

N72°00'E

81+06.0 ΔLt 6°40' Lt

81

80

79

N78°40'E

+28.0 ΔRt. 5°40 Rt.

78

77

76

N73°00'E

+96.45 P.T. 6°45' 13°30'

+50

75+49.33 P.C. Lt. R=200

T=28.67

E.D=1.39

78+74

N86°30'E

70+51.0 ΔLt. 7°35' Lt.

S85°55'E

Charges

50' .172

25 ch. corr = .108

Defl. 25' = 2°23.24'

" 1' = 5.729'

E = 2.6

T = 39.72'

D = 19°06'

R = 300'

Defl 14.7' = .35

Δ = 15°05' Rt

Sta 50+00 P.I.

offset 5' Rt from old line

S86°06'E

N78°40'E

P.T. = 80+39.28

P.C. = 79+60.28 Rt.

75+28 ΔRt 5°40'

Final 77+82 A

N73°00'E

75+96.45 P.T.

Δ 13°36

75+49.33 P.C. Lt.

24" corr. C.I.P.

N86°30'E

S83°57'E

69+3.8 ΔLt. 9°33'

8'L

				S 53°20' E
+45.94	PT	38°45'	77°30	
+25		36°23.94'		
88		33°02.05'	R=250	
+75		30°40.16'	T=200.64	
+50		27°48.27'	Def i=6.876	
+25		24°56.39'	Def 25=2°51.887'	
87		22°04.50'	C.D=24.99	
+75		19°12.61'		
+50		16°20.73'		
+25		13°28.84'		
86		10°36.95'		
+75		7°45.07'		
+50		4°53.18'		
+25		2°01.29'		
85+07.36	P.C Rt			
85				
				N 43°10' E
+38.08	P.T.	14°25'	28°50	
+50		11°33.73'	R=500	
84		8°47.85'	T=128.54	
+50		5°55.95'	Def i=3.438	
83		3°04.06'	" 5'=2°51.89	
+50		00°12.17'		
82+46.46	Δ P.C. Lt			
				N 72°00' E

