

**HYDROLOGICAL &
HYDROGEOLOGICAL
QUALITATIVE RISK
ASSESSMENT**

for

**A PROPOSED SHD
DEVELOPMENT AIKENS
VILLAGE (WOODSIDE) AND
KILGOBBIN, STEPASIDE,
CO. DUBLIN**

Technical Report Prepared For

Ironborn Real Estate Limited

Technical Report Prepared By

Marcelo Allende BSc, BEng,
Senior Environmental Consultant
(Hydrologist)

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Cork Office
Unit 5, ATS Building,
Carrigaline Industrial Estate,
Carrigaline, Co. Cork.
T: + 353 21 438 7400
F: + 353 21 483 4606

AWN Consulting Limited
Registered in Ireland No. 319812
Directors: F Callaghan, C Dilworth,
T Donnelly, T Hayes, D Kelly, E Porter

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1.0 INTRODUCTION

1.1 Background

AWN have been requested by Ironborn Real Estate Ltd. to carry out a Hydrological and Hydrogeological Qualitative Risk Assessment for a strategic housing development at 2no. contiguous sites (c. 3.39 Ha), at 'Sector 3', Aikens Village in the Townlands of Woodside and Kilgobbin, Stepside, Co. Dublin.

The development will consist of:

- 438no. 'Build-to-Rent' apartment units (154no. 1 bedroom units and 284no. 2 bedroom units) arranged in 9no. blocks ranging in height from 2 – 8 storeys over 2no. independent single level basements. Private patios / terraces and balconies are provided for some apartment units (not all units have a patio, terrace or balcony). Upper level balconies are proposed on elevations of all multi-aspect apartment buildings.
- Blocks A – D are located above Basement 1 (c. 6,002 sq. m gross floor area) and Blocks F – J are above Basement 2 (c. 5,058 sq. m gross floor area).
- Provision 1no. childcare facility (c. 514.9 sq. m gross floor area) in Block D.
- Provision of resident amenity space / communal areas (c. 1,455.7 sq. m gross floor area) in Block C and Block G.

And all associated and ancillary site development, infrastructural, landscaping and boundary treatment works including:

- New vehicular access to / from Basement 1 from Atkinson Drive and new vehicular access to / from Basement 2 from Thornberry Road.
- Provision of c. 9,799 sq. m public open space, including a public plaza onto Village Road and improvement works to existing open space area to the north of existing Griannan Fidh residential development.
- Provision of 350no. car parking spaces including basement parking, set down spaces for proposed childcare facility and repositioning of set down area on Atkinson Drive.
- Provision of 669no. bicycle parking spaces.
- Provision of 14no. motorcycle parking spaces.
- Communal bin storage and plant provided at basement level and additional plant provided at roof level.
- Provision of below ground wastewater storage tank (c. 500m³) and associated connection to the wastewater networks including ancillary above ground kiosk and appropriate landscaping on open space lands to the south of Griannan Fidh residential development..

The potential impacts on the receiving water environment considered are:

- Connection to foul sewer and stormwater sewer during operation.
- Management of foul, surface water run-off and accidental oil leaks during construction. Management of overflow foul water tank during operation (no bulk oil storage during operation).

1.2 Hydrological Setting

The site for proposed residential development is located approximately 700m south of the M50 in Aiken's Village, Stepside, Dublin 18. The site is a brownfield site currently used as a storage yard. The site is generally bounded by Thornberry Road

to the north, by Atkinson Drive and the adjoining open space lands to the west, Sandyford Hall residential development adjacent Ferncarraig Avenue to the east and by Village Road and Griannan Fidh residential development to the south (Townland of Woodside). The site for proposed below ground wastewater storage tank is on open space lands generally bounded Griannan Fidh residential development to the north, Sandyford Hall residential development to the east and open space lands (including detention basin) to the south and west (Townland of Kilgobbin). The development site is gradually sloping from north west to south east, dropping from a level of c. 129 mOD to c. 121 mOD

The Ballyogan Stream (EPA Name: Barnaculla Stream) flows eastwards c. 170 m to the south of the subject site (Woodside). The proposed underground wastewater storage tank is located adjacent to the Ballyogan Stream on its north bank (refer to Figure 1.1 below). The Carrickmines Stream is located c. 350 m to the west of the site.



Figure 1.1 Site Location and Hydrological Environment

The Ballyogan joins the Carrickmines Stream c. 2.8 Km to the southeast of the site after crossing the M50 motorway. The Carrickmines Stream joins the Shanganagh River at Cherrywood which in turns outfalls into the Irish Sea (Southwestern Irish Sea – Killiney Bay coastal waterbody) c. 7.3 km from the subject site.

A review of the EPA (2022) on-line database indicates that the nearest designated land to the site is the Fitzsimon's Wood pNHA (Site Code: 001753) at c.630m to the north of the subject site. As this site is located upstream of the proposed development, there is no potential for a source pathway linkage.

