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Mr. Shawn Persaud
Township of Tiny
130 Balm Beach Road West
Tiny, ON L0L 2J0

November 13, 2019

Dear Mr. Persaud:

RE: Letter of Objection to an Application for a Category 3 Class A Licence under the Aggregate Resources Act – North ½ of Lot 80, Concession 1, W.P.R & Part of Original Road Allowance between lots 80 and 81, Concession 1, W.P.R, Township of Tiny, County of Simcoe
(Cedarhurst Quarries and Crushing Limited (c/o CRH Canada Group Inc.)

Thank you very much for meeting with CRH on September 12, 2019 to discuss the status of the Township's technical review and we appreciated your acceptance of our October 4, 2019 follow up responses. On October 29, 2019 we received and reviewed the following peer review comments: Burnside Hydrological Peer Review dated September 11, 2019; Burnside Traffic Impact Peer Review dated September 11, 2019; Aercoustics Acoustic Peer Review dated July 10, 2019; Burnside Site Operation Peer Review dated September 11, 2019; and Severn Sound Environmental Association Natural Environment Peer Review dated September 27, 2019. Enclosed in attachment one is a chart summarizing the current status of the technical issues and additional CRH responses. Can the Township please provide these responses and attachments to the Township peer review team for confirmation that this addresses all outstanding issues.

We trust that this information adequately addresses the Township's outstanding comments. CRH will now update the site plans with the commitments as outlined in this letter, and provide a copy to the Township and MNRF.

If you have any questions, please do not hesitate to call.

Respectfully submitted,

Jessica Ferri, MCIP, RPP
Manager, Policy and Planning
CRH Canada Group Inc.

Attachments:
1. Figure 1 – CRH Response
2. Memorandum prepared by Goodban Ecological Consulting Inc., 2018 and 2019 Surveys for Eastern Whip-poor-will, August 29, 2019
3. Traffic Impact Study prepared by C.F. Crozier & Associates Inc., October 4, 2019
4. Letter prepared by GHD regarding Professional Opinion Regarding Neighboring Domestic Wells, September 25, 2019
5. Letter prepared by GHD regarding Response to Hydrogeological Comments #1, #2, and #3f, September 23, 2019
6. Sign-off from MECP regarding Whip-poor-will memo dated October 25, 2019

Attachment **1**

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Figure 1: CRH Response

	Township Comment	CRH Response June 20, 2019	Status of Issue Based on September 12, 2019 Meeting	Peer Review Responses provided to CRH October 29, 2019	CRH Response Nov 7, 2019
Hydrogeological					
1.	The hydrogeological assessment completed by GHD does provide some additional information on the geology in the vicinity of the sump pond/wash pond, however there is no discussion on how water levels in the ponds relate to levels in the local aquitard, the Newmarket Till and the Upper Thorncliffe.	The sump and wash ponds are located on the adjacent Teedon Pit. Discussion on how the ponds relate to the geology is not related to the pit extension application. For reference, we have included an electronic copy of the report prepared by GHD for the Teedon Pit titled "Category 1 Permit-to-take-Water Renewal Application – Supporting Hydrologic and Hydrogeologic Study".	CRH maintains the position that the wash plant is unrelated to the extension application. The wash plant and pond are located on the existing pit and is governed by MECP. If MECP does not permit the renewal of the existing permit, CRH will still proceed with the extension application as proposed. At our September 12, 2019 meeting, the Township requested the borehole logs for all drill holes in the vicinity of the wash pond, cross section drawings and a memo from GHD summarizing the reasons that the washing operation will not adversely impact wells. As requested, please see attached letters from GHD: • Letter dated September	Additional comments from Burnside dated September 11, 2019: "Although the wash pond and sump are not located on the proposed new pit site, the wash ponds and sump will eventually be used to wash the aggregate extracted from the new pit. As result, the existing wash ponds and sump are integral to the operation at the proposed new pit. Therefore, their impact on groundwater and surface water resources in the area should be considered as part of the new pit application. The information presented in the PTTW renewal application documentation does not provide the necessary site-specific information to	The wash plant and pond are located on the existing pit and is governed by MECP. If MECP does not permit the renewal of the existing permit, CRH will still proceed with the extension application as proposed. At our September 12, 2019 meeting, the Township requested the borehole logs for all drill holes in the vicinity of the wash pond, cross section drawings and a memo from GHD summarizing the reasons that the washing operation will not adversely impact wells. CRH submitted this requested information on October 4, 2019. Please see attached letters from GHD: • Letter dated September 25, 2019

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			25, 2019 regarding Professional Opinion Regarding Neighboring Domestic Wells • Letter dated September 23, 2019 regarding Response to Hydrogeological Comments #1, #2, and #3f	assess the impacts due to the on-going use of the wash pond and associated infrastructure to wash material from the proposed expansion. Burnside reviewed a January 8, 2019 GHD letter to CRH from GHD (Hydrogeological Assessment-Location of Water Table) which is available on https://www.dufferinaggregates.com/resourcecentre The report provides Borehole logs for some of the holes drilled in 2018 and includes cross sections. This information should be presented in a stand-alone documents that addresses impacts of the wash pond."	regarding Professional Opinion Regarding Neighboring Domestic Wells • Letter dated September 23, 2019 regarding Response to Hydrogeological Comments #1, #2, and #3f
2.	The addition of the new wells improves the understanding of the geology on the existing pit site and in the proposed pit extension area. The following additional information is required for Burnside to complete their peer	Please refer to the GHD report mentioned above as it addresses the requested information.	See response to Item 1 for the outstanding items the Township has requested.	Additional comment from Burnside September 11, 2019: "The PTTW report does not include any information from the boreholes/monitoring wells drilled in 2018. Several of the boreholes/monitoring wells are in close proximity	The PTTW report is not part of the extension application. CRH has provided this requested information on October 4, 2019. Please see attached letters from GHD: • Letter dated September 25, 2019 regarding Professional

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	review: • A table showing the dates that the manual water level data was collected and hydrographs showing the results for each well; • Borehole logs for the wells so that the geology can be seen at each location. Based on the cross sections, it appears that the sump pond/wash pond is effectively isolated from the underlying aquifer. The borehole logs would assist us with the interpretation of the extent of the silt and clay aquitard; and • A "regional" cross section that includes the reported depths of the wells reportedly impacted by previous operations at the quarry.			of the wash pond and would be helpful in confirming the presence of silt/clay aquitard that may be present."	Opinion Regarding Neighboring Domestic Wells • Letter dated September 23, 2019 regarding Response to Hydrogeological Comments #1, #2, and #3f
3(a)	Burnside recommends that:	The proposed Teedon Pit Extension is an above water pit. GHD concluded	Requested information has been provided. See response to Item 1.	Additional comment from Burnside September 11, 2019:	The extension application is for a Category 3 Pit above the water table.

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	• The current condition of nearby domestic wells be established, including the well depth and condition of the casing/screen, the well yield and general water quality.	that there would be no impact to local wells. To date there have been three (3) domestic well surveys completed: the first in 2015 was completed by Alpha Environmental where 27 wells were included; the second in 2017, was conducted by GHD on behalf of CRH where 5 were included; and the third, in 2018 included 78 domestic well surveys which was also conducted by GHD on behalf of CRH. For your information we have also included this report titled "2018 Domestic Well Survey" electronically.		"The majority of well concerns reported by residents were related to the presence of silt in their wells which many believed were the result of leakage from the wash pond. In their documentation of the domestic well survey GHD indicates the "the presence of the Local Aquitard would isolate the aggregate washing operations from the deeper aquifer". GHD should use the water level and geologic information from all the wells on the existing site and proposed expansion area to create cross sections that show the lateral and vertical extent of the Local Aquitard and how it relates to the domestic wells with reported siltation problems. Groundwater flow maps using the water level data from the site will be helpful in showing which domestic wells are downgradient of the existing and proposed site."	Neighbour well complaints are unrelated to extraction above the water table. For information purposes CRH has provided the Township with all additional work done completed by CRH. In addition, CRH forwarded the MECP letters that concur with the study's findings that well complaints are not caused by existing Teedon Pit operations. CRH has provided this information on October 4, 2019. Please see attached letters from GHD: • Letter dated September 25, 2019 regarding Professional Opinion Regarding Neighboring Domestic Wells • Letter dated September 23, 2019 regarding Response to Hydrogeological Comments #1, #2, and #3f

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3(b)	• Manual monitoring be done at least monthly and that Automatic Water level Recorders (AWLR's) be installed so that the peak spring water levels in 2019 can be captured and used to confirm that the proposed Teedon Pit Extension pit floor elevation is 1.5 m above the high-water table.	AWLR's have already been installed in all the monitoring wells at both the Teedon Pit and the proposed extension lands. CRH commits to revising Note #42 on the proposed Teedon Pit Extension operations plan to reflect the Town's request to have AWLRs loggers installed and for the wells to be monitored monthly.	Item resolved.
3(c)	• An additional monitoring well be installed between MW9-18 and MW8-18 to provide data on the water table as there are no other wells on the Teedon Pit Extension property that are completed in the sand aquifer. Similarly, an additional well should be installed along the eastern edge of the proposed extraction area. Wells on the Teedon Pit to the south should be included in the	CRH commits to revise the Teedon Pit Extension site plans to include the additional following note: "One year prior to extraction commencing, two additional monitoring wells shall be installed. One between MW9-18 and MW8-18 and the second shall be installed along the eastern edge of the extraction area". The additional monitoring wells referenced above will be added to Note #42	Item resolved.

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	monitoring program.	and to the monitoring well schematic on the Teedon Pit Extension operations plan.	
3(d)	• The Monitoring Program should include provisions to modify operations in the event the pit floor is less than 1.5 m above the water table.	The Teedon Pit Extension operations plan Note #44 already indicates that operations will be modified based on measured water levels. Note #44 states: "Extraction shall remain 1.5 metres above the established water table. In the event the water level data indicates the maximum depth of extraction is less than 1.5 metres above the established water table, the maximum depth of extraction shall be adjusted accordingly to maintain the 1.5 metre depth."	Item resolved.
3(e)	• Additional data be collected using AWLR's to confirm the water table elevation until the Teedon Pit Extension	As noted in response to 3(b) and 3(c), the AWLR loggers have already been installed and Note #42 on the Teedon Pit	Item resolved.

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	begins operations. Water level collection only began in June 2018 and may have missed peak spring water levels.	Extension Operations Plan will be revised to reflect this, the requirement for monthly monitoring, as well as the addition of the 2 monitoring wells.			
3(f)	• Testing be completed to evaluate the connection between the existing wash pond and the underlying aquifer. This may require the installation of additional shallow monitoring wells near the wash pond so that the water table can be monitored, and vertical gradients can be calculated. If it is found that the pond has the potential to impact groundwater water quality/quantity, then consideration should be given to the installation of a liner.	The testing and monitoring requirements for the wash pond are not related to the Teedon Pit Extension and are subject to the PTTW application process. For reference refer to the GHD report titled "Category 1 Permit-to-take-Water Renewal Application – Supporting Hydrologic and Hydrogeologic Study".	See response to Item 1.	Additional comment from Burnside September 11, 2019: "The wash pond will be used to wash material from the proposed pit expansion and the comment above should be addressed." The reference to the "comment above should be addressed" is the same comment as shown in the left column.	No washing of aggregates is proposed on the extension property. Please refer to the response to Item 1.

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Traffic			
4(a)	The Application material did not include a Traffic Impact Study, however it did include some traffic-related information. • In order to determine the impacts on Darby Road and on the Highway 93 intersection, a Traffic Impact Study (TIS) must be provided. It is acknowledged that the licensed extraction rate and truck volumes are not proposed to increase, however the length that the pit will be in operation will change. Based on the maximum annual extraction volume of 600,000 tonnes, it will take an additional 17 years of operation to exhaust the Teedon Pit Extension supply {assuming the existing Teedon Pit is near the end of its life). This should be a consideration in	As requested, CRH commits to conducting a Traffic Impact Assessment which will assist in determining the maneuverability conditions of Darby Road and will assess the intersection at Highway 93 & Darby Road. This will be completed and submitted to the Township for review.	Enclosed please find a copy of the traffic impact study prepared by C.F. Crozier & Associates Inc. dated October 4, 2019.

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	determining the revised traffic impact. • The alignment of Darby Road has a sharp bend at its intersection with Highway 93. The sight distances at this intersection are limited by the horizontal alignment on Highway 93. The traffic operations at the intersection of Darby Road and Highway 93 should be confirmed in the TIS. Safety issues (collision history) should be reviewed for the haul route (and intersection) to determine if there have been any incidents from the existing Teedon Pit operations.				
4(b)	• A scenario with 15 trucks idling close to the entrance before 5:00 am will impact the functionality of Darby Road in this area. This matter needs to be addressed.	A scenario with 15 trucks idling close to the entrance before 5:00 am is a scenario that should not occur. CRH encourages the Township to post no stopping signs along Darby Road to	Enclosed please find the TIS and please note the following information - The Township has agreed to install No Stopping signs along Darby Road at CRH's expense. CRH also commits to cover the cost	Additional comment from Burnside September 11, 2019: "The anticipated TIS report should confirm the measures proposed to address the potential for off-	CRH suggests the Township install "no parking" signs along Darby Road at CRH's expense. CRH also commits to cover the cost for paid OPP officers to monitor and ticket trucks in the

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		prevent this from occurring. CRH is prepared to cover the costs for the signage. If there are concerns related to the existing pit or proposed pit CRH remains committed to work with the Township and surrounding residents to ensure this is not happening. If required, CRH could open its gates earlier to avoid truck queuing on Darby Road. Item #5 from the Township of Tiny Staff Report (dated February 28, 2019) notes that there is no basis given for the estimate of 20 trucks incoming and ongoing from the pit on the worst peak hour. The model prepared in the Acoustic Assessment Report identified 20 trucks (40 passes) as being the maximum amount of trucks permitted in order to comply with MECP NPC-300 for Class 2 and 3 areas.	for paid OPP officers to monitor and ticket trucks in the event the No Stopping signs are not being adhered to. CRH also commits to communicate the hours of operation to its customers and truck drivers to prevent trucks from arriving prior to 5 am. As discussed at our meeting, during peak hours at the existing pit, there have been 20 trucks (40 truck trips) per hour and subject to approval of the extension, this will now be the maximum trips permitted in any given hour.	site queuing, as well as confirm whether off-site queuing has been observed under existing operations. The response suggests that the noise criteria will limit the truck volume to 40 trips in the peak hour. This maximum rate should be confirmed in the anticipated TIS and set out in the site plan agreement, along with monitoring provisions to ensure that this maximum is adhered to. The TIS should also provide an estimation of the peak hour truck trips that are currently experienced at the existing pit, to provide a sensitivity analysis as to whether the future traffic impacts are expected to increase, as compared to existing conditions.”	event the No Stopping signs are not being adhered to.. CRH continues to commit to communicate the hours of operation to its customers and truck drivers to prevent trucks from arriving prior to 5 am. As discussed at our meeting on September 12, 2019, during peak hours at the existing pit, there have been 20 trucks (40 truck trips) per hour and subject to approval of the extension, this will now be the maximum trips permitted in any given hour.

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4(c)	• It is noted that the Township has been approached by the Sarjeant Company Limited regarding a proposal to use the existing CRH entrance for their two pits. It is the Township's understanding that no formal application has been made to the MNRF relative to this proposal.	The potential Sarjeant proposal is unrelated to the proposed Teedon Pit Extension. As previously discussed with the Township, this scenario would require major site plan amendment under the Aggregate Resources Act to both Sargent and CRH's existing Teedon Pit site plans. No application has been made to the MNRF and if ever an application was to be submitted, the Township, County, and the public would be circulated for comment.	No application has been submitted and there are no plans to submit such an application. Although no application has been submitted, the Teedon Pit site plans will only permit a maximum of 15 trucks (30 truck trips) per hour prior to 7:00 am and 20 trucks (40 truck trips) per hour during daytime hours. This is the maximum number of trucks that can exist on the site per hour regardless of the origin of trucks.	Additional comment from Burnside September 11, 2019: "The anticipated TIS report should confirm CRH's position with respect to the potential interconnection between the two pits, as well as whether such interconnection could have merit from a traffic impact perspective. It is noted that the Township does not support the joint use of the Darby Road entrance for interconnection of the Sarjeant and CRH pits."	No application has been submitted and there are no plans to submit such an application. Although no application has been submitted, the Teedon Pit site plans will only permit a maximum of 15 trucks (30 truck trips) per hour prior to 7:00 am and 20 trucks (40 truck trips) per hour during daytime hours. This is the maximum number of trucks that can exist on the site per hour regardless of the origin of trucks.
Noise					
5(a)	A scenario with 15 trucks idling close to the entrance of the pit was modelled and it was found to have the potential to cause an objectionable noise impact. This matter needs to be addressed.	CRH is unclear why the Township's noise peer reviewer modelled this scenario. As noted above, a scenario with 15 trucks idling close to the entrance before 5:00 am is a scenario that should not occur. CRH	Item resolved.		

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		encourages the Township to post no stopping signs along Darby Road to assist in preventing this from occurring. CRH is prepared to cover the costs for the signage. If there are concerns related to the existing pit or proposed pit CRH remains committed to working with the Township and surrounding residents to ensure this is not happening. If required, CRH could open its gates earlier to avoid truck queuing on Darby Road.	
5(b)	The following additional information is required for Aercoustics to complete their peer review: •The operator should confirm that a 10 m high working face, which was modeled in all worst-case scenarios that forms an integral part of the noise control design,	CRH confirms that this is feasible based on the planned loader sizes and required safety and labour laws.	Item resolved.

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	can be maintained at all times and is feasible in the context of the planned front-end loader sizes, according to safety (working face structure) and labour laws (i.e. permitted height above the top of extended bucket).		
5(c)	• Restrictions on the number of permitted equipment and maximum sound level permitted should be incorporated in the licensing document.	As requested, CRH commits to including the equipment list and its associated maximum sound power into the proposed site plans and under the section titled “Equipment to be used Onsite and Noise/Air Mitigation”. In addition, this equipment list and sound power readings are identified in Section 2.0 of the Acoustical Assessment Report.	Item resolved.
5(d)	• Modelling parameters for the surrounding foliage such as height of trees and elevation of the ground relative to the	Please see attached memorandum from Theakston Environmental.	Item resolved.

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	existing topography at each point of the foliage object should be provided.		
5(e)	• Confirmation is required to be provided that the noise reduction due to foliage is reasonable for 12 months.	Please see attached memorandum from Theakston Environmental.	Item resolved.
5(f)	• There are acoustic barrier requirements and other noise controls outlined in the noise study which apply to the existing Licence. It should be confirmed whether requirements and noise controls will be implemented on the existing Licence and whether they will be feasible to implement and/or enforce.	CRH has submitted a minor site plan amendment to MNRF to permit the construction of the acoustic berms and restrict the location of the genset trailer on-site so that this can be completed immediately.	Item resolved.
Site Operation			
6.	The Operational Plan - Imported Materials, Note 50 specifies that "where	Note #49 on the proposed Teedon Pit Extension operations plan, states	Item resolved.

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	the imported material is not being placed within 1.5 metres of the surface, the criteria under Table 1 for Sodium absorption ratio and electrical conductivity do not have to be met." With the local groundwater sensitivity, we would recommend that Note 50 be replaced with "No fill shall be imported and disposed of at the site other than to establish slopes as specified in the Rehabilitation Plan."	that “clean inert fill may be imported to facilitate the establishment of side slopes.” CRH confirms that we will modify this note and add a new note to the rehabilitation page to state that “no fill shall be imported and disposed of at the site other than to establish slopes as specified in the Rehabilitation Plan.”			
7.	Considering the above noted point, the Township recommends that asphalt recycling be removed as a permitted use at the existing licensed Teedon Pit.	An asphalt recycling note does not exist on the proposed Teedon Pit Extension site plans and is unrelated to the extension application.	Item resolved. CRH commits to further revise the Teedon Pit Extension site plans to prohibit the storage of asphalt in the extension.		
8.	The Rehabilitation Plan - Tree Planting Schematic proposes an agricultural use in the pit floor, however, fertilizers and	There are several areas within the Township where agriculture is within 1.5m of the water table. To enhance biodiversity	Item resolved.		

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	other agricultural chemicals used for normal farming practices may negatively impact the aquifer especially considering the final depth of extraction will be a maximum of 1.5 metre above the established groundwater table. It is recommended that the rehabilitation plan be revised to remove this proposed use and replace it with a tree planting plan.	after extraction is complete, CRH will commit to revise Note #5 and Note #6 on the proposed Teedon Pit Extension Rehabilitation Plan to reflect the continuation of the setback and slope tree planting to the pit floor.			
Natural Environment					
9.	Table 2 of the NETR lists Species At Risk (SAR) with potential to occur in the study area. Since this table does not include endangered bats, it is not clear that SAR bats and their habitat (e.g., snags/cavity trees suitable for bat roosting or maternity sites) were considered in the preparation of the NETR, and clarification or	MNRF is satisfied with the work related to Species at Risk as it relates to the Endangered Species Act with the exception of whip-poor-will surveys. CRH has committed to do the whip-poor-will surveys this spring/ early summer and provide the survey results to MNRF.			Please see the attached email providing confirmation from MECP that they have no concerns related to the whip-poor-will survey.

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	additional information may be required. The SSEA defers to the Ministry of Natural Resources and Forestry (MNRF) on issues related to the Endangered Species Act, and understands that MNRF will be reviewing the proposal.				
10.	The NETR references the MNRF's Significant Wildlife Habitat Technical Guide (2000), and indicates that the Significant Wildlife Habitat (SWH) Criteria Schedules for Ecoregion 6E (MNRF 2015) were also consulted. The SWH Ecoregion Schedules provide specific criteria for identifying candidate and confirmed SWH. Clarification is required regarding the following types of SWH: • Amphibian Breeding Habitat (Woodland) -	See attached memorandum from Goodban Ecological Consulting.	Item resolved.		

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	according to the NETR, swamp community SWDM4a is within approximately 120 m of the proposed extraction area (see Figure 5), and several amphibian species including wood frog, spring peeper and gray treefrog were documented on site (section 5.4). As per the SWH Ecoregion Schedule, if these amphibians are present in sufficient numbers, the wetland plus a 230m radius of woodland area would be considered SWH and the NETR would have to address any potential negative impacts. The NETR does not discuss whether or not this area qualifies as candidate or confirmed SWH, and further information is required. • Woodland Area-Sensitive Bird Breeding Habitat - area-sensitive bird species were documented in the		

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	NETR at station 3 and 4 (see Attachment E, Point Count Data Summary), however these station locations were not included in the SWH mapping shown on Figure 8. Further explanation is required.		
11.	Planting as proposed for Forest Edge Management should include follow-up survival assessments of planted stock. Replacement planting should be undertaken, if necessary due to poor stock survival.	CRH will commit to adding the following to the forest edge management zone A and B on the Teedon Pit Extension operation plan: "The forest edge management zones shall be monitored for survival in the first, second and fifth years after planting. Replacement planting should be undertaken if survival is less than 60% for each species."	Item resolved. As requested CRH will change the "should" to "shall". The revised note will read: "The forest edge management zones shall be monitored for survival in the first, second and fifth years after planting. Replacement planting shall be undertaken if survival is less than 60% for each species."
12.	Survival assessments for rehabilitation tree planting of setbacks and side slopes:	Note #7 on the Teedon Pit Extension Rehabilitation Plan already requires a one (1) and two (2) year assessment. CRH	Item resolved.

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	• Survival assessments should be done at years one, two and five (free-to-grow assessment), as is currently the practice of tree planting agencies like Trees Ontario/Forests Ontario, rather than just in the first and second year after planting as indicated in the NETR. • The bullet regarding replacement planting if survival is less than 60% should be modified to indicate that 60% survival of each species is required to ensure post-planting species diversity.	commits to modifying this note to also require the five (5) year assessment. In addition, the note will be modified to require 60% survival of each species.	
13.	The SSEA would like to be provided with information on the projected timing of extraction for the site. If extraction is anticipated to be a considerable ways off, then management of forested areas on site may be	Tree Clearing Schematic Note #3 on the proposed Teedon Pit Extension Operations Plan indicates that “as extraction progresses north tree clearing shall occur as required to advance extraction and minimize the disturbed area”. The	Item resolved.

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	appropriate; in addition, the species proposed for use in rehabilitation planting should be re-assessed at a later date, to ensure that they are still appropriate and practical for climate and site conditions, according to the best available information at that time.	Management Plan is focussed on the enhancement of trees that will remain and trees to be planted. Management plans for trees to be removed is not beneficial to the site. The trees proposed for the rehabilitation planting are appropriate. Tree Planting Schematic (Reforestation of Side Slopes) Note #4 on the proposed Teedon Pit Rehabilitation Plan will be revised to include the following at the end of the note: "…or other appropriate species recommended by a qualified ecologist at the time of planting."	

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In addition, item #3 from the Township of Tiny Staff Report (dated February 28, 2019) also included additional comments from the Burnside peer review response dated February 15, 2019 (Appendix #5 of Staff Report) regarding recommendations 1, 2, 3 and 4 from Burnside's February 24, 2016 letter to the Township. The recommendations are addressed below:

	Township Comment	CRH Response June 20, 2019	Status of Issue Based on September 12, 2019 Meeting
14	The current condition of nearby domestic wells should be established, including the well depth and condition of the casing/screen, and the well yield and general water quality. The work should be completed by the proponent using an independent qualified consultant.	Please see response to comment #3(a) on page #2 of this response.	See response to issue 3(a).
15	The monitoring network at the Teedon Pit should be expanded to include a staff gauge in the wash pond, a nested well with screens completed at a variety of depths (to monitor change in gradients during use of the wash pond), along with a number of wells completed in the aquifer(s) that are used by domestic wells in the area. A professional geoscientist (or equivalent) should be present during the drilling of the wells to describe the geology and select the intervals for monitoring well completion.	Please see response to comment #1 on page #1 of this response.	Item resolved.
16	The proponent should provide additional information such as cross sections to confirm that the monitoring wells are completed at similar depths as domestic	Please see response to comment #3(a) on page #2 of this response.	See response to Issue 1.

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	wells in the area and will provide the necessary information to confirm that aquifers used by domestic wells are not being adversely impacted by the use of the well or wash pond on-site.		
17	An appropriate on-site monitoring network will eliminate the need for on-going monitoring of domestic wells.	Since 2016, modifications have been made to the monitoring network. Please refer to the revised ARA site plans for the updated monitoring network as well as the proposed modifications outlined in this letter to the monitoring network.	See response to 3(b), 3(c), 3(d) and 15.

Attachment **2**

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Phone: (905) 693-9064
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MEMORANDUM

To: **Brian Zeman, MHBC Planning**
Kevin Mitchell and Jessica Ferri, CRH Canada Group Inc.

From: **Anthony Goodban, Goodban Ecological Consulting Inc. (GEC)**

Date: **August 29, 2019**

Re: **Teedon Pit Extension**
2018 and 2019 Surveys for Eastern Whip-poor-will

Introduction

On March 25, 2019, the Midhurst District Office of the Ministry of Natural Resources and Forestry (MNRF) provided comments on the Teedon Pit Extension application in a letter to Ms. Jessica Ferri (Manager, Policy and Planning, CRH Canada Group Inc.). MNRF provided the following comments with respect to the Natural Environment Technical Report prepared by Goodban Ecological Consulting Inc. (GEC):

> *The proposed licence area appears to have strong suitability as potential habitat for the Eastern Whip-poor-will, a threatened species listed on the Species at Risk in Ontario (SARO) List. The roadside Whip-poor-will survey conducted on July 4, 2018 covered a broad area but there were no point counts conducted directly within the proposed licence boundary. To best assess the presence of Whip-poor-will during the breeding season, two surveys preferably within different lunar cycles are recommended.*
>
> *Additionally, Whip-poor-will vocalizations are most common in the early part of the breeding season and have been shown to decrease in July. As a result, MNRF requests that an additional whip-poor-will survey be completed that would include the area within the licence boundary and would incorporate two different lunar cycles between the period from late May to early July.*
>
> *We note that the Forked Three-awned Grass, an endangered species listed on the SARO list, was found on the subject property. Your company has registered for this species under Section 23.14 of Ontario Regulation 242/08 of the Endangered Species Act. We have no further comment on this matter.*

GEC completed the 2019 Eastern Whip-poor-will surveys as recommended by MNRF in their March 25, 2019 letter. This memorandum briefly describes the Eastern Whip-poor-will survey methods employed and presents the findings of the 2019 surveys.

2018 Eastern Whip-poor-will Survey

An Eastern Whip-poor-will nocturnal survey was completed on July 4-5, 2018. That night the moon was 68.9% illuminated. The survey extended from 2350 to 0230 hours. The weather was clear, wind was 1 on the Beaufort wind scale and temperature 25 to 24ÁC. Twenty-three (23) listening stops (3 minutes each) were made at the locations shown on **Figure 1**. The results of the 2018 survey was negative; no Eastern Whip-poor-wills were detected.

2019 Eastern Whip-poor-will Surveys

Nocturnal Surveys (Point Counts)

The Eastern Whip-poor-will survey windows for 2019 are presented in **Table 1**. The primary survey window is the 7 days leading up to a full moon, although the 7 days after the full moon may also be surveyed. Surveys were completed on June 11 and July 12. The surveys commenced at least 30 minutes after sunset.

Five stations were surveyed (Stations A to E) in 2019. Survey station locations are shown on **Figure 1**. Station A is located in the middle of the proposed Teedon Pit Extension extraction area. For each survey, a 15 minute point count was completed at Station A and 5 minute point counts were completed for Stations B to E.

Table 1: Eastern Whip-poor-will Survey Schedule - Southern Ontario 2019

Window	Full Moon	Primary Survey Window	Secondary Survey Window	Teedon Pit Ext. Survey Date
• Early Window (during migration period)	18 May	11 May - 18 May	19 May - 26 May	
• Mid-season Window (Breeding Season) • Optimal Timing	17 June	10 June - 17 June	18 June - 25 June	June 11
• Late Window (Breeding Season)	19 July	9 July - 16 July		July 12

Source for survey windows:

http://www.couchichingconserv.ca/general-info/volunteer/whip-poor-will-survey-window-2019/

On June 11, 2019, sunset was at 2102. The survey commenced at 2135. Winds were very light (0 to 1 on the Beaufort Wind Scale) and the sky was clear with very few clouds. Air temperature was 13^{o}C at 2100. That night the moon was 70.0% illuminated. The survey was completed around 2240. No Eastern Whip-poor-wills were detected during the June 11 nocturnal survey.

On July 12, 2019, sunset was at 2102. The survey commenced at 2140. Winds were very light (0 to 1 on the Beaufort Wind Scale) and the sky was clear with very few clouds. Air temperature was 16^{o}C at 2100. That night the moon was 85.7% illuminated. The survey was completed around 2245. No Eastern Whip-poor-wills were detected during the July 12 nocturnal survey.

Song Meter SM4 Recordings

To augment the 2019 Eastern Whip-poor-will nocturnal surveys, a Song Meter SM4 recorder was deployed at Station A on June 11, near the middle of the proposed Teedon Pit Extension extraction area (see **Figure 1**). The SM4 unit was programmed to record for 10 minute intervals starting 30 minutes, 90 minutes and 150 minutes after sunset. The SM4 unit was retrieved on the evening of the July 12 nocturnal survey.

Recordings from June 11 to 25 and July 9 to 11 were analyzed. No recordings of Eastern Whip-poor-will recordings were made. The SM4 unit recorded crickets, songbirds, Coyotes howling in the distance, small aircraft and vehicles on Darby Road and Highway 93, so it would certainly have picked up the loud song of the Eastern Whip-poor-will if any were present during the survey periods.

Conclusion

MNRF requested that an additional Eastern Whip-poor-will survey be completed in 2019 that would include the area within the proposed Teedon Pit Extension licence boundary and incorporate two different lunar cycles between the period from late May to early July.

GEC completed nocturnal surveys for Eastern Whip-poor-will on June 11, within the optimal breeding season survey window, and July 12, within the late breeding season survey window. The two surveys were completed during two separate lunar cycles. Point Count Station A was located in the middle of the proposed Teedon Pit Extension extraction area. A Song Meter SM4 recorder was also deployed at Station A from June 11 to July 12, to augment the nocturnal surveys.

In 2018 and 2019, no Eastern Whip-poor-will were detected during targeted surveys. It is concluded that the Teedon Pit Extension and adjacent land is not habitat for this species.

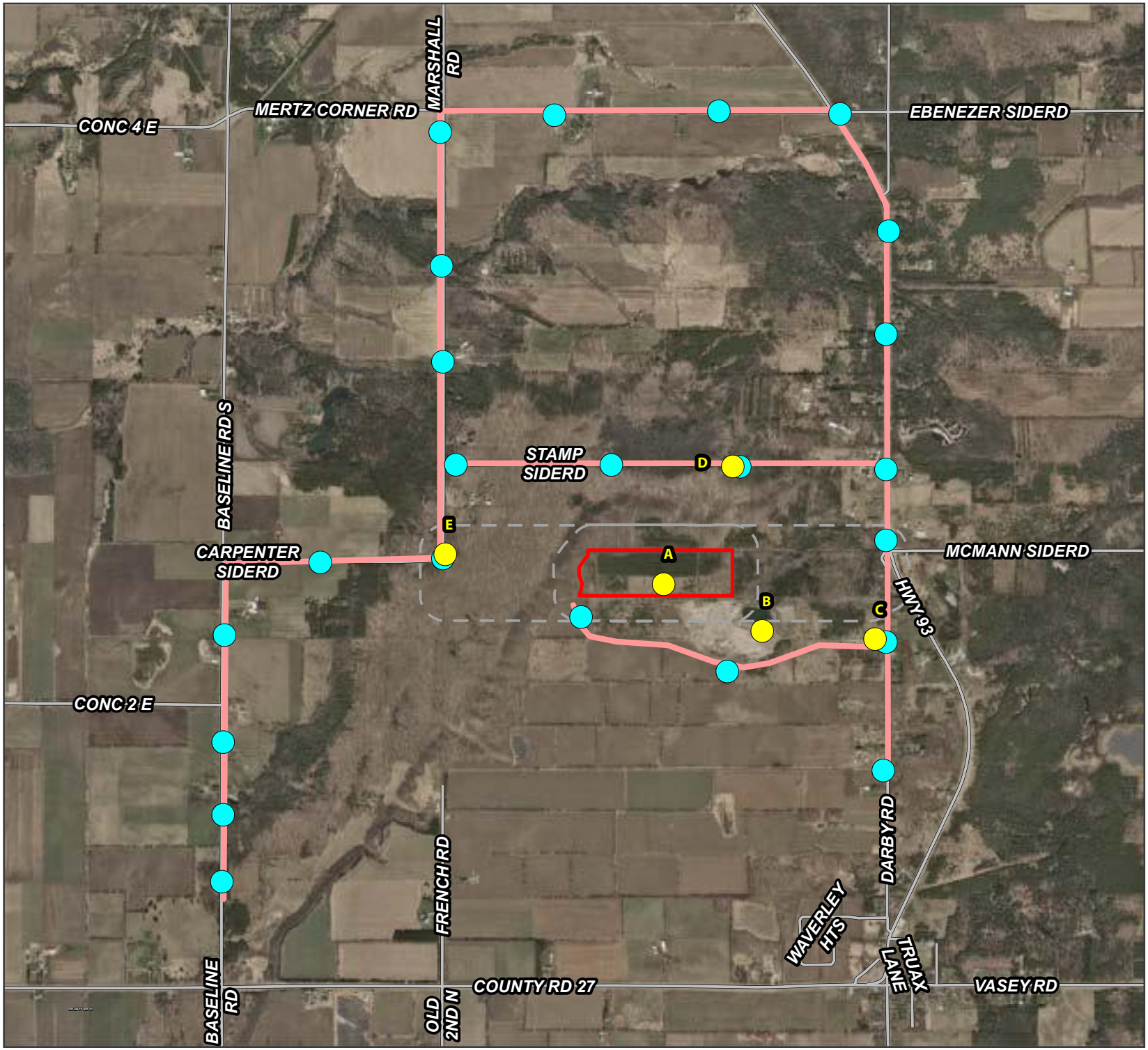

FIGURE 1

EASTERN WHIP-POOR-WILL SURVEY STATIONS (2018 & 2019)

Natural Environment Report

TEEDON PIT EXTENSION
2 Darby Road,
Part of Lot 80, Concession 1 W.P.R. &
Part of original road allowance between lots 80 & 81, Concession 1, W.P.R.
Geographic Township of Tiny
County of Simcoe

Legend

- Licensed Boundary
- 120m Buffer from Licensed Boundary
- 2018 Whip-poor-will Point Count Stations
- 2019 Whip-poor-will Point Count Stations
- 2018 Whip-poor-will Survey Route

Goodban Ecological Consulting Inc.

DATE
AUGUST 2019

SOURCES
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MHBC

Attachment **3**

TRAFFIC IMPACT STUDY

DARBY ROAD AND HIGHWAY 93
INTERSECTION IMPROVEMENTS
TOWNSHIP OF TINY

PREPARED FOR:
CRH CANADA GROUP INC.

PREPARED BY:

C.F. CROZIER & ASSOCIATES INC.
40 HURON STREET, SUITE 301
COLLINGWOOD, ONTARIO
L9Y 4R3

OCTOBER 4, 2019

CFCA FILE NO. 1028-5282

CROZIER
CONSULTING ENGINEERS

1.0 Executive Summary

C.F. Crozier & Associates Inc. (Crozier) was retained by CRH Canada Group Inc. (CRH) to prepare a Traffic Impact Study to assess traffic operations as a result of comments from the Township of Tiny on the proposed Teedon Pit Extension. The Teedon Pit is located at 40 Darby Road in the Township of Tiny and the proposed Teedon Pit Extension is adjacent to the existing Teedon Pit.

CRH is proposing an extension of the existing Teedon Pit operations to replace reserves for future customer supply. The annual licensed extraction rate and annual truck volumes associated with the Teedon Pit are not proposed to increase.

Based on existing conditions, there are currently maneuverability constraints on Darby Road at Highway 93 for heavy trucks travelling to and from the Teedon Pit. Trucks on Darby Road were observed utilizing the entire width of the roadway when traversing the curve on Darby Road at Highway 93, which has resulted in the roadside shoulders being rutted from tire tracks.

This study reviews the following main aspects of the intersection of Darby Road / McMann Sideroad and Highway 93 from a transportation engineering perspective:

- Traffic operations under existing conditions and future conditions;
- Sight distance availability and requirements;
- Traffic safety (i.e. collision history and trends); and
- Intersection improvements to improve truck operations.

The intersection is currently operating at acceptable levels of service with minor delays and no capacity constraints and is expected to continue operating acceptably in the 20-year horizon.

The available intersection sightlines on Highway 93 at the west approach (Darby Road) of the intersection exceed minimum sight distance requirements for both northbound and southbound movements.

The observed collision rate at the intersection is low and does indicate any collision trends that require attention.

Therefore, **no issues pertaining to intersection capacity, sight distance or collision trends were identified at the intersection of Darby Road / McMann Sideroad and Highway 93 related to the existing operation or proposed extension**

To improve heavy truck turning operations at Darby Road and Highway 93, **the widening of Darby Road at the west approach of the intersection is recommended.** This design would mitigate truck turning maneuverability issues and allow for simultaneous inbound and outbound truck turning movements.

A functional design for the Highway 93 and Darby Road intersection improvements is included as **Appendix J.**

In conclusion, the proposed extension of the Teedon Pit operations is supportable from a transportation operations and safety perspective, with the implementation of the noted intersection improvements.

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2.0 Introduction

2.1 Background

C.F. Crozier & Associates Inc. (Crozier) was retained by CRH Canada Group Inc. (CRH) to prepare a Traffic Impact Study to assess traffic operations as a result of comments from the Township of Tiny on the proposed Teedon Pit Extension. The Teedon Pit is located at 40 Darby Road in the Township of Tiny and the proposed Teedon Pit Extension is adjacent to the existing Teedon Pit.

CRH is proposing an extension of the existing Teedon Pit operations to replace reserves for future customer supply. The annual licensed extraction rate of 600,000 tonnes and annual truck volumes associated with the Teedon Pit are not proposed to increase, and if the extension is approved, the annual tonnage of 600,000 will be an annual limit for the Teedon Pit and Extension combined.

The proposed hours of operation of the Teedon Pit and extension will be as follows:

- **Shipping:** Monday to Friday between 5:00 a.m. – 7:00 p.m., and Saturday from 5:00 a.m. – 4:00 p.m.
- **Site Preparation, Extraction, Processing and Rehabilitation:** Monday to Friday between 7:00 a.m. – 7:00 p.m.
- **Extraction and Processing:** Saturday from 9:00 a.m. – 4:00 p.m.

Between the hours of 5:00 a.m. – 7:00 a.m. only shipping is permitted and may include a maximum of 15 highway trucks per hour (30 truck trips) and a maximum of one shipping loader in combination with the existing Teedon Pit (license #3670).

Between the hours of 7:00 a.m. – 7:00 p.m., highway trucks are limited to 20 trucks per hour (40 passes per hour) in combination with the existing Teedon Pit (license #3670).

There will be no operations on Sundays or statutory holidays. There are no time restrictions for site maintenance and equipment servicing.

Based on existing conditions, there are currently maneuverability constraints on Darby Road at Highway 93 for heavy trucks travelling to and from the Teedon Pit. Existing operations are discussed further in Section 3.4. This Traffic Impact Study analyzes truck operations at the intersection of Darby Road / McMann Sideroad and Highway 93 associated with the Teedon Pit and analyzes potential intersection improvements to improve truck operations.

Highway 93 is under the jurisidiction of the Ministry of Transportation of Ontario (MTO). Therefore, this Traffic Impact Study is also subject to review by the MTO.

2.2 Purpose and Scope

The purpose of a typical Traffic Impact Study is to evaluate the potential impacts of traffic generated by future development and to recommend mitigation measures on the external road network to support the development, if required. However, the application filed by the client has indicated that the licensed extraction rate and truck volumes associated with the Teedon Pit are not proposed to increase.

Therefore, this study reviews the following main aspects of the intersection of Darby Road / McMann Sideroad and Highway 93 from a transportation engineering perspective:

- Traffic operations under existing conditions and future conditions;
- Sight distance availability and requirements;
- Traffic safety (i.e. collision history and trends); and
- Intersection improvements to improve truck operations.

The study has been completed in accordance with the "Guidelines for the Preparation of Traffic Impact Studies (MTO, September 2014)" as well as agreed upon terms of reference with MTO staff. **Appendix A** contains the correspondence with the MTO.

3.0 Existing Conditions

3.1 Teedon Pit

The existing Teedon Pit is located at 40 Darby Road to the south of the intersection of Darby Road / McMann Sideroad and Highway 93 and is bound by the proposed pit extension to the north, agricultural lands to the south and west, and Darby Road to the east.

Figure 1 contains the Site Location Plan.

3.2 Study Intersections

The Traffic Impact Study analyzes the intersection of Darby Road / McMann Sideroad and Highway 93.

3.3 Boundary Road Network

The boundary road network at the site frontage is described in **Table 1**.

Table 1: Boundary Road Network

Feature	Roadway		
	Darby Road	**Highway 93**	**McMann Sideroad**
Direction	Two-way (north-south) [1]	Two-way (north-south)	Two-way (east-west)
Classification	Local Road	Provincial Highway	Local Road
Jurisdiction	Township of Tiny	MTO	Township of Tay
Area Type	Rural	Rural	Rural
Speed Limit	50 km/h	80 km/h	80 km/h (assumed)
Number of lanes	Two	Two	Two
Surface type	Asphalt	Asphalt	Granular
Median type	None	None	None
Pedestrian / Cycling Facilities	None	None	None

Note 1: While Darby Road spans primarily north-south, the roadway spans east-west at its intersection at Highway 93.

The intersection of Darby Road / McMann Sideroad and Highway 93 is unsignalized with side-street stop control at the east and west approaches of the intersection. There are auxiliary northbound and southbound right-turn tapers on Highway 93 at the intersection to allow right-turning traffic to decelerate and not interfere with through traffic.

There is a sharp horizontal curve on Darby Road approaching Highway 93.

Figure 2 illustrates the existing boundary road network, including lane configurations, storage lengths, and intersection control.

3.4 Field Observations

Field observations by Crozier staff in at the west approach of the intersection of Darby Road / McMann Sideroad and Highway 93 indicate that trucks on Darby Road are utilizing the entire width of the roadway when traversing the curve on Darby Road at Highway 93, and that the roadside shoulders are rutted from tire tracks. While there were no opposing vehicles turning from Highway 93 to Darby Road when heavy trucks were traversing Darby Road, field observations indicate that the road width of the west approach would not be sufficient to accommodate both a truck turning and any opposing vehicles.

