

# Technical Memorandum

To	North Kent 1 LP	Page	1
CC	Mark Van der Woerd (AECOM), Jody Law, Joshua Vaidhyan		
Subject	<b>North Kent Wind 1 (Chatham-Kent, ON)</b> <b>Well Water Impact Complaint Investigation – UPDATED v.2</b> [REDACTED] - PIN 007460069, [REDACTED]		
From	Jason Murchison, P.Geo.		
Date	November 15 <sup>th</sup> , 2017	Project No.	60343599

## 1. Introduction and Background

AECOM Canada Ltd. (AECOM) has been retained by North Kent Wind 1 LP (NKW1) to provide hydrogeological services pursuant to *Condition G* of Renewable Energy Approval (REA) No. 5272-A9FHRL.

The purpose of this Technical Memorandum (TM) is to present a response to email correspondence received by NKW1 from Ms. Deb Jacobs, Environmental Officer, with the Ministry of the Environment and Climate Change (MOECC), Windsor Area Office, dated July 31<sup>st</sup>, 2017. In this correspondence, Ms. Jacobs provides a summary narrative of a well interference complaint that was received by MOECC at approximately 1:50pm on 31-July-2017 from [REDACTED], the property owner of [REDACTED] (Dresden, ON).

In brief, Ms. Jacobs describes the complaint as relating to sediment inundation of an existing drilled well supply, beginning on the evening of 28-July-2017. Frequent cleaning of an existing water filtration system (i.e., every 6 hours), as well as loss of prime by the well's submersible pump are symptoms described by Ms. Jacobs to have been experienced by the property owner and submitted as part of the complaint reporting.

Further to Ms. Jacob's email above, AECOM directly received an email from [REDACTED] (which Ms. Jacobs was copied on) on 1-August-2017. In this email, [REDACTED] describes a progressive deterioration of their well water beginning that evening. Specifically, it is reported that their water filters were becoming plugged with sediment "faster than the pressure tank can fill". This situation had reportedly resulted in an inability for the well to provide a reliable supply of water to the residence, which presently services a resident population of six (6) persons, including: [REDACTED], [REDACTED].

A copy of each correspondence described above is provided herein (**Attachment A**).

## 2. REA Condition Response

**Table 1** provides a summary of action(s) taken pursuant to REA Condition G5 in response to the current well interference complaint.

**TABLE 1: REA CONDITIONS AND RESPONSE SUMMARY**

REA CONDITIONS	ACTION(S) TAKEN
<p><b>G5.</b> Should the Company receive a complaint about wells or well water from an owner of an active water well (i) within the Project Study Area; or (ii) outside of the Project Study area and located within 1 km from each individual Equipment and meteorological tower, the microwave tower, and the operations &amp; maintenance building, the Company shall retain a qualified expert (P.Eng or P.Geo) to immediately undertake the following:</p> <ol style="list-style-type: none"> <li>(1) collect a water well sample at the complainant's water well, prior to any treatment systems ("raw"), after allowing the distribution system to flow for approximately 5 minutes and submit the water sample to a qualified laboratory for an analysis of the general chemistry suite of water quality parameters identified in Condition G3;</li> <li>(2) compare the results of the analysis of the water sample noted in Condition G5(1) to the pre-construction water sampling analysis results noted in Condition G3 for the subject well (if a pre-construction water sample at the subject well was taken); and</li> <li>(3) provide a detailed written opinion as to whether the water sampling analysis results demonstrate that the construction, operation or decommissioning of the Facility caused or may have caused an adverse effect to the well's water supply.</li> </ol>	<p>Steps undertaken to satisfy the requirements of Condition G5 are summarized, as follows:</p> <ol style="list-style-type: none"> <li>(1) AECOM was retained by NKW1 to investigate the Complaint received on the afternoon of 31-July-2017 following MOECC notification.</li> <li>(2) AECOM arranged directly with the property owner an appointment to visit the property on 2-August-2017.</li> <li>(3) Site visit to the subject property was completed by AECOM on 2-August-2017. Tasks completed during our site visit included: i) an interview with the property owner regarding their reported issue(s); ii) collection of a groundwater sample for analytical laboratory testing; iii) measurement of groundwater levels within the site well both prior to and following completion of well pump actuation; and, iv) collection of digital photographs of pertinent site features (eg. water well, water treatment equipment, etc.).</li> <li>(4) Information obtained during the site visit has been compiled and is summarized within this technical memorandum. An opinion regarding the potential association of the complaint with local construction activities as part of the NKW1 Project is provided and potential remedial options are presented, as appropriate.</li> </ol>

### 3. Construction Activities and Vibration Monitoring

Pile driving activities for foundation construction at Turbine Location #7 (T7) commenced in the area of Pile #13 at 12:21pm on 27-July-2017. Following the initial pile installation, an additional fifteen (15) piles at the T7 site were driven on that same day, with work concluding at the location of Pile #2 at approximately 6:36pm. Two (2) additional piles at the T7 site were installed on the following day (28-July-2017), with the final installation (Pile #4) having been completed at 8:44am. The pile driving work described above at T7 was undertaken at a distance of approximately 750 m from the [REDACTED] water well.

Monitoring of vibration effects during pile driving at T7 was completed by Golder Associates Ltd. (GAL) on behalf of NKW1 in accordance with *Condition H* of the REA. The monitoring program developed and implemented by GAL (and as approved by MOECC) comprised the measurement of particle velocities at locations in close proximity to the piles, as well as at two (2) local private water well supplies. The local groundwater well supplies monitored during pile driving at T7 included Well 7 ([REDACTED]) and Well 8 ([REDACTED]), being located at radial distances of about 1,354 m and 2,883 m from the T7 turbine foundation centre, respectively. Vibration monitoring results obtained by GAL are summarized in a technical letter, dated 3-August-2017.

In addition to the foregoing, a site-specific vibration assessment pertaining to the subject property was completed by GAL, the results of which are presented in a letter, dated 24-October-2017 (revised 14-November-2017).

A copy of each GAL letter is included herein as **Attachment B**.

Based on the vibration monitoring completed by GAL, the following interpretation and conclusions are presented within their 3-August-2017 technical letter:

November 15<sup>th</sup>, 2017

*Vibration measurements obtained with the geophone system (Instantel Minimate) on the T7 site were well within expectations and lower than those measured at the T5 and T42 test pile sites. At the T7 site, many of the piles penetrated through the near-surface soils under their own weight and, thus, ground surface vibrations during this phase of pile driving for each pile were nominal. Vibrations measured when driving the piles on the glacial till or rock were also of relatively small magnitude as compared to the test pile sites. Wells 7 and 8 are located at distances of 1,354 and 2,883 metres, respectively, from T7. Vibration measurements made using the accelerometers mounted on the well casings were also within expectations based on the T5 and T42 test pile sites. At Wells 7 and 8, maximum vibration measurements of the well casings during 10 minute intervals when pile driving was not occurring slightly exceeded maximum measurements made for time intervals during pile driving.*

and,

*It is our opinion, based on these measurements, that the vibration magnitudes at Wells 5, 6, 7 and 8 during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at these well sites and inconsequential for the wells.*

The interpretation and conclusions above are reconfirmed by GAL within their site-specific assessment letter, dated 24-October-2017 (revised 14-November-2017), which reads:

*Based on the data available to-date from the test pile and construction monitoring programs, pile-induced vibrations at the [REDACTED] well, if any, for which the complaint was noted would be expected to be less than the magnitude of vibrations associated with nearby traffic and less than the International Standards Organization (ISO) threshold for human perception of vibrations at frequencies greater than 8 Hz (0.1 mm/s). It is our opinion that, based on these measurements, the vibration magnitudes during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at the [REDACTED] well, less than the observed and measured influences of typical well pumps in the area and inconsequential for the [REDACTED] well.*

### **3.1 Discussion**

The interpretation presented by GAL within their technical letters is confirmed through a review of the vibration monitoring data summary appended thereto. Reported daily Peak Particle Velocity (PPV) measurements obtained at Well 7 ranged between 0.010 and 0.069 mm/s (average 0.028 mm/s), whereas at Well 8 the values ranged between 0.011 and 0.066 mm/s (average 0.032 mm/s). GAL also reports that vibration monitoring data collected at Well 7 and Well 8 on July 27<sup>th</sup> and 28<sup>th</sup>, 2017, during periods when pile driving activities at T7 were not occurring, indicated PPV measurements as high as 0.073 mm/s due to local influences (eg. submersible well pump, passing vehicles, etc.) unrelated to turbine construction.

Vibration monitoring completed by GAL in the immediate vicinity of T7 ranged in offset distance from a minimum of 10.1 m at Pile #10 to a maximum of 27.0 m at Pile #1 (average of 19.5 m). During this monitoring, reported daily PPV values were consistent at 2.79 mm/s, with exception of Piles #3 and #4, where PPV values of 1.65 mm/s were reported. No apparent correlation (increase / decrease) is observed in PPV values measured at either Well 7 or Well 8 in response to pile driving activities at the latter two (2) pile locations.

Finally, GAL reports that local background PPV values generally fall within the range of <0.01 to 0.07 mm/s, based on data collected previously at T5 and T42. This range is generally consistent with the values presented above for monitoring during pile installation at T7. As a basis of comparison, the particle velocity threshold for human perception is stated by GAL to be approximately 0.1 mm/s at between about 8 and 100 Hz (ISO 2631-2).

#### 4. Well Construction Details

**Table 2** provides a summary of pertinent construction details for the current operating water well located at [REDACTED], based on a review of available MOECC Water Well Records and measurements / observations made by AECOM during our 2-August-2017 site visit.

A copy of the well record is included as **Attachment C** and a photograph of the well is provided as **Photo 1**.

