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CHAPTER 8: FLOOD RISK AND SURFACE WATER

8. FLOOD RISK AND SURFACE WATER

8.1 Introduction

This chapter presents an assessment of the likely significant effects of the development on terrestrial hydrological regimes, including surface water quality, drainage and the risk of on-shore flooding. The potential significant effects on the marine environment of Nigg Bay are assessed in Chapter 6: Marine Physical Environment and Chapter 7: Marine Water and Sediment Quality. Effects of ground contamination on the quality of surface waters and groundwater are assessed in Chapter 9: Ground Conditions and Contamination.

This chapter provides a description of the methods used in the assessment followed by a description of the relevant baseline conditions of the site and surrounding area. Subsequently, an assessment of the likely significant effects of the development during the construction works and once the development is completed and operational are described. Mitigation measures are identified, where appropriate, to prevent, reduce or offset any adverse effects and an assessment is provided of the significance of the likely residual effects.

This chapter draws primarily on information collated from a Flood Risk Assessment (FRA) and Drainage Impact Assessment (DIA) undertaken by Intertek Energy & Water Consultancy Services Limited in August 2015. The FRA and DIA documents are included as ES Appendix 8-A: Flood Risk Assessment and ES Appendix 8-B: Drainage Impact Assessment.

8.1.1 Assessment Methodology and Significance Criteria

8.1.1.1 Assessment Methodology

The FRA and DIA were undertaken in accordance with current guidance set out in the Scottish Planning Policy document (Scottish Government, 2014) and in line with guidance and policy from the Scottish Environment Protection Agency (SEPA), Scottish Water and Local Flood Risk Authority.

Both reports have been carried out in line with the relevant legislation including the EU Water Framework Directive (Directive 2000/16/EC), the Water Environment and Water Services (Scotland) Act 2003, the Water Environment (Controlled Activities) (Scotland) Regulations 2011, the Pollution Prevention and Control (Scotland) Regulations 2012 and the Flood Risk Management (Scotland) Act 2009 and in line with the policy and guidance outlined in the Dee Catchment Management Plan (Dee Catchment Partnership, 2007) and Sewers for Scotland (Scottish Water, 2015).

The FRA assesses the risk of flooding from all sources and recommends mitigation measures for any adverse impacts identified on or off site. The DIA addresses surface water run-off, and provides recommendations to reduce surface water run-off and improve the quality of the water discharged from the site.

The FRA and DIA have involved the following steps:

- Review of the proposed development and relevant planning policies;

- Review of sources of potential flooding (fluvial, tidal, surface water, sewer);
- Examination of existing and proposed ground levels in relation to annual probability flood levels;
- Consultation with the SEPA and Scottish Water; and
- Identification of appropriate mitigation measures for any potential adverse effects of flooding at the site, taking into consideration climate change and surface water run-off associated with the development.

The findings of the FRA and DIA have been used to inform the qualitative assessment presented in this chapter with respect to Flood Risk and Surface Water.

The assessment of baseline conditions has used t three level flood risk framework recommended by Scottish Planning Policy (Scottish Government, 2014) and presented in Table 8.1.

Table 8.1: Significance criteria for flood risk

Criterion	Description
Medium to High Risk	Annual probability of coastal or watercourse flooding is greater than 0.5% (1:200 years)
Low to Medium Risk	Annual probability of coastal or watercourse flooding is between 0.1% and 0.5% (1:1,000 to 1:200 years)
Little or No Risk	Annual probability of coastal or watercourse flooding is less than 0.1% (1:1,000 years)

The assessment of potential and residual effects has used the following seven level scale of significance indicated in Table 8.2.

