



Oak Ridges Moraine Groundwater Program (ORMGP)

MEMO

To: Richmond Hill Groundwater Working Group
From: Rick Gerber
Date: Thursday December 12, 2019
Re: v2: Richmond Hill Groundwater “Areas of Concern” Mapping

1. Background

Coordinated through the ORMGP, the Richmond Hill Groundwater Working Group is interested in mapping of groundwater “Areas of Concern” within the Town of Richmond Hill (herein referred to as the Town; Figure 1). Existing mapping of groundwater “Areas of Concern” is included in the Town’s 2014 Urban Master Environmental Servicing Plan (TMIG, 2014); however, there is now sufficient interest to update the 2014 mapping to include the most up-to-date information. This memo provides a discussion of a possible update to the existing groundwater “Areas of Concern” mapping. This mapping is intended to flag areas where known subsurface conditions exist related to groundwater that may affect infrastructure construction and maintenance activities. A key aspect of this mapping is that the interpretations can be refined as new information is incorporated. This will then better inform future construction, or post-construction maintenance activities.

A previous memo was prepared (dated March 5, 2018) that provided a summary of information available and managed by the ORMGP that can be used for groundwater “Areas of Concern” mapping. It should be noted that all information managed by the ORMGP is available to all partner agencies (Regions of York, Peel, Durham, City of Toronto, and the nine Conservation Authorities on the Oak Ridges Moraine) and their designates (e.g., consultants). Some information is available publically and some information is password protected on the Program website (www.oakridgeswater.ca).

2. Groundwater “Areas of Concern” Mapping

2.1 Factors/Considerations

Groundwater “Areas of Concern” within the Town generally occur in a narrow zone where the Oak Ridges Aquifer Complex (ORAC) pinches out and is overlain by Halton Till along the south slope of the Oak Ridges Moraine (Figure 2). This zone is characterized by artesian, and often flowing, aquifer conditions which can lead to instability and/or groundwater control concerns during and post-construction. Surficial geology mapping by the Ontario Geological Survey (OGS, 2010) generally shows till with a localized glaciolacustrine veneer south of the Oak Ridges Moraine Conservation Plan (ORMCP) boundary (Figure 1). North of the ORMCP boundary the surficial geology deposits are exposed sand and gravel of the Oak Ridges Moraine along with other areas of till outcrop. It should be noted that whereas the water table

can be up to 20 to 30 m below ground surface (mbgs) beneath the Oak Ridges Moraine in the northern part of the Town (Figure 2), for much of southern Richmond Hill the water table is generally within 5 m of ground surface. Depending upon construction activities and the depth to which they extend, these southerly areas of shallow water table may need some type of groundwater control during and perhaps post-construction, but not to the extent needed in the zone of artesian conditions.

Key to delineating groundwater "Areas of Concern" within Richmond Hill is the presence or absence of ORAC deposits. The factors considered in this proposed "Areas of Concern" mapping are as follows:

- a) Interpreted thickness of ORAC, particularly when overlain by Halton Till;
- b) Areas where the water table and/or the potentiometric surface for shallow deposits (geologic deposits above Lower Newmarket Till; Figure 2) is near or above the ground surface;
- c) Flowing well locations; and
- d) Groundwater Knowledge locations. These are locations where previous activities (e.g. drilling, construction) have run into groundwater problems. Many of them require groundwater control activities, either during construction or in perpetuity. These locations are being compiled through discussion with senior practitioners who are sharing their experience with ORMGP staff. Currently these locations are being compiled with the assistance of Ross Hodgins (retired MOECC, Central Region). Some of these locations are expected to be further documented as Case Studies outlining the nature of the problem encountered, and how the situation was addressed (e.g., groundwater pumping rates, groundwater level drawdown).

One other consideration related to groundwater "Areas of Concern" are those locations where an upward vertical hydraulic gradient exists between the Lower Sediments (Thornccliffe Formation (Figure 2) and the shallow subsurface (sediments above Lower Newmarket till). Interpretation of these areas suggests that they are coincident with or occur within the zone of flowing ORAC conditions, so they are not dealt with further in this exercise. Also not dealt with here are groundwater mapping products prepared under the Clean Water Act, namely Highly Vulnerable Aquifers and Groundwater Recharge Areas (SGRA). These areas are shown on the current 'Areas of Concern' mapping documented in TMIG 2014 (TMIG Figure 3-22). Another data set that could be considered in this mapping exercise would be MOECC Permit to Take Water locations, particularly those permits related to construction dewatering activities that might also be indicative of groundwater problems. These locations are not yet incorporated here because of uncertainty regarding the actual source and quantity of takings (surface water versus groundwater).

The methodology to delineate groundwater 'Areas of Concern' includes:

- 1) Combine areas (polygons) interpreted in factors a) and b) described above into a composite area (Areas of Concern);
- 2) Adjust composite area, if necessary, to include the locations listed in factors c) and d) above. The ORMGP database is being added to and refined on a daily basis. The interpretive products, factors a) and b), follow database refinement. Factors c) and d) are seen as checks on the interpretive products to delineate areas where refinement is necessary.

