Draft Report: Drilled Well Database Evaluation and Correction

103064.00 ● Final Report. ● January 2012

Prepared for:

Newfoundland Labrador

Department of Environment and Conservation, Water Resources Management Division

Prepared by:

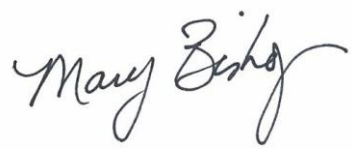
CBCL LIMITED
Consulting Engineers

Draft Report	M. Bishop	04/22/11		
Final Report	M. Bishop	01/10/12		
Issue or Revision	***Reviewed By:***	***Date:***	***Issued By:***	***Date:***

CBCL LIMITED
Consulting Engineers
ISO 9001
Registered Company

Signed and Sealed:

Approved For Final Issue By:



Contents

Appendices

List of Figures

List of Tables

EXECUTIVE SUMMARY

CBCL Limited was retained by the Newfoundland and Labrador Department of Environment and Conservation (DOEC) to review and update the province's Drilled Well Database. This revision process included rigorous evaluation and modification of the current database, resulting in a high-quality, coherent structure, including greatly improved location and lithology fields. The database has been prepared for convenient, accurate, and efficient access by government, industry, and the general public.

Each drilled well record was associated with the appropriate Local Government Identification number (LGID) using existing coordinate data or the community name listed in the record. Well records lacking coordinates were then assigned the centroid coordinate of the associated LGID. A new field was created to indicate whether the coordinates for a given record were assigned using a map reference, a handheld GPS unit, or an LGID centroid.

Descriptions of soil and rock cuttings provided by the well driller were edited using batch techniques, followed by manual checking of each of the 18,882 records. Geological descriptions were recoded to match the codes established by the Newfoundland and Labrador Department of Environment and Conservation (DOEC). Existing data had been stored as a single text string; this text string was sorted into separate fields showing the depth and description for the first three units encountered. The majority of records (77%) contained geological descriptions for three or fewer strata.

The name of the well owner was sorted into first and last name fields to allow for rapid identification of the original well owner by DOEC. Institutional owners were placed in the last name field. Driller comments in the well status field were separated to allow for rapid sorting of wells by status, and the water use field was edited for consistency to allow for sorting of the data by user type.

The updated geodatabase contains 51 fields. Population of the coordinate fields increased from 25% to 91%, and a total of 3388 geology codes were updated. As over 57% of the coordinates in the revised database are based on LGID centroids, the accuracy of most record locations is limited to 1000 metres or greater, and each LGID centroid contains a stacked group of well records for the area. Domestic wells accounted for the majority of wells (71%). Three driller license numbers together represented 58% of all wells recorded in the database. Well depths were generally between 31 and 76 metres, with the depth to bedrock generally falling between 2.1 and 6.7 metres. Static water levels were available for 4151 wells, and generally fell in the range 3 to 6 metres below the ground surface. Airlift yields commonly fell in the range 2.0 to 23 L/min, with a median rate of 9 L/min, and selected yields exceeding 100 L/min.

CHAPTER 1 INTRODUCTION

CBCL Limited was retained by the Newfoundland and Labrador Department of Environment and Conservation (DOEC) to review and update the province's Drilled Well Database. This revision process included rigorous evaluation and modification of the current database, resulting in a high-quality, coherent structure, including greatly improved location and lithology fields. The database has been prepared for convenient, accurate, and efficient access by government, industry, and the general public.

1.1 Existing Database

The existing provincial database contained 18,882 records in 68 different data fields. The population rate of those fields ranged from 100.0 to 0.6%. The database was built using information provided by licensed water well drillers and DOEC inspectors. New data is recorded manually on a Drilled Well Record and transmitted to DOEC for input into the provincial database. The earliest year recorded in the dataset is 1951. DOEC identified a need to update the database structure, reformat database fields for consistency, and fill in data gaps where possible. Effort was focused on assigning and confirming coordinates for each record, and on parsing and completing the lithology fields.

1.1.1 History of the Drilled Well Database

The following brief history of the development of the Drilled Well Database was provided by DOEC and provides a useful context for the review and for future users of the database.

- *In 1983 the Well Drilling Act and the Regulations under the Act were introduced. One of the key components of the Act was that all water well drillers in the Province were required to be licensed and also submit a Water Well Record Form for every well drilled in the Province on a regular basis.*
- *After the implementation of the Act the Department used information from the files of well drillers, consulting firms and government records to compile information on approximately 5,000 wells for the period 1950 to 1983. These records contain only basic information such as name, address and well depth but not map coordinates.*
- *As part of the implementation of the Regulations a Water Well Inspector was hired and the Water Well Record Form was developed. Subsequently, well records after 1984 contain much more information on each well such as well construction details and lithology.*
- *Between 1984 and 1990 a commercial groundwater software package called WELLCORR was used to enter and analyze the information from these forms. Since that time the*

database has passed through several transformations that include dBase III and IV, Microsoft Access and currently an Enterprise Oracle database with a supporting Intranet web application for data input and reporting.

- *Each year from 1984 to 1997 the Water Well Inspector would select a regionally representative subset of records for inspection. During this period about 7,900 wells were drilled and 3,800 were inspected (48%).*
- *The inspection process itself was a thorough procedure but one of the key items was that map coordinates were collected for each inspected well. From 1987 to 1992 coordinates were taken by reading the location from 1:50,000 topographic map sheets. In 1992 a portable GPS unit was acquired and all points collected since then have been collected in this manner. The Water Well Inspector continued to record coordinate in UTM but for about 8% of wells no UTM zone was recorded.*
- *At some point between 1992 and 1997 the GPS used by the Water Well Inspector was switched from NAD27 to NAD83 but the exact date of the changeover is unknown. The change from NAD27 to NAD83 can result in coordinate shifts of up to 200m. Between 1997 and 2003 about 2,500 wells were drilled and none of these have coordinate information.*
- *In 2004 a program was started where each licensed well driller was supplied with a handheld GPS unit and were required to record the location of each well in Degrees, Minutes and Decimal seconds. The program has been successful, and between 2005 and 2009, of the 2,300 wells drilled only 17% do not have coordinates.*

1.2 Goals and Objectives

The goal of this work was to produce a streamlined body of information that could be incorporated into a geodatabase used to interpret stratigraphic and hydrogeological information for a given map area. This work included the following objectives:

- Review and evaluate all data fields in the current database,
- Review, evaluate and edit or add location information for each well,
- Evaluate and edit lithology information for each well,
- Edit the database for consistency, completeness, and supplement with additional information where possible,
- Provide an updated Drilled Well database in MS Access format, and
- Provide a brief report describing the database improvements and a summary of the database content.

CHAPTER 2 METHODOLOGY

2.1 Review and Evaluation of Database Fields

Summary statistics were generated for existing well records to determine the number of fields populated (Table 2.1).

Table 2.1. Existing Database Fields and Field Population Summary (n = 18,882)

Field No.	Field Name	Populated Entries	Percentage Populated
1	Well_id	18882	100
2	Well_number	18877	100
3	Map_number	2951	16
4	Nad	0	0.0
5	Utm_zone	4346	23
6	Utm_northing	4657	25
7	Utm_easting	4642	25
8	Well_owner	18503	98
9	Town	18878	100
10	Community_index_No	1	0.0
11	Address	9679	51
12	Postal_code	1622	8.6
13	Static_water_level	4151	22
14	Well_depth	18503	98
15	Yield	16825	89
16	Drawdown	10849	57
17	Current_well_status	10206	54
18	Depth_water_found	7475	40
19	Zone1_depth	4539	24
20	Zone1_yield	4554	24
21	Zone2_depth	1403	7.4
22	Zone2_yield	1391	7.4
23	Zone3_depth	315	1.7
24	Zone3_yield	315	1.7
25	Zone4_depth	64	0.3
26	Zone4_yield	65	0.3

Table 2.1. Existing Database Fields and Field Population Summary (n = 18,882)

Field No.	Field Name	Populated Entries	Percentage Populated
27	Water_use	15036	80
28	Water_type	10656	56
29	Screen_information	1844	10
30	Lithology_listing	15144	80
31	Finished_as_required	993	5.3
32	Depth_to_bedrock	5247	28
33	Drive_shoe	5431	29
34	Abandoned	805	4.3
35	Test_duration	7539	40
36	Pump_test_rate	4341	23
37	Chem_sample_take	15205	81
38	Casing_type	5672	30
39	Casing_length	16434	87
40	Casing_thickness	4422	23
41	Casing_diameter	5143	27
42	Grout_used	4889	26
43	Grout_type	932	4.9
44	Grout_start_depth	688	3.6
45	Grout_end_depth	880	4.7
46	Overflow_casing	3011	16
47	Overflow_rate	114	0.6
48	Driller_licence_no	17696	94
49	Type_of_work_done	5801	31
50	Date_drilled	18243	97
51	Drilling_method	5786	31
52	Owner_available	519	3
53	Problem_code	196	1.0
54	Remarks	2155	11
55	Lat_deg	2013	11
56	Lat_min	2012	11
57	Lat_sec	2009	11
58	Long_deg	2012	11
59	Long_min	2008	11
60	Long_sec	2007	11
61	Lat_dd	2004	11
62	Long_dd	2004	11
63	Modified_by	3989	21
64	Modified_date	3989	21
65	Rec_pump_type	2860	15
66	Rec_intake_setting	1453	7.7
67	Rec_pump_rate	1168	6.2
68	Pump_test_method	3028	16

Many fields were relatively unpopulated. These fields and those that were deemed to be of low utility to database users were identified for archiving to a relational database. Table 2.2 shows 29 fields that were archived and omitted from the updated database. Archived fields are accessed by linking the new database to these fields using the Well ID.

Table 2.2. Deleted Fields (Information to be stored in the detailed well record only)

Field No.	Field Name	Populated Entries	Percentage Populated
3	Map_number	2951	15.63
4	Nad	0	0.00
5	Utm_zone	4346	23
6	Utm_northing	4657	25
7	Utm_easting	4642	25
10	Community_index_No	1	0.01
12	Postal_code	1622	8.59
29	Screen_information	1844	9.77
31	Finished_as_required	993	5.26
33	Drive_shoe	5431	28.76
34	Abandoned	805	4.26
35	Test_duration	7539	39.93
37	Chem_sample_take	15205	80.53
38	Casing_type	5672	30.04
40	Casing_thickness	4422	23.42
42	Grout_used	4889	25.89
43	Grout_type	932	4.94
44	Grout_start_depth	688	3.64
45	Grout_end_depth	880	4.66
46	Overflow_casing	3011	15.95
47	Overflow_rate	114	0.60
49	Type_of_work_done	5801	30.72
51	Drilling_method	5786	30.64
52	Owner_available	519	2.75
53	Problem_code	196	1.04
65	Rec_pump_type	2860	15.15
66	Rec_intake_setting	1453	7.70
67	Rec_pump_rate	1168	6.19
68	Pump_test_method	3028	16.04

Table 2.3 shows the fields that were targeted for detailed editing, parsing, and formatting. The field name “Address” was changed to “Owner_Address”. The data in these fields is dependent on the information provided by the driller, and cannot be improved without a field survey of each individual well. The data were checked to ensure that values fall within expected ranges.

Table 2.3. Fields Targeted for Editing

Field No.	Field Name	Populated Entries	Percentage Populated	Comment
27	Water_use	15036	79.63	This field was checked for consistency. Blank records were populated as information and time permitted.
30	Lithology_listing	15144	80.20	Database parsing and sorting was used to generate several new fields for the lithology and depth. Geological terminology was checked and modified for consistency.
55	Lat_deg	2013	10.66	Populated using GIS techniques and consolidated.
56	Lat_min	2012	10.66	
57	Lat_sec	2009	10.64	
58	Long_deg	2012	10.66	
59	Long_min	2008	10.63	
60	Long_sec	2007	10.63	
61	Lat_dd	2004	10.61	Blank records were populated using available GIS techniques.
62	Long_dd	2004	10.61	

Attention was focused on providing and checking coordinate information for each record. Missing coordinates were set equal to the centroid of the LGID for the community indicated in the existing well record. Coordinates were supplied for all locations in decimal degrees and degree-minute-second formats. Much of the remaining effort was directed towards creating consistency and accessibility within the lithology fields of the database. A new field for the georeferencing (coordinate assignment) method was added, providing an indication of the relative accuracy of the coordinates for each well record. Lithology information was parsed into individual fields to provide practical and consistent access to depth and lithological summaries for a given area.

Other updates to the database included:

1. All field titles (column headings) were converted to upper case.
2. The Local Government Identification (LGID) number was linked to all records. Links to towns were based on the current municipality name where applicable. For example, the seven communities that make up Conception Bay South received the same code.
3. Geological terms were standardized (e.g. abbreviations for gravel were changed to "GVL" for all occurrences as either a noun or an adjective). Descriptions were recoded based on established abbreviations.
4. Geological data were separated into three distinct fields for lithological description and three fields for depth of unit. Any remaining data was grouped into a final text-string field.
5. The field "Current_well_status" was parsed into two fields: (1) CURRENT_WELL_STATUS (a code for abandoned, active, etc.) and (2) CURRENT_WELL_COMMENTS (e.g. saline water).
6. Abbreviations in the fields "Water_use" and "Water_type" were replaced with full-text descriptions.
7. The field "Well_owner" was parsed into: (1) FIRST_NAME, and (2) LAST_NAME. Agency or company names were stored in the LAST_NAME field. This step is expected to improve search-ability of the database by internal government users.

8. Some fields were archived based on redundancy, low utility, and/or low population rates.
9. All recoded and/or edited fields were compared to the original database for quality control.
10. Recommendations were provided for the format of data collection (provided in Chapter 4).

2.2 Local Government Identification Number (LGID)

LGID data are assigned by the Department of Municipal Affairs, and consist of a four digit code for each community, town, city, or local service district (LSD) in Newfoundland and Labrador. GIS mapping is available for the administrative boundary of each LGID. The new field "LGID" was populated with the LGID for each community listed in the "Town" field of the existing database. The LGID dataset used for this project was obtained from the provincial Department of Municipal Affairs, Engineering Division. The dataset is considered to be under development and may contain errors and/or omissions. The data nevertheless served as a means of providing approximate location information where this data was lacking (Section 2.3). The LGID code was linked, were possible, to smaller communities that were incorporated into one larger community. For example, the Town of Conception Bay South consisted of eight smaller communities before amalgamation: Topsail, Chamberlains, Maunels, Long Pond, Foxtrap, Kelligrews, Upper Gullies and Seal Cove.

2.3 Location and Identification Data

Location information was generated for 57% of the existing data set (~10 700 records). Records lacking coordinate information were assigned the coordinates of the centroid of the community where the well was drilled. Community centroids were based on the associated LGID. The accuracy associated with this method depended on the size of each administrative boundary. A field showing the georeferencing method was generated to provide an indication of the relative accuracy of each well's coordinates. Coordinates based on the LGID method provide an estimated accuracy ranging from 0.6 to 12.4 kilometres, and an average accuracy of 2.7 kilometres.

Prior to 1992 coordinate information (when provided by the driller) was generated using a 1:50 000 UTM map reference. Coordinates were generally provided in UTM format but were in some cases recorded using an older Military Grid. The accuracy of map-generated coordinates varies according to the level of detail used by the driller, but is expected to range from 100 to 1000 metres. The province spans UTM zones 20, 21, and 22.

Beginning in 1992 DOEC began providing handheld GPS devices to drillers and requiring that well location coordinates be recorded. The UTM format was used until 1995. The accuracy of the GPS network was restricted to 100 metres until 2000. GPS coordinates collected after 2000 are expected to show an accuracy of 15 metres or better. GPS coordinates collected after 2000 were provided in degree-minute-decimal-seconds format (DD MM SS.SS).

Mapping of the completed geodatabase revealed coordinate errors for some records. Coordinates for these records were either in a format that could not be determined, contained transcribing errors, or produced an off-shore location. Coordinates requiring analysis on a case by case basis were flagged in

the COORD_METHOD field with the modifier “check”. It is anticipated that these records will be individually checked against manual records and corrected before the database is released to the public.

2.4 Lithology Data

Lithology data were listed in the existing database as a single field. Users of the database were required to access lithology data for each field manually before compiling or analyzing data for a given area. To improve access to depth and descriptions for each unit the dataset was parsed. The parsed data allow for separation of geological descriptions and the associated depth of each unit. Six new fields were created to accommodate this data:

- STRAT1
- STRAT2
- STRAT3
- DEPTH1
- DEPTH2
- DEPTH3

In most cases (77% of records) there were three or fewer strata; 60% of records contained two strata. The original text string data were retained in the “LITHOLOGY” field used in the original database. Data had been entered in varying orders and formats (e.g. “1 RED TPSL”, “RED TPSL 001”) which in some cases required manual sorting and checking. For example, 777 records in the “STRAT1” field were modified manually. The original dataset contained 3,738 records with no data in the “Lithology” field; the remaining 15,144 records showed a description for a least one geologic unit.

The terms used for the geologic unit, colour and descriptors were checked against the standardized list of permitted abbreviations. Terms that varied from the standard lists were checked manually and then replaced automatically. The resulting revised database contains only terms from the standardized list.

An additional field (STRATA) was created to indicate the number of distinct geologic units / cutting types described by the driller. Where more than 5 units were reported, the actual number was not determined, and the value was set to “9”.

Depths listed by the driller in the lithology field were checked against the “WELL_DEPTH” field, the total depth of the well reported by the driller. Discrepancies were identified, but the data were not modified as it was not possible to determine from the dataset which value was correct. With manual checking against the original well record forms it may be possible to perform some corrections.

2.5 Well Owner

The existing database contained the full name of the well owner at the time of drilling, stored in the “Well_owner” field. Data in this field was parsed to separate first and last names, and to allow for identification of institutional well owners. The new fields “FIRST_NAME” and “LAST_NAME” were created to replace the “Well_owner” field. Institution names were stored in the “LAST_NAME” field.

2.6 Current Well Status and Well Use

The status of the well was indicated for approximately half of the wells in the existing dataset, stored in the “Current_well_ status” field. This field contained a status code to indicate whether the well was

active (water supply), abandoned, a test hole, or an observation hole. The field was also used to record additional comments from the driller, such as “deepened”, “flowing well”, or “insufficient supply”.

Driller comments were parsed into the new field “CURRENT_WELL_COMMENTS”. The range of entries in the revised “CURRENT_WELL_STATUS” was thus reduced to a range of 4 possibilities. The revised CURRENT _WELL_STATUS field provides opportunities for spatial analysis and further filtering of the data (e.g. distribution and occurrence of abandoned wells).

Codes intended for the WATER_USE field were in some cases entered into the CURRENT_WELL_STATUS field and vice versa. These fields were cross-checked and updated, allowing for information to be moved to the correct field. There were two unknown codes in the WATER_USE field (OT, PU; 5 records), and seven unknown codes in the WATER_USE field (Ch, cl, ge, GR, hu, PA, SC; 15 records).

2.7 Municipal Water Supply

The “Water_use” field in the existing database contained records for 560 wells used as central water supplies. This data was cross-referenced with the “OWNER_ADDRESS” and “LAST_NAME” fields to check for additional municipal supplies. The “SUPPLY” field was created to show 1125 wells that appear to be owned by local government.

CHAPTER 3 DATABASE SUMMARY

3.1 Revised Database

The original drilled well database contained 68 data fields. The revised database contains 51 fields. The field names, applicable measurement units, and a full text explanation are provided in Table 3.1.

Tale 3.1. Field Names and Explanations

Field No.	Field Name	Units	Full Text Description
1	WELL_ID		Unique well identification number; used to access related databases of chemistry, archived data.
2	WELL_NUMBER		Original well identification number assigned by driller.
3	FIRST_NAME		First name or initials of well owner.
4	LAST_NAME		Last name or organization name of well owner.
5	OWNER_ADDRESS		Address of owner as of drilling date.
6	TOWN		Nearest community or town.
7	LGID		Local government identification number.
8	LGID_NAME		Local government identification name.
9	LAT_DD	degrees	Latitude in decimal degrees.
10	LONG_DD	degrees	Longitude in decimal degrees.
11	COORD_METHOD		Method of assigning coordinates to well; each method has an associated accuracy.
12	CURRENT_WELL_STATUS		Indicates if well is in use.
13	CURRENT_COMMENT		Provides additional information on well use, driller labels, and field observations.
14	STATIC_WATER_DEPTH	metres below ground surface	Static water level as measured by driller upon completion of well.
15	WELL_DEPTH	metres below ground surface	Total depth of well.
16	DEPTH_TO_BEDROCK	metres below ground surface	Thickness of unconsolidated material.
17	CASING_LENGTH	metres	Length of casing installed by driller.
18	SUPPLY		Indicates whether the well is used for municipal supply.

Tale 3.1. Field Names and Explanations

Field No.	Field Name	Units	Full Text Description
19	COLOR1		Colour of primary geologic unit.
20	STRAT1		Driller's description of first geologic unit encountered.
21	DEPTH1	metres below ground surface	Depth from ground surface to base of first geologic unit.
22	STRAT2		Driller's description of second geologic unit encountered.
23	DEPTH2	metres below ground surface	Depth from ground surface to base of second geologic unit.
24	STRAT3		Driller's description of third geologic unit encountered.
25	DEPTH3	metres below ground surface	Depth from ground surface to base of third geologic unit.
26	LITHOLOGY		Text string description and depths of all geologic units, including any remaining (deeper) geologic units.
27	WATER_USE		Intended water use (facility type) as of drilling date.
28	WATER_TYPE		Taste and odour characteristics of water as determined at time of drilling.
29	DATE_DRILLED	MM/DD/YYYY	Month, day and year that well was drilled.
30	DRILLER_LICENSE_NO		Driller license code, indicating name and license number of drilling contractor.
31	STRATA		Number of distinct geologic units reported by driller.
32	CASING_DIAMETER	millimetres	Casing diameter.
33	ZONE1_D1	metres below ground surface	Depth of first water bearing / producing zone encountered.
34	ZONE1_Y1	litres per minute	Driller's estimate of yield of first water bearing / producing zone encountered.
35	ZONE2_D2	metres below ground surface	Depth of second water bearing / producing zone encountered.
36	ZONE2_Y2	litres per minute	Driller's estimate of yield of second water bearing / producing zone encountered.
37	ZONE3_D3	metres below ground surface	Depth of third water bearing / producing zone encountered.
38	ZONE3_Y3	litres per minute	Driller's estimate of yield of third water bearing / producing zone encountered.
39	ZONE4_D4	metres below ground surface	Depth of fourth water bearing / producing zone encountered.
40	ZONE4_Y4	litres per minute	Driller's estimate of yield of fourth water bearing / producing zone encountered.
41	YIELD	litres per minute	Yield of well as determined by driller at time of drilling.

