

CLC Meeting

Goffs Quarry





Agenda

- Site visit
- Introduction to Golder Associates Ltd.
- Golder Team introductions
- CLC introductions
- Overview of the geologic and hydrogeologic conditions
- Summary of groundwater impact assessment
- Summary of the groundwater monitoring plan
- Summary of the blasting impact assessment with respect to private wells
- Private well survey summary
- NSE Reporting requirements
- Questions



The Golder Team

Phyllis McCrindle, B.Sc., M.Sc., P.Geo. (NS and Ont.)

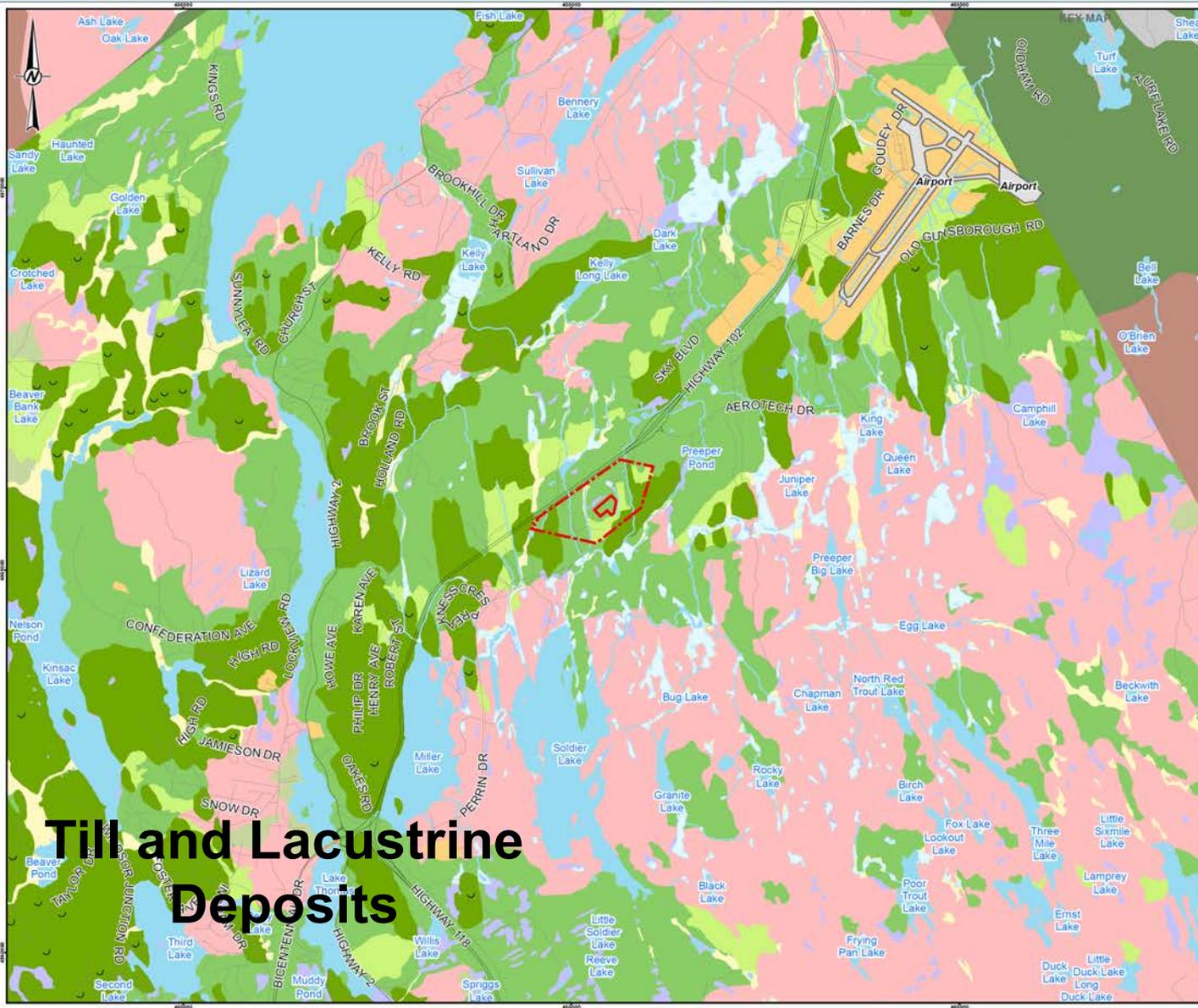
Associate, Senior Hydrogeologist, Project Director

