8 WATER

8.1 Introduction

This section of the EIAR was prepared by Dr Bill Bates BEng (Hons) MSc PhD CEng MIEI MICE, who has over 25 years' experience in civil engineering and the construction industry.

This section of the EIAR considers the impact on the water environment, both hydrological and hydrogeological, from the subject development. As outlined previously, the subject development includes the proposed construction of 1034no. housing units together with 6km of access road and associated infrastructure. Further textual detail is provided in Chapter 3: Description of Proposed Development of this EIAR. This section should be read in conjunction with the preliminary design drawings and reports which accompany this planning application.

8.2 Assessment Methodology

The assessment of effects on the water environment were assessed in accordance with the guidance published by the Environmental Protection Agency (EPA), Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (Draft - August 2017). Table 3.3 from these guidelines was used as the basis for a common description framework of the effects on the baseline environment.

8.2.1 Data Sources

EPA data was consulted in respect of the quality of hydrological (surface water) and hydrogeological (groundwater) data. The Geological Survey of Ireland (GSI) data was also reviewed in the context of groundwater. Ordnance Survey of Ireland (OSI) mapping and background data was also consulted.

A flood risk assessment was undertaken by reviewing information from the Office of Public Works (OPW) National Flood Hazard Mapping (www.floods.ie) and the Eastern CFRAM Study. This assessment was carried out in accordance with the procedure for a "Stage 1 Flood Risk Identification" as outlined in the OPW's Guidelines for Planning Authorities – The Planning System and Flood Risk Management (November 2009). The outcomes of this risk assessment are presented as part of the Site Specific Flood Risk Assessment submitted with this planning application.

A site visit was carried out in late 2018 in order to assess the baseline water environment at the site and the surrounding lands.

8.3 Receiving Environment

8.3.1 Proposed Development

8.3.1.1 Baseline Environment– Surface Water

The main receiving watercourse for surface water run-off from the proposed development is the Camac River (noted as Cammock on OSi mapping) as indicated on DBFL Drawing Series 170191-1055. There are two proposed surface water run-off discharge points from the development site. Lands to the north of the site, together with an associated portion of run-off from the main spine road and access roads, will be directed to an existing 450mm diameter drain within the Old Nangor Road at the junction of Kilcarbery Avenue. The remainder of the site will be directed to a surface water drain connection in Cherrywood Avenue. Both catchment networks will incorporate elements of Sustainable Drainage Systems (SuDs) as directed in this section of the EIAR and in the Infrastructure Design Report that forms part of this application.

Both catchment outfalls ultimately discharge to the Camac River. The Camac River runs for approximately 10 km from the subject site before discharging to the River Liffey at Heuston Station (Figure 8.1). The Camac river runs to the south of the subject site through Corkagh Park.