Tale 3.1. Field Names and Explanations

Field No.	Field Name	Units	Full Text Description
42	DEPTH_WATER_FOUND	metres below ground surface	Driller's estimate of depth of first or primary water bearing / producing zone encountered.
43	DRAWDOWN	metres below ground surface	Difference between static water level and water level while pumping.
44	LAT_DEG	degrees	Latitude degree field (DD.MM.SS.SS format)
45	LAT_MIN	minutes	Latitude minute field (DD.MM.SS.SS format)
46	LAT_SEC	seconds	Latitude seconds field (DD.MM.SS.SS format)
47	LONG_DEG	degrees	Longitude degree field (DD.MM.SS.SS format)
48	LONG_MIN	minutes	Longitude minute field (DD.MM.SS.SS format)
49	LONG_SEC	seconds	Longitude seconds field (DD.MM.SS.SS format)
50	MODIFIED_BY		DOEC personnel who entered data for this record.
51	MODIFIED_DATE		Date record was entered into this database.

Codes were, where possible and efficient, replaced by full text. Abbreviations and full text definitions used in the "CURRENT_WELL_STATUS" field are shown in Table 3.2a. Abbreviations and full text definitions used in the "WATER_USE" field are shown in Table 3.2b.

Table 3.2a. Current Well Status Code Definitions

Code	Explanation
AB	Abandoned
OB	Observation Hole
TH	Test Hole
WS	Water Supply

Table 3.2b. Well Use Code Definitions

Code	Explanation
AB	Abandoned
CO	Commercial
DO	Domestic
HP	Heat Pump
IN	Industrial
OB	Observation Hole
MU	Municipal
PS	Public Supply
ST	Stock

Abbreviations and full text definitions for geological descriptions ("STRAT1", "STRAT2", "STRAT3", and "LITHOLOGY" fields) are shown in Table 3.3. The colour abbreviation "PURP" was a new addition, used in one record in the database.

Table 3.3. List of Geological Abbreviations

Colours					
BLCK	black	GREN	green	RED	Red
BLGY	blue-grey	GREY	grey	WHIT	White
BLUE	blue	PURP	purple	YLLW	Yellow
BRWN	brown				
Geologic Material					
BLDR	boulders	GRVL	gravel	QRTZ	Quartz
BSLT	basalt	GRWK	greywacke	QSND	Quartzite
CGVL	coarse gravel	GYPS	gypsum	QTZ	Quartz
CHRT	chert	HPAN	hardpan	ROCK	Rock
CLAY	clay	IRFM	iron formation	SAND	Sand
CONG	conglomerate	LMSN	limestone	SHLE	Shale
CSND	coarse sand	MARL	marl	SHST	Schist
DLMT	dolomite	MGVL	medium gravel	SILT	Silt
DLSN	dolostone	MRBL	marble	SLTS	Siltstone
FGVL	fine gravel	MSND	medium sand	SLTE	Slate
FILL	fill	MUCK	muck	SNDS	Sandstone
FLDS	feldspar	OBDN	overburden	SPST	Soapstone
FLNT	flint	PEAT	peat	STNS	Stones
FSND	find sand	PGVL	pea gravel	TILL	Till
GNIS	gneiss	PRDG	previously dug or bored	TPSL	Topsoil
GRNT	granite	PRDR	previously drilled	UNKW	Unknown
GRSN	greenstone			WDFR	wood fragments
Descriptive Terms					
CGRD	coarse-grained	FOSS	fossiliferous	SHRP	Sharp
CLN	clean	GVLY	gravelly	SLTY	Silty
CLYY	clayey	HARD	hard	SNDY	Sandy
CMTD	cemented	LIMY	limy	SOFT	Soft
CRYS	crystalline	LOOS	loose	STKY	Sticky
DKCL	dark-coloured	LTCL	light-coloured	STNY	Stony
DNSE	dense	LYRD	layered (streaked)	THIK	Thick
DRTY	dirty	MGRD	medium-grained	THIN	Thin
DRY	dry	PCKD	packed	VERY	Very
FCRD	fractured (broken)	PORS	porous	WBRG	water-bearing
FGRD	fine-grained	SHLY	shaley	WTHD	Weathered

Upon completion of revisions the database was populated as shown in Table 3.4. Population of the latitude/longitude fields increased from 11% to 91%, and includes data in the decimal-degrees format for improved accuracy and ease of record keeping. A total of 17,255 records were populated but the remaining 1,627 records could not be associated with an LGID code. The majority of unpopulated LGID codes are assumed to be located in remote areas (e.g. cabins) or in Labrador. There was no LGID for many communities (including larger communities) in Labrador.

Table 3.4. Fields in Revised Database and Population

Field No.	Field Name	Populated Entries	Percentage Populated
1	WELL_ID	18882	100%
2	WELL_NUMBER	18877	99.97%
3	FIRST_NAME	13825	73%
4	LAST_NAME	15113	91%
5	OWNER_ADDRESS	9679	51%
6	TOWN	18878	99.98%
7	LGID	18810	99.62%
8	LGID_NAME	16830	89%
9	LAT_DD	17255	91%
10	LONG_DD	17225	91%
11	COORD_METHOD	18882	100%
12	CURRENT_WELL_STATUS	9771	52%
13	CURRENT_COMMENT	1225	6%
14	STATIC_WATER_DEPTH	4151	22%
15	WELL_DEPTH	18503	98%
16	DEPTH_TO_BEDROCK	5247	28%
17	CASING_LENGTH	16434	87%
18	SUPPLY	1125	6%
19	COLOR1	7828	41%
20	STRAT1	18878	99.98%
21	DEPTH1	14795	78%
22	STRAT2	17224	91%
23	DEPTH2	13266	70%
24	STRAT3	2099	11%
25	DEPTH3	2103	11%
26	LITHOLOGY	15143	80%
27	WATER_USE	15036	80%
28	WATER_TYPE	10656	56%
29	DATE_DRILLED	18243	97%
30	DRILLER_LICENSE_NO	17696	94%
31	STRATA	18870	99.94%
32	CASING_DIAMETER	5141	27%
33	ZONE1_D1	4539	24%
34	ZONE1_Y1	4554	24%
35	ZONE2_D2	1403	7%
36	ZONE2_Y2	1391	7%
37	ZONE3_D3	315	2%
38	ZONE3_Y3	315	2%

Table 3.4. Fields in Revised Database and Population

Field No.	Field Name	Populated Entries	Percentage Populated
39	ZONE4_D4	64	0.3%
40	ZONE4_Y4	65	0.3%
41	YIELD	16825	89%
42	DEPTH_WATER_FOUND	7475	40%
43	DRAWDOWN	10849	57%
44	LAT_DEG	17257	91%
45	LAT_MIN	17257	91%
46	LAT_SEC	17257	91%
47	LONG_DEG	17257	91%
48	LONG_MIN	17257	91%
49	LONG_SEC	17257	91%
50	MODIFIED_BY	3989	21%
51	MODIFIED_DATE	3989	21%

The number of records updated within the LITHOLOGY and STRAT fields is shown in Table 3.5. Codes updated for the colours green, brown, black, and white accounted for 1711 changes. Updated codes for the geology descriptions for overburden, shale, siltstone, and sandstone accounted for an additional 1366 changes, including 830 replacements for shale (SHLE). Changes to the codes for the terms fractured and loose accounted for 74 and 19 replacements respectively. A total of 3388 codes were updated.

Table 3.5 Changes to Lithology Fields in Revised Database

Corrected Code	Number of Changes
Colours	
BLCK	219
BRWN	845
GREN	491
WHIT	156
RED	1
GREY	68
PURP (New)	1
Geologic Material	
BLDR	29
BSLT	3
CHRT	6
CONG	4
DLSN	3
GNIS	1
GRNT	20
LMSN	16

Table 3.5 Changes to Lithology Fields in Revised Database

Corrected Code	Number of Changes
OBDN	215
SHLE	830
SLST	108
SLTE	42
SNDS	213
TPSL	17
UNKW	1
Descriptive Terms	
FCRD	74
LOOS	19
LYRD	1
PACK	1
SNDY	4

3.2 Well Coordinates

Addition of location information for each well record allows for map-based selection of the data using GIS filtering and spatial techniques. Users of the georeferenced data must, however, be aware that most records will be suitable only for more regional treatments of the data. As over 56% of the coordinates in the revised database are based on LGID centroids, the accuracy of most record locations is limited to 1000 metres or greater. In areas for which the geology is relatively uniform within a given LGID administrative boundary, the user may determine that this level of accuracy is adequate.

For work where more accurate mapping is required, the user can used the "COORD_METHOD" field to filter the data. For example, by selecting only those records showing a COORD_METHOD of "GPS" and drilling dates after 2000, the mapped records will show an accuracy of 15 metres or better. In some areas the density of these records will be sufficient to develop a more accurate conceptual model of hydrostratographic units.

When the geodatabase is plotted each LGID centroid shows a "stacked" group of wells. Table 3.6 shows the LGID centroid coordinates, the number of wells assigned to this centroid, and the LGID administrative boundary area. Table 3.6 also provides an approximation of the relative accuracy of well coordinates associated with each LGID. This estimate is equal to the radius of an assumed circular area for each LGID. For a more accurate assessment of the relative accuracy of coordinates associated with a given LGID the user should analyze the true LGID administrative boundary.

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
0	CARTWRIGHT	5	No Boundary			
0		2052	No Boundary			
20	ADMIRAL'S BEACH	14	25.5	2.9	47.0000	47.0000
35	ANCHOR POINT	9	2.4	0.9	51.2331	51.2331
65	BARACHOIS BROOK	13	No Boundary		48.4500	48.4500
85	APPLETON	12	6.2	1.4	48.9831	48.9831
100	AQUAFORTE	8	No Boundary		47.0000	47.0000
110	ARNOLD'S COVE	5	8.1	1.6	47.7500	47.7500
120	ASPEN COVE	14	No Boundary		49.4669	49.4669
125	AVONDALE	128	30.1	3.1	47.4169	47.4169
155	BADGER	18	1.7	0.7	48.9831	48.9831
165	NEW-WES-VALLEY	1	148.3	6.9	49.1169	49.1169
170	BAIE VERTE	19	401.1	11.3	49.9331	49.9331
180	BAINE HARBOUR	9	4.4	1.2	47.3669	47.3669
195	BARENEED	59	No Boundary		47.5831	47.5831
215	BARTLETT'S HARBOUR	1	No Boundary		50.9500	50.9500
240	BAULINE	91	16.5	2.3	47.7169	47.7169
245	BAY BULLS	159	31.0	3.1	47.3169	47.3169
251	BAY DE VERDE	53	13.1	2.0	48.0831	48.0831
260	BAY L'ARGENT	7	3.9	1.1	47.5500	47.5500
265	BAY ROBERTS	127	24.9	2.8	47.6000	47.6000
266	BAYTONA	41	15.1	2.2	49.3331	49.3331
268	BAY ST. GEORGE SOUTH	205	No Boundary		48.2000	48.2000
272	BEACHSIDE	12	2.4	0.9	49.6331	49.6331
280	BEAR COVE	8	No Boundary			
290	BEAU BOIS	6	No Boundary		47.1331	47.1331
305	BELLBURNS	4	9.5	1.7	50.3331	50.3331
315	BELLEORAM	3	No Boundary		47.5169	47.5169
330	BELLEVUE	19	No Boundary		47.6331	47.6331
332	BELLEVUE BEACH	7	No Boundary		47.6169	47.6169
335	HUMBER ARM SOUTH	9	66.2	4.6	49.0169	49.0169
340	BENOIT'S SIDING	3	No Boundary		47.8669	47.8669
345	BENTON	6	No Boundary		48.9000	48.9000
355	BIG BROOK	1	No Boundary		51.5169	51.5169
375	BIRCHY BAY	41	52.4	4.1	49.3500	49.3500
380	BIRCHY COVE	4	No Boundary		48.6000	48.6000
390	BIRD COVE	2	8.6	1.7	51.0500	51.0500
395	BISCAY BAY	3	No Boundary			
400	BISHOP'S COVE	15	1.7	0.7	47.6331	47.6331
405	BISHOP'S FALLS	22	27.2	2.9	49.0169	49.0169
425	BLACK DUCK BROOK-WINTERHOUSE	4	No Boundary		48.7000	48.7000
430	BLACK DUCK COVE	21	No Boundary		51.2000	51.2000
475	BLAKETOWN	45	No Boundary		47.4831	47.4831
485	BLOOMFIELD	105	No Boundary		48.3831	48.3831

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
490	BLOW ME DOWN	7	No Boundary		47.6000	47.6000
495	BLUE COVE	5	No Boundary		51.1000	51.1000
510	BOAT HARBOUR	19	No Boundary		47.4331	47.4331
520	BRISTOLS HOPE	47	No Boundary		47.7169	47.7169
525	BONAVISTA	51	33.1	3.2	48.6500	48.6500
546	BOSWARLOS	12	No Boundary		48.5669	48.5669
550	BOTWOOD	18	15.2	2.2	49.1500	49.1500
560	BOYD'S COVE	58	No Boundary		49.4500	49.4500
575	BRANCH	31	No Boundary		46.8831	46.8831
580	BRENT'S COVE	30	No Boundary		49.9331	49.9331
595	BRIDGEPORT	19	No Boundary		49.5500	49.5500
605	BRIG BAY	13	No Boundary		51.0669	51.0669
610	BRIGHTON	38	2.6	0.9	49.5500	49.5500
615	BRIGUS	59	11.3	1.9	47.5331	47.5331
616	BRIGUS JUNCTION	50	No Boundary		47.3831	47.3831
617	BRIGUS SOUTH	13	No Boundary		47.1169	47.1169
625	BRITANNIA	1	No Boundary		48.1500	48.1500
650	BROOKLYN	44	No Boundary		48.3831	48.3831
660	BROOKSIDE	3	No Boundary			
670	BROWN'S ARM	45	No Boundary		49.2500	49.2500
680	BRYANTS' COVE	28	No Boundary		47.6669	47.6669
685	BUCHANS	2	1.4	0.7	48.8169	48.8169
690	BUCHANS JUNCTION	5	No Boundary		48.8500	48.8500
710	BUNYAN'S COVE	60	No Boundary		48.4000	48.4000
720	BURGOYNE'S COVE	8	No Boundary		48.1831	48.1831
725	BURIN	8	35.0	3.3	47.0331	47.0331
740	BURLINGTON	2	4.1	1.1		
745	BURNSIDE-ST. CHADS	52	No Boundary		48.7169	48.7169
750	BURNT COVE-ST.MICHAEL'S-BAULINE EAST	12	No Boundary		47.2000	47.2000
775	BURNT ISLANDS	7	11.1	1.9	47.6000	47.6000
810	BUTTER COVE	17	No Boundary			
820	CALVERT	23	No Boundary		47.0500	47.0500
825	CAMPBELL'S CREEK	18	No Boundary		48.5169	48.5169
830	CAMPBELLTON	69	38.5	3.5	49.2831	49.2831
845	CANNING'S COVE	30	No Boundary		48.4500	48.4500
850	CAPE ANGUILLE	5	No Boundary		47.9000	47.9000
860	CAPE BROYLE	92	10.4	1.8	47.1000	47.1000
905	CAPE RAY	28	No Boundary		47.6331	47.6331
916	CAPE ST. GEORGE	71	34.6	3.3	48.4669	48.4669
935	CAPLIN COVE	12	No Boundary		48.0331	48.0331
945	CAPSTAN ISLAND	1	No Boundary		51.7169	51.7169
950	CARBONEAR	43	12.6	2.0	47.7331	47.7331
960	CARMANVILLE	26	43.9	3.7	49.4000	49.4000

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
985	CATALINA	10	No Boundary			
990	CAVENDISH	38	No Boundary		47.7169	47.7169
993	CENTREVILLE-WAREHAM-TRINITY	2	47.6	3.9	49.0169	49.0169
1010	CHANCE COVE	19	19.7	2.5	47.6831	47.6831
1020	CHANGE ISLANDS	78	5.4	1.3	49.6669	49.6669
1025	CHANNEL-PORT AUX BASQUES	13	No Boundary		47.5669	47.5669
1030	CHAPEL ARM	19	28.6	3.0	47.5169	47.5169
1040	CHARLESTON	23	No Boundary		48.3831	48.3831
1047	CHARLOTTETOWN	21	22.4	2.7	52.7669	52.7669
1050	CHURCHILL FALLS	2	No Boundary			
1055	CLARENVILLE	52	149.1	6.9	48.1669	48.1669
1060	CLARKE'S BEACH	84	12.5	2.0	47.5500	47.5500
1095	COACHMAN'S COVE	9	19.6	2.5		
1097	COAL BROOK	10	No Boundary		47.9331	47.9331
1100	COBB'S ARM	30	No Boundary		49.6169	49.6169
1105	CODROY	24	No Boundary		47.8831	47.8831
1114	COLD BROOK	28	No Boundary		48.6000	48.6000
1120	COLINET	25	6.1	1.4	47.2169	47.2169
1125	COLLIERS	77	29.0	3.0	47.8500	47.8500
1135	COME BY CHANCE	20	43.4	3.7		
1140	COMFORT COVE-NEWSTEAD	36	29.9	3.1	49.4000	49.4000
1140		3	No Boundary		49.4000	49.4000
1145	CONCEPTION BAY SOUTH	1376	61.4	4.4	47.5000	47.5000
1148	CONCEPTION HARBOUR	97	23.0	2.7	47.4331	47.4331
1150	CONCHE	18	9.8	1.8	50.8831	50.8831
1155	CONNE RIVER	25	No Boundary		47.8669	47.8669
1165	COOK'S HARBOUR	16	2.3	0.9	51.6000	51.6000
1195	CORMACK	111	129.3	6.4	49.3000	49.3000
1200	CORNER BROOK	76	155.7	7.0	48.9500	48.9500
1205	COTTLESVILLE	1	11.2	1.9	49.5000	49.5000
1210	COTTRELL'S COVE	17	No Boundary		49.4831	49.4831
1230	COW HEAD	2	17.3	2.3		
1235	COX'S COVE	9	6.9	1.5	49.1169	49.1169
1255	CROQUE	12	No Boundary		51.0669	51.0669
1275	CULLS HARBOUR	16	No Boundary		48.6831	48.6831
1280	CUPIDS	62	10.7	1.8	47.5500	47.5500
1305	CUSLETT	4	No Boundary		46.9669	46.9669
1315	DANIEL'S HARBOUR	10	8.6	1.7	50.2331	50.2331
1320		13	No Boundary			
1350	DEADMAN'S BAY	1	No Boundary			
1365	DEEP BIGHT	26	No Boundary		49.6669	49.6669
1380	DEER LAKE	18	82.4	5.1	49.1669	49.1669
1390	DIAMOND COVE	3	No Boundary		47.6169	47.6169

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
1395	DILDO	54	No Boundary		47.5669	47.5669
1440	DOYLES	21	No Boundary		47.8331	47.8331
1455	DUNFIELD	12	No Boundary		48.3500	48.3500
1460	DUNTARA	18	19.4	2.5	48.6000	48.6000
1490	EASTPORT	4	19.0	2.5	48.6500	48.6500
1496	EDDIES COVE	10	No Boundary		51.4169	51.4169
1510	ELLISTON	32	10.5	1.8	48.6331	48.6331
1515	EMBREE	22	18.4	2.4	49.3000	49.3000
1520	ENGLEE	2	30.2	3.1	50.7331	50.7331
1525	ENGLISH HARBOUR	10	No Boundary		48.3669	48.3669
1530	ENGLISH HARBOUR EAST	33	20.0	2.5	47.6331	47.6331
1545	EPWORTH-GREAT SALMONIER	6	No Boundary			
1575	FERMEUSE	7	41.1	3.6	46.9831	46.9831
1580	FERRYLAND	16	13.8	2.1	47.0331	47.0331
1605	FLAT BAY	15	No Boundary		48.4000	48.4000
1610	FLATROCK	218	19.2	2.5	47.7000	47.7000
1620	FLEUR DE LYS	5	41.7	3.6	50.1169	50.1169
1625	FLOWER'S COVE	31	8.9	1.7	51.3000	51.3000
1630	FOGO	109	6.2	1.4	49.7169	49.7169
1637	FOREST FIELD-NEW BRIDGE	6	No Boundary		47.1500	47.1500
1645	FORTEAU	2	7.7	1.6	51.4669	51.4669
1650	FORTUNE	7	53.7	4.1		
1655	FORTUNE HARBOUR	15	No Boundary		49.5169	49.5169
1665	FOX COVE-MORTIER	11	27.3	2.9	47.0831	47.0831
1675	FOX HARBOUR	38	21.6	2.6	47.3169	47.3169
1681	FOX ISLAND RIVER-POINT AU MAL	7	No Boundary		48.7000	48.7000
1700	FREDERICKTON	50	No Boundary		49.4331	49.4331
1710	FRENCHMAN'S COVE	6	76.4	4.9	47.2169	47.2169
1720	FRESHWATER	3	No Boundary		47.7500	47.7500
1750	GALLANTS	5	6.4	1.4	48.7000	48.7000
1755	GAMBO	13	101.3	5.7	48.7831	48.7831
1760	GANDER	25	108.7	5.9	48.9500	48.9500
1765	GANDER BAY NORTH	55	No Boundary		49.2831	49.2831
1775	GARDEN COVE	4	No Boundary		47.8500	47.8500
1780	GARNISH	7	45.6	3.8	47.2331	47.2331
1785	GASKIERS-POINT LA HAYE	1	24.8	2.8		
1807	GEORGES LAKE	18	No Boundary		48.7331	48.7331
1820	GEORGETOWN	14	No Boundary		47.5000	47.5000
1825	GILLAMS	6	6.7	1.5	49.0169	49.0169
1845	GLENBURNIE-BIRCHY HEAD-SHOAL BROOK	1	5.2	1.3	49.4500	49.4500
1855	GLENWOOD	17	6.8	1.5	48.9831	48.9831
1860	GLOVERS HARBOUR	15	No Boundary		49.4500	49.4500
1865	GLOVERTOWN	33	72.6	4.8	48.6831	48.6831

