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REPORT ON

**HYDROGEOLOGICAL
STUDY
PROPOSED RESIDENTIAL LOT SEVERANCE
27 DAVID STREET
SPENCERVILLE, ONTARIO**

Submitted to:

Ed Broniszeski
27 David Street
Spencerville, Ontario
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DATE October 28, 2022

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Ed Broniszeski
27 David Street
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RE: HYDROGEOLOGICAL STUDY
PROPOSED RESIDENTIAL LOT SEVERANCE
27 DAVID STREET
SPENCERVILLE, ONTARIO

Kollaard Associates Inc. was retained by Mr. Ed Broniszeski to undertake a hydrogeological and terrain study for a proposed residential lot severance with frontage on Charles Street in Spencerville, Ontario (Key Plan, Figure 1).

It is understood that it is being proposed to sever one residential lot of 0.09 acres, which is currently vacant. The retained parcel consists of about 0.09 hectares and is occupied by a single residence. It is identified as 27 David Street. A Lot Development Plan is provided as Figure 2.

The purpose of the severance is to allow single family dwelling on the proposed severed lot that is to be serviced by a well and the existing municipal sewer. It is understood that all residential dwellings within 500 metres are serviced by sanitary sewer, with the exception of the rural properties that are located on the opposite side of the South Nation River.

This report consists of an evaluation of the water quality and quantity for the existing well on the property.

The assessment was carried out on an existing drilled well to ensure that the water quality and quantity is acceptable using the following guidelines; Ministry of the Environment, Conservation and Parks (MECP) Guideline D-5-5 and the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG).

HYDROGEOLOGICAL STUDY

Background

A bedrock geology map for the site area indicates the bedrock at the site consists of dolostone and sandstone of the Beekmantown Group.

The surficial geology map indicates that the proposed severed lot is located within an area of glacial till. Most of the well records for the area wells indicate that there is between 0 and 2 metres of overburden, consisting of glacial till or sand and clay.



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A review of topographical information from the Province of Ontario online mapping indicates that the site topography is sloped towards the south of the proposed severed lot.

No well record was available for the existing drilled well at 27 David Street. The well depth was measured to be about 59.8 metres, and the casing was indicated by the owner to extend to about 30.5 metres deep. The static water level measured at the day of the test was about 7.43 metres.

The well record and Certificate of Well Compliance for the test well and area well records are provided herein as Attachment A.

Area Well Records

It is understood from information provided by the owner that the well that services the existing dwelling was installed when the municipal sanitary system was put into place. The well was constructed with recommendations from a private well and sewage system study completed by MS Thomson and Associates in 1984. A review of three other well records also installed at this time was carried out. The well records are provided (Attachment A). The depths of the wells are indicated to be between 61 and 70 metres, obtaining water from a dolomite aquifer. Test pumping rates were between 19 and 45 litres per minute. Recommended pumping rates were between 15 and 38 litres per minute. Overburden thickness was between 1.8 and 2.1 metres of sand or clay. The wells had 31.1 metres of casing. Specific capacity was between 0.3 and 0.8 litres per minute per metre of drawdown.

A review of eleven area well records constructed not due to the installation of the municipal sanitary system was also carried out. The well records are provided (Attachment A). The depths of the wells are indicated to be between 12 and 55 metres, obtaining water from a limestone aquifer. Test pumping rates for the area wells were 24 to 76 litres per minute. Recommended pumping rates were between 11 and 46 litres per minute. One well record indicated no overburden. In the other ten well records, overburden was identified as between 0.6 to 2.0 metres of till, topsoil, sand or clay. All area wells had between 4.0 to 9.5 metres of casing below the ground surface. Specific capacity for area wells is between 5 and 1050 litres per minute per metre of drawdown.

The test well is considered to be representative of the expected well yields based on other area wells, specifically those installed due to the municipal sanitary system.

Review of MECP Report

A review of the MECP Potable Well Water Quality Survey for the Village of Spencerville, dated November 6, 2020, was carried out as a part of this report. The MECP report details an investigation completed in 2020 regarding water quality and bacteria contamination in Spencerville, and focuses on a subject property at 32 David Street.

