Appendix 10.A – Detailed Dispersion Model Inputs and Outputs

Summary of Key Pollutants Considered

The key pollutant emissions associated with combustion processes are oxides of nitrogen (NO_x), CO, SO_2, volatile organic compounds (VOCs), water and other pollutants in trace quantities. Nitrogen Dioxide (NO_2) is classed as both a primary and a secondary pollutant. As a primary pollutant NO_2 is emitted from all combustion processes (such as a gas/oil fired boiler or a car engine). As a secondary pollutant NO_2 is derived from atmospheric reactions of pollutants that are themselves, derived mainly from traffic sources.

Of less concern is carbon monoxide – although predictions are still given for this pollutant. Carbon monoxide is produced from the partial oxidation of carbon-containing compounds (i.e. organic fuels such as coal, oil, petrol, diesel, wood, etc.) during the combustion process. CO forms when there is not enough oxygen to produce carbon dioxide (CO_2). As such, CO is a primary pollutant from all combustion process including vehicle exhausts, domestic heating, etc. The extent of CO emissions depends on the fuel type and the combustion conditions. Once inhaled, CO is quickly absorbed into the bloodstream from the lungs. Then it combines with haemoglobin in the blood to form carboxyhaemoglobin. This reduces the ability of the blood to carry oxygen around the body and it robs the heart, brain and other vital organs of oxygen.

Emissions of total NOx from combustion sources comprise nitric oxide (NO) and NO_2. The NO oxidises in the atmosphere to form NO_2. The assessment of operational impacts therefore focuses on changes in NO_2 concentrations at ground level receptors. Figure 10A.1 depicts the main emissions from vehicles.

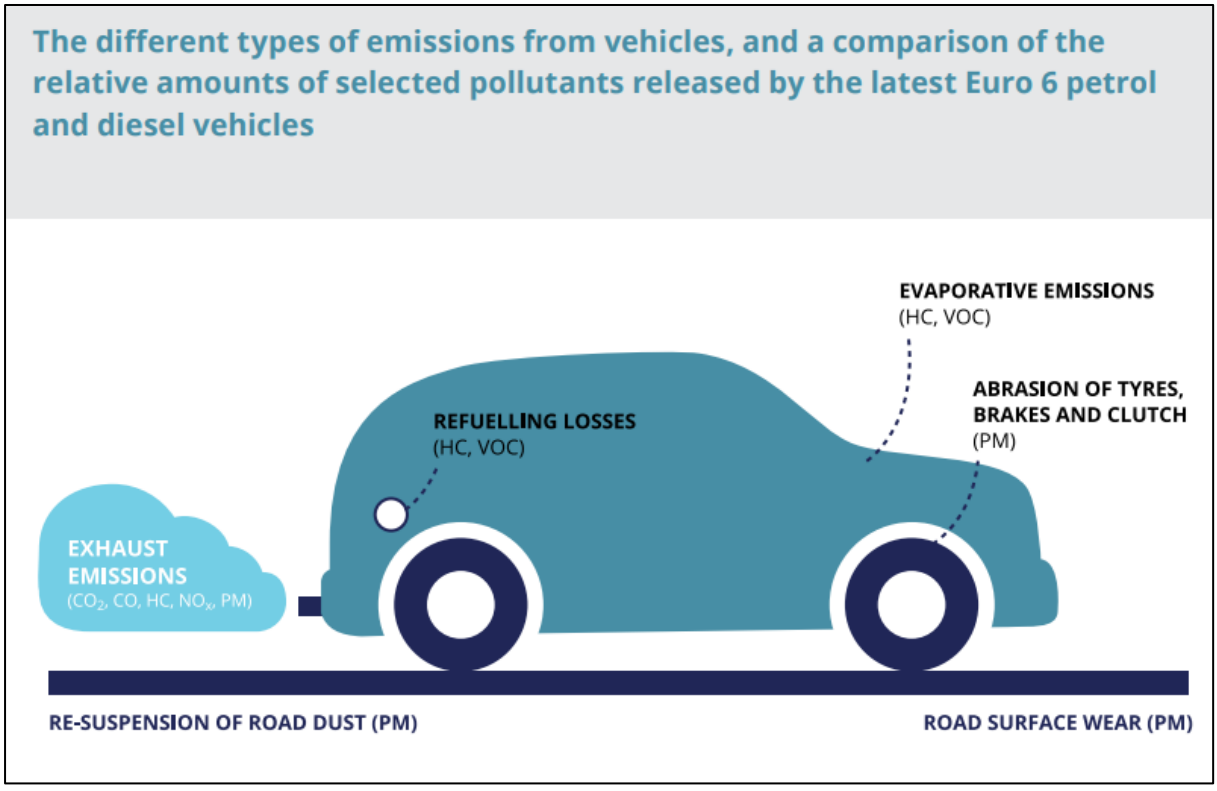


Figure 10A.1 Emissions from Vehicles

A number of different air pollutants and GHGs are emitted by road vehicles. These can be split into two groups: those that are regulated under EU road transport legislation and those that presently are not. The 'regulated' pollutants include:

- Carbon dioxide (CO_2), which is the main product of fuel combustion in vehicle engines, along with water. CO_2 is the most significant GHG influencing climate change, posing a threat to public health and the environment.
- Hydrocarbons (HCs), which are produced from either incomplete or partial combustion and which are toxic to human health. HCs, and particularly the volatile organic compounds (VOCs), contribute to the formation of ground-level ozone and photochemical smog in the atmosphere. Ozone irritates the eyes, damages the lungs and aggravates respiratory problems.
- Carbon monoxide (CO), a product of incomplete combustion, which occurs when the carbon in the fuel is only partially oxidised, forming CO and not CO_2. It is colourless and odourless but highly toxic. Direct exposure to CO reduces the flow of oxygen in the bloodstream and is particularly dangerous to people with heart disease. Like HCs, CO also contributes to the formation of ground-level ozone and smog.
- Particulate matter (PM), which is a product of incomplete combustion and a complex mixture of both primary and secondary PM. 'Primary' PM is the fraction of PM that is emitted directly into the atmosphere, whereas 'secondary' PM forms in the atmosphere following the release of precursor gases (mainly sulphur dioxide (SO_2), nitrogen oxides (NO_X), ammonia (NH_3) and some VOCs).
- In terms of its potential to harm human health, PM is one of the most important pollutants, as it penetrates into sensitive regions of the respiratory system and can cause or aggravate cardiovascular and lung diseases and cancers.
- Nitrogen oxides (NO_x) (see also box on nitrogen emissions from motor vehicles), which constitute a group of different chemicals that are all formed by the reaction of nitrogen — the most abundant gas in air — with oxygen. NO_x comprises colourless nitric oxide (NO) and the reddish-brown, very toxic and reactive nitrogen dioxide (NO_2). NO_x emissions also lead to the subsequent formation of 'secondary' PM and ground -level ozone in the atmosphere, and cause harm to the environment by contributing to the acidification and eutrophication of waters and soils.

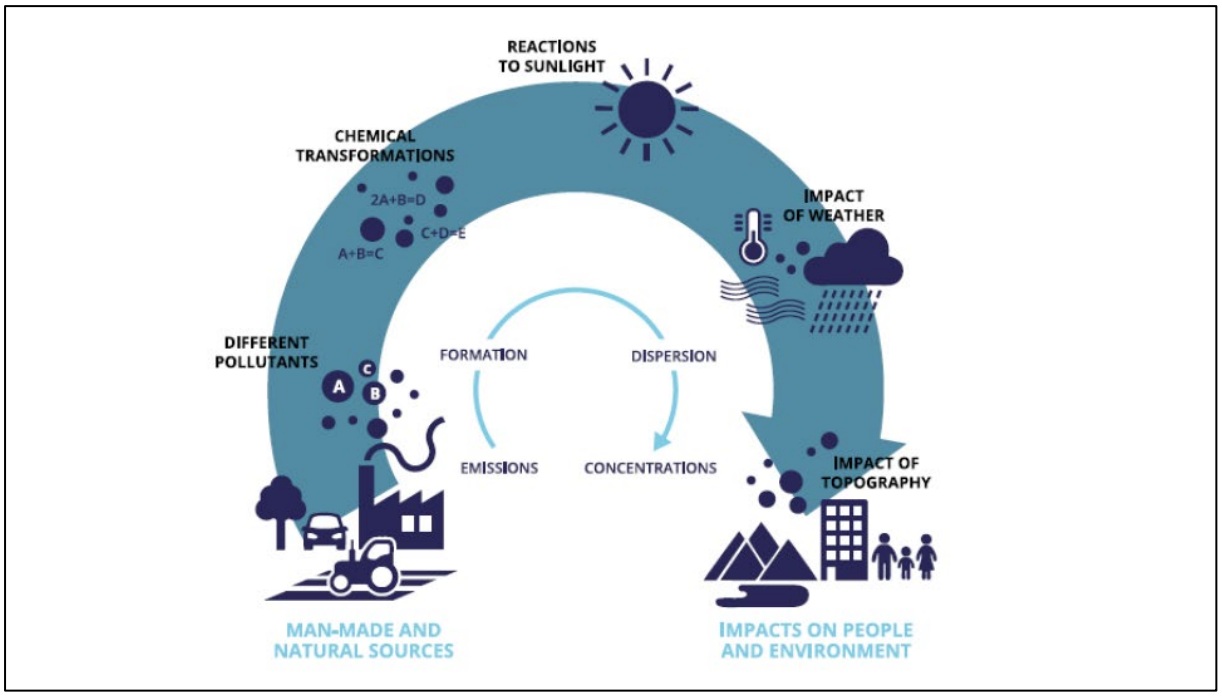


Figure 10A.2 Air Pollution from Emission to Exposure

Poor air quality is a serious health and environmental problem. Certain harmful air pollutants are emitted directly from vehicles, such as 'primary' particulate matter (PM) and nitrogen oxides (NO_X). Others, such as ozone and 'secondary' PM, form in the atmosphere after emissions of precursor pollutants, including

NO_X and volatile organic compounds. Different sources of pollution, including transport and non-transport sources, emit different types and ratios of pollutants.

The extent to which the population and environment are exposed to harmful levels of air pollution is a complex issue, dependent on how pollutants travel in the atmosphere, their mixing and how they react under different meteorological conditions. Road transport emissions are, relatively, more harmful than those from other sources, as most emissions tend to occur in areas where people live and work, such as cities and towns

Pollutant Concentrations

In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; such a model requires arange of input data, which can include emissions rates, meteorological data and local topographical information. The model used and the input data relevant to this assessment are described in the following sub-sections.

The atmospheric pollutant concentrations in an urban area depend not only on local sources at astreet scale, but also on the background pollutant level made up of the local urban-widebackground, together with regional pollution and pollution from more remote sources brought in on the incoming air mass. This background contribution needs to be added to the fraction from the modelled sources, and is usually obtained from measurements or estimates of urban background concentrations for the area in locations that are not directly affected by local emissions sources.

Dispersion Model Selection

A number of commercially available dispersion models are able to predict ground level concentrations arising from emissions to atmosphere from elevated point sources. Modelling for this study has been undertaken using ADMS, a version of the ADMS (Atmospheric DispersionModelling System) developed by Cambridge Environmental Research Consultants (CERC) that models a wide range of buoyant and passive releases to atmosphere either individually or in combination. The model calculates the mean concentration over flat terrain and also allows for the effect of plume rise, complex terrain, buildings and deposition. Dispersion models predict atmospheric concentrations within a set level of confidence and there can be variations in resultsbetween models under certain conditions; the ADMS model has been formally validated and iswidely used in the UK and internationally for regulatory purposes.

ADMS comprises a number of individual modules each representing one of the processes contributing to dispersion or an aspect of data input and output. Amongst the features of ADMS are:

- An up-to-date dispersion model in which the boundary layer structure is characterised by theheight of the boundary layer and the Monin-Obukhov length, a length scale dependent on the friction velocity and the heat flux at the surface. This approach allows the vertical structure of the boundary layer, and hence concentrations, to be calculated more accuratelythan does the use of Pasquill-Gifford stability categories, which were used in many previousmodels (e.g. ISCST3). The restriction implied by the Pasquill-Gifford approach that the dispersion parameters are independent of height is avoided. In ADMS the concentration distribution is Gaussian in stable and neutral conditions, but the vertical distribution is non- Gaussian in convective conditions, to take account of the skewed structure of the vertical component of turbulence;
- A number of complex modules including the effects of plume rise, complex terrain, coastlines, concentration fluctuations and buildings; and
- A facility to calculate long-term averages of hourly mean concentration, dry and wetdeposition fluxes and radioactivity, and percentiles of hourly mean concentrations, from either statistical meteorological data or hourly average data.

ADMS Roads is designed to estimate NO_2 and PM_{10} and other inert pollutant concentrations from motor vehicles. The science of ADMS Roads is significantly more advanced than that of most other air dispersion models (such as CALINE, ISC and R91) in that it incorporates the latest understanding of the boundary layer structure and goes beyond the simplistic Pasquill-Gifford stability categories method withexplicit calculation of important parameters. The model uses advanced algorithms for the height- dependence of wind speed, turbulence and stability to produce improved predictions.

Model Inputs

Oveview

- **GIS:** ADMS Roads has an interface with MapInfo GIS (Geographical Information System) packages, which were used in the building of the model.
- **User-defined outputs:** The pollutants assessed, the averaging time (which may be an annual average or a shorter period), the percentiles and exceedance values that are of interest, and whether or not a rolling average is required were set for the PM_{10} and NO_2 limits so they can be directly compared to the relevant Air Quality Objectives.
- **Surface roughness:** The surface roughness in the study area was set to 0.3m.
- **The Monin – Obukhov** length was set to reasonably limit the occurrence of very stable atmospheric conditions. In this case it was defined as 30 meters.
- **Receptor Locations:** The main sensitive receptors considered as part of the air quality assessment are the surrounding existing properties – these are representative worst-case receptors. Ground floor (1.5m) is considered. Table 10A.1 details the locations modelled.

Surface Roughness

A length scale parameter called the surface roughness length is used in the model to characterise the study area in terms of the effects it will have on wind speed and turbulence, which are key factors in the modelling. The roughness of the terrain over which a plume passes can have a significant effect on dispersion by altering the velocity profile with height, and the degree of atmospheric turbulence. This is accounted for by a parameter called the surface roughness length. A surface roughness length of 0.3 m has been used within the model to represent the average surface characteristics across the study area.

