Report

Noise and Air Quality Study at Whites Point Quarry

Bilcon of Nova Scotia
Digby, Nova Scotia

PROJECT NO. NSD19591

REPORT NO. NSD1591

REPORT TO

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Noise and Air Quality Study
at Whites Point Quarry

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NOISE AND AIR QUALITY STUDY AT THE WHITES POINT QUARRY

1.0 INTRODUCTION

Jacques Whitford was retained by Bilcon of Nova Scotia to assess the baseline noise levels and air quality at the site of Whites Point Quarry and Marine Terminal, in addition to assessing potential impacts of the project. The study included the main components:

1. Noise
2. Air

This report contains the observations of existing conditions for noise as determined by on-site measurements and observations. Existing air quality characteristics are based on on-site observations and the limited published information from the Nova Scotia Department of Environment and Labour (NSEL).

Predictions of impacts due to the development of the Whites Point Quarry and Marine Terminal are based on the project description information provided by Bilcon of Nova Scotia and standard techniques for impact prediction.

2.0 NOISE

2.1 Introduction to Noise

Noise is defined as unwanted sound. The level of noise, or the sound pressure level, is measured on a scale of decibels, abbreviated as dB.

Humans have different sensitivities to noise at different frequencies; that is, some frequencies sound louder than other frequencies, even though the energy content is the same. In order to allow for that, environmental measurements are conventionally conducted on the "A-weighted scale", denoting that they use a standard weighting system that accounts for human hearing response. These measurements are in decibels on the A-weighted scale and are abbreviated as dBA.

Sound pressure levels fluctuate, and they are conventionally averaged in such a way that the average is the sound pressure level corresponding to the sound pressure level that, if sustained for the period, would have the same energy content of the original signal; that is, it is energy-averaged.

These measurements are conventionally denoted as the Leq, usually with the time period specified, such as the 1-hour Leq, or the 3-minute Leq, for example.

Most persons experience sound pressure levels in the range of 30 dBA (quiet, rural setting) to 90 dBA (television). Table 2.0 shows the normal range for communication between persons.

Table 2.0 Normal Range of Communication Sound Levels

Voice category	Approximate Sound Level at 1 m from speaker (dBA)
Normal speaking voice	57
Raised speaking voice	65
Very loud voice	74
Shout	82
Maximum effort (scream)	88

Environmental noise has a larger range. Table 2.1 shows the complete range of foreseeable experience.

Table 2.1 Comparative Noise Levels

Sound, or noise source	Sound Pressure Level (dB)
Threshold of pain	140
	135
Jet aircraft takeoff at 100 m	125
	120
	115
	110
Rock music concert	105
	100
	95
	90
Heavy trucks at 20 m	85
	80
City street traffic	75
Noisy office, retail outlet	70
Busy office, typical daytime objective for residential area	65
	60
Conversational level	55
	50
Typical nighttime standards	45
Quiet office, library	40
Very quiet rural night	35
	30
Typical bedroom	25
	20
	15
	10
	5
Threshold of hearing	0

Noise is measured using sound pressure level meters of three types, as defined by ANSI classification. Type 1 meters are research grade, typically confined to laboratory or controlled conditions. Type 2 meters are suitable for routine monitoring programs. Type 3 meters should generally be restricted to diagnostic or screening use.

Table 2.2 Types of Sound Pressure Level (Noise) Meters

ANSI Classification	Characteristics	Advantages/Disadvantages
Type 1	Precision units , preferred for regulatory evidence, ANSI S1.4-1983	Most expensive, specialized use.
Type 2	General purpose, acceptable for Occupational Safety and Health Act requirements, ambient noise levels	General use, accuracy of +/- 1 dB
Type 3	Sound survey meters, non-professional and casual use	Least expensive, sometimes lacking in averaging or datalogging features, results subject to question in formal proceedings.

Because of the logarithmic nature of the measure, it is useful to introduce certain guides to the interpretation of noise measures.

- A doubling of the sound level energy corresponds to a numerical increase of 3 dB.
- An increase of 3 dB is barely perceptible to the human ear.
- An increase of 5 dB is perceptible to the human ear.
- An increase of 10 dB is perceived as a doubling of the noise level.
- A noise with a strong tonal component, such as a turbine, is perceived as stronger by about 5 dB than the actual noise level.
- A noise with an impulsive character, less than 10 cps (cycles per second, or hertz) such as a pile driver, is perceived as stronger by about 5-10 dB than the actual noise level.

Two other "rules of thumb" will be found useful in the review of noise assessments.

- The noise level from a *point source*, for example the exhaust of a stationary generator, decreases by *6 dB* for every doubling of the distance from the source to the receiver (Liu and Roberts, 1997).

- The noise level from a *line source*, such as a roadway of moving vehicles, decreases by *3 dB* for every doubling of the distance from the source to the receiver.

Finally, some benchmarks of mitigation will prove useful.

- Interruption of the line-of-sight from source to receiver results in a decrease of 5 dB.
- The noise reduction from noise barriers is typically 10 – 20 dBA.
- Housing provides noise attenuation of 15 to 25 dBA, depending on the composition of the structure.

This introduction to noise should help clarify the complexities of noise, and what must be considered and measured when coordinating a project like that of Whites Point Quarry.

2.2 Noise Guidelines

The regulation of noise in Nova Scotia is established through the Nova Scotia Department of Environment Guidelines for Noise Measurement and Assessment (Noise Guidelines) (NSDOE 1989) as follows.

- Leq 65dBA between 0700h and 1900h
- Leq 60dBA between 1900h and 2300h
- Leq 55dBA between 2300h and 0700h

Since the effect of land use may be influenced by noise from quarry construction and operation, the Noise Guidelines recommend values for residential or sensitive areas defined as "areas where people normally live, work, or take part in recreation." This does not apply to company work forces, which are protected under the Occupational Health and Safety Act.

2.3 Study Methods

Eight sites were identified to be monitored for a baseline noise study. Six of the locations were monitored for 20 minute intervals and two locations were monitored for 24 hour intervals. The locations were selected to provide sufficient baseline data coverage of potentially sensitive receptors and enable noise protection for these properties. Factors affecting noise propagation (ie., trees, topography) at particular properties have been observed and recorded

2.4 Field Conditions

Meteorological conditions, particularly wind, may affect noise levels. Baseline noise readings were taken between May 3 and June 21, 2005. Conditions during monitoring were mainly clear with calm to light winds (15 km/hr or less). Wind conditions were more brisk closer to the shorelines.

2.5 Equipment and Schedule

Sound levels were taken using Larson Davis Model 824 and Quest Model 2900 Type 2 integrating sound level meters. These instruments average the energy level of sound over a selected period of time and express this as Leq in dBA. Each measurement session comprised sound pressure levels logged one minute or one second Leq readings over defined periods of time. For the 24 hour recordings, measurements were then used to calculate the hourly Leq values. Pursuant to the Noise Guidelines, measurements were taken during portions of three daily periods: day (0700 to 1900), evening (1900 to 2300) and night (2300 to 0700). For the 20 minute recordings, measurements were used to calculate the one minute Leq values. These recordings were taken for comparison purposes of everyday activities that occur in the area.

