5.5 Water

This chapter of the EIS examines water quality, foul water, surface water, water supply and flood risk.

5.5.1 Water Quality

This section of the EIS (5.5.1 to 5.5.7 inclusive) assesses the potential impact of the proposed development on water quality in the receiving environment. Existing water quality in the vicinity of the proposed development is established based on available water quality information. The likely impacts on water quality as a result of the proposed development are assessed and where relevant mitigation measures to reduce impacts are proposed.

5.5.2 Methodology

A desk top study of existing records and studies was carried out and the following documentation and mapping was consulted:

- Environmental Protection Agency (EPA) Guidelines on the Information to be Contained in Environmental Impact Statements (2002),
- EPA Advice Notes on Current Practice (in the Preparation of EIS) (2003)Ordinance Survey of Ireland Mapping,
- EPA Database,
- GSI Online Maps,
- National Part & Wildlife Service (NPWS), Maps & Database,
- Water Framework Directive, wfdireland.ie,
- Eastern River Basin Management Plan, 2008,
- EPA Water Quality Report 2007-2009,
- IGSL Geotechnical Site Investigation July 2014,
- Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters, 2006
- Hydrographic Surveys- Sediment Analysis November 2013,
- Hydrographic Surveys- Sediment Analysis January 2015,
- Arup Water Quality Results-Dun Laoghaire Harbour, 2013,
- ABP Marine Environmental Research Ecology Assessment Marine study Report, Dun Laoghaire Harbour, 2014,
- OSPAR- Ecotoxicological Assessment Criteria, Water and Sediment quality ranges.

The quality, magnitude and duration of potential impacts are defined in accordance with the criteria provided in the EPA Guidelines, outlined in Table 5.5.1 below:

Table 5.5.1 Glossary of Impacts following EPA Guidelines

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	A change which does not affect the quality of the environment
	Negative	A change which reduces the quality of the environment
Significance	Imperceptible	An impact capable of measurement but without noticeable consequences
	Slight	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate	An impact that alters the character of the environment in a manner consistent with existing and emerging trends
	Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Profound	An impact which obliterates sensitive characteristics
Duration	Short-term	Impact lasting one to seven years
	Medium-term	Impact lasting seven to fifteen years
	Long-term	Impact lasting fifteen to sixty years
	Permanent	Impact lasting over sixty years
	Temporary	Impact lasting for one year or less
Type	Cumulative	The addition of many small impacts to create one larger, more significant impact
	'Do Nothing'	The environment as it would be in the future should no development of any kind be carried out
	Indeterminable	When the full consequences of a change in the environment cannot be described
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is not permanently lost
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
	Synergistic	Where the resultant impact is of greater significance than the sum of its constituents
	'Worst Case'	The impacts arising from a development in the case where the mitigation measures may substantially fail

5.5.2.1 Governing Legislation

A summary of the relevant legislation considered is provided below.

5.5.2.1.1Water Framework Directive

Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the Water Framework Directive), and transposing regulations, European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003), as amended by the European Communities (Water Policy) (Amendment) Regulations, 2005, establish a legal framework for the protection, improvement and sustainable management of rivers, lakes, transitional waters (estuaries), coastal waters (to a distance of one nautical mile) and groundwater.

The strategies and objectives of the WFD in Ireland have influenced a range of national legislation and regulations, since its inception in the year 2000. The following legislation further transposed the WFD into Irish law. These Regulations place a legal obligation on public authorities to aim to achieve those objectives in the context of their statutory functions:

- *SI No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations 2009 as amended (S.I. No. 327/2012)*

  These regulations have been devised to implement the requirements of the WFD and establish Environmental Quality Standards for the purpose of assessing the status of surface waters. These regulations supersede all previous water quality regulations. These Surface Waters Regulations apply to all surface waters - including lakes, rivers, canals, transitional waters, and coastal waters. The purpose of the regulations is to establish legally binding quality objectives for all surface waters and environmental quality standards for pollutants.

- *SI No. 9 of 2010 European Communities Environmental Objectives (Ground Waters) Regulations 2010 as amended (S.I. No. 149/2012)*

  These regulations establish environmental objectives to be achieved in groundwater bodies, groundwater quality standards and threshold values for the classification of groundwater and the protection of groundwater against pollution and deterioration in groundwater quality.

In addition, Irish legislation which predates the WFD also still has an input to the protection of the water environment. These include the following:

- *SI No. 293 of 1988 European Communities (Quality of Salmonid Waters) Regulations 1988*

  The Salmonid Regulations set water quality standards for salmonid waters, with identification of salmonid waters, water quality standards, and frequencies of sampling and methods of analysis and inspection.

- *Local Government (Water Pollution) Acts 1977-2007*

  These Acts are the main legislation for the prevention and control of water pollution. In terms of surface water, these Acts has been largely superseded by the 2009 regulations, however, current impact assessment and management must still be cognisant of the Acts.

- *SI No. 258 of 1998 Water Quality Standards for Phosphorus Regulations 1998*

  These regulations require water quality to be maintained or improved with reference to the biological quality river rating system assigned by the EPA. These Regulations have

been largely superseded by the 2009 regulations; however, current impact assessment and management must still be cognisant of the legislation.

5.5.2.1.2 Marine Strategy Framework Directive

The Marine Strategy Framework Directive (MSFD) (2008/56/EC) establishes a framework that requires necessary measures to achieve or maintain Good Environmental Status (GES) in the marine environment by 2020. This was formally adopted by the European Union in June 2008 and is transposed into Irish law by the European Communities (Marine Strategy Framework) Regulations, 2011 (SI No. 249 of 2011).

The main aims of the directive are as follows:

- Protect and preserve the marine environment,
- Prevent its deterioration,
- If Practicable, restore the marine ecosystem in areas where they have been adversely affected,
- Prevent and reduce inputs in the marine environment with a view to phasing out pollution,
- Ensure that there are no significant impacts on or risks to marine diversity, marine ecosystem, human health or legitimate uses of the sea.

The Directive requires the implementation of marine strategies across each region or sub-region. The marine strategy sets out the requirements that need to be included in each marine strategy which are as follows;

- An initial assessment of the current environmental status of national marine waters and the environment impact and socio-economic analysis of human activities in these waters;
- The determination of what GES means for national marine waters,
- The establishment of environment targets and associated indicators to guide progress toward achieving GES in marine waters,
- The establishment and implementation of monitoring programmes for the ongoing assessment of the environment status of marine waters and the regular update targets,
- The development of Programme of Measures designed to achieve or maintain GES.

The overarching aim of the Directive is to protect Europe's marine waters by applying an ecosystem-based approach to the management of human activities while enabling the sustainable use of the marine environment for present and future generations. The Directive establishes a legal framework for the development of marine strategies designed to achieve Good Environmental Status (GES) in the marine environment by the year 2020. The marine strategy involves defining GES, setting environmental targets and indicators, implementing monitoring programmes for ongoing assessment, and developing and implementing programmes of measures to achieve or maintain GES.

GES is defined as 'the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations'. The GES is to be achieved and maintained by 2020 with a consistent and integrated approach to be adopted for each region.

The assessment of GES is based on 11 descriptors or qualitative descriptors which are as follows:

- Biological diversity is maintained,
- The introduction of non-indigenous species by human activities does not adversely alter the ecosystem,
- Populations of all commercially exploited fish and shellfish are within safe biological limits and are indicative of a healthy stock,
- Elements of marine food webs are at normal abundance and diversity,
- Human-induced enrichment of water by nutrients (eutrophication) is minimized,
- Sea floor integrity is at level that ensures the structure and functions of ecosystems are safeguarded and benthic ecosystems,
- Concentration of contaminants do not give rise to pollution effects,
- Contaminants in fish and other seafood for human consumption do not exceed relevant standards,
- Properties and quantities of marine litter do not cause harm to the coastal and marine environment,
- The introduction of energy, including underwater noise is at a level that does not adversely affect the marine environment.

The development of the marine strategy is part of a cyclical process which will be repeated every six years starting in 2012

To date, an Initial Assessment (constituting a comprehensive review of the physical, chemical and biological characteristics of the marine area, as well as the human pressures acting upon it) has been undertaken (DEHLG 2013)). A comprehensive set of environmental targets and associated indicators is under development. These will be used to demonstrate that GES has been achieved or is being maintained in accordance with the objectives of the MSFD. A monitoring programme will be established by the Department of Environment, Community and Local Government and the Marine Institute to identify measures which will need to be taken in order to achieve or maintain GES in marine waters. To date, GES has not been established for individual water bodies.

5.5.2.1.3 Shellfish Directive 79/923/EEC

This Directive is transposed into Irish law by the European Communities (Quality of Shellfish Waters) Regulations, 2006 (S.I. No. 268 of 2006) as amended (S.I. No. 55 of 2009)

S.I. No. 55 of 2009 amends the 2006 Statutory Instrument by providing for designation of an additional number of important shellfish growing areas. The 49 additional areas, which have been designated, were identified as appropriate for selection because:

- They are aquaculture sites or wild shellfish harvesting sites that have been active in the preceding 3 years and
- The waters are in need of protection or improvement.

The boundaries of the 49 additional areas have been drawn to ensure that they encompass all of the active licensed aquaculture being carried on within them.

The additional designated areas together with their boundaries are shown on the maps that have been drawn up for each of the areas. The proposed development is not located within or in proximity to a Shellfish designated area however the water quality standards are used as reference.

5.5.2.1.4 Bathing Water Quality 2007-2009

The legislation governing the quality of bathing waters for the 2012 season is EU Directive (76/160/EEC) concerning the quality of bathing waters, transposed into Irish law by the Quality of Bathing Waters Regulations, 1992 (SI No. 155 of 1992).

A Directive on bathing water (2006/7/EC) came into force in March 2006, transposed into Irish law by the Bathing Water Quality Regulations, 2008 (SI No. 79 of 2008), and will repeal the 1976 Directive with effect from 31 December 2014. The 2006 Directive establishes a new classification system for bathing waters (based on microbiological standards) and requires that a classification of at least 'sufficient' be achieved by 2015 for all bathing waters. Standards for E.Coli and Intestinal Enterococci will be used to classify bathing waters into four categories (excellent, good, sufficient and poor). Classification will be based on assessment of water quality data over a rolling four year period using the data from 2011-2014 inclusive.

5.5.2.1.5 EU Urban Waste Water Treatment Directive (91/271/EEC)

The Urban Waste Water Treatment Regulations, 2001 (SI No. 254 of 2001) (which transpose the Urban Wastewater Treatment Directive (91/271/EEC) into Irish law and update the Environmental Protection Agency Act, 1992 (Urban Waste Water Treatment) Regulations, 1994 as amended in 1999) list nutrient sensitive waters in the Third Schedule.

5.5.2.1.6 EU Nitrates Directive (91/676/EEC)

The objective of the Nitrates Directive, which was adopted in 1991, is the reduction of water pollution caused or induced by nitrates from agricultural sources and the prevention of further such pollution, with the primary emphasis being on the management of livestock manures and other fertilisers.

5.5.3 Receiving Water Environment

5.5.3.1 Conservation Status

The proposed development is located in Dun Laoghaire townland which is part of Dublin County and within the Dublin Bay catchment. See Figure 5.5.1 for the hydrological environment of the study area.

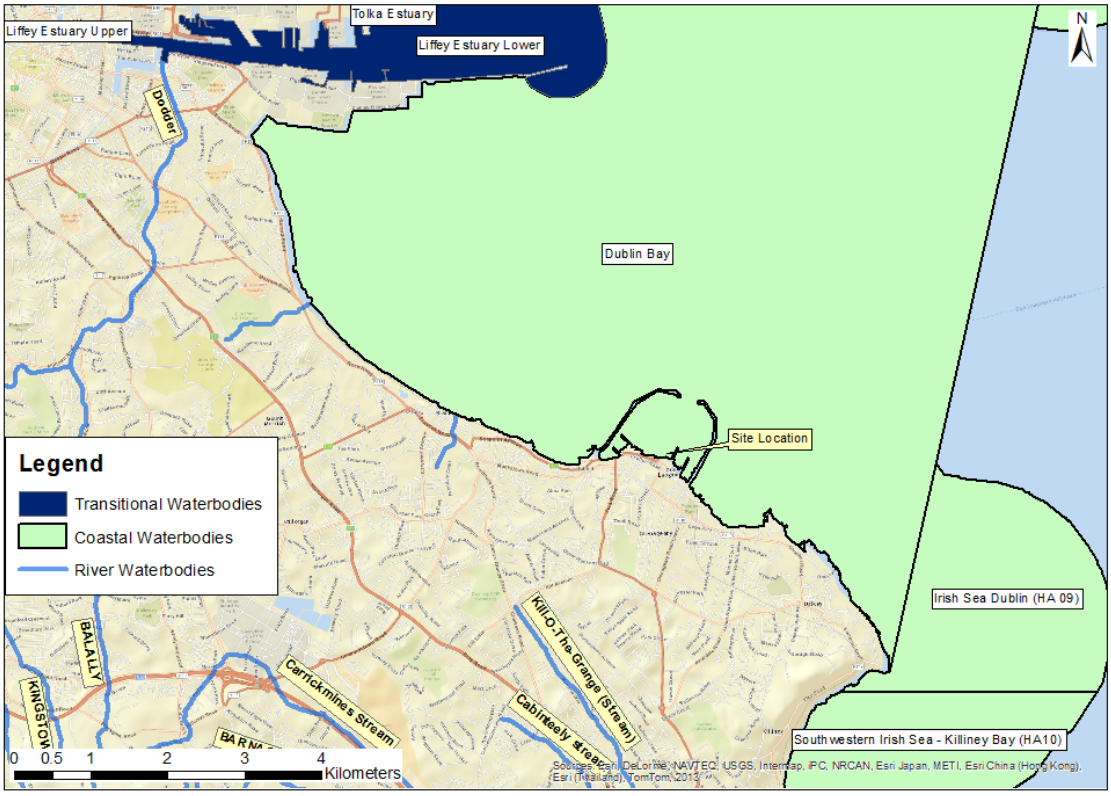

Figure 5.5.1 Site Location and Hydrogeological Environment

The proposed development is located within the South Dublin Bay water body which spans from Killiney Hill across Dublin Bay to Howth. The River Liffey is the main discharging water body in the study area, identified as the Liffey Estuary Lower in Figure 5.5.1 and is located approx. 4km to the north of the development. The Dodder, Camac and the Tolka also discharge to the Liffey Estuary. The remaining waterbodies in the study area are the Irish Sea Dublin (HA 09) and South Western Irish Sea- Kiliney Bay (HA 10), located approx. 3.5km to the southeast. There is no significant river body in the vicinity of the site.

Candidate Special Areas of Conservation (cSAC) are designated under the Habitats Directive (92/43/EEC). The EC (Natural Habitats) Regulations (1997) enables the protection, conservation and, where possible and necessary, the restoration of certain habitats and/or species (habitats listed on Annex I, and species listed on Annex II, of the Habitats Directive). Designated SACs are compiled within a framework of protected areas known as Natura 2000.

The following SAC's are located within the study area:

- South Dublin Bay (000210),
- Rockabill to Dalkey Hill (03000).

Special Protection Areas (SPAs) are designated under the Birds Directive (79/409/EEC). They are protected for birds listed on Annex I of the Birds Directive, as well as for populations of regularly occurring migratory species.

The following SPA is located within the study area:

- Dalkey Island.

Proposed Natural Heritage Areas (pNHAs) are designations introduced under the Wildlife Act 1976 (as amended). Although many NHA designations are not yet fully in force under this legislation, they are offered protection in the meantime under planning legislation which

requires that planning authorities give due regard to their protection in planning policies and decisions.

The following pNHA's are located in the study area:

- Dalkey coastal Zone and Kiliney Hill (001206).

See Figure 5.5.2 below for the location of the pNHA, SAC and SPA in the study area.

