

Particle Size Determination of Lake Sediment and an Analysis of Organic Fractions of 14 Samples from Elk Lake, including a Sample from the Channel.

~ A follow up to Bottom Sediment Analysis of Elk Lake, Victoria BC. ~

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Abstract

In conjunction with Bottom Sediment Analysis of Elk Lake, Victoria, BC, accurate particle size analysis was determined by chemically sieving 14 Ekman samples from the 97 samples collected from various locations at Elk Lake. The average of these samples is analyzed to the average of one sample, 3A', that was taken from the offshore island in the channel. Sodium hexametaphosphate was used to analyze sediments size < 0.125 mm and > 0.063 μ m. The chemical sieve method was derived from Simplified Method for Soil Particle-Size Determination to Accompany Soil-Quality Analyses by Kettler, Doran & Gilbert (2001), in which a modified rapid method was used. Loss on ignition analysis will be analyzed for samples 3A', 3B and 3H and how their organic matter compares to all 14 samples. The chemical sieve analysis, for the 14 samples, yielded an average of 75.63% for silt, 16.19% for clay and 8.19% for sand. The results from 3A' are silt at 82.30%, clay at 15.98% and sand at 1.81%. The R^2 value for the average samples are 0.84 and 0.88 for 3A', respectively. Analysis from loss on ignition provides a view of the samples that contained high organic matter and their relative location from the shoreline. Alternatively, a low organic matter either indicates the sample contains glacial till or was collected from areas with significant depths.

Introduction

This report is in conjunction with, Bottom Sediment Analysis of Elk Lake, Victoria, BC. (Flores & Nankabirwa, 2017). The Ekman sample, 2B, that was chemically sieved and analyzed for particle size > 0.063 mm and < 0.125 mm. The chemical sieve analysis was expanded to include 14 Ekman samples from the 31 samples that were analysed for organic matter through loss on

ignition. Figure 1, details were the 31 samples were collected and are represented by the yellow flags.