**TABLE 2: PRIVATE WELL CONSTRUCTION DETAILS**

DETAILS	[REDACTED] (PIN 007460069)
Well Tag #	--
Well ID	3308763
Installation Date	11-June-1991
Well Location	Rear Yard (N) of House
Contractor	Rumble Water Wells (Blenheim, ON)
Contractor No.	4642
Construction Method	Cable Tool
Total Depth	20.7 m (68')
Target Formation	Black Gravel (Loose) / Black Shale (Hard)
Casing Length	19.8 m (65')
Casing Diameter	127 mm (5")
Casing Material	Steel
Casing Stick-Up (AECOM; 2-Aug-2017)	0.42m (1.4')
Annular Seal	None Present (Section Crossed Out on Well Record by Contractor)
Sealant Type	None Present (Section Crossed Out on Well Record by Contractor)
Well Screen Installed?	Yes
Well Screen Details	Stainless Steel; 100 Slot (2.5 mm Openings); 0.9 m (3') long; 102 mm (4") Diameter
Well Screen Interval	19.7 to 20.6 mBGS (64.5' to 67.5'); Screen Attached to a 0.9 m (3') Long 'Riser Nipple' held into the Well Casing by a K-Packer Assembly positioned at 18.6 mBGS (61'); a 0.15 m (6") long 'Toe Nipple' is affixed to the base of the Well Screen forming a Sump
Well Cover Type	Metal; Vermin-Proof
Recommended Pump Intake Depth	14.0 mBGS (46')
Recommended Pumping Rate	13.3 L/min (3.5 USgpm)
Static Level (Well Record)	4.3 mBGS (14')
Water Level (AECOM; 2-Aug-2017)	3.53 mBGS (11.6')
Pumping Level (Well Record)	9.1 mBGS (30')
Kind of Water (Well Record)	Fresh / Clear



**PHOTO 1: Site Well (as on 2-August-2017)**

#### **4.1 Discussion**

In review of the MOECC record for the on-site drilled water well, it is evident that it obtains its groundwater source from the upper weathered portion of the shale bedrock. In this regard, a 'water found' depth interval of 19.8 m to 20.7 mBGS (65' to 67') is reported by the Contractor on the record. Above the shale bedrock interface, a 0.75 m thick layer of gravel and 'shale stones' is reported (water-bearing) which is in turn overlain by an approximately 17.8 m dense clay unit that extends to within 1.8 m of the ground surface. Surficially, a mixture of sand and clay is reported to reside locally atop the clay to the existing surface grade.

Groundwater entry to the well is facilitated through the installation of a 0.9 m long stainless steel well screen with its base positioned at a depth of approximately 20.6 mBGS (67.5'). Geologic details contained on the well record indicate that the lower 0.15 m of the screen is located within hard black shale bedrock, while the upper 0.75 m is positioned within the overlying 'black gravel' and 'shale stones'. Comparing the details above with water found depths reported by the Contractor on the well record, the effective screen intake length is estimated to be approximately 0.75 m.

The top of the well screen reportedly is positioned at a depth of 19.7 mBGS (64.5') corresponding to the interface between the water-bearing black gravel / stones and overlying grey clay. Considering that a well screen slot size of 100 was selected by the Contractor for their installation of the well (correlating to an aperture opening width of 2.5 mm), and that an annular seal was not installed (common for a cable tool drilling method), it is interpreted that the well could be susceptible to sediment particle entry via the upper portion of the well screen, given that clay particles (generally <0.002 mm) are significantly smaller than the well screen openings. Over time, these sediments may accumulate within the well, resulting in a progressive loss of effective screen length and potential yield, as well as increased potential for sediment ingress during active pumping due to re-suspension of entrained sediment and/or increased turbulence across the well screen.

A recommended pump setting of 14.0 mBGS (46'), or about 5.6 m above the top of the well screen interval is provided on the MOECC record. The actual current pump intake setting within the well is unconfirmed however. Based on the age of the well (>25 years), it is likely that the well pump has been replaced on at least one occasion and thus the current installed position of the pump may differ from the original recommendation provided by the well Contractor. What is known, however, is that the well presently draws water using a submersible well pump (pump specifications are not known).

Depending on the size of the pump that presently is installed, there lies a potential for sediment to be drawn into the well as a result of pumping in excess of its sustainable capacity (either short or long-term).

Based on the foregoing discussion, including the selected installation methodology for the well screen, absence of an annular seal, and relatively low reported yield from the 'black gravel' and 'shale stones', it is our opinion that an inherent susceptibility would exist for the influx of sediment (hence increases in total suspended solids and inorganic turbidity) during the course of normal pump operation and variations in groundwater demand. Due to the absence of an annular seal, the well also could be inherently susceptible to impact(s) arising from surface drainage ingress along the well casing exterior. This is supported by the presence of a relatively poor baseline raw (untreated) groundwater quality at the well, as will be discussed further in the following section.

## 5. Water Quality Data

**Table 3** provides a summary of available groundwater quality data for the site well. Laboratory Certificates of Analysis are included as **Attachment D**.

**TABLE 3: PRIVATE WELL SAMPLING SUMMARY**

LOCATION	SAMPLED BY	DATE	TYPE	PURPOSE
[REDACTED]	AECOM	2-February-2017	Raw (Untreated)	Baseline
[REDACTED]	MOECC	1-August-2017	Raw (Untreated)	Post-Construction
[REDACTED]	AECOM	2-August-2017	Raw (Untreated)	Post-Construction

### 5.1 Discussion

Available raw (untreated) groundwater sampling data for the well indicates the presence of relatively poor baseline groundwater quality, with elevated levels of pH, colour, turbidity, sodium, and iron. It is surmised that the elevated level of colour reported for the raw water source in the baseline testing result is attributed to one or a combination of dissolved metals, sediment, and/or organic materials.

At the time of AECOM's baseline site visit on 2-February-2017, water treatment at the [REDACTED] residence comprised multi-stage particle filtration (filter cartridge pore sizes unconfirmed), water softening, and reverse osmosis (latter two being confirmed as per water well survey information), indicating that the water was known to be of degraded quality prior to the outset of construction. During AECOM's 2-August-2017 site visit, a multi-stage particle (cartridge) filtration system was observed in a room located adjacent to that which AECOM staff had previously attended during baseline sampling (**Photo 2**). The filtration system shown in **Photo 3** was not present at the time of our 2-February-2017 site visit and is of recent origin, having been installed at the recommendation of Water Wells First (WWF) as part of an ongoing particle/sediment quality study. Raw water quality sampling during the August 2<sup>nd</sup> site visit was completed using the gate valve on the white PVC pipe at the far left hand side of Photo 3 (blue handle).

Hardness levels are relatively low (soft) in the raw (untreated) groundwater and below the Ontario Drinking Water Quality Standard (ODWQS) Operational Guideline (OG) range of 80-100 mg/L. This owes to the relatively low carbonate content of the local shale bedrock and correspondingly low concentrations of calcium and magnesium within the groundwater source. Low hardness levels within water can result in the accelerated corrosion of water pipes, appliances, and other metallic fixtures and components.



**PHOTO 2: Particle Filter System (as on 2-February-2017).  
Opposing side of wall from recent photograph.  
(Presence unconfirmed during 2-August-2017 site visit)**



**PHOTO 3: Particle Filter System (as on 2-August-2017)**

With the exception of Total Coliforms in the 2-August-2017 sample obtained by AECOM (2 CFU/100mL), no other exceedances of health-related parameters analyzed, including Escherichia and Total Coliform bacteria, Nitrate (as N), Nitrite (as N) and fluoride, were detected in either the baseline or post-construction water samples collected from the site well supply. Although not in exceedance of ODWQS limits, fluoride is noted to be elevated in both the baseline and post-construction sample results.

Turbidity is an Aesthetic Objective (AO) of the ODWQS. In this regard, a value of 5 Nephelometric Turbidity Units (NTU) has been established by MOECC. The MOECC's *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines* (June 2003; revised June 2006) makes a clear distinction between turbidity related to organic constituents and inorganic constituents stating: "Raw water supply which is ground water with very low organic content may contain inorganic-based turbidity, which may not seriously hinder disinfection. For such waters, an Operational Guideline for turbidity is not established". Further guidance is provided by MOECC regarding the relationship between turbidity and its organic and inorganic components, the disinfection processes, and as a measure of the water supply filtration and treatment efficiency. The technical explanations also note that while organic turbidity is an important measure as related to health concerns, the AO value is an aesthetic component which is set for all waters at the point of consumption (i.e., not at the source).

At the site well, turbidity levels in the samples fluctuate between a baseline (raw - AECOM) value of 6.2 NTU up to 86.8 NTU (raw - MOECC) on 1-August-2017. A raw water sample value of 57.3 NTU was determined on the subsequent day (2-August-2017). In considering this data, it should be noted that a turbidity variation of greater than 50 NTU would be readily visible to the naked eye, and thus present an adverse impact to the aesthetic quality of the groundwater source. Elevated turbidity levels of this magnitude may also lead to flow restrictions within the residence based on the capacity of the installed water treatment system and rate of sediment accumulation.

The potential for groundwater quality impacts associated with pile driving is both time-dependent and related to the intensity and propagation of ground-borne vibration. Similarly, based In the case of piling associated with T7, no quantifiable vibrations attributed to pile driving were detected at either

Well 7 or Well 8, as discussed previously in Section 3. Similarly, low daily PPV values were detected by GAL during their monitoring in close proximity to the T7 pile locations. Based on this monitoring data and considering the separation distance which exists between T7 and the site well (ie. ~750 m), the suspension of particles within or in its immediate vicinity is not considered plausible. As an alternate consideration, vibration impacts in the immediate vicinity of pile driving at T7 would have needed to result in: i) the suspension of settled particles within the groundwater system; ii) the particles remaining in suspension for a prolonged period of time; and, iii) the water well being situated in a position hydraulically downgradient of *or* within the radius of pumping influence relative to the location of T7. This second consideration also is not considered plausible in the context of the local hydrogeological setting (ie. potential hydraulic gradient and groundwater travel times) and reported timeline of onset of impact(s) at the site well.

## 6. Conclusions

Based on a review and interpretation of the information presented herein, it is AECOM's opinion that the groundwater quality / supply issues presently being experienced at [REDACTED] (PIN 007460069) are *not* as a result of NKW1 turbine foundation construction or pile-driving activities. The evaluation of potential alternative impact scenarios is outside of the scope of the current investigation and has not been completed herein.

This interpretation and opinions presented in this technical memorandum are based on information available as of the date the document was prepared. Should additional information become available at a future date, AECOM reserves the right to review and potentially reconsider the findings of our current assessment through the issuance of addenda to this technical memorandum.

-- End of Memorandum --



**AECOM**

# **Attachments**

**AECOM**

**Attachment A**

**Correspondence**

## Murchison, Jason

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**Subject:** Complaint Re. NKL pile driving and well water

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**From:** Jacobs, Deb (MOECC) [<mailto:deb.jacobs@ontario.ca>]

**Sent:** Monday, July 31, 2017 3:01 PM

**To:** Josh Vaidhyan ([j.vaidhyan@samsung.com](mailto:j.vaidhyan@samsung.com)); Jody Law ([jody.law@patternenergy.com](mailto:jody.law@patternenergy.com))

**Cc:** Smith, Mark (MOECC); Gilbert, Teri (MOECC); Lehouillier, Jason (MOECC); Harman, Bruce (MOECC); Colella, Nick (MOECC); Keyvani, Mohsen (MOECC)

**Subject:** Complaint Re. NKL pile driving and well water

Hello Joshua,

As discussed on the phone, I received the following complaint today at ~1:50pm:

Cell: [REDACTED]

Address: [REDACTED]

Caller says there were 3 pile drivers operating around her home Thurs. & Fri. of a last week (July 27 & 28). Friday night the "sediment built up in the tank" and the water pump associated with the well lost prime. Caller says that the sediment filter is plugging right up and they have had to clean it out approximately every 6 hours since. Caller said they have lived at that location for about 5 years and have not had this problem before. The caller reported that there is one well on the property and described it as an above-ground casing located outside of the house to the North. When asked, the caller confirmed that they had participated in the pre-construction water sampling program carried out by Aecom.