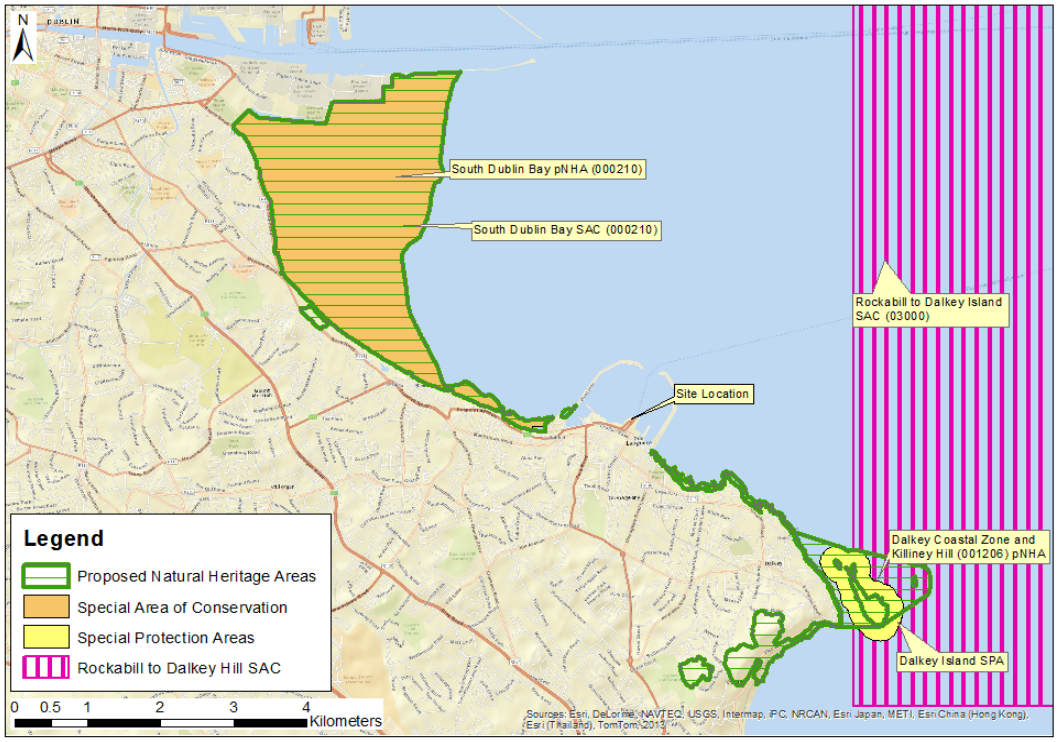

Figure 5.5.2 Conservation Areas

5.5.3.2 Water Quality Status

5.5.3.2.1 Water Framework Directive Waterbody Status

The aim of the Water Framework Directive (WFD) is to prevent deterioration of the existing status of waters and to ensure that all waters are classified as at least 'good' status (by 2015 in most cases, with all waters achieving good status by 2027 at the latest). A water body must achieve both good 'ecological status' and good 'chemical status' before it can be considered to be at good overall status.

Environmental Quality Standards (EQSs) for classifying surface water status are established in the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (SI No. 272 of 2009). These regulations set standards for biological quality elements, physicochemical conditions supporting biological elements (including general conditions and specific pollutants), priority substances and priority hazardous substances.

The South Eastern River Basin Management Plan (2009 - 2015), published in July 2010 establishes four core environmental objectives to be achieved generally by 2015:

- prevent deterioration,
- restore good status,
- reduce chemical pollution, and

- achieve water-related protected areas objectives.

The Plan also includes the objective to maintain water status for High and Good status waters and to restore to at least "Good Status" all waters by 2015.

The regulations set standards for biological quality elements and physico-chemical conditions, supporting biological elements (e.g. temperature, oxygen balance, pH, salinity, nutrient concentrations and specific pollutants), which must be complied with. These parameters establish the 'Ecological Status' of a water body. The 'Chemical Status' of a water body is assessed based on thresholds set for certain chemical pollutants, known as priority hazardous substances. A water body must achieve both 'Good Ecological Status' and 'Good Chemical Status' before it can be considered to be at 'Good Status' for the purposes of the WFD. Figure 5.5.3 shows a graphical overview of how results for different quality elements are combined to classify ecological status, chemical status and overall surface water status.

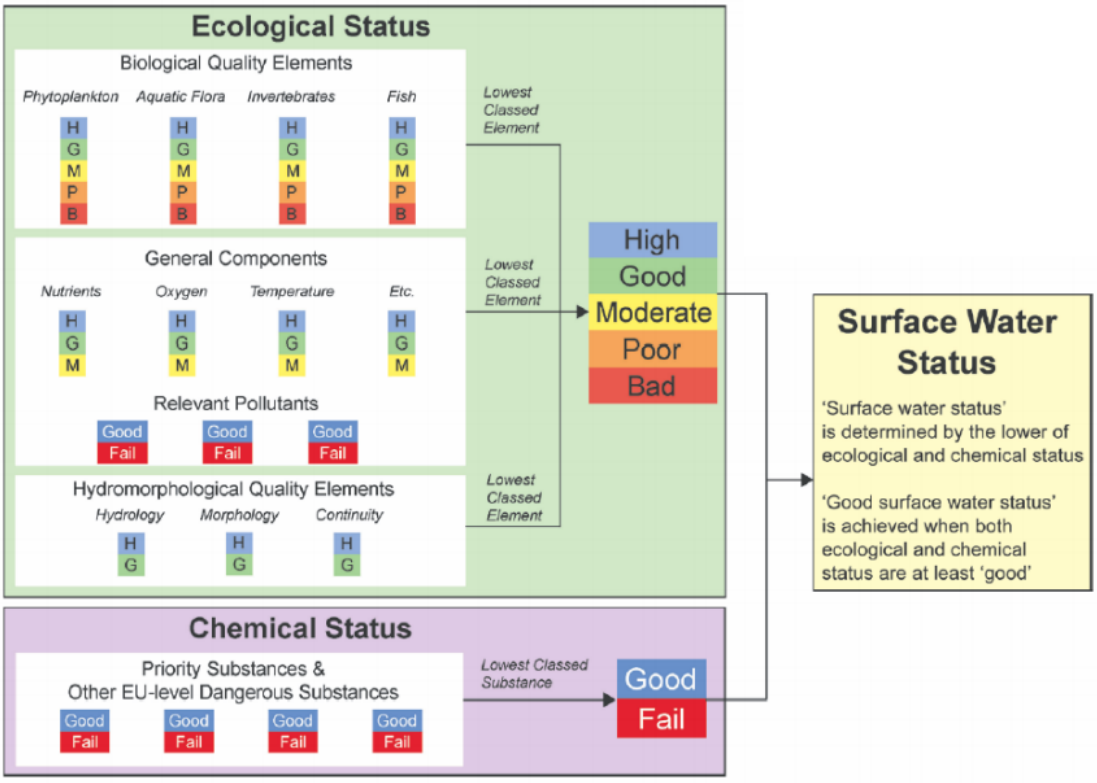

Figure 5.5.3 Surface Water Quality Status Overview

The WFD status of both the Liffey Estuary Lower and Dublin Bay (refer to Figure 5.5.1) water bodies was reported as 'moderate' in the final status classifications reported in 2011. Both water bodies are reported as having 'moderate' ecological status (both due to levels of Dissolved Inorganic Nitrogen (DIN) and Dublin Bay due to biological quality elements). Both are described as being at 'less than good' status for morphology. Both water bodies were also reported as being at 'moderate' status in the interim status classifications reported in 2009.

5.5.3.2.2 Marine Strategy Framework Directive

During 2013 Ireland undertook a preliminary assessment of the water quality of its marine waters. The first step in the implementation of the Marine Strategy Framework Directive (MSFD) in Ireland was an Initial Assessment of Ireland's marine waters and establishment of a comprehensive set of environmental targets and associated indicators for the marine waters so as to guide progress towards achieving Good Environmental Status (GES). The assessment area is an area of 488,762 km2 as shown in Figure 5.5.4 below.

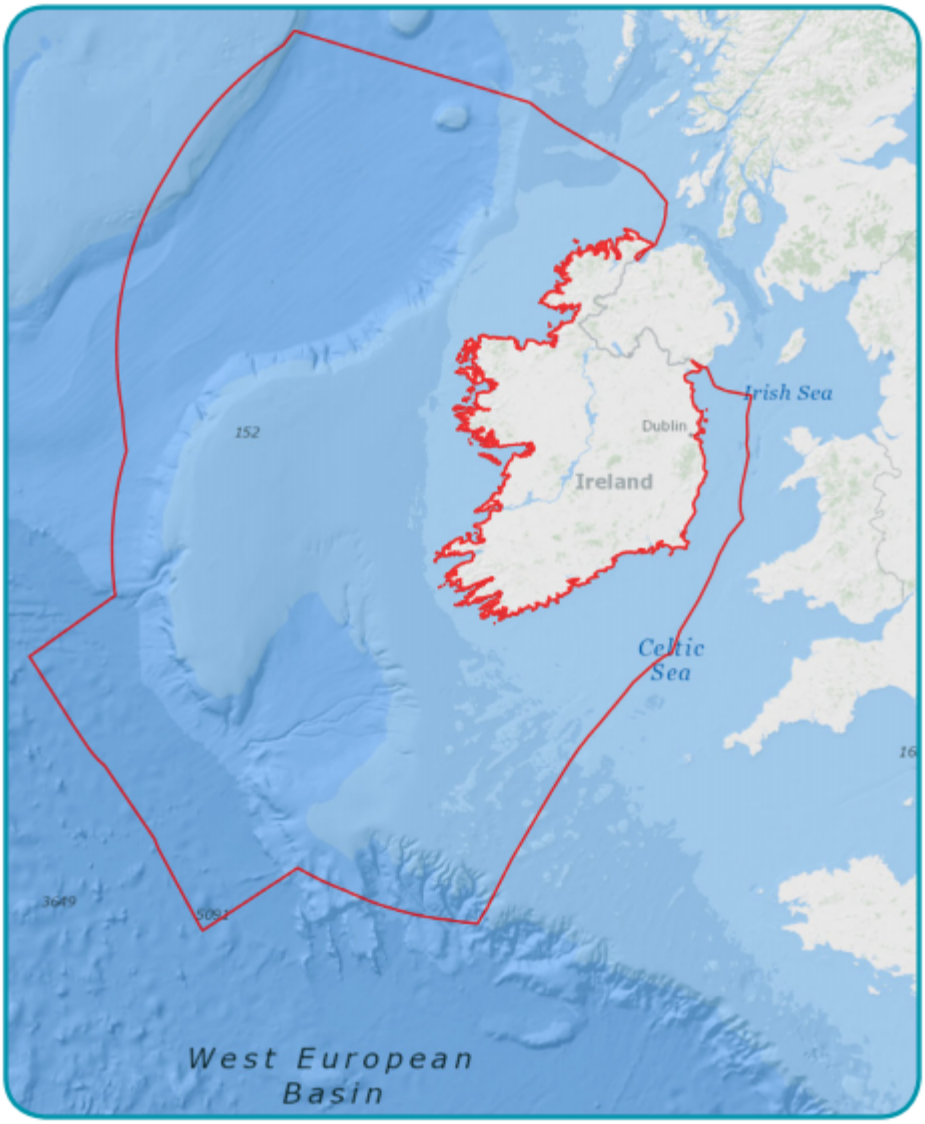

Figure 5.5.4 GES Assessment Area

Surface water temperatures fluctuate seasonally between averages of around 7°C after winter cooling, to 19°C following the warming influence of summer. In deeper water temperatures are cooler, ranging between around 6°C to 17°C along the shelf (up to 200 m depth) and in the Celtic Sea. The salinity (saltiness) of the coastal waters around Ireland varies depending on the freshwater input from rivers and coastal areas, which, in turn, is dependent on the amount of rainfall. In general, salinity is reduced during winter months when rainfall is greatest. Offshore, the influence of riverine water declines sharply and there has been very little recorded fluctuation in offshore salinity over long time periods

As shown in figure 5.5.5 below the waters around Dublin bay are classified as Shallow sublittoral sand. Regarding nutrient enrichment although not specifically stating the Dublin Bay area the overall water quality was considered to be of 'Good' Environmental Status.

In the two main areas of commercial fish and chemical contamination (including eutrophication) it was concluded that the overall water quality is generally improving.

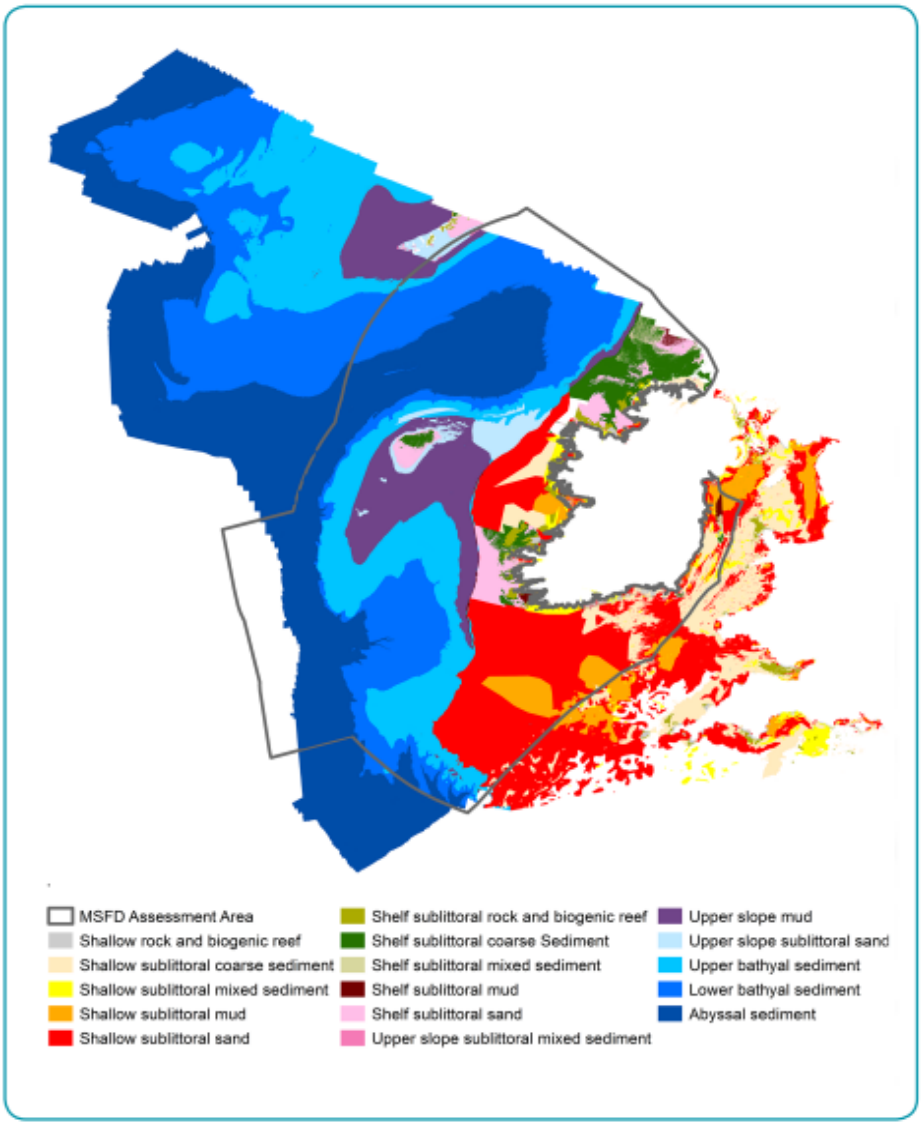

Figure 5.5.5 Assessment Area Sediment Classification

5.5.3.2.3 Bathing Water Quality 2007-2009

A Bathing designated area is located approx. 400m to the northwest of the proposed development along the coast. This is designated 'Seapoint' Code: IEEABWC090/0000_0100) and Dun-Laoghaire/Rathdown County Council is the relevant local authority.

The water quality has been assessed in the years from 2010 to 2013 and has consistently received a 'Good' quality rating.

5.5.3.2.4 Trophic status assessment

As part of the requirement of the EU Urban Waste Water Treatment Directive (91/271/EEC) and the EU Nitrates Directive (91/676/EEC) the trophic status of transitional and coastal water bodies are assessed under the EPA's Trophic Status Assessment Scheme (TSAS).

