



CE 3372 WATER SYSTEMS DESIGN

LESSON 23: DETENTION/RETENTION BASIN HYDRAULICS

PURPOSES

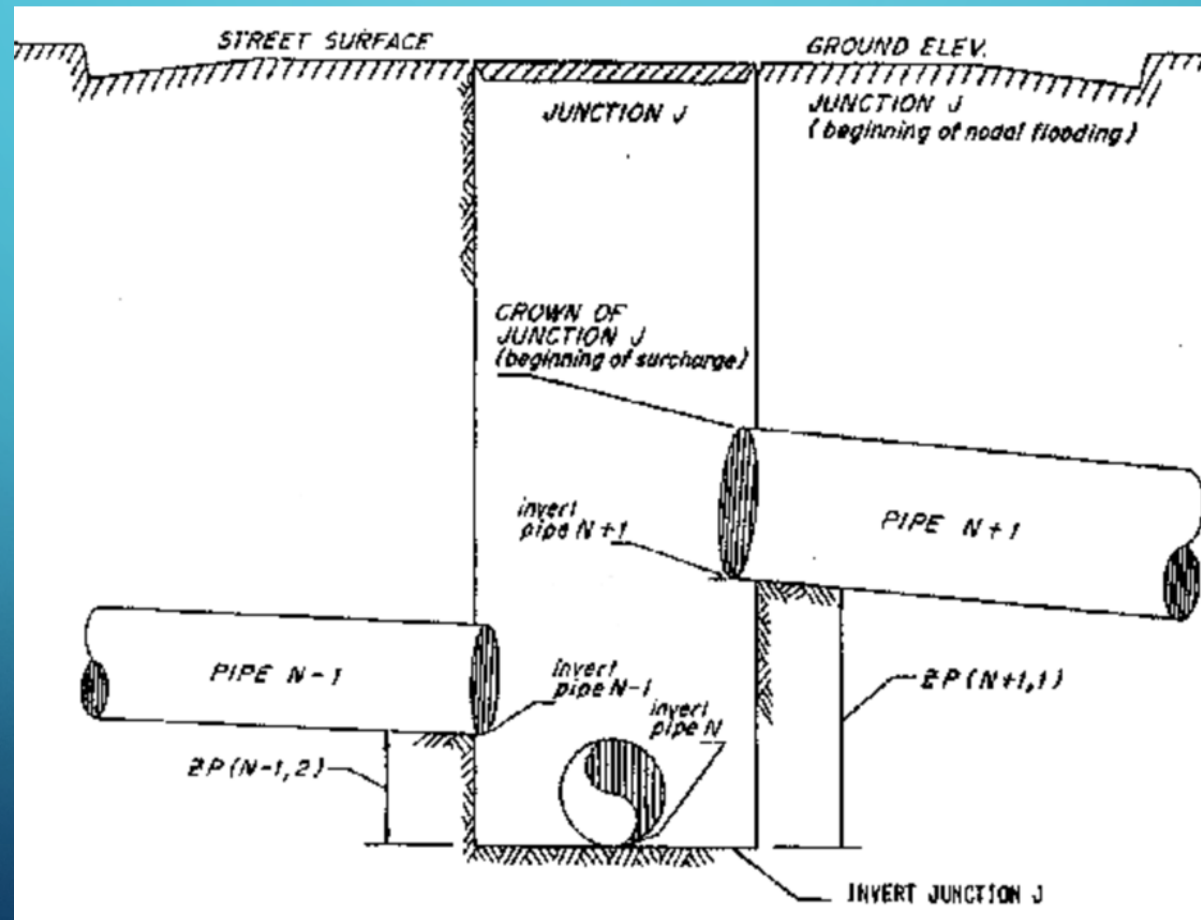
- Detention Basin
 - Mitigate peak discharge(s)
 - Provide water quality benefit

JUNCTION (NODE)

- Ordinary junction connects hydraulic elements (links)
- Junction attributes are:
 - Invert elevation (elevation of the bottom of the node)
 - Max elevation (elevation of top of node)
 - Set to land surface to plot profile grade line in SWMM
 - Set to land surface + added depth for dual (surface+subsurface drainage)
- When program runs, depth at the node is computed, but there is no storage (node has zero area)

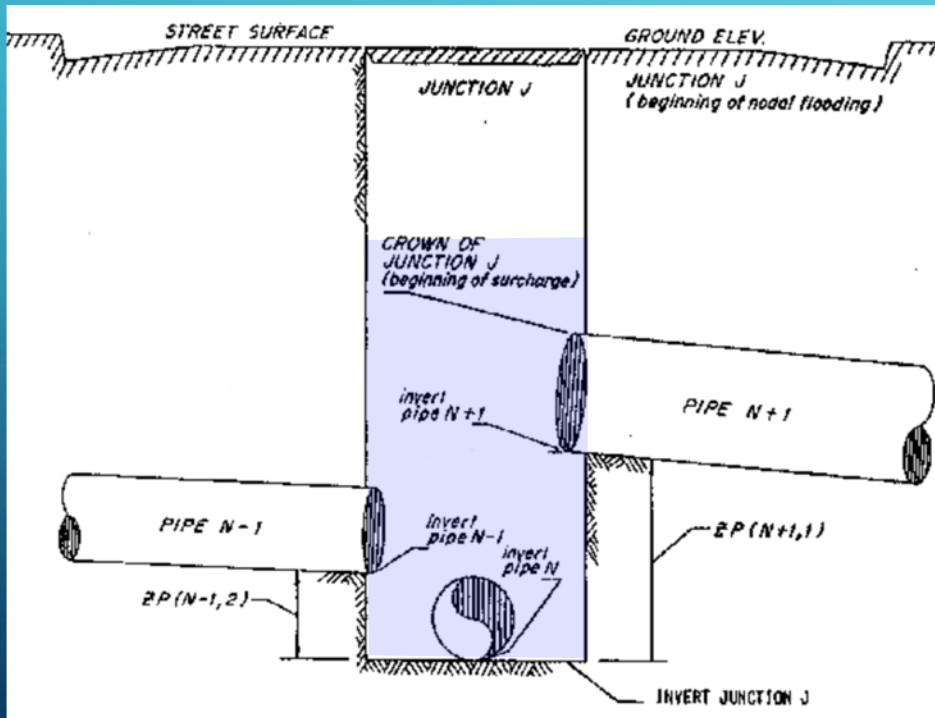
JUNCTION (NODE)

- Ordinary junction just connects pipes N-1, N, and N+1

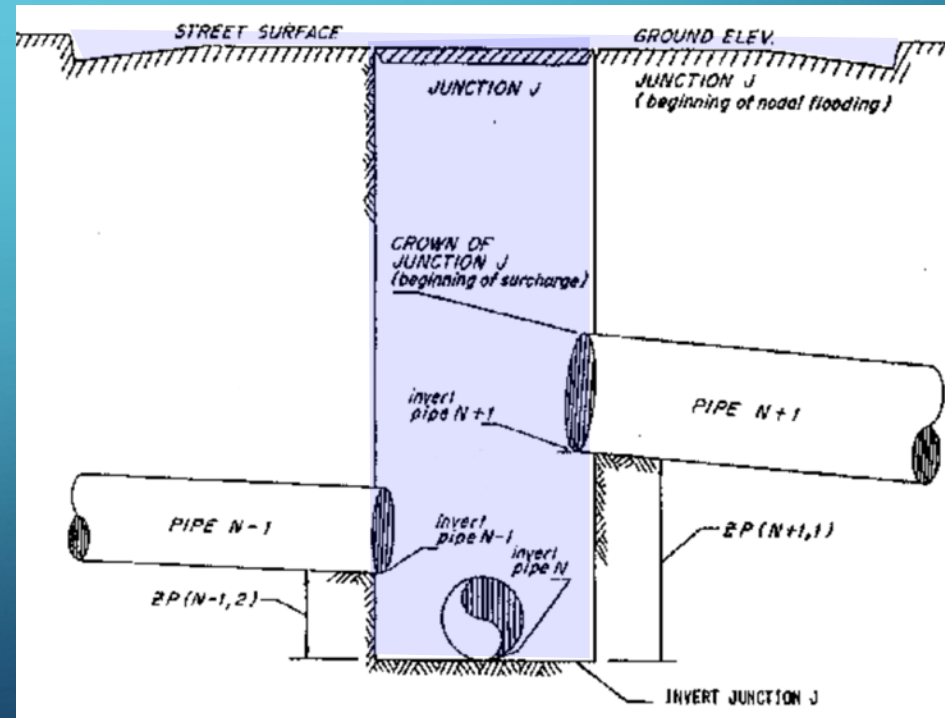


JUNCTION (NODE)

