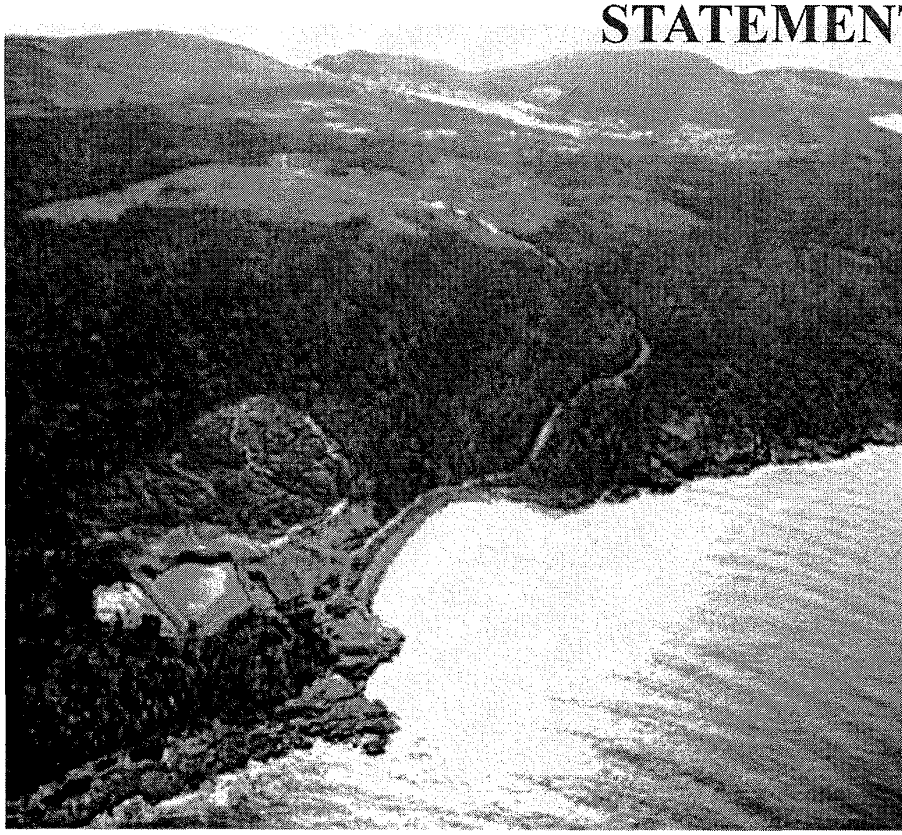
VOLUME I
PLAIN LANGUAGE SUMMARY

WHITES POINT QUARRY & MARINE TERMINAL

ENVIRONMENTAL IMPACT STATEMENT



BILCON OF NOVA SCOTIA

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March 31, 2006

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.