The nearest Natura 2000 Sites with potential hydrological link are Rockabill to Dalkey Island Special Area of Conservation (SAC), Dalkey Islands Special Protection Area (SPA) sites which are c. 8.5 km to the east of the site offshore

within the Southwestern Irish Sea – Killiney Bay and the Bray Head SAC, located in Bray c. 11 km to the southeast of the site. There will be an indirect discharge to the Irish Sea waterbody from the Proposed Development site through the stormwater and foul water site drainage as described in Section 1.4 below.

1.3 Objective of Report

The scope of this desktop review is to assess the potential for any likely significant impacts on receiving waters and protected areas during construction or post development, in the absence of taking account of any measures intended to avoid or reduce harmful effects of the proposed project (i.e. design or mitigation measures).

In particular, this review considers the likely impact of construction and operation impacts (construction run-off and domestic sewage) from the proposed development on water quality and overall water body status within the Irish Sea and Killiney Bay (where the relevant European Sites are located), including bathing water locations. The assessment relies on information regarding construction and design provided by Ironborn Real Estate Ltd. as follows:

- Drainage Design Report for Residential Development at Sector 3, Aiken's Village, Stepside, Dublin 18. Kavanagh Burke Consulting Engineers, August 2022.
- Flood Risk Assessment. Sector 3, Aiken's Village, Stepside, Dublin 18. JBA Consulting. August, 2022.
- Ground Investigation Report. Project Ironborn, Stepside, Dublin 18. IGSL. July, 2018 (included as Appendix F of Drainage Design Report).

This report was prepared by Marcelo Allende (BSc, BEng), and Teri Hayes (BSc MSc PGeol EurGeol). Marcelo is a Water Resources Engineer with over 15 years of experience in environmental consultancy and water resources studies. Marcelo is an Environmental Consultant with AWN Consulting, a member of the International Association of Hydrogeologists (Irish Group) and a member of Engineers Ireland (MIEI). Teri is a hydrogeologist with over 25 years of experience in water resource management and impact assessment. She has a Masters in Hydrogeology and is a former President of the Irish Group of the Association of Hydrogeologists (IAH) and has provided advisory services on water related environmental and planning issues to both public and private sector bodies. She is qualified as a competent person as recognised by the EPA in relation to contaminated land assessment (IGI Register of competent persons www.igi.ie). Her specialist area of expertise is water resource management eco-hydrogeology, hydrological assessment and environmental impact assessment.

1.4 Description of Current and Proposed Drainage

Current and Proposed Surface Water Drainage

There is an existing 525mm diameter storm water sewer which runs in a southerly direction through the eastern portion of the subject site before connecting to an existing 1,113m³ underground concrete attenuation tank located in the south west portion of the subject site. This existing outfall sewer continues through the park area (west of the Village Road) for approximately 215m before discharging to the Ballyogan Stream via a headwall. Refer to Drainage Design Report (Kavanagh Burke, 2022) for further details. It is proposed under this planning application to divert the 525mm sewer traversing the site to accommodate the proposed new development.

The surface water runoff generated from the proposed development will discharge from site through an existing storm water drainage network and through an existing flow control device (limiting the site runoff to a greenfield rate) using an existing connection to the Local Authority storm water drainage network along Village Road.

Surface water attenuation incorporating interception storage in the proposed extensive green roof (on top of blue roof storage system) and attenuation storage in both existing and proposed underground storage tanks is planned for this development. To allow for maintenance of the underground attenuation system, manholes are provided for access for removal of any possible debris in the event of such debris passing through the proposed trapped gullies.

In addition, as part of the design, vortex type silt trap/debris separator and the proprietary petrol interceptor are proposed to remove any silts, debris and possible hydrocarbons before the storm water runoff leaves the site and enters Local Authority drainage.

All private storm drainage will be connected through individual connections to storm water pipes located in the public space.

The design include Sustainable Urban Drainage Systems (SuDS) which will be incorporated to reduce run-off volumes and improve run-off water quality. The SuDS features comprise green roofs, permeable paving, petrol interceptors and an underground attenuation system. These features will be provided to cater for up to a 1-in-100 year rainfall event and 20% climate change. Refer to Drainage Design Report (Kavanagh Burke, 2022) for further details. It should be noted that these SuDS measures have not been taken into account in the subsequent analysis.

A Flood Risk Assessment, prepared by JBA Consulting Engineers sets out that the proposed development and the area where the overflow storage tank is proposed are fully within Flood Zone C. This indicates a low risk of fluvial, pluvial, groundwater and coastal flooding (less than 0.1% AEP or 1 in 1000 chance of flooding in a given year). There was previously a risk of flooding identified from the foul water system due to the insufficient capacity of the network which will be mitigated with the implementation of the proposed underground overflow storage tank.

