Waterman Moylan
Engineering Consultants

Flood Risk Assessment & Statement of Consistency

Dunshaughlin West / Phase 2 SHD, County Meath.

September 2020

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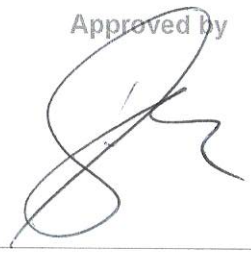

Disclaimer

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Statement of Consistency

This statement of consistency confirms the following:

This Site-Specific Flood Risk Assessment (SSFRA) has been prepared as part of the SHD Planning Application to An Bord Pleanála. The SSFRA is in accordance with the recommendations in the Strategic Flood Risk Assessment produced as part of the Meath County Development Plan 2013-2019 and the Flood Risk Management Guidelines for Planning Authorities published in November 2009.

1. Introduction

This report has been prepared by Waterman Moylan Engineering Consultants, on behalf of Castlethorn Construction ULC, as part of a SHD planning submission to An Bord Pleanala (ABP), for the **Phase 2** proposed development of 415 No. residential units with 1 No. childcare facility at Dunshaughlin, County Meath. Phase 1 granted under planning permission Reg. Ref. DA/120987, ABP Ref. PL17.241988 is currently under construction and nearing completion.

This Flood Risk Assessment has been carried out in accordance with the DEHLG/OPW Guidelines on the Planning Process and Flood Risk Management published in November 2009. This Assessment identifies and sets out possible mitigation measures against potential risks of flooding from various sources. Sources of possible flooding include coastal, fluvial, pluvial (direct heavy rain) and groundwater.

This report provides an assessment of the subject site for flood risk purposes only.

1.1 Site Location and Description

The site is located within the townlands of Readsland, Roestown and Knocks, Dunshaughlin, Co. Meath. The proposed Phase 2 development consists of the construction of 415 No. residential units with 1 No. childcare facility on a greenfield site that consists of natural planted areas and agricultural fields. The total site area is approximately 14.8 Ha and it is split into two discrete parts.

The northern part of the site has an area of 4.32 Ha. It is located to the west of the R125 and north of the Drumree Road.

The larger southern part has an area of 10.52 Ha. It is bounded to the west by the R125, a distributor road that links the town with a junction on the M3 motorway, and bounded to the North by the almost complete Phase 1 housing estate on the same landholding that has access from the Drumree Road.

For ease of reference, the portion of the Phase 2 development located to the north of Drumree Road will be referred to as **North Site** and portion to the south of Drumree Road will be referred to as the **South Site**. See Figure 1-1 below for details.

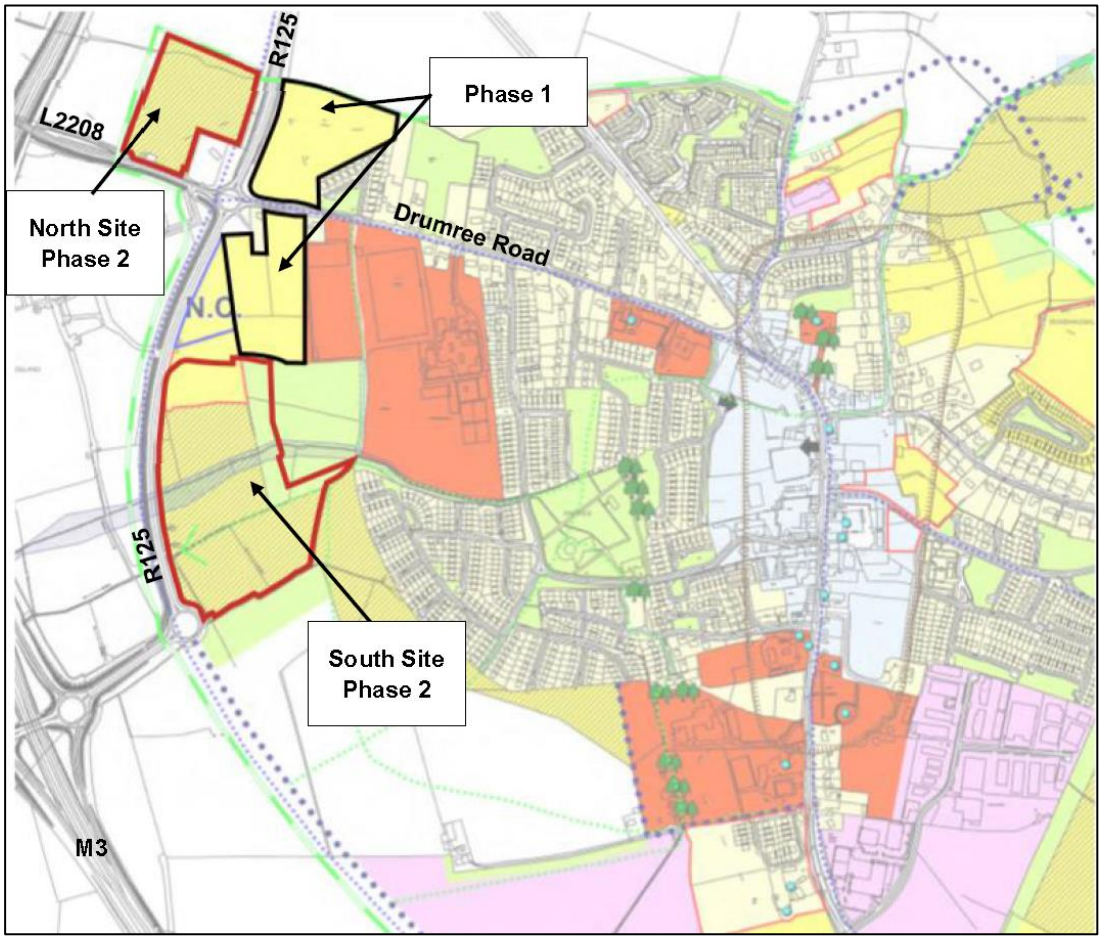


Figure 1-1: Site Location

North Site

The North Site area is approximately 4.32 Ha. The North Site generally falls c.1/67 from north to south. With a high point of 107.84m OD Malin and a low point of 104.44m OD Malin.

The proposed finished floor levels (FFL) would generally vary between 106.300m and 103.175m OD Malin.

The proposed finished road levels (RL) vary between 106.300m and 103.175m OD Malin.

Generally, a minimum of 150mm level difference between the finished floor levels and the finished crown road levels is provided, with the exception of Road G at the north east corner of the site. This road however is at the top of the site with the road levels falling away c.1/85 and all surface water will drain southwards, away from the apartment Block 03. Please refer to drawing 12-081A-P113 submitted with this planning application for details.

