
16.0 HYDROGEOLOGY OF ROBINSONS-ST.FINTANS ADA

16.1 General Description of Area

16.1.1 Location & Extent

The Robinsons – St. Fintans ADA is located along the southwest coast of Newfoundland, comprising an area of approximately 18,784 hectares, and encompassing an approximately 30 km long stretch of coast extending from just south of the community of Journois southward to the community of Highlands. The boundary of the Robinsons – St. Fintans ADA is shown on Drawing No. 1034406-16-1 in Appendix 16a.

The Robinsons – St. Fintans ADA overlaps the communities of Fischells, Heatherton, Robinsons, Cartyville, McKay's, Jeffrey's, St. David's, Maidstone, St. Fintan's, Loch Leven, and Highlands.

The main access to the Robinsons – St. Fintans ADA is provided by the Trans Canada Highway, and secondary Highway Routes 404 (Robinsons Road) and 405 (Highlands Road), which branch of the Trans Canada Highway and lead west to various communities along the coast. In addition, various graveled roads and ATV trails leading from the Trans Canada and Highway Routes 404 and 405 also provide access to some areas within the ADA.

16.1.2 Physiography, Topography & Drainage

The Robinsons – St. Fintans ADA is located within the physiographic region referred to as the West Coast Lowlands. This physiographic region is characterized by a low-lying coastal plain that is bounded by various upland regions, including the Lewis Hills and Serpentine Range in the north, the Long Range Mountains in the east, and the Anguille Mountains in the south. The Robinsons – St. Fintans ADA is characterized by undulating to hummocky terrain that slopes westward to the coast and is bisected by a number of west-trending stream and river valleys that drain directly to the Gulf of St. Lawrence. Elevations in the vicinity the ADA are generally less than 150 m above sea level with isolated hills rising above this level. Higher elevations are present in upland regions west of the ADA, with maximum elevations of up to 600 m above sea level present in the Long Range Mountains, located approximately 40 km east of the ADA. Coastal areas in the vicinity of ADA are relatively even and slope gently to the coast.

The Robinsons – St. Fintans ADA encompasses the lower courses of several stream and river systems with the largest being the Crabbe River drainage system. Other watercourses in the area include Fischell's Brook, Robinson's River, Middle Barachois River and Highland's River. The headwaters of these stream and river systems originate in the upland regions east of the ADA. Numerous small ponds are also common in the area.

No surface water Public Protected Water Supply Areas (PPWSA) are present within the ADA or its drainage catchment area.

16.1.3 Climate, Vegetation & Agricultural Land Use

The Robinsons – St. Fintans ADA is located within the Western Newfoundland ecoregion, one of the largest ecoregions in the province, stretching from the Codroy Valley in the south to Bonne Bay in the north and extending inland from the west coast and including much of the Long Range Mountains. This ecoregion is characterized by a humid climate with a relatively longer frost-free period compared to other parts of the island. The Robinsons – St. Fintans ADA is located within the Codroy subregion, and is characterized by the most favorable climate conditions in the island, with warm summers and the longest growing season. No specific climate data is available for the Robinsons – St. Fintans ADA. In lieu of this, climate data obtained from Environment Canada's nearby Stephenville Airport monitoring station dating back to 1971 was used to characterize climatic conditions in the ADA. The monthly mean temperature in the area is 4.6°C, ranging from a high of 16.2°C in August to a low of -7.5°C in February. Average annual precipitation in the area is 1,352 mm, of which 73% falls as rainfall and 27% as snowfall. January is typically the wettest month, and April is typically the driest month (Environment Canada, 2008). In the ADA, there are an average of 1,324 growing degree days (base temperature 5°C) for the year and 1,205 growing degree days for the vegetative season (i.e., May to September).

The landscape in the vicinity of the Robinsons – St. Fintans ADA is dominated by good forest growth. The main tree species is balsam fir in association with black spruce and white spruce. Yellow birch, trembling aspen and tamarack are common. Eastern white pine, black ash, balsam poplar, and white birch also occur. On flat coastal areas, extensive plateau bogs occur, while slope fens and alder swamps are the dominant wetland type on nutrient rich slopes and valleys. Based on agricultural land use information provided by the NL Department of Natural Resources Agrifoods Division, approximately 1,595 hectares (i.e., 8% of the total landmass of the ADA) is currently utilized for agriculture, with forage, pasture and vegetable crop land representing the most significant proportion of the ADA's agricultural land use.

16.2 Geology

16.2.1 Surficial Geology

The surficial geology of the Robinsons – St. Fintans ADA is summarized in Drawing No. 1034406-16-2 in Appendix 16a, and is based on most recent 1:50,000 scale mapping of the area by Liverman and Sheppard (1999) and Liverman (2001), as well as descriptions of surficial geology provided in Hender (1989) and Liverman, *et al.* (1999). For the purposes of this study, surficial geological units on existing maps have been simplified into four (4) groups, including exposed bedrock, areas of bog, areas of till and areas of sand and gravel.