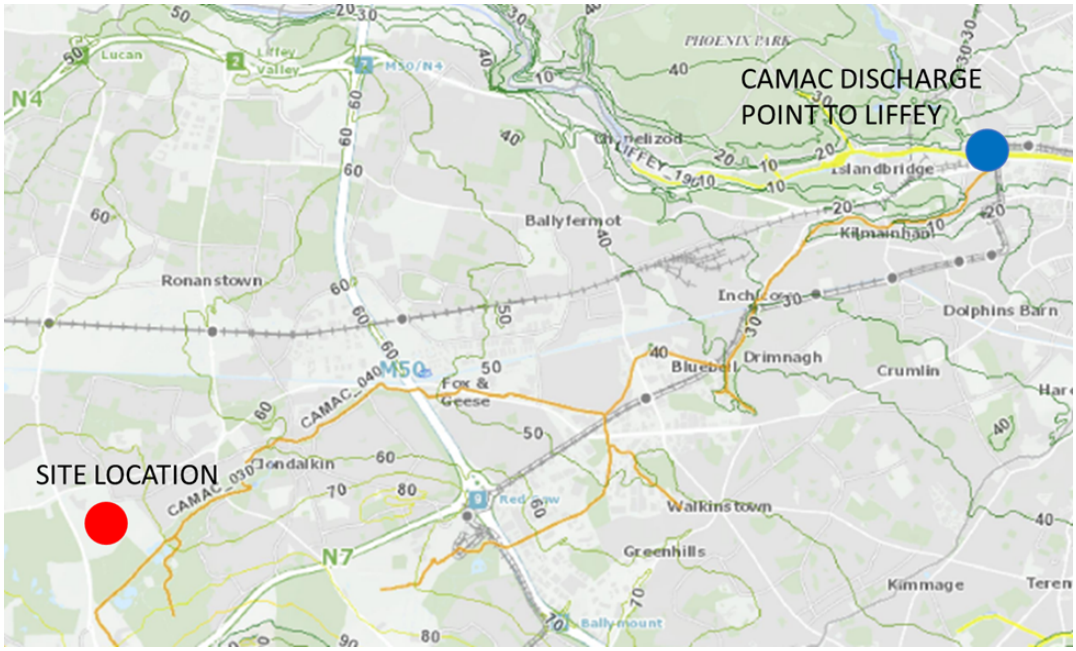

Figure 8.1 Route of Camac River (OSi)

The Camac River forms part of the River Liffey and Dublin Bay Water Framework Directive (WFD) catchment, which forms part of the Eastern River Basin District. The River Liffey itself is classified within the EPA database as a 'Good' River Waterbody under WFD Status 2010-2015. However, the Camac River is classified as moderate at the Baldonnel House station (1km upstream) and 'Poor' at the Riversdale station (2km downstream).

The ultimate receiving watercourse for surface water from the subject development is the River Liffey which rises between the mountains of Kippure and Tonduff in County Wicklow and flows for a distance of around 120km, before reaching the sea in Dublin Bay. The Liffey has been dammed in three places for the purposes of hydroelectric power generation and for water supply. These dams are located at Polluphuca, Golden Falls, which is above central County Kildare, including Newbridge, and finally at Leixlip. There are two wastewater treatment plants located along the River Liffey, one 14km downstream of Newbridge that discharges at Osbertown (the Upper Liffey Valley regional wastewater treatment plant) and one 0.5km downstream of Leixlip (the lower Liffey Valley regional wastewater plant).

The water quality of both the River Liffey and Camac River is monitored continuously by the EPA. The results of the assessment for the Camac at the stations upstream (Baldonnel House) and downstream at Riversdale are provided in Table 8.1.

	Upstream	Downstream
Station ID	RS09C020250	RS09C020310
Station Name	Br SE of Baldonnell Ho	Riversdale Estate Br
QV71	null	null
QV72	null	null
QV73	null	null
QV74	null	null
QV75	null	null
QV76	null	null
QV77	null	null
QV78	null	null
QV79	null	null
QV80	null	null
QV81	null	null
QV82	null	null
QV83	null	null
QV84	null	null
QV85	null	null
QV86	null	null
QV87	null	null
QV88	3	2 to 3
QV89	2 to 3	2 to 3
QV90	3	3
QV91	3	3
QV92	null	null
QV93	null	null
QV94	null	null
QV95	null	null
QV96	null	2 to 3
QV97	null	null
QV98	null	2 to 3
QV99	null	null
QV00	null	null
QV01	null	null
QV02	2 to 3	3
QV03	null	null
QV04	null	null
QV05	3	3
QV06	null	null
QV07	3/0	3
QV08	null	null
QV09	null	null
QV10	3 to 4	3
QV11	null	null
QV12	null	null
QV13	3 to 4	3
QV14	null	null
QV15	null	null
QV16	3 to 4	3
QLEGEND	Moderate	Poor
QLINEAR_VALUE	3 to 4	3

Table 8.1 Q Values Upstream and Downstream Stations.

Table 8.1 presents the biological water quality for the Camac River at stations upstream and downstream from the development site. Q Values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site. Direction on the classifications is provided in Table 8.2.

Quality Value	WFD Status	Pollution Status	Condition
Q5, Q4-5	High Status	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly Polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately Polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously Polluted	Unsatisfactory

Table 8.2 Direction on Water Quality.

With reference to Table 8.1 and Table 8.2, the water quality for the Camac River downstream of the subject development is currently considered as Q3 Poor. Further detail is included in the Appendix 8.1 to this Chapter.

8.3.1.2 Baseline Environment – Groundwater

According to the Geological Survey of Ireland, the generalised bedrock description at the site is "Dark Limestone & Shale (Calp)" (see Chapter7: Land, Soils & Geology of this EIAR). The site is located on the Lucan Formation. The formation comprises of dark-grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey. There are rare dark coarser grained calcarenitic limestones, sometimes graded, and interbedded dark-grey calcar. There are no identified outcrops on the site.

