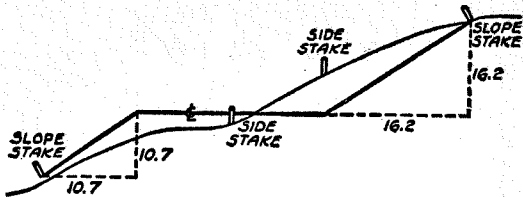


17

17

17
HARGO
FIELD BOOK



Book # 3.

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING
SLOPE 1 TO 1. ROADWAY OF ANY WIDTH

| | 0 | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| 0 | 0.00 | 0.10 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 0 |
| 1 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 | 1.50 | 1.60 | 1.70 | 1.80 | 1.90 | 1 |
| 2 | 2.00 | 2.10 | 2.20 | 2.30 | 2.40 | 2.50 | 2.60 | 2.70 | 2.80 | 2.90 | 2 |
| 3 | 3.00 | 3.10 | 3.20 | 3.30 | 3.40 | 3.50 | 3.60 | 3.70 | 3.80 | 3.90 | 3 |
| 4 | 4.00 | 4.10 | 4.20 | 4.30 | 4.40 | 4.50 | 4.60 | 4.70 | 4.80 | 4.90 | 4 |
| 5 | 5.00 | 5.10 | 5.20 | 5.30 | 5.40 | 5.50 | 5.60 | 5.70 | 5.80 | 5.90 | 5 |
| 6 | 6.00 | 6.10 | 6.20 | 6.30 | 6.40 | 6.50 | 6.60 | 6.70 | 6.80 | 6.90 | 6 |
| 7 | 7.00 | 7.10 | 7.20 | 7.30 | 7.40 | 7.50 | 7.60 | 7.70 | 7.80 | 7.90 | 7 |
| 8 | 8.00 | 8.10 | 8.20 | 8.30 | 8.40 | 8.50 | 8.60 | 8.70 | 8.80 | 8.90 | 8 |
| 9 | 9.00 | 9.10 | 9.20 | 9.30 | 9.40 | 9.50 | 9.60 | 9.70 | 9.80 | 9.90 | 9 |
| 10 | 10.00 | 10.10 | 10.20 | 10.30 | 10.40 | 10.50 | 10.60 | 10.70 | 10.80 | 10.90 | 10 |
| 11 | 11.00 | 11.10 | 11.20 | 11.30 | 11.40 | 11.50 | 11.60 | 11.70 | 11.80 | 11.90 | 11 |
| 12 | 12.00 | 12.10 | 12.20 | 12.30 | 12.40 | 12.50 | 12.60 | 12.70 | 12.80 | 12.90 | 12 |
| 13 | 13.00 | 13.10 | 13.20 | 13.30 | 13.40 | 13.50 | 13.60 | 13.70 | 13.80 | 13.90 | 13 |
| 14 | 14.00 | 14.10 | 14.20 | 14.30 | 14.40 | 14.50 | 14.60 | 14.70 | 14.80 | 14.90 | 14 |
| 15 | 15.00 | 15.10 | 15.20 | 15.30 | 15.40 | 15.50 | 15.60 | 15.70 | 15.80 | 15.90 | 15 |
| 16 | 16.00 | 16.10 | 16.20 | 16.30 | 16.40 | 16.50 | 16.60 | 16.70 | 16.80 | 16.90 | 16 |
| 17 | 17.00 | 17.10 | 17.20 | 17.30 | 17.40 | 17.50 | 17.60 | 17.70 | 17.80 | 17.90 | 17 |
| 18 | 18.00 | 18.10 | 18.20 | 18.30 | 18.40 | 18.50 | 18.60 | 18.70 | 18.80 | 18.90 | 18 |
| 19 | 19.00 | 19.10 | 19.20 | 19.30 | 19.40 | 19.50 | 19.60 | 19.70 | 19.80 | 19.90 | 19 |
| 20 | 20.00 | 20.10 | 20.20 | 20.30 | 20.40 | 20.50 | 20.60 | 20.70 | 20.80 | 20.90 | 20 |
| 21 | 21.00 | 21.10 | 21.20 | 21.30 | 21.40 | 21.50 | 21.60 | 21.70 | 21.80 | 21.90 | 21 |
| 22 | 22.00 | 22.10 | 22.20 | 22.30 | 22.40 | 22.50 | 22.60 | 22.70 | 22.80 | 22.90 | 22 |
| 23 | 23.00 | 23.10 | 23.20 | 23.30 | 23.40 | 23.50 | 23.60 | 23.70 | 23.80 | 23.90 | 23 |
| 24 | 24.00 | 24.10 | 24.20 | 24.30 | 24.40 | 24.50 | 24.60 | 24.70 | 24.80 | 24.90 | 24 |
| 25 | 25.00 | 25.10 | 25.20 | 25.30 | 25.40 | 25.50 | 25.60 | 25.70 | 25.80 | 25.90 | 25 |
| 26 | 26.00 | 26.10 | 26.20 | 26.30 | 26.40 | 26.50 | 26.60 | 26.70 | 26.80 | 26.90 | 26 |
| 27 | 27.00 | 27.10 | 27.20 | 27.30 | 27.40 | 27.50 | 27.60 | 27.70 | 27.80 | 27.90 | 27 |
| 28 | 28.00 | 28.10 | 28.20 | 28.30 | 28.40 | 28.50 | 28.60 | 28.70 | 28.80 | 28.90 | 28 |
| 29 | 29.00 | 29.10 | 29.20 | 29.30 | 29.40 | 29.50 | 29.60 | 29.70 | 29.80 | 29.90 | 29 |
| 30 | 30.00 | 30.10 | 30.20 | 30.30 | 30.40 | 30.50 | 30.60 | 30.70 | 30.80 | 30.90 | 30 |
| 31 | 31.00 | 31.10 | 31.20 | 31.30 | 31.40 | 31.50 | 31.60 | 31.70 | 31.80 | 31.90 | 31 |
| 32 | 32.00 | 32.10 | 32.20 | 32.30 | 32.40 | 32.50 | 32.60 | 32.70 | 32.80 | 32.90 | 32 |
| 33 | 33.00 | 33.10 | 33.20 | 33.30 | 33.40 | 33.50 | 33.60 | 33.70 | 33.80 | 33.90 | 33 |
| 34 | 34.00 | 34.10 | 34.20 | 34.30 | 34.40 | 34.50 | 34.60 | 34.70 | 34.80 | 34.90 | 34 |
| 35 | 35.00 | 35.10 | 35.20 | 35.30 | 35.40 | 35.50 | 35.60 | 35.70 | 35.80 | 35.90 | 35 |
| 36 | 36.00 | 36.10 | 36.20 | 36.30 | 36.40 | 36.50 | 36.60 | 36.70 | 36.80 | 36.90 | 36 |
| 37 | 37.00 | 37.10 | 37.20 | 37.30 | 37.40 | 37.50 | 37.60 | 37.70 | 37.80 | 37.90 | 37 |
| 38 | 38.00 | 38.10 | 38.20 | 38.30 | 38.40 | 38.50 | 38.60 | 38.70 | 38.80 | 38.90 | 38 |
| 39 | 39.00 | 39.10 | 39.20 | 39.30 | 39.40 | 39.50 | 39.60 | 39.70 | 39.80 | 39.90 | 39 |
| 40 | 40.00 | 40.10 | 40.20 | 40.30 | 40.40 | 40.50 | 40.60 | 40.70 | 40.80 | 40.90 | 40 |
| 41 | 41.00 | 41.10 | 41.20 | 41.30 | 41.40 | 41.50 | 41.60 | 41.70 | 41.80 | 41.90 | 41 |
| 42 | 42.00 | 42.10 | 42.20 | 42.30 | 42.40 | 42.50 | 42.60 | 42.70 | 42.80 | 42.90 | 42 |
| 43 | 43.00 | 43.10 | 43.20 | 43.30 | 43.40 | 43.50 | 43.60 | 43.70 | 43.80 | 43.90 | 43 |
| 44 | 44.00 | 44.10 | 44.20 | 44.30 | 44.40 | 44.50 | 44.60 | 44.70 | 44.80 | 44.90 | 44 |
| 45 | 45.00 | 45.10 | 45.20 | 45.30 | 45.40 | 45.50 | 45.60 | 45.70 | 45.80 | 45.90 | 45 |
| 46 | 46.00 | 46.10 | 46.20 | 46.30 | 46.40 | 46.50 | 46.60 | 46.70 | 46.80 | 46.90 | 46 |
| 47 | 47.00 | 47.10 | 47.20 | 47.30 | 47.40 | 47.50 | 47.60 | 47.70 | 47.80 | 47.90 | 47 |
| 48 | 48.00 | 48.10 | 48.20 | 48.30 | 48.40 | 48.50 | 48.60 | 48.70 | 48.80 | 48.90 | 48 |
| 49 | 49.00 | 49.10 | 49.20 | 49.30 | 49.40 | 49.50 | 49.60 | 49.70 | 49.80 | 49.90 | 49 |
| 50 | 50.00 | 50.10 | 50.20 | 50.30 | 50.40 | 50.50 | 50.60 | 50.70 | 50.80 | 50.90 | 50 |

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



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K for:

Land O' Lakes State
Forest (Cass & Crow-
wing Counties)

T. 138-26

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|
| 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | | | | | | | | | |
| 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | | | | | | | | |
| 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | | | | | | | |
| 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | | | | | | |
| 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | | | | | |
| 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | | | | |
| 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | | | |
| 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | | |
| 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | |
| 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | |
| 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

26

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"

23+00

8+00

0+00 started ~~Wast~~ from $\frac{16}{21} \frac{15}{22}$ 138-28

Look for:

Aspen - 6, 30E, 21Ks.

Y. Pine - 4, 535N, 22Ks.

Look for:

AT 2384.53' or 36.13 cbs.

Aspen 6" N71W 59Ks.

Y. Pine 18" S39N 110Ks.

Look for:

AT 825' or 12 $\frac{1}{2}$ cbs.

M. post 8

W. Birch 8" S75E 45Ks.

Y. Pine 8" N15E 30Ks.

Var. 7.58° or 7 $\frac{1}{2}$ °

26420 Set App. 1/4 corner
 25448 Road SW. nos. North.
 25448 Fence turns S.E. 138-26

23410 Left Jack pine center ASPEN

13706 FENCE RUNS NORTH - EAST Jack pine.
 13420 Set App. 1/4 corner

9490 center of Road leading from farm House.

0+00 started East from $\frac{16}{21} \frac{15}{22}$ 138-26

Look for:

At 2648.58' or
 40.13 ch. 1/4 cor.
 Aspen 6" N 30 E 2175.
 Oak 4" S 35 W 22175.

Found.
 No evidence

Aspen

Jack pine



Open field.

May, 1900
 Random line

Aspen

State Hwy. No. 6

Var. $72^{\circ} 55'$ or 72°

Jan. 13, 1939
 Woods Notes ch.
 Hayland ch.
 Buick ave
 Estrem ave

21.

52780 set App. sec cor.

15/14
22/23

13826

~~44700~~
43750 left Lake

29704 edge of Lake.

29700 continued East from 1/4 corner

2.
Same party

Look for:

Fir 6" N57E 34IKS.

" 8" N23W 36IKS.

W. Birch 4" S 23E 34IKS.

Blk. Ash 9" S69W 25IKS.

Found

No evidence

Look for:

At 4463.58' or 67.63 ch.

W. Birch 8" S75E 45IKS

Y. Pine 8" N15E 30IKS.

Magnifying glass
Random time
Lake

Look for: or 44 ch.

Found:

At 2904' M post

No evidence.

on W. side Ruth Lake

Aspen - 6" N71W 59IKS.

Y. Pine - 10" S39W 110IKS.

26+40 set app by car. 14/13
2/14 139-26
State game boundary line app. 50' W.

13+16 entered cedar swp,
13+20 set app west of car

H+62 open field north of line

0+00 Started East from center of road

15/14
32/23

Feb 14 1951

Look for:

At H+62 ch
White Ash 8" S 89 E 135 Ws
Elder 6" N 35 W 12 Ws
Yam 8" S 45 E 17
" 6" W 10

Woods - notes, etc.
Harland - ch.
Busick - brushing
Estrem - brushing

Found no
evidence
except game
refuge line

~~cedar~~
cedar
swamp

cedar
swamp

aspens

open field

Mag. sea. city, N 81° E.

Random 1100

ASPEN

var. 60

52+89.24' Off set 46.2' south
To 2" solid i.p.

$\frac{14}{23}$
23/24

138-26

44+79 Left cedar swamp enter Aspen.
Finished line Feb. 16, 1939

43+00 quit for day Feb. 14, 1939.

42+70 crossed state game line

37+60 Set app East $\frac{1}{2}$ cor.

26+40 Continued East from $\frac{14}{23}$ 138-26

Feb. 14, 1939

Woods - notes on
Harland ch.
Busick - brushing
Estern - brushing

Look for:

At 8000 ch

yellow pine 6" N50° E 36/Ks.

tan 6" N138° W 36/Ks.

white Birch 5" S 37° E 24/Ks.

yellow pine 6" S 58° W 20/Ks.

Found:

2" i.p. with

cap. scribed

$\frac{14}{23}$

23/24 also 10"

Used rod through

halted at pipe

10' pine snag

S 52 $\frac{1}{2}$ ° W

distance 115.5'

at pipe snag

did not have scribing

but had place for it

was
blazed
as could
been BT.

Cedar Swamp

Manq. Boundary N 84° E

Random line

Cedar Swamp

26+40

~~13~~
24 138-26

24+70 crossed creek

30+46 center Alder swamp

14+52 entered tall swamp

13+11 center of Road

0+00

started

East
used

From Cor.
I.P.

14/13
23/24 138-26

Feb 10/139
Woodc-Note
Harlow-N
Dulick-
Esteban-
Esteban-Pickel

5

Look for:

Elm 6' N. 75° W. 30/Ks Alder Swamp
W. Ash 8' S 38° E. 95/Ks *

Tully, * Tall Swamp
Swamp *

Mag. Bearing N 93° E

Barrow Line

○ I.P.

Var = 7°

53+63 offset 31' south to
3" square stake.

~~13/18~~
2/17 138-26

43+65 18" Norway pine and hick
42+90 cut of Aspen

39+60

29+70 quit today Feb. 16, 1939

Feb. 16 1939
Woods Notes
Harland - Ch.
Basick - brushing
Esterson - brushing
Esterson - plants

6

look for:

Aspen 11" N. 27° E. 26 lbs.

W. Birch 6" S. 22° E. 11 lbs.

" " 7" S. 15° W. 10 lbs.

" " 9" N. 23° W. 30 lbs.

Found:

3" sq. stake

scribed

S-13, S 14 - S 24 - 19

offset 31' so. to
stake from random
line

Alder
swamp

Mag. Bearing N 29° E

Alder
swamp

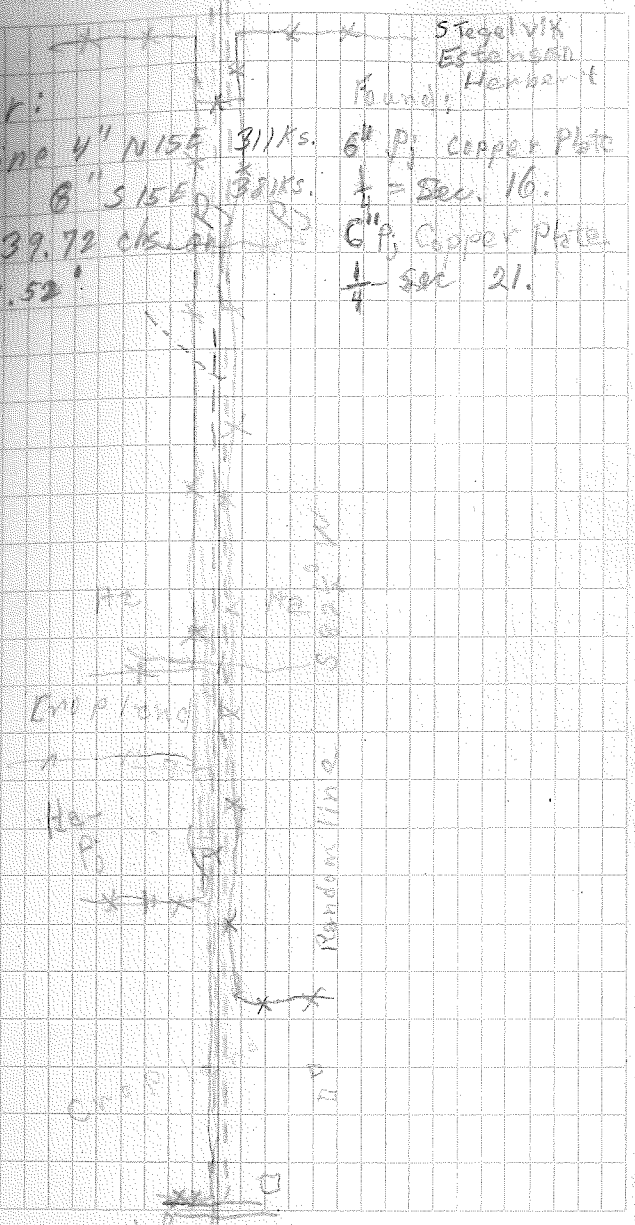
Random line

| | | | |
|-------|----------|-----------------|----------------------------|
| 20+40 | Set | APP. + Cor | $\frac{1}{2}$ 139-24 |
| 25+82 | Found | bits with copp | or Plate N |
| 25+75 | Fence | Run N + S | $\frac{1}{4}$ - 16 S. |
| 24+80 | Found | bit with copper | Plate $\frac{1}{4}$ - 21.5 |
| 24+05 | Gate | on road | |
| 2100 | Type | change | |
| 1047 | Track | Run SW | |
| 10+20 | Set | off E of | 139-26 |
| 10+25 | Fence | Run S | Type Change |
| 10+20 | | Type | change |
| 7+41 | Fence | Run S | + Type Change |
| 5+78 | Fence | Running N + W | |
| 2+10 | Farm | 200 FT N | |
| 1+00 | Building | 100 FT N | |
| 0+00 | Started | West from | $\frac{16}{21/22}$ 139-26 |

Feb. 13, 1957

Look for:

Hd. Pine 4" N 155° 311 Ks.
 " 6" S 155° 301 Ks.
 At 39.72 chs. 21
 26 21.52°



Var. 2.58° - 7 1/2

51-23 Found ^{37 FTS} BT, Copper Plate ^{6" Pj} 17/16 138-26
 51+44 Found Square stake 20/21
 5400 BT, Copper Plate, Sec 16/21 6" Pj
 Offset ^{11 FTS} 11' No.

