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Technical Memorandum

To	North Kent 1 LP	Page	1
CC	Mark Van der Woerd (AECOM), Jonathan Miranda (Pattern), Joshua Vaidhyan (Samsung)		
Subject	**North Kent Wind 1 (Chatham-Kent, ON)** **Well Water Impact Complaint Investigation #2 – UPDATED** [redacted] **– PIN 007420039,** [redacted]		
From	Jason Murchison, P.Geo.		
Date	June 5th, 2018	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 a water well interference complaint that was received by NKW1 via the Project's toll-free telephone line on 8-January-2018. Upon receipt of the complaint, email notification was provided by NKW1 (c/o Mr. Joshua Vaidhyan) to Ms. Deb Jacobs, Environmental Officer, with the Ministry of the Environment and Climate Change (MOECC), Windsor Area Office that same day. In his correspondence, Mr. Vaidhyan provided a summary narrative of the well interference complaint that was received from [redacted], the property owner of [redacted] (Dresden, ON).

In brief, Mr. Vaidhyan describes the current well interference complaint, as follows:

> *We received a complaint today through our Project's toll-free line, below. The complaint is from an existing complainant. The Well investigation Final report for this landowner was submitted to your office early Dec 2017. It's not clear to me how this complaint should be addressed/considered, please advise.*
>
> ***PIN:*** *7420039*
>
> ***Address:*** [redacted]
>
> ***Owner:*** [redacted]
>
> ***Phone:*** [redacted]
>
> ***Report:*** [redacted] *reports muddy water in his well that started within 3 days of a turbine spinning near his property.*
>
> ***Closest Turbine:*** *T12 approx.* [redacted] *away.*

In reply, Ms. Jacobs provided the following:

> *We too received a complaint from [redacted] and I was going to be sending it your way this morning, although you beat me too it. [redacted] indicated that a turbine near his house started spinning on Wednesday and he had problems with his well starting on Saturday.*
>
> *The Ministry considers this to be an official complaint. As it occurred during a different "phase" than [redacted] previous complaint (i.e. not during pile driving / construction), it is likely best if it gets treated as a separate / stand-alone complaint. There are Vibration monitoring requirements outlined in your commissioning plan, which I trust have been implemented and should provide you with some vibration information to help address this complaint. I trust that AECOM is still retained in order to conduct field visits / take water samples / hydrogeological reporting for the complaints, as before. The Ministry looks forward to receiving your report on this complaint.*
>
> *In the short term, please provide the details for the dates / times / durations of commissioning activities at the turbines closest to [redacted] residence. If NK1 isn't keeping detailed note on the commissioning activities, I would strongly suggest you start doing so immediately. It helps everyone with the evaluation of complaints, and we don't want a repeat of the pile driving schedule with rounds of inaccuracies, contradictions, revisions, etc.*

This well interference complaint represents the second that has been received by NKW1 from the property owner; the previous having been submitted on 10-October-2017 pertaining to project construction activities. An investigation of the previous water well interference complaint was completed by AECOM, the results of which are summarized in a TM dated 8-December-2017.

A copy of the correspondence described above pertaining to the property owner's current well interference complaint is provided herein as **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
G5. 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 & maintenance building, the Company shall retain a qualified expert (P.Eng or P.Geo) to immediately undertake the following: (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; (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,	Steps undertaken to satisfy the requirements of Condition G5 are summarized, as follows: (1) AECOM was retained by NKW1 to investigate a Well Interference Complaint received directly from the property owners on 8-January-2018. (2) AECOM arranged directly with the property owners an appointment to visit the property at 1:00pm on 16-January-2018, based on the availability of the property owner. (3) Tasks completed by AECOM during the well interference complaint site visit included: i) interview with the property owner regarding their reported well interference issue(s); ii) collection of a raw (untreated) groundwater sample for analytical laboratory testing; and, iii) digital photographs of pertinent site features (eg. well, pumping system, etc.). (4) Information obtained during the site visit has been compiled and is summarized within this technical memorandum. An opinion regarding potential association of the well interference complaint with

REA CONDITIONS	ACTION(S) TAKEN
(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.	local construction activities as part of the NKW1 Project is provided and potential remedial options are presented, as appropriate.

2.1 Property Owner Statements Regarding Well Interference Complaint

During AECOM's 16-January-2017 site visit to the subject property, a series of seven (7) standard questions were raised with the property owner ([redacted]) for the purposes of obtaining further details regarding their reported well water supply issue(s). The questions raised with the property owner were as detailed on *Form B: Well Complaint Procedure for Site Investigation*, included as part of MOECC's approved *Well Interference Protocol* (AECOM, 2017) for the NKW1 project.

TABLE 2: PROPERTY OWNER QUESTIONNAIRE RESPONSE SUMMARY

QUESTION	PROPERTY OWNER RESPONSE
"Please explain the type of problem you are having"	• Observed windmills surrounding his property (1 – 500m to the south, 1 – 1km to the northwest) turning on Wednesday 3-January-2018 until the morning of 6-January-2018. • Well started to have quantity and quality issues late on 6-January-2018. • Well is producing very turbid water with sediment. • Homeowner has been using an alternate water supply provided by Pattern since Sunday, 7-January, 2018. • Well pump had not been run since shutting down on 7-January-2018.
"What do you think is the cause?"	• Unknown.
"When did you first notice the problem (Date/Time)?"	• Saturday 6-January-2018, around late afternoon / evening.
"Is the problem still occurring?"	• Yes. On alternate source presently. • Collected small sample from well pump prior to AECOM arrival. Photos taken of that sample.
"Do you have an alternate source of potable water (i.e. municipal water)?"	• Arranged by Pattern. • Set up in garage of shop, feeds back into the house.
"Were you provided a temporary supply of potable water?"	• Yes.
"Did you participate in the Detailed Well Assessment program prior to construction?"	• Yes.

Upon completion of the questionnaire, the property owner ([redacted]) was provided an opportunity to review the responses detailed in **Table 2** to ensure their accuracy, but respectfully declined.

3. Operational Activities and Vibration Monitoring

3.1 Project Construction

No pile driving activities occurred within approximately a two (2) month timeframe preceding the property owner's current reported outset of well impact (6-January-2018), as foundation construction aspects of the NKW1 Project were completed at that time. The final pile installation for foundation construction as part of the NKW1 Project was completed on 8-November-2017 at turbine T34, located at a distance of more than [redacted] northwest of the subject property ([redacted]).

The following three (3) turbines represent the closest foundation construction locations to [redacted]:

- T12 – last pile completed on 6-July-2017 @ [redacted] m South-Southeast
- T7 – last pile completed on 28-July-2017 @ [redacted] m Northwest
- T31 – last pile completed on July 18th @ [redacted] m West-Southwest

Construction timeframes, along with approximate directions and distances away from the subject property are provided above for reference purposes. As can be observed, pile driving at the turbine sites listed above was completed in July 2017, more than two (2) months prior to the property owner's initial reported outset of well interference impact(s), and more than five (5) months prior to the reported current outset of impact.

Monitoring of vibration effects during pile driving at each of the above-noted turbine locations 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 local private water well supplies.

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-November-2017, which reads:

> *This letter is provided to summarize vibration monitoring data associated with Well Complaint [redacted] dated October 10, 2017 related to the well located at [redacted], in Chatham-Kent, Ontario. Golder Associates Ltd. (Golder) has been requested to summarize vibration monitoring data for the period starting one day prior to the first reported issues, identified as October 8, 2017, through to one day following the date of the reported well condition complaint. Based on Golder's records, no piles were driven on October 7, 8 or 9, 2017 and therefore there is no vibration monitoring data for this period. Given that there was no pile driving during this period, it is our opinion that the reported conditions at the well would not have been related to pile driving.*

Based on a review and interpretation of information gathered during AECOM's initial well interference complaint investigation for the subject property and presented within our 8-December-2017 TM, it was determined that the groundwater quality issue reported by the property owners was *not* as a result of NKW1 turbine foundation construction or pile-driving activities as no work had been completed within a [redacted] radius of the subject property within a one (1) month period prior to the reported outset of well impact on 8-October-2017. As no additional pile driving in the vicinity of the subject property has occurred subsequent to the intervening timeframe, the conclusions reached in our previous TM remain valid and no further assessment of possible pile driving effects is required or presented herein.

