CE 3372 WATER SYSTEMS DESIGN

LESSON 21: DETENTION/RETENTION BASIN HYDRAULICS

PURPOSES

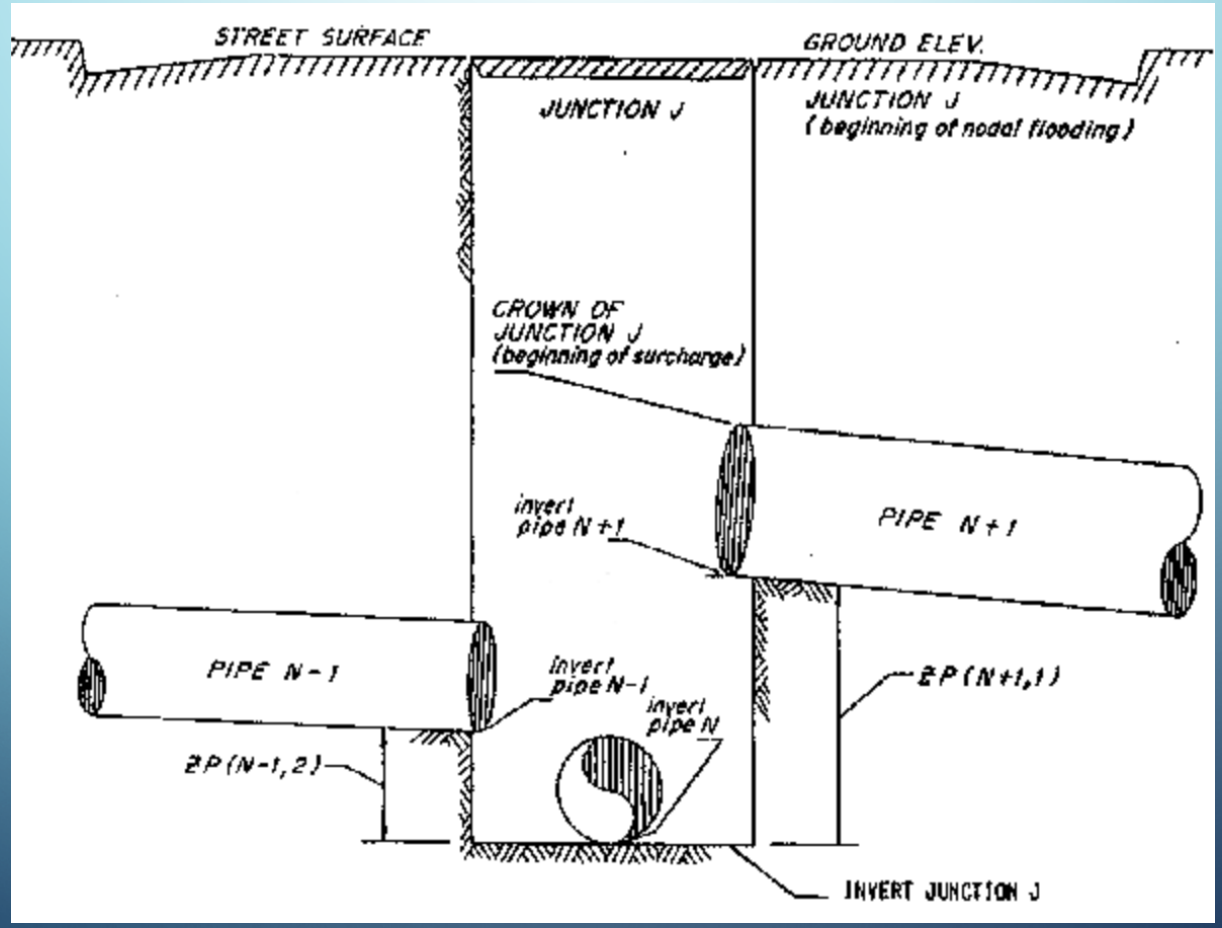
- Detention Basin
  - Mitigate peak discharge(s)
  - Provide water quality benefit

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)

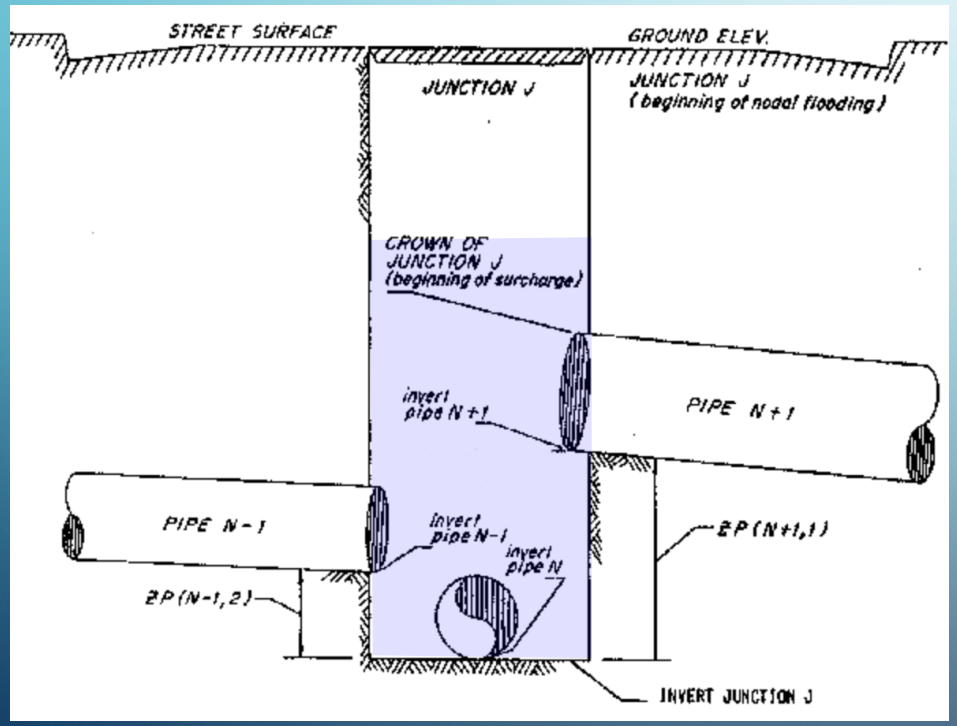
JUNCTION (NODE)