3.5 Traffic Data

Turning movement counts were conducted by Spectrum Traffic Data Inc. staff at the intersection of Darby Road / McMann Sideroad and Highway 93 on Saturday June 1, 2019 between 5:00 a.m. – 4:00 p.m., and Tuesday June 4, 2019 between 5:00 a.m. – 7:00 p.m. These time periods reflect the proposed hours of operation for the Teedon Pit.

The traffic count data is contained in **Appendix B**. **Figure 3** illustrates the 2019 existing traffic volumes that were recorded.

Intersection analysis was conducted utilizing peak hour factors (PHFs) as calculated for each intersection during each time period. **Table 2** outlines the calculated peak hour factors at each intersection during each peak hour.

Table 2: Peak Hour Factors

Intersection	Peak Hour	Peak Hour Factor
Darby Road / McMann Sideroad and Highway 93	Weekday 4:15 p.m. – 5:15 p.m.	0.91
	Saturday 11:00 a.m. – 12:00 p.m.	0.92

3.6 Traffic Modelling

The boundary road network was modelled in Synchro 9.2 using existing roadway geometrics, collected traffic data, and default modelling parameters such as ideal saturation flow rates and lost time values.

The assessment of intersections is based on the "Highway Capacity Manual (HCM)" methodology. Intersections are assessed using a Level of Service (LOS) metric with ranges of delay assigned a letter from "A" to "F"; "A" representing low delays and "F" representing heavy delays. The LOS definitions for signalized and unsignalized intersections are included in **Appendix C.**

3.7 Intersection Operations

The existing intersection operations at the intersection of Darby Road / McMann Sideroad and Highway 93 were analyzed using the existing traffic volumes illustrated in **Figure 3.** Detailed capacity analysis worksheets are included in **Appendix D**.

Table 3 outlines the 2019 existing traffic operations.

Table 3: 2019 Existing Traffic Operations

Intersection	Control	Peak Hour	Level of Service [1]	Control Delay	Critical v/c ratio [2]	95th Percentile Queue Length > Storage Length
Darby Road / McMann Sideroad and Highway 93	Stop (Minor)	Weekday	C	21.6 s (WBLTR)	0.02 (EBLTR)	None
		Saturday	C	16.3 s (EBLTR)	0.03 (EBLTR)	None

Note 1: The Level of Service of a signalized intersection is based on the average control delay per vehicle (Synchro/ICU). The Level of Service of a stop-controlled intersection is based on the delay associated with the critical minor road approach (HCM2000).

Note 2: The critical v/c ratio is considered to be the maximum v/c ratio for movements at the intersection. In addition, all v/c ratios greater than 0.85 for movements are outlined and highlighted.

The intersection of Darby Road / McMann Sideroad and Highway 93 is currently operating at LOS "C" during the weekday and Saturday peak periods with minor control delays and no critical volume-to-capacity ratios nor 95th percentile queue lengths. These operations indicate that the intersection is currently operating at satisfactory levels of service with reserve capacity for future traffic growth.

4.0 Future Conditions

4.1 Horizon Years

This study analyzes future traffic conditions for a 20-year horizon (2039).

4.2 Truck Traffic Volumes

It is noted that the existing traffic counts reflect the existing permitted maximum truck volume of 20 trucks per hour (40 truck trips) associated with the Teedon Pit between the hours of 7:00 a.m. – 7:00 p.m. As the Teedon Pit extension does not propose an increase in truck volumes, no additional truck forecasts were conducted for the Teedon Pit extension under future conditions.

4.3 Growth Rate

Historical growth rates were derived from Annual Average Daily Traffic (AADT) and Summer Average Daily Traffic (SADT) on Highway 93 in the study area to forecast future traffic volumes. The latest AADT data available is for 2016; thus, growth rates from 2012 to 2016 were analyzed. **Appendix E** contains the growth rate data and analysis.

The AADT from 2012 to 2016 yielded a growth rate of 1.0% compounded annually and the SADT from 2012 to 2016 yielded a growth rate of 0.6% compounded annually. Therefore, a growth rate of 1.0% compounded annually was applied to through traffic on Highway 93 to forecast 2039 future traffic volumes.

Figure 4 illustrates the 2039 future traffic volumes.

4.4 Signal Warrant Analysis

A signal warrant analysis was conducted for the intersection of Darby Road / McMann Sideroad and Highway 93 under 2039 future volumes. The analysis followed the procedures specified in Chapter 4 of the "Ontario Traffic Manual – Book 12", March 2012. Justifications 1 (Minimum Vehicular Volume), 2 (Delay to Cross Traffic), 3 (Combination of Justifications 1 and 2), and 4 (4-Hour Volume) were selected as the most appropriate warrants with which to assess the intersection of Darby Road / McMann Sideroad and Highway 93.

Signal warrant analysis was conducted for both the weekday and Saturday periods to determine signal requirements. The highest eight hours of each day were used in the analysis with each hour volume increased by approximately 1.22 (1% compounded annually over 20 years) to reflect 2039 future conditions.

As the posted speed limit on Highway 93 is 80 km/h, a "free flow" type was applied to traffic flow on Highway 93 for the signal warrant analysis.

Table 4 outlines the results of the signal warrant analysis.

Table 4: Signal Warrant Analysis Results

Location	Flow Type	Horizon Year	Number of Lanes on Major Road	Time Period	% Warranted	Traffic Signals Warranted?
Darby Road / McMann Sideroad and Highway 93	Free Flow	2039	Two	Weekday	9%	**No**
				Saturday	5%	**No**

The results of the signal warrant analysis indicate that traffic signals are not warranted at the intersection of Darby Road / McMann Sideroad and Highway 93 under 2039 future traffic conditions. This is attributed to the low turning volumes from Darby Road and McMann Sideroad onto Highway 93.

Appendix F contains the signal warrant sheets.

4.5 Left-Turn Lane Warrant Analysis

Auxiliary left-turn lane warrant analysis was conducted for the intersection of Darby Road / McMann Sideroad and Highway 93 under 2039 future traffic conditions. The analysis was conducted using the Ministry of Transportation (MTO)'s "Design Supplement for TAC Geometric Design Guide for Canadian Roads – June 2017." The northbound and southbound left-turn movements were analyzed for left-turn lane requirements.

The design speed of a roadway in an urban environment is typically 10-20 km/h greater than the posted speed limit. The posted speed limit on Highway 93 is 80 km/h. Therefore, a design speed of 100 km/h was assumed for the left-turn lane warrant analysis.

The weekday and Saturday peak hours of the intersection of Darby Road / McMann Sideroad and Highway 93 reflect the peak hours of the traffic volumes on Highway 93 given the comparably lower volumes on Darby Road and McMann Sideroad. However, the weekday and Saturday peak hour volumes do not reflect the highest northbound and southbound left-turn volumes at the intersection. Therefore, for the purposes of conservative analysis, the highest hourly northbound and southbound left-turn volumes observed at the intersection for both the weekday and Saturday time periods were analyzed. The volumes were increased by approximately 1.22 (1% compounded annually over 20 years) to reflect 2039 future conditions.

Table 5 outlines the results of the left-turn lane warrant analysis.

Table 5: Left-Turn Lane Warrant Analysis Results

Location	Movement	Design Speed	Horizon Year	Number of Lanes on Major Road	Left-Turn Lane Storage Requirement?
Darby Road / McMann Sideroad and Highway 93	Northbound left-turn	100 km/h	2039	Two	**None**
	Southbound left-turn	100 km/h	2039	Two	**None**

The results of the left-turn lane analysis indicate that no exclusive left-turn lanes are warranted on Highway 93 at Darby Road under 2039 future traffic conditions. This is attributed to the low turning volumes from Highway 93 to Darby Road and McMann Sideroad not triggering the minimum requirements for left-turn lanes.

Appendix G contains the left-turn warrant analysis worksheets.

4.6 Intersection Operations

The future intersection operations at the study intersections were analyzed using the 2039 future traffic volumes outlined in **Figure 4.** Detailed capacity analysis worksheets are included in **Appendix D**.

Table 6 outlines the 2039 future traffic operations, respectively.

Table 6: 2039 Future Traffic Operations

Intersection	Control	Peak Hour	Level of Service [1]	Control Delay	Critical v/c ratio [2]	95th Percentile Queue Length > Storage Length
Darby Road / McMann Sideroad and Highway 93	Stop (Minor)	Weekday	D	29.0 s (WBLTR)	0.03 (EBLTR)	None
		Saturday	C	19.6 s (EBLTR)	0.04 (EBLTR)	None

Note 1: The Level of Service of a signalized intersection is based on the average control delay per vehicle (Synchro/ICU). The Level of Service of a stop-controlled intersection is based on the delay associated with the critical minor road approach (HCM2000).

Note 2: The critical v/c ratio is considered to be the maximum v/c ratio for movements at the intersection. In addition, all v/c ratios greater than 0.85 for movements are outlined and highlighted.

The intersection of Darby Road / McMann Sideroad and Highway 93 is expected to change from LOS "C" to "D" during the weekday peak period under 2039 future traffic conditions with an increase in control delay of 7.4 seconds and increase in volume-to-capacity ratio of 0.01. These operations are attributed to 20 years of steady traffic growth on Highway 93. However, these operations are still considered acceptable.

Therefore, the intersection of Darby Road / McMann Sideroad and Highway 93 is expected to operate satisfactorily from a capacity perspective.

5.0 Sight Distance Analysis

The available sightlines at the west approach of Darby Road / McMann Sideroad and Highway 93 were measured and compared to the standards set out in the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (GDGCR).

The design speed of a roadway in an urban environment is typically 10-20 km/h greater than the posted speed limit. The posted speed limit on Highway 93 is 80 km/h. Therefore, a design speed of 100 km/h was assumed for the sight distance analysis.

Given the truck traffic at the west approach of Darby Road / McMann Sideroad and Highway 93, a combination truck (WB-19 or WB-20 tractor semi-trailer) was used as the design vehicle for determining sight distance requirements. It is noted that the trucks entering and exiting the Teedon Pit will consist of Pony Pup trailers which would result in a total truck length of approximately 17-18 metres (less than

the length of a typical WB-19 or WB-20 tractor semi-trailer). Therefore, the base time gap of 11.5 seconds used in the analysis below can be considered conservative.

Table 7 outlines the sight distance analysis for the proposed site accesses.

Table 7: Sight Distance Analysis

Feature	Darby Road
Access Type	Full Moves
Assumed Design Speed	100 km/h
Vehicle Type	Combination Truck (WB-19 or WB-20)
Base Time Gap	11.5 s [1]
Additional Time Gap	None
Grade of Roadway	Less than 3%
Horizontal Alignment of Roadway	Curve
Sight Distance Required	320 m [2]
Measured Sight Distance	Approx. 350 m to south > 500 m to north
Minimum Sight Distance Satisfied?	Yes

Note 1: Time gap for left-turning combination trucks from a stop onto a two-lane highway with no median and with a grade less than 3%. Value from Table 9.9.3 in the GDGCR.
Note 2: Sight distance values calculated from Intersection Sight Distance equation 9.9.1 in the GDGCR.

Therefore, safety issues pertaining to sight distance were not identified at the intersection of Darby Road / McMann Sideroad and Highway 93.

6.0 Collision Analysis

The Township of Tiny requested that collision analysis be conducted for the intersection of Darby Road / McMann Sideroad and Highway 93 to identify and address any collision trends at the intersection.

The MTO provided Crozier with collision history for the intersection of Darby Road / McMann Sideroad and Highway 93 from 2013 to 2019. **Appendix H** contains the collision history provided by the MTO.

The collision history within the last five years (i.e. 2015 to 2019) was analyzed. **Table 8** summarizes the collision history within the last five years.

Table 8: Five-Year Collision History

Date and Time of Collision	Collision Type	Location	Injury?	Road Conditions	Description	Notes
December 24, 2018 11:32 a.m.	Turning	Darby Road at Highway 93	Property Damage Only	Snow covered	Driver 1 (northbound) on Highway 93 slid into Driver 2 on Highway 93 waiting to turn left	N/A
May 4, 2017 6:30 p.m.	Single-Manned Vehicle (SMV) / Other	Darby Road north of Highway 93	Minor	Wet	Driver 1 (southbound) on Highway 93 struck cable guide rail, skidded and rolled over; struck Driver 2	Driver 1 impaired

As outlined above, there have been two reported collisions at the intersection of Darby Road / McMann Sideroad and Highway 93 within the last five-years. The following formula from the Highway Safety Manual (published by the American Association of State Highway and Transportation Officials) was used to quantify the collision rate at the intersection:

$$RMEV = (A * 1{,}000{,}000) / V$$

Where;
RMEV = Rate per million entering vehicles
A = number of collisions (total or by type) occurring in a single year at the location
*V = daily volume * 365*

A value of 0.4 was applied to the "A" parameter to reflect two collisions within the last five years. The latest AADT observed on Highway 93 is 7,750 vehicles per day.

The collision rate at the intersection of Darby Road / McMann Sideroad and Highway 93 was determined to be approximately 0.14 collisions per million entering vehicles. A collision rate of 1.5 collisions per million entering vehicles is commonly used as a general rule-of-thumb to indicate collision issues at an intersection. Therefore, the observed collision rate of 0.14 collisions per million entering vehicles is low.

Additionally, both reported collisions are attributed to wet or snow-covered road conditions. It is further noted that one of the collisions involved an impaired driver, indicating that these collisions are more attributed to human error than intersection characteristics. It is also noted that neither of these collisions involved heavy trucks.

Therefore, safety issues pertaining to collision trends were not identified at the intersection of Darby Road / McMann Sideroad and Highway 93.

7.0 Intersection Geometrics Analysis

The existing geometrics at the intersection of Darby Road / McMann Sideroad and Highway 93 were evaluated to identify opportunities to improve heavy truck turning operations and maneuverability.

To address this existing condition, the widening of Darby Road at the west approach of the intersection of Darby Road and Highway 93 is recommended while maintaining the existing horizontal

alignment. The widening of the roadway within the horizontal curve would improve heavy truck maneuverability to and from the Teedon Pit.

Field observations by Crozier staff identified an Enbridge Natural Gas Pipeline marker adjacent to Darby Road in the vicinity of the road widening. This pipeline has not been considered as part of the functional design (see **Appendix J**) but will be co-ordinated with Enbridge Inc. directly during the detailed design stage.

7.1 Implementation of Road Widening

A vehicle turning analysis was conducted for a WB-20 tractor semi-trailer turning onto and from Darby Road at Highway 93 to determine the required extents for the widening of Darby Road. **Appendix I** contains the vehicle turning analysis for a WB-20 tractor semi-trailer turning onto and from Darby Road at Highway 93.

As discussed earlier, the trucks entering and exiting the Teedon Pit will consist of Pony Pup trailers which would result in a total truck length of approximately 17-18 metres (less than the length of a typical WB-19 or WB-20 tractor semi-trailer). Therefore, the use of a WB-20 tractor semi-trailer in the vehicle turning analysis is considered conservative.

Additionally, best practices from the TAC GDGCR were incorporated into the intersection improvements. The TAC GDGCR recommends the implementation of a recovery taper beyond the intersection in conjunction with a right-turn taper to allow turning vehicles to safely return to the through lane. The implementation of a recovery taper on Highway 93 south of Darby Road would allow for an increased curb radius for heavy truck turning movements and allow turning trucks to gradually transition into the through lane. While the TAC GDGCR recommends a recovery taper length of 30 metres and offset of 1.5 metres, a recovery taper length of 50 metres and offset of 3.0 metres was included to accommodate heavy truck right-turn movements from Darby Road onto Highway 93 without navigating over the shoulder or into the opposing northbound lane on Highway 93.

Table 9 outlines the recommended geometrics at the intersection of Darby Road and Highway 93 to mitigate heavy truck turning maneuverability issues and allow simultaneous inbound and outbound truck turning movements.

Table 9: Recommended Geometrics at Darby Road and Highway 93

Location	Parameter	Recommended Value
Darby Road (west of Highway 93)	Pavement Width	14.0 metres (7.0 metre lanes)
Darby Road at Highway 93 (west approach)	Curb Radii	17 metres (northwest intersection corner) 15 metres (southwest intersection corner)
Highway 93 (south of Darby Road)	Recovery Taper	50 metres (length) 3.0 metres (offset)

It is recommended that the existing Darby Road centreline be maintained, and that the roadway be widened on both sides. This approach would maintain the geometric alignment between Darby Road and McMann Sideroad. If Darby Road were to be widened entirely on one side of the roadway, the roadway centreline would shift and result in a skewed intersection approach opposite McMann Sideroad which could lead to potential vehicle-vehicle conflicts.

Appendix J contains the functional design for the Darby Road and Highway 93 intersection improvements.

The proposed intersection design can occur within the existing right-of-way (ROW) limits.

8.0 Conclusions

The analysis contained within this report has resulted in the following key findings at the intersection of Darby Road / McMann Sideroad and Highway 93:

- The intersection is currently operating at acceptable levels of service with minor delays and no capacity constraints.
- The intersection is expected to continue operating at acceptable levels of service with minor delays and no capacity constraints in the 20-year horizon.
- The available intersection sightlines on Highway 93 at the west approach (Darby Road) of the intersection exceed minimum sight distance requirements for both northbound and southbound movements.
- The observed collision rate at the intersection is low and does indicate any collision trends that require attention.
- Therefore, **no issues pertaining to intersection capacity, sight distance or collision trends were identified at the intersection of Darby Road / McMann Sideroad and Highway 93 related to the existing operations or proposed extension**.

To improve heavy truck turning operations at Darby Road and Highway 93, **the widening of Darby Road at the west approach of the intersection is recommended.** This design would mitigate truck turning maneuverability issues and allow for simultaneous inbound and outbound truck turning movements.

A functional design for the Highway 93 and Darby Road intersection improvements is included as **Appendix J.**

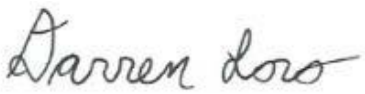
In conclusion, the proposed extension of the Teedon Pit operations is supportable from a transportation operations and safety perspective, with the implementation of the noted intersection improvements.

Respectfully submitted by,

C.F. CROZIER & ASSOCIATES INC.

Alexander J. W. Fleming, MBA, P.Eng.
Associate

C.F. CROZIER & ASSOCIATES INC.



Darren J. Loro, C.E.T.
Transportation Technologist

/DL

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APPENDIX A

Correspondence

Darren Loro

From: Tuen, Nelson (MTO) <Nelson.Tuen@ontario.ca>
Sent: Friday, July 26, 2019 4:57 PM
To: Darren Loro
Cc: Janke, Aaron (MTO); Peter Dorton
Subject: FW: Darby Road and Highway 93 TIS Proposed Terms of Reference (1028-5282)
Attachments: Hwy 93 - Darby Road - Collision History.xlsx

Hi Darren,

Please see the attached collision history of Highway 93 & Darby Road North Jct.

Thanks,

Nelson

From: Janke, Aaron (MTO)
Sent: July 26, 2019 8:58 AM
To: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>; Tuen, Nelson (MTO) <Nelson.Tuen@ontario.ca>
Cc: Akhtar, Usman (MTO) <Usman.Akhtar@ontario.ca>; Iannacito, Phil (MTO) <Phil.Iannacito@ontario.ca>
Subject: RE: Darby Road and Highway 93 TIS Proposed Terms of Reference (1028-5282)

The TOR sounds good. Please note we have had complaints at this intersection due to truck traffic related to the below concerns (poor geometry).

Nelson – Please provide the collision history.

Regards,

Aaron Janke
Traffic Supervisor
Traffic Office | Area 1, York/Simcoe
Ministry of Transportation | Central Region
159 Sir William Hearst Avenue | 6th Floor
North York, Ontario | M3M 0B7
Tel: (416) 235-4694 | Cell: (437) 778-4021
Email: Aaron.Janke@ontario.ca

From: Dorton, Peter (MTO)
Sent: July-26-19 8:55 AM

To: Janke, Aaron (MTO) <Aaron.Janke@ontario.ca>
Cc: Akhtar, Usman (MTO) <Usman.Akhtar@ontario.ca>; Iannacito, Phil (MTO) <Phil.Iannacito@ontario.ca>
Subject: FW: Darby Road and Highway 93 TIS Proposed Terms of Reference (1028-5282)

Aaron, please review and provide us with your comments on proposed Terms of Reference.

Thanks ï Peter D.

From: Darren Loro <dloro@cfcrozier.ca>
Sent: July 25, 2019 4:46 PM
To: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>
Cc: Alex Fleming <afleming@cfcrozier.ca>; Ryan MacLaughlan <rmaclaughlan@cfcrozier.ca>
Subject: RE: Darby Road and Highway 93 TIS Proposed Terms of Reference (1028-5282)

Hi Peter,

I've attached a map showing Darby Road and the Teedon Pit in relation to Highway 93. The map also includes a key plan showing the site location in relation to the surrounding area.

Hope this helps,

Darren Loro C.E.T. | Technologist
C.F. Crozier & Associates Consulting Engineers
40 Huron Street, Suite 301 | Collingwood, ON L9Y 4R3
cfcrozier.ca | dloro@cfcrozier.ca
tel: 705.446.3510 ext: 142

From: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>
Sent: Thursday, July 25, 2019 4:37 PM
To: Darren Loro <dloro@cfcrozier.ca>
Cc: Alex Fleming <afleming@cfcrozier.ca>; Ryan MacLaughlan <rmaclaughlan@cfcrozier.ca>
Subject: RE: Darby Road and Highway 93 TIS Proposed Terms of Reference (1028-5282)

Hi Darren.

Do you have a plan of the pit location in relation to the 93/Darby intersection?

Iôm not familiar with Teedon Pit.

Thanks,

Peter D.

From: Darren Loro <dloro@cfcrozier.ca>
Sent: July 25, 2019 4:32 PM
To: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>
Cc: Alex Fleming <afleming@cfcrozier.ca>; Ryan MacLaughlan <rmaclaughlan@cfcrozier.ca>
Subject: Darby Road and Highway 93 TIS Proposed Terms of Reference (1028-5282)

Good afternoon Peter,

We have been retained by CRH Canada Group Inc. (CRH) to prepare a Traffic Impact Study to assess traffic operations associated with the Teedon Pit located at 40 Darby Road in the Township of Tiny. CRH is proposing an expansion of the existing Teedon Pit operations to allow for longer extraction periods, although the licensed extraction rate and truck volumes associated with the Teedon Pit are not proposed to increase.

There are currently maneuverability constraints on Darby Road for heavy trucks travelling to and from the Teedon Pit. Field observations by Crozier staff at the west approach of the intersection of Darby Road and Highway 93 indicate that trucks on Darby Road are utilizing the entire width of the roadway when traversing the curve on Darby Road at Highway 93, and that the roadside shoulders were rutted from tire tracks.

The Township requires a Traffic Impact Study that analyzes truck operations at the intersection of Darby Road and Highway 93 associated with the Teedon Pit and analyzes potential intersection improvements to improve truck operations. Given the proximity to Highway 93, we understand that the MTO will also require a Traffic Impact Study.

Our proposed Terms of Reference for the Traffic Impact Study is outlined below:

1. Traffic counts have already been conducted at the intersection of Darby Road and Highway 93 on Saturday June 1, 2019 between 5:00 a.m. – 4:00 p.m., and Tuesday June 4, 2019 between 5:00 a.m. – 7:00 p.m. These time periods reflect the proposed hours of operation for the Teedon Pit.
2. Existing traffic operations at Darby Road and Highway 93 will be analyzed during the weekday and Saturday peak hours using Synchro 9.2.
3. The Township estimates that based on the maximum annual extraction volume of 600,000 tonnes, it would take approximately 17 years of operation to exhaust the Teedon Pit supply. However, this estimate also assumes that the existing Teedon Pit is nearing the end of its life. Accordingly, analysis of the 20-year horizon (2039) will be conducted to allow for a buffer on the 17-year estimate and result in more conservative analysis.
4. Future background traffic growth will be calculated using growth rates calculated from Annual Average Daily Traffic (AADT) and Summer Average Daily Traffic volumes on Highway 93 in the study area.
5. 2039 future traffic operations at Darby Road and Highway 93 will be analyzed during the weekday and Saturday peak hours.
6. Sight distance availability will be analyzed at the west approach of Darby Road at Highway 93 to compare to the minimum sight distance requirements set out in the MTO's "Design Supplement for TAC Geometric Design Guide for Canadian Roads- June 2017".
7. Traffic safety will be analyzed at the intersection of Darby Road and Highway 93. The following traffic safety components will be analyzed:
    a. Collision trends and counter-measures to address, if required
    b. Vehicle turning requirements for heavy trucks at the west approach of Darby Road and Highway 93
    c. Auxiliary left-turn lane requirements on Highway 93
    d. Intersection control (traffic signal warrant analysis will be conducted)
8. The analysis contained in this TIS will lead to recommendations for intersection improvements at Darby Road and Highway 93 to optimize traffic safety.

We would like to request the collision history for the intersection of Darby Road and Highway 93 for us to complete our analysis. If you could forward this request or direct us to the appropriate contact, that would be much appreciated!

If the proposed Terms of Reference is satisfactory to the MTO, we will begin preparing the TIS immediately.

Alex and Ryan (copied) are both on vacation next week. However, if you have any questions or wish to discuss further within the next week, please do not hesitate to give me a call.

Cheers,
Darren

Darren Loro C.E.T. | Technologist
C.F. Crozier & Associates Consulting Engineers
40 Huron Street, Suite 301 | Collingwood, ON L9Y 4R3
cfcrozier.ca | dloro@cfcrozier.ca
tel: 705.446.3510 ext: 142

APPENDIX B

Traffic Data

Turning Movement Count (1 . DARBY RD & HWY 93)

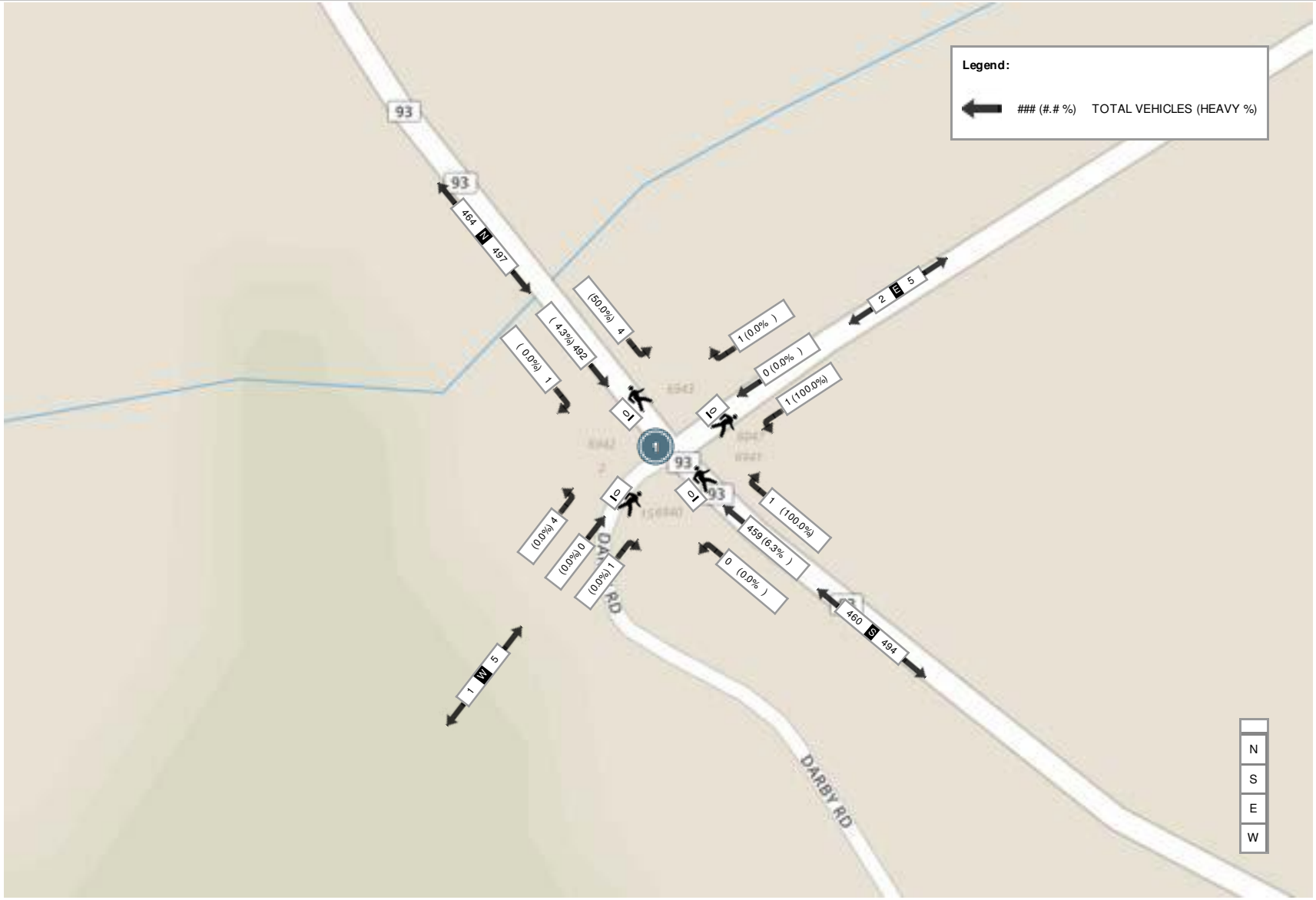
Start Time	N Approach HWY 93						E Approach MCMANN SIDEROAD						S Approach HWY 93						W Approach DARBY RD						Int. Total (15 min)	Int. Total (1 hr)
	Right N:W	Thru N:S	Left N:E	U-Turn N:N	Peds N:	Approach Total	Right E:N	Thru E:W	Left E:S	U-Turn E:E	Peds E:	Approach Total	Right S:E	Thru S:N	Left S:W	U-Turn S:S	Peds S:	Approach Total	Right W:S	Thru W:E	Left W:N	U-Turn W:W	Peds W:	Approach Total		
05:00:00	0	41	0	0	0	41	0	0	0	0	0	0	0	9	0	0	0	9	0	0	0	0	0	0	50	
05:15:00	0	43	0	0	0	43	0	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	0	48	
05:30:00	0	32	0	0	0	32	0	0	0	0	0	0	0	16	0	0	0	16	0	0	0	0	0	0	48	
05:45:00	0	47	0	0	0	47	0	0	0	0	0	0	0	25	0	0	0	25	0	0	0	0	0	0	72	218
06:00:00	0	72	0	0	0	72	0	0	0	0	0	0	0	35	0	0	0	35	0	0	0	0	0	0	107	275
06:15:00	0	76	1	0	0	77	0	0	1	0	0	1	0	57	1	0	0	58	0	0	0	0	0	0	136	363
06:30:00	0	62	0	0	0	62	0	0	0	0	0	0	0	71	0	0	0	71	0	0	1	0	0	1	134	449
06:45:00	1	66	0	0	0	67	0	0	0	0	0	0	0	54	0	0	0	54	0	0	2	0	0	2	123	500
07:00:00	0	83	0	0	0	83	0	0	0	0	0	0	0	63	4	0	0	67	1	0	0	0	0	1	151	544
07:15:00	0	126	1	0	0	127	0	0	0	0	0	0	0	94	0	0	0	94	3	0	0	0	0	3	224	632
07:30:00	1	100	1	0	0	102	2	0	0	0	0	2	0	132	1	0	0	133	1	0	1	0	0	2	239	737
07:45:00	2	96	0	0	0	98	0	0	0	0	0	0	0	106	2	0	0	108	1	1	1	0	0	3	209	823
08:00:00	0	100	0	0	0	100	2	0	0	0	0	2	0	95	3	0	0	98	4	0	0	0	0	4	204	876
08:15:00	0	90	0	0	0	90	1	0	0	0	0	1	1	109	1	0	0	111	2	0	1	0	0	3	205	857
08:30:00	0	76	0	0	0	76	0	0	0	0	0	0	0	96	1	0	0	97	0	0	2	0	0	2	175	793
08:45:00	0	89	1	0	0	90	0	0	0	0	0	0	0	77	2	0	0	79	2	0	1	0	0	3	172	756
09:00:00	2	84	0	0	0	86	0	0	0	0	0	0	0	70	3	0	0	73	1	0	3	0	0	4	163	715
09:15:00	1	86	0	0	0	87	0	0	0	0	0	0	0	67	2	0	0	69	3	0	1	0	0	4	160	670
09:30:00	0	80	0	0	0	80	0	0	0	0	0	0	0	83	1	0	0	84	1	0	1	0	0	2	166	661
09:45:00	0	65	1	0	0	66	1	0	0	0	0	1	0	68	1	0	0	69	0	1	4	0	0	5	141	630
10:00:00	2	59	0	0	0	61	0	0	0	0	0	0	0	68	1	0	0	69	2	0	2	0	0	4	134	601
10:15:00	0	90	0	0	0	90	0	0	0	0	0	0	1	72	5	0	0	78	0	0	1	0	0	1	169	610
10:30:00	1	81	0	0	0	82	2	0	0	0	0	2	0	71	3	0	0	74	1	0	1	0	0	2	160	604
10:45:00	2	68	0	0	0	70	0	0	1	0	0	1	0	73	1	0	0	74	5	0	1	0	0	6	151	614
11:00:00	1	67	0	0	0	68	0	0	0	0	0	0	0	76	2	0	0	78	1	0	2	0	0	3	149	629
11:15:00	1	70	0	0	0	71	0	0	0	0	0	0	0	58	1	0	0	59	2	0	2	0	0	4	134	594
11:30:00	0	59	0	0	0	59	0	0	1	0	0	1	0	82	1	0	0	83	5	0	0	0	0	5	148	582
11:45:00	0	72	0	0	0	72	0	0	0	0	0	0	1	59	0	0	0	60	2	0	0	0	0	2	134	565
12:00:00	0	83	0	0	0	83	0	0	0	0	0	0	0	69	0	0	0	69	0	0	1	0	0	1	153	569
12:15:00	1	82	0	0	0	83	0	0	0	0	0	0	0	72	2	0	0	74	0	1	1	0	0	2	159	594
12:30:00	1	72	0	0	0	73	0	0	0	0	0	0	0	70	2	0	0	72	3	0	0	0	0	3	148	594

12:45:00	1	76	0	0	0	77	0	0	0	0	0	0	0	84	0	0	0	84	1	0	1	0	0	2	163	623
13:00:00	0	83	0	0	0	83	0	0	0	0	0	0	0	51	4	0	0	55	0	0	1	0	0	1	139	609
13:15:00	0	83	0	0	0	83	0	0	0	0	0	0	0	71	2	0	0	73	3	0	3	0	0	6	162	612
13:30:00	4	79	0	0	0	83	0	0	0	0	0	0	0	73	3	0	0	76	2	0	0	0	0	2	161	625
13:45:00	0	72	0	0	0	72	0	0	0	0	0	0	0	66	2	0	0	68	5	0	1	0	0	6	146	608
14:00:00	1	75	0	0	0	76	0	0	0	0	0	0	0	89	1	0	0	90	2	0	1	0	0	3	169	638
14:15:00	0	99	0	0	0	99	1	0	0	0	0	1	0	83	0	0	0	83	0	0	1	0	0	1	184	660
14:30:00	1	91	1	0	0	93	0	0	0	0	0	0	0	92	0	0	0	92	1	0	1	0	0	2	187	686
14:45:00	3	61	0	0	0	64	1	0	0	0	0	1	1	80	1	0	0	82	0	0	1	0	0	1	148	688
15:00:00	0	104	0	0	0	104	0	0	0	0	0	0	0	69	0	0	0	69	1	0	1	0	0	2	175	694
15:15:00	0	103	1	0	0	104	0	1	0	0	0	1	0	89	0	0	0	89	1	0	0	0	0	1	195	705
15:30:00	1	103	0	0	0	104	1	0	0	0	0	1	0	98	0	0	0	98	0	0	0	0	0	0	203	721
15:45:00	1	89	1	0	0	91	0	0	0	0	0	0	0	95	0	0	0	95	1	0	0	0	0	1	187	760
16:00:00	2	94	1	0	0	97	2	0	0	0	0	2	0	110	0	0	0	110	0	0	0	0	0	0	209	794
16:15:00	0	129	0	0	0	129	0	0	0	0	0	0	0	109	0	0	0	109	1	0	0	0	0	1	239	838
16:30:00	0	131	2	0	0	133	0	0	0	0	0	0	0	112	0	0	0	112	0	0	0	0	0	0	245	880
16:45:00	0	110	2	0	0	112	1	0	0	0	0	1	1	102	0	0	0	103	0	0	0	0	0	0	216	909
17:00:00	1	122	0	0	0	123	0	0	1	0	0	1	0	136	0	0	0	136	0	0	4	0	0	4	264	964
17:15:00	2	110	0	0	0	112	0	0	0	0	0	0	0	100	0	0	0	100	0	0	0	0	0	0	212	937
17:30:00	1	88	0	0	0	89	0	0	0	0	0	0	0	87	0	0	0	87	0	0	0	0	0	0	176	868
17:45:00	0	63	0	0	0	63	0	0	0	0	0	0	0	107	1	0	0	108	0	0	0	0	0	0	171	823
18:00:00	0	60	1	0	0	61	1	0	0	0	0	1	1	103	0	0	0	104	1	0	0	0	0	1	167	726
18:15:00	2	76	0	0	0	78	0	0	0	0	0	0	0	74	0	0	0	74	0	0	2	0	0	2	154	668
18:30:00	0	64	1	0	0	65	0	0	0	0	0	0	0	83	0	0	0	83	0	0	0	0	0	0	148	640
18:45:00	0	41	0	0	0	41	1	0	0	0	0	1	1	51	1	0	0	53	0	0	1	0	0	1	96	565
Grand Total	36	4523	15	0	0	4574	16	1	4	0	0	21	7	4316	55	0	0	4378	59	3	47	0	0	109	**9082**	-
Approach%	0.8%	98.9%	0.3%	0%		-	76.2%	4.8%	19%	0%		-	0.2%	98.6%	1.3%	0%		-	54.1%	2.8%	43.1%	0%		-	**-**	-
Totals %	0.4%	49.8%	0.2%	0%		50.4%	0.2%	0%	0%	0%		0.2%	0.1%	47.5%	0.6%	0%		48.2%	0.6%	0%	0.5%	0%		1.2%	**-**	-
Heavy	2	382	5	0		-	4	0	1	0		-	3	363	47	0		-	50	1	6	0		-	**-**	-
Heavy %	5.6%	8.4%	33.3%	0%		-	25%	0%	25%	0%		-	42.9%	8.4%	85.5%	0%		-	84.7%	33.3%	12.8%	0%		-	**-**	-
Bicycles	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	**-**	-
Bicycle %	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	**-**	-

Peak Hour: 04:15 PM - 05:15 PM Weather: Clear Sky (4.73 °C)

Start Time	N Approach HWY 93						E Approach MCMANN SIDEROAD						S Approach HWY 93						W Approach DARBY RD						Int. Total (15 min)
	Right	Thru	Left	U-Turn	Peds	Approach Total	Right	Thru	Left	U-Turn	Peds	Approach Total	Right	Thru	Left	U-Turn	Peds	Approach Total	Right	Thru	Left	U-Turn	Peds	Approach Total	
16:15:00	0	129	0	0	0	129	0	0	0	0	0	0	0	109	0	0	0	109	1	0	0	0	0	1	239
16:30:00	0	131	2	0	0	133	0	0	0	0	0	0	0	112	0	0	0	112	0	0	0	0	0	0	245
16:45:00	0	110	2	0	0	112	1	0	0	0	0	1	1	102	0	0	0	103	0	0	0	0	0	0	216
17:00:00	1	122	0	0	0	123	0	0	1	0	0	1	0	136	0	0	0	136	0	0	4	0	0	4	264
Grand Total	1	492	4	0	0	497	1	0	1	0	0	2	1	459	0	0	0	460	1	0	4	0	0	5	**964**
Approach%	0.2%	99%	0.8%	0%		-	50%	0%	50%	0%		-	0.2%	99.8%	0%	0%		-	20%	0%	80%	0%		-	-
Totals %	0.1%	51%	0.4%	0%		51.6%	0.1%	0%	0.1%	0%		0.2%	0.1%	47.6%	0%	0%		47.7%	0.1%	0%	0.4%	0%		0.5%	-
PHF	0.25	0.94	0.5	0		0.93	0.25	0	0.25	0		0.5	0.25	0.84	0	0		0.85	0.25	0	0.25	0		0.31	-
Heavy	0	21	2	0		23	0	0	1	0		1	1	29	0	0		30	0	0	0	0		0	-
Heavy %	0%	4.3%	50%	0%		4.6%	0%	0%	100%	0%		50%	100%	6.3%	0%	0%		6.5%	0%	0%	0%	0%		0%	-
Lights	1	471	2	0		474	1	0	0	0		1	0	430	0	0		430	1	0	4	0		5	-
Lights %	100%	95.7%	50%	0%		95.4%	100%	0%	0%	0%		50%	0%	93.7%	0%	0%		93.5%	100%	0%	100%	0%		100%	-
Single-Unit Trucks	0	18	1	0		19	0	0	1	0		1	0	8	0	0		8	0	0	0	0		0	-
Single-Unit Trucks %	0%	3.7%	25%	0%		3.8%	0%	0%	100%	0%		50%	0%	1.7%	0%	0%		1.7%	0%	0%	0%	0%		0%	-
Buses	0	1	1	0		2	0	0	0	0		0	1	11	0	0		12	0	0	0	0		0	-
Buses %	0%	0.2%	25%	0%		0.4%	0%	0%	0%	0%		0%	100%	2.4%	0%	0%		2.6%	0%	0%	0%	0%		0%	-
Articulated Trucks	0	2	0	0		2	0	0	0	0		0	0	10	0	0		10	0	0	0	0		0	-
Articulated Trucks %	0%	0.4%	0%	0%		0.4%	0%	0%	0%	0%		0%	0%	2.2%	0%	0%		2.2%	0%	0%	0%	0%		0%	-
Bicycles on Road	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	-
Bicycles on Road %	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	-

Peak Hour: 04:15 PM - 05:15 PM Weather: Clear Sky (4.73 °C)



Turning Movement Count (1 . DARBY RD & HWY 93)

