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141 Brunel Road
Mississauga, ON
L4Z 1X3

T · 416 · 213 · 7121
F · 905 · 890 · 8499
www.geomorphicsolutions.ca

Geomorphic & Environmental Sciences
Hazard Land Assessment
Creek Rehabilitation
Water Resources Management

September 16, 2010

Alton Mill Pond Rehabilitation Committee
c/o The Alton Mill
1402 Queen Street
Alton (Caledon), Ontario
L7K 0C3

Attention: Mr. Jeremy Grant

Dear Mr. Grant

Re: Alton Mill Pond Rehabilitation Project
Town of Caledon
Our Project No. 10179.450

This letter provides a brief background review of the Alton Mill Pond and outlines the existing conditions and results of the recently completed field assessment, which included sediment core collection and documentation, preliminary estimates of the volume of sediment contained within the pond and the results of sediment testing according to Part XV.1 of the *Canadian Environmental Protection Act, 1999* (Ontario Regulation 153/04, last amendment 511/09).

INTRODUCTION

Alton Mill Pond is an online pond within the Shaw's Creek watershed and is located in the community of Alton, Town of Caledon. The pond is approximately 3 acres in size and has a drainage area of 5 km^2. The dam and pond were established approximately 130 years ago to power the turbine used in the mill. The pond has subsequently been infilling with sediment and recent concerns include contamination from residential, agricultural, and commercial land uses and the integrity of the dam structure itself. A sedimentological study was completed to better understand the characteristics of the sediments (grain size, relative levels of organic matter and the presence of contaminants) and the rate and volume of sediment accumulation within Alton Mill Pond to inform restoration strategies.

FIELD ASSESSMENT AND SEDIMENT COLLECTION

Field work was completed with the assistance of staff from Credit Valley Conservation on May 28, 2010. Six sediment cores were collected from five sites using a 1.5 m long, 0.05 m diameter Ogeechee Corer and ranged from 0.26 m to 0.5 m in length. The corer was penetrated as far as possible and a valve was closed (acting in the same manner as a rubber stopper on a syringe). The corer was then recovered and the sediment core was removed and capped for later analyses. This type is sampling apparatus is used to collect cores for stratigraphic analyses because the integrity of the sedimentary structures are retained upon collection. Sediment core locations are shown in Appendix A.

Two additional sediment samples were collected using a 4.6 m Raven Environmental Products Inc. Coretaker, which is suitable for collecting fine, unconsolidated and saturated sediments. These samples were submitted for testing for the presence of metals, inorganics and hydrocarbons. This apparatus does not retain the structural integrity of the sediments but was employed for sediment testing because sediments can be immediately removed from the core tube. One sample consisted of a composite of sediments collected from each of the five sediment core locations, while another sample was comprised of sediments collected near the storm outfall at the upstream extent of the pond. The samples were placed in a cooler and immediately transported to the lab for testing.

In general, the coring was completed as planned with no significant issues. The water was relatively shallow and ranged in depth from a maximum of approximately 1 m near the dam structure to approximately 0.2 m. Initial field observations indicated that the sediment was generally fine-grained and organic-rich. The sediment was highly unconsolidated, saturated, and easily disturbed and resuspended. Carp were observed disturbing the sediment as they moved around the pond. In all instances with the exception of cores 1 and 5, the coring equipment penetrated the pond sediments simply by the weight of the core tube and with little resistance. Core 1 was collected furthest from the dam structure and was therefore the least impacted and likely had the lowest sedimentation rate relative to the other locations. Core 5 was collected in front of the dam structure in the former location of Shaw's Creek.

In all instances the core tube was penetrated a greater distance than the length of the equipment. This suggests that either the uppermost sediments that are susceptible to disturbance when coring were not collected, the sediments were being compacted, or sediment rodding was occurring. Sediment rodding occurs during core penetration when the coring apparatus continues to move vertically through the substrate but sediment is not collected and by-passes on the outside of the tube. This is typically caused by different sediment types overlying one another, or by blockages at the base of the core tube. Aquatic plant material was observed at the top of all of the cores with the exception of core 5, suggesting that the saturated and loose sediments near the sediment – water interface were being collected. Given that the sediments were generally highly saturated, unconsolidated, and uniform in texture, it is likely that significant compaction occurred. Upon completion of the field assessment, the cores were extruded, split into two equal halves using a thin wire and documented according to sediment color, grain size, and structure.

