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Technical Memorandum

To	North Kent 1 LP	Page	1
CC	Mark Van der Woerd (AECOM), Jody Law (Pattern), Joshua Vaidhyan (Samsung)		
Subject	**North Kent Wind 1 (Chatham-Kent, ON)** **Well Water Impact Complaint Investigation – UPDATED v.2** [redacted] **- PIN 007530061,** [redacted]		
From	Jason Murchison, P.Geo.		
Date	November 22nd, 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 8-September-2017. In this correspondence, Ms. Jacobs provides a summary narrative of a well interference complaint that was received by MOECC on the morning of 7-September (exact time unspecified) from [redacted], the property owner of [redacted] (Dresden, ON).

In brief, Ms. Jacobs describes the well interference complaint as follows:

> [redacted] *contacted us yesterday, but we did not have a chance to speak with him until today. He indicated that he first noticed "black specks" and cloudiness in his well water on August 25th.*

A copy of the MOECC correspondence described above 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:	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 from MOECC at approximately 12:09pm on 8-September-2017. (2) AECOM arranged directly with the property owners an appointment to visit the property at 10:30am on 14-September-2017 (based on property owner

REA CONDITIONS	ACTION(S) TAKEN
(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 (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.	availability). (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); and, ii) collection of a raw (untreated) groundwater sample for analytical laboratory testing. Photographs of pertinent site features (eg. well, water treatment equipment, etc.) were not obtained at the request of the property owners. (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 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 14-September-2017 site visit to the subject property, a series of seven (7) standard questions were raised with the property owners ([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"	• 25-August-2017 noticed black specs in sediment trap (in morning), new issue. • Touch of cloudiness. • Affected flow. • Pump is running longer. • Laundry / dishes taking longer to supply water.
"What do you think is the cause?"	• Pile driving for turbine construction to southeast of property on 22-August-2017.
"When did you first notice the problem (Date/Time)?"	• Morning of 25-August-2017.
"Is the problem still occurring?"	• Yes.
"Do you have an alternate source of potable water (i.e. municipal water)?"	• No. • Using less water to be cautious, using bottled water for cooking and cleaning. • Not comfortable using well water.
"Were you provided a temporary supply of potable water?"	• Yes, soon. • Bottled water anticipated to be provided on 15-September-2017.
"Did you participate in the Detailed Well Assessment program prior to construction?"	• Yes

Upon completion of the questionnaire, the property owners ([redacted]) were provided an opportunity to review the responses detailed in **Table 2** and were in agreement that the information provided was accurate to the best of their knowledge.

3. Construction Activities and Vibration Monitoring

Within a two (2) week timeframe preceding the [redacted] reported outset of well impact (25-August-2017), pile driving for foundation construction as part of the NKW1 project was completed at the following six (6) turbine locations:

- T3 – August 22nd & 23rd @ 690 m South-Southeast
- T4 – August 24th & 25th @ 720 m Southeast
- T45 – August 23rd, 24th & 25th @ 2,400 m Northeast
- T32 – August 11th & 14th @ 3,800 m Southeast
- T43 – August 15th, 18th & 21st @ 3,950 m Northeast
- T28 – August 11th & 15th @ 5,220 m East-Southeast

Approximate directions and distances away from the subject property are provided above for reference purposes. T3 and T4 represent the nearest two (2) turbine locations to the subject property.

Pile driving activities for foundation construction at Turbine Location #3 (T3) commenced in the area of Pile #7 at 12:16pm on 22-August-2017. Following the initial pile installation, an additional ten (10) piles at the T3 site were driven on that same day, with work concluding at the location of Pile #8 at approximately 6:54pm. Seven (7) additional piles at the T3 site were installed on the subsequent day, with the final installation at Pile #3 having been completed at 12:41pm. Restrikes (to demonstrate resistance performance) also were completed at nine (9) pile locations this same day. A replacement Pile #7A was completed on 6-September-2017, albeit approximately one (1) week following the reported outset of well interference. As noted above, the pile driving work at T3 was undertaken at a distance of approximately 690 m (south-southeast) from the property owner's water well.

Pile driving activities for foundation construction at Turbine Location #4 (T4) commenced in the area of Pile #7 at 9:56am on 24-August-2017. Following the initial pile installation, an additional twelve (12) piles at the T4 site were driven on that same day, with work concluding at the location of Pile #8 at approximately 3:14pm. Five (5) additional piles at the T4 site were installed on the subsequent day, with the final installation at Pile #2 having been completed at 9:16am. As noted above, the pile driving work at T4 was undertaken at a distance of about 720 m (southeast) from the property owner's water well.

Based on their distances away from the [redacted] property, vibration monitoring relating to the installation of pile foundations at T45, T32, T43 and T28 has not been considered as part of this assessment.

Monitoring of vibration effects during pile driving at T3 and T4 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 T3 and T4 included Well 11 ([redacted]) and Well 12 ([redacted]), reportedly being located at radial distances of 1,707 m and 1,264 m from T3 and 1,424 m and 1,072 m from T4, respectively. Comparatively, the location of the water well on the subject property is positioned at a distance of

approximately 690 m from the nearest turbine location (T3). Vibration monitoring results obtained by GAL are summarized in a technical letter, dated 20-September-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 21-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 20-September-2017 technical letter:

> *In summary, vibration measurements obtained with the geophone system (Instantel Minimate) on all sites reported herein were within expectations as compared to those measured at the T5 and T42 test pile sites and general project expectations. On sites where piles penetrated through the near surface soils under their own weight or a low number of hammer blows (e.g., less than 5) the ground surface vibrations during this phase of pile driving for each pile were nominal. Ground surface vibrations measured when driving the piles on the glacial till or rock were also either comparable to or less than those at the test pile sites and, in all cases, were within expectations. Vibration measurements made using the accelerometers mounted on the well casings were also within expectations based on the T5 and T42 test pile sites and turbine to well distances.*
>
> *Well monitoring to-date has identified several wells for which the vibrations induced by the pumps dominated the instrument readings when the pumps were active or other activities dominated the measured vibrations. Relevant notes regarding various pumps, their operation and other influences on vibration measurements are described below:*
>
> ***Well 3:** Activities at the Well 3 property included crop harvesting, movement of farm vehicles and loading of haul trucks in relatively close proximity to Well 3.*
>
> ***Well 4:** Maximum well casing vibration velocities for Well 4 of about 4.8 mm/s were recorded on September 6, 2017 when a well pump was connected, operated and adjusted and the owner made frequent return visits to the well shed. Crop harvesting was also carried out as close as about 25 m from the well casing.*
>
> ***Well 6:** The pump for Well 6 is mounted in close proximity to the well casing (as illustrated on the attached Photograph 1). Maximum particle velocities of as much as 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. The influences of the pump were readily discernable in the monitoring data. Approximately 1 minute after driving of Pile 1 for turbine T12 concluded, a loaded tractor-trailer dump truck drove by on the road near Well 6 and, at the same time, the resident was hammering in a nearby shed. Vibrations associated with the loaded dump truck were also perceptible by our well monitoring staff and registered at about 2.8 mm/s.*
>
> ***Well 9:** A piston pump for Well 9 is located within the barn adjacent to the Well 9 casing location, a total distance (inside and outside) of about 3 to 4 m. During pile driving for turbines T28 and T32, on August 11, 2017, other work was occurring near Well 9. This work included construction along the access road leading to the T32 site and included movement of heavy equipment, excavator operations, dump truck traffic, discharge of stone from delivery vehicles and other activities. This surface construction work was as close as 100 m to Well 9. Additionally, Well 9 is approximately 74 m from Countryview Line that experiences significant traffic. Traffic included loaded construction equipment, buses, fuel tanker trucks and other vehicles. Golder conducted a separate monitoring event at this well on September 8, 2017 to measure the influence of the pump on well casing vibrations in the absence of pile driving. Maximum measured casing vibrations during this test were about 1.2 mm/s. Measurements at Well 9 on dates other than August 11, 2017 are consistent with expectations based on local traffic volumes and the potential influence of the adjacent piston pump.*

Well 10: *Well 10 exhibited maximum vibrations of about 1.25 mm/s during pump operation. The influence of pump operations were clearly discernable in the vibration monitoring data. The proximity of the pump and well casing are illustrated in the attached Photograph 2.*

Well 11: *Vibrations of the casing at Well 11 were measured during water quality sampling on August 17, 2017 in the absence of pile driving at any location. When the pump was operating, a maximum vibration magnitude of 0.016 mm/s was measured at this well. The pump is located within the residence and approximately 40 m from the well.*

Well 12: *During pile driving, Well 12 operated on a number of clearly definable occasions. Maximum vibration measurements of pump-induced well casing vibrations were as much as 2.4 mm/s. The pump for Well 12 is a piston pump mounted directly on top of the well casing as illustrated in the attached Photograph 3.*

Well 13: *Well 13 is located approximately 87 m from the centreline of Union Line which is subjected to local truck traffic. Review of the data indicates that well pumping and non-pile driving transient sources influenced the results at this location. Additional evaluation of transient, non-pile driving data is on-going and a specific monitoring period for well pump operation is being planned for a time without pile driving.*

Well 14: *Well 14 is located approximately 13 m from the centreline of Union Line which is subjected to local truck traffic. A limited evaluation of transient traffic vibrations indicated well casing velocities of at least 0.079 mm/s associated with this cause, though inspection of the data indicates higher values occurred outside of pile driving times. Additional evaluation of transient, non-pile driving data is on-going and a specific monitoring period for well pump operation is being planned for a time without pile driving.*

In summary, measured vibrations have been evaluated and reported as associated with driving 329 piles and replacement piles on the glacial till/rock along with restrike events and pile dynamic testing events. These measurements have been obtained at the turbine sites and at wells located at distances ranging from 580 to 4,359 m from the turbine sites. It is our opinion, based on these measurements, that the vibration magnitudes at all wells during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at these well sites, less than the observed and measured influence of well pumps and inconsequential for the wells.

The interpretation and conclusions above are reconfirmed by GAL within their site-specific assessment letter, dated 21-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 would be expected to be one or more orders of magnitude less than vibrations induced by typical pumping systems in the area, less than vibrations associated with vehicles operating near the wells and less than the International Standards Organization (ISO) threshold for human perception of steady-state vibrations at frequencies greater than 8 Hz (0.1 mm/s). It is our opinion, based on vibration measurements, that the vibration magnitudes during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at these well sites, less than the observed and measured influences of typical well pumps in the area and inconsequential for the [redacted] well.

4. Well Construction Details

Table 3 provides a summary of available construction details for the water well located at [redacted], based on details provided to AECOM by Mr. and Ms. [redacted] during our 14-September-2017 well interference complaint site visit, as well as information provided by the property

owners on their completed baseline water well survey (WWS) form and during our baseline site visit on 25-January-2017.

A review of the MOECC on-line database did not reveal a water well record for the subject property.

Measurement of well details (ie. including total type, total depth, water level, etc.) was unable to be completed by AECOM during our 14-September-2017 site visit due to the wellhead being buried within the front yard (reportedly below a garden bed).

A photograph of the well was unable to be obtained due to its buried condition and that permission to photograph the property (including water treatment equipment) was not provided by Mr. [redacted].

TABLE 3: REPORTED PRIVATE WELL CONSTRUCTION DETAILS

DETAILS	**[redacted] (PIN 007530061)**
Well Tag #	*Unknown*
Well ID	*Unknown*
Installation Date	Assumed Prior to 2009 (as on WWS states that [redacted] have owned property for 8 years)
Well Location	In Front Yard (as on WWS)
Contractor	*Unknown*
Contractor No.	*Unknown*
Construction Method	*Unknown*
Total Depth	*Unknown*
Target Formation	*Unknown*
Casing Length	*Unknown*
Casing Diameter	*Unknown*
Casing Material	*Unknown*
Casing Stick-Up	Below Grade (exact depth unknown as wellhead buried)
Annular Seal	*Unknown*
Sealant Type	*Unknown*
Well Screen Installed?	*Unknown*
Well Screen Details	*Unknown*
Well Screen Interval	*Unknown*
Well Cover Type	*Unknown* (wellhead buried)
Pump Intake Depth	*Unknown*
Pumping Rate	24 L/min / 6.3 USgpm (as measured by AECOM – treated water stream, average of 5 separate flow rate measurements)
Well Pump Type	Jet Pump (as observed by AECOM)
Well Pump Size	½ hp (as on WWS)
Static Level	*Unknown*

DETAILS	[redacted] (PIN 007530061)
Pumping Level	*Unknown*

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

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 C**.

TABLE 4: PRIVATE WELL SAMPLING SUMMARY

LOCATION	SAMPLED BY	DATE	TYPE	PURPOSE
[redacted]	AECOM	25-January-2017	Raw (Untreated)	Baseline
	AECOM	14-September-2017	Raw (Untreated)	Complaint Investigation

5.1 Discussion

Available raw (untreated) groundwater sampling data for the well indicates the presence of a poor baseline raw (untreated) groundwater quality, with elevated levels of total dissolved solids, chloride, colour and sodium, as shown in **Table 5**. Groundwater quality data reported for the raw groundwater sample collected by AECOM during our 14-September-2017 site visit also is included in the table for comparative purposes.

At the time of AECOM's baseline site visit on 25-January-2017, water treatment devices installed at the residence were observed to include a sediment filter (5 µm cartridge, as reported by Mr. [redacted]) and a water softener. These devices reportedly were present at the time the [redacted] purchased the property in May 2009. During AECOM's 14-September-2017 site visit, a particle filter (T-Standard sand separator) was observed to also have been installed within the basement of the residence ahead of the previously existing sediment (cartridge) filter. The installation date of the particle filter and mesh size of the filter element is unconfirmed.

TABLE 5: RAW (UNTREATED) GROUNDWATER SAMPLING RESULTS

PARAMETER	ODWQS CRITERIA	ODWQS TYPE	BASELINE (25-January-2017)	COMPLAINT INVESTIGATION (14-September-2017)
Escherichia coli	0 CFU/100mL	MAC	Non detection	Non detection
Total Coliforms	0 CFU/100mL	MAC	Non detection	Non detection
Electrical Conductivity	--	--	1,750 µS/cm	1,750 µS/cm
pH	6.5 – 8.5	OG	8.03	8.20
Total Hardness (as $CaCO_3$)	80 – 100 mg/L	OG	97.7 mg/L	98.8 mg/L
Total Dissolved Solids	500 mg/L	AO	**832 mg/L**	**828 mg/L**
Total Suspended Solids	--	--	<10 mg/L	<10 mg/L
Alkalinity (as $CaCO_3$)	30 – 500 mg/L	OG	188 mg/L	199 mg/L
Fluoride	1.5	MAC	0.76 mg/L	0.98 mg/L
Chloride	250	AO	**498 mg/L**	**456 mg/L**
Nitrate as N	10	MAC	<0.05 mg/L	<0.05 mg/L

Nitrite as N	1	MAC	<0.05 mg/L	0.12 mg/L
Bromide	--	--	<0.05 mg/L	<0.05 mg/L
Sulphate	500 mg/L	AO	<0.10 mg/L	<1.0 mg/L
Ammonia as N	--	--	0.30 mg/L	0.34 mg/L
Dissolved Organic Carbon	5 mg/L	AO	1.9 mg/L	4.7 mg/L
Colour	5 TCU	AO	**8 TCU**	**15 TCU**
Turbidity	5 NTU	AO	2.3 NTU	1.2 NTU
Calcium	--	--	23.0 mg/L	23.3 mg/L
Magnesium	--	--	9.78 mg/L	10.1 mg/L
Sodium	200 mg/L	AO	**295 mg/L**	**309 mg/L**
Potassium	--	--	2.63 mg/L	2.68 mg/L
Iron	0.300 mg/L	AO	0.220 mg/L	0.200 mg/L
Manganese	0.050 mg/L	AO	0.006 mg/L	0.007 mg/L

NOTE: MAC – maximum acceptable concentration (health-related); AO – Aesthetic Objective (non health-related); Operational Guideline (non health-related)

Sample collection during our 14-September-2017 site visit was completed using a valve installed adjacent to the well pump and upstream of the water treatment system in the basement of the [redacted] residence. Prior to sampling, the faucet was permitted to flush for a period of approximately thirteen (13) minutes with the pumped water being directed to a nearby sump hole. Following completion of sampling, a brief flow test also was completed by AECOM using a hose faucet within the garage of the residence and garden hose over an approximate 10 minute pumping duration. Periodic measurements obtained by AECOM during the flow test indicated an average water discharge rate (post filtration) of approximately 24 L/min (6.3 USgpm). No detectable changes in the quality of the water discharge stream (eg. colour, odour, sediment, etc.) were identified either during flushing / sample collection or subsequent flow rate testing activities. Intermittent gas content was observed within the discharge water stream; however this is common to the area. Flow rate testing at the point of sampling (prior to filtration) was not completed due to high discharge velocities resulting from a narrow diameter discharge hose that was installed at that location.

No exceedances of health-related parameters analyzed, including Escherichia coli and Total Coliform bacteria, Nitrate (as N), Nitrite (as N), and Fluoride, were detected either in the baseline or complaint investigation raw (untreated) groundwater samples collected from the existing on-site well supply.

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 2.3 NTU in the baseline sample and 1.2 NTU during the recent well interference complaint site visit. Both values are within ODWQS limits.

Total suspended solids (TSS) levels within both the baseline and complaint investigation raw groundwater samples were below laboratory method detection limits indicating a relative absence of detectable sediment 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 impacts associated with pile driving is both time-dependent and related to the intensity and propagation of ground-borne vibration. In the case of piling associated with T3 and T4 within two (2) weeks prior to the reported outset of well impacts (25-August-2017), no significant vibrations attributed to pile driving were detected either in close proximity to the work area, nor at Well 11 or Well 12, as discussed previously in **Section 3**.

According to questionnaire responses provided by the property owners (**Table 2**) during our recent well interference complaint site visit, the outset of water quality issues was first detected on 25-August-2017, approximately two (2) weeks prior to receipt of a well interference complaint by MOECC. The reported date of outset of well impact was two (2) days following the completion of pile driving at T3 and on the day of completion of pile driving at T4. During active pile driving at each of T3 and T4 between 22-August-2015 and 25-August-2017, minimal daily PPV values were detected by GAL based on their monitoring in close proximity to the individual pile locations, as well as at Well 11 and Well 12. Based on GAL's monitoring data and considering the separation distance which exists between T3 / T4 and the site well (ie. >690 m), the suspension of particles within or in its immediate vicinity is not considered plausible.

As an alternate consideration, to have the potential to impact the subject well vibration impacts in the immediate vicinity of pile driving at T3 and/or T4 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 location of T3 / T4. 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), vibration monitoring data collected by GAL, and recent sampling 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 quality issue reported by the property owners at [redacted] (PIN 007530061) is *not* as a result of NKW1 turbine foundation construction or pile-driving activities. No indication of water quality impact at the site well was apparent based on our recent sampling relative to baseline data collected prior to the outset of construction.

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: Friday, September 08, 2017 12:09 PM
To: zzJoshua Vaidhyan; Jody Law; mark.vanderwoerd@aecom.com
Cc: Harman, Bruce (MOECC); Smith, Mark (MOECC); Gilbert, Teri (MOECC); Lehouillier, Jason (MOECC); Moroney, Michael (MOECC); Keyvani, Mohsen (MOECC); Colella, Nick (MOECC); Schofield, Carine (MOECC); Lannin, Teresa (MOECC); Ubovic, Miroslav (MOECC)
Subject: [redacted] complaint update and New [redacted] Complaint

Hello Josh / Jody,

The Ministry has made arrangements to conduct a site visit at the home of << Propery Owner Information Redacted >>.

We have also received a **new complaint from** [redacted] **Line**. We have received permission from [redacted] to pass on his contact information to you.

[redacted] contacted us yesterday, but we did not have a chance to speak with him until today. He indicated that he first noticed "black specks" and cloudiness in his well water on August 25th.

It is the Ministry's expectation that Samsung / Pattern will implement the complaint response procedure (condition G5 in your REA) forthwith.

The Ministry is also requesting that the distances from the complainants home to the nearest pile driving and the related pile driving schedules for those sites be summarized and provided to us at your earliest convenience.

The Ministry anticipates visiting [redacted] on Monday, Sept 11 at approx. 11:30am

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

Attachment B

Vibration Monitoring Data (Golder Associates Ltd.)

November 21, 2017 Project No. 1668031-2000-L16R

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

WATER WELL COMPLAINT 8
NORTH KENT WIND 1 PROJECT
CHATHAM-KENT, ONTARIO

Dear Mr. Law:

This letter is provided to summarize vibration monitoring data associated with Well Complaint 8 dated September 8, 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 prior to the date on which the owner first reported well issues of August 25, 2017, through to one day after.

Table 1 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.

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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.

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) at Well 12.

Details of the well at [redacted] were not available. It was reported by AECOM (October 5, 2017) that the well casing was buried and inaccessible for viewing.

Since the location of the well complaint residence is closer to the pile driving at one of the turbine locations 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 monitored 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 0.030 to 0.003 mm/s, respectively. 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.

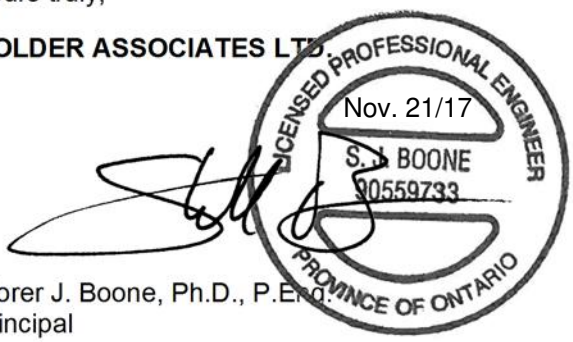
Based on the data available to-date from the test pile and construction monitoring programs, pile-induced vibrations at the [redacted] well would be expected to be one or more orders of magnitude less than vibrations induced by typical pumping systems in the area, less than vibrations associated with vehicles operating

near the wells and less than the International Standards Organization (ISO) threshold for human perception of steady-state vibrations at frequencies greater than 8 Hz (0.1 mm/s). It is our opinion, based on vibration measurements, that the vibration magnitudes during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at these well sites, 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

Attachments: Table 1 - Summary of Vibration Monitoring Data, Well Complaint 8

n:\active\2016\3 proj\1668031 pattern_north kent vib monit_chatham-kent\ph 2000-vib monit field work\2-correspondence\3-ltrs\l16\1668031-2000-l16r nov 21 17 water well complaint 8.docx

Table 1: Summary of Vibration Monitoring Data, Well Complaint 8[1]

Date	Turbine and Piles[4]	Measured Maximum Particle Velocities During Pile Driving, Inclusive of Traffic and Other Activities, Exclusive of Pump-Induced Vibrations (mm/s)[2]				Distance from Well Complaint Residence (m)
		Turbine Site	Monitored Well (Well No., distance)	Monitored Well (Well No., distance)	Other Notes[3]	
Complaint 8 August 25, 2017						
8/24/2017	T4 (13)	4.32	0.030 (W11, 1,424 m)	0.056 (W12, 1,072 m)		740
	T45 (12)	3.30	0.026 (W11, 1,223 m)	0.061 (W12, 1,635 m)		2,405
8/25/2017	T4 (5)	2.54	0.028 (W11, 1,424 m)	0.018 (W12, 1,072 m)		740
	T45 (15)	5.97	0.028 (W11, 1,223 m)	0.037 (W12, 1,635 m)	15 restrikes	2,405
8/26/2017	*No Pile Driving*					

NOTES:
1) Table shall be read in conjunction with accompanying letter.
2) Other activities included nearby car and truck traffic on adjacent road, vehicles entering and leaving the property, farm equipment travel near the well, etc.
3) See letter text for discussion of pump and other influences.
4) Number of piles driven on specified date shown in parentheses.

September 20, 2017 Project No. 1668031-2000-L06

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 PILE DRIVING – MULTIPLE TURBINES
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 being constructed as part of the North Kent Wind 1 project (NK1) at the locations listed in Table 1 (following the text of this letter) through to September 12, 2017, exclusive of data for Turbines T26 and T27 as these are still being processed and analyzed. 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 and issued June 9, 2017.