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
1885	GOOBIES	17	No Boundary		47.9331	47.9331
1905	GOOSE COVE EAST	4	No Boundary			
1910	GOOSEBERRY COVE	12	No Boundary			
1940	GRAND BANK	24	18.7	2.4	47.1000	47.1000
1950	GRAND BEACH	9	No Boundary		47.1331	47.1331
1960	GRAND FALLS-WINDSOR	1	76.1	4.9	48.9331	48.9331
1960	GRAND FALL-WINDSOR	85	No Boundary		48.9331	48.9331
1975	GRATE'S COVE	15	No Boundary		48.1669	48.1669
1980	GREAT BARASWAY	1	No Boundary		47.1331	47.1331
1985	GREAT BREHAT	9	No Boundary		51.4331	51.4331
1990	GREAT CODROY	11	No Boundary		47.8500	47.8500
2010	GREEN COVE	3	No Boundary		49.6331	49.6331
2015	GREEN'S HARBOUR	82	No Boundary		47.6500	47.6500
2030	GREEN ISLAND COVE	23	No Boundary		51.3831	51.3831
2040	GREENSPOND	7	2.8	0.9	49.0669	49.0669
2050	ST. LUNAIRE-GRIQUET	31	19.8	2.5	51.5169	51.5169
2070	GULL ISLAND	54	No Boundary			
2090	HAMPDEN	4	36.1	3.4	49.5500	49.5500
2095	HANT'S HARBOUR	10	34.0	3.3	48.0169	48.0169
2100	HAPPY ADVENTURE	3	10.1	1.8	48.6331	48.6331
2105		6	No Boundary			
2110	HARBOUR BRETON	4	15.0	2.2	47.4831	47.4831
2125	HARBOUR GRACE	89	35.9	3.4	47.7000	47.7000
2145	HARBOUR MAIN-CHAPEL'S COVE-LAKEVIEW	139	24.3	2.8	47.4331	47.4331
2150	HARBOUR MILLE-LITTLE HARBOUR EAST	16	No Boundary		47.5831	47.5831
2155	HARBOUR ROUND	42	No Boundary		49.9169	49.9169
2160	HARCOURT-MONROE-WATERVILLE	18	No Boundary		48.2000	48.2000
2165	HARE BAY	8	39.5	3.5	48.8500	48.8500
2170	HARRICOTT	4	No Boundary		47.1831	47.1831
2190	HARRY'S HARBOUR	14	No Boundary		49.7000	49.7000
2200	HATCHET COVE	8	No Boundary		48.0331	48.0331
2205	HAWKE'S BAY	6	49.9	4.0	50.6000	50.6000
2210	HAY COVE	8	No Boundary		51.6000	51.6000
2240	HEART'S CONTENT	4	72.3	4.8	47.8831	47.8831
2245	HEART'S DELIGHT-ISLINGTON	18	28.5	3.0	47.7669	47.7669
2250	HEART'S DESIRE	2	18.1	2.4	47.8169	47.8169
2265	HERMITAGE-SANDYVILLE	3	29.8	3.1	47.5331	47.5331
2270	HERRING NECK	13	No Boundary		49.6500	49.6500
2275	HIBBS COVE	12	No Boundary		47.6000	47.6000
2280	HICKMAN'S HARBOUR-ROBINSON BIGHT	4	No Boundary		0.0000	0.0000
2305	HILLVIEW	15	No Boundary		48.0331	48.0331

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
2305	HILLVIEW-ADEYTOWN-HATCHET COVE-ST. JONES WITHIN	5	No Boundary		48.0331	48.0331
2315	HODGE'S COVE	34	No Boundary		48.0169	48.0169
2320	HOLYROOD	143	134.4	6.5	47.3831	47.3831
2335	HOPEALL	19	No Boundary		47.6169	47.6169
2340	HOPEDALE	5	No Boundary			
2360	HORWOOD	24	No Boundary		49.4500	49.4500
2370	HOWLEY	8	21.1	2.6	49.1669	49.1669
2373	HUGHES BROOK	9	1.9	0.8	49.0000	49.0000
2380	HUMBER VILLAGE	19	No Boundary		48.9831	48.9831
2390	INDIAN COVE	2	No Boundary		49.6000	49.6000
2425	IRISHTOWN-SUMMERSIDE	14	12.1	2.0	48.9831	48.9831
2450	ISLE AUX MORTS	1	8.7	1.7	47.5831	47.5831
2470	IVANY COVE	5	No Boundary			
2475	JACKSON'S ARM	1	6.2	1.4	49.8669	49.8669
2480	JACKSON'S COVE-LANGDON'S COVE-SILVERDALE	17	No Boundary		49.5331	49.5331
2490	JAMESTOWN	17	No Boundary		48.4331	48.4331
2495	JEAN DE BAIE	5	No Boundary			
2530	JOB'S COVE	18	No Boundary		47.9831	47.9831
2535	JOE BATT'S ARM-BARR'D ISLANDS-SHOAL BAY	119	28.6	3.0	49.7169	49.7169
2565	KEELS	6	6.9	1.5	48.6000	48.6000
2570	KETTLE COVE	2	No Boundary			
2585	KING'S COVE	32	22.8	2.7	48.5669	48.5669
2595	KING'S POINT	5	46.9	3.9	49.5831	49.5831
2605	KINGSTON	5	No Boundary		47.8169	47.8169
2615	KIPPENS	35	14.9	2.2	48.5500	48.5500
2630	KNIGHTS COVE	2	No Boundary		48.5331	48.5331
2638	LABRADOR CITY	7	40.7	3.6		
2640	LADLE COVE	6	No Boundary		49.4669	49.4669
2675	LAMALINE	6	85.5	5.2	46.8669	46.8669
2677	LAMANCHE	3	No Boundary			
2680	LANCE COVE	8	No Boundary		47.6000	47.6000
2700	L'ANSE AU CLAIR	2	63.7	4.5		
2715	L'ANSE AU LOUP	9	3.5	1.1	51.5169	51.5169
2720	L'ANSE AUX MEADOWS	10	No Boundary			
2730	LARK HARBOUR	12	13.2	2.0	49.1000	49.1000
2735	LA SCIE	2	No Boundary		49.9500	49.9500
2740	LAURENCETON	37	No Boundary		49.2000	49.2000
2745	LAWN	1	3.2	1.0	46.9500	46.9500
2755	LEADING TICKLES	24	27.8	3.0	49.5000	49.5000
2765	LETHBRIDGE	134	No Boundary		48.3669	48.3669
2770	LEWIN'S COVE	6	6.7	1.5	47.0831	47.0831
2775	LEWISPORTE	46	36.5	3.4	49.2500	49.2500

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
2790	LITTLE BAY	2	1.8	0.7	49.6000	49.6000
2800	LITTLE BAY EAST	9	No Boundary		47.5500	47.5500
2805	LITTLE BAY ISLANDS	20	7.2	1.5	49.6500	49.6500
2825	LITTLE BURNT BAY	14	8.4	1.6	49.3500	49.3500
2830	LITTLE CATALINA	12	11.5	1.9	48.5500	48.5500
2860	LITTLE HARBOUR	10	No Boundary		49.6331	49.6331
2870	LITTLE HEARTS EASE	42	No Boundary		48.0169	48.0169
2882	LITTLE RAPIDS	29	No Boundary		48.9831	48.9831
2885	LITTLE ST. LAWRENCE	3	No Boundary		46.9331	46.9331
2915	LOCH LOMOND	15	No Boundary		47.8000	47.8000
2925	LODGE BAY	15	No Boundary			
2945	LOGY BAY-MIDDLE COVE-OUTER COVE	360	17.2	2.3	47.6331	47.6331
2954	LONG BEACH	8	No Boundary		47.9500	47.9500
2970	LONG HARBOUR-MOUNT ARLINGTON HEIGHTS	12	18.4	2.4	47.4331	47.4331
2985	LOON BAY	12	No Boundary		49.2669	49.2669
2995	LORD'S COVE	3	33.1	3.2		
3006	LOURDES	11	8.0	1.6	48.6500	48.6500
3010	LOW POINT	4	No Boundary		48.0500	48.0500
3030	LOWER ISLAND COVE	46	No Boundary		48.0000	48.0000
3040	LUMSDEN	8	21.9	2.6	49.3000	49.3000
3050	LUSHES BIGHT-BEAUMONT-BEAUMONT NORTH	9	No Boundary		49.6169	49.6169
3055	MCCALLUM	1	No Boundary		47.6331	47.6331
3065	MCIVERS	3	12.2	2.0	49.0831	49.0831
3075	MAIDSTONE	4	No Boundary		48.2000	48.2000
3085	MAIN BROOK	5	31.4	3.2	51.1831	51.1831
3101	MAINLAND	2	No Boundary		48.5669	48.5669
3105	MAKINSONS	57	No Boundary		47.4831	47.4831
3110	MAKKOVIK	5	No Boundary			
3115	MALL BAY	1	No Boundary		46.9831	46.9831
3145	MARKLAND	23	No Boundary		47.3831	47.3831
3150	MARY'S HARBOUR	6	No Boundary			
3155	MARYSTOWN	22	69.8	4.7	47.1669	47.1669
3165	MARYSVALE	40	No Boundary		47.5000	47.5000
3170	MATTIS POINT	5	No Boundary		48.4831	48.4831
3175	MEADOWS	10	4.1	1.1	48.9831	48.9831
3185	MELROSE	13	No Boundary			
3195	MICHAEL'S HARBOUR	9	No Boundary		49.3000	49.3000
3200	MIDDLE AMHERST COVE	2	No Boundary		48.5669	48.5669
3210	MIDDLE ARM	4	24.8	2.8	49.7000	49.7000
3240	MILLERTOWN	7	No Boundary		48.8169	48.8169
3245	MILLTOWN-HEAD OF BAY D'ESPOIR	7	27.3	2.9		

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
3255	MILLVILLE	16	No Boundary		47.8500	47.8500
3260	MILTON	4	No Boundary			
3275	MOBILE	33	No Boundary		47.2500	47.2500
3285	MONKSTOWN	1	No Boundary			
3295	MOORE'S COVE	2	No Boundary		49.5000	49.5000
3305	MORETON'S HARBOUR	45	No Boundary		49.5831	49.5831
3309	MORLEY'S SIDING	4	No Boundary		48.3169	48.3169
3335	MOUNT CARMEL-MITCHELLS BROOK-ST.CATHERINE'S	46	62.1	4.4	47.1500	47.1500
3335	NEW-WES-VALLEY	1	148.3	6.9	47.1500	47.1500
3340	MOUNT MORIAH	5	16.0	2.3	48.9669	48.9669
3345	MOUNT PEARL	54	15.4	2.2	47.5169	47.5169
3380	MUSGRAVE HARBOUR	13	71.7	4.8	49.4500	49.4500
3385	MUSGRAVETOWN	135	13.2	2.1	48.4000	48.4000
3390	NAIN	2	No Boundary			
3393	NAMELESS COVE	3	No Boundary			
3395	NEW BONAVENTURE	19	No Boundary		48.2831	48.2831
3405	NEW CHELSEA-NEW MELBOURNE-LEAD COVE-BROWNSDALE-SIBLE	48	No Boundary		48.0331	48.0331
3415	NEW HARBOUR	82	No Boundary		47.6000	47.6000
3435	NEW PERLICAN	2	27.6	3.0	47.9000	47.9000
3445	NEWMAN'S COVE	10	No Boundary		48.5831	48.5831
3463	NEWVILLE	12	No Boundary		49.5831	49.5831
3475	NIPPERS HARBOUR	2	No Boundary		49.8000	49.8000
3480	NODDY BAY	8	No Boundary		51.5831	51.5831
3485	NOELS POND	23	No Boundary		48.5669	48.5669
3490	NOGGIN COVE	27	No Boundary		49.4169	49.4169
3500	NORMAN'S COVE-LONG COVE	35	20.5	2.6	47.5669	47.5669
3505	NORRIS ARM	46	48.9	3.9	49.0831	49.0831
3510	NORRIS ARM NORTH	44	No Boundary		49.1169	49.1169
3515	NORRIS POINT	2	No Boundary		49.5169	49.5169
3520	NORTH BOAT HARBOUR	1	No Boundary			
3530	NORTH HARBOUR	13	No Boundary		47.8500	47.8500
3541	NORTH RIVER	67	4.6	1.2	47.5500	47.5500
3550	NORTH WEST BROOK	36	No Boundary		48.0169	48.0169
3555	NORTH WEST RIVER	3	2.4	0.9		
3560	NORTHERN ARM	16	28.3	3.0	49.1669	49.1669
3565	NORTHERN BAY	48	No Boundary			
3575	OCHRE PIT COVE	36	No Boundary		47.9169	47.9169
3585	O'DONNELLS	9	No Boundary		47.0669	47.0669
3590	OLD BONAVENTURE	17	No Boundary		48.2831	48.2831
3595	OLD PERLICAN	20	14.9	2.2	48.0831	48.0831
3600	OLD SHOP	30	No Boundary		47.5331	47.5331
3605	OPEN HALL-RED CLIFFE	33	No Boundary		48.5500	48.5500

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
3645	PACQUET	7	15.5	2.2	49.9831	49.9831
3655	PARADISE	694	31.5	3.2	47.5331	47.5331
3675	PARSON'S POND	3	16.9	2.3	50.0331	50.0331
3685	PASADENA	19	51.0	4.0	49.0169	49.0169
3690	PATRICK'S COVE-ANGELS COVE	6	No Boundary		47.0331	47.0331
3720	PERRY'S COVE	23	No Boundary		47.8000	47.8000
3750	PETLEY	6	No Boundary		48.1500	48.1500
3760	PETTY HARBOUR-MADDOX COVE	15	4.6	1.2	47.4669	47.4669
3765	PHILLIP'S HEAD	6	No Boundary		49.2331	49.2331
3773	PICCADILLY SLANT-ABRAHAM'S COVE	34	No Boundary		48.5500	48.5500
3779	PIDGEON COVE-ST. BARBE	10	No Boundary		51.2000	51.2000
3781	PIKE'S ARM	24	No Boundary		49.6500	49.6500
3785	PILLEY'S ISLAND	31	37.3	3.4	49.5169	49.5169
3790	PINES COVE	15	No Boundary		51.3669	51.3669
3795	PINWARE	8	No Boundary			
3800	PLACENTIA	13	59.8	4.4	47.2331	47.2331
3812	PLATE COVE EAST	17	No Boundary		48.5169	48.5169
3814	PLATE COVE WEST	27	9.1	1.7	48.5000	48.5000
3820	PLEASANTVIEW	9	No Boundary		49.3669	49.3669
3825	PLUM POINT	11	No Boundary		51.0669	51.0669
3830	POINT AU GAUL	1	4.0	1.1	46.8669	46.8669
3855	POINT LANCE	5	29.0	3.0	46.8169	46.8169
3860	POINT LEAMINGTON	34	26.9	2.9	49.3331	49.3331
3870	POINT OF BAY	27	24.3	2.8	49.2500	49.2500
3880	POINT VERDE	35	No Boundary		47.2331	47.2331
3890	POND COVE	5	No Boundary		51.1331	51.1331
3895	POOL'S COVE	16	1.4	0.7	47.6831	47.6831
3910	PORT ALBERT	4	No Boundary		49.5500	49.5500
3920	PORT ANSON	20	7.7	1.6	49.5331	49.5331
3935	PORT AU CHOIX	21	40.0	3.6	50.7169	50.7169
3940	PORT AU PORT EAST	26	25.3	2.8	48.5500	48.5500
3941	PORT AU PORT WEST-AGUATHUNA-FELIX COVE	6	16.4	2.3	48.5500	48.5500
3945	PORT BLANDFORD	19	51.1	4.0	48.3500	48.3500
3950	PORT DE GRAVE	82	No Boundary		47.5831	47.5831
3960	PORT HOPE SIMPSON	60	No Boundary			
3962	PORT KIRWAN	2	9.8	1.8	46.9669	46.9669
3965	PORT REXTON	99	12.3	2.0	48.3831	48.3831
3975	PORT SAUNDERS	17	41.7	3.6	50.6500	50.6500
3985	PORTERVILLE	6	No Boundary		49.2500	49.2500
3990	PORTLAND	20	No Boundary		48.4169	48.4169
3995	PORTLAND CREEK	1	No Boundary			
4000	PORTUGAL COVE-ST. PHILIP'S	883	59.4	4.3	47.6169	47.6169
4010	POSTVILLE	1	No Boundary			

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
4015	POUCH COVE	148	60.8	4.4	47.7669	47.7669
4050	PURBECKS COVE	1	No Boundary			
4065	PYNN'S BROOK	10	No Boundary		49.0831	49.0831
4070	QUEEN'S COVE	6	No Boundary		48.0169	48.0169
4075	QUIRPON	24	No Boundary		51.5831	51.5831
4095	RALEIGH	25	11.1	1.9	51.5669	51.5669
4100	RAMEA	3	2.0	0.8	47.5169	47.5169
4104	RANDOM ISLAND WEST	30	No Boundary		48.1331	48.1331
4110	RATTLING BROOK	8	No Boundary		49.6331	49.6331
4120	RENCONTRE EAST	3	No Boundary		47.6331	47.6331
4125	RED BAY	8	No Boundary		51.7331	51.7331
4143	RED HARBOUR	12	10.8	1.9	47.3000	47.3000
4150	RED HEAD COVE	21	No Boundary		48.1331	48.1331
4165	REEF'S HARBOUR-SHOAL COVE WEST-NEW FEROLLE	78	No Boundary		51.0169	51.0169
4172	REIDVILLE	7	55.9	4.2	49.2331	49.2331
4185	RENEWS-CAPPAHAYDEN	34	134.9	6.6	46.9000	46.9000
4200	RIGOLET	10	No Boundary			
4220	RIVER OF PONDS	3	5.4	1.3	50.5331	50.5331
4230	ROBERT'S ARM	9	41.7	3.6	49.4831	49.4831
4240	ROCK HARBOUR	7	No Boundary		47.1831	47.1831
4245	ROCKY HARBOUR	13	No Boundary		49.6000	49.6000
4250	RODDICKTON	46	19.0	2.5		
4265	ROSE BLANCHE-HARBOUR LE COU	2	4.7	1.2		
4295	RUSHOON	1	5.9	1.4		
4305	ST. ALBAN'S	10	20.5	2.6	47.8669	47.8669
4310	ST. ANDREW'S	30	No Boundary		47.7831	47.7831
4320	ST. ANTHONY	14	43.8	3.7	51.3669	51.3669
4325	ST. ANTHONY BIGHT	2	No Boundary		51.3831	51.3831
4335	ST. BERNARD'S-JACQUES FONTAINE	1	15.7	2.2	47.5331	47.5331
4340	ST. BRENDAN'S	25	9.4	1.7	48.8669	48.8669
4345	ST. BRIDE'S	21	No Boundary		46.9169	46.9169
4350	ST. CAROLS	14	No Boundary		51.3831	51.3831
4380	ST. GEORGE'S	56	26.0	2.9	48.4331	48.4331
4385	ST. JACQUES-COOMB'S COV	4	No Boundary		47.4669	47.4669
4385	ST. JACQUES-COOMB'S COVE	65	86.7	5.3	47.4669	47.4669
4400	ST. JOHN'S	909	479.8	12.4	47.5669	47.5669
4415	ST. JOSEPH'S	21	30.4	3.1	47.1169	47.1169
4420	ST. JOSEPH'S COVE-ST. VERONICA'S	5	No Boundary		47.9331	47.9331
4421	ST. JUDES	4	No Boundary		49.1500	49.1500
4425	ST. JULIEN'S	2	No Boundary		51.1000	51.1000
4435	ST. LAWRENCE	7	103.9	5.8	46.9169	46.9169

