8.0 EFFECTS ON THE ENVIRONMENT: Water.

8.1 Introduction.

8.1.1 This chapter assesses the potential impacts of the Draft Planning Scheme at Poolbeg Peninsula on the existing water environment during both the construction and operational phases. Accordingly, this chapter discusses the potential impacts of the Draft Planning Scheme on surface water and groundwater as well as river and coastal flooding and the abatement measures that may be employed to reduce/ eliminate all potential impacts associated with both phases where necessary.

8.2 Assessment Methodology.

8.2.1 The assessment of the potential impact of the Draft Planning Scheme on the water environment was based solely on a desk-based study as it was considered there was sufficient information available upon which to base an impact assessment.

8.2.2 The following sources of data were used in this assessment:

- The Geological Survey of Ireland (GSI) geological maps and records for the area were inspected with reference to groundwater, including the Groundwater Protection Scheme.
- EPA water quality data reports.
- The *Greater Dublin Strategic Drainage Study* policy document on climate change.
- The *Final Report of the Dublin Coastal Flooding Protection Project.*
- *Dublin City Development Plan 2005-2011*;
- Past / recent site investigation / environmental assessment reports as referenced in this chapter and also in Chapter 7.0 of this document.

8.2.3 Mott MacDonald Pettit produced a desk based strategic level flood risk assessment report for the proposed scheme which is contained within Appendix 8.1. The report addresses the scoping and screening phases of flood risk assessment as described in the Department of the Environment, Heritage and Local Government Consultation Draft Guidelines for Planning Authorities concerning the planning system and flood risk

management published in late September 2008. The strategic level flood risk assessment report is sufficient to show that the development will not increase flood risk elsewhere and that the development proposals include appropriate measures to reduce flood risk as outlined in this chapter under mitigation.

8.3 The Receiving Environment.

8.3.1 Surface Water.

Existing Water Bodies.

8.3.1.2 The water bodies of interest are Dublin Bay and the River Liffey estuary.

8.3.1.3 Dublin Bay is a shallow bay with water depths not greater than 20m at low tide at its outer limit between Sorrento Point and Baily at Howth. The water depth decreases towards the harbour with depths of less than 5m occurring in the inner half of the Bay. North of the harbour at Bull Island and south around Sandymount extensive areas dry out at low tide.

8.3.1.4 The River Liffey (Hydrometric Area 09; Code Ref: 09/L/01) rises between the mountains of Kippure and Tonduff in County Wicklow and flows for a distance of around 120 km before reaching the sea in the east at Dublin Bay. It enters Dublin Bay between Clontarf and Ringsend in the channel formed by the North Bull Wall and the Great South Wall.

8.3.1.5 Water quality within rivers is monitored on average each year by the EPA and provides a river by river assessment of water quality. The results of the monitoring programme serve as a useful baseline/ background of the river quality of that stretch of the particular river monitored.

8.3.1.6 ‘Q Values’ are used to express the biological water quality by the EPA, based on changes in the macro invertebrate and plant communities of riffle areas brought about by organic pollution. Q1, Q2 and Q1-2 indicates a seriously polluted watercourse; Q2-3 and Q3 indicates moderately polluted; Q3-4 indicates slightly polluted while Q4, Q4-5 and Q5 indicates unpolluted water.

8.3.1.7 Recent water sampling in the River Liffey has been carried out and includes water quality from the Liffey Estuary and Dublin Bay 2002 – 2006, taking in the stretch of the river from Islandbridge to Bull Wall. Table 8.3.1.1 and 8.3.1.2 below show the range of results for samples taken and monitoring carried out by the EPA for the Liffey Estuary during the period 2002 – 2006 (Islandbridge is the closest freshwater monitoring station to the Draft Scheme Area and is located approximately 6 km upstream of the same).

8.3.1.8 The latest biological quality rating (2006) for the stretch of the River Liffey at Islandbridge is Q4 (unpolluted). This has changed from the Q-value of Q3-4 in 2003 (slightly polluted). However, during the period 2002 - 2006 the Liffey Estuary (full stretch from Islandbridge to Bull Wall) was classed as intermediate, as both winter phosphorous and winter oxygen super-saturation breached their respective criteria.[1]

Table 8.3.1.1 EPA Estuarine Monitoring in Winter (based on data collected from 2002 -2006)

Estuary Winter											
Summary Stats	Salinity	Temp.	pH	Secchi	DO %	B.O.D.	TON	NH3	DIN	PO4	Chlorophyll a
DCC Data Winter	‰	(C)			Surface	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(ug/l)	mg/m³
MINIMUM	0.5	3.6	7.4	0.3	78.5	2.0	0.05	0.010	0.07	5	1.2
MEDIAN	31.5	8.3	7.9	1.3	99.3	2.0	0.30	0.080	0.42	45	1.7
MAXIMUM	34.5	18.0	8.2	4.0	155.8	13.0	3.02	8.270	10.25	1253	6.3
No of samples	500	489	479	269	488	383	493	462	493	501	248
05%ile ***/*** **90%ile**	5.2	5.7	7.8	0.5	91.4	**3.0**	**1.37**	**0.337**	**1.65**	**97**	**2.5**
95%ile	34.1	11.9	8.1	2.0	128.9	5.0	1.95	0.522	2.12	129	2.8

[1] Quality ratings of Q4 and higher represent satisfactory conditions where euthrophication is unlikely to be a problem

Table 8.3.1.2 EPA Estuarine Monitoring in Summer (based on data collected from 2002 - 2006)

Estuary Summer											
Summary Stats	Salinity	Temp.	pH	Secchi	DO %	B.O.D.	TON	NH3	DAIN	PO4	Chlorophyll a
DCC Data Summer	‰	(C)			Surface	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(ug/l)	mg/m³
MINIMUM	0.3	9.6	7.4	0.5	60.7	1.0	0.01	0.009	0.02	5	0.0
MEDIAN	32.8	14.2	8	2.0	98.4	2.0	0.08	0.070	0.20	38	3.2
MAXIMUM	34.4	23.8	8.3	7.5	142.5	27.0	2.45	2.518	2.64	1068	101.0
No of samples	1207	1205	1190	617	1166	910	1176	1184	1176	1084	616
05%ile / **90%ile**	13.4	10.4	7.8	0.8	80.0	**4.0**	**0.78**	**0.222**	**0.93**	**92**	**5.6**
95%ile	34.0	17.8	8.1	4.0	119.0	6.0	1.08	0.361	1.30	130	8.1

8.3.1.9 During the same sampling and monitoring period by the EPA (2002-2006) for the stretch of the River Liffey to Bull Wall, Dublin Bay was classed as 'unpolluted' as it did not breach any of the assessment criteria. Tables 8.3.1.3 and 8.3.1.4 below present sampling results for Dublin Bay in both winter and summer, respectively.

Table 8.3.1.3 EPA coastal monitoring, Dublin Bay in Winter (based on data collected from 2002 - 2006).

Dublin Bay Winter											
Summary Stats	Salinity	Temp.	pH	Secchi	DO %	B.O.D.	TON	NH3	DAIN	PO4	Chlorophyll a
Outer Winter	‰	(C)			Surface	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(ug/l)	mg/m³
MINIMUM	30.7	6.4	7.9	1.0	93.7	2.0	0.04	0.010	0.05	5	1.3
MEDIAN	33.6	9.1	8	1.8	99.1	2.0	0.16	0.035	0.19	26	1.7
MAXIMUM	34.4	12.0	8.1	5.8	112.7	6.0	0.33	0.171	0.45	54	4.1
No of samples	209	204	187	204	204	153	209	205	209	209	195
05%ile / **90%ile**	32.3	7.1	7.9	1.0	94.9	**2.0**	**0.26**	**0.088**	**0.32**	**40**	**2.4**
95%ile	34.2	11.7	8.1	3.2	108.9	3.0	0.28	0.098	0.33	43	3.1

Table 8.3.1.4 EPA coastal monitoring, Dublin Bay in Summer (based on data collected from 2002 - 2006)

Dublin Bay Summer											
Summary Stats	Salinity	Temp.	pH	Secchi	DO %	B.O.D.	TON	NH3	DAIN	PO4	Chlorophyll a
Outer Summer	‰	(C)			Surface	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(ug/l)	mg/m³
MINIMUM	32.5	10.1	7.9	1.5	86.2	2.0	0.01	0.010	0.02	4	0.4
MEDIAN	33.9	14.5	8.1	3.5	101.3	2.0	0.01	0.010	0.03	10	3.3
MAXIMUM	34.7	18.0	8.3	8.0	953.0	7.0	0.09	0.112	0.16	51	17.6
No of samples	281	281	270	231	277	123	270	271	270	235	248
05%ile / **90%ile**	33.2	10.4	8	2.0	95.6	**3.0**	**0.04**	**0.032**	**0.08**	**25**	**6.5**
95%ile	34.2	16.7	8.2	5.3	116.1	4.0	0.07	0.050	0.09	31	7.3

8.3.1.10 In the EPA-published report '*Water Quality in Ireland 2006 – Key Indicators of the Aquatic Environment*' the biological status of water quality in the Liffey Estuary and in Dublin Bay was outlined. The water quality status of the Liffey Estuary was reported as 'Intermediate', meaning slightly eutrophic, while both points monitored in Dublin Bay were reported as 'Unpolluted, or not eutrophic'.

Existing Discharge Points to Surface Water.

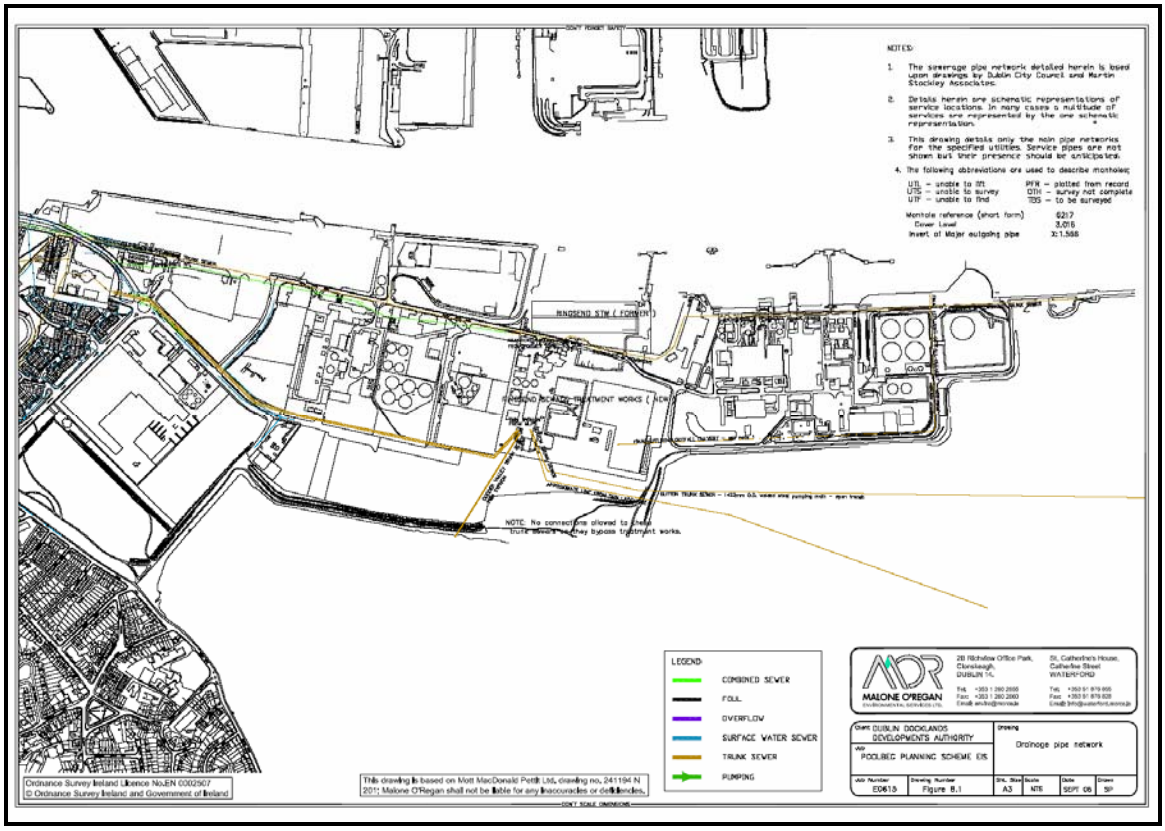
8.3.1.11 Both Poolbeg generating station (ESB – Pigeon House) and Ringsend generating station (ESB – Synergen) are currently discharging effluents to the Liffey Estuary, under IPPC Licences number 718 and 486, respectively. The effluents include condenser cooling water, discharge from the water treatment neutralisation tanks, boiler blowdown water and screen wash water. The IPPC Licences for these plants contain limits for the quality of the effluents in terms of physical and chemical properties.

