DEQ Certification Class Presentations

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July 2024

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Module 13

Plan Reading and Review

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Module 13 Contents

13a. Plan Reading Skills

13b. Plan Narrative

13c. Illustrative Portion of Plans

13d. Reviewing for Water Quantity

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Module 13a.

Plan Reading Skills

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ESC/ESM Plans

- Show how to develop the site and the phasing of construction
- Should be separate from the building construction drawings
- Consists of two parts:

ESC/ESM Plans

- Narrative – written out project description
- Illustrative – shows the project development drawn out on map sheets

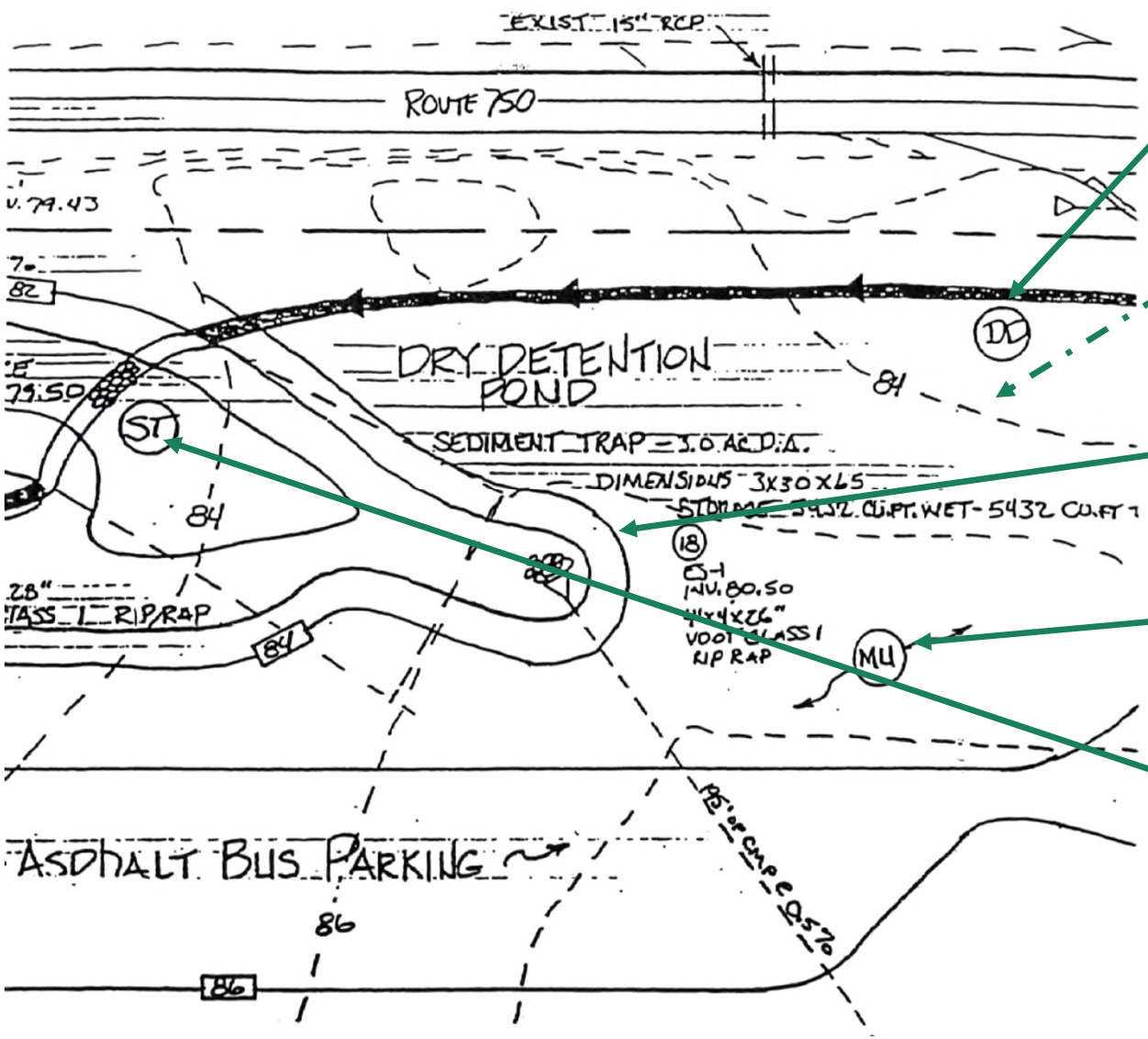
Plan Review Checklists

- Use one
- Publish it for plan preparers
- Make it your own
  - Locality needs/requirements
  - More stringent requirements

Review Requirements

- If you're not clear on what is being conveyed, no one else will know either
  - Get clarification or reject
- "Adequate" plan requirements
  - Minimum standards
  - Site specific
  - Variances

Illustrative Portion of ESC Plan



Temporary Diversion Dike (DD)

Existing contour

Proposed contour

Mulch (MU)

Sediment Trap (ST)

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QuickPoll

What is confusing for you when reading plans?

a. Envisaging what the plans are showing
b. Cut vs. fill
c. Ridge lines vs. swales
d. Eyeing slopes and calculations
e. I generally don't have confusion when reading plans

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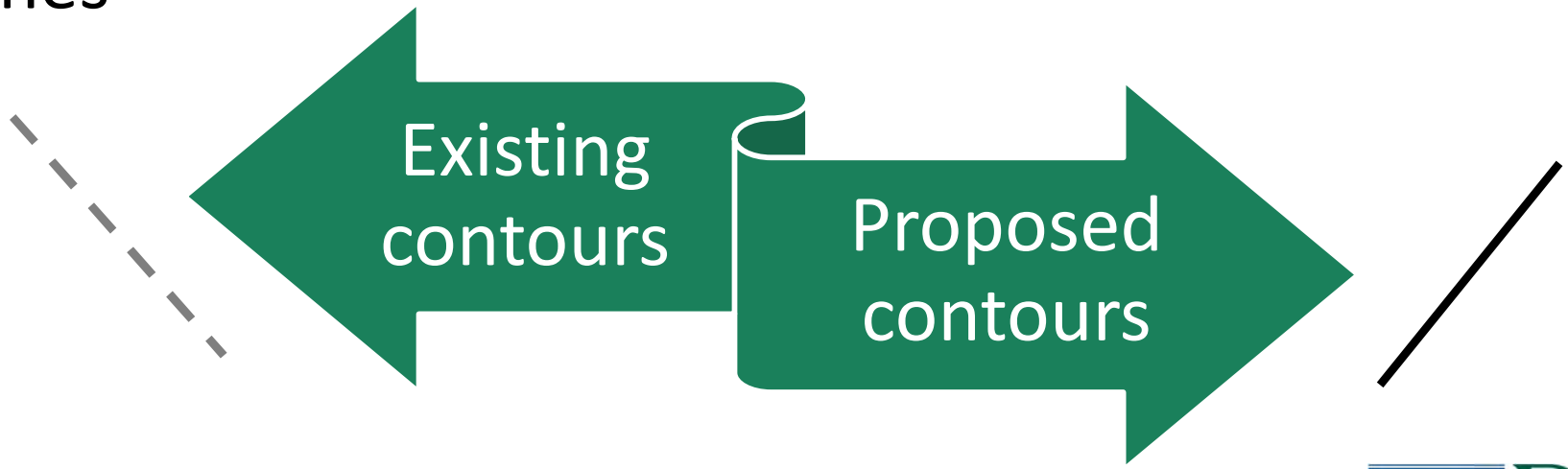
Contour Lines

- A line on a map connecting points of equal elevation (height relative to sea level)
- Existing contours are usually shown as lighter gray or dashed lines
- Proposed contours are usually shown as solid black lines



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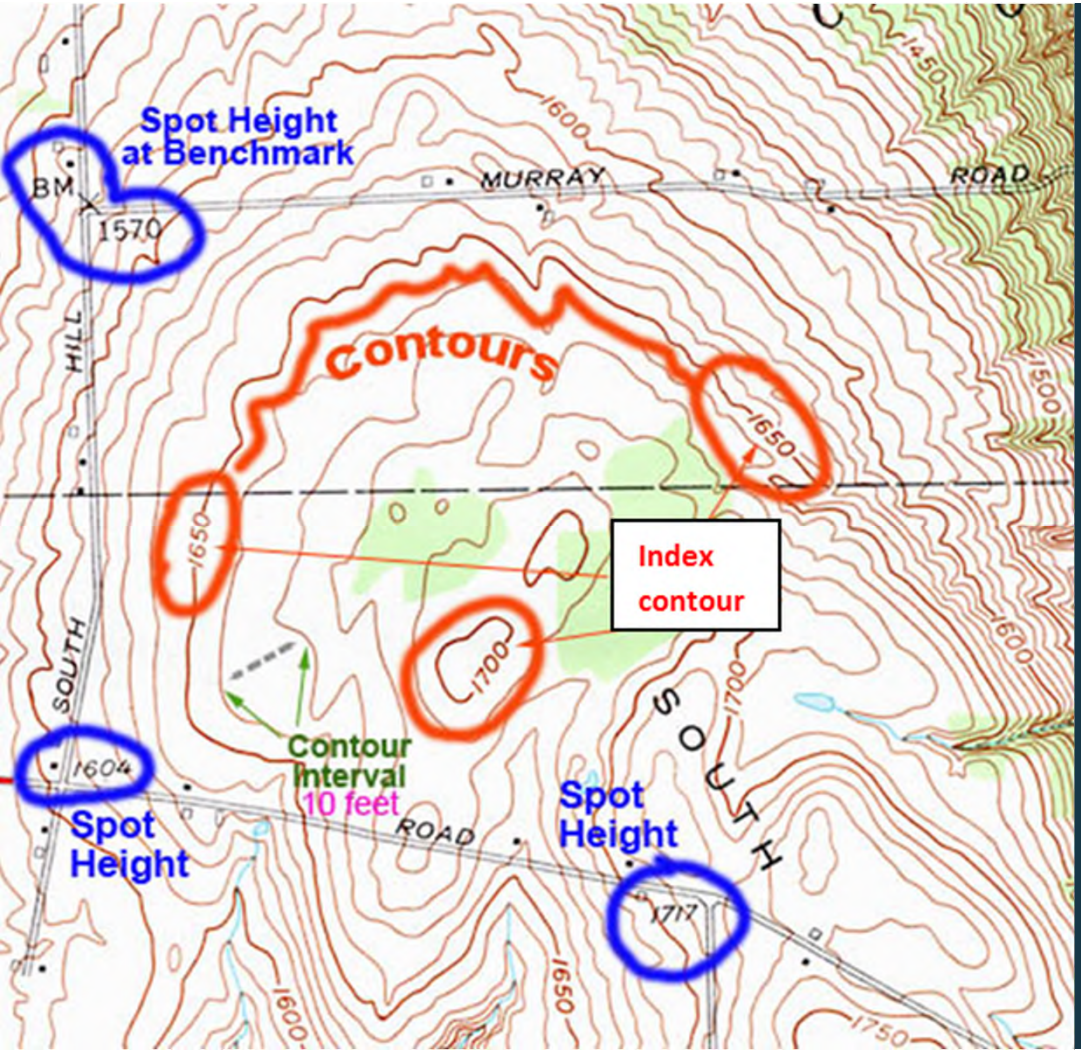
Other Contour Terms

- **Contour interval** – the difference in elevation between two adjacent contour lines
- **Index contour** – contour lines that are labeled to help you find the contour interval, usually bolded
- **Benchmark** – point of known elevation

Reading Contour Lines



- Indicate the steepness of the terrain
- The closer the lines are together = steeper terrain
- Further apart means less steep

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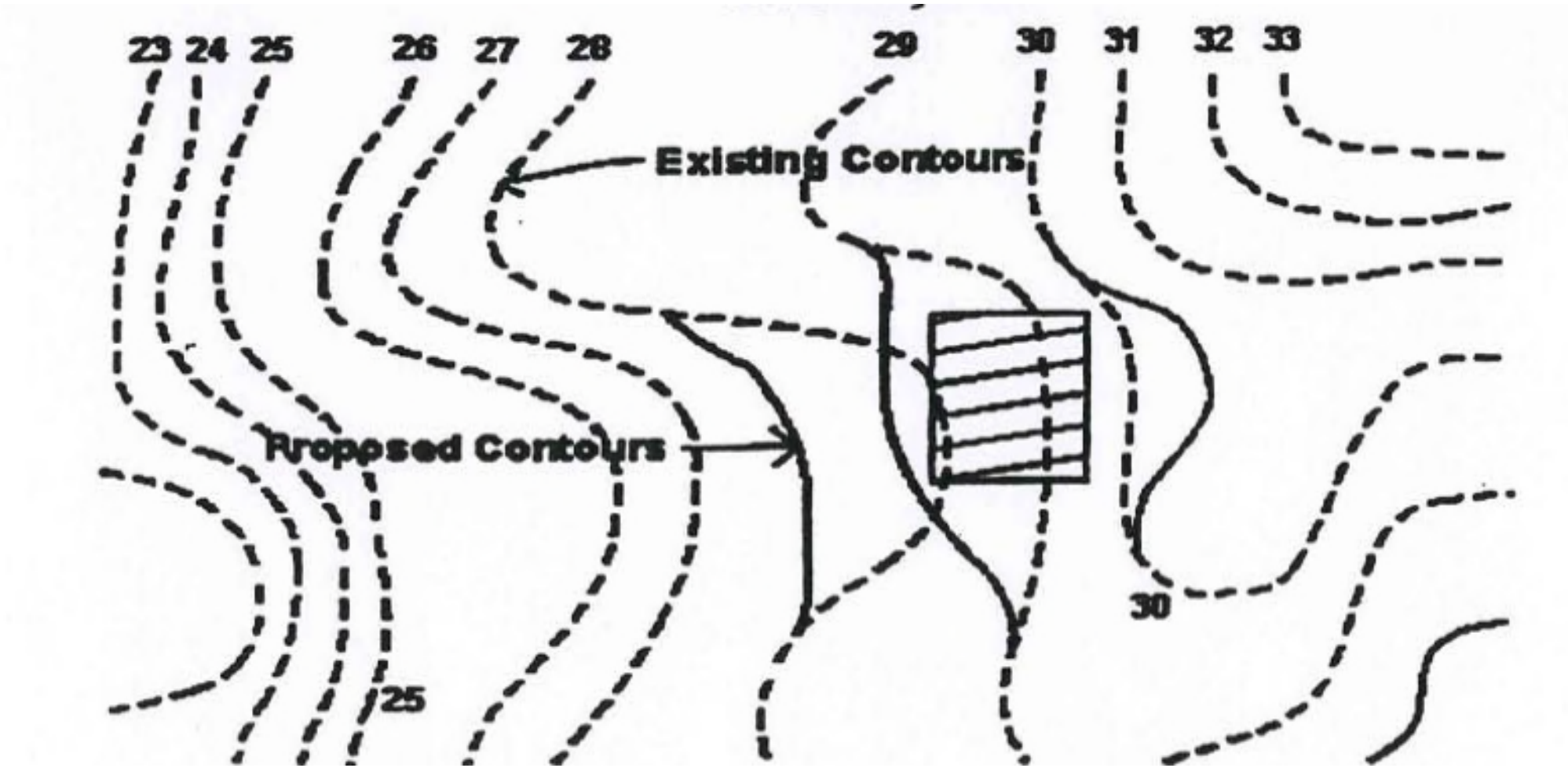
Cut & Fill Slopes



