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Consulting Hydrogeologists

ATLANTIC GOLD NL

HYDROGEOLOGICAL INVESTIGATIONS
TOUQUOY GOLD PROJECT
NOVA SCOTIA

Report: 0506_R01

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Report prepared for:

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1 INTRODUCTION

Atlantic Gold NL is conducting investigations at their Touquoy Gold Project in Nova Scotia to assess the viability of open pit mining and ore processing, and is progressing towards a Bankable Feasibility Study. The current mining proposal is to develop an open pit with a footprint of 750 m by 350 m, and depth up to 150 m.

Part of the initial investigations has involved assessing the site hydrogeology and in particular the likely rates of groundwater inflow that can be expected to an open pit. This report discusses the hydrogeological work completed for these investigations and the conclusions following from this work.

2 PROJECT SETTING

2.1 Location and Topography

The Touquoy Project is located in central Nova Scotia about 100 km ENE of Halifax and is about 30 km inland from the North Atlantic Ocean (Figure 1).

The project site is mostly forested, and has a hummocky surface typical of a remnant glacial landscape. There are several lakes, ponds, and wetlands in the area, and the project is located within the catchment of the Moose River. This catchment has an area of around 41 km^2 (CRA, 2005). The maximum local relief within the catchment is around 50 m, and the project site is relatively flat lying with local relief of a few metres.

The proposed open pit is about 100 m from the Moose Rover at its closest point.

2.2 Rainfall and Evaporation

Precipitation occurs as rain and during the cooler winter months as snow. Average annual precipitation (including snow as equivalent rainfall) is around 1,300 mm, and this tends to be evenly distributed throughout the year with average monthly precipitation of between 100 mm and 130 mm. Lake evaporation data presented in CRA (2005) indicates evaporations rates are negligible from November to April, and range between 40 mm and 110 mm from May to October. Annual lake evaporation is around 500 mm, which is about 40% of the annual precipitation.

2.3 Geology

The Touquoy gold deposit is located in the Meguma Group, which is a sequence of Cambro-Ordovician sandstones and mudstones that form the southern half of the province of Nova Scotia. About sixty underground quartz-vein style gold deposits within the Meguma Group have been mined since the mid-1800s. Gold mineralisation at the Touquoy deposit is disseminated thought the host sediments, and this offers the potential for developing a larger scale open pit mine.

The mineralisation at Touquoy occurs on the limbs of a relatively broad ENE trending anticline. The fold axis is sub-vertical, and the limbs dip at between 40°and 60°. Several local and regional scale faults cross the deposit. Figures 2 and 3 present a generalised geological plan and cross sections of the Touquoy site showing the major rock units and structures.

The Palaeozoic sequence at the Touquoy site is covered by glacial till deposits consisting of varying mixtures of fine grained and gravely materials. The thickness of till is up to 4 m across the eastern half of the deposit, and over 10 m in the western half of the deposit where the terrain is slightly elevated.

3 SITE HYDROGEOLOGY

The general impression of the site hydrogeology obtained from initial discussions with Atlantic Gold personnel is that the bedrock forms a fractured rock aquifer system which is overlain by a thin aquifer in the till. The degree of hydraulic connection amongst the smaller bedrock fracture systems is probably poor to moderate, and the main zones that are capable of storing and transmitting relatively large amounts of groundwater would be the larger scale faults.

The actual volume of groundwater stored in the bedrock aquifer is probably small, and this reflects the relatively small primary porosity of these rocks. Some of the larger bedrock structures may be hydraulically connected to surface water bodies which may become sources of aquifer recharge under a mine dewatering scenario.

The water table is close to the surface across the Touquoy site, reflecting the close proximity of surface water bodies and the relatively flat lying terrain, and also the excess of annual rainfall over evaporation. Thus the bedrock sequence and part of the overlying tills will be saturated with groundwater under ambient conditions.

Records provided by Atlantic Gold indicate the stage height of the Moose River has varied by about 1 m between August 2004 and January 2006. Given the presence of numerous surface water bodies in the area, river stage heights near the site are not likely to vary by much because the large storage volumes available in these surface water bodies would tend to buffer the river flow rates and stage heights. Thus under ambient conditions only small variations in the amounts water exchanged between the Moose River and the nearby shallow groundwater system can be expected.

Groundwater salinity in the area is expected to be relatively small and acceptable according to local drinking water standards. This is a common characteristic of groundwater in Nova Scotia (see Department of Environment and Labour web site: www.gov.ns.ca/enla/water). Some trace elements concentrations in groundwater from the bedrock sequence at Touquoy, and in particular arsenic and uranium, probably exceed the drinking water guidelines. Treatment of groundwater would need to be considered before any of these resources are used as drinking water supplies.

4 HYDROGEOLOGICAL TESTING PROGRAM

Atlantic Gold personnel conducted investigations to determine the basic hydrogeological parameters for estimating rates of groundwater inflow to an open pit from the glacial till and from the bedrock. Peter Clifton & Associates provided direction on how these investigations were to be conducted. These investigations included air-lift pumping from boreholes into the bedrock, and pumping from sumps in the till. The work programs for these investigations are discussed in the following sections.

Section 6 discusses recommended approaches for managing groundwater inflows to an open pit at Touquoy.

4.1 Borehole Testing

An initial testing program involved air-lift pumping of eight existing exploration boreholes in June 2005. This was followed by a second testing program in the last quarter of 2005 where groundwater exploration boreholes were drilled at locations targeting geological structures.

4.1.1 Stage 1 Testing

Eight cored boreholes that were drilled during the first half of 2005 were selected for testing on the basis of their location and the likelihood that they intersected major geological structures. Borehole locations are indicated on Figure 4, and details of each borehole and test results are listed in Table 1. Flow rates were determined by measuring the time required to fill a 20 L bucket. The flow rates listed in Table 1 are average rates for each test.

All of the tested boreholes are NQ diamond core holes with an internal diameter of 76 mm. Each hole has surface casing set below the till/bedrock contact, thus providing the opportunity for sealing borehole from the till sequence and ensuring all of the groundwater produced during testing would be derived from bedrock.

Air lift testing involved inserting a 25 mm diameter polyethylene pipe into the borehole to well below the static water level, and then pumping air into the pipe using a compressor. This causes the production of aerated groundwater at the collar of the borehole.

