Stormwater Management Report

2590 County Road 15

Picton, ON

June 3, 2025

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1 Introduction and Background

The owners of Edwin County Farms at 2590 County Road 15 are planning to convert part of their property south of County Road 15 and west of the farm buildings to facilitate a learning centre (see Figure 1-1).

The lands are currently vacant of any permanent structures and are used to store miscellaneous materials. Lands surrounding the development area are used for agricultural purposes and vacant field. The subject properties total more than 120ha in area, but only the northern 4.5ha is subject to development and activities as shown in Figure 1-1.

Figure 1-1: Development Site Location (Google, Maxar Tech 2025)

2 Existing Conditions

The entire property slopes gently toward the north with a slight tendency to the east in some areas at an average gradient of 2.5%.

2.1 Soils

Soils were reviewed from the Soil Survey of Prince Edward County (see Figure 2-2). The principal soil type is Solmesville Clay, and the other notable soil types are Farmington Loam, Ameliasberg Loam, Darlington Loam, Rock and Muck. The rock, muck, and Ameliasberg loam are present at the very southern tip of the property, and do not impact the developing land. Farmington Loam borders the road and encompasses the pond, while a Darlington Loam section splits the Solmesville portion. These are all shallow bedrock and partially stony, and imperfect drainage; consistent with hydrologic soils groups B and C.

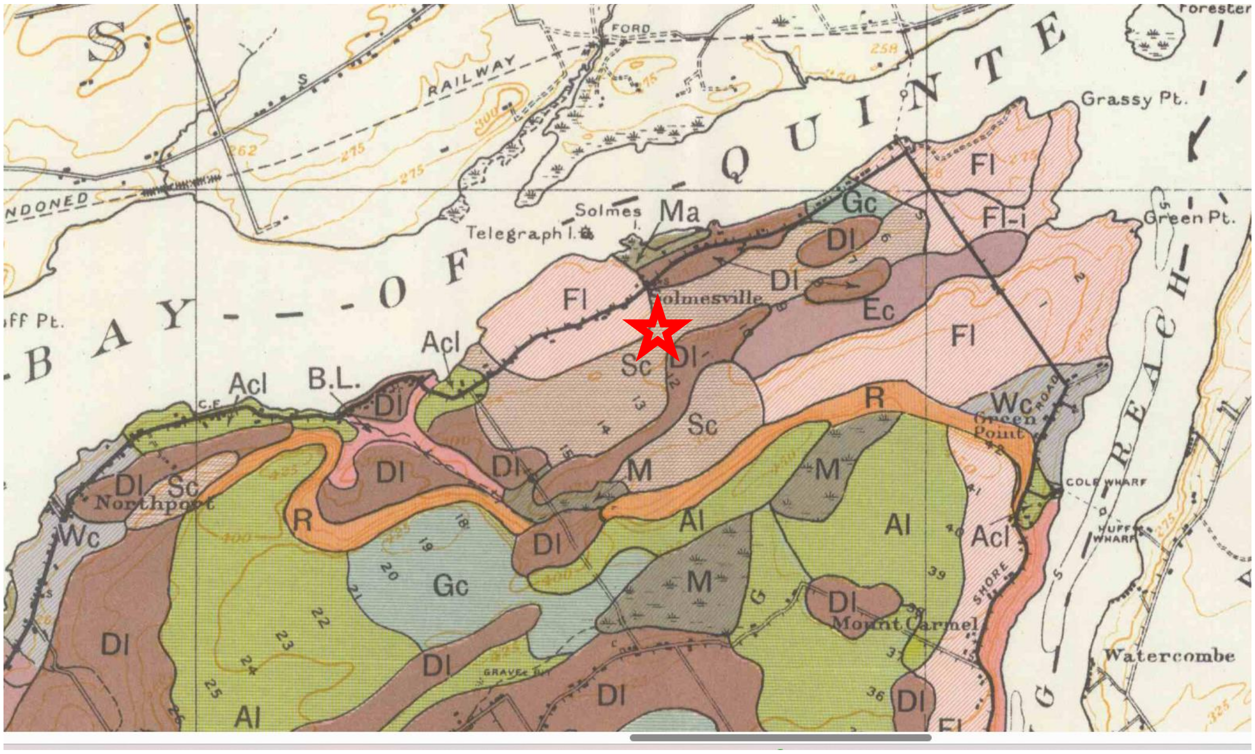


Figure 2-1: Soils Mapping of Prince Edward County, Report No. 10

The 2010 Sorbara Pond Installation Report shows that based on monitoring well records, the depth to bedrock ranges from 3 to 14 feet below ground surface, which aligns with the soil characteristics in the area which are typically shallow over bedrock. The infiltration of these imperfectly drained and shallow soils will be uncertain. Stormwater management and drainage features have been designed to function on this soil type.

2.2 Groundwater and Bedrock

The 2010 report makes note of a high groundwater table, the static level at the monitoring wells average 6.8 feet below ground surface, where the average bedrock is 6.3 feet. The high bedrock creates a perched aquifer on the top of the bedrock. The three test wells inside the pond showed that the static water level was less than one metre below ground surface.

The report also notes that of the total pond volume 75% is retained between events, and the other 25% is active storage for rainfall events. The report states that due to the flat topography and shallow overburden, surface water ponding following precipitation events would be expected.

The report also mentions that a well survey was sent to neighbours within a 500m radius of the property to further identify what that groundwater behaviour is at nearby properties. The survey had minimal response but offered insight as to the seasonal fluctuation of the groundwater table. The interested reader can find this report in Appendix F.

2.3 Targets

This site is expected to experience surface ponding during rainfall events as stated previously. This has been observed on site, and the developed conditions will ensure that the entrances and internal roads remain accessible during these events.

The stormwater management plan focuses on three environmental objectives when considering the treatment and conveyance of stormwater runoff. The objectives are to mitigate flooding, water quality impairments, and erosion impacts to the receiving system.

The Stormwater Management Planning and Design Manual (MOE, 2003) outlines potential negative impacts as a result of development, including water quality degradation, increase in surface runoff, soil erosion, and higher downstream flow velocities. The effects of development are understood on the basis of imperviousness.

Based on the guidance above, Jewell prepared a SWM solution to achieve the following targets:

Target #1: Quantity Control

- Ensure the post-development peak flows do not exceed pre-development peak flows for all return period events.

Target #2: Quality Control

- Ensure effluent water quality control does not experience degradation.

Target #3 Erosion and Sediment Control

- Minimize the potential for detrimental erosion of existing channels and watercourses

3 Hydrologic Modelling

The drainage scheme will continue to follow the natural drainage patterns to the outlet channel west of the property. Flow from the southern range is directed to a major swale through the center of the property, which outlets to the Sorbara Pond. The pond receives flow and passes it downstream to the west outlet.

Peak flows are determined using the Rational Method that is suited for catchments less than 100ha (Ministry of Transportation, 1997, p. 8.39) and OTTHYMO is used to model the catchments greater than 100ha.

Equation 1: Rational Method

$$Q = \frac{1}{360} CiA$$

Where:

Q = Peak Flow in cms
C = Runoff Coefficient
i = Rainfall Intensity in mm/hr
A = Area in hectares

The storage behaviour of the pond is determined by OTTHYMO pond routing during the 100-year 12-hour design storm. The calculations are included in Appendix D.

3.1 Model Inputs

Typical hydrologic inputs for the Modified Rational Method include:

- Precipitation data (intensity – duration – frequency)
- Area (ha)
- Time of Concentration
- Runoff Coefficient
- Imperviousness
- Slope

3.1.1 Precipitation

Precipitation records from Environment Canada were used for the Belleville station 6150689. The most recent Intensity Duration Frequency curves v3.3 (IDF curves) was released January 2023, and the Belleville station contains data from 1965-2017.

Precipitation statistics supplied to the model require the user to select:

- Station (i.e. Belleville)
- Duration (of the event in hours)
- Frequency (return period)

The MTO Drainage Manual (1997) recommends that the storm duration for smaller urban catchments to be in the range of 1-hr to 6-hr duration. The development lands are larger, thus longer duration events were reviewed. Typically, the storm duration should be equal to or greater than the time of concentration. The Rational Method does not use duration.

3.1.2 Area

The contributing area of each catchment is calculated using the assistance of LiDAR and GIS mapping. The total area that contributes to the property outlet after being captured by elements on site is 115ha.

3.1.3 Time of Concentration

The time of concentration is calculated using the Airport Method that is suitable for catchments with runoff coefficients less than 0.4. The Airport Method equation is shown below in Equation 2.

Equation 2: Time of Concentration by Airport Method

$$Tc = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w^{\ 0.33}}$$

Where:

T_C = Time of concentration in min
L = Length of Watershed in metres
C = Runoff Coefficient
S_W = Watershed Slope in %
A = Watershed area in hectares

The slope of each drainage area was determined using 85/10 Average Slope Method per Equation B2.2 of the MTO Drainage Manual. The interested reader can find these calculations in the Appendix C.

3.2 Runoff Coefficient

Runoff coefficients are estimates of the proportion of precipitation intensity that contributes directly to peak flows. The existing conditions runoff coefficient was assumed to be 0.20 to account for the long catchments and very little development.

Less than 5% of the property is under consideration for development, and of that 5% it is expected 50% of the area will experience any noticeable change. In these areas the runoff coefficient is around 0.30.

3.2.1 Imperviousness

Imperviousness is a representation of the proportion of impenetrable area to penetrable area, demonstrating the percentage of area that will produce pure runoff. A higher imperviousness suggests a higher runoff coefficient, while a lower percent imperviousness indicates a lower runoff coefficient. Typically, runoff coefficient is greater than imperviousness. In this case, the area is very sparsely populated with truly impervious area, so the runoff coefficient will be low.

3.2.2 Slope

The slope is used in the time of concentration calculation in the Airport Method.

3.3 Model Inputs

Typical hydrologic inputs for OTTHYMO include:

- Precipitation
- Area (ha)
- Time of Peak (for Nash)
- Curve Number
- Initial Abstraction

The following are inputs that differ from those already described as part of the Rational Method

3.3.1 Time of Peak

The time of peak was calculated as 2/3 of the time of concentration as recommended in the OTTHYMO user's manual.

3.3.2 Curve Number

Weighted Curve Number is calculated based on hydrologic soil group and land use characteristics within each catchment per MTO design charts 1.08 and 1.09. Based on hydrologic soil groups in the area, the curve number will be in the range of 65-76. A curve number of 71 has been used as a mediary for woodland and unimproved pasture.

Catchment 101 is the ‘direct to pond’ area, so it would be classified as lakes and wetlands which have a curve number of 50.

3.3.3 Initial Abstraction

The initial abstraction is the amount of precipitation that is directly removed from the calculations. This represents the depth of precipitation that is stored in depressions. This is typically applied as 2mm for asphalt and 5mm for landscaped areas. This site has no asphalt.

3.4 Peak Flows

The peak flow for each catchment is determined using the factors shown above. Any catchments that outlet to the pond have been modelled using OTTHYMO to demonstrate the pond behaviour under design conditions. Modelling was also used because the suggested limit of rational method is 100ha, beyond that point the calculations overestimate the peak flow exceeding the acceptable range of accuracy.

Catchments 100 and 101 are both routed through the pond, the routing calculations from OTTHYMO can be seen in the Appendix D. Catchment 100 is significantly bigger, so the times to peak will be offset from one another and will not be directly additive. The peak delay is more than thirty minutes based on the airport method for time of concentration and time to peak.

Table 3-1: Characteristics of catchments contributing to the pond - Minor Events (<5YR)

Minor Storm Inputs					
Catchment	**Area (ha)**	**Tp (hr)**	**CN**	**Slope (%)**	**Length (m)**
100	109	1.24	71	2.4	2340
101	1.94	0.21	50	0.6	150

Table 3-2: Characteristics of catchments contributing to the pond - Major Events (>5YR)

Major Storm Inputs					
Catchment	**Area (ha)**	**Tp (hr)**	**CN**	**Slope (%)**	**Length (m)**
100	109	1.17	71	2.4	2340
101	1.94	0.17	50	0.6	150

Catchments 102 and 103 do not get routed through the pond and have areas within the acceptable range for calculating their peak flow rate using the Rational Method, their inputs have been summarized below.

Table 3-3: Characteristics of catchments downstream of pond - Minor Events (<5YR)

Minor Storm Inputs					
Catchment ID	**Area (ha)**	**Runoff Coefficient**	**Slope (%)**	**Time of Concentration (min)**	**Intensity (mm/hr)**
102	0.53	0.3	1.5	21.7	52.6
103	3.79	0.3	2.6	36.2	37.2

Table 3-4: Characteristics of catchments downstream of pond - Major Events (>5YR)

Major Storm Inputs					
Catchment ID	**Area (ha)**	**Runoff Coefficient**	**Slope (%)**	**Time of Concentration (min)**	**Intensity (mm/hr)**
102	0.53	0.38	1.5	19.5	92.1
103	3.79	0.38	2.6	28.8	70.7

Jewell numbered the trail and road crossings based on the current concept plan. The 5-year and 100-year peak flows at each crossing is included below based on the results of Rational Method calculations and OTTHYMO modelling. The contributing flows from each catchment have been included to help identify the confluences and flow patterns around the property.

Hydrologic Point of Interest - Node 1 is the pond inlet, and Node 2 is the outlet. To conservatively estimate the storage capacity of the Sorbara pond and evaluate its flow attenuation ability, Jewell assumed that the static water level occurs at 80.40m. According to the owners, the water level during the middle of summer is approximately 80.20m, which allows the central island in the pond to be exposed.

The OTTHYMO modelling used a 12-hour storm to calculate the ability for the pond to attenuate incoming flows from Catchments 100 and 101. Refer to drawings in Appendix B for crossing locations.

Table 3-5: Peak flow at each point of interest

Node #	Contributing Catchments	5-year Peak Flow (m^3/s)	100-year Peak Flow (m^3/s)
1	100	1.05	2.21
2	100+101	1.15	2.81
3	100+101	1.15	2.81
4	102	0.02	0.05
5	103	0.22	0.28
6	All	1.40	3.14

A rule of thumb used in watershed and wetland modelling is 1.0 m^3/s per 100ha. This number is derived from flow gauges that have been analysed in other Jewell projects. This site is around 116ha and does not include any considerable wetlands within the area, so the expected flow based on flow gauge data would be around 1.5 m^3/s. The hydrology calculations predict 3.14 m^3/s, which is more than experimental research would suggest but within a reasonable tolerance to accept.

4 Stormwater Management Controls

4.1 Drainage Scheme

The drainage design follows the hierarchy of controls listed below in order of application:

1. Source Controls
2. Conveyance Controls
3. End of Pipe Controls

4.1.1 Source Controls

Source controls include techniques such as reduced lot grading, reductions in site imperviousness, and disconnection of roof drainage. Such types of controls reduce runoff volumes and minimize treatment facilities required to mitigate quality impairments. Source controls are not transferred to municipal control.

This site takes advantage of the rural area to seamlessly incorporate disconnected flow routes using rain gardens (also referred to planted buffers) to intercept flow prior to concentration. The parking lot and internal roads are gravel; this reduces the runoff generated compared to an asphalt surface.

4.1.2 Conveyance Controls

Conveyance controls provide treatment opportunities at flow concentrations where drainage is being collected and conveyed. These include grassed swales, ditches and storm sewers that are modified to infiltrate runoff.

Grassed swales and ditches will be used wherever possible on this site. Currently there are two distinct waterways that run through the property using roadside ditches. These ditches will be improved to convey all stormwater. The grassed swales have a low slope to promote infiltration.

4.1.3 End of Pipe Controls

When the source and conveyance controls are insufficient to achieve the targets, end of pipe controls may be applied. These typically include stormwater management ponds and constructed wetlands as well as Oil-Grit Separators.

This site currently has a pond which was originally installed as a decorative feature, taking advantage of the stream that run through the property in the springtime. This pond inadvertently serves as a poorly designed stormwater management pond in the spring.

4.2 Stormwater Conveyance

The stormwater conveyance strategy follows the major/minor principle as identified in the stormwater management design manual (Ministry of the Environment, 2003).

Existing

This site is poorly drained and experiences ponding throughout the property. The internal road network is very flat, and the pond is undersized to receive and effectively discharge attenuated flows. The operating range of the pond during the summer is 80.20 to 80.50, and the spring peaks annually exceed 80.60, causing spills to occur over low points around the pond. The following table shows the three critical locations which have existing controls governing their water surface elevation and correspond to Nodes 1, 2, and 6.

Table 4-1: Hydraulic parameters at critical junctures

Existing Conditions							
Node #	**Design Flow (m^3/s)**	**Size (m)**	**Culvert Invert (m)**	**# of Barrels**	**Weir Elevation (m)**	**WSEL (m)**	**Capacity Check**
1	2.21	/	None	None	80.9	81.18	✓
2	2.81	0.525	80.42	1	80.7	80.88	✓
6	3.14	0.525	80.2	1	80.58	80.73	✓

The weir elevation represents the average road elevation at the point of spilling. The weirs are between 10 and 20 meters wide, allowing the flow over the internal road network to be very broad and shallow. This in theory is beneficial; safe access is not a concern due to shallow depths over roads.

Proposed

As mentioned, any upgrades that can be done to relieve the road from being flooded each spring without causing undue flooding elsewhere on the property should be pursued. Jewell proposes some culvert improvement s and grade changes to manage drainage and reduce the frequency of any nuisance ponding. There will ne no increases of WSEL offsite.

Major and minor flows are conveyed at intersections with the roads by twin culverts for the primary waterway and single culverts for adjoining flow routes. Twin culverts are designed to overtop the gravel road during major events at a planned spillway, safely passing the flows without causing excessive head to develop on the upstream side. Minor flows will pass without overtopping the road.

The swales and culverts have been sized according to the peak flows shown in Section 3.4. The interested reader can find the calculations supporting the design of these elements in Appendix

D. The 5-year and 100-year results are shown below; it is expected that the 5-year flows would begin to engage weir flow.

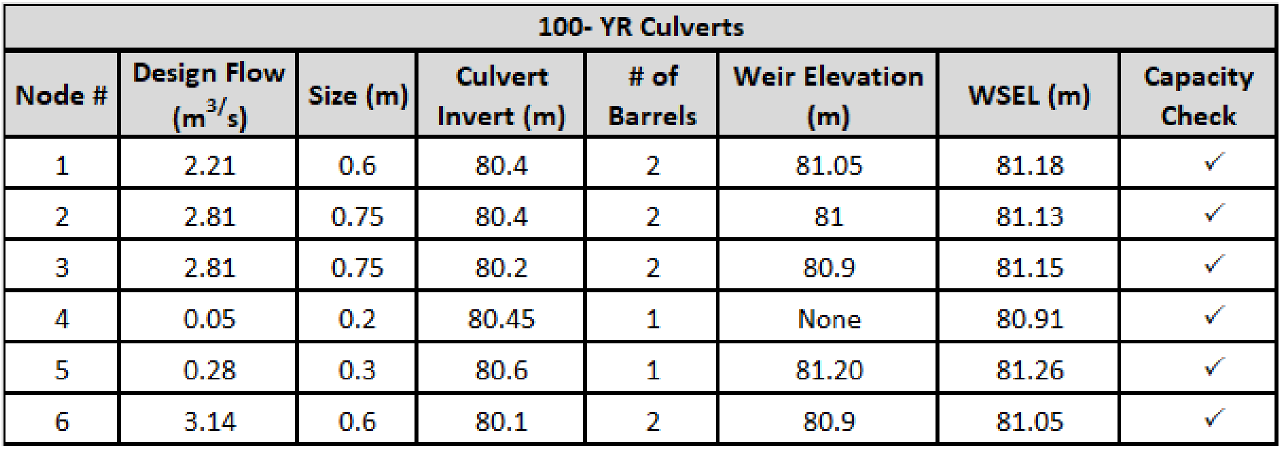
The proposed improvements include:

- **Culverts:** Culverts have been sized and specified at road crossings to safely pass the routine flows and help to pass major flows too. Culverts range in size from 200mm to 750mm and are twinned at high volume crossings.
- **Raising Roads:** The roads have been regraded to limit unpredictable flow patterns as well as provide sufficient cover over the culverts at crossings.
- **Widening Roads:** The roads will be widened up to 6m to accommodate fire access.
- **Refreshing Swales:** Swales will be refreshed and seeded to promote vegetation growth as well as ensure sufficient capacity to pass incoming flows without overtopping the banks.

Table 4-2: Hydraulic parameters following upgrades – 5- YR Culverts

5- YR Culverts							
Node #	**Design Flow (m^3/s)**	**Size (m)**	**Culvert Invert (m)**	**# of Barrels**	**Weir Elevation (m)**	**WSEL (m)**	**Capacity Check**
1	1.05	0.6	80.4	2	81.05	81.08	✓
2	1.26	0.75	80.4	2	81	81.03	✓
3	1.26	0.75	80.2	2	80.9	80.88	✓
4	0.02	0.2	80.45	1	None	80.63	✓
5	0.12	0.3	80.6	1	81.20	81.16	✓
6	1.41	0.6	80.1	2	80.9	80.95	✓

Table 4-3: Hydraulic parameters following upgrades – 100- YR Culverts

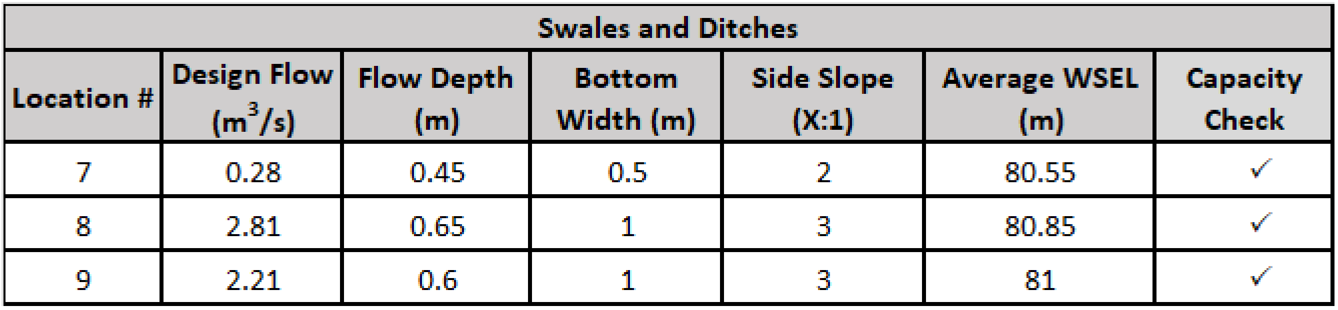


100- YR Culverts							
Node #	**Design Flow ($m^{3/}s$)**	**Size (m)**	**Culvert Invert (m)**	**# of Barrels**	**Weir Elevation (m)**	**WSEL (m)**	**Capacity Check**
1	2.21	0.6	80.4	2	81.05	81.18	✓
2	2.81	0.75	80.4	2	81	81.13	✓
3	2.81	0.75	80.2	2	80.9	81.15	✓
4	0.05	0.2	80.45	1	None	80.91	✓
5	0.28	0.3	80.6	1	81.20	81.26	✓
6	3.14	0.6	80.1	2	80.9	81.05	✓

The swales and ditches currently in use on the property are perfectly suited for the minor storm events, but they are easily overloaded during a major event. Jewell suggests that they are reshaped and improved to safely pass the 100-year design flows. Based on the culverts that are proposed at the upstream and downstream ends of the swales, the bottom width will be either 0.5m or 1.0m. An average bottom slope should be approximately 0.5% with 3:1 side slopes.

The reported average WSEL is based on the average of upstream and downstream pipe inverts, plus the flow depth. Node 7 has side slopes of 2:1 because it is in the middle of a dense cedar grove, so any adjustments to the swale should be minimized to reduce the number of conflicting trees. The root systems of the trees will be sufficient to maintain the steeper side slopes.

Table 4-4: Hydraulic parameters following upgrades – Swales and Ditches



Swales and Ditches						
Location #	**Design Flow (m^3/s)**	**Flow Depth (m)**	**Bottom Width (m)**	**Side Slope (X:1)**	**Average WSEL (m)**	**Capacity Check**
7	0.28	0.45	0.5	2	80.55	✓
8	2.81	0.65	1	3	80.85	✓
9	2.21	0.6	1	3	81	✓

4.3 Quality Treatment

This site does not have a dedicated quality treatment system, instead it has a stormwater pond and numerous planted buffers and rain gardens to offset any quality degradation.

The stormwater pond offers a chance for debris to settle and for sediment to accumulate in the pond bottom. The site is slated to undergo very little change and the change in impervious area is negligible compared to the greater catchment area. Negligible impact to water quality is expected.

Grassy contact through the 280m+ swales and ditches will help to clean the water on site. At the discharge point, where flows leave the immediate site area, there is a large marsh field owned by the same family which is mostly meadow in the summertime. This area is wet in the spring but offers another opportunity for water quality to be improved.

Culverts have been designed to have low velocities through the pipes to reduce the risk of erosion downstream.

Stormwater management Target #2 is satisfied.

4.4 Quantity Controls

The pond offers minimal peak flow attenuation. In the existing conditions the pond would produce a 100-year WSEL of 80.88m. At that level flows will be spilling out between the large berms north of the culvert and over the road to the south.

Jewell has proposed some re-grading in the area as per the Appendix B drawing. This will allow the pond to fill up slightly more than existing conditions but not cause backwatering to occur upstream. The existing 525mm culvert has minimal cover and holds water back causing the pond to spill over uncontrolled around its perimeter. The 525mm culvert will be replaced with two 750mm culverts to pass the accumulated flow without becoming a roadblock in the system.

The 750mm culverts and expanded low points in the road (weir) will improve flow passage reducing local velocities and water surface elevations. The 100-year flows can be controlled and discharged without becoming a hinderance or a safety issue by passing the flows through the 750mm culverts and 20m spillway. The configuration maintains low headwater on the upstream end, limiting high velocity flow through the culvert over the spillway. This site does not require any quantity control measures, however the proposed grading changes around the outlet and berms will certainly improve WSELs in routine events.

Table 4-5: WSEL change following improvements.

Water Surface Elevations				
Node #	**100-YR Design Flow (m^3/s)**	**WSEL-Pre (m)**	**WSEL-Post (m)**	**Difference (m)**
1	2.21	81.18	81.18	0.00
2	2.81	80.88	81.13	0.25
6	3.14	80.73	81.05	0.32

Node #1, the inlet to the pond on the east property border, experiences no change in WSEL after the improvements. The new inlet will have the same characteristics in the major storm event, thus ponding changes will not be seen offsite. At Node #2, the pond outlet, the WSEL increases by 0.25m which retains flows inside the pond allowing it to partially function as a stormwater facility. At the property discharge point, the water level will see the most change. The raised road will prevent flows from spilling over the road, and instead be constrained to the intended flow route, a byproduct of simplified drainage through the property.

This strategy satisfies stormwater management Target #1.

5 Climate Change

The province requires that all developments be planned to be resilient to the impacts of climate change. The predictions of climate change vary, but the province has suggested precipitation may vary by plus or minus 10%. Jewell finds that an increase in storage of 10% accounts for the additional precipitation input from climate change.

This site is undergoing minimal change, and most of the changes being made will be offset by the landscape architecture that is proposed. The planted buffers and rain garden combination will allow storage to be achieved in small underground pockets of stone and engineered soil. The groundwater table is high in this area, but the stored water will be used by the trees and shrubs above.

The Hydrologic Points of Interest have demonstrated that the flow over the proposed fire route and internal road network is not exceeding the 0.3m flow depth limit. The most flow over the road during the 100-year storm will be at Node 3, a crossing over the AODA pathway, which crests at 0.26m over the path. The additional 0.04m would be a combination of weir flow and culvert flow increasing the crossing capacity 3.23 m^3/s, a 15% increase.

The climate change effects have not been accounted for explicitly in the design, but the 10% buffer to safely pass increased flow rates at all nodes exists.

6 Low-Impact Development

Low Impact Development is a requirement of the 2020 Provincial Policy Statement. This requires that all developments consider LID strategies to reduce the impact of development on the hydrologic regime.

The Low Impact Development Guidelines (Toronto and Region Conservation Authority, 2010) states that “increases in the quantity, rate, and frequency of runoff can be linked to two root causes:

- the conversion of undeveloped or agricultural land cover to urban uses, and
- the application of storm sewer systems.”

The goal of LID site design strategies is to minimize these two sources of hydrologic impacts (Toronto and Region Conservation Authority, 2010, p. 3.3). Large urban areas are negatively impacted by flash flooding associated with extensive hardening. The LID design techniques seek to mitigate flooding and erosion associated with urbanization. While water quality improvements are associated with the recommended techniques, quantity control remains the focus of LID.

The guidelines provide some site design strategies for reducing the hydrologic impact postulating 4 major groupings or “themes”:

1) Preserving important hydrologic features and functions;
2) siting and layout of development;
3) reducing impervious area; and
4) using natural drainage systems.

