

**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**

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SUMMARY

A seabed sediment survey for particle size composition, inorganic and organic carbon content, and contaminants was conducted within the nearshore waters of the proposed basalt quarry site located in the vicinity of Whites Point, Digby Neck, Nova Scotia. A total of 30 sites were sampled but, despite repeated attempts, sediments could be collected at only nine sites suggesting that much of the area sampled is composed of exposed bedrock with little overlying sediment.

Sediments collected for analyses were composed largely of sands and gravel sized particles, much of which consists of shell fragments. Sediment organic content was less than one percent. Contaminants were also low and in all cases below the CCME Interim Guidelines for marine sediments.

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1. Introduction

On 14 July 2005, seabed sediments were collected from the nearshore waters off the proposed Whites Point Quarry site at Digby Neck, Nova Scotia. The objective of the survey was to document sediment contaminant levels, sediment carbon content and sediment particle size. Determinants for sediment contaminant levels included metals (cadmium, copper, lead, mercury and zinc), polychlorinated biphenyls (PCBs) and polyaromatic hydrocarbons (PAHs).

2. Methods

Sediment samples were collected with a 10.4 liter¹ Van Veen Grab fitted with weights and operated from a 15 metre lobster boat equipped with a hydraulic hauler (Figure 2.1).



Figure 2.1. Van Veen grab sampler used to collect seabed sediments.

¹ Surface area sampled equal to 0.1 square metres.

A total of 30 stations were sampled along three transects that ran perpendicular to the shoreline. One transect was located directly offshore of Whites Point, and the two other transects were located along the northern and southern boundaries of the proposed quarry site (Figure 2.2). Each transect extended from approximately 0.3 to 3 km offshore of the coastline. Ten sites were sampled along each transect, but in many cases (21 out of 30), repeated attempts (a minimum of three) failed to produce any sediments.

At those sites where sediments were collected the sample was emptied into a white enamel tray, photographed and then sub-sampled for analysis of contaminants, organic content and particle size by placing three 250 ml samples into clean glass containers. Sediment samples were kept cool and in the dark until analysis which was carried out by Maxxam Analytics Inc.