45+90 Type Change

39+00 Set Appr. W $\frac{1}{16}$ Cor $\frac{1}{2}$ 138-26

35+00 Type Change

26+40 Continued West From $\frac{16}{21}$ 138-26

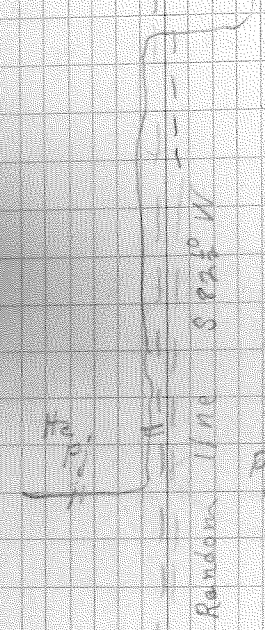
Feb. 13, 1919

Storgevik
Estensen
Herbert

Look for:

Hd. Pine - 8" S 20 E, 110 Ks
 Y. Pine - 20" S 12 W, 23 Ks.
 No other tree.

Found:
 B.T. Copper plate
 Sec 16 - 5' 6" Pj
 B.T. Copper plate
 stake. Sec 21 6" Pj



26+40 Set APP f Cor $\frac{17}{20}$

120+10 Type Change

19+12 Type Change

12+20 Type Change SET APP E 1/6 Cor $\frac{17}{20}$

9+00 Type Change

9+68 Trail Run NW + SE

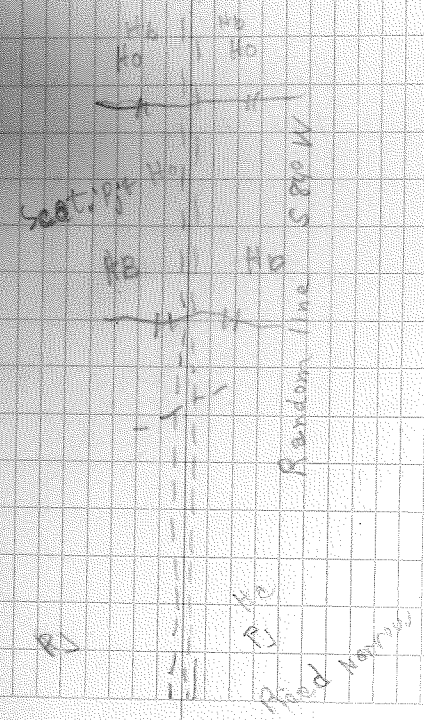
0+00 Started West from $\frac{17}{20}$ 16/21

Feb. 13, 1939

Stegelijk
Estacion
Herbert

Look for: Km Km
1/4 post
Pile of stone
rocks around post.
No trees near.

No Evidence



Var. 6°

32+80 Set App. Sec. Cori

$\frac{18/17}{18/20}$

39+60 Set APP W. $\frac{1}{16}$ Cori

35+50
39+44 Quite for the day Feb 11, 1939
Road Turns NW & SW

29+80 Type Change

26+40 Continued West From $\frac{1}{16}$

139-26

Feb. 13, 1939

10.

Look for:

Y. Pine 8" N87E, 43/ks.

" 18" S55E, 19/ks

J. Pine 11" S52W 22/ks

" 8" N $\frac{1}{2}$ W 146/ks.

80.05 c/s.

Stagglin

Estensen
Herbert

Found:

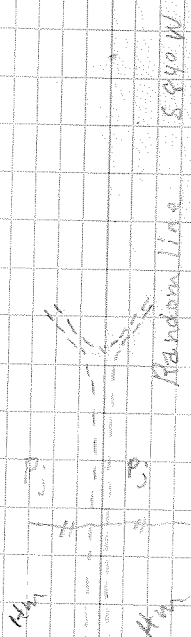
4" Jack Pine

Squared on Four

Sides. 63 Ft.

From APP Cori

Direction N 25° E.



26+40

Set APP $\frac{1}{4}$ Cor $\frac{18}{19}$ 138-26

21+11 Enter White Birch

18+12 Enter Mixed Hardwood

13+25 Enter Mixed Pine (white, Jack, Norway)

1+05 Left Scatterd Jack Pine. Enter Mixed Pine

0+00 Started West From APP Sec Car $\frac{18}{19}$

Look for:

X Pine 20" N71E $\frac{18}{19}$ 1/2.

X Pine 20" South 109 lks.

Feb. 20 1939

MORRISON - Chief
PETERSON - Dr. Chain
PETERSON - Br. Brush
KANGUS - Brush
CHASE - Picket

Found!

4" White Oak

Squared on Four
Sides. 34 FE

From APP Cor.

Blazes headed over.

Mixed
PineMixed
BrushPondok line
Mag. Var. 85° W

52+33

Found Mitchell Lake Road.

1318
29/19

138-2

46+12

Enter Mixed Hardwood

42+80

Enter White Pine

39+40

Enter ASPEN WITH UnderStory W. Pine

33+95

Enter Mixed Hardwood

32+52

Enter Jack Pine

27+11

Enter ASPEN
Continued West from15
19

138-26.

Mitchell

Lake Road 12

Feb. 20 1939

Matisson - Chief

Peterson, Dr. Chas.

Peterson, E. - Brush

Kangas - Brush

Chase - Picket

Look for:

X Pine 20" N 67° E, 180 Ks.

W Pine 20" S 57° E, 150 Ks.

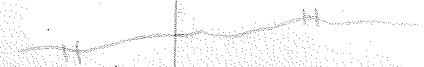
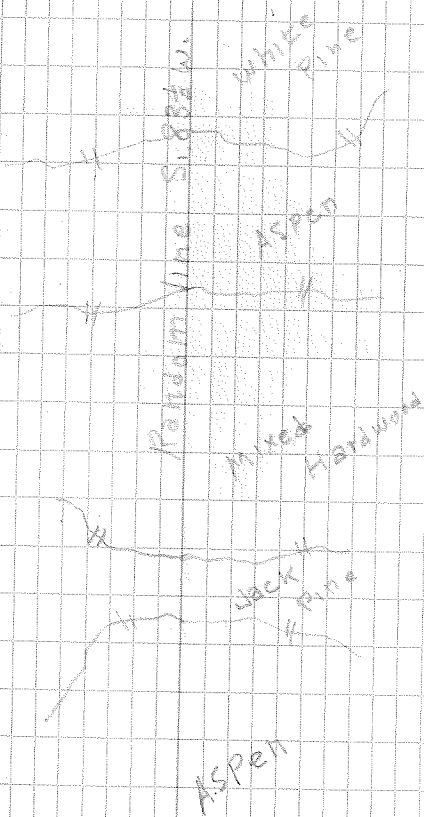
Y Pine 20" S 11° W, 188 Ks.

X Pine 20" N 7° W, 293 Ks.

Hardwood

Found

Road, No. B.T.S.



26+40

Set ^{APP} $\frac{1}{2}$ Cor. $\frac{10}{15}$ 137-26

25+70

Enter Mixed Brush

23+05

Fence runs Parallel with Ditch
Come onto Ditch

22+25

Enter Mixed Hardwood

18+78

Enter Swamp Willow

16+07

Enter Open Meadow - Fence Leaves Line

13+02

Enter Aspen

11+12

Enter Swamp Willow

6+05

Enter ASPEN

5+08

Enter White Pine

3+95

Fence runs North

1+04

Enter ASPEN

0+00

Started east from Center of road

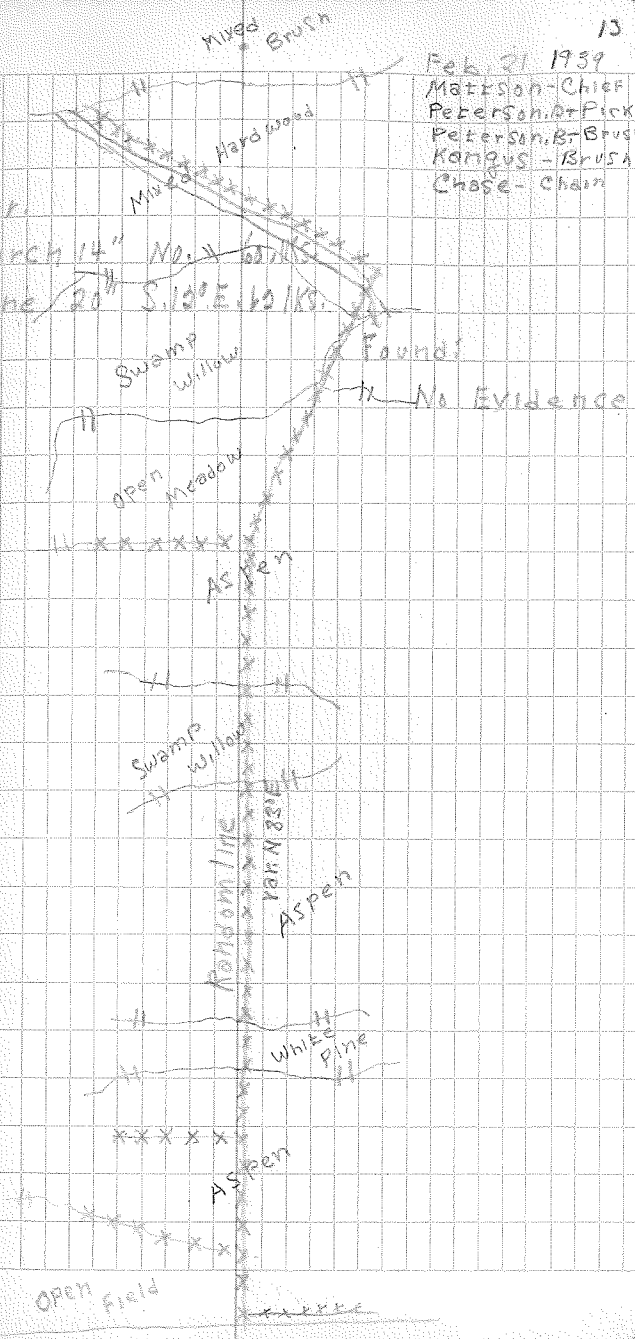
 $\frac{9}{15}$ 137-26

13

Feb 21 1939

MATTSON - Chief
PETERSON, B. Picket
PETERSON, B. Brush
KAMPUS - BRUSH, M.
CHASE - CHAIN

Look For:

W. Birch 14" No. 11
Y. Pine 20" S. 120° E 1/2 1/4 S.

52+80 Set App Section Corner

10/11
15/14 1375

50+49 Enter Swamp with Scattered B. Spruce
and Tamarack

35+20 Enter Mixed Brush

32+15 Enter Aspen

26+40 Continued East on random line

11
15

Scattered
B. Spruce &
Tamarack

14

Feb. 21, 1939

Look For:

Tam. 3" N 51° E. 14 Ks.

Tam. 3" N 55° W. 50 Ks.

Tam. 9" S 45° E. 70 Ks.

Tam. 4" S 22° W. 17 Ks.

Found:

Mattson - Chief
Peterson D. - Pickets
Peterson E. - Brush #1
Kangus - Brush #2
Chase - Chain

No Evidence of
Corner or 1375

Random Line
Yen N. 83° E.

Mixed
Brush

Aspen

Mixed
Brush

2640 found 12" p.p. W 25 S 16 N 1/2 Nail in
bottom of tree N 42° E dist. 105.8

2342 tail north

2140 enter jack pine

1740 enter sp. 5 sp.

1240 enter jack pine

1040 enter sp. 5 sp.

7400 entered jack pine

0400 started west from sec. 32 133

Feb. 15, 1939 15

Woods are
Eastern White-ch.
Hardwood ch.
Bark and
Eastern White

Look for:

Y. Pine 16" N 47° E 136 1/2

" 6" S 19° E 150 No.

H H

*

Found:

*

*

H H

jack pine

H H

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jack pine

P.P. 10" S 8 1/2° W
distance 102.6'

Open
field

RT

Random

BT

13724

52440 corner of State game area 31/32 138-26

40466 Road connects with another Road

27400 continued west from '14

Feb 15, 1936
~~pt 31~~ Same party

Look for:

X Pine 14" N60E 44Ks.

X Pine 6" S10E 48Ks.

" 8" S61W 14 Ks.

" 7" N43W 12 Ks.

Found:

2 B.T.s.

P.A. 12" Va S 8' W

Distance 28.6'

P.A. 14" Va N 17° E

Distance 40.1'

2" j.p. with

brass cap

scribed.

section
31/32
CORNER

26+00 Set APP $\frac{1}{4}$ Cor 3B No Evidence 138-26

24+30 Type Change

23+25 Type Change

18+00 Type Change

17+20 Set APP. W + Cor 2400 138-26

11+86 Type Change

0+00 Started East from 32/33 138-26

Feb. 16, 1939
Herbert
Stenlund
R. Peterson 17

Look For:
Aspen 6" N46W 20' 1Ks. Shm.
Aspen 4" S35W 16' 1Ks. H
Muc. $\frac{1}{4}$ Corner in lake " "

Found:

St
+ +

recharging old line
79

Hm scattered P₁ + P₂

Recharging

J. Pine BT
N. Pine BT

52+80

Set APP Sec. in Lake

33/34

139-26

Feb. 16, 1939

Herbert

Stegall

R. Peterson

18

Look for:

Corner in lake

Found:

39+60

Set APP E $\frac{1}{16}$ Cor

32/33

139-26

26+76

26+40

Lake Shore Dahler
Continued East from 32/33 138-26

Dahler

Lake

26440
26430
26400

Set APP 1/4 Cor ³⁴
BT. For 1/4 Cor 12" W. Pine 1/4-34 T 137-26
BT. For 1/4 Cor 14" W. Pine 1/4-34 T 137-26
46 FT 1/4 N

21 FT N

23490

Type change

21461

Type change

13425

Set APP W 1/4 Cor 33/34 139-26
Type change

10473
10446

BT. For M.C. 75' South
Lake shore

0440

Started East from 33/34 Cor 139-26

Feb. 16, 1959

19

Herbert
Stegallvik
R. Peterson

Look for:

MGR

Found:

W. Pine 6" S3E 11 Ks

2 B.Ts.

Scrub Pine 6" N42W 11 Ks

N. Pine 12" Sec 39

W. Pine 14"

BT

BT

BT

BT

BT

S

Lake

Daily

Rebrushing
N. 85° E

old cut 1200

Am scattered Pn-Rv

B.T. For M.C.
18" W. Pine
Sec. T 137 R 2 C

52+80

Set App Sec

Cor. in
lakeLake
34/25

138-26

39+60

Set App E $\frac{1}{16}$ Cor34

139-26

34+45

Lake shore Emily

33+99

B.T. For M.C. 6 FT. S

33+69

High way No. 6

26+00

Continued East from 34

138-26

Feb. 16, 1939

20

Herbert
Stegall's
R. Peterson

Look For

Sec. Corner in lake

Found:

Lake Emily

~~4m sec found~~
~~pt.~~

26+40 Set APP $\frac{1}{4}$ Cor.

$\frac{11}{14}$ 138-20

24+20 Enter open grass land

23+54 Enter ASPEN

15+92 Enter open grass land

13+21 Set W. $\frac{1}{16}$ Cor.

11+85 Enter Mixed brush

0+80
0+00

Enter ASPEN
Started East From APP. Cor. on same line

$\frac{10}{15}$ $\frac{11}{14}$ 138-20

21

H.A. Feb. 23, 1939

Mattson - Cole
Petersen - Pickett
Petersen - B. Brush
Kangas - Brush
Chase - Chalm

Look For:

Tam. 6" N 25° E 44' 1/2 S.

Tam. 7" S 27 1/2° E 137' 1/2 S.

open grass land

Mixed brush

ASPEN

B. Spruce &
tamarack

51+40 Reach Brushed line turning Not So.

46+00 Enter Scattered Aspen

40+22 Enter Mixed brush

39+60 Set APP E. $\frac{1}{16}$ Cor.

30+09 Enter Aspen

26+41 continued East. From $\frac{1}{4}$ cor $\frac{11}{14}$

$\frac{11}{13}$ 138-2
 $\frac{11}{13}$

221

Feb. 23, 1939

Mattison - Chief
Petersen, B. Pickett
Petersen, B. Pickett
Kanevsk - Brush
Chase - Chain

Look For:

Aspen 5" N 30° E. 89 IKS

Aspen 6" N 11° W. 75 IKS

W. Pine 6" S. 60° E. 60 IKS

Tam. 7" S. 75° W. 261 IKS

Scattered
Aspen

Found:

2" Squared

Post, 2151 Sec. 19 R1E

Mixed brush Offset 334' to Cor.

12' P.T. S 33° 10' W

Distance 130'

Random line var. 1830'

Aspen

Open grass land

26+46

Set App $\frac{1}{4}$ Cor.

$\frac{19}{13}$ 138-26

24+52

Enter Mixed Hardwood

13+20

Set App W. $\frac{1}{6}$ Cor.

10+20

Enter Spruce Swamp

0+00

Started East From Stake

$\frac{11}{14}$ $\frac{12}{13}$ 138-26

Feb. 24, 1939. 27

Woods - Chief

Peterson - Chain

Chase - Picket

Kangas - Brush H.

Look For:

Fir 4" S. 45° W. 9 1/2

Maple 8" N. 75° E. 28 1/2

Spruce Swamp

Random line
for N. 88° E.

Black Pine

32781

Set APP Sec cor.

 $\frac{12}{13}$
T
18

138-26

46+40

Enter Mixed Hardwood

43+84

Enter white Birch

39+60

Set APP E. 1/6 Cor.

37+74

Enter ASPEN

36+16

Enter White Birch

35+20

Found Logging trail

30+05

Enter ASPEN

29+08

Enter Swamp willow

26+46

Set APP East From

 $\frac{12}{13}$
T
18

138-26

Feb. 27, 1939 24

Mattson - Chief

Chase - Chain
Peterson, S. Brush, W.
Kangas - Pinned

Look For

Found:

W. Birch 8" N. 8° E. 42. 1/2 Ks.

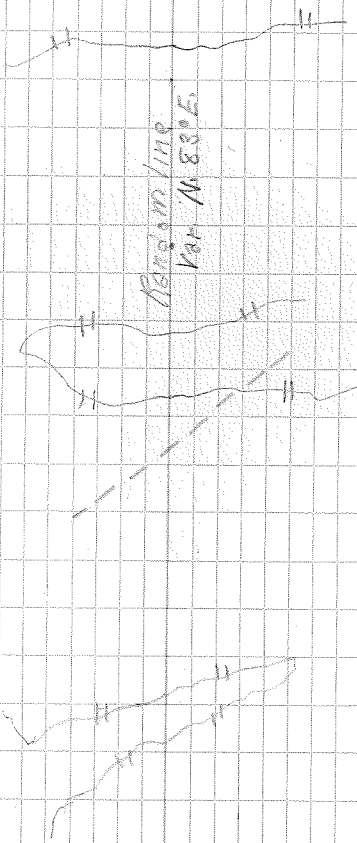
B. 2. 12" Birch

W. Birch -- S. 70° E. 8. 1/2 Ks.

W 45 ft. N. 18° E.

Fir -- S 44° W. 17 1/2 Ks.

W. Birch -- N. 59° W. 10. 1/2 Ks.



26+40 set app 5 cor.

$\frac{31}{6}$

138-26

17+80 Enter Oak

14+00 Enter lake

13+20 set app 5 cor.

0+00 started West from

$\frac{31}{6} \frac{32}{5}$

138-26

Date: Feb. 28, 1951 25

Estimation notes

Box - Ch...

Woods - ...

Look for:

Oak

Found: No

At 2706' M.C.

Evidence

Y. Pine 11" North 27ks.

" 6" S57W, 164ks.