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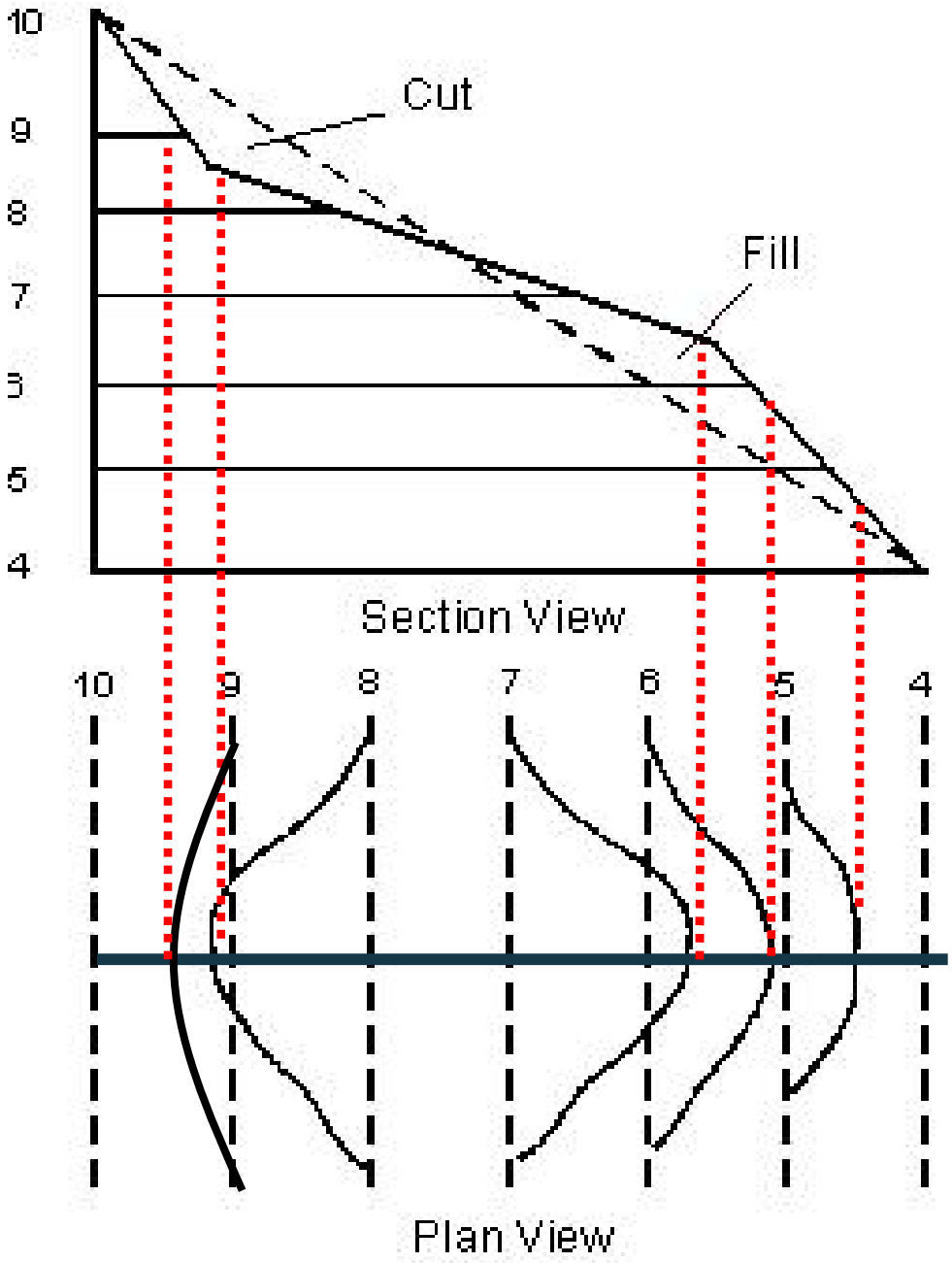
Cut & Fill Slopes



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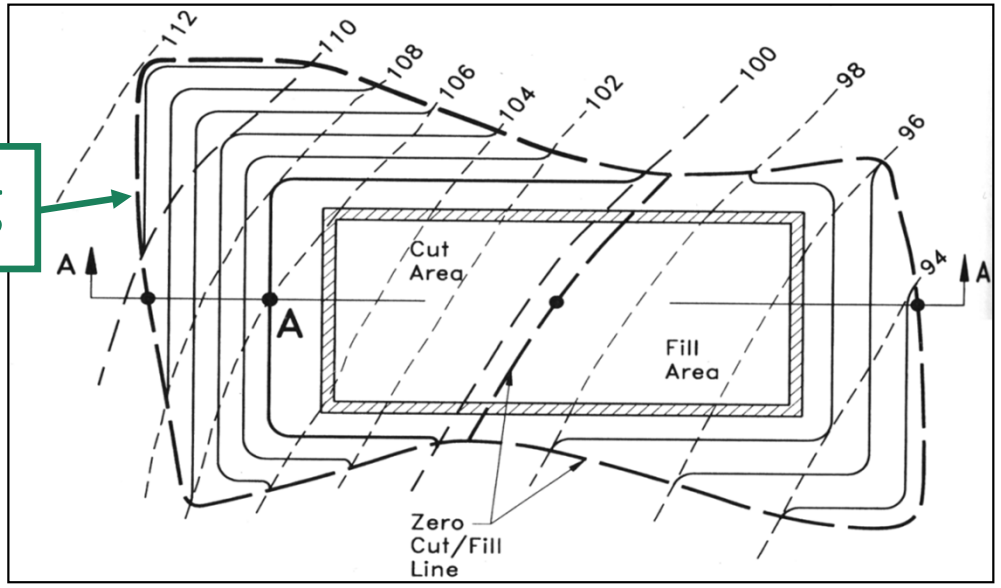
Cut & Fill Slopes

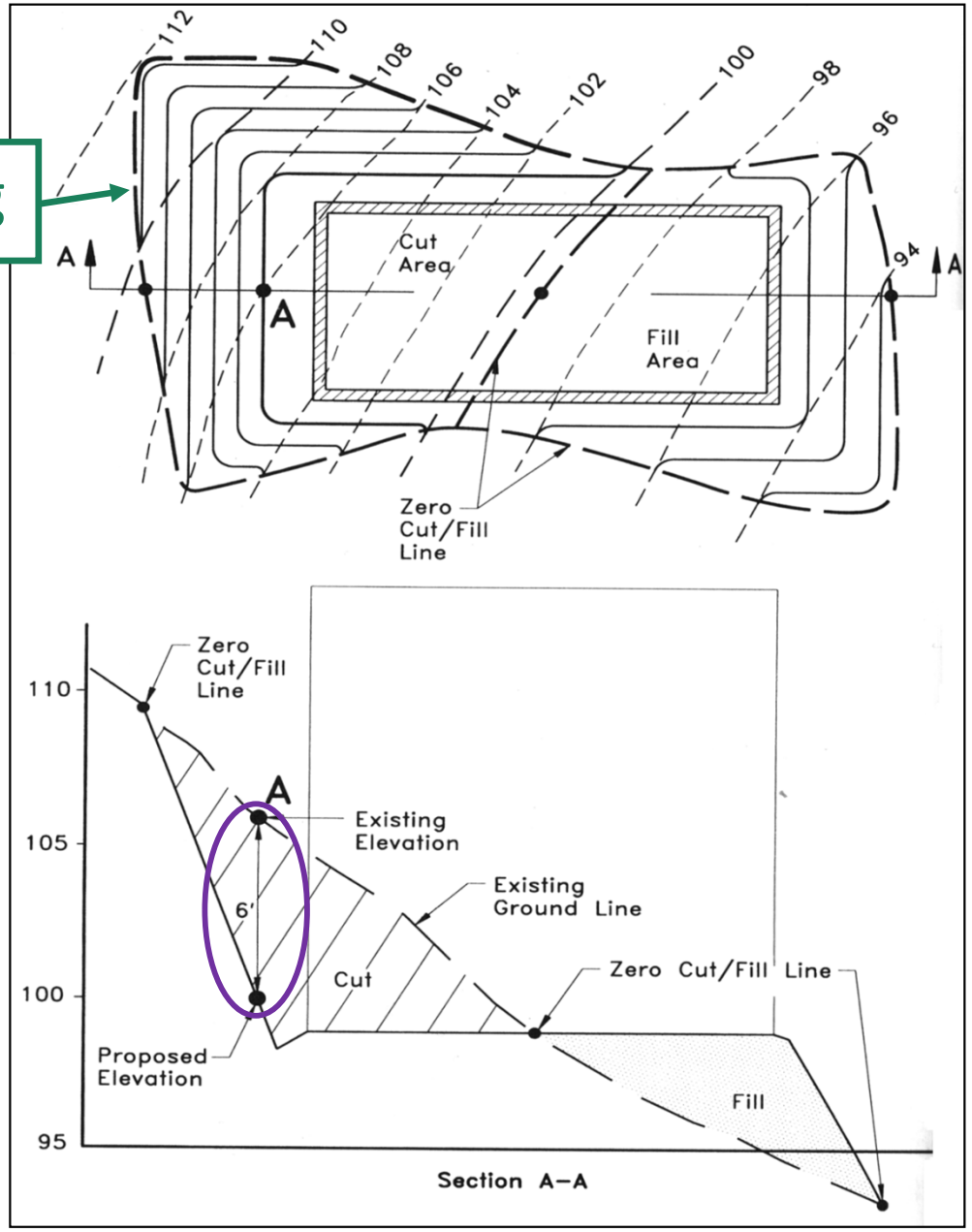


- Which way does the existing site drain?
- They want to put a building in the flow path, so a cut on the uphill side and a fill on the downhill side is required to create the flat building pad

Cut & Fill Slopes

Limits of grading

- Which way does the existing site drain?
- They want to put a building in the flow path, so a cut on the uphill side and a fill on the downhill side is required to create the flat building pad
- Water will be sent around the building to the downhill side



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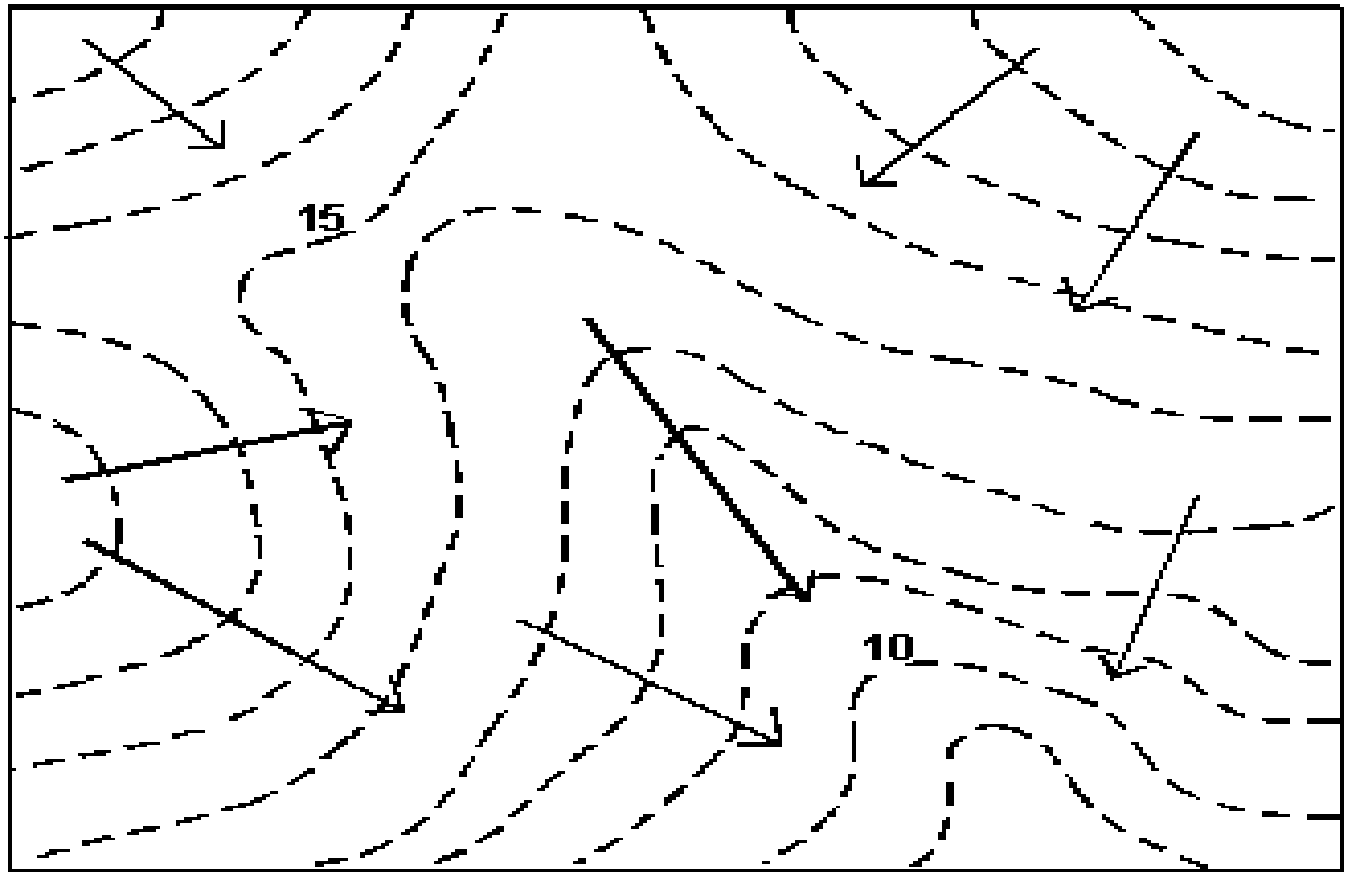
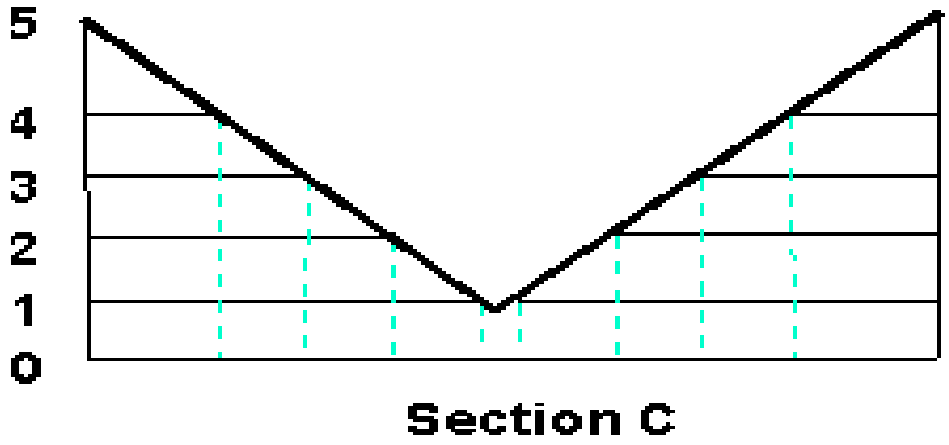
Reading Contours