This report contains recommendations on well construction in Spencerville, based on a previous report from 1985, due to poor water quality (from shallow contamination sources) particularly with regards to bacteria and sewage impacts from the private sewage systems. The recommended well construction was that wells should be cased to depths exceeding 25 to 32 metres. The 2020 sampling by the MOE indicated that fewer of the deeper cased wells (2 of 9 wells) had adverse bacteria results compared to some 6 of 9 wells with short casing lengths where some 67% had adverse bacteria results. The MOE indicated the following based on their 2020 well water sampling results:



Well owners with wells not conforming to the recommendations provided by Thompson (1985) and with chronic adverse water quality issues could also consider obtaining the services of a licensed well contractor to replace their existing well with one that is cased into the deeper less vulnerable aquifer. It should be noted that this recommendation is not a guarantee that potable water will be obtained; however, it would be expected to reduce the vulnerability (magnitude and frequency of adverse water quality) of the water supply and those recommendations provide above should still be followed. It should also be noted that the deeper bedrock units may produce water with elevated concentrations of iron and/or sulphur and additional treatment may be required to address them.

The well that was sampled does comply with the recommendations of the Thompson report. As such, it is highly recommended that the future well servicing the severed lot should also be constructed similarly.

Water Quantity

A pumping test was carried out on October 14, 2022, on the existing drilled well at the retained lot on the subject property (27 David Street).

The testing consisted of a 6 hour duration pumping test. During the pumping test, water level measurements were made on a regular basis to monitor the drawdown of the water level in the well in response to pumping and water levels were monitored at one minute intervals using a pressure transducer. Hourly field water quality readings were recorded for the water temperature, pH, total dissolved solids (conductivity) and turbidity. After the pump was shut off, the recovery of the water level in the well was measured until about 95% recovery of static water level had been achieved or for 24 hours.

The well was pumped for about 360 minutes at a pumping rate of about 30 litres per minute. Over the course of the pumping test, the water level in the well dropped 0.31 metres in response to that rate. At the end of pumping, 100 percent recovery of the total drawdown in the static water level created during pumping was measured after about 13 minutes.

The pumping test drawdown and recovery data and plots for TW1 are provided as Attachment B. The drawdown and recovery data provided were measured with reference to the top of the well casing at the test well location.

The pumping test data for the test well was analyzed using the method of Cooper and Jacob (1946). Although the assumptions on which these equations are based are not strictly met, this method provides a reasonable estimate of the aquifer transmissivity.

Transmissivity was calculated using the following relationship:

$$T = \frac{2.3Q}{4\pi ds}$$

where Q is the pump rate, m³/day
 ds is the change in drawdown over one time log cycle, m
 T is the transmissivity, m²/day

Based on the pumping test drawdown data, the transmissivity of the aquifer is estimated to be about 395 m²/day. Based on the recovery data from the pumping test, the transmissivity is



estimated to be about 132 m²/day. The aquifer parameters, such as transmissivity, can be determined more accurately by using a higher flow rate and a longer duration to establish hydraulic boundaries for the aquifer. The pumping rate and duration that were used were sufficient to confirm that the well yield is sufficient for the proposed use.

Based on the data obtained during the six hour pumping test, it can be concluded that the well is capable of sustaining a short term yield of at least 30 litres per minute. During the course of the pumping period, less than 1 percent of the available drawdown in the test well was utilized, based on an estimated pump depth of 56 metres and the static water level recorded the day of the pumping test (7.43 metres). The specific capacity of the well based on the pumping rate used is 81 litres per minute per metre of drawdown.

The typical residential peak demand rate is 22.5 litres per minute for a five bedroom dwelling. It is considered that the pumping rate used was sufficient to meet peak residential demands.

Based on the above noted assessment of the test well and what is known about the aquifer from adjacent wells, it is considered that future wells constructed in the same aquifer (to similar depths) on the proposed severed lots will provide sufficient water for domestic use for a residential dwelling.

Water Quality

During the pumping test, hourly field readings of pH, temperature, turbidity and total dissolved solids (conductivity) were recorded.

The results of the chemical, physical and bacteriological analyses of the water samples obtained from the test well are provided in Attachment C. A summary of the water quality measured in the field are provided as Table I, Water Quality Measurements for Test Well.