Therefore, any flood events will not cause flooding of the Proposed Development, and the development will not affect the flood storage volume or increase flood risk elsewhere.

Current and Proposed Foul Water Drainage

The proposed foul sewer works will include new foul sewer network and the relocation of the existing foul sewer serving the existing occupied development to the north. The existing foul sewer is traversing the site in the location of proposed apartment blocks F, G, H and J. It is proposed to relocate the existing foul sewer to the perimeter of the site.

A letter of "Design Acceptance" and "Confirmation of Feasibility" have been received from Irish Water and can be seen in the Drainage Design Report (Kavanagh Burke, 2022).

Currently, there is a risk of flooding from the foul water system due to the current capacity of the local network. In order to reduce the risk of flooding from the foul water system, upgrades to the network are required. An underground overflow

storage tank with a volume of 500m³ has been proposed to reduce the foul discharge during extreme storm events therefore reducing the flood risk. The tank will provide additional capacity in the wastewater network facilitating this development and others in the area to avoid downstream flooding as a result of storm water inflow through urban development creep entering the foul system. The site of the storage tank is at low risk of flooding. Once planning permission is granted a connection application to Irish Water will be made who will then proceed to install the tank.

The underground concrete foul storage tank in the location indicated on Figure 1.1 above is proposed to provide overflow storage to reduce the volume contributing to the treatment plant caused by surface water entering the foul system during extreme storm events. Therefore, flooding from the foul water system can occur if the system capacity is exceeded.

Following consultations with Irish Water Engineers a Confirmation of Feasibility letter was received on 19-07-2022 which states that "a storage tank (c. 500m³) to mitigate the impact of storm water in the network is required. The storage tank will be required to cater for future development in the area arising from modelling carried out of the potential future zoned development lands within the collection catchment over a 10 – 15 year time horizon. These upgrade works are not currently on the Irish Water investment plan therefore, the applicant will be required to fund these upgrades".

It should be noted that the development site will not contribute to the potential stormwater overflow to be collected and stored by the foul tank since, as explained above, its surface water drainage is designed to cater for up to a 1-in-100 year rainfall event and 20% climate change.

The foul water from the proposed development eventually discharges to the Shanganagh-Bray Waste Water Treatment Plant (WWTP).

2.0 ASSESSMENT OF BASELINE WATER QUALITY, RIVER FLOW AND WATER BODY STATUS

A reliable Conceptual Site Model (CSM) requires an understanding of the existing hydrological and hydrogeological setting. This is described below for the proposed development site and surrounding hydrological and hydrogeological environs.

2.1 Hydrological Catchment Description

The proposed development site lies within the Avoca-Vartry Catchment 10 and Dargle-SC-010 WFD sub-catchment 10-5 (Carrickmines Stream 010 WFD River Sub Basin; EPA, 2022).

The Environmental Protection Agency (EPA, 2022) on-line mapping presents the available water quality status information for water bodies in Ireland. The Ballyogan Stream belongs to the 'Carrickmines Stream_010' WFD surface waterbody (WFD code IE_EA_10C040350) which has a 'Moderate' Status (EPA, 2022) and its WFD risk score is 'At risk of not achieving good status'. The most recent surface water quality data for the Carrickmines Stream (2020) indicate that it is 'Unpolluted'. The macroinvertebrate fauna indicated a welcome improvement to good ecological conditions in June 2020 the first time since monitoring commenced at this site in 2006, however excessive siltation of the substratum was observed (refer to www.catchments.ie).

The Southwestern Irish Sea - Killiney Bay WFD coastal waterbody (WFD code IE_EA_100_0000) has been classified by the WFD (2013-2018 period) as having 'High' status and 'Not at risk'. This means this WFD is 'Unpolluted', i.e. there have been no breaches of the EPA's threshold values for nutrient enrichment, phytoplankton and invertebrate status/potential or disturbance of the level of phosphorous and dissolved oxygen normally present.

The Killiney Bay hosts the Killiney beach swimming location which protected by the bathing water directive 2006/7. Water quality data is collected for the Killiney bathing area and is reported by the EPA on www.beaches.ie. The EPA bathing status is not based on single events, rather it is based on a review of data over 4 years (based on data collected during the bathing season only). Bathing classes are determined as Excellent (highest cleanest class), Good (Generally good water quality), Sufficient (The water quality meets the minimum standard) and Poor (The water quality has not met the minimum standard). A review of this data for the last four years, shows that despite these temporary overflows in flood conditions, the current EPA (2022) Bathing Water Quality report has classified Killiney beach as 'Excellent' during 2021 and 2020 and as 'Good' for the previous three years 2017-2019. The Killiney bathing area is located c. 1.0 Km to the north of the outlet of the Shanganagh River.

