17.0 HYDROGEOLOGY OF CODROY VALLEY ADA

17.1 General Description of Area

17.1.1 Location & Extent

The Codroy Valley ADA covers an area of approximately 24,084 hectares along the southwest coast of Newfoundland, and encompasses the majority of the Codroy River Valley. The boundary of the Codroy Valley ADA is shown on Drawing No. 1034406-17-1 in Appendix 17a.

The Codroy Valley ADA overlaps the communities of Coal Brook, South Branch, Doyles, Tompkins, St. Andrews, Upper Ferry, Woodville, Searston, O'Regan's, Millville, and Codroy.

The main access to the Codroy Valley ADA is provided by the Trans Canada Highway, and secondary Highway Routes 406 (Codroy Road) and 407 (St. Andrews-Searston Road), which branch off the Trans Canada Highway and lead north to various communities along the coast. In addition, various graveled roads and ATV trails leading from the Trans Canada and Highway Routes 406 and 407 also provide access to some areas within the ADA.

17.1.2 Physiography, Topography & Drainage

The Codroy Valley 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 Codroy Valley forms the most southerly part of the West Coast Lowlands, extending southwest towards the coast between the Anguille Mountains to the west and the Long Range Mountains to the east, and is separated from the main lowland region to the north by the local uplands of Bald Mountain. The Codroy Valley is approximately 40 km in length and ranges in width from 10 km at the coast to approximately 4 to 5 km inland. Elevations along the axis of the valley range from 250 m above sea level at the head of the valley to sea level at the coast, rising moderately to steeply along the Long Range Mountains, Anguille Mountains and Bald Mountain to elevations of between 400 to 550 m above sea level. Coastal areas in the vicinity of the ADA are relatively even and slope gently to the coast.

The Codroy Valley ADA encompasses the Grand Codroy River. In the northern portion of the ADA, the Grand Codroy River bifurcates into the North Branch and South Branch tributary streams. The headwaters of Grand Codroy River drainage system originate in the upland regions east, west and north of the ADA. No surface water Public Protected Water Supply Areas (PPWSA) are present within the ADA or its drainage catchment area.

17.1.3 Climate, Vegetation & Agricultural Land Use

The Codroy Valley 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 Codroy Valley 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 climate normals data is available for the Codroy Valley ADA. In lieu of this, climate normals data obtained from Environment Canada's nearby Stephenville Airport monitoring station dating back to 1971 was used to characterized 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^{o}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 Codroy Valley 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 popular, 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 2,134 hectares (i.e., 9% 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.

17.2 Geology

17.2.1 Surficial Geology

The surficial geology of the Codroy Valley ADA is summarized in Drawing No. 1034406-17-2 in Appendix 17a, and is based on regional scale compilation by Liverman and Taylor (1990), as well as descriptions of surficial geology provided in Hender (1989) and Grant (1991). 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.

Thick deposits of glacial outwash and fluvial sand and gravel are present throughout the ADA occurring within the Codroy River valley as a relatively flat flood plain, with local areas of undulating raised terraces, hummocks and ridges. The glaciofluvial deposits are locally eroded and dissected, and marked by meltwater channel scars. Sand and gravel units shown in Drawing No. 1034406-17-2 in Appendix 17a 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. Till deposits are also present within the ADA, bordering the glaciofluvial sand and gravel at higher elevations along the valley flanks and occurring as both thin discontinuous veneer (typically less than 2 m thick), and more extensive moraine deposits with local thicknesses up to 20 m. The composition of the veneer and moraine tills are variable and bedrock-controlled, but generally consist of a silty to sandy loam derived from sandstone, siltstone, conglomerate, and minor limestone, shale and metamorphic and igneous rocks. Local areas of ridged till are also present in the ADA. Along with glacial units, small isolated deposits of organic and peaty soils occur within the ADA, overlying either till or bedrock. Extensive areas of bedrock are present along the summits of the Long Range and Anguille Mountains. Bedrock outcrops may be weathered and covered by a thin layer of angular, frost-shattered and frost heaved rock fragments, as well as be partially or fully concealed by forest vegetation. However, where exposed bedrock outcrops are commonly streamlined and display craig and tail structures that indicate

northwest directed ice flow. In addition, development of rock talus or colluviums is common along steep slopes of the Codroy River Valley. Available well logs indicate an average overburden thickness in the Codroy Valley ADA and surrounding area of approximately 14 m.

17.2.2 Bedrock & Structural Geology

The bedrock geology of the Codroy Valley ADA is summarized in Drawing No. 1034406-17-3 in Appendix 17a, 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 occurs within a thick sequence of Carboniferous 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.

17.3 Hydrogeology

17.3.1 Hydrostratigraphy

The groundwater potential of the various geological units within the Codroy Valley 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 135 drilled bedrock wells and 26 drilled surficial wells from 11 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. 1034406-17-3 in Appendix 17a.

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 Codroy Valley 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 Codroy Valley ADA is defined based on the estimated well yields obtained from the driller's records.

17.3.1.1 Surficial Hydrostratigraphic Units

The surficial deposits within the Codroy Valley 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 17.1. 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 forming both thin discontinuous veneer and moraine deposits blanket are locally present at higher elevations along the valley flanks mainly and comprise a silty to sandy loam. There are no documented data on the groundwater potential of the till material in the Codroy Valley 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. Twenty-six (26) wells from the communities of Coal Brook, Codroy, Doyles, Millville, South Branch, St. Andrews, Tompkins, and Woodville 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 to high yields, having water yields ranging from 5 to 709 L/min at well depths of 7 to 40 m, and an average yield of 91 L/min at 18 m depth. However, median yield and depth estimates of 40 L/min at 16 m depth are more likely representative of the typical groundwater potential of this unit.