The site design incorporates all four of the themes. Some strategies are applied with greater care since municipal requirements limit such techniques as setbacks, road design, parking, and drainage design. The LID guidelines provide a hierarchy of applying the LID techniques by first invoking the use of natural hydrologic areas and then development of green infrastructure. As such, the design adds limited green technologies that will encourage infiltration.

Discussion of the LID design used in the stormwater management design is provided below.

6.1 Theme 1 – Preserving Important Hydrologic Features

This theme focuses on preservation. Site design is adjusted to preserve natural features that benefit hydrology.

- Preserve stream buffers, including along intermittent and ephemeral channels
- Preserve areas of undisturbed soil and vegetation cover
- Avoid development on permeable soils
- Preserve existing trees and, where possible, tree clusters

Important hydrologic features include:

- Highly permeable soils
- Pocket wetlands
- Significant small (headwater) drainage features
- Riparian buffers
- Floodplains
- Undisturbed natural vegetation
- Tree clusters

This site makes good use of preserving the natural features and limiting development to the open areas.

6.2 Theme 2 – Application of Siting and Layout Techniques

Siting and layout techniques aim to reduce the environmental impacts of the development by fitting the development within the framework of the natural heritage features.

- Fit the design to the terrain
- Use open space or clustered development
- Use innovative street network designs
- Reduce roadway setbacks and lot frontages

The landscape design has been expertly executed by the designers at Victoria Taylor Landscape Architecture. The road network uses existing paths and the material storage area for the farm is being converted into a gravel turnaround area and parking area beside the schoolhouse.

6.3 Reducing the Impervious Area

Imperviousness can be reduced by minimizing unnecessary surface hardening. Some strategies include:

- Reducing street width
- Reducing building footprints
- Reducing parking footprints
- Considering alternatives to cul-de-sacs
- Eliminating unnecessary sidewalks and driveways

The layout of the AODA walking trails and fire route uses only the minimum width to minimize development efforts and impacts. There is minimal parking available, parents are expected to drop off kids at the gathering area and then promptly leave. Daily parking is for school staff only.

6.4 Theme 4 – Using Natural Drainage Systems

These strategies focus on the use of existing natural drainage systems where available “to take advantage of undisturbed vegetated areas and natural drainage patterns.”

- “Disconnect” impervious areas
- Preserve or create micro-topography
- Extend drainage flow paths

Drainage will continue to follow the existing regime that contributes to the west outlet. This is a well established drainage route with a defined channel and long path south of County Road 15.

6.5 LID Summary

There is significant vegetation on the property which will be preserved along with a pond and watercourse. In accordance with the LID goals, the existing drainage pattern will be maintained and the impervious area minimized. The most notable effort is disconnected runoff wherever possible with micro-grading to encourage infiltration to the limited permeability soils.

7 Erosion and Sediment Control

Erosion and sediment control is one of the three targets identified in Section 0. The following measures are proposed to prevent the negative erosion and sediment impacts of development.

Typical site development requires removal of some vegetated cover. While it is the intention to reduce vegetation removal, exposed soils from the work will be at risk of eroding into the receiving drainage system. Measures will need to be put in place to reduce erosion during construction. Typical erosion and sediment control measures include:

- Siltation fencing.
- Strawbale check dams.

Controls are to be placed downstream of all active work areas and upstream of protected receivers. Controls should also be placed around stockpiles of topsoil and fill materials.

Typical OPSDs provide good instruction on the correct placement and construction of the controls. The controls provide some protection if they are properly maintained, but they should be considered last-resort measures. The most effective means of control are those which prevent or reduce erosion at the source. This would include diligent stabilization of exposed areas immediately after grading is completed. Stabilization measures include topsoil and hydroseed on gently sloped areas (with slope 10% or less).

The site developer and contractor should actively maintain the new drainage works to remove accumulations of sediment within swales and ditches, as well as the pond.

A silt fence should be located along the upland perimeter of all sensitive features during the construction process, which should be maintained until the lands have been stabilized or as directed by the county. There would be benefit in maintaining this silt fence for up to 2 growing seasons.

By applying good installation techniques and maintaining the siltation controls in good condition, the proposed erosion and sediment controls will satisfy Target #3.

8 Conclusions

A single room learning centre is proposed to be constructed at 2590 County Road 15 on a 100ha+ parcel of land that is currently underutilized as farm adjacent land. The owners of Edwin Farms are expanding their offerings to include a learning centre for local youth.

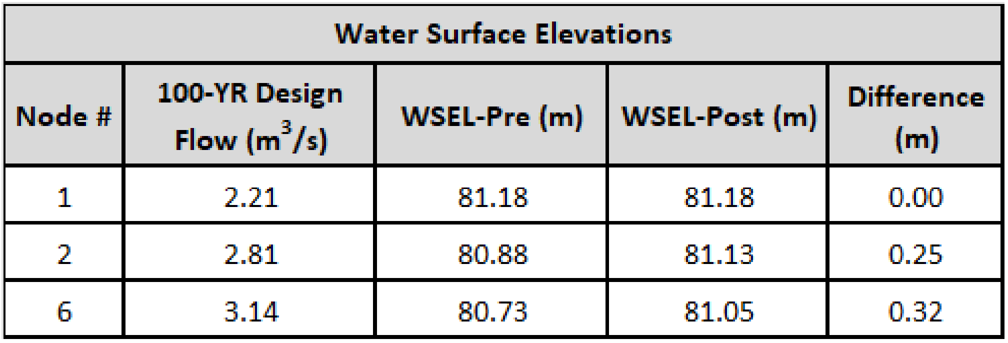
To facilitate this development, the site will need to undergo slight grading and layout changes to reduce the naissance ponding imposed by rain events. The site is poorly drained; it currently experiences localized flooding in pockets around the entire property when snow melt and precipitation events coincide.

Based on clayey soil conditions and gentle topography, this site has an average runoff coefficient of 0.27 in the 100-year design event with a time to peak just over an hour. The peak flow at the inlet to the pond is 2.8 m^3/s, this considers any development that is planned to occur. This modelling is conservative, and any improvements may be better than stated within this report.

Improvements include:

- **Culverts:** Culverts have been sized and specified at road crossings to safely pass the routine flows and help to pass major flows too. Culverts range in size from 200mm to 750mm and are twinned at high volume crossings.
- **Raising Roads:** The roads have been regraded to limit unpredictable flow patterns as well as provide sufficient cover over the culverts at crossings.
- **Widening Roads:** The roads will be widened up to 6m to accommodate fire access.
- **Refreshing Swales:** Swales will be refreshed and seeded to promote vegetation growth as well as have sufficient capacity to pass incoming flows without overtopping the banks. Often times debris and sediment fill the ditches, this can be easily remediated.

Table 8-1: WSEL effects due to drainage simplification



Water Surface Elevations				
Node #	100-YR Design Flow (m^3/s)	WSEL-Pre (m)	WSEL-Post (m)	Difference (m)
1	2.21	81.18	81.18	0.00
2	2.81	80.88	81.13	0.25
6	3.14	80.73	81.05	0.32

At the critical crossings the water surface will be increased within the confines of the property. This is the result of raising the road to no longer be overtopped during small events, as the culverts will now be responsible for passing this flow. The existing conditions clearly demonstrate that the pond is a roadblock in the system, so the low road profiles permit pond to prematurely discharge. The increased WSEL implies that the pond will have a longer retention time even though the peak flow has not been changed allowing the suspended sediments to settle. This improves water quality in accordance with stormwater management Target #2.

At Node 6, the WSEL is increased the most, but it does not backwater the other crossings. This increased water level across the property is acceptable, while the water level required at the inlet of the pond remains unchanged, demonstrating that no flooding increases will be experienced on the neighboring parcels.

Proposed culverts should be HDPE as they will have the longest lifespan and are easily installed at all crossings. Plastic pipes are known to be flexible and have a high flow rate.

The site is limited by misplaced berms around the property and undersized swales. Specifically, the berms at the inlet of the pond appear to constrain flows during major events (causing flooding on the adjacent property). Removing the berm will improve the drainage during minor and major events. The gaps between berms around the pond should also be closed to simply the drainage patterns.

The proposed planted buffers and rain gardens are the best solution to water quality and will help to seamlessly manage increased runoff while providing a water source for the flora.

These changes will benefit the property as their pond will now have a purpose, the road will stay dry during most events, and the property will drain into vacant field instead of slowly infiltrating into the poor soils.

9 Maintenance

The owners of the property are prepared to commit their time to improving the community and invest the time it takes to create a functional space for children to grow. This will involve maintaining the quality of all roads, rain gardens, water features, culverts, etc.

The rain gardens and planted buffers will have underground storage in stone with a high void ratio which promotes infiltration into the high groundwater table. This stone may be washed or replaced every year to ensure that sediment has not taken over this void space. Filter cloth should be sufficient to keep sediment out of the clear stone, but surface accumulation of rainwater may be an indicator that the fabric is breached and needs to be repaired.

Culverts should be free of debris and sediment accumulation each summer. Given that the roads will be granular material only, the culverts may be subjected to more sediment from driving over the gravel road. Swales should also be free of large debris and excessive sediment accumulation; cleaning should be done annually if possible.

The swales should be coated in a grass seed mixture, if possible, to promote the growth of native plant species. These will reduce erosion and allow suspended sediment to settle. The owners and architects connected to this project are well versed in horticulture and will be the most knowledgeable regarding native plants with deeper roots to stabilize the young soils.

Any noticeable washout of the road at the spillways should be fixed immediately following any major storms.

Overall, the maintenance of this property will not be much different than the existing conditions. Culverts and swales are already on the property, so routine maintenance of these features should be in alignment with the suggestions of Jewell.

Prepared by:

Matt W

Matthew Warner, BASc
Jewell Engineering Inc.

Submitted by:

LICENSED PROFESSIONAL ENGINEER
B. C. KEENE
June 3/25
PROVINCE OF ONTARIO

Bryon Keene, P.Eng.
Jewell Engineering Inc.

10 References

The information used to prepare this report is based on the following documents and information provided as noted below:

Ministry of the Environment. (2003). *Stormwater Management Planning and Design Manual.*

Ministry of Transportation. (1997). *Drainage Management Manual.*

MTO. (2008). Highway Drainage Design Standards.

Soil Survey of Hastings County. (1962). Canada Department of Agriculture.

Toronto and Region Conservation Authority. (2010). *Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0.*

APPENDIX A

Environment Canada IDF Curves

```
                  Environment and Climate Change Canada
                Environnement et Changement climatique Canada

            Short Duration Rainfall Intensity-Duration-Frequency Data
          Données sur l'intensité, la durée et la fréquence des chutes
                           de pluie de courte durée

                Gumbel - Method of moments/Méthode des moments

                                 2021/03/26

================================================================================

 TRENTON A                                             ON        6158875

 Latitude:  44 7'N     Longitude: 77 32'W    Elevation/Altitude: 86         m

 Years/Années :  1965 - 2017          # Years/Années :     46

================================================================================

********************************************************************************

Table 1 : Annual Maximum (mm)/Maximum annuel (mm)

********************************************************************************

          Year  5 min 10 min 15 min 30 min    1 h    2 h    6 h   12 h   24 h
         Année
          1965    7.4   10.9   14.7   17.3   18.3   19.0   26.9   29.5   43.9
          1966    8.1   10.9   11.7   16.5   20.1   22.4   35.8   44.7   45.7
          1967    9.1   10.9   11.7   14.2   15.5   16.3   29.7   47.2   69.6
          1968    4.1    6.1    7.4    9.7   13.5   16.5   33.0   40.1   40.9
          1969    5.8    9.7   13.5   18.8   21.6   24.6   34.0   39.1   54.9
          1970    6.1    7.9   10.2   13.7   15.0   20.6   28.2   40.4   48.0
          1971    7.1   10.9   11.2   12.2   12.7   17.5   22.1   29.0   35.1
          1972   11.2   13.2   13.7   15.5   16.0   20.8   27.7   31.5   47.2
          1973    6.6   10.4   10.4   15.0   15.5   22.4   43.2   52.1   53.6
          1975    6.9    7.6   10.7   13.7   15.5   25.4   32.3   33.5   34.3
          1976    6.9   11.2   11.7   12.7   14.0   14.5   27.9   29.2   30.2
          1977    6.9   11.2   11.7   21.8   37.1   45.5   67.3   72.1   72.1
          1978    7.1    9.9   11.2   15.0   15.9   19.9   31.7   34.1   36.6
          1979    6.5    9.3   11.5   11.5   11.5   17.0   37.7   54.8   55.8
          1980    9.3   14.0   16.3   22.9   31.1   37.6   46.6   46.6   60.0
          1981   11.4   20.2   25.0   25.0   25.0   25.0   32.9   46.8   48.2
          1982   14.2   18.4   22.2   22.4   23.2   30.7   39.0   39.0   39.0
          1983    5.9   10.3   14.0   15.0   21.8   34.0   36.4   42.0   63.3
          1984    4.4    7.2    7.8   10.1   11.8   13.0   27.7   41.7   42.2
          1985   12.2   15.2   18.3   24.3   24.4   37.1   37.1   39.3   39.7
          1986   24.3   24.8   26.0   27.1   27.1   32.8   63.2   65.0   65.6
          1987   12.2   13.6   14.7   17.3   18.3   20.3   30.4   39.1   42.4
          1988    4.7    8.1    8.8    9.9   15.1   15.2   20.2   28.0   28.0
```

```
        1989    7.3   10.5   10.5   16.8   25.3   25.3   29.8   29.8   34.7
        1990    6.6    7.5    9.0   11.0   12.7   16.7   32.9   46.1   50.0
        1991   10.6   11.6   12.6   12.8   14.0   15.8   25.7   26.2   32.8
        1992    4.7    8.1    9.6   12.1   14.9   20.2   30.1   38.0   42.8
        1993    4.2    6.8    9.3   11.7   21.1   23.6   25.5   41.7   56.0
        1994    5.6    8.8   10.5   14.6   17.8   19.6   31.3   32.5   34.8
        1995   10.6   14.6   18.0   22.2   28.3   41.4   50.4   56.8   64.9
        1996    3.4    6.2    7.3    9.5   14.2   19.8   30.0   33.8   42.8
        1997    5.0    9.1   11.7   19.8   34.8   43.1   48.7   48.7   53.9
        2000   11.4   17.6   22.3   33.5   59.6   68.2   69.8   69.8   71.6
        2001    4.7    5.2    7.0    9.2   17.4   19.5   22.3   32.9   40.4
        2002  -99.9  -99.9  -99.9  -99.9  -99.9  -99.9  -99.9   78.8   78.8
        2003    6.1   11.8   14.0   21.3   26.8   34.0   42.1   45.1   50.2
        2004    7.1   10.0   14.9   18.9   31.7   48.9   88.9  109.6  123.7
        2005    5.0    7.0    7.2    7.9   13.6   19.1   40.8   50.3   54.1
        2006    5.0    8.1    9.6   15.6   20.4   25.0   42.9   55.1   69.9
        2007   10.3   11.4   14.2   21.2   26.3   30.5   44.3   60.9   62.1
        2008    6.1   12.1   14.0   21.2   23.1   32.5   32.7   40.4   47.6
        2009    4.6    8.6    9.0   11.8   12.6   18.7  -99.9   58.0   75.8
        2010    5.0    5.3    6.9    8.4    9.6   11.8   24.7   48.3   59.1
        2012    5.5    8.0   10.5   21.1   35.7   44.5   60.5   79.9   80.6
        2013    5.4    9.5   13.8   20.5   20.8   25.0   30.7   33.5   42.8
        2014    7.8   10.7   11.3   13.7   23.9   33.6   43.3   47.1   79.4
        2016    7.1   10.9   16.1   23.7   24.8   27.2   34.9   46.2   46.2
        2017    5.5   10.3   12.6   13.8   20.3   27.8   33.8   52.0   66.3
      -------------------------------------------------------------------------
      # Yrs.     47     47     47     47     47     47     46     48     48
      Années
        Mean    7.5   10.7   12.7   16.5   21.1   26.4   37.5   46.4   53.3
     Moyenne
   Std. Dev.    3.6    3.8    4.5    5.6    8.9   11.2   13.8   16.0   17.5
 Écart-type
       Skew.   2.55   1.57   1.32   0.70   1.99   1.50   1.80   1.71   1.49
 Dissymétrie
    Kurtosis  12.61   6.57   4.92   3.48   9.40   6.09   6.82   7.30   7.19

        *-99.9 Indicates Missing Data/Données manquantes

 Warning: annual maximum amount greater than 100-yr return period amount
 Avertissement : la quantité maximale annuelle excède la quantité
                pour une période de retour de 100 ans
        Year/Année      Duration/Durée       Data/Données          100-yr/ans
              1986              5 min                24.3                18.7
              1986             10 min                24.8                22.7
              2000              1 h                  59.6                49.0
              2000              2 h                  68.2                61.4
              2004              6 h                  88.9                80.8
              2004             12 h                 109.6                96.5
              2004             24 h                 123.7               108.1

*************************************************************************
```

```
Table 2a : Return Period Rainfall Amounts (mm)
           Quantité de pluie (mm) par période de retour

********************************************************************************

 Duration/Durée        2        5       10       25       50      100   #Years
                  yr/ans   yr/ans   yr/ans   yr/ans   yr/ans   yr/ans   Années
          5 min      6.9     10.1     12.2     14.8     16.8     18.7       47
         10 min     10.0     13.4     15.7     18.5     20.6     22.7       47
         15 min     12.0     15.9     18.5     21.8     24.2     26.7       47
         30 min     15.5     20.5     23.8     27.9     31.0     34.0       47
          1 h       19.6     27.5     32.7     39.3     44.2     49.0       47
          2 h       24.5     34.4     41.0     49.2     55.4     61.4       47
          6 h       35.3     47.5     55.5     65.7     73.3     80.8       46
         12 h       43.8     57.9     67.2     79.1     87.8     96.5       48
         24 h       50.4     65.9     76.1     89.0     98.6    108.1       48

********************************************************************************

Table 2b :

 Return Period Rainfall Rates (mm/h) - 95% Confidence limits
 Intensité de la pluie (mm/h) par période de retour - Limites de confiance de
95%

********************************************************************************

 Duration/Durée        2        5       10       25       50      100   #Years
                  yr/ans   yr/ans   yr/ans   yr/ans   yr/ans   yr/ans   Années
          5 min     83.1    120.9    146.0    177.7    201.2    224.5       47
                +/- 11.2 +/- 18.9 +/- 25.6 +/- 34.5 +/- 41.3 +/- 48.1       47
         10 min     60.3     80.6     94.0    111.0    123.7    136.2       47
                +/-  6.0 +/- 10.2 +/- 13.7 +/- 18.5 +/- 22.1 +/- 25.8       47
         15 min     47.8     63.6     74.0     87.1     96.9    106.6       47
                +/-  4.7 +/-  7.9 +/- 10.6 +/- 14.3 +/- 17.1 +/- 20.0       47
         30 min     31.1     41.0     47.5     55.8     61.9     68.0       47
                +/-  2.9 +/-  4.9 +/-  6.7 +/-  9.0 +/- 10.8 +/- 12.5       47
          1 h       19.6     27.5     32.7     39.3     44.2     49.0       47
                +/-  2.3 +/-  3.9 +/-  5.3 +/-  7.2 +/-  8.6 +/- 10.0       47
          2 h       12.3     17.2     20.5     24.6     27.7     30.7       47
                +/-  1.5 +/-  2.5 +/-  3.3 +/-  4.5 +/-  5.4 +/-  6.3       47
          6 h        5.9      7.9      9.3     11.0     12.2     13.5       46
                +/-  0.6 +/-  1.0 +/-  1.4 +/-  1.9 +/-  2.2 +/-  2.6       46
         12 h        3.6      4.8      5.6      6.6      7.3      8.0       48
                +/-  0.3 +/-  0.6 +/-  0.8 +/-  1.1 +/-  1.3 +/-  1.5       48
         24 h        2.1      2.7      3.2      3.7      4.1      4.5       48
                +/-  0.2 +/-  0.3 +/-  0.4 +/-  0.6 +/-  0.7 +/-  0.8       48

********************************************************************************

Table 3 : Interpolation Equation / Équation d'interpolation: R = A*T^B
```

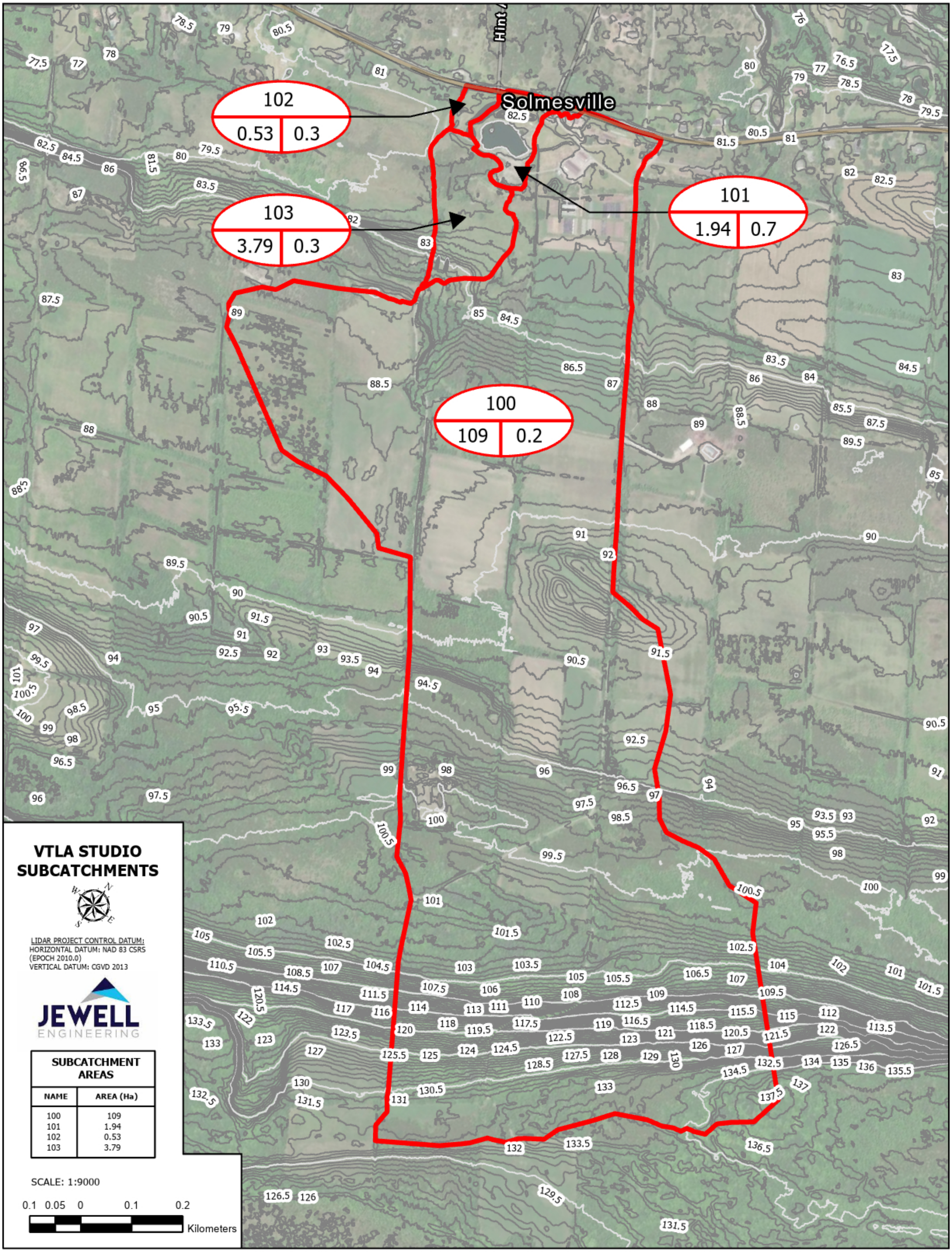
```
R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)
RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)
 T = Rainfall duration (h) / Durée de la pluie (h)

********************************************************************************

       Statistics/Statistiques      2      5     10     25     50    100
                               yr/ans yr/ans yr/ans yr/ans yr/ans yr/ans
      Mean of RR/Moyenne de RR   29.5   40.7   48.1   57.4   64.4   71.2
    Std. Dev. /Écart-type (RR)   28.6   40.4   48.3   58.4   65.8   73.2
        Std. Error/Erreur-type    4.5    4.2    4.2    4.5    4.9    5.3
               Coefficient (A)   18.6   25.2   29.6   35.2   39.3   43.4
         Exponent/Exposant (B) -0.656 -0.664 -0.668 -0.671 -0.673 -0.674
 Mean % Error/% erreur moyenne    5.1    5.0    5.2    5.6    6.0    6.2
```

APPENDIX B

Grading Plan and Catchment Area Drawings



VTLA STUDIO SUBCATCHMENTS

LIDAR PROJECT CONTROL DATUM:
HORIZONTAL DATUM: NAD 83 CSRS
(EPOCH 2010.0)
VERTICAL DATUM: CGVD 2013

JEWELL
ENGINEERING

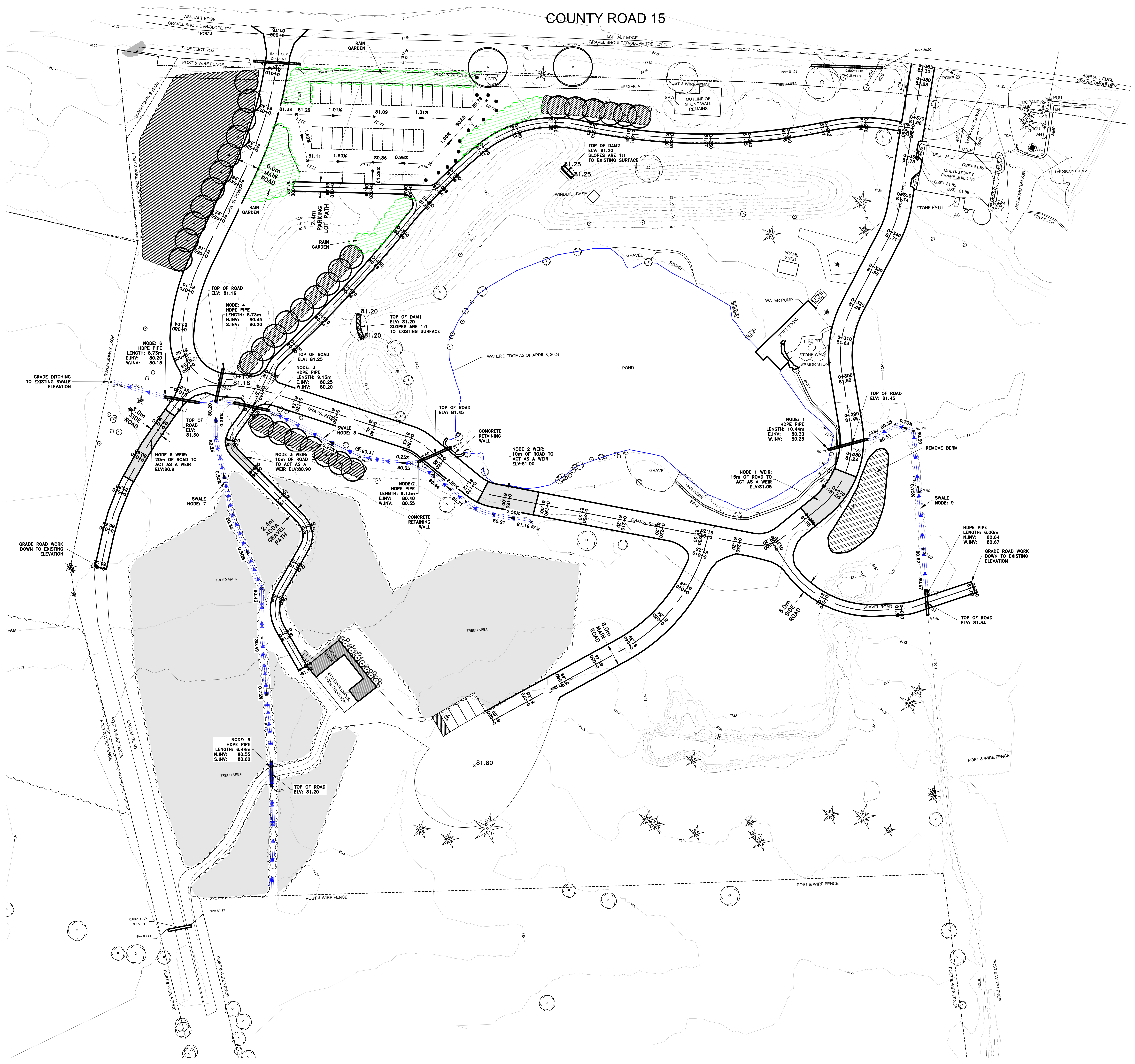
SUBCATCHMENT AREAS

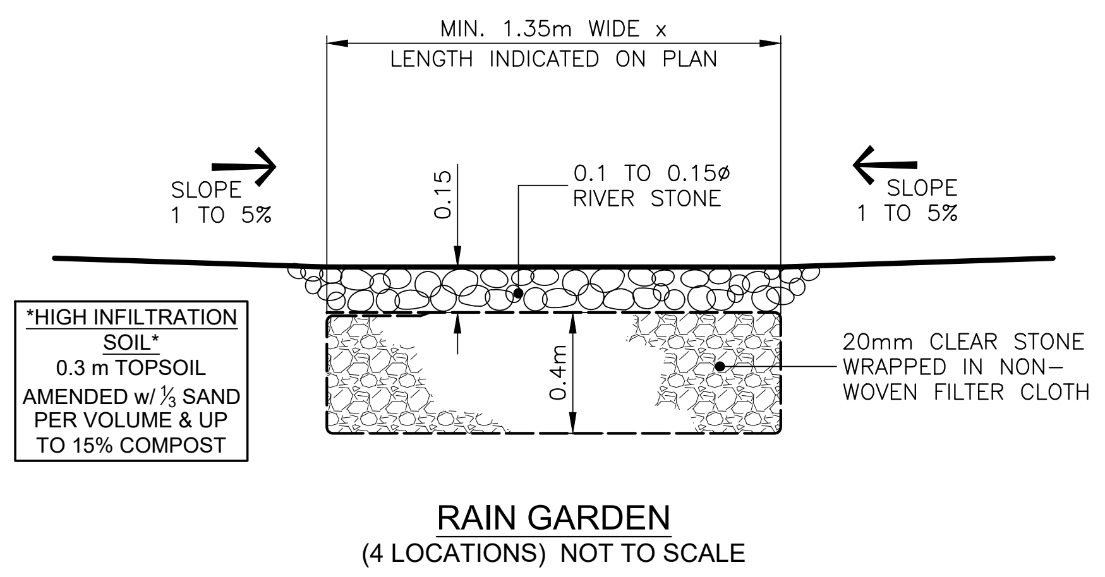
NAME	AREA (Ha)
100	109
101	1.94
102	0.53
103	3.79

