Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

Jp2g No. 23-6281A

August 29, 2023

Township of Edwardsburgh-Cardinal
P.O. Box 129
Spencerville, ON K0E 1X0

Attention: Wendy Van Keulen
Community Development Coordinator

**Re: Hydrogeologic Study Information**

Dear Ms. Van Keulen:

Further to your email dated August 22, 2023, we are pleased to provide the attached information regarding relevant studies that may be applied to "severance" type development applications. Specifically, we have provided comment to address the following as they relate to lot creation and private on-site sewage and water servicing.

relate to lot creation and private on-site sewage and water servicing.

- Explain the purpose of a hydrogeology investigation, terrain analysis and groundwater impact assessment (why are these studies completed? what do they tell us?)
- When are these studies required by provincial policy? (provide an interpretation of PPS 1.6.6.4 and definition of Negative Impacts)
- How are these studies completed? (D-5-4 and D-5-5 guidelines)
- Explain the difference between a groundwater impact assessment and requirements related to part 8 of the building code (why do we have both? Is there unnecessary overlap?)

We trust that the attached information is helpful. Please do not hesitate to call should you have any questions.

Yours truly,
**Jp2g Consultants Inc.**
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Andrew Buzza, P.Geo
Project Manager

## Why are HG Studies Required

Land use changes (i.e., residential, commercial and or industrial development) may result in changes to the quantity and quality of ground water naturally occurring beneath a property as well as that of adjacent properties. Hydrogeological studies are required in support of development applications involving a change in land use to ensure that ground water quantity or quality and its users will not be adversely affected, and that existing users of the groundwater are not adversely affected. In some cases, existing or past land use may have resulted in adverse ground water impacts. In such cases hydrogeological studies are required for purposes of redevelopment of a property. The scope of investigations depends upon the severity of the impacts and the proposed use of the property.

## When are HG Studies Required

Hydrogeological studies may be required in support of development applications for several different reasons as outlined below. These studies are generally completed in support of Official Plan Amendments, Zoning By-Law Amendments and prior to Draft Approval for Plans of Subdivision and Condominium. This may also apply to industrial, commercial, institutional, and multi residential developments. Although hydrogeological studies are not normally required for 'consent to sever' applications, municipalities and approval authorities should give serious consideration to hydrogeological investigation of areas that are likely to be developed by consent over a period of time. This would help in ensuring that the development would not create adverse effects on the groundwater or the users.

The most common circumstances which would require a hydrogeological study include:

a) a development requiring a ground water supply, either individual, communal, or municipal.

b) a development serviced by a sewage system(s) requiring subsurface disposal of sewage effluent via leaching or filter beds for individual, communal, or municipal systems, or via surface disposal using spray irrigation from a sewage lagoon.

c) proposed development sites having known or suspected soil and/or ground water contamination from either on-site or off-site sources; and

d) proposed development sites which are located on hydrogeologically sensitive areas.

## When are these Studies Required by Provincial Policy?

### PPS 1.6.6.4 and Definition of Negative Impacts

The Provincial Policy Statement, 2020 (PPS), issued under Section 3 of the Planning Act provides a policy framework for land use planning and development decisions in the Province of Ontario. Policy 1.6.6.4 permits individual on-site sewage and water services when municipal or private communal services are not available "provided that site conditions are suitable for the long-term provision of such services with no negative impacts".

The PPS defines negative impact regarding Policy 1.6.6.4 as "potential risks to human health and safety and degradation to the quality and quantity of water, sensitive surface water features and sensitive groundwater features, and their hydrologic functions, due to single, multiple or successive development."

The definition goes on to state that these negative impacts should be assessed through environmental studies including hydrogeological or water quality impact assessments in accordance with provincial standards.

The purpose of these studies is to demonstrate that there is an adequate supply of water in terms of both quantity and quality for the proposed development, and the land is suitable for the installation of a septic system. The Ontario Ministry of Environment and Energy developed technical guidelines and procedures in 1996 to complete these types of studies, Guideline D-5 Planning for Sewage and Water Services.

The scope of the studies is dependent on the density or intensity of the development and the sites sensitivity for negative impacts such as low water yield or interference with neighbouring wells, potential surface water contamination, septic system contamination or naturally occurring poor water quality.

The PPS policies regarding development on individual on-site services are to be incorporated into the Official Plan and shall apply in rural and agricultural areas. The Planning Act requires that decisions affecting planning matters shall be consistent with the PPS.