Table 17.1 Summary of Overburden Drilled Well Information for Codroy Valley 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	Coal Brook, Codroy, Doyles, Millville, South Branch, St. Andrews, Tompkins, Woodville	26	18.2 (16)	7.3-40	90.9 (40)	5-709

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

17.3.1.2 Bedrock Hydrostratigraphic Units

Well record information is available for the Carboniferous sedimentary rocks that underlie the ADA. The well yield and depth characteristics of this unit are summarized in Table 17.2.

Carboniferous Sedimentary Cover Rocks

A total of 135 well records from the communities of Coal Brook, Codroy, Doyles, Millville, O'Regan's, Searston, South Branch, St. Andrews, Tompkins, Upper Ferry, and Woodville 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 to high yields, having water yields ranging from 3 to 936 L/min at well depths of 13 to 115 m, and an average yield of 76 L/min at 36 m depth. However, median yield and depth estimates of 50 L/min at 32 m depth are more likely representative of the typical groundwater potential of these units.

Table 17.2 Summary of Bedrock Drilled Well Information for Codroy Valley 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 (Barachois, Codroy and Anguille groups)	Siliciclastic and minor carbonate and evaporitic sedimentary rocks	Coal Brook, Codroy, Doyles, Millville, O'Regan's, Searston, South Branch, St. Andrews, Tompkins, Upper Ferry, Woodville	135	36.5 (31.7)	12.9-114.8	76.3 (50)	3-936

17.3.2 Groundwater Flow System

The Codroy Valley 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 the topographic highs and discharging along the Grand Codroy River system. 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 north and south. Based on a review of water well records for the area, groundwater levels are generally assumed to be within 6 m of the ground surface and to be a subdued reflection of the topography.

17.4 Water Quality

17.4.1 Surface Water Quality

Surface water quality data for the Codroy Valley ADA is limited to ambient water quality monitoring data collected as part of the Canada–Newfoundland Water Quality Monitoring Agreement from two sites, including:

- Grand Codroy River (NF02ZA0006, 1986-2007); and,
- South Branch River@TCH River (NF02ZA0001, 1986-1997).

A summary of chemical data obtained from these surface water sources over the monitoring period is provided in Table 17.3 in Appendix 17b, 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 (Ca-Na-HCO_3-Cl-SO_4) type water. Surface water in the area is slightly acidic to slightly basic, and of low to moderate 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. 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.

Concentrations of all parameters tested at the surface water sites meet CCME CWQG-AWU for irrigation and/or livestock water use.

Based on chemical data, surface water quality within the ADA is considered good, returning an average Canadian Water Quality Index (CWQI) values of 94. The Grand Codroy River and South Branch River are not considered potable water sources, and would require treatment for disinfection, as well as to improve the aesthetic quality of the water.

17.4.2 Groundwater Quality

The groundwater quality data for the Codroy Valley ADA consists of analyses from 15 private drilled wells from the communities of O'Regans, St. Andrews, South Branch, Searston, Millville, Woodville, and Tompkins, as well as 13 protected public supply drilled well for the communities of Upper Ferry (WS-G-0841, WS-G-0757, WS-G-0758, and WS-G-0759), O'Regans (WS-G-0522 and WS-G-0523), St. Andrews (WS-G-0679, WS-G-0680, WS-G-0681, and WS-G-0821), Coal Brook (WS-G-0173), South Branch (WS-G-0667), and Tompkins (WS-G-0378) 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 17.4 and 17.5 in Appendix 17b, 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 sodium-calcium-chloride-sulfate-bicarbonate ($Na-Ca-Cl-SO_4-HCO_3$), calcium-sodium-bicarbonate-chloride-sulfate ($Ca-Na-HCO_3-Cl-SO_4$), and calcium-sodium-chloride-sulfate-bicarbonate ($Ca-Na-Cl-SO_4-HCO_3$) type waters. Groundwater in the area ranges from moderately to very hard, neutral to slightly basic, and of moderate alkalinity. Classification of groundwater according to dissolved-solids and specific conductance generally indicates fresh conditions. However, moderately saline conditions were identified in a private drilled well in O'Regans, returning a specific conductance value of 4,670 uS/cm.

With the exception of iron, manganese, sodium, sulphate, turbidity and total dissolved solids in several of the private wells, and lead, manganese, pH, total dissolved solids and turbidity in several of the protected groundwater supply wells, concentrations of all other parameters tested meet CDWQG. The guidelines for iron, manganese, sodium, sulphate, pH, 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 the case of iron, manganese, sodium, total dissolved solids and turbidity, and corrosion in the case of pH.

In addition, concentrations of chloride, manganese, sulphate, and total dissolved solids detected in several of the private drilled wells, and chloride, manganese, and total dissolved solids present in several of the protected groundwater supply wells that exceeded CCME CWQG-AWU for both irrigation and livestock water use.

Based on chemical data, groundwater quality within the ADA is considered excellent, returning average Canadian Water Quality Index (CWQI) values ranging from 88 to 100. However, a negative Langelier Index indicates that water is unsaturated with calcium carbonate and it will tend to be corrosive, leading to potential leaks in the distribution system. Treatment would be required to improve the aesthetic quality of the water. In addition, concentrations of chloride, manganese, sulphate, and total dissolved solids that exceeded CCME CWQG-AWU in several of the private and protected public groundwater supply wells may limit usage of these groundwater sources as potential agricultural water supplies without appropriate treatment. Further, the elevated specific conductance, chloride and sodium levels present in a private drilled well in O'Regans may be due to its coastal location and may suggest that saltwater intrusion may be a potential issue for water wells installed in coastal areas of the ADA. However, saline conditions present in this well may also be related to the underlying Carboniferous strata, which contains intercalated evaporite beds.