This report addresses vibration monitoring data obtained during pile foundation driving at the turbine sites and domestic water well pairs listed in Table 1, attached, as defined by the times and dates for pile driving within the seven geographic turbine clusters. The locations of the turbines and associated wells are illustrated on the attached figures. The attached pages of summary data and notes include particle velocity measurements made at the referenced sites that were taken in close proximity to the pile driving together with measurements obtained at domestic water well casings associated with the relevant turbine clusters. Previously issued summary pages have been updated to reflect changes, if and as applicable, related to:

- detailed review of Instantel Minimate data histogram files for the turbine sites;
- well and turbine site vibration monitoring data associated with pile dynamic analyser testing, subsequent pile restrikes or replacements;
- monitoring of vibrations during well pump operating periods in the absence of pile driving;

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- examination of vibration data associated with background conditions, other transient vibration sources (e.g., road traffic, movement of farm equipment, pump maintenance) and/or time durations during which pile driving was not actively in progress;
- clarifications or additions to pile driving monitoring notes; and
- typographical/clerical corrections, if and as needed.

The vibration measurements as reported on the attached pages are considered finalized for the analysis time periods, stated conditions and the context of this report. Golder reserves the right to update reports for the various turbine sites and wells as additional information becomes available and to address any of the items noted above. In particular, additional evaluation of turbine site geophone data is anticipated whereby actual off-set distances and vibration measurements at specific piles and times of day may be updated rather than the current listing of daily maximum measurements. A finalized report will be issued after the conclusion of all pile driving for this project.

Monitoring Work Plan

Vibration monitoring was carried out in accordance with the June 2, 2017 work plan submitted to and approved by the MOECC and reissued on June 9, 2017. In summary, key elements of the work plan include:

- Pile driving at the turbine sites is visually monitored by a Golder staff member who keeps notes regarding start and stop times of active pile hammering, monitoring data logging and instrument status and other site conditions as relevant to the pile driving. Ground surface vibrations at each turbine site are being monitored with two Instantel Minimate Pro III or Pro IV systems. Two systems are being utilized to allow periodic downloading of data so that vibrations, if any, could then be captured by the other redundant system. The geophone systems captured vibration velocities in three mutually perpendicular directions. One direction was vertical and the longitudinal direction was oriented toward the closest pile with the third (transverse) direction being determined by the other two.
- Three accelerometers are being securely coupled to the monitored well casings for which permissions to enter and carry out monitoring have been obtained. The accelerometers are oriented in three mutually perpendicular directions. One direction is vertical and the longitudinal direction is oriented toward the closest pile driving operation, with the third (transverse) direction being determined by the other two. Golder personnel monitor the instrument status and any other relevant activities around the wells such as local road traffic, movements of farm equipment, traffic in and out of the well properties, other construction activities (if any) and well pump operations or maintenance.

Overview of Pile Driving Conditions and Monitoring Notes

Pile driving at the turbine sites was conducted after constructing an access road, stripping topsoil, excavating to approximately 2.6 m below the ground surface and placing a concrete working pad. The concrete working pads have been fitted with pre-formed openings for the piles or constructed to a smaller diameter with the piles driven just beyond the outer perimeter of the concrete. Pile driving cranes were operated on timber mats placed on the concrete. Typically, piles were driven with the same hammer type as used for the pre-construction test pile and vibration monitoring program. In one case, a different hammer was used with a significantly lower driving energy. Subsequent use of this hammer has been rejected by the constructor.

On the attached monitoring reports, three times are reported for each driven pile. The column heading “Start” refers to the time of day when the pile hammering commenced on the indicated pile. Times of other site activities, such as crane movements, welding, equipment start-up and other work occurring prior to start of active pile hammering were not recorded except in specific instances where the turbine site geophones were inadvertently influenced by other equipment operating too closely. The column heading “Rock/Till” indicates the time at which hard driving started, as evidenced by the rate of pile depth change as compared to the numbers of hammer strikes on the pile. Commonly, the piles penetrated the first few metres of ground under their own weight, with nominal pile driving effort required until the underlying glacial till and/or rock was encountered. In many cases, the pile driving resistance in the upper soil layers was insufficient to engage the firing mechanism in the diesel hammer. Upon reaching the glacial till, the pile hammer fully engaged for the remainder of driving. The column heading “End” indicates the time of day at which active pile hammering ceased for the identified pile. While the total pile driving duration can be determined by the difference between the “Start” and “End” times, the duration of active pile hammering was frequently interrupted by pile splicing, welding, equipment repair, decision-making required for pile termination depths, pile testing and daily labour breaks. Many of these start and stop instances are identified on the attached summary pages.

Summary of Results

In summary, vibration measurements obtained with the geophone system (Instantel Minimate) on all sites reported herein were within expectations as compared to those measured at the T5 and T42 test pile sites and general project expectations. On sites where piles penetrated through the near-surface soils under their own weight or a low number of hammer blows (e.g., less than 5) the ground surface vibrations during this phase of pile driving for each pile were nominal. Ground surface vibrations measured when driving the piles on the glacial till or rock were also either comparable to or less than those at the test pile sites and, in all cases, were within expectations. Vibration measurements made using the accelerometers mounted on the well casings were also within expectations based on the T5 and T42 test pile sites and turbine to well distances.

Well monitoring to-date has identified several wells for which the vibrations induced by the pumps dominated the instrument readings when the pumps were active or other activities dominated the measured vibrations. Relevant notes regarding various pumps, their operation and other influences on vibration measurements are described below:

- **Well 3:** Activities at the Well 3 property included crop harvesting, movement of farm vehicles and loading of haul trucks in relatively close proximity to Well 3.
- **Well 4:** Maximum well casing vibration velocities for Well 4 of about 4.8 mm/s were recorded on September 6, 2017 when a well pump was connected, operated and adjusted and the owner made frequent return visits to the well shed. Crop harvesting was also carried out as close as about 25 m from the well casing.
- **Well 6:** The pump for Well 6 is mounted in close proximity to the well casing (as illustrated on the attached Photograph 1). Maximum particle velocities of as much as 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. The influences of the pump were readily discernable in the monitoring data. Approximately 1 minute after driving of Pile 1 for turbine T12 concluded, a loaded tractor-trailer dump truck drove by on the road near Well 6 and, at the same time, the resident was hammering in a nearby shed. Vibrations associated with the loaded dump truck were also perceptible by our well monitoring staff and registered at about 2.8 mm/s.

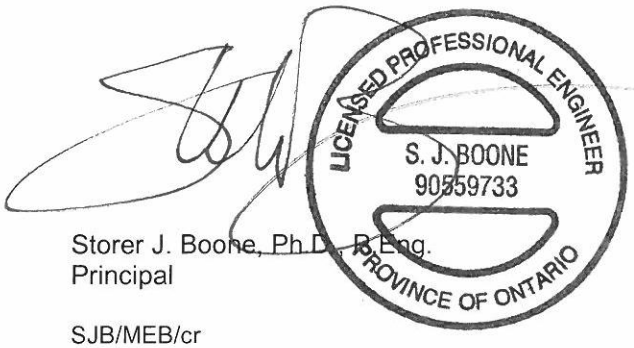
- **Well 9:** A piston pump for Well 9 is located within the barn adjacent to the Well 9 casing location, a total distance (inside and outside) of about 3 to 4 m. During pile driving for turbines T28 and T32, on August 11, 2017, other work was occurring near Well 9. This work included construction along the access road leading to the T32 site and included movement of heavy equipment, excavator operations, dump truck traffic, discharge of stone from delivery vehicles and other activities. This surface construction work was as close as 100 m to Well 9. Additionally, Well 9 is approximately 74 m from Countryview Line that experiences significant traffic. Traffic included loaded construction equipment, buses, fuel tanker trucks and other vehicles. Golder conducted a separate monitoring event at this well on September 8, 2017 to measure the influence of the pump on well casing vibrations in the absence of pile driving. Maximum measured casing vibrations during this test were about 1.2 mm/s. Measurements at Well 9 on dates other than August 11, 2017 are consistent with expectations based on local traffic volumes and the potential influence of the adjacent piston pump.
- **Well 10:** Well 10 exhibited maximum vibrations of about 1.25 mm/s during pump operation. The influence of pump operations were clearly discernable in the vibration monitoring data. The proximity of the pump and well casing are illustrated in the attached Photograph 2.
- **Well 11:** Vibrations of the casing at Well 11 were measured during water quality sampling on August 17, 2017 in the absence of pile driving at any location. When the pump was operating, a maximum vibration magnitude of 0.016 mm/s was measured at this well. The pump is located within the residence and approximately 40 m from the well.
- **Well 12:** During pile driving, Well 12 operated on a number of clearly definable occasions. Maximum vibration measurements of pump-induced well casing vibrations were as much as 2.4 mm/s. The pump for Well 12 is a piston pump mounted directly on top of the well casing as illustrated in the attached Photograph 3.
- **Well 13:** Well 13 is located approximately 87 m from the centreline of Union Line which is subjected to local truck traffic. Review of the data indicates that well pumping and non-pile driving transient sources influenced the results at this location. Additional evaluation of transient, non-pile driving data is on-going and a specific monitoring period for well pump operation is being planned for a time without pile driving.
- **Well 14:** Well 14 is located approximately 13 m from the centreline of Union Line which is subjected to local truck traffic. A limited evaluation of transient traffic vibrations indicated well casing velocities of at least 0.079 mm/s associated with this cause, though inspection of the data indicates higher values occurred outside of pile driving times. Additional evaluation of transient, non-pile driving data is on-going and a specific monitoring period for well pump operation is being planned for a time without pile driving.

In summary, measured vibrations have been evaluated and reported as associated with driving 329 piles and replacement piles on the glacial till/rock along with restrike events and pile dynamic testing events. These measurements have been obtained at the turbine sites and at wells located at distances ranging from 580 to 4,359 m from the turbine sites. It is our opinion, based on these measurements, that the vibration magnitudes at all wells during pile driving were within expectations, no greater than may be induced by other common day-to-day sources at these well sites, less than the observed and measured influence of well pumps 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: Table 1 - Vibration Measurement Locations
Photographs of Wells 6, 10 and 12 Pump Configurations
Preliminary Vibration Monitoring Summaries and Figures, Turbines T3, T4, T6, T7, T12, T14, T20, T21, T28, T30, T31, T32, T33, T35, T36, T43, T45 and T46

n:\active\2016\3 proj\1668031 pattern_north kent vib monit_chatham-kent\ph 2000-vib monit field work\2-correspondence\3-ltrs\l06\1668031-2000-l06 sep 20 17 summary of vibration monitoring.docx

TABLE 1 – VIBRATION MEASUREMENT LOCATIONS

Turbine	Well	Well
Turbine Cluster 1		
T12	5 ([redacted])	6 ([redacted])
T35		
T36		
Turbine Cluster 2		
T6	7 ([redacted])	8 ([redacted])
T7		
T31		
Turbine Cluster 3		
T28	9 ([redacted])	10 ([redacted])
T30		
T32		
Turbine Cluster 4		
T3	11 ([redacted])	12 [redacted]
T4		
T20		
T21		
T43		
T45		
T46		
Turbine Cluster 5		
T33	3 ([redacted])	4 ([redacted])
Turbine Cluster 6		
T14	13 ([redacted])	14 ([redacted])
T26		
T27		
Turbine Cluster 7		
No construction pile driving to date of this report	1A ([redacted])	2 ([redacted])

Note: Table to be read in conjunction with accompanying text.

Prepared By: SJB

Checked By: DB

SITE PHOTOGRAPHS



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



Photograph 2: Well 10 illustrating proximity of pump, hoses and tank to well casing.



Photograph 3: Well 12 illustrating pump mounted directly on well casing.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T3

	Pile Driving Times and Dates			Vibration Measurements at Turbine Site		Vibration Measurements at Wells		
					Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/23/2017 10:01	8/23/2017 10:10	8/23/2017 10:11	21.6	7.27	NA[e]	0.021	
2	8/23/2017 11:29	8/23/2017 11:35	8/23/2017 12:35	23.2	7.27	0.011	0.003	
3	8/23/2017 11:46	8/23/2017 11:56	8/23/2017 12:41	24.2	7.27	0.024	0.013	
4	8/23/2017 12:12	8/23/2017 12:19	8/23/2017 12:21	24.5	7.27	0.014	0.010	
5	8/23/2017 9:43	8/23/2017 9:49	8/23/2017 9:52	24.2	7.27	NA[e]	0.010	
6	8/23/2017 9:28	8/23/2017 9:35	8/23/2017 9:35	23.2	7.27	NA[e]	0.004	
7	8/22/2017 12:16	8/22/2017 12:22	8/22/2017 12:57	21.6	8.26	0.015	0.016	
8	8/22/2017 18:43	8/22/2017 18:49	8/22/2017 18:54	19.4	8.26	0.013	0.004	
9	8/22/2017 16:52	8/22/2017 16:58	8/22/2017 17:00	16.8	8.26	0.018	0.011	
10	8/22/2017 18:19	8/22/2017 18:27	8/22/2017 18:32	13.9	8.26	0.014	0.008	
11	8/22/2017 16:34	8/22/2017 16:40	8/22/2017 16:45	11.0	8.26	0.022	0.025	
12	8/22/2017 17:48	8/22/2017 17:57	8/22/2017 18:08	8.7	8.26	0.011	0.003	
13	8/22/2017 16:08	8/22/2017 16:16	8/22/2017 16:18	7.7	8.26	0.007	0.029	
14	8/22/2017 17:29	8/22/2017 17:38	8/22/2017 17:39	8.7	8.26	0.012	0.013	
15	8/22/2017 14:27	8/22/2017 14:33	8/22/2017 15:41	11.0	8.26	0.066	0.008	
16	8/22/2017 17:13	8/22/2017 17:20	8/22/2017 17:20	13.9	8.26	0.026	0.005	
17	8/22/2017 13:14	8/22/2017 13:22	8/22/2017 15:48	16.8	8.26	0.046	0.008	
18	8/23/2017 11:05	8/23/2017 11:12	8/23/2017 11:16	19.4	7.27	0.018	0.014	
Restrikes								
7C	8/23/2017 18:27	8/23/2017 18:27	8/23/2017 18:31	21.6	7.27	0.023	1.354	0.022
8C	8/23/2017 8:14	8/23/2017 8:14	8/23/2017 8:14	19.4	7.27	0.010	0.004	
11C	8/23/2017 8:18	8/23/2017 8:18	8/23/2017 8:18	11.0	7.27	0.009	2.405	0.006
12C	8/23/2017 8:22	8/23/2017 8:22	8/23/2017 8:22	8.7	7.27	0.009	2.405	0.006
13C	8/23/2017 8:25	8/23/2017 8:26	8/23/2017 8:26	7.7	7.27	0.009	0.007	
14C	8/23/2017 8:28	8/23/2017 8:28	8/23/2017 8:28	8.7	7.27	0.007	0.007	
16C	8/23/2017 8:31	8/23/2017 8:31	8/23/2017 8:32	13.9	7.27	0.007	0.007	
17C	8/23/2017 8:34	8/23/2017 8:34	8/23/2017 8:34	16.8	7.27	0.007	0.007	
6	8/23/2017 12:14	8/23/2017 12:15	8/23/2017 12:15	23.2	7.27	0.025	0.023	
Replacement Piles								
7A	9/6/2017 12:05	9/6/2017 12:14	9/6/2017 12:19	20.6	1.99	0.033	0.005	

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 1707 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 1264 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 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Continued pile driving on subsequent days are marked "C". Replacement piles are marked "A". Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. Maximum vibration measurements for Well 11 were 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. Maximum vibration measurements for Well 12 were 0.896 mm/s and this pump was mounted on the well casing. During pile driving on August 23, 2017, the maximum vibration measurement of the Well 12 casing was 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Data not available for Piles 1, 5 and 6 at Well 11 on August 23, 2017 due to battery failure in monitoring equipment. Battery was subsequently replaced. Driving/restriking of some piles occured in relatively rapid succession and, therefore, in some cases the vibration measurement data for the 10 minute periods of analysis are applicable to multiple piles. Where total driving duration between till/rock start and end times noted above is not representative, actual driving duration is shown in parentheses in minutes and seconds: 2(6:42), 3(5:13), 7(8:45), 12(7:08), 15(1:20), 17(1:42). Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Footnotes: a) start and end of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T4

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[c]
1	8/25/2017 8:00	8/25/2017 8:08	8/25/2017 8:09	23.9	2.54	0.004	0.006	
2	8/25/2017 8:30	8/25/2017 9:15	8/25/2017 9:16	25.6	2.54	0.006	2.335	0.008
3	8/25/2017 9:03	8/25/2017 9:09	8/25/2017 9:10	26.6	2.54	0.007	2.335	0.008
4	8/25/2017 8:47	8/25/2017 8:56	8/25/2017 8:57	27.0	2.54	0.005	0.011	
5	8/25/2017 8:15	8/25/2017 8:22	8/25/2017 8:23	26.6	2.54	0.028	0.018	
6	8/24/2017 13:01	8/24/2017 13:10	8/24/2017 13:11	25.6	4.32	0.011	0.056	
7	8/24/2017 9:56	8/24/2017 10:04	8/24/2017 10:51	23.9	4.32	0.018	1.511	0.024
8	8/24/2017 13:19	8/24/2017 15:13	8/24/2017 15:14	21.6	4.32	0.024	1.777	0.014
9	8/24/2017 10:56	8/24/2017 11:04	8/24/2017 11:04	19.0	4.32	0.006	0.004	
10	8/24/2017 13:35	8/24/2017 13:45	8/24/2017 13:45	16.1	4.32	0.006	0.018	
11	8/24/2017 11:10	8/24/2017 11:18	8/24/2017 11:18	13.2	4.32	0.013	0.026	
12	8/24/2017 13:52	8/24/2017 15:09	8/24/2017 15:10	11.0	4.32	0.024	1.777	0.014
13	8/24/2017 11:23	8/24/2017 11:32	8/24/2017 11:33	10.1	4.32	0.009	0.009	
14	8/24/2017 14:07	8/24/2017 14:17	8/24/2017 14:17	11.0	4.32	0.007	0.006	
15	8/24/2017 11:38	8/24/2017 15:03	8/24/2017 15:04	13.2	4.32	0.009	1.374	0.028
16	8/24/2017 14:24	8/24/2017 14:33	8/24/2017 15:01	16.1	4.32	0.009	1.374	0.028
17	8/24/2017 12:46	8/24/2017 14:55	8/24/2017 14:56	19.0	4.32	0.030	1.374	0.028
18	8/24/2017 14:40	8/24/2017 14:52	8/24/2017 14:52	21.6	4.32	0.030	0.029	

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 1424 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 1072 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 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. Maximum vibration measurements for Well 11 were 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. Maximum vibration measurements for Well 12 were 0.896 mm/s and this pump was mounted on the well casing. During pile driving on August 24, 2017, the maximum vibration measurement of the Well 12 casing was 1.777 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Note that driving of some piles was paused while the tip was in the upper soil deposits and subsequently driven to the glacial till/rock later in the day. In these instances, the hard driving conditions for different piles occured in relatively rapid succession and, therefore, the vibration measurement data for the 10 minute periods of analysis are applicable to multiple piles. Where total driving duration between till/rock start and end times noted above is not representative, actual driving duration is shown in parentheses in minutes and seconds: 2(7:33), 7(1:32), 8(0:53), 12(1:10), 15(1:15), 16(1:02), 17(1:31). Total driving durations derived from start and end times noted above include labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T6

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells	
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]	
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 7	Well 8
1	7/31/2017 11:25	7/31/2017 11:28	7/31/2017 11:32	27.0	4.57	0.068	0.049
2	7/31/2017 12:20	7/31/2017 12:26	7/31/2017 12:28	26.6	4.57	0.044	0.032
3	7/31/2017 12:37	7/31/2017 12:41	7/31/2017 12:46	25.6	4.57	0.018	0.028
4	7/31/2017 13:35	7/31/2017 13:40	7/31/2017 13:46	23.9	4.57	0.066	0.011
5	7/31/2017 13:18	7/31/2017 13:23	7/31/2017 13:28	21.6	4.57	0.017	0.010
6	7/31/2017 12:59	7/31/2017 13:05	7/31/2017 13:07	19.0	4.57	0.012	0.033
7	7/31/2017 7:33	7/31/2017 7:37	7/31/2017 7:42	16.1	4.57	0.050	0.050
8	7/31/2017 7:53	7/31/2017 7:56	7/31/2017 8:03	13.2	4.57	0.127	0.070
9	7/31/2017 8:14	7/31/2017 8:18	7/31/2017 8:22	11.0	4.57	0.051	0.015
10	7/31/2017 8:31	7/31/2017 8:37	7/31/2017 8:41	10.1	4.57	0.025	0.058
11	7/31/2017 8:48	7/31/2017 8:51	7/31/2017 8:53	11.0	4.57	0.035	0.012
12	7/31/2017 9:02	7/31/2017 9:07	7/31/2017 9:12	13.2	4.57	0.058	0.023
13	7/31/2017 9:21	7/31/2017 9:25	7/31/2017 9:33	16.1	4.57	0.118	0.005
14	7/31/2017 9:42	7/31/2017 9:47	7/31/2017 9:50	19.0	4.57	0.082	0.007
15	7/31/2017 10:21	7/31/2017 10:24	7/31/2017 10:29	21.6	4.57	0.039	0.032
16	7/31/2017 10:36	7/31/2017 10:40	7/31/2017 10:43	23.9	4.57	0.010	0.014
17	7/31/2017 10:51	7/31/2017 10:54	7/31/2017 10:58	25.6	4.57	0.040	0.057
18	7/31/2017 11:09	7/31/2017 11:13	7/31/2017 11:17	26.6	4.57	0.024	0.071

Well Information

Well No.: 7
Municipal Address: [redacted]
Distance from Turbine Centre: 1049 m

Well No.: 8
Municipal Address: [redacted]
Distance from Turbine Centre: 872 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 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Well monitoring undertaken during periods of time on these same days when pile driving was not occuring measured maximum particle velocities of as much as 0.37 mm/s (Well 7). Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T7

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells	
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]	
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 7	Well 8
1	7/27/2017 17:57	7/27/2017 18:03	7/27/2017 18:04	27.0	5.97	0.030	0.011
2	7/27/2017 18:31	7/27/2017 18:36	7/27/2017 18:36	26.6	5.97	0.063	0.013
3	7/28/2017 8:11	7/28/2017 8:16	7/28/2017 8:16	25.6	2.16	0.019	0.022
4	7/28/2017 8:37	7/28/2017 8:43	7/28/2017 8:44	23.9	2.16	0.035	0.045
5	7/27/2017 18:11	7/27/2017 18:17	7/27/2017 18:18	21.6	5.97	0.017	0.012
6	7/27/2017 15:27	7/27/2017 15:32	7/27/2017 15:33	19.0	5.97	0.019	0.028
7	7/27/2017 15:10	7/27/2017 15:15	7/27/2017 15:16	16.1	5.97	0.026	0.028
8	7/27/2017 14:30	7/27/2017 14:36	7/27/2017 14:37	13.2	5.97	0.017	0.027
9	7/27/2017 14:10	7/27/2017 14:16	7/27/2017 14:18	11.0	5.97	0.011	0.031
10	7/27/2017 13:55	7/27/2017 14:00	7/27/2017 14:01	10.1	5.97	0.030	0.012
11	7/27/2017 13:42	7/27/2017 13:46	7/27/2017 13:47	11.0	5.97	0.025	0.042
12	7/27/2017 13:09	7/27/2017 13:13	7/27/2017 13:23	13.2	5.97	0.019	0.035
13	7/27/2017 12:21	7/27/2017 12:34	7/27/2017 12:53	16.1	5.97	0.030	0.049
14	7/27/2017 15:42	7/27/2017 15:51	7/27/2017 15:54	19.0	5.97	0.026	0.039
15	7/27/2017 16:06	7/27/2017 16:12	7/27/2017 16:13	21.6	5.97	0.032	0.021
16	7/27/2017 16:34	7/27/2017 16:44	7/27/2017 16:45	23.9	5.97	0.010	0.066
17	7/27/2017 16:55	7/27/2017 17:01	7/27/2017 17:02	25.6	5.97	0.069	0.030
18	7/27/2017 17:17	7/27/2017 17:25	7/27/2017 17:26	26.6	5.97	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 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Well monitoring undertaken during periods of time on these same days when pile driving was not occuring measured maximum particle velocities of as much as 0.073 mm/s. Total driving duration between till/rock start and end times noted above for Pile 13 is not representative and actual driving duration was 00:1:45 due to pauses in actual hammering. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T12