The status of individual estuarine and coastal water bodies is assessed using the TSAS using the criteria set out in Table 5.5.2 below. The scheme compares the compliance of individual parameters against a set of criteria indicative of trophic state.

Table 5.5.2 Parameters and criteria used in the Trophic Status Assessment Scheme (TSAS)

Category	TSAS Criteria	Value from 3-year period	Threshold	Score
A: Nutrient Enrichment	Nitrogen, Phosphorus	DIN (Winter or Summer) MRP (Winter or Summer)	Salinity Corrected Threshold Value	Pass/Fail
B: Accelerated Growth	Chlorophyll, Macroalgae	Medium (Summer) 90%ile (Summer) WRD EQR[1] (Summer)		Pass/Fail
C: Undesirable Disturbance	Dissolved Oxygen	5%ile (Summer) 95%ile (Summer)		Pass/Fail

[1]Ecological Quality Ratio for Good Status, derived from WFD compliant assessment method

The final status of a Transitional or Coastal Water body is defined under the TSAS scheme as follows;

- *Eutrophic water bodies* are those in which criteria in each of the categories are breached, i.e. where elevated nutrient concentrations, accelerated growth of plants and undesirable water quality disturbance occur simultaneously;
- *Potentially Eutrophic water bodies* are those in which criteria in two of the categories are breached and the third falls within 15 per cent of the relevant threshold value;
- *Intermediate status water bodies* are those which breach one or two of the criteria;
- *Unpolluted water bodies* are those which do not breach any of the criteria in any category.

Under the latest TSAS assessment for Irish marine water bodies (EPA, 2010) The Liffey Estuary Lower and Dublin Bay water bodies are classified as 'unpolluted'. These water bodies have shown incremental water quality improvements in recent years. Improvements are most likely the result of upgraded levels of waste water treatment in the area, namely Ringsend WWTP.

The Liffey Estuary Upper transitional waterbody is classified as 'intermediate'.

5.5.3.2.4 Nutrient Sensitive Waters

Nutrient Sensitive Waters comprise nitrate vulnerable zones designated under the Nitrates Directive (91/676/EEC) and areas designated as sensitive under the Urban Waste Water Treatment Directive (91/271/EEC). These are transposed into law by the Urban Waste Water Treatment Regulations, 2001 (SI No. 254 of 2001).

The Liffey Estuary and the Tolka Estuary have been classified as a Nutrient Sensitive Water bodies. These are located approximately 4.3km north of the site.

5.5.3.3 Water Quality Reports

5.5.3.3.1 EPA Water Quality Report 2007-2009

The EPA Water Quality Report 2007-2009 was published in 2010 and presents a review of Irish ambient water quality for the years 2007 to 2009. The water quality information in relation to transitional and coastal waters outlined in the report was generated by the EPA as well as other organisations including the Marine Institute, Inland Fisheries Ireland (IFI), the Sea Fisheries Protection Authority (SFPA), the Irish Coast Guard and the Radiological Protection Institute of Ireland (RPII). The water quality results provided in Appendix 1 of the EPA Water Quality Report are detailed in Table 5.5.3 below

Table 5.5.3 EPA Water Quality Report Results

Winter Summary Stats				Summer Summary Stats			
Parameters	**Minimum**	**Median**	**Maximum**	**Parameters**	**Minimum**	**Median**	**Maximum**
Salinity	20.7	32.92	34	Salinity	27.7	33.3	34.9
Temp (°C)	4.5	6.95	11.7	Temp (°C)	4.9	13.4	17.28
pH	7.9	7.9	8	pH	8.1	8.1	8.1
Secchi (m)	1	1.3	1.3	Secchi (m)	0.9	3.2	5.5
DO sat. (%)	94	98	109	DO sat. (%)	94	101	123
DO (mg/l)	9.4	11.6	13.2	DO (mg/l)	8.4	11	12.9
BOD (mg/l)	< 2	< 2	< 2	BOD (mg/l)	< 2	< 2	3
TON (mg/l)	0.02	0.14	0.97	TON (mg/l)	< 0.01	0.03	0.86
NH_3 (mg/l)	< 0.01	0.03	0.32	NH_3 (mg/l)	< 0.01	< 0 .01	0.33
DIN (mg/l)	0.023	0.171	1.293	DIN (mg/l)	0.01	0.057	0.892
MRP (µg/l)	5	26	87	MRP (µg/l)	< 5	14	144
Chl. a (µg/l)	1.3	2	5.5	Chl. a (µg/l)	2.1	2.7	3.8

As shown in the table above both nitrogen, as dissolved inorganic nitrogen (DIN), and phosphorus, as molybdate reactive phosphorus (MRP) are monitored in conjunction with the EPA Water Quality Report and assessed against salinity-related thresholds and environmental quality standards (SI No. 272 of 2009). Sampling is undertaken during winter when levels are expected to be at their seasonal maximum due to the absence of any significant plant or algal growth. Levels of MRP are also monitored in summer to capture the potential effect of seasonal changes in river flow.

See Table 5.5.4 below for classification of results from the EPA monitoring programme in accordance with the Trophic Status Assessment Scheme (TSAS).

Table 5.5.4 EPA Water Quality Report Results

TSAS criteria	Threshold Value		Result
			Unpolluted
Winter DIN	0.442	0.171	Pass
Winter MRP	43	26	Pass
DIN-	0.378	0.057	Pass
MRP-	42	14	Pass
Chloro. Median	10.6	2.7	Pass
Chloro 90 percentile	21.1	3.6	Pass
Opportunistic algae	0.6		
DO%sat 5 percentile	79	96.0	Pass
DO%sat 95 percentile	121	111.0	Pass
BOD	4	< 2	Pass

5.5.3.3.2 ARUP Water Quality Report

On the 23/09/2013 ARUP undertook water quality analysis at two locations in Dun Laoghaire port which are shown in figure 5.5.6 below. Sample Point A is located within the pier walls while Sample Point B is located outside the harbor breakwater.

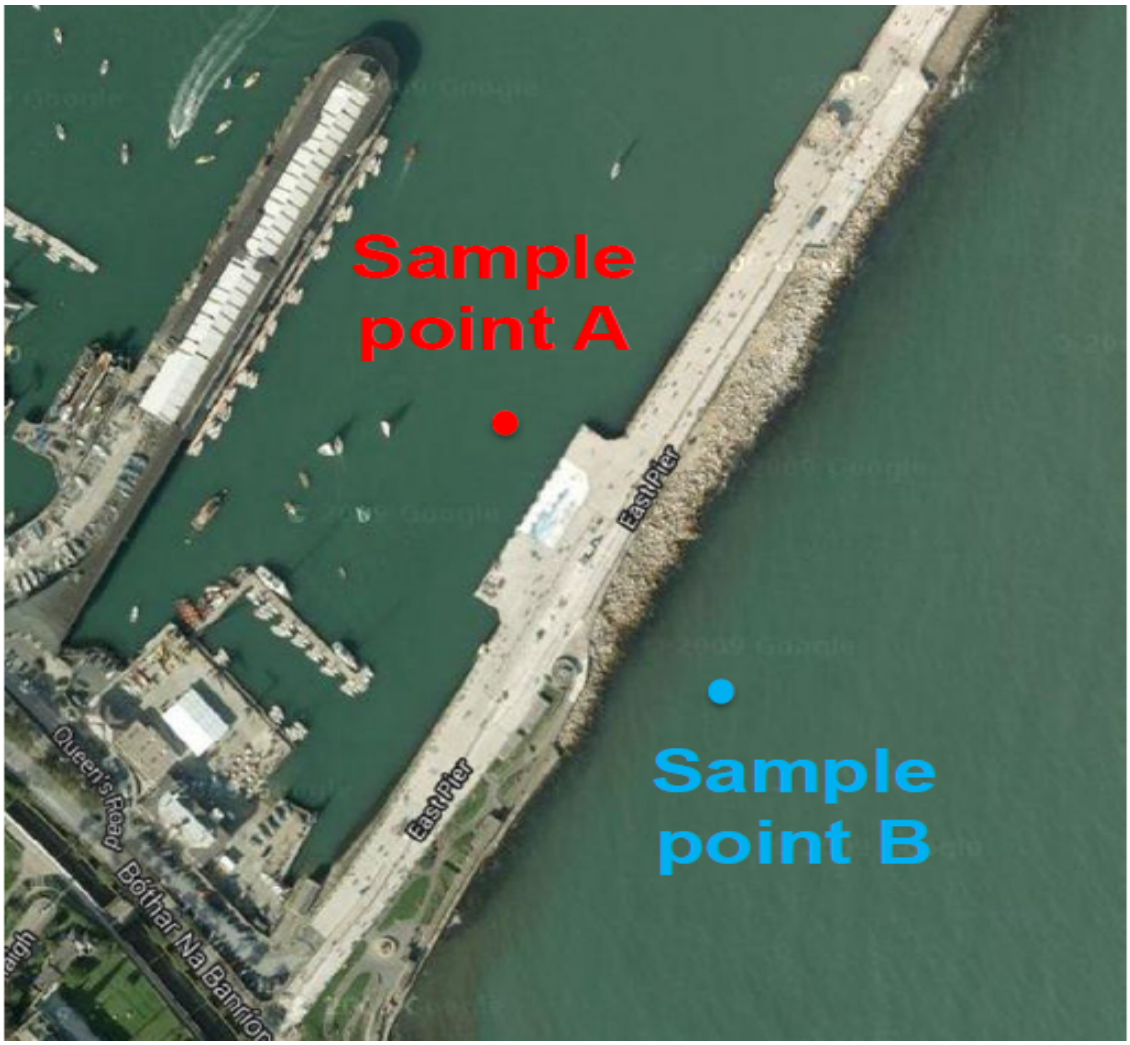

Figure 5.5.6 ARUP Sampling Locations

A sample of the parameters tested is presented in Table 5.5.5 below.

Table 5.5.5 2014 Water Quality Results

Parameter	Sample A	Sample B	Units	Surface Water Regulations		Shellfish Directive EQS	Surface Water Regulations 1989 A3 Waters EQS
				AA-EQS	MAC-EQS		
Atrazine	<3.400	<3.400	ng/l	0.6	2		
Cyanide, Total	<0.4	<0.4	ug/l				
Lead, Total	1.9	18.8	ug/l	7.2	-	20	
Chromium, Total	19	7	ug/l	0.6	32		
Cadmium, Total	13.2	8.1	ug/l	0.2	5		

Chlorophyll A	1.6	1	ug/l				
Arsenic, Total as As	2.7	2.8	ug/l			40	
Nitrite	<0.005	<0.005	mg/l				
Ammonia	0.39	0.45	mg/l				4
Phenol	<20.000	20	ug/l				
Nitrate	<2	<2	mg/l				50
Mineral Oil	<0.001	<0.001	mg/l				
Salinity	25.25	25.2	PPT				
Conductivity	50500	50400	µs/cm				
TSS	16	26	mg/				
pH	8.08	8.11	pH Units				
Salmonella	Not Detected	Not Detected					
Faecal streptococci	3	<1	cfu/100ml				
Ortho-phosphate as P	1.15	0.08	mg/l				0.7
Faecal Coliforms	10	4	cfu/100ml				
E.coli	<1	<1	MPN/100ml				

No pesticides were detected in either of the sample locations over the sampling round.

All monitoring results are below the relevant MAC-EQS Surface water limit and Shellfish quality values. Ortho-phosphate levels exceed the Surface Water 1989 quality value for A3 waters for both Sample A & B. The obtained results for sample points A and B are broadly similar between all the parameters.

5.5.3.4 Sediment Quality Reports

5.5.3.4.1 Hydrographic Surveys Sediment Sampling & Analysis January 2015

Sediment Analysis was undertaken by Hydrographic Surveys on behalf of the Dun Laoghaire Port Company during January 2015. 13 No. samples were taken to determine the sediments quality values for the following parameters; Mercury, Aluminium, Arsenic, Cadium, Lithium, Chrominium, Zinc, Nickel, Copper, Lead, Dibutylin, Tributylin, Polychlorinated Biphenyls and Polyaromatic Hydrocarbons. The locations of the sample points are shown in Table 5.5.6 and the results are detailed in Table 5.5.7.

The relevant results have been compared with the Ecotoxicological Assessment Criteria (EAC) developed by OSPAR, see Table 5.5.7. OSPAR is a mechanism by which 15 No. Governments together with the EU cooperate to protect the marine environment of the North Atlantic. EACs are the concentrations of specific substances in the marine environment below which no harm to the environment is expected.

Table 5.5.6 Hydrographic Surveys Sampling Locations

Sediment Sample	Location	
	Easting	Northing
M1	324604	229047
M2	324544	229076
M3	324606	229238
M4	324724	229364
M5	324766	229566
M6	324762	230027
M7	324961	230058
M8	325137	230093
M9	324875	230243
M10	325435	230051
M11	325619	230061
M12	325795	230054
M13	325985	230053

Table 5.5.7 Hydrographic Surveys Sediment Quality Results 2015

Parameters (mg/kg)	Borehole No.														
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	Lower EAC	Upper EAC
Mercury	0.0468	0.0533	0.079	0.0532	0.0421	0.00302	0.00347	0.00649	0.00265	0.00651	0.00676	0.00788	0.0122	0.05	0.5
Aluminium	27600	34000	33100	31800	22300	4120	4	4870	3050	4990	5530	6530	7810	-	-
Arsenic	9.28	**10.9**	**10.7**	**10.1**	8.22	5.86	5.38	4.94	4.98	4.41	4.65	5.32	4.69	1	10
Cadmium	0.202	0.154	0.178	0.153	0.158	0.043	0.42	0.044	0.03	0.05	0.055	0.058	0.066	0.1	1
Chromium	43.7	52.5	50.9	48.8	36.6	8.97	9.23	11.7	8	11.7	12.8	15.6	16.1	10	100
Copper	18.7	18.9	18.5	17.6	14.7	2.02	1.96	2.73	1.67	2.99	3.01	3.02	3.5	5	50
Lead	27.8	34.1	32.6	31.8	25.1	8.29	8.72	9.8	7.03	8.12	8.96	9.53	10.9	5	50
Lithium	38.5	46.4	48	44.1	31.3	9.56	6.59	7.24	5.38	7.31	8.57	7.01	12	-	-
Nickel	23.9	27.3	26.7	25.1	19.6	6.22	5.81	6.64	5.07	6.46	7.35	7.95	8.21	5	50
Zinc	113	103	98.8	95.9	75.5	315	23.3	27.4	21.9	30.3	31.2	33.3	35.3	50	500
Aldrin	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	-	-
DDE-pp	-	NT	**0.148**	**0.196**	**0.148**	NT	NT	NT	NT	-	NT	-	NT	0.0005	0.005
DDT-op	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	-	-
DDT-pp	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	-	-
Dieldrin	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	0.0005	0.005