Table 8.2: Significance criteria for flood risk and surface water

Criterion	Description
Major adverse	Permanent increased risk of flooding or change to flow characteristics of watercourses. Permanent adverse effect on the local drainage system and subsequent capacity implications. Permanent reduction in the quality of the surface water resource.
Moderate adverse	Severe temporary flooding or change to flow characteristics of watercourses. Severe temporary adverse effect on the local drainage system and subsequent capacity implications; severe temporary reduction in the quality of the surface water resource.
Minor adverse	Minor local flooding adjacent to the site. Minor local scale increase in the risk of pollution to the receiving waterbodies, reversible with time. Minor effect on the local drainage system and capacity implications. Minor local scale reduction in the quality of surface water, reversible with time.
Negligible	No appreciable impact on pollution levels or the local drainage system. No appreciable increase in flood risk. Minor local scale improvement to the quality of surface water resources. Any minor adverse effects are reversible.
Minor beneficial	Minor reduction in impact on the local drainage system. Minor reduction in localised flood risk.
Moderate beneficial	Moderate reduction in impact on the local drainage system. Moderate reduction in localised flood risk. Moderate local scale improvement to the quality of surface water resources.
Major beneficial	Major reduction in impact on the local drainage system. Significant local scale/ moderate to significant regional scale reduction in flood risk. Significant local scale/ moderate to significant regional scale improvement to the quality of surface water resources.

In addition, effects were assessed as being temporary or permanent and as being site wide, local (i.e. relevant beyond the site boundaries), regional (i.e. relevant to the Aberdeen City and Shire area) or national (Scotland-wide).

8.1.2 Consultation with Statutory Agencies

The EIA Scoping exercise (July 2013 (see ES Appendix 1-C: Scoping Report 2013), revised in July 2014 (see ES Appendix 1-D: Scoping Opinion 2014)) identified the following comments (made by SEPA) that are relevant to flood risk and surface water.

- Requested that climate change should be factored for all assessments;
- Indicated that the ES should identify if impacts of the proposal are likely to lead to deterioration of the water environment;
- Requested that details of the waste water provision and SUDS be provided;
- Requested that pollution prevention measures of site work should be listed and a draft schedule of mitigation prepared;
- Requested a site survey of existing water features and a map of the location of all proposed engineering activities in the water environment be included;
- Recommended that flood risk, water quality and pollution prevention are covered separately; and
- Requested that water abstractions proposed should be listed and cumulative impacts considered.

Each of the points above have been considered and addressed either in this chapter or, in some instances, in Chapter 6: Marine Physical Environment or Chapter 7: Marine Water and Sediment Quality. It should be noted that, in line with our standard methodology, pollution prevention of surface water was assessed as part of water quality. Also, there are no water abstractions currently proposed as part of the proposed development. Additional information on pollution prevention measures is contained within an outline Environmental Management Plan (EMP) provided with the Environmental Statement (ES).

8.2 Baseline Conditions

8.2.1 Site and Surrounding Area

The site comprises an area of irregular shape consisting of tidal open coastal waters in Nigg Bay, exposed rock headland and areas of rough vegetation and sand. A hard surfaced car park and pedestrian walkway/viewpoint area is located towards the north of the bay, off Greyhope Road. Exposed rock headland extends north from Nigg Bay towards Girdleness Lighthouse and Walker Park, which are located on the northern edge of the site.

The ground level rises from 0 m Above Ordnance Datum (AOD) at the shoreline to 50 m AOD on the headlands to the north and south. Coast Road, which passes around the bay, rises above the 10 m contour but, in the centre of the bay, where it crosses the East Tullos Burn, is around 4 m AOD.

8.2.2 Hydrology

Nigg Bay itself is an open tidal bay that straddles the terrestrial, intertidal and marine environments.

The nearest watercourse is the East Tullos Burn. This watercourse has its source to the north of Tullos Wood and then takes a course north-east towards the Nigg Waste Water Treatment Works (WWTW) to the west of Nigg Bay. Moving eastwards and to the north of the WWTW, the watercourse is then culverted under Coast Road before it discharges into Nigg Bay.

The Ness Tip Burn also discharges to Nigg Bay. This "burn" consists predominantly of leachate from the neighbouring landfill which discharges at the southern end of the beach in Nigg Bay. As the source of this burn is predominantly leachate the Ness Tip Burn is classified as infrastructure for this assessment.

The River Dee runs through Aberdeen and discharges at the existing harbour approximately 1 km to the north-west of the site and is the largest watercourse in proximity to Nigg Bay.

