[Report provided by Andrew Latimer, undergraduate student, SFU, 2017]
[Comments in square brackets are explanatory notes by J. Driver]

Grain Size Analysis

Goal: replicate the experiments that Sullivan (1993) performed on bulk samples from Charlie Lake Cave. [Driver suggested that Latimer should try to determine if sediments from the lower part of the site had been washed in from glacial and glaciolacustrine sediments on the hill above the site]

Sampling: the analysis is on samples 43,48, and 52 from TP1 column sample [Unit 6; column sample taken by Fladmark in 1983]; the fluted point association sample [from the layer in unit 5 that produced the fluted point]; and samples 1,2, and 3 from the backhoe trench [this was a waterline trench dug by a backhoe on a property on Butte Lane, and produced samples of diamicton and glacial lake silts].

Materials needed:
- A set of sieves
- 7 1L graduated cylinders
- Small spray bottle
- 1 labeled beaker corresponding to each graduated cylinder
- Rubber tube
- Drying oven

Procedure
1. Weigh coarse and fine fraction samples to get proportional weight. Produce a representative 100g sample for each. Make sure to break up aggregates.
2. Prepare wet screen. Run water and sediment through the set of screens, rocking the screens back and forth and collecting the coarser particles (gravel (>2mm), coarse sand (2-1mm), and fine sand (1mm-90 microns)) as each screen is removed. The less water used, the better, as it will reduce the amount of fine grained sediments carried away when if the bottom screen floods. Use spray bottle to minimize water use.
3. Record the weight of the empty graduated cylinders and the empty beakers, then collect muddy water and sediment from the bottom screen of each sample, and place it in the corresponding graduated cylinder, along with enough distilled water to reach the 1L mark.
4. Stir graduated cylinder contents from the bottom up, and leave for 24 hours to let the silt settle while the clay is still suspended.
5. After the 24 hours, suck out the water and suspended clay using the rubber tube, and siphon it into the corresponding beaker. Leave the settled sediments at the bottom of the graduated cylinder. You may have to repeat steps 4 and 5 several times: refilling the graduated cylinder up to 1L with distilled water, stirring the sediments up, and draining it every 24 hours. You will know that the clay content of

the graduated cylinder has been removed when the water is clear after 24 hours, instead of muddy.

6. The beakers which now contain the muddy water of each graduated cylinder should be drained should be placed in the drying oven at 50 degrees Celsius so that the water evaporates and all that is left is the clay. Weigh the beakers after the water evaporates, and the difference in weight between the original empty beaker scale reading and this later one is the sample's weight of clay.
7. Do the same thing with the graduated cylinders, evaporating the water and taking a final dry weight. The difference between the initial and final graduated cylinder weight is the samples weight of silt.

TP1 43
TP1 48
TP1 52
N21-22, E22-23, Layer 12-1
Backhoe Trench 3
Backhoe Trench 2
Backhoe Trench 1

Tables:

Gravel (>2mm)

Sample	Total Weight	Bag Weight	Paper Weight	Sediment Weight
TP1 43	5.8g	1.4g	0.6g	3.8g
TP1 48	13.1g	1.4g	0.6g	11.1g
TP1 52	15.2g	1.4g	0.6g	13.2g
N21-22, E22-23, Layer 12-1	18.3	1.4g	0.8g	16.1g
Backhoe Trench 3	4.1g	1.4g	0.7g	2.0g
Backhoe Trench 2	5.8g	1.4g	0.7g	3.7g
Backhoe Trench 1	14.2g	1.4g	0.9g	11.9g

Coarse Sand (2-1mm)

Sample	Total Weight	Bag Weight	Paper Weight	Sediment Weight
TP1 43	4.0g	1.4g	0.5g	2.1g
TP1 48	2.8g	1.4g	0.5g	0.9g
TP1 52	4.1g	1.4g	0.6g	2.1g
N21-22, E22-23, Layer 12-1	4.6	1.4g	0.6g	2.6g

Backhoe Trench 3	2.6g	1.4g	0.7g	0.5g
Backhoe Trench 2	2.6g	1.4g	0.7g	0.5g
Backhoe Trench 1	5.7g	1.4g	1.5g	2.8g

<u>Fine Sand (1mm-90microns)</u>

Sample	**Total Weight**	**Bag Weight**	**Paper Weight**	**Sediment Weight**
TP1 43	48.3g	1.4g	0.3g	46.6g
TP1 48	32.5g	1.4g	0.4g	30.7g
TP1 52	43.6g	1.4g	1.6g	40.6g
N21-22, E22-23, Layer 12-1	37.1g	1.4g	0.8g	34.9g
Backhoe Trench 3	48.4g	1.4g	1.7g	46.3g
Backhoe Trench 2	34.7	1.4g	0.7g	32.6g
Backhoe Trench 1	24.1g	1.4g	1.7g	21.0g

<u>Silt (62.5microns-2.0 microns)</u>

Sample	**Total Weight**	**Graduated Cylinder Weight**	**Sediment Weight**
TP1 43	279.4	249.7	29.7
TP1 48	287.9	250.1	37.8
TP1 52	277.0	249.7	27.3
N21-22, E22-23, Layer 12-1	277.7	249.4	28.3
Backhoe Trench 3	276.6	253.1	23.5
Backhoe Trench 2	295.7	244.6	51.1
Backhoe Trench 1	293.2	253.1	40.1

<u>Clay (<2.0microns)</u>

Sample	**Total Weight**	**Beaker Weight**	**Sediment Weight**
TP1 43	86.3	80.4	5.9
TP1 48	86.5	80.4	6.1
TP1 52	84.5	80.4	4.1
N21-22, E22-23, Layer 12-1	88.7	80.4	7.7
Backhoe Trench 3	96.1	80.7	10.4
Backhoe Trench 2	101.2	80.4	20.8

Backhoe Trench 1	134.6	117.5	17.1

Texture Sample Weights (100g sample)

Sample	Gravel	Sand (fine and coarse)	Silt	Clay	Loss
TP1 43	3.8g	48.7g	33.7g	5.9g	7.9g
TP1 48	11.1g	31.6g	46.8g	6.1g	4.4g
TP1 52	13.2g	42.7g	33.3g	4.1g	6.7g
N21-22, E22-23, Layer 12-1	16.1g	37.5g	32.3g	8.7g	5.4g
Backhoe Trench 3	2.0g	46.8g	31.1g	13.9g	6.2g
Backhoe Trench 2	3.7g	33.1g	43.1g	16.8g	4.7g
Backhoe Trench 1	11.9g	23.8g	41.1g	18.1g	5.1g

So what does this mean?

- In the gully, the gravel content increases with depth. Sand is dominant closer to the surface (TP1 43), but alternates between lower in the mid depths (TP1 48), and back to almost half the sample at the bottom (TP1 52). This alternating pattern is consistent with the spectra results. The silt component increases where sand decreases in TP1 48, but is still close to a third of the sediments in every sample. It is hard to identify a pattern in clay, because the sample size is so small (though it is likely that the weight lost in each sample would be from the smallest grain sizes).
- N21-22, E22-23 has a proportionally large gravel component, and similar sized sand and silt components.

- In the Backhoe Trench, sand dominated the layers close to the surface (Sample 3), but decreased with depth, while silt became more dominant and clay and gravel increased as well.

Also…

- The amount of silt in each sample may be inflated because we used a 90 micron screen instead of a 62.5 micron screen (which was unavailable), which is the largest particle size for silt. Therefore, sand particles between 90 and 62.5 microns would have been added to the silt weight of each sample, causing the silt component to weigh more than it otherwise might have.