Estimates of sediment depth were obtained during a second field visit on June 4, 2010. Sediment depth and water depth were measured at 22 locations in the pond using a metal rod and geo-referenced using a RTK GPS system in order to obtain a rough estimate of sediment volume. Sediment depths are shown in Appendix A. Generally the greatest sediment depths were encountered in proximity to the dam structure and along the north side of the pond where velocities are relatively low. Note that in many instances sediment depth measurements were limited by the length of the rod. As such, in some locations only the minimum sediment depth could be calculated.

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STRATIGRAPHIC OBSERVATIONS AND INTERPRETATION

As noted above, core locations can be found in Appendix A. A photographic inventory and stratigraphic logs of the six sediment cores are contained in Appendix B. Note that the stratigraphic profiles are plotted relative to the water surface (given a value of 0 m) for comparison purposes. As expected, the sediments were organic-rich, saturated, generally fine-grained and consisted of silt, clay, and in some instances very fine to fine sand. Sediment deposition appears to have been continuous throughout the collected record as sedimentary structures were absent. Sediments are typically referred to as being massive when structures are not visible.

Core 1 was collected furthest from the dam structure and was 28.8 cm in length. This core contained the highest amount of sand and largest grain size when compared to the other 5 cores. From the base of the core to 20.2 cm the sediments consisted of massive black silt, clay and fine to very fine sand. From 20.2 cm to 20 cm there was a thin light brown bed with diffuse contacts. From 20 cm to 16.5 cm the sediments were black and contained relatively large pieces of leaf material and woody debris. From 16.5 cm to 11.5 cm the sediments were dark brown and contained very fine to fine sand. The overlying sediments, from 11.5 cm to the top of the core were black, less 'gritty' than the previous interval, but still contained some fine to very fine sand and silt. Two large pieces of organic material, likely cattail stems, occurred at 10.1 and 8.2 cm.

Cores 2a and 2b were collected near the center of the pond and were 28 cm and 28.5 cm in length, respectively. Small fragments of organic matter and rootlets were visible throughout both of the cores and there was evidence of gas bubbles. The sediments in core 2a were massive, black clay and uniform in color and texture with the exception of the interval from 11 cm to 9 cm, which contained a concentration of organic debris consisting of pieces of leaf, root and stem pieces. In core 2b, from the base of the core to 13.5 cm the sediments consisted of black clay. There was a concentration of organic matter from 13.5 cm to 12.5 cm with organic pieces ranging in size from 2 to 3 mm in diameter. From 12.5 cm to the top of the core the sediment also consisted of clay.

Core 3 was collected near the northeast corner of the pond and was approximately 30 cm in length. Difficulty was encountered when extracting the core from the tube, with the top 6.5 cm of sediment stuck in the core tube. The extracted portion of the core consisted of massive black clay. There were notably fewer organics when compared to all of the other cores. The remainder of the uppermost sediments were removed from the core tube by hand and were consistent with the lower sediments.

Core 4 was collected in the north central portion of the pond near the dam structure and was 26 cm in length. This core contained massive black silt and clay sediments. The sediments were saturated and 'soupy'. Evidence of gas bubbles and organic matter were visible throughout the core.

Core 5 was collected near the dam structure in what was once the channel bed of Shaw's Creek. This was the deepest portion of Alton Mill Pond and as such a five foot extension handle was used to complete the coring. The sediment core was 50 cm in length. From the base of the core to 17.5 cm the sediments consisted of silt and clay, with a piece of organic matter at 33 cm. At 17.5 cm there was a diffuse shift from black to dark brown sediments that was unfortunately not captured in the photographic inventory. The sediment near the base of the core had high moisture content relative to sediments near the top of the core. However, the sediments were more compact and had lower moisture content relative to the other cores. From 17.5 cm to the top of the core the sediments were grittier, and consisted of silt, clay, and very fine sand.