Likely significant effects of ground based contamination on the quality of surface waters have been assessed in Chapter 9: Ground Conditions and Contamination. This chapter includes an assessment of the potential effects of pollution arising from the construction and operation of the proposed development on relevant terrestrial surface waters (i.e. the East Tullos Burn).

8.2.3 Hydrogeology

According to the BGS Hydrogeological Map of Scotland (1:625,000 scale), the geological deposits underlying the Site are classified as per Table 8.3.

Table 8.3: Summary of hydrogeological properties of the main geological strata

Stratum	BGS Classification	Hydrogeological Significance
Made ground	Not classified	May contain limited volumes of groundwater within granular layers.
Marine beach deposits Drumlithie sand and gravel formation Lochton gravel formation	Minor or moderately permeable aquifer	Locally important aquifer, although groundwater volume is variable. Belong to the Lower Dee Valley sand and gravel aquifer.
Mill of Forest till formation	Non or weakly permeable aquifer	Unlikely to contain significant volumes of groundwater, except within weathered or granular horizons.
Aberdeen formation	Non or weakly permeably aquifer	Unlikely to contain significant volumes of groundwater, except within weathered or granular horizons.

8.2.4 Surface Water Quality

The East Tullos Burn is currently classed as 'seriously polluted' under the SEPA River Classification Scheme which classifies waterbodies from "excellent" to "seriously polluted". The East Tullos Burn was determined to have 'poor' biology and 'poor' chemistry, both of which are attributed to point source and diffuse pollution. The East Tullos Burn was the subject of improvement works in 2014 to ameliorate the physical and ecological condition of the burn (Aberdeen City Council, 2015). The burn was remeandered and wetland pond areas were created for wildlife and biodiversity purposes. More

information on the surface water quality of the East Tullos Burn, including the results of water quality monitoring, is provided in Chapter 7: Marine Water and Sediment Quality.

The Ness Tip Burn consists of leachate from the neighbouring landfill and is highly polluted. More information on the surface water quality of the Ness Tip Burn including the results of water quality monitoring, is provided in Chapter 7: Marine Water and Sediment Quality.

The coastal waters of Nigg Bay, including an assessment of water quality, are discussed in Chapter 7: Marine Water and Sediment Quality.

8.2.5 Existing Infrastructure

There are four existing outfalls that discharge effluent within the vicinity of Nigg Bay. These are the Long Sea Outfall (LSO) which discharges outputs from the Nigg WWTW from the southern end of the bay, a second United Fish Industries outfall that discharges through the centre of Nigg Bay, and a third existing combined sewer outfall, known as St Fittick's Field Combined Sewer Outfall (CSO) that discharges north of Nigg Bay and will not impact upon, or be affected by, the development. The fourth outfall is the Ness Tip Burn which discharges leachate from the neighbouring landfill to Nigg Bay.

8.2.6 Tidal Flood Risk

The SEPA flood map shows the 1 in 200 (0.5%) year and 1 in 1,000 (0.1%) year tidal flood extent and indicates that the Site is at risk from extreme tidal flooding. The site lies inside the 1 in 200 (0.5%) year flood zone and is therefore in Flood Zone 3 and at "Medium to High Risk" according to the Scottish Planning Policy Flood Risk Framework (Scottish Government, 2014). There are currently no formal flood defences to protect the existing, undeveloped site.

A review of the tide gauge data at nearby Aberdeen Harbour shows that the highest recorded water levels occurred in January 2005 with a peak level of 5.306 m Above Chart Datum (ACD) (3.056 m AOD) and the second largest in December 2013 of 5.229 m ACD (2.979 m AOD). A comparison with site survey data along the foreshore suggests that limited flooding of the existing site would have occurred but that neither Greyhope Road nor Coast Road would have been flooded. Modelled data were used to assess extreme tide levels and climate changes effects. It was determined that the 1 in 200 (0.5%) year return period flood level with a 100 year climate change allowance is 4.11 m AOD.

The site is therefore considered to be at medium to high risk of tidal flooding.