South Site

The South Site area is an approx. 10.52 Ha. Approximately 297m of Skane River traverses the South Site dividing it into two catchments, namely A & B. The catchment to the north of Skane River, **Catchment A**, has a high point of 98.76m OD Malin and generally falls c. 1/180 from north to south. The catchment to the south of Skane River, **Catchment B**, has a high point of 96.63m OD Malin and generally falls c.1/42 from south to north.

The Skane River bed itself generally slopes 1/166 from east to west with the riverbed at levels from 93.53m OD Malin to 91.46m OD Malin, and natural banks level of 95.09m to 92.20m OD Malin.

The entire South Site has a low point of 91.46m OD Malin at the R125 culvert where the Skane River exits the subject site.

The proposed finished floor levels (FFL) would generally vary between 97.350m and 94.850m OD Malin.

The proposed finished road levels (RL) vary between 96.98 m and 94.59m OD Malin.

A minimum of 260mm level difference between the finished floor level and the finished road level is provided.

For details of the Phase 2 site topography for both the North and South Sites, refer to Figure 1-2 below.

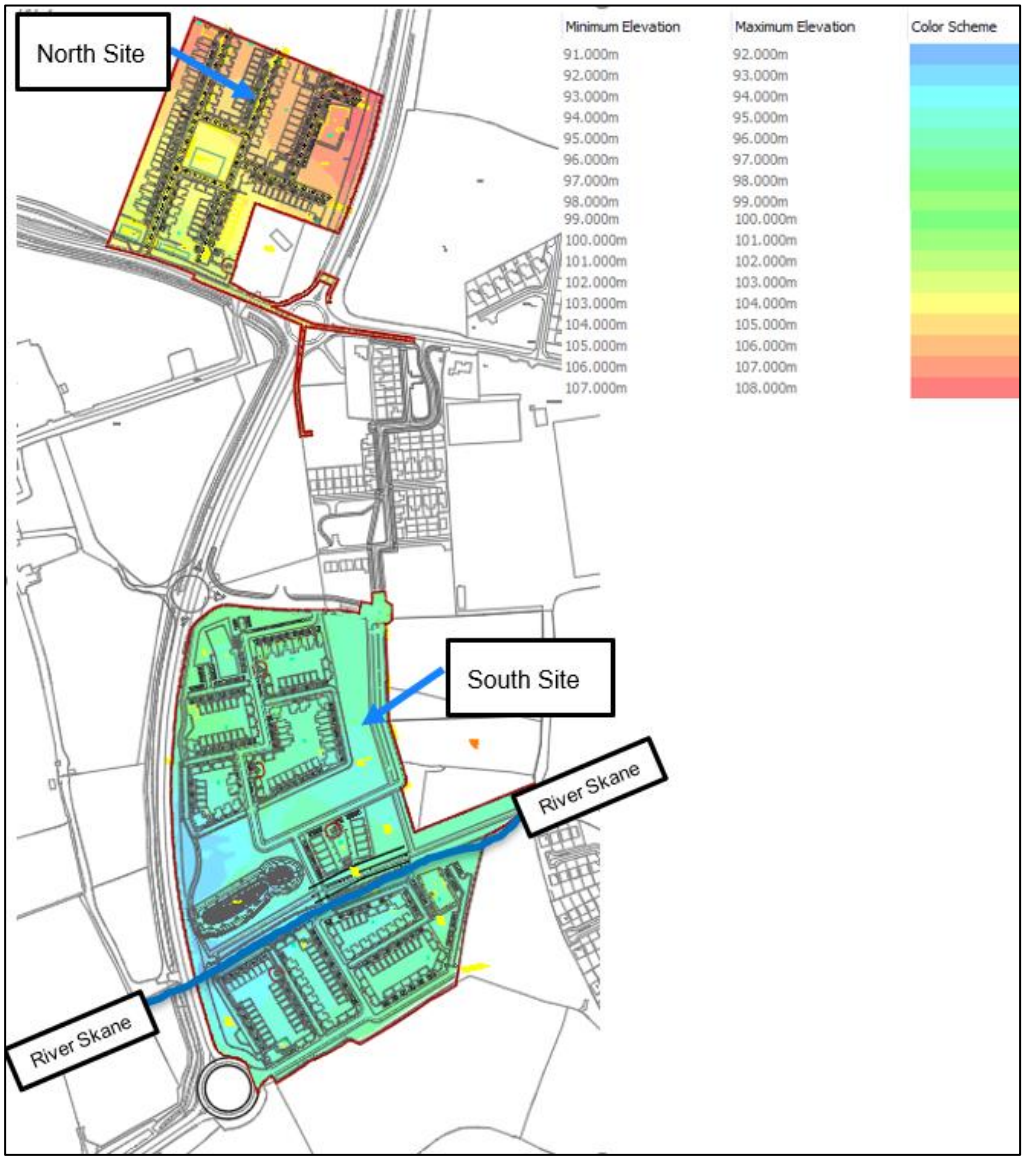


Figure 1-2: Subject Sites Existing Ground Contours

1.2 Background to the Report

The components to be considered in the identification and assessment of flood risk is as per Table 1 of the DEHLG/OPW guidelines:

- Tidal – flooding from high sea levels
- Fluvial – flooding from watercourses
- Pluvial – flooding from rainfall/surface water
- Ground Water – flooding from springs / raised groundwater
- Human/mechanical error – flooding due to human or mechanical error

Each component will be investigated from a Source, Pathway and Receptor perspective, followed by an assessment of the likelihood of a flood occurring, and the possible consequences.

The Source, Pathway and Receptor Model described in the OPW Guidelines can be seen in Figure 1-3 below:

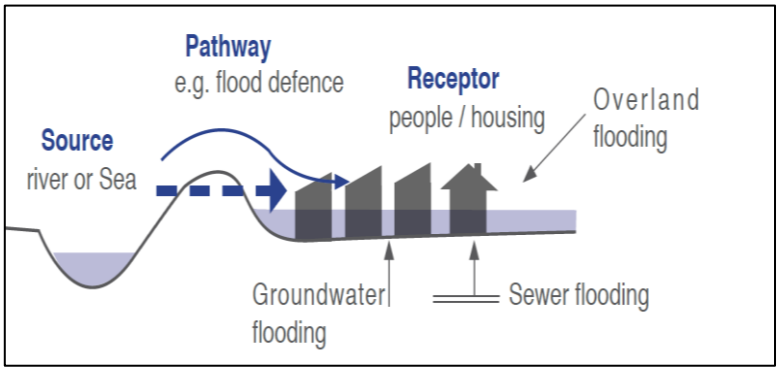


Figure 1-3: Source-Pathway-Receptor S-P-R Model

The ultimate aim of a flood risk assessment is to combine these components and map or describe the risks on a spatial scale so that the consequences can then be analyzed.