8.3.1.12 In addition, treated effluent from Ringsend wastewater treatment plant is discharged to the Liffey Estuary east of Poolbeg generating station. The maximum flow rate is $11m^3/s$ however flows would normally be lower. This plant is designed to ensure concentrations of BOD, TSS and Ammonia (as N) below 25 mg/l, 35 mg/l and 18.75 mg/l, respectively. The observed improved water quality in the Liffey Estuary in recent

years is, according to the EPA, "*clearly a result of the installation of significantly upgraded treatment facilities at Ringsend WWTP*".

8.3.1.13 There is an existing surface water outfall discharging into the Bay at the northeastern end of the Fabrizia site. Figure 8.3.1.1 illustrates the drainage layouts on the peninsula. Appendix 11.1 contains photographs of the outfall. The quality has not been monitored as part of this EIS but it is understood from local knowledge that sewage may discharge from this point.

Figure 8.3.1.1 Drainage Layout.



8.3.1.14 With regard to the Water Framework Directive, the River Liffey is part of the Eastern Region River Basin District. The Draft Liffey River Basin Management Plan is expected to be published imminently as the deadline for publication of the final plan is March 2009. This Plan will deal with the issues affecting water quality and environmental objectives and measures to achieve those objectives.

8.3.1.15 Concerns were expressed locally that a stream might exist on the Peninsula. Mott MacDonald Pettit carried out extensive research in this regard (See Appendix 8.1, Section3). The area in question was visited with local people and it was confirmed that there is a ditch but no stream present in the area.

8.3.2 Flooding and Sea Level Rise.

Historical Flooding on the Peninsula

8.3.2.1 The Poolbeg Peninsula is in an exposed location with the sea on three sides with no part of the Draft Planning Scheme Area more than 500m from the sea. Much of the land was reclaimed from the sea. While the northern area is protected from waves by the north and south bull walls, the southern area is exposed to significant wave action. The flood mechanism of most concern in the Poolbeg area is flooding due to high tides. The report in Appendix 8.1 addresses this issue in more detail.

8.3.2.2 A serious tidal flooding event occurred in February 2002 where existing flood defences were breached at the East Link Toll Bridge, the ESB Poolbeg Power Station and Sean Moore Park. Further detail is provided in Section 4 of the report contained in Appendix 8.1 and Figure 241194FR001 in Appendix 8.1. The flooding at Sean Moore Park was particularly significant as it led to flooding of several houses in the Sandymount area. The event led the Dublin local authorities to commission the Dublin Coastal Flooding Protection Project.

8.3.2.3 A detailed flood risk assessment has not been carried out for the Poolbeg Peninsula but the appropriate flood zones are conservatively estimated as set out in Chapter 8 of the flood report contained in Appendix 8.1. Parts of the Peninsula are within areas that are shown to be at risk of flooding, although it should be remembered that the maps ignore the very significant flood defences already in place. The majority of the area proposed for development can be taken as lying in Flood Zone C.

Sea Level Rise.

8.3.2.4 According to an EPA report 'Climate Change – Scenarios and Impacts for Ireland' Environmental RTDI Programme 2000 – 2006, a sea level rise of 0.5 metres is expected during the period 1990 – 2100, i.e. an average rise of 0.45 cm per year.

8.3.3 Groundwater.

8.3.3.1 The principal aquifer beneath the Draft Scheme Area is the fluvio-glacial deposited sand and gravel unit below the made grounds. The made ground and sands/ gravels are expected to be in hydraulic continuity, with the underlying clays and silts acting as aquitards restricting the downward movement of groundwater to bedrock.

8.3.3.2 Poolbeg Peninsula is located in Dublin Bay and as a result, groundwater across the Draft Planning Scheme Area is affected directly by the coastal water both in terms of water levels (tidal effects) and water quality (high salinity). Site investigations carried out in 2003 and 2005 in proximity of the Draft Planning Scheme Area recorded water levels at depths close to mean sea level[2]. The only continuous groundwater level data available for the peninsula comes from site investigations at the IGB site. Analysis of this data suggests that the groundwater on the site had a mean of around 0.6m ODM in August 2007 and fluctuated by approximately 0.5m corresponding to a tidal cycle of 3.25m i.e. groundwater is higher than the tide level at low tide but considerably lower than at high tide. The groundwater is not considered to be significant with regard to flood mechanisms in the area.

8.3.3.3 Shallow groundwater across the Draft Scheme Area is assumed to flow generally from west to east.

8.3.3.4 The hydrogeology of the area has been described by the Geological Survey of Ireland (McConnell and Philcox, 1994) as complex and very variable. The limestone bedrock is generally considered to be indurated and hence dominated by fissure permeability (eg joints and faults). Such permeability is likely to be low except where coarse, clean limestones, where present, have been karstified, dolomitised or are highly fractured.

[2] See Dublin Waste-to-Energy Environmental Impact Statement (2006)

8.3.3.5 Calp limestone in the Dublin Basin in general has a poor permeability with permeability higher near the surface where the rock is more weathered. Therefore the limestone rock beneath the Draft Planning Scheme Area is considered a minor aquifer. However, given its proximity to the coast, water supplies would not normally be abstracted from the groundwater in this area due to the high saline content.

8.3.3.6 Due to the previous history of landfilling, reclamation, current and historic industrial land uses on the Peninsula, numerous potential sources of groundwater contamination are present across the Draft Planning Scheme Area. Elevated concentrations of a range of pollutants at a number of sites within the Draft Planning Scheme Area have been detected during recent site investigations.

8.3.4 *Drainage Systems.*

Surfacewater.

8.3.4.1 Existing surface water drainage is mainly located at north-west of Poolbeg Peninsula. There are surface water drains located on Sean Moore Road, Southbank Road and Whitebank Road and combined sewers located on Southbank Road and Pigeon House Road.

Foul Drainage System.

8.3.4.2 The WWTP on the peninsula is due to expand its ultimate capacity. This will not be sufficient for the future needs of the region. Land constraints on the peninsula mean that it cannot be expanded further and a second major treatment plant will be required in another location. The lead-in time for this is likely to be ten years which is consistent with the projected first phase of development. The current plant is critical to sewerage treatment in the Dublin region. Its operations are vital to maintaining the water quality in Dublin Bay and the city's Blue Flag beaches.

8.3.4.3 This aspect is further discussed in detail in Chapter 20.0 - Utilities.

Potable Water.

8.3.4.4 This aspect is discussed and addressed in detail in Chapter 20.0 - Utilities.

Port of Dublin Reclamation

8.3.4.5 Dublin Port has recently reclaimed land on the Poolbeg Peninsula north of the overflow tanks from the Ringsend Wastewater Treatment Works. They are currently examining the issue of further land reclamation in the North Port. Neither of these areas is within the Planning Scheme boundary and these works do not come under the Draft Planning Scheme. The responsibility for examining any environmental, flooding or similar issues arising from these schemes rests with Dublin Port and their consultants.

8.4 Relevant Characteristics of Draft Planning Scheme.

8.4.1 The characteristics of the Draft Planning Scheme during the construction and operational phase with specific regard to the water environment are outlined in the following sections.

8.4.2 Construction Phase.

8.4.2.1 During the construction phase, excavation works will be required to accommodate underground parking, drainage installation etc. In addition, water features will be developed in the Draft Planning Scheme. A new water feature will be developed as part of Zone 1 or within the existing Fabrizia site.

8.4.2.2 The Draft Planning Scheme does not envisage any changes to the existing rock armour or flood defences, although the levels of some berms may be reduced or berms may be removed altogether along the Southern Shore. Where berms are removed, ground levels will be sloped upward away from the sea to ensure that the same level of flood protection is afforded.

8.4.2.3 There are proposals to raise ground levels on parts of the peninsula. This will be most noticeable on the IGB site. The area is already above high tide level and does not have a history of flooding. As such there is no question of flood waters being displaced.

8.4.2.4 No works are proposed which would interfere with existing streams, rivers or tidal flows.

8.4.3 Operational Phase.

8.4.3.1 The operational phase of the Draft Planning Scheme will include both mixed residential and commercial/ retail use.

8.4.3.2 Surface water run-off from the development roofs, site roads and paved areas may be collected within a sealed piped surface water system which will eventually discharge to the surrounding water bodies.

8.4.3.3 New development on the peninsula will drain to the Ringsend WWTP via a new network of foul sewers and a new sewage pumping station. The sewage pumping station will have a new minimum footprint of approximately 10 metres by 10 metres.

8.4.3.4 Run-off from underground parking will discharge to the foul system which will eventually discharge to the Ringsend WWTP.

8.5 Likely Impacts of the Draft Planning Scheme.

8.5.1 The potential impacts of the construction and operational phases of the Draft Planning Scheme on the water environment are outlined in the following sections.

8.5.2 Construction Phase.

Surface Water

8.5.2.1 Where parts of the Draft Scheme Planning Area are found to be contaminated, there may be excavation, handling and movement of contaminated soils/ materials. This may be the case for the excavation of the water feature proposed. Surface water generated during the construction phase, from excavations and from run-off, could therefore potentially be contaminated and could impact on the receiving water environment.

Groundwater.

8.5.2.2 The Draft Planning Scheme can potentially impact on groundwater through ground contamination by waste oil, fuel, chemical spillages etc used during construction. Point source contamination from seepage from potentially contaminated surface runoff may also occur. Furthermore, if not properly managed, contaminated soil can lead to further groundwater pollution during the construction phase. Pollutants in existing contaminated groundwater can also potentially migrate to clean waters during the construction phase.

8.5.2.3 Contamination of soils as a result of incorrect disposal of waste during construction, could potentially lead to contamination of the underlying groundwater across the Draft Planning Scheme Area. Mitigation measures are listed below seeking to include the correct disposal of waste during construction.

8.5.2.4 De-watering of excavations may also be required. Following on from Section 8.5.2.1 above, the water generated may be contaminated and could potentially impact on water bodies if discharged inappropriately.

8.5.3 Operational Phase.

Surface Water.

8.5.3.1 Contamination of surface waters arising from the proposed development may occur from two sources, the management and discharge of storm water run-off and the management and discharge of foul wastewater. In the case of surface water run-off oil, solids, debris etc. could potentially enter the surrounding water bodies through discharge from the surface water drainage system . Hydraulically the design of the surface water management systems will mimic the existing regime as much as possible with the principles of Sustainable Urban Drainage Systems (SuDS) being implemented where appropriate.

8.5.3.2 In the case of foul water adequate drainage and treatment capacity will be implemented as part of the proposed Planning Scheme.

Groundwater.

8.5.3.3 The Draft Planning Scheme can potentially impact on groundwater during the operational phase through run-off from all car park and paved areas across the Draft Scheme Area.

8.5.3.4 Possible leakage from sewage pipelines could contribute to organic and bacterial contamination to groundwater which could eventually discharge to the River Liffey or the Dublin Bay.

8.5.3.5 The Draft Planning Scheme may reduce recharge to groundwater due to the large proposed surface area covered by impermeable material, but this is not considered a significant impact given the tidal influence on groundwater at Poolbeg Peninsula.

8.5.3.6 There may be a localized change in groundwater flow direction around underground car-parking which will be sealed. It is unlikely that this will result in increased groundwater flow to the surrounding water bodies or impact significantly on water interactions likely to be relevant to ecological functioning.

8.5.3.7 Pumping of groundwater to surface will not be allowed when the scheme is completed.

8.5.3.8 The combined application of all the mitigation measures outlined in Section 8.6 below will ensure that inputs to, and subsequent contamination of surface water and groundwater do not occur within the Draft Planning Scheme Area during the construction and operational phase.

Flooding.

8.5.3.9 Following the remedial and mitigation measures outlined below, it is not envisaged that there will be any residual impacts of the Draft Planning Scheme in terms of flooding on Poolbeg Peninsula or surrounding areas.

'Do Nothing' Scenario.

8.5.3.10 The 'Do Nothing' scenario does not provide the opportunity to potentially remediate contaminated groundwater which is interacting with the estuarine waters and thus potentially affecting ecological systems in the area.

