

Review of an Application
for a Permit to Take Water for Aggregate Washing
at the Teedon Pit near Waverley, Ontario

Prepared by: **Wilf Ruland (P. Geo.)**

766 Sulphur Springs Road
Dundas, Ontario
L9H 5E3
Tel: (905) 648-1296
deerspring1@gmail.com

Prepared on behalf of:

Bonnie Pauze and Jake Pigeon
1189 Marshall Road
Tiny, Ontario
LOL 2J0

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1) Background

I am a hydrogeologist, and I have worked as an environmental consultant for 30 years (2 years for a larger firm in Germany, and 28 years independently in Canada). I am a specialist in water resource and contamination issues, and have dealt with many such issues over the course of my consulting career including numerous aggregate-related issues.

I have done high-profile work for the Ministry of the Environment and Climate Change and I have given testimony as an expert witness on hydrogeological issues before various boards, including the Environmental Review Tribunal, the Environmental Assessment Board, the Joint Board, the Canadian Nuclear Safety Commission, the Ontario Municipal Board and the Niagara Escarpment Commission. A copy of my Curriculum Vitae is available upon request.

I have been retained by Bonnie Pauze and Jake Pigeon to prepare a review of the application for a Permit to Take Water (PTTW) for aggregate washing at a nearby aggregate pit known as the Teedon Pit, which is owned by CRH Canada Group Inc. (hereafter referred to as “CRH”).

My clients believe that operations at the Teedon Pit have since 2009 caused negative impacts on the quality of their well water supplies. They have requested the (previous) site owners and the Ministry of the Environment and Climate Change (MOECC) to investigate and assist in developing a remedy to the problem, but instead have had discouraging experiences with both. As a result they have reluctantly decided to retain me to review the aforementioned PTTW Application.

This review outlines my findings, conclusions and recommendations following my review of the PTTW Application.. In preparing this review, I have reviewed the documents which are listed as references in **Appendix 1**.

The focus of my review is the January 18, 2018 document prepared for CRH entitled “Category 1 Permit-To-Take-Water Renewal Application” (hereafter referred to as the “PTTW Application”). The PTTW Application was commissioned by CRH in support of their application for a Permit to Take Water (PTTW) for the Teedon Pit, and was prepared by GHD.

The PTTW Application has been made available by CRH on the following website:
<https://www.dufferinaggregates.com/resourcecentre/#tab-id-4>

In my review I will be going through the PTTW Application in detail. It is my understanding (based on a CRH communication) that the January 18, 2018 PTTW Application document comprises the entirety of the documentation which was submitted to the MOECC in support of the CRH application to renew their PTTW.

2) Introduction and General Site Description

a) Topography

The Teedon Pit is situated in the Simcoe Uplands region of southern Ontario (Chapman and Putnam, 1984). It is sited on the flanks of a massive hill of ice-contact deposits (mainly stratified to substratified sands and gravels, with some incorporated silty till deposits) which extends southward and covers an area of at least 6 square km west of the village of Waverley.

The original ground surface generally sloped downward to the east, north, and west from the area of the CRH property - though the excavations for the Teedon Pit have now altered the original topography.

The ground surface on the highest parts of the CRH property has an elevation of over 300 meters above sea level (masl) to the west of the current pit, with the ground surface falling away quite steeply from there (more than 50 meters) to the west and north and sloping away somewhat more gently in an irregular fashion to the east through the area of the pit toward the property entrance on Darby Road.

b) Drainage

The CRH property is very well drained due to the sand and gravel nature of the subsurface, with no permanent drainage features such as streams or creeks.

Site topography and drainage has been radically altered due to the excavation of the pit, and the provisions made for the aggregate washing operations and for surface water drainage in and around the pit.

A source water “sump pond” and settling ponds have been excavated for the aggregate washing operation. On the date of my site tour on July 7, 2015 the settling pond area was dry and water levels in the source water “sump pond” were low.

Based on my observations during my 2015 site tour it appeared that at that time the runoff from the western part of the pit was into the sump pond and runoff from the eastern part of the pit was being diverted to the north (around the sump pond), flowing down a deeply eroded gully into the unnamed intermittent water course which drains northeast from the center of the CRH property. However air photos suggest and my site tour of April 12, 2018 confirms that this drainage pattern has changed over time.

On the date of my April 2018 site tour all runoff from the entire Teedon Pit was being diverted into the sump pond via an excavated “ramp” which led right to the west bank of the pond, and via a river-rock lined gully which feeds into the east side of the pond.

During heavy rain events, very significant amounts of silt-laden runoff from the area of the excavated pit will be running into the sump pond. The sump pond also receives silt-laden overflow from the aggregate washing operations. These combined inputs of silt-laden water account for the unnatural colour of pond which is often seen in air photos.

What has been created by the past and current owners of the Teedon Pit is a massive source of water which is often silt-laden and which resides in the sump pond at the site. This should be the starting point of any discussions about potential impacts of the pit and its various operations on off-site groundwater supplies.

c) Geology

The bedrock beneath the area is the Bobcaygeon Formation, a limestone bedrock. It is found deep beneath the ground surface, covered by very thick overburden deposits. None of the local wells on which information is available extend to the bedrock, and it is of no further interest in this matter and will not be discussed further in this review.

Overlying the bedrock are the very thick overburden deposits found in what is referred to by Chapman and Putnam (1984) as the Simcoe Uplands region of southern Ontario. The Simcoe Uplands consist of broad rolling till plains and moraines, overlain or interstratified locally with ice-contact deposits.

The Teedon Pit is sited on the flanks of a massive hill of ice-contact deposits (mainly stratified to substratified sands and gravels, with some incorporated silty till deposits). The sands and gravels are being mined in the Teedon Pit.

Figure 3.8 of the PTTW Application is a cross-section which gives a sense of the massive hill of sand and gravel which is being mined in the pit. The notch in the hill marks the area where aggregate is being mined.

There is no question that the local geology is quite complex - with almost every borehole log and cross-section through the area of the Teedon Pit and the surrounding properties presenting a different picture regarding the nature and composition of the overburden deposits in the area of the pit.

Stratigraphic logs for a very small subset of the boreholes and test pits at the site are provided in Appendix E of the PTTW Application. The logs provided in Appendix E seem to have been carefully selected, and create the impression that the aggregate deposit which is being mined in the Teedon Pit consists entirely of sand and gravel. This is not the case!

While there are certainly extensive deposits of sand and gravel at the Teedon Pit, there are also finer grained layers of silt and/or clay. One of the reasons for the aggregate washing operations is to get the silt/clay out of various aggregate products.

The existing pit provides an excellent cross-sectional view of the upper portions of the hill's geology in the various exposed faces in the extraction area. During my site tour of the pit on July 7, 2015 I saw extensive sand and gravel deposits. I did not see any clay. There were some places where finer grained materials were present but these materials generally had the consistency of silt (ie. finer than sand, but not as fine as clay). That having been said, I am not aware of any soils testing having been done to try to determine the size of particles which are present in the fine-grained deposits at the pit.

Overall, the complexity of the local geology is such that simplistic interpretations will risk missing the mark in terms of providing an understanding of how groundwater will move in this extraordinary environment. This has been a problem for the Teedon Pit owners' hydrogeologists, who have provided several conflicting interpretations of the site's hydrogeology - none of which are what I would consider to be an accurate description of the nature of groundwater movement in the area.

d) The Teedon Pit and the History of its Aggregate Washing Operations

CRH operates its Class A (Above the Water Table) Teedon Pit on Part of Lots 79 and 80, Concession 1 WPR, Township of Tiny, County of Simcoe. The Teedon Pit is situated on an 85.39 hectare property, of which 76.89 hectares are licensed for aggregate extraction.

There is a market for washed aggregate from the Teedon Pit. The previous owner (Cedarhurst) applied to the MOECC and in April 2008 obtained a Permit to Take Water (PTTW) allowing the company to pump up to 5.2 million liters/day of water from a specially constructed pond for aggregate washing. Aggregate washing commenced in 2009 but the company felt that the pond did not provide sufficient water for its aggregate washing, and subsequently applied to the MOECC for a major revision to its PTTW.

An amended PTTW was issued in July 2010. Under the terms of that amended PTTW (which are still in effect) in the event that natural processes are not adequate to fill the pond then the pond can be "topped up" by pumping up to 1.6 million liters/day of water from a production well (PW1-09) which is situated at the east end of the property.

Aggregate washing commenced in 2009 and has continued off and on since then. An important aspect of understanding the nature and extent of the potential off-site impacts of the aggregate washing activities is getting an understanding of the volumes of water which have been pumped at the Teedon Pit.

A summary of the volumes of water pumped at the Teedon Pit from 2008 through 2014 is provided on Tables 1 through 7 of a letter dated May 8, 2015 in Appendix C. 2 of the PTTW Application (on pages 123 through 129 of the PTTW Application). These annual amounts of water pumped from 2008 through 2014 (based on the data from Tables 1-7) are provided below in **Table 1** (on the next page of this review).

Table 1 - Water Pumped for Aggregate Washing at the Teedon Pit

<u>Year</u>	<u>Water Pumped from Wash Pond</u>	<u>Water Pumped from PW1-09 to Pond</u>
2008	none	none
2009	174,431,841 liters	none
2010	none	19,175,443 liters
2011	33,823,772 liters	14,203,674 liters
2012	51,338,692 liters	34,749,459 liters
2013	55,388,579 liters	18,183,554 liters
2014	none	none
2015	none	108,072,000 liters
2016	unknown	unknown
2017	133,006,943 liters	23,119,409 liters

Note: records relied upon for Table 1 are incomplete for 2009, 2016, and 2017
2017 pumping data are from August 17, 2017 onward (no prior data available)

Table 1 (above) also includes 2015 Teedon Pit pumping data. This data was not provided or alluded to in the main body of the PTTW Application - instead it was buried in a MOECC PTTW Inspection Report in Appendix C.1 of the PTTW Application.

The PTTW Inspection Report in Appendix C.1 of the PTTW Application indicates that an “unplanned pumping” took place at the Teedon Pit in 2015. As a result of a mistake by site personnel, the operator’s pumping well was allowed to pump full out (at an estimated rate of 950 Litres/minute or 1,368,000 Litres/day) for 79 days straight, with all of the pumped water being discharged to the “sump pond” at the Teedon Pit. The sump pond is the pond from which water is pumped to top up the aggregate wash ponds when aggregate washing is occurring.

The unplanned and uncontrolled pumping of massive amounts of groundwater into the sump pond in 2015 was not metered as required by Condition 4.1 of the site's PTTW. The uncontrolled pumping did not come to an end until it was discovered during a site visit on October 15, 2015 by the site manager. Aside from providing evidence of sloppy and questionable operational practices at the Teedon Pit, the uncontrolled pumping in 2015 constituted a massive test of the hydraulics of the pumping well (PW1-09) and of the sump pond. This will be discussed in detail in later sections of this review.

2017 data is only available in the PTTW Application report starting mid-August 2017. It appears that data which was required to be collected prior to that date by the previous owner was not collected or is not available - in non-compliance with the PTTW.

Unfortunately there are significant problems with the pumping data provided in the PTTW Application (which are summarized in **Table 1** above), including the following:

- the monthly pumping data for 2008-2014 (in the PTTW Application's Tables 1-7) are presented in 3 different sets of units (US gallons, Imperial gallons, and Litres) making it very difficult to compare and understand the relative amounts being pumped;
- the daily volumes which the PTTW Application's Table 3 indicates were pumped from PW1-09 in 2010 do not add up to the annual total for PW1-09, meaning there is a mistake in the data being presented;
- Condition 4.1 of the PTTW requires water volumes pumped from the pond and PW1-09 to be metered, but the consultant for the previous pit owners (Mr. Ross Campbell of consulting firm Alpha Environmental Services Inc.) has indicated that in much of 2009 at least there were no meters in use at the pit. It is therefore unclear what the actual basis is for the volumes shown in the PTTW Application's Table 2 (for 2009).
- The PTTW Application does not provide pumping data for 2016. The previous owners claimed that there was no pumping of water into the sump pond and no aggregate washing requiring water to be pumped from the pond. However the hydrograph for PW1-09 (on page 242 in Appendix G.2 of the PTTW Application) shows that there was pumping from PW1-09 in the spring of 2016, and there is a data gap in the second half of 2016. No sump pond pumping data are available at all for 2016.
- The PTTW Application provides no pumping data for the sump pond or for PW1-09 prior to mid-August 2017, apparently because no data could be obtained from the prior owner of the property.

One thing that is clear from the water taking summary which I have compiled in **Table 1** (above) is that a great deal of water has been moving through the pond since 2009. Prior to 2009 there was no sump pond at this location, then the pond was constructed, and the diversion of massive quantities of surface runoff as well as the pumping of massive volumes of water into and out of the pond commenced.

e) Residents' Complaints about Off-Site Impacts

Commencing at roughly the same time as the construction of the sump pond (January to May 2009) and aggregate washing operations at the Teedon Pit (which started in Spring 2009) were impacts on water quality in nearby local residents' domestic wells, including in particular the wells of my clients.

Starting in 2009 the wells began producing turbid (ie. cloudy) water with elevated levels of very fine grained particles. Local residents and experts for the MOECC and the pit owners have simply referred to these very fine grained particles as "silt". To my knowledge there has been no testing to determine the actual particle sizes of the fine grained particles which are turning up in residents' wells, and this is one of many deficiencies in the responses to residents' complaints by the MOECC and the pit owners.

I will likewise refer to the very fine grained particles which are causing the problems as "silt" following the practice of the various parties involved with this matter, but I expect that some of the "silt" in the water may actually consist of very fine clay-sized particles.

There have been complaints at one time or another since 2009 from a number of residents including the following:

- Bonnie Pauze and Jake Pigeon (1189 Marshall Road);
- Glenn and Janet Irvine (7062 Highway 93);
- Peter and Jenny Anderson (6970 Highway 93);
- Kim and Rob Tower (1190 Marshall Road);
- David Barkey (30 Darby Road);
- Rick Lang (20 Darby Road).

A common theme in many of the complaints including my clients' are episodes of cloudy "or silty" well water which in extreme cases clog filters and destroy equipment. Some complainants have also experienced prolonged periods of abnormally high groundwater levels which have caused local flooding problems and/or well issues.