As indicated in Table 1, most of the measured flow rates were much less than 1 L/sec within 10 to 15 minutes of pumping. The relatively large flow rate of around 5 L/sec from MR-05-086 is thought to be a consequence of the interconnection of this borehole with surface water in the adjacent mini pit, and is thus considered not to be representative of the potential groundwater production from bedrock at this site. If this result is excluded from the data set, the range of yields is 0.1 L/sec to 1 L/sec, with most yields being less than 0.3 L/sec.

4.1.2 Stage 2 Testing

The results of Stage 1 testing indicated the yields of groundwater from boreholes in bedrock across the Touquoy site are likely to be much less than 1 L/sec, however this hypothesis needed to be tested. It was then recommended that the bedrock groundwater yields be investigated by drilling vertical boreholes using air hammer methods, and converting two of three of these boreholes to trial dewatering wells that would allow pumping tests to be conducted. Air hammer boreholes necessarily have a larger diameter than NQ diamond core holes, and do not require the use of drilling fluids which can partly or completely block permeable joints and fractures. The use of air hammer boreholes for groundwater exploration in fractured rock aquifers is favoured because intervals where groundwater is produced can be readily identified. A program was then developed to drill eight air-hammer exploration boreholes.

The general approach to the Stage 2 program involved selecting sites for boreholes that would intersect zones within the bedrock which are likely to yield significant amounts of groundwater. Core photographs were examined, however this did not lead to any obvious targets for boreholes. Atlantic Gold personnel subsequently selected sites for boreholes using the following guidelines:

- Target obvious geological structures, and select sites so that the permeable structures will be intersected at depth and towards the bottom of the borehole
- Ensure there is a reasonable coverage of the planned open pit with the boreholes
- Boreholes should be drilled to 30 m to 50 m below the planned base of the open pit

Conversion of an exploration borehole to a trial dewatering well would be considered if the yield during drilling exceeded 2 L/sec.

Table 2 lists the sites selected by Atlantic Gold for the Stage 2 exploration boreholes, including a brief explanation of why these sites were chosen. Site locations are indicated on Figure 4.

The groundwater exploration boreholes were drilled during the last quarter of 2005 using a rotary drilling rig and 160 mm diameter conventional circulation air hammer bit. Borehole lithology and structure, and the intervals within the borehole where groundwater production was noted, are listed in Table 3. Table 4 lists the results of the final air lift pumping tests.

Borehole MR-05-WB02 produced groundwater at rates over 5 L/sec. However all of this production appeared to be derived from the till due to poorly seated surface casing, and the contribution of groundwater flows from the bedrock could not be quantified. A large proportion of this flow rate was probably due to recirculation and thus not necessarily representative of groundwater production from the till itself.

Sustainable groundwater production could only be achieved from three of the boreholes: MR-05-WB01 (~0.5 L/sec), MR-05-WB06 (0.1 L/sec to 0.2 L/sec), and MR-05-WB08 (0.1 L/sec to 0.2 L/sec). The remaining four boreholes did not produce measurable quantities of groundwater.

Following the completion of this phase of testing it was concluded that none of these exploration boreholes had sufficient yield of groundwater to warrant conversion to a trial dewatering well.

The results of the Stage 2 testing have confirmed the hypothesis that groundwater yields from boreholes into the bedrock at the Touquoy site are likely to be much less than 1 L/sec. It follows that dewatering wells will not be an efficient means of controlling groundwater levels and pressures at Touquoy, and an alternate approach is thus required. Recommendations for managing groundwater in an open pit at Touquoy are presented in Section 6.

4.2 Pit Testing

Potential groundwater inflows from the glacial till above bedrock were investigated by digging test pits at four sites to the till/bedrock contact, and conducting pumping tests from these pits. The pits were dug and tested during May 2006.

Table 5 lists the locations of the test pits, and the lithology and fabric of the till sequence in each pit. The most notable occurrences of groundwater seepages in the pits were from an 0.4 m thick basal layer of till in Pit #2, and point source seepages at the till / bedrock contact in Pit #4.

Prior to pumping, groundwater levels in the pits were allowed to recovery to near equilibrium overnight. Testing involved pumping the accumulated groundwater from the pit while monitoring the rate of pumping and the level of the water surface in the pit. A centrifugal type (“fireman’s”) pump was used as the pump.

It was initially intended that the pump would be run continuously while maintaining a constant level of water in each pit, however this test configuration could not be achieved at any of the pits because the seepage rates were much smaller than the minimum sustainable pumping rate of the pump which was >1 L/sec.

Table 6 lists the data collected during the tests. The duration of pumping was mainly dependent on the volume of groundwater in each pit, and ranged between 18 minutes at Pit #3 and 114 minutes at Pit #2. The volume of water pumped from each pit ranged between 4 kL (4 m^3) in Pits #3 and #4, and 26 kL in Pit #2.

Recovery water levels were monitored in Pit #1 for nearly 1 day. The estimated maximum rate of seepage into the pit, which occurred immediately after pumping stopped, was 0.4 L/sec. From the recovery data the transmissivity[1] of the till is estimated to be 3 m^2/day. This value of transmissivity is consistent with the poorly sorted nature and the fine grained matrix of the till deposits.

The main conclusion from the pit testing program is that the expected rates of groundwater seepage from the till into the open pit will be small. Estimated rates of seepage from the till and the bedrock into an open pit at Touquoy are presented in Section 5.

5 ESTIMATED GROUNDWATER INFLOW RATES

5.1 Seepage from Till

From pumping of the four test pits at the Touquoy site it is expected that the rates of seepage from the till sequence into the open pit will be small, and thus there should not be any major issues associated with managing these flows.

In order to estimate the rate of seepage from the till, the value of transmissivity determined by analysing the recovery water levels from Pit #1 has been used in an analytical model which simulates groundwater flow into a large diameter circular well.

[1] Transmissivity is a parameter that relates the rate of groundwater flow through a unit width of aquifer to the hydraulic gradient. Very permeable aquifers, such as the paleochannel aquifers in the goldfields of WA, can have transmissivities >1,000 m^2/day.

The circumference of the well used in the model was 1,800 m, and this is roughly the same as the perimeter of the proposed pit. Using these parameters the estimated total inflow rate from the till to the pit is 450 kL/day (5.2 L/sec).

Spatial variation in the rates of inflow from the till must be expected around the crest of the pit, and there are likely to be sections of the wall where seepage rates are negligible and others where the seepage is noticeable. Some seasonal variation in seepage rates from the till can also be expected. The recommended approach for managing groundwater seepage from the till is discussed in Section 6.

