

**Groundwater Supply Assessment and Reporting Guidelines
For Subdivisions Serviced by Individual Private Wells**



Department of Environment and Conservation
Water Resources Management Division

November 2009

PART 1 GENERAL

1.1 OBJECTIVES

The approval of new unserviced subdivisions or the addition of unserviced lots to existing unserviced subdivisions require that a groundwater assessment be done to determine with high probability that acceptable quality and quantity drinking water will be available to homeowners for both the short and long term. These guidelines provide administrative and technical guidance to developers applying for subdivision approval and ensure that the development proposals are submitted with the required technical support.

The objectives of these guidelines are as follows.

- To ensure that future owners of homes and lots in the areas not serviced by municipal water have a high probability of obtaining adequate quantities of potable water for domestic consumption for short- and long-term use.
- To identify and minimize potential impacts the proposed development may have on existing groundwater users and sensitive features (e.g. groundwater-recharge areas, wetlands, and groundwater-fed streams).
- To ensure that a qualified person* applies a consistent approach with the necessary technical information when undertaking a water-supply study.

* a qualified person means either a Professional Hydrogeologist or Professional Engineer with formal training in groundwater science, and who is a member of Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL)

These guidelines were developed in consultation with officials from the Departments of Government Services, Municipal Affairs, Health and Community Services, and Environment and Conservation. The first version of this document was approved in January 2009, and was revised in November 2009.

1.2 LEGISLATIVE AUTHORITY

The legislative authority for the collection of data on the availability of groundwater resources in the Province of Newfoundland and Labrador is administered by the Department of Environment and Conservation, Water Resources Management Division. The authority can be found under the *Water Resources Act SNL2002 CHAPTER W-4.01, Part III, Well Drilling, section 62, Groundwater Studies.*

Section 62 “The minister may order studies, monitoring and investigations for the purpose of collecting data and information on the availability of groundwater, sustainable rates of water withdrawal, spacing of wells, quality of household water supplies, pumping test methods, hydrogeological mapping, groundwater flow systems, groundwater quality and other matters considered necessary in the interest of the conservation, development, control, improvement and proper utilization of groundwater resources.”

1.3 APPROVAL PROCESS

A groundwater assessment report shall be required as part of the subdivision approval process where a minimum sized subdivision is to be serviced by individual wells. The Groundwater Assessment Report must be prepared by, or be under the direction of, a Qualified Person as defined in section 1.1.

A Groundwater Assessment is not intended to provide a guarantee that future home owners will have an adequate supply of potable water, but rather, is to provide a qualified opinion of the likelihood of obtaining an adequate supply of potable water.

An approval letter based on a groundwater assessment report will be required from Water Resources Management Division before Government Services will approve engineering plans for the subdivision.

All costs associated with the report shall be at the expense of the developer.

Subdivisions that are serviced by municipal water-supply systems shall be exempt from the requirements of this document.

1.4 REPORTING REQUIREMENTS

The Groundwater Assessment Report may consist of two levels, Level I and Level II.

Level I generally will consist of a description of the hydrogeology, site characterization, and sustainable groundwater quality and quantity for the area. A Level I study will gather together all available site information as outlined in Part 2, sections 2.1 and 2.2.

Level II assessment will require the information in Level I and additional information as outlined in Part 2, section 2.3. A Level II Groundwater Assessment Report includes information obtained from test well installation(s) and water quality testing information.

1.4.1 Triggers for Level I and II Groundwater Assessment

No Study Required

A groundwater assessment study will not be required for subdivisions less than 5 lots, each having a minimum 2023 m² (½ acre) size, unless the area has documented drinking-water quality and/or quantity problems.

Level I Study Required

A proposed subdivision from 5 to 15 lots will require a Level I assessment. If the Level I assessment findings recommends a Level II assessment study, Water Resources Management Division may request a Level II Assessment study be undertaken.

Level II Study Required

A proposed subdivision greater than 15 lots will require a Level II assessment, which requires a minimum of one test well. Each test well **must** have at least one observation well that is strategically placed to be influenced by the pumping well in order to obtain the maximum information about the aquifer. In no case shall the observation well be placed further than 90 metres from the test well, unless siting is approved in advance by the Department of Environment and Conservation. An additional test well is required for every additional 15 building lots. As an example, a 50-lot proposed subdivision would require three test wells. A Level I assessment that recommends a Level II assessment be undertaken will be reviewed by the Department of Environment and Conservation in order to determine if this additional work will be required.

The following table shows the assessment requirements based on the number of lots.