As the Proposed Development will have no additional stormwater run-off, when compared with the current situation, during a stormwater event, the development will, therefore, have no measurable impact on the water quality in any overflow situation at Shanganagh-Bray WWTP apart from a minor contribution from foul sewage. As explained in Section 3.4 below, the maximum contribution of foul sewage (peak flow of 14.092 l/s) from the Proposed Development is 1.13% of the peak hydraulic capacity at Shanganagh-Bray WWTP. The proposed stormwater and foul water networks within the site will be entirely independent systems and rainfall will have no impact on foul flows to the WWTP.

It should be noted that the bathing status has no direct relevance to the water quality status of the Natura 2000 sites due to rapid mixing and dilution resulting in no measurable change in water quality within the overall water body.

2.2 Aquifer Description & Superficial Deposits

Mapping from the Geological Society of Ireland (GSI, 2022 <http://www.gsi.ie>, accessed on 04-08-2022) classifies the bedrock beneath the site and the surrounding area as dominated by granite rocks from the Caledonian system. The site is located over rock Type 3 muscovite porphyritic (Rock Unit new code: IDNLGR3) which is described as Pale grey fine to coarse-grained granite with muscovite phenocrysts. The GSI also classifies the principal aquifer types in Ireland as:

- Lk - Locally Important Aquifer - Karstified
- LI - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- PI - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Rkd - Regionally Important Aquifer (karstified diffuse)

Presently, from the GSI (2022) National Bedrock Aquifer Map, the GSI classifies the bedrock aquifer beneath the subject site as a 'Poor Aquifer – Bedrock which is Generally Unproductive except for Local Zones'. The proposed development is within the 'Wicklow' groundwater body (Ground Waterbody Code: IE_EA_G_076) and is classified under the WFD Status 2013-2018 (EPA, 2021) as having 'Good status'. The WFD Risk Score system for this GWB is under review.

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. The GSI (2022) guidance presently classifies the bedrock aquifer in the region of the subject site as having 'High' and 'Extreme' vulnerability which indicates a general overburden depth potential 0-5 m, indicating that the aquifer is moderately protected by low permeability tills. The site investigation carried out by IGSL in 2018 is consistent with this classification as granite bedrock was encountered at depths between 2.7m and 4.2m BGL. The GSI The aquifer vulnerability class in the region of the site is presented as Figure 2.1 below.