- 19+ years professional experience
 - Licensing, permitting and monitoring for pits, quarries and mines
 - Liaison with Municipal, Provincial and Federal agencies

Sean McFarland, PhD, LLM, MBA, MSc., BSc., P.Geo. (Ont.), CPA (CMA), CMC, PMP

Principal

- 30+ years professional experience
 - Licensing, permitting and monitoring for pits and quarries
 - Expert witness at EA and OMB hearings



- LEGEND**
- MAJOR ROAD
 - LOCAL ROAD
 - WATERCOURSE
 - QUARRY BOUNDARY/PROJECT FOOTPRINT
 - SURVEY AREA
 - WATERBODY (CANVEC 2010)
 - RESERVOIR
 - WETLAND (CANVEC 2010)
 - DRUMLIN
- SURFICIAL GEOLOGY**
- ANTHROPOGENIC
 - ALLUVIAL
 - LACUSTRINE
 - HUMMOCKY TILL
 - TILL BLANKET
 - TILL VENEER
 - DRUMLINS
 - BEDROCK
 - LAKE
 - SILTY TILL PLAIN (GROUND MORAINE)
 - STONY TILL PLAIN (GROUND MORAINE)
 - ORGANIC DEPOSITS



NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC, OBTAINED 2010
2. SURFICIAL GEOLOGY - SURFICIAL GEOLOGY MAPPING PROJECT OF THE HALIFAX METROPOLITAN AND SURROUNDING AREAS, HALIFAX AND HANTS COUNTIES, NOVA SCOTIA, BY D. J. UTTING, 2011
3. PROJECTION: MODIFIED TRANSVERSE MERCATOR; UTM ZONE 20N