	Pile Driving Times and Dates			Vibration Measurements at Turbine Site		Vibration Measurements at Wells		
					Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 5	Well 6	No Pump[e]
1	7/5/2017 12:33	7/5/2017 12:46	7/5/2017 12:47	27.5	5.97	0.008	0.044	See Notes
2	7/5/2017 15:47	7/5/2017 16:01	7/5/2017 16:01	27.8	5.97	0.001	0.106	
3	7/6/2017 8:08	7/6/2017 8:19	7/6/2017 8:20	27.5	4.32	0.010	0.775	
4	7/6/2017 7:47	7/6/2017 7:58	7/6/2017 7:59	26.4	4.32	0.002	0.048	
5	7/5/2017 12:57	7/5/2017 13:26	7/5/2017 13:27	24.7	5.97	0.002	0.729	
6	7/5/2017 14:11	7/5/2017 14:22	7/5/2017 14:23	22.5	5.97	0.002	0.298	
7	7/4/2017 14:48	7/4/2017 14:57	7/4/2017 14:58	19.8	5.97	0.002	0.026	
8	7/5/2017 11:38	7/5/2017 11:49	7/5/2017 11:50	16.8	5.97	0.008	0.030	
9	7/4/2017 9:26	7/4/2017 9:58	7/4/2017 10:00	14.0	9.91	0.011	0.246	0.014
10	7/5/2017 11:11	7/5/2017 11:25	7/5/2017 11:26	11.8	5.97	0.002	0.047	0.014
11	6/30/2017 12:03	6/30/2017 13:47	6/30/2017 13:54	11.0	11.20	0.004	0.755	
12	7/4/2017 15:15	7/4/2017 15:25	7/4/2017 15:25	11.8	9.91	0.002	0.179	
13	7/4/2017 11:22	7/4/2017 11:33	7/4/2017 11:34	14.0	9.91	0.002	0.066	
14	7/4/2017 15:47	7/4/2017 15:58	7/4/2017 15:58	16.8	9.91	0.069	0.037	
15	7/4/2017 11:55	7/4/2017 12:06	7/4/2017 12:07	19.8	9.91	0.003	0.023	
16	7/4/2017 16:35	7/4/2017 16:47	7/4/2017 16:47	22.5	9.91	0.004	0.155	
17	7/4/2017 13:01	7/4/2017 13:14	7/4/2017 13:20	24.7	9.91	0.007	0.085	
18	7/4/2017 15:08	7/4/2017 15:27	7/4/2017 15:28	26.4	9.91	0.002	0.729	
Restrikes								
7	7/5/2017 8:42	7/5/2017 8:42	7/5/2017 8:42	19.8	5.97	0.007	0.647	0.027
9	7/5/2017 8:47	7/5/2017 8:47	7/5/2017 8:48	14.0	5.97	0.007	0.634	0.027
11	7/5/2017 8:51	7/5/2017 8:51	7/5/2017 8:52	11.0	5.97	0.007	0.634	0.032
12	7/5/2017 8:57	7/5/2017 8:57	7/5/2017 8:58	11.8	5.97	0.003	0.624	
13	7/5/2017 9:02	7/5/2017 9:02	7/5/2017 9:03	14.0	5.97	0.008	0.662	
14	7/5/2017 9:09	7/5/2017 9:09	7/5/2017 9:10	16.8	5.97	0.008	0.624	
15	7/5/2017 9:13	7/5/2017 9:13	7/5/2017 9:14	19.8	5.97	0.003	0.546	0.057
16	7/5/2017 9:17	7/5/2017 9:17	7/5/2017 9:19	22.5	5.97	0.002	0.546	0.057
17	7/5/2017 9:22	7/5/2017 9:22	7/5/2017 9:23	26.4	5.97	0.002	0.546	0.057

Well Information

Well No.: 5
Municipal Address: [redacted]
Distance from Turbine Centre: 3346 m

Well No.: 6
Municipal Address: [redacted]
Distance from Turbine Centre: 3368 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 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". On July 5, 2017, approximately 1 minute after pile driving stopped for Pile 1, the well monitoring personnel at Well 6 observed a loaded tractor/trailer dump truck drive by the well at 54 m distance and ground vibrations were sensed. At this time, the resident was also hammering on equipment within a nearby (120 m) shed during which it sounded as though a heavy sledge was being used with multiple recoil/hammer falls after each main strike. Vibrations associated with these activities (not separable) registered as 2.8 mm/s, consistent with the perception of vibrations by the well monitoring personnel. Monitoring of deliberate pump operation at Well 6 on July 13, 2017, during a period when no pile driving was occuring, measured maximum particle velocities of 0.08 to 0.8 mm/s. Driving/restriking of some piles occured in relatively rapid succession and, therefore, in some cases the vibration measurement data for the 10 minute periods of analysis are applicable to multiple piles. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time. The driving duration for Pile 11 on June 30, 2017 were unusually long since a small driving hammer was used for this pile. The total duration of driving on till/rock was 7 minutes for this pile.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T14

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 13	Well 14	No Pump[e]
1	9/11/2017 16:01	9/11/2017 16:06	9/11/2017 16:09	18.9	4.95	0.020	0.206	
2	9/11/2017 16:24	9/11/2017 16:29	9/11/2017 16:32	21.0	4.95	0.010	0.056	
3	9/11/2017 15:48	9/11/2017 15:54	9/11/2017 15:56	22.6	4.95	0.017	0.132	
4	9/11/2017 15:33	9/11/2017 15:39	9/11/2017 15:43	23.6	4.95	0.012	0.190	
5	9/11/2017 15:19	9/11/2017 15:24	9/11/2017 15:26	24.0	4.95	0.006	0.064	
6	9/11/2017 15:04	9/11/2017 15:10	9/11/2017 15:13	23.6	4.95	0.005	0.221	
7	9/11/2017 12:33	9/11/2017 12:39	9/11/2017 12:44	22.6	4.95	0.007	0.083	
8	9/11/2017 12:17	9/11/2017 12:25	9/11/2017 12:27	21.0	4.95	0.005	0.338	
9	9/11/2017 11:53	9/11/2017 11:59	9/11/2017 12:02	18.9	4.95	0.114	0.675	
10	9/11/2017 11:36	9/11/2017 11:43	9/11/2017 11:45	16.3	4.95	0.013	0.240	
11	9/11/2017 11:20	9/11/2017 11:25	9/11/2017 11:28	13.5	4.95	0.013	0.168	
12	9/11/2017 10:24	9/11/2017 10:30	9/11/2017 10:34	10.6	4.95	0.428	0.077	0.011
13	9/11/2017 10:07	9/11/2017 10:14	9/11/2017 10:16	8.1	4.95	0.543	0.141	0.008
14	9/11/2017 9:50	9/11/2017 9:56	9/11/2017 10:01	7.1	4.95	0.021	0.102	
15	9/11/2017 9:34	9/11/2017 9:39	9/11/2017 9:42	8.1	4.95	0.004	0.014	
16	9/11/2017 9:17	9/11/2017 9:24	9/11/2017 9:28	10.6	4.95	0.318	0.021	0.007
17	9/11/2017 8:57	9/11/2017 9:03	9/11/2017 9:05	13.5	4.95	0.026	0.070	
18	9/11/2017 8:39	9/11/2017 8:47	9/11/2017 8:49	16.3	4.95	0.007	0.018	

Restrikes

Well Information

Well No.: 13
Municipal Address: [redacted]
Distance from Turbine Centre: 841 m

Well No.: 14
Municipal Address: [redacted]
Distance from Turbine Centre: 580 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: Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time. Well 13 pump vibrations dominated data for periods of 1 to 5 minutes. "No pump" data column indicates vibration velocities exclusive of pump operating times for Well 13. Wells 13 and 14 are located approximately 87 m and 13 m from the centre line of Union Line, respectively. Vibration velocities noted above for both wells reflect maximum values induced by transient sources other than pile driving. Evaluation of acceleration time histories concluded that other transient vibrations occurring before, during and after pile driving times dominated all measurements. Data for two 10-minute time periods during which no pile driving occurred were evaluated with start times of 10:47 and 14:27 for Well 13 and and 10:48 and 14:36 for Well 14 indicated a maximum velocity of 0.079 mm/s. Additional evaluation of pump operations and other transient sources for both wells is pending.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T20

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/30/2017 15:30	8/30/2017 15:33	8/30/2017 15:54	25.0	5.33	0.016	NA[e]	
2	8/30/2017 18:17	8/30/2017 18:21	8/30/2017 18:29	26.0	5.33	0.005	0.008	
3	8/30/2017 18:33	8/30/2017 18:38	8/30/2017 18:45	26.3	5.33	0.003	0.004	
4	8/30/2017 17:55	8/30/2017 17:59	8/30/2017 18:10	26.0	5.33	0.004	0.005	
5	8/30/2017 17:38	8/30/2017 17:37	8/30/2017 17:49	25.0	5.33	0.004	0.855	0.022
6	8/30/2017 17:14	8/30/2017 17:19	8/30/2017 17:31	23.3	5.33	0.004	NA[e]	
7	8/30/2017 16:54	8/30/2017 16:56	8/30/2017 17:09	21.0	5.33	0.003	NA[e]	
8	8/30/2017 16:19	8/30/2017 16:24	8/30/2017 16:53	18.3	5.33	0.046	NA[e]	
9	8/30/2017 16:01	8/30/2017 16:05	8/30/2017 16:12	15.4	5.33	0.005	NA[e]	
10	8/30/2017 11:34	8/30/2017 11:38	8/30/2017 11:50	12.5	5.33	0.005	0.016	
11	8/30/2017 10:26	8/30/2017 10:29	8/30/2017 10:40	9.1	5.33	0.018	0.013	
12	8/30/2017 9:58	8/30/2017 10:02	8/30/2017 10:16	10.1	5.33	0.011	0.014	
13	8/30/2017 9:49	8/30/2017 9:44	8/30/2017 9:50	12.5	5.33	0.010	0.014	
14	8/30/2017 12:02	8/30/2017 12:04	8/30/2017 12:22	15.4	5.33	0.028	0.008	
15	8/30/2017 12:36	8/30/2017 12:39	8/30/2017 12:54	18.3	5.33	0.023	0.006	
16	8/30/2017 13:01	8/30/2017 13:05	8/30/2017 13:20	21.0	5.33	0.004	0.004	
17	8/30/2017 14:26	8/30/2017 14:29	8/30/2017 14:41	23.3	5.33	0.004	0.006	
18	8/30/2017 14:52	8/30/2017 14:56	8/30/2017 15:24	25.0	5.33	0.003	0.025	
Restrikes								
13	8/30/2017 13:23	8/30/2017 13:23	8/30/2017 13:35	12.5	5.33	0.008	0.008	

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 3800 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 3962 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: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. Maximum vibration measurements for Well 11 were 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. Maximum vibration measurements for Well 12 were 0.896 mm/s and the pump was mounted on the well casing. During pile driving on August 23, 2017, the maximum vibration measurement of the Well 12 casing was 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Data not available for Piles 1, 6, 7, 8 and 9 at Well 12 on August 30, 2017 due to battery failure in monitoring equipment. Battery was subsequently replaced. Total driving duration between till/rock start and end times noted above for Pile 1 is not representative and actual driving duration was 00:7:40 due to pauses in actual hammering. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T21

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/29/2017 12:01	8/29/2017 12:04	8/29/2017 12:14	23.7	2.79	NA[e]	0.008	
2	8/29/2017 1:27	8/29/2017 1:30	8/29/2017 1:39	25.4	2.79	0.003	0.006	
3	8/29/2017 1:44	8/29/2017 1:47	8/29/2017 1:54	26.4	2.79	0.009	0.006	
4	8/29/2017 11:20	8/29/2017 11:23	8/29/2017 11:32	26.8	2.79	0.003	0.013	
5	8/29/2017 11:05	8/29/2017 11:08	8/29/2017 11:13	26.4	2.79	NA[e]	0.013	
6	8/29/2017 8:48	8/29/2017 8:51	8/29/2017 8:59	25.4	2.79	NA[e]	0.026	
7	8/29/2017 8:28	8/29/2017 8:33	8/29/2017 8:40	23.7	2.79	NA[e]	0.005	
8	8/29/2017 8:07	8/29/2017 8:11	8/29/2017 8:19	21.5	2.79	NA[e]	0.003	
9	8/29/2017 7:51	8/29/2017 7:54	8/29/2017 7:59	18.8	2.79	0.004	0.004	
10	8/28/2017 16:40	8/28/2017 16:44	8/28/2017 16:53	15.9	3.30	0.015	0.071	
11	8/28/2017 16:11	8/28/2017 16:14	8/28/2017 16:27	13.0	3.30	0.007	1.551	0.039
12	8/28/2017 15:51	8/28/2017 15:58	8/28/2017 16:05	10.8	3.30	0.005	0.007	
13	8/28/2017 14:27	8/28/2017 14:30	8/28/2017 14:37	9.9	3.30	0.003	0.005	
14	8/28/2017 14:10	8/28/2017 14:13	8/28/2017 14:21	10.8	3.30	0.006	0.005	
15	8/28/2017 13:45	8/28/2017 13:48	8/28/2017 13:58	13.0	3.30	0.008	0.013	
16	8/28/2017 13:21	8/28/2017 13:24	8/28/2017 13:37	15.9	3.30	0.006	0.011	
17	8/28/2017 13:01	8/28/2017 13:05	8/28/2017 13:13	18.8	3.30	0.011	0.010	
18	8/29/2017 11:44	8/29/2017 11:47	8/29/2017 11:54	21.5	2.79	NA[e]	0.031	

Restrikes

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 3960 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 4161 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: Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. Maximum vibration measurement for Well 11 was 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. Maximum vibration measurement for Well 12 was 0.896 mm/s and the pump was mounted on the well casing. During pile driving on August 23, 2017, the maximum vibration measurement of the Well 12 casing was 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Data not available for Piles 1, 5, 6, 7, 8 and 18 at Well 11 on August 29, 2017 due to battery failure in monitoring equipment. Battery was subsequently replaced. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T28

Pile No.:	Pile Driving Times and Dates: Start[a]	Rock/Till	End[a]	Vibration Measurements at Turbine Site: Geophone Dist. (m)	Daily Maximum Particle Velocity (mm/s)[b]	Vibration Measurements at Wells: Particle Velocity (mm/s)[c, d] Well 9	Well 10	No Pump[e]
1	8/15/2017 14:33	8/15/2017 14:41	8/15/2017 14:43	21.6	3.17	0.061	0.020	
2	8/15/2017 14:53	8/15/2017 15:04	8/15/2017 15:06	23.9	3.17	0.019	0.036	
3	8/15/2017 15:31	8/15/2017 15:42	8/15/2017 15:44	25.6	3.17	0.111	0.805	0.019
4	8/15/2017 13:23	8/15/2017 13:37	8/15/2017 13:39	26.6	3.17	0.022	0.804	0.100
5	8/15/2017 12:10	8/15/2017 12:22	8/15/2017 12:24	27.0	3.17	0.108	0.158	
6	8/15/2017 11:46	8/15/2017 11:59	8/15/2017 12:00	26.6	3.17	0.012	0.095	
7	8/15/2017 9:56	8/15/2017 10:08	8/15/2017 10:11	25.6	3.17	0.027	0.052	
8	8/15/2017 9:16	8/15/2017 9:34	8/15/2017 9:36	23.9	3.17	0.040	0.009	
9	8/15/2017 8:51	8/15/2017 9:03	8/15/2017 9:04	21.6	3.17	0.046	0.015	
10	8/15/2017 8:18	8/15/2017 8:33	8/15/2017 8:35	19.0	3.17	NA[e]	0.750	0.026
11	8/15/2017 7:45	8/15/2017 7:58	8/15/2017 8:02	16.1	3.17	NA[e]	0.007	
12	8/11/2017 13:27	8/11/2017 14:45	8/11/2017 14:46	13.2	5.59	0.812	0.014	
13	8/11/2017 12:36	8/11/2017 12:48	8/11/2017 12:50	11.0	5.59	0.054	0.006	
14	8/11/2017 12:13	8/11/2017 12:25	8/11/2017 12:27	10.1	5.59	0.055	0.112	
15	8/11/2017 11:19	8/11/2017 11:28	8/11/2017 11:30	11.0	5.59	0.244	0.015	
16	8/11/2017 11:48	8/11/2017 12:02	8/11/2017 12:03	13.2	5.59	0.183	0.007	
17	8/11/2017 10:22	8/11/2017 11:06	8/11/2017 11:07	16.1	5.59	0.686	0.034	
18	8/15/2017 13:56	8/15/2017 14:09	8/15/2017 14:10	19.0	3.17	0.015	0.705	0.052
Restrikes								
2	8/16/2017 8:19	8/16/2017 8:19	8/16/2017 8:23	23.9	2.65	0.017	0.029	

Well Information

Well No.: 9
Municipal Address: [redacted]
Distance from Turbine Centre: 2568 m

Well No.: 10
Municipal Address: [redacted]
Distance from Turbine Centre: 1769 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 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Data for Well 9 was not available for August 15, 2017 during driving of piles 10 and 11 while awaiting site security changes implemented following an incident at the Well 9 property the evening of August 14, 2017. Highlighted values for Well 9 on August 11, 2017 are higher than and inconsistent with other measurements during pile driving at the T28 site. On August 11, 2017, construction activities were underway along the entrance road to T32, located as close as about 100 m from Well 9. These activities included: hammering, movements of large construction equipment (e.g., loaders, dump trucks, excavators, "stone throwers"), and equipment travelled on access road site without construction mats, equipment operating on T32 access resulted in "pounding" sounds. The Well 9 area is also subject to heavy passing traffic on Countryview Line (74 m from well) including: fuel trucks, loaded dump trucks, large transport trucks, a bus, and cranes/boom trucks among other vehicles. Further analysis of Well 9 vibration data was undertaken for 10 minute periods on August 11, 2017 during which pile driving was not occuring between 08:32:00 and 08:42:00, 09:12:00 and 09:22:00, 11:22:00 and 11:32:00, and 13:48:00 and 13:58:00. During these periods the maximum velocities (regardless of direction) of the Well 9 casing ranged from 0.011 to 1.2 mm/s. Data shown for Well 9 during driving of Piles 12, 15, 16 and 17 (highlighted) are considered unrepresentative of pile driving and associated with other vibration sources. The piston pump for Well 9 is within the barn approximately 4 to 5 m from the well location. When the Well 9 pump was deliberately operated on September 8, 2017, in the absence of pile driving, well casing velocities were up to 0.04 mm/s. When the pump for Well 10 was operating, well casing vibrations of as much as 1.25 mm/s were measured. "No pump" data is provided to indicate measurements exclusive of data consistent with typical pump operations. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and end of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T30

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells Particle Velocity (mm/s)[c, d]		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity			
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 9	Well 10	No Pump[e]
1	8/4/2017 14:24	8/4/2017 14:42	8/4/2017 15:01	23.0	4.70	0.054	0.815	0.014
1A	8/9/2017 9:30	8/9/2017 9:51	8/9/2017 9:58	23.5	2.41	0.080	0.935	0.027
2	8/8/2017 8:42	8/8/2017 8:52	8/8/2017 9:03	24.6	3.17	0.061	0.049	
3	8/8/2017 9:17	8/8/2017 9:25	8/8/2017 9:35	25.6	3.17	0.041	0.883	0.009
4	8/8/2017 7:49	8/8/2017 8:02	8/8/2017 8:10	26.0	3.17	0.035	1.251	0.036
5	8/4/2017 16:24	8/4/2017 16:32	8/4/2017 16:40	25.6	4.70	0.061	0.007	
6	8/4/2017 15:57	8/4/2017 16:03	8/4/2017 16:11	24.6	4.70	0.059	0.003	
7	8/4/2017 15:24	8/4/2017 15:34	8/4/2017 15:39	23.0	4.70	0.082	0.028	
8	8/4/2017 10:57	8/4/2017 11:03	8/4/2017 11:06	20.8	4.70	0.032	0.540	0.033
9	8/3/2017 13:33	8/3/2017 13:38	8/3/2017 13:46	18.1	5.33	0.076	0.088	
10	8/3/2017 13:07	8/3/2017 13:16	8/3/2017 13:20	15.2	5.33	0.088	0.014	
11	8/3/2017 11:46	8/3/2017 11:52	8/3/2017 11:56	9.1	5.33	0.029	0.007	
12	8/3/2017 11:25	8/3/2017 11:29	8/3/2017 11:34	10.1	5.33	0.066	0.005	
13	8/3/2017 10:44	8/3/2017 10:53	8/3/2017 10:59	12.4	5.33	0.059	0.876	0.005
14	8/3/2017 14:04	8/3/2017 14:11	8/3/2017 14:19	15.2	5.33	0.061	0.023	
15	8/3/2017 14:34	8/3/2017 14:47	8/3/2017 14:50	18.1	5.33	0.032	0.005	
16	8/4/2017 8:50	8/4/2017 8:55	8/4/2017 9:08	20.8	4.70	0.048	0.032	
17	8/4/2017 9:32	8/4/2017 9:38	8/4/2017 9:43	23.0	4.70	0.051	0.002	
18	8/4/2017 10:17	8/4/2017 10:33	8/4/2017 10:36	24.6	4.70	0.024	0.004	
Restrikes								
15C	8/4/2017 8:15	8/4/2017 8:15	8/4/2017 8:21	18.1	4.70	0.044	0.022	
1	8/8/2017 15:19	8/8/2017 15:19	8/8/2017 15:25	23.0	3.17	0.080	0.006	
5	8/8/2017 8:15	8/8/2017 8:15	8/8/2017 8:20	25.6	3.17	0.056	1.016	0.006
6	8/8/2017 9:40	8/8/2017 9:40	8/8/2017 9:41	24.6	3.17	0.041	1.116	0.146

Well Information

Well No.: 9
Municipal Address: [redacted]
Distance from Turbine Centre: 1808 m

Well No.: 10
Municipal Address: [redacted]
Distance from Turbine Centre: 1385 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 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: 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" (where applicable). Piles noted with "C" were those that were started on one day and continued on a separate day; therefore, additional well monitoring data is presented for the time periods during which piling continued on till/rock. When the pump for Well 10 was operating, well casing vibrations of as much as 1.25 mm/s were measured. "No pump" data is provided to indicate measurements exclusive of data consistent with typical pump operations. Total driving duration between till/rock start and end times noted above for Pile 1 is not representative and actual driving duration was 00:11:50 due to pauses in actual hammering. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T31

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells	
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]	
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 7	Well 8
1	7/17/2017 13:18	7/17/2017 13:24	7/17/2017 13:26	8.1	2.92	0.042	0.028
2	7/17/2017 14:46	7/17/2017 14:52	7/17/2017 14:54	9.1	2.92	0.038	0.034
3	7/18/2017 7:39	7/18/2017 7:47	7/18/2017 7:49	11.4	4.19	0.016	0.075
4	7/18/2017 8:03	7/18/2017 8:10	7/18/2017 8:13	14.3	4.19	0.023	0.005
5	7/17/2017 12:56	7/17/2017 13:01	7/17/2017 13:05	17.2	2.92	0.020	0.071
6	7/17/2017 11:49	7/17/2017 11:53	7/17/2017 11:54	19.8	2.92	0.100	0.099
7	7/17/2017 11:25	7/17/2017 11:30	7/17/2017 11:35	22.0	2.92	0.014	0.028
8	7/17/2017 10:25	7/17/2017 10:31	7/17/2017 10:36	23.6	2.92	0.044	0.028
9	7/17/2017 8:03	7/17/2017 8:09	7/17/2017 8:30	24.6	2.92	0.011	0.041
10	NA	NA	NA	25.0		NA	NA
11	7/14/2017 16:18	7/14/2017 16:25	7/14/2017 16:28	24.6	5.46	0.041	NA
12	7/13/2017 15:38	7/13/2017 15:44	7/13/2017 15:45	23.6	5.08	0.037	0.034
13	7/13/2017 16:12	7/13/2017 16:26	7/13/2017 16:30	24.6	5.08	0.012	0.015
14	7/14/2017 8:22	7/14/2017 8:47	7/14/2017 8:48	25.0	5.46	0.072	0.023
15	7/13/2017 16:56	7/13/2017 17:06	7/13/2017 17:08	24.6	5.08	0.156	0.020
16	7/14/2017 11:18	7/14/2017 11:23	7/14/2017 11:29	23.6	5.46	0.044	0.034
17	7/14/2017 11:40	7/14/2017 11:48	7/14/2017 11:51	22.0	5.46	0.074	0.075
18	7/14/2017 12:10	7/14/2017 12:16	7/14/2017 12:21	19.8	5.46	0.050	0.041