The majority of the ADA is underlain by thick deposits of glacial outwash and fluvial sand and gravel that occur as a relatively flat coastal flood plain, with local areas of undulating raised terraces, and remnant eskers. The glaciofluvial deposits are locally eroded and dissected, and marked by meltwater channel scars. Sand and gravel units shown in Drawing No. 1034406-16-2 in Appendix 16a also include un-subdivided marine terraces that contain various silt and clay deposits in addition to sands and gravels and occur locally in coastal areas of the ADA. A silty clay to sandy loam glacial till derived from sandstone, siltstone, conglomerate, shale, and lesser amounts of igneous and metamorphic rocks is also present within the ADA, occurring mainly as blanket moraine deposits bordering the glaciofluvial sand and gravel at higher elevations inland along the west boundary of the ADA. Local areas of

lineated till are also present in the northern portion of the ADA, where they display flute features indicating dominantly west and northwest-directed ice flow. Along with glacial units, deposits of organic and peaty soils are common in the vicinity of ADA, overlying either till or bedrock. Bog areas are particularly significant in the northern portion of the ADA in the vicinity of Robinsons River and Bank Head, where they are the dominant surficial sediment. Only local, isolated knobs of bedrock outcrop are exposed within the till and various other surficial deposits that underlie the ADA, and occur as areas of high ground. Bedrock outcrops may be partially or fully concealed by a thin mat of vegetation and sparse forest. In addition, local development of rock talus or colluviums occur along steep valleys within the ADA. Available well logs indicate an average overburden thickness in the Robinsons – St. Fintans ADA and surrounding area of approximately 20 m.

16.2.2 Bedrock & Structural Geology

The bedrock geology of the Robinsons – St. Fintans ADA is summarized in Drawing No. 1034406-16-3 in Appendix 16a, and is based on the regional 1:250,000 scale compilation mapping by Colman-Sadd and Crisby-Whittle (2005), as well as a description of bedrock geology provided in Boyce, *et al.* (2000) and Knight, *et al.* (2008).

The ADA is by a thick sequence of fluvial, alluvial and lacustrine sandstones, siltstones, shales, as well as minor evaporitic rocks of the Barachois, Codroy, and Anguille Groups. These Carboniferous sedimentary units represent clastic fill deposited within a large pull-apart successor basin, referred to as the Bay St. George Basin, following Devonian Acadian orogenesis

The Carboniferous rocks that underlie the ADA have undergone regional northeast-trending folding and faulting related to the Pennsylvanian to Permian Maritime Disturbance (Alleghenian Orogeny). The most prominent structural feature in the area is the Long Range fault, a regional northeast trending shear zone that defines the boundary between the Humber and Dunnage tectonostratigraphic zones, is located east of the ADA.

16.3 Hydrogeology

16.3.1 Hydrostratigraphy

The groundwater potential of the various geological units within the Robinsons – St. Fintans ADA was assessed utilizing available records for water wells completed within each unit obtained from the NLDEC-Water Resources Management Division Drilled Water Well Database for wells drilled between 1950 and March, 2008. The data provided in the well records are organized by community and includes information on the well depth and yield, well casing depth and diameter, depths to water bearing zone(s), plus data on the quality and use of the water and the driller's description of the depth and lithology of the overburden and bedrock units encountered.

A total of 78 drilled bedrock wells and 53 drilled surficial wells from 10 communities in the ADA and surrounding area had adequate well data to evaluate the groundwater potential of various surficial and bedrock strata in the ADA. Since lithologic information provided in the well records was of insufficient detail to define the bedrock encountered in each individual drilled well, the wells were assigned to their respective geologic units based on the community in which the wells were located and the corresponding underlying geologic unit, as shown on the bedrock geology map provided in Drawing No. 1034406-16-3 in Appendix 16a.



The groundwater potential of each geological unit was quantified by assessing the reported well yields and depths from the records of wells completed within each unit. Reported yields for drilled wells in the Robinsons – St. Fintans ADA to obtain a rough estimate of well capacity, and does not necessarily represent the short or long term safe yield of the well, or the groundwater yield characteristics of the corresponding aquifer. To accurately determine such values, aquifer testing, including step drawdown and constant rate pump testing must be conducted, ideally with monitoring of groundwater levels in nearby observation wells. No aquifer testing has been carried out on any of the drilled wells in the ADA and surrounding area. Therefore, in the absence of this data, the groundwater potential of the various geological strata in the Robinsons – St. Fintans ADA is defined based on the estimated well yields obtained from the driller's records.

16.3.1.1 Surficial Hydrostratigraphic Units

The surficial deposits within the Robinsons – St. Fintans ADA have been subdivided into two broad hydrostratigraphic units, including one comprised of till deposits, and the other predominantly of sands and gravels. The yield and depth characteristics of these units are summarized on Table 16.1. No water well information was available for the till deposits present in the ADA. Therefore groundwater potential within this overburden unit was inferred based on well records for similar overburden material in the St. John's ADA.

Till Deposits

Till deposits mainly forming blanket moraine and comprising a silty clay to sandy loam are present at higher elevations inland along the west boundary of the ADA. There are no documented data on the groundwater potential of the till material in the Robinsons – St. Fintans ADA. However, based on records of water wells within similar till material in the St. John's ADA, the range of yields from wells within the till can be expected to vary from 10 to 70 L/min at depths of 9.5 to 35 m. The average yield is estimated to be approximately 40 L/min at 21 m depth. However, median yield and depth estimates of 34 L/min at 20 m depth are more likely representative of the typical groundwater potential of this unit.

Sand and Gravel Deposits

Sand and gravel deposits of glacial outwash and fluvial origin underlie the majority of the ADA. These deposits are potentially significant groundwater aquifers. Fifty-three (53) wells from the communities of Cartyville, St. David's, Robinsons, Loch Leven, Jeffrey's, Highlands and Heatherston were available to characterize the groundwater potential of this unit in the ADA. Based on well data, the sand and gravel deposits are considered capable of providing wells with moderate yields, having water yields ranging from 4 to 160 L/min at well depths of 9 to 56 m, and an average yield of 46 L/min at 23 m depth. However, median yield and depth estimates of 45 L/min at 23 m depth are more likely representative of the typical groundwater potential of this unit.

