VOLUME VI
CHAPTERS 9.1 & 9.2

WHITES POINT QUARRY & MARINE TERMINAL

ENVIRONMENTAL IMPACT STATEMENT

BILCON OF NOVA SCOTIA

March 31, 2006

Table of Contents

Table of Contents

Table of Contents

List of Figures

List of Graphs

Table of Contents

List of Maps

List of Plans

List of Tables

9.0 ENVIRONMENTS AND IMPACT ANALYSIS

Introduction

An ecosystem approach has been taken during the preparation of this environmental impact statement. This approach involves determining not only the direct impact of an activity on an ecosystem component, but also how this impact may indirectly affect other ecosystem components. Assessment of the interactions between and within physical, biological, and human environmental ecosystem components is presented to the extent possible realizing that the boundaries of what is considered an "ecosystem" is arbitrary since all ecosystems interact with each other.

An ecosystem can be viewed as a "dynamic complex of plant, animal, and micro-organism communities and their non-living environment interacting as a functional unit" (Convention on Biological Diversity 2001-2005, Ref. 232). These organisms depend upon and are influenced by the habitat in which they live. It is this interaction of the living (biotic) and nonliving (abiotic) components that create an ecosystem. A typical ecosystem consists of four structural components (Smith 1966, Ref. 168): the abiotic component consisting of elements such as soil, water, and minerals; the autotrophic component consisting of producers such as green plants and chemosynthic microrganisms; the heterotrophic component consisting of the larger consumers which feed on plants and other organisms; and the decomposers consisting of bacteria and fungi which break down complex compounds of dead organic matter. The spatial area in which these organisms live is their 'habitat'. Habitats vary in scale and, as previously mentioned, for the purpose of this environmental impact statement have been placed in a hierarchy of local, regional, provincial, and national/international.

9.1 Physical Environment and Impact Analysis

Introduction

The regional setting for the proposed Whites Point quarry and Marine Terminal is the Digby Neck peninsula between the Bay of Fundy and Saint Mary's Bay. The climate is humid temperate with an annual mean precipitation of approximately 1300 mm and an average temperature range of approximately 18° C in summer to -3° C in winter.

Topography along Digby Neck ranges in relief from over 100 m along the ridge to sea level. Regional bedrock geology is shown on **Map 5.** The Digby Neck area is comprised of the North Mountain Formation. The North Mountain Formation is underlain by the Blomidon Formation. Four faults are shown in this regional area of Digby Neck, Long Island and Brier Island at Rossway, Sandy Cove, East Ferry, and Freeport.

Regional surficial geology is shown on **Map 8.** The Digby Neck area is characterized as a stony till plain with occasional alluvial, glaciofluvial, and colluvial deposits. The soils on Digby Neck in the area of the proposed Whites Point quarry are shown on **Map 9.** Rossway soils dominate the Digby Neck area. Surficial geology in the Bay of Fundy is shown on **Map 10.**

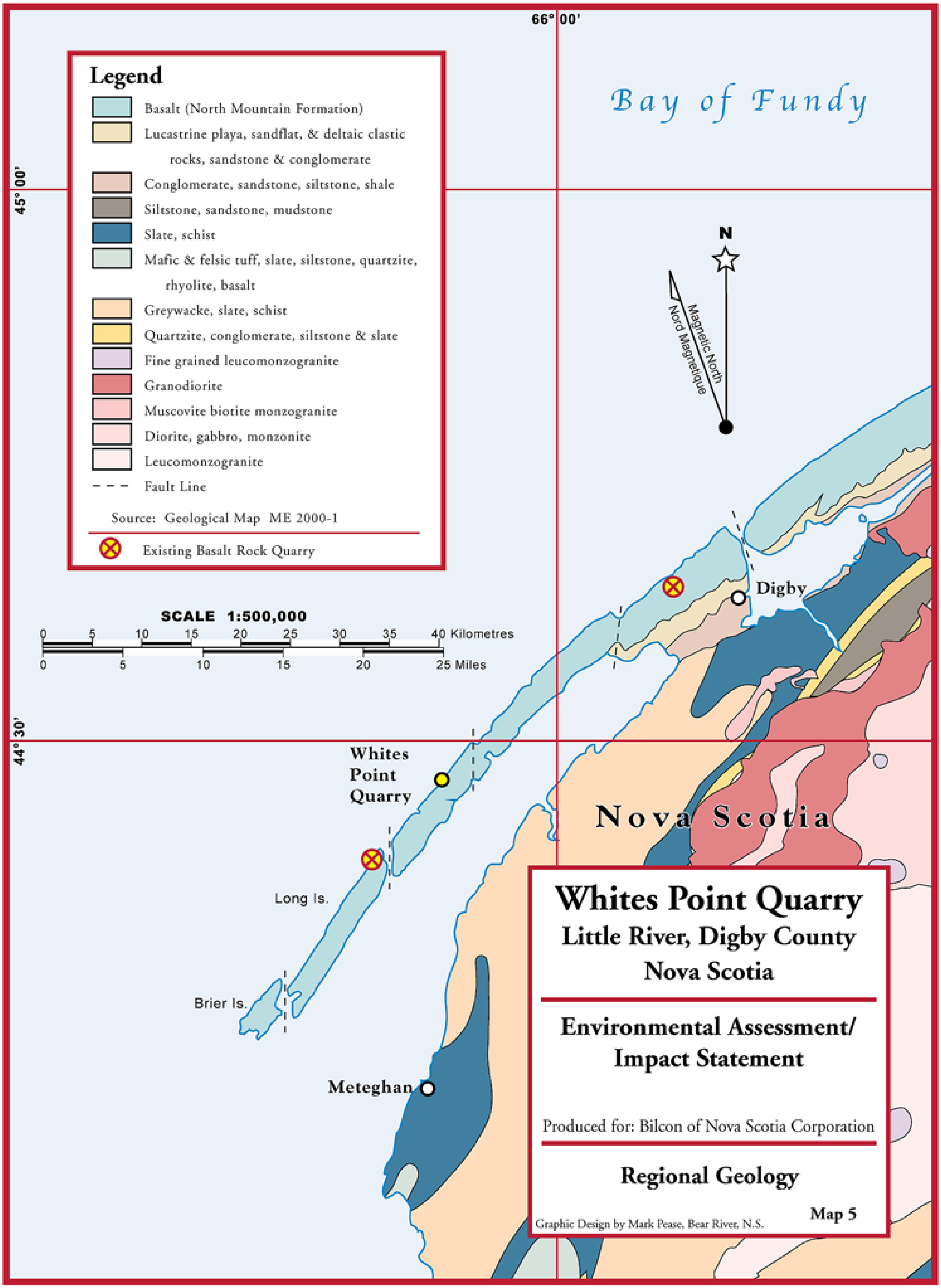
The Whites Point Quarry site is composed of the Jurassic North Mountain Basalt. North Mountain Basalt is present along the Bay of Fundy from Brier Island to Cape Blomidon, a distance of over 200 km. The Quaternary aged glacial deposit overburden on the quarry site is mapped as the Basalt Till Facies of the Beaver River Till Unit. This till is generally thin and mantled over the bedrock and may overlie older till deposits in some areas. Rossway soils cover the entire quarry site and are generally stony and well drained. These soils are chiefly forested in Digby County and on the site.

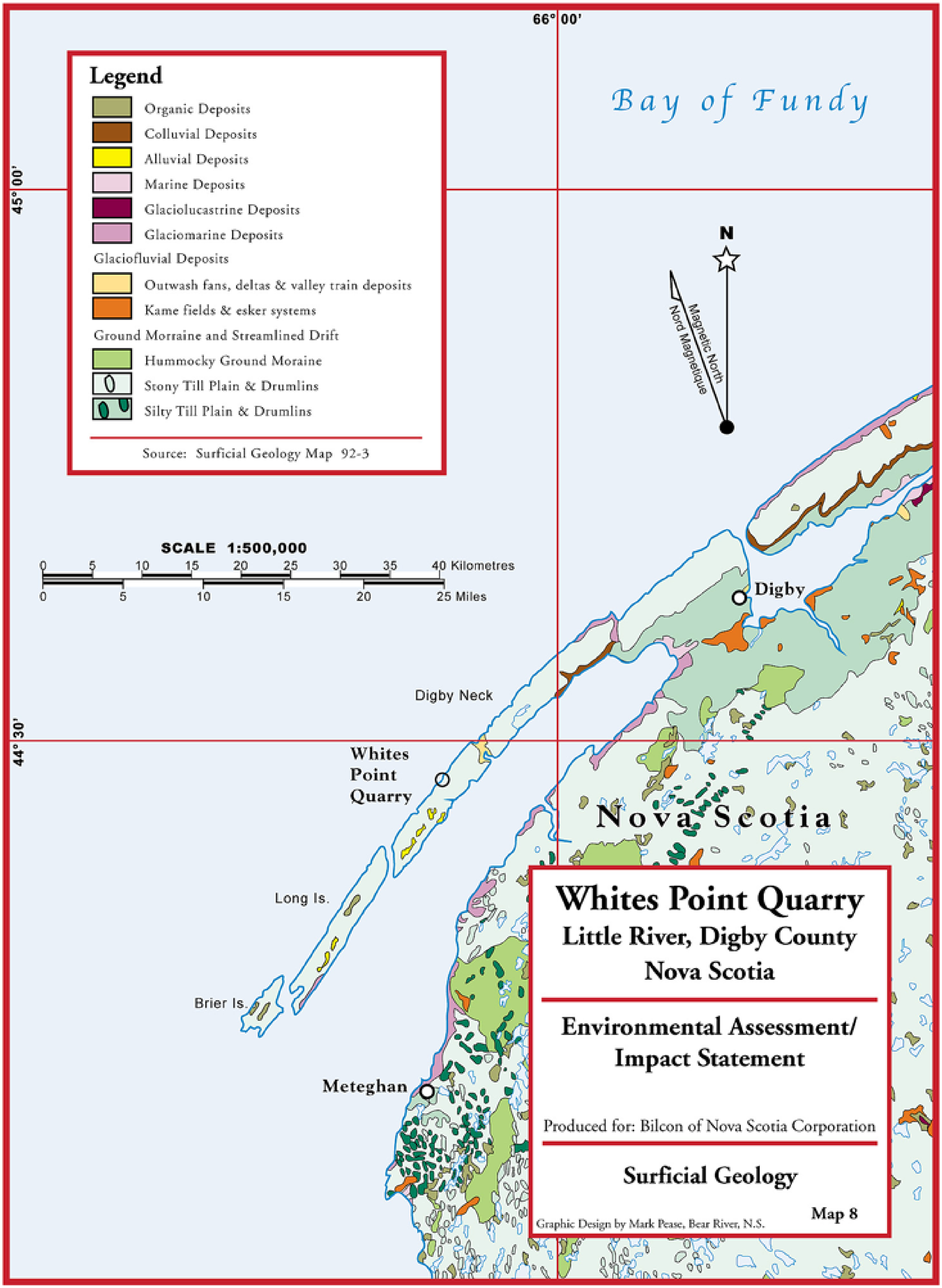
The existing topography of the proposed quarry site is steeply sloping toward the Bay of Fundy. Relief at the highest point is over 90 m. Extreme gradients range up to 50% slope with more common slopes in the 10% to 25% range, - see **Map 11** for slope analysis and aspect. Several areas such as those along the shoreline, the abandoned pit, and the southeast ridge of the site are relatively flat.

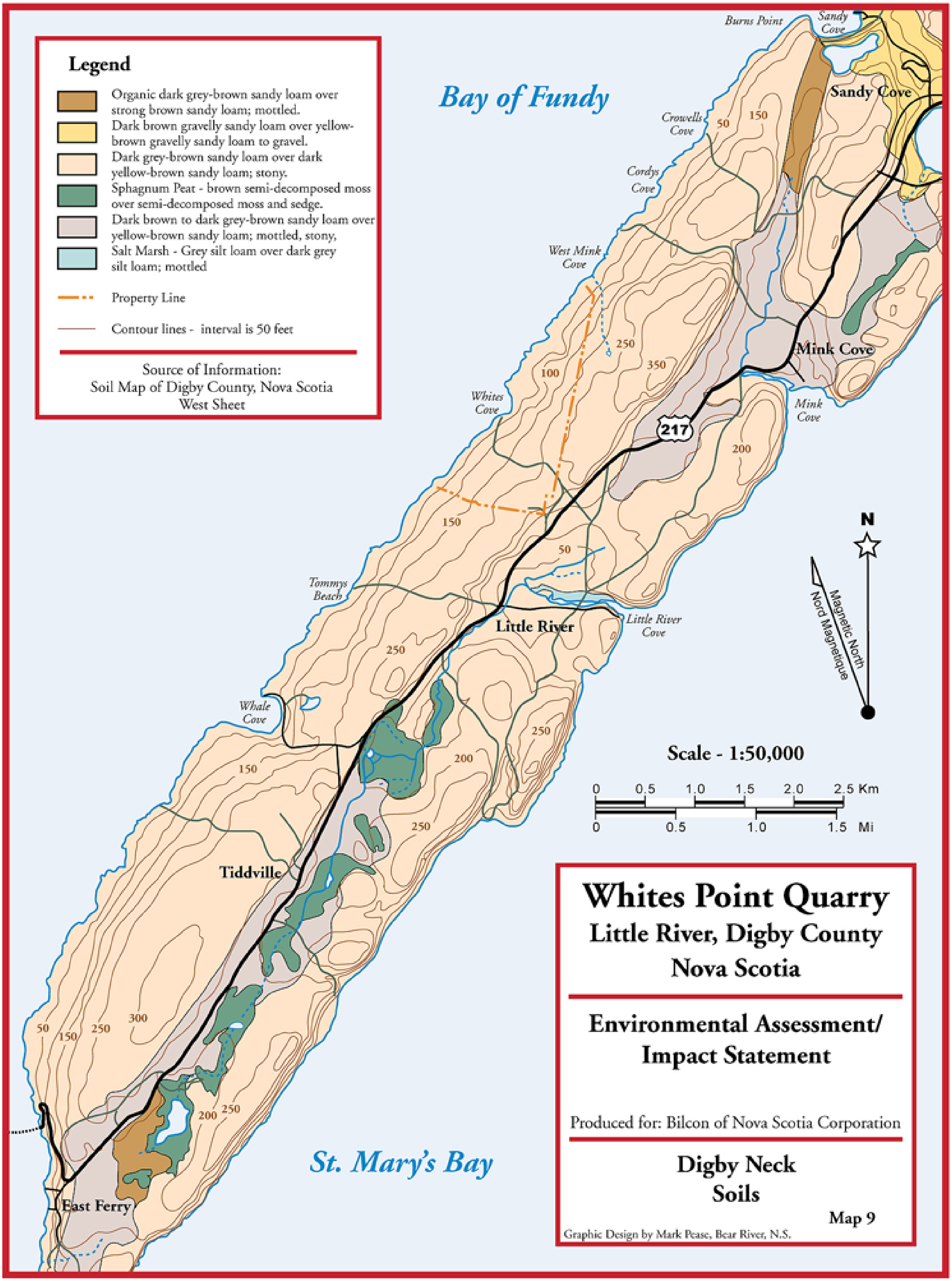
The ridge line and watershed divide are shown on **Map 12.** Surface water runoff from the majority of the site flows toward the Bay of Fundy except for an approximate 21 acre area at the southeast corner which drains toward Saint Mary's Bay. Several, small, intermittent, irregularly defined water courses, typical of the North Mountain, are evident flowing down the mountain side and dispersing into the Bay of Fundy.

The quarry site and nearshore waters are strongly influenced by the Bay of Fundy. An extreme tidal range occurs in this area of the outer Bay of Fundy with nearshore tidal currents ranging from 0 to 2.5 knots along the immediate coast depending on the state of the tide. The onshore basalt bedrock continues seaward into the Bay with areas of sand overlying the rock. Wind speed and direction vary seasonally in this area of the Bay.

Air quality on Digby Neck is good due to the combination of maritime climate, relatively small population, and few industrial bases. These climatic conditions provide good dispersion of air contaminants. The ambient air quality also benefits from the infusion of relatively clear polar and artic air masses. Occasionally, long-range transport of air masses from central Canada or the eastern seaboard of the Unites States may bring contaminants into the area.


66° 00'
45° 00'
44° 30'
Legend
Basalt (North Mountain Formation)
Lucastrine playa, sandflat, & deltaic clastic rocks, sandstone & conglomerate
Conglomerate, sandstone, siltstone, shale
Siltstone, sandstone, mudstone
Slate, schist
Mafic & felsic tuff, slate, siltstone, quartzite, rhyolite, basalt
Greywacke, slate, schist
Quartzite, conglomerate, siltstone & slate
Fine grained leucomonzogranite
Granodiorite
Muscovite biotite monzogranite
Diorite, gabbro, monzonite
Leucomonzogranite
Fault Line
Source: Geological Map ME 2000-1
Existing Basalt Rock Quarry
Bay of Fundy
N
Magnetic North
Nord Magnetique
SCALE 1:500,000
0 5 10 15 20 25 30 35 40 Kilometres
0 5 10 15 20 25 Miles
Digby
Whites Point Quarry
Long Is.
Brier Is.
Meteghan
Nova Scotia
Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/ Impact Statement
Produced for: Bilcon of Nova Scotia Corporation
Regional Geology
Map 5
Graphic Design by Mark Pease, Bear River, N.S.


66° 00'
45° 00'
44° 30'
Legend
Organic Deposits
Colluvial Deposits
Alluvial Deposits
Marine Deposits
Glaciolucastrine Deposits
Glaciomarine Deposits
Glaciofluvial Deposits
Outwash fans, deltas & valley train deposits
Kame fields & esker systems
Ground Morraine and Streamlined Drift
Hummocky Ground Moraine
Stony Till Plain & Drumlins
Silty Till Plain & Drumlins
Source: Surficial Geology Map 92-3
Bay of Fundy
N
Magnetic North
Nord Magnetique
SCALE 1:500,000
0 5 10 15 20 25 30 35 40 Kilometres
0 5 10 15 20 25 Miles
Digby
Digby Neck
Whites Point Quarry
Nova Scotia
Long Is.
Brier Is.
Meteghan
Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Produced for: Bilcon of Nova Scotia Corporation
Surficial Geology
Map 8
Graphic Design by Mark Pease, Bear River, N.S.



Whites Point Quarry

Little River, Digby County Nova Scotia

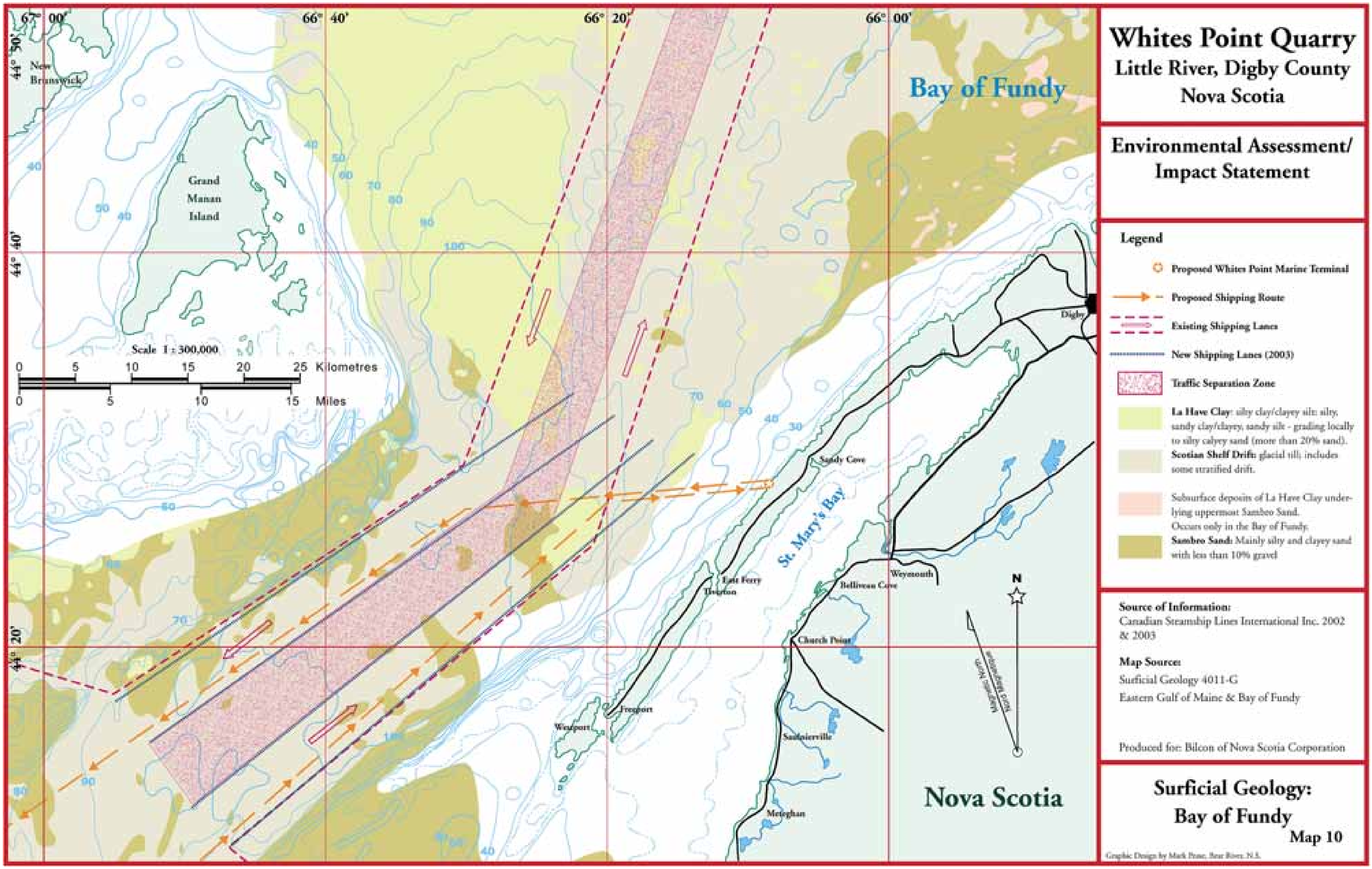
Environmental Assessment/ Impact Statement