The Quaternary geological period extends from about 1.5 million years ago. According to the Geological Survey of Ireland, the subsoil within the subject site is generally tills derived from limestone.

The site is recorded to be within a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones with an area of 1309 square kilometres.

The closest recorded karst landform on the GSI database is approximately 6km from the site at St.Columbs Well in Newtown, County Kildare.

There are a number of recorded groundwater borehole and spring type wells within 2km of the extremities of the site. These are outlined below

- Borehole reference (2923SEW006; Clondalkin) is noted as being for industrial use with a yield of approximately 157 cubic metres per day and has a yield class of 'good'. No owner is recorded.
- Borehole reference (2923SEW005; Clondalkin) is noted for industrial use with a yield of 185 cubic metres per day and has a yield class of 'good'. No owner is recorded.
- Borehole reference (2921NEW002; Cheeverstown) is noted as unknown use with a yield of 109 cubic metres per day and has a yield class of 'good'. The owner is recorded as Dublin County Council.
- Borehole reference (2921NEW003; Belgard) is noted for industrial use with a yield of 654 cubic metres per day and has a yield class of excellent. No owner is recorded.
- Spring reference (2923SEW041; Brideswell commons) is noted as a St Bridget's Well with no other recorded data.

The nearest recorded ground water drinking protection area is approximately 10km south west of the site in Kilteel.

Groundwater recharge is recorded as 200mm / year maximum for the site.

Groundwater vulnerability is recorded as high.

Further detail on the hydrogeology associated with the bedrock layer, and the impact on it, is provided in Chapter 7: Land, Soils & Geology.

Based on information extracted from the GSI website, the wells notified have depths ranging from 24 metres to 53 metres. Abstractions of up to 654m3/day are being taken from the aquifer. The aquifer is clearly a significant source of industrial water supply in the area.

The groundwater in the area is recorded as being part of the Dublin groundwater and is classified within the EPA database as a 'Good' Ground Waterbody based on the WFD Status 2010-2015 and is further classified as 'Not at risk' of retaining good status'. No detailed chemical results were provided by EPA.

8.3.1.3 Baseline Environment – Flood Risk

From consultation of the OPW website www.floodmaps.ie there were no flood events noted in the immediate vicinity of the site. However, the report does show flooding downstream of the Camac River in Cherrywood and Clondalkin most notably in June 1993.

No benefiting lands are identified in the vicinity of the site. [Note: Benefiting lands are lands that might benefit from implementation of a major drainage scheme or lands subject to flooding or poor drainage.]

Review of the OPW's Eastern CFRAM Study (Fluvial Flood Extent and Fluvial Flood Depth Maps) indicates the extent of fluvial flooding in the Kilcarbery area. No fluvial flooding is indicated in the vicinity of the site.

Other information sources were consulted to determine if there was any additional flood risk to the site including:

- Topographical Survey – The site is elevated above the predicated 1% AEP and 0.1% AEP fluvial flood level.
- Soils and Groundwater Data from the GSI – no alluvium deposits or groundwater wells / springs are shown within the site on the GSI online mapping system. However, it does indicate it could be vulnerable to water logging during high rainfall events due to low permeability.
- Groundwater information from IGSL – water ingress was rapid, rising to within a metre of the surface. "The prime consideration on this site will be control of groundwater, particularly from the aspect of roads, and excavations for services. Restoration of the existing land drainage system should be a priority, to ensure the stability of access roads".
- Walkover survey carried out– no potential sources of flooding identified.
- Irish Water Records – Existing surface water and foul drainage network are located to the north east of the site and south of the site through Corkagh Park.
- 6 inch OSI Map – no evidence of flooding or marsh areas shown within the site.

Review of the 'other sources' of information noted above did not indicate evidence of flood risk to the site

Further detail is provided in the Site-Specific Flood Risk Assessment submitted as part of this application.

8.4 Characteristics of the Proposed Development

8.4.1 Proposed Development

The subject development seeks planning permission for the following principal components (Additional detail is provided in Chapter 3: Description of Proposed Development of this EIAR): -

- Construction of 1034no. residential units made up of a mixture of individual housing units and apartments.
- On site vehicle circulating roads and streets with associated car parking provision.
- A mix of independent pedestrian and cyclist infrastructure together with shared street spaces.

- Drainage and water supply infrastructure to accommodate the residential status of the site.
- Lighting, power and communications infrastructure to accommodate the residential status of the site.