Table 16.1 Summary of Overburden Drilled Well Information for Robinsons – St. Fintans ADA

Overburden Unit	Communities	No. of Wells	Well Depth (m)		Well Yield (L/min)	
			Mean (Median)	Range	Mean (Median)	Range
Till*	St. John's ADA	6	21.3 (19.6)	9.5-35	39.5 (33.5)	10-70
Sand & Gravel	Cartyville, St. David's, Robinsons, Loch Leven, Jeffrey's, Highlands Heatherton	53	23 (23.4)	8.7-56	45.7 (45)	4-159.1

* Groundwater yield estimates for the till deposits based on well data from the St. John's ADA

16.3.1.2 Bedrock Hydrostratigraphic Units

Well record information is available for the Carboniferous sedimentary cover rocks that underlie the majority of the ADA. The well yield and depth characteristics of this unit are summarized in Table 16.2.

Carboniferous Sedimentary Cover Rocks

A total of 78 well records from the communities of Cartyville, St. Fintan's, St. David's, Robinsons, McKay's, Maidstone, Loch Leven, Jeffrey's, Highlands and Heatherton were used to characterize the groundwater potential of the Carboniferous sedimentary cover rocks. This unit underlies all of the ADA. Based on well data, the Carboniferous sedimentary cover rocks strata are considered capable of providing wells with moderate yields, having water yields ranging from 3 to 480 L/min at well depths of 6 to 92 m, and an average yield of 59 L/min at 42 m depth. However, median yield and depth estimates of 46 L/min at 40 m depth are more likely representative of the typical groundwater potential of these units.

Table 16.2 Summary of Bedrock Drilled Well Information for Robinsons – St. Fintans ADA

Rock Group	Rock Type	Communities	No. of Wells	Well Depth (m)		Well Yield (L/min)	
				Mean (Median)	Range	Mean (Median)	Range
Carboniferous Sedimentary Rocks (Barchois, Codroy and Anguille groups)	Siliciclastic and minor carbonate and evaporitic sedimentary rocks	Cartyville, St. Fintan's, St. David's, Robinsons, McKay's, Maidstone, Loch Leven, Jeffrey's, Highlands, Heatherton	78	41.8 (39.6)	6-92.4	59.4 (45.8)	3-480

16.3.2 Groundwater Flow System

The Robinsons – St. Fintans ADA and surrounding area is underlain by an unconfined aquifer system contained within the overburden material and underlying shallow bedrock. The movement of groundwater through the overburden material is controlled by primary porosity, while groundwater flow within the underlying bedrock can be expected to mainly occur within secondary openings, such as fractures and joints, and will be variable depending on the frequency and interconnection of these structural features.

Shallow groundwater flow within the ADA is controlled by water table conditions and local variations in topography. Groundwater is thought to be recharging along areas of high ground and discharging in

various wet lowland areas, ponds, lakes and rivers, as well as along the coast. It is expected that the shallow groundwater system in the ADA will be largely controlled by surface runoff and local recharge, while at moderate depths the flow system may be influenced by lateral inflow of groundwater from up-gradient areas to the east. Based on a review of water well records for the area, groundwater levels are generally assumed to be within 9 m of the ground surface and to be a subdued reflection of the topography.

16.4 Water Quality

16.4.1 Surface Water Quality

Surface water quality data for the Robinsons – St. Fintans ADA is limited to ambient water quality monitoring data collected as part of the Canada–Newfoundland Water Quality Monitoring Agreement, from the Crabbe’s River monitoring site (NF02ZA0007) over the monitoring period from 1987 to 2004. A summary of chemical data obtained from this surface water source over the monitoring period is provided in Table 16.3 in Appendix 16b, and is compared to the Canadian Drinking Water Quality Guidelines (CDWQG) (Health Canada, 2007), as well as the Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (CWQG-AWU) (October, 2005).

Based on major ion chemistry, surface water in the ADA and surrounding area can be classified as a calcium-sodium-bicarbonate-chloride-sulfate ($\text{Ca-Na-HCO}_3\text{-Cl-SO}_4$) type water. Surface water is neutral to slightly acidic, and of low alkalinity. Classification of surface water according to dissolved-solids and specific conductance indicates fresh conditions.

With the exception of iron, manganese, pH, and turbidity, concentrations of all other parameters tested meet CDWQG over the monitoring period. The guidelines for iron, manganese, pH, and turbidity are aesthetic objectives only and levels of these parameters detected at the surface water locations evaluated do not pose any health concerns, however problems may be experienced such as foul taste, deposition or staining in the case of iron, manganese, and turbidity, and corrosion in the case of pH.

In addition, concentrations of chromium were detected at Crabbe’s River ambient water quality monitoring site over the monitoring period that exceeded CCME CWQG-AWU for irrigation water use.

Based on chemical data, surface water quality within the ADA is considered good, returning an average Canadian Water Quality Index (CWQI) value of 81. Crabbe’s River is not considered a potable water source, and would require treatment for disinfection, as well as to improve the aesthetic quality of the water. In addition, the concentrations of chromium that exceeded CCME CWQG-AWU at the Crabbe’s River monitoring site may limit usage of this surface water source as a potential agricultural water supply without appropriate treatment.

