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# Preliminary Baseline Hydrogeology Study
# Great Atlantic Salt Deposit Project
# St. Georges, NL

GEMTEC Project: 101556.002

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Submitted to:

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# Great Atlantic Salt Deposit Project
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# 1.0 INTRODUCTION

## 1.1 General

As part of on-going mineral development activities, Atlas Salt Inc. (Atlas) of St. John's, NL engaged GEMTEC Consulting Engineers and Scientists Ltd. (GEMTEC) to carry out a preliminary baseline hydrogeology study of its proposed Great Atlantic Salt Deposit Project (the Project) located near St. Georges, NL (refer to Figure 1 in Appendix A).

## 1.2 Background

Atlas is proposing to develop an underground salt mine at its Great Atlantic Salt Deposit property located within the municipal limits of the town of St. George's and approximately 15 kilometers (km) south of the town of Stephenville, NL (refer to Figure 1 in Appendix A).

Based on information provided by Atlas, the Project will involve extraction of rock salt from the Great Atlantic Salt deposit using underground mining methods, followed by transportation from the mine to the existing Turf Point port for shipping using an overland conveyor system. Conceptual planning for mine development is on-going. The port facilities were constructed in the 1960's and currently function to load gypsum for shipping from Atlas' Flat Bay Gypsum Mine, located approximately 6 km southwest of the Project.

Atlas has not, as yet, registered the Project for Environmental Assessment (EA). Given the nature of the Project, we expect it will be subject to EA under the Newfoundland and Labrador Environmental Protection Act and may also require federal approval. The submission of a registration document will initiate both the provincial and federal EA processes, informing both levels of government of Atlas' intent to develop the Project. The registration document will also provide regulators with sufficient information regarding the proposed undertaking, existing baseline conditions and potential effects of the Project, to allow a determination regarding which EA process is required before Project approvals can be granted.

From GEMTEC's experience on similar mine development projects, we expect that groundwater resources will be considered a Valued Component requiring assessment as part of the EA process. Groundwater will likely interact with various Project activities such as underground mining and surface water drainage.

This report documents anticipated baseline hydrogeological conditions at the Great Atlantic Salt Deposit Project within a Study Area defined specifically for the current assessment. This Study Area is shown on Figure 1 in Appendix A and has been arbitrarily defined based on the limits of Atlas' mineral licences 027183M, 032295M, 027334M, 027335M, 027336M and a portion of 027333M. The Project's salt deposit and the location of the currently conceived mine infrastructure area footprint are present within the Study Area. We expect characterization of groundwater resources in the Study Area will be required information in support of the EA. Please note that this study is limited to preliminary baseline assessment of the Study Area and may not cover all areas of the final Project development including but not limited to the Turf Point port area and off-site sections of the overland conveyor transport system.

## 1.3 Objectives

The three main objectives of this preliminary baseline hydrogeology study are:

1. Describe the general groundwater flow regime and groundwater quality in the Study Area based on existing data and information.

2. Identify gaps in the current understanding of hydrogeological conditions in the Study Area and greater Project area, and hydrogeology-related requirements needed for the Project's Registration and EA.

3. Provide recommendations for future work to resolve hydrogeological gaps and requirements identified in objective 2.

## 1.4 Scope of Work

The scope of this preliminary hydrogeology baseline study is limited to a desktop review of existing geological and hydrogeological data and other relevant site information available for the Study Area. No additional field investigation or data collection were completed within the scope of this current study.

This desktop review supports the development of a first-generation conceptual hydrogeological model for the Project. Dedicated hydrogeological field study involving drilling of geotechnical boreholes, monitoring well installation with associated hydraulic conductivity testing (packer testing/slug testing), groundwater level monitoring and groundwater quality sampling will be required as development of the Project advances to refine the conceptual hydrogeological model.

## 1.5 Information Sources

There are two key hydrogeology-related investigation reports that provide important background information for this study. These are the "Exploratory Well Drilling Program for the Town of St. George's, NL" (Fracflow, 2003), and the "Factual Summary Report of Geotechnical Logging, Packer Testing and Downhole Geophysical Surveys, Salt Drilling Program, Great Atlantic Salt Deposit, St. George's, NL" (GEMTEC, 2023). A summary of these investigations is provided below. Borehole and testing locations for these investigations are presented in Figure 2 (Appendix A). In addition to these primary sources, various publicly available information and
Project-specific information were also used and are referenced in relevant sections of the report.

Exploratory Well Drilling Program for the Town of St. George's, NL (Fracflow, 2003)

In 2002 to 2003, Fracflow carried out several borehole and exploratory water well drilling programs and carried out various related hydrogeological testing and sampling programs on behalf of the Town of St. George's to identify and evaluate possible locations to develop an alternative public water supply for the town. This program included the following investigations that were relied upon for this study:

- Three NQ diamond drill holes (FR1, FR2 and FR3) were completed within the Study Area along or close to Flintkote Road in November/December 2002. Boreholes FR1 and FR2 were inclined approximately 78° from vertical and had along hole depths of approximately 61 m and 38 m, respectively. Borehole FR3 was a vertical hole with a depth of approximately 46 m. Packer testing was carried out during bedrock drilling in boreholes FR1 and FR2. Artesian conditions were encountered in boreholes FR1 and FR3, and depth discrete water quality samples were collected in these two boreholes.

  As a follow up, in June 2003, two 200 mm (8 inch) diameter exploratory water wells (FRWW1 and FR-WW2) and one 150 mm (6 inch) diameter exploratory water well (FR-WW3) were drilled in the area to depths of 50.3 m, 46 m, and 47.8 m, respectively. Bedrock chip samples were collected every 1.5 m depth during drilling for lithological identification. Stepdrawdown tests were completed an all three wells, and a 72-hour pumping test, followed by recovery monitoring, and a second 42-hour pumping test with recovery monitoring were conducted on FR-WW2. Artesian conditions were encountered in FR-WW1 and FR-WW2, and depth discrete water quality samples were collected in these two wells.

- Four boreholes (RW1, RW2, RW3 and RW4) were augured to a depth of 15 m along the former Canadian National (CN) railway track, located approximately 2 km northeast of the Study Area in December 2002. Split-spoon samples were collected every 1.5 m during auguring and were submitted for grainsize sieve analysis. Based on the grain size sieve results hydraulic conductivity values were calculated for the overburden material.

  As a follow up, in June 2003 one 200 mm (8 inch) diameter water well (RL-WW1) and one NQ diamond drill hole, RW-DD1 (used as an observation well during a pump test), were drilled in the overburden. Note that completion depths for RL-WW1 and RW-DD1 were not provided. A one-month pumping test was carried out in RL-WW1.

- One NQ diamond drill hole, MW1, was completed to a depth of 44.5 m on Muise's Road (located approximately 250 m east of the Study Area) in December 2002. Packer testing was completed during drilling of bedrock. No monitoring well was installed in this hole.

- Groundwater quality samples were collected from five wells within the Study Area as part of Fracflow's 2002 – 2003 programs. These samples were analyzed for general chemistry and total metals. Five of the water quality samples collected were from wells located along Flintkote Road (FR1, FR3, FR-WW1, FR-WW2 and FR-WW3) and one sample was collected from a pre-existing well at the Shallop Cove cemetery (CW-1).

Factual Summary Report of Geotechnical Logging, Packer Testing and Downhole Geophysical Surveys, Salt Drilling Program (GEMTEC, 2023)

GEMTEC in partnership with Terrane Geoscience Inc. (Terrane) carried out geotechnical logging, and conducted packer testing, and televiewer and natural gamma ray surveys as part of an exploration salt drilling program by Atlas between February 2022 and January 2023. GEMTEC/Terrane's field program included geotechnical logging of the upper siliciclastic sedimentary bedrock sequence (above the salt horizon) in five of Atlas' exploration boreholes (CC-22-6, CC-22-7, CC-22-8, CC-22-9, CC-22-9b) down to depths ranging from 146 m to 257 m. The program also involved the geotechnical logging of the upper siliciclastic sequence in historical borehole CC-4. Packer testing was carried out during bedrock drilling in boreholes CC-22-6 and CC-22-7. A total of 11 packer tests were attempted, including six in borehole CC-22-6 and five in CC-22-7. Of these, five packer tests were successfully completed (three in CC-22-6 and two in CC-22-7). Packer testing was carried out over depths ranging from 99 m to 296.1 m in CC-226, and from 87.3 to 144.9 m in CC-22-7. Packer tests could not be performed in the other six selected test intervals either due to obstruction (caving) of the interval or more often due to the instability of the borehole wall that resulted in poor packer seating and improper isolation of the test zone.

## 2.0 STUDY AREA SETTING

### 2.1 Location and Access

The boundary of the Study Area is shown in Figure 1 in Appendix A, and covers an area of approximately 1,300 ha within the southwestern portion of the municipal limits of the Town of St. George's. Access to and within the Study Area is provided by Flintkote Road, a gravel service road that runs approximately 8 km southwest from Atlas' Flat Bay Gypsum mine northeast to the port facilities at Turf Point. Flintkote Road connects with the Trans-Canada Highway at its southwest end and can be accessed from the St. George's Highway in the northeast.

The Study Area is predominately situated in an undeveloped natural area south of the town site, with low density residential development present along the St. George's Highway along its northern boundary.

### 2.2 Climate and Meteorology

The Study Area is located within the Southwestern Newfoundland Ecoregion, which covers the west coast of Newfoundland, south of the Northern Peninsula and west of the barrens of the southern Long Range Mountains and the Buchans Plateau. This ecoregion is characterized by cool summers and snowy, cold winters (Heritage NL, 2002).

Based on historical climate data from 1981 to 2010 recorded at the Stephenville A weather station (48°32' N, 58°33' W), located approximately 30 km north of the Study Area, August is typically the warmest month (daily average of 16.7°C), while February is typically the coldest (daily average of -6.7°C). The average annual precipitation is 1,340.4 mm, which includes 995.3 mm of rain and 393.2 cm of snow. August is the rainiest month (monthly average of 130.4 mm), and January is the snowiest month (monthly average of 124.6cm) (EC, 2023).

### 2.3 Physiography, Topography, and Drainage

Regionally the Study Area and overall Project are located within a low-lying physiographic region referred to as the West Coast Lowlands (Twenhofel and MacClintock, 1940). 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 Study Area sits at an elevation of approximately 60 m above sea level (masl) and slopes gently northwest to the coast at Flat Bay (St. George's Bay). Higher elevations are present in upland regions southeast of the Study Area, with maximum elevations of up to 600 masl in the Long Range Mountains, located approximately 15 km to the southeast.

The most significant surface water features in the Study Area are the marine waters of Flat Bay, which borders the Study Area to the northwest, and Flat Bay Brook, which flows roughly eastwest approximately 200 m to the south, at its closest point. Several small ponds are present within the Study Area, including Burnt Pond Brook, which is located along the eastern site boundary and serves as a headwater to Dribble Brook. Dribble Brook flows northeast – southwest through the southeastern corner of the Study Area and discharges into Flat Bay Brook approximately 250 south and upstream of the site.