Meteorological Data

The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind direction, wind speed and atmospheric stability as described below:

- Wind direction determines the sector of the compass into which the plume is dispersed;
- Wind speed affects the distance that the plume travels over time and can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise; and
- Atmospheric stability is a measure of the turbulence of the air, and particularly of its verticalmotion. It therefore affects the spread of the plume as it travels away from the source. Newgeneration dispersion models, including ADMS, use a parameter known as the Monin - Obukhov length that, together with the wind speed, describes the stability of the atmosphere.

For meteorological data to be suitable for dispersion modelling purposes, a number of meteorological parameters need to be measured on an hourly basis. These parameters includewind speed, wind direction, cloud cover and temperature. There are only a limited number of siteswhere the required meteorological measurements are made.

The year of meteorological data that is used for a modelling assessment can have a significant effect on source contribution concentrations. Dispersion model simulations have been performedusing three years of data from Dublin Airport, between 2016 and 2020.

Wind roses have been produced for each of the years of meteorological data used in this assessment and are presented in below.

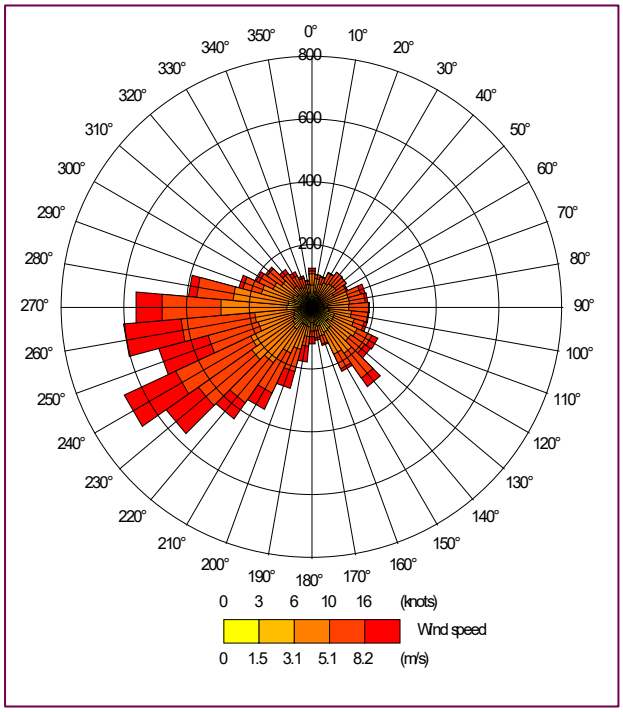


Figure 10A.3 Dublin Airport WindRose 2016

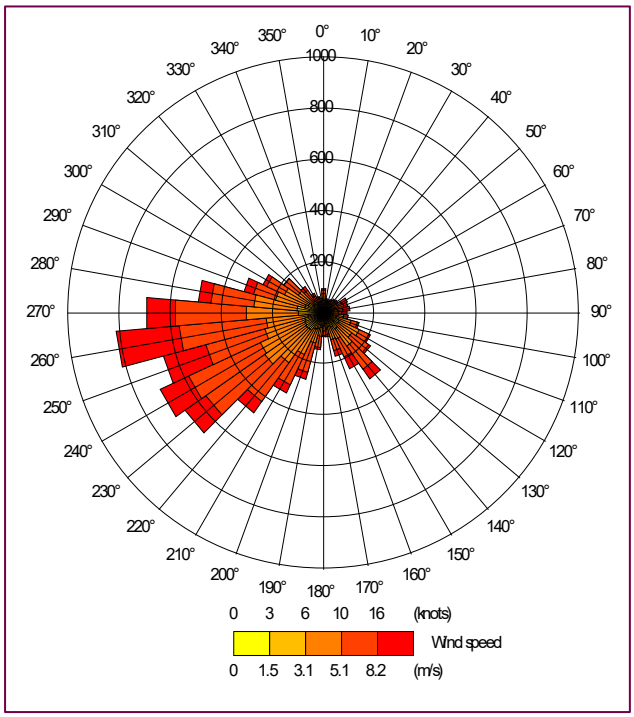


Figure 10A.4 Dublin Airport WindRose 2016

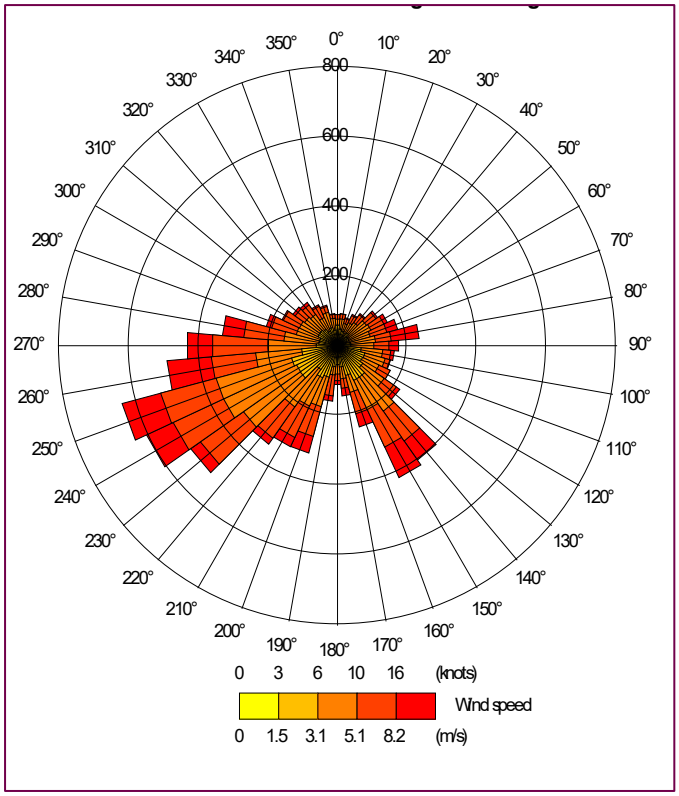


Figure 10A.5 Dublin Airport WindRose 2016

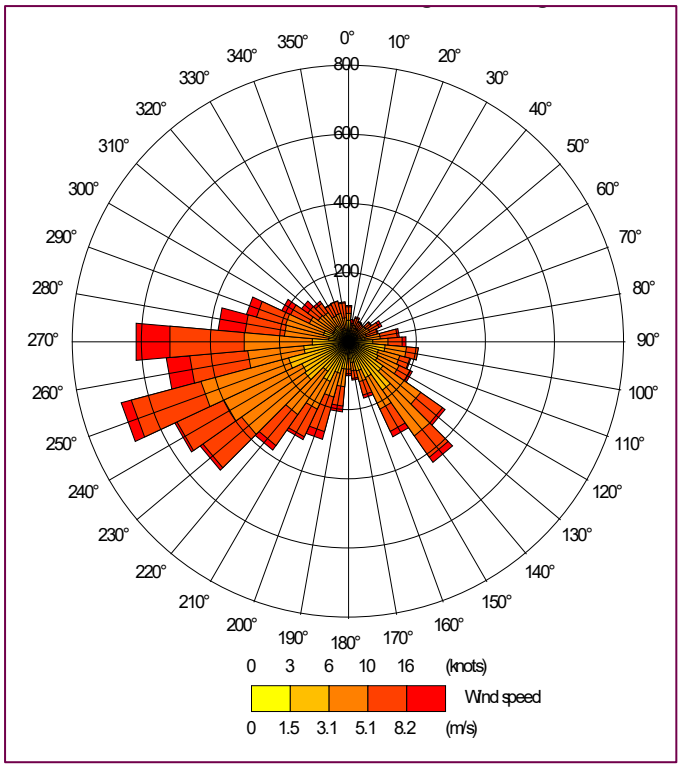


Figure 10A.6 Dublin Airport WindRose 2016

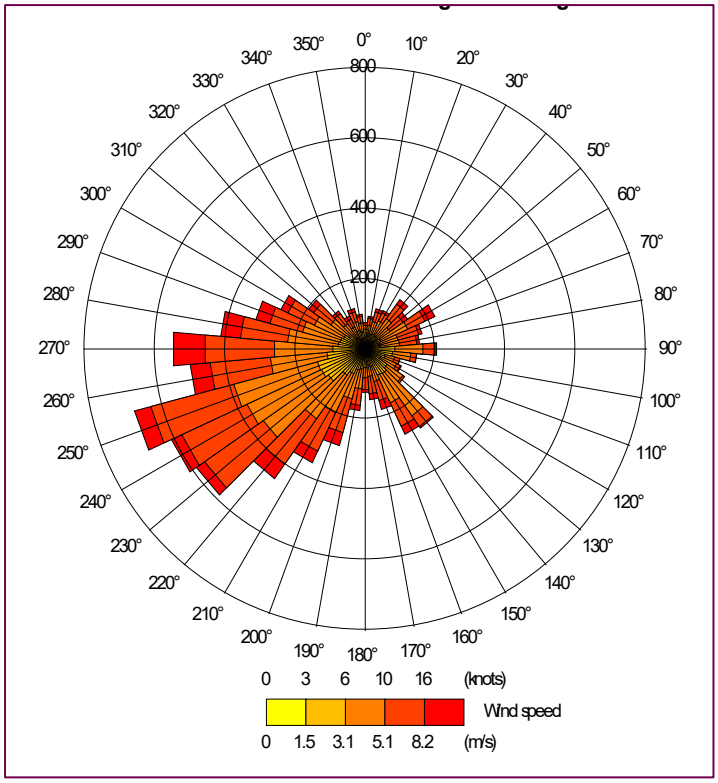


Figure 10A.7 Dublin Airport WindRose 2016

Traffic Flows

Table 10A.1 Traffic Flows used in Dispersion Modelling

Link	24hr AADT							
	Base 2023			Base 2028	Base 2043	Development Traffic	Base 2028 + Development Traffic	Base 2043 + Development Traffic
	24hr AADT (5-day, veh)	% HGV	Ave. Speed (kph)	24hr AADT (5-day, veh)	24hr AADT (5-day, veh)	24hr AADT (5-day, veh)	24hr AADT (5-day, veh)	24hr AADT (5-day, veh)
Site A - N56 north of Knocknamona Rbt	19,741	5.9%	50.3	20,706	22,466	68	20,774	22,534
Site B - R229 south of Knocknamona Rbt	17,312	0.6%	46.9	18,158	19,701	375	18,532	20,076
Site C - N56 west of Knocknamona Crescent	13,256	1.7%	56.3	13,904	15,086	443	14,346	15,528
Site D - N56 east of Carnamuggagh Lower	12,254	1.7%	73.8	12,853	13,946	157	13,011	14,103

Link	24hr AADT							
	Base 2023			Base 2028	Base 2043	Development Traffic	Base 2028 + Development Traffic	Base 2043 + Development Traffic
	24hr AADT (5-day, veh)	% HGV	Ave. Speed (kph)	24hr AADT (5-day, veh)	24hr AADT (5-day, veh)	24hr AADT (5-day, veh)	24hr AADT (5-day, veh)	24hr AADT (5-day, veh)
Knocknamona Crescent	**365**	**3.3%**	**-**	**389**	**421**	**711**	**1,101**	**1,133**
Carnamuggagh Lower	1,954	3.2%	-	2,082	2,255	111	2,193	2,366