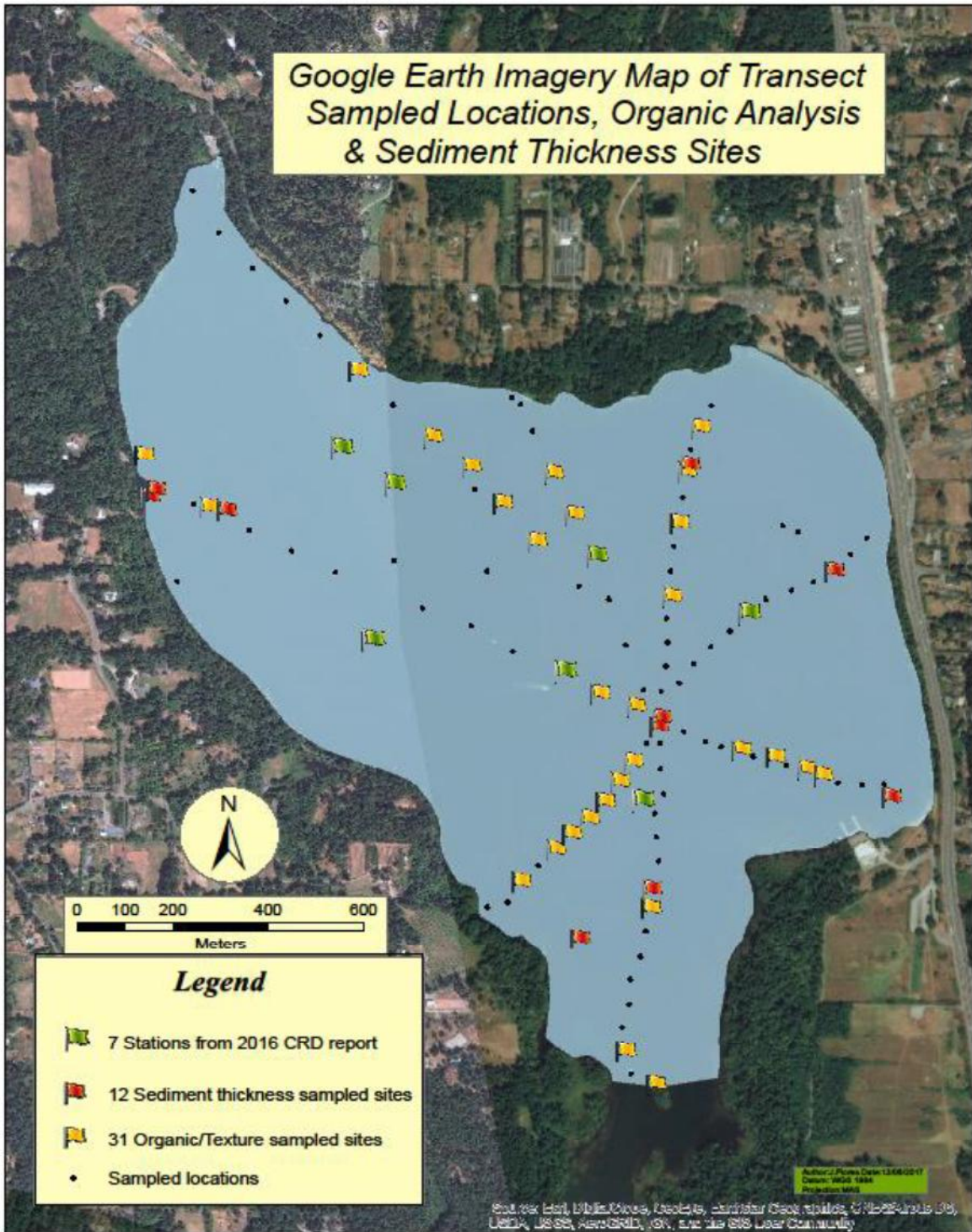


Figure 1 Locations for the 31 Ekman samples that were collected for organic matter analysis by loss on ignition are indicated by the yellow flags.

Figure 2, details the 14 sampled locations that were collected and analyzed for particle size.