- If flooding occurs, it is only considered when HGL is above node Max. Depth

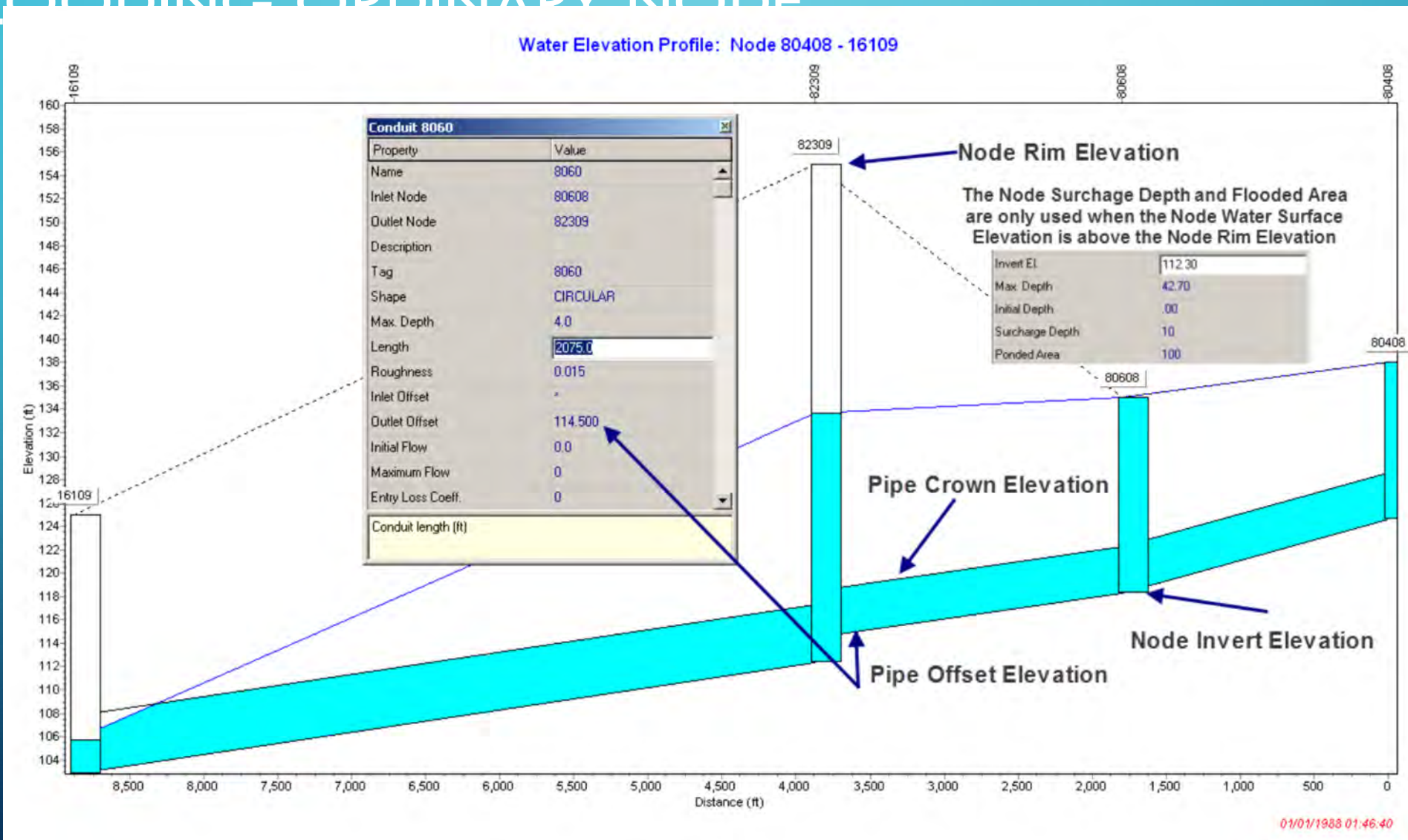


Node not flooded; pipes are surcharged



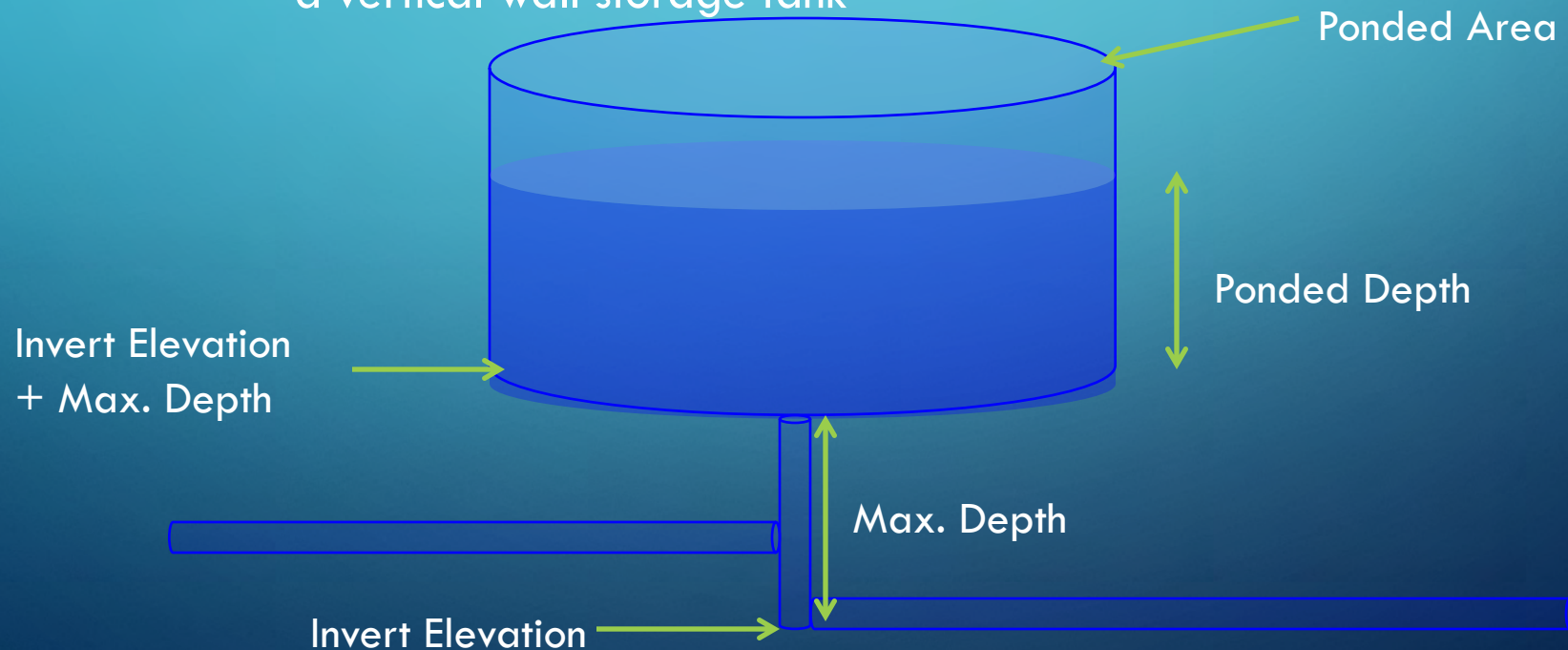
Node flooded; pipes are surcharged

FLOODING ORDINARY NODE



JUNCTION (NODE)