5.2 Seepage from Bedrock

Testing of the bedrock sequence at Touquoy has not identified any significant permeable zones that are likely to yield large amounts of groundwater to the open pit. Flows from boreholes have in most cases been much less than 1 L/sec, and the general conclusion is that seepage from the bedrock should not be a significant issue for the mining operation.

However the bedrock at Touquoy is saturated, and groundwater levels are close to the land surface under ambient conditions. Seepage from the bedrock into the pit will occur, albeit at small rates. There is also the issue of managing and lowering the groundwater pressures in the open pit walls to the extent necessary to ensure wall stability.

The rates of groundwater seepage into an open pit at Touquoy are expected to lie in the range 100 kL/day (1.2 L/sec) to 1,000 kL/day (12 L/sec). It is difficult to be more precise than these values primarily because of the lack of reliable hydraulic parameter estimates for the bedrock. However these estimates should be sufficient for planning purposes.

6 RECOMMENDATIONS FOR MANAGING GROUNDWATER SEEPAGE

From a mine dewatering perspective there are two groundwater seepage issues at Touquoy that require attention:

- Seepage from the glacial till deposits into the open pit, eg seepage that migrates along the till/bedrock contact
- Seepage from the bedrock sequence into the open pit and the associated groundwater pressures in the pit walls – this is an important issue that can influence open pit wall stability

The above issues follow from the hydrogeological conceptual model of the site, and different approaches are required to control inflows and seepage from these sources.

6.1 Seepage from Till

The glacial till at Touquoy is a sheet of poorly sorted sediment with a fine grained matrix and ranges up to about 10 m thick in the vicinity of the proposed open pit.

Rates of seepage from the till exposed around the perimeter of the open pit will vary, and will primarily be related to the proportion of fine grained matrix material. Larger rates of seepage can be expected where the till is relatively coarse and contains a small proportion of fines.

Seepage rates from the till to the open pit will also vary by small amounts seasonally due to normal seasonal changes in the level of the water table and stage height variations in the Moose River. Seepage rates from the till are expected to be greatest following the spring thaw and during the early summer months.

Where the till consists of relatively coarse grained gravels with a small proportion of fines there is the potential for larger groundwater inflows to occur. Whether these inflow rates are sustained will depend on the lateral extent of the gravel deposits, and the degree of interconnection between the gravels and surface water bodies. The latter is an unknown factor, and should be further investigated if the risk is considered significant by Atlantic Gold. Based on investigations to date and the results of the test pit program, the initial indication is that this should not be a significant issue for the project.

The estimated rate of groundwater seepage from the till into an open pit at Touquoy is 450 kL/day based on analysis of test pit data. This should be considered to be an average value, with seasonal variations superimposed.

Although the total rate of groundwater seepage from the till into the open pit is not expected to be large, if left unmanaged this could result in erosion, slumping of the till, and possibly water flowing over the crest of the pit. It is recommended that this seepage be intercepted and diverted before it reaches the open pit. This can be achieved with an open drain at the base of the till which is dug a short distance into the top of the bedrock, and one or more sumps at low points in the drain to collect the seepage and pump it from the pit. Because the expect flow rates are relatively small, the cross section area of the drain can safely be of order 1 m^2 and still provide sufficient carrying capacity. The drain may need to be lined where it crosses major structures to prevent recharge occurring to the bedrock groundwater system which may cause problems for pit wall stability.

Figure 5 presents a conceptual design of a drain at the base of the till in an open pit at Touquoy. The distance between the edge of the drain and the inner pit crest (ie, bedrock crest) is about 30 m. This is also the recommended length of sub-horizontal drain holes in the pit walls (see Section 6.2).

6.2 Seepage from Bedrock

The ambient water table at Touquoy is close to the land surface and the bedrock sequence is saturated. Groundwater will therefore flow into an open pit at Touquoy, and dewatering will be required to maintain dry working conditions. Lowering of groundwater pressures in the pit walls is required for wall stability (Peter O'Bryan & Associates, 2006), and dewatering of the bedrock sequence exposed in the walls will be important from this perspective. Dewatering facilities will also be needed in the pit to remove surface water that collects after rainfall.

Seepage through the bedrock sequence at Touquoy will largely be controlled by geological structures, and will vary around the pit due to variations in the density of joints and fractures, and the occurrence of major faults.

Investigations have indicated it will not feasible to dewater the bedrock sequence at Touquoy using wells. Yields from boreholes drilled into the major bedrock structures have all been relatively small, and <1 L/sec. Seepage from the bedrock will thus need to be directed into sumps on the pit floor or higher benches, and pumped from the pit.

Managing groundwater pressures in the pit walls at Touquoy will require groundwater levels to be monitored in piezometers behind the walls, and groundwater pressures in the walls to be dissipated by means of sub-horizontal drain holes. It is recommended that drain holes be located to intersect permeable structures 20 m to 30 m back from the walls. If possible, drain holes should be selectively located in areas where seepage is an obvious issue rather than placing them at regular spacing on every bench of the pit.

Figure 5 presents a conceptual design of pit wall drainage by means of sub-horizontal drain holes. Drains should be about 30 m long, and can be drilled with a blast hole rig. Flows from drains will generally diminish over time, and drains on the higher benches may eventually cease flowing as the mine is developed. Discharge from drains should be directed to a sump either through a series of pipes or channels. Collaring of drain holes may be necessary if large and persistent flow rates are encountered, however in most cases flows are expected to be no greater than a trickle and should diminish over time.

Monitoring of groundwater levels will require piezometers to be constructed at the pit crest, and progressively on some benches as the open pit is developed. Piezometers can be vertical boreholes drilled to a depth of 40 m to 50 m, possibly with a blast hole drilling rig, and cased with 32 mm or 40 mm PVC pipe which has been slotted from 10 m below surface. The annulus outside the slotted casing should be packed with graded sand (~2 mm grain size) to about 3 m above the top of the slots. Slots can be cut with a hacksaw, or machine slotted casing can be used if this is available.

Piezometers located at the pit crest will require the glacial till sequence to be collared to below the till/bedrock contact so that groundwater in the till cannot seep into the borehole. These piezometers should also include annular bentonite clay seals of height about 1 m on top of the sand pack. It may be necessary to modify the design of these piezometers during construction to ensure that the bentonite seal is a few metres below the till/bedrock contact.