8.4.1.1 Construction Stage

During the construction stage the site will be stripped of topsoil and then subsoil and bedrock will be excavated to reduce the levels to formation for the construction of residential housing and access roads. The site will be further reduced in level to allow for the installation of the surface water drainage, foul water drainage and water supply networks. Open channels and depressions for the management of surface water will also form part of the works. Further detail is provided on drawing series 170191-1055.

8.4.1.2 Operational Stage

In the operational stage, the baseline water environment and receiving water bodies will receive waters from the development either as direct surface run-off or indirectly via engineered/ sustainable processes to improve quality before discharge.

Surface Water Network (Direct)

There are a number of surface water run-off sources from the proposed development. In the context of quality of surface water discharge, and the level of risk posed to the receiving waterbody, this is directly related to the location at which the surface water falls and its flow path to the receiving environment, and as such will be treated according to these factors. At source and site-wide treatment elements will be provided at staged points along the different flow paths.

Typically, there are five core forms of surface water run-off applicable to the subject site. These are green space or soft landscaping, roofs, hard landscaping, parking and roads. These are further separated into public and private ownership. The approach to the sustainable management of surface water drainage is a function of flow path and future ownership and maintenance. Each form is discussed, and concepts established. Further detail is provided in the Infrastructure Design Report submitted with this application.

- Green Space (Private Gardens & Private Communal Spaces): The receiving environment here is generally groundwater and plant take up via rain gardens. The risk of contamination of the receiving water body is very low. There is little, or no maintenance, required. To protect against future removal, strict restrictions will be outlined to the owner that will have be considered with any further development of the plot.
- Open Green Space (Public Parks & Bioretention Areas): The receiving environment here is generally groundwater and plant take up. The risk of contamination of the receiving water body is very low. There is minimal maintenance required by Local Authority once taken in charge. During extreme rainfall events (in excess of 1%AEP) these spaces will be used to supplement sub surface facilities with further attenuation and management of flow volumes and will locally flood over short durations. Some areas will also be used as bioretention areas with run-off allowed to pass through strategically planted areas for cleansing and plant take up and only overflowing in extreme events to supplementary sub surface facilities. Landscaping will also be used in all cases to promote improved drainage and cleansing.
- Roofs (Housing Units): The receiving environment here is generally groundwater and plant take up. All run-off from roofs in private plots will be directed, via attenuating rain gardens (rear of property) or local planting (front of property). The risk of contamination of the receiving water body is low. The rain gardens/planting areas will be sized to accommodate the majority of critical storm events. Overflows in extreme events (excess of 1%AEP) will only pass to the main drainage conveyance network where surface flooding exceeds the saturation level of the surface soils and take up by plants. These will require minimal maintenance and will be the

responsibility of the private owner or housing authority. To protect against future removal, strict restrictions will be outlined to the owner that will have be considered with any further development of the plot.

- Roofs (Apartments Blocks): The receiving environment here is generally groundwater and plant take up. All run-off from the roofs will be directed to the collector drainage network for rainwater harvesting or directed to suitably sized rain gardens/planted areas. The harvested water will be used for further irrigation or recycled as non-potable supply for cleaning of external spaces. Flows exceeding the storage capacity of the harvesting system will be attenuated within the curtilage of apartment block in rain gardens or plant areas. Rain gardens and planting will be used to ensure that the majority of rainfall events are retained on site in accordance with the recommendations of the GDSDS. Maintenance will be privately managed by contracted management firm or housing authority (subject to agreement). Overflows in extreme events will pass to the main conveyance drainage network for further management.
- Hard Landscaped Areas: These areas will generally be directed to over the edge drainage systems and tree pits. Areas will fall towards planted green areas and allowed to drain naturally to the underlying soil or be taken up by planting. Diffusion storage may be required alongside larger areas to avoid local ponding. Overflows in extreme events will pass to the main conveyance drainage network.
- Roads & Public Parking Areas (Public): The surface water drainage network for the road will also act as a component part of the site conveyance main drainage network for controlled flows from private houses and apartment blocks. These flows pose a medium risk of contamination to the receiving water body. The network will generally be made up of gullies, a mix of sealed and perforated pipes and manholes sized to transfer flows in a controlled flow regime. Gullies will intercept road run-off removing any initial contaminated detritus, before being directed through conveyance infiltration trenches to ground (in low flow events) or take up by tree roots. Excess flows will be directed through the main conveyance drainage network which will be made up of conveyance infiltration trenches under car parking bays, swales and depressions. Flow controls will be used to hold flows and maximise infiltration at source. As the levels of contamination close to source will be limited, the two levels of treatment provided by the managed gully network and infiltration trenches will provide the necessary treatment levels. Where potentially waters progress to the larger site wide network due to lack of maintenance, accidental spillage or loss of infiltration due to saturation, further lines of defence will be provided by way of planted bioretention areas and petrol oil interception in advance of discharge to the receiving surface water network and upstream of the Camac River.