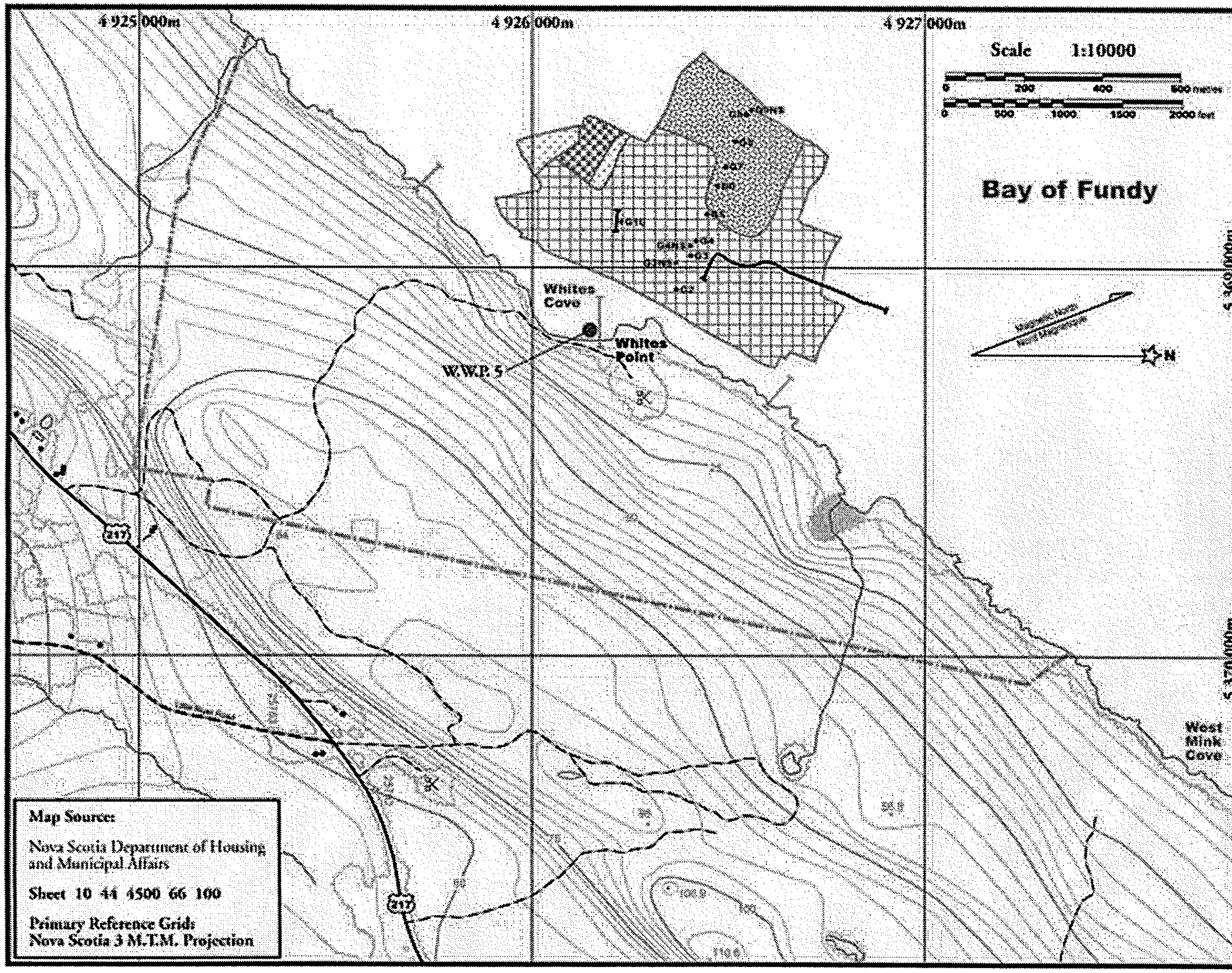
Local bathymetry in the area of the proposed marine terminal was mapped in 2002 (Canadian Seabed Research Ltd. 2002, Appendix 23) when an area 800 m along the coast at Whites Cove/Whites Point by 500 m seaward was mapped. Soundings were recorded continuously along survey lines using a Knudsen 320M (200kHz) 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 Research Ltd. June 2002

Produced for: Bilcon of Nova Scotia Corporation

Aquatic Ecology
Marine

Map 19B

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).

