Environmental Statement

7 Sediment Quality

7 Sediment Quality

7.1 Introduction

This chapter of the Environmental Statement (ES) concerns the quality of the seabed sediments and how it could be affected by Eastside. Although no specific issues were raised in the Town Planner's Scoping Opinion (Government of Gibraltar (GoG), 2005 - see Appendix A), dredging and marine works can affect marine sediment and give rise to impacts on the environment in the following ways:

- Disturbance of contaminants into the water column; and
- Deposition of contaminants onto the seabed.

Both of the above impacts relate to dredging activities during the construction phase of the project. One of these impacts really concerns water quality but has been considered in this chapter because the marine sediment and its disturbance is the source and cause of this potential impact.

No impacts have been identified for sediment quality for the operational phase of Eastside. Potentially polluting discharges from the operation of Eastside are considered in Chapter 6 on Water Quality.

7.2 Assessment Methodology

7.2.1 Baseline Environmental Survey

A sediment quality survey was conducted to ascertain the physical and chemical properties of the seabed. The survey area comprised the site of Eastside, coastal areas to the north into Spain, coastal areas to the south as far as Europa Point, and potential offshore borrow areas.

In total, 40 sediment samples were collected from the seabed's surface using a van Veen grab sampler. Of the 40 samples taken, three were retained as individual samples representing the seabed around Eastside. The remaining the 37 samples were mixed to create composite samples representing the seabed east of Eastside, the coastal areas to the north and south, and the potential borrow areas. In total, 13 individual and composite samples were derived, as identified in Table 7.1.

The samples were analysed for metals, polychlorinated biphenyls (PCBs), petroleum hydrocarbons, poly-aromatic hydrocarbons (PAHs), tributyl-tin (TBT), phenols and total cyanide (see Table 7.2). Analyses were carried out by a National Measurement Accreditation Service (NAMAS) / UK Accreditation System (UKAS) accredited laboratory.

Analyses for metals, PCBs, hydrocarbons, PAHs and TBT were included since these are the principal contaminants associated with marine sediments.

Analyses for phenols and total cyanide were included as indicators of potential contamination from the rubble tip.

The sediment samples were also subjected to other analyses (e.g. total organic carbon (TOC) content) to inform the impact assessments where appropriate.

Table 7.1 Schedule of Samples for Sediment Quality Laboratory Analysis

Sample No.	Sample Type	Sample Positions	Seabed Area Description
1	Composite	1, 2, 3, 4 and 5	Coastal area, Spain
2	Composite	6, 7 and 8	Coastal area, Eastern Beach / airport
3	Individual	11	Coastal area, Eastside Development
4	Individual	13	Coastal area, Eastside Development
5	Individual	14	Coastal area, Eastside Development
6	Composite	9, 12, 16, 17 and 18	Coastal area, Eastside Development
7	Composite	19, 20 and 21	Coastal area, Sandy Beach
8	Composite	23, 24 and 25	Coastal area, Governor's Bay
9	Composite	27, 28 and 29	Coastal area, Windhill Beach to Great Europa Point
10	Composite	15, 31, 32, 33 and 34	Northern borrow area
11	Composite	35, 36 and 37	Northern borrow area
12	Composite	22, 26 and 39	Southern borrow area
13	Composite	30, 38 and 40	Southern borrow area

7.2.2 *Modelling Approach – Sediment Plumes*

As described in Section 6.2, the sediment plumes released from dredging and reclamation activities have been simulated using the Delft3D flow model developed as part of this study (see Appendix B). The flow model has been linked with the Delft3D morphological module Delft3D-Online Morphology to include the processes of sediment dispersion, taking into account advection, diffusion and dispersion processes (see Section7, Appendix D). The modelling produces a set of plots showing isolines of the maximum concentrations (in mg/l) of total suspended solids.

7.2.3 *Modelling Approach – Sediment Deposition*

As described in Section 6.2, the sediment deposition due to dredging and reclamation activities have been simulated using the Delft3D flow model developed as part of this study (see Appendix B). The flow model has been linked with the Delft3D morphological module Delft3D-Online Morphology to include the processes of sediment dispersion, taking into account advection, diffusion and dispersion processes (see Section7, Appendix D). The modelling produces a set of plots showing isolines of the maximum thickness (in m) of sediment deposition.