CLIENT
SCOTIAN MATERIALS LIMITED

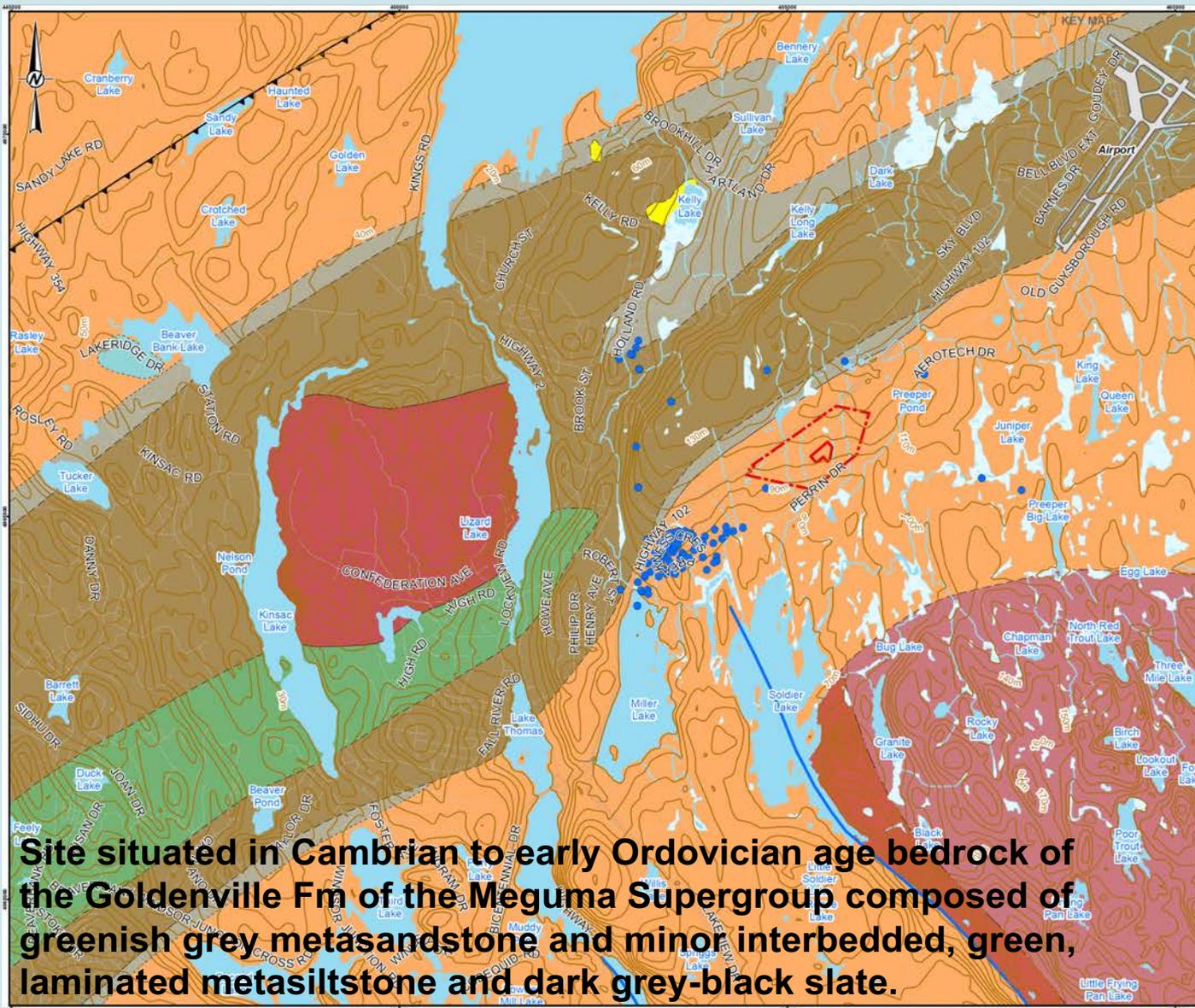
PROJECT
SCOTIAN MATERIALS PROPOSED GOFFS QUARRY

TITLE
SURFICIAL GEOLOGY

CONSULTANT	YYYY-MM-DD	2016-06-30
	DESIGNED	JB
	PREPARED	JB/JMC
	REVIEWED	AM
	APPROVED	PMCC

PROJECT NO. 1538794 **CONTROL** **REV.** **FIGURE** 2

Till and Lacustrine Deposits



LEGEND

- WATER WELL (DRILLED)
- FAULT
- SHEAR FAULT
- - - GEOLOGICAL CONTACT APPROXIMATE
- - - GEOLOGICAL CONTACT ASSUMED
- - - GEOLOGICAL CONTACT GENERAL
- - - GEOLOGICAL CONTACT GRADATIONAL
- MAJOR ROAD
- LOCAL ROAD
- CONTOURS - 10M INTERVAL
- WATERCOURSE
- ▭ QUARRY BOUNDARY/PROJECT FOOTPRINT
- ▭ SURVEY AREA
- WATERBODY (CANVEC 2010)
- RESERVOIR
- WETLAND (CANVEC 2010)

BEDROCK GEOLOGY

- CARROLLS CORNER FORMATION
- COLDSTREAM FORMATION
- LEUCOMONZOGRANITE
- MUSCOVITE-BIOTITE MONZOGRANITE
- KINSAC PLUTON
- GLEN BROOK MEMBER
- CUNARD MEMBER
- BEAVERBANK MEMBER
- GOLDENVILLE FORMATION

REFERENCE(S)