8.6 Mitigation.

8.6.1 In advance of construction in the Planning Scheme Area, a detailed site specific flood risk assessment must be carried out to ensure that all aspects of flooding are examined in line with the Department of Environment, Heritage and Local Government (DoEHLG) document "Planning Guidelines – The Planning System and Flood Risk Management – Consultation Draft Guidelines for Planning Authorities" and that appropriate measures are implemented to mitigate against flood risks in the findings.

8.6.1.1 Suitable remedial and mitigation measures which will be put in place during both the construction and operational phase are outlined below.

8.6.2 Construction Phase.

Surface Water.

8.6.2.1 Strict measures will be taken by developers to ensure that inflow of silt to surface waters as a result of the construction will be minimised by appropriately designed silt traps or other approved methods as outlined in the Construction Industry Research and Information Association (CIRIA) publication entitled, Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, CIRIA - C532 (2001).

8.6.2.1 Any chemicals, oils, paints, solvents, glues, pastes, waste oils or other potentially polluting substances used during construction will be stored in bunded areas or suitably bunded lockable storage containers by developers or operators which will contain any spillage that may occur. This will allow all stored liquids to be disposed of by a Local Authority approved waste disposal contractor or EPA approved waste management contractor for off-site treatment/ recycling/ disposal. Spill kits, hydrocarbon adsorbent

packs and other appropriate methods will be used to prevent pollution of surface and groundwater. All operators will be trained in the efficient use of this equipment.

8.6.2.2 Oil and fuel storage tanks shall be stored in designated areas, when not in use and these areas shall be bunded to a typical volume of 110% of the capacity of the largest tank/ container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Drainage from the bunded area(s) shall be diverted for collection and safe disposal.

8.6.2.3 All site vehicles and machinery will be refuelled in bunded or adequately sealed and covered areas; this will also include where the addition of hydraulic oils or lubricants to vehicles and machinery is required. If vehicles/ machinery cannot be moved to the dedicated refuelling area then a mobile double-skinned tank accompanied by trained personnel and a spill kit will be used to deliver fuel to the vehicle/ machinery.

8.6.2.4 Surface water generated within the Draft Planning Scheme Area will be regularly tested by the appropriate authority, prior to approved discharge, to ensure any related impacts are short term and neutral during the construction phase. Any discharge approved will be within limits set by Dublin City Council, as part of a trade effluent discharge licence. Other SuDS measures, such as treating the discharge through a hydrocarbon interceptor and grit trap, will be considered where deemed necessary.

8.6.2.5 Excavated materials will be handled appropriately by developers to minimise the risk of surface run-off from wet excavated materials or from rainwater falling on the material, entering the surrounding water bodies. This issue will be dealt with in the Construction Management Plan required to be undertaken by developers as part of the Section 25 process.

8.6.2.6 Other relevant proposed mitigation measures are described in the section related to groundwater below.

Groundwater.

8.6.2.7 All construction works undertaken by developers will be completed in line with the recommendations of the above-mentioned CIRIA publication and this will also serve to mitigate against any potential groundwater pollution occurring.

8.6.2.8 The discharge of any groundwater from the Draft Planning Scheme Area, for example during dewatering, to surface water or sewer will require the developer to obtain an appropriate licence from Dublin City Council. This will control the extent to which potentially contaminated groundwater is managed in the Draft Planning Scheme Area during construction.

8.6.2.9 Site investigation covering potential contamination aspects within the Draft Scheme Area will have to be undertaken to determine the nature and extent of ground contamination for each area to be developed. This is also referred to in Chapter 7.0 – Geotechnical, Soils and Ground Conditions.

8.6.2.10 Developers will be required to prepare Construction Management Plans covering management of run-off and waste material handling during construction to prevent adverse impact on the surrounding water bodies.

8.6.2.11 Other proposed mitigation measures relevant to groundwater are described in the section related to surface water above.

Alteration/Removal of Berms.

8.6.2.12 Berms will not be removed or reduced in size without detailed, site specific, flood risk assessments taking place to ensure that the existing level of flood protection is maintained or increased. This shall be undertaken by developers.

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8.6.3 Operational Phase

Surface Water

8.6.3.1 New development will be dependent on the expansion of the wastewater treatment works to ensure that adequate capacity exists for treatment as otherwise water quality

in the receiving waters could be affected through inadequate collection or wastewater treatment system capacity Therefore development will not proceed unless such capacity is provided in a timely manner.

8.6.3.2 Developers will be required to adopt comprehensive water use reduction, conservation and reuse initiatives within the built environment including sustainable urban drainage systems and rainwater recovery. A sustainability toolkit has been developed as part of the Draft Planning Scheme. These measures will in turn reduce run-off.

8.6.3.3 All new development in the Dublin City Council area must comply with the stormwater attenuation requirements of the New Development Policy drawn up under the Greater Dublin Strategic Drainage Study. Criteria 1, Water Quality Protection, will impose storage requirements for developments on the peninsula. A stormwater attenuation plan will be provided for all new development on the peninsula.

8.6.3.4 Surface water drains will be designed in accordance with BS 8000:1989 Part 14, BS 8010: Code of Practice for Pipelines; BS 8301: 1985 Code of Practice for Building Drainage; and BS EN 752:2008 Drain and sewer systems outside buildings, thereby minimising the potential for leaks in underground pipelines during the long term operation across the Draft Planning Scheme Area.

8.6.3.5 Developers must ensure that drainage from any roads or other spaces where traffic may be present will be treated through conventional oil/ water separators/ interceptors to mitigate against surface water pollution with collected run-off pumped out to the public surface water sewer system. These interceptors will be managed and periodically cleaned by developers or operators. Regular inspection will include a maintenance/ desludging programme whereby any oil/ solids/ debris trapped within the interceptors will be removed and disposed of off-site by an appropriately licensed Local Authority or EPA approved waste disposal contractors.

8.6.3.6 All waste materials generated within the Draft Planning Scheme Area during the operational phase which has the potential to contaminate surface and groundwater will be stored in an appropriately designed area by developers or operators, with a bunded

container and a connection to the foul drain, to ensure any leakages from waste containers and wash down water is controlled and diverted to foul sewer.

8.6.3.7 Future objectives of the Liffey River Basin Management Plan currently being prepared under the Water Framework Directive will be complied with where applicable to future development.

8.6.3.8 The drain currently discharging surface water to the strand from the north eastern corner of the Fabrizia site will be investigated in terms of contributing sources and sources will be redirected and/or the water will be remediated.

8.6.3.9 Development proposed will not compromise the requirements of the Bathing Water Quality Regulations, 2008 (S.I. No. 79 of 2008.)

Groundwater.

8.6.3.10 During long term operation, groundwater quality is unlikely to be impacted by the Draft Planning Scheme as surface water run-off from car parking, roads and paved areas will be collected in a new piped drainage system and pass through interceptors proposed for the Draft Planning Scheme Area. No infiltration of this surface water to soils and groundwater is therefore likely to occur.

8.6.3.11 Foul effluent and domestic sewage will be collected via a new and modern foul sewerage system within the Draft Scheme Area, including adequate storage capacity prior to discharge through designed connection to the Ringsend WWTP.

8.6.3.12 Other proposed mitigation measures relevant to ground water are described in the section related to surface water above.

8.6.4 Resilience to Flooding

8.6.4.1 The final report of the Dublin Coastal Flooding Protection Project recommends various flood defences for the peninsula. These vary in height from 4.2m ODM to 4.6m ODM depending on the exact location of the defences (susceptibility to wave action etc.) and whether or not extra protection such as groynes or breakwaters could be provided in front of the main defences. However, these levels were based on a sea level rise for a

design horizon of 2031 and were prepared to a 2003 baseline. These levels will be re-examined and possibly raised to take account of the longer design life now being considered and the latest guidance on climate change.

8.6.4.2 Future ground floor levels will be a minimum of 4.5m ODM. This level includes for a minimum freeboard of 500mm. This should provide adequate protection against flooding of buildings or basement car parks, against future extreme tide event although site specific flood risk assessments will be carried out. It should be noted that car parks will need to be waterproofed due to high ground water tables so ensuring that any openings/ entrances are higher than predicted flood levels and will mitigate against any risk of flooding.

8.6.4.3 Storage will be required to deal with tide locking. This is the process whereby low lying areas may not be able to drain to the sea or a tidally affected water course during high tide conditions. Any rain that falls during the relevant period has to be stored to prevent flooding. Detailed assessment of storage required for tide locking will have to be carried out by developers. Dublin City Council has indicated that storage should be provided when the tide level is higher than the invert level of any outlet pipe. Design should be carried out for a 30 year rainfall event and a one year tide event, equivalent to approximately 2.5mODM. For design purposes it can be assumed that the tide is 300mm lower one hour either side of high tide and 900mm lower after two hours. No allowance is made for climate change. These issues shall be addressed by developers at the Section 25 stage.

8.6.4.4 The report in Appendix 8.1.contains a discussion on flooding from groundwater. Notwithstanding the fact that there is very little detail on existing groundwater profiles, the report concludes that it is considered unlikely that the development of basements or underground structures under the Draft Planning Scheme would contribute to an increased risk of groundwater related flooding either on the peninsula or in the surrounding areas. This is because seawater intrusion is the dominant mechanism affecting groundwater levels on the peninsula and, if seawater is prevented from intruding into parts of the subsoil on the peninsula, the affect on sea levels elsewhere would be insignificant due to the very large surface areas involved when dealing with

tidal situations (which is the main flood mechanism affecting the area). It is however recognised that the data is limited and further assessment is required.

8.6.4.5 Developers will be required to carry out detailed flood risk assessments including assessment of groundwater movement across their sites. Developers will be required to implement mitigation measures for any development that might interfere with groundwater movement.

8.6.4.6 With regard to surrounding residential areas, no works will be undertaken as part of the Draft Planning Scheme which could potentially aggravate existing flooding.

8.7 References.

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8.8 Appendices

Appendix 8.1 – Poolbeg Peninsula Planning Scheme Flood Report, December 2008, Mott MacDonald Pettit

Dublin Docklands Development Authority
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Dublin 2

Dublin Docklands Development Authority

Poolbeg Peninsula Draft Planning Scheme

Strategic Flood Risk Assessment Report

January 2009

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Poolbeg Peninsula Draft Planning Scheme

Strategic Flood Risk Assessment Report

Issue and Revision Record

Rev	Date	Originator	Checker	Approver	Description
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B	Sept. 08	DMUR	PDOY	GREI	Updated Issue
C	Dec. 08	DMUR	PDOY	GREI	Final issue
D	Jan. 09	DMUR	PDOY	GREI	Revised to include Comments

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EXECUTIVE SUMMARY

This report has been prepared to assess at a strategic level, the flood risk associated with proposed new development as outlined in the Poolbeg Peninsula Draft Planning Scheme. The strategic assessment has been prepared in accordance with the Department of Environment, Heritage and Local Government (DoEHLG) issued document "Planning Guidelines – The Planning System and Flood Risk Management – Consultation Draft Guidelines for Planning Authorities", (2008) and addresses the Scoping and Screening stages of these draft Planning Guidelines. This report is an Appendix to the Environmental Impact Statement (EIS) on the Poolbeg Peninsula Draft Planning Scheme.

The report determines the following points:

- The majority of the proposed development within the Draft Planning Scheme area is not considered to be at significant risk from flooding.

- Geotechnical investigation works and ground water monitoring must be carried out where construction deep below ground level is proposed. The main aims of such investigations being to ascertain the possible impact on groundwater flows and devise appropriate mitigation measures.

- That all floor levels and entrances to basements in new developments in the Draft Planning Scheme area should be a minimum of 4.5m ODM (Ordnance Datum Malin) to protect against flooding from future predicted high tides.

- That drainage systems required as part of development proposals in the Draft Planning Scheme area at risk of tide locking should have appropriate attenuation sized at the detailed design stage to prevent flooding.

- That drainage system proposals in the Draft Planning Scheme area at risk of tide locking should incorporate appropriate measures such as SuDS practices to comply with river quality protection criteria.

- That any flood defence structures, either new or redesigned, should be constructed to provide a sufficiently high protection level to counter wave overtopping.

- The key recommendation of this report is that further more detailed assessments, such as site or development specific Flood Risk Assessments are carried out as development proposals of the Draft Planning Scheme are implemented, namely at detailed design stage so that all possible risks are fully understood and mitigated against.