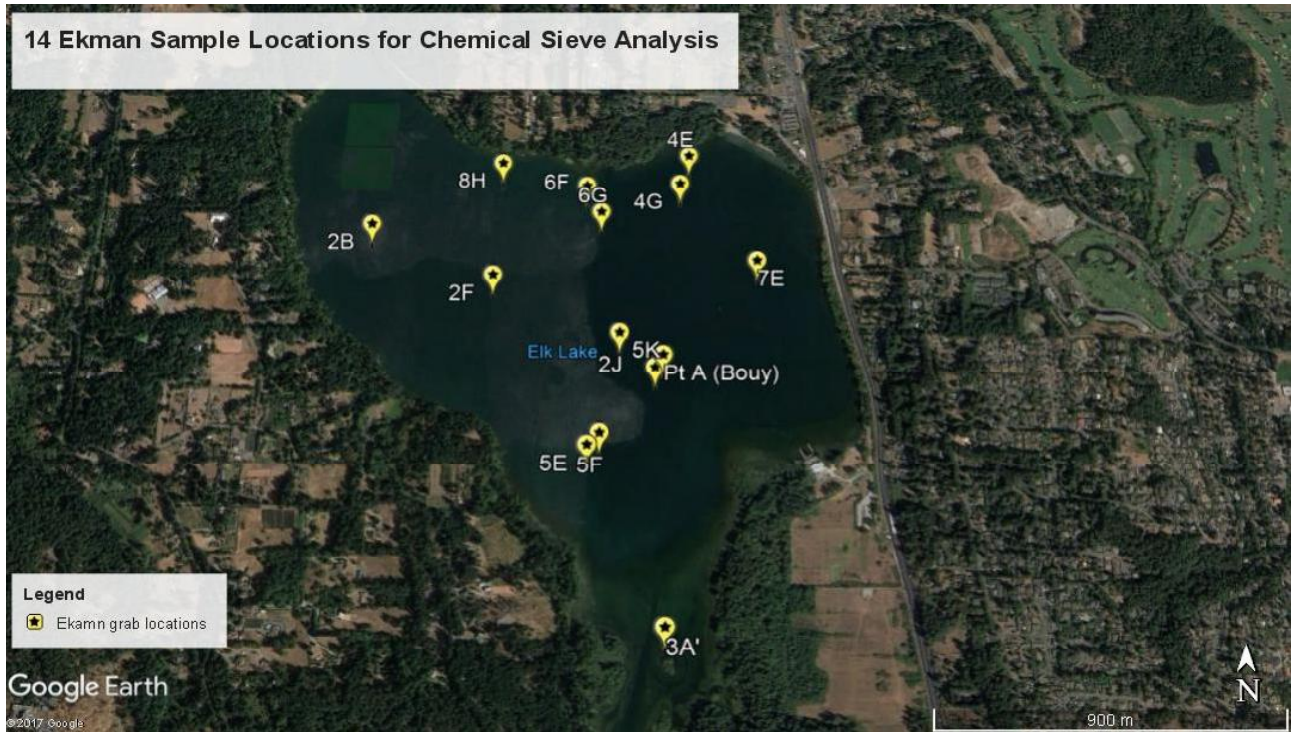


Figure 2 Ekman sample locations for particle size analysis.

The sampling location, 3A', was collected from the offshore island in the channel, at the end of transect 3. Figure 3 provides an inset map with the sample location 3A', circled in red.

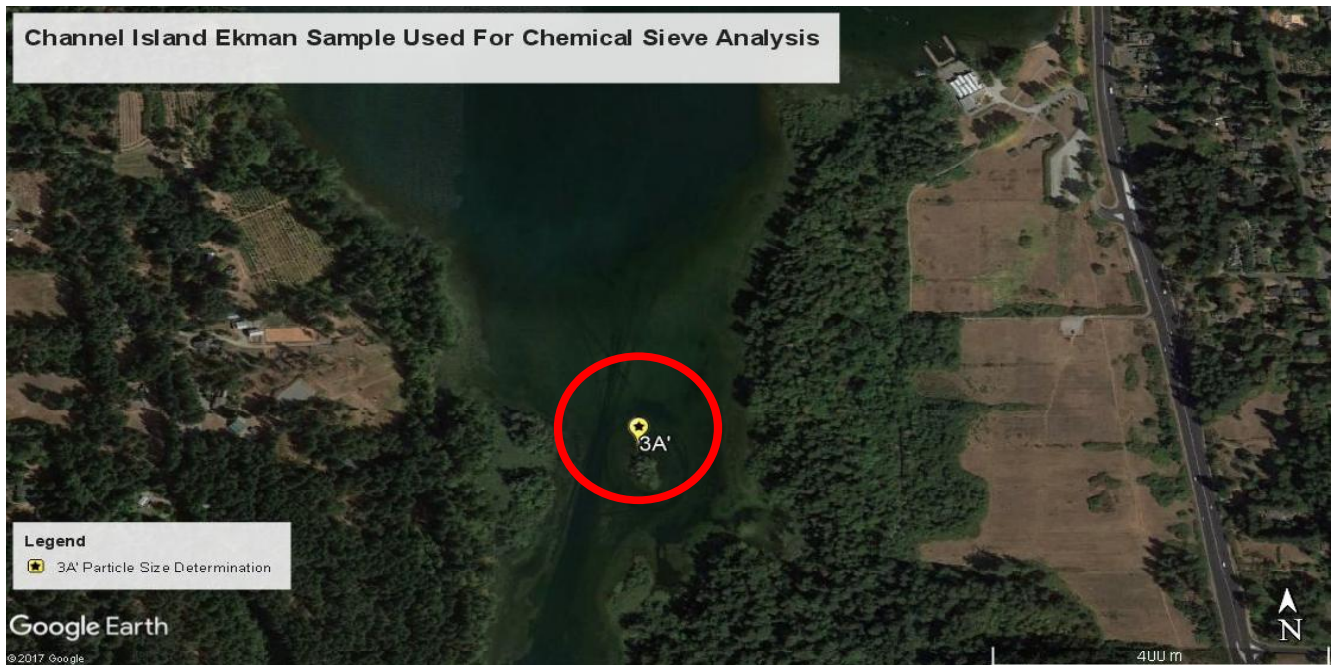


Figure 3 Inset map of sample location 3A' denoted within the red circle.