3.2 Project Commissioning / Operation

According to GAL (2018), commissioning of turbines T6, T7, T12, T28, T30, T32, T35 and T36 was occurring at the time of the property owner's current reported outset of well impact on 6-January-2018.

The following three (3) turbines represent the closest locations to the subject property where commissioning was being completed either on or immediately prior to the current reported date of outset of well impact (6-January-2018):

- T12 @ [redacted] m South-Southeast
- T7 @ [redacted] m Northwest
- T6 @ [redacted] m West-Northwest

Approximate directions and distances of the turbines away from the subject property are provided for reference purposes. As can be observed, T12 represents the nearest turbine location to the subject property where commissioning was being completed within the provided timeframe of impact.

To assess the potential for vibration impact(s) at the site well as a result of NKW1 Project commissioning activities, a site-specific vibration assessment was completed by GAL, the results of which are presented in a technical letter, dated 17-April-2018. The conclusions of GAL's site-specific assessment are summarized, as follows:

> *Based on the measured rock vibration magnitudes associated with multiple operational turbines, it is our opinion that the reported well conditions are unrelated to turbine operations. Vibrations measured within the rock that might be associated with turbine operations would be of no consequence at this well location given the extremely small vibration magnitudes and separation distances. The vibrations measured at all in-rock sensors at the mock wells were two or more orders of magnitude smaller than the threshold defined by Ontario NPC-207 (0.3 mm/s), one or more orders of magnitude smaller than nighttime vibration thresholds suggested by ASHRAE (0.144 mm/s, 8 to 80 Hz) and one or more orders of magnitude smaller than the International Standards Organization (ISO) threshold for human perception of vibrations at frequencies greater than 8 Hz (0.1 mm/s).*

A copy of GAL's site-specific vibration assessment letter is provided herein as **Attachment B**.

4. Well Construction Details

Table 3 provides a summary of available construction details for the existing water well located at [redacted], based on details provided to AECOM by [redacted] during our initial well interference complaint site visit on 11-October-2017, as well as information provided by the property owners on their completed water well survey (WWS) form and during our baseline site visit on 20-January-2017.

A review of the MOECC on-line database has revealed a water well record for the subject property that is consistent with the date of installation reported by the property owner (1989). Relevant information obtained from the MOECC record also is included in **Table 3**. In addition, a small number of other well installation and abandonment records also were located within the MOECC database for the subject property dating as far back as 1971 (with 2008 as most recent). A copy of the MOECC record interpreted to be associated with the currently used water well on the subject property is provided herein as **Attachment C**.

Visual assessment of the water well at surface did not reveal any apparent concerns regarding its condition. A photograph of the well is provided as **Photo 1**.

TABLE 3: REPORTED PRIVATE WELL CONSTRUCTION DETAILS

DETAILS	**[redacted] (PIN 007420039)**
Well Tag #	[redacted]
Well ID	[redacted]
Installation Date	24-November-1988
Well Location	Side Yard (Northeast of Residence)
Contractor	Marvin Johanston
Contractor No.	3065
Construction Method	Cable Tool
Total Depth	19.2 mBGS (63')
Target Formation	Black Shale
Casing Length	18.9 mBGS (62')
Casing Diameter	127 mm (5")
Casing Material	Steel
Casing Stick-Up	0.40 m (as measured by AECOM)
Annular Seal	None Indicated on WWR
Sealant Type	None Indicated on WWR
Well Screen Installed?	No
Well Screen Details	Open Hole (Shale Bedrock)
Well Screen Interval	Not Applicable
Well Cover Type	Metallic Slip Cap (non vermin-proof)
Pump Intake Depth	15.2 mBGS (50') recommended on WWR (unconfirmed)
Pumping Rate	15.2 L/min (4 USgpm) recommended on WWR (determined via air-lift) 21.0 L/min (5.5 USgpm) as measured by AECOM on 13-October-2017 (average of 3 separate flow rate measurements)
Well Pump Type	Jet Pump (as observed by AECOM)
Well Pump Size	½ hp (as observed by AECOM)
Static Level	4.0 mBGS (13') as on WWR
Pumping Level	7.6 mBGS (25') as on WWR

NOTE: mBGS - meters below ground surface; L/min – litres per minute; USgpm – US gallons per minute.



PHOTO 1: Drilled Water Well (as on 20-January-2017)

4.1 Limited Well Flow Rate Testing and Pumping System Assessment

During AECOM's recent well interference complaint investigation site visit on 16-January-2018, a limited flow rate test was completed to assess the current pumping capacity of the jet pump (½ hp) connected to the well. Testing was completed using a ball valve and braided hose assembly installed at the outlet side of the water system pressure tank within the basement portion of the residence (**Photo 2**).



PHOTO 2: Sampling and Flow Rate Testing Location in Basement (as on 16-January-2018)

For the test, the water system was permitted to flush continuously for a period of approximately eleven (11) minutes. During pumping, the discharge rate was assessed by AECOM on four (4) separate occasions; three (3) with the valve opened half way and one (1) with the valve opened completely. Flow rate measurement was completed by timing the collection of 12 L of water into a calibrated pail. Discharge from the hose was directed to a sump pit within the basement of the residence.

Test results indicated an average flow rate of approximately 15 L/min (4.0 USgpm) with the valve opened half way, and 72 L/min (19 USgpm) with the valve fully open. Comparatively, the MOECC

record for the well denotes a recommended pumping rate of approximately 15 L/min (4.0 USgpm) at a pump inlet depth of 15.2 mBGS (50'), or about 3.7 m (12') above the well bottom.

Based on the foregoing, it appears that the existing jet pump is oversized in relation to the recommended yield for the site well. The rate of discharge from the well pump appears to be regulated by way of an in-line ball valve assembly rather than a physical flow restrictor device. Thus, given the current pumping system configuration, there is a potential to take water from the well at a rate that exceeds its recommended yield should the valve, either intentionally or unintentionally, be adjusted to a rate in excess of its recommended yield. Over-pumping can result in water quality issues (short or long-term), physical damage, and/or ultimate failure of a well supply.

Dissimilar to that observed during the previous well interference complaint investigation on 11-October-2017, no evidence of dissolved gas was evident within the discharge water stream during the current testing program.

No variation in flow rate (including increasing or decreasing trends) was observed during testing. Similarly, no detectable changes in the quality of the water discharge stream (eg. colour, odour, sediment, etc.) were identified. The water pumped from the well was turbid, dark brown in colour and contained an appreciable amount of sandy-textured sediment (**Photo 3b**).

The source of the sandy sediment observed within the discharge water stream during testing has not been definitively identified, however, it is surmised that it likely is a function of the well's construction and/or current condition. As noted in **Table 3**, the well reportedly is constructed in an open-bottom configuration, absent of a well screen. The well casing is reported to extend to the overburden-bedrock contact, with the borehole being completed as an open hole within the shale bedrock for an additional 0.3 m depth below the casing terminus. An approximately 0.3 m thick layer of sand and gravel is described on the MOECC record to reside immediately atop the bedrock; the formation from which the well reportedly obtains its groundwater source. This configuration suggests that the upper bedrock is sufficiently fractured to permit the flow of groundwater (and possibly sediment) into the well from the sand and gravel formation above. Sediment accumulation within the well may occur over time as a result of normal well use (possibly exacerbated as a result of pumping in excess of the well's sustainable yield), which can negatively affect well productivity (depending on the thickness and porosity of the sediment), as well as result in sediment influx issues due to a decreased separation distance between the pump intake and well bottom.