ahead calcd

36°Curve

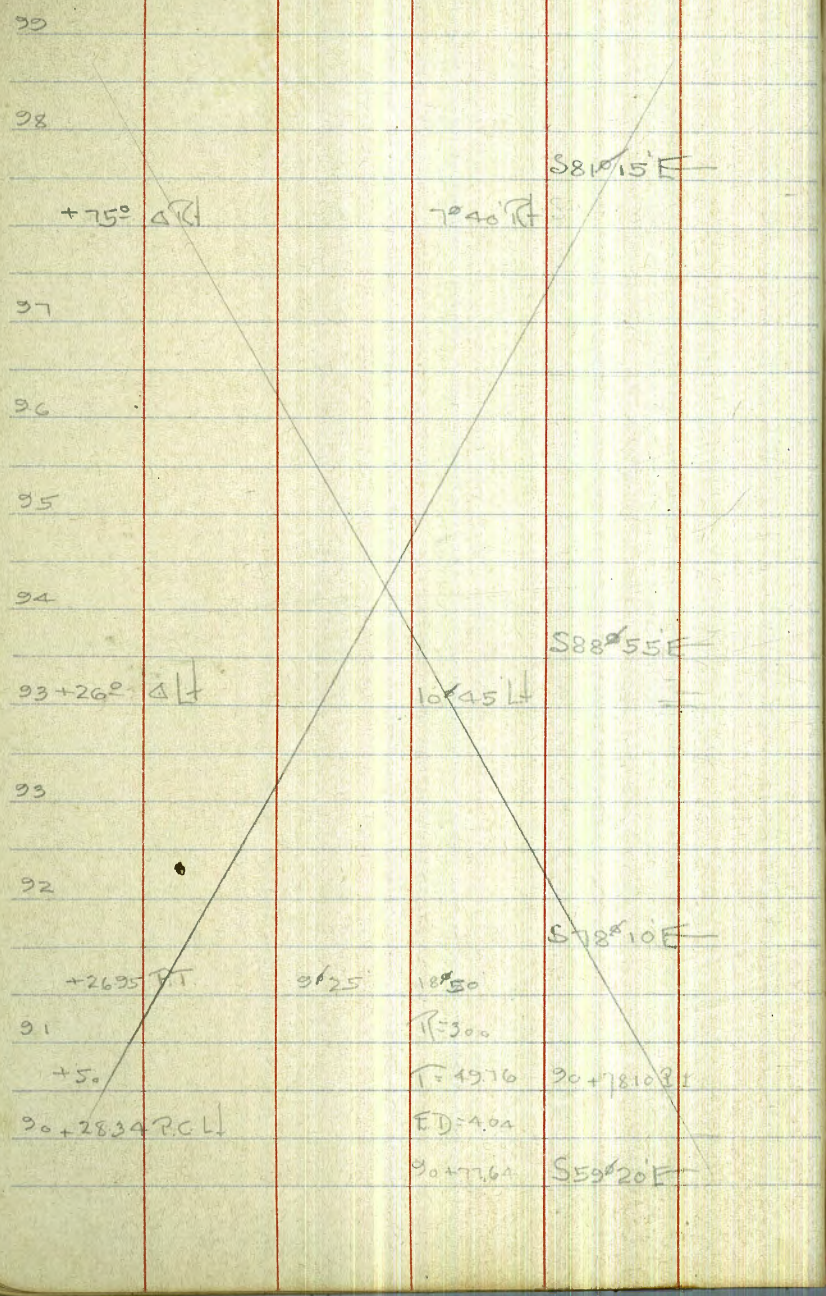
+86+95

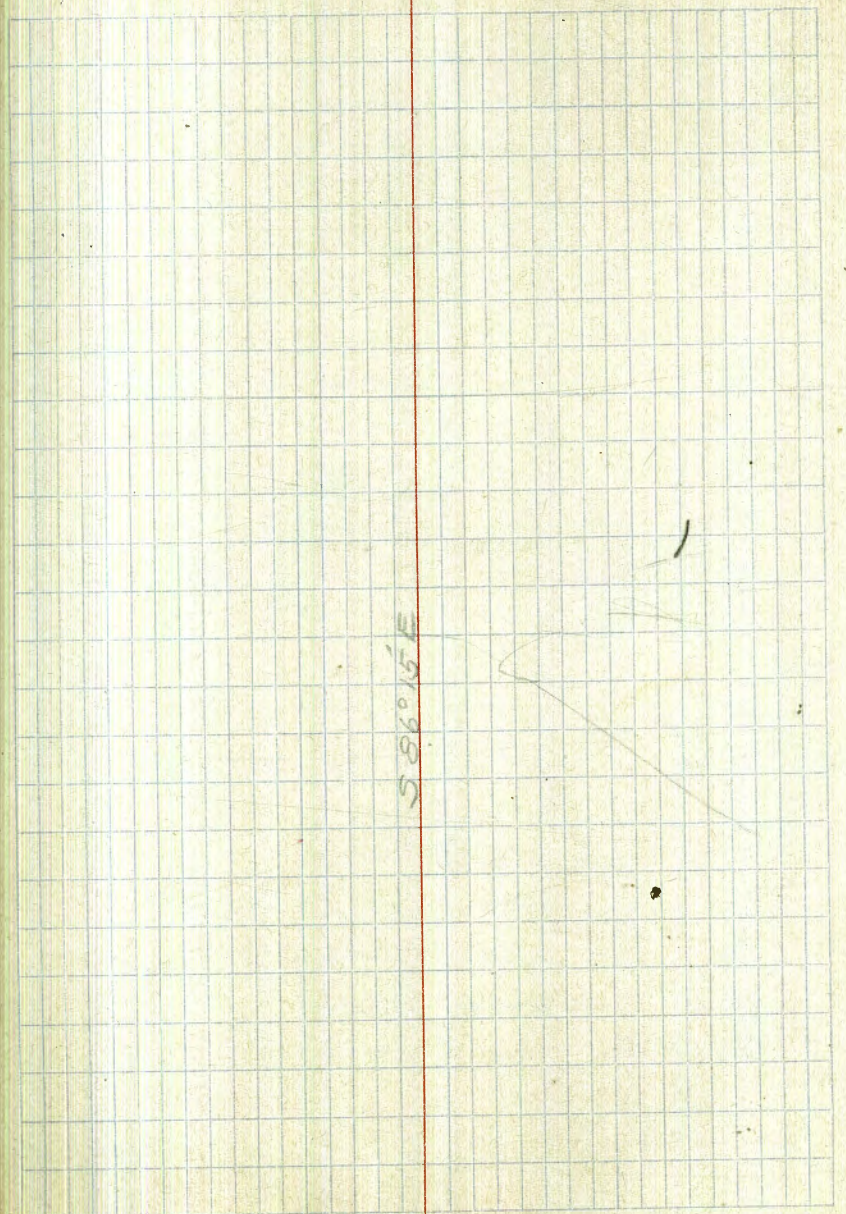
S 86°15' E

7 - 30

21 15

35 45


99
98
S81°15'E
+75° Δ Rt
7°40' Rt
97
96
95
94
S88°55'E
93+26° Δ Lt
10°45 Lt
93
92
S78°10'E
+2695 P.T
3°25
18°50
91
T=300
+5.
L=597.6
90+781.08 P.T
90+2834 P.C Lt
E.D=4.0a
90+77.64
S59°20'E


S 86°15'E

108

107

106

105

+86 67 P.T 14°35' 29°10' S63°05'E

+50 R=300

104 T=78.05

+50 E.D/9.67

+34 95 P.C. Lt Ft 104+11.26 PI=104+132

103

+63 18 P.T 28°40' 47°20' S33°55'E

+50 21°09.04' R=150

+25 16°22.55' T=65.74

102 11°36.06' Defl=1.46' 102+05 PI

+75 6°49.57' .25=4°46.48'

+50 2°03.08' C.D=24.97

101+39.26 P.C. Rt

99+51 P.O.T. chk=chk

S81°15'E

changes

Δ=28°45'

R=150

T=32.47

L=74.36 PI 106+90 Δ

E=4.7

P.T 107+25 85 const 2° Lt

106+90 mid pt. 3° L

P.C. 106+51 58 Lt. co

S65°25'E

E=5.0

T=65.14

L=130.17 PI 100+35.0 Δ

R=300

Δ=24°52'

D=19°06'

P.T. 100+89.93

End 3-8-16

P.C. 99+79 86 Rt.

30" C.P.C. K 10+61

S86°45'E

115

+97° Δ Lt. 5°40' Lt. N78°55E

114

113

N84°35'E

+26.68 P.T 18°20' 26°40'

R=200

112

+50

+33.6 P.C. Lt D: 4°7.40 PI: 111+81

ED: 5.99

111+80.34

111

110+23

110

109+30

109+50

109

S68°45'E

108+33° Δ Lt 5°40' Lt

S63°05'E

New Line
offset Rt. (from old Line)

N82°35'E

Old Line

New Line

5'

5'

3'

1½'

2' Lt.

Const 3½' Lt.

P.T. 112+26.68

5'

111+81

111+50

8'

10'

(New) 109+22.6 P.C. = 111+33.6 P.C. (old 16 offset)

Point

or 111+29.1 Back to old line

12" R.C.C.

12"

Centerline

S70°22'E

E = 4.35

L = 82.07

D = 26°58'

107+53.84 B.L.

Δ = 23°48'

T = 42.14

R = 200

P.T. 105+23.77

P.C. 107+41.73 R Const 1' L

N38°58'E

+50

125

124

123

+05

122

121

+50

120

119

118

+ 53

117

116

N78°55'E

offset Rt.

<0>

<3 1/3'>

<6 2/3'>

<10'>

12 corr. pipe

<10'>

<7.5'>

<5'>

12" corr pipe

<5'>

Copy 4 pages

133+06

133

132

N77°30'E

+97.47 P.T. 9°40 19°20'

+50 R=200 P.I. 131+64

+29.93 P.C.T. T=34.07

E.D.=284=131+6368

131

+94.0 P.O.T.