# of Lots	Level I required	Level II required	# of Test Wells
1 - 4	No	No	0
5 - 15	Yes	may be required*	may be required*
16 - 30	Yes	Yes	1
31 - 45	Yes	Yes	2
46 - 60	Yes	Yes	3
61 - 75	Yes	Yes	4
75 - 90	Yes	Yes	5
91 - 105	Yes	Yes	6

* A Level II study and/or a test well may be required if it has been determined that the location has a history of groundwater quantity/quality issues.

Where existing lots are already in place, any addition to their number in excess of five (5) lots total will trigger the above assessment requirements. For example, if a subdivision of 4 lots was previously approved and an additional 4 lots is being assessed, a Level I assessment will be required for the additional 4 lots since the number of unserviced lots in the subdivision is now 8.

Test wells may be located so that the wells can be used in the future as a private well for an individual lot.

Consultants should discuss these issues, as well as pump test and water quality sampling issues, with Water Resources Management Division staff before proceeding with a Level II study.

1.4.2 Implementation Date

The implementation date will be January 1, 2009.

PART 2 STUDY COMPONENTS FOR LEVEL I GROUNDWATER ASSESMENT

2.1 DESCRIPTION OF HYDROGEOLOGY

The objective of this work component is to characterize the local geology and hydrogeology and will include, but is not limited to, the following:

- Review and compile local well records from the most recent version of the province's Drilled Well Database.
- Review and compile pumping test results from the most recent version of the province's Pumping Test Database for the proposed aquifer source.
- Review and summarize available water quality analyses for the proposed aquifer source.
- Review of available groundwater studies and/or literature on the area.
- Consult with all appropriate provincial agencies and well contractors familiar with the area to obtain information on local groundwater resources.
- Assess local bedrock and surficial geology, including stratigraphy, depth, thickness, composition, texture, known relevant weathering/alteration/structural features (i.e. joints, fractures, faults, or bedding planes), water-bearing potential, and lateral continuity based on existing information.
- Assess local hydrogeology, including identification of hydrostratigraphic units and the hydraulic and hydrochemical characteristics of each unit based on existing information.
- Identify primary, secondary and tertiary sub-watersheds of the proposed development site and assess surface-water features within 500 metres of the site boundaries, including the types of surface-water features and the location of surface-water features relative to the site. Providing the information is available, surface-water features should also be assessed for water levels, flow rates, seasonal variation, surface-water quality, drainage patterns, flood risk and annual precipitation rates.

- If the data are available, review subdivision Stormwater Management Plans with respect to water-budget information and the potential for water quality impacts to local aquifers.

2.2 SITE CHARACTERIZATION

The objective of this work component is to identify existing water users and sensitive features, and to document any local water quantity and quality issues. The site characterization work will include, but is not limited to, the following:

- Identify wells and springs within the assumed groundwater influence area, which will be a minimum of 500 metres from the site boundaries, and discuss any water shortage/well interference problems experienced at existing wells in the area. The extent of the assumed groundwater influence area should be determined based on the site geological and hydrogeological conditions, the quantity of groundwater required, and the potential for impacts.
- Document any permitted water withdrawal approvals within the assumed groundwater influence area through Provincial Water Rights Registry request.
- Determine if there are, or have been, any land uses or activities in the assumed groundwater influence areas that may potentially contaminate, or have contaminated, groundwater resources (e.g., landfills, gas stations, dry cleaners, other commercial/industrial facilities, etc.).
- Identify land uses and large water users in a 1:10,000 scale mapping within the assumed groundwater influence area.

2.3 ADDITIONAL INFORMATION – LEVEL II

The object of a Level II assessment is to locate and construct suitable test wells for aquifer pumping tests and groundwater quality analysis. Test wells may be either dug or drilled wells as appropriate for the proposed development. Where the majority of the lots will have drilled wells or the local municipal authority does not allow dug wells, only drilled wells shall be used for aquifer pump tests.

All drilled water wells, private or otherwise, used for water supply must be constructed by a licenced water well driller.

Prevention of bacteria and other contaminants entering test wells and observation wells is required. Well and equipment disinfection must occur during each of the drilling, development, pumping test, and water-quality measurement stages of the assessment process.

2.3.1 Phased Development

Where a development application relates to an additional phase of a phase development, a supplementary study and report is required even though previous phases may already have been

approved on the basis of previous hydrogeological studies that encompassed those phases or the entire site.

The supplementary study and report must include analyses for the required parameters of water samples taken from wells representative of the same formation that are in use on nearby developed lots in previous phases. Well owners on nearby developed lots must be interviewed where possible regarding their experience with their well water quantity and quality. This information, as well as the Water Well Records and a map showing the locations of all new wells in previous phases, must be provided.