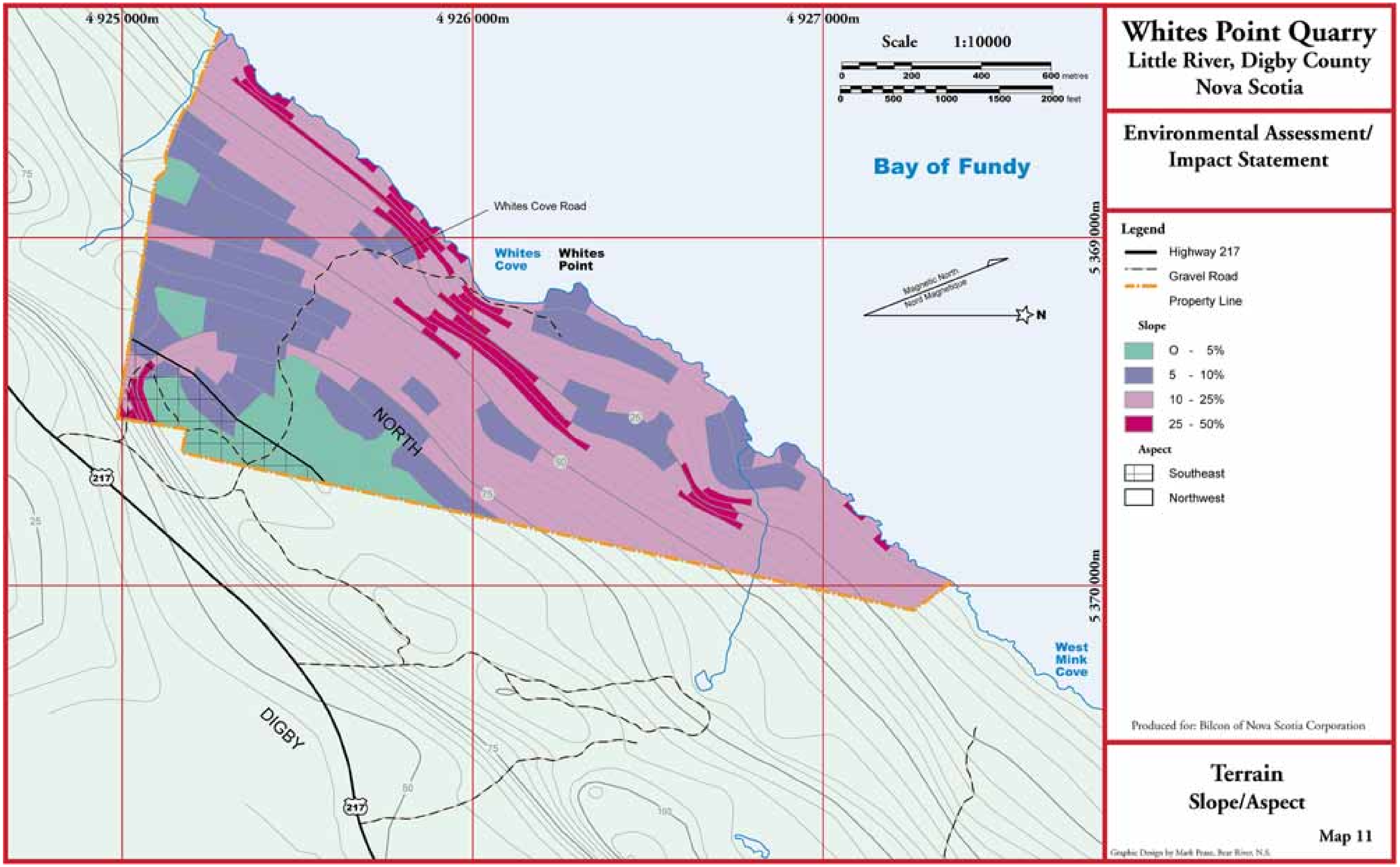
Produced for: Bilcon of Nova Scotia Corporation

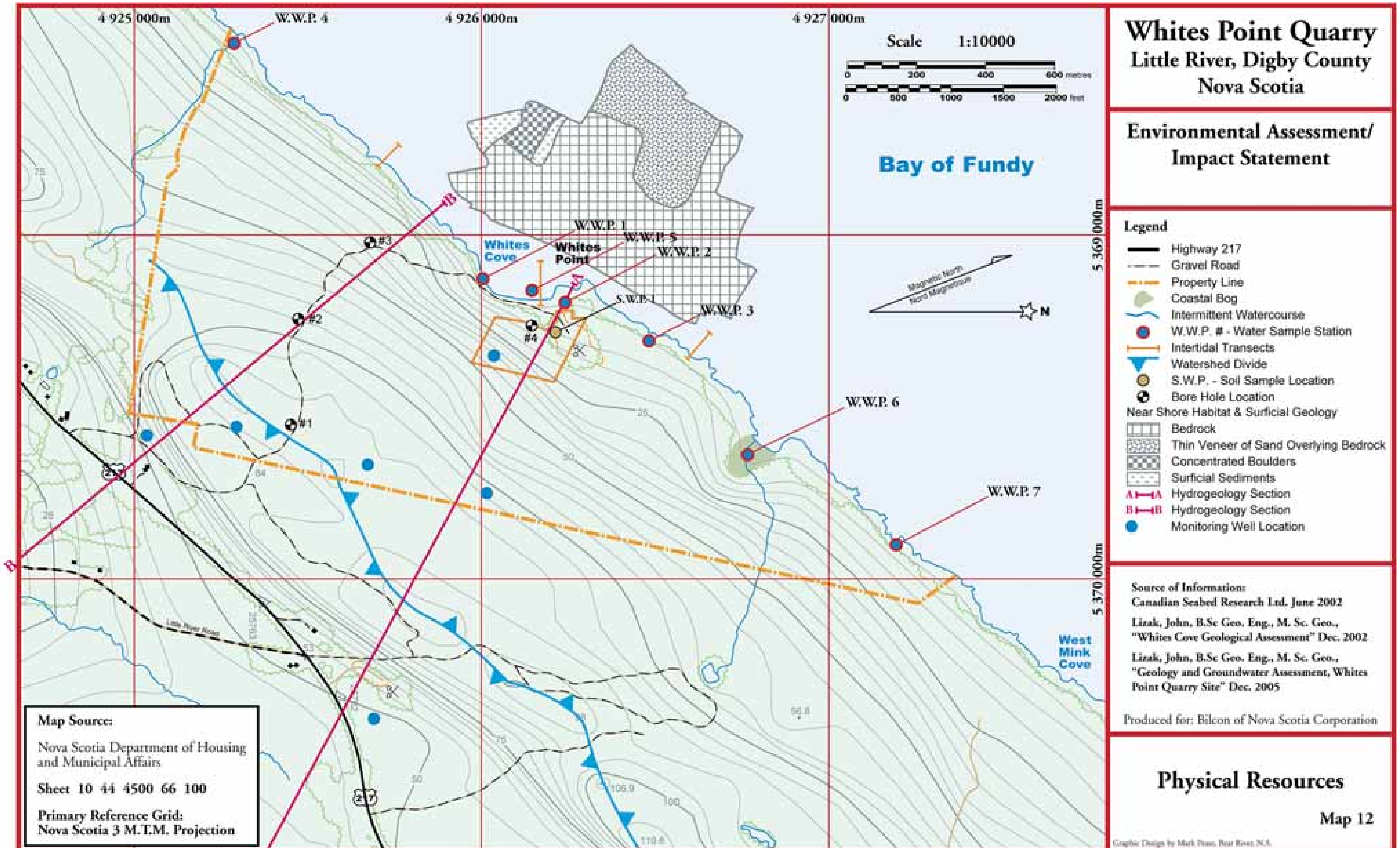
Digby Neck Soils

Map 9

Graphic Design by Mark Pease, Bear River, N.S.


Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Legend
Proposed Whites Point Marine Terminal
Proposed Shipping Route
Existing Shipping Lanes
New Shipping Lanes (2003)
Traffic Separation Zone
La Have Clay: silty clay/clayey silt: silty, sandy clay/clayey, sandy silt - grading locally to silty calyey sand (more than 20% sand).
Scotian Shelf Drift: glacial till; includes some stratified drift.
Subsurface deposits of La Have Clay underlying uppermost Sambro Sand. Occurs only in the Bay of Fundy.
Sambro Sand: Mainly silty and clayey sand with less than 10% gravel
Source of Information:
Canadian Steamship Lines International Inc. 2002 & 2003
Map Source:
Surficial Geology 4011-G
Eastern Gulf of Maine & Bay of Fundy
Produced for: Bilcon of Nova Scotia Corporation
Surficial Geology:
Bay of Fundy
Map 10
Graphic Design by Mark Pease, Bear River, N.S.
Bay of Fundy
Nova Scotia
New Brunswick
Grand Manan Island
St. Mary's Bay
Digby
Sandy Cove
East Ferry
Tiverton
Freeport
Westport
Weymouth
Belliveau Cove
Church Point
Saulnierville
Meteghan
N
Magnetic North
Scale 1 : 300,000
0 5 10 15 20 25 Kilometres
0 5 10 15 Miles
67° 00'
66° 40'
66° 20'
66° 00'
44° 50'
44° 40'
44° 20'


Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Legend
Highway 217
Gravel Road
Property Line
Slope
O - 5%
5 - 10%
10 - 25%
25 - 50%
Aspect
Southeast
Northwest
Produced for: Bilcon of Nova Scotia Corporation
Terrain
Slope/Aspect
Map 11
Scale 1:10000
0 200 400 600 metres
0 500 1000 1500 2000 feet
Bay of Fundy
Magnetic North
Nord Magnétique
N
4 925 000m
4 926 000m
4 927 000m
5 369 000m
5 370 000m
Whites Cove Road
Whites Cove
Whites Point
West Mink Cove
NORTH
DIGBY
217


Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Legend
Highway 217
Gravel Road
Property Line
Coastal Bog
Intermittent Watercourse
W.W.P. # - Water Sample Station
Intertidal Transects
Watershed Divide
S.W.P. - Soil Sample Location
Bore Hole Location
Near Shore Habitat & Surficial Geology
Bedrock
Thin Veneer of Sand Overlying Bedrock
Concentrated Boulders
Surficial Sediments
A—A Hydrogeology Section
B—B Hydrogeology Section
Monitoring Well Location
Source of Information:
Canadian Seabed Research Ltd. June 2002
Lizak, John, B.Sc Geo. Eng., M. Sc. Geo., "Whites Cove Geological Assessment" Dec. 2002
Lizak, John, B.Sc Geo. Eng., M. Sc. Geo., "Geology and Groundwater Assessment, Whites Point Quarry Site" Dec. 2005
Produced for: Bilcon of Nova Scotia Corporation
Physical Resources
Map 12
Graphic Design by Mark Pease, Bear River, N.S.
Scale 1:10000
0 200 400 600 metres
0 500 1000 1500 2000 feet
Bay of Fundy
Magnetic North
Nord Magnétique
N
4 925 000m
4 926 000m
4 927 000m
5 369 000m
5 370 000m
W.W.P. 1
W.W.P. 2
W.W.P. 3
W.W.P. 4
W.W.P. 5
W.W.P. 6
W.W.P. 7
S.W.P. 1
Whites Cove
Whites Point
West Mink Cove
#1
#2
#3
#4
A
B
217
Little River Road
Map Source:
Nova Scotia Department of Housing and Municipal Affairs
Sheet 10 44 4500 66 100
Primary Reference Grid:
Nova Scotia 3 M.T.M. Projection

9.1.1 Climate

9.1.1.1 Research

Precipitation and Temperature

Climatic data from two recording stations located on the Bay of Fundy was researched to establish regional baseline climate conditions. The Prim Point station in Digby County (44° 41' – N, 65° 47' – W) with records from 1965 to 1985 and the Meteghan River station in Digby County (44° 16' – N, 66° 08' – W) with records from 1937 to 1986 were used. Climatic conditions with seasonal variations for temperature and precipitation including rainfall and snowfall are presented in Appendix 14 .

Extreme daily rainfall and snowfall for the 1965 - 1985 period at Prim Point was 106.9 mm in June and 35.8 cm in January respectively. Extreme daily rainfall and snowfall for the 1937 - 1986 period at Meteghan River was 120.7 mm in July and 26.4 cm in February respectively. Highest total precipitation of 154 mm at Prim Point occurred in December and 138.2 mm at Meteghan river in December.

Extreme maximum temperature for the 1965 - 1985 period at Prim Point was 30 ° C in June and 30.6° C in August at Meteghan River. Extreme minimum temperature for the 1937 - 1986 period at Prim Point was – 22.2° C in January and –21.7° C in February at Meteghan River. The highest daily maximum temperatures occurring in August at Prim Point and Meteghan River were 21.2° C and 19.8° C respectively. The lowest daily minimum temperatures occurred in January at Prim Point and February at Meteghan River – 6.9° C and –6.8° C respectively.

Visibility

Canadian climate normals for the 30 year period (1971 – 2000) presents monthly averages for hours with visibility for distances less than 1 km., 1 to 9 km, and greater than 9 km. This data is from the Yarmouth station.

Hours with Visibility

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
<1 km	41.4	30.2	40.2	38.2	74.8	106.6	153.3	139.5	70.0	40.3	27.0	29.4	791.1
1 to 9 km	158.63	133.7	117.0	101.8	101.1	121.9	133.4	127.6	100.6	81.8	82.0	136.7	1396.1
>9 km	543.9-6	514.8	586.7	580.0	568.1	491.5	457.3	477.0	549.4	621.9	611.0	577.9	6579.5

The greatest number of hours (over 100) with less than 1 km of visibility occurs in the months of June, July, and August. The months with the greatest number of hours (over 600) with over 9 km of visibility occur in the months of October and November.

Greenhouse Gas

Some greenhouse gases (GHGs) occur naturally in the atmosphere, while others result from human activities. Natural GHGs include water vapour, carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). Other GHGs that are not naturally occurring in the atmosphere include hydrofluorocarbons (HFCs), perfluorocarbons (PECs), and sulphur hexafluoride (SF6) which are generated by a variety of industrial processes. These latter gases will not be used or produced at the Whites Point quarry. Based on the nature of the operations taking place at this quarry, carbon dioxide emissions will be the primary focus.

In Nova Scotia, more than 80% of greenhouse gas (GHG) emissions are caused by fuel consumption (Environment Canada 2002, Ref. 111). In the year 2000, GHG emissions by fuel consumption indicated that mining, next to the construction industry, contributed the least amount of all sources of GHGs. Following is the percent by use of GHG emissions from fuel consumption for Nova Scotia in 2000.

- Electricity and Heat Generation 45.5%
- Transport 30.4%
- Residential 9.3%
- Fossil Fuel Industries 5.1%
- Commercial and Institutional 4.7%
- Mining 0.3%
- Construction 0.1%
- Other 1.2%

9.1.1.2 Analysis

The Whites Point quarry and Marine Terminal will contribute to greenhouse gas emissions. Energy and fuel consumption will primarily consist of electrical energy for operation of the plant (crushing, conveying, screening, washing, loading) and fuel consumption for the mobile equipment. In this regard, the engine power of the equipment was used to determine the fuel consumption. Engine fuel consumption typically yields approximately 86 percent carbon which is directly related to the production of CO2. For the purpose of typical fuel consumption, the equipment was assumed to operate at 85 percent of its maximum power. Also, it was assumed that the equipment will be operational for 85 percent of the time under working conditions. The CO2 production at various stages of the operation and the overall tonnes/year of CO2 produced is presented in **Table GHG – 1.**

Table GHG – 1

Carbon Dioxide Production during Quarry Operations at Various Stages
Whites Point Quarry

Stage	Carbon Dioxide Produced (tonnes/year)
Primary	4119
Secondary	14,052
Fine Crushing	20,088
Washing Plant	32,863
Load Out	9,647
Heavy Diesel Vehicles x 3	997
Total	**81,766**

Source: Jacques Whitford 2005

9.1.1.3 Mitigation

The burning of brush during clearing activities for construction and over the life of the project is a common practice. In order not to contribute to emissions of gases such as carbon dioxide, methane, and nitrous oxide from burning, Bilcon of Nova Scotia Corporation proposes to chip and compost wood fibre resulting from land clearing. Chipping is a more costly process than burning, however, the environmental benefits from recycling the composted material as part of the land reclamation process will produce a more productive soil on the quarry site.

The first step in the utilization of carbon dioxide by living organisms is photosynthesis by green plants. In simple terms, green plants take-up carbon dioxide and, through photosynthesis, give off oxygen, and produce carbohydrates. Forests therefore contribute to the reduction of carbon dioxide through carbon dioxide uptake. In this regard, the Whites Point quarry will be developed in increments thereby conserving forest resources until required for quarry expansion. Reclamation will also be conducted incrementally and land will be reforested soon after the rock is extracted. Approximately 20 percent of the quarry site will be conserved in a preservation zone. Also, Bilcon of Nova Scotia Corporation intends to manage over 300 acres of buffer land adjacent to the quarry property as forest resource. This method of land management will greatly mitigate the production of GHGs from the quarry operation.

9.1.1.4 Monitoring

None proposed.

9.1.1.5 Impact Statement

Greenhouse Gas

Considering the inherent relative low production of greenhouse gas from quarry operations as compared to other sources, the amount of land to remain as forest resource over the life of the project, and the proposed reclamation procedures on the quarry site the result will be a ***long term, insignificant negative effect, of regional scale.***

9.1.2 Geology

9.1.2.1 Research

Much of the information on the regional geology has been excerpted from NSDNR Report of Activities 2001 published by D.J. Kontak titled "Internal Stratigraphy of the Jurassic North Mountain Basalt, Southern Nova Scotia". The North Mountain Basalt, typical of the site, has been subdivided into three units based on the nature of the basalt flows. The units are called the lower, middle, and upper flow units. The thickness of the upper flow unit reportedly varies from 0 to 154 m deep and has been subdivided into the columnar jointed lower part and the upper part which is more massive and often contains a honeycomb network of quartz veins. The middle flow unit is amygdaloidal, vesicular and zeolite rich in marked contrast to the massive, and generally vesicle-free, lower and upper flow units. The thickness of the middle flow ranges from 9 to 165 m and it contains 4 to 15 flows. The lower flow unit varies from 40 to 185 m and consists of one flow. The unit is a uniform textured, massive, holocrystalline basalt with well developed columnar jointing. The regional dip of the North Mountain Basalt is 3 to 8 degrees to the northwest and is offset at several locations by northeast trending right lateral faults.

Site geology was initially investigated and evaluated by Mineral Valuation & Capital Inc. – see Lizak, John, "Geological Assessment of the Whites Cove Site" December 2002 (Lizak 2002, **Ref. Vol. V, Tab 29**). The initial geologic assessment was primarily based upon the drilling program and field investigation that was conducted in the spring of 2002. Four core holes were drilled on-site in April and May of 2002 – see **Map 12.** All four holes were continuously cored to a depth from 35.0 to 74.5 m. All but one of the holes was drilled to a depth below sea level.

Field investigations were conducted with Dan Kontak, Ph.D., Regional Geologist with the NSDNR, Minerals and Energy Branch, the recognized expert on the North Mountain Basalt, in December 2004 and May 2005 to supplement the geologic information obtained from the drill holes. Dr. Kontak also examined, described, sampled, and tested the drill core. The primary objectives of the fieldwork were to delineate the structure and the stratigraphy of the upper and middle basalt flows and the contact between the units, and to further describe the physical, chemical, and hydrogeologic characteristics of the upper and middle basalt unit. Thirteen quarry operations in Nova Scotia and New Brunswick were also analyzed and/or inspected with NSDNR and NBDNR geology and quarry experts as part of the field investigation.

Six additional holes were drilled in September of 2005 and completed as monitoring wells – see Mineral Valuation & Capital Inc. "Geology and Groundwater Assessment – Whites Point Quarry Site". December 2005. **Ref. Vol. V, Tab 29.** The monitoring wells were drilled to depths ranging from 36.0 to 79.0 m.

Basalt bedrock samples from core #1 were laboratory analyzed by PSC Analytical Services for potential acid rock drainage. Three rock samples from depths of 5 m, 33 m, and 61 m were analyzed. Following are the analytical test results for acid rock drainage.

			SAMPLE		
Analyte	**Units**	**EQL**	**RWP-01-5**	**RWP-01-33**	**RWP-01-61**
Sulphate Sulphur	%(w)	0.001	0.001	0.003	0.001
Sulphide Sulphur	%(w)	0.03	nd	nd	nd
Max. Potential Acidity	ppt	1.0	nd	nd	nd
Neutralization Potential	ppt	1.	26	25	24
Net Neut. Potential	ppt	1.	26	25	24
Fizz Rating		-	None	Moderate	None
Leach, Aqueous Prep		0.01	5:1	5:1	5:1
PH Paste		-	9:3	9.8	9.3
Sulphur Sub	%(w)	0.020	0.020	nd	0.020

- The units for Maximum Potential Acidity, Neutralization potential and Net Neutralization Potential are : tonne $CaCO_3$ /1000 tonne.
- EQL = Estimated Quantitation Limit is the minimum concentration that can be reliably reported. It is not a regulatory limit.

  nd = Not Detected, instruments did not detect anything above standard EQL.

Basalt bedrock samples from core #1 were laboratory analyzed by PSC Analytical Services for baseline metals. Three rock samples from depths of 5 m, 33 m, and 61 m were analyzed – see Appendix 4 for analytical test results for metals in the bedrock.

The Digby Neck region is located within the Northern Appalachian Seismic Zone (NAN). Maps of seismic risk in the 1995 National Building Code of Canada by the Geological Survey of Canada show the area occurs within Zone 1 and is considered to have a low earthquake risk. Historically, earthquakes in the Digby Neck Region have been infrequent and of small magnitude. The nearest zone of earthquake activity is across the Bay of Fundy in the Passamaquoddy Bay region. The Oak Bay Fault is considered to be the site of the activity for that region. Two small earthquake epicenters have been reported to the northeast of Digby. Further, an assessment of the proposed quarry site was requested from the Geological Survey of Canada for evaluation against the 1995 National Building Code of Canada. Results of this assessment are contained in (Atlantic Marine Geological Consulting Ltd. 2005, **(Ref. Vol. 3, Tab 18**).