I indicated that I would be contacting Samsung / Pattern with the complaint and that she should expect to hear from you regarding the complaint, at least preliminarily, today. It is the Ministry's expectation that you will implement the project's complaint response procedure (as per Condition G5) forthwith, with expansion of action to include G6 requirements as necessary.

Joshua, you indicated to me that this individual contact you by email on Saturday, July 29 requesting information related to their water sampling only.

This caller asked me about getting a vibration monitor on their well. They also enquired about getting vibration monitoring data. I suggested in both cases speaking to Samsung / Pattern about it when they (you) contact her.

Please keep the Ministry apprised of any / all steps that Samsung / Pattern or its consultants undertake to look into / address this complaint.

Thank you

**Deb Jacobs**

*Environmental Officer / Agente de l'environnement*

*Ministry of the Environment and Climate Change*

*Ministère de l'Environnement et de l'Action en matière de changement climatique*

*Windsor Area Office / Bureau du Secteur de Windsor*

*4510 Rhodes Drive, Unit(è) 620*

*Windsor, Ontario*

## Murchison, Jason

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**From:** [REDACTED]  
**Sent:** Tuesday, August 01, 2017 8:23 PM  
**To:** Murchison, Jason; info@northkentwind.com  
**Cc:** deb.jacobs@ontario.ca  
**Subject:** There is now NO WATER at [REDACTED]

Greetings Mr. Murchison,

I understand that you have heard from the MOECC about a well interference complaint. I understand that testers are coming out tomorrow (Wednesday) at 2:00.

However, things have rapidly deteriorated. We have been able to clear the plugged filters since Saturday morning. However, this evening when we tried to clear the plug, sediment plugged the filters faster than the pressure tank can fill. To that end we have NO WATER GETTING TO THE PRESSURE TANK SO WE HAVE NO WATER for drinking, showers, dishwashers, laundry, flushing toilets, living.

Again, this is a problem that we have never had in 5 years at this house and has only occurred when pile drivers were active adjacent to our property.

Something needs to be done IMMEDIATELY! My [REDACTED] live in this house. We cannot live in these conditions.

[REDACTED]

## Murchison, Jason

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**Subject:** FW: Aug.1 observations & subsequent questions - for AECOM  
**Attachments:** AECOM sample August 2 2017 3pm.png; MOECC water sample - [REDACTED] - Aug 1, 2017.jpg

**From:** Jacobs, Deb (MOECC) [<mailto:deb.jacobs@ontario.ca>]

**Sent:** Friday, August 04, 2017 3:45 PM

**To:** zzJoshua Vaidhyan; Jody Law

**Cc:** Gilbert, Teri (MOECC); Moroney, Michael (MOECC); Smith, Mark (MOECC); Harman, Bruce (MOECC); Vantfoort, Richard (MOECC); Thuss, Simon (MOECC); Lehouillier, Jason (MOECC); Schofield, Carine (MOECC); Lannin, Teresa (MOECC)

**Subject:** Aug.1 observations & subsequent questions - for AECOM

Joshua, as discussed, please provide the following information to AECOM for consideration in their report the on this matter, which I understand is expected next week.

I received a complaint from [REDACTED] (Dresden) the afternoon of Monday July 31, the details of which were provided to you (Joshua Vaidyan) by phone and subsequently by email that same afternoon. In those communications I made it clear that the Ministry of the Environment and Climate Change expected the company to initiate their complaint response process, as per condition G5 in their REA.

In response to the complaint, I attended the [REDACTED] residence the afternoon of Tuesday August 1, 2017 accompanied by Richard Vantfoort, P. Geo, a hydrogeologist from the Ministry's South West Region Office in London. During this visit, we took water samples from the raw water tap located in the basement crawl space area of the home, upstream of all filtration units. This tap was flushed for approximately 10 minutes before we took the samples. The raw water was noticeably cloudy, and consistently so in the various bottles we filled. I have attached a copy of a photo I took of one of the filled sample bottles for visual reference. The photo is an accurate representation of what I observed in person. These samples were sent to the Ministry of the Environment and Climate Change lab for analysis. I request expedited /priority processing for the turbidity analysis and can confirm that the test was run within 24 hours of it being taken. I have also since been provided with interim results from the turbidity analysis – 86.8 NTU. I must reiterate these are our interim results – final results will be provided to us with the balance of the sample analysis results, anticipated in several weeks' time. We can most definitely forward these results once they became available, but felt it was necessary to provide you with information we have to-date.

I understand that AECOM attended the [REDACTED] residence on Aug. 2 in response to the above-noted complaint.

I have also seen a photo provided by [REDACTED] via email to Jody Law the evening of Aug. 3. It purports to be a photo of the sample taken by AECOM during their Aug. 2 visit to the [REDACTED] residence. In that photo, the sampled water appears noticeably cloudy (see attached)

In the email from you (Joshua Vaidyan) (10:33am, Aug 3) to Michael Moroney (and copied to me and others), you provides the following account of AECOM's observations during their Aug 2, 2017 visit to the [REDACTED] Residence (your italics):

*No evidence of any water quality deterioration (based on comparison with field observations during baseline sampling), no measured decrease in groundwater levels, no significant drawdown within the well in response to pumping, or apparent yield issues. All samples collected and measurements obtained by AECOM was witnessed by [REDACTED] and Kevin J. (WWF), along with the host of others representing the JV.*

I have also reviewed a copy of AECOM's results for the Detailed Well Assessment Program (i.e. Baseline sampling) provided to the [REDACTED] for the sampling which occurred February 2, 2017. This analysis shows a turbidity value of 6.2 NTU. It is my understanding that a water sample with this turbidity value would appear clear or very nearly so to the naked eye.

I am trying to reconcile this varying information. Is AECOM saying that the cloudy water collected and photographed during the Aug 2, 2017 visit is visually the same as the 6.2 NTU samples taken Feb. 2, 2017? Are there any photos of the Feb 2 sample? I am hoping that Aecom's report will address / answer these questions.

Additionally - has the turbidity result been received yet from AECOM's Aug. 2 sample? The Ministry expects that Samsung / Pattern will forward that result to us forthwith upon receiving it from AECOM / the lab.

Thank you

***Deb Jacobs***

*Environmental Officer / Agente de l'environnement*

*Ministry of the Environment and Climate Change*

*Ministère de l'Environnement et de l'Action en matière de changement climatique*

*Windsor Area Office / Bureau du Secteur de Windsor*

*4510 Rhodes Drive, Unit(è) 620*

*Windsor, Ontario*

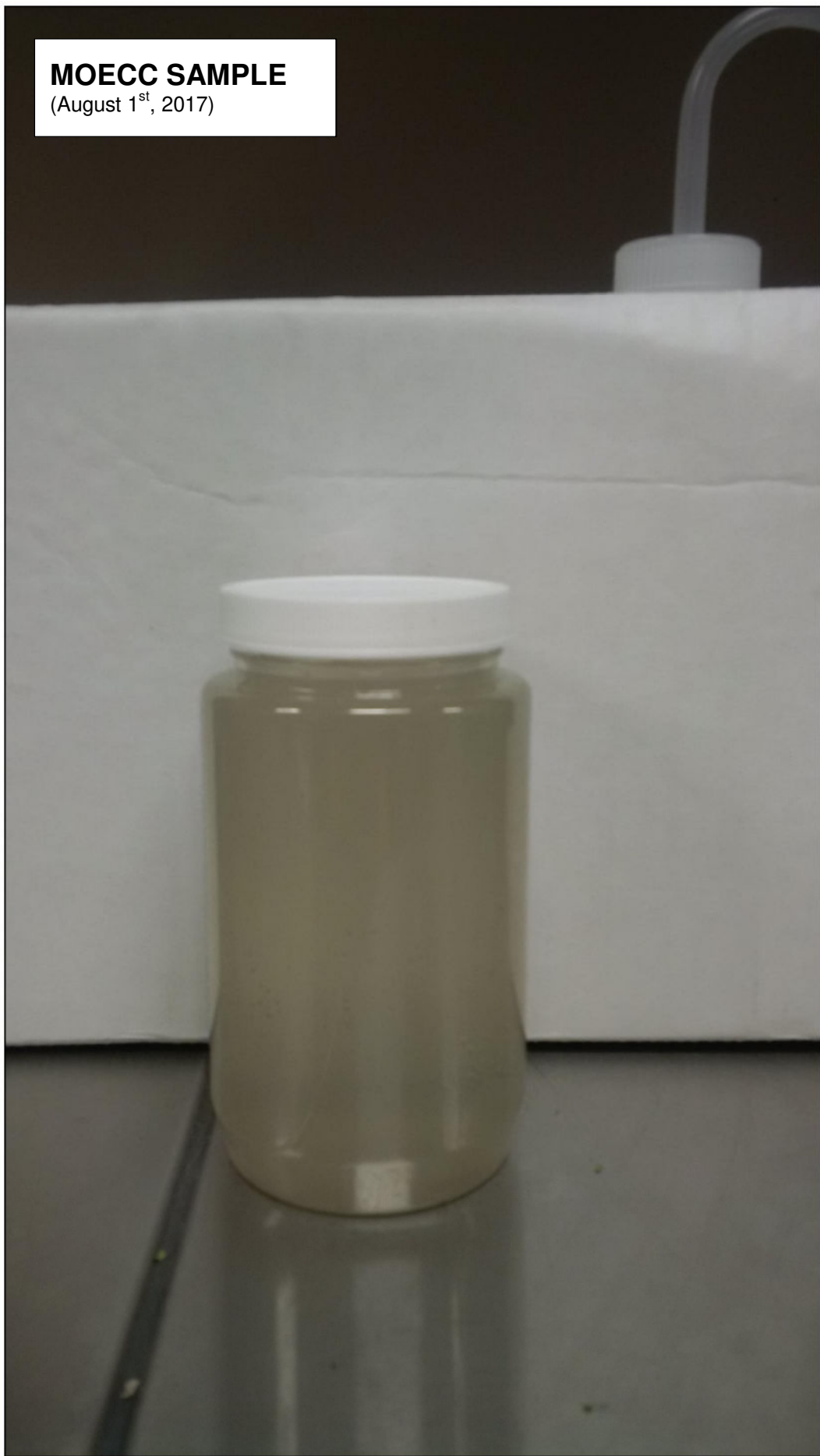
*N8W 5K5*

*Telephone: 519-948-4148*

*Fax / Télécopieur: 519-948-2396*

*E-Mail / Courriel: [deb.jacobs@ontario.ca](mailto:deb.jacobs@ontario.ca)*

**MOECC SAMPLE**  
(August 1<sup>st</sup>, 2017)



**AECOM SAMPLE**  
(August 2<sup>nd</sup>, 2017)



**AECOM**

**Attachment B**

**Vibration Monitoring Data  
(Golder Associates Ltd.)**

October 24, 2017  
Revised November 14, 2017

Project No. 1668031-2000-L11

Mr. Jody Law  
c/o North Kent Wind 1 LP  
355 Adelaide Street West, Suite 1000  
Toronto, ON M5V 1S2