1. BASE DATA - CANVEC, OBTAINED 2010
2. BEDROCK GEOLOGY - DP ME 141, VERSION 1, 2009. DIGITAL GEOLOGICAL DATA GENERATED FROM THE CENTRAL MEGUMA MAPPING PROJECT, 1995-1999 AND 2002-2004. IN THE MOUNT LUNAKKE AREA, HALIFAX AND HANTS COUNTIES, NOVA SCOTIA, NTS SHEET 11D113
3. WATER WELLS - DP ME 430, VERSION 2, 2013. ENHANCED GEOREFERENCED VERSION OF THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT'S NOVA SCOTIA WELL LOGS DATABASE (2013) COMPILED BY G. W. KENNEDY AND B. E. FISHER, 2013
4. PROJECTION MODIFIED TRANSVERSE MERCATOR UTM ZONE 20N

CLIENT
SCOTIAN MATERIALS LIMITED

PROJECT
SCOTIAN MATERIALS PROPOSED GOFFS QUARRY

TITLE
BEDROCK GEOLOGY

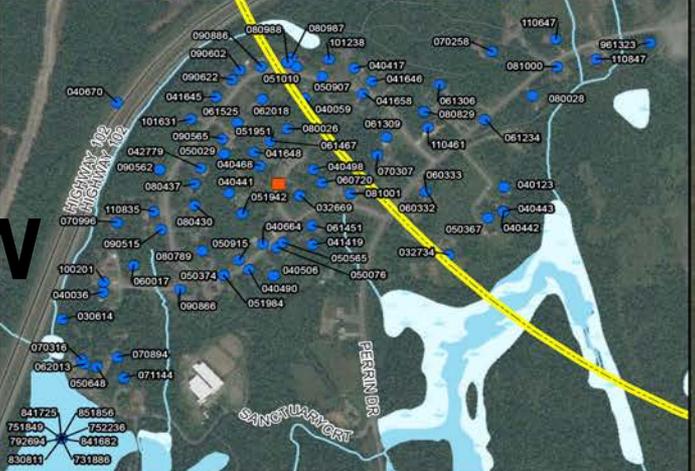
CONSULTANT	YYYY.MM.DD	2016-06-30
DESIGNED	JB	
PREPARED	JB/JMC	
REVIEWED	AM	
APPROVED	PMCC	

PROJECT NO: 1538794 CONTROL REV: FIGURE 3

Site situated in Cambrian to early Ordovician age bedrock of the Goldenville Fm of the Meguma Supergroup composed of greenish grey metasandstone and minor interbedded, green, laminated metasiltstone and dark grey-black slate.