- Flooded node attributes:
 - How deep is the flooding allowed (surcharge depth) above the top of the node
 - What is the ponded area during surcharge – treats the node as a vertical wall storage tank



STORAGE UNIT (NODE)

- A storage node explicitly considers storage in the node – including (if data are correctly supplied) the sub-grade portion of the node
- Storage Node Attributes
 - Same as an ordinary node +
 - Depth-Area relationship
 - Tabular
 - Functional

STORAGE UNIT (NODE)

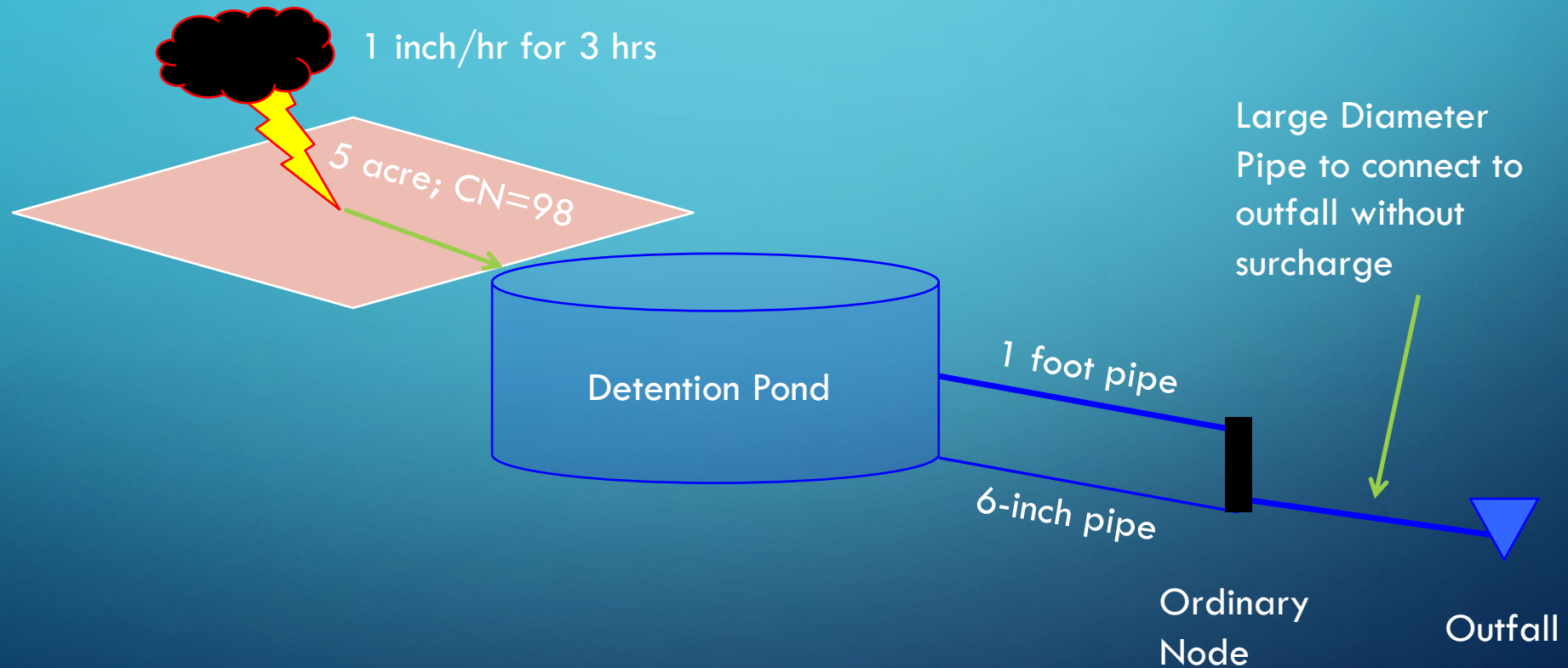
- Useful for:
 - Detention ponds
 - Modeling multiple level inlet/outlet hydraulics
 - Riser inlet
 - Outlet that has portion through a pipe, a portion over a weir (or another pipe at different elevation)

EXAMPLE

- Consider a detention pond that drains a 5-acre parking lot, then discharges to a nearby receiving stream
- Use SWMM to approximate the hydraulics
 - Sub-catchment, high CN (98) to represent the parking lot
 - 1-inch/hour storm for 3 hours
 - All flow passes through the detention pond before exiting to a stream through a 6-inch pipe at the inverts, and a 1-foot pipe at 2-feet above basin bottom

EXAMPLE

- Schematic of the system



SWMM MODEL RUN

The screenshot displays the SWMM 5.1 software interface with the following components:

- Project Map:** Shows the model structure with dropdown menus for Subcatchments, Nodes, Links, and Time Period (Date: 11/17/2015, Time of Day: 04:30:00, Elapsed Time: 0.04:30:00).
- Graph - Subcatchment 1 Runoff:** A hydrograph plot showing flow (CFS) vs. Elapsed Time (hours). The legend includes:
 - Subcatchment 1 Runoff (CFS) - Red line
 - Link LowerPipe Flow (CFS) - Pink line
 - Link UpperPipe Flow (CFS) - Blue line
 - Link OutfallPipe Flow (CFS) - Green line
- Study Area Map:** A map showing the spatial layout of the model with a red box highlighting the area shown in the hydrograph.
- Storage Curve Editor:** A dialog box for editing a storage curve named "DetentionPond". It contains a table with the following data:

	Depth (ft)	Area (ft2)
1	0	0
2	0.5	10890
3	1.5	15246
4	2.5	23958
5	3.5	30492
6	4.5	39204
7	5.5	52272
8	8.5	80586
9		
10		
11		
- Profile - Node 2 - 4:** Two side-by-side plots showing "Water Elevation Profile: Node 2 - 4". The y-axis is Elevation (ft) from 0 to 10, and the x-axis is Distance (ft) from 0 to 800. Both plots show a pipe profile with a manhole at approximately 400 ft distance.
- Functional Curve:** A dropdown menu is open, showing options: Coefficient, Exponent, Constant, Tabular Curve, and Curve Name.

EXERCISE ES 15

- Use SWMM to model a detention basin (Harris County Permit 8-262-4)