2.2 Mapping

The current interpreted thickness of ORAC where greater than 2 m thick is shown on Figure 3. Interpretations are refined as new information is received. Note the 'arm' of interpreted ORAC deposits extending south of the ORMCP boundary (purple line). This area contains the former Town municipal supply wells, Major Mackenzie-Cedar Avenue area, and also extends further south towards and south of Weldrick Road. This 'arm' will be termed the Bayview 'arm' for discussion purposes. Another 'arm' of ORAC sediment is also interpreted to occur along the southwestern part of Richmond Hill associated with the Maple 'arm' of the ORM where the ORMCP boundary extends south of 16th Avenue along Dufferin Street. A hatched area is drawn on Figure 4 to outline an approximate area where interpreted ORAC deposits are greater than 2 m thick. This represents the first of two polygons used to outline groundwater "Areas of Concern". Note that some hydraulically isolated areas in the east-southeast parts of Richmond Hill (i.e. areas not hydraulically connected to the main ORM sediments to the north) have been excluded from the hatched area. Also some areas of thin ORAC sediments (light orange colour) have also been excluded owing to a small degree of uncertainty in the interpretation of the ORAC sediment thickness. Uncertainty is attributed to the variable quality of the borehole information utilized to prepare the interpreted ORAC thickness (e.g. lower quality water well records versus higher quality consultant borehole logs). The Halton Till contains secondary permeability structures such as fractures and sand bodies. Groundwater pressures within the underlying ORAC can extend up into the overlying Halton Till, and also laterally within the Halton Till in areas where the ORAC pinches out.

Figure 5 illustrates where the current interpretation of the water table or potentiometric surface is within 4 m of ground surface or above ground surface. The depth of 4 m was chosen here to consider the depth of basement structures such as one or two levels of underground parking. Obviously site-specific subsurface details need to be considered depending on the final construction depth and form proposed. Figure 6 outlines these areas with blue hatching. This forms the second of two polygons used to outline groundwater "Areas of Concern".

Figure 7 overlays the four factors used to generate the groundwater 'Areas of Concern' for the Town of Richmond Hill (red line). This map basically overlays the hatched areas where the ORAC is greater than 2 m thick and/or the interpreted water table and/or potentiometric surface is within 4 m of ground surface or above ground surface. Note that the areas where the ORAC is greater than 2 m thick has been removed from much of the north Richmond Hill area where the water table is interpreted to be greater than 4 mbgs, and deep unconfined water table conditions are interpreted to exist. Figure 7 also shows known flowing well locations. These wells coincide with areas where the ORAC thins and pinches out, and is overlain by Halton Till leading to confined ORAC conditions. Also shown on Figure 7 are 'Knowledge – Groundwater' locations, in this case locations where groundwater control measures, either temporary or in perpetuity, are known to occur. All flowing well and 'Knowledge – Groundwater' locations are included within the delineated "Areas of Concern". The groundwater 'Areas of Concern' map can be refined as more information is obtained.

Figure 8 illustrates the proposed map of the "Areas of Concern" (red hatching) based on the methodology provided herein. For comparison purposes, Figure 9 shows this new proposed groundwater 'Areas of Concern' along with the current 'Areas of Concern' (TMIG, 2014) used by the Town and York Region as part of their development review process.

This memo has outlined the various factors that should be considered to prepare "Areas of Concern" mapping for the Town of Richmond Hill. These areas can be used by the Town and

Region to inform the development approval process and applicable requirements for pre and post-development necessary regarding groundwater investigation and control.

Should you have any questions or wish to discuss further please do not hesitate to contact the undersigned.

Sincerely,



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References

Earthfx Inc. 2006. Groundwater Modelling of the Oak Ridges Moraine Area. York-Peel-Durham-Toronto (YPDT) Groundwater Management Study, Toronto, Ontario. Available from www.oakridgeswater.ca.

Ontario Geological Survey. 2010. Surficial geology of southern Ontario. Ontario Geological Survey Miscellaneous Release – Data 128 – Revised.

The Municipal Infrastructure Group Ltd (TMIG). 2014. Richmond Hill Intensification Areas, Urban Master Environmental Servicing Plan, Class Environmental Assessment Master Plan. May.

Version History

Version	Date	Changes
Version 2	12-Dec-2019	Corrected Township boundary on Figures 1 and 3 to 8.
Version 1	30-Aug-2018	