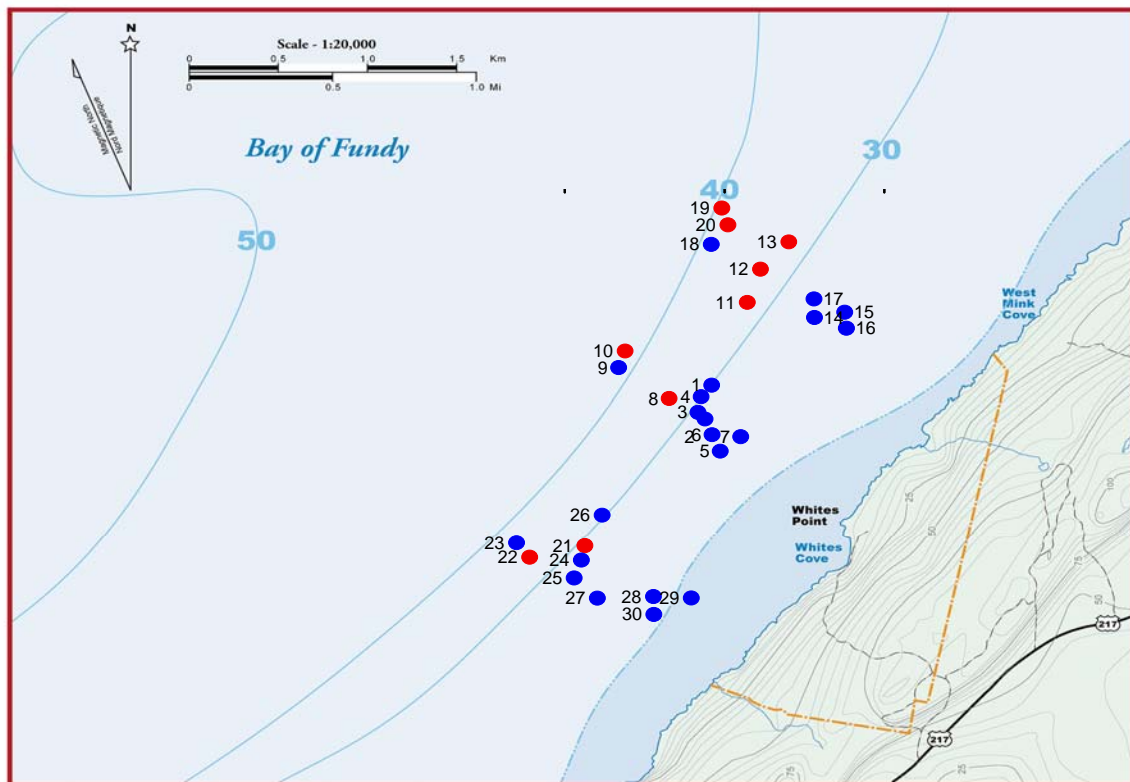


Figure 2.2. Location of sediment sample sites (red dots indicate stations at which sediments were collected; blue dots indicate stations that were sampled, but at which no sediments were collected by the grab).

3. Results

3.1. Grab Sample Collections

Table 3.1 lists the sample locations and provides a general description of each grab sample. Of the 30 grab samples taken, only nine contained sediments. These were mainly at the stations located furthest offshore at water depths of 30-40 metres (see Figure 2.2). The remaining samples, particularly those closest to the shoreline, contained little or no sediments, but in some cases larger benthic organisms such as echinoderms or kelps were collected.

Station Number	Location*		Depth** (meters)	Sample Collected	Description
	Northing	Easting			
1	4927792	726920	28.9	-	No sediments present
2	4927601	726878	30.0	-	No sediments present
3	4927638	726834	30.3	-	No sediments present
4	4927727	726854	29.2	-	Cobble and shell fragments
5	4927419	726973	15.2	-	No sediments present
6	4927512	726922	12.4	N	One kelp stipe
7	4927501	727101	16.1	-	No sediments present
8	4927717	726653	36.0	Y	Coarse sediments and shell fragments
9	4927891	726337	40.0	-	No sediments present
10	4927985	726378	43.9	Y	Coarse sediments, 2-3 cm cobble
11	4928259	727143	34.7	Y	Coarse sediments and shell fragments
12	4928447	727225	34.7	Y	Coarse sediments and shell fragments
13	4928601	727402	34.7	Y	Coarse sediments and shell fragments
14	4928174	727563	1.8	-	No sediments present
15	4928204	727752	1.8	-	No sediments present
16	4928113	727763	1.8	-	No sediments present
17	4928279	727560	1.8	-	No sediments present
18	4928587	726917	40.2	-	No sediments present
19	4928792	726983	40.2	Y	Coarse sediments, 2-3 cm cobble.
20	4928697	727021	34.7	Y	Coarse sediments, 2-3 cm cobble
21	4926886	726126	38.4	Y	Coarse sediments, 2-3 cm cobble
22	4926820	725781	38.4	Y	Coarse sediments and shell fragments
23	4926902	725698	38.4	-	No sediments present
24	4926804	726104	21.9	N	No sediments present
25	4926703	726059	21.9	-	No sediments present
26	4927058	726234	21.9	-	No sample
27	4926589	726204	7.3	N	No sediments; One kelp
28	4926598	726555	7.3	-	No sample
29	4926590	726792	7.3	-	No sample
30	4926497	726558	7.3	N	One kelp plant

* NAD83 coordinates
 ** Relative to chart datum

Samples from Stations 8 (offshore of Whites Point), 11 (offshore of the northern boundary of the proposed quarry site) and 22 (offshore of the southern boundary of the proposed quarry site) were subsequently used for analysis of contaminant levels, particle size and inorganic and organic carbon content.²

3.2 Particle Size Composition

There was relatively little variation in the percent particle size composition of the three samples analyzed. All were dominated by sands and gravels (Table 3.2 and Figure 3.1).