Endrin	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	0.005	-
HCH-Alpha	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	-	-
HCH-Beta	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	-	-
HCH-Gamma	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	-	-
Hexachlorobezene	-	NT	-	0.261	0.241	NT	NT	NT	NT	-	NT	-	NT	-	-
Hexachlorobutadiene	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	-	-
Isodrin	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	-	-
TDE-pp	0.175	NT	0.206	0.238	-	NT	NT	NT	NT	-	NT	-	NT	-	-
Acenaphthene	8.03	NT	5.31	5.63	11.6	NT	NT	NT	NT	-	NT	-	NT	-	-
Acenaphthylene	2.88	NT	2.02	3.96	8.34	NT	NT	NT	NT	-	NT	-	NT	-	-
Anthracene	**23.7**	NT	**14.6**	**19.2**	**56.7**	NT	NT	NT	NT	1.08	NT	**1.23**	NT	0.05	0.5
Benzo(a)anthracene	60.5	NT	48.5	53.5	134	NT	NT	NT	NT	3.74	NT	2.95	NT	-	-
Benzo(a)pyrene	**63.6**	NT	**65.9**	**62**	**130**	NT	NT	NT	NT	3.05	NT	**8.14**	NT	0.1	1
Benzo(b)fluoranthene	73.7	NT	85.3	79.1	117	NT	NT	NT	NT	5.47	NT	5.46	NT	-	-
Benzo(ghi)perylene	55	NT	56	64.7	86.6	NT	NT	NT	NT	4.44	NT	4.23	NT	-	-
Benzo(k)fluoranthene	36	NT	41.1	37.1	63.3	NT	NT	NT	NT	2.63	NT	2.55	NT	-	-
Chrysene	74.3	NT	68	75.9	152	NT	NT	NT	NT	5.03	NT	4.25	NT	-	-
Dibebzo(ah)anthracene	13	NT	12.8	14.7	22.1	NT	NT	NT	NT	-	NT	-	NT	-	-
Fluoranthene	**120**	NT	**90.7**	**106**	285	NT	NT	NT	NT	**8.84**	NT	**5.31**	NT	1	1
Fluorene	18.8	NT	15.4	15.8	24.8	NT	NT	NT	NT		NT		NT	-	-
Indeno(1,2,3-c,d)pyrene	55	NT	60.5	66.3	90	NT	NT	NT	NT	4.3	NT	4.42	NT	-	-
Naphthalene	41.2	NT	32.8	31.9	30.2	NT	NT	NT	NT	-	NT	-	NT	-	-
Phenanthrene	88.4	NT	67	75.1	191	NT	NT	NT	NT	-	NT		NT	-	-
Pyrene	**101**	NT	**75**	**84.8**	244	NT	NT	NT	NT	**8.3**	NT	**4.83**	NT	0.05	0.5
PCB-028	0.224	NT	0.323	0.33	0.249	NT	NT	NT	NT	-	NT	-	NT	-	-
PCB-052	<0.1	NT	0.129	0.107	-	NT	NT	NT	NT	-	NT	-	NT	-	-
PCB-101	0.124	NT	0.16	0.143	0.11	NT	NT	NT	NT	-	NT	-	NT	-	-
PCB-118	0.173	NT	0.238	0.218	0.158	NT	NT	NT	NT	-	NT	-	NT	-	-
PCB-138	0.223	NT	0.244	0.212	0.162	NT	NT	NT	NT	-	NT	-	NT	-	-
PCB-153	0.224	NT	0.251	0.231	0.16	NT	NT	NT	NT	-	NT	-	NT	-	-
PCB-180	0.183	NT	0.124	0.129	-	NT	NT	NT	NT	-	NT	-	NT	-	-
Dibutyl Tin	9.18	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	-	-
Tributyl Tin	-	NT	-	-	-	NT	NT	NT	NT	-	NT	-	NT	-	-

Bold= Exceeded EAC Limit Value. **-** Below Detectable Limit, NT-Not Tested

All values are below the relevant OSPAR EAC limit values with the exception of Arsenic which exceed the OSPAR Limit by <1mg/kg at sampling points M2, M3 and M4.

The majority of hydrocarbons are below the limits of detection. Anthracene, Benzo(a)pyrene, Fluoranthene and Pyrene were found to exceed the EAC upper limit values, however the results do not indicate significant contamination issues at the site.

5.5.3.4.2 IGSL Geotechnical Site Investigation July 2014

A geotechnical investigation was undertaken during July 2014 as part of the proposed cruise facility. A series of shallow and deep boreholes were undertaken as part of the assessment whose locations are shown in Figure 5.5.7 below.

Figure 5.5.7 Geotechnical Sampling Locations

Samples were taken at selected boreholes to identify the chemical characteristics at the site and determine the suitability of disposal. The relevant results have been compared with the Ecotoxicological Assessment Criteria (EAC) developed by OSPAR, see Table 5.5.8.

Table 5.5.8 IGLS Soil Quality Results

	Geotechnical Report									OSPAR (2000) EAC Values (mg/kg)	
	Borehole No.										
Parameters	BH2 (1.0 m)	BH2 (8.5 m)	BH1 (3.0 m)	BH1 (8.0 m)	BH1 (10.0 m)		RC1 (14.2-17.2 m)	RC 3 (9-10 M)	RC3 (18-19.50m)	Lower EAC	Upper EAC
Depth	1m	8.5m	3m	8m	10m		14.2-17.2 m	9-10m	18-19.5m	-	-
Chloride (g/l)	3.305	3.506	3.075	1.899	3.093		0.458	0.851	0.853	-	-

Sulphate as SO4 (g/l)	0.4393	0.522	0.4428	0.3896	0.4518		0.0996	0.411	0.3506		-	-
pH	8.44	8.64	8.45	8.39	8.1		8.11	7.94	7.9		-	-
Parameters (mg/kg)	**Borehole No.**										**Lower EAC**	**Upper EAC**
	BH11m	**BH 31m**	**BH4 3-4m**	**BH5 5m**	**BH71m**	**BH7 3-4m**	**BH 8 3-4m**	**BH 10 3-4m**	**BH11**	**BH 12 1-2m**		
Mercury	0.234	0.0311	0.0285	0.0105	0.016	0.0505	0.0143	0.016	0.0138	0.263	0.05	0.5
Aluminium	46900	28000	33500	33800	43100	24600	22800	43100	24300	23200	-	-
Arsenic	**15.4**	**20.1**	**12.7**	8.8	**11.5**	**11.6**	**16.3**	**11.5**	**11.9**	**11.8**	1	10
Cadmium	0.292	0.214	0.224	0.168	0.201	0.286	0.335	0.201	0.27	0.294	0.1	1
Chromium	88.4	**120**	**176**	66.4	94	**350**	**457**	94.0	**505**	**433**	10	100
Copper	40.7	20.4	21.1	18.4	22.7	18.7	19.6	22.7	19.6	19.8	5	50
Lead	54.5	20.5	13.5	11.5	14.7	14.2	15.9	14.7	15.5	14.9	5	50
Lithium	66.2	31.8	34.2	35.1	47.3	22.3	23.6	47.3	18.5	19.6	-	-
Nickel	33.8	18.8	24.7	22.2	30.6	23	23.5	30.6	21.2	21.2	5	50
Zinc	137	50	56	45	60.4	51.2	56	51.2	60.4	51	50	500
Aldrin	-	-	-	-	-	-	-	-	-	-	-	-
DDE-pp	-	-	-	-	-	-	-	-	-	-	0.0005	0.005
DDT-op	-	-	-	-	-	-	-	-	-	-	-	-
DDT-pp	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin	-	-	-	-	-	-	-	-	-	-	0.0005	0.005
Endrin	-	-	-	-	-	-	-	-	-	-	0.005	-
HCH-Alpha	-	-	-	-	-	-	-	-	-	-	-	-
HCH-Beta	-	-	-	-	-	-	-	-	-	-	-	-
HCH-Gamma	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobezene	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobutadiene	-	-	-	-	-	-	-	-	-	-	-	-
Isodrin	-	-	-	-	-	-	-	-	-	-	-	-
TDE-pp	1.06	-	-	-	-	-	-	-	-	-	-	-
Acenaphthene	10.8	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	4.54	-	-	-	-	-	-	-	-	-	-	-
Anthracene	**36.6**	**-**	**4.22**	**1.27**	-	-	-	-	-	--	0.05	0.5
Benzo(a)anthracene	138	2.40	10.2	3.44	-	-	1.65	1.52	-	1.2	-	-
Benzo(a)pyrene	**153**	**3.10**	**10.5**	**2.94**	-	-	**1.64**	**1.78**	-	-	0.1	1
Benzo(b)fluoranthene	153	2.24	7.88	4.33	-	-	1.56	4.96	-	-	-	-
Benzo(ghi)perylene	129	1.87	5.89	3.73	-	-	-	3.94	-	-	-	-
Benzo(k)fluoranthene	87.7	1.34	4.54	1.70	-	-	-	1.31	-	-	-	-
Chrysene	97.8		8.31	4.64	-	-	-	3.94	-	-	-	-
Dibebzo(ah)anthracene	30.6	-	2.16	-	-	-	-		-	-	-	-
Fluoranthene	**206**	**3.27**	**15.7**	**5.71**	-	-	**1.74**	**2.87**	-	**1.46**	1	1
Fluorene	19.5	-	-	-	-	-	-		-	-	-	-
Indeno(1,2,3-c,d)pyrene	118	1.75	4.81	1.85	-	-	-		-	-	-	-
Naphthalene	39.2	-	-	-	-	-	-		-	-	-	-

Phenanthrene	122	-	11.1	8.64	-	-	-	8.93	-	-	-	-
Pyrene	**225**	**4.11**	**16.5**	**6.42**	-	-	**2.13**	**3.36**	-	**1.78**	0.05	0.5
PCB-028	0.425	-	-	-	-	-	-	-	-	-	-	-
PCB-052	0.178	-	-	-	-	-	-	-	-	-	-	-
PCB-101	0.318	-	-	-	-	-	-	-	-	-	-	-
PCB-118	0.419	-	-	-	-	-	-	-	-	-	-	-
PCB-138	0.225	-	-	-	-	-	-	-	-	-	-	-
PCB-153	0.385	-	-	-	-	-	-	-	-	-	-	-
PCB-180	0.163	-	-	-	-	-	-	-	-	-	-	-
Dibutyl Tin	0.163	-	-	-	-	-	-	-	-	-	-	-
Tributyl Tin		-	-	-	-	-	-	-	-	-	-	-

Bold= Exceeded EAC Limit Value

- Below Detectable Limit

The majority of the parameters are within or below the range specified OSPAR EAC limit values with the exception of Arsenic and Chromium. The Arsenic concentrations exceeded the EAC limits over all the sampled boreholes with the exception of BH5. Chromium exceed the EAC limits for BH3, BH4, BH 8, BH10, BH11, BH12.

The majority of hydrocarbons are below the limits of detection. Anthracene, Benzo(a)pyrene, Fluoranthene and Pyrene were found to exceed the EAC upper limit values. Excessive values were encountered at BH1, however the results do not indicate significant contamination issues at the site.

Initial testing by IGSL indicates that the material is relatively uncontaminated (with reference to the relevant sediment quality standards set out in Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters, Marine Institute 2006) and should be suitable for disposal at the existing spoil disposal grounds at Burford Banks.

5.5.3.4.3 Hydrographic Surveys- Sediment Analysis November 2013

Sediment Analysis was undertaken by Hydrographic Surveys on behalf of the Dun Laoghaire Port Company during November 2013. Ten samples were taken to determine the sediments quality values for the following parameters; Granulometry, Organic Carbon, Zinc, Nickel, Copper, Lead, Arsenic, Cadium, Lithium, Aluminium, Chrominium, Mercury, Dibutylin, Tributylin, Polychlorinated Biphenyls and Polyaromatic Hydrocarbons. The results from the sampling programme are detailed in Table 5.5.9 below.

Table 5.5.9 Hydrographic Surveys Sediment Quality Results

Parameter	**Sample ID**										**OSPAR (2000) EAC Values (mg/kg)**	
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**Lower EAC**	**Upper EAC**
Lithium	10.5	13.6	12	13.8	13.8	14.3	43.9	38	48.8	46.3		
Aluminium	13300	14100	15400	14300	14500	10500	47600	42900	51700	48800		
Cadmium	<0.03	0.046	0.039	0.051	0.057	0.044	0.483	0.203	0.164	0.17	0.1	1
Mercury	0.002	0.002	0.004	0.003	0.004	0.01	0.025	0.074	0.077	0.05	0.05	0.5
Arsenic	6.39	6.32	6.27	5.01	4.88	2.57	8.7	8.05	9.89	9.38	1	10
Chromium	9.47	11.3	14.5	9.47	13.8	12.6	104	84.4	**107**	**103**	10	100
Copper	2.97	3.34	3.71	3.37	6.63	6.34	34.4	31.1	35.5	55.9	5	50
Lead	11.2	11.9	12.9	11.3	14	12.8	38.7	32.7	38.7	36.8	5	50

Nickel	5.93	6.09	6.37	5.09	14.4	6.15	54.8	40	**60.2**	**55**	5	50
Zinc	27.5	30.1	31.8	26	442	24.2	107	94.2	114	116	50	500
PCB 028 ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.28	0.28	0.28	<0.2		
PCB 052 ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
PCB 101 ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
PCB 118 ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
PCB 138 ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	<0.1	<0.1	<0.1		
PCB 153 ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.16	0.12	0.2	<0.1		
PCB 180 ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	<0.1	<0.1	<0.1		
PCB S 7 PCB ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.68	0.4	0.48	<0.1	0.001	0.01
PAH Acenaphthene ug kg^{-1}	<2	<2	<2	<2	<2	N/A	12.2	8.6	4.6	5.4		
PAH Acenaphthylene ug kg^{-1}	<2	<2	<2	<2	<2	N/A	29.3	10.5	11.2	9.4		
PAH Anthracene mg kg^{-1}	<0.002	<0.002	<0.002	<0.002	0.024	N/A	.0512	0.0323	0.0239	0.0136	0.05	0.5
PAH Benzo a anthracene mg kg^{-1}	<0.002	<0.002	0.0025	0.006.2	0.005.9	N/A	0.118	0.077	0.0895	0.0462	0.05	06
PAH Benzo (a) pyrene mg kg^{-1}	<0.002	0.0022	0.0047	0.005	0.0059	N/A	0.124	0.0842	0.0832	0.0514	0.1	1
PAH Benzo b fluoranthene ug kg^{-1}	<10	<10	<10	<10	10.2	N/A	121	91.6	101	71.9		
PAH Benzo ghi perylene ug kg^{-1}	<10	<10	<10	<10	<10	N/A	86.5	59.4	68.4	49.9		
PAH Benzo k fluoranthene ug kg^{-1}	<10	<10	<10	<10	<10	N/A	56	45.9	53.1	32.7		
PAH Chrysene ug kg^{-1}	<3	<3	3.2	6.9	8.4	N/A	120	86.3	101	60.4		
PAH Dibenz a,h anthracene ug kg^{-1}	<5	<5	<5	<5	<5	N/A	20.2	15.4	16	11.1		

PAH Fluorene ug kg^{-1}	<10	<10	<10	<10	<10	N/A	38.2	20.4	18.5	15.9		
PAH Fluoranthene ug kg^{-1}	<2	<2	<2	10.9	7.4	N/A	216	159	132	75.2		
PAH Indeno 1,2,3 – cd pyrene ug kg^{-1}	<10	<10	<10	<10	<10	N/A	101	69.2	82.7	61.2		
PAH Naphthalene ug kg^{-1}	<30	<30	<30	<30	<30	N/A	58.8	52.5	49.1	53.2		
PAH Phenanthrene mg kg^{-1}	<0.010	<0.010	<0.010	<0.010	<0.010	N/A	0.209	0.106	0.074.8	0.055	0.1	1
PAH Pyrene mg kg^{-1}	<0.003	<0.003	<0.003	0.0147	0.0076	N/A	0.231	0.166	0.118	0.0756		
PAH S 16 ug kg^{-1}	<30	<30	<30	43.7	47.8	N/A	1592.4	940.3	1027	713.6		

All values are below the relevant OSPAR EAC limit values with the exception of Chromium and Nickle at S9 and S10. The Chromium and Nickle values exceeded the limit value by 7mg/kg and 10.2mg/kg at S9 respectively and 3mg/kg and 5mg/kg respectively at S10.

5.5.3.5 Overall Water and Sediment Quality Status

The results from the water quality and sediment analysis indicates that there is no significant contamination or water quality issues within Dun Laoghaire Harbour. The sediment is of relatively good quality with some slight exceedences of Arsenic, Chromium, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Fluoranthene and Pyrene in relation to the OSPAR standards. The main finding of the IGLS report as previously stated is that the sediment meets acceptable standard for disposal as stated in the Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters, Marine Institute 2006.

The Hydrographic Surveys January 2015 monitoring round shows a general improvement in quality for Heavy Metals when compared to the IGSL 2014 and Hydrographic Surveys 2013 monitoring rounds.