The likelihood of flooding falls into three categories of low, moderate and high, which are described in the OPW Guidelines as seen in Table 1 below:

Likelihood	Low	Moderate	High
Tidal	Where probability < 0.1 % chance of occurring in a year	0.5 % chance of occurring in a year > probability > 0.1 % chance of occurring in a year	Where probability > 0.5 % chance of occurring in a year
Fluvial	Where probability < 0.1 % chance of occurring in a year	1 % chance of occurring in a year > probability > 0.1 % chance of occurring in a year	Where probability > 1 % chance of occurring in a year
Pluvial	Where probability < 0.1 % chance of occurring in a year	1 % chance of occurring in a year > probability > 0.1 % chance of occurring in a year 0.1 % chance of occurring in a year	Where probability > 1 % chance of occurring in a year

Table 1: Table A1 of DEHLG/OPW Guidelines on the Planning Process and Flood Management

For groundwater and human/mechanical error, the limits of probability are not defined and, therefore, professional judgment is used. However, the likelihood of flooding is still categorized as low, moderate and high for these components. From a consideration of the likelihoods and the possible consequences, the risk is evaluated. Should such a risk exist, mitigation measures will be explored, and the residual risks assessed.

This report has considered the OPW Eastern CFRAM maps with regard to flood risk.

1.2.1 Assessing Consequence

There is not a defined method used to quantify a value for the consequences of a flooding event. Therefore, in order to determine a value for the consequences of a flooding event, the elements likely to be adversely affected by such flooding will be assessed, with the likely damage being stated, and professional judgement will be used to determine a value for consequences. Consequences will also be categorized as low, moderate, and high.

1.2.2 Assessing Risk

Based on the determined ‘likelihood’ and ‘consequences’ values of a flood event, the following 3x3 Risk Matrix will then be referenced to determine the overall risk of a flood event.

		CONSEQUENCES		
LIKELIHOOD		LOW	MODERATE	HIGH
	LOW	Extremely Low Risk	Low Risk	Moderate Risk
	MODERATE	Low Risk	Moderate Risk	High Risk
	HIGH	Moderate Risk	High Risk	Extremely High Risk

Table 2: 3x3 Risk Matrix

2. Tidal – Irish Sea

The Irish Sea is approximately 30 kilometres east of the subject site. The subject site levels are between 91.46m to 107.84m OD Malin.

The Dublin Coastal Protection project indicates that the 2002 high tide event reached 2.95m OD Malin. The subject site is therefore between 88.51m and 104.53m above the highest tide recorded in the Dublin Coastal Area.

Therefore, due to the site's location and elevation in relation to the Irish Sea, likelihood of tidal flooding is extremely remote.

3. Fluvial

3.1 Source

The subject site is located within the catchment of the Skane River which traverses the southern portion of the site. The Skane River is a tributary of the River Boyne and drains ultimately northwards to the River Boyne just south of Navan.

All surface water from the subject site will drain to the Skane River. The Skane River crosses the South Site lands with a channel invert level of 93.53m to 91.46m OD Malin and proposed banks level of 95.09m to 92.20m OD Malin.

The lowest finished floor level of the proposed housing units fronting to the Skane River open space area is 94.850m OD Malin which is 2.65m higher than the adjacent Skane River bank level of 92.20m OD Malin.

There is no OPW Fluvial flood maps for the Skane River and the site is not identified as a flood zone in the CFRAM's study.

A Flood Risk Assessment and Management Plan (FRA&MP) report for the Meath County Development Plan 2020-2026 Strategic Flood Risk Assessment was published in December 2019. Section 5.16 summarises Dunshaughlin flood risk assessment results. The Skane River within the proposed development was identified as a minor watercourse which drains in a westerly direction adjacent to the GAA pitches and exerts only a small risk of flooding to surrounding lands.

3.2 Pathway

The FRA&MP flood map has incorrectly identified old field drainage ditches that appear to have had its outlet blocked, perhaps at the time that the R125 road was constructed. The Skane River is in fact located to the south of the existing attenuation pond as outlined below. This was confirmed by a site inspection and by the topographical survey of the lands. A separate report was issued to MCC earlier in 2020 drawing attention to the error on the mapping and perceived flood area. The ditch network has been subsequently opened as part of the Phase 1 works.

The 1 in 100-year flood extent has been estimated for the Skane River at its actual location, south of that indicated in the FRA&MP flood map. For details of the incorrectly mapped Skane River location according to the FRA&MP and correctly located Skane River mapped by the EPA please see sections 3.2.1 to 3.2.4 below.

3.2.1 Skane River Channel as Mapped by EPA *(Accurate)*

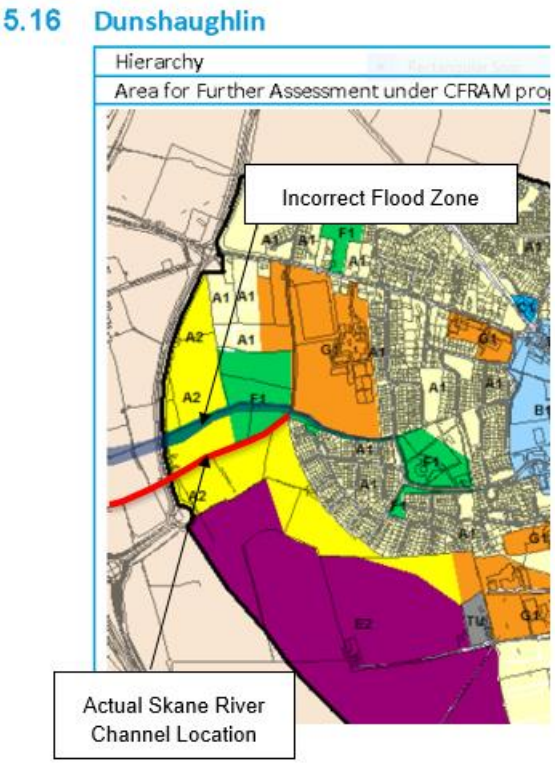
Skane River channel is located south of the existing attenuation pond as shown on the Environmental Protection Agency (EPA) map.

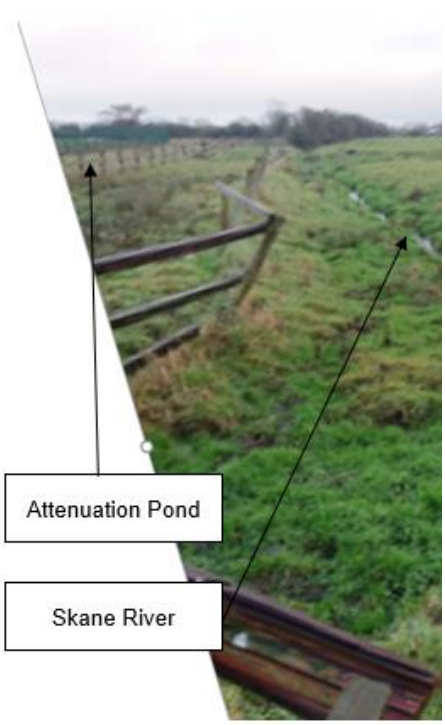
Skane River channel location was confirmed by a site inspection.

https://gis.epa.ie/EPAMaps/

3.2.2 Skane River Channel as Mapped on FRA&MP for Meath CDP 2020-2026 *(Inaccurate)*

Skane River channel appears to be inaccurately positioned on the Flood Zone map published in the Flood Risk Assessment and Management Plan (FRA&MP) for the proposed Meath County Development Plan 2020-2026, December 2019.