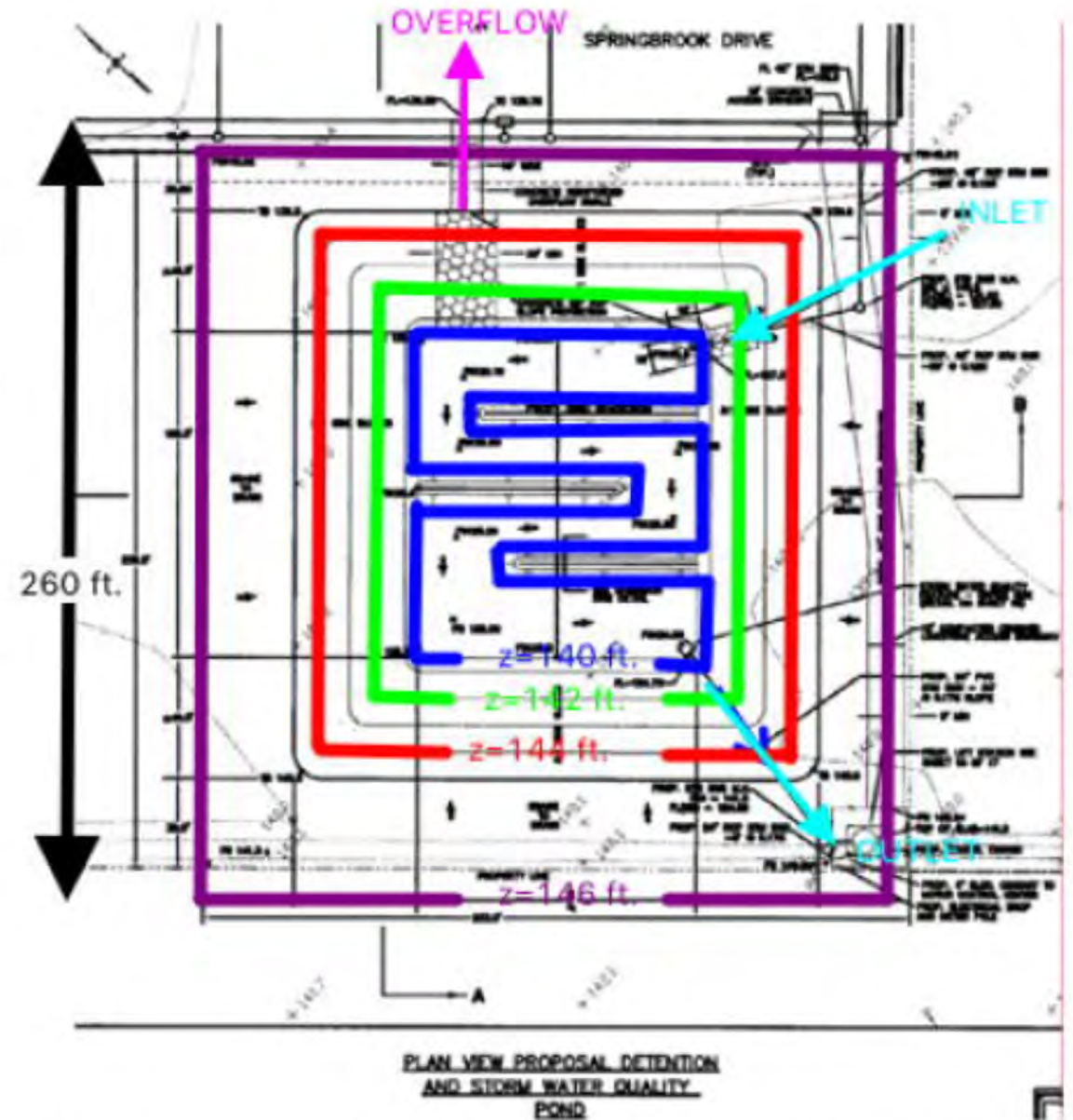


Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

EXERCISE ES 15

- Use SWMM to model a detention basin (Harris County Permit 8-262-4)

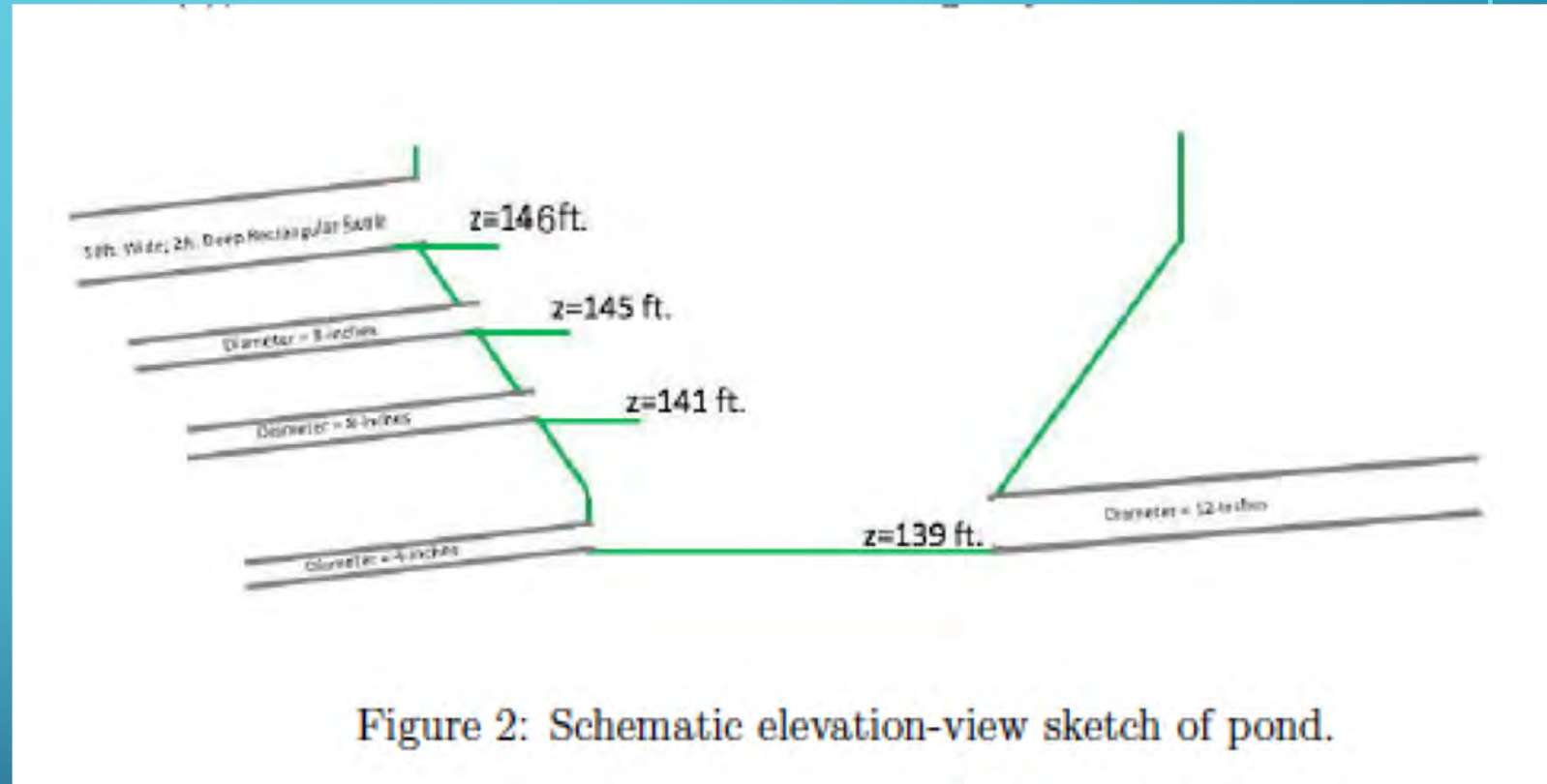


Figure 2: Schematic elevation-view sketch of pond.