Methodology

The rapid, chemical sieve procedure used was and can be found in the Simplified Method for Soil Particle-Size Determination to Accompany Soil-Quality Analyses (Kettler, Doran & Gilbert, 2001). This method was modified to accommodate the lake sediment samples. Each sample was grounded and then sieved to collect 15 g of sediment >0.063 mm and < 0.125 mm. The sample was transferred into a 50ml beaker containing a solution of 3%, sodium hexametaphosphate, for 3:1 ratio of solution to sieved sample. Each beaker is then placed in a shaker, at 120 reciprocations p/min, for a minimum of 9 hrs or until the solution is saturated. The slurry is then diluted with water and plunged with a 30ml syringe through the <0.063 mm sieve. The solution that sieved through is transferred to an 800ml beaker and left for a sedimentation period of 16hrs. The murky solution will be divided by heavy sedimentation (silt) at the bottom. The remaining volume will contain the clay. The clay solution is then decanted and the remaining fraction is placed in an oven at 100 °C for 9hrs or until dehydration. The sand and silt fractions can be quantified through this calculation (Kettler, Doran & Gilbert, 2001):

$$\text{Sand \%} = \left(\frac{\text{oven dry sand mass}}{\text{original sample mass}} \right) \times 100\%$$

$$\text{Silt \%} = \left(\frac{\text{oven dry silt mass}}{\text{original sample mass}} \right) \times 100\%$$

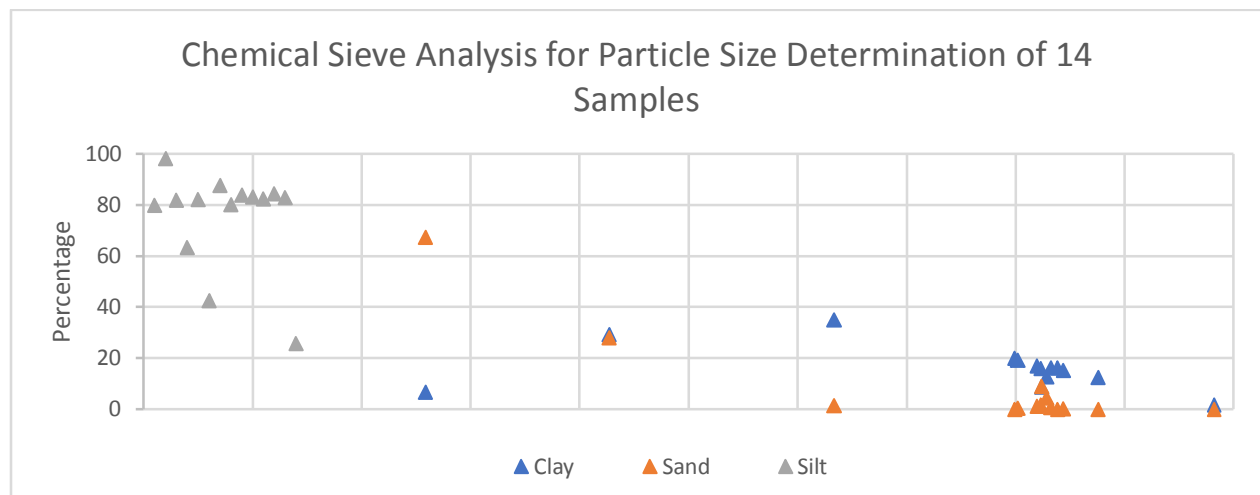
The remaining value from 100%, will be the clay fraction.

$$\text{Clay \%} = 100 - (\text{Silt \%} + \text{Sand \%})$$

Losses on ignition procedures are detailed in the previous study (Flores & Nankabirwa, 2017).