Modelled Roads

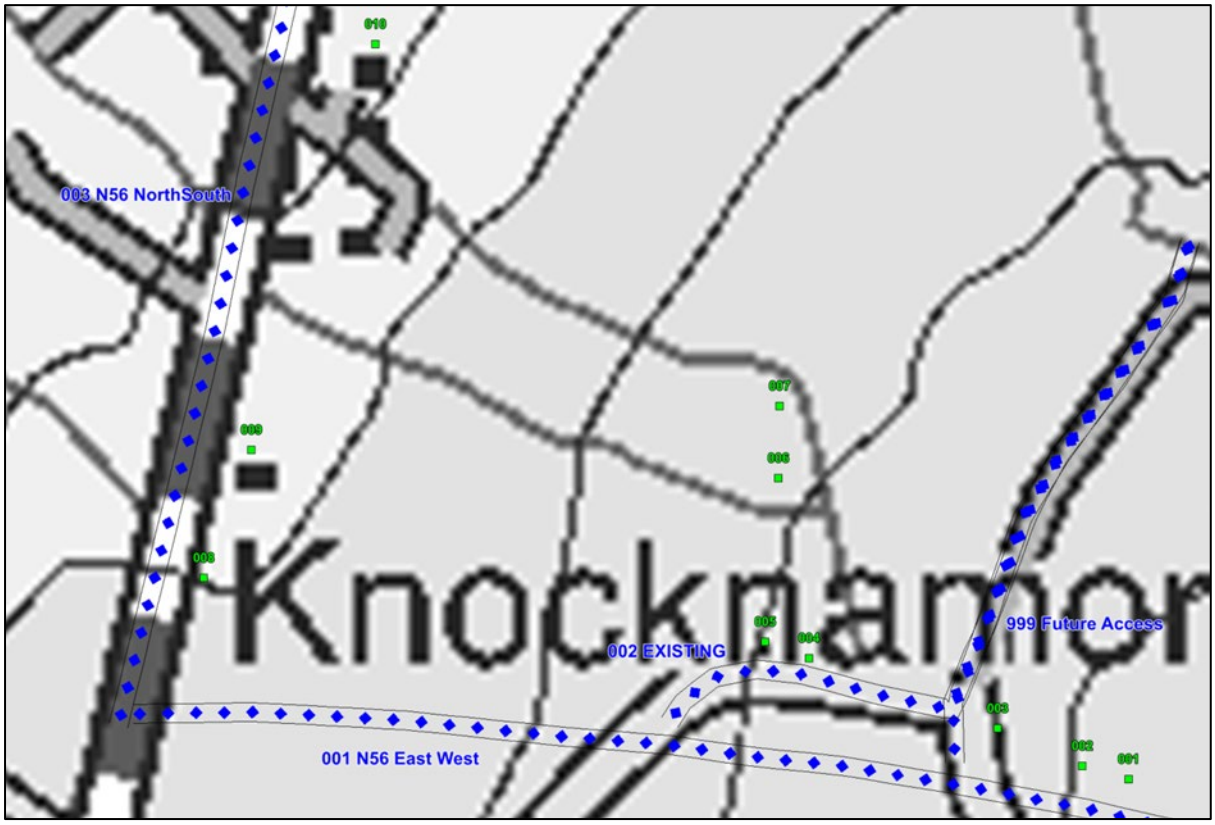


Figure 10A.8 Roads Modelled in the ADMS Dispersion Model

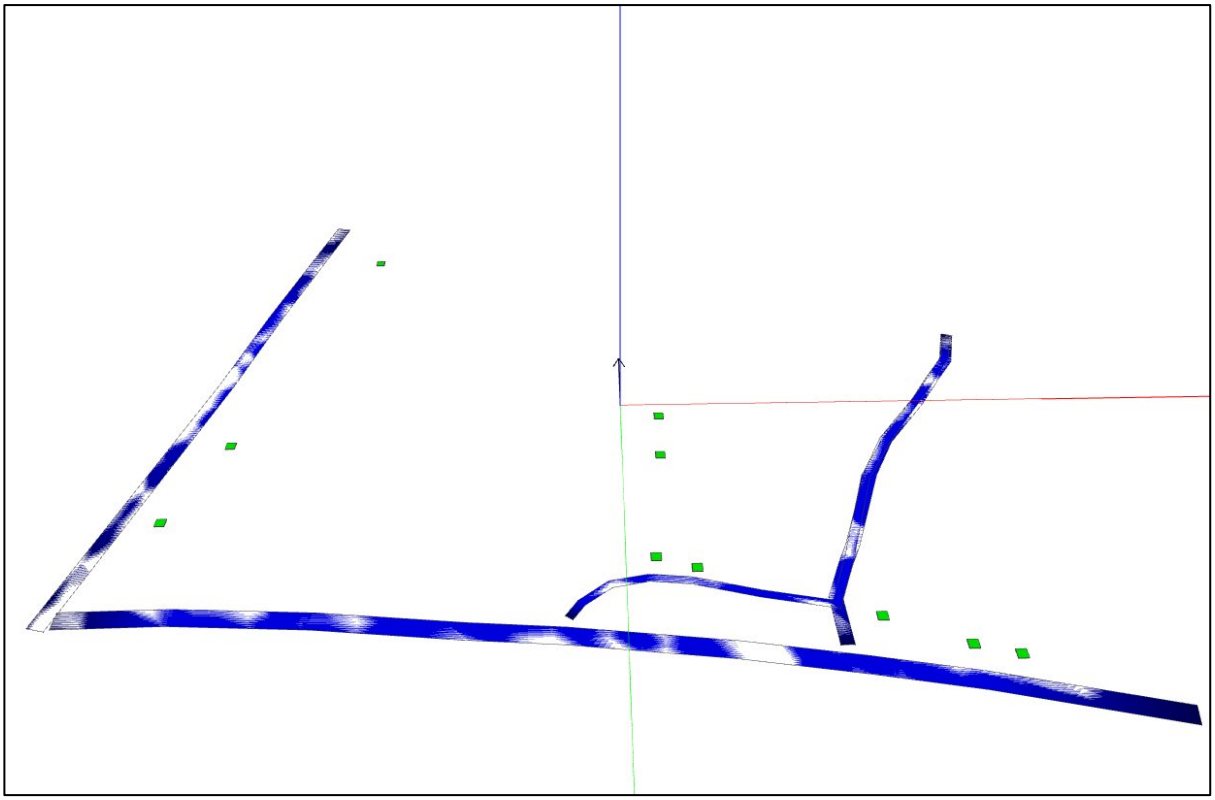


Figure 10A.9 Screen Shot from ADMS Dispersion Model showing Modelled Roads

Background Data

Particulate Matter - PM_{10}

Station 64. Letterkenny, Co. Donegal - The air quality station in Letterkenny was commissioned in May 2019. Automated, provisional results are available for PM_{10}, $PM_{2.5}$ and SO_2.

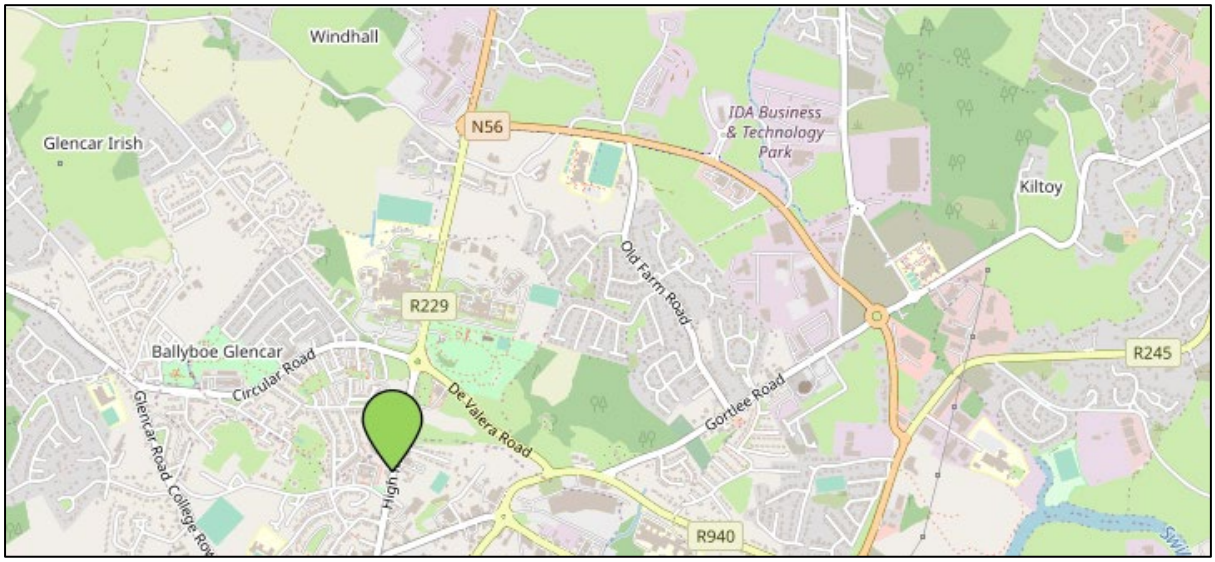


Figure 10A.10 Background Data Location for PM_{10}

The average for PM_{10} for 2023 is **15 µg/m³**. This is used as the background data concentration.

The latest average for $PM_{2.5}$ is **6.83 µg/m^3**. This is used as the background data concentration.

Nitrogen Dioxide - NO_2

Station 105. Eyre Square, Galway - The air quality station on Eyre Square was commissioned in January 2022. Automatic, provisional results are available for nitrogen dioxide. There are no nitrogen dioxide monitoring points in Letterkenny.

The latest average for NO_2 is **21.35 µg/m^3.** This is used as the background data concentration.

Model Outputs

Receptors

The air quality assessment predicts the impacts at locations that could be sensitive to any changes. Such sensitive receptors should be selected where the public is regularly present and likely to be exposed over the averaging period of the objective. LAQM.TG16 provides examples of exposure locations and these are summarised in Table 10A.1. Modelling of point source impacts has been undertaken using a grid of 3 km by 3 km centred on the stack, with a grid spacing of 30 m. All human receptors have been modelled at a height of 1.5 m, representative of typical head height. The locations of these discrete receptors are listed in Table 10A.2 and illustrated in Figure 10A.11.

Table 10A.2 Modelled Sensitive Receptors

Receptor Number	X(m)	Y (m)	Z(m)
1	217900	413036	1.5
2	217872	413044	1.5
3	217820	413067	1.5
4	217705	413110	1.5
5	217678	413120	1.5
6	217686	413220	1.5
7	217687	413264	1.5
8	217335	413159	1.5
9	217364	413237	1.5
10	217440	413485	1.5

Receptors have been modelled at 1.5m above ground level, representative of typical head height

The NO_2 objectives for all the different averaging periods apply at the façades of the modelled sensitive receptors.

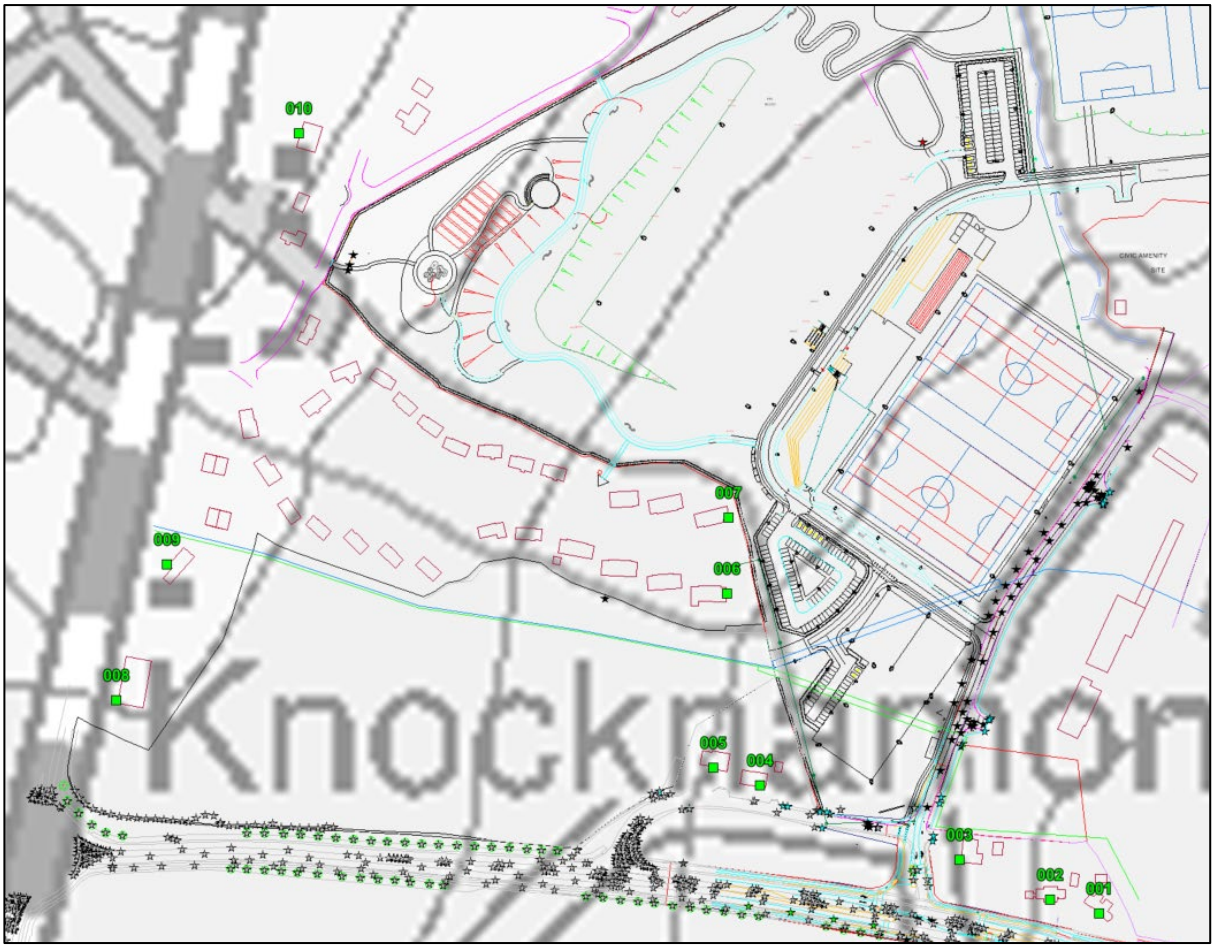


Figure 10A.11 Screen Shot from ADMS Dispersion Model showing Modelled Receptors

NO_x to NO_2 Relationship

The NO_x emissions will typically comprise approximately 90-95% nitrogen monoxide (NO) and 5-10% nitrogen dioxide (NO_2) at the point of release. The NO oxidises in the atmosphere in the presence of sunlight, ozone and volatile organic compounds to form NO_2, which is the principal concern in terms of environmental health effects. There are various techniques available for estimating the proportion of NO_x converted to NO_2 by the time it has reached receptors which depends on the distance and hence travel time betweenthe source and receptor. The methods used in this assessment are discussed below.

NO_x to NO_2 Assumptions for Annual-Mean Calculations

Total conversion (i.e. 100%) of NO to NO_2 is sometimes used for the estimation of the absolute upper limit of the annual mean NO_2. This technique is based on the assumption that all NO emitted is converted to NO_2 before it reaches ground level. However, in reality the conversion is an equilibrium reaction and even at ambient concentrations a proportion of NO_X remains in the form of NO. Total conversion is, therefore, an unrealistic assumption, particularly in the near field. While this approach is useful for screening assessments, it is not appropriate for detailed assessments.

Historically, the EPA has recommended that for a 'worst-case scenario', a 70% conversion of NO to NO_2 should be considered for calculation of annual average concentrations.If a breach of the annual average NO_2 objective/limit value occurs.

Following the withdrawal of the Environment Agency's H1 guidance document, there is no longer an explicit recommendation; however, for the purposes of this detailed assessment, a 70% conversion of NO to NO_2 has been assumed for annual average NO_2 concentrations in line with the Environment Agency's historic recommendations.

Modelling of Long-term and Short-term Emissions

Long-term (annual-mean) NO2 has been modelled for comparison with the relevant annual mean objectives. For short-term NO2, the objective is for the hourly-mean concentration not to exceed 200 µg.m-3 more than 18 times per calendar year. As there are 8,760 hours in a non-leap year, the hourly-mean concentration would need to be below 200 µg.m-3 in 8,742 hours, i.e. 99.79% of the time. Therefore, the 99.79th percentile of hourly NO2 has been modelled.

Uncertainty

All air quality assessment tools, whether models or monitoring measurements, have a degree of uncertainty associated with the results. The choices that the practitioner makes in setting-up the model, choosing the input data, and selecting the baseline monitoring data will decide whether the final predicted impact should be considered a central estimate, or an estimate tending towards the upper bounds of the uncertainty range (i.e. tending towards worst-case).

The atmospheric dispersion model itself contributes some of this uncertainty, due to it being a simplified version of the real situation: it uses a sophisticated set of mathematical equations to approximate the complex physical and chemical atmospheric processes taking place as a pollutant is released and as it travels to a receptor. The predictive ability of even the best model is limited by how well the turbulent nature of the atmosphere can be represented.

Each of the data inputs for the model, listed earlier, will also have some uncertainty associated with them. Where it has been necessary to make assumptions, these have mainly been made towards the upper end of the range informed by an analysis of relevant, available data to achieve an assessment that has a conservative bias overall. Where no significant effects are predicted, based on conservative assumptions, there is no need to revisit these assumptions, although the opportunity exists to do so.

The main components of uncertainty in the total predicted concentrations, made up of the background concentration and the modelled fraction, include those summarised in Table 10A.3.

Table 10A.3 Uncertainty

Concentration	Source of Uncertainty	Approach to Dealing with Uncertainty	Comments
Background Concentration	Characterisation of future baseline air quality (i.e. theair quality conditions in thefuture assuming that the development does not proceed)	The future background concentrationused in the assessment is the same as the current background concentration and no reduction has been assumed. This is a conservative assumption as, in reality, background concentrations are likely to reduce over time as cleaner vehicle technologies form an increasing proportion of the fleet.	The background concentration is the majorproportion of the total predicted concentration. The conservative assumptions adopted ensure that the background concentrationused within the model contribute to the result being towards the top of the uncertainty range, rather than a central estimate.