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
4445	ST. LEWIS	20	9.4	1.7		
4455	ST. MARY'S	12	38.3	3.5	46.9169	46.9169
4470	ST. PATRICK'S	11	No Boundary		49.5669	49.5669
4475	ST. PAULS	3	9.1	1.7	49.8669	49.8669
4505	ST. VINCENT'S-ST. STEPHEN'S-PETER'S RIVER	13	89.7	5.3	46.7669	46.7669
4520	SALMON COVE	73	4.9	1.3	47.7831	47.7831
4530	SALMONIER	40	No Boundary		47.0669	47.0669
4540	SALVAGE	26	16.3	2.3	48.6831	48.6831
4545	SANDRINGHAM	5	9.9	1.8	48.6669	48.6669
4550	SALLY'S COVE	1	5.1	1.3	49.7331	49.7331
4555	SALT HARBOUR	1	No Boundary			
4570	SANDY POINT	26	No Boundary		48.4500	48.4500
4590	SAVAGE COVE-SANDY COVE	34	6.9	1.5	51.3331	51.3331
4600	SEAL COVE	99	11.1	1.9	47.4831	47.4831
4610	SEARSTON	28	No Boundary		47.8331	47.8331
4630	SELDOM-LITTLE SELDOM	66	15.6	2.2	49.6000	49.6000
4655	SHEAVES COVE	4	No Boundary		48.5169	48.5169
4657	SHEPPARDVILLE	4	No Boundary			
4665	SHIP COVE-LOWER COVE-JERRY'S NOSE	7	No Boundary		48.5169	48.5169
4670	SHIP COVE	28	No Boundary		51.6000	51.6000
4680	SHIP HARBOUR	24	No Boundary		47.3669	47.3669
4700	SHOAL COVE EAST	15	No Boundary		51.3500	51.3500
4755	SMALL POINT-ADAM'S COVE-BLACKHEAD-BROAD COVE	48	23.6	2.7	47.8331	47.8331
4760	SMITH'S HARBOUR	11	No Boundary		49.7331	49.7331
4770	SNOOK'S ARM	2	No Boundary			
4791	SOP'S ARM	4	No Boundary		49.7669	49.7669
4805	SOUTH BRANCH	31	No Boundary		47.9169	47.9169
4810	SOUTH BROOK	5	18.8	2.4	49.4331	49.4331
4835	SOUTH RIVER	71	7.0	1.5	47.5331	47.5331
4850	SOUTHERN HARBOUR	3	5.5	1.3	47.7169	47.7169
4855	SOUTHPORT	9	No Boundary			
4860	SPANIARD'S BAY-TILTON	60	No Boundary		47.6169	47.6169
4870	SPANISH ROOM	16	No Boundary		47.2000	47.2000
4880	SPILLARS COVE	5	No Boundary		48.6669	48.6669
4910	SPRINGDALE	92	17.1	2.3	49.5000	49.5000
4930	STANHOPE	38	No Boundary		49.2831	49.2831
4935	STEADY BROOK	2	1.2	0.6		
4945	STEPHENVILLE	25	38.8	3.5	48.5500	48.5500
4950	STEPHENVILLE CROSSING	16	32.2	3.2	48.5000	48.5000
4955	STOCK COVE	10	No Boundary		48.5331	48.5331
4965	STONEVILLE	5	No Boundary		49.4669	49.4669
4975	SUMMERFORD	51	16.1	2.3	49.4831	49.4831

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
4985	SUMMERVILLE-PRINCETON-SOUTHERN BAY	61	No Boundary		48.4500	48.4500
4990	SUNNYSIDE	18	38.5	3.5	47.8500	47.8500
5000	SWEET BAY	23	No Boundary		48.4331	48.4331
5005	SWIFT CURRENT	39	No Boundary		47.8831	47.8831
5035	TERRA NOVA	58	No Boundary		48.5000	48.5000
5040	TERRENCEVILLE	7	17.1	2.3	47.6669	47.6669
5045	THORNLEA	4	No Boundary			
5090	THREE ROCK COVE	5	No Boundary		48.6169	48.6169
5092	TICKLE COVE	13	No Boundary		48.5831	48.5831
5095	TILTING	14	18.1	2.4	49.7000	49.7000
5100	TIZZARD'S HARBOUR	3	No Boundary		49.6000	49.6000
5110	TOMPKINS	15	No Boundary		47.8000	47.8000
5115	TOO GOOD ARM	21	No Boundary		49.6331	49.6331
5125	TORBAY	790	36.7	3.4	47.6669	47.6669
5130	TORS COVE	73	No Boundary		47.2169	47.2169
5135	TRAYTOWN	44	14.0	2.1	48.6669	48.6669
5145	TREPASSEY	6	57.6	4.3		
5150	TRINITY EAST	25	No Boundary		48.3831	48.3831
5155	TRINITY, T.B.	55	No Boundary		48.3669	48.3669
5170	TRITON	2	7.8	1.6	49.5169	49.5169
5175	TROUT RIVER	7	6.2	1.4	49.4831	49.4831
5180	TROUTY	23	No Boundary		48.3331	48.3331
5185	TURKS COVE	4	No Boundary		47.9331	47.9331
5195	TWILLINGATE	50	28.1	3.0	49.6500	49.6500
5200	UPPER AMHERST COVE	4	No Boundary		48.5500	48.5500
5205	UPPER FERRY	15	No Boundary		47.8500	47.8500
5215	UPPER ISLAND COVE	25	8.3	1.6	47.6500	47.6500
5220	VALLEY POND	39	No Boundary		49.5669	49.5669
5225	VICTORIA	33	21.5	2.6	47.7669	47.7669
5235	VIRGIN ARM-CARTER'S COVE	71	No Boundary		49.5331	49.5331
5245	WABANA	20	14.5	2.2	47.6331	47.6331
5295	WEST BAY	2	No Boundary		48.6331	48.6331
5310	WEST ST. MODESTE	26	7.3	1.5	51.6000	51.6000
5320	WESTERN BAY	71	No Boundary		47.8831	47.8831
5335	WESTPORT	1	4.6	1.2	49.7831	49.7831
5355	WHITBOURNE	81	25.7	2.9	47.4169	47.4169
5365	WHITEWAY	11	25.2	2.8	47.6831	47.6831
5385	WILD BIGHT	5	No Boundary			
5390	WILD COVE	5	No Boundary		50.0000	50.0000
5410	WILTONDALE	3	No Boundary		49.4000	49.4000
5425	WINTER BROOK	11	No Boundary		48.4331	48.4331
5445	WINTERLAND	29	56.2	4.2	47.1500	47.1500
5450	WINTERTON	4	12.0	2.0	47.9669	47.9669

Table 3.6 LGID Centroid Coordinates, Administrative Boundary Areas, and Number of Associated Well Records

LGID	LGID Name	Number of Wells	Area Km^2	r* (km)	Latitude	Longitude
5455	WITLESS BAY	143	16.8	2.3	47.2831	47.2831
5460	WOODDALE	3	No Boundary		49.0500	49.0500
5475	WOODVILLE	4	No Boundary		47.8669	47.8669
5490	WOODY POINT	6	3.1	1.0	49.5000	49.5000
5495	YORK HARBOUR	36	13.7	2.1	49.0669	49.0669
	TOTAL	18837	**MIN**	0.6		
			MAX	12.4		
			AVERAGE	2.7		

r* radius of equivalent circular area

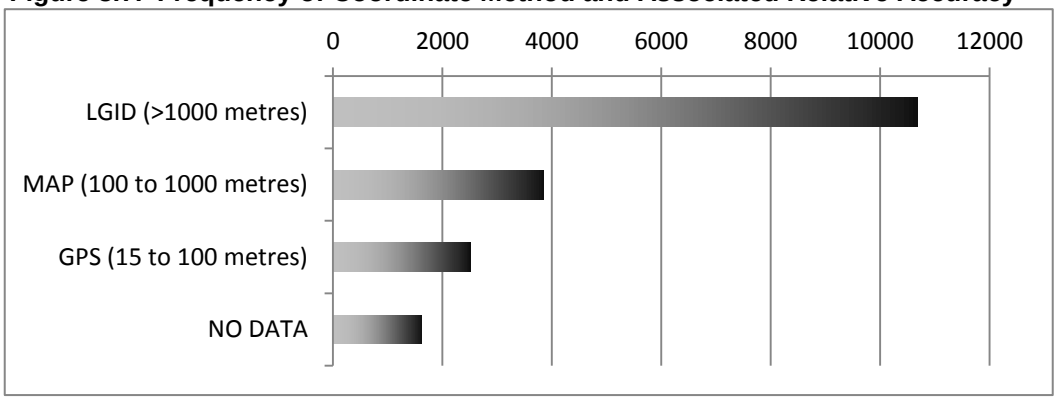
3.3 Data Frequency Summaries

Table 3.7 shows the number of coordinates assigned using each georeferencing method. LGID centroids were used to assign coordinates to 56% of the well records. Existing map and GPS coordinates accounted for 20% and 13% respectively. The remaining records (8.6%) contained no coordinates and could not be georeferenced. There were 242 records requiring further review, indicated with the code "-CHECK".

Table 3.7. Coordinate Method Frequency

COORD_METHOD	Frequency	Percent of Total
GPS	2502	13%
GPS-CHECK	178	1.0%
LGID	10676	56%
LGID-CHECK	4	0%
MAP	3841	20%
MAP-CHECK	60	0.3%
NO DATA	1621	8.6%
Total	**18882**	**100.0%**

Figure 3.7. Frequency of Coordinate Method and Associated Relative Accuracy

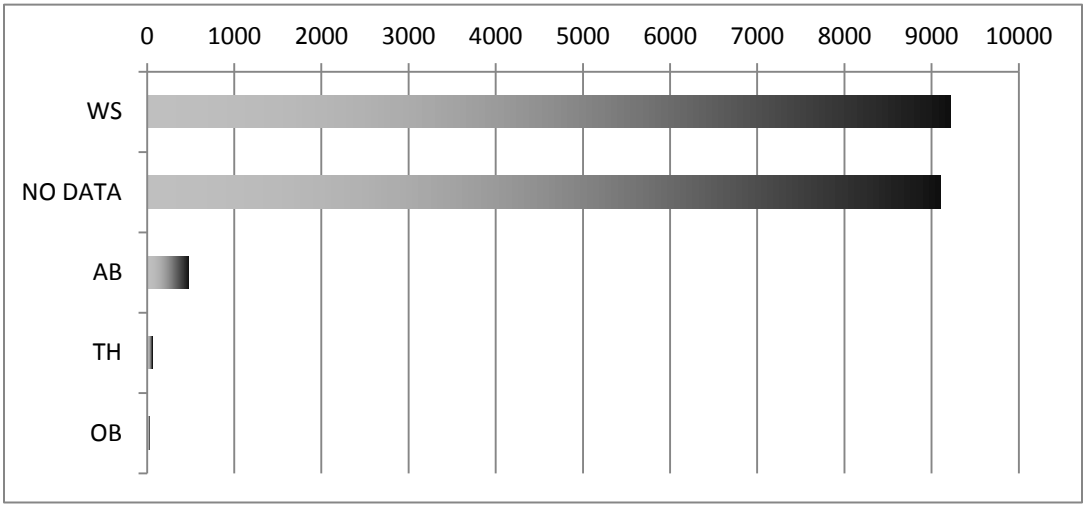


Approximately half of the records contained no information for the CURRENT_WELL_STATUS field (Table 3.8). Water Supplies ("WS") and domestic wells ("DO") accounted for the majority of remaining wells. Abandoned wells accounted for 2.5% of wells, and the remaining codes accounted for less than one percent of the total.

Table 3.8. Well Status Frequency

CURRENT_WELL_STATUS	Frequency	Percent of Total
NO DATA	9104	48%
ABANDONED	474	2.5%
OBSERVATION HOLE	28	0.15%
TEST HOLE	56	0.30%
WATER SUPPLY	9220	49%

Figure 3.8 Well Status Frequency

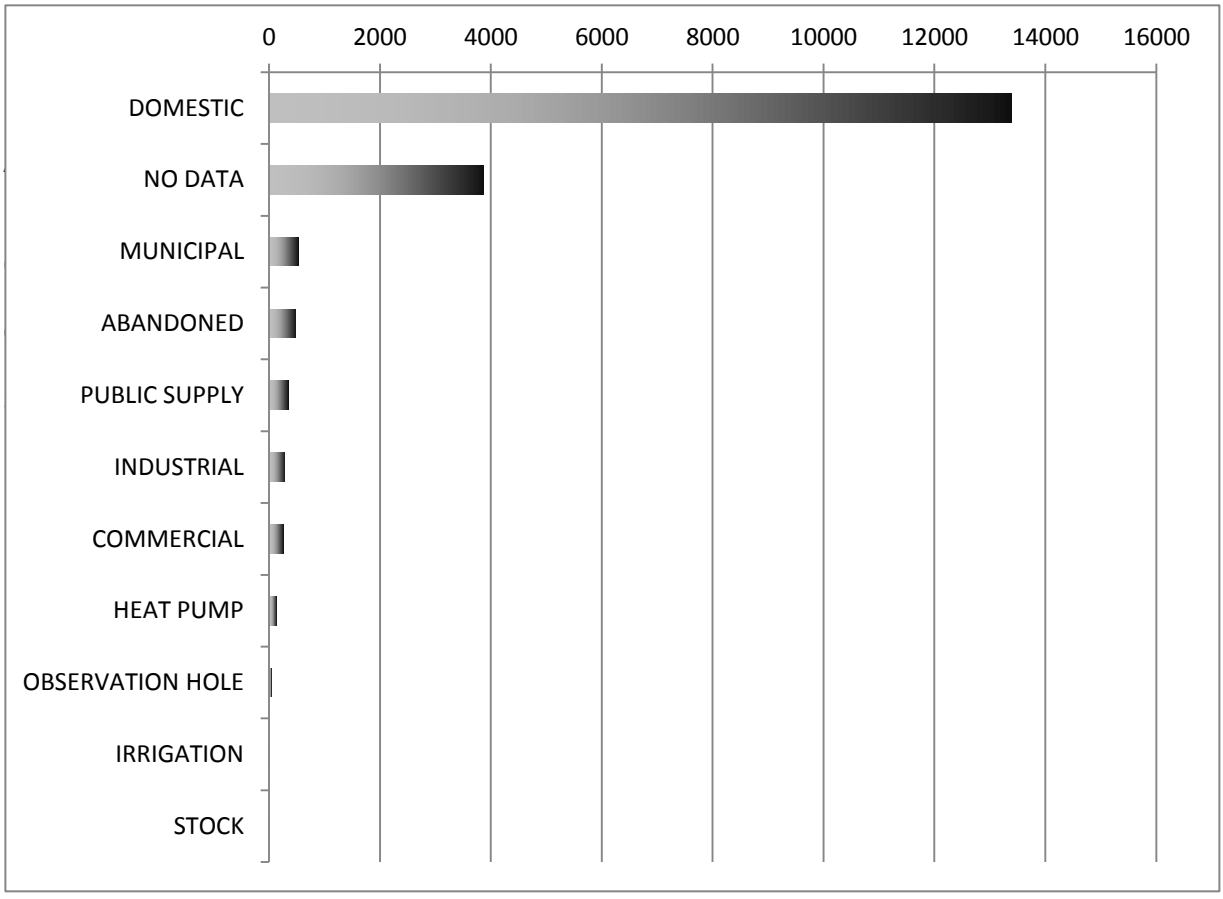


Similarly, domestic wells accounted for the majority of wells (71%) in the WATER_USE field, and 20% of records contained no data (Table 3.9). According to the WATER_USE field, municipal users accounted for 3% of water users, but new data provided in the SUPPLY field indicate that this number may be closer to 6%. Public supplies, industry, and commercial users accounted for 1.9%, 1.5%, and 1.4% respectively.

Table 3.9. Water Use Frequency

WATER_USE	Frequency	Percent of Total
NO DATA	3861	20%
ABANDONED	480	2.54%
COMMERCIAL	257	1.4%
DOMESTIC	13 386	71%
IRRIGATION	3	0.02%
HEAT PUMP	131	0.69%
INDUSTRIAL	285	1.5%
MUNICIPAL	522	2.8%
OBSERVATION HOLE	38	0.20%
PUBLIC SUPPLY	343	1.8%
STOCK	2	0.01%

Figure 3.9 Water Use Frequency



The number of strata reported by the driller was commonly two (60% of wells) as shown in Table 3.10. The number of strata was undetermined or greater than five for 20% of wells. Records showing just one geologic unit accounted for 9% of wells, and those showing 3 units accounted for 8% of wells. Water type frequencies are shown in Table 3.11. 55% of wells reported fresh water and the remaining 44% of wells contained no information. One to two percent of wells indicated problems associated with manganese, sulphur, and salt.

Table 3.10. Strata Frequency

STRATA	Frequency	Percent of Total
0	12	0.06%
1	1704	9.0%
2	11 320	60%
3	1585	8.4%
4	274	1.5%
5	248	1.3%
Unknown	3739	20%

Figure 3.10 Strata Frequency

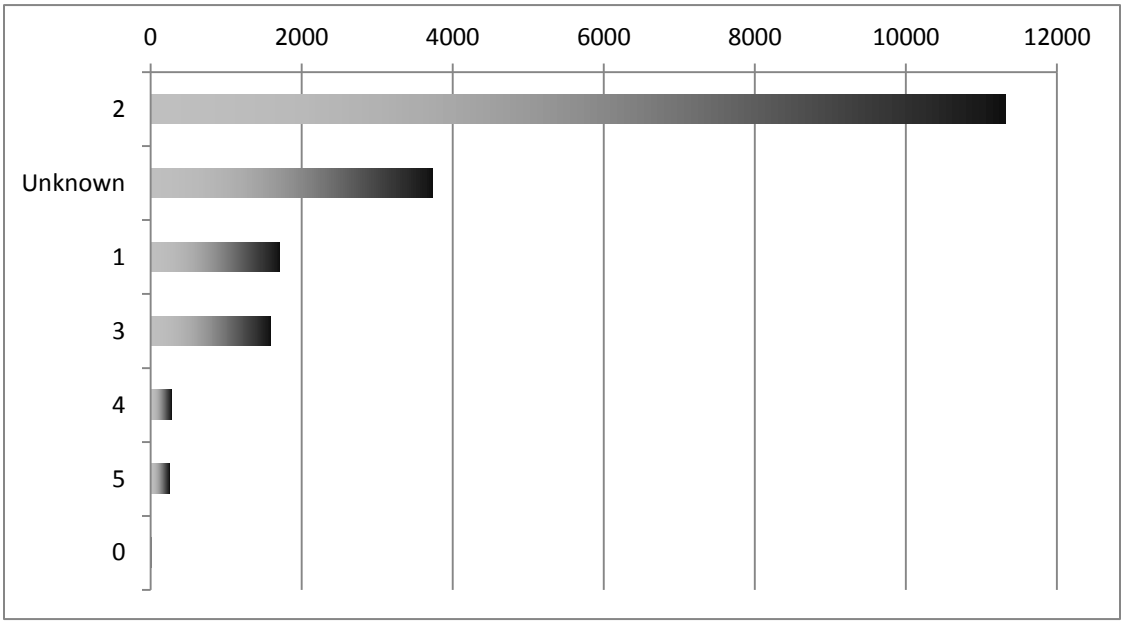


Table 3.11. Water Type Frequency

WATER_TYPE	Frequency	Percent of Total
NO DATA	8226	44%
FR	10 406	55%
MN	76	0.40%
SA	127	0.67%
SU	47	0.25%

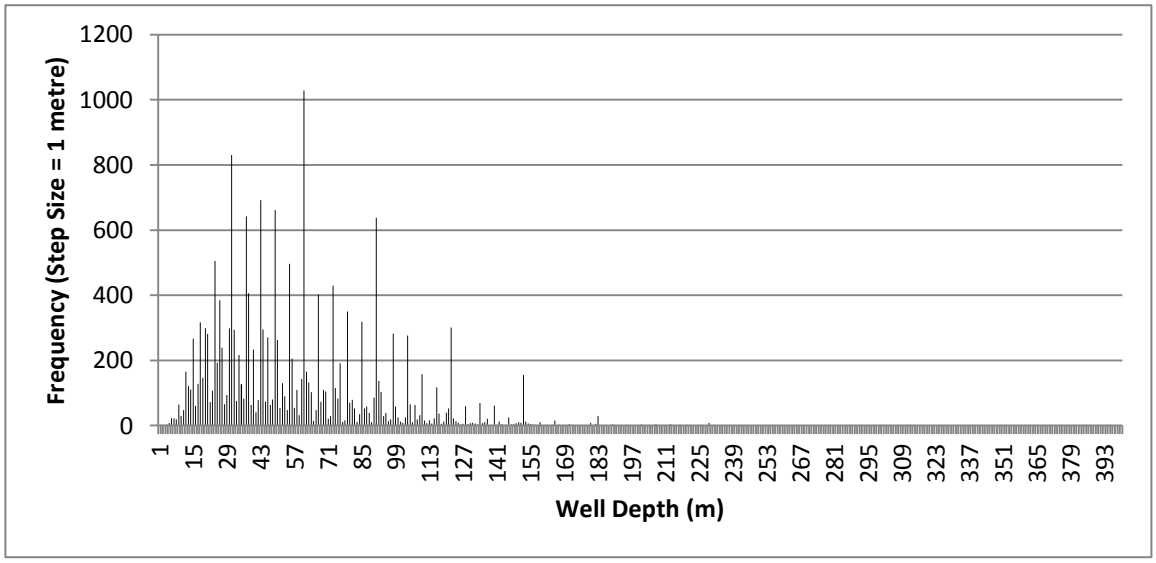
3.4 Water Well Characteristics

A summary of key water well characteristics for the full dataset is provided in Table 3.12. Well depths were generally between 31 and 76 metres, with median and mean depths of 49 and 57 metres. Figure 3.12 shows the distribution of well depths. Well depths exceeding 150 metres were uncommon, but selected wells reached up to 400 metres. The depth to bedrock was generally between 2.1 and 6.7 metres.