Table 7.2 Schedule of Laboratory Analyses

Parameter	Units	Detection Limits
TOC	%	1%
Arsenic	mg/kg	0.1mg/kg
Cadmium	mg/kg	0.02mg/kg
Chromium	mg/kg	0.1mg/kg
Copper	mg/kg	0.05mg/kg
Mercury	mg/kg	0.01mg/kg
Nickel	mg/kg	0.1mg/kg
Lead	mg/kg	0.05mg/kg
Zinc	mg/kg	0.1mg/kg
PCBs (28, 52,101, 118, 138, 153, 180)	mg/kg	0.0002mg/kg
Petroleum hydrocarbons (GROs)	mg/kg	None specified
PAHs (US EPA 16)*	mg/kg	0.0001mg/kg
TBT	mg/kg	<0.002mg/kg
Phenols	mg/kg	None specified
Total cyanide	mg/kg	<5mg/kg

** A standard suite of tests for PAHs, the US Environmental Protection Agency 16 = Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(ah)anthracene, Benzo(ghi)perylene, Indeno (123-cd)pyrene.*

7.2.4 Assessment Methodology – Sediment Quality Criteria

Impacts were assessed by comparing baseline survey data to established sediment quality standards and/or published research. There are no quantified environmental quality standards (EQSs) defining in situ quality for Gibraltar, European Union (EU) or United Kingdom (UK) sediments. At an EU level, guidance is given only for the substances under the European Commission (EC) Dangerous Substances Directive List I as 'standstill (no deterioration)'.

Without quantified Gibraltar, EU or UK standards, the following guidelines (i.e. assessment criteria) from other sources have therefore been used to assess the level of contamination present in the seabed sediments and the potential impact on receptors:

- Sediment quality guideline action levels for assessing the disposal of dredged material at sea in the UK (Centre for Environment, Fisheries and Aquaculture Science (CEFAS));
- Sediment quality criteria for the management of dredged material from Spanish ports (Centre for Studies and Experimentation on Public Works' (CEDEX)); and
- Canadian sediment quality guidelines for the protection of aquatic life (Canadian Council of Ministers of the Environment (CCME)).

CEFAS's action levels (see Table 7.3) are non-statutory criteria used by the UK's Department of the Environment, Food and Rural Affairs (DEFRA) as part of a weight-of-

evidence approach to licensing the disposal of dredged material at sea under the Food and Environment Protection Act 1985. The Action Levels act as potential triggers for further assessment and do not constitute pass or fail criteria. In this context, licence refusal is unlikely if contaminant concentrations are below Action Level 1 and likely if contaminant concentrations are above Action Level 2, and further assessment may be required if contamination concentrations are between Action Levels 1 and 2.

CEDEX's sediment quality criteria (see Table 7.3) aim to control the management of dredged material in Spanish waters. Sediment with <10% fine fraction (<63μm) are regarded as clean. Sediment with >10% fine fraction require chemical characterisation with regard to the sediment quality criteria identified in Table 7.3. Sediment where concentrations are below Action Level 1 can be disposed of at sea. Sediment where concentrations are between Action Levels 1 and 2 can be disposed of at sea subject to impact assessment and monitoring. Sediment where concentrations are above Action Level 2 cannot be disposed of at sea unless treated (IADC/CEDA, 1997).

Table 7.3 International Sediment Quality Guidelines *(All units in mg/kg)*

Statistic	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	ΣPAHs (US EPA 16)	Σ7PCBs	Petroleum Hydrocarbons	TBT
CEFAS (UK) Action Levels for the Disposal of Dredged Material at Sea												
CEFAS Action Level 1	10	0.2	20	20	25	0.15	10	65	-	0.01	100	0.1
CEFAS Action Level 2	25-50	2.5	200	200	250	1.5	100	400	-	-	-	1
CEDEX (Spain) Action Levels for the Disposal of Dredged Materials at Sea from Spanish Ports												
CEDEX Action Level 1	80	1	200	100	120	0.6	100	500	-	0.03	-	-
CEDEX Action Level 2	200	5	1000	400	600	3	400	3000	-	0.1	-	-
Canadian Sediment Quality Guidelines for the Protection of Aquatic Life												
Canadian TEL	7.24	0.7	52.3	18.7	30.2	0.13	-	124	-	0.0215	-	-
Canadian PEL	41.6	4.2	160	108	112	0.7	-	271	-	0.189	-	-