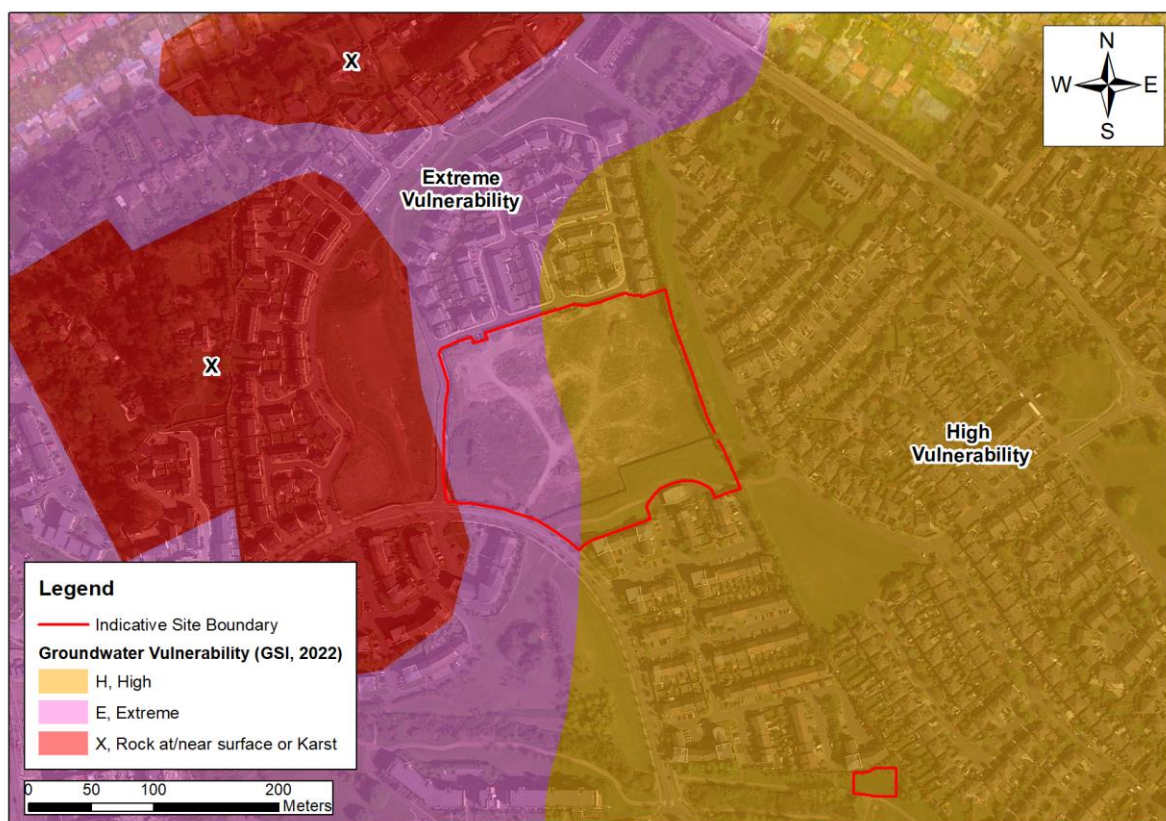


Figure 2.1 Aquifer Vulnerability (source: GSI, 2022)

The GSI/ Teagasc (2022) mapping database of the quaternary sediments in the area of the subject site indicates the principal subsoil type in the residential area comprises till Carboniferous (TLs and TGr, i.e. Till derived from limestones and granites, respectively). This is consistent with the subsoils described in the Site Investigation Report (IGSL, 2018).

3.0 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is developed based on a good understanding of the hydrological and hydrogeological environment, plausible sources of impact and knowledge of receptor requirements. This in turn allows possible Source Pathway

Receptor (S-P-R) linkages to be identified. If no S-P-R linkages are identified, then there is no risk to identified receptors.

3.1 Assessment of Plausible Sources

Potential sources during both the construction and operational phases are considered. For the purposes of undertaking the potential of any hydrological/hydrogeological S-P-R linkages, all potential sources of contamination are considered *without taking account of* any measures intended to avoid or reduce harmful effects of the proposed project (mitigation measures) i.e. a worst-case scenario. Construction sources (short-term) and operational sources (long-term) are considered below.

Construction Phase

The following potential sources are considered plausible risk scenarios for the proposed construction site:

- (i) Hydrocarbons or any hazardous chemicals will be stored in specific bunded areas. Refuelling of plant and machinery will also be carried out in bunded areas to minimise risk of any potential being discharged from the site. As a worst-case scenario, a rupture of a 1,000-litre tank to ground is considered in this analysis which disregards the effect of bunding. This would be a single short-term event.
- (ii) Leakage may occur from construction site equipment. As a worst-case scenario an unmitigated leak of 300 litres is considered. This would be a single short-term event.
- (iii) Use of wet cement is a requirement during construction. Run-off water from recent cemented areas will result in highly alkaline water with high pH. As this would only occur during particular phases of work this is again considered as a single short-term event rather than an ongoing event.
- (iv) Construction requires soil excavation and removal. Unmitigated run-off could contain a high concentration of suspended solids and contaminants such as hydrocarbons during earthworks, given the presence of contamination beneath the site according to site investigations. These could be considered intermittent short-term events, i.e. on the basis that adequate mitigation measures which are already incorporated in the Construction Environmental Management Plan (CEMP) fail.
- (v) During the excavations for foundations and basements, no significant dewatering is expected given the low permeability overburden underlying the site.

Operational Phase

The following sources are considered plausible post construction:

- (i) The Proposed Development does not require any bulk chemical storage and therefore the potential for water quality impact is negligible.
- (ii) Leakage of petrol/ diesel fuel may occur from individual cars in parking areas; run-off may contain a worst-case scenario of 70 litres for example. Any corresponding risk here will be mitigated by the proposed oil/ petrol interceptor at the site. Within the basement carpark area, any rainwater entering the

sealed system as a result of snow melt or raindrops from cars will pass through a petrol interceptor providing treatment before discharging to the foul sewer.

- (iii) The stormwater drainage system follows SuDS measures that comprises green roofs, permeable paving, petrol interceptors and an underground attenuation system. This system has been designed in order to discharge following the characteristics of a greenfield run-off into the public sewer. As such the potential for silt laden runoff is low. It should be noted that the worst-case scenario (70 litres) under consideration here disregards the effect of SuDS and petrol interceptors.
- (iv) The 500m³ underground foul tank is located adjacent to the Ballyogan Stream. As mentioned above, this tank is designed to reduce the foul discharge during extreme storm events, thereby reducing the flood risk from the foul water network. In the event that this tank potentially fails, a worst-case scenario is considered, where the overflow from the foul network is discharged directly into the stream. In this case, the foul peak flow estimated from the development (14.092 l/s) is considered.
- (v) The development will be fully serviced with separate foul and stormwater sewers which will have adequate capacity for the facility and discharge limits as required by Irish Water licencing requirements (refer to the Drainage Design Report for a COF reference). Discharge from the site to the public foul sewer will be sewage and grey water only due to the residential nature of the Proposed Development. The foul discharge from the site will join the public sewer and will be treated at the Irish Water Shanganagh-Bray WWTP prior to subsequent discharge to Southwestern Irish Sea. This WWTP is required to operate under an EPA licence and must meet environmental legislative requirements as set out in such licence.