The original hydrogeological report must be re-assessed in light of the new information obtained and according to any new criteria or guidelines which may not have been in effect at the time of the original study. Where well water quality or well yield in the previous phases are not compatible to that found in the original test wells or predicted by the original hydrogeological study, the new study must investigate and explain the causes and provide new recommendations based on a re-assessment of the original report. Where new guidelines require information which is not included in the original report, the new report must provide it.

If the new phase does not contain test wells from the original study, new wells must be installed. Where additional study involving new test wells is necessary, most or all of the criteria set forth in these Guidelines will apply.

2.3.2 Well Pump Test

The test wells must be fully developed prior to performing the pumping tests. A test well may be considered fully developed when a minimum of suspended solids is observed in the groundwater, and field parameters such as temperature, specific conductance, and pH have stabilized.

For sites with drilled test wells, which will be the case in most instances, initial step drawdown pumping tests must be performed in all test wells to estimate well yields, assess well efficiency, and to determine the optimum rate for a constant rate pumping test. The step drawdown pumping tests must include a minimum of four pumping intervals consisting of a minimum period of 30 minutes each.

For sites with dug test wells, a short-term pumping test must be performed in each well to determine the optimum rate for a constant rate pumping test.

The test wells must be fully recovered prior to proceeding with the constant rate pumping test.

The constant rate pumping test must be performed in at least one of the test wells.

The constant rate pumping test(s) must begin with a static water level and must be performed at a fixed rate ($\pm 5\%$) for a minimum of 24 hours of continuous pumping (no stoppages). The other test wells must be used for observation wells during the pumping test(s). The pumping rate used during the 24-hr pumping test must be based on the results of the step-drawdown pumping tests (or short-term pumping tests in the case of dug test wells).

The pumping test (s) must include continuous and regular water-level measurement both during and after pumping until 95% recovery occurs, or until sufficient data have been collected to establish a recovery curve. Water levels must be monitored in pumping wells(s) and observation wells.

During the pumping test(s), the discharge must be diverted an appropriate distance and direction away from the wellhead to prevent artificial recharge.

Surface-water bodies within 60 metres of the pumping well(s) must be monitored during the pumping test(s) in order to determine potential interference or adverse affects.

2.3.3 Well Water Testing

The consultant must obtain and analyze sufficient water-quality samples during each pumping test in order to determine the physical, chemical, and bacteriological quality of the water. At least one of these samples must be collected during the last hour of the test. It is the consultant's responsibility to address water quality changes over time and to demonstrate that the water quality data are representative of the quality of water which future residents can expect in the long term.

All water-quality samples must be collected from the well before chlorination and/or treatment is applied, utilizing proper sampling protocol. Samples must be submitted to an accredited water analysis laboratory for testing.

Where there are wells in nearby established developments, information must be obtained from residents and other sources, where possible, regarding water quality problems. If on-site sewage systems are used in the existing development(s) and are also to be used in the proposed development, well-water samples from the existing development should be obtained and analyzed. The consultant must use this information to predict the impact of the proposed on-site sewage systems on water quality within the proposed development.

Water quality may vary between aquifers or with depth in the same aquifer. The consultant must recommend appropriate well construction and must comment on the potential for cross-contamination between aquifers.

Shallow and/or unconfined aquifers are susceptible to contamination from sources located at or near the ground surface. If wells are to be constructed within such aquifers, and especially where individual on-site sewage systems are also proposed, the consultant must address the risk of contamination and recommend measures which will reduce the risk.

The minimum set of chemical parameters for well testing are listed in Appendix A. The Health Canada *Guidelines for Canadian Drinking Water Quality (GCDWQ)*, sixth edition, must be used as the standard in assessing the quality of the drinking water supply. The consultant must also determine whether conditions specific to the site or its surrounding area require the inclusion of additional parameters, e.g., hydrocarbons. Complete documentation of sampling locations,

times, any on-site analytical methods, and all analytical results must also be included in the report.

Bacteriological testing in Newfoundland and Labrador must follow the *Application of Standards for Bacteriological Quality of Private Wells* as stated in Appendix B.

If methane or other potentially explosive gases are encountered during the groundwater assessment, the consultant must make recommendations to adequately control this hazard.

Where water-quality results indicate health related maximum acceptable concentration(s) have been exceeded or treatment limits for aesthetic parameters have been exceeded, the areas which the relevant test wells represent may have to be excluded from the proposed development site. In this case, a justification for the selection of the boundary of the site is required.

2.3.4 Calculation of Minimum Test Rate and Well Yield

The long-term supply of water will determine the viability of a property for residential use. The minimum quantity of water available to an individual residential lot based on 340 litres per day for a four-person house is 0.94 litres per minute.