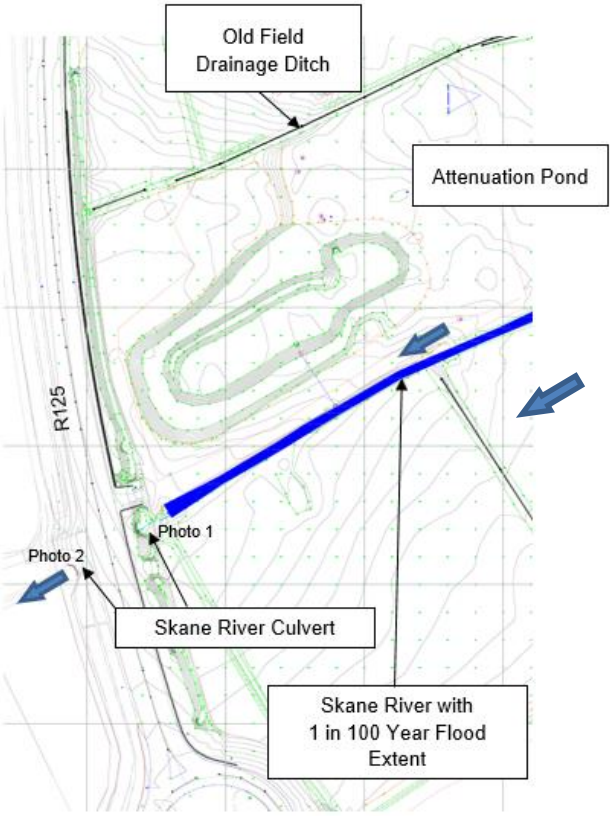


Photo1 and 2 attached below.

Photo 1: Existing Skane River Culvert under the R125 - looking west

Photo 2: Skane River West of the R125 embankment

The estimated flood extent in excess of 0.1% AEP (1 in 1000 year) within the proposed Phase 2 development can be seen in Figure 3-1 below.

The estimate is based on the historical flow rate obtained from Skane Rive metering station further downstream of Skane River at Drumree village. The highest recorded flow of 2.50m^3/s can be seen below in Figure 3-2. The measurement date seems to coincide with Tolka River bursting banks in Dunboyne on 4-5 November 2000.

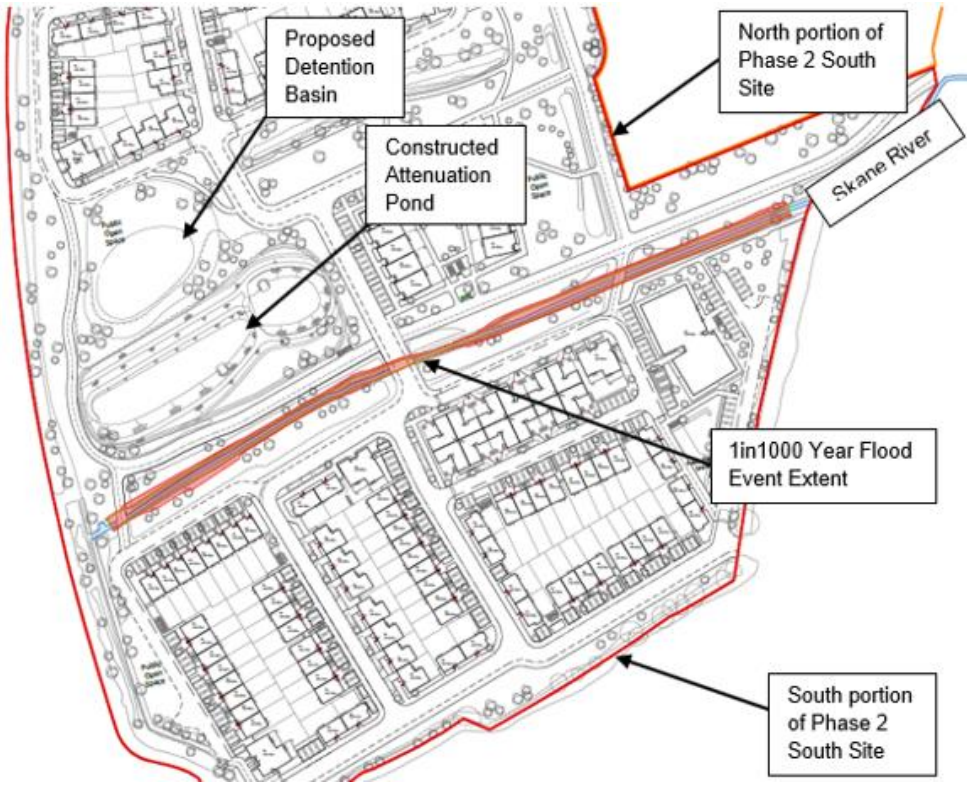


Figure 3-1: Proposed development & 1:1000 Year Flood Extent

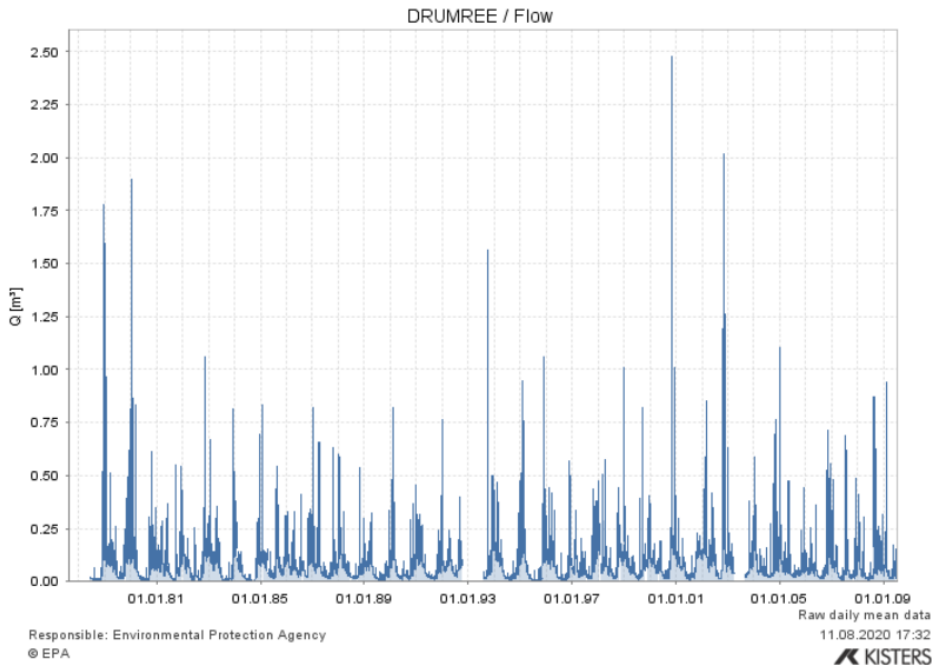


Figure 3-2: Highest recorded flow

The proposed development housing units are located within the Flood Zone C. Only water compatible aspects of the proposed development will be situated within Zone B such as open space, paths, outdoor sports and recreation amenities.