Well Information

Well No.: 7
Municipal Address: [redacted]
Distance from Turbine Centre: 636 m

Well No.: 8
Municipal Address: [redacted]
Distance from Turbine Centre: 2497 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 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: On July 14, 2017 at about 14:00, Golder was informed that piling operations at T31 were concluded. At 15:45 instruments were therefore turned off at Well 8 in preparation for removal for the day. Piling resumed at approximately 16:15. As a result, data was not captured for Wells 7 or 8 when driving Pile 10 and Well 8 when driving Pile 11. Well monitoring undertaken during periods of time when pile driving was not occuring measured maximum particle velocities of as much as 0.37 mm/s at Well 7. Total driving duration between till/rock start and end times noted above for Pile 9 is not representative and actual driving duration was 00:04:00 due to pauses in actual hammering. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: **T32**

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 9	Well 10	No Pump[c]
1	8/11/2017 14:41	8/11/2017 14:43	8/11/2017 15:01	25.0	3.43	0.069	0.020	
2	8/14/2017 15:43	8/14/2017 15:46	8/14/2017 16:19	23.3	4.83	0.050	0.013	
3	8/14/2017 16:25	8/14/2017 16:28	8/14/2017 16:57	21.1	4.83	0.045	0.045	
4	8/14/2017 14:51	8/14/2017 14:55	8/14/2017 15:21	18.4	4.83	0.046	0.697	
5	8/14/2017 13:52	8/14/2017 13:55	8/14/2017 14:11	15.5	4.83	0.059	0.035	
6	8/14/2017 13:12	8/14/2017 13:15	8/14/2017 13:33	12.7	4.83	0.055	0.009	
7	8/14/2017 11:40	8/14/2017 11:42	8/14/2017 12:18	10.4	4.83	0.062	0.049	
8	8/14/2017 11:20	8/14/2017 11:23	8/14/2017 11:33	9.5	4.83	0.050	0.880	
9	8/14/2017 7:47	8/14/2017 7:50	8/14/2017 7:54	10.4	4.83	0.041	0.733	
10	8/14/2017 10:59	8/14/2017 11:04	8/14/2017 11:12	12.7	4.83	0.028	0.010	
11	8/11/2017 10:53	8/11/2017 10:56	8/11/2017 11:00	15.5	3.43	1.090	0.049	
12	8/11/2017 10:42	8/11/2017 10:44	8/11/2017 10:47	18.4	3.43	0.871	0.014	
13	8/11/2017 10:28	8/11/2017 10:30	8/11/2017 10:34	21.1	3.43	1.346	0.738	0.005
14	8/11/2017 10:14	8/11/2017 10:19	8/11/2017 10:21	23.3	3.43	0.068	0.051	
15	8/11/2017 9:00	8/11/2017 9:03	8/11/2017 9:07	25.0	3.43	0.037	0.764	0.004
16	8/11/2017 11:07	8/11/2017 11:10	8/11/2017 11:14	26.0	3.43	0.229	0.034	
17	8/11/2017 13:12	8/11/2017 13:14	8/11/2017 13:19	26.4	3.43	0.230	0.684	0.009
18	8/11/2017 13:26	8/11/2017 13:28	8/11/2017 13:42	26.0	3.43	0.135	0.713	0.004

Restrikes

Well Information

Well No.: 9
Municipal Address: [redacted]
Distance from Turbine Centre: 680 m

Well No.: 10
Municipal Address: [redacted]
Distance from Turbine Centre: 1122 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 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: Highlighted values for Well 9 on August 11, 2017 are higher than and inconsistent with other measurements during pile driving at the T32 site. On August 11, 2017, construction activities were underway along the entrance road to T32, located as close as about 100 m from the well. These activities included: hammering, movements of large construction equipment (e.g., loaders, dump trucks, excavators, aggregate delivery equipment), and equipment travelled on site access road without construction mats, equipment operating on T32 access road resulted in "pounding" sounds. Well 9 area is subject to heavy passing traffic on Countryview Line (74 m from well) including: fuel trucks, loaded dump trucks, large transport trucks, a bus, and cranes/boom trucks among other vehicles. Further analysis of Well 9 vibration data was undertaken for 10 minute periods on August 11, 2017 during which pile driving was not occuring between 08:32:00 and 08:42:00, 09:12:00 and 09:22:00, 11:22:00 and 11:32:00, and 13:48:00 and 13:58:00. During these periods, the maximum velocities (regardless of direction) of the Well 9 casing ranged from 0.011 to 1.2 mm/s. Data shown for Well 9 during driving of Piles 12, 15, 16 and 17 (highlighted) are considered unrepresentative of pile driving and associated with other vibration sources. The piston pump for Well 9 is within the barn approximately 4 to 5 m from the well location. When the Well 9 pump was deliberately operated on September 8, 2017, in the absence of pile driving, well casing velocities were up to 0.04 mm/s. When the pump for Well 10 was operating, well casing vibrations of as much as 1.25 mm/s were measured. "No pump" data is provided to indicate measurements exclusive of data consistent with typical pump operations. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T33

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 3	Well 4	No Pump[e]
1	9/5/2017 13:10	9/5/2017 13:16	9/5/2017 13:25	10.9	5.3	0.015	0.118	
2	9/5/2017 13:46	9/5/2017 13:55	9/5/2017 14:03	11.8	5.3	0.011	0.138	
3	9/5/2017 14:11	9/5/2017 14:20	9/5/2017 14:27	14.0	5.3	0.056	0.174	
4	9/5/2017 14:38	9/5/2017 14:46	9/5/2017 14:54	16.8	5.3	0.035	0.082	
5	9/5/2017 15:05	9/5/2017 15:13	9/5/2017 15:18	19.7	5.3	0.049	0.137	
6	9/5/2017 15:34	9/5/2017 15:44	9/5/2017 15:48	22.4	5.3	0.009	0.072	
7	9/5/2017 17:02	9/5/2017 17:10	9/5/2017 17:10	24.6	5.3	0.030	0.298	
8	9/5/2017 17:32	9/5/2017 17:41	9/5/2017 17:49	26.3	5.3	0.036	0.131	
9	9/5/2017 18:14	9/5/2017 18:21	9/5/2017 18:28	27.4	5.3	0.034	0.083	
10	9/6/2017 9:30	9/6/2017 9:47	9/6/2017 9:53	27.8	3.2	0.004	0.243	
11	9/6/2017 10:09	9/6/2017 10:25	9/6/2017 10:35	27.4	3.2	0.004	0.089	
12	9/6/2017 12:03	9/6/2017 12:16	9/6/2017 12:26	26.3	3.2	0.005	0.179	
13	9/6/2017 12:58	9/6/2017 13:08	9/6/2017 13:16	24.6	3.2	0.003	0.162	
14	9/6/2017 13:33	9/6/2017 13:43	9/6/2017 13:58	22.4	3.2	0.004	0.161	
15	9/6/2017 14:37	9/6/2017 14:45	9/6/2017 14:54	19.7	3.2	0.005	4.987	
16	9/6/2017 16:01	9/6/2017 16:08	9/6/2017 16:20	16.8	3.2	0.006	0.277	
17	9/6/2017 15:29	9/6/2017 15:35	9/6/2017 15:45	14.0	3.2	0.003	0.175	
18	9/6/2017 14:13	9/6/2017 14:24	9/6/2017 14:36	11.8	3.2	0.004	0.622	
Restrikes								
6	9/6/2017 18:15	9/6/2017 18:15	9/6/2017 18:23	22.4	3.2	0.009	4.858	
5	9/6/2017 17:02	9/6/2017 17:02	9/6/2017 17:03	19.7	3.2	0.023	0.129	

Well Information

Well No.: 3
Municipal Address: [redacted]
Distance from Turbine Centre: 1778 m

Well No.: 4
Municipal Address: [redacted]
Distance from Turbine Centre: 2080 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: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time. During vibration monitoring on September 5, 2017, a forklift operated close to the geophone between 16:00:00 and 16:30:00 and triggered a maximum peak particle velocity of 6.2 mm/s. Value shown above excludes the peak measurement triggered by the forklift. On September 5, 2017, tractors, harvest haul trucks and other equipment travelled through Well 3 property frequently from 12:48 to 15:55 and occasionally thereafter until 16:50. On September 5, 2017, St. Clair Road traffic passing at 78 m from Well 4 was observed to include large tractor-trailers, concrete mixers and dump trucks at a rate of about 1 heavy vehicle every 1.5 to 2 minutes. Passenger vehicle movements on the Well 4 property passed and were parked near the well at 12:10, 14:40, 14:47, 15:06, 15:17, 15:42, 16:16, 16:35 and 19:02. On September 6, 2017, heavy vehicle traffic near Well 4 was similar to September 5, 2017. Combine harvesting was on-going as close as 25 to 30 m from Well 4, starting at 8:53 and continuing to after 14:30 on September 6, 2017. Passenger vehicle traffic on September 6, 2017 adjacent to Well 4 on the property was noted at 7:41, 10:40 - 10:45, 10:56 - 11:04, 11:46 - 11:52, 12:57 - 12:59, 13:22, 14:31, 14:36, 16:35, 16:42, 16:49, and 18:34. Various individuals were at and in the well shed at 16:35 to 16:54. Prior to September 6, 2017 obersvations by Golder personnel indicated that a pump was not connected at Well 4. During the afternoon of September 6, 2017 a pump was connected and operational. From 17:02 to 17:18 the newly connected Well 4 pump was cycled on and off, operating for periods of 1 to more than 7 minutes. The owner was physically working on Well 4 after 17:18 and returning to well shed frequently. All data highlighted above is considered to have been significantly influenced by near-well activities, particularly work directly related to the Well 4 pump and shed.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T35

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 5	Well 6	No Pump[e]
1	6/21/2017 9:16	6/21/2017 9:31	6/21/2017 9:58	25.3	4.32	0.005	0.011	
1A	7/4/2017 14:09	7/4/2017 14:15	7/4/2017 14:20	25.8	4.70	0.011	0.085	
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 11:24	6/30/2017 11:36	11.6	4.19	0.001	0.093	0.015
14	6/28/2017 8:34	6/28/2017 8:59	6/28/2017 9:16	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	
15A	7/4/2017 12:54	7/4/2017 13:00	7/4/2017 13:21	15.1	4.70	0.008	0.130	
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	
17A	7/4/2017 13:39	7/4/2017 13:45	7/4/2017 13:51	20.8	4.70	0.004	0.105	
18	6/28/2017 10:40	6/28/2017 10:55	6/28/2017 11:25	23.0	6.86	0.004	0.015	
Restrikes								
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	
PDA								
13A	7/6/2017 10:06	7/6/2017 10:06	7/6/2017 10:15	12.1	5.21	0.005	0.138	
13	7/6/2017 11:05	7/6/2017 11:05	7/6/2017 11:23	11.6	5.21	0.006	0.219	
15A	7/6/2017 11:39	7/6/2017 11:39	7/6/2017 11:40	15.1	5.21	0.009	0.130	
17A	7/6/2017 11:55	7/6/2017 11:55	7/6/2017 11:56	20.8	5.21	0.010	0.061	
1A	7/6/2017 12:18	7/6/2017 12:18	7/6/2017 12:18	25.8	5.21	0.011	0.084	

Well Information

Well No.: 5
Municipal Address: [redacted]
Distance from Turbine Centre: 623 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 3, when other common activities observed ranged from <0.01 tc 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 dominated 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. Piles noted with PDA indicate restrike events during which pile dynamics analyzer monitoring was completed. 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 occuring, measured maximum particle velocities of 0.08 to 0.8 mm/s. Where total driving duration between till/rock start and end times noted above is not representative, actual driving duration is shown in parentheses in minutes and seconds: 13A(10:00), 15A(6:24), 17 restrike (14:00), 13PDA(6:20). Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity 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 Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 5	Well 6	No Pump[e]
1	7/26/2017 10:33	7/26/2017 10:38	7/26/2017 10:48	23.3	7.87	0.005	0.086	
2	7/26/2017 18:16	7/26/2017 18:21	7/26/2017 18:28	21.1	7.87	0.003	0.016	
3	7/26/2017 19:24	7/26/2017 19:28	7/26/2017 19:42	18.4	7.87	0.002	0.005	
4	7/26/2017 18:37	7/26/2017 19:07	7/26/2017 19:19	15.5	7.87	0.002	0.027	
5	7/26/2017 17:59	7/26/2017 18:04	7/26/2017 18:10	12.7	7.87	0.012	0.016	
6	7/26/2017 17:30	7/26/2017 17:34	7/26/2017 17:44	10.4	7.87	0.004	0.032	
7	7/26/2017 17:10	7/26/2017 17:13	7/26/2017 17:23	9.5	7.87	0.010	0.044	
8	7/26/2017 16:41	7/26/2017 16:45	7/26/2017 16:56	10.4	7.87	0.007	0.038	
9	7/26/2017 16:19	7/26/2017 16:23	7/26/2017 16:33	12.7	7.87	0.004	0.010	
10	7/26/2017 15:48	7/26/2017 15:51	7/26/2017 16:03	15.5	7.87	0.005	0.070	
11	7/26/2017 15:12	7/26/2017 15:15	7/26/2017 15:23	18.4	7.87	0.004	0.045	
12	7/26/2017 14:32	7/26/2017 14:45	7/26/2017 14:57	21.1	7.87	0.005	0.048	
13	7/26/2017 14:15	7/26/2017 14:21	7/26/2017 14:28	23.3	7.87	0.014	0.018	
14	7/26/2017 13:58	7/26/2017 14:03	7/26/2017 14:08	25.0	7.87	0.009	0.031	
15	7/26/2017 13:16	7/26/2017 13:20	7/26/2017 13:32	26.0	7.87	0.005	0.111	0.029
16	7/26/2017 12:48	7/26/2017 12:53	7/26/2017 13:05	26.4	7.87	0.011	0.038	
17	7/26/2017 11:41	7/26/2017 11:47	7/26/2017 11:56	26.0	7.87	0.005	0.021	
18	7/26/2017 11:08	7/26/2017 11:12	7/26/2017 11:22	25.0	7.87	0.006	0.068	
Restrikes								
16	7/27/2017 7:36	7/27/2017 7:36	7/27/2017 7:37	26.4	0.89	0.003	0.437	0.028

Well Information

Well No.: 5
Municipal Address: [redacted]
Distance from Turbine Centre: 4201 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 3, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: A single restrike event occured on the day following with a total of 24 hammer blows on Pile 16 during a period of approximately 65 seconds. 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 dominated analysis of data. Monitoring of deliberate pump operation at Well 6 on July 13, 2017, during a period when no pile driving was occuring, measured maximum particle velocities of 0.08 to 0.8 mm/s. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T43

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/18/2017 12:35	8/18/2017 12:45	8/18/2017 12:52	24.8	5.59	0.006	0.008	
2	8/18/2017 13:01	8/18/2017 13:12	8/18/2017 13:20	23.8	5.59	0.006	0.007	
3	8/21/2017 8:28	8/21/2017 8:38	8/21/2017 8:48	22.2	3.18	0.010	0.007	
4	8/21/2017 12:47	8/21/2017 12:59	8/21/2017 13:10	20.0	3.18	0.007	0.006	
5	8/21/2017 9:03	8/21/2017 9:16	8/21/2017 9:23	17.4	3.18	0.006	1.468	0.009
6	8/21/2017 7:56	8/21/2017 8:08	8/21/2017 8:17	14.5	3.18	0.024	0.024	
7	8/18/2017 14:32	8/18/2017 14:43	8/18/2017 14:50	11.6	3.18	0.006	0.006	
8	8/18/2017 13:37	8/18/2017 13:49	8/18/2017 13:57	9.3	3.18	0.007	0.005	
9	8/15/2017 15:09	8/15/2017 15:18	8/15/2017 15:27	8.3	7.37	0.086	0.005	
10	8/15/2017 13:21	8/15/2017 13:28	8/15/2017 13:37	9.3	7.37	0.004	0.002	
11	8/15/2017 12:22	8/15/2017 12:34	8/15/2017 12:35	11.6	7.37	0.002	0.006	
12	8/15/2017 11:58	8/15/2017 12:10	8/15/2017 12:13	14.5	7.37	0.018	0.018	
13	8/15/2017 9:19	8/15/2017 9:42	8/15/2017 11:40	17.4	7.37	0.003	0.002	
14	8/15/2017 15:46	8/15/2017 15:57	8/15/2017 16:10	20.0	7.37	0.006	0.013	
15	8/18/2017 9:17	8/18/2017 9:23	8/18/2017 9:31	22.2	5.59	0.005	0.009	
16	8/18/2017 9:43	8/18/2017 9:50	8/18/2017 9:59	23.8	5.59	0.012	0.009	
17	8/18/2017 10:10	8/18/2017 10:17	8/18/2017 10:28	24.8	5.59	0.004	0.018	
18	8/18/2017 11:45	8/18/2017 12:02	8/18/2017 12:21	25.2	5.59	0.008	0.004	
Restrikes								
14	8/21/2017 10:43	8/21/2017 10:43	8/21/2017 10:43	20.0	3.18	0.012	0.010	
16(1)	8/21/2017 10:30	8/21/2017 10:30	8/21/2017 10:30	23.8	3.18	0.011	0.010	
16(2)	8/21/2017 11:52	8/21/2017 11:52	8/21/2017 11:54	22.2	3.18	0.005	0.029	

Well Information

Well No.: 11
Municipal Address: [redacted]
Distance from Turbine Centre: 4092 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 4359 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: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. Maximum vibration measurements for Well 11 were 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. Maximum vibration measurements for Well 12 were 0.896 mm/s and the pump was mounted on the well casing. During pile driving for turbine T3, on August 23, 2017, the maximum vibration measurement of the Well 12 casing was 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Note that driving/restriking of some piles occured in relatively rapid succession and, therefore, the vibration measurement data for the 10 minute periods of analysis are applicable to multiple piles. Driving of pile 13 was started and stopped on multiple occasions because of problems with fuel pump resulting in a total of approximately 88 minutes of standby between driving intervals for a total driving time on till/rock of 14:45 (minutes:seconds). Pile 18 total driving time on till/rock was 8:46 (minutes:seconds) due to intermittant stops and starts. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T45

	Pile Driving Times and Dates			Vibration Measurements at Turbine Site		Vibration Measurements at Wells		
					Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/23/2017 11:47	8/23/2017 11:53	8/23/2017 12:18	14.8	7.75	0.025	0.010	
2	8/23/2017 14:20	8/23/2017 14:27	8/23/2017 14:41	12.0	7.75	0.024	NA[e]	
3	8/23/2017 15:10	8/23/2017 15:17	8/23/2017 15:27	9.6	7.75	0.017	0.005	
4	8/23/2017 16:49	8/23/2017 16:55	8/23/2017 17:05	8.7	7.75	0.008	1.148	
5	8/23/2017 17:22	8/23/2017 17:30	8/23/2017 17:44	9.6	7.75	0.011	0.007	
6	8/23/2017 10:50	8/23/2017 11:00	8/23/2017 11:16	12.0	7.75	0.018	0.016	
7	8/24/2017 8:30	8/24/2017 8:38	8/24/2017 8:47	14.8	3.30	0.014	0.014	
8	8/24/2017 9:05	8/24/2017 9:14	8/24/2017 9:21	17.7	3.30	0.021	0.040	
9	8/24/2017 9:36	8/24/2017 9:44	8/24/2017 10:48	20.4	3.30	0.018	1.511	
10	8/23/2017 12:49	8/23/2017 12:58	8/23/2017 13:15	22.6	7.75	0.009	0.005	
11	8/24/2017 13:32	8/24/2017 13:42	8/24/2017 13:48	24.2	3.30	0.004	0.018	
12	8/24/2017 15:06	8/24/2017 15:15	8/24/2017 15:23	25.2	3.30	0.007	0.008	
13	8/24/2017 15:35	8/24/2017 15:44	8/24/2017 15:53	25.6	3.30	0.026	0.034	
14	8/24/2017 16:05	8/24/2017 16:14	8/24/2017 16:22	25.2	3.30	0.012	0.061	
15	8/24/2017 16:40	8/24/2017 16:46	8/24/2017 16:55	24.2	3.30	0.015	0.007	
16	8/24/2017 17:11	8/24/2017 17:18	8/24/2017 17:24	22.6	3.30	0.012	0.004	
17	8/24/2017 17:33	8/24/2017 17:39	8/24/2017 17:45	20.4	3.30	0.006	0.009	
18	8/24/2017 17:57	8/24/2017 18:08	8/24/2017 18:12	17.7	3.30	0.005	0.006	
Restrikes								
6	8/23/2017 13:28	8/23/2017 13:28	8/23/2017 13:29	12.0	7.75	0.043	0.017	
1	8/23/2017 13:13	8/23/2017 13:13	8/23/2017 13:13	14.8	7.75	0.009	0.005	
15	8/25/2017 7:45	8/25/2017 7:45	8/25/2017 7:47	24.2	5.97	0.015	0.032	
16	8/25/2017 9:11	8/25/2017 9:11	8/25/2017 9:13	22.6	5.97	0.007	2.335	0.008
17	8/25/2017 9:03	8/25/2017 9:03	8/25/2017 9:06	20.4	5.97	0.007	0.019	
18	8/25/2017 8:51	8/25/2017 8:51	8/25/2017 8:55	17.7	5.97	0.011	0.011	
1	8/25/2017 11:44	8/25/2017 11:44	8/25/2017 11:45	14.8	5.97	0.013	0.037	
12	8/25/2017 9:22	8/25/2017 9:22	8/25/2017 9:25	25.2	5.97	0.024	0.010	
18	8/25/2017 9:16	8/25/2017 9:16	8/25/2017 9:18	17.7	5.97	0.011	0.011	
4	8/25/2017 8:43	8/25/2017 8:43	8/25/2017 8:45	8.7	5.97	0.013	0.007	
5	8/25/2017 8:36	8/25/2017 8:36	8/25/2017 8:37	9.6	5.97	0.013	0.013	
7	8/25/2017 8:30	8/25/2017 8:30	8/25/2017 8:32	14.8	5.97	0.006	0.028	
8	8/25/2017 8:25	8/25/2017 8:25	8/25/2017 8:26	17.7	5.97	0.006	0.018	
10	8/25/2017 9:28	8/25/2017 9:28	8/25/2017 10:19	22.6	5.97	0.021	0.011	
13	8/25/2017 7:53	8/25/2017 7:54	8/25/2017 7:59	25.6	5.97	0.013	0.007	
9	8/25/2017 8:09	8/25/2017 8:09	8/25/2017 8:19	20.4	5.97	0.028	0.010	
11	8/25/2017 8:03	8/25/2017 8:03	8/25/2017 8:05	24.2	5.97	0.008	0.024	
Spliced								
13	8/30/2017 11:06	8/30/2017 11:06	8/30/2017 11:07	25.6	6.10	0.006	0.012	
2	8/30/2017 10:06	8/30/2017 10:06	8/30/2017 10:06	12.0	6.10	0.005	0.018	
3	8/30/2017 10:09	8/30/2017 10:09	8/30/2017 10:10	9.6	6.10	0.005	0.018	
4	8/30/2017 10:14	8/30/2017 10:14	8/30/2017 10:16	8.7	6.10	0.011	0.014	
5	8/30/2017 10:19	8/30/2017 10:19	8/30/2017 10:20	9.6	6.10	0.011	0.014	
6	8/30/2017 10:23	8/30/2017 10:23	8/30/2017 10:25	12.0	6.10	0.013	0.016	
7	8/30/2017 10:27	8/30/2017 10:27	8/30/2017 10:29	14.8	6.10	0.013	0.016	
8	8/30/2017 10:32	8/30/2017 10:32	8/30/2017 10:34	17.7	6.10	0.013	0.013	
10	8/30/2017 10:40	8/30/2017 10:40	8/30/2017 11:00	22.6	6.10	0.003	0.018	
Replacement Piles								
6A	9/12/2017 7:51	9/12/2017 7:59	9/12/2017 9:41	13.0	4.70	0.014	0.007	
10A	9/12/2017 8:29	9/12/2017 8:36	9/12/2017 9:37	23.6	4.70	0.015	0.003	
13A	9/12/2017 9:07	9/12/2017 9:13	9/12/2017 9:29	26.6	4.70	0.015	0.011	

NORTH KENT 1
Preliminary Vibration Monitoring Report

Well Information

Well No.: *11*
Municipal Address: [redacted]
Distance from Turbine Centre: 1223 m

Well No.: 12
Municipal Address: [redacted]
Distance from Turbine Centre: 1635 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: After installation, selected piles were struck again with the hammer to demonstrate resistance performance and these are noted as "restrikes". Vibration measurements were undertaken on August 17, 2017 at Wells 11 and 12 during water quality sampling events in the absence of pile driving within the cluster. Both pumps turned on and operated during the sampling events. The maximum vibration measurement for Well 11 was 0.016 mm/s and this pump was located within the residence approximately 40 m from the well. The maximum vibration measurement for Well 12 was 0.896 mm/s and the pump was mounted on the well casing. The maximum vibration measurement of the Well 12 casing during all monitoring completed to the date of report issue was about 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Note that driving/restriking of some piles occured in relatively rapid succession and, therefore, the vibration measurement data for the 10 minute periods of analysis are applicable to multiple piles. Data for Well 12 during driving of Pile 2 on August 23, 2017 was not captured when data logger battery failed and then changed. Total driving time on till/rock for Pile 9 was interrupted by repairs to the pile driving hammer and the actual driving duration on till/rock was 8:00 (minutes:seconds) for this pile. Total driving time on till/rock for restrike of Pile 10 was interrupted by damage to the pile top, splicing and welding and total driving duration on till/rock was 5:48 (minutes:seconds). Driving time on till/rock for driving of Pile 6A was interrupted from 8:07:35 to 8:10:35 and from 8:12:45 to 9:40:28. Driving time on till/rock for driving of Pile 10A was interrupted from 8:49:30 to 9:37:05. Driving time on till/rock for driving of Pile 13A was interrupted from 9:18:45 to 9:26:30. Total pile driving durations derived from start and end times noted above includes labour breaks, equipment work, splicing, welding and other standby time.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.