Based on review of the NL Department of Environment and Climate Change (NLDECC) online Water Resources Portal (NLDECC, 2023a), no surface water Public Protected Water Supply Areas (PPWSA) are present within the Study Area. The Dribble Brook PPWSA for the town of St. George's is located approximately 2.5 km up-stream of the Study Area (refer to Figure 1 in Appendix A). The town of St. George's also utilizes a groundwater supply. The wellfield PPWSA for this groundwater source is located approximately 1.5 km northeast of the site (refer to Figure 1 in Appendix A).

Surface drainage from the Study Area is expected to follow topography and to be predominantly to the northwest towards Flat Bay (St. George's Bay).

## 3.0 GEOLOGY

### 3.1 Surficial Geology

The surficial geology in the Study Area is summarized in Figure 3 in Appendix A, and is based on most recent 1:50,000-scale mapping of the area by Batterson (2001) and Liverman (2001).

The majority of the Study Area is underlain by glacial diamicton (till), occurring mainly as blanket deposits greater than 1.5 m thick transitioning to thin till veneer in the northern portion of the site. Deposits of marine clay, silt, gravel and diamicton occur in coastal areas along the northern boundary of the site and occur as dissected and eroded glacial fluvial fans (deltas) at the mouth of Little Barachois Brook. South of the Study Area, glacial outwash and fluvial sand and gravel greater than 1 m thick are present along Flat Bay River occurring as relatively flat plain deposits with local areas of raised terraces and eskers. Along with glacial units, deposits of organics and peaty soils are common in the area and generally overlie till.

An area of bedrock is present in the southwest portion of the site that is fully concealed by a thin mat of vegetation and sparse forest, and to a lesser extent by till veneer. Extensive areas of bedrock are present southeast of the Study Area where terrain rises steeply along the summits of the Long Range Mountains. Bedrock outcrops in this area 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 vegetation. In addition, development of rock talus (or colluviums) is common along steep slopes in this area. Ice flow parallel lineations including striations and crag-and-tail ridges indicate northwest-directed glacier movement.

Based on borehole drilling completed by Atlas and by Fracflow (2003), the thickness of surficial soils in the Study Area ranges from 3.5 m to 34.5 m, and averages 15.2 m.

### 3.2 Regional Bedrock Geology

The regional bedrock geology of the Study Area is summarized in Figure 4 (Appendix A), and is presented below, taken mainly verbatim from Collins (2017) and Northcott (2015), and based on Knight (1983).

The Study Area is situated in the Carboniferous Bay St. George Sub-Basin in southwestern Newfoundland. This sub-basin represents the northeastern extension of a series of sub-basins that collectively form the Maritimes Carboniferous basin, a large basin complex that underlies the Gulf of St. Lawrence and adjacent land areas. Rocks of the onshore Bay St. George Basin are developed in a 22 kilometer (km) wide zone between St. George's Bay and the Long Range Mountains.

The basin is believed to have formed as a pull-apart trough adjacent to, and west of, the northeasttrending Long Range Fault; a major strike-slip fault structure and part of the regional Cabot Fault system. Strike-slip movement began in the Middle or Late Devonian associated with Acadian orogenesis and ended in Early Carboniferous. As the basin developed, local tectonic features such as the Snake's Bight Fault, St. George's Coalfield Syncline, and the Flat Bay and Anguille Anticlines (all structural features located southwest of the Study Area) influenced deposition and created an irregular basin architecture characterized by depressions and fault-bounded ridges.

The St. George sub-basin was filled by approximately 10 km of Carboniferous sedimentary rocks that include three groups: 1) late Devonian- to early Mississippian-aged Anguille Group; 2) middle to late Mississippian-aged Codroy Group; and, 3) late Mississippian to early Pennsylvanian-aged Barachois Group. The Anguille Group is a sequence of non-marine siliciclastic rocks defining the oldest strata in the basin. This sequence is overlain by a series of marine and non-marine carbonates, evaporites and clastic lithologies of the Codroy Group that are in turn overlain by a variable interbedded sequence of sandstone, siltstone and shale comprising the Barachois Group. The Carboniferous basin sedimentary strata rest unconformably on Precambrian and early Paleozoic granitic and mafic gneiss and mafic to intermediate schist rocks of the Humber
Zone of the Appalachian orogen. This stratigraphic sequence is depicted in Figure 5 in Appendix A.

Sedimentary rocks in the St. George sub-basin were deformed in the Late Carboniferous to Early Permian (Alleghenian Orogeny). Major northeast-trending folds that strike obliquely to the Long Range Fault (for example the Flat Bay anticline located immediately southwest of the site), and northeast-trending synthetic and northwest-trending antithetic faults developed during this renewed period of strike slip faulting along the Cabot Fault system.

### 3.3 Local Bedrock Geology

A thick blanket of surficial till covers the majority of the Study Area limiting bedrock exposure, and an understanding of local geology is primarily based on results of exploration drilling programs completed on the property since 2002.

The Barachois Group, the youngest rocks in the St. George sub-basin stratigraphic sequence are not present in the Study Area and the top of the local stratigraphic section begins with the Jeffery's Village Member (JVM) of the Robinsons River Formation (Codroy Group). This unit extends from the bedrock surface (beneath the surficial till) to depths ranging from 170 m to 370 m, and generally comprises an upper cyclic sequence of interbedded siliciclastic sediments, including conglomerate, sandstone, siltstone and mudstone followed by a lower evaporitic sequence comprised primarily of massive, crystalline halite (salt) that make up the Great Atlantic Salt deposit. Localized interbeds of mudstone and potash are also present in the salt horizon. In drill core, the upper siliciclastic rocks are observed to be variably lithified, with soft, unconsolidated beds of mudstone, occurring throughout and interbedded with more competent but commonly

friable layers of sandstone and conglomerate. Bedding thicknesses in the upper siliciclastic sedimentary sequence range from less than 5 m up to tens of meters; bedding planes generally dip less than 45° from horizontal. Based on drilling results to date, the salt horizon ranges in thickness from 70 m to approximately 350 m and contains minor interbeds of variably coloured gypsum, halite, mixed red/grey siliciclastic beds and carbonates. The salt horizon is conformably underlain by a massive, competent blue-grey anhydrite unit belonging to the Codroy Road Formation (CRF) (Codroy Group). To date only one drill hole has extended below this anhydrite sequence. In this drillhole (CC #1), the anhydrite sequence extended to 597 m, and encountered a 7 m thick unit of limestone belonging to the Ship Cove Formation (SCF), before reaching the granitic basement rocks. The oldest sedimentary rocks in the St. George subbasin belonging to the Anguille Group have not been identified in the Study Area.

The Project's salt deposit has not been fully delineated but has been identified at least 2.5 km in length in the northeast-southwest direction and 600 m width in the southwest-northwest direction.

Geotechnical logging of Atlas' recent exploration boreholes CC-22-6, CC-22-7, CC-22-8, CC-229, CC-22-9b, and historical borehole CC-4 (detailed in GEMTEC, 2023) indicates the upper siliciclastic sedimentary sequence contains both open and clay-filled fracture zones throughout, as well as short rubble zones (generally less than 2 m thick) and local narrow (cm-scale) healed fault/shear zones. GEMTEC used the RQD data collected as part of this geotechnical logging program to further assess hydrostratigraphic conditions in the Study Area. The RQD data were categorized into 50-metre increments based on the average depth of the core sample, and summary statistics were calculated (provided in Appendix B). The logged sections of the exploration boreholes ranged in depth from 146 m to 257 m. Overall, the RQD data indicates a poor to fair rock mass quality (with mean RQD ranging from 45.6% to 59.7%) for the entire upper siliciclastic sedimentary sequence at all five borehole locations, with no trend in increased rock mass quality with depth. Based on these findings, we conclude that in addition to intergranular primary porosity in some of the coarser-grained units of the sequence, enhance zones of hydraulic conductivity and groundwater movement will occur through these rocks due to secondary permeability associated with the identified weather, fractured and rubble zones.

Geotechnical logging was not carried out of the cored sections of the salt and anhydrite units. However, lithological logs provided by Atlas indicate that these units generally occur as massive and competent deposits with very little internal fabric other than the occasional of thin interbeds of siliciclastic sedimentary and minor carbonate units.

## 4.0 LOCAL WATER USERS

As noted in Section 2.3 of this report, there are two PPWSAs near the Study Area that service the town of St. George's; including a protected groundwater well field (PPWSA ID WS-G-0876) located approximately 1.5 km northeast of the site, and a protected surface water source from the upper reaches of Dribble Brook (PPWSA ID WS-S-0689) located approximately 2.5 km east of the Study Area.

St. George's groundwater supply wellfield comprises four production wells (RW-WW1, RW-WW2, RW-WW3 and RL-WW4) completed to depths ranging from 25.6 m to 50.3 m within the overburden and shallow bedrock groundwater table aquifer. At present there is insufficient hydrogeological data for this well field or for the Study Area to understand their hydraulic connectivity and the potential for impacts to this water supply related to Project development.

The Study Area is situated downstream from the Dribble Brook PPWSA surface water supply, and as such run-off and drainage from this area is not expected to interact with this protected water source. Further, while lower sections of the Dribble Brook PPWSA may be feed, at lease seasonally, by groundwater, the potential for impacts to this surface water supply related to Project development via a groundwater pathway are not expected given the significant separation distance of 2.5 km between this PPWSA and the site.

Information from the Provincial Water Well Database provided by the NL Department of Environment and Climate Change (NLDECC) - Water Resources Management Division for this study indicates that a total of 69 water wells are present within an approximate 5 km radius of the site. A summary of well construction details for these wells is provided in Table C.1 in Appendix C. Based on the spatial information as supplied, none of the water wells in the provincial water well database lie within the Study Area. Of the 69 wells within 5 km of the site, 56 are mixed domestic, municipal, commercial, and industrial supply wells located within the town of St. George's, two are domestic supply wells located at Barachois Brook (4 km away from the site), and nine are domestic supply wells located at Sandy Point on Flat Island located appropriately 2.5 km offshore from St. George's. In addition, two non-domestic wells, one belonging to the local transportation depot, and the other located at the regional waste disposal facility, are present along the Trans-Canada Highway, approximately 3 km east of the site. Given the substantial distances and the various topographic and hydraulic drainage divides that separate the wells at Barachois Brook, Sandy Point and the transportation depot and waste disposal sites from the Study Area, GEMTEC does not consider that these wells are hydraulically connected to the Project.

Of the 56 wells identified in the provincial water well database for the town of St. George's, 40 are listed with the same generic geographic coordinates, and actual well locations are not provided. As such, it is not known if any of these wells are located in the vicinity of the Study Area and
Project. These wells range in depth from 7 m to 91 m with a mean of 28 m, and are a mixture of overburden and bedrock wells. At present there is insufficient hydrogeological data for the St. George's water wells or for the Study Area to understand their hydraulic connectivity and the potential for impacts to these private water supplies related to Project development.

A review of active water use licences within 5 km of the Study Area was carried out using the NL Water Use Licences online mapping tool (NLDECC, 2023b). The search indicated that there are no water rights holders in the immediate vicinity of the Study Area.