SCALE: 1:9000

06/03/2025

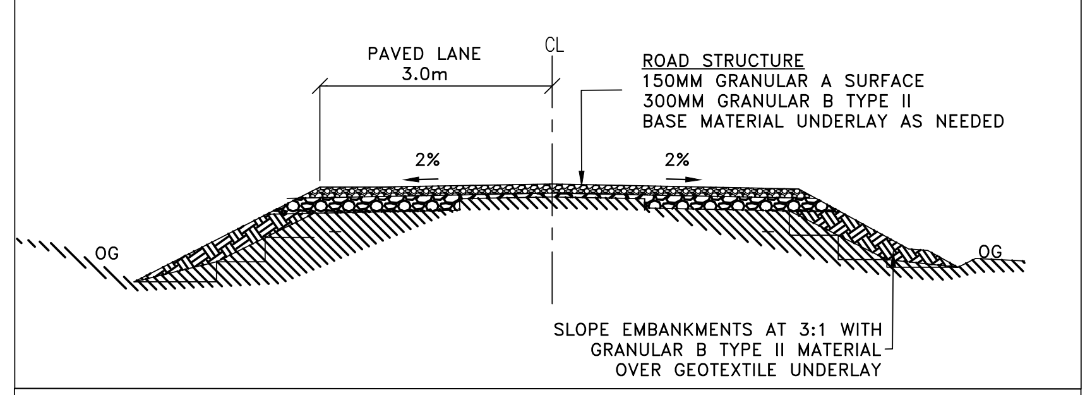
F:\FTP\PROJECT FILES\VTLA STUDIO 240-5708\DRAWINGS\2505708 VTLA GRADING MODEL



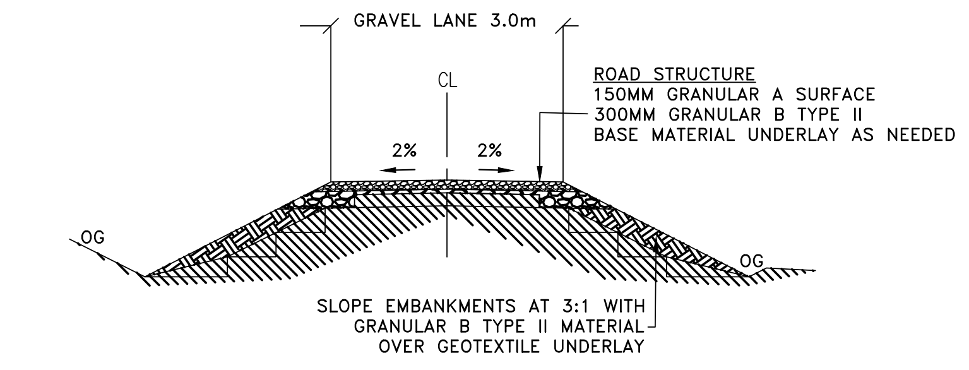


RAIN GARDEN
(4 LOCATIONS) NOT TO SCALE

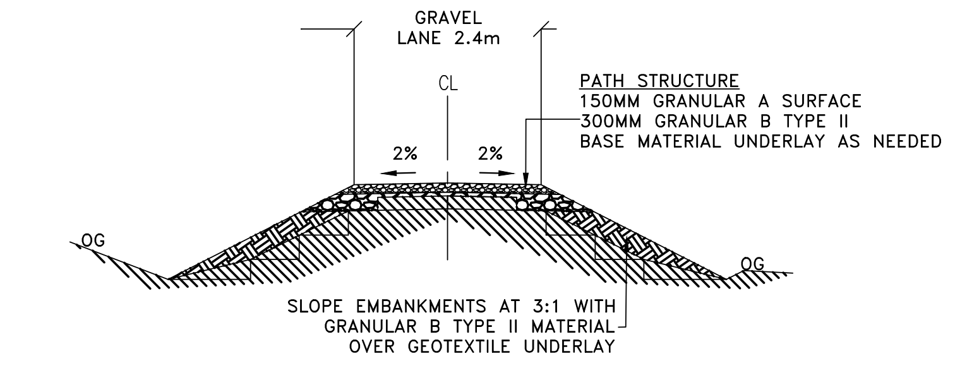
TYPICAL 6m WIDE MAIN ROAD
SCALE: N.T.S.



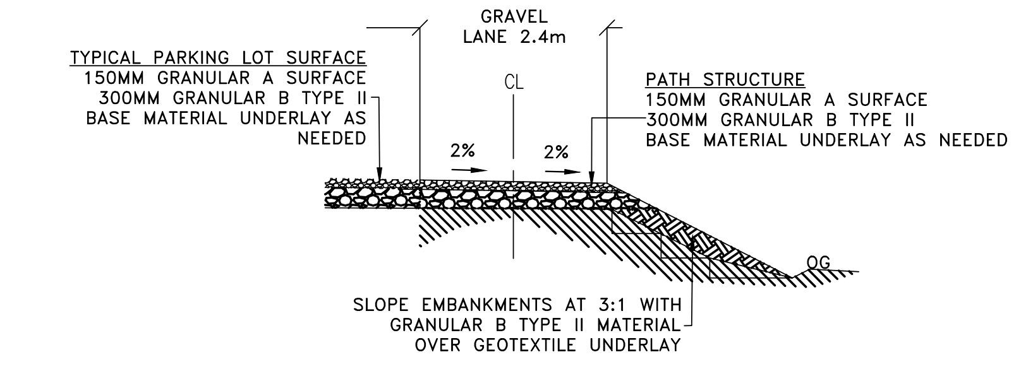
TYPICAL 3m WIDE SIDE ROAD
SCALE: N.T.S.



TYPICAL 2.4m AODA GRAVEL PATH
SCALE: N.T.S.



TYPICAL 2.4m PARKING LOT PATH
SCALE: N.T.S.



GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- ALL UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM THE LOCATION ON SITE AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL ELEVATIONS ARE IN REFERENCE TO LOCAL DATUM NAD83 - GEODETIC MODEL HT2_0, UNLESS DESCRIBED OTHERWISE.

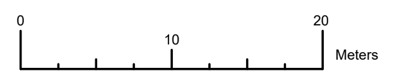
* * DRAWINGS ARE NOT TO BE SCALED * *

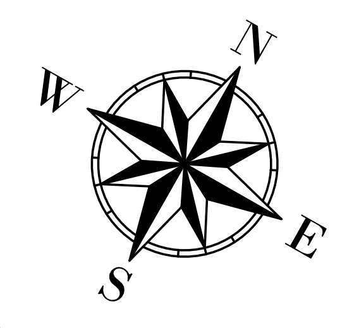
REVISIONS

NO.	DATE	DESCRIPTION	BY
1	05/26/2025	ISSUED FOR CLIENT COMMENT	ASG
2	06/03/2025	ISSUED FOR CONSTRUCTION	ASG

LEGEND

DESCRIPTION	EXISTING
EDGE OF PATHS/ROADS	━
CENTRE LINE OF ROAD	─ ─
VEGETATION LIMIT	⌒⌒
DITCHING	▶
PLANTED BUFFER	▨
RAIN GARDEN	▨
STORM CULVERT	▭
MATERIAL DAM	▦
WEIR LOCATIONS	▭
POND	▭





B. C. KEENE
June 3/25

JEWELL
ENGINEERING

VTLA STUDIOS
2590 COUNTY ROAD 15
PRINCE EDWARD COUNTY

GRADING DRAWING

DRAWN BY:	PROJECT NO:	
ASG	2405708	
DESIGNED BY:	DATE:	
ASG	MAY, 2025	
CHECKED BY:	SCALE:	
MW	HORIZONTAL - 1:500 VERTICAL -	
APPROVED BY:	CONTRACT NO:	DRAWING NO:
BK		GD

APPENDIX C

Hydrologic Calculations

Design Chart 1.07: Runoff Coefficients (Continued)

- Rural

Land Use & Topography[3]	Soil Texture		
	Open Sand Loam	Loam or Silt Loam	Clay Loam or Clay
CULTIVATED			
Flat 0 - 5% Slopes	0.22	0.35	0.55
Rolling 5 - 10% Slopes	0.30	0.45	0.60
Hilly 10- 30% Slopes	0.40	0.65	0.70
PASTURE			
Flat 0 - 5% Slopes	0.10	0.28	0.40
Rolling 5 - 10% Slopes	0.15	0.35	0.45
Hilly 10- 30% Slopes	0.22	0.40	0.55
WOODLAND OR CUTOVER			
Flat 0 - 5% Slopes	0.08	0.25	0.35
Rolling 5 - 10% Slopes	0.12	0.30	0.42
Hilly 10- 30% Slopes	0.18	0.35	0.52
BARE ROCK	COVERAGE[3]		
	30%	50%	70%
Flat 0 - 5% Slopes	0.40	0.55	0.75
Rolling 5 - 10% Slopes	0.50	0.65	0.80
Hilly 10- 30% Slopes	0.55	0.70	0.85
LAKES AND WETLANDS	0.05		

[2] Terrain Slopes

[3] Interpolate for other values of % imperviousness

Sources: American Society of Civil Engineers - ASCE (1960)
U.S. Department of Agriculture (1972)

Catchment 100

Time of Concentration

Calculate Time of Concentration by Airport Method

$$Tc = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w^{0.33}}$$

Where:

T_c = Time of Concentration in min
L = Watershed length in metres = 2340 m
C = Runoff Coefficient = 0.2
S_w = Watershed Slope in % 2.0 %
A = Watershed area in hectares 109 ha

T_c = 112.5 min

Slope Calculation

85/10 Method
Longest Flow Length = 2340 m
Elevation at 85% = 119 m
Elevation at 10% = 83.5 m
Length at 85/10 = 1755 m
Slope = 0.0202 m/m

Time to Peak Calculation (for hydrologic modelling if required)

Tp = 2/3 Tc

T_p = min

Use T_p = **74.3 min**
1.24 hr

Catchment 100 - 100 Year

Time of Concentration

Calculate Time of Concentration by Airport Method

$$Tc = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w^{0.33}}$$

Where:

T_c = Time of Concentration in min

L = Watershed length in metres = 2340 m

C = Runoff Coefficient = 0.25

S_w = Watershed Slope in % 2.0 %

A = Watershed area in hectares 109 ha

T_c = 106.2 min

Slope Calculation

85/10 Method

Longest Flow Length =	2340	m
Elevation at 85% =	119	m
Elevation at 10% =	83.5	m
Length at 85/10 =	1755	m
Slope =	0.0202	m/m

Time to Peak Calculation (for hydrologic modelling if required)

Tp = 2/3 Tc

T_p = min

Use T_p = **70.1 min**

1.17 hr

Catchment 101

Time of Concentration

Calculate Time of Concentration by Airport Method

$$Tc = \frac{3.26 \text{ x } (1.1 - C) \text{ x } L^{0.5}}{S_w^{0.33}}$$

Where:

T_c = Time of Concentration in min

L = Watershed length in metres = 150 m

C = Runoff Coefficient = 0.7

S_w = Watershed Slope in % 0.6 %

A = Watershed area in hectares 1.94 ha

T_c = 18.7 min

Slope Calculation

85/10 Method

Longest Flow Length = 150 m

Elevation at 85% = 80.6 m

Elevation at 10% = 79.9 m

Length at 85/10 = 112.5 m

Slope = 0.0062 m/m

Time to Peak Calculation (for hydrologic modelling if required)

Tp = 2/3 Tc

T_p = min

Use T_p = **12.3 min**

0.21 hr

Catchment 101 - 100 Year

Time of Concentration

Calculate Time of Concentration by Airport Method

$$Tc = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w^{0.33}}$$

Where:			Slope Calculation		
T_c = Time of Concentration in min			85/10 Method		
L = Watershed length in metres =	150	m	Longest Flow Length =	150	m
C = Runoff Coefficient =	0.85		Elevation at 85% =	80.6	m
S_w = Watershed Slope in %	0.6	%	Elevation at 10% =	79.9	m
A = Watershed area in hectares	109	ha	Length at 85/10 =	112.5	m
T_c =	**11.7**	**min**	Slope =	0.0062	m/m

Time to Peak Calculation (for hydrologic modelling if required)

Tp = 2/3 Tc

T_p =		min
Use T_p =	**7.7**	**min**
	0.13	**hr**

Catchment 102 - 100 Year

Time of Concentration

Calculate Time of Concentration by Airport Method

$$Tc = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w^{0.33}}$$

Where:

T_c = Time of Concentration in min

L = Watershed length in metres =	90	m	Longest Flow Length =	90	m
C = Runoff Coefficient =	0.38		Elevation at 85% =	81.1	m
S_w = Watershed Slope in %	1.5	%	Elevation at 10% =	80.1	m
A = Watershed area in hectares	0.53	ha	Length at 85/10 =	67.5	m
T_c =	**19.5**	**min**	Slope =	0.0148	m/m

Slope Calculation

85/10 Method

Time to Peak Calculation (for hydrologic modelling if required)

Tp = 2/3 Tc

T_p = min

Use T_p = **13.1** **min**

0.22 **hr**

Catchment 102

Time of Concentration

Calculate Time of Concentration by Airport Method

$$Tc = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w^{0.33}}$$

Where:

T_c = Time of Concentration in min		
L = Watershed length in metres =	90	m
C = Runoff Coefficient =	0.3	
S_w = Watershed Slope in %	1.5	%
A = Watershed area in hectares	0.53	ha
T_c =	**21.7**	**min**

Slope Calculation

85/10 Method

Longest Flow Length =	90	m
Elevation at 85% =	81.1	m
Elevation at 10% =	80.1	m
Length at 85/10 =	67.5	m
Slope =	0.0148	m/m

Time to Peak Calculation (for hydrologic modelling if required)

Tp = 2/3 Tc

T_p =		min
Use T_p =	**14.3**	**min**
	0.24	**hr**

Catchment 103

Time of Concentration

Calculate Time of Concentration by Airport Method

$$Tc = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w^{0.33}}$$

Where:

T_c = Time of Concentration in min

L = Watershed length in metres =	330	m	Longest Flow Length =	330	m
C = Runoff Coefficient =	0.3		Elevation at 85% =	86	m
S_w = Watershed Slope in %	2.3	%	Elevation at 10% =	80.4	m
A = Watershed area in hectares	3.79	ha	Length at 85/10 =	247.5	m
T_c = **36.2**	**min**		Slope =	0.0226	m/m

Slope Calculation

85/10 Method

Time to Peak Calculation (for hydrologic modelling if required)

Tp = 2/3 Tc

T_p = min

Use T_p =	**24.3**	**min**
	0.40	**hr**

Catchment 103 - 100 Year

Time of Concentration

Calculate Time of Concentration by Airport Method

$$Tc = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w^{0.33}}$$

Where:

T_c = Time of Concentration in min
L = Watershed length in metres = 285 m
C = Runoff Coefficient = 0.38
S_w = Watershed Slope in % 2.6 %
A = Watershed area in hectares 3.79 ha

T_c = 28.8 min

Slope Calculation

85/10 Method
Longest Flow Length = 285 m
Elevation at 85% = 86 m
Elevation at 10% = 80.4 m
Length at 85/10 = 213.8 m
Slope = 0.0262 m/m

Time to Peak Calculation (for hydrologic modelling if required)

Tp = 2/3 Tc

T_p = min

Use T_p = **19.3 min**
0.32 hr

APPENDIX D

OTTHYMO Output

```
===============================================================================

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    I N T E R H Y M O
       O   O    T      T    H   H   Y Y   MM MM  O   O   * * * 1989a * * *
       O   O    T      T    HHHHH    Y    M M M  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO    __________00003

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  Input   filename: VTLA5YR.DAT
  Output  filename: VTLA5YR.OUT
  Summary filename: VTLA5YR.SUM




DATE: 06-21-2024                      TIME: =3:17:15


COMMENTS: ____________________________________________________________


-------------------------------------------------------------------------------
*
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

*
*                   VTLA - 2590 CR 15
*                   Existing Pond
*                   5-yr Event
*                   April 28, 2025
*                   Matthew Warner
*
*                   111 ha
*
*                   Existing peak flow
*                   Solmesville, ON
*
*****************************************************************************
*                   5 Year - 12 Hr Duration
*****************************************************************************
*                   IDF Values from Environment Canada Station 6150689
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 743.652
| Ptotal= 56.29 mm |                          B=   6.053
--------------------                          C=    .769
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 12.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .33

                    The CORRELATION coefficient is =  .9999
```

```
                  TIME       INPUT INT.          TAB. INT.
                 (min)        (mm/hr)             (mm/hr)
                    5.         118.50              117.20
                   10.          86.80               87.96
                   15.          72.70               71.41
                   30.          47.30               47.22
                   60.          28.50               29.64
                  120.          17.90               18.03
                  360.           8.10                7.94
                  720.           4.80                4.69
                 1440.           2.70                2.76


              TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .08    1.13 |  3.08    3.73 |  6.08    3.29 |  9.08    1.59
               .17    1.15 |  3.17    4.05 |  6.17    3.19 |  9.17    1.57
               .25    1.17 |  3.25    4.44 |  6.25    3.09 |  9.25    1.55
               .33    1.20 |  3.33    4.92 |  6.33    3.00 |  9.33    1.53
               .42    1.22 |  3.42    5.54 |  6.42    2.91 |  9.42    1.52
               .50    1.24 |  3.50    6.38 |  6.50    2.83 |  9.50    1.50
               .58    1.26 |  3.58    7.55 |  6.58    2.75 |  9.58    1.48
               .67    1.29 |  3.67    9.33 |  6.67    2.68 |  9.67    1.46
               .75    1.32 |  3.75   12.38 |  6.75    2.62 |  9.75    1.44
               .83    1.34 |  3.83   18.86 |  6.83    2.55 |  9.83    1.43
               .92    1.37 |  3.92   41.73 |  6.92    2.49 |  9.92    1.41
              1.00    1.40 |  4.00  117.20 |  7.00    2.44 | 10.00    1.40
              1.08    1.43 |  4.08   53.04 |  7.08    2.38 | 10.08    1.38
              1.17    1.47 |  4.17   30.49 |  7.17    2.33 | 10.17    1.37
              1.25    1.50 |  4.25   21.33 |  7.25    2.28 | 10.25    1.35
              1.33    1.54 |  4.33   16.44 |  7.33    2.24 | 10.33    1.34
              1.42    1.58 |  4.42   13.42 |  7.42    2.19 | 10.42    1.32
              1.50    1.62 |  4.50   11.38 |  7.50    2.15 | 10.50    1.31
              1.58    1.67 |  4.58    9.90 |  7.58    2.11 | 10.58    1.30
              1.67    1.72 |  4.67    8.78 |  7.67    2.07 | 10.67    1.28
              1.75    1.77 |  4.75    7.91 |  7.75    2.03 | 10.75    1.27
              1.83    1.82 |  4.83    7.20 |  7.83    2.00 | 10.83    1.26
              1.92    1.88 |  4.92    6.63 |  7.92    1.96 | 10.92    1.25
              2.00    1.95 |  5.00    6.14 |  8.00    1.93 | 11.00    1.24
              2.08    2.01 |  5.08    5.73 |  8.08    1.90 | 11.08    1.22
              2.17    2.09 |  5.17    5.37 |  8.17    1.87 | 11.17    1.21
              2.25    2.17 |  5.25    5.06 |  8.25    1.84 | 11.25    1.20
              2.33    2.26 |  5.33    4.79 |  8.33    1.81 | 11.33    1.19
              2.42    2.36 |  5.42    4.55 |  8.42    1.78 | 11.42    1.18
              2.50    2.46 |  5.50    4.33 |  8.50    1.76 | 11.50    1.17
              2.58    2.58 |  5.58    4.14 |  8.58    1.73 | 11.58    1.16
              2.67    2.72 |  5.67    3.97 |  8.67    1.71 | 11.67    1.15
              2.75    2.87 |  5.75    3.81 |  8.75    1.68 | 11.75    1.14
              2.83    3.04 |  5.83    3.66 |  8.83    1.66 | 11.83    1.13
              2.92    3.23 |  5.92    3.53 |  8.92    1.64 | 11.92    1.12
              3.00    3.46 |  6.00    3.40 |  9.00    1.62 | 12.00    1.11


--------------------------------------------------------------------------------
*                    Catchment 100
--------------------
```

```
| CALIB              |
| NASHYD    (0001) |   Area    (ha)= 109.00   Curve Number   (CN)= 71.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.24

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

     Unit Hyd Qpeak  (cms)=   3.36

     PEAK FLOW       (cms)=   1.21 (i)
     TIME TO PEAK    (hrs)=   5.67
     RUNOFF VOLUME    (mm)=  16.92
     TOTAL RAINFALL   (mm)=  56.29
     RUNOFF COEFFICIENT   =    .30

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)= 109.00
| ID= 1   PCYC=212 |   QPEAK     (cms)=   1.21 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   5.67
--------------------   VOLUME     (mm)=  16.92
  Filename: PondIN.TXT
  Comments: 5-YR C100

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*                   Catchment 101
--------------------
| CALIB              |
| NASHYD    (0001) |   Area    (ha)=   1.96   Curve Number   (CN)= 50.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .21

     Unit Hyd Qpeak  (cms)=    .36

     PEAK FLOW       (cms)=    .03 (i)
     TIME TO PEAK    (hrs)=   4.25
     RUNOFF VOLUME    (mm)=   8.54
     TOTAL RAINFALL   (mm)=  56.29
     RUNOFF COEFFICIENT   =    .15

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   1.96
| ID= 2   PCYC=146 |   QPEAK     (cms)=    .03 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   4.25
--------------------   VOLUME     (mm)=   8.54
  Filename: 100yr.TXT
  Comments: 5-YR C101

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
-------------------------------------------------------------------------------

--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):   109.00     1.21     5.67    16.92
        + ID2= 2 (0001):     1.96      .03     4.25     8.54
          ==================================================
          ID = 3 (0001):   110.96     1.21     5.67    16.77

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)= 110.96
| ID= 3   PCYC=212 |   QPEAK     (cms)=   1.21 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   5.67
--------------------   VOLUME     (mm)=  16.77
  Filename: COMBINED.TXT
  Comments: 5-YR COMB

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
*                   Storm Pond
*                   Pond collects runoff and discharges through 2 750 + Weir
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 4 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |     .779       .263
                            .037       .044   |    1.051       .334
                            .144       .091   |    2.377       .412
                            .311       .141   |    4.518       .492
                            .526       .197   |    7.190       .573

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)    110.96      1.21      5.67      16.77
     OUTFLOW: ID= 4 (0001)    110.96      1.03      6.50      16.77

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 85.15
                   TIME SHIFT OF PEAK FLOW         (min)= 50.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .33

-------------------------------------------------------------------------------
*                   80.4 to 81.3 for ponding elv, 10 cm incr
*                   saving pond routing results
--------------------
| SAVE HYD  (0001) |   AREA       (ha)= 110.96
| ID= 4   PCYC=340 |   QPEAK     (cms)=   1.03 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   6.50
--------------------   VOLUME     (mm)=  16.77
  Filename: PND5OUT.TXT
  Comments: POND DISCHARGE
```

```
     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------

  FINISH
 ============================================================================
```

```
================================================================================

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    I N T E R H Y M O
       O   O    T      T    H   H   Y Y   MM MM  O   O   * * * 1989a * * *
       O   O    T      T    HHHHH    Y    M M M  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO    __________00003

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  Input   filename: VTL100YR.DAT
  Output  filename: VTL100YR.OUT
  Summary filename: VTL100YR.SUM




DATE: 06-21-2024                      TIME: =3:17:15


COMMENTS: ____________________________________________________________


--------------------------------------------------------------------------------
*
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

*
*                   VTLA - 2590 CR 15
*                   Existing Pond
*                   100-yr Event
*                   April 28, 2025
*                   Matthew Warner
*
*                   111 ha
*
*                   Existing peak flow
*                   Solmesville, ON
*
*****************************************************************************
*                   100 Year - 12 Hr Duration
*****************************************************************************
*                   IDF Values from Environment Canada Station 6150689
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1139.082
| Ptotal= 91.57 mm |                          B=   5.262
--------------------                          C=    .760
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 12.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .33

                    The CORRELATION coefficient is =  .9997
```

```
                     TIME       INPUT INT.          TAB. INT.
                    (min)        (mm/hr)             (mm/hr)
                       5.         194.50               194.10
                      10.         141.40               143.55
                      15.         119.60               115.74
                      30.          75.80                75.96
                      60.          45.00                47.58
                     120.          29.00                28.99
                     360.          13.20                12.85
                     720.           8.00                 7.63
                    1440.           4.30                 4.52

                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                  .08    1.91 |  3.08    6.12 |  6.08    5.42 |  9.08    2.67
                  .17    1.94 |  3.17    6.63 |  6.17    5.25 |  9.17    2.63
                  .25    1.97 |  3.25    7.25 |  6.25    5.09 |  9.25    2.60
                  .33    2.01 |  3.33    8.03 |  6.33    4.95 |  9.33    2.57
                  .42    2.05 |  3.42    9.01 |  6.42    4.81 |  9.42    2.54
                  .50    2.08 |  3.50   10.32 |  6.50    4.68 |  9.50    2.51
                  .58    2.12 |  3.58   12.16 |  6.58    4.56 |  9.58    2.48
                  .67    2.16 |  3.67   14.95 |  6.67    4.44 |  9.67    2.45
                  .75    2.21 |  3.75   19.69 |  6.75    4.33 |  9.75    2.42
                  .83    2.25 |  3.83   29.73 |  6.83    4.23 |  9.83    2.39
                  .92    2.30 |  3.92   65.78 |  6.92    4.13 |  9.92    2.37
                 1.00    2.35 |  4.00  194.10 |  7.00    4.04 | 10.00    2.34
                 1.08    2.40 |  4.08   83.82 |  7.08    3.96 | 10.08    2.32
                 1.17    2.46 |  4.17   47.82 |  7.17    3.87 | 10.17    2.29
                 1.25    2.52 |  4.25   33.55 |  7.25    3.79 | 10.25    2.27
                 1.33    2.58 |  4.33   25.98 |  7.33    3.72 | 10.33    2.24
                 1.42    2.65 |  4.42   21.30 |  7.42    3.65 | 10.42    2.22
                 1.50    2.71 |  4.50   18.13 |  7.50    3.58 | 10.50    2.20
                 1.58    2.79 |  4.58   15.84 |  7.58    3.51 | 10.58    2.18
                 1.67    2.87 |  4.67   14.10 |  7.67    3.45 | 10.67    2.16
                 1.75    2.95 |  4.75   12.73 |  7.75    3.39 | 10.75    2.14
                 1.83    3.04 |  4.83   11.63 |  7.83    3.33 | 10.83    2.12
                 1.92    3.14 |  4.92   10.72 |  7.92    3.27 | 10.92    2.10
                 2.00    3.24 |  5.00    9.95 |  8.00    3.22 | 11.00    2.08
                 2.08    3.35 |  5.08    9.30 |  8.08    3.17 | 11.08    2.06
                 2.17    3.47 |  5.17    8.74 |  8.17    3.12 | 11.17    2.04
                 2.25    3.61 |  5.25    8.25 |  8.25    3.07 | 11.25    2.02
                 2.33    3.75 |  5.33    7.82 |  8.33    3.02 | 11.33    2.00
                 2.42    3.91 |  5.42    7.44 |  8.42    2.98 | 11.42    1.98
                 2.50    4.08 |  5.50    7.09 |  8.50    2.93 | 11.50    1.97
                 2.58    4.28 |  5.58    6.78 |  8.58    2.89 | 11.58    1.95
                 2.67    4.49 |  5.67    6.50 |  8.67    2.85 | 11.67    1.93
                 2.75    4.74 |  5.75    6.25 |  8.75    2.81 | 11.75    1.92
                 2.83    5.01 |  5.83    6.01 |  8.83    2.77 | 11.83    1.90
                 2.92    5.33 |  5.92    5.80 |  8.92    2.74 | 11.92    1.89
                 3.00    5.69 |  6.00    5.60 |  9.00    2.70 | 12.00    1.87


-------------------------------------------------------------------------------
*                   Catchment 100
--------------------
```

```
| CALIB              |
| NASHYD    (0001) |   Area    (ha)= 109.00   Curve Number   (CN)= 71.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.17

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

     Unit Hyd Qpeak  (cms)=   3.56

     PEAK FLOW       (cms)=   3.03 (i)
     TIME TO PEAK    (hrs)=   5.50
     RUNOFF VOLUME    (mm)=  39.27
     TOTAL RAINFALL   (mm)=  91.57
     RUNOFF COEFFICIENT   =    .43

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)= 109.00
| ID= 1   PCYC=215 |   QPEAK     (cms)=   3.03 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   5.50
--------------------   VOLUME     (mm)=  39.27
  Filename: PondIN.TXT
  Comments: 100-YR C100

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*                   Catchment 101
--------------------
| CALIB              |
| NASHYD    (0001) |   Area    (ha)=   1.96   Curve Number   (CN)= 50.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .13

     Unit Hyd Qpeak  (cms)=    .58

     PEAK FLOW       (cms)=    .11 (i)
     TIME TO PEAK    (hrs)=   4.08
     RUNOFF VOLUME    (mm)=  21.70
     TOTAL RAINFALL   (mm)=  91.57
     RUNOFF COEFFICIENT   =    .24

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   1.96
| ID= 2   PCYC=146 |   QPEAK     (cms)=    .11 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   4.08
--------------------   VOLUME     (mm)=  21.70
  Filename: 100yr.TXT
  Comments: 100-YR C101

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):   109.00     3.03     5.50    39.27
        + ID2= 2 (0001):     1.96      .11     4.08    21.70
          ==================================================
          ID = 3 (0001):   110.96     3.04     5.50    38.96

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)= 110.96
| ID= 3   PCYC=215 |   QPEAK     (cms)=   3.04 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   5.50
--------------------   VOLUME     (mm)=  38.96
  Filename: COMBINED.TXT
  Comments: 100-YR COMB

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*                   Storm Pond
*                   Pond collects runoff and discharges through 2 750 + Weir
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 4 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |     .779       .263
                            .037       .044   |    1.051       .334
                            .144       .091   |    2.377       .412
                            .311       .141   |    4.518       .492
                            .526       .197   |    7.190       .573

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)    110.96      3.04      5.50      38.96
     OUTFLOW: ID= 4 (0001)    110.96      3.02      5.58      38.95

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 99.47
                   TIME SHIFT OF PEAK FLOW         (min)=  5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .44

--------------------------------------------------------------------------------
*                   80.4 to 81.3 for ponding elv, 10 cm incr
*                   saving pond routing results
--------------------
| SAVE HYD  (0001) |   AREA       (ha)= 110.96
| ID= 4   PCYC=347 |   QPEAK     (cms)=   3.02 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   5.58
--------------------   VOLUME     (mm)=  38.95
  Filename: PND1OUT.TXT
  Comments: POND DISCHARGE
```

```
     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

 FINISH
================================================================================
```