Concentration	Source of Uncertainty	Approach to Dealing with Uncertainty	Comments
Model Input/Output Data	Meteorological Data	Uncertainties arise from any differences between the conditions at the met station and the development site, and between the historical met years and the future years. These have been minimised by using meteorological data collated at a representative measuring site. The model has beenrun for 5 full years of meteorological conditions.	The modelled fraction islikely to contribute to theresult being between a central estimate and thetop of the uncertainty range.
	Receptors	The model has been run for a grid ofreceptors. In addition, receptor locations have been identified whereconcentrations are highest or where the greatest changes are expected.	

The analysis of the component uncertainties indicates that, overall, the predicted total concentration is likely to be towards the top of the uncertainty range (i.e. the worst case) rather than being a central estimate. The actual concentrations that will be found when the development is operational are unlikely to be higher than those presented within this report and are more likely to be lower.

ADMS Model Outputs – Gridded – No Background

Results have been reported for the location where the highest concentration is predicted. This is considered a robust and conservative approach.

Table 10.A.4: 2023 Base Year NOx, PM_{10} & $PM_{2.5}$ (ug/m^3)

Receptor Name	X(m)	Y (m)	Z(m)	NO_2 (µg/m^3) Annual Mean	PM_{10} (µg/m^3) Annual Mean	$PM_{2.5}$ (µg/m^3) Annual Mean
1	217900	413036	1.5	3.42	0.52	0.29
2	217872	413044	1.5	3.25	0.49	0.27
3	217820	413067	1.5	2.34	0.35	0.20
4	217705	413110	1.5	1.70	0.24	0.13
5	217678	413120	1.5	1.50	0.21	0.12
6	217686	413220	1.5	0.56	0.08	0.05
7	217687	413264	1.5	0.44	0.06	0.04
8	217335	413159	1.5	2.20	0.32	0.18
9	217364	413237	1.5	1.53	0.22	0.12
10	217440	413485	1.5	0.81	0.12	0.07

Table 10.A.5: 2028 Without Proposed Development in Place NOx, PM_{10} & $PM_{2.5}$ (ug/m^3)

Receptor Name	X(m)	Y (m)	Z(m)	NO_2 (µg/m^3) Annual Mean	PM_{10} (µg/m^3) Annual Mean	$PM_{2.5}$ (µg/m^3) Annual Mean
1	217900	413036	1.5	2.37	0.53	0.29
2	217872	413044	1.5	2.26	0.51	0.28
3	217820	413067	1.5	1.62	0.36	0.20
4	217705	413110	1.5	1.18	0.25	0.14
5	217678	413120	1.5	1.04	0.22	0.12
6	217686	413220	1.5	0.39	0.09	0.05
7	217687	413264	1.5	0.31	0.07	0.04
8	217335	413159	1.5	1.53	0.33	0.18
9	217364	413237	1.5	1.06	0.23	0.13
10	217440	413485	1.5	0.56	0.12	0.07

Table 10.A.6: 2028 With Proposed Development in Place NOx, PM_{10} & $PM_{2.5}$ (ug/m^3)

Receptor Name	X(m)	Y (m)	Z(m)	NO_2 (µg/m^3) Annual Mean	PM_{10} (µg/m^3) Annual Mean	$PM_{2.5}$ (µg/m^3) Annual Mean
1	217900	413036	1.5	2.39	0.54	0.30
2	217872	413044	1.5	2.28	0.51	0.28
3	217820	413067	1.5	1.71	0.37	0.21
4	217705	413110	1.5	1.04	0.23	0.13
5	217678	413120	1.5	0.95	0.21	0.12
6	217686	413220	1.5	0.40	0.09	0.05
7	217687	413264	1.5	0.31	0.07	0.04
8	217335	413159	1.5	1.56	0.34	0.19
9	217364	413237	1.5	1.09	0.24	0.13
10	217440	413485	1.5	0.58	0.12	0.07

ADMS Model Outputs – Gridded – With Background

Table 10.A.7: 2023 Base Year NOx, PM_{10} & $PM_{2.5}$ (ug/m^3)

Receptor Name	X(m)	Y (m)	Z(m)	NO_2 ($\mu g/m^3$) Annual Mean	PM_{10} ($\mu g/m^3$) Annual Mean	$PM_{2.5}$ ($\mu g/m^3$) Annual Mean
1	217900	413036	1.5	24.77	15.52	7.12
2	217872	413044	1.5	24.6	15.49	7.1
3	217820	413067	1.5	23.69	15.35	7.03
4	217705	413110	1.5	23.05	15.24	6.96
5	217678	413120	1.5	22.85	15.21	6.95
6	217686	413220	1.5	21.91	15.08	6.88
7	217687	413264	1.5	21.79	15.06	6.87
8	217335	413159	1.5	23.55	15.32	7.01
9	217364	413237	1.5	22.88	15.22	6.95
10	217440	413485	1.5	22.16	15.12	6.9

Table 10.A.8: 2028 Without Proposed Development in Place NOx, PM_{10} & $PM_{2.5}$ (ug/m^3)

Receptor Name	X(m)	Y (m)	Z(m)	NO_2 ($\mu g/m^3$) Annual Mean	PM_{10} ($\mu g/m^3$) Annual Mean	$PM_{2.5}$ ($\mu g/m^3$) Annual Mean
1	217900	413036	1.5	23.72	15.53	7.12
2	217872	413044	1.5	23.61	15.51	7.11
3	217820	413067	1.5	22.97	15.36	7.03
4	217705	413110	1.5	22.53	15.25	6.97
5	217678	413120	1.5	22.39	15.22	6.95
6	217686	413220	1.5	21.74	15.09	6.88
7	217687	413264	1.5	21.66	15.07	6.87
8	217335	413159	1.5	22.88	15.33	7.01
9	217364	413237	1.5	22.41	15.23	6.96
10	217440	413485	1.5	21.91	15.12	6.9

Table 10.A.9: 2028 With Proposed Development in Place NOx, PM10 & PM2.5 (ug/m^3)

Receptor Name	X(m)	Y (m)	Z(m)	NO_2 ($\mu g/m^3$) Annual Mean	PM_{10} ($\mu g/m^3$) Annual Mean	$PM_{2.5}$ ($\mu g/m^3$) Annual Mean
1	217900	413036	1.5	23.74	15.54	7.13
2	217872	413044	1.5	23.63	15.51	7.11
3	217820	413067	1.5	23.06	15.37	7.04
4	217705	413110	1.5	22.39	15.23	6.96
5	217678	413120	1.5	22.3	15.21	6.95
6	217686	413220	1.5	21.75	15.09	6.88
7	217687	413264	1.5	21.66	15.07	6.87
8	217335	413159	1.5	22.91	15.34	7.02
9	217364	413237	1.5	22.44	15.24	6.96
10	217440	413485	1.5	21.93	15.12	6.9

Table 10.A.10: 2028 Difference With – Without NOx, PM_{10} & $PM_{2.5}$ (ug/m^3)

Receptor Name	X(m)	Y (m)	Z(m)	NO_2 ($\mu g/m^3$) Annual Mean	PM_{10} ($\mu g/m^3$) Annual Mean	$PM_{2.5}$ ($\mu g/m^3$) Annual Mean
1	217900	413036	1.5	0.02	0.01	0.01
2	217872	413044	1.5	0.02	0	0
3	217820	413067	1.5	0.09	0.01	0.01
4	217705	413110	1.5	-0.14	-0.02	-0.01
5	217678	413120	1.5	-0.09	-0.01	0
6	217686	413220	1.5	0.01	0	0
7	217687	413264	1.5	0	0	0
8	217335	413159	1.5	0.03	0.01	0.01
9	217364	413237	1.5	0.03	0.01	0
10	217440	413485	1.5	0.02	0	0

There are no significant changes in air quality due to the proposed development. All changes are insignificant. All levels of pollution are within the relevant Irish and European thresholds.

TOBIN
CONSULTING ENGINEERS
BUILT ON KNOWLEDGE

Ollscoil
Teicneolaíochta
an Atlantaigh

Atlantic
Technological
University

Atlantic Technological University Donegal Letterkenny Regional Sports Activity Hub, Letterkenny, Co. Donegal

Flood Risk Assessment

Proposed Regional Sports Activity Hub at Letterkenny, Co. Donegal

Flood Risk Assessment

Document Control Sheet	
Document Reference	11438- ATU Letterkenny FRA
Report Status	Issued
Report Date	December 2022
Current Revision	B
Client:	Atlantic Technological University Donegal
Client Address:	Atlantic Technological University Donegal, Port Road, Letterkenny, Co. Donegal F92 FC93
Project Number	11438

Galway Office	Dublin Office	Castlebar Office
Fairgreen House, Fairgreen Road, Galway, H91 AXK8, Ireland Tel: +353 (0)91 565 211	Block 10-4, Blanchardstown Corporate Park, Dublin 15, D15 X98N, Ireland Tel: +353 (0)1 803 0406	Market Square, Castlebar, Mayo, F23 Y427, Ireland Tel: +353 (0)94 902 1401

Revision	Description	Author:	Date	Reviewed By:	Date	Authorised by:	Date
A	Draft	ST	14/12/2022	ML	14/12/2022	TM	14/12/2022
B	Issued	ST	16/12/2022	ML	16/12/2022	TM	16/12/2022

TOBIN Consulting Engineers

Table of Contents

1.0 INTRODUCTION 3
2.0 FLOOD RISK MANAGEMENT GUIDANCE 5
2.1 The Planning System and Flood Risk Management Guidelines 5
2.1.1 Flood Zones and Vulnerability Classes 5
2.1.2 The Justification Test 6
2.2 The Flood Risk Management Climate Change Adaptation Plan 7
2.3 County Donegal Development Plan 2018-2024 8
3.0 INITIAL FLOOD RISK ASESSMENT 9
3.1 Past Flood Events 9
3.2 OPW Preliminary Flood Risk Assessment (PFRA) Study 10
3.3 National Coastal Extreme Water Level Estimation Points (ICWWS 2018) 11
3.4 National Coastal Flood Hazard Mapping (NCFHM) 2021 11
3.5 Catchment Flood Risk Assessment and Management Study 13
3.6 Geological Survey Ireland Mapping 15
4.0 HYDRAULIC Assessment 17
4.1 Flow Estimation 17
4.1.1 Flood Studies Update (FSU) Methodology 17
4.1.2 CFRAM Methodology 19
4.2 Channel Capacity Calculation 20
4.2.1 Watercourse 3 (WC3) and Watercourse 4 (WC4) 20
4.3 Compensation Storage at Watercourse 2 (WC2) 22
4.4 Watercourse Crossings 23
5.0 DETAILED FLOOD RISK ASESSMENT 24
5.1 Fluvial Flooding 24
5.2 Pluvial Flooding 24
5.3 Groundwater Flooding 25
5.4 Coastal Flooding 25
6.0 CONCLUSIONS 26

Table of Figures

Figure 1-1 Site Location 3
Figure 1-2 Proposed Development 4
Figure 2-1 Criteria of the Justification Test 6
Figure 3-1 OPW Flood Map of Past Flood Events 9
Figure 3-2 Indicative Flood Mapping (extract from PFRA Map 404) 10
Figure 3-3 NCFHM Current Extents 12
Figure 3-4 NCFHM MRFS Extents 12
Figure 3-5 North Western CFRAM Current Fluvial Flood Extents 13
Figure 3-6 North Western CFRAM MRFS Fluvial Flood Extents 14
Figure 3-7 GSI Mapping of Karst Features 15
Figure 3-8 GSI Mapping of Groundwater and Surface Water Flooding 16
Figure 4-1 Knocknamona Stream Catchment Delineation 17
Figure 4-2 Extract from CFRAM map no. N01LKY_EXFCD_F0_09 19
Figure 4-3 Watercourses within the subject site 21
Figure 4-4 Compensation storage along WC2 22
Figure 4-5 2 No. crossings along WC 2 23
Figure 4-6 Crossing at the Proposed Signalised N56 / Knocknamona Crescent Junction 23

Table of Tables

Table 2-1 Decision Matrix for Determining the Appropriateness of a Development 5
Table 2-2 Climate Change Adaptation Allowances for Future Flood Risk Scenarios 7
Table 3-1 ICWWS 2018 North West Point NW42 water levels 11
Table 4-1 Summary of Catchment Descriptors 18
Table 4-2 Estimated Flows 18
Table 4-3 Estimated CFRAM Flows 20

1.0 INTRODUCTION

TOBIN Consulting Engineers were appointed by Atlantic Technological University Donegal (ATU Donegal) in September 2022 to undertake a Flood Risk Assessment (FRA) for their lands (see Figure 1-1) and proposed development (see Figure 1-2) at Letterkenny, Co. Donegal.

Figure 1-1 shows the location of the subject site. The 27.4ha greenfield site has existing ground levels ranging from approximately 71.25mOD at the southern site entrance bordering the N56, up to approximately 102.67mOD near the north-western site corner.

The proposed development at the subject site includes the main sports hub development in addition to two proposed future phases of development.

The subject site is bounded by a number of residential developments, agricultural lands, the national road the N56, and the Letterkenny ESB Networks substation and the Letterkenny Recycling Centre.

The purpose of this report ('Stage 2' Flood Risk Assessment report as defined by The Planning System and Flood Risk Management Guidelines) is to identify, quantify, and communicate the risks of flooding, if any. The report assesses at the entire land holdings including the proposed development and the areas for future development, as one subject site.

