

HYDROSTRATA

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February 7, 2024
Project No.: 2400.001

Mr. David Goodfellow, P.Tech.
Manager of Engineering Services
Engineering and Public Works Department
181 Blackwatch Avenue,
Oromocto, NB E2V 0L9

Dear Mr. Goodfellow,

Re: Final - Preliminary Groundwater Supply Investigation - Town of Oromocto, NB

Introduction

The Town of Oromocto (the Town) currently receives its demand for potable water (approximately 3 ML/day) from a surface water source that is withdrawn directly from the nearby Saint John River at a rate of up to approximately 5 ML/day. The surface water is subsequently treated by means of a surface water treatment facility (and associated infrastructure) that is owned and operated by CFB Gagetown (Camp Gagetown), prior to being distributed to consumers. It is understood that the adjacent Camp Gagetown also receives all of its potable supply from this treated surface water source (the balance of approximately 2 ML/day), since the treatment facility was constructed and placed into operation in late-1963. A site location plan for the Town and nearby subject area is included in the attached Figure 1.

Due to the age of the treatment facility and projected increasing costs associated with the current surface water potable supply, the Town decided in late-2023 to look into the potential for development of a nearby groundwater source to replace the current surface water source. On December 8, 2023, Hydrostrata was contacted by the Town to complete a preliminary investigation of this matter on their behalf.

Records Review and Interviews

In the process of investigating the potential for a viable groundwater supply for the Town, the following information was received and reviewed by Hydrostrata personnel to assess the known groundwater quantity and quality records for the Town, and associated area-of-interest;

1. *New Brunswick Online Well Log System (NBOWLS)* is a publicly available online database with well logs and drilling records that summarize water quality, quantity (well yield) and the intercepted stratigraphy in all wells drilled throughout NB since 1994.

2. *The New Brunswick Groundwater Chemistry Atlas: A Geographical Representation of Groundwater Quality in New Brunswick*. This is a thematic collage of maps and information generated by the New Brunswick Department of Environment in 2008 to summarize general and pertinent groundwater information that was collected in the NBOWLS database, for general public information and use.
3. A copy of an article originally published in "The Sapper" in January 1956 that summarizes the planning, design, and construction process for Camp Gagetown, and surrounding area, including details on the exploration, hydraulic testing, and development of the original potable (groundwater) supply for Camp Gagetown that consisted of two, large-diameter, high-yielding supply wells constructed and screened within the overburden (sand and gravel) aquifer near the southeastern confluence of the Oromocto River and Saint John River.
4. A letter from WB Akerly (Town of Oromocto Engineer) to Mr. John Feeney that is dated January 13, 1964, which presents information regarding the construction and development of Camp Gagetown, and surrounding area. This letter includes specific information on the failure of the originally developed and utilized groundwater supply system due to a progressive and significant increase in chloride concentrations in the pumped groundwater over the first year of operation and use (i.e., 1956 to 1957). Ultimately, a new surface water supply from the Saint John River, and associated surface water treatment facility, had to be constructed to replace the original (failed) groundwater supply, and this new (treated) surface water supply was subsequently placed into operation for Camp Gagetown in late-1963.
5. An Atlantic Geoscience research article from August 2006 entitled "Relict Seawater as a Source of Stratified Groundwater in Glaciated Estuarine Valleys: An Example from Fredericton Junction, New Brunswick". This article summarizes data and research compiled and completed by Dr. Bruce Broster (Professor and Researcher from UNB), and Gina Giudice (Hydrogeologist with the NB Department of Environment). Examination of drill records from groundwater exploration within the Carboniferous sedimentary bedrock of NB indicates that groundwater is commonly stratified, forming a surface zone of fresh water overlying a zone of saline water at depth. While saline intrusion of aquifers is known to be a hazard for coastal communities, drilling records indicate that glaciated estuarine valleys (such as that examined and studied in the area of Fredericton Junction, and that present in the immediate area of the Oromocto) may be especially at risk to salinization exacerbated by unrestricted exploitation (i.e., higher groundwater withdrawals).

The overall investigation process also included discussions with experienced local well drillers and other knowledgeable and experienced Hydrogeologists. These telephone interviews were completed on December 18, 2023 and January 9, 2024 with the following people, respectively:

1. *Mr. John Hart, P.Geo.*, - Mr. Hart is a very knowledgeable and experienced local Hydrogeologist with more than 40 years of hydrogeological consulting experience in the subject area. Mr. Hart has completed prior water supply source investigations,

assessments, well drilling, and groundwater exploration projects in and surrounding the local area-of-interest for much of his career. He has confirmed the presence of brackish or salty groundwater in the confined overburden (sand and gravel) aquifer and the deeper bedrock aquifer within and surrounding the Town of Oromocto.

2. *Mr. Darin Sullivan (Well Driller)* – Prior owner and current principal well driller for Sullivan's Well Drilling (now owned by Bill Kyte Enterprises). Mr. Sullivan has drilled and constructed most of the domestic wells in the nearby residential development of Richmond Estates, situated immediately west of the Oromocto River and the Town of Oromocto, including many of the bedrock supply wells throughout the neighbouring area and region. He has confirmed the presence of brackish or salty groundwater in the confined overburden (sand and gravel) aquifer and the deeper bedrock aquifer within and surrounding the Town of Oromocto.

Summary of Investigation Findings

The following factual information has been derived from the above-noted reviewed, and assessed information, and on prior experience:

1. The stratigraphy of unconsolidated sediments beneath the subject area-of-interest consists of a glacial retreat sequence (from bottom to top) of till, glaciofluvial sand and gravel, glaciolacustrine clay-silt, and a surface unit of alluvium that was deposited by the river. Bedrock underlying the subject area-of-interest is of sedimentary origin and consists of sandstone, conglomerate, and siltstones of Carboniferous age (or younger).
2. From a groundwater supply perspective, the current (minimal) water demands for the Town only (~3 ML/d), or for the Town and Camp Gagetown combined (~5 ML/d) cannot be practically sourced from the bedrock that is present beneath the area due to the relatively low transmissivity and insufficient well yields that are typical for shallow bedrock units in this area. Multiple, high-yielding, groundwater supply wells that are constructed in coarse and more transmissive overburden sediments (i.e., coarse, sand and gravel deposits) would be needed to provide the higher flow and groundwater recharge rates required to meet these daily water supply demands.
3. A highly transmissive, confined, sand and gravel aquifer is known to be present above bedrock in the area along the Saint John River, and immediately west of the Oromocto River, beneath the existing Richmond Estates Subdivision. The deepest extent of this confined, glaciofluvial, sand and gravel aquifer, which would be most appealing from an aquifer thickness perspective, is present within the old (original), infilled Saint John River channel deposit, beneath the Richmond Estates Subdivision (refer to attached Figure 1). It is believed that these deeper, infilled channel deposits extend further south of this subdivision, along the western extents of the Oromocto River. The current total groundwater withdrawals being used to meet daily (residential) water supply demands for the entire Richmond Estates Subdivision (~0.14 ML/d) is estimated to be a small fraction

(< 5%) of the withdrawals that would be required to meet the municipal potable supply demands for the Town and/or Camp Gagetown (~3 ML/d to 5 ML/d).

4. Based on the NBOWLS data retrieved from a 2-kilometre radius surrounding PID 60137684 (the parcel situated immediately southeast of the Oromocto bridge crossing on Highway 102), a total of 108 drilled wells (domestic and exploratory) were identified in the most promising area for development of a groundwater supply (as described above in point #3, within the vicinity of deeper, infilled sand and gravel channel deposits immediately west of the Oromocto River); however, the resulting groundwater chemistry for many of these wells suggest a significant influence from salty (or brackish) groundwater, as summarized below in Table 1.1.

Table 1.1 – A summary of selected indicator parameters for saline (or brackish) groundwater (data from NBOWLS database, January 2024)

Parameter	Na (mg/L)	Cl (mg/L)	Conductivity (µS/cm)	Theoretical TDS (mg/L)
Threshold ¹	120	150	600	300
Minimum	43.2	1.21	423	243
Average	124	64	665	376
Maximum	299	379	1540	839
% greater than the applied threshold ²	36 / 77 (47%)	8 / 77 (10%)	36 / 77 (47%)	57 / 71 (80%)

1. The threshold value applied is based on 60% of the corresponding CCME drinking water quality guideline, to provide an indicator of elevated concentrations.
2. The ratio of concentrations greater than the applied threshold are based on samples available in the dataset, which is dependent on which parameters were analyzed (i.e., only 77 chemistry data sets are available for the 108 groundwater wells).
3. Based on the results in the table above, nearly half of the samples have sodium and conductivity values that are elevated, while a handful of samples also have elevated chloride concentrations.

5. The entire area-of-interest, including further west towards Lincoln and Fredericton, and further south along the Oromocto River Valley towards Geary, Fredericton Junction, Welsford, and the Nerepis River Valley, is mapped to be within an area considered to have been inundated by an inland sea sometime between 14,000 and 12,000 years ago (i.e., the DeGeer Sea incursion and/or Acadia Sea incursion). From prior research and publicly available information, it is evident that saline (or brackish) water from that time has remained preferentially in pockets within the bedrock underlying these (now infilled) channel deposits. The (bedrock and unconsolidated) aquifers within the subject area-of-interest are considered to be vulnerable to saline (or brackish) water intrusion from unsustainable extraction of groundwater.
6. The prior development and use of a high-capacity groundwater supply from the overburden (i.e., pumping between 3.8 ML/d and 7.6 ML/d, or 3,800 m³/day to 7,600 m³/day from a nearby, confined, sand and gravel aquifer) for Camp Gagetown in 1955 had failed within one year of its operation due to a progressive and significant change in the groundwater quality that resulted in unacceptably high levels of chloride concentrations with time and continued pumping from the aquifer.

Conclusions

It is interpreted that if the (investigated and most-promising) sand and gravel aquifer is stressed with the higher groundwater withdrawals required to meet the Town's potable demand (~3 ML/d to 5 ML/d), it can reasonably be expected that the groundwater quality in that aquifer will progressively diminish and degrade to unacceptable levels with time and continued pumping, as was observed from similar groundwater pumping for Camp Gagetown in the mid-1950's.

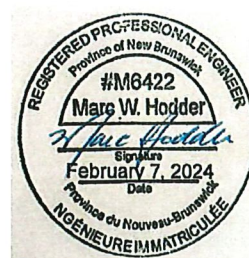
Based on the overall findings from the above-noted available data and information, it is interpreted that development of a high-yielding groundwater supply (or wellfield) for the Town would be at high risk of being unsustainable in the longer-term.

Please contact the undersigned should clarification be required, or if we can otherwise be of further assistance.

Yours sincerely,

HYDROSTRATA ENGINEERING & ENVIRONMENTAL INC.

per:



Marc W. Hodder, B.Sc., B.Sc.E., P.Geo., P.Eng.
Principal Hydrogeologist & Geological Engineer

Reviewed by:

Calvin O'Neill, M.Sc.E., MIT
Hydrogeological Engineer-in-Training

Attachments:

1. Figure 1 – Town of Oromocto – Subject Area Site Location Plan (Google Earth, 2024)
2. The New Brunswick Groundwater Chemistry Atlas: A Geographical Representation of Groundwater Quality in New Brunswick (NBDELG, 2008)
3. An article published in "The Sapper" in January 1956 (Town of Oromocto archived document)
4. A letter from WB Akerly to Mr. John Feeney dated January 13, 1964 (Town of Oromocto archived document)
5. Relict Seawater as a Source of Stratified Groundwater in Glaciated Estuarine Valleys: An Example from Fredericton Junction, New Brunswick (Atlantic Geoscience Research Article, August 2006)

Limitations and Closure

Hydrostrata Engineering & Environmental Inc. (Hydrostrata) prepared this document for the account of the Town of Oromocto. The material in it reflects the judgment of Hydrostrata staff in light of the information available to Hydrostrata at the time of document preparation. Any use which a third party makes of this document or any reliance on decisions to be based on it is the responsibility of such third parties. Hydrostrata accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this document.

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