The CCME's Canadian sediment quality guidelines (see Table 7.3) are derived from scientific information on the biological effects of sediment-associated chemicals, including acute and chronic toxicological effects identified by laboratory tests and subtler effects identified by

field surveys. The guidelines provide scientific benchmarks to be used as a basis for evaluating the toxicological significance of sediment chemistry data, and "thus to identify and focus the cleanup of contaminated sites, to predict the impacts of activities from various sectors on the aquatic environment, and to evaluate the effectiveness of proposed or existing site management strategies in protecting the aquatic environment" (CCME, 1999).

The Canadian sediment quality guidelines for the protection of aquatic life constitute threshold effect levels (TELs) and probable effect levels (PELs) that indicate in situ sediment quality with respect to biological effects. The two levels form three biological effects ranges for chemical contaminants as follows:

- Minimal effect range below the TEL where adverse biological effects occur rarely;
- Possible effect range between the TEL and PEL where adverse biological effects occur occasionally; and
- Probable effect range above the PEL where adverse biological effects occur frequently.

The TEL also acts as an interim sediment quality guideline (ISQG) level (CCME, 1999).

Cole et al (1999) recommend that "in the absence of any UK standards, these guidelines can be used as a first approximation in assessing whether organisms are at risk from sediment concentrations of toxic substances." Table 7.3 shows the TELs and PELs for metals. Nickel is not included under the Canadian guidelines.

7.2.5 *Assessment Methodology – Water Quality Criteria*

The EC Dangerous Substances Directive was adopted in 1976 to control pollution caused by certain dangerous substances on the aquatic environment. The Directive established List I substances, which are regarded as particularly dangerous because of their toxicity, persistence and bioaccumulation. Pollution by these substances must be eliminated. List II substances are regarded as less dangerous but have a deleterious effect on the aquatic environment; input of these substances must be reduced.

The Dangerous Substances Directive stipulates uniform emission standards (UESs, also known as limit values) and environmental quality standards (EQSs) as approaches for the control of List I substances. For List II substances, all member states are required to establish EQSs on a national level. EQSs for List I and List II substances have been implemented in the UK and are shown on Tables 7.4 and 7.5 respectively. These EQSs for List I and List II substances form the impact assessment criteria for water quality concerning dangerous substances.

Table 7.4 Selected List I Dangerous Substances*

Substance	EQS Type	Estuarine EQS (annual average, µg/l)
Mercury (dissolved)	Annual average	0.5
Cadmium (dissolved)	Annual average	5

** EQS List I taken from www.environment-agency.gov.uk, **Total concentration (i.e. without filtration) unless specified, *** all HCH isomers, including Lindane*

Table 7.5 Selected List II Dangerous Substances*

Substance	EQS Type	Estuarine EQS (annual average, µg/l)
Arsenic (dissolved)	Annual average	25
Chromium (dissolved)	Annual average	15
Copper (dissolved)	Annual average	5
Lead (dissolved)	Annual average	25
Nickel (dissolved)	Annual average	30
Tributyl tin	Maximum concentration	0.002
Zinc (total)	Annual average	40

**The full EQS List II is available on www.environment-agency.gov.uk*

7.2.6 *Impact Significance*

In order to provide a consistent framework for considering and evaluating impacts, the following terminology has been adopted:

- Negligible - the impact is not of concern;
- Minor adverse - the impact is undesirable but of limited concern;
- Moderate adverse - the impact gives rise to some concern but it is likely to be tolerable (depending on its scale and duration);
- Major adverse - the impact gives rise to serious concern; it should be considered as unacceptable unless unavoidable by best practicable means;
- Minor beneficial - the impact is of minor significance but has some environmental benefit;
- Moderate beneficial - the impact provides some gain to the environment; and
- Major beneficial - the impact provides a significant positive gain.