DETENTION POND DRAWING

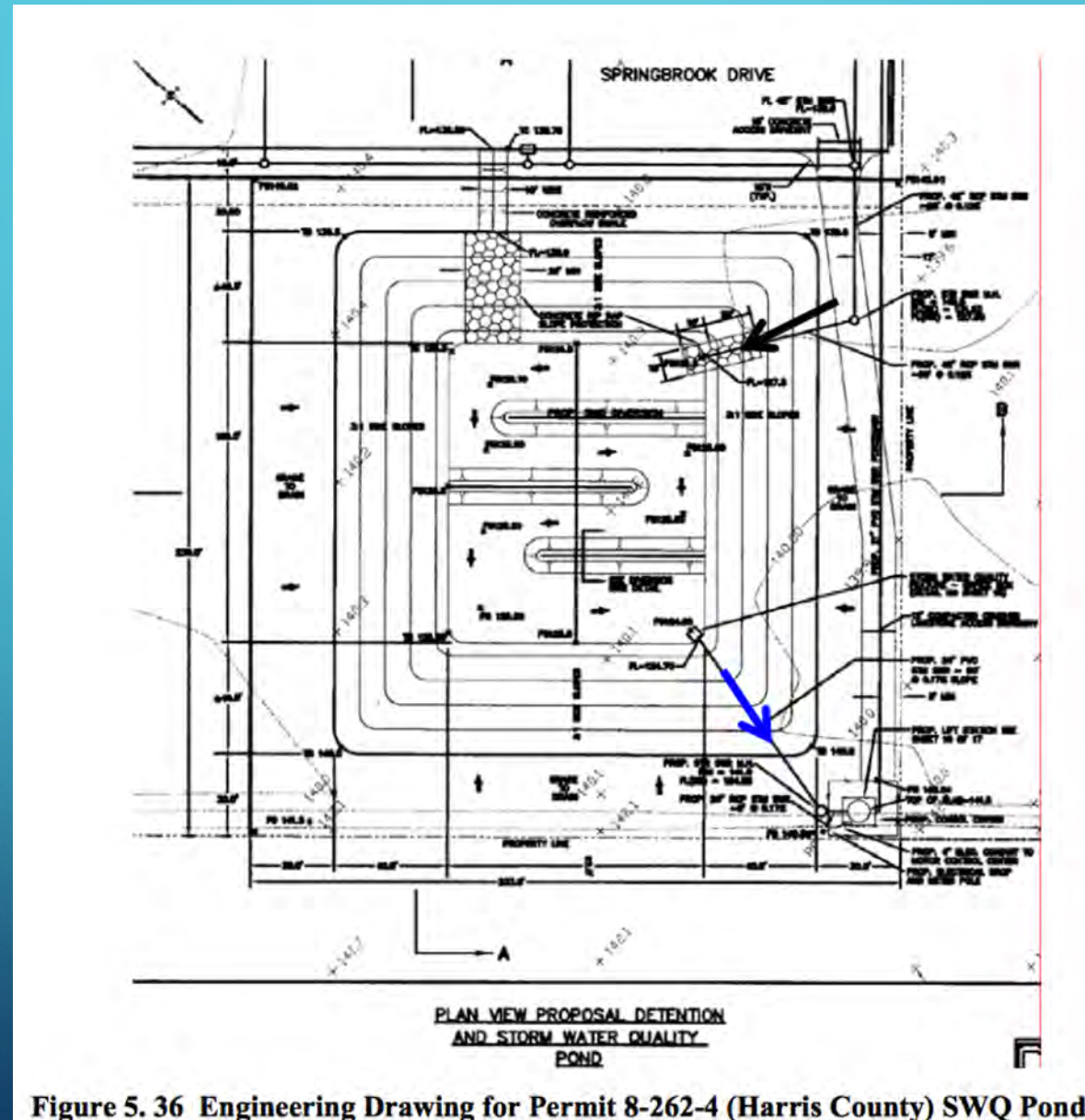
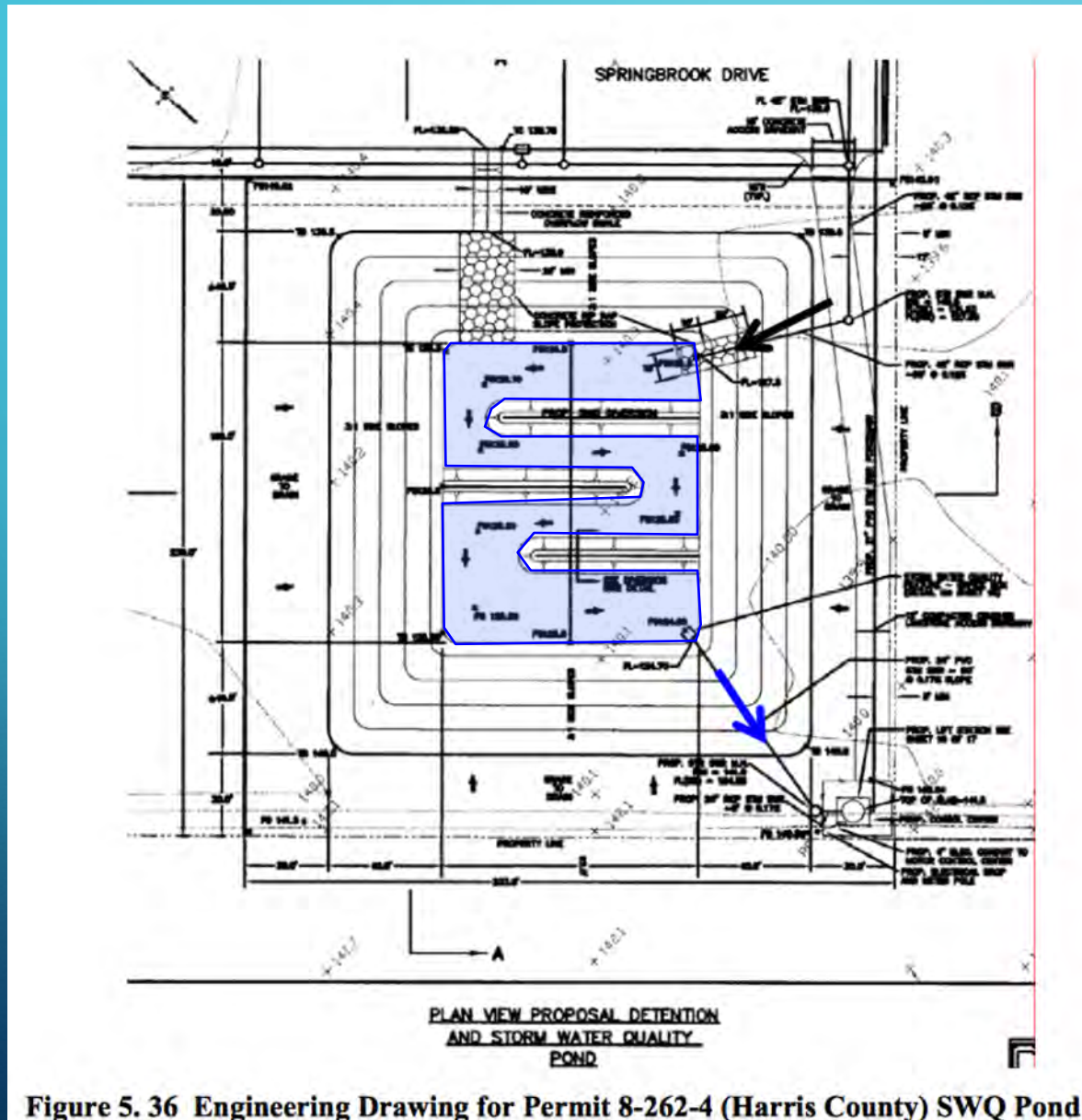