16.4.2 Groundwater Quality

The groundwater quality data for the Robinsons – St. Fintans ADA consists of analyses from three (3) private drilled wells from the community of St. David’s collected by the NL Department of Environment - Water Resources Management Division. A summary of chemical data obtained from these water wells is provided in Tables 16.4 in Appendix 16b, and is compared to the Canadian Drinking Water Quality Guidelines (CDWQG) (Health Canada, 2007), as well as the Canadian Council of Ministers of the

Environment (CCME) Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (CWQG-AWU) (October, 2005).

Based on major ion chemistry, shallow groundwater in the ADA can be classified as a combination of calcium-sodium-bicarbonate-chloride-sulfate ($\text{Ca-Na-HCO}_3\text{-Cl-SO}_4$) and sodium-calcium-chloride-sulfate-bicarbonate ($\text{Na-Ca-Cl-SO}_4\text{-HCO}_3$) type waters. Groundwater in the area is hard, slightly basic, and of moderate alkalinity. Classification of groundwater according to dissolved-solids and specific conductance indicates fresh conditions.

With the exception of iron, manganese, total dissolved solids, and turbidity, concentrations of all other parameters tested in the wells meet CDWQG. The guidelines for iron, manganese, total dissolved solids, and turbidity are aesthetic objectives only and levels of these parameters detected in the wells do not pose any health concerns, however problems may be experienced such as foul taste, deposition or staining.

In addition, concentrations of chloride, manganese, and total dissolved solids detected in several of the private drilled wells in St. David's exceeded CCME CWQG-AWU for irrigation water use.

Insufficient monitoring data was available to determine Canadian Water Quality Index (CWQI) values for groundwater in the ADA. However, available chemical data indicates that groundwater in the ADA and surrounding area is generally of good quality. However, treatment would be required to improve the aesthetic quality of the groundwater. In addition, concentrations of chloride, manganese, and total dissolved solids detected in several of the private drilled wells in St. David's that exceeded CCME CWQG-AWU for irrigation water may limit usage of these groundwater sources as potential agricultural water supplies without appropriate treatment.

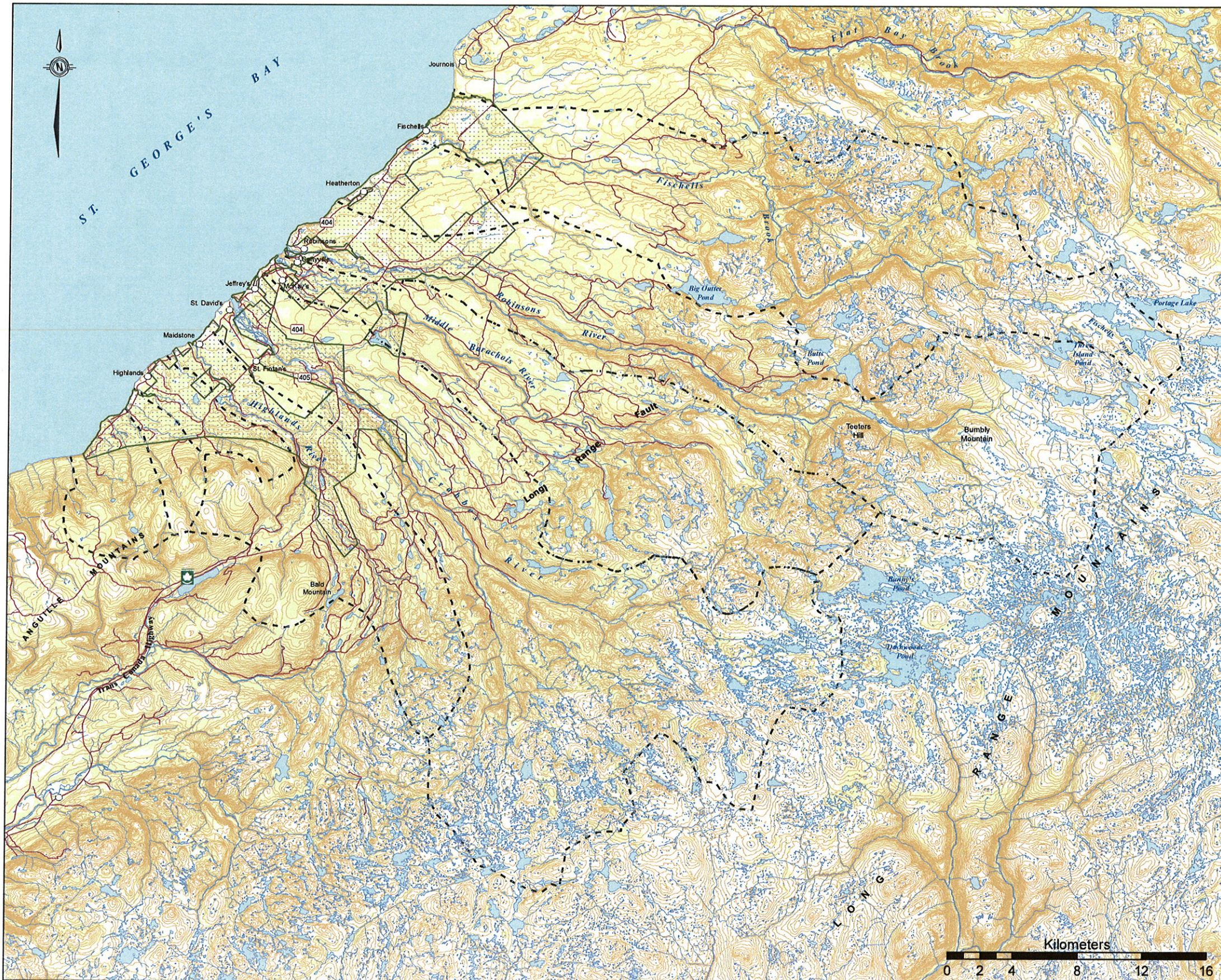
16.5 Groundwater Recharge & Availability