# 5.0 PRELIMINARY HYDROGEOLOGICAL CHARACTERIZATION

## 5.1 Groundwater Flow Conditions

### 5.1.1 Hydrostratigraphy

A summary of surficial and bedrock geology of the Study Area is provided in Section 3. From a hydrogeological perspective the geological materials underlying the site are classified into the following five hydrostratigraphic units according to their hydrogeological properties:

- Till Deposits
- Upper Siliciclastic Sedimentary Bedrock Sequence (JVM)
- Evaporite Sequences - Salt (JVM)/Anhydrite (CRF)
- Limestone (SCF)
- Basement Granitiod Rocks

Till Deposits

This surficial material underlies the majority of the Study Area occurring as thin veneer (less than 1 m thick) in the northwestern portion of the site transitioning to thicker blanket deposits up to 34.5 m thick to the southeast, and with an average thickness of 15 m. The composition of the site's till has not been determined but the material is classified as Unit A in the AMEC (2013) regional hydrogeological study. Unit A is described as ranging from silty sand to clayey silt with local interbeds of sand and gravel. The permeability of this unit is through its primary intergranular porosity and is generally low to moderate but may be higher within the local beds of sand and gravel material.

To GEMTEC's knowledge no hydraulic conductivity (K) testing has been completed on the till deposits in the Study Area. Fracflow (2003) provides estimates of K for till material determined using both sieve analysis and pumping test methods from a site located approximately 2 km northeast of the Study Area along the former CN Railway track. Based on Fracflow's sieve analysis results K values ranging from 7E-5 m/s to 1E-3 m/s were calculated for the till. A follow up 72-hour pumping test of a 15.2 m depth 200 mm- (8 inch) diameter water well completed in the till at the railway track site (RL-WW1) determined a K value of 1E-4 m/s, which is within the range of the sieve analysis K dataset. The range in K values determine for the till based on Fracflow's study are within the typical range of values in the literature for a silty sand material (e.g. Freeze and Cherry, 1979), and represents a moderate permeability. The till at the railway track site was described as poor- to well-graded silty sand with interbeds of poorly-graded sand, which appears to be lithologically similar to regional hydrostratigraphic Unit A, and is assumed to reflect the composition of till in the Study Area.

The till deposits are locally exploited for private water supplies in the region. Based on 39 well records, AMEC (2013) reports well yields ranging from 0 L/min to 232 L/min, with an average of 48 L/min for till Unit A. Well depths supporting these yields range from 9 m to 40 m, having an average of 21 m. None of the wells defining this hydrostratigraphic unit are located near the Study Area.

Upper Siliciclastic Sedimentary Bedrock Sequence (JVM)

The upper siliciclastic sedimentary sequence extends from beneath the surficial till deposits to a maximum depth of 370 m and comprises an interbedded sequence of conglomerate, sandstone, siltstone and mudstone having bedding thicknesses ranging from less than 5 m up to tens of meters. While this sequence is comprised of a number of lithologically distinct sedimentary beds (each with their own unique hydraulic properties), there is insufficient data available for these beds to be separated into discrete hydrostratigraphic units at this time. Instead, for the purposes of this preliminary hydrogeology study, the entire upper siliciclastic sedimentary bedrock sequence is grouped into one hydrostratigraphic unit. We expect that groundwater flow within this hydrostratigraphic unit will mainly be due to primary intergranular porosity and will be most pronounced within the more permeable sandstone and conglomerate beds, while the siltstones and mudstones will have low permeability. Secondary porosity associated with fracture networks and fault and rubble zones will locally enhance the permeability of the various sedimentary rock types within this hydrostratigraphic unit.

The K dataset for this hydrostratigraphic unit in the Study Area consists of the following:

- one pumping test of 72-hr duration test carried out in an exploration water well (FR-WW2) by Fracflow (2013); and,
- thirteen (13) packer tests, including five tests in two recent Atlas exploration boreholes (CC-22-6 and CC-22-7) (GEMTEC, 2023), and eight tests in two boreholes (FR1 and FR2) completed by Fracflow (2003).

The locations of these test wells and boreholes are shown on Figure 2 in Appendix A, and are all situated in the same general area along Flintkote Road. The five packer tests performed on the Atlas exploration boreholes CC-6 and CC-7 were conducted at depths ranging from approximately 87 m to 168 m and yielded K values ranging from 2E-8 m/s to 2E-6 m/s (GEMTEC, 2023). The K values determined from packer testing provided in Fracflow (2003) are presented as order-ofmagnitude estimates. These tests were conducted at slightly shallower depths ranging from approximately 15 m to 45 m, and yielded slightly higher K values ranging from 1E-5 m/s to 1E-6 m/s. The results of the pumping test of water well FR-WW2 by Fracflow (2013) yielded a geometric mean K of 7E-7 m/s. Fracflow (2003) also reported having completed pumping tests on two other exploratory water wells (FR-WW1 and FR-WW2) in the Study Area; however, no results were provided other than the calculated well yield estimates presented in the paragraph below. The packer testing and pumping test results discussed above show a broad range in K for this hydrostratigraphic unit spanning two orders-of-magnitude from 1E-08 m/s to 1E-06 m/s. It should be noted that these K estimates provide a composite value for the tested interval, which may contain interbeds of various sedimentary rock types of with differing permeability. It is possible that the individual coarser-

grained sand and conglomerate units in this sequence may have K values that are higher than this K range; while the finer-grained siltstone and mudstone units may have lower values.

This hydrostratigraphic unit corresponds to regional hydrostratigraphic Unit 4 in the AMEC (2013) regional hydrogeological study. The Carboniferous basin sedimentary rocks that define this unit are locally exploited for private water supplies in the region. Based on 586 well records, AMEC (2013) reports well yields ranging from 0.5 L/min to 1,530 L/min, and an average of 72.6 L/min for this unit. Well depths supporting these yields range from 6 m to 131.1 m, and average of 41 m. Of the 586 wells that define this regional hydrostratigraphic unit, none are located in the Study Area, but three wells are located in Flat Bay / Flat Bay West, approximately 4 km southwest of the site and are characterized by yields ranging from 4 L/min to 45 L/min, and an average of 26 L/min. The depths of these wells had a range of 25.3 m to 55 m, and an average of 43.4 m. The pumping tests carried out by Fracflow (2003) in their three Flintkote Road exploratory water wells (FR-WW1, FR-WW2, FR-WW3) had yields ranging from 50 L/min to 80 L/min. These yields are within the regional dataset but higher than those reported from the wells in Flat Bay / Flay Bay West.

Evaporite Sequences - Salt (JVM) / Anhydrite (CRF)

From a hydrogeological perspective, the halite unit underlying the upper siliciclastic sedimentary sequence of the JVM and the underlying anhydrite horizon of the CRF are interpreted to have simar lithological characteristics and are grouped together as one hydrostratigraphic sequence. To GEMTEC's knowledge no K testing has been completed on the halite or anhydrite in the Study Area; however, literature values for these evaporite units show ranges from 1E-12 m/s to 2E-10 m/s for the halite, and a slight wider range from 3E-13 m/s to 2E-8 m/s for the anhydrite (Domenico and Schwartz, 1998). The K ranges for the halite and anhydrite reflect low to very low permeabilities, and groundwater movement through these units is expected to be primarily associated with secondary porosity along bedding plane fractures with other interbedded sedimentary and carbonate units.

Limestone (SCF)

This unit has not been well characterized in the Study Area, having only been encountered in one exploration borehole (CC#1) where it occurred as a 7 m thick unit below the anhydrite horizon, and immediately above the granitic basement rocks. To GEMTEC's knowledge no K testing has been completed on this rock unit in the Study Area; however, literature values for limestone range from 1E-09 to 2E-06 m/s (Domenico and Schwartz, 1998). The K range for this unit reflects a low to moderate permeability, and groundwater movement through the limestone is expected to be associated with secondary porosity along fractures, joints and dissolution features.

Basement Granitiod Rocks

The basement rock, consisting of melanocratic granitoid, has not been well characterized in the Study Area, having only been encountered in one exploration borehole (CC#1) where it occurred beneath the Ship Cove Formation limestone. Based on Atlas' borehole logging this unit appears to be massive with only a weak irregular fabric and is not significantly fractured. To GEMTEC's knowledge no K testing has been

completed on this rock unit in the Study Area; however, literature values for unfractured igneous and metamorphic rocks range from 3E-14 m/s to 2E-10 m/s (Domenico and Schwartz, 1998), and reflects a very low permeability, virtually impermeable material.

### 5.1.2 Groundwater Levels and Flow Directions

Groundwater table level data for the Study Area is limited to one reading collected by Fracflow (2003) for exploratory water well FR-WW3. The groundwater table level in this well measured 4 mbgs. Outside the Study Area, regional groundwater table data for St. George's available in the provincial water well database indicates a broad range in water levels from 1 mbgs to 30 mbgs, and with a mean of 12 mbgs. In addition, Fracflow (2003) reported a water level of 14 mbgs for its exploratory water well MR-1 located approximately 250 m east of the site. There is insufficient groundwater level data to develop a piezometric contour map for the Study Area but based on the limited dataset we expect that the groundwater table will be within 14 m of ground surface at the site.

In a number of Atlas' exploration boreholes (including recently drilled CC-6, CC-7, CC-9 and CC9a), and several exploratory water wells and boreholes completed by Fracflow (2003) (FR-WW1, FR-WW2, FR-1, and FR-3), artesian conditions (i.e., groundwater levels above ground surface) were encountered at depth within the siliciclastic sedimentary bedrock sequence. While our understanding of the site's aquifer system(s) is presently limited, GEMTEC infers that these artesian conditions are likely attributed to either confining layers within the interbedded high and low permeability sequence or possibly reflect upward-directed groundwater flow resulting from the site's inferred groundwater discharge setting.

Groundwater flow in the Study Area is inferred to follow a local flow system that mimics topography and surface water drainage and flows in a northwest direction. Groundwater recharge is thought to mainly occur along the areas of high ground to the southeast (Long Range Mountains) and discharge in various wet lowland areas (bogs), ponds, and brooks that underlie the site, as well as along the coast at Flat Bay.

## 5.2 Groundwater Quality

Fracflow (2003) presents groundwater quality results for five of its exploration water wells completed in the Study Area (i.e., FR-1, FR-3, FR-WW1, FR-WW2, and FR-WW3). Based on these results, shallow groundwater at the site appears to be of calcium bicarbonate to sodium bicarbonate type, and the concentration of several metals parameters, aluminum, iron and manganese were noted as exceeding the Canadian Drinking Water Quality Guidelines applicable at the time of writing. Groundwater quality data is also available for one sample (CW-1) collected by Fracflow (2003) taken from the Shallop Cove cemetery well, located along the northern limit of the site. The results for this sample also indicated concentrations of iron and manganese that exceeded Canadian Drinking Water Guidelines.