The proposed housing units are located at least 20m outside the 1 in 1000 Skane River flood zone with finished floor levels set at minimum of 500mm above the estimated Skane River flood levels.

3.3 Receptor

The receptor for a fluvial flood event is the proposed residential units and surrounding landscaped areas.

3.4 Likelihood

Given that the residential aspects of the proposed development are located outside 0.1% AEP, the likelihood of fluvial flooding is LOW.

Some of the landscaped areas along the Skane River are within the 1% - 0.1% AEP flood zone, the likelihood of fluvial flooding is MODERATE.

3.5 Consequence

The consequences of a flooding event on the site would be damage to roads, landscaped areas and housing units building. The consequences of a fluvial flooding event are therefore assessed to be HIGH.

3.6 Risk

There is a MODERATE risk of fluvial flooding for housing units but high risk of flooding to landscaped areas and roads along the Skane River.

3.7 Flood Risk Management

The risk from fluvial flooding on the whole site is reduced by setting the finished floor levels of the housing units within the development at a minimum of 150mm on the North Site and 260mm on the South Site above the high point of the road adjacent to the property with no isolated low points as the site would free drain to the River Skane overland. Flood risk will be further reduced by designing the surrounding levels to connect to the road network to ensure that there are suitable overland flood routes away from the buildings. A map of the overland flood route has been provided in Appendix A.

3.8 Residual Risk

Given the flood risk management features referenced above, the residual risk is assessed to be LOW.

4. Pluvial

Pluvial flooding is from heavy rainfall and is often referred to as flooding from surface water. Surface water flooding can occur as a result of overland flow or ponding during periods of extreme prolonged rainfall. Flooding may occur through any of the pathways outlined in Table 3 and the risk associated with each pathway is outlined below.

	Pathway	Receptor
1	Surcharging of the proposed internal drainage systems during heavy rain events leading to internal flooding	Proposed residential buildings and roads
2	Surcharging from the existing surrounding drainage system leading to flooding within the subject site by surcharging surface water pipes	Proposed residential buildings and roads
3	Surface water discharging from the subject site to the existing drainage network leading to downstream flooding	Downstream properties and roads
4	Overland flooding from surrounding areas flowing onto the subject site	Proposed residential buildings and roads
5	Overland flooding from the subject site flowing onto surrounding areas	Downstream properties and roads

Table 3: Pathway – Receptor

4.1.1 On-site drainage system surcharging

The proposed on-site surface water drainage sewers have been designed to accommodate flows from a 5-year return event which indicates that the site-wide drainage system may surcharge during rainfall events with a return period in excess of five years. Therefore, the likelihood of surcharging of the on-site drainage system is considered high over the lifetime of the development. However, the risk of flooding is mitigated by providing SUDS measures for the development which can store water for the 1:100-year storm event plus a 20% allowance for climate change. In addition, the designed levels fall away from the dwellings so as to direct any surcharged surface water away from buildings, therefore, the residual risk is LOW.

A map of the overland flood route has been provided in Appendix A.

4.1.2 Flooding from the existing surrounding drainage system surcharging

There are no recorded instances of flooding on the site apart from the cut off ditch network referred to in Section 3.2. Below, seen in Figure 4-1, is an extract of the old Ditch network prior to the construction of the R125 and the location of where the ditch was blocked off to facilitate the construction of the R125. It would appear to have been left blocked off as an oversight when works were completed for the R125. This was

identified in the Phase 1 works and a new ditch was cut to alleviate the cut-off water standing in the ditch network whilst keeping in mind the draft layout of the proposed Phase 2 works.