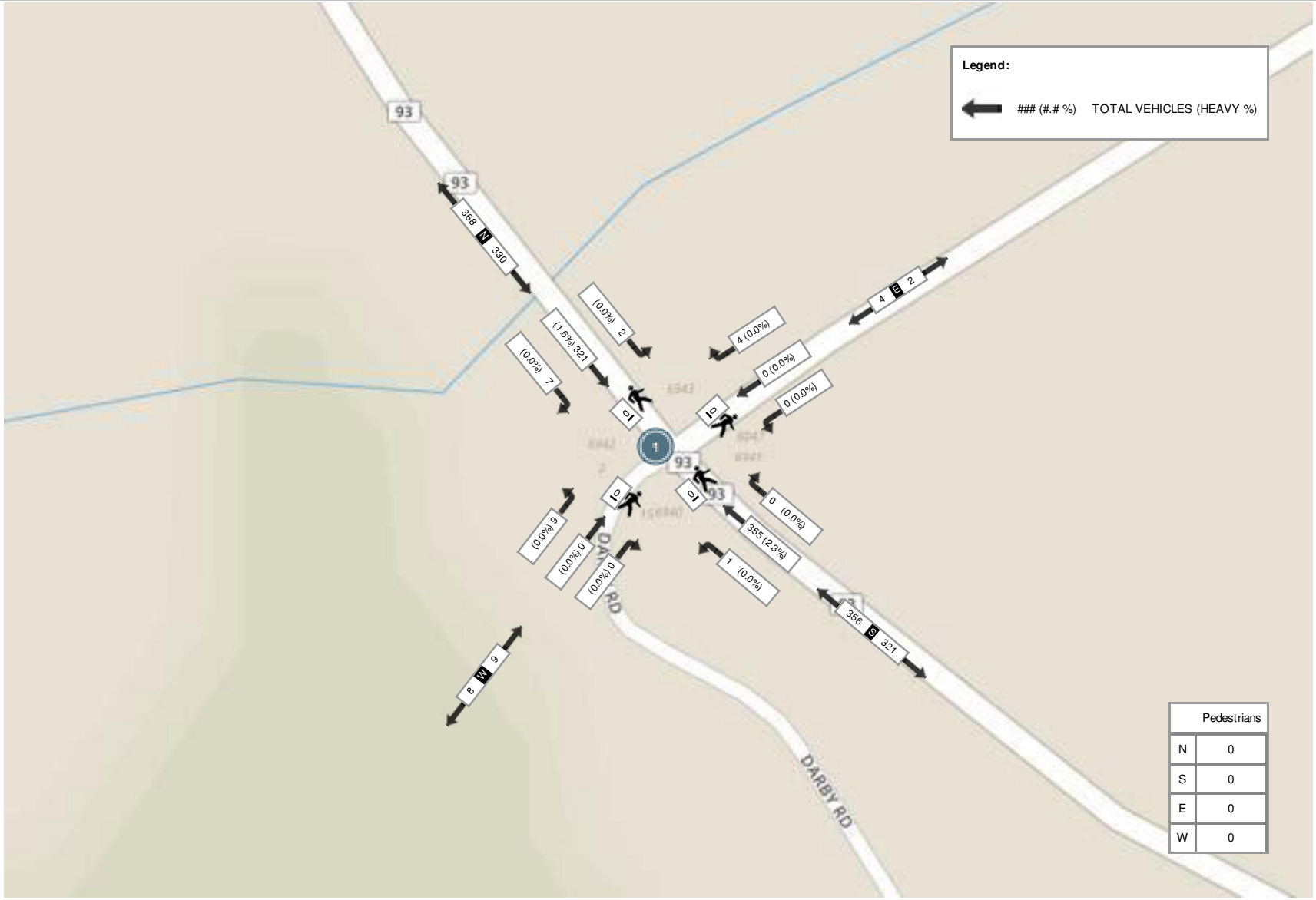
Start Time	N Approach HWY 93						E Approach MCMANN SIDEROAD						S Approach HWY 93						W Approach DARBY RD						Int. Total (15 min)	Int. Total (1 hr)
	Right N:W	Thru N:S	Left N:E	U-Turn N:N	Peds N:	Approach Total	Right E:N	Thru E:W	Left E:S	U-Turn E:E	Peds E:	Approach Total	Right S:E	Thru S:N	Left S:W	U-Turn S:S	Peds S:	Approach Total	Right W:S	Thru W:E	Left W:N	U-Turn W:W	Peds W:	Approach Total		
05:00:00	0	5	0	0	0	5	0	0	0	0	1	0	0	4	0	0	0	4	0	0	0	0	0	0	9	
05:15:00	0	13	0	0	0	13	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	17	
05:30:00	0	5	0	0	0	5	0	0	0	0	0	0	0	9	0	0	0	9	0	0	0	0	0	0	14	
05:45:00	0	13	0	0	0	13	0	0	0	0	0	0	0	10	0	0	0	10	0	0	1	0	0	1	24	64
06:00:00	0	14	0	0	0	14	0	0	0	0	0	0	0	22	0	0	0	22	0	0	0	0	1	0	36	91
06:15:00	0	18	1	0	0	19	0	0	0	0	0	0	0	20	0	0	0	20	0	0	0	0	0	0	39	113
06:30:00	0	19	0	0	0	19	0	0	0	0	0	0	0	30	0	0	0	30	0	0	0	0	0	0	49	148
06:45:00	0	38	0	0	0	38	0	0	0	0	0	0	0	13	0	0	0	13	0	0	0	0	0	0	51	175
07:00:00	0	35	0	0	0	35	0	0	0	0	0	0	0	25	0	0	0	25	0	0	0	0	0	0	60	199
07:15:00	0	47	0	0	0	47	0	0	0	0	0	0	0	28	0	0	0	28	0	0	0	0	0	0	75	235
07:30:00	0	35	0	0	0	35	1	0	0	0	0	1	0	33	0	0	0	33	0	1	1	0	0	2	71	257
07:45:00	1	49	0	0	0	50	0	0	0	0	0	0	0	24	0	0	0	24	1	0	0	0	0	1	75	281
08:00:00	0	37	0	0	0	37	0	0	0	0	0	0	0	33	0	0	0	33	0	0	0	0	0	0	70	291
08:15:00	1	48	0	0	0	49	1	0	0	0	0	1	1	45	0	0	0	46	0	0	1	0	0	1	97	313
08:30:00	0	44	0	0	0	44	0	0	0	0	0	0	0	60	0	0	0	60	1	0	1	0	0	2	106	348
08:45:00	0	46	0	0	0	46	0	0	0	0	0	0	0	49	0	0	0	49	0	0	0	0	0	0	95	368
09:00:00	0	47	0	0	0	47	0	0	0	0	0	0	0	47	0	0	0	47	0	0	0	0	0	0	94	392
09:15:00	1	71	0	1	0	73	0	0	1	0	0	1	0	51	0	0	0	51	0	0	0	0	0	0	125	420
09:30:00	1	55	0	0	0	56	0	0	0	0	0	0	0	93	0	0	0	93	0	0	0	0	0	0	149	463
09:45:00	2	58	0	0	0	60	2	0	0	0	0	2	0	81	0	0	0	81	0	0	1	0	0	1	144	512
10:00:00	1	65	2	0	0	68	0	0	0	0	0	0	0	58	0	0	0	58	0	0	2	0	0	2	128	546
10:15:00	0	71	0	0	0	71	0	0	0	0	0	0	0	86	0	0	0	86	0	0	1	0	0	1	158	579
10:30:00	0	74	0	0	0	74	1	0	0	0	0	1	0	69	0	0	0	69	0	0	1	0	0	1	145	575
10:45:00	0	74	0	0	0	74	0	0	0	0	0	0	0	84	0	0	0	84	0	0	0	0	0	0	158	589
11:00:00	3	66	0	0	0	69	2	0	0	0	0	2	0	92	0	0	0	92	0	0	1	0	0	1	164	625
11:15:00	2	95	1	0	0	98	0	0	0	0	0	0	0	73	1	0	0	74	0	0	1	0	0	1	173	640
11:30:00	0	77	1	0	0	78	2	0	0	0	0	2	0	87	0	0	0	87	0	0	6	0	0	6	173	668
11:45:00	2	83	0	0	0	85	0	0	0	0	0	0	0	103	0	0	0	103	0	0	1	0	0	1	189	699
12:00:00	0	83	0	0	0	83	1	0	0	0	0	1	0	76	0	0	0	76	0	0	1	0	0	1	161	696
12:15:00	1	86	0	0	0	87	0	0	0	0	0	0	0	67	0	0	0	67	0	0	1	0	0	1	155	678
12:30:00	2	80	1	0	0	83	0	0	0	0	0	0	2	95	1	0	0	98	1	0	1	0	0	2	183	688

12:45:00	1	78	0	0	0	79	2	0	1	0	0	3	2	80	0	0	0	82	0	0	0	0	0	0	164	663
13:00:00	2	81	0	0	0	83	0	0	0	0	0	0	1	81	1	0	0	83	1	0	0	0	0	1	167	669
13:15:00	2	70	0	0	0	72	0	0	0	0	0	0	0	90	0	0	0	90	0	0	0	0	0	0	162	676
13:30:00	0	68	0	0	0	68	1	0	0	0	0	1	0	81	0	0	0	81	0	0	0	0	0	0	150	643
13:45:00	0	79	0	0	0	79	0	0	0	0	0	0	0	80	0	0	0	80	0	0	1	0	0	1	160	639
14:00:00	1	81	1	0	0	83	0	0	0	0	0	0	0	62	0	0	0	62	0	0	0	0	0	0	145	617
14:15:00	0	74	0	0	0	74	0	0	0	0	0	0	0	72	0	0	0	72	0	0	0	0	0	0	146	601
14:30:00	0	85	0	0	0	85	0	1	0	0	0	1	0	84	0	0	0	84	0	0	0	0	0	0	170	621
14:45:00	0	71	0	0	0	71	0	1	0	0	0	1	0	76	0	0	0	76	0	0	0	0	0	0	148	609
15:00:00	1	64	0	0	0	65	0	0	0	0	0	0	0	82	0	0	0	82	0	0	2	0	0	2	149	613
15:15:00	0	87	2	0	0	89	0	0	0	0	0	0	0	80	0	0	0	80	0	0	0	0	0	0	169	636
15:30:00	3	58	0	0	0	61	0	0	0	0	0	0	1	68	0	0	0	69	0	1	0	0	0	1	131	597
15:45:00	1	74	0	0	0	75	0	0	1	0	0	1	0	85	0	0	0	85	0	0	0	0	0	0	161	610
Grand Total	28	2521	9	1	0	2559	13	2	3	0	1	18	7	2592	3	0	0	2602	4	2	24	0	1	30	**5209**	-
Approach%	1.1%	98.5%	0.4%	0%		-	72.2%	11.1%	16.7%	0%		-	0.3%	99.6%	0.1%	0%		-	13.3%	6.7%	80%	0%		-	**-**	-
Totals %	0.5%	48.4%	0.2%	0%		49.1%	0.2%	0%	0.1%	0%		0.3%	0.1%	49.8%	0.1%	0%		50%	0.1%	0%	0.5%	0%		0.6%	**-**	-
Heavy	0	56	1	0		-	0	0	0	0		-	0	55	1	0		-	0	0	0	0		-	**-**	-
Heavy %	0%	2.2%	11.1%	0%		-	0%	0%	0%	0%		-	0%	2.1%	33.3%	0%		-	0%	0%	0%	0%		-	**-**	-
Bicycles	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	**-**	-
Bicycle %	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	**-**	-

Peak Hour: 11:00 AM - 12:00 PM Weather: Few Clouds (10.42 °C)

Start Time	N Approach HWY 93						E Approach MCMANN SIDEROAD						S Approach HWY 93						W Approach DARBY RD						Int. Total (15 min)
	Right	Thru	Left	U-Turn	Peds	Approach Total	Right	Thru	Left	U-Turn	Peds	Approach Total	Right	Thru	Left	U-Turn	Peds	Approach Total	Right	Thru	Left	U-Turn	Peds	Approach Total	
11:00:00	3	66	0	0	0	69	2	0	0	0	0	2	0	92	0	0	0	92	0	0	1	0	0	1	164
11:15:00	2	95	1	0	0	98	0	0	0	0	0	0	0	73	1	0	0	74	0	0	1	0	0	1	173
11:30:00	0	77	1	0	0	78	2	0	0	0	0	2	0	87	0	0	0	87	0	0	6	0	0	6	173
11:45:00	2	83	0	0	0	85	0	0	0	0	0	0	0	103	0	0	0	103	0	0	1	0	0	1	189
Grand Total	7	321	2	0	0	330	4	0	0	0	0	4	0	355	1	0	0	356	0	0	9	0	0	9	**699**
Approach%	2.1%	97.3%	0.6%	0%		-	100%	0%	0%	0%		-	0%	99.7%	0.3%	0%		-	0%	0%	100%	0%		-	**-**
Totals %	1%	45.9%	0.3%	0%		47.2%	0.6%	0%	0%	0%		0.6%	0%	50.8%	0.1%	0%		50.9%	0%	0%	1.3%	0%		1.3%	**-**
PHF	0.58	0.84	0.5	0		0.84	0.5	0	0	0		0.5	0	0.86	0.25	0		0.86	0	0	0.38	0		0.38	**-**
Heavy	0	5	0	0		5	0	0	0	0		0	0	8	0	0		8	0	0	0	0		0	**-**
Heavy %	0%	1.6%	0%	0%		1.5%	0%	0%	0%	0%		0%	0%	2.3%	0%	0%		2.2%	0%	0%	0%	0%		0%	**-**
Lights	7	316	2	0		325	4	0	0	0		4	0	347	1	0		348	0	0	9	0		9	**-**
Lights %	100%	98.4%	100%	0%		98.5%	100%	0%	0%	0%		100%	0%	97.7%	100%	0%		97.8%	0%	0%	100%	0%		100%	**-**
Single-Unit Trucks	0	2	0	0		2	0	0	0	0		0	0	4	0	0		4	0	0	0	0		0	**-**
Single-Unit Trucks %	0%	0.6%	0%	0%		0.6%	0%	0%	0%	0%		0%	0%	1.1%	0%	0%		1.1%	0%	0%	0%	0%		0%	**-**
Buses	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	**-**
Buses %	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	**-**
Articulated Trucks	0	3	0	0		3	0	0	0	0		0	0	4	0	0		4	0	0	0	0		0	**-**
Articulated Trucks %	0%	0.9%	0%	0%		0.9%	0%	0%	0%	0%		0%	0%	1.1%	0%	0%		1.1%	0%	0%	0%	0%		0%	**-**
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	**-**
Pedestrians%	-	-	-	-	0%		-	-	-	-	0%		-	-	-	-	0%		-	-	-	-	0%		**-**

Peak Hour: 11:00 AM - 12:00 PM Weather: Few Clouds (10.42 °C)



APPENDIX C

Level of Service Definitions

Level of Service Definitions

Two-Way Stop Controlled Intersections

Level of Service	Control Delay per Vehicle (seconds)	Interpretation
A	≤ 10	EXCELLENT. Large and frequent gaps in traffic on the main roadway. Queuing on the minor street is rare.
B	> 10 and ≤ 15	VERY GOOD. Many gaps exist in traffic on the main roadway. Queuing on the minor street is minimal.
C	> 15 and ≤ 25	GOOD. Fewer gaps exist in traffic on the main roadway. Delay on minor approach becomes more noticeable.
D	> 25 and ≤ 35	FAIR. Infrequent and shorter gaps in traffic on the main roadway. Queue lengths develop on the minor street.
E	> 35 and ≤ 50	POOR. Very infrequent gaps in traffic on the main roadway. Queue lengths become noticeable.
F	> 50	UNSATISFACTORY. Very few gaps in traffic on the main roadway. Excessive delay with significant queue lengths on the minor street.

Adapted from Highway Capacity Manual 2000, Transportation Research Board

Level of Service Definitions

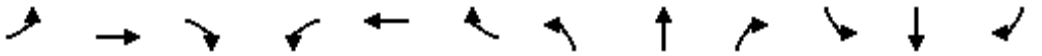
Signalized Intersections

Level of Service	Control Delay per Vehicle (seconds)	Interpretation
A	≤ 10	EXCELLENT. Extremely favourable progression with most vehicles arriving during the green phase. Most vehicles do not stop and short cycle lengths may contribute to low delay.
B	> 10 and ≤ 20	VERY GOOD. Very good progression and/or short cycle lengths with slightly more vehicles stopping than LOS "A" causing slightly higher levels of average delay.
C	> 20 and ≤ 35	GOOD. Fair progression and longer cycle lengths lead to a greater number of vehicles stopping than LOS "B".
D	> 35 and ≤ 55	FAIR. Congestion becomes noticeable with higher average delays resulting from a combination of long cycle lengths, high volume-to-capacity ratios and unfavourable progression.
E	> 55 and ≤ 80	POOR. Lengthy delays values are indicative of poor progression, long cycle lengths and high volume-to-capacity ratios. Individual cycle failures are common with individual movement failures also common.
F	> 80	UNSATISFACTORY. Indicative of oversaturated conditions with vehicular demand greater than the capacity of the intersection.

Adapted from Highway Capacity Manual 2000, Transportation Research Board

APPENDIX D

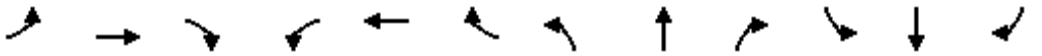
Detailed Capacity Analysis Worksheets



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	0	1	1	0	1	0	459	1	4	492	1
Future Volume (Veh/h)	4	0	1	1	0	1	0	459	1	4	492	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	4	0	1	1	0	1	0	504	1	4	541	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1054	1054	541	1054	1054	504	542			505		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1054	1054	541	1054	1054	504	542			505		
tC, single (s)	7.1	6.5	6.2	8.1	6.5	6.2	4.1			4.6		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	4.4	4.0	3.3	2.2			2.7		
p0 queue free %	98	100	100	99	100	100	100			100		
cM capacity (veh/h)	205	227	545	135	227	572	1037			853		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	5	2	504	1	545	1
Volume Left	4	1	0	0	4	0
Volume Right	1	1	0	1	0	1
cSH	234	219	1037	1700	853	1700
Volume to Capacity	0.02	0.01	0.00	0.00	0.00	0.00
Queue Length 95th (m)	0.5	0.2	0.0	0.0	0.1	0.0
Control Delay (s)	20.7	21.6	0.0	0.0	0.1	0.0
Lane LOS	C	C			A	
Approach Delay (s)	20.7	21.6	0.0		0.1	
Approach LOS	C	C				

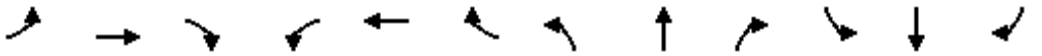
Intersection Summary				
Average Delay	0.2			
Intersection Capacity Utilization	42.8%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	0	0	0	0	4	1	355	0	2	321	7
Future Volume (Veh/h)	9	0	0	0	0	4	1	355	0	2	321	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	0	0	0	0	4	1	386	0	2	349	8
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	745	741	349	741	749	386	357			386		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	745	741	349	741	749	386	357			386		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	100	100	100	100	99	100			100		
cM capacity (veh/h)	330	346	699	334	342	666	1213			1184		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	10	4	387	0	351	8
Volume Left	10	0	1	0	2	0
Volume Right	0	4	0	0	0	8
cSH	330	666	1213	1700	1184	1700
Volume to Capacity	0.03	0.01	0.00	0.00	0.00	0.00
Queue Length 95th (m)	0.7	0.1	0.0	0.0	0.0	0.0
Control Delay (s)	16.3	10.4	0.0	0.0	0.1	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	16.3	10.4	0.0		0.1	
Approach LOS	C	B				

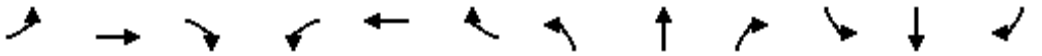
Intersection Summary				
Average Delay	0.3			
Intersection Capacity Utilization	35.4%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	0	1	1	0	1	0	560	1	4	600	1
Future Volume (Veh/h)	4	0	1	1	0	1	0	560	1	4	600	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	4	0	1	1	0	1	0	615	1	4	659	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1283	1283	659	1283	1283	615	660			616		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1283	1283	659	1283	1283	615	660			616		
tC, single (s)	7.1	6.5	6.2	8.1	6.5	6.2	4.1			4.6		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	4.4	4.0	3.3	2.2			2.7		
p0 queue free %	97	100	100	99	100	100	100			99		
cM capacity (veh/h)	142	166	467	90	166	495	938			769		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	5	2	615	1	663	1
Volume Left	4	1	0	0	4	0
Volume Right	1	1	0	1	0	1
cSH	165	152	938	1700	769	1700
Volume to Capacity	0.03	0.01	0.00	0.00	0.01	0.00
Queue Length 95th (m)	0.7	0.3	0.0	0.0	0.1	0.0
Control Delay (s)	27.4	29.0	0.0	0.0	0.1	0.0
Lane LOS	D	D			A	
Approach Delay (s)	27.4	29.0	0.0		0.1	
Approach LOS	D	D				

Intersection Summary				
Average Delay	0.2			
Intersection Capacity Utilization	48.5%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	0	0	0	0	4	1	433	0	2	392	7
Future Volume (Veh/h)	9	0	0	0	0	4	1	433	0	2	392	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	0	0	0	0	4	1	471	0	2	426	8
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	907	903	426	903	911	471	434			471		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	907	903	426	903	911	471	434			471		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	100	100	100	100	99	100			100		
cM capacity (veh/h)	256	278	633	260	276	597	1136			1101		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	10	4	472	0	428	8
Volume Left	10	0	1	0	2	0
Volume Right	0	4	0	0	0	8
cSH	256	597	1136	1700	1101	1700
Volume to Capacity	0.04	0.01	0.00	0.00	0.00	0.00
Queue Length 95th (m)	1.0	0.2	0.0	0.0	0.0	0.0
Control Delay (s)	19.6	11.1	0.0	0.0	0.1	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	19.6	11.1	0.0		0.1	
Approach LOS	C	B				

Intersection Summary				
Average Delay	0.3			
Intersection Capacity Utilization	39.5%	ICU Level of Service		A
Analysis Period (min)	15			

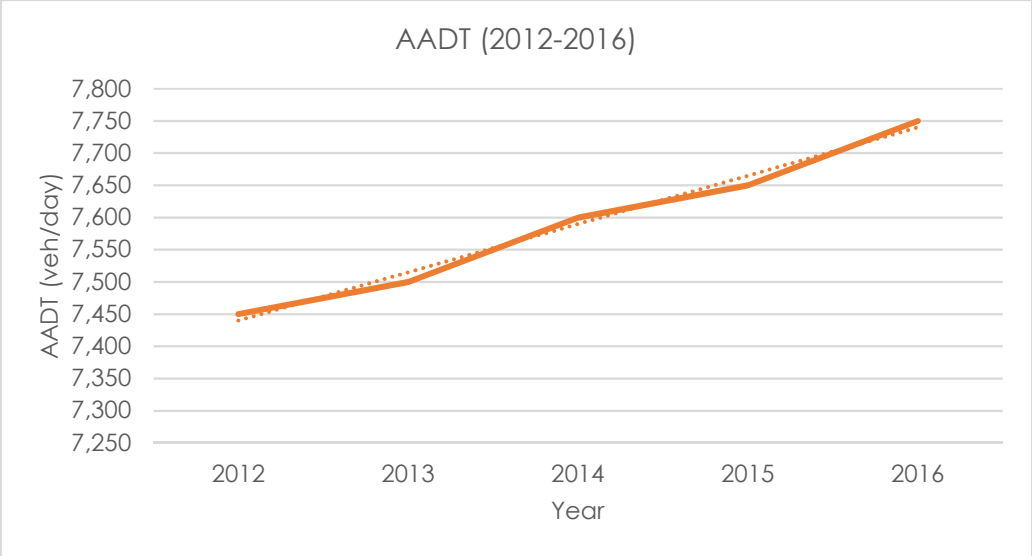
APPENDIX E

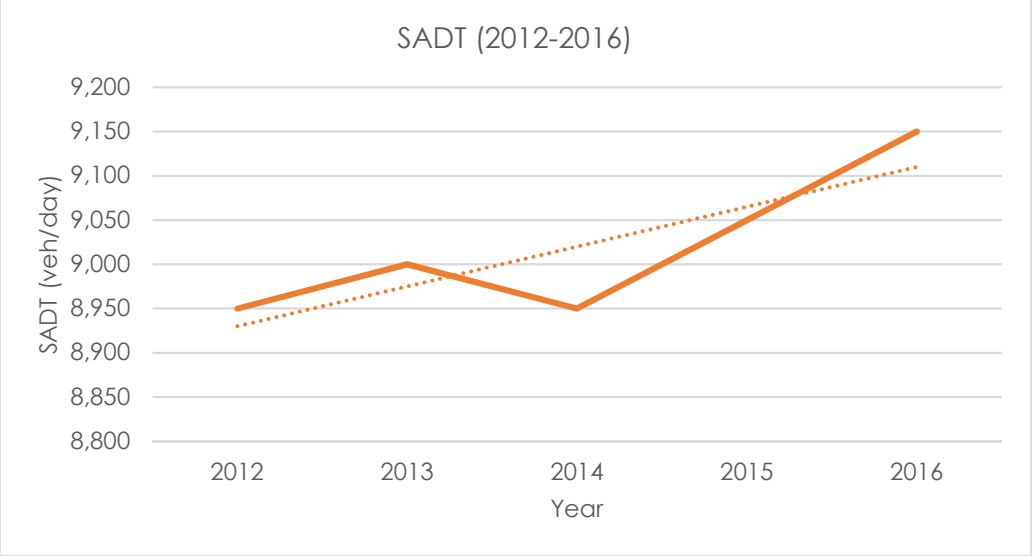
MTO Growth Rate Analysis

Growth Rate Calculations

Highway 93 - Highway 400 - End of NA

Year	AADT	% increase	SADT	% increase
2012	7,450		8,950	
2013	7,500	0.7%	9,000	0.6%
2014	7,600	1.3%	8,950	-0.6%
2015	7,650	0.7%	9,050	1.1%
2016	7,750	1.3%	9,150	1.1%
Average % increase		**1.0%**		**0.6%**





APPENDIX F

Signal Warrant Analysis Worksheets

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Darby Road / McMann Sideroad and Highway 93

What is the direction of the Main Road street? North-South

When was the data collected? 2039 (Future Total - Weekday)

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural **Population < 10,000 AND Speed >= 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	9	482	0	2	1	7	2	494	4	0	0	2	0
9:00	9	460	1	5	0	10	1	433	0	0	0	4	0
10:00	9	351	0	11	1	6	1	384	4	0	0	1	0
13:00	5	360	0	4	1	5	0	382	4	0	0	0	0
15:00	2	420	1	5	0	4	1	398	6	0	0	2	0
16:00	0	428	0	1	0	4	2	487	2	0	1	1	0
17:00	0	528	1	0	0	1	6	566	2	0	0	4	0
18:00	1	525	0	5	0	0	0	467	5	1	0	0	0
Total	**35**	**3,554**	**3**	**33**	**3**	**37**	**13**	**3,611**	**27**	**1**	**1**	**14**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	10,000	5	10	5	0	0	0	0	
Factored 8 hour pedestrian volume	20,005		25		0		0		
% Assigned to crossing rate	23%		34%		30%		100%		
Net 8 Hour Pedestrian Volume at Crossing									4,610
Net 8 Hour Vehicular Volume on Street Being Crossed									2,000

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	10,000	5	10	5	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	10	10	1	6	2	4	0	0	
Factored volume of total pedestrians	20,005		25		0		0		
Factored volume of delayed pedestrians	30		8		8		0		
% Assigned to Crossing Rate	23%		34%		30%		100%		
Net 8 Hour Volume of Total Pedestrians									4,610
Net 8 Hour Volume of Delayed Pedestrians									12

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Darby Road / McMann Sideroad and Highway 93 Count Date: 2039 (Future Total - Weekday)

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	10:00	13:00	15:00	16:00	17:00	18:00		
1A	480	720	600	900	1,003	923	768	761	839	926	1,108	1,004		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	12	19	19	10	11	7	5	6		
	COMPLIANCE %				10	16	16	8	9	6	4	5	74	9
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fullfilled each of 8 hours					Yes ☐		No ☑		
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours					Yes ☐		No ☑		

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	10:00	13:00	15:00	16:00	17:00	18:00		
2A	480	720	600	900	991	904	749	751	828	919	1,103	998		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	3	5	12	5	5	2	0	6		
	COMPLIANCE %				6	10	24	10	10	4	0	12	76	10
Free Flow Signal Justification 2:					Both 2A and 2B 100% Fullfilled each of 8 hours					Yes ☐		No ☑		
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours					Yes ☐		No ☑		

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More			Two Justifications Satisfied 80% or More	
Justification 1	Minimun Vehicular Volume	YES ☐	NO ☑	YES ☐	NO ☑
Justification 2	Delay Cross Traffic	YES ☐	NO ☑		NOT JUSTIFIED

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	8:00	991	10	119	8 %	5 %
	16:00	919	5	137	4 %	
	17:00	1,103	4	96	4 %	
	18:00	998	5	117	4 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Darby Road / McMann Sideroad and Highway 93 Count Date: 2039 (Future Total - Weekday)

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					Justified
	2601 - 7000					
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200			
	200 - 300			
	> 300	Not Justified		

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

Intersection: Darby Road / McMann Sideroad and Highway 93 Count Date: 2039 (Future Total - Weekday)

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%	☐	☑
	B	Crossing Volume	9	%		
2. Delay to Cross Traffic	A	Main Road	100	%	☐	☑
	B	Crossing Road	10	%		
3. Combination	A	Justificaton 1	9	%	☐	☑
	B	Justification 2	10	%		
4. 4-Hr Volume			5	%	☐	☑
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification met		☐	☑
	B	Delay	Justification not met			

Proposed Collision Justification (Justification 5A)

Return to Justifications 1- 6

INPUT

a.- Intersection type (no input required): 3

b.- What year is the intersection being considered for traffic signals? 2004

c.- What is the collision history and annual average daily traffic over the past few years? (Please fill in table below)

Year	Traffic Volume		Impact Type/Year						
	Major AADT	Minor AADT	Approach-ing	Angle	Rear end	Sideswipe	Turning movement	SMV	Other
2000	21626	3893	0	4	5	1	4	0	0
2001	22059	3971	0	6	4	1	3	1	1
2002	22500	4050	0	7	5	2	2	1	0
2003	23300	4200	0	8	3	3	2	1	0
2004	23648	6528	0	9	0	4	1	0	0

d.- If known, please enter the expected traffic volume after signals are introduced. Otherwise, leave the cell blank.

Year	Main AADT	Minor AADT
2004		

ANALYSIS

Reducible Collisions

	2000	2001	2002	2003	2004	2004 (Signal)
Total Number of Crashes Per Year	8	9	9	10	10	---
Parameter k	0.81	0.81	0.81	0.81	0.81	0.60
Model Prediction	1.46	1.50	1.53	1.59	2.15	2.15
Ci,y	0.680	0.696	0.712	0.741	1.000	1.000
Comp. Ratio for Period	3.829					1.000

Non-reducible Collisions

	2000	2001	2002	2003	2004	2004 (Signal)
Total Number of Crashes Per Year	6	7	8	7	4	---
Parameter k	1.47	1.47	1.47	1.47	1.47	1.19
Model Prediction	1.17	1.18	1.20	1.23	1.38	1.38
$C_{i,y}$	0.849	0.860	0.870	0.890	1.000	1.000
Comp. Ratio for Period	4.469					1.000

	Reducible Collisions	Non-reducible Collisions
Total Number of Historical Crashes	46	32
Expected Annual Crashes without Signalization based on SPF	2.150	1.377
Expected Annual Crashes without Signalization	11.131	6.046
Variance of Expected Annual Crashes without Signalization	2.647	1.092
Expected Annual Crashes after Signalization based on SPF	2.089	3.286
Expected Annual Crashes after Signalization	10.813	14.425
Variance of Expected Annual Crashes after Signalization	194.857	174.867

	Reducible Collisions	Non-reducible Collisions
Weights for Unsignalized Intersections	0.27	0.18
Weights for Signalized Intersections	0.29	0.25

RESULTS

Justification	Compliance		Signal Justified? YES	Signal Justified? NO
5. Collision Experience	Net Safety Change	2.648	☐	☑
	Total Collisions will ***Increase*** after this intersection is signalized			

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision | GO TO Justification:

What are the intersecting roadways? Darby Road / McMann Sideroad and Highway 93

What is the direction of the Main Road street? North-South

When was the data collected? 2039 (Future Total - Saturday)

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural **Population < 10,000 AND Speed >= 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
9:00	0	228	1	2	0	1	0	214	1	0	0	1	0
10:00	0	332	0	1	0	0	0	282	5	1	0	2	0
11:00	0	362	0	5	0	0	2	347	1	0	0	1	0
12:00	1	433	0	11	0	0	2	392	9	0	0	5	0
13:00	1	388	5	4	0	1	1	399	5	1	0	4	0
14:00	1	405	1	1	0	1	0	364	5	0	0	1	0
15:00	0	359	0	0	0	0	1	379	1	0	2	0	0
16:00	0	384	1	2	1	0	2	345	6	1	0	0	0
Total	**3**	**2,891**	**8**	**26**	**1**	**3**	**8**	**2,722**	**33**	**3**	**2**	**14**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

***** Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	10,000	5	10	5	0	0	0	0	
Factored 8 hour pedestrian volume	20,005		25		0		0		
% Assigned to crossing rate	23%		34%		30%		100%		
Net 8 Hour Pedestrian Volume at Crossing									4,610
Net 8 Hour Vehicular Volume on Street Being Crossed									2,000

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	10,000	5	10	5	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	10	10	1	6	2	4	0	0	
Factored volume of total pedestrians	20,005		25		0		0		
Factored volume of delayed pedestrians	30		8		8		0		
% Assigned to Crossing Rate	23%		34%		30%		100%		
Net 8 Hour Volume of Total Pedestrians									4,610
Net 8 Hour Volume of Delayed Pedestrians									12

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Darby Road / McMann Sideroad and Highway 93 Count Date: 2039 (Future Total - Saturday)

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00		
1A	480	720	600	900	448	623	718	853	809	779	742	742		
	COMPLIANCE %				93	100	100	100	100	100	100	100	793	99
1B	120	170	120	170	4	4	6	16	10	3	2	4		
	COMPLIANCE %				3	3	5	13	8	3	2	3	41	5
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fullfilled each of 8 hours Yes ☐ No ☑									
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours Yes ☐ No ☑									

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00		
2A	480	720	600	900	444	619	712	837	799	776	740	738		
	COMPLIANCE %				93	100	100	100	100	100	100	100	793	99
2B	50	75	50	75	2	2	5	11	5	1	2	4		
	COMPLIANCE %				4	4	10	22	10	2	4	8	64	8
Free Flow Signal Justification 2:					Both 2A and 2B 100% Fullfilled each of 8 hours Yes ☐ No ☑									
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours Yes ☐ No ☑									

Justification 3: Combination

Combination Justification 1 and 2

Justification Satisfied 80% or More				Two Justifications Satisfied 80% or More	
Justification 1	Minimun Vehicular Volume	YES ☐	NO ☑	YES ☐	NO ☑
Justification 2	Delay Cross Traffic	YES ☐	NO ☑		NOT JUSTIFIED

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	12:00	837	11	161	7 %	3 %
	13:00	799	5	173	3 %	
	14:00	776	2	180	1 %	
	15:00	740	2	192	1 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Darby Road / McMann Sideroad and Highway 93 Count Date: 2039 (Future Total - Saturday)

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					Justified
	2601 - 7000					
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200			
	200 - 300			
	> 300	Not Justified		

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

Intersection: Darby Road / McMann Sideroad and Highway 93 Count Date: 2039 (Future Total - Saturday)

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	99	%	☐	☑
	B	Crossing Volume	5	%		
2. Delay to Cross Traffic	A	Main Road	99	%	☐	☑
	B	Crossing Road	8	%		
3. Combination	A	Justificaton 1	5	%	☐	☑
	B	Justification 2	8	%		
4. 4-Hr Volume			3	%	☐	☑
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification met		☐	☑
	B	Delay	Justification not met			

Proposed Collision Justification (Justification 5A)

Return to Justifications 1- 6

INPUT

a.- Intersection type (no input required): 3

b.- What year is the intersection being considered for traffic signals? 2004

c.- What is the collision history and annual average daily traffic over the past few years? (Please fill in table below)

Year	Traffic Volume		Impact Type/Year						
	Major AADT	Minor AADT	Approach-ing	Angle	Rear end	Sideswipe	Turning movement	SMV	Other
2000	21626	3893	0	4	5	1	4	0	0
2001	22059	3971	0	6	4	1	3	1	1
2002	22500	4050	0	7	5	2	2	1	0
2003	23300	4200	0	8	3	3	2	1	0
2004	23648	6528	0	9	0	4	1	0	0

d.- If known, please enter the expected traffic volume after signals are introduced. Otherwise, leave the cell blank.

Year	Main AADT	Minor AADT
2004		

ANALYSIS

Reducible Collisions

	2000	2001	2002	2003	2004	2004 (Signal)
Total Number of Crashes Per Year	8	9	9	10	10	---
Parameter k	0.81	0.81	0.81	0.81	0.81	0.60
Model Prediction	1.46	1.50	1.53	1.59	2.15	2.15
Ci,y	0.680	0.696	0.712	0.741	1.000	1.000
Comp. Ratio for Period	3.829					1.000

Non-reducible Collisions

	2000	2001	2002	2003	2004	2004 (Signal)
Total Number of Crashes Per Year	6	7	8	7	4	---
Parameter k	1.47	1.47	1.47	1.47	1.47	1.19
Model Prediction	1.17	1.18	1.20	1.23	1.38	1.38
$C_{i,y}$	0.849	0.860	0.870	0.890	1.000	1.000
Comp. Ratio for Period	4.469					1.000

	Reducible Collisions	Non-reducible Collisions
Total Number of Historical Crashes	46	32
Expected Annual Crashes without Signalization based on SPF	2.150	1.377
Expected Annual Crashes without Signalization	11.131	6.046
Variance of Expected Annual Crashes without Signalization	2.647	1.092
Expected Annual Crashes after Signalization based on SPF	2.089	3.286
Expected Annual Crashes after Signalization	10.813	14.425
Variance of Expected Annual Crashes after Signalization	194.857	174.867

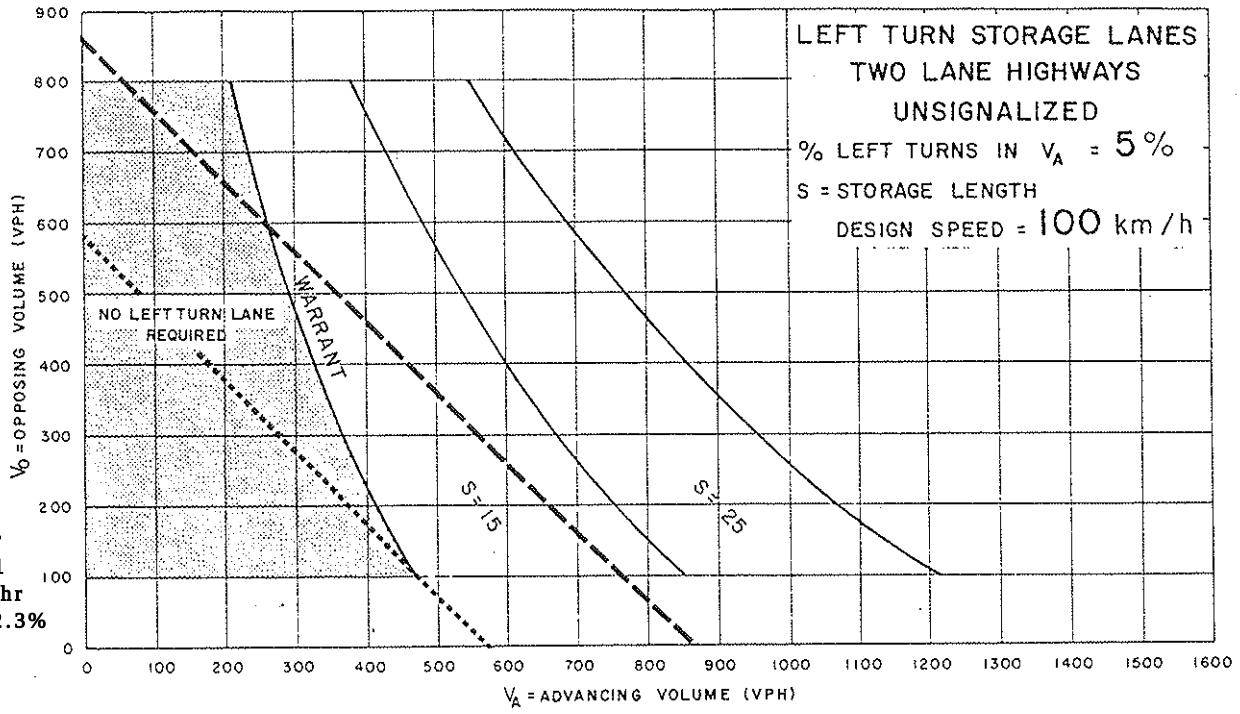
	Reducible Collisions	Non-reducible Collisions
Weights for Unsignalized Intersections	0.27	0.18
Weights for Signalized Intersections	0.29	0.25

RESULTS

Justification	Compliance		Signal Justified? YES	NO
5. Collision Experience	Net Safety Change	2.648	☐	☑
	Total Collisions will after this intersection is signalized	*Increase*		

APPENDIX G

Left-Turn Lane Warrant Analysis Worksheets



Weekday Peak:

VL = 13 veh/hr
VA = 13+560+1
= 574 veh/hr
% VL in VA = 2.3%

REQ = None

Saturday Peak:

VL = 1 veh/hr
VA = 1+433+0
= 434 veh/hr
% VL in VA = 0.0%

REQ = None

TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW

TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS

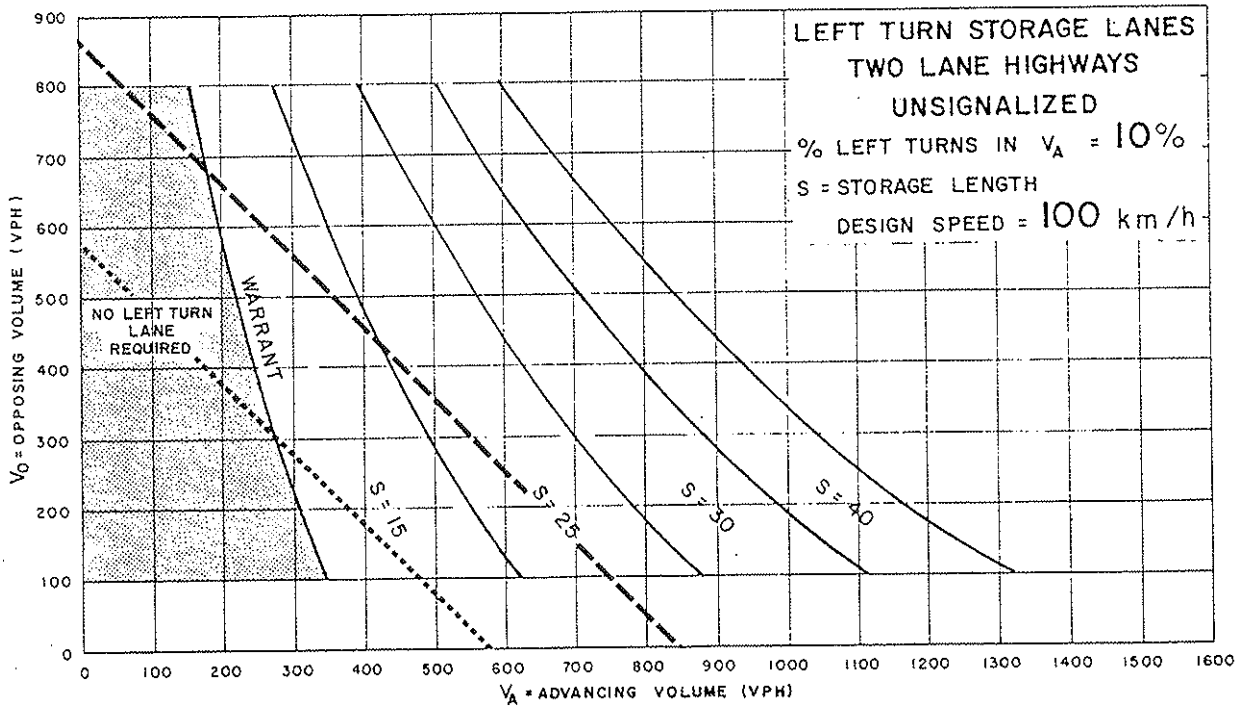
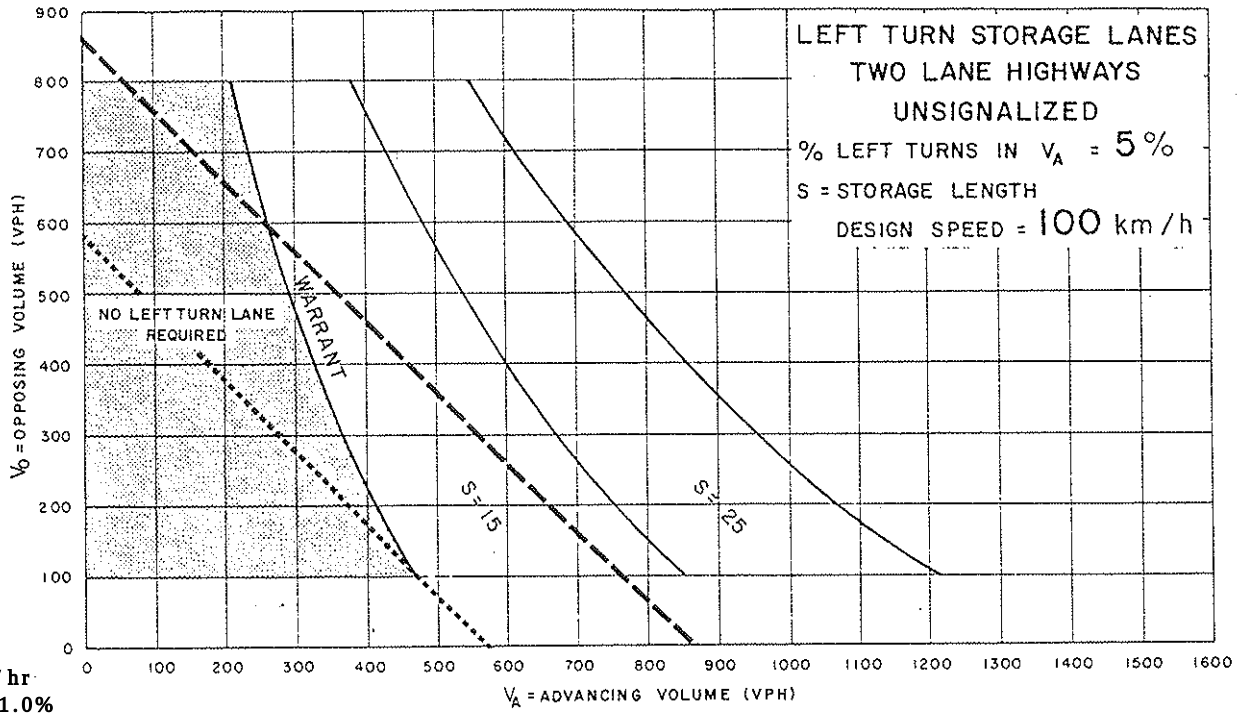