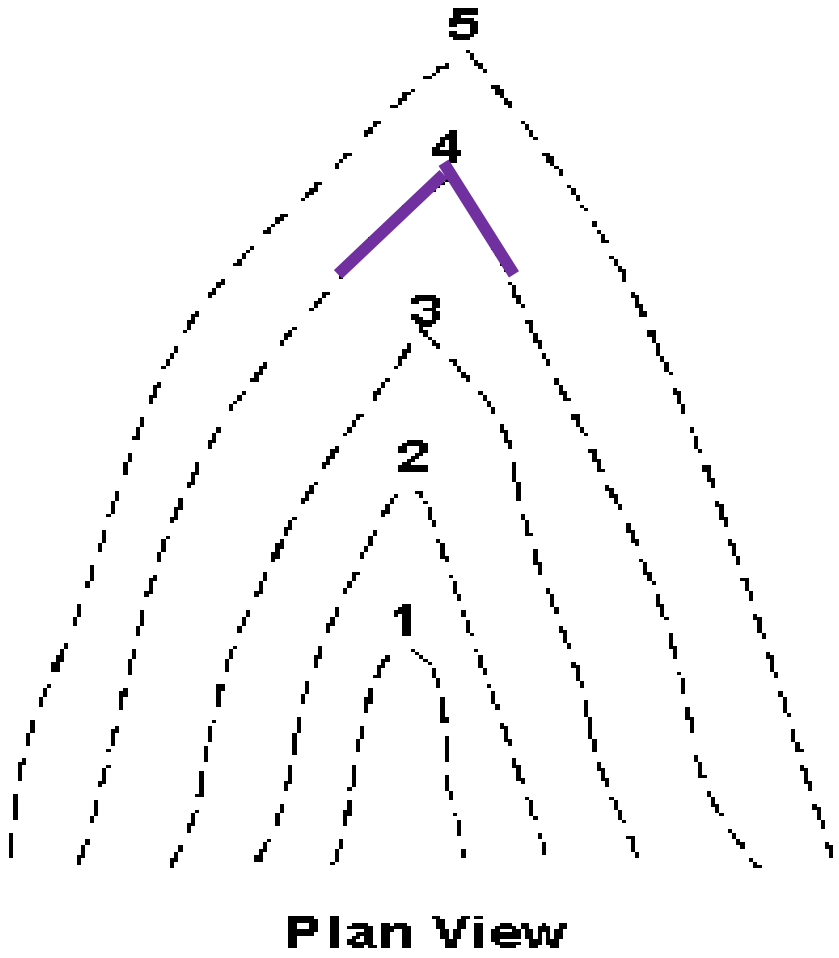
Water always flows perpendicular to contour lines.



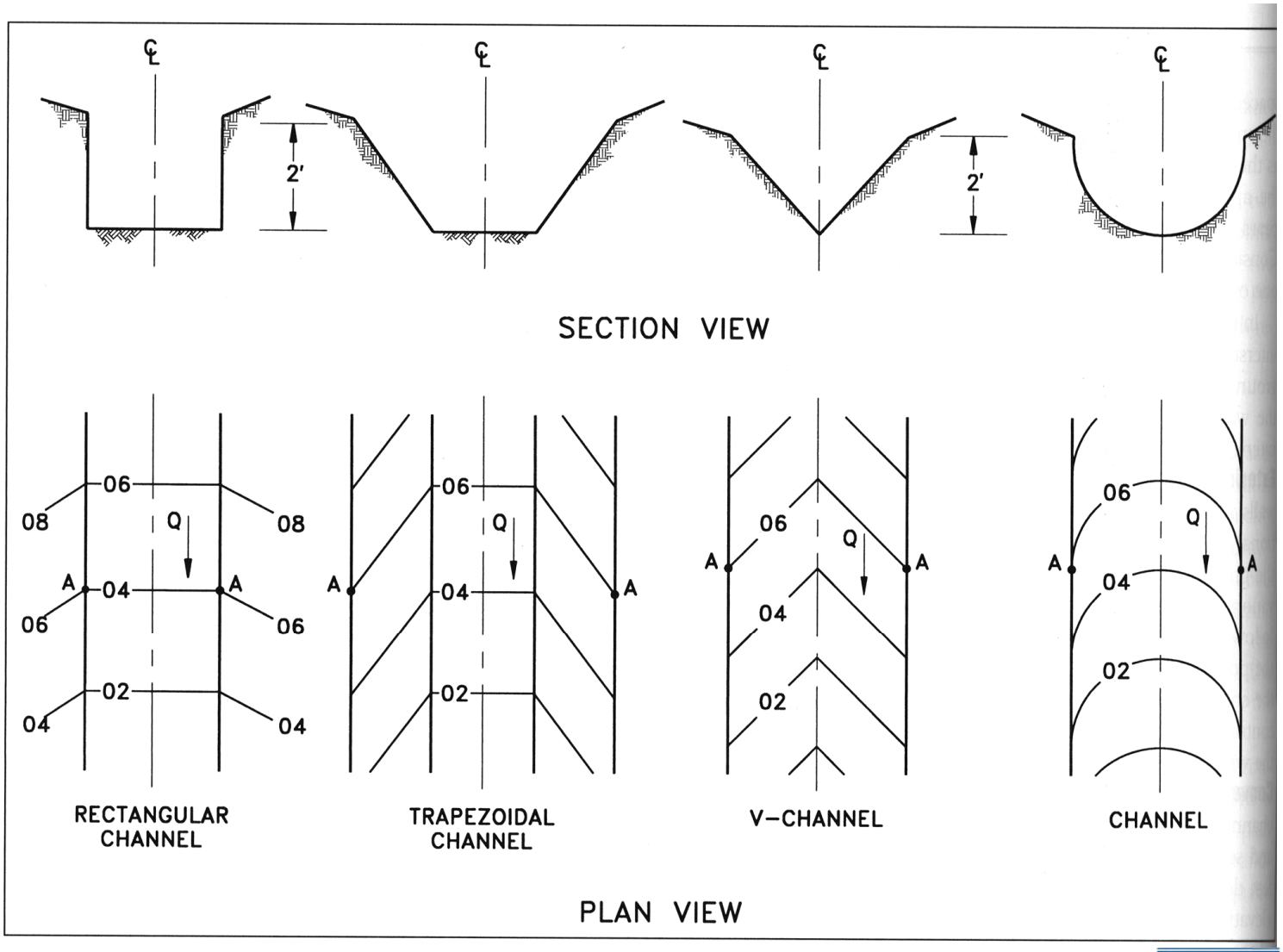
Valley or Swale



- Represented by contours which point toward the **higher** numbers
- Inverted V – points to higher numbers



Channel Shapes and Contours



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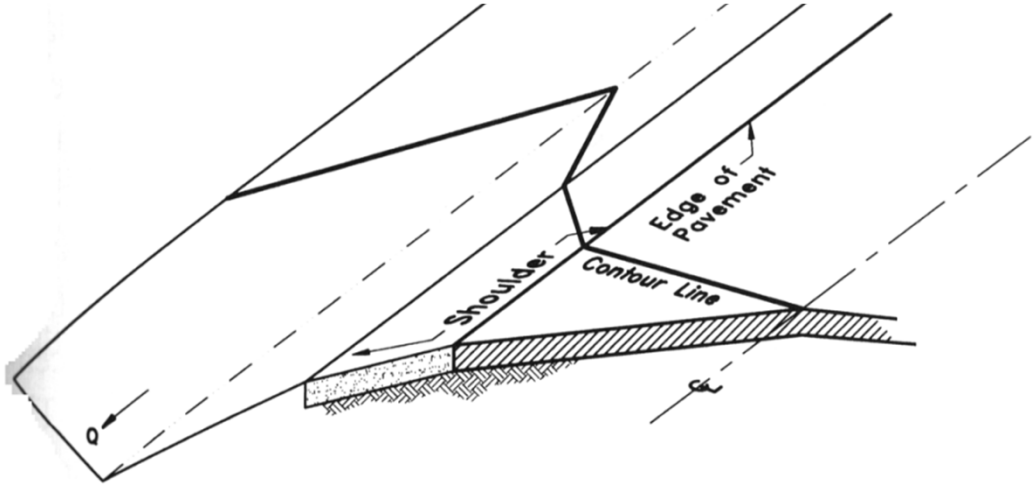
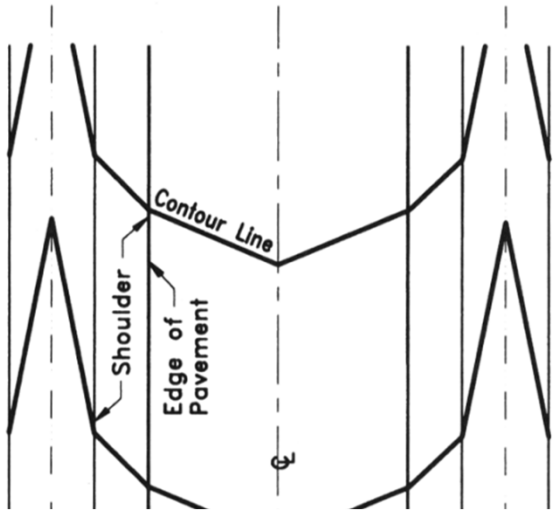
Road Drainage





- Crowned at center line to sheet flow off pavement
- "V"-shaped drainage along shoulders for roadside ditches or valley gutters

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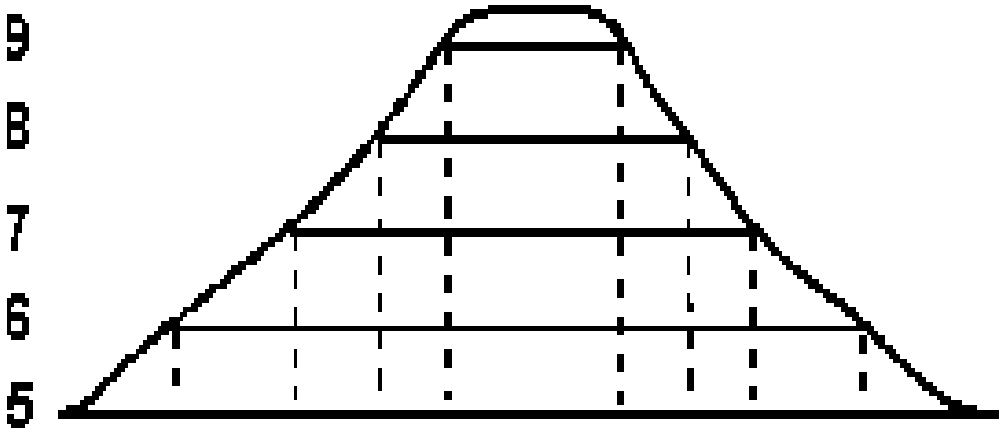
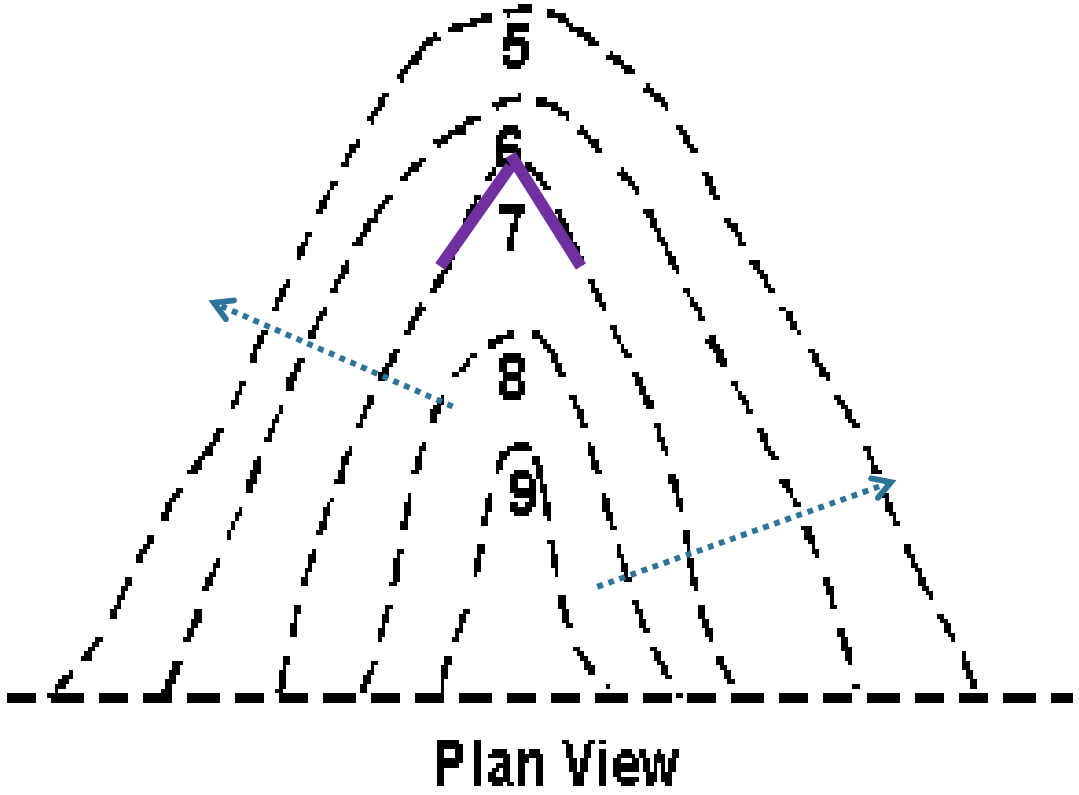
Ridge