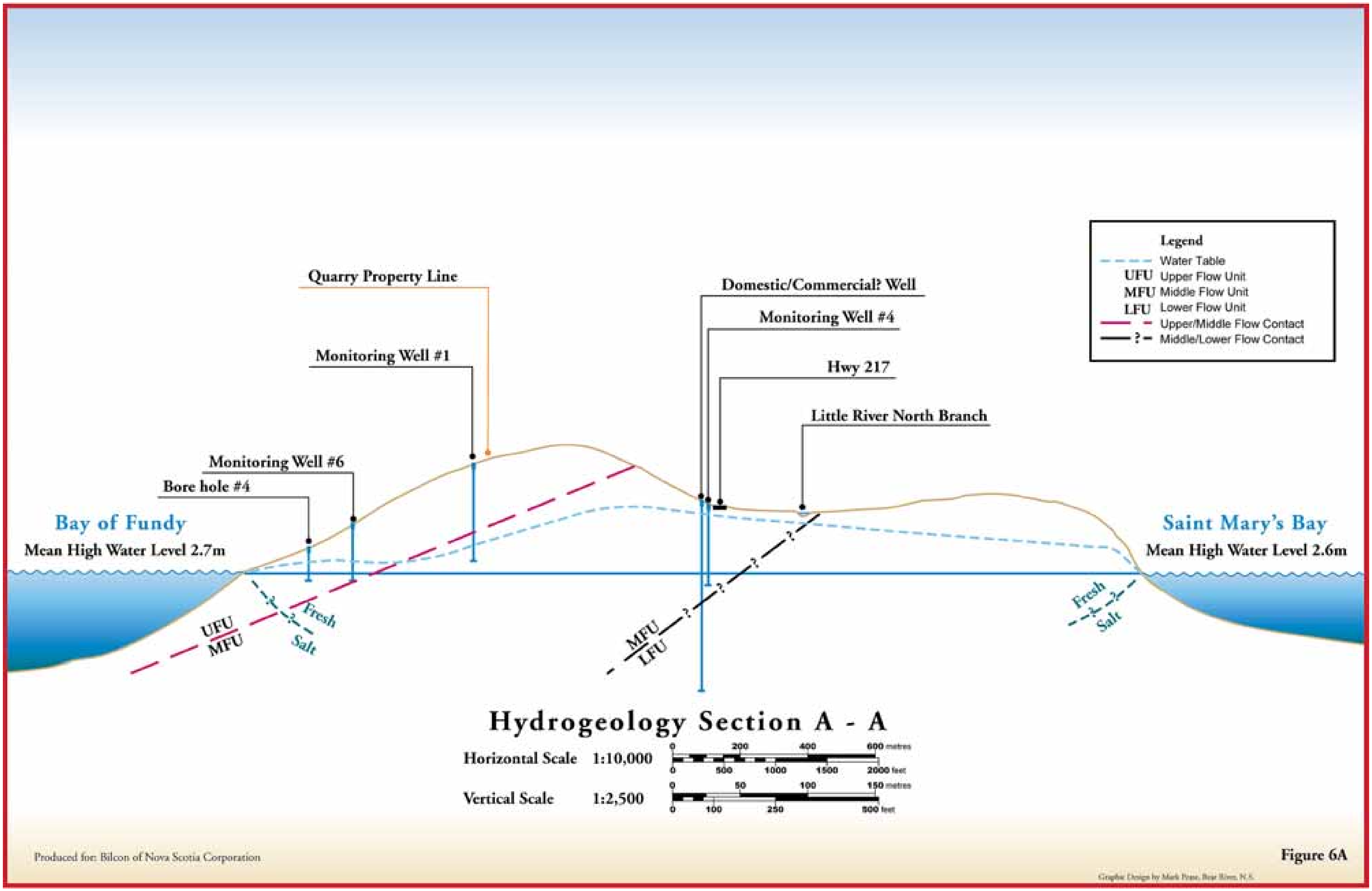
9.1.2.2 Analyses

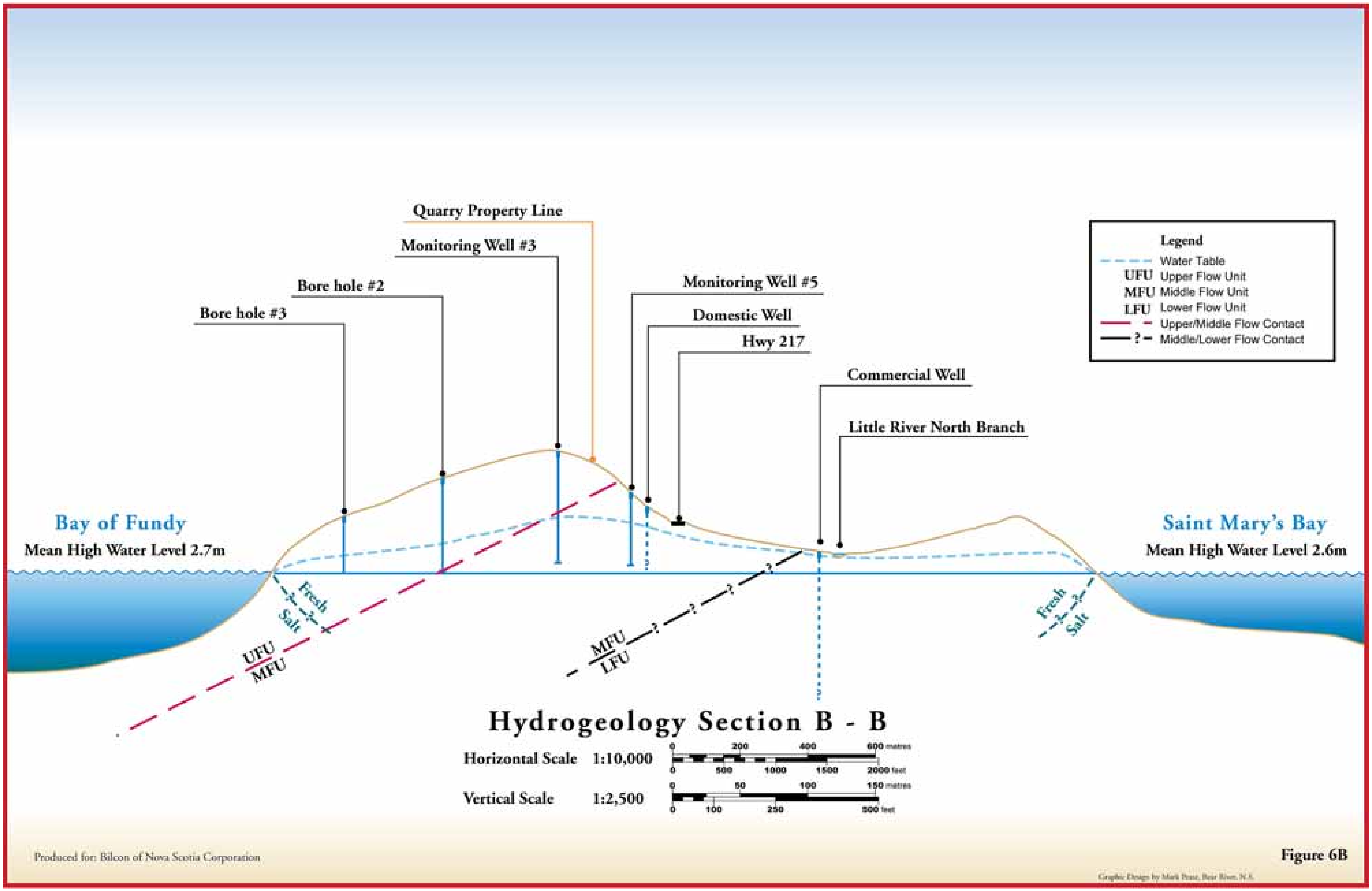
The drill data and the fieldwork confirm that the bedrock and the quarry at Whites Point will be comprised exclusively of the upper flow unit of the North Mountain Basalt. The upper flow unit (UFU) is a uniform, hard, massive, vesicle free, medium dark gray to black basalt. The unit attains a maximum thickness of approximately 76 m on the quarry site. It is virtually unweathered with vertical quartz veins observed in the upper third portion of the unit. Some of these veins showed red iron oxidation and some contained calcite. Minor vertical joints were occasionally observed in the basal portion of the upper flow unit, which may indicate the presence of a narrow, possibly lenticular band of columnar jointing. There is, however, virtually no communication between the joints due to the paucity of horizontal fractures and/or the sealing of the original fractures with secondary mineralization. The orientation, spacing, and sealing of the limited fractures in the basalt appear to be random and hence unpredictable.

The top portion of the middle flow unit (MFU) was penetrated by core hole #1 and #2 and monitoring wells #1, #2, and #3. In the southern part of the project area, the top part of the MFU consists of a medium dark gray to dark gray, vesicular, amygdaloidal, zeolite rich basalt with rust colored bands. The contact between the UFU and MFU is virtually indistinguishable on the northern part of the property because the vesicular, amygdaloidal zone is absent or isolated. Unlike the massive UFU, the vesicular, amygdaloidal, zeolite rich upper part of the MFU is not suitable for the production of construction aggregate.

The outcrop of the contact between the UFU and MFU is located along, or near, the southeast flank of the North Mountain (see **Figures 6A and 6B**). Consequently, the bedrock in the valley along Highway #217 is composed of the middle and lower flow units of the North Mountain Basalt. Unconsolidated, Quaternary aged glacial deposits and colluvium that range in thickness from 1m to over 50m purportedly overlie the bedrock in the valley along Highway #217.

On-site, the North Mountain Basalt dips approximately 6 degrees to the northwest and strikes northeast-southwest. Regional faulting is indicated on **Map 5 .** No evidence of unique geological features or faulting was observed on, or near, the Whites Point Quarry site.


Legend
Water Table
UFU Upper Flow Unit
MFU Middle Flow Unit
LFU Lower Flow Unit
Upper/Middle Flow Contact
? Middle/Lower Flow Contact
Quarry Property Line
Monitoring Well #1
Monitoring Well #6
Bore hole #4
Domestic/Commercial? Well
Monitoring Well #4
Hwy 217
Little River North Branch
Bay of Fundy
Mean High Water Level 2.7m
Saint Mary's Bay
Mean High Water Level 2.6m
UFU
MFU
Fresh
Salt
MFU
LFU
Hydrogeology Section A - A
Horizontal Scale 1:10,000
Vertical Scale 1:2,500
Produced for: Bilcon of Nova Scotia Corporation
Figure 6A



Quarry Property Line
Monitoring Well #3
Bore hole #2
Bore hole #3
Monitoring Well #5
Domestic Well
Hwy 217
Commercial Well
Little River North Branch
Legend
Water Table
UFU Upper Flow Unit
MFU Middle Flow Unit
LFU Lower Flow Unit
Upper/Middle Flow Contact
? Middle/Lower Flow Contact
Bay of Fundy
Mean High Water Level 2.7m
Saint Mary's Bay
Mean High Water Level 2.6m
Fresh
Salt
UFU
MFU
MFU
LFU
Hydrogeology Section B - B
Horizontal Scale 1:10,000
Vertical Scale 1:2,500
0 200 400 600 metres
0 500 1000 1500 2000 feet
0 50 100 150 metres
0 100 250 500 feet
Produced for: Bilcon of Nova Scotia Corporation
Figure 6B

In referring to the extensive outcrop of the upper flow unit of the North Mountain Basalt at Whale Cove, approximately 4 km from the proposed quarry at Whites Point, the statement was made " The exceptionally massive and fresh nature of the UFU here and its location on high-tide water level makes this an excellent location for aggregate production and the Whites Cove area just to the north of here is being examined for such purpose (as of spring 2005)" (Kontak et al 2005 Ref. 129, Page 112).

Additionally, physical and chemical laboratory tests indicate the proposed quarry site at Whites Point contains a large reserve of high quality construction aggregate material. The site contains in excess of 100 million tons of in-place stone which is ideally suited for quarrying and processing for the construction industry.

Sulphide sulphur was not detected at EQL 0.03 at various depths in core sample #1 nor was maximum potential acidity detected in the samples analyzed. Further, net neutralization potential at EQL 1. ranged from 24 – 26 ppt in the samples. Acid slates are not known to exist on the quarry property. Based on this data and research conducted by NSDNR, acid production will not occur on the site during, or after, quarrying of basalt rock.

As expected, the basalt parent material is rich in iron and aluminum as indicated by the 14,000 – 24,000 mg/kg of aluminum and the 20,000 to 23,000 mg/kg of iron in the rock samples – see Appendix 4 . Iron and aluminum in combination with organic matter have certain beneficial effects on soil structure and cation-exchange capacity (Hilchey 1969, Ref. 121). Thus, it is likely that the release of the iron and aluminum during the rock processing could benefit overall soil productivity when sediments are mixed with stripped, stockpiled, and composted organic material and spread during the reclamation process of the quarry site.

Quarrying of the upper flow unit and the related activities will not adversely impact the bedrock stability, the thermal regime, or the infrastructure within and near the Whites Point site. The evidence to support this conclusion comes from the investigation of local and Provincial quarries, assessments of local infrastructure and construction projects and the physical and chemical characterization of the surficial material and bedrock.

The upper flow unit is a uniform, hard, massive, stable basalt with an extremely high compressive strength, which is one of the reasons it is an advantaged source of construction aggregate. Bedding is absent and fracturing is absent or, at most, moderately developed and typically filled with secondary mineralization. As a result, the porosity and permeability are secondary and low. The unit is also resistant to weathering, is stable, has good cut slope stability, and is able to stand in steep cuts. The upper flow unit makes a good quality foundation for heavy structures. Blasting will not reduce the stability of the bedrock beyond the quarry face.

Quarrying and the related activities will not adversely impact the local infrastructure. The quarrying activities will be limited to the Whites Point site and, unlike other County projects, there will be no increased use of the land based infrastructure. Because there will be no quarry pumping or offsite discharge, the proposed activities will not contribute to frost heaving. Overall, quarrying will have less of an impact on the local infrastructure than the residential, non-residential building (schools, factories, hospitals, etc.) and non-building activities (roads, bridges, etc.) occurring in the area.

Concern about impacts on the thermal regime is typically limited to permafrost regions. The permafrost table may shift upward or downward, sometimes with undesirable consequences, when the thermal regime is upset by natural factors or human activities. However, because there is no permafrost, ground ice, or unusual geothermal activity (geothermal hotspots, underground mine fires, etc.) in the area, quarrying will not impact a permafrost zone or the thermal regime.

9.1.2.3 Mitigation

Quarrying will result in the removal of approximately 100 million tons of naturally occurring basalt rock over the 50 year life of the project, which will then be processed into a high quality, value added construction industry product. This natural geologic resource will be irretrievably lost from the site. Site clearing or opening of new areas within the quarry will proceed in a northerly and southerly direction from the Whites Cove Road. Approximately six acres will be cleared each year with reclamation beginning within five years of operation. This procedure will maintain existing habitat until required for quarrying and begin the reclamation of quarried areas concurrently with quarrying and before exhaustion of the rock resources. Details of the reclamation procedure are contained in **paragraph 7.10** .

No excavation is planned to be carried out below sea level. The floor of the quarry will not extend below the contact of the upper and middle flow units due to the marginal quality of the rock in the middle flow unit. Upon completion of quarry operations, the site will be totally reclaimed to enhance biological productivity and diversity as well as site graded for future development. During quarrying, the floor of the quarry will be sloped toward the working face. Surface water will be retained in this area, and be channeled to the sediment retention ponds.

9.1.2.4 Monitoring

Monitoring of surface water discharges, water quality in receiving marine waters, noise and vibration from blasting, general noise, ground water levels and quality, air borne particulates, and selected biological parameters is proposed by Bilcon of Nova Scotia Corporation. Details of specific monitoring procedures are presented in subsequent environmental component sections of this document.

9.1.2.5 Impact Statement

Basalt Rock

Quarrying will produce a site specific irretrievable loss of approximately 100 million tons of naturally occurring basalt rock and would result in a ***long term, insignificant negative effect, of local scale.***

9.1.3 Hydrogeology

9.1.3.1 Research

Non-intrusive hydrogeological investigations including literature research of the region and of the site and immediate area were conducted during September 5 – 10, 2002 by Jacques Whitford Environment Ltd. – see Hogg, Dwayne, M.Sc. P.Eng. and MacFarlane, David M.Sc. P. Geo. "Preliminary Hydrogeological Assessment, Proposed Quarry, Whites Cove, Digby Neck, Nova Scotia" December 2002 (**Ref. Vol V, Tab28**). The North Mountain Basalt is a groundwater aquifer on Digby Neck and the following research focuses on the hydraulic properties of the aquifer, ground water quantity, and ground water quality.

Regional hydraulic properties of the aquifer are based on hydraulic testing data from the Nova Scotia Department of Environment and Labour pumping test inventory for the Digby area. Based on ten pumping tests in basalt between Halls Harbour and Digby Neck, the basalt aquifer has an apparent transmissivity of 0.27 to 78.8 m^2/d, with a geometric mean of 5.75 m^2/d. Hydraulic testing suggests a safe sustainable well yield of 1.3 imperial gallons per minute (igpm) to 94 ipgm with a geometric mean of 14.4 ipgm for wells ranging in depth from 22.9m to 141.7m for a mean depth of 71.6m.

Review of 32 available well logs, primarily for domestic demand and excluding deep wells (greater than 120m) for fish plants in the Mink Cove and Little River area indicates a poor correlation between well depth and yield (R=0.11). In this area the higher yield wells are between depths of 25m to 30m and 50m to 55m with a mean well yield of 37 L/min (8.2gpm). Also, review of 72 well logs over a larger area from Lake Midway to Tiddville indicates a similar poor correlation (R=0.24). Again the higher yield wells occur between depths of 25m to 30m and 50m to 55m. Yields increase significantly at depths exceeding 107m upon penetration of the underlying Blomidon Shale Unit.

More specifically, the Nova Scotia Department of Environment and Labour well records for drilled water wells located within and between the communities of Little River and Mink Cove were reviewed. Information on 47 drilled water wells is recorded for this area. Well depths range from 18 to 277 m with a median depth of 55 m. Well yield ranged from 0.2 igpm to 65 igpm with a median yield of 7 igpm. It should be noted that these are not all inclusive of residential water sources for this area and many shallow wells or unrecorded drilled wells probably exist.

On-site water samples and water measurements were attempted in the four existing bore holes – see **Map 12.** Three of the four bore holes apparently had been vandalized and obstructions prevented access to the full depth of the holes. Only bore hole #1 could be made accessible to measure the depth to the existing water table. The measured depth to water in bore hole #1 was 53.0 m, inferring an existing ground water elevation of 35.9 m.

Water samples were taken from bore hole #1. Samples were collected in laboratory furnished bottles and analyzed for general chemistry and trace metals by PSC Analytical Services Ltd. Analytical results are contained in Appendix 45.

Subsequent to the initial preliminary hydrogeological investigations (Jacques Whitford Environmental Ltd. 2002, **Ref. Vol V, Tab 28**), comprehensive field investigations of the local geology and hydrogeology of the Whites Point site were conducted – see Mineral Valuation & Capital Inc. "Geology and Groundwater Assessment – Whites Point Quarry Site". December 2005 **Ref. Vol V, Tab 29.** This investigation included:

- The drilling and analysis of six groundwater monitoring wells
- Surveying the location of domestic and industrial well locations adjacent to the quarry property
- Consultation with provincial mining and hydrogeology experts
- Inspection and/or analysis of thirteen quarry operations in Nova Scotia and New Brunswick

Six monitoring wells were drilled in September 2005 – see **Map 12.** The wells were drilled to determine if the quarry operation will affect groundwater quantity or quality and to acquire additional data on groundwater chemistry, the water table, local aquifer characteristics, etc. Two monitoring wells were drilled in the midst of the neighbouring residential wells to directly monitor any effect of the quarry or other adjacent industrial water use on the local groundwater supply. Step down "air blow" tests and recharge tests were conducted to estimate the yield of the hydrostratigraphic units, the aquifer characteristics, etc. A program to routinely measure and record water levels and precipitation was implemented.

In anticipation of conducting a pre-blast survey as required by the Nova Scotia Department of Environment and Labour's "Procedure for Conducting a Pre-Blast Survey", November 1993, domestic and industrial wells adjacent to the quarry property were located. Horizontal coordinates and vertical elevations for 24 active wells were recorded.

Prior to this survey, Bilcon of Nova Scotia Corporation sent a letter to adjacent property owners requesting permission to do this work. All but one property owner agreed to the survey. The survey was conducted by a licensed Nova Scotia land surveyor and the wells were located with the help of the property owners. Twenty-four wells were located, 17 drilled wells and 7 dug wells.

9.1.3.2 Analyses

Using the above research data and relevant data contained in the previous Geology section, some comments can be made concerning potential influences the proposed quarry may have on surrounding residential water supplies. As previously stated, a local ground water source occurs in the basalt aquifer continuously along Digby Neck. However as previously stated, a poor correlation exists between recorded well depths and yield in the immediate area. Most of the original fracture permeability of the basalt has been lost due to secondary mineralization. Groundwater flow occurs primarily along horizontal discontinuities between lava flows with very limited flow along vertical discontinuities. The columnar joints transmit minimal, if any, amounts of groundwater. As a result, the massive upper and lower flow units are relatively tight. Groundwater flows mainly through the horizontal to sub-horizontal fractures located along contacts between flows in the middle unit. In general, the highest well yields are expected from the middle flow zone and poor well yields are expected in the upper and lower flow units.

Water table data was obtained from the existing core holes, the six monitoring wells and neighbouring wells. The ground water regime and the hydrostratigraphic units are shown on **Figures 6A** and **6B**. The two cross-sections - **see Map 12** - depict a "snapshot" of the water table, the hydraulic gradient etc. in the fall of 2005. The data show that the local water table mimics the topography and it is at or near the surface in the valley along Highway #217 and deep below the surface under the North Mountain.

The seventeen drilled wells in the surrounding area of the proposed quarry are completed in different hydrostratigraphic units than the quarry – see **Map 2.** Quarrying will occur in the upper flow unit of the North Mountain Basalt, whereas the neighbouring drilled wells are constructed in the middle or lower flow units of the North Mountain Basalt, or in the deeper Blomidon Formation. Five (Nos. 1, 8, 13, 16, and 19) of the seventeen drilled wells in this area have records. Yields from these wells ranged from 1.2 to 10 gpm. Since only five of the wells have records, other residences are expected to be served with either pre-1965 drilled wells, non-registered wells, dug wells, or springs.

It was concluded that "The Whites Point quarry will not adversely impact the quantity or quality of the groundwater supply or the local wells" (Mineral Valuation & Capital Inc. 2005). This conclusion is based on analysis of the local geology, the local hydrogeology, the monitoring well data, the quarry's operating parameters and relevant case studies and quarry investigations. The salient evidence is as follows:

- Quarrying and local water production will occur in different geologic horizons or hydrostratigraphic units. Quarrying will take place in the upper unit of the North Mountain Basalt, whereas the neighbouring drilled wells are completed in the middle unit of the North Mountain Basalt, the lower unit of the North Mountain Basalt, and the Blomidon Formation. The neighbouring dug wells appear to be completed in unconsolidated glacial and colluvial deposits.

- The neighbouring domestic and industrial wells are located hydraulically down-gradient of the quarry and/or on opposite sides of the groundwater divide that is near the crest of the North Mountain. The recharge and discharge areas for the quarry and the neighbouring wells are also located in different watersheds on opposite sides of the divide. The recharge area for the neighbouring wells is in the valley not the quarry area. Consequently, the quarry will not adversely impact the relevant recharge regime.

- Quarrying will be carried out above the natural water table. Consequently, mine dewatering and pumping will not be needed and there will be no groundwater withdrawal or drawdown. Bilcon will essentially be dry mining. Quarrying will be a non-consumptive use because none of the water that enters the relevant watershed will leave the watershed as a result of the proposed activity.

- Blasting will not impact the groundwater supply. Agencies such as the U.S. Bureau of Mines, the Montana Bureau of Mines & Geology, etc. have done studies to evaluate the effects of blasting on groundwater supplies and wells. These studies have investigated, among other things, the issues of blasting residue and groundwater chemistry, water well stability and turbidity, yield, etc. No change in groundwater quality or quantity was observed in these studies as a result of blasting in comparable mines.