This plant operates under an EPA licence (D0038-01). The most recent Annual Environmental Report (AER 2020) shows it is currently operating for a current maximum hydraulic load of 85,360 m³/day (988 l/s), which is less than the peak hydraulic capacity as constructed (108,000 m³/day or 1,250 l/s).

3.2 Assessment of Pathways

The following pathways have been considered within this assessment with impact assessment presented in Section 3.4:

The potential for offsite migration due to any construction discharges is low as there is no significant pathway in the aquifer or through land ditches or streams.

- (i) Vertical migration to the underlying Granite is moderately minimised due to the recorded 'High' to 'Extreme' vulnerability present at the site. However, the site is underlain by [generally low permeable] Granite which the GSI classifies as a *Poor Aquifer (PI)*, i.e. *Bedrock which is Generally Unproductive except for Local Zones*. Flow paths are generally not connected and limited to within the upper weathered zones identified. As such any potential for offsite migration through the underlying granite is considered low.
- (ii) There is no direct hydrological linkage for construction and operation run-off or any small hydrocarbon leaks from the site to the identified surface waterbodies located farther down-gradient (Ballyogan Stream) or the Irish Sea. There is an indirect connection as stormwater discharges into an existing

public sewer which ultimately discharges to the Ballyogan Stream and ultimately into the Irish Sea.

- (iii) There is an indirect pathway for foul sewage to Natura Sites in within Irish Sea 'indirect pathway' through the public foul sewer which ultimately discharges to the Shanganagh-Bray WWTP prior to final discharge to Southwestern Irish Sea post treatment. In addition, there could be a direct pathway in the event of failure of the underground overflow foul tank. In this case, the overflow would not be pumped/ collected by the public foul network and would discharge directly into the adjacent Ballyogan Stream.

3.3 Assessment of Receptors

The receptors considered in this assessment include the following:

- (i) Underlying Granite bedrock aquifer;
- (ii) Rockabill to Dalkey Island Special Area of Conservation SAC (site code: 003000); Dalkey Islands Special Protection Area SPA (site code: 004172) and Bray Head Special Area of Conservation SAC (site code 000714).

Other Natura 2000 Sites within Irish Sea or Dublin Bay that may be hydrologically connected to the proposed development site, but are located further away (South Dublin Bay SAC, site code: 210 and the South Dublin Bay and River Tolka Estuary SPA, site code: 4024) were excluded from the assessment due to their distance from the subject site, the potential loading of contaminant from the site (risk scenarios presented in Section 3.1) and significant dilution through its pathway.

3.4 Assessment of Source Pathway Receptor Linkages

Table 3.1 below summarises the plausible pollutant linkages (S-P-R) considered as part of the assessment and a review of the assessed risk is also summarised below.

The potential for impact on the aquifer is low based on the absence of any bulk chemical storage on site. The overburden thickness, low permeability nature of till and a lack of fracture connectivity within the granite bedrock aquifer will minimise the rate of off-site migration for any indirect discharges to ground at the site. As such there is no potential for a change in the groundwater body status or significant source pathway linkage through the aquifer to any Natura 2000 site.

During construction phase, there is no direct open-water pathway between the site and Natura 2000 sites within Irish Sea. However, there is an indirect pathway through the public surface sewer which discharges into the Ballyogan Stream. Should any silt-laden stormwater from construction or hydrocarbon-contaminated water from a construction vehicle leak/tank leak manage to enter into the surface water sewer, the suspended solids will naturally settle within the sewer; however, in the event of a worst case hydrocarbon leak of 1,000 litres this would be diluted to background levels (water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019) by the time the stormwater reaches the nearest Natura 2000 Sites (c 8.5 km downgradient, offshore within the Killiney Bay).

During operation, it should be noted that there is a potential direct pathway between the underground foul tank and the Ballyogan Stream in the event of this tank fails. However, the contribution of the development to the potential discharged overflow from the tank is considered to be low (worst case of 14.092 l/s), considering that it would occur during heavy rainfall events, indicating significant attenuation and dilution within the river network before reaching the Irish Sea. Therefore, there is no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I.

No. 386 of 2015 and S.I. No. 77 of 2019) in a worst case scenarios considered, consisting of a simultaneous overflow situation and failure of the foul tank, and the development will have no measurable impact on the water quality at the waterbodies that hosts the Natura 2000 sites mentioned above.