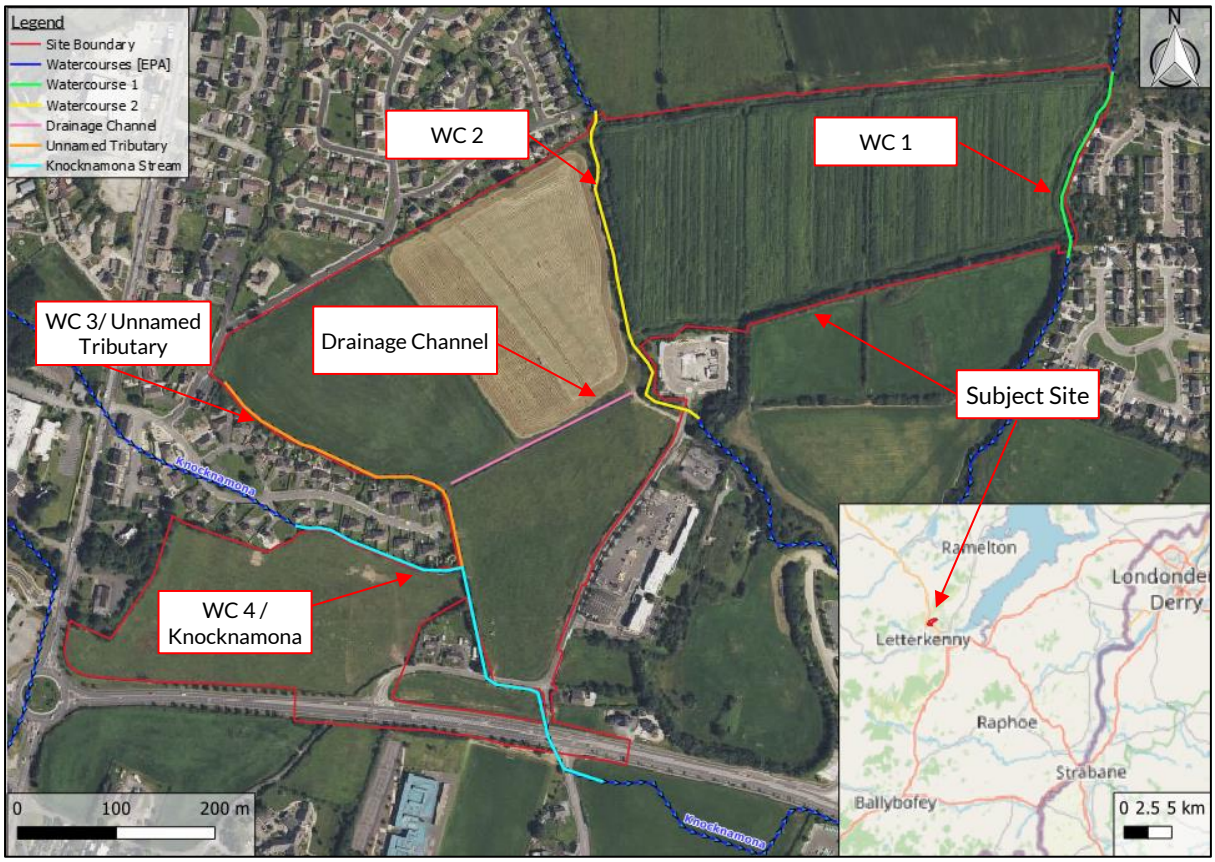


Figure 1-1 Site Location

The proposed development will consist of playing pitches, changing facilities, parking areas and all associated ancillary site works; see Figure 1-2.

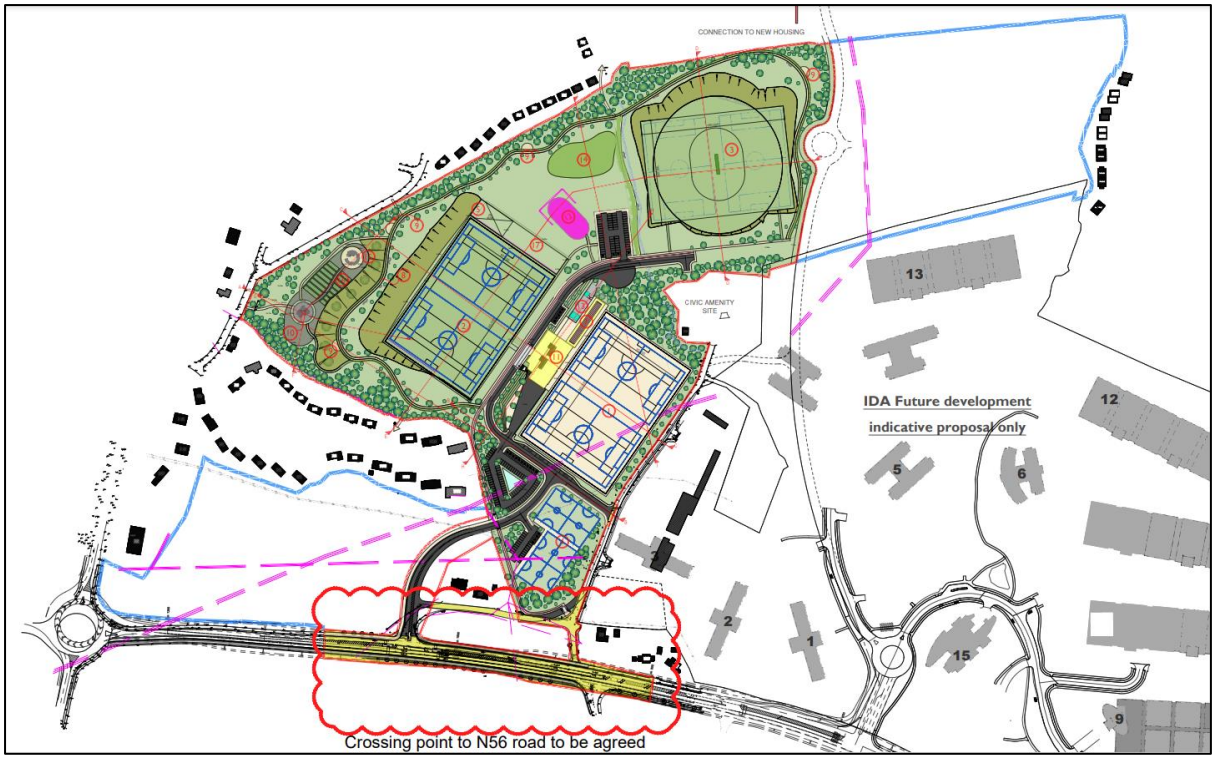


Figure 1-2 Proposed Development

2.0 FLOOD RISK MANAGEMENT GUIDANCE

This Strategic Flood Risk Assessment was carried out in accordance with the following flood risk management guidance documents:

- The Planning System and Flood Risk Management Guidelines for Planning Authorities
- Flood Risk Management Climate Change Sectoral Adaptation Plan
- Donegal County Council Development Plan 2018-2024

2.1 The Planning System and Flood Risk Management Guidelines

The Planning System and Flood Risk Management Guidelines for Planning Authorities (PSFRM Guidelines) were published in 2009 by the Office of Public Works (OPW) and Department of the Environment, Heritage and Local Government (DoEHLG). Their aim is to ensure that flood risk is considered in development proposals and the assessment of planning applications.

2.1.1 Flood Zones and Vulnerability Classes

The PSFRM Guidelines discuss flood risk in terms of flood zones A, B, and C, which correspond to areas of high, medium, or low probability of flooding, respectively. The extents of each flood zone are based on the Annual Exceedance Probability (AEP) of various flood events.

The PSFRM Guidelines also categorise different types of development into three vulnerability classes based on their sensitivity to flooding. The proposed pitches would be classified as water compactible development with the changing facilities being classified as a less vulnerable development.

Table 2-1 shows a decision matrix that indicates which types of development are appropriate in each flood zone and when the Justification Test (see Section 2.1.2) must be satisfied. The annual exceedance probabilities used to define each flood zone are also provided.

Table 2-1 Decision Matrix for Determining the Appropriateness of a Development

Flood Zone (Probability)	Annual Exceedance Probability (AEP)	Development Appropriateness		
		Highly Vulnerable	Less Vulnerable	Water Compatible
A (High)	Fluvial & Pluvial Flooding More frequent than 1% AEP Coastal Flooding More frequent than 0.5% AEP	Justification Test	Justification Test	Appropriate
B (Medium)	Fluvial & Pluvial Flooding 0.1% to 1% AEP Coastal Flooding 0.1% to 0.5% AEP	Justification Test	Appropriate	Appropriate
C (Low)	Fluvial, Pluvial & Coastal Flooding Less frequent than 0.1% AEP	Appropriate	Appropriate	Appropriate

2.1.2 The Justification Test

Any proposed development being considered in an inappropriate flood zone (as determined by Table 2-1) must satisfy the criteria of the Justification Test outlined in Figure 2-1 (taken from the PSFRM Guidelines).

Box 5.1 Justification Test for development management (to be submitted by the applicant)

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:
   - (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;
   - (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;
   - (iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and
   - (iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Figure 2-1 Criteria of the Justification Test

2.2 The Flood Risk Management Climate Change Adaptation Plan

The Flood Risk Management Climate Change Sectoral Adaptation Plan was published in 2019 under the National Adaptation Framework and Climate Action Plan. This plan outlines the OPW's approach to climate change adaptation in terms of flood risk management.

This approach is based on a current understanding of the potential impacts of climate change on flooding and flood risk. Research has shown that climate change is likely to worsen flooding through more extreme rainfall patterns, more severe river flows, and rising mean sea levels.

To account for these changes, the Adaptation Plan presents two future flood risk scenarios to consider when assessing flood risk:

- Mid-Range Future Scenario (MRFS)
- High-End Future Scenario (HEFS)

Table 2-2 indicates the allowances that should be added to estimates of extreme rainfall depths, peak flood flows, and mean sea levels for the future scenarios.

Table 2-2 Climate Change Adaptation Allowances for Future Flood Risk Scenarios

Parameter	Mid-Range Future Scenario (MRFS)	High-End Future Scenario (HEFS)
Extreme Rainfall Depths	+ 20%	+ 30%
Peak River Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 0.5 m	+ 1 m

For the purpose of this flood risk assessment, the proposed development has been assessed against the Mid-Range Future Scenario as it represents a likely future scenario.

2.3 County Donegal Development Plan 2018-2024

The current County Donegal Development Plan provides a strategic framework for land use planning for 2018 to 2024. Section 5.4 outlines Donegal County Council's strategy for the management of flooding, with the aim "to manage development proposals within flood risk areas in a sequential manner based on avoidance, substitution, justification and mitigation and to otherwise ensure that flood risks can be managed to an acceptable level without increasing flood risk elsewhere".

The development plan sets out seven key policies, integrating land use planning and flood risk management:

F-P-1 It is a policy of the Council to ensure that all development proposals comply with The Planning System and Flood Risk Management - Guidelines for Planning Authorities', November 2009, DoEHLG. In doing so the planning authority shall:

- Assess developments in accordance with the Sequential approach and precautionary principle set out the in the Planning System and Flood Risk Management – Guidelines for Planning Authorities'; and
- Utilise the Draft Flood Risk Management Plans (and any associated flood risk mapping) prepared as part of the CFRAMS programme, or any other flood risk datasets or mapping it considers appropriate, in assessing flood risk.

F-P-2 It is a policy of the Council to require applicants/developers to submit, where appropriate, an independent 'Flood Risk Assessment' in accordance with the Flood Risk Management Guidelines, DEHLG, 2009 or any subsequent related publication and/or 'Surface Water Drainage Calculations', from suitably qualified persons.

F-P-3 It is a policy of the Council to require applicants/developers to submit, where appropriate, evidence of compliance with the Justification test set out in S5.15 of The Planning System and Flood Risk Management - Guidelines for Planning Authorities' (DoEHLG 2009) or any subsequent related publication.

F-P-4 It is a policy of the Council not to permit development where flood or surface water management issues have not been, or cannot be, addressed successfully and/or where the presence of unacceptable residual flood risks remain for the development, its occupants and/or property or public infrastructure elsewhere including, inter alia, up or downstream.

F-P-5 It is a policy of the Council to promote the use of Sustainable Urban Drainage Systems (SUDs), flood attenuation areas, the controlled release of surface waters and use of open spaces and semi permeable hard surfaces for appropriate development proposals.

F-P-6 It is a policy of the Council to consider the development of long and short-term flood remediation works, including embankments, sea defences, drainage channels, and attenuation ponds to alleviate flood risk and damage to livelihoods, property and business subject to environmental considerations including potential impact on designated shellfish water and, fresh water pearl mussel catchment areas, compliance with Article 6 of the Habitats Directive, best practice in Coastal Zone Management and the Marine Resource and Coastal Management policies of this Plan.

F-P-7 It is a policy of the Council not to permit developments which would hinder the maintenance of river or drainage channels.

3.0 INITIAL FLOOD RISK ASESSMENT

3.1 Past Flood Events

The OPW's National Flood Information Portal[1] provides past flood event mapping with records of flooding reports, meeting minutes, photos, and/or hydrometric data.

The closest historical flood event to the subject site is located approximately 0.6km south-west of the subject site. This event occurred on the Sprack Burn stream and was located on the grounds of Letterkenny General Hospital (Flood ID 11905). This flood event occurred on the 26th July 2014. The source of the flood waters was a river (and the cause was a channel structure blockage). The flooding occurred in the Glencar, tributary of River Swilly, which is culverted under the site of Letterkenny General Hospital, overflowed after short-term heavy rainfall. 2 no. trash grilles were blocked, with debris that had washed downstream causing the channel to overflow through the carpark, hospital grounds and into the hospital buildings. flood event is hydraulically isolated from the watercourses located on the subject site, and remediation works have since taken place.

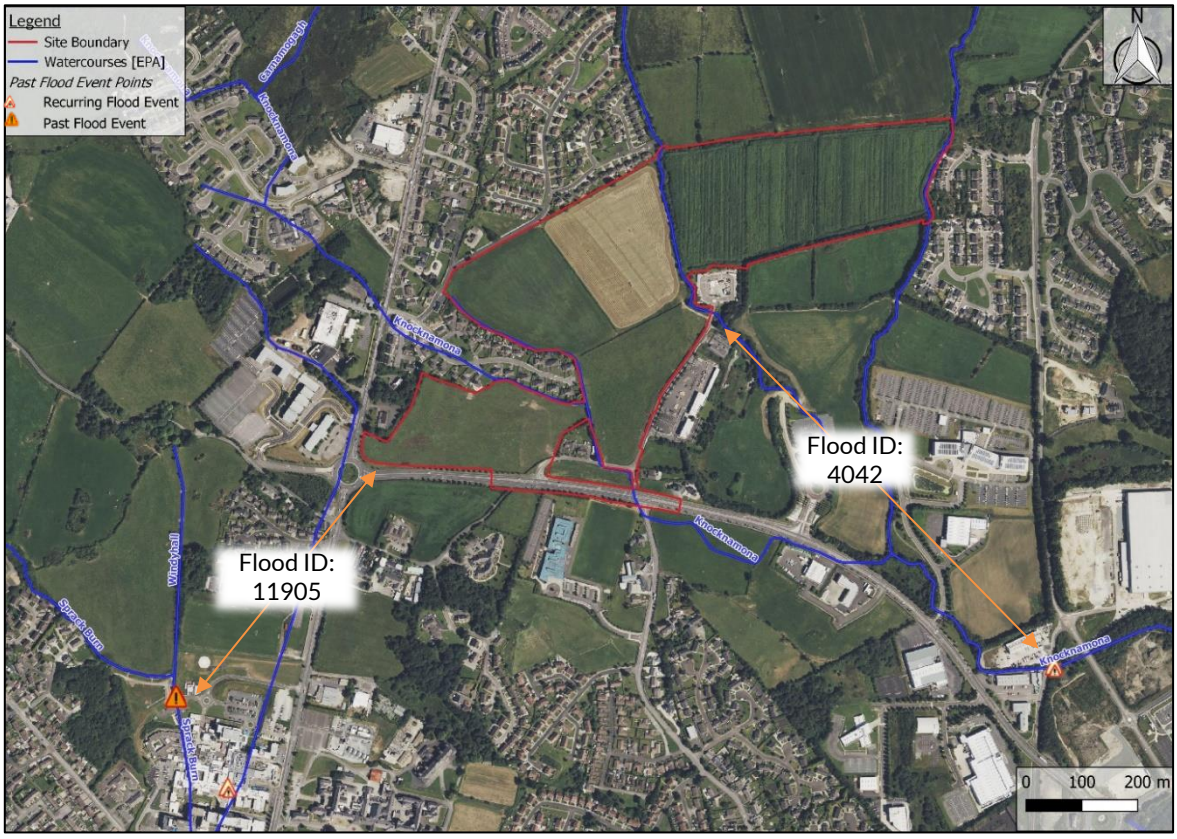


Figure 3-1 OPW Flood Map of Past Flood Events

Recurring flooding of the Knocknamona stream (Flood ID: 4042) is noted at a culvert located approximately 0.8km downstream of the subject site. The stream overflows its banks every year after heavy rainfall upstream of the culvert. The road located adjacent to the stream is liable to flood once every 3 years.