Look for:

At 2129.2' - M.C.

Found: No

J. Pine 12" N 70 $\frac{1}{2}$ W, 6ks.

Evidence

" 11" N 28 E, 7ks.

Jack pine
Hardwood

⊙

52+59 found wood ~~stake~~ ^{stake} $\frac{31}{6}$ 138-26


39+60 set app. W. to cor.
38+00 Enter marshy sup.



continued West from $\frac{31}{6}$ 138-26

Feb 28, 1939 26
Extremities
80 sq ft - 5 ft
woods - brushy

Look for: 


Lake


Marshy!

Look for:
at 3725' M.C.
on east side of
lake.  

Found:
3" wood stake
squared corners
sides:
SW

Found no
Evidence


Var. evidence
randomly

26+00

found $\frac{1}{4}$ cor.

$\frac{33}{2}$ 137-26

21+00

Enter spruce swp.

14+00

Cropland

13+20

set app. w. $\frac{1}{2}$ cor.

10+20

Center of Bridge, road and creek.

6+00

Enter mixed Hardwood

0+00

started East from cor.

$\frac{3435}{312}$

Mar. 1, 1939
Est. from NITE's
Ducek - ch
woods - brush

27

Jack fir:

spruce 4° N. 75 E. 54 lks.

spruce 3° S. 5 E. 30 lks.

Found:

line running

north 2" stake

fastened on trees

Cropland

Jack fir:

Mc. post on Emerald Lake

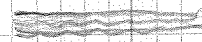
Aspen 8° S. 25 E. 35 lks.

W. Ash 10° N. 70 E. 27 lks.

Found: 20

Evidence

Mixed



Lake

Emery

59+07

found

Mar. 1, 1939

78

Party
Woods - Brush ch.
Extrem - Nodas
Buck - ch.

Look for:

w. Birch 7' S. N. 60 W. 42 1/2 lbs.

Fly 5" N. 30 E 26 1/2 lbs.

w. Birch 8' S. 60 E 15 1/2 lbs.

y. pine 20' S. 40 W. 31 1/2 lbs.

Found:

2" stake

1/2" stake

N. S.

DT 1/2" stake

N. S.

15" stake

S. 75 E

1/2" stake

S. 75 E

Aspen

39+60

set app. E. 1/2 cor

36+80

Enter Aspen

47+00

cont. East from

39+60

20+40 set app. to line

36
1 38-26

22+30 Enter N. pine

14+30 Enter Aspen

13+17 found small cor. 71 ft S from line
Offset to line running N. and S. 1/2

9+50 Enter tan sup.

0+00 started East from cor.

37
2 1

Mar 1, 1939
Estrem - N. to
Ezek - Ch.
Ward - bridge

29

look for:

w. pine 9 in. N. 64 w. 1/2 lbs Found: 20
Fir 6" S. S. W. 4 lbs. Evidence

Aspen

Found:

IP. with Brass Cap

Bottom 20 ft
S. S. W.

Bottom 31 ft
N. S. W.

Offset to line
running East and West
from IP.

PRY
COR

Aspen

52+30 set app. on

51+10 Enter back pine

47+30 Enter sup

39+60 set app. E. 1/4 cor.

May 1, 1939
Estrem - Notes
Back - ch.
Walds - branching

look for:

~~Fr 5' to N. 30 E 1/4 1/4~~

Found no

~~W. Birtah 7' N 60 W 1/4 1/4~~

Evidence

~~" " 8' S 60 E 1/4 1/4~~

~~Y. Pine 20' S 41 W 3/4 1/4~~

NOY
Walds
1/4 1/4
1/4 1/4
1/4 1/4

26+40 Center of a Dts

$\frac{27}{37} 137-26$

23+10 fence running N. and south

22+86 road running N. and S.

20+64 Highway 706

17+17 road running S.

16+64 road running S.

13+20 road running N.
set up for car

9+32 road running N.

6+70 fence running N. and E.

1+00 started East from con

$\frac{28}{33} 137$

Mar. 21 1939
Estrem. Notes
Boeck - ch

31

Jack pine

W. Pine

Aspen 6" N. 15 E 12/15

Y Pine 6" S. ~~W. 15 N. 15 E 12/15~~

Jack pine

M.P. on ~~W. side~~ ^{10'} ~~side~~ of Family

Y pine 12" N. 15 E

W. " 30" S. 15 W. 17 Ws.

Found:

B.T. 18" N.D.

5.4" W. Dist. 18'

set up for O.W. U.S. BT

B.T. N.P. 14"

N. 15 W. 15/50 14

Found: 20

Fredence

Jack pine

Random line

Crop

and

Found:

B.T. 19" 37 ft

S. 35 W.

52+60 set app sec cur.

~~44+60 Enter Aspen~~

~~44~~

~~44+60 Enter ... pine~~

39+60 set app E. in car

34+64 Enter Lake Emily
~~34+44~~ fence running N. & S.

32+10 Enter Alder swp.

30+00 offset N. to line 20

28+04.6 to center of ~~rest~~ building on line
offset 20 ft. south

Mar. 2, 1939
Estrelin - Notes
Bocek - ch
Woods - plants

39

Aspen

~~|||||~~

V N. pine

~~|||||~~

1/8

~~|||||~~

W. Pi

W. Pi
W. Pi
W. Pi

□

Mar. 21/29 quite a day

26+40 set app. 1/4 cor. 26 138-26
35

29+90 Enter Aspen

~~20+100 Enter Alder sup.~~
~~Enter 27/100 sup.~~

13+10 set app. 1/4 cor.

0+00 started East from cor. 2726
3435

Mar. 21/29
Est. Notes
Book-Cl.
Woods-pickets

33

Look for:
Aspen 21"
Aspen 21" N 35° E 10' Ks.
" 10" S. 20° W. 21' Ks.
W. Pine 20" N 125° 15' Ks. - 11
" 18" S 250 10' Ks.

Look for
M.C. at about
2073'
Elm 11" S. 55° E. 60' Ks.
Aspen 7" N. 15° W. 35' Ks.

Lake E. 27/100
var. 76
Hudson 27/100

var. 76

52+20 set app. sec cor.

44+60 Enter Aspen

40+42 Enter N. pine

39+60 set app. E. $\frac{1}{10}$ cor.

Mar. 21 1939
Estrem - Notes
Buck - Ch.
woods - pickets

34

look for:

y pine 22" N. 60 E 44/Ks.

Aspen 12" N. 65 W. 32/Ks

y pine " S. 30 E 58/Ks

" " 18" S. 30 W. 188/Ks

~~Aspen~~

" " "

N. pine

" " "

Aspen
Mar. 25 30 W.
Buck - Ch.
woods - pickets

2640 set app gear 138-26 $\frac{20}{34}$

24750 Enter spruce sup.

13+20 set app w. E. cor.

11+40 Enter Balsum

14+30 Enter spruce sup.

0+00 started East from cor. $\frac{26120}{25100}$

Mar 6, 1939 35

Estren - Notes

D. Peterson - brushy
Mattson - Pickets
woods - brushy
Chase - Ch.

Look for: Spruce sup.

Aspen 8" N 35 E 10 IRB.

" 16" S 20 W 22 IRB.

Found: 70

Evidence

Balsum

Spruce

var. Mitchell
sup.

Aspen

138-26

30

48+72 found sec cor. 2" stakes squared
on two sides

22+50 Enter tan sup

28+90 Enter spruce sup

26+70 Enter aspen

Mar 4, 1934
Est. sec. notes 36
D. Peterson - brooking
Mottson - pickets
Woods - by glazing
Chase - GA

Look for:

Tan 4" N 12° E 12 1/2

" 6" S. 57° E 8 1/2

Y. pine 6" S. 11° W 7 1/2

Found:

2" stake squared
on two sides 110 ft.

N from line

Rt 10" N. pine

S. 125° W. 45 ft.

Rt 10" N. pine

S. 109° W. 57 ft. S 36

with copper plate # 138

Rt 14" N. pine R 20

S. 90° E. 45 ft. S 31

with copper plate # 138

R 25

Ridge 55 ft. wide.

400 ft. long - Four N. pine

100 ft. wide - no other

trees on Ridge

tan sup
spruce sup
aspen

tan sup
spruce sup

tan sup
spruce sup

tan sup
spruce sup

24+71 off set 12 ft south 138-26 $\frac{3}{10}$
24+10 to 2" i.p. with oval shaped cap

15+65 Enter Aspen
tree rvy lay head south

7+10 fence running north and

6+00 cropland
5+50 fence run S.

2+42 fence running north E

0+00 started East from cor. $\frac{4}{3}$
 $\frac{9}{10}$

Mar. 7/1939 37

Estimate notes
Mason - Chisels
D. Peterson - brushing
Wooden brush legs

look for: + + +
W. Birch 4" South 85° W.
11 Birch 5" N. 45° W. 105° W.

Found

2" i.p. with oval
Shape cap. scribed
scribed $\frac{4}{5}$
 $\frac{10}{3}$

N.P. N 31° E

N.P. STUMP 1/4 S

S 31° E Dist. 6 1/2 S

Dead aspen N 40° E

Dist. 17'

14" aspen sq. ed

3 sides S.

S 21° W

Dist. 15'

No. Scribing

of aspens

Went to sec. cor. $\frac{4}{3}$
 $\frac{9}{10}$

Not knowing the exact

Location of corner

I inquired of xxxxxxxx

L. O. FRANKS who runs

The general store

in outing mill.

He told me the corner

was 300' ft south of AND set up compass

His store and ARR. RUNLINE N 83° E

4' east of center

of road. I went there

St. Highway

52480 corner fell in lake.
About 30 ft. from shore
on east side of lake.

37+14 Enter lake pass.
36+75 Bt. in center line with
Copper Plate M.C. T. 138 R26
Resurvey Bt.

28+00 enter Aspen
~~41+00~~
27+00 continued line East from I.P.
N 73° E

Mar 7 1939

Extra Notes 36

Ch. 2 - Ch.
M. post on picket
3/27/39. Brush in
woodst. 2/1/39

look for
M.C. post on E side of lake Found.

M.C. Bt. N.P. 14" S 43° E

Distance 120 ft.

Copper plate M.C.
S. 11. T. 138 - R. 26.

could not find M.C. post
Took reading from app. sec.
cont. in lake. continued
East 113° E

look for Orig. ↓

M.C. post on W side of lake
w. pine 24" N. 65° W 14 1/2 ft. 8" south of
Aspen 10" S. 20° W. 4 1/2 ft. line.

could not find

M.C. post

continued line

East across

lake N 73° E

Aspen
V. 113° E
Aspen

26+~~20~~⁴⁰

set app. $\frac{1}{4}$ cor.

138-26

$\frac{2}{11}$

26+20

Enter tan sup.

10+00

Enter Aspen

19+20

set app w. $\frac{1}{16}$ cor.

12+80

Enter spruce sup.

1+00

Enter Aspen

0+00

started East from con $\frac{312}{1111}$

Mar 6, 1939

Estrem - Notes

39

W. section - ch.
spruce - brushing
Woods

look for:

tan 6" S. 35 W. 20 lks.

spruce 4" N. 15 W. 78 lks.

Found 710

Evidence

Aspen

Spruce sup.

Aspen

Van N. 37° E
Mandan line

lake passage

52480 set app see cor

$\frac{1}{12}$

37738 1st Aspen on center of line
Enter Aspen

Mar. 1939

Estimate notes

Ch. 11
M. 11
D. 11
Woods

40

| | | | | |
|-----------|----|------------------|--|----------|
| Look for: | | | | |
| Aspen | 7" | N. 40° E 41 1/2 | | Evidence |
| " | 5" | N. 35° W. 37 1/2 | | |
| W. pine | 6" | S. 32° W. 19 1/2 | | |

Aspen

Bandage line

10
S
VAR. N. 53° E 20 P.
W

26+40 set app $\frac{1}{4}$ cir. 138-26 $\frac{1}{12}$

14+15 Enter Aspen

13+20 set app with car.

11+64 Enter spruce sup.

6+81 trail running N.W. and S.E

0+00 started East from car $\frac{2}{15}$

Mar. 9, 1939
Estrella - Notes
Chapin - CA
Mason - Pickets
Woods - Erby, Erskine

41

Look for:

Aspen 6" N. 60° E. 10 Ks.

Aspen 9" S. 30° E. 35 Ks.

Found: No evidence.

ASP

|| ||
*
*
|| ||

ASP

via
Bandon 11/15

52+80 set app. sec cor.

$\frac{116}{217}$

39+60 set app E to cor.

Mar. 9 1931
Estren - Notes H2
Chupla - ~~brush~~ ch.
Mulligan - brushing
D. Hefner - " "
Woods - " "

Oak fori

W. Birch 7' N. 8 E 25 Ks.
" " 6' S. 67 E 34 Ks.
" " 5' S. 46 W 30 Ks.
Blk Oak 6' N. 52 W 15 Ks.

Found: Ma
Fredence

Aspen

van N 995
Random line

26+40 set app $\frac{1}{4}$ cor.

138-26 $\frac{4}{9}$

17+60 Enter lake Roosevelt

13+20 set app E. $\frac{1}{10}$ cor.

9+00 East edge of lake Roosevelt
to the N. - 75 ft.

0+00 Started West from cor.

$\frac{4}{9}$

Mar. 10, 1939
Estim. - Notes
Chapko - ex.
Manson - brushing
Woods -

43

Look For:

M.C. post on E. side lake

w. Birch ging. S. of E. 3/4s.

Elm. Ging. N. of E. 3/4s.

Found: No

Evidence

lake

ASPEN
various
Random line

Spring 1939

52+60 set w/ sec. cor.

514
814

39+60 set app. w. 1/2 cor.

Mar. 10, 1939
Exp. Notes
Chopko - Ch.
Mills - Grading
D. Peterson -
Woods

44

Lake Roosevelt

various
random
finds

20+40 set app to cor 138-26 $\frac{5}{8}$

21+39 road running N.E. and S.W.

25+19 fence running N. and S.

27+20 set app E. to cor.

27+82 Enter Aspen

0+00 started West from cor. $\frac{5}{8}$

Mar. 10, 1939
Est. rem. - Notes
Chapin - ch.
Maffson - ch.
H. Peterson - ch.
Woods -

45

look for

w. pine 10' N. 60 W. 32 1/2 Ks

" " 28' S. 6 N. 55 1/2 Ks

N.E. post of ~~W. side lake~~

y. pine 18' N. 57 W. 31 1/2 Ks. Found: 70

" " 16' N. 57 W. 31 1/2 Ks. Evidence

very rough

and hilly

XXXXXXXXXXXXXXXXXXXX

~~W. side lake~~

var. w. Aspen

aspen

lake

52+00

Set app. sec cor

211
1112

51+00

Enter Aspen

42+20

Enter Birch

Mar. 18, 1939 - quite foggy

39+60

Set app 4 cor

36+20

Enter Mixed Brush

29+00

Enter spruce sup.

Mar. 13, 1939
Est. no. 107015
Matisa n. ca.
ca 1925 - 8700 ft
D. 1925 - 8700 ft
Woods

46

look for

Found: no
Evidence

spruce
var. 5. 8. 10
sup.

Aspen

26+40

set opp 4 cor.

138-26

$\frac{6}{7}$

16+90

Enter Aspen

13+20

set opp E. $\frac{1}{16}$ cor

5+80

Enter Mixed Hardwood

2+65

Enter pond

0+00

started west from cor.

Mar. 13, 1939
Estrem - notes
Mathson - 8A
Cangas - tracking
Peterson - 11
Woods - "

47

Look for:

Aspen 6 ins. N. 14 E 20 ks

w. pine 3" S. 32 E 28 ks

Found 770

Evidence

|| || ||

very rough and
hilly

Random line

~~|| || ||~~

random line

~~|| || ||~~

52+80 Set opp. sec cor.

$\frac{115}{1017}$

51+80 Enter SWP

43+32 Enter Birch

40+32 Enter lake

39+60 Set opp w. to cor.

May. 13, 1934
Estrem - notes
Mellson - ca
Sang 23 - brushing
D. of Pers
Woods -

48.

| look for: | | | | | Found: |
|-----------|-----|------|-------|------|-----------|
| y. pine | 24" | N 16 | E. 15 | 1Ks | 30 Evadev |
| " " | 14" | S 04 | E. 36 | 1Ks. | |
| " " | 20" | S 17 | W. 15 | 1Ks. | |
| " " | 16" | N 27 | W. 14 | 1Ks. | |

var. 58% w.
B and on line

26+40

Set APP $\frac{1}{2}$ Cor

138-26

~~33~~
4

~~24~~

19+55

Enter Lake

16+15

Reached Shore Enter White Birch

13+20

Set APP E. $\frac{1}{2}$ Cor.

0+00

Started West From

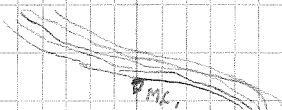
$\frac{33}{4}$
3

138-26

Mar. 19, 1939
Mitten notes
Estrem-el
Rings - brushing

49

look for:



look for:

MC. post on west side
Ash 10" N. 70 W. 11 Ks.
Maple 6" S. 60 W. 19 Ks.

White Birch

Found:

MC. post south
soft

Roosevelt
Lake

van der
Borden

53+33 Offset 36ft N. from line found J.P. 10th
N. from old line meaning west. Cont.
line west. var. S. 83° W.

41+03

Enter Mixed Hardwood

39+60

Set APP W. Kib Cor.

37+38

Enter Lake

33+16

Reached Land Enter ASPEN

26+40

Cont. West from

33
+ 137-26

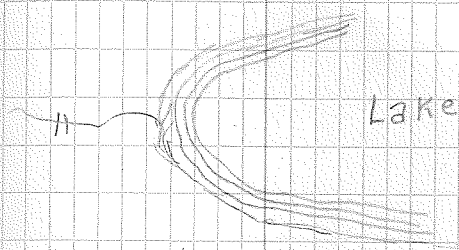
Mar. 14, 1939
Mottson - Notes
Estrom - ch.
Kangas - proshing

50

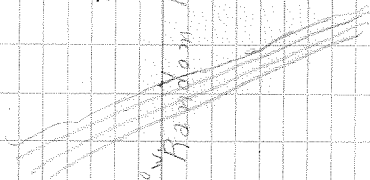
Look for:

| | |
|-----------------------------|------------------|
| Oak 12" N. 37 E. 78/Ks. | Bit 18" Virginia |
| Yip 11" S. 70 E. 17/Ks. | N. 35 W. 53 ft. |
| Yipine 14" S. 23 W. 129/Ks. | Series 3-32 |
| Oak 10" N. 86 W. 126/Ks. | |

Mixed Hardwood



ASPEN



Lake

138-26

$\frac{32}{5}$

26+40 Offset N. 75 ft. from line to
old line cont. chaining west

13+20 set app. ft. over

0700 started west from cor

$\frac{32}{54}$

Mar. 27, 1939

Party Notes
Est. 1938
Mickelson
Wood
D. Peterson
Brushing

51

Locker

w. pine 28" N. 67 E. 107 lbs.
" " 28" S. 44 180 lbs.

Found: no

Evidence

ASPE T

Randomize

Mag. Search 1938 w.

52780 set app. sec. cor.

3172
615

39760 set app. w. to cor.