NORTH KENT 1
Preliminary Vibration Monitoring Report

Turbine Location: T46

	Vibration Measurements at Turbine Site					Vibration Measurements at Wells		
	Pile Driving Times and Dates				Daily Maximum Particle Velocity	Particle Velocity (mm/s)[c, d]		
Pile No.:	Start[a]	Rock/Till	End[a]	Geophone Dist. (m)	(mm/s)[b]	Well 11	Well 12	No Pump[e]
1	8/29/2017 8:38	8/29/2017 8:44	8/29/2017 9:10	26.5	5.80	NA[e]	0.002	
2	8/29/2017 9:24	8/29/2017 9:33	8/29/2017 9:49	25.5	5.80	NA[e]	0.003	
3	8/29/2017 10:14	8/29/2017 10:19	8/29/2017 10:30	23.8	5.80	NA[e]	0.037	
4	8/29/2017 12:41	8/29/2017 12:52	8/29/2017 13:01	21.5	5.80	0.004	0.010	
5	8/29/2017 12:00	8/29/2017 12:09	8/29/2017 12:28	18.9	5.80	NA[e]	0.003	
6	8/29/2017 11:02	8/29/2017 11:11	8/29/2017 11:25	16.0	5.80	NA[e]	0.006	
7	8/28/2017 16:35	8/28/2017 16:47	8/28/2017 16:53	13.1	7.85	0.015	0.071	
8	8/28/2017 16:02	8/28/2017 16:12	8/28/2017 16:20	10.9	7.85	0.007	1.551	0.039
9	8/28/2017 13:25	8/28/2017 13:34	8/28/2017 13:36	10.0	7.85	0.006	0.011	
10	8/28/2017 12:44	8/28/2017 12:56	8/28/2017 12:59	10.9	7.85	0.006	0.008	
11	8/28/2017 11:25	8/28/2017 11:34	8/28/2017 11:41	13.1	7.85	NA[e]	0.011	
12	8/28/2017 10:07	8/28/2017 10:17	8/28/2017 10:20	16.0	7.85	0.003	0.009	
13	8/28/2017 9:33	8/28/2017 9:43	8/28/2017 9:49	18.9	7.85	0.021	0.015	
14	8/28/2017 9:00	8/28/2017 9:12	8/28/2017 9:16	21.5	7.85	0.003	0.003	
15	8/28/2017 8:30	8/28/2017 8:44	8/28/2017 8:47	23.8	7.85	0.004	0.004	
16	8/28/2017 13:53	8/28/2017 14:03	8/28/2017 14:07	25.5	7.85	0.002	0.006	
17	8/28/2017 14:27	8/28/2017 14:38	8/28/2017 14:48	26.5	7.85	0.017	0.004	
18	8/29/2017 7:53	8/29/2017 8:01	8/29/2017 8:05	26.9	5.80	NA[e]	0.002	
Restrikes								
9	8/29/2017 13:14	8/29/2017 13:14	8/29/2017 13:16	10.0	5.80	0.005	0.006	
8	8/29/2017 13:25	8/29/2017 13:25	8/29/2017 13:26	10.9	5.80	0.003	0.052	
16	8/29/2017 13:36	8/29/2017 13:36	8/29/2017 13:38	25.5	5.80	0.003	0.006	

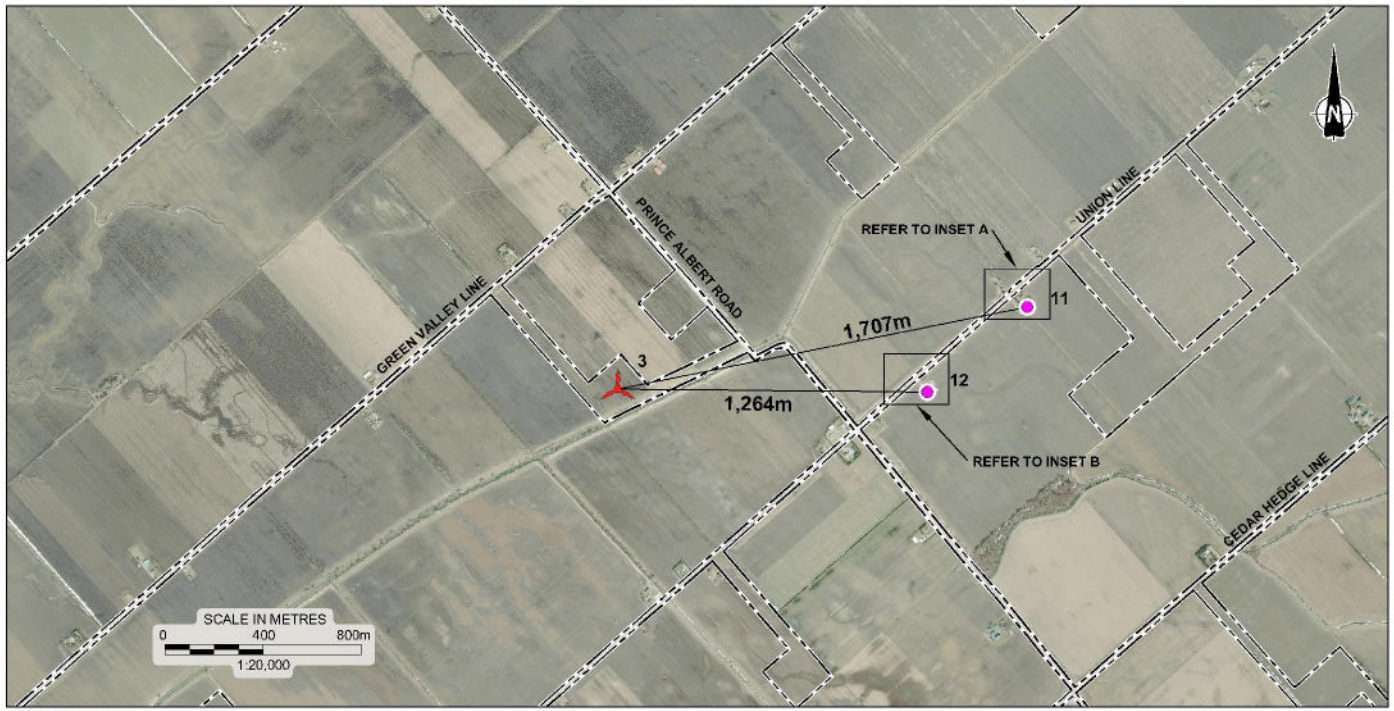
Well Information

Well No.:	***11***	**Well No.:**	12
Municipal Address:		Municipal Address:	
Distance from Turbine Centre:	1697 m	Distance from Turbine Centre:	2170 m

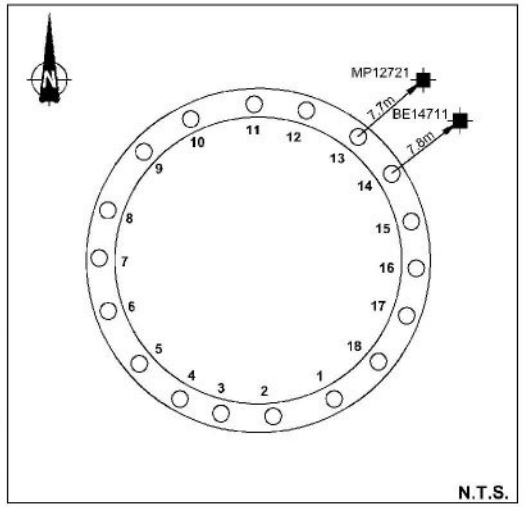
ISO 2631-2 particle velocity threshold for human perception is 0.1 mm/s between approximately 8 to 100 Hz
Background values at T5 and T42 test pile sites and Wells 1 and 2, when other common activities observed ranged from <0.01 to approximately 0.07 mm/s

Monitoring Notes: 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". Total duration for pile driving on rock/till based on times noted above is not representative for Piles 1 and where the actual duration for driving on till/rock was (minutes:seconds): 1(11:30) and 5(18:32) . Maximum vibrations for Well 12 were 1.55 mm/s for August 29, 2017. The pump was mounted on the well casing. During pile driving on August 23, 2017, the maximum vibration measurement of the Well 12 casing was 2.4 mm/s for clearly definable periods during which the pump was operating. Data shown for the "no pump" condition was obtained during pile driving when the pump was not operating. Data not available for Piles 1, 2, 3, 5, 6, 11 and 18 at Well 11 on August 28 and 29, 2017 due to several separate battery failures in monitoring equipment. Batteries were subsequently replaced upon discovery.

Footnotes: a) start and stop of pile driving are start and stop times for active hammering; 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 fast Fourier transform analyses of consecutive 1 second intervals for a total period of 10 minutes during pile driving on till/rock (600 seconds) and represent the maximum of the 1 second interval peak velocity values during these periods regardless of measurement direction; e) see monitoring notes above.



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

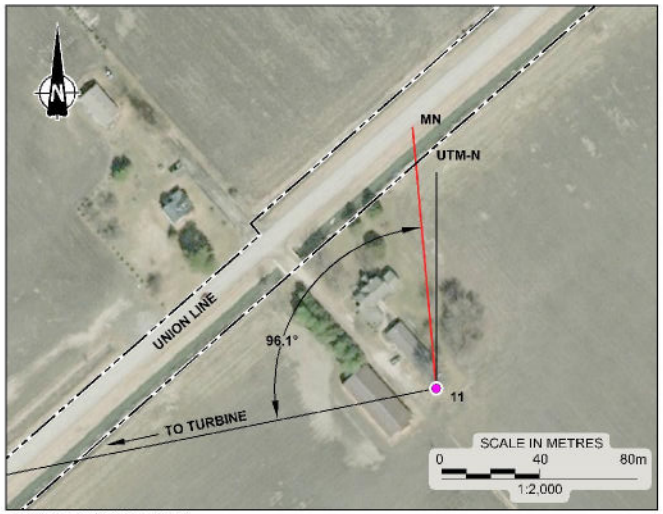
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

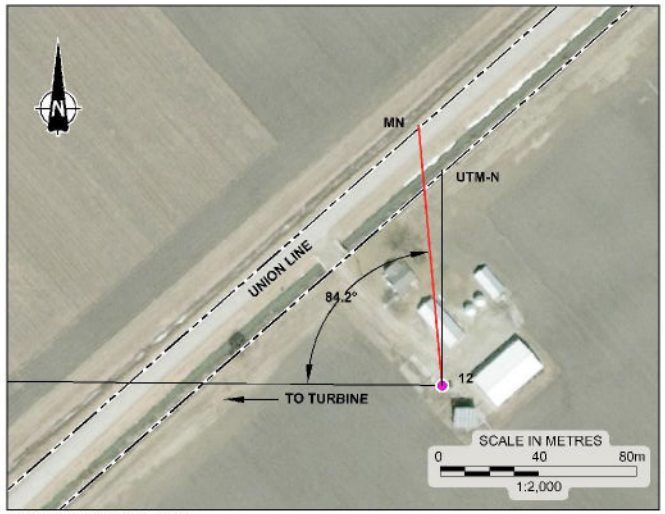
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

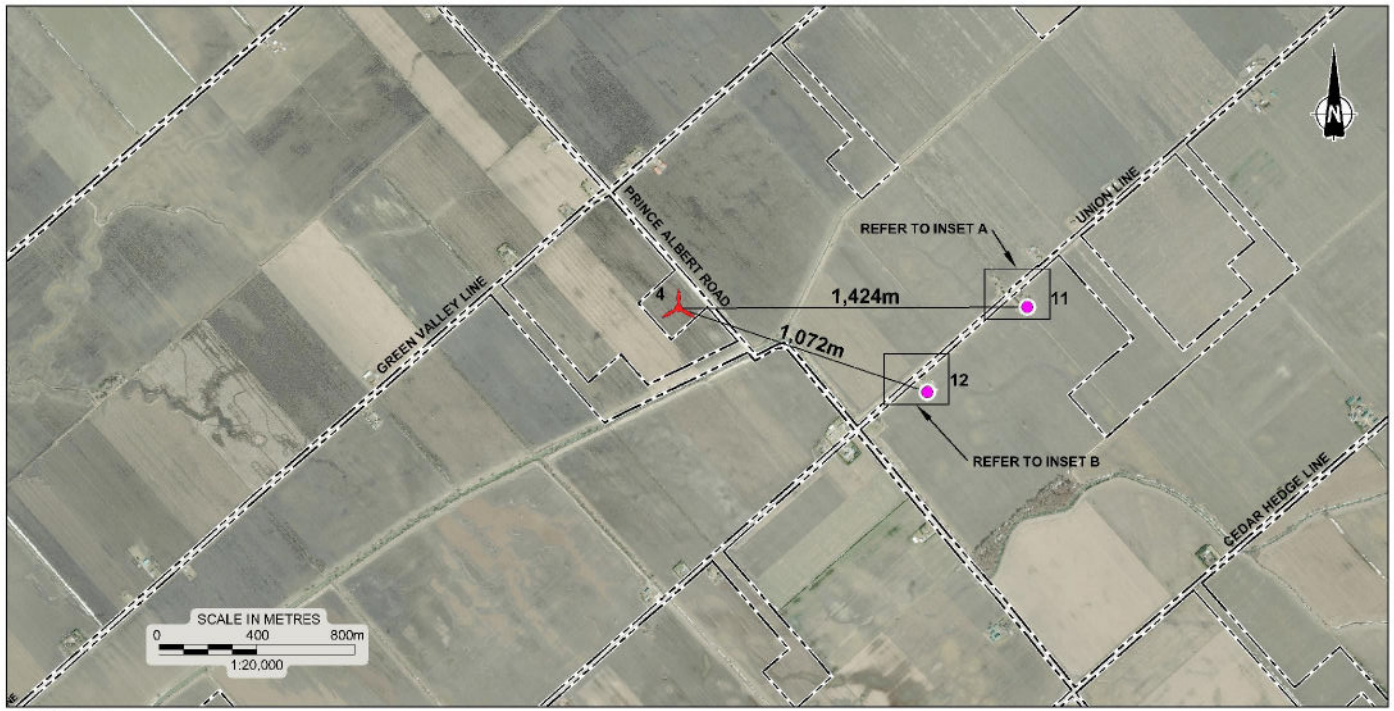
TURBINE PILES AND WATER WELL LOCATION PLAN, T3

Golder Associates

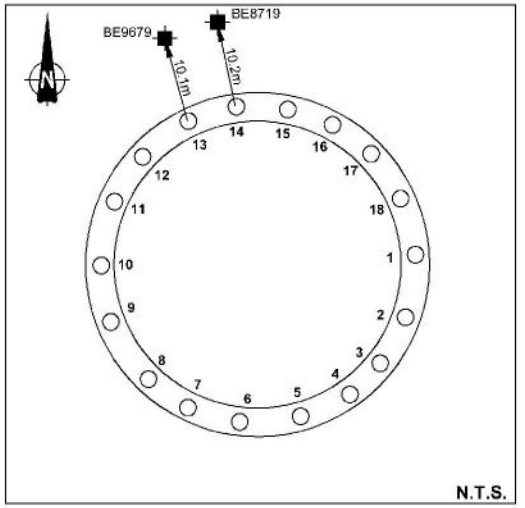
PROJECT No.	1668031	FILE No.	1668031-2000-R020T3
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T3

Drawing file: 1668031-2000-R020T3.dwg Sep 20, 2017 - 2:49pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

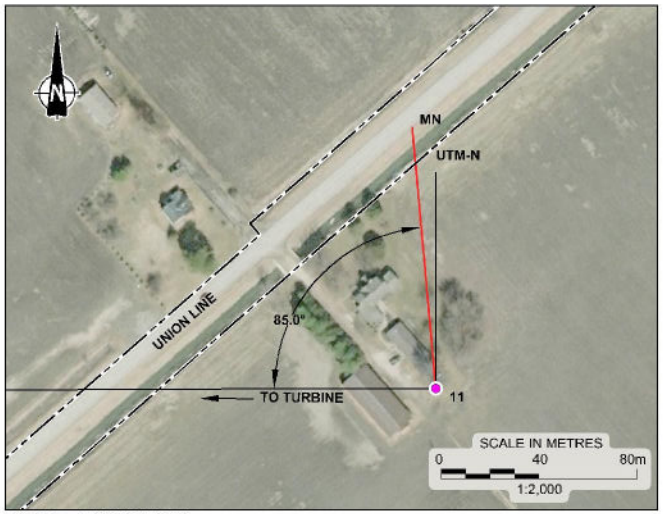
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

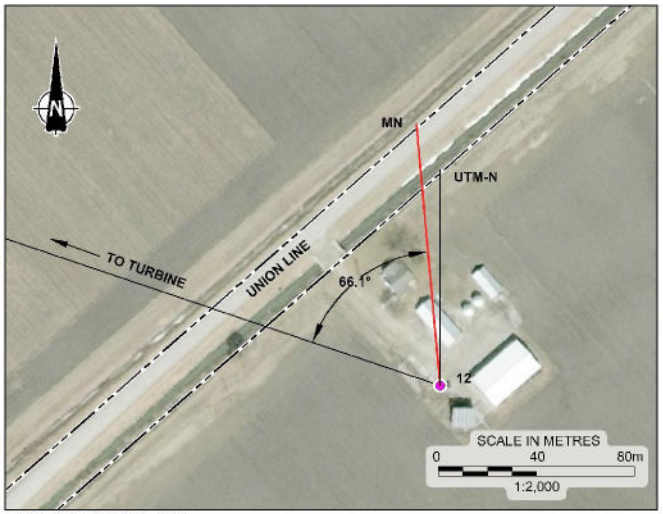
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T4

Golder Associates

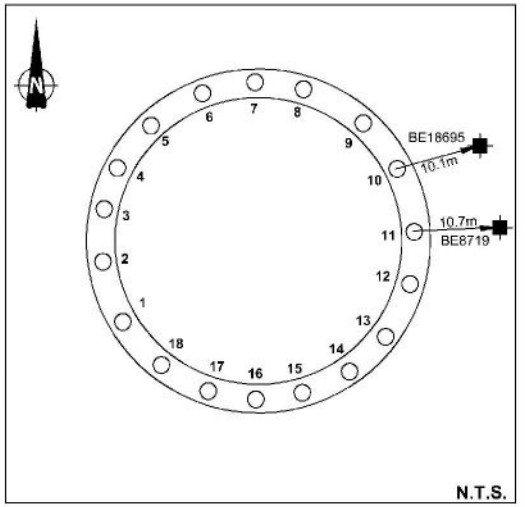
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CADD	DGH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T4

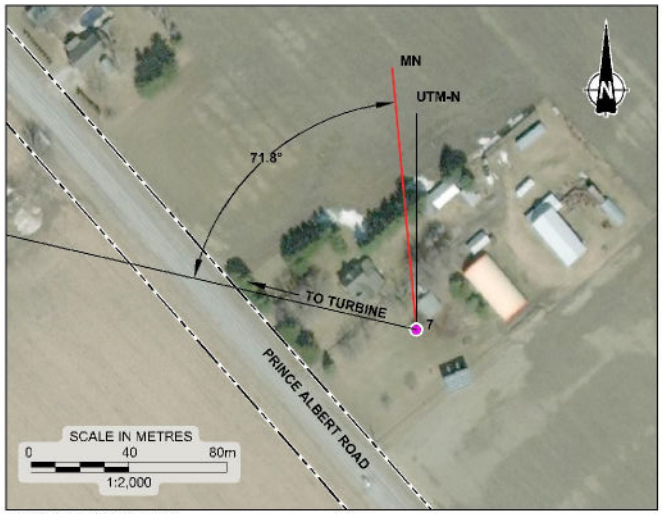
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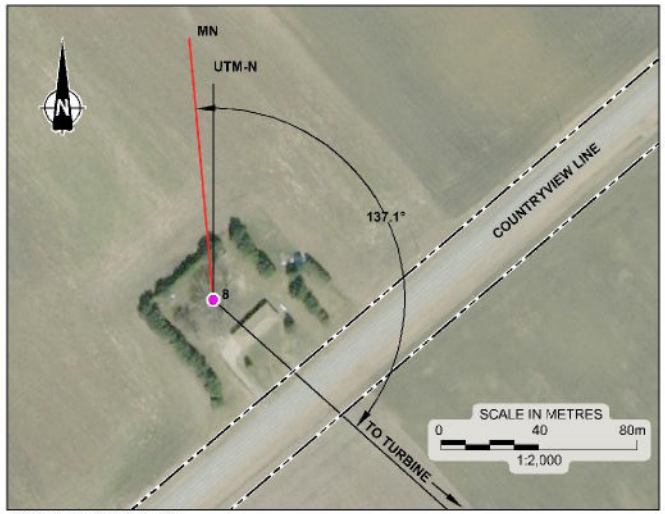
SITE PLAN



TURBINE PILE LAYOUT



INSET A (WELL #7)



INSET B (WELL #8)

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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ALL LOCATIONS ARE APPROXIMATE.