1 INTRODUCTION

1.1 Overview

Mott MacDonald Pettit has been appointed by Dublin Docklands Development Authority as Infrastructure Consultants for the Poolbeg Peninsula Draft Planning Scheme. Part of the brief is to provide a Flood Risk Assessment, make proposals for the discharge of surface water run off for the development proposals, recommend finished floor levels in respect of coastal and river flooding events, and provide engineering advice for any flood protection measures necessary to support development proposals within the Urban Design Framework. This report is an Appendix to the Environmental Impact Statement (EIS) for the Poolbeg Peninsula Draft Planning Scheme. It has been prepared in the context of the Draft Planning Scheme and its associated EIS.

1.2 Site Description

The Poolbeg Peninsula is in Dublin Bay within Hydrometric Area no. 9 and is part of the Eastern River Basin District. It is in an exposed location with the sea on three sides and no part of the area more than 500m from the sea. The Much of the land was reclaimed from the sea. While the northern area is protected from waves by the north and south bull walls, there is some exposure to fetch from a north easterly direction. The southern area is exposed to significant wave action. Adjacent areas at Ringsend and Sandymount have a history of flooding from the sea. Anticipated rises in sea level due to climate change will exacerbate any flood risk.

It is noted that the ground levels across much of the Peninsula are reasonably high with most of the peninsula being above 3m ODM. Many areas are above 5m ODM and the highest area of the peninsula, the nature park, rises to almost 20m ODM. Mean High Water Springs (average high tides) in the area are 1.69m ODM and the highest level of tidal flooding ever recorded was 2.95m ODM so the majority of the Peninsula is not currently perceived to be at significant risk from flooding. There are benefits to developing this area in terms of overall sustainability and the fact that any flood risk that does exist can be mitigated. Figure 1.1 shows an aerial view of Poolbeg Peninsula and shows the Draft Planning Scheme boundary in red. At its closest point to the proposed developments of the Planning Scheme area, the Dodder River is approximately 500m away.

1.3 Prevailing Geological Conditions

The principal geological layers present in the Draft Planning Scheme area are described below but it is important to bear in mind that depths can be quite variable depending on the location so these are indicative only. The uppermost layers in this area consist of imported fill material which has been previously found in layers ranging in depth from 1.5 – 6.0 m and is often overlain by top soil or made ground such as concrete or tarmacadam fininishes. Underlying the fill material is a layer of marine or seabed deposits, previously found in layers of approximately 3m. The marine deposits overlie up to 30m deep glacial drift deposits of sands, silts and clays. Below the drift deposits, limestone bedrock at depths of up to 50m is present Geological reports suggest that groundwater movement in the region is likely to be restricted mainly to the sand and gravel drift layers since the stiff clay layers are less permeable. Given that the Peninsula is surrounded on three sides by the sea, tide levels will have a significant influence on groundwater. Previous studies suggest that groundwater is likely to be encountered at depths of 2m to 4m below ground level – i.e. tying in with tide levels. The impact of climate change will include an increase in sea levels and probably in groundwater

flows and this should be considered in carrying out geotechnical design on the peninsula.

Figure 1.1: Poolbeg Peninsula including the Draft Planning Scheme Boundary

1.4 Scope of Report

This report will review the flood risk to the Peninsula including the exacerbated flood risk which is expected to arise due to climate change. It will make recommendations on flood protection proposals required and assess any impact on flood risk associated with the proposed development works. It will make recommendations on disposal of surface water in accordance with Dublin City Council/ Greater Dublin Strategic Drainage Study policies.

This report is based on a desktop review only and should not be relied upon for detailed design of buildings or infrastructure in areas that may be at risk of flooding. As the development proposals are implemented in the Draft Planning Scheme area, further, more comprehensive, flood risk work such as site or area specific assessments will be required. The requirement for more detailed flood risk assessment is a specific requirement of the Poolbeg Peninsula Draft Planning Scheme.

An initial sufficiency review has been undertaken by Royal Haskoning, consulting engineers in light of their involvement with the Dublin Coastal Flooding Protection Project (DCFPP).

2 PLANNING CONTEXT

In September 2008, the Department of Environment, Heritage and Local Government (DoEHLG) issued the document "Planning Guidelines – The Planning System and Flood Risk Management – Consultation Draft Guidelines for Planning Authorities". These Guidelines were issued subsequent to the preparation of the Draft Planning Scheme in October 2007. Flood risk assessments previously adhered to the DoEHLG's "Development Plan Guidelines "Appendix E – Planning in Areas at Risk from Flooding", but this document will shortly be superseded by the above Guidelines, when issued as Final Guidelines. The new Guidelines were issued as a draft consultation document and are not expected to be formally adopted until mid 2009 at the earliest, following an assessment of submissions received during the consultation stage.

A review of the main provisions of the draft Planning Guidelines is set out below, together with a comparison of the assessment work done to date.

The draft Planning Guidelines recommend that a staged approach is adopted to carrying out flood risk assessment. Authorities are recommended to carry out only the level of assessment that is required for the purposes of decision making. The stages of assessment are screening, scoping and appropriate risk assessment. These are described as:

Screening assessment – to identify whether there may be any flooding or surface water management issues related to a plan area or proposed development site that may warrant further investigation;

Scoping assessment – to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to scope the extent of the risk of flooding and potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures; and

Appropriate risk assessment – to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures.

It is considered that this flood risk assessment report addresses the scoping and screening phases set out in the draft Planning Guidelines and provides a strategic level flood risk assessment. This is considered to be an appropriate level of assessment for the purposes of preparing a Draft Planning Scheme but it is recognised, and it is recommended in the draft Planning Scheme, that more comprehensive, flood risk work such as site or area specific assessments will be required as the development proposals in the Draft Planning Scheme area implemented.

The draft Planning Guidelines recommend a risk based sequential approach to managing flood hazard and potential risk through the planning system. The key principles are:

1. Avoid development in areas at risk of flooding.

2. Where this is not possible, consider substituting a land use that is less vulnerable to flooding.

3. Only when both avoidance and substitution cannot take place should consideration be given by mitigation and management of risks.

Inappropriate types of development that would create unacceptable risk from flooding should not be planned for or permitted.

Exceptions to the restriction of development due to possible flood risks are provided for through the use of the Justification Test, where the planning need and the sustainable management of flood risk to an acceptable level can be demonstrated.

The draft Planning Guidelines recommend that development is guided away from flood risk areas through a sequential approach. This approach makes use of 'flood zones' for river and coastal flooding. These zones ignore the existence of flood defences on the basis that these may fail in the future, though this would be considered to be a conservative approach.

The three flood risk zones referred to above are:

Zone A – areas considered to have a high probability of flooding – those areas where flooding will occur for a 1:100 year event (river flooding) or a 1:200 year event (coastal flooding).

Zone B – areas considered to have a medium probability of flooding – areas outside of Zone A, but where flooding will occur in a 1:1000 year event (between 1 in 1000 and 1 in 100 for river flooding and between 1 in 1000 year 1 in 200 for coastal flooding).

Zone C – areas where flooding is not predicted to occur in a 1:1000 year flood event.

The draft Planning Guidelines recommend that all development should be directed towards Zone C and development only allowed in Zones A and B if no other suitable sites are available.

Development that is vulnerable to flooding should not be allowed in Zones A or B unless it can be demonstrated that this is necessary on wider sustainability grounds through the Justification Test. The main criteria specified in the Justification Test are:

1. That the area is within or adjoining the centre of a city or town designated for growth in key policy documents such as the National Development Plan, the National Spatial Strategy, any Regional Planning Guidelines in force, planning guidelines/directives under Sections 28/29 of the Planning and Development Act 2000 and/or an operative City/County development plan which has been adopted taking adequate account of these guidelines.

2. That the area comprises significant previously developed and/or underutilised lands within the urban envelope.

3. That development of the area is essential to facilitate regeneration or town and city centre expansion, as demonstrated in city and county development plans that have been assessed in accordance with these guidelines.

4. That a Strategic Environmental Assessment has been undertaken, where applicable, taking full account of flood risk.

5. That there are no reasonable and available alternative development areas or sites that meet the wider strategic policy requirements as outlined at 1 above, within low or lower flood probability areas.

Where the Justification Test is applied, further sequentially based decision making should be applied to direct areas of development to the lowest flood risk areas and to zone for low vulnerability land uses; the justification test should be reconsidered if there is any impact on adjacent land users; where impacts are manageable or acceptable, appropriate mitigation measures may be proposed.

A detailed flood risk assessment that addresses every stage set out in the Planning Guidelines has not been carried out for the Poolbeg Peninsula but the appropriate flood zones have been conservatively estimated as outlined in Chapter 3 so that this report represents a strategic level assessment.

3. UNDERSTANDING FLOODING

3.1 Sources of Flooding

In any discussion on flooding and flood risk, it is essential to understand what is meant by flooding and how it occurs. A short definition of Flooding is "*The inundation of land by water through the action of the sea, rivers or meteorological conditions*".

The Rivers Dodder and Liffey converge in the Docklands area. Historical Flood Maps of the River Dodder do not show its floodplain extending as far as the Poolbeg Peninsula. Discussions have been held with the Project Leader for the CFRAM (Catchment Flood Risk Assessment and Management) Study for the River Dodder that is currently under preparation. Although it is currently anticipated that the study will not be finalised until October of this year (2009), it has been demonstrated that flooding from the Dodder will not impact on the Poolbeg Peninsula even in extreme (1:1000 year) flood events.

The equivalent study for the River Liffey has yet to begin. However, modelling works completed for the Dublin Coastal Flooding Protection Project (see Chapter 4) within the estuarine reaches of both the River Dodder and River Liffey concluded that fluvial discharges had a limited effect on water levels in the lower reaches and certainly in the Dublin Port area. For the River Dodder extreme river water levels were seen to be tidally dominated downstream of London Bridge (Londonbridge Road), while in the River Liffey this was the case downstream of Father Matthews Bridge (Church Street). As such it can be concluded that fluvial extreme events will have little impact on the Poolbeg area.

Concerns were expressed locally that a stream might exist on the Peninsula. Extensive research was carried out to investigate this. In particular:

- Current and historical Ordnance Survey maps were checked.
- Aerial photos were checked.
- A number of people who have carried out surveys in the area were interviewed.
- Dublin City Council's Drainage Division was consulted.
- Clair Sweeney's Book, "The Rivers of Dublin", which is generally considered to be the definitive text on these matters, was consulted and did not show any streams or rivers, current or historical, in this area.

Finally the area is question was visited by Mott MacDonald Pettit, other consultants and a number of local people. While there was a ditch present, which might be mistaken for a stream in certain conditions, it was confirmed that there was no stream in this area. It was concluded that there are no local streams crossing the Peninsula.

There are a number of mechanisms by which flooding can occur:

- <u>Overtopping of coastal defence walls as a result of high tide levels</u>. This can be exacerbated by surge conditions, wave action or seiching.

- <u>Overtopping of riverine flood defence walls as a result of high flows in a river or stream.</u> This can be caused by unusually high rainfall conditions or high runoff from surface water due to soil saturation after a prolonged period of wet weather. Melting ice or snow can cause extra flood volumes and this is a major source of flooding in some regions. This is less important in Ireland but has contributed to significant flooding here in the past.

- Overtopping of flood defence walls due to a temporary obstruction to the flow (example: a tree caught under a bridge).

- Any combination of the above

- Flooding from stormwater or combined drains as a result of inadequate hydraulic capacity in the drainage system or a temporary obstruction of same. This may be seen in short intense rainfall events such as thunderstorms. Flooding due to intense, short duration rainfall events is frequently referred to as pluvial flooding.

- Flooding due to tide locking of a surface water drain where a pipe may have capacity but may be unable to discharge due to tide levels being higher than ground levels (direct inundation being prevented by flood defence walls).

- Flooding of low lying areas due to high groundwater levels.

Since fluvial flood sources will not impact on the Draft Planning Scheme area and pluvial sources and tide locking issues will be mitigated as part of detailed design requirements, the flood mechanism of most concern in the Poolbeg area is flooding due to high tides and this report will address that issue. The possibility of flooding due to high groundwater levels will also be assessed. Disposal of storm water will be considered particularly in the context of the possible risk of tide locking. The effects of predicted future climate change will be examined.