Overall, the sediments found in Alton Mill Pond were characteristic of those found in a low-energy environment. The collection of sediments deposited by fluvial processes would allow a rough estimation of the average sedimentation rate in the pond since the historical date of the establishment of Alton Mill is known. Relatively coarser grained sediments, indicative of a higher energy fluvial environment, were not recovered from any of the coring locations. Therefore, it is not possible to determine the average sedimentation rate without further analysis. Given the nature of the sediments recovered, it can be assumed that sedimentation has been more or less continuous since the creation of Alton Mill Pond although the rate of accumulation has likely varied. A detailed bathymetric survey of the pond and upstream and downstream elevations is recommended to be completed to obtain a more accurate estimation of sedimentation rates.

For a more detailed analysis of sedimentation rates, radiometric dating techniques (^{210}Pb, ^{137}Cs and ^{14}C,) could also be employed. One of the most common methods for dating recent sediments (<~150 years old) uses Lead-210 (^{210}Pb), which is a radioactive isotope in the Uranium-238 (^{238}Ur) decay series. In addition, the 1964 Cesium-137 (^{137}Cs) peak, often measured in conjunction with ^{210}Pb and associated with above-ground nuclear bomb testing during the late 1950s and early 1960s, can also be used as a stratigraphic indicator to calculate sedimentation rates (Appleby, 2001). Carbon-14 (^{14}C) dating is a commonly used technique for dating sediments as old as ~40,000 to ~50,000 years. However, dates calculated for the past 300 years are associated with high uncertainties because of varying atmospheric ^{14}C content, the release of 'old' carbon from fossil fuel combustion, and the increase of ^{14}C production during nuclear bomb testing (Björk and Wohlfarth, 2001). Although these techniques may provide additional insight into sedimentation rates over the last ~130 years they are not required for the successful implementation of a restoration plan.

SEDIMENT DEPTH AND VOLUME ESTIMATION

Preliminary estimations of sediment volume were completed for the area of the pond based on the field measurements using a 1.83 m (6 ft) rod. As noted previously, sediment depth measurements were limited by the length of the metal rod. In some areas of the pond sediment accumulation exceeded the measured value, particularly on the north side of the pond and in front of the dam structure. Areas where there was no sediment accumulation, noted with values of 0 in Appendix A, were not included in the calculations. The area of the pond where sediment accumulation was occurring was measured to be 6,033 m or 0.6 ha. This value was then multiplied by the average and maximum sediment depths, which were 0.89 m and 1.67 m, respectively. These simple calculations result in an average sediment volume estimation of 5,361 m^3 and a maximum sediment volume estimation of 10,075 m^3.

Sediment disposal can be very costly for large volumes of sediment using mechanical removal (Randle, 2002). Note that in this case, the amount of sediment required to be removed will be dependent on the rehabilitation design. A bathymetric survey of the pond and upstream and downstream channel gradient and elevation would provide further insight into sediment depths and the sediment volume contained in the pond.

SEDIMENT TESTING RESULTS

The sediments were submitted to AGAT Laboratories for analysis of metals, inorganics, petroleum hydrocarbons and polynuclear aromatic hydrocarbons according to Ontario Regulation 153/04. This Ontario Regulation follows a series of 6 tables that describe contaminants and their respective acceptable levels in soils and sediments (MOE, 2009). The guidelines are also dependent on the intended use of the soils. Table 1 was selected for testing as it contains the most stringent guidelines with the largest range of parameters. The guidelines outlined in Table 1 are considered to be typical province-wide background concentrations in soils that are not contaminated by point sources (MOE, 2009). However, a more realistic approach can be used by comparing the laboratory results to Table 2 guidelines (Appendix C). Table 2 includes guidelines for soils that can be used in agricultural, residential, parkland, institutional commercial and community property uses. Note that the sediment samples were compared to current guidelines that are in effect until July 2011. At that time revised guidelines containing 9 Tables will come into effect, with standards that will be generally more stringent.