- Analysis of core hole No. 1 – see Appendix 43 and groundwater samples indicates that the chemistry of the basalt, the groundwater, and the surface water is excellent. The basalt will provide an electrochemically neutral, naturally soft, low total dissolved solids, calcium-magnesium bicarbonate groundwater of very good chemical quality. All parameters except occasional manganese can be expected to meet the "Guidelines for Canadian Drinking Water Quality" (2001).

- Construction aggregate operations have been used to enhance recharge via artificial surface recharge. Quarrying at Whites Point may enhance the local groundwater regime by increasing stormwater retention and aquifer recharge.

- The quarry will not cause saltwater intrusion. Quarrying will occur well above sea level and the freshwater-saltwater interface. No quarry pumping will take place. Construction aggregate mines have been used in coastal areas to prevent saltwater intrusion. The quarry could be part of a long term, comprehensive strategy to protect the local water supply from the seawater intrusion that could result from the unregulated pumping from the deep industrial wells in the area.

9.1.3.3 Mitigation

Due to the lack of water well data for residential wells in the immediate area of the quarry, a pre-quarrying survey of water quality of neighbouring properties is proposed by Bilcon of Nova Scotia Corporation. The survey would be done in consultation with the Nova Scotia Department of Environment and Labour according to their guidelines "Procedure for Conducting a Pre-Blast Survey" November 1993, to establish baseline water quality data. This would include analysis of bacteriology, general chemistry, and trace metals. Six new ground water wells have been drilled – see **Map 12**, and these together with the four existing bore holes will be used to monitor water table levels as quarrying proceeds. In any event, Bilcon of Nova Scotia Corporation will replace, at their expense, any existing water supply, identified as lost or damaged as a result of their quarrying operation.

9.1.3.4 Monitoring

An on-site groundwater monitoring program was selected based on the following rationale:

- On-site and adjacent property groundwater data is essential for establishment of reliable, pre-project baseline conditions of groundwater quantity and quality.

- On-site and off-site monitoring will ensure and further demonstrate that there will be no diminution in groundwater quantity or quality.

A comprehensive groundwater monitoring program was initiated in the fall of 2005 in accordance with the recommendations of Provincial experts. The design and construction of six monitoring wells will allow implementation of a multi-level monitoring program from discreet depths and geologic horizons. The objectives of the monitoring program are to:

- Demonstrate that the quarry project will not diminish the quality or quantity of the neighbouring groundwater supply.

- Acquire additional data on groundwater chemistry, the water table, the local aquifer characteristics etc.

- Address the groundwater issues raised by the neighbours and educate the public about the nature of the local groundwater supply, well design, well maintenance etc.

- Provide a failsafe, early detection system should groundwater issues arise that are not related to Bilcon's quarrying activities.

Precipitation measurements are being recorded concurrently with water level measurements.

Pump or aquifer testing is not proposed as part of the monitoring program since quarrying will be limited to the upper flow unit. This flow unit is tight and it is deemed impractical and unnecessary to pump test a unit that yields less than 1 imperial gallon per day. As well, Bilcon will be "dry mining" above the natural water table. Pump tests could be conducted at wells drilled into the middle flow unit. However, quarrying will not occur in, or impact, this unit.

Water quality monitoring will be performed by Bilcon of Nova Scotia Corporation on an annual basis for bacteriology, general chemistry, and trace metals. Summary reports of groundwater levels and water quality will be provided to the Nova Scotia Department of Environment and Labour monthly during operation of the quarry.

Public participation is proposed to continue during quarry construction and operation. Bilcon of Nova Scotia Corporation intends to re-establish the Community Liaison Committee (CLC) that was established as a result of the permitting of the 4 hectare quarry at the Whites Point site in 2002. In this regard, two neighbours with wells, adjacent to the quarry property will be invited to participate on this committee and be involved with the water well monitoring program.

9.1.3.5 Impact Statements

Residential Water Well Quantity and Quality

Well water quantity and quality in neighbouring, existing wells will not be affected since the location of the wells occur in different geologic horizons or hydrostatigraphic units than those being quarried; the existing wells are located hydraulically down gradient of the quarry and/or on opposite sides of the groundwater divide; quarrying will be carried out above the natural water table with no groundwater withdrawal or drawdown; and blasting at comparable quarries indicates no change in groundwater quantity or quality; thus resulting in a ***long term, neutral (no) effect, of local scale.***

9.1.4 Surficial Geology and Soils

9.1.4.1 Research

The surficial geology of Digby Neck is shown on **Map 8.** The glacial deposit overburden along Digby Neck is mapped as the Basalt Till Facies of the Beaver River Till Unit (Stea 1992, Ref. 169). The Basalt Till Facies consists of yellowish grey, loose, sandy tills with many boulders, sand rims around clasts and inclusion of older tills. The Beaver River Till is generally thin (1 – 10 m thick) and mantled over bedrock topography.

Geochemistry of the Beaver River Till–Basalt Till Facies is contained in Table SG–1. The closest samples 341A and 342A are located near West Mink Cove and Whale Cove respectively. Chemical analysis of these samples are contained in Table SG – 2.

Table SG - 1

Glacial Geology – Geochemical Summary Statistics
Beaver River Till – Basalt Till Facies
N = 5

Element	**Mean** Standard Deriviation	Range **(95th percentile)**
Cd	**.16** .09	.10 - .30 **.30**
Ag	**.31** .26	.05 - .70 **.72**
Cu	**131** 54	80 - 218 **218**
Pb	**10** 4	4 - 15 **22**
Zn	**53** 11	40 - 70 **71**
Ni	**24** 8	17 - 37 **37**
Co	**22** 8	14 - 36 **37**
Mo	**3** 7	2 - 4 **5**
U	**2.3** .7	1.6 - 3.1 **3.6**
Sn	**10** 7	1 - 20 **24**
W	**5** 8	1 - 20 **22**
As	**10** 5	3 - 16 **47**

Source:Province of Nova Scotia - Department of Mines and Energy, 1982

Note: N = number of samples
All values in ppm

Table SG - 2

Glacial Geology – Geochemical Analysis
Beaver River Till – Basalt Till Facies

Element	Sample No. 341A	Sample No. 342A
Cd	.10	<2.0
Ag	.70	.40
Cu	80	107
Ni	20	37
Pb	15	4
Zn	52	70
Co	19	36
Fe%	3.75	5.50
Mn	1000	1000
Ca	3800	12800
Mg	14800	40000
Mo	3	2
U	2.80	1.60
As	16	3
Sn	10	20
W	<2	<2
Depth (m)	1.0	1.0

Source: Province of Nova Scotia – Department of Mines and Energy, 1982

Note: All values in ppm except Fe%

The entire 380 acre quarry site is comprised of the Rossway Series of soils-see **Map 9.** Rossway soils occupy 36,474 acres in Digby County which is 5.4% of the total area of Digby County. The parent material of these soils is a yellowish brown cobbly sandy loam till derived from basalt that is thin and stony. The subsoil is a dark yellowish brown sandy loam and the surface soil is dark grayish brown sandy loam. The soils are stony and well drained with internal drainage medium to rapid. Limiting factors from an agriculture standpoint include extreme stoniness, rock outcrops, and a generally shallow soil occurring on 16% to 30% slopes. Rossway soils in Digby County are chiefly forested and where the soils are thin, as on the site under study, vegetation is stunted.

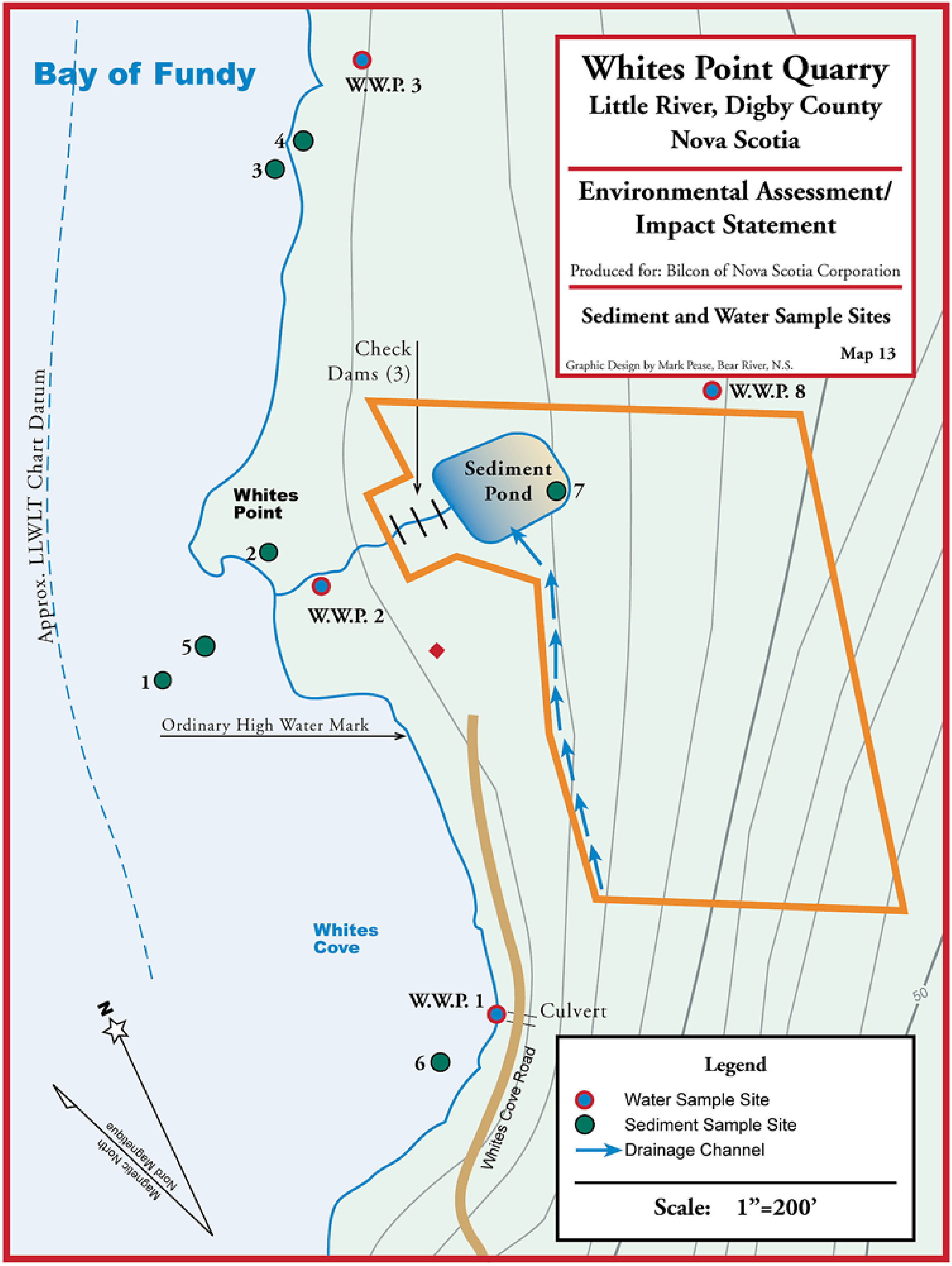
Site specific soil samples were taken on May 22, 2002 for analysis regarding site reclamation requirements and again on June 4, 2002 for analysis regarding available metals and BTEX/TPH MUST – Hydrocarbons for baseline data. The sampling site location (S.W.P. 1) is shown on **Map 12** and analytical data contained in Appendix 38 .

In the spring of 2003, a sediment retention pond was constructed to collect surface water runoff and sediments from a four hectare quarry site. Part of the four hectare quarry site was subsequently cleared of vegetation and grubbed. On July 14, 2005 a sediment sample was taken by Michael Brylinsky, PhD at sediment sample site 7 as shown on **Map 13**. The objective of this particular sample was to document any sediment contamination levels, sediment carbon content, and sediment particle size from the land disturbance caused by the grubbing of the four hectare quarry site.

9.1.4.2 Analyses

On-site soil analysis was conducted to determine baseline pH, nutrient levels, and minerals available in relation to site reclamation requirements. Prior to quarrying, the usable organic and soil layers will be removed and stockpiled for future reclamation use. Also, sediment accumulation from the on-site sediment retention ponds and from the high rate thickener will be recycled as part of the reclamation process. Dyked, stockpile areas are proposed for organic material and sediment disposal. Each area is approximately 30 acres, and is located on recently clear cut portions of the quarry site – see **Plan OP-1** Dykes will contain the wet sediment materials until dry enough to be mixed with the organic material for site reclamation. Likewise, the organic disposal area will be dyked to contain any runoff from this disposal area. Spreading and grading of these soil sources over the quarry floor and benches will be carried out and lime and fertilizer incorporated into the soil, based on the soil test results.

The soil tests taken indicate low pH levels (5.5), relatively high organic matter (18%), very low phosphorus, medium potassium, very low calcium, and high magnesium. After incorporation of the required soil amendments, hydro-seeding and selected planting/ reforestation will be conducted. Due to the thin mantle of till overlying bedrock on the site, the occurrence of land slides, slumping, creep, mudflows, or debris flow is highly unlikely.



Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Produced for: Bilcon of Nova Scotia Corporation
Sediment and Water Sample Sites
Map 13
Graphic Design by Mark Pease, Bear River, N.S.
Bay of Fundy
Approx. LLWLT Chart Datum
W.W.P. 3
4
3
Check
Dams (3)
W.W.P. 8
Sediment
Pond
7
Whites
Point
2
W.W.P. 2
5
1
Ordinary High Water Mark
Whites
Cove
W.W.P. 1
Culvert
6
Whites Cove Road
50
N
Magnetic North
Nord Magnétique
Legend
Water Sample Site
Sediment Sample Site
Drainage Channel
Scale: 1”=200’

The sediment sample taken from the existing sediment retention pond on the four hectare quarry site was analyzed by Maxxam Analytics Inc. – see Appendix 36**.**

Particle size composition for this sample was documented as 50% sand, 36% silt, 14% clay, and 0% gravel. Polychlorinated biphenyl (PCBs), polyaromatic hydrocarbons (PAHs) and organochlorinated pesticides were not detected at 0.01 concentration, detection level. Also, this sample was analyzed for levels of metals (cadmium, copper, lead, mercury and zinc). Levels of metals were compared to the Canadian Council of Ministers of the Environment (CCME) 1999 interim freshwater sediment quality guidelines.

All metals except copper were below the interim sediment quality guidelines (ISQG) and the probable effects level (PEL). Copper levels were 52 mg/kg which is greater than the ISQG level of 35.7 mg/kg^{-1} but less than the PEL of 197 mg/kg^{-1}. This level of copper is typical for this area and similar to the background geochemical analysis of the Beaver River Till (see Table SG-2) which ranges from 80 to 107 mg/kg at sample sites at nearby Whale Cove and West Mink Cove.

Also, copper levels taken at various depths in the bedrock indicated background levels ranging from 27 to 170 mg/kg at the estimated quantitation limit (EQL) of 2 mg/kg.

In summary, PCBs, PAHs, and organochlorinated pesticides were not detected in the sediment pond sample. The only metal to exceed the ISQG was copper which has high naturally high levels in this region (Province of Nova Scotia – Department of Mines and Energy, 1982 Ref. 157).

The "Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health – 1999 (Ref. 41), presents guidelines specifically for protection of the ecological receptors in the environment and for the protection of human health associated with identified land uses. These guideline levels are intended to provide a healthy, functioning ecosystem capable of sustaining the current and likely future uses of the site by ecological receptors that sustain normal activities on four categories of land uses (agriculture, residential/parkland, commercial, and industrial). Soil quality, relative to human health, will be presented in a subsequent section of this document.

9.1.4.3 Mitigation

The incremental reclamation procedure planned for the quarry operation will minimize the exposed land susceptible to erosion. Much of the site will remain undisturbed for many years. By beginning reclamation after only approximately five years of operation, the land area susceptible to erosion will be reduced. Also, recycling of soils for use in the site's reclamation process, incrementally, as the quarry operation proceeds, will use the existing resource. The addition of organic compost and other amendments will produce a healthier soil regime than previously existed and in turn support healthier vegetation.

9.1.4.4 Monitoring

Soil tests indicate additives are needed for a healthy soil regime. After spreading and grading of existing soil resources, soil tests will again be taken on the specific soils to be reclaimed. Amendments will be added to meet soil pH and fertility requirements and to ensure soil quality guidelines for the protection of environmental and human health for the particular land use are met.

9.1.4.5 Impact Statement

Soil Resource

Recycling of the existing soil resource and adding required soil nutrients necessary for a healthy soil regime will result in a ***long term, insignificant positive effect, of local scale.***

9.1.5 Little River Watershed

9.1.5.1 Research

The Whites Point Quarry property is located primarily within the Bay of Fundy watershed which stretches from East Ferry to beyond Sandy Cove. Twenty-one acres of the proposed 380 acre quarry, located in the southeast corner of the property, lie in the Little River watershed. The Little River watershed has two main branches – one to the south of the Little River estuary and one to the north of the Little River estuary. The south branch watershed comprises approximately 2,600 acres from Harris Lake to the head of the Little river estuary and the north branch watershed comprises approximately 415 acres from the head of the Little River estuary to the watershed divide. The Little River watershed comprises approximately 3,015 acres.

Land use in the Little River watershed is mainly residential. The highest density of residential development is in the community of Little River (but there are other resource industry land uses such as agriculture, forestry, and the fishery). The Little River watershed is interspersed with lakes and wetlands as shown on **Map 14.** Several "important freshwater wetlands" are designated by the Nova Scotia Department of Natural resources in their Wetlands Atlas in the south portion of the Little River watershed as shown on **Map 15.** These freshwater wetlands provide important habitat for wildlife, act as flood controls, protect subsurface water resources, remove water pollutants, control erosion and provide recreational, educational and scientific opportunities. The wetlands in the Little River watershed are scored from 65 – 79.5, out of a scoring range of 37 – 108, as to their value to wildlife by the Nova Scotia Department of Natural Resources.

Records of endangered plant species, (personal comm. R. Newell), exist for the south portion of the Little River watershed.

Guem peckii – Eastern Mountain Avens is a disjunct plant species found at only six sites in Digby Neck and Brier Island. It is listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and as endangered in 2000 as a wildlife species protected under the Endangered Species Act in Nova Scotia. One of the six records is from the Harris Lake area, all other records are from Brier Island. *Lophiola aurea* – Golden Crest is listed as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in May 2000. This plant is found in the Little River watershed in the Tiddville area at a former mine site.

Both plants are wetland plants and both are recorded from the southern portion of the Little River watershed before it flows into the Little River estuary and then into Saint Mary's Bay.

9.1.5.2 Analysis

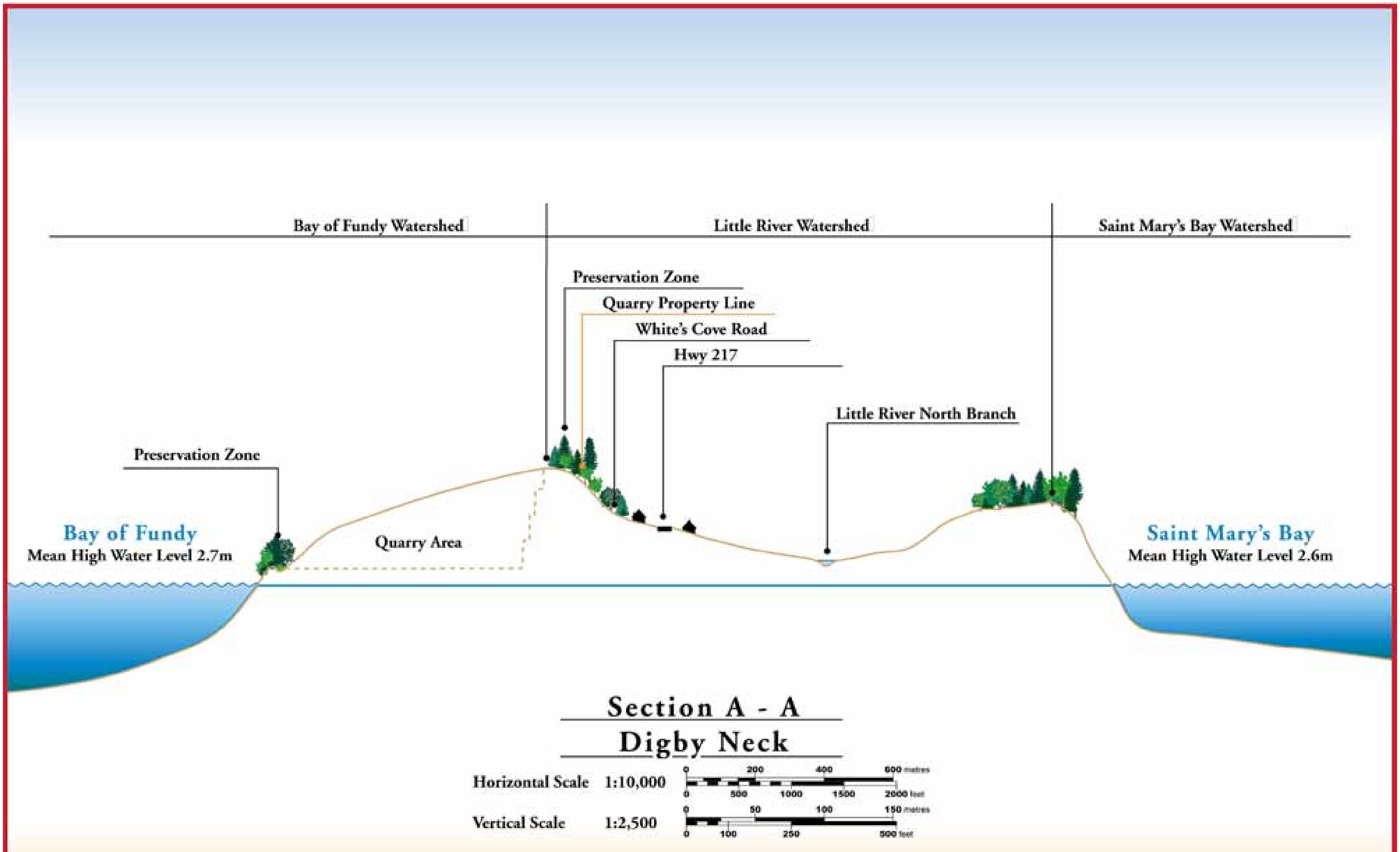
Land use proposed in the twenty-one acre parcel of quarry land lying in the Little River watershed includes the quarry compound area (5 acres) and environmental preservation lands (16 acres). The quarry compound area will contain an office, shop, fuel storage, equipment parking, roads, domestic water supply, on-site sewage disposal, and landscaped areas. Surface water drainage from the compound area will be directed toward the active quarry area and away from the Little River watershed. This runoff will be channeled into the sediment ponds and constructed wetlands before ultimately entering the Bay of Fundy. Thus, the only surface runoff contributed from this area will be from the forested, environmental preservation lands. Further, this contribution of surface runoff will be to the north branch of the Little River, avoiding the more sensitive south branch wetlands with endangered and threatened plant species. A typical section of this area through the Bay of Fundy, Little River and Saint Marys Bay watersheds is shown on **Figure 7.**

Small, isolated wetlands exist in the environmental preservation lands proposed adjacent to the compound area. These wetlands have been created in depressions in the surface of the basalt bedrock and due to the massive, vesicle free make-up of the basalt, minimal infiltration of surface water into the ground water regime is evident. Also, since the contact zone of the upper North Mountain Basalt flow and the middle flow will not be penetrated during quarrying, loss of ground water to the north branch of the Little River through this contact zone is unlikely.