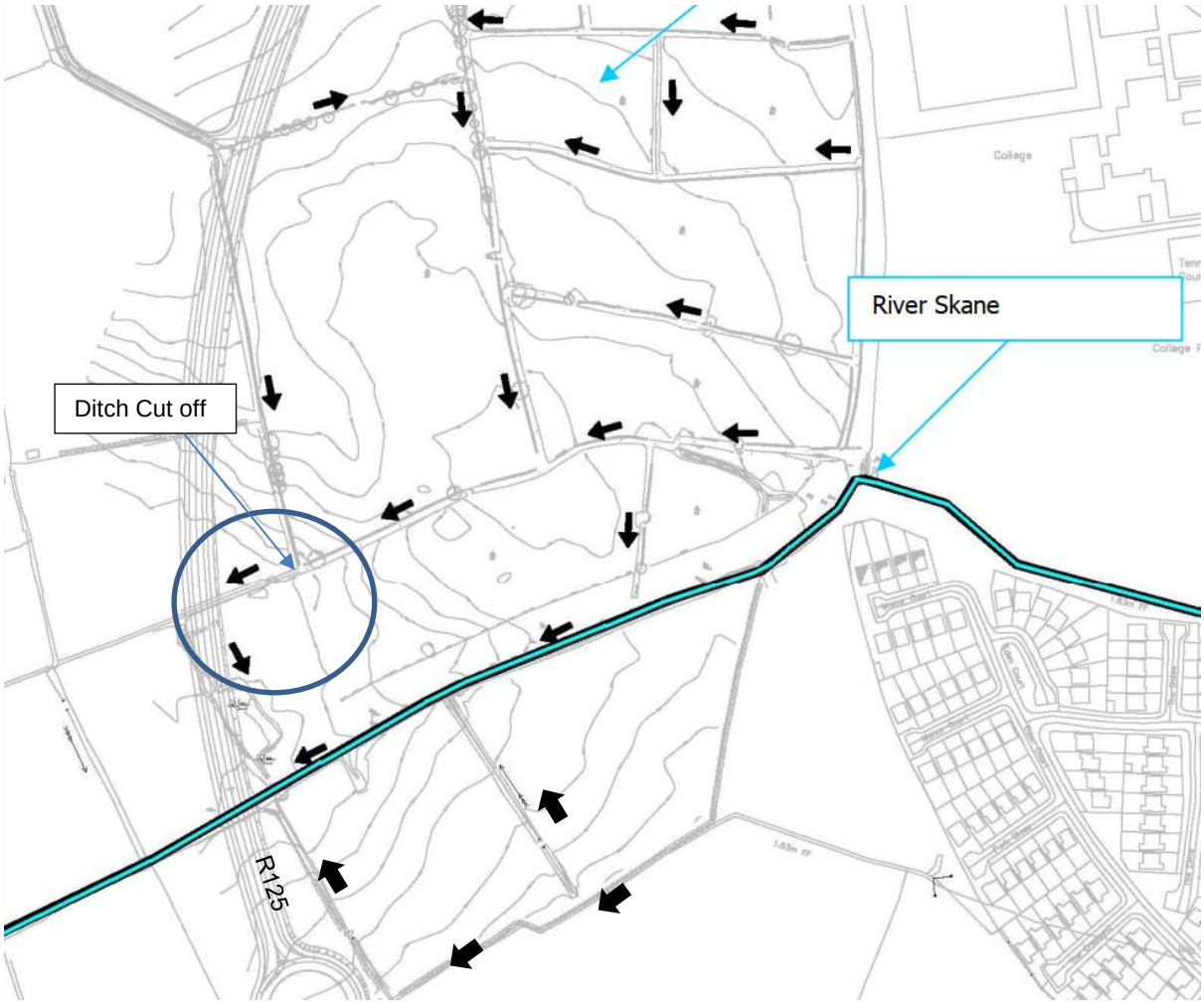


Figure 4-1: Old Ditch network pre Phase 1 development

The Figure 4-3 below reflects the location of the new ditch to alleviate ditch network and re-link the cut-off network back to the River Skane as part of the Phase 1 works and the ditch installed parallel to the R125.

The original ditch invert was cut off by the new drainage installed as part of the Phase 1 works, therefore the old ditch was drained in two directions as reflected in the Figure 4-2 below. The photos below, seen in Figure 4-3 and Figure 4-4, also reflect the pre and post views of the old ditch with standing water and now draining since the new relief ditch was installed. An additional photo showing the new relief ditch can be seen in Figure 4-5.

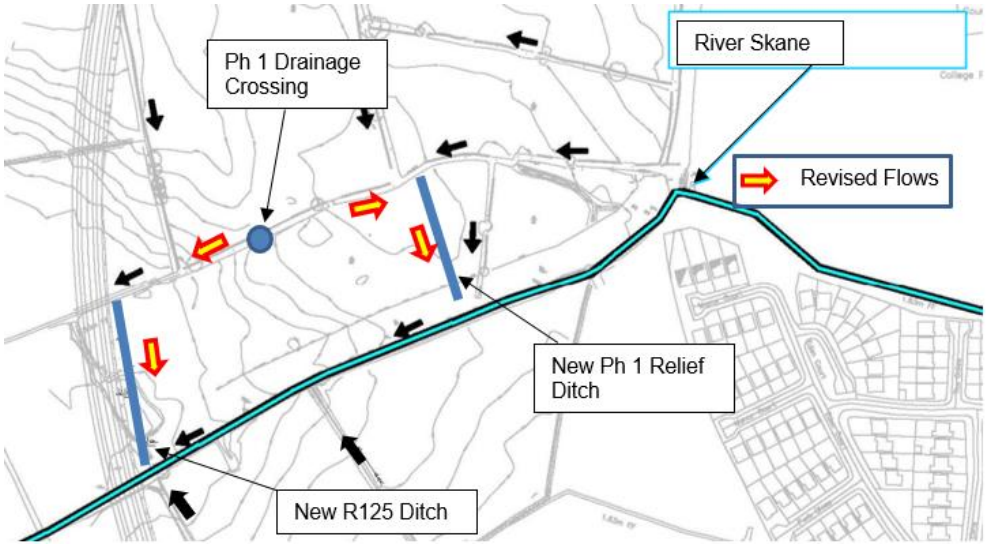


Figure 4-2: Ditch installed as part of Phase 1 and adjusted drainage routes

Figure 4-3: Old Ditch network pre installation of Phase 1 relief ditch

Figure 4-4: Old Ditch network post installation of Phase 1 relief ditch

Figure 4-5: Phase 1 relief ditch

The drainage system in the area has been designed to accommodate the proposed development. Flood risk is further reduced by designing the surrounding levels to ensure that there are suitable flood routes way from the buildings. A map of the overland flood route has been provided in Appendix A. There will, therefore, be a LOW risk of flooding from the existing surrounding drainage system surcharging.

4.1.3 Surface water discharge from the subject site causing downstream flooding

Due to the increase in hard standing area as a result of the proposed development, there is an increase in the likelihood of surface water discharging from the site, that could lead to downstream flooding, however excess discharge flows from the development will be attenuated up to the 1.0% AEP (1 in 100 year) storm event. Only flows in excess of 1.0% AEP storm event may result in downstream flooding of roads and green fields areas. Therefore, the resultant risk is LOW.

4.1.4 Overland flooding from surrounding areas flowing onto the subject site

A map showing all flood events within proximity of the subject site is provided below in Figure 4-6. There are 3 no. recorded flood events within a c. 2.0 km radius of the subject site. However, none of these events are located in the development area. It is considered that there is a LOW likelihood of flooding from surrounding areas.

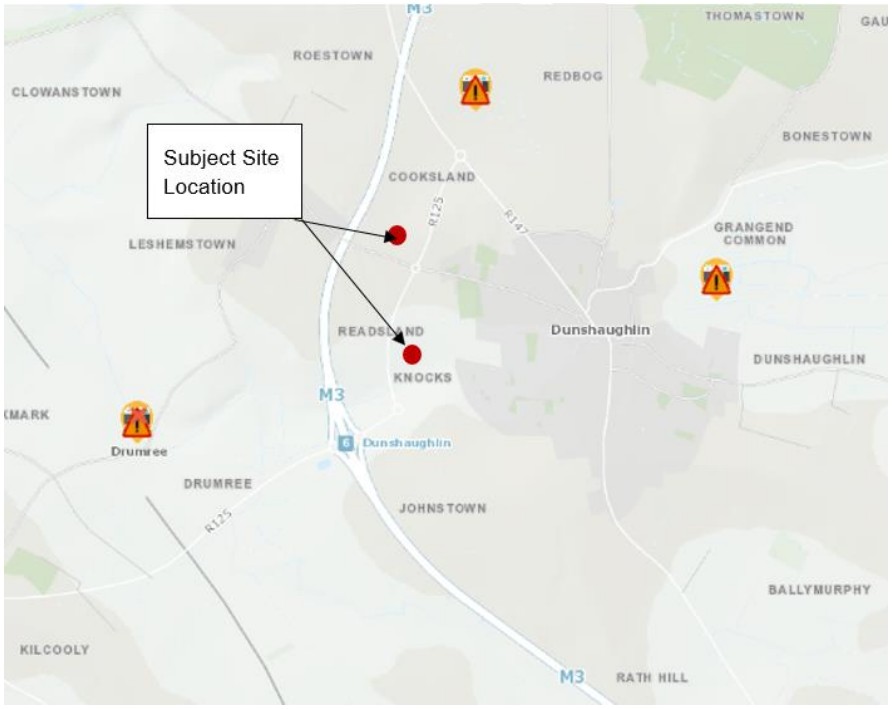


Figure 4-6: Location of Flood Events within proximity of the Subject Site.