The composite sample, collected from the same sites as the sediment cores, exceeded the standard for electrical conductivity, as outlined in Table 2 of Ontario Regulation 153/04 for soil and is highlighted in grey in Appendix C. Electrical conductivity, or total dissolved solids (TDS), is a measure of the number of dissolved ions in a substance. Although the sediment collected near the storm outfall did not have high electrical conductivity this may be a function of sediment grain size (the sample consisted largely of sand, which does not attract ions as efficiently as clay particles) and the time of year that the sample was taken (spring melt and run-off had occurred by the end in March). Given the proximity of the pond to the road, and taking into account the untreated discharge from the storm outfall to the pond in the spring, it was initially assumed that the electrical conductivity results indicated a significant concentration of salt. However, the sodium adsorption ratios (SAR) for both samples were well within the guidelines provided in Appendix C, albeit the outfall sample had a higher SAR than the composite sample. SAR represents the ratio of the concentration of sodium to that of calcium and magnesium (Al-Hamaiedeh and Bino, 2010).

The relatively low sodium content in both samples indicates that ions present in the sediments are largely not derived from run-off containing road salt. Although the relatively high electrical conductivity values will have an impact on where the sediments are placed, precautions can be taken to limit the negative impacts of the dissolved ions on vegetation communities, such as burying the sediments at a depth below the rooting zone.

CONCLUSIONS AND RECOMMENDATIONS

Six cores were successfully recovered from five locations within Alton Mill Pond. Although development of a geochronology was not possible due to the nature of the sediments, this discussion provides a coarse examination of the sedimentology of the pond and an evaluation of some of the possible contaminants. Overall, the sediment cores are dominated by massive, organic-rich fine-grained silt and clay deposits with the exception of core 1, which contained a relatively large amount of fine to very fine sand. The stratigraphy of the sediment cores suggests continuous sedimentation since the dam was in place. The sediment depth calculations were relatively simple but provide a rough estimate of the volume of fine sediment in the pond. The average and maximum sediment depth measurements were used in the calculations and resulted in an average sediment volume estimate of 5, 361 m^3 and a maximum sediment volume estimate of 10,075 m^3.

Historical aerial photographs from the years 1978, 1991, the late 1990s and 2004 provided by the Alton Mill Pond Rehabilitation Committee were also examined to study the rate of pond infilling. Given existing site conditions observed in the field and the rate of infilling over the past ~130 years, it is likely that the pond will be filled within the next 50 years. Note that this estimation assumes that the sedimentation rate will be similar to that since the Alton Mill Pond was created and the volume of sediment required to fill the pond will remain consistent.

As noted earlier, the amount of sediment required to be removed will depend on the rehabilitation design. The sediments could be removed and disposed of offsite while wet using standard mechanical dredging equipment. However, this method would create a risk of resuspending and/or releasing large volumes of sediment that would significantly impact the channel downstream, especially given the fine-grained organic rich nature of the sediments. It would also be costly due to the mass of materials. Significant aggradation downstream of the pond could result in an increased flood stage that would impact local residents, channel braiding, channel migration, bank erosion and avulsions (Randle, 2002). In addition to geomorphologial changes, the increased turbidity could impact water quality and aquatic habitat (Randle, 2002).

A second option would be to dredge the pond and dewater the sediments on-site. This would require the installation of sediment fence and a Filtrex berm or equivalent. An alternative to conventional dewatering would be the use of geotextile tubes. This approach has been used successfully in the past by deployment of a small horizontal auger dredge, or equivalent, with relatively light operating equipment such as a small farm tractor (Petersen, 2010; Mastin and Lebster, 2006). This type of approach also has a relatively limited impact on the surrounding landscape (Petersen, 2010; Mastin and Lebster, 2006). Water would be siphoned from the surface to reduce water levels in the pond and sediments could then be pumped to geotextile tubes for dewatering (Petersen, 2010; Mastin and Lebster, 2006). Polymers can also be injected into the geotextile tubes to promote coagulation of the sediment in the tubes (Petersen, 2010; Mastin and Lebster, 2006). The tubes are a cost effective solution for dewatering sediments and have a relatively small footprint when compared to conventional dewatering methods, and would be less costly than disposing of wet sediments off site (Petersen, 2010; Mastin and Lebster, 2006). Once the sediments were dry they could be used as fill on site and stabilized with vegetation.