2.6 Results

Baseline noise levels were tabulated and compared with the Noise Guidelines. Noise sources and additional remarks by field staff have also been listed. A summary of the Principle and Comparative Sites are presented in Tables 2.3 and 2.4, respectively.

The sites are described briefly in the following section.

<u>*Project Boundary*</u>

June 19 – 20, 2005

The project boundary area chosen consists of a wooded area with a public access dirt road. There is seldom any traffic except for a few all-terrain vehicles that pass through the area on occasion. At the time of monitoring there was a light breeze and clear skies. No unusual activity was recorded at the time of monitoring.

Nearest Receptor – Route 217

May 3 – 4, 2005

The nearest receptor chosen was the white house to the right of the entrance to the project site. At the time of monitoring no one occupied the house. The sound level meter was set up approximately 100 m from the highway and 10 m from the house. Sound sources would be from the local traffic on the highway, people in the area, wind, and animals. No unusual activity was recorded at the time of monitoring.

White's Cove Shoreline

(20 minute recordings)

This site is located on the project site near the shoreline in the area of the proposed loading dock. The sound level meter was set up approximately 50 m from the shore line.

May 3, 2005 – At the time of monitoring there was one fishing boat in the water, the wind was brisk and the waves could be heard hitting the coast.

May 4, 2005 – At the time of monitoring there were 3 fishing boats in the water and a calm wind.

Little River Intersection

The site is the major intersection in Little River. The sound level meter was set up approximately 10 m from the road and 5 m from the brook. There is a convenience store in the area along with many homes. Many trucks pass through this area to get to the Fish processing plant.

May 3, 2005 – No unusal activity was noted at the time of monitoring

May 4, 2005 – At the time of monitoring a truck was idling in front of the convenience store.

June 2, 2005 – No unusual activity was noted at the time of monitoring.

Whale Cove

The site is located at the end of a dirt road near a dock yard. The sound level meter was set up approximately 100 m from the shore line and to the right of the dock yard. There is very little traffic on this road.

May 4, 2005 – At approximately 11:55 a.m., a fishing boat docked, which spanned approximately 5 minutes.

June 3, 2005 – Due to the time of year the dock yard had more activity on shore and there were 3 fishing boats in the water.

East Ferry

The site chosen was in the yard of the local restaurant. The ferry was operational during both monitoring sessions. Sound sources include vehicles waiting, entering and departing the ferry, restaurant activity and local traffic.

May 4, 2005 – At the time of monitoring the restaurant was not open. The recording consists of vehicles idling while waiting for the ferry as well as passing traffic. At approximately 12:30 the ferry left the dock from East Ferry.

June 2, 2005 – At the time of monitoring the restaurant was open for business. The recording consists of traffic arriving for the ferry, restaurant activity, and traffic leaving the ferry. At approximately 11:00 am the ferry left Tiverton and arrived in East Ferry approximately 5 minutes later. At the end of the recording a large transport truck was idling in the area of the sound level meter contributing to the elevated sound pressure level.

Fish Processing Plant – Little River

This site is located at the end of the street in close proximity to the fish processing plant. The sound level meter was located near the docks and processing plant. The sources of sound include local traffic, people in the area, seagulls and wind. The plant was not in operation at the time of monitoring.

May 3, 2005 – At the time of monitoring there was little activity in the area.

June 3, 2005 – At the time of recording there was much boat activity in the harbor and more local traffic. The activity consisted of idling boats, large trucks unloading and numerous vehicles coming and going.

Bilcon Office Parking Lot – Conway

June 3, 2005

The site is located off the main street in Conway, Nova Scotia. The sound level meter was set up in the field to the left of the office and approximately 20m from the road. Sound sources include local traffic, people and wind.

2.7 Baseline Sound Pressure Levels

The values recorded at all baseline locations demonstrate typical levels expected in rural communities. The main sources of noise noted during the survey were traffic along Highway # 217 or local roadways, water activity (streams, waves, boats) and normal residential activity.

Table 2.3 shows the summary of sound pressure levels measured at the principal areas of concern – the nearest receptor and the property boundary.

Table 2.3 Principle Baseline Noise Monitoring Hourly Summary

Time of Day	Monitoring Sites		Guideline
	Nearest Receptor	Property Boundary	
12:00:00	35.1	43.9	65
13:00:00		37.0	65
14:00:00		35.3	65
15:00:00	48.1	36.4	65
16:00:00	40.1		65
17:00:00	37.6		65
18:00:00	35.7		65
19:00:00	35.7	57.6	65
20:00:00	35.6	45.4	60
21:00:00	43.2	49.2	60
22:00:00	35.1	38.2	60
23:00:00	33.1	37.7	60
00:00:00	33.3	36.1	55
01:00:00	32.9	35.6	55
02:00:00	33.2	35.7	55
03:00:00	32.9	35.3	55
04:00:00	34.0	36.4	55
05:00:00	36.1	49.7	55
06:00:00	34.9	37.5	55
07:00:00	37.1	44.9	65
08:00:00	34.2	36.9	65
09:00:00	37.6	40.9	65
10:00:00	37.1	45.5	65
11:00:00	36.3	37.6	65

In addition to these longer sets of measurements at the two principal locations, it was considered useful to conduct brief monitoring studies at representative local areas in order to provide some comparisons. Table 2.4 shows the Leq values obtained at these 6 additional sites.

Table 2.4 Baseline Sound Pressure Level Monitoring – Comparative Sites (20 minute intervals)

Site	Little River Intersection			White's Cove		East Ferry		Whale Cove		Fish Processing Plant		Bilcon Office
Date	May 3	May 4	June 2	May 3	May 4	May 4	June 2	May 4	June 3	May 3	June 3	June 3
Start Time	18:48	12:49	11:23	17:10	10:41	12:16	10:51	11:43	09:12	19:12	08:40	10:53
	Leq – 1 minute averages for 20 minute duration											
1	60.1	60.6	54.7	51.2	36.1	35.2	70	26.6	50.6	49.4	66.9	58.7
2	62.5	56.3	54.1	51.1	34.8	34.5	47.8	26.0	50.9	52.2	56.8	57.4
3	56.1	58.3	53.9	50.6	35.0	35.5	51.4	24.3	51.7	41.2	48.5	59.3
4	56.6	57.9	54.5	50.9	35.6	35.3	52.0	23.8	50.6	40.9	50.2	55.6
5	55.6	57.9	56.1	50.9	33.8	34.3	57.8	24.3	51.4	50.6	48.5	56.2
6	56.4	59.2	53.8	50.2	34.7	33.0	61.6	25.1	51.4	48.9	48.7	56.8
7	55.6	57.8	56.3	50.1	35.3	33.7	55.7	26.6	50.7	45.8	49.5	56.7
8	59.2	57.9	54.5	51.4	35.7	33.1	52.9	29.5	51.2	41.0	48.8	59.2
9	57.7	57.8	54.1	51.9	34.8	47.3	59.9	29.3	50.5	42.4	48.2	59.8
10	56.8	57.8	53.8	51.2	36.6	31.9	62.2	27.8	51.1	54.2	48.4	56.9
11	62.2	57.9	56.5	50.5	34.7	31.7	63.8	29.5	50.6	38.2	51.3	59.6
12	56	61.7	53.7	48.9	34.7	42.8	61.9	31.1	52.3	37.5	50.2	56.0
13	56.4	60.2	53.8	50.5	34.9	42.1	54.1	35.4	51.2	38.1	49.7	57.9
14	56.7	58.2	54.5	48.9	32.8	30.5	55.8	39.2	51.4	38.9	48.6	55.7
15	57.7	58.2	54.8	49.7	33.0	30.5	56.6	38.3	50.8	39.1	49.5	57.0
16	55.4	58.0	55.1	50.1	33.6	47.4	55.4	27.6	51.8	37.4	49.8	57.1
17	58.4	58.9	53.1	49.9	33.6	31.7	59.7	23.8	51.3	39.8	49.1	55.3
18	58.1	58.3	52.9	50.8	33.0	35.0	70.7	27.3	63.9	38.5	49.5	55.3
19	56.0	65.4	57.7	51.6	34.0	41.8	67.8		50.7	49.7	50.2	54.7
20	58.1	57.7	52.8	51.6	33.0	34.2	67.5		52.0	39.8	49.1	