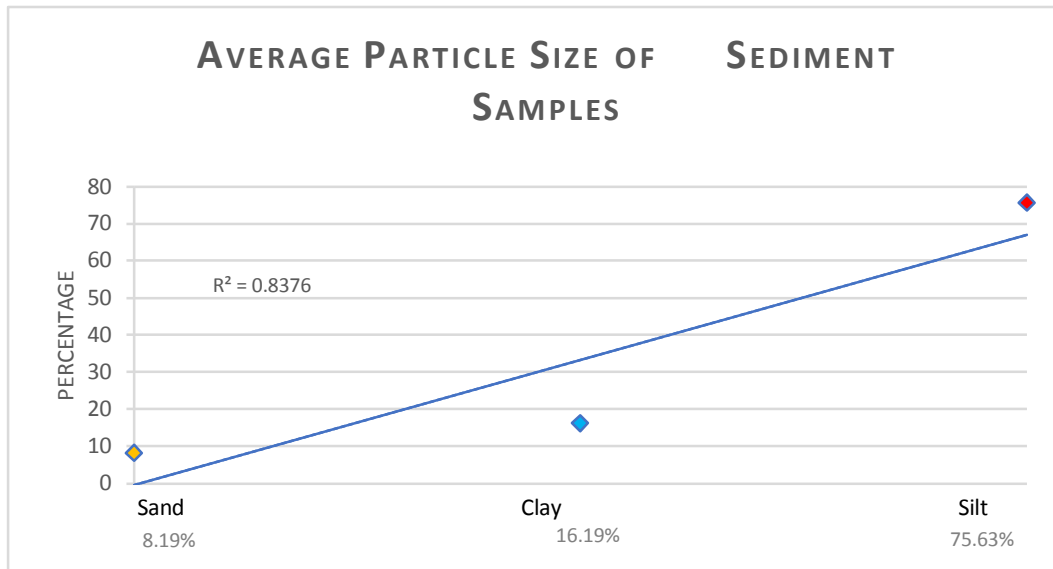
Results

The 14 samples that were analysed can be viewed in graph one. The dominating fraction of silt ranges in the 80, followed by clay which ranges in the 20 and sand ranging below 10.



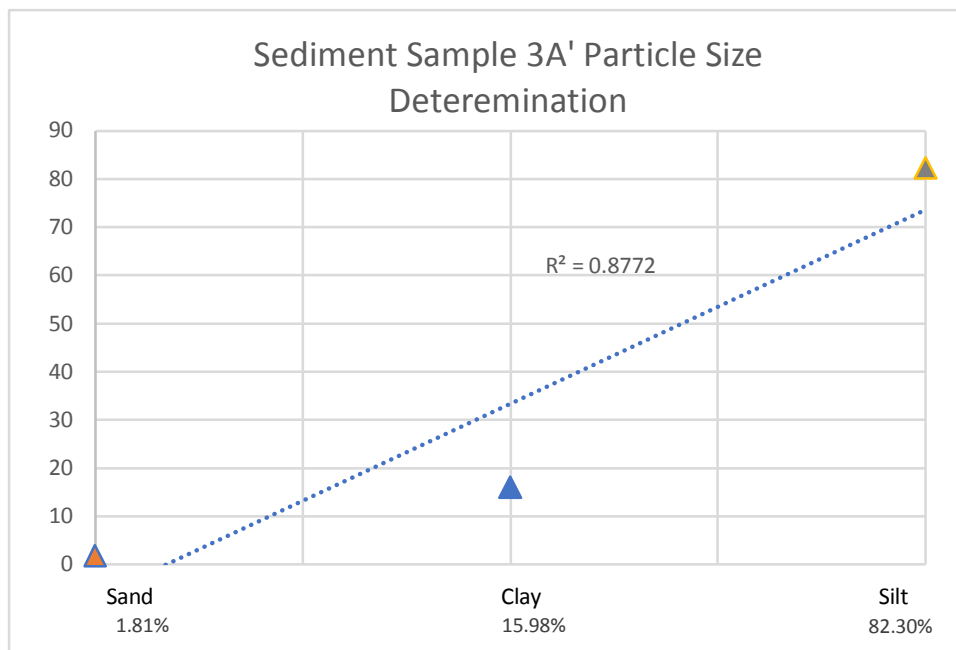
Graph 1 Chemical sieve analysis indicating a high percentage of silt followed by clay and sand.