SITE OVERVIEW



AEROTECH DR

Peeper Pond

HIGHWAY 162
HIGHWAY 162

MW16-1

WL5

STREAM 6

MW16-4

PID
00305941

WL3

MW16-5

STREAM 5

MW16-3

MW16-2

WL4

MW17-6

MW17-7

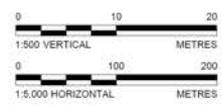
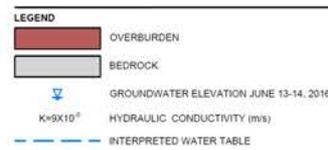
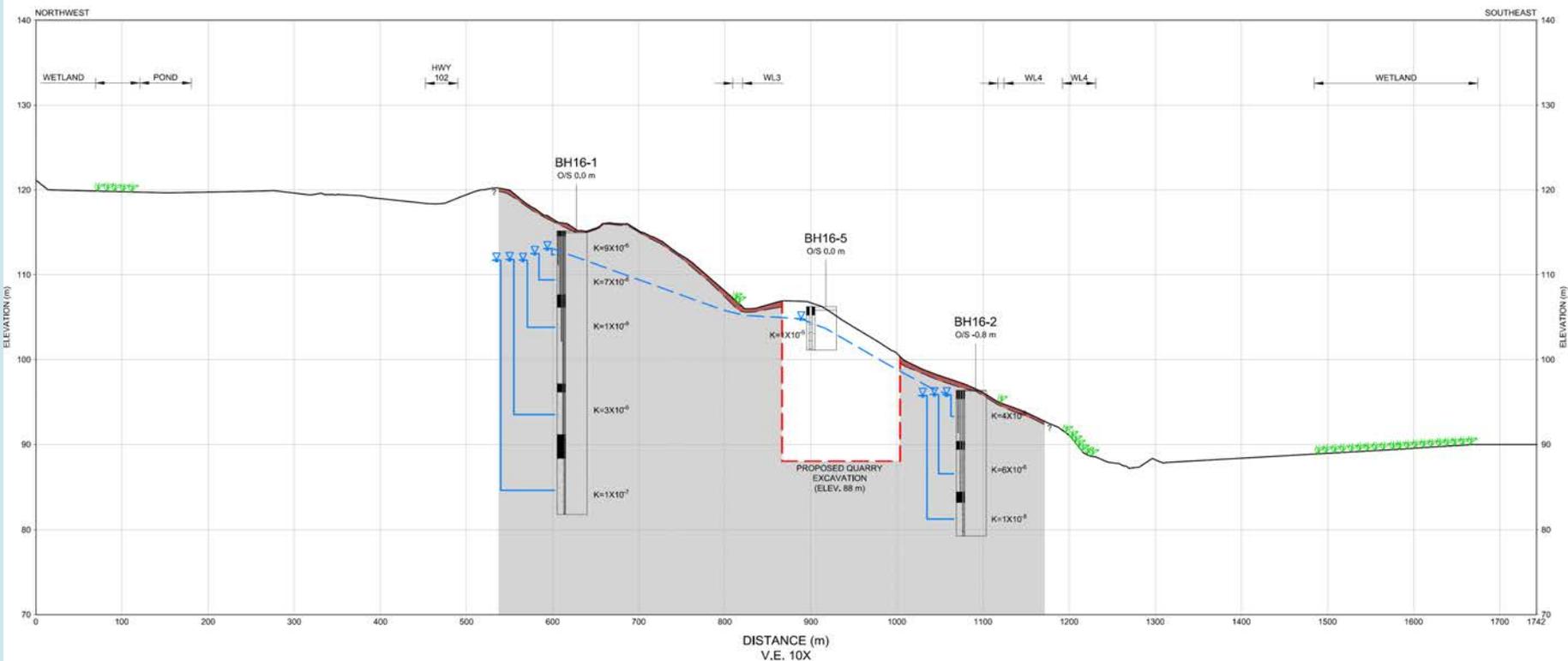
NSTIR WEIGH SCALE

CLOSE UP VIEW OF SITE BOREHOLE NETWORK





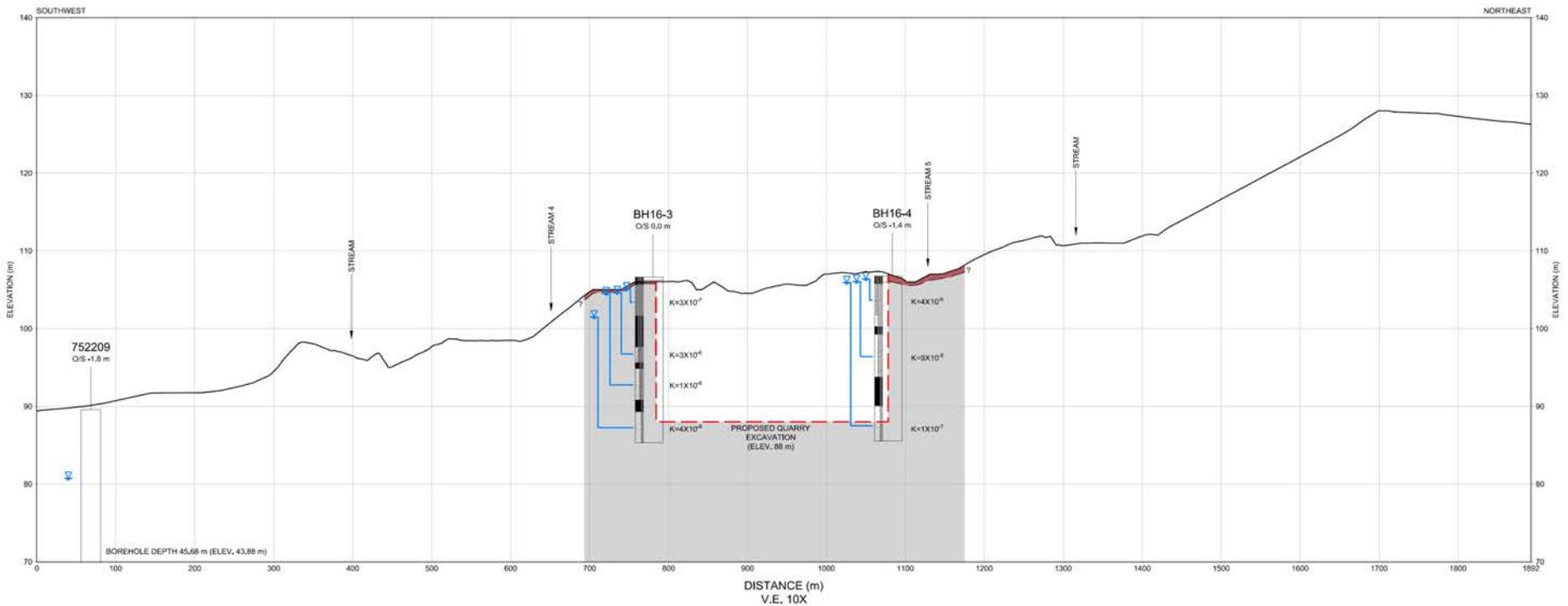
Groundwater flow is toward the south to southeast in the site area, from a high of elevation 106.5masl at Borehole 16-4 in the northeast to elevation 95.85masl at Borehole 16-2 in the southwestern area of the site.