4.1.5 Overland flooding from the subject site flowing onto surrounding areas

Appropriate drainage will be provided to collect rainwater and discharge to the sitewide SUDS system before attenuated up to the 1.0% AEP (1 in 100 year) storm event and finally discharging into the Skane River at greenfield runoff rates. The levels on site have been designed to ensure any overland flooding which occurs as a result of poor maintenance will be directed along the roads and will not enter the properties. A map of the overland flood route is provided in Appendix A. Only flows in excess of 1.0% AEP storm event may result in downstream flooding of roads and green fields areas. Therefore, the risk of overland flooding to surrounding areas is considered LOW.

4.2 Residual Risk:

As a result of the design measures detailed above in Section 4, there is a LOW residual risk of flooding from each of the surface water risks. The flood risk management measures set out above in Section 4 will minimise the risk, ensuring that any overland flooding from surface water will result in the flooding of the internal roads only.

5. Ground Water

5.1 Source

During periods with prolonged rainfall, the groundwater can seep to above ground level.

5.2 Pathway

During periods with prolonged rainfall, there is a possibility that the groundwater level would rise. This could result in groundwater seeping to the ground surface.

5.3 Receptor

The receptors would be the buildings, roads and park areas of the proposed development.

5.4 Likelihood

There is no known history of groundwater/springs seeping through the ground in this area. However, it is possible for groundwater to rise and cause potential flooding on the site during prolonged wet periods. The proposed roads and buildings are constructed above the existing ground level with no significant cut proposed on the site.

5.5 Consequence

The consequence of groundwater flooding would be some minor temporary seepage of groundwater through the ground around the proposed buildings and landscaped areas.

5.6 Risk

There is a low risk of groundwater flooding as the consequence is minor.

5.7 Flood Risk Management

Finished floor levels have been set above the road levels and surrounding garden levels to ensure any seepage of groundwater onto the development does not flood into the buildings. In the event of groundwater flooding on the site, this water can escape from the site via the overland flood routing shown in Appendix A.

5.8 Residual Risk

There is a low residual risk of flooding from groundwater.

6. Human / Mechanical Errors

6.1 Source

The subject lands will be drained by an internal private stormwater drainage system which discharges into existing stormwater drainage networks. This internal surface water network is the source of possible flooding from the system if it were to block.

6.2 Pathway

If the proposed private drainage system blocks this could lead to possible flooding within the private areas.

6.3 Receptor

The receptors are the ground floor units and roads.

6.4 Likelihood

There is a high possibility of flooding on the subject site if the surface water network was to block.

6.5 Consequence

The surface water network would surcharge and overflow through gullies and manhole lids flooding roads and ground floor units.

6.6 Risk

There is a high risk of surface water overflowing onto the surrounding road network, should the surface water network block.

6.7 Flood Risk Management

As described in Section 4, levels on site have been designed such that in the event of the surface water system surcharging, surface water can escape from the site by overland flood routing without damaging properties. The surface water network would need to be unblocked and maintained should a blockage occur.

6.8 Residual Risk

As a result of the flood risk management outlined above, there is a low residual risk of overland flooding from human/mechanical error.

7. Sequential Test

A sequential approach to planning is a key tool in ensuring that development, particularly new development, is first and foremost directed towards the land that is at low risk of flooding. The sequential approach is set out in *"The Planning System and Flood Risk Management Guidelines for Planning Authorities, 2009"* and shown in Figure 8 below.

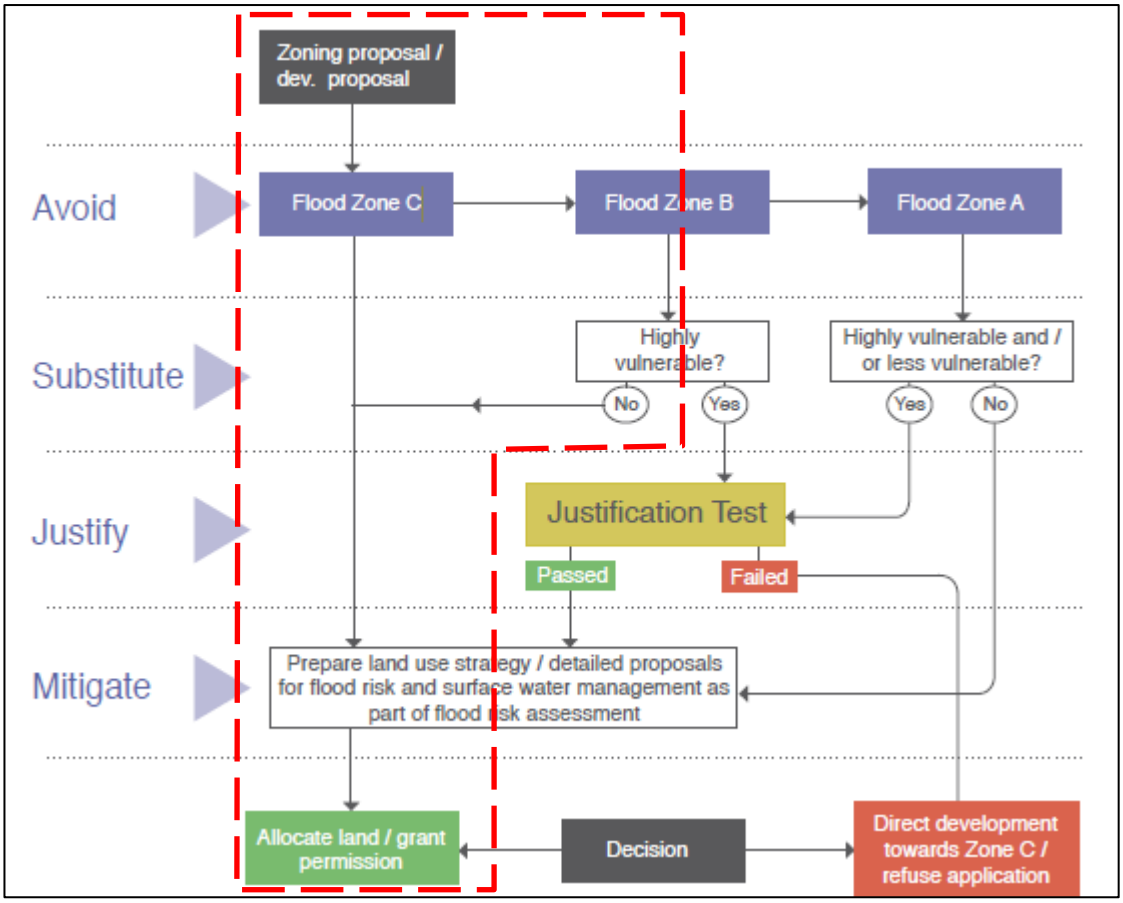


Figure 7-1: Sequential Test

The key principle of a risk-based sequential approach to managing flood risk: '*Avoid development in areas at risk of flooding; If this is not possible, consider substituting a land use that is less vulnerable to flooding*.', has been adhered to during the design process.