130

129

N58°10'E

+77.83 Δ Lt. 12°35' Lt

+50

128

+50

127

N70°45'E

126+94.0 Δ Lt. 8°10' Lt

N78°55'E

End -3-9-16

36" Corr. pipe 1 foot

℄ offset Rt. (from old line) 3-10-16 Trestle 3+11-14½" "

0'

0'

4'

4'

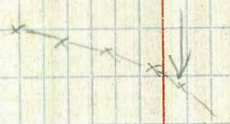
0'

0'

143				
142				
141				
140				
139+40	P.O.T.			
139+4				
				N48°20'E
+30.15	PT	14°35'	29°10'	
138		10°15.87'	R=200	PI=137+81.1
+50		3°06.15'	I=5266	ED=644
				137+79.24
+28.34	PC Lt			
137				
136				
135				
134				
				N77°30'E

152					
151					
+50	Ch/E			S60°00'E — Ch/E 3-14	
150+35.00	ΔRt		14°20' Rt		
149					
148				S74°20'E —	
+47.88	P.T.	8°20'	16°40'		
147			R=200 I=29.80 E.D.=2.11		
146+89.70	P.C. Rt		=147+18.79		
146				N80°00'E —	
+89.11	P.T.	10°10'	20°20'		
+50			R=200	P.I. = 145+54	
+18.19	P.C. Rt		I=35.87 E.D.=3.14 =145+53.62		
145					
				N68°40'E	
+47.11	P.T.	10°10'	20°20'		
144			R=200	P.I. = 144+12	
143+76.13	P.C. Rt		I=35.87 E.D.=3.14 =144+11.62	N48°20'E —	

Thru Harvey Ranch



169+5=4

13

2

1

160

9

8

7

6

155

+ 50

154

153

S60°00'E

Barns 200

N08°00'E

+09.84	P.T	56°00	112°00
172		54°07.30'	R=150
+75		49°20.82'	L=222.38
+50		44°34.34'	Dc=1°=1146
+25		39°47.87'	Dc 25=4°46.47'
171		35°01.39'	C.D=24.97
+75		30°14.91'	
+50		25°28.43'	
+25		20°41.95'	
170		15°55.47'	
+75		11°08.99'	
+50		6°22.51'	
+25		1°36.03'	169+56
169+76.62	P.C. Lt		
169			
168			
167			
166			
165			

S60°00'E

End 3-14-16

182 P. P.O.T

181

180

179+50

179

178

N30°40' E

+35⁵⁴ P.T. 11°20 22°40

177

I = 20°

D = 4°00'

+39⁹² P.C. R.H. 177+00 PI

~~D = 3°98~~

= 176+95.48

176

175

174

173

172

N08°00 E

Road Road

E ~~no~~ 3-15-16

				N14°00'W	
+00.32	P.T	22°20	44°40		
190		22°16.38'	Δ = 15°		
+75		17°29.90'	Δ_1 = 61.62		
+50		12°43.42'	Def = 11.46'		
+25		7°56.94'	"25' = 4°46.48		
189		3°10.46'	CD = 24.97		
+83.38	P.C.Lt				
+35.07	P.O.T				
188					
187					
186					
185					
184					
183					
				N30°40'E ←	

198				
			N53°28'E	
+81.00	Δ Rt		8°41' Rt	
197				
196				
			N41°41'E	
+71.8	Δ Rt.		1200 Rt	
+25 Δ				
195				
			N32°40'E	
+25.35	Δ Rt.		16°50' Rt.	
193				
192				
			N15°50'E	
+81.96	P.T.	14°55'	29°50'	
+50			R=200	
191			T=53.28	PI=191+31.40
190+77.82	P.C. Rt.		E.D=6.96	
			=191+29.89	N14°0.0'W

Change

Copy to date - 3-18-16

196+50 NEW Δ (Not moved)

offset 2ft L.

offset 1ft L

195+25 " 9 ft L NEW Δ

209

208

+81.54 P.T. 13°15' 26°30'

+50 12°20.785' R=1000

207 - 10°54.845' T=235.47

+50 9°28.901' Def'l=1.719' PI=205+54.5

206 8°02.985' 1"=50'=1°25944'

+50 6°37.013' CD=5.000

205 5°11.069'

+50 3°45.125'

204 2°19.181'

+50 0°53.237'

+19.03 P.C. PT

203

202

201 OK

200

199

N79°58' E

N53°28' E

Change

offset 8' R of old line

N79°58' E

207+63.53 P.T. 13°15'

+50 10°06'

206 8-34

+50 7-08

205 5-42

+50 4-16'

204 2°50'

+45 1°16'

203+01.02 P.C.

N53°28' E

CURVE

Δ = 26°30'

R = 1000'

T = 235.47

E = 27.32

Eng. 3-16-16.

L = 462.51

P.I. = 205+36.49

220				
219			N83°43E	
	+36.6	ΔLt	9° 15 Lt	
218				
217			S87°02E	
	+54.8	ΔRt.	13° 00 Rt	
216				
215				
214				
213				
212				
211				
210			N79°58E	

change

N83°43'E

Offset 8 ft of old line

End 3-21-16.
Rain 3-20-16.

229

228

N25°50'E

+22.50 ℄ Lt. 8°03' Lt

227

N33°53'E

+05.76 P.T. 10°50' 21°40'

R=200

226

+50.

I=38°37'

+30.13 P.C. Lt. E.D.=3.63

=225+67.94

225

N55°33'E

+00.88
+18.15 P.T. 14°05' 28°10'

R=200'

224

I=50.17'

+50

+02.56
+19.83 P.C. Lt. E.D.=6.20'

223+69
223+82.35

223

222

221

N83°43'E

Change

223+53.26 P.I.