17.5 Groundwater Recharge & Availability

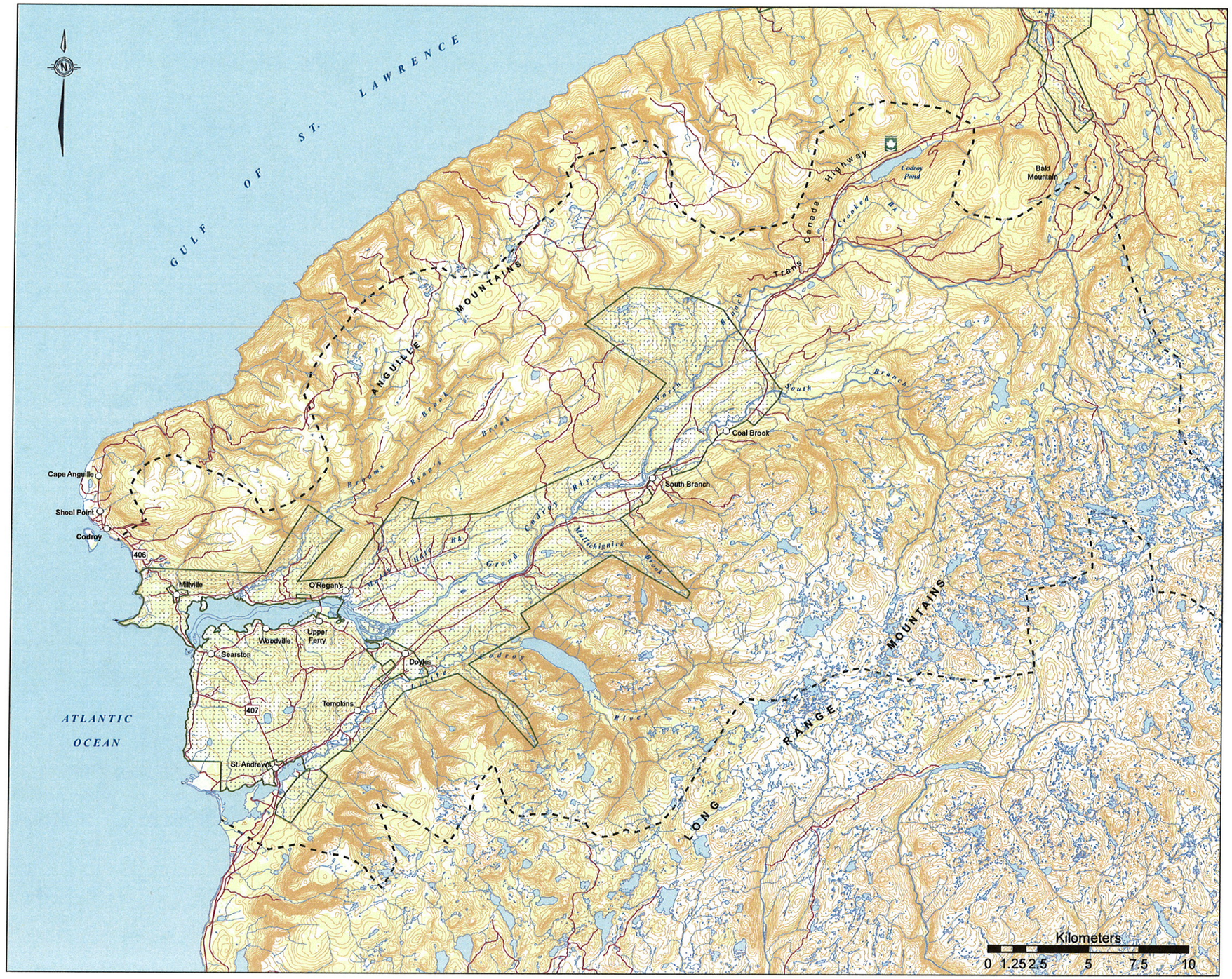
Recharge to the shallow groundwater system underlying the ADA is by direct infiltration of rainfall, after runoff and the requirements of evaporation and plant transpiration have been met, and is directly related to rainfall, infiltration characteristics and size of the recharge zone. A common practice 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 Codroy Valley ADA is estimated on the basis of a local groundwater catchment area equivalent to the area of the ADA of approximately 24,084 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 Codroy Valley ADA is estimated at $3.2x10^7 m^3$/year or $1,352 m^3$/hectares/yr.

Sixteen (16) protected public groundwater supplies are present in the vicinity of the ADA, including one public groundwater supply for the community of Coal Brook (Water Supply No. WS-G-0173) that serves a population of approximately 94, one public groundwater supply for the community of O'Regan's West (Water Supply No. WS-G-0522) that serves a population of approximately 61, one public groundwater supply for the community of South Branch (Water Supply No. WS-G-0667) that serves a population of approximately 170, four public groundwater supplies for the community of St. Andrew's (Water Supply Nos. WS-G-0679, WS-G-0680, WS-G-0681, and WS-G-0821) that serve a population of approximately 346, one public groundwater supply for the community of Tompkins (Water Supply No. WS-G-0738) that serves a population of approximately 93, and four public groundwater supplies for the community of Upper Ferry (Water Supply Nos. WS-G-0757, WS-G-0758, WS-G-0759, and WS-G-0841) that serve a population of approximately 189. The remainder of the water wells in the area of the ADA are limited to minor individual domestic, commercial industrial and public supply wells. No information is available regarding existing agricultural (i.e., irrigation and livestock) water demands in the Codroy Valley 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 17a

Drawings



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

PROJECT TITLE:

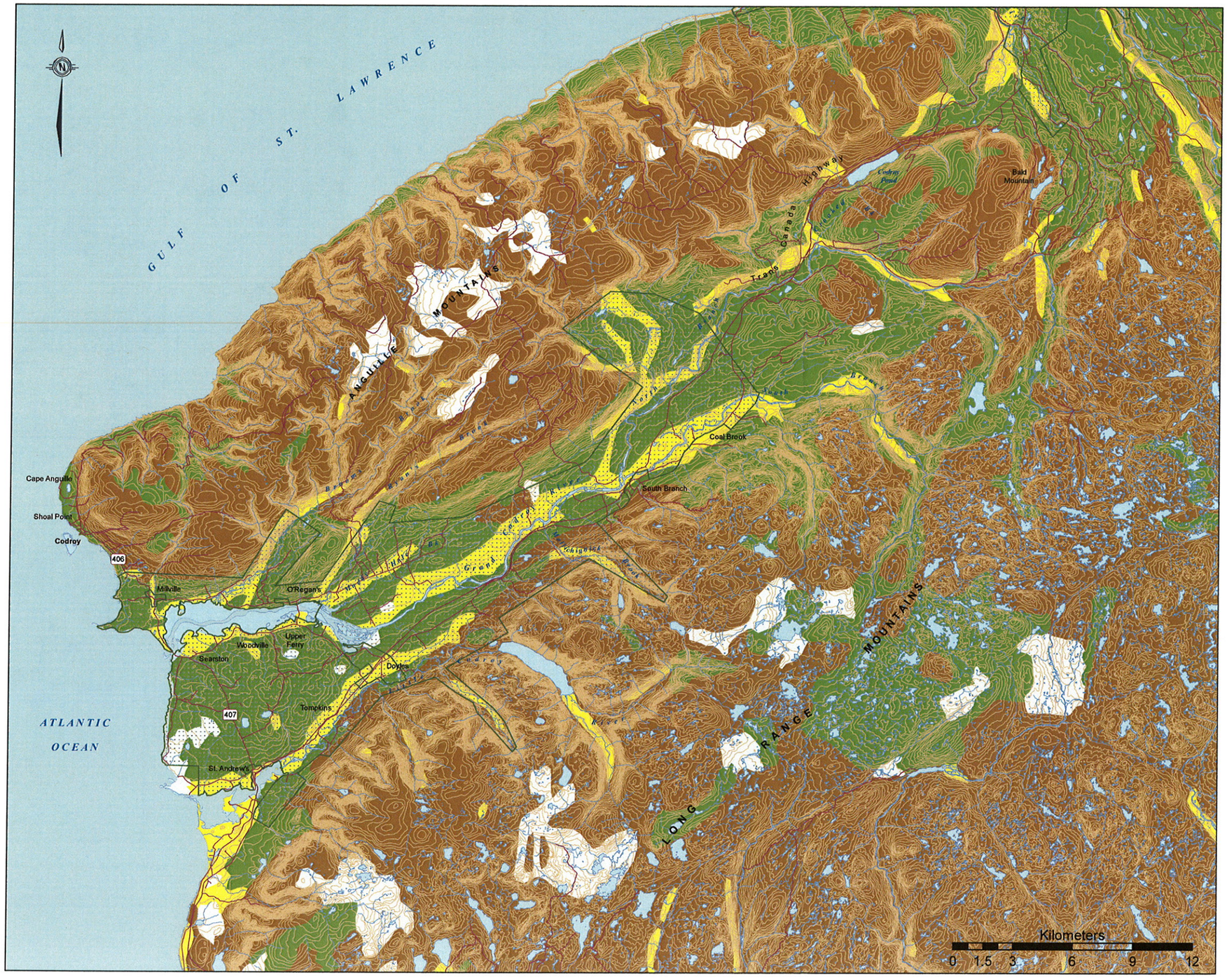
HYDROGEOLOGY OF AGRICULTURAL DEVELOPMENT AREAS, NEWFOUNDLAND AND LABRADOR

DRAWING TITLE:

CODROY VALLEY ADA LOCATION AND DRAINAGE

Jacques Whitford

SCALE: 1:200,000	DATE: 11/03/2008
DRAWN BY: JLB	CHECKED BY:
EDITED BY: JLB	REV. No: 0
DRAWING No.: 1034406-17-1	
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
- Transportation Route
- Contour Line
- Waterbody
- Agricultural Development Area

PROJECT TITLE:

HYDROGEOLOGY OF AGRICULTURAL DEVELOPMENT AREAS, NEWFOUNDLAND AND LABRADOR

DRAWING TITLE:

CODROY VALLEY ADA SURFICIAL GEOLOGY

Jacques Whitford

SCALE: 1:200,000	DATE: 03/06/2008
DRAWN BY: JLB	CHECKED BY:
EDITED BY: MCH	REV. No. 0
DRAWING No.: 1034406-17-2	
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

Late Ordovician to Middle Devonian
- Conglomerate, greywacke, sandstone, siltstone and shale; minor limestone, gabbro, and felsic and mafic volcanic rocks. (Windsor Point Complex)

Silurian to Devonian
- Granitic Rocks

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

Gander 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:

CODROY VALLEY ADA BEDROCK GEOLOGY

Jacques Whitford

SCALE: 1:200,000	DATE: 11/03/2008
DRAWN BY: JLB	CHECKED BY:
EDITED BY: JLB	REV. No. 0
DRAWING No.: 1034406-17-3	
MAP FILE: 1034406-XX.MXD	

APPENDIX 17b

Water Chemistry Data

Table 17.3 Surfacewater Chemistry, NL Ambient Water Quality Monitoring Sites, Codroy Valley ADA
Hydrogeology of Agricultural Development Areas, Newfoundland & Labrador