The average particle size fractions for silt was 75.63%, clay 16.19% and sand 8.19%. The R^2 value of 0.838 indicates a linear correlation for high silt content, above low clay content and low sand content of the 14 samples that were analyzed. These results can be viewed in graph 2.



Graph 2 Average percentages of silt, clay and sand of the 14 samples that were chemically sieved.

The average particle fractions for sample 3A' indicates silt at 82.30%, followed by clay at 15.98% and sand 1.81%. An R^2 value of 0.877 indicates a good linear correlation for high silt content along with above low clay content and a low sand content. View graph 3 for these results.



Graph 3 Average fractions for sample 3A' indicate a high value for silt, mid clay and low sand content.

Loss on ignition for organic matter for the samples 3A' and 3B indicate a high organic fraction and a low organic matter fraction for sample 3H. These values can be viewed in table 1a.

Table 1a Loss on ignition results for Ekman samples collected along transect 3. The organic matter fractions are highlighted.

Loss on ignition analysis steps for the 31 selected samples out of a total 97.							
Transect	Weight of crucible (g)	Weight of crucible + sample before heating (g)	Weight of crucible + sample after heating (g)	Weight of sample before heating (g)	Weight of sample after heating (g)	LOI (g)	% Organic matter
3A'	15.85	17.82	16.98	1.97	1.13	0.84	42.61
3B	15.11	17.03	16.19	1.92	1.08	0.85	43.97
3H	15.38	17.92	17.87	2.53	2.49	0.04	1.73

Discussion

The samples (Pt A) buoy, 2B, 4G and 5F indicate a 0% fraction of sand. 6G and 5E indicate 0.27% and 0.47% fraction of sand, with 5K indicating 0.60% for a sand fraction. However, samples 4E and 8H yielded a sand fraction of 27.99% and 67.47%, respectively. These results can be view on Table 2. The R^2 values for the average of the 14 samples are 0.84 and 0.88 for 3A'. In comparison, these values are representative of a good linear relationship for high silt content in Elk Lake and within the channel. Comparing the data from, loss on ignition, for 3A', 3B and 3H, a low organic matter fraction for 3H yielded, 1.73%. 3H is representative of glacial till due to its texture, colour and silky touch. Alternatively, loss on ignition samples 1C and 1D yielded high organic matter fractions. The distance of these locations can be compared to the location for 3A' and 3B; which were also collected off the shoreline from the channel island. See figure 4. Glacial till samples were also representative through loss on ignition. Their low organic matter, grey colour and clustered fluidity contrast with the dark colour, puree appearance and high viscosity. Other glacial till samples include 1H, 3H, 6F and 8H and the organic matter fractions can be viewed in table 3.

The Ekman samples 3A', 3B, 1C and 1D contain high organic fractions. The locations of these samples were collected within proximity from the shoreline. The R^2 value of the 14 samples and the 3A' are relatively close with a difference of 0.04 and illustrate a good linear relationship for high silt fractions throughout the channel and Elk Lake.

Table 1 Chemical sieve results for the 14 Ekman samples.

Trnsct #	Silt %	Clay %	Sand %	Depth m
Buoy	79.93	20.06	0	14.06
2B	98.22	1.78	0	13.13
2F	81.95	16.89	1.16	13.75
2J	63.33	35.14	1.53	14.06
3A'	82.30	15.98	1.81	0.67
4E	42.70	29.31	27.99	3.1
4G	87.60	12.40	0	10.63
5E	80.20	19.33	0.47	10.63
5F	83.86	16.14	0	11.56
5K	83.20	16.20	0.60	12.81
6F	82.40	8.73	8.87	15.31
6G	84.40	15.33	0.27	14.06
7E	82.86	12.67	4.47	14.38
8H	25.87	6.66	67.47	10.63
	Silt %	Clay %	Sand %	m
Average	75.63	16.19	8.19	11.34
Min	25.87	1.78	0	0.67
Max	98.22	35.14	67.47	15.31

Table 2 Loss on ignition results.