The last option would be to complete a gradual draw-down over a season or a couple of years. Water levels would have to be lowered to below the sediment depth in a controlled fashion. Once the sediments are dewatered they could be removed using standard mechanical excavation methods and spread onsite or moved offsite. Draw down would need to be controlled and timed to allow the surface to vegetate and stabilize. This is to avoid re-entrainment and deposition downstream. This option is the least costly, and given that the initial sediment testing results indicated that levels of metals and inorganics were relatively low, this option may be feasible (Randle, 2002). Although sediments would be released downstream over the short-term, provided that the draw-down is done in a controlled fashion, the impacts would be temporary as sediment would be eventually transported downstream. If the channel was allowed to stabilize naturally and supplemented with plantings to stabilize the remaining sediment, limited sediment removal would be required. Ponds could be formalized on either side of the channel to retain some of the previous features and provide aesthetic value to local residents and visitors to the Alton Mill Pond. Note that the gradual water draw-down would require continual monitoring to ensure that any unanticipated impacts can be mitigated. Monitoring once the rehabilitation is complete would provide valuable information regarding active channel processes, overall channel stability and aquatic ecosystem health. Before draw-down an assessment of potential entrainment for the pond surface should be completed to assure there is limited entrainment during draw-down (American Rivers et al., 1999).

Recommended future work includes the completion of a detailed topographic and bathymetric survey of the pond. This will further refine the results of the sedimentation rate, sediment depth and sediment volume estimations. The collection of multiple samples for further sediment testing to determine disposal alternatives is recommended if the material is to be disposed of off-site. In particular, a toxicity characteristic leachate procedure (TCLP) should be completed if it is determined that the material will be disposed of in a landfill. If more detailed information regarding past sedimentation rates is desired, a form of radiometric dating (^{210}Pb, ^{137}Cs and ^{14}C) could also be employed to develop a geochronology. In order to quantify contemporary sedimentation rates and inform management strategies in the future, the installation of sediment traps and depth of disturbance rods would be useful and would be of value if the dam is to be maintained in some form.

Should you have any comments or require clarification on any matter pertaining to this study, please contact the undersigned.

Respectfully Submitted,

GEOMORPHIC SOLUTIONS

Paul Villard, P.Geo., Ph.D.
Principle, General Manager, Senior Geomorphologist

Suzanne St. Onge, M.Sc.
Environmental Scientist

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APPENDIX A
SEDIMENT CORE LOCATIONS AND SEDIMENT DEPTHS

Legend

- Core Locations
- Sediment depth measurements (m)

Orthophoto: Google Earth Pro, 2005. Sediment depth measurements and Core locations: Geomorphic Solutions, 2010.

Alton Mill Pond

Pond Sediment Depth Measurements
and Core Locations

N

0 5 10 20

Metres

GEOMORPHIC SOLUTIONS

DRAWN BY: S.S., L.W.	DATE: JUNE 2010
PROJECT: 10179.450	APPENDIX A

APPENDIX B
SEDIMENT STRATIGRAPHY AND PHOTOGRAPHIC INVENTORY

<table>
<tr><td></td><td>Photo 1.
May 28, 2010
View to the northeast of Alton Mill Pond</td></tr>
<tr><td></td><td>Photo 2.
May 28, 2010
View to the southwest of Alton Mill Pond. Lillipads occurred throughout the pond. Carp were also observed during field work</td></tr>
</table>

	Photo 3. May 28, 2010 The 1.5 m Ogeechee Corer was used to collect sediments from 6 locations in the pond for stratigraphic analyses.
	Photo 4. May 28, 2010 A typical core collected from the Pond using the Ogeechee Corer. Sediments were generally organic rich and massive, and contained largely fine grained sediments.

	Photo 5. Additional sediment was collected from each of the coring locations and was combined to form a composite sample for sediment testing.
	Photo 6. Sediment grad samples were also collected from the outflow at storm outfall along the south side of the pond adjacent to Queen Street for sediment testing.

Photo 7.

Core # 1

Sediments were relatively coarse-grained, containing very fine to fine sand and silt. This is likely due to the proximity of the coring location to Shaw's Creek. The top of the sediment core is on the left.

Photo 8.

Core # 1

The sediments near the base of the core consisted of clay, silt, and very fine sand.

	Photo 9. *Core # 1* Note the light brown bed from 20.2 to 20.0 cm consisting of very fine sand and silt.
	Photo 10. *Core # 1* The sediments near the top of the core. Note the relatively large pieces of plant material, likely cattail stems.

Photo 11.