5.5.4 Maritime Works

5.5.4.1 Characteristics of the Proposed Development

The proposed development is located within the existing Dun Laoghaire harbour enclosure. The boundary of the harbour is defined by the western pier and eastern pier. Within the harbour there are two breakwaters which shelter the inner waters of the harbour. There are a variety of land uses on the landside of the Harbour i.e. along Harbour Road, Dun Laoghaire. These include the Irish Lights buildings and the Dun Laoghaire Marina (berthing of yachts and other small vessels) and associated recreational facilities. The proposed development contains both onshore and maritime works.

The maritime works comprise the following works:

- An approach navigation channel approximately 1,150m long situated beyond the existing Harbour breakwaters;
- A vessel turning circle situated approximately 500m diameter, situated outside the existing Harbour breakwaters;
- An inner navigation channel approximately 850m long within the existing Harbour breakwaters;
- A new quay approximately 435m long constructed in the west of the harbour water body;
- Disposal of dredged sediment at Burford Bank which is located in Dublin Bay.

See Figure 5.5.8 below for the layout of the proposed works.

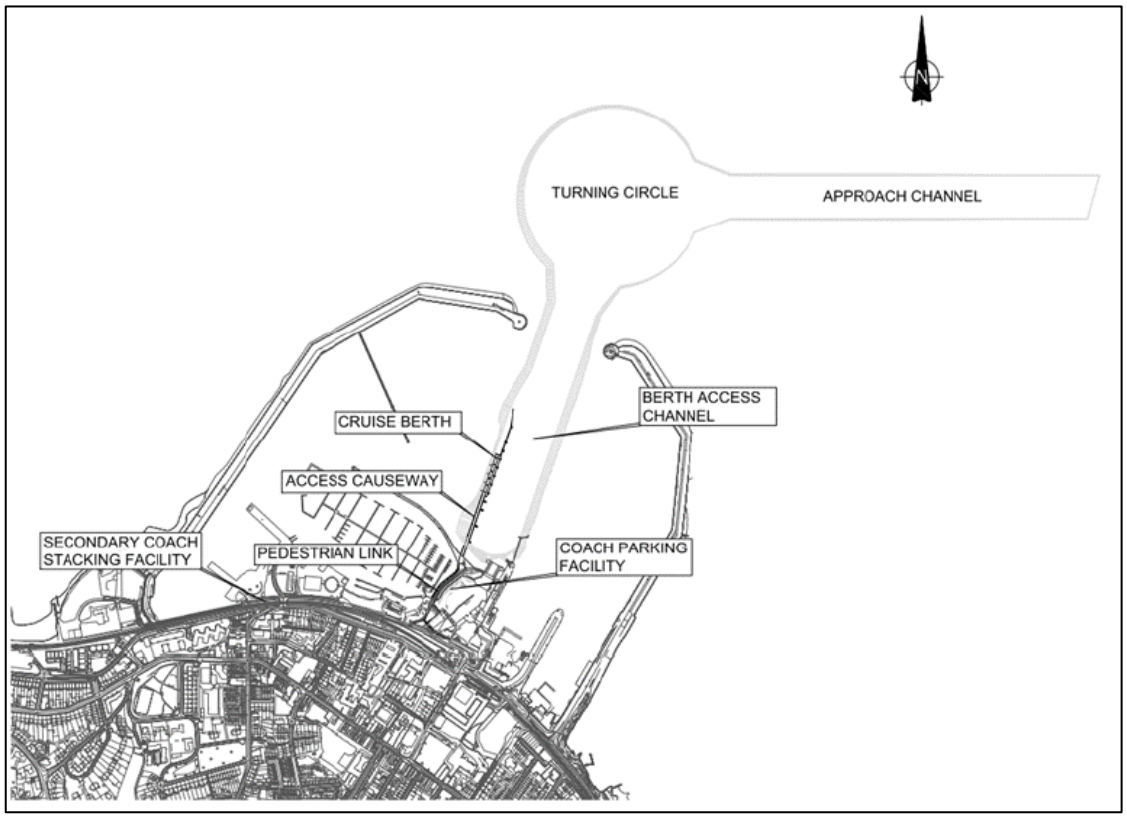

Figure 5.5.8 Layout of Proposed Works

The berth will consist of a 120m long by 20m wide concrete quay supported on tubular steel piles, located 180m north of the breakwater, this quay will be connected to the eastern marina breakwater by an approximately 8.5m wide concrete access causeway also supported on tubular steel piles. Ships will berth along the eastern side of the quay.

To ensure safe passage for the cruise ships sufficient water depth needs to be provided at the berth and the access navigation channel. The access channel will be dredged to a depth of 10.5m below Chart Datum to provide safe navigation for vessels and will be 120m wide. Cruise ships will approach from the harbour entrance from deep water to the east, to a turning circle, 550m in diameter and centered approximately 300m north of the harbour entrance. The creation of the channel will require the dredging of a minimum of 710,000m^3 of sediment comprising sand and silt from the seabed. It is proposed to dispose of the sands & silt at the existing spoil disposal grounds at Burford Banks which is located within Dublin Bay.

5.5.4.2 Potential Impact of the Proposal

Potential impacts without proposed mitigation measures are considered in this section.

Construction Phase

The aspects of the proposed development which could impact on water quality during construction are as follows:

- Dredging of the Proposed Navigation Channel and Turning Circle (for access into the Berth),
- Construction of the 120m long 20m wide quay which will be extended northwards by means of installing 8 monopiles (3m in diameter each). Each monopile will support a fender on the berthing side of the pile. A mooring bollard and necessary lighting will be provided on the top of each pile. A lightweight metal walkway will be provided to access the northern mooring piles when constructed.

The dredging process and disposal operations will produce a plume of suspended solids in the immediate area around the dredger which could impact in water quality. The plume outside of the harbour will consist entirely of sands while dredging within the harbour will result in more disperse plumes consisting of silts and fines. During most tidal cycles the sediment will recirculate within the harbour however during specific tidal flows the plume may be carried outside of the harbour (Ref. Section 5.4 Coastal Processes).

Suspended silts may be transported 250-500m from the dredging channel during a conservative worst case scenario. Any suspended solids which settle back on the approaching channel above the target level will be subsequently dredged. Disturbed sediment will ultimately deposit on the seabed, however the sediment plume could potentially impact on nearby protected habitats.

Water quality impacts from potential spillages and leakages of fuels/oils from the dredging vessel could occur during the construction phase.

Operational Phase

The excavation of the access channels will increase the cross-sectional area and thereby the tidal currents and wave patterns inside and outside of the harbour. This may impact on the mobilisation and deposition patterns around Dun Laoghaire harbour.

An accidental spill event, including potential wastewater discharges from vessels, could have an impact on the protected habitats within Dublin Bay, if not adequately mitigated.

Do Nothing Scenario

In the do-nothing scenario there will be no change to the operations or infrastructure at Dun Laoghaire Harbour therefore no change in water quality.

5.5.4.3 Avoidance, Remedial or Reduction Measures

Construction Phase

The main potential impact identified during the construction phase is the dredging process and associated sediment plumes. Modelling of the sediment plumes by ABP MER Ltd., highlight rapid settlement of sands outside the harbour and low suspended solids

concentrations that may impact on local habitats. This modelling study concluded that dredging within the harbour will create more disperse plumes however this will have little and short term impact on the quality of the waterbody. No specific mitigation measures are provided for in the ABP MER Ltd. Sediment modelling report due to the limited impact on water quality during the dredging process.

Operational Phase

No remedial measures are required during the operational phase to protect or improve water quality in the study area.

The wave action of the proposed scheme has been found by ABP MER Ltd. to have only a very limited effect on sediment deposition and tidal flow therefore no remedial measures are required. The impact of the proposal on wave height is limited, both in terms of its scale and the conditions under which these impacts occur, as such no remedial measures are proposed.

The operation of the cruise ships, specifically with regard to diesel storage and usage, should be subject to an Environmental Management Plan (EMP) and relevant operational guidelines for cruise ships at port, including entering and exiting of the port. Specific adherence should be given to the following:

- Usage of diesel when in port including potential refueling processes,
- No disposal of waste while in port or in the vicinity of Dun Laoghaire Harbour,
- Hazardous chemicals onboard should be stored in sealed drums with relevant labels in locked chemical storage cabinets,
- Spillages on deck should be controlled with absorbent materials or 'Spill Kits'

5.5.4.4 Predicted Impact of the Proposal

Construction Phase

No significant long-term impacts are foreseen during the construction phase. Disturbance of sand outside the harbour are expected to settle quickly and disperse no further than 100m from the dredger with no negative impact to the local environment. Within the harbour the dredging process will likely disturb finer silts. Modelling indicates the level of suspended sediment will be less than 5mg/l. The impact of the dredging process as identified during the modelling process characterises the impact as localised, short term with a temporary increase in suspended solid concentrations.

Historic dredging operations and disposal at Burford Bank have found no significant impacts. The plume footprints from sequential spoil releases from the dredging have little or no potential to overlap therefore cumulative impacts are not likely.

Sediment plumes within the harbour will extend to 250-500m from the channel which may result in worst case thicknesses of 10mm but likely to range from 0.3-0.8mm. From reviewing the ABR MERP sediment & wave modeling report the impact of the sediment plume will likely be short term and negligible on the waterbody. Therefore the overall the impact during the construction phase for the maritime works will be Short term- Imperceptible with a neutral impact on quality.

Operational Phase

The ABR MERP sediment & wave modeling report concluded that no measurable differences in local wave height due to the presence of the access channel are predicted to occur either inside or outside of the harbour when waves and/or winds come from any direction.

Furthermore, it is considered that the wake waves created by passing ships will be considerably less than 1m in height. By the time it reaches any potentially sensitive receptors the waves will be no greater than waves that might occur under natural conditions, therefore providing no increased risk of sediment disturbance. The distribution of sediments within the harbour will also continue to vary naturally due to baseline processes. Any contribution of the scheme to sediment transportation and deposition will be therefore be relatively small.

Operations of cruise ships should be undertaken according to MARPOL guidelines for the prevention of pollution from ships and relevant International Marine Organisation guidelines. When undertaken according to the relevant guidelines the proposed operations should not negatively impact on the water quality status of Dun Laoghaire harbour. Overall the impact during the operational phase will be long term- Imperceptible with a neutral impact on quality.

Worst Case Scenario

The worst case scenario would be a leakage from the cruise ship within the harbour from malfunction of equipment or impact event. Such an event would lead to direct contamination of the harbour waterbody. The likelihood of contamination from a cruise ship is low due to the regular maintenance of cruise ships to international standards which will prevent severe malfunction of equipment. Furthermore, operation of the cruise ship activities such as waste management and movement within are harbour will be undertaken according to International marine guidelines and relevant EMP's. This will ensure that the risk of contamination from the proposed harbour activities will be low with minimal impact on water quality.

5.5.5 Onshore Works

5.5.5.1 Characteristic of the Proposed Development

The onshore work comprises a new berth to be located in the centre of the harbour directly south of the existing harbour mouth. The main onshore works proposed are as follows:

- A shared use pedestrian and private vehicle access zone located adjacent to the existing,
- Marina together with a new boardwalk parallel to this shared area, complete with new feature lighting,
- A new pedestrian footpath with high quality concrete pavement along Harbour Road providing linkage with the existing Terminal Plaza complete with new feature lighting,
- A 20 coach drop off/ pick up area within a dedicated section of the existing HSS ferry marshalling area,
- A coach overflow holding area placed within Accommodation Walk which straddles the Old Quay Bridge at the west of the Harbour,
- Local modifications to an existing retaining wall adjoining the car park located adjacent to the Old Quay area also at the west of the Harbour,
- Demolition of certain harbour infrastructure such as an RC boundary wall along the HSS Yard boundary, the motorist's administration building, a section of the port cocher canopy structure, plus tree removal and replacement,
- Construction of new buried utilities and services, and miscellaneous lighting columns and signage for vehicles and non-motorised users.

5.5.5.2 Potential Impact of the Proposal

Potential impacts without proposed mitigation measures are considered in this section.

Construction Phase

Surface water runoff during the construction phase may contain increased silt levels from construction activities which can arise from exposed ground, stockpiles, construction processes and access roads. Runoff containing construction silt if not mitigated may have a direct pathway to the Dun Laoghaire harbour waterbody.

During the construction phase, there is a risk of accidental pollution incidences if contamination is allowed to infiltrate surface water systems and/or receiving watercourses. The following are potential sources of contamination if not adequately managed and mitigated:

- Spillage or leakage of oils and fuels stored on site
- Spillage or leakage of oils and fuels from construction machinery
- Run off from the use of concrete and cement
- Leakage from damaged sewers

Operational Phase

Due to increased movement of passengers and traffic at the site there is a greater potential for accidental localised spillages/leakage in the carpark or access ways to cruise ship.

Do Nothing Scenario

In the do-nothing scenario there will be no change to the operations or infrastructure at Dun Laoghaire Harbour therefore no change in water quality.

5.5.5.3 Avoidance, Remedial or Reduction Measures

Construction Phase

A project-specific Construction and Environmental Management Plan (CEMP) will be established and maintained by the contractors during the construction phase of the proposed Project. The Plan will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures. As a minimum, the manual will be formulated in consideration of the standard best international practice including but not limited to:

- CIRIA, (2001), Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors,
- Construction Industry Research and Information Association (CIRIA) Environmental Good Practice on Site (C650), 2005,
- BPGCS005, Oil Storage Guidelines,
- CIRIA 697, The SUDS Manual, 2007,
- UK Pollution Prevention Guidelines (PPG) UK Environment Agency, 2004.

During the construction phase surface water runoff will not be discharged directly to local watercourses therefore the following procedures should be adhered to:

- Silt traps will be placed in the existing drainage network around the site to minimise silt loss. These should be inspected and cleaned regularly,

- Weather conditions will be taken into account when planning construction activities to minimise risk of run off from the site,
- Oils, solvents and fuels used during construction will be stored within temporary bunded areas to a volume of 110% of the capacity of the largest tank/container within it (plus an allowance of 30 mm for rainwater ingress),
- Re-fuelling of construction equipment and the addition of hydraulic oil or lubricants to vehicles/ equipment will take place in designated bunded or hard standing areas where possible.

Operational Phase

Mitigation measures for the surface water system within car parks and trafficked areas include the existing interceptors which will be monitored and maintained to ensure that the required level of protection form accidental spillage is maintained.

Operations such the movement of passengers from the cruise ship should be undertaken in accordance with Dun Laogharire harbour's EMP to minimise the risk of potential spillages.

5.5.5.4 Predicted Impact Of The Proposal

Construction Phase

The mitigation measures proposed for the development will ensure that the predicted impacts on the receiving environment will not occur. The impact during the construction phase is classified as Short Term- Imperceptible with a neutral impact on quality.

Operational Phase

The mitigation measures proposed for the development will ensure that the predicted impacts on the receiving environment will not occur. The impact during the operational phase is classified as Long Term- Imperceptible with a neutral impact on quality.

Worst Case Scenario

The worst case scenario for the onshore works would be leakage from the stormwater system during a hydrocarbon spill in the port facility. Such an event is unlikely due to the routine maintenance of the stormwater system and the unlikely event of a spill occurring. Any spillage will be of low volume. Furthermore retardation of the contaminants will be provided by the soil media therefore any hydrocarbons reaching the harbour waterbody will be of low concentration with subsequent minor impact on water quality.

5.5.6 Monitoring

Monitoring of ongoing operations will be undertaken in accordance with international practice for cruise ships in port and Dun Laoghaire's port EMP.

Water quality monitoring of Dublin Bay will be undertaken by the EPA as a continuation of the monitoring programme as required under the Water Framework Directive and Bathing Water Directive.

5.5.7 Reinstatement

No Reinstatement is required as part of the proposed works.

5.5.8 Foul Water, Surface Water and Water Supply

Section 5.5.8 to 5.5.12 inclusive addresses the impact of the land side elements of the proposed development on the existing harbour foul water, surface water and watermain infrastructure.

Water supply, waste water drainage and surface water runoff from the landside facilities are addressed.

5.5.9 Methodology

A desk top study of existing records was carried out and the following documentation and mapping was consulted:

- Ordinance Survey of Ireland Mapping
- Dun Laoghaire Rathdown County Council records of existing public watermains and public waste water and storm water sewers.
- Dun Laoghaire Harbour Company records of existing services within the harbour area
- Topographical survey of the area prepared by Baseline Surveys in 2013
- Watermain pressure and flow testing at Queen's fountain, Dun Laoghaire in 2013

In addition, an inspection of the existing drainage was carried out on site. This inspection included the lifting of manhole lids to check the condition of the sewers.