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

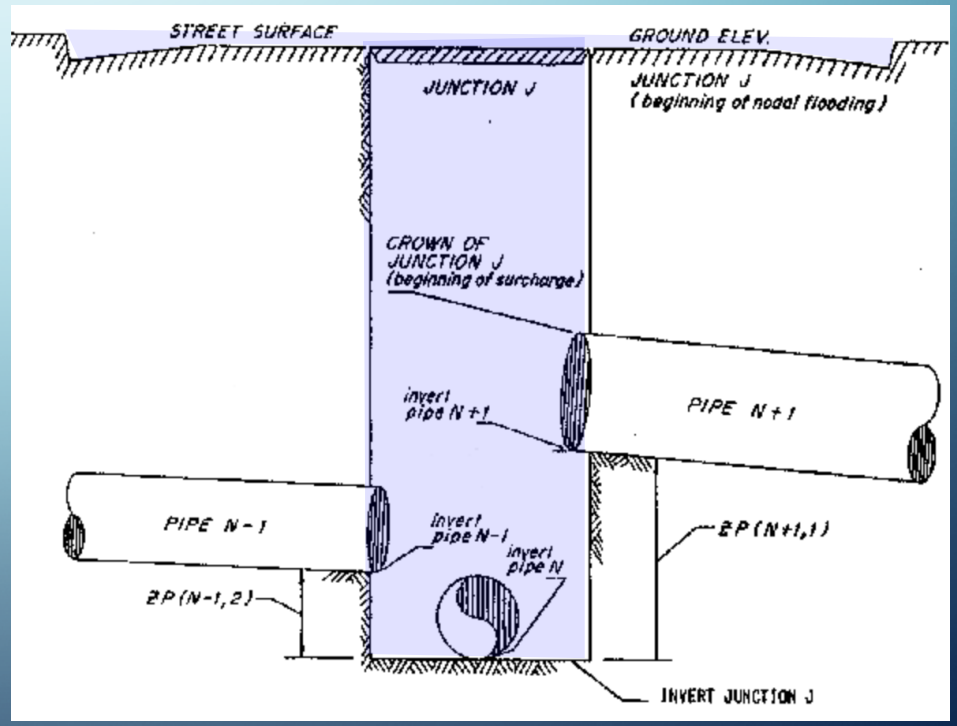


JUNCTION (NODE)

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

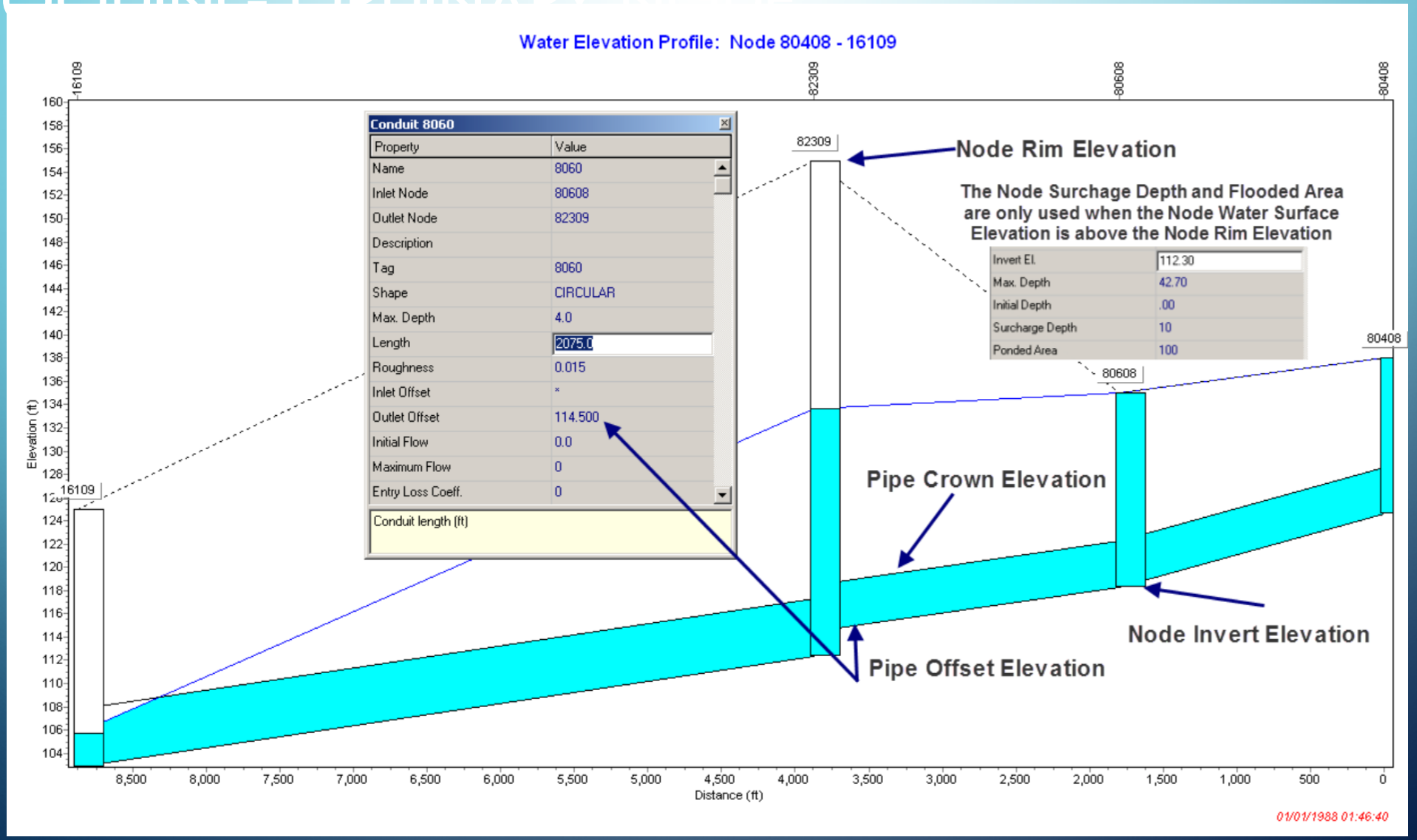


Node not flooded; pipes are surcharged



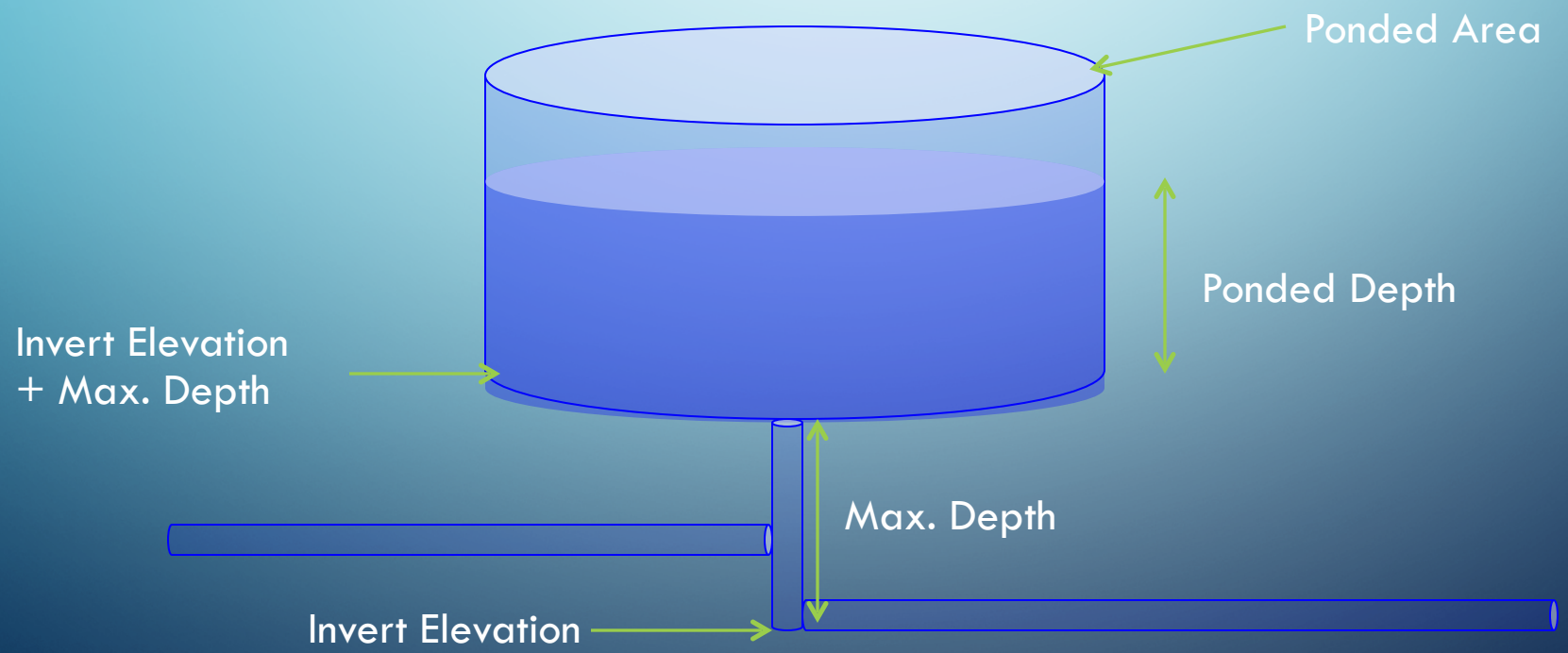
Node flooded; pipes are surcharged

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)