Foul Sewerage Network (Indirect)

The site's proposed waste water main layout is shown on DBFL Drawing Series 170191-1050. Irish Water Record Drawings indicate that there is a 750mm concrete foul water sewer along the site's southern boundary. This is an ideal point to discharge the sites foul network and has been agreed with SDCC as part of the masterplan.

Due to the topography of the site, certain portions of the site (specifically to the north and west) will require pumping, while the rest of the site will use a gravity network. The proposed waste water drainage network within the development has been designed in compliance with Irish Water's Code of Practice for Wastewater Infrastructure.

The drainage from the site will be domestic in nature. It will be conveyed via sealed pipework to the existing public sewer network and treatment before discharging to the Irish Sea at Ringsend.

The on site network will be designed using the following codes of practice: -

- Irish Water Code of Practice for Wastewater Infrastructure
- Department of the Environment's Recommendations for Site Development Works for Housing Areas

- Department of the Environment's Building Regulations "Technical Guidance Document Part H Drainage and Waste Water Disposal"
- IS EN 752: 2008 Drain and Sewer Systems Outside Buildings

Further details are provided in the Infrastructure Design Report submitted with this application.

Potable Water Network

The site's proposed water main layout is shown on DBFL Drawing Series 170191-1270. Early consultation with Irish Water has indicated that a 200mm diameter connection off the existing 700mm diameter public water supply line (located along the R134) will provide the required service supply. This 200mm main will also connect to the existing 100mm main on the Old Nangor Road and the 100mm main on Kilcarbery Avenue to the south east of the site in line with recommendations made by South Dublin County Council.

A series of 150mm diameter water mains will be provided (generally along the site's arterial road) which will be looped back into the 200mm core supply main. Further subordinate 100mm diameter mains will be looped around each development block and back to the 150 second level mains with connections at two points minimum.

The proposed water main layout and connections to existing public water mains have been designed in accordance with Irish Water Standard Codes of Practice and in full consultation with Irish Water. All proposed water mains will be HDPE 100 SDR17 in accordance with Irish Water Standards.

Connection arrangements including water meters, sluice valves, air valves and hydrants will be as directed by Irish Water and in compliance with their specification. Water supply networks within the site will be designed in accordance with the requirements of Irish Water based on pressure and flow requirements.

8.5 Potential Impact of the Proposed Development

8.5.1 Proposed Development

8.5.1.1 Construction Stage

Receiving Surface Watercourse (Hydrology)

Surface water runoff during the construction phase may contain increased silt levels or become polluted from construction activities. Runoff containing large amounts of silt can cause damage to the receiving watercourse. Silts in water can arise from dewatering excavations, exposed material stockpiles and site haul roads.

Pouring of concrete has the potential to contaminate receiving watercourse(s) and groundwater receptors. Concrete and cement are very alkaline and corrosive and can cause serious pollution.

Machinery on site during the construction phase may result in contamination of the receiving watercourse. The potential impacts include accidental spillage of fuels, oils, paints and solvents, which could impact the receiving surface water.

The construction of the proposed development is likely to give rise to a temporary and moderate negative effect on the receiving surface water course, taking into consideration the measures outlined subsequently.

Groundwater Receptor (Hydrogeology)

Many of those issues outlined above for the receiving surface watercourse are also applicable to the groundwater receptor. The construction of the development is likely to give rise to a temporary and moderate negative effect.

It is noted earlier that there is a moderately productive aquifer within the bedrock. The level of this aquifer is at a depth (~50metres) well below the formation required for the proposed buildings and associated surface and sub surface infrastructure. Nevertheless, if groundwater is encountered during excavation activities, controlled dewatering will take place. Any pumped excavation ground water will also be filtered or treated prior to discharge to the surface water system or fed back to the underlying geology at a location away from the works to prevent contamination. Reductive measures and best practice will be employed to prevent any possible contamination of the groundwater.