2.8 Potential Issues, Interactions and Concerns

The effects of noise will vary depending on the number and location of sensitive noise receptors (e.g. residential properties, schools), and factors affecting the distance over which noise travels (e.g. vegetation, topography, meteorological). In general, noise due to construction and noise due to operation on the quarry are different, and may affect receptors differently.

Noise due to construction is usually louder than normal quarry operation, but is of relatively short duration. It can affect land uses directly adjacent to the RoW. Quarry development will involve typical road and facility building activities. Table 2.5 lists the noise outputs of construction and operation machinery commonly used. The noise level on quarry sites will always fluctuate with the level of activity on the site.

Table 2.5 Probable Noise Levels of Construction Tools

(Table from: University of Washington, Department of Environmental and Occupational Health Sciences, R. Neitzel, July 2005)

Equipment Type	Noise level at Operator's Ear will probably exceed... (dBA)
Air compressor	90
Air gun	108
Air hammer	110
Air track drill	110
Asphalt grinder	111
Backhoe	85
Belt sander	90
Bored piledriver using auger (at 15m)	81
Brick saw	94
Bulldozer	87
Chipper, pneumatic	100
Chipping gun	96
Chopsaw	92
Circular saw	88
Compactor	90
Compressed air gun	104
Compressor (at 7m)	70-77
Concrete mixer truck at 50 ft	75
Concrete pump at 50 ft	81
Concrete saw	98
Concrete vibrator	90
Cutoff saw	98
Diesel hammer piledriver (at 15m)	95-99
Double scraper	92
Drill	87
Drop hammer piledriver (at 15m)	83-93
Dump truck	78
Electric grinder	98

Excavator	80
Forklift	93
Framing saw	82
Front end loader	90
Generator at 50 ft	72
Grader/scraper	107
Grinder	87
Hammer	85-89
Jackhammer	102
Jigsaw	91
Manlift	84
Mechanical tamper	90
Mobile crane	78
Motorized wheel barrow	86
Nailgun	97
Paver (at 50ft)	86
Piledriver (at 50 ft)	95
Portaband	83
Portable welder	84
Powdered actuated tool	89
Reciprocating saw	86
Road grader	95
Rotohammer	84
Router	90
Scraper	117
Screw gun	86
Steam roller	84-85
Stud welder	101
Vibratory piledriver (at 15m)	85
Welding equipment	92

Operational traffic noise and blasting from the quarry can affect sensitive receptors adjacent to the quarry access road. The topography of the land will greatly reduce noise for the quarry as well as the fact that most aggregate will be removed by ship and not along the highway.

2.9 Residual Environmental Effects Evaluation Criteria

A positive effect occurs when project-related activities result in a reduction in ambient noise level (i.e., through construction of sound barriers).

A significant adverse environmental effect with respect to noise may be defined by any of the following:

- A noticeable change in noise level (approximately 5 dBA) that results in an exceedance of the Noise Guideline levels;
- A noticeable change in noise level (approximately 5 dBA) above existing noise levels in areas where the guideline levels are already exceeded; or
- A change in noise level of approximately 10 dBA above existing noise levels in areas where the Guideline levels are not exceeded (Liu and Roberts, 1997).

The severity of change combined with the resulting Leq (equivalent continuous sound level measurement) will determine mitigation requirements and residual effect.

2.10 Analysis, Mitigation and Residual Environmental Prediction

The potential sources of noise are first recognized, and from there a mitigation plan can be formulated to minimize or eliminate the effects of noise. The following section discusses the mitigation options that could be employed.

2.11 Construction

Roadbed preparation and grading of the access road will have the most potential of affecting nearby residents. Construction noise, for the purpose of this assessment, has been assumed to be generated by 3 machines (grader, loader and dump truck), working in a group. Based on the median output levels, this would give a combined sustained source level of approximately 92 dBA at a distance of 15 m and would attenuate 6 dBA for each doubling distance as the source is localized (May 1978).

As a result, a receptor within 400m of the activity with no other mitigation present for noise would experience sound pressure levels that exceed the Noise Guidelines for 65 dBA for daytime noise levels.

Any receptor within 80 m of the activity would exceed 80 dBA, which is the level at which hearing protection is required by the Nova Scotia Occupational Health and Safety Regulations. Land clearing is a construction operation that is generally quieter and of shorter duration than roadbed preparation.

The nearest residence is about 500 m from the quarry site, and just over 1 km from the marine terminal. Noise during this phase of work will be perceptible, but of short duration and below critical levels. In addition, work will be limited to less sensitive time periods.

2.12 Operation and Maintenance

For the most part, actual quarry operations will not generate excessive amounts of noise. All operating equipment will be outfitted with standard noise suppression exhaust systems and kept generally in good working order. Ongoing vehicle inspections will be conducted to ensure that contracted haulers possess functioning engine noise muffling devices. Other potential measures could include regular maintenance and lubrication of machinery, usage of quieter backup alarms for large vehicles, and implementing noise compliance monitoring in the form of an on-site technician.

The significant potential noise sources within the quarry site are the crusher and conveyors used to process the rock. Bilcon has determined that an enclosed structure will be used so that noise from these activities is sufficiently dampened to meet noise guidelines. This commitment represents the most effective design mitigation that could be applied, and will reduce the incidental impulse noises, such as rattles, as well as the average noise levels significantly, avoiding any offsite impacts.

It is stipulated by Bilcon that the noise at the crusher building will not exceed 85 dBA at 15 m. At the nearest receptor, this noise should attenuate to below 40 dBA with distance, and a further 10 to 15 dBA due to landform and vegetation. Other vehicle related noise at site will be of the same order. It is likely that those sources will be only perceived when the background levels at the receptors is very low, and they will meet the guidelines of Section 2.2 by a large margin.

The proponent has also committed to the use of rubber lined boxes on the trucks that carry material within the quarry site. This is a very effective method of reducing the loading noise.