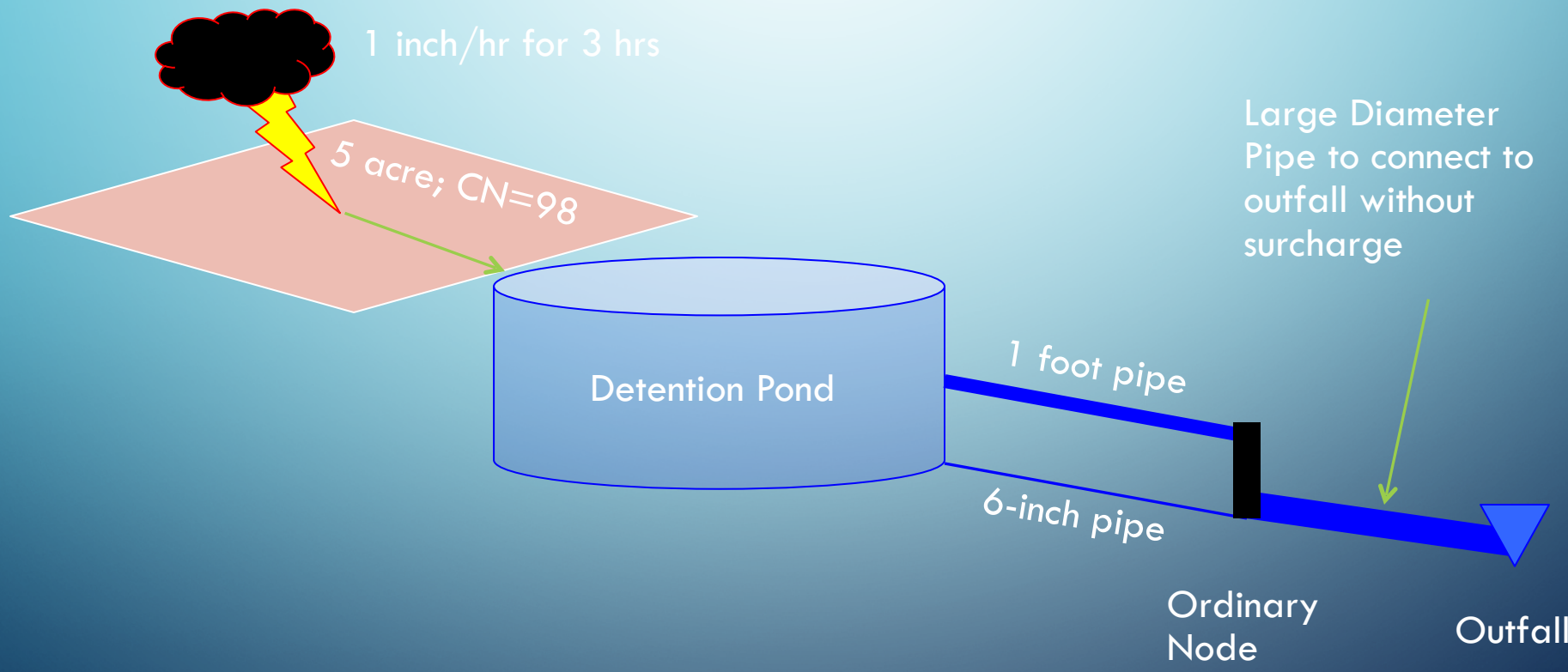
- Useful for:
  - Detention ponds
  - Modeling multiple level inlet/outlet hydraulics
    - Riser inlet
    - Outlet that has portion through a pipe, a portion over a weir (or another pipe at different elevation)

EXAMPLE

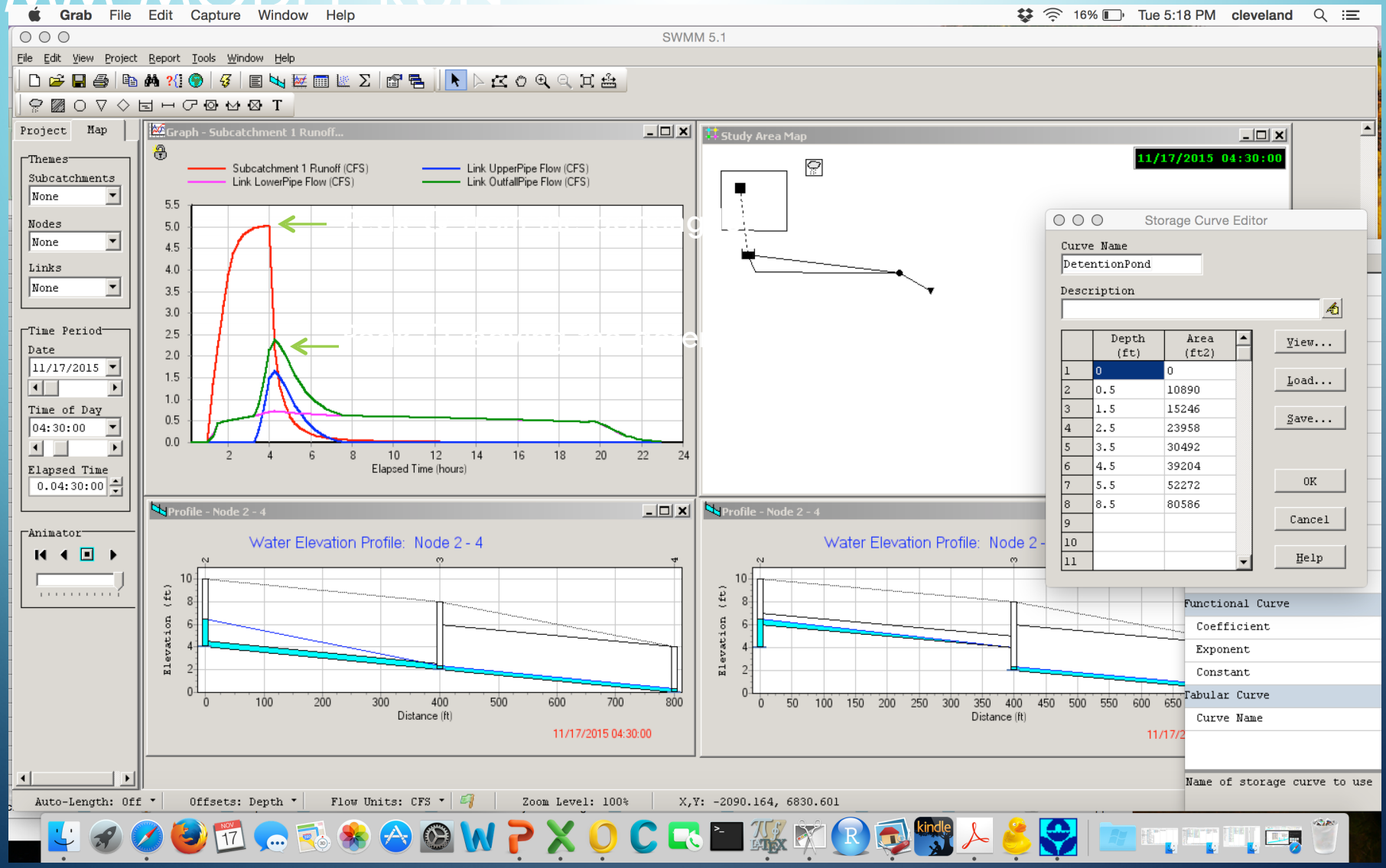
- Consider a detention pond that drains a 5-acre parking lot, then discharges to a nearby receiving stream
- Use SWMM to approximate the hydraulics
  - Sub-catchment, high CN (98) to represent the parking lot
  - 1-inch/hour storm for 3 hours
  - All flow passes through the detention pond before exiting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