**WATER WELL COMPLAINT 1  
NORTH KENT WIND 1 PROJECT  
CHATHAM-KENT, ONTARIO**

Dear Mr. Law:

This letter is provided to summarize vibration monitoring data associated with Well Complaint 1 dated July 31, 2017, related to the well located at [REDACTED] in Dresden, Ontario. For the purposes of this letter, vibration data is summarized for the period starting one day prior to the first reported issue, the date of the reported issue of July 28, 2017, and one day following the date of the reported well condition issue

Table I is attached summarizing the following data:

- 1) date of pile driving;
- 2) turbine site at which pile driving was undertaken and the number of piles driven on the identified date;
- 3) maximum measured particle velocities at three locations:
  - a. at the turbine site; and
  - b. at the two wells within the turbine cluster specified for monitoring where the distance from the turbine site to the monitored well is also shown;

where these tabulated measurements specifically exclude vibrations directly associated with the well pumps (described below) but include vibrations attributable to other general sources such as nearby road and utility construction, nearby road car and truck traffic and movements of farm equipment, as examples, and the distances from the pile driving to the well monitoring locations;

- 4) notes specific to the monitoring data; and
- 5) the distance from the pile driving to the well for which the complaint was submitted.



Pile driving of the closed-end pipe piles was completed in accordance with the Project foundation design using equipment with a driving hammer with a rated energy no greater than the hammer used during the test pile vibration monitoring. During pile driving, the times during which the pile was being actively struck by the hammer were recorded from the start of hammering to conclusion of hammering. Further, the times during which the pile was driven on glacial till/rock were recorded based on observations of the pile driving conditions. It should be noted that very little energy was required during initial pile penetration since piles penetrated significant depths into the soft clay soil under their own weight or with very few hammer blows. Table 1 summarizes the numbers of individual piles driven at each turbine location on the noted dates, the distances from the turbine locations and monitored wells, and distances of pile driving to the well for which the complaint was reported.

Vibrations at the turbine sites were monitored using portable construction vibration monitoring geophone devices common to construction monitoring and in accordance with the approved monitoring work plan. Vibrations at the well locations were monitored using three accelerometers mounted to the steel well casings and a portable data collection system in accordance with the approved monitoring plan. Monitoring of the well casings and pile driving sites was completed continuously during driving of all piles relevant to this letter. All monitoring instruments were calibrated at the manufacturer or manufacturer-approved facility prior to use by Golder. All such calibrations were conducted on a schedule as required according to the manufacturer or instrument supplier. Field verification of accelerometer calibration was completed with a portable controlled vibration source before and after each time the accelerometers were installed on well casings. Accelerometer responses during field verification remained within required tolerances.

Following pile driving, data was downloaded from all devices, stored electronically, vibration magnitudes were assessed, compared to pile driving records and observations at the well sites and summarized. Assessment of vibrations included examination of time histories of data with a specific focus on comparing observation of vibration energy sources such as pile driving, well pumps and nearby farm and roadway vehicle traffic. Analysis of accelerometer data was completed using the methods defined in the test pile vibration monitoring program (June, 2017). Evaluation of data was completed in Golder's London, Ontario office.

The well at the property for which the complaint was reported is located in the rear yard of the residence. According to the MOECC well record (3308763) it was drilled in 1991 with a cable-tool system (free-falling weighted chisel bit and bailer) approximately 0.3 m into the Kettle Point Formation black shale to a total depth of 20.7 m. The well casing was installed to 19.8 m terminating in "shale gravel" and included a 0.9 m long screen section (slot opening size of about 2.5 mm).

When reviewing Table 1, attached, it should be noted that during well monitoring of multiple wells in the area, well casing vibrations directly attributable to the well pumps were measured and these were as much as 2.4 millimetres per second (mm/s) with one well experiencing vibrations of almost 5 mm/s during installation, initial operation and adjustments. The Well 6 casing exhibited vibrations of as much as 0.44 mm/s directly attributable to the well pump operating. Vibration monitoring at Wells 7 and 8 undertaken outside of times during which pile driving was underway recorded maximum measured well casing vibrations of 0.370 mm/s, consistent with vibration magnitudes associated with other transient sources including nearby traffic and vehicles entering and leaving the properties.

Since the location of the well complaint residence is closer to the pile driving than the monitored wells during the period in question, other data gathered as part of Phase 1 test pile vibration monitoring program and other wells monitored during the Phase 2 construction pile driving monitoring program were also reviewed since the ground conditions, pile driving systems and pile types and sizes are directly comparable. At distances between pile driving and wells ranging from about 580 m to 911 m, directly relevant to this water well complaint, maximum vibration

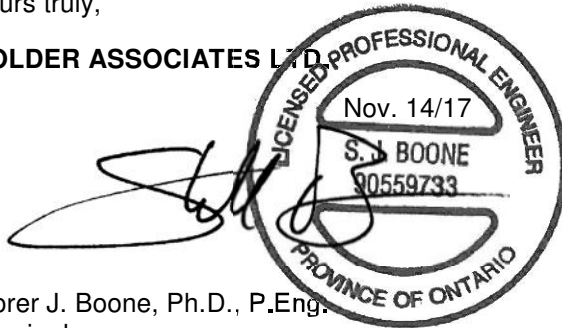
velocities related to pile driving ranged from 0.003 to 0.030 mm/s. Vibration velocities at the well for which the complaint was reported would have been within this range. These measured well casing vibration magnitudes are consistent with expected vibration magnitude and distance attenuation relationships and less than the magnitudes anticipated based on the Phase I test pile driving evaluation.

Based on the data available to-date from the test pile and construction monitoring programs, pile-induced vibrations at the [REDACTED] well, if any, for which the complaint was noted would be expected to be less than the magnitude of vibrations associated with nearby traffic and less than the International Standards Organization (ISO) threshold for human perception of vibrations at frequencies greater than 8 Hz (0.1 mm/s). It is our opinion that, based on these measurements, the vibration magnitudes during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at the [REDACTED] well, less than the observed and measured influences of typical well pumps in the area and inconsequential for the [REDACTED] well.

We trust that this letter is adequate for your present requirements. If any point requires further clarification, please contact this office.

Yours truly,

**GOLDER ASSOCIATES LTD.**



Storer J. Boone, Ph.D., P.Eng.  
Principal

SJB/MEB/cr

CC: J. Vaidyan, Samsung

Attachment: Table 1 - Summary of Vibration Monitoring Data, Well Complaint 1

n:\active\2016\3 proj\1668031 pattern\_north kent vib monit\_chatham-kent\ph 2000-vib monit field work\2-correspondence\3-ltrs\11\1668031-2000-l11 nov 14 17 (revised 2) water well complaint 1.docx

**Table 1: Summary of Vibration Monitoring Data, Well Complaint 1<sup>1</sup>**

Date	Turbine and Piles <sup>4</sup>	Measured Maximum Particle Velocities During Pile Driving, Inclusive of Traffic and Other Activities, Exclusive of Pump-Induced Vibrations (mm/s) <sup>2</sup>				Distance from Well Complaint Residence (m)
		Turbine Site	Monitored Well (Well No., distance)	Monitored Well (Well No., distance)	Other Notes <sup>3</sup>	
<b><i>Complaint 1 July 28, 2017</i></b>						
7/27/2017	T7 (16)	0.89	0.069 (7, 1354 m)	0.066 (8, 2883 m)	See letter text.	759
7/28/2017	T7 (2)	5.97	0.035 (7, 1354 m)	0.045 (8, 2883 m)	See letter text.	759
7/29/2017	<i>No Pile Driving</i>					

- NOTES:
- 1) Table shall be read in conjunction with accompanying letter.
  - 2) Other activities included nearby road and utility construction, travel of loaded farm equipment on the property, car and truck traffic on adjacent road, etc.
  - 3) See letter text for discussion of pump influences and specific pile vibration measurements and distances.
  - 4). Number of piles driven on specified date shown in parentheses.

August 3, 2017

Project No. 1668031-2000-L03

Mr. Jody Law  
c/o North Kent Wind 1 LP  
355 Adelaide Street West, Suite 1000  
Toronto, ON M5V 1S2

**SUMMARY OF VIBRATION MONITORING  
FOUNDATION PILES - TURBINES T7, T35 AND T36  
NORTH KENT WIND 1 PROJECT  
CHATHAM-KENT, ONTARIO**

Dear Mr. Law:

Please find attached a summary of the vibration monitoring that has been undertaken during driving of foundation piles for turbines T7 and T36 being constructed as part of the North Kent Wind 1 project (NK1). Vibration monitoring was carried out to meet Section H1 of the Renewable Energy Approval (REA) document issued by the Ontario Ministry of the Environment and Climate Change (MOECC). The work was carried out in accordance with a vibration monitoring program prepared by Golder Associates Ltd. (Golder) dated June 2, 2017 and subsequently approved by MOECC. The attached pages of summary data and notes include particle velocity measurements made at the T7 and T36 sites in close proximity to the pile driving, along with measurements obtained at Wells 5, 6, 7 and 8. An updated summary report for vibration measurements associated with the T35 site is also attached.