26740

cont. line west from

32

Mar. 27, 1939

32

Party notes
Est. rock
location
Dipeter's breaking

Leak logs

| | | | |
|---------|-----|-------------|-----|
| w. pine | 15" | N. 39 E. 55 | 1/5 |
| " | 17" | S. 42 E. 78 | 1/5 |
| " | 24" | S. 53 W. 27 | 1/5 |
| " | 7" | N. 63 W. 63 | 1/5 |

Found: 70

Evidence

ASPE

Random line

Map Best by N 53° W

138-26

31
6

21+80 Enter lake wood

18+79 Enter Aspen

13+20 set up E. K. cor.

12+66 Enter lake

0+00 started west from cor. $\frac{3132}{65}$

Mar. 23, 1939

53

Party
Entrance notes
D. Peterson Ch.

Look for:

M.C. post on E side lake wood
y. pine 6" N. 21 $\frac{1}{2}$ W. 54 Ks.
w. Birch 2" S. 24 E. 147 Ks.

Found:

Look for:

M.C. post on w. side lake
Pine 3" N. 30 $\frac{1}{2}$ W. 52 Ks.
w. Birch 5" S. 27 W. 58 Ks.

Found: no

Evidence

Aspen

lake

Bandage line

Look for:

M.C. post on E side lake

Found: no

Evidence

1 w. pine 16" N. 41 E. 111 Ks.
" " 12" S. 13 W. 49 Ks.

Aspen

may be bearing N. 50 E. W.

E 3

52+50
52+19

set opp. sec. car.
road running N.W. + S.E.

36131
116

50+00

road running N.W. + S.E.

47+77

Enter Aspen

43+46

Enter lake

39+60

set opp. with car.

29+28

Enter Birch

27+00

cont. west from car.

31
6

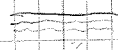
Mar. 23, 1939 Party 54
Eaton-Niles
Speterson-ek.

Look for:

Aspen 8" S 88 E 7 lks.
" 2" S 80 W 16 lks.
" 4" N 17 W 24 lks.

Found: 70

Evidence



lake



Look for:

Mc. Post on inside lake wood
Aspen 7" N. 20 W. 11 lks.
" 10" S. 60 W. 25 lks.

Found: 70

Evidence

Birch

Barney line

Mc. Post on inside lake wood



26+40 set app. 1/4 corner 138-26 34
26+00 Center of Hwy. No. 6. 3

24+40 Left Lake found two M.C. i.P.
One App. 1 1/2 ft tall the other
2 ft. tall continued East down
old line.

0+00 started East from car. 3312
413

53

March 11, 1991

Look for: Aspen Aspen woods, ch-Notes
spruce 10" N. 11 E 33 1/2 ft
W. Birch 8" S. 21 E 15 1/2 ft Chase-Ch.
M.C. post on E. side lake peterson, pickets
W. Birch 8" N. 35 E 6 1/2 ft
S. spruce 11" S. 21 E 8 1/2 ft

Lake

Lake

Went to M.C. on East
side of ~~Roosevelt~~ Roosevelt Lake
Measured 24+40 feet West on Lake
To App sec. cor. in lake, started line
East from there.

Mag. Bearing N83° 0' E
70'

Lake

Lake

52+40 sec. cor. fell in lake.

47+49. Found M.C. 2" I.P.

39+60 set app E to cor.

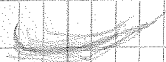
27+00. continued. East of old line.

56

March 14, 1937.

Woods. ch. Notes

Smoky Hollow Chase - ch.
Lake. peter's own pictures



Aspen

Aspen

Mag. Bearing $N 87^{\circ} 10' E$
Random line

26+40 set app 1/4 cor. 138-24 35
2

26+00 Enter Aspen
24+26 fence runs south

19+90 fence running N. and S.
Enter Chapland

13+40 fence running N. and S.
13+20 set app with cor

12+00 Offset back to line running East
Continued line E.

11+89 To center of building. Offset South

10+70 Enter Aspen from line 10 ft.

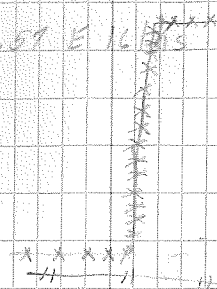
0+00 Started East from Cor. 3435
312

Mar. 16, 1939

57

Part
Est. in notes
W. side - brushy
D. side - brushy
M. side - ch.
M. side - 770

Look for: # # # Found: #
Pine 12' N. 57 E 16' S. Fredance



xxxxxxx

Look for: Found: No M.C.
M.C. post on E. side lake. or evidence
Aspen 10' N. ~~57 E 16 S~~ Ks. found B.M.
Pine 12' S. 40 E 36' Ks. 7' S. of line.

var. 8 ft
Fredance

small lake

52+80 O.P. set Mt. line running E. and W.
 51+70 113.6' North. East. line East, N. 83.2 E.
 Enter Aspen

44+89 road running north and south

42+90 Enter spruce sup.

39+60 set app E. 1/2 cor.

~~38+90 Enter spruce sup~~

31+90 Enter Aspen

28+60 Enter Birch

Mar. 16, 1959

58

Party
 Est. notes
 West - brushing
 S. Peterson
 Mattson - exp.
 Found

Look for: " " "

| | | | | | | | |
|-----|----|----|----|----|----|------|-------------------|
| Tan | 7" | N. | 44 | W. | 33 | lbs. | 6" Aspen |
| " | 8" | N. | 34 | E. | 69 | lbs. | squashed on three |
| " | 8" | S. | 73 | E. | 47 | lbs. | sides and two |
| " | 5" | S. | 43 | W. | 25 | lbs. | 16" white pine |

SPRUCE SUP. with old blazes
 on N. & S. sides.

=====

" " "

" " "

ASPER

113.6
 v. random line

" " "

" " "

26+40 set app. $\frac{1}{4}$ cor. 138-26 36
25+30 Squared post on old random
line.

13+20 set app. W. $\frac{1}{4}$ cor.

0+00 started East from cor.

138-26
211

Mar. 16, 1939

Part
Eastern notes
Squar. brush
found.

69

Look for:

Aspen 6" N. T. W. 16/ks
" 6" South 14/ks.

A squared 4"
hdwd. stake set
on brushed line

Aspen

MSQ. Teaching
E. Random Line

52750 set app. sec. cor.

341

1/6

A 3" white birch, faced
on 2 sides.

52760 set app. E. cor.

Mar. 16, 1939

Partly notes 60
Eastern - brushing
B. Patton on 1/6
Madison - brushing
Chase C

look for:

W. pine 20" S. 39 E. 17/Ks.

W. pine 7" N. 58 E. 14/Ks.

W. Birch 8" S. 20 W. 21/Ks.

B.K. Oak 6" N. 79 W. 29/Ks

Found: no

Evidence

Aspen

Mag. Sec. 2635° E.
Hamden 1/6

FOREST MANAGEMENT
CROW WEG
I.C.C.

T. 138-27

STATE OF MINNESOTA
DEPARTMENT OF CONSERVATION
DIVISION OF FORESTRY

RECONNAISSANCE

Sec. _____ Twp. _____ R. _____

Area _____ Mag. Decl. _____ Date _____

Compassman _____ Estimator _____

| | | | | | |
|----|----|----|----|----|----|
| 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 8 | 9 | 10 | 11 | 12 |
| 18 | 17 | 16 | 15 | 14 | 13 |
| 19 | 20 | 21 | 22 | 23 | 24 |
| 66 | 65 | 64 | 63 | 62 | 61 |
| 30 | 29 | 28 | 27 | 26 | 25 |
| 71 | 72 | 70 | 69 | 68 | 67 |
| 73 | 74 | 75 | 76 | | |
| 31 | 32 | 33 | 34 | 35 | 36 |

0+00

Started west from corner

T. 138-27

21126
31167

May 20, 1939

61.

Party Notes
Estimator - ch.
Johnston - accuracy
Notes - "

Look for:

W. pine 24" N. 70 E. 45 lbs.

Found: 710

N. pine 18" S. 9 W. 71 lbs.

Evidence

Birch
P.M.O.

Look for:

Found: 720

M. pest on side lake

Evidence

Y. pine 20" N. 59 W. 30 lbs.

W. Birch 5" S. 81 W. 50 lbs.

Lake F
Mag. Bearing 88° 20' W. of
Hazard line

Map. T. 138-27

| AGI | | | | | SPECIES | TYPE |
|-----------------|--|--|--|--|---------|------|
| NUMBER PER ACRE | | | | | | |
| | | | | | | |
| | | | | | | |
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| REMARKS | HEIGHT | VOLUME | | | SPECIES | TYPE |
|---------|--------|--------|------|---------|---------|------|
| | | CORDS | POLE | BD. FT. | | |
| | | | | | | |
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| | | | | | | |
| | | | | | | |

90 ft. per day Mar. 26, 1927
 138-27
 21
 28
 set app. 3' cor. = A 3"
 white birch stake faced on
 two sides.

17+23 Enter Birch and pine

0+00 Started west from cor.
 T. 138-27
 31/22
 31/27

Mar. 26, 1927
 Part
 Est. Peterson - Notes
 Johnson - Ch.
 Woods - " "

Look for
 w. pine 24' N. 70 E. 45 lbs. Found: no
 N. pine 15' S. 9 W. 71 lbs. Evidence
 Birch
 Pine O.
 Look for
 No. part on w. side lake Found: no
 Evidence
 y. pine 20' N. 59 W 30 lbs.
 w. birch 5' S. 81 W 50 lbs.

Lake F
 Mag. bearing 330° 0' / N. 200' from line

52+80

Sat. ~~10/21~~ 10/21

10/21
29/27

A 3" w. birch stake faced on three sides.

39+60

set app w. to cor.

26+70

cont. west from

$\frac{21}{28}$

Mar. 21, 1939

Party

62.

Est. - notes
- D. Peterson - ch.
- J. H. H. - by H. H. H. H. H.
- W. H. H. - by H. H. H. H. H.

Found: 70

Evidence

Red Oak 6" N. 40 E. 45 lks.

W. Birch 7" N. 32 W. 29 lks.

w. pine 24" S. 63 E. 38 lks.

Red Oak 7" S. 40 W. 61 lks.

Map. Bearby 5. 31 W. P. a mid. 777 Line

26+40 set app. 1/4 Cor.
2" Aspen stake.

139-27

20
20

19+49 Enter Aspen

19+70 set app. E. 1/4 cor.

19+80 Enter white pine

8+60 Enter Aspen

See π deer tracks. think it could be
deer yard

0+00

started west from cor.

20
20

April 11, 1939 63.
Estym. notes - CH.
Johnson S.M.
Wood - brushing
HISTORICAL - brushing
found.

Back for:

Red Oak 6" N. 15 W. 15 Hs.

W. pine 30" S. 26 E. 20 Hs.

No evidence.

---|---|---

---|---|---
A
---|---|---
M
---|---|---
S
---|---|---
P
---|---|---

51+17 Center of Road North-South.
off set North 241 ft.

41+20 Road RUNS North-South

Continued West from APR 1/4 009.

APR 11, 1939

64.

ESTIMATED

4th day on

wood-axe

1/20 5:00 PM AXE

Leath Pori:

Aspen 10" S. 42 E. 44 Ks.

W. pine 12" S. 19 W. 104 Ks.

" " 16" N. 52 E. 94 Ks.

" " 20" N. 45 W. 49 Ks.

Found:

2" i.P. oval cap

scribed N 45° W.

Could not find sec.

corner because of

SNOW started here

West from J.P.

Mag. Bearing 58° 10' W
B. 2700 ft. 1/20 5:00 PM

06440 set App 1/4 stake
2" ASPEN stake

138-27

19
30

03751 Fence NW-SE.

10436 Fence RUNS SE-NW Road Along side
of Fence

0400 started west from cor.

1920
5077

65.

April 11 1929

~~Sand~~: Estrem-Hales

Townsend CH

Wood-Axe-cht.

Hilstom-Axe

Look for:

Birch 9" N. 17 E. 28/10s.



□ - det.

map bearing 88° W. ~~random line~~

50490 Off set 160 ft south to 2" i.p.

Also fence west-south

49467 Fence North-South Also Telephone line

38431 Fence North-South

28445 Road Runs N-S.



Locators:

- w. pine 2 1/2" N. 46 E. 435 lks.
- y. pine 20" N. 83 E. 557 lks.
- " " 15" S. 77 W. 7.30 lks.
- " " 15" N. 22 W. 788 lks.

Found:

- 2" i.p. scribble ^{24/19} _{25/30}
- 2" i.p. N 45° W Dist. 40'
- 2" i.p. N 45° E Dist. 44'
- 2" i.p. S 46° E Dist. 48'
- 2" i.p. S 45° W Dist. 49'

~~xxxxx~~
Mag. bearing 58° N. 1775

1175

26450 Road North Fence South

138-27

28

33

23464 Road To Farm House 150' South

16415 Fence North

13420 Reed Run North

10420 open field south of line fence runs S.

8458 Road South

0+00 Start West from cor. At Road

28/27

33/34

April 4, 1939 E.T.

Woods. Notes - ch

Look for:

ASpen xxxx

Found:

Eschschol-cy
painted - projects

No evidence

Black Oak 8" N. 85° W. 50' N/S

~~Aspen 10" S 71° E. 50' N/S~~

Open Field

Aspen

Look for:

Mc. 077 E. side of Rk

Aspen 6" N 99° E. 55' N/S

Aspen 4" S 71° E. 50' N/S

Aspen

Aspen

Found:

2" i.p. N 43° W Dist 5' 3"

2" i.p. N 45° E Dist 4' 7"

2" i.p. S 45° W Dist 4' 4"

2" i.p. S 45° E Dist 4' 0"

52+80 set APP sec. cov.
52+82 old survey line rds south

43+58 Fence south

April 4 1939

Woods - Notes - ch

Estrem - ch

Johnson - pickets

Aspen

Aspen

x x x

~~xxxxxx~~
Bamboo

look for:

Aspen 6' N. 29 E. 33/ks.

Aspen 4' S. 71 E. 27/ks.

Aspen

Aspen

138-27 $\frac{27}{32}$
261 do off set south 35' to road
Running west continued chaining
West on Road.

20100 West Lake

16100 North end of Lake

1157 Road swings North west.
0400 started West from cor.

$\frac{29}{32}$
28

69.

April 11, 1939

Woods Notes - ch

Estym - ch.

Johnson - pickets.

Found.

Aspen

Aspen

Look for:

MC post on East side lake

W. pine 24" N. 65 E. 87/Ks.

" " " 515 E. 110/Ks.

Aspen

off set 35' North to

Telephone wire

continued chaining west

of telephone wire.

May 10, 1939
32000
112

51400 Center of Road Intersection
FOUND 4 I.P. Poles with N.B.S. caps

70.

April 4 1939

Woods Notes - on
Eastern - ch

Found Johnson - pines

2" NW dist 44'

2" SW dist 47'

2" SE dist 43'

2" NE dist 42'

All I.P. have caps
Aspen

Aspen

Aspen line

Aspen

Aspen

26+40 continued west from 'L' box.

24128

24132

Found 1/4 cor 2" GP

138-27

30

31

offset 7' North to line from East
Fence Turns North East.

14788 Logging Rd. NW+SE

14777 fence North and East.

10740 End of swamp

9780 Swamp

0+00

started ~~west~~ EAST

from cor. approx.

25/30
36/31~~25/30~~
~~36/31~~

April 7, 1939.

look for:



Found:

2" GP scribed 1/4 30-31

2" I.P. NW+SW Dist. 45

2" I.P. NW+SE Dist. 45

2" I.P. SW+W Dist. 45

2" I.P. SW+SE Dist. 45

Aspen

Aspen

xxxx

Aspen

Found:

Sec. cor 2" i.p. buried

2" inc. center of Road

scribed 25/30

36/31

Aspen

T137 R27W sec. cor.

2" i.p. NW+SW dist 40'

2" i.p. NW+SE dist 40'

2" I.P. SW+W dist 40'

2" I.P. SW+SE dist 40'

Random Line starts 9 ft. South of se.
I.P. Witness Monument

50429

50430 center of Road intersection ^{30/29} _{31/32}

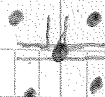
48462 Road NW-5

48457 Trail N-S

26+40 cont. ~~WEST~~ ^{EAST} from $\frac{1}{4}$ cor.

April 7 1939 '92

look for:



Found:

2" i.P. S45W Dist. 47

2" i.P. S45E Dist. 43

2" i.P. N45E Dist. 42

2" i.P. N45W Dist. 41

Aspen

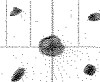
Aspen

Random Line

Aspen

Aspen

Mag. Bearing N. 54 E



138-27
26+27 off set 34' south to W cor
fence North - East

27
34

0+00 Started East from con.

28/27
33/34

138-27

APR 17 1939

Woods-ch-Notes

1st Area - 21' x 21' 73

2nd Area - 21' x 21'

3rd Area - 21' x 21'

4th Area - 21' x 21'

Look for

20" N 57° W 11/15

16" S 72½° W 14/15

Found

2" i.p. oval shaped cap

Scribed 27/27
34

2" i.p. N 45° W dist 50'

2" i.p. N 45° E dist 50'

2" i.p. S 45° W dist 50'

2" i.p. S 45° E dist 50'

Map showing N 45° E
Map showing N 45° E

Found

2" i.p. oval shaped cap

Scribed 27/27
33/34

2" i.p. N 45° W dist 50'

2" i.p. N 45° E dist 50'

2" i.p. S 45° E dist 50'

2" i.p. S 45° W dist 50'

52+68 Offset 2 ft. South to sec. cor.

39+53 fence North

26+40

cont East from 7 cor.

Jeep fence



79
April, 7 1939

Woods - ch - notes

Johnsont - ch

Esty - ch - axe

Hilstrom - axe

Faulstich - axe

2" I.P. scribed 32 36

34 35

2" I.P. N 45 W dist. 50

2" I.P. N 45 E dist. 50

2" I.P. S 45 W dist. 50

2" I.P. S 45 E dist. 50

Hand on line

Hand on line

Hand on line

Hand on line

26+00 Set app. 1/4 cor. 2" ASPEN stake. ²⁶
25+00 Fence North - South.

15+00 Road NE-SW.

6+00 end of marsh

3+00 edge of creek flowing South

0+00 started East from cor.

27+00
34+00

75

April 7 1939

Woods - CH - Notes.

Johnson - CH

Estham - axe

Hilston - axe

Funk - axe

Look for: ~~xx~~
y. pine N. 09 E. 1/2 Ks
j. pine S. 4/2 N. 1/2 Ks

NESE
Random Line
during
* * *
* * *
* * *
* * *
* * *

Could Not chain Across

kick estimated

distance across then

went to where I could

cross then continued
like East.

52+40 center of Road N-S offset 57.5 to
52+20 Fence Telephone line

47+90 Road NW-SE

34+25 edge of creek.

33+60 edge of Marsh Swamp

31+00 edge of Marsh Swamp

26+40 Cont. East from $\frac{1}{4}$ cen.

APPI sec. cor.

76

Friday April 9.