All piezometers should be finished with steel surface casing about 0.7 m above ground level, and these casings should be painted fluoro orange or green so that they are clearly visible. Piezometers should be surveyed to determine locations and reference elevations for measuring water levels against.

It is recommended that piezometers be constructed on seven transects leading from the crest down into the pit at roughly 200 m spacing between transects and three or four piezometers per transect, depending on the pit depth at the particular transect. Data from the piezometers will provide a profile of the phreatic surface which will be important for stability assessments. If access to piezometers over the longer term is uncertain, consideration should be given to equipping these facilities with pressure transducers that connect to logging units at the crest of the pit.

Figure 6 is a plan showing the pit shell and possible locations for piezometer transects. These locations can be modified according to the final pit design.

7 REMAINING HYDROGEOLOGICAL ISSUES

Hydrogeological issues at Touquoy that may need to be considered for the feasibility study are:

- Quality and quantity of any groundwater that may need to be discharged off site, ie in excess of what can be utilised for ore processing
- Groundwater and surface water monitoring programs that may need to be established under statutory requirement for mining operations in Nova Scotia

A possible issue that may need to be considered given the setting is the effect of freezing temperatures on groundwater seepage close to the pit walls. The expansion of water that occurs at temperatures below 4°C and when ice is formed has the potential to cause slight dilation of the rock mass and joints. This process may lead to exfoliation at the pit walls. Whether this will be a significant process in an open pit at Touquoy is unclear. Avoiding this condition would require that the wall rocks be completely dewatered, especially close to the face of the pit.

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REFERENCES

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Peter O’Bryan & Associates, 2006, “Touquoy Gold Project Nova Scotia, Preliminary Geotechnical Assessment Open Pit Mining”, consultant report prepared for Atlantic Gold NL, July 2006.

Table 1: Stage 1 Air Lift Tested Boreholes

Borehole	Local Grid		Dip / Azimuth	Depth (m)	Water table depth (m)		Air Line		Test		Comments
	East	North			Inclined	Vertical	Depth (m)	Submergence (m)	Duration	Yield (L/sec)	
MR-05-072	21,726.1	10,259.3	60 / 182	141	1.60	1.39	48	40	30	1	
MR-05-086	21,551.8	10,195.8	67 / 177	60	0.20	0.18	21	19	12	5	Hole blocked; air bubbling in adjacent mini-pit
MR-05-094	21,627.1	10,017.7	43 / 4	115	6.10	4.16	59	36	13	0.14	
MR-05-095	21,698.9	9,907.9	47 / 360	152	3.10	2.27	53	36	10	0.27	
MR-05-098	22,024.4	10,020.6	60 / 360	113	0.10	0.09	46	40	10	0.18	
MR-05-102	21,896.5	10,234.9	70 / 179	80	2.80	2.63	45	40	15	0.30	
MR-05-111	22,024.8	10,161.9	64 / 360	50	1.50	1.35	46	40	15	0.13	
MR-05-116	22,155.8	10,277.0	45 / 182	65	2.50	1.77	55	37	10	0.08	

Table 2: Stage 2 Borehole Sites and Selection Criteria

Site	Local Grid		Nominal Depth (m)	Actual Depth (m)	Predicted Till Depth (m)	Target / Comments
	East	North				
MR-05-WB01	21,925	10,015	130	129	4	South Fault (+ Redden Fault?)
MR-05-WB02	21,866	10,020	100	100	3	South Fault (+ Miller Fault?)
MR-05-WB03	21,955	10,190	100	99	6	Redden Fault
MR-05-WB04	21,854	10,265	100	109	4 to 6	NE Fault
MR-05-WB05	21,650	10,170	160	153	4	NE Fault (+ Hilchie Fault?). Located 8 m north of MR-88-228 (strongly sheared over 23 m), and 35 m north of mini pit.
MR-05-WB06	21,640	10,090	115	115.5	5	West Fault (and poss linkage with Prest Fault)
MR-05-WB07	21,510	10,220	70	70	4	Poorly constrained shear intersected in MR-88-237 (strong shearing over lower 23 m), and possibly MR-04-051 and MR-04-059.
MR-05-WB08	21,540	10,070	90	88	7	Poorly constrained shear intersected in MR-04-051 and MR-04-059, and possibly MR-88-237. Shear inferred to roughly parallel the West Fault and correlate with strong shearing in MR-88-237. Site access restricted due to collapsed shafts.

Table 3: Stratigraphy and Groundwater Occurrences in Stage 2 Exploration Boreholes [1]

Site	Depth (m)		Lithology / Structure	Groundwater Occurrence
	From	To		
MR-05-WB01	0	3	Overburden	
	3	4	Casing in greywacke	
	3	98	Interbedded argillite and greywacke; argillite typically platey, moderately to weakly sheared	18-20 m, samples damp (suppressing dust, but not flowing); groundwater flow after 35 m
	98	129	Sheared argillite; moderately to weakly sheared siltstone and claystone	
MR-05-WB02	0	5	Overburden	
	5	6.5	Casing	
	6.5	27	Greywacke with occasional argillite interbeds	Considerable groundwater production after setting surface casing
	27	37	Sheared argillite; moderately to weakly sheared	
	37	60	Greywacke with occasional argillite interbeds	
	60	81	Sheared argillite; rare greywacke interbeds; argillite moderately to weakly sheared	
	81	98	Greywacke with rare argillite interbeds	
	98	100	Sheared argillite; shearing moderate to weak	Groundwater production similar at beginning and end of borehole

continued…

Table 3 (cont): Stratigraphy and Groundwater Occurrences in Stage 2 Exploration Boreholes (1)

Site	Depth (m)		Lithology / Structure	Groundwater Occurrence
	From	To		
MR-05-WB03	0	2.5	Overburden	
	2.5	6	Argillite (cased)	
	6	10	Argillite	
	10	30	Sheared argillite; shearing moderate to weak	Trace of groundwater at 28 m
	30	99	Argillite	Damp samples at 78 m rod change
MR-05-WB04	0	2.5	Overburden	
	2.5	6	Greywacke (cased)	
	6	20	Greywacke and lesser interbedded argillite	
	20	28	Greywacke	
	28	34	Argillite; occasional moderately to weakly sheared intervals	Damp samples from 32 m on rod changes
	34	53	Greywacke and lesser interbedded argillite; occasional weakly sheared intervals	
	53	63	Argillite with lesser interbedded greywacke; occasional weakly sheared intervals	
	63	79	Argillite with frequent moderately to weakly sheared intervals	
	79	94	Interbedded greywacke and argillite; occasional weakly sheared intervals	
	94	109	Sheared argillite; shearing moderate to weak	

continued…

Table 3 (cont): Stratigraphy and Groundwater Occurrences in Stage 2 Exploration Boreholes (1)