3.2 Flood Zone Maps

Under the new draft Planning Guidelines it is necessary to draw up maps showing Flood Zones A, B and C, representing in this case areas that are at risk of flooding in either a 1:200 event, a 1:1000 event or areas that will not flood even in a 1:1000 event. It is worth considering these criteria in the context that the 2002 storm discussed in the next chapter is now considered to have been a 1:70 flood event, which. The drafting of the required zoning maps involves a degree of Flood Risk modelling that has not yet been carried out. Although further flood risk assessment work will be required to generate more comprehensive and detailed Flood Zone maps, preliminary assessment, Flood Zone Maps have been prepared giving a best possible approximation to flood zones A, B and C.

In order to produce these maps, available information from the DCFPP and the Greater Dublin Strategic Drainage Study was assessed. Discussions were held with Dublin City Council and Royal Haskoning staff involved in the DCFPP. Discussions were also held with those responsible for two as yet unpublished studies, the Dublin City Council "SAFER (Strategies and Actions for Flood Emergency Risk management)" project and the Department of Agriculture, Fisheries and Food's "Irish Coastal Protection Strategy Study - Ph.3 North East Coast Draft Report". All available information on predicted future extreme tide levels (see section 9) was then assessed against available information on existing levels on the peninsula. It should be noted that these levels were based on LIDAR data. It is important to note that the Flood Zone Maps also use current ground levels and that some of these levels are expected to be raised in the as part of the Draft Planning Scheme proposals.

The information obtained was used to produce the Flood Zone Maps in Appendix A. Two maps are provided showing flood risk with and without climate change. The guidelines call for Zones A, B and C (1:200 and 1:1000 flood zones and areas not considered to be at significant risk) to be shown.

It must be appreciated that these maps are for the purposes of this Strategic Flood Risk Assessment and do not purport to represent detailed, accurate Flood Risk Assessment maps of that area. The maps produced do not take into account the existing flood defences and possible flood routes across the peninsula (flood routes are the direction in which flood waters are permitted to flow from a high point to a low point due to the topography - along a road for example). It is recognised in the draft Guidelines that flood risk management strategies in defended areas can factor in the presence of flood defences and their effectiveness during a flood event.

Any areas that are below predicted high tide levels are shown to be at risk of flooding though in practice many parts of Dublin that are below these levels have never experienced flooding because there is no existing flood route leading into the area.. The maps do not take into account the effects of wave action. These are intended for initial assessment only with more accurate flood maps to be produced under detailed flood risk assessments as development proposals are implemented.

4 HISTORICAL TIDAL FLOODING

Tide related flooding is considered to be the dominant flood risk for the Poolbeg Area. It is thus fortunate that very comprehensive tidal records exist and there is very detailed data available for an historic flooding which occurred on the 1st February 2002.

An exceptionally high tide occurred in Dublin on the 1st February 2002, which resulted in significant flooding throughout parts of the city. This event caused particularly bad flood damage in the areas of Ringsend, Sandymount and Northwall and led the Dublin local authorities to commission the Dublin Coastal Flooding Protection Project (DCFPP). This was finalised in 2005 and is the report is available from Dublin City Council. The results of that study were examined by Mott MacDonald Pettit and relevant Dublin City Council staff were interviewed in preparing to present this report.

The study reported that this flooding event coincided with the highest spring tide conditions associated with the full moon for that year. The highest flood level that occurred was 2.95m ODM (i.e. above the Irish Ordnance Survey Datum at Malin Head). This was some 1.02m higher than the highest predicted value of 1.93m ODM around that time based on the Dublin Port Tide Tables.

The mechanisms resulting in such a surge in tide level are not fully clear but it is known from meteorological data that a system of extremely low pressure had been formulating to the northwest of Ireland over a number of days before the event. This low pressure system in the Atlantic was the driver for the exceptionally high surge levels experienced at Dublin, in the form of a surge wave on the Irish Sea. This combined with strong winds, which were up to gale force from south to south westerly, increased the sea level significantly. Rainfall and river flows were found not to have been significant contributing factors.

These were the highest tides measured in over eighty years in Dublin and caused sea defences to overtop and rivers and canals to overflow. Structural damage was recorded and many residential units were inundated leading to residents being evacuated.

It is worth noting that despite the unprecedented flooding caused by the 2002 storm, the DCFPP found that this represented a 1:70 year return period event, meaning that any future design will be required to cater for conditions of even greater severity than experienced on that occasion.

5 FLOODING ON THE POOLBEG PENINSULA

5.1 Areas Susceptible to Flooding in Poolbeg

A number of locations susceptible to tidal flooding either at or close to the Draft Planning Scheme area are identified in the DCFPP Report. The Draft Planning Scheme does not include proposals for buildings or significant infrastructure in any areas that previously flooded. However, the fact that flooding previously occurred gives an indication of potential future flooding under more extreme climatic conditions and the possible need for flood defences in these areas needs to be considered.

Also, the potential effects on other local areas such as private housing, public roads etc due to implementing flood prevention measures should be kept in mind since there is often a chain reaction effect whereby flooding is sometimes just relocated rather than actually prevented.

The locations identified in the DCFPP Report as being at risk from tidal flooding and relevant to the Draft Planning Scheme area are shown on drawing no. 241194 FR 001 and are listed and discussed below;

- East Link Toll Bridge
- ESB Poolbeg Power Station
- Sean Moore Park

<u>East Link Toll Bridge</u>

Flooding occurred in 2002 on the south quay near the toll booths at the East Link Toll Bridge. This flooding of the roadway was due to overtopping of the south bank of the River Liffey. Flooding reached depths of 400mm and caused significant traffic disruption since this is a main arterial road. The road in question leads to the proposed redevelopment site at Poolbeg and as a result it may be assumed that flooding at the Toll Bridge will cause significant disruption to access to the site. This would be particularly critical given that access/ traffic issues are already considered as a key constraint to development on the Peninsula and this road also caters for substantial volumes of through traffic. The road is unlikely to act as a flood path into the site as survey levels recorded during the DCFPP showed that the levels increase towards the roundabout at the top of Sean Moore Road.

<u>ESB Poolbeg Power Station</u>

Flooding also occurred in the 2002 event at the south side of the ESB Poolbeg Power Station. Flood defences at this location consist of a low earth mound on the seaward side of the road which is protected from erosion by rock revetments above a small beach. The function of this mound is to protect the road. Behind the road there is a vegetated bank 1.5-2m high to protect the ESB land from flooding. This bank would also aid with screening / access control for the power station. The flooding in 2002 was caused by waves overtopping the existing flood defences on the seaward side of the road and flooding along the road before finding gaps in the inner vegetated mounds. The largest gap (around 140m) in the vegetated mounds was in front of the Bord Gáis depot on the west side of the ESB site. In addition water flowed back along the coast road to the entrance of the Power Station near Pigeon House Quay. Furthermore some flooding of the Power Station ground from the River Liffey side was also reported by power station staff although this was fairly localised in nature and did not cause any significant issues. One of the main issues reported with the power station was that the

cooling water outflow channel became surcharged and as such the power station came very close to being shut down.

Sean Moore Park/ Beach Road

There is an existing masonry wall at the junction of Sean Moore Park and Beach Road which although may not have been designed specifically as a flood defence, does provide some level of protection from wave action. Since this existing masonry wall is quite low, overtopping can easily occur as was observed during the February 2002 storm events due to high water levels and significant wave action. It was also noted that a large amount of beach material was washed into the park and adjacent road. Although there are no houses affected by overtopping into the park area, the level of the park is higher than the surrounding streets so flood water from the park flowed back towards the beach and out an existing access gap in the wall. This gap has since been blocked but this does illustrate the possibility of flooding occurring in areas that are not immediately obvious. Flooding also occurred on Beach Road to the south of Sean Moore Park where waves overtopped the low sea wall. This resulted in flooding of a number of lower lying streets, particularly Marine Drive where depths of water up to 600mm occurred and some 20 houses were flooded.

The DCFPP Report suggests that the waves run along a vertical wall in this location when the tide is in and as a result become concentrated in the corner of Strand Road/ Beach Road and the park, making overtopping significantly worse.

5.2 Recommended Flood Defence Measures from DCFPP

Possible flood defence measures at the above locations were proposed under the DCFPP. These flood defence measures would have been determined prior to the current Draft Planning Scheme and as such they are based on an assessment of the existing infrastructure and risk. It is also important to note that these options were developed with a design horizon of 2031 and taking account of predicted sea level rises by that date. Some of these works have now been undertaken at Sean Moore Park but not in the other two areas.

Higher standards of protection may be required if higher value land uses were to pertain in the three areas in question or in surrounding areas. Development proposed under the Draft Planning Scheme would require a longer design life than that used for the DCFPP and hence any relevant protection measures would need to be revised to account for further climate change issues etc.

Flood defence measures proposed under the DCFPP would need to be revisited to suit proposals under the Draft Planning Scheme. However, keeping in mind the fact that further flood risk assessments will have to be carried out, it is useful to report on the measures originally proposed to demonstrate potential measures to reduce the risk to the current situation. It should be noted that the measures referred to below do not relate to areas proposed for development under the Draft Planning Scheme.

East Link Toll Bridge

Preventative measures are recommended in the DCFPP Report from the Toll Bridge to the Ringsend Yacht Club adjoining the Poolbeg Site and consist of options for either upgrading the existing traffic barrier to form a flood defence barrier, raising the existing roadway or

constructing a new flood wall.

There are no development proposals at this location under the Draft Planning Scheme but flooding at this location could impede access to the Draft Planning Scheme area. This flood risk will remain until flood prevention works are implemented.

ESB Poolbeg Power Station

Again, the DCFPP Report has recommended an option to prevent future reoccurrences of flooding. Firstly, it recommends that new mounds be constructed with a crest level of 4.5m ODM on the coastal side of the road overlapping with the existing vegetated mounds in front of any access gaps. This would reduce overtopping directly onto the site. It also recommends that ramps be constructed within the footprint of the new mounds to ensure that any water that does overtop onto the road beyond this new outer defence does not run back along the road and in through the access gaps. Existing gaps which are not required for access should be repaired to match the existing defences. A new rock revetment would be required to protect the new mounds from the effects of the sea. The main focus of these recommendations was to prevent flooding of the ESB site rather than minor flooding of the road. Flooding at this location does not pose a risk to the Draft Planning Scheme area or others surrounding areas.

Sean Moore Park/ Beach Road

The Dublin Coastal Flooding Protection Project Report suggests that the waves can run along the vertical wall in this location when the tide is high which can increase the overtopping at various locations as well as resulting in concentrated wave energy in the corner, making overtopping significantly worse. It recommends reducing or disrupting the wave action along the wall and before it reaches the corner. This could be done using perpendicular groynes and a low level breakwater. This would have the effect of breaking up the waves and would also encourage the build-up of material to enhance the beach at that location which would further promote wave breaking. This would impact on the geomorphology (sand and sediment transport) in the area and this would need to be assessed in detail to ensure there would be no unforeseen affects.

The option of increasing the level of the wall at Sean Moore Park to 4.6m ODM was also examined. A bullnose would be required to deflect waves and perpendicular rock structures might also be required. This option would help prevent overtopping, but it involves raising the existing wall by up to 1m in places. Structural analysis of the existing wall would be required before this could be carried out. This option might be deemed to have a negative visual impact.

Another option considered was to raise the wall level to 4.2m ODM which would have a lesser visual impact. This would be accompanied by a revetment in front of the wall to dissipate waves and prevent them breaking over it. It is considered that this might also lead to accretion of beach material at the bottom of the revetment.

Not all options in the report recommend measures to prevent overtopping in to the park but all recommend closing the existing access gap with a new masonry wall here to prevent water running out of Sean Moore Park and into the lower lying streets via Beach Road. This has already been done.

In the longer term, the most likely option for flood alleviation at this location will involve widening the promenade. It is possible that this will be carried out as part of the Sutton to

Sandycove (S2S) cycleway project, if that scheme proceeds. There will be a flood risk to the Sandymount area until flood protection works are carried out. However, development propoals under the Poolbeg Peninsula Draft Planning Scheme will not increase this flood risk and the Draft Planning Scheme proposals will not themselves be at risk from flooding at this location.

Although mitigation works have been identified in the above section for areas that experienced flooding during the 2002 tidal event, these works were based on sea level rise for a design horizon of 2031, a 200 year flood event and were prepared to a 2003 baseline. As part of future detailed flood risk assessment work, these levels will need to be re-examined and possibly raised to take account of the longer design life now being considered and the latest guidance on Climate Change.