8.2.7 Fluvial Flood Risk

The SEPA flood map does not indicate the East Tullos Burn to be at risk of fluvial flooding. Although SEPA flood maps indicate limited instances of surface water flooding within the East Tullos Burn, this does not affect the site.

An assessment was undertaken to determine if the culverted stretch of the East Tullos Burn beneath Coast Road has sufficient capacity to convey flood flows without flooding the road. Even assuming a worst case scenario that the culvert is 100% blocked, the 1 in 100 (1%) year flood flow with climate change would give a maximum depth on the road of 120 mm or 132 mm for the 1 in 1,000 year event, with overland flow discharging directly to the sea.

Modelled fluvial flood risk has been developed using the FEH CD Version 3. The potential attenuating effects of the East Tullos Burn improvement works have not been factored for in these calculations. The results therefore consider a conservative worst-case scenario.

Given the evidence outlined above, the site is considered to be at little or no risk of fluvial flooding.

8.2.8 Pluvial (Surface Water) Flood Risk

Pluvial flooding occurs when natural and engineered systems have insufficient capacity to deal with the volume of rainfall. Pluvial flooding can sometimes occur in urban areas during extreme, high intensity, low duration summer rainfall events which overwhelm the local surface water drainage system. This flood water is then conveyed via overland flow routes dictated by the local topography.

SEPA pluvial flood maps show those areas likely to experience surface water flooding during heavy rain storms and suggest the site is at low risk of flooding from surface water.

There are no recorded incidents of sewer flooding in the vicinity of the site although this does not definitively confirm that no events have taken place.

The existing site is largely undeveloped apart from the Nigg WWTW at the southern end of the bay. Existing surface water is understood to discharge naturally into Nigg Bay.

Surface water run-off calculations indicate that the existing site would have a 100 year 30 minute storm peak discharge of 44 l/s and storm volume of 80 m^3 whilst the 100 year 6 hour storm peak flow discharge would be 10 l/s and of a volume of 223 m^3.

Given that no flooding incidents are recorded for the site and the other evidence outlined in this section, pluvial (surface water) flooding is considered to be of little or no risk.

8.2.9 Groundwater Flood Risk

Groundwater flooding is usually associated with chalk and sandstone catchments that allow groundwater to rise to the surface through the permeable subsoil following long periods of wet weather.

While there are no records of the area having been affected by groundwater flooding. The risk of groundwater flooding is highly variable and depends on local conditions at any particular time and it is not possible to accurately assess the risk. There are no records of the area having been affected. Therefore, flooding from groundwater is considered to be of little or no risk.

8.2.10 Flood Risk from Artificial Sources

Flooding from the failure or overtopping of impounded waterbodies such as lakes, reservoirs, canals or other waterbodies was considered.

The assessment confirmed there are no lakes, reservoirs, canals or other waterbodies in the local area whose failure would have an impact on flooding the site. Therefore, flooding from artificial

sources is considered to be of no risk. Flood risk from artificial sources has, therefore, not been considered further in this chapter.

8.2.11 Foul Drainage

There are no existing sewers located within the Site. However, the site lies adjacent to the Nigg WWTW.

8.3 Assessment of Effects

8.3.1 Construction

8.3.1.1 Surface Water Quality

During the construction phase of the development it is unlikely that surface water run-off from newly constructed areas would enter the East Tullos Burn, as flows would discharge directly to coastal waters.

Existing proposals assume the East Tullos Burn will remain in its current location and will discharge through the quay wall once the harbour is built. Potential contamination to the burn and coastal waters would be mitigated against through the use of best practice measures such as petrol/oil interceptors and control valves. An EMP will be developed to prevent pollution and ensure there is no adverse impact to surface water quality.

Accounting for the above, the potential effect of construction works upon surface water quality during would be of **negligible** significance, which is not significant in EIA terms.

8.3.1.2 Existing Infrastructure

As noted above, there are four existing outfalls that discharge effluent within the vicinity of Nigg Bay. As part of the construction methodology of the proposed development, these outfalls would be protected, if necessary, to ensure that their current operation is maintained during the construction process. Any necessary diversions of outfalls within the bay would be commenced early in the construction programme as indicated in Chapter 3: Description of the Development and undertaken in accordance with all current best practice such as Scottish Water's Sewers for Scotland (Scottish Water, 2015).