Loss on ignition analysis steps for the 31 selected samples out of a total 97.							
Transect	Weight of crucible (g)	Weight of crucible + sample before heating (g)	Weight of crucible + sample after heating (g)	Weight of sample before heating (g)	Weight of sample after heating (g)	LOI (g)	% Organic matter
1C	15.39	18.27	17.01	2.88	1.62	1.26	43.77
1D	16.23	18.72	17.77	2.49	1.54	0.95	38.15
1F	15.85	18.36	17.88	2.50	2.03	0.47	18.91
1H	15.70	18.03	17.89	2.32	2.18	0.14	5.93
2A'	15.10	17.65	17.04	2.56	1.95	0.61	23.89
2B	15.93	18.44	17.78	2.52	1.86	0.66	26.23
2J	14.69	17.30	16.73	2.60	2.03	0.57	21.84
2K	15.36	17.90	17.30	2.54	1.94	0.60	23.68
3A'	15.85	17.82	16.98	1.97	1.13	0.84	42.61
3B	15.11	17.03	16.19	1.92	1.08	0.85	43.97
3H	15.38	17.92	17.87	2.53	2.49	0.04	1.73
4E	16.19	18.74	18.13	2.55	1.94	0.61	24.01
4G	16.11	18.72	18.05	2.61	1.94	0.66	25.49
4I	15.25	17.86	17.28	2.61	2.03	0.59	22.47
4L	16.12	18.75	18.37	2.63	2.25	0.38	14.30
5C	14.38	16.97	16.25	2.59	1.87	0.72	27.82
5E	15.02	15.92	15.77	0.90	0.75	0.15	16.73
5F	15.67	18.24	17.73	2.58	2.06	0.52	20.11
5G	15.56	18.07	17.52	2.50	1.95	0.55	21.96
5H	14.71	17.23	16.63	2.52	1.92	0.60	23.75
5I	15.55	18.11	17.47	2.55	1.92	0.63	24.81
5J	16.04	18.71	18.04	2.67	2.00	0.66	24.90
5K	15.32	17.85	17.20	2.54	1.88	0.66	25.92
6F	15.31	18.16	18.12	2.85	2.81	0.05	1.69
6G	14.66	17.27	16.64	2.60	1.98	0.62	23.96
7E	15.17	17.72	17.09	2.55	1.92	0.63	24.62
8F	15.25	17.98	17.88	2.73	2.63	0.10	3.69
8H	16.18	18.69	18.66	2.51	2.48	0.03	1.05
8I	15.22	17.84	17.23	2.62	2.01	0.60	23.09
8J	14.83	17.38	16.78	2.55	1.95	0.60	23.50
8K	15.95	18.45	17.85	2.50	1.90	0.60	23.98
blank-1	15.76	15.76	15.76	0.00	0.00	0.00	-150.00
blank-2	15.77	15.77	15.77	0.00	0.00	0.00	175.00
FS0F 1	15.83	16.81	16.07	0.99	0.25	0.74	74.92
FS0F 2	15.54	16.54	15.81	0.99	0.27	0.73	73.24
KMB14M 1	15.55	18.12	17.95	2.57	2.40	0.17	6.44
KMB14M 2	15.17	17.76	17.59	2.58	2.42	0.16	6.32