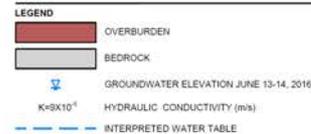
CLIENT	SCOTIAN MATERIALS LIMITED		
PROJECT	SCOTIAN MATERIALS PROPOSED GOFFS QUARRY		
TITLE	CROSS SECTION A - A'		
CONSULTANT	YYYY-MM-DD	2016-06-29	
	DESIGNED		
	PREPARED	DD	
	REVIEWED	AM	
	APPROVED		
PROJECT NO	CONTROL	REV	FIGURE
1538794		A	6

Section A-A' runs through the site from the wetland located to the north west outside of the property boundary to the wetland located to the southeast of the boundary passing through on site boreholes. The proposed quarry is located on the southern flank of a bedrock high and will be excavated just below the ground surface to the south of the site.





Section B-B' runs through the site from the southwestern property boundary to the northeastern property boundary extending through on-site boreholes. The quarry is excavated below the surrounding water courses. The closest water well is situated at about 1km from the quarry boundary.



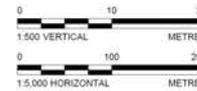
CLIENT
SCOTIAN MATERIALS LIMITED

PROJECT
SCOTIAN MATERIALS PROPOSED GOFFS QUARRY

TITLE
CROSS SECTION B - B'

CONSULTANT	YYYY-MM-DD	2016-06-29
	DESIGNED	
	PREPARED	DD
	REVIEWED	AM
	APPROVED	

PROJECT NO. 1538794 CONTROL REV. A FIGURE 7





Site overview and hydrogeology

- Quarry topography ranges from 110 masl in north to 96 masl in south.
- Full quarry extraction will be extracted to 88 masl.
- 21 groundwater monitors at 7 borehole locations on-site.
- Soil hydraulic conductivity (K) (i.e. ability for groundwater to flow) is based on grain size analysis and ranges from 2×10^{-8} m/s to 1×10^{-7} m/s.
- Rock hydraulic conductivity (K) ranges from 1×10^{-8} m/s to 6×10^{-5} m/s. Based upon 33 well response test and K tend to get tighter with depth.
- Groundwater levels measured monthly and range from 0.18 to 5.1 mbgs (82.5 to 113.6 masl). All have downward hydraulic gradient. Levels are influenced by topography.
- The groundwater quality samples from the on-site boreholes are pre-quarry baseline samples against which any future changes in quality will be compared.