8.5.1.2 Operational Stage

Receiving Surface Watercourse

In operation there are limited sources of impact on the receiving surface water course. Run-off routing, as noted earlier, is generally to the ground water receptor during the 'first flush' and only being directed to the surface water receptor in extreme events at which point much of the contaminant would have largely gone. Therefore, the likelihood of an accidental spillage impacting on the surface water receptor is considered extremely low. Moreover, when taken in the context of a surface water drainage network incorporating gullies and an interceptor upstream of the receiving water course, the effect is unlikely and requires no further consideration.

Another effect of the development on the receiving surface watercourses is the risk of flooding. This has the potential to give rise to a significant and long-term negative effect. Reference should be made to the DBFL Site Specific Flood Risk Assessment for further details on management of risk and measures aimed at reducing the effect to long term and neutral.

Groundwater Receptor

As noted above, the majority of surface water run-off from the site will be managed at source and allowed to infiltrate to the underlying geology or be taken up by plants. The level of accumulated contamination would therefore be considered low and would be filtered prior to reaching the underlying aquifer at some 50metre below ground.

The impact of leaching foul water network is a potential negative effect. The pipework and manholes associated with this network will be installed, tested and commissioned to Irish Water specification ensuring no leakage. Therefore, the effect is unlikely to occur.

8.5.1.3 Do-Nothing Impact

The proposed site is located in an area zoned under the current County Development Plan 2016-2022 for the provision of new residential communities in accordance with approved area plans

If this particular development was not to proceed, it is likely that a similar development would be developed at the site. Therefore, the increase in surface water discharge to the receiving surface watercourse or reduction in discharge to the groundwater receptors associated with this development is likely to occur at this site at some stage in the future. This would be a similar for foul water loads and volumes to the existing treatment network.

Were no development to proceed at the proposed location, despite zoning for residential development, the land use would remain unused or agricultural, and there would be no increase in surface water discharge to the receiving surface watercourses or reduction in discharge to the groundwater receptor under natural climatic change. There would also be no additional loads applied to the existing waste water network

8.6 Ameliorative, Remedial or Reductive Measures

8.6.1 Proposed Development

8.6.1.1 Construction Stage

In order to minimise the potential impacts from the development of the subject site during construction, the following ameliorative, remedial or reductive measures will be implemented. These measures will ensure that contamination of groundwater receptor and receiving surface water course does not occur.

The Department of the Marine and National Resources published guidelines in 1997 that are designed to ensure the impact of construction work on the water environment is minimised. The United Kingdom (UK) Department of the Environment has also published guidance as to the approach to minimise impacts of construction and operation of developments on the water environment. A joint publication by the Environment Agency (EA), Scottish Environmental Protection Agency (SEPA) and the Environment and Heritage Services (EHS) are also relevant in relation to the proposed development. These publications are used to develop appropriate management measures during construction activities.

Receiving Surface Watercourse

There will be no uncontrolled discharge to any watercourse during construction. Any surface water collecting in excavations will be directed to onsite sedimentation ponds to settle solids, where it will be filtered of possible pollutants prior to discharge to the receiving surface water course at a controlled rate.

Sub surface tanks, planted open green depressions and petrol oil interceptors will form part of the permanent works to provide attenuation and a final treatment level in advance of discharge to the receiving watercourse. [Further detail on the attributes of the individual areas is provided in the Infrastructure Design Report for the subject site and produced by DBFL and submitted with this application. The location of the permanent attenuation areas is illustrated on DBFL drawing series 17019-11055.] The attenuation depressions and interceptors will be installed as part of an enabling phase package of works for the site that will include temporary drainage routes and holding areas for the monitoring and management of construction stage run-off or pumped waters from excavations.

The construction of the development is to be progressed in phases. Each phase will create a temporary holding pond at exit for discharge of waters that will be connected to the permanent systems outlined above. Further direction on phasing is provided in the Infrastructure Design Report included with this submission.

Oil and fuel storage tanks will be stored in designated areas, and these areas will be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30mm for rainwater ingress). Filling and draw-off points will be located entirely within the bunded area(s). Drainage from the bunded area(s) shall be diverted for collection and safe disposal.

Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area (where possible) of the site, which will be away from any active drainage component leading to the receiving watercourse. In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank. An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in this area. All relevant personnel will be fully trained in the use of this equipment.

