Lab 10: Surface water and groundwater

One of the greatest forces for shaping topography is the action of running water.

**Determining the Boundaries of the Varden Creek Watershed**

A. Using the portion of the Silver Star Mountain, Washington, attached, locate the outlet point of Varden Creek. This will be the lowest elevation in the watershed and in most cases will be the mouth of your stream.

B. Trace the stream from its mouth to its tributaries. Using a pencil, make marks along the stream and its tributaries every inch or so.

C. At each mark, draw a faint line (preferably with pencil) perpendicular to the stream or tributary, running out in both directions.

D. Follow each line out from the stream or tributary until you reach a maximum elevation. Mark all of these elevation high spots with an “X”.

E. Locate the beginning of each tributary, or the place where the stream’s water originates. Extend a line out from each of these locations, in the direction opposite to the flow of water. Follow these lines until you reach a maximum elevation. Mark these high points with an “X”.

F. Connect all high points with a line, following ridges and crossing slopes at right angles to contour lines. The line resulting from connecting the dots will be the boundary of your watershed. Double check your boundaries to ensure accuracy, and then mark them with a pen.

**The Thornton Creek Watershed**

1. Look at the topographic map and 3-D model of the Thornton Creek watershed in North Seattle. What kind of topographic features define the boundaries of this watershed?

2. Would it be difficult to define the boundaries of the Thornton Creek watershed using the same contour interval as the Silver Star map? Why or why not?

3. What size contour interval might be useful in defining the boundaries of the Thornton Creek Watershed?
Clearly, seeing some of this topography in the field is an excellent way of determining some general behavior of streams. In this field trip, you will look at:

- the erosion, transport and deposition of sediment by running water, both qualitatively and quantitatively.
- the landforms generated and modified by streams.

Some vocabulary that you will need from the chapter on groundwater:

**Aquifer** — a layer of sediment or body of rock that can hold and transmit groundwater.

**Aquiclude** — a layer of sediment or a body of rock that is **impermeable** to water.

**Water table** — the subsurface plane that separates saturated and unsaturated sediment.

*Directions:* Take I-5 North to 128th St. SW (exit 186) and turn left (west) off the off-ramp. Continue west as it becomes Gibson Rd., and turn left, then a quick right onto 17th Ave. W. Go to the end of the road and exit the van at the lakeshore.

**Stop 1 — Lake Stickney**

This lake is the source of Swamp Creek, which eventually empties into Lake Washington in Kenmore.

The elevation of this lake is approximately 450 feet. Clearly, the lake fills up if there is **precipitation**. Across the lake is where Swamp Creek begins. Between the creek and seepage into the ground, how can this lake stay basically the same size all year, even during the summer when there is virtually no precipitation? In other words, what is another source besides rain or snow?

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Draw a schematic **cross-section** of the lake and its surrounding hills, showing the **profile** of the lake bottom and hills, and the level of the lake surface. Draw the **water table** in this area with dotted lines.
Take I-5 south to 164th St. (exit 183); turn left (west) off the off-ramp. Follow the road to the bottom of the valley (less than a half mile) and turn right into a small gravel parking lot across from a large stormwater treatment facility. Park and examine the artesian well.

**Stop 2** — The 164th Street well (elevation 360 feet)
This is an **artesian** well, which simply means that no pump is needed to bring the water out of the ground. How does this water source differ from the water source of Lake Stickney?

Read the sign and determine the **source** of the water (including the **depth** to the water).

Draw another schematic cross-section through this valley, showing the profile of the riverbed and hills, and the river surface. Shade in what level you think the **aquifer** is at. Must the layer above the aquifer be an **aquiclude**? If so, label the layer above the aquifer as such.

Return to the vans, and head back east on 164th St. Head south on I-5 to N 145th St. (exit 175); head right (west) on 145th. Turn right (north) on 1st Ave. NE and park on the side of the road next to Twin Ponds Park.

**Stop 3** — Near the headwaters of the North Fork of Thornton Creek
The North Fork really begins about a mile north, at Ronald Bog, but this is a spot which is typical of the headwaters area of any stream.
According to the map, what is the elevation here? The elevation at Ronald Bog is feet; what is the gradient (in feet/mile) of Thornton Creek between here and Ronald Bog?

Examine the stream as it leaves Twin Ponds. Fill in the table below:

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<thead>
<tr>
<th>Width (m)</th>
<th>Depth (m)</th>
<th>Cross-sectional area (m²)</th>
<th>Velocity (m/s)</th>
<th>Discharge (m³/s)</th>
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How turbid is the lake water? Use the Secchi disk to determine a measure of turbidity by: 1) filling a bucket with water from the lake; 2) quickly pouring it into the large clear plastic container until the container is full; 3) making sure the Secchi disk is under the container (perhaps you should do this first); 4) removing the rubber stopper from the side of the container to let the water out until...5) you can see the Secchi disk clearly by looking straight down into the container from the top. Write down the depth of water left in the container as a measure of turbidity (use centimeters as units).