EXERCISE ES 15

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

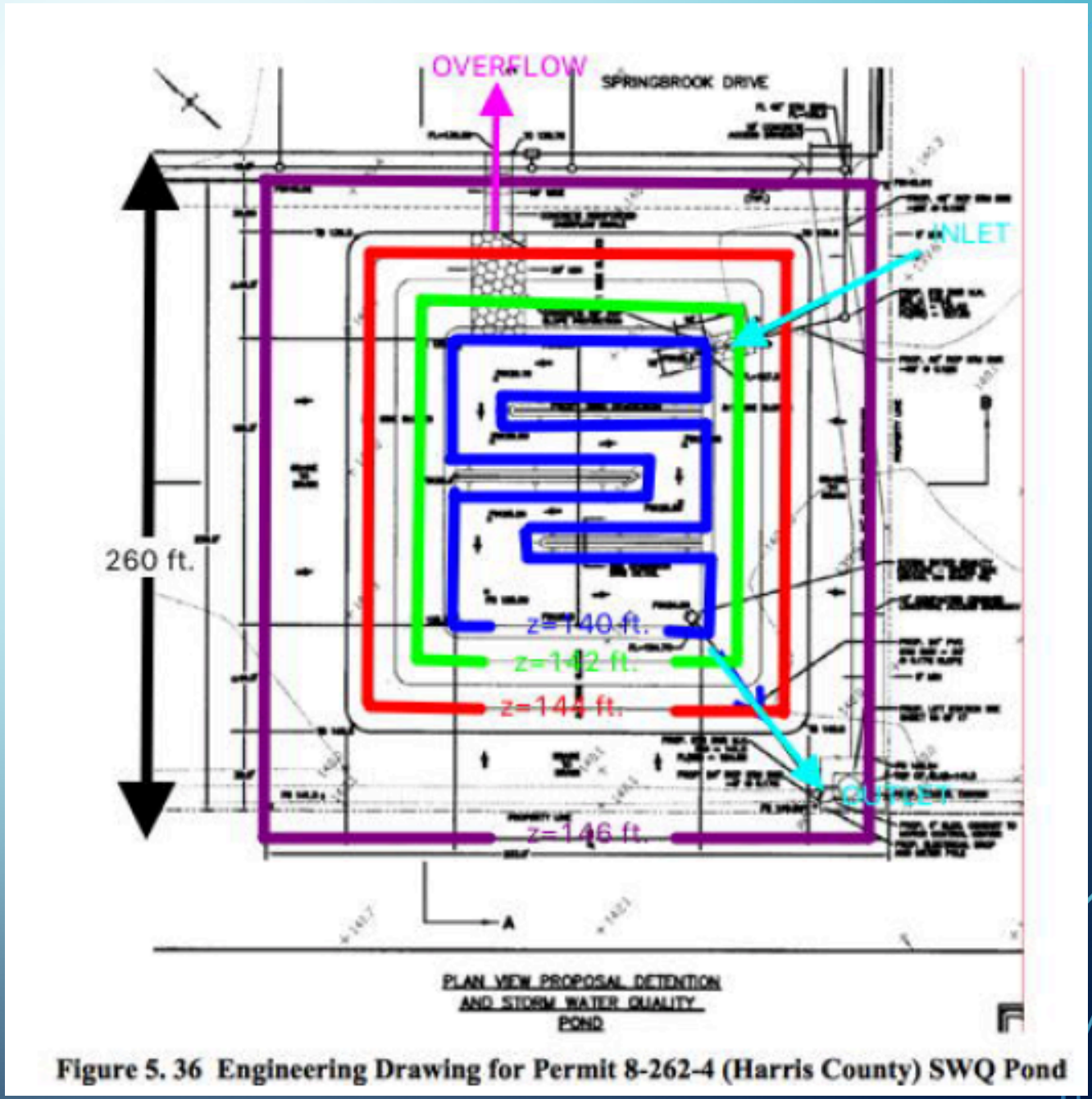


Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

EXERCISE ES 15

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

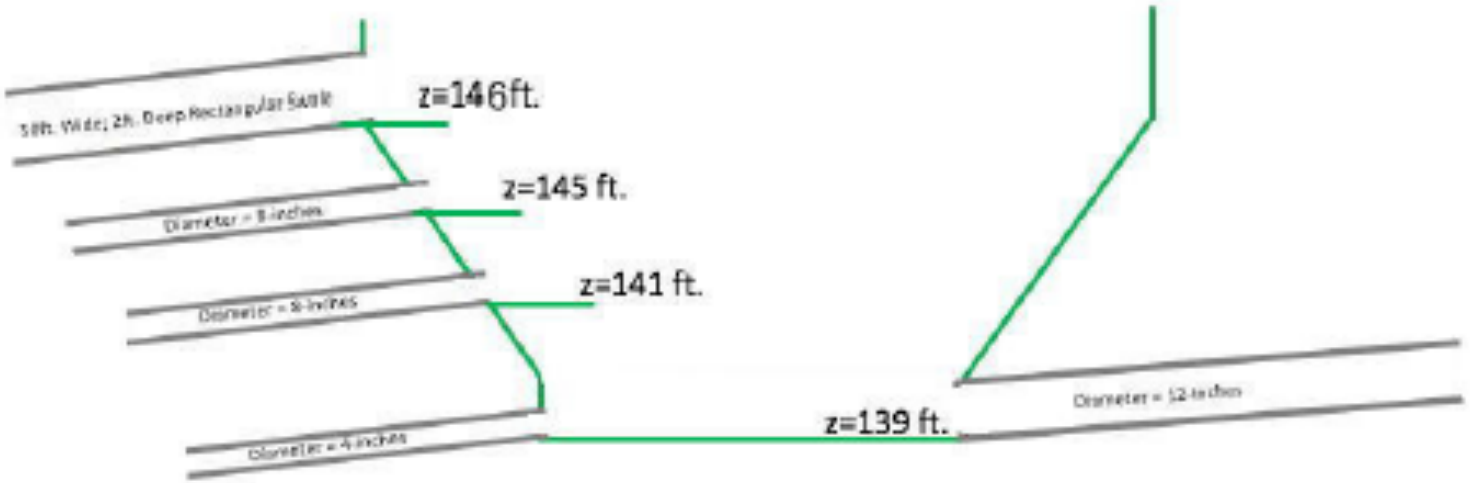


Figure 2: Schematic elevation-view sketch of pond.