Figure EA-22



Weekday Peak:

VL = 6 veh/hr
VA = 6+600+1
= 607 veh/hr
% VL in VA = 1.0%

REQ = None

TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW

TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS

Saturday Peak:

VL = 2 veh/hr
VA = 2+392+7
= 401 veh/hr
% VL in VA = 0.0%

REQ = None

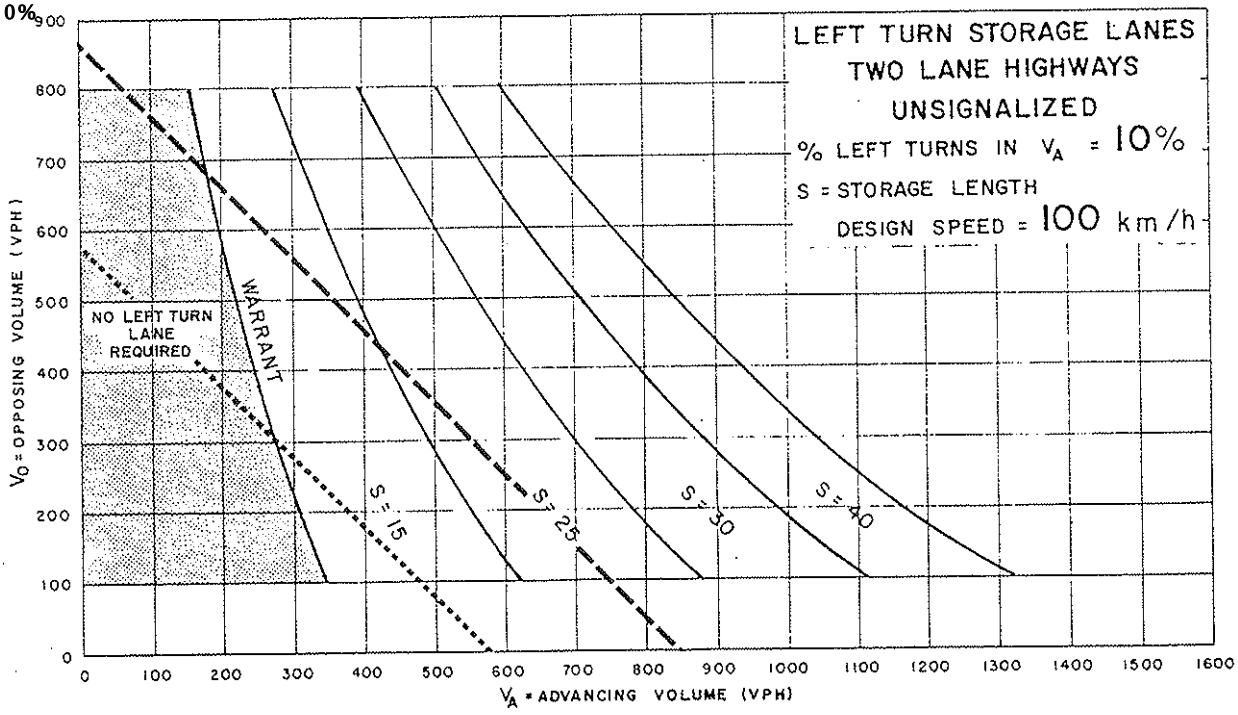


Figure EA-22

APPENDIX H

Collision History

FERENCE_	OFFSET	MFSER	ACIDAT	TIMACI	YWEK_DE	LASAC_DES	VEHNO	RECT_DES	FATRCT	ITIMP_DES	ONG_DES	LOCA_DES
39119	1.6	30011360	12-Jan-13	1240	Sat	PDOnly	1	N	0	SideSwipe	Daylight	NonIntSect
39119	1.6	30011360	12-Jan-13	1240	Sat	PDOnly	2	N	0	SideSwipe	Daylight	NonIntSect
39119	1.6	30720815	1-Jan-13	1618	Tue	PDOnly	1	N	0	SnglVeh	Daylight	NonIntSect
39119	1.6	52130179	12-Jan-15	1320	Mon	PDOnly	1	N	0	SnglVeh	Daylight	NonIntSect
39119	1.6	52130179	12-Jan-15	1320	Mon	PDOnly	2	N	0	SnglVeh	Daylight	NonIntSect
39119	1.6	52130179	12-Jan-15	1320	Mon	PDOnly	3	N	0	SnglVeh	Daylight	NonIntSect

RTRA_DES	DALI1_DES	ENV1_DES	OSUR1_DES	RACT_DES	CCOND_DE	EHTYP_DES	HMAN_DE	3JCO1_DES	3JCO2_DES	3JCO3_DES	RAMPNO
W	CrvLvl	Clear	Dry	Oth-DrAct	Normal	Auto+Stn Wagon	Gng Ahead	Other motor veh.	& -	&--	0
E	CrvLvl	Clear	Dry	Driving properly	Normal	Pick Up Truck	Gng Ahead	Other motor veh.	& -	&--	0
N	CrvLvl	Snow	Wet	Speed Too Fast	Normal	Auto+Stn Wagon	Gng Ahead	Skidding/Sliding	& Cable guide rail	&--	0
Unk-DirTra	StrLvl	Clear	Dry	Unk-DrAct	Unk-DrCnd	Auto+Stn Wagon	Unk-VehMan	Debris off vehicle	& -	&--	0
S	StrLvl	Clear	Dry	Driving properly	Normal	School Bus	Gng Ahead	Debris off vehicle	& -	&--	0
S	StrLvl	Clear	Dry	Driving properly	Normal	Auto+Stn Wagon	Gng Ahead	Debris off vehicle	& -	&--	0

LHRS	Offset	Microfilm #	Latitude	Longitude	SR/PR	Date (M/D/Y)	Year	Month	Day	Time	# of Veh	Driver Number
39119	10.6	2319926V1	44.6566	-79.8362	PR	5/4/2017	2017	May	Thu	18:30	2	1
39119	10.6	2319926V1	44.6566	-79.8362	PR	5/4/2017	2017	May	Thu	18:30	2	2
39119	1.8	2931743V1	44.6557	-79.8345	PR	12/24/2018	2018	Dec	Mon	11:32	3	1
39119	1.8	2931743V1	44.6557	-79.8345	PR	12/24/2018	2018	Dec	Mon	11:32	3	2
39119	1.8	2931743V1	44.6557	-79.8345	PR	12/24/2018	2018	Dec	Mon	11:32	3	3

# of Occupants	# of Fatalities	ROAD 1	ROAD 2	HWY	Ramp #	Classifiction of Accident	Accident Location	Impact Location	Thru Lane #	Environment Condition		Light
						42	1	2	3	4	5	6
1		-	DARBY RD	93	-	Inj	IntRel	NotRd-R	-	Rain	???	Day
1		-	DARBY RD	93	-	Inj	IntRel	NotRd-R	-	Rain	???	Day
3		-	DARBY RD	93	-	PD	NonInt	ThruLane	1	Snow	???	Day
1		-	DARBY RD	93	-	PD	NonInt	ThruLane	1	Snow	???	Day
???		-	DARBY RD	93	-	PD	NonInt	ThruLane	1	Snow	???	Day

Traffic Control	Traffic Control Condition	Road Character		Road Surface		Road Condition		Road Surface Condition		Road Alignment		Road Pavem
7	8	9[R1]	10[R2]	11[R1]	12[R2]	13[R1]	14[R2]	15[R1]	16[R2]	17[R1]	18[R2]	19[R1]
NoCntrl	???	Undvd-2W	Undvd-2W	Asphalt	Asphalt	Good	Good	Wet	Wet	CvLvl	CvLvl	Exist
NoCntrl	???	Undvd-2W	Undvd-2W	Asphalt	Asphalt	Good	Good	Wet	Wet	CvLvl	CvLvl	Exist
NoCntrl	???	Undvd-2W	???	Asphalt	???	Good	???	PkSnw	???	StrLvl	???	Exist
NoCntrl	???	Undvd-2W	???	Asphalt	???	Good	???	PkSnw	???	StrLvl	???	Exist
NoCntrl	???	Undvd-2W	???	Asphalt	???	Good	???	PkSnw	???	StrLvl	???	Exist

ent Markings	Vehicle Type	Towed Vehicle	Vehicle Condition	Apparent Driver Action	Driver Condition	Road Jurisdiction	Initial Direction of Travel	Initial Impact Type	Vehicle Manoeuver			
20[R2]	21	25	31	33	35	41	43	45	46	First	Other- Specified	Offset
NonEx	Car	???	NoDefect	LostCtrl	Impair(Dg)	Prov	S	SMV other	GngAhead	Cable guide	-	R<3.1 m
NonEx	Car	???	NoDefect	DrvgProp	Normal	Prov	S	SMV other	GngAhead	Other moto	-	???
???	Car	???	NoDefect	LostCtrl	Normal	Prov	N	Turning	GngAhead	Skidding/sl	-	???
???	Car	???	NoDefect	DrvgProp	Normal	Prov	W	Turning	TurnLeft	Other moto	-	???
???	Car	???	???	DrvgProp	Normal	Prov	N	Turning	Slwg/Stpg	Other moto	-	???

(48), (50), (52) Sequence of Events						Vehicle Damage	Location of Vehicle Damage or Area of Impact	Location of Vehicle Damage or Area of Impact	Statement	Witness Indicator	Emergency Service Provided	Indirectly Involved
Second	Other- Specified	Offset	Third	Other- Specified	Offset	60	62	63				
Skidding/sl	-	???	Rollover	-	???	Demolishe	RSCmpl	FtCmpl	V1 SB ON R	FALSE	FALSE	FALSE
???	-	???	???	-	???	Moderate	FtCmpl	???	V1 SB ON R	FALSE	FALSE	FALSE
Other moto	-	???	???	-	???	Severe	LFtCnr	L-Front	ALL VEHICL	FALSE	FALSE	FALSE
???	-	???	???	-	???	Severe	L-Rear	L-RearCnr	ALL VEHICL	FALSE	FALSE	FALSE
???	-	???	???	-	???	Light	LCtr	???	ALL VEHICL	FALSE	FALSE	FALSE

Driverless Vehicle	Geographic Location Type	Geographic Location	Distance From Keypoint (LHRS)	MTO District	Approx. Travelling Speed	Max Speed Posted		Advisory Speed Posted		Failed to Remain	Apprehended	Suspended
			Distance,Unit ,Direction			R1	R2	R1	R2			
FALSE	Municipalit	TAY	10MS	6	-	80	50	-	-	FALSE	FALSE	TRUE
FALSE	Municipalit	TAY	10MS	6	80	80	50	-	-	FALSE	FALSE	FALSE
FALSE	Municipalit	TAY	20MS	6	-	80	-	60	-	FALSE	FALSE	FALSE
FALSE	Municipalit	TAY	20MS	6	-	80	-	60	-	FALSE	FALSE	FALSE
FALSE	Municipalit	TAY	20MS	6	-	80	-	60	-	FALSE	FALSE	FALSE

Breath Blood Test Indicator	License Jurisdiction	License Class	License Condition	Proper License Class for Vehicle	Model Year	Make	Model	Colour	License Class Required	Plate Jurisdiction	Plate/Vehicle Mismatch	Trailer Make
FALSE	ON	G1	*/N	FALSE	2015	JEEP	CHK	WHI	G	ON	FALSE	-
TRUE	ON	G	X/N	TRUE	2010	HOND	CRV	BLU	G	ON	FALSE	-
TRUE	ON	G	*/N	TRUE	2012	NISS	ROG	BLK	-	ON	FALSE	-
TRUE	ON	G	*/N	TRUE	2006	CHEV	IMP	BLK	-	ON	FALSE	-
TRUE	ON	G	*/N	TRUE	2018	HYUN	ESM	BLU	-	ON	FALSE	-

Trailer Type	Trailer Connection	Plate Jurisdiction	Loaded	AirBrake	Age	Gender	Position	Injuries	Ejection	Safety Equipment Used	Determination of Use	Age
					72	73	74	75	76	77	78	72
???	???	-	FALSE	FALSE	27	M	FrntL	Minor	N	AirBagDepl	???	-
???	???	-	FALSE	FALSE	27	F	???	???	???	???	???	-
???	???	-	-	FALSE	29	M	???	???	???	???	???	-
???	???	-	-	-	29	M	???	???	???	???	???	-
???	???	-	-	-	68	F	???	???	???	???	???	-

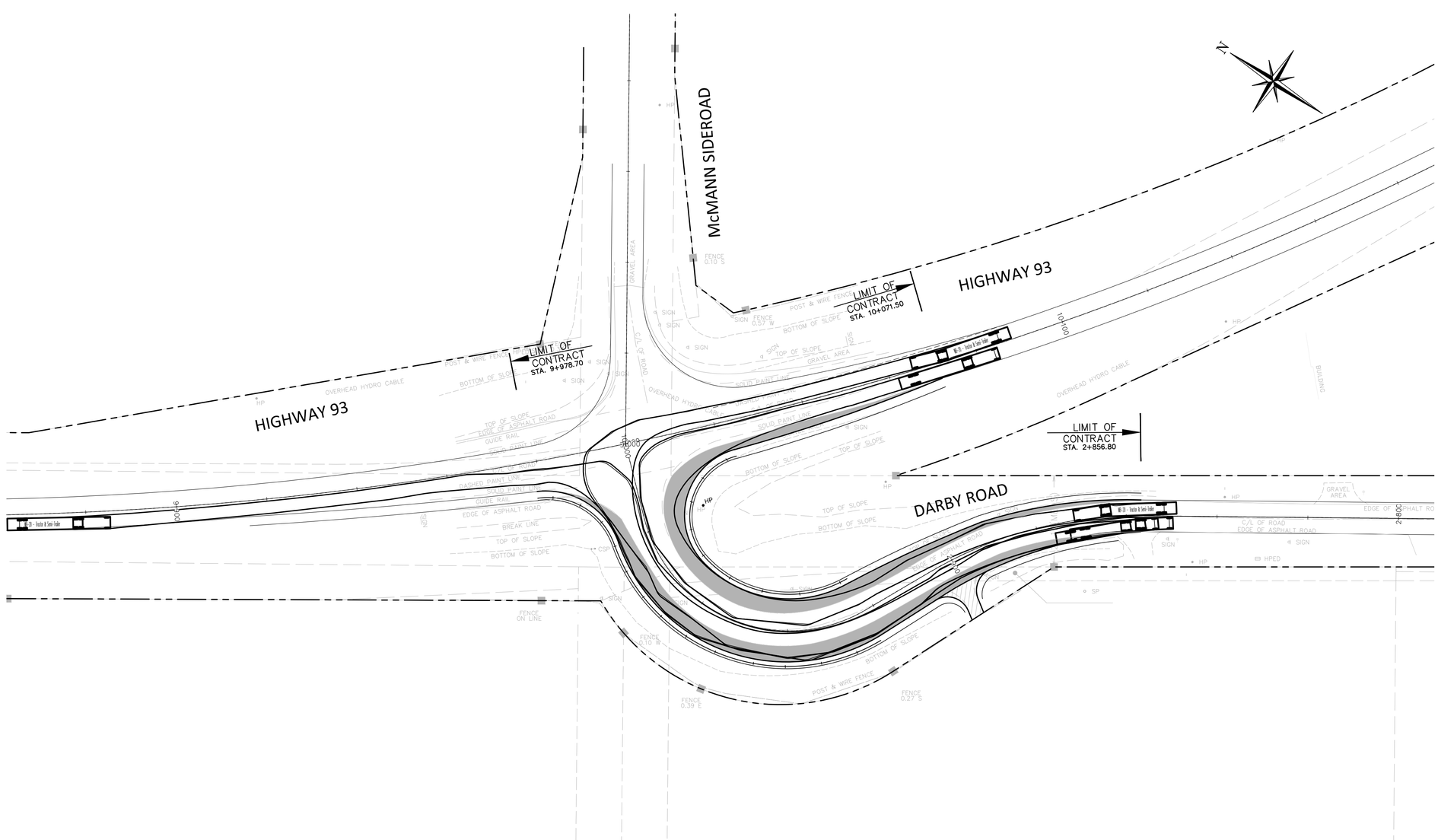
Gender	Position	Injuries	Ejection	Safety Equipment Used	Determination of Use	Pedestrian Condition	Pedestrian Action	Age	Gender	Position	Injuries	Ejection
73	74	75	76	77	78	37	39	72	73	74	75	76
-	???	???	???	???	???	???	???	-	-	???	???	???
-	???	???	???	???	???	???	???	-	-	???	???	???
-	???	???	???	???	???	???	???	-	-	???	???	???
-	???	???	???	???	???	???	???	-	-	???	???	???
-	???	???	???	???	???	???	???	-	-	???	???	???

Safety Equipment Used	Determination of Use	Pedestrian Condition	Pedestrian Action	Age	Gender	Position	Injuries	Ejection	Safety Equipment Used	Determination of Use	Pedestrian Condition	Pedestrian Action
77	78	37	39	72	73	74	75	76	77	78	37	39
???	???	???	???	-	-	???	???	???	???	???	???	???
???	???	???	???	-	-	???	???	???	???	???	???	???
???	???	???	???	-	-	???	???	???	???	???	???	???
???	???	???	???	-	-	???	???	???	???	???	???	???
???	???	???	???	-	-	???	???	???	???	???	???	???

Age	Gender	Position	Injuries	Ejection	Safety Equipment Used	Determination of Use	Pedestrian Condition	Pedestrian Action	Emergency Equpiment in Attendance	Service Performed
72	73	74	75	76	77	78	37	39		
-	-	???	???	???	???	???	???	???	???	
-	-	???	???	???	???	???	???	???	???	
-	-	???	???	???	???	???	???	???	???	
-	-	???	???	???	???	???	???	???	???	
-	-	???	???	???	???	???	???	???	???	

APPENDIX I

Vehicle Turning Analysis



KEY PLAN
SCALE: N.T.S.

LEGEND

EXISTING ROW

NEW ASPHALT PAVEMENT

10 0m 10 20 30 40
SCALE: 1:500

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Town

No.	ISSUE	DATE: MM/DD/YYYY
1	ISSUED FOR DESIGN REVIEW	09/24/2019

Engineer

FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

Engineer

Project
HIGHWAY 93 & DARBY ROAD
INTERSECTION IMPROVEMENT
TOWN OF TINY

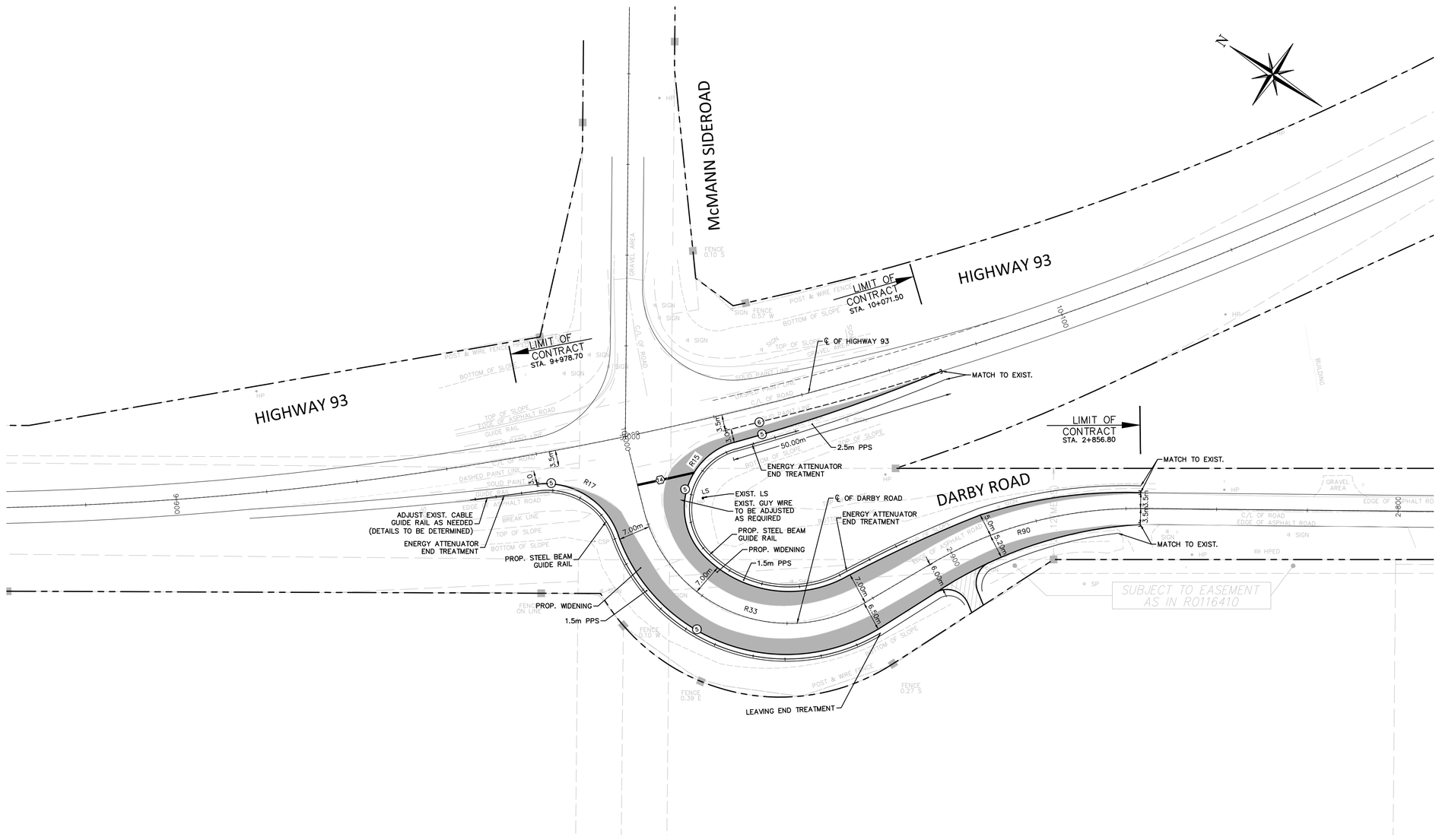
Drawing
FUNCTIONAL DESIGN
WB-20 TRUCK MOVEMENT

CROZIER CONSULTING ENGINEERS
211 Yonge Street,
Suite 301
Toronto, ON M5B 1M4
416-477-3392
www.cfcrozier.ca

Drawn By	Design By	Project	
I.Z.	I.Z.		1028-5282
Check By	Check By	Scale	Drawing
R.M.		1:500	2

APPENDIX J

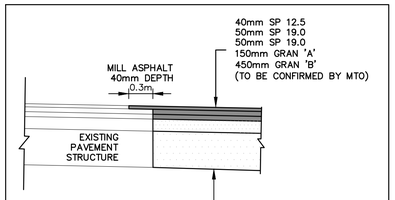
Functional Design – Darby Road and Highway 93



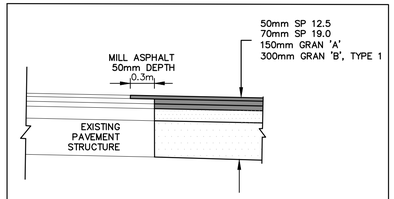
LEGEND

EXISTING ROW

NEW ASPHALT PAVEMENT



HIGHWAY 93
PAVEMENT STRUCTURE AND STEP JOINT
NTS



DARBY ROAD PAVEMENT STRUCTURE
AND STEP JOINT
NTS

PAVEMENT MARKINGS LEGEND

5	SOLID WHITE, 10cm
6	333 BROKEN WHITE, 10cm
14	SOLID WHITE, 45cm
][	LIMITS OF MARKINGS

NOTES:
1. 333 DENOTES PAVEMENT MARKING SPACING AS 3m LINE, 3m GAP, 3m LINE
2. USE (X) TO DENOTE PAVEMENT MARKING
3. USE (X) TO DENOTE DURABLE PAVEMENT MARKING

Town

No.	ISSUE	DATE: MM/DD/YYYY
1	ISSUED FOR DESIGN REVIEW	09/24/2019

Engineer

FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

Engineer

Project
HIGHWAY 93 & DARBY ROAD
INTERSECTION IMPROVEMENT
TOWN OF TINY

Drawing
FUNCTIONAL DESIGN

CROZIER CONSULTING ENGINEERS
211 Yonge Street, Suite 301
Toronto, ON M5B 1M4
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Drawn By	I.Z.	Design By	I.Z.	Project	1028-5282		
Check By	R.M.	Check By		Scale	1:500	Drawing	1

FIGURES

Legend

Project

DARBY ROAD

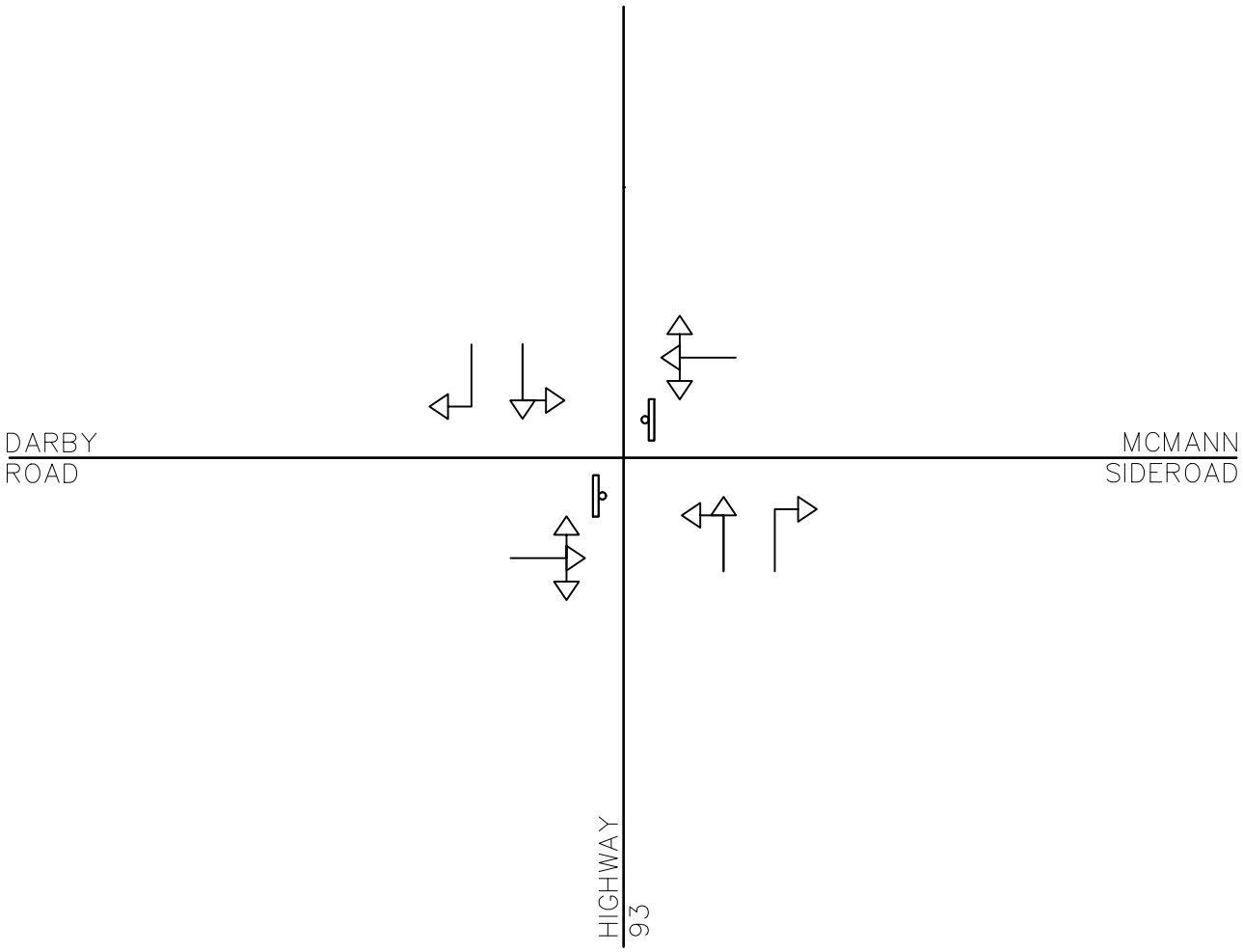
Drawing

SITE LOCATION PLAN

CROZIER & ASSOCIATES Consulting Engineers
The HarbourEdge Building,
40 Huron Street, Suite 301,
Collingwood, ON L9Y 4R3
705 446-3510 T
705 446-3520 F
www.cfcrozier.ca
info@cfcrozier.ca

Drawn By	Design By	Project
D.L.	D.L.	1028-5282

Scale	Date	Check By	Drawing
N.T.S.	SEPT. 3, 2019	A.F.	FIG. 1



NOTE: THIS FIGURE IS FOR SCHEMATIC
PURPOSES ONLY & IS NOT TO BE SCALED.

Legend

SIGNAL CONTROL

STOP CONTROL

Project

DARBY ROAD

Drawing

BOUNDARY ROAD NETWORK

CROZIER & ASSOCIATES Consulting Engineers
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40 Huron Street, Suite 301,
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705 446-3520 F
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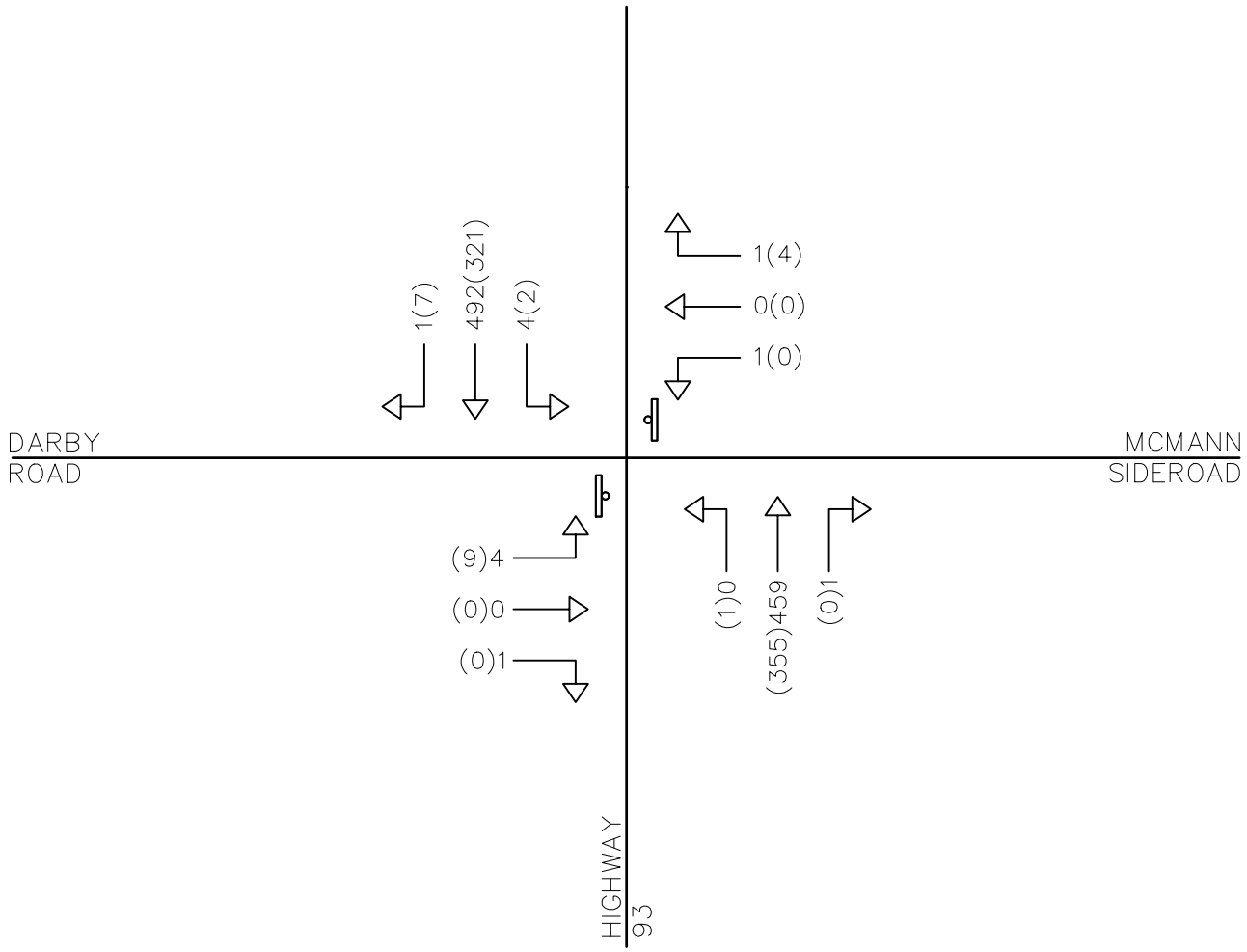
info@cfcrozier.ca

Drawn By	Design By	Project	Scale	Date	Check By	Drawing
D.L.	D.L.	1028-5282	N.T.S.	SEPT. 3, 2019	A.F.	FIG. 2



NOTE: THIS FIGURE IS FOR SCHEMATIC PURPOSES ONLY & IS NOT TO BE SCALED.

Legend

- SIGNAL CONTROL
- STOP CONTROL
- XX(YY) WEEKDAY (SATURDAY) PEAK HOUR TRAFFIC VOLUMES

Project: DARBY ROAD

Drawing: 2019 EXISTING TRAFFIC VOLUMES

CROZIER & ASSOCIATES Consulting Engineers
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40 Huron Street, Suite 301,
Collingwood, ON L9Y 4R3
705 446-3510 T
705 446-3520 F
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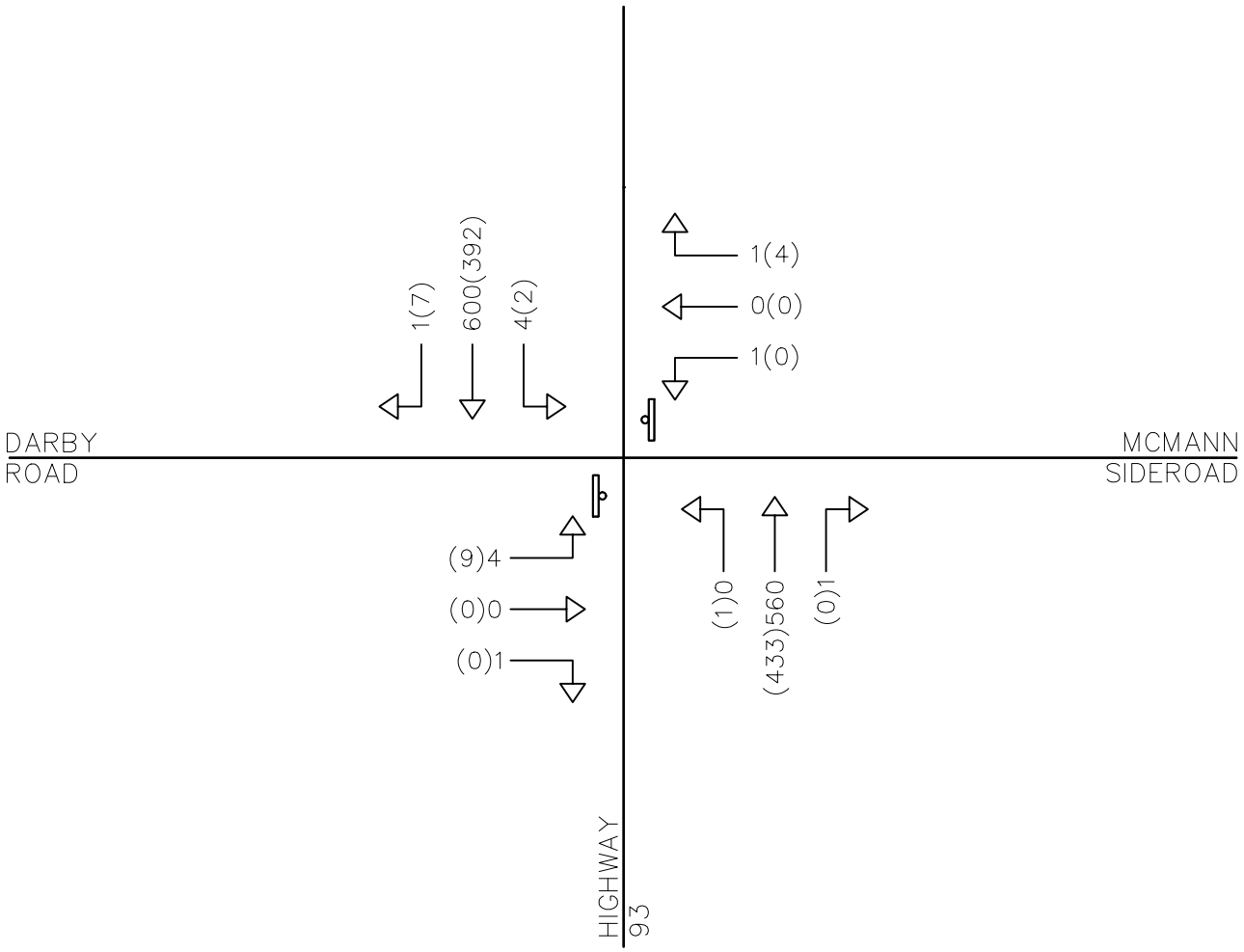
info@cfcrozier.ca

Drawn By	Design By	Project
D.L.	D.L.	1028-5282

Scale	Date	Check By	Drawing
N.T.S.	SEPT. 3, 2019	A.F.	FIG. 3



NOTE: THIS FIGURE IS FOR SCHEMATIC PURPOSES ONLY & IS NOT TO BE SCALED.

Legend

- SIGNAL CONTROL
- STOP CONTROL
- XX(YY) WEEKDAY (SATURDAY) PEAK HOUR TRAFFIC VOLUMES

Project: DARBY ROAD

Drawing: 2039 FUTURE TRAFFIC VOLUMES

CROZIER & ASSOCIATES Consulting Engineers
The HarbourEdge Building,
40 Huron Street, Suite 301,
Collingwood, ON L9Y 4R3
705 446-3510 T
705 446-3520 F
www.cfcrozier.ca
info@cfcrozier.ca

Drawn By	Design By	Project
D.L.	D.L.	1028-5282

Scale	Date	Check By	Drawing
N.T.S.	SEPT. 3, 2019	A.F.	FIG. 4

Attachment **4**

September 25, 2019 Reference No. 11155365

Ms. Jessica Ferri
CRH Canada Group Inc.
2300 Steeles Avenue West, 4th Floor
Concord, Ontario
L4K 5X6

Dear Ms. Ferri:

Re: Professional Opinion Regarding Neighboring Domestic Wells Complaints - Teedon Pit Extension
North 1/2 of Lot 80, Concession 1, W.P.R & Part of Original Road Allowance between Lots 80 and 81, Concession 1, W.P.R, Township of Tiny, County of Simcoe
(Dufferin Aggregates, a division of CRH Canada Group Inc.)

1. Introduction

As requested, GHD has prepared the following letter in regards to the neighboring domestic wells near the Dufferin Aggregates (Dufferin), a division of CRH Canada Group Inc., Teedon Pit Extension located on the North 1/2 of Lot 80, Concession 1, W.P.R and Part of the original road allowance between Lot 80 and 81, Concession 1, W.P.R, Township of Tiny, County of Simcoe, Ontario.

During a recent meeting between the Township of Tiny, R.J. Burnside & Associates, CRH Canada Group Inc. and MHBC on September 12, 2019, it was requested by the Township of Tiny that a letter be prepared with a professional opinion on the neighboring domestic wells complaints and whether impacts can be anticipated as a result of pit operations.

2. Previous Investigations

Historically, residents have raised concerns regarding water quality and quantity issues related to operation of the Teedon Pit. A summary of the investigations is documented below.

2.1 2015 Alpha Investigation and Water Well Survey

Following a Public Meeting conducted on January 26, 2015 at the Planning and Development Department of the Township of Tiny, Alpha Environmental Services, Inc. (Alpha), the Consultant for the previous owner (K.J. Beamish Construction Co., Limited ï or Beamish), contacted many of the local residents to ascertain the nature of any concerns.

Alpha conducted a well survey to identify supply wells around the Teedon Pit. A total of 27 wells were identified. The water 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.

The five residents were:

- 1189 Marshall Road
- 6970 Highway 93
- 7062 Highway 93
- 1190 Marshall Road
- 1119 Marshall Road

A hydrogeologic assessment of the water quality concerns was conducted by Alpha in May 2015. The hydrogeologic assessment concluded that the silt in the domestic wells and the reduced water supply are not due to the operations at Teedon Pit.

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. It was noted by the May 2015 Alpha hydrogeologic assessment that the shallow overburden contains a significant amount of silt.

2.2 2015 Ministry of Environment, Conservation, and Parks (MECP) Assessment

Following the water well survey and investigation by Alpha in May 2015, the MECP reviewed water well interference complaints at 1189 Marshall Road, 6970 Highway 93 and 7062 Highway 93.

The MECP concurred with the assessment by Alpha and stated:

> *I do not believe that the water well impacts of the three water well interference complaintants are due to the water takings associated with the Permit for the Teedon Pit.*

The MECP added that poor well maintenance and/or construction may be the cause for the presence of silt in the domestic wells. The MECP correspondence in regards to the water well interference complaints are provided in Attachment A.

2.3 2017 Ontario Water Wells Services Inc. Domestic Well Survey and Water Analytical Samples

Ontario Water Wells Services Inc. on behalf of CRH Canada Group Inc. completed a focused domestic well survey and collected groundwater samples from five nearby domestic wells in late summer 2017 in response to complaints of silt in the domestic wells. The groundwater samples were collected by a licensed water well contractor. The addresses that participated in the interview, well inspection and had water quality samples collected as part of the domestic well survey were the following:

- 20 Darby Road
- 30 Darby Road

- 1189 Marshall Road
- 6970 Highway 93
- 7062 Highway 93

The groundwater quality data collected from these five domestic wells are summarized in the GHD Category 1 Permit-To-Take-Water Renewal Application ï Supporting Hydrologic and Hydrogeologic Study (January 2018) and indicate the following:

- Chloride levels are generally low ranging from less than 1.0 to 27 milligrams per litre (mg/L)
- Sulphate concentrations are low and range from 7.7 to 21 mg/L
- Sodium levels are generally low and range from 2.5 to 14 mg/L (aesthetic objective is 200 mg/L)
- Generally low concentrations of metals with the exception of iron (ranges from less than 100 to 470 mg/L which exceeds the aesthetic objective of 300 mg/L) and aluminum (ranges from less than 5 to 300 mg/L which exceeds the Ontario Drinking Water Quality Standards of 200 mg/L)
- Relatively high levels of magnesium ranging from 4,100 to 15,000 micrograms per litre (Õg/L)
- Manganese for the most part less than 2.0 Õg/L but at 1189 Marshall Road was 29 Õg/L

The groundwater quality data collected from these five domestic wells were typical of glacial deposits groundwater and are consistent with published regional groundwater quality reports (Singer et al 1999 Severn Sound Study) for this area.

The data did not show impact by Teedon Pit operations. In addition, the properties showed no sign of silt in any of the domestic wells at the time of the domestic well survey.

2.4 2018 GHD Domestic Well Survey

GHD, on behalf of CRH Canada Group Inc., completed a domestic well survey in 2018 for the properties within a 1 kilometre (km) radius of the Teedon Pit. This domestic well survey also included properties with historical water well complaints beyond the 1 km radius. The study area included 78 properties along Baseline Road South, Carpenter Sideroad, Darby Road, French Road, Highway 93, McMann Sideroad, Marshall Road, Stamp Sideroad, and Wood Road.

The MECP usually requires a domestic well survey to include properties within a 500 m radius of the proposed water taking location. The study area for this domestic well survey was significantly larger than the 500 m radius requirement by MECP.

Each property that had a house on the lot was visited by GHD staff between March 27 and April 12, 2018 and was asked to participate in answering a few questions regarding domestic well water usage or quality/quantity issues. Of the 78 properties visited, 38 completed the domestic well survey form with the GHD representative.

Based on the completed domestic well survey forms, water well records and previously completed water well surveys, a total of 55 wells were identified and assessed within the study area.