2.13 Blasting

Blasting creates as udden and intense airborne noise that could affect nearby receptors negatively. Additionally, blasting could create local ground vibrations, which is dependent upon various factors, such as the type of soil/rock, type of explosive, amount of explosive used, depth of explosion and meteorological conditions. Even though under most conditions, ground vibrations would not effect or damage property, it may result in disturbances to sensitive locations.

A qualified blasting contractor should be retained to determine the size, type, and location of blasting to minimize disturbance to nearby residents, and to ensure that no property damage will result from blast noise and vibration. Notification of blasting activity should also be forwarded to residents in the immediate vicinity of the blasting zone. Other options could include using blast mats or other techniques, to minimize noise (Thalheimer, 2004).

A blasting plan should be developed as a part of the approvals process and be distributed to concerned citizens.

2.13.1 Traffic to and from site

Vehicular traffic to and from the site must be considered with respect to noise. All categories of vehicles from passenger vehicles to heavy trucks generate noise. Traffic management is one route to look at, which includes modification of speed limits and limitation of truck traffic in and around the site. Roadway design measures can also be incorporated, which entails altering the roadway alignment and depressing roadway cut sections. Alteration of roadway alignment achieves noise reduction noise levels by moving the traffic farther away from the affected receivers. Noise receivers are the third route to take, by employing physical barriers that block the transmission of traffic-generated noise.

Whites Point Quarry will transport no material to and from the site by road. This will prevent nighttime traffic noise. Also, the topography effectively presents a noise mitigation berm (e.g. line of sight barrier) between the quarry operations and potential receivers. As all aggregate will be transported away from the site via ship, road traffic is restricted to quarry staff and problems are very unlikely.

2.13.2 Loading of Ships

All of the aggregate transport from the site will be by marine transport. The loading and unloading of aggregate will cause noise levels above that of the existing background noise that could affect receptors including marine life, and surrounding commercial marine-related operations within a few hundred meters of activities.

Since the loading and unloading of ships will be short-term actions that will be carried out in a designated location this will only cause minor disruption. The distance and topographic shielding will further attenuate the noise to acceptable levels.

2.13.3 Water Traffic

The noise created by way of water traffic is somewhat connected with the loading and unloading of cargo. Noise and vibration will be generated by ships on their routes to and from the location,how ever the ship operation is at significantly reduced speed, and is likely to be much less than the noise generated by commercial fishing vessels that frequent the area. The use of large cargo ships will minimize the frequency of vessel passages.

2.14 Follow-up and Monitoring

Follow-up actions should include providing usable knowledge to on-site staff to enforce compliance to developed noise guidelines. Noise will continue to be monitored periodically to ensure compliance is taking place.

Community participation will also be encouraged to create a dialog involving the local residents. Finally, a noise complaint process will be established so that concerns can be addressed in a timely manner.

3.0 AIR QUALITY

3.1 Introduction to Air Quality

Due to the nature of the Whites Point Quarry project, the majority of the work occurring on-site consists of heavy construction work. There can be significant dust generation that may have a substantial temporary impact on local air quality. Dust emissions often vary substantially on a daily basis at construction sites depending on the level of activity, the specific operations, and the prevailing meteorological conditions.

Emissions during quarrying and material handling can be associated with combustion gases from heavy vehicles, which produce particulate-containing exhaust consisting of a variety of contaminants. For the current project it is the dust emissions produced from construction operations including drilling, blasting, crushing, screening, storage, and ground excavation, which is of particular relevance. The concentration of Total Suspended Particulate (TSP) generated from dust emissions is the primary focus of this air quality study.

There will be three to five heavy duty diesel powered vehicles operating on-site, but those emissions will not be perceptible beyond the site boundaries.

The potential emissions, their effect and the resulting recommendations for mitigation are discussed in the following sections.

3.2 Criteria of Assessment

The typical contaminants assessed are the criteria air contaminants which have ambient air quality standards. These include:

- Carbon Monoxide (CO): A colourless and odorless gas that is a byproduct of burning carbon-based fuels. High CO emissions most likely occur during cold-engine startup.

- Nitrogen Oxide (NOx): This is a generic term for a group of highly reactive gases containing nitrogen and oxygen in varying amounts. Nitrogen oxides form as a byproduct of the combustion process and can be a chief contributor of smog.

- Carbon Dioxide (CO_2): CO_2 is a primary product of the combustion process and a recognized greenhouse gas. During repeatable emission testing events, CO_2 can be used as a measure of fuel economy.

- Hydrocarbons (HC): Diesel fuel is composed chiefly of hydrocarbon compounds, organic compounds consisting of carbon and hydrogen. When diesel fuel is burned, the organic portion of the exhaust is primarily HC, and generally, the entire organic portion of diesel exhaust is referred to as HC. However, it should be noted for off-road equipment, HC can also be referred to as volatile organic compounds (VOC). Diesel engines typically have low HC emissions, and even a slight change in emission properties can lead to a large change in emissions on a percentage basis.

- Total Suspended Particulate (TSP). The ambient concentration of total suspended particulate matter (TSP or PM) is a measure of the particles in the atmosphere with an aerodynamic diameter up to 44 µm and may remain suspended for significant periods of time. TSP is produced by mechanical processes, such as the abrasion of vehicle tires on unpaved roads, and combustion. Most particulate matter formed by combustion is either as mineral ash, or as hydrocarbons formed by incomplete combustion.

- Fine and Respirable Particulates (PM_{10} and $PM_{2.5}$). Although TSP or PM is an excellent measure of the loading of particulate matter in the air, it does not necessarily reflect the health risks of the particulate matter. In higher organisms, larger aerodynamic particles are trapped by the upper airways of the respiratory system, and usually do not enter the lungs. Smaller diameter particles, however, can make their way to the lungs and may become lodged there with the potential to create adverse effects on health. Over the past decade, increasing concern over the potential health effects of these fine particles has led to research resulting in new sampling methods and criteria.

Quantitative limits are discussed in the following sections however, due to the nature of the project operations, the contaminants of primary concern are the particulates.

3.3 Air Quality Guidelines

The regulatory limits for ambient air quality are set forth by the Nova Scotia Department of the Environment. These are expressed as the maximum permissible ground level concentrations that should not be exceeded. These values are presented in Table 3.1.

Table 3.1 Ambient Air Quality Criteria

Contaminant	Averaging Period	Regulatory Limit ($\mu g/m^3$) Desirable / Acceptable
Nitrogen Oxides (as NO_2)	1 hour 24 hour Annual	213 / 400 - / - 53 / 100
Sulfur Dioxide (SO_2)	1 hour 3 hour 24 hour Annual	344 / 900 - 115 / 300 23 / 60
Particulate Matter (PM)	24 hour Annual	- / 120 - / 70
Particulate Matter < 10 microns (PM_{10})	24 hour Annual	- -
Carbon Monoxide (CO)	1 hour 8 hour	31,000 / 35,000 13,000 / 15,000
Hydrogen Sulfide (H_2S)	1 hour 24 hour	30 / 42 6 / 8

A significant adverse environmental effect is defined as one that would reduce air quality, such that the level of TSP matter exceeds 120 $\mu g/m^3$ over a 24 hour averaging period or 70 $\mu g/m^3$ over an annual averaging period. These limits are specified as the 'maximum permissible ground level concentrations' under the Nova Scotia Air Quality Regulations and as the 'maximum acceptable' limits under the Canadian Environmental Protection Act (CEPA) Ambient Air Quality Objectives.