DETENTION POND DRAWING

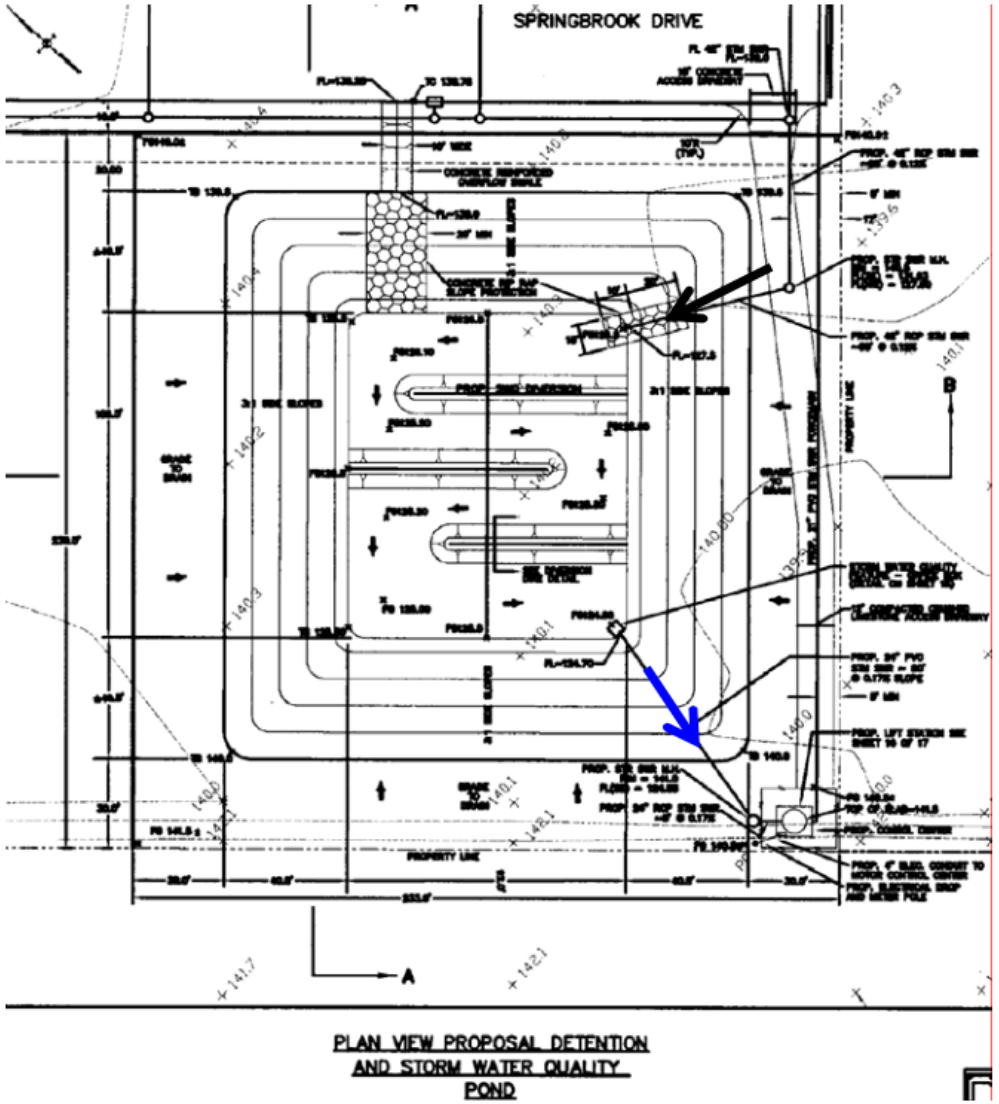


Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

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

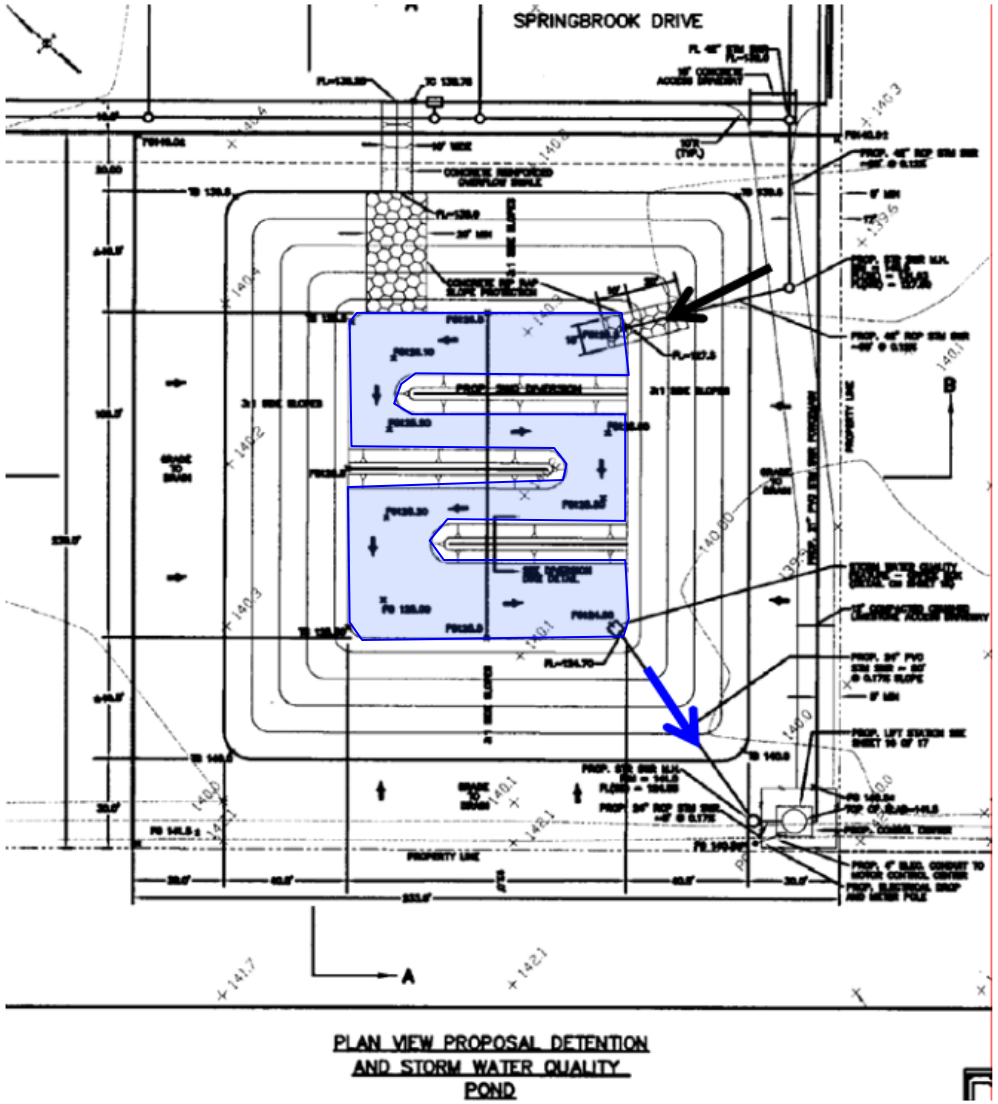


Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

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

DEPTH-ELEVATION

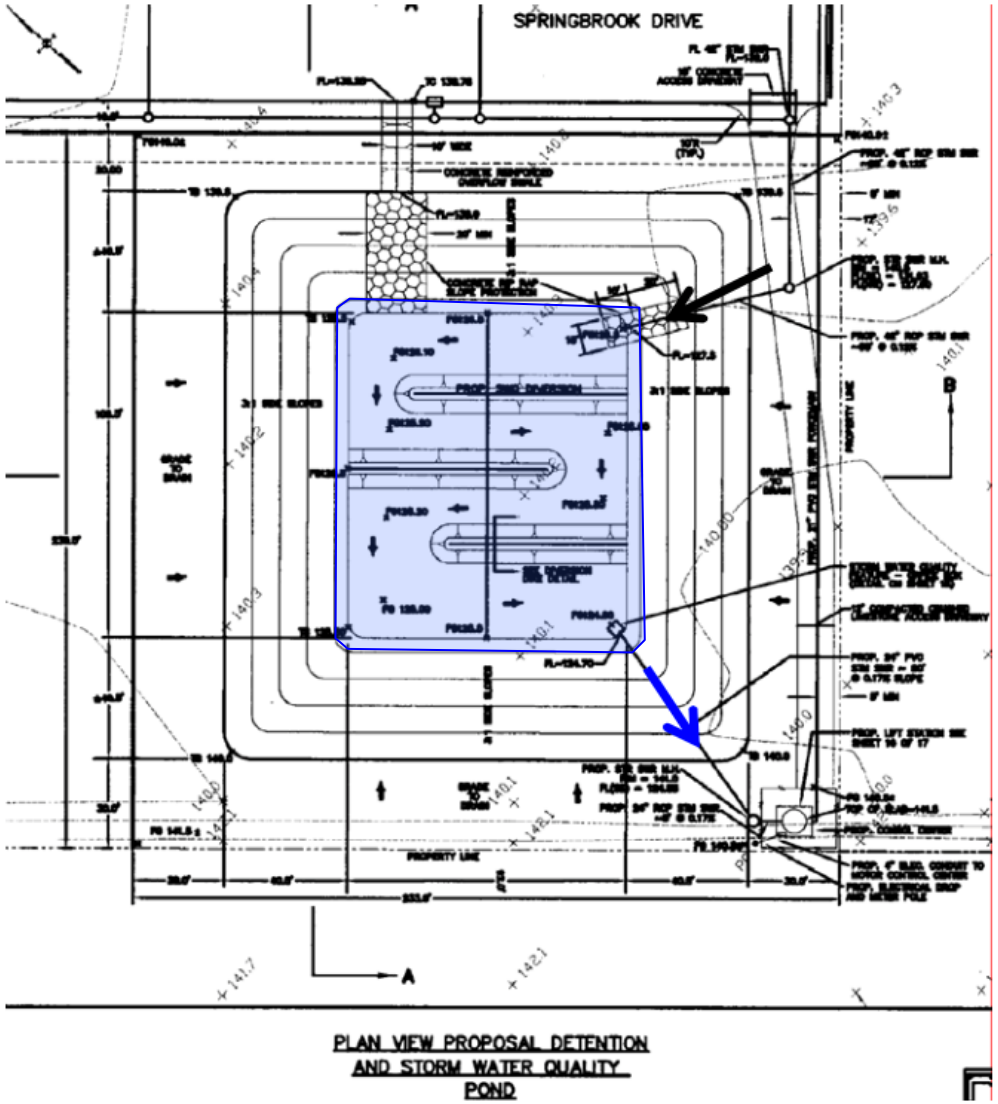


Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

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

DEPTH-ELEVATION

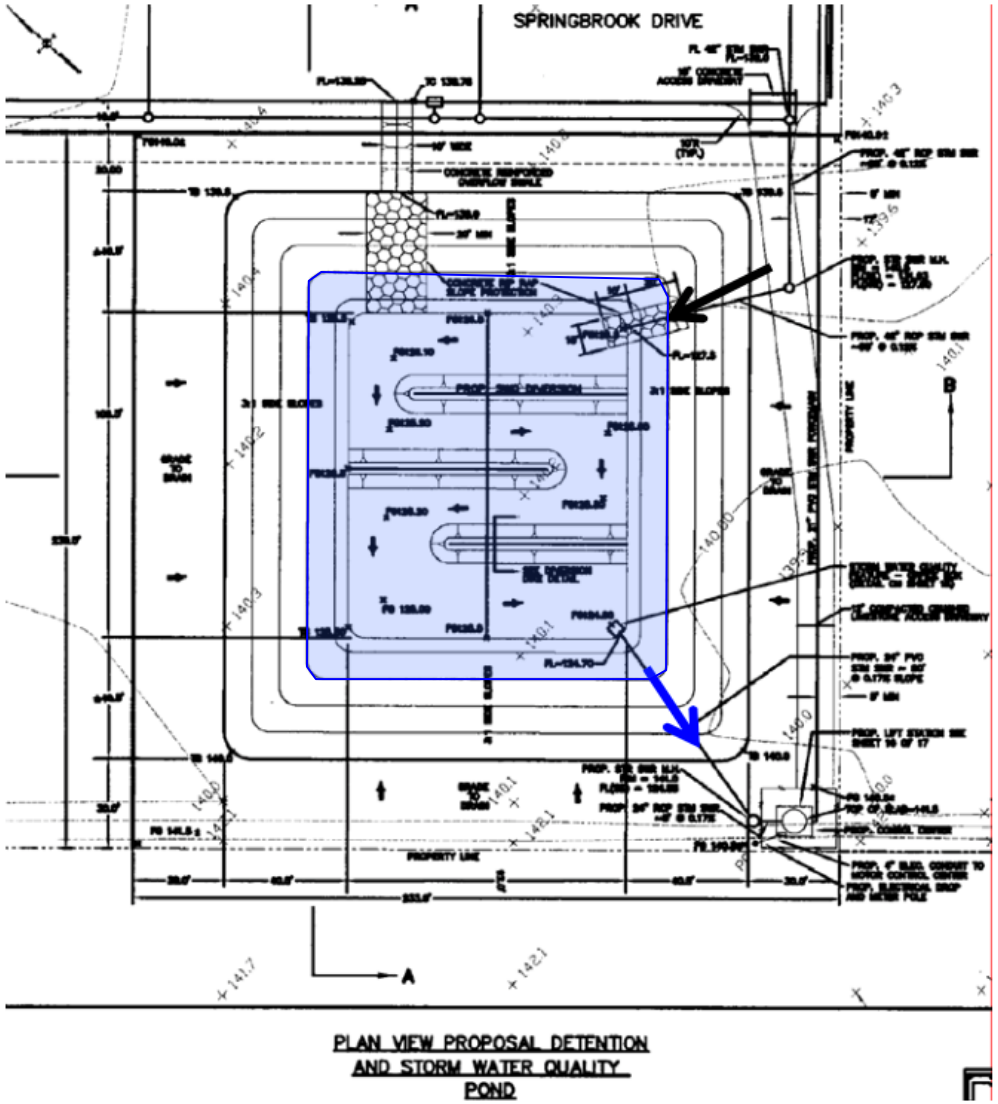


Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

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

DEPTH-ELEVATION

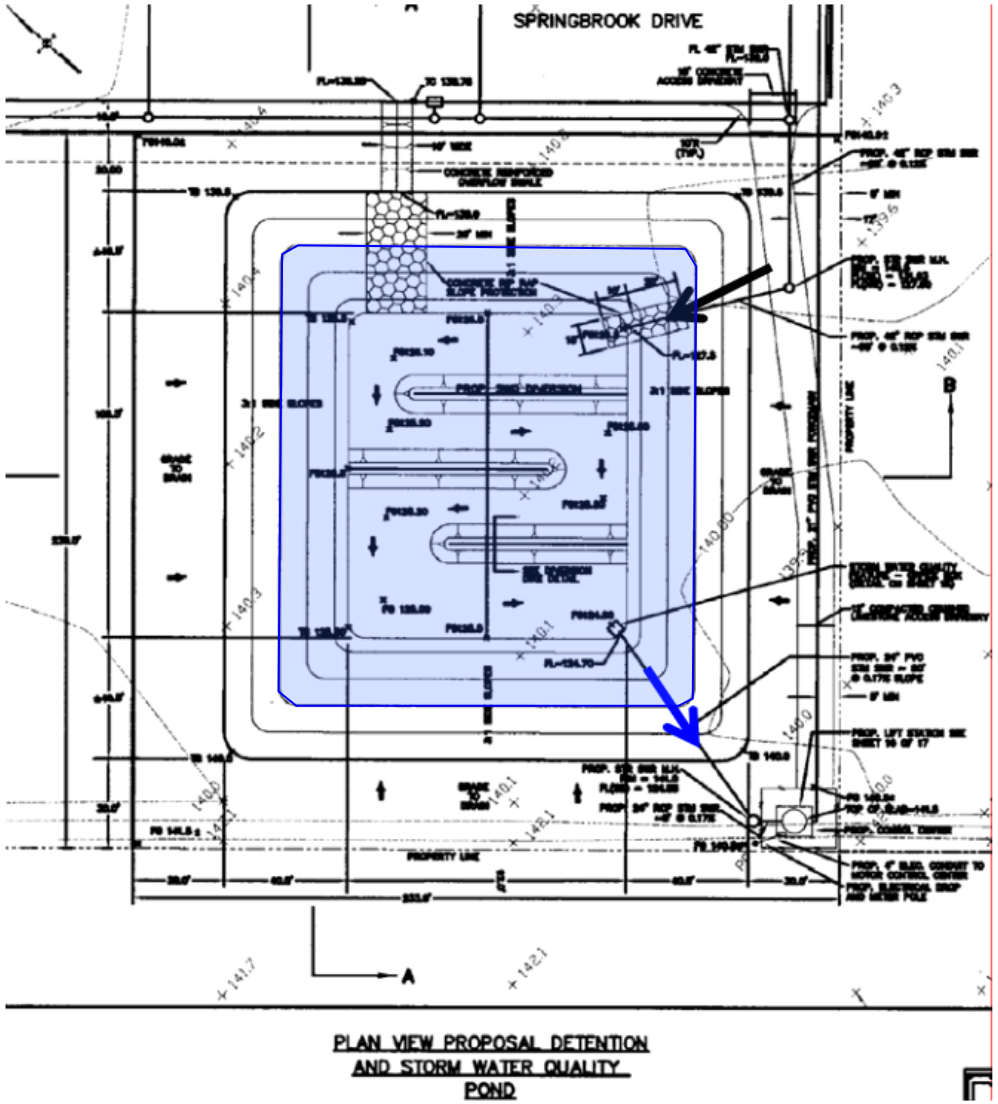


Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

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

DEPTH-ELEVATION

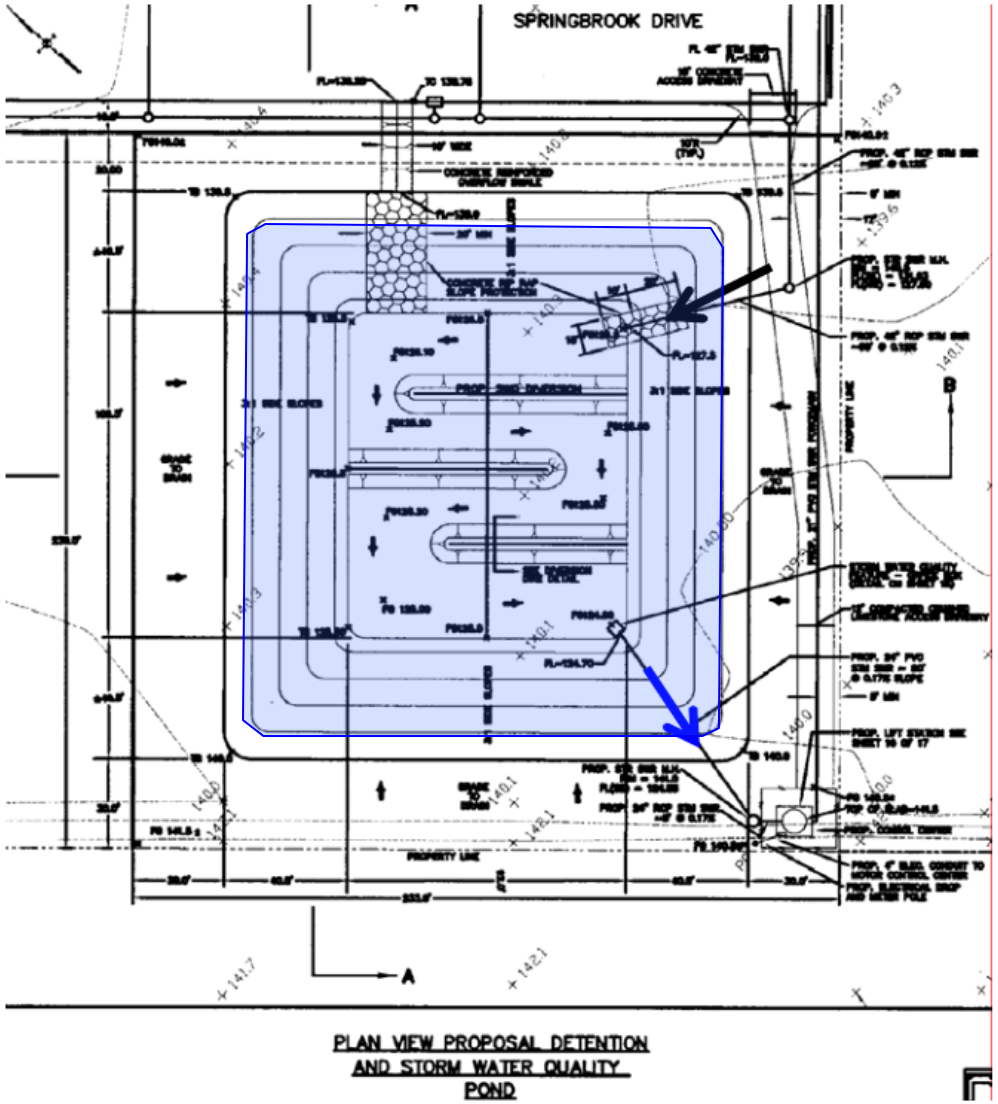


Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

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

DEPTH-ELEVATION

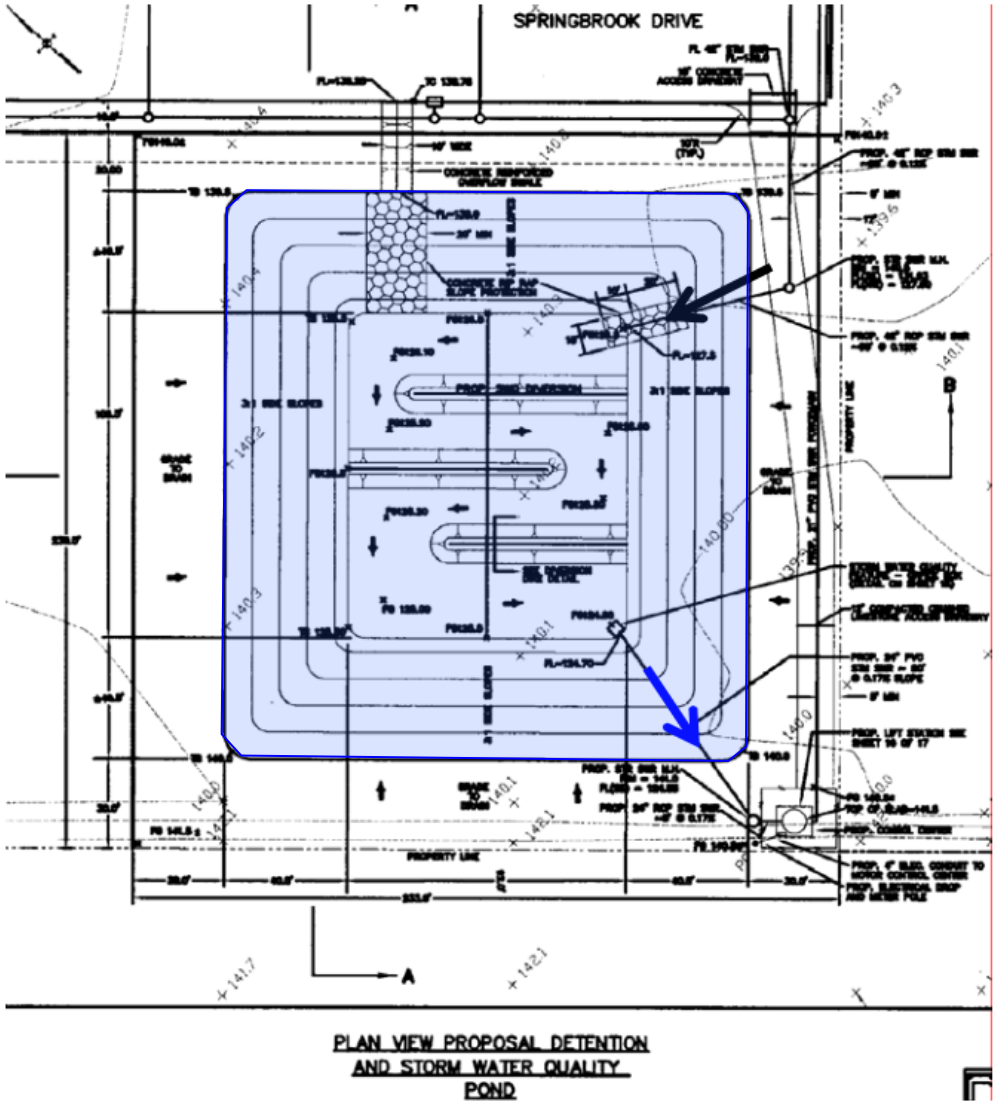


Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