Assessment of Water Quantity

The identified wells were categorized as shallow and deep, with the well classified as shallow if less than 20 m and deep if more than 20 m for the purpose of this evaluation.

To place the quantity assessment into context and determine potential interference effects, historical pumping test and hydraulic monitoring data were evaluated as described below:

- A pumping test was conducted in March 2010 by Alpha in the on-Site water supply well PW1-09 (depth of 69.3 m) at a rate of 950 litres per minute (L/min). The cone of influence associated with the pumping test only extended 300 m with a maximum drawdown of 0.75 m measured in the nearest domestic well, which is also a deep well (57 m).
- In addition to the 2010 pumping test, the historical hydraulic monitoring data collected since 2009 have shown that only the deep domestic wells within 300 m of the Site could be potentially affected by operating PW1-09. Historically, water levels in shallow wells have not responded to pumping of PW1-09.

The locations of the 55 wells identified within the study area were compared to the 300 m cone of influence created by operating PW1-09 (as identified in the March 2010 pumping test data). Based on this, it was determined that:

- Only 10 wells were within the 300 m cone of influence.
- Of the 10 wells, only 4 of the wells are deep (>20 m) and could potentially be affected by operating PW1-09.
- The 4 deep wells had available drawdowns of 58 m, 38 m, 15 m and 37 m.
- A well located approximately 200 m east of PW1-09 that experienced a maximum of 0.75 m drawdown during the 2010 pumping test and less than 0.5 m of drawdown during regular operation of PW1-09. This is insignificant given the large available drawdown in the well.

Therefore, it was concluded that it is highly unlikely that operation of PW1-09 would result in water quantity interference effects in any nearby domestic wells.

Assessment of Water Quality

Eleven of the 38 residents who completed the survey reported silt issues in their wells.

The following hydrogeological factor is important in the evaluation of silt issues in domestic wells in the area:

- A thick section of aquitard material (primarily fine-grained deposits ï Local Aquitard) underlie the aggregate washing operations (Sump Pond and Silt Ponds) providing a low permeability layer of protection to the deeper aquifer.

The presence of the Local Aquitard isolates the aggregate washing operations from the deeper aquifer.

Furthermore, the silt issue complaints were already assessed by Alpha in May 2015 which concluded that silt in the domestic wells was not associated with the aggregate washing operations at the Teedon Pit. The MECP concurred with the review of the silt issue complaints and concluded that the silt issue in the domestic wells was not related to aggregate washing at the Teedon Pit. GHD concurs with both assessments.

2.5 Additional Investigations and Assessments

MECP and Ontario Geologic Survey (OGS) Involvement

Dufferin has been proactive with notifying and involving the MECP of activities occurring at the Site. The MECP and OGS were invited to observe the installation of new monitoring wells at the Site in March 2018. Dufferin and GHD have also shared geologic information from the new wells and boreholes with OGS and worked alongside OGS to confirm the Quaternary geology in the area of the Site.

Sump Pond Bank Inspections

In addition, representatives from MECP, Dufferin, GHD, and Anthony Goodban from Goodban Ecological Consulting Inc. have visited the aggregate washing operations at the Teedon Pit on a few occasions and found no evidence of silt emanating from the banks of the Sump Pond.

Site Hydrogeologic Conceptual Model and Estimated Groundwater Travel Time

The additional hydrogeologic data collected in 2018 were evaluated together with the existing data and were used to formulate a hydrogeologic conceptual model.

A three-dimensional diagram of the hydrogeologic conceptual model is provided in Attachment B.

Based on the hydrogeologic conceptual model, it would take approximately 19.5 to 34 years for water leaking from the Sump and Silt Ponds to travel vertically through the Local Aquitard and then horizontally through the underlying Upper Aquifer to reach the nearest domestic well. This would be the travel time for groundwater to move through the subsurface. Silt cannot move with groundwater as groundwater travels from one point to another.

3. Conclusions

Past claims by a small number of nearby residents to the water quality (silt) in their domestic wells as being caused by aggregate washing operations has been investigated extensively and were determined to be unfounded. The MECP has attributed the domestic well quality issues to the silty nature of the shallow overburden and/or poor well maintenance.

As stated in Section 7 of the Hydrogeological Assessment ï Location of the Water Table for the Teedon Pit Extension:

> *Since extraction will remain 1.5 m above the established groundwater table, there will be no impact to private wells or groundwater resources.*

Based on the significant number of historical and recent investigations and assessments, it is concluded by GHD that CRH Canada Group Inc. will not have any negative impacts on neighboring wells as a result of operation of the Teedon Pit or Teedon Pit Extension.

Should you have any questions, please do not hesitate to contact me.

Sincerely,

GHD

Gary I. Lagos, M.Sc., P. Geo.

EM/ev/3

Encl.

cc: Kevin Mitchell, CRH Canada Group Inc.
Brian Zeman, MHBC

Attachment A

Ministry of the Environment and Climate Change

Central Region Office
Technical Support Section
Water Resources Unit

5775 Yonge Street
8th Floor
North York ON M2M 4J1

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Fax: 416-325-6347

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

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Tél: (416) 326-6700
Téléc: (416) 325-6347

November 23, 2015

Robert E. Graham
Cedarhurst Quarries & Crushing Limited
3300 King Vaughan Townline,
Post Office Box 250
King, Ontario, L7B 1B2

Dear Mr. Graham

The Ministry of Environment and Climate Change (MOECC) has reviewed the three water well interference complaints (Janet Irvine, Bonnie Pauze/Jake Pigeon, and Peter Anderson) regarding the Permit to Take Water # 4317-87CNZN (Permit) for Cedarhurst Quarries & Crushing Limited (Permit Holder) at the Teedon Pit, 90 Darby Road, Tiny Township (Teedon Pit).

I have concluded the following:

- I agree that when issuing the latest Permit, the MOECC should have kept the condition that required monitoring the surface elevation of the wash pond that was in the original 2008 Permit. I am requesting that Cedarhurst Quarries & Crushing Limited recommence with this type of monitoring effective immediately as outlined below in bullets *i* and *ii*, and provide the MOECC a response indicating your agreement to conduct said monitoring. The MOECC would also advise you that any requests to renew or amend the Permit will reinstate this condition.
  - i. *Prior to water being taken from the Wash Pond each year, the Permit Holder shall establish a staff gauge in the Wash Pond and determine the elevation of the staff gauge. The Permit Holder shall measure and record the Wash Pond water level at the start and end of each day on which taking occurs.*
  - ii. *If, during the year of operation, the elevation of the staff gauge is changed, the Permit Holder shall determine the new elevation.*

- The potential violations of the Permit regarding notification of well interference complaints have been forwarded to the local environmental officer who is planning on conducting a Permit inspection of the Teedon Pit in the near future.

- I believe that there have been sufficient hydrogeological investigations completed on-site to warrant the issuance of the Permit.

- I disagree with Mr. Ruland's conceptual model that silt from the wash pond is affecting local wells. It is not possible for silt to flow through a silt, sand and gravel aquifer as a silt plume as Mr. Ruland has proposed.

- I do not believe that the water well impacts of the three water well interference complainants are due to the water takings associated with the Permit for the Teedon Pit.

I have written separate letters to each of the complainants stating my above findings as well as commenting on their individual well issues. A copy of each of these letters is attached to this letter.

Should you have any questions, please do not hesitate to contact myself at (416) 325-7487 or Mr. Mihran Aslanyan, who will be taking over this file, at (416) 326-4418.

Sincerely,

Christopher Munro

Christopher R. Munro, M.Sc.Eng., P.Eng.
Geological Engineer / Hydrogeologist

cc. Helen Zhang, Supervisor, Water Unit, Technical Support Section, MOECC
Mihran Aslanyan, Hydrogeologist, Water Unit, Technical Support Section, MOECC
Greg Athron, Environmental Officer, Barrie District, MOECC
Ross Campbell, Alpha Environmental Services
Prabin Sharma, Aggregates Technical Intern, MNRF
Shawn Persaud, Manager of Planning & Development, Township of Tiny

Attachments: Letters to water well interference complainants (Janet Irvine, Bonnie Pauze/Jake Pigeon, and Peter Anderson)

Ministry of the Environment and Climate Change

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Tél: (416) 326-6700
Téléc: (416) 325-6347

November 23, 2015

Mrs. Janet Irvine
7062 Highway 93
Tiny Township, Ontario
L0K 2E1

Dear Ms. Irvine

The Ministry of Environment and Climate Change (MOECC) has reviewed your water well interference complaint regarding the Permit to Take Water # 4317-87CNZN (Permit) for Cedarhurst Quarries & Crushing Limited (Permit Holder) at the Teedoh Pit, 90 Darby Road, Tiny Township (Teedon Pit). In response to your complaint a site visit was conducted on June 30, 2015, and the Permit Holder's hydrogeologist, Ross Campbell, produced a water well assessment report dated August 2015. Acting on Mrs. Pauze and Mr. Pigeon's behalf, hydrogeologist, Wilf Ruland, conducted his own assessment and presented a report on October 20, 2015. In response, Mr. Campbell, produced another report responding to Mr. Ruland's report on November 5, 2015.

I have reviewed the above noted reports as well as the documentation within the file the MOECC has for this Permit and conclude the following:

- I agree that when issuing the latest Permit in 2010, the MOECC should have kept the condition that required monitoring the surface elevation of the wash pond that was in the original 2008 Permit. I am requesting that the Permit Holder recommence with this type of monitoring and recommend that upon any requests to renew or amend the Permit that this condition be reinstated.

- The potential violations of the Permit regarding notification of well interference complaints have been forwarded to the MOECC's local environmental officer who is planning on conducting a Permit inspection of the Teedon Pit in the near future.

- I believe that sufficient hydrogeological investigations were completed on-site to warrant the issuance of the Permit when it was issued in 2010.

- I disagree with Mr. Ruland's conceptual model that silt from the wash pond is affecting local wells, including your well. It is not possible for silt to flow through a silt, sand and gravel aquifer as a silt plume as Mr. Ruland has proposed.

- I do not believe that your water well impacts are due to the water takings associated with the Permit for the Teedon Pit.

During the site visit, you showed us the sediment that was collecting on the metal filter of your hot water tank and in the toilet tank. This material did not look like the silt/clay material of Mrs. Pauze. Mr. Campbell's water quality sample resulted in no detected total suspended solids or turbidity, iron related bacteria were present, and a background bacteria count of 1000 CFU/100 mL.

It is clear from the reported bacteria level that the well is contaminated with biological material that is likely due to construction of your well at surface. The top of your well is only about 2 inches above ground surface and the well cap has an open hole on the centre of it which is designed for piping to exit; however there is no pipe or other plug sealing this hole. The wellhead has a large overturned metal bowl shaped container loosely covering it. At the present your well is vulnerable to insects, vermin, horse manure runoff, and foreign mater entering your well through the top of the well.

The materials on your filter and toilet tank are likely from either material falling into your well from the hole in your well cap or from the scaling of the inside of the well casing.

I recommend that you hire a licenced water well technician to raise the height of your well, to install a protective well cap, and inspect/disinfect/clean the inside of the well casing. Should you have any questions, please do not hesitate to contact myself at (416) 325-7487 or Mr. Mihran Aslanyan, who will be taking over this file, at (416) 326-4418.

Sincerely,

Christopher Munro

Christopher R. Munro, M.Sc.Eng., P.Eng.
Geological Engineer / Hydrogeologist

cc. Helen Zhang, Supervisor, Water Unit, Technical Support Section, MOECC
Mihran Aslanyan, Hydrogeologist, Water Unit, Technical Support Section, MOECC
Greg Athron, Environmental Officer, Barrie District, MOECC
Robert E. Graham, Permit Holder, Cedarhurst Quarries & Crushing Limited
Ross Campbell, Alpha Environmental Services
Prabin Sharma, Aggregates Technical Intern, MNRF
Shawn Persaud, Manager of Planning & Development, Township of Tiny

Ministry of the Environment and Climate Change

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Téléc: (416) 325-6347

Ontario

November 23, 2015

Bonnie Pauze and Jake Pigeon
1189 Marshall Road
PO Box 1262
Tiny Township, Ontario
L0L 2J0

Dear Mrs. Pauze and Mr. Pigeon

The Ministry of Environment and Climate Change (MOECC) has reviewed your water well interference complaint regarding the Permit to Take Water # 4317-87CNZN (Permit) for Cedarhurst Quarries & Crushing Limited (Permit Holder) at the Teedon Pit, 90 Darby Road, Tiny Township (Teedon Pit). In response to your complaint a site visit was conducted on June 30, 2015, and the Permit Holder's hydrogeologist, Ross Campbell, produced a water well assessment report dated August 2015. Your hydrogeologist, Wilf Ruland, conducted his own assessment and presented a report on October 20, 2015. In response, Mr. Campbell, produced another report responding to Mr. Ruland's report on November 5, 2015.

I have reviewed the above noted reports as well as the documentation within the file the MOECC has for this Permit and conclude the following:

- I agree that when issuing the latest Permit in 2010, the MOECC should have kept the condition that required monitoring the surface elevation of the wash pond that was in the original 2008 Permit. I am requesting that the Permit Holder recommence with this type of monitoring and recommend that upon any requests to renew or amend the Permit that this condition be reinstated.

- The potential violations of the Permit regarding notification of well interference complaints have been forwarded to the MOECC's local environmental officer who is planning on conducting a Permit inspection of the Teedon Pit in the near future.

- I believe that sufficient hydrogeological investigations were completed on-site to warrant the issuance of the Permit when it was issued in 2010.

- I disagree with Mr. Ruland's conceptual model that silt from the wash pond is affecting local wells, including your well. It is not possible for silt to flow through a silt, sand and gravel aquifer as a silt plume as Mr. Ruland has proposed.

- I do not believe that your water well impacts are due to the water takings associated with the Permit for the Teedon Pit.

At the time of the site visit, it is clear that there is a silt issue with the well water at your house. I believe the silt issues with the house well and barn well are due to well construction and improper screen design. I cannot determine why the problem started in 2009; however, wells do deteriorate with age. My concern with the house well is that the silt that it is producing is likely coming from around the well screen (if a well screen is even present) and creating a void. With the house situated within a few metres of the well, I am concerned that this void may cause land subsidence that may damage or structurally compromise the house.

I strongly recommend that you hire a licensed well contractor and/or Professional Engineer/Professional Geoscientist to investigate your wells and that the appropriate actions be taken ensure that your wells stop discharging silt. Alternately, your current wells could be abandoned and a new well(s) be constructed.

Should you have any questions, please do not hesitate to contact myself at (416) 325-7487 or Mr. Mihran Aslanyan, who will be taking over this file, at (416) 326-4418.

Sincerely,

Christopher R. Munro, M.Sc.Eng., P.Eng.
Geological Engineer / Hydrogeologist

cc. Helen Zhang, Supervisor, Water Unit, Technical Support Section, MOECC
Mihran Aslanyan, Hydrogeologist, Water Unit, Technical Support Section, MOECC
Greg Athron, Environmental Officer, Barrie District, MOECC
Robert E. Graham, Permit Holder, Cedarhurst Quarries & Crushing Limited
Ross Campbell, Alpha Environmental Services
Prabin Sharma, Aggregates Technical Intern, MNRF
Shawn Persaud, Manager of Planning & Development, Township of Tiny

Ministry of the Environment and Climate Change

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Ontario

November 23, 2015

Mr. Peter Anderson
6970 Highway 93
Tiny Township, Ontario
L0K 2E1

Dear Mr. Anderson

The Ministry of Environment and Climate Change (MOECC) has reviewed your water well interference complaint regarding the Permit to Take Water # 4317-87CNZN (Permit) for Cedarhurst Quarries & Crushing Limited (Permit Holder) at the Teedon Pit, 90 Darby Road, Tiny Township (Teedon Pit). In response to your complaint a site visit was conducted on June 30, 2015, and the Permit Holder's hydrogeologist, Ross Campbell, produced a water well assessment report dated August 2015. Acting on Mrs. Pauze and Mr. Pigeon's behalf, hydrogeologist, Wilf Ruland, conducted his own assessment and presented a report on October 20, 2015. In response, Mr. Campbell, produced another report responding to Mr. Ruland's report on November 5, 2015.

I have reviewed the above noted reports as well as the documentation within the file the MOECC has for this Permit and conclude the following:

- I agree that when issuing the latest Permit in 2010, the MOECC should have kept the condition that required monitoring the surface elevation of the wash pond that was in the original 2008 Permit. I am requesting that the Permit Holder recommence with this type of monitoring and recommend that upon any requests to renew or amend the Permit that this condition be reinstated.

- The potential violations of the Permit regarding notification of well interference complaints have been forwarded to the MOECC's local environmental officer who is planning on conducting a Permit inspection of the Teedon Pit in the near future.

- I believe that sufficient hydrogeological investigations were completed on-site to warrant the issuance of the Permit when it was issued in 2010.

- I disagree with Mr. Ruland's conceptual model that silt from the wash pond is affecting local wells, including your well. It is not possible for silt to flow through a silt, sand and gravel aquifer as a silt plume as Mr. Ruland has proposed.

- I do not believe that your water well impacts are due to the water takings associated with the Permit for the Teedon Pit.

Your well is a drilled well situated with a well pit, likely an old dug well, therefore the well head is not accessible and is located below ground. Mr. Campbell's water quality sample resulted in no detected total suspended solids or turbidity, and no bacteria issues. At the time of water quality sampling there appears to be no water quality issues.

Wells that are installed in well pits can be susceptible to being flooded and material can enter the well through the top of well at these times or even around the outside of the drilled well casing if an appropriate seal is not in place. I recommend that you hire a licenced water well technician to inspect your well and to potentially raise the height of your well to above ground level, fill in the well pit with low permeable material to create a good seal from surface water, and to install a protective well cap.

Should you have any questions, please do not hesitate to contact myself at (416) 325-7487 or Mr. Mihran Aslanyan, who will be taking over this file, at (416) 326-4418.

Sincerely,

Christopher Munro

Christopher R. Munro, M.Sc.Eng., P.Eng.
Geological Engineer / Hydrogeologist

cc. Helen Zhang, Supervisor, Water Unit, Technical Support Section, MOECC
Mihran Aslanyan, Hydrogeologist, Water Unit, Technical Support Section, MOECC
Greg Athron, Environmental Officer, Barrie District, MOECC
Robert E. Graham, Permit Holder, Cedarhurst Quarries & Crushing Limited
Ross Campbell, Alpha Environmental Services
Prabin Sharma, Aggregates Technical Intern, MNRF
Shawn Persaud, Manager of Planning & Development, Township of Tiny

Attachment B

Teedon Pit Hydrogeologic Model/Pit Operation

Upper Aquifer

Hydraulic Conductivity of Upper Aquifer

1x10^{-2} cm/sec

Horizontal groundwater flow velocity through Upper Aquifer

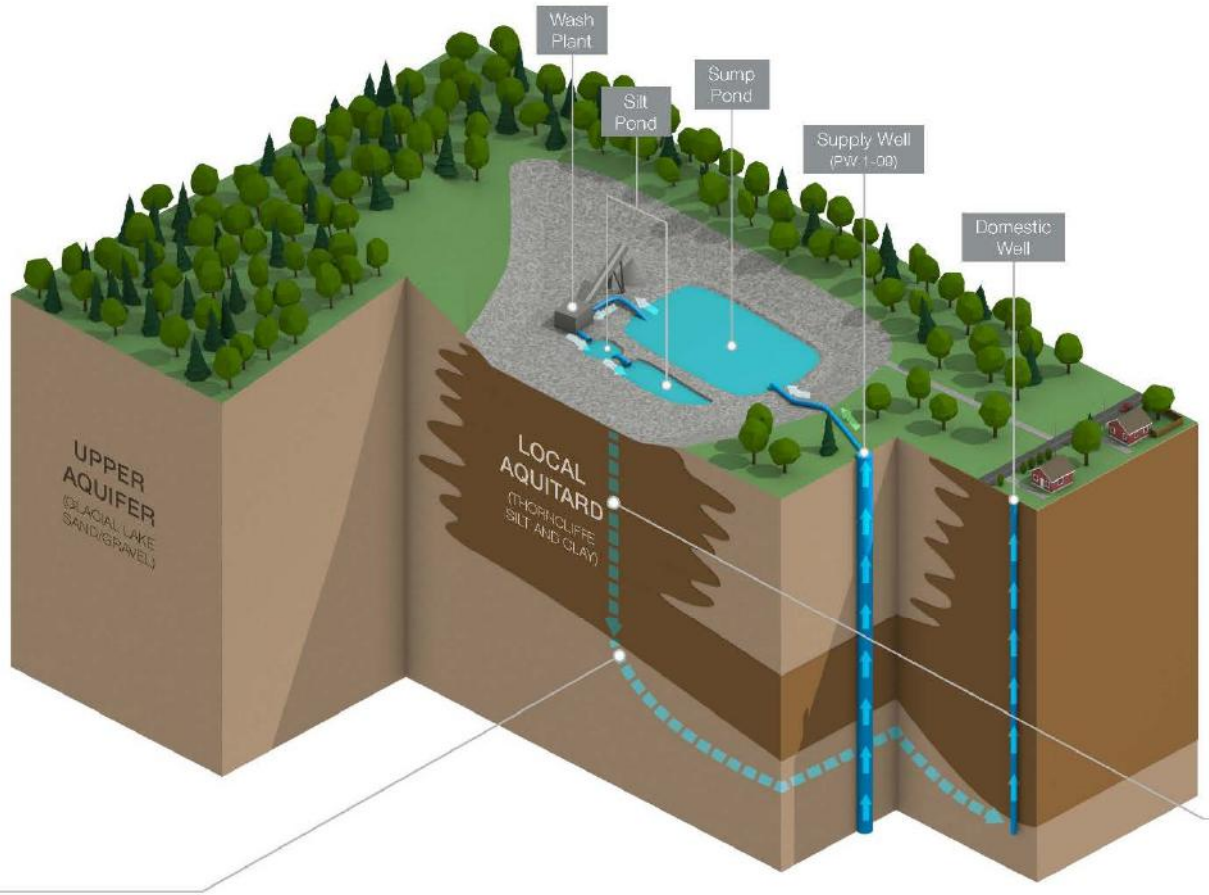
53 to 21m/year

Distance from Sump Pond to nearest Domestic Well

500m

Travel time of groundwater through the Upper Aquifer from the Sump Pond following travel through Local Aquitard to nearest Domestic Well

9.5 to 24 years



Local Aquitard

Hydraulic Conductivity of Local Aquitard

1x10^{-5} cm/sec

Vertical groundwater flow velocity through Local Aquitard beneath Sump Pond

3m/year

Thickness of Local Aquitard beneath Pond

30m

Vertical travel time of groundwater through Local Aquitard from bottom of Sump Pond to Upper Aquifer

10 years

Attachment **3**

September 23, 2019 Reference No. 11155365

Ms. Jessica Ferri
CRH Canada Group Inc.
2300 Steeles Avenue West, 4th Floor
Concord, Ontario
L4K 5X6

Dear Ms. Ferri:

Re: Response to Hydrogeological Comments #1, #2, and #3f
Letter of Objection to an Application for a Category 3 Class A Licence Under the Aggregate Resources Act ï North 1/2 of Lot 80, Concession 1, W.P.R & Part of Original Road Allowance between Lots 80 and 81, Concession 1, W.P.R, Township of Tiny, County of Simcoe (Dufferin Aggregates, a division of CRH Canada Group Inc.)

1. Introduction

As requested, GHD has prepared the following responses to hydrogeological comments #1, #2, and #3f with regards to the Dufferin Aggregates (Dufferin), a division of CRH Canada Group Inc. Teedon Pit Extension (Site) located on the North 1/2 of Lot 80, Concession 1, W.P.R and Part of the original road allowance between Lot 80 and 81, Concession 1, W.P.R, Township of Tiny, County of Simcoe, Ontario.

During the notification and consultation period in regards to the proposed Teedon Pit Extension, comments were provided by the Township of Tiny to CRH Canada Group Inc. on March 25, 2019. Responses to the comments were submitted by CRH Canada Group Inc. to the Township of Tiny on June 20, 2019.

During a recent meeting between the Township of Tiny (Township), R.J. Burnside & Associates, CRH Canada Group Inc. and MHBC on September 12, 2019, it was requested by the Township of Tiny that the responses and supporting information be provided for the hydrogeological comments #1, #2, and #3f.

2. Comment #1

Township's March 25, 2019 Comment

The hydrogeological assessment completed by GHD does provide additional information on the geology in the vicinity of the sump pond/wash pond, however there is no discussion on how water levels in the ponds relate to levels in the local aquitard, the Newmarket Till, and the Upper Thorncliffe.

Dufferin's June 20, 2019 Response

The sump and wash ponds are located on the adjacent Teedon Pit. Discussion on how the ponds relate to the geology is not related to the pit extension application. For reference, we have included an electronic copy of the report prepared by GHD for the Teedon Pit titled "Category 1 Permit-To-Take-Water Renewal Application ï Supporting Hydrologic and Hydrogeologic Study".

GHD Response

Additional investigations were completed in 2018 in the vicinity of the Sump Pond. Four additional boreholes (BH1-18 to BH4-18) and three additional monitoring wells (MW6-18, MW6R-18 and MW7-18) were completed around the perimeter of the Sump Pond to provide additional stratigraphic information on the subsurface geology. Each of the new monitoring well locations, existing monitoring well MW1, and the Sump Pond were each equipped with dataloggers to measure the groundwater elevations.

The Site Hydrogeologic Cross-Sections as presented in the Hydrogeological Assessment ï Location of Water Table for the Teedon Pit Extension, which have incorporated all the 2018 subsurface investigation stratigraphic data, are presented herein as Figures 1 to 3. The hydrogeologic cross-sections have been updated to include the most recent groundwater elevation data from July 18, 2019.

Hydrogeologic cross-section A-A' and B-B' each show the relative location and completion depth of the Sump Pond compared to nearby monitoring wells and boreholes. Cross-sections A-A' and B-B' each show the Sump Pond and nearby shallow monitoring wells (MW1 and MW7-18) and boreholes (BH2-18 and BH3-18) are all completed within the Local Aquitard Unit. Deeper monitoring wells in the vicinity of the Sump Pond (MW6-18 and MW6R-18) are both completed within the Upper Aquifer Unit, specifically the Middle Thorncliffe Unit.

The monitoring wells completed in the Local Aquitard Unit (MW1 and MW7-18) all have similar elevations to the Sump Pond. The Sump Pond water elevation was about 263.8 on July 18, 2019 and the water elevations of the Aquitard Unit wells was approximately 259.5 m AMSL. The deeper monitoring wells completed in the vicinity of the Sump Pond within the Upper Aquifer Units (MW6-18 and MW6R-18) have July 18, 2019 groundwater elevations of approximately 238 m AMSL.

As shown on hydrogeologic cross-section A-A' and B-B', the monitoring wells completed within the Local Aquitard Unit (Thorncliffe Silt and Clay) have groundwater elevations over twenty metres higher than those completed in the Upper Aquifer Unit (Middle Thorncliffe).

There are no monitoring wells completed within the Newmarket Till at the Site because this unit is unsaturated within the Site.

The water table in the vicinity of the Sump Pond is within the Upper Aquifer Unit (Middle Thorncliffe) and found at elevations of approximately 238 m AMSL.

A local zone of saturation exists above the water table where the relatively impervious Local Aquitard interrupts/intercepts percolation causing groundwater saturation. This is not considered the water table for the purpose of establishing the on-Site water table due to its isolated nature and limited function.

Therefore, distinct and separate groundwater elevations exist at the Site in the vicinity of the Sump Pond for the Local Aquitard Unit (Thorncliffe Silt and Clay) versus the Upper Aquifer Unit (Middle Thorncliffe), as demonstrated by the groundwater elevation data and cross-sections.

3. Comment #2

Township's March 25, 2019 Comment

The addition of the new wells improves the understanding of the geology on the existing pit Site and in the proposed pit extension area. The following additional information is required for Burnside to complete their peer review:

- A table showing the dates that the manual water level data was collected and hydrographs showing the results for each well.
- Borehole logs for the wells so that the geology can be seen at each location. Based on the cross-sections, it appears that the sump pond/wash pond is effectively isolated from the underlying aquifer. The borehole logs would assist us with the interpretation of the extent of the silt and clay aquitard.
- A "regional" cross-section that includes the reported depths of the wells reportedly impacted by previous operations at the quarry.

Dufferin's June 20, 2019 Response

Please refer to the GHD report mentioned above as it addresses the requested information.

GHD Response

The manual groundwater elevation data is provided herein in Table 1 for the pumping well, monitoring wells and domestic wells and in Table 2 for the surface water monitoring location. Hydrographs for each of the monitoring locations are provided herein in Attachment A. The hydrographs show not only the manual elevation data but also the transducer data, where available, and precipitation data. All tables and hydrographs have been updated to include data from the most recent monitoring event on July 18, 2019.

Stratigraphic and instrumentation logs are provided in Attachment B for the monitoring wells completed in 2018 (MW5-18, MW6-18, MW6R-18, MW7-18, MW8-18, MW9-18, MW10S-18, and MW10D-18). In addition, the borehole logs are also provided in Attachment B that were completed in 2018 (BH1-18, BH2-18, BH3-18, and BH4-18). Hydrogeologic cross-sections that incorporate all the 2018 monitoring well and borehole stratigraphic data are also provided on Figures 1, 2, and 3.

Hydrogeologic cross-section A-A' which has the superimposed reported depths of the domestic wells which have had complaints are provided in Attachment C. Please note the following for this cross-section:

- The properties are far from the prepared hydrogeologic cross-sectional boundary and are therefore represent approximate conditions.
- Only two of the properties had water well records located (20 Darby and 7062 Hwy 93) while the information for the other properties was obtained from interviews during previous domestic water well surveys.
- Ground surface elevations were approximated from Google Earth imagery.

4. Comment #3f

Township's March 25, 2019 Comment

Testing be completed to evaluate the connection between the existing wash pond and the underlying aquifer. This may require the installation of additional shallow monitoring wells near the wash pond so that the water table can be monitored, and vertical gradients can be calculated. If it is found that the pond has the potential to impact groundwater water quality/quantity, then consideration should be given to the installation of a liner.

Dufferin's June 20, 2019 Response

The testing and monitoring requirements for the wash pond are not related to the Teedon Pit Extension and are subject to the PTTW application process. For reference refer to the GHD report titled "Category 1 Permit-To-Take-Water Renewal Application ï Supporting Hydrologic and Hydrogeologic Study"

GHD Response

As detailed in the Response to Comment #1, the water levels in the Sump Pond are similar to those monitoring wells within the shallower groundwater system and are classified as being within the Local Aquitard Unit, not the water table aquifer (i.e., Upper Aquifer). The Upper Aquifer is generally the source of water supply for the nearby domestic wells and for the aggregate washing operations within the existing Teedon Pit. There is no aggregate washing proposed within the Teedon Pit Extension.

As shown on hydrogeologic cross-section A-A' and B-B', the monitoring wells completed within the Local Aquitard Unit (Thorncliffe Silt and Clay) have groundwater elevations over twenty metres higher than those completed in the Upper Aquifer Unit (Middle Thorncliffe).

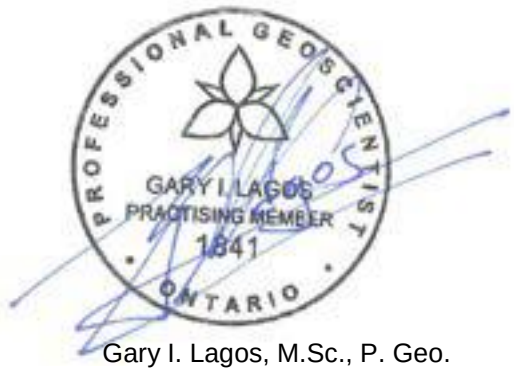
Notwithstanding the above information, vertical hydraulic gradients were calculated in the vicinity of the Sump Pond from the Local Aquitard to the Upper Aquifer Units.

Using the July 18, 2019 groundwater elevation data the vertical hydraulic gradient from the Sump pond within the Local Aquitard Unit to the underlying Aquifer Unit was calculated to be 0.7 downward and serve as evidence for the separation of the Sump Pond and Aquifer Unit.

Should you have any questions, please do not hesitate to contact me.

Sincerely,

GHD

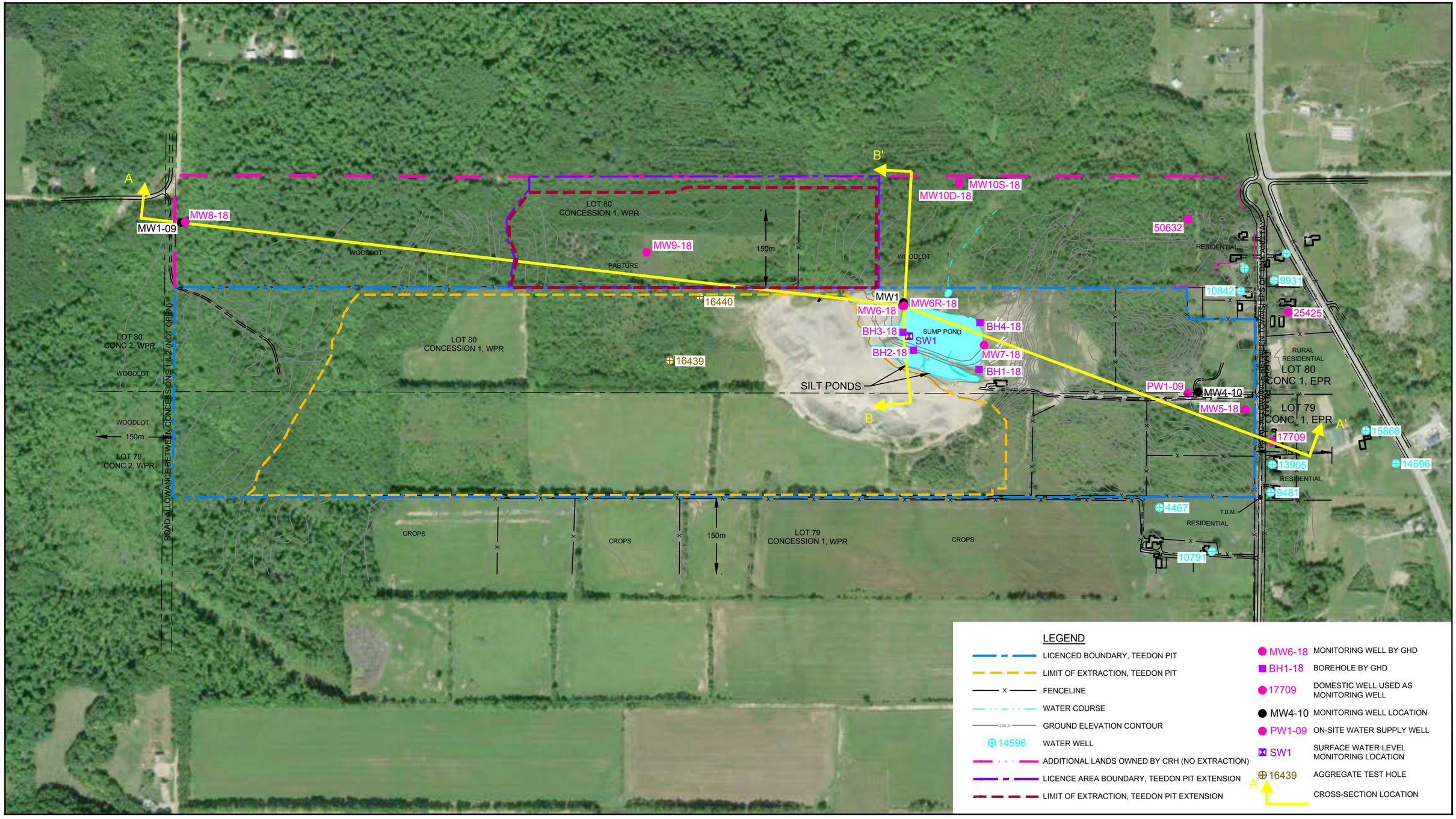


Gary I. Lagos, M.Sc., P. Geo.

EM/ev/2

Encl.

cc: Kevin Mitchell, CRH Canada Group Inc.
Brian Zeman, MHBC



Source: Microsoft Product Screen shot Reprinted with permission from Microsoft Corporation, Aquisition Date 2018, Accessed April, 2018

0 70 140 210m

TEEDON PIT EXTENSION
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

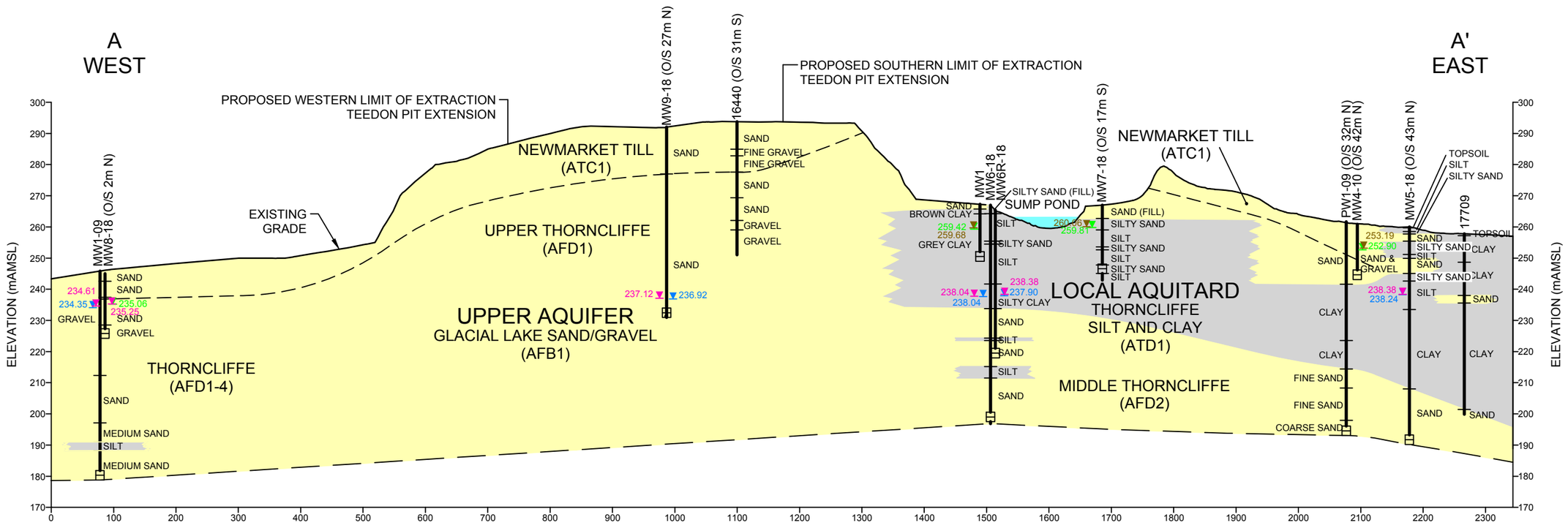
11155365-10

Sept 19, 2019

HYDROGEOLOGIC CROSS-SECTION LOCATIONS

FIGURE 1

CAD File: P:\drawings\11155000s\11155365\11155365-CORR\11155365-10(FERRI001)\11155365-10(FERRI001)GN\11155365-10(FERRI001)GN-WA001.DWG



DISTANCE metres
HORIZONTAL TO VERTICAL EXAGGERATION 5 : 1

LEGEND

- COARSE GRAINED DEPOSITS
- FINE GRAINED DEPOSITS
- 252.90 SHALLOW GROUNDWATER ELEVATION JULY 18, 2019
- 238.24 DEEP GROUNDWATER ELEVATION, JULY 18, 2019
- 238.38 MAXIMUM OBSERVED GROUNDWATER ELEVATION
- 253.19 MAXIMUM OBSERVED SHALLOW AQUITARD GROUNDWATER ELEVATION

LOCAL STRATIGRAPHY AND HYDROSTRATIGRAPHY OBTAINED BY GHD ON BEHALF OF DUFFERIN WAS CORRELATED WITH THE 2017 WORK BY RILEY P. M. MULLIGAN AND ANDY F. BAJC. "QUATERNARY SEDIMENT ARCHITECTURE OF SIMCOE COUNTY, SOUTHERN ONTARIO"
SUMP POND TOPOGRAPHY BY DELPH & JENKINS LIMITED, MAY 2018.

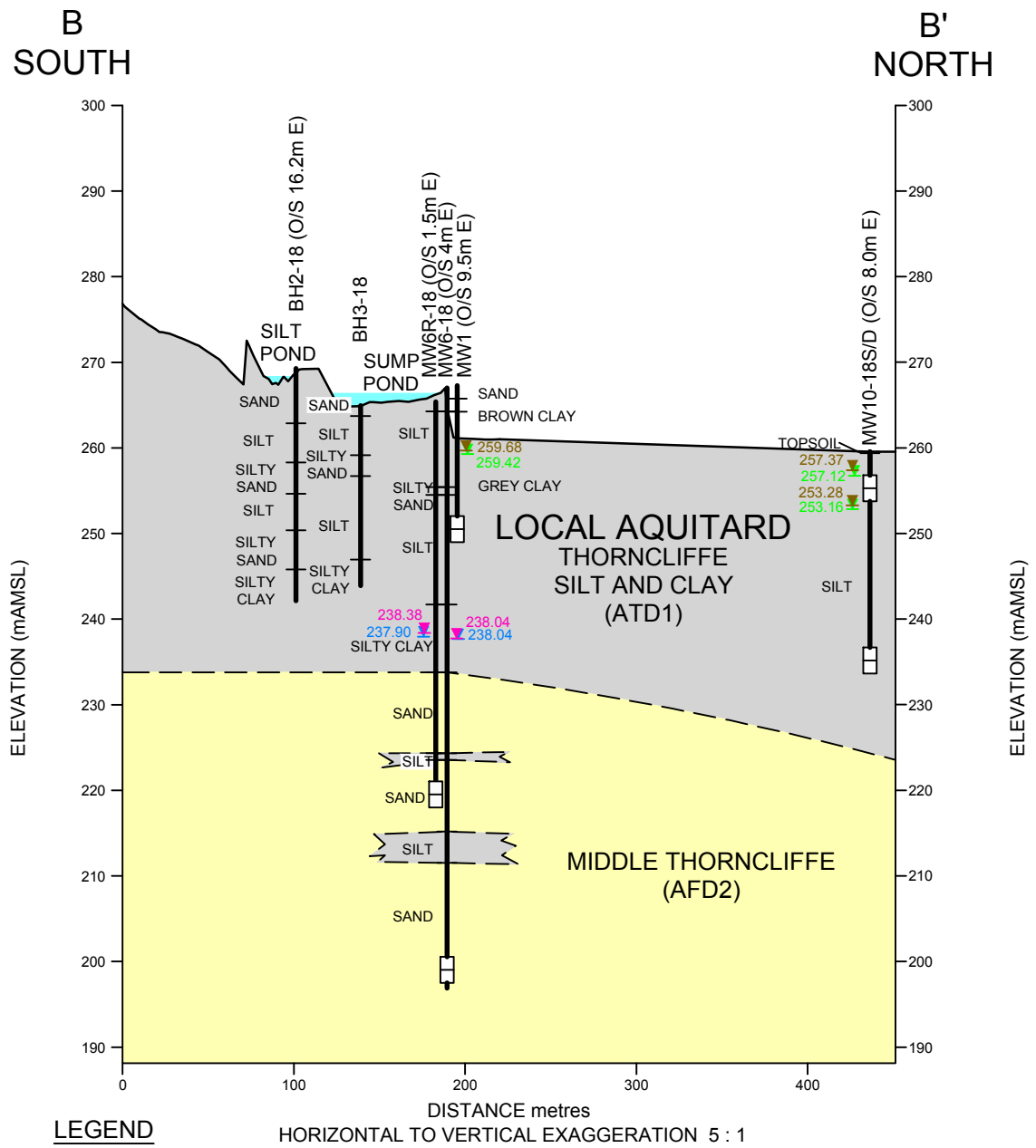
TEEDON PIT EXTENSION
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

Sept 19, 2019

SITE HYDROGEOLOGIC CROSS-SECTION A-A'

FIGURE 2

CAD File: P:\drawings\11155000s\11155365\11155365-CORR\11155365-10(FERRI001)\11155365-10(FERRI001)GN\11155365-10(FERRI001)GN-WA002.DWG



LEGEND

HORIZONTAL TO VERTICAL EXAGGERATION 5 : 1

COARSE GRAINED DEPOSITS

FINE GRAINED DEPOSITS

259.42 SHALLOW GROUNDWATER ELEVATION, JULY 18, 2019

237.90 DEEP GROUNDWATER ELEVATION, JULY 18, 2019

238.38 MAXIMUM OBSERVED GROUNDWATER ELEVATION

259.68 MAXIMUM OBSERVED SHALLOW AQUITARD GROUNDWATER ELEVATION

LOCAL STRATIGRAPHY AND HYDROSTRATIGRAPHY OBTAINED BY GHD ON BEHALF OF DUFFERIN WAS CORRELATED WITH THE 2017 WORK BY RILEY P. M. MULLIGAN AND ANDY F. BAJC. "QUATERNARY SEDIMENT ARCHITECTURE OF SIMCOE COUNTY, SOUTHERN ONTARIO"
SUMP POND TOPOGRAPHY BY DELPH & JENKINS LIMITED, MAY 2018.