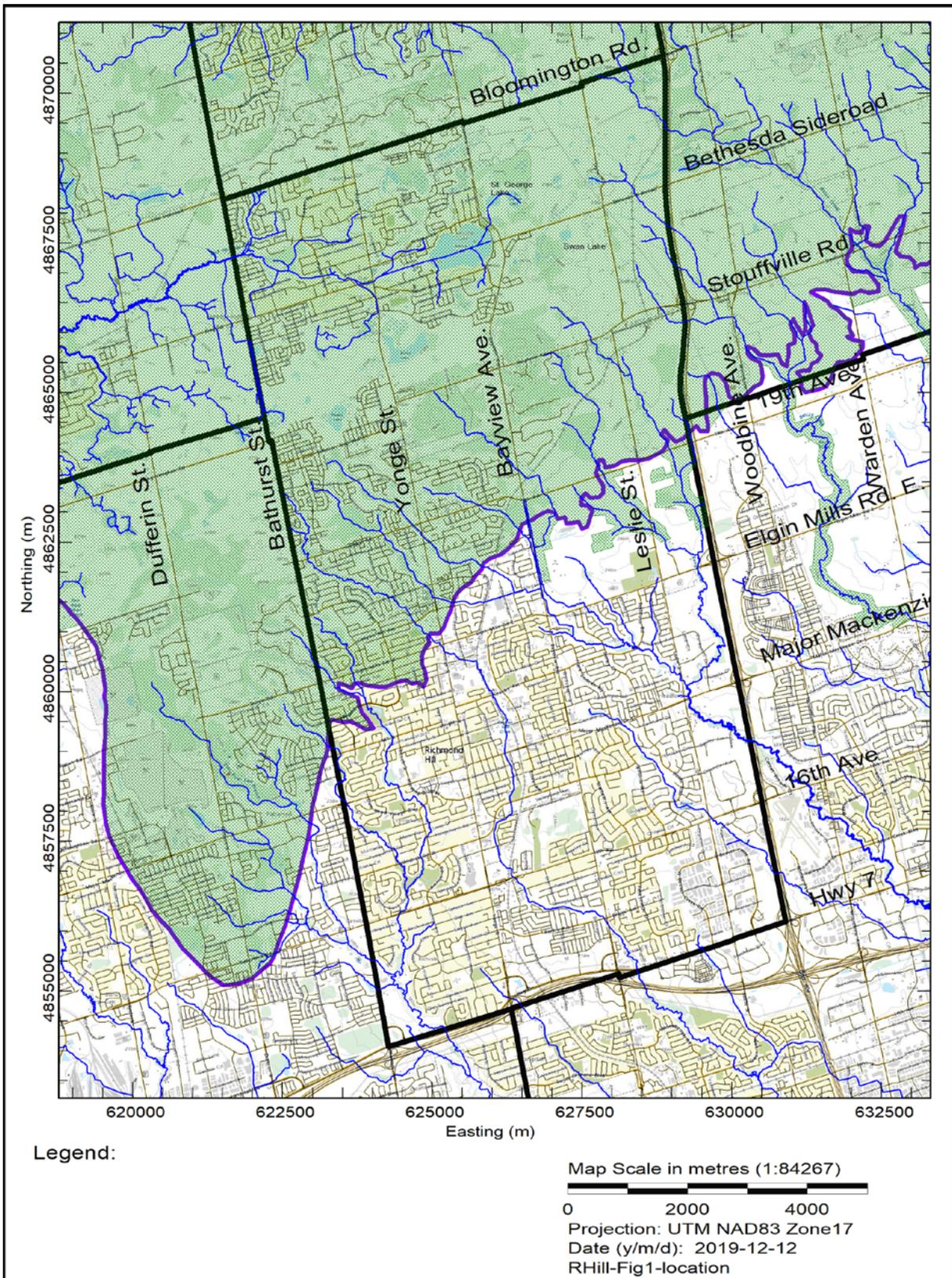


Figure 1: Town of Richmond Hill lands showing Greenbelt (green hatch) and ORMCP (purple line) boundaries. The Greenbelt incorporates the ORMCP.