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T6

Golder Associates

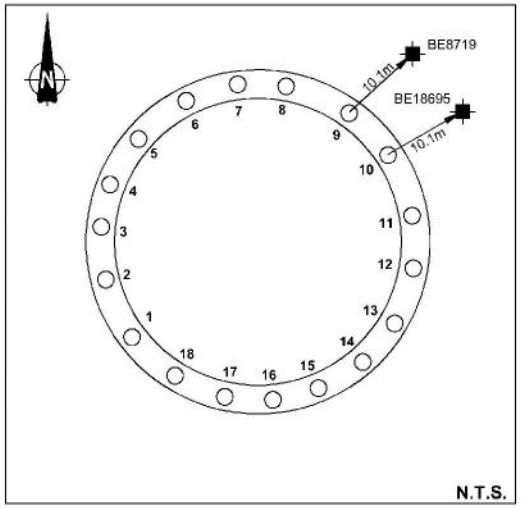
PROJECT No.	1658031	FILE No.	1658031-2000-R02016
DESIGN		SCALE	AS SHOWN
CADD	DCH/ZJE Sept. 18/17	REV.	
CHECK			

FIGURE T6

Drawing file: 1658031-2000-R02016.dwg Sep 20, 2017 - 2:52pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

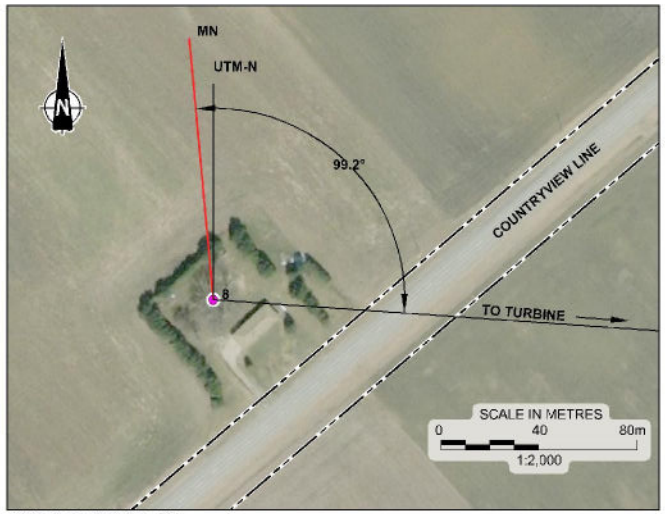
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #7)



INSET B (WELL #8)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T7

Golder Associates

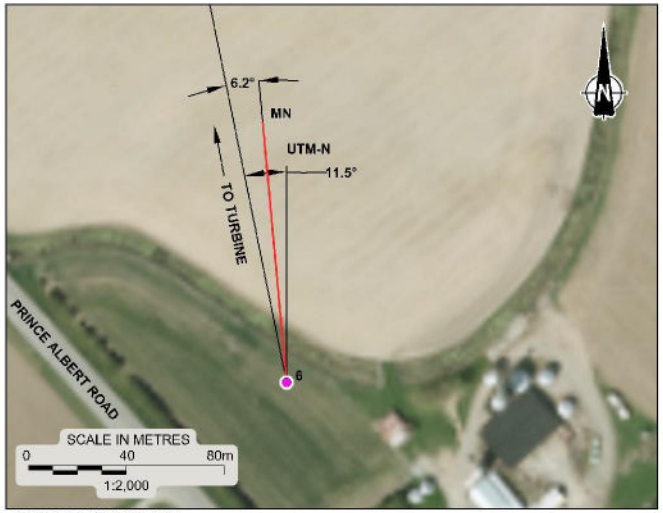
PROJECT No.	1668031	FILE No.	1668031-2000-R02T7
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CADD	DCH/ZJB	Sept. 18/17	REV.
CHECK			

FIGURE T7

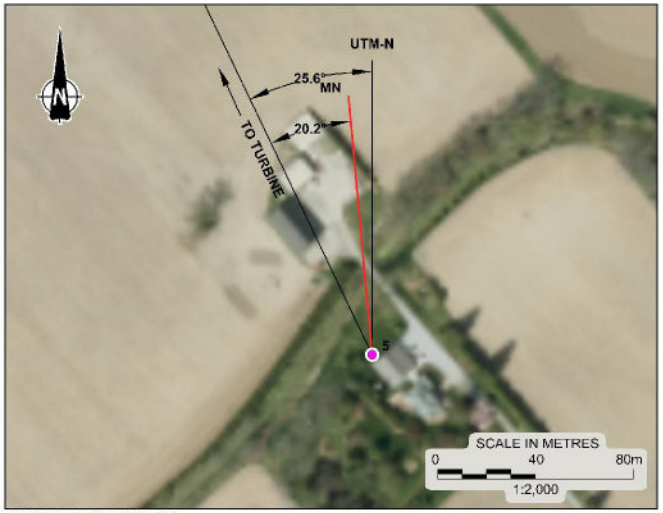
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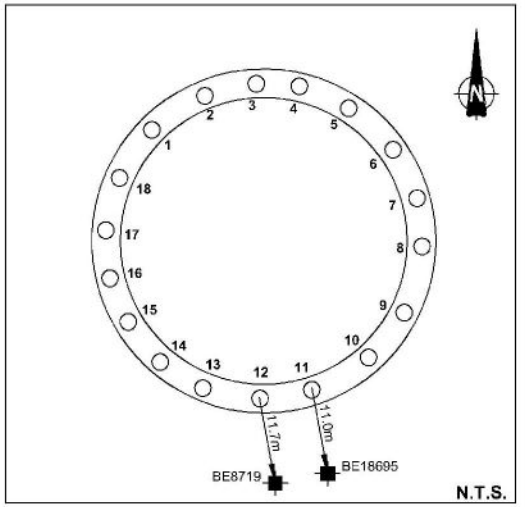
SITE PLAN



INSET A (WELL #6)



INSET B (WELL #5)



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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ALL LOCATIONS ARE APPROXIMATE.

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T12

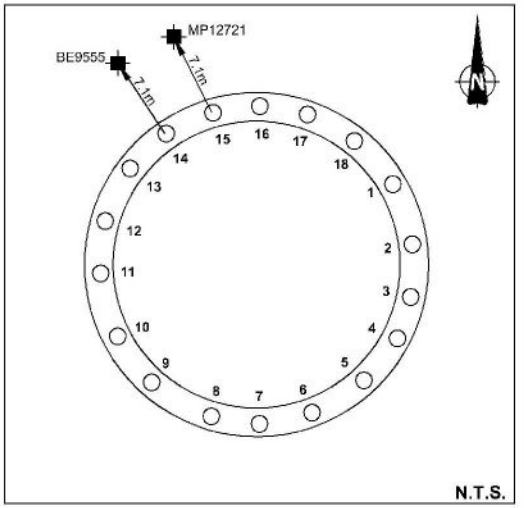
Golder Associates

PROJECT No.			1658031	FILE No. 1658031-2000-R02T12
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 20/17		FIGURE T12
CHECK				

Drawing file: 1658031-2000-R02T12.dwg Sep 20, 2017 - 12:39pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

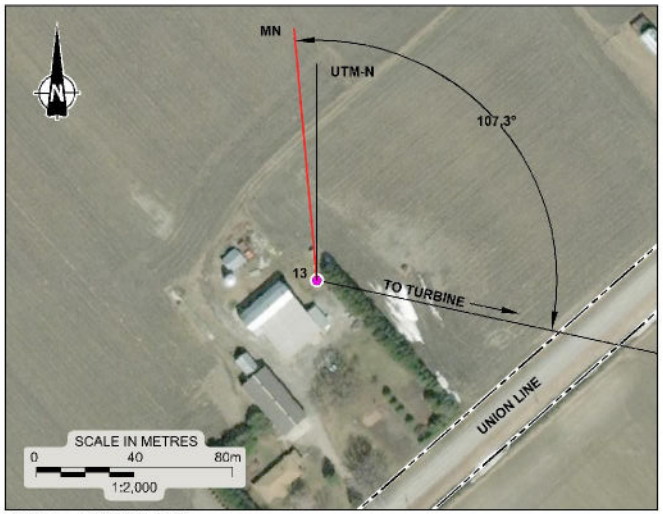
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

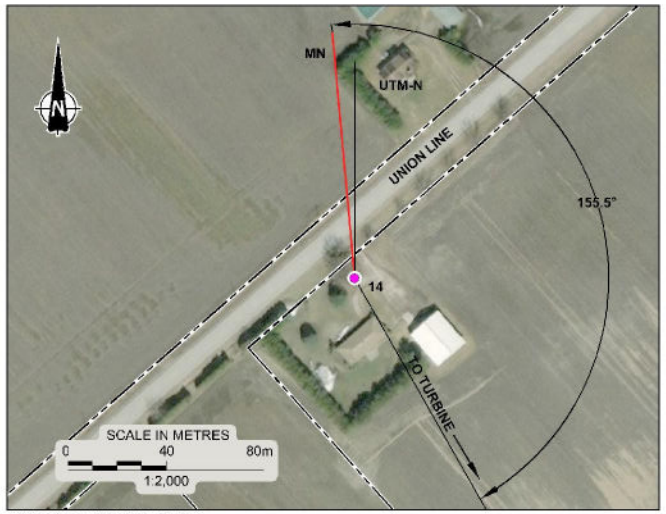
NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #13)



INSET B (WELL #14)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T14

Golder Associates

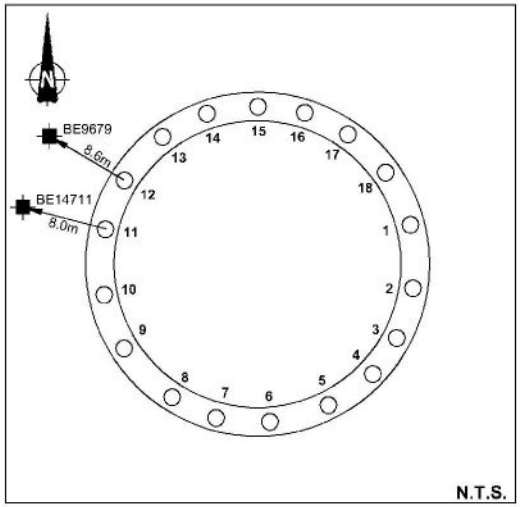
PROJECT No.			1668031	FILE No. 1668031-2000-R02T14
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 18/17		
CHECK				

FIGURE T14

Drawing file: 668031 2000 R02T14.dwg Sep 18, 2017 4:46pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN MAGNETIC NORTH
- UTM-N UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

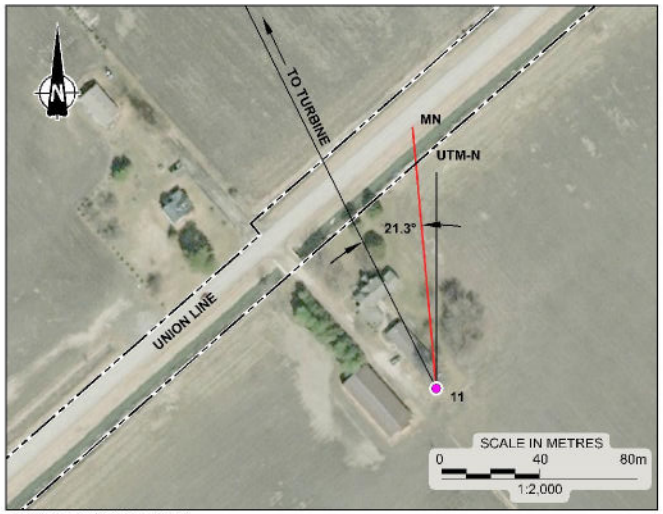
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

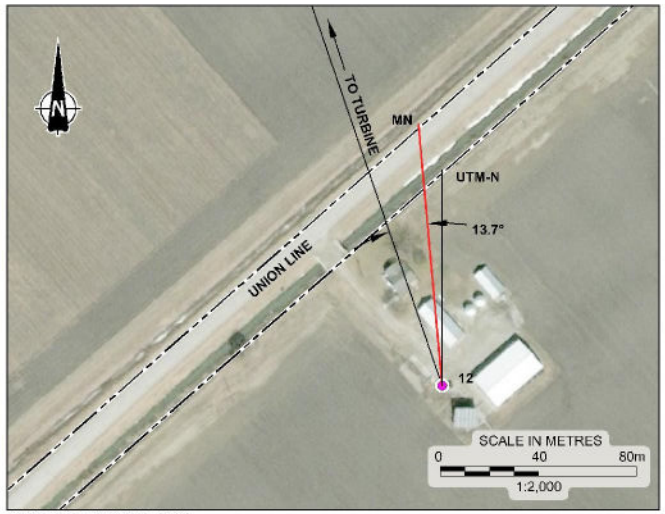
NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T20

Golder Associates

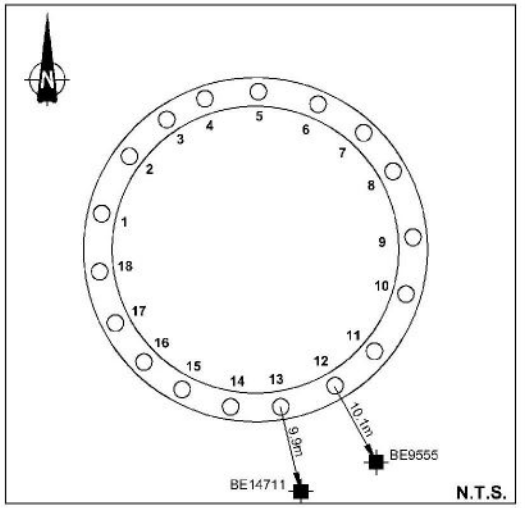
PROJECT No.			1668031	FILE No. 1668031-2000-R02T20
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 18/17		
CHECK				

FIGURE T20

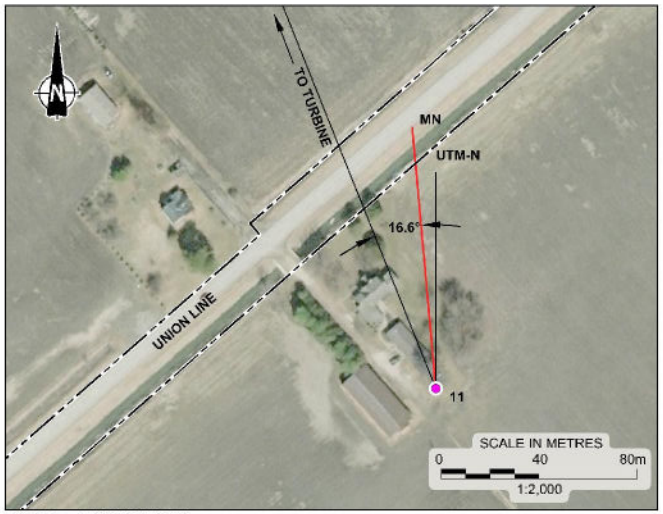
Drawing file: 1668031-2000-R02T20.dwg Sep 18, 2017 - 2:21pm



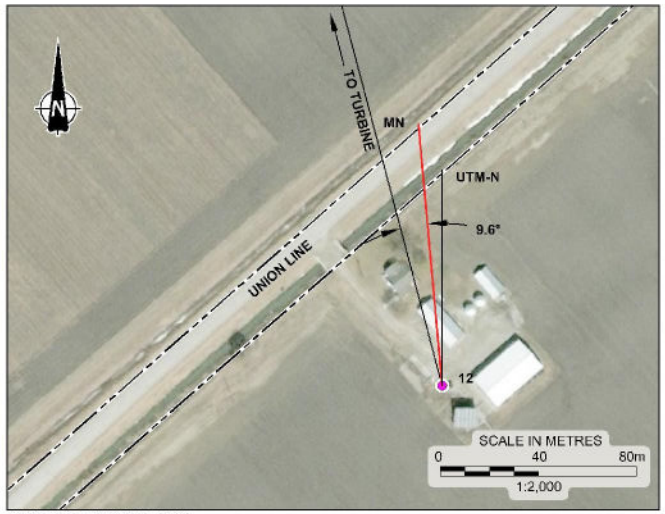
SITE PLAN



TURBINE PILE LAYOUT



INSET A (WELL #11)



INSET B (WELL #12)

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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ALL LOCATIONS ARE APPROXIMATE.

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T21

Golder Associates

PROJECT No.			1668031
CADD	DCH/ZJB	Sept. 18/17	
CHECK			

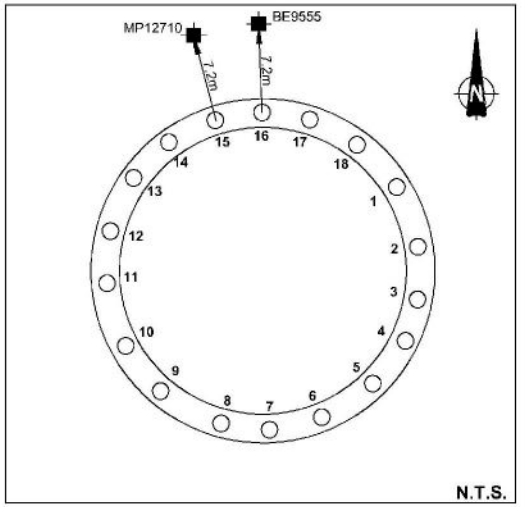
FILE No. 1668031-2000-RG2T21
SCALE AS SHOWN REV.

FIGURE T21

Drawing file: 668031 2000 RG2T21.dwg Sep 18, 2017 2:24pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

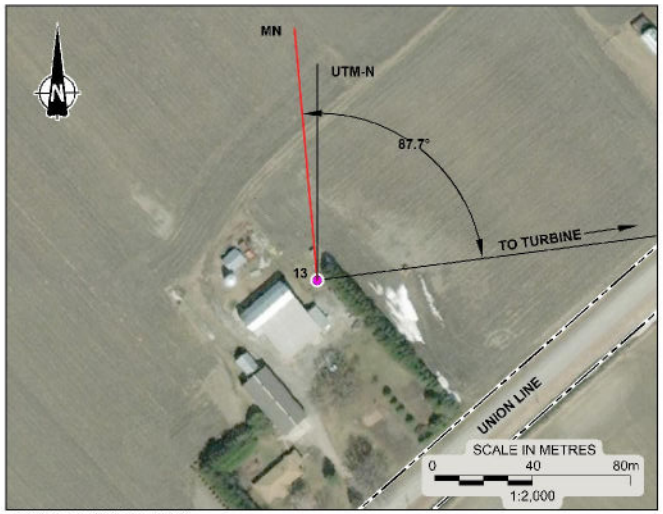
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT. INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

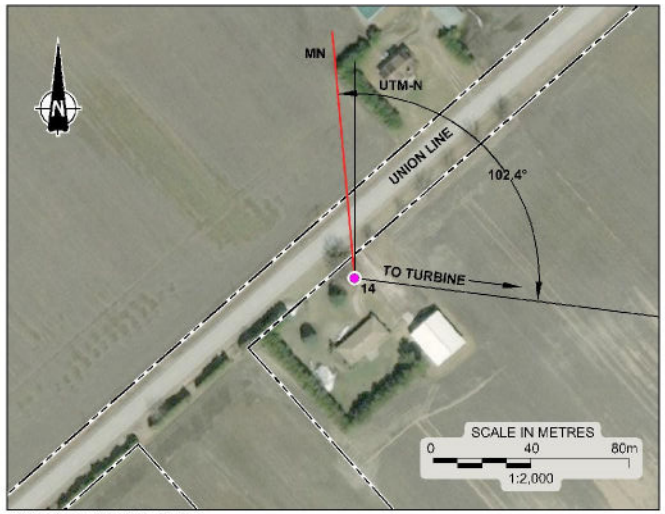
NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #13)



INSET B (WELL #14)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T26

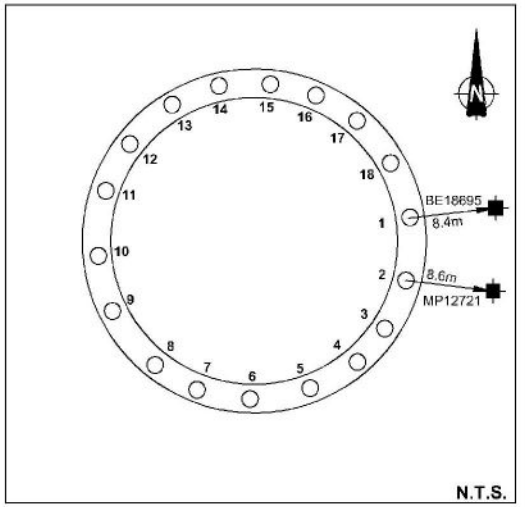
Golder Associates

PROJECT No.			1668031	FILE No. 1668031-2000-R02T26
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 20/17		FIGURE T26
CHECK				

Drawing file: 1668031-2000-R02T26.dwg Sep 20, 2017 - 11:15am



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

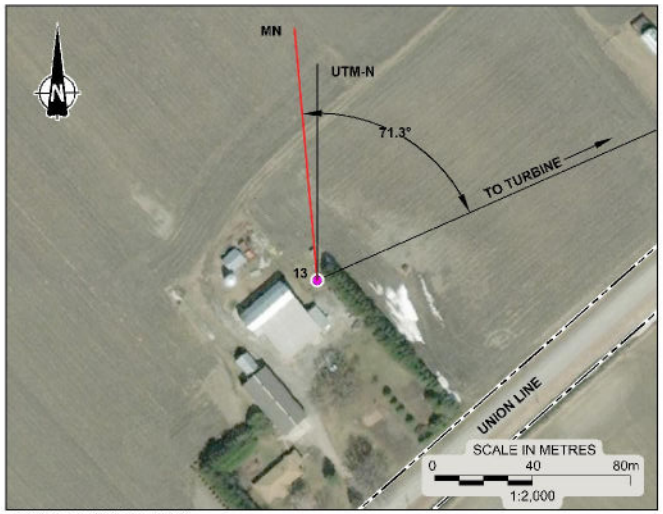
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

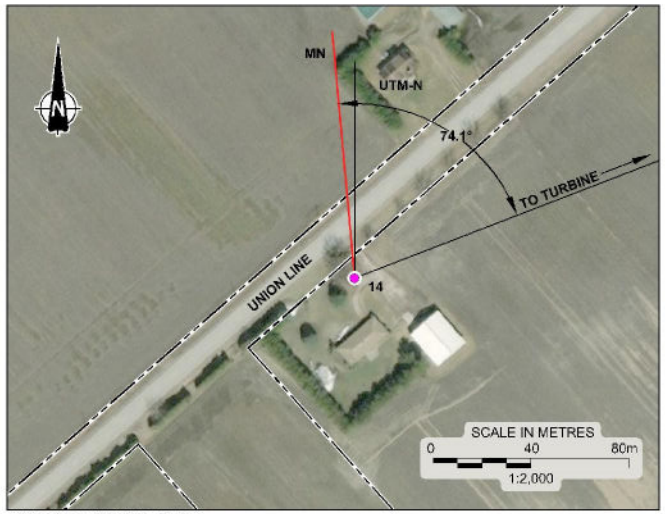
NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #13)



INSET B (WELL #14)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

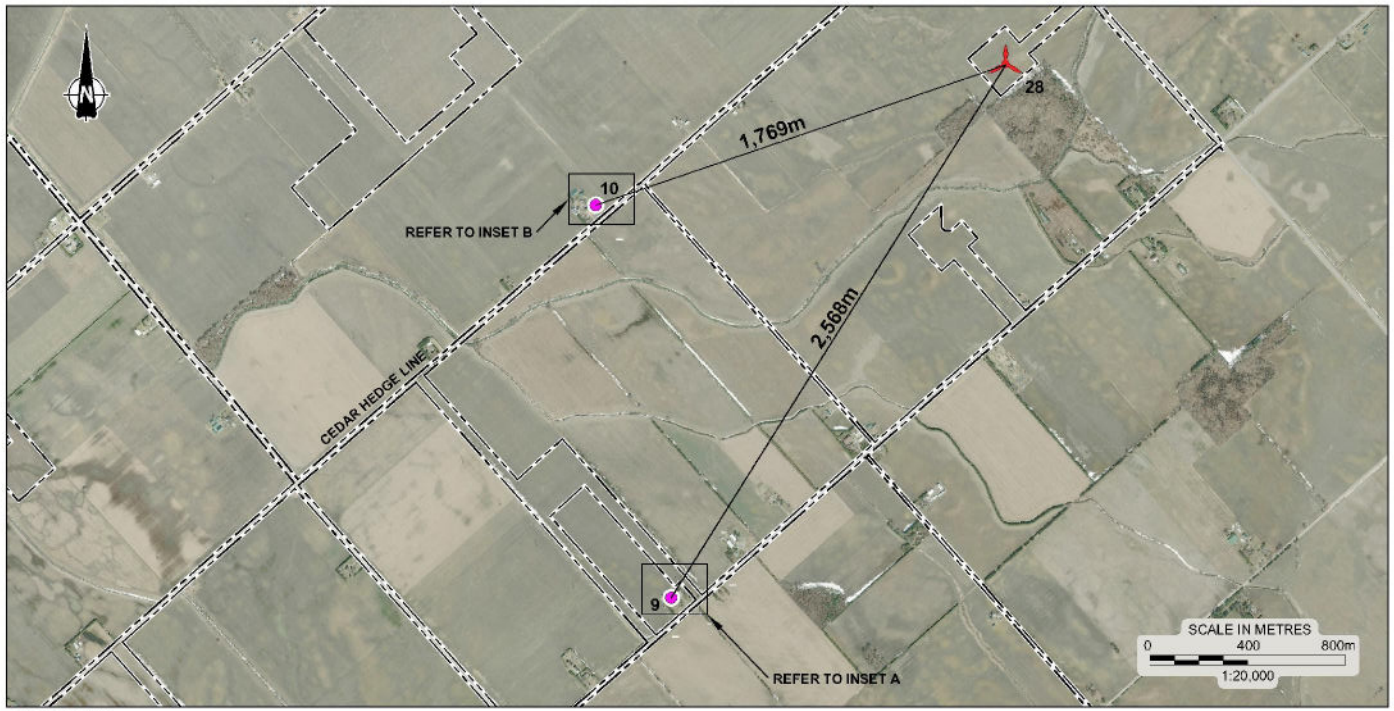
TURBINE PILES AND WATER WELL LOCATION PLAN, T27

