

Client: [Illinois Central College](#)

Client Interest: [Constructed Wetland](#)

Planning and site evaluation

- [What to look for when visiting the site](#)
- [What to consider when evaluating the site](#)
- [What to ask the landowner](#)

Preliminary design

- [Size and depth to meet criteria](#)
- [Treatment area size and layout](#)
- [Additional considerations](#)



PLANNING

1. Location

2. Site Conditions

3. Drainage Area

4. Review

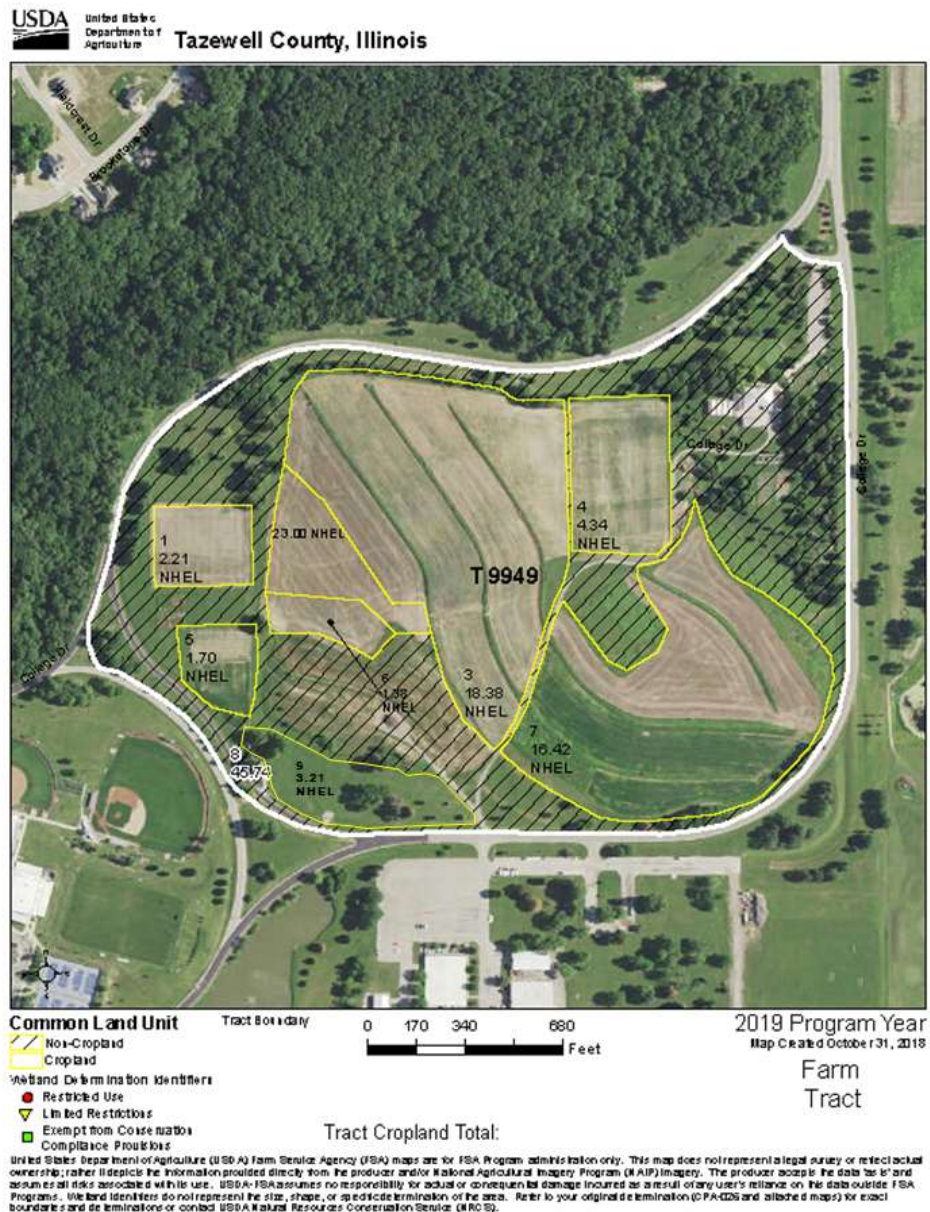
LOCATION

- A. Property Location & Boundary
- B. Wetland Compliance
- C. Landscape Position
- D. Landowner Preference
- E. Receiving Waterbody
- F. Floodplain

SOURCES

- USDA Farm Map
- County tax assessor (GIS)
- Plat book

EXHIBIT A



Map has been modified.

PLANNING

1. Location

2. Site Conditions

3. Drainage Area

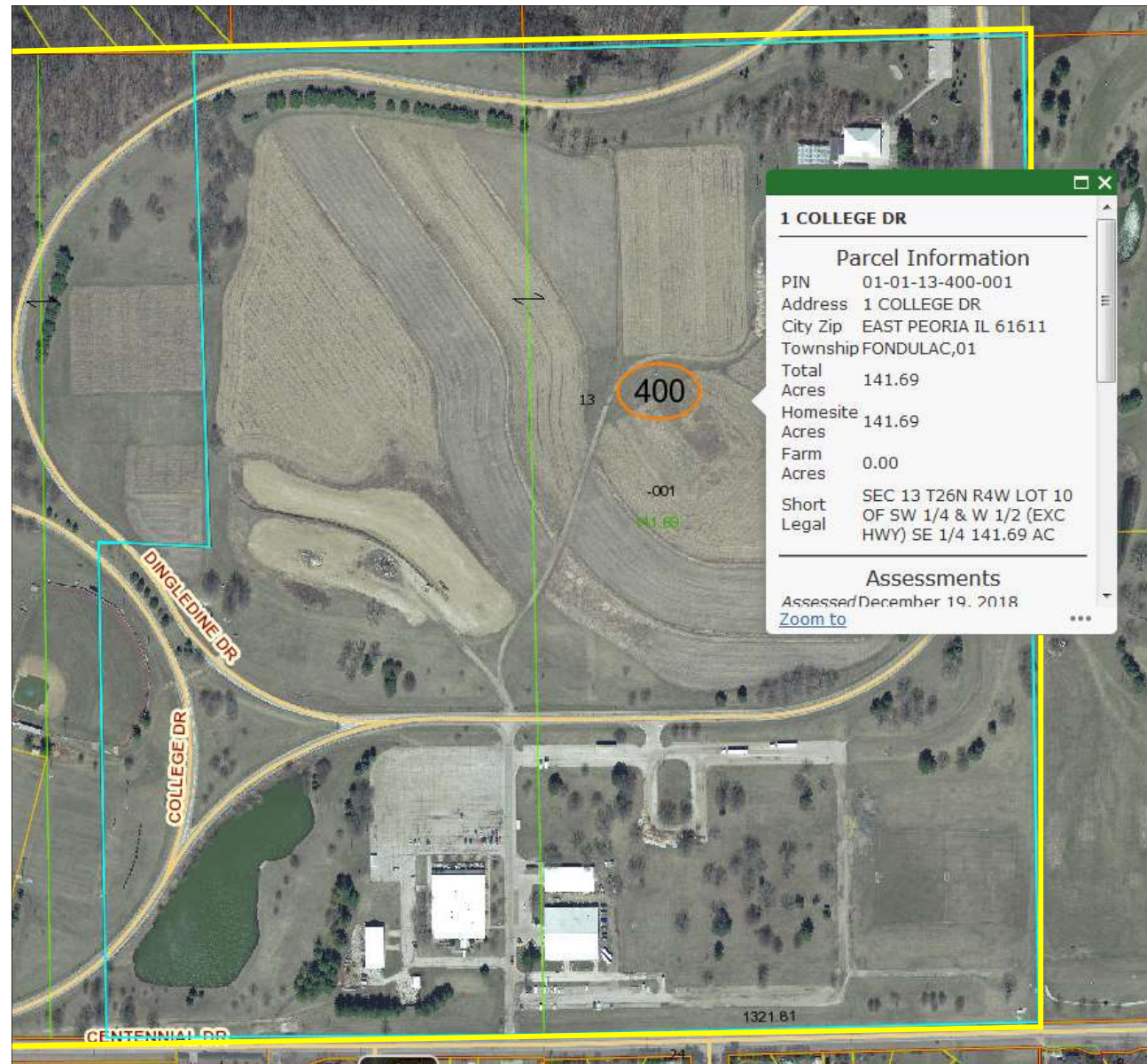
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PLANNING