7.3 Baseline Conditions

7.3.1 *Survey Data*

A full version of the survey data collected during the EIA process and used to inform the baseline environmental conditions are presented in Appendix E to this ES.

7.3.2 *Chemical Conditions*

A summary of the survey data for a range of contaminants (metals, PCBs, petroleum hydrocarbons (as GROs), PAHs, and TBT) is given in Table 7.6.

The survey recorded concentrations of all metals, PAHs and petroleum hydrocarbons (although some results for mercury and petroleum hydrocarbons were below the analytical detection limit), suggesting that the baseline environment exhibits concentrations of these parameters at levels that can be considered to be above uncontaminated environmental conditions.

The survey recorded concentrations of summed PCBs and TBT below the analytical detection limit (with the exception of one TBT result), suggesting that the baseline environment does not exhibit elevated concentrations of these parameters.

The survey data are compared against three international sediment quality guidelines to inform the baseline environment conditions, particularly for the parameters present in elevated concentrations. The comparisons are presented in Table 7.6.

Compared against the CEFAS Action Levels applied in the UK, the sediment contains contaminants at concentrations that are generally below Action Level 1 with the exception of chromium and nickel which are at concentrations between Action Levels 1 and 2.

Therefore, the data suggest that the contaminants present in the sediment are sufficiently low such that an application for a licence to dispose of the sediment (as dredged material) at sea is likely to be successful (in terms of contaminants).

Compared against the CEDEX Action Levels applied in Spain, the sediment contains contaminants at concentrations that are all below Action Level 1. Therefore, the data suggest that the contaminants present in the sediment are sufficiently low such that the sediment (as dredged material from a Spanish port) could be disposed of at sea (in terms of contaminants).

Compared against the sediment quality guidelines applied by the CCME in Canada, the sediment contains contaminants at concentrations that are generally below the TEL with the exception of arsenic which is at concentrations between the TEL and PEL. Therefore, the data suggest that the contaminants in the sediment are sufficiently low such that they are in the minimal effect range where adverse biological effects occur rarely.

Table 7.6 Statistical Summary of Sediment Data and Comparison against International Sediment Quality Guidelines

Statistic	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	ΣPAHs (US EPA 16)	Σ7PCBs	Petroleum Hydrocarbons	TBT
Statistical Summary of Sediment Data												
No. samples	13	13	13	13	13	13	13	13	13	13	13	13
Min (mg/kg)	7.82	0.015	22.334	3.55	3.67	<0.005	46.478	14.88	0.009	<0.0001	<1	<0.001
Max (mg/kg)	12.017	0.051	47.047	23.890	39.806	0.042	90.567	71.072	0.324	<0.0001	4.7	<0.031
Median (mg/kg)	9.252	0.019	33.574	5.685	7.928	<0.005	72.34	22.975	0.141	<0.0001	<0.1	<0.001
Comparison against CEFAS (UK) Action Levels for the Disposal of Dredged Material at Sea												
No. samples < CEFAS Action Level 1	9	13	0	12	12	13	0	12	n/a	13	13	13
No. samples CEFAS Action Level 1 - 2	4	0	13	1	1	0	13	1	n/a	0	0	0
No. samples > CEFAS Action Level 2	0	0	0	0	0	0	0	0	n/a	0	0	0
Comparison against CEDEX (Spain) Action Levels for the Disposal of Dredged Materials at Sea from Spanish Ports												
No. samples < CEDEX Action Level 1	13	13	13	13	13	13	13	13	n/a	13	n/a	n/a
No. samples CEDEX Action Level 1 - 2	0	0	0	0	0	0	0	0	n/a	0	n/a	n/a
No. samples > CEDEX Action Level 2	0	0	0	0	0	0	0	0	n/a	0	n/a	n/a
Comparison against Canadian Sediment Quality Guidelines for the Protection of Aquatic Life												
No. samples < Canadian TEL	0	13	13	12	12	13	n/a	13	n/a	13	n/a	n/a
No. samples Canadian TEL - PEL	13	0	0	1	1	0	n/a	0	n/a	0	n/a	n/a
No. samples > Canadian PEL	0	0	0	0	0	0	n/a	0	n/a	0	n/a	n/a

7.4 Predicted Impacts

7.4.1 Construction Phase: Impact on Water Quality due to Sediment Disturbance

Dredging for Eastside has the potential to disturb and release sediment-bound chemical contaminants into the overlying water column. This effect could increase concentrations in coastal waters and affect water quality with regard to EQSs required by the EC Dangerous Substances Directive (see Tables 7.4 and 7.5).