5.3 Other areas of potential flood risk

The Dublin Coastal Flood Protection Study identified a number of areas that did not flood during the 2002 storm event but were considered to be at risk of future tidal flooding and as such requiring further flood risk assessment. These are shown on drawing no. 241194 FR 001 and are listed below.

Five areas were deemed to have a **high priority** for flood risk assessment:

- **Ringsend Yacht Club** – flood risk due to presence of slipway/ ramp
- **Outflow channel for Synergen Plant**
- **Pigeon House Dock** – flood risk due to holes in walls
- **North of fuel tanks at Poolbeg Generating Station** – flood risk due to standard of protection provided by quay wall
- **Car Park along beach to South East of ESB tank farm** – flood risk due to poor condition of revetment.

Two areas were deemed to have a **medium priority** for flood risk assessment:

- **South of Everton Haulage/ Irishtown Nature Park** – flood risk due to required repairs/ rebuilding of revetment
- **East of Irishtown Nature Park** – flood risk due to condition of revetment

It should be noted that these areas did not actually flood, these are merely listed in the defence asset database as areas where further flood risk assessment is required.

6 FLOODING FROM GROUNDWATER

The principal geological layers in this area consist of imported fill material overlaying glacial drift deposits of sands, silts and clays overlaying limestone bedrock. Groundwater movement in the region is likely to move principally in the drift layers rather than the hard limestone bedrock. The flow will also be restricted mainly to the sand and gravel drift layers since the stiff clay layers are less permeable. Groundwater flow is also likely to occur through fill material. Given that the Peninsula is surrounded on three sides by the sea and that no part of the Peninsula is more than 500m from the sea, tide levels will have a significant influence on groundwater. This has been established under previous studies including physical measurement. Previous studies researched in compiling this report include investigations undertaken on the Irish Glass Bottle, Fabrizia and Waste to Energy sites. It should be noted that there are gaps in available data and continuous ground water monitoring data for this area is limited.

The only continuous groundwater level data available for the peninsula comes from site investigations at the former IGB site. Analysis of this data suggests that the groundwater on the site had a mean of around 0.6m ODM in August 2007 and fluctuated by something in the order of 0.5m corresponding to a tidal range of 3.25m on a given day. That is to say groundwater is higher than the tide level at low tide but considerably lower than it is at high tide. For example, at one high tide measurement, the water level in a borehole was 0.52m ODM and the tide level was 1.5m ODM, but at the next low tide the water level in the borehole was 0.39m ODM and the tide level was -1.19m ODM . At low tide the groundwater flow is towards the sea as would be expected. However, at high tide the groundwater profile flows from the sea - i.e. intrusion of seawater appears to be a significant factor in groundwater levels in this area. This view is supported by observations received during the pre-statutory consultation process from local people who observe that the levels of a visible pond on the Peninsula fluctuate with the tide. To further complicate this scenario, observations at the Fabrizia site which is between the IGB site and the sea, suggest that groundwater on that site has a low point in the centre of the site and is higher on both the inland and the coastal side of that position. There is no obvious reason for this, it merely highlights the complexity of groundwater movement across the Peninsula.

The previous studies suggest that groundwater is likely to be encountered at depths of 2m to 4m below ground level – tying in with tide levels. This will have impacts for construction as de-watering is likely to be required in any area where significant excavation is required such as for basements. More importantly, it needs to be considered in the context that extensive construction below the groundwater table could potentially contribute to flooding by obstructing normal flow paths for groundwater – see below. The impact of climate change will include an increase in sea levels and hence corresponding groundwater levels and this could exacerbate the potential problem.

Before this is discussed in detail, it is important that the potential problem is understood. It is acknowledged that groundwater levels on parts of the peninsula are high, as they are in most of the Docklands area. Levels will fluctuate in response to tides and exceptionally high tides will produce corresponding high groundwater levels. It should be noted that the Draft Planning Scheme does not propose new, hard engineered, sea defences structures. Ground conditions mean that very deep excavations such as multi-storey basements are considered unlikely in this area. The majority of car parking will be underground. Much of this will be in area where ground levels are higher than existing levels but there remains the possibility that developers will choose to construct basements, possibly two stories deep, below existing ground levels. Any such basements constructed on the peninsula would be tanked (sealed) to prevent the entry of groundwater. Developers would not be permitted to interfere with

groundwater levels outside of their basements by permanent dewatering so basements would only effect the existing groundwater regime if they were to act as an impediment to groundwater flow paths.

During the consultation, local people expressed a concern that any massive structures below the groundwater table might impede groundwater movement. If such structures key into low permeability layers, they will act as a cutoff and lead to increases in groundwater levels in adjacent, upgradient areas. If the structures only penetrate partially into the high permeability layers, groundwater will still be able to flow under the structures and there will be a less cut-off effect. The significance of the cut-off effect thus depends on the depth of the basement in relation to the geological layers, the width of the structures transverse to the direction of groundwater flow, the quantity of groundwater flowing through the site and the space between basements that will still provide a residual pathway for flow to continue. The maximum groundwater level rise will occur at mid structure on the upstream face; groundwater level rises elsewhere will be less.

To assess this accurately, it is necessary to have detailed information on existing groundwater conditions and the extents of proposed below ground structures/ basements. As proposed developments are implemented, it will be necessary to have a detailed Site Investigation showing geotechnical profiles over the site to accurately assess permeable strata and hence flow mechanisms. As stated above, there is currently only limited data available. However, the following paragraphs describe how the issue of groundwater flooding due to basements can be judged to be of limited significance in the case of this proposed development and it is unlikely there will be a substantial interference to groundwater movement leading to increased groundwater levels outside the footprint of the development.

The classic groundwater flow profile that might be expected in a coastal area such as this is for the groundwater profile to slope constantly towards the sea (west to east in this case) in order that recharge to the aquifer from rainfall infiltration will drain away. The outlet level for the groundwater would increase with increasing tides, leading to a corresponding increase in tide levels further upstream. However, analysis of that information available suggests that this is not the current groundwater profile on the peninsula.

There are a number of factors that could lead to complexity in the planning scheme area. The drift geology is variable with pockets of impermeable material meaning flow paths will be complex. The fill material is likely to be even more variable meaning that permeability within the soil is likely to differ across the site. In addition the sea is to the east and south of the site, the tidal reach of the Liffey is just north of the site and the River Dodder lies less than a kilometre to the west. The site is virtually surrounded by watercourses meaning that groundwater outflow could occur in a number of different directions and this would affect the groundwater levels and profiles.

The proximity of the surrounding water bodies is such that there is a limited catchment area for infiltration of rainfall to take place. This limits the volume of groundwater requiring a pathway across the site boundary to drain away which in turn reduces the potential for water level rise on the upstream face of any deep basement structures that act as a partial cut off.

There is evidence that groundwater fluctuations reduce with distance from the sea but permeability differences mean that this effect varies from place to place. In terms of the proposed Planning Scheme Area, the absence of a clear west to east groundwater profile means that the introduction of substantial basements would not interfere with significant groundwater flow. Instead, if seawater intrusion is the dominant mechanism, both incoming and outgoing flows may be restricted but these would balance out – i.e. it would take longer

for groundwater to get out as tide levels reduce but the volume of groundwater intruding would also be less. If seawater is prevented from intruding into parts of the drift and fill layers on the peninsula, the effect on sea levels elsewhere would be insignificant due to the very large surface areas involved when dealing with tidal situations.

In summary, no new hard engineered sea defences are proposed. It is considered unlikely that the development of basements or underground structures under the Draft Planning Scheme would contribute to an increased risk of groundwater related flooding either elsewhere on the peninsula or in surrounding areas. However it is recognised that the data on which this assertion is based is somewhat limited. It is recommended that developers carry out detailed flood risk assessments for individual sites by assessment of groundwater levels and movement across their sites and the proportion of the flow path that might be cut off by any deep basements. Mitigation measures should be proposed and implemented for any development that might interfere with groundwater movement and result in a significant rise in maximum groundwater levels.

7. PROPOSALS UNDER THE POOLBEG DRAFT PLANNING SCHEME

This section should be read in conjunction with the Poolbeg Peninsula Draft Planning Scheme. Under the Draft Planning Scheme proposals, there are four zones designated for comprehensive development, redevelopment, rejuvenation and renewal. These are outlined below and illustrated in Figures 7.1 and 7.2;

- Zone 1: Proposals in this area will comprise a mixed use neighbourhood including residential, commercial and retail development. It will be the focal point for the remainder of the peninsula and existing neighbouring communities and will also include new public open spaces. Zone one will also include a promenade along its Dublin Bay edge.

- Zone 2: It is proposed that this area will be reserved for commercial developments under the Draft Planning Scheme.

- Zone 3: Proposals for this area will include commercial and residential developments while also incorporating open amenity space in the form of a beach park. Significant re-grading of the topography and landform is also proposed.

- Zone 4: Due to the existence of a number of iconic buildings and structures, this area is proposed to be the focal point for heritage, arts, culture and media uses resulting in a mixed use development including extensive new public open space and a multifunctional area for a variety of amenity, recreation and cultural uses.

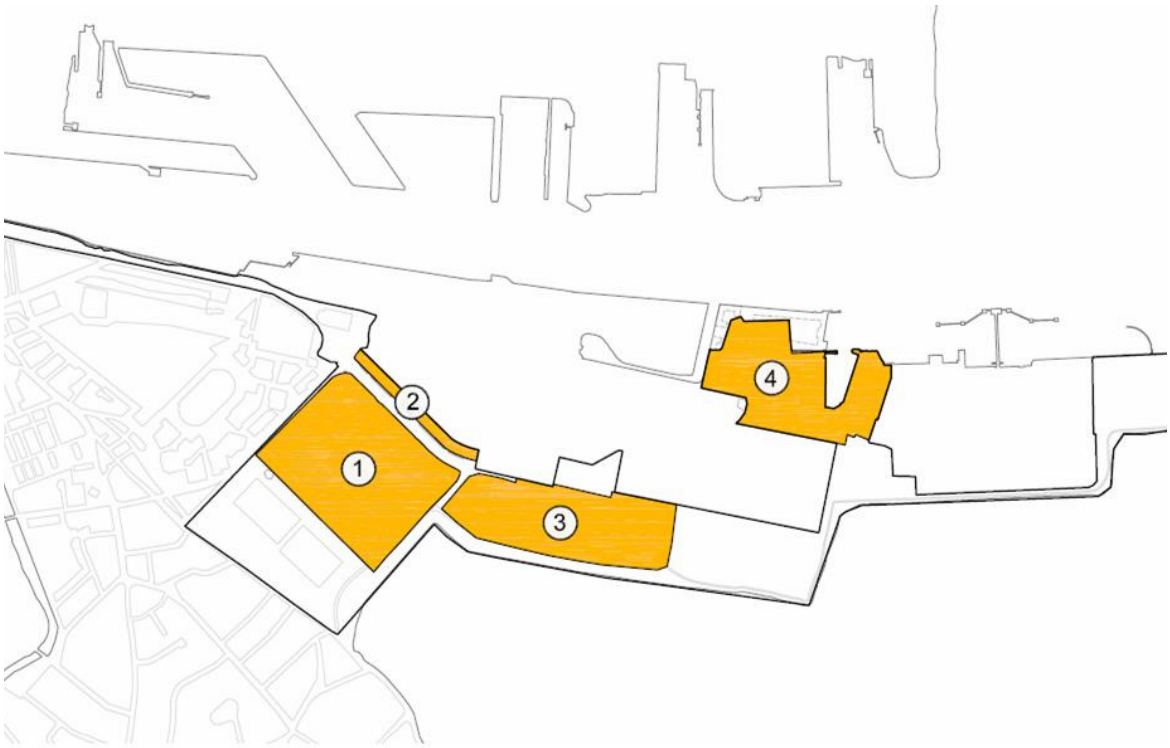

Figure 7.1: Draft Planning Scheme Development Zones 1 – 4

Figure 7.2: Draft Planning Scheme Development Zone Use Types

As discussed in Chapter 3, maps are provided in Appendix A, illustrating flood risk with and without climate change for Flood Zones A, B and C (1:200 and 1:1000 flood zones and areas not considered to be at significant risk) to be shown.

Most of proposed Development Zones 1, 2 and 3 under the Draft Planning Scheme are within Zone C and hence there are no flood related restrictions on development there. Parts of the proposed development areas, most notably in Development Zone 4 are in Flood Zones A or B. Development in either of these flood zones is dependent on the Justification Test and further Flood Risk Assessment work being undertaken as discussed in Chapter 2.