5. Water Quality Data

Table 4 provides a summary of available groundwater quality data for the site well. Laboratory Certificates of Analysis are included as **Attachment D**.

TABLE 4: PRIVATE WELL SAMPLING SUMMARY

LOCATION	SAMPLED BY	DATE	TYPE	PURPOSE
[redacted]	AECOM	20-January-2017	Raw (Untreated)	Baseline
	AECOM	11-October-2017	Raw (Untreated)	Complaint Investigation #1
	AECOM	16-January-2018	Raw (Untreated)	Complaint Investigation #2

5.1 Discussion

Available raw (untreated) groundwater quality data for the site well is provided in **Table 5**, which includes analysis results from AECOM's 16-January-2018 site visit pertaining to the property owner's current interference complaint, as well as that of a previous complaint site visit relating to NKW1

project construction on 11-October-2017, and baseline (pre-construction) sampling that was completed on 20-January-2017.

TABLE 5: RAW (UNTREATED) GROUNDWATER SAMPLING RESULTS

PARAMETER	ODWQS CRITERIA	ODWQS TYPE	BASELINE (20-January-2017)	COMPLAINT INVESTIGATION #1 (11-October-2017)	COMPLAINT INVESTIGATION #2 (16-January-2018)
Escherichia coli	0 CFU/100mL	MAC	**NDOGN**	Non detection	Non detection
Total Coliforms	0 CFU/100mL	MAC	**NDOGN**	**90 CFU/100 mL**	**128 CFU/100 mL**
Electrical Conductivity	--	--	548 µS/cm	540 µS/cm	541 µS/cm
pH	6.5 – 8.5	OG	8.23	8.21	8.38
Total Hardness (as $CaCO_3$)	80 – 100 mg/L	OG	**36.7 mg/L**	**37.2 mg/L**	**35.5 mg/L**
Total Dissolved Solids	500 mg/L	AO	292 mg/L	318 mg/L	332 mg/L
Total Suspended Solids	--	--	<10 mg/L	<10 mg/L	2,080 mg/L
Alkalinity (as $CaCO_3$)	30 – 500 mg/L	OG	258 mg/L	269 mg/L	267 mg/L
Fluoride	1.5	MAC	1.37 mg/L	1.44 mg/L	**1.55 mg/L**
Chloride	250	AO	20.7 mg/L	20.8 mg/L	21.0 mg/L
Nitrate as N	10	MAC	<0.05 mg/L	<0.05 mg/L	<0.05 mg/L
Nitrite as N	1	MAC	<0.05 mg/L	<0.05 mg/L	<0.05 mg/L
Bromide	--	--	0.26 mg/L	<0.05 mg/L	0.18 mg/L
Sulphate	500 mg/L	AO	<0.10 mg/L	<0.10 mg/L	<0.10 mg/L
Ammonia as N	--	--	0.09 mg/L	0.69 mg/L	0.19 mg/L
Dissolved Organic Carbon	5 mg/L	AO	3.8 mg/L	4.2 mg/L	4.0 mg/L
Colour	5 TCU	AO	**19 TCU**	**67 TCU**	**705 TCU**
Turbidity	5 NTU	AO	3.7 NTU	**10.9 NTU**	**361 NTU**
Calcium	--	--	9.29 mg/L	9.44 mg/L	8.93 mg/L
Magnesium	--	--	3.29 mg/L	3.32 mg/L	3.20 mg/L
Sodium	200 mg/L	AO	114 mg/L	116 mg/L	112 mg/L
Potassium	--	--	1.33 mg/L	1.37 mg/L	1.13 mg/L
Iron	0.300 mg/L	AO	0.010 mg/L	**0.733 mg/L**	**4.83 mg/L**
Manganese	0.050 mg/L	AO	0.002 mg/L	0.011 mg/L	**0.232 mg/L**

NOTE: MAC – maximum acceptable concentration (health-related); AO – Aesthetic Objective (non health-related); Operational Guideline (non health-related); NDOGN – No Data, Sample Overgrown with Target (refers to over-crowding microbial growth).

At the time of AECOM's baseline site visit on 20-January-2017, no water treatment devices were observed or reported by the property owner to be installed at the subject property. Likewise, no treatment equipment or reported to be present was observed during either of our 11-October-2017 or 16-January-2018 complaint investigation site visits.

Raw (untreated) groundwater sample collection during AECOM's 16-January-2018 site visit was completed using a ball valve and braided hose assembly installed at the discharge end of the water system pressure tank in the basement of the residence; the same location as was utilized during flow rate testing (**Photo 2**). Prior to sample collection, the orifice of the discharge hose disinfected (using chlorine) and flushed. Clean nitrile gloves were worn by AECOM staff during sample collection.

The groundwater sample was examined by AECOM in the field for visual or olfactory evidence of impact then immediately placed in laboratory-supplied sample bottles prepared in advance with the appropriate preservatives, sealed, labeled and stored on ice to maintain a sample temperature of 10°C or lower during transportation under chain of custody documentation to a CALA-accredited environmental analytical laboratory within the specified sample analyte holding times.

At the time of sampling on 16-January-2018, the raw (untreated) groundwater pumped from the well was observed to be turbid, brown in colour and contain an appreciable amount of sand-textured sediment. The sediment content appeared to increase relative to pumping rate and duration. No apparent odour(s) were detected.

A photograph of the water quality sample collected by AECOM for laboratory testing on 16-January-2018 is shown in **Photo 3a**, whereas a zoomed-in perspective of settled sediment (sand) is shown in **Photo 3b**.



PHOTO 3a: Water Quality Sample Clarity (as on 16-January-2018)

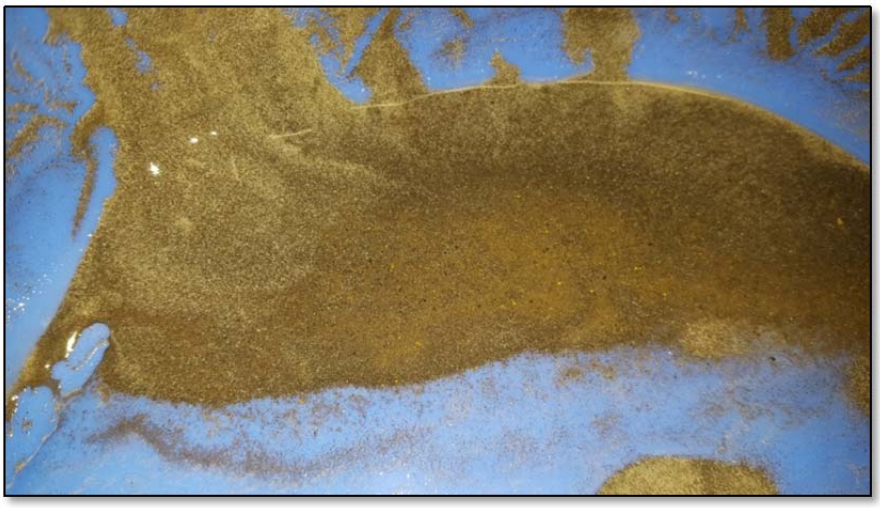


PHOTO 3b: Sandy Textured Sediment Observed During Sampling (as on 16-January-2018)

A detectable population of total coliforms (128 CFU/100 mL) was identified within the raw (untreated) groundwater sample collected from the well on 16-January-2018. This result is consistent with baseline sampling results where significant (ie. overgrown) bacteriological populations for both total coliforms and Escherichia coli (E.coli) were identified, as well as during AECOM's 11-October-2017 complaint site visit where a total coliforms concentration of 90 CFU/100 mL was determined. It is noted that E.coli was reported to be absent in the two (2) most recent water quality samples. Both total coliforms and E.coli represent health-related parameters of the Ontario Drinking Water Quality Standards (ODWQS).