The responses to these complaints have been very poor. The previous owners of the pit (Cedarhurst) did not appreciate complaints. Complaints were often not logged or responded to (in violation of Condition 5.1 of the PTTW), and when there was a complaint response the company and/or its agents could be aggressively hostile. A scientific approach was absent, and victim blaming was often resorted to.

The MOECC wasn't much better. What I would have expected from the MOECC is a proper, science based investigation of the complaints - unfortunately this has never happened. And rather than admitting to its failings in licensing an aggregate washing operation on top of a hill overlying a vulnerable and valuable aquifer without thinking through the potential consequences, the MOECC has resorted to downplaying and/or ignoring complaints and to criticizing residents for poor well construction/maintenance.

I can see no sign in the record of the MOECC and/or the (previous) site owners' complaint responses of an open mind or of a sincere effort to take the complaints at face value and to conduct a proper scientific investigation of whether there was some possible linkage between what was happening at the Teedon Pit and the complainants' observations of impacts on off-site groundwater resources.

f) Off-site Impacts - My Clients' Particular Experiences and Concerns

My clients (Bonnie Pauze and Jake Pigeon) have lived at their present location on Marshall Road about 1.4 km downgradient from the Teedon Pit since 1993. They have 2 wells on their property (one for the house and one for the barn), which until 2009 consistently provided excellent quality water supplies. There were no exceptions, their wells simply delivered excellent quality water.

Since the construction of the wash pond (starting January 2009) and the beginning of aggregate washing at the Teedon Pit (in spring 2009), my clients have suffered very negative impacts to the quality of water from their 2 wells caused by periodic episodes of high levels of very fine particles (silt/clay) in their well water. Their February 2015 written complaint which was sent to the MOECC is provided in **Appendix 2**.

The episodes since 2009 have a seasonal aspect to them. In general, the winter months are good and the wells deliver clear water. Once the snow cover has melted the silt problems can arise. For example after having silt problems earlier in the fall of 2017, since freeze up there was no silt at all in their wells through the winter until an episode which began February 19, 2018 and lasted for about a month. Then it got colder and the wells became clear again and have been so up until the time of my writing this review.

The prior owners' consultant and the MOECC resorted to victim blaming, rejecting any responsibility and telling my clients that the age and/or poor construction of their wells was to blame for any silt problems. This is hard to accept. If there were a problem with the wells' construction, then it would be an ongoing problem. It would not be something that was episodic as has been experienced by my clients. The timing of the problems developing (both wells delivering excellent water until 2009, and then both wells having episodic silt issues since then) is also highly unlikely to have occurred by chance.

The silt episodes seem to be sometimes related to recent aggregate washing activities at the Teedon Pit, but there have been times when a silt episode develops even though no aggregate has been washed recently.

My clients have numerous jars and sample bottles full of cloudy water, which they have shown the MOECC and the consultants for the previous owners. Testing by the prior owners' consultants confirmed elevated levels of turbidity and total suspended solids (TSS) in 2015. In future I recommend that testing be done for both turbidity and TSS.

I have instructed my clients to start collecting simple data which can be used to document and hopefully help understand the silt episodes. When their well water quality is good they are to collect a clear sample bottle weekly (on the same date and time each week), and to write the date on the bottle. As soon as a silt episode develops, they are to collect a bottle daily for the first week and then twice weekly until the water is clear again and then to go back to weekly sampling. In this fashion, some basic data can be collected and hopefully correlated back to events at the pit and/or climatic occurrences.

g) Next Steps

The years since 2009 represent a missed opportunity on the part of both the MOECC as well as the Teedon Pit site owners to develop an understanding of the nature of the silt issue plaguing homeowners downgradient of the pit.

The new owners of the Teedon Pit are now seeking a 10-year renewal of the Permit to Take Water (PTTW) to allow aggregate washing operations to take place at the pit. Given the poor past track record of the pit owners (albeit mostly the previous owners) in running their operation and the poor track record of the MOECC in providing protective PTTW conditions as well as adequate regulatory investigation and oversight, it is my professional opinion that the application for a 10-year renewal should not be approved.

In the following sections of this review I will first be discussing the problematic track record of the site owners in running their operation and investigating and responding to complaints. I will then focus on the MOECC's deficiencies in providing protective PTTW conditions in the original site approvals, and in providing adequate regulatory oversight of the Teedon Pit operations - and its unsatisfactory responses to residents complaints. Finally, I will provide my thoughts on the PTTW application, and my conclusions and my recommendations on how best to proceed.

3) Owners' Deficiencies in Operations and Monitoring of the Teedon Pit

a) Introduction

I will start this section of my review by differentiating clearly between the past owners of the Teedon Pit (Cedarhurst Quarries and Crushing Limited, hereafter referred to as Cedarhurst) and the current owners (CRH).

Cedarhurst ran a relatively small and sloppy aggregate operation at the Teedon Pit. During my tour of the site on July 7, 2015, I noted a general poorly organized layout of the site operations and poor housekeeping practices. I will be describing some of these issues in more detail in the next section of this review.

By comparison, the new owners of the Teedon Pit (CRH) have been in possession of the operation for only 8 or so months (5 of which were winter). In that short time they have significantly and visibly improved the operation and the impression it conveys.

In describing the owners' deficiencies in this section of my review, I will be noting the dates of the occurrences or practices being discussed. CRH received its amended PTTW on August 14, 2017, so any problems before that time would have been the responsibility of Cedarhurst. Any problems after permit issuance are CRH's responsibility.

b) Deficiencies in Site Operations

As outlined above, the prior owners of the Teedon Pit (Cedarhurst) ran a relatively small and sloppy aggregate operation. I had the opportunity to see the pit first hand during my tour of the site in 2015, during which I noted a general poorly organized layout of the site operations and poor housekeeping practices.

Old equipment and piles of debris were scattered around various parts of the pit, and surface water management practices were poor. In particular, I noted (as described in a prior October 2015 Report for my clients) that all of the runoff from the eastern part of the pit was flowing down a deeply eroded gully, around the east side of the sump pond, and discharging off-site straight into the unnamed intermittent surface water course which drains northeast from near the center of the north side of the property.

This is not an acceptable surface water management practice for an aggregate operation.

During each heavy storm event the gully would have been carrying dirty surface water from the pit floor (laden with fine sediment particles), and will have picked up additional coarser sediment as it flowed down the gully (which was deeply eroded into the sandy soils) to the east of the sump pond. All of this silt- and sediment-laden water was being discharged straight from the site into the natural environment - it will not have been beneficial to the downstream natural environment. It will also have been rapidly transmitted downstream (by streamflow) to the vicinity of homes along Highway 93.

In fairness I need to state that the picture was very different during my recent site tour earlier in April 2018 (8 months after CRH took control of the operation). Site layout and organization are noticeably improved, as are housekeeping practices. Surface water drainage is now entirely into the sump pond - there are no uncontrolled discharges into the intermittent surface water course running east from the north part of the site.

Drainage on the east side of the pit is down a cleanly defined channel lined with river rock, eliminating the possibility of increasing the sediment load as a result of erosion of surface water ditching. I noted that flow from the majority of the pit floor is straight into the sump pond, and CRH should consider measures to reduce sediments in this flow.

c) Deficiencies in Owners' Compliance with Conditions of Permits to Take Water

A question which needs to be carefully considered by the MOECC when deciding whether to renew a PTTW, is the track record of the holders of the Permit (ie. the site owners) in complying with the Terms and Conditions of the existing PTTW.

There have been three PTTWs issued to the owners to allow aggregate washing operations at the site as follows:

- 1) PTTW No. 0503-7D4PX7, issued to Cedarhurst on April 18, 2008.
- 2) PTTW No. 4317-87CNZN, issued to Cedarhurst on July 23, 2010.
- 3) PTTW No. 5003-APFH26, issued to CRH on August 14, 2017.

I will deal with the compliance issues for each of these PTTWs in turn.

i) April 18, 2008 PTTW

This was the original PTTW which allowed aggregate washing at the site. Schedule A of the PTTW does not list any supporting documents, so the Permit Holders simply needed to comply with the PTTW Conditions as worded.

Following is a list of non-compliance issues regarding the Conditions of this PTTW by the Permit Holders (which for brevity's sake I am simply calling "violations" in the record I have assembled below).

Condition 4.1

This Condition required the Permit Holder to maintain records of all water takings from the sump pond. The records were to be kept up to date and available for immediate inspection. The total amounts of water pumped were to be measured using a flow meter.

Violation 1

A flow meter was not installed and records were not kept as required by Condition 4.1. An August 2015 Report prepared for Cedarhurst states on page 17 that:

"For a portion of the time in which washing took place in 2009, the water meter was not installed. For another period in 2009, the meter actually failed and had to be repaired while washing continued."

Violation 2

The records were not available for immediate inspection. In fact they were misplaced entirely for many years. When I wrote my previous 2015 Report for my clients the records could not be located, which impeded my work.

Violation 3

In my review of information for this review, I became aware of 2 conflicting sets of records for the takings of water from the sump pond in July 2009.

The earlier record is contained in the April 2010 Report by Alpha Environmental Services Inc. (AES) which supported the Application for the 2nd PTTW for the site. This record is provided on page 7 of Appendix D of the report, and covers the dates July 10, 2009 through July 27, 2010.

The later record is contained on the first page in Appendix A of a November 15, 2015 AES report by the same author, and is said to cover all of 2009.

There are disquieting discrepancies between the two records, including the following:

- There are minor discrepancies in the wash pond staff gauge readings on two dates (July 16 and July 20).
- There are significant discrepancies in the calculations of water recharge volume and water loss volume for every date on which the 2 tables overlap.
- There are significant discrepancies in the calculations of water recharge rate and water loss rate for every date on which the 2 tables overlap.
- There are significant discrepancies in the estimated wash water use volumes for July 15, 16, 17, 20, 21, and 22.
- Perhaps most unsettling is the fact that the earlier record indicates that wash water use (which was required to be recorded by the PTTW) was in fact not recorded on July 10, 13, 14, and 23. The later record replaces the “not recorded” entries with daily volumes of 180,000 US gallons, 120,000 gallons, 540,000 gallons, and 333,000 gallons respectively.
- Finally, the table in the 2015 Report indicates that the area of the wash pond is a fixed 5,750 square meters (m²). By comparison the earlier 2010 Report which contains all of the details of the wash pond’s construction (prepared by the same author) indicates that the area of the wash pond varies from a maximum of 9,866 m² to a minimum of 4,550 m² (based on dimensions provided on a diagram showing the pond’s base measurement details).

I am not sure what all to make of these discrepancies. They certainly undermine my confidence in the accuracy of the records and aggregate washing water use estimates which were the basis for for impact predictions in the MOECC’s 2010 approval of the second PTTW for the site. They also raise questions about the accuracy and veracity of record-keeping by/for Cedarhurst.

Condition 4.2

This Condition required the Permit Holder to measure and record static water levels in monitoring well MW1 and nearby test pit standpipes on a weekly basis, commencing with the first day of taking for the season and continuing until the last day of taking.

Violation 1

Aggregate washing started in Spring 2009. Continuous water level monitoring records for MW1 commence in the Fall of 2010, with only 5 manual readings prior to that - meaning that the required measurements and records are generally not available for the first 1 1/2 seasons of site operations.

Violation 2

Weekly water level measurement records are not available at all for the test pit standpipes - they were to be kept from the first day of aggregate washing 2009.

Condition 4.3

This Condition required the Permit Holder to establish a staff gauge in the sump pond and determine its elevation. Pond water levels were to be measured and recorded at the end of each day on which taking occurred.

Violation 1

These records were not available because “they could not be located” at the time I prepared my prior 2015 Report for my clients.

Condition 5.1

This Condition required the Permit Holder to immediately notify the local MOECC District Office of any complaints and report any actions which have been taken.

Violation 1

Mr. Steve Ogden wrote to Cedarhurst in June 2009 expressing concern of abnormally high water levels on his property (which may well have been caused by the excavation of the sump pond and the diversion of all surface drainage from the pit into the pond). Cedarhurst never replied to Mr. Ogden’s letter. It appears that no notification was provided to the MOECC of the concerns raised.

ii) July 23, 2010 PTTW

This second PTTW was requested because the Permit Holder determined that “natural” recharge of the sump pond was not going to provide enough water to support the aggregate washing operations. The claim that the sump pond was not providing sufficient water for aggregate washing is problematic, given that far more aggregate was able to be washed in 2009 (in the apparent absence of “top up” water) than in any subsequent year.

In any event, the MOECC granted approval of the PTTW application, subject to conditions spelled out in the PTTW. Schedule A of the PTTW lists 3 supporting documents, so the Permit Holders needed to ensure compliance with both the PTTW Conditions as well as the project requirements listed in the supporting documents.

Following is a list of non-compliance issues (ie. “violations”) by the Permit Holder regarding the Conditions of this PTTW and violations of the project requirements stipulated in the supporting documents in Schedule A.

Condition 4.1

This Condition required the Permit Holder to install and maintain flow meters on PW1-09 and the sump pond. Meter readings were to be recorded daily and available for inspection by the MOECC.

Violation 1

When I conducted my site tour on July 7, 2015 neither of the required flow meters were installed (in fact they couldn't be found). I believe that the failure to have the flow meters in place may well have contributed to the unplanned and uncontrolled 79-day full-out pumping of water from PW1-09 into the wash pond - this at a time when Cedarhurst claimed that no water was needed.

Violation 2

Flow meter readings for PW1-09 are not available for 2016 or the first half of 2017, in contravention of the requirements of this Condition.

The previous owners claimed there was no pumping in 2016, however the water level hydrograph for PW1-09 (on page 242 of Appendix G.2 of the PTTW Application) shows that this is not correct - there was pumping from PW1-09 in the spring of 2016, and there is an anomalous gap in the hydrograph data in the second half of 2016.

Violation 3

Flow meter readings for the wash pond are not available for 2016 or before mid-August 2017 - they only recommence after the site comes under the control of CRH. There is no way to determine if water was pumped from the wash pond in 2016 or prior to mid-August 2017.

Condition 4.2

This Condition required the Permit Holder to install and maintain continuous water level recorders on PW1-09, a well of comparable depth to PW1-09 (MW1-09), and a well in the shallow aquifer on the site. Data collected were to be available to MOECC staff at any time upon request.