Table 3.12. Summary Statistics

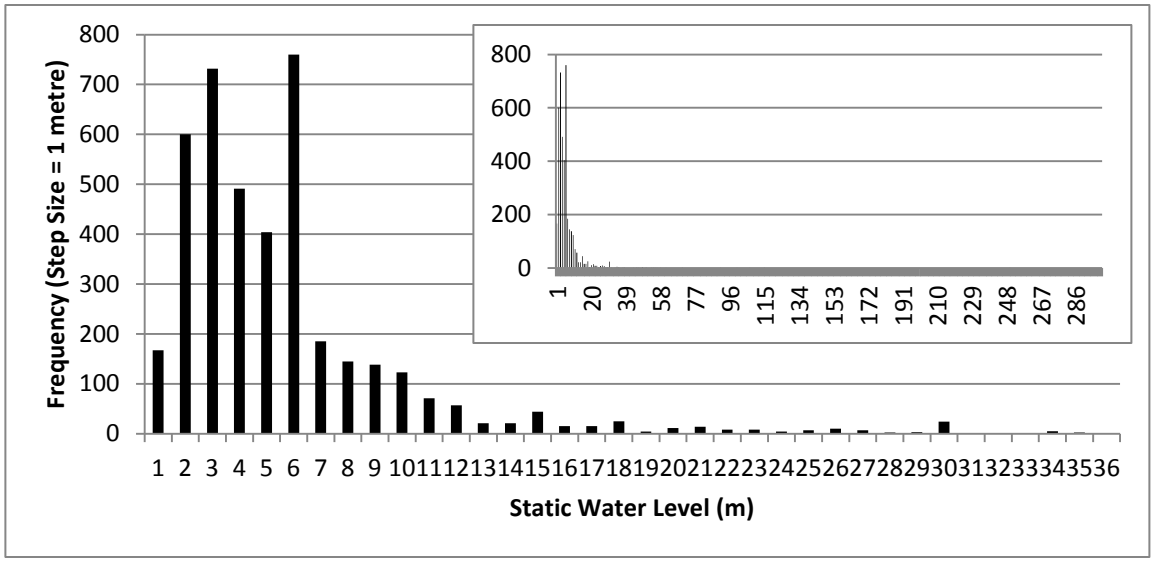
	Depth to Bedrock (m)	Well Depth (m)	Static Water Level (m)	Airlift Yield (L/min)
# Records	5247	18 503	4151	16 825
Mean	5.7	57	6.1	25
Variance	48	1126	76	4352
Standard Deviation	7	34	8.7	66
Minimum	0	2.0	0	0
First Quartile	2.1	31	3.0	2.0
Median	4.0	49	5.0	9.0
Third Quartile	6.7	76	6.0	23
Maximum	110	400	304	2250

Figure 3.12 Well Depth Histogram



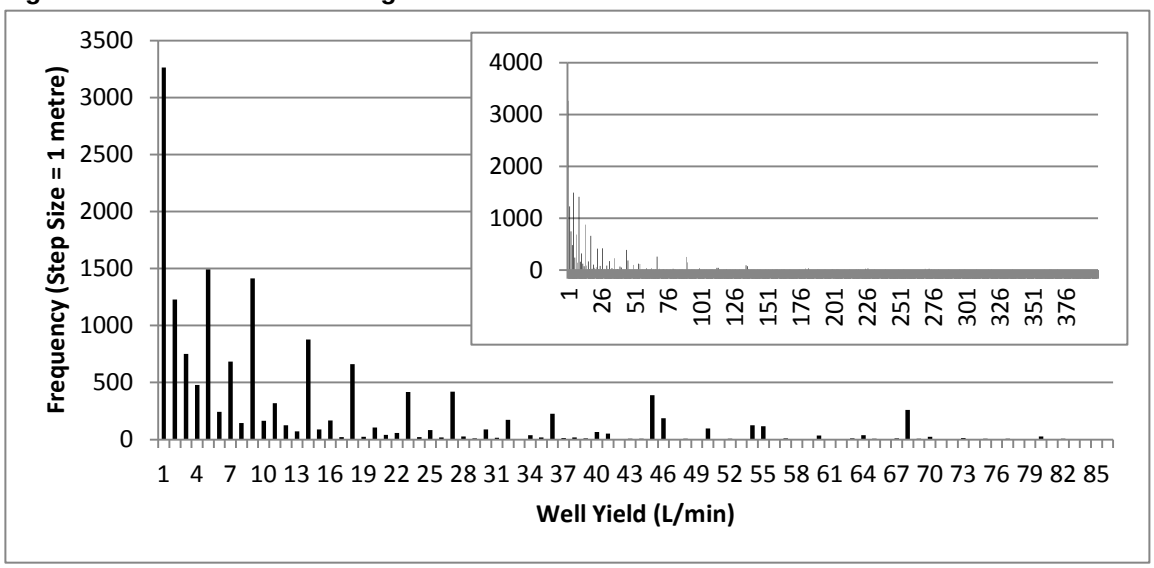
Static water levels were available for 4151 wells, and generally fell in the range 3 to 6 metres below the ground surface. The median static water level was 5.0 metres. Figure 3.13a shows the distribution of available static water levels for the province. Almost all wells showed static water levels at depths of 15 metres or less, with over 75% of wells exhibiting static water levels at depths of 6 metres or less.

Figure 3.13a. Static Water Level Histogram



Airlift yields commonly fell in the range 2.0 to 23 L/min, with a median rate of 9 L/min, and selected yields exceeding 100 L/min. Figure 3.13b shows the distribution of well yields. The collective data suggest that a well exhibiting typical construction would be 49 metres deep, with 4 metres of overburden, a static water level of 5 metres, and a yield on the order of 9 L/min.

Figure 3.13b. Well Yield Histogram



3.5 Preliminary Mapping

(All figures referred to in Section 3.5 are found at the end of this section.)

The revised database was used to plot regional maps of commonly used fields. Figure series 3.14 shows drilled wells terminating in unconsolidated deposits only, overlain on quaternary geology mapping. The parsed and edited stratigraphy data allowed for relatively rapid sorting and filtering of the data to omit wells installed in bedrock units. Data for the province as a whole are shown on Figure 3.14a. Water well records are concentrated in coastal areas and community centres. Figure 3.14b shows the south-western part of Newfoundland. Wells in quaternary deposits are consistently located in glaciofluvial valleys (orange), suggesting that, when drilling in valley areas, drillers have targeted the fluvial deposits for their favourable yields.

Figure 3.14c shows a similar pattern for north central Newfoundland. The location of wells in glaciofluvial valley deposits concentrates water withdrawals. Although these aquifers are likely to exhibit favourable transmissivity and yield, with increasing development they could begin to show irreversible declines in hydraulic head. Figure 3.14d shows the northern part of the Avalon Peninsula. Wells are not clearly correlated with outwash deposits. This could indicate better yields in other quaternary units, but more likely reflects the pressures and constraints to well locations imposed by subdivision development in growing urban centres. Further analyses such as those shown in Figure series 3.14 should make it possible to create an inventory of outwash valley aquifers in Newfoundland to assist with water resources management and development.

Location data and the coordinate method field were used to create a subsample of the full dataset. Only wells located using a map or GPS coordinates were included in this subsample. The dataset of quaternary wells was also omitted from this subsample, limiting the analysis to bedrock wells. The data were then intersected with bedrock geology mapping to show the mapped rock type for each well record in the subsample. Mapped rock types at each well were grouped according to the general rock type and associated groundwater flow characteristics (or Hydrostratographic Units, HUs). These broad groups included plutonic, volcanic, metamorphic, mixed sedimentary and volcanic, mixed sedimentary and carbonate, and carbonate bedrock. The result for Newfoundland is shown on Figure 3.15a, together with bedrock mapping. Coloured groupings for each region are readily apparent. Figure 3.15e provides a bedrock geology legend.

Figure 3.15b shows detail for western Newfoundland. Wells overlying sedimentary-carbonate rock types predominate (siliclastic and evaporitic units). Carbonate rocks extending from Cape St. George through Stephenville to Corner Brook are also frequently populated by wells. Figure 3.15c shows well types in north central Newfoundland. Sedimentary-Carbonate wells predominate in central and eastern parts of the map, but wells in the coastal areas to the north and northwest are generally installed in volcanic and plutonic rocks. Figure 3.15d shows the predominance of wells installed in sedimentary-carbonate rocks, with smaller but clear groupings of wells in rock of plutonic and volcanic origin. Well development in areas away from the coast in Colliers, Conception Harbour, Avondale, and Holyrood appears to be dependent on volcanic and plutonic rocks. Yields in these zones are expected to be generally lower, with lower associated sustainable aquifer and basin yields. Further confirmation and

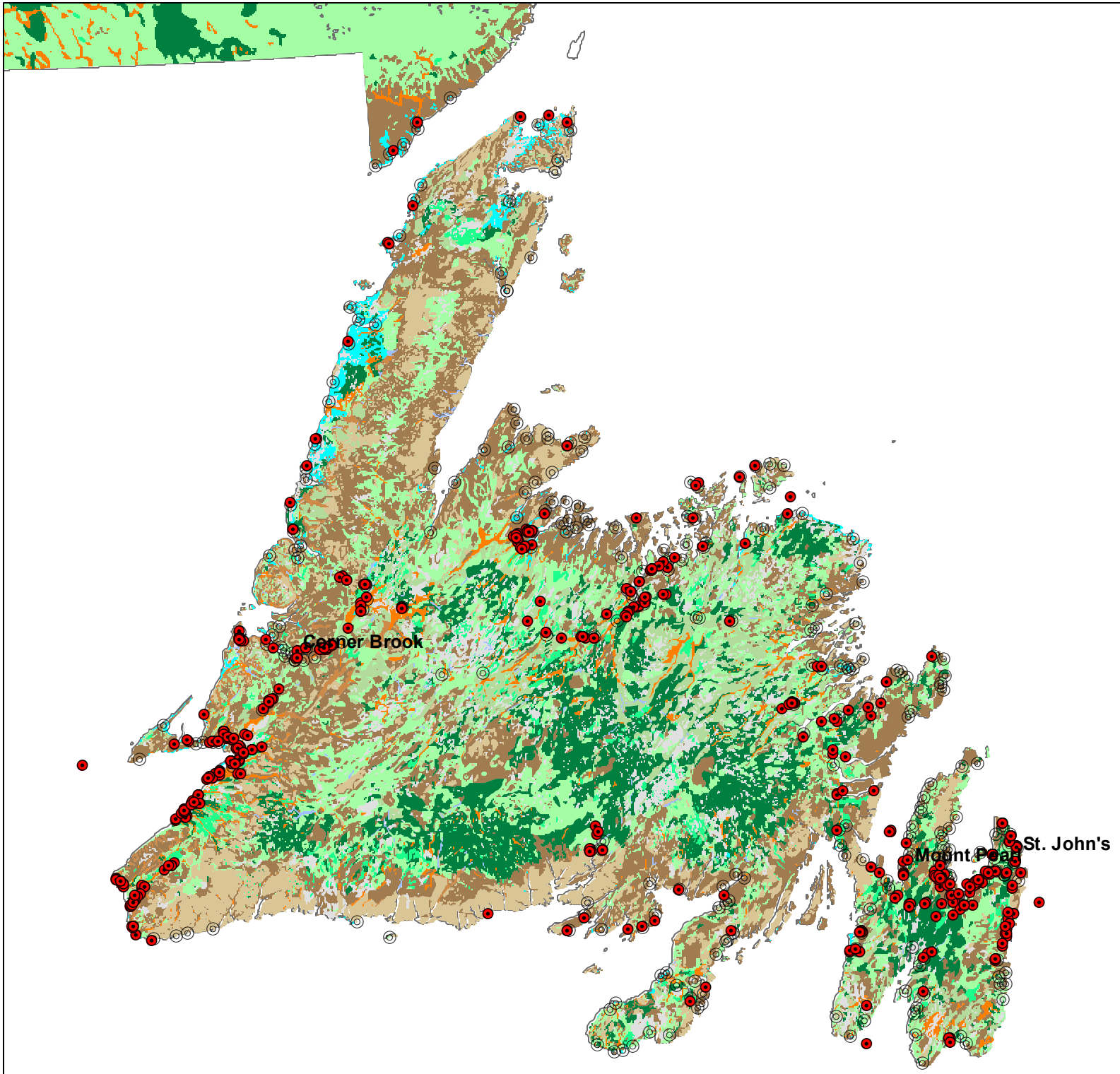
analysis of the data generated for Figure series 3.15 could provide summary tables on the yield, depth, and specific capacity for each major rock grouping (or HU) in Newfoundland.

Well yields were plotted for western Newfoundland (Figure 3.16a), north central Newfoundland (Figure 3.16b), and the Avalon Peninsula (Figure 3.16c). Yields appear to be generally favourable in the Codroy-Channel-Port aux Basques area (Figure 3.16a, map inset), most often exceeding 20 L/min. Yields appear to be more variable in the Cape St. George area and Corner Brook. More detailed mapping would be required to allow for analysis of aquifer-specific data. Well yields near Musgravetown are shown on Figure 3.16b (inset). There appear to be two areas in the centre and centre-north where yields are particularly good. Data for the Avalon Peninsula show an even distribution of yields across the area. Detail of the area around Conception Harbour shows no clear grouping of higher yield wells. This is consistent with yields in fractured volcanic and plutonic rock, where obtaining a favourable yield depends on whether the well intersects a major fracture.

Well depths were plotted on Figures 3.17a, 3.17b, and 3.17c. Well depths were most commonly in the 20 to 50 metre range in western Newfoundland, but reached up to 150 metres closer to Corner Brook. Figure 3.17b shows an even distribution of well depths throughout the north central map region. Well depths up to 100 and 150 metres are not uncommon. Data for the Avalon Peninsula show some minor groupings of well depths (Figure 3.17c). Well depths of 20 to 50 metres are most common, but in areas away from the coast in the St. John's and Mount Pearl areas, and to the south of Conception Bay, well depths more frequently exceed 75 metres and reach up to 200 metres.

Data from the well status and well status comment fields were used to generate a map of abandoned wells and the associated reason for abandonment (Figure 3.18). Poor yield appears to be the most common reason for well decommissioning, followed closely by poor water quality (including cloudiness, bacteria, poor taste and odour, and staining). There were no clear regional trends for caving or saltwater intrusion.

Wells were mapped according to the updated and corrected WATER_USE field (Figure 3.19), including cross-referenced data to identify municipal users. Domestic water supplies have been omitted from Figure 3.19. Wells of each type appear throughout the map area. Heat pumps show the clearest spatial trend, grouped in the St. John's- Mount Pearl area where the density of water supply wells is also generally the highest. Abandoned wells are distributed evenly and occur near potentially high capacity wells. There is a concentration of commercial wells in the Cape St. George-Stephenville area. The water use types shown on Figure 3.19 tend to require higher volumes and peak demands. With a more detailed analysis of the aquifer in each area, density mapping of these wells should aid in water allocation management.



CBCL LIMITED
Consulting Engineers

FIGURE 3.14a
Wells in Unconsolidated Deposits: Newfoundland

Newfoundland and Labrador Drilled Well Database

Legend

- Water Well Record(s)

Community Centers

- City
- Town
- Village

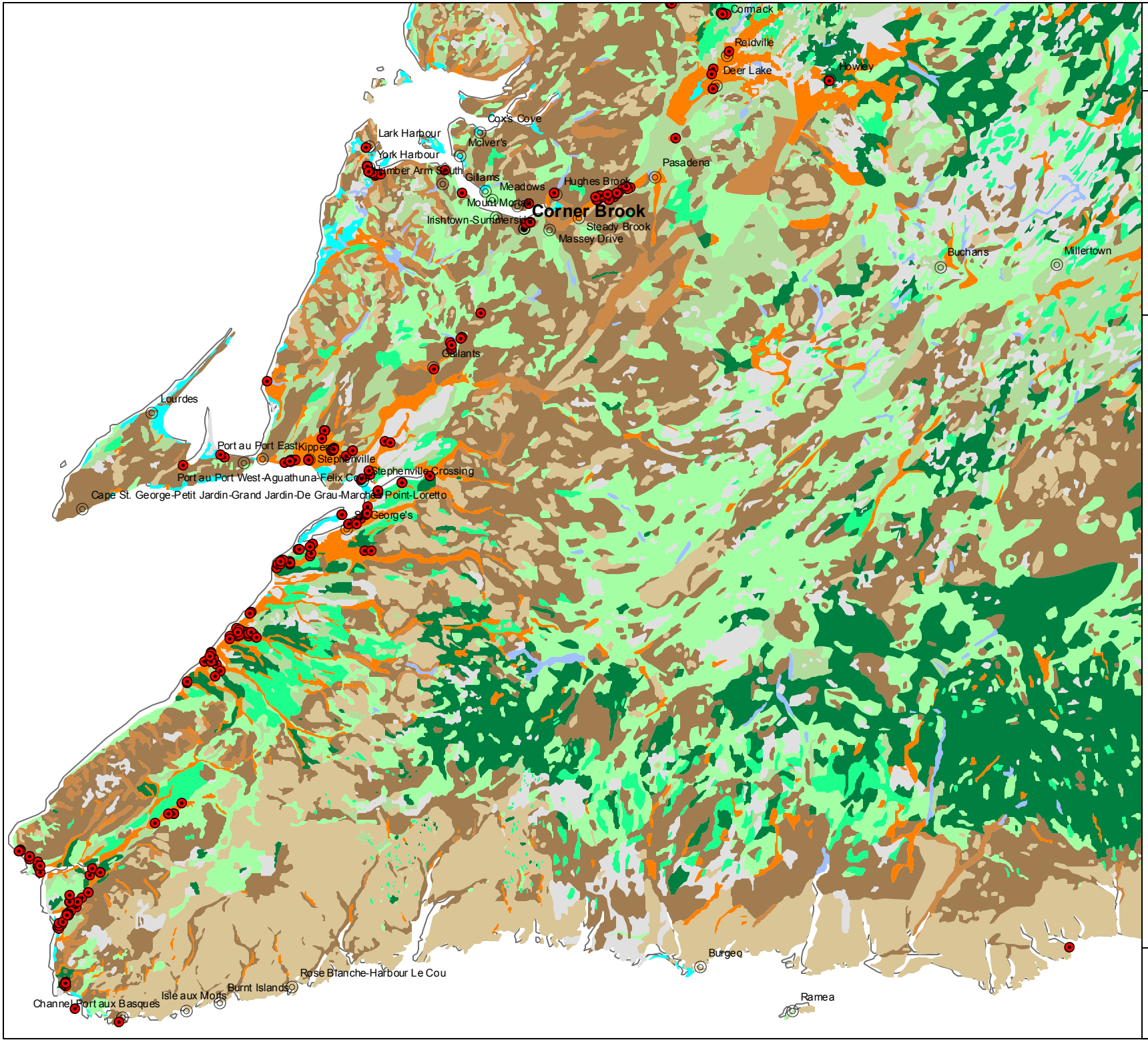
Surficial Geology

- ablation drift
- alluvium
- bog
- colluvium
- drift poor
- exposed bedrock
- glaciofluvial
- glaciolacustrine
- glaciomarine and marine
- rogen moraine
- till blanket
- till, undifferentiated

Scale 1:3,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 2:02:33 PM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.14b Wells in Unconsolidated Deposits: Western Newfoundland

Newfoundland and Labrador Drilled Well Database

Legend

- Water Well Record(s)
- Lakes

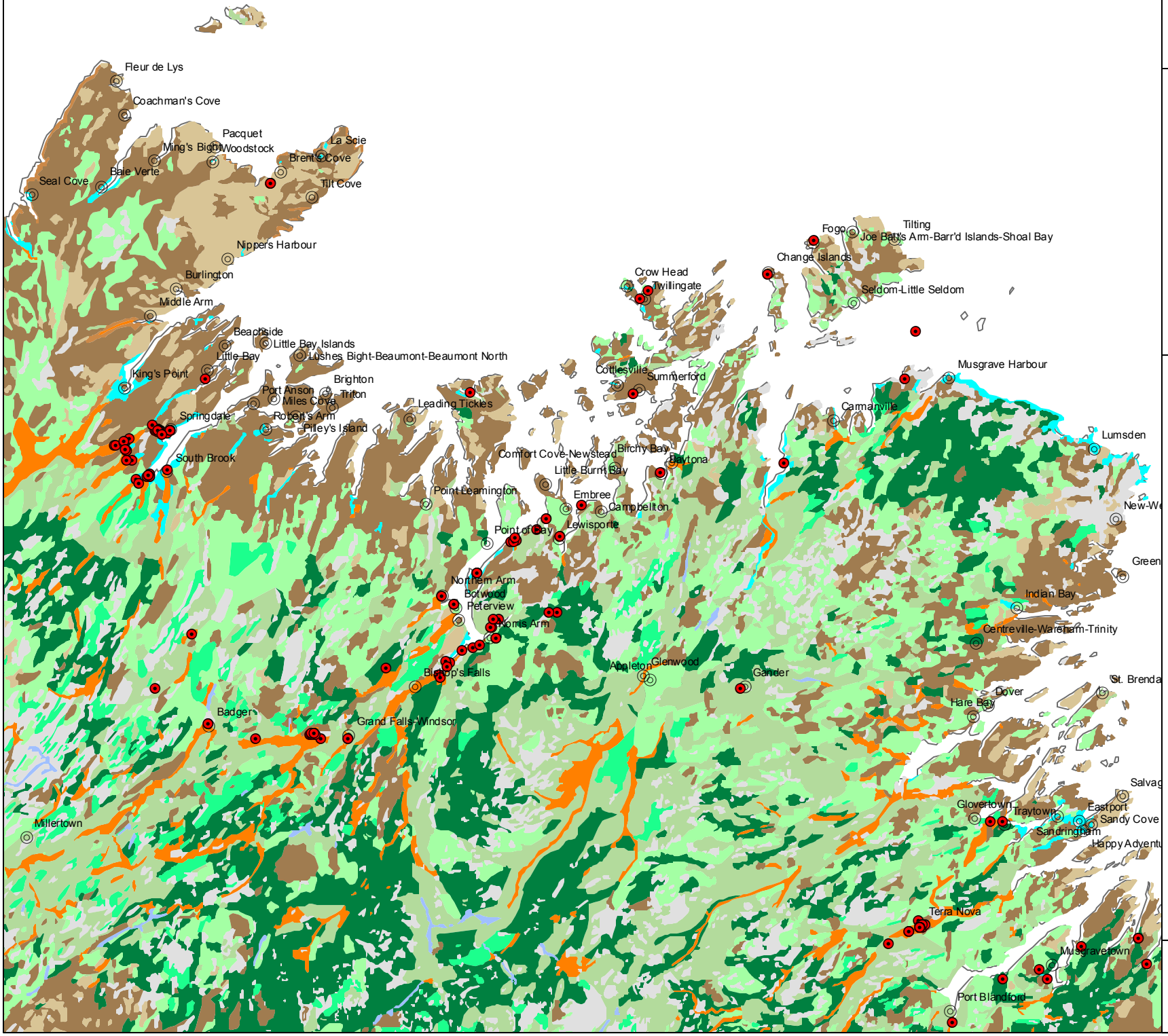
Surficial Geology

- ablation drift
- alluvium
- bog
- colluvium
- drift poor
- exposed bedrock
- glaciofluvial
- glaciolacustrine
- glaciomarine and marine
- rogen moraine
- till blanket
- till, undifferentiated