TEEDON PIT EXTENSION
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365-10

Sept 19, 2019

SITE HYDROGEOLOGIC CROSS-SECTION B-B'

FIGURE 3

CAD File: P:\drawings\11155000s\11155365\11155365-CORR\11155365-10(FERRI001)\11155365-10(FERRI001)GN\11155365-10(FERRI001)GN-WA003.DWG

Table 1

Historical Manual Groundwater Elevations
Dufferin Teedon Pit
Township of Tiny, County of Simcoe, Ontario

PW1-09			MW1			MW1-09			MW4-10		
GS =	260.00	From Site Plan	GS =	263.00	From Site Plan	GS =	247.50	From Site Plan	GS =	260.00	From Site Plan
GS =	**260.72**	March 15, 2018 Survey	GS =	**267.45**	March 15, 2018 Survey	GS =	**245.45**	From July 19, 2018 Survey	GS =	**260.60**	March 15, 2018 Survey
REF =	260.62	From Nov 1 Inspection	REF =	263.20	From Nov 1 Photo (estimate)	REF =	247.96	From Nov 1 Inspection	REF =	260.82	From Inspection
REF =	**261.32**	March 15, 2018 Survey	REF =	**267.64**	March 15, 2018 Survey	REF =	**246.04**	From July 19, 2018 Survey	REF =	**261.31**	March 15, 2018 Survey
Date/Time	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**
-	-	-	-	-	-	6/3/2009 11:23	11.52	234.53	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	7/7/2009 11:30	8.20	259.44	7/7/2009 13:00	11.60	234.44	-	-	-
7/15/2009 09:00	23.09	238.23	-	-	-	-	-	-	-	-	-
7/20/2009 13:00	23.10	238.22	7/20/2009 16:08	8.31	259.33	7/20/2009 13:35	11.65	234.39	-	-	-
7/29/2009 10:51	23.07	238.25	-	-	-	-	-	-	-	-	-
8/14/2009 13:23	23.05	238.27	8/14/2009 12:42	8.18	259.46	8/14/2009 14:38	11.67	234.37	-	-	-
-	-	-	3/18/2010 10:43	8.22	259.42	3/18/2010 11:23	11.96	234.08	-	-	-
3/22/2010 07:53	23.43	237.89	3/22/2010 8:04	8.24	259.40	3/22/2010 8:36	11.96	234.08	-	-	-
3/30/2010 11:35	23.44	237.88	3/30/2010 12:13	8.22	259.42	3/30/2010 1:23	11.91	234.13	-	-	-
-	-	-	-	-	-	-	-	-	8/4/2010 14:36	8.80	252.51
8/19/2010 13:25	23.50	237.82	-	-	-	8/19/2010 15:00	12.04	234.00	8/19/2010 11:10	8.85	252.46
10/19/2010 12:20	23.58	237.74	10/19/2010 12:50	8.48	259.16	10/19/2010 13:58	12.15	233.90	10/19/2010 12:35	9.98	Not Used
5/12/2011 12:10	23.55	237.77	5/12/2011 12:45	8.27	259.37	5/12/2011 13:42	11.80	234.24	5/12/2011 12:25	8.57	252.74
8/4/2011 14:23	23.43	237.90	8/4/2011 15:08	8.17	259.47	8/4/2011 15:30	11.90	234.14	8/4/2011 14:45	8.44	252.87
10/28/2011 11:54	23.48	237.84	10/28/2011 12:33	8.29	259.35	10/28/2011 13:15	12.05	233.99	10/28/2011 12:17	8.73	252.58
-	-	-	7/30/2012 15:58	8.51	259.13	7/30/2012 16:26	12.15	233.89	7/30/2012 15:38	8.89	252.42
8/23/2012 15:09	30.87	230.45	8/23/2012 14:38	8.44	259.20	8/23/2012 13:00	12.24	233.81	8/23/2012 14:58	9.00	252.32
11/6/2012 11:41	23.80	237.52	11/6/2012 12:10	8.21	259.43	11/6/2012 12:50	12.36	233.69	11/6/2012 11:39	9.18	252.13
6/11/2013 12:25	30.79	230.53	6/11/2013 13:09	8.12	259.52	6/11/2013 14:52	11.84	234.20	6/11/2013 12:47	8.45	252.86
8/23/2014 11:05	23.08	238.24	8/23/2014 10:50	8.36	259.28	8/23/2014 13:20	11.79	234.25	8/23/2014 11:55	8.22	253.09
10/25/2014 10:04	23.16	238.16	10/25/2014 9:49	8.41	259.23	10/25/2014 9:18	11.89	234.15	10/25/2014 10:18	8.41	252.90
3/16/2017 14:20	23.61	237.71	3/16/2017 14:00	8.14	259.50	3/16/2017 15:47	12.03	234.01	3/16/2017 14:10	8.89	252.42
-	-	-	-	-	-	-	-	-	-	-	-
10/5/2017 09:53	30.45	230.87	10/5/2017 10:24	8.06	259.58	10/5/2017 11:45	11.74	234.30	10/5/2017 09:58	8.33	252.98
11/1/2017 11:35	23.15	238.17	11/1/2017 12:35	7.96	259.68	11/1/2017 14:00	11.84	234.20	11/1/2017 12:00	8.49	252.82
4/5/2018 11:44	23.23	238.09	4/5/2018 11:13	8.12	259.52	4/5/2018 11:13	11.78	234.26	4/5/2018 11:13	8.59	252.72
4/20/2018 00:00	23.18	238.14	4/20/2018 10:41	8.08	259.56	4/20/2018 0:00	11.71	234.33	4/20/2018 00:00	8.47	252.84
6/14/2018 13:15	23.03	238.29	6/14/2018 13:47	8.12	259.52	6/14/2018 15:10	11.43	234.61	6/14/2018 13:20	8.15	253.16
6/18/2018 12:21	22.97	238.35	6/18/2018 13:20	8.17	259.47	6/18/2018 17:20	11.48	234.56	6/18/2018 12:14	8.12	253.19
-	-	-	-	-	-	-	-	-	-	-	-
7/19/2018 16:20	30.32	231.00	7/19/2018 12:31	8.28	259.36	7/19/2018 10:14	11.86	234.18	7/19/2018 16:30	8.24	253.07
9/6/2018 14:08	30.25	231.07	9/6/2018 15:19	8.32	259.32	9/6/2018 17:35	11.82	234.22	9/6/2018 14:00	8.50	252.81
-	-	-	-	-	-	10/2/2018 11:10	11.88	234.16	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
10/10/2018 12:15	23.17	238.15	10/10/2018 12:59	8.37	259.27	10/10/2018 16:40	11.94	234.10	10/10/2018 12:05	8.65	252.66
10/30/2018 13:43	30.73	230.59	10/30/2018 13:20	8.34	259.30	10/30/2018 14:30	11.98	234.06	10/30/2018 13:43	8.80	252.51
4/4/2019 15:00	23.40	237.92	4/4/2019 14:35	8.27	259.37	4/4/2019 8:50	12.03	234.01	4/4/2019 15:00	8.89	252.42
7/18/2019 10:12	23.17	238.15	7/18/2019 11:00	8.22	259.42	7/18/2019 9:15	11.69	234.35	7/18/2019 10:12	8.41	252.90

Note: PW1-09 was resurveyed on March 15, 2018. All hydraulic monitoring data has been re-calculated from this survey data.

Note: MW1 was resurveyed on March 15, 2018. All hydraulic monitoring data has been re-calculated from this survey data.

Note: MW1-09 was re-surveyed on July 19, 2018. All hydraulic monitoring data has been re-calculated from this survey data.

Note: MW4-10 was resurveyed on March 15, 2018. All hydraulic monitoring data has been re-calculated from this survey data.

Table 1

Historical Manual Groundwater Elevations
Dufferin Teedon Pit
Township of Tiny, County of Simcoe, Ontario

MW5-18			MW6-18			MW6R-18			MW7-18		
GS =	**256.39**	April 18, 2018 Survey	GS =	**267.60**	April 18, 2018 Survey	GS =	**267.57**	October 11, 2018 Survey	GS =	**266.83**	April 18, 2018 Survey
REF =	**257.19**	April 18, 2018 Survey	REF =	**268.43**	April 18, 2018 Survey	REF =	**268.20**	October 11, 2018 Survey	REF =	**267.56**	April 18, 2018 Survey
Date/Time	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
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Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
4/20/2018 9:02	19.04	238.15	4/20/2018 10:37	18.81	Issue	Not Installed	Not Installed	Not Installed	4/20/2018 10:04	7.66	259.90
6/14/2018 12:15	18.83	238.36	6/14/2018 13:44	11.82	Issue	Not Installed	Not Installed	Not Installed	6/14/2018 13:40	7.50	260.06
6/18/2018 12:01	18.81	238.38	6/18/2018 13:40	11.80	Issue	Not Installed	Not Installed	Not Installed	6/18/2018 13:00	7.54	260.02
-	-	-	6/27/2018 12:00	11.70	Issue	Not Installed	Not Installed	Not Installed	-	-	-
7/19/2018 16:35	19.33	237.86	7/19/2018 13:39	11.55	Issue	Not Installed	Not Installed	Not Installed	7/19/2018 11:06	7.63	259.93
9/6/2018 16:32	19.21	237.98	9/6/2018 15:45	29.43	Issue	Not Installed	Not Installed	Not Installed	9/6/2018 16:22	7.65	259.91
10/2/2018 08:55	19.14	238.05	10/2/2018 09:16	30.70	237.74	Not Installed	Not Installed	Not Installed	-	-	-
10/3/2018 12:08	18.98	238.22	10/3/2018 11:42	30.73	237.70	10/3/2018 11:48	29.82	238.38	-	-	-
10/10/2018 15:40	18.97	238.22	10/10/2018 13:06	30.76	237.67	10/10/2018 13:12	30.24	237.96	10/10/2018 12:33	7.75	259.81
10/30/2018 13:56	19.43	237.76	10/30/2018 13:20	30.68	237.75	10/30/2018 13:20	30.34	237.86	10/30/2018 13:10	7.77	259.79
4/4/2019 15:20	19.20	237.99	4/4/2019 14:35	30.79	237.64	4/4/2019 14:35	30.58	237.63	4/4/2019 14:25	7.83	259.73
7/18/2019 10:12	18.95	238.24	7/18/2019 11:00	30.39	238.04	7/18/2019 11:00	30.30	237.90	7/18/2019 10:52	7.75	259.81

Table 1

Historical Manual Groundwater Elevations
Dufferin Teedon Pit
Township of Tiny, County of Simcoe, Ontario

MW8-18			MW9-18			MW10S-18			MW10D-18		
GS =	**245.35**	From July 19 2018 Survey	GS =	**291.58**	June 13, 2018 Survey	GS =	**259.44**	June 13, 2018 Survey	GS =	**259.55**	June 13, 2018 Survey
REF =	**245.88**	From July 19 2018 Survey	REF =	**292.50**	June 13, 2018 Survey	REF =	**260.42**	June 13, 2018 Survey	REF =	**260.52**	June 13, 2018 Survey
Date/Time	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
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Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
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Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed	Not Installed
6/14/2018 15:09	10.66	235.22	6/14/2018 14:04	55.38	237.12	6/14/2018 14:30	3.05	257.37	6/14/2018 7:24	7.24	253.28
6/18/2018 17:20	10.63	235.25	6/18/2018 14:15	55.39	237.11	6/18/2018 15:00	3.18	257.24	6/18/2018 15:05	7.26	253.26
-	-	-	-	-	-	-	-	-	-	-	-
7/19/2018 10:26	10.78	235.10	7/19/2018 15:55	55.41	237.09	7/19/2018 16:12	3.56	256.86	7/19/2018 16:12	7.47	253.05
9/6/2018 17:30	10.91	234.97	9/6/2018 14:30	55.55	236.95	9/6/2018 14:47	3.66	256.76	9/6/2018 14:50	7.63	252.89
10/2/2018 08:30	10.98	234.91	10/2/2018 09:48	55.61	236.90	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
10/10/2018 16:45	10.65	235.23	10/10/2018 14:37	55.64	236.86	10/10/2018 15:25	3.67	256.75	10/10/2018 15:20	7.67	252.85
10/30/2018 14:30	11.03	234.85	10/30/2018 10:00	55.72	236.78	10/30/2018 11:00	3.55	256.87	10/30/2018 11:00	7.64	252.88
4/4/2019 8:50	11.09	234.79	4/4/2019 10:00	55.93	236.57	4/4/2019 13:50	2.94	257.48	4/4/2019 13:50	7.32	253.20
7/18/2019 9:15	10.82	235.06	7/18/2019 11:32	55.59	236.92	7/18/2019 11:18	3.30	257.12	7/18/2019 11:18	7.36	253.16

Table 1

Historical Manual Groundwater Elevations
Dufferin Teedon Pit
Township of Tiny, County of Simcoe, Ontario

#50632			#25425			#17709		
GS =	260.50	From Site Plan	GS =	**254.00**	From Site Plan	GS =	256.00	From Site Plan
GS =	**260.48**	From July 19 2018 Survey	REF =	**254.50**	Estimated	GS =	**256.73**	From July 19 2018 Survey
REF =	261.05	From Inspection				REF =	256.40	From Inspection
REF =	**261.12**	From July 19 2018 Survey				REF =	**257.27**	From July 19 2018 Survey
Date/Time	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**	**Date/Time**	**Depth to Water (m)**	**Groundwater Elevation (m AMSL)**
No Access	No Access	No Access	6/3/2009 10:00	4.36	250.14	6/3/2009 13:08	19.70	236.70
No Access	No Access	No Access	6/4/2009 14:12	4.37	250.13	-	-	-
No Access	No Access	No Access	7/7/2009 13:34	4.53	249.97	7/7/2009 13:50	19.00	237.40
No Access	No Access	No Access	-	-	-	-	-	-
No Access	No Access	No Access	7/20/2009 14:55	4.63	249.87	7/20/2009 15:10	19.01	237.39
No Access	No Access	No Access	-	-	-	-	-	-
No Access	No Access	No Access	8/14/2009 14:10	4.56	249.94	8/14/2009 13:45	19.06	237.34
No Access	No Access	No Access	3/18/2010 12:25	4.83	249.68	3/18/2010 13:45	19.32	237.08
No Access	No Access	No Access	3/22/2010 9:30	4.85	249.65	3/22/2010 9:09	19.33	237.07
No Access	No Access	No Access	3/30/2010 13:02	4.91	249.59	3/30/2010 12:42	19.36	237.04
No Access	No Access	No Access	-	-	-	-	-	-
8/19/2010 14:13	23.21	237.84	-	-	-	-	-	-
10/19/2010 13:05	28.79	232.26	10/19/2010 14:40	5.28	249.22	10/19/2010 14:58	19.53	236.87
5/12/2011 14:18	26.60	234.45	5/12/2011 14:50	5.33	249.17	5/12/2011 15:08	22.75	233.65
8/4/2011 15:58	23.28	237.77	8/4/2011 16:20	5.28	249.22	8/4/2011 16:33	19.35	237.05
10/28/2011 13:39	23.71	237.34	10/28/2011 13:56	5.06	249.44	10/28/2011 14:10	19.40	237.00
7/30/2012 16:51	24.65	236.40	7/30/2012 17:16	5.36	249.14	7/30/2012 17:30	20.73	235.67
8/23/2012 13:32	24.66	236.40	8/23/2012 13:50	5.48	249.02	8/23/2012 14:19	20.05	236.35
11/6/2012 13:16	23.95	237.10	11/6/2012 13:35	5.36	249.14	11/6/2012 13:48	20.30	236.10
6/11/2013 14:00	23.43	237.62	6/11/2013 13:44	4.71	249.79	6/11/2013 13:27	19.90	236.50
8/23/2014 14:40	22.25	238.81	8/23/2014 12:25	4.75	249.75	8/23/2014 12:15	18.94	237.46
10/25/2014 11:06	22.92	238.13	10/25/2014 10:50	4.88	249.62	10/25/2014 10:39	19.03	237.37
3/16/2017 12:30	24.22	236.83	3/16/2017 13:06	4.63	249.87	3/16/2017 13:30	19.54	236.86
-	-	-	No Access	No Access	No Access	7/14/2017 13:15	18.98	237.42
10/5/2017 11:15	30.45	230.60	No Access	No Access	No Access	10/5/2017 10:50	19.45	236.95
11/1/2017 10:30	26.68	234.37	No Access	No Access	No Access	11/1/2017 11:15	19.17	237.23
4/5/2018 11:13	24.59	236.46	No Access	No Access	No Access	4/5/2018 11:13	19.16	237.24
-	-	-	No Access	No Access	No Access	-	-	-
6/14/2018 14:55	22.77	238.28	No Access	No Access	No Access	No Access	No Access	No Access
6/18/2018 17:00	24.77	236.28	No Access	No Access	No Access	6/18/2018 16:00	18.83	237.57
-	-	-	-	-	-	-	-	-
7/19/2018 16:40	23.55	237.57	No Access	No Access	No Access	7/19/2018 10:00	19.25	238.02
9/6/2018 17:00	28.65	232.47	No Access	No Access	No Access	9/6/2018 16:50	19.40	237.87
-	-	-	No Access	No Access	No Access	-	-	-
-	-	-	-	-	-	-	-	-
10/10/2018 16:20	23.32	237.80	No Access	No Access	No Access	10/10/2018 16:00	19.00	238.27
10/30/2018 14:10	28.76	232.36	No Access	No Access	No Access	10/30/2018 14:02	19.50	237.77
4/4/2019 15:45	23.09	238.03	No Access	No Access	No Access	4/4/2019 15:30	19.35	237.92
7/18/2019 9:45	28.17	232.95	No Access	No Access	No Access	7/18/2019 10:00	19.10	238.17

Note: #50632 was re-surveyed on July 19, 2018. All hydraulic monitoring data has been re-calculated from this survey data.

Note: #17709 was re-surveyed on July 19, 2018. All hydraulic monitoring data has been re-calculated from this survey data.

Table 2

Historical Manual Surface Water Elevations
Dufferin Teedon Pit
Township of Tiny, County of Simcoe, Ontario

	SW1	
GS =	**NA**	
REF =	264.37	Top of Staff Gauge - 2017
REF =	264.60	Top of Staff Gauge - 2018
REF =	**264.59**	Top of 1.0m Elevation - July 19 2018 Survey
REF =	264.85	Top of TBAR - July 19 2018 Survey

Date/Time	Depth to Water (m)	Groundwater Elevation (m AMSL)
8/21/2017	0.20	263.57
8/22/2017	0.22	263.59
8/23/2017	0.23	263.60
8/24/2017	0.25	263.62
8/25/2017	0.31	263.68
8/28/2017	0.37	263.74
8/29/2017	0.41	263.78
8/30/2017	0.49	263.86
8/31/2017	0.55	263.92
9/01/2017	0.60	263.97
9/05/2017	0.59	263.96
9/06/2017	0.49	263.86
9/07/2017	0.44	263.81
9/08/2017	0.38	263.75
9/11/2017	0.33	263.70
9/12/2017	0.27	263.64
9/13/2017	0.21	263.58
9/14/2017	0.26	263.63
9/15/2017	0.30	263.67
9/18/2017	0.24	263.61
9/19/2017	0.24	263.61
9/20/2017	0.21	263.58
9/21/2017	0.21	263.58
9/22/2017	0.30	263.67
9/25/2017	0.20	263.57
9/26/2017	0.21	263.58
9/27/2017	0.22	263.59
9/28/2017	0.16	263.53
9/29/2017	0.16	263.53
10/02/2017	0.16	263.53
10/03/2017	0.12	263.49
10/04/2017	0.17	263.54
10/05/2017	0.14	263.51
10/06/2017	0.15	263.52
10/10/2017	0.13	263.50
10/11/2017	0.19	263.56
10/12/2017	0.14	263.51
10/13/2017	0.19	263.56
10/16/2017	0.18	263.55
10/17/2017	0.18	263.55
10/18/2017	0.11	263.48
10/19/2017	0.18	263.55
10/20/2017	0.17	263.54

Table 2

Historical Manual Surface Water Elevations
Dufferin Teedon Pit
Township of Tiny, County of Simcoe, Ontario

	SW1	
GS =	**NA**	
REF =	264.37	Top of Staff Gauge - 2017
REF =	264.60	Top of Staff Gauge - 2018
REF =	**264.59**	Top of 1.0m Elevation - July 19 2018 Survey
REF =	264.85	Top of TBAR - July 19 2018 Survey

Date/Time	Depth to Water (m)	Groundwater Elevation (m AMSL)
10/23/2017	0.15	263.52
10/24/2017	0.21	263.58
10/25/2017	0.17	263.54
10/26/2017	0.24	263.61
10/27/2017	0.19	263.56
10/30/2017	0.21	263.58
10/31/2017	0.22	263.59
11/01/2017	0.28	263.65
11/02/2017	0.25	263.62
11/03/2017	0.29	263.66
11/06/2017	0.29	263.66
11/07/2017	0.36	263.73
11/08/2017	0.34	263.71
11/09/2017	0.36	263.73
11/13/2017	0.33	263.70
11/14/2017	0.40	263.77
11/16/2017	0.39	263.76
11/17/2017	0.33	263.70
11/20/2017	0.31	263.68
11/21/2017	0.31	263.68
11/22/2017	0.40	263.77
11/23/2017	0.36	263.73
11/24/2017	0.31	263.68
11/27/2017	0.39	263.76
11/28/2017	0.34	263.71
11/29/2017	0.31	263.68
11/30/2017	0.33	263.70
12/01/2017	0.30	263.67
12/04/2017	0.33	263.70
4/20/2018 0:00	Ice on Pond	Ice on Pond
5/7/2018 7:00	0.39	263.99
5/8/2018 12:00	0.37	263.97
5/9/2018 7:00	0.37	263.97
5/10/2018 7:00	0.27	263.87
5/11/2018 7:00	0.22	263.82
5/14/2018 7:00	0.17	263.77
5/15/2018 7:00	0.21	263.81
5/16/2018 7:00	0.15	263.75
5/17/2018 7:00	0.15	263.75
5/18/2018 7:00	0.11	263.71
5/22/2018 7:00	0.17	263.77
5/23/2018 7:00	0.15	263.75
5/24/2018 7:00	0.15	263.75

Table 2

Historical Manual Surface Water Elevations
Dufferin Teedon Pit
Township of Tiny, County of Simcoe, Ontario

	SW1	
GS =	**NA**	
REF =	264.37	Top of Staff Gauge - 2017
REF =	264.60	Top of Staff Gauge - 2018
REF =	**264.59**	Top of 1.0m Elevation - July 19 2018 Survey
REF =	264.85	Top of TBAR - July 19 2018 Survey

Date/Time	Depth to Water (m)	Groundwater Elevation (m AMSL)
5/25/2018 7:00	0.16	263.76
5/28/2018 7:00	0.14	263.74
5/29/2018 0:00	0.16	263.76
5/30/2018 7:00	0.18	263.78
5/31/2018 7:00	0.13	263.73
6/1/2018 7:00	0.17	263.77
6/4/2018 7:00	0.14	263.74
6/5/2018 7:00	0.16	263.76
6/6/2018 7:00	0.10	263.70
6/7/2018 7:00	0.07	263.67
6/8/2018 7:00	0.15	263.75
6/11/2018 7:00	0.16	263.76
6/12/2018 7:00	0.17	263.77
06/13/2018 07:00	0.14	263.74
06/14/2018 07:00	0.17	263.77
06/15/2018 07:00	0.20	263.8
06/18/2018 07:00	0.16	263.76
06/19/2018 00:00	0.10	263.7
06/20/2018 00:00	0.15	263.75
06/21/2018 07:00	0.14	263.74
06/22/2018 00:00	0.13	263.73
06/25/2018 00:00	0.17	263.77
06/26/2018 11:17	0.11	263.71
06/27/2018 00:00	0.17	263.77
06/28/2018 00:00	0.12	263.72
07/03/2018 00:00	0.21	263.81
07/04/2018 00:00	0.15	263.75
07/05/2018 00:00	0.16	263.76
07/06/2018 00:00	0.21	263.81
07/09/2018 00:00	0.17	263.77
07/10/2018 00:00	0.12	263.72
07/11/2018 00:00	0.10	263.7
07/12/2018 00:00	0.12	263.72
07/13/2018 00:00	0.14	263.74
07/16/2018 00:00	0.10	263.7
07/17/2018 00:00	0.08	263.68
07/18/2018 00:00	0.04	263.64
07/19/2018 09:18	0.06	263.65
07/20/2018 00:00	0.10	263.69
07/23/2018 00:00	0.10	263.69
07/24/2018 00:00	0.12	263.71
07/25/2018 00:00	0.13	263.72
07/26/2018 00:00	0.17	263.76

Table 2

Historical Manual Surface Water Elevations
Dufferin Teedon Pit
Township of Tiny, County of Simcoe, Ontario

	SW1	
GS =	**NA**	
REF =	264.37	Top of Staff Gauge - 2017
REF =	264.60	Top of Staff Gauge - 2018
REF =	**264.59**	Top of 1.0m Elevation - July 19 2018 Survey
REF =	264.85	Top of TBAR - July 19 2018 Survey

Date/Time	Depth to Water (m)	Groundwater Elevation (m AMSL)
07/27/2018 00:00	0.13	263.72
07/30/2018 00:00	0.13	263.72
07/31/2018 00:00	0.16	263.75
08/01/2018 00:00	0.11	263.70
08/02/2018 00:00	0.13	263.72
08/03/2018 00:00	0.10	263.69
08/07/2018 00:00	0.12	263.71
08/08/2018 00:00	0.10	263.69
08/09/2018 00:00	0.10	263.69
08/10/2018 00:00	0.11	263.70
08/13/2018 00:00	0.12	263.71
08/14/2018 00:00	0.12	263.71
08/15/2018 00:00	0.12	263.71
08/16/2018 00:00	0.13	263.72
08/17/2018 00:00	0.16	263.75
08/20/2018 00:00	0.19	263.78
08/21/2018 00:00	0.13	263.72
08/22/2018 00:00	0.23	263.82
08/23/2018 00:00	0.17	263.76
08/24/2018 00:00	0.21	263.80
08/27/2018 00:00	0.17	263.76
08/28/2018 00:00	0.27	263.86
08/29/2018 00:00	0.26	263.85
08/30/2018 00:00	0.24	263.83
08/31/2018 00:00	0.20	263.79
09/04/2018 00:00	0.23	263.82
09/05/2018 00:00	0.20	263.79
09/06/2018 00:00	0.10	263.69
09/07/2018 00:00	0.11	263.70
09/10/2018 00:00	0.11	263.70
09/11/2018 00:00	0.05	263.64
09/12/2018 00:00	0.04	263.63
09/13/2018 00:00	0.07	263.66
09/14/2018 00:00	0.09	263.68
09/17/2018 00:00	0.15	263.74
09/18/2018 00:00	0.16	263.75
09/19/2018 00:00	0.16	263.75
09/20/2018 00:00	0.14	263.73
09/21/2018 00:00	0.07	263.66
09/24/2018 00:00	0.13	263.72
09/25/2018 00:00	0.09	263.68
09/26/2018 00:00	0.12	263.71
09/28/2018 00:00	0.16	263.75

Table 2

Historical Manual Surface Water Elevations
Dufferin Teedon Pit
Township of Tiny, County of Simcoe, Ontario

	SW1	
GS =	**NA**	
REF =	264.37	Top of Staff Gauge - 2017
REF =	264.60	Top of Staff Gauge - 2018
REF =	**264.59**	Top of 1.0m Elevation - July 19 2018 Survey
REF =	264.85	Top of TBAR - July 19 2018 Survey

Date/Time	Depth to Water (m)	Groundwater Elevation (m AMSL)
10/01/2018 00:00	0.18	263.77
10/02/2018 00:00	0.15	263.74
10/03/2018 00:00	0.17	263.76
10/04/2018 00:00	0.16	263.75
10/05/2018 00:00	0.15	263.74
10/09/2018 00:00	0.12	263.71
10/10/2018 13:40	0.08	263.67
10/11/2018 00:00	0.10	263.69
10/12/2018 00:00	0.12	263.71
10/15/2018 00:00	0.17	263.76
10/16/2018 00:00	0.12	263.71
10/17/2018 00:00	0.10	263.69
10/18/2018 00:00	0.11	263.70
10/19/2018 00:00	0.12	263.71
10/22/2018 00:00	0.14	263.73
10/23/2018 00:00	0.15	263.74
10/24/2018 00:00	0.17	263.76
10/25/2018 00:00	0.14	263.73
10/26/2018 00:00	0.16	263.75
10/29/2018 00:00	0.19	263.78
10/30/2018 13:35	0.10	263.69
10/31/2018 00:00	0.17	263.76
11/01/2018 00:00	0.16	263.75
11/02/2018 00:00	0.21	263.80
11/05/2018 00:00	0.21	263.80
11/06/2018 00:00	0.21	263.80
11/07/2018 00:00	0.19	263.78
11/08/2018 00:00	0.16	263.75
11/09/2018 00:00	0.20	263.79
11/12/2018 00:00	0.21	263.80
11/13/2018 00:00	0.19	263.78
11/14/2018 00:00	0.18	263.77
11/15/2018 00:00	0.19	263.78
11/16/2018 00:00	0.19	263.78
11/19/2018 00:00	0.24	263.83
11/23/2018 00:00	0.23	263.82
11/30/2018 00:00	0.24	263.83
12/03/2018 00:00	0.29	263.88
12/04/2018 00:00	0.29	263.88
12/05/2018 00:00	0.28	263.87
12/06/2018 00:00	0.27	263.86
12/10/2018 00:00	0.24	263.83
12/11/2018 00:00	0.20	263.79

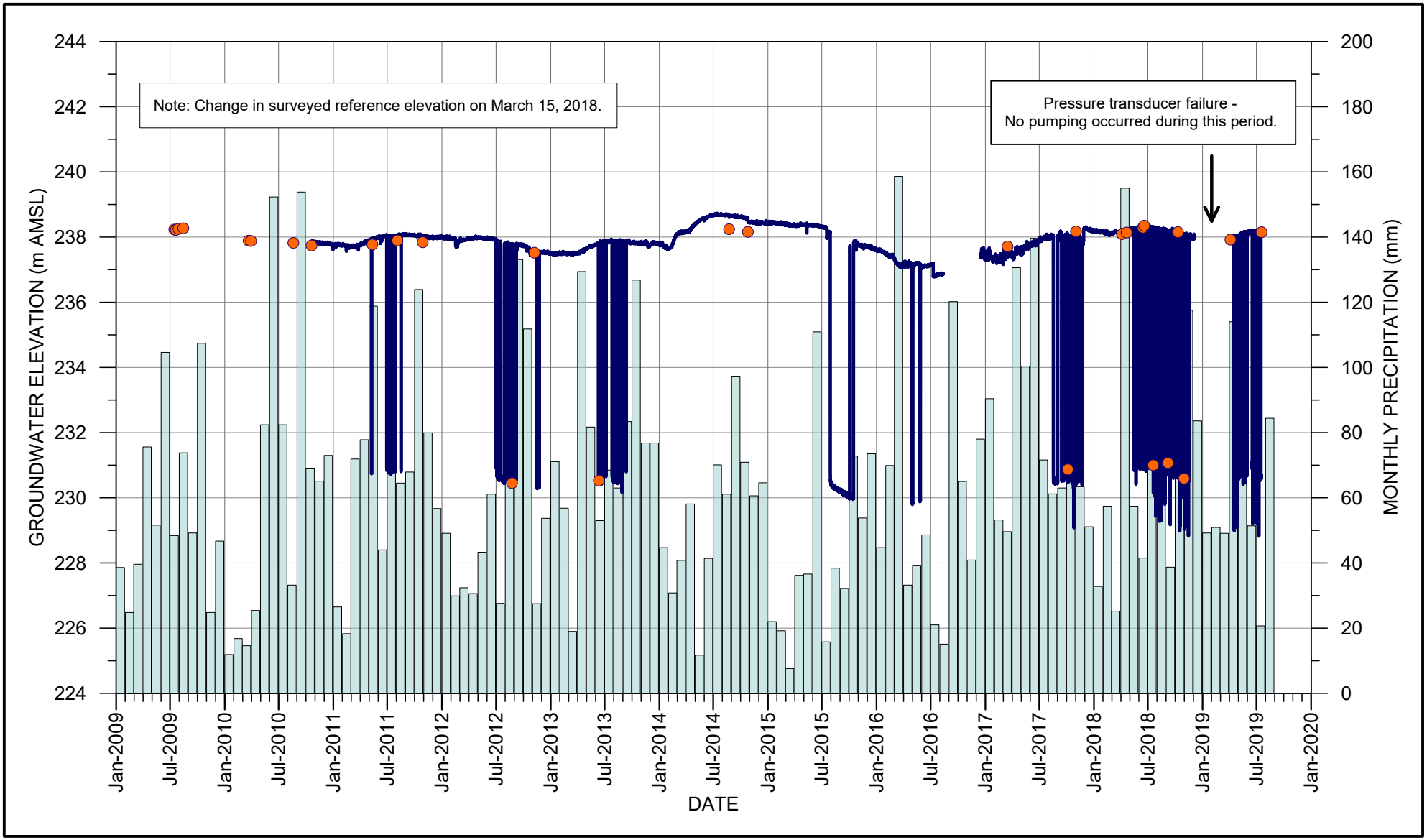
Table 2

Historical Manual Surface Water Elevations
Dufferin Teedon Pit
Township of Tiny, County of Simcoe, Ontario

	SW1	
GS =	**NA**	
REF =	264.37	Top of Staff Gauge - 2017
REF =	264.60	Top of Staff Gauge - 2018
REF =	**264.59**	Top of 1.0m Elevation - July 19 2018 Survey
REF =	264.85	Top of TBAR - July 19 2018 Survey

Date/Time	Depth to Water (m)	Groundwater Elevation (m AMSL)
12/12/2018 00:00	0.20	263.79
12/13/2018 00:00	0.18	263.77
4/4/2019 14:45	0.39	263.98
7/18/2019 10:45	0.16	263.75

Attachment A



PW1-09 Transducer
PW1-09 Manual
Precipitation

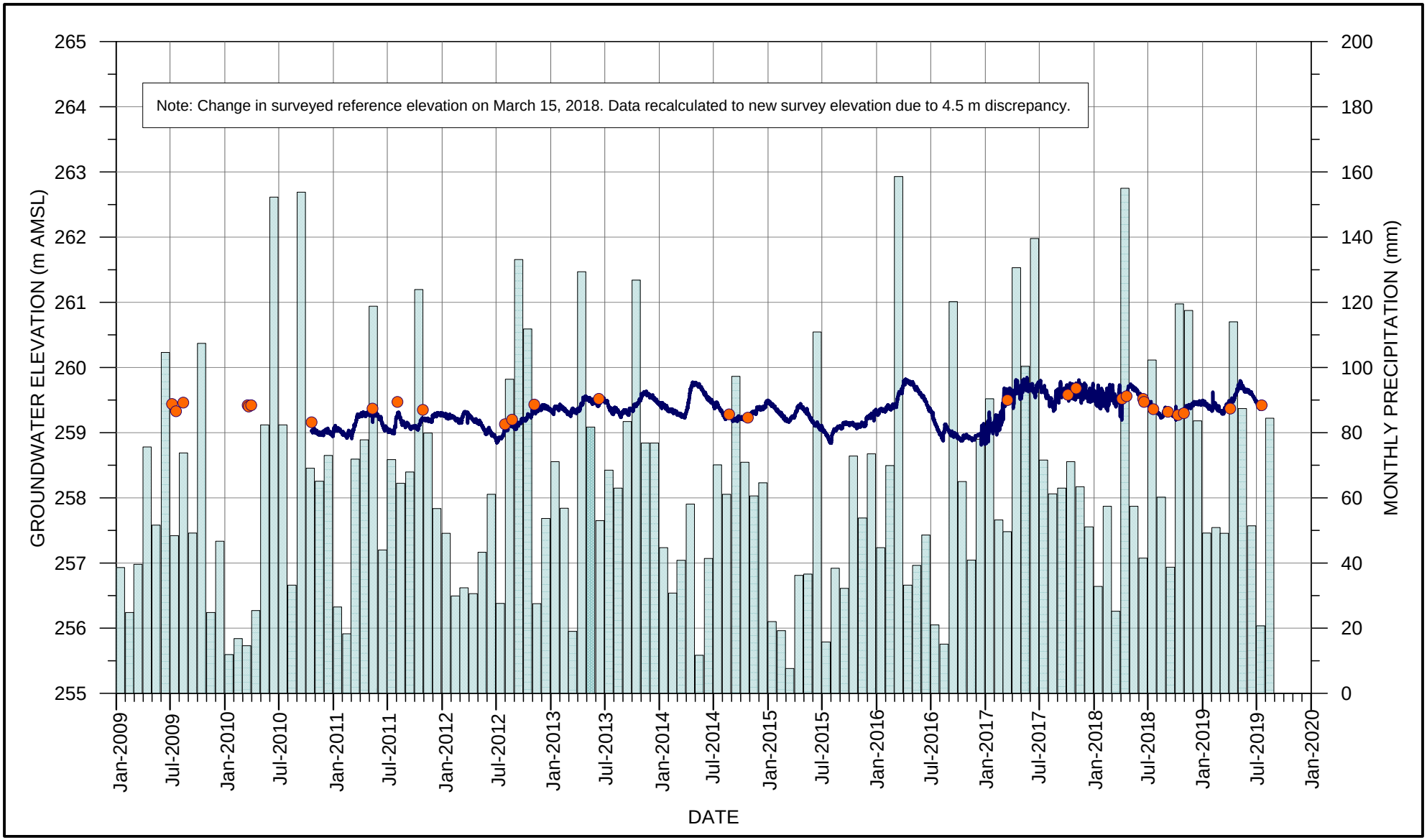
DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365

Sep 19, 2019

FIGURE 1
PW1-09 HYDROGRAPH

WAT file: C:\Users\lbender\AppData\Local\Microsoft\Windows\INetCache\Content.Outlook\YQ7GEY3M\11155365 - Teedon Pit - PW1-09new (002).grf



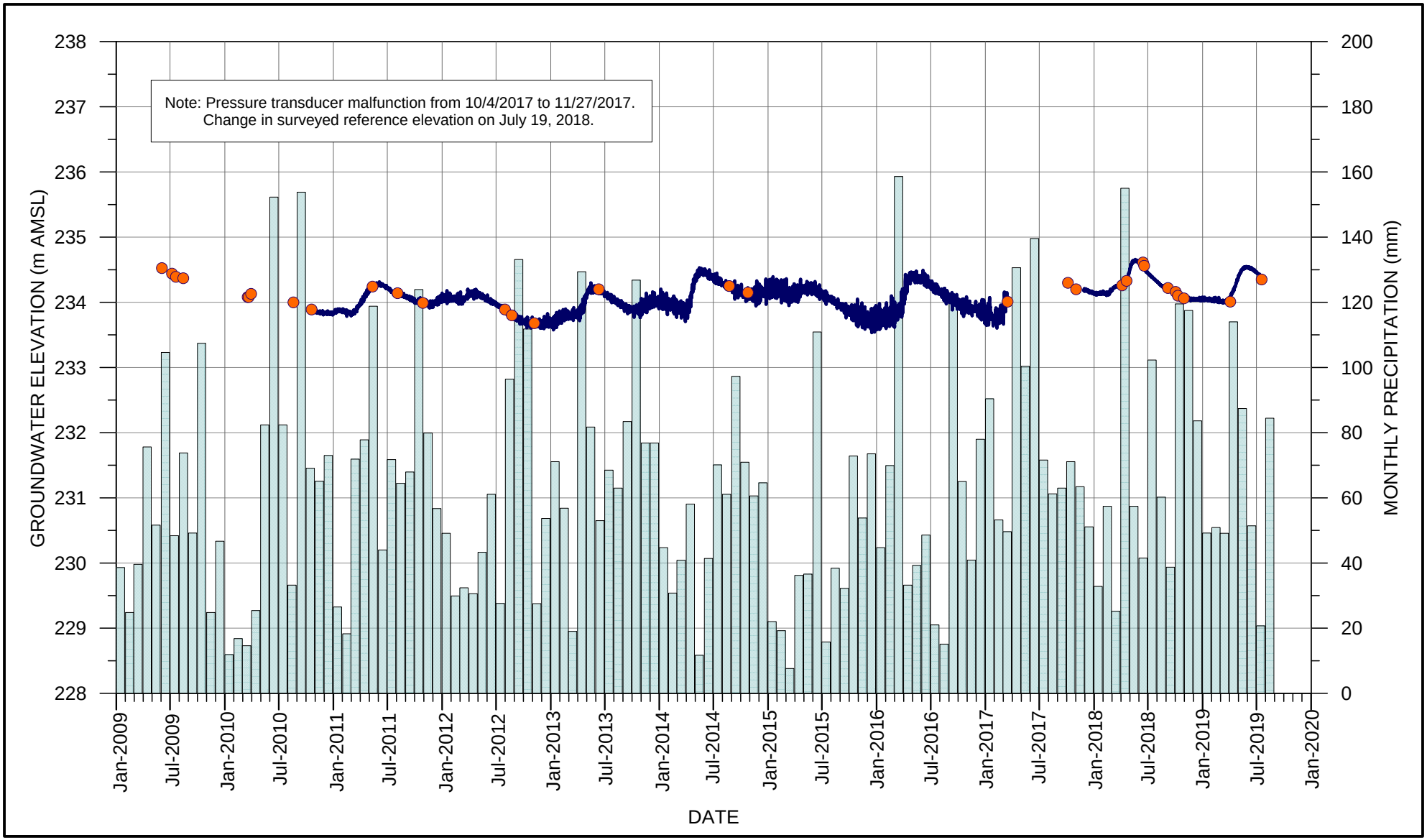
MW1 Transducer
MW1 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 2
MW1 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW1new.grf



MW1-09 Transducer
MW1-09 Manual
Precipitation

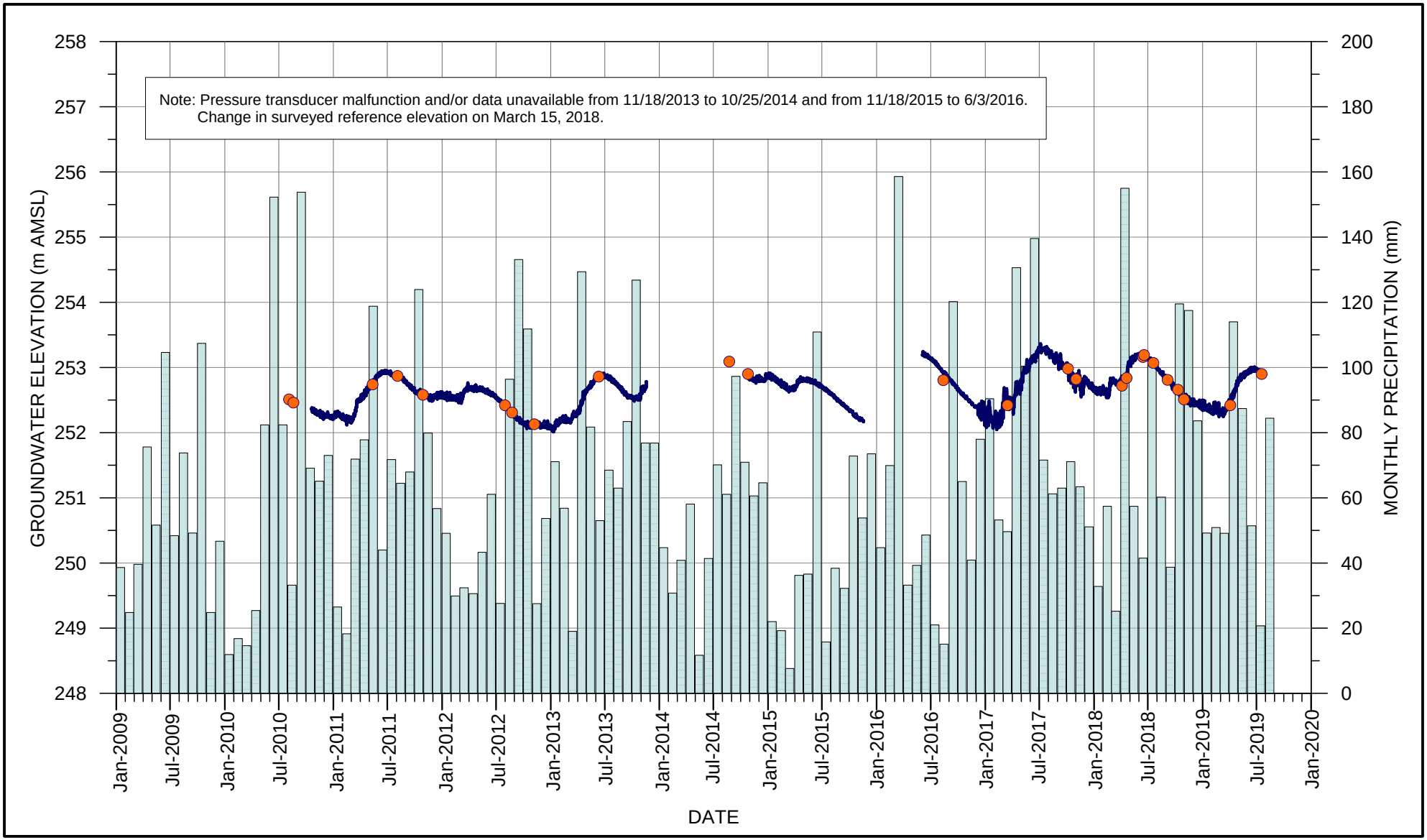
DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365