5.5.10 Foul Water Drainage

5.5.10.1 Receiving Environment

There is an existing foul water drainage system which serves the existing Motorists Building and the Stenna security building at the entrance to the Stenna vehicle storage area.

These drains are connected to the drainage for the Stenna terminal building which discharges to a private pumping station located within the Stenna vehicle storage area. Waste water is pumped from this pumping station to the public sewer at the entrance to the harbour.

There are no reports of any malfunctioning or defects in the existing foul drainage system.

There are no known direct foul water discharges to the harbour water body from the development site.

Refer to the figure below for details.

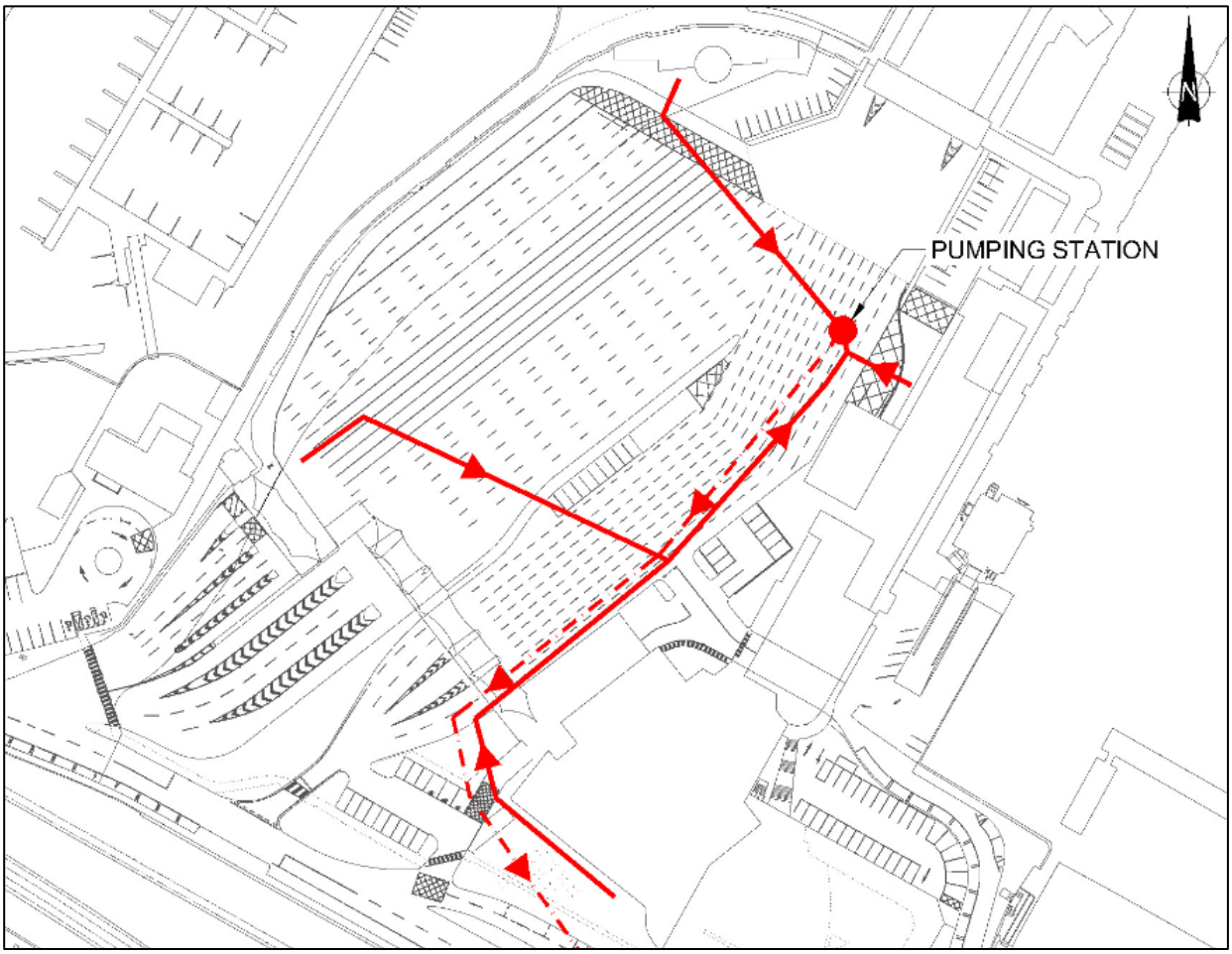

Figure 5.5.9: Existing Foul Sewer Drainage Network

5.5.10.2 Characteristics of the Proposal

Construction Phase

During the construction phase the existing foul drainage serving the Security Building will be decommissioned and the existing drain to serve the Motorist Building cruise facility will be upgraded.

Operational Phase

Waste water facilities will be required for the service building at the location of the existing Motorists Building. This building will provide wash room facilities for the cruise terminal only and will not be available to the general public.

It is intended that the wash room facilities will make use of the existing waste water drain shown in Figure 5.5.9.

5.5.10.3 Potential Impact of the Proposal

Construction Phase

During the construction phase there is a potential for damage to the existing drainage system when excavating trenches for other services and for foundations.

During the reconnection of the Motorist Building there is a potential for debris entering the drainage system causing blockages or damage to the pumping station.

Operational Phase

The operational phase of the development will discharge waste water from the wash room facility to the existing private drainage system. The volume of effluent that will be discharged to the sewer system has been estimated as follows:

Vessels considered	Lower Range	312 guests
	Upper Range	3,780 guests
Total guests two vessels simultaneous		4,092 guests
Percentage disembarking		60% average estimate
Total disembarking		2,455 guests
Assess 20% using washroom facilities		490 guests
Flow l/day/person		
(EPA WWT Manual Table 3)		5 l/day/person
Total projected waste water discharge		2.45 m^3/day

This is a low flow (approximately the equivalent of the daily discharge from 4 dwellings) and the existing sewer system is capable of accommodating this flow.

There will be no connection from the vessels to the sewer system and therefore there will be no direct impact by the cruise ships on the foul sewer system.

There will be no direct discharge from the vessels to the water body and therefore there will be no impact on the water body from waste water discharges from the vessels.

Do-Nothing Impact

In the do-nothing scenario there will be no change to the foul sewer system and therefore there is no impact on this service.

5.5.10.4 Avoidance, Remedial or Reductive Measures

Construction Phase

Prior to the commencement of the construction phase on site, the existing drains within and adjacent to the construction site will be inspected and a CCTV record of the drain conditions will be made. Any repairs required to the drains which are to be retained will be carried out during the construction phase.

In areas where the location of the drains are not clearly known, hand excavation and exploratory slit trenches will be carried out prior to any bulk excavations taking place.

On completion of the construction works, an inspection of the new and existing retained drains will be carried out including a CCTV survey to ensure that no damage has occurred to the drain system.

Operational Phase

As there will be no significant impact on the foul drain system following completion of the construction works, no remedial measures are proposed for the operational phase.

5.5.10.5 Predicted Impact of the Proposal

Construction Phase

If the remedial measures noted are implemented there is no predicted adverse impact on the foul drain system.

In the event that defects are identified within the existing foul drain system these will be repaired as part of the construction phase for the proposed development and an improved performance of the existing system will result.

Operational Phase

There will be no adverse impacts on the foul drain system resulting from the proposed development.

Worst Case Impact

Worst case scenario would be significant damage to the existing drain system during the course of construction. This is an unlikely impact and may occur only in the event that the remedial or reductive measures are not implemented. In the event of damage occurring, this will be detected and will be easily repaired prior to commissioning of the drains. No short or long term impacts on the foul drain system is envisaged.

5.5.11 Surface Water Drainage

5.5.11.1 Receiving Environment – Land Side

The proposed development site consists of an existing surfaced car park which is used for a standing area for the Stena Dun Laoghaire to Hollyhead fast ferry.

This area is used to store waiting vehicles, private cars and HGV's waiting to board the ferry vessel. Vehicles unloading from the vessel generally depart directly from the unloading ramps on to Harbour Road and to the public road networks with only very short delays.

The entire area approximately 4.3 ha is used for the vehicle holding area and has been paved with impermeable paving consisting of black top and cobble lock surfacing. The surface water drainage consists of gullies discharging to an existing piped surface water collection network. The piped system discharges to the receiving water body via light liquid separator at three outfalls. Figure 5.5.10 below indicates the existing surface water arrangement.

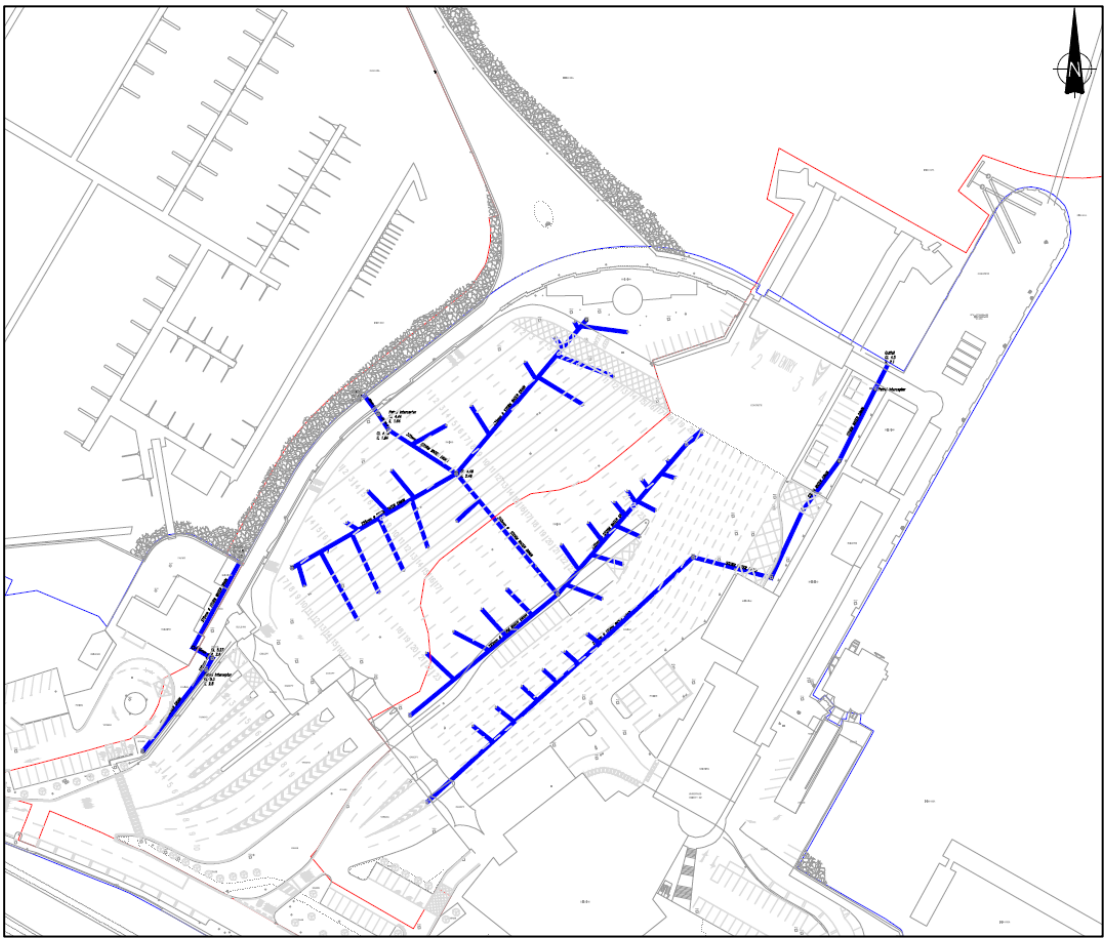

Figure 5.5.10: Existing Surface Water Drainage Network

5.5.11.2 Characteristics of the Proposal

Construction phase

Impact on the existing surface water drainage system will be minimised as far as possible during the construction phase. The proposed development involves the resurfacing of certain areas of the public walkways and the existing vehicle standing area and does not involve any significant adjustments to the existing surface water drainage system. The existing security wall to the vehicle staging areas will be removed and new high quality surface finishes are proposed in the public pedestrian areas. The existing surfacing to the vehicle staging area will be retained where possible to provide a coach loading and unloading area.

These construction works will involve the relocation of some gullies in the vicinity of the boardwalk and the alteration of some local drainage systems. The function of the existing drainage system will be retained, no works to the existing light liquid separators are envisaged and the existing surface water discharges to the harbour water body will also be retained.

Operational Phase

During the operational phase, surface water from the pedestrian walkways and the proposed coach parking area will be collected via gullies to the surface water drainage system and discharged to the harbour water body. Refer to the figure below for details.

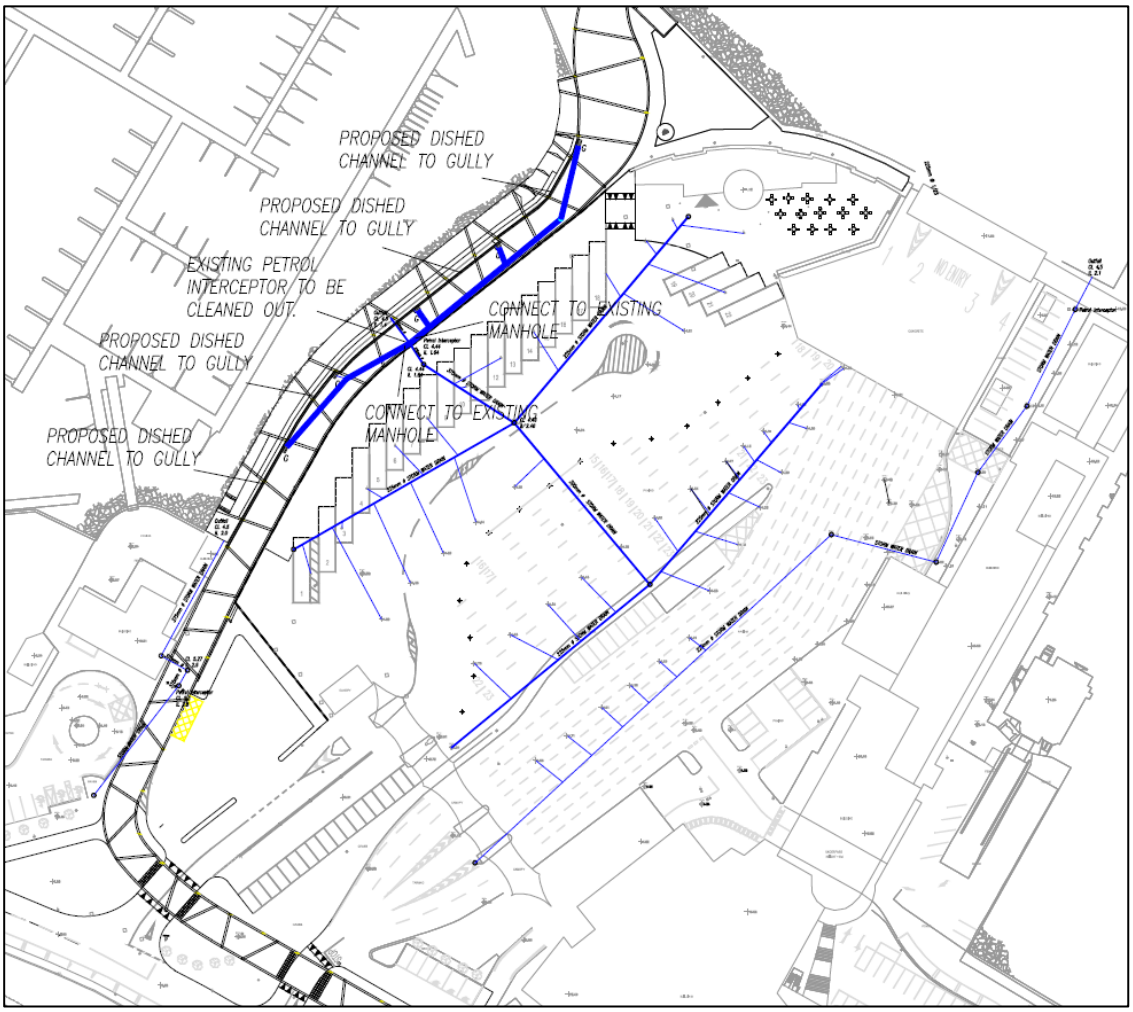

Figure 5.5.11: Proposed Surface Water Drainage Network

5.5.11.3 Potential Impacts of the Proposal

Construction Phase

During the construction phase, the potential impacts of the proposal on the surface water drainage network are limited to the accidental discharge of contaminants, typically fuels and hydrocarbons, to the surface water drainage system. Damage to the pipe network, manholes or existing light liquid separators may also occur.