Golder Associates

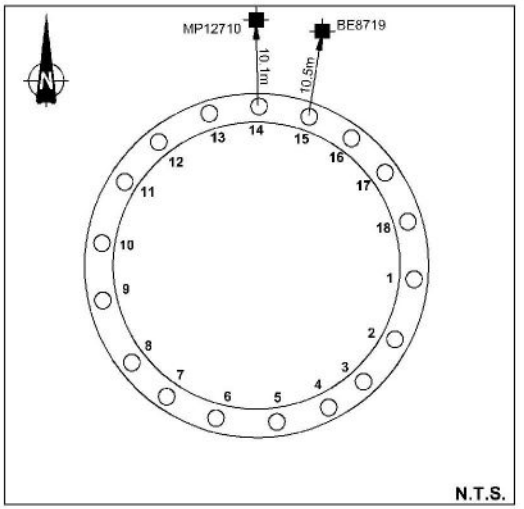
PROJECT No.		1668031	FILE No. 1668031-2000-R02727	
			SCALE AS SHOWN	REV.
CADD	DCH/ZJB	Sept. 20/17		
CHECK				

FIGURE T27

Drawing file: 1668031-2000-R02727.dwg Sep 20, 2017 - 11:10am



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

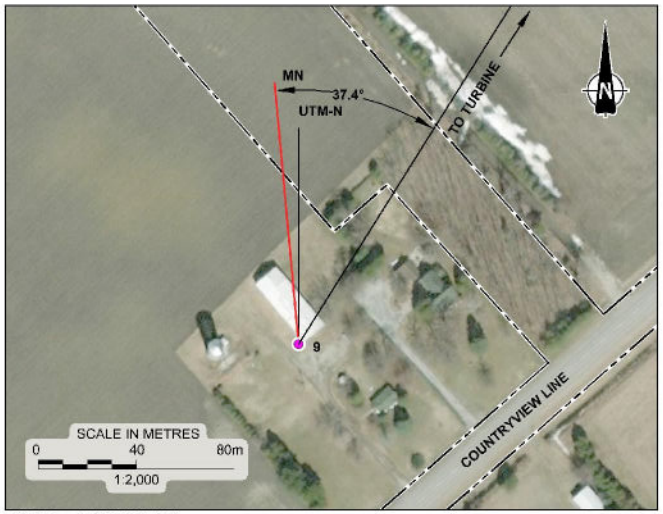
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

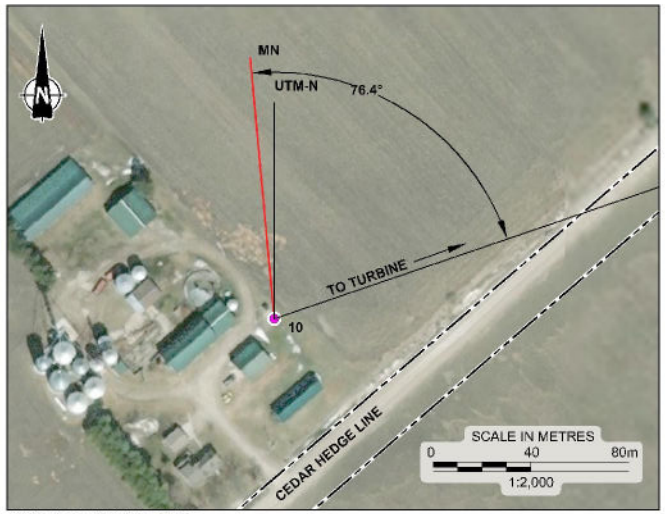
NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #9)



INSET B (WELL #10)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T28

Golder Associates

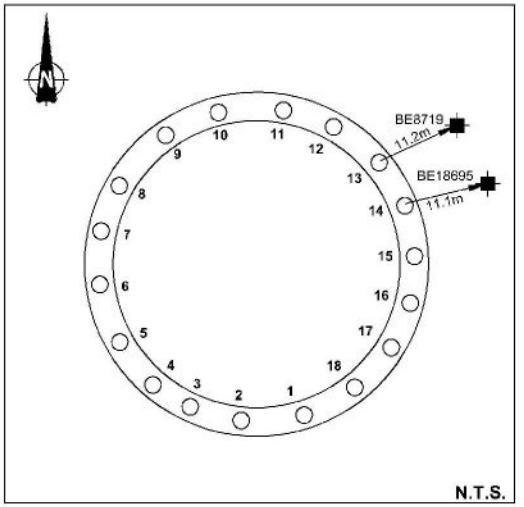
PROJECT No.			1668031	FILE No. 1668031-2000-R02T28
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 20/17		
CHECK				

FIGURE T28

Drawing file: 668031 2000 R02T28.dwg Sep 20, 2017 12:39pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

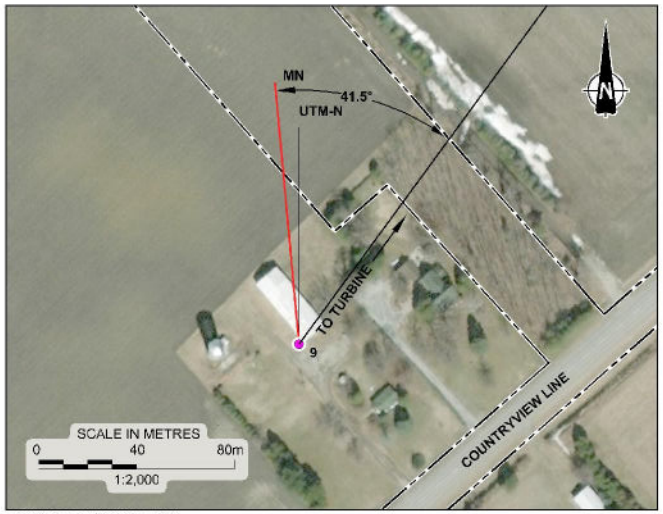
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

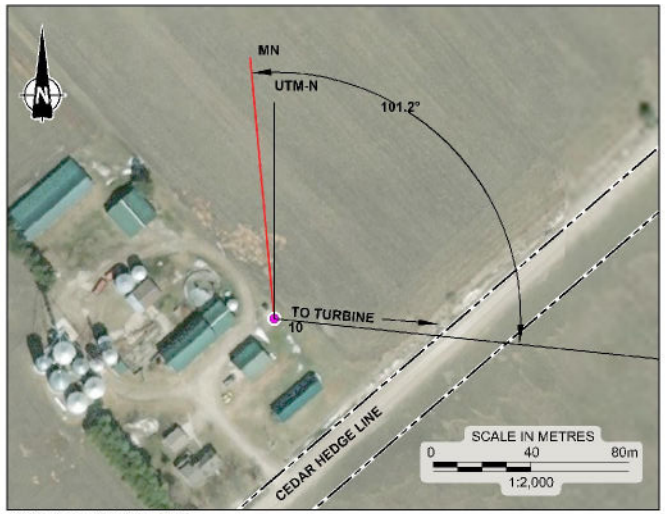
NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #9)



INSET B (WELL #10)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T30

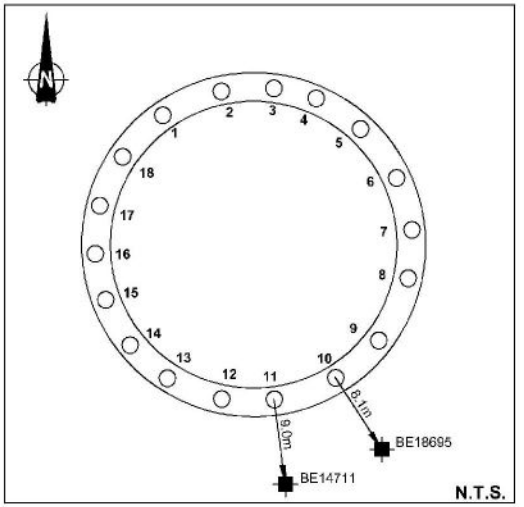
Golder Associates

PROJECT No.			1668031	FILE No. 1668031-2000-R02T30
				SCALE AS SHOWN REV.
CADD	DCH/ZJB	Sept. 20/17		
CHECK				FIGURE T30

Drawing file: 1668031-2000-R02T30.dwg Sep 20, 2017 - 2:41pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

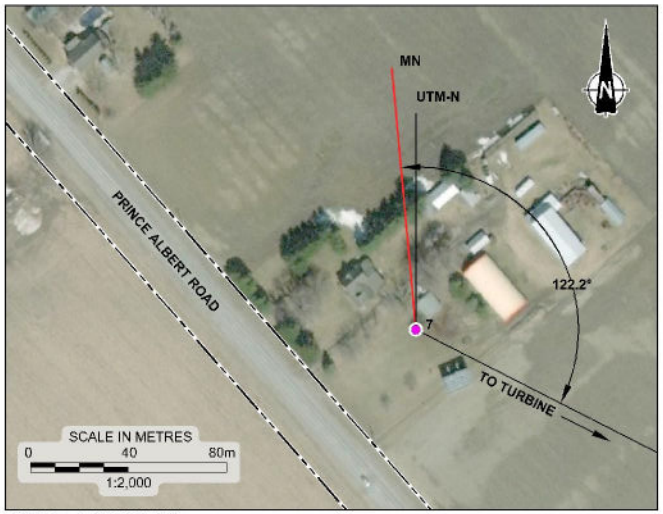
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

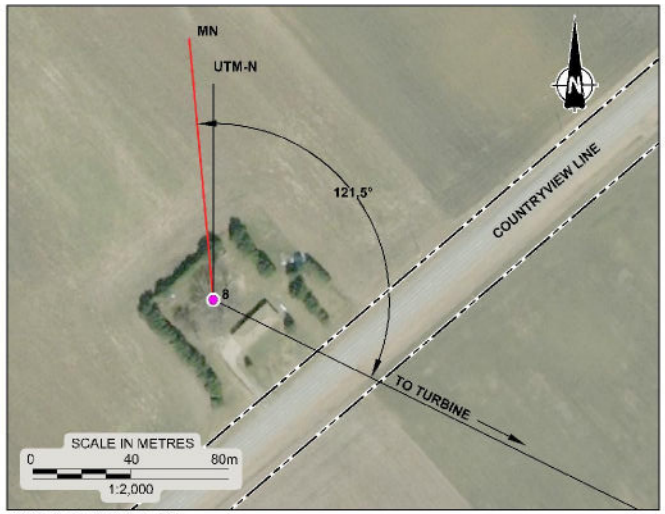
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #7)



INSET B (WELL #8)

PROJECT
NORTH KENT 1
VIBRATION MONITORING

TITLE
TURBINE PILES AND WATER WELL LOCATION PLAN, T31

Golder Associates

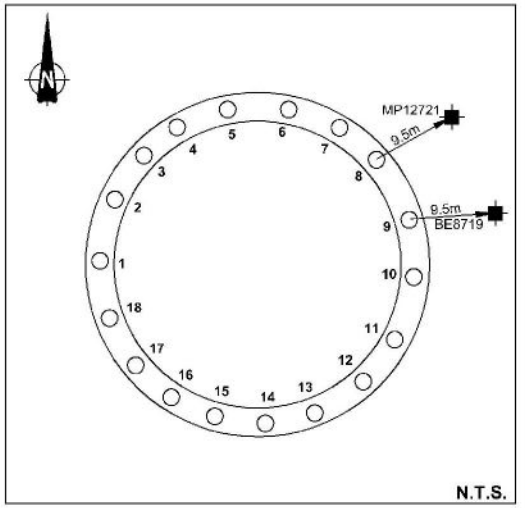
PROJECT No.	1668031		FILE No.	1668031-2000-RG2T31
			SCALE	AS SHOWN
CADD	DDI/ZJB	Sept. 18/17	REV.	
CHECK				

FIGURE T31

Drawing file: 668031 2000 RG2T31.dwg Sep 20, 2017 12:42pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

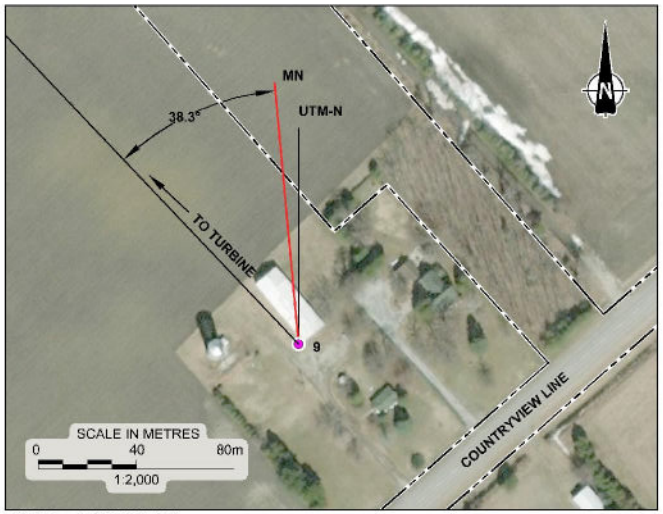
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

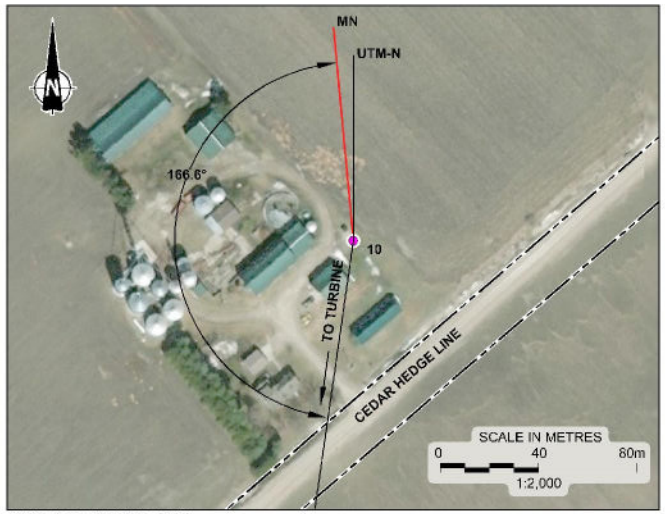
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #9)



INSET B (WELL #10)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T32

Golder Associates

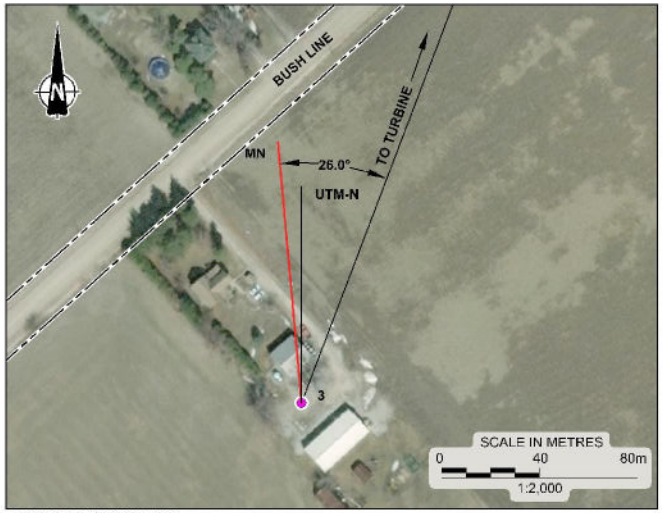
PROJECT No.	1668031	FILE No.	1668031-2000-R02T32
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T32

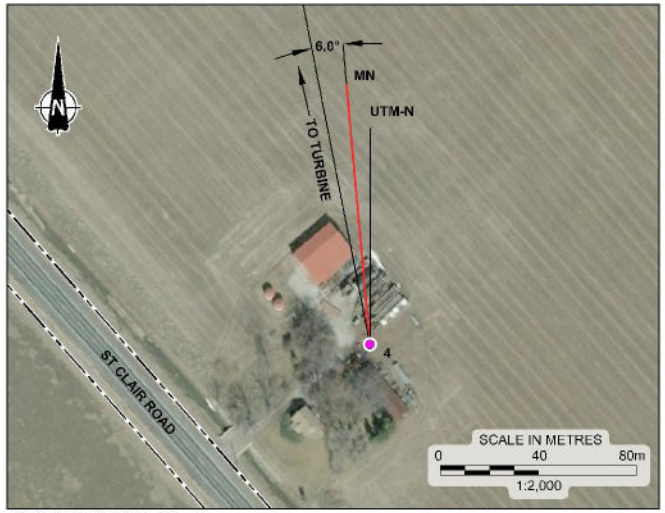
Drawing file: 668031 2000 R02T32.dwg Sep 20, 2017 12:55pm



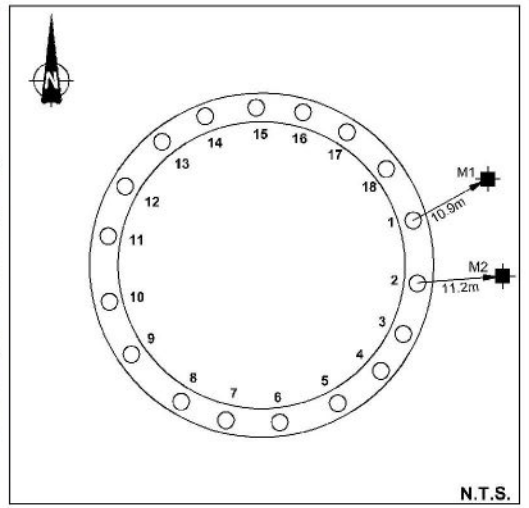
SITE PLAN



INSET A (WELL #3)



INSET B (WELL #4)



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

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ALL LOCATIONS ARE APPROXIMATE.

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T33

Golder Associates

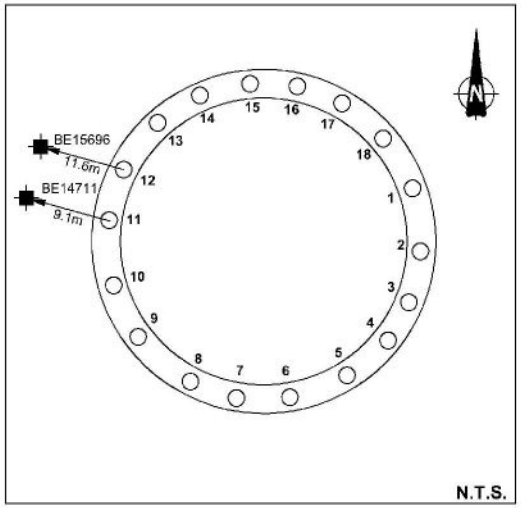
PROJECT No.	1668031	FILE No.	1668031-2000-R02T33
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T33

Drawing file: 1668031-2000-R02T33.dwg Sep 20, 2017 - 2:46pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

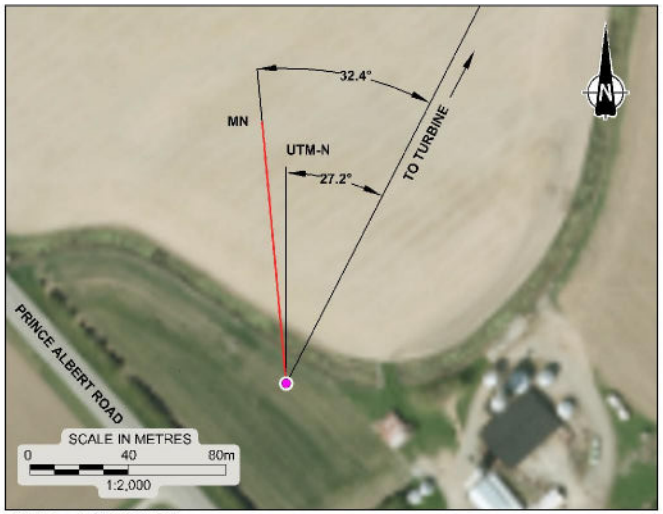
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

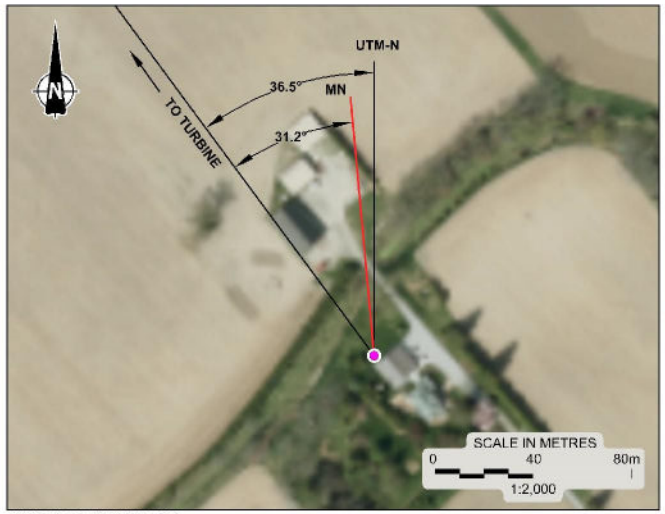
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #6)



INSET B (WELL #5)

PROJECT
NORTH KENT 1
VIBRATION MONITORING

TITLE
TURBINE PILES AND WATER WELL LOCATION PLAN, T35

Golder Associates

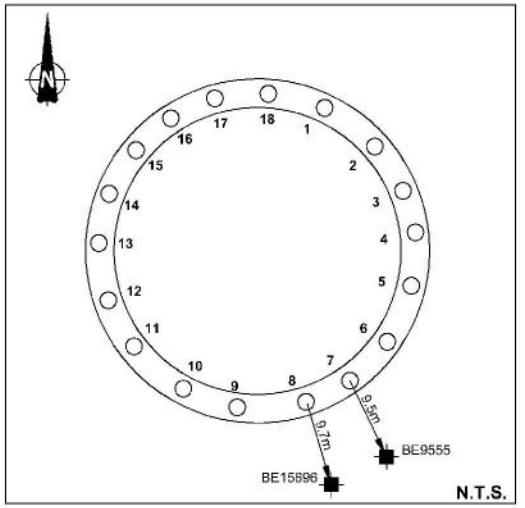
PROJECT No.	1668031	FILE No. 1668031-2000-R02T35
		SCALE AS SHOWN REV.
CADD	DDH/ZJB Sept. 18/17	
CHECK		

FIGURE T35

Drawing file: 1668031 2000 R02T35.dwg Sep 20, 2017 12:47pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

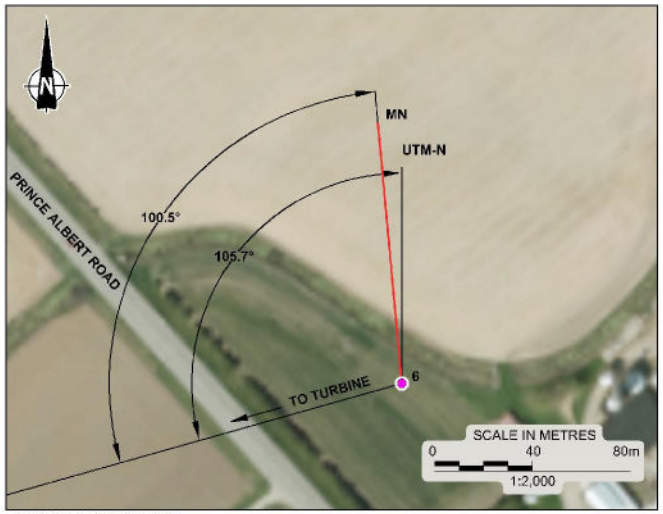
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

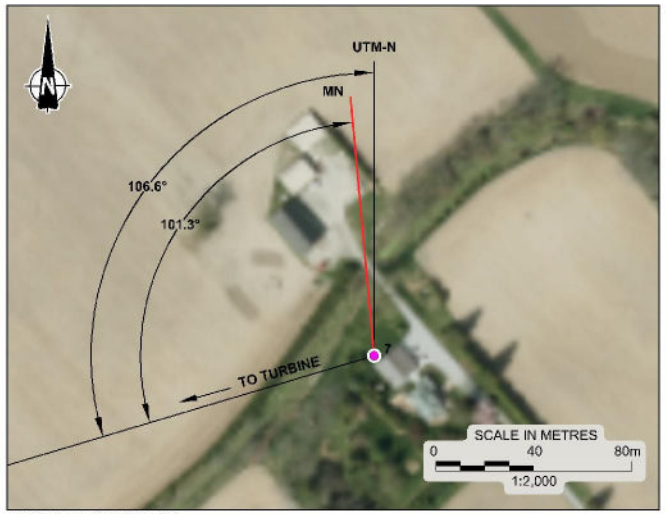
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #6)



INSET B (WELL #5)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T36

Golder Associates

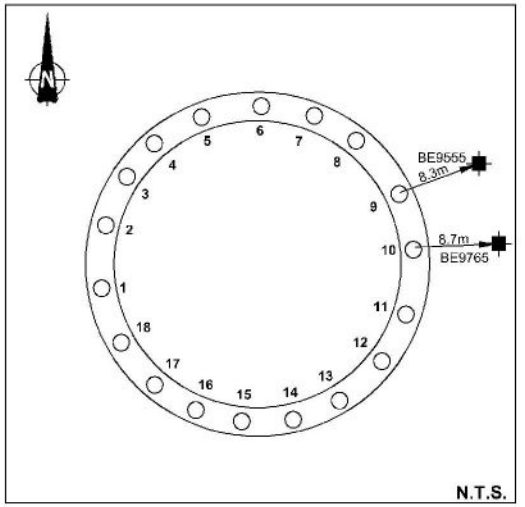
PROJECT No.	1668031		FILE No.	1668031-2000-R02T36
CADD	DCH/ZJB	Sept. 20/17	SCALE	AS SHOWN
CHECK			REV.	