- Appears similar to a valley, but represented by contours which point toward the **lower** numbers
- Denotes drainage divides



Section E



Plan View

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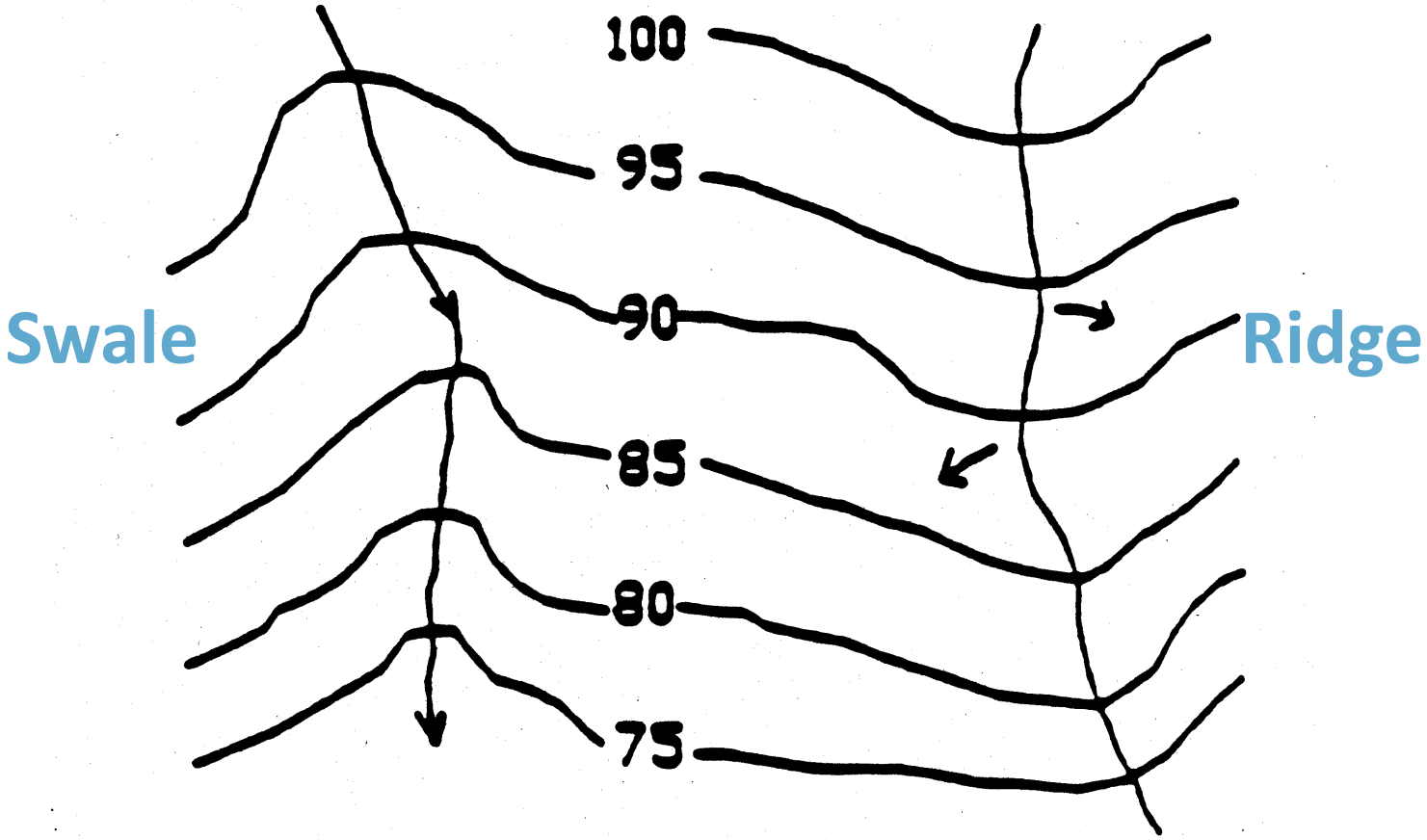
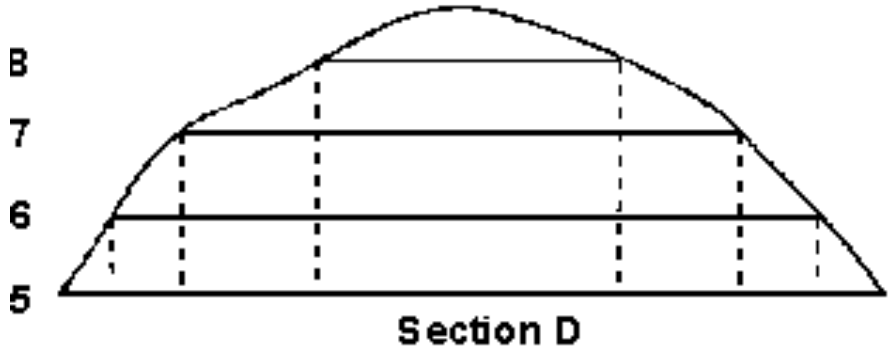
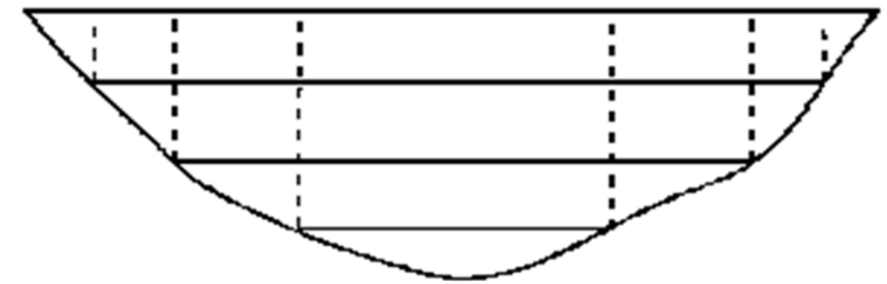
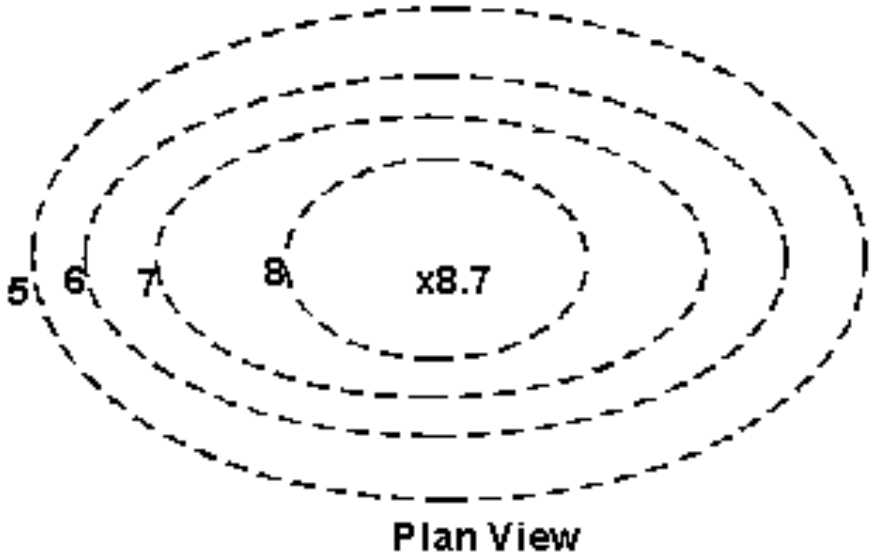
Ridge or Swale?

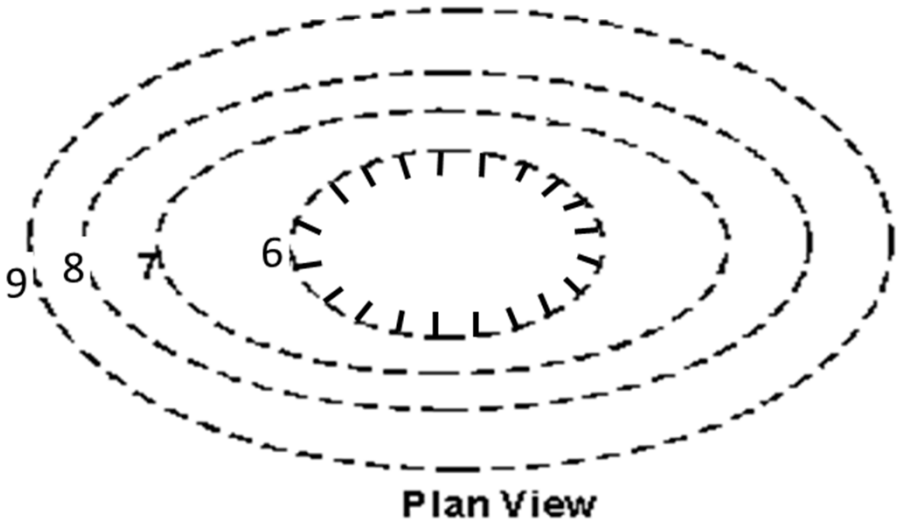


Summit vs. Depression









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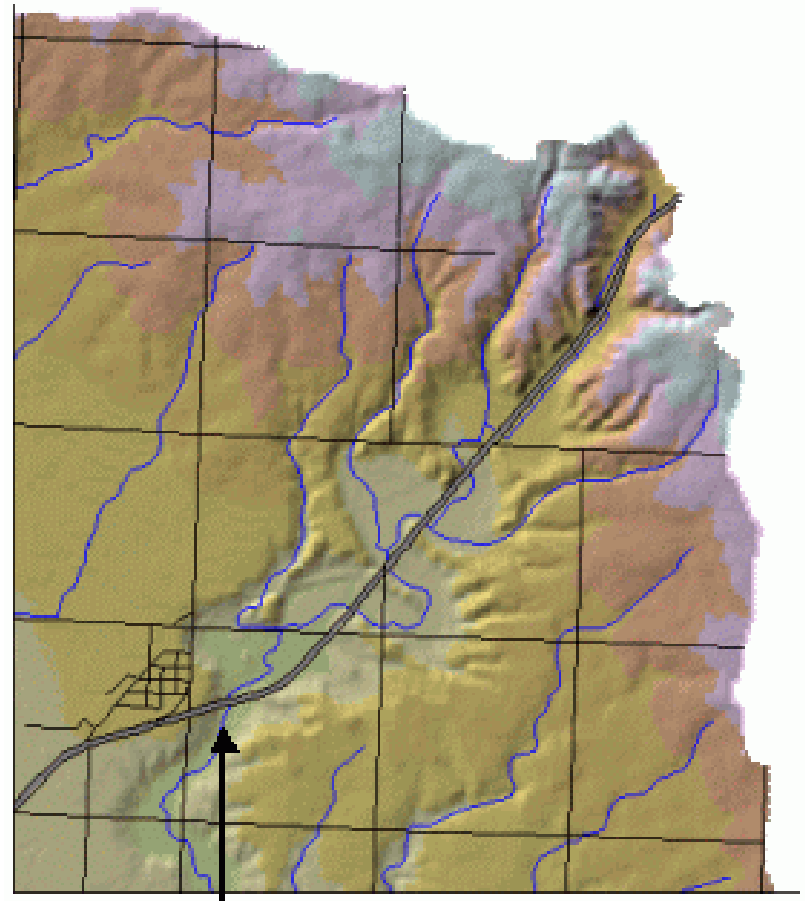
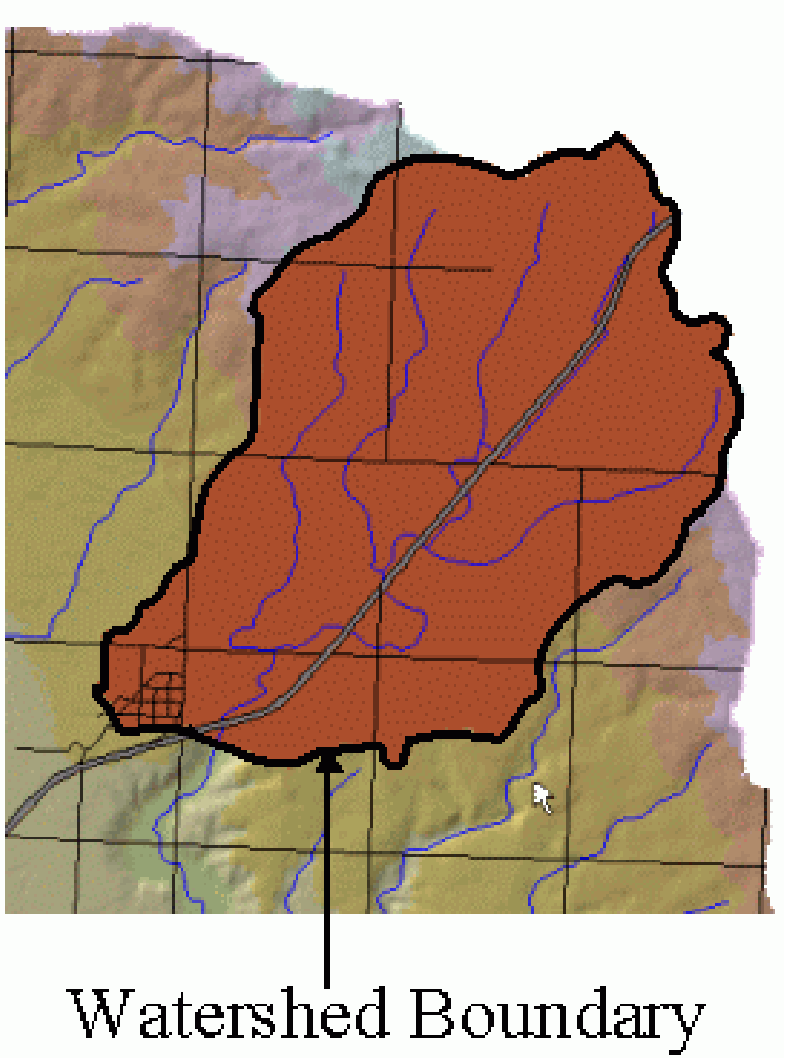
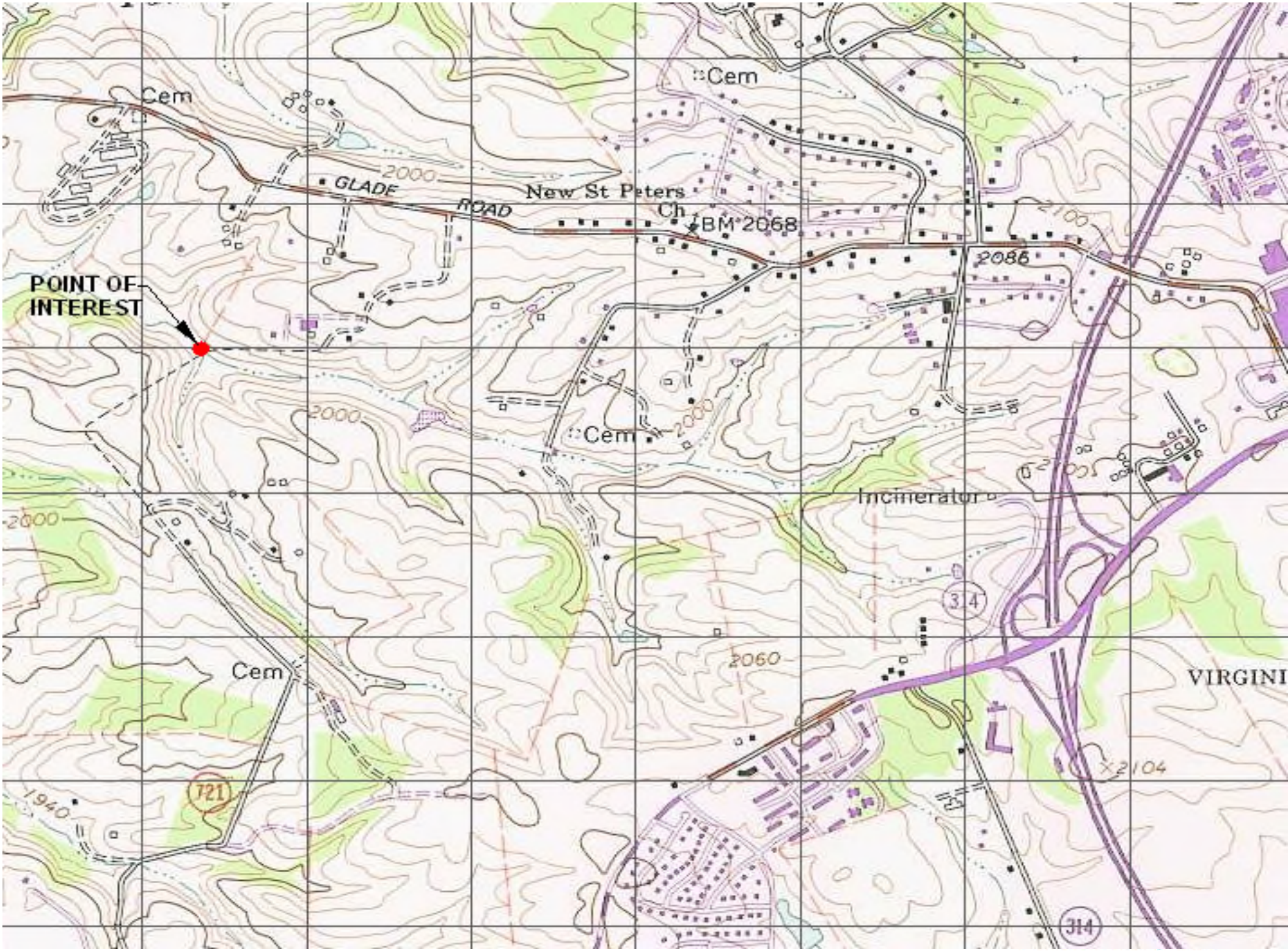
Using Contours to Designate Watersheds