The MOECC record for the well does not indicate that sealing of the annular space along the exterior of the well casing was completed by the contractor at the time the well was constructed. A lack of annular sealing can permit the migration of shallow water (eg. runoff, snowmelt, etc.) and/or contaminates (including bacteria) into a well from the near surface. The persistent detection of total coliforms within the on-site well supply, as presented in **Table 5**, tends to support an interpretation regarding shallow water impact, possibly as a result of annular leakage. It is noted that sealing of the annular space is a current requirement for well construction in accordance with Section 14.4(2) of Ontario Regulation 903 ('Wells'), as amended, made under the Ontario Water Resources Act (R.S.O. 1990), which states (**bold** added for emphasis as it applies to the current unscreened well):

> *(2) If a new well is constructed by any method, other than a method described in section 14.1, 14.2 or 14.3 or by the use of a jetted point, the person constructing the well shall comply with section 14 by ensuring that the following rules are complied with:*
>
> *1. If a well screen is installed,*
>
> *i. the annular space shall be filled, from the bottom of the well to at least the top of the well screen with clean, washed gravel or sand that is,*
>
> *A. deposited during or after placement of the well screen and casing, or*
>
> *B. developed, after placement of the sealant referred to in subparagraph ii, by surging water through the well screen to remove the adjacent fine grained soils, and*
>
> *ii. any remaining annular space shall be filled with suitable sealant, upward from the top of the gravel or sand referred to in subparagraph i to the ground surface.*
>
> ***2. If no well screen is installed, the annular space shall be filled with suitable sealant from the bottom of the casing upward to the ground surface.***
>
> *3. The top of the gravel or sand referred to in paragraph 1 shall not be closer than six metres to the ground surface, unless the only useful aquifer available necessitates a shallower well, in which case the top of the gravel or sand shall not be closer than 2.5 metres to the ground surface.*
>
> *4. The sealant referred to in paragraphs 1 and 2 shall be continuously deposited by forcing sealant through a tremie pipe, with the bottom end of the pipe immersed in the rising accumulation of sealant.*
>
> *5. If the sealant referred to in paragraphs 1 and 2 contains cement,*
>
> *i. it shall be allowed to set according to the manufacturer's specifications or for 12 hours, whichever is longer, and*
>
> *ii. if, after setting in accordance with subparagraph i, the sealant has settled or subsided, it shall be topped up to the original level. O. Reg. 372/07, s. 15*

An exceedance of the inorganic health-related parameter fluoride was detected in the 16-January-2018 raw (untreated) groundwater sample. This result was similar to (marginally higher than) previous water quality results and does not represent a substantial change in concentration. No other health-related exceedances of the parameters analyzed, including Nitrate (as N) and Nitrite (as N), were detected either in the baseline or complaint investigation raw (untreated) groundwater samples collected from the existing on-site well supply.

It is recommended that the property owner seek the guidance of MOECC, their local Public Health Unit, and/or an experienced water treatment specialist to address the elevated levels of bacteria and fluoride (health-related parameters) within the well.

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 were 3.7 NTU in the January 2017 baseline sample and 10.9 NTU in the October 2017 well interference complaint sample. Comparatively, testing results for the 16-January-2018 raw (untreated) groundwater sample indicated a concentration of 361 NTU which was elevated significantly relative to previous results, albeit consistent with field observations made by AECOM at the time of sample collection, and a likely reflection of the sandy sediment observed within the discharge water stream.

Iron concentrations were determined to be in excess of the ODWQS AO limit of 0.3 mg/L in the complaint investigation (4.83 mg/L) raw groundwater sample collected by AECOM on 16-January-2018. This concentration was elevated relative to previous analysis results, however, once again not being unexpected given the volume of suspended sediment (sand) that was observed to be present in the raw (untreated) groundwater stream at the time of sample collection. A similar observation was made in the most recent sampling results for manganese (0.232 mg/L), which also was found to be elevated above the ODWQS AO of 0.05 mg/L and previous analyses. Elevated concentrations of iron and manganese can impart a brownish to black discolouration to a water (including staining of fixtures and laundry) and cause it to become undesirable for consumption. It is surmised that the elevated concentrations of iron and manganese in the 16-January-2018 water sample of a natural (non-anthropogenic) source, possibly entering the well by way of the casing terminus.

Where elevated iron concentrations occur in well water, the presence of iron-related bacteria (IRB) is not uncommon. IRB combine iron (as well as manganese, where present) with oxygen as part of their metabolic processes to form visible 'rust' deposits / stains (eg. yellow, orange, red or brown) that are typically associated with a greasy or slimy texture. Various foul odours may also be associated with the presence of IRB within a well water system (eg. rotten egg, swampy, sewage-like, etc.). The 'slime' will tend stick to fixtures and water system components, including filter elements, pump foot valve assemblies, and well screens, which can result in flow restrictions over time. While not assessed as part of this investigation, IRB may potentially be present within the site well which could affect sample results, most notably turbidity. Although being a nuisance, there is no documented health risk associated with IRB, if present, and can be managed through treatment combined with regular maintenance disinfection of the well supply.

Total suspended solids (TSS) levels within the 16-January-2018 complaint investigation raw groundwater sample was reported at 2,080 mg/L, indicating the presence of a significant sediment (sandy) load in the raw (untreated) groundwater pumped from the well. An ODWQS criteria limit has not been established for this parameter.

The potential for groundwater quality impact(s) associated with turbine operations is time-dependent and related to the intensity, propagation and duration of any ground-borne vibration. In this regard,

commissioning of turbines T6, T7, T12, T28, T30, T32, T35 and T36 was occurring at the time of the current well interference complaint, with T12 representing the closest location at a distance of approximately [redacted] to the south-southeast. As previously discussed in Section 3, the results of a site-specific vibration assessment completed by GAL (2018) indicated that "v*ibrations measured within the rock that might be associated with turbine operations would be of no consequence at this well location given the extremely small vibration magnitudes and separation distances"*.

As an alternate consideration, to have the potential to impact the subject well, vibration impacts in the immediate vicinity of an operating turbine 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 and/or within the radius of pumping influence relative to the pile driving location. Factors (ii) and (iii) above are not considered plausible in the context of the local hydrogeological setting (ie. potential hydraulic gradient and groundwater travel times), the vibration assessment completed by GAL, and current investigation results.

6. Conclusions

Based on a review and interpretation of information gathered during AECOM's well interference complaint investigation, as presented herein, it is our opinion that the groundwater quantity and quality issues currently reported by the property owners at [redacted] (PIN 007420039) are *not* as a result of NKW1 turbine operations.

The water well impacts reported by the property owner appear to be related to local water system and/or well construction / condition issues versus an area-wide impact to the local groundwater system. It is recommended that the property owners consult with a qualified water well contractor regarding the current condition and configuration of their on-site well supply and pumping system.

It is further recommended that the property owner seek the guidance of MOECC, their local Public Health Unit, and/or an experienced water treatment specialist to address the elevated levels of bacteria and fluoride (health-related parameters) within their well.

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 --

Attachments

Attachment A

Correspondence

From: Jacobs, Deb (MOECC) [mailto:deb.jacobs@ontario.ca]
Sent: Tuesday, January 09, 2018 11:00 AM
To: Joshua Vaidyan
Cc: Gilbert, Teri (MOECC); Smith, Mark (MOECC); Harman, Bruce (MOECC); Thuss, Simon (MOECC); Moroney, Michael (MOECC); Lehouillier, Jason (MOECC); McDonald, Dan (MOECC); 'Pat Murray'; gagan.chambal@patternenergy.com; 'Beth O'Brien'; Murchison, Jason; 'Sre.Bop'; 'Boone, Storer'; Colella, Nick (MOECC); Keyvani, Mohsen (MOECC); 'Jody Law'; Van der Woerd, Mark; 'Jonathan Miranda'; 'Kevin Deters'
Subject: RE: Complaint received - [redacted] North Kent 1

Hi Josh,

Happy New Year.