APPENDIX E

Hydraulic Calculations

Hydrologic Point of Interest – Node 1 (existing)

Pond Elevations		**Outlet 1**		**Outlet 2**		**Outlet 3**	
Perm.Pool	80.85	Use Outlet 1?	Yes	Use Outlet 2?	Yes	Use Outlet 3?	No
Max. Elev	81.4	Type	Weir	Type	Weir		
Increment	0.05	Invert	81	Invert	80.9		
		Length	4	Length	7		
		No. of Outlets	1	No. of Outlets	1		
		Q = 1.67LH^1.5		**Q = 1.67LH^1.5**			

Orifice Equation:

$$= \langle h \le 2r \rangle 0.6 * \left[\left(arccos\left(\frac{r-h}{r}\right) \right) r^2 - r(r-h) * sin\left(arccos\left(\frac{r-h}{r}\right) \right) \right] * \sqrt{2g * \left(\frac{4r * sin^3\left(arccos\left(\frac{r-h}{r}\right) \right)}{3\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) - sin\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) \right) \right)} - (r-h) \right)}$$

$$+\langle h > 2r \rangle 0.6\pi r^2 * \sqrt{2g(h-r)}$$

Elevation m	**Incr.Vol m3**	**Cum.Vol m3**	**Head on inv., m**	**Q, m3/s**	**Head on inv., m**	**Q, m3/s**	**Head on inv., m**	**Q, m3/s**	**Q.total m3/s**
80.85		0	-	0.000	-	0.000	-	0.000	0.000
80.90			-	0.000	-	0.000	-	0.000	0.000
80.95			-	0.000	0.05	0.131	-	0.000	0.131
81.00			-	0.000	0.1	0.370	-	0.000	0.370
81.05			0.05	0.075	0.15	0.679	-	0.000	0.754
81.10			0.1	0.211	0.2	1.046	-	0.000	1.257
81.15			0.15	0.388	0.25	1.461	-	0.000	1.849
81.20			0.2	0.597	0.3	1.921	-	0.000	2.518
81.25			0.25	0.835	0.35	2.421	-	0.000	3.256
81.30			0.3	1.098	0.4	2.957	-	0.000	4.055
81.35			0.35	1.383	0.45	3.529	-	0.000	4.912
81.40			0.4	1.690	0.5	4.133	-	0.000	5.823

Hydrologic Point of Interest – Node 1

Pond Elevations		**Outlet 1**		**Outlet 2**		**Outlet 3**	
Perm.Pool	80.4	Use Outlet 1?	Yes	Use Outlet 2?	Yes	Use Outlet 3?	No
Max. Elev	81.3	Type	Orifice	Type	Weir		
Increment	0.05	Invert	80.4	Invert	81.05		
		diam (m)	0.6	Length	15		
		No. of Outlets	2	No. of Outlets	1		

Q = 1.67LH^1.5

Orifice Equation:

$$= \langle h \leq 2r \rangle 0.6 * \left[\left(arccos\left(\frac{r-h}{r}\right) \right) r^2 - r(r-h) * sin\left(arccos\left(\frac{r-h}{r}\right) \right) \right] * \sqrt{2g * \left(\frac{4r * sin^3\left(arccos\left(\frac{r-h}{r}\right) \right)}{3\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) - sin\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) \right) \right)} - (r-h) \right)}$$

$$+ \langle h > 2r \rangle 0.6\pi r^2 * \sqrt{2g(h-r)}$$

Elevation m	Incr.Vol m3	Cum.Vol m3	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Q.total m3/s
80.40		0	0	0.000	-	0.000	-	0.000	0.000
80.45			0.05	0.008	-	0.000	-	0.000	0.008
80.50			0.1	0.033	-	0.000	-	0.000	0.033
80.55			0.15	0.073	-	0.000	-	0.000	0.073
80.60			0.2	0.126	-	0.000	-	0.000	0.126
80.65			0.25	0.192	-	0.000	-	0.000	0.192
80.70			0.3	0.268	-	0.000	-	0.000	0.268
80.75			0.35	0.353	-	0.000	-	0.000	0.353
80.80			0.4	0.446	-	0.000	-	0.000	0.446
80.85			0.45	0.543	-	0.000	-	0.000	0.543
80.90			0.5	0.641	-	0.000	-	0.000	0.641
80.95			0.55	0.738	-	0.000	-	0.000	0.738
81.00			0.6	0.823	-	0.000	-	0.000	0.823
81.05			0.65	0.889	-	0.000	-	0.000	0.889
81.10			0.7	0.951	0.05	0.280	-	0.000	1.231
81.15			0.75	1.008	0.1	0.792	-	0.000	1.800
81.20			0.8	1.063	0.15	1.455	-	0.000	2.518
81.25			0.85	1.115	0.2	2.241	-	0.000	3.355
81.30			0.9	1.164	0.25	3.131	-	0.000	4.295

Hydrologic Point of Interest – Node 2 (existing)

Pond Elevations

Perm.Pool	80.4
Max. Elev	81.45
Increment	0.05

Outlet 1

Use Outlet 1?	Yes
Type	Orifice
Invert	80.42
diam (m)	0.525
No. of Outlets	1

Outlet 2

Use Outlet 2?	Yes
Type	Weir
Invert	80.7
Length	20
No. of Outlets	1

Q = 1.67LH^1.5

Outlet 3

Use Outlet 3?	No

Orifice Equation:

$$= \langle h \le 2r \rangle 0.6 * \left[\left(arccos\left(\frac{r-h}{r}\right) \right) r^2 - r(r-h) * sin\left(arccos\left(\frac{r-h}{r}\right) \right) \right] * \sqrt{2g * \left(\frac{4r * sin^3\left(arccos\left(\frac{r-h}{r}\right) \right)}{3\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) - sin\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) \right) \right)} - (r-h) \right)}$$

$$+\langle h > 2r \rangle 0.6\pi r^2 * \sqrt{2g(h-r)}$$

Elevation m	Incr.Vol m3	Cum.Vol m3	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Q.total m3/s
80.40	0	0	-	0.000	-	0.000	-	0.000	0.000
80.45	215	215	0.03	0.001	-	0.000	-	0.000	0.001
80.50	225	440	0.08	0.010	-	0.000	-	0.000	0.010
80.55	230	670	0.13	0.026	-	0.000	-	0.000	0.026
80.60	238	908	0.18	0.048	-	0.000	-	0.000	0.048
80.65	246	1154	0.23	0.075	-	0.000	-	0.000	0.075
80.70	260	1414	0.28	0.108	-	0.000	-	0.000	0.108
80.75	272	1685	0.33	0.144	0.05	0.373	-	0.000	0.518
80.80	290	1975	0.38	0.183	0.1	1.056	-	0.000	1.239
80.85	318	2293	0.43	0.224	0.15	1.940	-	0.000	2.164
80.90	333	2626	0.48	0.263	0.2	2.987	-	0.000	3.251
80.95	343	2969	0.53	0.298	0.25	4.175	-	0.000	4.473
81.00	375	3344	0.58	0.324	0.3	5.488	-	0.000	5.812
81.05	384	3728	0.63	0.349	0.35	6.916	-	0.000	7.265
81.10	392	4120	0.68	0.372	0.4	8.450	-	0.000	8.821
81.15	398	4517	0.73	0.393	0.45	10.082	-	0.000	10.476
81.20	400	4917	0.78	0.414	0.5	11.809	-	0.000	12.223
81.25	405	5322	0.83	0.433	0.55	13.624	-	0.000	14.057
81.30	407	5729	0.88	0.452	0.6	15.523	-	0.000	15.975
81.35	409	6138	0.93	0.470	0.65	17.503	-	0.000	17.973
81.40	412	6550	0.98	0.487	0.7	19.561	-	0.000	20.048
81.45	413	6962	1.03	0.504	0.75	21.694	-	0.000	22.198

Hydrologic Point of Interest – Node 2

Pond Elevations	
Perm.Pool	80.4
Max. Elev	81.3
Increment	0.05

Outlet 1		**Outlet 2**		**Outlet 3**	
Use Outlet 1?	Yes	Use Outlet 2?	Yes	Use Outlet 3?	No
Type	Orifice	Type	Weir		
Invert	80.4	Invert	81		
diam (m)	0.75	Length	20		
No. of Outlets	2	No. of Outlets	1		

Q = 1.67LH^1.5

Orifice Equation:

$$= \langle h \leq 2r \rangle 0.6 * \left[\left(arccos\left(\frac{r-h}{r}\right) \right) r^2 - r(r-h) * sin\left(arccos\left(\frac{r-h}{r}\right) \right) \right] * \sqrt{2g * \left(\frac{4r * sin^3\left(arccos\left(\frac{r-h}{r}\right) \right)}{3\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) - sin\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) \right) \right)} - (r-h) \right)}$$

$$+\langle h > 2r \rangle 0.6\pi r^2 * \sqrt{2g(h-r)}$$

Elevation m	Incr.Vol m3	Cum.Vol m3	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Q.total m3/s
80.40	0	0	0	0.000	-	0.000	-	0.000	0.000
80.45	215	215	0.05	0.010	-	0.000	-	0.000	0.010
80.50	225	440	0.1	0.037	-	0.000	-	0.000	0.037
80.55	230	670	0.15	0.083	-	0.000	-	0.000	0.083
80.60	238	908	0.2	0.144	-	0.000	-	0.000	0.144
80.65	246	1154	0.25	0.220	-	0.000	-	0.000	0.220
80.70	260	1414	0.3	0.311	-	0.000	-	0.000	0.311
80.75	272	1685	0.35	0.413	-	0.000	-	0.000	0.413
80.80	290	1975	0.4	0.526	-	0.000	-	0.000	0.526
80.85	318	2293	0.45	0.649	-	0.000	-	0.000	0.649
80.90	333	2626	0.5	0.779	-	0.000	-	0.000	0.779
80.95	343	2969	0.55	0.914	-	0.000	-	0.000	0.914
81.00	375	3344	0.6	1.051	-	0.000	-	0.000	1.051
81.05	384	3728	0.65	1.188	0.05	0.373	-	0.000	1.562
81.10	392	4120	0.7	1.321	0.1	1.056	-	0.000	2.377
81.15	398	4517	0.75	1.438	0.15	1.940	-	0.000	3.378
81.20	400	4917	0.8	1.531	0.2	2.987	-	0.000	4.518
81.25	405	5322	0.85	1.618	0.25	4.175	-	0.000	5.793
81.30	407	5729	0.9	1.701	0.3	5.488	-	0.000	7.190

Hydrologic Point of Interest – Node 3

Pond Elevations		**Outlet 1**		**Outlet 2**		**Outlet 3**	
Perm.Pool	80.2	Use Outlet 1?	Yes	Use Outlet 2?	Yes	Use Outlet 3?	No
Max. Elev	81.4	Type	Orifice	Type	Weir		
Increment	0.05	Invert	80.2	Invert	80.9		
		diam (m)	0.75	Length	5		
		No. of Outlets	2	No. of Outlets	1		

Q = 1.67LH^1.5

Orifice Equation:

$$= \langle h \le 2r \rangle 0.6 * \left[\left(arccos\left(\frac{r-h}{r}\right) \right) r^2 - r(r-h) * sin\left(arccos\left(\frac{r-h}{r}\right) \right) \right] * \sqrt{2g * \left(\frac{4r * sin^3\left(arccos\left(\frac{r-h}{r}\right) \right)}{3\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) - sin\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) \right) \right)} - (r-h) \right)}$$

$$+\langle h > 2r \rangle 0.6\pi r^2 * \sqrt{2g(h-r)}$$

Elevation m	**Incr.Vol m3**	**Cum.Vol m3**	**Head on inv., m**	**Q, m3/s**	**Head on inv., m**	**Q, m3/s**	**Head on inv., m**	**Q, m3/s**	**Q.total m3/s**
80.20		0	0	0.000	-	0.000	-	0.000	0.000
80.25			0.05	0.010	-	0.000	-	0.000	0.010
80.30			0.1	0.037	-	0.000	-	0.000	0.037
80.35			0.15	0.083	-	0.000	-	0.000	0.083
80.40			0.2	0.144	-	0.000	-	0.000	0.144
80.45			0.25	0.220	-	0.000	-	0.000	0.220
80.50			0.3	0.311	-	0.000	-	0.000	0.311
80.55			0.35	0.413	-	0.000	-	0.000	0.413
80.60			0.4	0.526	-	0.000	-	0.000	0.526
80.65			0.45	0.649	-	0.000	-	0.000	0.649
80.70			0.5	0.779	-	0.000	-	0.000	0.779
80.75			0.55	0.914	-	0.000	-	0.000	0.914
80.80			0.6	1.051	-	0.000	-	0.000	1.051
80.85			0.65	1.188	-	0.000	-	0.000	1.188
80.90			0.7	1.321	-	0.000	-	0.000	1.321
80.95			0.75	1.438	0.05	0.093	-	0.000	1.531
81.00			0.8	1.531	0.1	0.264	-	0.000	1.795
81.05			0.85	1.618	0.15	0.485	-	0.000	2.104
81.10			0.9	1.701	0.2	0.747	-	0.000	2.448
81.15			0.95	1.781	0.25	1.044	-	0.000	2.824
81.20			1	1.856	0.3	1.372	-	0.000	3.228
81.25			1.05	1.929	0.35	1.729	-	0.000	3.658
81.30			1.1	1.999	0.4	2.112	-	0.000	4.112
81.35			1.15	2.067	0.45	2.521	-	0.000	4.588
81.40			1.2	2.133	0.5	2.952	-	0.000	5.085

Hydrologic Point of Interest – Node 4

Pond Elevations

Perm.Pool	80.45
Max. Elev	81.15
Increment	0.05

Outlet 1

Use Outlet 1?	Yes
Type	Orifice
Invert	80.45
diam (m)	0.2
No. of Outlets	1

Outlet 2

Use Outlet 2?	No

Outlet 3

Use Outlet 3?	No

Orifice Equation:

$$= \langle h \leq 2r \rangle 0.6 * \left[\left(arccos\left(\frac{r-h}{r}\right)\right) r^2 - r(r-h) * sin\left(arccos\left(\frac{r-h}{r}\right)\right)\right] * \sqrt{2g * \left(\frac{4r * sin^3\left(arccos\left(\frac{r-h}{r}\right)\right)}{3\left(2\left(arccos\left(\frac{r-h}{r}\right)\right) - sin\left(2\left(arccos\left(\frac{r-h}{r}\right)\right)\right)\right)} - (r-h) \right)}$$

$$+\langle h > 2r \rangle 0.6\pi r^2 * \sqrt{2g(h-r)}$$

Elevation m	Incr.Vol m3	Cum.Vol m3	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Q.total m3/s
80.45		0	0	0.000	-	0.000	-	0.000	0.000
80.50			0.05	0.002	-	0.000	-	0.000	0.002
80.55			0.1	0.009	-	0.000	-	0.000	0.009
80.60			0.15	0.017	-	0.000	-	0.000	0.017
80.65			0.2	0.026	-	0.000	-	0.000	0.026
80.70			0.25	0.032	-	0.000	-	0.000	0.032
80.75			0.3	0.037	-	0.000	-	0.000	0.037
80.80			0.35	0.042	-	0.000	-	0.000	0.042
80.85			0.4	0.046	-	0.000	-	0.000	0.046
80.90			0.45	0.049	-	0.000	-	0.000	0.049
80.95			0.5	0.053	-	0.000	-	0.000	0.053
81.00			0.55	0.056	-	0.000	-	0.000	0.056
81.05			0.6	0.059	-	0.000	-	0.000	0.059
81.10			0.65	0.062	-	0.000	-	0.000	0.062
81.15			0.7	0.065	-	0.000	-	0.000	0.065

Hydrologic Point of Interest – Node 5

Pond Elevations

Perm.Pool	80.6
Max. Elev	81.3
Increment	0.05

Outlet 1

Use Outlet 1?	Yes
Type	Orifice
Invert	80.6
diam (m)	0.3
No. of Outlets	1

Outlet 2

Use Outlet 2?	Yes
Type	Weir
Invert	81.2
Length	6
No. of Outlets	1

Q = 1.67LH^1.5

Outlet 3

Use Outlet 3?	No

Orifice Equation:

$$= \langle h \leq 2r \rangle 0.6 * \left[\left(arccos\left(\frac{r-h}{r}\right) \right) r^2 - r(r-h) * sin\left(arccos\left(\frac{r-h}{r}\right) \right) \right] * \sqrt{2g * \left(\frac{4r * sin^3\left(arccos\left(\frac{r-h}{r}\right) \right)}{3\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) - sin\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) \right) \right)} - (r-h) \right)}$$

$$+\langle h > 2r \rangle 0.6\pi r^2 * \sqrt{2g(h-r)}$$

Elevation m	Incr.Vol m3	Cum.Vol m3	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Q.total m3/s
80.60		0	0	0.000	-	0.000	-	0.000	0.000
80.65			0.05	0.003	-	0.000	-	0.000	0.003
80.70			0.1	0.011	-	0.000	-	0.000	0.011
80.75			0.15	0.024	-	0.000	-	0.000	0.024
80.80			0.2	0.039	-	0.000	-	0.000	0.039
80.85			0.25	0.057	-	0.000	-	0.000	0.057
80.90			0.3	0.073	-	0.000	-	0.000	0.073
80.95			0.35	0.084	-	0.000	-	0.000	0.084
81.00			0.4	0.094	-	0.000	-	0.000	0.094
81.05			0.45	0.103	-	0.000	-	0.000	0.103
81.10			0.5	0.111	-	0.000	-	0.000	0.111
81.15			0.55	0.119	-	0.000	-	0.000	0.119
81.20			0.6	0.126	-	0.000	-	0.000	0.126
81.25			0.65	0.133	0.05	0.112	-	0.000	0.245
81.30			0.7	0.139	0.1	0.317	-	0.000	0.456

Hydrologic Point of Interest – Node 6 (existing)

Pond Elevations		**Outlet 1**		**Outlet 2**		**Outlet 3**	
Perm.Pool	80.5	Use Outlet 1?	Yes	Use Outlet 2?	Yes	Use Outlet 3?	No
Max. Elev	80.8	Type	Weir	Type	Orifice		
Increment	0.05	Invert	80.58	Invert	80.2		
		Length	30	diam (m)	0.525		
		No. of Outlets	1	No. of Outlets	1		

Q = 1.67LH^1.5

Orifice Equation:

$$= \langle h \le 2r \rangle 0.6 * \left[\left(arccos\left(\frac{r-h}{r}\right) \right) r^2 - r(r-h) * sin\left(arccos\left(\frac{r-h}{r}\right) \right) \right] * \sqrt{2g * \left(\frac{4r * sin^3\left(arccos\left(\frac{r-h}{r}\right) \right)}{3\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) - sin\left(2\left(arccos\left(\frac{r-h}{r}\right) \right) \right) \right)} - (r-h) \right)}$$

$$+\langle h > 2r \rangle 0.6\pi r^2 * \sqrt{2g(h-r)}$$

Elevation m	Incr.Vol m3	Cum.Vol m3	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Q.total m3/s
80.50		0	-	0.000	0.3	0.122	-	0.000	0.122
80.55			-	0.000	0.35	0.160	-	0.000	0.160
80.60			0.02	0.142	0.4	0.199	-	0.000	0.341
80.65			0.07	0.928	0.45	0.240	-	0.000	1.168
80.70			0.12	2.083	0.5	0.278	-	0.000	2.361
80.75			0.17	3.512	0.55	0.308	-	0.000	3.820
80.80			0.22	5.170	0.6	0.334	-	0.000	5.504

Hydrologic Point of Interest – Node 6

Pond Elevations

Perm.Pool	80.1
Max. Elev	81.45
Increment	0.05

Outlet 1

Use Outlet 1?	Yes
Type	Orifice
Invert	80.1
diam (m)	0.6
No. of Outlets	2

Outlet 2

Use Outlet 2?	Yes
Type	Weir
Invert	80.9
Length	20
No. of Outlets	1

Q = 1.67LH^1.5

Outlet 3

Use Outlet 3?	No

Orifice Equation:

$$= \langle h \leq 2r \rangle 0.6 * \left[\left(arccos \left(\frac{r-h}{r} \right) \right) r^2 - r(r-h) * sin \left(arccos \left(\frac{r-h}{r} \right) \right) \right] * \sqrt{2g * \left(\frac{4r * sin^3 \left(arccos \left(\frac{r-h}{r} \right) \right)}{3 \left(2 \left(arccos \left(\frac{r-h}{r} \right) \right) - sin \left(2 \left(arccos \left(\frac{r-h}{r} \right) \right) \right) \right)} - (r-h) \right)}$$

$$+ \langle h > 2r \rangle 0.6 \pi r^2 * \sqrt{2g(h-r)}$$

Elevation m	Incr.Vol m3	Cum.Vol m3	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Q.total m3/s
80.10		0	0	0.000	-	0.000	-	0.000	0.000
80.15			0.05	0.008	-	0.000	-	0.000	0.008
80.20			0.1	0.033	-	0.000	-	0.000	0.033
80.25			0.15	0.073	-	0.000	-	0.000	0.073
80.30			0.2	0.126	-	0.000	-	0.000	0.126
80.35			0.25	0.192	-	0.000	-	0.000	0.192
80.40			0.3	0.268	-	0.000	-	0.000	0.268
80.45			0.35	0.353	-	0.000	-	0.000	0.353
80.50			0.4	0.446	-	0.000	-	0.000	0.446
80.55			0.45	0.543	-	0.000	-	0.000	0.543
80.60			0.5	0.641	-	0.000	-	0.000	0.641
80.65			0.55	0.738	-	0.000	-	0.000	0.738
80.70			0.6	0.823	-	0.000	-	0.000	0.823
80.75			0.65	0.889	-	0.000	-	0.000	0.889
80.80			0.7	0.951	-	0.000	-	0.000	0.951
80.85			0.75	1.008	-	0.000	-	0.000	1.008
80.90			0.8	1.063	-	0.000	-	0.000	1.063
80.95			0.85	1.115	0.05	0.373	-	0.000	1.488
81.00			0.9	1.164	0.1	1.056	-	0.000	2.220
81.05			0.95	1.212	0.15	1.940	-	0.000	3.152
81.10			1	1.257	0.2	2.987	-	0.000	4.245
81.15			1.05	1.302	0.25	4.175	-	0.000	5.477
81.20			1.1	1.344	0.3	5.488	-	0.000	6.832
81.25			1.15	1.386	0.35	6.916	-	0.000	8.301
81.30			1.2	1.426	0.4	8.450	-	0.000	9.875
81.35			1.25	1.465	0.45	10.082	-	0.000	11.547
81.40			1.3	1.503	0.5	11.809	-	0.000	13.312
81.45			1.35	1.540	0.55	13.624	-	0.000	15.164

Hydrologic Point of Interest – Node 7

Manning's - Open Channel Flow

Determines the full flow capacity of a trapezoidal channel
(V-shaped if Bottom Width is set to 0)

Project: 2590 CR 15
Design: M.D
Date: 21-May-25

Equations: **Continuity** **Manning's**

$$Q = VA \qquad V = \frac{R^{2/3} S^{1/2}}{n}$$

Where:

V = Channel Velocity (m/s)
Q = Channel Flow Capacity
R = Hydraulic Radius = A/P
P = Wetted Perimeter (m)
A= Area (m^2)
n = Manning's Roughness Coefficient

Desired Flow Capacity = **0.283** **cms**

Channel Configuration *Does not include Freeboard*

Given:			**Find:**		
Bottom Width	**0.5**	m	V =	**0.562**	
Side Slopes	**2**	:1	Q =	**0.354**	**cms**
Slope	**0.005**	m/m	R =	0.630	
Roughness	**0.05**		P =	2.512	
Channel Depth	**0.45**	m	A =	0.251	

Capacity of the Proposed Channel is 0.4 cms, which is adequate to convey desired flow of 0.283 cms.

Hydrologic Point of Interest – Node 8

Manning's - Open Channel Flow

Determines the full flow capacity of a trapezoidal channel
(V-shaped if Bottom Width is set to 0)

Project: 2590 CR 15
Design: M.D
Date: 21-May-25

Equations: **Continuity** **Manning's**

$$Q = VA \qquad V = \frac{R^{2/3}S^{1/2}}{n}$$

Where:
V = Channel Velocity (m/s)
Q = Channel Flow Capacity
R = Hydraulic Radius = A/P
P = Wetted Perimeter (m)
A= Area (m^2)
n = Manning's Roughness Coefficient

Desired Flow Capacity = **2.81** **cms**

Channel Configuration *Does not include Freeboard*

Given:			**Find:**		
Bottom Width	**1**	m	V =	**1.471**	
Side Slopes	**3**	:1	Q =	**2.82**	**cms**
Slope	**0.005**	m/m	R =	1.918	
Roughness	**0.025**		P =	5.111	
Channel Depth	**0.65**	m	A =	0.375	

Capacity of the Proposed Channel is 2.8 cms, which is adequate to convey desired flow of 2.81 cms.