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Cem
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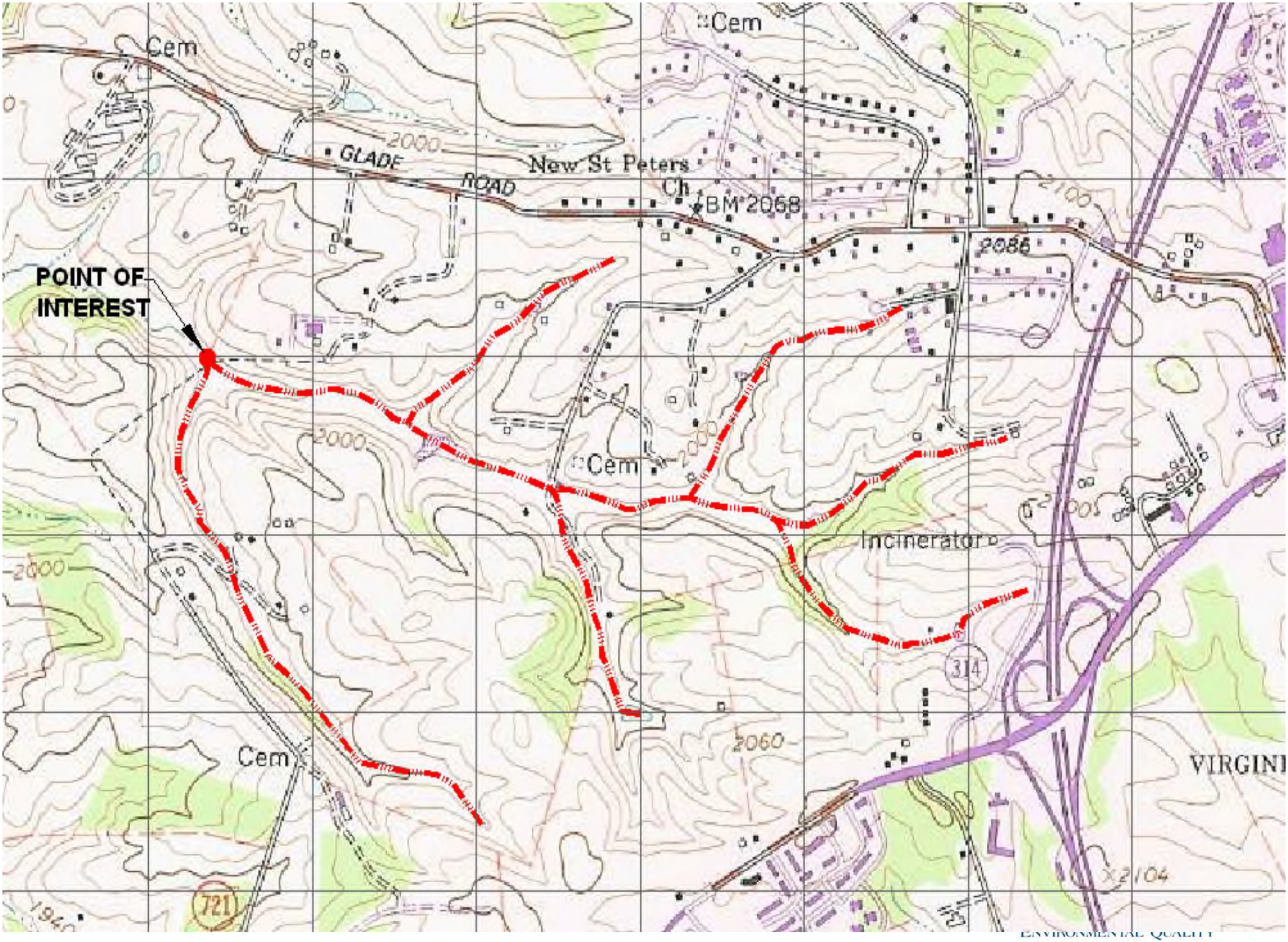
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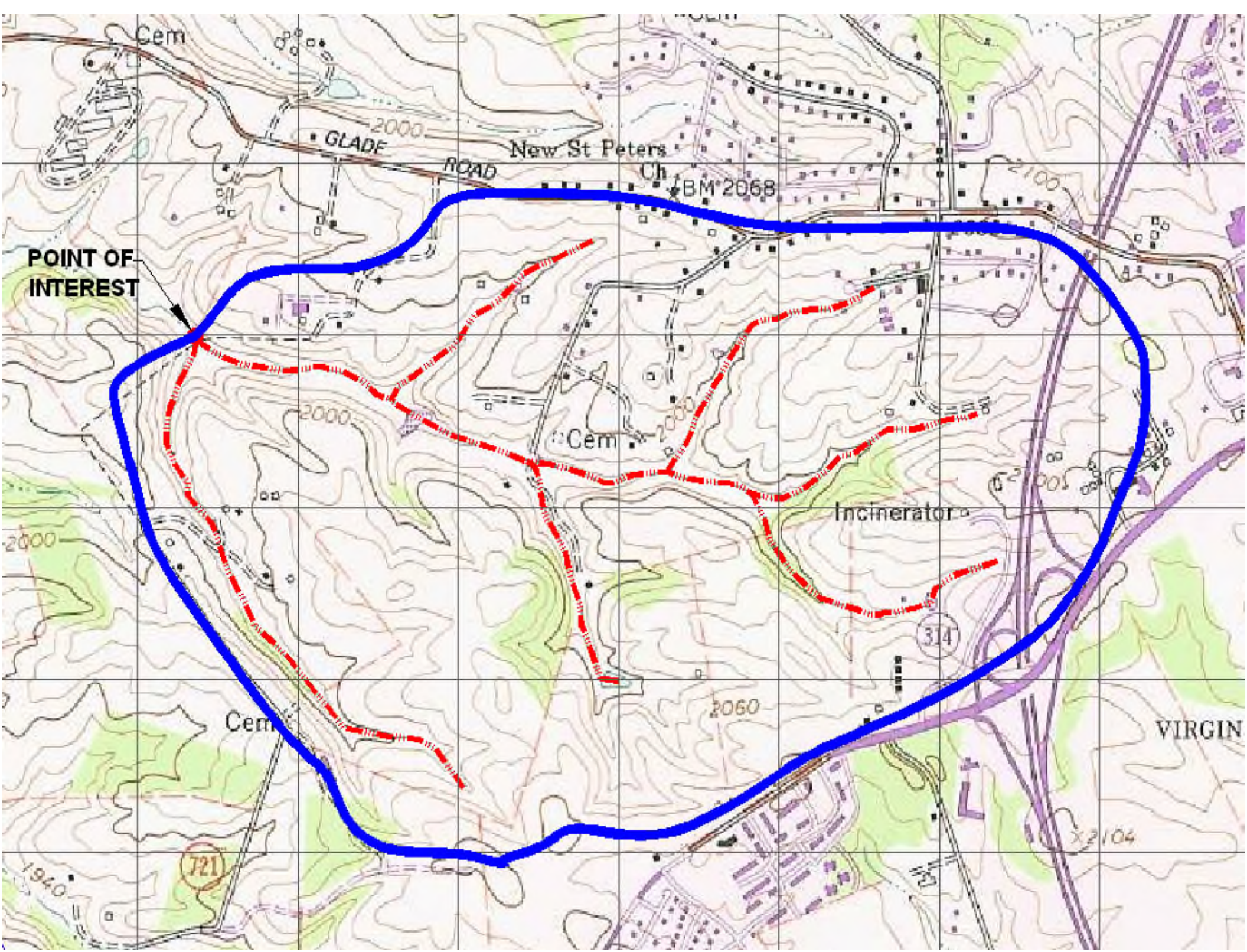
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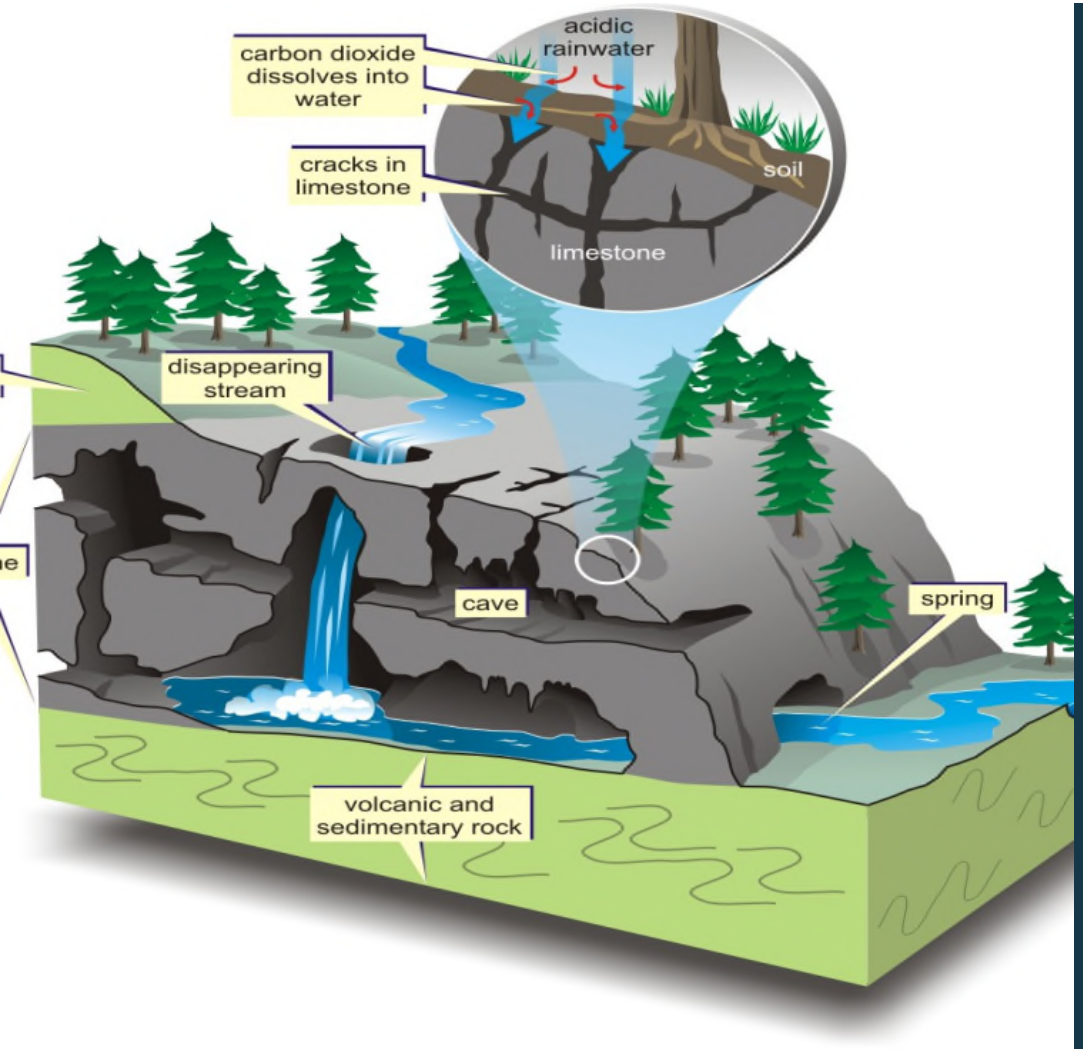
Karst Topography