9.1.5.3 Mitigation

A minimum 30 m wide environmental preservation zone is proposed around the perimeter of the quarry property. As a mitigation measure, this preservation zone has been expanded to include all quarry lands contributing surface water runoff to the adjacent Little River watershed. The remaining lands presently within the Little River watershed proposed for the compound area, will be graded to drain toward the quarry property. Consequently, only surface water runoff from forested and wetlands will flow toward the north branch of the Little River.

Due to the massive, vesicle free make-up of the upper flow unit of the basalt bedrock, no transmission of ground water was evident upon examination of the cores (personnel comm. J. Lizak). Thus no transmission or loss of ground water from the Little River watershed is expected during quarrying and no further mitigation is proposed.



Bay of Fundy Watershed
Little River Watershed
Saint Mary's Bay Watershed
Preservation Zone
Quarry Property Line
White's Cove Road
Hwy 217
Little River North Branch
Preservation Zone
Bay of Fundy
Mean High Water Level 2.7m
Quarry Area
Saint Mary's Bay
Mean High Water Level 2.6m
Section A - A
Digby Neck
Horizontal Scale 1:10,000
Vertical Scale 1:2,500
Produced for: Bilcon of Nova Scotia Corporation

Figure 7

9.1.5.4 Monitoring

Periodic inspection and maintenance of grading and drainage structures in the compound area by Bilcon of Nova Scotia Corporation will be carried out to ensure that surface water flow from the compound area is toward the quarry property and the environmental control structures (constructed wetlands and sediment ponds). Monitoring of surface water flow from the environmental preservation zone proposed for quarry lands in the Little River watershed is not proposed.

Wells were drilled in October 2005 for ground water quality and quantity monitoring along the east property line of the quarry and east of the groundwater divide. These monitoring wells will provide data on the ground water resource near the ground water divide of the quarry lands and the Little River watershed.

9.1.5.5 Impact Statement

Little River Watershed

Since only surface water runoff from 16 acres of forested and wetlands from the quarry property will enter the north portion of the Little River watershed and sensitive wetlands and endangered/threatened plant species are not reported to be present in the north portion of the Little River watershed, and no loss of ground water from the Little River watershed in the direction of the quarry is expected, this would result in a ***long term, neutral (no) effect, of regional scale.***

9.1.6 On-site Surface Water Drainage

9.1.6.1 Research

Surface water drainage flows are intermittent on the Whites Point quarry site. On-site observations by David W. Kern, B.Sc., indicated several of the watercourses or drainage ways had no flow of water evident during the latter part of August 2002. This was especially evident in the drainage ways entering the coastal bog. Other water courses near the north and south property lines were barely flowing at this time in August. During periods of heavier rainfall, such as in the spring and fall, moderate flows were observed in the more defined watercourses.

Subsequent to the 2002 investigations, on-site review of the two watercourses entering the coastal bog was conducted by David W. Kern, BSc and Michael Brylinsky, PhD on July 14, 2005. The flow in these watercourses was not adequate for flow measurements. Barely a trickle of water flow was evident in both water courses.

Water quality background samples were taken at six locations by David W. Kern, B.Sc. during spring and early summer of 2002 in areas where surface water runoff enters the intertidal zone of the Bay of Fundy. The location of the water sample sites are shown on **Map 12** and a summary of water data analysis is in Appendix 45.

In accordance with the terms and conditions of the four hectare quarry permit, weekly water quality monitoring was conducted for Total Suspended Solids (TSS) and pH in the spring of 2003. Sample station WWP-2 was used to monitor surface water discharges from the quarry operation into the Bay of Fundy. Background water samples were also taken in the watershed up slope from the four hectare quarry at station WWP-8, see **Map 13.** Water data analysis for 2003 is contained in Appendix 45.

View of the 4 Hectare Quarry - Photo by David W. Kern

Sedimentation Pond Looking Toward the Bay of Fundy - Photo by David W. Kern

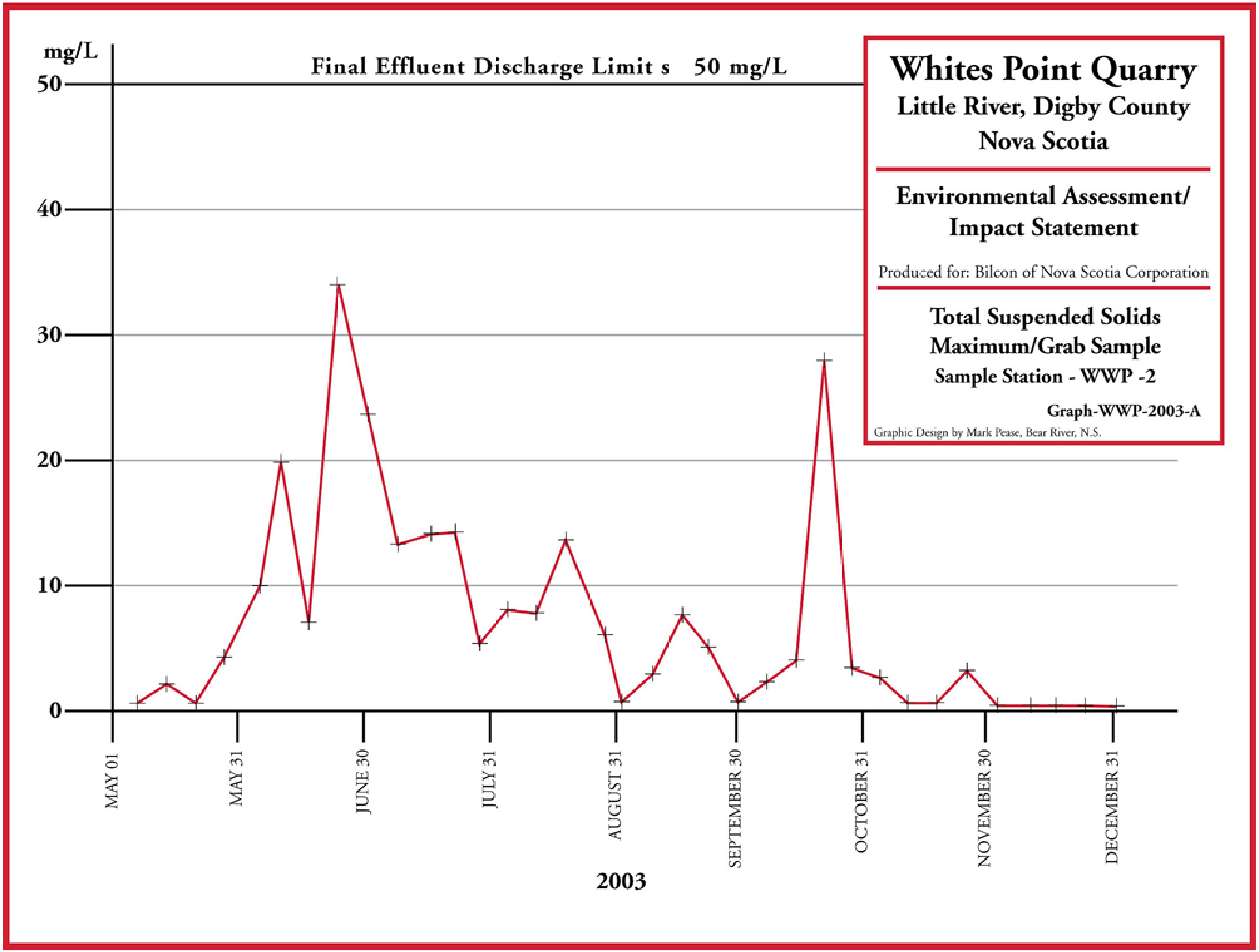
9.1.6.2 Analysis

Since former sea levels on the site were as high as the 45 m land elevation, fine grained silts and clays have already been removed from the site during regression and transgression associated with past sea level changes. Large areas of the site have a thin overburden and bedrock exposure resulting in minimal amounts of surficial materials having to be removed and redistributed. Also, those materials requiring excavation are mostly well-sorted clean sands and gravels without a fine- grained silt and clay component. This overburden characteristic considerably reduces the potential quantity of fine-grained particulates that could be produced during construction and operation.

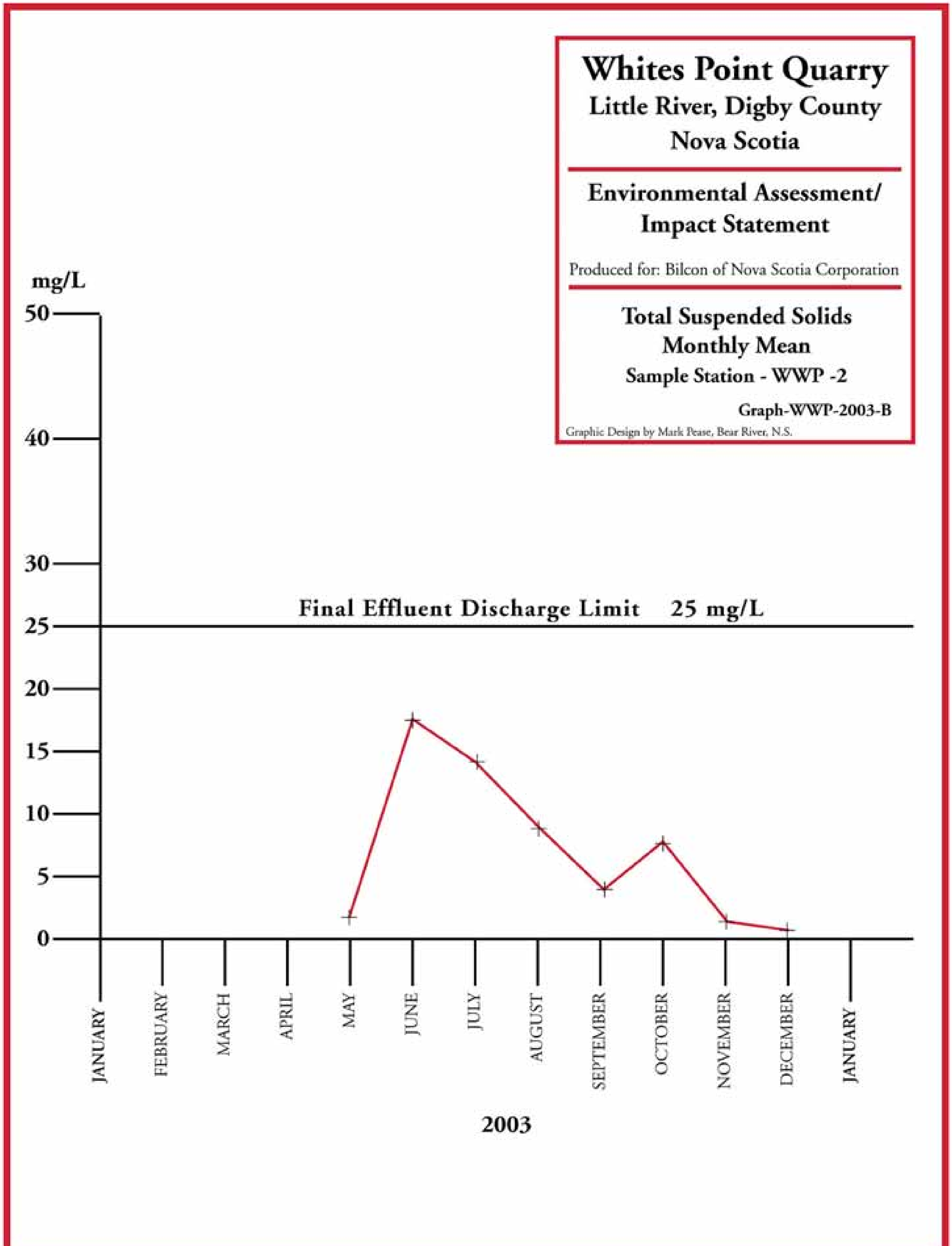
One of the most critical physical water quality parameters in fresh water and marine environments is the presence of Total Suspended Solids (TSS). Unacceptable levels of TSS in the water can cause adverse effects on fish, marine mammals, and general fish habitat. Analysis of water samples taken in 2002 from the watercourses/drainage ways entering the Bay of Fundy indicated background levels of TSS in a range of none detected to 4.0 mg/l. Low levels of sediment transport such as these are common from thin soiled, predominately rocky slopes with the underlying bedrock characteristic of this site.

Monitoring of water quality from the clearing and grubbing operation on the four hectare quarry site located within the proposed Whites Point Quarry was conducted. Work commenced on the four hectare quarry in the spring of 2003. Monitoring, as required in the approval document, was conducted on a weekly frequency at station WWP – 2 for Total Suspended Solids (TSS) and pH, - See Appendix 45 . All TSS and pH data are well within the limits set forth in the four hectare quarry approval document. It should be noted that the samples taken during the spring of 2003 were taken during construction of the sediment retention pond, associated dykes, and clearing and grubbing of the four hectare site. Heavy rain events also occurred during this time period.

The permit for construction and operation of the four hectare quarry required that TSS not exceed 50 mg/L per grab sample or a monthly mean of 25 mg/L. **Graph WWP-2003-A and Graph WWP-2003-B** display the maximum TSS recorded per grab sample (50mg/L) and maximum monthly mean (25mg/L) respectively.


mg/L
Final Effluent Discharge Limit s 50 mg/L
50
40
30
20
10
0
MAY 01
MAY 31
JUNE 30
JULY 31
AUGUST 31
SEPTEMBER 30
OCTOBER 31
NOVEMBER 30
DECEMBER 31
2003
Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Produced for: Bilcon of Nova Scotia Corporation
Total Suspended Solids
Maximum/Grab Sample
Sample Station - WWP -2
Graph-WWP-2003-A
Graphic Design by Mark Pease, Bear River, N.S.

Buxton & Kern


Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Produced for: Bilcon of Nova Scotia Corporation
Total Suspended Solids
Monthly Mean
Sample Station - WWP -2
Graph-WWP-2003-B
Graphic Design by Mark Pease, Bear River, N.S.
mg/L
50
40
30
25
20
15
10
5
0
Final Effluent Discharge Limit 25 mg/L
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
2003

Buxton & Kern

Comparison of TSS at WWP-2 (quarry discharge point into the Bay of Fundy) and WWP-8 (background watershed) are presented below.

	WWP-2	**WWP-8**
July 23, 2003	14.2 mg/L	27.5 mg/L
August 14, 2003	7.5 mg/L	not detected @EQL 0.5
October 29, 2003	3.5 mg/L	5.5 mg/L
November 26, 2003	not detected @EQL 0.5	3.2 mg/L
December 24, 2003	not detected @EQL 0.5	not detected @EQL 0.5

These results indicate that in all but one instance, TSS was equal to or less than background, at the point of discharge from the four hectare site. Also, TSS and pH were well within the limits set forth in the terms and conditions of the permit.

Sediment samples were taken from the bottom of tide pools within a potential area of influence of the four hectare quarry and from tide pools remote from the quarry operation for comparison – see **Map 13.** Six tide pools, above and below ordinary high tide, indicate no appreciable difference in organic and inorganic composition of bottom sediments. This monitoring of tide pool sediments indicates that there has been little, if any, export of sediments into tide pools in proximity to the four hectare quarry, - see Brylinsky, Michael. "Results of a Suspended Solids Survey at the Whites Point Quarry, Little River, Digby County, Nova Scotia". June 2003. (**Ref. Vol II, Tab 12**). A similar erosion/sediment control plan, as successfully implemented for the four hectare quarry, is proposed for the Whites Point Quarry operation.

9.1.6.3 Mitigation

The quarrying of basalt rock will alter the existing topography of the site and its drainage patterns. A schematic section of the resultant quarry is shown on **Figure 5** contained in the Reclamation Section. The quarry floor during quarry operation, will be back sloped toward the working face to direct surface runoff away from the receiving waters of the Bay of Fundy. Natural surface runoff from the mountain side will be interrupted near the quarry face and diverted at this point into controlled drainage ways and into the environmental control areas such as sediment retention ponds and constructed wetlands, before entering the receiving waters of the Bay. As the quarry operations proceed in a northerly direction, appropriate flows into the coastal bog will be maintained from the diverted water courses. Even though no rare plants or animal species at risk were identified in the bog itself, it was identified as an area of diverse habitat within the site, unusual on a local basis, and it is part of the proposed environmental preservation zone. In this regard, it is proposed to maintain its existing natural habitat requirements such as an intermittent surface water flow through the bog.

Maintaining the appropriate surface water flow into the coastal bog preservation area will be accomplished by diverting runoff from the quarry floor to the sediment retention ponds, through a constructed wetland, and then to the head of the bog. This bog has functioned as a natural filter for upland surface water runoff for years. Thus, the objective is to maintain this natural filtering system for runoff before entering the marine environments of the Bay. All water from the working area of the quarry will enter the sediment retention ponds before flowing into the bog area or being discharged into the constructed wetland and then into the Bay. This will maximize the retention time of any suspended solids before entering marine waters. It should be noted that the background TSS in the marine waters ranged from 9.6 mg/l to 19.2 mg/l – See Appendix 43.

9.1.6.4 Monitoring

Water quality monitoring of all outflows from sediment retention ponds will be conducted weekly for Total Suspended Solids (TSS) and pH and monthly for general chemistry. TSS will be maintained at less than 50 mg/l per grab sample or 25 mg/l monthly arithmetic mean while pH will be maintained within a range of 5 – 9 per grab sample or 6 – 9 monthly arithmetic mean at the sediment pond outlet. These TSS and pH limits correspond with those contained in the permit for the four hectare quarry on this site. The frequency of monitoring will be weekly for TSS and pH and a monthly summary of results will be prepared by Bilcon of Nova Scotia Corporation and be available to regulatory agencies.

9.1.6.5 Impact Statements

Wetlands

Given the inclusion of the coastal bog in the environmental preservation zone and the maintenance of surface water flows to the coastal bog during quarry operations, the effect on this natural wetland would result in a ***long term, neutral (no) effect, of local scale.***

Surface Water Quality

By constructing controlled drainage ways, sediment retention ponds, constructed wetlands, and maintaining a perimeter environmental preservation zone, the effect on receiving marine waters of the Bay of Fundy and adjacent watersheds from quarry runoff would result in a ***long term, neutral (no) effect, of local scale.***

9.1.7 Physical Oceanography

9.1.7.1 Research

Bathymetry

General bathymetry of the outer Bay of Fundy is shown on Nautical Chart 4011 – Approaches to Bay of Fundy. Water depths range from over 100 m in parts of the inbound/ outbound shipping lanes to 16 m below chart datum at the proposed marine terminal. Regional bathymetry in the area extending southwest from Sandy Cove was mapped by the Geological Survey of Canada (Atlantic) using multibeam bathymetry imagery.

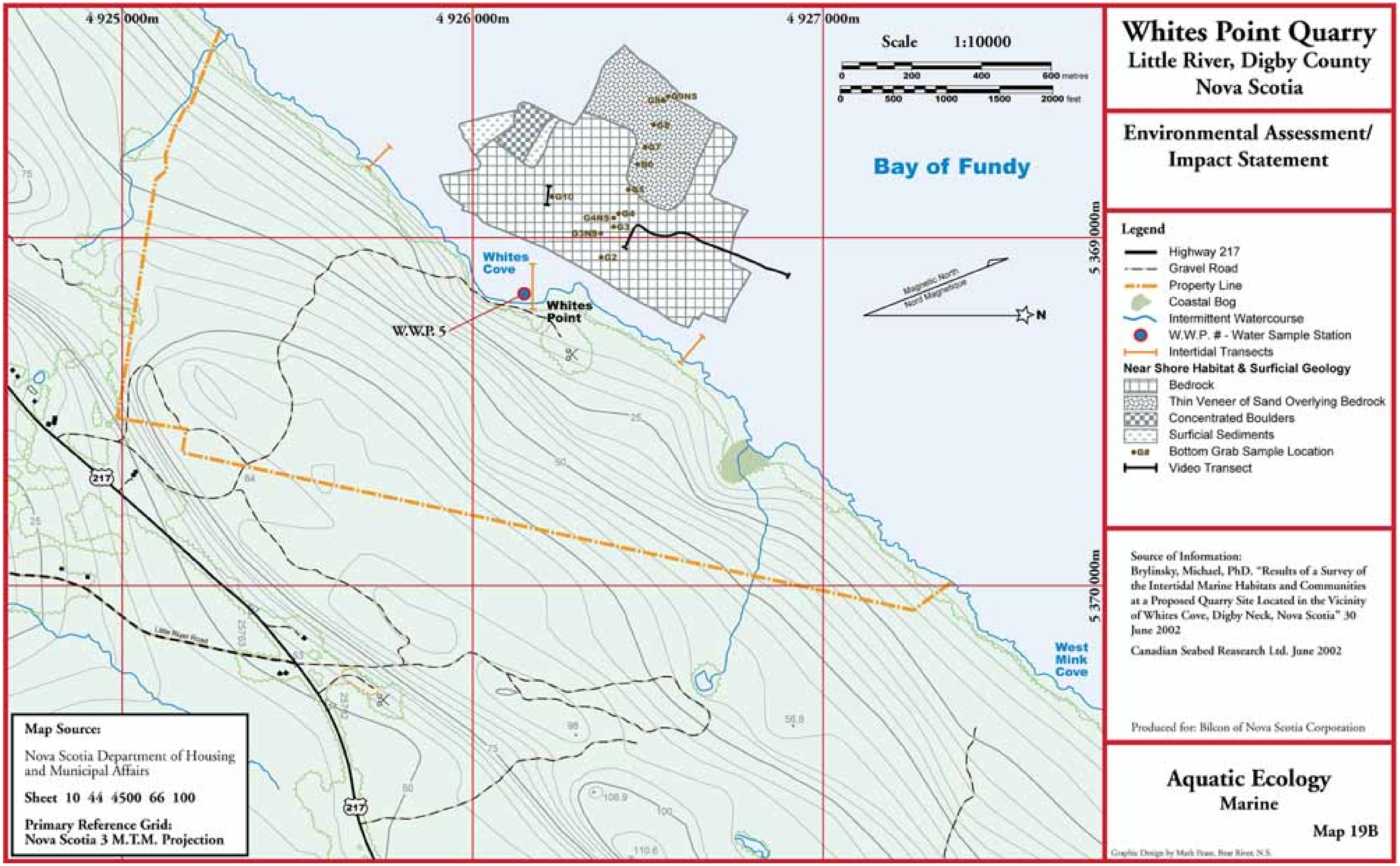
Local bathymetry in the area of the proposed marine terminal was mapped in 2002 (Canadian Seabed Research Ltd. 2002, Appendix 23) when an area 800 m along the coast at Whites Cove/Whites Point by 500 m seaward was mapped. Soundings were recorded continuously along survey lines using a Knudsen 320M (200kHz) echosounder. Bathymetric contours were then plotted at one m intervals. The regional multibeam bathymetry and local bathymetry were georeferenced in 2005 (XY GeoInformatics Services 2005, **Ref. Vol. V, Tab 26**). The general bathymetry of the Bay is shown on **Map 4** and the detailed bathymetry of the marine terminal area is shown on **Figure 2.**

The shoreline of the proposed Whites Point quarry is dominated by exposed basalt rock which extends into the intertidal and sublittoral zones of the Bay of Fundy. Surficial geology of the nearshore at Whites Point is shown on **Map 19B**. Transects in the intertidal zone were conducted in 2002 (Brylinsky 2002, **Ref. Vol. II, Tab 10**).