Operational Phase

Potential impact of the proposal during the operational phase is the accidental spillage of fuels or hydrocarbons onto the hardstanding area drained to the surface water drainage system.

Discharges of normal car parking contaminants to the surface water may also be expected.

Do-Nothing Impact

In the event that the project does not proceed, the status quo of the existing drainage system will be retained. The existing pipe network and the light liquid separators will continue to function as before.

5.5.11.4 Avoidance remedial or reductive measures

Construction Phase

During the construction phase, all chemical and fuel storage areas will be segregated within appropriate storage and bunded areas to ensure their separation from the surface water drainage system. Construction equipment will be refuelled within bunded areas capable of retaining any possible spillage of fuel during the re-fuelling process and protecting the surface water drainage system from the possible accidental spillages.

The Contractor for the construction works will be required to prepare a pollution incident management plan, which will include detailed procedures and equipment required to be maintained on site in the event that an uncontrolled discharge of construction pollutants, which may impact on the surface water drainage system, occurs.

Operational Phase

During the operational phase, the existing light liquid separators will be monitored and maintained to ensure that the required level of protection form accidental spillage is maintained.

The existing Dun Laoghaire Harbour emergency management system will be extended to address the proposed coach parking areas both first wave and second wave parking at the proposed coach overflow holding areas at Old Quay and along the DART railway line.

5.5.11.5 Predicted impact of the proposal

Construction Phase

If the proposed remedial measures are implemented during the construction phase, the likeyhood of any damage to the surface water drainage system is very low and the impact of an accidental spillage on the surface water system will be controlled and minimised.

Operational Phase

If the proposed remedial measures are implemented during the operational phase, in particular the maintenance regime of the light liquid separators, the impact of the proposed development will be negligible and may be considered as less than the possible impact of the current operations of the ferry standing area.

Worst Case Impact

In the event of a major spillage of petrol or oils within the coach parking area, this will be controlled by the Dun Laoghaire Harbour emergency plan and by the existing light liquid separator on all outfalls from the drainage system to the harbour water body.

5.5.12 Water Supply

5.5.12.1 Receiving Environment

Water to the development area is provided by a 150mm public water main along Harbour Road.

This existing water supply to the proposed development area consisting of the following:

1. Water to the existing Motorists building for washroom and small scale catering facilities.
2. Water to the security facility at the entrance to the existing Stenna ferry holding area.
3. Water to existing fire hydrants serving the Stenna Ferry holding area.

Figure below indicates the existing water supply to the site.

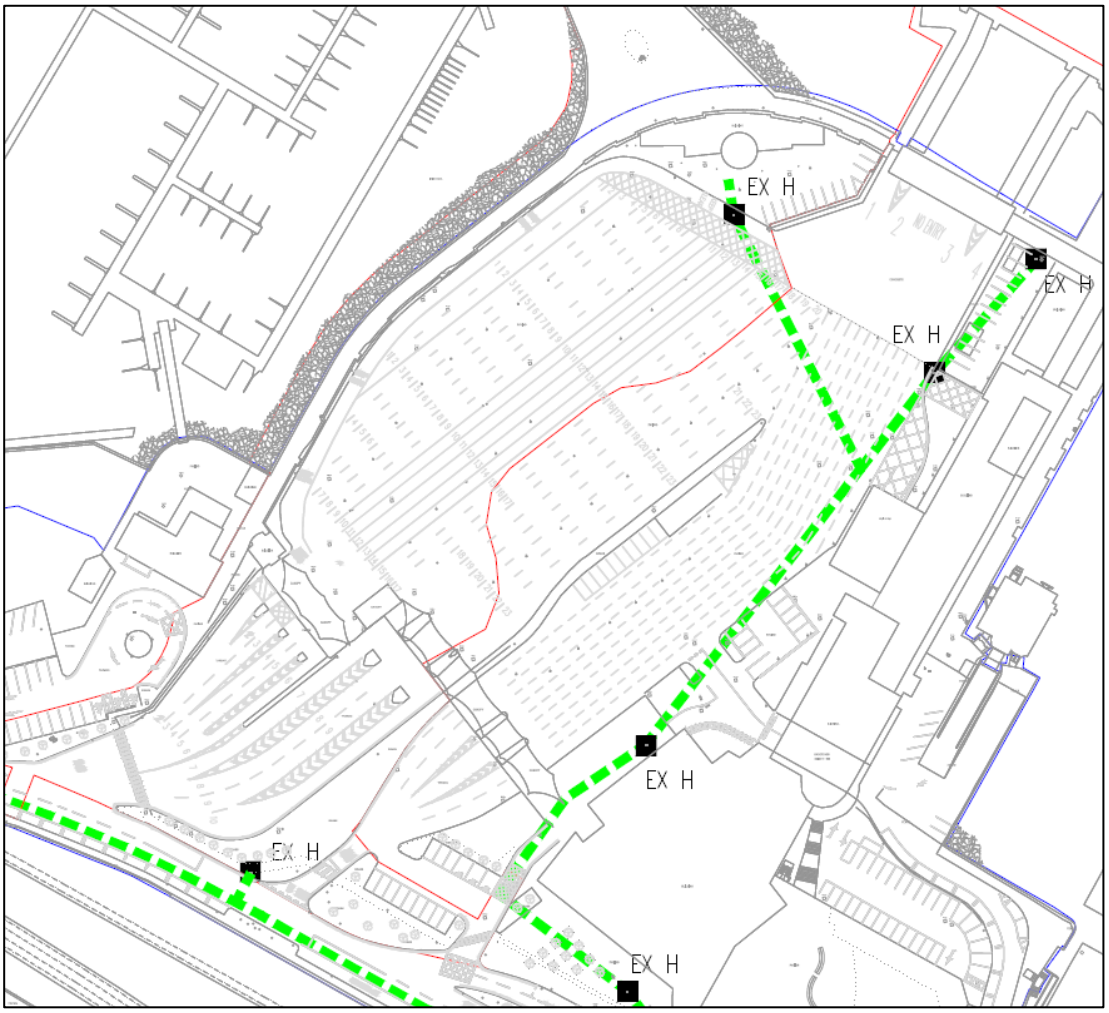

Figure 5.5.12: Existing Water Supply

A pressure flow test was carried out by Dun Laoghaire Rathdown County Council at the request of the applicant in September 2013. This test indicated that there is a flow of 26.5 l/s at a pressure of 3 bar.

5.5.12.2 Characteristics of the proposal

Construction Phase

During the construction phase, some adjustments to the existing water supply system will be required. These adjustments are expected to be relatively minor and will not impact on the existing water supply system.

Operational Phase

In terms of water supply, the proposed development will make use of the existing supply to the Motorists Building and cut off the supply to the control facility to the Stenna Ferry holding area. Other than the addition of two fire hydrants at jetty, no material changes to the existing fire hydrant facilities are envisaged. Additional fire hydrants will not be serving the vessel.

This water demand has been estimated as follows:-

Vessels considered	Lower Range	312 guests
	Upper Range	3,780 guests
Total guests two vessels simultaneous		4,092 guests
Percentage disembarking		60% average estimate
Total disembarking		2,455 guests
Assess 20% using washroom facilities		490 guests
Flow l/day/person		
(EPA WWT Manual Table 3)		5 l/day/person
Total projected water to supply		2.45 m^3/day

It is proposed that, in order to isolate the existing Motorists Building and the hydrants to the proposed quay, a new metered watermain be constructed along the proposed pedestrian route.

A new connection to the existing water supply on Harbour Road will be required. This will involve the construction of a new tapping to the existing watermain and the installation of a new meter to monitor water supply to the new quay. The existing supply to the Motorists Building will be diverted to connect to the new meter to ensure that all activities associated with the new quay are monitored by a single meter.

Figure below indicates the proposed water supply to the site.

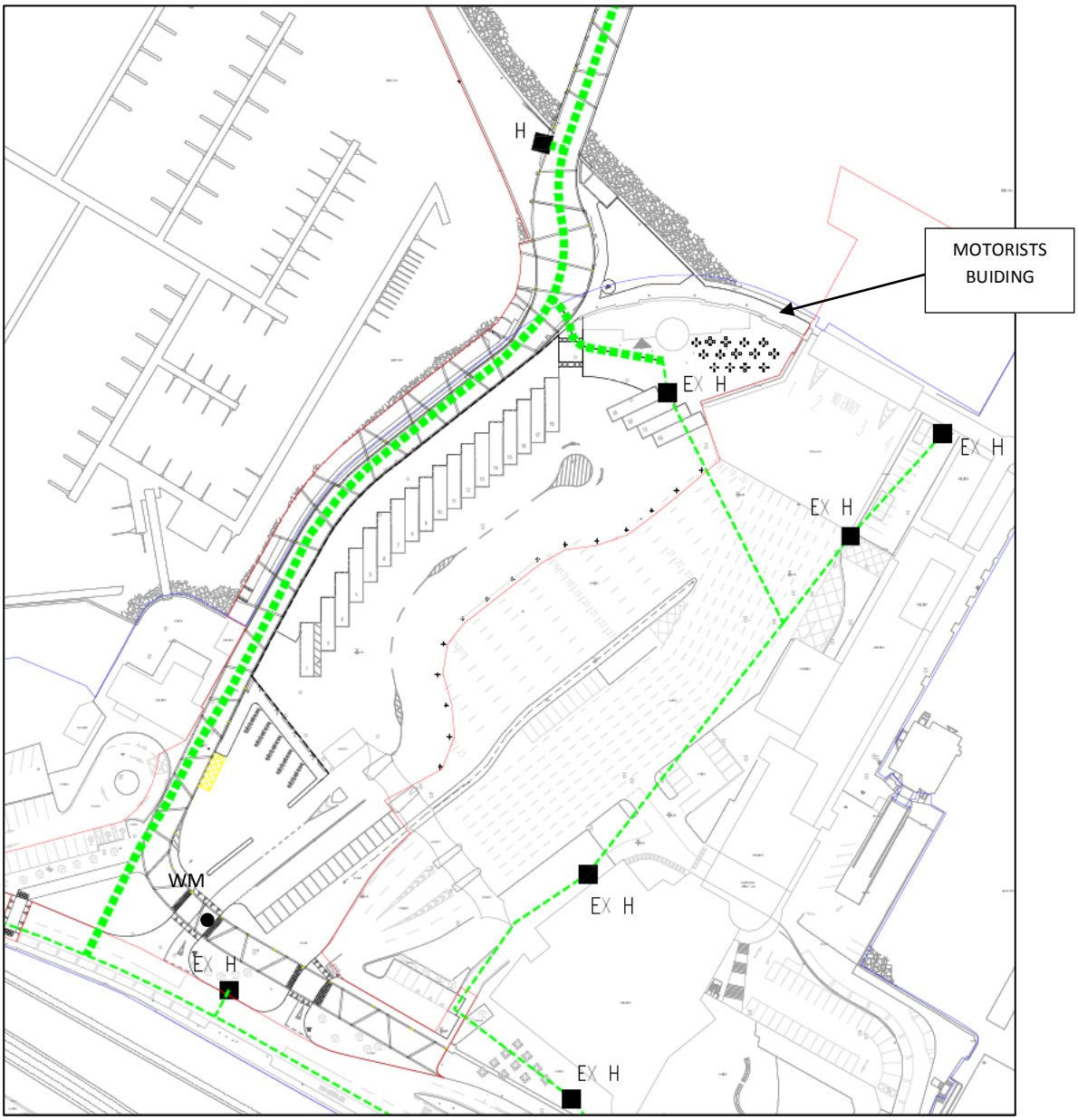

Figure 5.5.13: Proposed Water Supply

5.5.12.3 Potential Impact of the Proposal

Construction Phase

As there will be minimal intervention to the existing water supply to the development area, the potential impact of the proposal on the existing water supply will be insignificant.

As a result of the proposed adjustments to the existing water supply, there is a potential of damage and contamination of the existing supply.

Operational Phase

The water demand from the proposed development will possibly increase during a ship visit as a result of cruise passengers using washing facilities at the Motorist building.

Do-Nothing Impact

In the event that the proposed development does not proceed, there will be no change to the existing water supply network in the area of the development.

5.5.12.4 Avoidance Remedial measures

Construction Phase

During the construction phase, all adjustment to the water supply and the laying of new water mains will be carried out in accordance with Dun Laoghaire Rathdown County Council Code of Practice for water supply.

All new watermains will be swabbed and chlorinated in accordance with the Council's requirements before being commissioned and connected to the public water supply system.

All connections to the public water supply system will be made under the supervision of Dun Laoghaire Rathdown County Council.

Operational Phase

The water supply to the development will be monitored by a bulk meter which will measure all water used on the pedestrian route, Motorists Building and at the quay itself. Any exceptional usage of water will be noted and any required corrective measures will be implemented.

New water mains to be constructed as part of the proposed development will be installed in locations which are accessible by repair equipment and crews and access to the entire length of the main will be maintained.

Records of the location and equipment installed will be maintained to facilitate future maintenance and repair of the main.

5.5.12.5 Predicted Impact

Construction Phase

As the intervention of the proposed development on the existing water supply is minimal and all connections to the existing water supply will be monitored by DLRCC, the construction impacts of the proposed development is not expected to be significant.

Operational Phase

There will be no significant increase by the proposed development in the consumption of water and the impact of the operational phase on the existing water supply network is not considered significant.

As water consumption within the area of the development is to be metered, the proposed development will provide additional protection against potential water losses or leakage in the area.

Worst Case Impact

The worst case landside scenario would be a major break in the new water supply system. This scenario is unlikely and in the event that a significant break occurs it will be identified on the ground or noted by the routine reading of the water meter. Routine repairs if required will not unduly disrupt the usage of the Motorists Building.

An infrequent yet plausible worst case maritime scenario relates to water supply to a cruise vessel. Cruise vessels normally fill with their full complement of fresh water at their home port prior to departure. Cruise vessels come fitted with filtration systems and therefore are generally self-sufficient in relation to fresh water. As a result no routine water supply to vessels seems warranted, particularly as the proposed cruise berth will be a port-of-call facility only (i.e. no terminal facilities).

Ships' Masters may occasionally request a fresh water supplement at ports-of-call in instances, for example, if filtration systems aboard temporarily malfunction before return to the home port for full replenishment. In such instances the Harbour Company may require to be able to offer a limited volume of water off-peak while passengers are not on board. This low volume water supply would be supplied at ambient pressures and would be monitored by a bulk meter. Any exceptional usage of water would be recorded and any required corrective measures would be implemented by Harbour Company staff who are trained in infrastructure management.

In mitigation, such need would normally be requested by the ship's Master approximately 24Hrs in advance of arrival at port to allow mains pressure checks to be confirmed. Supply could be restricted to off-peak periods preferably during the daytime. Supply and mains pressure would be monitored, and metered, to ensure other Harbour Users are not unduly inconvenienced. In instances where water pressure on the watermain, as identified by DLRCC personnel in 5.5.12.1 above, drops below a sustainable level then supply to a vessel would be restricted or refused. This should ensure that draw down from the main only occurs when pressure is available, thereby converting a nominally 'worst case' scenario to that identified in 5.5.12.5.2 above, namely to the normal scenario where there should be no enduring significant impact to Harbour Users.