- Limestone prevalent and easily dissolves
- Sinkholes
- Geotech should investigate areas prior to SWM facility placement/approval

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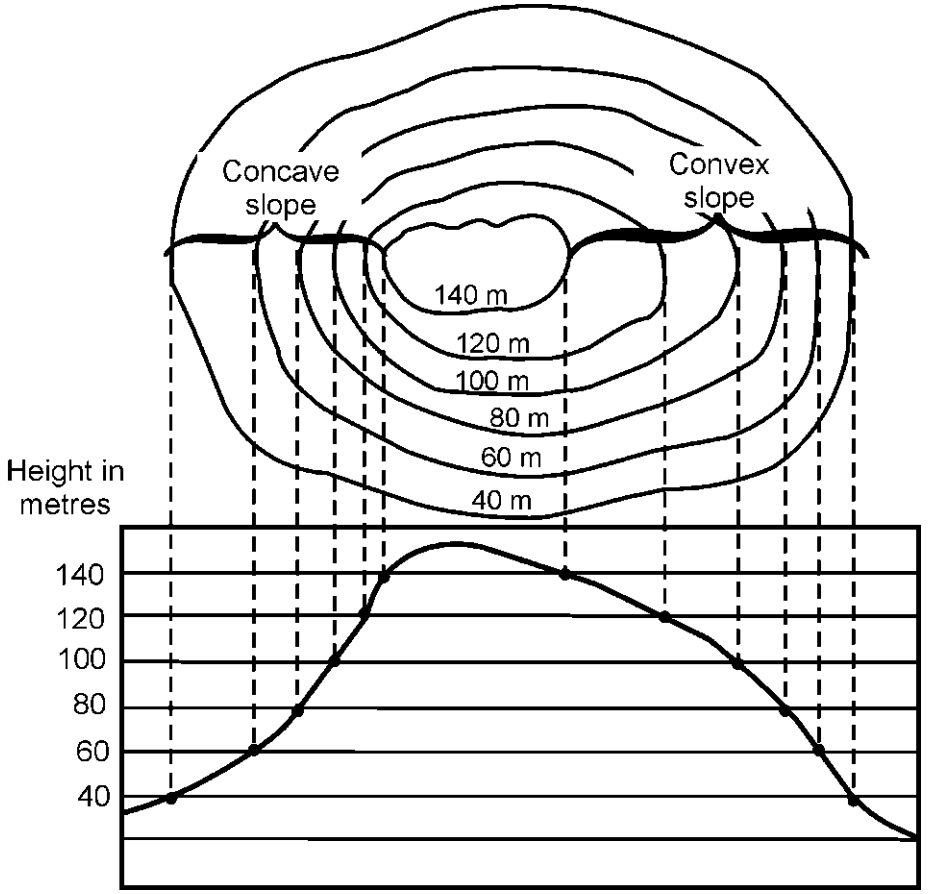
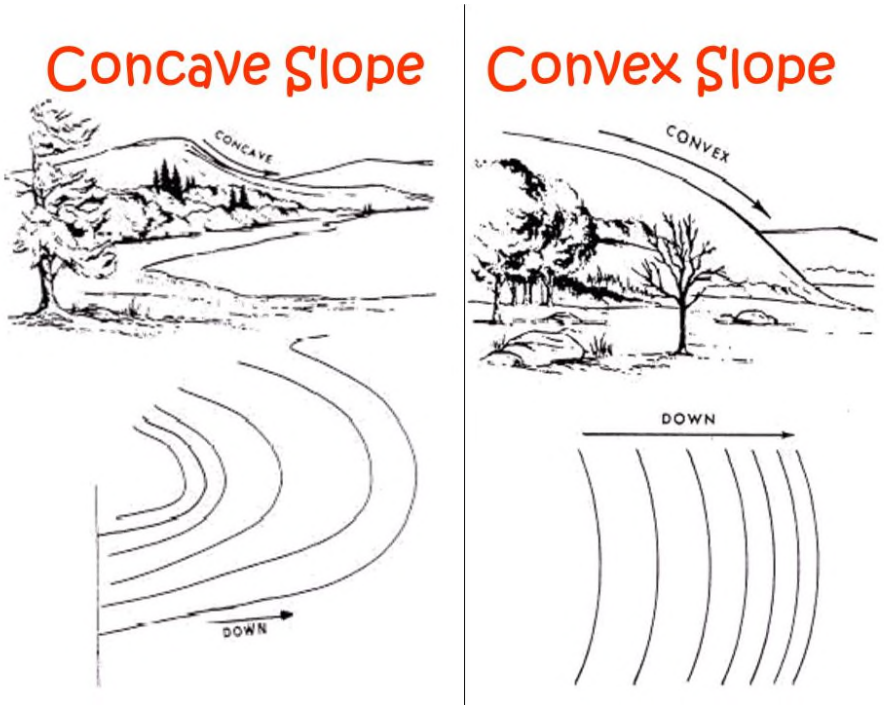
Sinkhole Problem in SWM Pond

Slopes and Slope Calculations

Contour profiles



Concave vs. Convex



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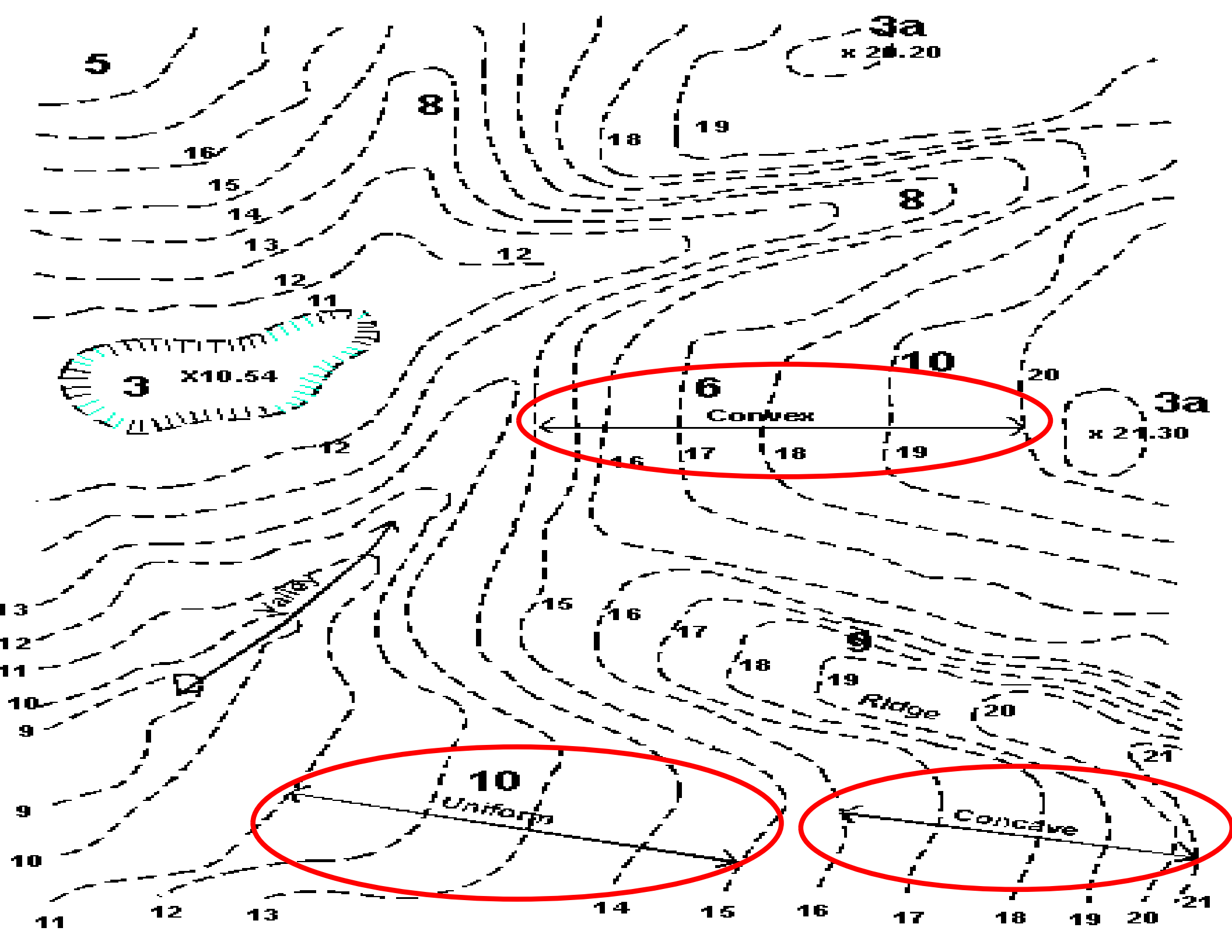
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5
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12
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x10.54
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Convex
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3a
x 21.30
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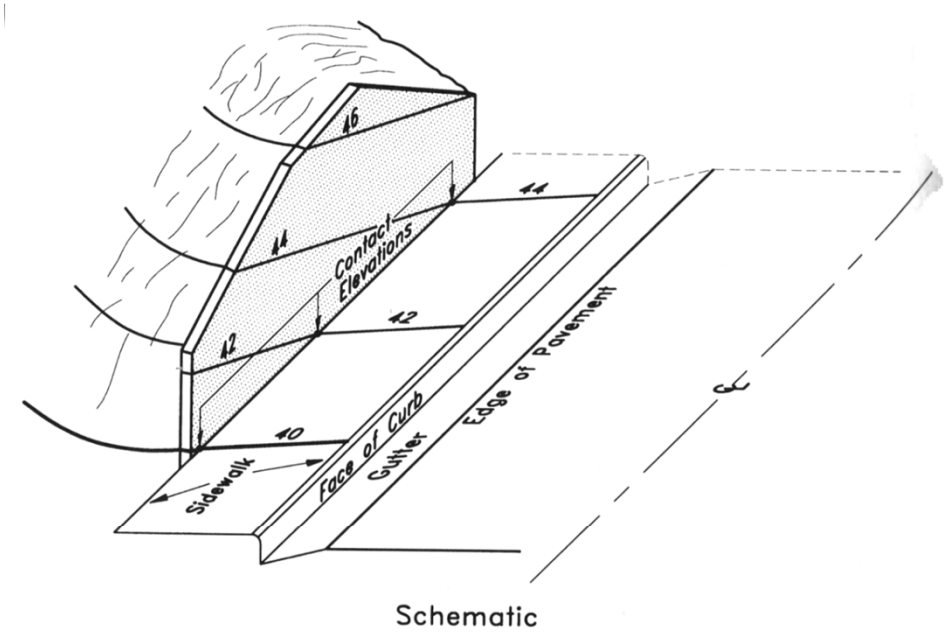
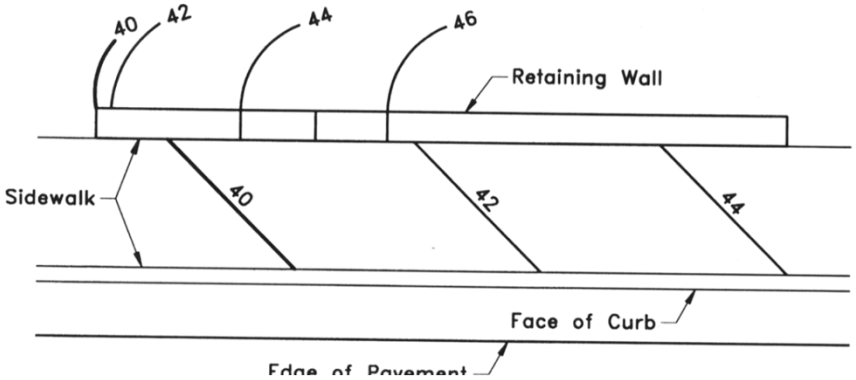
Retaining Walls and Contours



Schematic



- Looks as if contours disappear or do not connect properly
- TW and BW elevations
- Consider how water will flow at the bottom edge

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Slopes and Angles

- Presented as ratios (2:1, 3:1) or as percentages (50%, 33%)
- The closer the first number is to 0 or the higher the percentage, the steeper the slope.
- Slope = rise/run
- But ratios flip those two numbers, so it's run:rise
- For every three horizontal feet, there is one foot of vertical rise (3:1)

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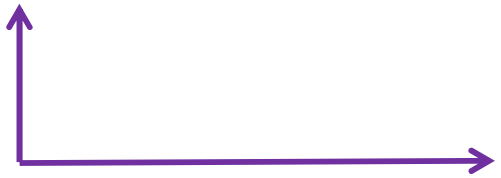
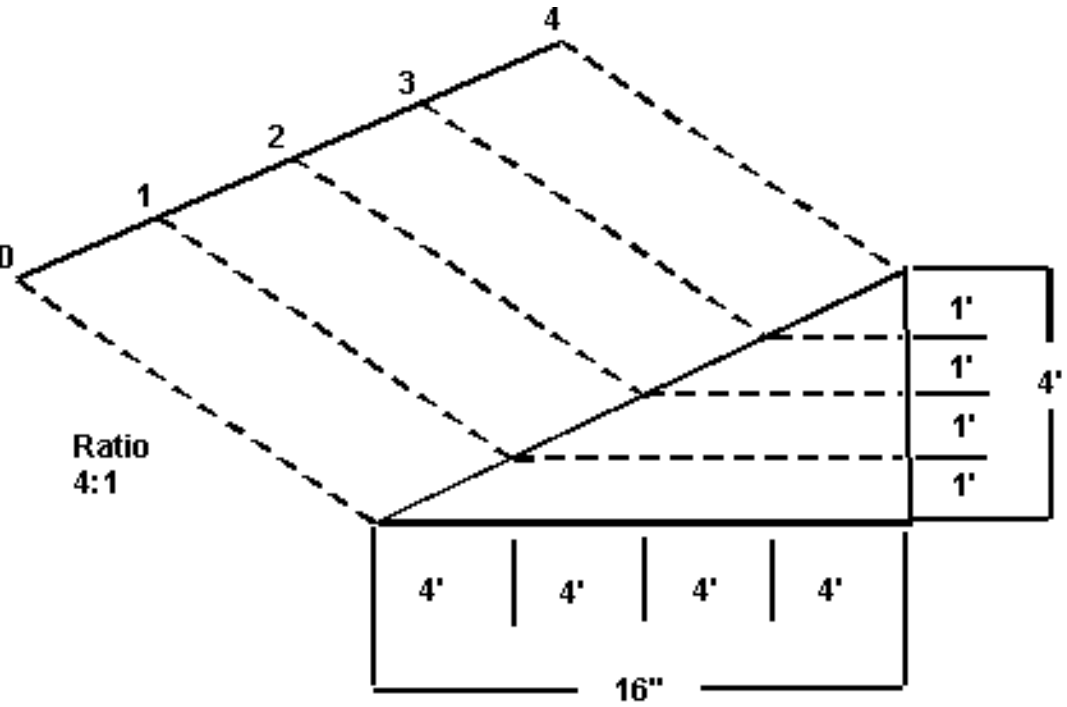
Slopes and Angles





- Slope percentage divides the vertical distance by the horizontal distance, then multiplies by 100.
  - $\frac{1}{3} \times 100 = 33.3\%$ slope
  - What is a 4:1 slope as a percentage?