1. Location

2. Site Conditions

3. Drainage Area

4. Review

LOCATION

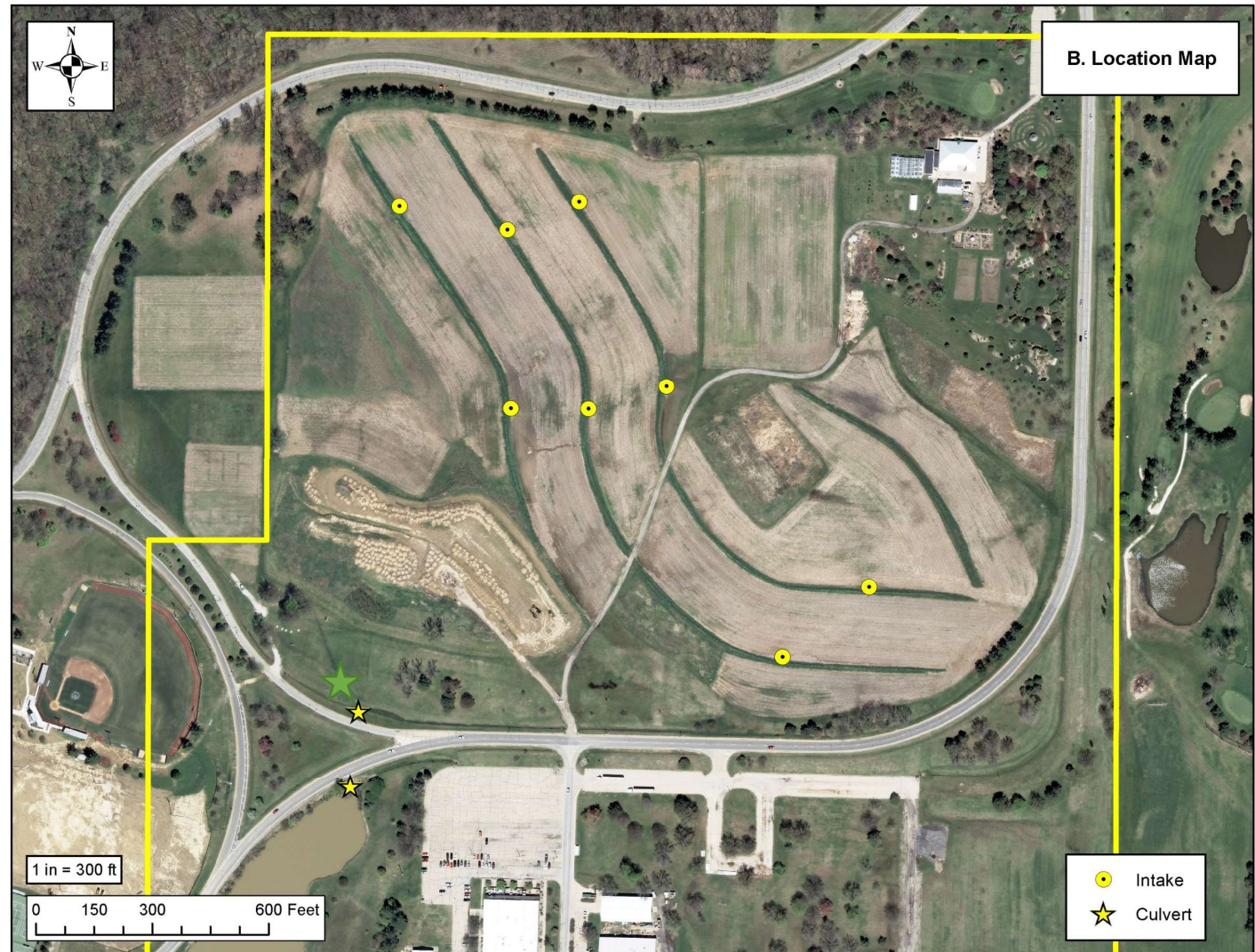
A. Property Location & Boundary

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- F. Floodplain

SOURCES

- USDA Farm Map
- County tax assessor (GIS)
- Plat book

EXHIBIT B



PLANNING

1. Location

2. Site Conditions

3. Drainage Area

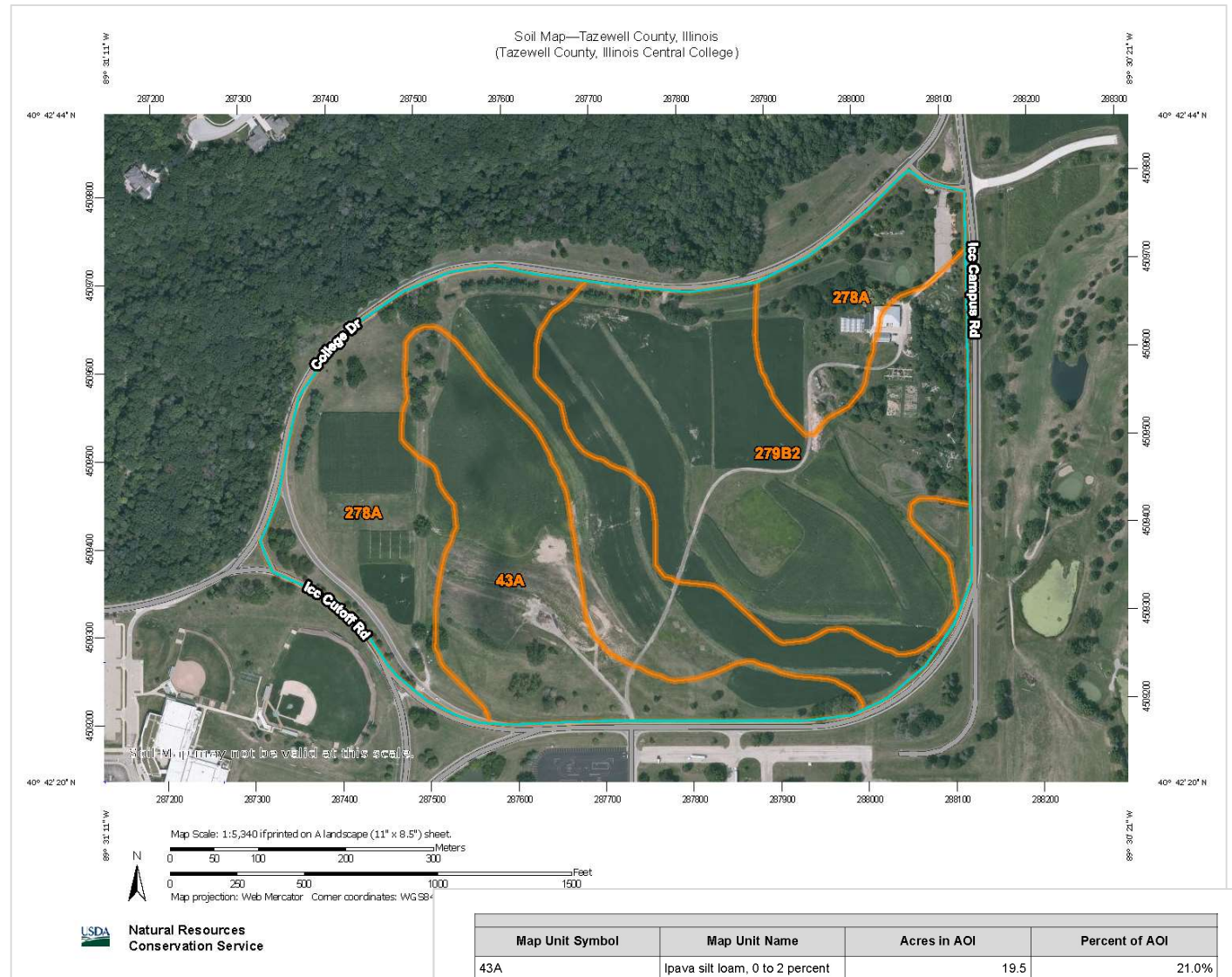
4. Review

LOCATION

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- E. Receiving Waterbody
- F. Floodplain

SOURCES

- Soils map
- CPA-026
- NRCS wetland inventory map



PLANNING

1. Location

2. Site Conditions

3. Drainage Area

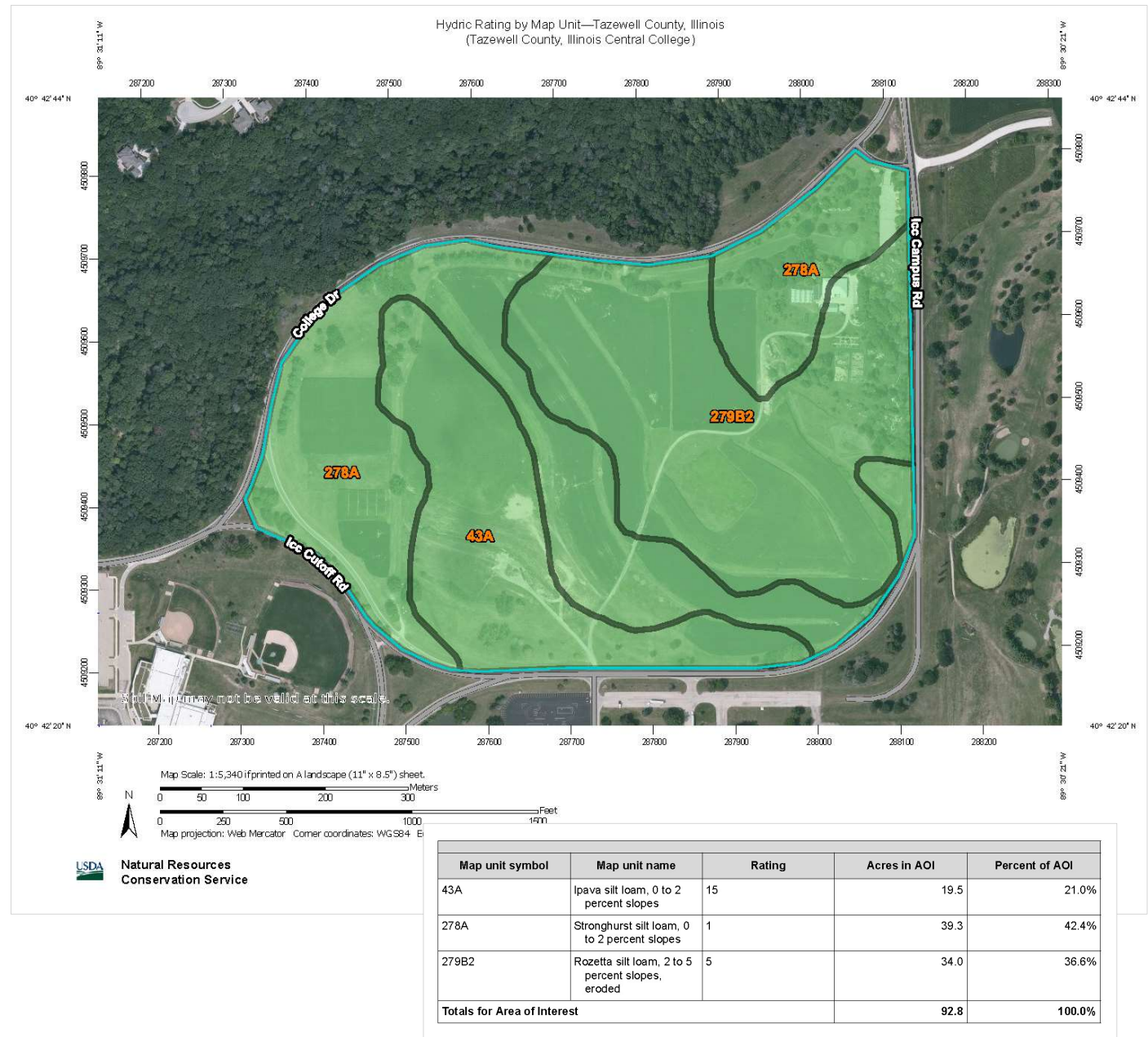
4. Review

LOCATION

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PLANNING

1. Location

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4. Review

LOCATION

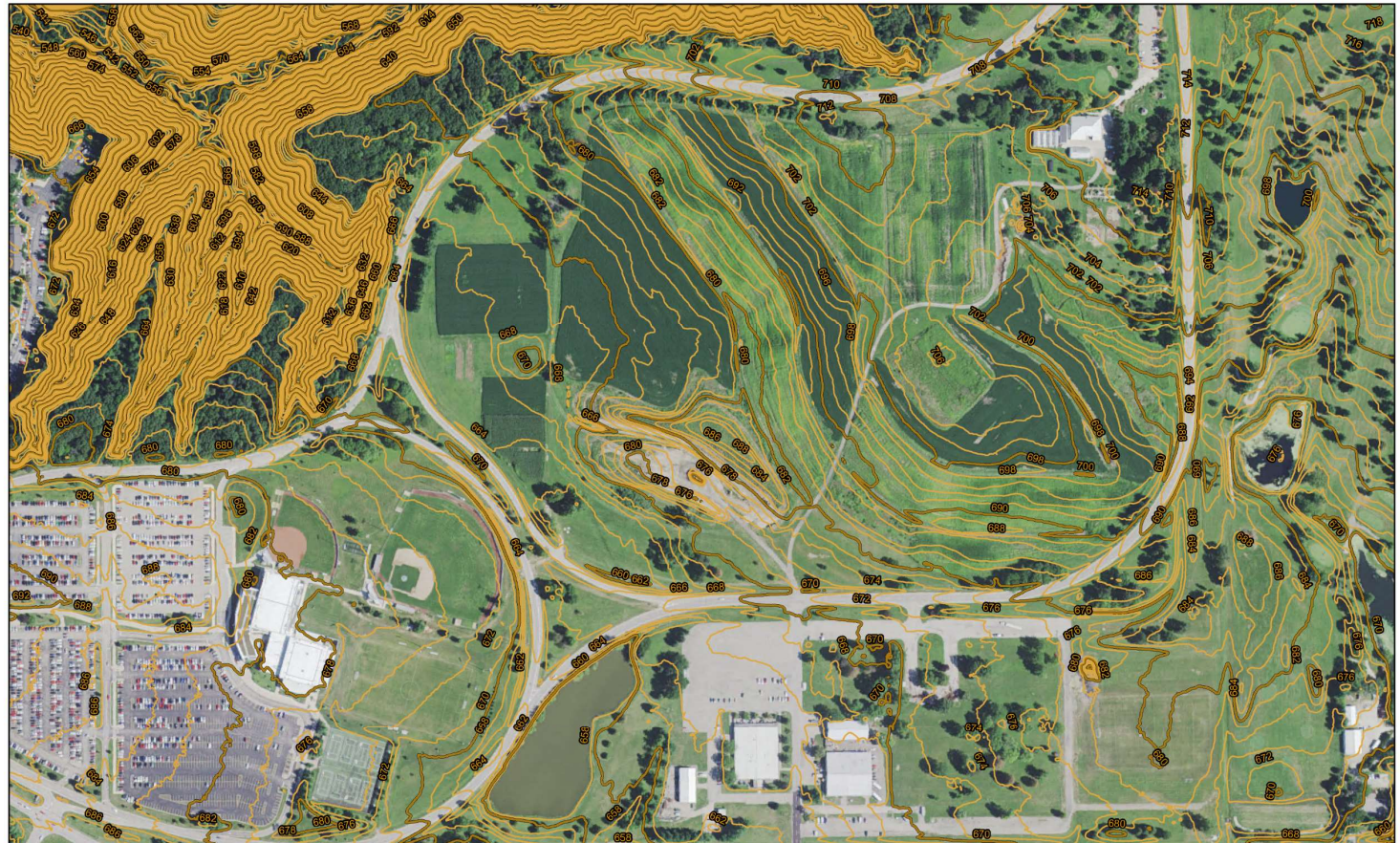
- A. Property Location & Boundary
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- E. Receiving Waterbody
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SOURCES

- USGS topo
- LiDAR
- On-ground topo

EXHIBIT C

ICC Topographic Map



300 150 0 300 600
Feet

- ▶ Low on the landscape (be able to daylight the tile)



LOCATION

- A. Property Location
& Boundary
- B. Wetland
Compliance
- C. Landscape
Position
- D. Landowner
Preference
- E. Receiving
Waterbody
- F. Floodplain

What questions should you ask landowner/operator?

