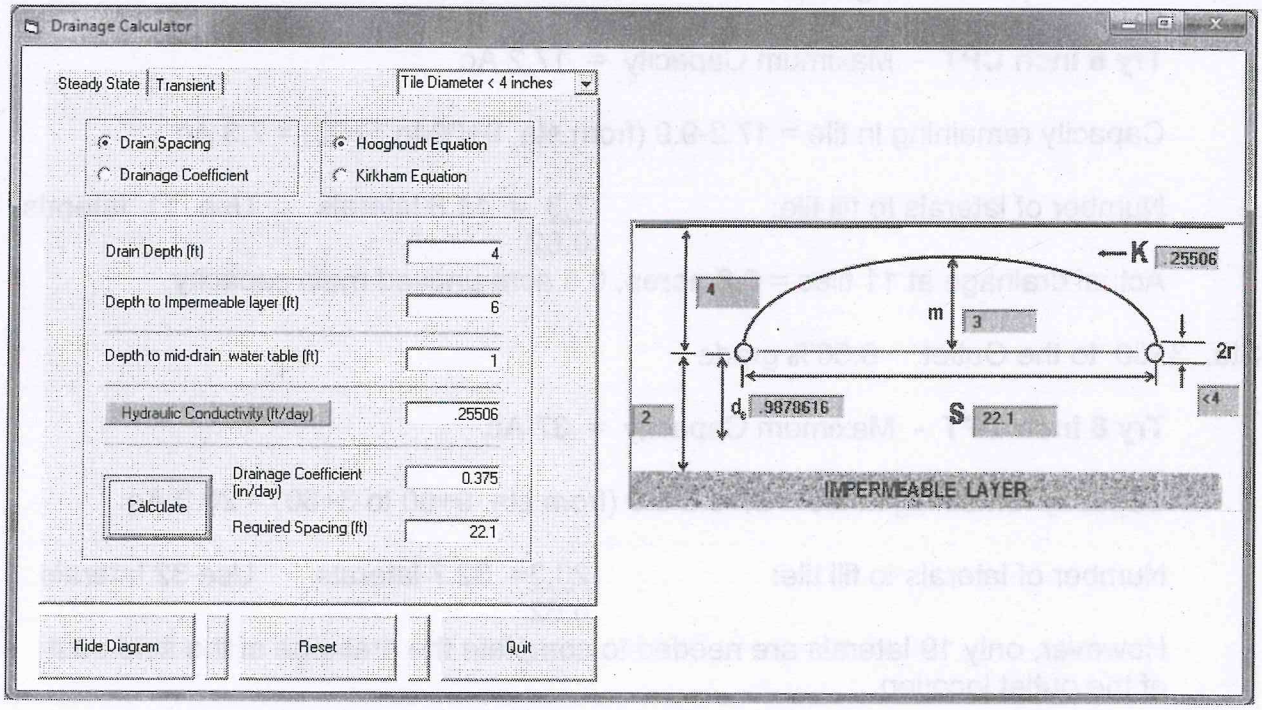
Problem #5 - Design 1

Solution Calculations

1. Completed contour map was provided.
2. From Web Soil Survey, predominate soil type on this field is Tina Silt Loam
3. Problem stated corn, wheat and soybeans are raised and this is a mineral soil. Per Standard 606, DC could be 3/8" per day to ½" per day. Designer chose ~~3/8"~~ ½ ~~due to clay content of soil preventing less drainable water.~~
4. Based on the average hydraulic conductivity in the 12"-41" depth of Tina Silt Loam, designer chose a tile depth of 4' and per the soil survey, average hydraulic conductivity in the 12"-41" region is **0.9** micrometer/second. Using the Drainage Calculator, designer computed a spacing of 22.1', rounded down to **20'**.
   Using the conversion factors-
   1 micrometer/second=**0.2834** feet/day
   0.9 x 0.2834=**0.25506 feet/day**



5. Outlet location for the main was shown on the map at the northwest corner of the field and this point was assigned station 0+00. Designer chose to place the main along the north end of the field and run laterals perpendicular to the main in a south to north orientation since the contour map showed fall from south to north and main fall from east to west. An existing ground profile was created using the provided contour map and graph paper. The profile plot indicated that the main could be designed on a constant grade of 0.56% and would be approximately 900' in length.