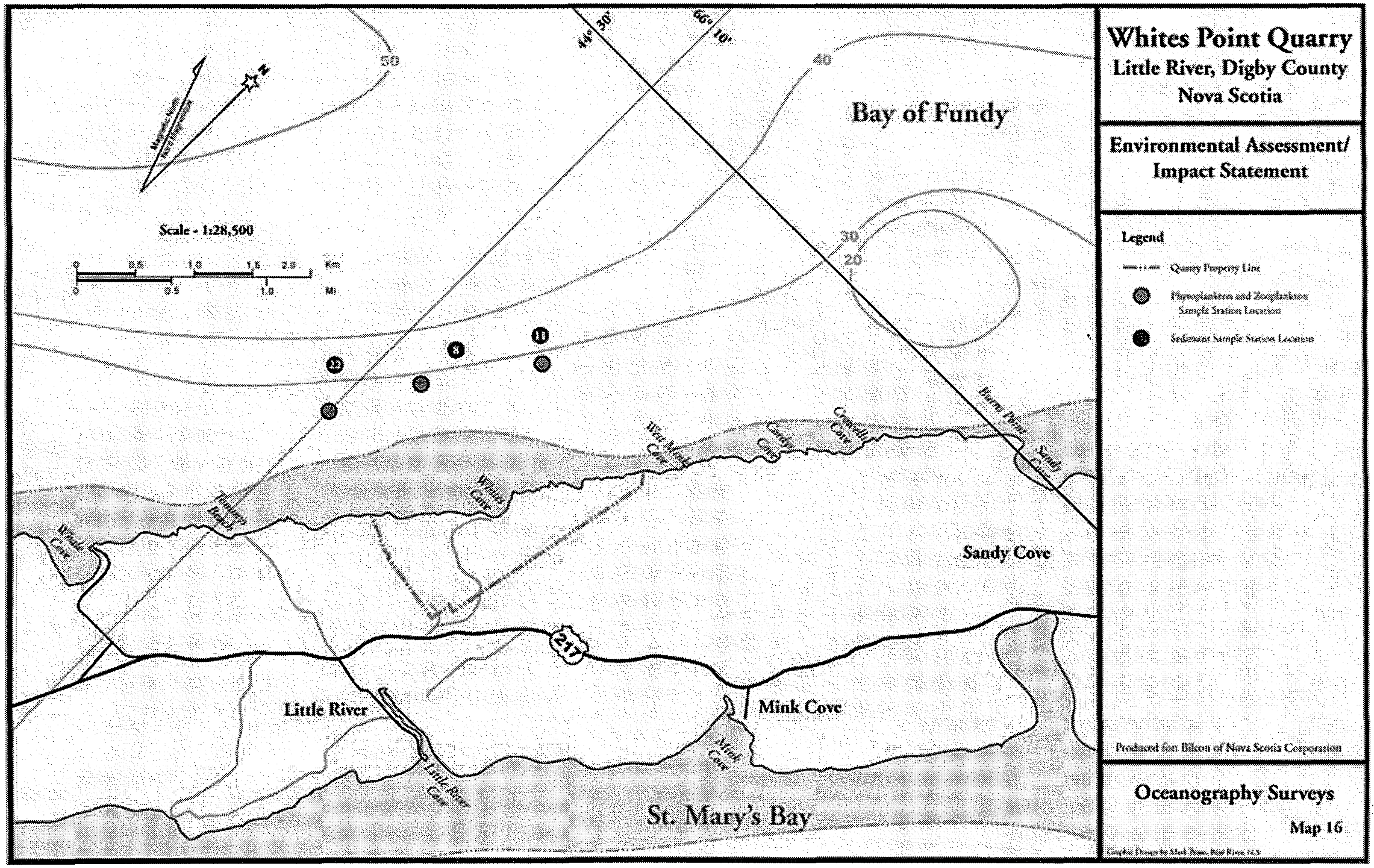
Sediment samples in the nearshore waters off the Whites Point quarry site were taken on July 14, 2005 – see Brylinsky, Michael. "Results of a Sediment Survey in the Near Offshore Waters of the Proposed Quarry Site in the Vicinity of Whites Cove, Digby Neck, Nova Scotia". September 2005. **(Ref. Vol. 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
Bay of Fundy
St. Mary's Bay
Scale - 1:28,500
Sandy Cove
Little River
Mink Cove
217
44° 30'
66° 10'
50
40
30
20

0185598

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.