Parameter	Units	CDWQG	CWQG-AWU		Grand Codroy River NF02ZA0006 (1986-2007)[1]			South Branch River@TCH River NF02ZA0001 (1986-1997)[1]		
			Irrigation Water	Livestock Water	Min	Max	Mean	Min	Max	Mean
Alkalinity	mg/L $CaC0_3$	na	na	na	1	58.4	13.6	1	23.7	7.1
Aluminum	mg/L	na	5	5	0.03	1.84	0.14	0.03	0.41	0.14
Ammonia	mg/L	na	na	na	-	-	-	-	-	-
Antimony	mg/L	0.006	na	na	0.00004	0.00002	0.00001	-	-	-
Arsenic	mg/L	0.01	0.1	0.025	0.0001	0.001	0.0001	0.0001	0.0002	0.0001
Barium	mg/L	1	na	na	-	-	-	0.0017	0.0124	0.0055
Beryllium	mg/L	na	0.1	0.1	0.000	0.05	0.01	0.05	0.05	0.05
Bicarbonate	mg/L $CaC0_3$	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	0.000002	0.0002	0.00007	0.0001	0.0001	0.0001
Calcium	mg/L	na	na	na	3.51	5.13	3.94	-	-	-
Carbonate	mg/L $CaC0_3$	na	na	na	-	-	-	-	-	-
Chloride	mg/L	250*	100 - 700	na	7.14	17.9	10.75	-	-	-
Chromium	mg/L	0.05	0.005	0.05	0.0002	0.004	0.0004	0.0002	0.001	0.0003
Copper	mg/L	1*	0.2 - 1,000	0.5-5	0.0002	0.0181	0.001	0.0002	0.02	0.001
Dissolved Organic Carbon	mg/L	na	na	na	0.1	11.3	4.7	0.10	11.30	4.92
Fluoride	mg/L	1.5	1	1 - 2	-	-	-	-	-	-
Hardness	mg/L $CaC0_3$	na	na	na	-	-	-	-	-	-
Iron	mg/L	0.3*	5	na	0.00001	2.41	0.14	0.01	0.48	0.13
Kjeldahl Nitrogen	mg/L	na	na	na	0.08	0.16	0.13	0.09	0.15	0.12
Langelier Index	-	na	na	na	-	-	-	-	-	-
Lead	mg/L	0.01	0.2	0.1	0.00001	0.002	0.0005	0.0002	0.002	0.0005
Magnesium	mg/L	na	na	na	0.78	1.10	1.02	-	-	-
Manganese	mg/L	0.05*	0.2	na	0.001	0.14	0.01	0.001	0.04	0.006
Mercury	mg/L	0.001	na	0.003	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001
Nickel	mg/L	na	0.2	1	0.0002	0.0032	0.0004	0.0002	0.002	0.0004
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	5.89	8.32	6.90	5.89	7.70	6.71
Potassium	mg/L	na	na	na	0.26	0.32	0.30	-	-	-
Reactive Silica	mg/L SiO2	na	na	na	0.98	4.90	2.72	0.98	4.90	2.65
Selenium	mg/L	0.01	0.02 - 0.05	0.05	0.0001	0.0008	0.0001	0.0001	0.0004	0.0001
Silver	mg/L	na	na	na	0.000001	0.0001	0.00002	-	-	-
Sodium	mg/L	200*	na	na	3.37	4.8	4.45	-	-	-
Specific Conductance	uS/cm	na	na	na	19.1	1,480	97.3	19.1	674.0	66.7
Sulphate	mg/L	500*	na	1,000	4.44	28.7	11.66	-	-	-
Sulphide	mg/L H2S	0.05*	na	na	-	-	-	-	-	-
Thallium	mg/L	na	na	na	0.000002	0.000024	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	0.05	0.0041	0.0003	0.03	0.0039
Total Suspended Solids	mg/L	na	na	na	-	-	-	-	-	-
True Color	TCU	15*	na	na	-	-	-	-	-	-
Turbidity	NTU	0.3/1.0/0.1**	na	na	0.08	14	0.65	0.08	1.85	0.40
Uranium	mg/L	0.02	0.01	0.2	0.00002	0.00019	0.00011	-	-	-
Vanadium	mg/L	na	0.1	0.1	0.0001	0.0036	0.0003	0.0001	0.001	0.0003
Canadian Water Quality Index (CWQI)	-	-	-	-	-	-	94.19	-	-	93.96
Zinc	mg/L	5*	1 - 5	50	0.0002	0.02	0.001	0.0002	0.0041	0.0012

Notes:

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

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

1 = Summary statisitics calculated using chemicial data obtained from the NL Ambient Water Quaility 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 17.4 Groundwater Chemistry, Private Drilled Wells, Codroy Valley ADA
Hydrogeology of Agricultural Development Areas, Newfoundland & Labrador