The Canadian Council of Ministers of the Environment (CCME) has proposed a Canada-wide standard for the finer fraction of PM, which is $PM_{2.5}$. The standard to be achieved by 2010 is a concentration of 30 $\mu g/m^3$ of $PM_{2.5}$, averaged over 24 hours. In addition, as part of the implementation strategy for $PM_{2.5}$, provinces will strive to maintain air quality through use of best available economically feasible technologies on new sources and upgrades to existing sources in those areas currently below the proposed standards.

A positive effect occurs when there is a predicted or expected improvement in ambient air quality and mitigative measures in the area affected by Project activities.

3.4 Existing Conditions

The Project area and Nova Scotia in general, has good air quality due to the combination of maritime climate and relatively small population and industrial bases (NSDOE 1998). Climatic conditions provide good dispersion of air contaminants. The ambient air quality also benefits from the infusion of relatively clean polar and arctic air masses. Occasionally, however, long-range transport of air masses from central Canada or the eastern seaboard may transfer contaminants into the area, causing occasions of poorer air quality.

Ambient air quality is monitored in Nova Scotia with a network of 28 sites, operated by The Nova Scotia Department of Environment and Labour (NSDEL), Environment Canada, and Nova Scotia Power Inc. (NSPI). The NSDEL monitoring site nearest the study area is located at the Pictou Museum and monitors sulfur dioxide (SO_2), total reduced sulfur, and total suspended particulates (TSP). Monitoring sites in Halifax and Point Tupper are the nearest to the Project ,which monitor nitrogen dioxide (NO_2), carbon monoxide (CO), Hydrogen Sulfide (H_2S) and ground level ozone (O_3). These sites are jointly operated by NSDEL and Environment Canada.

In general, the air quality of Nova Scotia meets the desired federal ambient air quality criteria, with one-hour maximums below maximum acceptable limits for CO, NO_2 and TSP (refer to Table 3.2). Occasional hourly exceedances for $SO_2$and H_2S occur in localized areas with high industrial activity (i.e., Point Tupper) (NSDOE 1995b) (Table 3.2). Hourly exceedances of ground level ozone have occurred on an occasional basis over the entire province, but are generally higher in southwestern Nova Scotia. The ozone is associated with long range transport of pollutants from central Canada and the US (NSDOE 1998).

It may therefore be assumed that ambient air quality of the study area generally meets the desired criteria, except when long-range transport results in high levels of ozone.

Table 3.2 Maximum Values for Air Quality Parameters Measured at Monitoring Stations in Nova Scotia

Parameter	Measured Maximum	NSDEL Limit	Period	
SO_2	33.5 pphm	34 pphm	hourly	Pictou (NSPI)

TRS1	13 ppb	30 ppb	hourly	Pictou
TSP	187 µg/m³	120 µg/m3	24 hours	Pictou
H2S	84 ppb	30 ppb	hourly	Point Tupper
CO	3.8 pphm	31 pphm	hourly	Halifax
NOx	7.8 pphm	21 pphm	hourly	Halifax
O3	2 exceedance events	82 ppb (objective)	hourly	Halifax

1Total Reduced Sulphur (TRS)
Source: NSDOE 1995b

3.5 Potential Issues, Interactions, and Concerns

There are several operations within a quarry that can be responsible for the generation of particulate matter. Provincial regulations, reflected in the Pit and Quarry Guidelines, specify that particulate emissions will not exceed the following limits at the site property boundaries:

Annual Geometric Mean	70 $\mu g/m^3$
Daily Average (24 hrs)	120 $\mu g/m^3$

There are a variety of activities that can lead to the generation of particulate matter on the construction site. The primary potential sources of TSP include:

- Exhaust gas emissions due to incomplete combustion from diesel compression engine;
- Road dust;
- Wind erosion on storage piles;
- Blasting activities;
- Conveyors;
- Crushing operations;
- Screening operations;
- Material handling;
- Material transport; and
- Truck loading / truck unloading.

Some of the more pertinent contributors are discussed in detail in the following paragraphs.

- Blasting can result in a concentrated plume of particulate matter, but the volume and time duration of such plumes are constrained. Even when blasts result in a visible plume, the contribution to 24-hour averages, as in the Air Quality Regulations, will be negligible. Much of the material in the initial plume is larger than the aerodynamic diameter of particles that can remain suspended in the air, and deposit within a relatively short distance (e.g., 100 m) of the blast site. In this project, the proponent will take measures to minimize visible plumes. Although not visible due to topography, it is recognized that they are of concern to the public and regulators, and control is appropriate.

- Both crushing and screening are mineral extracting operations that involve the generation ofpartic ulate emissions. Uncontrolled processing operations like these can produce nuisance problems and can have an effect upon attainment of ambient particulate standards. However, the generally large particles produced often can be controlled readily. Sometimes crushing and screening take place with high moisture content and such processes do not generate appreciable particulate emissions. In this project, the crushing is to be conducted in an enclosed space, which is to be ventilated through filters to the outdoors. The material is collected after crushing, and the finer particles are transported in a moist state to be used as fill on the property.

- Material handling activities can result in the generation of particulate matter. The source is often the vertical drop of material movement. As the fine material passes through the air, the finest material may become windblown and travel downwind.

- Storage piles and exposed areas are often left uncovered due to the need for frequent material transfer, which can lead to considerable dust generation. Dust emissions can take place during several points in the storage cycle, including material loading onto the pile, disturbances by strong wind currents, and removing loads from the pile. The potential drift distance of particles caused by wind is determined by the initial injection height of the particle, the terminal settling velocity of the particle, and the degree of atmospheric turbulence.

- Particulate emissions can occur whenever vehicles travel over both paved and unpaved surfaces. Particulate emissions from paved roads are caused by direct emissions from vehicles such as exhaust, brake wear and tire wear emissions and resuspension of loose material on the road surface. Resuspended particulate emissions from paved roads originate from, and result in the depletion of, the loose material present on the surface. Regarding unpaved roads, the force of the wheels on the road surface causes pulverization of surface material. Particles are picked up and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake following the vehicle continues to act on the road surface after the vehicle has passed.

- Although there are also emissions of combustion gases and products of incomplete combustion from the exhaust of the on-site vehicles and equipment, these are considered nominal. Due to the nature of the project operations, the contaminants of primary concern are the particulates.

3.6 Mitigation Options of Potential Sources

After identifying the potential sources of dust emissions that negatively impact air quality, it is necessary to develop a mitigation strategy to lessen or eliminate this impact. The following section discusses the mitigation options that could be employed.

