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REPORT ON

Investigation of Preparation and Analysis Procedures for Harbour Sediments

Prepared for

Environment Canada C & P
Management & Emergencies Branch
Hull, Quebec K1A 0H3

Prepared by

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January 25, 1990
File No. 7600A

Mr. Paul Mudroch
Environment Canada C & P
Management & Emergencies Branch
351 St. Joseph Blvd., 15th Floor
Hull, Quebec
K1A 0H3

Dear Paul,

Re: Investigation of Preparation and Analysis Procedures for Harbour Sediments.

Enclosed are the copies of our final report for the above reference project. The report includes all data generated in the study as well as extensive discussion of the results. Every effort was made to discuss and explain observed trends although a project of this size and complexity has some anomalies.

We trust we have satisfied the project requirements as outlined in the initial concept and proposal stages. We would have preferred to recommend one "universal" test method however the diversity of sediment types does not allow this.

Thank you for your support and contribution to this project.

Best regards,

ASL ANALYTICAL SERVICE LABORATORIES LTD.

R. W. Deverall
Senior Partner

RWD/mm

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EXECUTIVE SUMMARY

Laboratories have generally been left to select their own methods for sample preparation and analysis of sediments. Providing the laboratory has demonstrated a certain degree of competency, their data is accepted without concern for how it was produced. Regulatory decisions based on this data are often made without all the important facts.

Analysts are rarely given sufficient guidance regarding testing protocols when performing analysis of samples for regulatory purposes. They are often faced with a multitude of choices on how to prepare the samples and carry out the analytical measurements. Samples that contain large amounts of coarse or foreign material typically pose the greatest challenge to the analyst. How they deal with these types of samples is a question not readily answered by consulting literature. Some researchers suggest sieving or pulverizing the sediment prior to testing, however this may not always be practical or valid. In addition, the analyst must also decide which methods to use for the digestion and analysis of the samples. Depending on the method choices the resulting data could be dramatically affected.

This project was conceived to evaluate how trace metal data would be affected using various methods of sediment preparation and digestion. The ultimate goal was to compare these methods to see which one was most appropriate for sediment analysis. Five harbours were selected from the West Coast of Canada, each providing a unique array of sediment types. From these harbours, a total of 20 samples were chosen for analysis.

The project design included the comparison of six preparation schemes along with three digestion methods for five elements. The resulting data provides an insight into many interesting trends regarding method differences and/or sediment characteristics. All data has been summarized in tables as well as in graphical format.

Evaluation and selection of the most appropriate method was the main object of this study. In order for a method to be judged "most appropriate" it must perform within acceptable quality assurance guidelines, be rapid enough to provide realistic turnaround of data, and simple enough that most laboratories performing regulatory sediment analysis could conform. However the sediments varied so much in texture and composition that no one method proved to be universally suited. Instead, we were able to select methods that were best suited to accommodate those sediments having unique characteristics.

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ACKNOWLEDGEMENTS

The authors wish to express their gratitude to those who contributed to the successful completion of this project. Without their assistance this work could not have been completed to the required standards.

The primary authors were Messrs. Rob Deverall, Patrick Mueller, James Downie, Rob Waters and Paul Mudroch. Sediment samples were collected for the project using equipment and personnel provided by Environmental Protection - Pacific Region and Castor Consultants. A special thank you to Messrs. Duane Brothers, Hal Nelson and Rob Waters for their efforts in collecting the sediments and their support towards the project.

Many analysts from ASL were involved in the analysis of the samples with a particular thank you to Trish McKeen, Fred Chen, Curtis Cloutier, Mark Wintjes and Dave Randhawa.

The manuscript was expertly typed by Mrs. Maureen McLachlan.

1.0 INTRODUCTION

Laboratories have been performing analysis of sediments and dredged material for regulatory purposes for many years. Until recently, few guidelines were available for methodology and quality assurance (QA) procedures. Laboratories were left to use their own analytical procedures providing the QA data was favourable. QA data typically contains results for procedure blanks, duplicate analysis and Standard Reference Material (SRM's). Although this criterion for data acceptance is a step in the right direction, it does not realistically address concerns the analyst faces with actual samples. Concerns such as how to prepare a non-homogeneous sample containing elevated contaminant levels is common yet no guidelines currently exist.

Environment Canada has undertaken a study to investigate the preparation and analytical procedures for sediment and dredged material destined for ocean disposal. The sampling was carried out by Environmental Protection - Pacific Region in conjunction with Castor Consultants Ltd. The preparation and analysis component was handled by ASL Analytical Service Laboratories Ltd.

The objective of this project is to develop a practical and scientifically valid method for sediment sample preparation and analysis for trace metals. The laboratory methods must use fairly common equipment and instrumentation and not contain any cumbersome steps requiring highly trained personnel. This will allow most suitably equipped laboratories to carry out the required work.

Once the project was under way, the proposed analytical procedures were not altered to accommodate unique properties of the samples. Instead, the methods were kept consistent to allow for a meaningful comparison of the data once all work was completed.

Samples were collected between April and June, 1989 from Vancouver Harbour, B.C. (Port Moody Arm and Vancouver Harbour), False Creek (Vancouver, B.C.), Esquimalt Harbour (Esquimalt, B.C.) and Alberni Inlet (Port Alberni, B.C.). All samples were processed through 6 sediment preparation schemes then 3 digestion schemes and analyzed for the metals Cu, Pb, Cd, Hg, and Zn. In total 120 sediment samples were prepared for analysis of physical and chemical parameters.

This report covers the results and discussion for the analysis of 20 sediment samples collected from 5 harbours on the west coast. Discussion of the preparation methods and resulting data is designed to point out noted trends that developed and bring to light some probable causes of these trends.

2.0 SAMPLING

Following is a discussion of the various aspects of the marine sediment sampling methodology involved in the collection of samples for this project (contract #KE144-8-6429). The methods generic to all sites sampled are outlined, followed with a site by site commentary. The methods of site selection, identification of sample location, sampling equipment and procedures, and timing are discussed first.

2.1 Site selection

Sample sites were selected with the input from Conservation and Protection staff to meet the particular needs of the protocol development program. The objective was to select as diverse a range of sediment textures/grain sizes as feasible to represent the diversity of coastal dredgeates. The sites included False Creek, Vancouver Harbour (Vancouver Harbour and Port Moody Arm), Alberni Inlet and Esquimalt and Victoria Harbours, each representing different characteristics through their respective geographical settings and industrial uses.

2.2 Sample Station Location

While a diversity of sediment textures was desirable, other parameters were also taken into consideration in the selection of sample stations. Within each site, station locations were chosen in areas where dredging will be undertaken in the near future. The exact station locations were selected in consultation with Environment Canada staff who were familiar with proposed dredging operations.

2.3 Sampling Equipment

Equipment for this project included standard sampling devices normally used in the collection of surface marine sediments. The sediment sampling was carried out from a 21' Romeny using a stainless steel grab (modified ponar) capable of collecting approximately 5 liters of material and sampling an area of approximately 500cm^2 to a maximum depth of 15cm. Sub-sampling was conducted using stainless steel pans and utensils. A camera, tape measure and cooler were also employed. Samples were retained in precleaned glass jars with teflon lid inserts (archived for possible future organic analysis) and in 15 litre heavy gauge plastic bags for the determination of heavy metals.

2.4 Sampling Procedures

The following procedures were generic to the sampling program. Any deviations from these procedures are described under specific site discussions. The sampling sequence was as follows: retrieve grab; open and discharge sediment into the pan; make observations on texture, colour, odour, fauna; prepare an ID card and photograph sample; expose the inner sediments and collect the appropriate sample aliquots. A minimum of 2 Kg (wet weight) was collected from each site. All subsamples were clearly labelled with the site description.

The stainless steel pans and spoon were cleaned between sampling locations to minimize intersite contamination. The procedure included rinsing and removing sediment residues from all equipment with sea water. The pan and spoon were allowed to stand a few minutes to drain water then rinsed and wiped consecutively with acetone and hexane.

2.5 Sampling Schedule

Sampling was conducted over two time periods to accommodate the two geographic areas of the Lower Mainland and Vancouver Island where the selected sites were located. The former was sampled on April 11 and 13, 1989 and the latter on June 26 and 27, 1989.

2.6 Site Specific Discussions

The following outlines in two sections, based on geography, site specific characteristics notable in the program at each site. While there were no specific sampling anomalies per se, the following offers a breakdown of the sampling procedure and sample conditions. These are essentially reflected in the number of grabs required at any given site to acquire sufficient material for the sample. Generally when more grabs were taken at a sampling station the material consisted of either a hard bottom or material of such a size so as to keep the grab sampler open and thus reduce sediment recovery and frustrate the sampling effort. In the latter section covering the Vancouver Island sites, two grabs were normally required in order to ensure adequate volume was obtained. Individual grabs from the same site were composited to form the test sample. The sample locations and number of grabs required for each are given in Table 1.

2.6.1 Lower Mainland

Vancouver Harbour sample stations, with the exception of one station (VH-1), generally required 2 or more grabs reflecting coarser materials as a result of well washed (sorted) sediments. Three grabs at station VW-3 turned up only very large rocks.

Port Moody Arm stations PM-1, 2 and 3 required only one grab per station reflecting finer sediments in this relatively protected area.

False Creek sample stations, with the exception of Station CB-1, 2 and EB-1 where two grabs were taken, required only one grab each. This reflects the low energy environment of the inlet and the associated fine materials deposited there.

2.6.2 Vancouver Island

Alberni Inlet sample stations, with the exception of Alberni #5 where only one grab was taken, required two or more grabs at all other stations to sample a range of sediment textures in the area. Two samples of the fine material at station Alberni #1 were taken to compensate for its apparently very high water content.

Esquimalt Harbour stations all required two or more grabs whereas one grab was adequate for the Victoria Harbour stations. Two stations, in particular (ESQ #1 and #4) required 5 and 3 grabs respectively, due to anthropogenic inputs including coarse blasting grits and electrical extension cords from ship repair activities. In the case of the cables they were removed from the sample since they were too bulky to retain.

Refer to field collection notes (Appendix 5) for further sampling information.

Table 1: Sampling Data

Location	Sampling Date	No. of Grabs	Sample Label
A. Lower Mainland			
Port Moody Arm			
Port Moody I	April 11/89	1	PM-1
*Port Moody II, Inside Boom	April 11/89	1	PM-2
*Port Moody III, Inside Boom	April 11/89	1	PM-3
Vancouver Harbour			
Mouth Of Seymour River	April 11/89	3	SR
Neptune Terminals	April 11/89	4	NT
*Coal Harbour	April 11/89	3	CH
*Vancouver Wharves, Off Load A	April 11/89	5	VW
Vancouver Wharves, 40 ft Depth	April 11/89	2	VW-2
Vancouver Wharves, 60 ft Depth	April 11/89	3	VW-3
*Vancouver Harbour, EP Stn 14	April 13/89	1	VH-1
Vancouver Harbour, EP Stn 15	April 13/89	2	VH-2
False Creek			
*Centre Channel,	April 13/89	1	CG
*Centre Basin #1	April 13/89	2	CB-1
Centre Basin #2	April 13/89	2	CB-2
*East Basin #1	April 13/89	2	EB-1
*East Basin #2	April 13/89	1	EB-2
*East Basin #3	April 13/89	1	EB-3
B. Vancouver Island			
Alberni Inlet			
*Alberni #1	June 26/89	2	Alberni #1
*Alberni #2	June 26/89	4	Alberni #2
*Alberni #3	June 26/89	2	Alberni #3
*Alberni #4	June 26/89	2	Alberni #4
*Alberni #5	June 26/89	1	Alberni #5
Esquimalt Harbour			
*D Jetty	June 27/89	5	ESQ #1
*Centre Harbour	June 27/89	2	ESQ #2
*Graving Dock	June 27/89	2	ESQ #3
Victoria Harbour			
*Point Hope	June 27/89	3	ESQ #4
*Laurel Point	June 27/89	1	ESQ #5

* indicates samples selected for analysis

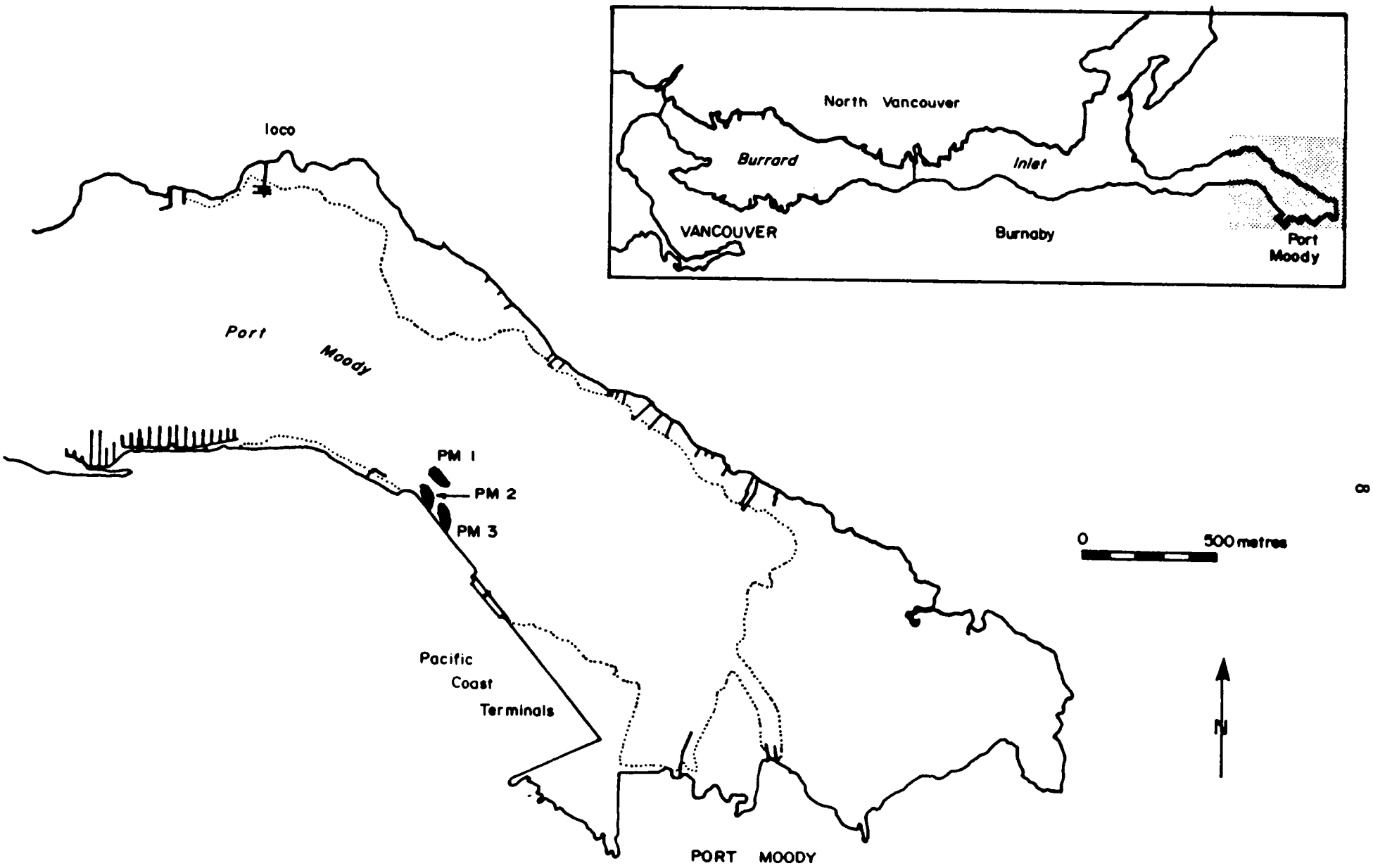


Figure 1 - Sample Locations within Port Moody Arm

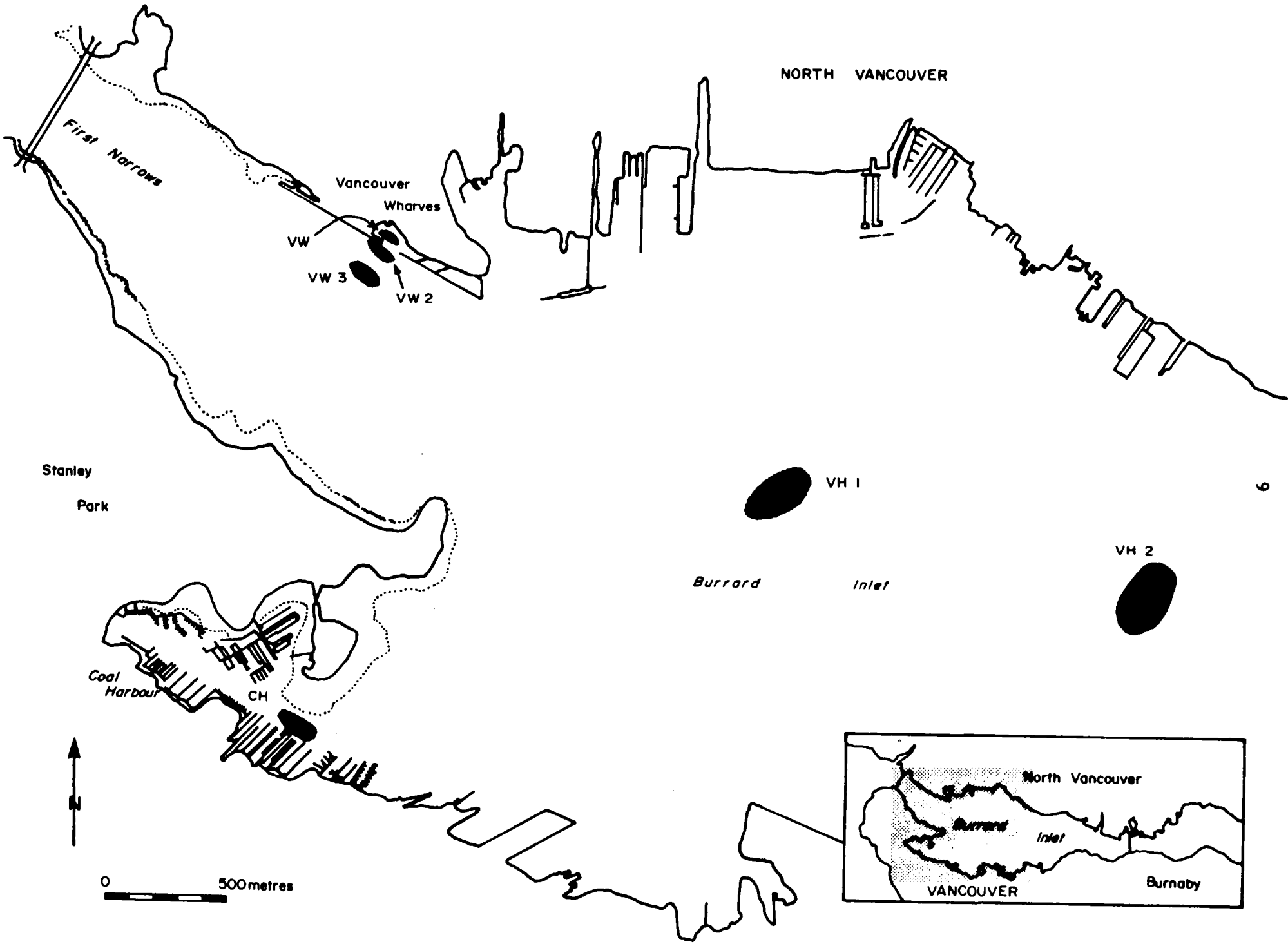


Figure 2 - Sample Locations within Burrard Inlet

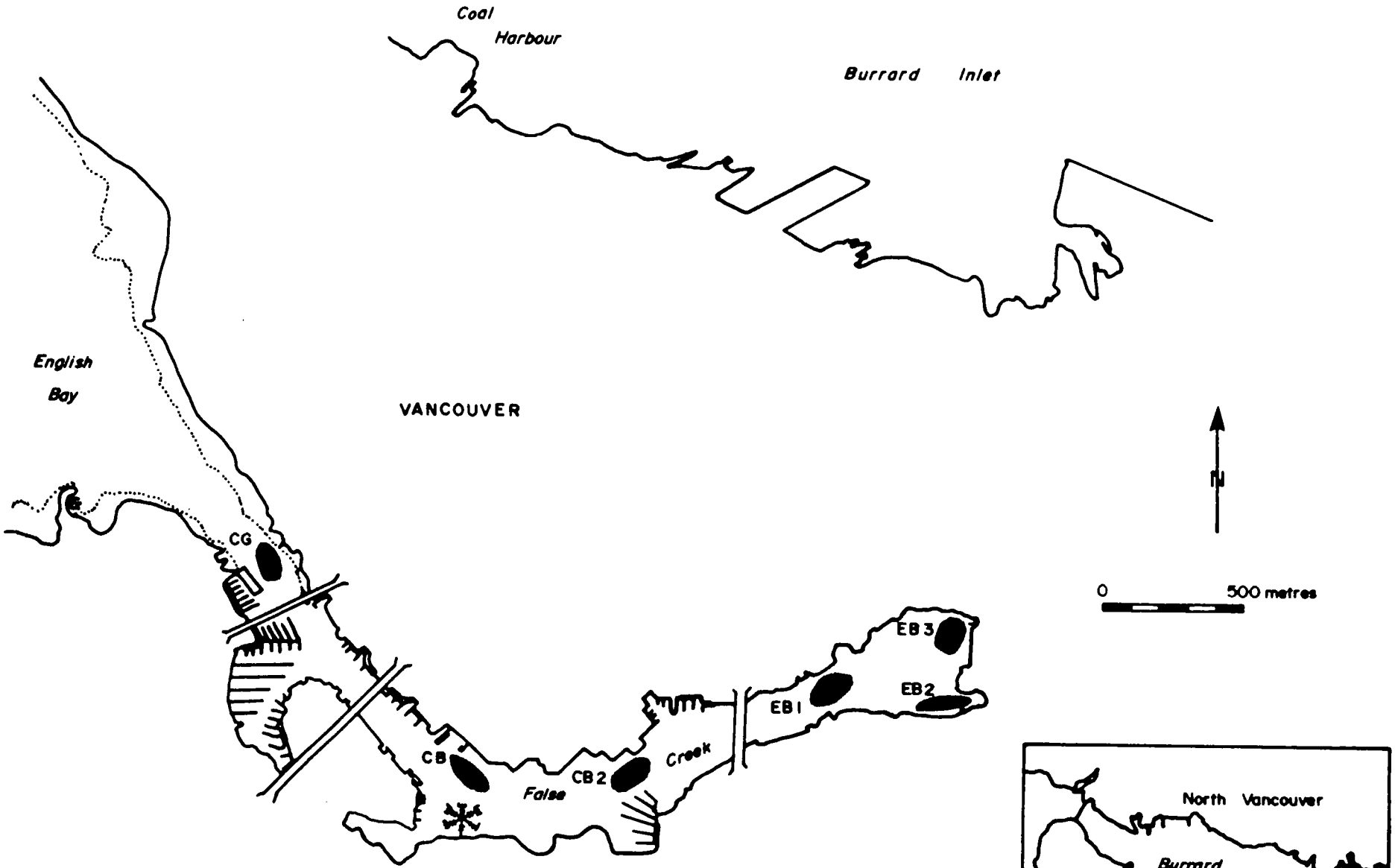


Figure 3 - Sample Locations within False Creek

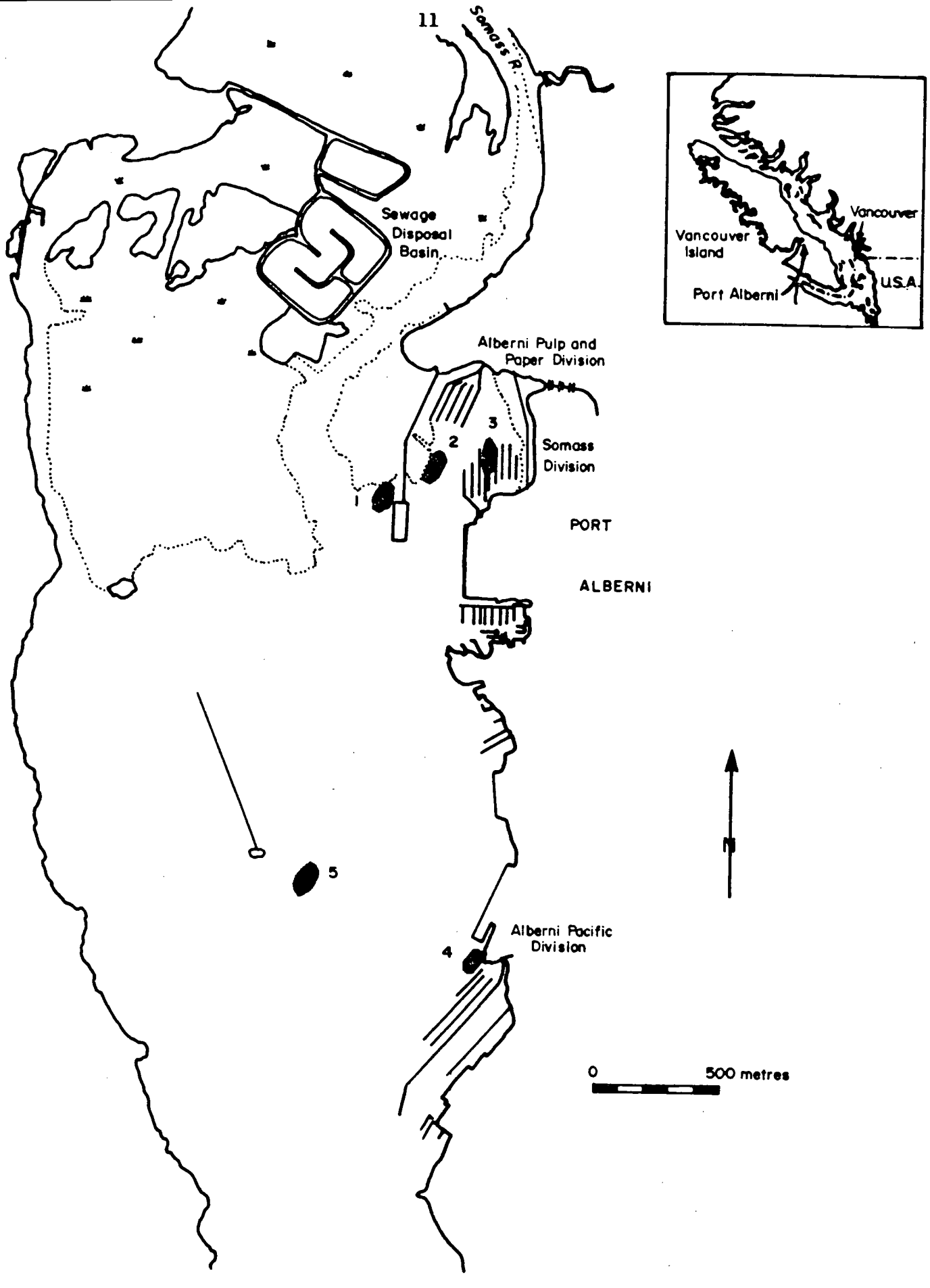


Figure 4 - Sample Locations within Alberni Inlet

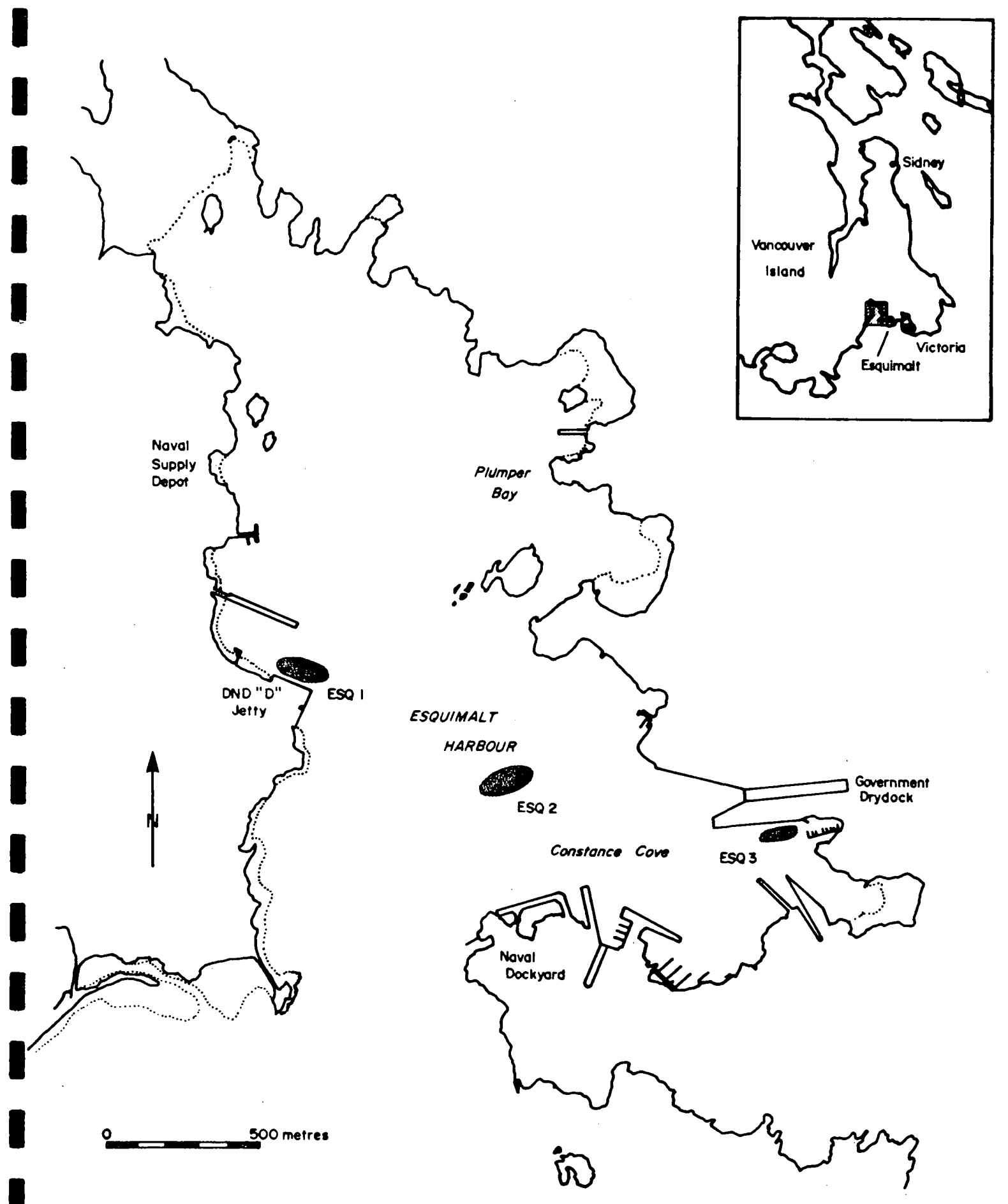


Figure 5 - Sample Locations within Esquimalt Harbour

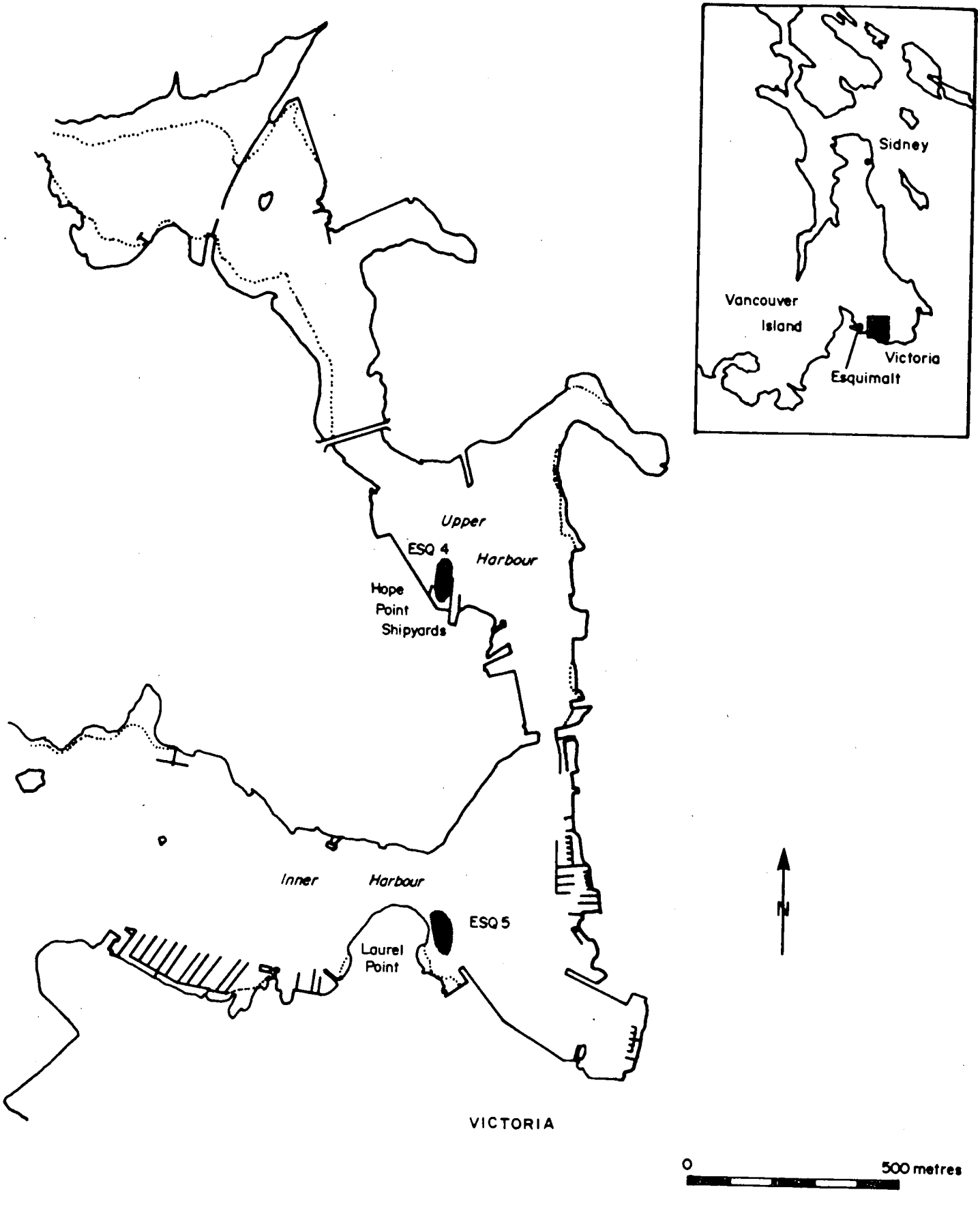


Figure 6 - Sample Locations within Victoria Harbour

3.0 SAMPLE HANDLING AND STORAGE

The samples were returned to the laboratory as soon as practical after collection. During transport they were stored in their original containers held in a cooler at 4°C.

Once in the lab, the sample aliquots selected for analysis were labelled then stored in a large walk-in cold room (4°C). Selection was based on maintaining as diverse a range of sediment type (texture, colour, foreign material etc.) as possible. Those samples not selected for analysis and the archived sediments for the determination of organic contaminants were sealed in boxes then returned to the cold room.

During storage and handling every precaution was taken to ensure that sample integrity was maintained. All apparatus including blenders, homogenizers, sieves etc. was dedicated to this project to avoid any cross contamination with other samples. In addition, a dedicated work area was also used for the duration of the project.

4.0 SAMPLE PREPARATION

The sample preparation scheme (see figure 7) generated six different fractions per sample, and was conducted in a two stage process. Samples were removed from the cold room (4°C) as required, manually homogenized in their original containers until judged a uniform consistency, then 2/3 removed as a subsample. This subsample was further divided in two then each half transferred to prerinsed 3 L plastic containers.

One subsample was placed in an oven and dried to constant weight at 60-70°C. Experience shows this temperature fully dries the sample while not losing significant amounts of the volatile elements. After drying, the sample was homogenized with a mortar and pestle and then subdivided into three fractions for further processing into the following fractions:

- Dry and Grind
- <1.0 mm Dry Sieved
- <0.5 mm Dry Sieved

Moisture content of the bulk sample was calculated by determining weight loss of a separate aliquot after drying at 105°C.

The other subsample was immediately split into three portions and processed into the following fractions:

- Wet Blend
- <1.0 mm Wet Sieved
- <0.5 mm Wet Sieved

After preparation, each fraction was further split into three subfractions labelled as follows:

- Working Fraction (25 g)
- Archived Fraction (~25 g)

- Particle Size Fraction (~100 g) - not analyzed since the bulk particle size was considered sufficient.

These subfractions were sealed in 120 ml plastic jars and returned to the cold room prior to sample digestion and/or analysis.

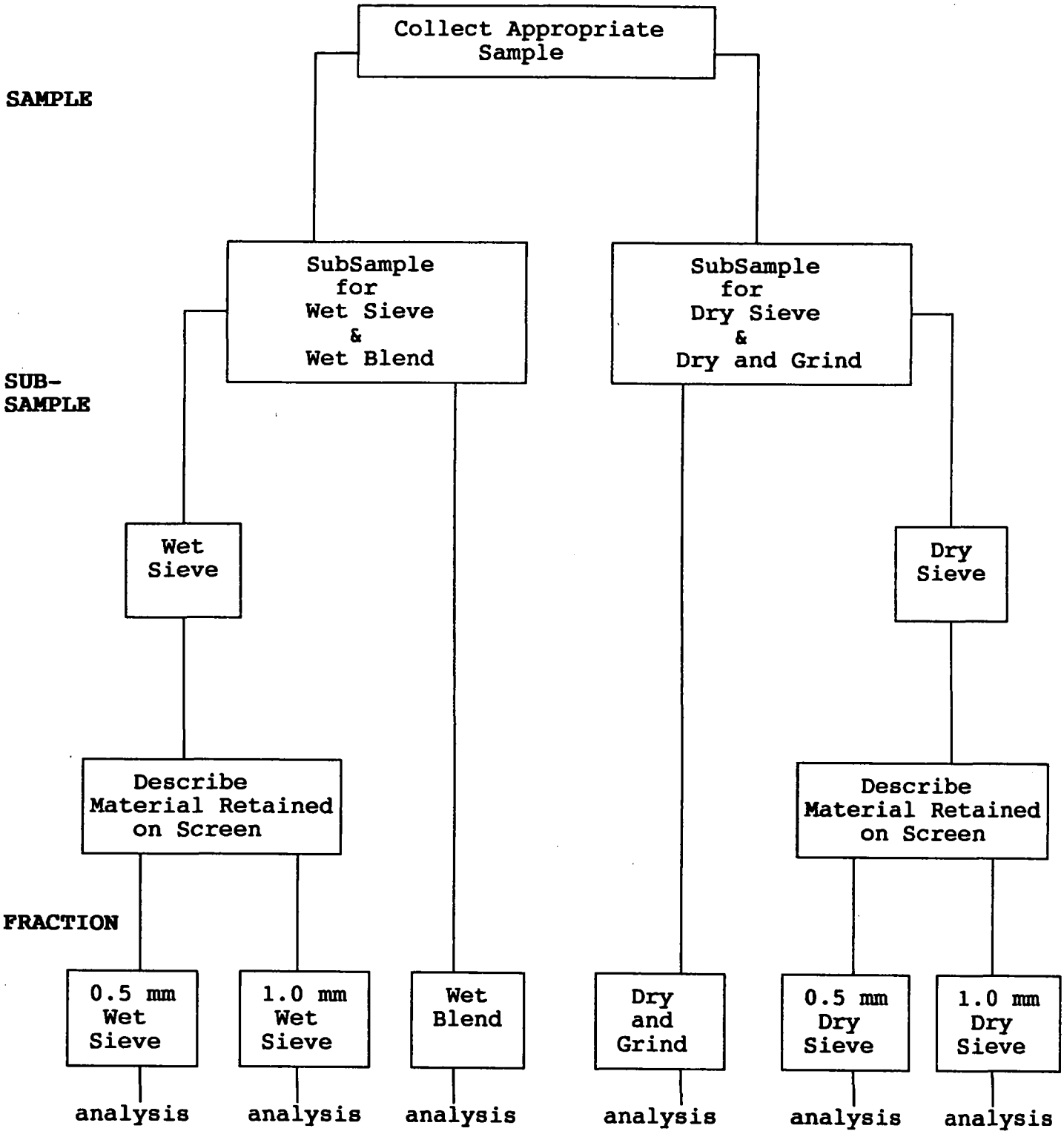
The goal of the sample preparation scheme was to produce representative aliquots of roughly 150 g (dry weight) for each sample fraction. This was accomplished in all cases with the exception of those samples having limited sample volume and/or a very coarse texture. The weight of each sample fraction was recorded for later mass balance calculation.

Each selected sample was passed through the full preparation scheme before the next sample was processed. This kept the preparation manageable and also avoided any cross contamination with other samples. In addition, all preparation equipment i.e. sieves, blenders, spatulas and weighing balances, was thoroughly washed with distilled de-ionized water (DDW) between samples. Only stainless steel or non-metallic implements were used during preparation and all precautions were taken to ensure that sample integrity was maintained.

The following apparatus was used during preparation:

- OHAUS Model Triple Beam Balance (>500 g)
- Sartorius Model L610D Top Loading Balance (<500 g)
- WS Tyler No. 16 stainless steel sieve (1.0 mm)
- WS Tyler No. 32 stainless steel sieve (0.5 mm)
- WS Tyler Model Rx24 Ro-tap Portable Sieve Shaker

Figure 7: Flow Diagram of Sample Preparation Scheme



4.1 Dry and Grind Fraction

After drying the appropriate subsample to a constant weight it was homogenized as much as possible with a glass mortar and pestle. Larger fragments of wood, shells and rocks were removed during homogenizing then added back in after the sample was judged to be an even consistency. The smaller particles of foreign material or rocks were not removed due to time constraints but were found to inhibit thorough grinding. A 150 g (dry weight) fraction was then removed and split into three subfractions, sealed in 120 ml plastic jars, clearly labelled (dry blend) then returned to the cold room.

4.2 <1.0 mm (or <0.5 mm) Dry Sieved Fraction

A 250 g (approx dry weight) fraction was removed from the above dried and ground subsample and placed on a 1.0 mm (or 0.5 mm) stainless steel sieve and agitated on the Ro-tap Portable Sieve Shaker for seven minutes. Seven minutes was generally sufficient to completely sieve a homogenized sediment of about 200 - 300g. The fraction which passed through the sieve was then split into three subfractions, sealed in 120 ml plastic jars, labelled (dry sieved) and returned to the cold room. The fraction retained on the sieve was weighed, described, sealed in 120 ml plastic jars and returned to the cold room for archiving.

4.3 Wet Blend Fraction

A 150 g (approx dry weight) portion of the original homogeneous subsample was split further into three equal subfractions, sealed in 120 ml plastic jars, labelled (wet blend) then returned to the cold room. The samples were split simply by removing appropriate aliquots from the bulk sediment after mixing to an even consistency as judged by the analyst.

4.4 <1.0 mm (or <0.5 mm) Wet Sieved Fraction

A 250 g (approx dry weight) fraction was removed from the above subsample and placed on a 1.0 mm (or 0.5 mm) stainless steel sieve. The sample was washed through the sieve with approximately 1.5 L of DDW. The sieved fraction was allowed to settle out of the wash water and the supernatant was decanted into two 1 L plastic bottles. The wet sieved fraction was then transferred to a 500 ml glass jar. Both portions were then allowed to settle for one to three weeks in the cold room. The clear supernatant was then decanted from all fractions, composited and immediately analyzed for analyte leaching. The solid fractions were composited, split into three subfractions, sealed in 120 ml plastic jars, labelled and returned to the cold room. A portion of the prepared sediment was re-analyzed for moisture content for use in calculating dry weight results. The fraction retained on the sieve was weighed, described, sealed in 120 ml plastic jars and returned to the cold room for archiving.

Refer to sample preparation notes (Appendix 4) for further information.

5.0 SAMPLE DIGESTIONS

Three distinct digestion schemes were carried out on each sample fraction (see Figure 8). These included the following acid and oxidant combinations:

- 1 Part Hydrochloric Acid and 1 Part Nitric Acid- defined as 1:1 HCl/HNO3 Digestion in this study.
- 1 Part Hydrogen Peroxide and 1 Part Nitric Acid- defined as Hydrogen Peroxide (H_2O_2) Digestion in this study.
- 3 Parts Hydrofluoric Acid, 2 Parts Hydrochloric Acid and 1 Part Nitric Acid - defined as Hydrofluoric Digestion (HF)in this study. Based on method of Rantalla and Loring as described in Walton (1978).

Each of the above digestion procedures are based on published methods that have been adopted for use by ASL and modified to accommodate our needs. Most modifications are minor with the resulting methods validated through numerous interlab studies and the analysis of certified standards.

All digestion apparatus was dedicated for the duration of this study. Between each set of digestions the apparatus was put through a vigorous clean-up sequence to minimize cross contamination. It included a one hour dilute acid leach of all digestion vessels followed by 3 washes with DDW. To insure the effectiveness of the above clean-up and also to quantify digestion efficiencies, various quality assurance/quality control (QA/QC) samples were included in each digestion set (refer to section 7.0). Apparatus used in this study included the following:

- 125 ml erlenmeyer flasks with tuttle type reflux caps
- 50 ml Lorran Type Teflon Bombs

- Sartorius Model L610D Top Loading Balance
- Sybron Model 2200 Hot Plate
- Lab Line Model L-C Oven
- Class A volumetric flasks (50 & 100 ml) for bulking extracts to volume

Reagents used for dissolution included the following:

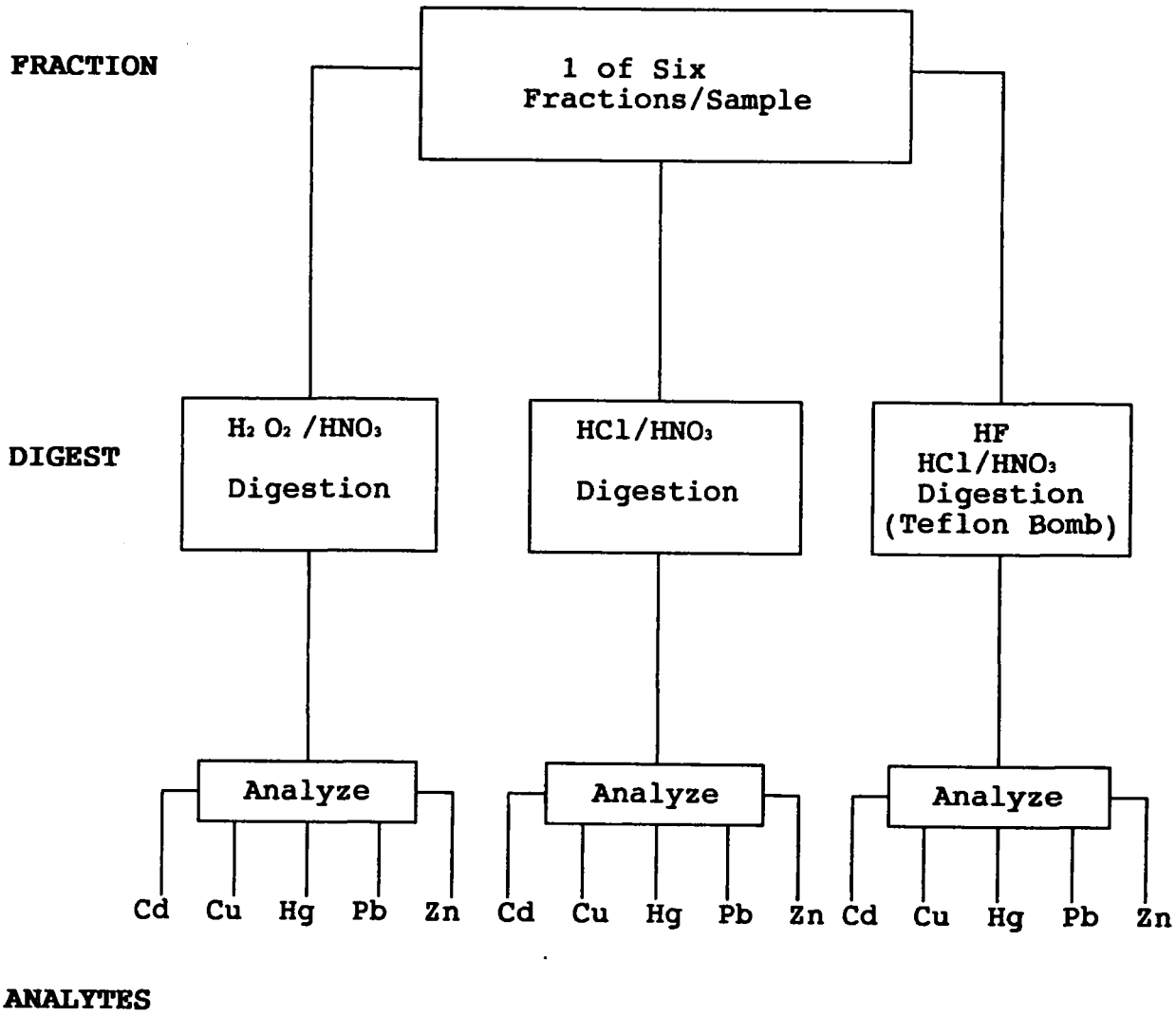
- Baker Instra Analyzed grade 70% Nitric Acid (HNO_3)
- Baker Analyzed grade 38% Hydrochloric Acid (HCl)
- BDH Analar grade 48% Hydrofluoric Acid (HF)
- Merck grade 30% Hydrogen Peroxide (H_2O_2)
- BDH Analar grade Boric Acid Salt diluted to a 2% (w/v) solution with DDI water

A detailed discussion of each digestion scheme follows below.

5.1 Hydrochloric / Nitric acid (1:1) Digestion

A 2 g (approx dry weight) subsample was weighed into a 125 ml erlenmeyer flask and 5 ml of HNO_3 was added. After mixing and insertion of a reflux cap the sample/acid mixture was allowed to stand for 8 hours at room temperature (approximately 25°C). This step was included to allow acid to begin digesting sample prior to heating. Many researchers have suggested that some volatile compounds (ie. methyl mercury) can be lost if sample is heated too quickly after acid addition. Five ml of HCl was then added and the mixture was refluxed for 8 hours at 90°C. The solution was then cooled to room temperature and bulked to volume (100 ml volumetric flask) with DDW. The resulting extract and undigested solids were transferred to a 120 ml plastic bottle then reserved for analysis.

Figure 8: Flow Diagram of Digestion and Analysis



5.2 Hydrogen Peroxide Digestion (H_2O_2)

A 2 g (approx dry weight) subsample was weighed into a 125 ml erlenmeyer flask and 5 ml of HNO_3 was added. After mixing and insertion of a reflux cap the sample/acid mixture was allowed to stand for 8 hours at room temperature (approximately 25°C). Five ml of H_2O_2 was then added and the mixture was refluxed for 8 hours at 90°C. The solution was then cooled to room temperature and bulked to volume (100 ml) with DDW. The resulting extract and undigested solids were transferred to a 120 ml plastic bottle then reserved for analysis.

5.3 Hydrofluoric Acid Digestion (HF)

A 0.5 g (approx dry weight) subsample was weighed into a 50 ml teflon bomb. Two ml of HCl and 1 ml of HNO_3 was added. After mixing and allowing to stand at room temperature for two hours, the open bomb containing the sample/acid mixture was heated at low temperature (60-70°c) on the hotplate to near dryness. Three ml of HF was added, the bomb was sealed then heated (110-120°C) for 3 hours in a conventional oven. After cooling to room temperature, the bomb contents were bulked to volume (50 ml volumetric flask) with a 2% Boric Acid solution used to neutralize any remaining HF. The solution was then transferred to a 120 ml plastic bottle then reserved for analysis.

6.0 ANALYSIS

The digests were analyzed as soon as practical after preparation to avoid extract degradation. Extensive quality assurance measures were taken to ensure the data produced was of a known and acceptable level of precision and accuracy.

The samples were analyzed in accordance with procedures outlined in the U.S. EPA 301(h) analytical protocols (written by ASL on behalf of Tetra Tech). The sample solutions were analyzed for the metals of interest using various optimized atomic absorption and emission techniques. The detection methods are summarized as follows:

Element	Instrument Detection Mode
Hg	Pharmacia Model U.V. mercury monitor equipped with a 30 cm absorption cell
Cu, Pb, Zn	Perkin Elmer Model 2380 dual beam spectrophotometer equipped with flame atomization (AAS) and automatic background correction. A Perkin Elmer Model P-40 inductively coupled plasma emission spectro-photometer (ICP) was also used to compliment the flame AAS data.
Cd, Pb (<10 µg/g)	Varian Model SpectrAA 300 graphite furnace spectrophotometer equipped with automatic Zeeman background correction. Palladium was used as matrix modifier to minimize interference effects

The physical parameters were determined in the sediment samples by appropriate means as follows:

TOC - a representative aliquot of the sample was analyzed for TOC using a Leco Induction Furnace.

Particle size - particle size was determined in each bulk sample using the standard sieve and pipette method as outlined in ASTM methods of analysis

Moisture - determined by measuring weight loss of a sample after drying at 105°c for 12 hours.

7.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Extensive quality assurance measures were taken to ensure the highest possible level of precision and accuracy was maintained. All analyses were performed using accepted procedures and included the concurrent analysis of method QA/QC checks and instrumental QA/QC checks.

Method QA/QC checks included reagent blanks, sample duplicates, analyte spikes and standard reference materials (SRM). All QA/QC data are presented in the appropriate results section. Method QA/QC samples analyzed with the sediments for each Harbour were:

Digestion Blanks (n = 12)
Sample Duplicates (n = 30)
Standard Reference Material (SRM) (n = 18)
- 6 - MESS (Marine Sediment) National Research Council (NRC)
- 6 - BCSS (Marine Sediment) NRC
- 6 - 1646 (Estuarine Sediment) U.S. National Bureau of Standards

Instrumental QA/QC checks included calibration blanks, calibration standards, recalibration check standards, aqueous standard reference materials, and post digestion spike and recoveries determinations.

QA/QC samples analyzed with a typical instrumental run (n = 50) are as follows:

Calibration Blanks (n = 6)
Calibration standards (n = 3)
Recalibration Check Standards (n = 5)
Aqueous Standard Reference Materials (n = 2)
- 2 - U.S. EPA Quality Control Solutions

The QA/QC data was continuously reviewed throughout this study to ensure methods were performing consistently over the required time frame. Apart from expected analytical variance and a few noted exceptions, the QA/QC data was acceptable. When a measured SRM value fell just outside the certified limits it was accepted since it did not change the interpretation of the sample data.

The following sections discuss the results from the major components of the QA/QC program.

7.1 Digestion Blanks

Digestion and reagent blanks, analyzed throughout this study indicate good contamination control for copper, lead and zinc since none of these metals were detected in any blanks.

Small amounts of cadmium were found in five out of 48 blanks analyzed, however they were close to the detection limit and not considered a concern.

Elevated concentrations of mercury were observed through out this study in the hydrofluoric (HF)/teflon bomb digestions blanks. Ten out of sixteen blanks measured indicated levels of mercury exceeding the detectable concentration for this analysis. It was determined, after extensive investigation, that these elevated results were due to a vapour phase anomaly which interfered positively when analysed by cold vapour atomic absorption (CVAA). The exact cause of this anomaly was not determined. For the purposes of this study the mercury data produced from the HF digestion should be considered questionable.

Mercury concentrations in all other digestion blanks fell below detectable levels for this analysis.

7.2 Standard Reference Material

The cadmium, copper, lead and zinc results for the Standard Reference Materials (SRM) confirmed that analytical accuracies were good with some minor exceptions typical of analytical variance. In some cases the measured values were just outside the tolerance values for the SRM's however these results do not affect the data comparisons.

Mercury results for National Research Council SRM MESS-I and BCSS-I indicated a serious bias (high) through out this study. In virtually every analysis batch these results fell outside the upper confidence limit. Every effort was undertaken before, during and after this project to determine the cause of these anomalies including a parallel study by NRC staff. A dialogue is continuing between NRC Scientists and ASL who are both working on this concern. In addition, samples of the suspect SRM's have been submitted to other "expert" laboratories by NRC for confirmation.

Mercury results for National Bureau of Standards SRM 1646 in all cases fell with in acceptable analytical limits for this analyte during this study (excluding the HF/teflon bomb results).

Since it appears the MESS and BCSS certified values for Hg are in question and not the analysis, the intercomparison of data for this study is not compromised.

7.3 Sample Duplication

Sample duplicate results for False Creek and Alberni Inlet demonstrated good analytical precision with some minor exceptions. These results illustrate the overall homogeneity of these two sample sets indicating their 'ideal' sample qualities.

Sample duplication for some Vancouver Harbour sites and overall for Esquimalt and Victoria Harbours demonstrated a high degree of variability. It was concluded this was due to a non-homogeneous distribution of analytes within the samples which was not overcome during sample preparation. These results also illustrate the "real world" nature of the samples collected from these harbours. This will be discussed further in the results and discussion section of this report.

8.0 RESULTS AND DISCUSSION

Sample Preparation

The data collected during sample preparation are given in Tables 2 - 6 and in Appendix 5.

This discussion focuses on the handling and physical preparation procedures used throughout the study. Observations and data collected during sample preparations have assisted us in deciding which method is most appropriate for the sediment types encountered.

Soon after their arrival in the laboratory the samples were homogenized and split as discussed in Section 4.0. The organic analysis fraction which was collected during sampling was frozen (-20°C) for future reference. The working fractions were processed through the sample preparation schemes as previously discussed. The archived test fractions were all stored in the cold room until required for analysis.

A total of five harbours were sampled as follows:

- Vancouver Harbour (Port Moody Arm/Vancouver Harbour) (11 samples collected on April 11, 1989)
- False Creek (6 samples collected on April 13, 1989)
- Alberni Inlet (5 samples collected on June 26, 1989)
- Esquimalt Harbour (3 samples collected on June 27,1989)
- Victoria Harbour (2 samples collected on June 27,1989)

See Maps (Fig 1-6) of each harbour giving the exact sampling locations. Five samples were selected from each of the first three harbours while 3 were selected from Esquimalt and 2 from Victoria. Selection was based on obtaining as diverse a range of sediment textures as possible.

The preparation methods and their applicability to actual samples will be discussed, outlining notable features within each harbour.

The key points of interest will be the apparent differences and difficulties in the preparation techniques and their effects on final sample composition.

Other information included in this investigation are bulk sediment characteristics such as percent moisture, Total Organic Carbon (and possible source description) and particle size distribution (as percent silt and clay). In addition, during preparation, data was recorded on the weight percent of sample retained during sieving and the most notable physical features of the samples. This information is summarized in Tables 2 to 5.

Analysis

The analysis data obtained on each of the samples is presented in Appendix 1 (data Summary) and Appendix 2 (raw data).

This section will discuss the data obtained after digestion and analysis of the prepared sediment samples. Since each sample was processed through six preparation schemes then three different acid digestions, a large volume of data was produced which exhibited interesting trends. Many of the trends noted were duplicated from sample to sample while some characteristics were unique to a few sediment types.

As stated in earlier sections of this report, all methodologies were selected to reflect fairly common techniques and practices used in most laboratories performing sediment analysis. As such, samples did not receive individual attention or special treatment (i.e., extra grinding, selective subsampling, etc.) to address unique properties.

8.1.1 Vancouver Harbour

Port Moody II - Inside Boom

This sample, collected near a sulfur loading facility contained approximately 90% by weight of sulfur particles. The remaining 10% of the sample was comprised mainly of fine silt and clay material. No other foreign material was noted.

Sample Preparation

The effect of the sample composition on the preparation methods was significant. Since the major portion of the sample was of a foreign nature, we expected (and found) major discrepancies between results from the different preparation schemes. The wet blend and dry blend schemes did not pose any technical problems, however when subsampling it was difficult not to favour the finer fractions. Sulfur particles ranged up to 25 mm across.

During drying, the sulfur balls prevented the sample from caking although some clay aggregate was formed. The sample was easily broken up during and after the drying process. Grinding the sample prior to sieving did not appear to significantly fracture the hard sulphur balls. All of the larger sulphur particles were removed by the sieving process. This produced a sample having a higher concentration of fines than the bulk sample.

TABLE 2 VANCOUVER HARBOUR

Physical Characteristics Summary

PORT MOODY II

		Port Moody II - Inside Boom	Port Moody III-Inside Boom	Coal Harbour (by Boat Houses)	Vancouver Wharves, off load A	Vancouver Harbour (EP Station No. 14)
Moisture	(%)	26.5	67.7	43.4	39.2	18.0
Silt + Clay	(%)	10.	91.	36.	10.5	1.8
Total Organic Carbon	(%)	0.87	3.14	0.86	2.46	0.02
Sieve Separation						
% Retained On 1.0mm Wet		58.8	1.0	18.8	35.8	88.9
1.0mm Dry		89.5	37.4	40.6	27.9	75.4
% Retained On 0.5mm Wet		68.3	1.3	37.5	60.5	93.4
0.5mm Dry		90.2	67.4	43.1	37.4	93.7
Most Notable Features		Large chunks of sulphur	Very fine sediment	"Typical" harbour sediment	Sample was black with some oil	Well washed (sorted) sediment-medium to coarse texture

The wet sieving scheme posed fewer initial technical problems than the dry sieving operations. The fine sediment material was easily washed through the sieve separating the coarser fraction. Quantitatively separating the fines from the water did however pose some difficulties. Preliminary work suggested gravity separation was preferable over filtration or centrifugal techniques. Filtration was not practical with samples containing clay materials since the filters became clogged almost immediately. Using coarser "prefilters" only caused the important fine fraction to become impregnated into the filter making it impossible to recover. Centrifugation of the slurry was ruled out as it took too long. Typical bench top centrifuge systems only handle 4 x 50 ml volumes which would require 8 - 10 cycles for each sample. The use of larger scale centrifuge systems was ruled out since these are not common to most labs. Instead we decided to let the slurries sit at room temperature to settle all visible fines. This allowed all wet sieved samples to settle out at the same time keeping labor and sample to apparatus contact to a minimum. Unfortunately, for most samples containing fines, settling took from 1 to 3 weeks which is prohibitive to most studies. During decanting of the supernatant a small amount of fines were lost which could not be prevented without further filtration.

Another concern (other than time) with allowing the slurries to settle over extended periods was the potential leaching of analytes into the DDW. In order to determine if significant loss did occur we analysed all supernatants (from 0.5 mm wet sieving) for the elements of interest. No significant loss occurred for any of the elements of interest (Table 3).

Analysis

The effect of the sulfur was typical of most "foreign" material in that it tended to lower the apparent concentration of the

metals in the bulk sediment. All elements tested increased (by 5 - 10x) when comparing results obtained between pre-sieve and post-sieve. This is not unexpected since the metals are generally associated with the finer fractions of the sediment. In addition the wet sieved values were higher than the dry sieved (except Hg). This would likely be caused by the fact that approximately 10% of the sample was actual sediment and of this most was either silt or clay. During wet sieving, most of the fines would be washed through and retained for analysis. During dry sieving however, some of the fines would form aggregates that would be as strong or stronger than the sulfur particles. During hand grinding the sample prior to dry sieving, some sulfur would also be crushed. The net effect would be to increase the percentage of sulfur passing the sieves thereby diluting the elemental concentrations in the test fraction. Mercury did not follow the same trends as the other elements although it did increase after sieving.

For this sample, no definite trends were noted between the different digestions used. Where sample results varied it was generally attributed to the non-homogeneity of the elements within the sample. This was especially apparent with the HF-teflon bomb digestions since only 0.5 g of sample is used for digestion.

TABLE 3: ANALYSIS OF <0.5 mm WET SIEVE WASH WATER FOR LEACHING OF Cd, Cu, Hg, Pb, Zn

Sample Identification	Wash Water Vol (ml)	Cadmium	Copper	Lead	Mercury	Zinc
DETECTION LIMIT	-	0.05	0.10	0.50	0.025	0.05
LOWER MAINLAND						
Port Moody Arm						
Port Moody II, Inside Boom	4950.	<	0.27	<	<	<
Port Moody III, Inside Boom	1780.	<	<	<	<	0.33
Vancouver Harbour						
Coal Harbour	1675.	<	0.19	0.50	<	<
Vancouver Wharves Off Load A	1425.	<	<	<	<	<
Vancouver Harbour EP Stn 14	1590.	<	<	<	<	<
False Creek						
Centre Channel off	1575.	<	<	<	<	<
Centre Basin off	1975.	<	<	<	<	<
East Basin #1	1925.	<	<	<	<	0.13
East Basin #2	2200.	<	0.13	<	<	0.24
East Basin #3	1025.	<	<	<	<	0.08
VANCOUVER ISLAND						
Alberni Inlet						
Alberni #1	1700.	<	0.88	0.60	<	5.70
Alberni #2	1355.	<	<	<	<	0.23
Alberni #3	1610.	<	<	<	<	0.34
Alberni #4	2290	<	0.15	<	<	0.38
Alberni #5	1250	<	<	<	<	0.67
Esquimalt Harbour						
D Jetty	2600	<	<	0.50	<	0.45
Centre Harbour	1155	<	<	<	<	<
Graving Dock	3545	<	<	<	<	0.29
Victoria Harbour						
Point Hope	1800	<	0.45	<	<	1.54
Laurel Point	1915	<	<	<	<	0.16

< = Less than detection limit shown
Results expressed as micrograms per gram dry weight of sediment

Port Moody III - Inside Boom

This sample was taken within a few metres of the previous sample (Port Moody II) but differed in that it contained only small amounts of sulphur. The sediment was very fine consisting of over 90% silt and clay fractions.

Sample Preparation

The effect of the fine sediment texture was to produce similar subsamples irrespective of preparation. The very low coarse and foreign material content provided an ideal homogeneous test fraction.

One notable concern with the preparation methods was the hard aggregate formed during drying. Although much of the "cake" was broken up prior to sieving some of the aggregate particles were sufficiently strong to stay intact and not pass the sieve. However, this particular sample was so fine and homogeneous this did not appear to present a problem since the prepared test fraction was judged representative of the bulk sample. Another concern resulting from the high level of fines was the additional settling time required after wet sieving. As discussed in the previous section this was overcome by increasing the settling time to a few weeks.

Analysis

A general review of the data shows good comparison of results between digestion and preparation methods. Since there was little foreign material and the sample consisted almost entirely of fines (silt + clay) we found all subfractions to be fairly representative of the bulk sample.

Again no obvious discrepancies existed between digestions although the HF-teflon bomb data was less precise than the other two.

Coal Harbour

This sample was classed as a "typical" harbour sediment containing 36% fines and a few rocks and shells. A mild H_2S odour was noted but the colour (grey) and TOC level (<1.0%) suggests the sample was low in organic matter.

Sample Preparation

The high level of clay and silt caused the sample to form a very hard cake upon drying. Although more difficult to break up than some other samples, we were satisfied that after homogenizing in the mortar and pestle a representative portion was collected after sieving. No additional problems were encountered in any of the preparation schemes other than the long settling time during wet sieving.

Analysis

The data obtained on this sample suggests a non-homogeneous distribution of metals in the sample. The presence of a coarse fraction (37.5% is >0.5mm) affected the ability to obtain a representative subsample. This was reflected in many of the duplicate results. To further illustrate the effect of the coarse material on sample homogeneity we can see the precision of data improve as the samples are sieved. The elemental concentrations did not increase during sieving indicating a fairly even distribution between coarse and fine fractions. No obvious patterns were observed between the data obtained from the different acid digestions.

Vancouver Wharves

This sample was obtained near a mineral ore loading facility and was the composite of five casts. Apart from typical shells and many wood fragments the sample also contained some oil.

Sample Preparation

The effect of the sample composition was to present some problems, particularly with subsampling. The presence of large wood particles forced analyst bias when subsampling even after dry and wet blending. During wet sieving a larger than expected difference occurred between retained fractions (35% for 1.0 mm and 71.2% for 0.5 mm). Upon reviewing the retained archived material it was discovered that the 1.0 mm wet sample contained a large piece of wood. Since the wood is less dense than shells and rocks the apparent coarse fraction was actually less when taken as a weight percent.

Analysis

The data obtained from this sample indicates that the elements analysed for are again associated with the finer sediment fraction. It is interesting to note that the values from the dry sieved fractions were virtually the same as the bulk sediment results (wet blend and dry blend). These data similarities could be coincidental in that the normal "high grading" due to sieving was offset by the retention of clay aggregate. The wet sieved fractions however were higher (1.5 - 2X) in all elemental concentrations. This discrepancy between wet and dry could again be attributed to clay aggregate, containing the highest elemental concentrations being retained on the sieve after drying.

The high values of Cu, Pb and Zn found after wet sieving are likely due to ore concentrate loading facilities located nearby.

Vancouver Harbour - EP Stn 14

This sample was a well washed (sorted) material containing almost no fines. The majority of the material was very coarse sand, small rocks and shells.

Sample Preparation

During sample preparation, the abundance of coarse material caused some problems in all schemes. The material was difficult to subsample for both the wet and dry blend schemes particularly at the digestion level. During sieving, as little as 6% of the sample passed the 0.5mm sieve. This increased the bulk sample size requirement in order to obtain adequate prepared sample for analysis.

Analysis

The lack of fine sediment material was reflected in the low elemental concentrations found in all preparation fractions. Although a large percentage of the samples (up to 94%) was removed during sieving the elemental concentrations did not vary significantly between preparation methods. This would indicate that the elements are evenly distributed within all size fractions.

8.1.2 False Creek

Initially, during sample collection and laboratory review, the five False Creek samples appeared to differ in texture and appearance from one another. They varied in colour from all brown to all black and in odour from nil to high sulfide to very high creosote. However, during sample preparation these samples behaved similarly with a few notable exceptions. For this reason we will present the sample preparation discussion as one harbour not on a sample by sample basis as with Vancouver Harbour. Refer to Table 4 for the Physical Characteristics Summary.

Sample Preparation

The samples were all fairly consistent muds containing from 50-96% fines. The effect of this composition was to produce homogeneous subsamples for all fractions. During drying, the

samples formed clay aggregates which again were retained on the sieves. This did not pose a problem since the samples were well homogenized after drying and the material passing the sieve appeared representative.

The presence of coarse and foreign material ranged from less than 1 to approximately 30% by weight between samples. This material was mainly coarse sand, wood and shells which did not significantly hamper subsampling efforts.

The main concern with preparing one sample was the level of petroleum hydrocarbons (5.85 %) found in the sediment taken at East Basin (C). Apart from the toxic implications of handling this sample it also posed some unique challenges to preparation and analysis. The sample required 5 days to dry at 70°C. It initially formed a protective skin which after continued mixing dried to a thick black paste. The measured TOC values (6.7%) may be low due to losses of volatile organics during sample preparation.

All subsamples from the False Creek sediments appeared to be representative of the original irrespective of the preparation method used.

TABLE 4 **FALSE CREEK**

Physical Characteristics Summary

False Creek

		Centre Channel	Centre Basin #1	East Basin #1	East Basin #2	East Basin #3
Moisture	(%)	26.5	37.9	46.8	42.2	51.4
Silt + Clay	(%)	58.	51.	58.	96.	81.
Total Organic Carbon	(%)	0.74	3.89	9.58	2.44	6.72
Total Organic Carbon Dup	(%)	-	-	-	-	7.81
Oil & Grease	(%)	-	-	-	-	5.85
Sieve Separation						
% Retained On 1.0mm Wet		3.5	32.2	31.1	0.9	1.5
1.0mm Dry		55.9	72.5	72.8	57.5	57.7
% Retained On 0.5mm Wet		6.6	39.1	31.7	1.2	2.6
0.5mm Dry		57.3	80.1	70.3	65.1	58.1
Most Notable Features		Fine Sediment with some wood, shells and sand	Medium Sediment with wood and sand	Fine Sediment with lots of wood and some shells	Fine Sediment with some wood and shells	Fine Sediment very oily

Centre Channel

This sample was characterized as a fine sediment with a small amount of wood and shells. The sample was low in organic content (<1%) and in general appeared "clean".

Analysis

The data indicates that all elements analysed are evenly distributed throughout the sample. No apparent trends were noted in the data due to either preparation method or digestion. The variability of Cd between digestions of the 0.5 mm dry sieved fractions is unexplained. For these same samples, all other elements gave acceptable precision.

Centre Basin, #1

This sample was characterized as having a medium to fine texture containing a significant amount of wood and shells. A few small rocks and coarse sand were also noted during preparation.

Analysis

The data obtained on this sample indicates a fairly even distribution of elements throughout. All elemental concentrations were elevated showing the influence of historical industry typical of False Creek. The presence of foreign material did cause a slight increase (approx. 25%) in apparent concentration of the elements after sieving. No other significant trends in data were noted between preparation or digestion methods.

East Basin #1

This sample was characterized as having a medium to fine texture containing a large amount of wood particles and some shells. The

sample was black and contained almost 10% organic carbon, likely from the wood.

Analysis

The data obtained for this sediment sample again is typical of the False Creek area. Analytical variability is high (variance up to 38% for Zn) although no apparent trends exist for either preparation or digestion methods. The variability is likely due to non-homogeneity of the elements in each test fraction even after preparation.

East Basin #2

This sample was characterized as having a very fine texture with small amounts of wood and shells. The sediment had a brown surface (1 cm) with a black sublayer having a very strong sulfide odour. The sample contained a plastic bag which was removed prior to testing.

Analysis

The very high silt and clay content (96%) gave a typically homogeneous subsample irrespective of the preparation method. The absence of significant foreign matter is confirmed by the fact that pre and post sieved results are comparable for all elements. As with the previous False Creek sediments, this sample also gave elevated levels of metals. No discrepancies were noted between any of the analysis methods.

East Basin #3

This sample was characterized as having a very fine texture and containing a large amount of petroleum hydrocarbons. Small amounts of wood and shells were also present.

Analysis

The data produced from this sample was much the same as the other False Creek samples in spite of the high oil content. Mercury values were approximately two times higher than the other East Basin samples while the other elemental concentrations were very similar. As with other samples from this location, no apparent trends were noted between preparation or analysis methods.

8.1.3 Alberni Inlet

Alberni #1

This sample was taken near the outfall pipe of a Pulp and Paper mill at a depth of 1.5 metres. The sediment material was predominately fine but contained a high amount of wood fibres and some oil. The oil material coated the sampling apparatus and could only be removed by scrubbing with soap and water. The physical characteristics are summarized in Table 5.

Sample Preparation

The presence of the wood fibre gave the sediment a peat moss appearance especially after drying. The net affect of the wood fibre was to produce subsamples having unique handling properties. For example, the sample had a very high moisture content and dried to a fibrous matt. During dry sieving a much larger portion of the sample was retained as compared to wet sieving since dried aggregate would form and cling to the fibre mass. In addition the fibre mass would ball up and roll around the screen during sieving. The sieved fractions were high in organic content since many of the wood fibres passed through the screen. During wet sieving some of the buoyant wood material floated on top of the water thereby increasing the workup time. There was also a significant amount of wood fibres retained on the sieve which appeared much like very wet peat moss.

Analysis

As discussed in the preparation scheme, sediments with a high amount of wood fibre were difficult to subsample particularly at the digestion level where aliquots as small as 0.5 grams were used.

Review of the data indicates the wet blend values are up to 1 1/2 times higher than the dry blend values. The wet blend H_2O_2 digestion for cadmium appears to be an outlier compared to the other data in this set. All values, with the exception of mercury, increase upon sieving of the sample which is consistent with the observations made during sampling such as the clay and wood fraction being retained. Duplicate values are generally acceptable for all elements although comparisons between digestions are not as close as we have seen with other sediment types. This is likely due to the non-homogeneous distribution and the elevated concentrations of some of the elements.

Alberni #2

This sample was taken from a depth of 1.5 metres, was somewhat coarser and contained more wood pieces (up to 8 cm in length) than the previous sample. The sample had a unique almost gelatinous type consistency. The coarse wood particles were splinters about 1 cm wide and 8 cm long.

Sample Preparation

The net effect of this composition was to make sub-sampling more difficult due to the larger wood pieces. The wet blend and dry blend preparation schemes did nothing to remove the foreign material. This again forced the analyst to be biased towards the fine material during sub-sampling. During dry sieving some clay aggregate was formed which was retained on the screen. Some difficulty was noted during wet sieving due to the gelatinous

nature of the sediment sample. It required twice the volume (3 L) of water to force the finer particles through the sieve increasing the handling time and labour. A large percentage of the wood fiber was removed during both wet and dry sieving although a significant amount of organic material was noted in the finer fractions.

Analysis

This sample was significantly lower than the previous sample for most elements, particularly cadmium, copper, lead and zinc. When reviewing the dry and wet sieved values no apparent trends existed between any of the preparation or digestion methods. Most noteworthy with this sample was its texture and composition which made subsampling more difficult. This fact is reflected in many of the duplicate values showing a fairly non-homogeneous sample producing random scattering of data.

TABLE 5 ALBERNI INLET

Physical Characteristics Summary

		Alberni #1	Alberni #2	Alberni #3	Alberni #4	Alberni #5
Moisture	(%)	83.6	45.0	78.0	50.9	54.1
Silt + Clay	(%)	81.5	33.6	76.7	67.4	80.6
Total Organic Carbon	(%)	14.6	3.12	9.14	6.15	1.21
Sieve Separation						
% Retained On 1.0mm Wet		16.8	42.5	9.8	41.8	7.8
1.0mm Dry		49.7	35.9	7.7	53.2	28.7
% Retained On 0.5mm Wet		18.1	43.0	14.5	43.2	10.2
0.5mm Dry		62.2	56.8	13.9	66.1	35.0
Most Notable Features		Very high fine wood fibre content, raw sample showed oily and tarry spots	Many large wood chunks The raw sediment had a soupy colloid-like texture, some shells, sand	Very high in fine wood fibre. Sample took 9 days to dry (60-70°C) layer of crystals formed on dried surface	Many large bark chunks some shells, pebbles and wood fibre	Fine sediment with some pebbles, sand and wood fragments

Alberni #3

This sample was obtained near the shore of the Inlet at a depth of 1.5 metres. The sample was characterized as a fine textured sediment having a high wood fibre content.

Sample Preparation

Observations made during the preparation suggested that the wood fibre was significantly less than either of the two previous stations within Alberni Inlet. During drying (nine days at 70°C) a layer of crystals formed on the surface. Isolation and analyses of these crystals confirm they were sodium chloride. The reason crystals formed in this particular sample and not in other high moisture sediments is unknown. The dried sample was easily ground to a fine consistency in a mortar and pestle but did contain a large amount of wood fibres. It did not however contain enough fibre to form a visible matt upon drying. During dry sieving there was a small amount of fibre and clay aggregate retained on the sieve which also rolled around as in previous samples. No attempt was made to further grind this wood and combine it in with the fine fraction. During wet sieving a small fibre matt was retained on the screen which had the appearance of wet peat moss. Comparisons between dry and wet sieving suggest that although the mass of the material retained on both sieves was similar between the wet and dry the actual composition was not. The wet material was made up predominately of wood fibres whereas the dry sieved fractions were fibres containing clay aggregate.

Analysis

Data comparisons between the dry blend and wet blend preparation methods show the wet blend values slightly higher than the dry blend although not significantly. Comparing values between dry and wet sieving show a slight increase in wet sieving consistent with a sediment having high silt and clay content. During

preparation it was noted that a significant amount of clay aggregate remained on the sieve thus explaining the higher values after wet sieving for all of the metals except mercury. This sample gave better duplicate values and replicate values between digestions than the previous two sediments.

Alberni #4

This sample was characterized as a fine sediment containing some coarse material (shells, pebbles, wood pieces) and some small wood chips 1 to 3 cm long.

Sample Preparation

During drying of this sample no problems were encountered. In fact the sample dried quickly and was easily blended in a mortar and pestle. As with other samples containing large fragments of foreign material, it was difficult to obtain representative subsamples for the wet and dry blend fractions. The analyst had a tendency to favour the smaller size particles during sub-sampling thereby selectively removing some of the larger aggregates. During sieving a large amount of material (42% to 60%) was retained on the screens. This material was predominately bark, shells, stones, larger wood fibres and in the case of the dry sieve, some clay aggregate.

Analysis

Reviewing the data between dry blend and wet blend again indicates wet blend values to be approximately 1.5 times the dry blend values. No reason for this fact is obvious at this time. As a rule the wet blend values are higher than the dry blend values although not by as large a factor as we have seen with other sediments. This is probably due to the fact that most of the foreign material noted in the sample was either wood chips or wood bark.

Alberni #5

This sample was collected at a point furthermost from the Pulp and Paper mill at a depth of 3 metres. The sample was characterized as a fine sediment containing some coarse sand, pebbles and wood pieces. The sample did not contain much fine wood fibre as noted in all other locations within Alberni Inlet.

Sample Preparation

The high content of sediment fines provided only a minor problem with sample preparation in that clay aggregate was formed after drying. This was confirmed by the fact that the fractions retained on the dry sieves were greater than those on the wet.

Analysis

Review of the data shows the sediment with slightly elevated levels of all the elements analysed. The wet sieved values were slightly higher than the dry sieved values due to retained clay aggregates. Duplication between samples was generally good with one exception for the 1mm wet blend HF digestion, cadmium result. This is likely an outlier as all other elements within that same preparation and digestion scheme provided good duplicates.

8.1.4 Esquimalt and Victoria Harbours

Esquimalt Harbour - D Jetty

The sample was characterized as having a medium to coarse texture and containing large amounts of foreign material. During the sampling, pieces of rope, electrical cable, some scallops and crab were retrieved with the grabs. Each of these were discarded prior to collecting the sample. The most notable concerns with this particular sample was the presence of foreign material within the retained fraction. Apart from the sediment itself the sample also contained what appeared to be black

sandblasting grit, oil and numerous metallic particles which were attracted to a magnet. Refer to Table 6 for a summary of the physical characteristics of the samples.

Sample Preparation

The presence of foreign material made it very difficult to obtain a representative subsample. After drying, the sediment was difficult to grind due to the presence of the blasting grit. The grit is a very hard material which limits the effectiveness of the hand grinding and homogenizing process. In fact the particle size of the sample aggregate could only be reduced to the size of grit itself which was large enough that some was retained on the sieve. During dry sieving up to 42% was retained on the sieve and described as primarily shells, wood, clay aggregate, sand and sand blasting grit. A few small pebbles were also noted. The material passing the sieve, although less than the 0.5 mm or 1.0 mm particle size was described as still very non-homogeneous. During wet sieving up to 35% of the material was retained on the sieve and was described primarily as small pebbles, sand and shells. No wood, clay aggregate or sand blasting grit was found to be retained upon wet sieving.

Analysis

The elemental concentrations indicate the sediment is highly contaminated in Cd, Cu, Pb and Zn. The presence of metal fragments and other foreign material made it difficult to produce a homogeneous sample irrespective of the method of preparation. The elevated levels of metals only serves to enhance the apparent nonhomogeneity of this sample which can be seen from the rather poor duplication within the analysis set.

The most noteworthy fact with the data, apart from the elevated levels of elements is the decrease in elemental concentration after sieving. This is opposite to what we have seen with most other sediments in this study. The coarse fraction which was largely removed by sieving, contained what appeared to be metal

fragments and metal bearing foreign material. A large percentage of this material was attracted to a magnet confirming it's metallic (ferrous) composition. No apparent trends in analysis data existed between any of the preparation or digestion schemes.

Esquimalt Harbour - Centre Harbour

This sample was characterized as a very fine textured sediment with almost no foreign material. During sampling however, some worms and clams were retrieved in the grab and subsequently removed.

Sample Preparation

During drying the sample formed a hard clay aggregate which was easily blended in a mortar and pestle. It was noted after drying that the sample did contain some metal fragments which were attracted to a magnet. A few small shells were also noted in the sample during preparation. This particular sample did not pose any unusual problems during preparation with the exception of the clay aggregate formation and the time required for settling during wet sieving.

Analysis

The data scatter did not seem to improve as the samples were sieved. For instance, the 0.5 mm sieved samples gave no better replicates than did the dry blend and wet blend fractions. No apparent trends were noted between any of the preparation or digestion schemes.

Esquimalt Harbour - Graving Dock

This sample was characterized as having a fine to coarse texture containing a large amount of foreign material. During sampling it was noted to have the appearance and aroma of a sewage sludge and contained what appeared to be wheat grains.

Sample Preparation

After drying the sample was easily homogenized in a mortar and pestle and was noted to contain some fine metallic particles which were again attracted to a magnet. During dry sieving up to 46% of the material was retained on the sieve and described as containing shells, some clay aggregate and a few small twigs. During wet sieving up to 40% of the material was retained on the sieve and described as containing sand, shells, some organic material, a hair net and an aluminum soup package. As with all the Esquimalt Harbour samples none of the preparation methods employed in this project were able to produce a completely homogeneous subsample.

Analysis

A review of the data shows a sediment highly contaminated with all the metals of interest. Mercury values ranged up to almost 4 ppm. The presence of the metallic particles and nonhomogeneous distribution of metals is again reflected in the poor duplication of results for all elements. Because of this random scatter it is sometimes difficult to observe trends in the data although some minor ones do appear. For instance some metal levels increased slightly after sieving due to the removal of some of the "cleaner" foreign material such as shells and twigs.

TABLE 6 ESQUIMALT/ VICTORIA HARBOUR

Physical Characteristics Summary

		D-Jetty	Centre Harbour	Graving Dock	Point Hope	Laurel Point
Moisture	(%)	46.2	54.2	59.9	53.7	56.7
Silt + Clay	(%)	36.1	86.4	66.8	51.8	70.2
Total Organic Carbon	(%)	2.51	1.51	2.66	3.24	4.06
Sieve Separation						
% Retained On 1.0mm Wet		23.9	1.1	33.3	13.7	6.8
1.0mm Dry		25.8	22.7	41.6	26.7	31.6
% Retained On 0.5mm Wet		35.1	4.5	39.7	28.3	10.5
0.5mm Dry		42.2	28.7	46.0	38.0	37.0
Most Notable Features		Black & oily appearance Black sandblasting grit. Rope and electrical cable were also found at this site	Fine grey sediment with little foreign material	Extraneous material - hair net, aluminum packaging black and oily appearance	Black sediment some wood, bark, and black sandblasting grit and metal flakes	Grey sediment with some shells and wood fragments

NOTE: All samples contained small amounts of metal flakes and filings

Victoria Harbour - Point Hope

This sample was characterized as having a fine to coarse texture containing wood, sand blasting grit and metal flakes. The sample was similar to those collected from Esquimalt Harbour in its texture and presence of foreign material. Obtaining a representative sub-sample was also a problem irrespective of preparation schemes.

Sample Preparation

During drying no problems were encountered although the blending step was hampered somewhat by the foreign material. During dry sieving up to 38% of the sample was retained which was comprised primarily of clay aggregate, wood, bark, shells and some sand blasting materials. During wet sieving up to 28% was retained on the sieve and was comprised primarily of wood, shells, sand and some blasting grit.

Analysis

Review of the data shows a sample highly elevated in all of the elements of interest. Again the nonhomogeneous nature of the sediment is apparent from the lack of precision between duplicates. In general the metal concentrations decreased after sieving indicating the removal of contaminated coarser materials. No apparent trends existed between any of the digestion methods used.

Victoria Harbour - Laurel Point

This sample was characterized as having a fine texture with some shells and wood fragments.

Sample Preparation

After drying, a hard clay aggregate was formed which was easily blended in a mortar and pestle. After dry sieving up to 37% was

retained on the sieve and consisted of some wood chips and shells but predominately clay aggregate. Some metal fragments were also noted in the prepared samples. During wet sieving just over 10% was retained on the sieve and consisted primarily of wood fibres and shells. No other problems were encountered with any of the preparation methods used.

Analysis

The data produced for all elements indicates this sample is much more homogeneous than the previous four from this region. The metal concentrations are also lower than the other four samples from Esquimalt/Victoria although still elevated in comparison to many other harbours from this study. In general, the replication is acceptable considering the presence of some metal particles. No apparent trends were noted between any of the digestion or analysis schemes.

8.2 Overall Evaluation of the Preparation and Analysis Methods

8.2.1 Preparation Methods

During the physical preparation of the sediment samples, many observations were made with respect to the effectiveness of the methods. The ideal method sought is one which produces a prepared sediment representative of the bulk sample that is also suitable for analysis. This all must be accomplished in a relatively simple and timely fashion.

Evaluation of the preparation steps included a comparison of the general method performance as well as the time and effort involved. We found that the comparison of methods with respect to producing a representative subsample is as much a function of the sediment type as the method itself. All methods performed well with some samples but poorly for others. The evaluation also depends somewhat on the equipment available for sample preparation. This equipment was restricted to what would realistically be used in a routine monitoring program by suitably equipped laboratories. Obviously some of the discussion will be subjective since all labs are not the same. What is considered routine in one lab may be more difficult in another. For instance, a lab dedicated to the preparation and analysis of soil and sediment samples may have large scale handling equipment whereas other laboratories may not.

The textures of sediments involved in this study were numerous ranging from very fine clay like materials to very coarse sand and pebbles. In addition, the foreign material present in the samples ranged from nil to very high in wood fibre, sulphur, metal fragments, sand blasting grit and numerous other particles of natural and manmade origin. The reality of such a diverse range of sediment types makes the selection of a "best" universal method from any one of the study procedures difficult or, in

fact, impossible. In order to illustrate this we should look at each of the preparation methods in some detail and discuss the pros and cons of each.

Wet Blend

This procedure was the simplest of those used since it only involved rapid blending of the material in a suitable homogenizing container. It is ideal for situations where time constraints are involved and where drying and/or sieving are not practical. This method requires little in the way of apparatus or special equipment thereby reducing potential contamination through contact with numerous surfaces. It also does not involve drying the sample which may lead to losses of volatile analytes. On the negative side, this procedure does not perform well for samples containing large amounts of aggregate material. Whenever shells, wood or large particles are present they tend to cause subsampling problems, and in fact, force the analyst to be somewhat selective in sampling. Given the choice, most analysts will favour the finer fractions when extracting an aliquot for analysis.

Dry and Grind

This procedure is more time consuming than the wet blend although some of this time is recovered by simplifying the subsampling and calculation of the data afterwards. Drying of most sediments can usually be accomplished overnight although samples containing high amounts of wood fibre and/or petroleum hydrocarbons have been shown to take up to five days to dry at the temperatures (60 - 70°C) chosen for this study. Once a sample is dry it is usually ground to a fairly consistent powder although coarse material can present a problem. Selective subsampling in the presence of coarse material is a concern with dry and grind as it is with wet blend. One major benefit when subsampling dry

sediment is the analyst can measure consistent weights from sample to sample. This produces digests which are closely matrix matched reducing problems with the analysis. In addition, the use of consistent sample weights greatly simplifies the data calculation process.

One concern with drying is the potential loss of volatile compounds. Of the metals analyzed in this study, mercury is typically the most volatile. When comparing mercury data between the dry blend and wet blend methods we conclude that no apparent losses were observed. Drying temperatures did not exceed 70°C for this study so possible losses of mercury above that temperature are still in question.

Dry Sieving

The initial steps involved with dry sieving are essentially the same as the dry and grind, in that the material is oven dried at between 60° and 70°C. The aggregates are broken up throughout the drying process with a mortar and pestle and the resulting dried material is then sieved. For the purposes of this study we compared sieving at 1 mm size fractions and 0.5 mm size fractions. For most of the sediments we encountered, little difference existed between these two sieve sizes. The benefits of dry sieving over dry blend is the removal of some of the coarse and foreign material. Where the samples contained coarse shells, wood, and other fragments these were generally removed in the sieving process. This has been shown to "high grade" the contaminants which are generally associated with the finer sediment fractions. Conversely, if the sediment has a large amount of clay this can form stable aggregates which without further grinding are retained on the sieve. The effect of this could be to "low grade" the contaminants since they may be removed with the clay. The analyst does have the option to retrieve the coarse fraction from the sieve, grind it further and

repeat the process until all clay aggregate had passed. This can be hampered by the presence of coarse particles such as rocks and shells. Further grinding efforts were outside the mandate of this study.

In addition to the clay aggregate concern, the dry sieve method generated dust requiring a sophisticated ventilation system. This dust becomes very significant in laboratories performing ultra trace determinations of trace metals. It was also a relatively labour intensive preparation method requiring far more time than the previous two.

The subsamples produced after dry sieving were by far the easiest to handle of any of the preparation methods. We generally were left with a reasonably consistent dry powder, free of significant amounts of large aggregates. This simplified the subsampling process by removing analyst bias towards selectivity. Assuming the analyst records the amount and the description of the material removed during sieving we feel this method shows promise.

Wet Sieving

Wet sieving was by far the most complex of the four chosen, requiring both the longest time and the greatest amount of analyst labour. The wet sieving was accomplished by washing a aliquot of sediment through a specified sieve with approximately 1500 ml of deionized distilled water. This method allowed us to sieve the samples without formation of clay aggregate and in fact virtually all fine material was easily washed through the sieve. Problems encountered during the preparation was in the recovery of the fine fraction after wet sieving. The analyst was typically faced with approximately 1700 - 2000 ml of slurry from which to recover the sediment. As previously discussed we ruled

out filtration and centrifugation favoring the simpler gravity separation.

Once the fines were separated from the liquid we were left with a sediment reasonably easy to handle for analysis. The moisture content of the sediment was changed during wet sieving requiring a secondary moisture determination to be carried out in order to calculate values on a dry weight basis.

One possible benefit of wet sieving over dry sieving is the retention of volatile compounds. More work would be required to compare data for volatile compounds between this preparation method and ones involving drying.

8.2.2 Digestion and Analysis Methods

To evaluate the digestion and analysis procedures for harbour sediments we must take many unrelated factors into account. The selection of a universally accepted procedure would require that it meets the criteria as defined at the beginning of the project. In addition, the analysis method must be compatible with the physical preparation procedures, the instrument with which the analysis will be performed on, equipment available to most laboratories, etc. After reviewing the data produced in this study it was concluded that no one analysis procedure consistently outperformed the others. As with the preparation methods we found that all analysis procedures performed well for some samples but poorly for others.

There are numerous pros and cons with every method depending on the nature of the sample. The best way to present our findings would be to discuss the performance of the individual methods in the following sections.

Nitric/Hydrochloric (1:1 HNO_3 /HCl)

This procedure, with it's various interpretations has been used successfully in many laboratories for years. It is a good universal digestion ideally suited to the analysis of sediments for most elements of environmental concern. It uses acids that are safer to work with than some others (hydrofluoric, perchloric etc.) used for sediment analysis. In addition, the apparatus, glassware and fume removal systems are common to most laboratories.

This digestion worked well for all prepared sediments from wet blend through to dry sieve. It is a simple procedure providing an extract which is easy to analyse by conventional spectroscopy techniques. One notable benefit of this digestion is the ability to handle a fairly large sample aliquot (3g - 5g dry weight). This is important when samples are non-homogeneous requiring a larger aliquot to provide a more representative subsample. Another benefit with digesting larger subsamples is the analyte is more concentrated in the final extract. This may reduce the need for using the most sensitive analytical methods which are often more time consuming and costly. For instance this digestion allows the determination of lead (Pb) by flame AA while still achieving an adequate detection limit.

The HNO_3 /HCL digestion does not fully recover those elements associated with the silicate matrix of the sediment. This was not a concern for the elements measured in this study but would be if elements such as chromium are to be determined.

Nitric/Peroxide (HNO_3 /H_2O_2)

Many of the comments and observations made with the 1:1 HNO^3 /HCL digestion are directly applicable to this procedure. The apparatus and glassware used for the digestion is essentially the

same as the above. The only difference between the two digestions is the substitution of hydrochloric acid with hydrogen peroxide. We did not notice any increase or decrease in performance between the two digestions, although it was apparent that those samples higher in organics were better handled by the nitric/peroxide digestion.

Hydrofluoric Acid/Teflon Bomb

This procedure, with its multiple options has been used by many researchers with various degrees of success. The teflon bomb procedure uses the concept of acid, heat and pressure to dissolve a sample. Although the concept is simple, the method can differ in details such as sample weights, acid strengths and acid combinations. This study used the method proposed by Loring and Rantalla described in Walton (1978). Although the method performs well for some sediment types, it lacks the ability to handle non-homogeneous samples. The size of many bombs restrict the sample weight to approximately 0.5g. The analyst can use larger bombs which will allow increased sample weight although there are limits to practical bomb size. The small sample weight requires the sediment to be very homogeneous and fine textured in order to insure that 0.5g is representative of the bulk sample. For many "typical" harbour sediments the preparation must essentially pulverize the sample to an even and fine consistency. The effort involved, the time required and the potential for contamination for this type of preparation is prohibitive for routine analysis.

The resulting extracts from this digestion were generally more complex than the previous two (acid/flask type) digestions. After digestion, the excess HF is neutralized with two percent boric acid. This increases the dissolved solids content of the solution to a level where instrumental analysis can become more difficult. High dissolved solids increases the need to use

special precautions (matrix modification) in nonflame AA methods as well as other instrumental techniques. In addition, the small sample weight (0.5g) digested increases the dilution of the analytes in the final extract. Typically a half gram would be bulked to about 50ml giving a dilution factor of 100. Conversely with the two previous digestions the factors are between 25 & 50. The high dilution factor increases the need for more sensitive instrumental techniques particularly for the analysis of lead.

The teflon bomb digestion was not suitable for the analysis of mercury. During analysis of the extracts by cold vapor AA a positive interference was noted. The cause of this artifact has not been confirmed although indications point to a non-specific vapor that absorbs at the analysis wavelength (254 nm). Throughout the study this digestion gave consistently higher mercury values than the other two for all samples and QA solutions. The level of enhancement was different from batch to batch although it was fairly consistent within batches allowing us to blank correct to provide more realistic data. We do conclude however that the mercury data from the HF digestions should be used for indication only and not relied upon throughout this study.

8.2.3 Selection of Method

The target of this study was to develop a "best" method for the preparation and analysis of typical harbour sediments for a select group of heavy metals. As the data became available it became more evident that this target was somewhat unrealistic. The proposed methods proved to be either too time consuming or not able to accommodate some of the unique properties of the more complex sediment types. A definitive method may still exist which meets the basic needs as outlined at the beginning of this project. For instance :

- The method needs to be rapid since many programs require the data be available often within a few days.

- The method needs to be simple using common equipment available to most laboratories performing this type of work.

- The method needs to be reliable having proven performance through not only the analysis of standard reference materials but "real world" samples as well.

None of the methods used in this study fully satisfied our test criteria for all sediment types. For instance the wet blend preparation method worked well for sediments having little or no foreign material but gave questionable results when foreign material was present. Likewise the HF teflon bomb digestion worked well when sediment consistency was fine but performed poorly when foreign or non-homogeneous material was present.

Preparation

After reviewing all information it becomes apparent that no one preparation method suits all sediment types. In fact the choice of preparation method depends on the sediment type and to a certain extent the analytes being determined. For instance a homogeneous sediment containing little or no foreign material would best be prepared by the simple wet blend method. Experience has shown that this method would be applicable to virtually all open ocean sediments and a good percentage of coastal and harbour sediments. Those samples that contained large amounts of foreign material or aggregates but no concern for volatile analytes may be best prepared by a dry and grind or dry sieve method. The choice between the simple dry and grind versus sieving would depend on the degree of foreign material present. If a sample contained a large amount of foreign material or aggregates and volatile compounds were required for analysis then a wet sieve method may be preferred. Ideally if

one was to use the wet sieve method as a routine then a large scale centrifuge would be required to keep preparation time realistic.

Digestion

Rather than suggest one particular digestion and analysis method it is more appropriate to provide guidelines and performance criteria for analysts to follow. The guidelines could be in the form of suggested procedures providing there is enough selection to accomodate the laboratories. The performance criteria would need to be established by Regulatory bodies after reviewing available information. Consultation with groups such as :

- Regional Ocean Dumping Advisory Committee (RODAC)
- Marine Analytical Chemistry Standards Program (MACSP)
- United States Environmental Protection Agency (U.S.E.P.A.)

may assist in designing these performance criteria.

Often the choice of a test method depends on analyst experience and preference, available equipment, analytes being determined, sediment types, regulatory requirements, etc. This study confirmed that with the exception of mercury, no major discrepancies in data could be attributed to any of the digestion methods. Each method out performs the others in certain areas as discussed. For most sediments of natural origin the 1:1 HNO^3 / HCl procedure works well. The HNO_3 /H_2O_2 procedure is ideally suited for sediments with slightly higher organic content and the HF is ideal for those samples of very fine consistency containing little or no foreign material.

The methods of analysis designed for, and used within this study, are one of many options available to the analyst. This report

and the conclusions derived from this work should not preclude the use of other acceptable analysis methods. Laboratories performing this type of work should be required to carry out appropriate quality assurance and report all data with the sample results. If the published performance criteria is not met by any one laboratory the data must be questioned or discarded. Additional programs such as interlaboratory comparisons could also be used to ensure comparability of data between different groups.

9.0 RECOMMENDATIONS AND CONCLUSIONS

9.1 Recommendations

- Performance criteria should be established by the regulatory groups governing the quality of work carried out. Guidelines on how to perform the work should be provided although details should be left to the participating laboratories/consultants.

- All data generated from this study should be reviewed and summarized by a statistician to allow for further interpretation. Trends in the data not obvious to the reviewer may become apparent after statistical analysis.

- The methods selected for use in this study were not modified once they were established. Some modifications should be investigated to see how they may affect the data. A few suggestions would be :

  - further grind the fraction retained after sieving to ensure all clay aggregates have passed the screen.
  - pulverize the entire sample to minus 100 mesh after drying to ensure it is representative of the bulk sample and fine textured enough for all digestions.
  - compare how smaller sieve sizes will affect the preparation methods and resulting analysis data.
  - investigate alternate digestions or modifications to the ones used for this study.

- Perform analysis for other inorganic parameters of interest on the prepared sediments or a select group of samples.

- Consider a future study along the same lines as the one for heavy metals but analysing for organic parameters.

Organics of interest should include PAH's, PCB's, Pesticides, Chlorinated Phenols, Chlorinated Dioxins and Furans and other organo-chlorine compounds.

- Compare loses of volatile components before and after drying to establish an "optimum" temperature and conditions. Organic compounds already known to be lost during drying would not be included in this study.

9.2 Conclusions

- Sediment types and textures vary greatly between harbours and within the same harbour. In extreme cases sediments were found to vary significantly in composition when sampled only a few meters apart.

- Preparation methods varied in both complexity and their ability to perform on difficult samples. All preparation schemes performed well for some sediment types but poorly for others. Wet blend was the simplest method requiring very little handling and preparation time. Wet sieving on the other hand was the most time consuming and was deemed not practical to meet the study criteria.

- No preparation method was able to fully homogenize all sediment types particularly the Esquimalt and Victoria samples which contained fine metal fragments.

- The method selected to prepare the sediments had a major influence on the data produced if the sample had significant amounts of coarse material. For this reason the interpretation of the data must include how the sediment was prepared.

- Analysis procedures were generally less critical than the physical preparation methods with some noted exceptions. Exceptions to this were:

  - Mercury by the HF teflon bomb method were discarded due to vapour artifacts causing an enhancement of values.

  - Poor agreement between duplicates where samples were non-homogeneous. This was more a shortcoming of the preparation method although it appeared more evident with the HF teflon bomb digestions. This is likely due to the fact that only 0.5g was used in this digestion thereby exaggerating the non-homogeneous nature of the sample.

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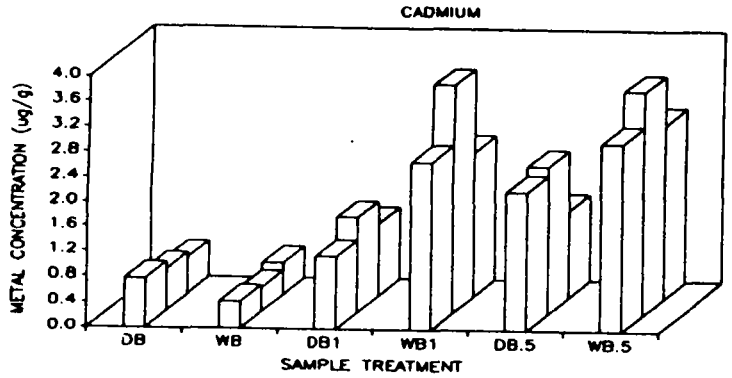
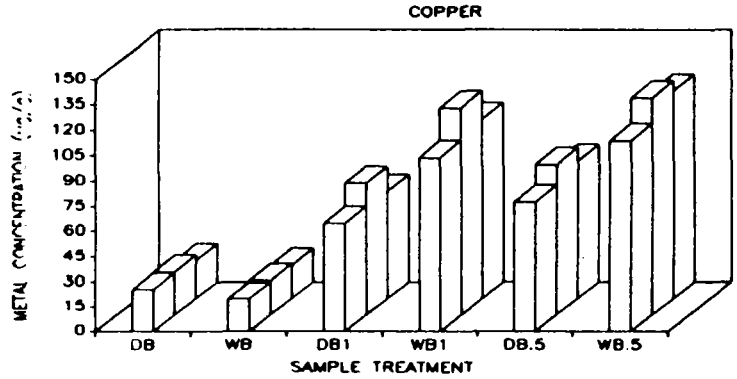
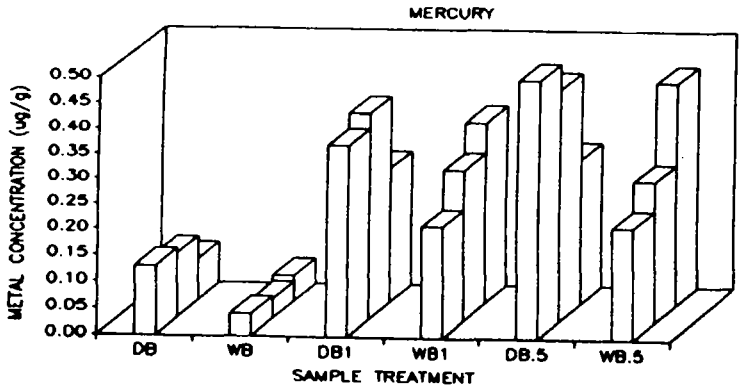
VANCOUVER HARBOUR

SUMMARY DATA

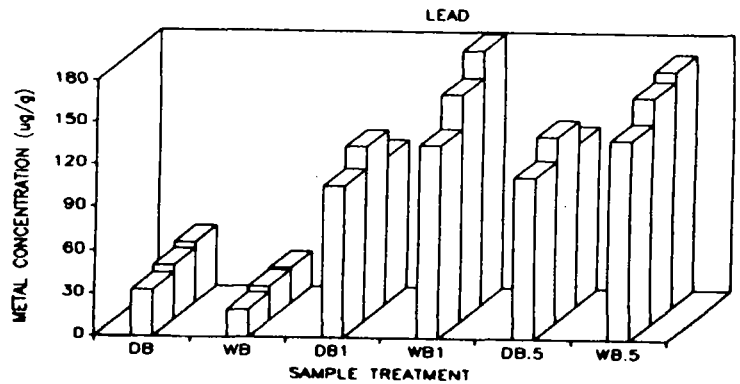


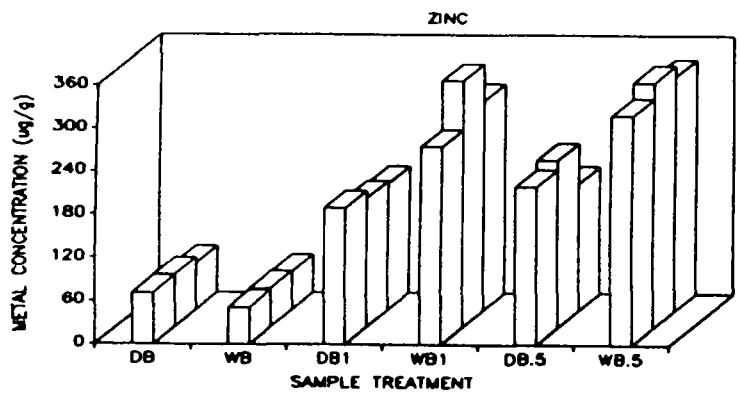




KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve
Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb





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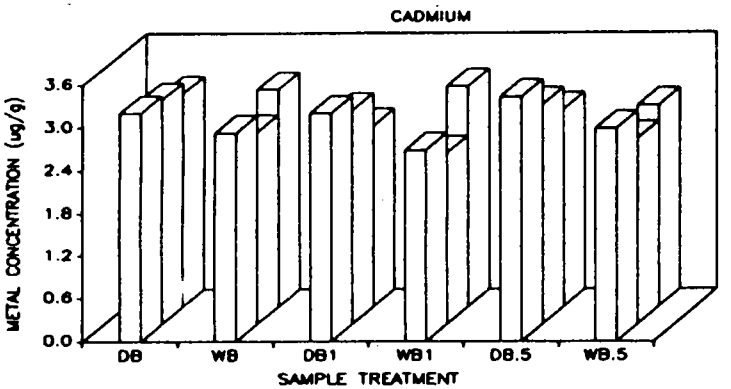
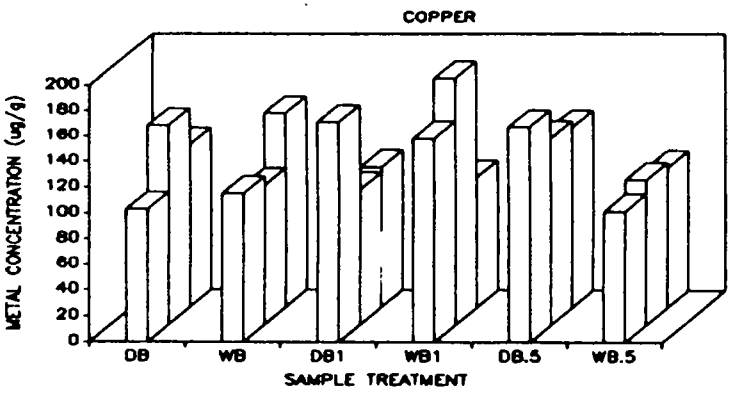
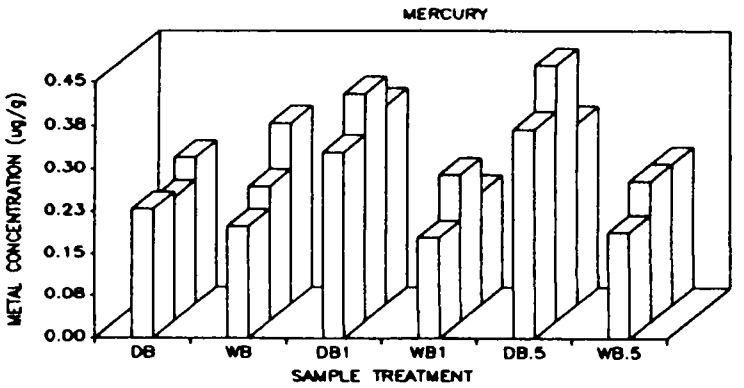
PORT MOODY II - INSIDE BOOM - COMPARISON OF DIGESTION AND PREPARATION METHODS.







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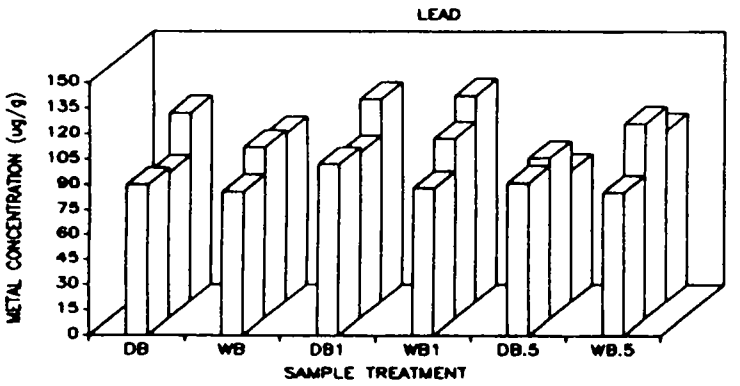
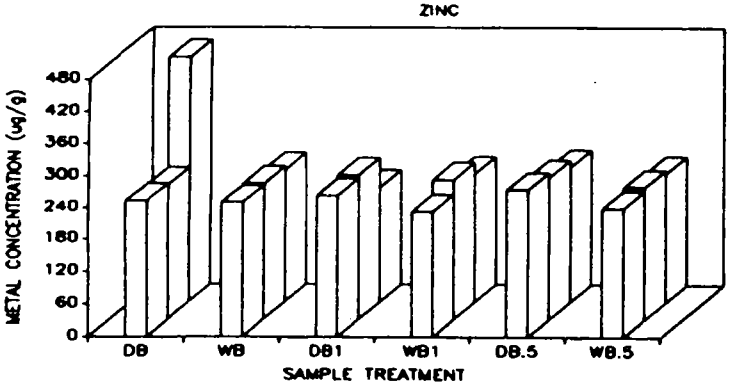
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

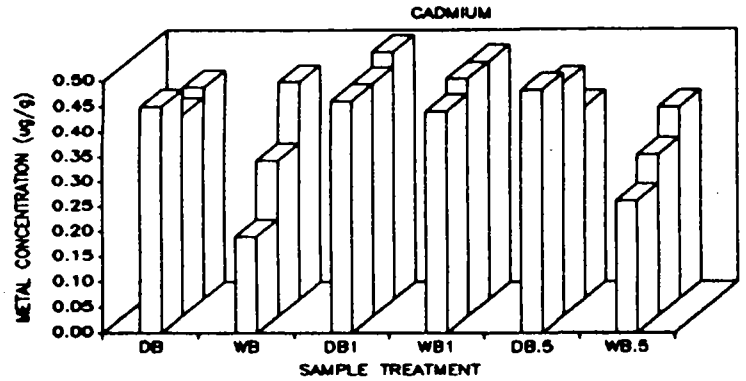


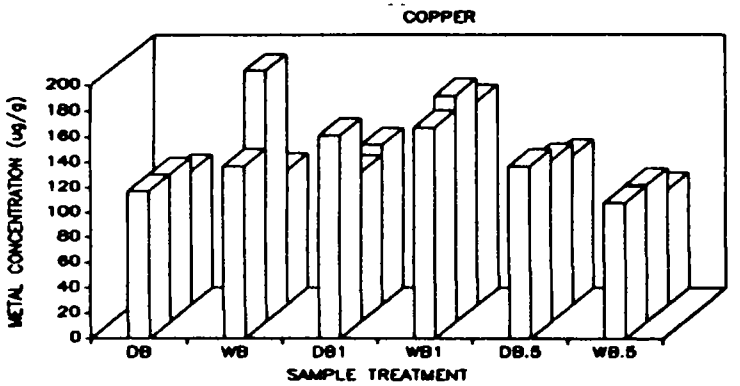


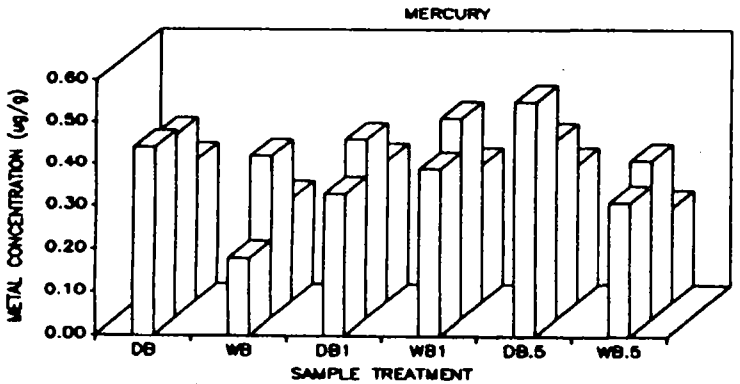
PORT MOODY III. INSIDE BOOM

COMPARISON OF DIGSTION AND PREPARATION METHODS

ASL



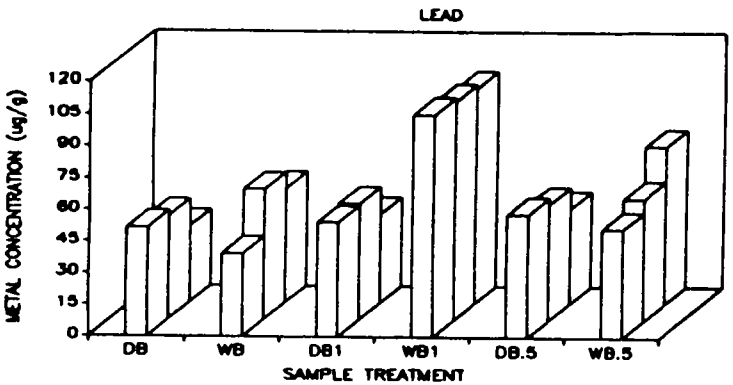


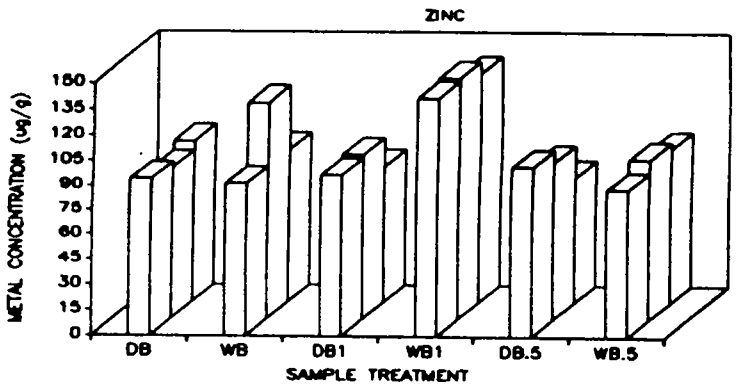


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

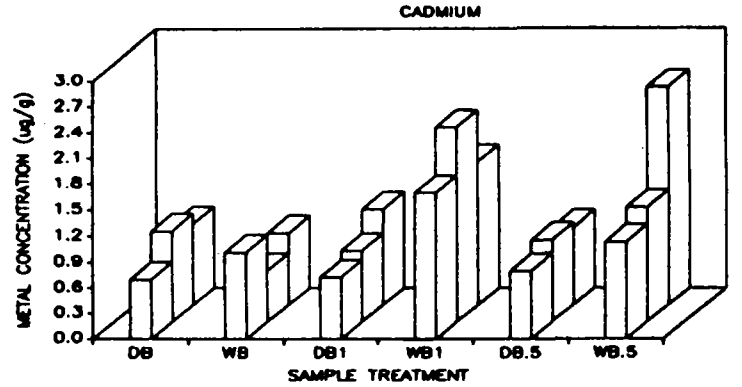


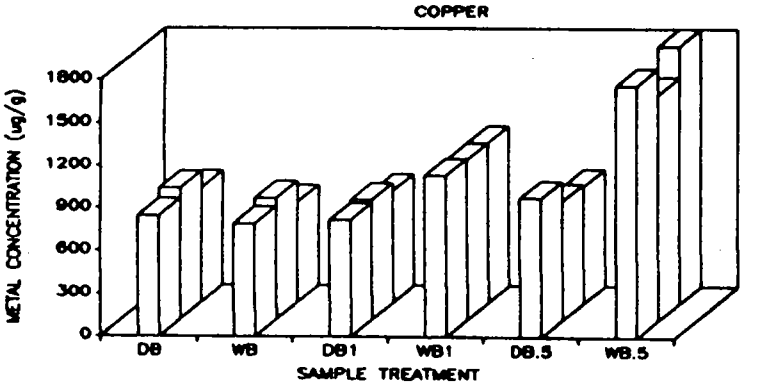


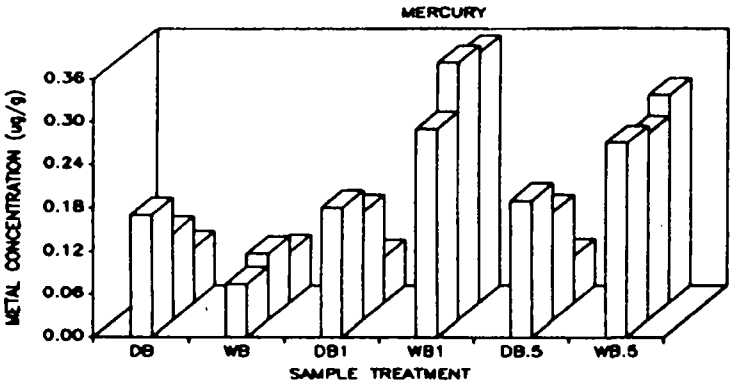
ASL

COAL HARBOUR

COMPARISON OF DIGESTION AND PREPARATION METHODS



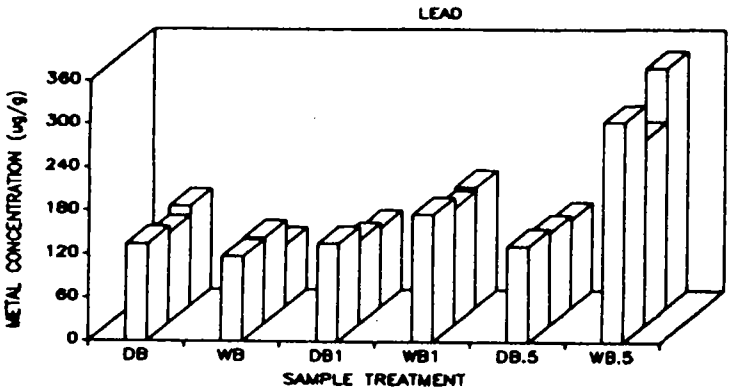


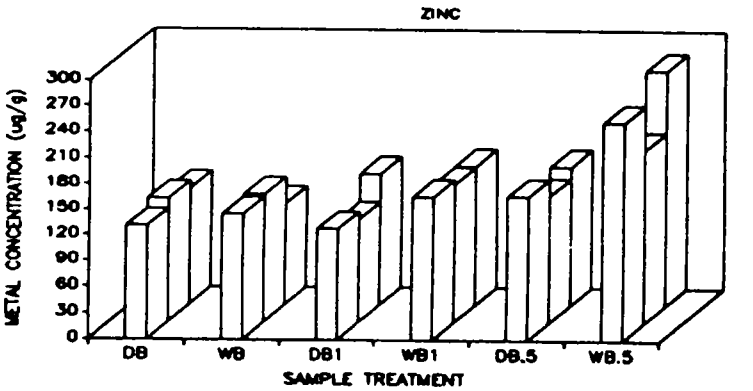


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

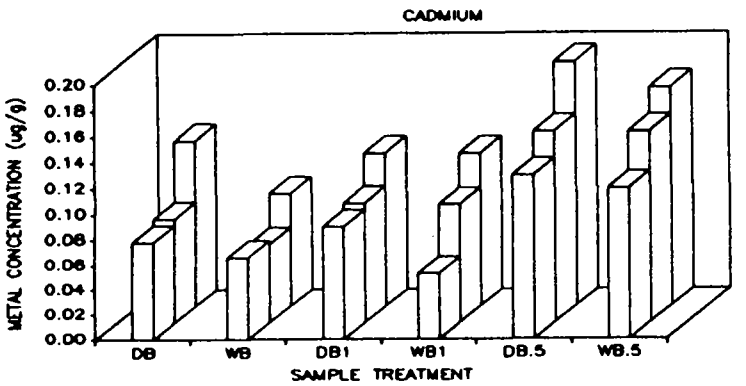


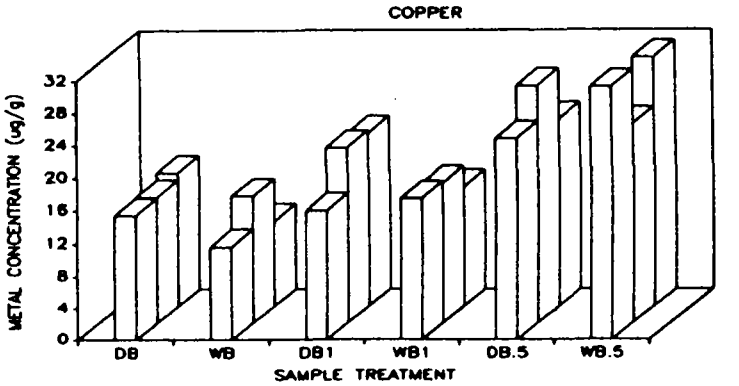


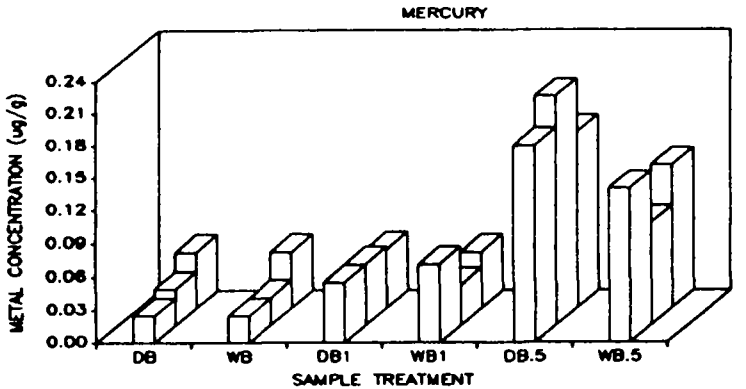
ASL

VANCOUVER WHARVES. OFF LOAD A

COMPARISON OF DIGESTION AND PREPARATION METHODS



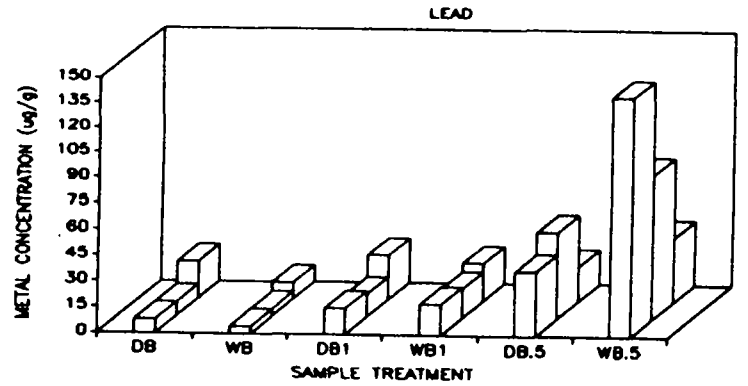


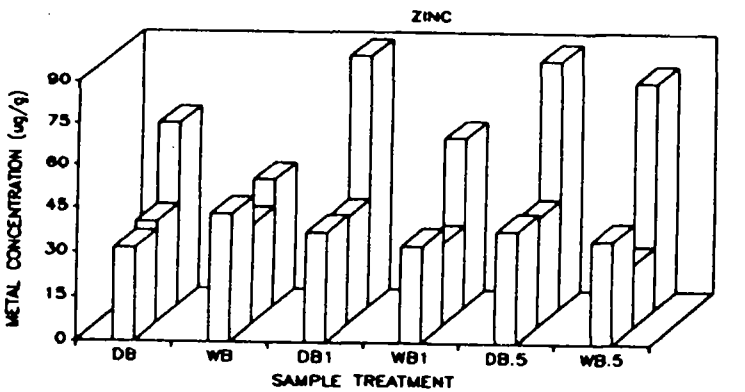


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb





ASL

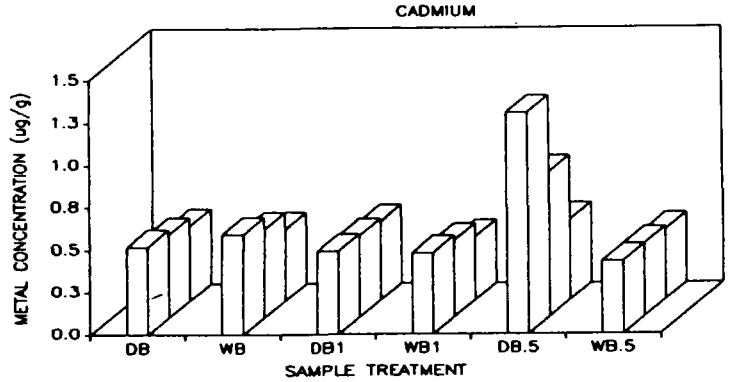
VANCOUVER HARBOUR. EP STN 14

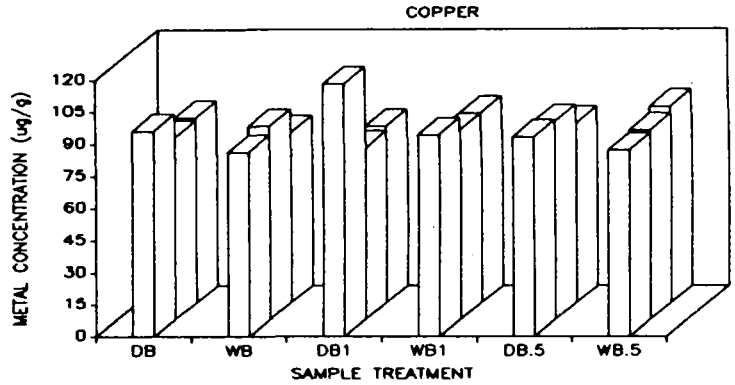
COMPARISON OF DIGESTION AND PREPARATION METHODS

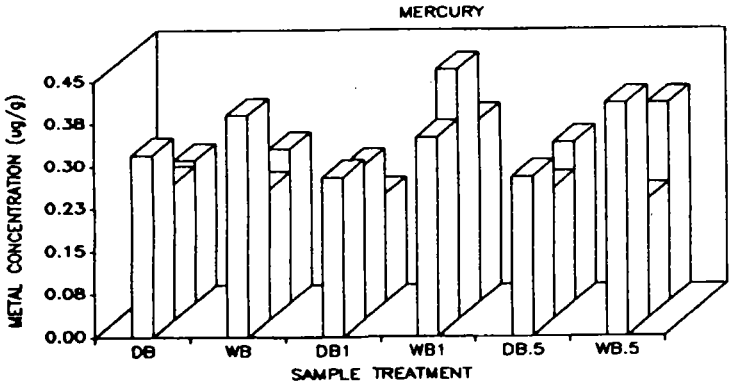
ASL

FALSE CREEK

SUMMARY DATA



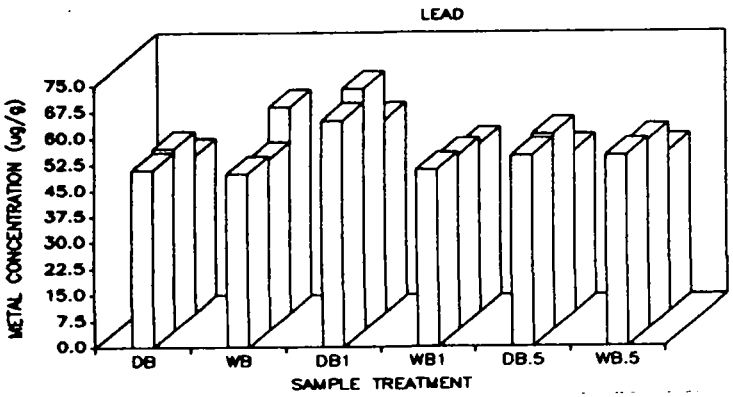


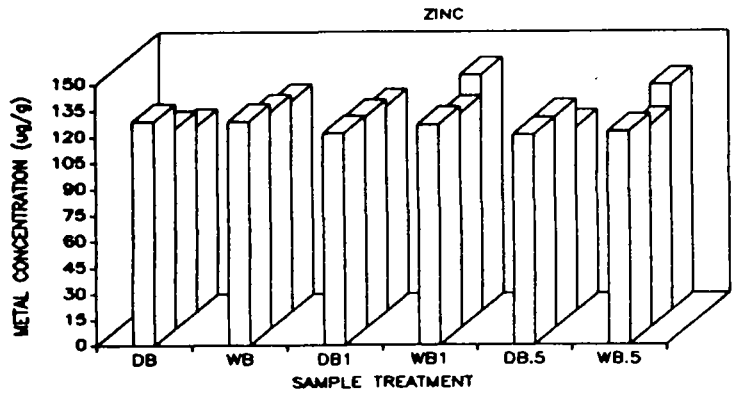


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

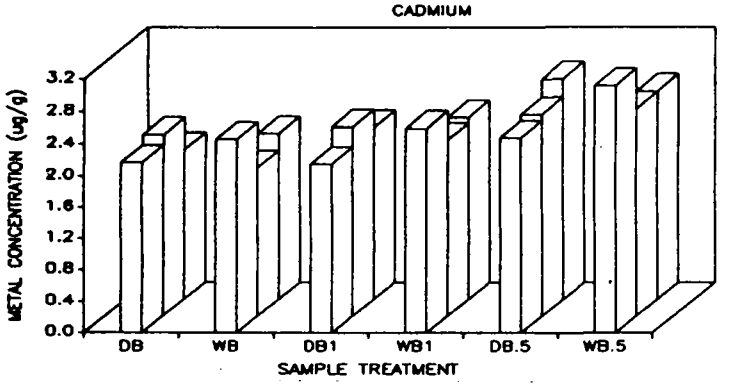


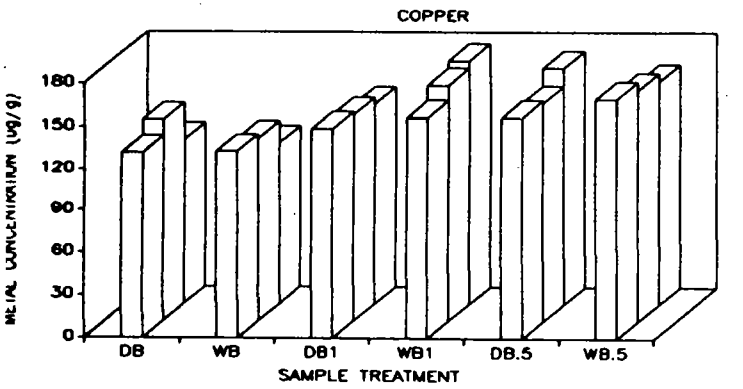


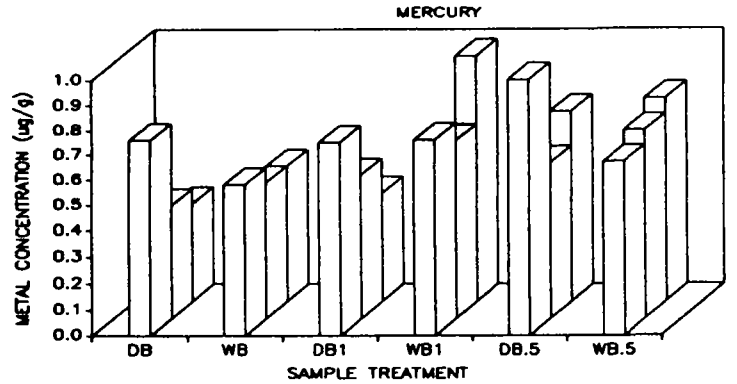
ASL

FALSE CREEK - CENTRE CHANNEL

COMPARISON OF DIGESTION AND PREPARATION METHODS



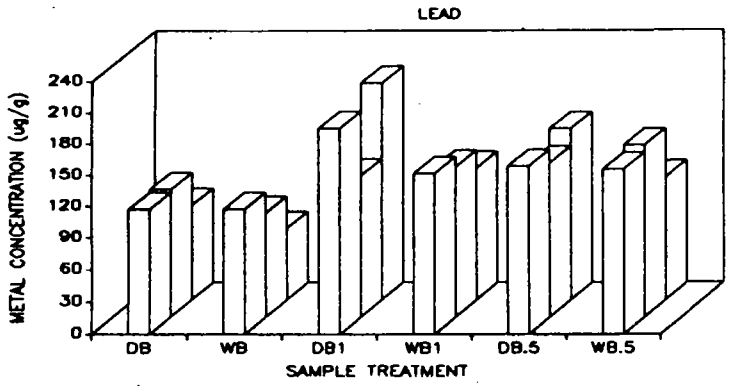


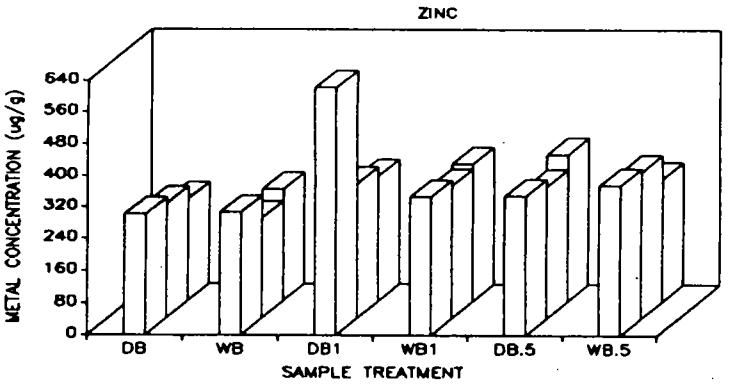


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

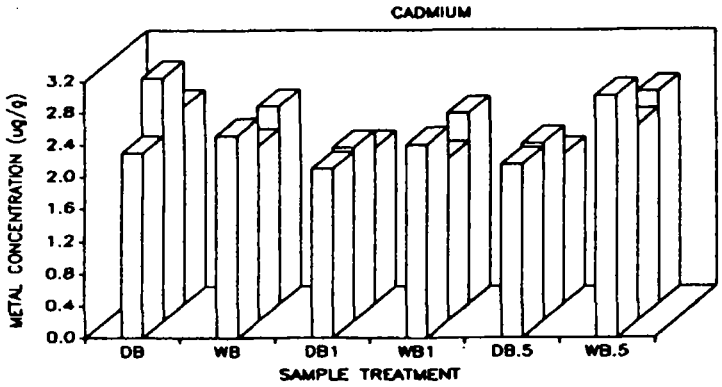


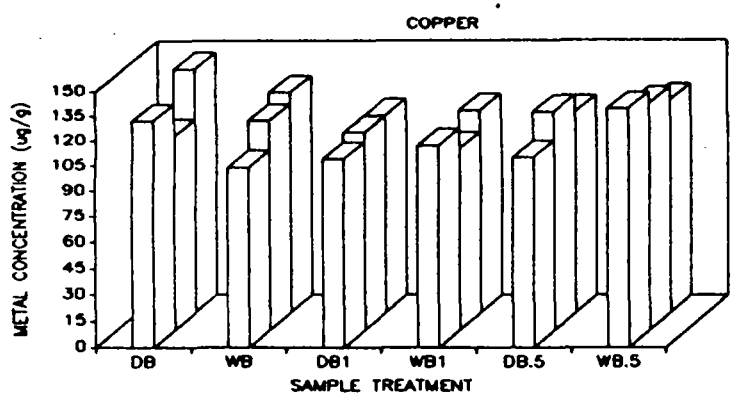


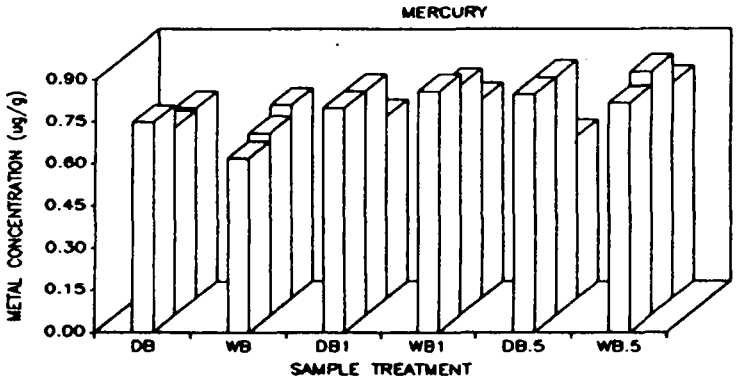
ASL

FALSE CREEK - CENTRE BASIN #1

COMPARISON OF DIGESTION AND PREPARATION METHODS



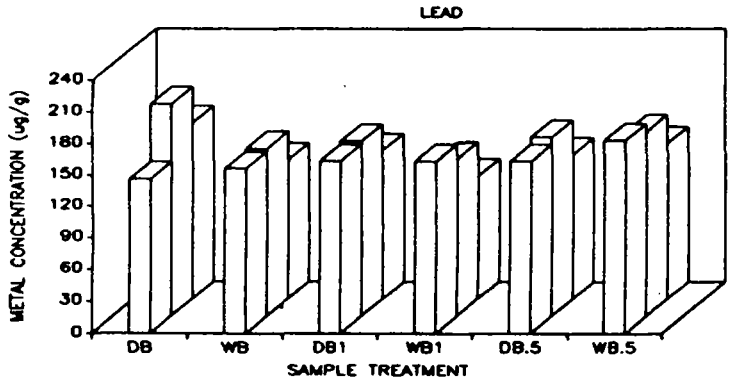


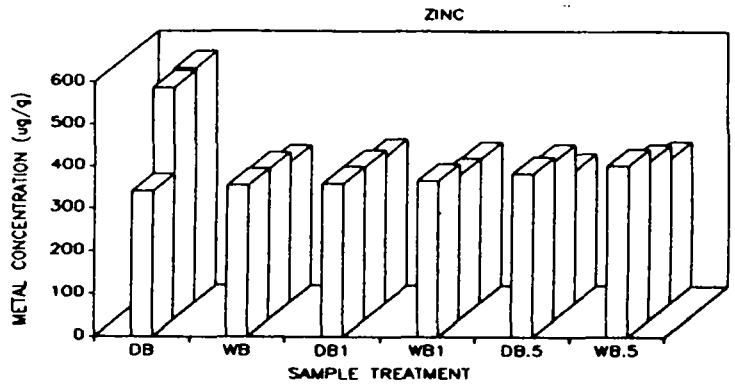


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

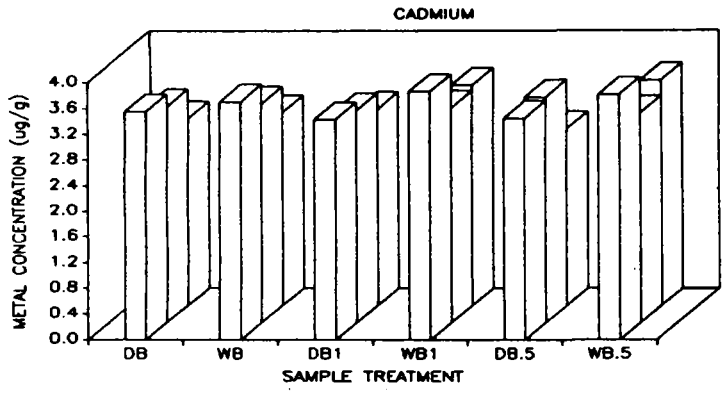


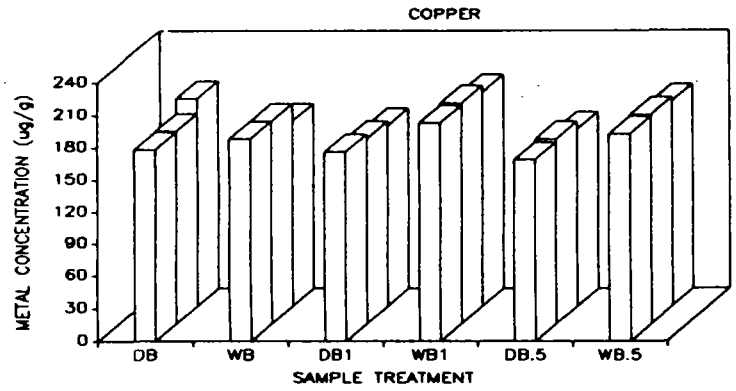


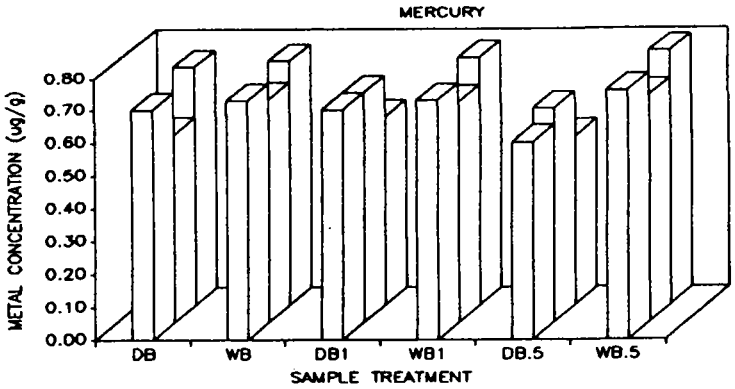
ASL

FALSE CREEK - EAST BASIN #1

COMPARISON OF DIGESTION AND PREPARATION METHODS



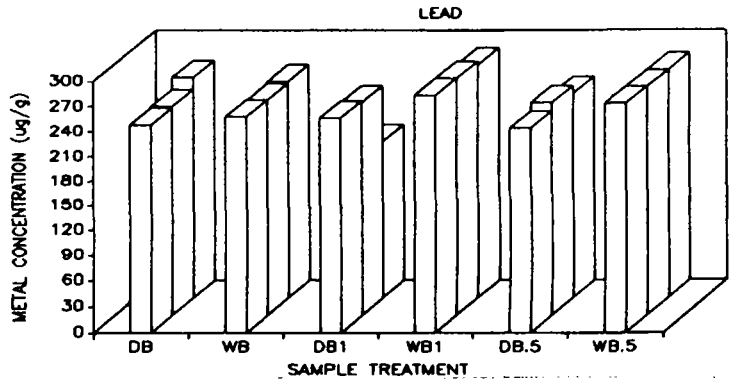


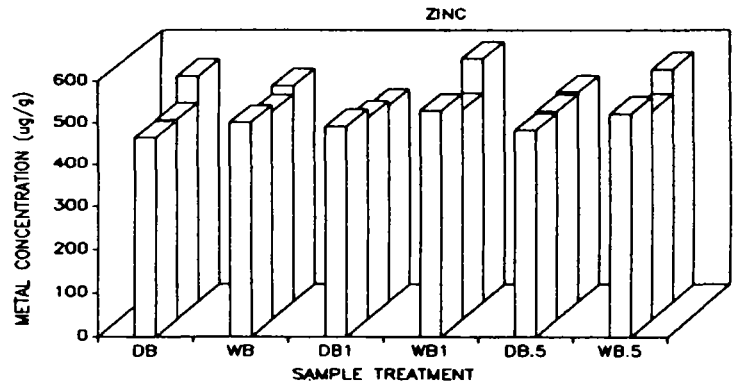


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

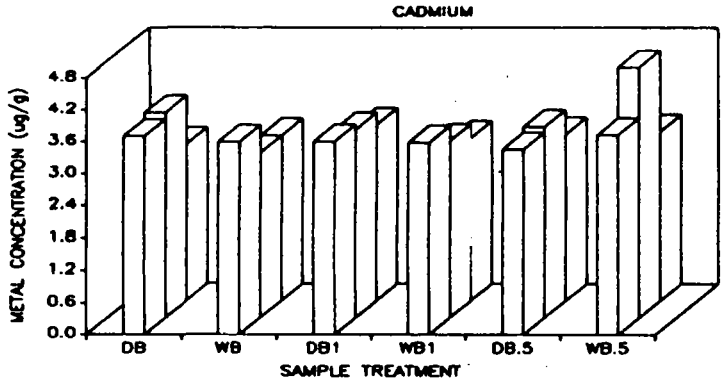


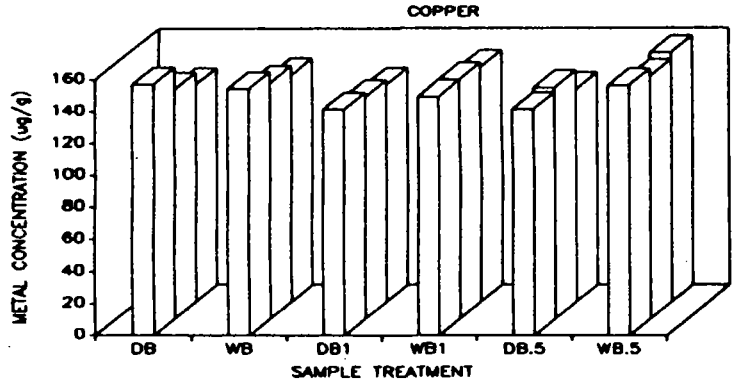


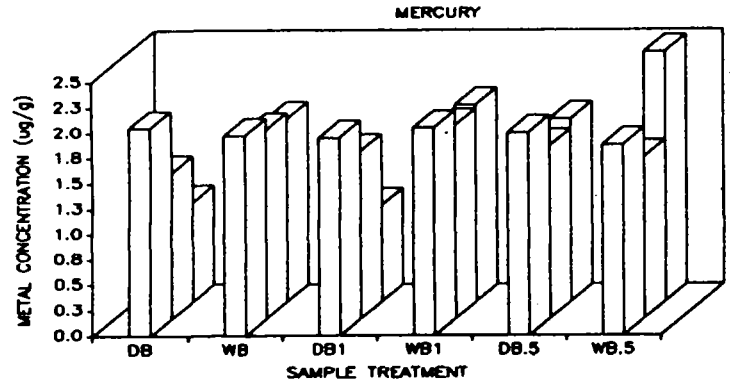
ASL

FALSE CREEK - EAST BASIN #2

COMPARISON OF DIGESTION AND PREPARATION METHODS



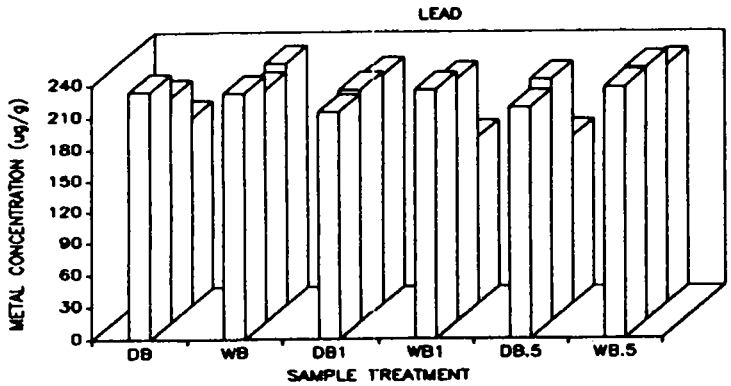


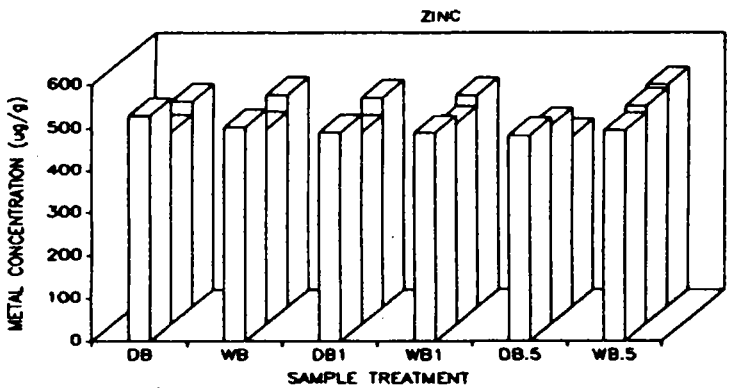


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3:HCl
SECOND	:	HNO_3/Peroxide
THIRD	:	HF/Teflon Bomb





ASL

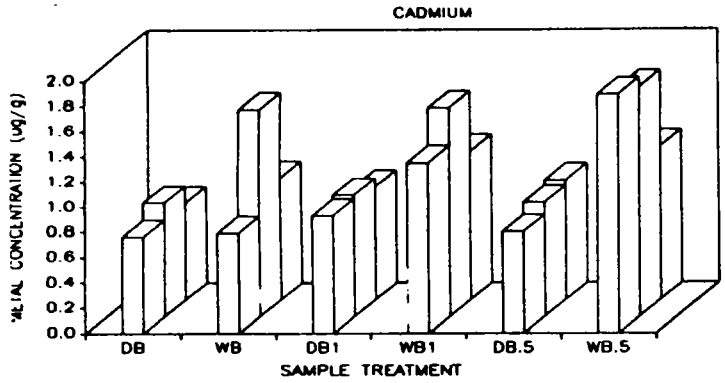
FALSE CREEK - EAST BASIN #3

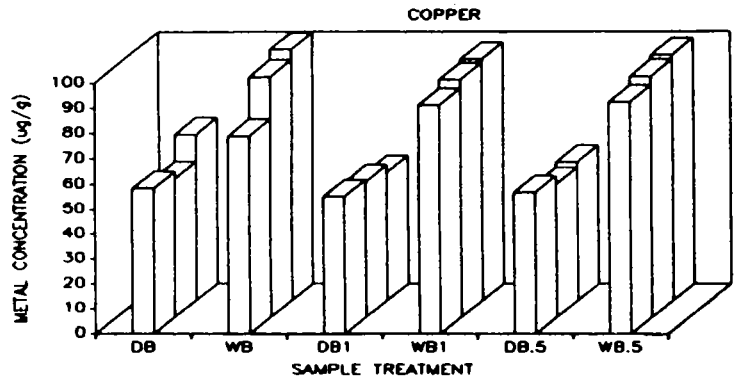
COMPARISON OF DIGESTION AND PREPARATION METHODS

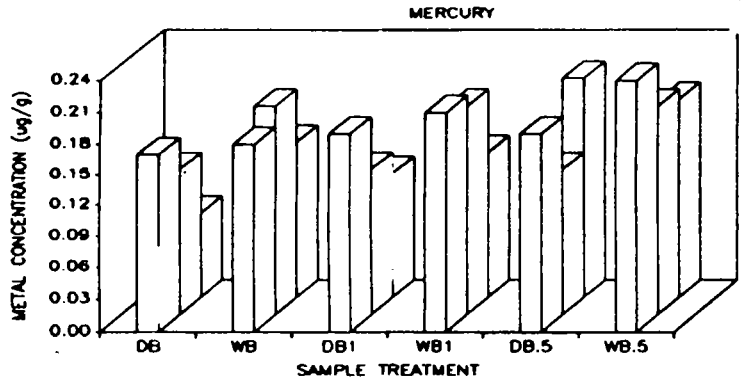
ASL

ALBERNI INLET

SUMMARY DATA



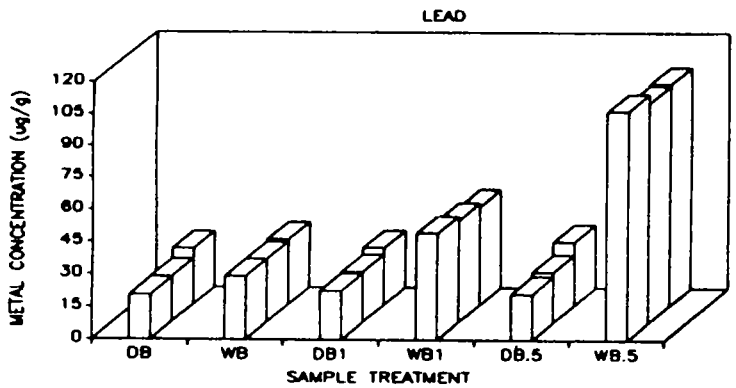


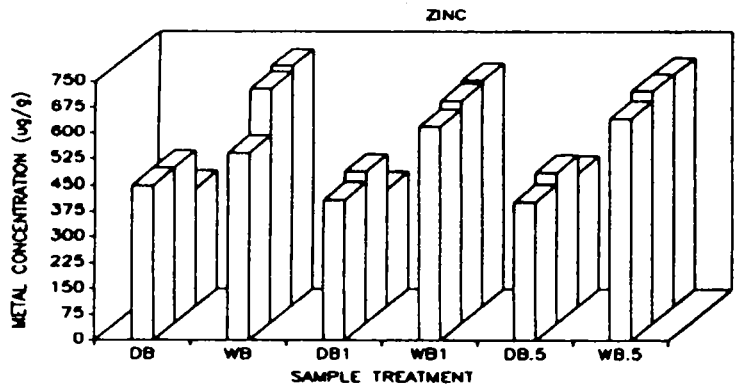


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

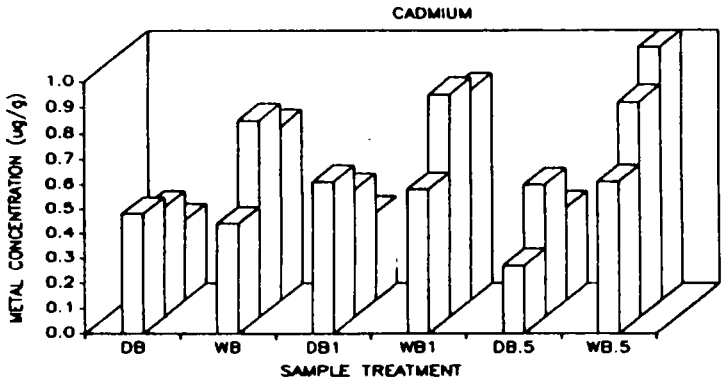


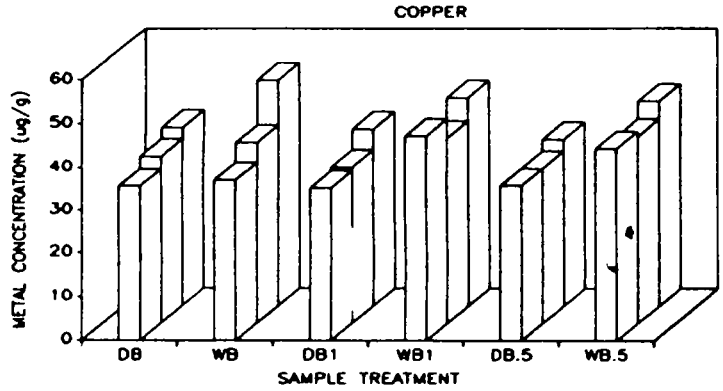


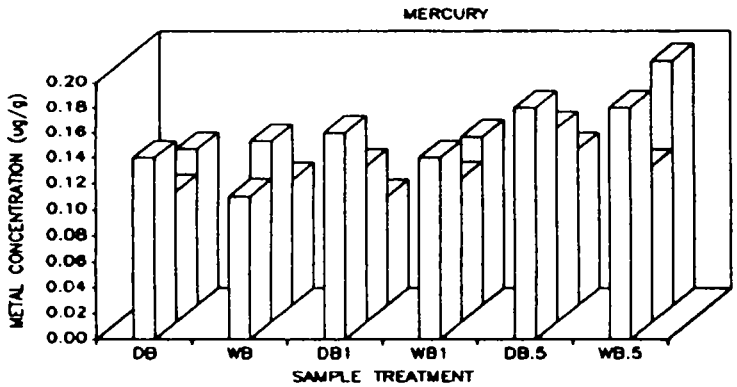
ASL

ALBERNI INLET - ALBERNI #1

COMPARISON OF DIGESTION AND PREPARATION METHODS



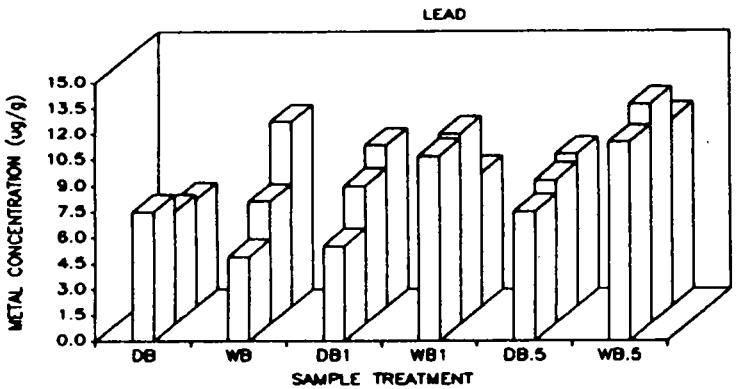


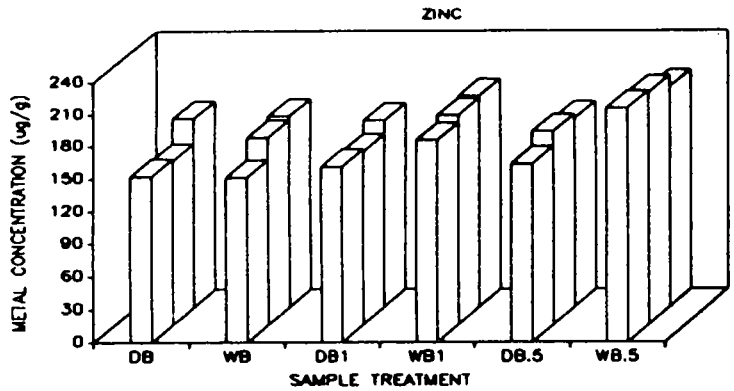


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

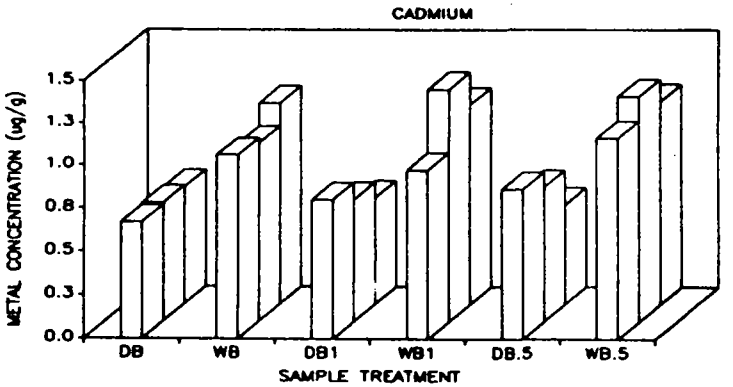


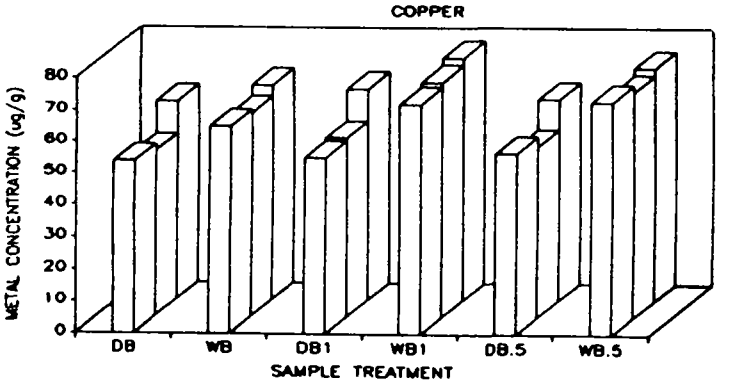


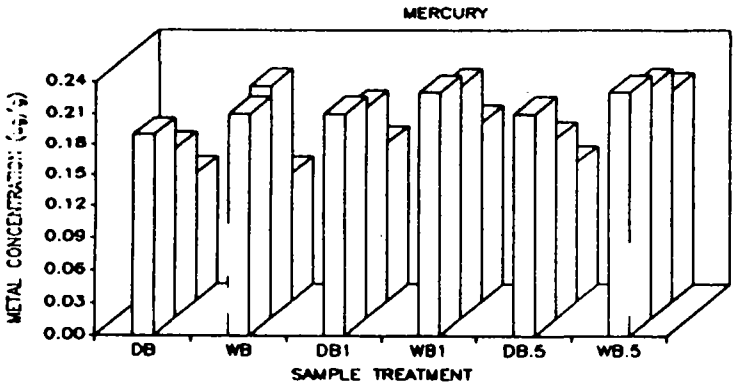
ASL

ALBERNI INLET - ALBERNI #2

COMPARISON OF DIGESTION AND PREPARATION METHODS



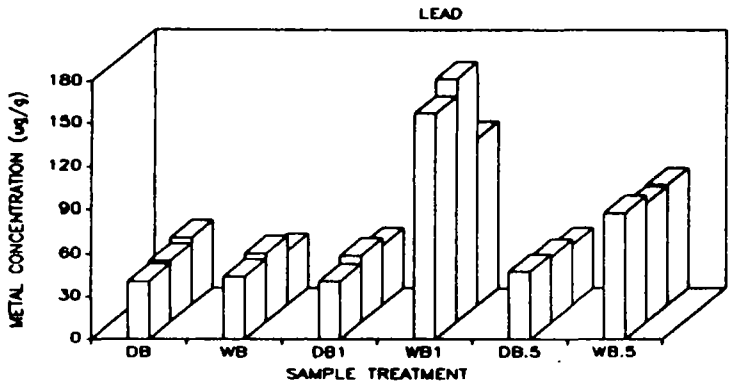


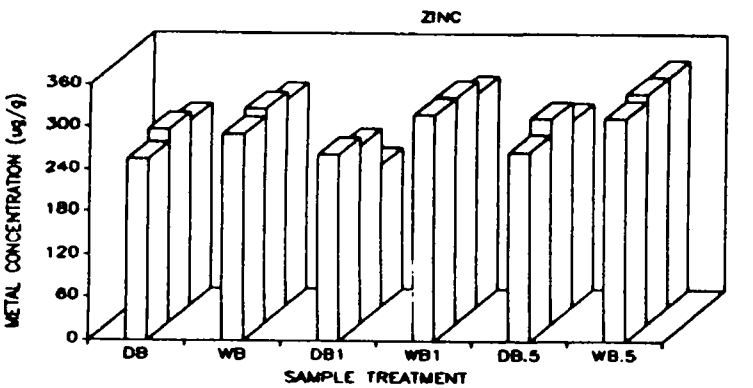


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb





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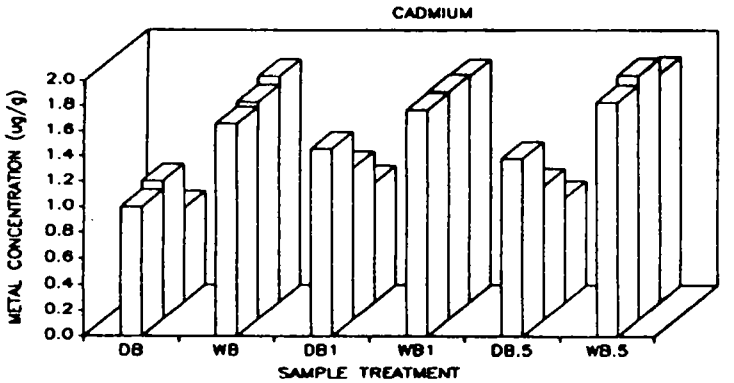
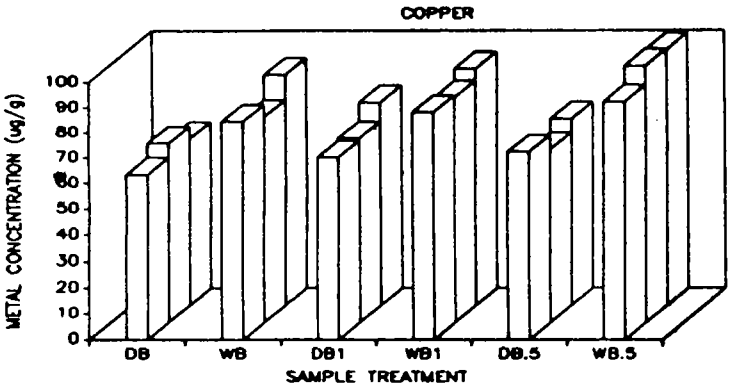
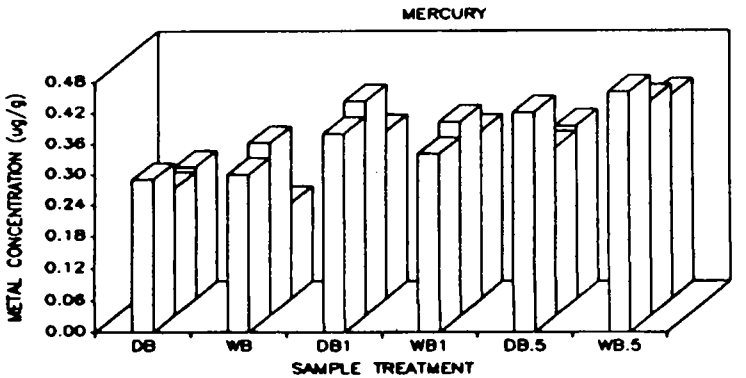
ALBERNI INLET - ALBERNI #3

COMPARISON OF DIGESTION AND PREPARATION METHODS



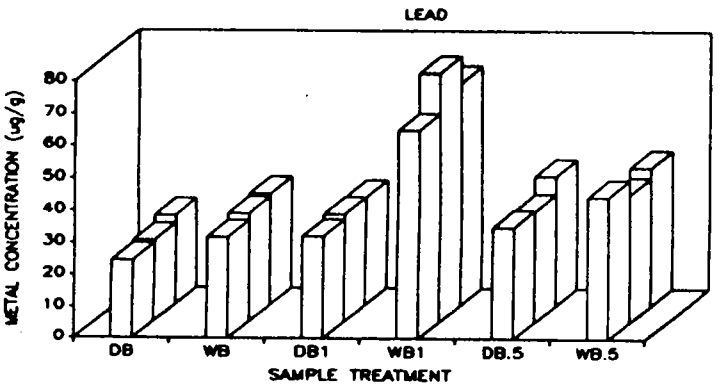


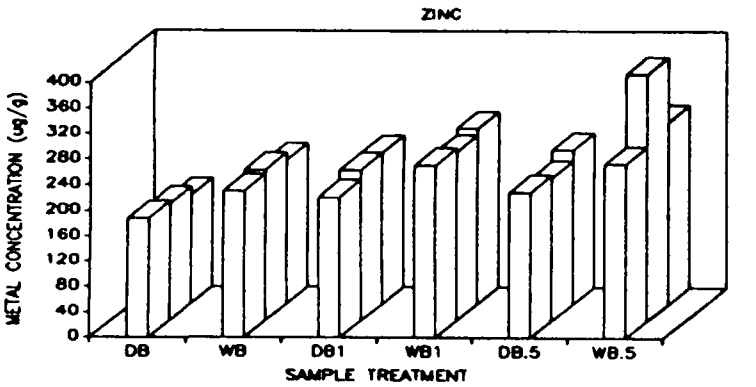


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb





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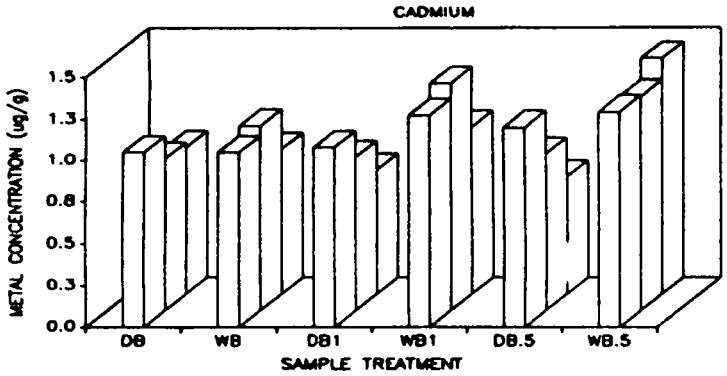
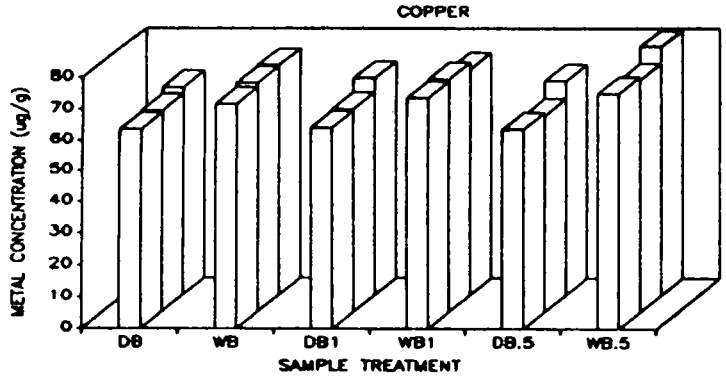
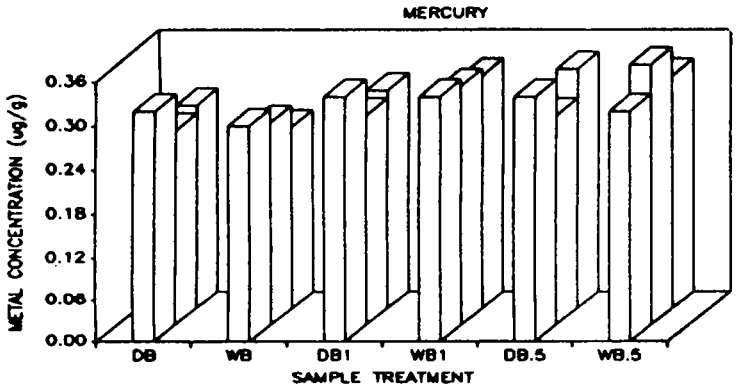
ALBERNI INLET - ALBERNI #4

COMPARISON OF DIGESTION AND PREPARATION METHODS



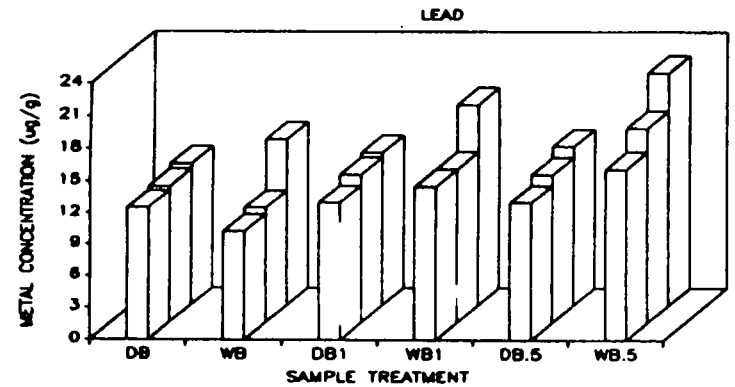


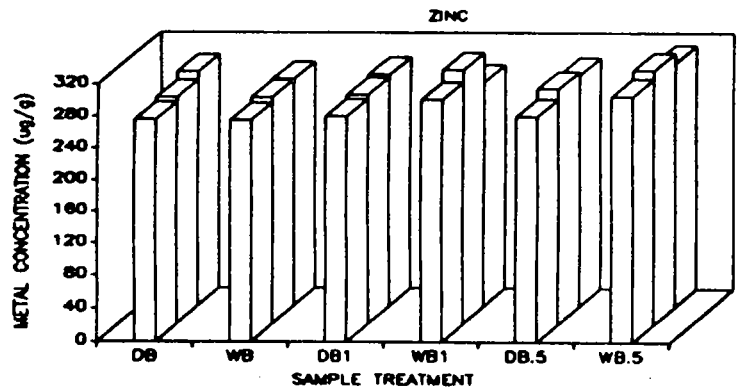


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3:HCl
SECOND	:	HNO_3/Peroxide
THIRD	:	HF/Teflon Bomb





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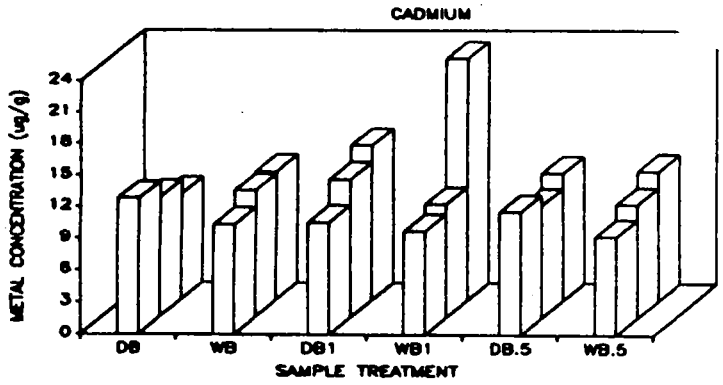
ALBERNI INLET - ALBERNI #5

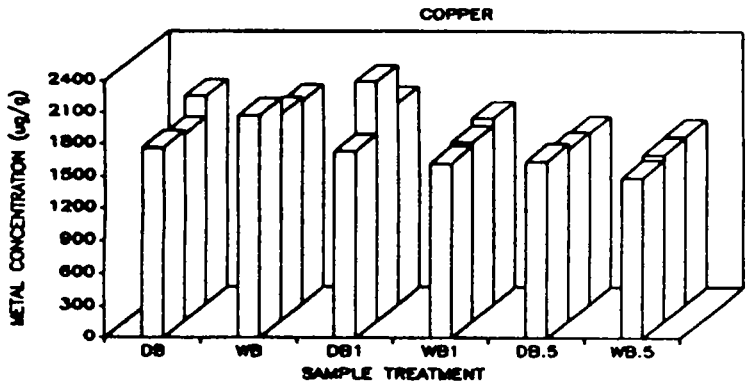
COMPARISON OF DIGESTION AND PREPARATION METHODS

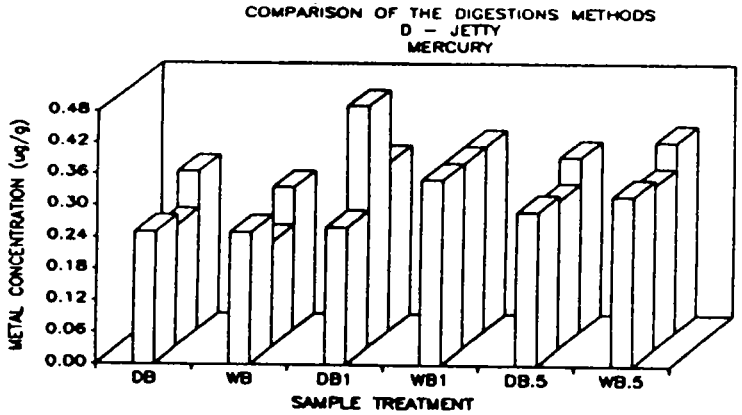
ASL

ESQUIMALT HARBOUR
AND
VICTORIA HARBOUR

SUMMARY DATA



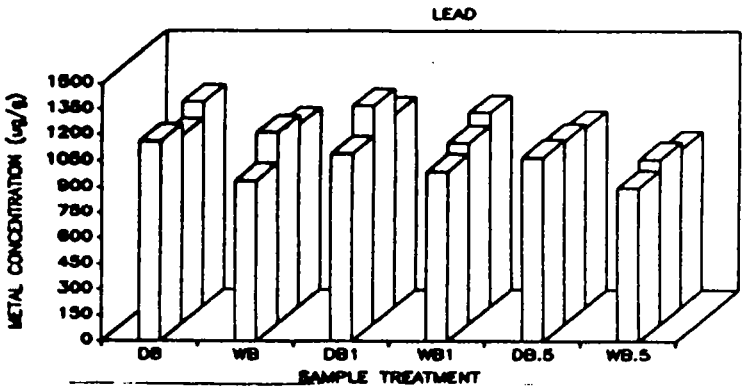


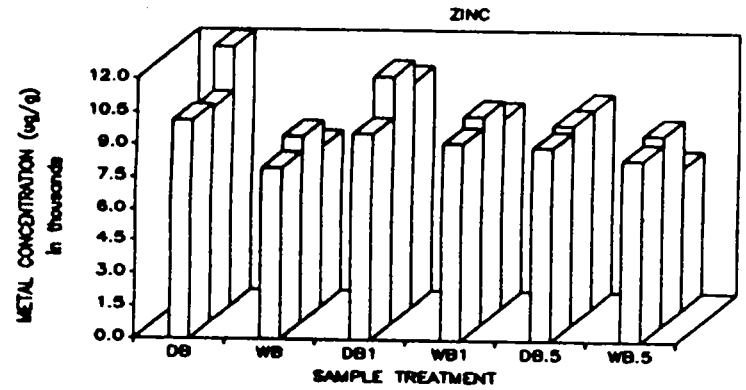


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

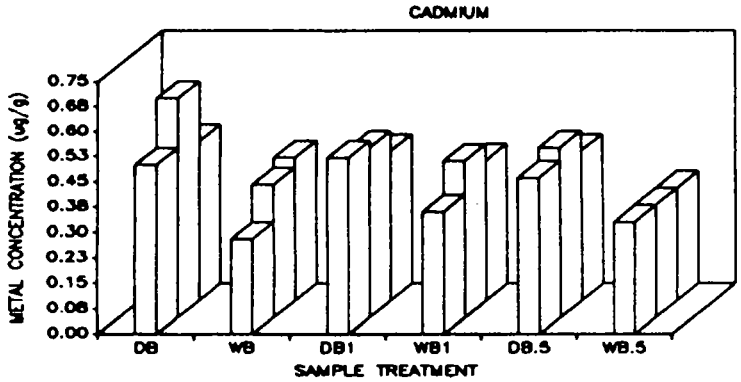


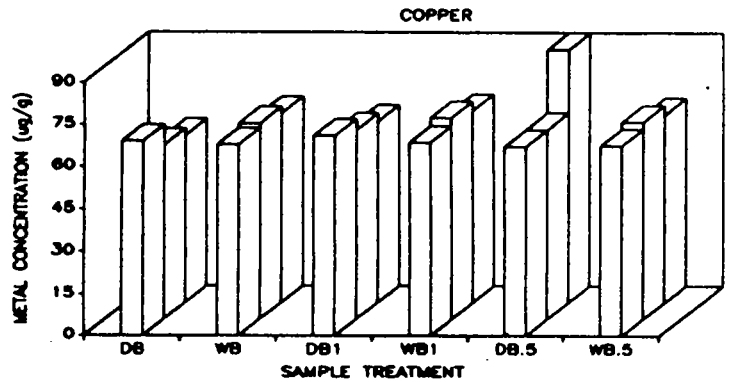


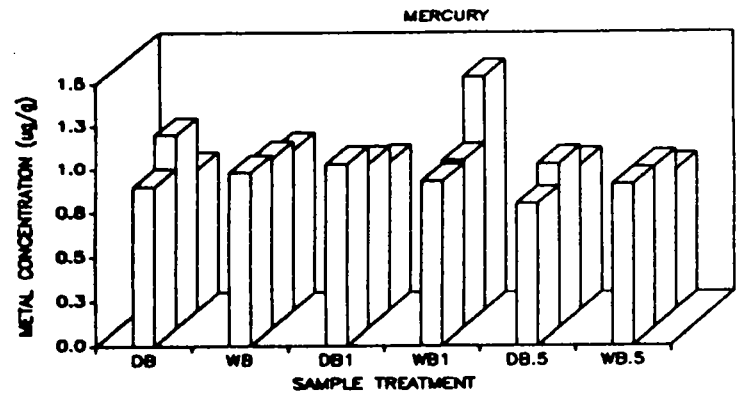
ASL

ESQUIMALT HARBOUR - D JETTY

COMPARISON OF DIGESTION AND PREPARATION METHODS



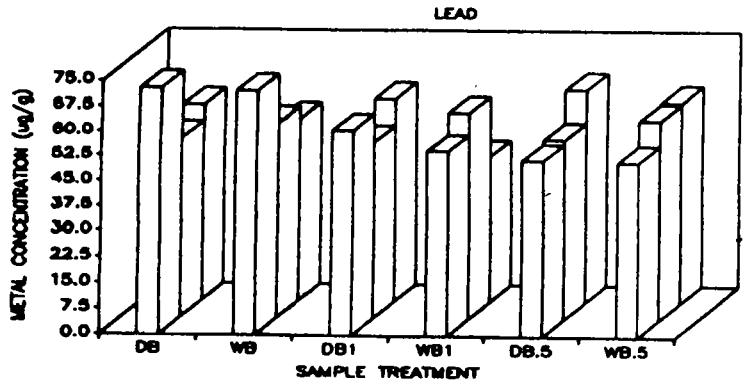


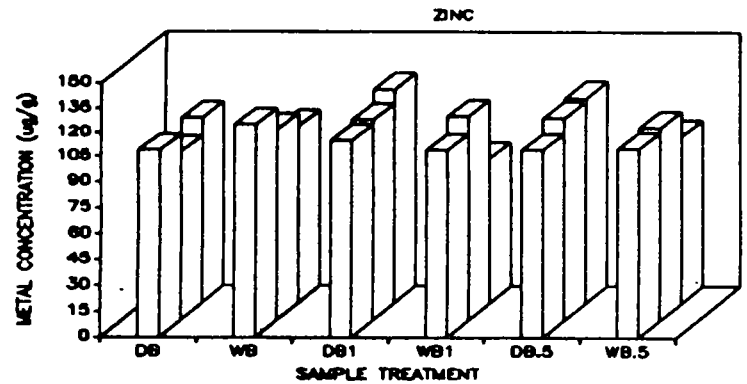


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

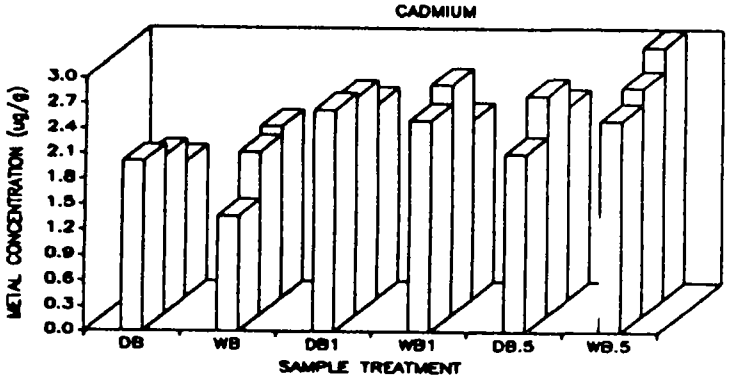


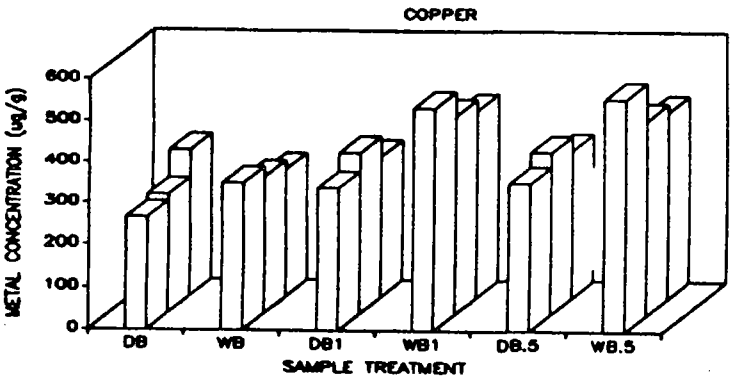


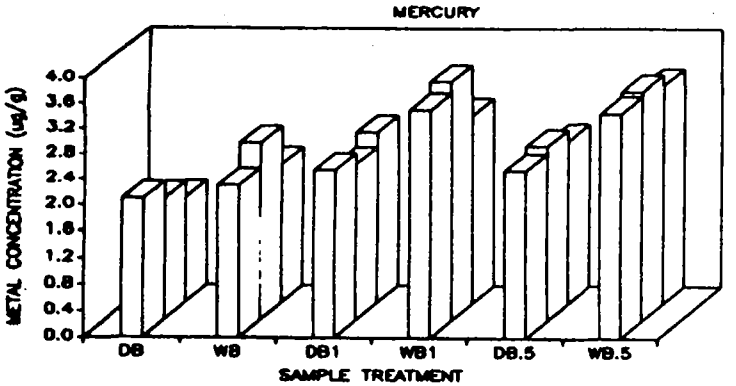
ASL

ESQUIMALT HARBOUR - CENTRE HARBOUR

COMPARISON OF DIGESTION AND PREPARATION METHODS



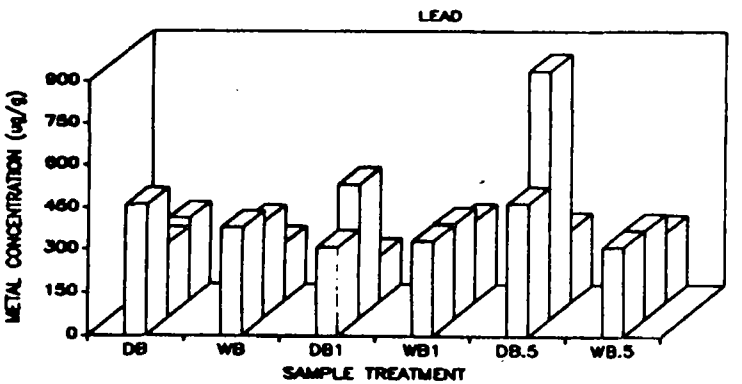


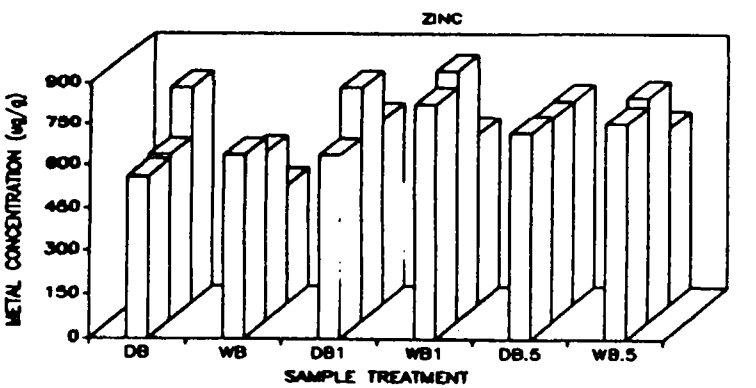


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb

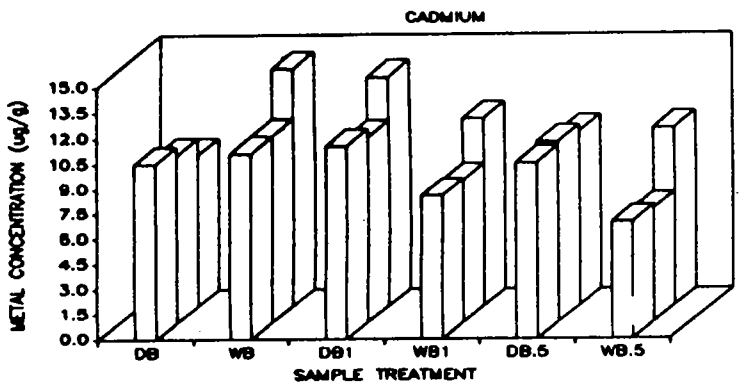


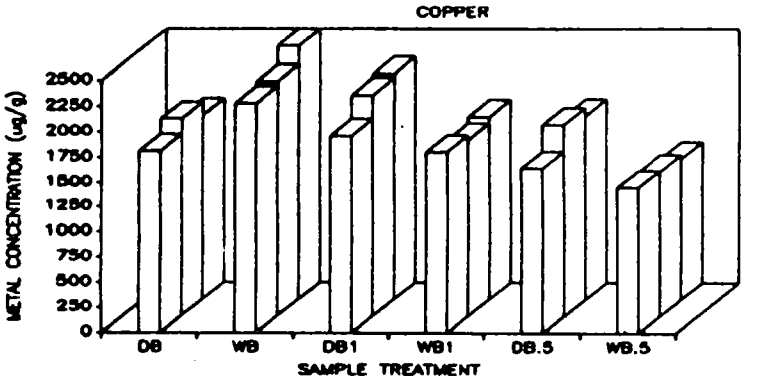


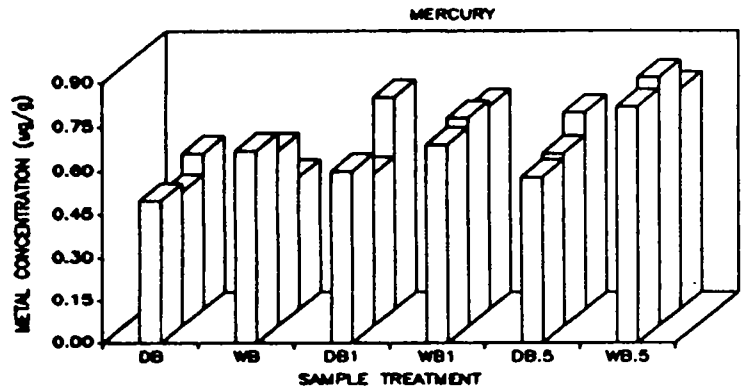
ESQUIMALT HARBOUR - GRAVING DOCK

COMPARISON OF DIGESTION AND PREPARATION METHODS

ASL



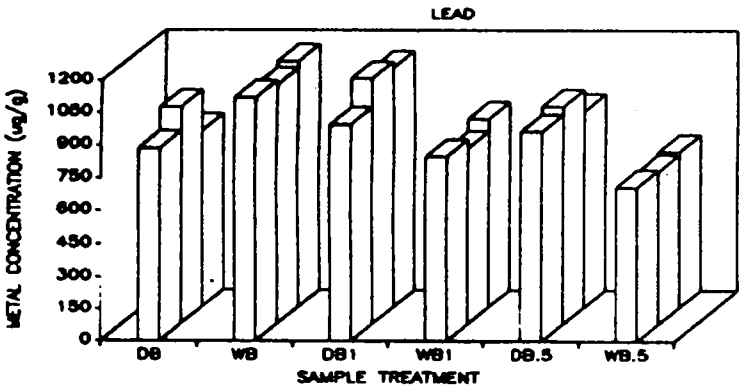


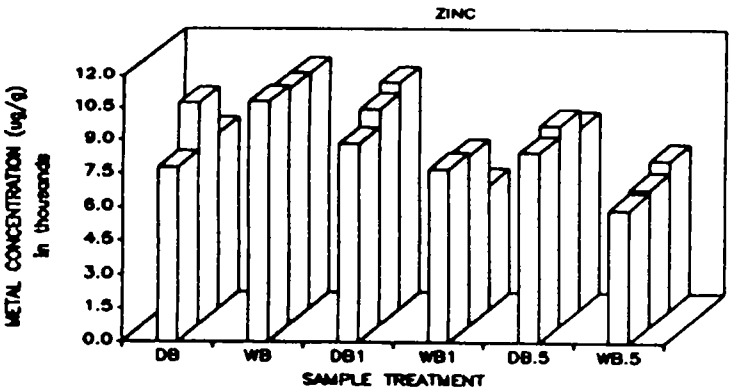


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb





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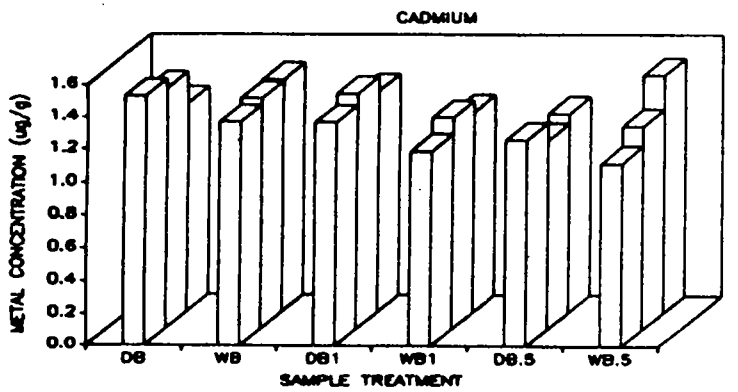
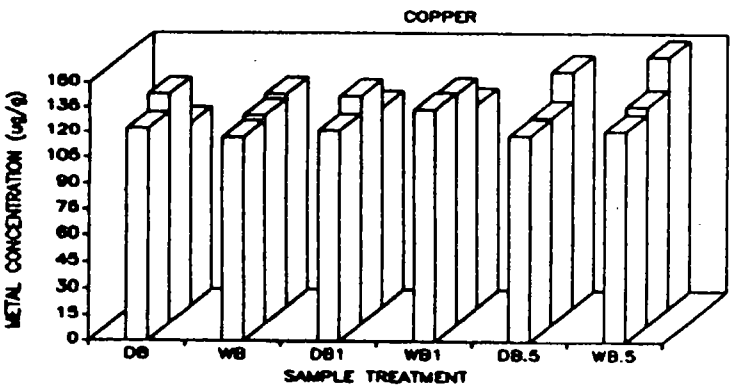
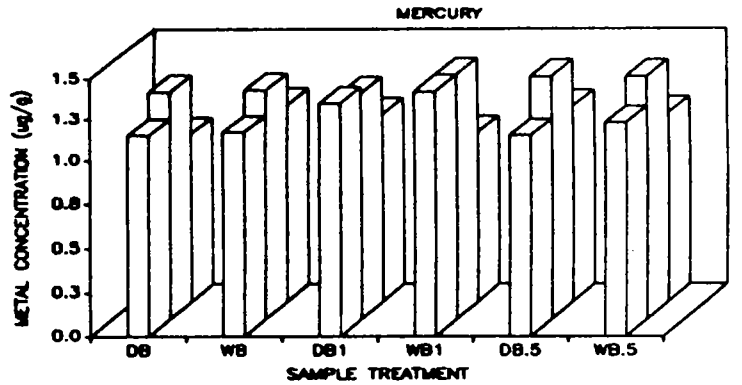
VICTORIA HARBOUR - POINT HOPE

COMPARISON OF DIGESTION AND PREPARATION METHODS



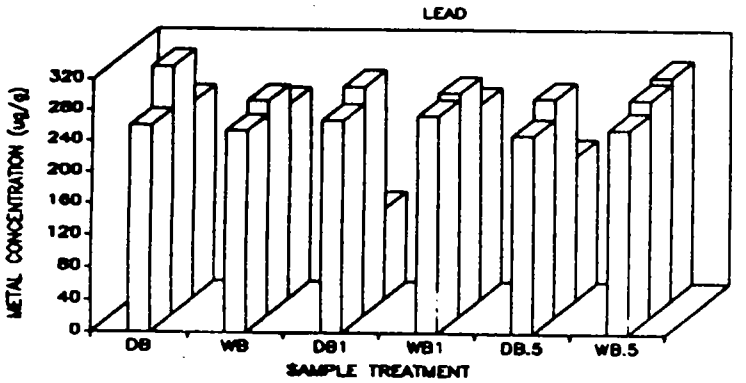


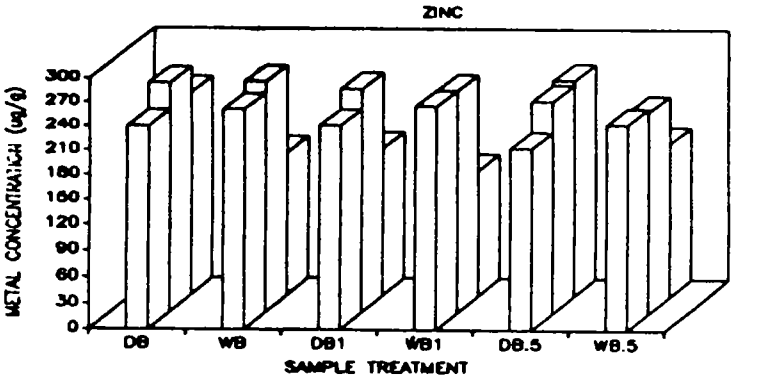


KEY

DB	=	dry and blend
WB	=	wet blend
DB1	=	<1.0mm dry sieve
WB1	=	<1.0mm wet sieve
DB.5	=	<0.5mm dry sieve
WB.5	=	<0.5mm wet sieve

Z AXIS	:	3 digestions used
FIRST	:	1:1 HNO_3 :HCl
SECOND	:	HNO_3 /Peroxide
THIRD	:	HF/Teflon Bomb





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VICTORIA HARBOUR - LAUREL POINT

COMPARISON OF DIGESTION AND PREPARATION METHODS

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APPENDIX 2

RAW DATA

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SEDIMENT

PHYSICAL

CHARACTERISTICS

PHYSICAL PARAMETERS OF ORIGINAL HARBOUR SEDIMENTS

Sample	Particle Size Distribution (%)				Total Organic Carbon (%)	Moisture (%)
	Gravel >2mm	Sand (2mm-63μ)	Silt (63μ-4μ)	Clay (<4μ)		
Port Moody Arm						
Port Moody II, Inside Boom	62.9	27.1	4.5	5.5	0.87	26.5
Port Moody III, Inside Boom	-	9.2	36.9	53.9	3.14	67.7
Burrard Inlet						
Coal Harbour by Boathouse	6.8	57.3	20.6	15.3	0.86	43.4
Vancouver Wharves Off Load A	15.9	73.6	5.1	5.4	2.46	39.2
Vancouver Harbour, EP Stn 14	53.7	44.5	0.9	0.9	0.02	18.0
False Creek						
Centre Channel Off Coast Guard Station	-	42.5	34.6	22.9	0.74	26.5
Centre Basin off Heather Marina	24.6	24.1	24.7	26.6	3.89	37.9
East Basin #1	13.1	29.4	29.7	27.8	9.58	46.8
East Basin #2	-	4.5	47.2	48.3	2.44	42.2
East Basin #3	-	18.8	47.4	33.8	6.72	51.4
Alberni Inlet						
Alberni Pulp Flume	-	18.5	51.5	30.0	14.6	83.6
Alberni Pulp East Storage	-	66.4	23.1	10.5	3.12	45.0
Somass Sawmill	-	23.3	51.4	25.3	9.14	78.0
Alberni Pacific Division	-	32.6	41.7	25.7	6.15	50.9
Holm Island	-	19.4	56.2	24.4	1.21	54.1
Esquimalt Harbour						
D Jetty	-	63.9	19.8	16.3	2.51	46.2
Centre Harbour	-	13.6	65.5	20.9	1.51	54.2
Graving Dock	-	33.2	40.4	26.4	2.66	59.9
Victoria Harbour						
Point Hope	-	48.2	26.1	25.7	3.24	53.7
Laurel Point	-	29.8	40.0	30.2	4.06	56.7

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Key for Digestion and Fraction Abbreviations

Fraction Abbreviations:

DB	-	dry and blend
WB	-	wet blend
1D	-	<1.0 mm dry sieve
1W	-	<1.0 mm wet sieve
.5D	-	<0.5 mm dry sieve
.5W	-	<0.5 mm wet sieve

DRY - Refers to Reagent Blanks and Standard Reference Materials digested with dry samples

WET - Refers to Reagent Blanks and Standard Reference Materials digested with wet samples

Digestion Abbreviations:

AR	-	1:1 $HCl:HNO_3$
H_2O_2	-	1:1 $H_2O_2:HNO_3$
HF	-	HF, HCl/HNO_3, Teflon Bomb
DUP	-	duplicate digested sample

ASL

VANCOUVER HARBOUR

RAW DATA

ASL

PORT MOODY ARM

File No. 7600A-1

SAMPLE: Port Moody II, Inside Boom

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		0.75	23.0	0.11	32.0	58.0
DB	AR	DUP	0.80	28.3	0.14	33.0	83.0
DB	H202		0.60	26.0	0.12	43.0	64.0
DB	H202	DUP	0.70	26.0	0.12	33.0	80.0
DB	HF		0.54	21.4	0.056	41.0	63.0
DB	HF	DUP	0.57	23.7	0.096	43.0	65.0
WB	AR		0.42	19.8	0.042	19.6	51.3
WB	H202		0.37	20.8	0.036	23.5	53.2
WB	HF		0.49	19.7	0.047	24.5	52.1
1D	AR		0.95	64.0	0.43	107.	191.
1D	AR	DUP	1.13	65.0	0.37	106.	190.
1D	H202		1.50	79.0	0.40	122.	180.
1D	HF		1.50	64.0	0.26	122.	170.
1D	HF	DUP	0.77	64.0		84.0	181.
1W	AR		2.71	105.	0.19	135.	279.
1W	AR	DUP	2.63	102.	0.22	135.	271.
1W	H202		3.66	124.	0.29	153.	344.
1W	H202	DUP	3.60	121.	0.28	166.	343.
1W	HF		2.26	105.	0.36	174.	282.
1W	HF	DUP	2.34	107.	0.33	183.	302.
.5D	AR		2.20	78.0	0.50	113.	220.
.5D	H202		2.35	90.0	0.45	130.	233.
.5D	HF		1.60	79.6	0.28	100.	171.
.5D	HF	DUP	1.15	84.0		127.	183.
.5W	AR		2.99	114.	0.21	140.	320.
.5W	H202		3.55	129.	0.27	159.	342.
.5W	HF		2.76	123.	0.43	166.	327.

< = Less than

Results expressed as milligrams per dry kilogram of sample

APPENDIX 1
DATA SUMMARY

APPENDIX 2
RAW DATA

ASL

PORT MOODY ARM

File No. 7600A-2

SAMPLE: Port Moody III, Inside Boom

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		3.20	103.	0.23	90.0	253.
DB	H202		3.15	155.	0.22	87.0	251.
DB	HF		3.00	126.	0.26	112.	456.
WB	AR		2.96	120.	0.20	82.8	239.
WB	AR	DUP	2.90	110.	0.19	88.9	261.
WB	H202		2.82	105.	0.23	101.	258.
WB	H202	DUP	2.57	111.	0.24	102.	247.
WB	HF		2.84	180.	0.29	101.	251.
WB	HF	DUP	3.28	122.	0.35	99.5	240.
1D	AR		3.50	200.	0.37	101.	282.
1D	AR	DUP	2.80	142.	0.28	103.	244.
1D	H202		3.00	105.	0.40	99.0	269.
1D	HF		2.60	108.	0.35	139.	197.
1D	HF	DUP	2.47	110.		101.	231.
1W	AR		2.69	158.	0.18	87.9	232.
1W	H202		2.41	192.	0.26	107.	261.
1W	HF		3.10	101.	0.20	122.	240.
.5D	AR		3.40	171.	0.35	88.0	274.
.5D	AR	DUP	3.45	162.	0.38	94.0	273.
.5D	H202		3.15	135.	0.46	97.0	267.
.5D	H202	DUP	3.00	154.	0.44	94.0	263.
.5D	HF		2.64	139.	0.31	68.0	235.
.5D	HF	DUP	2.89	140.	0.32	88.0	268.
.5W	AR		2.99	102.	0.19	85.4	239.
.5W	H202		2.61	113.	0.25	116.	247.
.5W	HF		2.83	109.	0.25	102.	241.

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

VANCOUVER HARBOUR

File No. 7600A-3

SAMPLE: Coal Harbour

	Cadmium	Copper	Mercury	Lead	Zinc
DB AR	0.42	117.	0.48	50.0	94.0
DB AR DUP	0.47	117.	0.40	53.0	95.0
DB H202	0.36	112.	0.30	44.0	89.0
DB H202 DUP	0.44	121.	0.55	54.0	93.0
DB HF	0.44	108.	0.41	41.0	97.0
DB HF DUP	0.40	104.	0.25	31.0	96.0
WB AR	0.19	137.	0.18	39.2	91.8
WB H202	0.21	213.	0.38	47.7	102.
WB H202 DUP	0.41	183.	0.38	75.6	155.
WB HF	0.55	123.	0.25	58.7	108.
WB HF DUP	0.31	91.9	0.22	49.2	75.5
1D AR	0.46	161.	0.33	54.0	97.0
1D H202	0.46	119.	0.42	55.0	99.0
1D HF	0.49	127.	0.33	42.0	82.0
1W AR	0.44	167.	0.39	105.	142.
1W H202	0.47	178.	0.47	103.	143.
1W HF	0.47	160.	0.32	101.	136.
.5D AR	0.48	137.	0.55	58.0	102.
.5D H202	0.46	128.	0.42	55.0	95.0
.5D HF	0.38	118.	0.32	45.0	76.0
.5W AR	0.27	107.	0.27	53.1	87.1
.5W AR DUP	0.25	108.	0.34	49.1	90.0
.5W H202	0.33	107.	0.45	54.6	94.1
.5W H202 DUP	0.30	111.	0.28	60.7	99.8
.5W HF	0.40	94.1	0.22	76.4	91.1
.5W HF DUP	0.36	89.8	0.21	71.9	95.5

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

VANCOUVER HARBOUR

File No. 7600A-4

SAMPLE: Vancouver Wharves, Off Loading Area

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		0.70	845.	0.17	134.	131.
DB	H202		1.05	920.	0.12	125.	143.
DB	HF		0.93	802.	0.076	138.	135.
WB	AR		0.93	809.	0.080	113.	137.
WB	AR	DUP	1.08	764.	0.067	121.	152.
WB	H202		0.60	857.	0.099	118.	139.
WB	H202	DUP	0.60	836.	0.086	120.	157.
WB	HF		0.80	661.	0.067	79.1	115.
WB	HF	DUP	0.86	739.	0.075	91.7	118.
1D	AR		0.75	815.	0.17	126.	129.
1D	AR	DUP	0.70	815.	0.18	143.	126.
1D	H202		0.85	840.	0.15	116.	129.
1D	H202	DUP	0.80	830.	0.15	116.	108.
1D	HF		1.20	848.	0.076	104.	130.
1D	HF	DUP	1.00	709.	0.052	113.	174.
1W	AR		1.69	1,130.	0.29	175.	165.
1W	H202		2.25	1,120.	0.36	160.	160.
1W	HF		1.65	1,120.	0.35	165.	161.
.5D	AR		0.80	970.	0.19	132.	166.
.5D	H202		0.95	830.	0.15	127.	147.
.5D	HF		0.89	814.	0.066	121.	161.
.5W	AR		1.13	1,760.	0.27	303.	252.
.5W	H202		1.32	1,580.	0.26	255.	201.
.5W	HF		2.51	1,800.	0.29	330.	273.

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

VANCOUVER HARBOUR

File No. 7600A-5

SAMPLE: Vancouver Harbour, EP Station No. 14

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		0.075	14.8	<0.025	8.0	26.7
DB	AR	DUP	0.080	16.0	0.025	8.0	36.2
DB	H202		0.075	16.8	0.030	8.0	37.3
DB	H202	DUP	0.090	14.2	0.035	8.0	31.2
DB	HF		0.10	14.6	<0.050	25.0	52.6
DB	HF	DUP	0.15	18.0	<0.050	18.0	73.9
WB	AR		0.061	10.8	<0.025	4.6	34.9
WB	AR	DUP	0.070	12.4	<0.025	3.7	51.2
WB	H202		0.063	15.6	<0.025	4.1	33.6
WB	HF		0.089	10.4	<0.050	9.4	43.1
1D	AR		0.090	16.0	0.055	15.0	37.1
1D	H202		0.095	21.5	0.055	13.0	36.2
1D	HF		0.12	21.1	0.052	26.0	87.6
1W	AR		0.040	16.5	0.031	17.6	31.3
1W	AR	DUP	0.065	18.5	0.11	17.8	33.9
1W	H202		0.10	17.5	0.036	17.0	29.7
1W	H202	DUP	0.088	16.8	0.036	16.2	25.6
1W	HF		0.12	13.5	<0.050	21.0	52.6
1W	HF	DUP	0.12	15.6	<0.050	22.4	63.9
.5D	AR		0.13	24.8	0.18	37.0	37.8
.5D	H202		0.15	29.2	0.21	50.0	36.7
.5D	HF		0.19	22.8	0.16	20.0	86.1
.5W	AR		0.12	31.2	0.14	140.	34.7
.5W	H202		0.15	24.4	0.092	83.6	21.1
.5W	HF		0.17	30.6	0.13	37.5	78.6

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

FALSE CREEK

RAW DATA

ASL

FALSE CREEK

File No. 7600A-6

SAMPLE: Centre Channel

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		0.52	97.0	0.34	51.0	126.
DB	AR	DUP	0.51	94.0	0.28	50.0	121.
DB	H202		0.51	81.0	0.23	52.0	117.
DB	H202	DUP	0.47	88.0	0.24	51.0	113.
DB	HF		0.45	80.0	0.29	29.0	88.0
DB	HF	DUP	0.43	95.0	0.21	61.0	123.
WB	AR		0.59	86.0	0.39	50.0	129.
WB	H202		0.52	90.0	0.23	49.0	124.
WB	HF		0.41	78.0	0.26	55.3	118.
WB	HF	DUP	0.43	79.0	0.27	58.3	121.
1D	AR		0.49	118.	0.28	65.0	122.
1D	H202		0.48	80.0	0.27	69.0	121.
1D	HF		0.46	82.0	0.19	55.0	117.
1W	AR		0.48	97.0	0.27	53.0	128.
1W	AR	DUP	0.47	90.0	0.33	49.0	126.
1W	H202		0.40	89.0	0.23	52.0	121.
1W	H202	DUP	0.49	87.0	0.64	48.0	124.
1W	HF		0.39	93.0	0.32	47.0	139.
1W	HF	DUP	0.34	83.0	0.31	48.0	131.
.5D	AR		1.30	93.0	0.28	55.0	121.
.5D	H202		0.85	92.0	0.23	56.0	121.
.5D	HF		0.47	83.0	0.28	46.0	105.
.5W	AR		0.43	87.0	0.41	55.0	123.
.5W	H202		0.43	88.0	0.21	54.0	116.
.5W	HF		0.41	91.0	0.35	46.0	129.

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

FALSE CREEK

File No. 7600A-7

SAMPLE: Centre Basin #1

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		2.25	139.	0.56	119.	305.
DB	AR	DUP	2.09	125.	0.95	115.	297.
DB	H202		2.30	143.	0.43	120.	286.
DB	HF		1.80	114.	0.38	75.0	228.
DB	HF	DUP	1.99	119.	0.36	103.	282.
WB	AR		2.42	135.	0.42	111.	305.
WB	AR	DUP	2.50	131.	0.73	122.	306.
WB	H202		1.89	124.	0.44	90.0	253.
WB	H202	DUP	1.88	136.	0.59	104.	244.
WB	HF		2.01	121.	0.58	85.0	293.
WB	HF	DUP	2.18	108.	0.45	47.0	267.
1D	AR		2.15	149.	0.75	195.	322.
1D	H202		2.40	147.	0.55	133.	337.
1D	HF		2.06	143.	0.29	286.	312.
1D	HF	DUP	2.30	141.	0.53	125.	313.
1W	AR		2.60	157.	0.76	151.	346.
1W	H202		2.24	167.	0.69	141.	332.
1W	HF		2.30	172.	0.96	124.	344.
.5D	AR		2.45	159.	0.80	162.	354.
.5D	AR	DUP	2.50	154.	1.10	154.	344.
.5D	H202		2.60	157.	0.55	147.	338.
.5D	H202	DUP	2.50	152.	0.65	142.	322.
.5D	HF		2.77	167.	0.74	162.	368.
.5W	AR		3.12	170.	0.67	155.	376.
.5W	H202		2.62	164.	0.73	162.	367.
.5W	HF		2.62	158.	0.79	115.	307.

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

FALSE CREEK

File No. 7600A-8

SAMPLE: East Basin #1

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		2.55	166.	0.80	155.	365.
DB	AR	DUP	2.05	97.0	0.70	137.	319.
DB	H202		2.51	113.	0.70	172.	358.
DB	H202	DUP	3.55	113.	0.64	230.	736.
DB	HF		2.57	170.	0.62	183.	741.
DB	HF	DUP	2.38	116.	0.73	151.	365.
WB	AR		2.51	104.	0.62	156.	356.
WB	H202		2.17	122.	0.65	159.	354.
WB	HF		2.45	129.	0.69	132.	331.
1D	AR		2.10	109.	0.80	163.	360.
1D	H202		2.15	115.	0.80	166.	359.
1D	HF		1.54	119.	0.58	127.	329.
1D	HF	DUP	2.32	110.	0.71	154.	361.
1W	AR		2.40	117.	0.86	163.	367.
1W	H202		2.01	105.	0.82	149.	340.
1W	HF		2.36	118.	0.71	117.	338.
.5D	AR		2.15	110.	0.85	163.	384.
.5D	H202		2.20	127.	0.85	170.	374.
.5D	HF		1.74	117.	0.42	103.	273.
.5D	HF	DUP	1.96	116.	0.74	171.	350.
.5W	AR		2.93	136.	0.78	182.	397.
.5W	AR	DUP	3.09	142.	0.85	183.	408.
.5W	H202		2.41	129.	0.81	171.	379.
.5W	H202	DUP	2.43	135.	0.92	178.	369.
.5W	HF		2.59	119.	0.75	153.	332.
.5W	HF	DUP	2.66	128.	0.79	142.	349.

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

FALSE CREEK

File No. 7600A-9

SAMPLE: East Basin #2

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		3.55	178.	0.70	248.	465.
DB	H202		3.36	179.	0.57	250.	467.
DB	HF		2.98	200.	0.77	278.	561.
DB	HF	DUP	2.83	185.	0.68	250.	501.
WB	AR		3.81	189.	0.70	264.	513.
WB	AR	DUP	3.58	186.	0.75	252.	488.
WB	H202		3.34	184.	0.67	254.	483.
WB	H202	DUP	3.46	191.	0.69	260.	489.
WB	HF		2.90	167.	0.75	256.	516.
WB	HF	DUP	3.09	177.	0.74	262.	500.
1D	AR		3.40	176.	0.70	255.	493.
1D	AR	DUP	3.45	175.	0.70	256.	491.
1D	H202		3.30	172.	0.65	253.	476.
1D	H202	DUP	3.30	171.	0.75	255.	472.
1D	HF		3.08	169.	0.67	174.	445.
1D	HF	DUP	3.02	166.	0.46	202.	475.
1W	AR		3.86	203.	0.73	283.	529.
1W	H202		3.34	205.	0.67	283.	491.
1W	HF		3.42	199.	0.76	279.	573.
.5D	AR		3.45	169.	0.60	244.	483.
.5D	H202		3.50	172.	0.65	254.	487.
.5D	HF		2.89	158.	0.32	246.	492.
.5D	HF	DUP	2.61	171.	0.70	244.	494.
.5W	AR		3.81	193.	0.76	273.	522.
.5W	H202		3.26	194.	0.69	273.	489.
.5W	HF		3.49	190.	0.78	273.	548.

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

FALSE CREEK

File No. 7600A-10

SAMPLE: East Basin #3

	Cadmium	Copper	Mercury	Lead	Zinc
DB AR	3.85	160.	2.20	242.	545.
DB AR DUP	3.55	154.	1.90	226.	515.
DB H202	3.64	145.	1.39	219.	459.
DB H202 DUP	4.00	141.	1.48	207.	444.
DB HF	2.76	132.	0.85	180.	469.
DB HF DUP	3.04	138.	1.10	175.	495.
WB AR	3.59	154.	1.97	232.	504.
WB H202	3.07	147.	1.86	219.	459.
WB HF	3.07	141.	1.80	227.	497.
1D AR	3.60	141.	1.95	215.	492.
1D H202	3.50	138.	1.65	219.	452.
1D HF	3.27	135.	0.95	216.	491.
1W AR	3.41	144.	2.03	231.	491.
1W AR DUP	3.75	154.	2.06	239.	491.
1W H202	3.17	148.	1.94	227.	461.
1W H202 DUP	3.41	149.	1.86	229.	480.
1W HF	3.14	149.	2.09	139.	472.
1W HF DUP	2.89	143.	1.79	179.	519.
.5D AR	3.45	141.	2.00	219.	486.
.5D H202	3.55	144.	1.70	228.	468.
.5D HF	3.09	132.	1.80	160.	403.
.5W AR	3.72	156.	1.88	237.	497.
.5W H202	5.82	150.	1.75	246.	495.
.5W H202 DUP	3.53	151.	1.43	230.	530.
.5W HF	3.14	155.	2.45	224.	521.

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

ALBERNI INLET

RAW DATA

ASL

ALBERNI INLET

File No. 7600A-11

SAMPLE: Alberni #1

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		0.66	56.2	0.17	20.0	445.
DB	AR	DUP	0.85	60.3	0.16	21.0	450.
DB	H202		0.90	56.5	0.14	21.5	445.
DB	H202	DUP	0.90	54.5	0.14	20.0	450.
DB	HF		0.72	69.0	0.057	25.0	340.
DB	HF	DUP	0.79	62.0	0.10	26.0	338.
WB	AR		0.79	78.8	0.18	28.9	541.
WB	H202		1.64	95.5	0.20	28.8	678.
WB	HF		0.96	99.5	0.15	30.0	695.
1D	AR		0.93	54.9	0.19	22.5	408.
1D	H202		0.96	54.0	0.14	23.0	437.
1D	HF		0.87	50.0	0.065	24.0	302.
1D	HF	DUP	0.91	52.0	0.18	28.0	372.
1W	AR		1.42	93.9	0.21	47.3	614.
1W	AR	DUP	1.28	88.0	0.21	50.5	621.
1W	H202		1.66	93.0	0.20	45.3	636.
1W	H202	DUP	1.64	95.8	0.19	48.2	647.
1W	HF		1.17	95.7	0.10	43.3	662.
1W	HF	DUP	1.17	95.7	0.17	46.4	642.
.5D	AR		0.80	56.5	0.19	21.0	402.
.5D	H202		0.90	53.0	0.14	23.0	435.
.5D	HF		0.94	55.0	0.21	29.0	382.
.5W	AR		1.89	92.2	0.24	106.	641.
.5W	H202		1.81	95.7	0.20	102.	670
.5W	HF		1.21	97.3	0.19	103.	670.

< = Less than

Results expressed as milligrams per dry kilogram

ASL

ALBERNI INLET

File No. 7600A-12

SAMPLE: Alberni #2

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		0.48	35.7	0.14	7.5	152.
DB	H202		0.44	38.5	0.10	6.5	150.
DB	HF		0.32	41.1	0.12	6.2	174.
WB	AR		0.40	40.3	0.12	5.7	157.
WB	AR	DUP	0.47	34.0	0.10	4.1	145.
WB	H202		0.79	42.3	0.14	6.9	177.
WB	H202	DUP	0.76	41.1	0.14	7.3	167.
WB	HF		0.66	44.8	0.12	7.4	187.
WB	HF	DUP	0.72	58.9	0.072	14.0	165.
1D	AR		0.61	35.3	0.16	5.5	161.
1D	H202		0.51	36.0	0.12	8.0	159.
1D	HF		0.35	40.7	0.083	9.3	172.
1W	AR		0.58	47.2	0.14	10.7	186.
1W	H202		0.88	42.7	0.11	11.7	193.
1W	HF		0.83	47.9	0.13	7.7	195.
.5D	AR		0.60	36.0	0.18	7.0	163.
.5D	AR	DUP	0.53	35.5	0.18	8.0	164.
.5D	H202		0.55	36.0	0.15	8.5	180.
.5D	H202	DUP	0.50	35.5	0.15	8.0	176.
.5D	HF		0.37	38.1	0.11	9.6	171.
.5D	HF	DUP	0.36	38.7	0.12	8.0	176.
.5W	AR		0.61	44.3	0.18	11.5	216.
.5W	H202		0.85	43.1	0.12	12.7	214.
.5W	HF		1.00	47.1	0.19	10.8	203.

< = Less than

Results expressed as milligrams per dry kilogram

ASL

ALBERNI INLET

File No. 7600A-13

SAMPLE: Alberni #3

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		0.68	55.3	0.19	42.5	260.
DB	AR	DUP	0.66	52.3	0.18	39.5	250.
DB	H202		0.69	51.5	0.15	42.2	275.
DB	H202	DUP	0.66	52.0	0.16	44.1	268.
DB	HF		0.62	59.0	0.095	48.0	245.
DB	HF	DUP	0.71	65.0	0.15	45.0	277.
WB	AR		1.06	65.0	0.21	44.2	290.
WB	H202		1.03	63.8	0.22	48.4	302.
WB	HF		1.17	67.1	0.12	37.9	291.
1D	AR		0.80	55.0	0.21	41.0	262.
1D	H202		0.70	56.0	0.20	47.0	250.
1D	HF		0.61	66.0	0.15	42.0	200.
1W	AR		0.97	72.1	0.23	157.	318.
1W	H202		1.35	73.5	0.22	170.	319.
1W	HF		1.16	75.7	0.17	115.	302.
.5D	AR		0.86	56.6	0.21	48.0	266.
.5D	H202		0.77	53.5	0.17	46.3	289.
.5D	HF		0.57	63.0	0.13	42.0	263.
.5W	AR		1.17	74.1	0.23	86.6	306.
.5W	AR	DUP	1.14	71.7	0.23	88.5	322.
.5W	H202		1.26	70.2	0.21	82.1	319.
.5W	H202	DUP	1.35	71.0	0.22	82.0	330.
.5W	HF		1.10	73.7	0.20	82.2	333.
.5W	HF	DUP	1.25	71.7	0.20	83.8	317.

< = Less than

Results expressed as milligrams per dry kilogram

ASL

ALBERNI INLET

File No. 7600A-14

SAMPLE: Alberni #4

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		1.00	63.3	0.29	24.5	188.
DB	H202		1.07	69.0	0.24	25.3	183.
DB	HF		0.72	64.0	0.25	27.7	170.
WB	AR		1.59	82.5	0.27	33.3	226.
WB	AR	DUP	1.72	86.0	0.32	30.0	233.
WB	H202		1.76	81.5	0.32	34.8	245.
WB	H202	DUP	1.64	77.2	0.33	32.5	226.
WB	HF		1.69	87.8	0.11	36.5	228.
WB	HF	DUP	1.84	90.7	0.25	32.4	219.
1D	AR		1.41	70.5	0.36	30.5	221.
1D	AR	DUP	1.50	69.6	0.39	33.5	220.
1D	H202		1.19	69.5	0.39	34.1	228.
1D	H202	DUP	1.15	72.5	0.42	33.1	219.
1D	HF		0.98	82.0	0.30	33.0	231.
1D	HF	DUP	0.86	75.0	0.34	34.0	240.
1W	AR		1.77	88.0	0.34	64.9	270.
1W	H202		1.78	87.1	0.37	77.3	264.
1W	HF		1.77	91.7	0.32	68.8	274.
.5D	AR		1.38	72.2	0.42	35.0	229.
.5D	H202		1.03	66.5	0.32	34.6	224.
.5D	HF		0.80	72.0	0.33	40.1	241.
.5W	AR		1.83	92.1	0.46	44.4	273.
.5W	H202		1.91	99.4	0.41	39.8	386.
.5W	HF		1.79	98.9	0.39	42.9	285.

< = Less than

Results expressed as milligrams per dry kilogram

ASL

ALBERNI INLET

File No. 7600A-15

SAMPLE: Alberni #5

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		1.15	63.4	0.30	12.5	274.
DB	AR	DUP	0.95	63.8	0.34	12.5	278.
DB	H202		0.86	64.0	0.28	13.3	283.
DB	H202	DUP	0.96	64.0	0.26	12.5	280.
DB	HF		0.87	68.0	0.32	13.7	296.
DB	HF	DUP	0.88	64.0	0.24	13.0	287.
WB	AR		1.05	71.5	0.30	10.2	275.
WB	H202		1.11	72.8	0.28	10.9	282.
WB	HF		0.87	73.2	0.25	15.6	283.
1D	AR		1.08	64.1	0.34	13.0	280.
1D	H202		0.92	64.5	0.29	14.0	285.
1D	HF		0.74	69.0	0.30	14.4	289.
1W	AR		1.36	73.9	0.35	12.1	301.
1W	AR	DUP	1.18	72.8	0.33	16.8	301.
1W	H202		1.33	72.9	0.32	14.3	311.
1W	H202	DUP	1.38	75.0	0.34	14.7	321.
1W	HF		0.60	63.4	0.35	19.8	255.
1W	HF	DUP	1.39	80.2	0.29	17.8	304.
.5D	AR		1.20	63.6	0.34	13.0	280.
.5D	H202		0.94	62.5	0.29	14.0	293.
.5D	HF		0.70	68.0	0.33	15.0	289.
.5W	AR		1.29	74.7	0.32	16.1	305.
.5W	H202		1.28	73.7	0.36	18.3	316.
.5W	HF		1.41	79.3	0.30	21.7	304.

< = Less than

Results expressed as milligrams per dry kilogram

ASL

ESQUIMALT AND VICTORIA HARBOURS

RAW DATA

ASL

ESQUIMALT HARBOUR

File No. 7600A-16

SAMPLE: D-Jetty

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		14.0	1,900.	0.25	1,260.	10,500.
DB	AR	DUP	11.5	1,610.	0.25	1,050.	9,750.
DB	H202		11.5	1,850.	0.22	1,140.	10,700.
DB	H202	DUP	11.0	1,600.	0.23	1,030.	9,150.
DB	HF		8.30	2,030.	0.23	1320.	12,700.
DB	HF	DUP	11.7	1,830.	0.37	1060.	11,200.
WB	AR		10.3	2,070.	0.25	937.	7,940.
WB	H202		11.9	1,920.	0.20	1,110.	8,670.
WB	HF		15.8	2,130.	0.26	1,190.	4,220.
WB	HF	DUP	8.47	1,630.	0.28	926.	10,700.
1D	AR		10.5	1,730.	0.26	1,090.	9,550.
1D	H202		13.0	2,230.	0.46	1,270.	11,400.
1D	HF		14.6	1,860.	0.32	1,120.	10,400.
1W	AR		9.35	1,620.	0.26	985.	8,870.
1W	AR	DUP	9.93	1,620.	0.44	996.	9,380.
1W	H202		10.3	1,630.	0.32	1,040.	9,390.
1W	H202	DUP	10.9	1,660.	0.38	1,060.	9,880.
1W	HF		9.48	1,660.	0.35	1,210.	9,700.
1W	HF	DUP	13.4	1,770.	0.34	1,040.	7,900.
.5D	AR		11.5	1,640.	0.29	1,070.	8,950.
.5D	H202		10.5	1,590.	0.28	1,060.	9,250.
.5D	HF		12.0	1,580.	0.33	1,040.	9,220.
.5W	AR		9.16	1,490.	0.32	899.	8,400.
.5W	H202		10.6	1,540.	0.31	958.	8,820.
.5W	HF		12.2	1,550.	0.36	918.	6,630.

< = Less than

Results expressed as milligrams per dry kilogram

ASL

ESQUIMALT HARBOUR File No. 7600A-17

SAMPLE: Centre Harbour

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		0.50	69.0	0.90	73.0	109.
DB	H202		0.65	61.5	1.10	53.0	98.0
DB	HF		0.47	59.0	0.80	58.0	109.
WB	AR		0.27	67.3	0.85	70.8	131.
WB	AR	DUP	0.28	68.1	1.11	73.5	118.
WB	H202		0.31	69.4	0.86	55.1	110.
WB	H202	DUP	0.47	69.3	1.05	60.2	114.
WB	HF		0.39	66.9	0.95	54.6	84.4
WB	HF	DUP	0.45	67.0	0.86	53.2	124.
1D	AR		0.53	69.0	1.05	59.5	115.
1D	AR	DUP	0.50	72.0	1.00	61.5	114.
1D	H202		0.54	66.0	0.93	51.0	115.
1D	H202	DUP	0.46	67.0	0.93	53.0	121.
1D	HF		0.46	63.0	0.77	61.0	126.
1D	HF	DUP	0.42	64.0	0.91	59.0	126.
1W	AR		0.36	68.4	0.93	54.3	109.
1W	H202		0.46	71.3	0.95	61.0	120.
1W	HF		0.41	67.8	1.34	42.8	83.7
.5D	AR		0.46	67.0	0.80	51.5	109.
.5D	H202		0.50	67.0	0.93	53.0	119.
.5D	HF		0.44	90.0	0.82	63.0	121.
.5W	AR		0.33	67.3	0.91	51.1	110.
.5W	H202		0.33	69.8	0.91	58.8	113.
.5W	HF		0.33	66.4	0.79	59.3	97.7

< = Less than
Results expressed as milligrams per dry kilogram

ASL

ESQUIMALT HARBOUR File No. 7600A-18

SAMPLE: Graving Dock

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		1.91	257.	2.00	316.	520.
DB	AR	DUP	2.11	273.	2.20	605.	600.
DB	H202		1.77	277.	1.88	237.	570.
DB	H202	DUP	1.97	287.	1.78	283.	580.
DB	HF		1.70	388.	1.65	325.	911.
DB	HF	DUP	1.50	312.	1.51	256.	615.
WB	AR		1.36	350.	2.31	379.	636.
WB	H202		1.92	325.	2.71	340.	584.
WB	HF		2.03	303.	2.11	202.	410.
1D	AR		2.63	339.	2.55	308.	635.
1D	H202		2.58	385.	2.38	473.	825.
1D	HF		2.30	337.	2.61	158.	649.
1W	AR		2.51	533.	3.50	329.	825.
1W	H202		2.73	475.	3.68	332.	885.
1W	HF		2.02	446.	2.82	232.	602.
1W	HF	DUP	2.21	449.	2.94	340.	592.
.5D	AR		2.11	352.	2.55	467.	720.
.5D	H202		2.60	388.	2.67	877.	715.
.5D	HF		2.28	354.	2.49	254.	717.
.5W	AR		2.63	518.	3.56	351.	759.
.5W	AR	DUP	2.39	593.	3.33	266.	750.
.5W	H202		2.65	462.	3.68	305.	779.
.5W	H202	DUP	2.75	470.	3.38	314.	801.
.5W	HF		3.09	465.	3.70	241.	518.
.5W	HF	DUP	2.88	427.	3.01	249.	724.

< = Less than
Results expressed as milligrams per dry kilogram

ASL

VICTORIA HARBOUR File No. 7600A-19

SAMPLE: Point Hope

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		10.5	1,810.	0.50	885.	7,750.
DB	H202		10.0	1,960.	0.47	995.	9,970.
DB	HF		9.00	1,830.	0.54	805.	7,820.
WB	AR		10.6	2,150.	0.82	1,040.	10,500.
WB	AR	DUP	11.5	2,400.	0.52	1,200.	11,100.
WB	H202		10.5	2,280.	0.65	1,130.	10,700.
WB	H202	DUP	11.6	2,350.	0.56	1,070.	10,600.
WB	HF		14.3	2,630.	0.41	1,160.	11,200.
WB	HF	DUP	13.6	2,370.	0.51	1,090.	10,100.
1D	AR		11.5	1,960.	0.60	995	8,850.
1D	H202		11.0	2,190.	0.53	1,130.	9,700.
1D	HF		13.5	2,230.	0.73	1,100.	10,200.
1W	AR		8.57	1,800.	0.69	848.	7,700.
1W	H202		8.49	1,750.	0.72	806.	7,570.
1W	HF		11.1	1,810.	0.70	860.	5,500.
.5D	AR		10.5	1,630.	0.60	955.	8,600.
.5D	AR	DUP	10.5	1,650.	0.55	970.	8,300.
.5D	H202		10.5	1,920.	0.60	1,000.	8,850.
.5D	H202	DUP	10.9	1,880.	0.59	995.	9,040.
.5D	HF		9.88	1,720.	0.74	905.	8,010.
.5D	HF	DUP	10.7	1,910.	0.61	891.	8,190.
.5W	AR		6.92	1,450.	0.82	708.	5,930.
.5W	H202		6.71	1,440.	0.86	698.	6,080.
.5W	HF		10.5	1,400.	0.76	710.	6,620.

< = Less than
Results expressed as milligrams per dry kilogram

ASL

VICTORIA HARBOUR

File No. 7600A-20

SAMPLE: Laurel Point

			Cadmium	Copper	Mercury	Lead	Zinc
DB	AR		1.51	123.	1.10	256.	222.
DB	AR	DUP	1.54	120.	1.20	263.	258.
DB	H202		1.50	137.	1.35	282.	284.
DB	H202	DUP	1.44	128.	1.28	347.	264.
DB	HF		1.25	106.	0.99	239.	239.
DB	HF	DUP	1.28	104.	0.93	258.	244.
WB	AR		1.37	117.	1.17	253.	261.
WB	H202		1.41	120.	1.33	271.	276.
WB	HF		1.42	123.	1.14	246.	167.
1D	AR		1.37	121.	1.35	267.	241.
1D	H202		1.44	132.	1.31	290.	267.
1D	HF		1.35	115.	1.08	112.	173.
1W	AR		1.23	140.	1.49	278.	265.
1W	AR	DUP	1.14	128.	1.35	267.	265.
1W	H202		1.24	133.	1.49	282.	277.
1W	H202	DUP	1.34	132.	1.35	281.	252.
1W	HF		1.26	113.	1.03	242.	192.
1W	HF	DUP	1.18	120.	0.91	251.	99.6
.5D	AR		1.26	118.	1.15	248.	213.
.5D	H202		1.15	119.	1.41	275.	252.
.5D	HF		1.21	137.	1.13	180.	258.
.5W	AR		1.12	121.	1.23	256.	243.
.5W	H202		1.24	126.	1.41	274.	239.
.5W	HF		1.45	146.	1.09	282.	180.

< = Less than

Results expressed as milligrams per dry kilogram

Appendix 3
QA/QC
Data

ASL

APPENDIX 3

QA/QC DATA

ASL

VANCOUVER HARBOUR

File No. 7600A

REAGENT BLANK SUMMARY

	Cadmium	Copper	Mercury	Lead	Zinc
BLK 1 DRY AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK 1 DRY H202	<0.025	<0.25	<0.025	<2.5	<1.0
BLK 1 DRY HF	<0.050	<0.50	0.12	<5.0	<2.0
BLK 1 WET AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK 1 WET H202	0.027	<0.25	<0.025	<2.5	<1.0
BLK 1 WET HF	<0.050	<0.50	0.060	<5.0	<2.0
BLK 2 DRY AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK 2 DRY H202	<0.025	<0.25	<0.025	<2.5	<1.0
BLK 2 DRY HF	<0.050	<0.50	0.070	<5.0	<2.0
BLK 2 WET AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK 2 WET H202	0.035	<0.25	<0.025	<2.5	<1.0
BLK 2 WET HF	<0.050	<0.50	<0.050	<5.0	<2.0

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

VANCOUVER HARBOUR

File No. 7600A

QUALITY CONTROL DATA SUMMARY

Sample	Digestion	Cadmium	Copper	Mercury	Lead	Zinc
MESS	CERT	0.59	25.1	0.171	34.0	191.
MESS	CERT LIMIT	±0.10	±3.8	±0.014	±6.1	±17.
MESS	DRY AR	0.70	24.0	0.23	32.5	175.
MESS	DRY H2O2	0.57	27.0	0.22	34.5	200.
MESS	DRY HF	0.69	25.7	0.15	30.4	186.
MESS	WET AR	0.55	25.0	0.29	34.0	180.
MESS	WET H202	0.55	27.0	0.33	35.0	187.
MESS	WET HF	0.51	26.0	0.21	38.0	178.
BCSS	CERT	0.25	18.5	0.129	22.7	119.
BCSS	CERT LIMIT	±0.04	±2.7	±0.012	±3.4	±12.
BCSS	DRY AR	0.27	17.0	0.18	25.5	109.
BCSS	DRY H2O2	0.24	20.0	0.16	24.0	107.
BCSS	DRY HF	0.31	17.3	0.16	21.8	120.
BCSS	WET AR	0.20	23.0	0.15	22.5	103.
BCSS	WET H202	0.29	20.0	0.20	23.0	114.
BCSS	WET HF	0.25	25.0	0.13	22.0	113.
1646	CERT	0.36	18.0	0.063	28.2	138.
1646	CERT LIMIT	±0.07	±3.0	±0.012	±1.8	±6.
1646	DRY AR	0.44	17.0	0.070	25.0	124.
1646	DRY H2O2	0.38	21.0	0.070	23.5	121.
1646	DRY HF	0.37	16.3	0.076	25.6	140.
1646	WET AR	0.25	17.0	0.065	27.0	120.
1646	WET H202	0.39	21.0	0.10	28.0	133.
1646	WET HF	0.30	18.0	0.070	30.0	135.

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

FALSE CREEK

File No. 7600A

REAGENT BLANK SUMMARY

	Cadmium	Copper	Mercury	Lead	Zinc
BLK1 DRY AR	0.026	<0.250	<0.025	<2.50	<1.00
BLK1 DRY H202	<0.025	<0.250	<0.025	<2.50	<1.00
BLK1 DRY HF	<0.050	<0.500	<0.050	<5.00	<2.00
BLK1 WET AR	<0.025	<0.250	<0.025	<2.50	<1.00
BLK1 WET H202	<0.025	<0.250	<0.025	<2.50	<1.00
BLK1 WET HF	<0.050	<0.500	<0.050	<5.00	<2.00
BLK2 DRY AR	0.027	<0.250	<0.025	<2.50	<1.00
BLK2 DRY H202	0.026	<0.250	<0.025	<2.50	<1.00
BLK2 DRY HF	<0.050	<0.500	<0.050	<5.00	<2.00
BLK2 WET AR	<0.025	<0.250	<0.025	<2.50	<1.00
BLK2 WET H202	<0.025	<0.250	<0.025	<2.50	<1.00
BLK2 WET HF	<0.050	<0.500	<0.050	<5.00	<2.00

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

FALSE CREEK

File No. 7600A

QUALITY CONTROL DATA SUMMARY

	Cadmium	Copper	Mercury	Lead	Zinc
MESS CERT	0.59	25.1	0.171	34.0	191.
MESS CERT LIMIT	±0.10	±3.8	±0.014	±6.1	±17.
MESS DRY AR	0.53	25.5	0.20	30.0	194.
MESS DRY H202	0.55	25.5	0.18	33.5	180.
MESS DRY HF	0.57	25.0	0.20	34.0	178.
MESS WET AR	0.62	23.5	0.19	33.5	184.
MESS WET H202	0.58	23.0	0.18	30.0	182.
MESS WET HF	0.67	27.0	0.19	33.0	198.
BCSS CERT	0.25	18.5	0.129	22.7	119.
BCSS CERT LIMIT	±0.04	±2.7	±0.012	±3.4	±12.
BCSS DRY AR	0.21	18.1	0.13	19.0	105.
BCSS DRY H202	0.24	20.2	0.14	22.5	112.
BCSS DRY HF	0.24	18.0	0.14	24.0	107.
BCSS WET AR	0.27	15.0	0.12	22.3	112.
BCSS WET H202	0.23	15.2	0.14	22.4	111.
BCSS WET HF	0.24	19.1	0.15	25.0	126.
1646 CERT	0.36	18.0	0.063	28.2	138.
1646 CERT LIMIT	±0.07	±3.0	±0.012	±1.8	±6.
1646 DRY AR	0.24	14.0	0.060	28.1	132.
1646 DRY H202	0.33	16.5	0.075	26.5	122.
1646 DRY HF	0.32 u	18.3	0.060	28.0	132.
1646 WET AR	0.40	17.4	0.068	26.0	130.
1646 WET H202	0.32	16.3	0.075	24.3	131.
1646 WET HF	0.40	20.1	0.075	28.5	141.

< = Less than

Results expressed as milligrams per dry kilogram of sample

ASL

ALBERNI INLET File No. 7600A

REAGENT BLANK SUMMARY

	Cadmium	Copper	Mercury	Lead	Zinc
BLK1 DRY AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK1 DRY H202	<0.025	<0.25	<0.025	<2.5	<1.0
BLK1 DRY HF	<0.050	<0.50	0.090	<5.0	<2.0
BLK1 WET AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK1 WET H202	<0.025	<0.25	<0.025	<2.5	<1.0
BLK1 WET HF	<0.050	<0.50	0.12	<5.0	<2.0
BLK2 DRY AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK2 DRY H202	<0.025	<0.25	<0.025	<2.5	<1.0
BLK2 DRY HF	<0.050	<0.50	<0.050	<5.0	<2.0
BLK2 WET AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK2 WET H202	<0.025	<0.25	<0.025	<2.5	<1.0
BLK2 WET HF	<0.050	<0.50	0.10	<5.0	<2.0

< = Less than
Results expressed as milligrams per dry kilogram

ASL

ALBERNI INLET File No. 7600A

QUALITY CONTROL DATA SUMMARY

	Cadmium	Copper	Mercury	Lead	Zinc
MESS CERT'D	0.59	25.1	0.171	34.0	191.
MESS CERT'D LIMITS	±0.10	±3.8	±0.014	±6.1	±17.
MESS DRY AR	0.56	22.5	0.21	31.0	180.
MESS DRY H202	0.53	22.3	0.18	32.5	178.
MESS DRY HF	0.54	22.7	0.15	30.3	177.
MESS WET AR	0.57	24.3	0.21	32.0	183.
MESS WET H202	0.54	23.5	0.22	32.0	180.
MESS WET HF	0.61	26.0	0.19	30.0	182.
BCSS CERT'D	0.25	18.5	0.129	22.7	119.
BCSS CERT'D LIMITS	±0.04	±2.7	±0.012	±3.4	±12.
BCSS DRY AR	0.23	15.9	0.17	23.5	115.
BCSS DRY H202	0.28	15.8	0.14	21.5	110.
BCSS DRY HF	0.22	18.0	0.14	23.0	120.
BCSS WET AR	0.25	18.4	0.16	21.0	113.
BCSS WET H202	0.25	16.5	0.16	24.0	115.
BCSS WET HF	0.26	18.0	0.13	23.0	118.
1646 CERT'D	0.36	18.0	0.063	28.2	138.
1646 CERT'D LIMITS	±0.07	±3.0	±0.012	±1.8	±6.
1646 DRY AR	0.35	16.2	0.070	26.5	132.
1646 DRY H202	0.34	16.5	0.084	29.0	133.
1646 DRY HF	0.30	16.0	0.075	27.1	132.
1646 WET AR	0.34	16.9	0.059	28.5	134.
1646 WET H202	0.40	17.0	0.075	28.0	136.
1646 WET HF	0.35	18.0	0.073	28.0	135.

< = Less than
Results expressed as milligrams per dry kilogram

ASL

ESQUIMALT HARBOUR

File No. 7600A

REAGENT BLANK SUMMARY

	Cadmium	Copper	Mercury	Lead	Zinc
BLK1 DRY AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK1 DRY H202	<0.025	<0.25	<0.025	<2.5	<1.0
BLK1 DRY HF	<0.050	<0.50	0.090	<5.0	<2.0
BLK1 WET AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK1 WET H202	<0.050	<0.25	<0.025	<2.5	<1.0
BLK1 WET HF	<0.050	<0.50	0.080	<5.0	<2.0
BLK2 DRY AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK2 DRY H202	<0.025	<0.25	<0.025	<2.5	<1.0
BLK2 DRY HF	<0.050	<0.50	0.090	<5.0	<2.0
BLK2 WET AR	<0.025	<0.25	<0.025	<2.5	<1.0
BLK2 WET H202	<0.025	<0.25	<0.025	<2.5	<1.0
BLK2 WET HF	<0.050	<0.50	0.080	<5.0	<2.0

< = Less than

Results expressed as milligrams per dry kilogram

ASL

ESQUIMALT HARBOUR File No. 7600A

QUALITY CONTROL DATA SUMMARY

	Cadmium	Copper	Mercury	Lead	Zinc
MESS CERT'D	0.59	25.1	0.171	34.0	191.
MESS CERT'D LIMITS	±0.10	±3.8	±0.014	±6.1	±17.
MESS DRY AR	0.57	24.0	0.20	30.0	185.
MESS DRY H202	0.52	22.6	0.20	32.5	180.
MESS DRY HF	0.61	23.0	0.16	34.0	187.
MESS WET AR	0.54	24.5	0.17	34.0	179.
MESS WET H202	0.51	25.5	0.24	30.5	181.
MESS WET HF	0.62	23.0	0.13	32.0	204.
BCSS CERT'D	0.25	18.5	0.129	22.7	119
BCSS CERT'D LIMITS	±0.04	±2.7	±0.012	±3.4	±12.
BCSS DRY AR	0.25	16.0	0.17	22.5	107.
BCSS DRY H202	0.24	15.8	0.17	24.0	113.
BCSS DRY HF	0.24	17.0	0.18	22.0	118.
BCSS WET AR	0.21	16.8	0.14	23.5	107.
BCSS WET H202	0.26	17.2	0.18	22.0	113.
BCSS WET HF	0.28	17.0	0.14	23.0	113.
1646 CERT'D	0.36	18.0	0.063	28.2	138.
1646 CERT'D LIMITS	±0.07	±3.0	±0.012	±1.8	±6.
1646 DRY AR	0.35	16.5	0.075	26.5	133.
1646 DRY H202	0.29	16.5	0.074	26.5	132.
1646 DRY HF	0.40	15.0	0.059	28.0	134.
1646 WET AR	0.31	16.8	0.075	27.0	133.
1646 WET H202	0.36	17.0	0.074	27.5	132.
1646 WET HF	0.32	20.0	0.061	30.0	134.

< = Less than
Results expressed as milligrams per dry kilogram

Appendix 4
Prep. Notes and Field Collection Notes

ASL

APPENDIX 4

FIELD COLLECTION NOTES

ASL

VANCOUVER HARBOUR

FIELD COLLECTION NOTES

SEDIMENT SAMPLING FIELD NOTES

DATE : Apr 11/89 TIME: 10:15 am

LOCATION: Port Moody (2) - inside boom

SAMPLE LABEL: PM (2) (ASL # 7600 -1)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR dark w/ S yellow

: ODOUR H_2S

: GRAIN SIZE fine

: FOREIGN MATTER Sulfur chunks

: OTHER

UNIQUE HANDLING (IF ANY): same as PM(1) (org cut)

PROBLEMS (IF ANY):

GENERAL COMMENTS: After 2 wks storage in cold room opaque white coating on inside of plastic bag that could be rubbed off

SEDIMENT SAMPLING FIELD NOTES

DATE : Apr 11/89 TIME: 10:20 AM

LOCATION: Port Moody (3) - inside boom

SAMPLE LABEL: PM 3 (ASL #7600-2)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR dark

: ODOUR H_2S

: GRAIN SIZE fine

: FOREIGN MATTER nil

: OTHER

UNIQUE HANDLING (IF ANY): Same as PM(1)

PROBLEMS (IF ANY):

GENERAL COMMENTS: 2 wks storage in cold room → get opaque white coating on inside of plastic bag that could be rubbed off.

2

SEDIMENT SAMPLING FIELD NOTES

DATE : Apr. 11/89 TIME: 13:39

LOCATION: Coal Harbour - by boat houses

SAMPLE LABEL: CH (ASL # 7600-3)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR grey/dark

: ODOUR —

: GRAIN SIZE fine to coarse (some rocks

: FOREIGN MATTER shells

: OTHER

UNIQUE HANDLING (IF ANY): Composite of 3 casts

PROBLEMS (IF ANY):

GENERAL COMMENTS:

SEDIMENT SAMPLING FIELD NOTES

DATE : Apr. 11/84 TIME: 14:00

LOCATION: Vancouver Wharves - ~~between~~ - between shore & wharfe of concentrate loading area

SAMPLE LABEL: VW (ASL # 7600 -4)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR black

: ODOUR H_2S + oily

: GRAIN SIZE fine to coarse

: FOREIGN MATTER some shells wood pieces (many)

: OTHER oil in 5th cast (see below)

UNIQUE HANDLING (IF ANY): Composite of 4 casts + 1 cast 10 m closer to docks ⇒ 5 casts

PROBLEMS (IF ANY): initial casts turned up only rocks → moved 30m closer to docks

GENERAL COMMENTS: 2 wks storage, cold room → opaque white coating on inside of plastic bag.

SEDIMENT SAMPLING FIELD NOTES

DATE : April 13/89 TIME: _____

LOCATION: Vancouver Harbour - EP Stn #14

SAMPLE LABEL: VH-1 (ASL # 7600-5)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Grey/white

: ODOUR —

: GRAIN SIZE medium - Coarse Sd.

: FOREIGN MATTER _____

: OTHER Shells +

UNIQUE HANDLING (IF ANY): 1 grab

PROBLEMS (IF ANY): —

GENERAL COMMENTS:

Looks OK. Well washed sediments

Biota Obs

ASL

FALSE CREEK

FIELD COLLECTION NOTES

SEDIMENT SAMPLING FIELD NOTES

DATE : April 13/89. TIME: 9:30Am

LOCATION: False Creek – Coast Guard.
Centre Channel

SAMPLE LABEL: GG - False Cr. (ASL# 7600 – 6)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR : Brown

: ODOUR Good. – no H_2S.

: GRAIN SIZE Medium Sands / silt

: FOREIGN MATTER shells / twigs / rocks

: OTHER —

UNIQUE HANDLING (IF ANY): — None

PROBLEMS (IF ANY): 1 grab.

GENERAL COMMENTS: Looked OK

SEDIMENT SAMPLING FIELD NOTES

DATE : Apr 13/89 TIME: 10:00

LOCATION: False Creek - Center Basin (Center Channel) off Coop Marina at E end Granville I.

SAMPLE LABEL: CB-1 False Cr. (ASL # 7600-7)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Brn Surface 2cm Blk beneath

: ODOUR —

: GRAIN SIZE fine to medium

: FOREIGN MATTER —

: OTHER Some rocks/shell

UNIQUE HANDLING (IF ANY): 2 grabs

PROBLEMS (IF ANY): —

GENERAL COMMENTS: looked OK

SEDIMENT SAMPLING FIELD NOTES

DATE : April 13/89 TIME: 10:45

LOCATION: East Basin – False Creek directly s/f BC. Pav. Point in mid Chan. at EP-FC-6 28'

SAMPLE LABEL: EB-1 False Cr. (ASL # 7600-8)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Brn Wood Blk/Grey Clay/Silts

: ODOUR —

: GRAIN SIZE Fine-Medium

: FOREIGN MATTER Wood. (Toredo)

: OTHER —

UNIQUE HANDLING (IF ANY): 2 grabs

PROBLEMS (IF ANY):

GENERAL COMMENTS: Looks OK specially C the biota

Biota Present - jw. Cancer sp, marine worms

2 wks cold storage → Fe_2O_3(?) coating on inside of plastic bag.

SEDIMENT SAMPLING FIELD NOTES

DATE : April 13/89 TIME: 11:00

LOCATION: False Creek – East Basin

East end of Sandertanken at EP FC-3 23'

SAMPLE LABEL: EB-2 False Cr (ASL # 7600-9)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Surface Brn (1cm) Blk beneath

: ODOUR H_2S (strong)

: GRAIN SIZE fine - silt.

: FOREIGN MATTER – plastic bag (piece)

: OTHER –

UNIQUE HANDLING (IF ANY): 1 grab

PROBLEMS (IF ANY): —

GENERAL COMMENTS: Almost - "classic" False Cr. Sed.

Little or no Biota

SEDIMENT SAMPLING FIELD NOTES

DATE : April 13/89 TIME: 11:15

LOCATION: False Cr. - East Basin off Lafarge Dock in NE corner of E. Basin. 28'

SAMPLE LABEL: EB-3 False cr. (ASL # 7600-10)

SAMPLING DETAILS:

PHYSICAL APPEARANCE :

COLOUR Surficial Skim Br Oil

: ODOUR Creosote & H_2S

: GRAIN SIZE Fine - Silts

: FOREIGN MATTER Creosote

: OTHER —

UNIQUE HANDLING (IF ANY): 1 grab (good one)

⇒ Do oil & grease test.

PROBLEMS (IF ANY): —

GENERAL COMMENTS:

Terrible looking stuff

No Biota

2 wks cold storage → some white & greasy (?) looking coating on inside of of plastic bag.

ASL

ALBERNI INLET

FIELD COLLECTION NOTES

SEDIMENT SAMPLING FIELD NOTES

DATE : June 26/89 TIME: 2:30

LOCATION: Alberni Inlet. - Al Pulp Flume
#4f.

SAMPLE LABEL: Alberni #1 (ASL # 7600-11)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Black

: ODOUR Pulp mill / H_2S

: GRAIN SIZE fibre

: FOREIGN MATTER fibre / oil spots

: OTHER tarry spots

UNIQUE HANDLING (IF ANY): —

PROBLEMS (IF ANY): —

GENERAL COMMENTS:

2 jars / organics

2 grabs / bag - very liquid.

- No photo

- blackened ss pan on contact

- HIV - bag + 1l jar / AC. / EPS

SEDIMENT SAMPLING FIELD NOTES

DATE : June 26/89 TIME: 15:00

LOCATION: Alberni #2 — Alpulp E. Storage

3.8f

SAMPLE LABEL: Alberni 2 (ASL # 7600-12)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Grey - Black / Brown

: ODOUR some H_2S

: GRAIN SIZE ~~coarse~~ sand / clay.

: FOREIGN MATTER wood / fibre

: OTHER

UNIQUE HANDLING (IF ANY):

PROBLEMS (IF ANY):

GENERAL COMMENTS:

2 jars

4 grabs - 2 reasonable size

sandy

No photo

SEDIMENT SAMPLING FIELD NOTES

DATE : Jun 26/89 TIME: 3:30

LOCATION: Alberni 3 – Somass Saw Mill
≈ 4F

SAMPLE LABEL: Alberni 3 (ASL # 7600-13)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Black

: ODOUR H_2S

: GRAIN SIZE fine

: FOREIGN MATTER Wood?

: OTHER

UNIQUE HANDLING (IF ANY):

PROBLEMS (IF ANY):

GENERAL COMMENTS:

2 jars

2 grabs – HN Somass PAH / AC

HN – sample PAH

No photo

SEDIMENT SAMPLING FIELD NOTES

DATE : June 26/89 TIME: 15:30

LOCATION: Alberni 4 – Alberni Pacific Div.

SAMPLE LABEL: Alberni 4 (ASL # 7600-14)

SAMPLING DETAILS:

PHYSICAL APPEARANCE :

COLOUR : Brown - Dark Brown

ODOUR : slightly S in Wood

GRAIN SIZE : fine - medium sand

FOREIGN MATTER : wood chips

OTHER :

UNIQUE HANDLING (IF ANY):

PROBLEMS (IF ANY):

GENERAL COMMENTS:

2 jars

2 grabs - very diff

No photo

HN - sample PAH.

SEDIMENT SAMPLING FIELD NOTES

DATE : June 26/89 TIME: 1600

LOCATION: Alberni 5 - Hohm Is.
9F.

SAMPLE LABEL: Alberni 5 (ASL # 7600-15)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Light Brown

: ODOUR —

: GRAIN SIZE fine silts

: FOREIGN MATTER —

: OTHER a rock noted.

UNIQUE HANDLING (IF ANY):

PROBLEMS (IF ANY):

GENERAL COMMENTS:

2 jars/organic
1 grab - full/fine marine sed.
HH - sample PAH
No photo

ASL

ESQUIMALT HARBOUR

AND

VICTORIA HARBOUR

FIELD COLLECTION NOTES

SEDIMENT SAMPLING FIELD NOTES

DATE : June 27 / 89 TIME: 1000

LOCATION: D - Jetty - Esquimalt Harbour

SAMPLE LABEL: ESQ - *1 (ASL # 7600-16)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Black

: ODOUR some H_2S

: GRAIN SIZE fine - coarse grit

: FOREIGN MATTER electrical cable, rope

: OTHER Kelp crab, scallop.

UNIQUE HANDLING (IF ANY):

PROBLEMS (IF ANY):

GENERAL COMMENTS:

Photo. - see HN.

2 jars / organics

5 grabs 3 good ones.

HM - Sample PAH

SEDIMENT SAMPLING FIELD NOTES

DATE : June 27/89 TIME: 1100

LOCATION: Center - ESQuimalt Harbour

SAMPLE LABEL: ESQ - #2 (ASL # 7600-17)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Light brown - brown

: ODOUR —

: GRAIN SIZE fine

: FOREIGN MATTER —

: OTHER polychaetes / clam

UNIQUE HANDLING (IF ANY):

PROBLEMS (IF ANY):

GENERAL COMMENTS:

2 Jars Organic

2 grabs -

HN - PAH Sample Photo - see HN

SEDIMENT SAMPLING FIELD NOTES

DATE : June 27/89 TIME: 1200

LOCATION: Graving Dock – Esquimalt.

SAMPLE LABEL: ESQ #3 (ASL# 7600-18)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Black

: ODOUR H_2S + sewage?

: GRAIN SIZE fine

: FOREIGN MATTER yes

: OTHER wheat grains

UNIQUE HANDLING (IF ANY): —

PROBLEMS (IF ANY): —

GENERAL COMMENTS:

Very odourous

2 jars Organ

2 jars –

Photo – see HN.

SEDIMENT SAMPLING FIELD NOTES

DATE : June 27/89 TIME: 1500hrs

LOCATION: Point Hope Shipyard - Victoria Harbour

SAMPLE LABEL: ESQ 4 (ASL # 7600-19)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR Black

: ODOUR —

: GRAIN SIZE coarse (fine)

: FOREIGN MATTER grit

: OTHER ~~sand~~ worms

UNIQUE HANDLING (IF ANY):

PROBLEMS (IF ANY):

GENERAL COMMENTS:

Sand blasting area.

2 jars organisms.

3 grabs. Photo - see HH

SEDIMENT SAMPLING FIELD NOTES

DATE : June 27/89 TIME: 1600

LOCATION: Laurel Point

SAMPLE LABEL: ESQ #5 (ASL # 7600-20)

SAMPLING DETAILS:

PHYSICAL APPEARANCE : COLOUR - int - Dark Brown

: ODOUR —

: GRAIN SIZE fine

: FOREIGN MATTER —

: OTHER worms.

UNIQUE HANDLING (IF ANY):

PROBLEMS (IF ANY):

GENERAL COMMENTS:

2 jars organic

1 grab Photo - see MN

Appendix 5
Prep. Notes

APPENDIX 5

PREPARATION NOTES

ASL

VANCOUVER HARBOUR

PREPARATION NOTES

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID HARBOUR VAN. HARBOUR ASL NO. 7600-1

FIELD LABEL PM(2) SAMPLE LABEL PORT MOODY (2)

PHYSICAL DESCRIPTION

Sediment Texture fines + sulfur Odour H_2S

Foreign Material Wood + S balls Colour grey & yellow S

Notes: V. high S content

water seepage from bag

~90% Larger chunks

Wet Sieving Cont. Wt 72.05 Final Wt 86.9 Analyst CURTIS Date June 16/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 58.8%	PS	<1.0mm ARC	LAB	Initial (0.5mm) 100%	>.5mm 68.3%	PS	<0.5mm ARC	LAB
Sample + Tare	1136.1	360.6				771.7	384.5			
Tare	771.7	146.0	17.13	16.82	16.85	422.7	146.2	17.15	17.12	16.89
Sample Wt	364.4	214.4				349.0	238.3			
Description		pure S balls					pure S balls			

Comments:

Dry Sieving S+T: 845.6 T: 72.01 Analyst P.M Date June 13/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 89.5%	<1.0mm 10.4%	Initial (0.5mm) 100%	>.5mm 90.2%	<0.5mm 9.7%
Sample + Tare	311.0g	278.3	p.size: 21.7 archive: 5.3 working: 5.2 32.2	289.9g	261.5	p.size: 18.8 archive: 2.8 working: 16.5 28.1
Tare						
Sample Wt						
Description	lots big chunks S	Sulfur & clay agg		fewer large S chunks	Sulfur & clay agg.	

Comments:

Analyse As Is Analyst P.M Date June 13/89

Initial 422.7 86.9 wt 335.8

	ARC	LAB	PS
S+T	73.36	156.33	152.15
T	17.09	17.15	17.14

Hand Blend Wet S. Wt

Dry & Grind Sample + Tare — Tare — Sampe Wt. 48.4

p. size: 87.9 arch: 37.2

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID **HARBOUR** VAN. HARBOUR **ASL NO.** 7600-2

FIELD LABEL PM(3) **SAMPLE LABEL** PORT MOODY (3)

PHYSICAL DESCRIPTION

Sediment Texture fine **Odour** H_2S

Foreign Material some wood **Colour** grey - black

Notes: FINE predominates

Wet Sieving Cont Wt 74.15 Final Wt 85.33 **Analyst** CURTIS **Date** June 22/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 1.0% PS	<1.0mm LAB	<1.0mm ARC	Initial (0.5mm) 100%	>.5mm 1.3% PS	<0.5mm LAB	<0.5mm ARC
Sample + Tare	1173.4	21.13			739.1	21.87		
Tare	739.1	16.84	16.87	17.06	375.0	17.11	17.19	17.06
Sample Wt	434.3	4.29 / 16.96			364.1	4.76 / 16.90		
Description		5 balls, wood bits, sand				5 balls, wood bits, sand.		

Comments:

Dry Sieving S+T : 411.7 T : 74.1 **Analyst** P.M. **Date** June 13/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 37.4%	<1.0mm 62.2%	Initial (0.5mm) 100%	>.5mm 67.4%	<0.5mm 32.5%
~~Sample + Tare~~			p.size 82.1			p.size 33.9
~~Tare~~			archive: 5.7			arch: 7.3
Sample Wt	151.3	56.6	lab: 6.3 / 94.1	145.4	98.0	lab: 16.1 / 47.3
Description	large clay chunks retained	clay agg/wood		some clay agg	clay agg/wood	

Comments:

Analyse As Is Arc LAB P.S. **Analyst** P.M. **Date** June 15/89

S+T 375.0 85.33 S.Wt 289.7 **Hand Blend Wet** S+T 78.92 94.74 172.13 T 17.21 16.78 17.07 S.Wt

Dry & Grind **Sample + Tare** — **Tare** — **Sampe Wt.** 10.3

part. size: 20.2 arch: 10.4

Dried to a hard cake (broken up during drying)

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID **HARBOUR** VAN. HARBOUR **ASL NO.** 7600-3

FIELD LABEL CH **SAMPLE LABEL** COAL HARBOUR

PHYSICAL DESCRIPTION

Sediment Texture fine **Odour** H_2S

Foreign Material some shell fragments **Colour** grey

Notes:

cont. wgt st. 73.4
" " final 75.4

Wet Sieving **Analyst** I. M. **Date** June 22/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 18.8% Rej	P.S.	<1.0mm LAB	ARCH	Initial (0.5mm) 100%	>.5mm 37.5% Rej	P.S.	<0.5mm LAB	ARCH
Sample + Tare	1074.0	79.83				739.3	141.15			
Tare	739.3	16.962	16.808	16.957	16.874	408.4	16.958	16.821	17.235	17.390
Sample Wt	334.7	62.87				330.9	124.19			
Description		shells, rocks, compacted mud & sand					shells, rocks, (compacted) mud & sand.			

Comments:

Dry Sieving S+T: 703.02 T: 73.5 **Analyst** P.M **Date** June 13/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 40.6%	<1.0mm 59.3%	Initial (0.5mm) 100%	>.5mm 43.1%	<0.5mm 56.7%
~~Sample + Tare~~ ~~Tare~~ Sample Wt	218.0	88.4	p size: 84.8 arch: 23.1 lab: 21.3 / 129.2	327.4	141.0	p site: 109. arch: 34.2 lab: 40.6 / 185.7
Description		clay agg / shells			clay agg / shells	

S+T 408.4 − 75.4 = 333.0

Comments:

	S+T	P.S	Lab	Arch
Analyse As Is	T	16.781	16.794	17.036
Hand Blend Wet	WT			

Analyst P.M. **Date** June 13/89

Dry & Grind **Sample + Tare** — **Tare** — **Sampe Wt.** 20.4

Dried to a hard cake. (Broken up during drying)

part size: 51.0
arch: 12.9

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID **HARBOUR** VAN. HARBOUR **ASL NO.** 7600-A

FIELD LABEL VW **SAMPLE LABEL** VANC. WHARVES

PHYSICAL DESCRIPTION

Sediment Texture medium (silty) **Odour** prev. H_2S, rotten eggs (ripe)

Foreign Material wood pieces **Colour** grey

Notes: water seepage from bag

cont wgt: 70.06
final 732

Wet Sieving **Analyst** T. M. **Date** June 22/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 35.8% Rej	P.S.	<1.0mm	Lab	Arch	Initial (0.5mm) 100%	>.5mm ~~2.24~~ 60.5% Rej	P.S.	<0.5mm	Lab	Arch
Sample + Tare	1097.3	140.02					754.8	260.68				
Tare	~~754.8~~	17.371	16.821		16.826	17.004	412.6	17.038	16.747		16.860	16.867
Sample Wt	342.5	122.65					342.2	243.64				
Description		wood, sand & silt, shells						wood, sand & silt shells				

Comments:

Dry Sieving S+T: 788.90 T: 70.80 **Analyst** P.M. **Date** June 13/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 27.9%	<1.0mm 72.0%	Initial (0.5mm) 100%	>.5mm 37.4%	<0.5mm 62.4%
~~Sample + Tare~~ ~~Tare~~ Sample Wt	262.1	73.2	p.size: 103.2 arch: 51.7 lab: 33.9 188.8	355.9	133.0	p.size: 106.0 arch: 75.86 lab: 40.3 222.2
Description		clay agg/wood			clay agg/wood	

initial T412.6 − 73.2 = wgt 339.4

Comments:

Analyse As Is S+T 16.680 16.744 16.616 T Swgt **Analyst** P.M. **Date** June 13/89

Hand Blend Wet

Dry & Grind **Sample + Tare** — **Tare** — **Sampe Wt.** 27.1

lot size: 52.4
arch: 20.6

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID **HARBOUR** VAN. HARBOUR **ASL NO.** 7600-5

FIELD LABEL V1+ **SAMPLE LABEL** VANC. HARB. EP Stn 4

PHYSICAL DESCRIPTION

Sediment Texture coarse → rocks **Odour** fishy

Foreign Material shells / rocks **Colour** grey

Notes: consists of crushed shells

Cont. wet: 76.7g
final: 78.9g

Wet Sieving **Analyst** T.M. **Date** June 22/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm ~~25.1%~~ 88.9% Rej	P.S.	<1.0mm lab	arch	Initial (0.5mm) 100%	>.5mm ~~31.0%~~ 93.4% Rej	P.S.	<0.5mm lab	arch
Sample + Tare	1161.5	320.19				780.0	354.09			
Tare	780.0	17.094	16.807	17.044	16.766	419.0	16.974	16.758	17.287	17.069
Sample Wt	341.5	303.10				361.0	337.12			
Description		sand, shells (lots)					sand, lots of shells			

Comments:

Dry Sieving S+T: 1072.40 T: 79.0 **Analyst** P.M. **Date** June 13/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm ~~22.7%~~ 75.4%	<1.0mm 72.0%	Initial (0.5mm) 100%	>.5mm ~~37.4%~~ 93.7%	<0.5mm 62.4%
~~Sample + Tare~~ ~~Tare~~ Sample Wt	405.5	305.9	p.size: 56.3 arch: 17.9 lab: ~~25.3~~ 99.4	510.3	478.9	p.size: 15.5 arch: 4.9 lab: 11.9 31.3
Description		coarse sand/shells	v. whitish (shells)		coarse sand/shell frag	v. whitish (shells)

final S+T 419.0
78.9
340.1

Comments:

	S+T	P.S.	lab	arch
Analyse As Is	T			
Hand Blend Wet	S+T	17.013	16.367	17.352

Analyst P.M. **Date** June 13/89

Dry & Grind Sample + Tare _____ Tare _____ Sampe Wt. 21.9

p.i.t size: 39.6

arch: 16.0

ASL

FALSE CREEK

PREPARATION NOTES

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID **HARBOUR** False Creek **ASL NO.** 7600-6

FIELD LABEL False Ck. Coastguard **SAMPLE LABEL** CG - False Creek

PHYSICAL DESCRIPTION

Sediment Texture _____ **Odour** _____

Foreign Material woody **Colour** black

Notes: _____

Initial container: 78.6
Final container: 88.3

Wet Sieving **Analyst** T.M. **Date** June 22/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 3.5% Rej	P.S.	<1.0mm lab	arch	Initial (0.5mm) 100%	>.5mm 6.6% Rej	P.S	<0.5mm lab	arch
Sample + Tare	1150.0	29.80				793.2	42.28			
Tare	793.2	16.871	16.815	16.787	16.894	396.	16.9A	16.703	17.372	16.913
Sample Wt	366.8	12.93				397.2	26.37			
Description		sand, shells wood fibre					same as L1.0			

Comments: _____

Dry Sieving **Analyst** P.M. **Date** July 6/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 55.9% reject	<1.0mm 43.9%	Initial (0.5mm) 100%	>.5mm 57.3%	<0.5mm 42.5%
~~Sample + Tare~~ ~~Tare~~ Sample Wt	230.07	128.66	lab: 22.31 arch: 24.60 p. size: 54.04	327.65	187.77	lab: 127.04 arch: 26.45 p. size: 85.70
Description	clay agg.	clay agg + shells	100.95	clay agg	clay agg + shells	139.19

wet initial
T = 396.0
T = 88.3
307.7

Comments: P.S. LAB ARC.

Analyse As Is S+T= T= 17.015 16.862 16.365 **Analyst** _____ **Date** _____

Hand Blend Wet S+T= _____

Dry & Grind **Sample + Tare** _____ **Tare** _____ **Sampe Wt.** _____

raw
lab arch part
33.53 30.74 74.54

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID **HARBOUR** False Creek **ASL NO.** 7600-7

FIELD LABEL False Ck. Coaster Basin **SAMPLE LABEL** CB-1. False Creek.

PHYSICAL DESCRIPTION

Sediment Texture _____ **Odour** _____

Foreign Material wood + fish scales **Colour** _____

Notes: _____

initial cont: 77.3
final cont: 80.1

Wet Sieving **Analyst** J.M. **Date** June 22/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 32.2% Ref	P.S.	<1.0mm Lab	Arch	Initial (0.5mm) 100%	>.5mm 39.1% Ref	P.S	<0.5mm Lab	Arch
Sample + Tare	1128.5	129.37				771.5	152.88			
Tare	778.5	16.844	16.673	16.916	17.022	429.2	16.280	17.081	16.948	17.39
Sample Wt	350.0	112.53				349.3	136.60			
Description		sand, wood, some shells					sand, wood, some shells			

Comments: _____

Dry Sieving **Analyst** P.M. **Date** July 6/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 72.5%	<1.0mm 27.3%	Initial (0.5mm) 100%	>.5mm 80.1%	<0.5mm 19.4%
~~Sample + Tare~~ ~~Tare~~ Sample Wt	249.13	180.50	lab: 10.32 arch: 10.15 p.size: 47.59	234.05	187.51	lab: 7.57 arch: 5.52 p.size: 32.30
Description	wood + clay agg.	wood + clay agg	68.06	wood + clay agg	wood + clay agg	45.39

Comments: P.S. LAB ARCH

Analyse As Is: SHT: 16.728 17.248 17.074 **Analyst** _____ **Date** _____

Hand Blend Wet Spec:

initial SHT: 429.2
80.1
: 349.1

Dry & Grind **Sample + Tare** _____ **Tare** _____ **Sampe Wt.** _____

raw 30.86

arch 23.71

p.size 63.18

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID HARBOUR False Creek ASL NO. 76000-8

FIELD LABEL East Basin F.C SAMPLE LABEL EB-1 (F.C.)

PHYSICAL DESCRIPTION

Sediment Texture _____ Odour _____

Foreign Material _____ Colour black

Notes: lots of wood

cont. wgt: 71.1
final wgt: 71.9

Wet Sieving Analyst J. Mc. Date June 23/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 31.1% Reg	P.S.	<1.0mm Lab	Arc.	Initial (0.5mm) 100%	>.5mm 31.7% Reg	P.S	<0.5mm Lab	Arch
Sample + Tare	1167.4	130.55				802.4	132.57			
Tare	802.4	17.184	16.978	16.836	17.037	437.2	16.962	16.671	16.803	17.169
Sample Wt	365.0	113.37				365.2	115.61			
Description		lots of wood, some shells, sand					same as L1.0			

Comments: _____

Dry Sieving Analyst P.M. Date July 6/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 72.8%	<1.0mm 26.9%	Initial (0.5mm) 100%	>.5mm 70.3%	<0.5mm 29.2%
~~Sample + Tare~~ ~~Tare~~ Sample Wt	200.36	145.79	lab: 6.06 arch: 6.14 p.size: 41.64 53.84	209.99	147.62	lab: 8.98 arch: 7.50 p.size: 45.91 61.39
Description	Bark + clay agg	Bark clay agg		Bark + clay agg	Bark + clay agg	

Comments: P.S lab Arc.

Analyse As Is T (Spl+T) 16.765 16.933 16.336 Analyst _____ Date _____

Hand Blend Wet (Spl)

Dry & Grind Sample + Tare _____ Tare _____ Sampe Wt. _____

lab: 25.75
arch. 20.37
p.size. 62.43

initial
Spl+T: 437.2
T: 71.9
: 365.3

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID **HARBOUR** Alice Creek **ASL NO.** 7600-9

FIELD LABEL False Ck East Basin **SAMPLE LABEL** ~~7600-9~~ . EB-2(FC)

PHYSICAL DESCRIPTION

Sediment Texture _____ **Odour** _____

Foreign Material _____ **Colour** black

Notes: very silty little residue

initial wt: 73.3
final wt: 72.3

Wet Sieving **Analyst** T.M. **Date** June 23/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 0.9% Rej	P.S.	<1.0mm Lab	Arc	Initial (0.5mm) 100%	>.5mm 1.2% Rej	P.S.	<0.5mm Lab	Arc
Sample + Tare	1105.6	20.411				766.9	20.883			
Tare	766.9	17.321	16.879	17.248	16.772	428.2	16.817	16.279	16.949	16.785
Sample Wt	338.7	3.090				338.7	4.066			
Description		shells, wood bits, silt					shells, wood bits, silt			

Comments: _____

Dry Sieving **Analyst** P.M. **Date** July 6/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 57.5%	<1.0mm 41.7%	Initial (0.5mm) 100%	>.5mm 65.1%	<0.5mm 34.1%
~~Sample + Tare~~ ~~Tare~~ Sample Wt	214.64	123.51	lab: 17.11 arch: 10.55 p.size: 61.88	178.49	116.18	lab: 6.75 arch: 7.39 p.size: 46.64
Description	clay agg. plastic	clay agg	89.54	clay agg.	clay agg.	60.78

Comments: P.S Lab Arc

Analyse As Is S+T 16.872 16.875 16.249 **Analyst** _____ **Date** _____

Hand Blend Wet Spl.

initial: 428.2
T: 72.3
355.9

Dry & Grind **Sample + Tare** _____ **Tare** _____ **Sampe Wt.** _____

lab: 31.48
arch: 32.80
p.size: 85.31

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID **HARBOUR** FALSE CREEK **ASL NO.** 7688-10

FIELD LABEL _____ **SAMPLE LABEL** _____

PHYSICAL DESCRIPTION

Sediment Texture v. fine **Odour** V. ripe, rotten eggs

Foreign Material _____ **Colour** BLACK

Notes:

initial cont. wgt: 73.3
final " " : 84.4

Wet Sieving **Analyst** T.M. **Date** June 23/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 15% Rej	P.S.	<1.0mm lab	arch	Initial (0.5mm) 100%	>.5mm 2.6% Rej	P.S.	<0.5mm lab	arch
Sample + Tare	1125.7	21.621				774.9	25.572			
Tare	774.9	16.417	16.993	16.811	16.330	424.1	16.290	17.251	16.790	16.883
Sample Wt	350.8	5.204				350.8	9.282			
Description		oily: wood, sand, shell fragments					same as L1.0			

Comments:

Dry Sieving **Analyst** P.M. **Date** July 6/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0mm 57.7%	<1.0mm 42.2%	Initial (0.5mm) 100%	>.5mm 58.1%	<0.5mm 41.1%
~~Sample + Tare~~ ~~Tare~~ Sample Wt	150.35	92.50	lab: 7.55 arch: 6.85 p.size: 53.24	148.72	86.46	lab: 7.81 arch: 6.03 psize, 47.33
Description	clay agg ~~strong~~ v.g. smell	clay agg	67.64	clay agg	clay agg	61.17

initial 424.1 84.4 339.7

Comments: PS lab arch

Analyse As Is STT 17.312 17.05 17.26

Hand Blend Wet sple **Analyst** _____ **Date** _____

Dry & Grind **Sample + Tare** _____ **Tare** _____ **Sampe Wt.** _____

lab: 32.86
arch: 39.93
psize: 77.15

Dried slowly to a thick paste. V dark on unexposed surfaces. Took 4-5 days @ 60-70 °C. Looks to be high in organics.

ASL

ALBERNI INLET

PREPARATION NOTES

EC/RODAC

HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID HARBOUR Alberni Inlet ASL NO. 7600-11

FIELD LABEL Alberni Pulp Flume SAMPLE LABEL Alberni #1

PHYSICAL DESCRIPTION

Sediment Texture varied Odour Bleachy H2S

Foreign Material wood shells Colour Black

Notes: Mild sulfurous smell. Smaller pieces of wood and chunks of seashells present. Lots of organics and some coarse sand

dry wgt
initial cont. 77.0
+ sple - 1033.18

Dry Sieving Analyst CURTIS Date AUG 3/89

Sieve Fraction	Initial (1.0mm)	>1.0 mm	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm)	>.5 mm	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
	100%	49.7%	47.5%			100%	62.2%	36.7%		
Sample + Tare	233.44	43.539	30.803	24.774	21.099	180.21	49.606	29.897	20.837	19.534
Tare	180.21	17.070	17.072	17.075	16.910	128.30	17.296	16.769	17.017	17.409
Sample Wt	53.23	26.469	13.731	9.701	4.189	51.91	32.31	13.128	3.820	2.125
			TOTAL:	25.269				TOTAL:	19.073	
Description	Soft-fibre wood in rejects		Peat Moss appearance				same as LHS			

Comments: All fractions look almost like Peat Moss and have a very high capacity to absorb liquids.

Analyse As Is **Dry and Grind**

Sample Fraction	Initial	Dry and Grind Part Size	Dry and Grind Lab	Dry and Grind Arc
Sample + Tare	128.30	39.699	41.809	23.813
Tare	74.51	17.326	16.651	17.409
Sample Wt	53.79	22.373	25.158	6.404

- five days: (@ 60-70°C) Broken up, but still very moist, crystal(?)-like layer on some chunks. Visually to sample 13 (Alberni #3).

Wash = 1700 ml

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET Page 2

SAMPLE ID HARBOUR Alberni Inlet ASL NO. 7600-11

FIELD LABEL Alberni Pulp Flume SAMPLE LABEL Alberni #1

Wet Sieving Analyst Drost Date July 11/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0 mm. 16.8% Rej	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm) 100%	>.5 mm 18.1% Rej	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
Sample + Tare	1454.20	94.37	16.869	16.948	16.908	995.26	99.75	17.035	17.174	16.845
Tare	995.26	17.342				533.62	16.252			
Sample Wt	458.94	77.03				461.64	83.50			
Description		similar to thick slurry of wet peat moss					same as >1.0			

Comments: Supernatants ± suspended solids very slow to settle out. @ 6 days still turbid.
@ 3 wks still turbid.

Initial Container Wt 77.0 Final Container Wt 82.3

Analyse As Is **Hand Blend Wet**

Sample Fraction	Initial	Hand Blend Wet Part Size	Hand Blend Wet Lab	Hand Blend Wet Arc
Sample + Tare	533.62	16.906	17.251	16.921
Tare	82.30			
Sample Wt	451.32			

EC/RODAC

HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID HARBOUR Alberni #2 ASL NO. 7600-12

FIELD LABEL Al. Pulp East Storage SAMPLE LABEL Alberni #2

PHYSICAL DESCRIPTION

Sediment Texture Soupy colloid Odour H2S

Foreign Material wood, organics Colour Black

Notes: a gelatinous suspension Difficulty washing sed. through screen because of suspension in organic matter.

dry wgt
est. 74.24g
+ splwet 1317.42g

Dry Sieving Analyst CURTIS Date Aug 3/89

Sieve Fraction	Initial (1.0mm). 100%	>1.0 mm 35.9%	<1.0mm 63.7% Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm) 100%	>.5 mm 56.8%	<0.5mm 43.1% Part Size	<0.5mm Lab	<0.5mm Arc
Sample + Tare	533.92	299.69	106.47	63.87	30.259	757.61	341.78	90.03	33.87	21.41
Tare	299.34	215.45	16.754	17.243	17.070	533.92	214.64	16.319	16.357	16.330
Sample Wt	234.58	84.24	89.716	46.627	13.189	223.69	127.14	73.711	17.513	5.08
			TOTAL:	149.53				TOTAL:	96.374	
Description		lots of large wood pieces, some clay agg some sand, some pebbles					Same as L1.0			

Comments:

Analyse As Is **Dry and Grind**

Sample Fraction	Initial	Dry and Grind Part Size	Dry and Grind Lab	Dry and Grind Arc
Sample + Tare	299.34	116.14	92.50	60.99
Tare	77.49	15.696	15.726	16.918
Sample Wt	221.85	100.444	76.774	44.072

WASH vol: 375+ 900.

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET Page 2

SAMPLE ID HARBOUR Alberni Inlet ASL NO. 7600-12

FIELD LABEL Alberni Pulp East Storage SAMPLE LABEL Alberni #2

Wet Sieving Analyst Irish Date July 11/89

Sieve Fraction	Initial (1.0mm)	>1.0 mm	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm)	>.5 mm	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
	100%	42.5%				100%	43.0%			
Sample + Tare	1386.60	202.44				948.20	204.72			
Tare	948.20	16.330				510.61	16.350			
Sample Wt	438.40	186.11	17.239	17.263	17.210	437.59	188.37	17.316	16.269	17.071
Description		shells sand wood fibre					shells sand wood fibre			

Comments: supernatant slow to settle out. Still turbid @ 6 days

Initial Container Wt 74.24g Final Container Wt 78.39g

Analyse As Is **Hand Blend Wet**

Sample Fraction	Initial	Hand Blend Wet Part Size	Hand Blend Wet Lab	Hand Blend Wet Arc
Sample + Tare	510.61			
Tare	78.39			
Sample Wt	432.22	16.806	16.944	17.347

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID HARBOUR Alberni ASL NO. 7600-13

FIELD LABEL Somass Sawmill SAMPLE LABEL Alberni #3

PHYSICAL DESCRIPTION

Sediment Texture very fine + very soupy Odour _____

Foreign Material _____ Colour Black

Notes: ⇒ looks very high in humus

Air dry wgt
Cont. 79.378
+ Spl 1441.52

Dry Sieving Analyst FCloe Date Aug. 9; 1989

Sieve Fraction	Initial (1.0mm)	>1.0 mm	<1.0mm			Initial (0.5mm)	>.5 mm	<0.5mm		
	100%	7.7%	91.3%			100%	13.9%	85.1%		
			Part Size	Lab	Arc			Part Size	Lab	Arc
Sample + Tare	380.80	24.25	60.65	52.04	36.09	269.50	29.06	53.13	41.46	33.60
Tare	269.50	15.66	15.97	15.41	15.80	173.33	15.67	15.65	15.00	15.69
Sample Wt	111.30	8.59	44.68	36.63	20.29	96.17	13.39	37.48	26.46	17.91
			TOTAL:	101.60				TOTAL:	81.85	
Description		Wood fibres + clay aggregate		Fibre rolls, wood bits			same as L1.0			

Comments: _____

Analyse As Is **Dry and Grind**

Sample Fraction	Initial	Dry and Grind		
		Part Size	Lab	Arc
Sample + Tare	173.33	69.59	40.77	33.30
Tare	77.40	16.11	15.65	16.00
Sample Wt	95.93	53.48	25.12	17.30

⇒ Took 9 days to dry.

⇒ Day 1 of drying: 60-70°C sample foamed up ~ 1" medium light foam. disappeared upon cooling.

⇒ ~~4 days drying @ 60 - 70°C~~ : still a very moist cake, looks like crystals forming on surface, dark, has shrunken considerably, Hmmm... U.V. high in organics

two days: film (broken) forming on top of underneath sed. crystals?

.UBH: 410+1200
vol

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET Page 2

SAMPLE ID HARBOUR Alberni Inlet ASL NO. 7600-13

FIELD LABEL Alberni Inlet SAMPLE LABEL Alberni #3
Somass Sawmill

Wet Sieving Analyst Trask Date July 13/89.

Sieve Fraction	Initial (1.0mm) 100%	>1.0 mm Rej 9.8%	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm) 100%	>.5 mm Rej 14.5%	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
Sample + Tare	1502.00	64.19	16.944	16.902	17.036	1021.92	85.11	17.334	17.062	16.955
Tare	1021.92	17.040				554.15	17.257			
Sample Wt	480.08	47.15				467.77	67.85			
Description		"peat moss"					"peat moss"			

Comments: Supernatant slow to settle out. Still turbid @ 6 days

Initial Container Wt 79.37. Final Container Wt 84.31

Analyse As Is Hand Blend Wet

Sample Fraction	Initial	Hand Blend Wet Part Size	Hand Blend Wet Lab	Hand Blend Wet Arc
Sample + Tare	554.15	17.005	16.817	16.904
Tare	84.31			
Sample Wt	469.84			

EC/RODAC

HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID

HARBOUR Alberni Inlet ASL NO. 7600-14

FIELD LABEL Alberni Inlet SAMPLE LABEL Alberni #4

Alberni Pacific Div.

PHYSICAL DESCRIPTION

Sediment Texture Fine Odour None

Foreign Material Lots of big chunks of wood Colour Black

Notes:

dry wgt corr: 76.42

Dry Sieving Analyst [illegible] Date Aug. 9, 1989

Sieve Fraction	Initial (1.0mm)	>1.0 mm	<1.0mm			Initial (0.5mm)	>.5 mm	<0.5mm		
	100%	53.2%	Part Size	Lab	Arc	100%	46.1%	Part Size	Lab	Arc
Sample + Tare	555.54	97.66	51.66	37.07	28.27	401.44	111.83	36.00	31.13	27.14
Tare	401.44	15.72	15.68	15.13	15.00	256.48	15.97	15.97	15.54	15.57
Sample Wt	154.10	81.94	35.98	21.94	13.27	144.96	95.86	20.03	15.59	11.57
			TOTAL:	71.19				TOTAL:	47.19	
Description		Bark, clay aggregate, shells, stones					same as L1.0			

Comments:

Analyse As Is Dry and Grind

Sample Fraction	Initial	Dry and Grind		
		Part Size	Lab	Arc
Sample + Tare	256.48	98.30	73.80	54.47
Tare	76.57	15.66	15.56	15.66
Sample Wt	179.91	82.64	58.24	38.81

VASH 38+1900

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID **HARBOUR** Alberni Inlet **ASL NO.** 7600-14

FIELD LABEL Alberni Inlet **SAMPLE LABEL** Alberni #4
Alberni Pacific Div.

Wet Sieving **Analyst** Trish **Date** July 13/89

Sieve Fraction	Initial (1.0mm)	>1.0 mm Rejects	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm)	>.5 mm Rejects	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
	100%	41.8%				100%	43.2%			
Sample + Tare	1360.92	182.46	16.781	16.951	17.145	931.72	196.67	16.702	16.954	16.694
Tare	931.72	2.86				514.80	16.589			
Sample Wt	429.20	179.60				416.92	180.08			
Description		v. large bark pieces, shell (frag.) wood fibre, some sand, rocks					wood fibre, some sand & rocks			

Comments: Supernatant slow to settle out. Still Turbid @ 6 days

Initial Container Wt 76.42 Final Container Wt 82.71

Analyse As Is **Hand Blend Wet**

Sample Fraction	Initial	Hand Blend Wet Part Size	Hand Blend Wet Lab	Hand Blend Wet Arc
Sample + Tare	514.80	17.296	16.958	16.797
Tare	82.71			
Sample Wt	432.09			

EC/RODAC

HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID

HARBOUR Alberni Inlet ASL NO. 7600-15

FIELD LABEL Alberni 5 SAMPLE LABEL Alberni #5

Holm Island ( )

PHYSICAL DESCRIPTION

Sediment Texture fine - medium silt Odour none.

Foreign Material few pebbles. Colour grey

Notes:

Dry Sieving Analyst [signature] Date Aug. 11, 1989

Sieve Fraction	Initial (1.0mm)	>1.0 mm	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm)	>.5 mm	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
	100%	28.7%	71.1%			100%	35.0%	64.2%		
Sample + Tare	600.05	72.99	90.82	56.42	41.87	400.95	65.40	61.57	44.91	31.09
Tare	400.95	15.81	15.98	15.97	15.65	258.92	15.67	16.00	15.40	15.01
Sample Wt	199.10	57.18	74.84	40.45	26.22	142.03	49.73	45.57	29.51	16.08
			TOTAL:	141.51				TOTAL:	91.16	
Description		clay aggregate					same as L1.0			

Comments:

Analyse As Is **Dry and Grind**

Sample Fraction	Initial	Dry and Grind Part Size	Dry and Grind Lab	Dry and Grind Arc
Sample + Tare	258.92	121.31	67.60	40.10
Tare	76.50	15.66	15.44	15.57
Sample Wt	182.42	105.65	52.16	24.53

TOTAL WASH VOLUME: 1250mls

EC/RODAC

HARBOUR SEDIMENT PREPARATION DATA SHEET Page 2

SAMPLE ID HARBOUR Alberni Inlet ASL NO. 7600-15

FIELD LABEL Alberni 5 SAMPLE LABEL Alberni #5
Holm Island

Wet Sieving Analyst Irish Date July 13/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0 mm Rejects 7.8%	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm) 100%	>.5 mm Rejects 10.2%	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
Sample + Tare Tare Sample Wt	1283.20 881.75 401.45	48.544 17.047 31.497	16.963	16.908	17.225	881.75 482.12 399.63	57.485 16.892 40.593	16.241	17.356	17.026
Description		rocks, sand, wood					rocks, sand, wood fibre			

Comments:

Initial Container Wt 76.2 Final Container Wt 81.40

Analyse As Is **Hand Blend Wet**

Sample Fraction	Initial	Hand Blend Wet Part Size	Hand Blend Wet Lab	Hand Blend Wet Arc
Sample + Tare Tare Sample Wt	482.12 81.40 400.72	16.932	16.971	17.321

ASL

ESQUIMALT HARBOUR
AND
VICTORIA HARBOUR

PREPARATION NOTES

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID

HARBOUR Esquimalt ASL NO. 7600-16

FIELD LABEL D-Jetty ESQ. Harbor SAMPLE LABEL ESQ#1

PHYSICAL DESCRIPTION

Sediment Texture Fine Odour slight H_2S; Sewagey

Foreign Material chunks of wood + grass Colour Black + Oily

Notes:

Dry wgt
Cond wgt 78.10
+80% 1311.6

Dry Sieving Analyst Ellen Date Aug. 11, 1989

Sieve Fraction	Initial (1.0mm) 100%	>1.0 mm 25.8%	<1.0mm 73.7% Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm) 100%	>.5 mm 42.2%	<0.5mm 57.2% Part Size	<0.5mm Lab	<0.5mm Arc
Sample + Tare	742.71	61.67	69.83	62.10	46.09	565.29	116.12	79.17	60.16	43.49
Tare	565.29	15.95	15.81	15.80	15.65	326.56	15.44	15.69	15.65	14.98
Sample Wt	177.42	45.72	54.02	46.30	30.44	238.73	100.68	63.48	44.57	28.51
			TOTAL	130.76				TOTAL:	136.50	
Description		shells, wood, clay agg., sand, a few pebbles, shiney black particles					same as L1.0 except more shiney black particles			

Comments:

Analyse As Is Dry and Grind

Sample Fraction	Initial	Dry and Grind Part Size	Dry and Grind Lab	Dry and Grind Arc
Sample + Tare	326.56	157.06	77.44	60.78
Tare	78.30	15.76	15.65	15.98
Sample Wt	248.26	141.08	61.79	44.80

WASH
Val: 300 + 250 + 205U

4B → 904-49,

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET Page 2

SAMPLE ID **HARBOUR** _____ **ASL NO.** 7600-16

FIELD LABEL _____ **SAMPLE LABEL** _____

Wet Sieving **Analyst** T.M. **Date** July 17/09

Sieve Fraction	Initial (1.0mm)	>1.0 mm Rej	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm)	>.5 mm Rej	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
	100%	23.9%				100%	35.1%			
Sample + Tare	1318.20	116.23				903.40	161.62			
Tare	903.40	16.942	16.637	17.323	17.093	491.80	17.061	17.354	16.856	16.861
Sample Wt	414.80	99.29				411.60	144.56			
Description		pebbles, sand, shells,					same as L1.0			

Comments: Supernatant clear to settleout. Still turbid @ 6 days.

Initial Container Wt 78.10 Final Container Wt 86.72

Analyse As Is **Hand Blend Wet**

Sample Fraction	Initial	Hand Blend Wet Part Size	Hand Blend Wet Lab	Hand Blend Wet Arc
Sample + Tare	491,80			
Tare	86.72	17 348	17.026	17.325
Sample Wt	405,08			

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID HARBOUR Esq. ASL NO. 7600-17.

FIELD LABEL Centre Esq Harbour SAMPLE LABEL ESQ # 2

PHYSICAL DESCRIPTION

Sediment Texture medium Odour none

Foreign Material few rocks + shells Colour grey

Notes: Dry Wt
spg cond: 77.40
+spg 17190

Dry Sieving Analyst Fuller Date Aug. 14, 1989

Sieve Fraction	Initial (1.0mm)	>1.0 mm	<1.0mm			Initial (0.5mm)	>.5 mm	<0.5mm		
	100%	22.7%	Part Size	Lab	Arc	100%	28.7%	Part Size	Lab	Arc
Sample + Tare	579.46	54.47	80.89	58.25	38.62	408.68	62.14	76.33	49.27	35.67
Tare	408.68	15.69	15.42	15.54	15.57	247.20	15.81	16.13	15.67	15.81
Sample Wt	170.78	38.78	65.47	42.71	23.05	161.48	46.33	60.20	33.60	19.86
			TOTAL:	131.23				TOTAL:	113.66	
Description		clay agg's, couples of tiny shells					same as L1.0			

Comments:

Analyse As Is **Dry and Grind**

Sample Fraction	Initial	Dry and Grind		
		Part Size	Lab	Arc
Sample + Tare	247.20	110.94	62.34	42.75
Tare	78.09	14.99	16.13	15.68
Sample Wt	169.11	95.95	46.21	27.07

TOTAL WASH VOLUME: 1075 mL + 180 925 - 930

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET **Page 2**

SAMPLE ID **HARBOUR** _____ **ASL NO.** 7600-17

FIELD LABEL _____ **SAMPLE LABEL** _____

Wet Sieving **Analyst** I.M. **Date** July 17/89

Sieve Fraction	Initial (1.0mm)	>1.0 mm Rej	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm)	>.5 mm Rej	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
	100%	1.19%				100%	4.5%			
Sample + Tare	1350.12	21.065	16.426	16.881	16.898	928.30	36.179	16.280	17.066	16.926
Tare	928.30	16.230				500.68	16.805			
Sample Wt	421.82	4.835				427.62	19.374			
Description		wood, shell frag, a few pebbles					wood, shell frag, rock, (whole clam)			

Comments: _____

Initial Container Wt 77.40 **Final Container Wt** 81.66

Analyse As Is **Hand Blend Wet**

Sample Fraction	Initial	Hand Blend Wet Part Size	Hand Blend Wet Lab	Hand Blend Wet Arc
Sample + Tare	500.68	17.060	16.237	16.392
Tare	81.66			
Sample Wt	419.02			

EC/RODAC

HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID HARBOUR _____ ASL NO. 7600-18

FIELD LABEL _____ SAMPLE LABEL BG #3

PHYSICAL DESCRIPTION

Sediment Texture fine Odour H2S-4

Foreign Material wood, sticks, rocks Colour Black + oily

Notes: "gunk" present

Dry wt and 79.62 + spl 1431.5

Dry Sieving Analyst Fuller Date Aug. 14, 1989

Sieve Fraction	Initial (1.0mm)	>1.0 mm	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm)	>.5 mm	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
	100%	41.6%	57.9%			100%	46.0%	53.5%		
Sample + Tare	623.24	93.81	71.68	49.64	34.13	436.63	101.42	60.91	49.57	35.70
Tare	436.63	16.12	15.68	15.98	15.67	250.07	15.57	15.81	14.98	15.64
Sample Wt	186.61	77.69	56.00	33.66	18.46	186.56	85.85	45.10	34.59	20.06
			TOTAL:	108.12				TOTAL:	99.75	
Description		shells, clay aggregate, twigs					same as L1.0			

Comments: _____

Analyse As Is **Dry and Grind**

Sample Fraction	Initial	Dry and Grind Part Size	Dry and Grind Lab	Dry and Grind Arc
Sample + Tare	250.07	110.49	58.39	48.41
Tare	79.33	15.67	15.44	15.67
Sample Wt	170.74	94.82	42.95	32.74

TOTAL WASH VOLUME } 3355ml + 190

1003
86.

EC/RODAC

HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID

HARBOUR _____ ASL NO. 7600-18

FIELD LABEL _____ SAMPLE LABEL _____

Wet Sieving Analyst TM Date July 17/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0 mm 33.3% Rej	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm) 100%	>.5 mm 39.7% Rej	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
Sample + Tare	1525.69	163.69	16.326	17.393	17.267	1042.90	194.50	17.296	16.347	16.392
Tare	1042.90	3.15				561.00	3.21			
Sample Wt	482.79	160.54				481.90	191.29			
Description		sand, shells, organics, (hair net)					sand shells organics Mr. Noodle flavour pack.			

Comments: _____

Initial Container Wt 79.62 Final Container Wt 86.3

Analyse As Is **Hand Blend Wet**

Sample Fraction	Initial	Hand Blend Wet Part Size	Hand Blend Wet Lab	Hand Blend Wet Arc
Sample + Tare	561.00			
Tare	86.30	16.263	16.213	17.010
Sample Wt	474.70			

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID HARBOUR Esq ASL NO. 7600-19

FIELD LABEL Point Hope Shipyard VIC SAMPLE LABEL Esq #4

PHYSICAL DESCRIPTION

Sediment Texture fine + coarse bits Odour none

Foreign Material wood + shell fragments Colour Black

Notes: dry wt
corr 79.70
IC spl 1499.31

Dry Sieving Analyst FCller Date Aug. 23, 1989

Sieve Fraction	Initial (1.0mm) 100%	>1.0 mm 26.7%	<1.0mm 72.7% Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm) 100%	>.5 mm 38.0%	<0.5mm 61.5% Part Size	<0.5mm Lab	<0.5mm Arc
Sample + Tare	738.26	72.27	89.60	67.16	43.91	526.49	101.81	67.35	71.44	46.84
Tare	526.49	15.71	15.67	15.57	15.43	300.83	15.98	15.82	15.41	15.67
Sample Wt	211.77	56.56	73.93	51.59	28.48	225.66	85.83	51.53	56.03	31.17
			TOTAL:	154.00				TOTAL:	138.73	
Description	Clay aggregate, wood, bark some shells, a few shiney black particles						same as L1.0 except lots of shiney black particles			

Comments:

Analyse As Is Dry and Grind

Sample Fraction	Initial	Dry and Grind Part Size	Dry and Grind Lab	Dry and Grind Arc
Sample + Tare	300.83	143.38	75.13	49.95
Tare	79.49	15.98	15.80	15.80
Sample Wt	221.34	127.40	59.33	34.15

Took 4 days to dry @ 60 - 70°C to a cake V. fine, V. dark on unexposed surfaces, smelly. Looks high in Organics.

TOTAL WASH VOLUME } 1600 mls + 20s

937,554

EC/RODAC

HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID

HARBOUR _____ ASL NO. 7600-19

FIELD LABEL _____ SAMPLE LABEL _____

Wet Sieving Analyst T.M Date July 18/89

Sieve Fraction	Initial (1.0mm) 100%	>1.0 mm Ref 13.7%	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm) 100%	>.5 mm Ref 28.3%	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
Sample + Tare	1231.10	57.307	16.327	16.966	16.945	936.40	100.40	16.805	16.758	16.309
Tare	936.40	16.913				641.23	16.694			
Sample Wt	294.70	40.394				295.37	83.71			
Description		wood, shells, sand, shiney black flakes					wood, shells sand. shiney black flakes.			

Comments: _____

Initial Container Wt 79.7 Final Container Wt 88.32

Analyse As Is **Hand Blend Wet**

Sample Fraction	Initial	Hand Blend Wet Part Size	Hand Blend Wet Lab	Hand Blend Wet Arc
Sample + Tare	641.23	16.759	16.718	17.393
Tare	88.32			
Sample Wt	552.91			

EC/RODAC
HARBOUR SEDIMENT PREPARATION DATA SHEET

SAMPLE ID HARBOUR Esq. ASL NO. 7600-20
FIELD LABEL Laurel Point SAMPLE LABEL Esq 45

PHYSICAL DESCRIPTION

Sediment Texture Medium Odour Peat
Foreign Material wood + twigs Colour grey-black
Notes:
%H2O
corr 78.32
spl 135.76

Dry Sieving Analyst Ellen Date August 23/89

Sieve Fraction	Initial (1.0mm)	>1.0 mm	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm)	>.5 mm	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
	100%	31.6%	67.9%			100%	37.0%	62.1%		
Sample + Tare	630.68	74.66	76.09	55.53	41.78	444.07	81.41	60.73	57.10	39.12
Tare	444.07	15.65	15.14	15.81	15.71	265.92	15.56	15.14	15.67	15.54
Sample Wt	186.61	59.01	60.95	39.72	26.07	178.15	65.85	45.59	41.43	23.58
			TOTAL:	126.74				TOTAL:	110.60	
Description	Shells, wood, clay aggregate						same as L1.0			

Comments:

Analyse As Is **Dry and Grind**

Sample Fraction	Initial	Dry and Grind Part Size	Dry and Grind Lab	Dry and Grind Arc
Sample + Tare	265.92	121.41	61.48	50.67
Tare	78.51	15.69	15.66	15.00
Sample Wt	187.41	105.72	45.82	35.67

TOTAL WASH VOLUME 475 mL to 490

EC/RODAC

HARBOUR SEDIMENT PREPARATION DATA SHEET Page 2

SAMPLE ID **HARBOUR** _____ **ASL NO.** 7600-20

FIELD LABEL _____ **SAMPLE LABEL** Eq #5

Wet Sieving **Analyst** Jrust **Date** July 18/79

Sieve Fraction	Initial (1.0mm) 100%	>1.0 mm 6.8%	<1.0mm Part Size	<1.0mm Lab	<1.0mm Arc	Initial (0.5mm) 100%	>.5 mm 10.5%	<0.5mm Part Size	<0.5mm Lab	<0.5mm Arc
Sample + Tare Tare Sample Wt	1247.00 857.21 389.79	43.393 17.078 26.315	16.744	16.756	16.921	857.21 466.25 390.96	57.773 16.856 40.917	16.898	16.879	16.823
Description		wood fibre, shells					wood fibre, shells			

Comments: _____

Initial Container Wt 78.829 Final Container Wt 113.60

Analyse As Is **Hand Blend Wet**

Sample Fraction	Initial	Hand Blend Wet Part Size	Hand Blend Wet Lab	Hand Blend Wet Arc
Sample + Tare Tare Sample Wt	466.25 113.60 352.65	16.870	16.973	16.805