Figure 5.36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

DEPTH-AREA

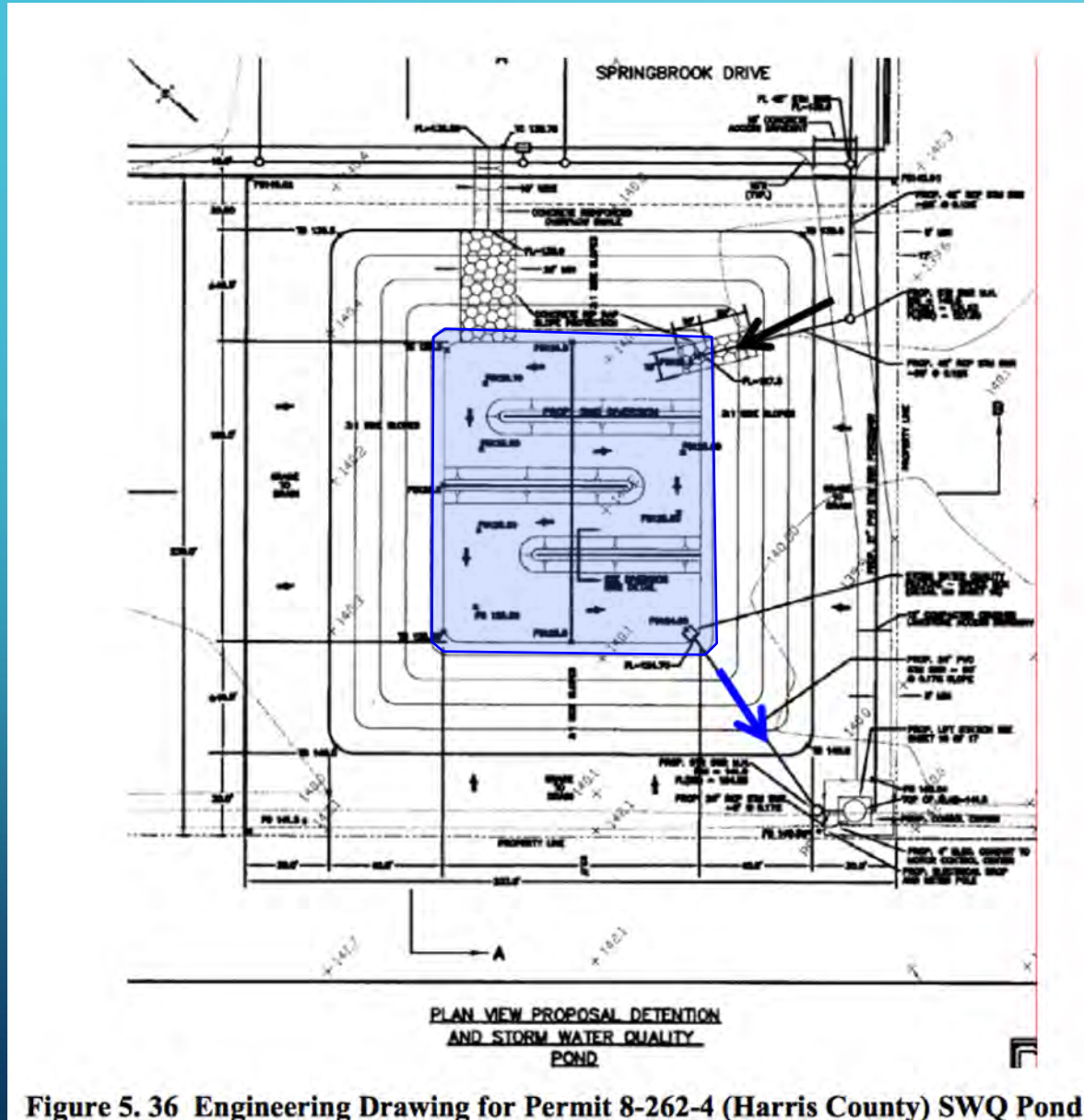
- Use the drawing to determine the depth-area of the pond
 - Pick an elevation (depth)
 - Find pool area for that elevation (depth)
 - Record the depth and the area (in acres usually)

DEPTH-ELEVATION



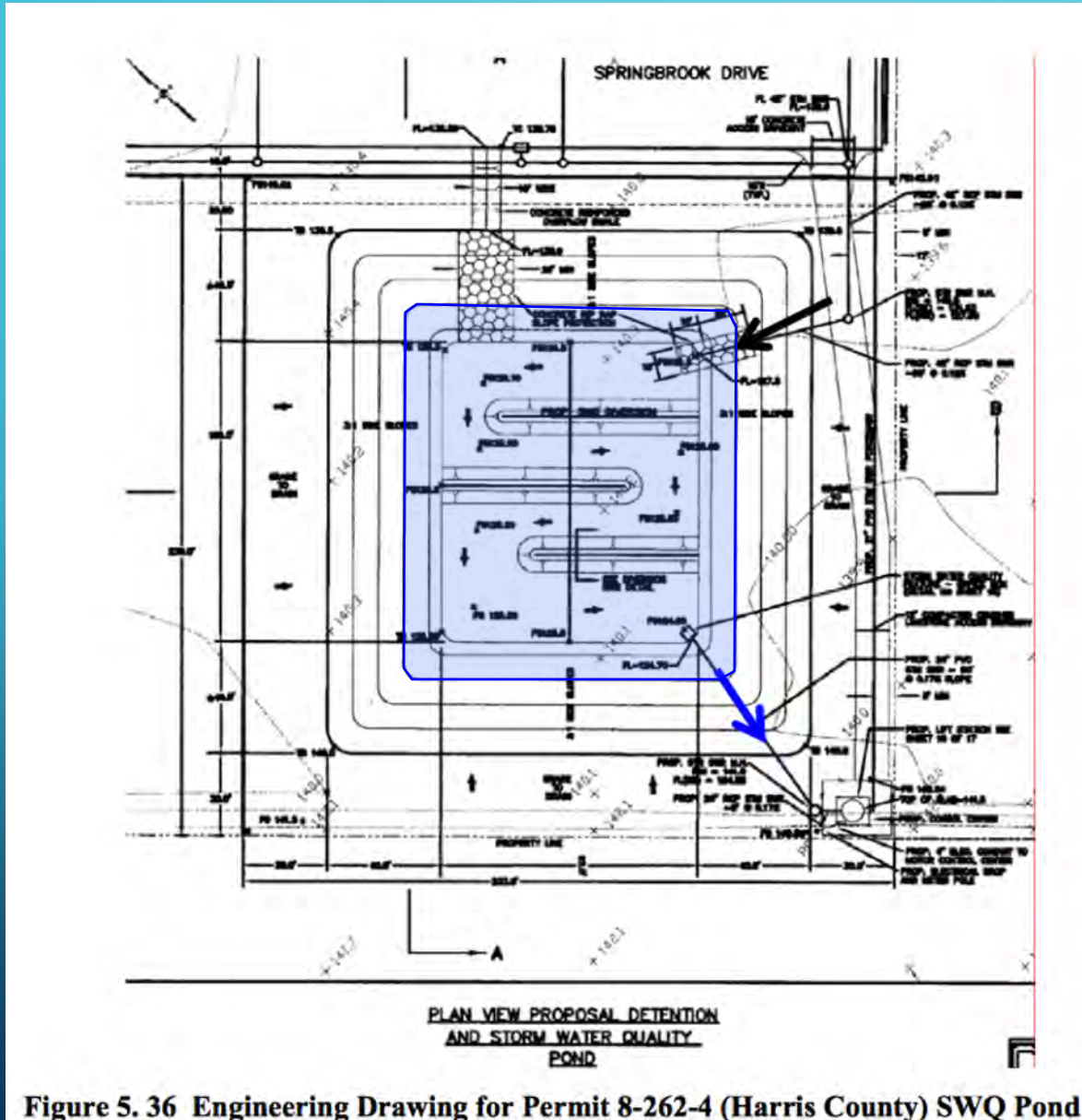
- Pool elevation = 140 ft.
- Depth = 0.5 ft.
- Pool Area = 0.25 acres