## Ministry Procedure D-5-4 and D-5-5

### *D-5-4 Technical Guideline For Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment*

Methodology on water quality impact assessment is described in the Ministry's Procedure D-5-4. The intent of the assessment is to ensure that combined effluent discharges from the individual septic systems of the development (i.e., the proposed number of septic systems) will have minimal effect on the groundwater on the site or adjacent properties. The guideline describes nitrate as being the critical contaminant of concern, and the Ontario Drinking Water Objective (ODWO) of 10 mg/L as the indicator of groundwater impact.

Procedure D-5-4 outlines the groundwater impact assessment process for individual on-site sewage disposal systems. The assessment involves a three-step process, and typically, the need to advance to the next step depends on the conditions that are defined in the previous step. The three steps are:

1. Lot size considerations
2. Evaluating the relationship between the septic systems and the groundwater
3. Contaminant loading to the groundwater (i.e., dilution)

*Lot Size*

Typically, if the proposed lots within the development are one (1) hectare or larger, or the average lot size is 1 ha or larger and there are no lots being smaller than 0.8 ha, the risk of individual septic systems at the boundary limits is considered acceptable and may not require a detailed hydrogeological assessment, if it is demonstrated that the site is not hydrogeologically sensitive. In this instance it is assumed that the attenuative processes within the 1 ha lot will be sufficient to reduce the nitrate-nitrogen concentrations to acceptable limits.

*System Isolation*

This instance requires an evaluation of whether the sewage effluent will be hydrogeologically isolated from the existing or potential water supply aquifers. Developments will normally be considered as low risk where it can be demonstrated that sewage effluent is hydrogeologically isolated from the underlying aquifers. This involves evaluating the probable groundwater receiver of sewage effluent and the lower hydraulic confining barriers that will protect the groundwater. Typical studies would include a review of geological mapping and nearby well records and sampling of nearby wells to assess the absence/presence of nitrates in the groundwater. Low nitrate values would be an indication that the underlying aquifers have not been impacted. Below is information from a typical water well record that provides evidence of an adequate isolation layer.

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 | | | 0 | 15 |
| Grey | clay | | | 15 | 80 |
| Blue | clay | | | 80 | 95 |
| Brown | gravel | | | 95 | 100 |
| Brown | shale | | | 100 | 101 |
| | | | | | |
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In this instance, there is a layer consisting of approximately 30 metres of clay over the basal gravel and bedrock aquifers.

The above lines of evidence (i.e., low values of nitrate sampling results and thick sequence of clay that acts as a restrictive barrier) would support the conclusion that the groundwater supply is sufficiently isolated from the sewage effluent.

*Contaminant Attenuation*

The most common method for assessing the potential "contaminant attenuation" is through a predictive assessment methodology. Other assessments are monitoring based and rely on the sampling and analysis of existing developments.

About the treatment and dispersal of effluent from leaching beds, a maximum septic system density and or predicted nitrate concentration is determined at the property boundary. The lot density and or boundary nitrate concentrations (max concentration is NO3 10 mg/L) are calculated by assuming 1000L/day sewage disposal containing 40 mg/L nitrate. Infiltration of meteoric water is used to dilute the septic effluent. Below are typical spreadsheets showing the available surplus water and dilution model to determine lot densities.

# Evapotranspiration and Available Moisture Calculations

| Month | Monthly Total Precipitation (mm) | Monthly Mean Temperature (°C) | Thornthwaite Potential Evapotranspiration | | |
|---|---|---|---|---|---|
| | | | Monthly Heat Index, $I_i$ | Potential Evapotranspiration$_{i,o}$, PET$_{i,o}$ (mm) | Potential Evapotranspiration, PET (mm) |
| January | 55.5 | -12.1 | 0.00 | 0.00 | 0.00 |
| February | 48.8 | -9.9 | 0.00 | 0.00 | 0.00 |
| March | 51.9 | -3.7 | 0.00 | 0.00 | 0.00 |
| April | 69.8 | 5.3 | 1.09 | 26.34 | 29.50 |
| May | 75.4 | 11.9 | 3.72 | 59.82 | 74.18 |
| June | 70.7 | 16.8 | 6.26 | 84.88 | 110.77 |
| July | 78.8 | 19.7 | 7.97 | 99.76 | 127.69 |
| August | 82.3 | 18.4 | 7.19 | 93.08 | 109.84 |
| September | 72.2 | 13.4 | 4.45 | 67.48 | 70.85 |
| October | 71.0 | 7.2 | 1.74 | 35.94 | 32.88 |
| November | 66.0 | 0.2 | 0.01 | 0.95 | 0.77 |
| December | 53.1 | -7.8 | 0.00 | 0.00 | 0.00 |
| **Total Annual (mm):** | **795.5** | | | | **556.48** |
| **Total Av. Moisture (mm):** | **239.0** | | | | |