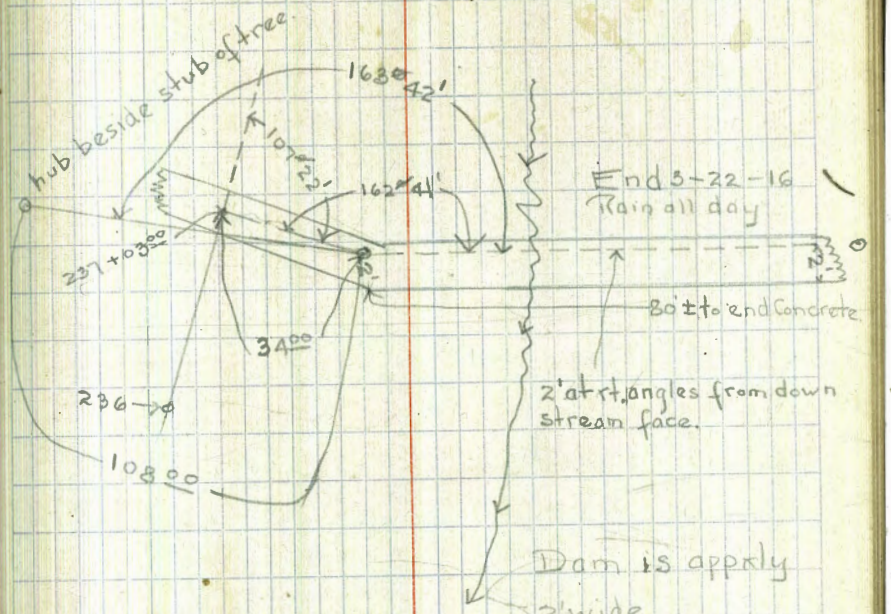
L.C.=98.32

Offset 8ft of old line

N55°33'E CURVE

N83°43'E

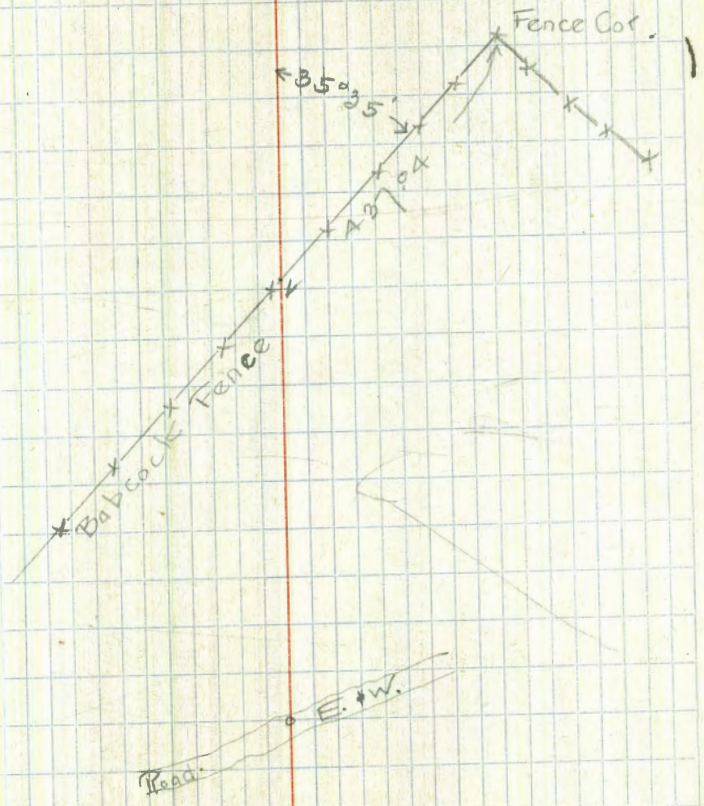
10+03.00	End	℄ ± Dam		
237				
236				
235				
234				
				N78°20E
+75.42	P.T.	26°1.5'	52°30'	
233		22°31.73' R=200		
+50		15°25.01' T=98.63		PI=232+4.
232		8°15.29' Def'l=8.59		
+50		1°05.57' Def/50'=7°02.2		
+42.31	P.C.P.T.			
231				
230+16.6	P.O.T.			
				N25°50E

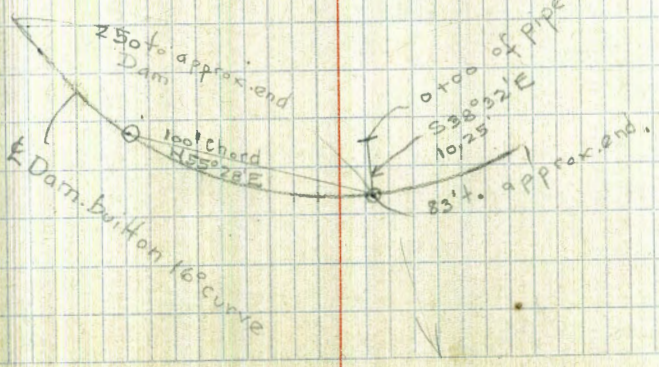


14+66.39 P.O.T.

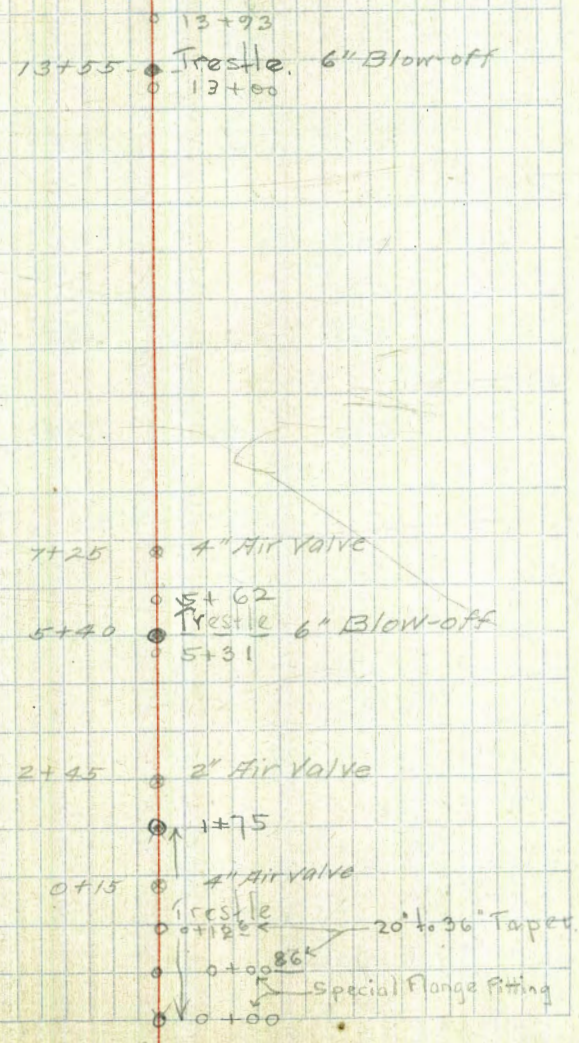
11+97.2

Sta 20+00




250 ft. approx. end
Dam
100' chord
N 55° 28' E.
℄ Dam. bur'd on 16° curve
℄ of pipe line
S 38° 32' E
10.25
83' ft. approx. end.