No anecdotal evidence was collected by TOBIN during the site survey that would suggest a history of flooding in the vicinity of the subject site.

[1] floodinfo.ie

3.2 OPW Preliminary Flood Risk Assessment (PFRA) Study

In 2009, the OPW produced a series of maps to assist in the development of a broad-scale FRA throughout Ireland. These maps were produced from several sources.

The OPW's National Preliminary Flood Risk Assessment (PFRA) Overview Report from March 2012 noted that *"the flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location"*[2].

Figure 3-2 provides an overview of the fluvial, coastal, pluvial, and groundwater indicative flood extents in the vicinity of the subject site. The subject site is not identified as suffering from any flooding based on the PFRA mapping.

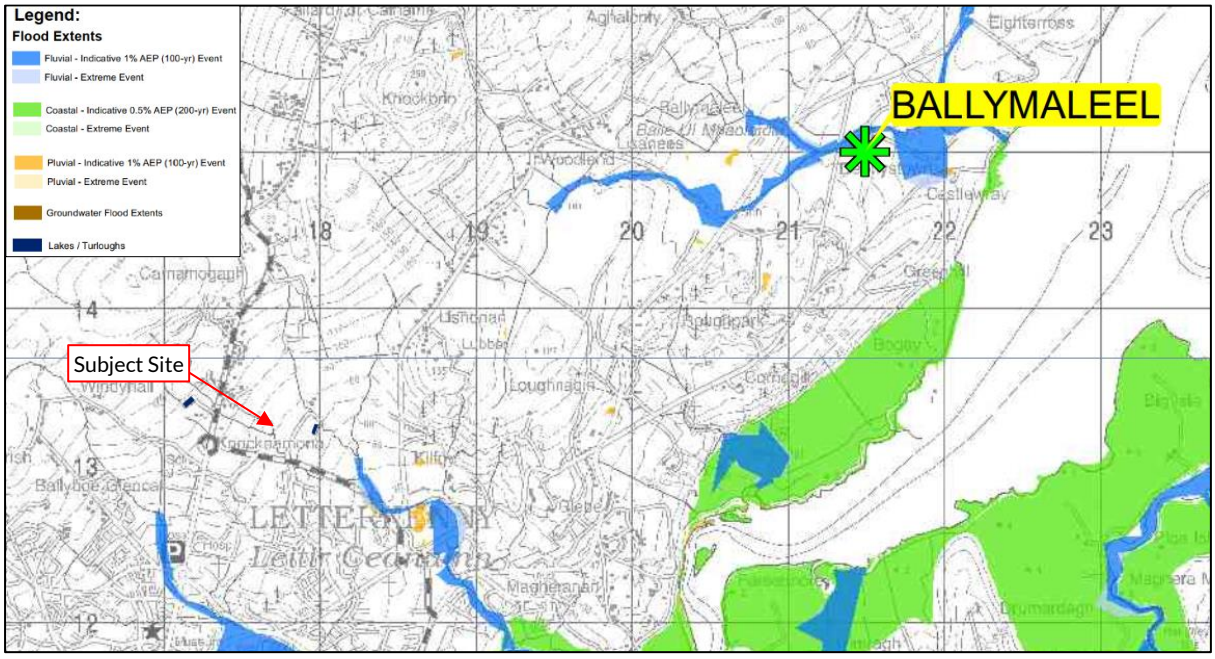


Figure 3-2 Indicative Flood Mapping (extract from PFRA Map 404)

Limitations on potential sources of error associated with the PFRA maps include:

- Assumed channel capacity (due to absence of channel survey information)
- Absence of flood defences and other drainage improvements and channel structures (bridges, weirs, culverts)
- Local errors in the national Digital Terrain Model (DTM)

Improved hydraulic modelling was carried out through the Catchment Flood Risk Assessment and Management Study (CFRAM) in 2015 (discussed in Section 3.3) and is considered more accurate than the PFRA study as it utilised surveyed river geometry and was subject to greater model calibration.

[2] The National Preliminary Flood Risk Assessment (PFRA) Overview Report, OPW (March 2012)

3.3 National Coastal Extreme Water Level Estimation Points (ICWWS 2018)[3]

The Irish Coastal Wave and Water Level Modelling Study (ICWWS) 2018 provides an update to the Estimated Extreme Coastal Boundary Water Levels, associated with astronomical tide, storm surge and seiche/local wind set-up allowance, for the coast of Ireland, originally presented as output from the Irish Coastal Protection Strategy Study (ICPSS) undertaken between 2004 and 2013, as well as two further future scenario extreme water level datasets associated with 1.5m (H+EFS) and 2.0m (H++EFS) of Sea Level Rise. The ICPSS had previously provided equivalent extreme coastal water levels for a similar range of Annual Exceedance Probability (AEP) events at the same coastal points or nodes around the coast of Ireland and for the current and two future scenarios (MRFS and HEFS). The latter ICPSS outputs are now superseded by these ICWWS 2018 Phase 1 outputs.

The closest modelled point in the study is the North West Point NW42. This is located approximately 19km east of the subject site off the coast of Inch Island.

Table 3-1 ICWWS 2018 North West Point NW42 water levels

Annual Exceedance Probability (AEP)	Scenario Water Level (OD Malin OSG15 in meters)				
	Present Day	MRFS	HEFS	H + EFS	H ++ EFS
50%	3.18	3.68	4.18	4.68	5.18
20%	3.32	3.82	4.32	4.82	5.32
10%	3.41	3.91	4.41	4.91	5.41
5%	3.51	4.01	4.51	5.01	5.51
2%	3.63	4.13	4.63	5.13	5.63
1%	3.73	4.23	4.73	5.23	5.73
0.5%	3.82	4.32	4.82	5.32	5.82
0.1%	4.03	4.53	5.03	5.53	6.03

The highest estimated water level from the study is 6.03mOD. This is significantly lower than the ground levels of the subject site. They range from approximately 71.25mOD at the southern site entrance bordering the N56, up to approximately 102.67mOD near the north-western site corner.

3.4 National Coastal Flood Hazard Mapping (NCFHM) 2021

The National Coastal Flood Hazard Mapping (NCFHM) is based on the levels outlined in the ICWWS 2018 study. Table 3-1 in section 3.3 above outlines the water levels that are applicable to the subject site.

Figure 3-3 and Figure 3-4 below show both the current day and MRFS flooding extents for the subject site. Coastal flood waters do not encroach onto the site in either scenario. The closest extents are located 1.5km south-east of the subject site.

[3] Microsoft Word - IBE1505_ICWWS_Ph1_Rp01_F02.docx

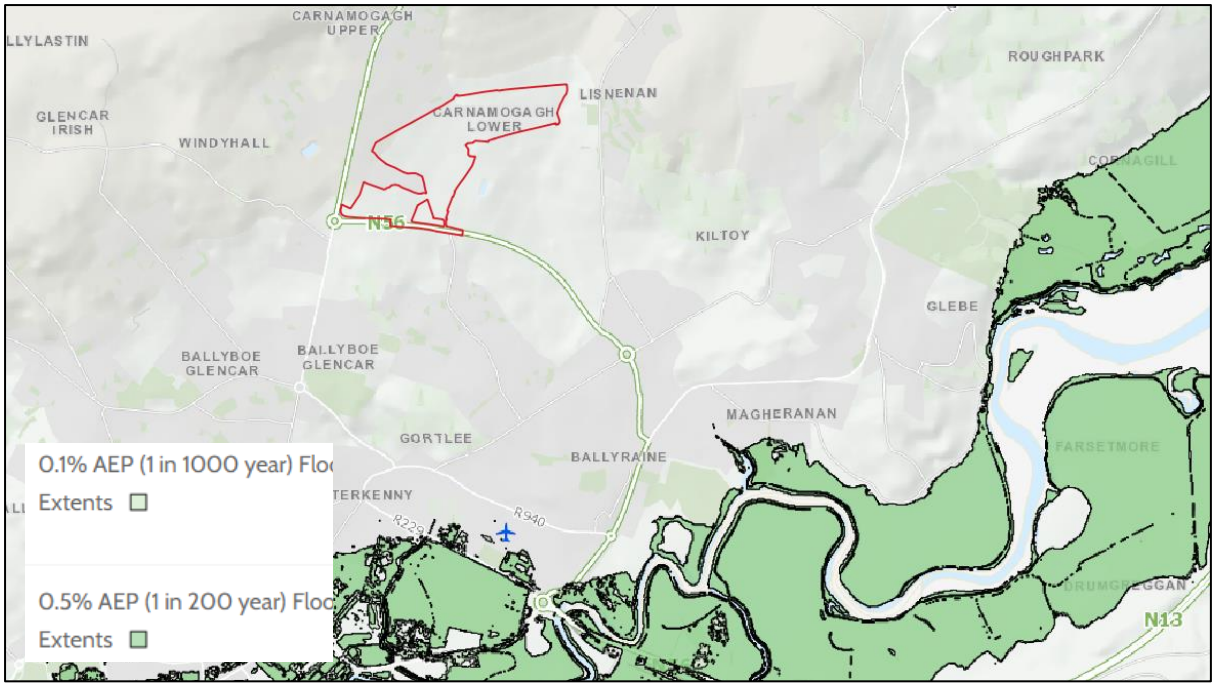


Figure 3-3 NCFHM Current Extents

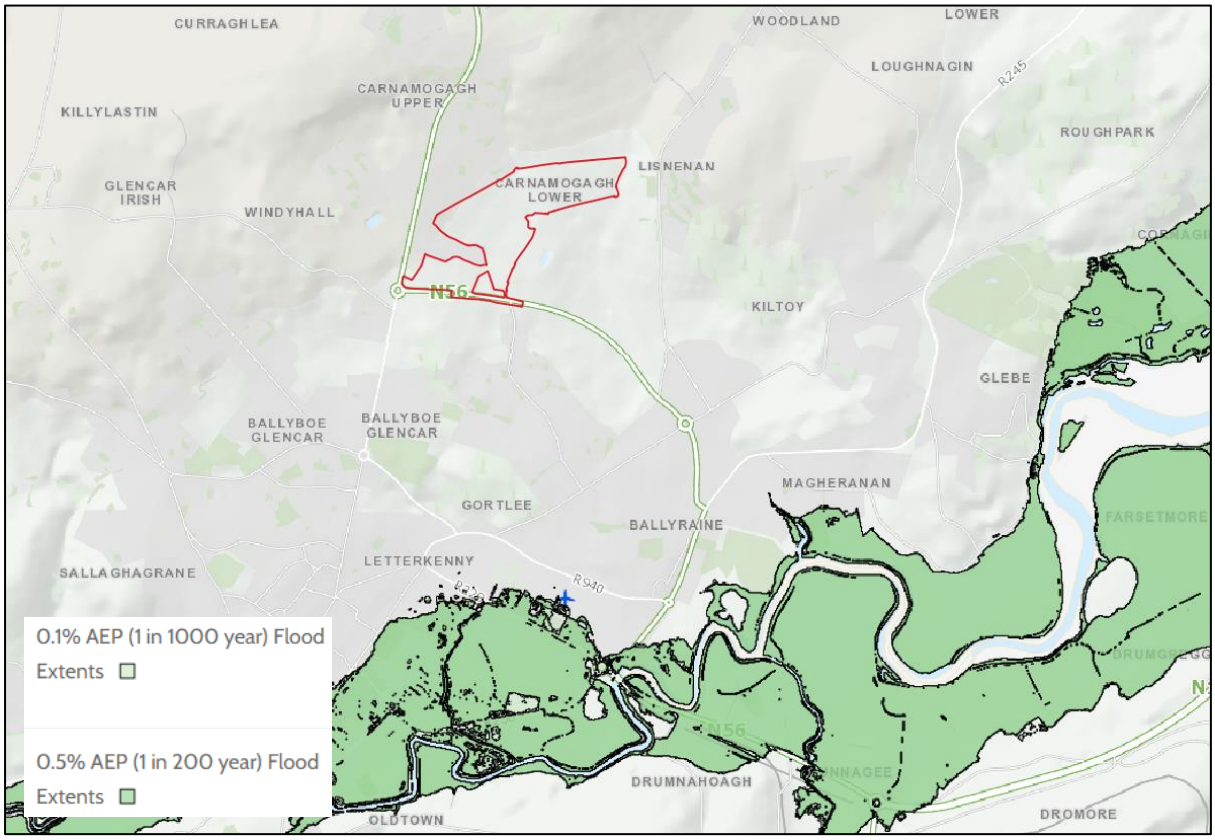


Figure 3-4 NCFHM MRFS Extents

3.5 Catchment Flood Risk Assessment and Management Study

In 2015, the OPW produced flood maps as part of the Catchment Flood Risk Assessment and Management (CFRAM) Study. The flood extents in these maps are based on detailed modelling of Areas for Further Assessment identified by the National Preliminary Flood Risk Assessment.