Hydrologic Point of Interest – Node 9

Manning's - Open Channel Flow

Determines the full flow capacity of a trapezoidal channel
(V-shaped if Bottom Width is set to 0)

Project: 2590 CR 15
Design: M.D
Date: 21-May-25

Equations: **Continuity** **Manning's**

Q = VA

$$V = \frac{R^{2/3}S^{1/2}}{n}$$

Where:

V = Channel Velocity (m/s)
Q = Channel Flow Capacity
R = Hydraulic Radius = A/P
P = Wetted Perimeter (m)
A= Area (m^2)
n = Manning's Roughness Coefficient

Desired Flow Capacity = **2.21** **cms**

Channel Configuration *Does not include Freeboard*

Given:			**Find:**		
Bottom Width	**1**	m	V =	**1.406**	
Side Slopes	**3**	:1	Q =	**2.36**	**cms**
Slope	**0.005**	m/m	R =	1.680	
Roughness	**0.025**		P =	4.795	
Channel Depth	**0.6**	m	A =	0.350	

Capacity of the Proposed Channel is 2.4 cms, which is adequate to convey desired flow of 2.21 cms.

APPENDIX F

2010 Sorbara Pond Installation

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PERMIT TO TAKE WATER FOR POND INSTALLATION ON LOTS 12&13, CONCESSION WEST OF GREEN POINT SOPHIASBURGH WARD, PRINCE EDWARD COUNTY

Prepared for:

Gregory Sobara
Richmond Hill, Ontario

Prepared by:

Lissom Earth Sciences
Picton, Ontario

February 2010

Ref# 4010

APGO ASSOCIATION OF PROFESSIONAL GEOSCIENTISTS OF ONTARIO

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SUMMARY

The Sorbara's would like to establish a pond for aesthetics in a vacant field on their property in Sophiasburgh, Prince Edward County, Ontario. They have retained Lissom Earth Sciences to carry out the necessary work to support approval for construction of this pond. Catherine Chisholm of Lissom, met on the Sorbara property on September 3, 2009 with representatives from Quinte Conservation (QC), Greer Excavating, and the Ministry of the Environment (MOE). The scope of work for the Permit To Take Water (PTTW) was discussed, along with specific concerns of the MOE and QC. At that time, overburden was mounded at the perimeter of the purposed pond area exposing the bedrock surface. Neighbours contacted QC and the MOE regarding potential impacts on their wells, as a result of the movement of the overburden on the Sorbara property.

The proposed kidney-shaped pond will be located in a field approximately thirty metres south of County Road 15, southeast of an existing barn. The proposed pond is located on an intermittent stream and it will be approximately 45metres by 91.5metres by 2.4metres deep with an approximate capacity of 9,882cubic metres.

Lissom's PTTW investigation evaluated the potential impacts to surface water and ground water, as a result of the pond installation. The potential impacts to ground water were evaluated by conducting a MOE Well Record Search and consulting neighbouring residents for information about existing ground water conditions. The Well Record Database returned no records and neighbour participation was limited. Therefore, a total of seven monitor wells were installed in the area of the pond. Three monitor wells were installed within the pond footprint and four monitor wells were installed near the pond perimeter. Static levels in all the monitor wells were recorded and water samples were collected from the monitor wells and participating neighbours. In addition, local geological and topographical maps were consulted. To evaluate existing surface water conditions, a site visit of the Sorbara property was conducted on October 15, 2009. The local terrain was visually evaluated, including mapping of stream courses, and topography measurements.

The proposed pond will be taking water from the West Stream during spring snowmelt and precipitation events (spring and fall). The proposed pond will store a maximum volume of 9,882 cubic metres. Once the pond has reached is maximum storage, water will be lost through: the pond outlet, evaporation and ground water recharge. The potential water taking from a five-year storm event ranges from 4,150m^3 to 23,643m^3. The potential water taking from an average precipitation event is 5,156m^3. The maximum water taking will be 9,882m^3.

There will be no long term deleterious impact on wells neighbouring the Sorbara property from the installation of a pond. As long as the inlet and outlet elevations are consistent with the existing grades, there will be no long term deleterious impact on the quality or quantity of water in the West Stream from the installation of a pond.

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LIST OF TABLES AND FIGURES

1.0 INTRODUCTION

The Sorbara Family would like to establish a pond for aesthetics in a vacant field on their property in Sophiasburgh, Prince Edward County, Ontario. They have retained Lissom Earth Sciences to carry out the necessary work to support approval for construction of this pond.

1.1 The Client

Lissom Earth Sciences was retained by Mr. Greg Sorbara, to complete a Permit to Take Water (PTTW) application for submission to the Ministry of the Environment (MOE). The Sorbara property is located at 6590 County Road 15 (Northport Road), Sophiasburgh, Prince Edward County, Ontario (Figure 1: Site Location).

1.2 Background

Catherine Chisholm of Lissom, met on the Sorbara property on September 3, 2009 with Paul McCoy of the Quinte Conservation Alliance, Paul Greer of Greer Excavating, and Frank Crossley, Victor Castor and John Morrish of the MOE. The scope of work for the PTTW was discussed, along with specific concerns of the MOE and QC. At that time, overburden was mounded at the perimeter of the purposed pond area exposing the bedrock surface. Neighbours contacted Quinte Conservation (QC) and the MOE regarding potential impacts on their wells, as a result of the movement of the overburden on the Sorbara property.

1.3 Scope of Work

Lissom's PTTW investigation evaluated the potential impacts to surface water and ground water, as a result of the pond installation. Existing ground water conditions were evaluated using theoretical information from existing well records, topographic maps, geologic maps, and available hydrogeological reports. To confirm the theoretical evaluation, a neighbourhood well survey was completed and raw water was sampled from participating neighbours to determine background ground water chemistry. In addition, four monitor wells were installed in the area surrounding the pond and three monitor wells were installed within the pond footprint. Water samples were collected from the four monitor wells surrounding the pond and the samples were sent to an accredited laboratory for background water quality information.

To evaluate existing surface water conditions, a site visit of the Sorbara property was conducted on October 15, 2009. The local terrain was visually evaluated, including mapping of stream courses. The topography was further evaluated using an AutoLaser 3000 on November 18, 2009.

Information from the ground water and surface water investigation were compared and water taking calculations were determined based on data for a five year storm event.

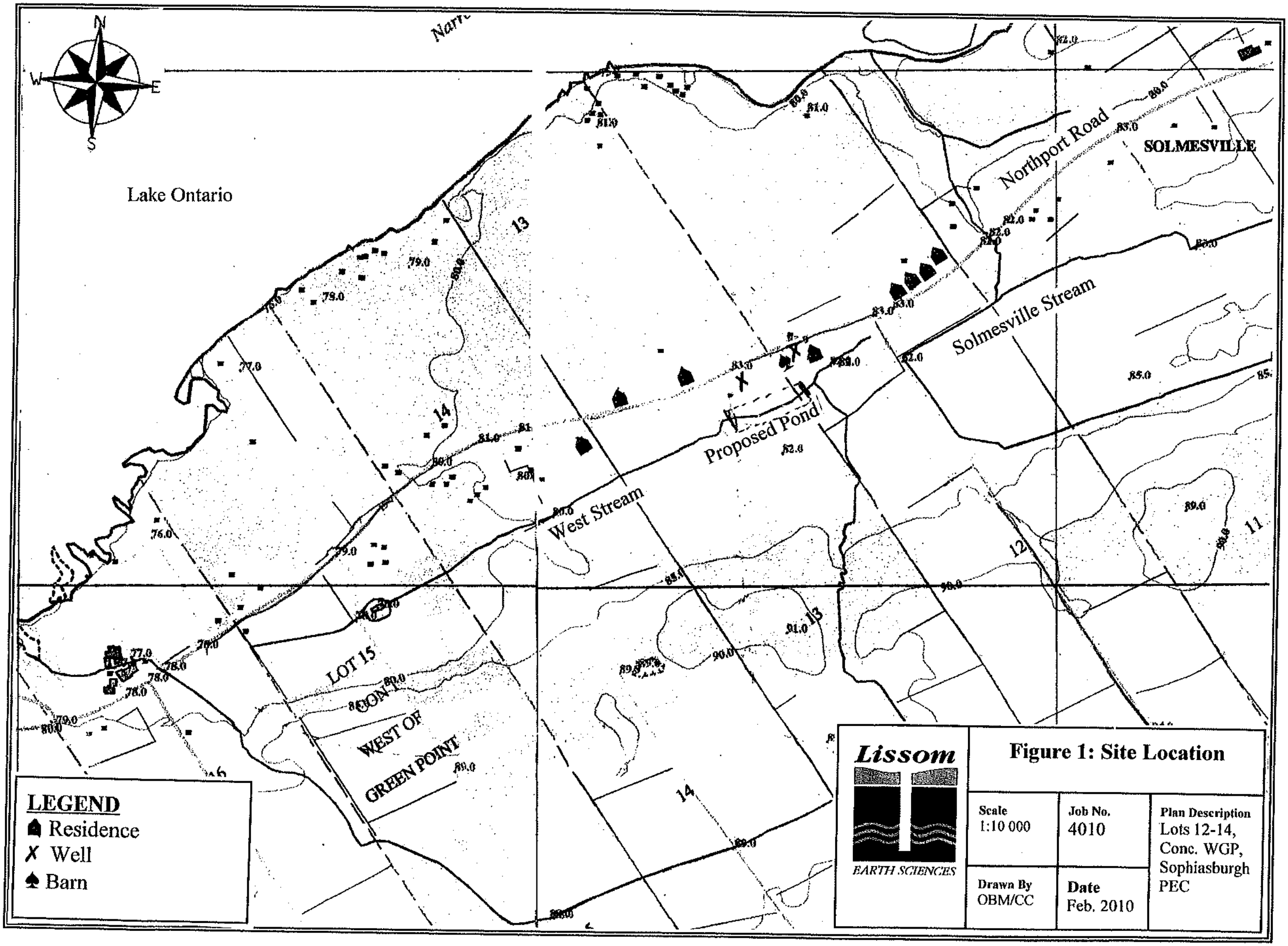

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Figure 1: Site Location

Scale 1:10 000	**Job No.** 4010	**Plan Description** Lots 12-14, Conc. WGP, Sophiasburgh PEC
Drawn By OBM/CC	**Date** Feb. 2010	

1.4 Site Description

The Sorbara property is located at 6590 County Road 15 (Northport Road), Sophiasburgh, Prince Edward County, Ontario (Figure 1: Site Location). The legal description is Lots 11, 12 and 13, Concession West of Green Point, Sophiasburgh Ward, Prince Edward County. The property consists of approximately 265 hectares of cultivated land, woodlots and open space on the south side of County Road 15. The north boundary of the property is defined by County Road 15. The southern boundary is the southern concession line. The east and west boundaries are both defined by fence lines.

There are two wells on the Sorbara property (Figure 1: Site Location). One well is located on Lot 13, immediately adjacent to the fence on the south side of County Road 15. This well is not in use. The well has an approximate 1.5 metre diameter and is constructed of rock cribbing. The surface of the well is covered with a concrete platform. During the site visit on October 15, 2009, surface water was entering the well through the rocks beneath the concrete. The second well supplies water to the Sorbara home. The well is located approximately twenty metres from the southwest corner of the home. A concrete tile extends approximately 0.1 metres above the ground surface. The tile was opened to examine the well construction. An eight inch steel casing extends approximately 0.3 metres above the floor of a well pit that is approximately 1.5 metres deep. The pit is constructed of concrete tiles.

1.5 The Pond

The proposed pond will be located in a field approximately thirty metres south of County Road 15, southeast of an existing barn (Figure 1: Site Location). The pond area is accessed by a driveway between the barn and a residence on the property. The kidney-shaped pond will be approximately 45 metres by 91.5 metres by 2.4 metres deep with an approximate capacity of 9,882 cubic metres. The pond is located on a seasonal stream.

At the time of this investigation, overburden had been scraped from an area of approximately forty-six metres by ninety metres, exposing the underlying limestone bedrock. Quinte Conservation has requested that the elevations of the inlet and outlet of the stream be consistent with existing grades and that the flow of the stream match existing flow rates.

2.0 GROUND WATER INVESTIGATION

The potential impacts to ground water were evaluated by conducting a MOE Well Record Search and consulting neighbouring residents for information about existing ground water conditions. The Well Record Database returned no records and neighbour participation was limited. Therefore, a total of seven monitor wells were installed in the area of the pond. Three monitor wells were installed within the pond footprint and four monitor wells were installed near the pond perimeter. Static levels in all the monitor wells were recorded and water samples were collected. In addition, local geological and topographical maps were consulted.

2.1 Hydrogeology

A search of the MOE Well Record Database was conducted for Lots 9-15, Concession West of Green Point, Sophiasburgh, Prince Edward County (Appendix A: Well Records). The search returned no records. Another search was conducted referencing the UTM coordinates for Zone 18 from 329300 to 333000 Easting and 4890000 to 4892500 Northing. The search returned no records. Lissom subsequently accessed ten well records from a company database for Lots 11-14, Concession West of Green Point, Sophiasburgh, Prince Edward County (Appendix A: Well Records). The well locations described in the records could not be matched to specific properties along County Road 15. These records indicate water is found in the limestone at a 3.5 to 18 metre (12-58 foot) depth, with static level for these wells ranging from 1 to 4.6metres (3-15 feet) (Table I: Well Records Summary). Surface plots of static levels and hydraulic heads (water found minus static level) suggest the ground water flow direction is from the north to the south.

Five (50%) of the wells report flows of greater than three gallons per minute. Nine records report fresh water and one well is reported dry. Statistical analysis of well record data suggests the supply aquifer is unconfined to semi-confined, as a function of interconnected fracturing in the limestone (Table 1: Well Record Summary).

2.2 Geology

2.2.1 Surficial Geology

A map of surficial geology by Leyland (1982) shows bedrock exposed; or with less than one metre of drift cover. Field inspection shows soils in the area appear to be residual alkaline silty clay with limestone rock fragments.

2.2.2 Bedrock Geology

Carson (1981) has interpreted the area as being underlain by the Verulam Formation consisting of medium brown and grey limestone interbedded with brown and green bioclastic limestone and shale. Outcrops are reported on the north side of County Road 15, less than one hundred metres from the property and also along the shore of the Bay of Quinte approximately eight hundred metres from the property.

2.3 Homeowner Surveys

During October and November 2009, homeowners along County Road 15, within an approximate four hundred metre radius of the pond centre, were invited to participate in a survey to provide information on well water quality and supply (Appendix B: Homeowner Surveys). Residents who chose to complete a survey occupied the following addresses: 2494, 2537 and 2629 County Road 15 (Figure 2: Addresses Visited for Homeowner Survey). Information was collected regarding individual well characteristics, water quality and seasonal flow patterns.

TABLE I: WELL RECORD SUMMARY

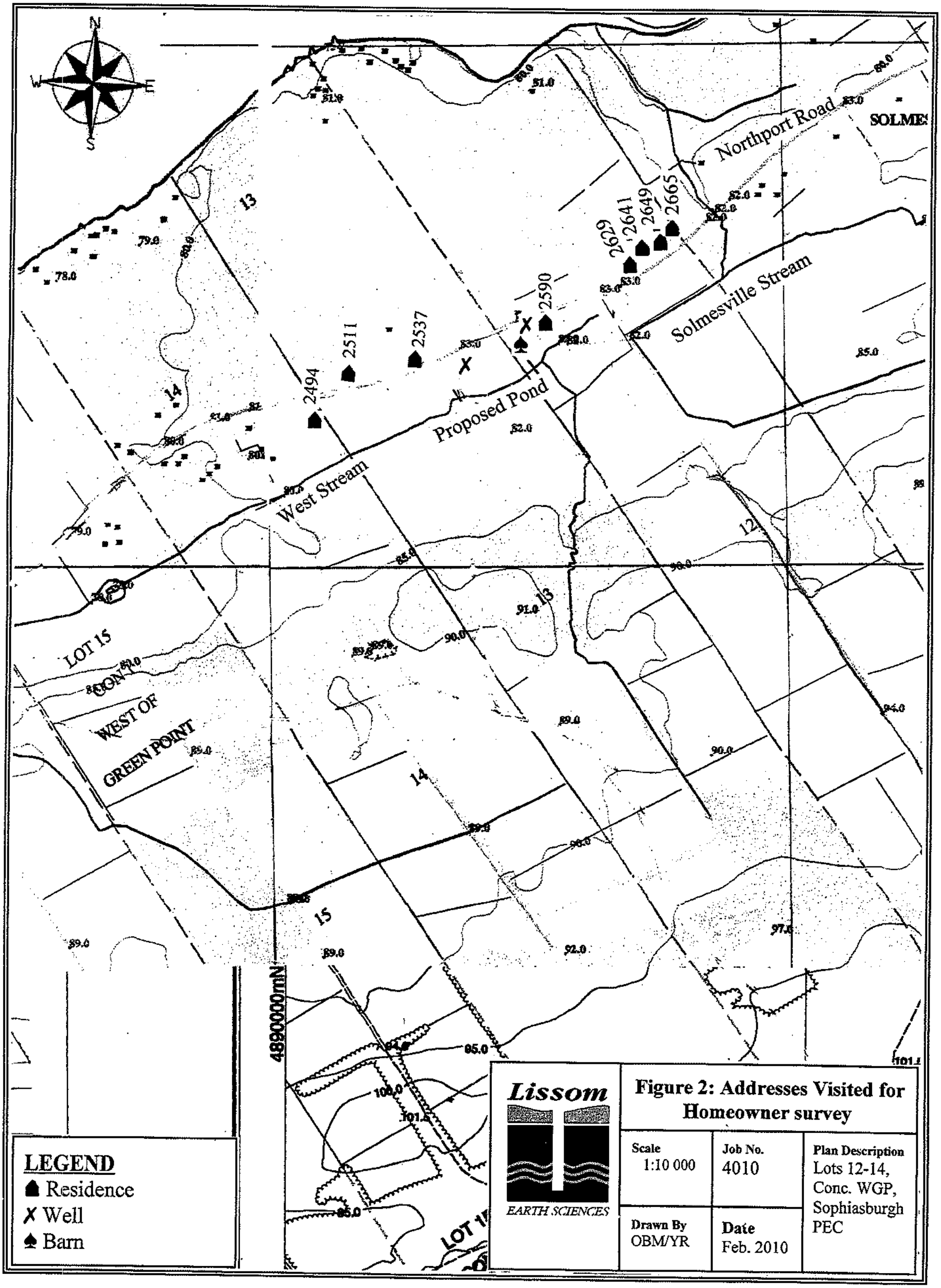
WELL NUMBER	UTM EASTING	NORTHING	WATER FOUND (ft)	STAT LEVEL (ft)	TEST RATE (gpm)	DEPTH TO BEDROCK (ft)	HOLE DEPTH (ft)	WF-BR (ft)	HD-WF (ft)	WF-SL (ft)	WF/ (WF-SL)
1658	330798	4891488	30	6	5	5	35	25.0	5.0	24.0	1.3
1663	330547	4891336	36	12	3	14	40	22.0	4.0	24.0	1.5
1661	330182	4891780	23	4	10	6	26	17.0	3.0	19.0	1.2
5303586	330260	4891100	43	15	40	4	46	39.0	3.0	28.0	1.5
1662	329757	4891254	22	6	2	7	25	15.0	3.0	16.0	1.4
1660	330272	4891632	23	3	20	3	30	20.0	7.0	20.0	1.2
5302777	330708	4891369	58	3	3	8	60	50.0	2.0	55.0	1.1
5303990	330700	4891400	Well abandoned, dry			5	60				
6303991	330720	4891400	12	8	3	5	40	7.0	28.0	4.0	3.0
1659	330462	4891334	18	4	6	5.5	20	12.5	2.0	14.0	1.3

Maximum	58	15	40	14	60	50	28	55	3.0
Minimum	12	3	2	3	20	-13	2	4	1.1
Average	29.4	6.8	10.2	6.3	38.2	23.1	6.3	22.7	1.5
Median	23	6	5	5.25	37.5	20	3	20	1.3

LEGEND

WF= Water Found
SL= Static Level
BR= Depth to Bedrock
HD= Hole Depth
ft= feet
gpm= gallons per minute

CORRELATION COEFFICIENT									
	WF	**SL**	**TEST RATE**	**BR**	**HD**	**WF-BR**	**HD-WF**	**WF-SL**	**WF/(WF-S**
WF	1								
SL	0.20	1.00							
TR	0.23	0.50	1.00						
BR	0.32	0.27	-0.48	1.00					
HD	0.81	0.29	0.14	0.11	1.00				
WF-BR	0.97	0.15	0.35	0.10	0.80	1.00			
HD-WF	-0.50	0.09	-0.18	-0.21	0.09	-0.48	1.00		
WF-SL	0.96	-0.10	0.08	0.24	0.74	0.95	-0.54	1.00	
WF/(WF-SL	-0.46	0.34	-0.11	-0.07	0.10	-0.47	0.94	-0.57	1.00



LEGEND

☗ Residence

✗ Well

♠ Barn

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Figure 2: Addresses Visited for Homeowner survey

Scale 1:10 000	Job No. 4010	Plan Description Lots 12-14, Conc. WGP, Sophiasburgh PEC
Drawn By OBM/YR	Date Feb. 2010	

As part of the survey, the homeowners were given the opportunity to have a raw water sample collected from their wells and analyzed at an accredited lab. Water samples were collected, before treatment where possible, from two locations: 2494 and 2537 County Road 15. The samples were analysed and compared for chloride (Cl), nitrate (NO_3), sulphate (SO_4), Total Dissolved Solids (TDS), hardness, and sodium (Na) (Appendix C: Laboratory Reports).

2.4 Homeowner Survey Results

2.4.1 Survey

Of the three homeowners who completed a survey questionnaire, two homes are supplied by drilled wells and one home has a dug and drilled well (Table II: Homeowner Well Survey Responses). Information provided by the well owners indicates the average depth of the wells is 6.7 metres (22 feet). Two of the residents report good water flow year round and one resident reports low flows in the summer. According to the survey, all three wells have hard water and two of the wells have high levels of iron in the water. All three homes have installed a softener, and one home also has filtration.

2.4.2 Well Conditions

The condition of wells neighbouring the Sorbara property varied. Seven properties are within four hundred metres of the pond centre. These properties were viewed from the road to observe the location of the wells. Some of the wells have exposed six inch casing, some wells have concrete casing and some wells were not visible. The wells were located in the middle of gardens and lawns or adjacent to private walkways.

2.4.3 Sampling

One of the six parameters tested in the water samples collected from the two neighbouring wells did not meet the Ontario Drinking Water Standards (ODWS) (Table III: Background Water Quality Analysis). Hardness levels exceeded the ODWS in both of the water samples (Appendix C: Laboratory Reports). Therefore, elevated hardness may be a characteristic of the supply aquifer.

2.5 Monitor Wells

Due to the lack of data on groundwater conditions, seven monitor wells were proposed for the area, with the following objectives:

1. Establish local aquifer static levels
2. Determine baseline water quality characteristics
3. Provide an opportunity to monitor ground water conditions during and following pond installation
4. Determine if base of pond will intercept water table

TABLE II: HOMEOWNER WELL SURVEY RESPONSES

Location	Well Depth	Type of Well	Pump	Quantity	Quality	Treatment
2494 County Road 15	7.9m	Drilled	Shallow jet	Good year round	Sodium Hard	Softener/Filtration
2537 County Road 15	4.9-6.1m	Drilled	Shallow jet	Good year round	Hard	Softener
2629 County Road 15	Unknown	Dug and Drilled	Shallow jet	Low flow in summer	Sodium Hard	Softener

TABLE III: BACKGROUND WATER QUALITY ANALYSIS

Parameter	Units	MDL	ODWS	Date	Well					
					2494 North Port Road	2537 North Port Road	MW A A089216	MW B A089217	MW C A089218	MW D A089219
Total Dissolved Solids	ppm	1	500	19-Nov-09	378	406	**3270**	**515**	**633**	**1890**
Chloride	mg/L	1	250	19-Nov-09	16	6	**1480**	96	145	**755**
Nitrate	mg/L	0.1	10	19-Nov-09	<0.1	4.4	<0.1	0.1	1.6	0.6
Sulphate	mg/L	1	500	19-Nov-09	19	16	**531**	57	68	196
Hardness ($CaCO_3$)	mg/L	1	80-100	19-Nov-09	**292**	**310**	**1620**	**367**	**396**	**822**
Sodium	mg/L	0.2	200	19-Nov-09	7.3	4.9	**607**	42.0	71.9	**371**

2.5.1 Procedure

Seven monitor wells were installed using an air track drill, to Ontario Regulation 903 specifications, on October 28, 2009 (Figure 3: Monitor Well Locations, Appendix D: Monitor Well Records). Four monitor wells were installed around the perimeter of the pond and three monitor wells were installed within the pond footprint. The four monitor wells were installed to depths similar to local wells to intercept the local supply aquifer. The three monitor wells were installed at a depth to represent the final elevation of the pond base. Two inch polyvinylchloride piping was used for casing. Five foot screens were installed on the four wells around the perimeter of the pond and two foot screens were installed on the wells in the pond footprint. The location of each well was recorded using a hand-held GPS Magellan unit. The locations of the four wells around the perimeter of the pond were selected for nearness to neighbouring wells, access of drilling equipment, and suitability for ground water monitoring.

The four perimeter wells were developed by removing approximately 2.85 litres of water from each well using a plastic bailer. The static levels were recorded before bailing and again prior to sample collection (Table IV: Monitor Well Data). The static levels in all seven wells were also measured on February 22, 2010. The static levels were compared to information from the MOE well records. Water samples were collected from the four perimeter wells on November 19, 2009. The samples were sent to Caduceon Laboratories in Kingston for analysis of TDS, chloride, nitrate, sulphate, hardness and sodium (Appendix C: Laboratory Results). The results were compared to the water sample results from the two neighbouring wells (Table III: Background Water Quality Analysis).

2.5.2 Results

The static levels in Monitor Wells A (Well Number A089216) and C (Well Number A089218) were approximately 9 metres below ground level prior to sample collection (Figure 4: Monitor Well Cross-Section). The static level in Monitor Well C rose to approximately one metre below ground level following development. The static levels in Monitor Wells B (Well Number A089217), D (Well Number A089219), 1, 2, and 3 (Cluster Number A089220) averaged 0.6 metres below ground surface. The static levels were recorded one day following a precipitation event. The static levels recorded in wells A, B, C, and D on February 22nd 2010, were consistent with the static levels recorded in November (Figures 4A&B: Monitor Well Cross-Section). The water in the three shallow wells was frozen. The elevation of the frozen water was consistent with the November static level measurements. To correct for the removal of overburden in the three shallow wells, 0.3metres was added to the static level measurements. Following comparison with information from the MOE well records, the local water table elevation is approximately 0.6metres below ground level.