Problem #5 - Design 1

Sta. 9+00 to 5+80 0.56% grade DC = ~~3/8~~ 1/2 inch

Begin with 5 inch CPT - Maximum Capacity (from slide rule) = 10.5 Ac

Laterals are 1330' ft. long with 20' spacing.
Contribution by each lateral= 1350' to include area drained by main.

$\frac{1350' \times 20'}{43{,}560\ ft^2/Ac.}$ = 0.62 Ac. Per lateral

Number of laterals to fill tile: $\frac{10.5}{0.62}$ = 16.9 laterals Use 16 laterals

Actual drainage at 16 tiles = **9.9 acres**, 0.6 acre unused main capacity

Sta. 5+80 to 3+60 0.56% grade

Try 6 inch CPT - Maximum Capacity = 17.2 Ac

Capacity remaining in tile = 17.2-9.9 (from sta. 9+00 to 5+80) = 7.3 Ac

Number of laterals to fill tile: $\frac{7.3}{0.62}$ = 11.8 laterals Use 11 laterals

Actual drainage at 11 tiles = **6.8 acres**, 0.5 acre unused main capacity

Sta. 3+60 to the Outlet 0.56% grade

Try 8 inch CPT - Maximum Capacity = 37 Ac

Capacity remaining in tile = 37-6.8-9.9 (from sta. 9+00 to 3+60) = 20.3 Ac

Number of laterals to fill tile: $\frac{20.3}{0.62}$= 32.7 laterals Use 32 laterals

However, only 19 laterals are needed to complete the drainage of the field east of the outlet location.

19 x 0.62 acres = **11.8 acres**.

Total main capacity required at outlet = 11.8+6.8+9.9 = **28.5 Acres which is less than the available 37.**

The remaining approximatley 100' of field west of the given outlet could be collected via 5" cpt and outleted at the same elevation, or could be tied into the 8" main.

DESIGN TABLE FOR SUBSURFACE DRAINAGE

Project: Problem #5 Design #1 Location: Charlton Co

Designed by: Date: Checked by: Date:

Drainage Coefficient, DC: 1.25 in/day Lateral Diameter: 4 inch ver 1/10/2013

Lateral Design

Main Connect Station ft	Lateral ID or Group ID ID	Number of Laterals in Group ea	Grade %	Spacing (S) ft	Lateral Length (L) ft	Drained Length (S+L) ft	Drained Area per Lateral* ac	Drained Area per Group ac	Accum. Drained Area ac
5+80	A	16		20'	1330	1350	0.62	9.9	9.9
3+60	B	11		20'	1330	1350	0.62	6.8	16.7
0+00	C	19		20'	1330	1350	0.62	11.8	28.5

** Includes area drained by main and upper end of lateral = S x (S + L) ÷ 43,560*

Main ID: Design #1 Pipe Material: CPT

Main Design

Main Reach					Main Reach Capacity			Drained Area	
From Station ft	To Station ft	Length ft	Grade %	Main Dia. in	Maximum Flow Volume (Q_{max}) cfs	Maximum Flow Velocity (V_{max}) fps	Maximum Drained Area (DA_{max}) ac	Lateral Accum. Drained Area ac	Unused Main Capacity ac
9+00	5+80	320	0.56	5			10.5	9.9	0.6
5+80	3+60	260	0.56	6			17.2	16.7	0.5
3+60	0+00	360	0.56	8			37	28.5	8.5