Sta	Band Spacing	Head	Total No Bands	Length of Pipe
	6.12"	70'	16	
21+75		X		
	5.33"	80'	1685	
14+18		X		
	4.76"	90'	803	
12+91		X		
	5.33"	80'	198	
12+03		X		
	6.12"	70'	132	
11+38		X		3910.
	7.14"	60'	83	
10+88		X		
	8.57"	50'	182	
9+68		X		
	10"	40'	510	
5+85		X		
	8.57"	50'	125	
5+04		X		
1+75			676	
	10"	40'		
0+12.6		V		
			14	Special Single
0+00	Face of Flange 20" Valve	V		Nut Bands



Sta	Band Spacing	Head	Total No Bands	Length Pipe
	7.14"	60'	531	
42+58		X		
	6.12"	70'	409	
40+43		X		
	5.33"	80'	445	
38+47		X		
	4.76"	90'	295	
37+36		X		
	5.33"	80'	351	4661.
35+75		X		
	6.12"	70'	1481	
28+19		X		
	5.33"	80'	278	
26+97				
	6.12"	70'	262	
25+65		X		
	7.14"	60'	609	
22+11	End Taper	X		
Taper	30" to 36"		18	
21+99.86	Begin Taper			
30" T	Fitting	70'		
21+94.70	End Taper			
Taper	36" To 30"		18	
21+84	Begin Taper			

41

38+29
38+20 Trestle 6" Blow-off
37+66

34+85 4" Air Valve
30+07 4" Air Valve
28+05
Trestle
27+57

23+12 4" Air Valve

30" T + Valve

Sta	Band Spacing	Head	Total No. Bands	Length of Pipe
	5.33"	80	273	
74+68		X		
	6.12"	70	651	
71+32		X		
	7.14"	60	483	
68+54		X		
	6.12"	70	497	
66+07		X		
	7.14"	60	326	
64+20		X		
	6.12"	70	383	
62+35		X		
	5.33"	80	152	
61+66		X		6238
	4.76"	90	265	
60+61		X		
	4.29"	100	525	
58+74		X		
	4.76"	90	265	
57+68		X		
	5.33"	80	312	
56+29		X		
	6.12"	70	2106	
45+56		X		
	7.14"	60		

70+25 @ 4" Air Valve

64+90 @ 4" Air Valve

@ 59+59
59+40 @ Trestle 6" Blow-off
@ 59+28

44+05 @ 4" Air Valve

Sta	Band Spacing	Head	Total No. Bands	Length of Pipe
		110	135	
95+75				
		100	177	
95+15				
		90	137	
94+61				
		80	114	1172
94+10				
		70	382	
92+17				
		60	119	
91+50				
		70	58	
91+20			Present end pipe, not change in head	
	6.12"	70'	232	
89+98				
	7.14"	60	1775	
79+77				
	6.12"	70	171	2907
				6238
78+89				4661
	5.33"		191	3910
		80		17776. Total No. of Double nut bands.
78+03				Original order 18000. 46
	4.76"	90	538	
75+91				
	5.33"	80		

91+20 - 146+64
Copy from Book # —
File 1311 By LEB.

95+90 ● 6" Blow-off

578 ft relay

91+24 — Single nut bands

81+85 ● 4" Air Valve

76+90 ● Trestle 6" Blow-off

Double nut Bands

137+36 I			
	75		
135+37 I			
	100		
134+38			
	75		
114+89 S			
	75	478	
112+30			
	100	249	
111+10			
	75	1793	
101+50			
	100	281	
100+25			
	75	50	
99+96			
	70	420	
97+87			
	80	143	
97+23			
	90	133	
96+70			
	100	147	
96+17			

843
1122
1965 Total No. Single nut bands.
17716 " " Double " "
50 " " Spec'l Taper Bands
19731 " " ½" Bands

138+08 E ⊙ 4" Blow-off

135+73 S ⊙ 2" Air Valve

134+87 ⊙ 4" Blow-off

132+92 ⊙ 2" Air Valve

119+59 E ⊙ 2" Air Valve

114+89 S - E. d 24" Stove ✕ Machine banding begins

111+75 ⊙ 2" Blow-off

103+09 S ⊙ 2" Air Valve

100+85 ⊙ 2" Blow-off

Reduces 99+96 ⊙ 24" C.S. begins.

99+02 S ⊙ 4" Air Valve

99+20

Single nut Bands

146+64	
	150
145+62	
	100
142+96	
	75
141+20	
	100
139+44	
	75
138+79	
	100

1+25 @ 4" Blow-off

146+64 ✕ = 0+00 New Line

142+143 @ 2" Air Valve

140+39 @ 4" Blow-off

139+142 @ 2" Air Valve

0°07' Rt

34+83 18°48' Lt T = 56' (approx)
E = 5.5'

31+88 △ 0°48' Rt

7+25 △ 4°13' Rt

UPPER OTAY - HARVEY PIPE LINE

Sta	Band Spacing	Head	Nº Bands Required	Actual Count	Length of Pipe
0+07					
	4.72"	80'	95	95	39 0
0+45					
	4.19	90	151	152	52 3
0+97					
	3.77	100	313	312	98 2
1+95					
	3.43	110	491	489	140 0
3+35					
	3.14	120	2184	2179	572 0
9+07					
	3.43	110	315	316	90 0
9+97					
	3.77	100	202	202	64 0
10+68					
	4.19	90	138	138	47 1
11+07					
	4.72	80	163	161	63 5
11+70					
	5.38	70	1369	1359	614 0
17+85					
	6.28	60	507 +5	512	265 0
20+50					
	5.38"	70	380	380	170 5
22+20					
	4.72"	80'	160	160	63 0
Page Totals			6473	6455	2279 2

Sta Length	Nº per 100'
Adj Nº of Bands +1.0	
38	254 2
52 +1.0	286 6
98 +.5	318 3
140	349 8
572	382 2
90 +.5	349 8
63 +1.0	318 3
47 +1.0	286 6
63 +.5	254 2
615	223 0
265	191 1
170	223 0
63	254 2

By L.E. Brunner
Field Eng'r.