The potential effect of the construction works upon the existing sewer outfall infrastructure would therefore be of **negligible** significance, which is not significant in EIA terms.

8.3.1.3 Tidal Flood Risk

As detailed earlier in this chapter, and within ES Appendix 8-A: Flood Risk Assessment, the site is at medium to high risk of tidal flooding.

Works within the bay will comprise the raising of site levels as required to meet the agreed finished floor levels, above the flood levels, and the construction of the new foundations and proposed breakwaters, quays, berths and buildings.

It is not considered that any of the works listed above would compromise the tidal flood risk to the site or the surrounding area. Indeed, the phased build-out of the new breakwaters and quays will, over time, reduce the risk of tidal flooding in the local area. The potential effect of the construction phase will, therefore, range from **negligible** to a **permanent, site-wide, beneficial** effect of **minor** significance on tidal flooding, which is not significant in EIA terms.

8.3.1.4 Fluvial Flood Risk

As detailed earlier in this chapter, and within ES Appendix 8-A: Flood Risk Assessment, the site is at little or no risk of fluvial flooding.

Existing proposals assume the East Tullos Burn will remain in its current location and will discharge through the quay wall once the harbour is built. Any development should maintain at least the existing culvert capacity to ensure there is no increase in flood risk. All works will be carried out in line with best practice.

Accounting for the above, the potential effect of the construction works upon fluvial flood risk would therefore be of **negligible** significance, which is not significant in EIA terms.

8.3.1.5 Pluvial (Surface Water) Flood Risk

As previously mentioned, the Site itself is not considered to be at risk from surface water flooding. Furthermore, no flooding incidents have been recorded on the site. This would remain the case during the construction works.

During the construction works, rainfall entering the site would discharge directly to Nigg Bay. As construction progresses, an increase in impermeable surface area would lead to an increase in surface water run-off volume and rate. However, as the site discharges to coastal waters there is no benefit in using SUDS to control peak flow and the volume of run-off. The FRA confirmed that there are no predicted significant adverse effects and therefore no mitigation measures are required. Nevertheless, the drainage would be designed in accordance with the current best practice, to ensure surface water is suitably discharged into coastal waters.

Accounting for the above, the potential effect of the construction works upon pluvial (surface water) flood risk would be of **negligible** significance, which is not significant in EIA terms.

8.3.1.6 Groundwater Flood Risk

As previously mentioned, the site itself is considered to be at little or no risk of groundwater flooding. Moreover, the proposed development would be raised above the local ground level and so the risk from groundwater flooding to the proposed quays and buildings is likely to be low.

Accounting for the above, the potential effect of construction works upon groundwater flooding to the site and the surrounding area would be of **negligible** significance, which is not significant in EIA terms.

8.3.1.7 Foul Drainage

There are no existing sewers located within the existing site. During the construction works it is anticipated that foul water would be stored onsite and be removed by specialised contractors in accordance with current best practices, such as those set out under the Pollution Prevention Guidelines and CIRIA C532 (CIRIA, 2001), so as to ensure no pollution is caused to the water environment.

Accounting for the above, the overall effect of the construction works upon foul water drainage is anticipated to be of **negligible** significance, which is not significant in EIA terms.

8.3.2 Completed Development

8.3.2.1 Surface Water Quality

Following the completion of the development it is unlikely that surface water run-off from newly constructed areas would enter the East Tullos Burn, as flows would discharge to coastal waters.

Existing proposals assume the East Tullos Burn will remain in its current location and will discharge through the quay wall once the harbour is built. Potential contamination to the burn and coastal waters should be mitigated against through the use of best practice measures such as petrol/oil interceptors and control valves. An EMP will be developed to prevent pollution and ensure there is no adverse impact to surface water quality.

Accounting for the above, the potential effect of the completed development upon surface water quality following the development would be of **negligible** significance, which is not significant in EIA terms.