A trend of increasing groundwater salinity concentrations with depth attributed to formational brines was identified by Fracflow (2003) based on depth discrete water sampling carried out in several of the exploration water wells at the former CN railway track site, as well as at several wells in the former Dribble Brook potable supply well field (refer to Figure 2 in Appendix A). Given the occurrence of halite and

anhydrite units at depth in the Study Area, a similar tend of increasing salinity with depth may also occur at the site.

## 6.0 INFORMATION GAPS & RECOMMENDATIONS

This study provides a preliminary overview of anticipated hydrogeological conditions in the Study Area but is limited to very sparse site-specific data. The following information gaps have been identified relating to: 1) our understanding of baseline conditions for groundwater quantity and quality in the Study Area; 2) the evaluation of groundwater interactions associated with a potential future mine development Project; and, 3) how the Project might interact with the natural hydrogeological and hydrological systems as well as public and private water supplies in the area.

The identified information gaps are provided below along with an overview of recommended field programs to address those gaps:

- Detailed site-specific hydraulic conductivity values for overburden and bedrock underlying the Project; useful to estimate various mine site infrastructure seepage, underground mine inflows and radius of influence through analytical and numerical modeling methods, groundwater velocities, on-site groundwater supply potential; obtained through slug tests, pumping tests and/or packer injection tests.

- Project-wide and seasonal groundwater level variations; required to determine groundwater flow directions and hydraulic gradients; obtained through water level surveys of existing exploration boreholes, as well as purpose-built hydrogeological monitoring wells, with water level data loggers installed at select locations to collect temporal data.

- Vertical hydraulic gradients; obtained using water level data from multi-level monitoring wells.

- Groundwater quality in both shallow and deeper groundwater systems; obtained from purpose-built monitoring wells or water supply wells, with groundwater sampling at various depths and in different rock types, chemical analysis for various water quality parameters, including general chemistry and metals.

- Interactions between groundwater and surface water in the vicinity of the underground mine and other mine infrastructure areas; important to assess potential effects of mine dewatering or other groundwater extraction on nearby surface water bodies; obtained through integrated hydrology/hydrogeology investigations.

- Interactions between the groundwater at the Project and private and public groundwater supply sources in the area; determined using collected site hydrogeological datasets noted above, carrying out a detailed survey of water supply wells in the area, and applying analytical and numerical modeling methods.

The usual method of determining baseline hydrogeology is to install a series of monitoring wells at strategic locations within the Project area, supplemented with collection of hydrogeological data from existing exploration boreholes, where available. The groundwater monitoring wells can be installed independently or installed concurrent with any geotechnical investigations at the various Project components and can be used for baseline as well as compliance monitoring of groundwater conditions in the vicinity of the underground mine and other mine components (such as fuel storage facilities) as the Project advances through development and into operation.

GEMTEC would be pleased to provide a detailed work plan and associated costing for a baseline hydrogeological field investigation comprising installation of groundwater monitoring wells and associated hydrogeological testing as described above, at Atlas' request.

## 7.0 CLOSURE

This report has been prepared for the sole benefit of our client, Atlas Salt Inc. The report may not be relied upon by any other person or entity without the express written consent of GEMTEC Consulting Engineers and Scientist Limited and our client, Atlas Salt Inc.

Any use that a third party makes of this report, or any reliance or decisions made based on it, is the responsibility of such third parties. GEMTEC Consulting Engineers and Scientist Limited

accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The conclusions presented represent the best technical judgment of GEMTEC Consulting Engineers and Scientist Limited based on current engineering and scientific practices. Should additional information become available, GEMTEC Consulting Engineers and Scientist Limited requests that this information be brought to our attention so that we may re-assess the conclusions presented herein.

We trust this report provides sufficient information for your present purposes. This report was prepared by Candice Williams, P.Eng, and reviewed by Carolyn Anstey-Moore, P.Geo. on behalf of GEMTEC Consulting Engineers and Scientists Limited. If you have any questions concerning this report, please do not hesitate to contact the undersigned.

Respectfully submitted,

**GEMTEC Consulting Engineers and Scientist Limited**

REGISTERED PROFESSIONAL GEOSCIENTIST
CAROLYN ANSTEY-MOORE
SIGNATURE
10/03/2023
DATE
NEWFOUNDLAND & LABRADOR

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Signature of Member Number
(Member-in-Responsible Charge)

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# APPENDIX A

Figures


## Legend

- Protected Public Water Supply Area
- Contour_20 m
- Waterbody
- Study Area
- Mine Infrastructure Area
- Road
- Watercourse
- Municipal Boundary

Scale: 1:18,000

0 1,000 2,000 4,000 m

NAD83/ UTM Zone 21N

General Notes:

1. Coordinate System: NAD 1983 UTM ZONE 21 N
2. Topographic map 12H, source GeoGratis(Government of Canada)
3. Public water supply information obtained from the provincial online Water Resource Portal (accessed February 2023)

PROJECT

**PRELIMINARY BASELINE HYDROGEOLOGY STUDY, GREAT ATLANTIC SALT DEPOSIT PROJECT, ST. GEORGE'S. NL**

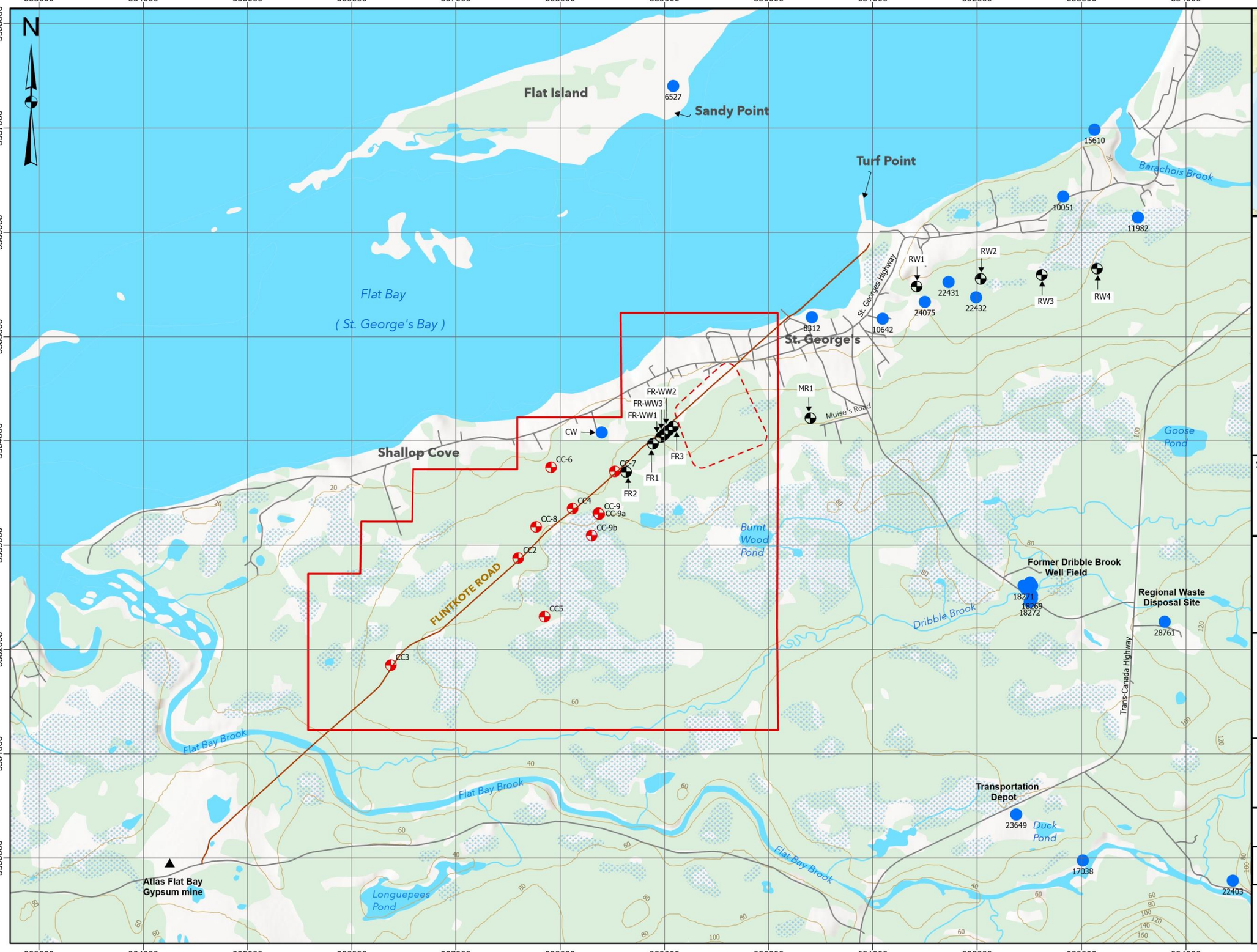
DRAWING

**PROJECT LOCATION MAP OVERVIEW**

| DATE | DRAW BY | CHECKED BY |
|---|---|---|
| FEBRUARY 2023 | MA | CAM |
| PROJECT NUMBER: | DRAWING NUMBER | REV. No. |
| 101556.002 | FIGURE 1 | 0 |

GEMTEC
Consulting Engineers and Scientists

ATLAS SALT




General Notes:

1. Coordinate System: NAD 1983 UTM ZONE 21 N
2. Topographic map 12H, source GeoGratis(Government of Canada)
3. Water well locations shown from the provincial Water Well database provided by the NL Department of Environment and Climate Change - Water Resource Management Division.