Site	Depth (m)		Lithology / Structure	Groundwater Occurrence
	From	To		
MR-05-WB05	0	4	Overburden	
	4	6	Argillite (cased)	
	6	18	Argillite	
	18	36	Greywacke and lesser interbedded argillite	
	36	50	Argillite; occasional weakly sheared intervals	Trace groundwater at 44 m
	50	101	Sheared argillite; shearing moderate to weak	Minor groundwater at 87 m
	101	115	Argillite	Minor groundwater at 105 m
	115	153	Argillite; weakly sheared	
MR-05-WB06	0	4.5	Overburden	
	4.5	7	Argillite (cased)	
	7	16	Argillite; weakly sheared	
	16	19	Quartz-veined argillite	
	19	23	Argillite; weakly sheared	
	23	43	Graphitic argillite; 31-40 m quartz-veined	Slight groundwater flow from 39 m
	43	58	Argillite	Damp samples at rod changes
	58	66	Quartz-veined greywacke	Wet samples from 65 m
	66	94	Interbedded, quartz-veined greywacke and argillite	
	94	101	Greywacke; frequent quartz veins	
	101	106	Interbedded, quartz-veined greywacke and argillite	
	106	116	Quartz (and carbonate) veined greywacke	

continued…

Table 3 (cont): Stratigraphy and Groundwater Occurrences in Stage 2 Exploration Boreholes (1)

Site	Depth (m)		Lithology / Structure	Groundwater Occurrence
	From	To		
MR-05-WB07	0	3.5	Overburden	
	3.5	5.5	Argillite (cased)	
	5.5	35	Argillite; 6-20 m weakly sheared intervals	
	35	62	Interbedded greywacke and lesser argillite	
	62	66	Greywacke	
	66	68	Interbedded greywacke and argillite	
	68	70	Greywacke	
MR-05-WB08	0	4	Overburden	
	4	6	Argillite (cased)	
	6	21	Argillite; moderately to weakly sheared	
	21	33	Interbedded argillite and greywacke; frequent quartz veins	
			(to be updated)	
	69	88	Greywacke	

1. Logging by Atlantic Gold NL

Table 4: Results of Air Lift Tests of Stage 2 Exploration Boreholes

Site	Hole Depth (m)	V-notch Weir			Comments
		Time (min)	Height (cm)	Flow (L/sec)	
MR-05-WB01	129	0	4.5	0.6	
		5	4.3	0.5	
		10	4.3	0.5	
		15	4.2	0.5	
		25	4.2	0.5	
MR-05-WB02	100	0	7.0	1.8	All groundwater appears to be from till due to surface casing blow out
		2	9.5	3.8	
		5	11.0	5.5	
		10	10.0	4.3	
		15	10.0	4.3	
		25	10.5	4.9	
MR-05-WB03	99				Borehole rested for 10 minutes after drilling and before start of air lift; no groundwater produced
MR-05-WB04	109				Trickle of groundwater only
MR-05-WB05	153				Air lifted for 35 minutes; flow too small to measure
MR-05-WB06	115.5	0	2.5	0.1	
		5	3.0	0.2	
		10	2.5	0.1	
		15	2.5	0.1	
		20	2.5	0.1	
MR-05-WB07	70				Insufficient groundwater produced to measure flow
MR-05-WB08	88	10	3.0	0.2	
		15	2.5	0.1	
		25	3.0	0.2	
		35	2.5	0.1	

Table 5: Test Pit Locations and Lithology

Pit #	Local Grid		Depth (m)		Lithology / Fabric
	East	North	From	To	
1	21,735	10,260	0.0	0.7	Soil and Boulder Horizon: rounded greywacke cobbles and boulders to 80 cm diameter with dark brown organic sand matrix; abundant tree roots and other organic debris
			0.7	3.0	Till: poorly sorted gravel, fine sand and clay; gravel ranges from tabular, 1-3 cm diameter and 2mm wide argillite plates to 10 cm diameter rounded greywacke and rare granite cobbles; gravel clasts are matrix supported by brown clay (which predominates) and very fine sand; no layering in till; undulose contact (abrupt colour change) with basement
			3.0	3.5	Argillite Basement: dark grey, highly fragmented; base of pit at 3.5 m
2	21,530	10,205	0.0	1.9	Till: gravel with brown fine-sand matrix; matrix supported; tabular grey argillite plates from 2 mm to 3 cm diameter and 2-3 mm wide; lesser subrounded greywacke pebbles and cobbles 1 cm to 5 cm diameter, and to 10 cm diameter within basal 50 cm of unit
			1.9	2.3	Argillite Till: argillite dominated with 1 cm to 20 cm diameter dark grey clasts and lesser sandstone clasts; clasts supported by brown fine grained matrix; this layer appears to be associated with most of water inflow
			2.3	2.4	Argillite Basement: dark grey, highly fragmented; base of pit at 2.4 m
3	21,700	9,990	0.0	0.3	Gravelly Soil: tabular and rounded argillite and greywacke clasts from 2 mm to 20 cm diameter with brown sandy organic soil matrix; organic debris (wood and tree roots)
			0.3	1.8	Till: poorly sorted gravel with medium grained sand matrix; matrix-supported in places and pebble (2 mm to 1 cm diameter) supported in others; several large argillite slabs including one slab 50 cm by 10 cm; undulose, abrupt but not sharp, contact with argillite basement
			1.8	2.2	Argillite Basement: dark grey fractured argillite; base of pit at 2.2 m

continued…

Table 5 (cont): Test Pit Locations and Lithology

Pit #	Local Grid		Depth (m)		Lithology / Fabric
	East	North	From	To	
4	21,925	10,000	0.0	0.4	Soil: brown and grey mottled sand; brown after organic material; only occasional cobbles
			0.4	3.6	Till: very poorly sorted gravel with fine sand matrix; both clast and matrix support fabric; crude horizontal layering in 40 cm wide interval ~40 cm above base of unit; boulders mainly towards base of unit and distinctive step in basement; water inflows from point sources, particularly close to basement contact, rather than as sheets or seepage over broad areas
			3.6	4.0	Argillite Basement: dark grey, relatively coherent compared with Pits 1 to 3