Vibration measurements obtained with the geophone system (Instantel Minimate) on the T7 site were well within expectations and lower than those measured at the T5 and T42 test pile sites. At the T7 site, many of the piles penetrated through the near-surface soils under their own weight and, thus, ground surface vibrations during this phase of pile driving for each pile were nominal. Vibrations measured when driving the piles on the glacial till or rock were also of relatively small magnitude as compared to the test pile sites. Wells 7 and 8 are located at distances of 1,354 and 2,883 metres, respectively, from T7. Vibration measurements made using the accelerometers mounted on the well casings were also within expectations based on the T5 and T42 test pile sites. At Wells 7 and 8, maximum vibration measurements of the well casings during 10 minute intervals when pile driving was not occurring slightly exceeded maximum measurements made for time intervals during pile driving.

Vibration measurements obtained with the geophone system on the T36 site were within expectations and comparable to those measured at the T5 and T42 test pile sites. At the T36 site, many of the piles readily penetrated the near-surface soils under their own weight or a few pile driving hammer blows. Wells 5 and 6 are located at distances of 4,198 m and 3,380 m from Turbine T36. Vibration measurements made using the accelerometers mounted on the well casings were also within expectations based on the T5 and T42 test pile sites.



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**Golder Associates Ltd.**

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**Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America**



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Maximum particle velocities of 0.08 to 0.8 mm/s were obtained from monitoring data collected at Well 6 on July 13, 2017 when the well pump was operating during a time period without pile driving. Pump operation was triggered by allowing the household outdoor hose to run fully open for about 10 minutes. At the Well 6 site, maximum well casing particle velocities associated with pump operation during the known time period were an order of magnitude greater than any measurements made during pile driving within the turbine cluster associated with Well 6. A photograph of Well 6 is attached to this letter illustrating the proximity of the well pump to the casing that likely influenced the transmission of pump vibrations to the casing. The vibration monitoring summary report prepared for the T35 site has been updated and attached to reflect recent processing of data for the deliberate pump operation at Well 6, as described above.

It is our opinion, based on these measurements, that the vibration magnitudes at Wells 5, 6, 7 and 8 during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at these well sites and inconsequential for the wells.

We trust that this letter is adequate for your present requirements. If any point requires further clarification, please contact this office.

Yours truly,

**GOLDER ASSOCIATES LTD.**



Storer J. Boone, Ph.D., P.Eng.  
Principal

SJB/MEB/cr

Attachments: Photograph of Well 6 Pump Configuration  
Vibration Monitoring Summaries for Turbines T7, T35 (updated) and T36

n:\active\2016\3 proj\1668031\_pattern\_north kent vib monit\_chatham-kent\ph 2000-vib monit field work\2-correspondence\3-ltrs\03\1668031-2000-l03 aug 3 17 summary of vibration monitoring t7.docx



Photograph 1: Well 6 illustrating proximity of pump, hoses and tank to well casing.

## Preliminary Vibration Monitoring Report

Turbine Location: T7

## Vibration Measurements at Turbine Site

## Vibration Measurements at Wells

Pile No.:	Pile Driving Times and Dates			Geophone Dist. (m)	Daily Maximum	Particle Velocity (mm/s) <sup>c, d</sup>	
	Start <sup>a</sup>	Rock/Till	End <sup>a</sup>		Particle Velocity (mm/s) <sup>b</sup>	Well 7	Well 8
1	7/27/2017 17:57	7/27/2017 18:03	7/27/2017 18:04	27.0	2.79	0.030	0.011
2	7/27/2017 18:31	7/27/2017 18:36	7/27/2017 18:36	26.6	2.79	0.063	0.013
3	7/28/2017 8:11	7/28/2017 8:16	7/28/2017 8:16	25.6	1.65	0.019	0.022
4	7/28/2017 8:37	7/28/2017 8:43	7/28/2017 8:44	23.9	1.65	0.035	0.045
5	7/27/2017 18:11	7/27/2017 18:17	7/27/2017 18:18	21.6	2.79	0.017	0.012
6	7/27/2017 15:27	7/27/2017 15:32	7/27/2017 15:33	19.0	2.79	0.019	0.028
7	7/27/2017 15:10	7/27/2017 15:15	7/27/2017 15:16	16.1	2.79	0.026	0.028
8	7/27/2017 14:30	7/27/2017 14:36	7/27/2017 14:37	13.2	2.79	0.017	0.027
9	7/27/2017 14:10	7/27/2017 14:16	7/27/2017 14:18	11.0	2.79	0.011	0.031
10	7/27/2017 13:55	7/27/2017 14:00	7/27/2017 14:01	10.1	2.79	0.030	0.012
11	7/27/2017 13:42	7/27/2017 13:46	7/27/2017 13:47	11.0	2.79	0.025	0.042
12	7/27/2017 13:09	7/27/2017 13:13	7/27/2017 13:23	13.2	2.79	0.019	0.035
13	7/27/2017 12:21	7/27/2017 12:34	7/27/2017 12:53	16.1	2.79	0.030	0.049
14	7/27/2017 15:42	7/27/2017 15:51	7/27/2017 15:54	19.0	2.79	0.026	0.039
15	7/27/2017 16:06	7/27/2017 16:12	7/27/2017 16:13	21.6	2.79	0.032	0.021
16	7/27/2017 16:34	7/27/2017 16:44	7/27/2017 16:45	23.9	2.79	0.010	0.066
17	7/27/2017 16:55	7/27/2017 17:01	7/27/2017 17:02	25.6	2.79	0.069	0.030
18	7/27/2017 17:17	7/27/2017 17:25	7/27/2017 17:26	26.6	2.79	0.027	0.060

## Well Information

Well No.: 7

Municipal Address: [REDACTED]

Distance from Turbine Centre: 1354 m

Well No.: 8

Municipal Address: [REDACTED]

Distance from Turbine Centre: 2883 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz

Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

**Monitoring Notes:** Pile driving was completed within two days. During initial pile driving, there was little resistance to pile installation and some piles penetrated many metres into the ground under their own weight. Well monitoring undertaken during periods of time on these same days when pile driving was not occurring measured maximum particle velocities of as much as 0.073 mm/s.

**Footnotes:** a) start and stop of pile driving are start and stop times for active hammering and not other associated work; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT values during these periods regardless of measurement direction.

# NORTH KENT 1

## Preliminary Vibration Monitoring Report

Turbine Location: T35

Vibration Measurements at Turbine Site					Vibration Measurements at Wells			
Pile No.:	Pile Driving Times and Dates			Geophone Dist. (m)	Daily Maximum	Particle Velocity (mm/s) <sup>c, d</sup>		
	Start <sup>a</sup>	Rock/Till	End <sup>a</sup>		Particle Velocity (mm/s) <sup>b</sup>	Well 5	Well 6	No Pump <sup>e</sup>
1	6/21/2017 9:16	6/21/2017 9:31	6/21/2017 10:06	25.3	4.32	0.005	0.011	
2	6/28/2017 11:40	6/28/2017 11:50	6/28/2017 11:56	27.0	6.86	0.004	0.002	
3	6/29/2017 11:15	6/29/2017 11:26	6/29/2017 11:37	28.1	4.70	0.004	0.080	0.009
4	6/29/2017 11:45	6/29/2017 12:28	6/29/2017 12:35	28.4	4.70	0.002	0.003	
5	6/29/2017 10:36	6/29/2017 10:53	6/29/2017 10:59	28.1	4.70	0.003	0.008	
6	6/29/2017 9:49	6/29/2017 10:09	6/29/2017 10:19	27.0	4.70	0.002	0.017	
7	6/28/2017 16:45	6/28/2017 16:55	6/28/2017 16:59	25.3	6.86	0.002	0.006	
8	6/28/2017 16:19	6/28/2017 16:28	6/28/2017 16:36	23.0	6.86	0.004	0.008	
9	6/29/2017 15:55	6/29/2017 16:03	6/29/2017 16:09	20.3	4.70	0.003	0.011	
10	6/28/2017 15:23	6/28/2017 15:35	6/28/2017 15:43	17.4	6.86	0.002	0.010	
11	6/28/2017 14:34	6/28/2017 14:52	6/28/2017 14:56	14.6	6.86	0.002	0.081	0.011
12	6/28/2017 14:04	6/28/2017 14:19	6/28/2017 14:23	12.4	6.86	0.003	0.016	
13	6/26/2017 16:52	6/26/2017 17:15	6/26/2017 17:22	11.6	4.06	0.004	0.093	0.015
13A	6/30/2017 10:53	6/30/2017 11:23	6/30/2017 11:37	11.6	4.19	0.001	0.093	0.015
14	6/28/2017 8:34	6/28/2017 8:59	6/28/2017 8:16	12.4	6.86	0.005	0.110	0.023
15	6/26/2017 16:03	6/26/2017 16:26	6/26/2017 16:28	14.6	4.06	0.002	0.009	
16	6/28/2017 9:32	6/28/2017 9:52	6/28/2017 9:57	17.4	6.86	0.002	0.004	
17	6/26/2017 7:45	6/26/2017 8:19	6/26/2017 8:20	20.3	4.06	0.012	0.002	
18	6/28/2017 10:40	6/28/2017 10:55	6/28/2017 11:25	23.0	6.86	0.004	0.015	
<b>Restrikes</b>								
1	6/26/2017 7:39	6/26/2017 7:39	6/26/2017 7:39	25.3	4.06	0.007	0.007	
17	6/28/2017 12:54	6/28/2017 12:54	6/28/2017 13:14	20.3	6.86	0.004	0.014	
10	6/29/2017 13:31	6/29/2017 13:31	6/29/2017 13:32	17.4	4.70	0.006	0.004	
13	6/29/2017 13:37	6/29/2017 13:37	6/29/2017 13:42	11.6	4.70	0.004	0.002	
14	6/29/2017 13:47	6/29/2017 13:47	6/29/2017 13:50	12.4	4.70	0.006	0.003	
16	6/29/2017 13:54	6/29/2017 13:54	6/29/2017 13:56	17.4	4.70	0.005	0.003	
15	6/29/2017 14:20	6/29/2017 14:20	6/29/2017 14:25	14.6	4.70	0.008	0.011	

**Well Information**

Well No.: 5  
Municipal Address: [REDACTED]  
Distance from Turbine Centre: 634 m

Well No.: 6  
Municipal Address: [REDACTED]  
Distance from Turbine Centre: 880 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz

Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

**Monitoring Notes:** Tractor was observed operating frequently near Well 6. Water pump was observed cycling on and off during pile driving operations and remaining on for periods of 2 to 4 minutes. When pump was operating, casing at Well 6 exhibited particle velocities in the range of 0.08 to 0.12 mm/s and this data dominated FFT analysis of data. Pile restrike events were of short duration with the following total number of hammer blows shown in parentheses: Pile 1 (20), Pile 10 (5 to 7), 13 (205), 14 (140), 16 (51), 15 (214). Pile 17 experienced 446 hammer blows over a period of 9 minutes. Data obtained during pile dynamic analyses is pending. Piles noted with "A" represent piles installed to replace similarly-numbered piles. After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Monitoring of deliberate pump operation at Well 6 on July 13, 2017, during a period when no pile driving was occurring, measured maximum particle velocities of 0.08 to 0.8 mm/s.