Likewise, from the residential development area, the potential for a release is low as there is no bulk fuel/chemical storage and no silt laden run-off. Stormwater will be collected by a drainage system which includes SuDS measures, an attenuation system and oil/ petrol interceptors prior to discharge off-site (albeit these measures have been disregarded for this analysis). In addition, the potential for hydrocarbon discharge is quite minimal based on an individual vehicle (70 litres) leak being the only source for hydrocarbon release. However, even if the operation of the proposed SuDS and interceptor systems are excluded from consideration, there is no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019) in the worst case scenarios described above at section 3.2 and there will be no significant effect on any European site. The volume of contaminant release is low and combined with the significant attenuation within the stormwater drainage network, hydrocarbons will dilute to background levels with no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019 at any Natura 2000 sites.

It can be concluded that the in-combination effects of surface water arising from the Proposed Development taken together with that of other permitted developments will not be significant based on the in-combination low potential chemical and sediment expected loading. This may also apply to the overflow from the proposed underground foul water; the combined overflow from other development is not expected to be significant in terms of impacting receiving waters as this scenario would occur during heavy rainfall events suggesting considerable dilution during their pathway through the river network. Therefore, based on the loading of any hazardous material considered in the worst case scenarios mentioned in Section 3.1 above during construction and operation phases, there is subsequently no potential for impact on downgradient Natura 2000 habitats (located c. 8.5 km from the site, within Southwestern Irish Sea).

The peak wastewater discharge is calculated at 14.092 l/s (Kavanagh Burke, 2022). The sewage discharge will be licensed by Irish Water, collected in the public sewer and treated ultimately Irish Water's Shanganagh-Bray WWTP prior to discharge to Killiney Bay. This WWTP is required to operate under an EPA licence (D0038-02) and to meet environmental legislative requirements. The peak foul discharge calculated for the proposed development is well within the capacity of the WWTP.

Even without treatment at the Shanganagh-Bray WWTP, the peak effluent discharge, calculated for the proposed development as 14.092 l/s (which would equate to 1.13% of the licensed discharge at Shanganagh-Bray WWTP [peak hydraulic capacity]), would not have a measurable impact on the overall water quality within Southwestern Irish Sea and Killiney Bay and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive). The most recent water quality assessment of Killiney Bay WFD Waterbody undertaken by the EPA also shows that Killiney Bay on the whole, currently has an 'Unpolluted' water quality status (refer to www.catchments.ie).

The assessment has also considered the effect of cumulative events, such as release of sediment laden water combined with a hydrocarbon leak on site (1,000 litres as a worst case scenario during the construction phase). As there is adequate assimilation and dilution between the site and the Natura 2000 sites (located c. 8.5

km downgradient, offshore within the Killiney Bay), it is concluded that no perceptible impact on water quality would occur at the Natura 2000 sites as a result of the construction or operation of this Proposed Development. It can also be concluded that the cumulative or in-combination effects of effluent arising from the Proposed Development with that of other permitted proposed developments, or with development planned pursuant to statutory plans in the greater Dublin, Meath and Kildare areas, which will be discharged into Shanganagh-Bray WWTP will not be significant having regard to the size of the calculated discharge from the Proposed Development and having regard to the following:

- The Shanganagh-Bray WWTP ensures compliance with Water Framework Directive requirements.
- All new developments are required to comply with SuDS which ensures management of run-off rate within the catchment of Shanganagh-Bray WWTP.
- The natural characteristics of Southwestern Irish Sea and Killiney Bay result in enriched water rapidly mixing and degrading such that the plume has no appreciable effect on water quality at Natura 2000 sites.

A list of the project assessed as part of the cumulative assessment is included in Appendix A of the EIA Screening Assessment.

As the Proposed Development will have no additional stormwater run-off during a stormwater event over and above the current level, surface water run-off from the development in the operational phase will therefore have no impact on the current water quality in any overflow situation at Southwestern Irish Sea and Killiney Bay.

It should also be noted that the bathing status has no direct relevance to the water quality status of the Natura sites due to rapid mixing and dilution resulting in no measurable change in water quality within the overall water body.

In addition, there is no long term discharge planned which could have an impact on the status of the water body. In the scenario of an accidental release (unmitigated leaks mentioned above) there is potential for a temporary impact only which would not be of a sufficient magnitude to effect a change in the current water body status.

Finally, in a worst-case scenario of an unmitigated leak and not considering the operation of the SuDS and interceptor already included in the design, as well as a failure of the underground foul tank during an overflow event, no perceptible risk to any Natura 2000 Sites is anticipated given the distance from source to protected areas (>8.5 km). Potential contaminant loading will be attenuated, diluted and dispersed near source area.

Table 3.1 below presents a summary of the risk assessment undertaken.