Table 6: Test Pit Pumping Results

Pit #	Pumping time (minutes)	Volume pumped (kL)	Change in water surface elevation (m)
1	80	18	0.96
2	114	26	1.36
3	18	4	0.43
4	40	4	0.79

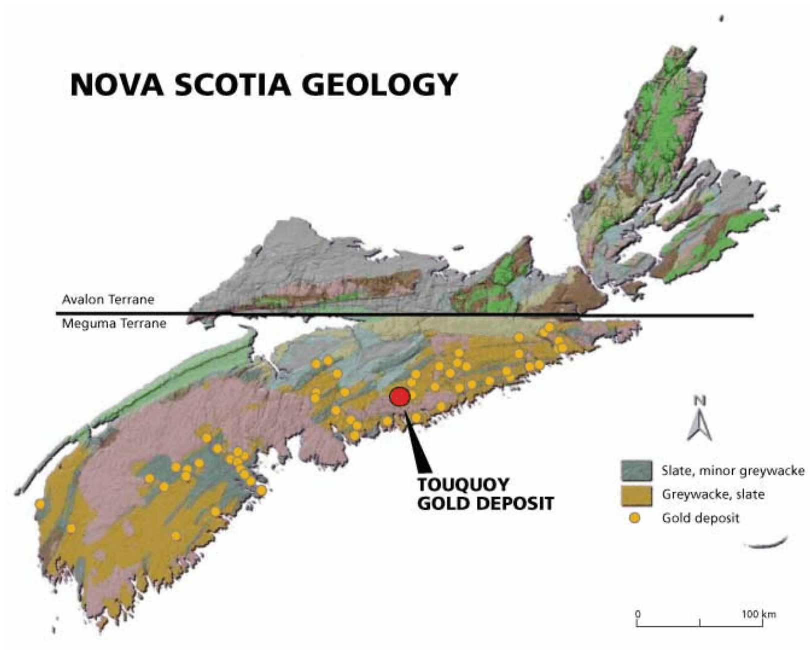


Figure 1: Location of Touquoy Gold Project and Generalised Geological Plan of Nova Scotia (from www.atlanticgold.com.au)

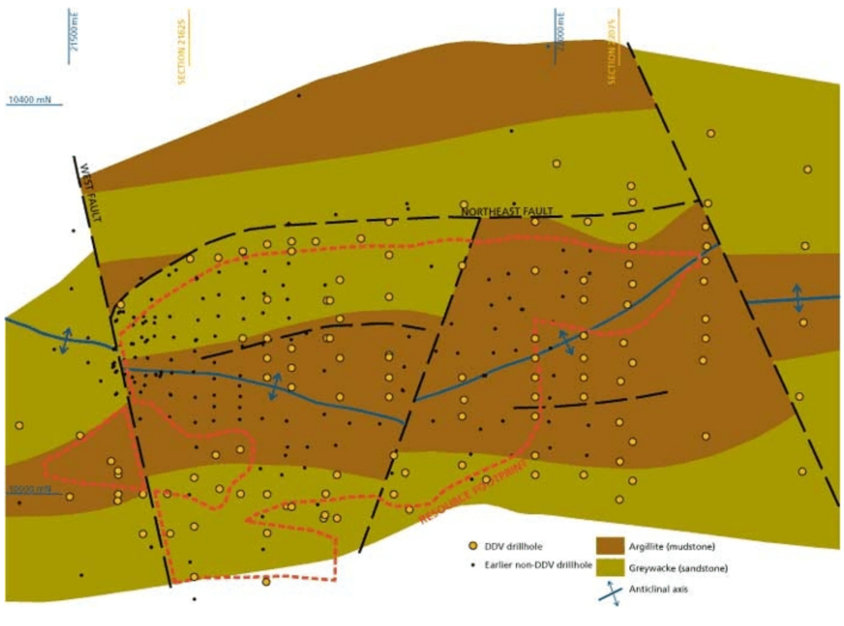
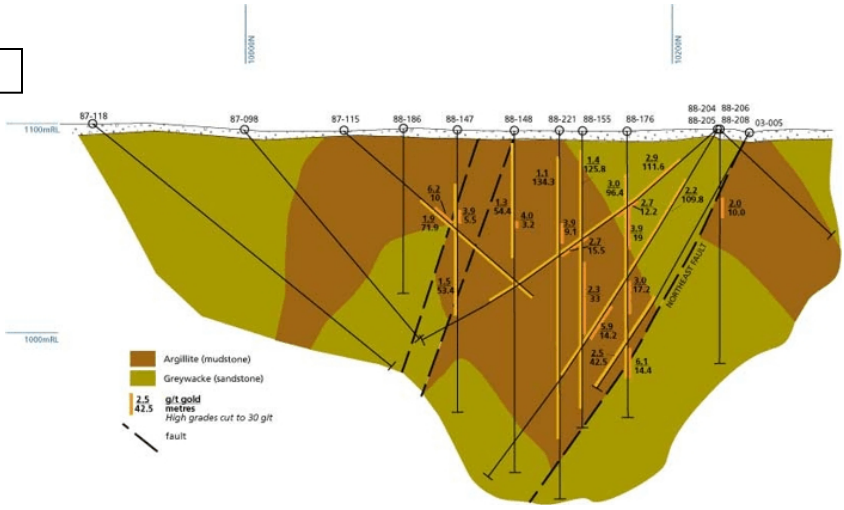


Figure 2: Touquoy Site Generalised Geological Plan (from www.atlanticgold.com.au)