5.5.13 Flood Risk

The remaining sub-sections of this chapter examine flood risk. The proposed development was assessed to determine the flood risk for the purposes of this EIS. A desk top study was carried out to establish potential changes the flood risk in the area.

This study included reviews of the following sources:

- The Planning System and Flood Risk Management Guidelines for Planning Authorities Planning, DEHLG/OPW 2009
- The Irish Coastal Protection Strategy Study (ICPSS), OPW 2010
- Cruise Berth, Dun Laoghaire Harbour: Wave, Tide and Sediment Plume Modelling by ABP Marine Environmental Research Ltd., ABPMER 2014
- Dun Laoghaire Harbour Masterplan Flood Risk Assessment, July 2011
- Global and European sea-level rise (CLIM 012) Assessment, European Environment Agency, EEA 2014

5.5.13.1 Receiving environment

The Harbour is located at the coastline of Dun Laoghaire town, County Dublin, on the east coast of the Republic of Ireland, within the Irish Sea on the North East European Continental shelf.

The subject site is at a lower level than the immediate townland. The landside portion of the proposed development is located entirely on made ground and underlain by Wicklow Granite. There is no major watercourse in the vicinity of the site. Although Dun Laoghaire Town constitutes surface gradients towards the Harbour those contours are intersected by the railway reservation and Crofton Road. The latter have their own surface water storm drainage systems. Therefore there is no significant contributing catchment area above the site.

The main source of flooding for the site is therefore coastal flooding and potentially flooding from the Harbour's foul and storm water drainage system.

Coastal Flooding

Coastal flooding is caused by higher sea levels than normal, largely as a result of storm surges, resulting in the sea overflowing onto the land. Coastal flooding is influenced by high tide level, storm surges, and wave action exacerbated by any intended lowering in surface level.

The recorded high tidal level information for Dublin Port is as follows:

- Highest Astronomical Tide +2.09mODM
- Mean High Water Springs + 1.59m ODM

Climate change effects are expected to emerge over time. For a medium low emissions scenario (EEA 2014), according to published findings of the European Environment Agency, there is growing scientific opinion that climate change is expected to raise mean water levels in the study area by between 0.3m and 0.4m by the period 2081 to 2100, relative to sea levels in the period 1986 to 2005.

The Irish Coastal Protection Strategy Study (ICPSS) is a national study that was commissioned in 2003 with the objective of providing information to support decision making about how best to manage risks associated with coastal flooding. The prediction of extreme water levels is a key element of flood risk assessment. Two future scenarios were considered representing a Mid-Range Future Scenario (MRFS) and High End Future Scenario (HEFS).

The ICPSS gives the following extreme tide plus surge levels:

- 1 in 200 year water level of 2.99m OD Malin
- 1 in 1000 year water level of 3.21m OD Malin

Assuming conservatively the ICPSS's suggested allowance for mean sea level rise is 0.5m up to year 2100 for the Mid-Range Future Scenario (MRFS), the rise in sea level due to climate change would yield:

- 1 in 200 year extreme water level of 3.49m OD Malin
- 1 in 1000 year extreme water level of 3.71m OD Malin.

According to the Dun Laoghaire Harbour Masterplan Flood Risk Assessment of July 2011, the landside portion of the proposed development on the Eastern Breakwater is located within Flood Zone C.

Flood Zone	Flood probability	Level (m ODM)
A	greater than 0.5% (1in200)	below +3.49m
B	0.5% (1in200) to 0.1% (1in1000)	+3.49m to +3.71m
C	Smaller than 0.1% (1in1000)	above than +3.71m

Figure 5.5.14: Dun Laoghaire Harbour Flood Zones*

*Excerpt from the Dun Laoghaire Harbour Masterplan Flood Risk Assessment, July 2011

A section of the western edge of the East Pier is located in flood Zone A.

A number of areas of the yacht clubs and RNLI are at levels in Zone A however these activities would be deemed suitable for this zone.

There are a few small areas located on the East Pier that fall into Zone B – again as above these activities would be deemed suitable for this zone.

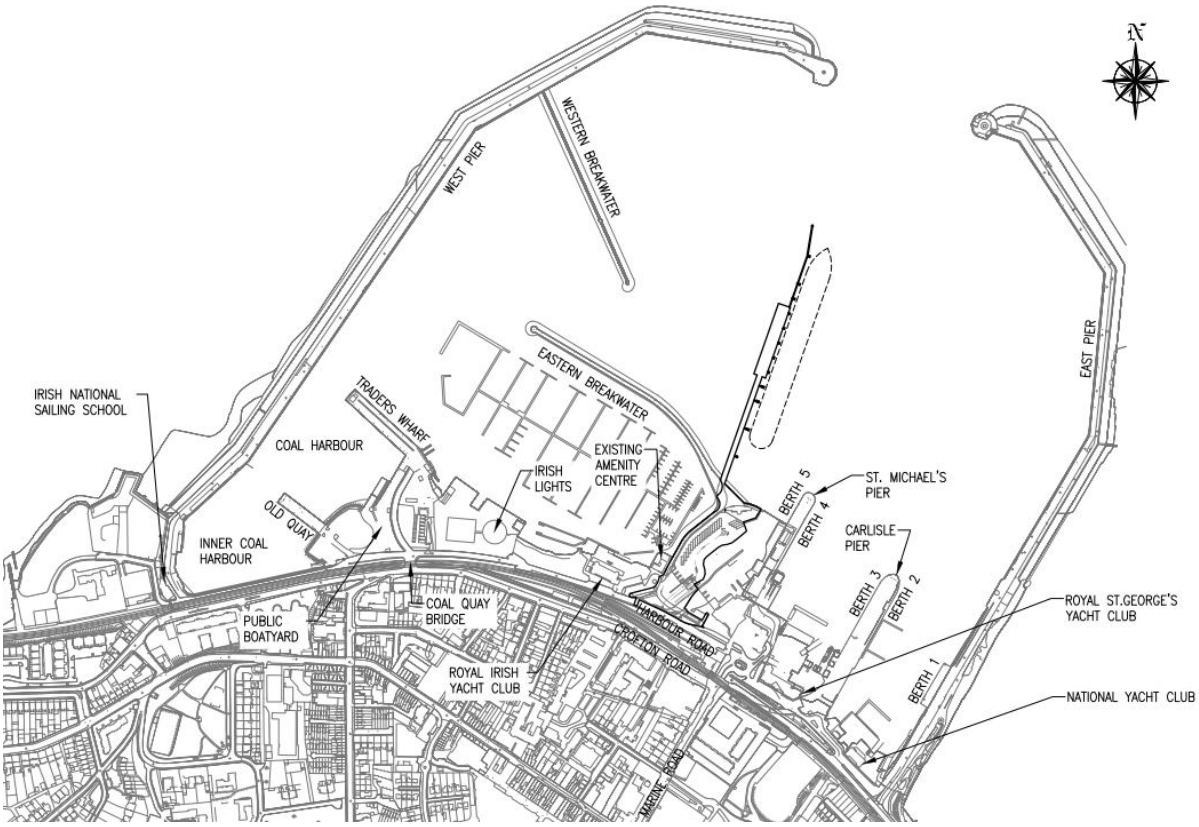

Figure 5.5.15: Harbour showing Proposed Berth Location

Flooding from drainage system

There are no reports of any malfunction or defects in the existing foul or surface water drainage systems that serve the subject site. Tidal flap valves already exist to exclude sea water from the surface water system

5.5.13.2 Characteristic of the proposal

Construction phase

Maritime works for the proposed development include the installation of a new piled suspended jetty and capital dredging works. The dredging works proposed include the construction of a dredge channel below existing seabed level to a depth of -10.5m CD of navigable width 120m.

Landside works will include installation of a new suspended boardwalk, resurfacing and small local modifications to accommodate coach parking.

It is envisaged that the existing levels along the quay waterfront will be generally unaffected by the construction works.

No deep excavations or alteration to existing water's edge are envisaged as part of the landside construction works. All excavations of materials are envisaged above the water level.

Operational Phase

The development will comprise access ways and infrastructure to accommodate passenger access once the cruise ships have berthed, that is following transit directly to the proposed berth in the centre of Harbour from the Harbour Mouth - refer to Figure above.

Apart from removal of a short section of handrail plinth, there will be no change to the existing Eastern Breakwater levels as a result of the proposed development. The levels of the proposed development along the water's edge as per existing vary from 4.4m to 4.6m OD Malin, as per existing levels.

The proposed landside development will not significantly increase the load on the existing foul and storm drainage network.

Further to the above, a Justification Test of the proposed development in terms of flooding (based on Section 3 of the 2009 DEHLG/OPW Guidelines) was conducted. This test classified the development as being appropriate from a flood risk perspective.

5.5.13.3 Potential Impact of the Proposal

Construction phase

Given that the subject site at the Eastern Breakwater is generally sloping towards the sea and that it is located within an area with a low probability of flooding from the sea (Flood Zone C) and that no deep excavations or change in levels along the waterfront are envisaged, there will be no increase in the existing flood risk from coastal flooding during construction phase of the proposed landside development.

Similarly, for the previously mentioned areas of the East Pier and yacht club areas, the Masterplan 2011 flood risks will remain unchanged – see Figure 5.5.14 above.

Operational Phase

The proposed landside development at the eastern Breakwater lowest level is 4.4m OD Malin (same as existing). During the 1 in 1000 year extreme event with water level reaching 3.71m OD Malin (including 0.5m for sea level rise) the freeboard will still be 0.69m when surge predictions are included.

Similarly, for the previously mentioned areas of the East Pier and yacht club areas, the Masterplan 2011 flood risks will remain unchanged – see Figure 5.5.14 above.

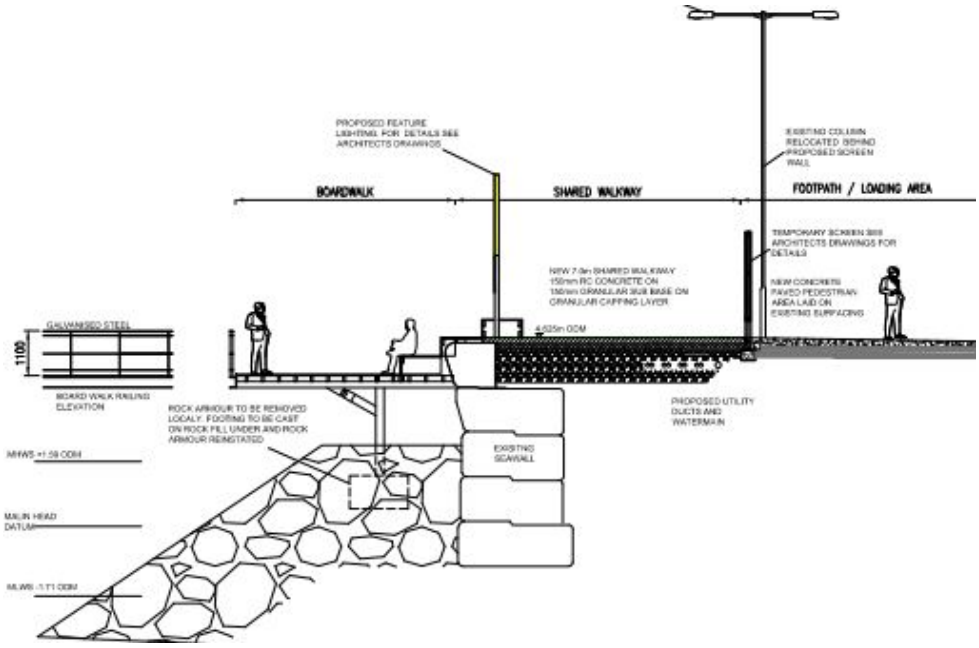

Figure 5.5.16: Proposed Boardwalk

The level of the proposed public boardwalk will place it in the Zone A flood risk category, putting it in the same exposure in the longer term as the existing East Pier. The boardwalk will be in a more sheltered area inside the marina breakwater compared to the exposed East Pier and therefore at relatively reduced risk of overtopping.

Compared to an existing recorded highest astronomical tide of +2.09m ODM the boardwalk will have a freeboard in excess of 1.0m at opening to cruise traffic, which would provide a sensible allowance for climate change and overtopping.

The effects of dredging have been established in the October 2014 report by Allied British Ports Marine, Environmental Research Ltd Wave, Tide and Sediment Plume Modelling (Refer EIS Appendix 5.4.1, in Volume 2).

The result of this modelling of the dredging under extreme environmental conditions has yielded the following general patterns of change:

- A reduction in wave height and possibly also steepness inside of the harbour between the main entrance and the entrance to the inner harbour, to the west of the dredged channel;
- A reduction in wave height and possibly also steepness outside of the harbour within the turning circle and dredged approach channel;
- An increase in wave height and possibly also steepness inside of the harbour in the eastern part of the harbour and along the dredged channel to the new jetty and existing Ro-Ro (Stena ferry) berth (see Worst case scenario section within this chapter for details);
- An increase in wave height and possibly also steepness outside of the harbour to the north of the turning circle;
- Wave heights in the north western harbour and the inner harbour are not measurably affected (>±0.05 m) under any of the wave conditions tested;
- Impacts on wave period in all locations and under all wave conditions tested are negligible (<±0.1 s); and

- Impacts on wave direction relate to refraction caused by the change in bathymetry in the footprint of the dredged channel. Absolute differences in mean wave coming direction locally are however relatively minor (typically <±1°, maximum ±4°) in all locations and under all wave conditions tested.

The ABPmer report suggests a predicted increase in wave height under extreme storm conditions of up to 0.15m, or 0.05m to 0.10m for more favourable wind directions depending on location within the Harbour. Broadly, the development decreases waves where they are currently highest, and increases waves marginally where they are currently more benign.

5.5.13.4 Avoidance, Remedial or Reductive Measures

Construction phase

The Contractor will be required to develop and implement a Construction and Demolition Management Plan. The Construction and Demolition Management Plan will include an Emergency Response Plan which will outline procedures to be undertaken in an unlikely event of flooding to avoid and mitigate its temporary effects at the area of the proposed landside development on the Eastern Breakwater.

Operational Phase

The existing Dun Laoghaire Harbour emergency management plan will be addressed to encompass and cater for the presence of the proposed cruise facility.

All surface water runoff will be discharged through a suitable light liquid separator will be kept maintained. Existing tidal flap valves on the surface water discharge points will be retained and kept in working order.

For areas of the East Pier and yacht club areas as per the Masterplan 2011, flood risks will remain unchanged – see Figure 5.5.14 above.

5.5.13.5 Predicted Impact of the Proposal

Construction phase

During the construction phase of the proposed development there should be no impact on the existing flooding levels within the harbour or surrounding areas.

Operational Phase

Given that the proposed development is located on the coastline, and that the site itself is generally sloping to the sea and that there will be no change to the existing levels or significant rise in demand on foul and surface water drainage network, the proposed development will not increase the flood risk in the harbour area and therefore have no impact on the existing flooding conditions. For areas of the East Pier and yacht club areas, the Masterplan 2011 flood risks will remain unchanged – see Figure 5.5.14 above. The proposed boardwalk level will have sufficient freeboard allowance for climate change.

During the operational phase of the proposed development there should normally be no perceptible impact on the existing flooding levels within the harbour or surrounding areas.

Worst Case

The presence of the dredged channel was assessed under a range of extreme operating conditions. According to the ABPMER 2014, under the worst case scenario, (with wind/wave return period of 1:50, coming direction at DLH 60/85 °N) an increase in wave height up to 0.15m, and possibly also wave steepness, inside the south-eastern part of the Harbour, and up to 0.1m along the dredged channel and at the existing Stena Line ferry berth may be expected.

The probability of occurrence of the modelled wave height added to the already predicted 1:1,000 extreme water event (coincident with surge) is extremely low, and unrealistic.

As a result, under a worst case scenario, the 1 in 200 extreme water level may reach 3.64m OD Malin (including climate change) for example in the south-eastern part of the Harbour. However, this will result only in (A) imperceptible change in the existing available freeboard associated with the Harbour flood risk zones outlined in Figure 5.5.14, and (B) nominally increased risk of overtopping compared to the existing well know overtopping regime.