The water level data from the monitor wells suggest the limestone bedrock is tight, characterized by fracturing. Individual well characteristics are influenced by well

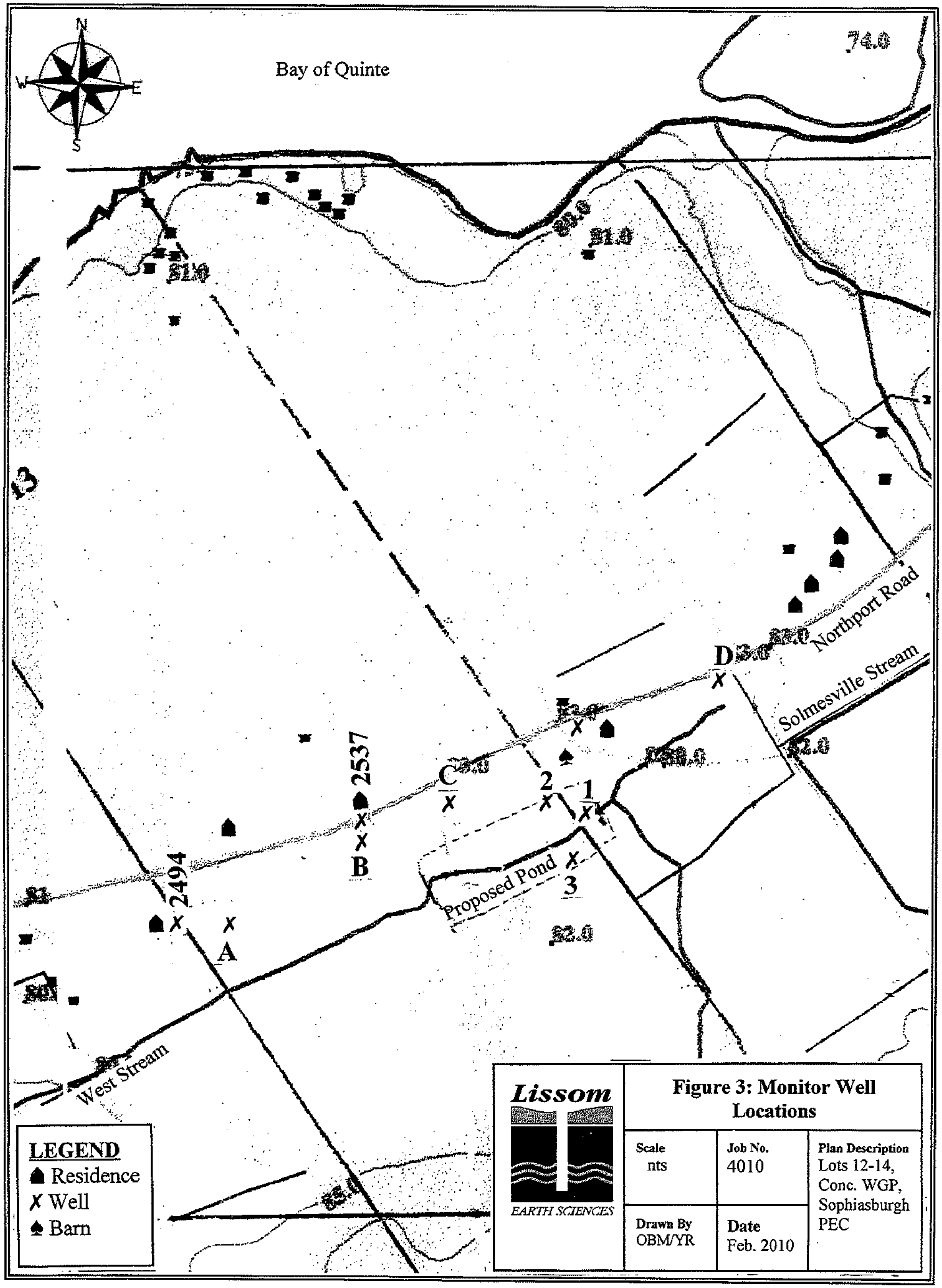

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Figure 3: Monitor Well Locations

Scale nts	Job No. 4010	Plan Description Lots 12-14, Conc. WGP, Sophiasburgh PEC
Drawn By OBM/YR	Date Feb. 2010	

TABLE IV: MONITOR WELL DATA

Date: Nov. 19, 2009

Date: Feb. 22, 2010

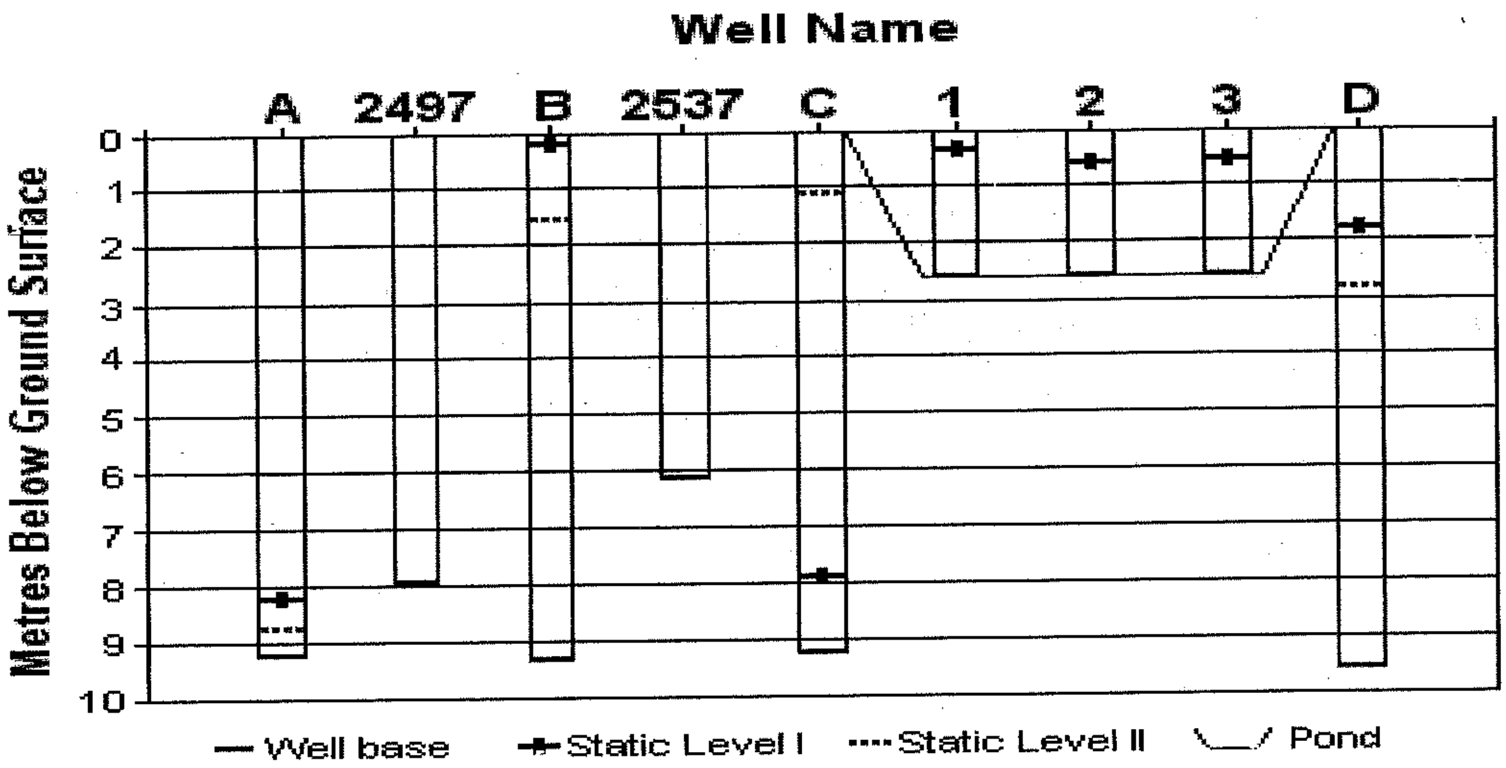
Monitor Well	Well Number	Easting	Northing	Total Depth (m BGS)	Static Level I (m BGS)	Time	Static Level II (m BGS)	Time	Static Level (mBGS) Feb.
A	A089216	18T 0330148	UTM 4891286	9.212	8.181	9:25 AM	8.715	11:55 AM	8.614
B	A089217	18T 0330230	UTM 4891340	9.285	0.161	9:44 AM	1.495	12:03 PM	0.873
C	A089218	18T 0330323	UTM 4891366	9.210	7.866	9:49 AM	1.060	12:13 PM	0.892
D	A089219	18T 0330666	UTM 4891510	9.505	1.731	9:54 AM	2.812	12:20 PM	2.104
1	A089220	18T 0330476	UTM 4891355	2.531	0.276	N/A	N/A	N/A	0.106
2	A089220	18T 0330421	UTM 4891359	2.554	0.536	N/A	N/A	N/A	0.194
3	A089220	18T 0330462	UTM 4891341	2.537	0.472	N/A	N/A	N/A	0.246

BGS = below ground surface

Reference GPS Locates

1. Lane East of House - 18T 0330695, UTM 4891529
2. Sorbara Well - 18T 0330504, 4891451
3. Lane @ 2615 (north side of road) - 18T 0330648, UTM 4891528

Static Level in Wells (November 18, 2009).

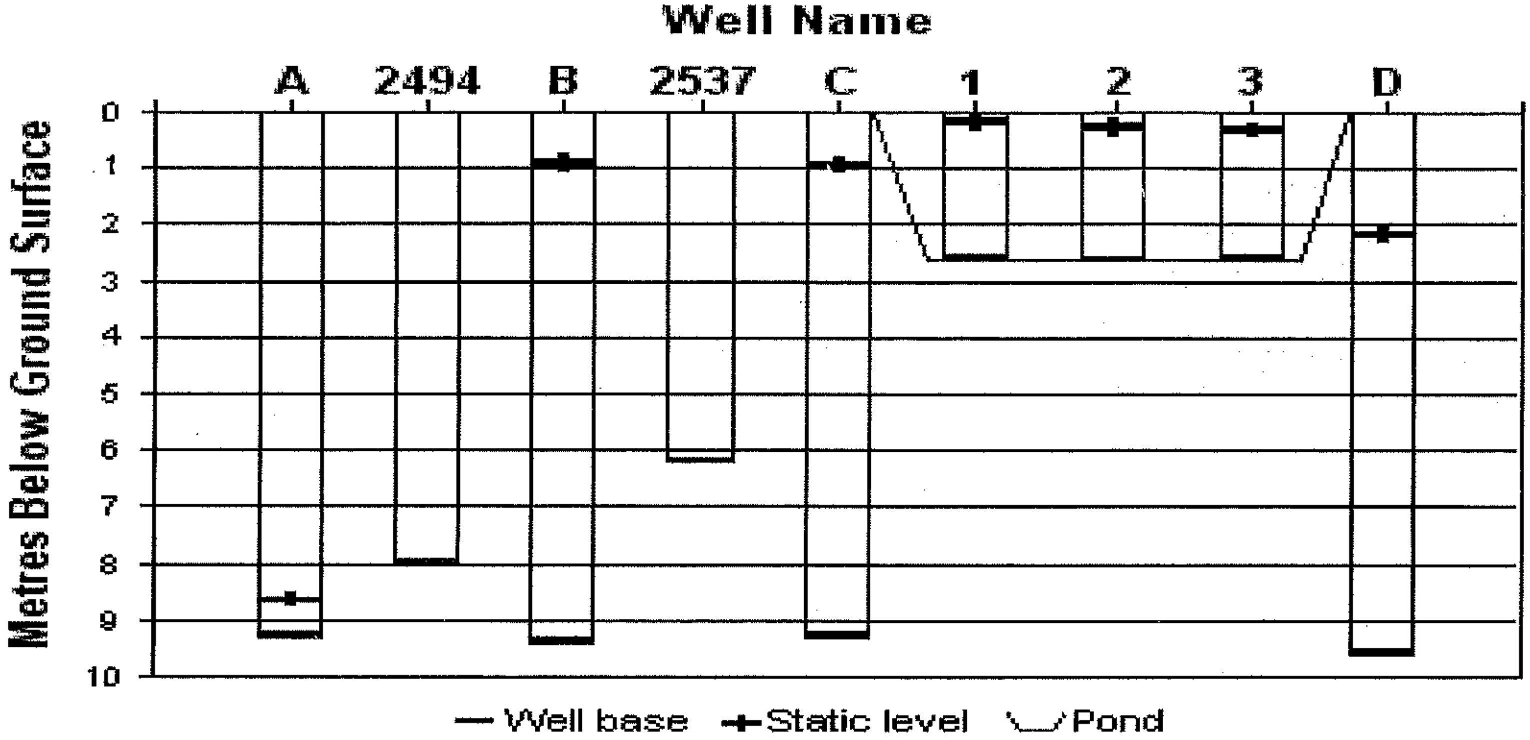


Lissom
EARTH SCIENCES

Figure 4A: Monitor Well Cross-Section. November 2009

Scale nts	**Job No.** 4010	**Plan Description** Lots 12-14, Conc. WGP, Sophiasburgh PEC
Drawn By OBM/YR	**Date** Feb. 2010	

Static Level in Wells (February 22, 2010).



Lissom
EARTH SCIENCES

Figure 4B: Monitor Well Cross-Section. February 2010		
Scale nts	**Job No.** 4010	**Plan Description** Lots 12-14, Conc. WGP, Sophiasburgh PEC
Drawn By OBM/YR	**Date** Feb. 2010	

construction and the quality and quantity of the fractures encountered by the well. The static level in Monitor Well A is expected to rise over time.

Two of the six parameters tested in the water samples from the monitor wells did not meet the Ontario Drinking Water Standards (ODWS) (Table III: Background Water Quality). Hardness and TDS levels exceeded the ODWS in the water samples (Appendix C: Laboratory Reports). The hardness level supports the results of the neighbourhood sampling results and therefore, hardness may be a characteristic of the supply aquifer. Chloride and sodium levels exceeded the ODWS in Monitor Wells A and D. The level of sulphate in Monitor Well A also exceeded the ODWS, however, the water chemistry ratios were consistent with the other monitor wells.

3.0 SURFACE WATER INVESTIGATION

3.1 Site Evaluation

On October 15, 2009, Catherine Chisholm and Josh Coghlan, of Lissom, conducted a site evaluation of the Sorbara property. Neighbouring water users within 500metres of the proposed pond were located, surface water flow patterns were observed, and defined water courses on the Sorbara property were mapped. A water course was considered defined if banks were approximately 0.5 metres, or greater, in height above the channel bed. The evaluation was limited to within 500 metres of the proposed pond, including publicly accessible areas, such as roads and lanes.

No neighbouring surface water users were identified within 500 metres of the proposed pond. Seven neighbouring potential ground water users were identified within 500 metres of the proposed pond area (Section 2.3 Homeowner Surveys).

The topography was generally flat. Surface water drains from County Road 15 south to an existing water course. Surface water also drains from the south end of the property to the north. Due to the flat topography and shallow overburden, surface water ponding following precipitation events would be expected.

Two defined water courses were identified (Figure 1: Site Location). The water courses are not named on the OBM, for the purposes of this investigation the water courses will be called the West Stream and the Solmesville Stream.

3.1.1 West Stream

A confluence of three channels was located approximately 50metres south of the Sorbara barn (Figure 1: Site Location). During the site meeting on September 3rd, no water was observed at this confluence. However, on October 15th, surface water at the confluence was approximately one metre deep and 2.5metres wide. The water was flowing west into the proposed pond area.

The West Stream receives runoff from the surrounding area following/during spring snowmelt and precipitation events. The West Stream also receives water that infiltrates into the shallow overburden of the surrounding area and then flows across the bedrock surface into the Stream. When the Stream contains water, it represents a perched water table on top of the bedrock. Eventually, the volume of water lost from the stream and the surrounding area, due to evaporation and infiltration into the limestone, is greater than the volume of precipitation added to the system. During this time of year, the Stream is dry.

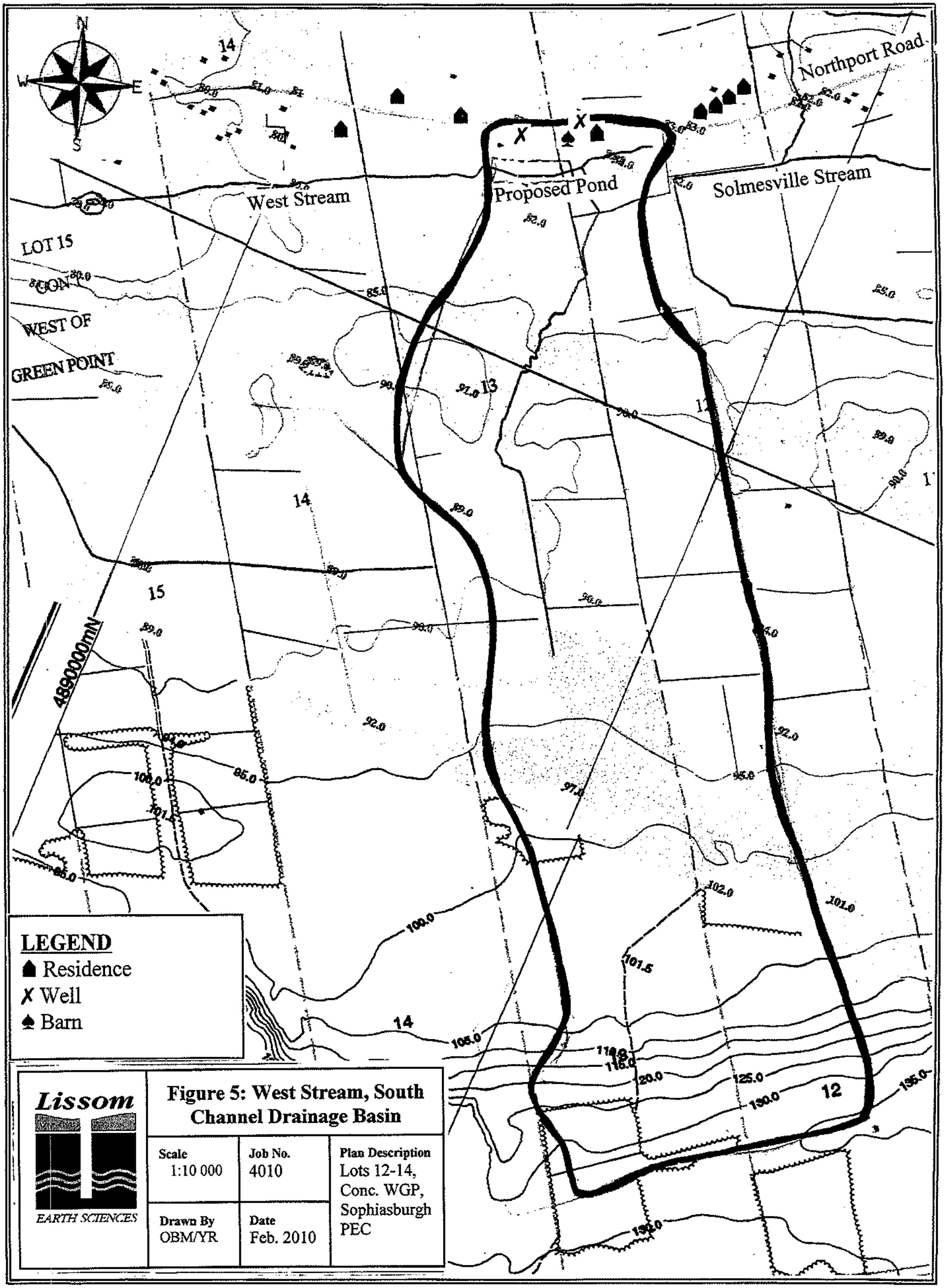
The three stream channels were followed to determine the physical characteristics of the West Stream. The bed of the channels was bedrock. Water in the channels was not always continuous, ponding was common. The flow rate in each channel was slow. For example, the south channel was dry approximately one hundred metres south of the confluence. Water was observed flowing north in the same channel approximately three hundred metres further south of the confluence. Of note, a channel is shown east of the confluence on the OBM. The banks of the east channel were defined and contained water until a culvert under a lane south of the Sorbara house. The banks became undefined on the east side of the culvert; the topsoil had been scraped from the land surface where the channel is shown on the OBM and this area was dry.

3.1.2 Solmesville Stream

An elbow of a second water course was identified 200metres west of the east boundary of Lot 12, approximately 90metres south of Northport Road (Figure 1: Site Location). The banks were defined and appeared to be recently excavated. The width of the water varied between 1 to 3.5metres and the depth of the water varied between 0.1 to 0.3metres. The flow of water in the channel was east. South of the elbow, the water flows north parallel, approximately 200metres, to a lane extending south from Northport Road. The volume and flow rate of water in the Solmesville Stream was visibly greater than the West Stream.

3.2 Topography

The surface topography in the area of the pond is generally flat. According to the OBM, the highest elevation within 500metres of the pond is 91mASL on Lot 13. The lowest elevation is 82mASL approximately 100metres south of the proposed pond. An AutoLaser 3000 was used to further confirm the flow direction of the West Stream, and to evaluate the probability of a connection forming between the West and Solmesville Streams. The slope of the bedrock surface in the area cleared for the pond was measured, as well as elevations for three cross-sections of the field between the West Stream and the Solmesville Stream.



LEGEND
☗ Residence
✗ Well
♠ Barn

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Figure 5: West Stream, South Channel Drainage Basin

Scale 1:10 000	**Job No.** 4010	**Plan Description** Lots 12-14, Conc. WGP, Sophiasburgh PEC
Drawn By OBM/YR	**Date** Feb. 2010	

TABLE V: WATER TAKING CALCULATIONS

WATER TAKING AREA (ha)= 104.8

DURATION	5 YEAR (mm)	5 YEAR (m)	WATER FALLING (m3/time)	infiltration factor	Infiltrating to GW (m3)	SW Runoff (m3)	Infiltrating to GW (L)	SW Runoff (L)
5 MIN	9.9	0.0099	10375.2	0.4	4150.08	6225.12	4,150,080	6,225,120
10 MIN	13.7	0.0137	14357.6		5743.04	8614.56	5,743,040	8,614,560
15 MIN	16	0.016	16768		6707.2	10060.8	6,707,200	10,060,800
30 MIN	22	0.022	23056		9222.4	13833.6	9,222,400	13,833,600
1 H	25.1	0.0251	26304.8		10521.92	15782.88	10,521,920	15,782,880
2 H	32.1	0.0321	33640.8		13456.32	20184.48	13,456,320	20,184,480
6 H	43.7	0.0437	45797.6		18319.04	27478.56	18,319,040	27,478,560
12 H	49.6	0.0496	51980.8		20792.32	31188.48	20,792,320	31,188,480
24 H	56.4	0.0564	59107.2		23642.88	35464.32	23,642,880	35,464,320
Daily Avg	8.2	0.0082	8593.6		3437.44	5156.16	3,437,440	5,156,160

3.2.1 Surveying Results

The downward slope of the bedrock surface in the proposed pond area is one percent east to west and is an average of 0.4 percent south to north.

The elevation of water in the West Stream and the Solmesville Stream is approximately the same at their closest geographical location. In order for water in the two streams to intercept, the water would have to travel a horizontal distance of approximately 150metres and a vertical distance of 0.23metres.

4.0 WATER TAKING CALCULATIONS

The proposed pond will be taking water from the West Stream during spring snowmelt and precipitation events (spring and fall). The West Stream is dry during the summer. The proposed pond will store a maximum volume of 9,882 cubic metres. Once the pond has reached is maximum storage, water will be lost through: the pond outlet, evaporation and ground water recharge. The drainage area of the Stream upgradient from the proposed pond was calculated as 104.8 hectares (Figure 5: West Stream, South Channel Drainage Basin). To determine the maximum water taking, five-year storm precipitation rates for Belleville, Ontario were applied to the MOE water balance model (Appendix E: Water Taking Calculation Supporting Documents). A typical water taking was calculated by applying the water balance model to the average 24 hour precipitation rate in the months of April to October 2009, at the Trenton A Weather Station. An infiltration factor of 0.4 was applied, based on rolling land, tight impervious soil and cultivated land.

The kidney-shaped pond will be approximately 45metres by 91.5metres by 2.4metres with a total volume of 9,882 cubic metres. The potential water taking from a five-year storm event ranges from 4,150m^3 to 23,643m^3 (Table V: Water Taking Calculations). The potential water taking from an average precipitation event is 5,160m^3. The maximum water taking will be 9,882m^3. Excess surface water will drain from the west outlet of the pond into the existing stream channel.

5.0 CONCLUSIONS

1. The local supply aquifer is hydraulically connected, unconfined/semi-confined and vulnerable to contamination.

2. The base of the proposed pond may intercept the water table. Over time, ground water will account for an approximate volume of 7411.5 cubic metres (75% of the total pond volume).

3. The base of the proposed pond will be at an elevation that will not disrupt the quality or quantity of water supplying wells neighbouring the Sorbara property.

4. The information from the West Stream, combined with the static level data in the monitor wells, indicates the proposed pond will be located in a ground water recharge zone. Due to the physical characteristics of the limestone, the water in the wells is slowly recharging into the bedrock. The rate of recharge is dependent on the number of fractures intersected in the limestone.

5. The proposed pond will receive approximately 2471 cubic metres (25% of the total pond volume) of surface water runoff from the West Stream in addition to precipitation that falls into the pond. Additional water will discharge through an outlet into the existing stream channel.

6 There will be no long term deleterious impact on wells neighbouring the Sorbara property from the installation of a pond.

7. As long as the inlet and outlet elevations are consistent with the existing grades, there will be no long term deleterious impact on the quality or quantity of water in the West Stream from the installation of a pond.

6.0 RECOMMENDATIONS

1. No futher modification of the West Stream channels outside the pond footprint should occur.

2. The rock crib well that is not in use, on Lot 13, should be abandoned as per Ontario Regulation 903.

3. No water should be removed from the pond, beyond normal evaporation, discharge into the West Stream, and infiltration to the ground water.

LISSOM EARTH SCIENCES

CATHERINE CHISHOLM B.Sc.(Env).
February 26, 2010

APPENDIX A:
WELL RECORDS

UTM 1|8 Z 3|3|0|7|9|8 E

5 ~~9~~ R 4|8|9|1|4|8|8 N

lev. 5 ~~9~~ R 0|2|6|5

asin 2|4|

31C3L

53 № 1658

C

The Ontario Water Resources Commission Act

WATER WELL RECORD

ounty or District PRINCE EDWARD Township, ~~Village, Town or City~~ SOPHIASBURG

on. ~~W. of Green Point~~ 1 CON Lot ~~12~~ 11 Date completed 20 (day) 4 (month) 65 (year)

from a telephone conversation with the [illegible]

wner [redacted] Address 291 AVE. RD. TORONTO

Casing and Screen Record

side diameter of casing 6¼"

otal length of casing 5'

ype of screen

ngth of screen

epth to top of screen

ameter of finished hole 6¼"

Pumping Test

Static level 6'

Test-pumping rate 5 G.P.M.

Pumping level 35'

Duration of test pumping ½ hr

Water clear or cloudy at end of test CLEAR

Recommended pumping rate 2 G.P.M.

with pump setting of 32 feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
Gravel	0	5	30'	fresh
Limestone	5	35		

what purpose(s) is the water to be used? [redacted]

SUMMER HOME.

ell on upland, in valley, or on hillside? UPLAND

ling or Boring Firm Ralph Ralston

ress Bloomfield Ont

nce Number 1656

ne of Driller or Borer SAME

ress

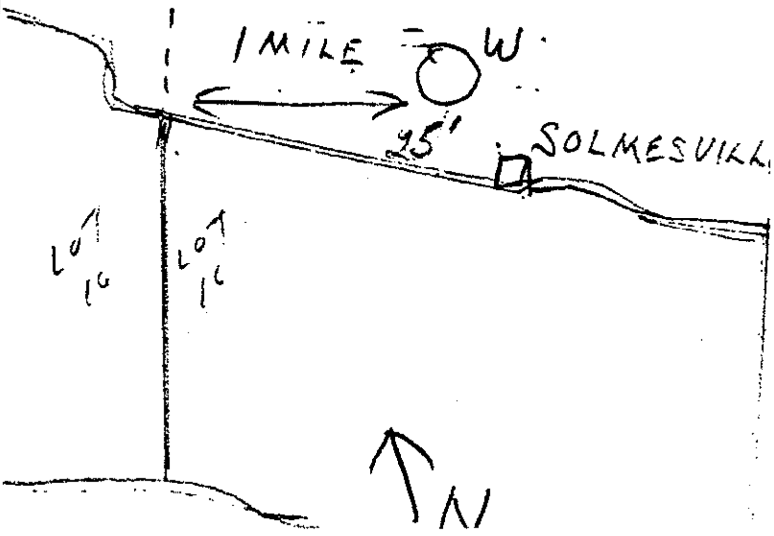
22/6/65

Ralph Ralston

(Signature of Licensed Drilling or Boring Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



7 15M-60-4138

RC COPY

UTM 1 8 Z 3 3 0 5 4 7 E 3103L

Green R Peirto West 4 8 9 1 3 3 6 N

Con 19 R 1 0 2 6 5
Lot 14

Basin 2 4 L P R

GROUND WATER BRANCH
53 No 1663
OCT 22 1963
ONTARIO WATER RESOURCES COMMISSION

e

The Ontario Water Resources Commission Act

WATER WELL RECORD

County or District P.E.D.

Township, Village, Town or City SOPHIASBURG

Con. I GPW PT. ~~PW OF GREEN PT.~~ Lot ~~15~~ 14

Date completed 8 (day) OCT (month) 63 (year)

Owner [redacted]

Address PICTON RR

Casing and Screen Record

Inside diameter of casing 6 1/4

Total length of casing 14

Type of screen

Length of screen

Depth to top of screen

Diameter of finished hole 6

Pumping Test

Static level 12

Test-pumping rate 3 G.P.M.

Pumping level 21

Duration of test pumping 1 HR

Water clear or cloudy at end of test CLEAR

Recommended pumping rate 3 G.P.M.

with pump setting of 35 feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
CLAY	0	14		
LIMESTONE	14	40	36	FRESH

(Water Record)

For what purpose(s) is the water to be used? FARM

Well on upland ✓, in valley, or on hillside?