Parameter	Units	CDWQG	CWQG-AWU		Communities[1]														
					O'Regans			St. Andrews					South Branch	Searston	Millville		Woodville		Tompkins
			Irrigation	Livestock	10178	12567	13127	11685	15440	16502	17672	17831	16989	17671	13128	17016	12229	13851	16993
Alkalinity	mg/L $CaC0_3$	na	na	na	207.6	62.5	142	89.4	141	183	163	170	82.1	113	201	121	141	140	93.3
Aluminum	mg/L	na	5	5	-	-	-	-	-	-	-	0.05	-	-	-	-	-	-	-
Ammonia	mg/L	na	na	na	-	-	-	-	0.05	0.02	0.05	0.01	0.02	0.05	-	0.02	-	0.02	0.02
Antimony	mg/L	0.006	na	na	-	-	-	-	-	-	-	0.01	-	-	-	-	-	-	-
Arsenic	mg/L	0.01	0.1	0.025	-	-	-	-	0.005	-	-	0.01	-	-	-	-	-	-	-
Barium	mg/L	1	na	na	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-
Beryllium	mg/L	na	0.1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicarbonate	mg/L $CaC0_3$	na	na	na	-	-	-	-	-	-	163	-	-	113	-	-	-	-	-
Boron	mg/L	5	0.5 - 6	5	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-
Bromide	mg/L	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	mg/L	0.005	0.005	0.08	-	-	-	-	-	0.0005	-	0.001	0.0005	-	-	0.0005	-	0.0005	0.0005
Calcium	mg/L	na	na	na	77	503	73	36	21	32	33.1	40	19	21.8	59	17	62	94	22
Carbonate	mg/L $CaC0_3$	na	na	na	-	-	-	-	-	-	1	-	27	1	-	-	-	-	-
Chloride	mg/L	250*	100 - 700	na	63	724	40	37	**109**	34	42.7	56	-	32.9	11.5	15.3	21	30	43
Chromium	mg/L	0.05	na	na	-	-	-	-	-	-	-	0.005	-	-	-	-	-	-	-
Copper	mg/L	1*	0.2 - 1	0.5-5	-	-	-	-	0.01	0.005	0.01	0.01	0.01	0.01	-	0.005	-	0.01	0.005
Dissolved Organic Carbon	mg/L	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride	mg/L	1.5	1	1 - 2	0.04	0.4	-	0.06	0.1	0.13	-	0.27	0.08	-	0.11	0.07	0.07	0.27	0.13
Hardness	mg/L $CaC0_3$	na	na	na	258	1354	220	118	67.3	120	107	126	60.2	72.1	193	82.4	193	270	80.1
Iron	mg/L	0.3*	5	na	0.01	0.33	0.05	0.05	0.04	0.01	0.02	0.02	0.01	0.16	0.02	0.01	0.07	0.01	0.01
Kjeldahl Nitrogen	mg/L	na	na	na	-	-	-	-	-	-	-	0.05	-	-	-	-	-	-	-
Langelier Index	-	na	na	na	-	-	-	-	-	-	-0.24	-	-	-0.59	-	-	-	-	-
Lead	mg/L	0.01	0.2	0.1	-	-	-	-	0.002	-	-	0.001	-	-	-	-	-	-	-
Magnesium	mg/L	na	na	na	16	0.68	9.2	6.9	3.6	9.8	6	6.3	3.09	4.3	11	9.7	9.3	8.5	6.1
Manganese	mg/L	0.05*	0.2	na	0.01	-	-	0.01	0.18	**0.38**	**0.35**	**0.38**	0.005	0.02	-	0.005	0.005	0.02	0.005
Mercury	mg/L	0.001	na	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	mg/L	na	0.2	1	-	-	-	-	-	-	-	0.005	-	-	-	-	-	-	-
Nitrate	mg/L N	45	na	na	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-
Nitrate + Nitrite	mg/L N	na	na	100	0.749	-	6	1.4	0.05	0.004	0.05	0.005	0.29	0.29	-	0.064	0.27	0.29	0.31
Nitrite	mg/L	na	na	10	-	-	-	0.003	-	0.001	-	0.001	0.002	-	-	0.002	0.001	0.001	0.001
Orthophosphate	mg/L P	na	na	na	-	-	-	-	0.01	0.02	0.01	0.01	0.02	0.01	-	0.02	-	0.02	0.02
pH	Units	6.5-8.5*	na	na	-	7.6	7.23	6.65	8.5	7.95	7.8	7.88	8.07	7.8	7.79	8.1	7.73	7.22	8.1
Potassium	mg/L	na	na	na	1.07	41	-	1.98	3.7	3.08	3.7	3.9	3.58	3.4	0.98	3.32	0.61	0.96	1.34
Reactive Silica	mg/L SiO2	na	na	na	-	-	-	-	-	-	12.1	-	-	5.9	-	-	-	-	-
Selenium	mg/L	0.01	0.02 - 0.05	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver	mg/L	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	mg/L	200*	na	na	23	600	19	25	108	26	56	53	15	44.2	11	18	13	23	21
Specific Conductance	uS/cm	na	na	na	-	4,670	439	361	680	399	489	494	232	357	355	261	370	720	291
Sulphate	mg/L	500*	na	1,000	6.9	**1,400**	-	26	11	11	11	10	5.5	8	5.3	15	23	225	11
Sulphide	mg/L H2S	0.05*	na	na	-	-	-	-	-	0.02	-	-	0.01	-	-	0.01	-	0.03	0.02
Thallium	mg/L	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin	mg/L	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	mg/L	500*	500 - 3,500	3,000	-	-	-	240	-	270	-	340	159	-	220	178	258	**707**	198
Total Organic Carbon	mg/L	na	na	na	-	-	-	-	-	1.1	0.5	0.5	0.5	0.9	-	0.6	-	0.7	0.5
Total Phosphorus	mg/L	na	na	na	0.043	-	-	0.01	-	0.02	-	0.01	0.02	-	-	0.02	0.01	0.02	-
Total Suspended Solids	mg/L	na	na	na	-	-	-	-	-	4	-	2	4	-	-	4	-	4	4
True Color	TCU	15*	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	0.3/1.0/0.1**	na	na	-	-	-	-	0.5	0.14	1.8	0.05	0.32	30.5	-	0.09	-	0.95	0.44
Uranium	mg/L	0.02	0.01	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/L	na	0.1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	mg/L	5*	1 - 5	50	0.37	0.02	-	0.02	0.01	0.005	0.01	0.01	0.005	0.01	-	0.005	0.03	0.005	0.005

Notes:
CDWQG = Health Canada Canadian Drinking Water Quality Guidelines (March, 2007)
CWQG-AWU = CCME Canadian Water Quaility Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) (October, 2005)
1 = Chemicial 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

Table 17.5 Groundwater Chemistry, Protected Public Drilled Wells, Codroy Valley ADA
Hydrogeology of Agricultural Development Areas, Newfoundland & Labrador