The 30 – year (1971 – 2000) frequency of presence of sea ice in the Bay of Fundy is 0% (Environment Canada 2004, Ref. 59). However, sea ice in the Bay of Fundy area has not been reported consistently in the period 1971 – 2000. Consequently, data from this reference document is not reliable in that area. Traditional knowledge indicates floating ice has been observed in the Bay off Whites Point, presumably from ice break-up in the inner Bay of Fundy and the Annapolis Basin.

Marine Sediments

Research on seabed sediments, sediment transport, and suspended sediments have been ongoing throughout the Bay of Fundy system (Atlantic Marine Geological Consulting Ltd. 2005, **Ref. Vol. III, Tab 19**). The following research will focus on the regional and local dynamics within the outer Bay of Fundy and the local area that could be influenced by the proposed Whites Point Quarry and Marine Terminal. Fine-grained material (silt and clay) is introduced into the Bay by both natural and anthropogenic sources including ocean dumping activities, river barrier construction, seabed fishing activities and natural erosion of the seabed and adjacent land.


Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Legend
Highway 217
Gravel Road
Property Line
Coastal Bog
Intermittent Watercourse
W.W.P. # - Water Sample Station
Intertidal Transects
Near Shore Habitat & Surficial Geology
Bedrock
Thin Veneer of Sand Overlying Bedrock
Concentrated Boulders
Surficial Sediments
Bottom Grab Sample Location
Video Transect
Source of Information:
Brylinsky, Michael, PhD. "Results of a Survey of the Intertidal Marine Habitats and Communities at a Proposed Quarry Site Located in the Vicinity of Whites Cove, Digby Neck, Nova Scotia" 30 June 2002
Canadian Seabed Reasearch Ltd. June 2002
Produced for: Bilcon of Nova Scotia Corporation
Aquatic Ecology
Marine
Map 19B
Scale 1:10000
Bay of Fundy
Whites Cove
Whites Point
W.W.P. 5
West Mink Cove
4 925 000m
4 926 000m
4 927 000m
5 369 000m
5 370 000m
Map Source:
Nova Scotia Department of Housing and Municipal Affairs
Sheet 10 44 4500 66 100
Primary Reference Grid:
Nova Scotia 3 M.T.M. Projection

The first comprehensive Bay of Fundy wide assessment of suspended sediment was conducted by Miller in 1966. Water samples were taken during mid-flood and mid-ebb from 43 stations, at the bottom, 1 m from the bottom, 10 m from the bottom and at the surface. The average concentration was 6.6 mg/l. An analysis by Miller indicates high turbidity water during the ebb moves south and west toward the Gulf of Maine and high turbidity water enters the Bay from the southwest side of Saint John Harbour. Concentration of suspended sediments would be higher during maximum flood and ebb flows. Examination of the suspended sediment found sand, silt, clay, phytoplankton, and other organic debris. Silt and organic debris were the major components. Selected vertical turbidity profiles located off Digby Neck showed near bottom suspended sediment increased on the ebb tide, indicating a source from the northeast and not local erosion of the seabed.

Important to the understanding of sediment deposition, erosion, and transport in the Bay of Fundy is the distribution of sediments at the seabed of the outer Bay in geologic and recent history. Large areas of the seabed of the outer Bay consist of gravel that occurs as a thin layer of till that was deposited directly by glaciers. Surficial geology map 4011 – G depicts the seabed off Digby Neck as consisting largely of till in water depths greater than 90 m. Little has happened to these gravels since they were deposited. As such, they are not in dynamic equilibrium with present conditions of erosion and deposition. These areas of till are non-depositional zones where fine-grained sediments are not deposited on the seabed. As a result, these sediments are not sources for fine-grained material to be eroded and transported throughout the Fundy system.

Sediment transport and deposition in the Bay of Fundy is unique and does not fit the typical model of a continental shelf coastal environment where sediment deposition and transport is controlled by water depth, abundant source material and low velocity currents. In the Bay of Fundy, the strong tidal currents dominate seabed processes and have an effect in all water depths. Additionally, a complex sea-level history of rise and fall has developed sediment textures, distribution and surfaces of high energy that are relict from past environments.

The Marine Terminal will be located on an area of exposed bedrock at the seabed. The only local sediments at the terminal site are small patches of coarse sand and gravel that occur in crevices and ledges on the bedrock surface. Seaward of the Marine Terminal location, is an area of continuous and thin coarse sand that overlies the bedrock surface. The sand is generally less than one metre in thickness and many boulders protrude from beneath the sand. This distribution of bedrock and sand is the direct result of relict processes resulting from sea-level change that occurred over the past 9,000 years. The sea both regressed and transgressed all surfaces in the region from a maximum depth of approximately 60 m to the present shoreline. This effectively eroded previously deposited glacial sediments and produced the present conditions of exposed bedrock in the nearshore.

Multibeam bathymetry collected from the area of the Marine Terminal continuing to the north and sidescan sonar data at the Marine terminal location show that the nearshore off Digby Neck is dominated by a bedrock exposed platform that extends to a water depth of approximately 50 m. At that depth, the seabed steepens and dips rapidly to 70 m water depth where it is dominated by glacial coarse-grained gravelly sediments and glacial unmodified features such as drumlins and flute-shaped gravel ridges. Both the side scan imagery and multibeam bathymetry show no bedforms such as sand waves and mega ripples in this region.

The surficial geology of the nearshore at Whites Point is described and shown on **Map 19B.** This area which was investigated in detail (Canadian Seabed Research Ltd. 2002, Appendix 23) is comprised mainly of massive basalt bedrock outcrops and boulders. In some areas the bedrock is overlain with a thin veneer of sand, and in other areas surficial sediments consisting mainly of coarse to very coarse sand and shell fragments occur. Based on sediment transport modeling, the lack of bedforms in coarse sand indicates that the currents at the seabed are less than 45 cm/s. Small ripples can form in coarse sand at between 35 and 25 cm/s. No sediment bedforms were visible on the sidescan sonar and photographic data indicating little current movement close to the bottom.

A more detailed analysis of bottom sediments and lack of sediments is contained in **Table GS – 2002, see paragraph 9.2.4.1.** Due to the minimal thickness of sediments covering the bedrock in the area of the Marine Terminal, no vertical profiles were taken. Since proposed construction techniques for the marine terminal do not include dredging or dredge spoil disposal, those sections of the Canadian Environmental Protection Act, 1999, and its Disposal at Sea Regulations are not applicable in this case.

In summary, the nearshore of Digby Neck can be described as a starved sediment platform of exposed bedrock formed by relict erosional processes of sea level rise and fall from former low stands to high stands. Sediments are sparse and do not appear to be in transport within the Marine Terminal area and adjacent areas.

Contaminants

On a regional scale, the general distribution of heavy metal concentrations in sea-floor sediments in the outer Bay of Fundy along Digby Neck is low (Bay of Fundy Ecosystem Partnership 2003, Ref. 99). This is relative to the high concentrations on the New Brunswick side northeast of Grand Manan Island, south of Saint John, and along the shores of Annapolis and Kings Counties. Generally, metal concentrations are lower in the coarser, sandier sediments of the central and eastern parts of the Bay and higher in the finer sediments around the Passamaquoddy Bay region of southwestern New Brunswick. The abundance of metals in different areas was also related to the presence of bedrock of differing geologic origins in coastal formations around the Bay. Elevated concentrations of chromium, vanadium, and nickel in the sediments along the Nova Scotia coast and near Grand Manan Island probably result from weathering of volcanic rocks with high metal content (Bay of Fundy Ecosystem Partnership 2004, Ref. 99).

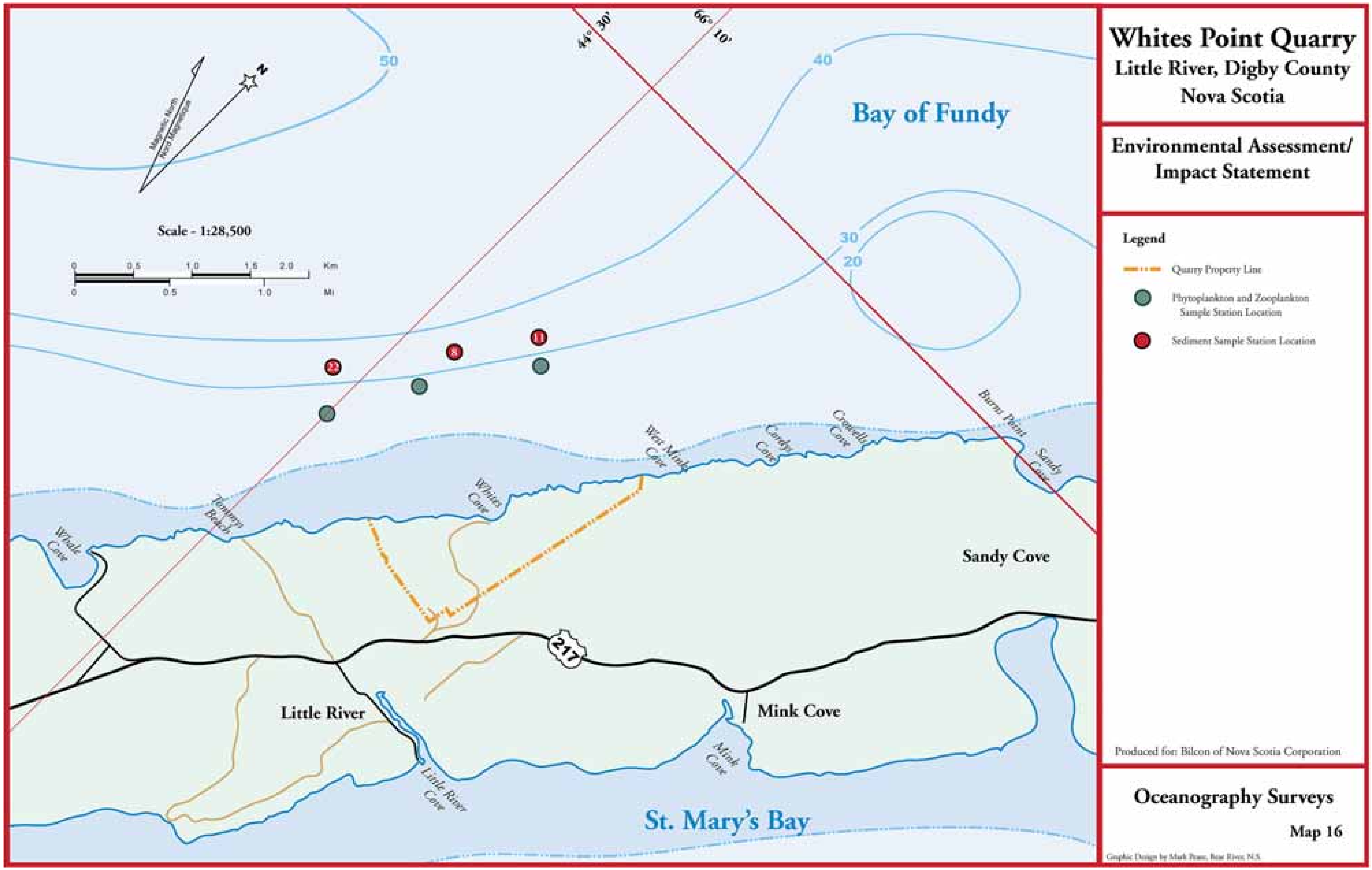
Sediment samples in the nearshore waters off the Whites Point quarry site were taken on July 14, 2005 – see Brylinsky, Michael. "Results of a Sediment Survey in the Near Offshore Waters of the Proposed Quarry Site in the Vicinity of Whites Cove, Digby Neck, Nova Scotia". September 2005. (**Ref. Vol. II, Tab 9**). The objective of the survey was to document sediment contaminant levels, sediment carbon content and sediment particle size. Sediment samples were collected with a 10.4 liter Van Veen Grab fitted with weights, and a total of 30 stations were sampled along three transects perpendicular to the shoreline. Ten sites were sampled along each transect extending from approximately 0.3 to 3 km offshore in water depths ranging from 1.8 to 43.9 m relative to chart datum. Of the 30 grab samples taken, only nine contained sediments.

A sediment sample from each of the three transects, station 8, 11, and 22 – see **Map 16**, was selected for laboratory analysis. Laboratory analysis was performed by Maxxam Analytics Inc. – see Appendix 45 .

Particle size composition varied little among samples and was dominated by sands and gravels. Sands ranged from 34% to 54% depending on sample location while gravels ranged from 29% to 43%. Clays ranged from 2.6% to 15% depending on sample location while silts ranged from 1.1% to 15%. Sediment organic carbon content was very low (less than one percent). The predominant bedrock bottom had a low organic carbon content and a paucity of fine sediments indicating an environment unsuitable for the development of a significant infauna community in these nearshore waters.

Sediment contaminant levels for metals (cadmium, copper, lead, mercury and zinc), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) and organochlorinated pesticides were analyzed. These data were compared to the Canadian Council of Ministers of the Environment (CCME) 1999 interim guidelines for marine sediment quality. In all cases, the sediment contaminant levels were below the interim sediment quality guideline (ISQG) and the probable effects level (PEL) for metals, total PAHs and total PCBs. Pesticides were not detected at the detection limit of 0.01.

In summary "The results of the sediment survey indicate that the nearshore waters off of the proposed quarry site are characterized by relatively pristine conditions. In most cases contaminant levels are well below current CCME guidelines" and "together with the lack of fine sediments, especially clays, makes it unlikely to be an area where pollutants would be entrained" (Brylinsky 2005 **Ref Vol. II, Tab 9**). Only copper with a contaminant level of 17 mg/kg at station number 8 approached the ISOG guideline of 18.7 mg/kg. This is most likely due to the inherently high background levels of copper in this region.


Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Legend
Quarry Property Line
Phytoplankton and Zooplankton Sample Station Location
Sediment Sample Station Location
Produced for: Bilcon of Nova Scotia Corporation
Oceanography Surveys
Map 16
Graphic Design by Mark Pease, Bear River, N.S.
Bay of Fundy
St. Mary's Bay
Sandy Cove
Mink Cove
Little River
Scale - 1:28,500
Km
Mi
44° 30'
66° 10'
50
40
30
20
Whale Cove
Tommys Beach
Whites Cove
West Mink Cove
Candys Cove
Crowells Cove
Burns Point
Sandy Cove
Mink Cove
Little River Cove
217
22
8
11

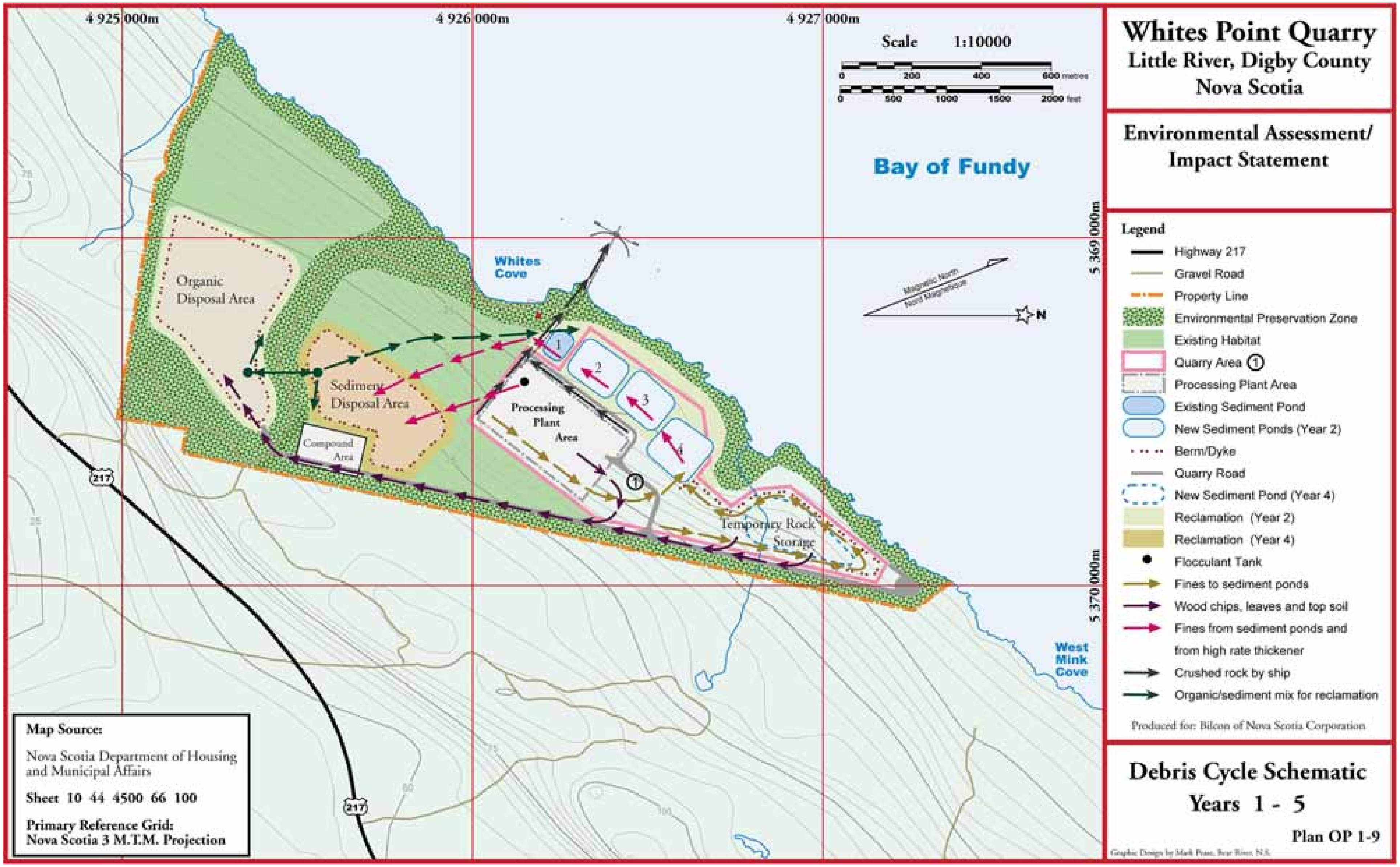
Debris Cycle

The debris remaining from the crushing process will initially be stored in designated areas and subsequently used in the reclamation process. **Plan OP1-9** – Debris Cycle Schematic shows the track of debris for the initial 1-5 years of the quarry operation. Subsequent five-year periods are similar.

Topsoil and chips from the clearing and grubbing process will be transported to the organic disposal area in the southeast corner of the site for temporary storage. This area will be bermed to prevent material washing further down the slope.

Fines from the exposed operations area will be collected in the settling ponds which will be periodically emptied and the fines transported to the sediment disposal area in the easterly area of the site for temporary storage. Fines from the washing operation will be directed to the high rate thickener where, following dewatering, they will be pumped to the sediment disposal area for temporary storage. The sediment disposal area will be bermed to prevent migration of the fines further downslope.

As material is required for reclamation, the organic material and the fine sediment will be mixed and spread for replanting following the addition of soil amendments. Crushed rock and grits will be loaded via the loading tunnel and the shiploader on a period basis for trans-shipment to New Jersey. No debris will be transported off-site since it will all be employed in the reclamation process which will be carried out incrementally throughout the life of the project.



Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Legend
Highway 217
Gravel Road
Property Line
Environmental Preservation Zone
Existing Habitat
Quarry Area 1
Processing Plant Area
Existing Sediment Pond
New Sediment Ponds (Year 2)
Berm/Dyke
Quarry Road
New Sediment Pond (Year 4)
Reclamation (Year 2)
Reclamation (Year 4)
Flocculant Tank
Fines to sediment ponds
Wood chips, leaves and top soil
Fines from sediment ponds and
from high rate thickener
Crushed rock by ship
Organic/sediment mix for reclamation
Produced for: Bilcon of Nova Scotia Corporation
Debris Cycle Schematic
Years 1 - 5
Plan OP 1-9
Scale 1:10000
0 200 400 600 metres
0 500 1000 1500 2000 feet
Bay of Fundy
4 925 000m
4 926 000m
4 927 000m
5 369 000m
5 370 000m
Whites Cove
West Mink Cove
N
Organic Disposal Area
Sediment Disposal Area
Compound Area
Processing Plant Area
Temporary Rock Storage
217
Map Source:
Nova Scotia Department of Housing and Municipal Affairs
Sheet 10 44 4500 66 100
Primary Reference Grid:
Nova Scotia 3 M.T.M. Projection

Ocean Tides and Currents

The tidal regime of the Bay of Fundy is essentially of a lunar semi-diurnal nature (two complete tidal oscillations daily). The tidal range recorded for Sandy Cove (44°30'N Latitude and 66°06'W Longitude) and Tiverton, at Boars Head (44°24'N Latitude and 66°13'W Longitude) is as follows.

	Mean Tide (feet)	Large Tide (feet)
Sandy Cove	18.4	25.7
Tiverton, Boars Head	17.0	23.1

The location of the proposed marine terminal at Whites Point is 44°28'N Latitude and 66°08'W Longitude. Mean water level, above Chart Datum, at Whites Point is approximately 11.5 feet.

Major tidal current patterns in the main portion of the Bay of Fundy indicating the hourly rate and direction are shown in Appendix 40. The currents shown are those to be expected for the average tidal range at Saint John, New Brunswick of 20.0 feet. Currents in this portion of the Bay in the vicinity of the bulk carriers route from the inbound/outbound shipping lanes to the marine terminal at Whites point ranges from 0 – 2.5 knots. It should be noted that these currents are for normal weather conditions. Strong winds and abnormal barometric pressures may modify the rates and directions shown on these charts by causing currents of a non-periodic nature.