Groundwater samples were prepared and preserved in the field using appropriate techniques. Chlorine residuals were measured prior to obtaining water samples for lab submission and free chlorine was measured to be zero. The water samples were submitted to Eurofins Environmental Laboratory in Ottawa, Ontario, for the chemical, physical and bacteriological analyses listed in the MECP guideline entitled Procedure D-5-5, Technical Guideline for Private Wells: Water Supply Assessment, August 1996.

The water quality as determined from the results of the analyses is acceptable. The water meets all the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG) health and aesthetic parameters tested for at the test well except for hardness, hydrogen sulphide, turbidity, iron and TDS. Sodium is above the medical advisory level of 20 milligrams per litre for those who require a sodium reduced diet. The sodium level is about 57 milligrams per litre. When sodium levels exceed 20 mg/l, the local Medical Officer of Health should be informed so that the information can be relayed to local physicians.

Hardness

The water is considered to be moderately hard by water treatment standards. Water with hardness above 80 to 100 milligrams per litre as CaCO₃ is often softened for domestic use. The hardness at the well is 417 to 420 milligrams per litre, which is considered poor but tolerable. Treatment using ion exchange water softeners is effective to reduce hardness.

Water softening by conventional sodium ion exchange may introduce relatively high concentrations of sodium into the drinking water, which may contribute a significant percentage to the daily sodium



intake for a consumer on a sodium restricted diet. Where ion exchange water softeners are used, a separate unsoftened water supply could be used for drinking and culinary purposes.

Iron

Iron was measured at a level of 2.20 to 2.28 mg/l, compared to the aesthetic objective of 0.3 mg/l. Excessive iron levels may cause brown or black discolouration of laundry and fixtures, affect the taste and colour of water, and iron precipitation in pipes and hot water tank can also promote the growth of iron bacteria. For iron levels of up to 5.0 mg/L, a manganese greensand iron filters (or other proprietary iron filter) is effective in removing iron from the water supply.

Turbidity

Turbidity at the well was initially recorded at less than 5 NTU (during the first two hours of the pumping test), which is acceptable for groundwater at the point of consumption. However, turbidity became elevated and even increased between about three six hours (8.0 and 20.6 NTU). The elevated turbidity measured in the field during the test was likely due to the iron deposits in the well casing and the agitation of the well surfaces created during the pumping test. Given the depth of well casing, there is significant well surface and the iron in the water and in the casing could contribute to the turbidity.

The lab based turbidity measurements for the three and six hour samples were 14.6 and 24.8 NTU, respectively. This is consistent with the field readings and also higher due to the presence of iron which can cause turbidity to exceed due to precipitation that occurs as the water sample changes temperatures and is exposed to air during storage and transportation prior to the laboratory sampling.

Water treated through an iron filter is expected to meet the required turbidity levels of less than 5 NTU in the treated water. It is considered that the untreated water has a turbidity level of less than 5 NTU (based on the first two hours of water tested using field equipment) and that treatment to reduce iron will also cause the turbidity to be less than 5 NTU in the treated water.

Sulphide

Sulphide was measured at levels of 0.09 and 0.12 mg/L as hydrogen sulphide, compared to the aesthetic objective of 0.05 mg/L. Excessive sulphide levels may produce black deposits on pipes and fixtures and black stains on laundered items. The sulphide can be removed using the same manganese filter that is needed for iron reduction. Proprietary filters for iron and sulphide removal as well as manganese greensand filters are effective at reducing sulphide levels of up to 1.0 and 2.5 mg/L.

Total Dissolved Solids

Total dissolved solids (TDS) were elevated above the aesthetic objective of 500 mg/l, about 607 to 610 mg/l. The Ryznar Stability Index (RSI) and Langelier Saturation Index (LSI) were calculated for both water samples. The RSI values for the water samples were 6.81 and 6.67 for the three and six hour samples, respectively. The LSI values for the water samples were 0.32 and 0.44 for the three and six hour samples, respectively. RSI values less than 6 indicate that the scale potential increases and values greater than 7 indicate that a calcium carbonate formation does not lead to a protective corrosion inhibiting film. In this case, the water is mildly scale forming and not corrosive. Positive values for LSI indicate that scale can form and calcium carbonate precipitation may occur, while values close to zero indicate borderline scale potential. In this case, the LSI values are positive, indicating borderline scale potential. Combined with the RSI values, it is likely that the water is slightly scale forming and is not corrosive. According to the Support Document for the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG), the palatability of drinking water with a TDS level less than 500 mg/l is generally considered to be good. The effect of