**Footnotes:** a) start and stop of pile driving are start and stop times for active hammering and not other associated work; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT values during these periods regardless of measurement direction; e) see monitoring notes above.

# NORTH KENT 1

## Preliminary Vibration Monitoring Report

Turbine Location: T36

Vibration Measurements at Turbine Site					Vibration Measurements at Wells			
Pile No.:	Pile Driving Times and Dates			Geophone Dist. (m)	Daily Maximum Particle Velocity (mm/s) <sup>b</sup>	Particle Velocity (mm/s) <sup>c, d</sup>		
	Start <sup>a</sup>	Rock/Till	End <sup>a</sup>			Well 5	Well 6	No Pump <sup>e</sup>
1	7/26/2017 10:33	7/26/2017 10:38	7/26/2017 10:48	23.3	4.70	0.005	0.086	
2	7/26/2017 18:16	7/26/2017 18:21	7/26/2017 18:28	21.1	4.70	0.003	0.016	
3	7/26/2017 19:24	7/26/2017 19:28	7/26/2017 19:42	18.4	4.70	0.002	0.005	
4	7/26/2017 18:37	7/26/2017 19:07	7/26/2017 19:19	15.5	4.70	0.002	0.027	
5	7/26/2017 17:59	7/26/2017 18:04	7/26/2017 18:10	12.7	4.70	0.012	0.016	
6	7/26/2017 17:30	7/26/2017 17:34	7/26/2017 17:44	10.4	4.70	0.004	0.032	
7	7/26/2017 17:10	7/26/2017 17:13	7/26/2017 17:23	9.5	4.70	0.010	0.044	
8	7/26/2017 16:41	7/26/2017 16:45	7/26/2017 16:56	10.4	4.70	0.007	0.038	
9	7/26/2017 16:19	7/26/2017 16:23	7/26/2017 16:33	12.7	4.70	0.004	0.010	
10	7/26/2017 15:48	7/26/2017 15:51	7/26/2017 16:03	15.5	4.70	0.005	0.070	
11	7/26/2017 15:12	7/26/2017 15:15	7/26/2017 15:23	18.4	4.70	0.004	0.045	
12	7/26/2017 14:32	7/26/2017 14:45	7/26/2017 14:57	21.1	4.70	0.005	0.048	
13	7/26/2017 14:15	7/26/2017 14:21	7/26/2017 14:28	23.3	4.70	0.014	0.018	
14	7/26/2017 13:58	7/26/2017 14:03	7/26/2017 14:08	25.0	4.70	0.009	0.031	
15	7/26/2017 13:16	7/26/2017 13:20	7/26/2017 13:32	26.0	4.70	0.005	0.111	0.029
16	7/26/2017 12:48	7/26/2017 12:53	7/26/2017 13:05	26.4	4.70	0.011	0.038	
17	7/26/2017 11:41	7/26/2017 11:47	7/26/2017 11:56	26.0	4.70	0.005	0.021	
18	7/26/2017 11:08	7/26/2017 11:12	7/26/2017 11:22	25.0	4.70	0.006	0.068	
<b>Restrikes</b>								
16	7/27/2017 7:36	7/27/2017 7:36	7/27/2017 7:37	26.4	0.00	0.003	0.437	0.028

**Well Information**

Well No.: 5  
Municipal Address: [REDACTED]  
Distance from Turbine Centre: 4198 m

Well No.: 6  
Municipal Address: [REDACTED]  
Distance from Turbine Centre: 3380 m

ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz  
Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

**Monitoring Notes:** Pile driving was completed within one day. A single restrike event occurred on the day following with a total of 24 hammer blows on Pile 16 during a period of approximately 65 seconds. During initial pile driving, there was little resistance to pile installation and some piles penetrated many metres into the ground under their own weight or a few hammer blows. After installation, one pile was struck again with the hammer to demonstrate resistance performance and this event is noted under "restrikes". Water pump was observed cycling on and off during pile driving operations and remaining on for periods of 2 to 4 minutes. When pump was operating during pile driving, casing at Well 6 exhibited particle velocities of up to 0.44 mm/s and this data dominated FFT analysis of data. Monitoring of deliberate pump operation at Well 6 on July 13, 2017, during a period when no pile driving was occurring, measured maximum particle velocities of 0.08 to 0.8 mm/s.

**Footnotes:** a) start and stop of pile driving are start and stop times for active hammering and not other associated work; b) values shown are maximum daily values regardless of direction; c) preliminary values subject to further data review/analysis; d) values shown are based on FFT analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 measurements) and represent the maximum of the 1 second interval peak FFT values during these periods regardless of measurement direction; e) see monitoring notes above.

**AECOM**

**Attachment C**

**MOECC Water Well  
Record (#3308763)**

1. PRINT ONLY IN SPACES PROVIDED  
2. CHECK  CORRECT BOX WHERE APPLICABLE

3308763

MUNICIPALITY 33002

CON. CON.

07

COUNTY OR DISTRICT: **KEELE** TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: **CHATHAM** CON. BLOCK TRACT SURVEY ETC: **7** LOT: **8**  
 DATE COMPLETED: DAY **6** MO **11** YR **91**  
 WELL NO: **04940** ELEVATION: **602**

**LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)**

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET	
				FROM	TO
BROWN	SAND	CLAY	MIXED	0	6
GREY	CLAY		DENSE	6	64 1/2
BLACK	GRAVEL	SHALE STONES	LOOSE	64 1/2	67
BLACK	SHALE		HARD	67	68

*Handwritten notes on log:*  
 6" TOE NIPPLE  
 3FT SCREEN  
 3FT RISER NIPPLE  
 K-PACKER

31  
32

**41 WATER RECORD**

WATER FOUND AT - FEET	KIND OF WATER		
65-67	<input checked="" type="checkbox"/> FRESH <input type="checkbox"/> SALTY	<input type="checkbox"/> SULPHUR <input type="checkbox"/> MINERALS <input type="checkbox"/> GAS	

**51 CASING & OPEN HOLE RECORD**

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET	
			FROM	TO
5	STEEL	.188	65	65
4	SCREEN		65	68

**SCREEN**

SIZE - S. OF OPENING (SLOT) NO.	DIAMETER	LENGTH
100	4 INCHES	3 FEET

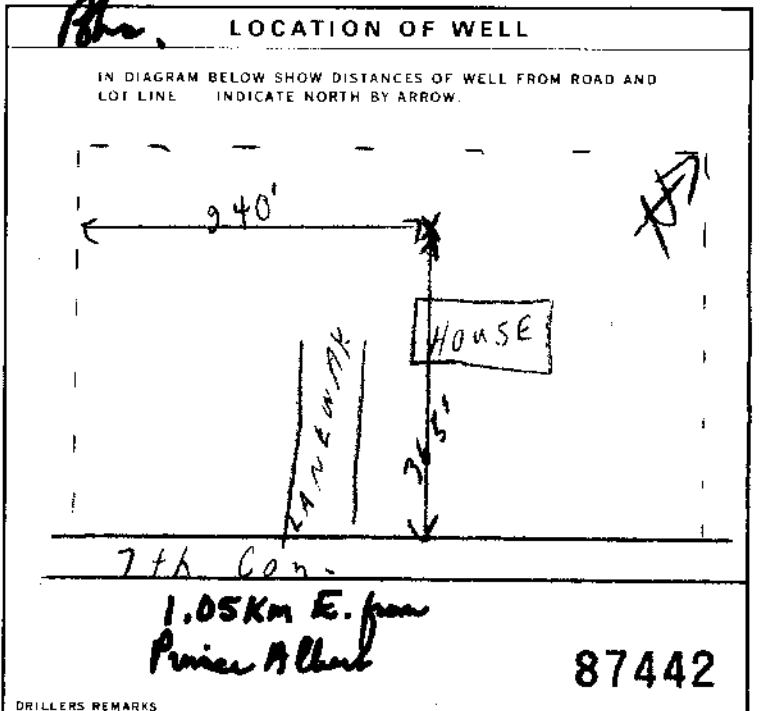
MATERIAL AND TYPE: **SS SLOT**  
 DEPTH TO TOP OF SCREEN: **61-K-PACKER**

**61 PLUGGING & SEALING RECORD**

DEPTH SET AT - FEET	MATERIAL AND TYPE
	<del>CEMENT GROUT LEAD PACKER, ETC.</del>

**71 PUMPING TEST**

PUMPING TEST METHOD:  PUMP  BAILER  
 PUMPING RATE: **3 1/2** GPM  
 DURATION OF PUMPING: **30** MINUTES  
 WATER LEVELS DURING: 15 MINUTES: **20** FEET, 30 MINUTES: **18** FEET, 45 MINUTES: **17 1/2** FEET, 60 MINUTES: **17** FEET  
 PUMP INTAKE SET AT: **44** FEET  
 WATER AT END OF TEST:  CLEAR  CLOUDY  
 RECOMMENDED PUMP SETTING: **46** FEET  
 RECOMMENDED PUMPING RATE: **3 1/2** GPM



**FINAL STATUS OF WELL**

WATER SUPPLY  
 OBSERVATION WELL  
 TEST HOLE  
 RECHARGE WELL  
 ABANDONED, INSUFFICIENT SUPPLY  
 ABANDONED, POOR QUALITY  
 UNFINISHED  
 DEWATERING

**WATER USE**

DOMESTIC  
 STOCK  
 IRRIGATION  
 INDUSTRIAL  
 OTHER

**METHOD OF CONSTRUCTION**

CABLE TOOL  
 ROTARY (CONVENTIONAL)  
 ROTARY (REVERSE)  
 ROTARY (AIR)  
 AIR PERCUSSION  
 BORING  
 DIAMOND  
 JETTING  
 DRIVING  
 DIGGING  
 OTHER

**CONTRACTOR**

NAME OF WELL CONTRACTOR: **RUMBLE WATER WELLS**  
 WELL CONTRACTOR'S LICENCE NUMBER: **4642**  
 ADDRESS: **RR # 5 BLENHEIM**  
 NAME OF WELL TECHNICIAN: **GARNET RUMBLE**  
 WELL TECHNICIAN'S LICENCE NUMBER: **T-0066**  
 SIGNATURE OF TECHNICIAN/CONTRACTOR: *[Signature]*  
 SUBMISSION DATE: DAY **8** MO **11** YR **91**