To assess the potential impact on compliance with the EQSs, a sediment-water partitioning approach has been used. This approach assumes that the critical factor in sediment toxicity is the concentration of the contaminant in the interstitial water. The potential impact is assessed by identifying whether contaminant concentrations in the in situ sediment could cause concentrations in the interstitial water that exceed the water quality criteria (i.e. the EQSs for contaminants as identified by the EC Dangerous Substances Directive). The assessment uses sediment criteria derived from equilibrium partitioning to provide concentrations that may be considered as environmentally safe concentrations - that is, where contaminant concentrations in a seabed sediment's interstitial water are less than the EQSs, they are not expected to cause an impact on the quality of the overlying water. The sediment criteria are calculated using published partition coefficients (Webster and Ridgway, 1994). These express the relationship between the contaminant concentration in the sediment and the surrounding water and are referred to as K_{oc}. The sediment concentration above which the EQS would be exceeded in the water column is referred to as the C_{sed} and is calculated using the following equation $C_{sed} = K_{oc}.EQS.TOC$ where TOC is total organic carbon of the sediment sample. C_{sed} values are then compared to measured sediment concentrations and if C_{sed} are exceeded, there is the potential for an EQS to be exceeded.

K_{oc} are derived for a selected number of contaminants where the necessary information is available and where most survey results have recorded a value above detection limits. The mean TOC for the seabed is very low at 0.11%. Table 7.7 summarises these values and calculates the sediment concentration likely to cause a breach in the EQS for the overlying water. Values are then compared to actual mean sediment concentrations in Table 7.7.

The comparison in Table 7.8 shows that no median values and no minimum to maximum values exceed the assessment criteria. Accordingly, it is predicted that sediment disturbance due to the dredging and marine works for Eastside will have no impact on water quality in terms of exceeding EQSs under the EC Dangerous Substances Directive.

Table 7.7 Sediment Levels (C_{sed}) Derived from Equilibrium Partitioning

Substance	EQS (µg/l)	K_{oc} (Webster & Ridgway 1994)	TOC (%)	C_{sed} (mg/kg)
Arsenic (dissolved)	25	13,000	0.11	35.75
Chromium (dissolved)	2.5	64,000	0.11	17.6
Copper (dissolved)	5	1,700,000	0.11	935
Lead (dissolved)	25	380,000	0.11	1045
Mercury (dissolved)	0.3	8,000	0.11	0.264
Zinc (total)	40	330,000	0.11	1452

Table 7.8 Comparison of Sediment Criteria to Sediment Survey Results

Substance	C_{sed} Criteria (mg/kg)	C_{sed} Baseline Survey, Median Values (mg/kg)	C_{sed} Baseline Survey, Min – Max Values (mg/kg)
Arsenic (dissolved)	35.75	9.252	7.82 - 12.017
Chromium (dissolved)	17.6	0.019	0.015 – 0.051
Copper (dissolved)	935	5.685	3.55 – 23.89
Lead (dissolved)	1045	7.928	3.67 - 39.806
Mercury (dissolved)	0.264	<0.005	<0.005 – 0.042
Zinc (total)	1452	22.975	14.88 – 71.072

7.4.2 Impact on Sediment Quality due to Sediment Deposition

Dredging and associated marine works (e.g. land reclamation and rock armouring) can cause large-scale releases of sediment into the water column, causing sediment transport and deposition on the seabed. Sediment deposition can alter the chemical properties of the sediment, such as contamination levels, and can have indirect impacts on the marine ecological receptors exposed to it. Following numerical modelling (see Appendix D), the deposition thickness of sediment plumes has been described and assessed in Section 5.4 of the ES for a range of worst case scenarios. The impact assessment for sediment quality is based on the findings for sediment deposition which – in summary – identify the following:

- Dredging and marine works around Eastside generate localised sediment deposition around Eastside above 0.1m (see Figures 5.11 and 5.12);
- Dredging at the northern borrow area generates localised sediment deposition around the borrow area above 0.1m and wider sediment deposition of less than 0.1m (see Figure 5.11); and

- Dredging and marine works around Eastside generate localised sediment deposition above 0.1m around the southern borrow area and wider sediment deposition of less than 0.1m (see Figure 5.12).