3.6.1 Mechanized Work Process Mitigation

The sources of particulate emissions were discussed in the preceding section. Through the entire process of material preparation, storage, and unloading, there are steps that will be taken to minimize PM emissions. Such steps can include some or any of the following recommendations (Stäbuli and Kropf, 2004):

- Apply dust suppressant, preferably using a wet spray process with non-alkaline additives;
- Place crushers in enclosed buildings so as to cause as little dust as possible;
- Crush using pressure instead of pounding;
- Equip pulverizers with dust traps;
- Employ transfer processes with small dump heights, low exit velocities and closed receptacles;
- Cover outdoor lengths of conveyor belts to abate dust;
- Encapsulate all transfer points;

- Minimize trimming (e.g. scraping and pushing rubble heaps on transfer sites); and
- Minimize the working face of the piles.

For the most part materials remain undisturbed in storage; however some control measures may be required, as suggested below:

- Encapsulate the filling and emptying mechanism of silos storing dusty or powdery materials and filter the air displaced from the silos;
- Prevent wind blowing dust away from deposits of rubble, which are frequently shifted. This could be done by moistening, protective walls or halting work during unfavourable weather conditions;
- Shield infrequently accessed dumps from wind exposure by covering with mats, tarpaulins, or similar;
- Greening non-working faces of material piles with vegetation; and
- Applying dust suppressant as warranted.

There are additional measures that may be implemented for transportation on site (Stäbuli and Krodf, 2004):

- Apply dust suppressant, preferably using a wet spray process with non-alkaline additives;
- Restrict maximum speed on construction site pathways;
- Stabilize intensively used trails with suitable dust abating surfacing (e.g. asphalting or greening). Regularly clean the trails and bind dust to prevent dirt accumulating;
- Equip the exits of construction sites with effective dirt traps;
- Dismantle demolition objects in large pieces, with suitable dust binding; and
- Provide intensive sprinkling or water curtains to bind dusts from large-scale demolitions and blasting, when enclosing is impossible.

In fact, dust generated by truck movement must be minimized via speed control, proper truck loading, application of dust suppressants, proper construction of on-site roads, suitable rehabilitation planning (including windscreens), and/ or other means as required by NSEL. Because all movement of material by truck is on-site, as opposed to public roads, there is no anticipated impact of dust generation.

3.7 Maintenance of Particulate Control Measures

The operation and maintenance of the air quality initiative for the quarry largely depends on which measures will be executed to deal with PM emissions. Typically maintenance would most likely involve remoistening of the appropriate dust-laden areas and frequent cleaning of such devices like dust traps. Naturally, as new areas, transportation trails, or equipment are integrated into the project, the necessary preventive measures and maintenance must be adhered to.

Exhaust emissions from equipment and vehicles will be mitigated by following standard maintenance practices to ensure efficient operation and minimization of emissions.

3.8 Environmental Protection Plan

A dust control plan will be developed to meet operating permit stipulations and, as a minimum, the following procedures should be followed to minimize dust generation:

a) Rock drills will be equipped with dust collectors, which are in good working order and will be operational during the drilling activities.
b) Conveyor loading systems will be equipped with hoods.
c) Dust from construction activities will be controlled where possible by frequently applying water spray. Locations where water is to be applied, the amount of water to be applied and the times at which it shall be applied shall be determined by the Operations Manager. Water will not be applied in situations where surface water could freeze and create a potential safety or traffic hazard.
d) At least one water truck shall be available to the work site at all times. Water shall be applied by means of a pressure type distributor equipped with a spray system of nozzles that will ensure a uniform application of water. Minimal amounts of water required to control dust will be applied such that potential for surface runoff of sediment is minimized.
e) Water trucks are not to be driven down to the edge of any watercourse, unless the area is firm, so that ruts will not form.
f) Rock and gravel may be moved by hand to obtain a pool for a suction pipe, but a backhoe, bulldozer, or other earth moving equipment is not to be used in a watercourse.
g) Waste oil will not be used for dust control, but other agents such as calcium chloride may be used, subject to the approval by the regulatory authority.
h) All approved dust control agents will be stored and contained to prevent inadvertent release to the environment.

i) To reduce the quantity of ambient dust and potential for erosion, the Operations Manager shall reasonably minimize the amount of disturbed area exposed at one time.
j) The Operator shall not burn refuse or other material on site, without prior approval from the regulatory authority.
k) All vehicles and equipment will be maintained following recommended maintenance schedules.

3.9 Follow-Up and Monitoring

Monitoring of total suspended particulate matter will be undertaken during the operational phase using TSP Hi-Vol samplers, as required.

A complaint resolution program will also be put into place whereby public concerns communicated to the quarry are tracked and resolved in a suitable and timely manner. Where applicable, the monitoring programs will be modified to address voiced concerns. For example, the dust monitoring program could address concerns that deposits in a specific area are related to quarry activities. In such cases, it may be possible to determine the source of the deposit and, if not attributed to the quarry site, it would not warrant ongoing monitoring.

4.0 GREENHOUSE GAS INVENTORY

Greenhouse gases are basically chemical compounds that allow sunlight to enter the earth's atmosphere freely. When sunlight enters and strikes the Earth's surface, some of it is reflected back towards space as infrared radiation, which is then absorbed and trapped in the Earth's atmosphere by greenhouse gases. This phenomenon is what is referred to as the Greenhouse Effect, and over time causes global climatic changes, which have a significant impact on the environment.

Some greenhouse gases occur naturally in the atmosphere, while others result from human activities. Natural greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). However, certain human activities add to the levels of most of these naturally occurring gases:

- CO_2 is released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are combusted.
- CH_4 is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from the decomposition of organic wastes.

- N_2O is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.

Other greenhouse gases that are not naturally occurring in the atmosphere include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), which are generated in a variety of industrial processes (EPA, 2005). These gases will not be used in this project. In February 2005, the Kyoto Protocol came into force, which requires the participating countries to reduce their emissions of CO_2 and five other greenhouse gases.

With respect to the Whites Point Quarry, it is CO_2 emissions, which will be focused on due to the nature of the operations taking place at the site.

4.1 Greenhouse Gas Emission Sources

The CO_2 emissions sources at Whites Point Quarry primarily consist of all of the machinery and devices on-site. The operation comprises five different stages including: primary treatment, secondary treatment, fine crushing, the washing plant, and load out procedures. All five of these stages require a variety of equipment utilizing electric motors including such units as conveyor belts, screens, feeders, and pumps, which can require engine power within a wide range of approximately 10-300 horsepower (hp).

The engine power of the equipment can then be used to determine the fuel consumption. With engine fuel combustion typically yielding approximately 86 percent carbon, this is directly related to the production of CO_2. For the purpose of typical fuel consumption, the equipment was assumed to operate at 85 percent of its maximum power. The equipment was also assumed to be operational for 85 percent of the time to practically portray working conditions. The CO_2 production at each stage of operation and overall results is presented in Table 3.3, below.

Table 3.3 Carbon Dioxide Production during Quarry Operations at all Five Stages

Stage	CO_2 Produced (tonnes/year)
PRIMARY	4,119
SECONDARY	14,052
FINE CRUSHING	20,088
WASHING PLANT	32,863

LOAD OUT	9,647
HEAVY DIESEL VEHICLES x3	997
TOTAL	81,765

5.0 LIGHT

Light can be defined as visible radiation (about 0.4 to 0.7 microns in wavelength) considered in terms of its luminous efficiency. Human-generated light, as opposed to natural light, is of relevance for the Whites Point Quarry project and will be discussed in the succeeding section.