Wt one band 7½#

*N.B. The "+" denotes extra bands acct. 6" spar joints.

Sta	Band Spacing	Head	Nº Bands Required	Actual Count	Length of Pipe	Sta Length	Nº Bands per 100'
22+83							
	5.38"	70'	372	374	166 5	167	223 0
24+50							
	6.28	60	+5 502	507	262 8	264	191 1
27+14							
	7.54	50	+20 353	364	222 0	222	159 15
29+36							
	6.28	60	+13 1620	1656	847 4	847	191 1
37+83							
	5.38	70	753	787	337 5	337	223 0
41+20 (= 41+31)							
(U.S. 11" Jacket)	6.28	60	+5 514	520	268 9	268	191 1
44+00							
	7.54	50	+18 318	336	200 0	200	159 1
46+00							
	9.43	40	+126 1149	1281	903 0	903	127 2
55+03							
	7.54	50	+42 739	787	464 5	464	159 1
59+67							
	6.28	60	+5 361	365	189 0	189	191 1
61+56							
	5.38	70	3713	3736	1664 7	1664	223 0
78+20							
	4.72	80	702	698	276 0	274	254 3
81+00							
	4.19"	90'	504	499	176 0	176	286 6
Page Totals			11834	11910	5978 3		

Sta	Band Spacing	Head	Nº Bands Required	Actual Count	Length of Pipe
82+76					
	3.77"	100'	471	465	148⁰
84+24					
	3.43	110	381	377	109⁸
85+33					
88+00	3.77	100	850 + 2276	914 + 2227	982⁰
95+15					
	4.19	90	3830	3804	1336⁵
108+47					
Eq. 109+22.6 = 111+29.1	4.72	80	5378	5339	2115⁵
131+69					
	4.19	90	505	504	176³
133+45					
	4.72	80	991	998	390⁰
137+35					
	5.38	70	375	371	168⁰
139+03					
	6.28	60	631 +9	655	330⁰
142+33					
	7.54	50	242 +13	255	152⁰
143+85					
	9.43	40	391 +48	445	307⁰
146+92					
	7.54	50	437 +22	453	271⁶
149+63					
	6.28	60	262 +9	263	137⁴
Page Totals			17,111	17,093	6623³

Sta Length	Nº Bands per 100'
148	318³
109	349⁸
982	318³
1332	256⁶
211	254²
176	286⁶
390	254²
168	223⁹
330	191¹
152	159¹
307	127²⁵
271	159¹
137	191¹

Est. ± 84+46

N.B. Spaced wrong by Pipe Co.

106+15 = 106+18⁸

Sta	Band Spacing	Head	Nº Bands Required	Actual Count	Length of Pipe
151+00					
	5.38"	70'	373	373	167 0/2
152+67					
	4.72	80	3058	3060	1203 0/2
164+70					
	5.38	70	255	255	114 1/2
165+84					
	6.28	60	147 +2	147	76 7/12
166+60					
	7.54	50	156 +9	165	98 0/2
167+58					
	9.43	40	533 +89	625	419 0/2
171+77					
	10.00	30	56 +8	66	46 1/2
172+25					
	9.43	40	95 +9	105	75 0/2
173+00					
	7.54	50	135 +17	141	84 6/12
173+84					
	6.28	60	419 +6	427	219 0/2
176+03					
	7.54	50	190 +11	203	119 5/12
177+22					
	9.43	40	480 +60	540	378 0/2
180+98					
	10.00"	30'	394 +53	454	328 3/12
Page Totals			6550	6561	3328 1/2

Sta Length	Nº Bands per 100'
167	223 0/2
1203	254 2/5
114 +4	223 0/2
76 +7	191 1/2
98 +10	159 1/2
419	127 2/5
48	120 0/2
75 +10	127 2/5
84 +5	159 1/2
219	191 1/2
119 +5	159 1/2
376	127 2/5
328	120 0/2

Sta	Band Spacing	Head	Estm. of No Bands Required	No Bands Used Actual Count	Length of Pipe
184+26					
	9.43"	40'	302 +38	338	237 9/12
186+63					
	10.00"	30	2346 +376	2729	1953
206+18					
	9.43	40	397 +49	460	312
209+30					
	10.00	30			
223+73			3312 +440	3872	2758 6/12
	10.00	20			
236+87 3/12					
Page Totals			7,270	7,399	5260 6/12
Grand Total			49,238	49,418	23,470.3

Sta Length	No Bands per 100'
237' 4"	127 25/100
1955	120 00/100
312	127 25/100
	120 00/100
2757 3/12	
	120 00/100

Tie 187+25

42 N9 Bands used Sept 1, Est. to Sta 184+97 5/12

18280.7 To Sept 1st Est.

7130
6500
11910
6500
49130

Dulzura Pipe Line
Lin. ft. of pipe for each Head

20+30	40	50	60	70	LEB. 80	90	100	110	120	
	903	222	265	615	39	53	98.5	140	572	
		200	264	170	63.5	48	64.0	90.5		
		457	847	167	63.0	176	148.0	72.0		
			268	337	280.0					
			196	384						
	903	879	1840	530	445.5	277	310.5	302.5	572	
374.7	1250.0	733.2	756.2	1199.6	3704.5	1511.8	981.7	365		
1953.0	166									
2758.6	312									
5086.3	2631	1612.2	2596	3402.6	4150	1788.8	1292.2	339	572	Totals

Grand Total 23,470.3

Profile Levels - Diverting Dam. Harvey Ranch

	+	H.I.	−	El	
B.M.		511.04		505.46	Hub W. End of Axis A-B
0+00			5.6	505.4	" " " "
+02			6.1	504.9	
+04			9.5	501.5	
+12			10.0	501.0	
+18			13.0	498.0	
+23		508.30	14.2	494.1	
+29			15.6	492.7	
+36			16.0	492.3	Creek
+50			15.0	493.3	
+85			14.5	493.8	
1+10	abandoned		13.0	495.3	
+25			15.0	493.3	
+60			10.7	497.6	
+61			8.6	499.7	
+78			6.8	501.5	
2+50			7.1	501.2	
3+40			10.1	498.2	
+73			7.1	501.2	
4+00			1.4	506.9	
+08	Hub		−1.6	509.9	Hub E. End A-B

Profile of Point #10 - #2.