Sep 19, 2019

FIGURE 3
MW1-09 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW1-09new.grf



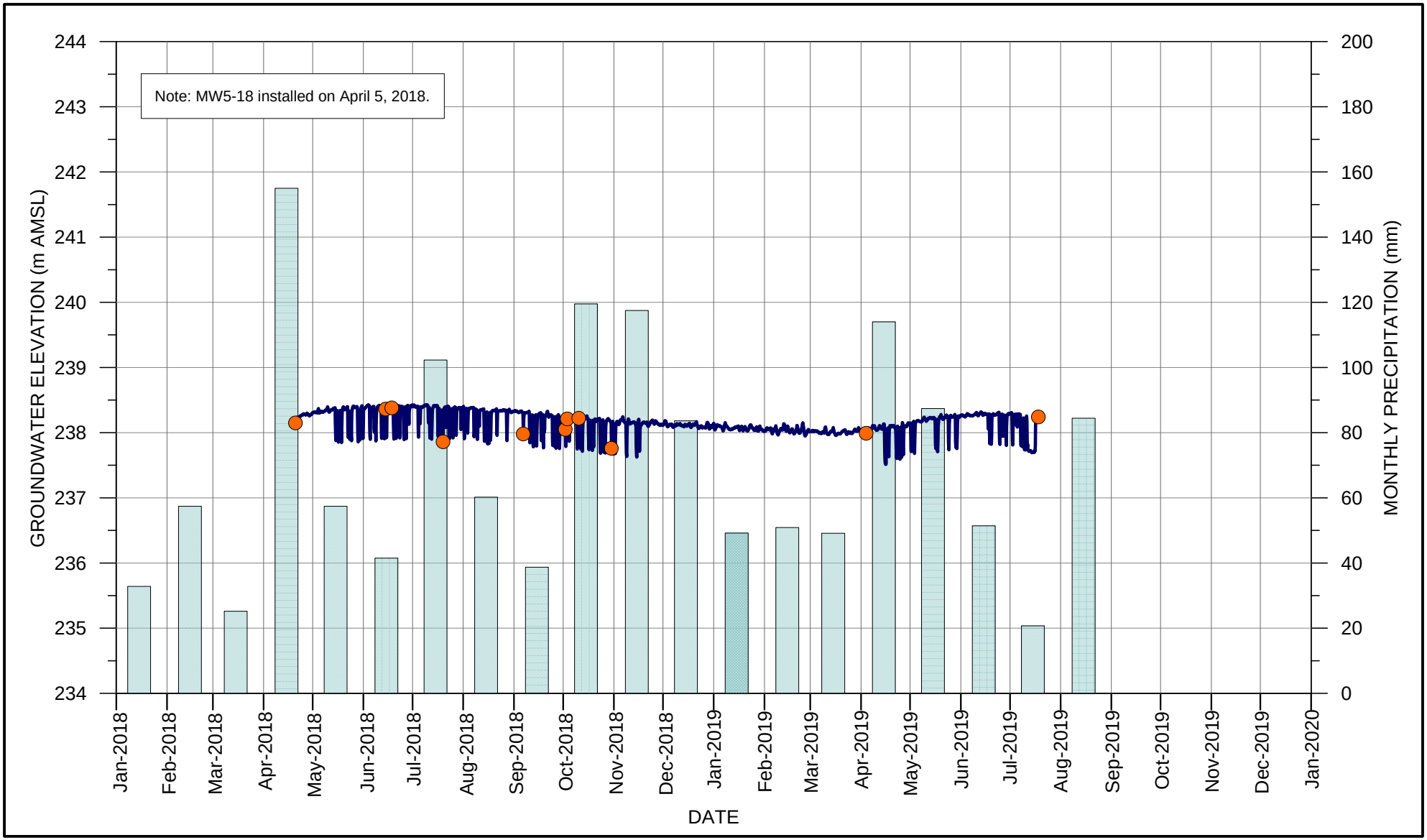
MW4-10 Transducer
MW4-10 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 4
MW4-10 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW4-10new.grf



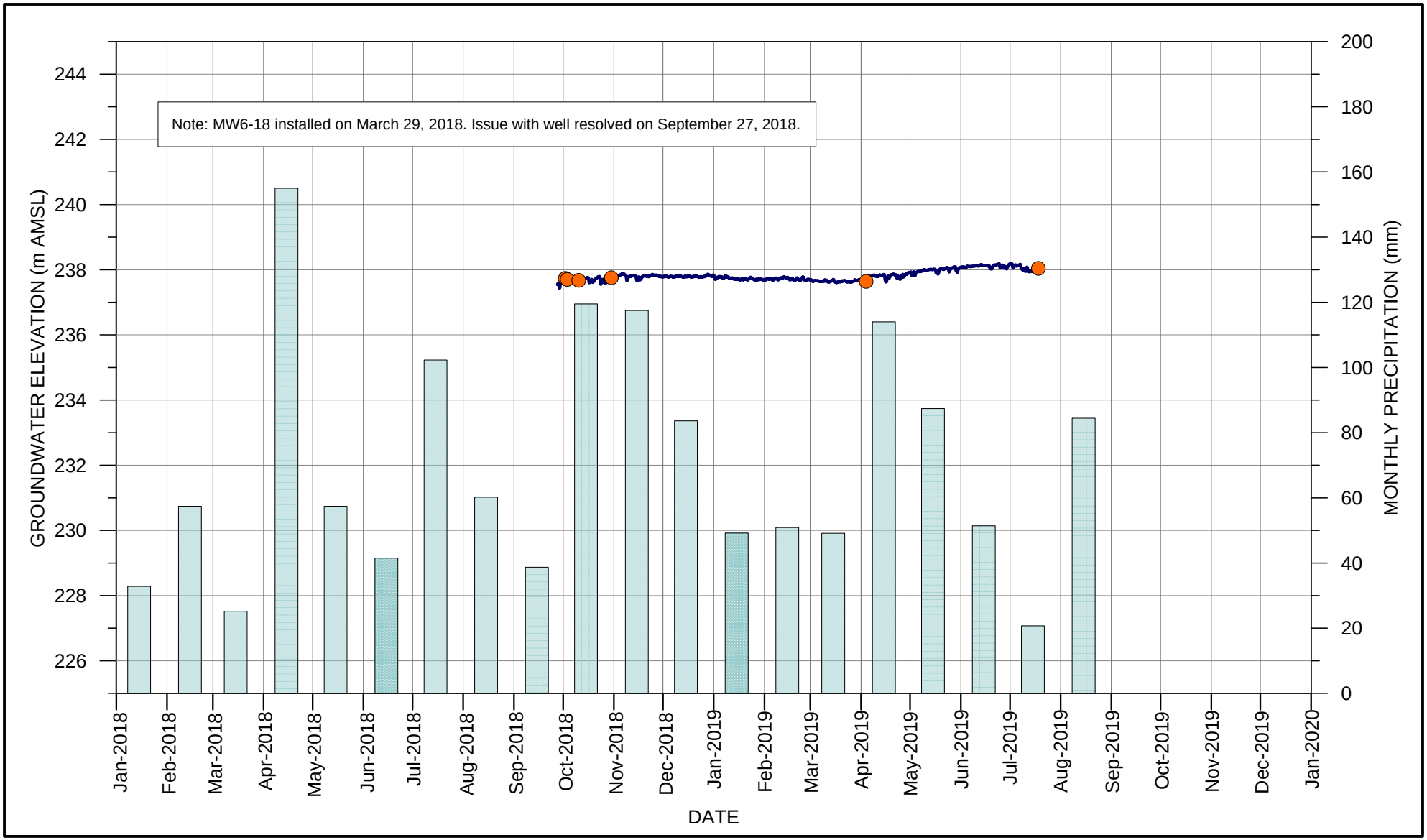
MW5-18 Transducer
MW5-18 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 5
MW5-18 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW5-18new.grf



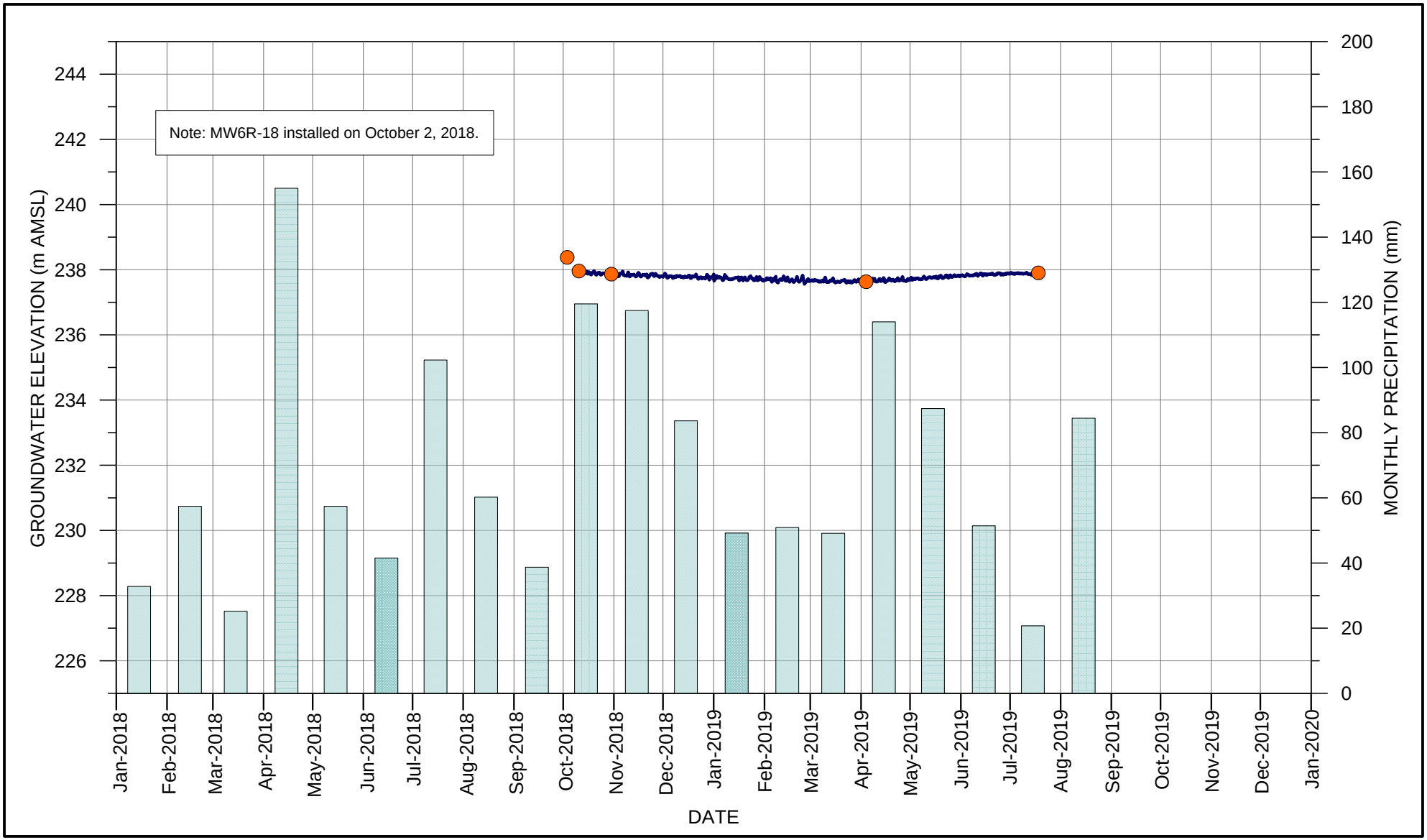
MW6-18 Transducer
MW6-18 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 6
MW6-18 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW6-18new.grf



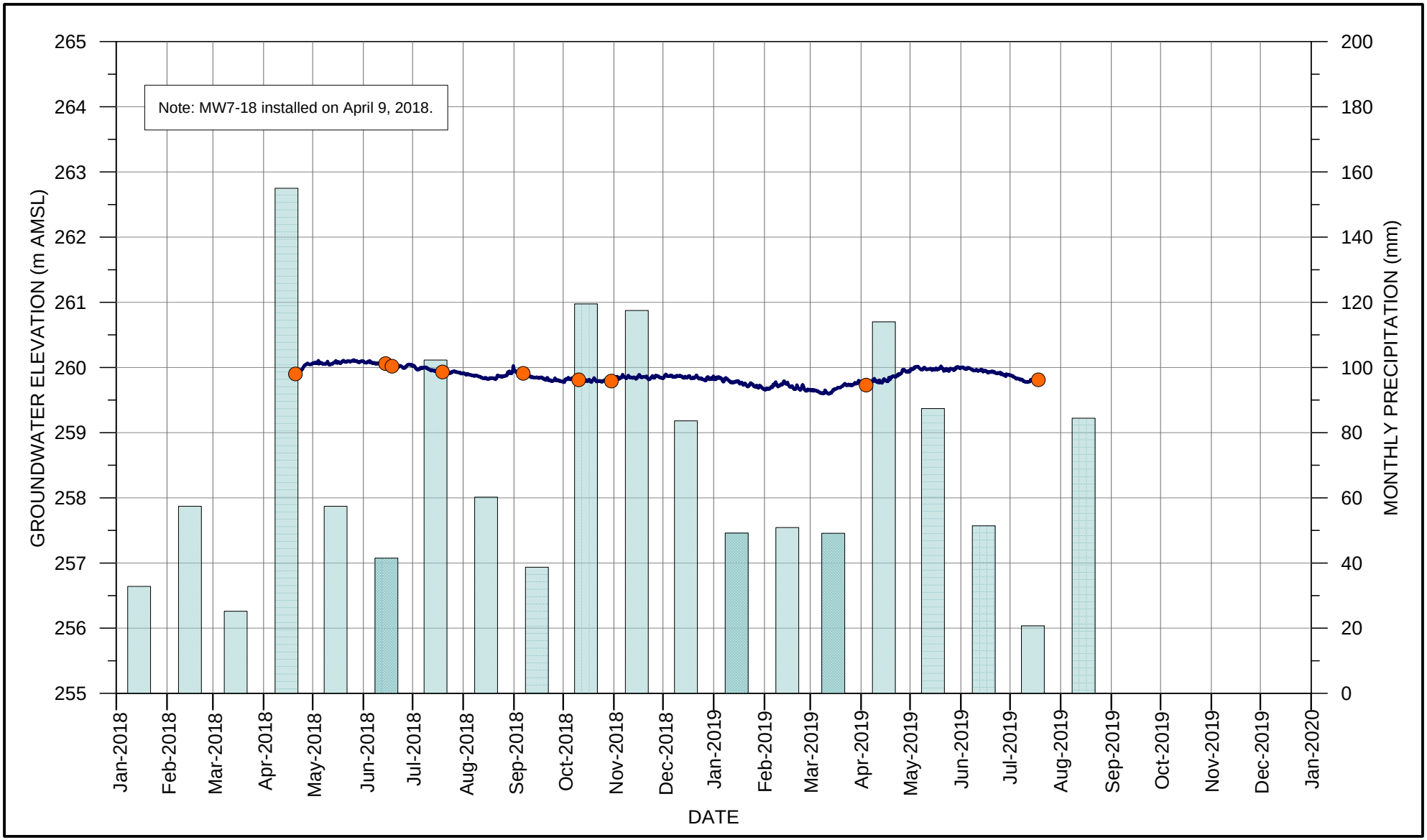
MW6R-18 Transducer
MW6R-18 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 7
MW6R-18 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW6R-18new.grf



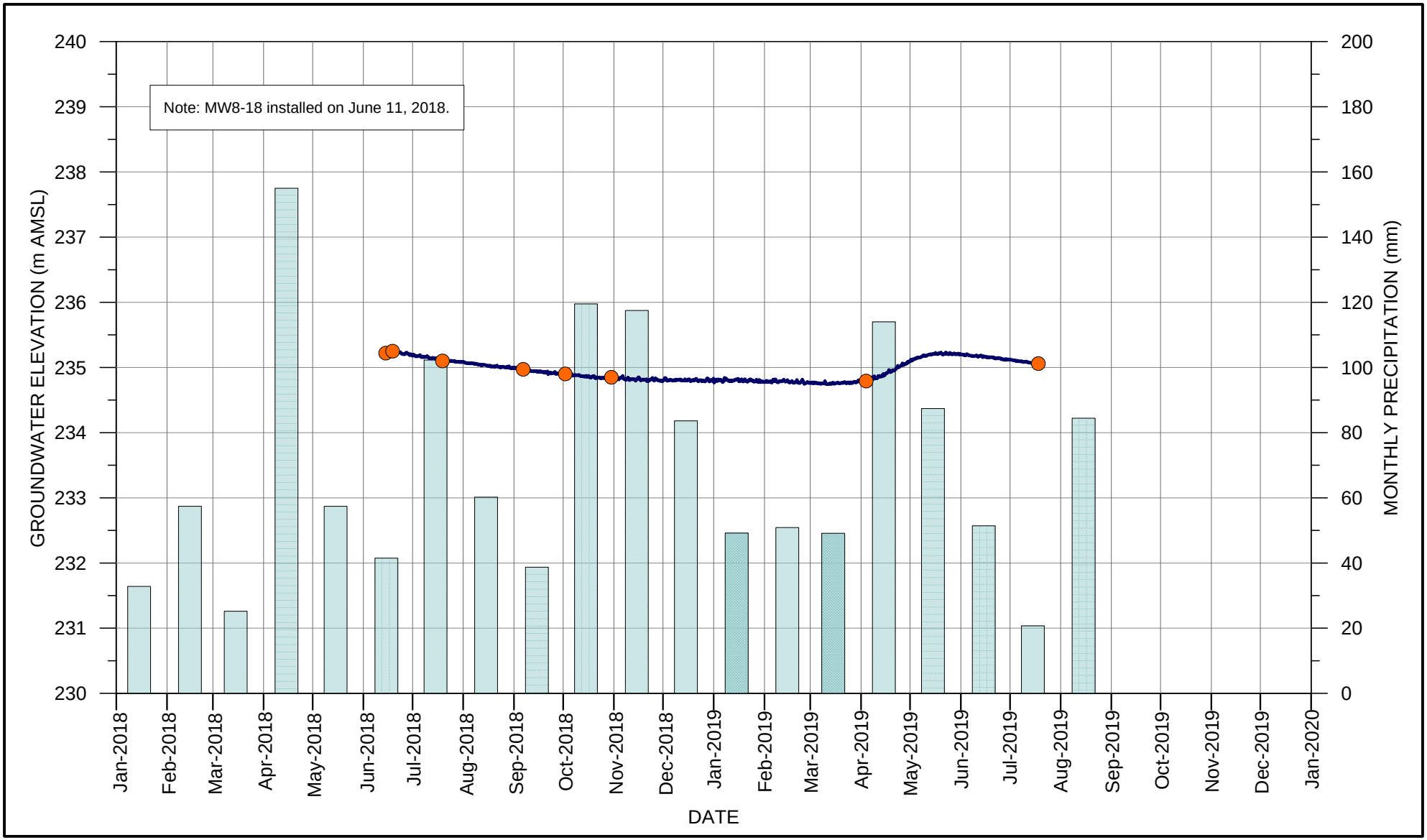
MW7-18 Transducer
MW7-18 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 8
MW7-18 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW7-18new.grf



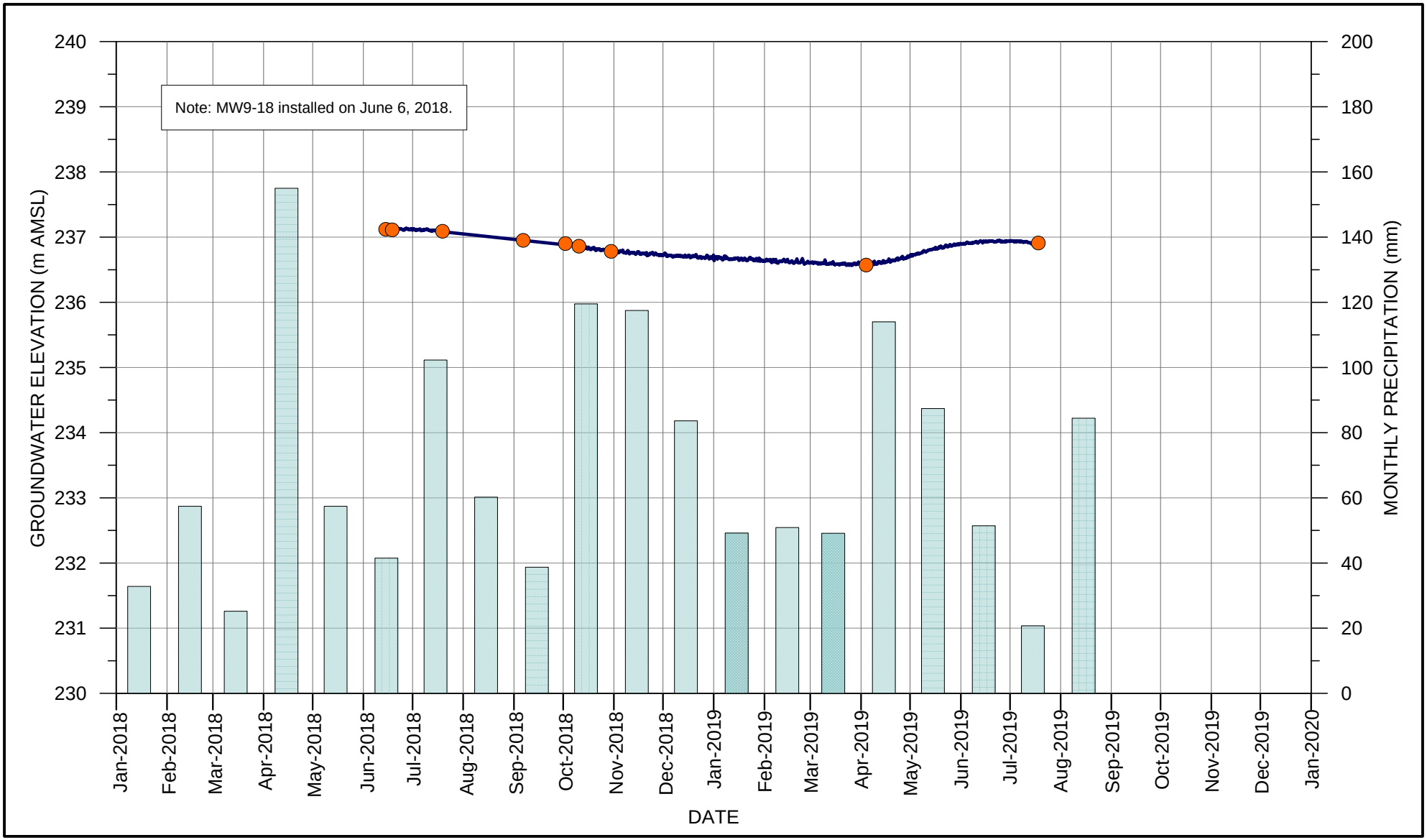
MW8-18 Transducer
MW8-18 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 9
MW8-18 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW8-18new.grf



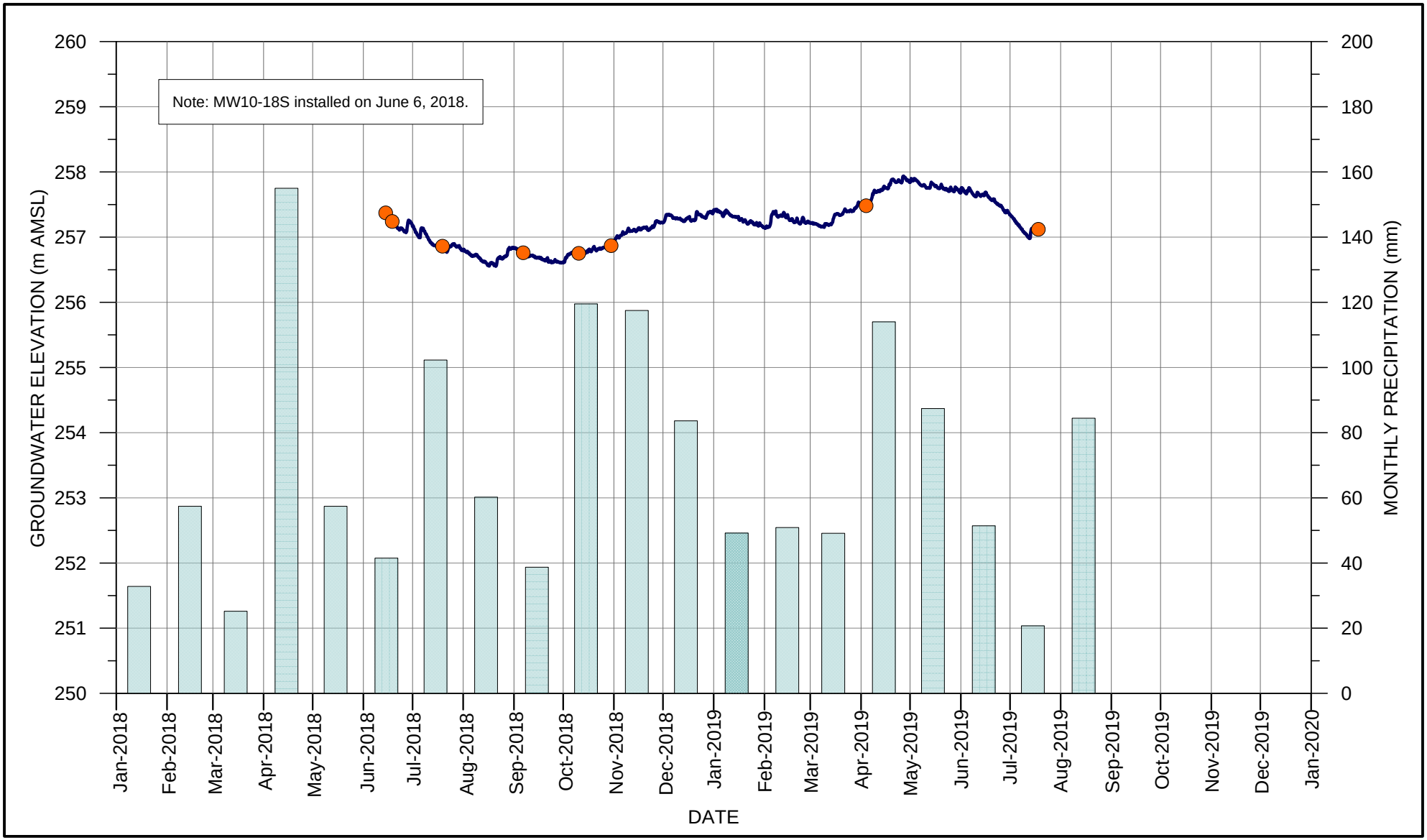
MW9-18 Transducer
MW9-18 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 10
MW9-18 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW9-18new.grf



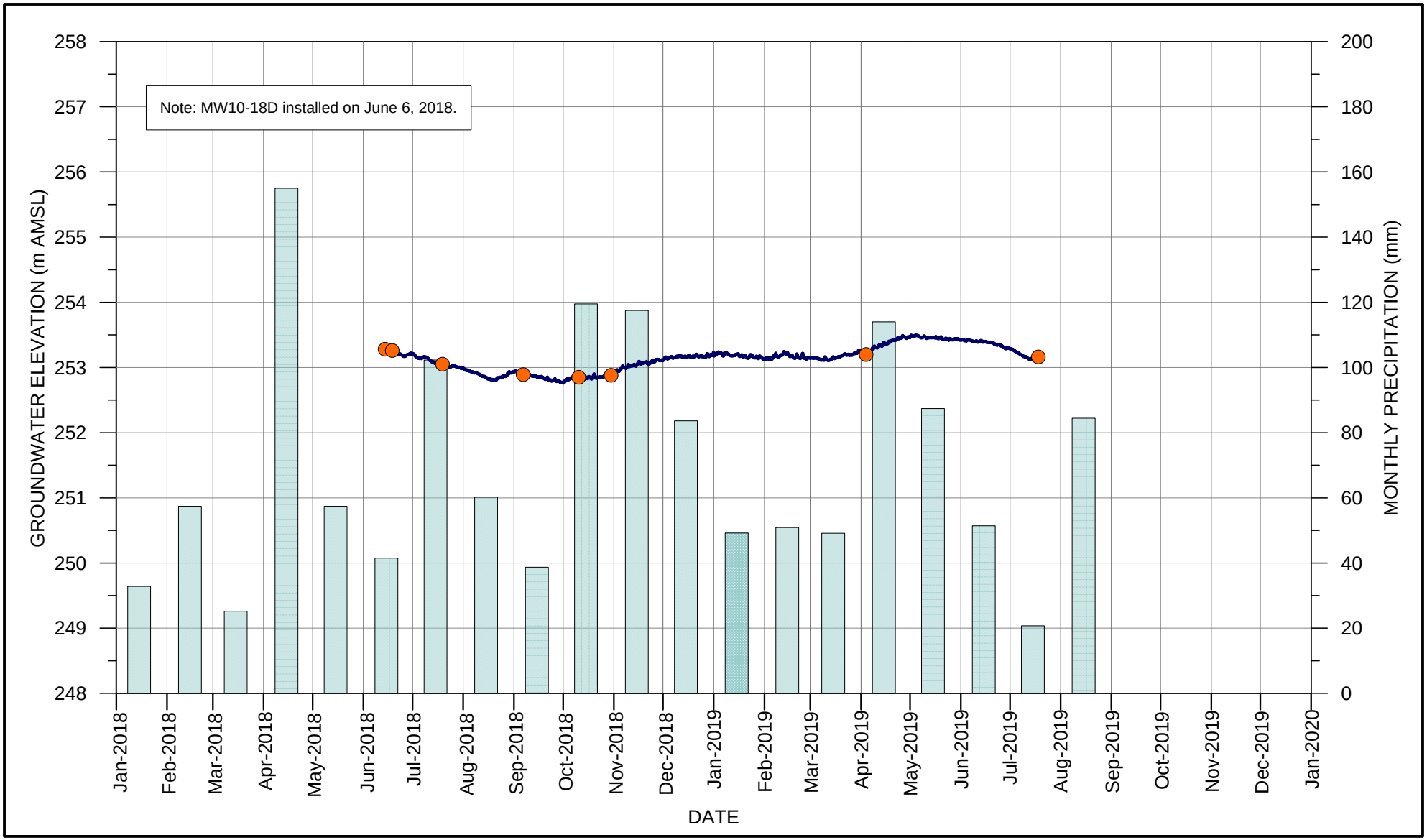
MW10-18S Transducer
MW10-18S Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 11
MW10-18S HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW10-18Snew.grf



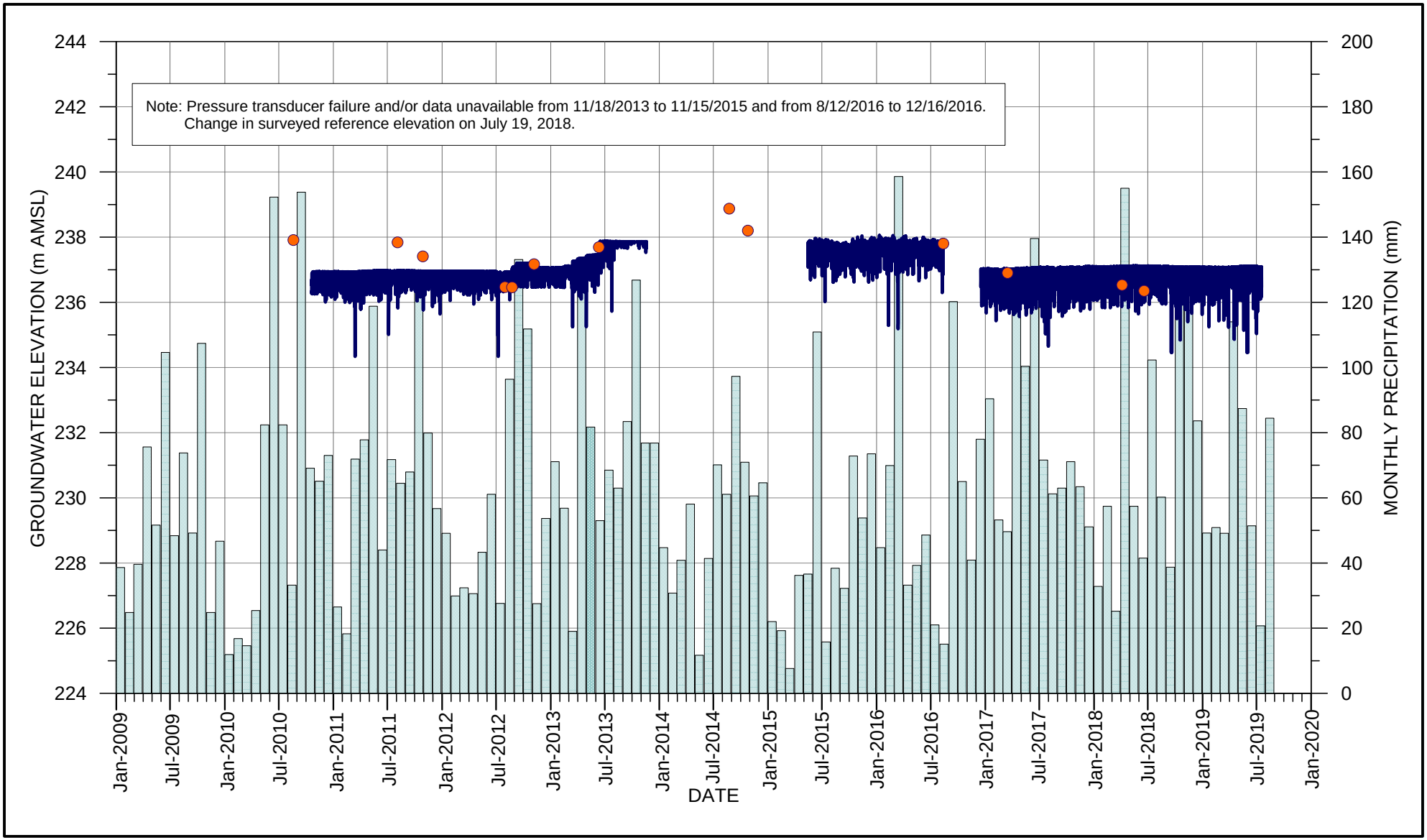
MW10-18D Transducer
MW10-18D Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 12
MW10-18D HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - MW10-18Dnew.grf



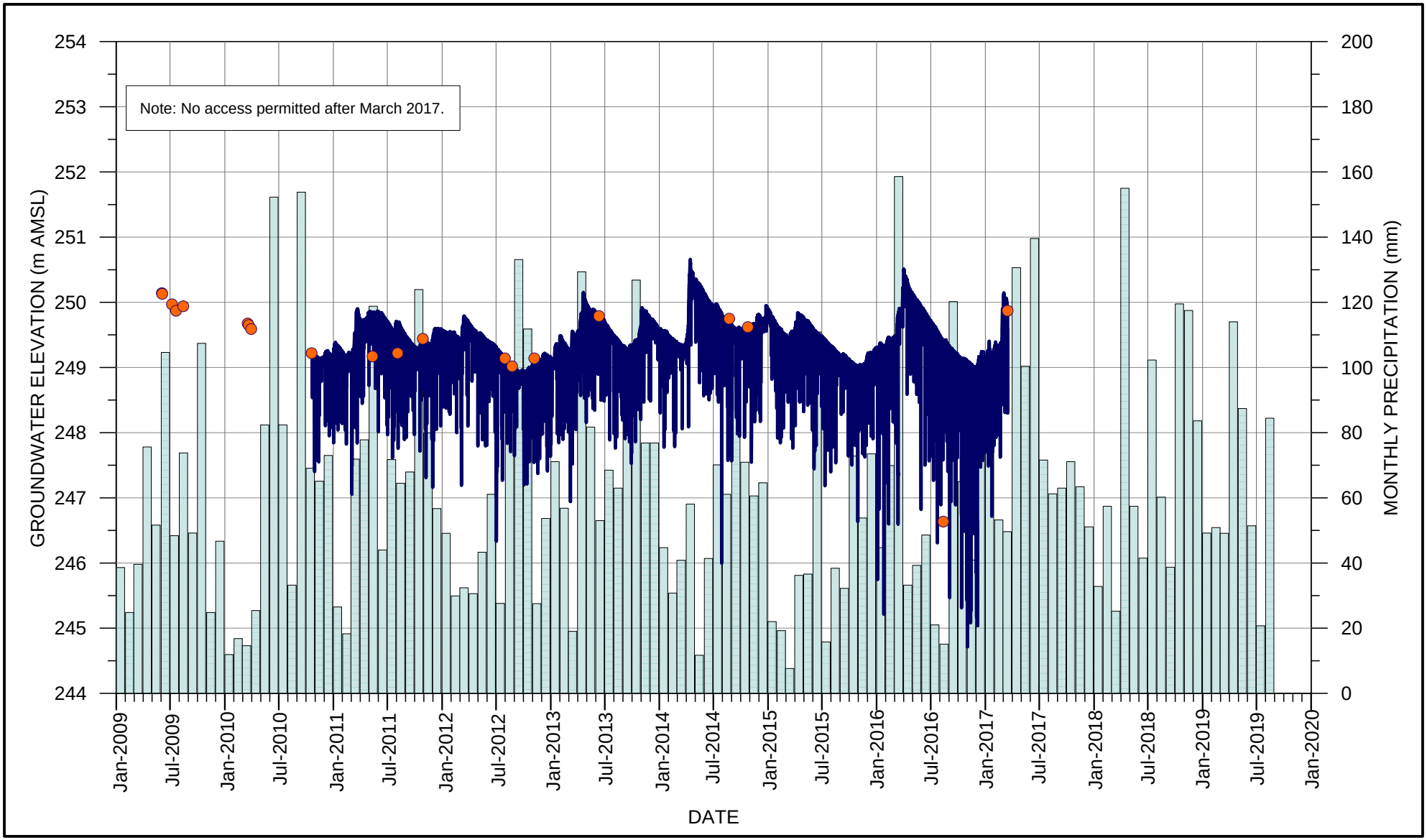
50632 Transducer
50632 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 13
#50632 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - 50632new.grf



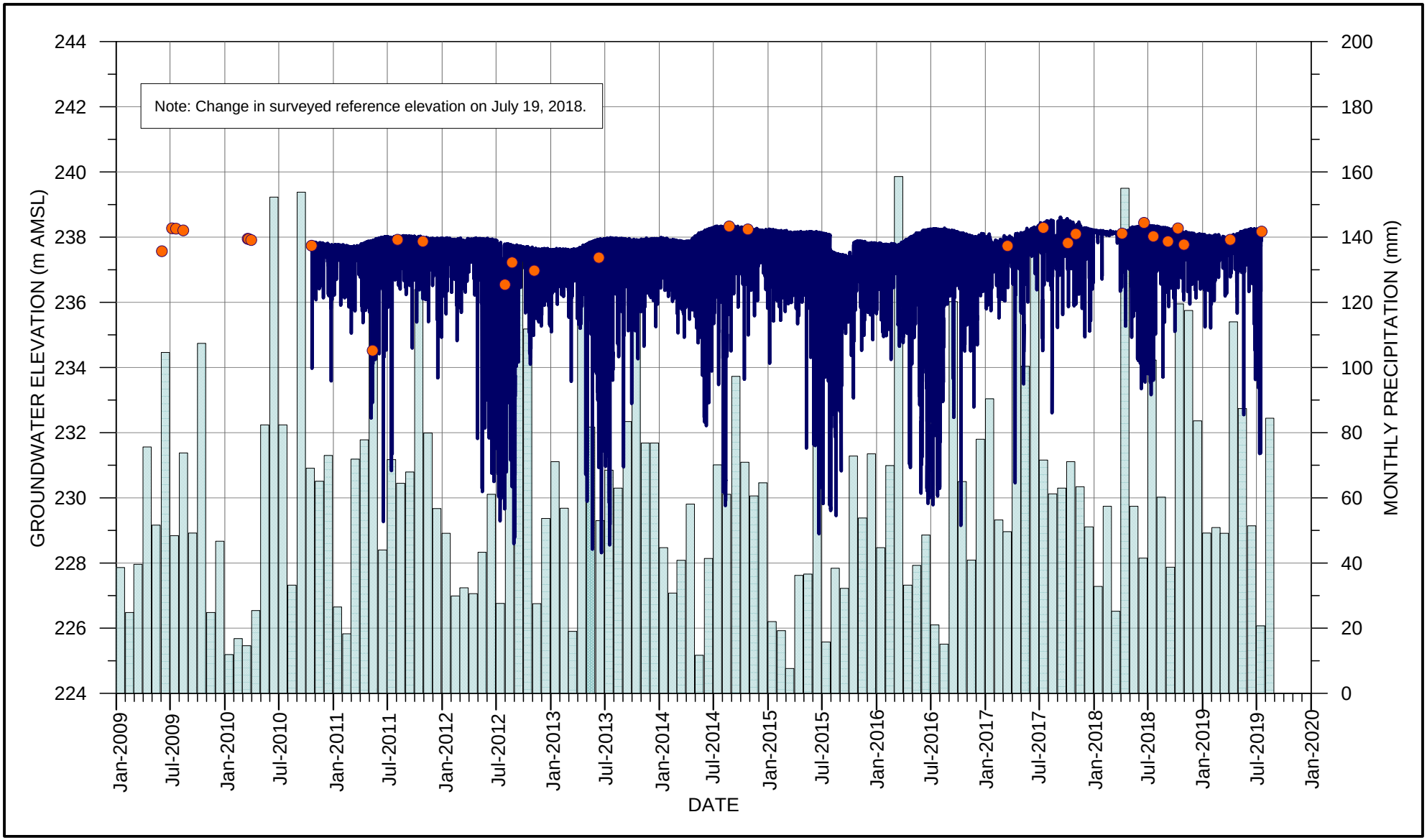
25425 Transducer
25425 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 14
#25425 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - 25425new.grf