Violation 1

There is a gap of about 5 months (in the second half of 2016) in the water level hydrograph from the water level recorder on PW1-09. The recorder was clearly not being maintained in that time.

Condition 5.1

This Condition required the Permit Holder to immediately notify the local MOECC District Office of any complaints and report any actions which have been taken.

Numerous Violations

The previous Permit Holder (Cedarhurst) often did not inform the local (Barrie) MOECC District Office of complaints which they received. My clients know this from their own first hand experience (including instances where they made complaints which were not disclosed to the MOECC at all by Cedarhurst), and I understand that other residents may have had similar experiences.

The MOECC's January 2016 Inspection Report (which can be found starting on page 85 of the PTTW Application) confirms deficiencies in regard to this Condition.

Item 1 of Schedule A

This Item is the Application Form for the 2010 Permit to Take Water, which was signed on April 29, 2010. It is one of the supporting documents for the PTTW, and it is considered to form part of the PTTW.

Violation 1

Page 5 of 7 of Application Form states that the earliest dates of taking of water from the sump pond and PW1-09 will be May 1st and that the latest date will be December 1st.

Review of the water level hydrograph for PW1-09 suggests that there was pumping of PW1-09 prior to May 1st in 2011 and 2016.

ii) August 14, 2017 PTTW

This third PTTW was issued in response to the change in ownership of the Teedon Pit from Cedarhurst to CRH. I did not find changes in any of the operative Conditions or Schedule A documents.

The re-issuance of a PTTW at the time of a change in ownership is routine, and I have no problem with the PTTW being revised and re-issued to reflect the new ownership.

Item 1 of Schedule A

This Item is the Application Form for the prior 2010 Permit to Take Water, which was signed on April 29, 2010. It remains one of the supporting documents for this amended PTTW, and it is considered to form part of the PTTW.

Violation 1

Page 5 of 7 of Application Form states that the earliest dates of taking of water from the sump pond and PW1-09 will be May 1st and that the latest date will be December 1st.

Review of the records for aggregate washing-related water takings (from the sump pond and PW1-09) which can be found in Appendix G.3 of the PTTW Application suggests that there was pumping of both the sump pond and PW1-09 on several days subsequent to December 1st in 2017.

Given the overall much-improved appearance of the site I expect that this incidence of non-compliance on the part of the new Permit Holders could have been inadvertent. I note that the application for a new 10-year permit removes the date restrictions, and if approved will allow pumping of PW1-09 and/or the wash pond on any day of the year for a total of up to 210 days.

Overall, the above record of non-compliance issues (or violations) of PTTW Conditions is of considerable concern. It speaks to a site which for many years was at best sloppily operated by the previous Permit Holder without adequate oversight from the MOECC.

The MOECC's first inspection of the site to assess compliance with the PTTW did not occur until 6 years after aggregate washing began (in June 2015), and only came after numerous complaints had been made to the site operators and the MOECC itself.

It is worth noting that the MOECC was not aware of (or if it was aware did not disclose to the public) most of the numerous instances of non-compliance with Conditions of the PTTW which are listed above. This does not build confidence in the MOECC as the regulatory authority for the site.

Ministry of Natural Resources (MNR) oversight of the site was also not impressive. The original 1993 Operational Site Plan for the site did not include provisions for an aggregate washing operation. The wash ponds and sump pond were constructed and aggregate washing was ongoing for years before this aspect of the pit operation was permitted by MNR and included on an approved Operations Site Plan for the site.

It was not until a major set of site plan amendments was approved on November 30, 2016 that a wash plant and wash pond were permitted on-site - 7 years after washing had commenced. The site plans for the site were subsequently updated to show the details of the aggregate washing operation and to reference the PTTW.

d) Deficiencies in Previous Owners' Hydrogeological Monitoring and Investigations

By 2015, the previous owner and PTTW Permit Holder (Cedarhurst) was receiving complaints and hearing concerns from a number of local residents about impacts that they believed were being caused by operations at the Teedon Pit.

Based on my meetings with my clients and many of the other residents I believe that their complaints were made fairly and in good faith, and that a thoughtful review and scientific investigation of potential impacts of site operations would have been the appropriate response. The company's actual response to these complaints and concerns can best be described as a failure.

A report was produced in August 2015 for Cedarhurst entitled "Assessment of Local Well Water Quality Complaints", and it is referred to hereafter as the "Complaints Assessment Report". I covered the deficiencies in the Complaints Assessment Report in detail in Section 4 of my 2015 Report which I prepared previously for my clients. That report of mine is provided in **Appendix 4** of this review.

I do not plan to replicate my entire discussion of the deficiencies in the prior Permit Holder's Complaints Assessment Report in this review. However it is worth providing a bullet point summary of those deficiencies, and I do so below. If more detailed description and discussion than what is provided below is being sought, then I refer the reader to Section 4 of my 2015 Report in **Appendix 4**.

In order for the prior owner of the Teedon Pit to properly assess the off-site impacts of their aggregate washing operation, the starting point needed to be a solid and detailed understanding of the site hydrogeology. The work which was done in this regard for Cedarhurst was in my professional opinion inadequate to allow for a proper assessment of the potential impacts of the aggregate washing activities.

The following items (which I believe are necessary to allow for a proper assessment of impacts) were not included in the previous Permit Holders' Complaints Assessment Report:

1. A detailed history of all operational events and activities at the Teedon Pit which could have affected groundwater levels and/or groundwater quality and thus could have contributed to the complaints by local residents should have been provided - but was not.
2. In my view the most likely source of the off-site well impacts being reported by neighbours of the site is leakage of silt/clay-laden washwater from the sump pond. Records of water levels in the pond or in wells installed in adjacent test pits (which could be used to determine rates and impacts of leakage) should have been kept and compiled - but are generally not available.

3. A history of all complaints of well interference (impacts on well water levels or water quality) which had been made to the MOECC and/or Cedarhurst from the surrounding area starting in 2009 was needed, but not provided in the 2015 Complaints Assessment Report. This history should have included full details of the particular concern(s) of each household and whether or not the complaint had been resolved to the satisfaction of the homeowner(s). It seems bizarre that in a report intended to investigate and report on complaints from neighbours about well interference, that there was no record in the report of the details of those complaints.
4. The focus of the Complaints Assessment Report was the issue of silt levels in domestic wells, which neighbours of the site believe are related to aggregate washing activities at the site. A key aspect to any such issue is the question of how water quality in the domestic wells has evolved over time, but no information is provided in this regard in the Complaints Assessment Report. A baseline account was needed for each household at which well interference is alleged to have occurred regarding their pre-washing (ie. pre-2009) well water levels and well water quality - but not provided.
5. Given that the complainants were concerned that the Teedon Pit aggregate washing activities had negatively affected their properties and wells, a key aspect of the investigation of the complaints and the local hydrogeology should have been aimed at developing a clear description of the geology in the immediate area of the sump pond and wash ponds based on nearby borehole and test pits records. This was not done in the Complaints Assessment Report.
6. The aggregate washing operations at the Teedon Pit suffer from inexplicably high rates of water loss from what is supposed to be a “closed loop system”. Several mutually inconsistent hydrogeological conceptual models for the site were developed by consultants for Cedarhurst, none of which properly explained what was happening at the site. The problems with each of the models is discussed in detail in Section 4 of my 2015 Report (see **Appendix 4** of this review). A coherent site conceptual model to account for the inexplicably large water losses from the wash pond during aggregate washing operations is urgently required - but was never produced.
7. The monitoring well network which was being relied upon by the prior Permit Holder (Cedarhurst) was utterly inadequate for the task to which it was being applied. The Permit Holder was receiving neighbours’ complaints that aggregate washing at the Teedon Pit had caused off-site impacts on groundwater quality (silty wells) and groundwater levels (localized flooding). It follows that the monitoring wells being used to investigate such off-site impacts should be hydraulically connected to the shallow aquifer beneath the wash pond, and should be situated downgradient of the wash pond - between the wash pond and the domestic wells which are subject of the complaints. The Cedarhurst monitoring well network failed on both counts.

4) Problems with the MOECC

a) Introduction

I understand from colleagues and from my work experience that the MOECC has a very broad mandate and that various offices are often short-staffed with untenable workloads for individual staffers. That having been said, the MOECC has played multiple roles in regard to the aggregate washing operations - and has in my opinion failed at every one of them.

The MOECC has played the following main roles in regard to this undertaking:

- the MOECC was responsible for oversight of the review of the technical details of the owners' applications for PTTWs in 2008 and 2010, will have coordinated technical comments, and ultimately issued the PTTW approvals (subject to the Conditions included in the PTTWs);
- the MOECC's Barrie District Office has the job of inspecting and overseeing the operations of PTTW holders in its district;
- the MOECC's Central Region Technical Support staff includes hydrogeologists who reviewed and responded to complaints from local residents about the impacts of the Teedon Pit on the domestic well water supplies.

In the following sections of this review I will discuss the very significant problems which I have become aware of in regard to the MOECC's exercise of the above responsibilities.

b) PTTW Application Reviews and Approvals

The MOECC oversaw the review and ultimately approved 2 PTTW applications - the original application for a PTTW in 2008, and the subsequent application to amend the PTTW in 2010. I will deal with each of these processes in turn.

i) Original PTTW Application and 2008 Approval

The original conceptual model for the Teedon Pit (provided in a September 2006 Report in support of the PTTW Application by Waterloo Geoscience Consultants, or WGC) was that the sump pond would provide all of the water needed for aggregate washing, and that the pond would be replenished through a combination of rainfall, stormwater runoff (which would be directed to the pond from around the pit), and groundwater inflows from the shallow aquifer.

The possibility of water quality impacts was not considered in the WGC Report, nor was the possibility that funnelling into the pond of huge quantities of stormwater might cause problems.

The author of the report stated on page i) that:

“None of the existing private wells will be affected by the proposed wash plant since:

- 1) the nearest private well is greater than 500 metres away from the proposed taking;*
- 2) all of the private wells obtain groundwater from a source deeper in the sand and gravel aquifer”*

In this very optimistic scenario, there would be no possibility of off-site impacts. Accordingly the only monitoring instrumentation installed on the Teedon Pit property consisted of 4 very shallow standpipes (placed in 3 to 4 metre deep test pits which had been excavated around the proposed sump pond location), a minipiezometer installed at the pond location, and MW1 (a token well beside the sump pond which was completed in thick “clay”).

The author of the WGC Report seemed generally unaware or unworried about the fact that the Teedon Pit is sitting on the flanks of a huge sand and gravel hill comprising a valuable and vulnerable aquifer, in an area where local residents are 100% dependent on wells for their drinking water supplies.

The role of the MOECC as approvals authority in this instance should have been to ensure the following protective measures would be in place (in addition to the measures required through the ultimate PTTW conditions):

- that the pit owner developed a network of properly installed on- and off-site monitoring wells around the Teedon Pit property in order to provide an adequate understanding of the site hydrogeology and local groundwater flow directions in shallow and deeper aquifers (on the order of 9 monitoring locations with multiple wells in a “nest” at each location would have been optimal to accomplish this goal);
- that the pit owner did “baseline” water level and water quality monitoring in a representative number of wells from residences in the surrounding area, prior to any aggregate washing being allowed to take place at the pit.

The MOECC failed in this regard. There was no proper monitoring well network required to be installed by the PTTW Holder, and no baseline testing of domestic wells was required or done. This left local residents in the absurd and unfair position of later having to try to prove (in the absence of any means of collecting the required evidence) that impacts on their wells related to the aggregate washing operations were occurring.

ii) Subsequent PTTW Amendment Application and 2010 Approval

By later in 2009 it was clear that there were problems with the WGC conceptual model. In particular, less water than hoped was available from the sump pond - even though it had been made 2 to 3 times larger than had been originally proposed by WGC.

Cedarhurst had a new consultant by this point (Alpha Environmental Services Inc., or AES) and AES put together a PTTW application report dated April 2010 in support of a new application for an amended PTTW. The proposed amended PTTW, if approved, would allow the wash pond to be “topped up” with water from a newly drilled well (PW1-09) near the site entrance.

In response to MOECC questions regarding the PTTW application, AES provided calculations on page 11 of a July 30, 2009 letter to the MOECC showing that water losses from the sump pond were much higher than had been expected - in the range of 47.5% of the wash water used, compared to an “industry standard” of 10%. Clearly a very considerable amount of water was being lost from the pond, and the prior conceptual model which had been the basis for the original PTTW was flawed.

AES put forward 2 hypotheses for the water losses (on page 11 of their July 30, 2009 letter):

- that there was an underestimate of the amount being pumped, because the required flow meter had not yet been installed.
- that there was “an immature return groundwater flow system for the wash water that has drained from the washed aggregate which will be rectified with time and additional aggregate washing”.

Hypothesis b) is interestingly worded. I take this to mean that the author figured that water was leaking from the settling ponds and/or wash pond into the groundwater flow system, but that once enough silt-laden water had been run through the system it would eventually “mature” and plug up any leaks with silt.

In any event, AES simply left it at that and Cedarhurst requested MOECC approval of the proposal to “top up” the wash pond with water pumped from PW1-09.

Even though there were clearly major unresolved problems with the prior WGC conceptual model which had been the basis for the original approval, the MOECC ultimately approved the AES proposal with an amended PTTW dated July 23, 2010. I firmly believe that the MOECC’s issuance of this second PTTW approval was a mistake, which compounded the problems caused by the original (2008) PTTW approval.

I think that the MOECC (as approving authority) and Cedarhurst needed to ask the question “*Where is the water which is being lost from the aggregate washing operation going?*” before putting in place a scheme that would allow massive additional inputs of water to the aggregate washing operation. That question should have been clearly articulated by the MOECC’s technical reviewer(s), who should have insisted on a detailed and plausible answer which could be incorporated into a revised conceptual model before issuing the amended PTTW.

The MOECC as approving authority made what I believe were further mistakes in issuing the amended PTTW:

- it dropped the requirement for daily measurements of sump pond water levels (making it impossible to determine leakage losses of water from the sump pond) and it dropped the requirement for measuring water levels in the standpipes in nearby test pits TP1 - TP4;
- it again did not require precautionary monitoring of well water levels and well water quality in a representative number of homes around the Teedon Pit, despite the pit’s location upgradient of numerous homes and the known massive losses of silt-laden water from the aggregate washing operation;
- it did not require new monitoring wells which were hydraulically connected to the shallow aquifer to be installed around and downgradient of the wash pond in order to monitor the effects of the aggregate washing operation on the downgradient groundwater flow system.