Core # 2a

Sediments consisted of massive silt, clay and organics. There was a concentration of organic matter from 11 to 9 cm. No sedimentary structures present.

Photo 12.

Core # 2a

Sediments near the base of the core.

Photo 13.

Core # 2a

Sediments near the top of the core.

Photo 14.

Core # 2b

The core was comprised of massive, saturated silt and clay, and also contained small fragments of shell. No sedimentary structures were apparent.

Photo 15.

Core # 2b

The sediments near the base of the core. This core was difficult to split due to the high moisture content.

Photo 16.

Core # 2b

The sediments near the top of the core.

Photo 17.

Core # 3

The sediments were saturated and consisted of massive clay. This core had relatively low organic matter content when compared to the other cores and was difficult to extract from the core tube.

Photo 18.

Core # 3

Sediments near the base of the core.

Photo 19.

Core # 3

Sediments in the middle portion of the core.

Photo 20.

Core # 3

Sediments near the top of the core.

Photo 21.

Core # 4

Sediments were saturated and ‘soupy’.

Photo 22.

Core # 4

Sediments near the base of the core.

Photo 23.

Core # 4

The sediments near the top of the core.

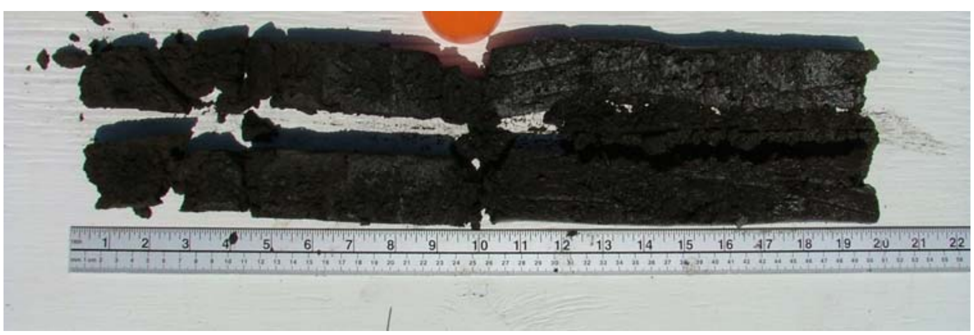


Photo 24.

Core # 5

This core was collected in the near the dam in the deepest portion of the pond. The sediments consisted of silt and clay overlain by very fine to fine sand and silt.

Photo 25.