5.1 Lightscape Management

Light generated by quarrying operations is not uncommon and is an issue that should be addressed to preserve the natural ambient landscape. The activities taking place at Whites Point Quarry will limit artificial outdoor lighting to that which is necessary for basic safety requirements, and in turn increases energy efficiency on-site. In addition, outdoor lighting will be primarily directed towards the ground and will be shielded to the maximum extent possible, to keep light on the intended subject and out of the night sky. Operational lights will be kept to a minimum and synchronized with the operational needs. For example, those on the dock will be used only to facilitate the safe docking and departure of vessels. The economic savings offer a significant incentive to the reduction of unnecessary light.

To ensure that light is not directed into the nearby bodies of water, light sources will be positioned strategically. This will prevent any negative effects the light could impose on the marine life, and thus other associated activity such as fishing in the area. At present, there are no lights at the site, and the project objectives are to minimize additional lighting.

6.0 CONCLUSIONS

The noise and air quality impacts of the Whites Point Quarry and Marine Terminal can be controlled by design mitigation, and operational controls to levels that do not create significant adverse impacts to the surrounding community.

7.0 REFERENCES

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5. Thalheimer, Erich. (2004). "Construction noise control program and mitigation strategy at the Central Artery/Tunnel Project", *Noise Control Engineering Joumal,* Vol. 48(5).