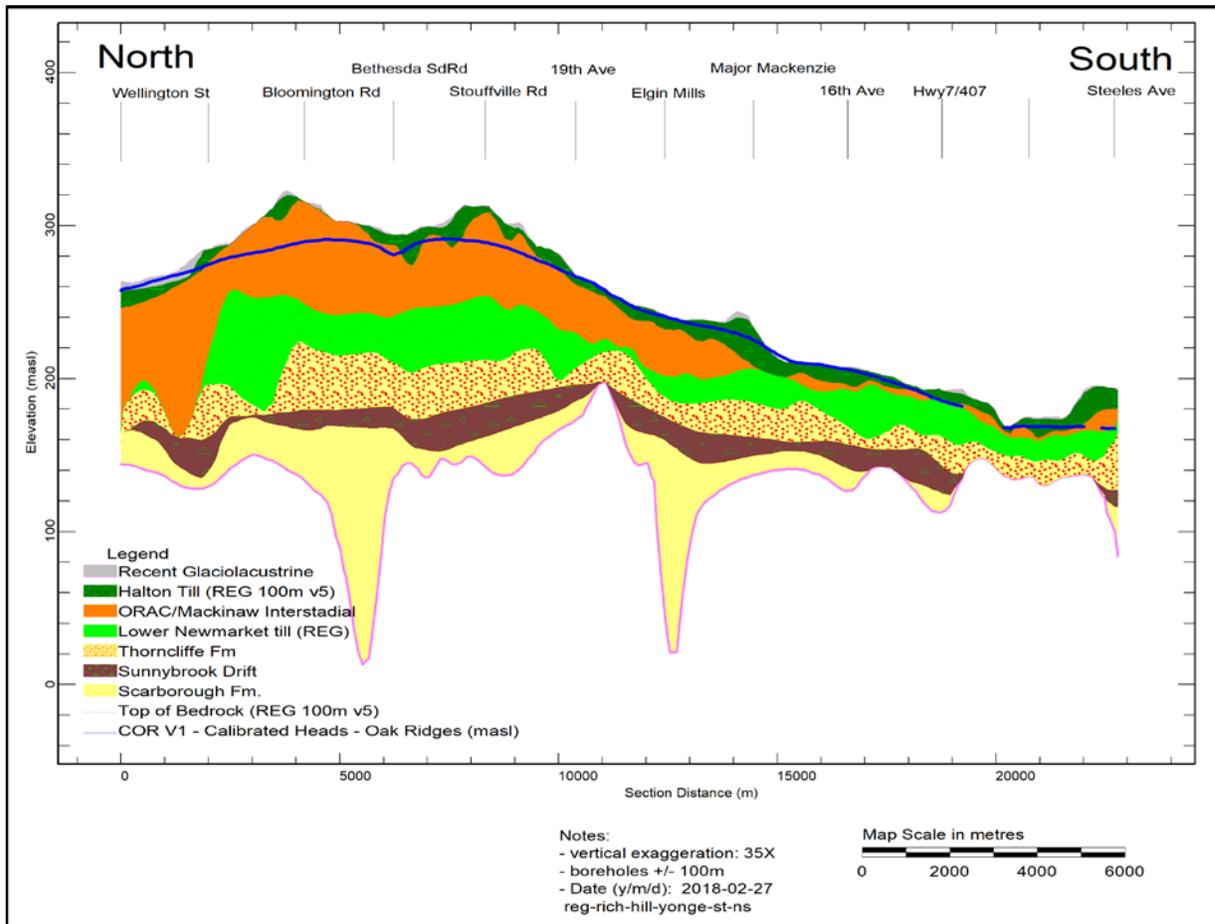


Figure 2: North-south cross-section along Yonge Street through Richmond Hill. Bedrock beneath the Town is mapped as shale. Interpreted ORAC shown in orange shading. Simulated shallow water table/potentiometric surface (COR V1 – Calibrated Heads – Oak Ridges (masl)) from Earthfx, 2006.

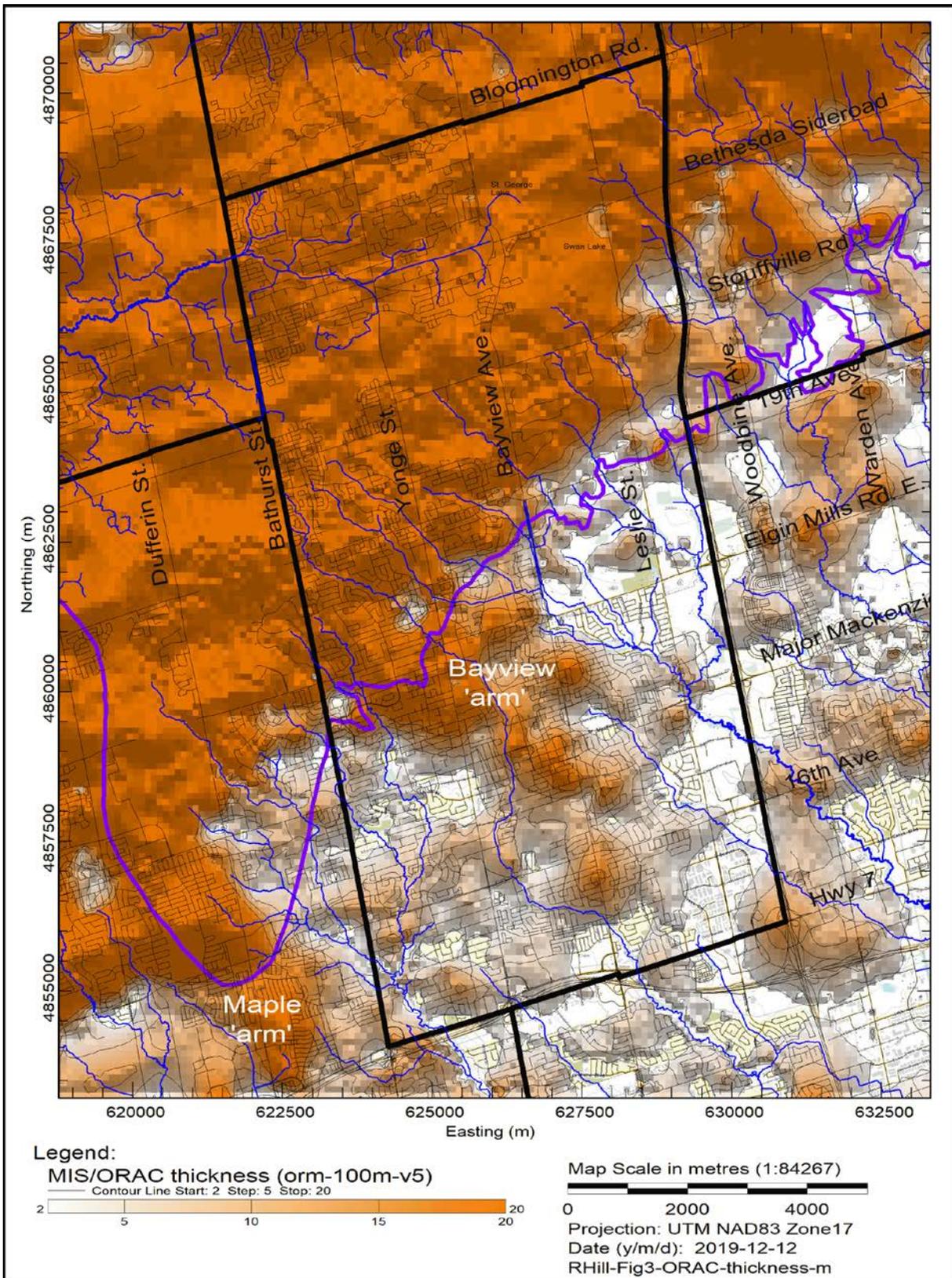


Figure 3: Areas where current interpreted thickness (m) of the Oak Ridges Aquifer Complex > 2 m (orange shade). ORAC > 20 m thick in northern half of Richmond Hill.