PLANNING

1. Location

2. Site Conditions

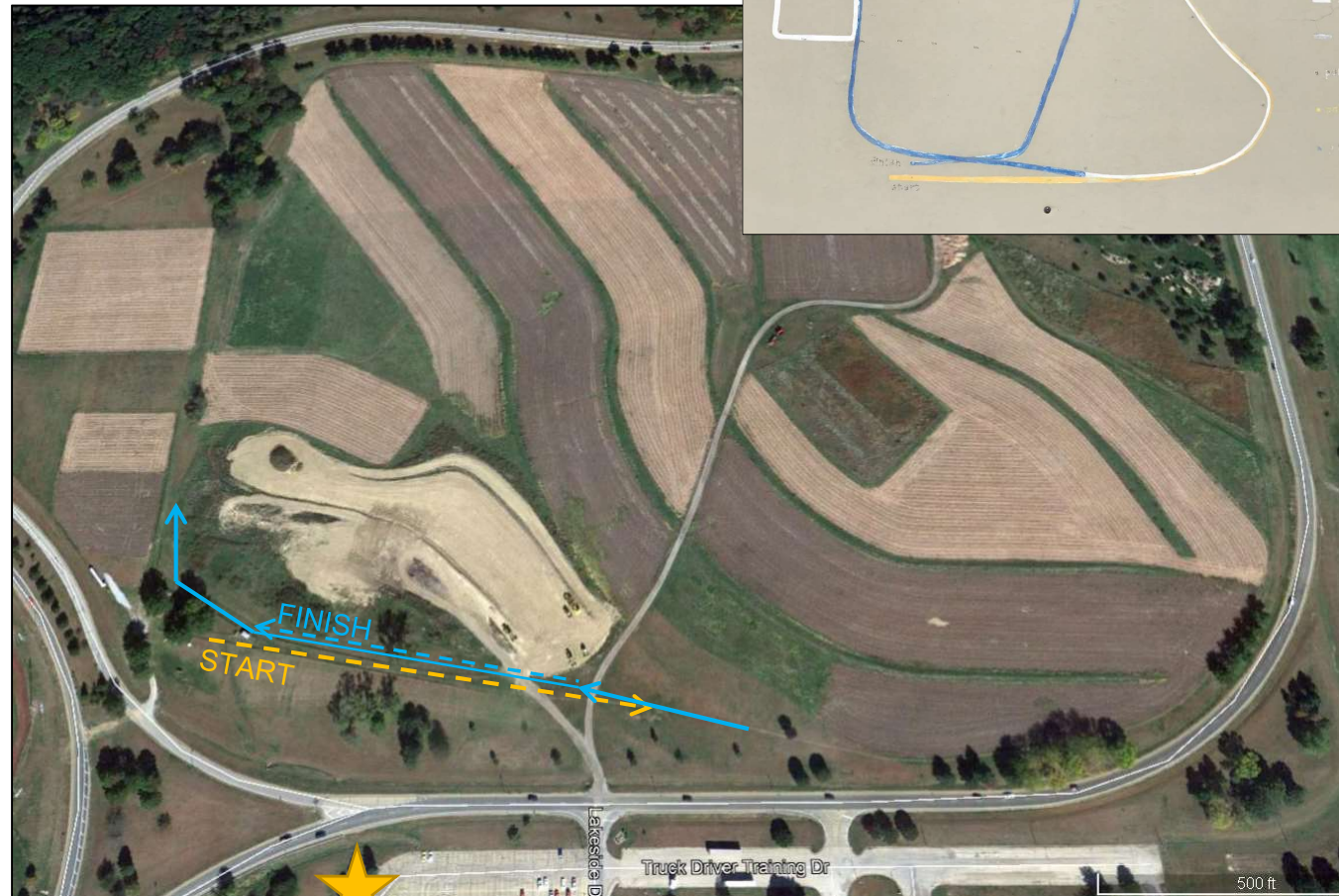
3. Drainage Area

4. Review

LOCATION

- A. Property Location & Boundary
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- D. Landowner Preference
- E. Receiving Waterbody
- F. Floodplain

- Maintain primary research farm plots and bioreactor location
- Consider proposed ICC Sustainability Center location
- Consider existing cross-country course
- Variety of wetland and buffer habitats



LOCATION

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What is the receiving waterbody?

- ▶ Tile main
- ▶ Grassed waterway
- ▶ Pond
- ▶ Ditch/Stream

What are the main considerations?

- ▶ Capacity
- ▶ Erosion
- ▶ Stream bank stability
- ▶ Water level (normal and storm event)
- ▶ “Downstream” impacts

PLANNING

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ICC Topographic Map



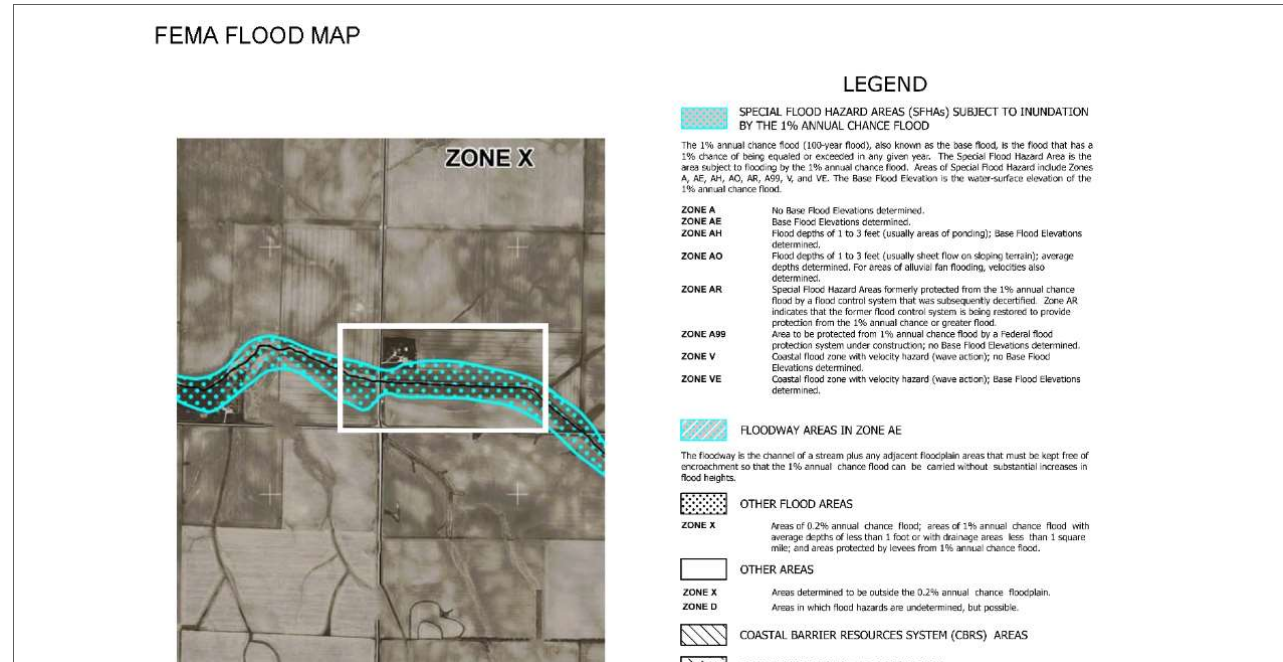
12" HPDE drain discharges to a 42" concrete culvert that runs beneath Dingledine and College Drives into campus pond, which outlets to a tributary of Farm Creek.

LOCATION

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SOURCE

- FEMA Flood Map Service (FIRMette)



Avoid 100-year floodplain unless you:

- ▶ Build to withstand flood events
- ▶ Meet permit requirements (building in a floodplain)
- ▶ Make sure landowner agrees to additional maintenance requirements

PLANNING

1. Location

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3. Drainage Area

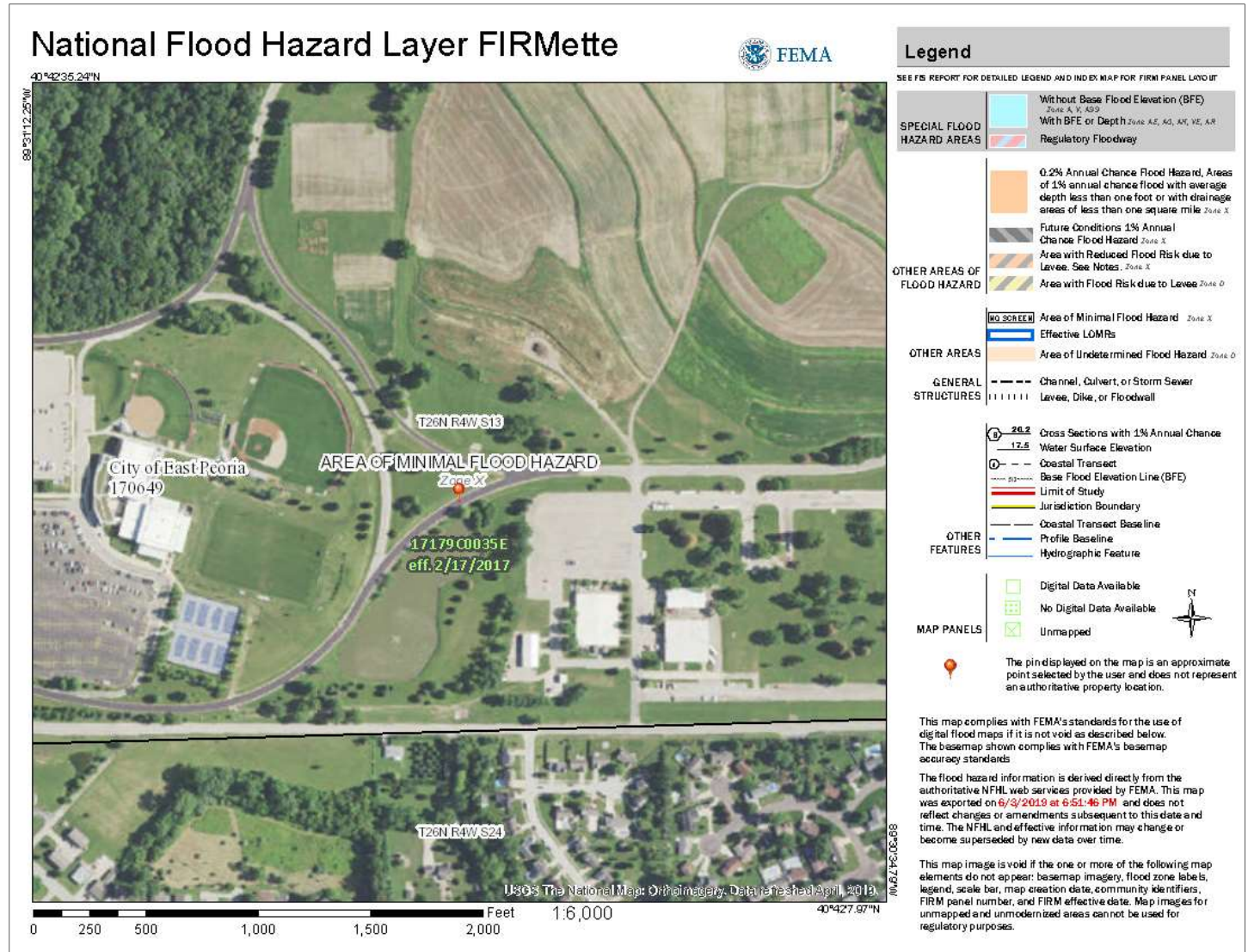
4. Review

LOCATION

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SOURCE

- FEMA Flood Map Service (FIRMette)



PLANNING

1. Location

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4. Review

Any red flags at this point in the planning process?