All housing aspects of the proposed development are in Flood Zone C. In Zone B, only less vulnerable aspects of the proposed development are situated, such as open spaces, paths, outdoor sports and recreation amenities. There is no need to perform the justification test.

8. Conclusions and Recommendations

The subject lands have been analysed for risks from flooding from the Irish Sea, fluvial flooding, pluvial flooding, groundwater and failures of mechanical systems. Through careful design and appropriate mitigation measures, the risks and consequences of flooding have been mitigated across the development.

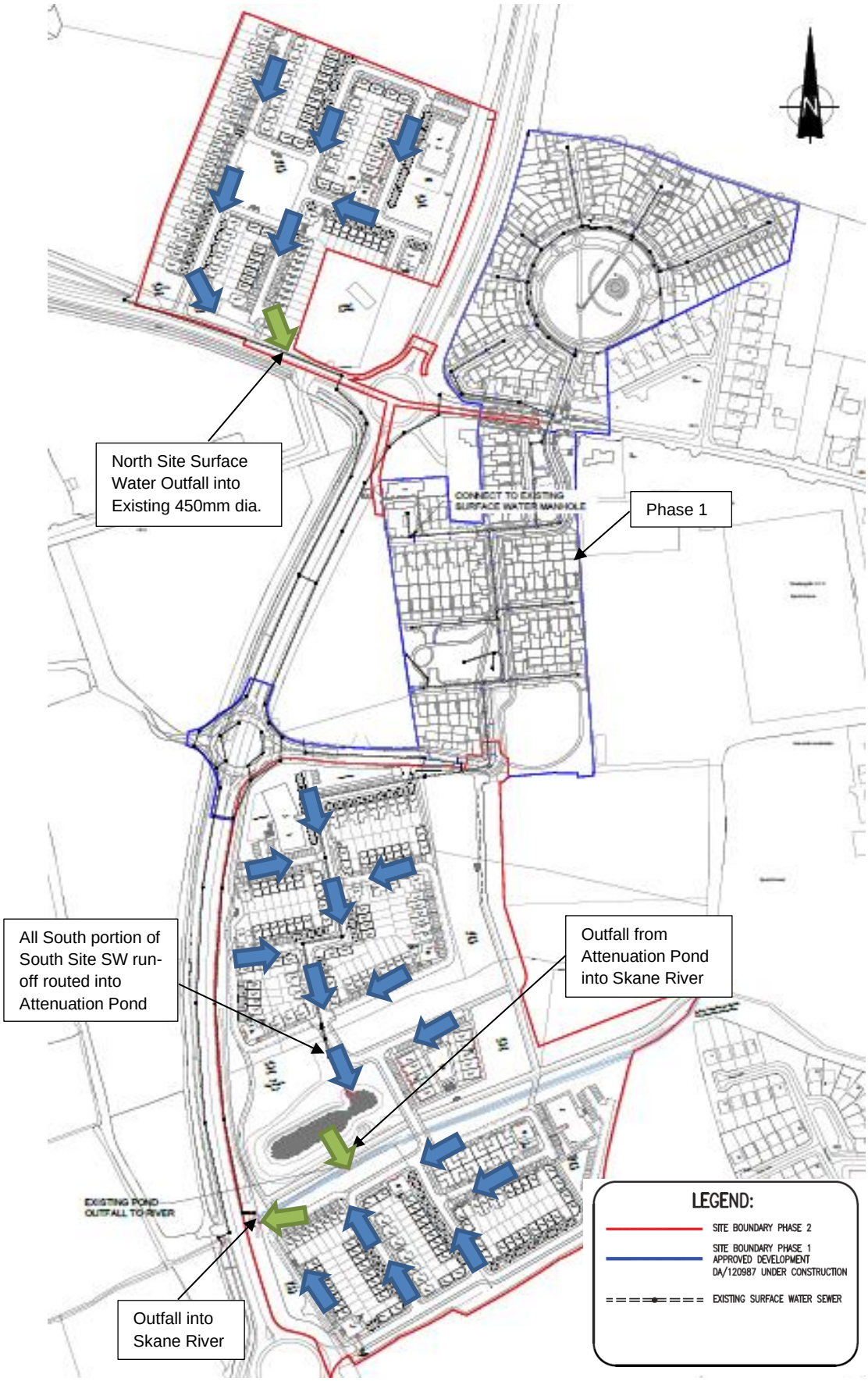
Surface water runoff from the site is limited to Greenfield runoff and does not impact on developments upstream or downstream of the subject site.

Source	Pathway	Receptor	Likelihood	Consequence	Risk	Mitigation Measure	Residual Risk
Tidal	None	Proposed Development	N/A	N/A	N/A	N/A	N/A
Fluvial	None	Proposed Development	Low - Moderate	High Water Ingress in Buildings	There is a moderate risk of fluvial flooding for housing units but high risk of flooding to landscaped areas and roads	Design levels with min. 500mm freeboard to account for fluvial flooding and overland flood routing.	**Low**
Pluvial	Private and Public Drainage Network	Proposed Development	High	High Flooding of the proposed buildings and roads	High risk of minor to severe damage to dwellings	Appropriate drainage design, overland flood routing and setting of floor levels	**Low**
Ground Water	Ground	Proposed Development	Low	Moderate Saturation of the surrounding grounds during long rainfall periods	Low risk of minor saturation of area around the development	Appropriate drainage design, overland flood routing and setting of floor levels	**Low**
Human / Mechanical Error	Drainage network	Proposed Development	High	High Surcharging of surface water network resulting in flooding of the properties	High risk of damage to dwellings	Appropriate drainage design, overland flood routing and setting of floor levels	**Low**

Table 4: Summary of the Flood Risks from the Various Components

APPENDICES

A. Overland Flood Route Layout


North Site Surface Water Outfall into Existing 450mm dia.
CONNECT TO EXISTING SURFACE WATER MANHOLE
Phase 1
All South portion of South Site SW run-off routed into Attenuation Pond
Outfall from Attenuation Pond into Skane River
EXISTING POND OUTFALL TO RIVER
Outfall into Skane River
LEGEND:
SITE BOUNDARY PHASE 2
SITE BOUNDARY PHASE 1 APPROVED DEVELOPMENT DA/120987 UNDER CONSTRUCTION
EXISTING SURFACE WATER SEWER

UK and Ireland Office Locations