PROJECT

**PRELIMINARY BASELINE HYDROGEOLOGY STUDY, GREAT ATLANTIC SALT DEPOSIT PROJECT, ST. GEORGE'S. NL**

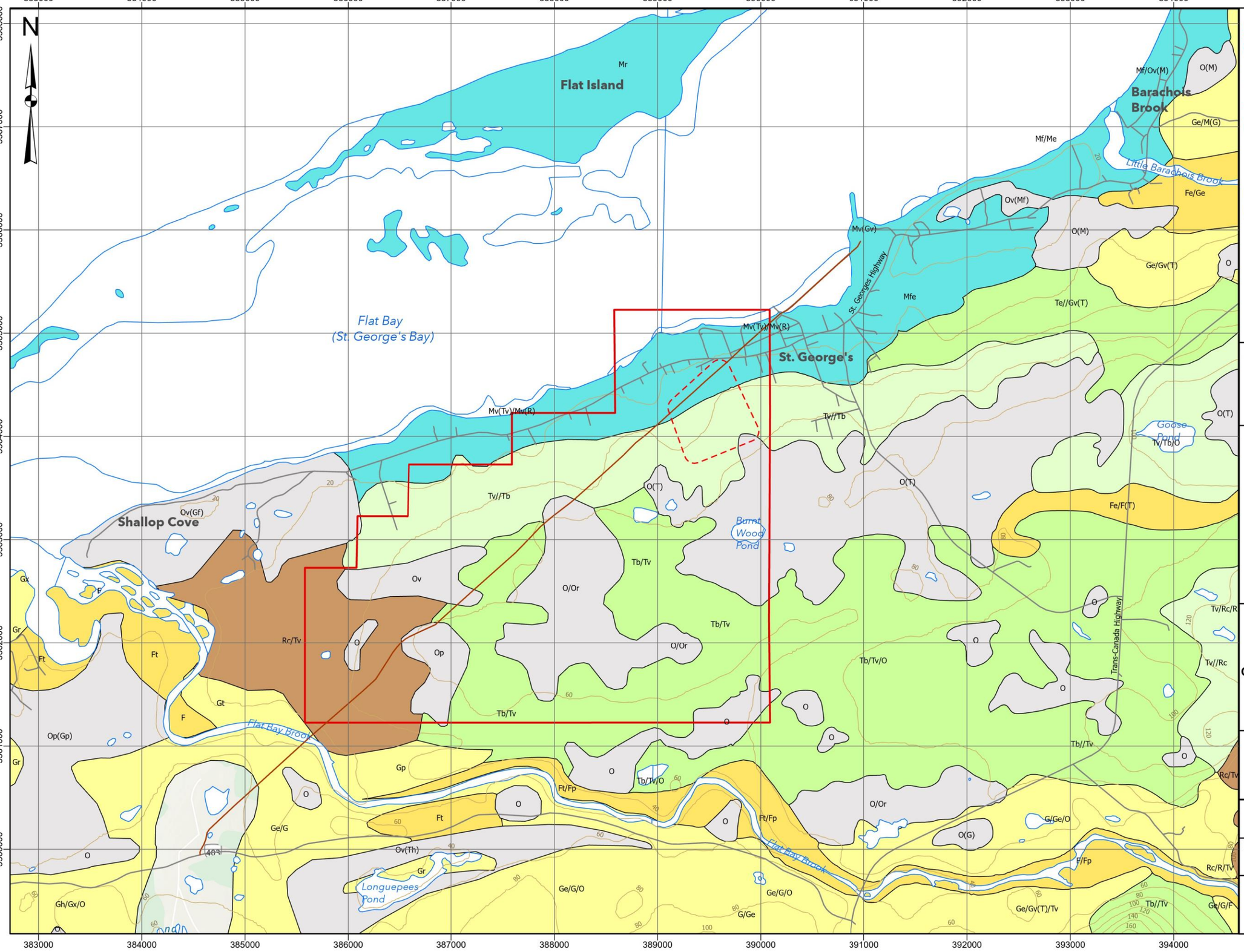
DRAWING

**STUDY AREA**

| DATE | DRAW BY | CHECKED BY |
|---|---|---|
| FEBRUARY 2023 | MA | CAM |
| PROJECT NUMBER: 101556.002 | DRAWING NUMBER FIGURE 2 | REV. No. 0 |

GEMTEC
Consulting Engineers and Scientists

ATLAS SALT




Study Area
Mine Infrastructure Area
Road
Contour_20 m
Flintkote Road
Waterbody

Surficial Geology Units:

Organics (O)
Fluvial (Ff)
Colluvium (G)
Aeolian (Er)
Glaciofluvial (Gr)
Lacustrine (L)
Marine (Mv)
Till Veneer (Tv)
Thick Till (Tb)
Lineated Till (Tr)
Hummocky Till (Th)
Rock (R)
Rock Concealed (Rc)

Scale: 1:35,000

0 500 1,000 2,000 m

NAD83/ UTM Zone 21N

General Notes

1. Coordinate System: NAD 1983 UTM ZONE 21 N
2. Topographic map 12H, source GeoGratis(Government of Canada)
3. Surficial Geology Data acquired from the Government of Newfoundland and Labrador Geoscience Online

PROJECT

**PRELIMINARY BASELINE HYDROGEOLOGY STUDY, GREAT ATLANTIC SALT DEPOSIT PROJECT, ST. GEORGE'S. NL**

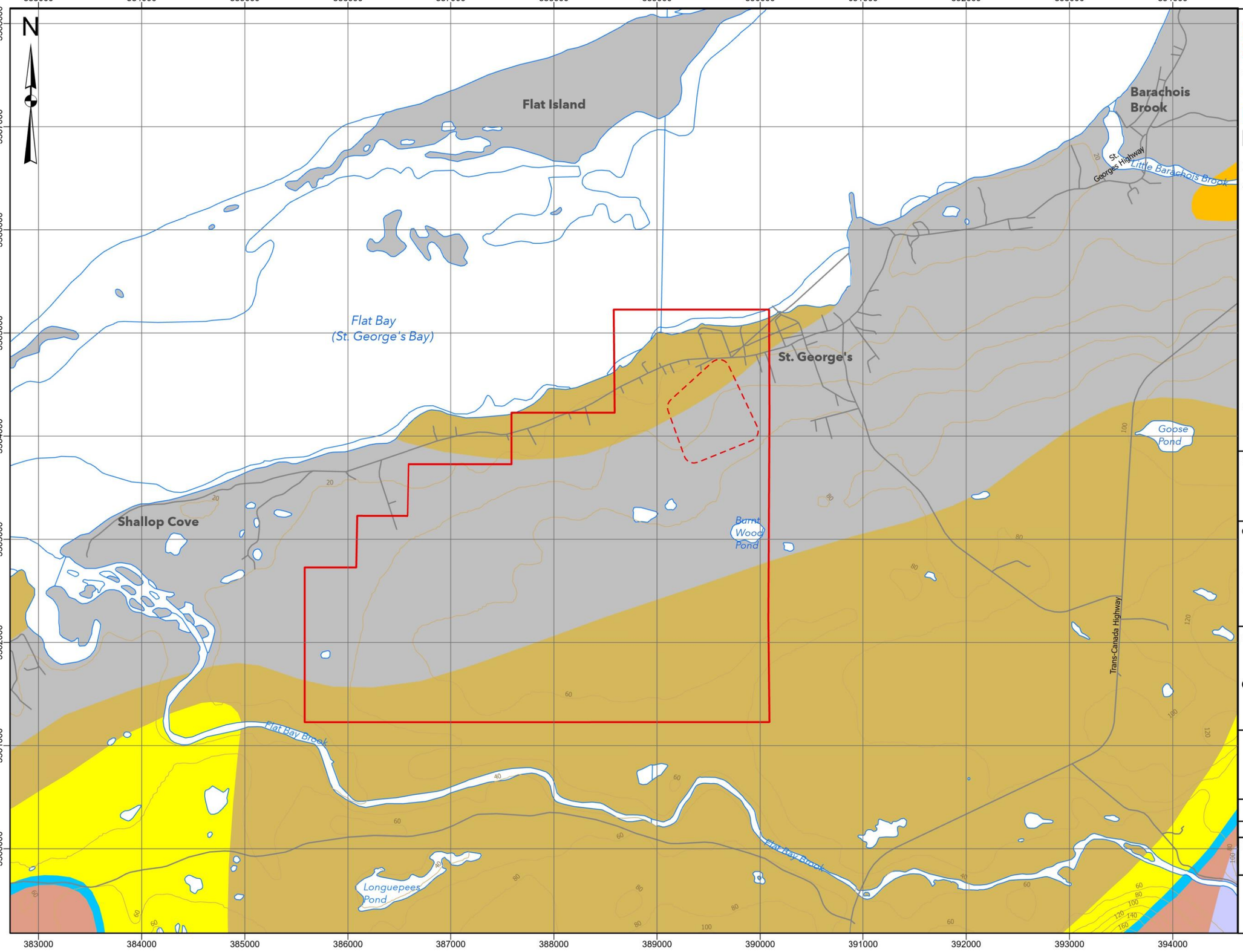
DRAWING

**SURFICIAL GEOLOGY**

| DATE | DRAW BY | CHECKED BY |
|---|---|---|
| FEBRUARY 2023 | MA | CAM |
| PROJECT NUMBER: 101556.002 | DRAWING NUMBER FIGURE 3 | REV. No. 0 |

GEMTEC
Consulting Engineers and Scientists

ATLAS SALT




Study Area

Mine Infrastructure Area

Road

Contour_20 m

Waterbody

Drift-Covered Area

**Bedrock Geology Units:**

**CODROY GROUP**

**ROBINSON RIVER FORMATION**

Siliciclastic non-marine ( Undivided )

Siliciclastic non-marine (Jeffreys Village Member)

**CODROY ROAD FORMATION**

Siliciclastic non-marine and evaporites

**SHIP COVE FORMATION**

Limestone and muddy sandstone

**ANGUILLE GROUP**

Siliciclastic non-marine conglomerate

**PRE- CARBONIFEROUS BASEMENT**

Plutonic anorthosite

Scale: 1:35,000

0 500 1,000 2,000 m

NAD83/ UTM Zone 21N

General Notes:

1. Coordinate System: NAD 1983 UTM ZONE 21 N
2. Topographic map 12H, source GeoGratis(Government of Canada)
3. Bedrock Geology Data acquired from the Government of Newfoundland and Labrador Geoscience Online

PROJECT

**PRELIMINARY BASELINE HYDROGEOLOGY STUDY, GREAT ATLANTIC SALT DEPOSIT PROJECT, ST. GEORGE'S. NL**

DRAWING

**BEDROCK GEOLOGY**

| DATE | DRAW BY | CHECKED BY |
|---|---|---|
| **FEBRUARY 2023** | **MA** | **CAM** |
| PROJECT NUMBER: **101556.002** | DRAWING NUMBER **FIGURE 4** | REV. No. **0** |