Table 3.2. Percent sediment particle size and inorganic and organic carbon composition (see Figure 2.2 for location of each site).						
Site	Percent Composition					
	Clay	Silt	Sand	Gravel	Inorganic Carbon	Organic Carbon
8	2.6	1.1	54	43	1.1	0.1
11	15	15	34	36	3.6	0.6
22	12	13	46	29	4.0	0.8

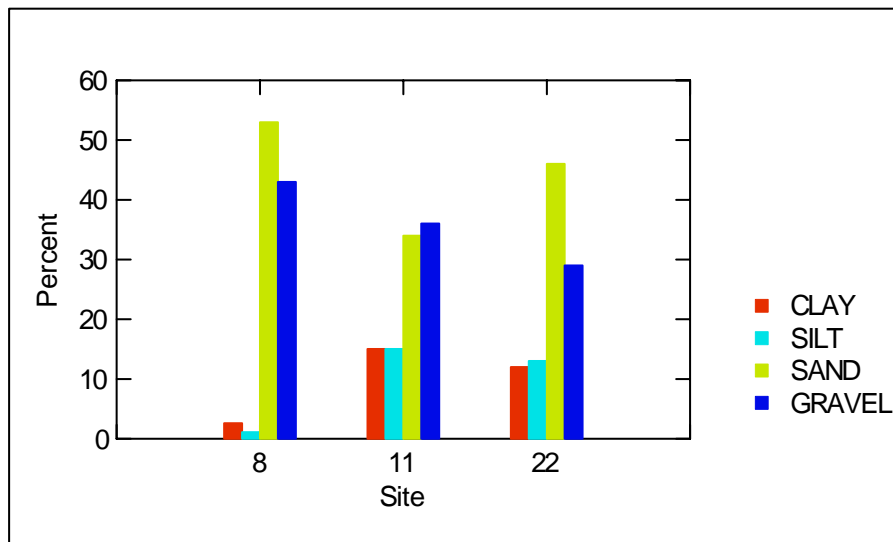


Figure 3.1. Percent sediment particle size composition (see Figure 2.2 for location of each site).

² Appendix I contains a photographic record of the samples used for analyses of sediment properties.

Sediment organic carbon content was very low (less than one percent). This, together with the paucity of fine sediments, indicates an environment unsuitable for the development of a significant infauna community.

3.3 Sediment Contaminant Levels

Table 3.2 lists the results of the sediment contaminant analyses³. These data were compared with the existing CCME (1999) interim guidelines for marine sediment quality (Table 3.3).

Table 3.3. Results of sediment contaminant analyses.							
Station Number	Contaminant						
	Cadmium (mg kg⁻¹)	Copper (mg kg⁻¹)	Lead (mg kg⁻¹)	Mercury (mg kg⁻¹)	Zinc (mg kg⁻¹)	Total PAHs (µg kg⁻¹)	Total PCBs (mg kg⁻¹)
8	<0.5	17	14	<0.01	52	<0.05	<0.01
11	<0.5	11	14	0.01	43	<0.05	<0.01
22	<0.5	11	17	0.01	42	<0.05	<0.01

In all cases, the sediment contaminant levels fall below the existing ISQG and PEL guidelines. Cadmium, Total PAHs and Total PCBs were undetectable. Mercury was undetectable for two of the three samples and at the limit of detection for the remaining sample. The levels of zinc were about one-third of the ISQG guideline. Copper was at about one-half the ISQG guideline for two of the samples and approached the guideline for one sample.

³ A more complete listing of sediment contaminant levels is contained in Appendix II.

Table 3.4. CCME interim marine sediment quality guidelines (from Canadian Council of Ministers of the Environment 1999).		
Contaminant	ISQG*	PEL**
Cadmium	0.7 mg kg ⁻¹	4.2 mg kg ⁻¹
Copper	18.7 mg kg ⁻¹	108 mg kg ⁻¹
Mercury	0.13 mg kg ⁻¹	0.70 mg kg ⁻¹
Lead	30.2 mg kg ⁻¹	112 mg kg ⁻¹
Zinc	124 mg kg ⁻¹	271 mg kg ⁻¹
Total PAHs	_***	_***
Total PCBs	21.5 µg kg ⁻¹	189 µg kg ⁻¹
*ISEQ – Interim sediment quality guideline ** PEL – Probable effects level *** CCME has not yet developed guidelines for Total PAHs, but has for 13 individual PAHs. For marine sediments, the ISQGs for these range between 6.22 and 153 µg kg ⁻¹ , and the PELs range from 88.9 to 544 µg kg ⁻¹ .		

4. Discussion

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.

The nature of the sediments, mainly sands and gravel, and the difficulty of collecting sediments at many of the sites sampled, indicate this environment to be largely erosional and composed of exposed bedrock with only thin layer of coarse sediments in some areas. This, together with the lack of fine sediments, especially clays, makes it unlikely to be an area where pollutants would be entrained.

5. References

Canadian Council of Ministers of the Environment. 1999. Canadian environmental quality guidelines. Canadian Council of Ministers of the Environment, Winnipeg.

Appendix I

Photographic Record of Samples Taken for Analyses



SAMPLE NUMBER 8



SAMPLE NUMBER 11



SAMPLE NUMBER 22

Appendix II.

Results of Sediment Analyses

SEDIMENT PROPERTIES					
Parameter	Units	Site Number			Detection Limit
		22	8	11	
CONVENTIONALS					
Total Inorganic Carbon (C)	g/kg	40	11	36	N/A
Organic Carbon (TOC)	g/kg	60	7.5	1.1	0.2
Total Carbon	g/kg	48	13	42	0.2
PARTICLE SIZE					
< +1 Phi	%	57	6.7	46	0.1
< +2 Phi	%	48	4.4	41	0.1
< +3 Phi	%	43	4.3	37	0.1
< +4 Phi	%	25	3.8	30	0.1
< +5 Phi	%	21	3.5	27	0.1
< +6 Phi	%	18	3.3	22	0.1
< +7 Phi	%	14	2.8	17	0.1
< +8 Phi	%	12	2.6	15	0.1
< +9 Phi	%	8.7	2	11	0.1
< 0 Phi	%	62	21	54	0.1
< -1 Phi	%	71	57	64	0.1
< -2 Phi	%	100	100	100	0.1
< -3 Phi	%	100	100	100	0.1
< -4 Phi	%	100	100	100	0.1
Clay	%	12	2.6	15	0.1
Gravel	%	29	43	36	0.1
Sand	%	46	54	34	0.1
Silt	%	13	1.1	15	0.1

ELEMENTS					
Parameter	Units*	Site Number			Detection Limit
		22	8	11	
Mercury (Hg)	mg/kg	0.01	ND	0.01	0.01
Total Cadmium (Cd)	mg/kg	ND	ND	ND	0.15
Total Copper (Cu)	mg/kg	11	17	11	2
Total Lead (Pb)	mg/kg	17	14	14	0.5
Total Zinc (Zn)	mg/kg	42	52	43	5
*ND – Not Detected					

PAHs					
Parameter	Units	Site Number			Detection Limit
		22	8	11	
1-Methylnaphthalene	mg/kg	ND	ND	ND	0.05
2-Methylnaphthalene	mg/kg	ND	ND	ND	0.05
Acenaphthene	mg/kg	ND	ND	ND	0.05
Acenaphthylene	mg/kg	ND	ND	ND	0.05
Anthracene	mg/kg	ND	ND	ND	0.05
Benzo(a)anthracene	mg/kg	ND	ND	ND	0.05
Benzo(a)pyrene	mg/kg	ND	ND	ND	0.05
Benzo(b)fluoranthene	mg/kg	ND	ND	ND	0.05
Benzo(g,h,i)perylene	mg/kg	ND	ND	ND	0.05
Benzo(k)fluoranthene	mg/kg	ND	ND	ND	0.05
Chrysene	mg/kg	ND	ND	ND	0.05
Dibenzo(a,h)anthracene	mg/kg	ND	ND	ND	0.05
Fluoranthene	mg/kg	ND	ND	ND	0.05
Fluorene	mg/kg	ND	ND	ND	0.05
Indeno(1,2,3-cd)pyrene	mg/kg	ND	ND	ND	0.05
Naphthalene	mg/kg	ND	ND	ND	0.05
Perylene	mg/kg	ND	ND	ND	0.05
Phenanthrene	mg/kg	ND	ND	ND	0.05
Pyrene	mg/kg	ND	ND	ND	0.05
*ND = Not detected					

OC PESTICIDES					
Parameter	Units*	Site Number			Detection Limit
		22	8	11	
o,p-DDD	mg/kg	ND	ND	ND	0.01
o,p-DDE	mg/kg	ND	ND	ND	0.01
o,p-DDT	mg/kg	ND	ND	ND	0.01
p,p-DDD	mg/kg	ND	ND	ND	0.01
p,p-DDE	mg/kg	ND	ND	ND	0.01
p,p-DDT	mg/kg	ND	ND	ND	0.01
PCBs					
Total PCB	mg/kg	ND	ND	ND	0.01
*ND – Not Detected					