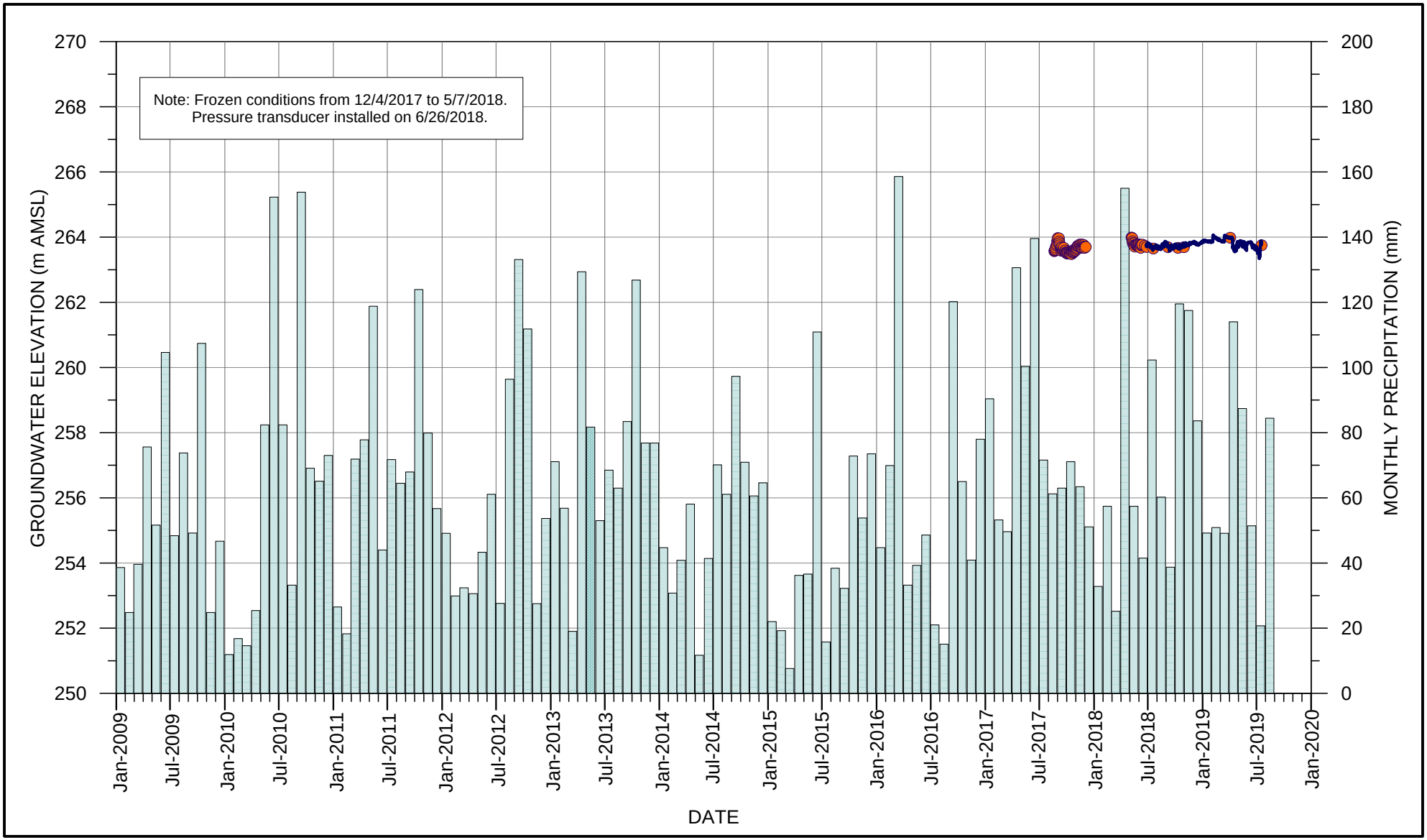
17709 Transducer
17709 Manual
Precipitation

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 15
#17709 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - 17709new.grf



SW1 Transducer
SW1 Manual
Precipitation

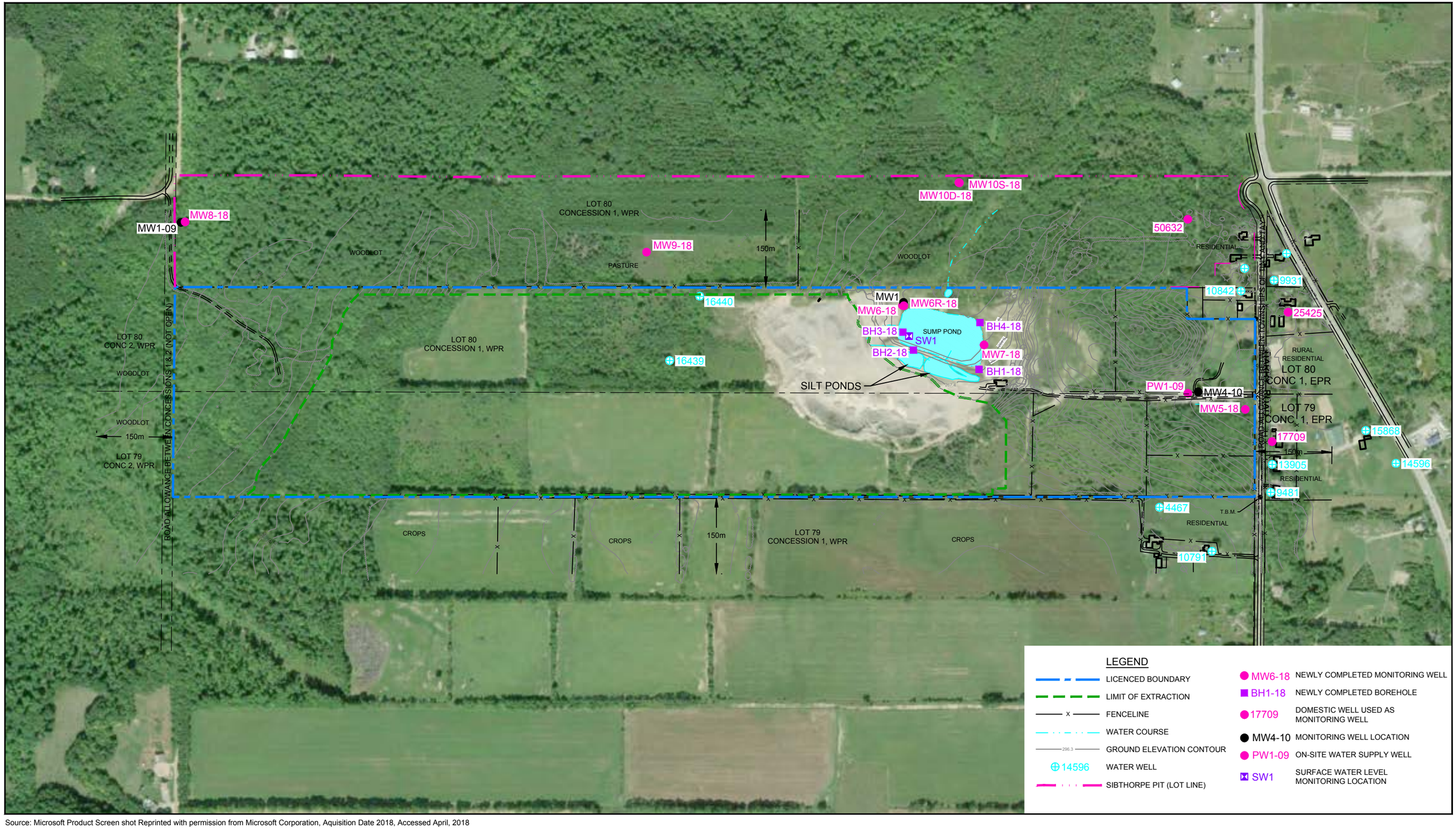
DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365
Sep 19, 2019

FIGURE 16
SW1 HYDROGRAPH

WAT file: Z:\11155365\Teedon Pit\Data\Hydrographs\11155365 - Teedon Pit - SW1new.grf

Attachment B



Source: Microsoft Product Screen shot Reprinted with permission from Microsoft Corporation, Aquisition Date 2018, Accessed April, 2018

0 70 140 210m

DUFFERIN TEEDON PIT
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

11155365-10

Oct 30, 2018

2018 MONITORING WELL AND BOREHOLE LOCATIONS

FIGURE 1

CAD File: P:\drawings\11155000s\11155365\11155365-PRES\11155365-10(PRES013)\11155365-10(PRES013GN\11155365-10(PRES013)GN-WA001.DWG

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW5-18
DATE COMPLETED: 5 April 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: K. VANDER MEULEN

NORTHING: 4945106.2
EASTING: 592450.79

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
	TOP OF RISER	257.19				
	GROUND SURFACE	256.39				
0	TOPSOIL	256.08	CONCRETE			
	ML-SILT, some clay, loose, brown, oxidized, wet	254.86	BENTONITE GROUT	1RS		71
2	SM-SILTY SAND, compact, very fine grained, dilatant, poorly graded, brown, wet	254.10				
4	SP-SAND, with silt, trace gravel, compact, very fine grained, poorly graded, brown, wet	251.82	51mm PVC WELL CASING	2RS		100
6	SM-SILTY SAND, trace clay, compact, very fine grained, slightly dilatant, poorly graded, brown, wet			3RS		100
8			152mm BOREHOLE			
	ML-SILT, with very fine sand, compact, dilatant, brown, wet	247.55				
10	SP-SAND, trace silt, compact, fine grained, poorly graded, brown, wet	246.33		4RS		100
12				5RS		100
14						
	SM-SILTY SAND (Till), with gravel, trace clay, compact, very fine grained, poorly graded, grey, very moist to wet	241.45		6RS		100
16						
18	ML-SILT, trace clay, compact, dilatant, grey, wet	239.01				
	- with clay at 18.90m BGS			7RS		100
20						
22				8RS		100
24						
	- with clay at 24.99m BGS			9RS		100
26						
	CL-SILTY CLAY, stiff, low plasticity, slightly dilatant, grey, wet	229.87				
28				10RS		100
30						
32				11RS		100
34				12RS		100
36						
38	- medium plasticity at 38.10m BGS			13RS		100
40				14RS		100

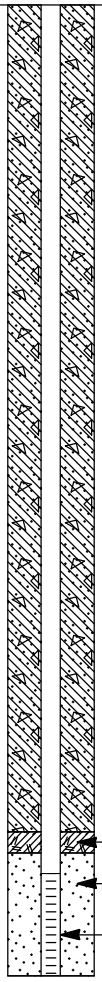
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW5-18
DATE COMPLETED: 5 April 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: K. VANDER MEULEN

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
42						
44	- 51mm medium sand seam at 44.20m BGS			15RS		100
46				16RS		100
48				17RS		100
50						
52	SP-SAND, compact, very fine grained, poorly graded, grey, wet	204.42		18RS		100
54						
56				19RS		100
58						
60	- fine grained at 60.05m BGS			20RS		100
62				21RS		100
64						
66	- trace gravel, trace to with silt at 65.53m BGS			22RS		100
68				23RS		100
70	END OF BOREHOLE @ 69.19m BGS	186.59				
72						
74						
76						
78						
80						



WELL DETAILS
Screened interval:
189.64 to 186.59m
66.75 to 69.80m BGS
Length: 3.05m
Diameter: 51mm
Slot Size: 0.010
Material: PVC SCH 80
Seal:
190.86 to 190.25m
65.53 to 66.14m BGS
Material: BENTONITE PELLETS
Sand Pack:
190.25 to 186.59m
66.14 to 69.80m BGS
Material: SAND

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW6-18
DATE COMPLETED: 29 March 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: K. VANDER MEULEN

NORTHING: 4944916.15
EASTING: 591778.54

TOP OF RISER 268.43
GROUND SURFACE 267.60

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m
0	SM-SILTY SAND (FILL), little gravel, compact, very fine grained, poorly graded, brown, moist	
2		
		264.86
	ML-SILT, trace clay, trace very fine sand, compact, brown, moist	
4	- no clay or sand at 3.66m BGS	
6	- dilatant, wet at 6.10m BGS	
8		
10		
		256.02
12	SM-SILTY SAND, compact, very fine grained, poorly graded, brown, wet	255.10
	ML-SILT, trace clay, compact, dilatant, grey, wet	
14		
16	- with clay, very moist to wet at 16.76m BGS	
18	- trace clay at 17.98m BGS	
20	- with clay at 20.42m BGS	
22		
24		
		242.30
26	CL-SILTY CLAY, stiff, low plasticity, grey, wet	
	- medium plasticity at 25.91m BGS	
28		
30		
32		
		234.38
34	SP-SAND, with coarse gravel, compact, medium grained, poorly graded, grey, wet	
	- trace gravel, fine grained at 33.83m BGS	
36		
38		
40	- trace silt, very fine grained at 39.62m BGS	

MONITORING WELL: CONCRETE; BENTONITE GROUT; 51mm PVC WELL CASING; 152mm BOREHOLE

SAMPLE NUMBER	INTERVAL	REC (%)
1RS		60
2RS		100
3RS		100
4RS		100
5RS		100
6RS		100
7RS		100
8RS		100
9RS		100
10RS		100
11RS		100
12RS		100
13RS		100
14RS		100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW6-18
DATE COMPLETED: 29 March 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: K. VANDER MEULEN

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
42				15RS		100
	ML-SILT, dense, dilatant, grey, wet	224.93				
44	SP-SAND, trace silt, compact, very fine grained, poorly graded, grey, wet	224.17		16RS		100
46				17RS		100
48						
50				18RS		100
52	ML-SILT, compact, dilatant, grey, wet	215.78		19RS		100
54						
56	SP-SAND, trace silt, compact, very fine grained, poorly graded, grey, wet, dark layering	212.13		20RS		100
58						
60				21RS		100
62	- fine grained, grey at 61.87m BGS - fine grained, brown at 62.79m BGS			22RS		100
64						
66			BENTONITE PELLETS	23RS		100
68			51mm PVC WELL SCREEN			
70	END OF BOREHOLE @ 70.10m BGS	197.50	SAND PACK	24RS		100
72						
74						
76						
78						
80						

WELL DETAILS
Screened interval:
201.15 to 198.11m
66.45 to 69.49m BGS
Length: 3.05m
Diameter: 51mm
Slot Size: 0.010
Material: PVC SCH 80
Seal:
202.37 to 201.76m
65.23 to 65.84m BGS
Material: BENTONITE PELLETS
Sand Pack:
201.76 to 197.50m
65.84 to 70.10m BGS
Material: SAND

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW6R-18
DATE COMPLETED: October 2, 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: G. LAGOS

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
	NORTHING: 4944916.96 EASTING: 591780.6 TOP OF RISER / GROUND SURFACE	268.20 / 267.57				
0	SM-SILTY SAND (FILL), little gravel, compact, very fine grained, poorly graded, brown, moist		CONCRETE; BENTONITE GROUT; 51mm PVC WELL CASING; 152mm BOREHOLE			
2						
		264.82				
4	ML-SILT, trace clay, trace very fine sand, compact, brown, moist - no clay or sand at 3.66m BGS					
6	- dilatant, wet at 6.10m BGS					
8						
10						
		255.99				
12	SM-SILTY SAND, compact, very fine grained, poorly graded, brown, wet	255.07				
14	ML-SILT, trace clay, compact, dilatant, grey, wet					
16	- with clay, very moist to wet at 16.76m BGS					
18	- trace clay at 17.98m BGS					
20	- with clay at 20.42m BGS					
22						
24						
		242.27				
26	CL-SILTY CLAY, stiff, low plasticity, grey, wet - medium plasticity at 25.91m BGS					
28						
30						
32						
		234.34				
34	SP-SAND, with coarse gravel, compact, medium grained, poorly graded, grey, wet - trace gravel, fine grained at 33.83m BGS					
36						
38						
40	- trace silt, very fine grained at 39.62m BGS					

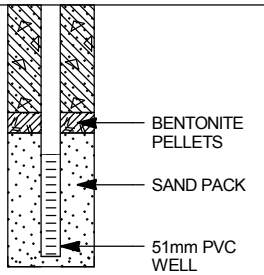
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW6R-18
DATE COMPLETED: October 2, 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: G. LAGOS

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
42						
	ML-SILT, dense, dilatant, grey, wet	224.90				
44	SP-SAND, trace silt, compact, very fine grained, poorly graded, grey, wet	224.13				
46						
48		218.80				
	END OF BOREHOLE @ 48.77m BGS					
50						
52						
54						
56						
58						
60						
62						
64						
66						
68						
70						
72						
74						
76						
78						
80						



WELL DETAILS
Screened interval:
222.15 to 219.10m
45.42 to 48.46m BGS
Length: 3.05m
Diameter: 51mm
Slot Size: 0.010
Material: PVC
Seal:
223.37 to 222.76m
44.20 to 44.81m BGS
Material: BENTONITE PELLETS
Sand Pack:
222.76 to 218.80m
44.81 to 48.77m BGS
Material: SAND

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

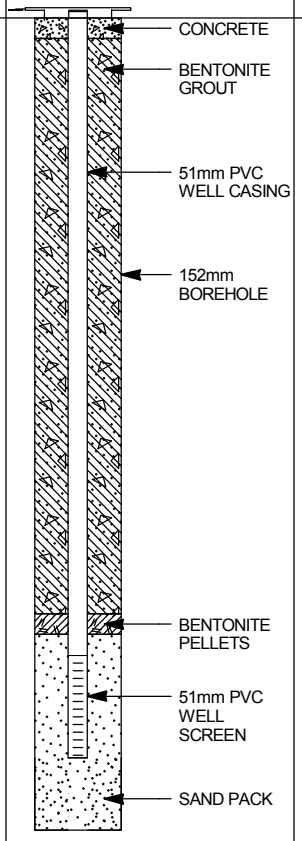
HOLE DESIGNATION: MW7-18
DATE COMPLETED: 9 April 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: K. VANDER MEULEN

NORTHING: 4944937.13
EASTING: 591953.92

TOP OF RISER 267.56
GROUND SURFACE 266.83

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m
0	SP-SAND (FILL), with silt, compact, very fine grained, poorly graded, brown, moist	
4	SM-SILTY SAND, loose, very fine grained, poorly graded, dilatant, brown, wet	262.57
8	ML-SILT, trace very fine sand, loose, dilatant, grey, wet	258.91
12		
14	SM-SILTY SAND, compact, very fine grained, slightly dilatant, poorly graded, grey, wet	253.42
	ML-SILT, compact, dilatant, grey, wet - trace to with clay at 15.85m BGS	252.51
18		
20	SM-SILTY SAND, compact, very fine grained, slightly dilatant, poorly graded, grey, wet	247.63
22	ML-SILT, with clay, compact, grey, wet	244.89
24	END OF BOREHOLE @ 24.08m BGS	242.75
26		
28		
30		
32		
34		
36		
38		
40		

MONITORING WELL



WELL DETAILS
Screened interval:
247.94 to 244.89m
18.90 to 21.95m BGS
Length: 3.05m
Diameter: 51mm
Slot Size: 0.010
Material: PVC SCH 80
Seal:
249.16 to 248.55m
17.68 to 18.29m BGS
Material: BENTONITE PELLETS
Sand Pack:
248.55 to 242.75m
18.29 to 24.08m BGS
Material: SAND

SAMPLE NUMBER	INTERVAL	REC (%)
1RS		67
2RS		60
3RS		100
4RS		100
5RS		100
6RS		100
7RS		100
8RS		100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW8-18
DATE COMPLETED: 11 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: S. MOLONEY

NORTHING: 4944303.17
EASTING: 590518.91

TOP OF RISER 245.88 m
GROUND SURFACE 245.35 m

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
0.0	SW-SAND, with fine and coarse subrounded gravel, trace cobble, fine grained, well graded, light brown, dry		CONCRETE	1RS		100
2.5	SP-SAND, fine grained, poorly graded, brown, dry	242.91	BENTONITE GROUT; 51mm PVC WELL CASING; 152mm BOREHOLE	2RS		100
7.5	SW-SAND, with fine gravel, trace coarse subrounded gravel, fine grained, brown, dry	237.73		3RS		100
				4RS		100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW8-18
DATE COMPLETED: 11 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: S. MOLONEY

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
10.5				5RS		75
11.0						
11.5						
12.0						
12.5						
13.0				6RS		20
13.5						
14.0						
14.5	- medium grained, with fine grained, wet at 14.63m BGS					
15.0						
15.5						
16.0				7RS		100
16.5	GP-SANDY GRAVEL/GRAVEL, with fine sand, fine and coarse subrounded to subangular gravel, well graded, grey, wet	228.89	BENTONITE PELLETS			
17.0						
17.5						
18.0			SAND PACK			
18.5						
19.0				8RS		100
19.5			51mm PVC WELL			

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW8-18
DATE COMPLETED: 11 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: S. MOLONEY

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)		
20.5			SCREEN					
	END OF BOREHOLE @ 20.73m BGS	224.62	WELL DETAILS Screened interval: 227.67 to 224.62m 17.68 to 20.73m BGS Length: 3.05m Diameter: 51mm Slot Size: 0.010 Material: PVC Seal: 229.19 to 228.28m 16.15 to 17.07m BGS Material: BENTONITE CHIPS Sand Pack: 228.28 to 224.62m 17.07 to 20.73m BGS Material: SAND					
21.0								
21.5								
22.0								
22.5								
23.0								
23.5								
24.0								
24.5								
25.0								
25.5								
26.0								
26.5								
27.0								
27.5								
28.0								
28.5								
29.0								
29.5								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW9-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: Shawn Moloney

NORTHING: 4944734.11
EASTING: 591302.29

TOP OF RISER 292.50
GROUND SURFACE 291.58

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m
0.0	TOPSOIL, sandy silt, loose, fine grained sand, dark brown, dry	
0.5		
		290.97
1.0	SM- SAND, with silt, with to trace fine and coarse gravel, loose, fine grained, well graded, brown, dry	
1.5		
2.0		
2.5		
		288.84
3.0	SW- SAND, with gravel, trace silt, compact, fine grained, fine and coarse subrounded gravel, light brown, dry	
3.5	- gravelly sand, fine to medium sand from 3.61 to 6.48m BGS	
4.0		
4.5		
5.0		
5.5		
6.0		
6.5	- silty sand, with gravel, with cobbles seam, fine grained, dry from 6.50 to 7.32m BGS	
7.0		
7.5		
8.0		
8.5	fine to medium grained, fine gravel, brown	
		282.74
9.0	fine grained, fine and coarse gravel, trace cobbles, light grey	
9.5		
	- silt seam, very fine grained, light grey from 9.91	

MONITORING WELL: CONCRETE; BENTONITE GROUT; 51 mm PVC WELL CASING; 152 mm BOREHOLE

SAMPLE NUMBER	INTERVAL	REC (%)
1RS		56
2RS		100
3RS		100
4RS		100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

WATER FOUND ▽

OVERBURDEN LOG 11155365-WI.GPJ GHD_Corp 15/6/18

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW9-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: Shawn Moloney

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
	to 11.05m BGS			5RS		100
10.5						
11.0						
11.5						
12.0	- with to trace gravel, trace cobbles, grey at 11.89m BGS	279.70				
12.5						
13.0	SP- SAND, fine grained, poorly graded, brown/grey, dry	278.68		6RS		100
13.5						
14.0						
14.5	- moist at 14.68m BGS					
15.0	SW- SAND with GRAVEL, trace cobble, fine grained sand, fine and coarse grained gravel, well graded, brown, moist	276.60				
15.5	- dry at 15.70m BGS					
16.0	- trace gravel seam, moist from 16.15 to 16.76m BGS					
16.5				7RS		100
17.0						
17.5	- gravelly sand, moist at 17.73m BGS					
18.0						
18.5						
19.0	- with gravel, grey at 18.90m BGS					
19.5				8RS		100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW9-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: Shawn Moloney

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
20.5						
21.0						
21.5						
22.0						
22.5				9RS		100
23.0						
23.5						
24.0						
24.5						
25.0						
25.5	- trace silt seam, fine to very fine grained from 25.60 to 26.44m BGS			10RS		100
26.0						
26.5						
27.0						
27.5						
28.0						
28.5	- trace silt seam, fine to very fine grained from 28.65 to 29.03m BGS			11RS		100
29.0						
29.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW9-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: Shawn Moloney

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
30.5						
31.0	- with to trace silt, fine and coarse subrounded gravel, subrounded, well graded, light grey at 30.91m BGS					
31.5				12RS		100
32.0						
32.5						
33.0						
33.5						
34.0						
34.5				13RS		70
35.0						
35.5						
36.0	- gravelly sand to sand with gravel, grey at 36.27m BGS					
36.5						
37.0						
37.5						
38.0				14RS		100
38.5						
39.0						
39.5						
	- silty sand, with gravel, very fine grained, light					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

WATER FOUND ▽

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW9-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: Shawn Moloney

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
40.5	grey at 39.93m BGS					
41.0				15RS		100
41.5						
42.0						
42.5	- sand, with gravel, medium grained, brown-grey at 42.37m BGS					
43.0	- fine grained at 42.98m BGS					
43.5	- gravelly sand seam, trace cobbles, fine grained, fine and coarse subrounded to subangular gravel, well graded from 43.48 to 44.20m BGS					
44.0				16RS		100
44.5						
45.0	- medium grained, with fine grained at 44.88m BGS					
45.5						
46.0						
46.5						
47.0				17RS		100
47.5						
48.0						
48.5						
49.0						
49.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW9-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: Shawn Moloney

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
50.5				18RS		100
51.0	- gravel, with sand seam from 50.98 to 51.21m BGS					
51.5						
52.0	- fine grained at 52.17m BGS					
52.5						
53.0				19RS		100
53.5						
54.0						
54.5	- wet at 54.56m BGS		▽			
55.0	- fine grained sand seam, poorly graded, brown-grey from 55.02 to 56.08m BGS					
55.5						
56.0	- medium grained at 56.08m BGS			20RS		100
56.5			BENTONITE PELLETS			
57.0						
57.5						
58.0			SAND PACK			
58.5						
59.0			51mm PVC WELL SCREEN	21RS		100
59.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW9-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: Shawn Moloney

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)		
60.5								
	END OF BOREHOLE @ 60.66m BGS	230.93	WELL DETAILS Screened interval: 233.98 to 230.93m 57.61 to 60.66m BGS Length: 3.05m Diameter: 51mm Slot Size: 10 Material: Sch. 80 PVC Seal: 236.11 to 234.59m 55.47 to 57.00m BGS Material: BENTONITE PELLETS Sand Pack: 234.59 to 230.93m 57.00 to 60.66m BGS Material: SILICA SAND No.2 --- Seal: 290.97 to 234.59m 0.61 to 57.00m BGS Material: BENTONITE GROUT --- Seal: 291.58 to 290.97m 0.00 to 0.61m BGS Material: CONCRETE					
61.0								
61.5								
62.0								
62.5								
63.0								
63.5								
64.0								
64.5								
65.0								
65.5								
66.0								
66.5								
67.0								
67.5								
68.0								
68.5								
69.0								
69.5								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW10D-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: S. MOLONEY

NORTHING: 4945177
EASTING: 591741.82

TOP OF RISER 260.52
GROUND SURFACE 259.55

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
0.0	TOPSOIL, with silt, trace sand, trace organics, dark brown, moist	259.39	CONCRETE			
0.5	ML-SILT, trace very fine sand, medium dilatancy, brown, moist to wet					
1.0	- highly dilatant, wet at 0.69m BGS					
1.5	- no sand, grey at 1.22m BGS		BENTONITE GROUT	1RS		100
2.0						
2.5						
3.0						
3.5	- trace very fine sand at 3.56m BGS					
4.0				2RS		100
4.5	- trace to no sand at 4.27m BGS		51mm PVC WELL CASING			
5.0						
5.5	- trace very fine sand at 5.13m BGS					
6.0						
6.5						
7.0				3RS		100
7.5			152mm BOREHOLE			
8.0	- with clay seam, hard, low plasticity at 7.82m BGS					
8.5						
9.0						
9.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW10D-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: S. MOLONEY

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
10.5				4RS		100
11.0						
11.5						
12.0						
12.5						
13.0				5RS		100
13.5						
14.0						
14.5						
15.0	- trace very small clay lenses 1 to 2cm, medium dilatancy at 15.24m BGS					
15.5						
16.0				6RS		100
16.5						
17.0						
17.5						
18.0						
18.5						
19.0				7RS		100
19.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW10D-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: S. MOLONEY

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
20.5						
21.0						
21.5			BENTONITE CHIPS			
22.0				8RS		100
22.5						
23.0	- with clay seam, hard, low plasticity, moist to dry from 23.01 to 23.32m BGS					
23.5			SAND PACK			
24.0						
24.5			51mm PVC WELL SCREEN			
25.0				9RS		100
25.5						
26.0	END OF BOREHOLE @ 25.91m BGS	233.64				
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						

WELL DETAILS
Screened interval:
236.69 to 233.64m
22.86 to 25.91m BGS
Length: 3.05m
Diameter: 51mm
Slot Size: 0.010
Material: PVC
Seal:
238.82 to 237.30m
20.73 to 22.25m BGS
Material: BENTONITE CHIPS
Sand Pack:
237.30 to 233.64m
22.25 to 25.91m BGS
Material: SAND

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW10S-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: S. MOLONEY

NORTHING: 4945177.24
EASTING: 591743.06

TOP OF RISER 260.42 m
GROUND SURFACE 259.44 m

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)
0.0	TOPSOIL, with silt, trace sand, trace organics, dark brown, moist	259.28	CONCRETE			
0.5	ML-SILT, trace very fine sand, medium dilatancy, brown, moist to wet					
1.0	- highly dilatant, wet at 0.69m BGS					
1.5	- no sand, grey at 1.22m BGS		BENTONITE GROUT	1RS		80
2.0						
2.5						
3.0			51mm PVC WELL CASING			
3.5	- trace very fine sand at 3.56m BGS					
4.0				2RS		100
4.5	- trace to no sand at 4.27m BGS		152mm BOREHOLE			
5.0						
5.5	- trace very fine sand at 5.13m BGS					
6.0						
6.5			BENTONITE PELLETS			
7.0				3RS		100
7.5						
8.0	- with clay seam, hard, low plasticity at 7.82m BGS		SAND PACK			
8.5						
9.0			51mm PVC WELL SCREEN			
9.5				4RS		100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: MW10S-18
DATE COMPLETED: 6 June 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: S. MOLONEY

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)		
10.5	END OF BOREHOLE @ 10.67m BGS	248.77	WELL DETAILS Screened interval: 251.82 to 248.77m 7.62 to 10.67m BGS Length: 3.05m Diameter: 51mm Slot Size: 0.010 Material: PVC Seal: 253.34 to 252.43m 6.10 to 7.01m BGS Material: BENTONITE CHIPS Sand Pack: 252.43 to 248.77m 7.01 to 10.67m BGS Material: SAND					
11.0								
11.5								
12.0								
12.5								
13.0								
13.5								
14.0								
14.5								
15.0								
15.5								
16.0								
16.5								
17.0								
17.5								
18.0								
18.5								
19.0								
19.5								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: BH1-18
DATE COMPLETED: 12 April 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: K. VANDER MEULEN

NORTHING: 4944891.79
EASTING: 591971.55

GROUND SURFACE 268.88

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m
0	SW-SAND (FILL), with gravel, with silt, odd cobble, compact, fine to medium grained, well graded, brown, moist	
6	SM-SILTY SAND, compact, very fine grained, slightly dilatant, poorly graded, brown, wet	264.31
14	ML-SILT, trace very fine sand, compact, dilatant, grey, wet	254.25
20	- little clay content from 19.81 to 20.73m BGS - little clay content at 21.34m BGS	
24.38	END OF BOREHOLE @ 24.38m BGS	244.49

BOREHOLE: 152mm BOREHOLE; BACKFILLED WITH BENTONITE GROUT

SAMPLE NUMBER	INTERVAL	REC (%)
1RS		56
2RS		100
3RS		100
4RS		100
5RS		100
6RS		100
7RS		100
8RS		100
9RS		100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: BH2-18
DATE COMPLETED: 10 April 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: K. VANDER MEULEN

NORTHING: 4944854.4
EASTING: 591843.66

GROUND SURFACE 269.26

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m
0	SP-SAND (FILL), with gravel, cobble, compact, very fine to medium grained, well graded, brown, moist	
6	ML-SILT, trace very fine sand, compact, dilatant, brown, wet	262.86
10	SM-SILTY SAND, compact, very fine grained, slightly dilatant, poorly graded, brown, wet	258.29
14	ML-SILT, compact, dilatant, grey, wet	254.63
18	SM-SILTY SAND, compact, very fine grained, slightly dilatant, poorly graded, grey, wet	250.36
24	CL-SILTY CLAY, stiff, low plasticity, grey, very moist to wet	245.79
27.13	END OF BOREHOLE @ 27.13m BGS	242.13

BOREHOLE: 152mm BOREHOLE; BACKFILLED WITH BENTONITE GROUT

SAMPLE NUMBER	INTERVAL	REC (%)
1RS		33
2RS		50
3RS		100
4RS		100
5RS		100
6RS		100
7RS		100
8RS		100
9RS		100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

OVERBURDEN LOG 11155365-WI.GPJ GHD_Corp 15/6/18

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: BH3-18
DATE COMPLETED: 10 April 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: K. VANDER MEULEN

NORTHING: 4944872.89
EASTING: 591807.36
GROUND SURFACE — 264.93

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m
0	SP-SAND (FILL), with silt, cobble, loose, very fine grained, poorly graded, brown, wet	263.71
2	ML-SILT, compact, dilatant, brown, wet	
6	SM-SILTY SAND, compact, very fine grained, slightly dilatant, poorly graded, grey, wet	259.14
8	ML-SILT, compact, dilatant, grey, wet	256.70
12	- with clay, low plasticity, grey from 12.19 to 14.33m BGS	
14	- trace very fine sand at 14.33m BGS	
16	- trace clay at 16.76m BGS	
18	CL-SILTY CLAY, firm, low to medium plasticity, grey, very moist to wet	246.95
20	END OF BOREHOLE @ 21.03m BGS	243.90

BOREHOLE: 152mm BOREHOLE; BACKFILLED WITH BENTONITE GROUT

SAMPLE NUMBER	INTERVAL	REC (%)
1RS		
2RS		100
3RS		100
4RS		100
5RS		100
6RS		100
7RS		100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

OVERBURDEN LOG 11155365-WI.GPJ GHD_Corp 15/6/18

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: CRH-TEEDON PIT
PROJECT NUMBER: 11155365
CLIENT: CRH CANADA GROUP INC
LOCATION: TINY TOWNSHIP, ONTARIO

HOLE DESIGNATION: BH4-18
DATE COMPLETED: 15 April 2018
DRILLING METHOD: SONIC
FIELD PERSONNEL: K. VANDER MEULEN

NORTHING: 4944969.53
EASTING: 591923.8

GROUND SURFACE 265.43

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m
0	SW/GW-SAND/GRAVEL (FILL, roadway), compact, fine to medium grained, well graded, brown, moist	264.52
0.3	TOPSOIL	264.21
0.6	SM-SILTY SAND, compact, very fine grained, poorly graded, dark brown, moist	
5.8	- dilatant, wet at 5.79m BGS	
8.8	- grey at 8.84m BGS	
11.6	ML-SILT, compact, dilatant, grey, wet	253.85
14.3	- trace to little clay content at 14.33m BGS	
18.1	SM-SILTY SAND, compact, very fine grained, dilatant, poorly graded, grey, wet	246.53
21.0	END OF BOREHOLE @ 21.03m BGS	244.40

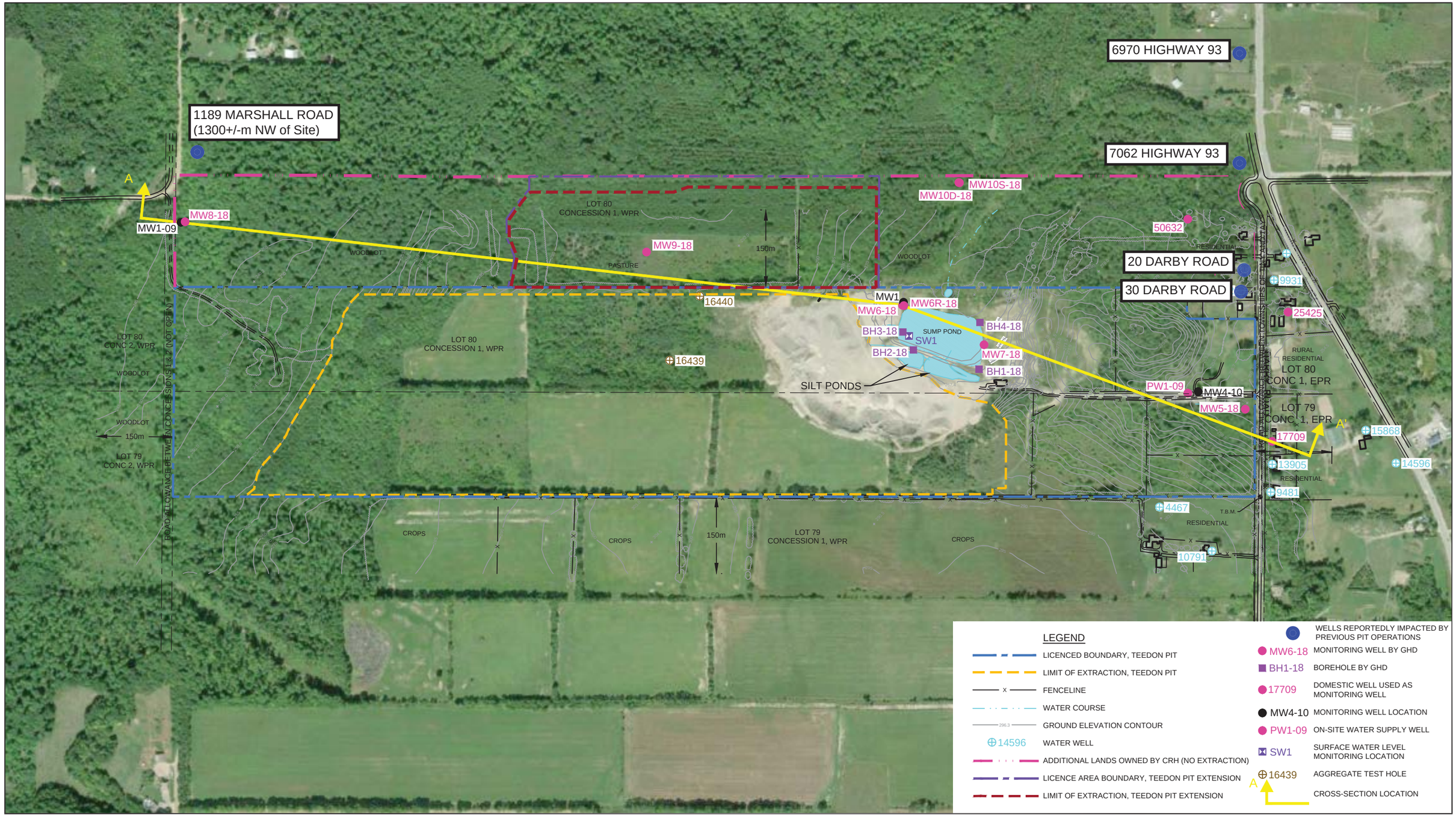
BOREHOLE: 152mm BOREHOLE; BACKFILLED WITH BENTONITE GROUT

SAMPLE NUMBER	INTERVAL	REC (%)
1RS		44
2RS		50
3RS		100
4RS		100
5RS		100
6RS		100
7RS		100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

OVERBURDEN LOG 11155365-WI.GPJ GHD_Corp 15/6/18

Attachment C



Source: Microsoft Product Screen shot Reprinted with permission from Microsoft Corporation, Aquisition Date 2018, Accessed April, 2018

0 70 140 210m

GHD

TEEDON PIT EXTENSION
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

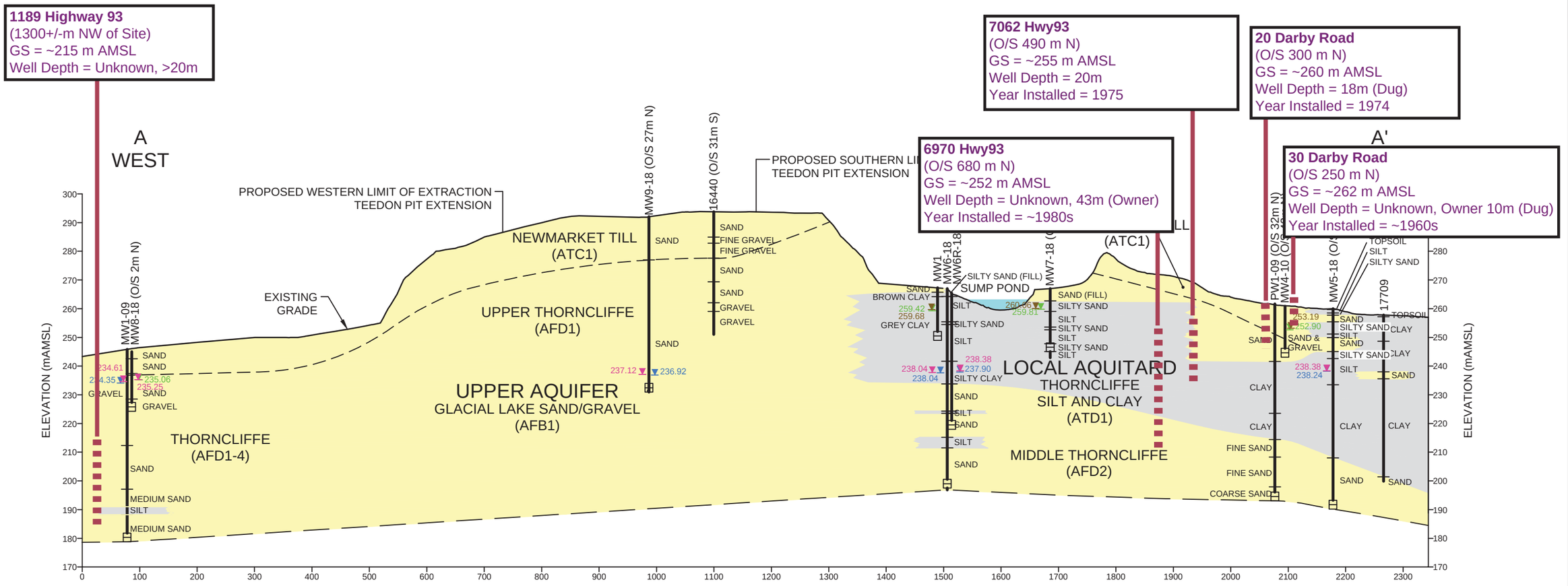
11155365-10

Sept 19, 2019

HYDROGEOLOGIC CROSS-SECTION LOCATIONS

FIGURE 1

CAD File: P:\drawings\11155000s\11155365\11155365-CORR\11155365-10(FERRI001)\11155365-10(FERRI001)GN\11155365-10(FERRI001)GN-WA001.DWG



NOTES:
(1) ALL OF THE PROPERTIES ARE SUFFICIENTLY FAR FROM THE CROSS-SECTION AND ARE THEREFORE APPROXIMATE.
(2) ONLY 2 OF THE PROPERTIES HAD WATER WELL RECORDS LOCATED (20 DARBY AND 7062 HWY 93) AND THE OTHER PROPERTIES HAD INFORMATION OBTAINED FROM INTERVIEWS DURING PREVIOUS DOMESTIC WATER WELL SURVEYS.
(3) GROUND SURFACE ELEVATIONS WERE APPROXIMATED FROM GOOGLE EARTH IMAGERY.

DISTANCE metres
HORIZONTAL TO VERTICAL EXAGGERATION 5 : 1

LOCAL STRATIGRAPHY AND HYDROSTRATIGRAPHY OBTAINED BY GHD ON BEHALF OF DUFFERIN WAS CORRELATED WITH THE 2017 WORK BY RILEY P. M. MULLIGAN AND ANDY F. BAJC. "QUATERNARY SEDIMENT ARCHITECTURE OF SIMCOE COUNTY, SOUTHERN ONTARIO"
SUMP POND TOPOGRAPHY BY DELPH & JENKINS LIMITED, MAY 2018.

LEGEND

- APPROXIMATE WELL DEPTH
- COARSE GRAINED DEPOSITS
- FINE GRAINED DEPOSITS
- 252.90 SHALLOW GROUNDWATER ELEVATION JULY 18, 2019
- 238.24 DEEP GROUNDWATER ELEVATION, JULY 18, 2019
- 238.38 MAXIMUM OBSERVED GROUNDWATER ELEVATION
- 253.19 MAXIMUM OBSERVED SHALLOW AQUITARD GROUNDWATER ELEVATION

TEEDON PIT EXTENSION
TOWNSHIP OF TINY, COUNTY OF SIMCOE, ONTARIO

Sept 19, 2019

SITE HYDROGEOLOGIC CROSS-SECTION A-A'

FIGURE 2

CAD File: P:\drawings\11155000s\11155365\11155365-CORR\11155365-10(FERRI001)\11155365-10(FERRI001)GN\11155365-10(FERRI001)GN-WA002.DWG

Attachment **4**

From: Scheifley, Jody (MECP)
Sent: October 25, 2019 1:33 PM
To: Nadon, Mallory (MECP) <Mallory.Nadon@ontario.ca>
Cc: Heeney, Paul (MECP) <Paul.Heeney@ontario.ca>
Subject: RE: AGGREGATES - Teedon Pit Extension, Township of Tiny, Simcoe County

Hi Mallory,

I would recommend with the absence of any whop-poor-will (survey conducted as per protocol) that MECP would have no outstanding concern with the Teedon Pit extension.

Jody Scheifley
Management Biologist | Permissions and Compliance Section, Species at Risk Branch
Ministry of Environment, Conservation and Parks
519-371-8422
1450 7TH Avenue East Owen Sound, Ontario, N4K 2Z1