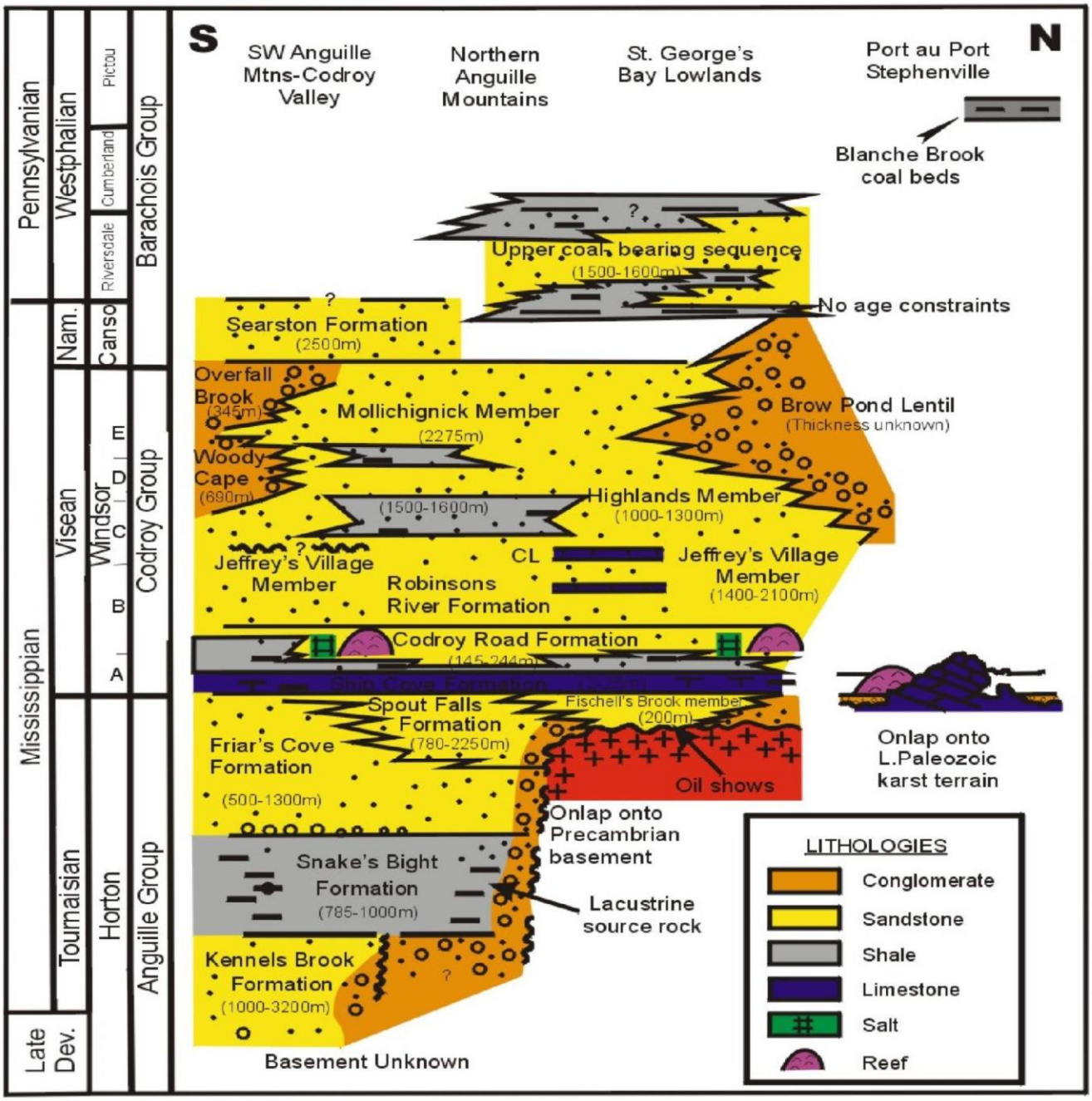
GEMTEC Consulting Engineers and Scientists

ATLAS SALT

# Bay St. George Area Stratigraphic Chart

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
Department of Mines and Energy

## Carboniferous Stratigraphy Bay St. George Area




Taken from Collins ( 2017)

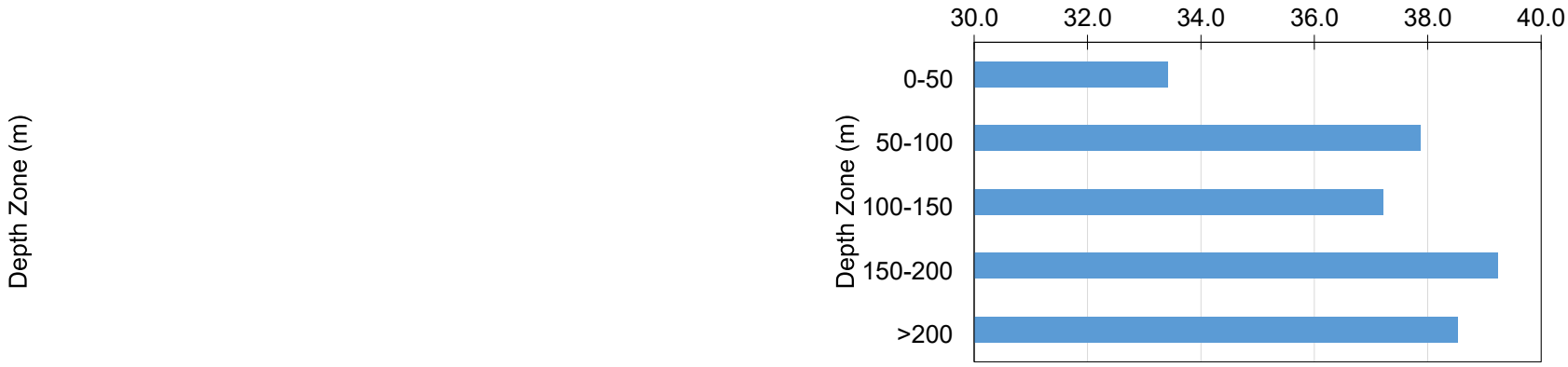
| | | | | |
|---|---|---|---|---|
| Project: **PRELIMINARY BASELINE HYDROGEOLOGY STUDY, GREAT ATLANTIC SALT DEPOSIT PROJECT, ST.GEORGE'S. NL** | | | Drawing: **Lithostratigraphy of the Bay St. George Sub-Basin** | GEMTEC Consulting Engineers and Scientists |
| Drawing By: MA | Date: 2/24/2023 | Project Number: 101556002 | Drawing Number: FIGURE 5 | Revision No. 0 |

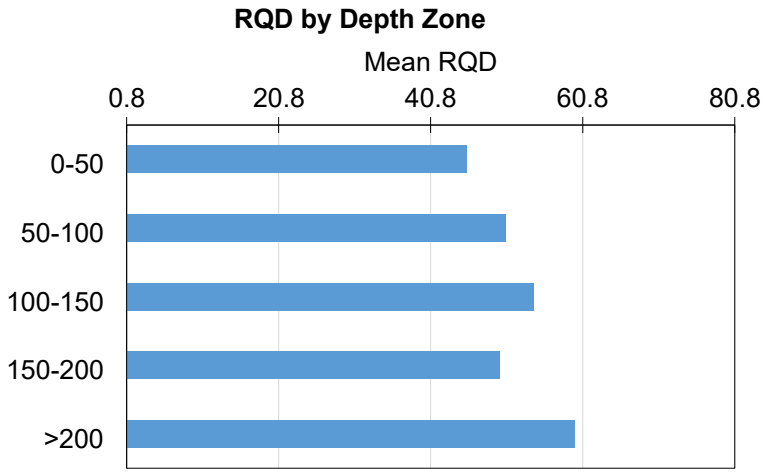
# APPENDIX B

## RQD Summary Statistics

**Table B1: Summary Statistics on Exploration Borehole Rock Quality Designations - Boreholes CC-4, CC-22-6, CC-22-7, CC-22-8, CC-22-9, CC-22-9b**

| Summary Statistic | Depth Range | | | | |
|---|---|---|---|---|---|
| | 0-50 | 50-100 | 100-150 | 150-200 | >200 |
| Minimum (%) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mean (%) | 45.6 | 50.7 | 54.4 | 49.9 | 59.7 |
| Maximum (%) | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Standard Deviation (%) | 33.4 | 37.9 | 37.2 | 39.2 | 38.5 |
| # entries | 52 | 100 | 95 | 86 | 236 |
| | | | | Total entries: | 569 |






