

Environmental Impact Assessment Registration

Groundwater Exploration Program
Communauté rurale de Kedgwick, New Brunswick

Communauté rurale de Kedgwick



November 25, 2015

Reference No. 11102988

Mr. Paul Vanderlan, Director
Sustainable Development, Planning & Impact Evaluation Branch
New Brunswick Department of Environment and Local Government
20 McGloin Street, P.O. Box 6000
Fredericton, New Brunswick E3B 5H1

Dear Mr. Vanderlan:

**Re: Water Supply Source Assessment Environmental Impact Assessment Registration
Communauté rurale de Kedgwick, New Brunswick**

We are pleased to present a copy of the Registration Document for the above noted project. This document is being submitted on behalf of the Communauté rurale de Kedgwick, to the New Brunswick Department of Environment and Local Government, for review as part of the initial application for a water supply source assessment.

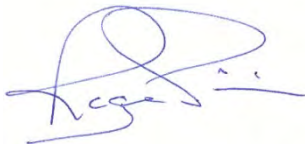
GHD Limited (GHD) has been retained by Boissonault McGraw, on behalf of the Communauté rurale de Kedgwick, to complete a hydrological study for the future development of an additional water supply for the municipality. The demand for water withdrawal continues to increase for the Village due to population growth and increasing commercial/industrial pressures.

It is understood that the EIA Regulation requires that all waterworks with a capacity greater than 50 m³/day be registered for an environmental impact assessment with your Department. The proposed undertaking consists of the construction of additional water well, with a pumping capacity of 400 m³/day (60 igpm).

There are no significant environmental impacts predicted from the construction, operation and maintenance of this undertaking. We look forward to working with your staff in reviewing this application and securing the necessary approvals. If you have any questions, do not hesitate to contact the undersigned at 506-458-1248.

Sincerely,

GHD Limited



Roger Poirier, P.Eng.



Mario Theriault, Ctech.

RP/ad (1)

Encl.

cc: Jacques Boissonnault
Francis Bérubé

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Figure 1 Site Location

Figure 2 Site Plan

Attachment

Attachment A Water Supply Source Assessment – Initial Application, Communauté rurale de Kedgwick, NB

1. The Proponent

1.1 Name of the Proponent

Communauté rurale de Kedgwick, New Brunswick

1.2 Address of Proponent

Communauté rurale de Kedgwick
114 Notre Dame Street
Kedgwick, NB E8B 1H8

1.3 Chief Executive Officer

Francis Bérubé
Directeur général
Communauté rurale de Kedgwick
Tél.: 506-284-2160
Fax : 506-284-2859
crkedgwick.fb@bellaliant.com

1.4 Principal Contact Person for Purposes of Environmental Impact Assessment

Roger Poirier, P.Eng.
GHD Limited
466 Hodgson Road
Fredericton, NB E3C 2G5

Tel: 506-458-1248
Fax: 506-462-7646
roger.poirier@ghd.com

1.5 Property Ownership

PID #50195395
Communauté Rurale de Kedgwick

The proposed drilling target area is located within the Communauté rurale de Kedgwick property.

2. The Undertaking

2.1 Introduction

This document is for work related for the completion of a Water Supply Source Assessment (WSSA) for the Communauté rurale de Kedgwick, NB. A copy of the WSSA application is presented as Attachment A.

2.2 Name of the Undertaking

Water supply source assessment for the Communauté rurale de Kedgwick, NB.

2.3 Project Overview

Complete a water supply source assessment for the possible development of an additional water supply for the municipality. The demand for water withdrawal continues to increase for the Village due to population growth and increasing commercial/industrial pressures. The proposed well would be located approximately 100 metres to the northeast of the existing groundwater production well PW-2 and within Zone A of the current wellfield protection area for the Communauté rurale de Kedgwick wellfield.

The proponent would like to undertake the proposed testing work as soon as possible following approval of the undertaking.

2.4 Purpose/Rational/Need for the Undertaking

The purpose for the undertaking is to provide the Communauté rurale de Kedgwick with an additional water resource to meet its daily requirements. The additional water resource would extract water from the same aquifer as the two existing production wells.

The current wellfield was developed in 1982, with the construction of two production wells (PW-1 and PW-2) in a sandy gravel aquifer along the western bank of Hailes Brook. In the early 1990s, PW-1 was abandoned when the pump could not be recovered from the well. At this time, PW-3 was constructed to replace PW-1.

The project details are presented in Item 6 of the attached WSSA application. In summary, one 150 mm diameter well will be constructed and preliminary testing completed. If the test results are positive, a 200 or 250 mm diameter production well would be constructed and pump tested.

Once the well is successfully constructed and tested, additional information pertaining to the connection to the water supply system will be provided to your department for evaluation prior to undertaking the construction activities.

2.5 Project Location

The potential drill target is located on property PID #50195395, approximately 100 metres to the northeast of the existing groundwater production well PW-2 (Figure 1). This location was selected due to the close proximity to existing water infrastructure (pipeline and pumphouse), and the anticipated presence of a significant gravel aquifer in the area.

The coordinates for the target area are 47° 39' 09.95" north, 67° 20' 17.58" west.

2.6 Sitting Considerations

The stratigraphy intersected during drilling of the municipal well in 1982 includes 6.7 to 7.6 metres of sandy gravel underlain by bedrock. In addition, the well would be located close to existing water distribution infrastructure, thereby minimizing cost and potential impacts of connecting the well to the water supply system. This location was selected in consultation with representatives of the Communauté rurale de Kedgwick and Boissonault McGraw.

Watercourses or wetlands have been identified within 60 metres of the proposed drill target area. Details on the location of nearby watercourses and wetlands are provided in Item 9 of the attached WSSA application. The wetland and watercourses are also identified on Figures 1 and 2.

2.7 Physical Components of the Project

The drill target is located approximately 100 metres to the northeast of the existing groundwater production well PW-2 (Figure 2). The location of the existing production wells are identified on Figure 2.

The undertaking pertains to the construction and testing of wells in the study area. Once the wells have been developed, additional information pertaining to related infrastructure requirements (pipeline connections, pump house construction, etc.) will be provided to your department prior to undertaking the work.

It is expected that the undertaking will require work within 30 metres of a watercourse or wetland. Should work be required within this 30 metre buffer, a watercourse alteration application will be submitted prior to undertaking this work.

There will be minimal increases in vehicle traffic due to the undertaking. Some temporary storage of materials may be required on-Site during the construction activities, but minimal storage will be required during the drilling and testing activities.

2.7.1 Construction Details

The construction of the proposed additional water well and pump test activities, as per the New Brunswick Clean Water Act, will be carried out by a licensed Well Driller under the supervision of CRA personnel.

The following describes the work that is to be completed for the drilling of the additional well:

- Complete underground clearances prior to commencing drilling activities.
- Install and maintain sediment and erosion control structure over the course of well construction, development and pump testing (if required).
- Construction of one 150 mm diameter test well at the target site using standard drilling method (air rotary) to an approximate depth of 6-10 metres below ground surface (mbgs), with a 150 mm steel casing installed into the gravel formation. The well will be logged by an experienced CRA professional.
- A preliminary yield estimate will be completed based on airlift volumes following construction of the test well. Preliminary groundwater samples will be collected after initial development and analyzed for general chemistry and metals.
- If the estimated yield and preliminary chemistry results are acceptable, a 200-250 mm diameter test well with stainless steel screen will be constructed near the initial well. A three 30 minute step tests will be completed on the test well, followed by a 72 hour pump test, to evaluate the aquifer yield. Water levels will be measured in the 200-250 mm diameter test well, the 150 mm diameter monitoring well and the existing production wells during the pump test. Water samples will be collected at 24 hour interval during the test for chemical analysis.

- A detailed report on the hydrogeological investigation will be submitted to the NB Department of Environment office upon completion of the testing program. The report will meet the requirements outlined in NBDELG's Water Supply Source Assessment Guidelines, and will include well logs, pump test information, chemistry data and yield estimate.
- The drilling activities will be completed during daytime hours.
- Pump testing activities will be completed for a continuous 72 hour period.
- Refueling of the equipment used during the construction activities will either be completed off-site or at a designated on-site location.

2.7.2 Operation and Maintenance

Periodic maintenance of the well will be required from time to time, and may include removing/replacing the pump, well re-development activities, etc. Operation and maintenance of the well is not expected to cause significant environmental impacts.

2.7.3 Future Modification, Extensions, or Abandonment

Details on any construction activities necessary to connect the new well to the existing water supply (pipeline installation, pump house construction, etc.) will be provided for approval prior the proceeding with the work.

2.7.4 Project Related Document

The Water Supply Source Assessment – Initial Application document is presented as Attachment A.

3. Description of Existing Environment

3.1 Physical and Natural Features

The site topography near the target area is relatively flat, with an approximate elevation of 300 metres above sea level. The water from Hailes brook flows from the north to the south. The regional groundwater flow is expected to be south.

Watercourses and wetlands have been identified within 60 metres of the proposed drill target area. There is one NBDELG regulated wetlands located approximately 5 metres east of the drill target area. Hailes Brook is located approximately 10 metres east of the target area as well.

The existing municipal well (PW-2) is located within 100 metres of the target area. The target area is therefore located within Zone A of the wellfield. The proposed well would extract water from the same aquifer as the current municipal wells. However, a hydrogeological study of Hailes Brook indicated that the area can provide the required water based on recharge estimates and low flow calculations (see WSSA, Attachment A).

3.2 Cultural Features

The target area is located on the Communauté rurale de Kedgwick property. There are no cultural features identified near the target area.

3.3 Existing and Historic Land Use

The target area is located on the Communauté rurale de Kedgwick property. A description of the neighbouring land uses are provided as Item 7 of the attached WSSA application.

4. Summary of Environmental Impacts

Environmental impacts related to the construction and testing of the proposed wells will be minimal, as described above. If the estimated yield and water chemistry results are acceptable, the new well will be connected to existing underground piping and details for this work will be provided to your department prior to undertaking the work.

5. Summary of Proposed Mitigation

- The drill site will be equipped with spill kit
- Equipment will be inspected daily to ensure it is in good working order and free of leaks
- Vehicle fueling and maintenance must occur at least 30 m away from any watercourse, either off-site or at a designated on-site location
- Sediment and erosion controls will be installed and maintained over the course of the well construction, development and pump testing (if required)
- All work (except for the pump testing) will be completed during daylight hours, to minimize disturbance to the local area

6. Public Involvement

The Communauté rurale de Kedgwick will seek and consider public input in relation to the proposed project. Individuals, companies, agencies, organized interest groups, and others that may be affected by the project will be contacted, made aware of the undertaking, explained the details of the project and asked for comments, related to the project.

A report documenting the public involvement process will be submitted to the Department of the Environment within 60 days of this registration.

7. Approval of the Undertaking

The following permits, licenses, approvals, and permissions are required for this undertaking:

- a) Water Supply Source Assessment Initial Application Approval by NBDELG

8. Funding

This project is being funded by the Communauté rurale de Kedgwick, NB.

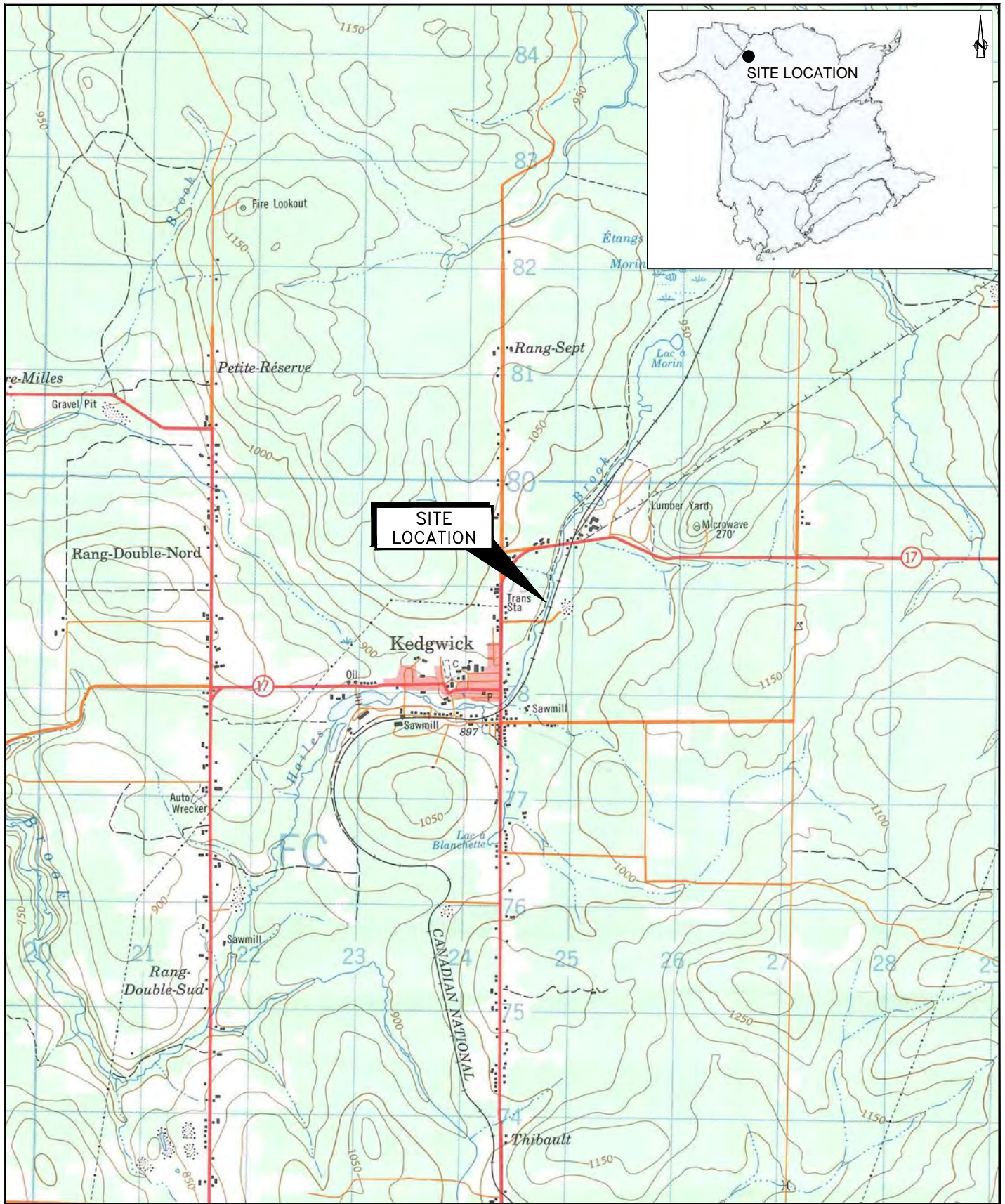
9. Signature

Please accept this EIA Registration for the construction of a back-up well.

Signature of Chief Executive

Date

Francis Bérubé
Directeur général
Communauté rurale de Kedgwick



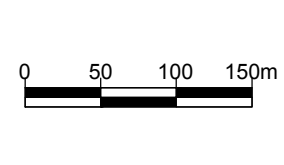
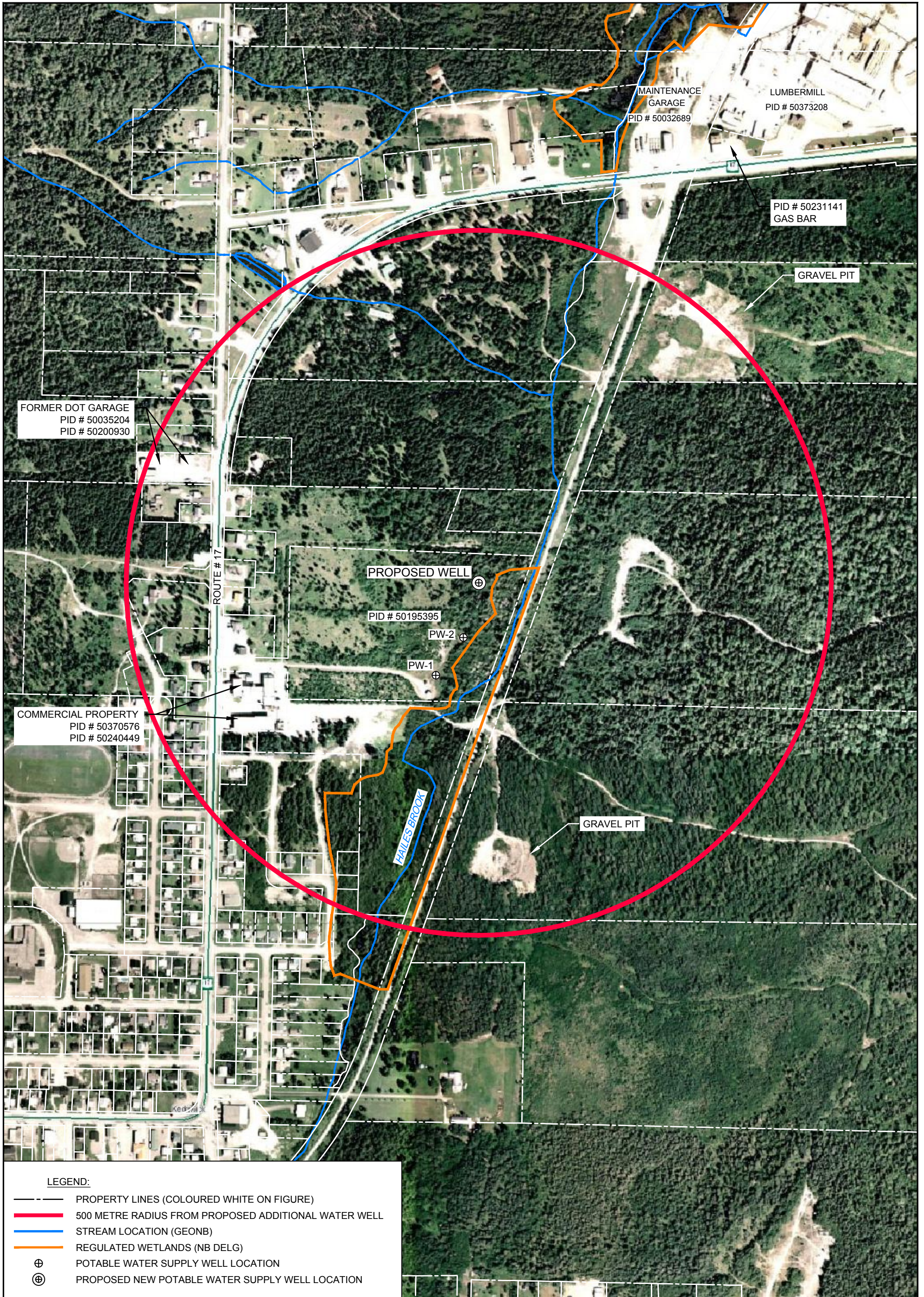
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COMMUNAUTÉ RURALE DE KEDGWICK
 KEDGWICK, NB
 EIA REGISTRATION
 WATER SUPPLY SOURCE ASSESSMENT
SITE LOCATION

11102988-00
 Nov 26, 2015

FIGURE 1



COMMUNAUTÉ RURALE DE KEDGWICK
 KEDGWICK, NB
 EIA REGISTRATION
 WATER SUPPLY SOURCE ASSESSMENT
 SITE PLAN

11102988-00
 Nov 26, 2015

FIGURE 2

Attachment A
Water Supply Source Assessment - Initial
Application, Communauté rurale de
Kedgwick, NB



November 25, 2015

Reference No. 11102988

Department of Environment and Local Government
20 McGloin Street, 3rd Floor North Wing
PO Box 6000
Fredericton, NB E3A 5T8

**Re: Water Supply Source Assessment
Initial Application
Communauté rurale de Kedgwick, NB**

GHD Limited (GHD) has been retained by Boissonault McGraw, on behalf of the Communauté rurale de Kedgwick, to complete a hydrological study for the future development of an additional water supply for the municipality. The demand for water withdrawal continues to increase for the Village due to population growth and increasing commercial/industrial pressures.

The Communauté rurale de Kedgwick currently obtains their water supply from a wellfield located along Hailes Brook. Due to increasing water demands, the Village requires additional water resources to meet its daily requirements. It is our intention to complete the proposed testing work as soon as possible following receipt of NBDELG approval.

The current wellfield was developed in 1982, with the construction of two production wells (PW-1 and PW-2) in a sandy gravel aquifer along the western bank of Hailes Brook. In the early 1990s, PW-1 was abandoned when the pump could not be recovered from the well. At this time, PW-3 was constructed to replace PW-1. The proposed additional well would be located approximately 100 metres to the northeast of the current well PW-2 (Figure 1). The proposed test location would be located within Zone A of the current wellfield protection area for the wellfield.

This letter is an application to initiate a water supply source assessment project for the Communauté rurale de Kedgwick, as defined in the "Water Supply Source Assessment Guidelines" document dated March 14, 2014.

Name of proponent:

Communauté rurale de Kedgwick.

1) Location of drill targets and purpose of the proposed water supply:

The potential drill target is located on property PID #50195395, approximately 100 metres to the northeast of the existing groundwater production well PW-2 (Figure 1). This location was

selected due to the close proximity to existing water infrastructure (pipeline and pumphouse), and the anticipated presence of a significant gravel aquifer in the area.

The purpose for the undertaking is to provide the Communauté rurale de Kedgwick with an additional water resource to meet its daily requirements. The additional water resource would extract water from the same aquifer as the two existing production wells.

It is noted that a hydrological study of Hailes Brook was completed by GHD in November 2015 to determine if there is sufficient recharge within the creek system to sustain the installation of additional municipal water wells (Hailes Brook Drainage Basin Hydrological Study, GHD, November 4, 2015 – Appendix A). Analysis shows the minimum predicted low flow for Hailes Brook at Kedgwick to be approximately 570,000 imperial gallons per day (igpd). The municipality is currently using 180,000 igpd. Assuming that all of the recharge for the wellfield comes from the brook, this would equate to approximately 32% of the base low flow for Hailes Brook. Should a second well be drilled in the area to augment the capacity by 50%, the total water withdrawal (270,000 igpd) would equate to less than 50% of the 7Q₁₀ base flow, leaving ample water for sustaining the freshwater aquatic life in the brook. The above represents the worst case scenario, as the brook is not the only source of recharge water for the aquifer.

Furthermore, the drainage area for Hailes Brook at Kedgwick is estimated at 30 km². Assuming an annual precipitation of 1 meter, and an infiltration/recharge rate of 10% (which is conservative), the available water for the drainage basin can be calculated at 1.8M igpd on average. Given the maximum projected municipal water consumption of 270,000 igpd, this only represents 15% of the available recharge for the area.

Based on this information, the Hailes Brook drainage basin could sustain the additional water required by the municipality.

2) Required water quantity (in m³/day) and/or required pumping rate:

The municipality is currently using 180,000 igpd. The production wells PW-1 and PW-2 were both rated at 90,000 igpd during a pump test completed in 1982.

Ideally, the additional water supply would have a similar yield to the existing municipal well. Based on the above information, the estimated minimum water requirement for the proposed water supply is 90,000 igpd.

3) List alternate water supply sources in area (including municipal systems):

There are no other known municipal water supplies in the area.

4) Area hydrogeology:

The stratigraphy intersected during drilling of the municipal well in 1982 includes 6.7 to 7.6 metres of sandy gravel underlain by bedrock.

The water from Hailes brook flows from the north to the south. The regional groundwater flow is expected to be south.

5) Proposed hydrogeological testing and work schedule:

Following approval of the undertaking from NB Department of Environment and Local Government, CRA will supervise the drilling of one 150 mm diameter test well at the drill target site (Figure 1). The well will be logged by an experienced CRA professional and the drilling contractor will be a licensed well driller.

A preliminary yield estimate will be completed based on airlift volumes following construction of the test well. Preliminary groundwater samples will be collected after initial development and analyzed for general chemistry and metals.

If the estimated yield and preliminary chemistry results are acceptable, a 200-250 mm diameter test well will be constructed near the initial well. A step test will be completed on the test well, followed by a 72 hour pump test, to evaluate the aquifer yield. Water levels will be measured in the 200-250 mm diameter test well and the 150 mm diameter monitoring well during the pump test. Water samples will be collected at 24 hour interval during the test for chemical analysis.

A detailed report on the hydrogeological investigation will be submitted to the NB Department of Environment office upon completion of the testing program. The report will meet the requirements outlined in NBDELG's Water Supply Source Assessment Guidelines, and will include well logs, pump test information, chemistry data and yield estimate.

The proponent would like to undertake the proposed testing work as soon as approval to proceed is received.

6) Existing pollution or contamination hazards within a (minimum) 500 m radius of the proposed drill targets.

The following constraints have been identified within 500 metres of the proposed drill target area:

- a) The drill target area is located adjacent to Hales Brook within a vacant lot approximately 350 metres east of Highway 17.
- b) A former rail road track, currently owned by Natural Resources and Energy, is located approximately 50 metres east of the drill target area. The rail corridor is currently used as an ATV/snowmobile trail.
- c) A commercial property (kitchen cabinet manufacturer) is located approximately 350 metres southwest of the drill target area (PIDs #50370576 and #50240449).
- d) Gravel pits are located approximately 350 metres southeast and 400 metres northeast of the drill target area.
- e) A former Department of Transportation maintenance garage is located approximately 450 metres to the northwest of the drill target area. These properties (PIDs #50030204 and 50200930) are listed on Service New Brunswick Land Gazette as a former petroleum

storage site and also registered under the New Brunswick Remediation Management program.

In addition, the following constraints have been identified slightly over 500 m of the proposed drill target area:

- f) A commercial truck maintenance garage is located approximately 700 metres to the northeast of the target area. This property (PID #50032689) is listed on Service New Brunswick Land Gazette as a petroleum storage site.
- g) A fuel/gasoline gas bar is located approximately 725 metres to the northeast of the target area. This property (PID #50231141) is listed on Service New Brunswick Land Gazette as a petroleum storage site and registered under the New Brunswick Remediation Management program.
- h) A lumber mill is located approximately 750 metres to the northeast of the drill target area. This property (PID #50373208) is listed on Service New Brunswick Land Gazette as a petroleum storage site.

All of these properties noted above are located within the Communauté rurale de Kedgwick Wellfield Protection Area for the existing municipal well.

Although the land uses listed above represent potential contamination hazards, the current municipal well is located in the same target area and has not been affected by the activities listed above.

7) Groundwater use problems (quantity or quality) that have occurred in the area.

The water chemistry (organic and inorganic) for the current municipal wells PW-2 and PW-3 (April 2015) is included as Appendix B. All parameters analyzed for meet the Canadian Drinking Water Guidelines.

There have been no quantity or quality issues reported for the both current municipal wells. The water chemistry for the proposed additional well would be expected to be similar to the chemistry for the current municipal wells.

8) Watercourse(s) within 60 m of the proposed drill targets.

A watercourse (Hailes Brook) is located approximately 40 metres to the east of the drill target area. There is an NBDELG regulated wetlands located within 25 metres to the east of the proposed drill target area.

9) Site supervisory personnel involved in the source development (municipal officials, consultants and drillers).

- Client Contact:
 - Francis Bérubé (Directeur Général, Communauté Rural de Kedgwick NB)
 - Email: crkedgwick.fb@bellaliant.com
 - Phone: 506-284-2160

- Project Manager/Senior Hydrogeologist: Roger Poirier (Senior Hydrogeologist, GHD)
 - email: roger.poirier@ghd.com
 - Phone: 506-458-1248
- Site Supervisors: Mario Theriault / Mike Gaines / Mike Graves (Senior Technicians, GHD)
- Licensed Well Driller: A qualified licensed well driller will be identified to complete the drilling and pump test activities.

10) 1:10,000 map and/or recent air photo identifying:

- **Proposed location of drill targets and property PID**
- **Domestic or production wells within a 500 m radius from the drill target**
- **Any potential hazards identified in Question 6**

A 1:10,000 site plan identifying the potential drill target is attached as Figure 1. Other than the Communauté rurale de Kedgwick production well adjacent to the drilling target, there are no other known water supplies within a 500 m radius of the target area. The features discussed in Question 6 above are also identified on Figure 1 for reference purposes.

11) Land use/zoning map of the area. Superimpose drill targets on this map.

Land use/zoning map for the area of the drilling target is not available. The property is wooded and hosts a pump house and two production wells. The properties immediately to the south of the drilling target area are zoned residential (R2A).

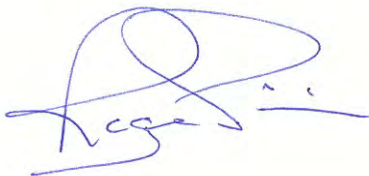
12) Contingency plan for open loop earth energy systems.

Not applicable to this project.

We trust this information is sufficient for your evaluation at this time. Please contact our office should there be questions.

Sincerely,

GHD Limited



Roger Poirier, M.A.Sc., P.Eng.

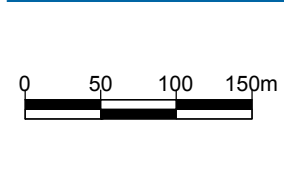
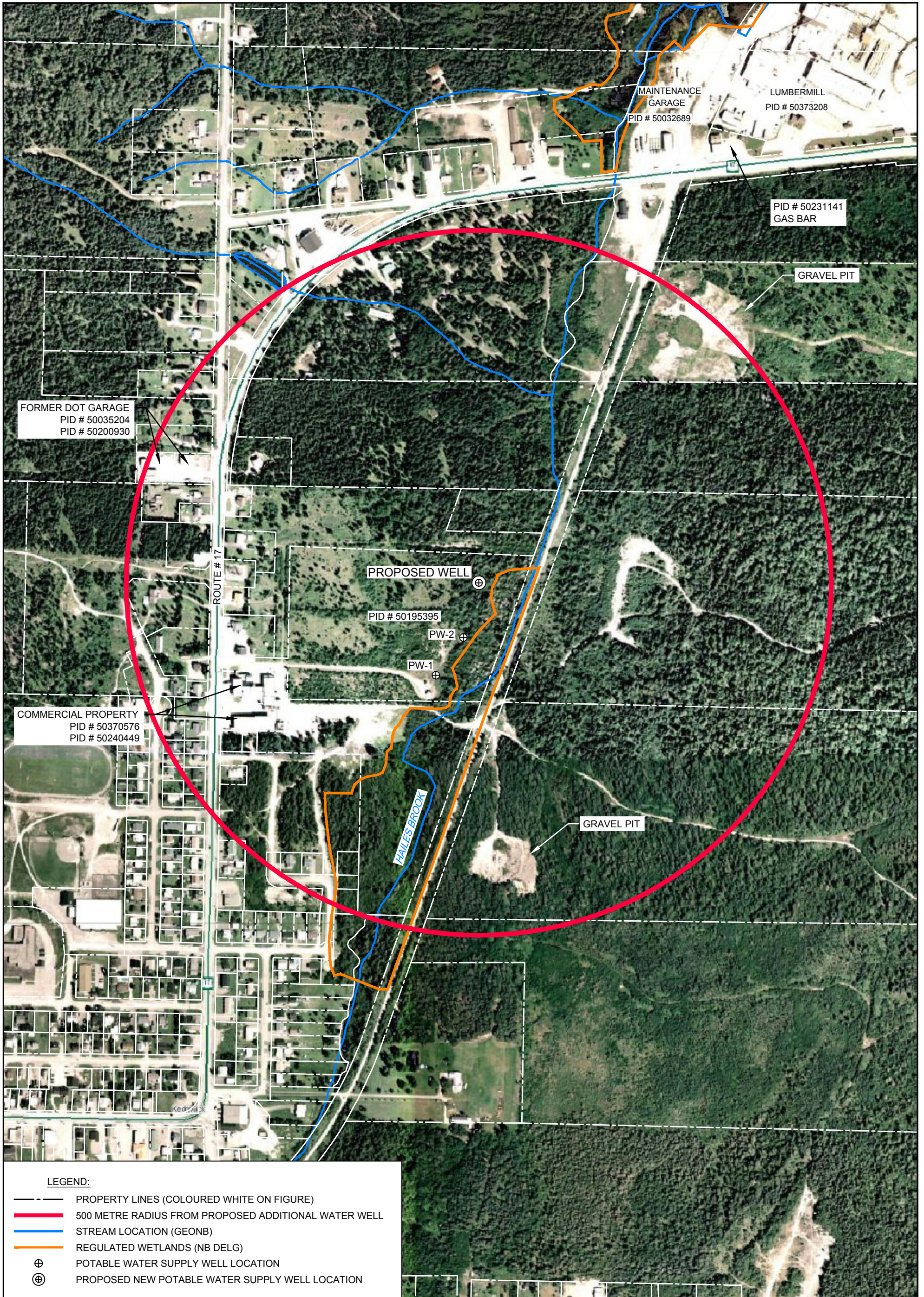


Mario Theriault, Ctech.

RP/ad/1

Encl.

cc: André Boissonault



BOISSONEAULT McGRAW
 COMMUNAUTÉ RURALE DE KEDGWICK, NB
 WATER SUPPLY SOURCE ASSESSMENT

SITE PLAN

11102988-00
 Nov 26, 2015

FIGURE 1

Appendix A

Hailes Brook Drainage Basin Hydrological Study



Memorandum

To: Roger Poirier

Ref. No.: 1

From: Paul Farquharson; Jian Gao

Date: November 4, 2015

CC:

Re: Hailes Brook Drainage Basin Hydrological Study

1. Introduction and Background

The village of Kedgwick (Village) currently obtains their water supply from a well field located in the vicinity of Hailes Brook. The demand for water withdrawal continues to increase for the village due to population growth. Therefore, the Village is considering the installation of additional municipal water wells within the well field (Site). GHD was retained by Boissonnault McGraw (Client) to complete a hydrological study of Hailes Brook in support of a larger Project to determine if there is sufficient recharge within the creek system to sustain the installation of additional municipal water wells.

This technical memorandum consists of a desktop study to provide estimates of environmental flows within Hailes Brook at the Site. Hailes Brook is an ungauged watershed. Therefore, estimates of environmental flows will rely upon gauge data from surrounding watersheds, operated by the Water Survey of Canada (WSC).

2. Environmental Flow Study

As a result of increasing water demand and growing awareness of environment protection, the concept of 'environmental flows' was developed to determine the minimum instream flow, or low flow condition, that is required to sustain the ecological health of a watercourse at an acceptable level. One of the methods in determining environmental flows for a watercourse is to complete a statistical frequency analysis to determine the low flow indices of a watercourse at a site.

Determination of low flow indices at an ungauged Site utilizes daily discharge gauge data collected from surrounding gauge stations. In most instances the gauge data is not in close proximity to the study area. Therefore the statistical analysis of the gauge data is related to the study area based upon a comparison of the measured discharge at the Site to the gauge data or other variables such as watershed area and land cover.

Previous studies by Fisheries and Oceans Canada (Caissie 2006) investigated the relationship between river discharge and drainage basin area in New Brunswick. Caissie (2006) suggested that it is appropriate to assume hydrologic homogeneity for watercourses within New Brunswick and developed equations related

the mean annual flow to the drainage area. The report suggests that the discharge at an ungauged site can be estimated by relating the site watershed to the surrounding gauge stations.

This memo provides estimates of the $7Q_1$ and $7Q_{10}$ discharge, commonly referred to as low flow indices. The $7Q_{10}$ is determined through statistical analysis of the gauge data record and represents the minimum average flow over seven consecutive days having a 10-year recurrence interval. The 10-year recurrence interval implies that there is a 10% probability in any given year that the average seven day flow will be less than the $7Q_{10}$.

The $7Q_1$ is known as the dry weather flow or typical base flow. The $7Q_{10}$ is one of the most widely used low flow indices and is often considered the minimum flow necessary to protect/regulate water quality in support of discharge or water withdrawal licenses. The $7Q_{20}$ is used in Ontario and is considered the minimum flow required to prevent extinction or significant stress on the ecosystem resources in a watercourse (Pyrce, 2004)

2.1 Hydrologic Setting of Study Area

Kedgwick Village is located within the Appalachian Mountains in the west of Restigouche County. It is approximately 75 kilometers (Km) southwest of Campbellton and 15 Km east of the Restigouche River. The Village is located within Hailes Brook drainage basins, which is a third order watercourse that discharges to the Restigouche River Basin. The headwaters of the basins approach 350 metres above sea level (masl). The overall topography in the drainage basins flattens from the headwaters to the study area of 300 masl. The Site watershed area is approximately 30 square kilometers. Figure 1 illustrates the Site watershed area relative to the overall Hailes Brook watershed.

2.2 Data Sources

The following data sources were reviewed and applied as part of this study:

- New Brunswick Hydrographic Network (NBDNR 2015)
- New Brunswick Digital Topographic Database (SNB 1998)
- Water Survey of Canada Hydrometric Station Data (Environment Canada 2010)

2.3 Regional Hydrologic Characteristics at Gauged Watercourses

2.3.1 Water Survey Canada Gauge Stations

Estimating the low flow indices for a study area is determined by relating the low flow indices of the surrounding gauge stations to the study area. Daily average flow data from gauge stations are selected for source data based on the proximity to the study area, length of record, and physiographic characteristics. Figure 2 illustrates the location of the gauge stations relative to the study area.

These stations monitor stream flow in drainage basins ranging in size from 29 km² to 7,740 km². The periods of record for the 9 WSC stations range from 18 to 92 years. Stations that had regulated flow restrictions and stations with less than ten years of data were not included in the regional streamflow analysis. A list of these 9 WSC stations considered in this memo is summarized in Table 1.

2.3.2 Frequency Analysis of Regional Data

The statistical analysis was performed using the software program HEC-SSP 2.0 Statistical Software Package developed by U.S. Army Corps of Engineers was used for this calculation. Low flow indices were calculated utilizing the long term daily mean flow data from the gauging stations. The statistical analysis utilized a Log-Pearson Type III probability distribution (U.S. Interagency Advisory Committee on Water Data, 1982).

Table 2 provides a summary of the $7Q_1$ and $7Q_{10}$ for each respective gauge station. Figure 3 provides a comparison of the 7Q-discharge for each gauge station based upon its overall watershed area. A regression analysis was completed to determine the relationship between 7Q-discharge and drainage basin area and to test if such a relation is statistically significant. The coefficient of determination (R^2 value) for the regression curve is between 0.96 and 0.98 for the $7Q_1$ and $7Q_{10}$. This indicates the low flow indices are related to the watershed area.

Table 2 also provides estimates of the $7Q_1$ and $7Q_{10}$ at the Site and Hailes Brook watershed based upon the regression equations.

2.3.3 Site Discharge (Alternative Method)

The Client provided discharge data within Hailes Brook at the Study Area on September 30, 2015. The Client determined the cross section of the water was 0.392 m², water surface elevation was 274.19m and the surface velocity of the water was 0.616 m/s.

The estimated discharge at the site was calculated using the surface velocity method using a (USGS, 1982). The estimated discharge is 0.20 cubic metres per second (cms) by applying a surface-velocity coefficient of 0.86.

GHD obtained the gauge data records for September 30th from the Water Survey of Canada and compared the gauge data to the Site discharge on a per unit area basis. Table 3 provides a comparison of the discharge data measured at the Site and the gauge stations on September 30, 2015.

The Site watershed area is similar to Gauge #01BP002. However the discharge per unit area value of the gauge station is much greater than the Site value. This would indicate the gauge data watershed may be in an area that has a greater groundwater contribution which supports base flow than the Site and is therefore not suitable for comparison.

The Site discharge per unit area is similar to Gauge #01AF009. However the gauge watershed area is six times greater than the Site. Therefore the application of low flow indices of Gauge #01AF009 would be related to the Site by a factor of six. As shown on Table 3 the estimated $7Q_1$ and $7Q_{10}$ are estimated to be approximately 0.66 and 0.06 cms. These estimated discharge rates are nearly two times greater than the estimated results in Table 2.

3. Summary

The estimated 7Q1 at the Site is estimated to be between 0.36 and 0.66 cms, by considering both methods. The estimated 7Q10 at the Site is estimated to be 0.04 and 0.06 cubic metres per second, by considering both methods.

The low flow indices are based upon a statistical analysis of 9 gauge stations operated by the WSC. Site discharge measurements collected on September 15, 2015 are relatively consistent with the gauge station measurements based upon the watershed area. Further continuous monitoring of the Hailes Brook discharge at the Site would provide necessary data to refine these estimates.

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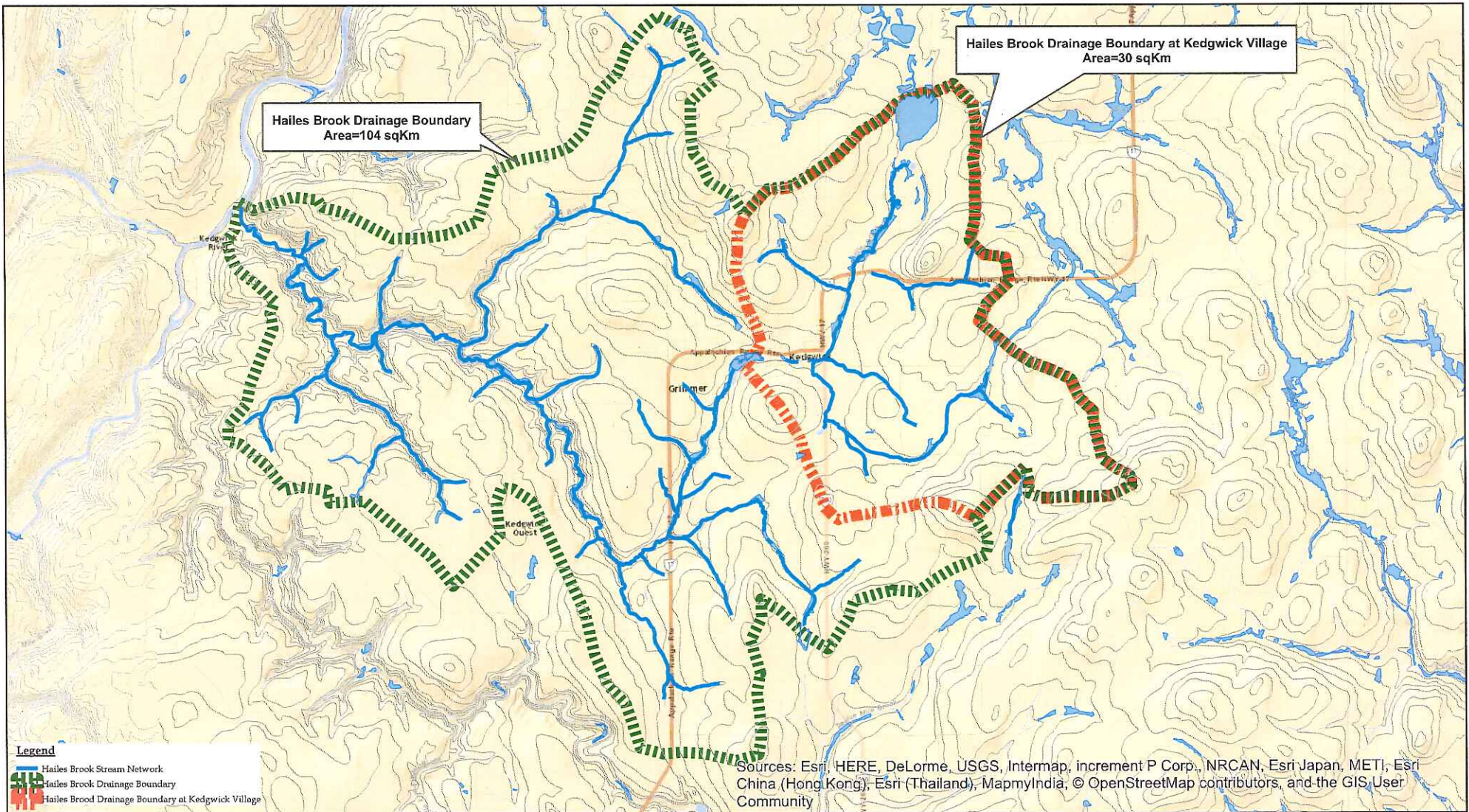
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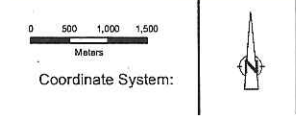
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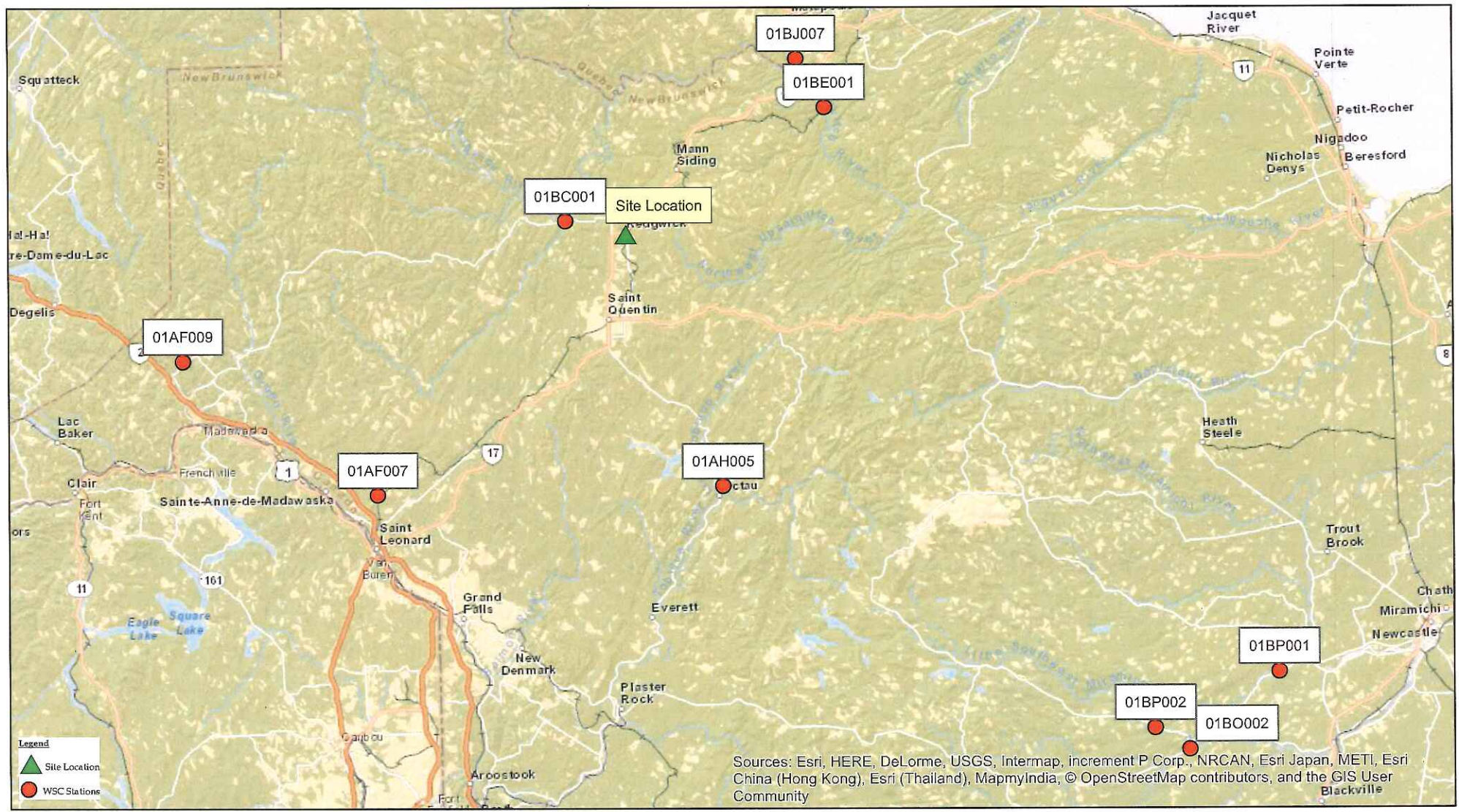


BOISSONNAULT MCGRAW
KEDGWICK NEW BRUNSWICK

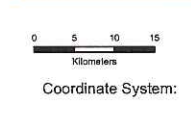
HAILES BROOK DRAINAGE BOUNDARY

11102988(MEMO001)
Nov 4, 2015

FIGURE 1



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SITE LOCATION AND WSC GAUGE STATION LOCATIONS

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FIGURE 2

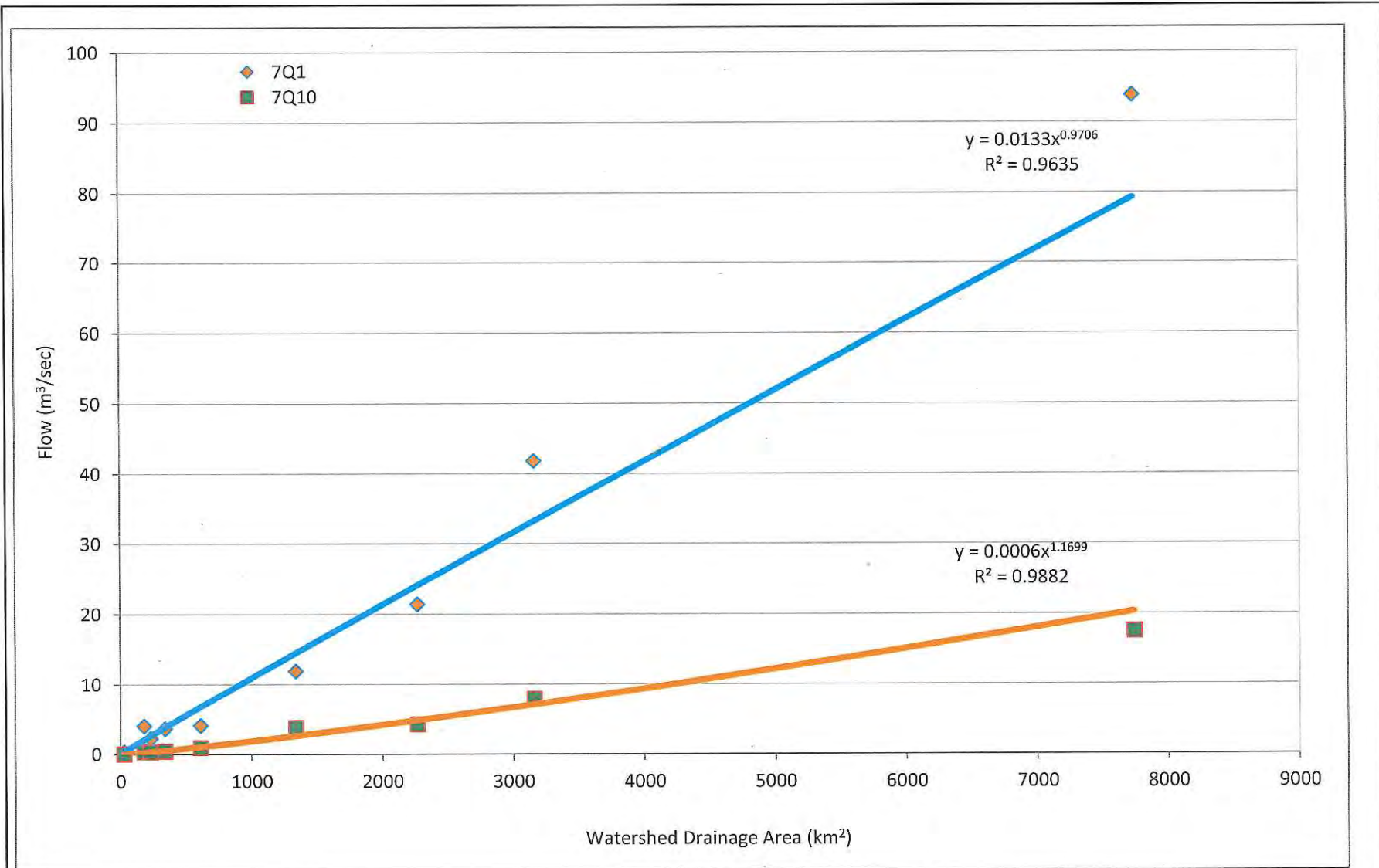


figure 3
7Q₁ AND 7Q₁₀ LOW FLOW ANALYSIS FOR WSC STATION DATA
HYDROLOGICAL STUDY-KEDGWICK WATER SUPPLY
kedgwick New Brunswick

TABLE 1
HYDROLOGICAL STATION INFORMATION
HYDROLOGICAL STUDY-KEDGWICK WATER SUPPLY
Kedgwick, New Brunswick

<i>Station ID</i>	<i>Station Name</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Period of Record</i>	<i>Basin Area</i> (Km ²)
Hailes Brook at Kedgwick Village	-	47.6444	-67.3472	-	30
01AF009	IROQUOIS RIVER AT MOULIN MORNEAULT	47.4578	-68.3568	1991-2010	182
01AF007	GRANDE RIVIERE AT VIOLETTE BRIDGE	47.2470	-67.9213	1977-2010	339
01AH005	MAMOZEKEL RIVER NEAR CAMPBELL RIVER	47.2508	-67.1422	1972-1990	230
01BC001	RESTIGOUCHE RIVER BELOW KEDGWICK RIVER	47.6671	-67.4831	1962-2010	3160
01BE001	UPSALQUITCH RIVER AT UPSALQUITCH	47.8325	-66.8871	1918-2010	2270
01BJ007	RESTIGOUCHE RIVER ABOVE RAFTING GROUND BROOK	47.9087	-66.9481	1968-2010	7740
01BO002	RENOUS RIVER AT MCGRAW BROOK	46.8214	-66.1147	1965-1995	611
01BP001	LITTLE SOUTHWEST MIRAMICHI RIVER AT LYTTLETON	46.9360	-65.9074	1951-2010	1340
01BP002	CATAMARAN BROOK AT REPAP ROAD BRIDGE	46.8566	-66.1901	1989-2010	29

NOTE:

1 All stations operated by Water Survey of Canada

TABLE 2

WATER SURVEY CANADA GAUGE STATION
LOW FLOW ANALYSIS
HYDROLOGICAL STUDY-KEDGWICK WATER SUPPLY
Kedgwick, New Brunswick

Water Survey Canada Gauge Station Low Flow Analysis

	Drainage Area	7Q ₁	7Q ₁₀
	(km ²)	(m ³ /sec)	(m ³ /sec)
01AF009	182	4.01	0.35
01AF007	339	3.62	0.41
01AH005	230	2.26	0.32
01BC001	3160	41.86	7.95
01BE001	2270	21.41	4.24
01BJ007	7740	93.82	17.48
01BO002	611	4.09	0.91
01BP001	1340	11.88	3.75
01BP002	28.7	0.33	0.03

Hailes Brook Low Flow Analysis

	Drainage Area	7Q ₁	7Q ₁₀
	(km ²)	(m ³ /sec)	(m ³ /sec)
Hailes Brook Drainage Basin	104	1.21	0.14
Hailes Brook at Kedgwick Village	30	0.36	0.03

TABLE 3

WATER SURVEY CANADA GAUGE STATION AND
HAILES BROOK DISCHARGE COMPARISON
HYDROLOGICAL STUDY-KEDGWICK WATER SUPPLY
Kedgwick, New Brunswick

	Drainage Area	Flow Sep 30, 2015	Flow / Area	7Q ₁	7Q ₁₀
	(km ²)	(m ³ /sec)	(m ³ /sec/Km ²)	(m ³ /sec)	(m ³ /sec)
Hailes Brook Drainage Basin	104	(-)			
Hailes Brook at Kedgwick Village	30	0.20	0.007	0.66	0.06
01AF009	182	1.22	0.007	4.01	0.35
01AF007	339	4.55	0.013		
01BC001	3160	16.15	0.005		
01BE001	2270	6.66	0.003		
01BJ007	7740	32.30	0.004		
01BP001	1340	49.12	0.037		
01BP002	28.7	5.08	0.177		