PLANNING

1. Location

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4. Review

SITE CONDITIONS:

- A. Soils
- B. Elevations
- C. Existing Conditions

A. Soils

B. Elevations

C. Existing Conditions

SOURCES

- Web Soil Survey
- On-site investigation

- Web Soil Survey
- On-site investigation

Appropriate for
“growth media”?

Can it hold water?



Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
43A	Ipava silt loam, 0 to 2 percent slopes	19.5	21.0%
278A	Stronghurst silt loam, 0 to 2 percent slopes	39.3	42.4%
279B2	Rozetta silt loam, 2 to 5 percent slopes, eroded	34.0	36.6%
Totals for Area of Interest		92.8	100.0%



PLANNING

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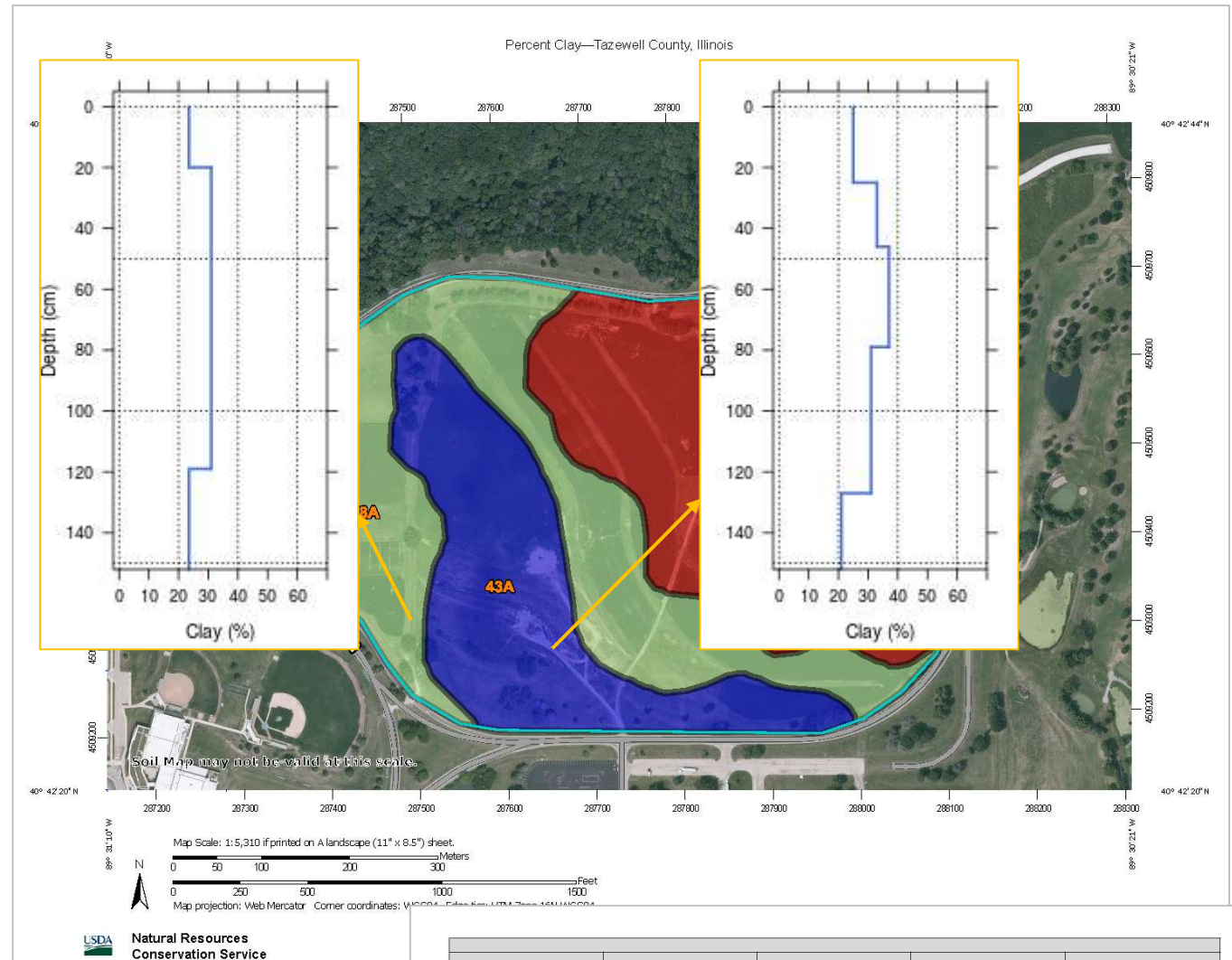
4. Review

SITE CONDITIONS:

- A. Soils
- B. Elevations
- C. Existing Conditions

SOURCES

- Web Soil Survey
- On-site investigation



Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
43A	Ipava silt loam, 0 to 2 percent slopes	30.8	19.2	21.2%
278A	Stronghurst silt loam, 0 to 2 percent slopes	29.0	37.2	41.0%
279B2	Rozetta silt loam, 2 to 5 percent slopes, eroded	28.3	34.3	37.8%
Totals for Area of Interest			90.7	100.0%



PLANNING

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3. Drainage Area

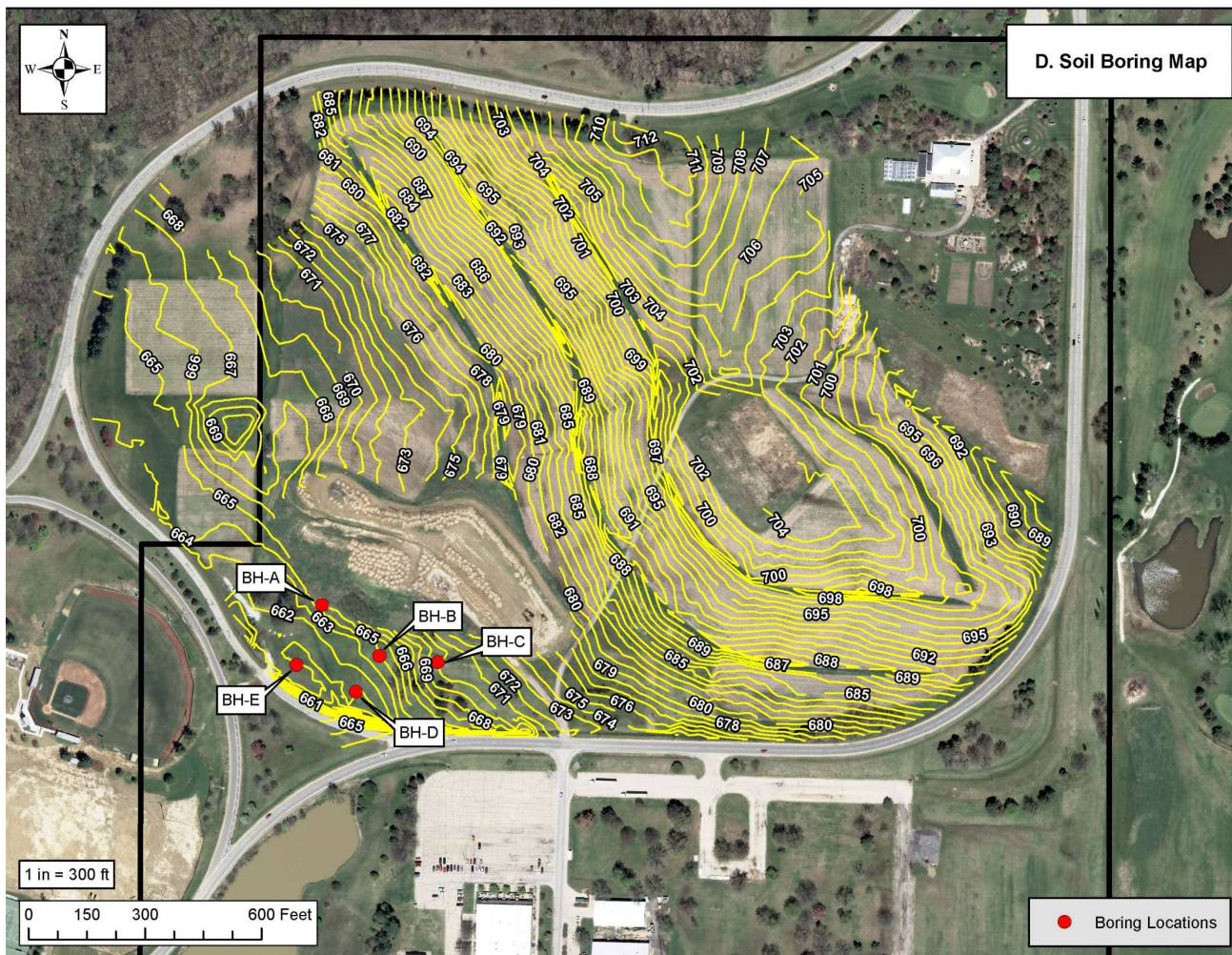
4. Review

SITE CONDITIONS:

A. Soils

B. Elevations

C. Existing Conditions



PLANNING

1. Location

2. Site Conditions

3. Drainage Area

4. Review

SITE CONDITIONS:

A. Soils


B. Elevations

C. Existing Conditions

SOURCES

- Web Soil Survey
- On-site investigation

EXHIBIT D

		Natural Resource Conservation Service, Illinois		Weather: Sunny, warm, ~70°F		Date: 05/10/2017, 2:40pm				
Landowner: Illinois Central College, District 514						Hole No.: BH-A				
County: Tazewell County, Illinois				Site No.:		Sheet: 1 of 1				
Legal Location: T26N, R4W, Sec 13				Coord. System:						
Location of Structure: Ag area N side of Dingleline Rd				Lat.: 40.707145N		Long.: -89.515006W				
Exploration Equipment: Giddings Model # 25-SHDGSRPS				Exploration Method: 2.5" ID x 4' SP						
Personnel: J. Kostel, PE				Surface Elevation (ft): ~664.0' (est. from topo map)						
Logged by: D. Lamb, PG				Water Level:						
				Total Depth: 8.0'						
Run No.	Depth (ft)	Recovery (ft)	Elevation (ft)	Sample type/No.	Lithology graphic	Description	Borehole detail	USCS	CPT -Blows/6"	Notes
1	1		660.0			Yellow-brown, Clayey SILT, slightly moist, firm, with grass, fine roots	backfill	CL/ML		10YR5/4
	2				thin sand seam ~2" thick					
	3									
	4	3.9'								
2	5		656.0			Dark yellow-brown, CLAY, moist, stiff, with trace gravel		CH		10YR4/6
	6					Becomes very moist, soft, Clayey SILT		CL		10YR4/6
	7					Dark Yellow-brown, Sandy, clayey GRAVEL wet, moderately soft		GC		10YR4/6
	8	4.0'				Yellow-brown, fine SAND, wet, moderately soft		SP		10YR5/6
	9					EOB = 8.0'				End of Boring (EOB)
	10									
Sample Type (s)						Exploration Method				
SB - soil boring						SPT - split spoon		non-distinct boundary		
SM - small						FA - Flight auger		distinct boundary		
ST - Shelby tube						BH - Backhoe		water table (WT)		
LG - large						HSA - Hollow stem auger				
						SP - Soil probe				



ILLINOIS
SUSTAINABLE
AG PARTNERSHIP

PLANNING

1. Location

2. Site Conditions

3. Drainage Area

4. Review

SITE CONDITIONS:

A. Soils






B. Elevations

C. Existing Conditions

SOURCES

- Web Soil Survey
- On-site investigation

EXHIBIT D

		Natural Resource Conservation Service, Illinois		Weather: Sunny, warm, ~70°F		Date: 05/10/2017, 2:05pm				
Landowner: Illinois Central College, District 514						Hole No.: BH-B				
County: Tazewell County, Illinois				Site No.:		Sheet: 1 of 1				
Legal Location: T26N, R4W, Sec 13				Coord. System:						
Location of Structure: Ag area N side of Dingleline Rd				Lat.: 40.706797N		Long.: -89.514458W				
Exploration Equipment: Giddings Model # 25-SHDGSRPS				Exploration Method: 2.5" ID x 4' SP						
Personnel: J. Kostel, PE				Surface Elevation (ft): ~662.5' (est. from topo map)						
Logged by: D. Lamb, PG				Water Level:						
				Total Depth: 8.0'						
Run No.	Depth (ft)	Recovery (ft)	Elevation (ft)	Sample type/No.	Lithology graphic	Description	Borehole detail	USCS	CPT -Blows/6"	Notes
1	1		658.5			Dark yellow-brown, Clayey SILT, slightly moist, firm, with grass, fine roots	backfill	CL/ML		10YR4/4
	2					Dark yellow-brown, Clayey SILT, with yellow-brown (10YR5/4), moist, firm, trace dark mottles		CH		10YR4/6
	3									
	4	3.9'				Becomes gray-brown, Silty CLAY, mottled, moist, moderately firm, trace black		CH		10YR5/2
2	5		654.5			Dark yellow-brown, Clayey SAND to Sandy CLAY, wet, moderately soft		SM/SC		10YR4/6
	6					Dark yellow-brown, Sandy, clayey GRAVEL, wet, moderately soft		GC		
	7									
	8	4.0'				EOB = 8.0'				End of Boring (EOB)
	9									
	10									
Sample Type (s)						Exploration Method				
SB - soil boring						SPT - split spoon		non-distinct boundary		
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ST - Shelby tube						HSA - Hollow stem auger		water table (WT)		
LG - large						SP - Soil probe				



ILLINOIS
SUSTAINABLE
AG PARTNERSHIP

PLANNING

1. Location

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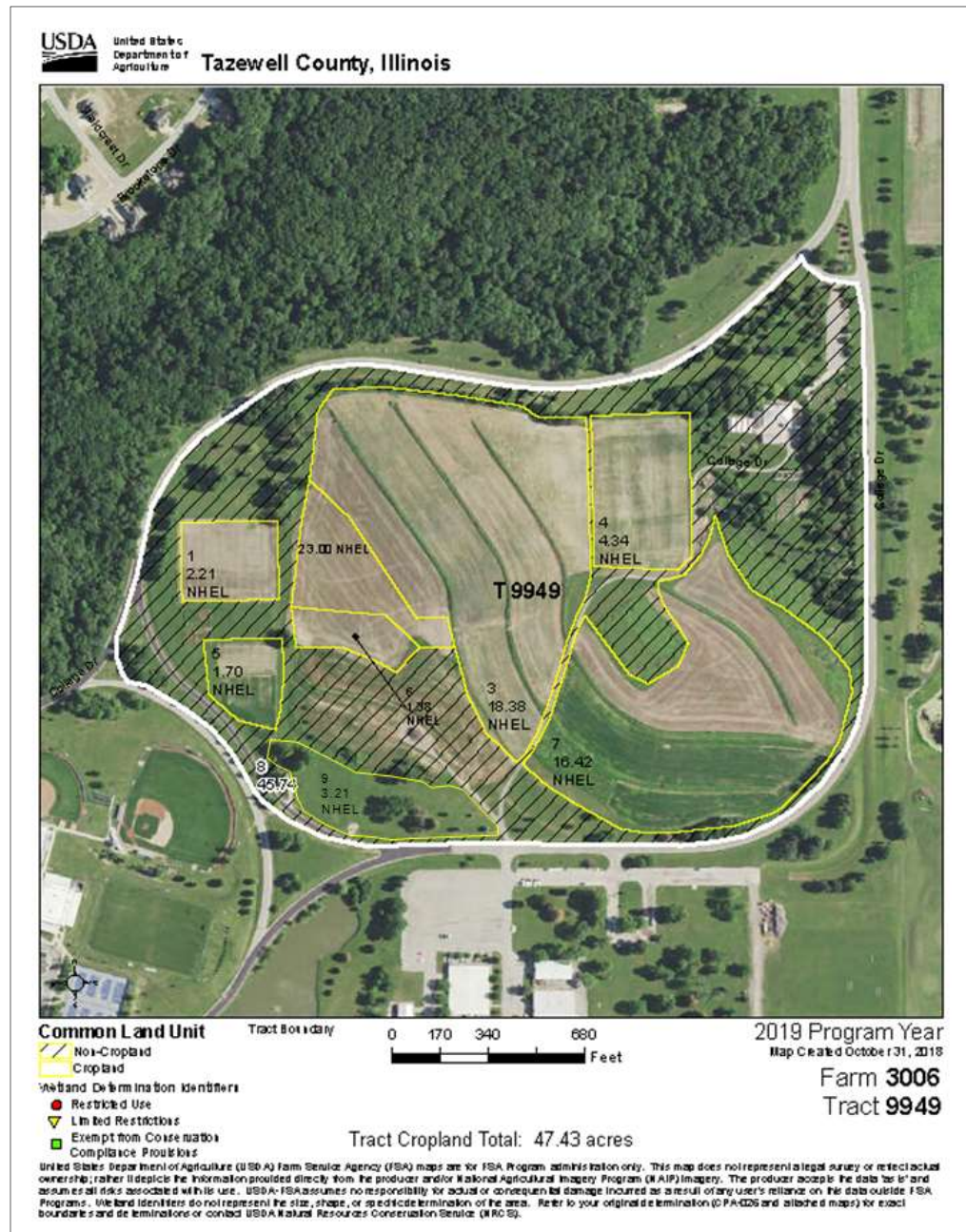
4. Review

SITE CONDITIONS:

- A. Soils
- B. Elevations
- C. Existing Conditions

SOURCES

- Farm map
 - On-site visit
-
- Cropland or not cropland
 - Type of crops
 - Existing Conservation Programs



PLANNING

1. Location

2. Site Conditions

3. Drainage Area

4. Review

SITE CONDITIONS:

A. Soils

B. Elevations

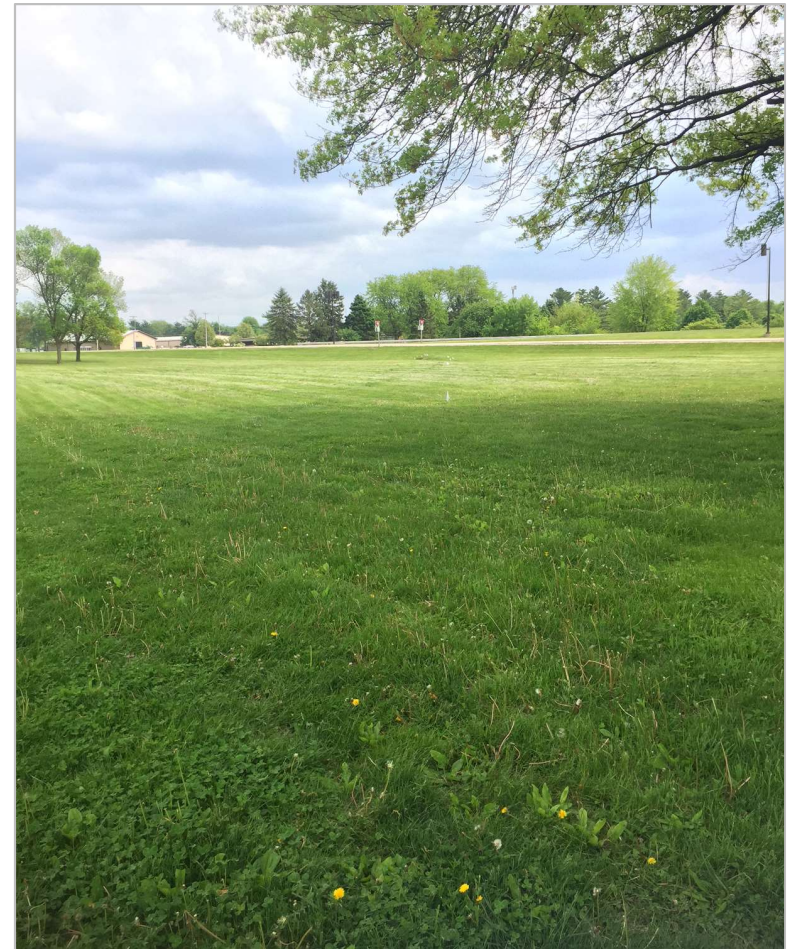
C. Existing Conditions

Top of tile is 30" below surface except at outlet swale
Tile is DW HDPE (12" ID, 14.5" OD)

Ground cover is "cover crop"
Swale to culvert for surface runoff

SOURCES

- Farm map
- On-site visit



PLANNING

1. Location

2. Site Conditions

3. Drainage Area

4. Review

SITE CONDITIONS:

- A. Soils
- B. Elevations
- C. Existing Conditions

SOURCES

- Topo Survey

EXHIBIT E



Concrete culvert invert = 657.3 ft Elev.



PLANNING

1. Location

2. Site Conditions

3. Drainage Area

4. Review

Any concerns at this point in the planning process?



PLANNING

1. Location

2. Site Conditions

3. Drainage Area

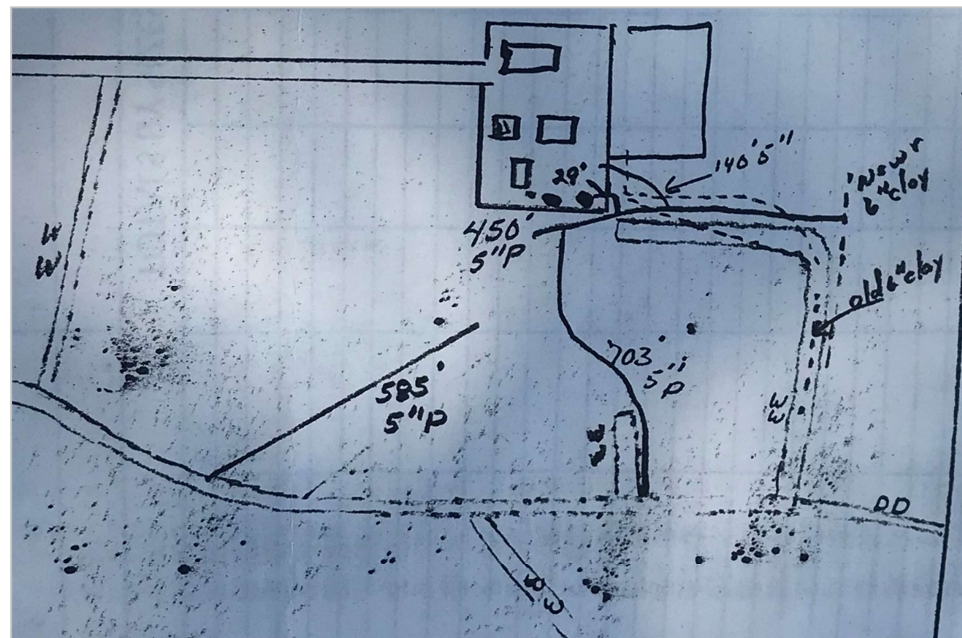
4. Review

DRAINAGE AREA

- A. Locating Tile
- B. Estimating Tile Drainage Area
- C. Determining Surface Drainage Area

SOURCES

- Tile Map
- Imagery
- Probing



PLANNING

1. Location

2. Site Conditions

3. Drainage Area

4. Review

DRAINAGE AREA

- A. Locating Tile
- B. Estimating Tile Drainage Area
- C. Determining Surface Drainage Area

SOURCES

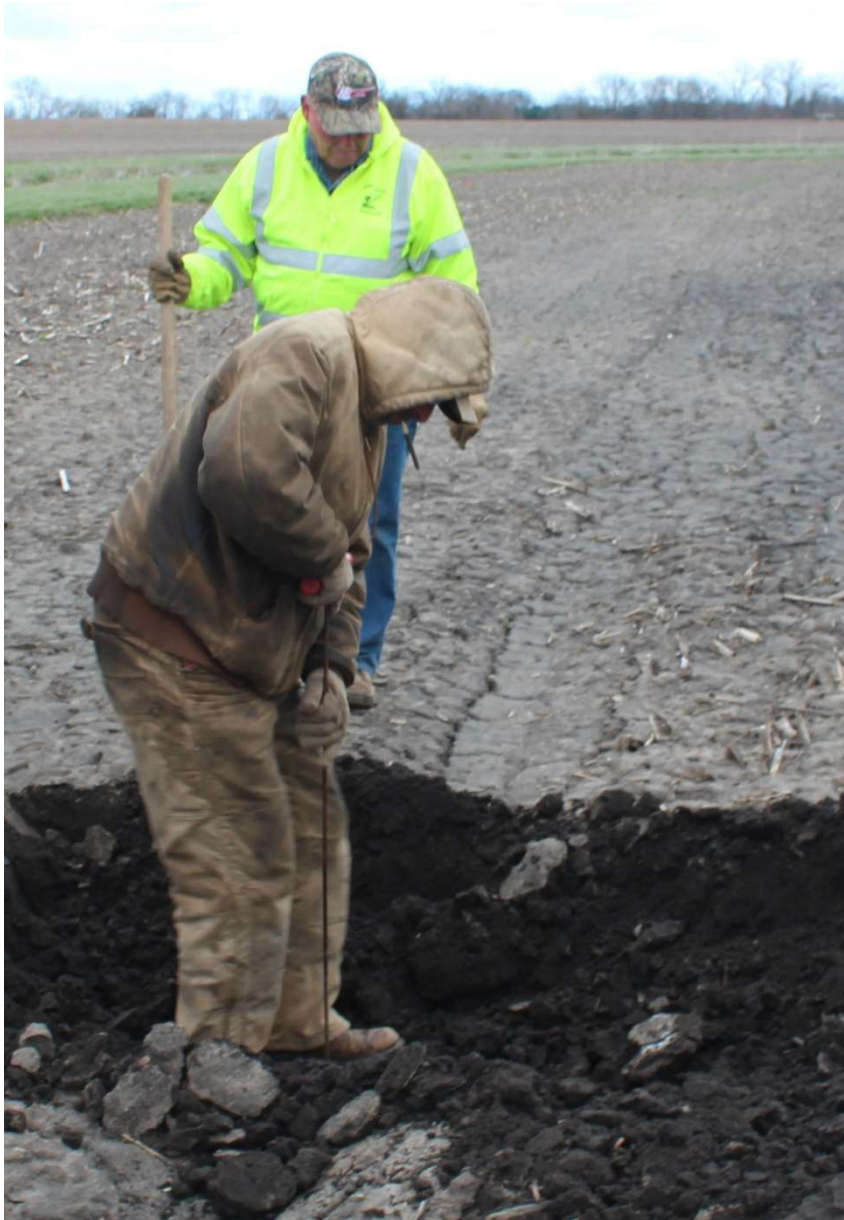
- Tile Map
- Imagery
- Probing





USGS 1998, 2005

TILE PROBE





TRANSMITTER



PLANNING

1. Location

2. Site Conditions

3. Drainage Area

4. Review

DRAINAGE AREA

- Locating Tile
- Estimating Tile Drainage Area
- Determining Surface Drainage Area

SOURCES

- Tile/Drainage Tables

EXHIBIT F

Tile main:

Material: Dual Wall HDPE

Diameter: 12"

Grade: 0.0118 ft/ft

Drainage Coefficient: 3/8"

Option 1 – Existing Drainage System Capacity

$$Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$$

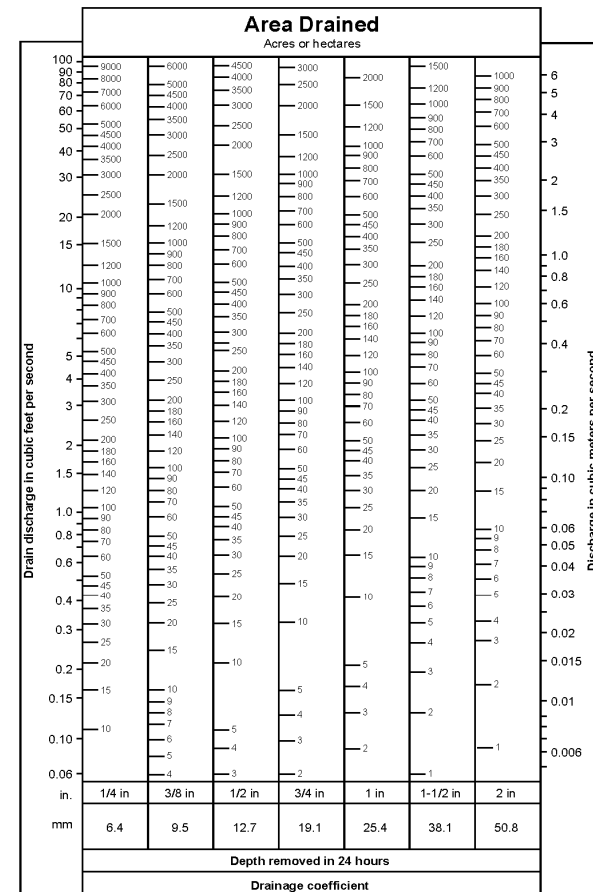
$$Q = 4.2 \text{ cfs}$$

Chapter 14

Water Management (Drainage)

Part 650
Engineering Field Handbook

Figure 14-33 Subsurface drain discharge



Note: Use acres with ft³/s and hectares with m³/s
(Source: ASAE Standard EP200.4)

(210-VI-NEH, April 2001)



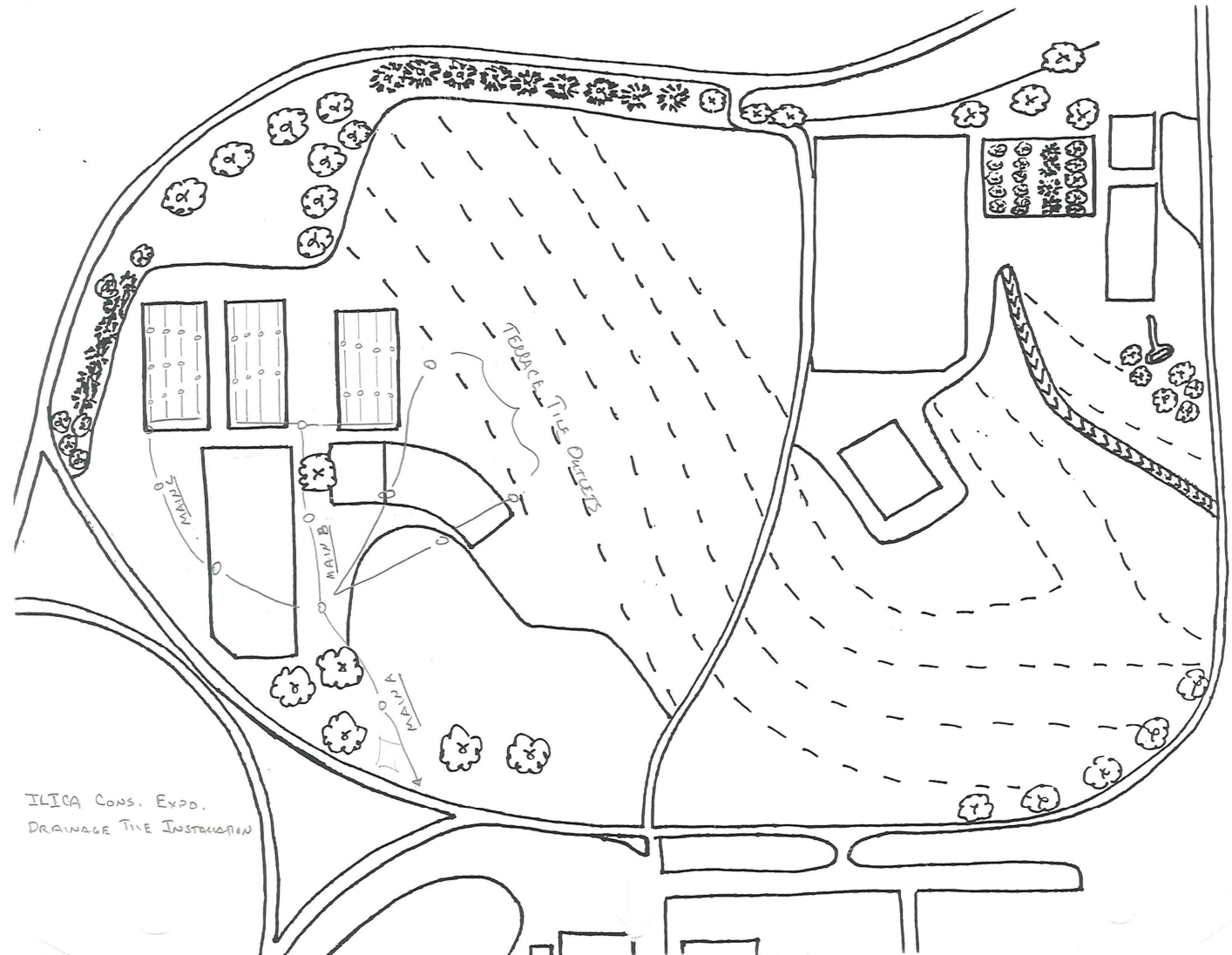
DRAINAGE AREA

- A. Locating Tile
- B. Estimating Tile Drainage Area
- C. Determining Surface Drainage Area

SOURCES

- Tile Map
- Imagery
- Probing

Option 2 – Existing Drainage System Capacity



ICC Tile Design Map (2001)

PLANNING

1. Location

2. Site Conditions

3. Drainage Area

4. Review

DRAINAGE AREA

- A. Locating Tile
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SOURCES

- Tile Map
- Imagery
- Probing



ICC Tile Map (2017)

Tile - Name

■ 4" (3,164.64 ft)



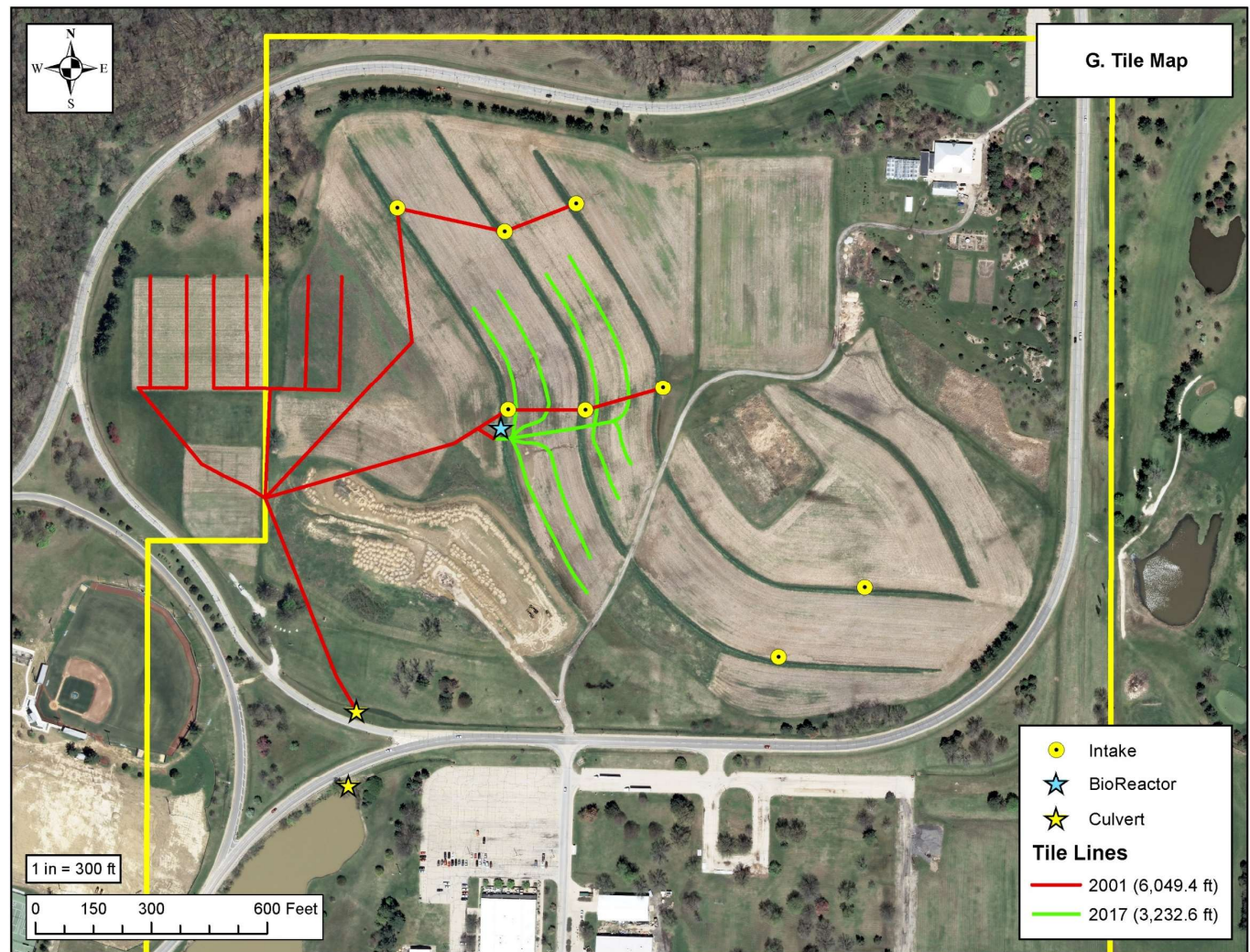
DRAINAGE AREA

- A. Locating Tile
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EXHIBIT G

- ▶ Delineate drained acres by drawing a line around the tile system, $\frac{1}{2}S$ on each side of the tile.
- ▶ Illinois Drainage Guide, $S = 80-100'$
- ▶ Length of tile = 9,282'

Option 2 – Existing Drainage System Capacity



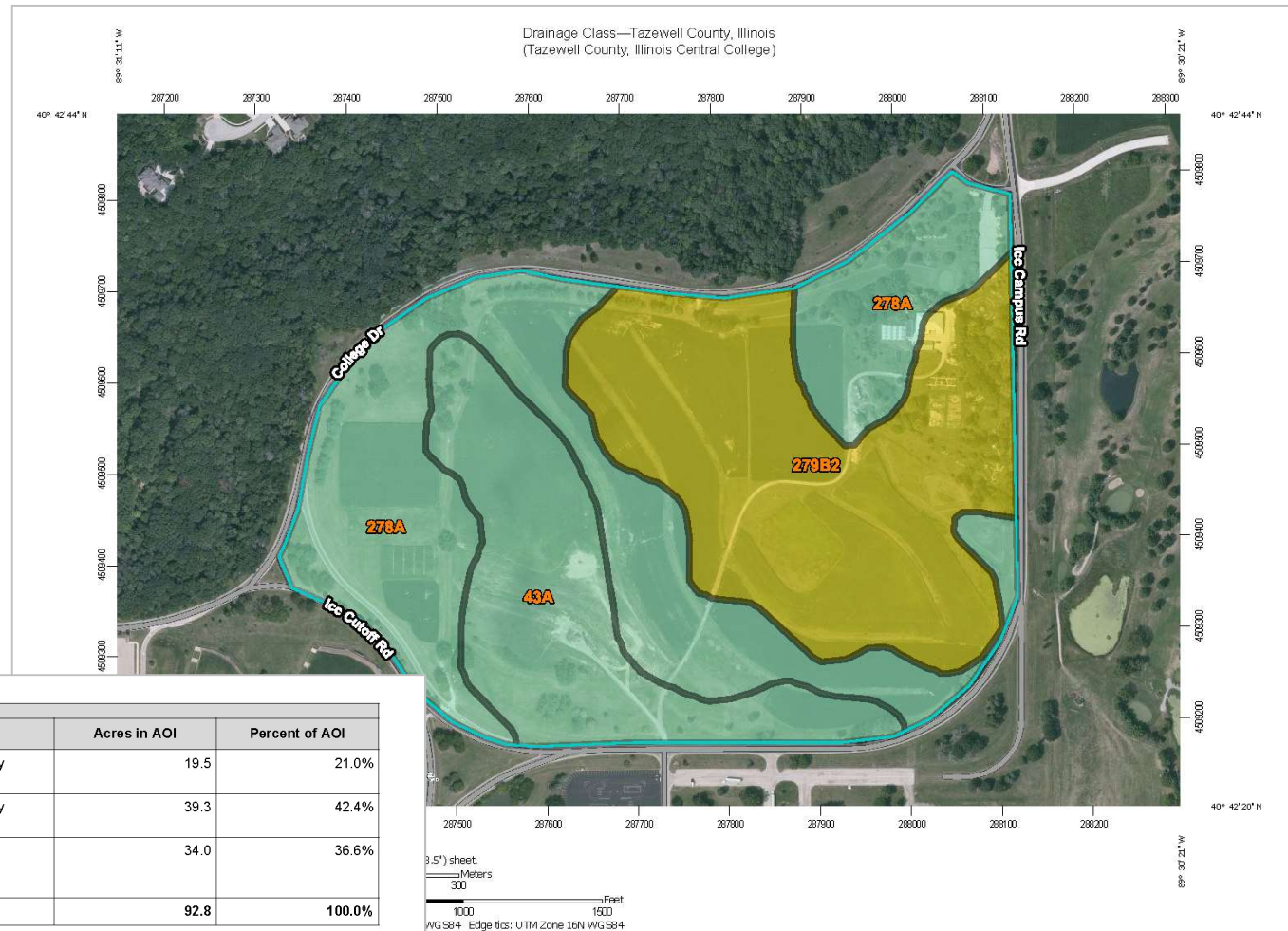
DRAINAGE AREA

- A. Locating Tile
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- C. Determining Surface Drainage Area

SOURCES

- Soil map

Option 2 – Existing Drainage System Capacity if No tile map



PLANNING

1. Location

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4. Review

DRAINAGE AREA

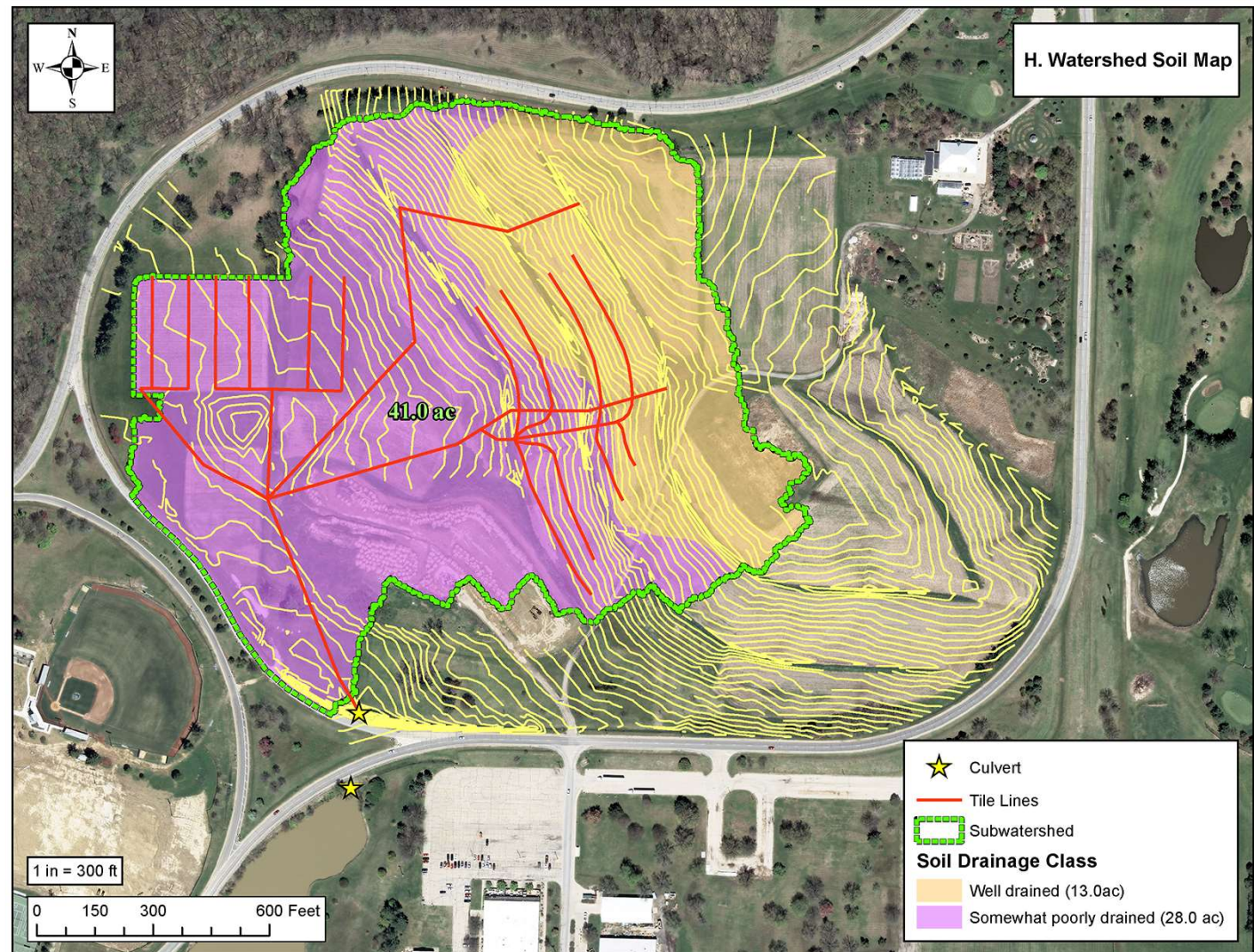
- A. Locating Tile
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- C. Determining Surface Drainage Area

SOURCES

- Soil map with topo

EXHIBIT H

Option 2 – Existing Drainage System Capacity if No tile map



What is the contributing drainage area to your constructed wetland?

**Acres drained
by tile system**

+

**Acres
contributing
surface flow to
wetland**

- ▶ Does it have tile drainage?
- ▶ Is the land currently under a conservation program?
- ▶ Preferences of the client
 - ▶ Available location(s) on property
 - ▶ Size limitations
 - ▶ Vegetation preferences
- ▶ Will the site be used for monitoring/research?
- ▶ Site conditions
 - ▶ Vegetation on site (photos?)
 - ▶ Will the soil hold a water table?
 - ▶ Crops/ proximity
 - ▶ Receiving channel/ area (does it flood regularly?)
 - ▶ Elevations (baseflow, crop, proposed wetland site, etc.)
 - ▶ Bank stability (if applicable)

DESIGN

1. Size

2. Water Depth

3. Shape

4. Calculations

In small groups, you are going to design your constructed wetland.



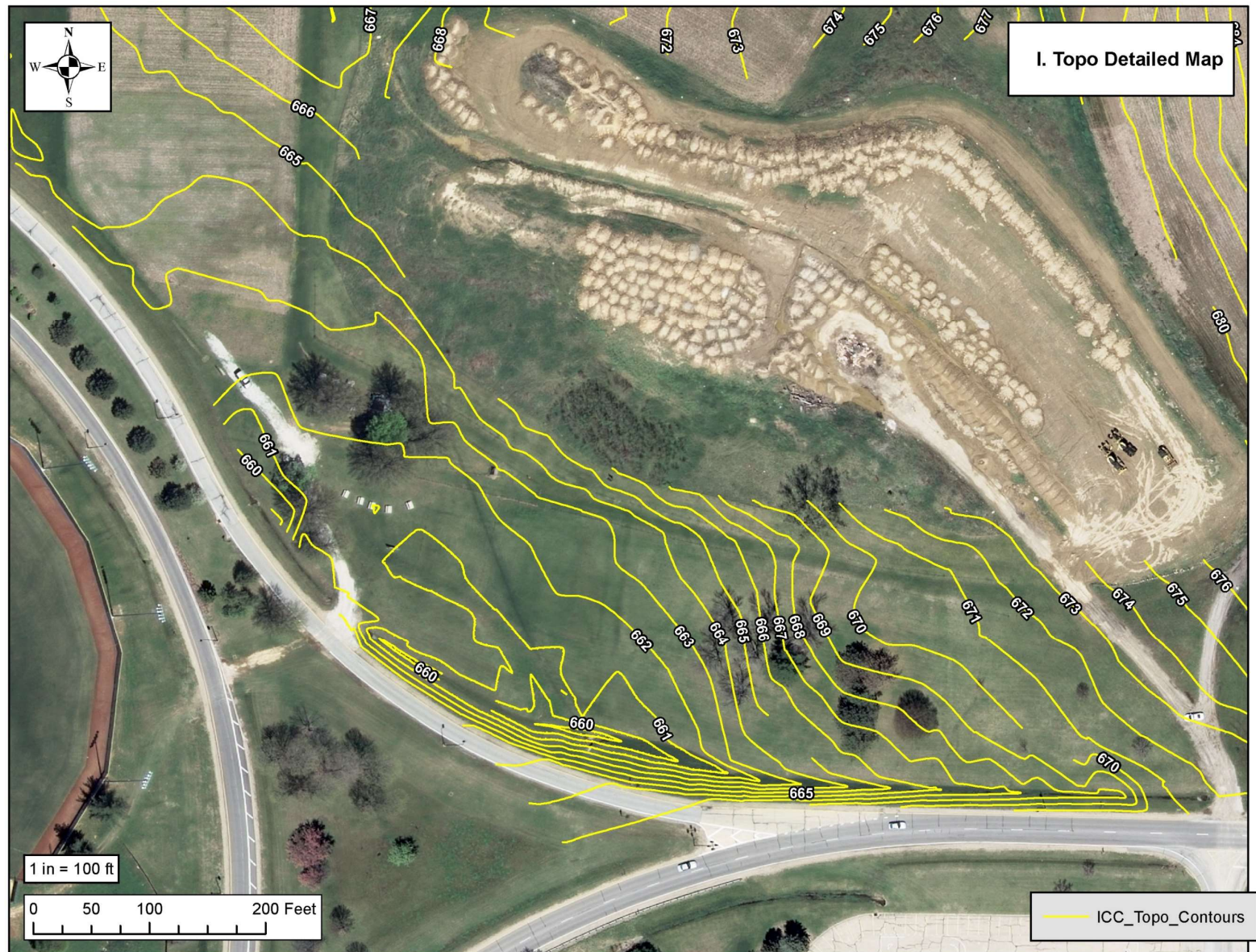
DESIGN

1. Size

2. Water Depth

3. Shape

4. Calculations



SIZE

Guidance Criteria? ▶ Treatment area at least 1% of contributing watershed

Research Recommendations? ▶ Treatment area at 2.5-5% of contributing watershed

- ▶ Determine your wetland's treatment area based on your estimated drainage area (acres and square ft)

DEPTH

- Guidance Criteria? ▶ Permanent pool must be at or below tile flow line
- ▶ At least 50% of treatment area should be 12" deep or less
 - ▶ Count all areas between 24" below to 12" above permanent pool
 - ▶ Account for accretion/sediment input

Are there any design constraints for the wetland depth?

DEPTH

- Guidance Criteria? ▶ Permanent pool must be at or below tile flow line
- ▶ At least 50% of treatment area should be 12" deep or less
 - ▶ Count all areas between 24" below to 12" above permanent pool
 - ▶ Account for accretion/sediment input
- ▶ Determine where you want to intercept the tile (daylight)
 - ▶ Determine what the tile flow line elevation
 - ▶ Determine your wetland's treatment bottom depth, normal pool elevation (outlet), and max elevation.
 - ▶ Sketch a cross-section to show elevations

SHAPE

- Guidance Criteria?
- ▶ Outlet hydraulically distant from inlet to maximize hydraulic retention time
 - ▶ Consider spreaders or interior berms to minimize short circuiting

Research Recommendations? ▶ Longer than wider

- ▶ Sketch out your proposed layout (show location, shape, inlet, outlet)
- ▶ Estimate your area, volume, and flow path length

HYDRAULIC RESIDENCE TIME CALCULATION

- ▶ Try to maximize HRT

$$HRT(hours) = \frac{Volume (ft^3)}{Flow Rate (ft^3 \text{ per second})} \times \frac{1}{3600}$$

- ▶ Calculate your hydraulic residence time (100% flow & 10% flow capacity)



VELOCITY CALCULATION

- ▶ Maximum 1.5 ft/sec
 - ▶ During the 10-year, 24-hr storm event (if surface flow)
 - ▶ When the tile flows full
- ▶ Cross-sectional area at the limiting location along the path from inlet to outlet

$$\text{Velocity (ft/sec)} = \frac{\text{Inflow (ft}^3\text{/sec)}}{\text{Limiting cross section (ft}^2\text{)}}$$

- ▶ Calculate your velocity (100% flow capacity)

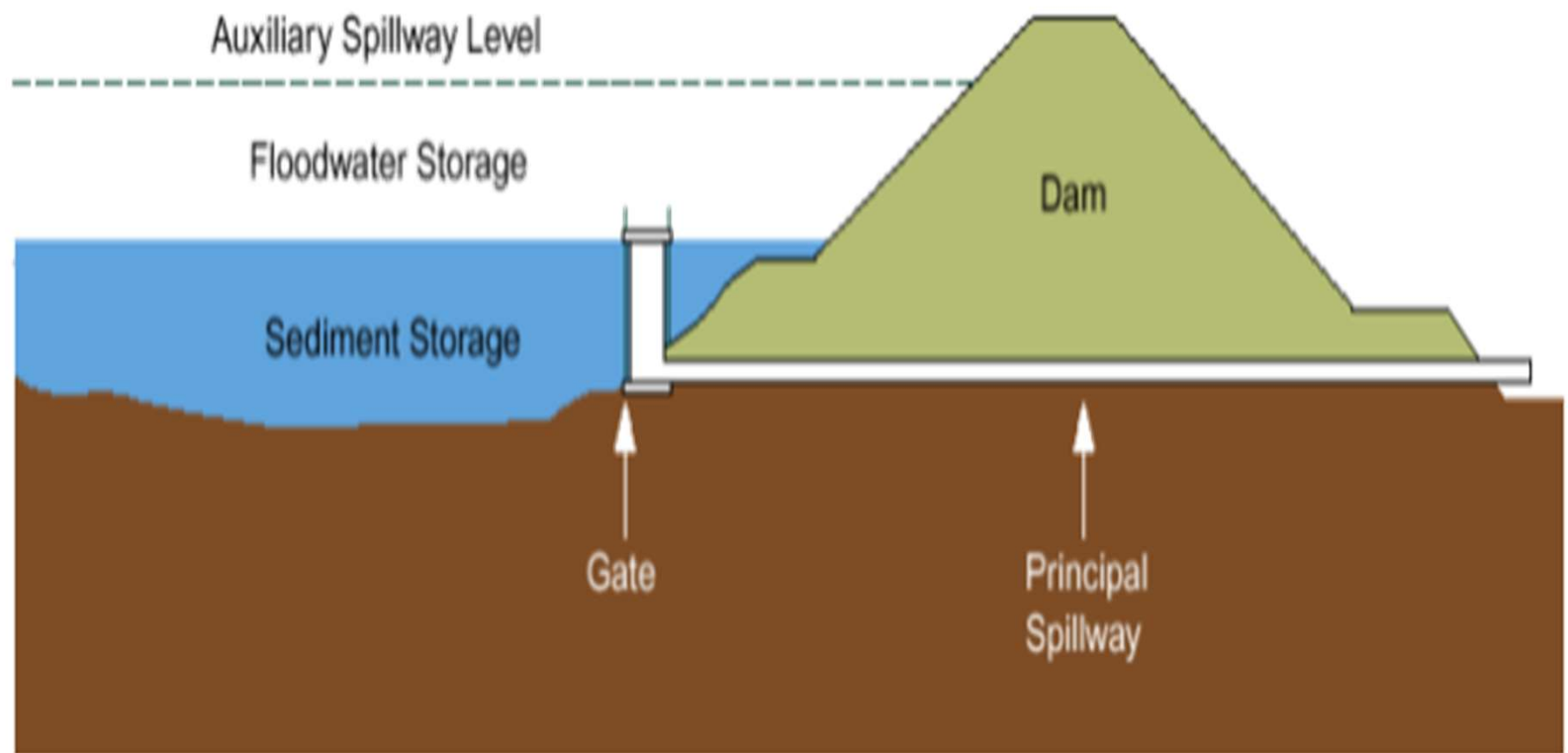
FLOOD ROUTING

- ▶ Big enough to handle peak flow and volume from 25-year, 24-hour storm without overtopping
- ▶ Auxiliary should not flow until site receives more than 25-yr flow (10-yr if drainage area is ≤ 20 acres)



FLOOD ROUTING

Stage in a Pond (or a Constructed Wetland)



FLOOD ROUTING