In essence after the issuance of the amended PTTW in 2010 both Cedarhurst and the MOECC (as regulator) were left “flying blind”, with no appropriately situated monitoring wells in place which could be used to help assess the well interference complaints coming from my clients (and other complainants) and with no conceptual model which could provide an explanation for the massive losses of water from the aggregate washing operation.

The imprudent PTTW approvals issued for the Teedon Pit by the MOECC created a problem which then became the responsibility of other branches of the MOECC - the Technical Support staff in Central Region, and the inspectors and local staff at the Barrie District office. As will be discussed in the following sections of this review, neither of these branches of the MOECC did any better in dealing with the challenges posed by the Teedon Pit.

In the meantime and looking forward, the MOECC is now evaluating the merits of a third PTTW application for the Teedon Pit. I sincerely hope that they do better in reviewing this application than they did previously, and I provide recommendations on how to deal with the application near the end of this review.

c) The MOECC's Central Region

Technical support staff for issues such as hydrogeology are typically found in the MOECC's regional offices. The regional office which is responsible for the area including the Teedon Pit is the Central Region MOECC office.

Normally complaints about PTTW-related issues would go to the district offices of the MOECC, with staff there requesting the technical assistance of hydrogeologists from the regional office as needed.

Cedarhurst had not notified the MOECC of well interference complaints (as required by the PTTW) and local residents did not know who at the MOECC to direct their concerns to given Cedarhurst's inaction, so in some cases complaints were made to the Barrie District office and in some cases to the MOECC's Central Region office. Central Region's hydrogeologists were generally not helpful when responding to complaints.

Several hydrogeologists at the Central Region office have been involved with this matter since the PTTW was originally granted. Early on complaints to Central Region went to Mr. Ross Hodgins (a Central Region hydrogeologist), including the written February 2015 complaint sent by my clients (a copy of which can be found in **Appendix 2** of this review).

An e-mail from Mr. Hodgins to the Cedarhurst consultant (dated February 27, 2015) may help shed light on why the Central Region has been so unhelpful when dealing with residents' complaints (such as my clients') about water quality impacts on their wells. In his email (which can be found on page 108 of the current PTTW Application), Mr. Hodgins states the following about my clients' complaint (which was verbal at that point):

"From her description, it appears the wells feed a cistern or reservoir from which they then pump for use.. Assuming the wells rely totally on a free flow condition to an adjacent reservoir from which they then pump for use, long-standing Ministry policy would therefore not protect such supplies against interference".

This is in my professional opinion a misapplication of MOECC policy. The policy in question is intended to be applied to interference issues related to water quantity, whereas my clients' main complaint pertains to water quality impacts. Whether this misapplication of policy is widespread among the MOECC's hydrogeologists is not clear. What is clear through correspondence such as can be found in the PTTW Application (in Appendix C.1) is that they have made up their minds that there is no possibility that the Teedon Pit is impacting off-site well water supplies.

How they have managed to reach this position is a mystery to me, given that to date the Teedon Pit has suffered from a lack of scientific data (due to an MOECC-approved inadequate monitoring well network) to allow them to responsibly take such a position.

d) The MOECC's Barrie District Office

The MOECC's Barrie District office is responsible for overseeing and conducting inspections of the operations of PTTW holders in their district. Many MOECC District offices face an overwhelming workload which makes it challenging to adequately fulfill their PTTW oversight role. In any event, there was no inspection of the Teedon Pit's aggregate washing operations until June 2015 - even though the PTTW had been in place since 2008 with aggregate washing occurring intermittently since the sump pond's construction in 2009.

Given the tendency of the previous Permit Holder (Cedarhurst) to not inform the MOECC of complaints from local residents (as required), it is perhaps understandable that in the first few years after the original PTTW was issued the Barrie MOECC office was under the impression that nothing was amiss at the Teedon Pit.

But by 2015, complaints about water quantity and water quality impacts were coming in to the local Township and the MOECC Barrie District and Central Region offices from several families living in the vicinity of the pit (including my clients).

District offices typically rely on Technical Support staff at the MOECC's regional offices for specialized technical support on issues such as hydrogeology. The general unhelpful position of the MOECC Central Region hydrogeologists seems to have coloured the response of the District Office to well interference complaints. Aside from conducting an inspection of the Teedon Pit in June 2015, the MOECC's Barrie District office has done little to help local residents near the Teedon Pit who are experiencing well problems.

Moreover, between them the two MOECC offices have not exercised proper oversight of the PTTW Holder and enforcement of the PTTW conditions. The pit owners' many deficiencies in compliance with PTTW Conditions over the years (outlined in detail in **Section 3c** of this review) were in my opinion facilitated by a lack of MOECC oversight.

e) Summary

As described above, the MOECC has not done very well in fulfilling its various responsibilities with respect to the aggregate washing activities at the Teedon Pit.

The proposal to pump water to wash aggregate was imprudently approved with virtually no safeguards in place to protect the valuable and vulnerable downgradient aquifer and local residents' well water supplies. After the PTTW approval, there was almost no oversight of the PTTW with numerous issues of non-compliance or violations of PTTW conditions occurring over the years. Complaints about impacts on local wells have poured in, with poor responses.

Going forward the MOECC needs to do better, starting with this PTTW application.

5) Hydrogeological Conceptual Models and Real World Observations

a) Introduction

Section 4h) of my October 2015 Report for my clients (which can be found in **Appendix 4** of this review) discusses the various conceptual models developed over the years by the Cedarhurst hydrogeologists. For those who are interested in the details of this very technical issue, I refer them to Section 4h) of my report (**in Appendix 4**).

The main PTTW-relevant challenge for any conceptual model is to explain the high rates of water loss from the sump pond (which are discussed in the next section of this review). The water in the sump pond has not been sampled or characterized to my knowledge, but it is likely generally quite turbid due to its high silt/clay content. The current PTTW Application generally avoids this question of water losses from the (silty) sump pond entirely, leaving the MOECC's Approvals Branch with little to consider in that regard.

Overall it is fair to say that there are widely differing professional opinions which are reflected in widely differing conceptual models to explain the water flows at the site and the sump pond water losses. I believe that the main reason for the very wide divergence in the interpretations about what is happening in the groundwater flow system at the Teedon Pit has been the severe lack of useful hydrogeological monitoring information available to the various professionals.

As discussed previously, the MOECC failed to require the previous PTTW Permit Holder to install an adequate groundwater monitoring network or to do any baseline monitoring of local residents' wells. As a result there is very little useful hydrogeological information to work with in trying to understand the sump pond's (silty) water losses, and to determine the potential relationship(s) between activities at the pit and problems being experienced by local residents with their wells.

In this regard, I am very pleased to have learned during my April 12, 2018 site tour that the new owners of the site (CRH) are conducting a new hydrogeological investigation which includes expanding the site's groundwater monitoring well network. This is a good step forward, and I commend the Township's peer reviewers for joining me in requesting this work (after the MOECC failed to). The hydrogeologists for all parties will benefit from the additional information which will be acquired going forward.

In the meantime, the MOECC has before it the January 18, 2018 PTTW application from CRH which was put together in the absence of any of the information which will be coming in from the new wells and investigations. Given this situation (where too little technical information is available now to make an informed decision, but much more will be known in the not too distant future) it would be prudent for the MOECC to consider providing a short-term PTTW approval with improved Conditions while awaiting the provision from CRH of a lot of relevant new technical data in the near future.

b) Sump Pond Leakage into the Groundwater System

An estimate of water losses of 47.5% (vs. an “industry standard” of 10%) was provided by AES in a July 30, 2009 letter to Mr. Christopher Munro (MOECC). This is the best available estimate (based on pond water levels) of the percentage of water losses from Cedarhurst’s early aggregate washing operation.

While the original 2008 PTTW required water levels to be measured and records to be kept, in 2010 the MOECC issued the amended PTTW which no longer required measurements of pond water levels to be taken. The outcome of this poor MOECC decision has been an inability to accurately estimate water losses from the sump pond.

A very rough check on this early estimate of 47.5% water losses in 2009 can be obtained by comparing the annual volumes of water pumped from the wash pond (for aggregate washing) in 2011, 2012, and 2013 with the volumes of “top up” water pumped into the wash pond from PW1-09. Keep in mind that the rule of thumb in the industry is 10% losses.

Table 1 on page 7 of this review provides the annual totals of water pumped from the wash pond for aggregate washing, and of water pumped from PW1-09 to top up the wash pond. Comparing these figures shows the following:

In 2011, about 33.8 million liters of water were pumped from the wash pond and about 14.2 million liters were pumped from PW1-09 to top up the wash pond - the relative percentage of top up water to wash water is 42%.

In 2012, about 51.3 million liters of water were pumped from the wash pond and about 34.7 million liters were pumped from PW1-09 to top up the wash pond - the relative percentage of top up water to wash water is about 68%.

In 2013, about 55.4 million liters of water were pumped from the wash pond and about 18.2 million liters were pumped from PW1-09 to top up the wash pond - the relative percentage of top up water to wash water is about 33%.

Averaging the figures for the 3 years, we come up with an average percentage of about 47.7% which is very close to the original AES estimate of 47.5% water losses. It should be noted that these estimates are not conservative - there is a sizeable “water surplus” in this part of Ontario, meaning that any pond with an impermeable base will accumulate water on an annual basis. The sump pond is losing all of the annual water surplus for the wash pond PLUS that portion of the pit runoff which was directed into the pit PLUS much of the top up water being pumped from PW1-09.

The bottom line is that the pit’s sump pond has been shown to be a very leaky pond.

The leakiness of the sump pond was also confirmed when 108,000,000 litres were inadvertently pumped into the pond during an uncontrolled and unplanned 79-day release from July 29 through October 15, 2015 and were absorbed by the pond with no problem. When the site manager finally discovered this pumping on the 79th day the pond was not full - the water level was below the overflow pipe on the north side of the pond!

These 108,000,000 Litres which were pumped into the pond in 2015 did not all evaporate - they went somewhere, namely into the groundwater flow system by leakage out the sides and/or bottom of the pond. Even though the water leaking from the pond in 2015 was clean water pumped from PW1-09, my clients suffered a massive silt episode in the late summer of that year (perhaps due to the effects of surcharging of the shallow aquifer). There is likewise heavy leakage when the water in the sump pond is laden with silt, such as during aggregate washing periods or after a very heavy rainstorm has washed all of the fines from the pit floor and walls into the pond.

Overall water losses from the Cedarhurst aggregate washing operations in 2009 through 2016 seem to have been just under 50% of every liter pumped - on peak days these are losses on the order of 1,000,000 L/day (or 11.5 L/second). This should be a red flag for both CRH and the MOECC - these water losses are not reasonable, and they certainly have the potential to be causing offsite impacts in areas downgradient of the Teedon Pit.

The onus is now on the MOECC as approving authority to consider these massive water losses from the sump pond, and the resulting leakage into the downgradient groundwater flow system. In their review of the current PTTW Application, the MOECC technical reviewers need to consider the complaints of off-site well interference and also the documented massive losses of silt-laden water from the Teedon Pit aggregate washing operations in a proactive and precautionary manner.

The last pages of CRH's Jan. 18, 2018 PTTW Application include pumping figures from mid-August through early December 2017 for PW1-09 (23,119,409 Litres pumped into the sump pond) and for water pumped from the sump pond for aggregate washing (133,006,943 Litres). The percentage water losses are 17.4% (compared to the industry rule of thumb of 10%) - still high, but not nearly as high as in years past.

To my mind this can at least partly be explained by the fact that CRH is now directing all of the runoff water from the entire pit into the sump pond. (Recall that during my site tour in 2015 I observed that runoff from all of the east side of the pit was being diverted around the sump pond and allowed to discharge in an uncontrolled fashion into the downstream natural environment on the north side of the site.)

A second likely explanation for the lower percentage water losses in 2017 is the fact that figures are only available for the period from mid-August through early December 2017. Evaporative losses from the pond during the late summer and fall will be much lower than earlier in the season, and precipitation tends to be higher as well.

c) Wash Water Quality

The wash water from the Teedon Pit is “cloudy”, due to the presence of very fine silt/ clay particles in the water. Please note that I have adopted the convention used by the MOECC and owners’ experts and have generally simply referred to these very fine silt and clay particles as “silt” in this review (as shorthand for any tiny particles finer grained than sand) - and I would request this is how my references to “silt” should be interpreted.

The wash water from the Teedon Pit looks “muddy” to the eye, and if poured in a glass and left to stand there would be some settling out of residue at the bottom of a glass. The largest diameter (sand and coarse silt) particles will settle out first, and the longer the water is allowed to stand the smaller (or finer) the size of particles which will settle out. Most difficult to remove from water are the smallest (finest) sized particles. Most problematic for off-site well owners would be the finer grained silt or clay particles in the wash water - that is, those that wouldn’t settle out quickly in the sump pond and thus could be carried off-site in the groundwater flow system.

Throughout the history of aggregate washing at the Teedon Pit, there has been no work done to actually assess the nature and levels of silt/clay contamination in the wash water. I find this remarkable, given that hydrogeologists for both the MOECC and the previous owners of the Teedon Pit have categorically rejected the possibility that “silt” laden water from the pit could be affecting off-site wells.

The science regarding the movement of suspended silt and clay particles is one which most hydrogeologists are not very familiar with. A few definitions are needed when considering this topic - and it is not easy because soil scientists are not unanimous when it comes to these definitions.

I have adopted the definitions found on the US Geological Survey (USGS) website and have taken the image below from that website, but there are other definitions which are also in use.

SEDIMENT COMES IN ALL SIZES		
256 mm and up	BOULDERS	GRAVEL
64-256 mm	COBBLES	
2-64 mm	PEBBLES	
0.0625-2 mm	SAND	
0.002-0.0625 mm	SILT	
0.002 mm and smaller	CLAY	

As can be seen from this image:

“Silt” size particles are those ranging in diameter from 0.002 mm to 0.06 mm.

“Clay” size particles are those with diameters of less than 0.002 mm.

Water filters in typical household use come with opening in the filter media in sizes of 25 microns, 5 microns, or 1 micron. 1 micron = 0.001 mm.