21625E



22075E

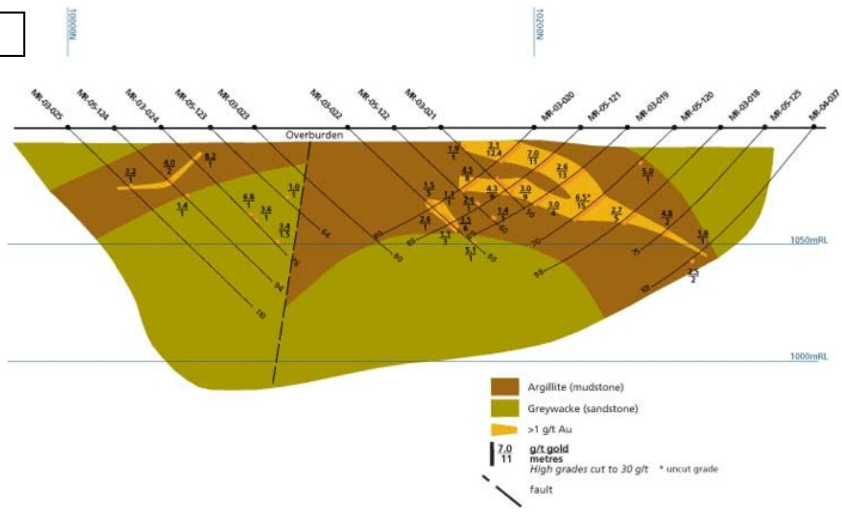
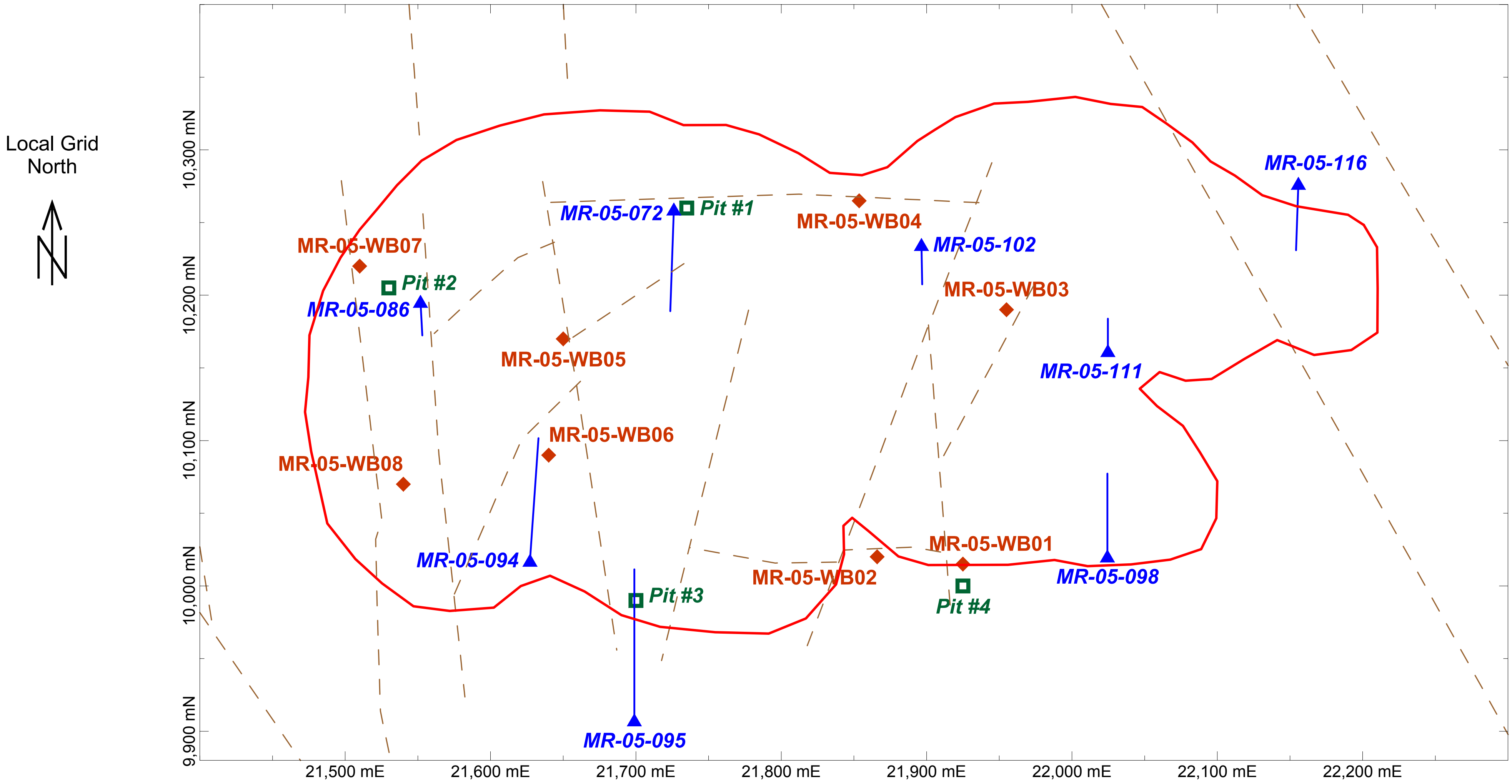


Figure 3: Touquoy Site Generalised Geological Cross Sections
(from www.atlanticgold.com.au)



Scale 1:4,000

0m 100m 200m

Mine Grid Coordinates

- ▲ Borehole collar - Stage 1 testing
- Borehole trace - Stage 1 testing (inclined diamond core holes)
- ◆ Borehole collar - Stage 2 testing
- ▣ Test pit
- Fault
- Pit Shell (Run 10, Shell 15)