CFRAM mapping of existing fluvial flood extents, presented in Figure 3-5, indicates portions of the subject site may be at risk of flooding during a 0.1% AEP fluvial flood event. Accordingly, portions of the subject site are located within Flood Zones B, while the majority is within Flood Zone C.

It should also be noted that the flood plain mapping produced as part of the CFRAM study is based on LiDAR data which has a vertical accuracy of +/- 0.2m (RMSE).

During the current 1 in 1,000-year event (without climate change) the CFRAM study estimates that water levels at the upstream boundary of the subject site will be 88.72mOD.

Figure 3-5 North Western CFRAM Current Fluvial Flood Extents

The North Western CFRAM study also included an assessment of the likely impact of climate change on flood risk in the area. The flood extents for a Mid-Range Future Scenario are shown in Figure 3-6.

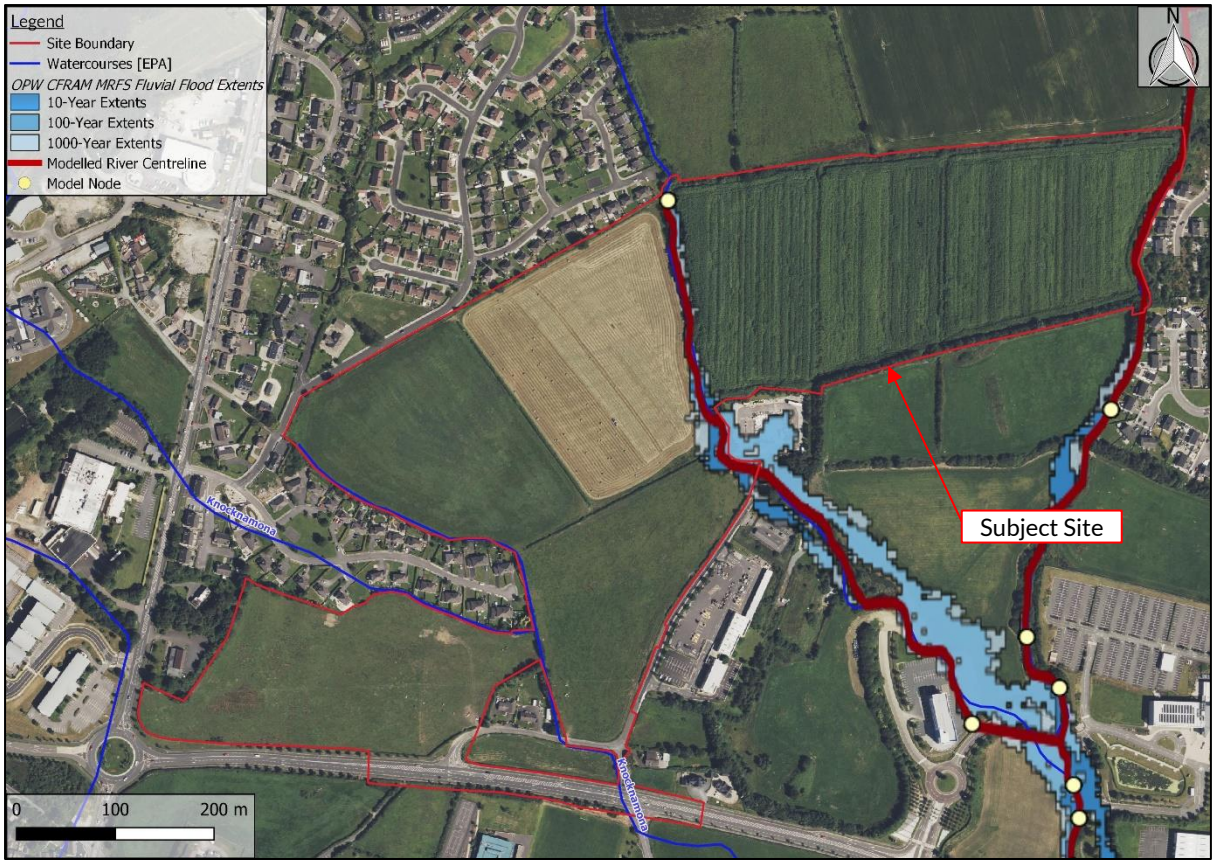


Figure 3-6 North Western CFRAM MRFS Fluvial Flood Extents

3.6 Geological Survey Ireland Mapping

The Geological Survey Ireland (GSI) provides mapping[4] with data related to Ireland's subsurface. Based on the map shown in Figure 3-7, there are no karst features (caves, springs, turloughs, etc.) in the surrounding area.

There is no groundwater flooding identified by GSI mapping in the vicinity of the subject site[5]. This suggests the subject site is not at risk of groundwater flooding.

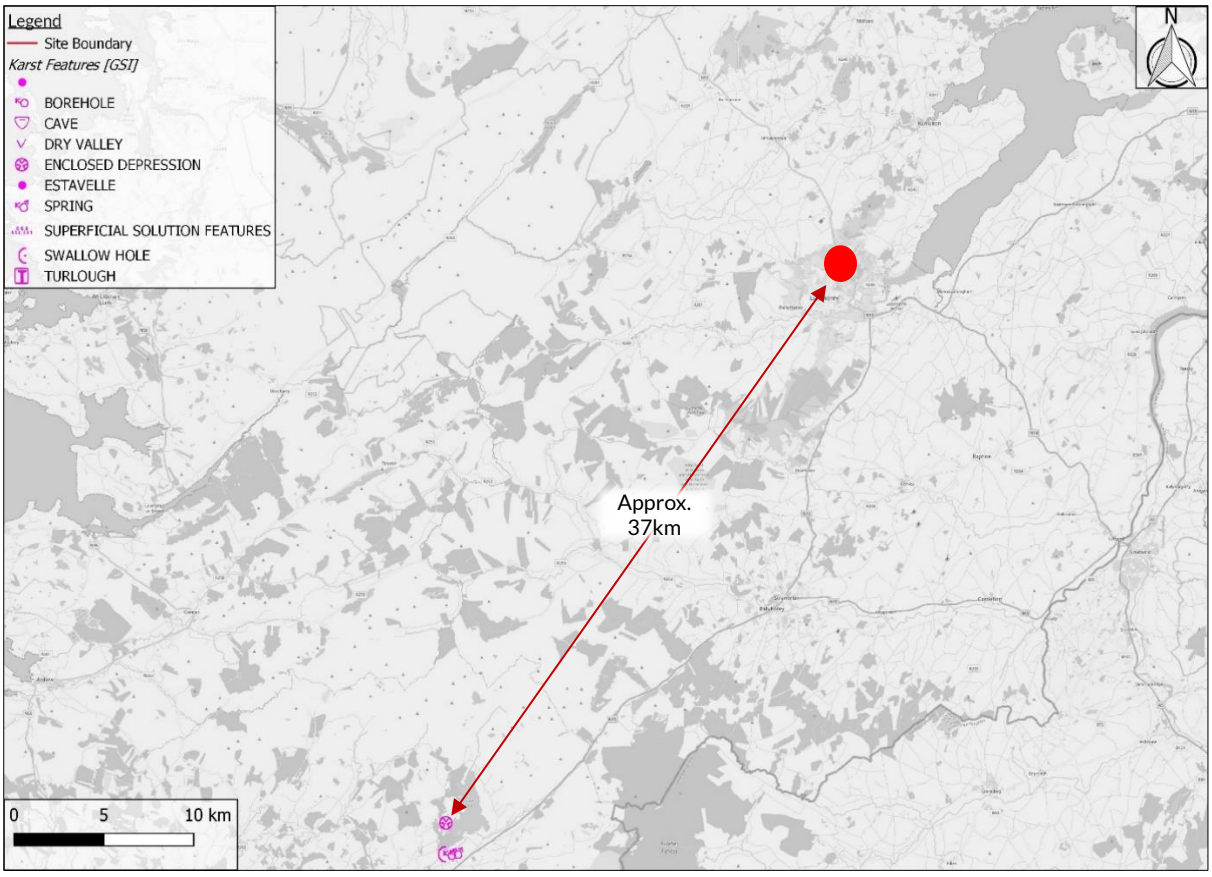


Figure 3-7 GSI Mapping of Karst Features

[4] https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx

[5] https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=848f83c85799436b808652f9c735b1cc

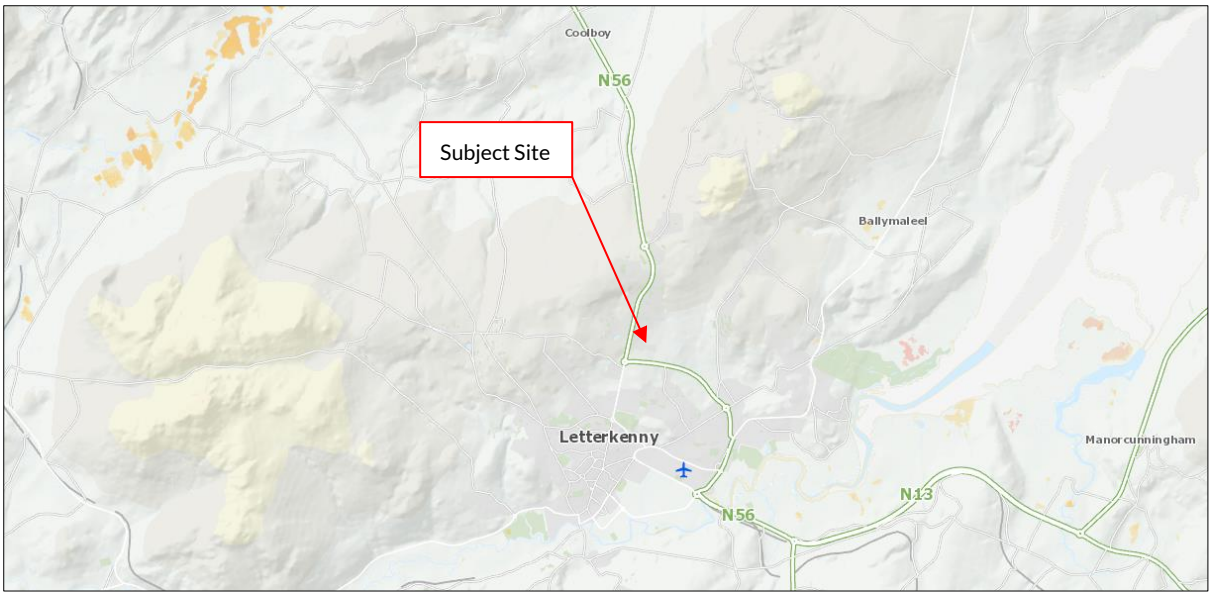


Figure 3-8 GSI Mapping of Groundwater and Surface Water Flooding

4.0 HYDRAULIC ASSESSMENT

With only two (WC 1 and WC 2) of the four watercourses at the subject site being modelled by the CFRAM study, a hydraulic assessment of the Knocknamona and unnamed stream were undertaken to quantify the potential flood risk posed to the subject site.

4.1 Flow Estimation

The Knocknamona Stream flows through the subject site and has an unnamed tributary that joins the stream within the boundary of the subject site (see Figure 1-1).

4.1.1 Flood Studies Update (FSU) Methodology

The Knocknamona catchment was not delineated by the FSU as a single catchment, but as a minor tributary to a larger catchment (FSU Ungauged Catchment No. 37_2192_1). This catchment has an estimated area of 2.4km^2 based on the OPW's FSU dataset and the topography of the area; see Figure 4-1. The portion of the 37_2192_1 catchment containing WC 1 and WC 2 only is delineated as (39_306_1). This was compared with the overall catchment to estimate the Q_{MED} of the Knocknamona Stream. The Knocknamona catchment contributes to approximately 31% of the overall 37_2192_1 catchment area. The Q_{MED} for the two catchments was subtracted from another to give design flows for the Knocknamona stream.

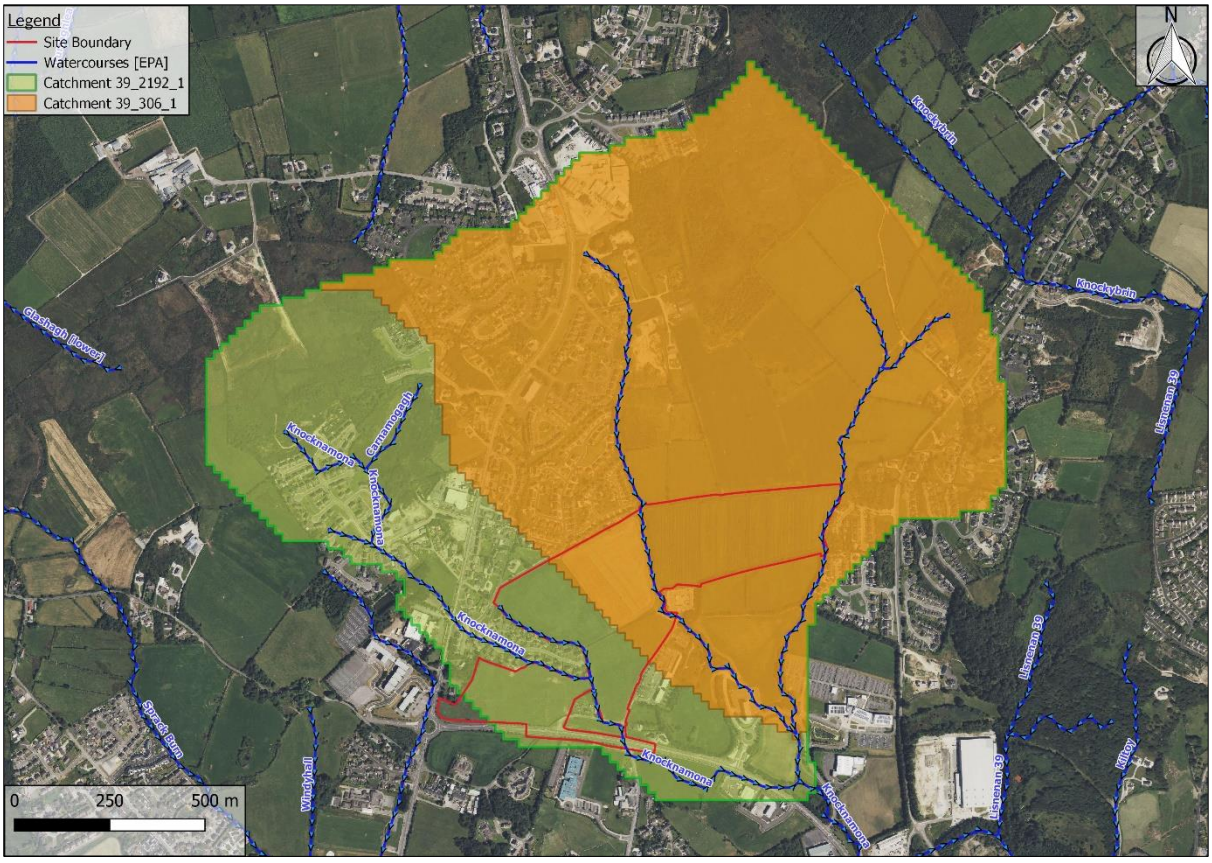


Figure 4-1 Knocknamona Stream Catchment Delineation

Given the size of the catchment, The Centre for Ecology and Hydrology Flood Estimation Handbook (FEH) methodology was considered appropriate to estimate flows at the subject site.