Flooding of some areas such as the beach park in Zone 3 will be permitted in extreme events, however, the Draft Planning Scheme contains no alterations to flood defences below the High Water Mark.

The Draft Planning Scheme requires developers to carry out further Flood Risk Assessments such as site or area specific assessments before proposals in the Draft Planning Scheme area are implemented. As such, the development proposals will not reduce flood protection and should increase flood protection in a number of locations.

There are no proposals under the Draft Planning Scheme to alter existing rock armour or flood defences, though the levels of some berms may be reduced and some berms will be removed altogether along the southern shoreline. The existing berms are high man made embankments which provide some degree of flood protection, though gaps in these would raise some questions about their effectiveness against extreme tidal events. Where berms are to be removed, ground levels will be sloped upwards away from the sea to ensure that the same level of flood protection is afforded. Berms will not be removed, or reduced in size, without

further detailed flood risk assessments taking place to ensure that the existing level of flood protection is maintained or increased.

There are proposals to raise ground levels on parts of the Poolbeg Peninsula, figure 7.3 illustrates the proposed topography levels under the Draft Planning Scheme. [Refer to Chapter 6 of the draft Planning Scheme]. This will be most noticeable in the Irish Glass Bottle site and surrounding area where levels will be raised as part of the development proposals. This area is already above high tide level and does not have a history of flooding. As such, there is no question of flood waters being displaced.

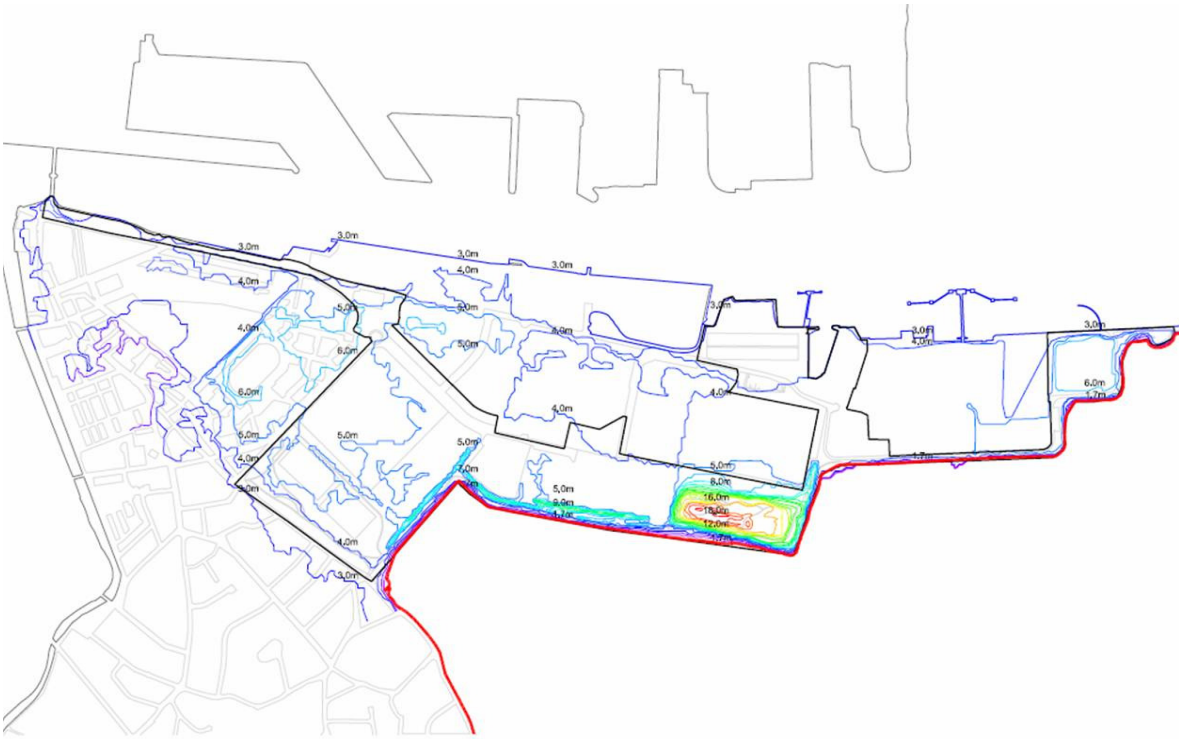

Figure 7.3: Draft Planning Scheme proposed topography levels

Proposed development in the Pigeon House Dock area would be vulnerable to predicted future flood levels. Building floor levels will be required to be high enough to ensure they do not flood and other flood protection works may also be required. The DCFPP study demonstrated that this area is affected by tides rather than river flows. In this scenario, the small volumes of water potentially displaced by new flood defenses would be insignificant. These works would therefore not be expected to impact on the tidal regime or on flood levels in other areas.

The proposals under the draft Planning Scheme do not interfere with existing streams or rivers. The proposals do not interfere with tidal flows and any impact on groundwater movement will be insignificant. As such, it is not considered that any of the works proposed under this Draft Planning Scheme would increase the level of flood risk in any other area.

Detailed Flood Risk Assessments carried out at design stage will be required to clearly demonstrate that this is the case for all future developments in the Draft Planning Scheme area. The OPW will produce Flood Risk Assessment guidelines in the near future and all detailed flood risk assessments will be required to comply with these guidelines.

Alterations to road levels or new road construction will ensure that access and egress is available to all areas during flood events. Developers will be required to ensure that access

routes within their developments will be high enough to ensure that these will remain operational, for all vehicles, even in extreme flood events.

The EPA's report - "Climate Change – Scenarios and Impacts for Ireland" by Sweeney et al proposes planned retreat from some coastal areas and prohibition on developments in vulnerable zones. This area is within Dublin Bay and is not considered especially vulnerable to erosion. The history of the bay suggests that deposition is more likely than erosion. Planned retreat from the centre of Dublin or a prohibition on development there is not a practical proposition.

It should be noted that there are projects proposed in areas adjacent to the Peninsula but outside the Draft Planning Scheme but necessary to ensure its implementation. [Refer to Chapter 10 of the Planning Scheme, section entitled Projects Required outside of the Planning Scheme boundary] These would include a proposed bridge over the River Dodder at Britain Quay and a potential future bridge crossing of the Liffey in the event of a LUAS crossing.

The draft Planning Scheme suggests that a cruise terminal could be realised at Pigeon House Dock by an investment in land reclamation. This is outside the scope of works proposed by the draft Planning Scheme and would require detailed design and assessment and a separate planning procedure. There are also current proposed reclamation works by Dublin Port at North Port These have not been assessed in this report but the designers of any such schemes will be required to carry out a full flood risk assessment as part of their design and planning processes.

As previously mentioned, should be noted that these Flood Zone maps are conservative in that they ignore any flood defences already in place. It is recognised in the draft Guidelines that flood risk management strategies in defended areas can factor in the presence of flood defences and their effectiveness during a flood event.

Before development can proceed in the areas that are at risk, the draft Guidelines require that the Justification Test is carried out. While the Justification Test has not been carried out to date for the Poolbeg Peninsula Draft Planning Scheme, the development proposals under the Draft Planning Scheme do satisfy national, local and regional planning guidelines and is consistent with the Dublin Docklands Masterplan

It is also important to note that this report refers to floods occurring in extreme, very rare, events but that these extreme events are considered in line with standard assessment criteria. It is not disputed that areas outside the Draft Planning Scheme boundary would be vulnerable to extreme events and that flood protection measures are required in those areas. However, the works proposed under the Draft Planning Scheme will not increase this flood risk and the required detailed flood risk assessments that will accompany implementation of the proposals are expected to confirm this.

8 RECOMMENDED EXTREME TIDE AND DEFENCE LEVELS

A critical aspect of any Flood Risk Assessment is to decide on likely future flood water levels and the standards of protection to be applied to defend habitable areas against those events. Generally speaking flood levels are defined in terms of probability – i.e. in a coastal scenario one would typically design for a 1:200 year event, i.e., a storm that statistically has a 1:200 probability of occurring in any given year. However, climate change has greatly complicated this process because it is now believed that extreme events are already occurring more often than would be statistically expected. This means that the level accepted as representing a 1:200 or 1:1000 year event is evolving. This is further complicated by the general acceptance that sea level rise has already begun and is certain to continue meaning that future flood levels need to take this into account. A number of different studies have looked at this issue and some of the more pertinent findings are outlined below.

The Greater Dublin Strategic Drainage Study produced a policy document on Climate Change. This was largely driven by development in the Docklands area. It addresses infrastructural issues and makes recommendations on engineering measures needed to provide protection against the likely impacts of climate change. It sets an absolute minimum future design tide level of 3.4m ODM for Docklands with 4.00m ODM being used for key strategic infrastructure. These figures include an allowance for climate change until 2080 - 2100. Developers would be expected to provide some freeboard above these levels when designing ground floors/ car park entrance levels. While no specific freeboard allowance is given, a minimum freeboard of 500mm would be considered reasonable for coastal areas. This figure could be altered on detailed examination of wave affects, likely overtopping of defences etc.

The DCFPP carried out a detailed probabilistic assessment of tidal records from 1924 to 2002 and determined the following estimates of extreme tide levels which would be relevant to the base date of the data used:

1:200	3.13m ODM
1:1000	3.31m ODM

However Dublin City Council now believes that the 1:10 year level given in the DCFPP report is now being exceeded on an annual basis and that these figures would need to be revised upwards. As such, the following future high water levels are considered to be more appropriate:

1:200	3.3m ODM
1:1000	3.5m ODM

These figures do not include an allowance for climate change. There is considerable uncertainty about the sea level rise that can be expected due to climate change, with this being at least partially dependent on future choices on lifestyles and Carbon Dioxide emissions. A conservative figure of 500mm is adopted here to give the following levels:

1:200	3.8m ODM
1:1000	4.0m ODM

The latter figure agrees with the higher figure recommended in the GDSDS report. Dublin City Council is strongly of the view that this 4.0m ODM figure should be used on the

Peninsula, given it's exposed location, it's vulnerability to a significant wave regime from the south and the fact that catering for this level will be relatively easy given the extensive new development which will be taking place. It is recommended that this standard be adopted for the Draft Planning Scheme area.

It can be seen from the flood maps that the majority of the Draft Planning Scheme area can be taken as lying in Flood Zone C.

Once again, it is important to emphasise that this is the level that future extreme tide events might be expected to reach. Floor levels and entrances to basements should be set above this level. This report recommends a minimum freeboard of 500mm for this location but his would need to be confirmed by site specific Flood Risk Assessments**. This report recommends that all floor levels in the Draft Planning Scheme area be a minimum of 4.5m ODM.**

In parts of the Docklands, setting high ground floor levels for flood protection could lead to floor levels being much higher than adjacent streets, thus creating a hostile streetscape for pedestrians. This would also cause obvious problems for infill development if floor levels were required to be significantly higher than those of neighbouring properties. As such, it has been recognised that ground floor levels below predicted high tide levels could be allowable in limited circumstances. However, these would require flood resistant construction using water resistant materials and electrical fittings at high levels. It would also be necessary to impose planning restrictions in these areas with residential use not being favoured below predicted tide levels. While this is necessary for parts of Docklands, it is considered better to keep floor levels above future tide levels in the Poolbeg area as this area is relatively high in any case and the quantum of new development would mean that there would be no clashes with existing buildings.

The Final Report of the DCFPP recommends various flood defences for the Peninsula. These vary in height from 4.2m ODM to 4.6m ODM depending on the exact location of the defences (susceptibility to wave action, etc.) and whether or not extra protection such as groynes or breakwaters could be provided in front of the main defences. However, these levels were based on sea level rise for a design horizon of 2031 and were prepared to a 2003 baseline. These levels need to be re-examined and possibly raised to take account of the longer design life now being considered and the latest guidance on climate change. They should be treated as preliminary levels only pending the detailed Flood Risk Assessment where final tide levels and issues such as wave action, surges etc. will be more robustly assessed. Note that the levels referred to in this paragraph relate to flood defence structures and are slightly higher than the design tide levels referred to in the first two paragraphs which are relevant to setting minimum floor heights. This extra height is necessary allow for the effects of wave action and overtopping.

9 STORMWATER ATTENUATION

All new development in the Dublin City Council area must comply with the stormwater attenuation requirements of the New Development Policy drawn up under the Greater Dublin Strategic Drainage Study. This includes the following four criteria for stormwater attenuation.