Considering the above, it is clear that even the best (1 micron) household filters will be effective in trapping silt particles, but will not remove most clay particles.

When it comes to water quality analyses, there are typically two measures which are used to determine the levels of very fine particulate matter in a sample:

- turbidity (which is measured in nephelometric turbidity units or NTU);
- total suspended solids (which have units of mg/L).

Turbidity is defined on the USGS website as follows:

“Turbidity is the measure of relative clarity of a liquid. It is an optical characteristic of water and is an expression of the amount of light that is scattered by material in the water when a light is shined through the water sample. The higher the intensity of scattered light, the higher the turbidity. Material that causes water to be turbid include clay, silt..”

Total suspended solids (or TSS) are solids in water that can be trapped by a filter.

This clearly implies that the size of filter being used is critical to the definition.

Unfortunately there are different filter sizes used by different groups, and thus there is no clear definition of this term, but typically TSS will mainly be a measure mainly of the silt sized particles in a water sample. If a smaller-opening filter size is used, then TSS can also pick up some the larger clay sized particles in a water sample.

Water samples have been taken from my clients’ well by consultants for the Teedon Pit owners and tested for turbidity levels on several occasions. I am aware of the following turbidity/TSS sample results, as shown in **Table 2** below.

Table 2 - Turbidity and TSS Test Results on Pauze/Pigeon Domestic Well

<u>Date</u>	<u>Location</u>	<u>Turbidity</u>	<u>TSS</u>
June 30, 2015	House Well	19 NTU	24 mg/L
Aug. 16, 2017	House Well	2.1 NTU	not tested
Sept. 8, 2017	House Well	3.5 NTU	not tested

Note: The aesthetic objective for turbidity in the Ontario Drinking Water Quality Standards is 5 NTU.

These results are not nearly adequate to determine possible water quality trends or patterns which may be present. The informal weekly collection of sample bottles which I have initiated should be helpful in this regard.

d) My Updated Conceptual Model

In my 2015 Report I outlined my hydrogeological conceptual model at the time (based on the information available at that time of the local hydrogeology, and the aggregate washing operations at the Teedon Pit). What I was aiming to do was find a reasonable explanation for the following observations:

- no issues with silt in my clients' wells prior to 2009, just excellent quality water being delivered by both wells without exception;
- construction of the sump pond and wash pond at the site in early 2009, followed by aggregate washing with massive leakage in the second half of the year;
- the development of significant silt problems with both my clients wells in 2009, which persisted on and off since then;
- significant silt problems developed in some neighbours' wells in recent years.

Additional information has become available since I wrote my 2015 Report, most importantly the observation that even though PW1-09 was inadvertently allowed to pump full out into the sump pond for 79 days (resulting in 108,000,000 Litres being pumped into the pond in that time) this did not cause the pond to come close to overflowing. This observation has very persuasively confirmed the leaky nature of the pond, and confirmed that the estimated water losses from the pond during aggregate washing (of just under 50% of the top up water) are not unreasonable.

I have also had more time to consider the overall hydrogeological setting of the site. At any rate my updated hydrogeological conceptual model is provided below:

- The Teedon Pit is situated on the northern edge of a very large hill (6 square km) of gravel and sand. This hill is a groundwater recharge area, meaning that it is a place where rainfall enters the ground and recharges the regional groundwater flow system.
- Groundwater flow directions are generally outward from the hill to the surrounding lower lands, with specific flow directions dependent on local variations in hydraulic gradients and permeabilities of the geologic materials.
- There are numerous residential and farm properties downgradient of the Teedon Pit which are 100% reliant upon groundwater for their well water supplies. All of the complainants' properties are situated downgradient of the Teedon Pit and its aggregate washing operations - that is, there is a hydraulic potential which would allow for groundwater flow from the Teedon Pit to any of the complainants' wells.
- Actual pathways for downgradient groundwater movement from the Teedon Pit towards the wells of individual complainants are very difficult to determine - even in the best of circumstances (if there were an adequate network of monitoring wells between the Teedon Pit and the complainants' properties).

- None of the monitoring wells installed by the previous owners are appropriate for assessing potential sump pond - centered impacts of aggregate washing operations at the pit on any of the complainants' wells.
- Aggregate washing operations began at the Teedon Pit in 2009, and occurred in the years 2009, 2011, 2012, 2013, and 2017. It is not clear if washing took place in 2016.
- In 2009 the water for aggregate washing is said to have come entirely from the sump pond, which is fed by precipitation and by runoff of snowmelt and stormwater from the larger area of the Teedon Pit into the pond. Given the various questionable aspects of the owner's operations at the time, it would not surprise me to learn that water was taken from PW1-09 in that year without the taking being reported.
- Certainly starting in 2011 there was an additional source of water for the aggregate washing, namely water which was pumped into the sump pond from well PW1-09.
- There were very significant water losses from the aggregate washing operations at the Teedon Pit. These water losses were estimated at 47.5% by AES (based on sump pond water levels measured in July 2009). As discussed in the previous section's discussion of sump pond water losses, subsequent years' water losses were in the same range.
- It is my position that the difference of 37.5% (between the 10% "rule of thumb" water losses for aggregate washing operations, and the 47.5% estimated losses from the sump pond) represents water losses caused by leakage of silt-laden wash water into the underlying groundwater flow system at times of aggregate washing.
- I believe that such leakage is occurring through one or more "windows" which allow rapid outward and/or downward flow of silt-laden wash water into the underlying groundwater flow system. When aggregate washing is occurring, volumes of one million liters/day or more of wash water are moving through the system with potential leakage losses which average around 500,000 liters/day. There will be both short-term and longer-term effects resulting from these massive inputs of leaking wash water to the underlying groundwater flow system.

The short-term effects of the leakage of massive amounts of silt-laden wash water will include the following:

- The leakage of on the order of 500,000 liters/day of wash water will quickly and massively raise hydraulic heads in the underlying groundwater flow system.
- During periods of aggregate washing the area of the wash pond and settling ponds will become the high point in the local groundwater flow system - with outward movement in all downgradient directions from there.

- The quick rise in hydraulic heads will surcharge the shallow aquifer and will be transmitted rapidly through the groundwater flow system, leading to similarly rapid rises in off-site groundwater levels - with the magnitude of the rise dependent on distance from the wash pond area and on the degree of hydraulic connection between the wash pond area and the specific off-site location.
- This may lead to anomalous episodes of surface flooding if off-site groundwater levels rise above the ground surface, and it may also lead to problematic rises in water levels in domestic wells.
- These surcharges or pulses of water originating from the sump pond may also lead to some “flushing” of the shallow aquifer, causing silts/clays to travel into domestic wells.

The longer-term effects of the leakage of massive amounts of silt/clay-laden wash water will include the following:

- Each day of aggregate washing will cause a slug of silt-laden wash water to leak into the underlying groundwater flow system, and that silt/clay-contaminated groundwater will be moving downgradient from the area of the wash pond.
- The preferred directions of flow will in part depend on the unpredictable position of higher-permeability pathways, but will also tend to be toward low points in the downgradient groundwater flow system (ie. wells).
- Plumes of silt/clay-contamination will be emanating outward from the area of the wash pond in an unpredictable fashion, due to the intermittent nature of the aggregate washing operations and to the fact that initially preferred flow channels may “plug up” over time with fine-grained materials.
- Heavy rainstorms will send pulses of silt-laden runoff from the pit walls and floor into the sump pond as well, and will further compound the unpredictability of the silt inputs from the pond to the shallow groundwater flow system.
- The greatest amounts of silt/clay contamination will be moving in the highest hydraulic conductivity features.
- It is not possible to precisely estimate rates of contaminant movement in the groundwater system because of the absence of suitable monitoring wells (discussed previously), but given the very steep hydraulic gradients and the very coarse nature of some of the local gravel deposits peak flow rates in the 10s of meters per day to over 100 meters per day seem possible.

- The estimate of groundwater flow rates (presented in Figure 26 of the 2015 Complaint Assessment Report prepared for the prior Permit Holders) which suggests that it would take groundwater over 1,000 years to travel from the Teedon Pit to Marshall Road where my clients live is utterly implausible, and based on the unrealistic assumption that hydraulic conductivity throughout the groundwater flow system would be 3.5×10^{-7} m/s (ie. that the geological deposits all along the flow path would be silt). In the predominantly sand/gravel aquifer which is present flow rates would of course be very much more rapid.
- The effects of dispersion and attenuation of the silt plume in the downgradient groundwater flow system will cause silt levels to remain elevated long after aggregate washing operations have ceased, although in the absence of renewed washing activities (or heavy rains) silt levels should be steadily decreasing with time.
- The observation that the wells generally clear in the winter months (when there is no aggregate washing and the site is covered in snow) supports the above hypothesis.

6) Review Comments on the PTTW Application

a) Introduction

The PTTW Application is to my knowledge the first report which was produced for the new owners of the Teedon Pit (CRH). As such, I have considered it carefully and looked for signs of a fresh approach to site operations and monitoring, assessment of impacts, and dealing with concerns of off-site impacts. In that regard, the PTTW Application is a bit of a disappointment.

The authors of the report have done little in the way of original investigations or analysis, relying instead on a grab bag of information gleaned from various sources. Perhaps this is understandable, given that CRH took over the Teedon Pit in August 2017 and the report was issued 5 months later in January 2018.

I had been hoping for progressive recommendations on ways to improve site operations, monitoring, complaints management, and future hydrogeological investigations. Given their relative absence in the PTTW Application, I have developed recommendations of my own which follow in **Section 9** of this review.

b) My Detailed Comments on the PTTW Application

My detailed comments on the PTTW Application follow below. I have organized my comments sequentially, going from front to back through the PTTW Application.

i) Purpose

The PTTW Application indicates in Section 1.1 that the purpose of the report is “*to demonstrate that the aggregate washing operations at the Teedon Pit do not pose a threat to water supplies or the environment.*”

As indicated in **Section 3d, Point 7** of this review, the current monitoring network and the data coming from that network are not adequate to demonstrate that the aggregate washing operations at the Teedon Pit do not pose a threat.

ii) History

The PTTW Application provides a selective overview of the history of the site in Section 1.2.1.

Missing from that historical overview is the fact that aggregate washing began in 2009 in the absence of permission to do so on the official Site Plans for the site. Aggregate washing did not become a permitted operation at this site until a major site plan amendment was approved in November 2016.

iii) Teedon Pit Water Use

The PTTW Application provides a description of water use of the site in Section 1.2.4. That description includes the statement that “*In this operation only a small amount of “make up” water is needed to compensate for moisture retained on the sand and gravel and for evaporation*”.

As described in detail in Section 5b of this review, the sump pond leaks heavily - with typical historical water losses at close to 50% of the top up water which is pumped. If only a “small amount” of top up water is required, then perhaps the maximum permitted taking of 1.64 million Litres per day (= 19 Litres per second) could be scaled down to a more reasonable figure of 500,000 L/day. This would be in keeping with the 10% rule of thumb in the industry, given a permitted pumping from the wash pond for aggregate washing of 5.2 million L/day.

iv) Description of the Current Water Taking

The PTTW Application provides a description of the site’s current water taking in Section 2. That description includes the statement that “*The expected maximum amount of daily loss of wash water from the system is 523,728 litres*”.

Given that this is the case, it is not clear why approval is being sought for daily “top up” pumping into the sump pond of 1,635,840 Litres.

v) Description of Regional Hydrogeology

Section 3.1.6 of the PTTW Application relies heavily on a 1999 Study of Severn Sound.

Most of this section of the PTTW Application is comprised of a presentation of groundwater quality characteristics from across the entire Severn Sound Region.

The 1999 Severn Sound Study considers hydrogeology in a very large region, which extends from Penetanguishene in the northwest to Orillia in the southeast and goes from south of Orr Lake to the far north end of Severn Sound. Water quality results ranges for this vast region are presented in this section of the PTTW Application - but these ranges have little to do with the actual water quality in the area of the Waverley Uplands (where the Teedon Pit is situated), which is vastly better than that of the larger region.

vi) Description of Study Area Hydrogeologic Setting

Section 3.2.3 of the PTTW Application provides a description of the site's Hydrogeologic setting. That description is based on the hypothesis of a simple system consisting of a shallow aquifer (which the sump pond and wash pits are completed in) and a deeper aquifer, with the two aquifers separated by a thick layer of "clay".

This hypothesis is consistent with the recent interpretations of the site hydrogeology done for Cedarhurst, however in my opinion there has not been enough information available to date to make such an interpretation with confidence. The test drilling and the new monitoring wells which were being installed at the site when I was there for my tour on April 12th, 2018 will provide much more in the way of useful information, and once that information is available hypotheses regarding the site hydrogeology will be able to be made with more confidence.

vii) Discussion of Potential Water Quality Impacts

Section 5.1 of the PTTW Application opens with the statement that:

"Recirculation washing systems, such as the one at the Teedon Pit, do not consume large amounts of water or have large impacts on groundwater flow systems or associated resources".

I guess this is a matter of perspective. Perhaps the authors of the PTTW Application are coming at this from a large-scale industrial perspective. Having heard the concerns of my clients and their neighbours, I come at this from a local perspective. A rural family of 4 may use up to 1,000 Liters/day, if it is using a lot of well water. As discussed in previous sections of this review, the sump pond at the site is capable of leaking in excess of 1,000,000 Liters per day of water into the ground-water flow system - enough to provide ample supplies to over 1000 rural families.

1,000,000+ Litres per day is a large amount of water, and the leakage of that much dirty water into the groundwater flow system certainly brings with it a potential for off-site impacts. What has been missing to date on the part of the pit owners and the MOECC is an acknowledgement of this potential, and a sincere effort to determine whether actual impacts are occurring.

viii) Evaluation of Hydrographs

Section 5.1.1 of the PTTW Application discusses hydrographs of site monitoring wells and selected domestic wells, and offers opinions on whether water quantity effects are being felt downgradient of Teedon Pit. It closes with the following statement:

“Therefore, in summary, operation of supply well PW1-09 and the Sump Pond has not caused interference to the domestic well supplies. There is no indication that the future operation of the supply well and Sump Pond will result in interference to domestic well supplies.”

There are several problems with this statement. First, not all of the wells from which complaints have been received are being monitored. For example, the residence which experienced the most severe flooding after 2009 was Steve Ogden’s - he has since sold his property and moved away.