Drilling or Boring Firm H + R ROLSTON

Address BLOOMFIELD

Licence Number 919

Name of Driller or Borer SAME

Address

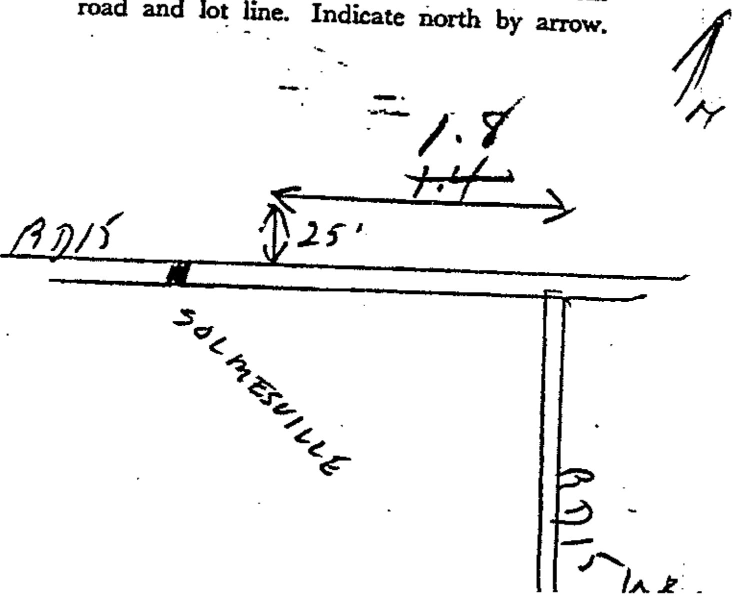
Date 8 Oct 66

Ralph Rolston
(Signature of Licensed Drilling or Boring Contractor)

7 15M-60-4138

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



. CI.

UTM 18 Z 330182 E

Green Point West [illegible] N

Elev. 54 R 5250

Lot 12

Basin 24

31C3L

The Ontario Water Resources Commission Act

WATER WELL RECORD

53 No 1661

WATER RESOURCES DIVISION DEC 5 1966

ONTARIO WATER RESOURCES COMMISSION DEC 1965

County or District Prince Edward

Township, ~~Village, Town or City~~ Sophiasburgh

Con ~~1~~ W. of Green Pt. Lot 12

TEPW

Date completed July 9, 1965 (day month year)

Owner [redacted] letters)

Address 2 North Drive, Scarborough, Ont.

Casing and Screen Record

Inside diameter of casing 8''

Total length of casing 6 ft.

Type of screen

Length of screen

Depth to top of screen

Diameter of finished hole 8''

Pumping Test

Static level 4 ft.

Test-pumping rate 10 G.P.M.

Pumping level 12 ft.

Duration of test pumping 1 hr.

Water clear or cloudy at end of test clear

Recommended pumping rate 6 G.P.M.

with pump setting of 23 feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
clay and large stones	0	6	23 ft.	fresh
brown limestone	6	26		

For what purpose(s) is the water to be used? cottage use

Is well on upland, in valley, or on hillside? level ground

Drilling or Boring Firm L.H.McClennon & Son

Address Wellington, Ont.

Licence Number 1688

Name of Driller or Borer L.H.McClennon

Address Wellington, Ont.

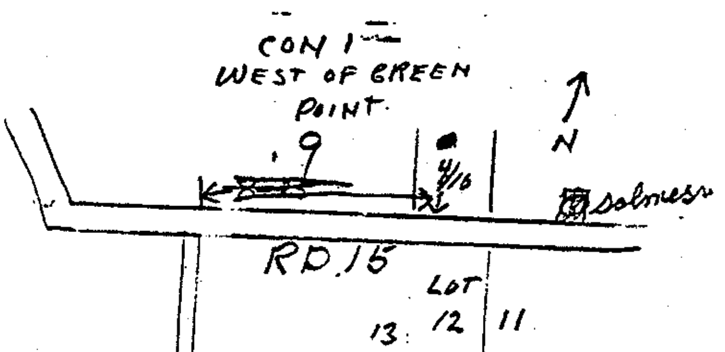
Date July 31, 1965

L.H. McClennon

(Signature of Licensed Drilling or Boring Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



7 15M-60-4138

WRC COPY

Ministry of the Environment
Ontario

The Ontario Water Resources Act 31c/3h

WATER WELL RECORD

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

11 | 5303586 | MUNICIP. 53007 | CON. GP. W. 01

COUNTY OR DISTRICT: Prince Edward
TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: Sophiasburgh
CON., BLOCK, TRACT, SURVEY, ETC.: ~~[illegible]~~ I G.P.W.
LOT: 913
OWNER: [redacted]
ADDRESS: R. R. # 2, Picton
DATE COMPLETED: DAY 17 MO. 10 YR. 77

21 530260 | NORTHING 4891100 | RC. 4 | ELEVATION 0270 | RC. 4 | BASIN CODE 24

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
Brown	Clay		Packed	0	4
Grey	Limestone		Hard	4	46

31 0004606791 | 0046021573
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
~~43~~ 0043	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
~~6¼~~ 06	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	.188	0	0020
~~6¼~~ 06	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		20	0046
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.):
DIAMETER: INCHES
LENGTH: FEET
MATERIAL AND TYPE:
DEPTH TO TOP OF SCREEN: FEET

61 PLUGGING & SEALING RECORD

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

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☒ BAILER
PUMPING RATE: 0040 GPM
DURATION OF PUMPING: 01 HOURS 00 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
015 FEET	035 FEET	015 FEET	015 FEET	015 FEET	015 FEET

WATER LEVELS DURING: 1 ☐ PUMPING 2 ☒ RECOVERY
IF FLOWING, GIVE RATE: GPM
PUMP INTAKE SET AT: FEET
WATER AT END OF TEST: 1 ☒ CLEAR 2 ☐ CLOUDY
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP
RECOMMENDED PUMP SETTING: 043 FEET
RECOMMENDED PUMPING RATE: 0040 GPM

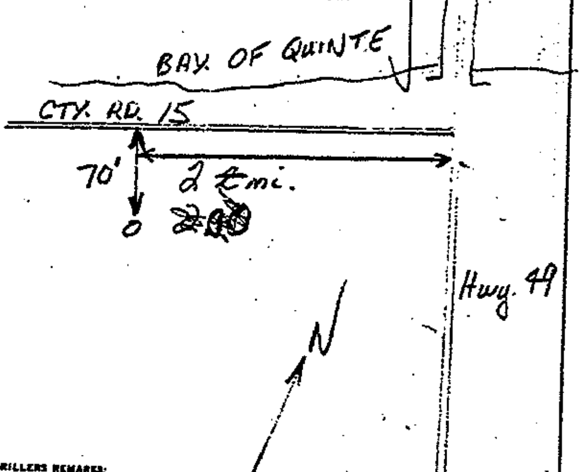
FINAL STATUS OF WELL 1
1 ☒ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED

WATER USE 01
1 ☒ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☐ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF DRILLING 4
1 ☐ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☒ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING

LOCATION OF WELL

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



DRILLERS REMARKS:

CONTRACTOR

NAME OF WELL CONTRACTOR: CHAIK WELL DRILLING LTD.
LICENCE NUMBER: 1507
ADDRESS: R. R. # 6, Napánee
NAME OF DRILLER OR BORER: George R. Chalk
LICENCE NUMBER: 1559
SIGNATURE OF CONTRACTOR: CHALK WELL DRILLINGLTD.
SUBMISSION DATE: DAY 17 MO. 10 YR. 77

OFFICE USE ONLY

DATA SOURCE: 1
CONTRACTOR: 1507
DATE RECEIVED: 190178
DATE OF INSPECTION:
INSPECTOR: KM
REMARKS:

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506-4-77

TM 18 Z 3297575 E 31638

N

Elev. 5 R 92555

Lot 14

sin 24

GROUND WATER BRANCH
OCT 22 1963
ONTARIO WATER
RESOURCES COMMISSION

No. 1662

The Ontario Water Resources Commission Act

WATER WELL RECORD

unty or District PRINCE. ED. Township, Village, Town or City SOPHIASBURG

n. [illegible] Lot 14 Date completed 14 (day) SEP (month) 63 (year)

ner [redacted] Address 978 DANFORTH RD SCARBORO

Casing and Screen Record	
ide diameter of casing	6 1/4
al length of casing	7
pe of screen	
gth of screen	
th to top of screen	
meter of finished hole	6

Pumping Test		
Static level	6	
Test-pumping rate	2	G.P.M.
Pumping level	20	
Duration of test pumping	1 HR	
Water clear or cloudy at end of test	CLEAR	
Recommended pumping rate	2	G.P.M.
with pump setting of	22	feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
GRAVEL	0	7		
LIMESTONE	7	25	22	FRE

what purpose(s) is the water to be used? COTTAGE

ll on upland, in valley, or on hillside?

ng or Boring Firm R + B RALSTON

ess BLOOMFIELD

ce Number 919

of Driller or Borer SAME

ss

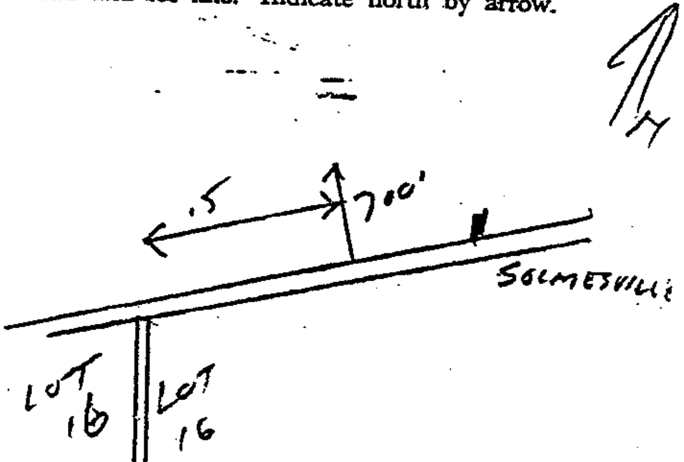
OCT 16

Ralph Ralston

(Signature of Licensed Drilling or Boring Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



7 15M-60-4138

UTM 1|18 z 3|3|0|2|7|2 E
5 R 4|8|9|1|6|3|2 N
Green Point West
Elev. 5 R 0|9|3|5
Basin 1|2|4 |_|_|_|
Lot 12

3103L

GROUND WATER BRANCH
53 № 1660
JUL 15 1960
ONTARIO WATER
RESOURCES COMMISSION

The Ontario Water Resources Commission Act, 1957

WATER WELL RECORD

County or ~~District~~ Prince Edward Township, ~~Village, Town or City~~ Sophiasburgh

Con ~~1st~~ Green Point West Lot 12 Date completed 18 (day) June (month) 1968 (year)

Owner [redacted] Address Picton R.R.6. Ont.

Casing and Screen Record

Inside diameter of casing 6¼"

Total length of casing 3'

Type of screen

Length of screen

Depth to top of screen

Diameter of finished hole 6¼"

Pumping Test

Static level 3'

Test-pumping rate 20 G.P.M.

Pumping level 18'

Duration of test pumping 1 hr

Water clear or cloudy at end of test Clear

Recommended pumping rate 3 G.P.M.

with pumping ~~level of~~ 26

Well Log / Water Record

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	No. of feet water rises	Kind of water (fresh, salty, sulphur)
			23'	20'	fresh
Clay gravel	0	3			
grey limestone	3	30			

For what purpose(s) is the water to be used? Cottage

Is well on upland, in valley, or on hillside? below Hill by Bay of Quinte

Drilling Firm L. H. McClennon & Son

Address Box 339 Wellington Ont

Licence Number 585

Name of Driller Kenneth McClennon

Address Wellington

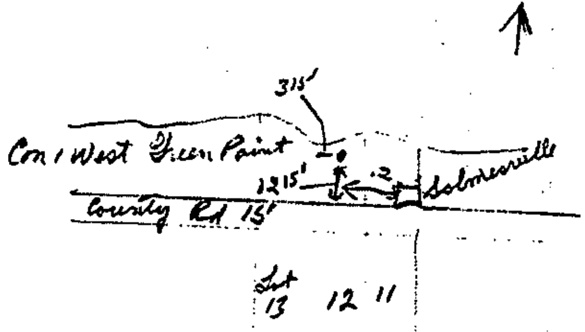
Date July 11 1960

L. H. McClennon

(Signature of Licensed Drilling Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Ontario D

The Ontario Water Resources Act

WATER WELL RECORD

3/C/3h

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

11 | 5302777 | MUNICIP. 53007 | CON. GP W 01

COUNTY OR DISTRICT Prince Edward	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE Sophiasburgh	CON., BLOCK, TRACT, SURVEY, ETC. ~~1 WGP~~ ~~II~~ IGPW	012 ~~Pt. 12~~
OWNER (SURNAME FIRST) [redacted]	ADDRESS R. R. # 2, Picton		DATE COMPLETED DAY 26 MO. 05 YR. 73

21 | Z 18 | EASTING 330708 | NORTHING 4891369 | RC 4 | ELEVATION 0270 | RC. 4 | BASIN CODE 24

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
Brown	Clay		Packed	0	8
Grey	Limestone		Hard	8	60

31 00056051 00602151

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0058	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
06 ~~6¼~~	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	.188	0	0011
06 ~~6¼~~	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		11	0060
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)

DIAMETER INCHES

LENGTH FEET

MATERIAL AND TYPE

DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

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

71 PUMPING TEST

PUMPING TEST METHOD 1 ☐ PUMP 2 ☒ BAILER

PUMPING RATE 0003 GPM

DURATION OF PUMPING 01 HOURS 20 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING 1 ☐ PUMPING 2 ☒ RECOVERY 15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
003 FEET	060 FEET	018 FEET	009 FEET	003 FEET	003 FEET

IF FLOWING, GIVE RATE GPM

PUMP INTAKE SET AT FEET

WATER AT END OF TEST 1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING 057 FEET

RECOMMENDED PUMPING RATE 0003 GPM

000·1

FINAL STATUS OF WELL 1

1 ☒ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED

WATER USE 01

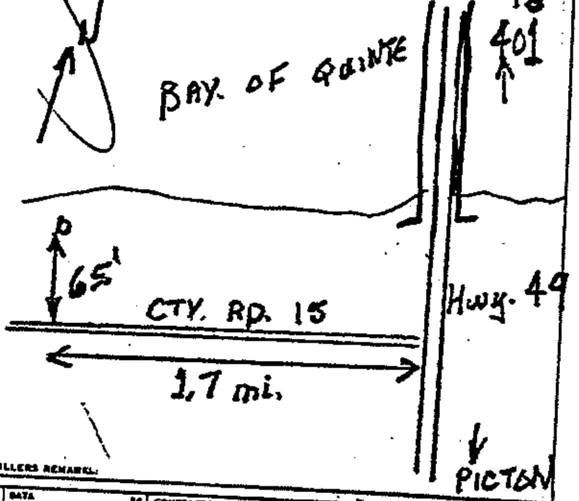
1 ☒ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☐ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF DRILLING 4

1 ☐ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☒ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING

LOCATION OF WELL 3091

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



DRILLERS REMARKS:

CONTRACTOR

NAME OF WELL CONTRACTOR: CHALK WELL DRILLING LTD. | LICENCE NUMBER: 1507

ADDRESS: R. R. # 6, Napanee

NAME OF DRILLER OR BORER: George R. Chalk | LICENCE NUMBER: 1559

SIGNATURE OF CONTRACTOR: CHALK WELL DRILLING LTD.

SUBMISSION DATE: DAY 26 MO. 5 YR. 73

OFFICE USE ONLY

DATA SOURCE 1 | CONTRACTOR 1507 | DATE RECEIVED 270274

DATE OF INSPECTION | INSPECTOR

REMARKS:

MINISTRY OF THE ENVIRONMENT COPY

FORM 7 07-091

Ontario
Ministry
of the
Environment

The Ontario Water Resources Act 31C/3h

WATER WELL RECORD

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

11 5303990

MUNICIP. 53007 CON. GP. W. 01

COUNTY OR DISTRICT: Prince Edward

TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: Sophiasburgh

CON., BLOCK, TRACT, SURVEY, ETC: 1 WGP

LOT: 012

OWNER (SURNAME FIRST): [redacted]

ADDRESS: Picton

DATE COMPLETED: DAY 14 MO. 05 ~~May~~ YR. 80

21 | 18 | 330700 | NORTHING 4891400 | RC 4 | ELEVATION 0270 | RC 4 | BASIN CODE 24

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
			Loam	0	5
			Soft Gray Limestone	5	40
			Hard Gray Limestone	40	60

No Casing. Advised customer to Aband Well

31 0005 02 | 0040 01 5186 | 0060 01 5132

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

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

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

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

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☐ BAILER

PUMPING RATE: GPM

DURATION OF PUMPING: HOURS MINS

STATIC LEVEL: FEET

WATER LEVEL END OF PUMPING: FEET

WATER LEVELS DURING: 1 ☐ PUMPING 2 ☐ RECOVERY

15 MINUTES: FEET | 30 MINUTES: FEET | 45 MINUTES: FEET | 60 MINUTES: FEET

IF FLOWING, GIVE RATE: GPM

PUMP INTAKE SET AT: FEET

WATER AT END OF TEST: 1 ☐ CLEAR 2 ☐ CLOUDY

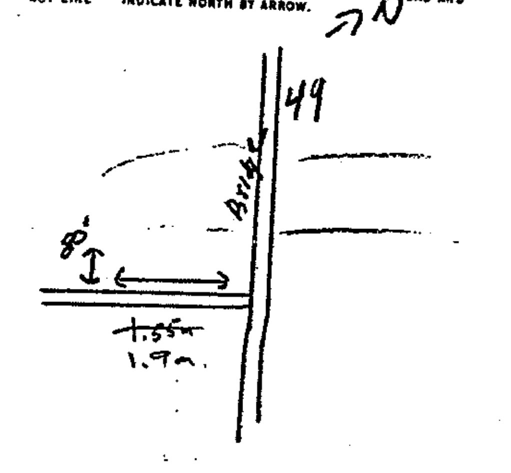
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☐ DEEP

RECOMMENDED PUMP SETTING: FEET

RECOMMENDED PUMPING RATE: GPM

LOCATION OF WELL

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



DRILLERS REMARKS:

FINAL STATUS OF WELL 5

1 ☐ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☒ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED POOR QUALITY
7 ☐ UNFINISHED

WATER USE

1 ☐ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☐ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF DRILLING 1

1 ☐ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: L Campbell | LICENCE NUMBER: 1506

ADDRESS: Newburgh

NAME OF DRILLER OR BORER: L Campbell | LICENCE NUMBER: 1506

SIGNATURE OF CONTRACTOR: L Campbell

SUBMISSION DATE: DAY ____ MO. ____ YR. ____

OFFICE USE ONLY

DATA SOURCE: 1 | CONTRACTOR: 1506 | DATE RECEIVED: 1408 80

DATE OF INSPECTION: | INSPECTOR: K

REMARKS:

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506—4—77 FORM 7

Ministry of the Environment
Ontario

The Ontario Water Resources Act 31C/3h

WATER WELL RECORD

5303991

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

(11) 53007 GP.W. 01

County or District: Prince Edward
Township, Borough, City, Town, Village: SOPHIASBURGH
Con., Block, Tract, Survey, etc.: 1 WGP
Lot: 012
Owner (Surname First): [redacted]
Address: Picton
Date Completed: Day ~~13~~ Mo. 05 Yr. 80

(21) 18 330700 4891400 4 0270 4 24

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
			Loam	0	5
			Hard Gray Limestone	5	10
			Soft Gray Limestone	10	25
			Hard Gray Limestone	25	40

(31) 0005 02 | 0010 02 15 73 | 0025 02 15 26 14 | 0040 02 15 73
(32)

(41) WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0012	1 ☒ FRESH 3 ☒ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL slight
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

(51) CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
06 6 1/4	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	.188	0	010
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN
Size(s) of opening (slot no.):
Diameter: inches
Length: feet
Material and type:
Depth to top of screen: feet

(61) PLUGGING & SEALING RECORD

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

(71) PUMPING TEST

Pumping test method: 1 ☐ PUMP 2 ☒ BAILER
Pumping rate: 0003 GPM
Duration of pumping: 00 hours 15 mins

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING 1 ☒ PUMPING 2 ☐ RECOVERY: 15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
008 feet	039 feet	039 feet	feet	feet	feet

If flowing, give rate: GPM
Pump intake set at: feet
Water at end of test: 1 ☐ CLEAR 2 ☐ CLOUDY
Recommended pump type: ☐ SHALLOW ☒ DEEP
Recommended pump setting: 039 feet
Recommended pumping rate: 0001 GPM not tested

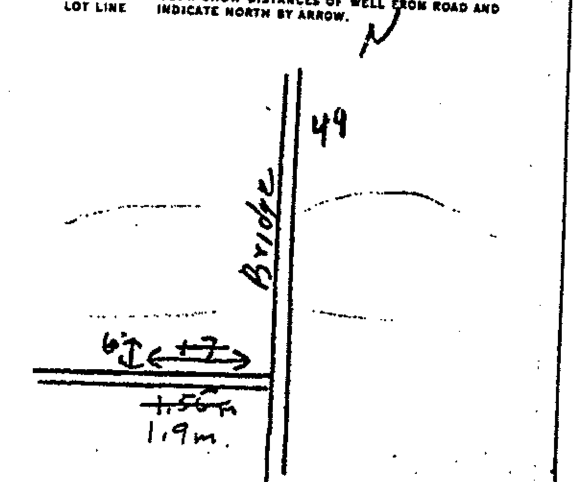
FINAL STATUS OF WELL 1
1 ☒ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED

WATER USE 01
1 ☒ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☐ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF DRILLING 1
1 ☒ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING

LOCATION OF WELL

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



DRILLERS REMARKS:

CONTRACTOR
Name of well contractor: L Campbell
Licence number: 1506
Address: Newburgh
Name of driller or borer: L Campbell
Licence number: 1506
Signature of contractor: L Campbell
Submission date: Day 9 Mo. Aug Yr. 80

OFFICE USE ONLY
Data source: 1
Contractor: 1506
Date received: 1408 80
Date of inspection:
Inspector:
Remarks:

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506—4—77 FORM 7

UTM 18 Z 330462 E
Green Point West
5 R 4871334 N
Ca93
Elev. 5 R 0265
Lot 67
Basin 24

31C3L

GROUND WATER BRANCH
53 No 16[illegible]9
SEP 28 1959
ONTARIO WATER RESOURCES COMMISSION

The Ontario Water Resources Commission Act, 1957

WATER WELL RECORD

County or District PRINCE EDWARD Township, Village, Town or City SOPHIASBURG

Con. 1GPW Lot 12 Date completed 28 AUG 57 (day month year)

Owner [redacted] Address PICTON

Casing and Screen Record		Pumping Test	
Inside diameter of casing	6 1/4	Static level	4
Total length of casing	5'6"	Test-pumping rate	6 G.P.M.
Type of screen	—	Pumping level	7
Length of screen	—	Duration of test pumping	1 HR
Depth to top of screen	/	Water clear or cloudy at end of test	CLEAR
Diameter of finished hole	6 1/4	Recommended pumping rate	6 G.P.M.
		with pumping level of	7

Well Log			Water Record		
Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	No. of feet water rises	Kind of water (fresh, salty, sulphur)
GRAVEL	0	5 1/2			
LIMESTONE	5 1/2	20	18	14	FRESH

For what purpose(s) is the water to be used? HOUSE

Is well on upland, in valley, or on hillside? ✓

Drilling Firm H + R ROLSTON

Address BLOOMFIELD

Licence Number 225

Name of Driller SAME

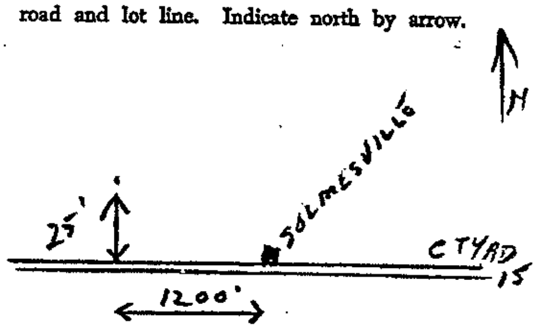
Address

Date SEP 22/59

Ralph Rolston
(Signature of Licensed Drilling Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Form 3
15M-58-4149

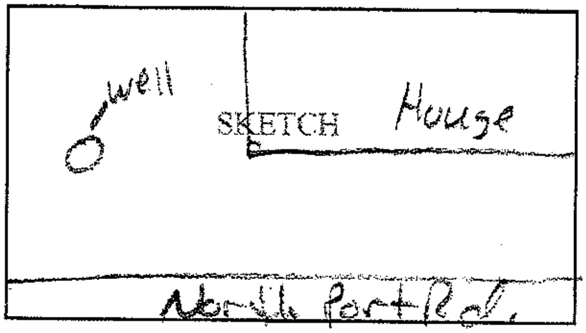
APPENDIX B:
HOMEOWNER SURVEYS

Call ahead of time to schedule
Sampling. No2/09

NEIGHBOURHOOD WELL SURVEY

PROJECT: The Pond
Date: Oc 1/09
911 Address: 2494
Tel: [redacted]
OWNER: [redacted]
since 16 years

WELL LOCATION:



WELL DEPTH:
20

WELL CONSTRUCTION:
DUG: ☐ Rock ☐ Tile ☐ Other ☐
DRILLED: ☑ Buried ☐ Pit ☐ Casing Exposed ☐

TYPE OF PUMP:
Shallow Jet ☑ Deep Well Jet ☐ Submersible ☐ Unknown ☐

WATER QUANTITY:
Good Year Round ☑ Dry In Summer ☐ Low Flow ☐

WATER QUALITY:
Good ☑ Bacteria ☐ Methane ☐ Hard ☑
Sulphur ☐ Sodium ☑ Iron ☐ Other ☐

TREATMENT EQUIPMENT:
Softener ☑ Filtration ☑ UV ☐ Chlorination ☐
Trickle System ☐ Other ☐

RESPONSE:

I would like to participate in the ground water study by having a water sample collected from my well

[redacted]
Signature

Oct. 1/09
Date

~ OR ~

I would NOT like to participate in the ground water study by having a water sample collected from my well

Signature

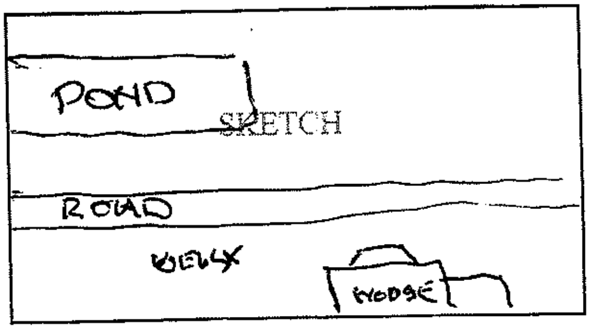
Date

Called 10/2/09 @ 2:00pm - left message on machine

NEIGHBOURHOOD WELL SURVEY

PROJECT: The Pond
Date: SE 30/09
911 Address: 2537 CR 15
Tel: [redacted]
OWNER: [redacted]
since 1975

WELL LOCATION:



WELL DEPTH:
16'-20'

WELL CONSTRUCTION:
DUG: ☐ Rock ☑ Tile ☐ Other ☐
DRILLED: ☑ Buried ☐ Pit ☐ Casing Exposed ☐

TYPE OF PUMP:
Shallow Jet ☑ Deep Well Jet ☐ Submersible ☐ Unknown ☐

WATER QUANTITY:
Good Year Round ☑ Dry In Summer ☐ Low Flow ☐

WATER QUALITY:
Good ☑ Bacteria ☐ Methane ☐ Hard ☑
Sulphur ☐ Sodium ☐ Iron ☐ Other________ ☐

TREATMENT EQUIPMENT:
Softener ☑ Filtration ☐ UV ☐ Chlorination ☐
Trickle System ☐ Other ________ ☐

RESPONSE:

I would like to participate in the ground water study by having a water sample collected from my well

[redacted]
Signature

10-01-09
Date

~ OR ~

I would NOT like to participate in the ground water study by having a water sample collected from my well

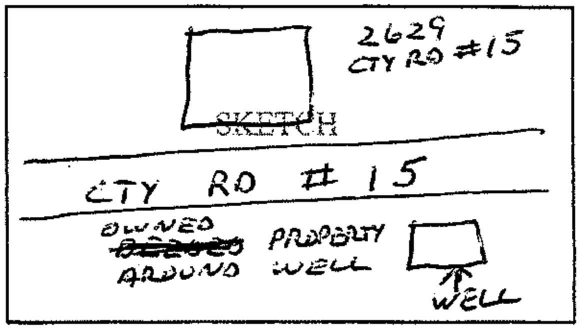
Signature

Date

NEIGHBOURHOOD WELL SURVEY

PROJECT: The Pond Date: NO 19/09
911 Address: 2629 Northport Rd. Tel: [redacted]
OWNER: [redacted] since 2002

WELL LOCATION:



WELL DEPTH: ____________

WELL CONSTRUCTION:
DUG: ☑ Rock ☑ Tile ☐ Other ☐
DRILLED: ☑ Buried ☐ Pit ☐ Casing Exposed ☐

TYPE OF PUMP:
Shallow Jet ?? ☑ Deep Well Jet ☐ Submersible ☐ Unknown ☐

WATER QUANTITY:
Good Year Round ☑ Dry In Summer ☐ Low Flow ☑ IN SUMMER

WATER QUALITY:
Good ☐ Bacteria ☐ Methane ☐ Hard ☑
Sulphur ☐ Sodium ☑ Iron ☐ Other________ ☐

TREATMENT EQUIPMENT:
Softener ☑ Filtration ☐ UV ☐ Chlorination ☐
Trickle System ☐ Other ________ ☐

RESPONSE:
I would like to participate in the ground water study by having a water sample collected from my well

[redacted]
Signature

Nov 19/09
Date

~ OR ~
I would NOT like to participate in the ground water study by having a water sample collected from my well

____
Signature

____
Date

APPENDIX C
LABORATORY REPORTS

CADUCEON™
ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

REPORT No. B09-36362

.O.C.: ---

Report To:

Lissom Earth Sciences
67 King St. Unit 3, P.O. Box 1450
Picton, ON, K0K 2T0
Attention: Catherine Wagner

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston, Ontario, K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 20-Nov-09
DATE REPORTED: 01-Dec-09
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Sorbara Pond
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.:		MWA	MWB	MWC	MWD
			Sample I.D.:		B09-36362-1	B09-36362-2	B09-36362-3	B09-36362-4
			Date Collected:		19-Nov-09	19-Nov-09	19-Nov-09	19-Nov-09
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Chloride	mg/L	1	SM4110	27-Nov-09/K	1480	96	145	755
Nitrate (N)	mg/L	0.1	SM4110	27-Nov-09/K	< 0.1	0.1	1.6	0.6
Sulphate	mg/L	1	SM4110	27-Nov-09/K	531	57	68	196
Total Dissolved Solids	mg/L	3	SM2540D	26-Nov-09/K	3270	515	633	1890
Hardness (as CaCO3)	mg/L	1	SM 3120	26-Nov-09/O	1620	367	396	822
Sodium	mg/L	0.2	SM 3120	26-Nov-09/O	607	42.0	71.9	371

Michelle Dubien
Lab Supervisor

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,P-Peterborough,M-Moncton

CADUCEON™
ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

REPORT No. B09-36367

C.O.C.: --

Report To:
Lissom Earth Sciences
67 King St. Unit 3, P.O. Box 1450
Picton, ON, K0K 2T0
Attention: Catherine Wagner

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston, Ontario, K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 20-Nov-09
DATE REPORTED: 01-Dec-09
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Sorbara Pond
P.O. NUMBER: 4010
WATERWORKS NO.