Consultants must address the issue of whether the groundwater withdrawals in the proposed development, and other existing or planned developments in the area, will exceed the long-term safe yield of the aquifer or significantly decrease flow to sensitive watercourses.

Where there are established subdivisions in the vicinity, information from residents and other sources regarding well-yield problems (water shortages, replacement wells, etc.) and any sensitive watercourses must be obtained.

Consultants must provide a statement indicating that, in their professional opinion, the probable well yields determined on the basis of their investigations are representative of the yields which residents of the development are likely to obtain from their wells in the long term.

2.4 GROUND SOURCED HEAT PUMPS

Open-looped groundwater sourced heat pumps will not be permitted in unserviced subdivisions.

PART 3 GROUNDWATER ASSESSMENT REPORTING

A report must be prepared that provides an overall assessment of the source to provide adequate quantities of potable quality groundwater for domestic consumption over both the short- and long-term, without causing unacceptable impacts to existing water users and the environment. The methods of analysis used by the qualified person must be documented and justified in the report.

The report must be sent to:

Groundwater Section
Water Resources Management Division
Department of Environment and Conservation
PO Box 8700
St. John's NL A1B 4J6
Attention: Groundwater Resources Manager (729-2539)

3.1 REPORT CONCLUSIONS

The report must identify the future use of test wells and ~~will~~ must provide, as a minimum, the following conclusions:

- State the expected range of well yields and aquifer properties in the proposed subdivision.
- State whether or not the groundwater source can provide a sustainable water supply to homeowners in the proposed subdivision based on projected needs for all water users and for peak demands.
- State the expected effects of groundwater withdrawals associated with the proposed subdivision on any existing water wells and the environment.
- State whether or not water wells in the proposed subdivision are expected to meet the Health Canada *Guidelines for Canadian Drinking Water Quality*, and whether groundwater quality is expected to change over time.
- If groundwater quality is not expected to meet the GCDWQ, list the parameters that are expected to exceed the guidelines and the long-term viability of the required treatment to meet the GCDWQ.

3.2 REPORT RECOMMENDATIONS

The report must provide, as a minimum, the following recommendations:

- Minimum lot sizes.
- Well construction with respect to well depth, casing length and grouting.
- Well spacing to minimize well interference problems.
- Lot yield (estimated recharge) and sustainable pumping rate.
- Phasing of development, including the necessity and scope of supplemental reports to update hydrogeological information from previous phases.
- If applicable, a description of the recommended water-storage system(s) and any special water treatment devices that may be necessary for their proper functioning.
- Mitigation measures, including contingency plans where applicable, to address any identified water quality or quantity concerns. Examples of potential mitigation measures are provided in Appendix C.

3.3 SUPPORTING DOCUMENTATION

The required supporting documentation for the submission of a Groundwater Assessment Report is outlined in the table below:

Section	Supporting Documentation
2.1 Description of Hydrogeology	Characterization of the local geology and hydrogeology, including geological mapping and relevant records, pumping test results, water quality results, and surface water/watershed characteristics.
2.2 Site Characterization	Identification of land-uses, environmental concerns, sensitive features and existing well users on the proposed development site and within the assumed groundwater influence area.
2.3 Additional Information	Results of field survey of existing well users within the assumed groundwater influence area (if required by WRMD). Test well locations and well construction characteristics, including logs prepared by the well contractor and the qualified person.
2.3.2 Well Pump Test	Details on pumping test procedures and pumping test data. Detailed analysis/interpretation of pumping test data, including aquifer type, properties, and boundaries, hydraulic gradients and flow patterns, and a justification of the method used and the assumptions associated with the selected method(s) of analysis. Details regarding the estimates of the theoretical long-term sustainable yield of the aquifer relative to water requirements of proposed subdivision, including a justification of the methodology used (e.g. 20-year safe yield calculation) and associated assumptions. Description of proposed storage systems (if applicable). Details regarding the assessment of the potential for interference with other groundwater user, including a justification of the methodology used (e.g. distance-drawdown calculation) and associated assumptions. Details regarding the assessment of the hydraulic relationship between surface-water and groundwater resources, and the potential for water withdrawals to impact baseflow to nearby watercourses and sensitive areas (e.g. wetlands).

2.3.3 Well Water Testing

Details on the water sampling protocol;

Groundwater quality sample results compared to the GCDWQ and the expected background groundwater chemistry.

Laboratory analysis certificate.

Details regarding the assessment of the potential for changes in groundwater quality (e.g. due to nearby sources of contamination).