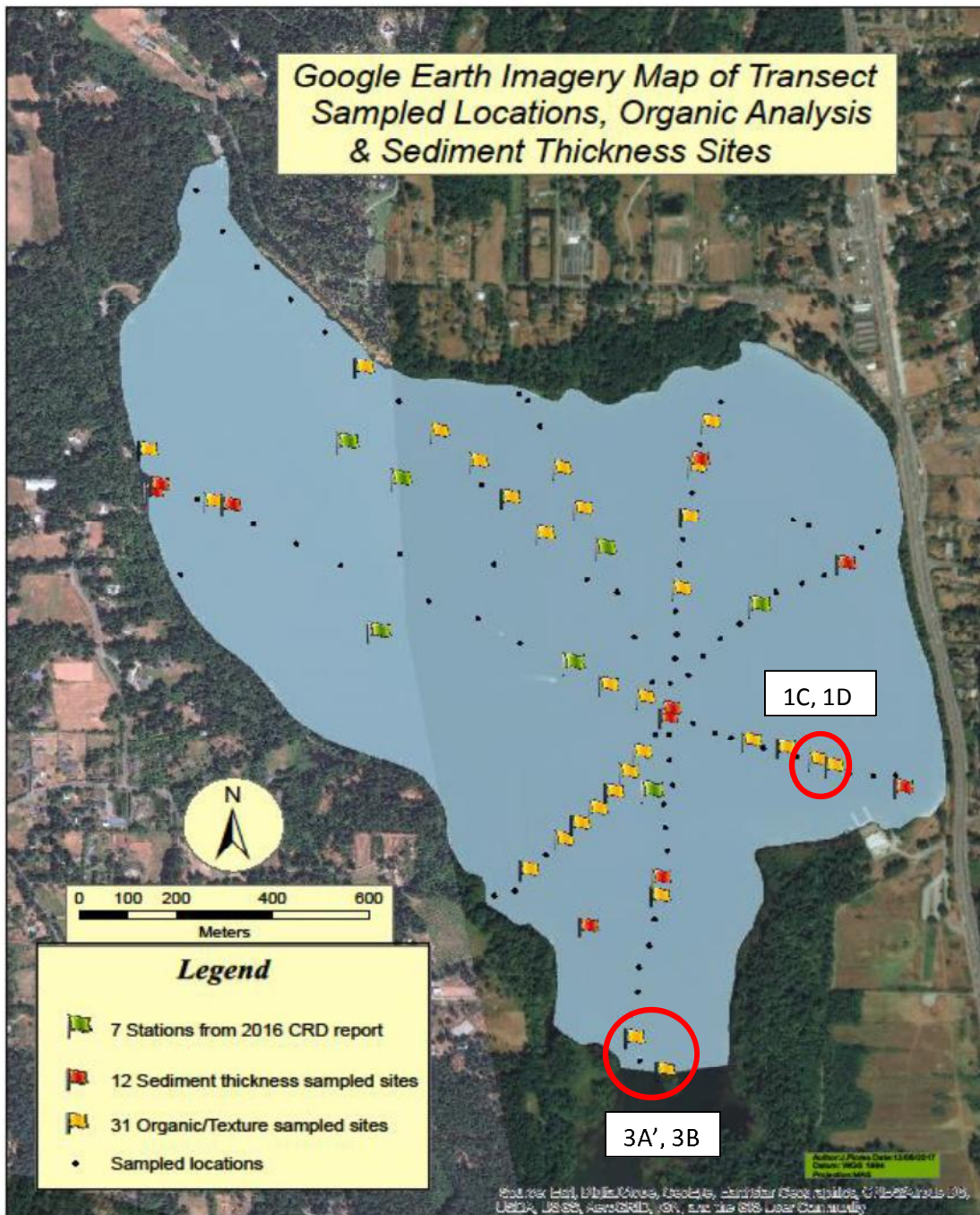


Figure 4 ArcMap indicating the locations of the Ekman samples 1C, 1D, 3A' and 3B.

References

- Flores, Julio & Nankabirwa, Queen Ester, (2017). *Bottom Sediment Analysis of Elk Lake, Victoria, BC*. Camosun College Environmental Technology Sustainable Research Project.
- Kettler, T. A., Doran, John W, & Gilbert, T. L. (2001). *Simplified Method for Soil Particle-Size Determination to Accompany Soil-Quality Analyses*. Retrieved from <http://digitalcommons.unl.edu/usdaarsfacpub/305>