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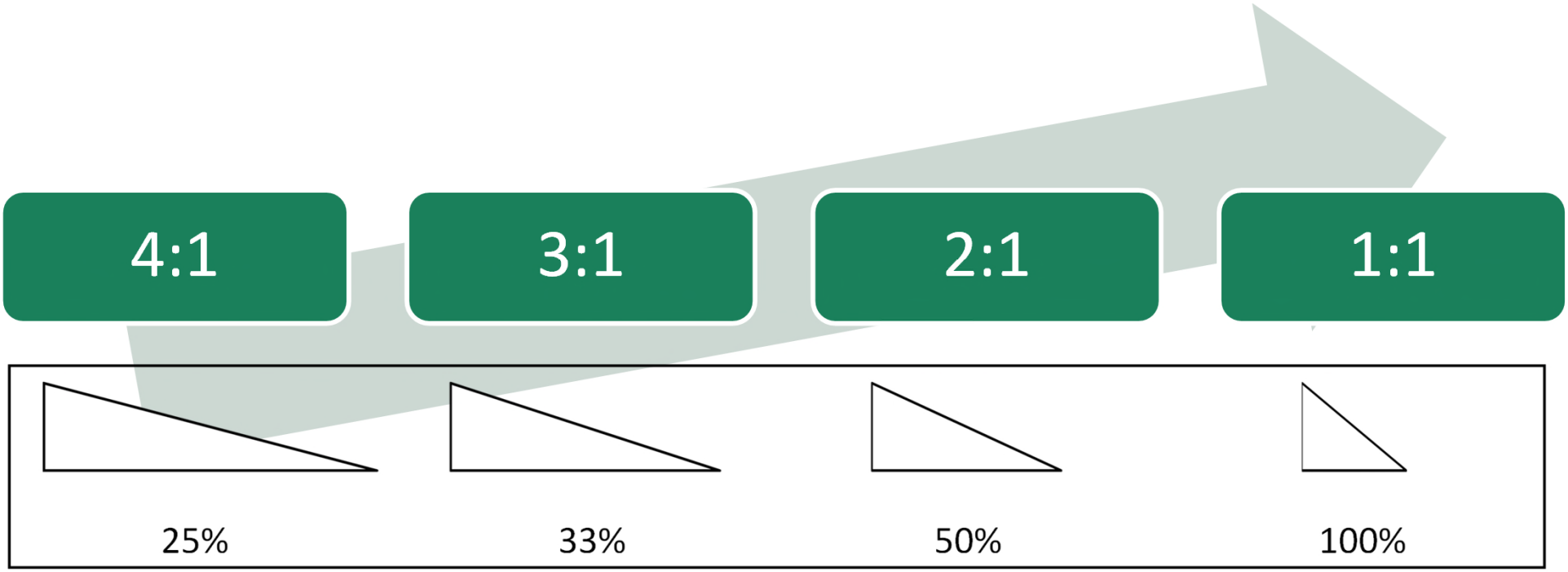
Slope Steepness



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Calculating Slope Steepness

- Choose two points of interest
- Find the elevation change (rise)
  - Subtract the two points of interest
- Measure the slope length (run)
- Divide rise/run
- Multiply by 100

$$\frac{(125 - 110)}{40} \times 100 = 37.5\% \text{ slope}$$

Additional Example

A slope is 250’ long. The first point of interest is at the 20’ contour. The second is on the 50’ contour. What is the slope percentage? Is it critical?

$$\frac{(50-20)}{250} \times 100 = 12\% \text{ slope}$$

At 12%, the slope should be no longer than 150 feet not to be critical.

Q&A

Reading contour lines

Cut and fill

Common site topography

Slopes and angles

Module 13b.

Plan Narrative

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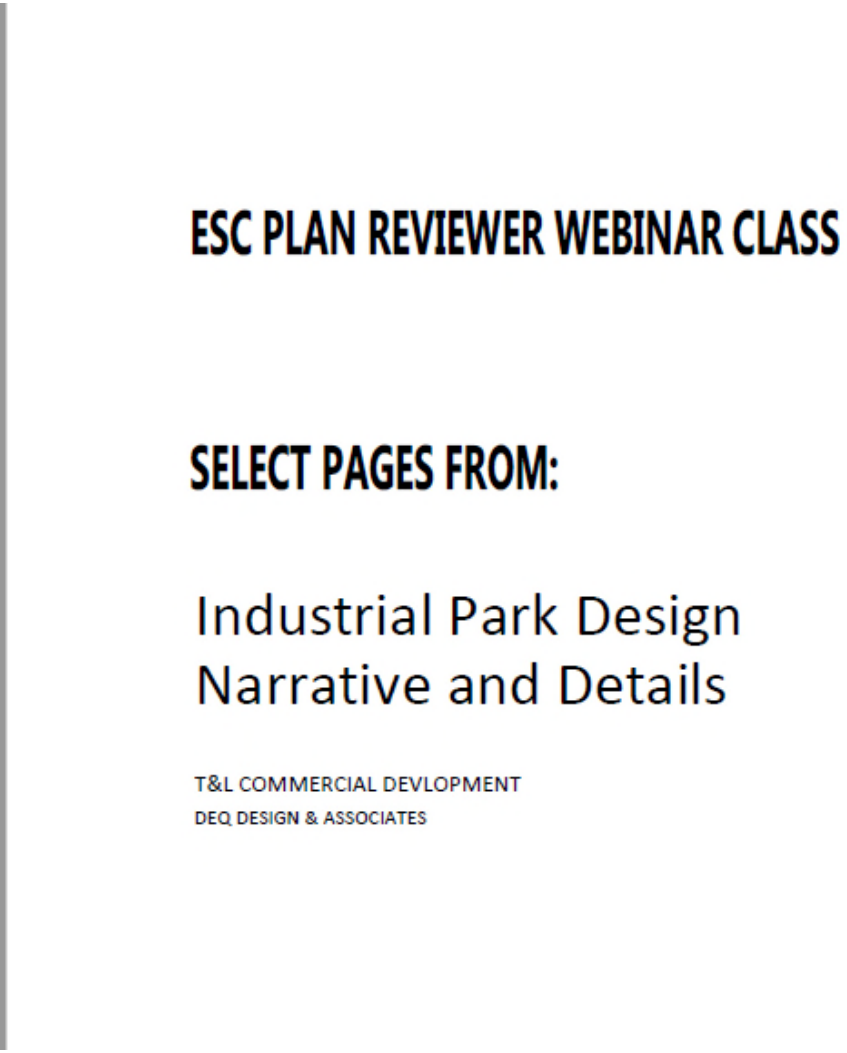
Narrative Portion of Plans

- Written out description of project
  - Existing conditions
  - Site development
- Read through this first
- So let's do that!

Narrative Exercise



- We'll do a guided reading through the highlights
- Please do not write on this booklet or mark it up
- Use the table provided in the PG for your notes

Narrative Plan Review Pgs. 1-2

- Project description
  - Nature, purpose, and size of the LDA
- Existing site conditions
  - Existing topography, vegetation, and drainage
- Adjacent properties
  - Neighboring areas that might be affected by LDA
- Off-site areas
  - Borrow sites, stockpiles, etc.

1 Project Description

T & L Commercial Development is proposing to develop a 6.7 acre vacant lot. The lot is located in Small County at 1111 Landry Lane. The project includes the construction of one 20,000 SF office building. Two travel lanes connect two separate parking lots, one on either side of the office building to Landry Lane. An employee picnic area is located at the rear of the office building and connected to the western parking lot. The McMcutcheon Pedestrian plaza and outdoor walkways connect various entrances to the building and parking lots. The parking lots provide a total of 70 parking spaces. The total traffic average daily trips to the site is estimated to be 100.

The office park is intended to meet the needs of a functioning business while also offering places for employees to enjoy the outdoors. Providing the patio area adjacent to an open turf area and meadow allow for a more aesthetically open and natural place for employees to escape the office if only for a few minutes. The site is zoned B-2 and the development is a by-right development with no special provisions or waivers. The adjacent properties to the east, north, and west are all vacant and forested.

2 Existing Site Conditions

The vast majority of the existing site is a grassed, open field, with a small portion along the northern edge of the property that is forested. There is approximately 5.8 acres of fair conditioned open space and 0.9 acres of forest. The site is on moderate slopes, with an average slope of 7% sloping mostly down to Landry Lane, with the eastern and western edges draining to either side. The soils are predominantly Hydrologic Soil Group (HSG) C soils, as indicated by the NRCS Websoil Survey, which indicates moderately well drained soils. Specifically they are classified as Codorus silt loam (43%) and Delanco loam (57%).

There are no known wetlands or streams on-site, however the southern edge of the property along Landry Lane drains through an existing 18" RCP pipe under the road to an existing stream, called Harper Creek. Harper Creek is an intermittent stream and is in poor condition, with a down cutting channel. No erosion around the culvert was evident during a field visit by Design & Design Associates on June 26th, 2013, but channel erosion and downsutting was taking place immediately downstream.

The site is in the Chesapeake Bay watershed and Harper Creek drains to DD stream, which is impaired for bacteria. A TMDL has not been developed for the impaired waterway.

Adjacent Areas

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Off-site Areas

Where, oh where, are the off-site areas?

Or at least the acknowledgement that there are none?

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Narrative Plan Review

- Soils
  - Name, erodibility, texture, etc.
- Critical areas
  - Steep slopes, karst, other sensitivities, etc.
- ESC measures
  - How erosion and sedimentation will be controlled
- Construction sequence
  - Order of operations (ESC first)

2 Existing Site Conditions

Soils

The vast majority of the existing site is a grassed, open field, with a small portion along the northern edge of the property that is forested. There is approximately 5.8 acres of fair conditioned open space and 0.9 acres of forest. The site is on moderate slopes, with an average slope of 7% sloping mostly down to Landry Lane, with the eastern and western edges draining to either side. The soils are predominantly Hydrologic Soil Group (HSG) C soils, as indicated by the NRCS Websoil Survey, which indicates moderately well drained soils. Specifically they are classified as Codorus silt loam (43%) and Delanco loam (57%).

There are no known wetlands or streams on-site, however the southern edge of the property along Landry Lane drains through an existing 18" RCP pipe under the road to an existing stream, called Harper Creek. Harper Creek is an intermittent stream and is in poor condition, with a down cutting channel. No erosion around the culvert was evident during a field visit by Design & Design Associates on June 26th, 2013, but channel erosion and downsutting was taking place immediately downstream.

The site is in the Chesapeake Bay watershed and Harper Creek drains to DD stream, which is impaired for bacteria. A TMDL has not been developed for the impaired waterway.

2 Existing Site Conditions

Critical Areas

The vast majority of the existing site is a grassed, open field, with a small portion along the northern edge of the property that is forested. There is approximately 5.8 acres of fair conditioned open space and 0.9 acres of forest. The site is on moderate slopes, with an average slope of 7% sloping mostly down to Landry Lane, with the eastern and western edges draining to either side. The soils are predominantly Hydrologic Soil Group (HSG) C soils, as indicated by the NRCS Websoil Survey, which indicates moderately well drained soils. Specifically they are classified as Codorus silt loam (43%) and Delanco loam (57%).

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13b. | PLAN NARRATIVE BOOKLET | Pg. 1-2

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Critical Areas cont'd

4 Site Drainage and Hydrology

4.1 Existing Site Hydrology and Drainage

Currently there is one primary drainage area of approximately 5.8 acres draining the site. It begins just north of the northern edge of the property and flows overland to the existing culvert along the southern edge of the property that drains under Landry Lane, which serves as the outlet from the site. The culvert then outfalls to Harper Creek on the other side of the road. The existing culvert is an 18" concrete pipe that is undersized for the site currently. Large storms every few years flood the road. Flows also exit the pipe at high velocities and have caused severe erosion downstream. The time of concentration (Tc) was estimated as 22 minutes and the curve number (CN) equal to 79 based on fair existing site conditions.