Wind

The Whites Point Quarry and Marine Terminal site is located in the Bay of Fundy sub-area 1 of the East Coast of Canada as described in Volume I of the Wind and Wave Climate Atlas – see **Figure 8** for spatial definition. Wind speed and direction vary seasonally in this area of the Bay. Monthly wind statistics (frequency of wind speed by direction) for East Coast Area 1 – Bay of Fundy is contained in Appendix 48. Monthly data statistics indicate December has the highest mean wind speed (21.6 knots) from the northwest. The lowest mean wind speed (13.3 knots) from the southwest occurs in August. Maximum wind speed varies from 49.0 knots in August to 69.0 knots in October. These statistics are based on over 4,000 observations per month.

Wave

Volume I of the Wind and Wave Climate Atlas – see **Figure 8** for spatial location, indicates wave height and direction vary seasonally in this area of the Bay. Monthly wave statistics (frequency of significant wave height by direction) for East Coast Area 1 – Bay of Fundy is contained in **Appendix 46.** Monthly wave statistics indicate December and January have mean wave height of 1.1 m. These statistics are based on over 800 observations per month. The highest percentage frequency of wave occurrence is from the southwest.

Water Quality

Water column characteristics, including temperature, salinity, and water transparency were taken at three locations in nearshore waters – see **Map 16 -** during spring, summer, and fall of 2004 (Brylinsky 2004, **Ref. Vol II, Tab 11**). Water quality sampling in the intertidal zone was conducted by David W. Kern, B.Sc. in 2002 – see **Map 12.** Parameters analyzed included coliform and e-coli, general chemistry and trace metals. Laboratory analysis was conducted by Comeau Lab (coliform and e-coli) and PSC Analytical Services (general chemistry and trace metals) – see Appendix 45.

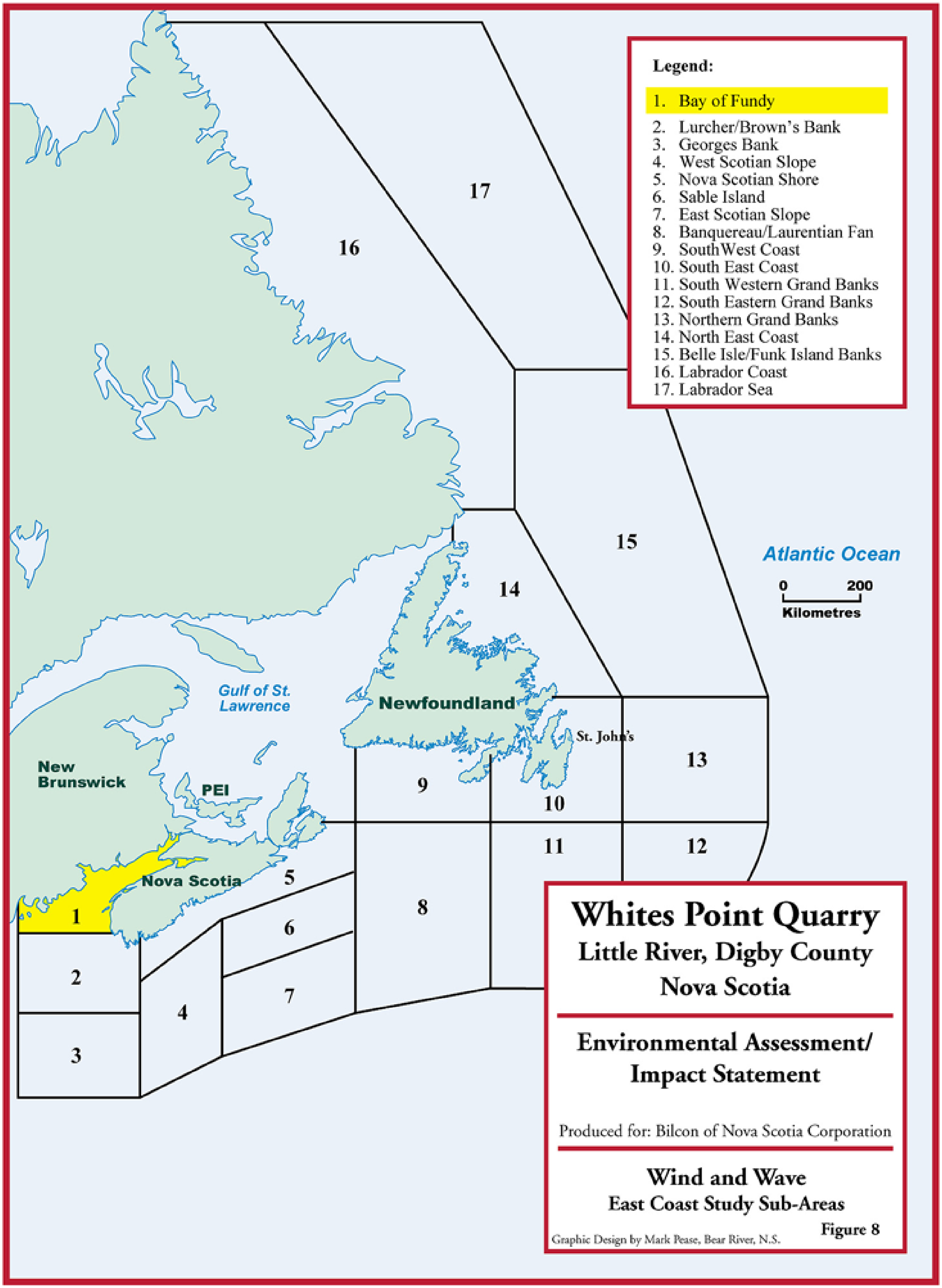
Physical characteristics were surveyed in temporal context during April, July, and October, 2004. Measurements of water column stratification (based on temperature and salinity profiles), water transparency (as Secchi Disk depth) were taken using a Yellow Springs Instrument Salinity – Conductivity – Temperature Meter and a standard 20 cm diameter Secchi Disk. Results of this survey data are contained in (Brylinsky, 2004 **Ref. Vol II, Tab 11,Table 4.2**). There was no indication of water column stratification at any of the sampling stations or during any of the sampling periods. Salinity varied little (30.0-32.3 ppt) and Secchi Disk depth varied little (7.0 – 7.3 m) indicating relatively clear water.

Sea Level Change

Historically, in the Bay of Fundy and particularly along Digby Neck, a former sea level as high as the present land elevation of 45 m occurred at the end of the last glaciation. This was followed by falling relative sea levels to a maximum of 60 m in the Bay of Fundy. During this process, fine-grained sediments were removed and transported to deeper water. Due in part to global melting of glaciers, the resulting sea level rose to the present shoreline elevation. Presently, sea level change is slowing but still rising at rates of between 20 and 30 cm/century (Atlantic Marine Geological Consulting Ltd. 2005, **Ref. Vol. III, Tab 17**).

The sensitivity of coastal areas to a potential global rise in sea level (such as might be caused by global warming) was addressed by a “coastal vulnerability index” (Shaw et al 1998, Ref. 167). Seven variables including relief and vertical land movements, lithology and coastal landform, rates of erosion, wave energy, and tidal range were considered. For example, a coast with a high sensitivity index would be a region with low relief and unconsolidated sediments, with barrier islands, high tidal range, high wave energy levels and where relative sea level is already rapidly rising. This is characteristic of much of the south shore of Nova Scotia along the Atlantic coast. The south shore area has a sensitivity index between 5.0 and greater or equal to 15.0.

A coast with a low sensitivity index would have high relief, a rocky shore with resistant, non-eroding bedrock, falling sea level, low tidal range and low wave energy. This type of coastline, typical of the Bay of Fundy at Digby Neck, is not subject to significant retreat under current conditions and would remain stable even if the sea level rises at the predicted rates. The sensitivity index along Digby Neck coast at Whites Point is low (0 -4.9) indicating a relatively stable shoreline at the Whites Point quarry and Marine Terminal site.


Legend:
1. Bay of Fundy
2. Lurcher/Brown's Bank
3. Georges Bank
4. West Scotian Slope
5. Nova Scotian Shore
6. Sable Island
7. East Scotian Slope
8. Banquereau/Laurentian Fan
9. SouthWest Coast
10. South East Coast
11. South Western Grand Banks
12. South Eastern Grand Banks
13. Northern Grand Banks
14. North East Coast
15. Belle Isle/Funk Island Banks
16. Labrador Coast
17. Labrador Sea
Atlantic Ocean
0 200
Kilometres
Gulf of St. Lawrence
Newfoundland
St. John's
New Brunswick
PEI
Nova Scotia
Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Produced for: Bilcon of Nova Scotia Corporation
Wind and Wave
East Coast Study Sub-Areas
Figure 8
Graphic Design by Mark Pease, Bear River, N.S.

9.1.7.2 Analysis

The bathymetry of the Bay of Fundy in the region of the proposed marine terminal affords adequate, unobstructed water depth for bulk carrier navigation and transport of aggregate materials. Water depths in the proposed ship route from the inbound/outbound shipping lanes ranges from over 100 m to 16 m at the terminal. Location of the terminal near the entrance to the Bay requires no deep penetration of the Bay by shipping and has the closest deep water route to the adjacent Gulf of Maine from the Bay of Fundy. Surficial sediments, including sand and/or muddy sediments are minimal in this region of the Bay.

The marine terminal site consists of a stable and hard bedrock seabed and occurs along a typical Bay of Fundy coastal segment without anomalous bathymetric, bedrock, or sedimentological characteristics. No in water blasting, dredging or dredge spoil disposal are proposed during construction of the marine terminal. Pipe piles are proposed to support the marine terminal infrastructure. Erosion at the base of the piles is extremely unlikely due to the absence of sediments in this area.

Minimal disturbance to the morphology of the seabed in the sublittoral, intertidal, and shoreline zones will result from construction of the marine terminal. The proposed construction method using pipe piles will produce minimal effects on bottom morphology. Analysis of existing bottom current speed and patterns indicate erosion at the base of the pipe piles will not occur. The location of the marine terminal is on exposed bedrock. No armour rock protection at the base of the piles will be required thereby confining the area of direct effect to the pile footprint. The majority of the sublittoral, intertidal and shoreline zones will be spanned – see **Figures 2** and **3,** and produce no direct effect on the bottom in the area of the spanned construction.

The location of the quarry and marine terminal on the Bay of Fundy coastline presents the possibility of potential adverse natural forces affecting the project. Climatic events such as storm surges, tides, and meteorological conditions individually and in combination will present the most probable effect on components of the marine terminal (mooring dolphins, ship loader, and conveyor system). The all time extreme wind event, recorded for this period at the Yarmouth weather station occurred on February 2, 1976. This storm event commonly called the “groundhog day storm” had recorded maximum hourly wind speed of 108.0 km and maximum gust speed of 163.0 km from the southwest.

Detailed engineering design will ensure that the structural systems chosen will be capable of withstanding these natural forces. Necessary studies including wave height and duration, wind speed, and potential sea level rise of 30 cm/century will be conducted during detailed engineering design to ensure adequate infrastructure over the 50 year life of the project.

Terrestrial surface disturbance during construction and operation phases of the quarry including aggregate washing operations will be contained on-site. A system of drainage channels, sediment retention ponds, constructed wetlands, and an environmental preservation zone will minimize runoff into marine waters. Surface water discharge levels will meet the thresholds established by the Nova Scotia Department of Environment and Labour "Pit and Quarry Guidelines – 1999". Aggregate washing operations will be arranged in a closed circuit and make-up water for the washing will be supplied from surface water runoff. Uncontrolled releases of solids from the closed circuit wash water system are highly unlikely and would be contained by the environmental control structures.

Marine sediment redistribution during construction is extremely unlikely since pilings for the marine terminal are located on exposed bedrock. The design of the marine terminal infrastructure on pipe piles allows for practically unobstructed current and tidal flows when compared to other marine construction techniques (sheet piling and infill or rock fill). This construction technique will produce minimal effects on temperature, salinity, and nutrient concentrations during construction and operational phases. Since currents and tides are practically unobstructed by construction of the marine terminal, effects on nearshore navigation, marine ecology, and harvesting of sea life will be minimal. Also, minimal turbidity will result from drilling of the bedrock to anchor the pile driving templates and pile anchors. If turbidity exceeds the "Canadian Water Quality Guidelines for the Protection of Aquatic Life – Total Particulate Matter". (Ref.45), mitigation measures such as silt curtains will be implemented.

It is highly unlikely that water quality in the marine environment will be affected by the proposed marine terminal construction and operation. Laboratory analysis of marine bottom sediments indicates that metals, PCBs, PAHs, and organochlorinated pesticides were either not detected or are within the CCME interim marine sediment quality guidelines. No provisions for ship refueling are proposed at the marine terminal. Also, uncontrolled releases of fuel oils or nutrients from land infrastructure, operational procedures and mobile equipment will be contained by the environmental control structures. Heavy metals, PCBs, PAHs, and organochlorines substances will not be used or produced during construction and operation. Seasonal water column investigations indicate a non-stratified water column exists in the nearshore marine waters in the vicinity of the quarry property. Since there is no stratification of the water column or seasonal mixing, and, no uncontrolled releases from aggregate washing and no releases of fuel oils, heavy metals, organochlorines or nutrients, there would be no effects on water quality.

In conclusion, based on a marine geological, structural, sedimentological and bathymetric understanding of the Bay of Fundy, the location of the proposed marine terminal offshore Digby Neck is the most optimum location for such a facility within the entire Bay of Fundy " In my opinion, based on a marine geological, structural, sedimentological and bathymetric understanding of the Bay of Fundy, the location of the marine terminal offshore Digby Neck is the most optimum location for such a facility within the entire Bay by shipping and has the closest deep water route to the adjacent Gulf of Maine from the Bay of Fundy. It occurs over a stable and hard bedrock seabed with no surficial sediments including sand and /or muddy sediments. It occurs along a typical Bay of Fundy coastal segment without anomalous bathymetric, bedrock, or sedimentological characteristics. The area has no active faults within the bedrock and is considered to have a low seismic risk”(G. Fader, Atlantic Marine Geological Consulting Ltd. - personal communication). Additionally, the sensitivity index for sea level change in this area is low, and the proposed site will not require dredging or dredge spoil disposal during the construction and operational phases of the project.

9.1.7.3 Mitigation

Site selection for the marine terminal at Whites Point constitutes a significant mitigating factor from a physical oceanography standpoint. The site is located to provide a natural, unobstructed deep water port. Its location avoids the potentially archaeologically sensitive underwater ridge extending from Sandy Cove. It is located in an area of the Bay with little sediment in the nearshore area. It provides a sound geological bedrock support for the terminal construction and is in an area of practically non-existent seismic activity. Penetration of shipping activity into the outer Bay is minimal and the distance from established shipping lanes to the marine terminal is short and direct. The above factors all contribute to mitigate effects on the regional ecosystem.

Selection of the alternate means of construction – pipe pile supports – for marine terminal infrastructure minimizes effects in the local marine environment. This mitigation measure contributes positively to sustainable development objectives when compared to other marine construction such as withinin water blasting and dredge operations and infill. The marine terminal extends offshore into adequate existing water depth and eliminates the need for blasting and dredging to achieve the necessary water depth. Turbidity within the water column is also greatly reduced with piling construction compared to placing rock infill within the intertidal and sublittoral marine zone. Again, to the extent possible, impact avoidance has been considered.

The primary direct effects on the physical oceanography will be during the construction phase of the marine terminal. Construction affecting the bottom of the intertidal and sublittoral zones will be scheduled during periods of low biological activity. Construction within the sublittoral zone will be carried out from floating platforms to further minimize effects on the pelagic and benthic communities. Construction within the intertidal zone will be done from shore and to the extent possible at low tide. During installation of the pipe pile support structures, if turbidity exceeds prescribed thresholds, silt curtains, a well established and proven mitigation measure (Vagle 2003,Ref. 90), will be installed. Pipe pile construction was selected to minimize effects on nearshore currents and tides. The pilings will provide a stable substrate for long term habitat colonization in the water column.

Secondary effects on marine waters could result from quarry operations. However, runoff from land sources during quarry operations will be routed through sediment retention ponds and constructed wetlands before entering marine waters. This system of sediment control of Total Suspended Solids (TSS) proved successful in meeting the thresholds established by the Nova Scotia Department of Environment and Labour during construction operations at the 3.9 hectare quarry on the Whites Point site.

9.1.7.4 Monitoring

Monitoring potential effects on the physical oceanography will focus on the direct influences during the construction phase of the marine terminal. Minimal turbidity in the marine water column is anticipated when pipe pile templates and pilings are installed within the intertidal and sublittoral bottom. Turbidity monitoring will be conducted during this construction process. If turbidity exceeds the "Canadian Water Quality Guidelines for the Protection of Aquatic Life – Total Particulate Matter". (Ref. 45), silt curtains will be implemented. Liquid effluent discharge levels from land sources will meet the thresholds established by the Nova Scotia Department of Environment and Labour "Pit and Quarry Guidelines – 1999". (Ref.77).

9.1.7.5 Impact Statements

Physical Oceanography – Construction

Since the only direct construction within intertidal and sublittoral marine waters consists of installation of pipe piles in areas of bedrock, turbidity will be minimal and result in a ***short term, insignificant negative effect, of local scale.***

Physical Oceanography – Life of Project

Placement of pipe piles within the intertidal and sublittoral marine waters will produce minimal alteration and obstruction to nearshore currents and tides and result in a ***long term, insignificant negative effect, of local scale.***

9.1.8 Air Quality

9.1.8.1 Research

On-site investigations indicate no development presently exists on the Whites Point Quarry property and no commercial or industrial land uses are adjacent to the property. The nearest industrial activities are two fish processing plants in the village of Little River over 1km away. Vehicle traffic on Highway #217 is generally light with some increase during the summer tourist season and only minimal internal combustion engine emissions are evident. Emissions from diesel powered fishing boats along the nearshore are also minimal. Vehicular traffic on Whites Cove Road, due to the unimproved condition is practically limited to four wheel drive vehicles and all terrain vehicles which frequent the site. A portion of the site was recently clear cut with logging trucks hauling out along Whites Cove Road generating greater than normal emissions and dust.

Total suspended particulate (TSP) has been the air quality parameter of most concern for quarry operations in Nova Scotia in regard to potential effects on human health and the environment. In June 2000, the Canadian Council of Ministers of the Environment (CCME) “Canada-Wide Standards for Particulate Matter (PM) and Ozone” see – CCME 2000. Ref.46 **.** was endorsed. Further, “Regulations Related to Health and Air Quality” were published by Health Canada (Health Canada 2003, Ref.63). This latter document sets forth National Ambient Air Quality Objectives & Guidelines in Canada and establishes the following for Total Suspended Particulate (TSP):

Maximum Desirable Level	(annual) 60 µg/m³	(24 hour)
Maximum Acceptable Level	(annual) 70 µg/m³	(24 hour) 120 µg/m³
Maximum Tolerable Level	(annual)	(24 hour) 400 µg/m³

Further, as indicated in Appendix D of the NSDEL Pit and Quarry Guidelines (NSDEL 1999, Ref.77) paragraph VI establishes the following limits for suspended particulate levels at or beyond the property boundary.

Suspended Particulate Matter

Maximum Limit	60 – 70 µg/m³ 120 µg/m³ ave.	annual geometric mean concentration over a 24 hr period

Ambient air quality is monitored in Nova Scotia with a network of 28 sites and generally meets federal ambient air quality criteria for S02, TRS1, H2S, CO, NO, and O3. An exception may be when long-range, trans-boundary events occur (Jacques Whitford 2005, **Ref. Vol V, Tab 31**).

9.1.8.2 Analysis

Particulates such as dust, generated by quarry operations will not exceed the criteria established by the NSDEL at or beyond the property boundaries of 70 $\mu g/m^3$ annual geometric mean or 120 $\mu g/m^3$ daily average (24 hour). Dust generated from on-site haul roads will be controlled with water spray or other approved methods. Dust from rock processing will also be controlled by water sprays from recycled water from the sediment retention ponds.

Quarrying will require heavy mobile equipment, primarily diesel powered, for land operations. Arrival and departure of the bulk carrier once a week will briefly involve diesel powered emissions. Some increase in vehicle traffic, primarily private vehicles, will be generated by the quarry workforce and commercial vehicles delivering equipment and materials during quarry operations. All heavy mobile equipment including quarry trucks and loaders, will have approved emission controls meeting U.S. Environmental Protection Agency Tier 3 emissions regulations. This equipment will be maintained in prescribed mechanical operating condition.

Electrical power will be used for land operations such as the conveyor systems, stationary equipment, and ship loading systems. As a result, emissions are not expected to affect adjacent residences, especially since no stationary machinery activities such as crushing and screening will take place within 800 m of the adjacent residences.

9.1.8.3 Mitigation

Since quarry products will be shipped by water to markets, no heavy trucks hauling rock will generate dust in adjacent residential areas. Also, access to the Whites Point quarry is presently being investigated. A paved access road from Highway #217 to the quarry property is planned. Paving the access road will practically eliminate dust generated from employee and delivery vehicles. The physical plant area where crushing and screening will take place has been located approximately 1000 m from the nearest residence to further reduce any effects of air borne particulates on residential life. As a further precautionary measure, processing equipment will be enclosed whenever practical and hooded conveyor systems used to reduce fugitive dust. Dust control at the source with water sprays, horizontal and vertical separation, maintaining existing forest cover, and an approximate five year revegetation program will collectively eliminate any adverse effect of dust on adjacent residences.

Heavy operational (quarry trucks and loader) mobile equipment will be equipped with diesel engines meeting the U.S. Environmental Protection Agency Tier 3 emission standards and maintained in prescribed mechanical operating condition. This will further ensure emissions of particulate matter, hydrocarbons, nitrous oxide and carbon monoxide are within regulatory standards. Smaller maintenance equipment used on an infrequent basis may not be equipped to Tier 3 emission standards.

The burning of brush and associated wood fibre from land clearing activities causes emissions of gases such as carbon dioxide, methane, and nitrous oxide into the air. This practice is presently common in Nova Scotia with appropriate burning permits. Construction and the opening of new quarry areas over the life of the project will require land clearing. To eliminate the resultant emissions from open burning of brush, Bilcon of Nova Scotia Corporation intends to chip the remaining wood fibre after merchantable timber has been harvested. Wood chips will then be placed in the organic disposal area on-site to be composted and used during land reclamation. The chipping and composting process constitutes a mitigation measure that will increase the costs associated with land clearing.

9.1.8.4 Monitoring

Particulate emissions (dust) will be monitored by Bilcon of Nova Scotia Corporation if requested by the Nova Scotia Department of Environment and Labour. The location of monitoring stations will be established by the Nova Scotia Department of Environment and Labour. If requested, particulates will be measured by the high volume method as described in report No. E.P.S. 1 – AP – 73 –2.