Core # 5

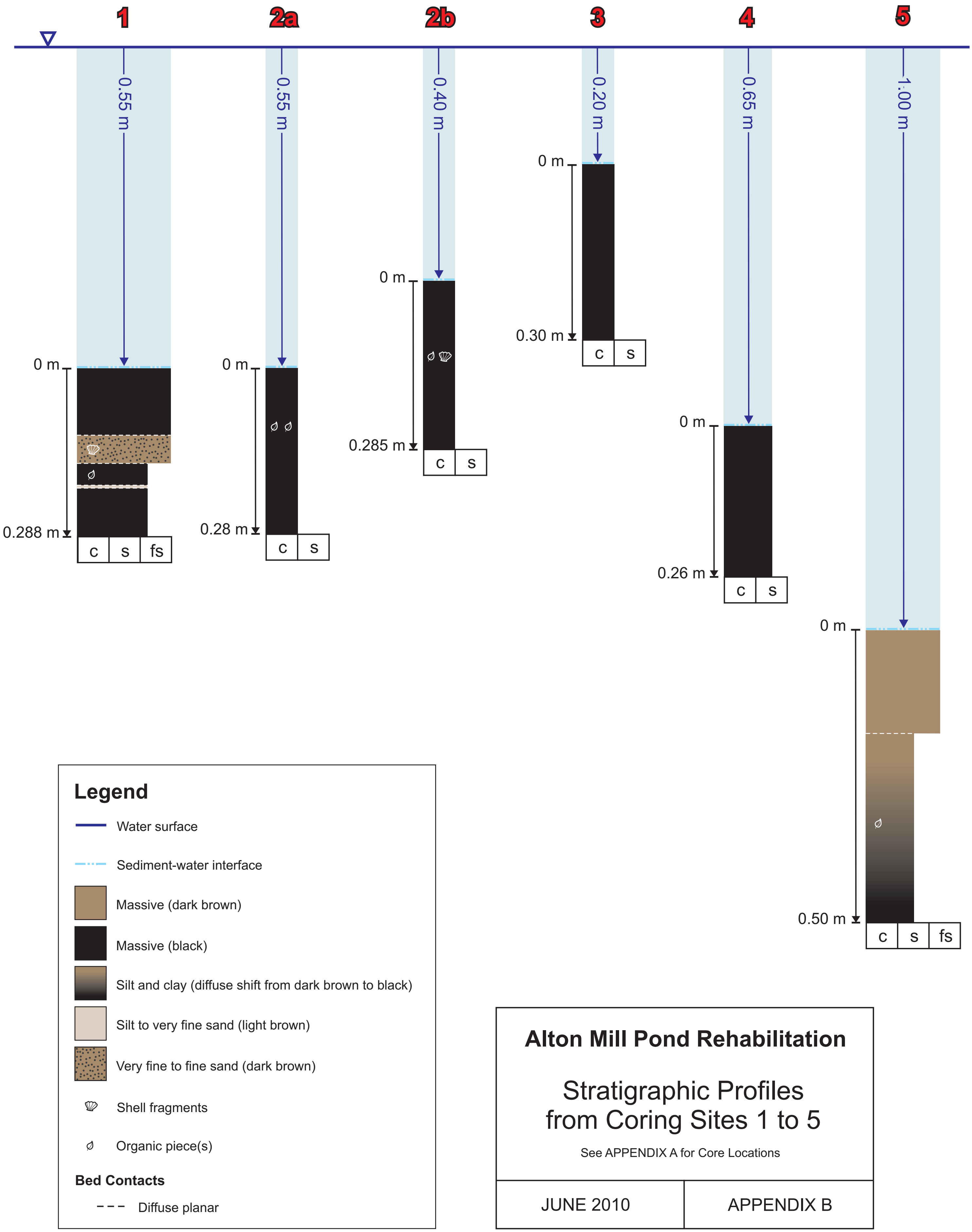
The sediments near the base of the core were relatively fine grained when compared to the overlying sediments.

Photo 26.

Core # 5

The middle portion of the core.

	Photo 27. *Core # 5* The sediments near the top of the core contained very fine to fine sand and silt. Although not visible in this photograph, there was a shift in color from black to brown at 17.5 cm depth.