The guidelines provided by the Department of the Marine and Natural Resources, with respect to concrete wash water, and the UK Department of the Environment will be adhered to, in order to ensure that there is a neutral and imperceptible impact on the receiving surface watercourse during the construction phase.

Each classification of excavated material will be stored in separate stockpiles in accordance with the soil resource plan. All stockpiled material will be stored away from receiving watercourses with run-off from the stockpiles directed to temporary holding lagoons for filtration prior to entry to the receiving watercourse.

The aforementioned measures will ensure that accidental inputs to, and subsequent contamination of, the active drainage network and receiving surface watercourse do not occur during normal and or emergency conditions.

Groundwater Receptor

To limit any impact on the underlying subsurface strata and groundwater receptor, the above ameliorative, remedial or reductive measures for the receiving surface water course also apply.

In the event of groundwater being encountered during the construction phase, additional measures may be necessary. These will include dewatering of excavations to appropriate treatment/ filtration areas prior to discharge. Other measures include restrictions on use, or storage of, potentially contaminating material such as fuels and oils onto this part of the site. Any groundwater ingress to excavations will be pumped to onsite temporary sedimentation pond/lagoon/tank to settle solids, where it will be tested and filtered of any possible pollutants prior to discharge to the surface water system or back to ground water at a controlled rate.

8.6.1.2 Operational Stage

The ameliorative, remedial or reductive measures outlined in this section will ensure that, specifically in terms of wastewater and storm water discharges, the residual effect on the receiving water environment is reduced to neutral.

Receiving Surface Watercourse

Surface water run-off from the proposed development will be designed to replicate existing flow characteristics from the predevelopment lands to counteract the risk of flooding. Further detail is provided in the Infrastructure Design Report and Site Specific Flood Risk Assessment for the proposed development, produced by DBFL Consultants Limited, and submitted with this application. The proposals detailed in the reports when applied as indicated on DBFL Drawing Series 170191-1055, will ensure the effect of flooding is reduced to neutral.

The majority of surface water run-off from the site will be directed to the groundwater receptor or taken up by plants in the first instance with only residual flows in more critical events taken to the surface water course in a controlled and managed network. Waters will be directed above ground as far as possible, before moving to conveyance infiltration systems below ground for management in accordance with the recommendations of the GDSDS. In extreme events (above 100 year return periods), water will move along designated flood routes and in above ground channels and swales and held until the storm recedes. Therefore, by applying the management procedures outlined in the Infrastructure Design Report and the Site Specific Flood Risk Assessment, the impact on the receiving surface water course will be long term and neutral.

Groundwater Receptor

In operation the majority of surface water run-off from the site will be directed to the groundwater receptor or taken up by plants. Waters will be directed at source and allowed to filtrate slowly to the underlying soil.

Roof run off from housing and apartment blocks will be directed through rain gardens. This will prevent the risk of contamination with low accumulation and filtration of particulates. The rain gardens will also assist with the management of flood risk with additional support from harvesting tanks in apartment blocks.

In hard landscaped areas run off will be directed over the edge into trenches and tree pits. Areas will fall towards green areas and allowed to drain naturally to the underlying soil. Diffusion storage may be required alongside larger areas to avoid local ponding. Overflows in extreme events will pass to the main conveyance drainage network for volume management.

The moderate risk from run off from Roads & Public Parking Areas is reduced by the fact that the contaminants entering the receiving water body are not allowed to substantially accumulate before discharge. Protection is also provided by road gullies that will initially intercept road run-off removing any contaminated detritus, before being directed to the infiltration system. As the levels of contamination close to source will be limited, the two levels of treatment provided by the managed gully network and infiltration will provide the necessary treatment levels prior to discharge to the groundwater receptor.

8.6.2 Cumulative – Kilcarbery

8.6.2.1 Construction Stage

There are not considered to be any cumulative effects on the water environment during the construction stage.

8.6.2.2 Operational Stage

In the context of water and hydrology, consideration is given to the longer-term cumulative effects on the water environment post development. The most significant of these is development of the zoned lands upstream of the subject site. The development of these lands has the potential to increase the effects on the water environment outlined above through increased impermeable cover, increased pollutant potential and increased risk of flooding.

A preliminary search was undertaken for the subject site and no permitted development plans apart from those related to the subject site were found. Future risks will need to be considered as development progresses and in the context of the proposed development.