Recharge to the shallow groundwater system underlying the ADA is by direct infiltration of rainfall, after runoff and the requirements of evaporation and plant transpiration have been met, and is directly related to rainfall, infiltration characteristics and size of the recharge zone. A common practice in estimating the long term groundwater recharge for an area is to multiply the groundwater catchment area by the percent of precipitation estimated as able to infiltrate. The recharge to groundwater in the Robinsons – St. Fintans ADA is estimated on the basis of a local groundwater catchment area equivalent to the area of the ADA of approximately 18,784 hectares, and a conservative recharge coefficient of 10% of the mean annual rainfall (i.e., 10% of 1,352 mm, equivalent to 135 mm). Based on these values, the groundwater recharge to the Robinsons – St. Fintans ADA is estimated at $2.5 \times 10^7 \text{m}^3/\text{year}$ or $1,352 \text{m}^3/\text{hectares}/\text{yr}$.

Groundwater use in the area is currently limited to minor individual domestic, public, commercial, and industrial wells. No information is available regarding existing agricultural (i.e., irrigation and livestock) water demands in the Robinsons – St. Fintans ADA, thus preventing an accurate balance of groundwater supply and demand to be estimated, and making it difficult to evaluate groundwater supply potential for future agricultural development in the area. However, considering the current, overall under-utilization of groundwater in the area from other users, it is expected that an adequate supply of groundwater of sufficient quality is available to meet and/or augment water supply requirements for various existing and future agricultural needs in the ADA.

APPENDIX 16a

Drawings



- Transportation Route
- Drainage Catchment Area
- Contour Line
- Waterbody
- Agricultural Development Area
- Wetland/String Bog
- Vegetated Area

PROJECT TITLE:

HYDROGEOLOGY OF AGRICULTURAL DEVELOPMENT AREAS, NEWFOUNDLAND AND LABRADOR

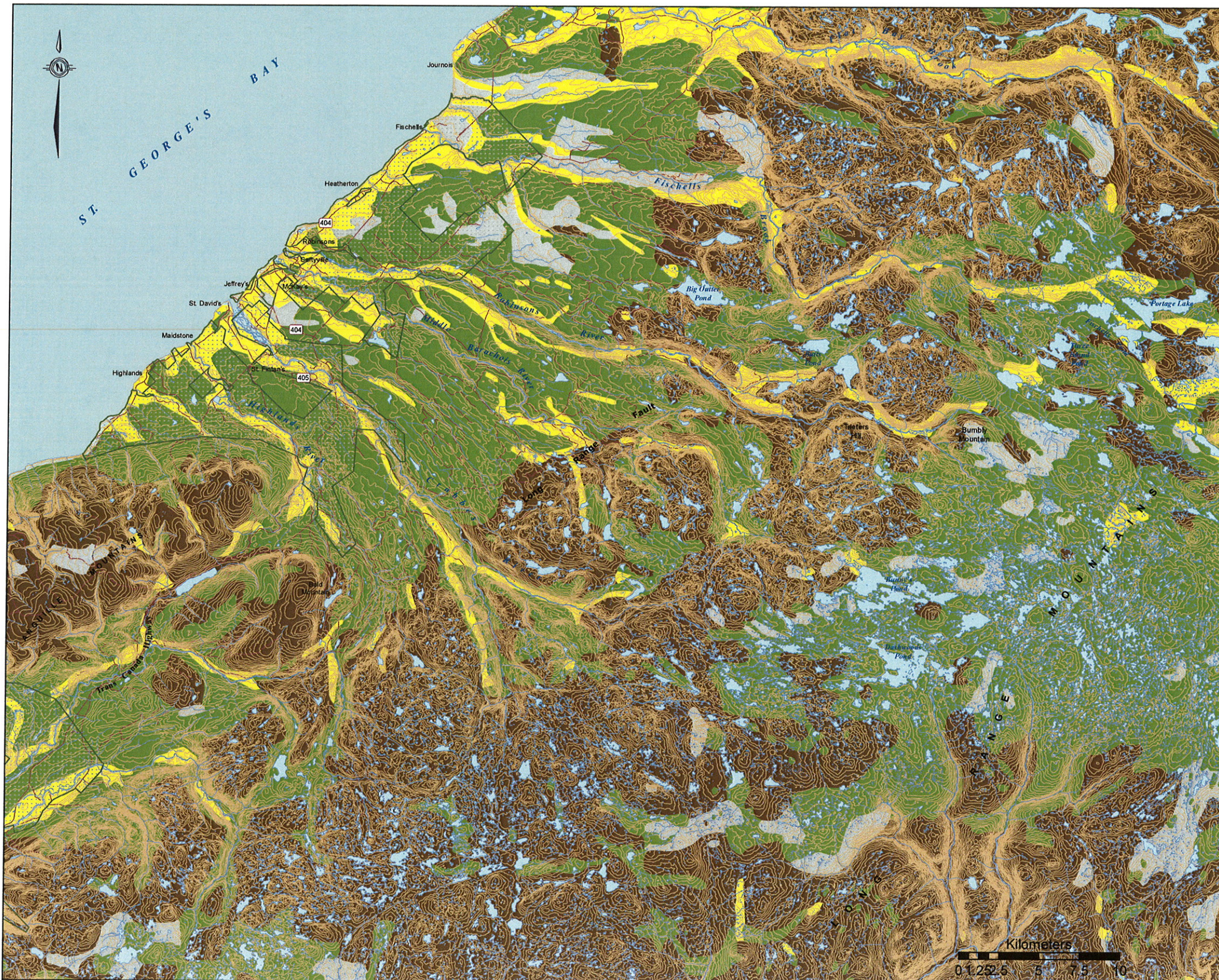
DRAWING TITLE:

ROBINSONS - ST. FINTAN'S ADA LOCATION AND DRAINAGE

Jacques Whitford

SCALE: 1:250,000	DATE: 11/03/2008
DRAWN BY: JLB	CHECKED BY:
EDITED BY: JLB	REV. No.: 0
DRAWING No.: 1034406-16-1	
MAP FILE: 1034406-XX.MXD	





Surficial Geology Legend

- Bog: Poorly drained accumulations of peat, peat moss and other organic matter; developed in areas of poor drainage
- Sand & Gravel: Sands, gravels and silts of glaciofluvial, fluvial, lacustrine or marine terrace origin
- Glacial Till: Till veneer and moraine deposits of varying thickness overlying bedrock. Composed of diamicton (poorly sorted sediment containing a mixture of grain sizes from clay to boulders)
- Rock: Exposed Bedrock, includes areas concealed by vegetation, till veneer, as well as colluvium

- Stream
- Waterbody
- Transportation Route
- Agricultural Development Area
- Contour Line

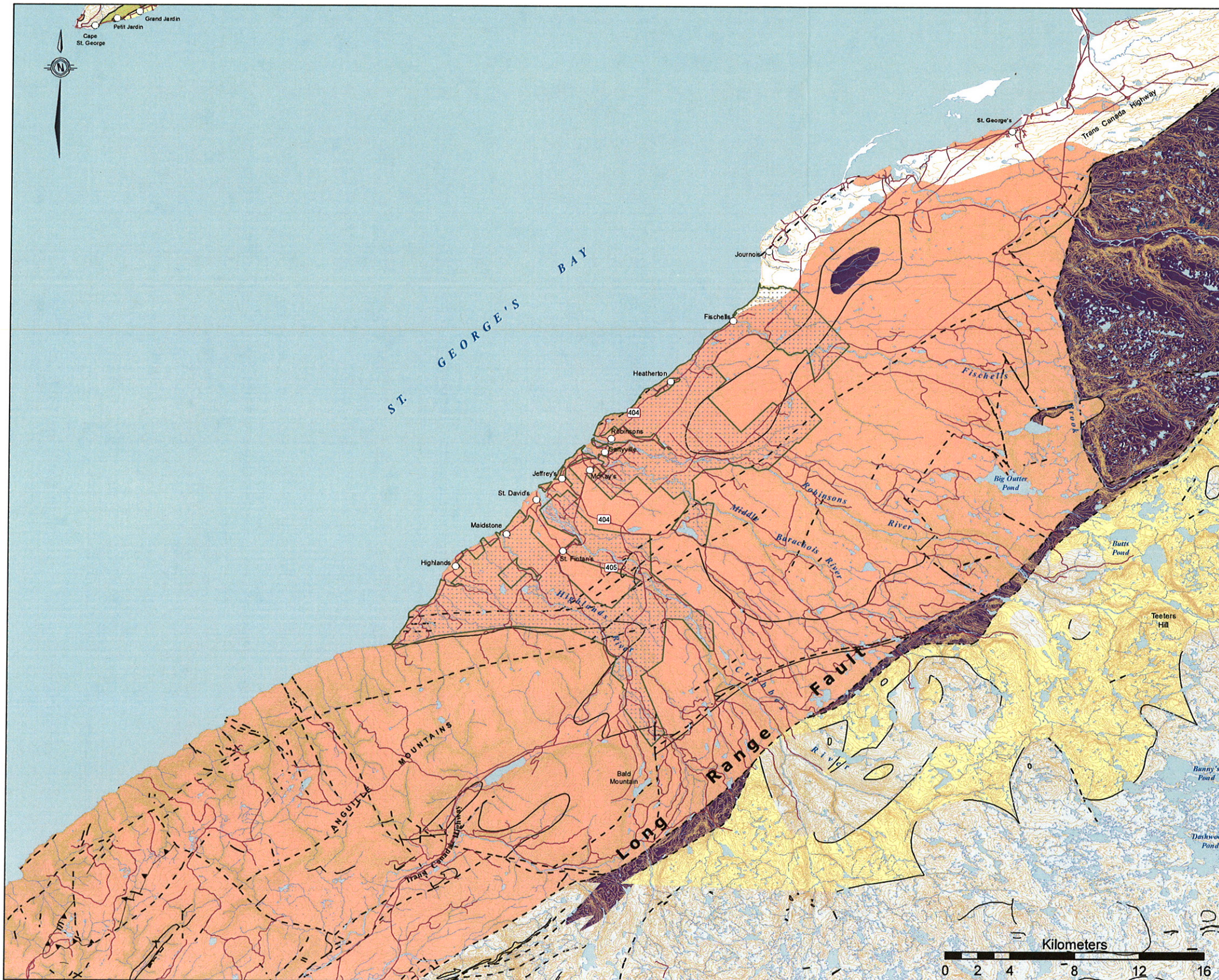
PROJECT TITLE:
HYDROGEOLOGY OF AGRICULTURAL DEVELOPMENT AREAS, NEWFOUNDLAND AND LABRADOR