How turbid is the stream water? Give the depth of water left in the container with this water.

Given both turbidities, is their relative magnitude what you expected? Why or why not? Use “water energy” in your explanation.

What sediment grain size is predominant in the streambed here?

Was this sediment transported here by the stream or was it already here (presumably deposited by the glaciers) and uncovered by erosion? How can you tell?
Across the street is the Aegis Retirement Home, a new and controversial development due to its siting on the Twin Ponds wetland. What precautions have the developers taken to try and prevent their ground disturbance from silting up the wetlands? Can you tell if they were successful?

Return to the vans and go back to I-5; cross over the freeway and turn right (south) on 5th Ave. NE. Continue south and note Jackson Park Golf Course with its brand new stormwater detention ponds on the left. Turn left at NE Roosevelt Way. Turn left at 10th Ave. NE and park on the left side of the road next to the P-Patch. Walk through the patch, being careful not to disturb the raised beds. On the northwest side of the patch is a trail that heads down the hill into the golf course. Be careful heading down this hill; glance at the glacial erratic to your left as you go down. At the foot of the hill, follow the gravel path to the left to Thornton Creek. Please do not disturb any golfers. Follow the stream left until it enters a wooded area that is obviously not the golf course.

**Stop 4 — Downstream of two major ground disturbances in the North Fork of Thornton Creek**

According to the map, what elevation is this area?

Draw a simple map view of this area showing the stream, its cut banks and its point bars. Draw arrows indicating relative speeds at different points in the river. Finally, use the standard symbols to indicate the distribution of cobbles and pebbles, sand, and silt and clay on the banks and in the riverbed.

Examine the stream. Fill in the table below:

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How turbid is the stream water? Give the depth, as usual.

Compare the turbidity depths between the Twin Ponds section of the creek and here; are their relative magnitudes what you expected? Why or why not? If it was unexpected, give a possible reason for the observed behavior.
Return to the vans and turn around; head south on 10th Ave. NE and turn left at NE 125th St. Follow this to 35th Ave. NE and turn right. Go south to Meadowbrook Playfield and park next to the Community Center. Head to the north part of this parking lot.

**Stop 5a** — The South Fork of Thornton Creek, just upstream of the confluence

Note that the South Fork, which has its headwaters in the wetlands across the street from North Seattle CC (y’know, where the road is always flooded), is **channelized**. Give a reason why the city might have wanted to channelize the stream here.

According to the map, what elevation is this area?

Examine the stream. Fill in the table below:

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Cross 35th Ave. NE and enter the “Beaver Pond” area of Meadowbrook; this little park represents many years of habitat restoration of an urban stream (just getting rid of the non-native plant species took three years).

**Stop 5b** — The North Fork of Thornton Creek, just upstream of the confluence

Examine the stream. Fill in the table below:

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<tr>
<th>Width (m)</th>
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**Stop 5c** — The Main Branch of Thornton Creek, just downstream of the confluence

Examine the stream. Fill in the table below:

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Should the discharge from stop 5a added to the discharge from stop 5b equal the discharge from stop 5c, in principle? What could cause this equation to not sum properly?

Walk down the path towards the “beaver pond”. What happens to the stream here that might throw off our stream behavior pattern ideas?

Return to the vans and head south on 35th Ave. NE. Turn left at NE 105th St. and head east; turn right onto Sand Point Way NE. Continue south until NE 93rd St.; turn left. After a block, turn left into the Matthews Beach Park lot. Exit the vans, head southeast through the picnic grounds and encounter Thornton Creek one last time just before it empties into Lake Washington.

**Stop 6 — The mouth of Thornton Creek**

According to the map, what elevation is this area?

Examine the stream. Fill in the table below:

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Does the discharge value make sense compared to all the other ones we have measured?

Measure the turbidity; report the depth, as usual. Does the turbidity value make sense compared to all the other ones we have measured?

What is the gradient of the lower part of Thornton Creek? The distance between Meadowbrook and here is about a mile, so report the gradient as feet/mile, as before. How does this number compare to the upstream gradient? Is this to be expected?
Finally, what is the grain size of the sediment in the riverbed? Is this consistent with the answers to the two questions above?

Return to the vans and get back to Sand Point Way NE; turn right, and then make a quick left onto NE 95th St. Continue west to Lake City Way NE; turn right and follow this north until a gentle left up the hill at 24th Ave. NE. At the top of the hill, turn left onto NE Northgate Way. Head west to Meridian Ave. N; turn left and head back to NSCC.