**OFFICE USE ONLY**

DATA SOURCE: **4642**  
 CONTRACTOR: **4642**  
 DATE RECEIVED: **NOV 22 1991**  
 DATE OF INSPECTION: \_\_\_\_\_  
 INSPECTOR: \_\_\_\_\_  
 REMARKS: \_\_\_\_\_

**AECOM**

**Attachment D**

**Water Quality Data**

Sample Collected By					AECOM	MOECC	AECOM
Sample Description					007460069; [REDACTED]	Basement Tap - Raw Water	007460069; [REDACTED]
Date Sampled					2/2/2017	8/1/2017	8/2/2017
Parameter	Unit	G / S	Type	RDL			
Escherichia coli	CFU/100mL	0	MAC	1	ND		ND
Total Coliforms	CFU/100mL	0	MAC	1	ND		2
Electrical Conductivity	uS/cm			2	626		599
pH	pH Units	(6.5-8.5)	OG	NA	8.7		8.39
Hardness (as CaCO <sub>3</sub> )	mg/L	(80-100)	OG	0.5	46.7		54
Total Dissolved Solids	mg/L	500	AO	20	312		374
Total Suspended Solids	mg/L			10	11		54
Alkalinity (as CaCO <sub>3</sub> )	mg/L	(30-500)	OG	5	273		275
Fluoride	mg/L	1.5	MAC	0.05	1.21		1.10
Chloride	mg/L	250	AO	0.10	29.7		28.0
Nitrate as N	mg/L	10.0	MAC	0.05	<0.05		<0.05
Nitrite as N	mg/L	1.0	MAC	0.05	<0.05		<0.05
Bromide	mg/L			0.05	<0.05		0.25
Sulphate	mg/L	500	AO	0.10	<0.10		<0.10
Ammonia as N	mg/L			0.02	0.13		0.07
Dissolved Organic Carbon	mg/L	5	AO	0.5	3.5		4.2
Colour	TCU	5	AO	5	27		281
Turbidity	NTU	5	AO	0.5	6.2	86.8	57.3
Calcium	mg/L			0.05	12.0		11.9
Magnesium	mg/L			0.05	4.06		4.03
Sodium	mg/L	200 <sup>a</sup>	AO	0.05	117		117
Potassium	mg/L			0.05	3.44		3.59
Iron	mg/L	0.3	AO	0.010	0.407		1.320
Manganese	mg/L	0.05	AO	0.002	0.011		0.020

**NOTES:**

- G/S - Guideline / Standard, as per *Technical Support Document for Ontario Drinking Water Standards, Objectives & Guidelines*, Ontario Ministry of the Environment (June 2003, Revised June 2006), PIBS 4449e01
- mg/L - Denotes milligrams per litre
- TCU - Denotes True Colour Units
- NTU - Denotes Nephelometric Turbidity Units
- xxx.xx - Denotes exceedance of the applicable guideline or standard
- AO - Aesthetic Objective (non Health-Related)
- OG - Operational Guideline (non Health-Related)
- MAC - Maximum Acceptable Concentration (Health-Related)
- a - Values in excess of 20mg/L should be considered by persons on sodium restricted diets

**CLIENT NAME: AECOM CANADA LTD  
105 COMMERCE VALLEY DR.W 7TH FLOOR  
MARKHAM, ON L3T7W3  
(905) 886-7022**

**ATTENTION TO: Erin Wilson**

**PROJECT: 60343599**

**AGAT WORK ORDER: 17T184075**

**MICROBIOLOGY ANALYSIS REVIEWED BY: Inesa Alizarchyk, Inorganic Lab Supervisor**

**WATER ANALYSIS REVIEWED BY: Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab Supervisor**

**DATE REPORTED: Feb 14, 2017**

**PAGES (INCLUDING COVER): 8**

**VERSION\*: 2**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

**\*NOTES**

VERSION 2:Version 2 supersedes work order 17T184075, Version 1, issued February 06, 2017.

**All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.**



## Certificate of Analysis

AGAT WORK ORDER: 17T184075

PROJECT: 60343599

5835 COOPERS AVENUE  
 MISSISSAUGA, ONTARIO  
 CANADA L4Z 1Y2  
 TEL (905)712-5100  
 FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY: David Dunn

### Microbiological Analysis (water)

DATE RECEIVED: 2017-02-03

DATE REPORTED: 2017-02-14

007460069

SAMPLE DESCRIPTION:   
 SAMPLE TYPE: Water  
 DATE SAMPLED: 2017-02-02

Parameter	Unit	G / S	RDL	8167198
Escherichia coli	CFU/100mL	0	1	ND
Total Coliforms	CFU/100mL	0	1	ND

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to SDWA - Microbiology  
 8167198 ND - Not Detected.

Certified By:

# Certificate of Analysis

AGAT WORK ORDER: 17T184075

PROJECT: 60343599

5835 COOPERS AVENUE  
 MISSISSAUGA, ONTARIO  
 CANADA L4Z 1Y2  
 TEL (905)712-5100  
 FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY: David Dunn

## North Kent - Groundwater Samples

DATE RECEIVED: 2017-02-03

DATE REPORTED: 2017-02-14

007460069

SAMPLE DESCRIPTION:

SAMPLE TYPE: Water

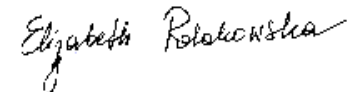
DATE SAMPLED: 2017-02-02

8167198

Parameter	Unit	G / S	RDL	8167198
Electrical Conductivity	uS/cm		2	626
pH	pH Units	(6.5-8.5)	NA	8.65
Total Hardness (as CaCO <sub>3</sub> )	mg/L	(80-100)	0.5	46.7
Total Dissolved Solids	mg/L	500	20	312
Total Suspended Solids	mg/L		10	11
Alkalinity (as CaCO <sub>3</sub> )	mg/L	(30-500)	5	273
Fluoride	mg/L	1.5	0.05	1.21
Chloride	mg/L	250	0.10	29.7
Nitrate as N	mg/L	10.0	0.05	<0.05
Nitrite as N	mg/L	1.0	0.05	<0.05
Bromide	mg/L		0.05	<0.05
Sulphate	mg/L	500	0.10	<0.10
Ammonia as N	mg/L		0.02	0.13
Dissolved Organic Carbon	mg/L	5	0.5	3.5
Colour	TCU	5	5	27
Turbidity	NTU	5	0.5	6.2
Calcium	mg/L		0.05	12.0
Magnesium	mg/L		0.05	4.06
Sodium	mg/L	20 (200)	0.05	117
Potassium	mg/L		0.05	3.44
Iron	mg/L	0.3	0.010	0.407
Manganese	mg/L	0.05	0.002	0.011

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O.Reg.169/03(mg/L)

Certified By:





## Guideline Violation

AGAT WORK ORDER: 17T184075

PROJECT: 60343599

5835 COOPERS AVENUE  
MISSISSAUGA, ONTARIO  
CANADA L4Z 1Y2  
TEL (905)712-5100  
FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8167198	007460069	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Colour	TCU	5	27
8167198	007460069	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Iron	mg/L	0.3	0.407
8167198	007460069	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Sodium	mg/L	20 (200)	117
8167198	007460069	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Turbidity	NTU	5	6.2
8167198	007460069	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	pH	pH Units	(6.5-8.5)	8.65

## Quality Assurance

**CLIENT NAME:** AECOM CANADA LTD  
**PROJECT:** 60343599  
**SAMPLING SITE:**

**AGAT WORK ORDER:** 17T184075  
**ATTENTION TO:** Erin Wilson  
**SAMPLED BY:** David Dunn

### Microbiology Analysis

RPT Date: Feb 14, 2017			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE		MATRIX SPIKE				
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

**Microbiological Analysis (water)**

Escherichia coli	8167132	8167132	ND	ND	NA	< 1
Total Coliforms	8167132	8167132	ND	ND	NA	< 1

Comments: ND – Not detected; NA - % RPD Not Applicable

Certified By: \_\_\_\_\_



## Quality Assurance

CLIENT NAME: AECOM CANADA LTD  
 PROJECT: 60343599  
 SAMPLING SITE:

AGAT WORK ORDER: 17T184075  
 ATTENTION TO: Erin Wilson  
 SAMPLED BY: David Dunn

Water Analysis															
RPT Date: Feb 14, 2017			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE		MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

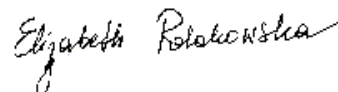
**North Kent - Groundwater Samples**

Electrical Conductivity	8167388		1780	1780	0.0%	< 2	106%	80%	120%	NA			NA		
pH	8167388		8.39	8.27	1.4%	NA	106%	90%	110%	NA			NA		
Total Dissolved Solids	8167132	8167132	388	390	0.5%	< 20	100%	80%	120%	NA			NA		
Total Suspended Solids	8165236		<10	<10	NA	< 10	98%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8167388		1180	1020	14.5%	< 5	98%	80%	120%	NA			NA		
Fluoride	8167776		<0.25	<0.25	NA	< 0.05	99%	90%	110%	107%	90%	110%	102%	80%	120%
Chloride	8167776		159	152	4.5%	< 0.10	95%	90%	110%	96%	90%	110%	102%	80%	120%
Nitrate as N	8167776		1.69	1.67	1.2%	< 0.05	96%	90%	110%	96%	90%	110%	108%	80%	120%
Nitrite as N	8167776		<0.25	<0.25	NA	< 0.05	NA	90%	110%	93%	90%	110%	109%	80%	120%
Bromide	8167776		0.81	0.81	0.0%	< 0.05	110%	90%	110%	92%	90%	110%	83%	80%	120%
Sulphate	8167776		343	330	3.9%	< 0.10	97%	90%	110%	92%	90%	110%	92%	80%	120%
Ammonia as N	8167190	8167190	0.14	0.13	7.4%	< 0.02	92%	90%	110%	95%	90%	110%	96%	80%	120%
Dissolved Organic Carbon	8167132	8167132	1.9	2.1	NA	< 0.5	97%	90%	110%	NA	90%	110%	102%	80%	120%
Colour	8167132	8167132	16	18	NA	< 5	102%	90%	110%	NA			NA		
Turbidity	8167132	8167132	3.6	3.4	5.7%	< 0.5	104%	90%	110%	NA			NA		
Calcium	8167132	8167132	8.41	8.51	1.2%	< 0.05	102%	90%	110%	100%	90%	110%	105%	70%	130%
Magnesium	8167132	8167132	3.73	3.72	0.3%	< 0.05	97%	90%	110%	96%	90%	110%	99%	70%	130%
Sodium	8167132	8167132	143	140	2.1%	< 0.05	98%	90%	110%	99%	90%	110%	97%	70%	130%
Potassium	8167132	8167132	1.45	1.47	1.4%	< 0.05	97%	90%	110%	98%	90%	110%	100%	70%	130%
Iron	8167132	8167132	0.531	0.527	0.8%	< 0.010	102%	90%	110%	103%	90%	110%	103%	70%	130%
Manganese	8167132	8167132	0.007	0.007	NA	< 0.002	103%	90%	110%	106%	90%	110%	93%	70%	130%