Scale 1:1,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/13/2011 4:02:08 PM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.14c Wells in Unconsolidated Deposits: North Central Newfoundland

Newfoundland and Labrador Drilled Well Database

Legend

- Water Well Record(s)
- Lakes

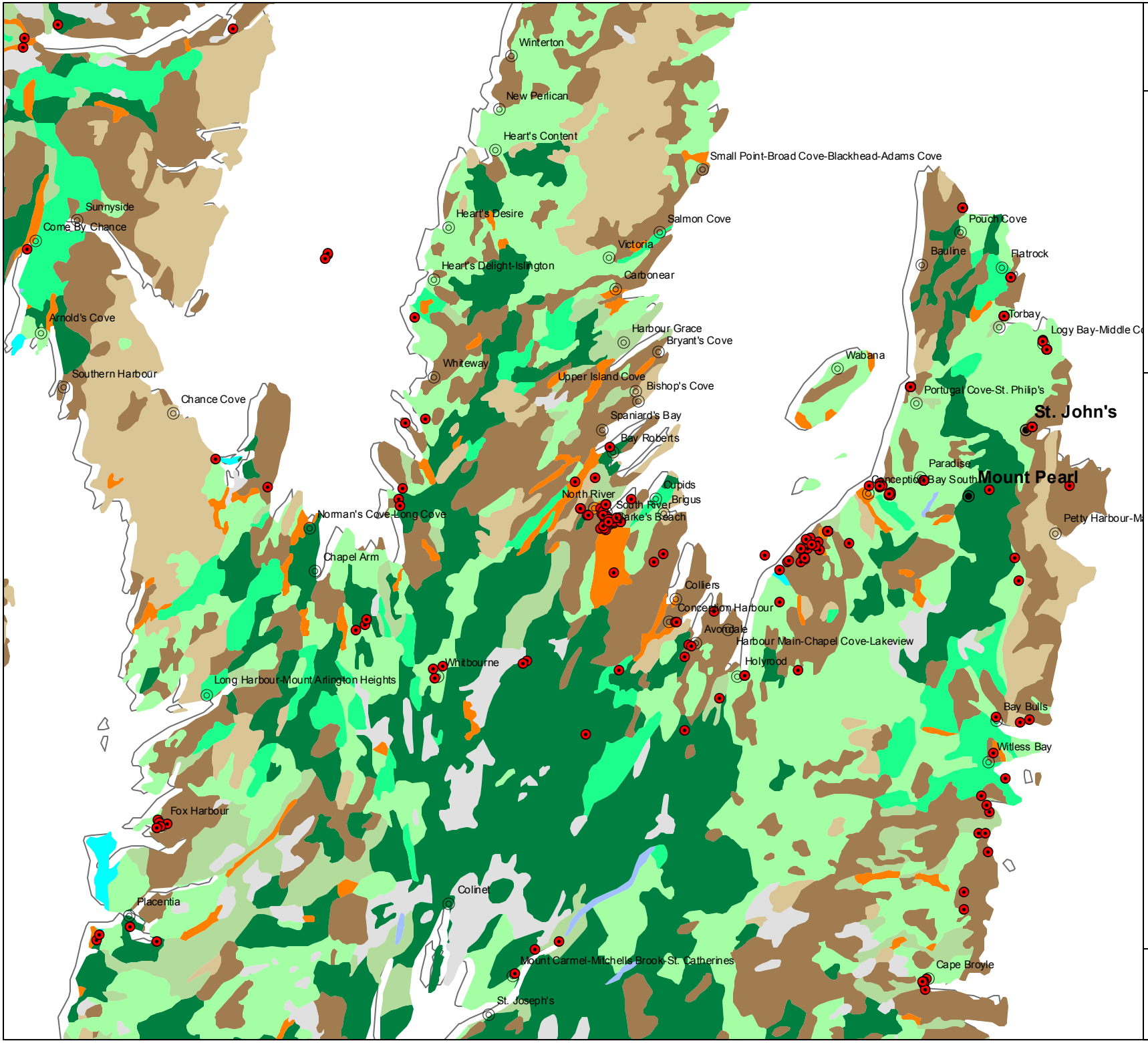
Surficial Geology

- ablation drift
- alluvium
- bog
- colluvium
- drift poor
- exposed bedrock
- glaciofluvial
- glaciolacustrine
- glaciomarine and marine
- rogen moraine
- till blanket
- till, undifferentiated

Scale 1:1,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/13/2011 4:06:15 PM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.14d Wells in Unconsolidated Deposits: Avalon Peninsula

Newfoundland and Labrador Drilled Well Database

Legend

- Water Well Record(s)

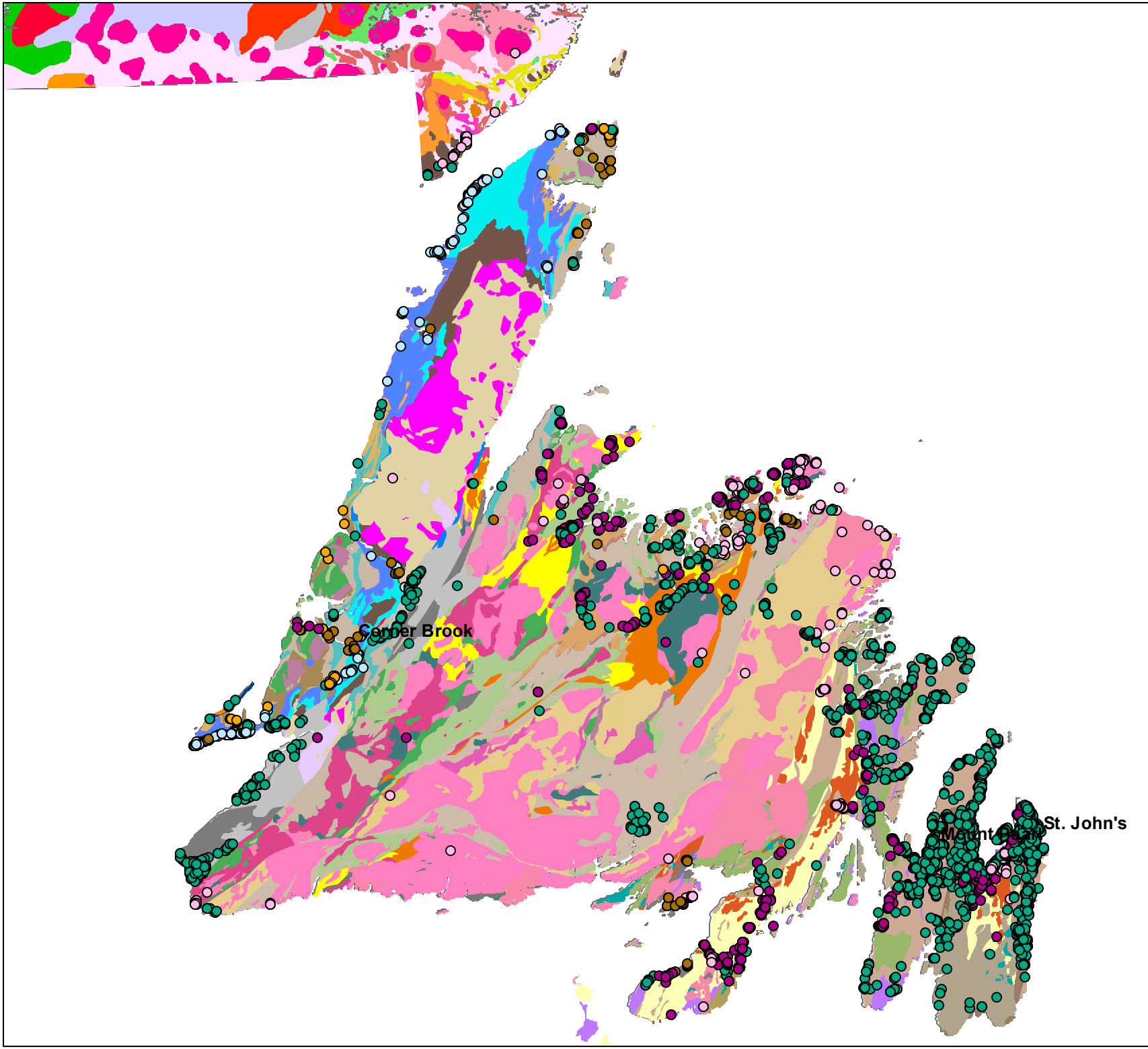
Surficial Geology

- ablation drift
- alluvium
- bog
- colluvium
- drift poor
- exposed bedrock
- glaciofluvial
- glaciolacustrine
- glaciomarine and marine
- rogen moraine
- till blanket
- till, undifferentiated

Scale 1:500,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 10:25:41 AM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.15a
Bedrock Wells by Rock Type: Newfoundland

Newfoundland and Labrador Drilled Well Database

Legend

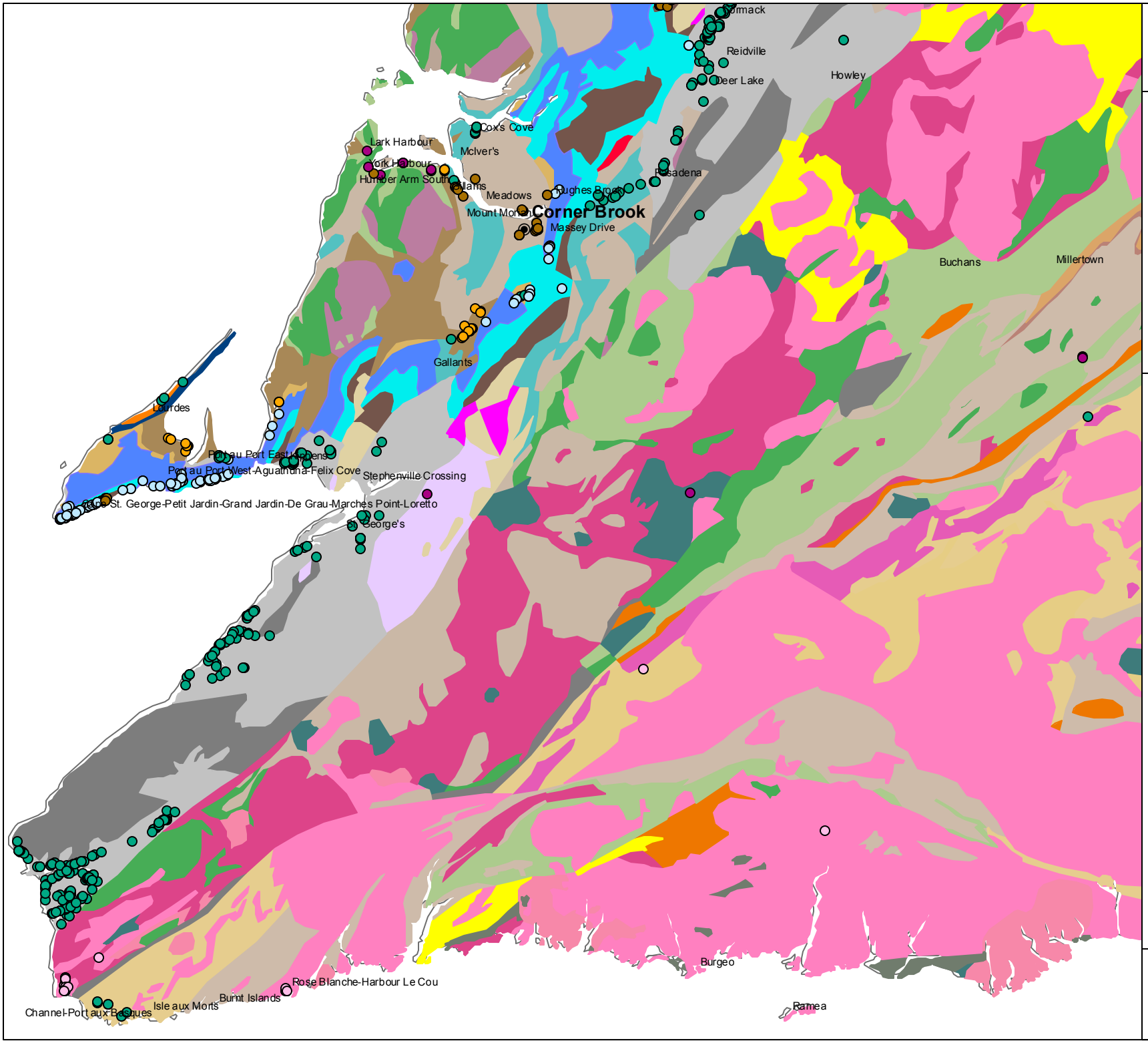
Rock Type at Well

- Plutonic
- Volcanic
- Metamorphic
- Sedimentary and Volcanic
- Sedimentary and Carbonate
- Carbonate
- Lakes

Scale 1:3,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/13/2011 4:52:24 PM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.15b Bedrock Wells by Rock Type: Western Newfoundland

Newfoundland and Labrador Drilled Well Database

Legend

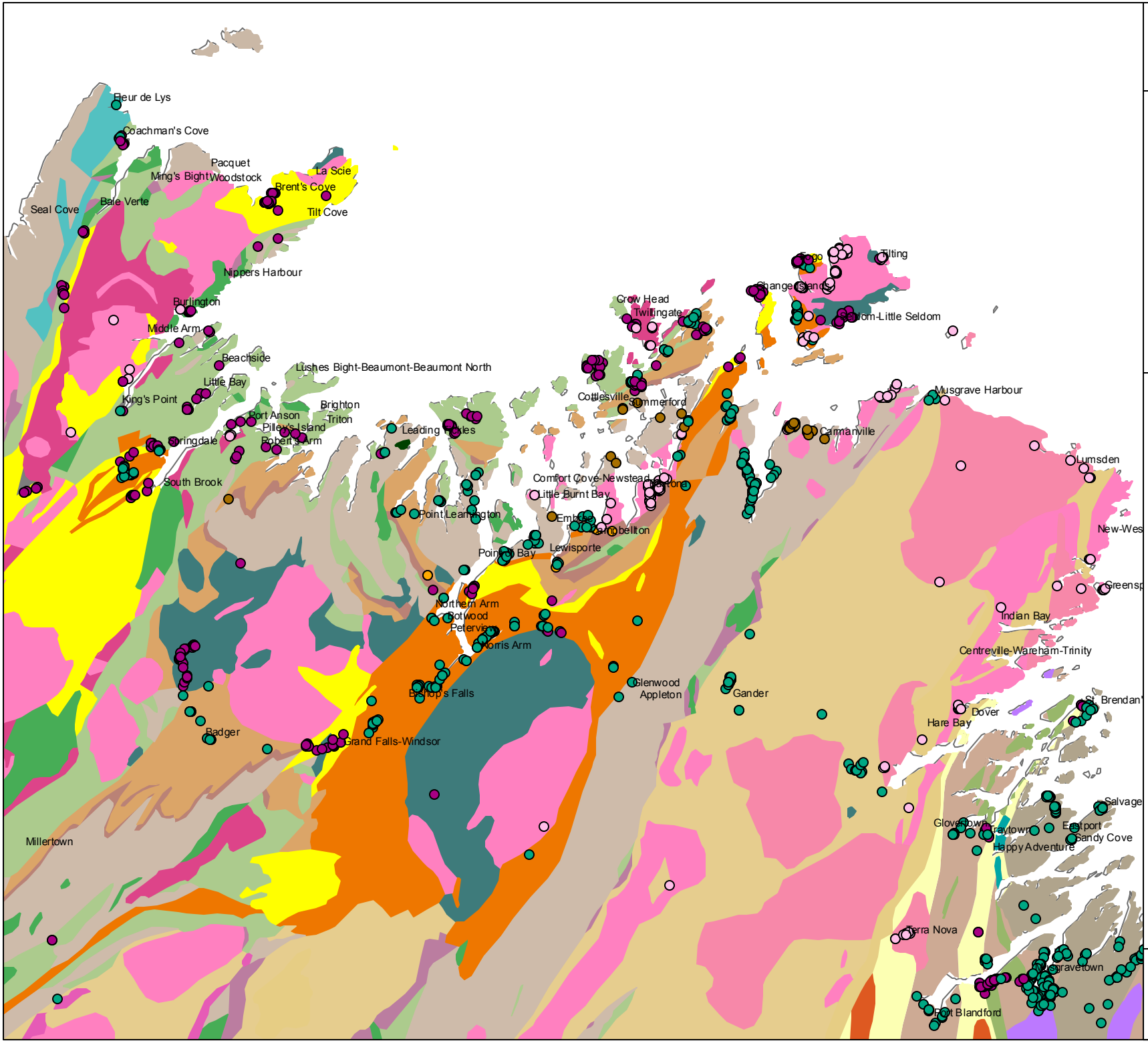
Rock Type at Well

- Plutonic
- Volcanic
- Metamorphic
- Sedimentary and Volcanic
- Sedimentary and Carbonate
- Carbonate

Scale 1:1,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 10:39:53 AM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.15c Bedrock Wells by Rock Type: North Central Newfoundland

Newfoundland and Labrador Drilled Well Database

Legend

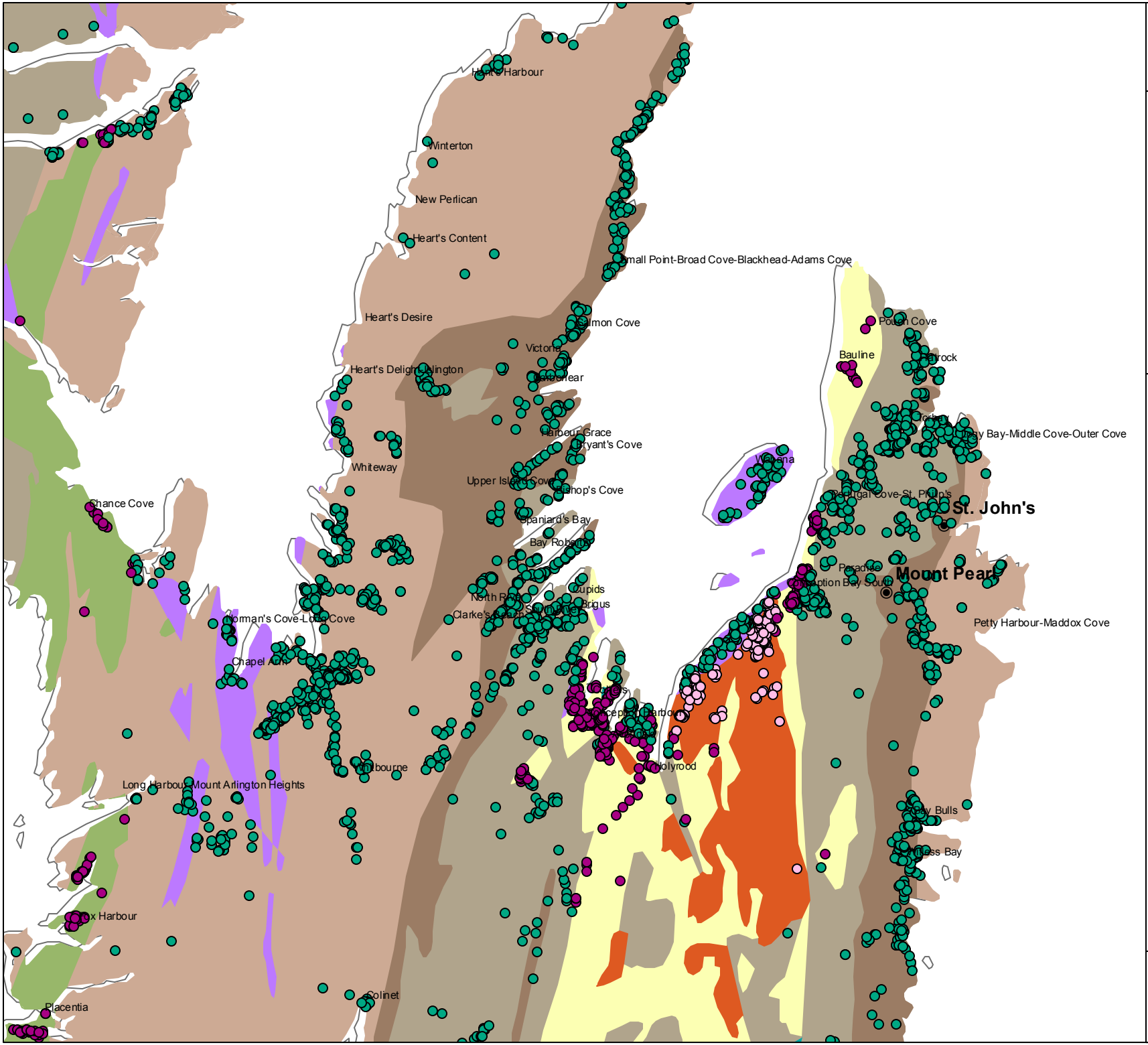
Rock Type at Well

- Plutonic
- Volcanic
- Metamorphic
- Sedimentary and Volcanic
- Sedimentary and Carbonate
- Carbonate

Scale 1:1,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 10:59:44 AM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.15d Bedrock Wells by Rock Type: Avalon Peninsula

Newfoundland and Labrador Drilled Well Database

Legend

Rock Type at Well

- Plutonic
- Volcanic
- Metamorphic
- Sedimentary and Volcanic
- Sedimentary and Carbonate
- Carbonate