We too received a complaint from [redacted] and I was going to be sending it your way this morning, although you beat me too it. [redacted] indicated that a turbine near his house started spinning on Wednesday and he had problems with his well starting on Saturday.

The Ministry considers this to be an official complaint. As it occurred during a d different "phase" than [redacted] previous complaint (I.e. not during pile driving / construction) , it is likely best if it gets treated as a separate / stand-alone complaint. There are Vibration monitoring requirements outlined in your commissioning plan, which I trust have been implemented and should provide you with some vibration information to help address this complaint. I trust that AECOM is still retained in order to conduct field visits / take water samples / hydrogrological reporting for the complaints, as before. The Ministry looks forward to receiving your report on this complaint.

In the short term, please provide the details for the dates / times / durations of commissioning activities at the turbines closest to [redacted] residence. (If NK1 isn't keeping detailed note on the commissioning activities, I would strongly suggest you start doing so immediately. It helps everyone with the evaluation of complaints, and we don't want a repeat of the pile driving schedule with rounds of inaccuracies, contradictions, revisions, etc_

Please let me know if you require further guidance

Best Regards
Deb Jacobs
Environmental Officer / Agente de l'environnement
Telephone: 519-948-4148
deb.jacobs@ontario.ca

From: Joshua Vaidyan [mailto:j.vaidhyan@samsung.com]
Sent: January 8, 2018 3:20 PM
To: Jacobs, Deb (MOECC)
Cc: Gilbert, Teri (MOECC); Smith, Mark (MOECC); Harman, Bruce (MOECC); Thuss, Simon (MOECC); Moroney, Michael (MOECC); Lehouillier, Jason (MOECC); McDonald, Dan (MOECC); 'Pat Murray'; gagan.chambal@patternenergy.com; 'Beth O'Brien'; 'Murchison, Jason'; 'Sre.Bop'; 'Boone, Storer'; Colella, Nick (MOECC); Keyvani, Mohsen (MOECC); 'Jody Law'; mark.vanderwoerd@aecom.com; 'Jonathan Miranda'; 'Kevin Deters'
Subject: Complaint received - [redacted] North Kent 1

Hi Deb,

We received a complaint today through our Project's toll-free line, below. The complaint is from an existing complainant. The Well investigation Final report for this landowner was submitted to your office early Dec 2017. It's not clear to me how this complaint should be addressed/considered, please advise.

PIN: 7420039
Address: [redacted]
Owner: [redacted]
Phone: [redacted]
Report: [redacted] reports muddy water in [redacted] well that started within 3 days of a turbine spinning near his property.
Closest Turbine: T12 approx. [redacted] away.

[redacted]

Regards,
Josh

Attachment B

Vibration Monitoring Data (Golder Associates Ltd.)

Golder Associates

April 17, 2018

Project No. 1668031-3000-L01

Mr. Jonathan Miranda, Facility Manager
North Kent Wind 1 LP
Operations & Maintenance Building
9525 Eberts Line
Chatham ON, N7M 5J2

WATER WELL COMPLAINT [redacted]
NORTH KENT WIND 1 PROJECT
CHATHAM-KENT, ONTARIO

Dear Mr. Miranda:

This letter is provided to address vibration concerns associated with Well Complaint [redacted] dated January 8, 2018, related to the well located at [redacted] in Chatham-Kent, Ontario. Golder understands that the resident noticed problems with the well starting on January 6, 2018. During the time period of the observed well problems and date of the complaint, turbines T06, T07, T12, T28, T30, T32, T35 and T36 were being commissioned. The closest of these was turbine T12, located approximately [redacted] (m) from the residence.

In accordance with the approved long-term vibration monitoring program, an instrumented mock well with sensors grouted into the bedrock was constructed at each of the turbine locations T23, T41 and T51. Installation was completed on December 21 and 22, 2017. All accelerometers were calibrated by the manufacturers, tested in Golder's office using a controlled vibration source and validated during installation. The mock wells were located at distances of [redacted] from the T23, T41 and T51 turbines, based on surveys completed following their installation. The instruments at the T51 mock well are also within [redacted] of turbine T19, which forms a small two-turbine cluster at this location where the turbines are separated by about [redacted]

During the period covering the date of the well interference complaint for [redacted] none of the turbines at T23, T41 and T51 were operating. Therefore, all other data available for the in-rock mock well accelerometers for T23, T41 and T51 for periods during which these turbines, as well as turbine T19, were operating and not operating were used as a basis for evaluating the vibration magnitudes that would be expected at the [redacted] well location. The nearest operating turbine was T12, at a distance of [redacted] The maximum wind speed during the days of January 6, 7 and 8, 2018 was approximately 16.5 metres per second (m/s) and the maximum power output for the individual turbines during this time period was approximately 3,200 kilowatts (kW).

Available data was examined for the period of December 22, 2017 through to 12:00 am, April 4, 2018 when the turbines were and were not operating. Operational and meteorological data were also reviewed for the 42-day

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period from February 21, 2018 through April 3, 2018, during which time the 33 turbines were regularly operating simultaneously. For comparison to the date of the complaint, data associated with a wind speed of approximately 16.7 m/s was recorded on March 31, 2018 and a maximum power generation from the individual turbines of approximately 3,200 kW was recorded on March 8, 2018, noting that the power output maximum does not necessarily increase linearly with wind speed. In all cases, whether the turbines were or were not operating, persistent or repeating vibrations (i.e., exclusive of transient vibrations or other external influences[1]) measured during the non-operational (i.e., "quiet"), commissioning and operational time periods were all of magnitudes less than $2x10^{-3}$ millimetres per second (mm/s) at frequencies of 1 Hertz (Hz) or more. All turbines at the mock well sites were operating, thus the data also represents the effects from a cluster of simultaneously operating turbines at distances ranging from about [redacted] The power and wind speed events during the period for which operational data is available at the mock well turbine locations is also directly comparable to the conditions associated with the well interference complaint.

Based on the measured rock vibration magnitudes associated with multiple operational turbines, it is our opinion that the reported well conditions are unrelated to turbine operations. Vibrations measured within the rock that might be associated with turbine operations would be of no consequence at this well location given the extremely small vibration magnitudes and separation distances. The vibrations measured at all in-rock sensors at the mock wells were two or more orders of magnitude smaller than the threshold defined by Ontario NPC-207 (0.3 mm/s)[2], one or more orders of magnitude smaller than nighttime vibration thresholds suggested by ASHRAE (0.144 mm/s, 8 to 80 Hz)[3] and one or more orders of magnitude smaller than the International Standards Organization (ISO) threshold for human perception of vibrations at frequencies greater than 8 Hz (0.1 mm/s)[4].

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/MAS/cr

CC: J. Vaidyan, Samsung

[redacted]

[1] Transient vibration sources can include vehicles entering the site and passing the instrumentation (e.g., repairs to turbine T41, access road snow plowing), municipal road traffic, equipment owned by the farm site operating within the detection range of the instruments, pedestrian traffic and personnel movements near the instruments (i.e., during instrument checks and maintenance and data collection). Further, data artefacts caused by electrical voltage perturbations were excluded from the data. Such perturbations can be associated with manual changing of primary and backup batteries, solar power voltage regulators, electrical ground loops, and temporary loss of battery power (primary and backup) during long periods of inclement weather and darkness.

[2] Impulse Vibration In Residential Buildings, (NPC-207), Ministry of Environment, Ontario, 1983.

[3] 2007 ASHRAE Handbook—HVAC Applications (SI), American Society of Heating, Refrigerating and Air-Conditioning Engineers, threshold for nighttime acceptable levels.