8.3.2.2 Existing Infrastructure

There are four existing outfalls that discharge effluent within the vicinity of Nigg Bay. The proposed development would be designed to ensure that these outfalls are protected so that there would be no adverse effect on the way they function caused by the completed development.

The overall effect of the completed development upon the existing infrastructure would therefore be of **negligible** significance, which is not significant in EIA terms.

8.3.2.3 Tidal Flood Risk

As detailed earlier in this chapter, and within ES Appendix 8-A: Flood Risk Assessment, the site is at medium to high risk of tidal flooding.

Proposed finished floor levels of the development are 4.45 m AOD which are above the extreme modelled 1 in 200 (0.5%) year event plus climate change tidal flood level meaning the developed site is unlikely to be susceptible to flooding. The proposed breakwater would be constructed at a height of 9.75 m AOD and would provide protection against extreme wave heights. According to hydraulic modelling results this would likely lead to a decrease in the extreme flood levels entering the bay and, in most instances, a decrease in extreme wave heights in the surrounding area. A safe dry escape route from the site is available to the north-west which leads to higher ground.

The likely effect of the completed development on tidal flood risk to the site is therefore considered to be a **permanent, local, beneficial** effect of **minor** significance, which is not significant in EIA terms.

8.3.2.4 Fluvial Flood Risk

As detailed earlier in this chapter, and within ES Appendix 8-A: Flood Risk Assessment, the site is at little or no risk of fluvial flooding.

Existing proposals assume the East Tullos Burn will remain in its current location and will discharge through the quay wall once the harbour is built. Any development should maintain at least the existing culvert capacity to ensure there is no increase in flood risk.

Accounting for the above, the potential effect of the completed development upon fluvial flood risk would therefore be of **negligible** significance, which is not significant in EIA terms.

8.3.2.5 Pluvial (Surface Water) Flood Risk

As previously mentioned, the site itself is not considered to be at risk from surface water flooding. This would remain the case once the development is operational. Furthermore, no flooding incidents have been recorded on the site.

The development would lead to an increase in impermeable area to approximately 75% of the total site area. Surface water run-off calculations were provided in ES Appendix 8-A: Flood Risk Assessment with a 30% allowance for climate change. The results show the peak flows from the developed Site would increase to 239 l/s for the 100 year 30 minute storm event with a volume of 429 m^3, whilst the 100 year 6 hour storm peak flow would increase to 56 l/s and volume of 1198 m^3.

However, as the site lies adjacent to the sea there is no requirement to, or benefit in, using SUDS to control peak flow and the volume of run-off. Nevertheless, the drainage network will be designed in accordance with current best practice, to ensure all surface water is suitably discharged into coastal waters. Areas of the development subject to particularly high pollution risk would be minimised and runoff directed to the foul sewer.

Additionally, the operational floor level of the quays will be raised above the local ground level and this will prevent surface water from entering the site or any new buildings and the risk of storm water flooding will therefore be low.

Accounting for the above, the overall effect of the development on pluvial (surface water) flood risk to the site and surrounding area is considered to be of **negligible** significance, which is not significant in EIA terms.

8.3.2.6 Groundwater Flood Risk

As previously mentioned, the site itself is considered to be at little or no risk from groundwater flooding. However, as the completed development would be raised above the local ground level, the risk from groundwater flooding to the proposed quays and buildings is likely to be low.

Therefore the risk of groundwater flooding to the site and the surrounding area would be of **negligible** significance, which is not significant in EIA terms.

8.3.2.7 Foul Drainage

There are no existing sewers located within the existing site. However, as the site lies adjacent to the Nigg WWTW it is unlikely that there would be any issues connecting to the existing sewerage network and any connection is likely to be straightforward with the minimum of additional infrastructure. A Pre-development Enquiry has been sent to Scottish Water to confirm that the treatment works has the capacity to serve the development. No response had been received at the time of submission.

Foul water would need to be pumped to the WWTW to serve the completed development. Any pumping station would be designed in accordance with all current best practice, including the current edition of Scottish Water's Sewers for Scotland (Scottish Water, 2015), to ensure there would be no increased risk of flooding.