9.1.8.5 Impact Statement

Particulate Emissions

Fugitive dust from quarry operations will be controlled on-site and will not exceed 120 $\mu g/m^3$ daily average or 60 – 70 $\mu g/m^3$ annual geometric mean at the property line as established by the Nova Scotia Department of Environment and Labour's Pit and Quarry Guidelines resulting in a ***long term, neutral (no) effect, of local scale.***

9.1.9 Noise and Vibration - Blasting

9.1.9.1 Research

The Nova Scotia Department of Environment and Labour's terms and conditions for operation of the four-hectare quarry located on the Whites Point Quarry site includes the following:

1 No blasting within 30 m of the boundary of a public or common highway

2 No blasting within 30 m of the bank of any watercourse or ordinary high water mark

3 No blasting within 800 m of the foundation or base of a structure located off site

4 No blasting within 15 m of the property boundary when a structure on the abutting property is not involved.

Further to the above, no blasting will be permitted if there is a thermal atmospheric inversion or a low cloud cover or fog conditions. No blasting shall occur on Sunday, on a statutory holiday prescribed by the Province of Nova Scotia, or on any day between 1800 and 0800 hours.

9.1.9.2 Analysis

The above terms and conditions will be adhered to during blasting operations at the proposed Whites Point Quarry. Also, a technical blast design will be prepared by a qualified person (a blaster with a minimum Class 2 certification for the province of Nova Scotia). The blast design will ensure air concussion does not exceed 128 dBA within 7 m of the nearest structure not located on the site and that ground vibration of 12.5 mm/sec peak particle velocity will not be exceeded below grade or less than 1 m above grade in any part of the nearest structure not located on the site. No blasting is proposed within 800 m of a structure not located on the site, without written permission of the structure owner.

Blast monitoring data at other rock quarries in Nova Scotia indicates concussion below 128 dBA and ground vibration below 12.5 mm/sec as required by the Nova Scotia Department of Environment and Labour can be routinely achieved. For example, data from a rock blast using a four-inch hole loaded at 214 kg of explosive per delay with an average collar of 7 feet produced 88 dBA at 1460 m and 122.4 dBA at 420 m (personal communication**,** P. Caza, Dyno Nobel North America). A prediction of ground vibration using the Holmberg Equation and a K factor of 400 (based on actual blast results in a basalt rock quarry), an explosive weight of 45 kg per delay, would result in 1mm/sec ground vibration at a structure 1120 m from the blast site and 7 mm/sec at 150 m. The above circumstances indicate values well within the criteria established by the Nova Scotia Department of Environment and Labour.

The frequency of blasting during quarry start-up is planned to be once per week and once every two weeks during normal operations. Blasting is proposed throughout the year and each blast design will likely be different in regard to number and size of holes, weight of explosives per detonation, and location. However, all blasting will be designed to meet the 128 dBA and 12.5 mm/sec criteria.

9.1.9.3 Mitigation

A minimum 30-m environmental preservation zone is proposed around the perimeter of the quarry and Whites Cove Road. The 30-m zone along the landward property line, between the quarry and residential dwellings, will remain in a forested condition. This forested "buffer" will absorb and deflect sound waves generated by blasting activities. Also, the proposed restoration schedule provides for re-vegetation of quarried areas approximately every five years. The revegetation will provide greater absorption of sound generated by blasting. Further, as a mitigative measure, no blasting is proposed within 800 m of residential structures not located on the quarry property without written permission.

9.1.9.4 Monitoring

Three land monitoring stations are proposed as shown on **Map 2 .** Each blast will be monitored for concussion and ground vibration. Additionally, all blasts will be video taped to record blast efficiency. Monthly reports summarizing the results of blasting activities will be submitted to the Nova Scotia Department of Environment and Labour.

9.1.9.5 Impact Statement

Blasting

Concussion and ground vibration from blasting activities will meet the criteria established by the Nova Scotia Department of Environment and Labour and not exceed 128 dBA and 12.5 mm/sec respectively and result in a ***long term, neutral (no) effect, of local scale.***

9.1.10 Noise and Vibration - Plant

9.1.10.1 Research

Sound levels in rural areas are generally in the range of a minimum of 30 decibels (dB) to a maximum of 75 decibels. The transmission of noise is primarily influenced by climatic conditions, distance from the source, and attenuation resulting from elements or barriers between the sound source and the receiver.

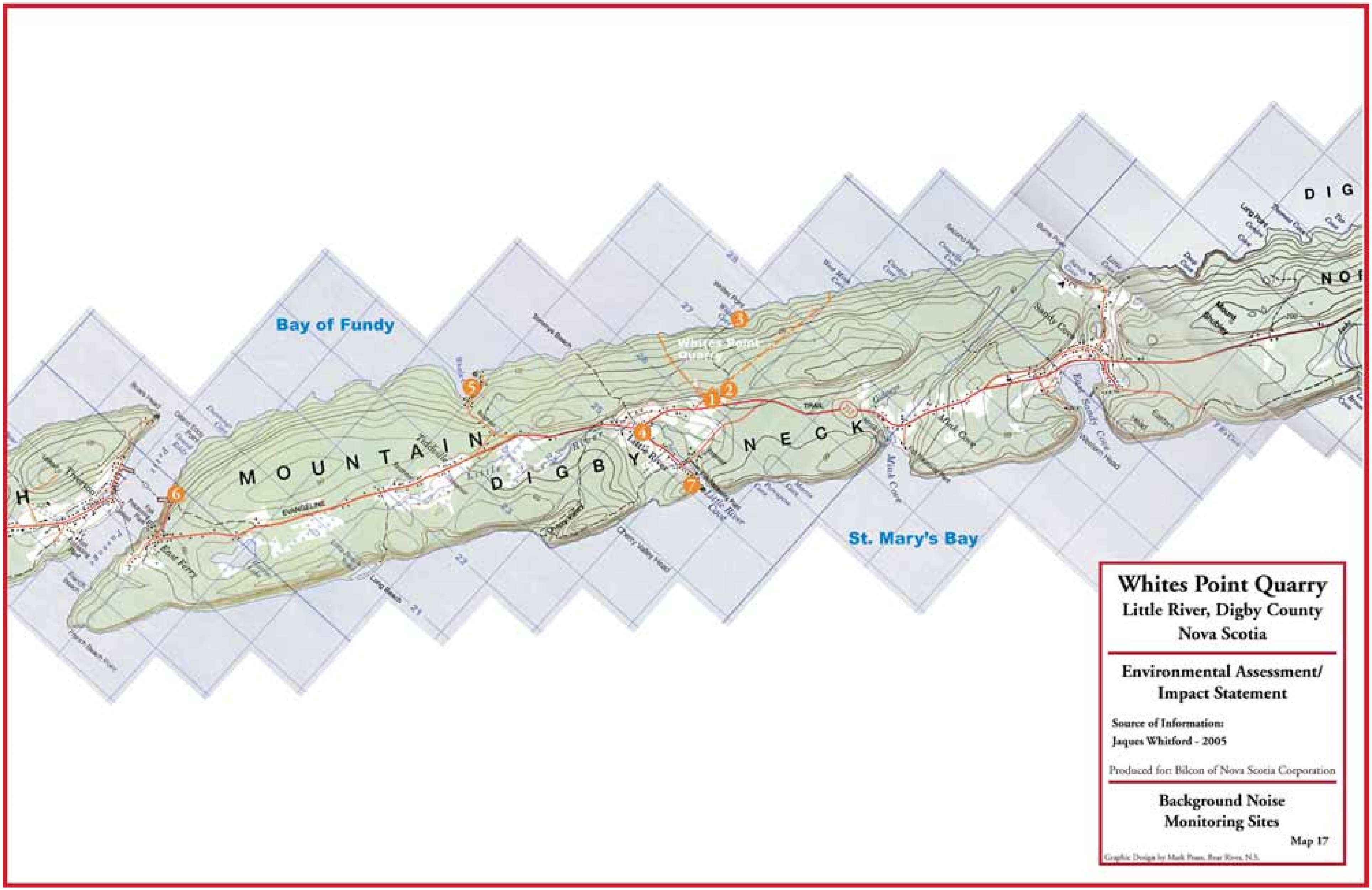
Baseline noise levels of existing conditions were determined by on-site measurements at the Whites Point quarry site and surrounding areas. Measurements were taken during May and June 2005, (Jacques Whitford 2005, **Ref. Vol V, Tab 31**). Sound levels were taken using a Larson Davis Model 824 and Quest Model 2900 Type 2 integrating sound level meters. Eight sites - see **Map 17** - including two on the quarry site, one at the nearest receptor, and five at various locations were measured to compare background sound levels of everyday activities in nearby communities.

Following is the list of sites monitored and the range of sound levels recorded. For details see (Jacques Whitford 2005 **Ref. Vol. V, Tab 31**).

Site Number	Location	Sound Level Range (dBA)
1	Residence Hwy #217	32.9 – 48.1
2	Quarry Property Boundary	35.3 – 57.6
3	Whites Cove Shore	32.8 – 51.9
4	Little River Intersection	52.8 – 65.4
5	Whale Cove Harbour	32.8 – 51.9
6	East Ferry	30.5 – 70.7
7	Little River Fish Plant	37.4 – 66.9
8	Highway #303 Conway	54.7 – 59.8

The frequency of data collection for sites 1 and 2 was at one minute intervals, then averaged for hourly Leq values. Measurements were taken during portions of three daily periods (day 0700 – 1900, evening 1900 – 2300, and night 2300 – 0700) corresponding with provincial guidelines. Sites 3 – 8 used twenty minute recordings to calculate the one minute Leq values.

Sound monitoring was also conducted by David W. Kern B.Sc. in a rural area in Annapolis County, Nova Scotia using a Martel 325 Sound Level Meter with the following results. Rural highway traffic produced a maximum of 75 dB sound level at a distance of 30 m


Bay of Fundy
St. Mary's Bay
Whites Point Quarry
MOUNTAIN
DIGBY NECK
Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Source of Information:
Jaques Whitford - 2005
Produced for: Bilcon of Nova Scotia Corporation
Background Noise
Monitoring Sites
Map 17

from the highway. Comparatively, a person operating a chain saw experienced 88 dB while a person 30 m away experienced a 68 dB noise level. Also, a person operating a diesel powered farm tractor experienced 75 dB to 83 dB while a person 30 m away experienced 60 dB to 65 dB. Studies generally indicate there is a 20 dB reduction in sound level due to distance from a point source at 30 m. Further reductions per 30 m ranging from 1 dB to 5 dB or greater may be achieved by attenuation. A 1 dB reduction per 30 m may be achieved from absorption by a rough grass cover while a 5 dB or greater reduction per 30 m may be achieved from absorption and the scattering of sound waves by vegetative tree cover (Robinette 1972 Ref. 163).

As indicated in Appendix D of the NSDEL Pit and Quarry Guidelines, paragraph VII establishes the following guidelines for sound level limits at the property boundaries of the quarry.

<u>Leq. Sound Level Limits</u>

Night	23:00 – 07:00 & all day Sunday and statutory holidays	55dBA
Evening	19:00 – 23:00	60dBA
Day	07:00 – 19:00 hours	65dBA

9.1.10.2 Analysis

Background noise levels at sites 1 and 2 (residence Highway #217 and the quarry property boundary) did not exceed the guideline sound levels during the twenty-four hour monitoring periods. Background noise level at sites 4, 6, and 7, in surrounding communities, very infrequently exceeded the guideline sound levels during the twenty minute monitoring period. The highest average sound levels recorded were 70.0 – 70.7 dBA at East Ferry, influenced by the arrival and departure of ferry traffic and a transport truck idling near the sound level meter. It should be noted that peak noise levels at sites 5 (Whale Cove) and 7 (Little River Fish Plant) reached 80dBA as a result of harbour activity including boats, trucks, and general traffic.

General noise levels from operations at the Whites Point quarry at the source are expected to be in the range of 65 dB to 85 dB. The primary sources of noise will be from drilling, blasting, hauling, and crushing basalt rock. Sound pressure levels measured at 15 m for operating off-road equipment varied from 82 – 84 dBA. The largest mobile equipment to be used during quarry operations are off-highway trucks (Caterpiller 773E) and a quarry face wheeled loader (Caterpiller 990 Series II). The 773 off-highway truck has a 15 m sound pressure level of 84dBA for the mode of operation that gives the highest level. The 990 wheel loader at 15 m in mid-gear moving operations has a sound pressure level of 82dBA. Other operating equipment such as excavators and bulldozers have similar sound pressure levels. Specific considerations regarding blasting will be discussed in a subsequent section of this report.

The location of the physical plant, which includes the crushers, screens, and conveyor systems, is shown on **Figure 1.** The distance to the nearest residence is approximately 1000 m horizontally and over 60 m below the ridge line separating the quarry and adjacent residences. In addition to the reduction of noise by attenuation over the 1000-m horizontal distance, sound waves will be deflected upwards and dissipated due to the vertical change in topography. As mentioned previously and considering a maximum 85 dB sound level at the physical plant site, the horizontal and vertical separation in conjunction with attenuation by vegetative cover should adequately reduce noise levels at the quarry property line to well below the 65 dBA daytime level and 55 dBA night time level required by the Nova Scotia Department of Environment and Labour.

Noise generated during construction of the quarry access road from Highway #217 to the quarry property would have the potential of affecting nearby residents. Depending on the type of equipment used, and combination of equipment, sound level pressures are not expected to be greater than any other rural road construction. Access road location to the quarry is presently being planned to provide the greatest separation distance feasible from adjacent residences.

9.1.10.3 Mitigation

The primary mitigation measure will be to minimize noise generated at the source from construction and operational activities. For example, during construction of the marine terminal, the installation of steel pipe piles into bedrock will be required. To minimize noise during this construction process, it is proposed to drill sockets in the bedrock for seating the piles rather than a continuous pile driving process.

Equipment design, as a mitigation measure, is also proposed. Processing equipment will be enclosed whenever practical to reduce noise levels at the source. Additionally, noise generated during loading rock into quarry trucks will be reduced by the use of rubber lined truck beds. Rubberized screens will also be used to reduce noise during the aggregate screening process.

A minimum 30 metre environmental preservation zone is proposed around the perimeter of the quarry property and Whites Cove Road. This preservation zone will also act as a noise buffer zone and will remain in a forested condition between the quarry and adjacent residences and public roads. Also, the proposed reclamation schedule provides for re-vegetation of quarried areas approximately every five years. The re-vegetation will provide greater absorption of sound and further reduce noise levels generated by the physical plant operation and associated activities.

9.1.10.4 Monitoring

Monitoring of sound levels will be conducted to ensure the thresholds at the property line is not exceeded. The following equivalent sound levels (Leq) will be met.

Leq	65 dBA 60 dBA 55 dBA	0700 – 1900 hours (days) 1900 – 2300 hours (evenings) 2300 – 0700 hours (nights and all day Sunday and statutory holidays)

Sound level monitoring stations will be located in consultation with the Nova Scotia Department of Environment and Labour. Monthly summary reports of sound level data will be provided to the Nova Scotia Department of Environment and Labour.

9.1.10.5 Impact Statement

Noise – Plant

Sound levels from quarry plant operations are not expected to exceed typical noise experienced in rural residential environments and will not exceed the decibel levels at the quarry property line as required by the Nova Scotia Department of Environment and Labour resulting in a ***long term, neutral (no) effect, of local scale.***

9.1.11 Noise and Vibration – Ship Loading

Questions regarding noise levels during ship loading were raised during the public consultation process. To address these concerns, Bilcon of Nova Scotia Corporation contracted with Jacques Whitford to conduct background noise investigations in the area of the proposed Whites Point Quarry and Marine Terminal – see **Map 17 .**

9.1.11.1 Research

Background sound levels were taken onshore at the Whites Point marine terminal location on May 3 and 4, 2005 (Jacques Whitford 2005 **Vol. V, Tab 31)**. At this time, fishing boats were operating in the nearshore waters and wind conditions varied from calm to brisk with waves hitting the shore. The averaged background sound levels ranged from 32.8 dBA to 51.9 dBA. The higher noise levels were recorded on May 3, 2005 with continuous peaks of over 55 dBA. These higher recordings were presumably due to the wind and wave conditions on that day. Average background noise levels on May 3, 2005 were 50.6 dBA, while on May 4, 2005, average background noise levels were 34.5 dBA.

9.1.11.2 Analysis

Prediction of noise levels at the proposed marine terminal at Whites Point during ship loading are presented from research conducted at a similar loading facility at Sechelt, British Columbia in April 2004 (Klohn Crippen Consultants Ltd. 2004, Ref. 69).

Background noise levels were taken at Sechelt when no loading or shipping activities were taking place. Weather conditions varied from calm to windy, similar to background weather conditions at Whites Point during background noise monitoring. Average background noise levels at the Sechelt facility ranged from 45 dBA to 53 dBA. During ship loading with conveyors running, radial arm ship loader in operation and the loading of holds in the vessel, the following sound levels were recorded and compared to everyday sound levels.

20 m from source – 70 dBA (equivalent to a vacuum cleaner at 3 m)
500 m from source – 60 dBA (equivalent to conversational speech)
1000 m from source – 58 dBA (equivalent to normal conversation)

It should be noted that these sound levels were recorded over open water with no intervening attenuation features.

The proposed ship loading facility at Whites Point is located approximately 1000 m from the quarry property line and 1500 m from the nearest residential receptor. Using the comparable data from Sechelt of noise levels of 58 dBA at 1000 m over open water and considering further attenuation provided by land mass, forested buffer zones and horizontal and vertical separation, night time noise levels would be considerably less than 55 dBA at the property line. Further reduction by attenuation would be realized by the 1500 m distance to the nearest residential receptor. This is verified based on data recorded at Sechelt, where without any land or forest attenuation, the maximum distance for sound levels to attenuate to 45 dBA was 1480 m. In association with attenuation, this would be comparable with background noise levels recorded at the nearest receptor to the Whites Point quarry.

The Nova Scotia Department of Environment and Labour's Pit and Quarry Guidelines indicate noise levels at the quarry property line should not exceed 55 dBA between 2300 and 0700 hours. In this regard, night time noise levels from ship loading would be less than the noise levels specified in the Pit and Quarry Guidelines. Therefore, ship loading at night will not exceed the provincial guidelines.

9.1.11.3 Mitigation

The proposed environmental preservation zones along the coast line and property lines of the quarry between the ship loading activities and human receptors will further reduce sound levels by attenuation. These buffer zones and horizontal separation will attenuate noise levels and the vertical separation between the source and human receptors will disperse sound waves upward contributing to dissipation of the noise.

9.1.11.4 Monitoring

Monitoring of sound levels will be conducted to ensure thresholds established in the Pit and Quarry Guidelines are not exceeded. - see **paragraph 9.1.10.4** for monitoring details.

9.1.11.5 Impact Statement

Noise – Ship Loading

Sound levels from ship loading operations are not expected to exceed typical noise experienced in rural residential environments and to not exceed the decibel levels at the quarry property line as required by the Nova Scotia Department of Environment and Labour's Pit and Quarry Guidelines resulting in a ***long term, neutral (no) effect, of local scale.***

9.1.12 Light

9.1.12.1 Research

Anthropogenic light at the proposed Whites Point Quarry and Marine Terminal site is presently non-existent. Existing ambient light levels at the project site consist of natural light. Investigations regarding potential effects of light from project development were conducted – see Jacques Whitford. "Noise and Air Quality Study at Whites Point Quarry"" November 2005. Light can be defined as visible radiation (about 0.4 to 0.7 microns in wavelength) considered in terms of its luminous efficiency.

9.1.12.2 Analysis

The proposed daily operating schedule of the quarry is from 0600 – 2200 hours. This schedule will require artificial lighting in several general areas of the quarry site including the working face, the physical plant, the compound area, and the shiploader and mooring facilities. The level of lighting and timing will vary according to basic safety and operational requirements. Operational lighting will be kept to a minimum and synchronized with needs to reduce energy consumption at the quarry.

The working face of the quarry will require minimal lighting during short daylight days in the spring and fall. Mobile flood lighting directed toward the ground at the base of the face would be mounted on elevated stands, angled downward, and shielded to reduce light spill into the night sky. The vertical face will also act to block light flow horizontally toward adjacent residences. The flood lighting will be directed away from nearshore waters. However, during these times of the year (spring and fall), some "glow" in the night sky may be evident during early evening hours.

Lighting at the physical plant and compound area is in most cases within structures. Security lighting at the compound area would be pole mounted with illumination directed downward. All security lighting would be equipped with dusk to dawn controls for energy efficiency. It should be noted that neither of these buildings and areas would be visible from adjacent residences due to vertical elevation change and forested buffer zones. Some night sky "glow" will result from the security lighting. However, this is expected to be comparable to other adjacent community lighting.

The marine terminal would have navigational lighting as required by Transport Canada. Operation of the shiploader is scheduled once per week. Shiploading is expected to take approximately twelve hours and could occur at night. Lighting of the shiploader and conveyor systems will be required for night time shiploading. Conveyor system lighting will be shielded and directed onto the conveyor belts. The elevated shiploader will be equipped with lighting directed downward to the holds of the ship. Minimal light spill is expected into the marine waters and into the night sky. Whenever feasible, ship loading would be conducted in daylight hours to avoid night light that could attract fish or birds. More detailed discussion of possible light effects on wildlife are contained in subsequent sections on fish and migratory birds. Again, if ship loading is conducted during early evening, it could contribute to the night sky glow. Considering the horizontal separation distances, vertical change in elevation, and forested buffer zones, minimal light annoyance is anticipated at adjacent residences. No known commercial fishery or whale and seabird cruises or recreational boating are presently conducted at night in the nearshore waters. The only recreational uses observed in the evening were on land by OHV's using the Whites Cove Road. These vehicles are equipped with their own lights.

9.1.12.3 Mitigation

Mitigation measures to reduce the effects of artificial illumination at the quarry site include the timing and frequency of activities, and the location of the light source. All lighting will be designed specifically for the intended use, to reduce light spill, and for overall energy efficiency. Much of the lighting will be enclosed within structures. Outdoor lighting will be shielded to illuminate specific areas or operating elements. The overall objective of the mitigation will be to manage the lightscape to avoid effects on the human and biological environments.

9.1.12.4 Monitoring

Re-establishment of the Community Liaison Committee will provide an opportunity for Bilcon of Nova Scotia Corporation to invite a neighbour to participate on the Committee. This person could communicate any concerns neighbours of the quarry may have about night lighting at the quarry and discuss resolutions.

9.1.12.5 Impact Statement

Light

Considering the duration, frequency and location of proposed night lighting at the quarry and marine terminal site, no direct light is expected to be viewed by neighbouring residences. However, minimal night sky glow may occasionally be experienced resulting in a ***long term, insignificant negative effect, of local scale.***