Look for

x pmo N. 47 E. 42/1/3

x " N 04 W. 70/1/3

w " S 15 E. 52/1/3

y " S 59 W. 47/1/3

Woodsch. No. 1.

Johnsdon

Estern ave

Hilston ave

F. W. M. ave

A Farmer living approx
600 ft. North East
of corner said the
corner was in the
center of the Road
straight out from
the fence corner.

Aspen

Basement line

Could not chain

across creek

could not cross

Swamp offset

at right angles

at north and run line

parallel to sec. line

at 33+60 offset south

100 ft. to sec. line.

Estimated distance

across and then

went to where I

could cross the

came up other

side and continued

line East.

12
13

look for:

77
Fossils

Mag. Bearing
Mazdaon line

0+00

void 71.7m. ~~138-27-12~~
Started west from sect. car 13

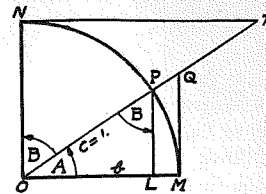


TABLE II

TRIGONOMETRIC FORMULAE

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

$$R = OB = c = 1$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

TABLE II—Continued
TRIGONOMETRIC FORMULAE (continued)

In any triangle:

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

Use Law of Tangents.

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

Use Law of Sines.

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

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

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

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

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

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

Area of a triangle:

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

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

PRISMOIDAL FORMULA

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

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

TABLE III
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 IV
INCHES IN DECIMALS OF A FOOT

| | | | | | | | | | | | |
|----------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|---------------|---------------|---------------|
| $\frac{1}{16}$ | $\frac{3}{32}$ | $\frac{1}{8}$ | $\frac{3}{16}$ | $\frac{1}{4}$ | $\frac{5}{16}$ | $\frac{3}{8}$ | $\frac{7}{16}$ | $\frac{1}{2}$ | $\frac{5}{8}$ | $\frac{3}{4}$ | $\frac{7}{8}$ |
| .0625 | .0938 | .1250 | .1875 | .2500 | .3125 | .3750 | .4375 | .5000 | .5625 | .6250 | .6875 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| .0833 | .1667 | .2500 | .3333 | .4167 | .5000 | .5833 | .6667 | .7500 | .8333 | .9167 | 1.0000 |

TABLE V.—RADII, ORDINATES AND DEFLECTIONS

| Deg. | Radius | Mid. Ord. | Tan. Offset | Def. for 1 Foot | Deg. | Radius | Mid. Ord. | Tan. Offset | Def. for 1 Foot | |
|------|--------|-----------|-------------|-----------------|-------|--------|-----------|-------------|-----------------|-------|
| 0° | 10' | 34377.5 | .036 | .145 | 0.05' | 7° | 819.02 | 1.528 | 6.105 | 2.10' |
| | 20' | 17188.8 | .073 | .291 | 0.10 | 20' | 781.84 | 1.600 | 6.395 | 2.20 |
| | 30' | 11459.2 | .109 | .436 | 0.15 | 30 | 764.49 | 1.637 | 6.540 | 2.25 |
| | 40' | 8594.42 | .145 | .582 | 0.20 | 40 | 747.89 | 1.673 | 6.685 | 2.30 |
| | 50' | 6875.55 | .182 | .727 | 0.25 | | | | | |
| 1 | | 5729.65 | .218 | .873 | 0.30 | 8 | 716.78 | 1.746 | 6.976 | 2.40 |
| | 10 | 4911.15 | .255 | 1.018 | 0.35 | 20 | 688.16 | 1.819 | 7.266 | 2.50 |
| | 20 | 4297.28 | .291 | 1.164 | 0.40 | 30 | 674.69 | 1.855 | 7.411 | 2.55 |
| | 30 | 3819.83 | .327 | 1.309 | 0.45 | 40 | 661.74 | 1.892 | 7.556 | 2.60 |
| | 40 | 3437.37 | .364 | 1.454 | 0.50 | | | | | |
| | 50 | 3125.36 | .400 | 1.600 | 0.55 | 9 | 637.28 | 1.965 | 7.846 | 2.70 |
| 2 | | 2864.93 | .436 | 1.745 | 0.60 | 20 | 614.56 | 2.037 | 8.136 | 2.80 |
| | 10 | 2644.58 | .473 | 1.891 | 0.65 | 30 | 603.80 | 2.074 | 8.281 | 2.85 |
| | 20 | 2455.70 | .509 | 2.036 | 0.70 | 40 | 593.42 | 2.110 | 8.426 | 2.90 |
| | 30 | 2292.01 | .545 | 2.181 | 0.75 | 10 | 573.69 | 2.183 | 8.716 | 3.00 |
| | 40 | 2148.79 | .582 | 2.327 | 0.80 | 30 | 546.44 | 2.292 | 9.150 | 3.15 |
| | 50 | 2022.41 | .618 | 2.472 | 0.85 | 11 | 521.67 | 2.402 | 9.585 | 3.30 |
| 3 | | 1910.08 | .655 | 2.618 | 0.90 | 30 | 499.06 | 2.511 | 10.02 | 3.45 |
| | 10 | 1809.67 | .691 | 2.763 | 0.95 | 12 | 478.34 | 2.620 | 10.45 | 3.60 |
| | 20 | 1719.12 | .727 | 2.908 | 1.00 | 30 | 459.28 | 2.730 | 10.89 | 3.75 |
| | 30 | 1637.28 | .764 | 3.054 | 1.05 | 13 | 441.68 | 2.839 | 11.32 | 3.90 |
| | 40 | 1562.88 | .800 | 3.199 | 1.10 | 30 | 425.40 | 2.949 | 11.75 | 4.05 |
| | 50 | 1494.95 | .836 | 3.345 | 1.15 | 14 | 410.28 | 3.058 | 12.18 | 4.20 |
| 4 | | 1432.69 | .873 | 3.490 | 1.20 | 30 | 396.20 | 3.168 | 12.62 | 4.35 |
| | 10 | 1375.40 | .909 | 3.635 | 1.25 | 15 | 383.07 | 3.277 | 13.05 | 4.50 |
| | 20 | 1322.53 | .945 | 3.718 | 1.30 | 30 | 370.78 | 3.387 | 13.49 | 4.65 |
| | 30 | 1273.67 | .982 | 3.926 | 1.35 | 16 | 359.27 | 3.496 | 13.92 | 4.80 |
| | 40 | 1228.11 | 1.018 | 4.071 | 1.40 | 30 | 348.45 | 3.606 | 14.35 | 4.95 |
| | 50 | 1185.78 | 1.055 | 4.217 | 1.45 | 17 | 338.27 | 3.716 | 14.78 | 5.10 |
| 5 | | 1146.28 | 1.091 | 4.362 | 1.50 | 18 | 319.62 | 3.935 | 15.64 | 5.40 |
| | 10 | 1109.33 | 1.127 | 4.507 | 1.55 | 19 | 302.94 | 4.155 | 16.51 | 5.70 |
| | 20 | 1074.68 | 1.164 | 4.653 | 1.60 | 20 | 287.94 | 4.374 | 17.37 | 6.00 |
| | 30 | 1042.14 | 1.200 | 4.798 | 1.65 | 21 | 274.37 | 4.594 | 18.22 | 6.30 |
| | 40 | 1011.51 | 1.237 | 4.943 | 1.70 | 22 | 262.04 | 4.814 | 19.08 | 6.60 |
| | 50 | 982.64 | 1.273 | 5.088 | 1.75 | 23 | 250.79 | 5.035 | 19.94 | 6.90 |
| 6 | | 955.37 | 1.309 | 5.234 | 1.80 | 24 | 240.49 | 5.255 | 20.79 | 7.20 |
| | 10 | 929.57 | 1.346 | 5.379 | 1.85 | 25 | 231.01 | 5.476 | 21.64 | 7.50 |
| | 20 | 905.13 | 1.382 | 5.524 | 1.90 | 26 | 222.27 | 5.697 | 22.50 | 7.80 |
| | 30 | 881.95 | 1.418 | 5.669 | 1.95 | 27 | 214.18 | 5.918 | 23.35 | 8.10 |
| | 40 | 859.92 | 1.455 | 5.814 | 2.00 | 28 | 206.68 | 6.139 | 24.19 | 8.40 |
| | | | | | | 29 | 199.70 | 6.360 | 25.04 | 8.70 |
| | | | | | | 30 | 193.18 | 6.583 | 25.88 | 9.00 |

Note. Chord Deflection = 2 times tangent deflection.

TABLE VI.—TANGENTS AND EXTERNALS TO A 1° CURVE

| Central Angle | Tangent | External | Central Angle | Tangent | External | Central 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 | 52.80 | 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 VI.—TANGENTS AND EXTERNALS TO A 1° CURVE

| Central Angle | Tangent | External | Central Angle | Tangent | External | Central Angle | Tangent | External |
|---------------|---------|----------|---------------|---------|----------|---------------|---------|----------|
| 31° | 1589.0 | 216.3 | 41° | 2142.2 | 387.4 | 51° | 2732.9 | 618.4 |
| 10' | 1593.0 | 218.7 | 10' | 2151.7 | 390.7 | 10' | 2743.1 | 622.3 |
| 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 | 483.3 | 30 | 3014.5 | 744.6 |
| 40 | 1843.3 | 289.2 | 40 | 2412.4 | 487.2 | 40 | 3025.2 | 749.6 |
| 50 | 1852.5 | 292.0 | 50 | 2422.3 | 491.0 | 50 | 3035.8 | 754.6 |
| 36 | 1861.7 | 294.9 | 46 | 2432.1 | 494.8 | 56 | 3046.5 | 759.6 |
| 10 | 1870.9 | 297.7 | 10 | 2441.9 | 498.7 | 10 | 3057.2 | 764.6 |
| 20 | 1880.1 | 300.6 | 20 | 2451.8 | 502.5 | 20 | 3067.9 | 769.7 |
| 30 | 1889.4 | 303.5 | 30 | 2461.7 | 506.4 | 30 | 3078.7 | 774.7 |
| 40 | 1898.6 | 306.4 | 40 | 2471.5 | 510.3 | 40 | 3089.4 | 779.8 |
| 50 | 1907.9 | 309.3 | 50 | 2481.4 | 514.3 | 50 | 3100.2 | 784.9 |
| 37 | 1917.1 | 312.2 | 47 | 2491.3 | 518.2 | 57 | 3110.9 | 790.1 |
| 10 | 1926.4 | 315.2 | 10 | 2501.2 | 522.2 | 10 | 3121.7 | 795.2 |
| 20 | 1935.7 | 318.1 | 20 | 2511.2 | 526.1 | 20 | 3132.6 | 800.4 |
| 30 | 1945.0 | 321.1 | 30 | 2521.1 | 530.1 | 30 | 3143.4 | 805.6 |
| 40 | 1954.3 | 324.1 | 40 | 2531.1 | 534.2 | 40 | 3154.2 | 810.9 |
| 50 | 1963.6 | 327.1 | 50 | 2541.0 | 538.2 | 50 | 3165.1 | 816.1 |
| 38 | 1972.9 | 330.2 | 48 | 2551.0 | 542.2 | 58 | 3176.0 | 821.4 |
| 10 | 1982.2 | 333.2 | 10 | 2561.0 | 546.3 | 10 | 3186.9 | 826.7 |
| 20 | 1991.5 | 336.3 | 20 | 2571.0 | 550.4 | 20 | 3197.8 | 832.0 |
| 30 | 2000.9 | 339.3 | 30 | 2581.0 | 554.5 | 30 | 3208.8 | 837.3 |
| 40 | 2010.2 | 342.4 | 40 | 2591.0 | 558.6 | 40 | 3219.7 | 842.7 |
| 50 | 2019.6 | 345.5 | 50 | 2601.1 | 562.8 | 50 | 3230.7 | 848.1 |
| 39 | 2029.0 | 348.6 | 49 | 2611.2 | 566.9 | 59 | 3241.7 | 853.5 |
| 10 | 2038.4 | 351.8 | 10 | 2621.2 | 571.1 | 10 | 3252.7 | 858.9 |
| 20 | 2047.8 | 354.9 | 20 | 2631.3 | 575.3 | 20 | 3263.7 | 864.3 |
| 30 | 2057.2 | 358.1 | 30 | 2641.4 | 579.5 | 30 | 3274.8 | 869.8 |
| 40 | 2066.6 | 361.3 | 40 | 2651.5 | 583.8 | 40 | 3285.8 | 875.3 |
| 50 | 2076.0 | 364.5 | 50 | 2661.6 | 588.0 | 50 | 3296.9 | 880.8 |
| 40 | 2085.4 | 367.7 | 50 | 2671.8 | 592.3 | 60 | 3308.0 | 886.4 |
| 10 | 2094.9 | 371.0 | 10 | 2681.9 | 596.6 | 10 | 3319.1 | 892.0 |
| 20 | 2104.3 | 374.2 | 20 | 2692.1 | 600.9 | 20 | 3330.3 | 897.5 |
| 30 | 2113.8 | 377.5 | 30 | 2702.3 | 605.3 | 30 | 3341.4 | 903.2 |
| 40 | 2123.3 | 380.8 | 40 | 2712.5 | 609.6 | 40 | 3352.6 | 908.8 |
| 50 | 2132.7 | 384.1 | 50 | 2722.7 | 614.0 | 50 | 3363.8 | 914.5 |

TABLE VI.—TANGENTS AND EXTERNALS TO A 1° CURVE

| Central Angle | Tangent | External | Central Angle | Tangent | External | Central 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 | 2213.3 |
| 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 | 1293.8 | 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 VI.—TANGENTS AND EXTERNALS TO A 1° CURVE

| Central Angle | Tangent | External | Central Angle | Tangent | External | Central 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 | 3646.5 | 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 VII.—CORRECTIONS FOR TANGENTS AND EXTERNALS

These corrections are to be added to the approximate values, found by dividing the tangent, or external, for a 1° curve (Table VI) by the degree of curve, in order to obtain the true tangents, or externals. Intermediate values may be obtained by interpolation.

| FOR TANGENTS ADD | | | | | | | | | | | | | | |
|------------------|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Central Angle | DEGREE OF 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 |
| 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 | .79 | .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 | 3.73 |
| 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 | 4.48 |
| 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 | 4.99 |
| 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 | 5.33 |
| 95° | .39 | .79 | 1.19 | 1.55 | 2.00 | 2.40 | 2.80 | 3.20 | 3.61 | 4.02 | 4.40 | 4.98 | 5.38 | 5.82 |
| 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 |
| 110° | .51 | 1.03 | 1.56 | 2.08 | 2.61 | 3.14 | 3.67 | 4.21 | 4.76 | 5.31 | 5.86 | 6.43 | 7.01 | 7.60 |
| 120° | .62 | 1.25 | 1.93 | 2.52 | 3.16 | 3.81 | 4.45 | 5.11 | 5.77 | 6.44 | 7.12 | 7.80 | 8.50 | 9.22 |

FOR EXTERNALS ADD

| Central Angle | DEGREE OF 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 |
| 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 | .136 |
| 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 | .446 |
| 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 | .771 | .845 | .922 | 1.01 |
| 70° | .080 | .159 | .240 | .321 | .403 | .485 | .568 | .652 | .735 | .819 | .906 | .994 | 1.08 | 1.17 |
| 75° | .095 | .182 | .266 | .353 | .440 | .528 | .618 | .707 | .797 | .887 | .977 | 1.07 | 1.18 | 1.29 |
| 80° | .110 | .220 | .332 | .445 | .558 | .671 | .787 | .903 | 1.02 | 1.15 | 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 | .885 | 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 |
| 110° | .263 | .536 | .806 | 1.08 | 1.35 | 1.63 | 1.93 | 2.20 | 2.48 | 2.76 | 3.05 | 3.35 | 3.66 | 3.96 |
| 120° | .360 | .721 | 1.08 | 1.45 | 1.82 | 2.19 | 2.57 | 2.95 | 3.33 | 3.72 | 4.11 | 4.50 | 4.91 | 5.32 |

TABLE VIII.—CORRECTIONS FOR SUB-CHORDS AND LONG CHORDS

| FOR SUB-CHORDS ADD | | | | | | | | | | | Excess of Arc per 100 ft. | LONG CHORDS | | | | |
|--------------------|-----|-----|------|------|------|------|------|------|-----|-----|---------------------------|-------------|--------|--------|--------|--------|
| D | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | D | | 200 | 300 | 400 | 500 | |
| 4° | .00 | .00 | .01 | .01 | .01 | .01 | .01 | .01 | .00 | .02 | | 1 | 199.99 | 299.97 | 399.92 | 499.85 |
| 6 | .00 | .01 | .02 | .02 | .03 | .03 | .03 | .03 | .02 | .01 | 2 | 199.97 | 299.88 | 399.70 | 499.39 | |
| 8 | .01 | .02 | .03 | .04 | .05 | .05 | .05 | .05 | .04 | .03 | 3 | 199.93 | 299.73 | 399.32 | 498.63 | |
| 10 | .01 | .02 | .03 | .04 | .05 | .06 | .06 | .06 | .05 | .04 | 4 | 199.88 | 299.51 | 398.78 | 497.57 | |
| 12 | .02 | .04 | .05 | .06 | .07 | .07 | .07 | .07 | .06 | .05 | 5 | 199.81 | 299.24 | 398.10 | 496.20 | |
| 14 | .02 | .05 | .07 | .08 | .09 | .09 | .09 | .09 | .07 | .06 | 6 | 199.73 | 298.90 | 397.26 | 494.53 | |
| 16 | .03 | .06 | .09 | .11 | .12 | .12 | .12 | .12 | .09 | .08 | 7 | 199.63 | 298.51 | 396.28 | 492.57 | |
| 18 | .04 | .08 | .11 | .14 | .15 | .15 | .15 | .15 | .12 | .07 | 8 | 199.51 | 298.05 | 395.14 | 490.31 | |
| 20 | .05 | .10 | .14 | .17 | .19 | .20 | .20 | .20 | .15 | .09 | 9 | 199.38 | 297.54 | 393.86 | 487.75 | |
| 22 | .06 | .12 | .17 | .21 | .23 | .24 | .24 | .24 | .18 | .10 | 10 | 199.24 | 296.96 | 392.42 | 484.90 | |
| 24 | .07 | .14 | .20 | .25 | .28 | .28 | .28 | .28 | .21 | .12 | 12 | 198.90 | 295.63 | 389.12 | 478.34 | |
| 26 | .09 | .17 | .24 | .29 | .32 | .33 | .33 | .33 | .25 | .15 | 14 | 198.51 | 294.06 | 385.22 | 470.65 | |
| 28 | .10 | .19 | .27 | .34 | .37 | .38 | .38 | .38 | .29 | .17 | 16 | 198.05 | 292.25 | 380.76 | 461.86 | |
| 30 | .11 | .22 | .31 | .39 | .43 | .44 | .44 | .44 | .31 | .19 | 18 | 197.54 | 290.21 | 375.04 | 452.02 | |
| 32 | .13 | .25 | .36 | .44 | .49 | .50 | .50 | .50 | .38 | .22 | 20 | 196.96 | 287.94 | 370.17 | 441.15 | |
| 34 | .15 | .28 | .40 | .50 | .55 | .57 | .57 | .57 | .43 | .25 | 22 | 196.32 | 285.44 | 364.06 | 429.30 | |
| 36 | .17 | .32 | .45 | .56 | .62 | .64 | .64 | .64 | .48 | .28 | 24 | 195.63 | 282.71 | 357.43 | 416.53 | |
| 38 | .18 | .36 | .51 | .62 | .70 | .71 | .71 | .71 | .53 | .31 | 26 | 194.87 | 279.76 | 350.30 | 402.89 | |
| 40 | .21 | .40 | .56 | .69 | .77 | .79 | .79 | .79 | .59 | .35 | 28 | 194.06 | 276.59 | 342.69 | 388.43 | |
| 42 | .23 | .44 | .62 | .76 | .85 | .87 | .87 | .87 | .65 | .38 | 30 | 193.18 | 273.20 | 334.61 | 373.20 | |
| 44 | .25 | .48 | .68 | .84 | .94 | .96 | .96 | .96 | .72 | .42 | 32 | 192.25 | 269.61 | 326.08 | 357.28 | |
| 46 | .27 | .52 | .75 | .92 | 1.02 | 1.05 | .98 | .98 | .78 | .46 | 34 | 191.26 | 265.81 | 317.12 | 340.73 | |
| 48 | .30 | .57 | .81 | 1.00 | 1.12 | 1.14 | 1.06 | .86 | .50 | .29 | 36 | 190.21 | 261.80 | 307.77 | 323.61 | |
| 50 | .32 | .62 | .89 | 1.09 | 1.21 | 1.24 | 1.15 | .93 | .55 | .32 | 38 | 189.10 | 257.69 | 298.03 | 305.99 | |
| 52 | .35 | .67 | .96 | 1.18 | 1.31 | 1.35 | 1.25 | 1.01 | .59 | .35 | 40 | 187.94 | 253.21 | 287.94 | 287.94 | |
| 54 | .38 | .73 | 1.04 | 1.28 | 1.42 | 1.46 | 1.35 | 1.09 | .64 | .38 | 42 | 186.72 | 248.63 | 277.51 | 269.54 | |
| 56 | .41 | .78 | 1.12 | 1.38 | 1.53 | 1.57 | 1.46 | 1.17 | .69 | .40 | 44 | 185.44 | 243.87 | 266.78 | 250.85 | |
| 58 | .44 | .84 | 1.20 | 1.48 | 1.65 | 1.69 | 1.57 | 1.26 | .74 | .42 | 46 | 184.10 | 239.93 | 255.78 | 231.95 | |
| 60 | .47 | .91 | 1.29 | 1.59 | 1.76 | 1.81 | 1.68 | 1.35 | .80 | .47 | 48 | 182.71 | 233.83 | 244.51 | 212.92 | |