Parameter	Units	CDWQG	CWQG-AWU		Upper Ferry WS-G-0841 (2002-2007)[1]			Upper Ferry WS-G-0757 (2001-2007)[1]			Upper Ferry WS-G-0758 (2001-2007)[1]			Upper Ferry WS-G-0759 (2001-2007)[1]			O''Regans East WS-G-0523 (2001-2007)[1]			O'Regans West WS-G-0522 (2001)[1]	St. Andrews WS-G-0679 (2001-2007)[1]			St. Andrews WS-G-0680 (2001-2007)[1]			St. Andrews WS-G-0681 (2001-2007)[1]			St. Andrews WS-G-0821 (2003-2007)			Coal Brook WS-G-0173 (2001)[1]	South Branch WS-G-0667 (2001)[1]	Tompkins WS-G-0378 (2001-2007)[1]		
			Irrigation	Livestock	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean			Min	Max	Mean
Alkalinity	mg/L $CaCO_3$	na	na	na	175	198	183	108	138	122	80	133	101	97	142	128	111	129	119	163	119	141	129	130	150	140	102	139	119	169	174	171	18	52	145	159	152
Aluminum	mg/L	na	5	5	0	0.12	0.03	0	0.11	0.05	0	0.57	0.12	0	0.1	0.03	0	0.025	0.00	0.03	0	0.05	0.02	0.01	0.15	0.04	0.01	0.14	0.04	0	0.15	0.05	0.025	0.025	0.025	0.1	0.05
Ammonia	mg/L	na	na	na	0.02	0.05	0.04	0	0.01	0.01	0	0.01	0.01	0	0.01	0.01	0	0.16	0.02	0.06	0	0.03	0.01	0.03	0.1	0.05	0	0.08	0.02	0.07	0.09	0.08	0.01	0.01	0	0.01	0.01
Antimony	mg/L	0.006	na	na	0	0.0005	0.0003	0	0.0005	0.0003	0	0.0005	0.0003	0	0.0005	0.0003	0	0.0005	0.0001	-	0	0.0005	0.0001	0	0.0005	0.0001	0	0.0005	0.0001	0	0.0005	0.0002			0	0.0005	0.0003
Arsenic	mg/L	0.01	0.1	0.025	0.002	0.002	0.0020	0	0.002	0.001	0	0.001	0.0007	0	0.001	0.0006	0	0.001	0.0003	0.001	0	0.001	0.0005	0	0.002	0.0011	0	0.001	0.0004	0	0.001	0.0003	0.001	0.001	0	0.001	0.0006
Barium	mg/L	1	na	na	0.05	0.07	0.06	0.19	0.23	0.21	0.07	0.12	0.10	0.09	0.17	0.11	0.22	0.31	0.28	0.23	0.36	0.46	0.41	0.04	0.11	0.08	0.07	0.11	0.09	0.12	0.14	0.13	0.04	0.06	0.05	0.07	0.06
Beryllium	mg/L	na	0.1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicarbonate	mg/L $CaCO_3$	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	5	0.5 - 6	5	0.12	0.22	0.18	0.01	0.06	0.03	0.02	0.03	0.03	0.02	0.04	0.03	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.04	0.03	0.02	0.05	0.03	0.05	0.07	0.06	0.03	0.03	0.06	0.09	0.07
Bromide	mg/L	na	na	na	0	0.11	0.03	0	0.03	0.02	0	0.15	0.03	0	0.06	0.02	0	0.17	0.04	0.14	0	0.29	0.11	0	0.44	0.25	0	0.16	0.08	0	0.32	0.19	0.03	0.21	0	0.19	0.07
Cadmium	mg/L	0.005	0.005	0.08	0	0.00005	0.00003	0	0.00005	0.00003	0	0.00005	0.00003	0	0.00005	0.00003	0	0.00005	0.00002	0.00005	0	0.00005	0.00003	0	0.00005	0.00002	0	0.00005	0.00002	0	0.0001	0.00004	0.00005	0.00005	0	0.00005	0.00003
Calcium	mg/L	na	na	na	11	20	17	29	35	32	25	41	31	29	41	37	36	50	44	66	58	68	64	8	25	17	17	27	21	33	40	37	9	22	31	42	35
Carbonate	mg/L $CaCO_3$	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloride	mg/L	250*	100 - 700	na	41	96	55	9	13	11	9	26	17	14	17	15	23	49	36	59	73	**115**	93	90	**121**	**103**	47	**106**	67	50	54	52	63	47	34	59	51
Chromium	mg/L	0.05	na	na	0.0005	0.002	0.001	0	0.001	0.0007	0	0.002	0.0008	0	0.002	0.0007	0	0.002	0.0008	0.0005	0.0005	0.003	0.001	0	0.003	0.001	0	0.003	0.001	0.0005	0.002	0.0013	0.001	0.0005	0.0005	0.003	0.0013
Copper	mg/L	1*	0.2 - 1	0.5-5	0	0.002	0.001	0.001	0.006	0.003	0	0.004	0.002	0	0.029	0.008	0.001	0.026	0.005	0.001	0.002	0.041	0.009	0	0.02	0.004	0.002	0.081	0.013	0	0.003	0.001	0.007	0.001	0	0.021	0.005
Dissolved Organic Carbon	mg/L	na	na	na	0	2.2	0.8	0	1.8	0.7	0	3.2	0.7	0	0.6	0.3	0	1.1	0.7	0.3	0.8	1.8	1.1	0	8.8	2.0	1.4	4.4	2.9	0	1.3	0.5	0.3	2	0	0.3	0.2
Fluoride	mg/L	1.5	1	1 - 2	0.34	0.41	0.37	0	0.13	0.08	0	0.14	0.09	0	0.14	0.10	0	0.13	0.08	0.1	0	0.14	0.10	0	0.47	0.29	0	0.19	0.12	0.29	0.34	0.31	0.05	0.05	0.23	0.28	0.26
Hardness	mg/L $CaCO_3$	na	na	na	48	79	69	111	122	118	87	135	104	97	140	126	110	154	134	235	190	223	210	24	78	53	55	84	65	107	129	117	43	67	102	138	118
Iron	mg/L	0.3*	5	na	0	0.03	0.01	0	0.06	0.03	0	0.06	0.02	0	0.04	0.01	0	0.06	0.01	0.005	0	0.15	0.04	0	0.22	0.06	0	0.08	0.03	0	0.06	0.02	0.07	0.03	0	0.07	0.03
Kjeldahl Nitrogen	mg/L	na	na	na	0	0.11	0.07	0	0.025	0.02	0	0.06	0.02	0	0.07	0.03	0.05	0.24	0.12	0.06	0.07	0.17	0.13	0	0.3	0.12	0	0.2	0.11	0	0.16	0.09	0.05	0.025	0	0.14	0.04
Langelier Index	-	na	na	na	-1.49	0.02	-0.20	-0.52	0.02	-0.24	-1.18	-0.06	-0.64	-0.59	-0.02	-0.22	-1.56	-0.54	-0.88	-	-0.94	-0.38	-0.58	-0.87	-0.1	-0.51	-1.45	-0.15	-0.69	-0.51	0	-0.15	-0.31	-1.59	-0.65	-0.06	-0.15