DRAWING TITLE:
ROBINSONS - ST. FINTAN'S ADA SURFICIAL GEOLOGY

Jacques Whitford

SCALE:	1:250000	DATE:	03/06/2008
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EDITED BY:	MCH	REV. No.:	0
DRAWING No.:	1034406-16-2		
MAP FILE:	1034406-XX.MXD		





Generalized Bedrock Geology Legend

Overlap Sequences

Quaternary

Surficial unconsolidated deposits

Carboniferous

Conglomerate, sandstone, siltstone and mudstone; minor dolomitic limestone, gypsum, oil shale and bituminous coal

Humber Zone

Allochthon Complex

Cambrian to Ordovician

An allochthonous (transported) complex of deep water sedimentary, igneous and metamorphic rocks

Basement

Precambrian

Crystalline basement, undifferentiated

Dunnage Zone

Undifferentiated

--- Fault, Strike-Slip and High Angle

— Contact

▲ Fault, Thrust

— Transportation Route

— Contour Line

— Stream

Waterbody

Agricultural Development Area

PROJECT TITLE:

HYDROGEOLOGY OF AGRICULTURAL DEVELOPMENT AREAS, NEWFOUNDLAND AND LABRADOR

DRAWING TITLE:

ROBINSONS - ST. FINTAN'S ADA BEDROCK GEOLOGY

Jacques Whitford



SCALE:	1:250,000	DATE:	11/03/2008
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EDITED BY:	JLB	REV. No.:	0
DRAWING No.:	1034406-16-3		
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APPENDIX 16b

Water Chemistry Data

Table 16.3 Surface Water Chemistry, NL Ambient Water Quality Monitoring Sites, Robinsons - St. Fintan's ADA Hydrogeology of Agricultural Development Areas, Newfoundland & Labrador

Parameter	Units	CDWQG	CWQG-AWU		Crabbe's River NF02ZA0007 (1987-2004) ¹		
			Irrigation Water	Livestock Water	Min	Max	Mean
Alkalinity	mg/L CaCO ₃	na	na	na	1.8	21.9	8.9
Aluminum	mg/L	na	5	5	0.03	1.71	0.2
Ammonia	mg/L	na	na	na	-	-	-
Antimony	mg/L	0.006	na	na	0.000004	0.00002	0.00001
Arsenic	mg/L	0.01	0.1	0.025	0.0001	0.001	0.0002
Barium	mg/L	1	na	na	0.004	0.03	0.012
Beryllium	mg/L	na	0.1	0.1	0.000003	0.05	0.025
Bicarbonate	mg/L CaCO ₃	na	na	na	-	-	-
Boron	mg/L	5	0.5 - 6	5	0.003	0.01	0.005
Bromide	mg/L	na	na	na	-	-	-
Cadmium	mg/L	0.005	0.005	0.08	0.000002	0.0003	0.00008
Calcium	mg/L	na	na	na	1.91	8.07	4.64
Carbonate	mg/L CaCO ₃	na	na	na	-	-	-
Chloride	mg/L	250*	100 - 700	na	-	-	-
Chromium	mg/L	0.05	0.005	0.05	0.0001	0.006	0.0005
Copper	mg/L	1*	0.2 - 1,000	0.5-5	0.0002	0.012	0.0009
Dissolved Organic Carbon	mg/L	na	na	na	2.1	12.5	5.4
Fluoride	mg/L	1.5	1	1 - 2	-	-	-
Hardness	mg/L CaCO ₃	na	na	na	-	-	-
Iron	mg/L	0.3*	5	na	0.02	2.68	0.19
Kjeldahl Nitrogen	mg/L	na	na	na	-	-	-
Langelier Index	-	na	na	na	-	-	-
Lead	mg/L	0.01	0.2	0.1	0.00003	0.002	0.0004
Magnesium	mg/L	na	na	na	0.28	1.94	0.97
Manganese	mg/L	0.05*	0.2	na	0.001	0.17	0.009
Mercury	mg/L	0.001	na	0.003	0.00001	0.00012	0.00001
Nickel	mg/L	na	0.2	1	0.0002	0.0034	0.0005
Nitrate	mg/L N	45	na	na	-	-	-
Nitrate + Nitrite	mg/L N	na	na	100	-	-	-
Nitrite	mg/L	na	na	10	-	-	-
Orthophosphate	mg/L P	na	na	na	-	-	-
pH	Units	6.5-8.5*	na	na	6.09	7.81	6.80
Potassium	mg/L	na	na	na	0.2	1.5	0.9
Reactive Silica	mg/L SiO ₂	na	na	na	0.000001	4.61	2.27
Selenium	mg/L	0.01	0.02 - 0.05	0.05	0.0001	0.0011	0.0002
Silver	mg/L	na	na	na	-	-	-
Sodium	mg/L	200*	na	na	2.9	5.11	4.01
Specific Conductance	uS/cm	na	na	na	26.2	312	105.6
Sulphate	mg/L	500*	na	1,000	-	-	-
Sulphide	mg/L H ₂ S	0.05*	na	na	-	-	-
Thallium	mg/L	na	na	na	0.000002	0.000006	0.000005
Tin	mg/L	na	na	na	-	-	-
Total Dissolved Solids	mg/L	500*	500 - 3,500	3,000	-	-	-
Total Organic Carbon	mg/L	na	na	na	-	-	-
Total Phosphorus	mg/L	na	na	na	0.0003	0.06	0.005
Total Suspended Solids	mg/L	na	na	na	-	-	-
True Color	TCU	15*	na	na	-	-	-
Turbidity	NTU	0.3/1.0/0.1**	na	na	0.1	15.6	1.01
Uranium	mg/L	0.02	0.01	0.2	0.00009	0.00024	0.00017
Vanadium	mg/L	na	0.1	0.1	0.0001	0.0037	0.0003
Canadian Water Quality Index (CWQI)	-	-	-	-	-	-	81.10
Zinc	mg/L	5*	1 - 5	50	0.0002	0.1	0.002