NOTE.—When a chord of less than 100 ft. is used the corrections given in the above table should be added to the nominal length of chord to get the length which should be used in order that the 100 ft. points will check with those obtained by using the standard 100 ft. chord. Thus in locating a 14° curve by 25 ft. chords measure 25.06 for each chord. Long chords are useful in passing obstacles.

TABLE IX.—MIDDLE ORDINATES FOR RAILS IN FEET

| Deg. of Curve | LENGTH OF RAILS | | | | | | | Deg. of Curve | LENGTH OF RAILS | | | | | | |
|---------------|-----------------|------|------|------|------|------|------|---------------|-----------------|------|------|------|------|------|------|
| | 32 | 30 | 28 | 26 | 24 | 22 | 20 | | 32 | 30 | 28 | 26 | 24 | 22 | 20 |
| | 1° | .022 | .020 | .016 | .013 | .011 | .009 | | .008 | 16° | .356 | .313 | .273 | .236 | .200 |
| 2 | .045 | .038 | .034 | .029 | .025 | .021 | .017 | 17 | .378 | .333 | .290 | .252 | .213 | .180 | .148 |
| 3 | .037 | .058 | .051 | .044 | .037 | .031 | .026 | 18 | .400 | .351 | .306 | .265 | .225 | .190 | .156 |
| 4 | .089 | .079 | .069 | .060 | .050 | .042 | .035 | 19 | .423 | .371 | .324 | .280 | .238 | .201 | .165 |
| 5 | .112 | .099 | .086 | .074 | .063 | .053 | .044 | 20 | .445 | .392 | .341 | .296 | .250 | .212 | .174 |
| 6 | .134 | .117 | .102 | .088 | .076 | .064 | .052 | 21 | .466 | .410 | .357 | .309 | .262 | .222 | .182 |
| 7 | .156 | .137 | .120 | .104 | .088 | .074 | .061 | 22 | .487 | .430 | .375 | .325 | .275 | .233 | .191 |
| 8 | .179 | .158 | .137 | .119 | .100 | .085 | .070 | 23 | .509 | .450 | .390 | .338 | .287 | .243 | .199 |
| 9 | .201 | .175 | .153 | .133 | .112 | .095 | .078 | 24 | .531 | .469 | .408 | .354 | .299 | .253 | .208 |
| 10 | .223 | .196 | .171 | .148 | .125 | .106 | .087 | 25 | .552 | .486 | .424 | .367 | .311 | .263 | .216 |
| 11 | .245 | .216 | .188 | .163 | .139 | .117 | .096 | 26 | .573 | .506 | .441 | .382 | .323 | .274 | .225 |
| 12 | .268 | .236 | .206 | .179 | .151 | .128 | .105 | 27 | .594 | .524 | .457 | .39 | | | |

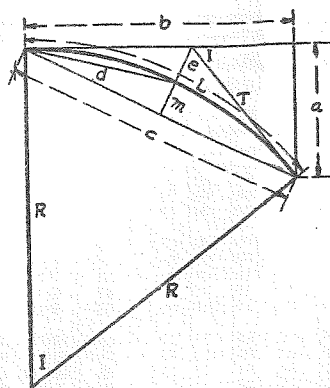


TABLE X
CURVE FORMULAE FOR SIMPLE CURVES.
COMPILED BY J. CALVIN LOCKE, C.E.

- (1) $c = \sqrt{2Ra}$ (2) $c = \sqrt{a^2 + b^2}$
 (3) $c = \sqrt{2R(R - \sqrt{(R+b)(R-b)})} = \sqrt{2R(R - \sqrt{R^2 - b^2})}$
 (4) $c = 2\sqrt{m(2R - m)}$
 (5) $c = 2R \sin \frac{1}{2} I$ (6) $c = 2T \cos \frac{1}{2} I$
 (7) $e = R \operatorname{exsec} \frac{1}{2} I$
 (8) $e = R \tan \frac{1}{2} I \tan \frac{1}{4} I$ (9) $e = T \tan \frac{1}{4} I$
 (10) $b = \sqrt{a(2R - a)}$
 (11) $b = \sqrt{\left(c + \frac{c^2}{2R}\right)\left(c - \frac{c^2}{2R}\right)} = \sqrt{c^2 - \frac{c^4}{4R^2}}$
 (12) $b = R \sin I$ (13) $b = a \cot \frac{1}{2} I$
 (14) $R = \frac{a^2 + b^2}{2a} = \frac{c^2}{2a}$ (15) $R = \frac{d^2}{2m} = \frac{c^2 + 4m^2}{8m}$
 (16) $d = \sqrt{R(2R - \sqrt{(2R+c)(2R-c)})} = \sqrt{R(2R - \sqrt{4R^2 - c^2})}$
 (17) $d = \sqrt{2Rm}$ (18) $d = 2R \sin \frac{1}{4} I$ (19) $m = \frac{d^2}{2R}$
 (20) $m = R = \sqrt{\left(R + \frac{c}{2}\right)\left(R - \frac{c}{2}\right)} = R = \sqrt{R^2 - \frac{c^2}{4}}$
 (21) $m = R \operatorname{vers} \frac{1}{2} I$ (22) $m = R \sin \frac{1}{2} I \tan \frac{1}{4} I$ (23) $m = \frac{1}{2} c \tan \frac{1}{4} I$
 (24) $a = \frac{c^2}{2R}$ (25) $a = R - \sqrt{(R+b)(R-b)} = R - \sqrt{R^2 - b^2}$
 (26) $a = 2R(\sin^2 \frac{1}{2} I)^2$ (27) $a = R \operatorname{vers} I$ (28) $a = R \sin I \tan \frac{1}{2} I$
 (29) $a = b \tan \frac{1}{2} I$ (30) $a = T \sin I$ (31) $T = R \tan \frac{1}{2} I$
 (32) $I = \frac{L}{R} \times 57.295780$ (33) $R = \frac{L}{I} \times 57.295780$
 (34) $L = IR \times 0.01745329$ (35) $L = \frac{8d - c}{3}$
 (36) $\text{Area Seg.} = \frac{LR - R^2 \sin I}{2} = \frac{LR - Rb}{2}$

TABLE XI.—CALCULATION OF EARTHWORK

| Width | HEIGHT | | | | | | | | | | | | | | |
|-------|--------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 1 | .02 | .04 | .06 | .07 | .09 | .11 | .13 | .15 | .17 | .18 | .20 | .22 | .24 | .26 | .28 |
| 2 | .04 | .07 | .11 | .15 | .18 | .22 | .26 | .30 | .33 | .37 | .41 | .44 | .48 | .52 | .56 |
| 3 | .06 | .11 | .17 | .22 | .28 | .33 | .39 | .44 | .50 | .56 | .61 | .67 | .72 | .78 | .83 |
| 4 | .07 | .15 | .22 | .30 | .37 | .44 | .52 | .59 | .67 | .74 | .81 | .89 | .96 | 1.04 | 1.11 |
| 5 | .09 | .19 | .28 | .37 | .46 | .56 | .65 | .74 | .83 | .93 | 1.02 | 1.11 | 1.20 | 1.30 | 1.39 |
| 6 | .11 | .22 | .33 | .44 | .56 | .67 | .78 | .89 | 1.00 | 1.11 | 1.22 | 1.33 | 1.44 | 1.55 | 1.67 |
| 7 | .13 | .26 | .39 | .52 | .65 | .78 | .91 | 1.04 | 1.16 | 1.30 | 1.42 | 1.55 | 1.68 | 1.81 | 1.94 |
| 8 | .15 | .30 | .44 | .59 | .74 | .89 | 1.04 | 1.19 | 1.33 | 1.48 | 1.63 | 1.78 | 1.92 | 2.08 | 2.22 |
| 9 | .17 | .33 | .50 | .67 | .83 | 1.00 | 1.17 | 1.33 | 1.50 | 1.67 | 1.83 | 2.00 | 2.17 | 2.33 | 2.50 |
| 10 | .18 | .37 | .56 | .74 | .93 | 1.11 | 1.30 | 1.48 | 1.67 | 1.85 | 2.04 | 2.22 | 2.41 | 2.59 | 2.78 |
| 11 | .20 | .41 | .61 | .82 | 1.02 | 1.22 | 1.43 | 1.63 | 1.83 | 2.04 | 2.24 | 2.44 | 2.65 | 2.85 | 3.06 |
| 12 | .22 | .44 | .67 | .89 | 1.11 | 1.33 | 1.56 | 1.78 | 2.00 | 2.22 | 2.44 | 2.67 | 2.89 | 3.11 | 3.33 |
| 13 | .24 | .48 | .72 | .96 | 1.20 | 1.44 | 1.68 | 1.92 | 2.16 | 2.41 | 2.65 | 2.89 | 3.13 | 3.37 | 3.61 |
| 14 | .26 | .52 | .78 | 1.04 | 1.30 | 1.55 | 1.81 | 2.08 | 2.33 | 2.59 | 2.85 | 3.11 | 3.37 | 3.63 | 3.89 |
| 15 | .28 | .56 | .83 | 1.11 | 1.39 | 1.67 | 1.94 | 2.22 | 2.50 | 2.78 | 3.06 | 3.33 | 3.61 | 3.89 | 4.17 |
| 16 | .30 | .59 | .89 | 1.18 | 1.48 | 1.78 | 2.07 | 2.37 | 2.67 | 2.96 | 3.26 | 3.56 | 3.85 | 4.15 | 4.44 |
| 17 | .31 | .63 | .94 | 1.26 | 1.57 | 1.89 | 2.20 | 2.52 | 2.83 | 3.13 | 3.46 | 3.78 | 4.09 | 4.41 | 4.72 |
| 18 | .33 | .67 | 1.00 | 1.33 | 1.67 | 2.00 | 2.33 | 2.67 | 3.00 | 3.33 | 3.67 | 4.00 | 4.33 | 4.67 | 5.00 |
| 19 | .35 | .70 | 1.06 | 1.41 | 1.76 | 2.11 | 2.46 | 2.82 | 3.17 | 3.52 | 3.87 | 4.22 | 4.57 | 4.92 | 5.28 |
| 20 | .37 | .74 | 1.11 | 1.48 | 1.85 | 2.22 | 2.59 | 2.96 | 3.33 | 3.70 | 4.07 | 4.44 | 4.81 | 5.18 | 5.56 |
| 21 | .39 | .78 | 1.17 | 1.55 | 1.94 | 2.33 | 2.72 | 3.11 | 3.50 | 3.89 | 4.28 | 4.67 | 5.06 | 5.44 | 5.83 |
| 22 | .41 | .81 | 1.22 | 1.63 | 2.04 | 2.44 | 2.85 | 3.26 | 3.67 | 4.07 | 4.48 | 4.89 | 5.30 | 5.70 | 6.11 |
| 23 | .43 | .85 | 1.28 | 1.70 | 2.13 | 2.56 | 2.98 | 3.41 | 3.83 | 4.26 | 4.68 | 5.11 | 5.54 | 5.96 | 6.39 |
| 24 | .44 | .89 | 1.33 | 1.78 | 2.22 | 2.67 | 3.11 | 3.56 | 4.00 | 4.44 | 4.89 | 5.33 | 5.78 | 6.22 | 6.67 |
| 25 | .46 | .92 | 1.39 | 1.85 | 2.31 | 2.78 | 3.24 | 3.70 | 4.17 | 4.63 | 5.09 | 5.56 | 6.02 | 6.48 | 6.94 |
| 26 | .48 | .96 | 1.44 | 1.92 | 2.41 | 2.89 | 3.37 | 3.85 | 4.33 | 4.82 | 5.30 | 5.78 | 6.26 | 6.74 | 7.24 |
| 27 | .50 | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 | 6.00 | 6.50 | 7.00 | 7.50 |
| 28 | .52 | 1.04 | 1.55 | 2.07 | 2.59 | 3.11 | 3.63 | 4.15 | 4.67 | 5.18 | 5.70 | 6.22 | 6.74 | 7.26 | 7.78 |
| 29 | .54 | 1.07 | 1.61 | 2.15 | 2.68 | 3.22 | 3.76 | 4.30 | 4.83 | 5.37 | 5.91 | 6.44 | 6.98 | 7.52 | 8.06 |
| 30 | .56 | 1.11 | 1.67 | 2.22 | 2.78 | 3.33 | 3.89 | 4.44 | 5.00 | 5.55 | 6.11 | 6.67 | 7.22 | 7.78 | 8.33 |
| 31 | .57 | 1.15 | 1.72 | 2.30 | 2.87 | 3.44 | 4.02 | 4.59 | 5.17 | 5.74 | 6.32 | 6.89 | 7.46 | 8.04 | 8.61 |
| 32 | .59 | 1.18 | 1.78 | 2.37 | 2.96 | 3.56 | 4.15 | 4.74 | 5.33 | 5.92 | 6.52 | 7.11 | 7.70 | 8.30 | 8.89 |
| 33 | .61 | 1.22 | 1.83 | 2.44 | 3.05 | 3.67 | 4.28 | 4.89 | 5.50 | 6.11 | 6.72 | 7.33 | 7.94 | 8.55 | 9.17 |
| 34 | .63 | 1.26 | 1.89 | 2.52 | 3.15 | 3.78 | 4.40 | 5.04 | 5.67 | 6.29 | 6.93 | 7.56 | 8.18 | 8.81 | 9.44 |
| 35 | .65 | 1.30 | 1.94 | 2.59 | 3.24 | 3.89 | 4.53 | 5.18 | 5.83 | 6.48 | 7.13 | 7.78 | 8.42 | 9.08 | 9.72 |
| 36 | .67 | 1.33 | 2.00 | 2.67 | 3.33 | 4.00 | 4.66 | 5.33 | 6.00 | 6.67 | 7.33 | 8.00 | 8.67 | 9.33 | 10.00 |
| 37 | .68 | 1.37 | 2.06 | 2.74 | 3.42 | 4.11 | 4.79 | 5.48 | 6.17 | 6.85 | 7.54 | 8.22 | 8.91 | 9.59 | 10.28 |
| 38 | .70 | 1.41 | 2.11 | 2.82 | 3.52 | 4.22 | 4.92 | 5.63 | 6.33 | 7.03 | 7.74 | 8.44 | 9.15 | 9.85 | 10.56 |
| 39 | .72 | 1.44 | 2.17 | 2.89 | 3.61 | 4.33 | 5.05 | 5.78 | 6.50 | 7.22 | 7.95 | 8.67 | 9.39 | 10.11 | 10.83 |
| 40 | .74 | 1.48 | 2.22 | 2.96 | 3.70 | 4.44 | 5.18 | 5.92 | 6.67 | 7.41 | 8.15 | 8.89 | 9.63 | 10.37 | 11.11 |

Table gives cu. yds. in 1 ft. of a triangle of given width and height. Corrections for tenths of width are one tenth the values found under each height considering the widths from 1 to 9 as tenths and similarly the corrections for tenths of height are one tenth the figures opposite width considering the heights from 1 to 9 as tenths. Thus if $w = 16.2$ ft. and $h = 5.3$, cu. yds. = $1.48 + .028 + .089 = 1.597$ cu. yds. or practically 160 cu. yds. per 100 ft. If w exceeds 40 ft., use one-half and multiply result by 2, if both w and h are large use one-half of each and multiply result by 4. Any cross-section may be divided into triangles by the following rule. To the triangle of the sum of the outside outs (or fills) = h , and $\frac{1}{2}$ the roadbed = w , add the triangles formed by taking the distance out to each break in turn (= w 's) by the difference between the outs (or fills) on each side of it (= h 's) always subtracting the outer from the inner.