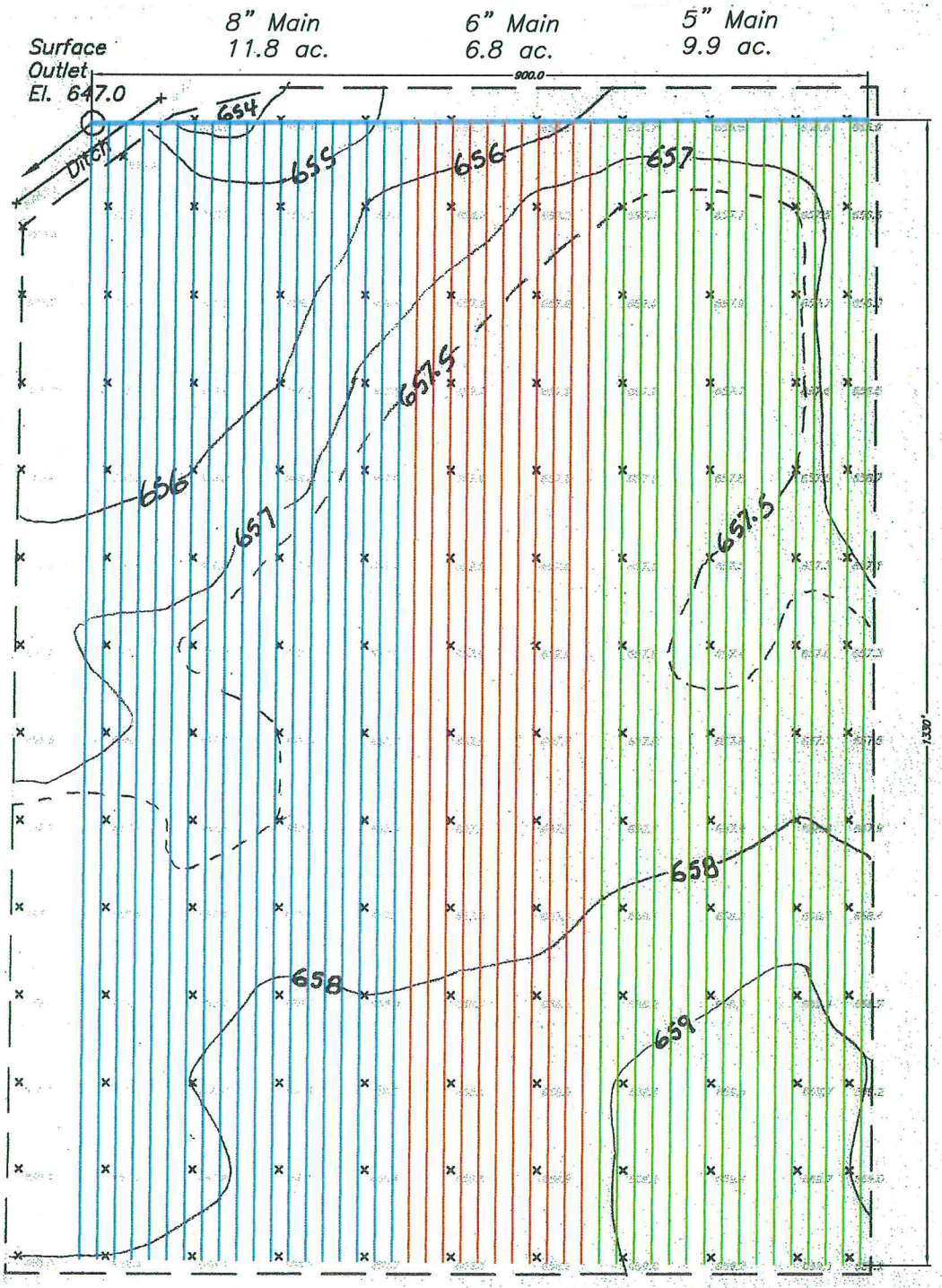
Comments:

Outlet Size: 8 in Material: PVC - SDR 35

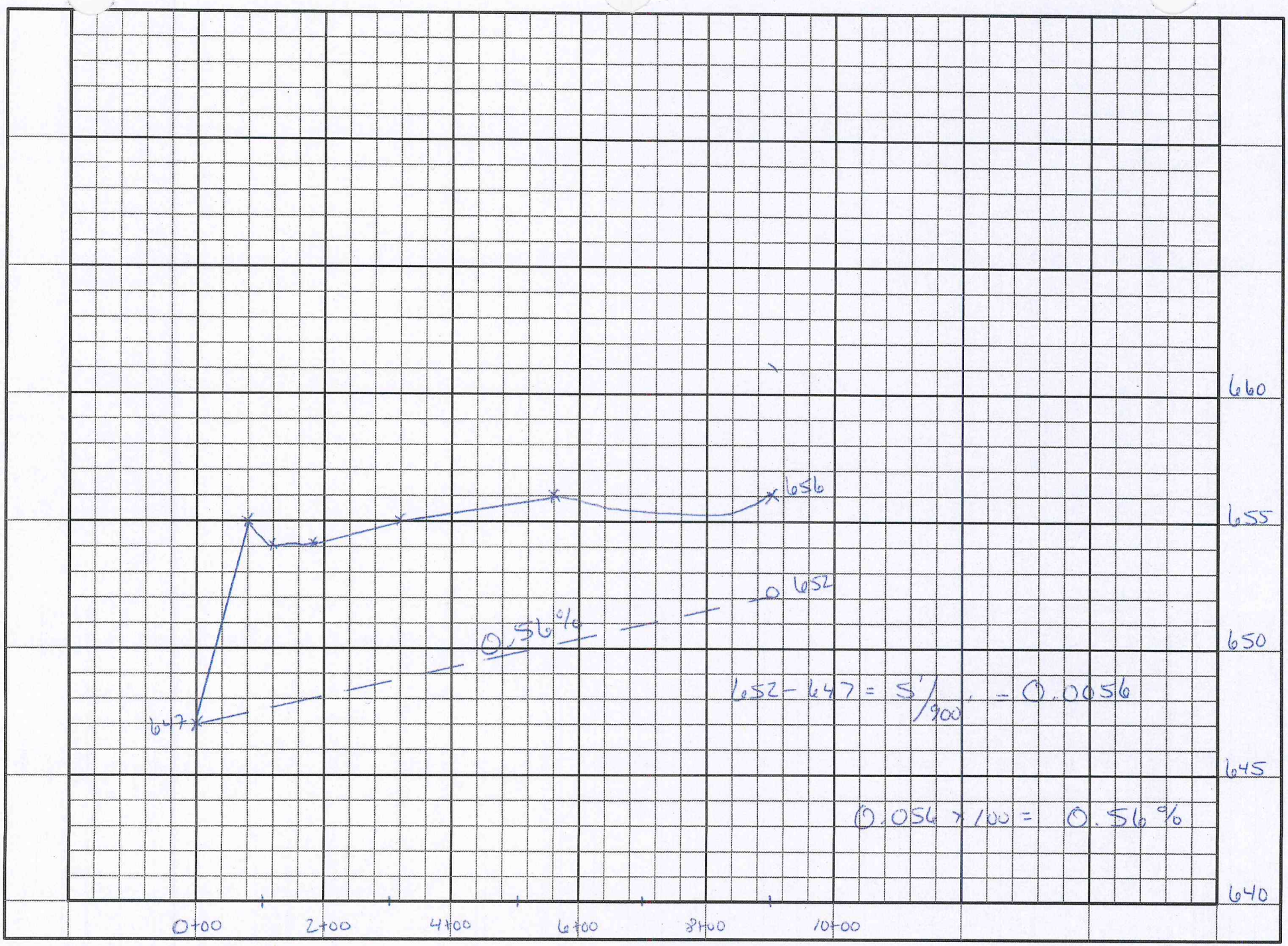
Length: 20 feet Animal Guard (Y/N): Y

1 acre = 43,560 square feet

Q_{req} = 0.0421 x DC x DA


8" Main
11.8 ac.
6" Main
6.8 ac.
5" Main
9.9 ac.
Surface
Outlet
El. 647.0
900.0
Ditch
654
655
656
657
657.5
656
657
657.5
658
658
659
1330'
30 Total
Acres
N
200 100 0 200 400
Scale in Feet

Problem #5



Profile - Problem #5 Design #1