Groundwater Monitoring Well Quality

- The activities associated with operating the quarry are not anticipated to change the groundwater quality concentrations.
- These results were compared to Canadian Drinking Water Quality guidelines. Naturally-occurring water quality in Nova Scotia include arsenic, chloride, hardness, iron, manganese, radionuclides, radon, sulphate and uranium. These parameters are related to natural chemistry of the soil and rock.
- Under normal quarry operations, groundwater intercepted by the quarry will be mixed with fresh precipitation inputs and quarry discharge is expected to be further mixed with runoff and streamflow from upstream and adjacent drainage areas.
- Water well interference related to quarry dewatering is not expected, as the closest water wells are well beyond the estimated radius of influence of groundwater level drawdown.



Predicted radius of groundwater influence due to full extraction to 88 masl is 211m from quarry boundary. Local water used for drinking with the nearest private well approx. 1 km from quarry boundary.



Blasting and Private Well Survey

- Potential fracture development around blasts are not anticipated beyond a distance of about 5 to 10 m from the blast. The nearest private well is located over 1 km away from the quarry boundary.
- The NSE guideline for vibration (included Goffs IA) is well below levels which would impact wells. Ground vibrations produced from the quarry blasting operations would have no effect on the neighboring water wells.
- In properly executed blasts, the explosives are consumed within the detonation process. Negligible deleterious compounds will be produced such as nitrates which are monitored in both the on-site groundwater and surface water sampling programs as approved by the NSE.
- Private well survey was conducted in the Miller Lake subdivision to establish a baseline pre-blasting. If the quarry was to impact water quality, the costs to replace the water source will be solely at the expense of Scotian Materials. However blasting is not expected to effect water quality and any blasting effects will likely be confined to the quarry.



Goffs Monitoring Requirements

Appendix A

Groundwater, Surface Water and Wetland Monitoring		
Parameter	Location	Frequency
Water Level	BH16-1*, BH16-2*, BH16-3*, BH16-4*, BH16-6, BH16-7	Weekly: March to November; Monthly: December to February
General Chemistry, Metals, BTEX and PHC's	BH16-1*, BH16-2*, BH16-3*, BH16-4*	Quarterly: Year 1; Semi-Annual (2 times per year) thereafter
General Chemistry, Metals, BTEX and PHC's	BH16-6, BH16-7	Quarterly: Year 1; Upon Department request.
General Chemistry, Metals, TSS and pH	Stream 4 - Upstream, Stream 4 - Downstream, Stream 5 - Upstream, Stream 5 - Downstream	Quarterly
Surface Flow	SW1, SW2, SW3, SW4	Monthly
General Chemistry, Metals and TSS	Outlet of Sedimentation Ponds A and B	Prior to discharge to the environment; Monthly while discharge is occurring
pH	Outlet of Sedimentation Ponds A and B	Weekly while discharge is occurring
Visual Observations	Groundwater Seeps	Monthly
Benthic Invertebrates	Stream 4	Baseline prior to quarrying activities; Upon Department Request
Wetland Water Level	WL3, WL4, WL5	Automatic level logger recording an hourly time interval; Quarterly manual measurement
Wetland extent, structure and function	WL3, WL4, WL5	Baseline prior to quarrying activities; Annual at the same time every year using standardized methods.

*All nested wells are to be included in monitoring events



Reporting to Nova Scotia Environment

An annual monitoring report is to be submitted to NSE by February 15th. The report is to include the following:

- Methods used for sampling and methods used to analyze data.
- Description and map of sample locations.
- A review of the current monitoring programs and recommendations for modifications, as applicable.
- Current and historical static water elevation data.
- Current and historical groundwater and surface water quality including an analysis of trends with comparison to applicable guidelines and historical (baseline) data.
- Laboratory certificates of analysis.
- Identification of any adverse impacts, potential adverse impacts or changes resulting from operations and activities on this property and associated recommendations, if applicable.
- Identification of any instances of significant water drop, along with an analysis into the cause and any additional mitigation measures, as applicable.
- Summary of water withdrawal rates.



Questions