Alton Mill Pond Rehabilitation

Stratigraphic Profiles from Coring Sites 1 to 5

See APPENDIX A for Core Locations

JUNE 2010	APPENDIX B

APPENDIX C
LABORATORY TEST RESULTS

ALTON MILL POND REHABILITATION - Our Project No. 10179.450

Laboratory Test Results Summary Sheet

Parameters	Units (dry weight)	Pond Composite	Outfall	O.REG. 153 TABLE 2			
				SOIL			SEDIMENT
				AGRIC.	RESID.	COM/IND	
Metals							
Antimony	(ug/g)	<0.8	<0.8	13	13	(44) 40	NV
Arsenic	(ug/g)	5.00	2.00	(25) 20	(25) 20	(50) 40	6
Barium	(ug/g)	106.00	17.00	(1000) 750	(1000) 750	(2000) 1500	NV
Beryllium	(ug/g)	<0.5	<0.5	1.2	1.2	1.2	4
Boron	(ug/g)	8.00	<5				
Boron (HWS)	(ug/g)	0.45	0.61	1.5	1.5	2	NV
Cadmium	(ug/g)	0.70	<0.5	(4.0) 3	12	12	0.6
Chromium	(ug/g)	14.00	10.00	(1000) 750	(1000) 750	(1000) 750	26
Cobalt	(ug/g)	4.00	2.10	(50) 40	(50) 40	(100) 80	50
Copper	(ug/g)	18.00	15.00	(200) 150	(300) 225	(300) 225	16
Lead	(ug/g)	35.00	10.00	200	200	1000	31
Molybdenum	(ug/g)	<0.5	<0.5	5	40	40	NV
Nickel	(ug/g)	8.00	5.00	(200) 150	(200) 150	(200) 150	16
Selenium	(ug/g)	1.40	0.50	2	10	10	NV
Silver	(ug/g)	<0.2	<0.2	(25) 20	(25) 20	(50) 40	0.5
Thallium	(ug/g)	<0.4	<0.4	4.1	4.1	32	NV
Uranium	(ug/g)	<0.5	<0.5				
Vanadium	(ug/g)	14.00	9.00	(250) 200	(250) 200	(250) 200	NV
Zinc	(ug/g)	203.00	173.00	(800) 600	(800) 600	(800) 600	120
Mercury	(ug/g)	0.20	0.01	10	10	10	0.2
Polynuclear Aromatic Hydrocarbons							
Naphthalene	(ug/g)	0.09	<0.03	4.6	4.6	4.6	NV
Acenaphthylene	(ug/g)	0.04	<0.02	100	100	130	NV
Acenaphthene	(ug/g)	<0.06	<0.03	15	15	15	NV
Fluorene	(ug/g)	0.07	0.03	340	340	340	0.19
Phenanthrene	(ug/g)	0.62	0.50	40	40	40	0.56
Anthracene	(ug/g)	0.18	0.04	28	28	28	0.22
Fluoranthene	(ug/g)	0.97	1.10	40	40	40	0.75
Pyrene	(ug/g)	0.83	0.84	250	250	250	0.49
Benzo(a)anthracene	(ug/g)	0.35	0.27	6.6	6.6	6.6	0.32
Chrysene	(ug/g)	0.32	0.45	12	12	17	0.34
Benzo(b)fluoranthene	(ug/g)	0.27	0.55	12	12	18	NV
Benzo(k)fluoranthene	(ug/g)	0.12	0.23	12	12	18	0.24
Benzo(a)pyrene	(ug/g)	0.24	0.42	1.2	1.2	1.9	0.37
Indeno(1,2,3-cd)pyrene	(ug/g)	0.10	0.22	12	12	19	0.2
Dibenz(a,h)anthracene	(ug/g)	<0.04	0.06	1.2	1.2	1.9	0.06
Benzo(g,h,i)perylene	(ug/g)	0.10	0.38	40	40	40	0.17
2-and 1-methyl Naphthalene	(ug/g)	0.11	<0.05	1.2	1.2	1.2	NV
Chrysene-d12 *	%	83.00	83.00	60 - 130 (Acceptable Limits)			

Petroleum Hydrocarbons F1 - F4 (C6 - C50) (-BTEX)							
C6 - C10 (F1)	µg/g	<10	<5	(180) 30	(180) 30	(180) 230	NV
C6 - C10 (F1 minus BTEX)	µg/g	<10	<5				
C>10 - C16 (F2)	µg/g	<20	<10	(250) 150	(250) 150	(250) 150	NV
C>16 - C34 (F3)	µg/g	390.00	300.00	(800) 400	(800) 400	(2500) 1700	NV
C>34 - C50 (F4)	µg/g	310.00	570.00	(5600) 2800	(5600) 2800	(6600) 3300	NV
(P & T) BTEX							
Benzene	µg/g	<0.002	<0.002	0.24	0.24	0.24	NV
Toluene	µg/g	<0.002	<0.002	2.10	2.10	2.10	NV
Ethylbenzene	µg/g	<0.002	<0.002	0.28	0.28	0.28	NV
m & p-Xylene	µg/g	<0.002	<0.002				
o-Xylene	µg/g	<0.002	<0.002				
Xylene Mixture (Total)	µg/g	<0.002	<0.002	25.00	25.00	25.00	NV
Toluene-d8 *	% Recovery	107.00	96.00		60 - 130 (Acceptable Limits)		
4-Bromofluorobenzene *	% Recovery	89.00	86.00		70 - 130 (Acceptable Limits)		
General Chemistry							
Chromium, Hexavalent	(ug/g)	<0.2	<0.2	(10) 8	(10) 8	(10) 8	NV
Conductivity	(mS/cm)	1.16	0.695	0.7	0.7	1.4	NA
Cyanide, Free	(ug/g)	<0.05	<0.05	100	100	100	0.1
pH	-	6.75	6.8				
SAR	-	0.392	1.34	5	5	12	NA
Nitrate and Nitrite	(ug/g)	<1	1				
Moisture Content	%	59.80	36.60				