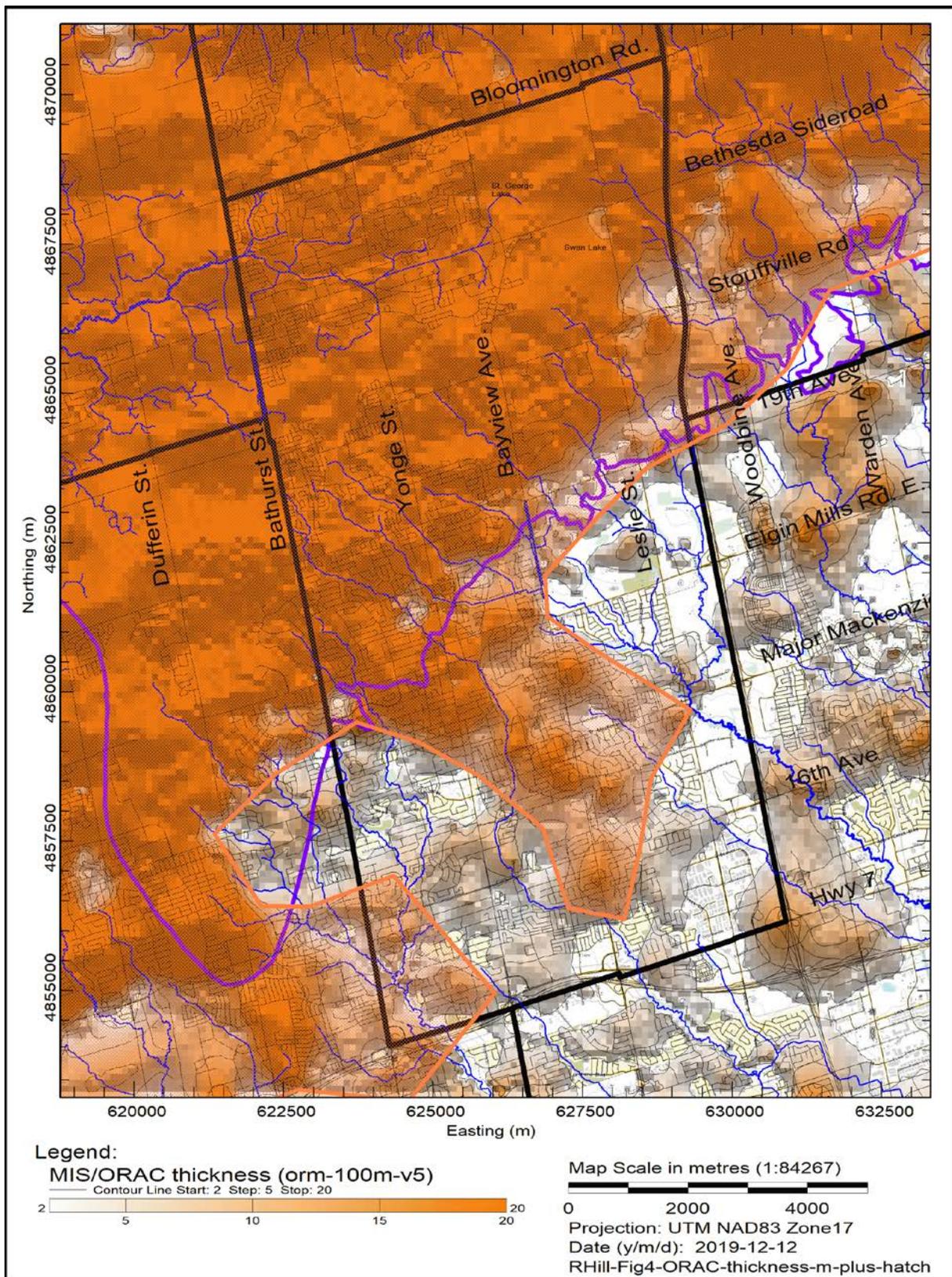


Figure 4: Orange hatching outlines area where the ORAC is generally interpreted to be > 2 m thick. Note that due to uncertainty in the generation of the ORAC geology that some smaller shaded areas are excluded. These areas should be checked as new information is obtained.