| Latitude: | 45°N |
|---|---|

**Inputs in blue

| NITRATE DILUTION FOR SEPTIC SYSTEM DESIGN | | | | |
|---|---|---|---|---|
| **Climate Data** | | | | |
| **Precipitation** | 795.50 | mm/year | Climate data transferred from | |
| **Evapotranspiration** | 556.48 | mm/year | Evapotranspiration and Available | |
| **Potential Infiltration** | 239.02 | mm/year | Moisture Spreadsheet | |
| **Site Hydrology** | | | | |
| **Site Area** | 222200.0 | $m^2$ | | |
| **Infiltration Reduction Factor** | 0.8 | | **Table Entry** | **Manual Entry** |
| - Topography Component | Rolling land, 2.8 < Savg < 3.8m/km | | 0.2 | |
| - Soil Component | Open Sandy Loam | | 0.4 | |
| - Cover Component | Woodland | | 0.2 | |
| **Net Potential Infiltration** | 0.19 | m/year | | |
| **Hydraulics and Chemistry** | | | | |
| **Background Nitrate Concentration** | 0.1 | mg/L | Background Dilusion Potential of the Entire Site | |
| **Rainfall Infiltration** | 42,488,037 | L/year | | |
| **Natural Nitrate Loading** | 4,248,804 | mg/year | | |
| **Effluent Nitrate Concentration** | 40.0 | mg/L | Loading from One Septic System | |
| **Volume of Wastewater** | 1000 | L/day/system | | |
| | 365,000 | L/year/system | | |
| **Septic System Nitrate Loading** | 14,600,000 | mg/year/system | | |
| **Calculation Method** | Calculate the number of allowable lots (i.e. num. of septic systems) | | | |
| **Max. allowable nitrate loading at property boundary** | 9.9 | | Maximum allowable number of septic systems at the site or the concentration at the property boundary with a known number of septic systems | |
| **Number of Septic Systems** | X | | | |
| **Total Nitrate Loading from all onsite Septic Systems** | 554,800,000 | | | |
| | mg/L | | | |
| **Max. Number of Septic Systems** | X = 38 | | | |

## D-5-5 Technical Guidelines for Private Wells: Water Supply Assessment

Methodology on the assessment of water supplies for developments on individual private wells is described in the Ministry's Procedure D-5-5. The guideline was developed to ensure that future owners of lots or homes had a high probability of being able to access adequate quantities of potable water for human consumption. The Ministry at that time the procedure was developed in 1996 typically did not review development proposals consisting of five (5) or fewer lots but did encourage these types of developments to follow the Ontario Drinking Water Objectives (ODWOs).

The objectives of D-5-5 are:

- To provide technical guidance for professionals involved in land development in the assessment of groundwater quality and quantity.
- To provide an interpretation of the application of MOEE policy to development of individual private well water supplies; and
- to ensure that development proposals are submitted with the required technical support.

Procedure D-5-5 typically provides guidance on the following:

- Water quality and quantity
- The number of test wells required for development depends on size. Potential well locations to optimize spatial distribution across the site.
- Well construction details. Compliance with Ontario Regulation 903.
- Water quantity testing methodology (pumping tests, flow rates and duration)
- Minimum test rate and well yield
- Water quality testing methodology (raw water sampling and analysis
- Treatment units
- Land and water use conflicts
- Reporting

## Groundwater impact assessment and requirements related to Part 8 of the Building Code

Groundwater impact assessment details and the requirements of the Ontario Building Code are not the same.

Impact assessments, as discussed (see D-5-4) are designed to ensure that combined effluent discharges from individual septic systems will have minimal effect on the groundwater resources on and adjacent to development properties. The guideline describes nitrate as being the critical contaminant of concern and specifies the use of 1,000 L/day per system at 40 mg/L as typical input parameters in the assessment.

The Ontario Building Code (OBC) is a regulation under the Building Code Act and at a minimum, outlines the legal requirements for the safety of buildings for public health and safety, accessibility, fire protection and structural sufficiency. Part 8 of the Building Code deals with requirements for the design, construction, operation, and maintenance of on-site Sewage Systems with design capacities of 10,000 litres per day or less. Typical standards of on-site sanitary sewage systems include the following: site evaluations, sewage design flows, standards for septic tanks, design standards for the various classes of systems and construction and maintenance standards.