**Standard Deviation of RQD by Depth Zone**

Standard Deviation of RQD

# APPENDIX C

Excerpts from the Provincial Water Well Database

**Table C.1 Summary of Well Construction Details, Water Wells, St. George's, NL**

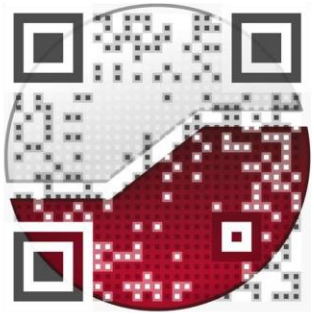
| Well Number | Name | LAT_DD | LONG_DD | Well Town | Well_Address | Depth to Bedrock (m) | Static water level (m) | Well Depth (m) | Casing length (m) | Supply | Colour | Strat1 | Depth1 (m) | Strat2 | Depth2 (m) | Strat3 | Depth3 (m) | Lithology | Water Use | Water Type | Date Drilled | Drilling Company | Strata | Casing Diameter (mm) | Yield (L/min) | Screen | Flowing Well | Pump Test | Pumping rate (L/min) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6527 | | 48.450 | -58.500 | SANDY POINT | | | | 57.3 | 20.4 | | | NO DATA | 0 | NO DATA | 0 | | | | | | | J. GOODYEAR AND SONS LTD | 9 | | 0 | No | No | | |
| 8312 | ST. MICHAELS COLLEGE | 48.433 | -58.483 | ST. GEORGE'S | | | 20 | 32.3 | 0 | | | OBDN | 18 | ROCK | 32 | | | OBDN 018 ROCK 032 | | | 9/15/1955 | | 2 | | 0 | No | No | | |
| 8313 | | 48.433 | -58.483 | ST. GEORGE'S | | | 30 | 30.5 | 0 | | | NO DATA | 0 | NO DATA | 0 | | | | | | 9/15/1953 | | 9 | | 0 | No | No | | |
| 8314 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 7 | 0 | | | OBDN | 5 | ROCK | 7 | | | OBDN 005 ROCK 007 | | | | | 2 | | 0 | No | No | | |
| 8315 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 18.3 | 17.4 | | | NO DATA | 0 | NO DATA | 0 | | | | DOMESTIC | | 11/15/1970 | J. GOODYEAR AND SONS LTD | 9 | | 90.9 | No | No | | |
| 8316 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 11.6 | 5.2 | | | NO DATA | 0 | NO DATA | 0 | | | | DOMESTIC | | 10/15/1970 | J. GOODYEAR AND SONS LTD | 9 | | 18.2 | No | No | | |
| 8317 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 7.6 | 10.4 | | | NO DATA | 0 | NO DATA | 0 | | | | | | | J. GOODYEAR AND SONS LTD | 9 | | 18.2 | No | No | | |
| 8318 | | 48.433 | -58.483 | ST. GEORGE'S | | | 11 | 15.2 | 0 | | | OBDN | 11 | ROCK | 15 | | | OBDN 011 ROCK 015 | | | | | 2 | | 0 | No | No | | |
| 8319 | D.M.A.H. | 48.433 | -58.483 | ST. GEORGE'S | | | 10 | 38.1 | 18.3 | | | NO DATA | 0 | NO DATA | 0 | | | | | | | WEST COAST DRILLING CO. | 9 | | 27.3 | No | No | | |
| 8320 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 37.8 | 8.8 | | | GRVL | 9 | ROCK | 38 | | | GRVL 009 ROCK 038 | | | 11/15/1968 | J. GOODYEAR AND SONS LTD | 2 | | 40.9 | No | No | | |
| 8321 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 15.2 | 6.1 | | | SAND | 0 | | 0 | | | SAND | | | 8/15/1966 | J. GOODYEAR AND SONS LTD | 1 | | 0 | No | No | | |
| 8322 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 17.1 | 17.4 | | | NO DATA | 0 | NO DATA | 0 | | | | DOMESTIC | | 10/15/1970 | J. GOODYEAR AND SONS LTD | 9 | | 90.9 | No | No | | |
| 8323 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 17.4 | 14.3 | | | NO DATA | 0 | NO DATA | 0 | | | | | | | J. GOODYEAR AND SONS LTD | 9 | | 45.5 | No | No | | |
| 8324 | WHITES CONST. LIMITED | 48.433 | -58.483 | ST. GEORGE'S | | | | 25.3 | 7.6 | | | NO DATA | 0 | NO DATA | 0 | | | | INDUSTRIAL | | 10/15/1970 | J. GOODYEAR AND SONS LTD | 9 | | 18.2 | No | No | | |
| 8325 | GOLDEN EAGLE STATION | 48.433 | -58.483 | ST. GEORGE'S | | | | 18.3 | 15.5 | | | BLDR-CBBL-GRVL | 18 | ROCK | 0 | | | BLDR/CBBL/GRVL 018 ROCK 000 | INDUSTRIAL | | 10/15/1968 | J. GOODYEAR AND SONS LTD | 2 | | 45.5 | No | No | | |
| 8326 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 33.2 | 6.4 | | | GRVL | 6 | ROCK | 33 | | | GRVL 006 ROCK 033 | | | 9/15/1968 | J. GOODYEAR AND SONS LTD | 2 | | 0 | No | No | | |
| 8327 | IRVING OIL | 48.433 | -58.483 | ST. GEORGE'S | | | | 11.3 | 11.3 | | | NO DATA | 0 | NO DATA | 0 | | | | INDUSTRIAL | | | J. GOODYEAR AND SONS LTD | 9 | | 22.7 | No | No | | |
| 8328 | C.N. RAILWAY | 48.433 | -58.483 | ST. GEORGE'S | | | | 20.7 | 9.4 | | | NO DATA | 0 | NO DATA | 0 | | | | INDUSTRIAL | | 3/15/1973 | J. GOODYEAR AND SONS LTD | 9 | | 27.3 | No | No | | |
| 8329 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 33.5 | 15.2 | | | SAND-UKNW | 15 | ROCK | 34 | | | SAND/PUG 015 ROCK 034 | | | 8/15/1966 | J. GOODYEAR AND SONS LTD | 2 | | 0 | No | No | | |
| 8330 | IRVING OIL COMPANY | 48.433 | -58.483 | ST. GEORGE'S | | | | 19.8 | 19.8 | | | NO DATA | 0 | NO DATA | 0 | | | | INDUSTRIAL | | 10/15/1973 | J. GOODYEAR AND SONS LTD | 9 | | 36.4 | No | No | | |
| 8331 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 36.6 | 18.6 | | | SAND-UKNW | 18 | ROCK | 37 | | | SAND/PUG 018 ROCK 037 | | | 8/15/1966 | J. GOODYEAR AND SONS LTD | 2 | | 0 | No | No | | |
| 8332 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 62.5 | 12.2 | | | UNKW | 3 | ROCK | 62 | | | SOFT PUG 003 ROCK 062 | | | 7/15/1966 | J. GOODYEAR AND SONS LTD | 2 | | 0 | No | No | | |
| 8333 | NFLD FOREST SERVICE | 48.433 | -58.483 | ST. GEORGE'S | | | | 22.3 | 22.3 | | | NO DATA | 0 | NO DATA | 0 | | | | INDUSTRIAL | | | J. GOODYEAR AND SONS LTD | 9 | | 9.1 | No | No | | |
| 8334 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 34.4 | 32.6 | | | NO DATA | 0 | NO DATA | 0 | | | | DOMESTIC | | 12/15/1970 | J. GOODYEAR AND SONS LTD | 9 | | 54.6 | No | No | | |
| 8335 | | 48.433 | -58.483 | ST. GEORGE'S | | | 17 | 26.2 | 0 | | | NO DATA | 0 | NO DATA | 0 | | | | | | | | 9 | | 0 | No | No | | |
| 8336 | IRVING OIL | 48.433 | -58.483 | ST. GEORGE'S | | | | 10.7 | 0 | | | GRVL | 17 | ROCK | 0 | | | GRVL 017 ROCK 000 | | | 9/15/1975 | WALTSON'S DRILL COMPANY LTD | 2 | | 54.6 | No | No | | |
| 10051 | | 48.441 | -58.449 | BARACHOIS BROOK | | | 18 | 29.8 | 28 | | BRWN | FILL | 1 | GRVL | 29 | | | BRWN FILL 001 GREY GRVL 029 | DOMESTIC | FRESH | 5/29/1980 | WALTSON'S DRILL COMPANY LTD | 2 | | 0 | No | No | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10642 | | 48.430 | -58.472 | ST. GEORGE'S | | | | 17.4 | 0 | | | NO DATA | 0 | NO DATA | 0 | | | | DOMESTIC | | | NEWFOUNDLAND AND LABRADOR DRILLING | 9 | 152 | 10 | No | No | | |
| 11982 | | 48.439 | -58.439 | BARACHOIS BROOK | | | 13 | 37.8 | 22.5 | | BRWN | GRVL | 22 | SNDS | 38 | | | BRWN GRVL 022 GREY SNDS 038 | DOMESTIC | FRESH | 5/7/1986 | NEWFOUNDLAND AND LABRADOR DRILLING | 2 | | 45 | No | No | | |
| 15610 | | 48.447 | -58.445 | ST. GEORGE'S | | | | 85.2 | 33.5 | | | NO DATA | 0 | NO DATA | 0 | | | | DOMESTIC | FRESH | 5/17/1990 | NEWFOUNDLAND AND LABRADOR DRILLING | 9 | | 23 | No | No | | |
| 15991 | CHAMBER OF COMMERCE | 48.433 | -58.483 | ST. GEORGE'S | | | 8 | 12.1 | 12.1 | | BRWN | GRVL | 8 | GRVL | 10 | SAND | 12 | BRWN GRVL 008 GREY GRVL 010 SAND 012 | COMMERCIAL | FRESH | 7/10/1991 | NEWFOUNDLAND AND LABRADOR DRILLING | 3 | | 14 | No | No | | |
| 17038 | | 48.384 | -58.445 | ST. GEORGE'S | | | | 12.2 | 12.2 | | RED | GRVL | 12 | | 0 | | | RED GRVL 12 | DOMESTIC | FRESH | 7/28/1993 | NEWFOUNDLAND AND LABRADOR DRILLING | 1 | | 13.6 | No | No | | |
| 17058 | | 48.430 | -58.472 | ST. GEORGE'S | | | | 39.6 | 23.8 | | GREY | SAND | 24 | SNDS | 40 | | | GREY SAND 24 RED SNDS 40 | DOMESTIC | FRESH | 12/22/1993 | NEWFOUNDLAND AND LABRADOR DRILLING | 2 | | 4.5 | No | No | | |
| 17190 | | 48.450 | -58.500 | SANDY POINT | | | 6 | 30 | 29.9 | | BRWN | OBDN | 30 | ROCK | 30 | | | BRWN OBDN 30 RED ROCK 30 | | FRESH | 10/5/1993 | P. OBRIEN WELL DRILLING LTD | 2 | | 6 | No | No | | |
| 17191 | | 48.450 | -58.500 | SANDY POINT | | | 6 | 18.3 | 18.3 | | BRWN | OBDN | 18 | ROCK | 18 | | | BRWN OBDN 18 RED ROCK 18 | | FRESH | 10/5/1993 | P. OBRIEN WELL DRILLING LTD | 2 | | 10 | No | No | | |
| 18059 | TOWN | 48.433 | -58.483 | ST. GEORGE'S | | | 3 | 30.5 | 6.1 | MUNICIPAL | RED | CLAY | 6 | SNDS | 31 | | | RED CLAY 6 RED SNDS 31 | PUBLIC SUPPLY | FRESH | 12/6/1995 | D.A. CONSTRUCTION LTD | 2 | | 200 | No | No | | |
| 18082 | | 48.450 | -58.500 | SANDY POINT | | | 4 | 18.5 | 18.5 | | | SAND | 19 | | 0 | | | SAND GRVL 19 | DOMESTIC | FRESH | 5/26/1995 | AQUA DRILLING LTD | 1 | | 18 | No | No | | |
| 18096 | | 48.450 | -58.500 | SANDY POINT | | | 6 | 35 | 35 | | | SAND-CLAY | 35 | | 0 | | | SAND/CLAY 35 | DOMESTIC | FRESH | 8/10/1995 | AQUA DRILLING LTD | 1 | | 2 | No | No | | |
| 18097 | | 48.450 | -58.500 | SANDY POINT | | | | 45 | 45 | | | CLAY | 45 | | 0 | | | CLAY 45 | | SALT | 8/10/1995 | AQUA DRILLING LTD | 1 | | 45 | No | No | | |
| 18269 | TOWN | 48.407 | -58.452 | ST. GEORGE'S | STEEL MOUNTAIN ROAD | 3 | | 30 | 9 | MUNICIPAL | | TILL | 3 | SNDS | 30 | | | TILL 3 RED GREY SNDS 30 | MUNICIPAL | | 11/20/1996 | P. SULLIVAN AND SONS LTD. | 2 | 150 | 200 | No | No | | |
| 18271 | TOWN | 48.407 | -58.453 | ST. GEORGE'S | STEEL MOUNTAIN ROAD | 3 | | 43 | 6 | MUNICIPAL | BRWN | TILL | 3 | SNDS | 43 | | | BRWN TILL SAND 3 RED CLYY SNDS 43 | MUNICIPAL | | 11/21/1996 | P. SULLIVAN AND SONS LTD. | 2 | 200 | 43 | No | No | | |
| 18272 | TOWN | 48.406 | -58.453 | ST. GEORGE'S | STEEL MOUNTAIN ROAD | 4 | | 91 | 8 | MUNICIPAL | BRWN | OBDN | 4 | SNDS | 91 | | | BRWN RED OBDN 4 CLYY SNDS 91 | MUNICIPAL | | 11/25/1996 | P. SULLIVAN AND SONS LTD. | 2 | 200 | 40 | No | No | | |
| 18273 | TOWN | 48.407 | -58.453 | ST. GEORGE'S | STEEL MOUNTAIN ROAD | 5 | | 91 | 0 | MUNICIPAL | BRWN | OBDN | 5 | ROCK | 91 | | | BRWN OBDN SAND 5 GREY FCRD SOFTROCK 91 | MUNICIPAL | | 11/27/1996 | P. SULLIVAN AND SONS LTD. | 2 | | 76 | No | No | | |
| 18275 | TOWN | 48.407 | -58.452 | ST. GEORGE'S | STEEL MOUNTAIN ROAD | 2 | | 43 | 6 | MUNICIPAL | BRWN | TILL | 2 | SNDS | 43 | | | BRWN SNDY TILL 2 RED CLYY SNDS 43 | MUNICIPAL | | 11/28/1996 | P. SULLIVAN AND SONS LTD. | 2 | 200 | 55 | No | No | | |
| 18276 | TOWN | 48.408 | -58.453 | ST. GEORGE'S | STEEL MOUNTAIN ROAD | 3 | | 43 | 6 | MUNICIPAL | BRWN | TILL-SAND | 3 | SNDS | 43 | | | BRWN TILL SAND 3 RED CLYY SNDS 43 | MUNICIPAL | | 11/28/1996 | P. SULLIVAN AND SONS LTD. | 2 | 200 | 55 | No | No | | |
| 18277 | TOWN | 48.407 | -58.453 | ST. GEORGE'S | STEEL MOUNTAIN ROAD | 3 | | 31 | 6 | MUNICIPAL | BRWN | TILL | 3 | SNDS | 31 | | | BRWN SNDY TILL 3 RED CLYY SNDS 31 | MUNICIPAL | | 11/29/1996 | P. SULLIVAN AND SONS LTD. | 2 | 200 | 100 | No | No | | |
| 18279 | TOWN | 48.406 | -58.452 | ST. GEORGE'S | STEEL MOUNTAIN ROAD | 3 | | 61 | 6 | MUNICIPAL | | SAND | 3 | UNKW | 61 | | | TILL SAND 3 RED CLYY 61 | MUNICIPAL | | 11/30/1996 | P. SULLIVAN AND SONS LTD. | 2 | 200 | 300 | No | No | | |
| 19884 | TOWN | 48.433 | -58.483 | ST. GEORGE'S | | 24.3 | | 49.8 | 24.3 | MUNICIPAL | RED | CLAY | 24 | SNDS | 50 | | | RED CLAY SILT 24 RED SNDS 50 | MUNICIPAL | | 1/6/2001 | NEWFOUNDLAND AND LABRADOR DRILLING | 2 | 150 | 228 | No | No | | |
| 19885 | TOWN | 48.433 | -58.483 | ST. GEORGE'S | | 19.8 | | 49.4 | 19.8 | MUNICIPAL | GREY | GRVL | 10 | CLAY-SILT | 20 | SNDS | 49 | GREY GRVL 10 RED CLAY SILT 20 RED SNDS49 | MUNICIPAL | | 1/7/2001 | NEWFOUNDLAND AND LABRADOR DRILLING | 3 | 150 | 182 | No | No | | |
| 19886 | TOWN | 48.433 | -58.483 | ST. GEORGE'S | | | | 0 | 7.6 | MUNICIPAL | GREY | GRVL | 6 | CLAY | 8 | SLTE | 32 | GREY GRVL 6 RED CLAY 8 RED SLTS 32 | NON-DOMESTIC | | 1/8/2001 | NEWFOUNDLAND AND LABRADOR DRILLING | 3 | 150 | 0 | No | No | | |
| 19887 | TOWN | 48.433 | -58.483 | ST. GEORGE'S | | 16.8 | | 37.8 | 16.8 | MUNICIPAL | GREY | GRVL | 17 | SLTS | 38 | | | GREY GRVL SILT 17 RED SLTS 38 | NON-DOMESTIC | | 1/10/2001 | NEWFOUNDLAND AND LABRADOR DRILLING | 2 | 150 | 0 | No | No | | |
| 20173 | | 48.450 | -58.500 | SANDY POINT | | 0 | | 16.9 | 16.9 | | | GRVL | 16.9 | | 0 | | | GRVL 16.9 | DOMESTIC | | 9/19/2001 | NORTHEAST WELL DRILLING LTD. | 1 | 150 | 90 | No | No | | |
| 20276 | | 48.450 | -58.500 | SANDY POINT | | | | 15.3 | 15.3 | | | SAND | 15.3 | | 0 | | | SAND 15.3 | DOMESTIC | | 6/22/2002 | NORTHEAST WELL DRILLING LTD. | 1 | 150 | 112.5 | No | No | | |
| 20290 | | 48.450 | -58.500 | SANDY POINT | | | | 17.2 | 17.2 | | | SAND | 17.2 | | 0 | | | SAND 17.2 | DOMESTIC | | 9/18/2002 | NORTHEAST WELL DRILLING LTD. | 1 | 150 | 9 | No | No | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20355 | | 48.433 | -58.483 | ST. GEORGE'S | | 21 | | 31.6 | 21.9 | | | GRVL | 1 | UNKW | 2 | SAND-GRVL | 6 | GRVL (FILL) BRWN 1 LOOM BLCK 2 SAND GRVL BRWN 6 | DOMESTIC | | 7/1/2002 | NEWFOUNDLAND AND LABRADOR DRILLING | 3 | 150 | 25 | No | No | | |
| 20578 | | 48.433 | -58.483 | ST. GEORGE'S | MAIN STREET ST. GEORGE'S | 10 | | 80 | 0 | | | SAND | 10 | BDRK | 80 | | | GRVL SAND BRWN 10 BEDROCK GREY 80 | DOMESTIC | | 12/7/2002 | NEWFOUNDLAND AND LABRADOR DRILLING | 2 | 150 | 4.5 | No | No | | |