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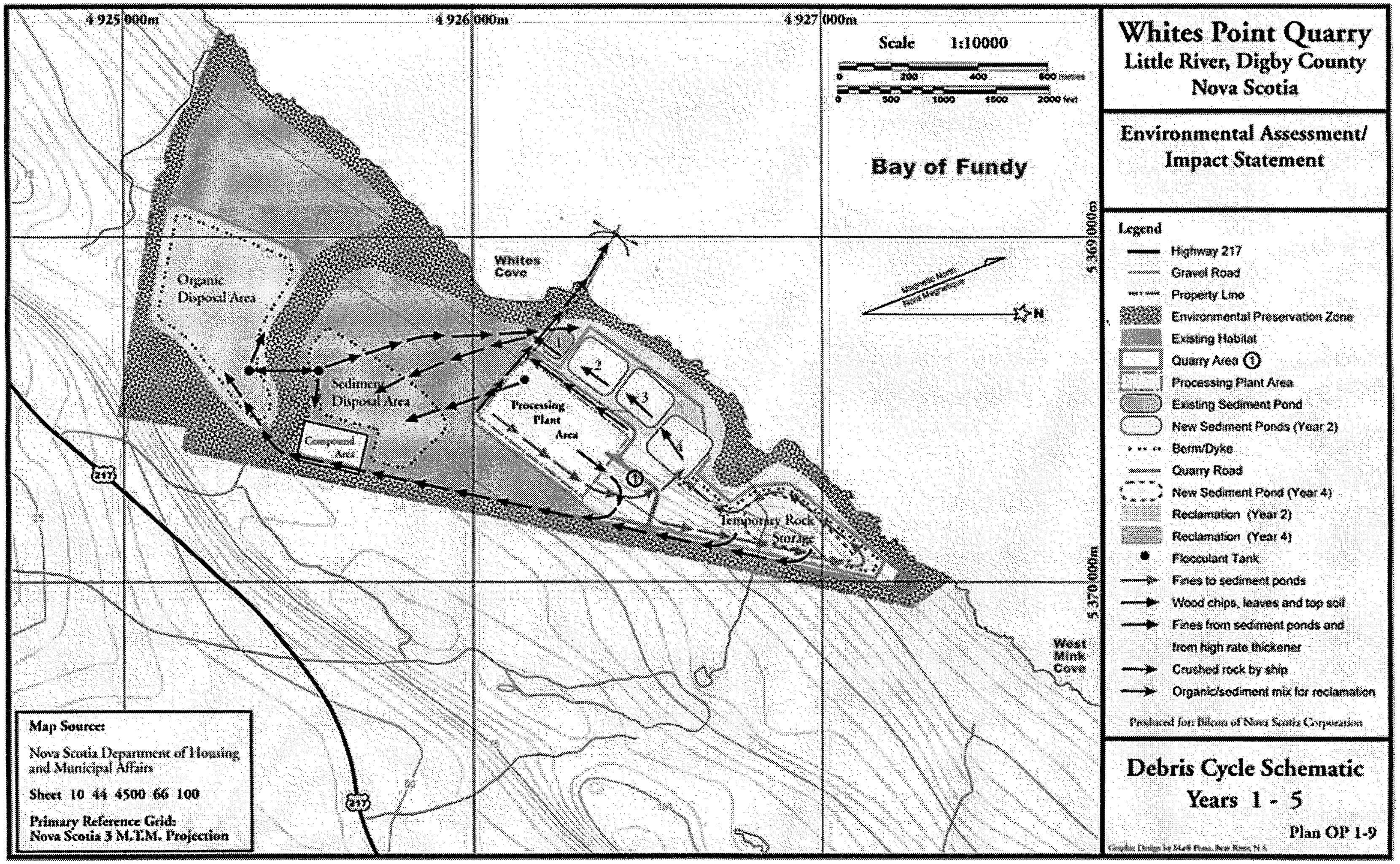


Whites Point Quarry
Little River, Digby County
Nova Scotia
Environmental Assessment/
Impact Statement
Legend
Highway 217
Gravel Road
Property Line
Environmental Preservation Zone
Existing Habitat
Quarry Area ①
Processing Plant Area
Existing Sediment Pond
New Sediment Ponds (Year 2)
Berm/Dyke
Quarry Road
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
Bay of Fundy
4 925 000m
4 926 000m
4 927 000m
5 369 000m
5 370 000m
Whites Cove
West Mink Cove
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 ComeauLab (coliform and e-coli) and PSC Analytical Services (general chemistry and trace metals) – see Appendix 45.