0+00	508.3		500.0
+18		12.6	495.7
+25		13.3	495.0
+38		13.0	495.3
+52		13.5	494.8
+58		14.0	494.3
+66		14.0	494.3
+68		11.1	497.2
+78		11.6	496.7
+92	abandoned	13.0	495.3
+97		12.0	496.3
1+40		10.0	498.3
+65		12.0	496.3
+99		9.7	498.6
2+00		8.6	499.7
+09½		8.3	500.0

0+00	Profile #9 - #5	500.0	
+08	508.3	10.4	497.9
+23		11.7	496.6
+60		8.8	499.5
+75		11.0	497.3
1+05		10.1	498.2
+31.5			500.0

Point #10 - 506 Contour

Creek

Point #2 - 506 Contour

" #9 - " "

Creek

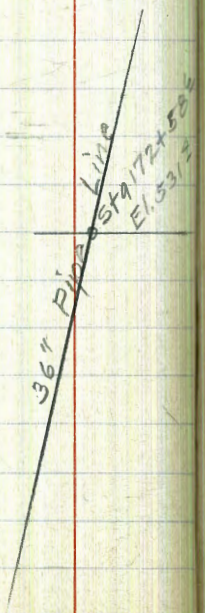
"

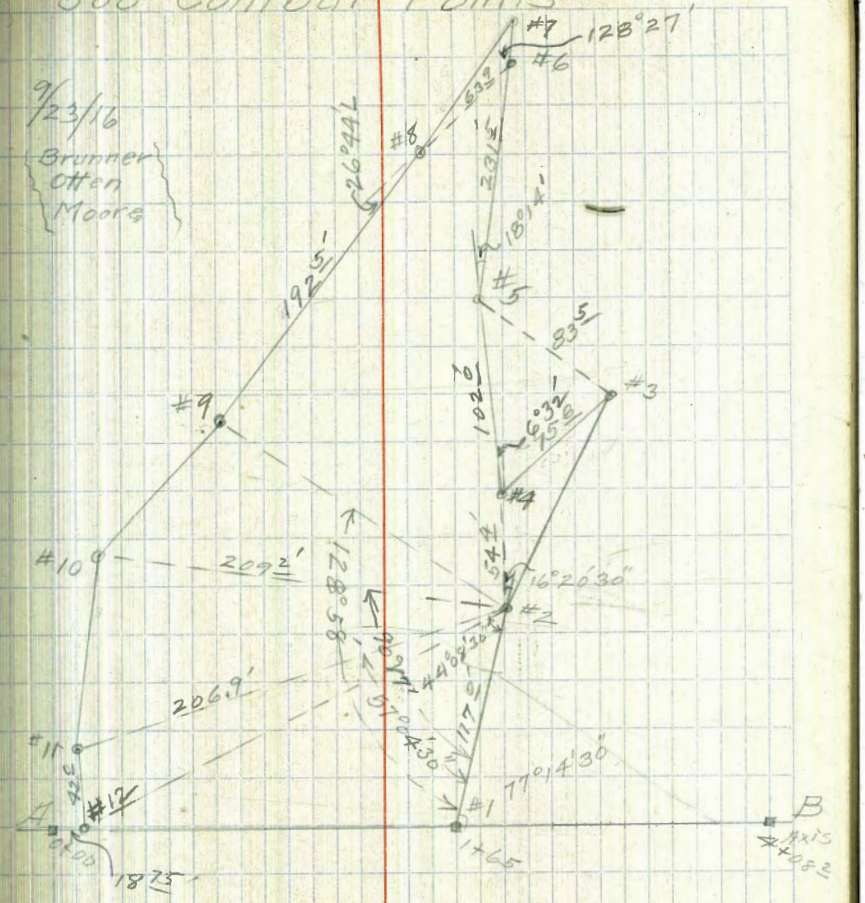
Point #5 " "

530.54 B.M.
4.30
534.84
12.14
522.70 T.P.
0.65
523.35
12.52
510.83 T.P.
0.21
511.04
12.79
On boulder near water 498.25 T.P.
10.05
508.30 H.I.

Dam Site
500' Contour Points

9/23/16
Brunner
Otten
Moore





Notes on Road
Upper to Lower Otay.

Sta	Offset from Pipe Line
0	
6	20' W
18	"
23 - 38+75	Branch road to Coag. House.
26	20' W
42	"
44	6½%
51	4½%
52	"
56	"
56+80	"
60+50	"
62+50	"
63+50	5%
70+50	6½%
83	"
85+50	5%
103	1½%
104	6%
	4%

Sta	# Bands
0+0+45	114
0+45-0+97	149
0+97-1+95	312
1+95-3+35	496
3+35-9+65	2408
9+65-10+27	217
10+27-10+77	160
10+77-11+30	150
11+30-12+44	292
12+44-22+00	2132

Pipe Line - Upper to Lower Cotty.
Leaks - May 16, '16

Leaks Sta	Bands Needed Sta		
1+30 -		64+40	64+70
1+95		65+90	
2+25		66+20	
2+65 -		+97	
3+60		67+05	74+05
4+80		74+12	
5+00		75+05	74+10
+44			
+60		78+40	
8+10 -		78+60	
8+50 -		79+40	
9+30 -		79+50	
9+60 -		79+55	
9+70		80+10	
13+05 -		80+40	
14+68 -	15+75 -	82+05	
16+90 -		83+10	
17+60		83+25	
17+90		83+90	
18+60	18+25	89+10	
19+12 -		96+30 -	
22+30	22+40	97+00	96+20
23+85		99+10 -	
23+70 -	22+92	+60	100+80
25+13		103+00	
26+15	23+00	104+15	
26+25		105+85	
31+18	27+60	106+20	
32+00		110+70	
33+04 -	29+30	111+75	
33+70 -		116+25	
34+15		119+40	
34+85 -		121+15	
35+10		122+00	
35+30 -		122+20	
36+80	36+00	122+80	
44+00		122+90	
46+60	37+70	123+20	
47+50 -		123+50	
47+60	40+50	124+20	
48+90		124+96	
49+85 -		126+40	
50+20 -		126+50	
50+90 -		126+85	
51+05		126+92	
52+30		10(5132)	
52+90			
53+10			
54+00			
56+20			
57+40			
58+10			
58+25 -			