			Client I.D.:		2494 North Port Road	2537 North Port Road		
			Sample I.D.:		B09-36367-1	B09-36367-2		
			Date Collected:		19-Nov-09	19-Nov-09		
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Conductivity	µmho/cm	1	SM2513	26-Nov-09/K	591	635		
Chloride	mg/L	1	SM4110	27-Nov-09/K	16	6		
Nitrate (N)	mg/L	0.1	SM4110	27-Nov-09/K	< 0.1	4.4		
Sulphate	mg/L	1	SM4110	27-Nov-09/K	19	16		
Hardness (as CaCO3)	mg/L	1	SM 3120	26-Nov-09/O	292	310		
Sodium	mg/L	0.2	SM 3120	26-Nov-09/O	7.3	4.9		

Michelle Dubien
Lab Supervisor

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,P-Peterborough,M-Moncton

APPENDIX D
MONITOR WELL RECORDS

Ontario Ministry of the Environment

Measurements recorded in: ☒ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
A089216

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name GREGORY	Last Name / Organization SORBARA	E-mail Address	☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name) 44 HIGHLAND LANE, RICHMOND HILL	Municipality	Province ON	Postal Code L4C3S1
Telephone No. *(inc. area code)*			

Well Location

Address of Well Location (Street Number/Name) 2590 NORTHPORT RD.	Township SOPHIASBURGH	Lot 14	Concession WOGP
County/District/Municipality PRINCE EDWARD COUNTY	City/Town/Village	Province **Ontario**	Postal Code
UTM Coordinates NAD 83 Zone 18 Easting 0330148 Northing 4891286	Municipal Plan and Sublot Number	Other	

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth *(m/ft)* From	To
BROWN	CLAY	SILT	LOOSE	0	0.9
GREY	LIMESTONE	BEDROCK	HARD	0.9	9.21

Annular Space

Depth Set at *(m/ft)* From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m^3/ft^3)*
0	7.412	BENTONITE	0.064
			0.015
7.412	9.212	SAND	

Method of Construction

☐ Cable Tool
☐ Rotary (Conventional)
☐ Rotary (Reverse)
☐ Boring
☒ Air percussion
☐ Other, *specify*
☐ Diamond
☐ Jetting
☐ Driving
☐ Digging

Well Use

☐ Public
☐ Domestic
☐ Livestock
☐ Irrigation
☐ Industrial
☐ Other, *specify*
☐ Commercial
☐ Municipal
☐ Test Hole
☐ Cooling & Air Conditioning
☐ Not used
☐ Dewatering
☒ Monitoring

Construction Record - Casing

Inside Diameter *(cm/in)*	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness *(cm/in)*	Depth *(m/ft)* From	To
5.0	PLASTIC	0.4	0	7.712

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☒ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Construction Record - Screen

Outside Diameter *(cm/in)*	Material (Plastic, Galvanized, Steel)	Slot No.	Depth *(m/ft)* From	To
5.8	PLASTIC		7.712	9.212

Water Details

Water found at Depth 8.3 *(m/ft)* ☐ Gas | Kind of Water: ☐ Fresh ☒ Untested ☐ Other, *specify*
Water found at Depth *(m/ft)* ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*
Water found at Depth *(m/ft)* ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth *(m/ft)* From	To	Diameter *(cm/in)*
0	9.212	12

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify*

If pumping discontinued, give reason:

Pump intake set at *(m/ft)*

Pumping rate *(l/min / GPM)*

Duration of pumping
_____ hrs + _____ min

Final water level end of pumping *(m/ft)*

If flowing give rate *(l/min / GPM)*

Recommended pump depth *(m/ft)*

Recommended pump rate *(l/min / GPM)*

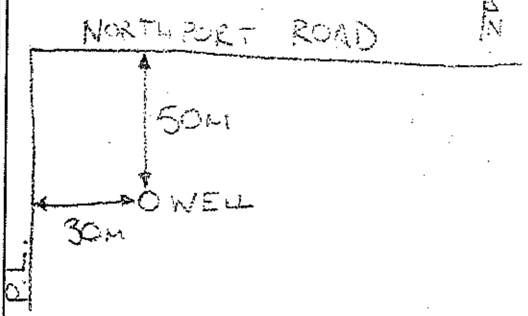
Well production *(l/min / GPM)*

Disinfected?
☐ Yes ☐ No

Draw Down Time *(min)*	Water Level *(m/ft)*	Recovery Time *(min)*	Water Level *(m/ft)*
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor LISSOM EARTH SCIENCES	Well Contractor's Licence No. 6813
Business Address (Street Number/Name) 67 KING STREET	Municipality PICTON
Province ON	Postal Code K0K2T0
Business E-mail Address water@lissom.com	
Bus.Telephone No. *(inc. area code)* 6134768147	Name of Well Technician (Last Name, First Name) PORRITT JOHN
Well Technician's Licence No. 2165	Signature of Technician and/or Contractor
Date Submitted 2009 [illegible]	

Well owner's information package delivered
☐ Yes
☒ No

Date Package Delivered
Y Y Y Y M M D D

Date Work Completed
2009 [illegible] 18

Ministry Use Only
Audit No. Z 10525
Received

0506E (12/2007)

Well Owner's Copy

Ontario Ministry of the Environment

Measurements recorded in: ☒ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* A089217

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name: GREGORY
Last Name / Organization: SORBARA
E-mail Address:
☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name): 99 HIGHLAND LANE
Municipality: RICHMOND HILL
Province: ON
Postal Code: L4C3S1
Telephone No. *(inc. area code)*:

Well Location

Address of Well Location (Street Number/Name): 2590 NORTHPORT RD
Township: SOPHIASBURGH
Lot: 14
Concession: WOSP
County/District/Municipality: PRINCE EDWARD COUNTY
City/Town/Village:
Province: **Ontario**
Postal Code:
UTM Coordinates: NAD 83 Zone 18 Easting 330230 Northing 4891340
Municipal Plan and Sublot Number:
Other:

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth *(m/ft)* From	To
BROWN	CLAY	SILT	LOOSE	0	1.0
GREY	LIMESTONE	BEDROCK	HARD	1.0	9.285

Annular Space

Depth Set at *(m/ft)* From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	7.285	BENTONITE	0.063
7.285	9.285	SAND	0.017

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify*
If pumping discontinued, give reason:
Pump intake set at *(m/ft)*
Pumping rate *(l/min / GPM)*
Duration of pumping: ___ hrs + ___ min
Final water level end of pumping *(m/ft)*
If flowing give rate *(l/min / GPM)*
Recommended pump depth *(m/ft)*
Recommended pump rate *(l/min / GPM)*
Well production *(l/min / GPM)*
Disinfected? ☐ Yes ☐ No

Draw Down Time *(min)*	Water Level *(m/ft)*	Recovery Time *(min)*	Water Level *(m/ft)*
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Method of Construction

☐ Cable Tool
☐ Rotary (Conventional)
☐ Rotary (Reverse)
☐ Boring
☒ Air percussion
☐ Other, *specify*
☐ Diamond
☐ Jetting
☐ Driving
☐ Digging

Well Use

☐ Public
☐ Domestic
☐ Livestock
☐ Irrigation
☐ Industrial
☐ Other, *specify*
☐ Commercial
☐ Municipal
☐ Test Hole
☐ Cooling & Air Conditioning
☐ Not used
☐ Dewatering
☒ Monitoring

Construction Record - Casing

Inside Diameter *(cm/in)*	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness *(cm/in)*	Depth *(m/ft)* From	To
5.0	PLASTIC		0	7.785

Status of Well

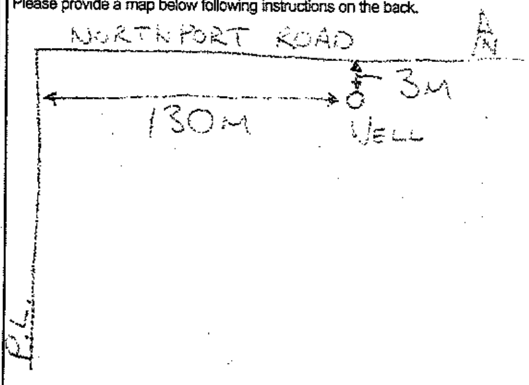
☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☒ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Construction Record - Screen

Outside Diameter *(cm/in)*	Material (Plastic, Galvanized, Steel)	Slot No.	Depth *(m/ft)* From	To
5.8	PLASTIC		7.785	9.285

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Water Details

Water found at Depth 8.2 *(m/ft)* ☐ Gas
Kind of Water: ☐ Fresh ☒ Untested ☐ Other, *specify*
Water found at Depth ___ *(m/ft)* ☐ Gas
Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*
Water found at Depth ___ *(m/ft)* ☐ Gas
Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth *(m/ft)* From	To	Diameter *(cm/in)*
0	9.285	12

Well Contractor and Well Technician Information

Business Name of Well Contractor: LISSOM EARTH SCIENCES
Well Contractor's Licence No.: 6183
Business Address (Street Number/Name): 67 KING STREET
Municipality: PICTON
Province: ON
Postal Code: K0K2T0
Business E-mail Address: water@lissom.com
Bus.Telephone No. *(inc. area code)*: 6139768147
Name of Well Technician (Last Name, First Name): PORRITT JOHN
Well Technician's Licence No.: 2165
Signature of Technician and/or Contractor:
Date Submitted: [illegible]

Well owner's information package delivered: ☐ Yes ☒ No
Date Package Delivered: Y Y Y Y M M D D
Date Work Completed: [illegible]

Ministry Use Only

Audit No. Z102530
Received

0506E (12/2007)

Well Owner's Copy

Ontario Ministry of the Environment

Measurements recorded in: ☒ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* A089218

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name: GREGORY
Last Name / Organization: SORBARA
E-mail Address:
☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name): 19 HIGHLAND LANE, RICHMOND HILL
Municipality:
Province: ON
Postal Code: L4C3S1
Telephone No. *(inc. area code)*:

Well Location

Address of Well Location (Street Number/Name): 2590 NORTHPORT RD
Township: SOPHIASBURGH
Lot: 14
Concession: WOGP
County/District/Municipality: PRINCE EDWARD COUNTY
City/Town/Village:
Province: **Ontario**
Postal Code:
UTM Coordinates NAD 8 3 Zone 18 Easting 330323 Northing 4891366
Municipal Plan and Sublot Number:
Other:

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth *(m/ft)* From	To
BROWN	CLAY	SILT	LOOSE	0	1.10
GREY	LIMESTONE	BEDROCK	HARD	1.10	9.21

Annular Space

Depth Set at *(m/ft)* From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	7.380	BENTONITE	0.0640
7.380	9.210	SAND	0.016

Method of Construction

☐ Cable Tool
☐ Rotary (Conventional)
☐ Rotary (Reverse)
☐ Boring
☒ Air percussion
☐ Other, *specify*
☐ Diamond
☐ Jetting
☐ Driving
☐ Digging

Well Use

☐ Public
☐ Domestic
☐ Livestock
☐ Irrigation
☐ Industrial
☐ Other, *specify*
☐ Commercial
☐ Municipal
☐ Test Hole
☐ Cooling & Air Conditioning
☐ Not used
☐ Dewatering
☒ Monitoring

Construction Record - Casing

Inside Diameter *(cm/in)*	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness *(cm/in)*	Depth *(m/ft)* From	To
5.0	PLASTIC		0	7.710

Construction Record - Screen

Outside Diameter *(cm/in)*	Material (Plastic, Galvanized, Steel)	Slot No.	Depth *(m/ft)* From	To
5.8	PLASTIC		7.710	9.210

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☒ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Water Details

Water found at Depth 8.2 *(m/ft)* ☐ Gas | Kind of Water: ☐ Fresh ☒ Untested ☐ Other, *specify*
Water found at Depth *(m/ft)* ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*
Water found at Depth *(m/ft)* ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth *(m/ft)* From	To	Diameter *(cm/in)*
0	9.210	12

Results of Well Yield Testing

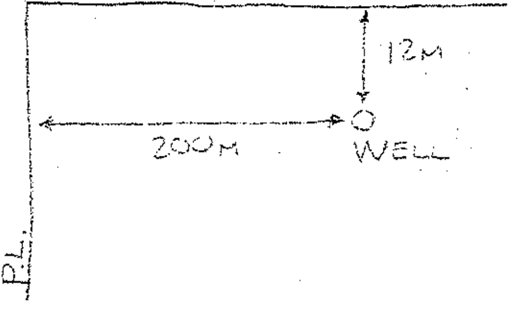
After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify*
If pumping discontinued, give reason:
Pump intake set at *(m/ft)*
Pumping rate *(l/min / GPM)*
Duration of pumping hrs + min
Final water level end of pumping *(m/ft)*
If flowing give rate *(l/min / GPM)*
Recommended pump depth *(m/ft)*
Recommended pump rate *(l/min / GPM)*
Well production *(l/min / GPM)*
Disinfected? ☐ Yes ☐ No

[illegible]

Draw Down Time *(min)*	Water Level *(m/ft)*	Recovery Time *(min)*	Water Level *(m/ft)*
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor: LISSOM EARTH SCIENCES
Well Contractor's Licence No.: 6 6 8 3
Business Address (Street Number/Name): 67 KING STREET
Municipality: PICTON
Province: ON
Postal Code: K0K2T0
Business E-mail Address: water@lissom.com
Bus. Telephone No. *(inc. area code)*: 6134769147
Name of Well Technician (Last Name, First Name): PORRITT JOHN
Well Technician's Licence No.: 2165
Signature of Technician and/or Contractor:
Date Submitted: 20100205

Well owner's information package delivered: ☐ Yes ☒ No
Date Package Delivered: Y Y Y Y M M D D
Date Work Completed: 20091118

Ministry Use Only
Audit No. Z 10 529
Received

0506E (12/2007)

Well Owner's Copy

Ontario Ministry of the Environment

Measurements recorded in: ☒ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
A089219

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
GREGORY	SORBARA		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
99 HIGHLAND LANE	RICHMOND HILL	ON	L4C3S1	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
2590 NORTHPORT RD	SOPHIASBURGH	14	WOGP

County/District/Municipality	City/Town/Village	Province	Postal Code
PRINCE EDWARD COUNTY		Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	330666	4881510		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth *(m/ft)* From	To
BROWN	CLAY	SILT	LOOSE	0	1.2
GREY	LIMESTONE	BEDROCK	HARD	1.2	9.505

Annular Space

Depth Set at *(m/ft)* From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	7.305	BENTONITE	0.063
7.305	9.505	SAND	0.019

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify*

If pumping discontinued, give reason:

Pump intake set at *(m/ft)*

Pumping rate *(l/min / GPM)*

Duration of pumping
___ hrs + ___ min

Final water level end of pumping *(m/ft)*

If flowing give rate *(l/min / GPM)*

Recommended pump depth *(m/ft)*

Recommended pump rate *(l/min / GPM)*

Well production *(l/min / GPM)*

Disinfected?
☐ Yes ☐ No

Draw Down Time *(min)*	Water Level *(m/ft)*	Recovery Time *(min)*	Water Level *(m/ft)*
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Method of Construction

☐ Cable Tool
☐ Rotary (Conventional)
☐ Rotary (Reverse)
☐ Boring
☒ Air percussion
☐ Other, *specify*
☐ Diamond
☐ Jetting
☐ Driving
☐ Digging

Well Use

☐ Public
☐ Domestic
☐ Livestock
☐ Irrigation
☐ Industrial
☐ Other, *specify*
☐ Commercial
☐ Municipal
☐ Test Hole
☐ Cooling & Air Conditioning
☐ Not used
☐ Dewatering
☒ Monitoring

Construction Record - Casing

Inside Diameter *(cm/in)*	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness *(cm/in)*	Depth *(m/ft)* From	To
5.0	PLASTIC		0	8.005

Status of Well

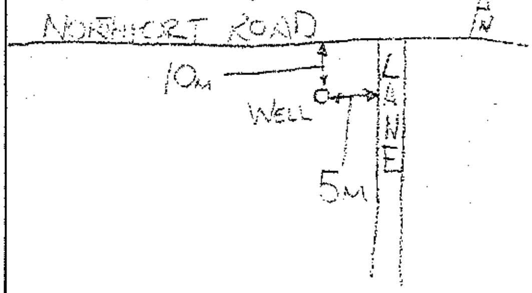
☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☒ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Construction Record - Screen

Outside Diameter *(cm/in)*	Material (Plastic, Galvanized, Steel)	Slot No.	Depth *(m/ft)* From	To
5.8	PLASTIC		8.005	9.505

Map of Well Location

Please provide a map below following instructions on the back.



Water Details

Water found at Depth 9.1 *(m/ft)* ☐ Gas | Kind of Water: ☐ Fresh ☒ Untested ☐ Other, *specify*

Water found at Depth *(m/ft)* ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Water found at Depth *(m/ft)* ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth *(m/ft)* From	To	Diameter *(cm/in)*
0	9.55	12

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
LISSOAA EARTH SCIENCES	6913

Business Address (Street Number/Name)	Municipality
57 KING STREET	PICTON

Province	Postal Code	Business E-mail Address
ON	K0K2T0	water@lissom.com

Bus.Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
6134769147	PORRITT JOHN

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
2165		2010 M M D S

Comments:

Well owner's information package delivered
☐ Yes
☒ No

Date Package Delivered
Y Y Y Y M M D D

Date Work Completed
2008 M M D 8

Ministry Use Only
Audit No. Z102528
Received

0506E (12/2007)

Well Owner's Copy

Ontario Ministry of the Environment

Measurements recorded in: ☒ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
A089220

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name: GREGORY
Last Name / Organization: SORBARA
E-mail Address:
☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name): 99 HIGHLAND LANE
Municipality: RICHMOND HILL
Province: ON
Postal Code: L4C3S1
Telephone No. *(inc. area code)*:

Well Location

Address of Well Location (Street Number/Name): 2590 NORTHPORT RD
Township: SOPHIASBURGH
Lot: 14
Concession: WO6P
County/District/Municipality: PRINCE EDWARD COUNTY
City/Town/Village:
Province: **Ontario**
Postal Code:
UTM Coordinates: NAD 83 Zone 18 Easting 330476 Northing 4891355
Municipal Plan and Sublot Number:
Other:

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
GREY	LIMESTONE	/	HARD	0	2.55

WELL FEATURES: WELLS #1/2/3

- CONSTRUCTION METHOD, DEPTH AND COMPONENTS ARE THE SAME FOR ALL THREE WELLS

NOTE: PLEASE CONTACT ME IF FURTHER INFORMATION IS REQUIRED

Annular Space

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)
0	1.65	BENTONITE	0.016
1.65	2.55	SAND	0.008

Method of Construction

☐ Cable Tool
☐ Rotary (Conventional)
☐ Rotary (Reverse)
☐ Boring
☑ Air percussion
☐ Other, *specify*
☐ Diamond
☐ Jetting
☐ Driving
☐ Digging

Well Use

☐ Public
☐ Domestic
☐ Livestock
☐ Irrigation
☐ Industrial
☐ Other, *specify*
☐ Commercial
☐ Municipal
☐ Test Hole
☐ Cooling & Air Conditioning
☐ Not used
☐ Dewatering
☒ Monitoring

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
5.0	PLASTIC		0	1.95

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☒ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
5.8	PLASTIC		1.95	2.55

Water Details

Water found at Depth 2.5 (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☒ Untested ☐ Other, *specify*
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
0	2.55	12

Well Contractor and Well Technician Information

Business Name of Well Contractor: LISCOM EARTH SCIENCES
Well Contractor's Licence No.: 6813
Business Address (Street Number/Name): 67 KING STREET
Municipality: PICTON
Province: ON
Postal Code: K0K2T0
Business E-mail Address: water@liscom.com
Bus. Telephone No. *(inc. area code)*: 6134769147
Name of Well Technician (Last Name, First Name): PORRITT, JOHN
Well Technician's Licence No.: 21165
Signature of Technician and/or Contractor:
Date Submitted: [illegible]

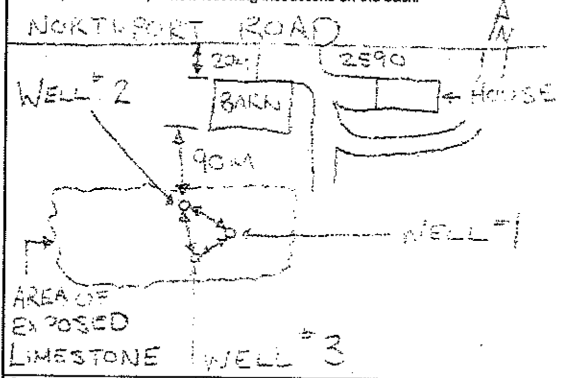
Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify*
If pumping discontinued, give reason:
Pump intake set at *(m/ft)*
Pumping rate *(l/min / GPM)*
Duration of pumping ___ hrs + ___ min
Final water level end of pumping *(m/ft)*
If flowing give rate *(l/min / GPM)*
Recommended pump depth *(m/ft)*
Recommended pump rate *(l/min / GPM)*
Well production *(l/min / GPM)*
Disinfected? ☐ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well owner's information package delivered ☐ Yes ☒ No
Date Package Delivered: Y Y Y Y M M D D
Date Work Completed: [illegible]

Ministry Use Only
Audit No. Z 102526
Received

0506E (12/2007)

Well Owner's Copy

APPENDIX E:
WATER TAKING CALCULATION SUPPORTING DOCUMENTS

ATMOSPHERIC ENVIRONMENT SERVICE
SERVICE DE L"ENVIRONNEMENT ATMOSPHERIQUE

RAINFALL INTENSITY-DURATION FREQUENCY VALUES
INTENSITE, DUREE ET FREQUENCE DES PLUIES

GUMBEL - METHOD OF MOMENTS/METHODE DES MOMENTS - 1990

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TABLE 2 BELLEVILLE ONT (COMPOSITE) 6150689

LATITUDE 4409 LONGITUDE 7724 ELEVATION/ALTITUDE 76 M

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RETURN PERIOD RAINFALL AMOUNTS (MM)
PERIODE DE RETOUR QUANTITIES DE PLUIE (MM)

DURATION DUREE	2 YR/ANS	5 YR/ANS	10 YR/ANS	25 YR/ANS	50 YR/ANS	100 YR/ANS	# YEARS ANNEES
5 MIN	7.2	9.9	11.6	13.9	15.5	17.1	22
10 MIN	10.3	13.7	15.9	18.8	20.9	22.9	22
15 MIN	12.3	16.0	18.4	21.5	23.8	26.1	23
30 MIN	16.8	22.0	25.5	29.9	33.2	36.5	23
1 H	19.8	25.1	28.6	33.0	36.3	39.6	23
2 H	25.0	32.1	36.8	42.8	47.2	51.7	23
6 H	35.1	43.7	49.4	56.6	62.0	67.3	23
12 H	40.2	49.6	55.9	63.8	69.7	75.5	23
24 H	46.2	56.4	63.1	71.6	77.9	84.2	23

Chicago Storm

RETURN PERIOD RAINFALL RATES (MM/HR)-95% CONFIDENCE' LIMITS
ENSITE DE LA PLUIE PAR PERIODE DE RETOUR (MM/H)-LIMITES DE CONFIANCE DE 95%

$\frac{A}{(t+B)^c}$

A=1062
B=3.75
C=.785

DURATION DUREE	2 YR/ANS	5 YR/ANS	10 YR/ANS	25 YR/ANS	50 YR/ANS	100 YR/ANS
5 MIN	86.8 +/- 13.8	118.6 +/- 23.3	139.8 +/- 31.5	166.4 +/- 42.4	186.2 +/- 50.7	205.8 +/- 59.1
10 MIN	61.9 +/- 8.8	82.2 +/- 14.8	95.6 +/- 20.0	112.6 +/- 27.0	125.1 +/- 32.3	137.6 +/- 37.6
15 MIN	49.0 +/- 6.3	63.9 +/- 10.6	73.7 +/- 14.3	86.1 +/- 19.3	95.3 +/- 23.1	104.5 +/- 26.9
30 MIN	33.5 +/- 4.5	44.0 +/- 7.5	51.0 +/- 10.2	59.9 +/- 13.7	66.4 +/- 16.4	72.9 +/- 19.2
1 H	19.8 +/- 2.2	25.1 ✓ +/- 3.8	28.6 +/- 5.1	33.0 +/- 6.9	36.3 +/- 8.2	39.6 +/- 9.6
2 H	12.5 +/- 1.5	16.0 +/- 2.6	18.4 +/- 3.5	21.4 +/- 4.7	23.6 +/- 5.6	25.8 +/- 6.5
6 H	5.9 +/- 0.6	7.3 +/- 1.0	8.2 +/- 1.4	9.4 +/- 1.9	10.3 +/- 2.2	11.2 +/- 2.6
12 H	3.3 +/- 0.3	4.1 +/- 0.6	4.7 +/- 0.8	5.3 +/- 1.0	5.8 +/- 1.2	6.3 +/- 1.4
24 H	1.9 +/- 0.2	2.3 +/- 0.3	2.6 +/- 0.4	3.0 +/- 0.6	3.2 +/- 0.7	3.5 +/- 0.8

Table 2: Infiltration Factors

Description of Area/Development Site	Value of Infiltration Factor
TOPOGRAPHY	
■ Flat land, average slope not exceeding 0.6 m per km	0.30
■ Rolling land, average slope of 2.8 m to 3.8 m per km	0.20
■ Hilly land, average slope of 28 m to 47 m per km	0.10
SOIL	
■ Tight impervious clay	0.10
■ Medium combinations of clay and loam	0.20
■ Open sandy loam	0.4
COVER	
■ Cultivated lands	0.1
■ Woodland	0.2

Ground water recharge has also been determined in some areas on a watershed or subwatershed basis. This information is available in selected water resource studies completed by the former Water Resources Branch of the MOEE. A listing of these reports is provided in AppendixB.

Climatic conditions vary throughout Ontario and will, together with factors such as soil conditions and physical settings determine the amount of ground water recharge over a given area. Based upon experience typical ground water recharge rates that can be expected in Southern Ontario are outlined as follows: