

## 7. SEDIMENT QUALITY AND BENTHIC SURVEY

### Introduction

- 7.1 The EIA Study predicts that the Project would not induce adverse effect on sediment deposition pattern, sediment quality and benthos habitats. In order to verify the findings of the EIA Study, a monitoring programme for the sediment quality and benthic ecology is proposed.
- 7.2 The recommended monitoring programme for the sediment quality and benthic ecology aims to achieve the following objectives:
- To check whether the Project would cause an increase in chlorination by-product (CBP) concentrations in sediment
  - To check whether the Project would induce changes in benthic community structure
- 7.3 The details of the recommended sediment quality and benthic survey are presented below.

### Sediment Quality Monitoring

#### Monitoring Locations

- 7.4 It is recommended to set up 8 monitoring stations (4 near field, 2 mid field and 2 far field) with their indicative locations as shown in [Figure 7.1](#). The coordinates of the proposed monitoring stations (indicative) are listed in [Table 7.1](#). The exact locations of the sediment quality monitoring stations should be determined in advance of the baseline monitoring and agreed with the Environmental Consultant and approved by EPD and DSD.

**Table 7.1 Proposed Sediment Quality Monitoring Station**

Station	Description	Easting	Northing
Near Field Stations			
1	Edge of Mixing Zone (northwest of effluent diffuser)	829762.00	819604.47
2	Edge of ZID (northwest of effluent diffuser)	830117.99	819251.93
3	Edge of ZID (southeast of effluent diffuser)	830186.21	819184.37
4	Edge of Mixing Zone (southeast of effluent diffuser)	830525.00	818848.87
Mid Field Stations			
WS1	EPD Sediment Monitoring Station	820118.17	828048.67
VS6	EPD Sediment Monitoring Station	817473.60	832495.44
Far Field Stations			
SS3	EPD Sediment Monitoring Station	805902.89	826179.81
SS4	EPD Sediment Monitoring Station	810037.23	825718.54

- 7.5 To provide sufficient data for analysis, it is recommended to collect at least eight replicates of composite samples (i.e. 5 grab samples obtained using a cluster grab) at each monitoring station. The Environmental Consultant shall review the number of replicates by statistical power analysis after the first session of baseline sediment quality monitoring.

### **Monitoring Schedule**

- 7.6 For baseline monitoring, sediment sampling shall be performed two times over a year before commissioning of the Project to give adequate coverage of both wet and dry seasons. Similarly, for operation phase monitoring, sediment sampling shall be performed two times over the first year of Project operation to give adequate coverage of both wet and dry seasons.

### **Sediment Sampling Equipment**

#### Sampler

- 7.7 At each sediment monitoring station, the top 5cm of seabed sediment should be collected using a 5-component cluster grab sampler which collects surficial sediments with a minimal disruption to the surface layer. The sediment sampler and all other utensils should be rinsed with seawater after each sample has been collected to avoid cross contamination between samples.

#### Monitoring Position Equipment

- 7.8 A hand-held or boat-fixed type digital Differential Global Positioning System (DGPS) with way point bearing indication or other equipment instrument of similar accuracy, shall be provided and used during sediment sampling to ensure the sampling vessel is at the correct location before taking sediment samples.

### **Sample Storage**

- 7.9 Sediment sample collected by the five-cluster grab should be combined, stored and preserved in suitable and clean containers according to the Standard Methods, and packed in ice (cooled to 4 °C without being frozen) and delivered to the laboratory and analysed within 24 hours after collection.

### **Monitoring Parameters**

- 7.10 The list of parameters to be analyzed in collected sediment samples are presented in **Table 7.2**. Prior to the baseline monitoring, the analytical method and detection limit for various parameters shall be proposed by the Monitoring Team, and approved by the Environmental Consultant.

**Table 7.2 Parameters to be Analyzed in Collected Sediment Samples**

<b>Parameter (TRC and Potential CBPs)</b>		<b>Other Parameter</b>
Bromoform	2-chlorophenol	Percentage of sand / silt / clay
Bromodichloromethane	2,4-dichlorophenol	pH
Chloroform	p-chloro-m-cresol	Acid volatile sulphides
Dibromochloromethane	Pentachlorophenol	Total volatile solids
Methylene chloride	2,4,6-trichlorophenol	Total organic carbon
Carbon tetrachloride	Bis(2-chloroethoxy)methane	
Chlorobenzene	1,4-dichlorobenzene	
1,1-dichloroethane	Hexachlorobenzene	
1,2-dichloroethane	Hexachlorocyclopentadiene	
1,1-dichloroethylene	Hexachloroethane	
1,2-dichloropropane	1,2,4-trichlorobenzene	
Tetrachloroethylene	Alpha-BHC	
1,1,1-trichloroethane	Beta-BHC	
1,1,2-trichloroethane	Gamma-BHC	
Trichloroethylene		

- 7.11 Total residual chlorine and haloacetic acids (bromoacetic acid, chloroacetic acid, dibromoacetic acid, dichloroacetic acid, trichloroacetic acid) are not included in the sediment analysis because there is no available standard extraction and testing method for analyzing these chemical species in sediment. Also, these chemical species have low Kow (octanol-water partition coefficient) value, indicating that

they will be mostly dissolved in water rather than adsorbed to sediment particles. Hence, it would be very unlikely for the Project to induce increase of TRC and haloacetic acids concentration in sediment.

#### ***Laboratory Measurement / Analysis***

- 7.12 Analysis of parameters shall be carried out in a HOKLAS or other international accredited laboratory. Detailed testing methods, pre-treatment procedures, instrument to be used, Quality Assurance/Quality Control (QA/QC) details (such as blank, spike recovery, number of duplicate samples per batch, etc.), detection limits and accuracy shall be submitted to the Environmental Consultant for approval. If in-house or non-standard methods are proposed, details of the method verification shall be required to submit to the Environmental Consultant. In any circumstance, the sample testing shall have comprehensive quality assurance and quality control programmes. The laboratory shall prepare to demonstrate the programmes to Environmental Consultant or his representatives when requested.

#### ***Statistical Analysis of Monitoring Data***

- 7.13 After the data of the first session of baseline sediment quality monitoring has been obtained, a statistical power analysis shall be conducted to verify and review the number of replicates required for subsequent baseline and operation phase monitoring sessions.
- 7.14 The monitoring data (TRC/CBP concentrations in sediment and other parameters) should be analyzed using analysis of variance techniques or other appropriate statistical techniques to test for differences between sampling locations. Once a time series of data (sequential sampling events) has been gathered, difference should be tested between the stations and between the different sampling events to examine any temporal trends in TRC/CBP concentrations in sediment. The statistical analysis of monitoring data would provide information to identify any difference of TRC/CBP concentration in sediment in spatial and temporal terms.
- 7.15 Should significant increase be detected in the TRC/CBP concentrations in sediment, a review of the other monitoring parameters shall be undertaken. Assessment of the statistical significance of the data, confidence in the data and the presence of supporting data from other components (e.g. effluent and marine water quality monitoring) of the monitoring programme should be jointly assessed.

### **Benthic Survey**

#### ***Monitoring Locations***

- 7.16 The monitoring locations for benthic survey shall be same as the sediment quality monitoring stations.
- 7.17 To provide sufficient data for analysis, it is recommended to collect at least eight replicates of samples at each monitoring station. The Environmental Consultant shall review the number of replicates by statistical power analysis after the first session of baseline benthic survey.

#### ***Monitoring Schedule***

- 7.18 For baseline and operation phase monitoring, sampling for benthic survey shall be performed in parallel with the sediment sampling described above.

#### ***Benthic Sampling Equipment and Procedures***

##### Benthic Sampler

- 7.19 At each benthic survey station, seafloor sampling shall be carried out with a modified Van Veen grab sampler (dimensions 0.3m x 0.32m x 0.16m). One subsample of approximately 1kg sediment shall be collected from each sample for analysis of percentage of sand/silt/clay in sediment. The grab and all other utensils should be rinsed with seawater after each sample has been collected to avoid cross contamination between samples.

### Sampling Procedures

- 7.20 Collected samples shall be labelled and sieved through a 0.5mm sieve; all residues and organisms shall be retained, doubled-bagged and preserved in 4% buffered formalin in seawater. A vital stain shall be added to distinguish organic materials and organisms from other non-living residues. The preserved samples shall be transferred to the laboratory for benthic organisms sorting and identification.

### **Survey Parameters**

- 7.21 The collected benthic sediment samples shall be analyzed for the following parameters:
- Percentage of sand/silt/clay in sediment
  - Faunal abundance
  - Faunal biomass
  - Species composition
  - Benthic community structure

### **Laboratory Measurement / Analysis**

- 7.22 Sorting and identification of benthic organisms as well as the analysis of other parameters shall be carried out in laboratory. Detailed pre-treatment procedures, organisms sorting and identification techniques, instrument use, Quality Assurance/Quality Control (QA/QC) details, detection limits and accuracy etc. shall be submitted to the Environmental Consultant for approval prior to the commencement of monitoring programme. If in-house or non-standard methods are proposed, details of the method verification shall be required to submit to Environmental Consultant. In any circumstance, the sample testing shall have comprehensive quality assurance and quality control programmes. The laboratory shall prepare to demonstrate the programmes to Environmental Consultant or his representatives when requested.

### **Statistical Analysis of Monitoring Data**

- 7.23 After the data of the first session of baseline benthic survey has been obtained, a statistical power analysis shall be conducted to verify and review the number of replicates required for subsequent baseline and operation phase survey sessions.
- 7.24 The monitoring data should be analyzed by univariate analysis (e.g. using analysis of variance techniques) and multivariate analysis (e.g. using multi dimensional scaling technique) where appropriate to test for differences between sampling locations. Once a time series of data (sequential sampling events) has been gathered, difference should be tested between the stations and between the different sampling events to examine any temporal trends in benthic community structure. The statistical analysis of monitoring data would provide information to identify any difference of benthic community structure in spatial and temporal terms.