[4] International Standards Organization. 1989. Evaluation of human exposure to whole-body vibration. Part 2: Continuous and shock-induced vibration in buildings, ISO 2631, threshold for human response in buildings.

Attachment C

MOECC Water Well Record

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

11 | [redacted] | MUNICIP 3,3,0,0,2 | CON. CON | 0,6

COUNTY OR DISTRICT | TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE | CON | BLOCK, TRACT, SURVEY, ETC. | LOT | DATE COMPLETED

[redacted] | [redacted] | [redacted] | DAY 24 MO 11 YR 86

WELL ID NUMBER 705293 | RC | ELEVATION 600 | RC | BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
Brown	topsoil			0	2
Brown	Sand			2	10
Blue	clay	stones		10	61
Black	sand	Gravel		61	62
Black	shale			62	63

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
61-62	1 ☑ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
5	1 ☑ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	188	0	62
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☑ OPEN HOLE 5 ☐ PLASTIC		62	63
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☑ PUMP 2 ☐ BAILER | PUMPING RATE: 4 GPM | DURATION OF PUMPING: 5 HOURS [redacted] MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☑ PUMPING 2 ☐ RECOVERY			
		15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
13 FEET	25 FEET	17 FEET	21 FEET	24 FEET	25 FEET

IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	FEET	1 ☑ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☑ DEEP	50 FEET	4 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.

70m

[redacted]

N

Shed

36

X 132

27611

DRILLERS REMARKS: M. LaMaster

FINAL STATUS OF WELL	1 ☑ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 6 ☐ ABANDONED, INSUFFICIENT SUPPLY 8 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED 9 ☐ DEWATERING
WATER USE	1 ☑ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☑ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED
METHOD OF CONSTRUCTION	1 ☑ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: MARVIN LaMaster | WELL CONTRACTOR'S LICENCE NUMBER: 3005

ADDRESS: R R 1 Pain Court

NAME OF WELL TECHNICIAN: MARVIN LaMaster | WELL TECHNICIAN'S LICENCE NUMBER: T0274

SIGNATURE OF TECHNICIAN/CONTRACTOR: Marvin LaMaster | SUBMISSION DATE: DAY 24 MO 11 YR 86

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 3005 | DATE RECEIVED JAN 13 1989

DATE OF INSPECTION | INSPECTOR

REMARKS: WDE

CSS.S8

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Attachment D

Water Quality Data

AGAT Laboratories

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**
105 COMMERCE VALLEY DR.W 7TH FLOOR
MARKHAM, ON L3T7W3
(905) 886-7022

ATTENTION TO: **Erin Wilson**

PROJECT: **60343599**

AGAT WORK ORDER: **17T180137**

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

WATER ANALYSIS REVIEWED BY: **Mike Muneswar, BSc (Chem), Senior Inorganic Analyst**

DATE REPORTED: **Jan 30, 2017**

PAGES (INCLUDING COVER): **9**

VERSION*: **1**

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

*NOTES

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

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested
All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 17T180137

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:B. M.

Microbiological Analysis (water)

DATE RECEIVED: 2017-01-23

DATE REPORTED: 2017-01-30

				007420039; [redacted]
			SAMPLE DESCRIPTION:	
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-01-20
Parameter	Unit	G / S	RDL	8142060
Escherichia coli	CFU/100mL	0	1	NDOGN
Total Coliforms	CFU/100mL	0	1	NDOGN

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to SDWA - Microbiology

8142060 NDOGN – No Data; Overgrown with non- target, refers to over-crowding microbial growth;

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 17T180137

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE:

ATTENTION TO: Erin Wilson

SAMPLED BY:B. M.

North Kent - Groundwater Samples

DATE RECEIVED: 2017-01-23

DATE REPORTED: 2017-01-30

				SAMPLE DESCRIPTION:	007420039; [redacted]
				SAMPLE TYPE:	Water
				DATE SAMPLED:	2017-01-20
Parameter	Unit	G / S	RDL	8142060	
Electrical Conductivity	uS/cm		2	548	
pH	pH Units	(6.5-8.5)	NA	8.23	
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	36.7	
Total Dissolved Solids	mg/L	500	20	292	
Total Suspended Solids	mg/L		10	<10	
Alkalinity (as CaCO3)	mg/L	(30-500)	5	258	
Fluoride	mg/L	1.5	0.05	1.37	
Chloride	mg/L	250	0.10	20.7	
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	0.26	
Sulphate	mg/L	500	0.10	<0.10	
Ammonia as N	mg/L		0.02	0.09	
Dissolved Organic Carbon	mg/L	5	0.5	3.8	
Colour	TCU	5	5	**19**	
Turbidity	NTU	5	0.5	3.7	
Calcium	mg/L		0.05	9.29	
Magnesium	mg/L		0.05	3.29	
Sodium	mg/L	20 (200)	0.05	**114**	
Potassium	mg/L		0.05	1.33	
Iron	mg/L	0.3	0.010	**0.305**	
Manganese	mg/L	0.05	0.002	0.010	

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

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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CANADA L4Z 1Y2
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FAX (905)712-5122
http://www.agatlabs.com

Guideline Violation

AGAT WORK ORDER: 17T180137

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Erin Wilson

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 COOPERS AVENUE
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TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T180137

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:B. M.

Microbiology Analysis

RPT Date: Jan 30, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Microbiological Analysis (water)															
Escherichia coli	8142038	8142038	ND	ND	NA	< 1									
Total Coliforms	8142038	8142038	ND	ND	NA	< 1									

Comments: ND - Not Detected, NA - % RPD Not Applicable

Microbiological Analysis (water)															
Escherichia coli	8142104	8142104	NDOGN	NDOGN	NA	< 1									
Total Coliforms	8142104	8142104	NDOGN	NDOGN	NA	< 1									

Comments: NDOGN – No Data; Overgrown with non- target, refers to over-crowding microbial growth;
NA - % RPD Not Applicable

Certified By:

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested

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TEL (905)712-5100
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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T180137

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:B. M.

Water Analysis

RPT Date: Jan 30, 2017

PARAMETER	Batch	Sample Id	DUPLICATE Dup #1	DUPLICATE Dup #2	DUPLICATE RPD	Method Blank	REFERENCE MATERIAL Measured Value	REFERENCE MATERIAL Acceptable Limits Lower	REFERENCE MATERIAL Acceptable Limits Upper	METHOD BLANK SPIKE Recovery	METHOD BLANK SPIKE Acceptable Limits Lower	METHOD BLANK SPIKE Acceptable Limits Upper	MATRIX SPIKE Recovery	MATRIX SPIKE Acceptable Limits Lower	MATRIX SPIKE Acceptable Limits Upper
North Kent - Groundwater Samples															
Electrical Conductivity	8142104	8142104	550	550	0.0%	< 2	101%	80%	120%	NA			NA		
pH	8142104	8142104	8.40	8.27	1.6%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8142038	8142038	430	398	7.7%	< 20	98%	80%	120%	NA			NA		
Total Suspended Solids	8142110	8142110	< 10	< 10	NA	< 10	96%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8142104	8142104	256	265	3.5%	< 5	96%	80%	120%	NA			NA		
Fluoride	8142066	8142066	1.36	1.36	0.0%	< 0.05	94%	90%	110%	106%	90%	110%	95%	80%	120%
Chloride	8142066	8142066	21.0	20.6	1.9%	< 0.10	93%	90%	110%	103%	90%	110%	103%	80%	120%
Nitrate as N	8142066	8142066	< 0.05	<0.05	NA	< 0.05	94%	90%	110%	107%	90%	110%	101%	80%	120%
Nitrite as N	8142066	8142066	< 0.05	<0.05	NA	< 0.05	NA	90%	110%	93%	90%	110%	119%	80%	120%
Bromide	8142066	8142066	0.29	0.28	3.5%	< 0.05	106%	90%	110%	102%	90%	110%	84%	80%	120%
Sulphate	8142066	8142066	< 0.10	<0.10	NA	< 0.10	94%	90%	110%	99%	90%	110%	96%	80%	120%
Ammonia as N	8142054	8142054	0.10	0.10	0.0%	< 0.02	93%	90%	110%	98%	90%	110%	104%	80%	120%
Dissolved Organic Carbon	8142038	8142038	2.4	2.2	NA	< 0.5	98%	90%	110%	92%	90%	110%	87%	80%	120%
Colour	8142048	8142048	7	7	NA	< 5	98%	90%	110%	NA			NA		
Turbidity	8142038	8142038	1.4	1.4	NA	< 0.5	104%	90%	110%	NA			NA		
Calcium	8142038	8142038	7.92	8.34	5.2%	< 0.05	102%	90%	110%	101%	90%	110%	99%	70%	130%
Magnesium	8142038	8142038	2.43	2.46	1.2%	< 0.05	96%	90%	110%	97%	90%	110%	96%	70%	130%
Sodium	8142038	8142038	169	174	2.9%	< 0.05	99%	90%	110%	100%	90%	110%	91%	70%	130%
Potassium	8142038	8142038	1.67	1.68	0.6%	< 0.05	99%	90%	110%	100%	90%	110%	99%	70%	130%
Iron	8142038	8142038	0.190	0.193	1.6%	< 0.010	105%	90%	110%	100%	90%	110%	105%	70%	130%
Manganese	8142038	8142038	0.009	0.009	NA	< 0.002	101%	90%	110%	103%	90%	110%	86%	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:

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Results relate only to the items tested and to all the items tested

AGAT Laboratories

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

Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T180137

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:B. M.

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Microbiology Analysis			
Escherichia coli	MIC-93-7010	EPA 1604	Membrane Filtration
Total Coliforms	MIC-93-7010	EPA 1604	Membrane Filtration
Water Analysis			
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Hardness (as CaCO3)	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 CaCO3)	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 NH3-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

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http://www.agatlabs.com

CLIENT NAME: AECOM CANADA LTD
105 Commerce Valley Drive West 7th Floor
MARKHAM, ON L3T7W3
(905) 886-7022

ATTENTION TO: Jason Murchison

PROJECT: 60343599

AGAT WORK ORDER: 17T270567

MICROBIOLOGY ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

WATER ANALYSIS REVIEWED BY: Yris Verastegui, Report Reviewer

DATE REPORTED: Oct 17, 2017

PAGES (INCLUDING COVER): 8

VERSION*: 1

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

*NOTES

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

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Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T270567

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

North Kent - Microbiological Analysis (water)

DATE RECEIVED: 2017-10-12

DATE REPORTED: 2017-10-17

				007420039; [redacted]
SAMPLE DESCRIPTION:				
SAMPLE TYPE:				Water
DATE SAMPLED:				2017-10-11
Parameter	Unit	G / S	RDL	8807888
Escherichia coli	CFU/100mL	0	1	ND
Total Coliforms	CFU/100mL	0	1	90

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.

8807888 ND - Not Detected.

Certified By: Divine Basily

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Certificate of Analysis

AGAT WORK ORDER: 17T270567

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

North Kent - Groundwater Samples

DATE RECEIVED: 2017-10-12

DATE REPORTED: 2017-10-17

				007420039; [redacted]
SAMPLE DESCRIPTION:				
SAMPLE TYPE:				Water
DATE SAMPLED:				2017-10-11
Parameter	Unit	G / S	RDL	8807888
Electrical Conductivity	uS/cm		2	540
pH	pH Units	(6.5-8.5)	NA	8.21
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	37.2
Total Dissolved Solids	mg/L	500	20	318
Total Suspended Solids	mg/L		10	<10
Alkalinity (as CaCO3)	mg/L	(30-500)	5	269
Fluoride	mg/L	1.5	0.05	1.44
Chloride	mg/L	250	0.10	20.8
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	0.69
Dissolved Organic Carbon	mg/L	5	0.5	4.2
Colour	Apparent CU	5	5	67
Turbidity	NTU	5	0.5	10.9
Calcium	mg/L		0.05	9.44
Magnesium	mg/L		0.05	3.32
Sodium	mg/L	20 (200)	0.05	116
Potassium	mg/L		0.05	1.37
Iron	mg/L	0.3	0.010	0.733
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)
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: Iris Verástegui

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Guideline Violation

AGAT WORK ORDER: 17T270567

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T270567

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Microbiology Analysis

RPT Date: Oct 17, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
North Kent - Microbiological Analysis (water)															
Escherichia coli	8807888	8807888	ND	ND	NA	< 1									
Total Coliforms	8807888	8807888	90	81	10.5%	< 1									

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

Certified By: Divine Basily

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T270567

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Oct 17, 2017

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			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	8807179		1250	1260	0.8%	< 2	102%	80%	120%	NA			NA		
pH	8807179		8.35	8.21	1.7%	NA	99%	90%	110%	NA			NA		
Total Dissolved Solids	8807888	8807888	318	318	0.0%	< 20	100%	80%	120%	NA			NA		
Total Suspended Solids	8807179		<10	<10	NA	< 10	102%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8807179		402	403	0.2%	< 5	100%	80%	120%	NA			NA		
Fluoride	8790200		0.41	0.43	4.8%	< 0.05	96%	90%	110%	102%	90%	110%	111%	80%	120%
Chloride	8790200		10.4	9.99	4.0%	< 0.10	91%	90%	110%	109%	90%	110%	109%	80%	120%
Nitrate as N	8790200		<0.05	<0.05	NA	< 0.05	90%	90%	110%	100%	90%	110%	105%	80%	120%
Nitrite as N	8790200		<0.05	<0.05	NA	< 0.05	NA	90%	110%	97%	90%	110%	96%	80%	120%
Bromide	8790200		<0.05	<0.05	NA	< 0.05	104%	90%	110%	107%	90%	110%	89%	80%	120%
Sulphate	8790200		113	112	0.9%	< 0.10	103%	90%	110%	106%	90%	110%	95%	80%	120%
Ammonia as N	8807888	8807888	0.69	0.71	2.9%	< 0.02	105%	90%	110%	95%	90%	110%	95%	80%	120%
Dissolved Organic Carbon	8807179		2.7	2.6	3.8%	< 0.5	103%	90%	110%	106%	90%	110%	99%	80%	120%
Colour	8807179		33	33	0.0%	< 5	107%	90%	110%	NA			NA		
Turbidity	8807134		3.6	3.7	2.7%	< 0.5	100%	90%	110%	NA			NA		
Calcium	8807888	8807888	9.44	9.44	0.0%	< 0.05	95%	90%	110%	95%	90%	110%	94%	70%	130%
Magnesium	8807888	8807888	3.32	3.36	1.2%	< 0.05	97%	90%	110%	97%	90%	110%	97%	70%	130%
Sodium	8807888	8807888	116	116	0.0%	< 0.05	101%	90%	110%	100%	90%	110%	98%	70%	130%
Potassium	8807888	8807888	1.37	1.37	0.0%	< 0.05	100%	90%	110%	99%	90%	110%	98%	70%	130%
Iron	8810249		0.289	0.259	10.9%	< 0.010	94%	90%	110%	93%	90%	110%	82%	70%	130%
Manganese	8810249		0.069	0.065	6.0%	< 0.002	96%	90%	110%	91%	90%	110%	90%	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: Iris Verástegui

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AGAT Laboratories

5835 COOPERS AVENUE
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Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T270567

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Microbiology Analysis			
Escherichia coli	MIC-93-7010	EPA 1604	Membrane Filtration
Total Coliforms	MIC-93-7010	EPA 1604	Membrane Filtration
Water Analysis			
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Hardness (as CaCO3)	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 CaCO3)	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-93-6002	AMM-002-A & SM 4500 NH3-G	DISCRETE ANALYZER
Dissolved Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Colour	INOR-93-6046	SM 2120 C	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

Results relate only to the items tested and to all the items tested

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FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: AECOM CANADA LTD
55 WYNDHAM STREET NORTH SUITE 215
GUELPH, ON N1H7T8
(519) 840-2251

ATTENTION TO: Brian Holden

PROJECT: 60343599

AGAT WORK ORDER: 18T302764

MICROBIOLOGY ANALYSIS REVIEWED BY: Inesa Alizarchyk, Inorganic Lab Supervisor

WATER ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Jan 18, 2018

PAGES (INCLUDING COVER): 8

VERSION*: 1

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

*NOTES

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AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18T302764

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Brian Holden

SAMPLING SITE:

SAMPLED BY:

North Kent - Microbiological Analysis (water)

DATE RECEIVED: 2018-01-17

DATE REPORTED: 2018-01-18

				007420039
			SAMPLE DESCRIPTION:	[redacted]
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2018-01-16
Parameter	Unit	G / S	RDL	9015721
Escherichia coli	CFU/100mL	0	2	ND
Total Coliforms	CFU/100mL	0	2	128

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON 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.