FIGURE T36

Drawing file: 1668031-2000-R02T36.dwg Sep 20, 2017 - 2:49pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

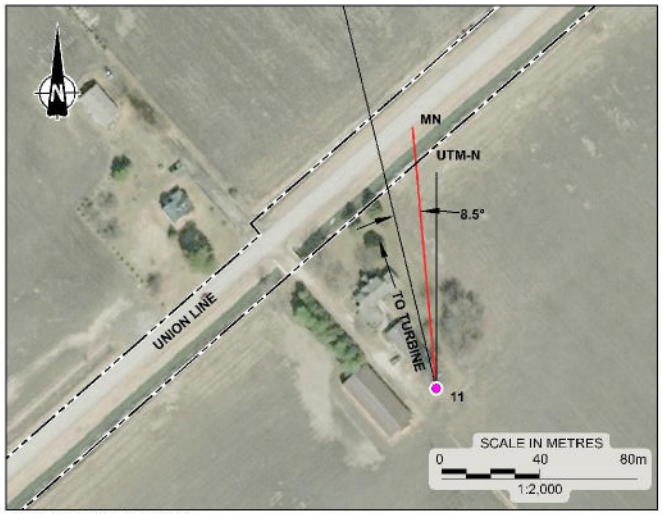
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT. INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

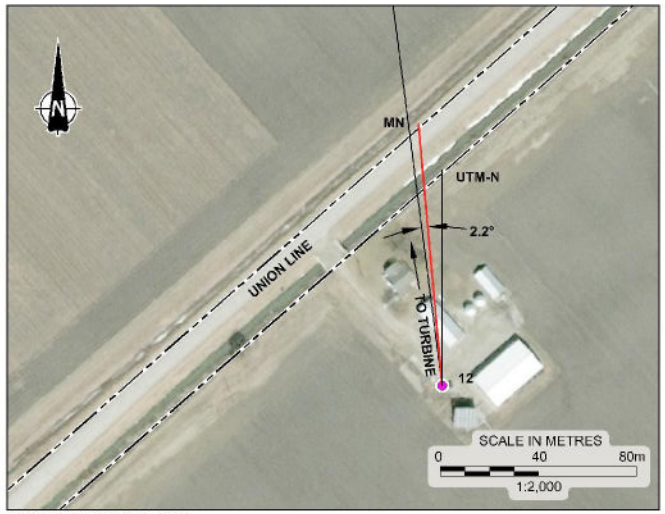
NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T43

Golder Associates

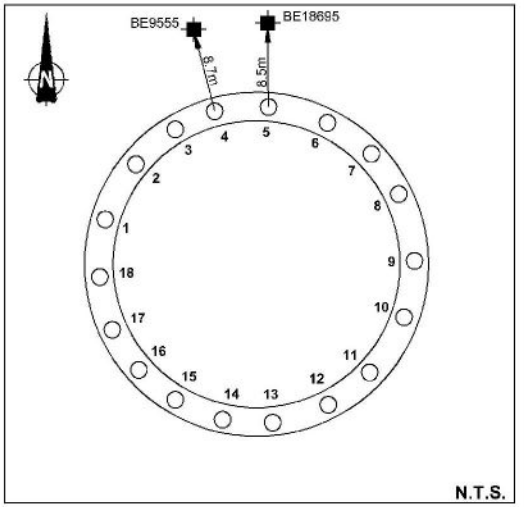
PROJECT No.	1668031	FILE No.	1668031-2000-R02T43
		SCALE	AS SHOWN
CADD	DCH/ZJR Sept. 20/17	REV.	
CHECK			

FIGURE T43

Drawing file: 1668031-2000-R02T43.dwg Sep 20, 2017 - 2:08pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

- INSTANTEL MINIMATE GEOPHONE
- WATER WELL
- TURBINE BEING CONSTRUCTED
- MN — MAGNETIC NORTH
- UTM-N — UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

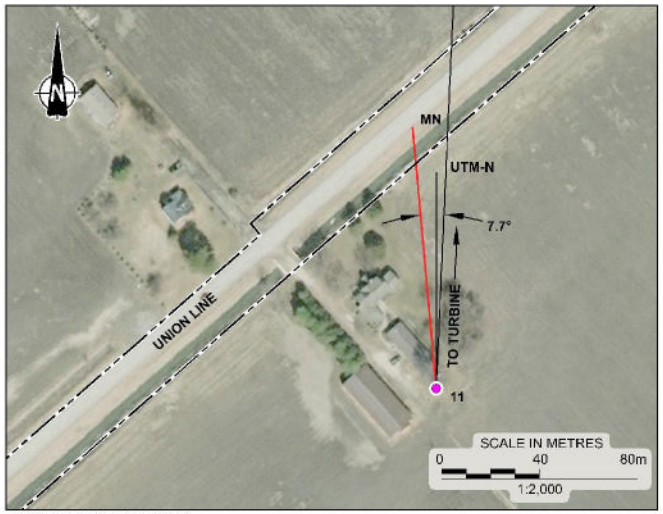
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

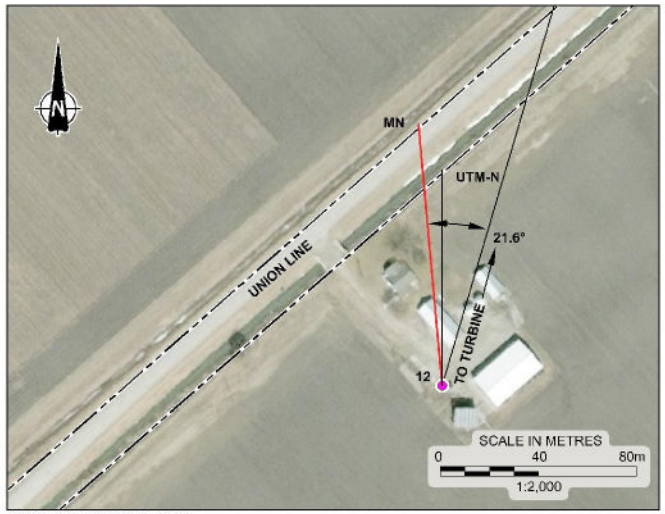
NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T45

Golder Associates

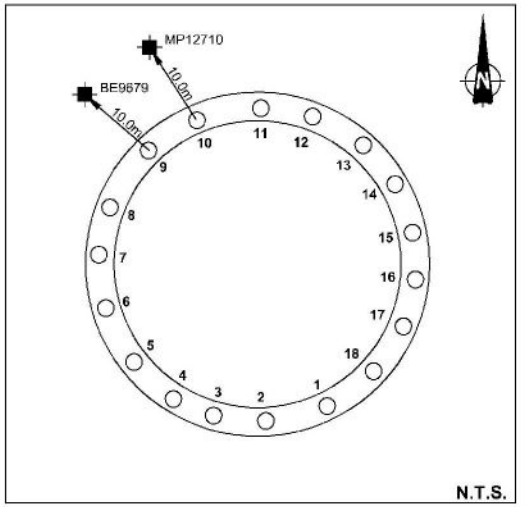
PROJECT No.	1668031	FILE No.	1668031-2000-R02T45
CADD	DCH/ZJB Sept. 18/17	SCALE	AS SHOWN
CHECK		REV.	

FIGURE T45

Drawing file: 1668031-2000-R02T45.dwg Sep 18, 2017 - 2:07pm



SITE PLAN



TURBINE PILE LAYOUT

LEGEND

	INSTANTEL MINIMATE GEOPHONE
	WATER WELL
	TURBINE BEING CONSTRUCTED
MN	MAGNETIC NORTH
UTM-N	UNIVERSAL TRANSVERSE MERCATOR GEOGRAPHIC NORTH

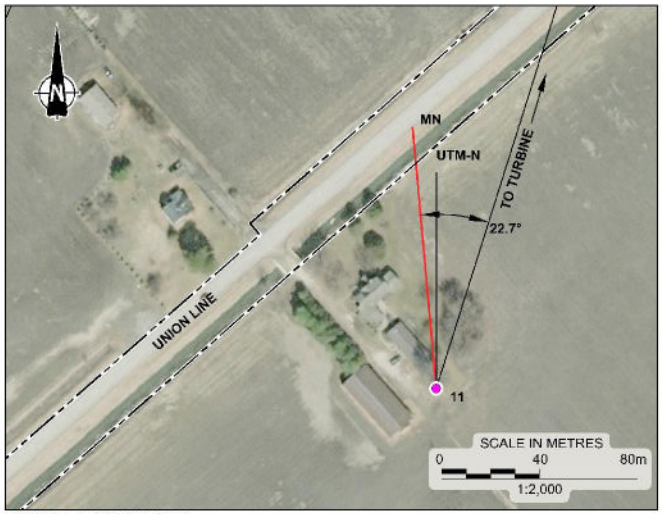
REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

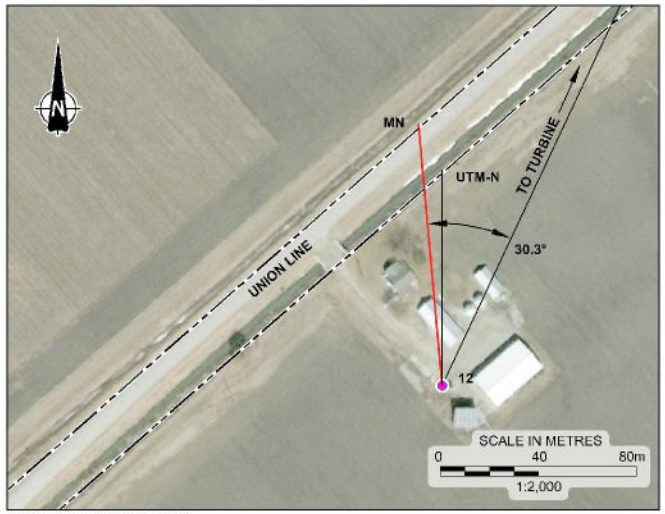
NOTES

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ALL LOCATIONS ARE APPROXIMATE.



INSET A (WELL #11)



INSET B (WELL #12)

PROJECT

NORTH KENT 1
VIBRATION MONITORING

TITLE

TURBINE PILES AND WATER WELL LOCATION PLAN, T46

Golder Associates

PROJECT No.	1658031	FILE No.	1658031-2000-R02T46
		SCALE	AS SHOWN
CADD	DCH/ZJB Sept. 18/17	REV.	
CHECK			

FIGURE T46

Drawing file: 1658031 2000 R02T46.dwg Sep 18, 2017 2:07pm

Attachment C

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: **17T181490**

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 03, 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)

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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: 17T181490

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE:

ATTENTION TO: Erin Wilson

SAMPLED BY:D. D. / B. M.

Microbiological Analysis (water)

DATE RECEIVED: 2017-01-26

DATE REPORTED: 2017-02-03

				007530061[redacted]
			SAMPLE DESCRIPTION:	[redacted]
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-01-25
Parameter	Unit	G / S	RDL	8151193
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

8151193 ND - Not Detected.

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
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Certificate of Analysis

AGAT WORK ORDER: 17T181490

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE:

ATTENTION TO: Erin Wilson

SAMPLED BY:D. D. / B. M.

North Kent - Groundwater Samples

DATE RECEIVED: 2017-01-26

DATE REPORTED: 2017-02-03

				007530061[redacted]
			SAMPLE DESCRIPTION:	[redacted]
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2017-01-25
Parameter	Unit	G / S	RDL	8151193
Electrical Conductivity	uS/cm		2	1750
pH	pH Units	(6.5-8.5)	NA	8.03
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	97.7
Total Dissolved Solids	mg/L	500	20	**832**
Total Suspended Solids	mg/L		10	<10
Alkalinity (as CaCO3)	mg/L	(30-500)	5	188
Fluoride	mg/L	1.5	0.05	0.76
Chloride	mg/L	250	1.0	**498**
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	0.30
Dissolved Organic Carbon	mg/L	5	0.5	1.9
Colour	TCU	5	5	**8**
Turbidity	NTU	5	0.5	2.3
Calcium	mg/L		0.10	23.0
Magnesium	mg/L		0.10	9.78
Sodium	mg/L	20 (200)	0.10	**295**
Potassium	mg/L		0.10	2.63
Iron	mg/L	0.3	0.010	0.220
Manganese	mg/L	0.05	0.002	0.006

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

8151193 Elevated RDLs indicate the degree of sample dilution prior to analyses in order to reduce matrix interference and to keep analytes within the calibration range of the instrument.

Certified By: Elizabeth Rolakowska

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

AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 17T181490

PROJECT: 60343599

5835 COOPERS AVENUE
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CANADA L4Z 1Y2
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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
8151193	007530061 [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Chloride	mg/L	250	498
8151193	007530061 [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Colour	TCU	5	8
8151193	007530061 [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Sodium	mg/L	20 (200)	295
8151193	007530061 [redacted]	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Total Dissolved Solids	mg/L	500	832

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

Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T181490

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:D. D. / B. M.

Microbiology Analysis

RPT Date: Feb 03, 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	8151173	8151173	ND	ND	NA	< 1									
Total Coliforms	8151173	8151173	ND	ND	NA	< 1									

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

Microbiological Analysis (water)															
Escherichia coli	8151248	8151248	ND	ND	NA	< 1									
Total Coliforms	8151248	8151248	ND	ND	NA	< 1									

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

Certified By:



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

Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T181490

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:D. D. / B. M.

Water Analysis

RPT Date: Feb 03, 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 - Groundwater Samples															
Electrical Conductivity	8148894		581	583	0.3%	< 2	104%	80%	120%	NA			NA		
pH	8148894		7.73	7.80	0.9%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8151173	8151173	434	424	2.3%	< 20	98%	80%	120%	NA			NA		
Total Suspended Solids	8151173	8151173	<10	<10	NA	< 10	98%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8148894		60	60	0.0%	< 5	96%	80%	120%	NA			NA		
Fluoride	8153424		<0.25	<0.25	NA	< 0.05	99%	90%	110%	94%	90%	110%	94%	80%	120%
Chloride	8153424		25.6	25.8	0.6%	< 0.10	92%	90%	110%	94%	90%	110%	95%	80%	120%
Nitrate as N	8153424		<0.25	<0.25	NA	< 0.05	91%	90%	110%	100%	90%	110%	101%	80%	120%
Nitrite as N	8153424		<0.25	<0.25	NA	< 0.05	NA	90%	110%	107%	90%	110%	104%	80%	120%
Bromide	8153424		<0.25	<0.25	NA	< 0.05	109%	90%	110%	92%	90%	110%	83%	80%	120%
Sulphate	8153424		38.6	37.1	4.0%	< 0.10	94%	90%	110%	90%	90%	110%	90%	80%	120%
Ammonia as N	8151173	8151173	0.12	0.12	0.0%	< 0.02	94%	90%	110%	96%	90%	110%	92%	80%	120%
Dissolved Organic Carbon	8151173	8151173	2.0	1.8	NA	< 0.5	98%	90%	110%	100%	90%	110%	93%	80%	120%
Colour	8161451		56	56	0.0%	< 5	102%	90%	110%	NA			NA		
Turbidity	8147850		<0.5	<0.5	NA	< 0.5	103%	90%	110%	NA			NA		
Calcium	8151242	8151242	10.8	10.8	0.2%	< 0.05	101%	90%	110%	99%	90%	110%	102%	70%	130%
Magnesium	8151242	8151242	4.19	4.16	0.6%	< 0.05	97%	90%	110%	95%	90%	110%	98%	70%	130%
Sodium	8151242	8151242	200	196	2.0%	< 0.05	101%	90%	110%	101%	90%	110%	101%	70%	130%
Potassium	8151242	8151242	1.84	1.84	0.1%	< 0.05	99%	90%	110%	99%	90%	110%	103%	70%	130%
Iron	8151173	8151173	0.162	0.169	4.2%	< 0.010	97%	90%	110%	95%	90%	110%	103%	70%	130%
Manganese	8151173	8151173	0.008	0.008	NA	< 0.002	102%	90%	110%	105%	90%	110%	89%	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: Elizabeth Rolakowska

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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: 17T181490

PROJECT: 60343599

ATTENTION TO: Erin Wilson

SAMPLING SITE:

SAMPLED BY:D. D. / 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

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

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: 17T260419

MICROBIOLOGY ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

WATER ANALYSIS REVIEWED BY: Parvathi Malemath, Data Reviewer

DATE REPORTED: Sep 19, 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.

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
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

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Certificate of Analysis

AGAT WORK ORDER: 17T260419

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Microbiological Analysis (water)

DATE RECEIVED: 2017-09-15

DATE REPORTED: 2017-09-19

		SAMPLE DESCRIPTION:		007530061
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2017-09-14
Parameter	Unit	G / S	RDL	8720027
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
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.

8720027 ND – Not detected;

Certified By: Divine Basily

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Certificate of Analysis

AGAT WORK ORDER: 17T260419
PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD
SAMPLING SITE:

ATTENTION TO: Jason Murchison
SAMPLED BY:

North Kent - Groundwater Samples

DATE RECEIVED: 2017-09-15

DATE REPORTED: 2017-09-19

		SAMPLE DESCRIPTION:		007530061
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2017-09-14
Parameter	Unit	G / S	RDL	8720027
Electrical Conductivity	uS/cm		2	1750
pH	pH Units	(6.5-8.5)	NA	8.20
Total Hardness (as CaCO3)	mg/L	(80-100)	0.5	99.8
Total Dissolved Solids	mg/L	500	20	828
Total Suspended Solids	mg/L		10	<10
Alkalinity (as CaCO3)	mg/L	(30-500)	5	199
Fluoride	mg/L	1.5	0.05	0.98
Chloride	mg/L	250	5.0	456
Nitrate as N	mg/L	10.0	0.05	<0.05
Nitrite as N	mg/L	1.0	0.05	0.12
Bromide	mg/L		0.05	<0.05
Sulphate	mg/L	500	1.0	<1.0
Ammonia as N	mg/L		0.02	0.34
Dissolved Organic Carbon	mg/L	5	0.5	4.7
Colour	Apparent CU	5	5	15
Turbidity	NTU	5	0.5	1.2
Calcium	mg/L		0.50	23.3
Magnesium	mg/L		0.50	10.1
Sodium	mg/L	20 (200)	0.50	309
Potassium	mg/L		0.50	2.68
Iron	mg/L	0.3	0.010	0.200
Manganese	mg/L	0.05	0.002	0.007

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.

8720027 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:



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Guideline Violation

AGAT WORK ORDER: 17T260419

PROJECT: 60343599

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Jason Murchison

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8720027	007530061	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Chloride	mg/L	250	456
8720027	007530061	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Colour	Apparent CU	5	15
8720027	007530061	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Sodium	mg/L	20 (200)	309
8720027	007530061	O.Reg.169/03(mg/L)	North Kent - Groundwater Samples	Total Dissolved Solids	mg/L	500	828

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T260419

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Microbiology Analysis

RPT Date: Sep 19, 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	8720026	8720026	ND	ND	NA	< 1									
Total Coliforms	8720026	8720026	ND	ND	NA	< 1									

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

Certified By: Nivine Basily

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Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T260419

PROJECT: 60343599

ATTENTION TO: Jason Murchison

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Sep 19, 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	8721372		2440	2500	2.4%	< 2	109%	80%	120%						
pH	8721372		7.92	7.91	0.1%	NA	99%	90%	110%						
Total Dissolved Solids	8720026	8720026	544	568	4.3%	< 20	98%	80%	120%						
Total Suspended Solids	8719893		863	882	2.2%	< 10	96%	80%	120%						
Alkalinity (as CaCO3)	8721372		386	381	1.3%	< 5	101%	80%	120%						
Fluoride	8722422		<0.05	<0.05	NA	< 0.05	101%	90%	110%	98%	90%	110%	103%	80%	120%
Chloride	8722422		4.33	4.34	0.2%	< 0.50	91%	90%	110%	108%	90%	110%	104%	80%	120%
Nitrate as N	8722422		<0.05	<0.05	NA	< 0.05	90%	90%	110%	107%	90%	110%	91%	80%	120%
Nitrite as N	8722422		<0.05	<0.05	NA	< 0.05	NA	90%	110%	97%	90%	110%	88%	80%	120%
Bromide	8722422		<0.05	<0.05	NA	< 0.05	104%	90%	110%	108%	90%	110%	104%	80%	120%
Sulphate	8722422		<0.10	0.46	NA	< 0.10	95%	90%	110%	107%	90%	110%	103%	80%	120%
Ammonia as N	8722931		<0.02	<0.02	NA	< 0.02	92%	90%	110%	100%	90%	110%	89%	80%	120%
Dissolved Organic Carbon	8720026	8720026	7.2	6.7	7.2%	< 0.5	93%	90%	110%	105%	90%	110%	95%	80%	120%
Colour	8720026	8720026	15	15	NA	< 5	105%	90%	110%						
Turbidity	8720026	8720026	1.4	1.4	NA	< 0.5	100%	90%	110%						
Calcium	8713953		15.9	15.8	0.6%	< 0.10	96%	90%	110%	97%	90%	110%	98%	70%	130%
Magnesium	8713953		4.39	4.32	1.6%	< 0.10	97%	90%	110%	98%	90%	110%	98%	70%	130%
Sodium	8713953		51.9	51.5	0.8%	< 0.10	99%	90%	110%	99%	90%	110%	101%	70%	130%
Potassium	8713953		2.10	2.06	1.9%	< 0.10	99%	90%	110%	99%	90%	110%	100%	70%	130%
Iron	8720026		0.178	0.174	2.3%	< 0.010	97%	90%	110%	103%	90%	110%	107%	70%	130%
Manganese	8720026		0.010	0.010	0.0%	< 0.002	101%	90%	110%	105%	90%	110%	109%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the Reporting Limit (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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Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 17T260419

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-93-6059	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 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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