17 bands for 120 leaks or 1/10

Valve Locations

Air Valves Size	Station (approx)	Blow Off Valves Size	Station (approx)
4"	0+15	6"	5+40
2"	2+45	6"	13+55
4"	7+25	6"	38+20
4"	23+12	6"	59+40
4"	30+07	6"	76+90
4"	34+85	6"	95+90
4"	44+05	2"	100+85
4"	64+90	2"	111+75
4"	70+25	4"	134+87
4"	81+85	4"	+37+04 138+08
4"	99+03	4"	+39+30 140+39
2"	103+10		
2"	119+60		
2"	132+93	4"	1+95 Lower Cotty
2"	135+60		
2"	138+10		
2"	142+12		

Copied on page 46

T+G Gate Valve Sta 22

Upper Gray-
Lumber on Job - May 23 '16

Sta	
91	1-2X12 X 10'
	1-4X6 X 6'
Inside wire gate	~~1-6X6 X 16'~~
	1-3X12 X 16'
	1-4X12 X 16'
Road betw gates	~~1-6X6 X 18'~~
	~~2-6X6 X 16'~~
	~~1-6X6 X 12'~~
	~~2-4X6 X 12'~~
	17-4X12 X 16'
	16-2ft Blocks
#1 Trestle	6 7-6X6 X 12'
	~~7-2X12X16'~~
	1 sled runner
#2 Trestle	~~2-6X6 X 12'~~
	3 8-2X12 X 16
	6-4X12 X 12
Filter Plant	~~8-2X12 X 16~~
	1-4X12 X 12
	1-4X12 X 16

+80		10°15.51'		
+70		8°20.91'		
+60		6°26.31'		
+50		4°31.71'		
0+40		2°37.11'		
0+33.84	Bent #3	1°26.52'		
0+26.29	P.C. Rt.			
0+185	℄ Bent #2			
0+03	℄ Bent #1			
0+00	= Face of Valve			S 40° 08' E
				S 08° 35' W
7+50	Δ Rt.		4°02' Rt.	
				S 04° 33' E
4+59	Δ Rt.		16°24' Rt.	
				S 11° 51' E
4+00	Δ Rt.		7°43' Rt.	
				S 19° 34' E
2+32.2	Δ Rt.		7°04' Rt.	
				S 26° 38' E
0+00	℄ 20 Valve Upper Otay Dam			

7+50 ± Δ Rt 4°02' Rt S 08°35' W

Sight on 7+50

=4+53 ±

S 04°33' W 13°36' Rt

4+59.38 Δ Rt 17°46 Rt

S 13°13' E sta 4 5°39' Rt

3+51.57 Δ Rt 5°38 Rt 7°09'

S 18°51 E

2+27.95 Δ Rt 13°17 Rt

1+74.24 Bent #1

S 32°08' E

1+72.19 P.T. 8°00' 16°00'

1— R=200

1+59.66 Bent 6 6°11.86 I=28.11

Defl=8.594

1+44.26 Bent #5 4°00.03'

1+28.92 Bent #4 1°48.20'

1+16.34 P.C. Lt

1+13.58 Bent #3

0+98.08 Bent #2

S 16°08' E

0+89.12 P.T. 12°00' 24°00'

0+82.94 ± Bent #1 10°47' R=150

0+80 10°15'51" I=3188

Defl=11.459

Built to

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.

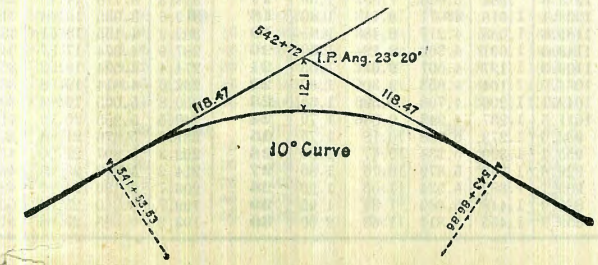
2° 19½′=def. for sta.	542	I. P.=sta.	542+72
4° 49½′= " " "	+50	Tan.=	1.18.47
7° 19½′= " " "	543	B. C.=sta.	541+53.53
9° 49½′= " " "	+50	L. C.=	2.33.33
11° 40′= " " "	543+	E. C.=sta.	543+86.86
	86.86		

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.)



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	3.8657	3.9136	3.9617	14
36	7265	7310	7355	7400	7445	7490	53	76	4.0108	4.0611	4.1126	4.1653	4.2193	4.2747	13
37	7536	7581	7627	7673	7720	7766	52	77	4.3315	4.3897	4.4494	4.5107	4.5736	4.6382	12
38	7813	7860	7907	7954	8002	8050	51	78	4.7046	4.7729	4.8430	4.9152	4.9894	5.0658	11
39	8098	8146	8195	8243	8292	8342	50	79	5.1446	5.2257	5.3093	5.3955	5.4845	5.5764	10
deg.	60′	50′	40′	30′	20′	10′	deg.	deg.	60′	50′	40′	30′	20′	10′	deg.

deg.	0′	10′	20′	30′	40′	50′	deg.
80	5.6713	5.7694	5.8708	5.9758	6.0844	6.1970	9
81	6.3138	6.4348	6.5606	6.6912	6.8269	6.9682	8
82	7.1154	7.2687	7.4287	7.5958	7.7704	7.9530	7
83	8.1443	8.3450	8.5555	8.7769	9.0098	9.2553	6
84	9.5144	9.7882	10.078	10.385	10.711	11.059	5
85	11.430	11.826	12.250	12.706	13.197	13.727	4
86	14.300	14.924	15.605	16.350	17.169	18.075	3
87	19.081	20.206	21.470	22.903	24.542	26.432	2
88	28.636	31.242	34.368	38.189	42.964	49.104	1
89	57.290	68.750	85.940	114.588	171.885	343.77	0
deg.	60′	50′	40′	30′	20′	10′	deg.

Natural Cotangents

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

ROADWAY 14 FEET WIDE. SIDE SLOPES 1½ TO 1.

FOR SINGLE TRACK EMBANKMENT.

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

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