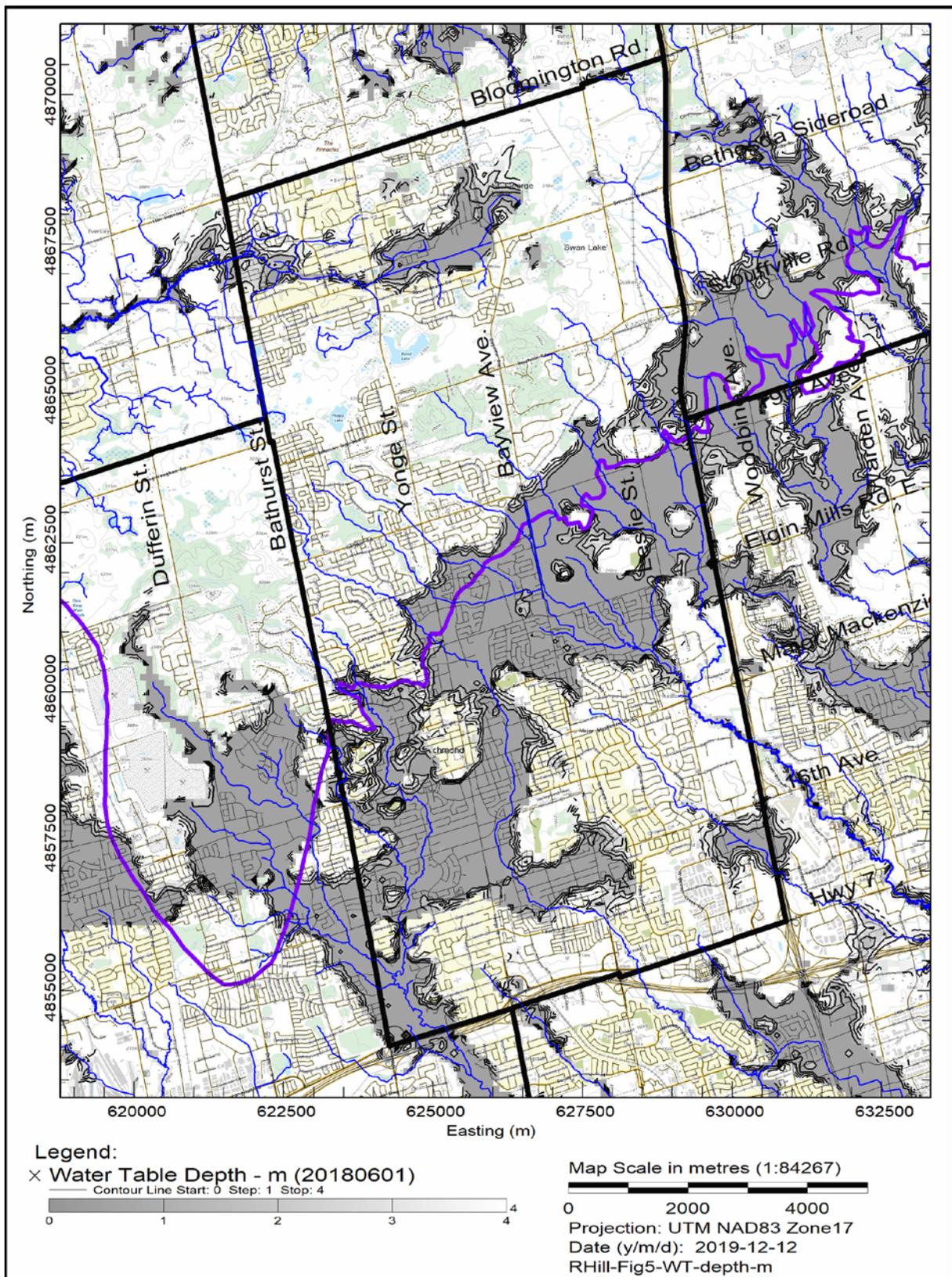


Figure 5: Current areas where interpreted water table and/or potentiometric surface is within 4 m of ground surface (grey shading). Interpreted from MOECC water well records and available consultant reports for piezometer depths less than or equal to 20 mbgs.

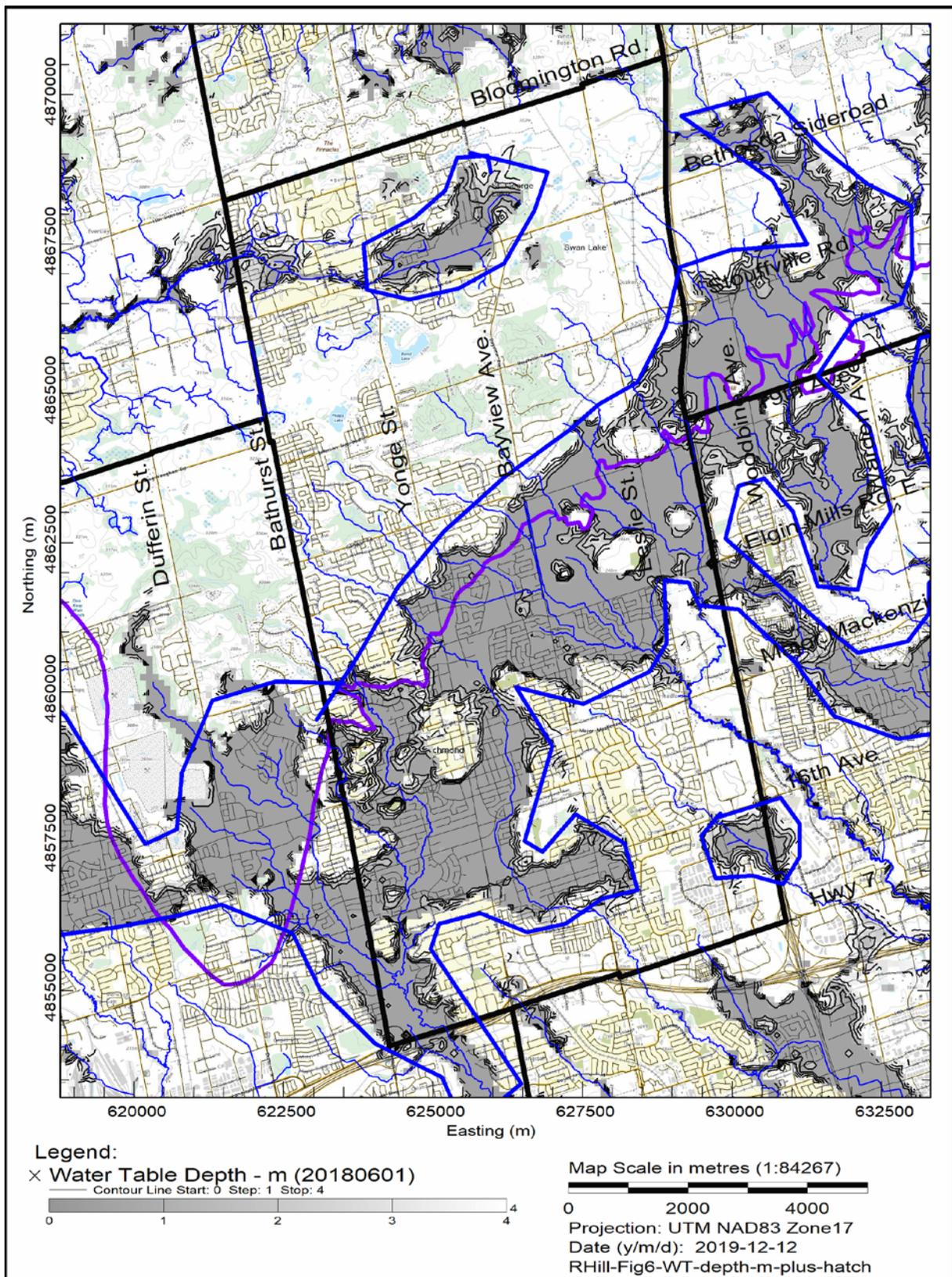


Figure 6: Blue hatch outlines the approximate area where the interpreted water table and/or potentiometric surface is either within 4 m of ground surface or above ground surface. These areas should be refined as new information becomes available.