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

DEPTH-ELEVATION

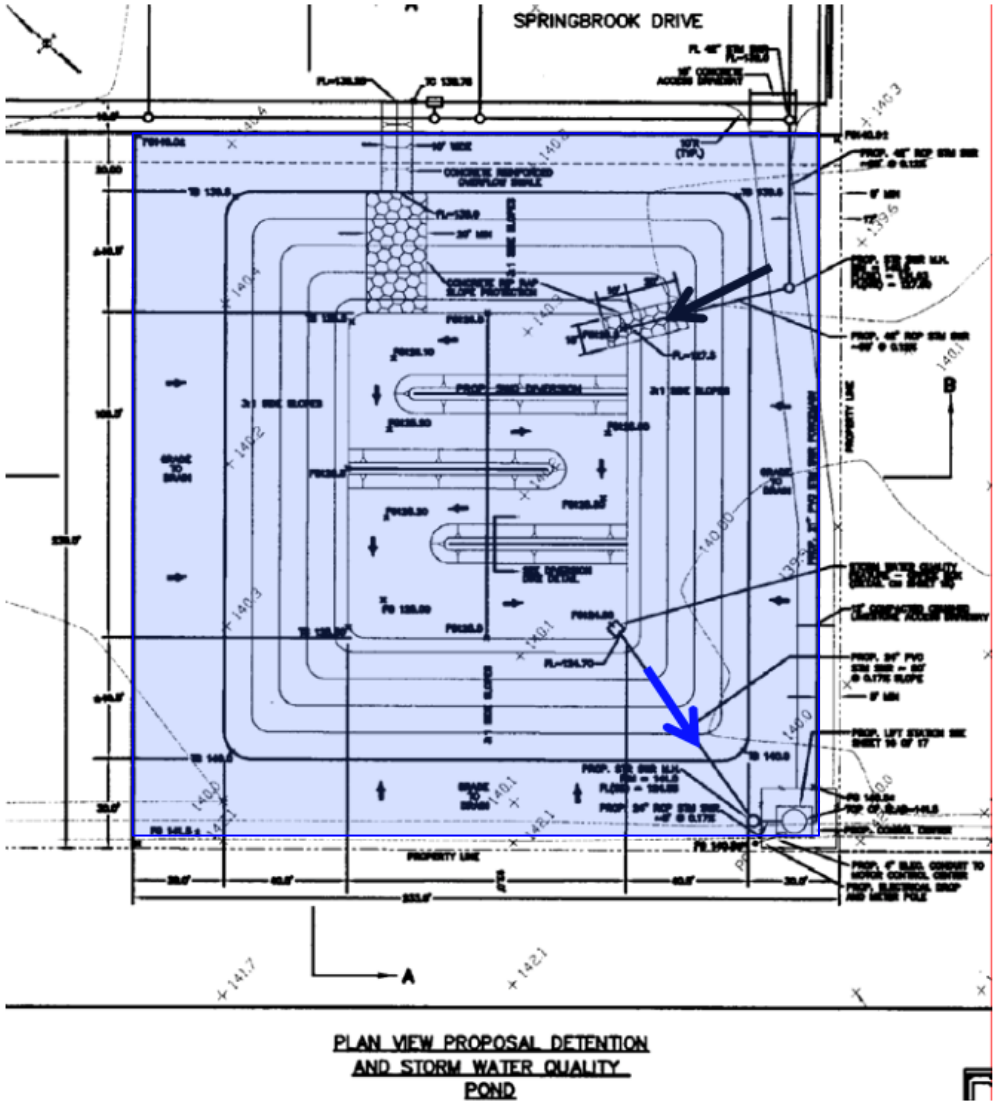


Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

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

Any deeper and we are inundating off-site property

ENTER INFORMATION INTO SWMM

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