FIGURE 4

Touquoy Preliminary Pit Shell

Locations of Air Lift Tested Boreholes and Test Pits

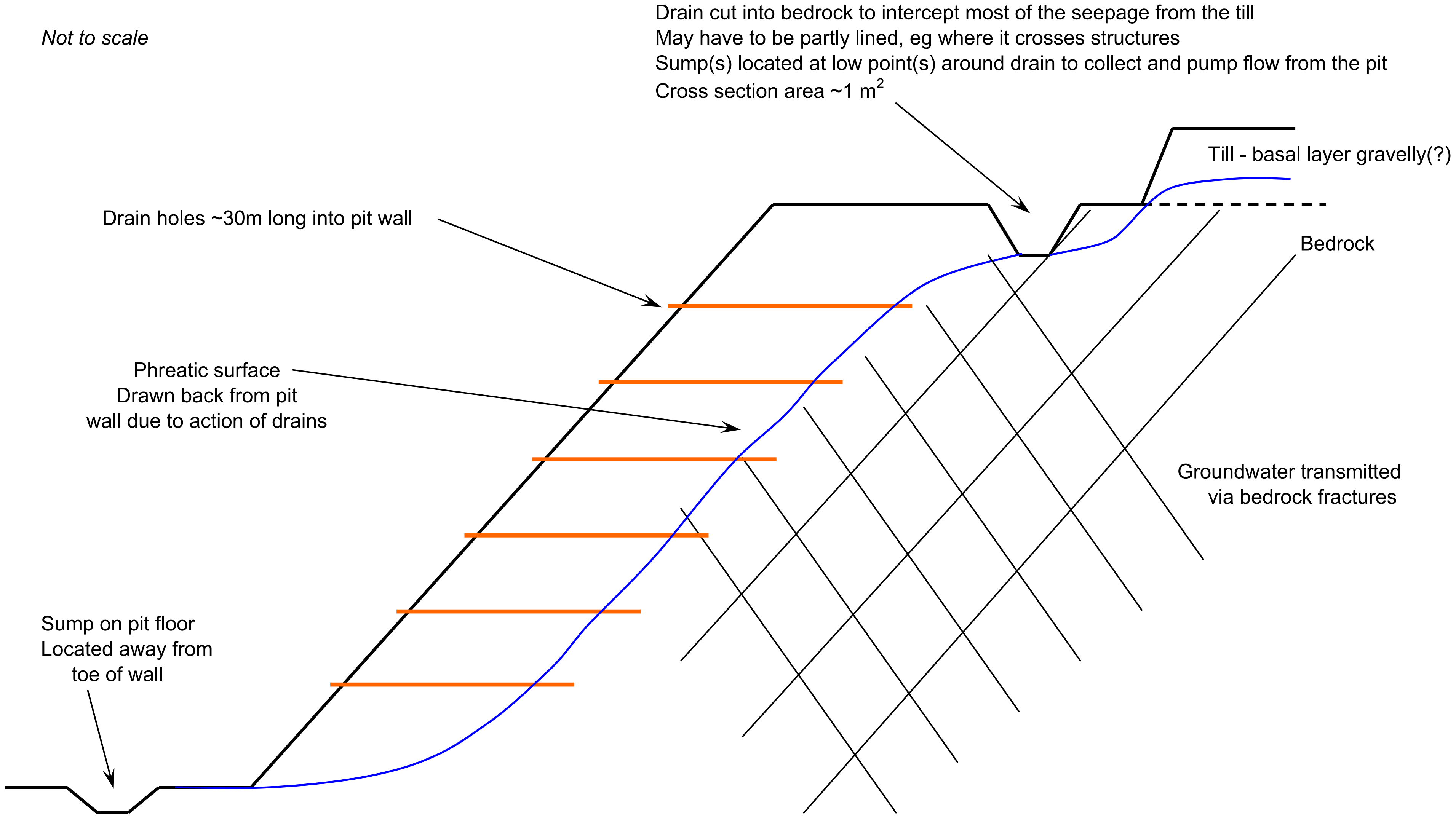


FIGURE 5

Conceptual Design of Pit Wall and Till Drainage Systems at Touquoy

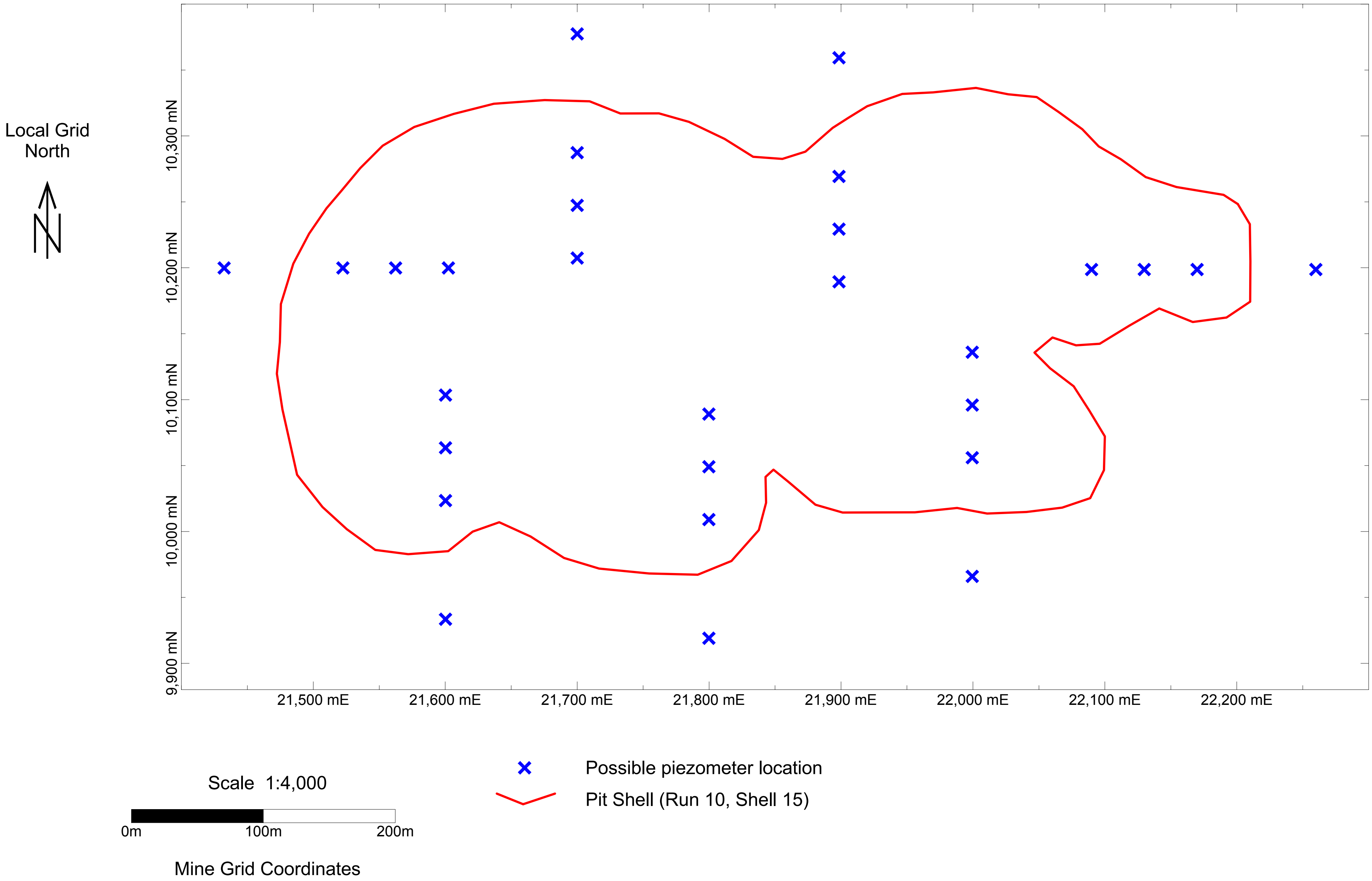


FIGURE 6
Possible Locations for Pit Wall Piezometers