Lead	mg/L	0.01	0.2	0.1	0	0.001	0.001	0	0.001	0.001	0	0.02	0.003	0	0.003	0.001	0	0.001	0.000	0.001	0	0.001	0.001	0	0.011	0.002	0	0.01	0.002	0	0.002	0.001	0.002	0.001	0	0.002	0.001
Magnesium	mg/L	na	na	na	5	7	6	7	12	9	6	8	7	6	9	8	5	7	6	17	11	13	12	1	3.9	3	3	4.2	3.4	6	7	6	5	3	6	8	7
Manganese	mg/L	0.05*	0.2	na	0	0.021	0.010	0	0.014	0.004	0	0.046	0.008	0	0.026	0.009	0	0.005	0.001	0.005	0	0.07	0.029	0.04	**0.763**	**0.337**	0	0.034	0.007	**0.352**	**0.49**	**0.410**	0.005	0.005	0	0.006	0.003
Mercury	mg/L	0.001	na	0.003	0	0.00005	0.00003	0	0.00005	0.00003	0	0.00005	0.00003	0	0.00005	0.00003	0	0.00005	0.00002	0.00005	0	0.00005	0.00003	0	0.00005	0.00002	0	0.00005	0.00002	0	0.00005	0.00002	0.00005	0.00005	0	0.00005	0.00003
Nickel	mg/L	na	0.2	1	0	0.005	0.002	0	0.005	0.002	0	0.005	0.002	0	0.005	0.002	0	0.005	0.001	0.005	0	0.005	0.002	0	0.005	0.001	0	0.005	0.001	0	0.003	0.001	0.005	0.005	0	0.005	0.002
Nitrate	mg/L N	45	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate + Nitrite	mg/L N	na	na	100	0	0.05	0.03	0.18	0.59	0.39	0	0.31	0.12	0	0.26	0.10	1.89	3.25	2.61	0.15	1.85	7.85	4.10	0	0.36	0.06	0	0.63	0.40	0	0.05	0.02	0.79	0.25	0.26	0.49	0.36
Nitrite	mg/L	na	na	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orthophosphate	mg/L P	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	Units	6.5-8.5*	na	na	7.9	8.4	8.1	7.3	8.1	7.8	7	8	7.6	7.2	8.1	7.8	6.9	7.6	7.2	7.9	6.9	7.7	7.4	7.5	8.4	7.9	7.1	8	7.6	7.6	8.2	7.9	6.4	7.3	7.8	8.2	8.0
Potassium	mg/L	na	na	na	6	13	8.3	1	6	2.8	1	3	2.0	2	5	3.0	3	4	3.2	0.5	4	6	4.7	3	5	3.4	4	7	4.8	4	6	4.7	1	0.5	3	6	4.6
Reactive Silica	mg/L SiO2	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium	mg/L	0.01	0.02 - 0.05	0.05	0	0.001	0.0007	0	0.001	0.0006	0	0.001	0.0006	0	0.001	0.0006	0	0.001	0.0003	0.001	0	0.001	0.0005	0	0.001	0.0004	0	0.001	0.0004	0	0.001	0.0003	0.001	0.001	0	0.001	0.0006
Silver	mg/L	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	mg/L	200*	na	na	81	134	96	7	9	8	9	15	11	9	11	10	20	26	22	28	21	31	27	93	135	109	47	98	70	53	62	57	34	23	50	68	57
Specific Conductance	uS/cm	na	na	na	506	801	588	241	297	272	220	321	262	244	335	303	333	406	384	566	546	653	596	565	725	619	376	634	470	487	508	499	252	259	454	538	507
Sulphate	mg/L	500*	na	1,000	28	61	36	4	7	5	6	10	8	7	10	8	10	12	11	58	8	9	9	9	11	10	10	19	13	10	10	10	8	6	28	29	29
Sulphide	mg/L H2S	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	329	**521**	382	157	193	175	132	209	166	159	218	192	216	264	247	336	328	424	383	318	452	385	229	412	292	317	330	324	172	156	295	340	322
Total Organic Carbon	mg/L	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphorus	mg/L	na	na	na	0	0.04	0.02	0.005	0.02	0.01	0	0.03	0.02	0.005	0.05	0.03	0	0.02	0.01	0.005	0	0.03	0.02	0	0.05	0.02	0	0.03	0.01	0	0.06	0.03	0.005	0.005	0	0.04	0.02
Total Suspended Solids	mg/L	na	na	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
True Color	TCU	15*	na	na	0	1	1	0	2	1	0	1	1	0	1	1	0	2	1	1	0	3	2	0	3	1	4	9	6	0	1	0	1	1	0	1	1
Turbidity	NTU	0.3/1.0/0.1**	na	na	0.2	2.2	0.8	0.2	3.5	1.0	0.1	0.4	0.2	0.1	3.9	0.9	0.05	0.5	0.2	0.6	0.3	1.8	0.8	0.1	13.8	2.6	0.3	2	0.9	0.2	3.3	0.9	0.1	0.3	1	7.1	3.5
Uranium	mg/L	0.02	0.01	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	-	-	0	0	0
Vanadium	mg/L	na	0.1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canadian Water Quality Index (WQI)	-	-	-	-	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	-	100	100	100	-	-	-	100	100	100	88	88	88	-	-	96	96	96
Zinc	mg/L	5*	1 - 5	50	0	0.01	0.004	0	0.005	0.003	0	0.01	0.00	0	0.02	0.01	0	0.005	0.00	0.005	0	0.005	0.00	0	0.019	0.00	0	0.051	0.01	0	0.005	0.00	0.01	0.005	0	0.005	0.00

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 = Chemicial data obtained from the NL Department of Environment - Water Resources Management Division Drinking Water Quality Database. Note in the
data base, prior to March 31, 2004 analytical results less than the detection limit were reported as half of the detection limit, while after March 31, 2004
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