Accounting for the above, the overall likely effect of the completed development upon foul water drainage capacity is anticipated to be of **negligible** significance, which is not significant in EIA terms.

8.4 Mitigation Measures

8.4.1 Construction

The likely effect of the construction works on surface water quality, existing infrastructure, tidal flooding, fluvial flooding, pluvial (surface water) flooding, groundwater flooding and foul drainage would be either negligible or beneficial providing best practice measures, outlined in previous sections, are followed. Therefore, no specific mitigation measures are required.

However, indicative best practice measures with respect to preventing pollution of the water environment are outlined below:

- An EMP will be implemented during the construction and operational activities of the new harbour to reduce the risk of pollutant releases to the environment and/or accidental spills, including as a minimum the following measures:
    - Surface water drains will either drain to a sewer or be fitted with interceptors/silt-traps and shut off valves as appropriate;
    - Materials will be stored as per specifications in appropriately designed containers and staff will be trained to ensure chemicals are appropriately disposed of;
    - Crews will be trained to collect debris before washing down the deck;
    - Staff will be trained in the prevention measures to adopt during maintenance, cleaning and repainting of vessels. Vessels are removed from water to an appropriately drained area for hull cleaning operations;
    - Bunkering operations are completed only by trained personnel with constant presence at valves, sight gauges and 'stop' switches; and

- A Spill Contingency Plan will be in place in the harbour. Dock Control Officers will patrol the area regularly for spills; stocks of absorbents will be maintained and staff will be trained to report and clean-up spills immediately.

SEPA's Pollution Prevention Guidelines as detailed in Section 7.1.4 will also be enforced during construction and operation of the proposed development.

More detailed measures, would be provided as part of the EMP once detailed design has been confirmed.

8.4.2 Completed Development

The likely effect of the completed development on surface water quality, existing infrastructure, tidal flooding, fluvial flooding, pluvial (surface water) flooding, groundwater flooding and foul drainage would be either negligible or beneficial providing best practice measures, outlined in previous sections, are followed. Therefore, no specific mitigation measures are required.

See Section 8.3.1. for indicative best practice measures to be developed as part of the EMP.

8.5 Residual Effects

8.5.1 Construction

8.5.1.1 Surface Water Quality

Assuming all works are undertaken in accordance with best practice measures, and the details provided in EMP are followed, there would be little risk of adverse effects on surface water quality during the construction phase. Therefore the residual effect would be of **negligible** significance, which is not significant in EIA terms.

8.5.1.2 Existing Infrastructure

As the protection of existing infrastructure during the construction stage would be undertaken in accordance with all current best practice the residual effect would be of **negligible** significance, which is not significant in EIA terms.

8.5.1.3 Tidal Flood Risk

As the construction of the breakwaters and the quays progress throughout the construction phases, there would be a decrease in the extreme tidal flood levels entering the bay. In the latter stages of the construction phase, once the breakwaters and quays are completed, the residual effect would increase from **negligible** to a **permanent, site wide, beneficial** effect of **minor** significance to tidal flood risk, which is not significant in EIA terms.

8.5.1.4 Fluvial Flood Risk

Assuming all works are undertaken in accordance with best practice measures, and that any development should maintain at least the existing culvert capacity to ensure there is no increase in flood risk the risk of impacts on fluvial flood risk during the construction phase would not increase. Therefore the residual effect of fluvial flood risk would be of **negligible** significance, which is not significant in EIA terms.

8.5.1.5 Pluvial (Surface Water) Flood Risk

As the site would discharge directly to Nigg Bay during construction and there is no requirement to, or benefit in, using SUDS to control peak flow and run-off volume, so long as the drainage network is designed in accordance with the current best practice, the residual effect would be of **negligible** significance, which is not significant in EIA terms.

8.5.1.6 Groundwater Flood Risk

As the site is raised above the local ground level, the risk from groundwater flooding to the proposed development is likely to be low. Therefore, the residual effect of groundwater during construction works would be of **negligible** significance, which is not significant in EIA terms.