Secondly, data from 2 aquifers are being intermingled in this discussion. The sump pond is excavated into the shallow aquifer, and most of the residents’ complaints are for wells in the shallow aquifer. PW1-09 draws water from the deeper aquifer. The observed 300 meter cone of influence during pumping of PW1-09 (in the deeper aquifer) is utterly irrelevant to the impacts of sump pond water flows on the shallow aquifer. Mixing up information from the two aquifers in the analysis of the Teedon Pit’s impacts obfuscates what is really happening.

ix) Potential Water Quality Impacts

Section 5.2 of the PTTW Application considers water quality impacts. Several problematic statements are made in this section - I will present each statement (*in italics*) and will then deal with each of them in turn.

- *“Alpha conducted a well survey to identify supply wells around the Teedon Pit. A total of 27 wells were identified... The well survey identified four residents who indicated that they had well water quality and/or quantity concerns. The four residents and an additional resident, declined an offer to inspect and sample their wells by Alpha.”*

My understanding is that the reason the residents initially declined the offer to inspect/sample their wells was because of the generally hostile approach that Cedarhurst had been taking to complaints up until that time.

- *“ A hydrogeologic assessment of the water quality concerns was conducted by Alpha in 2015 and is presented in Appendix C of this report. The hydrogeologic assessment concluded that the silt in the domestic wells and the reduced water supply is not due to the operations at Teedon Pit.”*

My detailed review of the 2015 Alpha hydrogeologic assessment is provided in **Appendix 3** of this review. Suffice it say that I profoundly disagree with the way the assessment was conducted and with the conclusions it reached.

- *“The distance of these domestic wells from the Teedon Pit and their shallow nature preclude Teedon Pit from being the cause of silt in the water supply. The shallow aquifer contains a significant amount of silt. The MOECC concurred with this assessment (see MOECC letter to residents provided in Appendix C). The MOECC added that poor well maintenance and/or construction may be the cause for the presence of silt in the domestic wells.”*

The wells in question are found in 2 clusters - two wells are on Highway 93, and 3 are on Marshall Road.

Regarding the wells on Highway 93, it should be noted that Cedarhurst at the time of my tour in 2015 was diverting silt-laden runoff from the entire east side of the pit to the watercourse which runs northeastward from the site to Highway 93. There are places along the watercourse where the flow slows, and the ponded silty water would have been available to replenish the shallow aquifer. No information is available regarding how long the diversion of silt-laden pit runoff to the watercourse was occurring.

Regarding the wells on Marshall Road and the wells on Highway 93, the shallow aquifer is an aquifer with thick sequences of sand/gravel, and given the steep hydraulic gradients flow velocities toward both areas could be considerable. More detailed discussion is provided in the description of my Hydrogeologic Conceptual Model in **Section 5d** of this review.

I don't disagree with the statement that the shallow aquifer contains a significant amount of silt. There have been massive inputs of silt-laden water from the Teedon Pit sump pond, and there also appear to be silt/clay interbeds in the shallow aquifer.

With respect to the MOECC's position, as far as I have been able to discern the MOECC has done no original work or analysis - or if it has, then it has never presented the results. It simply cites the work done by Cedarhurst's consultants.

- *“Dufferin collected groundwater samples from five nearby domestic wells in late summer 2017. The groundwater samples collected from the nearby domestic wells in late summer 2017 were due to complaints of silt in the wells..”*

This statement is potentially misleading. While samples were collected from 5 nearby domestic wells from which complaints had been received at some time in the past, they were not prompted by complaints made by my clients at that time. The sampling may have been prompted by concerns expressed by the Andersons.

In any event I know that my clients were having no silt issues in late summer 2017, and they certainly didn't contact CRH to complain about silt in their well at that time. My clients' understanding was that for them the late summer 2017 sampling was intended to be baseline sampling (prior to CRH's planned commencement of aggregate washing) as their wells had been free of silt for an extended period.

As described earlier, the silt occurrences are episodic. For GHD to sample at a time when there is no silt and then imply there is no silt problem is not a fair approach. Even more concern is that when silt problems did develop for my clients from early November through early December 2017 and CRH was notified - no arrangements were ever made to do sampling. I understand that the Anderson family also had a similar experience with CRH in late 2017 - which concerns me greatly.

- “*Therefore, it is concluded as was concluded in the 2015 study by Alpha and as concurred by the MOECC that the silt in some of the domestic wells around Teedon Pit are not caused by the aggregate washing operations or water taking*”.

This statement appears to be based mainly on the 2015 Alpha study, given that the text of the PTTW Application provides almost no original analysis of the issue. The MOECC also did no original analysis (or if they did they have never shared it), so it seems that GHD and the MOECC are relying on the 2015 Alpha study when concluding that the Teedon Pit is not the cause of any off site water quality issues.

The 2015 Alpha study is inadequate, inaccurate, and incomplete - and should certainly not be used as the basis for forming opinions on the complaints of well interference in the area of the Teedon Pit. My detailed review of the 2015 Alpha study is provided in **Appendix 3** of this review.

x) Proposed Monitoring Program

The proposed go-forward monitoring program is provided in Section 6 of the PTTW Application.

I will present each monitoring proposal (*in italics*) and will then deal with each of them in turn below. My specific recommendations are provided in **bold type**.

xi) Water Taking Volume

Section 6.1 states that “*It is proposed that the volume of water taking be recorded on a daily basis (when water taking is underway) and tabulated monthly. It is recommended that the water volumes be measured near the point of taking at the Sump Pond, before water enters the aggregate wash process.*”

There is no commitment in this section to recording the volumes of “top up” water taken from PW1-09. This is a significant and problematic omission, which should be rectified - **PW1-09 water takings should be recorded on a daily basis.**

There is also no indication of how CRH proposes to measure or estimate the water taking volumes. **I recommend that dedicated flow meters be used to measure the water taking volumes, and that these be recalibrated at the start of each water taking season.**

xii) Groundwater Monitoring

- Section 6.2 on Groundwater Monitoring states that “*Groundwater monitoring will include hydraulic monitoring only.*”

This is unacceptable. Most of the complaints regarding the Teedon Pit’s impacts on off-site domestic wells are water quality complaints. The statement above signals that CRH will not be addressing this issue, regardless of how bad it is currently and no matter how bad it gets.

Given that CRH is running an aggregate wash operation which is leaking massive amounts of silty wash water from the sump pond, the company has a responsibility to determine where these massive amounts of water are going - and part of making that determination on a fair and scientific basis needs to include water quality monitoring in on-site wells but also local domestic wells.

Regular water quality monitoring of on-site shallow aquifer wells and the wells of residents reporting silt problems must be a core part of the go-forward groundwater monitoring program. I recommend recruiting the residents in a surveillance program such as I have instituted with my clients to try to determine the longer term patterns of the silt episodes. Regular laboratory testing of water quality should focus on the parameters turbidity and TSS, as these are direct measures of silt contamination of a well.

- Section 6.2 goes on to state that “*A total of seven monitoring wells will be part of the groundwater monitoring network, as shown on Figure 6.1. The seven monitoring wells include...*

- *MW1, PW1-09, MW1-09 and MW4-10*

- *Three domestic wells located on private property (#50632, #25425, and #17709)*

Since the PTTW Application was prepared, CRH has installed new monitoring wells, which include MW7-18 and MW8-18. **I recommend that all new wells be added to the monitoring program, with regular monitoring for both water quality (turbidity and TSS) and continuous monitoring of water levels.**

xiii) Surface Water Monitoring (Section 6.3)

- Section 6.3 starts by stating that “*Surface water monitoring will include water level monitoring.*”

There is no mention of surface water quality monitoring, which is unacceptable. The sump pond is capable of leaking over 1 million litres per day of silt-contaminated water into the groundwater system.

Information on variations in the silt load of the sump pond is badly needed.

I recommend monthly monitoring of sump pond turbidity and TSS be done in 2018 - with the monitoring focussed on establishing TSS and turbidity levels both at times of washing, and after long periods of inactivity. I also recommend measuring TSS and turbidity after very heavy storm events which have involved runoff from the pit floor into the sump pond.

- Section 6.3 goes on to state that “ *There is presently one surface water monitoring location .. (SW1), as shown on Figure 6.1. The SW1 location is identified by a staff gauge in the Sump Pond. Surface water levels will also be measured manually three times per year in conjunction with groundwater monitoring events: prior to wash operations commencing in the spring, after operations are stopped for the year in late fall, and during operations of the wash plant.*”

The above statement is not clear on the proposed frequency of staff gauge measurements. **I recommend that the staff gauge water level be recorded twice daily from the first day of water taking through to the last day. This will allow leakage from the sump pond to be estimated.**

- Section 6.3 fails to mention a key variable (which has never been required to be monitored by the MOECC), namely overflow out of the sump pond through the draingae pipe in the berm on its north side. It is not possible to develop an accurate water balance for the pond without recording pond overflows.

I recommend that the elevation of the invert of the sump pond’s discharge pipe should be established, and overflows from the pipe should be recorded on every day that they are occurring. Flows rates should be measured as accurately as possible on any date that overflows are occurring.

- Section 6.3 also does not mention an important safety aspect of surface water monitoring, namely the condition of the retention berm on the north side of the sump pond.

My understanding is that the sump pond is reportedly about 6 meters deep, and has an average area on the order of 7500 m² - meaning that when full it is holding a volume of about 45,000 m³ (= 45 million litres). It looked to me on my April 2018 site tour as if the berm had been raised, so this estimate of the pond volume may be too low. In any event, a catastrophic overflow/failure of the berm during a heavy rain storm could have very serious consequences downstream.

I recommend that the condition of the sump pond’s retention berm be assessed daily by CRH staff, and monthly by a qualified engineer. Any changes and/or repairs to the berm should be approved in advance if possible, and reported to the MOECC within 24 hours of having been undertaken.

xiv) Reporting (Section 6.4)

- This section of the PTTW Application opens by stating the following:

“ In the unexpected event that any water quantity or quality issues attributable to activities at the Teedon Pit, are identified through the course of the monitoring program, Dufferin will contact MOECC. In the event of a private water supply complaint, Dufferin will immediately undertake an investigation to determine the cause of the interference.”

This statement sounds reassuring, but it is misleading in that regard. CRH is not proposing to do any water quality monitoring. If the MOECC approves this proposal, then it will be impossible for the monitoring program to identify any water quality issues.

The recommendations which I have provided in this section (if required by the MOECC) will ensure that the commitment made in this section is meaningful.

- Section 6.4 of the PTTW Application describes CRH’s proposal for reporting as follows:

“A monitoring report, providing a summary of the pumping data and interpretation of the results of monitoring activities will be completed annually (or at another frequency as specified by MOECC in the PTTW) by a qualified professional, and submitted to MOECC on or before March 31, for the previous calendar year. A copy of the previous year's report will be retained at the Teedon Pit and provided to the MOECC inspector upon request. All monitoring data, including data collected subsequent to the annual report, will be available to the MOECC upon request..”

I welcome CRH’s proposal to commence preparation and submission of annual monitoring reports for the Teedon Pit. This is a long overdue means of assembling and documenting the results of the site monitoring program.

I note that there is no mention of providing the report to interested members of the public and/or First Nations upon request. I consider the timely provision of monitoring information to be an essential part of a progressive aggregate operation.

There is often a dire imbalance between the MOECC (which has investigation and enforcement powers) and the operator (who has all of the monitoring information), and members of the public (esp. nearest neighbours) and First Nations.

For example at just the time when I was preparing my 2015 Report for my clients (which they had commissioned at considerable expense to themselves, in hope of achieving progress with their well interference problems), the unplanned 79-day discharge of 108 million litres of water to the sump pond was discovered - neither the MOECC, the company nor its consultant ever shared the details of this incident with myself or my clients. It was not until after the new owner (CRH) submitted the PTTW Application (over 2 years later) that I learned the full details of this incident - which was critically relevant to the report I had been writing in 2015.

I recommend that any approval of the PTTW Application be amended to include a requirement for the Permit Holder to provide copies of the annual monitoring reports to members of the public and First Nations upon request.

xv) Summary and Recommendations

These are provided in Sections 7 of the PTTW Application.

Summary

The first part of this section simply provides a Conclusions-type summary of the main points made in the PTTW Application. I have addressed every one of these conclusions in my detailed comments above, and will not replicate them here.

My own Conclusions are provided in Section 8 of this review.

Recommendations

The second part of this section contains 3 overarching recommendations:

- a) that the requested PTTW renewal be granted for 10 years;
- b) that the quantity of water takings remain unchanged from the previous PTTW;
- c) that the monitoring program described in Section 6 be implemented.

I will deal with each of these recommendations in turn.

- a) I consider a 10-year PTTW renewal to be inappropriate under the circumstances. This is a site which has had a checkered history under the previous owners - with numerous PTTW and site license violations, poor operational practices, and numerous complaints which were often met with hostile responses to complainants.

The MOECC has not done well in terms of ensuring that the site was properly designed and monitored - and in particular has been poor in providing oversight, and in dealing with complaints from neighbours.

Given this history I do not feel that a 10-year extension to the PTTW would be appropriate. I am also cognizant of the fact that new boreholes have been drilled at the site and new monitoring wells installed - with lots of new information coming in the 2018 operations season.

I acknowledge that the new owner of the site (CRH) has been working hard to improve the situation, but much more needs to be done in many different areas.

I recommend that a PTTW extension of 1 year be granted by the MOECC, subject to acceptance and implementation of my recommendations for improving the site operations and monitoring programs (which are summarized in Section 9 of this review).

- b) I have no issue with the proposal to maintain the quantity of the water takings.
- c) I have provided my detailed comments and recommendations on the monitoring program in the previous sections of this review. My Recommendations are summarized in **Section 9** of this review.

7) Discussion

I do not consider the past Company and MOECC approach to handling the complaints of off-site well interference from the Teedon Pit aggregate washing operations (which seems to consist mainly of denying that any problem exists) to be reasonable or acceptable.

On the order of 50% of every liter of “top up” water being pumped during Cedarhurst’s aggregate washing operations is being “lost”, and that silt-laden water is going somewhere. The complaints from neighbours of the site appear to indicate that at least some of the lost silt-laden wash water is causing silt contamination of their wells and/or flooding of their properties.