Notes:

CDWQG = Health Canada Canadian Drinking Water Quality Guidelines (March, 2007)

CWQG-AWU = CCME Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) (October, 2005)

1 = Summary statistics calculated using chemical data obtained from the NL Ambient Water Quality Database available through the Canada and Newfoundland/Labrador Aqua Link (CANAL) website.

na = No applicable criteria

* = Aesthetic objective

** = Operational guideline value based on conventional treatment/slow sand or diatomaceous earth filtration/membrane filtration.

.- = Not analyzed

Shaded = Value does not meet applicable criteria

Bolded = Value does not meet CWQG-AWU for irrigation and/or livestock water

**Table 16.4 Groundwater Chemistry, Private Drilled Wells, Robinsons - St. Fintan's ADA
Hydrogeology of Agricultural Development Areas, Newfoundland & Labrador**

Parameter	Units	CDWQG	CWQG-AWU		Community ¹ St. David's		
			Irrigation Water	Livestock Water	10168	13413	10481
			Alkalinity	mg/L CaCO ₃	na	na	na
Aluminum	mg/L	na	5	5	-	0.74	-
Ammonia	mg/L	na	na	na	0.07	0.01	-
Antimony	mg/L	0.006	na	na	-	-	-
Arsenic	mg/L	0.01	0.1	0.025	-	0.005	-
Barium	mg/L	1	na	na	-	-	-
Beryllium	mg/L	na	0.1	0.1	-	-	-
Bicarbonate	mg/L CaCO ₃	na	na	na	-	-	-
Boron	mg/L	5	0.5 - 6	5	-	-	-
Bromide	mg/L	na	na	na	-	-	-
Cadmium	mg/L	0.005	0.005	0.08	-	0.00005	-
Calcium	mg/L	na	na	na	28	70	40
Carbonate	mg/L CaCO ₃	na	na	na	-	-	-
Chloride	mg/L	250*	100 - 700	na	149	21	66
Chromium	mg/L	0.05	na	na	-	-	-
Copper	mg/L	1*	0.2 - 1	0.5-5	-	0.01	-
Dissolved Organic Carbon	mg/L	na	na	na	-	-	-
Fluoride	mg/L	1.5	1	1 - 2	0.3	0.05	0.05
Hardness	mg/L CaCO ₃	na	na	na	119	191	162
Iron	mg/L	0.3*	5	na	0.08	2.16	0.22
Kjeldahl Nitrogen	mg/L	na	na	na	-	-	-
Langelier Index	-	na	na	na	-	-	-
Lead	mg/L	0.01	0.2	0.1	-	0.007	-
Magnesium	mg/L	na	na	na	12	4	15
Manganese	mg/L	0.05*	0.2	na	0.05	0.6	0.02
Mercury	mg/L	0.001	na	0.003	-	-	-
Nickel	mg/L	na	0.2	1	-	-	-
Nitrate	mg/L N	45	na	na	-	-	-
Nitrate + Nitrite	mg/L N	na	na	100	0.004	0.004	0.005
Nitrite	mg/L	na	na	10	0.001	-	-
Orthophosphate	mg/L P	na	na	na	-	0.01	-
pH	Units	6.5-8.5*	na	na	8.03	7.28	-
Potassium	mg/L	na	na	na	7.7	-	3.93
Reactive Silica	mg/L SiO ₂	na	na	na	-	-	-
Selenium	mg/L	0.01	0.02 - 0.05	0.05	-	0.01	-
Silver	mg/L	na	na	na	-	-	-
Sodium	mg/L	200*	na	na	131	17	36
Specific Conductance	uS/cm	na	na	na	-	375	-
Sulphate	mg/L	500*	na	1,000	98	29	31
Sulphide	mg/L H ₂ S	0.05*	na	na	-	-	-
Thallium	mg/L	na	na	na	-	-	-
Tin	mg/L	na	na	na	-	-	-
Total Dissolved Solids	mg/L	500*	500 - 3,500	3,000	613	271	301
Total Organic Carbon	mg/L	na	na	na	-	-	-
Total Phosphorus	mg/L	na	na	na	0.02	-	0.06
Total Suspended Solids	mg/L	na	na	na	-	4	-
True Color	TCU	15*	na	na	-	-	-
Turbidity	NTU	0.3/1.0/0.1**	na	na	-	15.8	-
Uranium	mg/L	0.02	0.01	0.2	-	-	-
Vanadium	mg/L	na	0.1	0.1	-	-	-
Zinc	mg/L	5*	1 - 5	50	0.005	0.01	0.02

Notes:

CDWQG = Health Canada Canadian Drinking Water Quality Guidelines (March, 2007)

CWQG-AWU = CCME Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) (October, 2005)

1 = Chemical data obtained from the NL Department of Environment - Water Resources Management Division Drinking Water Quality Database

na = No applicable criteria

* = Aesthetic objective

** = Operational guideline value based on conventional treatment/slow sand or diatomaceous earth filtration/membrane filtration.

"-" = Not analyzed

Shaded = Value does not meet applicable criteria

Bolded = Value does not meet CWQG-AWU for irrigation and/or livestock water