9015721 RDL >1 indicates dilutions of the sample.
ND - Not Detected.

Certified By:

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AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 18T302764

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Brian Holden

SAMPLING SITE:

SAMPLED BY:

North Kent - Groundwater Samples

DATE RECEIVED: 2018-01-17

DATE REPORTED: 2018-01-18

					007420039
				SAMPLE DESCRIPTION:	[redacted]
				SAMPLE TYPE:	Water
				DATE SAMPLED:	2018-01-16
Parameter	Unit	G / S: A	G / S: B	RDL	9015721
Electrical Conductivity	uS/cm			2	541
pH	pH Units		6.5-8.5	NA	8.38
Total Hardness (as CaCO3)	mg/L		80-100	0.5	35.5
Total Dissolved Solids	mg/L		500	20	332[<B]
Total Suspended Solids	mg/L			10	2080
Alkalinity (as CaCO3)	mg/L		30-500	5	267
Fluoride	mg/L	1.5		0.05	1.55[>A]
Chloride	mg/L		250	0.10	21.0[<B]
Nitrate as N	mg/L	10.0		0.05	<0.05[<A]
Nitrite as N	mg/L	1.0		0.05	<0.05[<A]
Bromide	mg/L			0.05	0.18
Sulphate	mg/L		500	0.10	<0.10[<B]
Ammonia as N	mg/L			0.02	0.19
Dissolved Organic Carbon	mg/L		5	0.5	4.0[<B]
Colour	Apparent CU		5	10	705[>B]
Turbidity	NTU		5	0.5	361[>B]
Calcium	mg/L			0.05	8.93
Magnesium	mg/L			0.05	3.20
Sodium	mg/L	20	200	0.05	112[A-B]
Potassium	mg/L			0.05	1.13
Iron	mg/L		0.3	0.010	4.83[>B]
Manganese	mg/L		0.05	0.002	0.232[>B]

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Ontario Drinking Water Quality Standards. Na value is derived from O. Reg. 248, B Refers to Ontario Drinking Water Quality Standards - Aesthetic Objectives and Operational Guidelines
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.

9015721 Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

Certified By: Amanjot Bhela

Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 COOPERS AVENUE
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CANADA L4Z 1Y2
TEL (905)712-5100
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http://www.agatlabs.com

Guideline Violation

AGAT WORK ORDER: 18T302764

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Brian Holden

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
[redacted]							

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 18T302764

PROJECT: 60343599

ATTENTION TO: Brian Holden

SAMPLING SITE:

SAMPLED BY:

Microbiology Analysis

RPT Date: Jan 18, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
North Kent - Microbiological Analysis (water)															
Escherichia coli	9015598		ND	ND	NA	< 1									
Total Coliforms	9015598		ND	ND	NA	< 1									

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

Certified By:

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 18T302764

PROJECT: 60343599

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SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Jan 18, 2018

PARAMETER	Batch	Sample Id	DUPLICATE Dup #1	DUPLICATE Dup #2	DUPLICATE RPD	Method Blank	REFERENCE MATERIAL Measured Value	REFERENCE MATERIAL Acceptable Limits Lower	REFERENCE MATERIAL Acceptable Limits Upper	METHOD BLANK SPIKE Recovery	METHOD BLANK SPIKE Acceptable Limits Lower	METHOD BLANK SPIKE Acceptable Limits Upper	MATRIX SPIKE Recovery	MATRIX SPIKE Acceptable Limits Lower	MATRIX SPIKE Acceptable Limits Upper
North Kent - Groundwater Samples															
Electrical Conductivity	9015721	9015721	541	541	0.0%	< 2	104%	80%	120%	NA			NA		
pH	9015721	9015721	8.38	8.21	2.0%	NA	99%	90%	110%	NA			NA		
Total Dissolved Solids	9014851		340	344	1.2%	< 20	102%	80%	120%	NA			NA		
Total Suspended Solids	9015721	9015721	2080	2340	11.8%	< 10	100%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	9015721	9015721	267	268	0.4%	< 5	99%	80%	120%	NA			NA		
Fluoride	9015721	9015721	1.55	1.54	0.6%	< 0.05	107%	90%	110%	92%	90%	110%	93%	80%	120%
Chloride	9015721	9015721	21.0	21.1	0.5%	< 0.10	91%	90%	110%	105%	90%	110%	100%	80%	120%
Nitrate as N	9015721	9015721	<0.05	<0.05	NA	< 0.05	92%	90%	110%	103%	90%	110%	104%	80%	120%
Nitrite as N	9015721	9015721	<0.05	<0.05	NA	< 0.05	NA	90%	110%	100%	90%	110%	93%	80%	120%
Bromide	9015721	9015721	0.18	<0.05	NA	< 0.05	109%	90%	110%	103%	90%	110%	103%	80%	120%
Sulphate	9015721	9015721	<0.10	<0.10	NA	< 0.10	98%	90%	110%	108%	90%	110%	103%	80%	120%
Ammonia as N	9017151		0.02	<0.02	NA	< 0.02	104%	90%	110%	105%	90%	110%	85%	80%	120%
Dissolved Organic Carbon	9017087		4.3	4.5	4.5%	< 0.5	99%	90%	110%	98%	90%	110%	96%	80%	120%
Colour	9015721	9015721	705	700	0.7%	< 5	109%	90%	110%	NA			NA		
Turbidity	9014851		3.2	3.3	3.1%	< 0.5	100%	90%	110%	NA			NA		
Calcium	9014082		100	100	0.0%	< 0.05	101%	90%	110%	100%	90%	110%	98%	70%	130%
Magnesium	9014082		21.1	21.5	1.9%	< 0.05	99%	90%	110%	97%	90%	110%	94%	70%	130%
Sodium	9014082		61.9	61.6	0.5%	< 0.05	99%	90%	110%	99%	90%	110%	95%	70%	130%
Potassium	9014082		5.97	6.08	1.8%	< 0.05	94%	90%	110%	93%	90%	110%	91%	70%	130%
Iron	9014438		<0.010	<0.010	NA	< 0.010	105%	90%	110%	110%	90%	110%	98%	70%	130%
Manganese	9014438		0.003	0.003	NA	< 0.002	93%	90%	110%	107%	90%	110%	106%	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

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Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 18T302764

PROJECT: 60343599

ATTENTION TO: Brian Holden

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Microbiology Analysis			
Escherichia coli	MIC-93-7010	EPA 1604	Membrane Filtration
Total Coliforms	MIC-93-7010	EPA 1604	Membrane Filtration
Water Analysis			
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Hardness (as CaCO3)	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 CaCO3)	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-93-6002	AMM-002-A & SM 4500 NH3-G	DISCRETE ANALYZER
Dissolved Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Colour	INOR-93-6046	SM 2120 C	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

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