I have considered several options which the MOECC could consider as means of addressing the Teedon Pit’s massive wash water losses and the residents’ complaints. These options were originally outlined in Section 6 of my October 2015 Report (which is included in **Appendix 4** of this report), and they can still be found there.

I am tending toward the conclusion that the cleanest go-forward solution (in every sense of the word) to most of the issues raised in this review may well be for the MOECC to require that CRH implement a true “closed loop” wash operation, with impermeable settling ponds and an impermeable wash pond. I understand that there are numerous logistical considerations which must be evaluated, so I am simply putting this idea forward for discussion at this time.

This idea would require all ponds to be lined with an impermeable liner, to be connected by pipe, for the sump pond to not have outflow capabilities, and would require ongoing measurements of pond water levels and nearby groundwater levels to confirm that no leakage was occurring. Inputs of “top up water” for the closed loop system would be strictly monitored, and should have an upper limit of the industry standard 10% of the water being pumped for aggregate washing.

Eliminating outflows of silt-laden water from the sump pond and wash ponds would eliminate the possibility of the aggregate washing operations at the Teedon Pit causing well interference to various neighbours of the site. If silt and/or flooding issues persist after sump and wash pond outflows to the natural environment are eliminated, then the issues would clearly be related to other causes and it would be up to each resident to ensure that their own issues were dealt with.

What would not be reasonable or desirable from my perspective would be a continuation of the status quo, which would be a recipe for continued off-site impacts and needless conflict between residents and the Permit Holder and the MOECC. I sincerely encourage the MOECC to carefully consider the contributions that their past actions and inactions have made to the current uncomfortable situation, and for the Company to draw a lesson from the missteps of their predecessor.

Neither the MOECC nor CRH should be surprised that local residents are going to significant lengths to protect themselves in this matter - it is quite understandable given their dependence on their well water supplies.

I sincerely hope that the MOECC and/or CRH decide to do the right thing, and take action to get to the bottom of the current situation. If not, then remedies available to my clients and the other complainants include complaints made directly to the Environmental Commissioner of Ontario and/or the Minister of the Environment. Civil suits are also a possibility. Finally, if the PTTW Application is approved without amendments then filing a request for leave to appeal the PTTW renewal is yet another possible course of action.

However it would be vastly preferable for this matter to be dealt with in a proactive and precautionary manner. All parties are fortunate that this is not an insoluble problem - the state of the science is adequate to appropriately deal with this matter once CRH and/or the MOECC decide to do so.

I have one other matter which I would like to bring to the attention of CRH. I am aware that there is grave concern among neighbours and in the broader community including First Nations about the major Site Plan Amendment which was issued by the MNR on November 30, 2016. In particular, the fourth bullet point in the MNR letter containing the consent for the Site Plan Amendment permits:
“the importation of asphalt, concrete, aggregate, and topsoil/fill for transfer processing”.

I would like to strongly recommend to CRH that it voluntarily not make use of the permission granted by MNR to import these various materials to the site for processing.

The groundwater supplies contained in the aquifer are very valuable and they are vulnerable as well. The entire Teedon Pit is a recharge area for the aquifer, meaning that rain falling onto the site will go into the ground and be carried downward and outward into the groundwater flow system. If rain falls onto stockpiles of foreign materials which have been imported into the site, then it can potentially dissolve contaminants (if present) and carry these downward and outward into the groundwater flow system.

This is a matter of grave concern to the community, and **I recommend that CRH should engage in meaningful dialogue with its neighbours and the broader public and with First Nations before considering the possible importation of foreign materials to the site.**

8) Conclusions

Following careful consideration of the documents listed in **Appendix 1** of this review, I have reached the following conclusions regarding the PTTW Application for the CRH Teedon Pit:

1) The Teedon Pit is situated on the flanks of a massive 50+ meter high hill of mainly stratified to substratified sands and gravels, with some incorporated silty till deposits. Groundwater movement through sands and gravels in steep terrain such as is found at the Teedon Pit can be relatively rapid, with flow rates on the order of 10s of meters per day quite possible. Sands and gravels are vulnerable to contamination problems because groundwater moves through them so quickly.

2) The pit is near the top of the local groundwater flow system, and as such is a “recharge area” for that flow system. This means that water infiltrating into the ground at the pit will move downward and outward into the underlying groundwater flow system, moving off-site in a downgradient (downhill) direction toward lower lying areas.

3) Rural residences which are 100% dependent on groundwater wells for their water supplies are found throughout the lower lying areas downgradient of the Teedon Pit. They are potential receptors in the event the operations at the pit are causing problems with respect to groundwater quality or groundwater flows.

4) Aggregate is being mined from the pit, and there have been 2 companies which have owned the Teedon Pit during the period since 2008 when the original PTTW was approved:

- Cedarhurst Quarries and Crushing Limited (hereafter referred to as Cedarhurst) owned and operated the pit from 2008 until mid-2017;
- CRH then purchased the pit from Cedarhurst, and has owned and operated it since then.

5a) An aggregate washing operation has been operating on an occasional basis since 2009. The aggregate washing operation requires a Permit to Take Water (PTTW), and several such permits have been granted by the MOECC since 2008.

5b) In my professional opinion, the MOECC was not as careful or precautionary as it needed to be when issuing the PTTWs for the Teedon Pit, and the MOECC’s oversight and monitoring of PTTW-related operations at the Teedon Pit have not been adequate. My concerns about these issues are presented in in **Section 4** of this review.

6) The aggregate washing operation requires a “sump pond” from which fresher wash water is drawn for aggregate washing, and to which silty wash water returns after some clarification. Water in the sump pond can be very cloudy due to the presence of fine silt and clay particles which are in suspension in the waters of the pond.

The sources of the silt/clay particles are silt from the aggregate washing operation and silt-laden runoff from the floor of the pit (all of which is directed into the pond). In effect, what has been created by the past and current owners of the Teedon Pit is an occasional but massive source of silt-laden water which resides in the sump pond at the site. The issue of sump pond water quality is discussed in detail in **Section 5c** of this review.

7) There have been unanticipated problems with the aggregate washing operations. These problems center around the fact that the sump pond has been leaking heavily since its construction in 2009. Water losses of almost 50% of the water being pumping for washing have been estimated. These water losses are discussed and described in detail in **Section 2d and 5b** of this review.

8) Commencing at roughly the same time as the construction of the sump pond and aggregate washing operations at the Teedon Pit (which started in Spring 2009) were negative impacts on nearby local residents’ domestic wells, including in particular the wells of my clients.

These impacts generally took the form of episodes during which wells were producing turbid (ie. cloudy) water with elevated levels of very fine grained particles and/or episodes of abnormally high groundwater levels which caused flooding and/or problems with wells. The complaints of local residents and in particular my clients are discussed and described in detail in **Sections 2e and 2f** of this review.

9a) The prior owner (Cedarhurst) ran a small and sloppy operation. Non-compliance with PTTW Conditions and with Site Plan Conditions was the norm, and during my first tour of the site on July 7, 2015 I observed that housekeeping practices were poor. My concerns about the operations and monitoring of the Teedon Pit by Cedarhurst are outlined in **Section 3** of this review.

9b) The previous PTTW holder’s responses to complaints were problematic to say the least, and thus there is an unfortunate history of poor relations with local residents.

10) The earlier owner of the site did not install (and the MOECC did not require them to install) an adequate groundwater monitoring network at the site, and the collection and analysis and retention of monitoring data has generally not been adequate.

As a result, there is insufficient information to properly understand what is happening in the groundwater flow system and the degree to which the Teedon Pit's operations are impacting downgradient wells.

11a) My hydrogeological conceptual model to explain what is happening is presented in **Section 5d** of this review. I believe that there is significant potential linkage between the massive wash water losses at the Teedon Pit and the well interference impacts being experienced by various residents situated around the pit including my clients.

11b) I am aware that the new owner (CRH) commissioned new hydrogeological investigations including the installation and monitoring of new wells, however further information is not available at this time. Once available, the new information will likely help reshape and refine the understanding of the site hydrogeology by all of the professionals who are involved with this matter.

12) I am also aware that CRH has generally been making a significant effort to run a better aggregate operation than their predecessor. That having been said, I am somewhat disappointed with the January 18, 2018 PTTW Application which has been submitted to the MOECC.

My review comments on the PTTW Application are presented in **Section 6** of this review.

13) In regard to the requested 10-year PTTW extension, this is a site which has had a checkered history under the previous owners - with many instances of non-compliance with PTTW and site license conditions, poor operational practices, and numerous complaints which were often met with hostile responses to complainants. The MOECC has not done well in terms of ensuring that the site was properly designed and monitored - and in particular has been poor in providing oversight, and in dealing with complaints from neighbours.

Given this history I do not feel that a 10-year extension to the PTTW would be appropriate. I am also cognizant of the fact that new boreholes have been drilled at the site and new monitoring wells installed - with considerable new information coming in the 2018 operations season.

In the meantime, I have developed a series of recommendations (presented in **Section 9** of this review), which are intended to help improve various aspects of the site's operations and monitoring. If these recommendations are accepted, then I would consider it appropriate for a 1 year extension to the PTTW to be approved by the MOECC. During that year, all parties would have the opportunity to carefully evaluate the new owner's operational and monitoring practices and to consider the additional information coming from the recently commissioned hydrogeological investigation.

9) Recommendations

Recommendation #1

- a) PW1-09 water takings should be recorded on a daily basis and tabulated monthly, together with the water takings from the sump pond.
- b) Dedicated flow meters should be used to measure the water taking volumes, and these should be recalibrated at the start of each water taking season.

Recommendation #2

- a) Regular water quality monitoring of on-site shallow aquifer wells and the wells of residents reporting silt problems must be a core part of the go-forward groundwater monitoring program. Regular laboratory testing of water quality should focus on the parameters turbidity and TSS, as these are direct measures of silt contamination of a well.
- b) Recruiting the affected residents in a surveillance program to try to determine the longer term patterns of the silt episodes is recommended. When water quality testing of residents' wells is done, results should be provided to the respective residents as soon as they come back from the laboratory.

Recommendation #3

All new wells should be added to the groundwater monitoring program, with regular monitoring for both water quality (turbidity and TSS) and continuous monitoring of water levels.

Recommendation #4

- a) Monthly monitoring of sump pond turbidity and TSS should be done in 2018 - with the monitoring focussed on establishing TSS and turbidity levels both at times of washing, and after long periods of inactivity.
- b) Measuring sump pond TSS and turbidity after very heavy storm events (which have involved runoff from the pit floor into the sump pond) is also recommended.

Recommendation #5

The staff gauge water level should be recorded **twice daily** in 2018 (before pumping and after pumping) from the first day of water taking through to the last day. This will allow wash water losses from the sump pond to be estimated.

9) Recommendations - continued

Recommendation #6

The elevation of the invert of the sump pond's discharge pipe should be established, and overflows from the pipe should be recorded on every day that they are occurring. Flows rates should be measured as accurately as possible on any date that overflows are occurring.

Recommendation #7

The condition of the sump pond's retention berm should be assessed daily by CRH staff, and monthly by a qualified engineer. Any changes and/or repairs to the berm should be approved in advance if possible, and reported to the MOECC within 24 hours of having been undertaken.

Recommendation #8

I recommend that any approval of the PTTW Application be amended to include a requirement for the Permit Holder to provide copies of the annual monitoring reports to members of the public and First Nations upon request.

Recommendation #9

It is recommended that CRH engage in meaningful dialogue with its neighbours and the broader public and with First Nations before considering the possible importation of foreign materials to the site.

Recommendation #10

The MOECC and CRH should take steps to re-establish public confidence in the complaints process. A handout clearly explaining complaints procedures should be developed in consultation with and circulated through the PLC, and to neighbours within 2 km of the site. All complaints to either the Company or the MOECC should be recorded and discussed in Annual Reports for the site - including their resolution, if any.

Recommendation #11

Instead of a 10-year renewal, it is recommended that a PTTW extension of 1 year be granted by the MOECC, subject to acceptance and implementation of my recommendations for improving the site operations and monitoring programs (which are outlined above).

10) Signature and Professional Stamp

This report has been prepared in its entirety by Wilf Ruland (P. Geo.). It is based on my honest conviction and my knowledge of the matters discussed herein following careful consideration and review of the documents in the Reference List in **Appendix 1** of this Report.

This review has been prepared exclusively for the use of my clients, Bonnie Pauze and Jake Pigeon.

Signed on the 23rd of April, 2018



WRuland

Wilf Ruland (P. Geo.)

766 Sulphur Springs Road
Dundas, Ont.
L9H 5E3
Tel: (905) 648-1296
deerspring1@gmail.com

Appendix 1

List of Documentation Reviewed or Referenced

The following list includes most of the key documentation which has been reviewed or referenced in the course of preparing this Report.

Alpha Environmental Services Inc. August 2015. Addendum to the Response to Local Well Water Quality Complaints. November 5, 2015.

Alpha Environmental Services Inc. May 8, 2015. Letter to Mr. Sean Persaud (Tiny Township) re Water Quality and Water Quantity Concerns of Local Residents.

Alpha Environmental Services Inc. May 5, 2015. Assessment of Local Well Water Quality Complaints.

Alpha Environmental Services Inc. April 2010. Aggregate Wash Water Supplementary Supply Pumping Test Results.

Alpha Environmental Services Inc. June 30, 2009. Letter to Mr. Christopher Munro, MOECC.

Chapman and Putnam (1984). The Physiography of Southern Ontario.

Domenico, P.A. and Schwartz, F.W. 1998. Physical and Chemical Hydrogeology.

Freeze, R.A. and Cherry, J.A. 1979. Groundwater.

GHD. January 18, 2018. Category 1 Permit to Take Water Renewal Application.

GHD. March 28, 2018. 2017 Annual Monitoring Report, Dufferin Teedon Pit.