APPENDIX A - Figures

Figure A.1

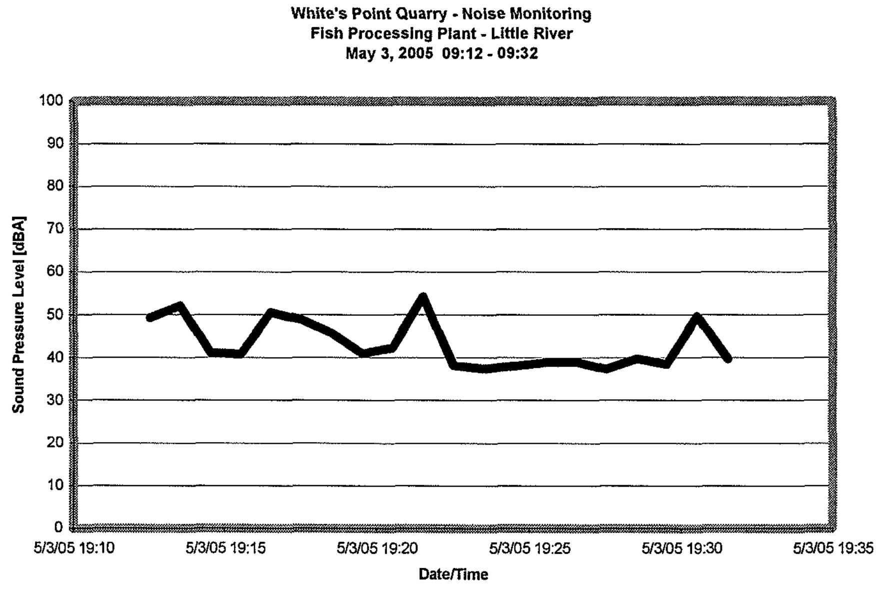


Figure A.2

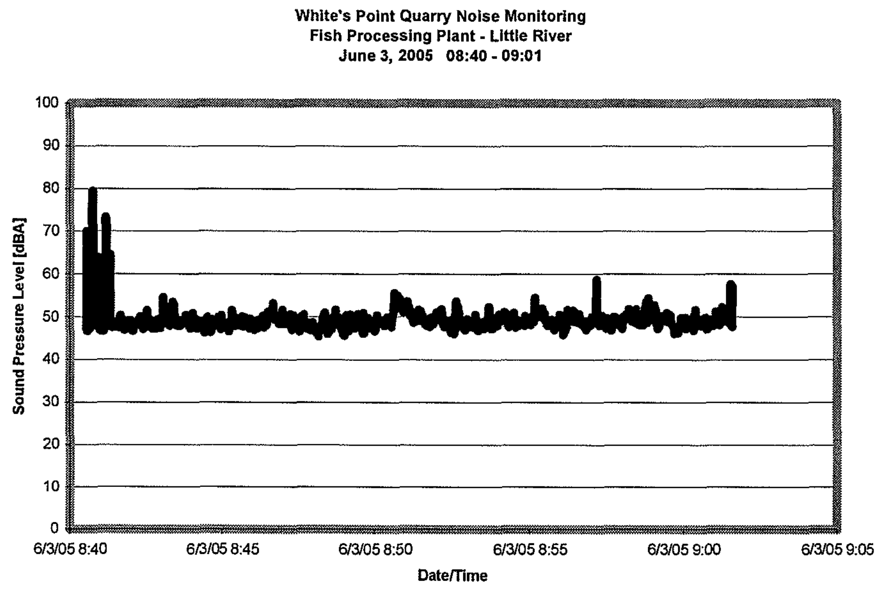


Figure A.3

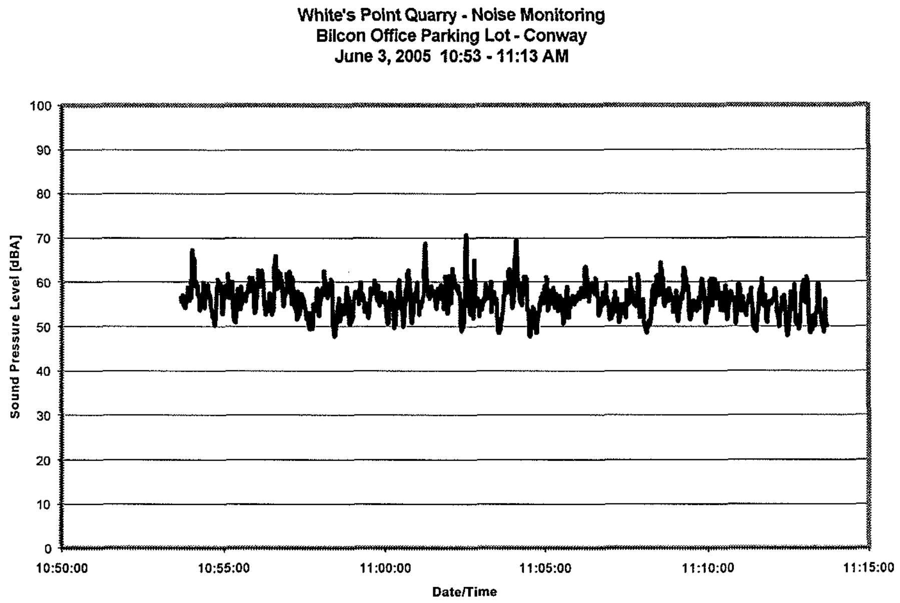


Figure A.4

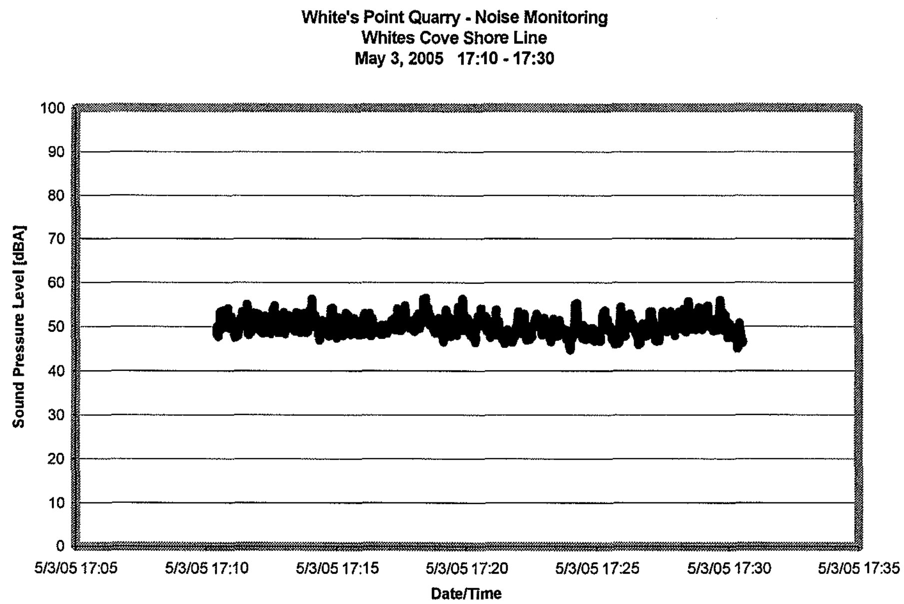


Figure A.5

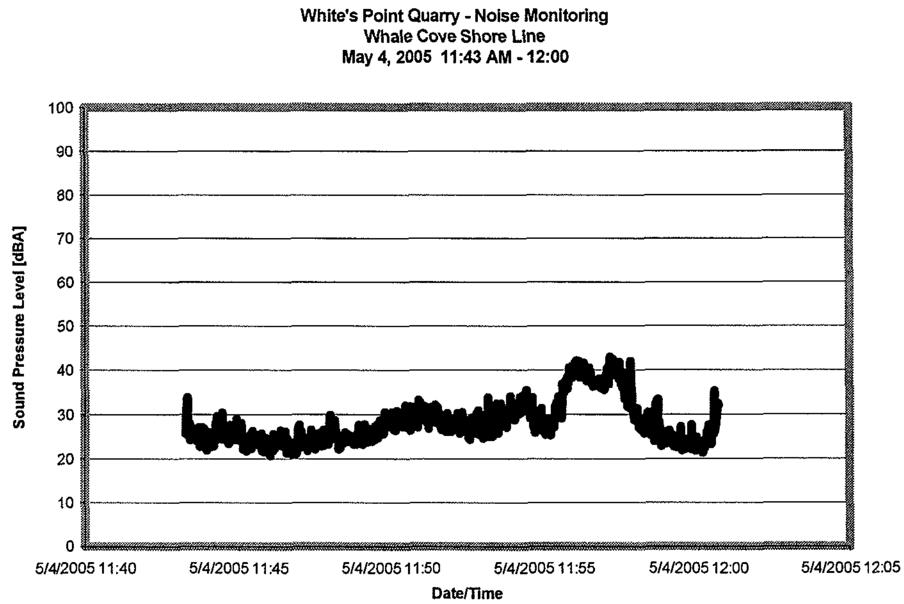
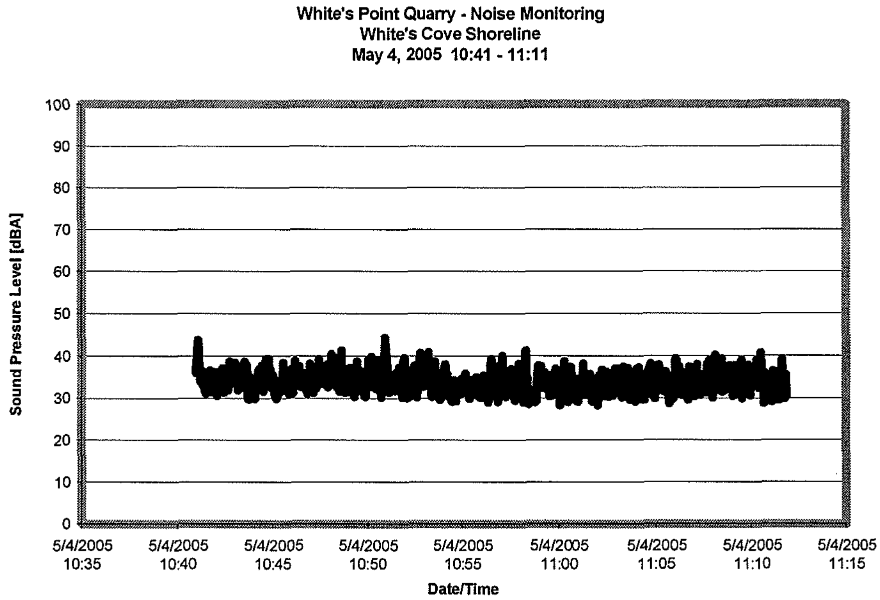


Figure A.6



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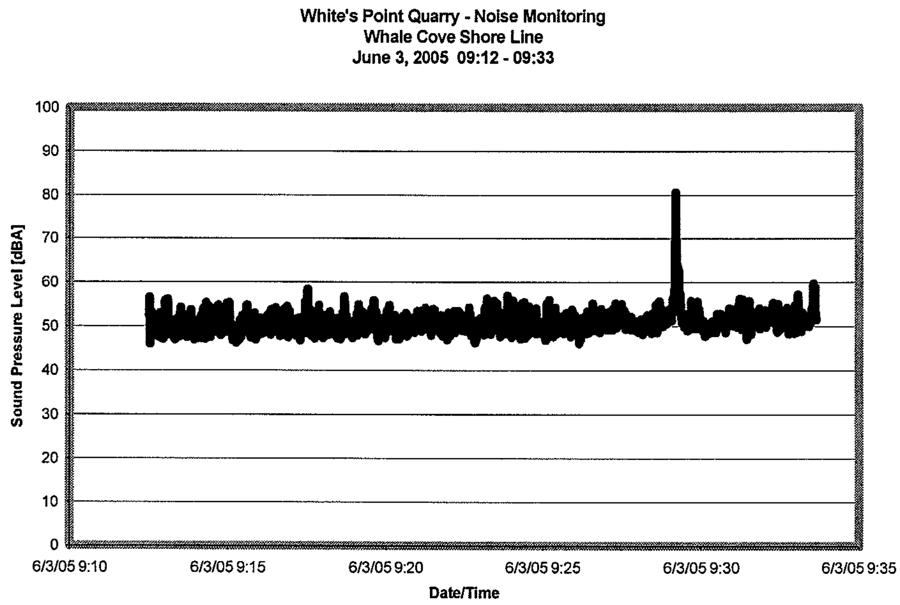
White's Point Quarry - Noise Monitoring
Whale Cove Shore Line
June 3, 2005 09:12 - 09:33
Sound Pressure Level [dBA]
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90
80
70
60
50
40
30
20
10
0
6/3/05 9:10
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