TABLE XII. STADIA REDUCTIONS
VERTICAL HEIGHTS.

| Minutes | 0° | 1° | 2° | 3° | 4° | 5° | 6° | 7° | 8° | 9° | 10° |
|---------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| 0 | 0.00 | 1.74 | 3.49 | 5.23 | 6.96 | 8.68 | 10.40 | 12.10 | 13.78 | 15.45 | 17.10 |
| 2 | 0.06 | 1.80 | 3.55 | 5.28 | 7.02 | 8.74 | 10.45 | 12.15 | 13.84 | 15.51 | 17.16 |
| 4 | 0.12 | 1.86 | 3.60 | 5.34 | 7.07 | 8.80 | 10.51 | 12.21 | 13.89 | 15.56 | 17.21 |
| 6 | 0.17 | 1.92 | 3.66 | 5.40 | 7.13 | 8.85 | 10.57 | 12.26 | 13.95 | 15.62 | 17.26 |
| 8 | 0.23 | 1.98 | 3.72 | 5.46 | 7.19 | 8.91 | 10.62 | 12.32 | 14.01 | 15.67 | 17.32 |
| 10 | 0.29 | 2.04 | 3.78 | 5.52 | 7.25 | 8.97 | 10.68 | 12.38 | 14.06 | 15.73 | 17.37 |
| 12 | 0.35 | 2.09 | 3.84 | 5.57 | 7.30 | 9.03 | 10.74 | 12.43 | 14.12 | 15.78 | 17.43 |
| 14 | 0.41 | 2.15 | 3.90 | 5.63 | 7.36 | 9.08 | 10.79 | 12.49 | 14.17 | 15.84 | 17.48 |
| 16 | 0.47 | 2.21 | 3.95 | 5.69 | 7.42 | 9.14 | 10.85 | 12.55 | 14.23 | 15.89 | 17.54 |
| 18 | 0.52 | 2.27 | 4.01 | 5.75 | 7.48 | 9.20 | 10.91 | 12.60 | 14.28 | 15.95 | 17.59 |
| 20 | 0.58 | 2.33 | 4.07 | 5.80 | 7.53 | 9.25 | 10.96 | 12.66 | 14.34 | 16.00 | 17.65 |
| 22 | 0.64 | 2.38 | 4.13 | 5.86 | 7.59 | 9.31 | 11.02 | 12.72 | 14.40 | 16.06 | 17.70 |
| 24 | 0.70 | 2.44 | 4.18 | 5.92 | 7.65 | 9.37 | 11.08 | 12.77 | 14.45 | 16.11 | 17.76 |
| 26 | 0.76 | 2.50 | 4.24 | 5.98 | 7.71 | 9.43 | 11.13 | 12.83 | 14.51 | 16.17 | 17.81 |
| 28 | 0.81 | 2.56 | 4.30 | 6.04 | 7.76 | 9.48 | 11.19 | 12.88 | 14.56 | 16.22 | 17.86 |
| 30 | 0.87 | 2.62 | 4.36 | 6.09 | 7.82 | 9.54 | 11.25 | 12.94 | 14.62 | 16.28 | 17.92 |
| 32 | 0.93 | 2.67 | 4.42 | 6.15 | 7.88 | 9.60 | 11.30 | 13.00 | 14.67 | 16.33 | 17.97 |
| 34 | 0.99 | 2.73 | 4.48 | 6.21 | 7.94 | 9.65 | 11.36 | 13.05 | 14.73 | 16.39 | 18.03 |
| 36 | 1.05 | 2.79 | 4.53 | 6.27 | 7.99 | 9.71 | 11.42 | 13.11 | 14.79 | 16.44 | 18.08 |
| 38 | 1.11 | 2.85 | 4.59 | 6.33 | 8.05 | 9.77 | 11.47 | 13.17 | 14.84 | 16.50 | 18.14 |
| 40 | 1.16 | 2.91 | 4.65 | 6.38 | 8.11 | 9.83 | 11.53 | 13.22 | 14.90 | 16.55 | 18.19 |
| 42 | 1.22 | 2.97 | 4.71 | 6.44 | 8.17 | 9.88 | 11.59 | 13.28 | 14.95 | 16.61 | 18.24 |
| 44 | 1.28 | 3.02 | 4.76 | 6.50 | 8.22 | 9.94 | 11.64 | 13.33 | 15.01 | 16.66 | 18.30 |
| 46 | 1.34 | 3.08 | 4.82 | 6.56 | 8.28 | 10.00 | 11.70 | 13.39 | 15.06 | 16.72 | 18.35 |
| 48 | 1.40 | 3.14 | 4.88 | 6.61 | 8.34 | 10.05 | 11.76 | 13.45 | 15.12 | 16.77 | 18.41 |
| 50 | 1.45 | 3.20 | 4.94 | 6.67 | 8.40 | 10.11 | 11.81 | 13.50 | 15.17 | 16.83 | 18.46 |
| 52 | 1.51 | 3.26 | 4.99 | 6.73 | 8.45 | 10.17 | 11.87 | 13.56 | 15.23 | 16.88 | 18.51 |
| 54 | 1.57 | 3.31 | 5.05 | 6.79 | 8.51 | 10.22 | 11.93 | 13.61 | 15.28 | 16.94 | 18.57 |
| 56 | 1.63 | 3.37 | 5.11 | 6.84 | 8.57 | 10.28 | 11.98 | 13.67 | 15.34 | 16.99 | 18.62 |
| 58 | 1.69 | 3.43 | 5.17 | 6.90 | 8.63 | 10.34 | 12.04 | 13.73 | 15.40 | 17.05 | 18.68 |
| 60 | 1.74 | 3.49 | 5.23 | 6.96 | 8.68 | 10.40 | 12.10 | 13.78 | 15.45 | 17.10 | 18.73 |

HORIZONTAL CORRECTIONS

| Dist. | 0° | 1° | 2° | 3° | 4° | 5° | 6° | 7° | 8° | 9° | 10° |
|-------|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| 100 | 0.0 | 0.0 | 0.1 | 0.3 | 0.5 | 0.8 | 1.1 | 1.5 | 1.9 | 2.5 | 3.0 |
| 200 | 0.0 | 0.1 | 0.2 | 0.5 | 1.0 | 1.5 | 2.2 | 3.0 | 3.9 | 4.9 | 6.0 |
| 300 | 0.0 | 0.1 | 0.4 | 0.8 | 1.5 | 2.3 | 3.3 | 4.5 | 5.8 | 7.4 | 9.1 |
| 400 | 0.0 | 0.1 | 0.5 | 1.1 | 2.0 | 3.0 | 4.4 | 6.0 | 7.8 | 9.8 | 12.1 |
| 500 | 0.0 | 0.2 | 0.6 | 1.4 | 2.5 | 3.8 | 5.5 | 7.5 | 9.7 | 12.3 | 15.1 |
| 600 | 0.0 | 0.2 | 0.7 | 1.6 | 2.9 | 4.6 | 6.5 | 8.9 | 11.6 | 14.7 | 18.1 |
| 700 | 0.0 | 0.2 | 0.8 | 1.9 | 3.4 | 5.3 | 7.6 | 10.4 | 13.6 | 17.2 | 21.1 |
| 800 | 0.0 | 0.2 | 1.0 | 2.2 | 3.9 | 6.1 | 8.7 | 11.9 | 15.5 | 19.6 | 24.2 |
| 900 | 0.0 | 0.3 | 1.1 | 2.4 | 4.4 | 6.8 | 9.8 | 13.4 | 17.5 | 22.1 | 27.2 |
| 1000 | 0.0 | 0.3 | 1.2 | 2.7 | 4.9 | 7.6 | 10.9 | 14.9 | 19.4 | 24.5 | 30.2 |

TABLE XII. STADIA REDUCTIONS
VERTICAL HEIGHTS

| Minutes | 11° | 12° | 13° | 14° | 15° | 16° | 17° | 18° | 19° | 20° |
|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | 18.73 | 20.34 | 21.92 | 23.47 | 25.00 | 26.50 | 27.96 | 29.39 | 30.78 | 32.14 |
| 2 | 18.78 | 20.39 | 21.97 | 23.52 | 25.05 | 26.55 | 28.01 | 29.44 | 30.83 | 32.18 |
| 4 | 18.84 | 20.44 | 22.02 | 23.58 | 25.10 | 26.59 | 28.06 | 29.48 | 30.87 | 32.23 |
| 6 | 18.89 | 20.50 | 22.08 | 23.63 | 25.15 | 26.64 | 28.10 | 29.53 | 30.92 | 32.27 |
| 8 | 18.95 | 20.55 | 22.13 | 23.68 | 25.20 | 26.69 | 28.15 | 29.58 | 30.97 | 32.32 |
| 10 | 19.00 | 20.60 | 22.18 | 23.73 | 25.25 | 26.74 | 28.20 | 29.62 | 31.01 | 32.36 |
| 12 | 19.05 | 20.66 | 22.23 | 23.78 | 25.30 | 26.79 | 28.25 | 29.67 | 31.06 | 32.41 |
| 14 | 19.11 | 20.71 | 22.28 | 23.83 | 25.35 | 26.84 | 28.30 | 29.72 | 31.10 | 32.45 |
| 16 | 19.16 | 20.76 | 22.34 | 23.88 | 25.40 | 26.89 | 28.34 | 29.76 | 31.15 | 32.49 |
| 18 | 19.21 | 20.81 | 22.39 | 23.93 | 25.45 | 26.94 | 28.39 | 29.81 | 31.19 | 32.54 |
| 20 | 19.27 | 20.87 | 22.44 | 23.99 | 25.50 | 26.99 | 28.44 | 29.86 | 31.24 | 32.58 |
| 22 | 19.32 | 20.92 | 22.49 | 24.04 | 25.55 | 27.04 | 28.49 | 29.90 | 31.28 | 32.63 |
| 24 | 19.38 | 20.97 | 22.54 | 24.09 | 25.60 | 27.09 | 28.54 | 29.95 | 31.33 | 32.67 |
| 26 | 19.43 | 21.03 | 22.60 | 24.14 | 25.65 | 27.13 | 28.58 | 30.00 | 31.38 | 32.72 |
| 28 | 19.48 | 21.08 | 22.65 | 24.19 | 25.70 | 27.18 | 28.63 | 30.04 | 31.42 | 32.76 |
| 30 | 19.54 | 21.13 | 22.70 | 24.24 | 25.75 | 27.23 | 28.68 | 30.09 | 31.47 | 32.80 |
| 32 | 19.59 | 21.18 | 22.75 | 24.29 | 25.80 | 27.28 | 28.73 | 30.14 | 31.51 | 32.85 |
| 34 | 19.64 | 21.24 | 22.80 | 24.34 | 25.85 | 27.33 | 28.77 | 30.19 | 31.56 | 32.89 |
| 36 | 19.70 | 21.29 | 22.85 | 24.39 | 25.90 | 27.38 | 28.82 | 30.23 | 31.60 | 32.93 |
| 38 | 19.75 | 21.34 | 22.91 | 24.44 | 25.95 | 27.43 | 28.87 | 30.28 | 31.65 | 32.98 |
| 40 | 19.80 | 21.39 | 22.96 | 24.49 | 26.00 | 27.48 | 28.92 | 30.32 | 31.69 | 33.02 |
| 42 | 19.86 | 21.45 | 23.01 | 24.55 | 26.05 | 27.52 | 28.96 | 30.37 | 31.74 | 33.07 |
| 44 | 19.91 | 21.50 | 23.06 | 24.60 | 26.10 | 27.57 | 29.01 | 30.41 | 31.78 | 33.11 |
| 46 | 19.96 | 21.55 | 23.11 | 24.65 | 26.15 | 27.62 | 29.06 | 30.46 | 31.83 | 33.15 |
| 48 | 20.02 | 21.60 | 23.16 | 24.70 | 26.20 | 27.67 | 29.11 | 30.51 | 31.87 | 33.20 |
| 50 | 20.07 | 21.66 | 23.22 | 24.75 | 26.25 | 27.72 | 29.15 | 30.55 | 31.92 | 33.24 |
| 52 | 20.12 | 21.71 | 23.27 | 24.80 | 26.30 | 27.77 | 29.20 | 30.60 | 31.96 | 33.28 |
| 54 | 20.18 | 21.76 | 23.32 | 24.85 | 26.35 | 27.81 | 29.25 | 30.65 | 32.01 | 33.33 |
| 56 | 20.23 | 21.81 | 23.37 | 24.90 | 26.40 | 27.86 | 29.30 | 30.69 | 32.05 | 33.37 |
| 58 | 20.28 | 21.87 | 23.42 | 24.95 | 26.45 | 27.91 | 29.34 | 30.74 | 32.09 | 33.41 |
| 60 | 20.34 | 21.92 | 23.47 | 25.00 | 26.50 | 27.96 | 29.39 | 30.78 | 32.14 | 33.46 |

HORIZONTAL CORRECTIONS

| District | 11° | 12° | 13° | 14° | 15° | 16° | 17° | 18° | 19° | 20° |
|----------|------|------|------|------|------|------|------|------|-------|-------|
| 100 | 3.6 | 4.3 | 5.1 | 5.9 | 6.7 | 7.6 | 8.5 | 9.5 | 10.6 | 11.7 |
| 200 | 7.3 | 8.6 | 10.1 | 11.7 | 13.4 | 15.2 | 17.1 | 19.1 | 21.2 | 23.4 |
| 300 | 10.9 | 13.0 | 15.2 | 17.6 | 20.1 | 22.8 | 25.6 | 28.6 | 31.8 | 35.1 |
| 400 | 14.6 | 17.3 | 20.2 | 23.4 | 26.8 | 30.4 | 34.2 | 38.2 | 42.4 | 46.8 |
| 500 | 18.2 | 21.6 | 25.3 | 29.3 | 33.5 | 38.0 | 42.7 | 47.7 | 53.0 | 58.5 |
| 600 | 21.8 | 25.9 | 30.4 | 35.1 | 40.2 | 45.6 | 51.3 | 57.3 | 63.6 | 70.2 |
| 700 | 25.5 | 30.2 | 35.4 | 41.0 | 46.9 | 53.2 | 59.8 | 66.8 | 74.2 | 81.9 |
| 800 | 29.1 | 34.6 | 40.5 | 46.8 | 53.6 | 60.8 | 68.4 | 76.4 | 84.8 | 93.6 |
| 900 | 32.8 | 38.9 | 45.6 | 52.7 | 60.3 | 68.4 | 76.9 | 85.9 | 95.4 | 105.3 |
| 1000 | 36.4 | 43.2 | 50.6 | 58.5 | 67.0 | 76.0 | 85.5 | 95.5 | 106.0 | 117.0 |

TABLE XIII.—SINES, COSINES, TANGENTS, COTANGENTS

| Deg. | sin 0' | tan 0' | sin 10' | tan 10' | sin 20' | tan 20' | sin 30' | tan 30' | sin 40' | tan 40' | sin 50' | tan 50' | Deg. |
|------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| 0 | 0000 | 0000 | 0029 | 0029 | 0058 | 0058 | 0087 | 0087 | 0116 | 0116 | 0145 | 0145 | 89 |
| 1 | 175 | 0175 | 0204 | 0204 | 0233 | 0233 | 0262 | 262 | 291 | 291 | 320 | 320 | 88 |
| 2 | 349 | 349 | 378 | 378 | 407 | 407 | 436 | 437 | 465 | 466 | 494 | 495 | 87 |
| 3 | 523 | 524 | 552 | 553 | 581 | 582 | 610 | 612 | 640 | 641 | 669 | 670 | 86 |
| 4 | 698 | 699 | 727 | 729 | 756 | 758 | 785 | 787 | 814 | 816 | 843 | 864 | 85 |
| 5 | 872 | 875 | 901 | 904 | 929 | 934 | 958 | 963 | 987 | 992 | 1016 | 1022 | 84 |
| 6 | 1045 | 1051 | 1074 | 1080 | 1103 | 1110 | 1132 | 1139 | 1161 | 1169 | 1190 | 1198 | 83 |
| 7 | 219 | 228 | 248 | 257 | 279 | 287 | 305 | 317 | 334 | 346 | 363 | 376 | 82 |
| 8 | 392 | 405 | 421 | 435 | 449 | 465 | 478 | 495 | 507 | 524 | 536 | 554 | 81 |
| 9 | 564 | 584 | 593 | 614 | 622 | 644 | 650 | 673 | 679 | 703 | 708 | 733 | 80 |
| 10 | 736 | 763 | 765 | 793 | 794 | 823 | 822 | 853 | 851 | 883 | 880 | 914 | 79 |
| 11 | 908 | 944 | 937 | 974 | 965 | 2004 | 994 | 2035 | 2022 | 2065 | 2051 | 2095 | 78 |
| 12 | 2079 | 2126 | 2108 | 2156 | 2136 | 186 | 2164 | 217 | 193 | 247 | 221 | 278 | 77 |
| 13 | 250 | 309 | 278 | 339 | 306 | 370 | 334 | 401 | 363 | 432 | 391 | 462 | 76 |
| 14 | 419 | 493 | 447 | 524 | 476 | 555 | 504 | 586 | 532 | 617 | 560 | 648 | 75 |
| 15 | 588 | 679 | 616 | 711 | 644 | 742 | 672 | 773 | 700 | 805 | 728 | 836 | 74 |
| 16 | 756 | 867 | 784 | 899 | 812 | 931 | 840 | 962 | 868 | 994 | 896 | 3026 | 73 |
| 17 | 924 | 3057 | 952 | 3089 | 939 | 3121 | 3007 | 3153 | 3035 | 3185 | 3062 | 217 | 72 |
| 18 | 3090 | 249 | 3118 | 281 | 3145 | 314 | 173 | 346 | 201 | 378 | 228 | 411 | 71 |
| 19 | 256 | 443 | 283 | 476 | 311 | 508 | 338 | 541 | 365 | 574 | 393 | 607 | 70 |
| 20 | 420 | 640 | 448 | 673 | 475 | 706 | 502 | 739 | 529 | 772 | 557 | 805 | 69 |
| 21 | 584 | 839 | 611 | 872 | 638 | 906 | 665 | 939 | 692 | 973 | 719 | 4008 | 68 |
| 22 | 746 | 4040 | 773 | 4074 | 800 | 4108 | 827 | 4142 | 854 | 4176 | 881 | 210 | 67 |
| 23 | 907 | 245 | 934 | 279 | 961 | 314 | 987 | 348 | 4014 | 383 | 4041 | 417 | 66 |
| 24 | 4067 | 452 | 4094 | 487 | 4120 | 522 | 4147 | 557 | 173 | 592 | 200 | 628 | 65 |
| 25 | 226 | 663 | 253 | 699 | 279 | 734 | 305 | 770 | 331 | 806 | 358 | 841 | 64 |
| 26 | 384 | 877 | 410 | 913 | 436 | 950 | 462 | 986 | 488 | 5022 | 514 | 5059 | 63 |
| 27 | 540 | 5095 | 566 | 5132 | 592 | 5169 | 617 | 5206 | 643 | 243 | 669 | 280 | 62 |
| 28 | 695 | 317 | 720 | 354 | 746 | 392 | 772 | 430 | 797 | 467 | 823 | 505 | 61 |
| 29 | 848 | 543 | 874 | 581 | 899 | 619 | 924 | 658 | 950 | 696 | 975 | 735 | 60 |
| 30 | 5000 | 774 | 5025 | 5812 | 5050 | 851 | 5075 | 890 | 5100 | 930 | 5125 | 969 | 59 |
| 31 | 150 | 6009 | 175 | 6048 | 200 | 6088 | 225 | 6128 | 250 | 6168 | 275 | 6208 | 58 |
| 32 | 299 | 249 | 324 | 289 | 348 | 330 | 5373 | 371 | 398 | 412 | 422 | 453 | 57 |
| 33 | 446 | 494 | 471 | 536 | 495 | 577 | 519 | 619 | 544 | 661 | 568 | 708 | 56 |
| 34 | 592 | 745 | 616 | 787 | 640 | 830 | 664 | 873 | 688 | 916 | 712 | 959 | 55 |
| 35 | 736 | 7002 | 760 | 7046 | 783 | 7089 | 807 | 7133 | 831 | 7177 | 854 | 7221 | 54 |
| 36 | 878 | 265 | 901 | 310 | 925 | 355 | 948 | 400 | 972 | 445 | 995 | 490 | 53 |
| 37 | 6018 | 536 | 6041 | 581 | 6065 | 627 | 6088 | 673 | 6111 | 720 | 6134 | 766 | 52 |
| 38 | 157 | 813 | 180 | 860 | 202 | 907 | 225 | 954 | 248 | 8002 | 271 | 8050 | 51 |
| 39 | 293 | 8098 | 316 | 8146 | 338 | 8195 | 361 | 8243 | 383 | 292 | 406 | 342 | 50 |
| 40 | 428 | 391 | 450 | 441 | 472 | 491 | 494 | 541 | 517 | 591 | 539 | 642 | 49 |
| 41 | 561 | 693 | 583 | 744 | 604 | 796 | 626 | 847 | 648 | 899 | 670 | 952 | 48 |
| 42 | 691 | 9004 | 713 | 9057 | 734 | 9110 | 756 | 9163 | 777 | 9217 | 799 | 9271 | 47 |
| 43 | 820 | 325 | 841 | 380 | 862 | 435 | 884 | 490 | 905 | 545 | 926 | 601 | 46 |
| 44 | 947 | 657 | 967 | 713 | 988 | 770 | 999 | 827 | 7030 | 884 | 7050 | 942 | 45 |
| 45 | 7071 | 1.0000 | 7092 | 1.0058 | 7112 | 1.0117 | 133 | 1.0176 | 153 | 1.0235 | 173 | 1.0295 | 44 |
| 60' | 60' | 50' | 50' | 40' | 40' | 30' | 30' | 20' | 20' | 10' | 10' | | Deg. |