8.5.1.7 Foul Drainage

During the construction works it is anticipated that foul water will be managed in accordance with current best practice measures to ensure no pollution is caused to the water environment. Therefore, the residual effect would be of **negligible** significance, which is not significant in EIA terms.

8.5.2 Completed Development

8.5.2.1 Surface Water Quality

Assuming all works are undertaken in accordance with best practice measures, to ensure the development does not cause any degradation of surface water quality, there would be little risk of adverse effects on surface water quality following the completed development. Therefore the residual effect of the completed development would be of **negligible** significance, which is not significant in EIA terms.

8.5.2.2 Existing Infrastructure

The proposed development would be designed to ensure that the existing infrastructure is protected so that there would be no adverse effect on the way it functions caused by the completed development. The residual effect would therefore be of **negligible** significance, which is not significant in EIA terms.

8.5.2.3 Tidal Flood Risk

Following the completion of the development the proposed breakwater would be likely to lead to a decrease in the extreme tidal flood levels entering the bay. This would represent a **permanent, site-wide, beneficial** effect of **minor** significance, which is not significant in EIA terms.

8.5.2.4 Fluvial Flood Risk

Assuming all works are undertaken in accordance with best practice measures, and that any development should maintain at least the existing culvert capacity to ensure there is no increase in flood risk the risk of impacts on fluvial flood risk following the completion of the development would not increase. Therefore the residual effect of fluvial flood risk would be of **negligible** significance, which is not significant in EIA terms.

8.5.2.5 Pluvial (Surface Water) Flood Risk

Surface water will be managed in line with best practice measures which will ensure there is no increase to the risk of pluvial flooding. Therefore, the residual effects of pluvial (surface water) flood risk would be of **negligible** significance, which is not significant in EIA terms.

8.5.2.6 Groundwater Flood Risk

As the site is raised above the local ground level the risk from groundwater flooding to the proposed development is likely to be low. Therefore the residual effect would be of **negligible** significance, which is not significant in EIA terms.

8.5.2.7 Foul Drainage

Any pumping station included as part of the proposed development would be designed in accordance with all current best practice, to ensure there would be no increased risk of flooding. Therefore, the residual effect would be of **negligible** significance, which is not significant in EIA terms.

8.6 Summary and Conclusions

It is considered that the proposed development is unlikely to lead to significant adverse effects in relation to surface water quality, existing infrastructure, fluvial flooding, pluvial (surface water) flood risk, groundwater flood risk, flood risk from artificial sources, or foul drainage, and that where adverse effects could potentially arise, these can be removed through the implementation of best practice measures.

There is expected to be a beneficial effect to tidal flood risk with the proposed breakwaters potentially reducing the extreme flood levels within the bay.

A summary is provided in Table 8.4.

Table 8.4: Summary of effects

Issue	Likely Significant Effect	Mitigation Measures	Likely Residual Effect
Construction			
Surface Water Quality	Negligible	None required, but follow best practice and EMP	Negligible
Existing Infrastructure	Negligible		Negligible
Tidal Flood Risk	Range from negligible to permanent, site-wide, minor beneficial		Range from negligible to permanent, site-wide, minor beneficial
Fluvial Flood Risk	Negligible		Negligible
Pluvial (Surface Water) Flood Risk	Negligible		Negligible
Groundwater Flood Risk	Negligible		Negligible
Foul Drainage	Negligible		Negligible
Completed Development			
Surface Water Quality	Negligible	None required, but follow best practice and EMP	Negligible
Existing Infrastructure	Negligible		Negligible

Table 8.4: Summary of effects continued

Issue	Likely Significant Effect	Mitigation Measures	Likely Residual Effect
Completed development			
Tidal Flood Risk	Permanent, site-wide, minor beneficial		Permanent, site-wide, minor beneficial
Fluvial Flood Risk	Negligible		Negligible
Pluvial (Surface Water) Flood Risk	Negligible		Negligible
Groundwater Flood Risk	Negligible		Negligible
Foul Drainage	Negligible		Negligible

8.7 References

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