The chemical contaminants in the seabed sediments are described in Section 7.3. A comparison of the baseline sediment survey data with various assessment criteria indicates that some contaminants are present, but at levels that are generally below the lowest sediment quality criteria established by CEFAS, CEDEX and CCME. Accordingly, the magnitude of contamination in the sediment is low.

As shown in Table 7.4, the ranges of survey results for the 13 samples (from the minimum to the maximum concentrations) tend to be distributed within the same CEFAS Action Level, CEDEX Action Level or Canadian guideline. This indicates that, even with the sediment deposition associated with dredging and marine works for Eastside, the redistribution of sediments will only have a negligible impact on the contaminant concentrations within the seabed areas predicted to be affected by sediment deposition. That is, the deposition of sediment released from the northern borrow area (represented by samples 10 and 11) and the southern borrow area (represented by samples 12 and 13) will have a negligible effect on the sediment quality of the seabed subject to deposition, irrespective of the deposition point along the east coast of Gibraltar (represented by samples 2 to 13) and Spain (represented by sample 1), if that change is compared to the CEFAS, CEDEX and/or Canadian sediment quality assessment criteria.

7.4.3 *Operation Phase*
No impacts have been identified for sediment quality for the operational phase of Eastside.

7.5 Mitigation Measures

7.5.1 *Construction Phase: Impact on Water Quality due to Sediment Disturbance*
No impact on water quality has been identified and so no mitigation measures are recommended.

7.5.2 *Construction Phase: Impact on Sediment Quality due to Sediment Deposition*
A negligible impact on sediment quality has been predicted and so no mitigation measures are recommended for sediment quality.

7.5.3 *Operational Phase: Impact on Sediment Quality due to Sediment Deposition*
No impacts have been identified and so no mitigation measures are required.

7.6 Residual Impacts

7.6.1 *Construction Phase: Impact on Water Quality due to Sediment Disturbance*
There will be no residual impact.

7.6.2 *Construction Phase: Impact on Sediment Quality due to Sediment Deposition*
There will remain a residual negligible impact.

7.6.3 *Operation Phase:*
No impacts have been identified for sediment quality for the operational phase of Eastside and so there will be no residual impacts.

7.7 Cumulative Effects

7.7.1 *Cumulative Effect on Water Quality due to Sediment Disturbance*
The cumulative effect of Eastside in combination with other plans or projects (see Section 4.10) has been assessed for water quality due to sediment disturbance by using the same approach as described in Sections 6.7 and 7.4.

As described in Section 6.7, the Both Worlds Project is not expected to involve dredging and reclamation that coincides with the dredging and reclamation for Eastside, and therefore no cumulative effect is predicted as a result of sediment plumes.

Accordingly, no mitigation measures are recommended and therefore there will be no residual cumulative effect.

7.7.2 *Cumulative Effect on Sediment Quality due to Sediment Deposition*

The cumulative effect of Eastside in combination with other plans or projects (see Section 4.10) has been assessed for sediment deposition by using the same approach as described in Sections 5.7 and 7.4.

As described in Section 5.7, the Both Worlds Project is not expected to involve dredging and reclamation that coincides with the dredging and reclamation for Eastside, and therefore no cumulative effect is predicted.

Accordingly, no mitigation measures are recommended and therefore there will be no residual cumulative effect.

7.8 Transboundary Effects

7.8.1 *Transboundary Effect on Water Quality due to Sediment Disturbance*

The transboundary effect of Eastside has been assessed for water quality due to sediment disturbance by using the same approach as described in Sections 6.8 and 7.4.