Source	Pathways	Receptors considered	Risk of Impact
Construction Impacts (Summary)			
Unmitigated leak from an oil tank to ground/ unmitigated leak from construction vehicle (1,000 litres worst case scenario).	Bedrock protected by <5m low permeability overburden. Low fracture connectivity within the granite will limit any potential for offsite migration	Granite bedrock aquifer (Poor Aquifer)	Low risk of migration through poorly connected fracturing within the granite rock mass (Poor Aquifer). No likely impact on the status of the aquifer/off site migration due to low potential loading, natural attenuation within overburden and discrete nature of fracturing reducing off site migration.
Discharge to ground of runoff water with High pH from cement process/ hydrocarbons from construction vehicles/run-off containing a high concentration of suspended solids	Indirect pathway through stormwater drainage and river network to Southwestern Irish Sea and Killiney Bay waterbody (distance source-receptor: >8.5km)	Dalkey Island SAC/ SPA Bray Head SAC	Potential for local temporary exceedances of statutory water quality standards at outfall. However, no perceptible risk to water requirements for the Natura 2000 sites in Irish Sea based on loading and high level of dilution in the surface water sewer and on the distance of c. 8.5 km between the source and Irish Sea.
Operational Impacts (Summary)			
Foul effluent discharge to sewer	Indirect pathway to Southwestern Irish Sea through public sewer	Dalkey Island SAC/ SPA Bray Head SAC	No perceptible risk – Even without treatment at Shanganagh-Bray WWTP, the peak effluent discharge (14.092 l/sec which would equate to 1.13% of the licensed discharge at Shanganagh-Bray WWTP); would not impact on the overall water quality within Irish Sea and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive).
Overflow from underground foul tank to Ballyogan Stream (14.092 l/s worst case scenario)	Indirect pathway through Ballyogan Stream and river network to Southwestern Irish Sea and Killiney Bay waterbody (distance source-receptor: >8.5km)	Dalkey Island SAC/ SPA Bray Head SAC	No perceptible risk – taking into account the extent of loading of contaminant, distance between the source and Irish Sea is c. 8.5 km and significant dilution in the river network (as this scenario only would occur during heavy rainfall events) will ensure any released contaminants are at background levels (i.e., with no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019).

Operational Impacts (Summary, cont.)			
Discharge to ground of hydrocarbons from carpark leak (70 litres worst case scenario)	Indirect pathway through stormwater drainage and river network to Southwestern Irish Sea and Killiney Bay waterbody (distance source-receptor: >8.5km)	Dalkey Island SAC/ SPA Bray Head SAC	No perceptible risk – taking into account the extent of loading of contaminant, distance between the source and Irish Sea is c. 8.5 km and significant dilution in the surface water sewer will ensure any released hydrocarbons are at background levels (i.e., with no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019).

Table 3.1 Pollutant Linkage Assessment (without mitigation)

4.0 CONCLUSIONS

A conceptual site model (CSM) has been prepared following a desk top review of the site and surrounding environs. Based on this CSM, plausible Source-Pathway-Receptor linkages have been assessed assuming an absence of any measures intended to avoid or reduce harmful effects of the proposed project (i.e. mitigation measures) in place at the proposed development site.

During construction and operation phases there is no direct source pathway linkage between the proposed development site and open waters. There is no direct source pathway linkage between the Proposed Development site and any Natura 2000 sites (i.e. Dalkey Island SAC/SPA and Bray Head SAC). There are indirect source pathway linkage from the Proposed Development through the public stormwater sewer, and the foul sewer which will eventually discharges to the Shanganagh-Bray WWTP and ultimately discharges to Southwestern Irish Sea. The future development has a peak foul discharge that would equate to 1.13% of the licensed discharge at Shanganagh-Bray WWTP (peak hydraulic capacity).

In addition, in the event of a scenario where the underground foul tank fail during an overflow events, the contribution of the development to the potential discharged overflow from the tank is considered to be low, considering that it would occur during heavy rainfall events, indicating significant attenuation and dilution within the river network before reaching the Irish Sea.

Even disregarding the operation of design measures including an attenuation system and petrol interceptors on site, it is concluded that there will be imperceptible impacts from the proposed development to the water bodies due to emissions from the site stormwater drainage infrastructure to the wider drainage network. It should be noted the proposal also includes an attenuation system and petrol interceptors as part of best practice project design, and these features will provide additional filtration from the site to the drainage network.

It is concluded that there are no pollutant linkages as a result of the construction or operation of the Proposed Development which could result in a water quality impact which could alter the habitat requirements of the Natura 2000 sites within Southwestern Irish Sea and Killiney Bay.

Finally, and in line with good practice, appropriate and effective mitigation measures will be included in the construction design, management of construction programme and during the operational phase of the proposed development. With regard the

construction phase, adequate mitigation measures will be incorporated in the Construction Environmental Management Plan (CEMP). These specific measures will provide further protection to the receiving soil and water environments. However, the protection of downstream European sites is in no way reliant on these measures and they have not been taken into account in this assessment.

5.0 REFERENCES

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