Scale 1:500,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 11:01:20 AM

L:\103064 - NFLD Water Well

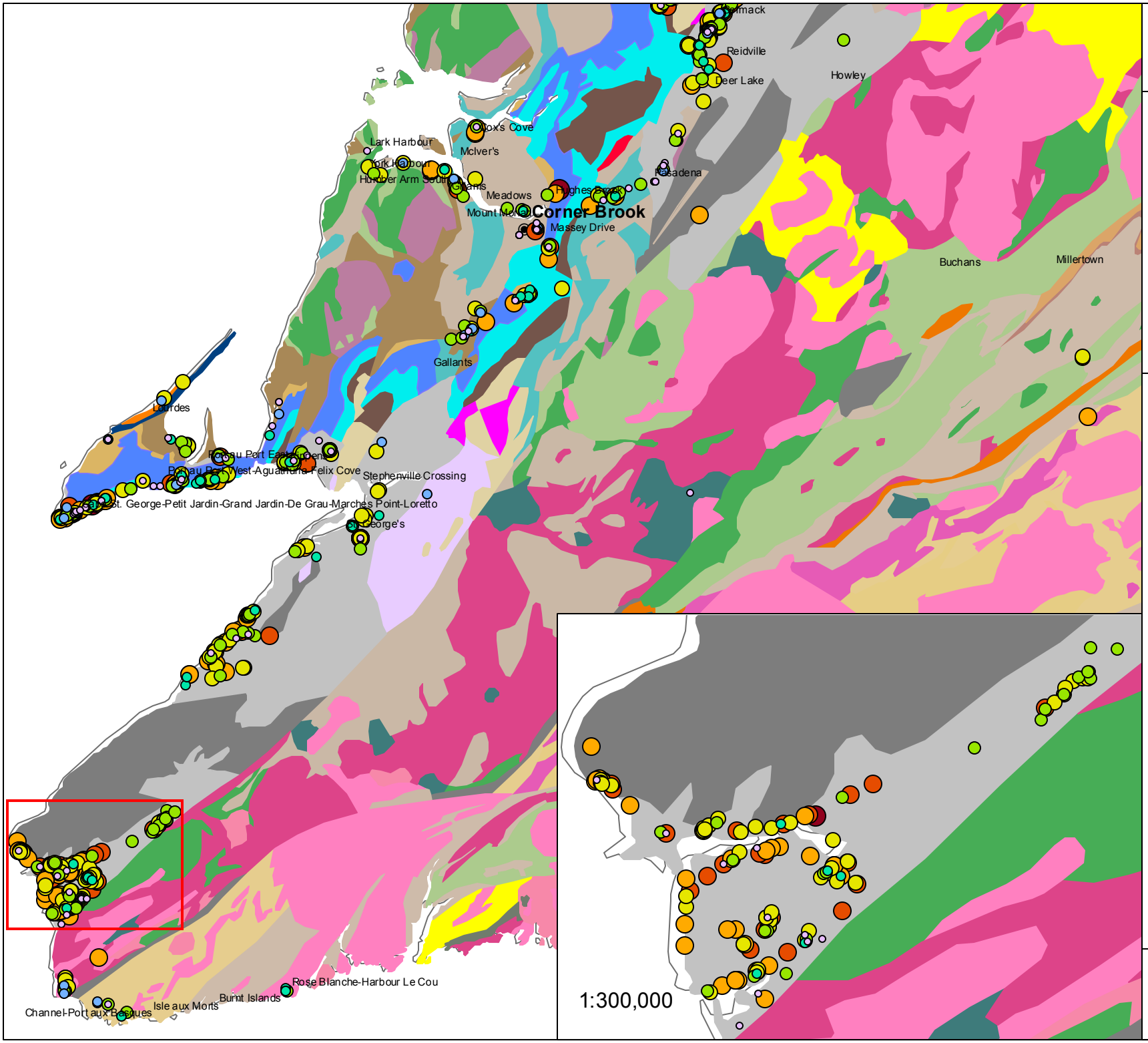
Legend

- A-Pg, Granite
- A-Pggn, Granitic gneiss
- A-Pgn, Gneiss
- A-Psgn, Pelitic gneiss
- ANga, Gabbroid
- ANggn, Granitic gneiss
- ANsgn, Metasedimentary gneiss
- APsgn, Pelitic gneiss
- COg, granitoid suites
- COm, mafic intrusions
- COs, siliciclastic sediments
- COsg, siliciclastic sediments
- COsl, siliciclastic and carbonate rocks
- COsm, sedimentary and volcanic melange
- COu, ultramafic rocks
- COv, submarine mafic to felsic volcanics
- Cc, carbonate rocks
- Cs, siliciclastic and evaporitic sediments
- DCg, granitoid suites
- DCsv, sedimentary and volcanic rocks
- M1qd, Quartz diorite
- M2ga, Gabbro
- M2gr, Granite
- M2mga, Ferrodiorite
- M2mv, Basalt
- M2pv, Peralkaline rhyolite
- M3ga, Gabbro
- Mm, mafic intrusions
- OSs, turbidites
- OSsm, melange
- Oc, carbonate rocks
- Og, granitoid suites
- Osf, turbidites and carbonate breccia
- Osm, shale-matrix ophiolitic melange
- P-Mg, Granitoid
- P-Mgn, Gneiss
- P1P2gn, granitoid gneiss and paragneiss
- P2dm, Dolomite marble
- P2eg, Granite
- P2gg, granitoid suites
- P2ggn, Granitic gneiss
- P2m, mafic and anorthositic intrusions
- P2mv, Basalt
- P2mva, Amphibolite
- P2sgn, Pelitic gneiss
- P2sgnT, Metasedimentary gneiss
- P2u, Peridotite
- P3C, undivided mainly metamorphic rocks
- P3COs, marine siliciclastic sediments
- P3COu, siliciclastic and carbonate rocks
- P3Cg, granitoid suites
- P3Cm, mafic intrusions
- P3Crc, siliciclastic sediments and volcanics
- P3Crs, siliclastic and mafic volcanic rocks
- P3eg, Granite
- P3g, granitoid suites
- P3gdn, Granodiorite gneiss
- P3ggn, Granitic gneiss
- P3sd, siliciclastic sediments
- P3sf, siliciclastic sediments
- P3sgn, Pelitic gneiss
- P3st, turbidites
- P3vb, subaerial mafic and felsic volcanics
- P3vl, mafic and felsic volcanic rocks
- P3vm, mafic volcanic and sedimentary rocks
- SDg, granitoid suites
- SDm, mafic intrusions
- SDs, sandstone conglomerate shale limestone
- Ss, siliciclastic sediments
- Sv, subaerial mafic and felsic volcanics

CBCL LIMITED
Consulting Engineers

FIGURE 3.15e
Bedrock Unit Descriptions

Newfoundland and Labrador Drilled Well Database



CBCL LIMITED
Consulting Engineers

FIGURE 3.16a
Bedrock Well Yield: Western Newfoundland

Newfoundland and Labrador Drilled Well Database

Legend

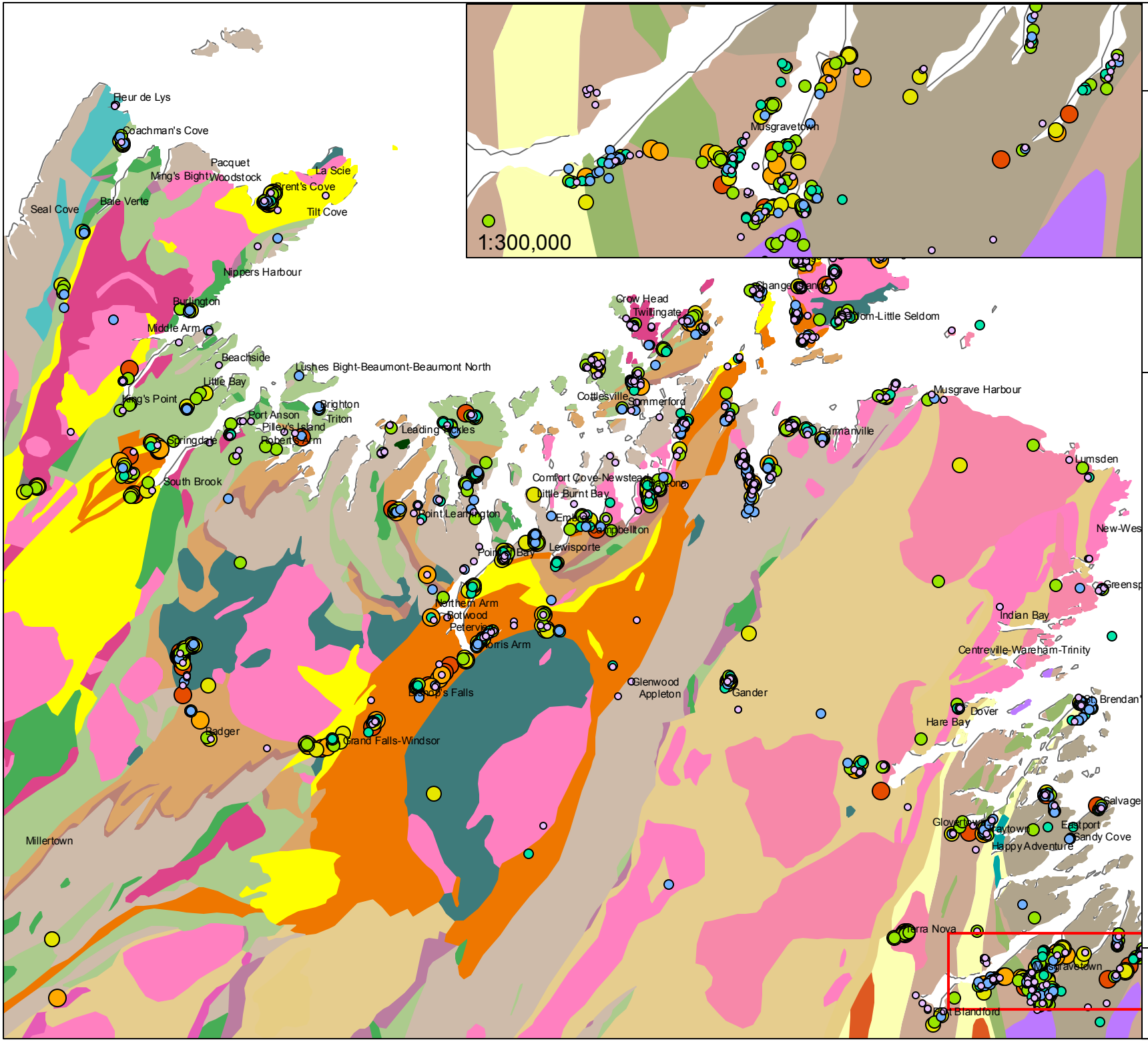
Yield at Well (L/min)

- 0 - 1
- 2
- 3 - 5
- 6 - 20
- 21 - 50
- 51 - 100
- 101 - 500
- 501 - 1800

Scale 1:1,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 12:07:59 PM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.16b
Bedrock Well Yield: North Central Newfoundland

Newfoundland and Labrador Drilled Well Database

Legend

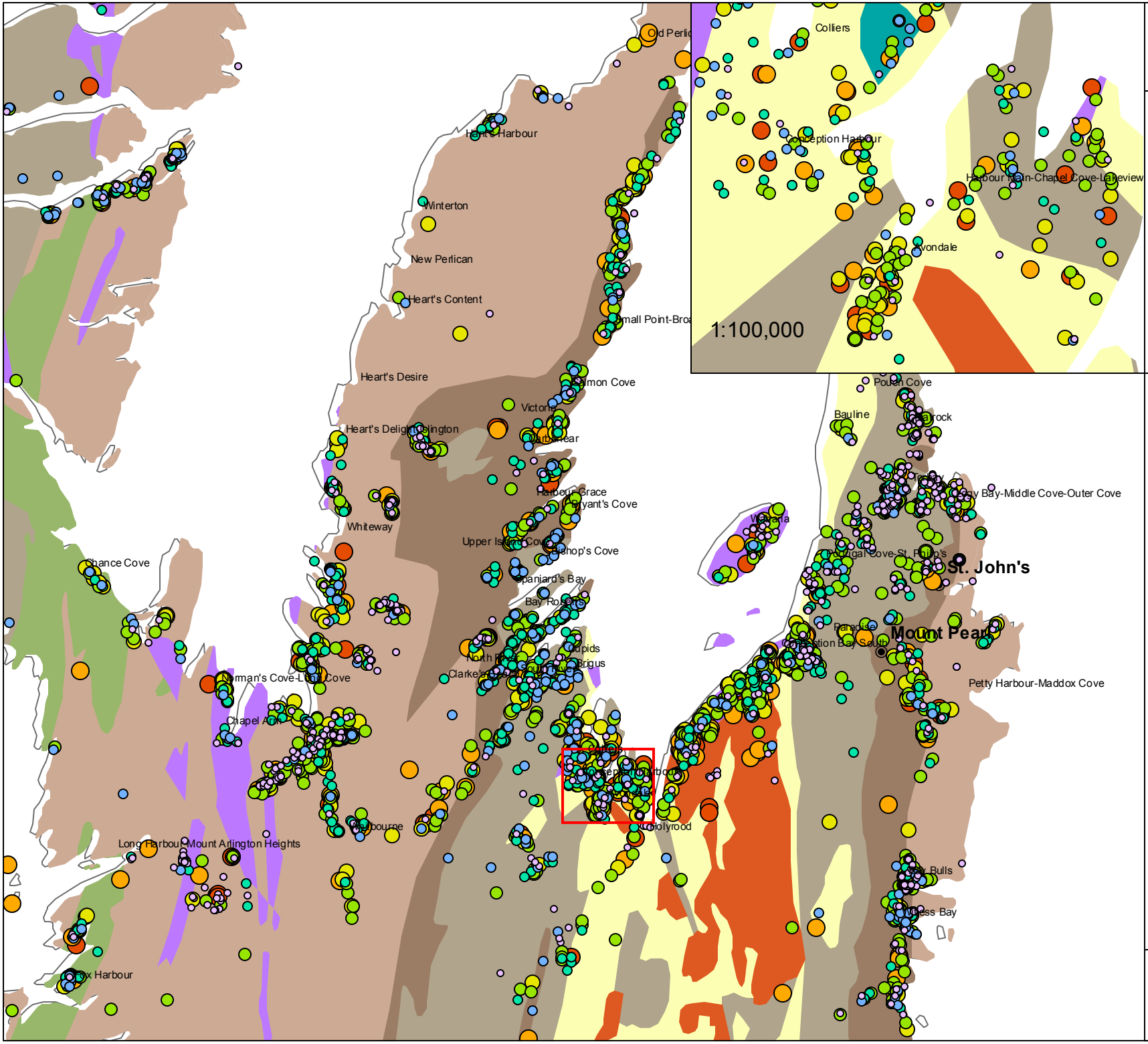
Yield at Well (L/min)

- 0 - 1
- 2
- 3 - 5
- 6 - 20
- 21 - 50
- 51 - 100
- 101 - 500
- 501 - 1800

Scale 1:1,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 12:14:45 PM

L:\103064 - NFLD Water Well



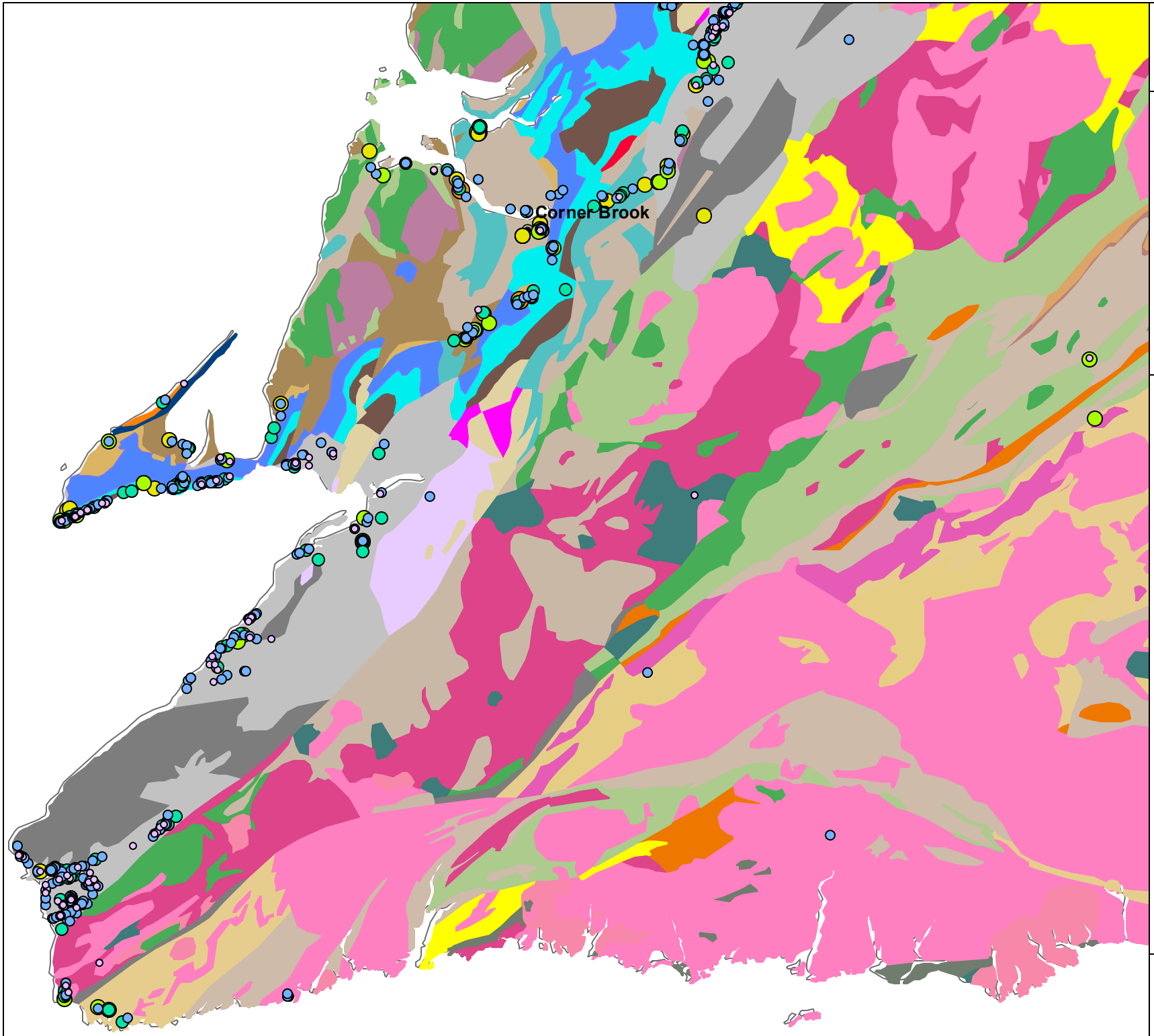
CBCL LIMITED
Consulting Engineers

FIGURE 3.16c
Bedrock Well Yield: Avalon Peninsula

Newfoundland and Labrador Drilled Well Database

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 12:21:54 PM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.17a
Well Depth: Western Newfoundland

Newfoundland and Labrador Drilled Well Database

Legend

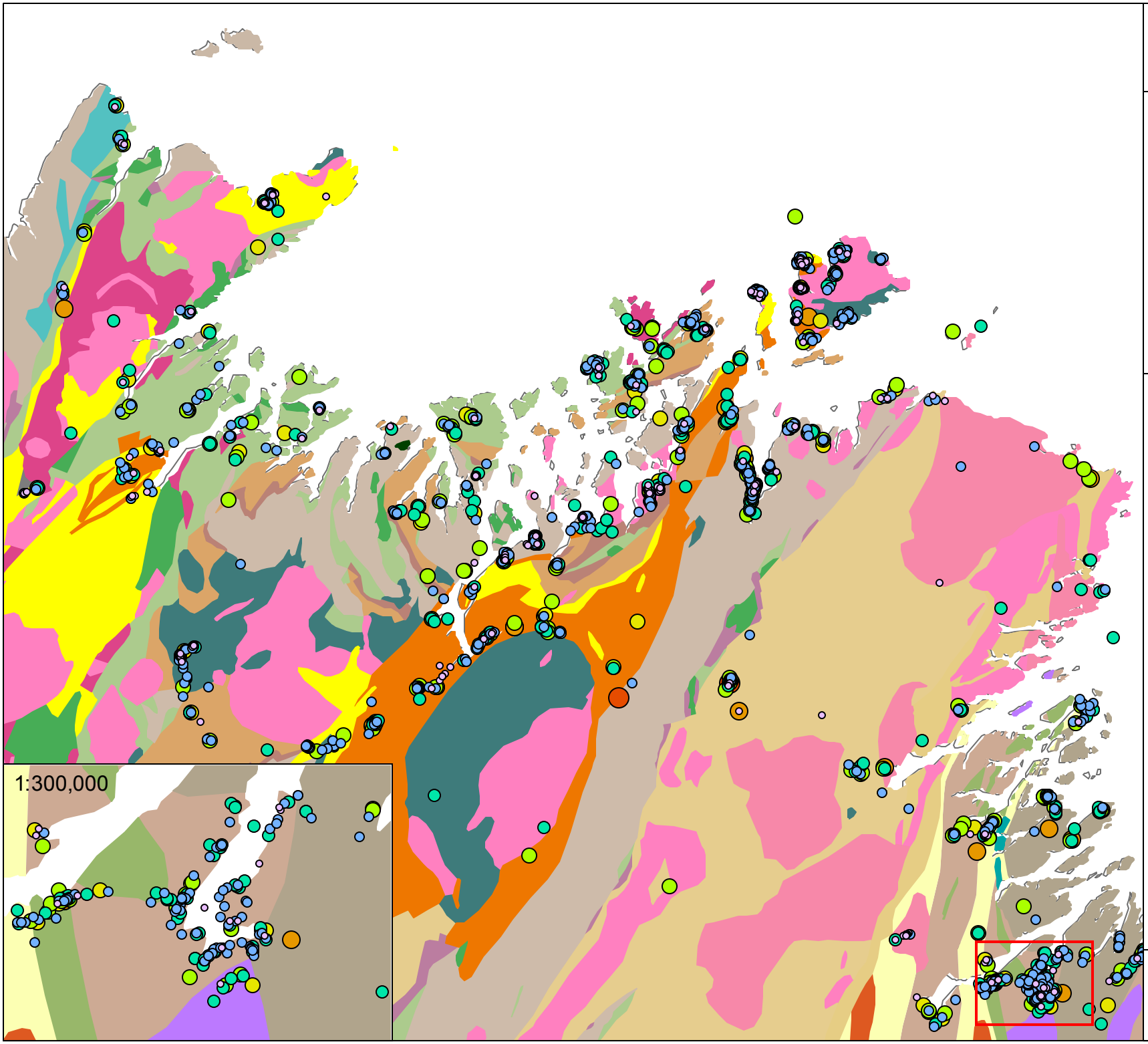
Well Depth (m)