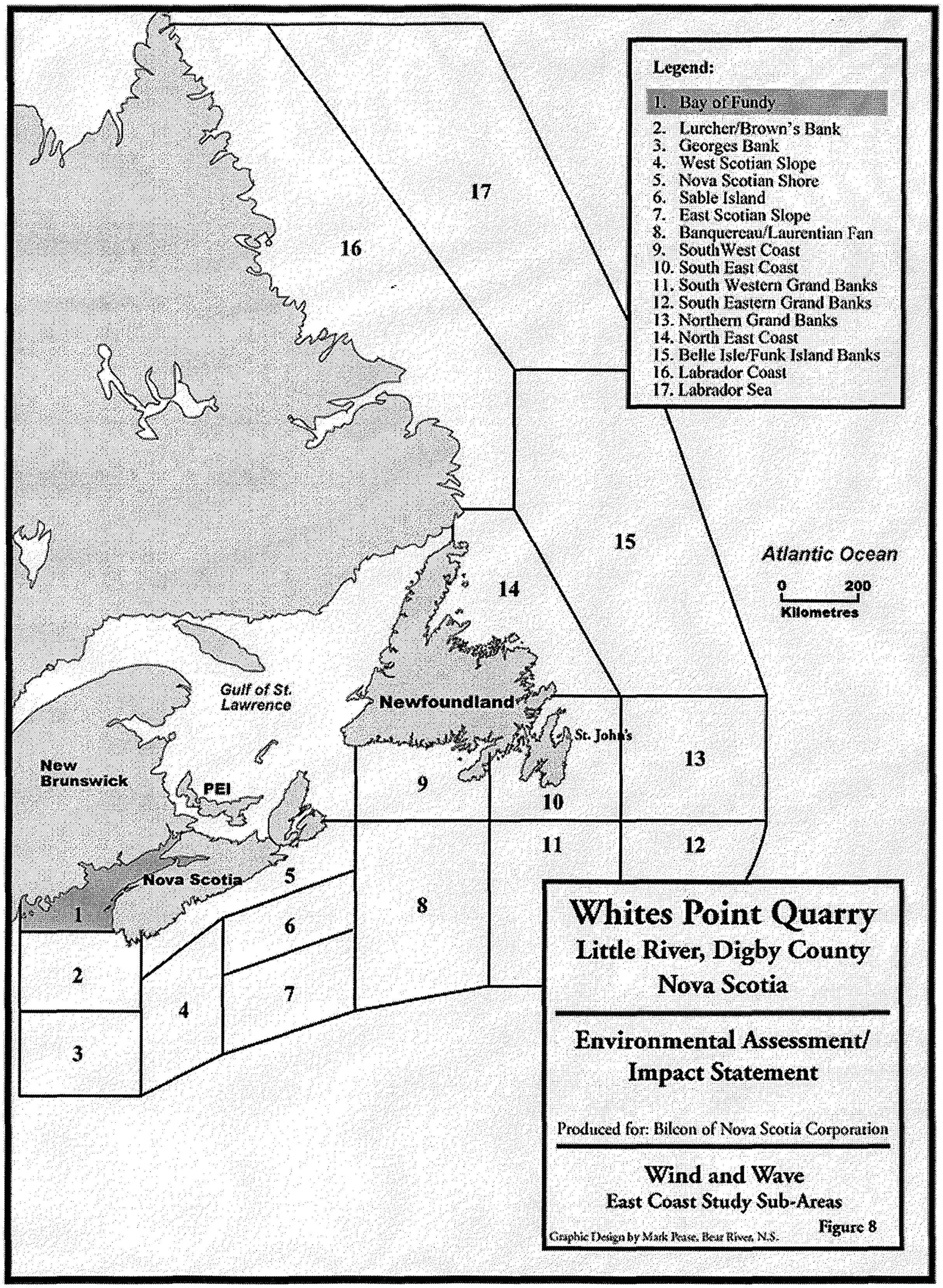
Physical characteristics were surveyed in temporal context during April, July, and October, 2004. Measurements of water column stratification (based on temperature and salinity profiles), water transparency (as Secchi Disk depth) were taken using a Yellow Springs Instrument Salinity – Conductivity – 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
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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.***

9.3.9.2 Analysis

Two major phases of the Whites Point quarry and Marine Terminal project were analyzed to determine potential effects on the local, regional, provincial and national economies. The construction phase is expected to take approximately one year to complete for a total capital cost of $40.6 million. Operation and maintenance is expected to continue for the fifty year life of the rock reserves with an annual expenditure of approximately $20.0 million. Final decommissioning will take place during the final year of operation. High-quality basalt rock reserves are estimated to be in excess of 100 million tonnes within the active quarry area on the site. Bilcon of Nova Scotia Corporation intends to construct and operate the quarry and marine terminal without public monies.