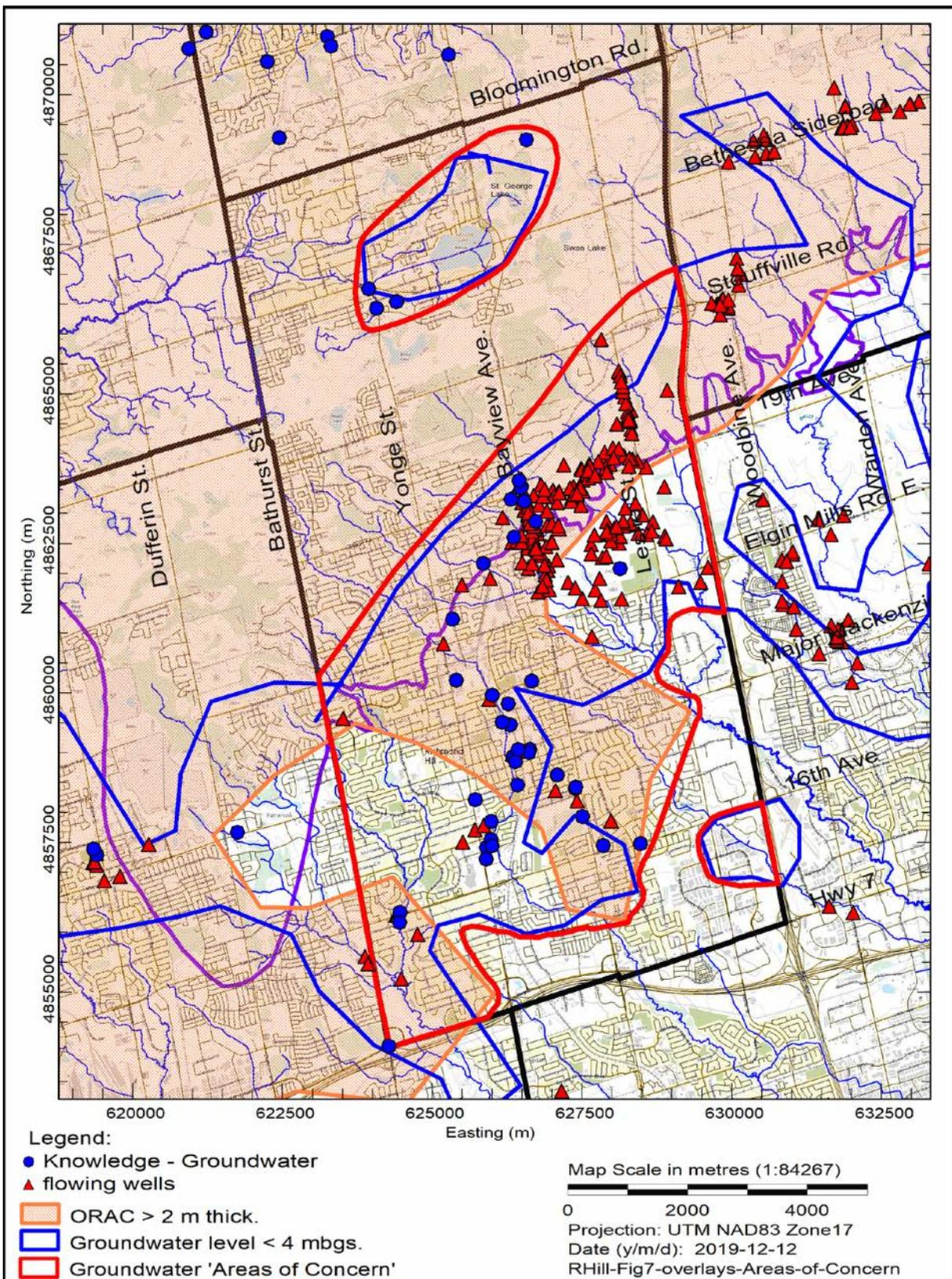


Figure 7: Overlay of factors used to generate groundwater 'Areas of Concern' for the Town of Richmond Hill

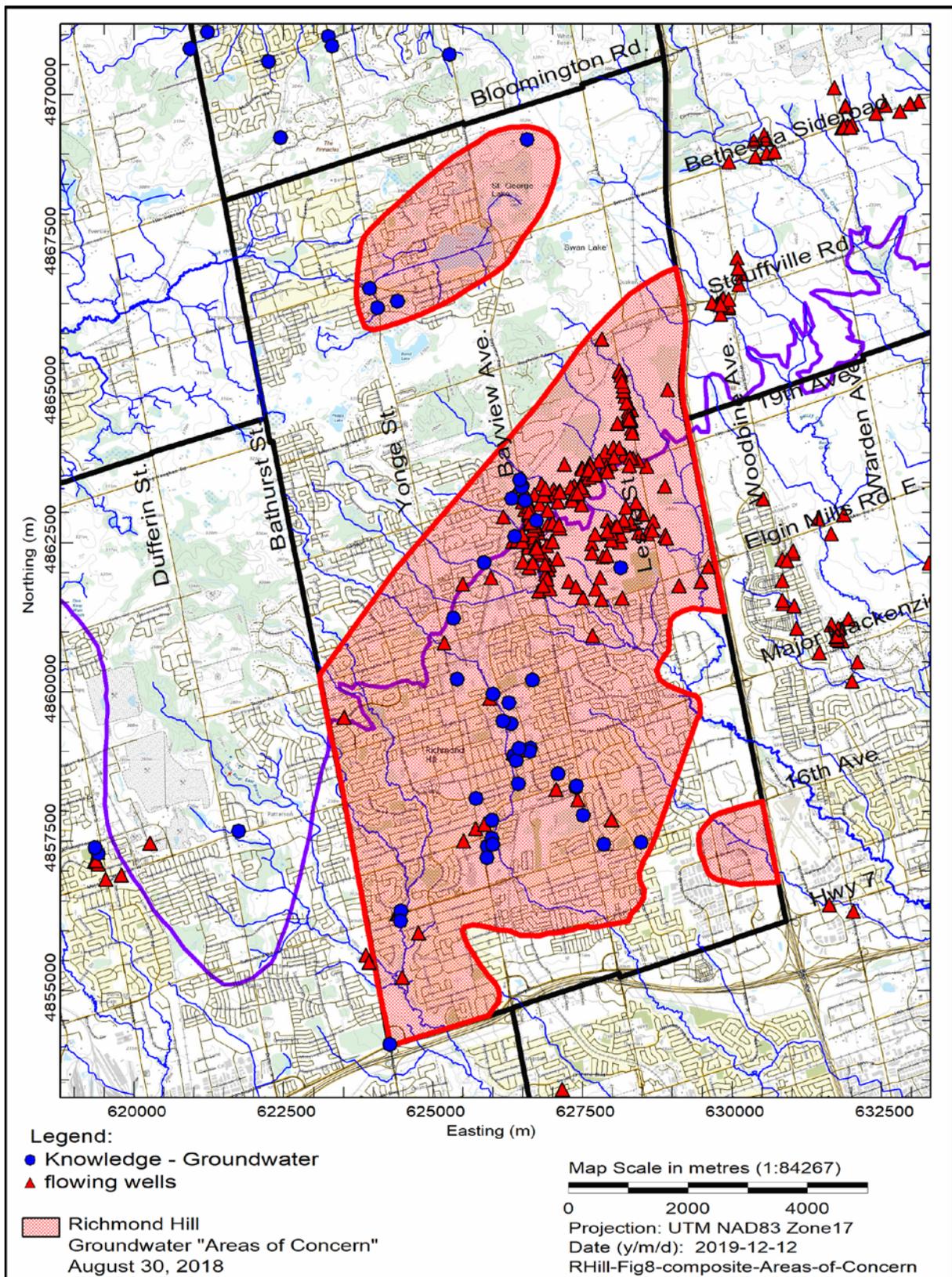


Figure 8: Town of Richmond Hill (only) groundwater "Areas of Concern" map (red shading). 'Knowledge - Groundwater' locations are where groundwater issues or control measures (either temporary or in perpetuity) are known to have historically occurred.