- 0-20
- 20-50
- 50-75
- 75-100
- 100-150
- 150-200
- 200-400

Scale 1:1,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 12:24:04 PM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.17b
Well Depth: North Central Newfoundland

Newfoundland and Labrador Drilled Well Database

Legend

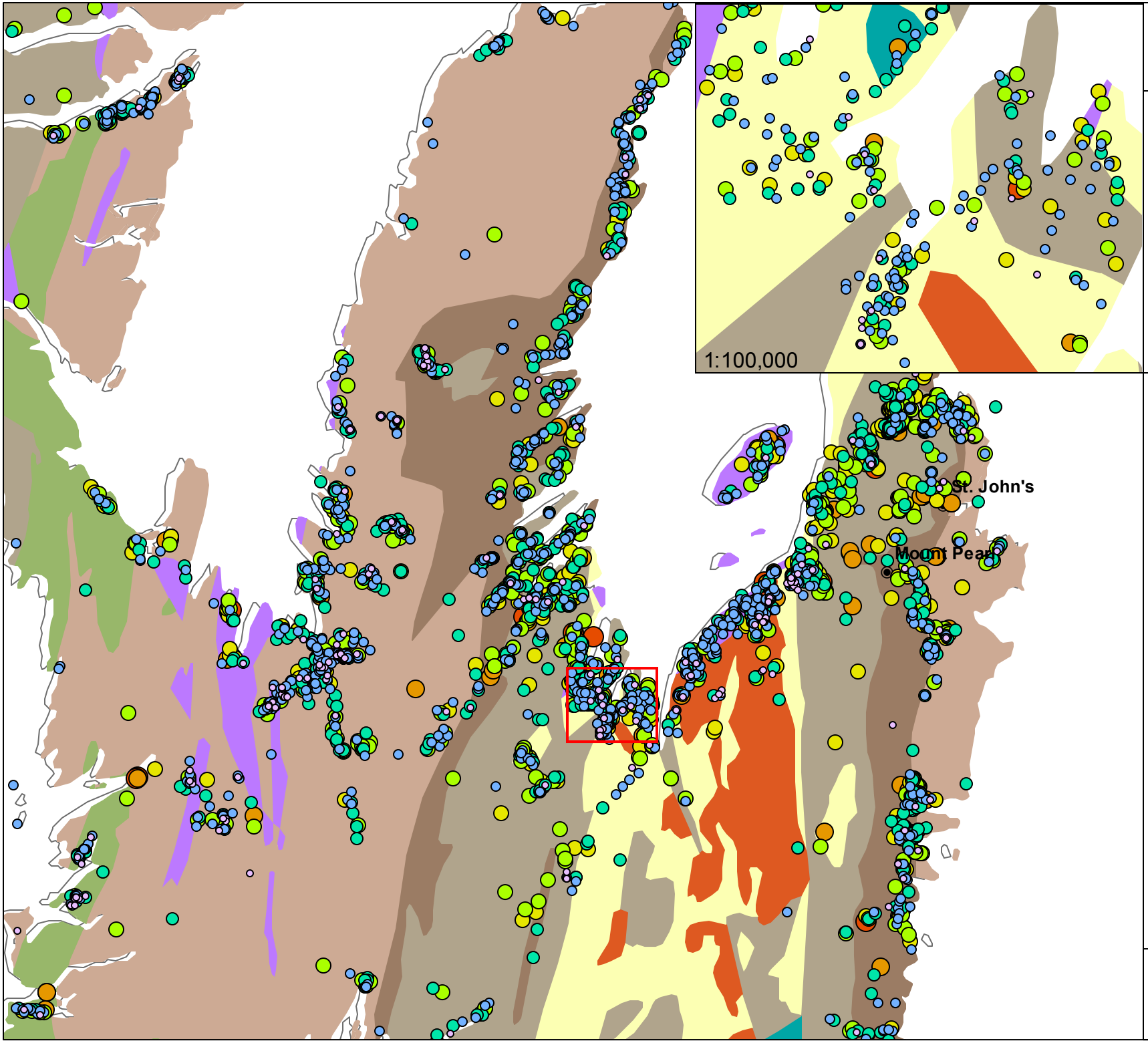
Well Depth (m)

- 0-20
- 20-50
- 50-75
- 75-100
- 100-150
- 150-200
- 200-400

Scale 1:1,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 12:29:15 PM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.17c
Well Depth: Avalon Peninsula

Newfoundland and Labrador Drilled Well Database

Legend

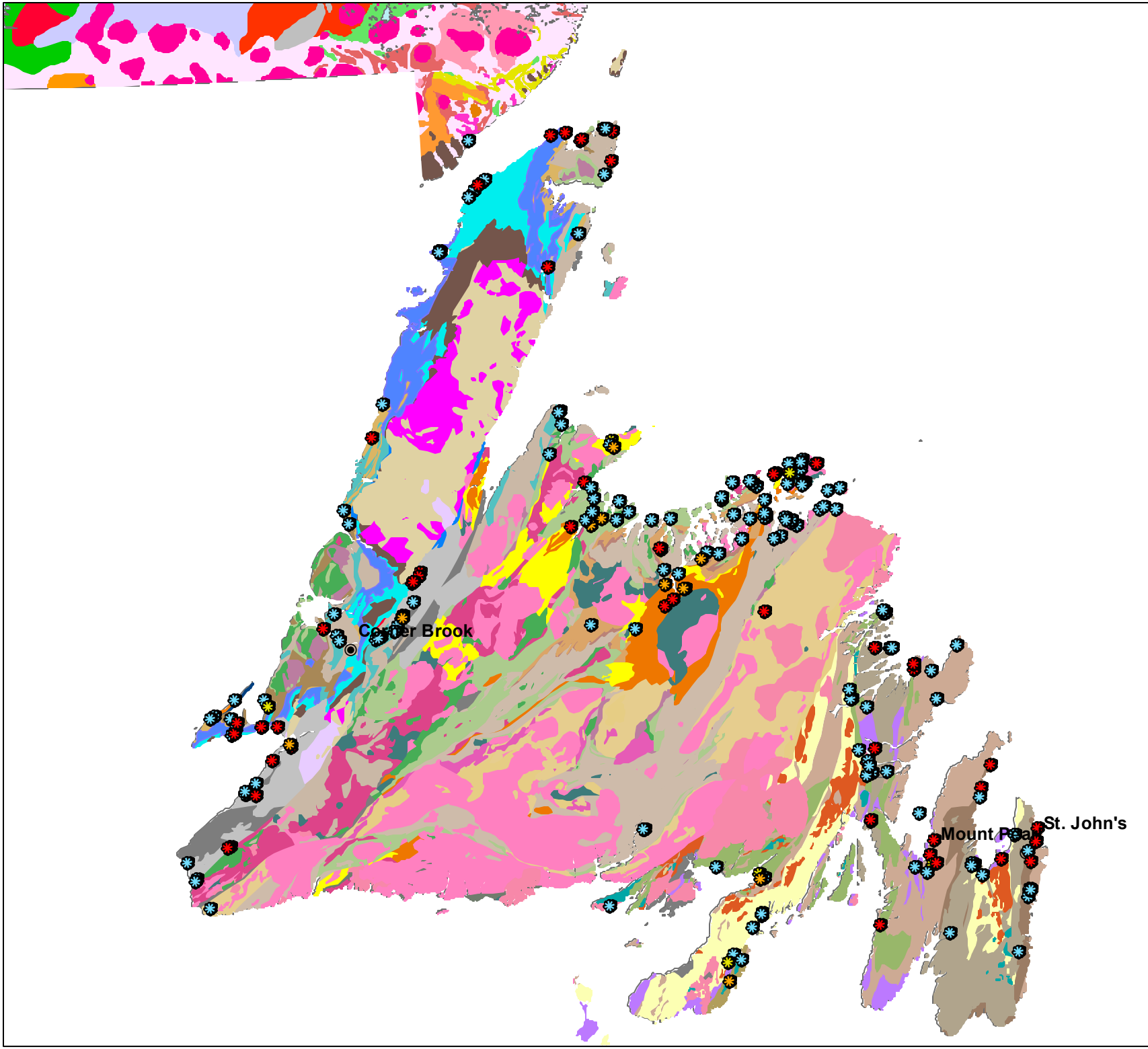
Well Depth (m)

- 0-20
- 20-50
- 50-75
- 75-100
- 100-150
- 150-200
- 200-400

Scale 1:500,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/18/2011 12:32:43 PM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.18
Abandoned Wells

Newfoundland and Labrador Drilled Well Database

Legend

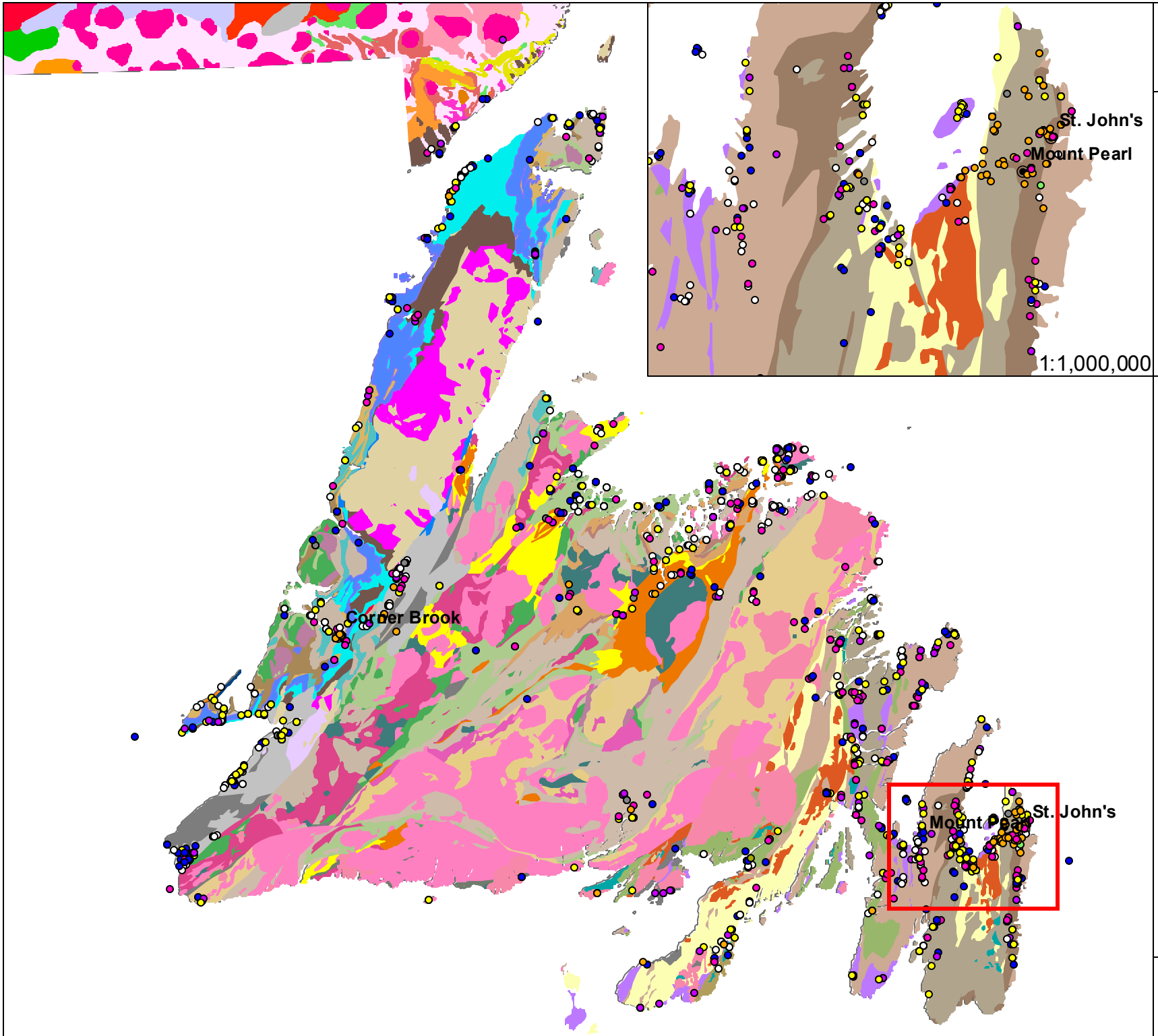
Abandoned Wells

- Caved or Blocked
- Poor Quality
- Poor Quantity
- Salt

Scale 1:3,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/13/2011 5:45:54 PM

L:\103064 - NFLD Water Well



CBCL LIMITED
Consulting Engineers

FIGURE 3.19
Well User Types

Newfoundland and Labrador Drilled Well Database

Legend

Water Use

- MUNICIPAL (522)
- PUBLIC SUPPLY (343)
- COMMERCIAL (257)
- INDUSTRIAL (285)
- HEAT PUMP (131)
- IRRIGATION (3)
- STOCK (2)
- OBSERVATION HOLE (38)
- ABANDONED (480)

Scale 1:3,000,000

CBCL Project # 103064.00
Datum: NAD 1983 Canada Atlas Lambert
4/19/2011 12:25:58 PM

L:\103064 - NFLD Water Well

CHAPTER 4 RECOMMENDATIONS

4.1 Raw Data Collection

Database edits were required to correct and format data that was input incorrectly, or that was input in an inconsistent format. Inconsistencies may be generated by the drillers at the time of logging, by the drilling company when the information is transcribed, or by the data processor who inputs the log information. It is recommended that the method of data collection be updated to take advantage of current technology and software and increase consistency in the data.

It is recommended that the DOEC Drilled Water Well Record be reformatted and issued in both digital and hardcopy format. The digital format would comprise a form prepared in portable document format (pdf) with drop-down lists where appropriate. Each field in the form could be programmed to accept only the appropriate format, number of digits, and decimal places (e.g. GPS coordinate entry). The form would likewise prompt the user to complete required fields before being saved and/or submitted on-line. The saved form could be linked directly to the database, exporting the data into the database and creating a link to the pdf itself. The form could also be formatted to allow for printing and manual completion. Manually completed forms would be transferred to a digital version of the form as a means of linking into the database. An example form is provided in Appendix A.

The resulting standardized field structure would conform to best practices with respect to database design. The structure of the new design would be more rigid in its layout (i.e. fewer comment fields) and more robust in the way that data can be sorted, analyzed and viewed by users.

The following specific items are recommended:

- Use whole integers for the depth of well and possibly for most of the stratigraphic depth entries.
- Limit entry of coordinate data to decimal degree format, four decimal places.
- Limit the number of characters allowed in comment fields.
- Include colloquial terms as allowable input in the form, but automatically recode these terms to the associated technical term (e.g. allow “PUG” on the input form but automatically recode to “MUCK” when transferred to the database).

4.2 Location Information

To encourage consistency, reduce entry errors, and allow for efficient mapping, it is recommended that all future coordinate data be recorded and stored in decimal degree format. This information can be automatically re-projected to populate the UTM Eastings and Northings, and if desired, the DegMinDecimalSec (DMS.x) field. Alternatively, it may be expedient to eliminate the DMS.x field.

The DMS.x field is a long entry format (example 45 32 12.4N -54 55 11.9W), and based on an analysis of the existing database has been prone to errors. Although these coordinates are now collected using handheld GPS units, it appears that the data is commonly transcribed by hand at least once before being entered into the database. For example, the "seconds" field should have a maximum value of 59.99, but entries such as 87.8 and 91.4 etc. are common.

It is further recommended that the "TOWN" field be further sorted and differentiated to eliminate redundancy in future record entry. Some community names (e.g. Black Duck Cove) appear in the Gazetteer up to five times. If possible these communities should be differentiated by region or map direction, allowing for better sorting options.

Some records were identified as potentially incorrect. These records were flagged in the georeferencing field with the modifier "-check" (e.g. MAP-check). It is recommended that each of these records be checked by hand against the original record to establish new location data. In some cases these coordinates were missing a digit, assigned a negative value, or placed in the wrong column. The data cannot be corrected without manual checking. If coordinate data are unavailable for these records, they should be assigned coordinates using the LGID method.

Several LGID coordinates were noted to fall outside of the LGID administrative boundary or over water. Records that were assigned coordinates based on this LGID centroid were also marked with the modifier "-check". The administrators of the LGID dataset noted that the dataset was incomplete and contained errors. When LGIDs with incorrect centroid coordinates have been corrected, well records associated with those LGID centroids can be updated automatically. It is recommended that the updated and corrected LGID coordinates be obtained as soon as possible, and that the associated well record coordinates likewise be updated.

4.3 Geology and Hydrogeology Data

Hydrogeological investigations have been completed or are forthcoming for Western Newfoundland, Eastern Newfoundland, and Labrador. Mapping from these studies will provide bedrock unit groupings into major hydrostratographic units. GIS map layers from these studies should be compared to and incorporated into the results of the current updates and analysis. Digital map layers from these studies were unavailable at the time of this investigation.

Summary data on the yield, depth, and depth to bedrock could be further analyzed according to the rock groupings used in this investigation, or using those provided in the Hydrogeological Investigations of Newfoundland and Labrador. By extracting data for each unit the median, mean, quartile values, and histograms of these fields could be prepared to provide generalized properties of bedrock types or HUs of Newfoundland and Labrador. The data could furthermore be mapped using coupled data such as yield and rock type, yield and depth, yield and water use etc. to provide further information on the distribution and performance of water wells in the province.

CHAPTER 5 REFERENCES

Dillon Consulting Ltd., 2000. Recommendations on the Development of a Province Wide Strategy for the Protection of Municipal Groundwater Supplies in Prince Edward Island. 123p.

Driscoll, F.G., 1986. Groundwater and Wells, 2nd Ed. Johnson Screens, Saint Paul, Minnesota. Eighth Printing. 1089 p.

Freeze, R.A. and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, N.J.

Newfoundland and Labrador Department of Environment, 2010. Drilled Well Database.

Interactive Map of Geology, Geophysics, Geochemistry Mineral Occurrences, Claims, Drill Core Reports, and Maps. Newfoundland and Labrador Department of Natural Resources. Klassen, R.A., Paradis, S., Bolduc, A.M. and Thomas, R.D. 1992. http://gis.geosurv.gov.nl.ca/; accessed April 19,2011.

Nova Scotia Department of Environment and Labour (NSE), 2011. Pumping Test Database (1973-present).

Nova Scotia Department of Environment and Labour (NSE), 2011. Water Well Database (1978 to Present).

Poehls, D.J., and Smith, G.J., 2009. Encyclopedic Dictionary of Hydrogeology. Elsevier Academic Press, Burlington, MA. 517p.

APPENDIX A

Water Well Inventory – Page 1

Resident Name _____

911 Number _____ Road _____

Address _____

_____

Phone Number _____ email _____

Property Owner: ☐ Yes ☐ No If No, Property Owner's Name _____

Previous Property Owners _____

Number of Wells on property _____ ☐ Don't Know

Type of Well: ☐ Drilled ☐ Dug ☐ Sand Point ☐ Other _____ ☐ Don't Know

Diameter of Well: ☐ 2 inches ☐ 4 inches ☐ 6 inches ☐ 8 inches ☐ 3 feet ☐ Don't Know

Depth of Well _____ ☐ Don't Know

Depth to Water _____ ☐ Don't Know

Pump Depth _____ ☐ Don't Know

Pump Type _____ ☐ Don't Know

Water Source: ☐ Bedrock ☐ Sand/Gravel/Overburden ☐ Don't Know

Name of Well Driller _____ ☐ Don't Know

Date Installed _____ ☐ Don't Know

I have the MOE Water Well Record ☐ Yes ☐ No ☐ Don't Know

MOE Water Well Record Number _____ ☐ Don't Know

Type of Water Use: ☐ Domestic ☐ Farm ☐ Irrigation ☐ Industrial ☐ Other _____

Water Treatment: ☐ Softener ☐ Sand Filter ☐ Carbon Filter ☐ Fiber Filter ☐ Aluminum Oxide

☐ UV ☐ Reverse Osmosis ☐ Distillation ☐ Ion Exchange ☐ Ozonation

Other Water Treatment _____ ☐ Don't Know

Water Well Inventory – Page 2

Condition of Well Casing ☐ Good ☐ Buried ☐ Corroded ☐ Seized ☐ Broken ☐ Don't Know

Other _____

Any problems with water quantity in the past? ☐ Yes ☐ No

Any problems with water quality in the past? ☐ Yes ☐ No

If yes, what type ? ☐ Sulphur smell ☐ Iron taste ☐ Brown water ☐ Bacteria

Other _____

Location of Septic Bed _____

Potential Sources of Contamination: ☐ barn ☐ manure pile ☐ gas tanks ☐ heating oil tank

Other _____

Is the well easily accessible? ☐ Yes ☐ No

If Yes, may we measure the water level in this well? ☐ Yes ☐ No

Describe Well Location _____

_____

Sketch a diagram to show the location of well(s), house, buildings, road(s), and septic bed:

Important!! Learn to protect your water supply. Ask us for an information package or visit:

www.gca.ca

www.wellaware.ca