As described in Section 6.8, the proposed dredging and other works will generally create short-term (i.e. 2 weeks for sc1 and seven weeks for sc2) increases to TSS concentrations in the coastal waters off Spain. Therefore, dredging for Eastside has the potential to disturb and release sediment-bound chemical contaminants into the overlying water column, which could increase concentrations in coastal waters and affect water quality with regard to EQSs required by the EC Dangerous Substances Directive (see Tables 7.4 and 7.5). The EQSs are relevant for this assessment since Spain is a member state of the European Union so the EC Dangerous Substances Directive is applicable.

To assess the potential impact on compliance with the EQSs, a sediment-water partitioning approach has been used (see Section 7.4). Since Spain is a member state to the European Union where the EC Dangerous Substances Directive is applied, the comparison in Table 7.8 is valid for this transboundary effect assessment.

The comparison in Table 7.8 shows that no median values and no minimum to maximum values exceed the assessment criteria. Accordingly, it is predicted that sediment disturbance due to the dredging and marine works for Eastside will have no transboundary effect on water quality in Spanish waters in terms of exceeding EQSs under the EC Dangerous Substances Directive.

No mitigation measures are recommended and there will be no residual transboundary effect.

7.8.2 *Transboundary Effect on Sediment Quality due to Sediment Deposition*

The transboundary effect of Eastside has been assessed for sediment deposition by using the same approach as described in Sections 5.8 and 7.4.

As described in Section 5.8, the model predicts that for sc2a (dredging at the northern borrow area), the expected maximum thickness of deposited sediment is above 0.1m just across the border in water depths of around 15m. This is due to the relatively high sediment release rates during dredging for seven weeks using a THSD (see Figure 5.11). Deposition is

not significant further into Spanish water. Therefore, dredging and associated marine works for Eastside can cause large-scale releases of sediment into the water column, causing sediment transport and deposition on the seabed. Sediment deposition can alter the chemical properties of the sediment, such as contamination levels, and can have indirect impacts on the marine ecological receptors exposed to it.

For the same reasons described in Section 7.4, the redistribution of sediments due to Eastside will only have a negligible impact on the contaminant concentrations within the seabed areas predicted to be affected by sediment deposition due to dredging at the northern borrow area (see Figure 5.11). That is, deposition of sediment released from the northern borrow area (represented by samples 10 and 11) will have a negligible change to the sediment quality of the Spanish seabed subject to deposition (represented by sample 1), if that change is compared to the CEFAS, CEDEX and/or Canadian sediment quality assessment criteria. Deposition of sediment released from the southern borrow area (represented by samples 12 and 13) will have no impact to the sediment quality of the Spanish seabed because no deposition due to this activity will occur on the Spanish seabed (see Figure 5.12).

No mitigation measures are recommended and there will be a residual negligible transboundary effect due to sediment deposition following dredging at the northern borrow area and no residual transboundary effect due to sediment deposition following dredging at the southern borrow area.

7.9 Uncertainty

The results of the modelling studies are valid given the applied assumptions and conditions. It should be noted, however, that when there is a significant change in these assumptions, the results may change. For example, the results of the sediment plume modelling may change with different dredging methods, different dredging locations and/or different sediment particle size distribution. In cases of relatively small differences (e.g. in the proportion of fine grained particles in the sediment), then linear scaling of the model results is possible. Uncertainty has been addressed by using the best available data to inform the modelling.

7.10 Summary

This chapter has assessed the potential impacts, cumulative effects and transboundary effects of Eastside associated with sediment quality.

During construction, the principal impacts associated with sediment relate to contaminants in the seabed's sediment and how they may be released into the water column during dredging to affect water quality, and deposited on the seabed after dredging to affect sediment quality. Calculations were made based on sediment-water partitioning of contaminants and show that there would be no significant impact on water quality when compared to criteria established by the EC Dangerous Substances Directive. Although sediment deposition will affect the sediments in coastal waters, the change in contaminant concentrations was predicted to have a negligible impact, particularly when existing concentrations are compared to sediment quality guidelines applied in the UK, Spain and Canada. Since a very low level of impact has been predicted, no mitigation measures have been recommended.

No potential impacts relating to sediment quality were predicted during the operation of Eastside. Accordingly, no mitigation measures have been recommended.