Economic impacts of the quarry and marine terminal have been estimated for both construction and annual operation. Direct and spin-off impacts from expenditures made to develop and operate the new facility are defined as follows:

- Direct impact is defined to include expenditures made by Bilcon of Nova Scotia Corporation and resulting in an economic impact

- Spin-off impacts include both indirect and induced impacts. Indirect impacts are those gained by firms supplying goods and services to Bilcon's activities and induced impacts are those attributable to income and employment generated by consumer spending at the direct and indirect impact stages

Construction

Capital construction expenditures are estimated to be $40.6 million with $7.5 million for mobile equipment, $14.0 million for plant infrastructure, and $19.1 million for a marine terminal and loading system.

Total construction employment resulting from construction of the Whites Point quarry and Marine Terminal in Nova Scotia amounts to 225.4 person-years of employment including all direct and spin-off impacts. Forty-five of these person years will be attributable to Digby County. At an annual average salary of $35,000.00, over $1.5 million would be attributable to Digby County construction workers.

Gross Domestic Product (GDP) is an important measure of economic activity. The total construction GDP for Nova Scotia is $14.5 million including direct and spin-off impacts of which $2.4 million are attributable to Digby County.

Federal and Provincial tax revenues will be generated from construction activities at the quarry and marine terminal. Total Federal tax revenue for both direct and spin-off will be almost $2.0 million with an additional provincial tax revenue of $1.6 million. Of this total, Federal tax revenue from Digby County would amount to $.31 million and $.27 million for provincial tax revenues from Digby County.

Operation

Total annual employment, including direct and spin-off is estimated to be 91 person-years in Nova Scotia. Of this total employment, almost 52 person-years of employment will be attributed to Digby County. Over the fifty year life of the project, total employment will exceed 4,550 person-years. At an annual average salary of $30,000.00, over $1.5 million would be attributable to the Digby County work force associated with the quarry and marine terminal each year.

A full-time work force of 34 persons working two shifts will be employed for approximately 44 weeks per year. Wages will range from $12.50 to $20.00 per hour. It should be noted that quarry employment is one of the highest paying industries. Skill requirements and training will be discussed in **paragraph 9.3.23.**

Gross Domestic Product (GDP) associated with annual operations is estimated to total $6.3 million in Nova Scotia. Over the fifty year life of the quarry project, a total GDP of over $315.5 million is estimated.

Federal, Provincial, and Municipal tax revenues will be generated from quarry operations each year. Total Federal tax revenues attributable to the quarry would be about $1.0 million, total provincial tax revenues about $.8 million and municipal taxes payable to the Municipality of Digby to be approximately $400,000.00. Tax revenues to be paid by Bilcon of Nova Scotia Corporation to the Municipality of Digby alone would amount to $20.0 million over the fifty year life of the quarry.

In conclusion, the Whites Point Quarry and Marine Terminal will provide direct, full-time employment at the quarry for 34 persons working two shifts for approximately 44 weeks per year. Wages will range from $12.50 to $20.00 per hour. Skill requirements and training are discussed in **paragraph 9.3.23.** Incremental tax revenues for municipal, provincial, and federal levels of government will result without expenditures of public monies. The Whites Point quarry and Marine Terminal will be privately financed and no government wage subsidies are applied for. A community opportunity will result which will include direct, stable, full-time employment and indirect supply of local goods and services. In broader economic context, the quarry project will provide alternative, sustainable choices to existing seasonal industries presently operating on Digby Neck/ Islands. Economic diversification, stability and resiliency will result in more favourable long term economic conditions for this coastal community.