Skelton Brumwell & Associates, February 1993 and January 2017. The ARA Site Plans, including the following sheets:

Drawing 1 - Existing Features

Drawing 2 - Operational Plan

Drawing 3 - Progressive and Final Rehabilitation Plan

Drawing 4 - Cross-Sections

- Ontario Ministry of Natural Resources (MNR), 2017. Rules and Regulations; under The Aggregate Resources Act. Available on the MNR website.
- Ontario Ministry of Natural Resources (MNR). November 30, 2016. Letter to Cedarhurst Quarries and Crushing Limited re Major Site Plan Amendment.
- Ontario Ministry of the Environment, April 18, 2008. Permit to Take Water (PTTW) No. 0503-7D4PX7.
- Ontario Ministry of the Environment and Climate Change; July 23, 2010. Amended Permit to Take Water No. 4317-87CNZN.
- Shotyk, W. et al, 2010. Trace Elements in Recent Groundwater of an Artesian Flow System.
- Singer et al, 1999. The The Groundwater Resources of The Severn Sound Remedial Action Plan Area.
- Waterloo Geoscience Consultants Inc. May 17, 2007. Hydrogeological Investigation to Support an Application for a Permit to Take Water, proposed Wash Plant, Teedon Pit.

Appendix 2

E-mailed Complaint

from Bonnie Pauze and Jake Pigeon.

Sent to MOECC on February 24, 2015.

Follow up Email from our telephone conversation of Feb 9/2015 regarding the Beamish Waverley pit (Cedarhurst Quarries)

We are making a formal complaint to the Ministry of the Environment regarding the existing Beamish Pit in Waverley ON.. (Cedarhurst Quarries and Crushing LTD). We are experiencing an adverse impact and the following neighbours are also experiencing an adverse impact.

- **Peter and Jenny Anderson**
- **Kim Tower**
- **Glenn and Janet Irvine**
- **Bonita and Rick Haggart**
- **David Barkey**
- **Rick Lang**

We have lived at 1189 Marshal Rd. since 1993.

We have two artesian wells that are essential to our existence and to our farming operation.

The quality ,quantity and clarity of our water was excellent. This was validated through extensive testing which was done by a world renown hydro geologist during the site 41 conflict. This was Dr.Bill Shotyk University of Heidelberg as Professor and Director of the Institute of Enviromental Geochemistry.

It was the spring of 2009 when there were the initial changes to our two flows .The quantity of water significantly diminished.

In June, July, August and September 2009 we had silt in our water in both flows. The water was no longer clear. It was muddy and we could no longer drink it.

In 2009, the well which is south of us, overflowed. This well belonged to our neighbor MR. Steve Ogden. Also, and in addition to this, water started to flood the ditches on Marshall Rd to such a point that the Township of Tiny had to place a culvert across Stamp Side Road to divert the excess water.

The only changed activity was the development and mining of Cedarhurst Quarry off of Darby Rd. in Tiny Township

In the winter of 2009, the amount of silt in our water diminished.

In the spring 2010 the silt returned to both artesian wells. At this point I started to collect water samples.

Summer 2010 my husband visits the Pit on Darby road and speaks to a pit worker who says they wash gravel. He calls [705 325 7447](tel:7053257447) he speaks to Rick who said he would make a note of it but they had not washed any gravel this year.

Summer 2010 called the township and complained to By law

Sept 2010 Silt continues.

Replaced two washing machine due to silt destroying the pumps.

Pressure tank needed to be replaced

Water pump all needed replacement due to the silt

October 2010 cleaned holding area for water. It had buckets of silt .

The Intake was covered

We bought a water filtration system with .005 filters

January 2011 hot water tank cleaned for two pails of silt Hydro Bill 700 dollars

And we Replaced two toilets damaged by silt

June 2011 silt increases in both wells

Dr. Bill Shotyk University of Heidelberg as Professor and Director of the Institute of Environmental Geochemistry, was called and he retested our water.

July 2011 replaced hot water tank

Flushed our hot water heating system and replaced radiators.

Aug 5/2011 lots of silt in both flows

I called Rick at Beamish expressing my frustration and concerns. He said he would send a man to have a look the following day but didn't feel it's his problem and they that are not having an impact on our wells. No study was done to confirm whether or not they were having an impact.

I waited all day no one appeared .

Aug 6 /2011 I called back to Beamish and left voice mail. No one returned my call.

On Aug 2011 I called the township bylaw who said they would call us when there would be a public mtg.

Spring 2012. silt in our water cleaned well reservoir

replaced another washing machine.

Pump in Jacuzzi plugged with silt

Waiting for mtg .

2013 silt in both flows

2014 received notification from Tiny Township of Beamishes request to expand and the public meeting January 26/2015.

Outcome of the Mtg. Tiny Township agrees to put Zoning approval on hold due to a lack of information and concerns addressing the issues.

Ad hoc information

Our neighbor Steve Ogden had adverse effects with Beamish regarding his water and had reported it to the MOE ,MNR, County of Simcoe, and the Township of Tiny with no positive outcome or cumulative impact study implemented

He decided to sell his property and it was purchased by Sarjeant's Paving Company. How coincidental?

Our concerns are also with Sarjeant's NEW developments where they have clear cut approximately 40 acres of old growth maples and they have permit to remove 2 million tonnes of aggregate per year. We are very concerned how this will further impact our aquifer. This area is over the very recharge zone which is referred to in Jagger Hims calibrated model report which was completed for the county of Simcoe.

Do they have a water taking permit?

Has a cumulative impact study been completed involving a three kilometer radius of this site?

At present Beamish Pit ,Cedar Hurst Quarry Pit, and the Sidhorpe Pit have a permit to remove 600 thousand tonnes per year and can remove 1.2 million liters' of water from the aquifer daily. This is the very aquifer that is identified in the Jagger Report, Hydro Geologist consultation, which indicates that the Waverley uplands are a recharge zone and need to be protected.

In Conclusion:

It is our understanding that when a water taking permit has been issued by the Ministry of Environment, it is the responsibility of the permit holder to address any complaints and/or concerns and the district office shall immediately be notified. Has this been done by the permit holder?

There has been a permanent adverse effect and a negative impact to our water supply since they commenced mining the Waverley Uplands.

This area has been investigated in the past. Site 41 was stopped with prudent judgement to protect the precious aquifer. There is substantial investigation and

documentation that would support our request for a cumulative impact study before any further mining occurs in this very water sensitive area.

Looking forward to your response to our concerns.

Bonnie Pauze and Jake Pigeon

Box 1262

1189 Marshall Rd

Tiny Ontario

L0L 2J0

[705-322-2579](tel:705-322-2579)

brentstore@ymail.com

Appendix 3

Critical Review of May 8, 2015 AES Letter

entitled

“Water Quality and Quantity Concerns of Local Residents”

Appendix 3 - Review Comments on the AES May 8, 2015 Letter

1) Introduction

The PTTW Application provides little in the way of new information, original investigations or analysis - relying instead on an assortment of information gleaned from various sources.

On the issue of impacts of the Teedon Pit on residential well water quality, the only historic technical report which is cited and included in full in the PTTW Application (in Appendix C.2) is a May 8, 2015 letter prepared by Cedarhurst's consultant AES (which is hereafter referred to as the "AES Letter").

The information provided in the AES Letter is incomplete, inaccurate, and inadequate. My detailed comments follow below.

2) My Detailed Comments on the AES May 8, 2015 Letter

a) At the bottom of page 1, the AES Letter indicates that 4 families with water quality/quantity concerns were identified (Pigeon/Pauze, Andersons, Irvines, Towers) and that these families "*declined the offer of inspection and sampling*".

In this regard, the record should be corrected/completed by noting that it is my understanding that at that time the Company and its consultant were behaving in an aggressively hostile manner toward my clients and that this was the reason they declined to have their wells inspected/sampled. My client (Ms. Pauze) can be contacted directly if there are further questions about this issue.

b) Groundwater elevations in the shallow aquifer are said to be described on Figure 1 and page 2 of the AES Letter, which indicates that the high point of the shallow flow system in February 2015 is centered around the MW1 well.

MW1 had a groundwater elevation of 252 meters above sea level (masl) . I note that MW1 does not appear to have a hydraulic connection to the shallow aquifer, and thus is not really relevant to this discussion. It was completed in an aquitard unit, in a thick sequence of "clay with silt". It is not clear why the AES Letter did not point this out.

The nearby sump pond itself provides a much more useful reference, given that it is leaking vast amounts of water and thus is for sure connected to the shallow aquifer. At times of heavy pumping (such as occurred in the summer of 2015) the pond water level will reflect the elevation of the water table. Depending on how full it is, the sump pond water surface elevation is on the order 260 - 264 masl - making it by far the highest point in the shallow aquifer flow system.

c) The last paragraph on page 2 of the AES Letter sets out a conceptual model suggesting that the wells of 2 of the complainants (Pigeon/Pauze and Tower) are completed in the shallow aquifer, and makes reference to Figure 3.

Unfortunately, Figure 3 is not included in the report. In any event, at this time there is insufficient hydrogeological information to confirm the simple 2-aquifer model put forward in the AES Letter. It is hoped that the current investigation being done for CRH will provide further insights.

d) The first indented paragraph on page 3 of the AES Letter describes the Pauze/Pigeon wells and in the course of doing so quotes from an e-mail from Ross Hodgins (MOECC hydrogeologist) who states that *“From her description, it appears the wells feed a cistern or reservoir from which they then pump for use and Ms. Pigeon complained that the flow had declined in the past few years... Assuming the wells rely totally on a free flow condition to an adjacent reservoir from which they then pump for use, long standing Ministry policy would therefore not protect such supplies against interference”*.

First of all, my client’s name is Bonnie Pauze (or Ms. Pauze).

Secondly, Mr. Hodgins managed to utterly mischaracterize my client’s complaint - Ms. Pauze complained of silt and did not complain of declining well water flows (personal communication). I can attest that I was retained by my clients in 2015 and they clearly articulated two concerns:

- the main concern was that they were experiencing major problems with silt in their wells;
- a lesser concern was that they were also experiencing periods of very high groundwater levels (flooding).

Thirdly, the reference to MOECC policy is in my professional opinion a misapplication of that policy. The policy in question is intended to be applied to interference issues related to water quantity, whereas my clients’ main complaint pertained to water quality impacts.

4) The last bullet point on page 4 of the AES Letter makes reference to and discusses Tables 1 to 7 of the report, which provide the water pumping summaries for the Teedon Pit for 2008 to 2014 respectively (which I have summarized in **Table 1** on page 6 of this review).

Issues related to water pumping at the Teedon Pit are discussed in detail in **Section 2d** of this review.

5) The first bullet point on Page 5 of the AES Letter states that: *“Since the concept of a closed-loop aggregate washing system is not familiar to the local residents, please refer to the graphic representation of this concept that is attached as Figure 4 and Figure 7.”*

This statement and the referenced Figures 4 and 7 neglect entirely to draw any attention to the massive ongoing losses of water from the sump pond. Those losses are highly relevant to the complaints. This section of the AES Letter is highly misleading. This is not a “closed-loop” system, it is a “leaky” system.

6) The last bullet point on page 5 of the AES Letter provides a discussion of PW1-09, and asserts that pumping of PW1-09 will not have (loss of water) impacts on the wells of the complainants.

I am not sure why the AES Letter includes this discussion. None of the complainants raised a concern about loss of water related to pumping of PW1-09.

7) The second last paragraph on page 6 of the AES Letter suggests that pumping of PW1-09 into the sump pond causes water levels to rise in well MW1 (which is situated beside the pond).

As I discussed above, MW1 does not appear to have a hydraulic connection to the shallow aquifer (or the sump pond). MW1 was completed in an aquitard unit, in a thick sequence of “clay with silt”. It is not clear why the AES Letter does not point this out.

Moreover, Figure 6 which is cited as supposedly showing that adding water to the wash pond (via PW1-09) raises water levels in MW1 actually does no such thing. The vertical scale on the right side of Figure 6 has been hugely stretched, to make it appear as though there are major fluctuations in water levels occurring in MW1. In fact the groundwater levels in MW1 are remarkably flat - varying by less than 1 meter over a 4 1/2 year period. This can be seen clearly if one considers the MW1 hydrograph in Figure 3 in Appendix G.2 of the PTTW Application.

Moreover, when one looks at the overlain PW1-09 pumping records and the stretched hydrograph in Figure 6 of the AES Letter then the following becomes apparent:

- in 2011 during the main period of PW1-09 pumping into the sump pond, MW1 water levels actually declined very gradually through almost the entire pumping period - not rising until around the time when pumping had ceased;
- in 2012 during the main period of pumping, MW1 water levels went up only marginally (by all of 20 cm over 2 months);
- in 2013 during the main period of PW1-09 pumping, MW1 water levels declined.

In the course of carefully studying the pumping records for PW1-09 in Figure 6 of the AES Letter I also noticed something else. Namely, that that PW1-09 pumping records in Tables 4 and 5 of the AES Letter are incomplete.

The PW1-09 hydrograph (which can be seen more clearly in Figure 1 of Appendix G.2 of the PTTW Application) clearly shows a period of pumping of PW1-09 in the spring of 2011 and another in the fall of 2012. These periods of PW1-09 pumping are not recorded in Table 4 of the AES letter (for 2011) or in Table 5 of the AES Letter (for 2012). Why not?

These omissions have decreased my confidence in the veracity of data being presented in the AES Letter.

8) The first big paragraph on Page 7 of the AES Letter mainly consists of references to the MOECC's opinions on the complaints which have been received. No technical information is provided to support those opinions.

My very detailed discussion of the problems with the MOECC's opinions and actions are set out in **Section 4** of this review.

9) Page 7 of the AES Letter concludes by suggesting that the shallow aquifer is naturally silty, and that the silt in the complainants wells is coming from the aquifer.

Not addressed in the AES Letter is the fact that there were no issues with my clients' wells prior to when a very leaky sump pond was excavated and taken into operation at the Teedon Pit. The fact of the sump pond's extreme leakiness (47.5% water losses, which had been calculated previously by the same author) was also not disclosed in the AES Letter.

Overall the AES Letter is an incomplete, inaccurate and inadequate - but representative - example of what my clients and their neighbours have been having to deal with in regards to their complaints about well interference from the Teedon Pit.

It is disappointing that CRH's consultants have chosen the AES Letter as the only complete technical reference document pertaining to water quality concerns to include with their PTTW Application.

Appendix 4

October 20, 2015 Report on Hydrogeological Impacts

Caused by Aggregate Washing

at the Teedon Pit near Waverley, Ontario

My October 20, 2015 Report is a separate stand-alone report which I prepared in 2015 for my clients. It is referenced repeatedly in this review.

It is attached to the submission of this review as a second PDF, in order to reduce the file size of this review.