TABLE XIII.—SINES, COSINES, TANGENTS, COTANGENTS (Continued)

| Deg. | sin 0' | tan 0' | sin 10' | tan 10' | sin 20' | tan 20' | sin 30' | tan 30' | sin 40' | tan 40' | sin 50' | tan 50' | Deg. |
|------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| 46 | 7193 | 1.0355 | 7214 | 1.0416 | 7234 | 1.0477 | 7254 | 1.0533 | 7274 | 1.0599 | 7294 | 1.0661 | 43 |
| 47 | 314 | .0724 | 333 | .0786 | 353 | .0850 | 373 | .0913 | 392 | .0977 | 412 | .1041 | 42 |
| 48 | 431 | .1106 | 451 | .1171 | 470 | .1237 | 490 | .1303 | 509 | .1369 | 528 | .1436 | 41 |
| 49 | 547 | .1504 | 566 | .1571 | 585 | .1640 | 604 | .1708 | 623 | .1778 | 642 | .1847 | 40 |
| 50 | 660 | 1.1918 | 7679 | 1.1988 | 7698 | 1.2059 | 7716 | 1.2131 | 7735 | 1.2203 | 7753 | 1.2276 | 39 |
| 51 | 771 | .2349 | 790 | .2423 | 808 | .2497 | 826 | .2572 | 844 | .2647 | 862 | .2723 | 38 |
| 52 | 880 | .2799 | 898 | .2876 | 916 | .2954 | 934 | .3032 | 951 | .3111 | 969 | .3190 | 37 |
| 53 | 986 | .3270 | 8004 | .3351 | 8021 | .3452 | 8039 | .3514 | 8056 | .3597 | 8073 | .3680 | 36 |
| 54 | 8090 | .3764 | 107 | .3848 | 124 | .3934 | 141 | .4019 | 158 | .4106 | 175 | .4193 | 35 |
| 55 | 192 | .4281 | 208 | .4370 | 225 | .4460 | 241 | .4550 | 258 | .4641 | 274 | .4733 | 34 |
| 56 | 290 | .4826 | 307 | .4919 | 323 | .5013 | 339 | .5108 | 355 | .5204 | 371 | .5301 | 33 |
| 57 | 387 | .5399 | 403 | .5497 | 418 | .5597 | 434 | .5697 | 450 | .5798 | 465 | .5900 | 32 |
| 58 | 480 | .6003 | 496 | .6107 | 511 | .6212 | 526 | .6319 | 542 | .6426 | 557 | .6534 | 31 |
| 59 | 572 | .6643 | 587 | .6753 | 601 | .6864 | 616 | .6977 | 631 | .7090 | 646 | .7205 | 30 |
| 60 | 660 | 1.7321 | 8675 | 1.7437 | 8689 | 1.7556 | 8704 | 1.7675 | 8718 | 1.7797 | 8732 | 1.7917 | 29 |
| 61 | 746 | .8040 | 760 | .8165 | 774 | .8291 | 788 | .8418 | 802 | .8546 | 816 | .8676 | 28 |
| 62 | 829 | .8807 | 843 | .8940 | 857 | .9074 | 870 | .9210 | 884 | .9347 | 897 | .9486 | 27 |
| 63 | 910 | .9626 | 923 | .9768 | 936 | .9912 | 949 | 2.0057 | 962 | 2.0204 | 975 | 2.0353 | 26 |
| 64 | 988 | 2.0503 | 9001 | 2.0655 | 9013 | 2.0809 | 9026 | .0965 | 9038 | .1123 | 9051 | .1283 | 25 |
| 65 | 9063 | .1445 | 075 | .1609 | 088 | .1775 | 100 | .1943 | 112 | .2113 | 124 | .2286 | 24 |
| 66 | 135 | .2460 | 147 | .2637 | 159 | .2817 | 171 | .2998 | 182 | .3183 | 194 | .3369 | 23 |
| 67 | 205 | .3559 | 216 | .3750 | 228 | .3945 | 239 | .4142 | 250 | .4342 | 261 | .4545 | 22 |
| 68 | 272 | .4751 | 283 | .4960 | 293 | .5172 | 304 | .5386 | 315 | .5605 | 325 | .5826 | 21 |
| 69 | 336 | .6051 | 346 | .6279 | 356 | .6511 | 367 | .6746 | 377 | .6985 | 387 | .7228 | 20 |
| 70 | 397 | 2.7475 | 9407 | 2.7725 | 9417 | 2.7980 | 9426 | 2.8239 | 9436 | 2.8502 | 9446 | 2.8770 | 19 |
| 71 | 455 | .9042 | 465 | .9319 | 474 | .9600 | 483 | .9887 | 492 | 3.0178 | 502 | 3.0475 | 18 |
| 72 | 511 | 3.0777 | 520 | 3.1084 | 528 | 3.1397 | 537 | 3.1716 | 546 | .2041 | 555 | .2371 | 17 |
| 73 | 563 | .2709 | 572 | .3052 | 580 | .3402 | 588 | .3759 | 596 | .4124 | 605 | .4495 | 16 |
| 74 | 613 | .4874 | 621 | .5261 | 628 | .5656 | 636 | .6059 | 644 | .6470 | 652 | .6891 | 15 |
| 75 | 659 | .7321 | 667 | .7760 | 674 | .8208 | 681 | .8657 | 689 | .9136 | 696 | .9617 | 14 |
| 76 | 703 | 4.0108 | 710 | 4.0611 | 717 | 4.1126 | 724 | 4.1653 | 730 | 4.2193 | 737 | 4.2747 | 13 |
| 77 | 744 | .3315 | 750 | .3897 | 757 | .4494 | 763 | .5107 | 769 | .5736 | 775 | .6382 | 12 |
| 78 | 781 | .7046 | 787 | .7729 | 793 | .8430 | 799 | .9152 | 805 | .9894 | 811 | 5.0658 | 11 |
| 79 | 816 | .1446 | 822 | 5.2257 | 827 | 5.3093 | 833 | 5.3955 | 838 | 5.4845 | 843 | .5764 | 10 |
| 80 | 9848 | 5.6713 | 9853 | 5.7694 | 9858 | 5.8708 | 9863 | 5.9758 | 9868 | 6.0844 | 9872 | 6.1970 | 9 |
| 81 | 877 | 6.3138 | 881 | 6.4348 | 886 | 6.5606 | 890 | 6.6912 | 894 | .8269 | 899 | .9682 | 8 |
| 82 | 903 | 7.1154 | 907 | 7.2687 | 911 | 7.4287 | 914 | 7.6958 | 918 | 7.7704 | 922 | 7.9530 | 7 |
| 83 | 925 | 8.1443 | 929 | 8.3450 | 932 | 8.5555 | 936 | 8.7769 | 939 | 9.0098 | 942 | 9.2553 | 6 |
| 84 | 945 | 9.5144 | 948 | 9.7882 | 951 | 10.078 | 954 | 10.385 | 957 | 10.711 | 959 | 11.059 | 5 |
| 85 | 962 | 11.430 | 964 | 11.826 | 967 | 12.250 | 969 | 12.706 | 971 | 13.197 | 974 | 13.727 | 4 |
| 86 | 976 | 14.300 | 978 | 14.924 | 980 | 15.605 | 981 | 16.350 | 983 | 17.169 | 985 | 18.075 | 3 |
| 87 | 986 | 19.081 | 988 | 20.206 | 989 | 21.470 | 990 | 22.903 | 992 | 24.542 | 993 | 26.432 | 2 |
| 88 | 994 | 28.636 | 995 | 31.242 | 996 | 34.368 | 997 | 38.189 | 997 | 42.964 | 998 | 49.104 | 1 |
| 89 | 9998 | 57.290 | 9999 | 68.750 | 9999 | 85.940 | 9999 | 114.58 | 1000 | 171.88 | 1000 | 343.77 | 0 |
| 60' | 60' | 50' | 50' | 40' | 40' | 30' | 30' | 20' | 20' | 10' | 10' | | Deg. |

1891

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Feb 26th ...
Feb 27th ...
Feb 28th ...

Mar 1st ...

[The right page of the notebook is mostly blank, with some faint, illegible markings and a large, irregular white stain or smudge covering the right half of the page.]

Leitner
Miller
Newport
Karschaw
O Bonn
Wain
Derberg

S. 84° 15' W

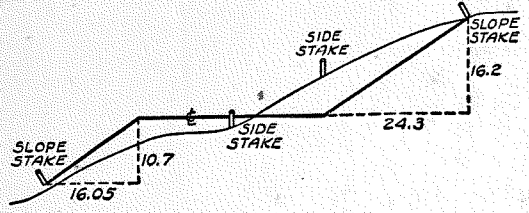
23+10 E Lake shore

22+80 Cor in lake

2+0 Lake shore

4+0 Bog

6+80 Ash swamp Enter Hardwood B + Oak



DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING
SLOPE 1 1/2 TO 1. ROADWAY OF ANY WIDTH

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| 0 | 0.00 | 0.15 | 0.30 | 0.45 | 0.60 | 0.75 | 0.90 | 1.05 | 1.20 | 1.35 | 0 |
| 1 | 1.50 | 1.65 | 1.80 | 1.95 | 2.10 | 2.25 | 2.40 | 2.55 | 2.70 | 2.85 | 1 |
| 2 | 3.00 | 3.15 | 3.30 | 3.45 | 3.60 | 3.75 | 3.90 | 4.05 | 4.20 | 4.35 | 2 |
| 3 | 4.50 | 4.65 | 4.80 | 4.95 | 5.10 | 5.25 | 5.40 | 5.55 | 5.70 | 5.85 | 3 |
| 4 | 6.00 | 6.15 | 6.30 | 6.45 | 6.60 | 6.75 | 6.90 | 7.05 | 7.20 | 7.35 | 4 |
| 5 | 7.50 | 7.65 | 7.80 | 7.95 | 8.10 | 8.25 | 8.40 | 8.55 | 8.70 | 8.85 | 5 |
| 6 | 9.00 | 9.15 | 9.30 | 9.45 | 9.60 | 9.75 | 9.90 | 10.05 | 10.20 | 10.35 | 6 |
| 7 | 10.50 | 10.65 | 10.80 | 10.95 | 11.10 | 11.25 | 11.40 | 11.55 | 11.70 | 11.85 | 7 |
| 8 | 12.00 | 12.15 | 12.30 | 12.45 | 12.60 | 12.75 | 12.90 | 13.05 | 13.20 | 13.35 | 8 |
| 9 | 13.50 | 13.65 | 13.80 | 13.95 | 14.10 | 14.25 | 14.40 | 14.55 | 14.70 | 14.85 | 9 |
| 10 | 15.00 | 15.15 | 15.30 | 15.45 | 15.60 | 15.75 | 15.90 | 16.05 | 16.20 | 16.35 | 10 |
| 11 | 16.50 | 16.65 | 16.80 | 16.95 | 17.10 | 17.25 | 17.40 | 17.55 | 17.70 | 17.85 | 11 |
| 12 | 18.00 | 18.15 | 18.30 | 18.45 | 18.60 | 18.75 | 18.90 | 19.05 | 19.20 | 19.35 | 12 |
| 13 | 19.50 | 19.65 | 19.80 | 19.95 | 20.10 | 20.25 | 20.40 | 20.55 | 20.70 | 20.85 | 13 |
| 14 | 21.00 | 21.15 | 21.30 | 21.45 | 21.60 | 21.75 | 21.90 | 22.05 | 22.20 | 22.35 | 14 |
| 15 | 22.50 | 22.65 | 22.80 | 22.95 | 23.10 | 23.25 | 23.40 | 23.55 | 23.70 | 23.85 | 15 |
| 16 | 24.00 | 24.15 | 24.30 | 24.45 | 24.60 | 24.75 | 24.90 | 25.05 | 25.20 | 25.35 | 16 |
| 17 | 25.50 | 25.65 | 25.80 | 25.95 | 26.10 | 26.25 | 26.40 | 26.55 | 26.70 | 26.85 | 17 |
| 18 | 27.00 | 27.15 | 27.30 | 27.45 | 27.60 | 27.75 | 27.90 | 28.05 | 28.20 | 28.35 | 18 |
| 19 | 28.50 | 28.65 | 28.80 | 28.95 | 29.10 | 29.25 | 29.40 | 29.55 | 29.70 | 29.85 | 19 |
| 20 | 30.00 | 30.15 | 30.30 | 30.45 | 30.60 | 30.75 | 30.90 | 31.05 | 31.20 | 31.35 | 20 |
| 21 | 31.50 | 31.65 | 31.80 | 31.95 | 32.10 | 32.25 | 32.40 | 32.55 | 32.70 | 32.85 | 21 |
| 22 | 33.00 | 33.15 | 33.30 | 33.45 | 33.60 | 33.75 | 33.90 | 34.05 | 34.20 | 34.35 | 22 |
| 23 | 34.50 | 34.65 | 34.80 | 34.95 | 35.10 | 35.25 | 35.40 | 35.55 | 35.70 | 35.85 | 23 |
| 24 | 36.00 | 36.15 | 36.30 | 36.45 | 36.60 | 36.75 | 36.90 | 37.05 | 37.20 | 37.35 | 24 |
| 25 | 37.50 | 37.65 | 37.80 | 37.95 | 38.10 | 38.25 | 38.40 | 38.55 | 38.70 | 38.85 | 25 |
| 26 | 39.00 | 39.15 | 39.30 | 39.45 | 39.60 | 39.75 | 39.90 | 40.05 | 40.20 | 40.35 | 26 |
| 27 | 40.50 | 40.65 | 40.80 | 40.95 | 41.10 | 41.25 | 41.40 | 41.55 | 41.70 | 41.85 | 27 |
| 28 | 42.00 | 42.15 | 42.30 | 42.45 | 42.60 | 42.75 | 42.90 | 43.05 | 43.20 | 43.35 | 28 |
| 29 | 43.50 | 43.65 | 43.80 | 43.95 | 44.10 | 44.25 | 44.40 | 44.55 | 44.70 | 44.85 | 29 |
| 30 | 45.00 | 45.15 | 45.30 | 45.45 | 45.60 | 45.75 | 45.90 | 46.05 | 46.20 | 46.35 | 30 |
| 31 | 46.50 | 46.65 | 46.80 | 46.95 | 47.10 | 47.25 | 47.40 | 47.55 | 47.70 | 47.85 | 31 |
| 32 | 48.00 | 48.15 | 48.30 | 48.45 | 48.60 | 48.75 | 48.90 | 49.05 | 49.20 | 49.35 | 32 |
| 33 | 49.50 | 49.65 | 49.80 | 49.95 | 50.10 | 50.25 | 50.40 | 50.55 | 50.70 | 50.85 | 33 |
| 34 | 51.00 | 51.15 | 51.30 | 51.45 | 51.60 | 51.75 | 51.90 | 52.05 | 52.20 | 52.35 | 34 |
| 35 | 52.50 | 52.65 | 52.80 | 52.95 | 53.10 | 53.25 | 53.40 | 53.55 | 53.70 | 53.85 | 35 |
| 36 | 54.00 | 54.15 | 54.30 | 54.45 | 54.60 | 54.75 | 54.90 | 55.05 | 55.20 | 55.35 | 36 |
| 37 | 55.50 | 55.65 | 55.80 | 55.95 | 56.10 | 56.25 | 56.40 | 56.55 | 56.70 | 56.85 | 37 |
| 38 | 57.00 | 57.15 | 57.30 | 57.45 | 57.60 | 57.75 | 57.90 | 58.05 | 58.20 | 58.35 | 38 |
| 39 | 58.50 | 58.65 | 58.80 | 58.95 | 59.10 | 59.25 | 59.40 | 59.55 | 59.70 | 59.85 | 39 |
| 40 | 60.00 | 60.15 | 60.30 | 60.45 | 60.60 | 60.75 | 60.90 | 61.05 | 61.20 | 61.35 | 40 |
| 41 | 61.50 | 61.65 | 61.80 | 61.95 | 62.10 | 62.25 | 62.40 | 62.55 | 62.70 | 62.85 | 41 |
| 42 | 63.00 | 63.15 | 63.30 | 63.45 | 63.60 | 63.75 | 63.90 | 64.05 | 64.20 | 64.35 | 42 |
| 43 | 64.50 | 64.65 | 64.80 | 64.95 | 65.10 | 65.25 | 65.40 | 65.55 | 65.70 | 65.85 | 43 |
| 44 | 66.00 | 66.15 | 66.30 | 66.45 | 66.60 | 66.75 | 66.90 | 67.05 | 67.20 | 67.35 | 44 |
| 45 | 67.50 | 67.65 | 67.80 | 67.95 | 68.10 | 68.25 | 68.40 | 68.55 | 68.70 | 68.85 | 45 |
| 46 | 69.00 | 69.15 | 69.30 | 69.45 | 69.60 | 69.75 | 69.90 | 70.05 | 70.20 | 70.35 | 46 |
| 47 | 70.50 | 70.65 | 70.80 | 70.95 | 71.10 | 71.25 | 71.40 | 71.55 | 71.70 | 71.85 | 47 |
| 48 | 72.00 | 72.15 | 72.30 | 72.45 | 72.60 | 72.75 | 72.90 | 73.05 | 73.20 | 73.35 | 48 |
| 49 | 73.50 | 73.65 | 73.80 | 73.95 | 74.10 | 74.25 | 74.40 | 74.55 | 74.70 | 74.85 | 49 |
| 50 | 75.00 | 75.15 | 75.30 | 75.45 | 75.60 | 75.75 | 75.90 | 76.05 | 76.20 | 76.35 | 50 |

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

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