8.7 Residual Impact of the Proposed Development

8.7.1 Proposed Development

8.7.1.1 Construction Stage

Provided the above ameliorative, remedial or reductive measures and management procedures are incorporated during the construction phase for management of run-off, the residual impact on the water receiving environment will be temporary and neutral.

Receiving Watercourse/ Surface Water Network

The implementation of the management procedures and monitoring measures outlined subsequently will ensure that the residual effect is rendered unlikely temporary and imperceptible.

Groundwater Receptor

Again, the implementation of the management procedures and monitoring measures outlined subsequently will ensure that the residual effect is reduced to unlikely, temporary and imperceptible.

8.7.1.2 Operational Stage

Provided the management procedures and monitoring measures are incorporated as part of the operational phase, the residual impact post development on the water environment will be unlikely, temporary and neutral.

8.7.1.3 Worst Case Impact

The majority of the measures outlined previously are design solutions that will be managed through the design and construction process and enforced as part of an agreed development plan with South Dublin County Council.

Notwithstanding the above, the likely worst-case effects that may arise during construction will be spillage of liquid products within the site. The spillage of fuel and oil products has the potential to contaminate upper soil layers, but it will be localised, and a temporary emergency plan would have to be in operation and coordinated with the Local Authority.

In the operational phase, the risk of liquid spillage is the likely impact on the water environment. However, given that liquid carrying tankers are unlikely to be moving through the site, the effect would be unlikely, short term and localised and would be manged as part of the Local Authority's emergency plan for spillage on their adopted road network.

8.8 Monitoring

8.8.1 Proposed Development

8.8.1.1 Construction Stage

Receiving Watercourse/Surface Water Network

Facilitation for sampling of surface water run-off from the site will be provided at all discharge locations. Monitoring of the receiving surface watercourse will continue for 12 months' post construction to ensure no residual matters require attention.

Groundwater Receptor

Groundwater monitoring wells may be installed as part of the works in consultation with the EPA and South Dublin County Council at agreed locations.

8.8.1.2 Operational Stage

Receiving Watercourse/Surface Water Network

Long term monitoring stations are provided on the Camac River and are periodically recorded. This is monitored by the Environmental Protection Agency (EPA).

Groundwater Receptor

Groundwater monitoring wells installed as part of the works in consultation with the EPA and South Dublin County Council will remain in place for monitoring by the EPA.

8.9 Reinstatement

8.9.1 Proposed Development

8.9.1.1 Construction Stage

Normal post construction reinstatement of works on the receiving surface water course would take place in consultation with the EPA, South Dublin County Council Environment Section and Fisheries Board as necessary. Further direction on ecological matters is provided elsewhere.

8.9.1.2 Operational Stage

There is no further reinstatement of the water environment during operation.

8.10 Difficulties Encountered

Although every effort has been made to ensure the accuracy of the data published on the Geological Survey of Ireland online mapping portal, the GSI accept no responsibility for the accuracy of the data presented.

The site investigations, while extensive and reflective of the makeup generally, only represent a small proportion of the overall site area.

8.11 Accidents and Disasters

Flooding could give rise to an accident or disaster. This includes flooding of the road network, preventing access to safe areas or prevention of emergency services from accessing buildings during an incident.

To counteract this risk, the drainage network for the site is designed to accommodate flood events up to 1% AEP. In events above this risk level, surface water is directed along the road surface at shallow depth and overflows into ditches and green areas. The maximum depth of standing water within the road network will typically be 200mm at low points. Therefore, the risk is considered manageable even during disaster levels of flooding.

8.12 Impact on Human Health

A risk to human health from water, hydrology and hydrogeology can be linked to the potential for contamination of the potable water supply. The ground water and supply network would present possible pathways. The risk is considered below.

8.12.1 Groundwater Supply

As noted earlier, the underlying receiving groundwater is a locally important aquifer and is at a significant depth (approximately 50metres). The risk to the contamination of this water supply source from surface water run-off from the site during construction and operation is considered to be a long-term negative effect. However, by implementing the aforementioned management measures, the residual effect is reduced to a long term and neutral.

8.12.2 Network Supply

The water supply network will not become operational within the development site until after completion of the core enabling and service infrastructure. Therefore, the risk of impact will be negligible during construction.

The potable water supply will be delivered in new pipework infrastructure in accordance with Irish Water's specification. Therefore, the risk to human health through the water supply network from the road in operation will be very low. The installation of new water supply network will also provide a positive effect to human health in the surrounding areas by way of a controlled network.