Description of rationale for selected water-treatment alternative (if applicable) and expected capital and maintenance costs.

Mapping of groundwater-flow direction and discussion of risks to supply wells associated with proposed on-site sewage-disposal systems.

APPENDIX A

MINIMUM CHEMICAL SAMPLING PARAMETERS

The following list of water-quality parameters is the minimum to be tested. Other chemical parameters may be required depending on the history of the location and/or past spills.

General Water Quality Parameter List for Groundwater

Alkalinity
Aluminum
Ammonia
Antimony
Arsenic
Barium
Boron
Bromide
Cadmium
Calcium
Chloride
Chromium
Color (true)
Conductivity
Copper
Dissolved Organic Content
Fluoride
Hardness
Iron
Kjeldahl Nitrogen
Lead
Magnesium
Manganese
Mercury
Nickel
Nitrate/Nitrite
pH
Potassium
Selenium
Sodium
Sulphate
Total Dissolved Solids
Total Phosphorus
Turbidity
Uranium
Zinc

APPENDIX B

APPLICATION OF STANDARDS FOR BACTERIOLOGICAL QUALITY OF PRIVATE WELLS

1. Drinking-water samples from private wells submitted to the Public Health Laboratory or Government Service Centers for bacteriological analysis will be tested for the presence of both total coliform bacteria and the fecal indicator *Escherichia coli* (*E.coli*). If neither are detected, the sample fully meets the standard.
2. If the bacteriological test reveals the presence of 1 to 10 total coliforms, but no *E.coli*, in a 100 mL sample, the drinking water is considered satisfactory and is **adequate** for private consumption. No further action is necessary except further routine testing.
3. If the bacteriological test reveals the presence of more than 10 total coliforms, but no *E.coli*, in a 100 mL sample, the drinking water is considered **substandard** but not to pose an immediate health risk. Disinfection of the water source should be recommended to the owner. Retesting should be carried out following disinfection of the water source. Until disinfection is carried out and retest results are known, the water may be boiled before being consumed or an alternative safe source of drinking water may be used.
4. If the bacteriological test reveals the presence of *E.coli*, the drinking water is considered **unsatisfactory** and unsafe for drinking. It is recommended that the drinking water be boiled and that corrective action be taken to deal with fecal contamination entering the well. Retesting should be carried out following appropriate corrective action.
5. Reporting of the results will be carried out in accordance with the provincial document "*Reporting of Bacteriological Results from Private Water Supplies*".

Rev: April 9, 2002

APPENDIX C

EXAMPLES OF POTENTIAL MITIGATIVE MEASURES

1. Larger lot sizes to reduce the concentration of withdrawals
2. Smaller total number of lots to reduce the volume of groundwater withdrawals over the proposed development area.
3. Development of alternative water sources.
4. Communal supply with water treatment (operated according to “Development Agreement” and conditions set out).
5. Designation of subdivision and individual lots to optimize groundwater recharge.
6. Minimum setback requirement of wells from wetlands, streams, or salt water.
7. Designation of important recharge areas as green space.
8. Development of short- or long-term monitoring plan, including specific “triggers” for a contingency plan to prevent well interference, stream flow depletion, sea water intrusion, or other adverse effects.
9. Development of contingency plans to deal with validation and resulting of well interference and other claims. For example, if the development impacts off-site existing wells, the developer may be required to take corrective action (e.g. replace wells, deepen wells, lower pump settings, install storage, etc.)
10. Restrictions on non-consumptive water use (e.g. controls on open-loop groundwater heat pumps to minimize well interference effects).
11. Water-conservation measures in subdivision homes, such as low-flow showers heads, ultra-low-flow toilets, water-efficient appliances (e.g. front loading washers), water metering at homes, etc.
12. Recommendations for wellhead-protection measures

CREDITS

This document follows closely the Halifax (Nova Scotia) Regional Municipality document *Guidelines for Groundwater Assessment and Reporting*, September 2006.

Other documents reviewed and relied upon were:

- Town of Hampton, New Brunswick, *Water Supply Assessment Guidelines for Subdivisions Services by Individual Wells*, March 2008
- Ministry of Environment and Energy, Province of Ontario, *Procedure D-5-5, Technical Guideline for Private Wells; Water Supply Assessment*, August 1996.
- Private Water Wells, sections 800.0 to 805.0, *Alberta Water Act*, June 1999

Mr. David McFarlane, Principal Senior Hydrogeologist, Stantec Inc., Dartmouth, Nova Scotia, and Ms. Sara Ryan, Hydrogeologist with Golder Associates, Ottawa, Ontario, provided invaluable information for this document.

These guidelines maybe revised at any time.