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:



## Method Summary

**CLIENT NAME: AECOM CANADA LTD**
**AGAT WORK ORDER: 17T184075**
**PROJECT: 60343599**
**ATTENTION TO: Erin Wilson**
**SAMPLING SITE:**
**SAMPLED BY: David Dunn**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
<b>Microbiology Analysis</b>			
Escherichia coli	MIC-93-7010	EPA 1604	Membrane Filtration
Total Coliforms	MIC-93-7010	EPA 1604	Membrane Filtration
<b>Water Analysis</b>			
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Hardness (as CaCO <sub>3</sub> )	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Total Dissolved Solids	INOR-93-6028	SM 2540 C	BALANCE
Total Suspended Solids	INOR-93-6028	SM 2540 D	BALANCE
Alkalinity (as CaCO <sub>3</sub> )	INOR-93-6000	SM 2320 B	PC TITRATE
Fluoride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Bromide	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INOR-93-6059	QuikChem 10-107-06-1-J & SM 4500 NH <sub>3</sub> -F	LACHAT FIA
Dissolved Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Colour	INOR-93-6046	SM 2120 B	SPECTROPHOTOMETER
Turbidity	INOR-93-6044	SM 2130 B	NEPHELOMETER
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Magnesium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sodium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS

CLIENT NAME: AECOM CANADA LTD  
105 COMMERCE VALLEY DR.W 7TH FLOOR  
MARKHAM, ON L3T7W3  
(905) 886-7022

ATTENTION TO: Jason Murchison

PROJECT: 60343599

AGAT WORK ORDER: 17T244871

MICROBIOLOGY ANALYSIS REVIEWED BY: Inesa Alizarchyk, Inorganic Lab Supervisor

WATER ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Aug 04, 2017

PAGES (INCLUDING COVER): 8

VERSION\*: 2

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

**\*NOTES**

VERSION 2:Version 2 supersedes Version 1 issued August 3, 2017.  
Report now includes Microbiology and Total Dissolved Solids.

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



## Certificate of Analysis

AGAT WORK ORDER: 17T244871

PROJECT: 60343599

5835 COOPERS AVENUE  
 MISSISSAUGA, ONTARIO  
 CANADA L4Z 1Y2  
 TEL (905)712-5100  
 FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

### Microbiological Analysis (water)

DATE RECEIVED: 2017-08-03

DATE REPORTED: 2017-08-04

00746009

SAMPLE DESCRIPTION:   
 SAMPLE TYPE: Water  
 DATE SAMPLED: 2017-08-02

Parameter	Unit	G / S	RDL	8608831
Escherichia coli	CFU/100mL	0	1	ND
Total Coliforms	CFU/100mL	0	1	2

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to SDWA - Microbiology  
 Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.  
 8608831 ND - Not Detected.

Certified By:



## Certificate of Analysis

AGAT WORK ORDER: 17T244871

PROJECT: 60343599

5835 COOPERS AVENUE  
 MISSISSAUGA, ONTARIO  
 CANADA L4Z 1Y2  
 TEL (905)712-5100  
 FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

### North Kent - Groundwater Samples

DATE RECEIVED: 2017-08-03

DATE REPORTED: 2017-08-04

00746009

SAMPLE DESCRIPTION:   
 SAMPLE TYPE: Water  
 DATE SAMPLED: 2017-08-02

Parameter	Unit	G / S	RDL	8608831
Electrical Conductivity	uS/cm		2	599
pH	pH Units	(6.5-8.5)	NA	8.39
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	46.3
Total Dissolved Solids	mg/L	500	20	374
Total Suspended Solids	mg/L		10	54
Alkalinity (as CaCO3)	mg/L	(30-500)	5	275
Fluoride	mg/L	1.5	0.05	1.10
Chloride	mg/L	250	0.10	28.0
Nitrate as N	mg/L	10.0	0.05	<0.05
Nitrite as N	mg/L	1.0	0.05	<0.05
Bromide	mg/L		0.05	0.25
Sulphate	mg/L	500	0.10	<0.10
Ammonia as N	mg/L		0.02	0.07
Dissolved Organic Carbon	mg/L	5	0.5	4.2
Colour	TCU	5	5	281
Turbidity	NTU	5	0.5	57.3
Calcium	mg/L		0.05	11.9
Magnesium	mg/L		0.05	4.03
Sodium	mg/L	20 (200)	0.05	117
Potassium	mg/L		0.05	3.59
Iron	mg/L	0.3	0.010	1.32
Manganese	mg/L	0.05	0.002	0.020

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O.Reg.169/03(mg/L)  
 Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Certified By:

*Amanjot Bhela*



# Guideline Violation

AGAT WORK ORDER: 17T244871

PROJECT: 60343599

5835 COOPERS AVENUE  
MISSISSAUGA, ONTARIO  
CANADA L4Z 1Y2  
TEL (905)712-5100  
FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8608831	00746009	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Colour	TCU	5	281
8608831	00746009	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Iron	mg/L	0.3	1.32
8608831	00746009	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Sodium	mg/L	20 (200)	117
8608831	00746009	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Turbidity	NTU	5	57.3
8608831	00746009	SDWA - Microbiology	Microbiological Analysis (water)	Total Coliforms	CFU/100mL	0	2

## Quality Assurance

 CLIENT NAME: AECOM CANADA LTD  
 PROJECT: 60343599  
 SAMPLING SITE:

 AGAT WORK ORDER: 17T244871  
 ATTENTION TO: Jason Murchison  
 SAMPLED BY:

### Microbiology Analysis

RPT Date: Aug 04, 2017			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE		MATRIX SPIKE				
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

**Microbiological Analysis (water)**

Escherichia coli	8608865	16	4	NA	< 1
Total Coliforms	8608865	NDOGT	NDOGT	NA	< 1

Comments: NA - % RPD Not Reportable based on the number of colonies count acceptable for RPD calculation  
 NDOGT - No Data; Overgrown with Target, refers to over-crowding microbial growth; NA - % RPD Not Applicable

Certified By: \_\_\_\_\_



## Quality Assurance

CLIENT NAME: AECOM CANADA LTD  
 PROJECT: 60343599  
 SAMPLING SITE:

AGAT WORK ORDER: 17T244871  
 ATTENTION TO: Jason Murchison  
 SAMPLED BY:

Water Analysis															
RPT Date: Aug 04, 2017			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE		MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

**North Kent - Groundwater Samples**

Electrical Conductivity	8604782		842	842	0.0%	< 2	103%	80%	120%	NA			NA		
pH	8604782		7.92	7.98	0.8%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8608831	8608831	374	380	1.6%	< 20	98%	80%	120%	NA			NA		
Total Suspended Solids	8605182		1	1	NA	< 10	100%	80%	120%						
Alkalinity (as CaCO3)	8604782		324	324	0.0%	< 5	95%	80%	120%	NA			NA		
Fluoride	8604782		<0.25	<0.25	NA	< 0.05	98%	90%	110%	95%	90%	110%	94%	80%	120%
Chloride	8604782		25.7	25.1	2.4%	< 0.10	90%	90%	110%	104%	90%	110%	104%	80%	120%
Nitrate as N	8604782		0.45	0.42	6.9%	< 0.05	93%	90%	110%	101%	90%	110%	101%	80%	120%
Nitrite as N	8604782		<0.25	<0.25	NA	< 0.05	NA	90%	110%	97%	90%	110%	96%	80%	120%
Bromide	8604782		<0.25	<0.25	NA	< 0.05	96%	90%	110%	97%	90%	110%	101%	80%	120%
Sulphate	8604782		101	98.3	2.7%	< 0.10	94%	90%	110%	101%	90%	110%	98%	80%	120%
Ammonia as N	8606324		2.69	2.70	0.4%	< 0.02	90%	90%	110%	102%	90%	110%	96%	80%	120%
Dissolved Organic Carbon	8606324		1.8	1.9	NA	< 0.5	104%	90%	110%	93%	90%	110%	88%	80%	120%
Colour	8604455		25	25	0.0%	< 5	108%	90%	110%	NA			NA		
Turbidity	8607560		<0.5	<0.5	NA	< 0.5	102%	90%	110%	NA			NA		
Calcium	8606324		38.2	38.0	0.5%	< 0.05	98%	90%	110%	97%	90%	110%	98%	70%	130%
Magnesium	8606324		14.6	14.7	0.7%	< 0.05	97%	90%	110%	96%	90%	110%	95%	70%	130%
Sodium	8606324		14.0	13.9	0.7%	< 0.05	99%	90%	110%	98%	90%	110%	99%	70%	130%
Potassium	8606324		0.82	0.83	1.2%	< 0.05	96%	90%	110%	96%	90%	110%	99%	70%	130%
Iron	8608831	8608831	1.32	1.33	0.8%	< 0.010	106%	90%	110%	103%	90%	110%	104%	70%	130%
Manganese	8608831	8608831	0.020	0.020	0.0%	< 0.002	105%	90%	110%	109%	90%	110%	102%	70%	130%

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: \_\_\_\_\_

*Amanjot Bhela*

## Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T244871

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
<b>Microbiology Analysis</b>			
Escherichia coli	MIC-93-7010	EPA 1604	Membrane Filtration
Total Coliforms	MIC-93-7010	EPA 1604	Membrane Filtration
<b>Water Analysis</b>			
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Hardness (as CaCO <sub>3</sub> )	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Total Dissolved Solids	INOR-93-6028	SM 2540 C	BALANCE
Total Suspended Solids	INOR-93-6028	SM 2540 D	BALANCE
Alkalinity (as CaCO <sub>3</sub> )	INOR-93-6000	SM 2320 B	PC TITRATE
Fluoride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Bromide	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INOR-93-6059	QuikChem 10-107-06-1-J & SM 4500 NH <sub>3</sub> -F	LACHAT FIA
Dissolved Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Colour	INOR-93-6046	SM 2120 B	SPECTROPHOTOMETER
Turbidity	INOR-93-6044	SM 2130 B	NEPHELOMETER
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Magnesium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sodium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS



**AECOM**