1. River Water Quality Protection:

   The requirement to provide for treatment of stormwater to prevent pollution of the water course to which it ultimately discharges.

2. River Regime Protection:

   The requirement to control the rate of runoff of stormwater to a receiving water to prevent erosion or deposition in the river or stream.

3. Level of Service (Flooding) for the Site:

   The requirement to prevent flooding of the site or of adjacent sites other than temporary flooding of areas which have been designed for that purpose.

4. River Flooding Protection:

   The requirement for long term storage to prevent flooding of a river downstream of the site.

The Poolbeg Peninsula is at the end of the River Liffey. Stormwater discharge will be either directly to the sea or to the Liffey Estuary. As the river is wide at this point, river morphology will not be an issue. There are no concerns about downstream river flooding. As such, criteria 2 and 4 will not apply. These are the criteria that generally drive the requirement for on site attenuation storage. Criteria 3 will apply on the Poolbeg Peninsula, but it should not have any implications in terms of a requirement for storage.

The one criterion that may impose storage requirements in this area is Criteria 1, Water Quality Protection. This will apply on the Peninsula and is in keeping with Dublin Docklands Development Authority's own requirements for sustainability in this area. This criterion calls for the first 5-10mm of rainfall to be intercepted if possible. There are various ways of doing this, in most cases a combination of techniques will be required which could include rainwater recycling, green roofs, permeable paving, swales and soakways. Many of these techniques also have benefits for biodiversity by creating habitats. Infiltration techniques can only be used if soil conditions are suitable. If it is not possible to intercept this rainfall, then alternative treatment facilities are required. This could take the form of a mechanical device such as a vortex separator but the preferred solution is a permanent pond. A pond would be required to have a permanent water volume equivalent to 15mm of rainfall – i.e. 15mm multiplied by the contributing impermeable area. Additional volume would be required to store rainfall events. The exact means of meeting this criterion can only be finalised at detailed design stage but it is likely that the use of public open spaces and roads (in particular, the Dublin Bay Valley Park) to form part of an area-wide SuDS system will be sought.

The Poolbeg Peninsula is unusual in that the river protection criteria do not apply but there is an additional requirement in this area for storage to be provided to deal with tide locking. This is the process whereby low lying areas may not be able to drain to the sea or a tidally affected watercourse during high tide conditions. Any rain that falls during the relevant period has to be stored to prevent flooding.

Detailed assessment of storage required for tide locking will have to be carried out at detailed design stage. Dublin City Council has indicated that storage should be provided when the tide level is higher than the invert level (bottom internal level) of the outlet pipe. Design should be carried out for a 30 year rainfall event and a one year tide event, equivalent to approximately 2.5m ODM. For design purposes it can be assumed that the tide is 300mm lower one hour either side of high tide and 900mm lower after two hours. No allowance is made for climate change in this simplified approach to designing for tide locking and this will be considered further at detailed design stage.

These requirements are quite conservative, though the omission of climate change considerations makes them less so. This is intended as a starting point only with more detailed assessments being carried out at design stage after which developers designers may apply more stringent standards or may make a case for a relaxation depending on their particular site circumstances. These more detailed assessments would be expected to include an allowance for climate change. Given the relatively high levels on the Peninsula and the relatively short drainage distances, the storage requirement should not be too onerous though some level of storage will probably be required. Storage areas provided to address the water pollution criterion could also be considered, as could oversized pipes. Once again, interception of rainfall through rainwater recycling, green roofs, infiltration, etc. will reduce the required storage. This is also more environmentally sustainable and should be encouraged throughout the Peninsula.

As discussed above, criteria 3 will apply at this location, though this is not expected to impose additional storage requirements. This criterion is a requirement to prevent flooding of the site or of adjacent sites, though temporary flooding would be allowable in areas which have been designed for that purpose. Generally speaking piped drainage systems should be adequate to cater for most rainfall events though it is recognised that they cannot be expected to cater for extreme, short term events such as thunderstorms. Developers are required to assess likely overland flows in these events, to ensure that they do not cause flooding outside of their own sites and to ensure that any areas within the site that do flood are in non critical areas and that buildings are not affected.

10. CONCLUSIONS & RECOMMENDATIONS

This Strategic Flood Risk Assessment reviews previous flood study reports and other information relevant to the Poolbeg Peninsula. While all development proposed in this area will require further more detailed flood risk assessment work, the following conclusions can be drawn at this stage.

The Poolbeg Peninsula is in an exposed location with the sea on three sides and no part of the area more than 500m from the sea. The southern area is exposed to significant wave action and parts of the Peninsula have experienced flooding from the sea. Anticipated rises in sea level due to climate change will exacerbate any flood risk.

The ground levels across much of the Peninsula are reasonably high, only relatively minor flooding has occurred on the Peninsula itself in the past and the most of the proposed planning scheme area is not currently perceived to be at significant flood risk. Mitigation works have been identified for all those areas that experienced flooding during the 2002 tidal event, however these works were based on sea level rise for a design horizon of 2031 and were prepared to a 2003 baseline. As part of future detailed flood risk assessment work, these levels will need to be re-examined and possibly raised to take account of the longer design life now being considered and the latest guidance on Climate Change.

The majority of the planning scheme area is not considered to be at significant flood risk. However, small areas of Development Zones 1 -3 and most of Development Zone 4 are proposed in locations estimated to be covered by Flood Zones A and B, which means they have moderate (1 in 1000) to high probability (1 in 200) of coastal flooding. Proposed developments in these areas are considered to be justified on the basis of overall sustainability and the fact that any potential flood risk to the area can be mitigated, though Detailed Flood Risk Assessment is required as the project is implemented.

While basement construction may have some impact on groundwater flow, the impact is expected to be minor and will not contribute to an increase in flood risk either in the development areas or elsewhere.

It is recommended that future ground floor levels are designed based on a future tide height of 4.0m ODM in accordance with the requirements of Dublin City Council. This means that actual floor levels should be 4.5m ODM to comply with this report's recommendation for 500mm of freeboard. Any Flood Defence structures should be constructed to provide a sufficiently high protection level to counter wave overtopping. Final levels would be site specific. The levels stated above are preliminary recommendations only. These may change as a result of more detailed and site specific flood risk assessments.

Attenuation storage will be required to deal with water pollution and to allow for tide locking. Exact volumes can only be assessed at detailed design stage but these requirements are not expected to be unduly onerous.

In summary, our recommendations as a result of this strategic level Flood Risk Assessment include the following;

- Further more detailed assessments, such as site or development specific Flood Risk Assessments must be carried out as development proposals of the Draft Planning Scheme are implemented, namely at detailed design stage so that all possible risks are fully understood and mitigated against.

- Geotechnical investigation works and ground water monitoring must be carried out where construction deep below ground level is proposed. The main aims of such investigations being to ascertain the possible impact on groundwater flows and devise appropriate mitigation measures if required.

- That all floor levels and entrances to basements in new developments in the Draft Planning Scheme area should be a minimum of 4.5m ODM to protect against flooding from future predicted high tides.

- That drainage systems required as part of development proposals in the Draft Planning Scheme area at risk of tide locking should have appropriate attenuation sized at the detailed design stage to prevent flooding.

- That drainage systems in the Draft Planning Scheme area at risk of tide locking should incorporate appropriate measures such as SuDS practices to comply with river quality protection criteria.

- That any flood defence structures, either new or redesigned, should be constructed to provide a sufficiently high protection level to counter wave overtopping.

GLOSSARY

Catchment:

The area that is drained by a river or artificial drainage system.

Climate change:

Long-term variations in global temperature and weather patterns, which occur both naturally and as a result of human activity, primarily through greenhouse gas emissions.

Estuarial flooding:

Flooding from an estuary, where water level may be influenced by both river flows and tidal conditions, with the latter usually being dominant.

Fetch:

Distance over which a wind acts to produce waves - also termed fetch length.

Flooding (or inundation):

Flooding is the overflowing of water onto land that is normally dry. It may be caused by overtopping or breach of banks or defences, inadequate or slow drainage of rainfall, underlying groundwater levels or blocked drains and sewers. It presents a risk only when people, human assets and ecosystems are present in the areas that floods.

Flood defence:

A man-made structure (e.g. embankment, bund, sluice gate, reservoir or barrier) designed to prevent flooding of areas adjacent to the defence.

Flood zones:

A geographic area for which the probability of flooding from rivers, estuaries or the sea is within a particular range as defined within the Draft Planning Guidelines.

Fluvial flooding:

Flooding from a river or other watercourse.

Groundwater flooding:

Flooding caused by groundwater escaping from the ground when the water table rises to or above ground level.

Hydrometric Area:

For the purposes of hydrological activities and by agreement between the various hydrological agencies in Northern Ireland and the Republic of Ireland, Ireland was divided into 40 hydrometric areas. Each Hydrometric Area comprises a single large river basin, or a group of smaller ones, and neighbouring coastal areas. Each area was assigned a number

from 01 to 40 beginning at the Foyle Catchment and proceeding in a clockwise direction (an exception to this general scheme is the catchment of the River Shannon and its tributaries which, because of its size, was divided into two hydrometric areas, 25 (Lower Shannon) and 26 (Upper Shannon) . The Poolbeg Peninsula is located within Hydrometric Area No. 09 – Liffey and Dublin Bay.

Likelihood (or probability) of flooding:

A general concept relating to the chance of an event occurring. Likelihood is generally expressed as a probability or a frequency of a flood of a given magnitude or severity occurring or being exceeded in any given year. It is based on the average frequency estimated, measured or extrapolated from records over a large number of years and is usually expressed as the chance of a particular flood level being exceeded in any one year. For example, a 1 in 100 or 1% flood is that which would, on average, be expected to occur once in 100 years, though it could happen at any time. The probability of flooding will relate to all sources of flooding.

Justification Test:

An assessment of whether a development proposal within an area at risk of flooding meets specific criteria for proper planning and sustainable development and demonstrates that it will not be subject to unacceptable risk nor increase flood risk elsewhere. The justification test should be applied only where development is within flood risk areas that would be defined as inappropriate under the screening test of the sequential risk based approach adopted by this guidance.

Mean High Water Spring:

(Also known as Spring High Water) The average height of the high waters of the spring tides. Spring tides are those tides of increased range occurring bi-monthly as the result of the gravitational effect of the moon.

Mitigation measures:

Elements of a development design which may be used to manage flood risk to a development, either by reducing the incidence of flooding both to the development and as a result of it and/or by making the development more resistant and/or resilient to the effects of flooding.

Overtopping of defences:

Failure of a flood defence or exceedance mechanism, when flood water reaches levels that are higher than the flood defence level and flows over the top of the structure. While the may remain stable, however, erosion of the landward face of the defence could cause the defence to collapse.

Pathways:

These provide the connection between a particular source (e.g. high river or tide level) and the receptor that may be harmed (e.g. property). In flood risk management, pathways are often ‘blocked’ by barriers, such as flood defence structures, or otherwise modified to reduce the incidence of flooding.

Pluvial flooding:

Usually associated with convective summer thunderstorms or high intensity rainfall cells within longer duration events, pluvial flooding is a result of rainfall-generated overland flows which arise before run-off enters any watercourse or sewer. The intensity of rainfall can be such that the run-off totally overwhelms surface water and underground drainage systems.

Run-off:

The flow of water, caused by rainfall, from an area which depends on how permeable the land surface is. Run-off is greatest from impermeable areas such as roofs, roads and hard standings and less from vegetated areas – moors, agricultural and forestry land.

Seiche

A short-period oscillation occurring in a harbour, bay or gulf. It can be caused by change in meteorological conditions, such as the passage of an intense depression or line squall or local topography. The period between successive waves may be anything between a few minutes and about two hours and the height of the waves may be anything from a few centimetres to a metre or even more.

Source:

Source refers to a source of flooding (e.g. the sea, heavy rainfall)

Strategic Flood Risk Assessment (SFRA):

The assessment of flood risk on a wide geographical area against which to assess development proposed in an area (Region, County, Town).

Surge

A coastal rise in water level caused by changes in meteorological conditions.

Sustainable Drainage Systems (SuDS):

A form of drainage that aims to control run-off as close to its source as possible using a sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques.

Tide

Rise and fall of the sea, happening twice each lunar day.

Tide locking:

This occurs when flow entering a system, such as an urban storm water drainage system, but cannot discharge due to a high water level in the receiving watercourse. Tide locking can cause surcharging and flooding if there is no storage capacity in the system.

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