elevated TDS levels on drinking water depends on the individual components, which are principally chlorides, sulphates, calcium, magnesium and bicarbonates. Depending on which parameters are elevated, TDS exceedances can include hardness, taste, mineral deposition or corrosion. In this case, the water samples had high hardness. Sodium and chloride are both well within the aesthetic objectives and are unlikely to significantly affect the taste of the water. Hardness generally increases the mineral deposition. However, in this case, the water is not indicated to be scale forming. Based on the above noted information, it is considered that treatment to reduce hardness will reduce the potential for scale forming as it affects TDS.

Total Coliforms

The water samples obtained after 3 and 6 hours of pumping on October 14, 2022 both had total coliforms of 4 counts/ 100 mL with E. Coli and faecal coliforms absent.

MECP Procedure D-5-5 states the following with regards to total coliforms:

While the stated ODWS for Total Coliforms is 0 counts per 100 ml of sample, it is recognized that the objective had been set as an indicator of inadequate disinfection within the distribution systems associated with water works. For private water wells not subject to approval under the OWRA, the MOEE and Health Units have historically used the limit of <5 counts per 100 ml in the absence of a chlorine residual as indicating acceptable water quality.

As the total coliforms were within the wells allowed for existing wells and E. Coli was absent, the presence of total coliforms is considered acceptable. The owner was informed and recommendations were provided to test at least quarterly for bacteria through the public health unit.

RECOMMENDATIONS

The following is recommended for the construction of the future well to service the proposed severed lot with frontage on Charles Street:

- The well construction should conform with the recommended construction in the Thomson report from 2005 that was supported through the MOE report from 2020, as follows:
 - well should be cased to a depth of at least 25 to 32 metres; AND
 - the annulus of the well shall be sealed using suitable grouting and sealant for its entire length to the ground surface.

The following should be considered for expected water quality and well construction for the future well on the severed lot.

- The water is considered to be hard by water treatment standards. Water with hardness above 80 to 100 milligrams per litre as CaCO_3 is often softened for domestic use. The hardness at the well is ~420 milligrams per litre. Treatment using ion exchange water softeners is effective to reduce hardness. Water softening by conventional sodium ion exchange may introduce relatively high concentrations of sodium into the drinking water, which may contribute a significant percentage to the daily sodium intake for a consumer on a sodium restricted diet. Where ion exchange water softeners are used, a separate unsoftened water supply could be used for drinking and culinary purposes. Sodium level in the untreated water is 57 mg/L, which is above the 20 mg/l medical advisory limit and well within the aesthetic objective of 200 mg/L. When sodium levels exceed 20 mg/l, the local Medical Officer of Health should be informed so that the information can be relayed to local physicians.



- Total dissolved solids (TDS) may be present above the aesthetic objective of 500 mg/l in the future well. It is likely that the water is slightly scale forming. According to the Support Document for the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG), the palatability of drinking water with a TDS level less than 500 mg/l is generally considered to be good. There is no treatment recommendation for TDS. Treatment to reduce hardness will reduce scale potential associated with elevated TDS.
- Iron was measured at between 2.2 and 2.28 mg/L, compared to the aesthetic objective of 0.3 mg/L. Sulphide was measured at a level of 0.09 to 0.12 mg/L, compared to the aesthetic objective of 0.05 mg/L. Excess iron and sulphide levels may produce coloured deposits on pipes and fixtures and stains on laundered items. It also produces an unpleasant taste and odour. Both iron and sulphide may be reduced using manganese greensand filters or other proprietary filter at iron levels up to 5.0 mg/L and sulphide levels of up to 1.0 to 2.5 mg/L.

We trust this letter provides sufficient information for your purposes. If you have any questions concerning this letter, please do not hesitate to contact our office.

Regards,

Kollaard Associates Inc.



Colleen Vermeersch, P. Eng.

Attachments:	Table I	Summary of Hourly Field Water Quality
	Figure 1	Key Plan
	Figure 2	Site Plan Sketch
	Attachment A	Well Records
	Attachment B	TW1-Pumping Test Data
	Attachment C	TW1-Laboratory Water Testing Results