DEPTH-ELEVATION



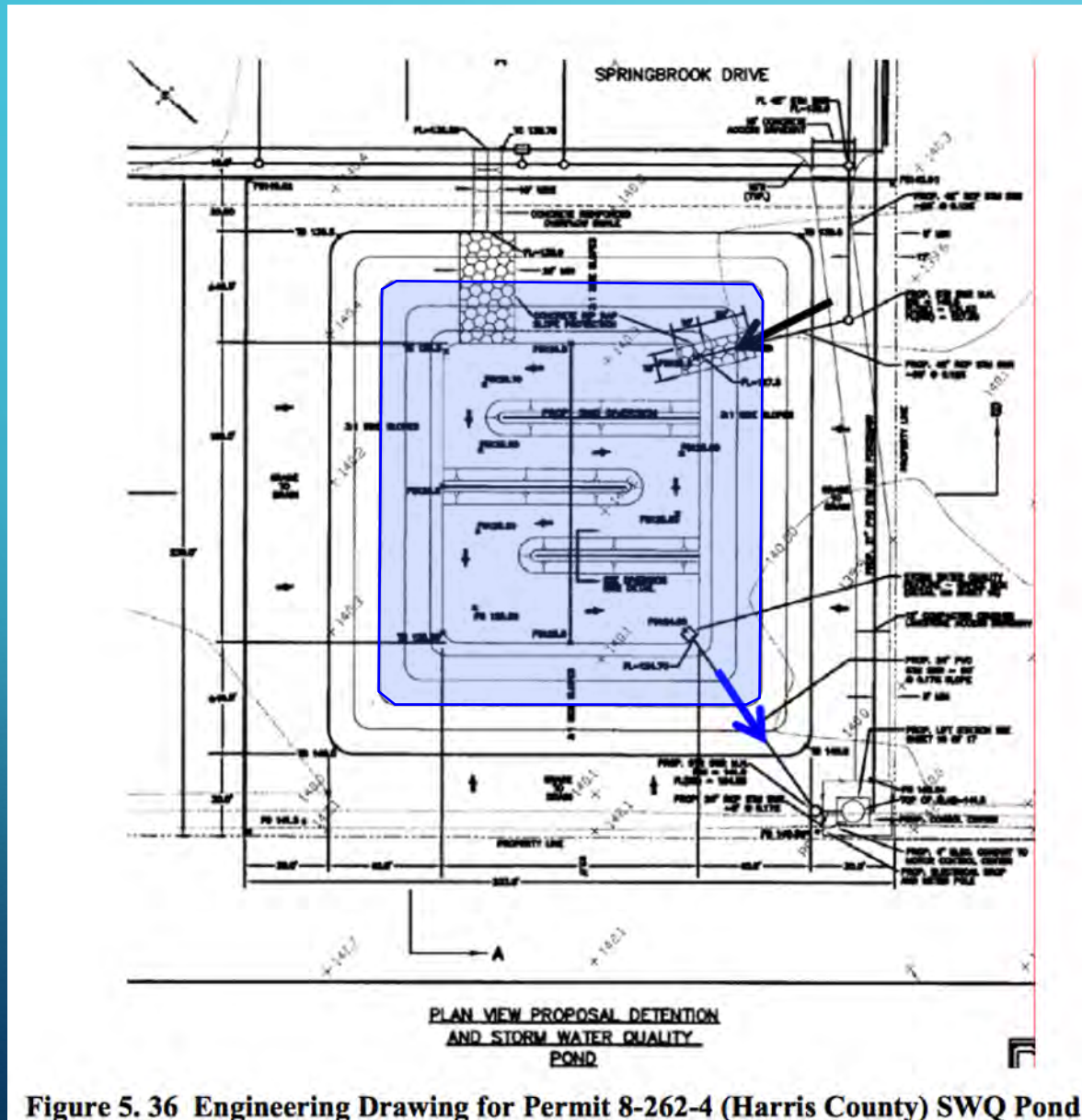
- Pool elevation = 141 ft.
- Depth = 1.5 ft.
- Pool Area = 0.35 acres

DEPTH-ELEVATION



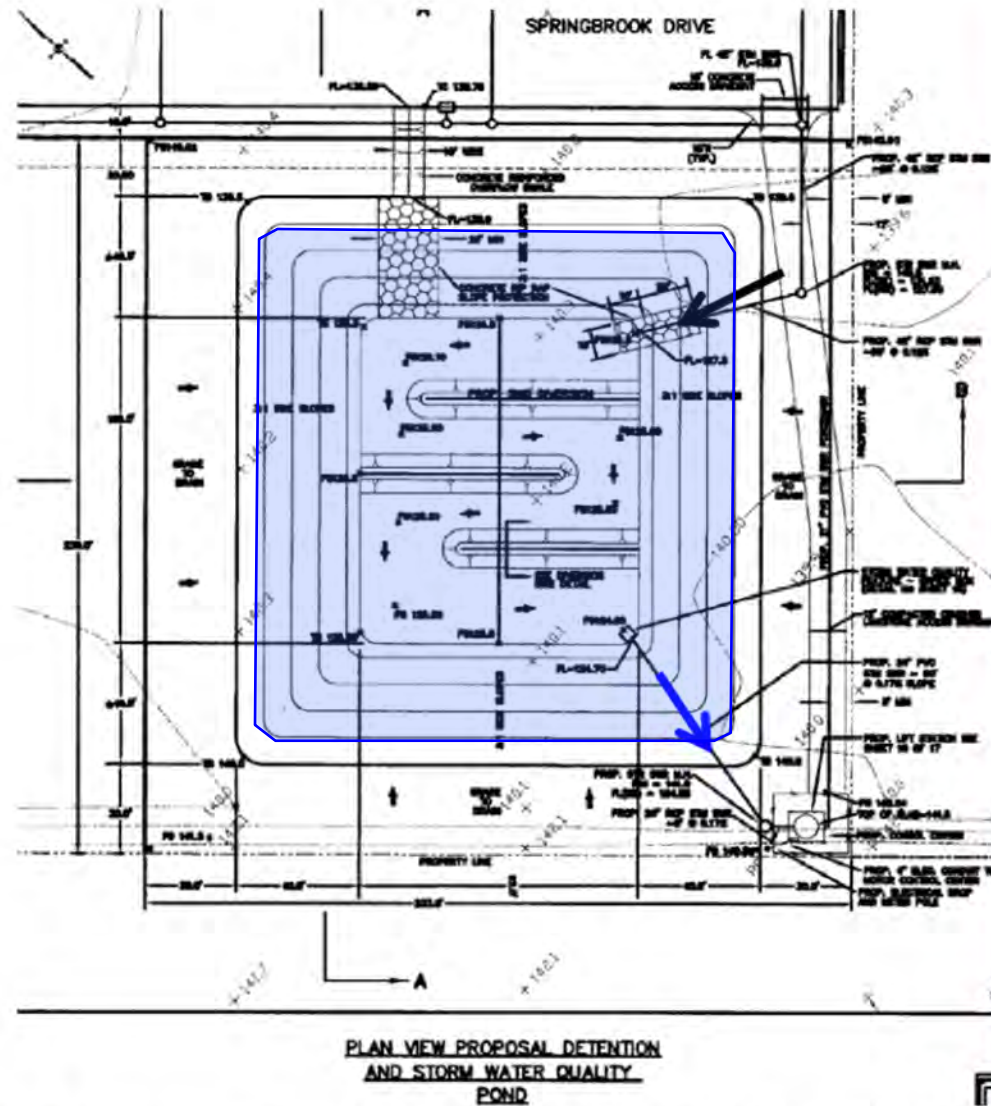
- Pool elevation = 142 ft.
- Depth = 2.5 ft.
- Pool Area = 0.55 acres

DEPTH-ELEVATION



- Pool elevation = 143 ft.
- Depth = 3.5 ft.
- Pool Area = 0.70 acres

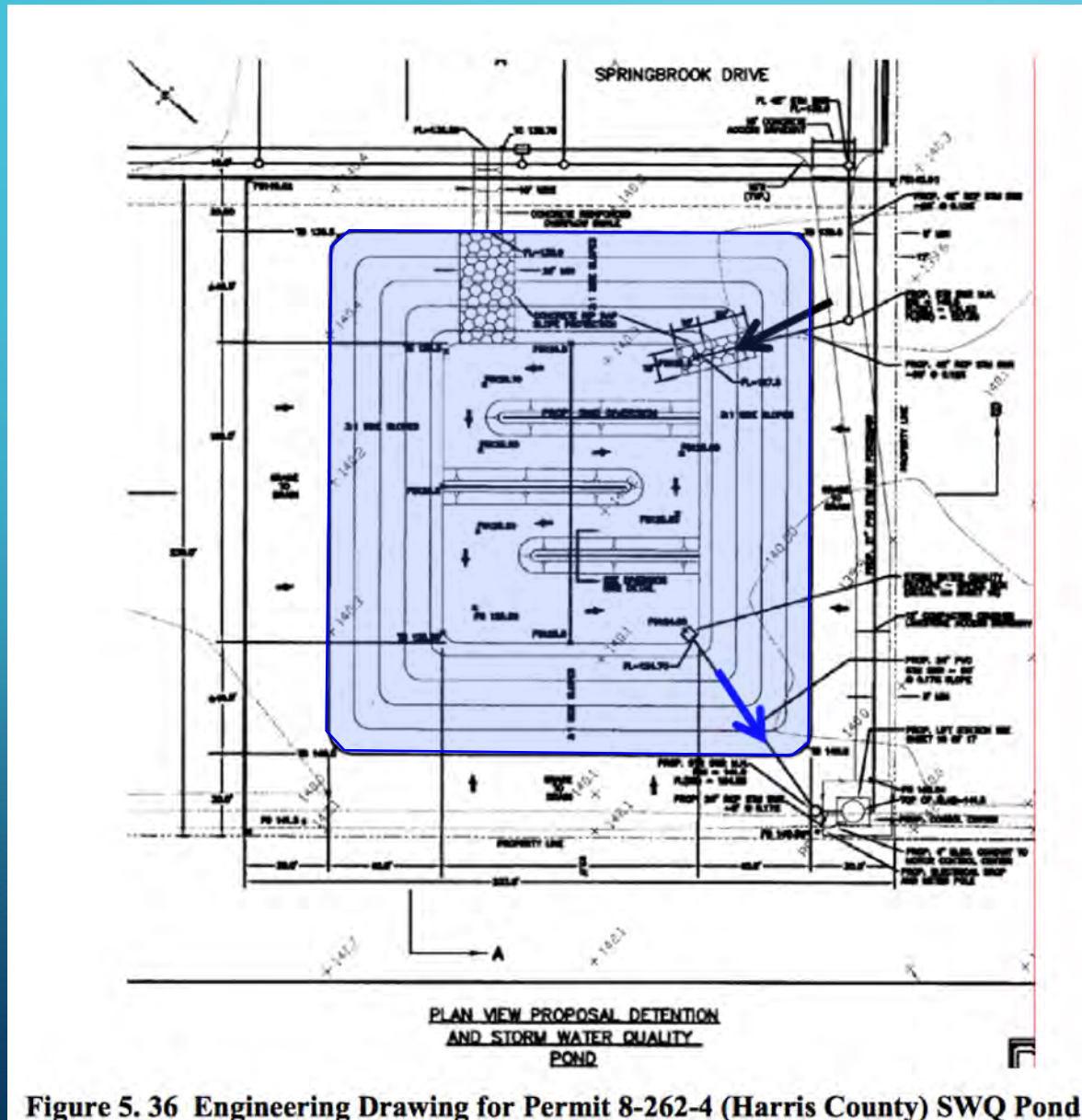
DEPTH-ELEVATION



- Pool elevation = 144 ft.
- Depth = 4.5 ft.
- Pool Area = 0.90 acres

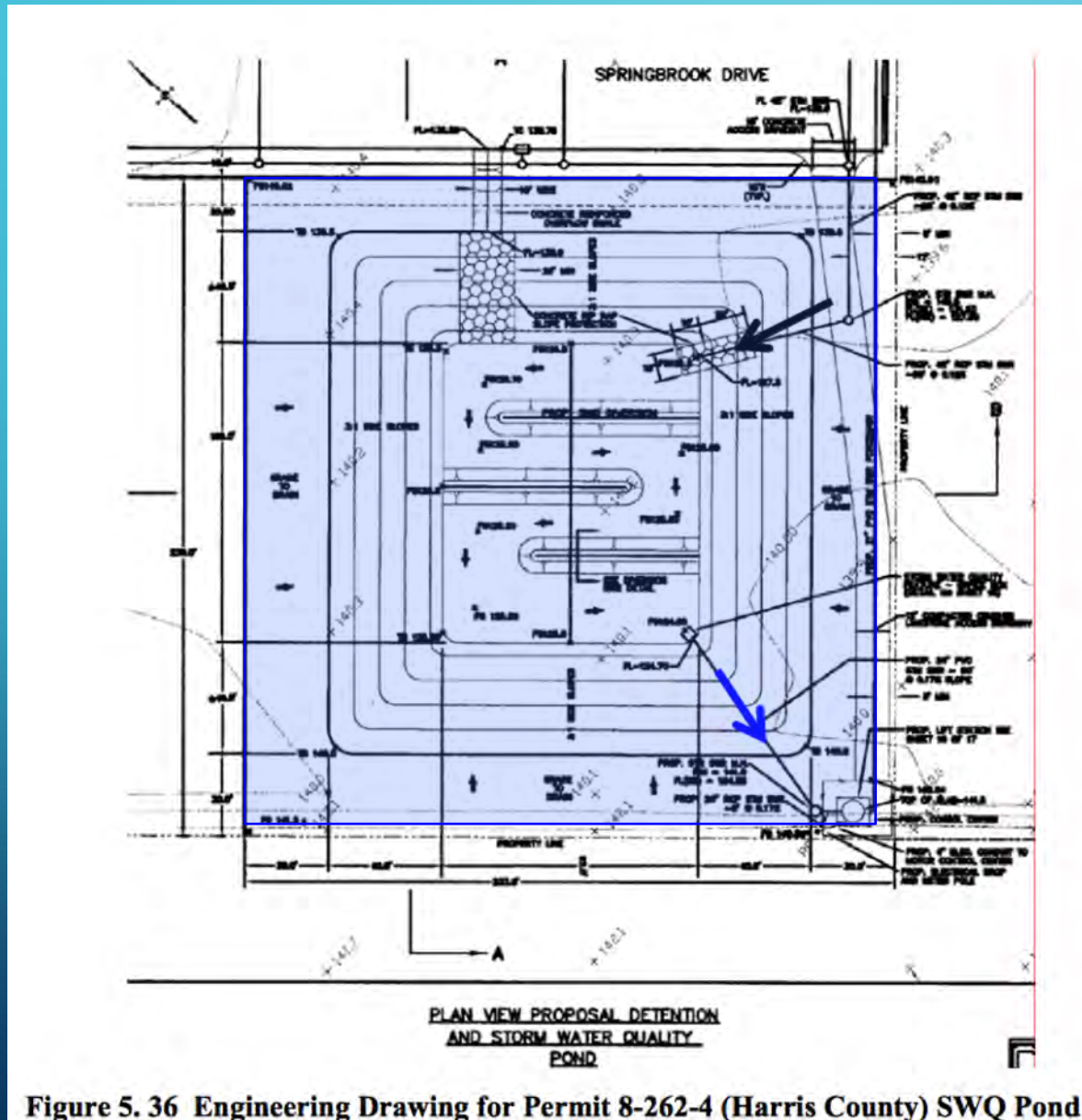
Figure 5.36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

DEPTH-ELEVATION



- Pool elevation = 145 ft.
- Depth = 5.5 ft.
- Pool Area = 1.20 acres

DEPTH-ELEVATION



- Pool elevation = 148 ft.
- Depth = 8.5 ft.
- Pool Area = 1.85 acres

Any deeper and we are inundating off-site property

Figure 5.36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

ENTER INFORMATION INTO SWMM

- Storage tabular element
- Apply a rainfall (flow)
- Simulate pond fill/drain and outflow hydrograph