Narrative Plan Review

- ESC measures
  - Not included
  - Sure better be on the plan sheets, with appropriate detail images
- Construction sequence
  - Not included
  - Hopefully on plan sheets
  - Thorough, easy to understand

Narrative Plan Review

- Permanent stabilization
  - Types proposed after construction
- Stormwater runoff considerations
  - Strategies for water quantity compliance for channel and flood protection
- Calculations
  - Water quantity, ESC measures, permanent SWM facilities
  - Pre- and post-development

Narrative Plan Review

- Permanent stabilization
  - Not included
  - I’m tired of this trend

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Stormwater runoff considerations

- Narrative booklet pages 2-4, top of 6, and 9
  - Curve numbers
  - Time of concentration
  - Precipitation amounts
  - Existing peak flows
  - Channel Protection
  - Flood Protection

Calculations

- Narrative booklet back of last page (App. B)
  - Won't evaluate now
- Remember, we don't know about any ESC measures yet
  - Still have to look for those: SBs, STs, DDs, IPs, OPs, etc.

Module 13c.

Illustrative Portion of Plans

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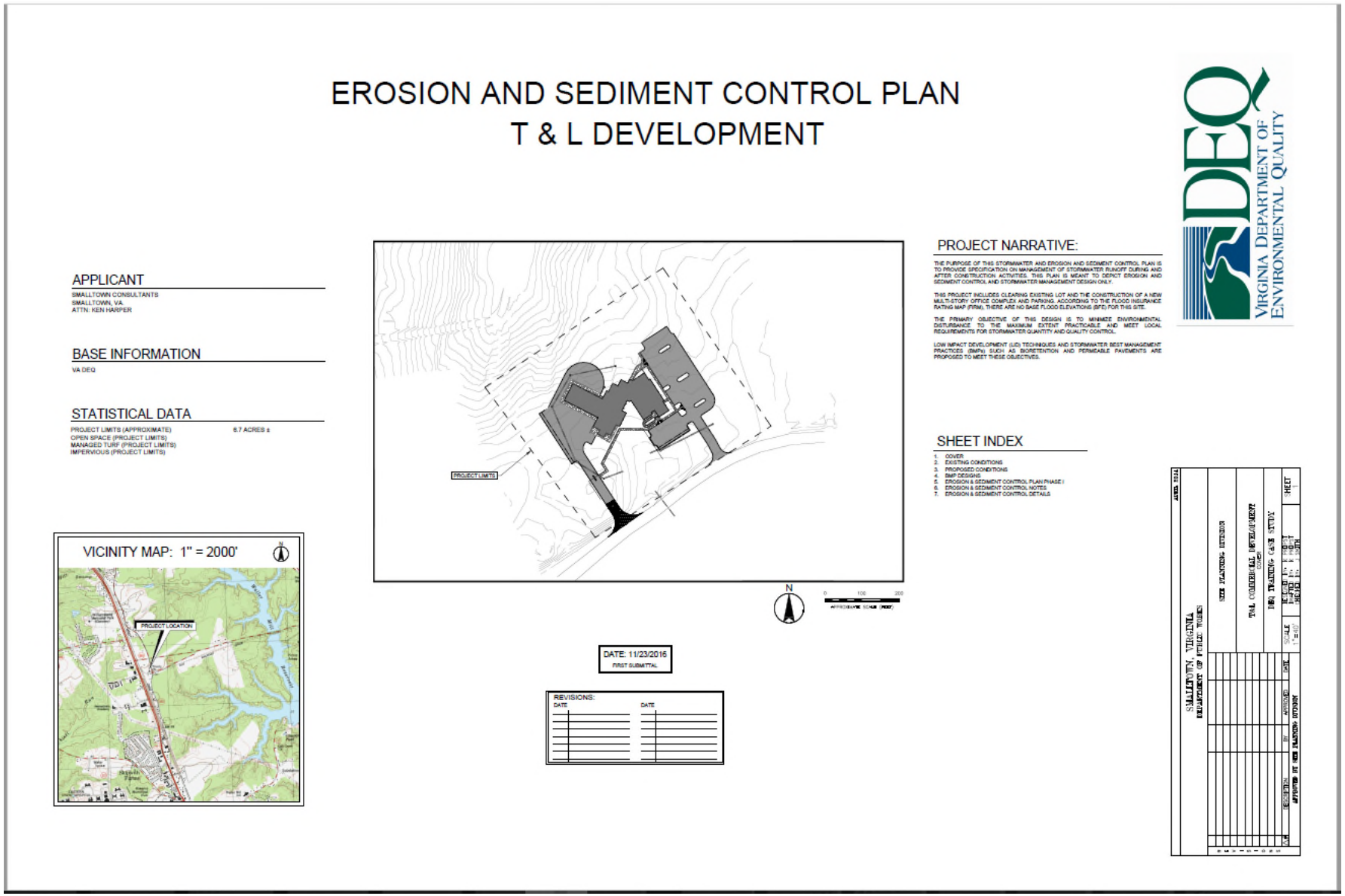
Full-sized map sheets

- Cover sheet with a small vicinity map showing the general location of the project
- Soils map
- Map showing the drainage areas and general drainage directions on the site
- Map showing original conditions
- Plat showing the proposed development, including the ESC/ESM plans
- A detail sheet of the C-BMPs

You can mark on the plans



13c. | ILLUSTRATIVE PLAN | Separate plan

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Illustrative PR Pages 1-3

- Vicinity map
  - Site in relation to surrounding area
- North arrows
- Limits of clearing and grading
  - Match up
- Existing contours
  - Dashed or lighter gray lines

Illustrative PR Pages 1-3

- Adjacent areas
  - Upstream and downstream
- Final contours
  - Permanent SWM
  - Make sense with existing?
  - Evaluate cut/fill and steep slopes
- Existing vegetation
  - Tree lines

Illustrative PR Pages 2-4

- Soils
  - Boundaries of different soil types
  - Compare to major grading activities
- Existing drainage patterns
  - Drainage areas and sizes noted
- Critical areas
  - Slopes, endangered species, etc.
- Site development
  - All improvements shown

Illustrative PR Pages 3-6

- Location of practices
  - ESC and SWM practices
- Off-site areas
  - Borrow and waste areas
  - ESC controls
- Detail drawings
  - ESC and SWM
- Maintenance
  - ESC (and SWM) structures and responsibility

After both the narrative and illustrative review, are you ready to approve this plan?

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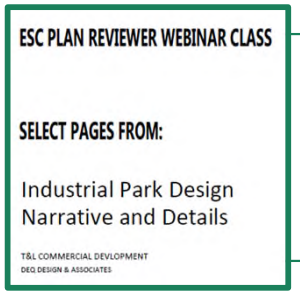
Q&A

13a. Plan reading skills



13b. Plan narrative

13c. Illustrative portion of plans

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Module 13d.

Reviewing for Water Quantity

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Channel Protection Compliance

How did they show channel protection compliance?

- Determined allowable release rate using Energy Balance Method
- Provide post-development flow rate after routing through stormwater management BMPs
- Narrative concludes SWM design reduced post-development release rate lower than allowable release rate

Channel Protection Compliance

Are channel protection requirements satisfied?

Evaluate EB equation shown in narrative booklet

- Is the allowable release calculated correctly?

Channel Protection Compliance

4.2.3 Water Quantity Requirements

A. Channel Protection Requirement - The site drains concentrated stormwater flow into a natural stormwater conveyance system. Therefore, the energy balance equation must be satisfied for the 1-year storm. The energy balance equation is:

$$Q_{1,post} x\ Vpost \leq Q_{1,pre} x\ Vpre$$

Where **Qpre = 3.6 cfs** and **Vpre = 0.43 Acre-ft**. The Vpost and Qpost shall be less than the product of Qpre and Vpre. $Q_{allowable}$ is 4.1 cfs. See Appendix B for detailed calculations.

Narrative p. 4

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Channel Protection Compliance

Energy Balance:

$$Q_{post} \leq Q_{pre}\left(\frac{V_{pre}}{V_{post}}\right)$$

$$= 3.6 \times \left(\frac{0.43}{0.38}\right)$$

$$= 4.1\ cfs$$

Allowable Q_1 > Proposed Q_1

Proposed design discharge is 3.56 cfs

- Less than existing site discharge of 3.6 cfs

- Less than allowable release rate using Energy Balance method

Narrative, Appendix B

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Channel Protection Compliance

Are channel protection requirements satisfied?

- Used Energy Balance to show compliance

but did not include improvement factor (IF)

X Allowable release rate not calculated correctly

Channel Protection Compliance

Energy Balance:

$$Q_{post} \leq Q_{pre}\left(\frac{V_{pre}}{V_{post}}\right)$$

$$= 3.6 \times \left(\frac{0.43}{0.38}\right)$$

$$= 4.1\ cfs$$

Allowable Q_1 > Proposed Q_1

What else should you check?

What about peak flow rates?

- Check inputs
  - P
  - Tc
  - CN

Narrative, Appendix B

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Channel Protection Compliance

Inputs:

Time of Concentration (pre-development and post-development)

- What is **post Tc**?

5 minutes per plan
(computed using HEC-HMS)

Channel Protection Compliance

Inputs:

Time of Concentration (pre-development and post-development)

- What is **pre Tc**?

Channel Protection Compliance

4 Site Drainage and Hydrology

4.1 Existing Site Hydrology and Drainage

Currently there is one primary drainage area of approximately 5.8 acres draining the site. It begins just north of the northern edge of the property and flows overland to the existing culvert along the southern edge of the property that drains under Landry Lane, which serves as the outlet from the site. The culvert then outfalls to Harper Creek on the other side of the road. The existing culvert is an 18" concrete pipe that is undersized for the site currently. Large storms every few years flood the road. Flows also exit the pipe at high velocities and have caused severe erosion downstream. The time of concentration (Tc) was estimated as 22 minutes and the curve number (CN) equal to 79 based on fair existing site conditions.

Narrative, p. 2

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Evaluate

1. Time of Concentration (pre-development and post-development)

   pre Tc = 22 minutes

Verify using plans and TR-55 Tc method from Module 9.

Time of Concentration

Online demo of WIN TR-55

Channel Protection Compliance

Energy Balance:

$$Q_{post} \leq Q_{pre}\left(\frac{V_{pre}}{V_{post}}\right)$$

$$= 3.6 \times \left(\frac{0.43}{0.38}\right)$$

$$= 4.1\ cfs$$

Allowable Q_1 > Proposed Q_1

What else should you check?

What about peak flow rates?

- Check inputs
  - P ✓
  - Tc ✓
  - CN

Narrative, Appendix B

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Channel Protection Compliance

4 Site Drainage and Hydrology

4.1 Existing Site Hydrology and Drainage

Currently there is one primary drainage area of approximately 5.8 acres draining the site. It begins just north of the northern edge of the property and flows overland to the existing culvert along the southern edge of the property that drains under Landry Lane, which serves as the outlet from the site. The culvert then outfalls to Harper Creek on the other side of the road. The existing culvert is an 18" concrete pipe that is undersized for the site currently. Large storms every few years flood the road. Flows also exit the pipe at high velocities and have caused severe erosion downstream. The time of concentration (Tc) was estimated as 22 minutes and the curve number (CN) equal to 79 based on fair existing site conditions.

Narrative, p. 2

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Existing Curve Number

From Report: "… the curve number (CN) equal to 79 based on fair existing site conditions."

Wrong: Curve Number for existing conditions should be calculated assuming **good** existing site conditions.

When reviewing Table 2-2A from TR-55 User's Manual, curve number for good existing site conditions is at most **74**.

Channel Protection Compliance

Appendix B: Water Quantity Calculations

Existing Conditions:

Pre: $S = \frac{1000}{CN} - 10 = \frac{1000}{79} - 10 = 2.7in$

$$q_{pre} = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(2.6 - (0.2 \times 2.7))^2}{2.6 + (0.8 \times 2.7)} = 0.90\ in$$

$$V_{pre} = q\ x\ A\ x\ \frac{1}{12} = 0.90\ in\ x\ 5.7\ Ac\ x\ \frac{1\ ft}{12\ in} = \mathbf{0.43\ Acre - ft}$$

Narrative, Appendix B

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Channel Protection Compliance

Are channel protection requirements satisfied?

Used Energy Balance to show compliance

but did not include improvement factor (IF)

X Allowable release rate not calculated correctly

X Incorrectly assumed fair for existing conditions (predevelopment peak flow rate incorrect)

Allowable Discharge

Does the proposed discharge leaving the site meet the allowable discharge?

$$q_{1post} \leq q_{1pre}\left(\frac{Vr_{pre1}}{Vr_{post1}}\right)(IF)$$

$$= 3.6 \times \left(\frac{0.32}{0.38}\right) \times 0.8 = 2.4\, cfs$$

NO → - Proposed design discharge is 3.56 cfs

- Less than existing site discharge of 3.6 cfs

BUT not low enough to meet Energy Balance requirements

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Channel Protection Compliance

Are channel protection requirements satisfied?

No

Channel Protection – Energy Balance

Curve Numbers can then be used to find water quantity requirements for site.

$$\text{Post } S = \frac{1000}{CN} - 10 = \frac{1000}{78} - 10 = 2.8\ in$$

$$Q_{post} = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(2.6 - (0.2 \times 2.8))^2}{2.6 + (0.8 \times 2.8)} = 0.86\ in$$

$$\text{Pre } S = \frac{1000}{CN} - 10 = \frac{1000}{74} - 10 = 3.5\ in$$

$$Q_{pre} = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(2.6 - (0.2 \times 3.5))^2}{2.6 + (0.8 \times 3.5)} = 0.67\ in$$

$$Vr_{post1} = Q \times A \times \frac{1}{12} = 0.86\ in \times 5.3 Ac \times \frac{1\ ft}{12 in} = 0.38\ Acre - ft$$

$$Vr_{pre1} = Q \times A \times \frac{1}{12} = 0.67\ in \times 5.7 Ac \times \frac{1\ ft}{12 in} = 0.32 Acre - ft$$

Flood Protection Compliance

Are flood protection requirements satisfied?

Flood Protection Compliance

B. Flood Protection – The existing outfall is currently experiencing localized flooding, as the culvert is undersized. Therefore, the SWM Plan was designed such that the 10 year, 24 hour post-development peak discharge will be less than the pre-development 10-year, 24 hour storm event.

$$Q_{10,post} \leq Q_{10,pre}$$

The flood protection criteria are satisfied as the pre-development **$Q_{10,\,post}$ of 15.9 cfs,** is less than the **$Q_{10,\,pre}$ of 17.5 cfs.**

Narrative p. 4

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All areas discharging from site identified?

No → Where did the other 0.4 acres go?

Important to evaluate all outfalls from site, even if they are not the primary outfall.

Other outfalls could be negatively affected if more drainage is being forced to flow to other areas.

Questions?

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