| Well Number | Name | LAT_DD | LONG_DD | Well Town | Well_Address | Depth to Bedrock (m) | Static water level (m) | Well Depth (m) | Casing length (m) | Supply | Colour | Strat1 | Depth1 (m) | Strat2 | Depth2 (m) | Strat3 | Depth3 (m) | Lithology | Water Use | Water Type | Date Drilled | Drilling Company | Strata | Casing Diameter (mm) | Yield (L/min) | Screen | Flowing Well | Pump Test | Pumping rate (L/min) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20746 | FRACFLOW CONSULT. INC. | 48.433 | -58.483 | ST. GEORGE'S | | | | 15.4 | 6.2 | | GREY | SAND | 15.4 | | 0 | | | SAND GREY 15.4 | | FRESH | 6/20/2003 | NORTHEAST WELL DRILLING LTD. | 1 | 200 | 450 | No | No | | |
| 20747 | FRACFLOW CONSULT. INC. | 48.433 | -58.483 | ST. GEORGE'S | | 3.3 | | 47.7 | 7.4 | | BRWN | GRVL | 3.3 | SNDS | 47.7 | | | GRVL BRWN 3.3 SNDS RED BRWN 47.7 | | | 6/20/2003 | NORTHEAST WELL DRILLING LTD. | 2 | 150 | 90 | No | No | | |
| 20748 | FRACFLOW CONSULT. INC. | 48.433 | -58.483 | ST. GEORGE'S | | 4.3 | | 46.2 | 7.4 | | BRWN | GRVL | 4.3 | SNDS | 46.2 | | | GRVL BRWN 4.3 SNDS RED BRWN 46.2 | | FRESH | 6/9/2003 | NORTHEAST WELL DRILLING LTD. | 2 | 200 | 72 | No | No | | |
| 20749 | FRACFLOW CONSULT. INC. | 48.433 | -58.483 | ST. GEORGE'S | | 3.4 | | 50.8 | 11.1 | | BRWN | OBDN | 3.4 | SNDS | 50.8 | | | OBDN BRWN 3.4 SNDS RED BRWN GREY 50.8 | | FRESH | 6/10/2003 | NORTHEAST WELL DRILLING LTD. | 2 | | 0 | No | No | | |
| 20966 | | 48.433 | -58.483 | ST. GEORGE'S | FLAT BAY BROOK ROAD | | | 18.8 | 18.8 | | BRWN | SAND-CLAY | 9.2 | SAND-GRVL | 16.5 | GRVL | 18.8 | 9.2 BRWN SAND/CLAY; 16.5 BRWN SAND/GRVL; 18.8 BRWN GRVL | DOMESTIC | FRESH | 10/14/2003 | NEWFOUNDLAND AND LABRADOR DRILLING | 3 | 150 | 41 | No | No | | |
| 20967 | | 48.433 | -58.483 | ST. GEORGE'S | STEEL MOUNTAIN ROAD | | | 34 | 34 | | BRWN | BLDR-GRVL | 6 | SAND-SILT | 32 | GRVL | 54 | 6 BRWN BLDR/GRAVEL; 32 BRWN SAND; 54 GREY/BRWN GRAVEL | DOMESTIC | FRESH | 10/11/2003 | NEWFOUNDLAND AND LABRADOR DRILLING | 3 | 150 | 45 | No | No | | |
| 20976 | | 48.433 | -58.483 | ST. GEORGE'S | | | | 45.5 | 0 | | | UNKW | 0 | UNKW | 0 | | | SAME AS OTHER( REFER TO OTHER REPORT) | DOMESTIC | FRESH | 10/11/2003 | NEWFOUNDLAND AND LABRADOR DRILLING | 0 | | 4.6 | No | No | | |
| 22403 | | 48.382 | -58.426 | ST. GEORGE'S | STEEL MOUNTAIN ROAD, ST. GEORGES | | | 18.2 | 18.2 | | GREY | GRVL-BLDR | 18.2 | | 0 | | | 18.2 GREY GRVL & BLDR | DOMESTIC | FRESH | 7/25/2006 | ATLANTIC DRILLING AND BLASTING LTD. | 1 | 150 | 50 | No | No | | |
| 22431 | TOWN OF ST. GEORGES | 48.434 | -58.464 | ST. GEORGE'S | OLD RAILWAY BED, ST. GEORGES | | 1 | 17.1 | 6.4 | MUNICIPAL | GREY | SAND | 17.1 | | 0 | | | 17.1 GREY SAND | MUNICIPAL | FRESH | 10/9/2006 | NORTHEAST WELL DRILLING LTD. | 1 | 200 | 130 | No | No | | |
| 22432 | TOWN OF ST. GEORGES | 48.432 | -58.460 | ST. GEORGE'S | OLD RAILWAY BED, ST. GEORGES | | | 17.1 | 6.4 | MUNICIPAL | BRWN | SAND-GRVL | 17.1 | | 0 | | | 17.1 BRWN SAND & GRVL | MUNICIPAL | FRESH | 10/13/2006 | NORTHEAST WELL DRILLING LTD. | 1 | 200 | 33.8 | No | No | | |
| 23649 | TRANSPORTATION DEPOT | 48.388 | -58.454 | STEEL MOUNTAIN | | | 1 | 55.4 | 20.7 | | BRWN | ROCK-GRVL | 6 | CLAY-SHLE | 20.7 | SAND | 55.4 | BRWN, UNCONSOLIDATED ROCK & GRAVEL 6 ;BRWN & GREY, CONSOLIDATED CLAY - SHLE 20.7 ;BRWN & GREY, SAND 55.4 | NON-DOMESTIC | FRESH | 3/20/2009 | ATLANTIC DRILLING AND BLASTING LTD. | 3 | 150 | 30 | No | No | | |
| 24075 | TOWN OF ST. GEORGE'S | 48.432 | -58.467 | ST. GEORGE'S | | | 9.3 | 25.6 | 11.9 | | GREY | CLAY | 7.6 | SAND | 25.6 | | | | MUNICIPAL | FRESH | 3/12/2009 | DAVE SULLIVAN'S DRILLING | 0 | 150 | 295 | NO | NO | AIRLIFT | 295 |
| 28761 | WESTERN WASTE MANAGEMENT | 48.405 | -58.435 | ST GEORGES WASTE SITE | TCH | 7.62 | | 83.82 | 11.88 | | BROWN | CLAY | 7.62 | BEDROCK | 83.82 | | | | NON-DOMESTIC | FRESH | 10/1/2017 | NORTHEAST WELL DRILLING LTD. | 0 | 150 | 1 | | NO | AIRLIFT | 1 |

experience • knowledge • integrity



| | |
|---|---|
| civil | civil |
| geotechnical | géotechnique |
| environmental | environnement |
| structural | structures |
| field services | surveillance de chantier |
| materials testing | service de laboratoire des matériaux |

expérience • connaissance • intégrité