The Institute of Hydrology Report No. 124 (IH124) method was also applicable to estimating the flow in the Knocknamona stream.

The 100- and 1,000-year flows in the watercourses were therefore estimated based on catchment descriptors, see Table 4-1. The two different methodologies were considered:

- The Centre for Ecology and Hydrology Flood Estimation Handbook (FEH) method
- The Institute of Hydrology Report No. 124 (IH124) method

Table 4-1 Summary of Catchment Descriptors

Descriptor	Units	Value	Source
Watercourse	-	**Full Knocknamona Stream**	EPA
Catchment Area	km^2	0.8	FSU/TOBIN
Method Applicability			
FEH	-	YES	FEH
IH124	-	YES	IHI24
Catchment Descriptors			
BFI_{SOIL}	-	0.339	FSU
SAAR	mm	1,225.600	FSU/MET
FARL	-	1.000	FSU/TOBIN
DRAIND	km/km^2	2.402	FSU
S1085	m/km	52.134	FSU/DEM
ARTDRAIN2	-	0.000	FSU
URBEXT	-	0.195	FSU
S1		0	WRAP
S2		0	WRAP
S3		0	WRAP
S4		0.6	WRAP
S5		0.4	WRAP
i_{10}	mm/hr	19.60	MET
i_{100}	mm/hr	34.10	MET
i_{1000}	mm/hr	54.35	MET
CWI	-	124.5	graph
URBAN	fraction	0.20	user
UCWI (winter)	-	151.3	graph

Generated GEV growth factors as defined by the FSU were applied to the estimation of Q_{bar} to predict the 100- and 1,000-year flows, respectively.

The largest flows from each methodology were compared, see Table 4-2.

Table 4-2 Estimated Flows

Description	Units	Full Catchment		Knocknamona Stream	
Method adopted	-	**FEH**	**IH124**	**FEH**	**IH124**
Q_{MED}	m^3/s	2.67	1.22	0.83	0.59
10-year Flow	m^3/s	3.81	2.19	1.03	0.81
100-year Flow	m^3/s	5.22	3.01	1.42	1.03
1000-year Flow	m^3/s	6.61	3.81	1.79	1.18
100-year Flow (MRFS)	m^3/s	6.27	3.61	1.70	0.98
1000-year Flow (MRFS)	m^3/s	7.93	4.57	2.15	1.23

4.1.2 CFRAM Methodology

To further understand the flow in the watercourse, the North Western - Neagh Bann CFRAM Study UoM 01 Hydrology Report[6] was reviewed. This report details the hydrology behind the CFRAM model that covers the subject site.

The report analyses the full catchment for the River Swilly in Letterkenny and provides a detailed breakdown of the respective sub-catchments. The catchments in the vicinity of the subject site are outlined in the report. The calculated flows are based on specific catchment descriptors.

There are several modelled nodes in the vicinity of the subject site that have flow data. CFRAM map no. N01LKY_EXFCD_F0_09, outlines the node locations in relation to the subject site. The portion of the Knocknamona Stream that flows through the subject site is not shown on the CFRAM mapping. Based on the location of the modelled nodes, individual flows for the two modelled watercourses could be obtained.

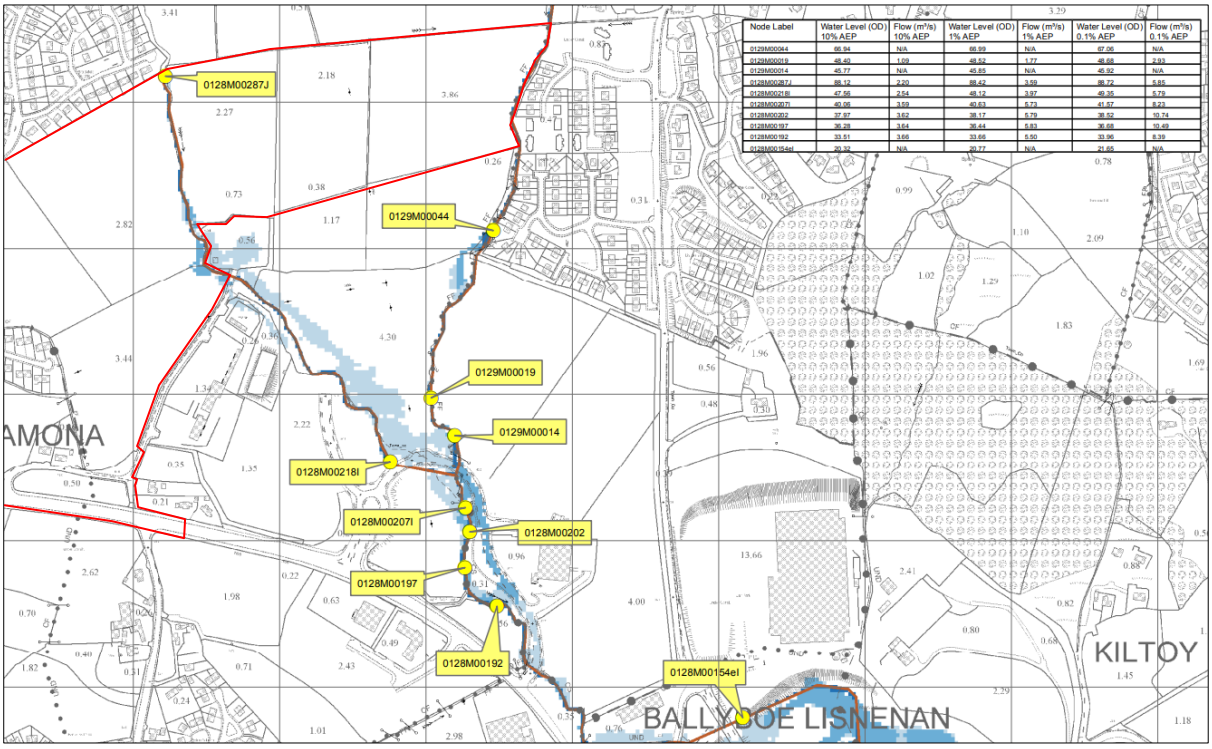


Figure 4-2 Extract from CFRAM map no. N01LKY_EXFCD_F0_09

The model node 0128M00202 is located downstream of the confluence of WC1 and WC2. The total flow in this node was greater than the combined discharges from WC1 (Node: 0129M00019) and WC2 (Node: 128M00218I). This difference in flow was assumed to be the flow for the Knocknamona stream. The exact inflow point of the Knocknamona Stream to this watercourse is unknown, therefore the largest flow downstream of the WC1 and WC2 confluence was used (Node: 0128M00202).

The details of the calculation are shown in Table 4-2 below.

[6]North Western - Neagh Bann CFRAM Study UoM 01 Hydrology Report Microsoft Word - IBE0700Rp0006_UoM01 Hydrology Report_F03.docx

Table 4-3 Estimated CFRAM Flows

Description	Units	Return Period of 1 in 1,000-year
Node: 0129M00019	m^3/s	2.93
Node: 128M00218I	m^3/s	5.79
Combined Total (Node: 0128M00202)	m^3/s	10.74
Estimated Flow in Knocknamona Stream	m^3/s	2.02

The estimated CFRAM flow for the Knocknamona Stream is slightly lower than the FEH flow.

4.2 Channel Capacity Calculation

There are 4 no. watercourses within the subject site. Watercourse (WC 1) is located along the eastern boundary of the subject site and flows in a southerly direction towards the N56 and through the IDA Business & Technology Park. Its headwaters rise approximately 0.5km north of the subject site.

The second watercourse (WC 2) is an unnamed watercourse that flows through the centre of the subject site. It flows in a southerly direction towards the N65. Its headwaters rise approximately 0.7km north of the subject site. WC 2 joins WC 1 approximately 0.4km south of the subject site. Both watercourses are modelled by the North Western CFRAM study (see Section 3.3), and therefore do not need further channel capacity calculations.

4.2.1 Watercourse 3 (WC3) and Watercourse 4 (WC4)

The third watercourse (WC 3) is an unnamed watercourse that flows adjacent to the western boundary of the subject site. Its headwaters rise within the subject site. It is a tributary of the Knocknamona Stream (WC 4). It has a short reach of approximately 0.35km before entering the Knocknamona Stream. Both watercourses had wide beds with steep side slopes. The banks are well defined. There was very little vegetation within the watercourse. They are both steep and fast flowing. This suggests there may have been channel maintenance in the past.

The Knocknamona Stream headwaters rise approximately 1km north-west of the subject site. The stream is culverted under an existing residential development initially before returning to an open channel for approximately 0.2km before it re-enters another culvert. The culvert runs for approximately 0.25km before returning to an open channel within the subject site.

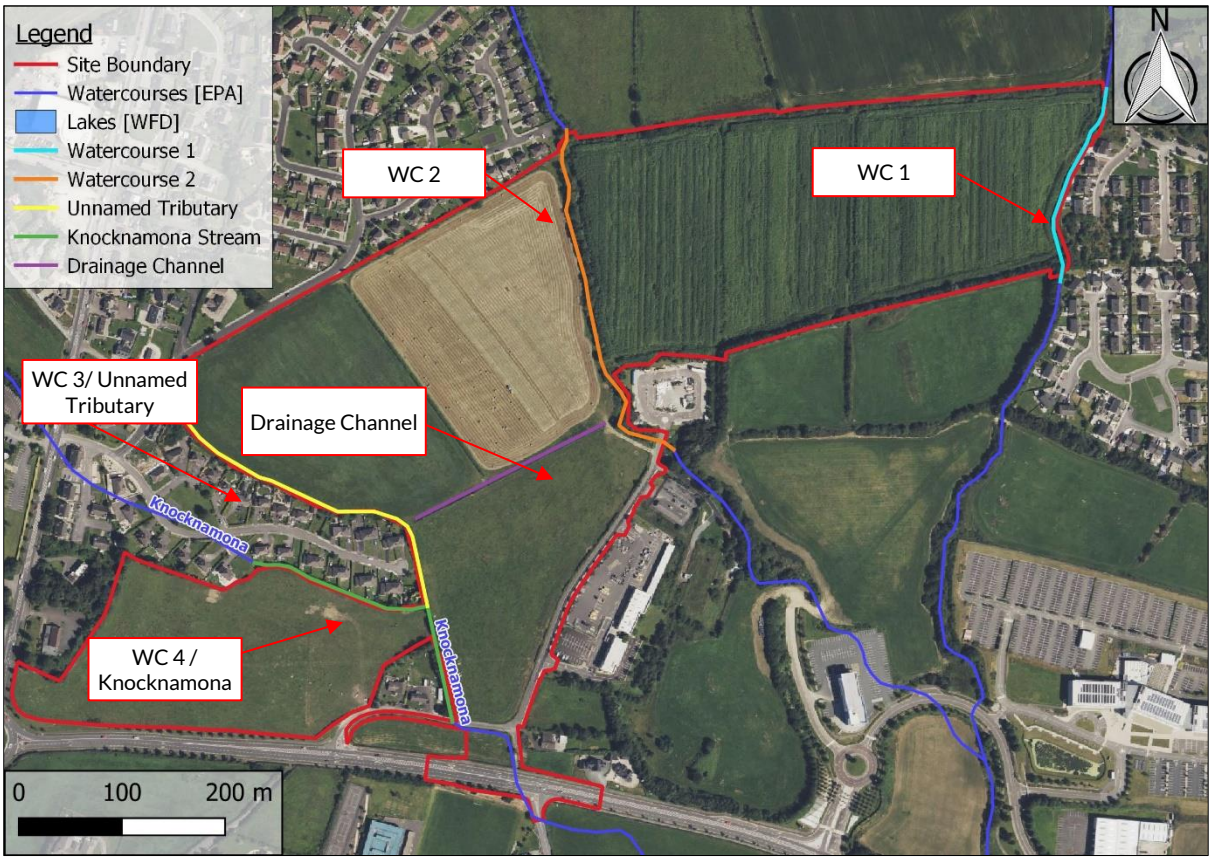


Figure 4-3 Watercourses within the subject site

A topographical survey was carried out by TOBIN on the 26th September 2022. This survey established the geometry and slope of the Knocknamona stream and its' unnamed tributary. This information was then used to complete a channel capacity calculation.

Typical cross sections along the stream reaches were created to calculate the capacity of the stream in various locations. To be conservative, the smallest surveyed cross section was used in the capacity calculation. The surveyed invert, bank level and water level at this cross section was 85.36mOD, 86.34mOD and 85.78mOD respectively. The localised slope of the channel was calculated to be 1 in 15. A conservative value for Mannings Coefficient of 0.04 was also used. The max discharge of the channel was calculated to be 2.16m^3/s. This is greater than both the estimated CFRAM 1 in 1,000-year flow (2.02 m^3/s) and the FEH 0.1% AEP MRFS flow of 2.15 m^3/s. This indicates that the channel has capacity to convey the flow of a 1 in 1,000-year flood event without bursting its banks. Both watercourses had wide beds with steep side slopes. The banks are well defined. There was very little vegetation within the watercourse. They are both steep and fast flowing. This suggests there may have been channel maintenance in the past.

The same process was applied to the unnamed tributary. The surveyed invert, bank level and water level at this cross section was 96.82mOD, 97.45mOD and 97.25mOD respectively. The localised slope of the channel was calculated to be 1 in 11. A conservative value for Manning's Coefficient of 0.04 was also used. The max discharge of the channel was calculated to be 2.12m^3/s. To be conservative this discharge rate was compared to the CFRAM 1 in 1,000-year flow. The discharge rate is greater than the estimated CFRAM 1 in 1,000-year flow. This indicates that the channel has capacity to convey the flow of a 1 in 1,000-year flood event without it bursting its banks.

4.3 Compensation Storage at Watercourse 2 (WC2)

CFRAM mapping from Section 3.3 indicates that a culvert at the downstream end of WC2, is over capacity in the 0.1% AEP flood event, leading to inundation at the south-eastern section of the proposed development. The proposed development proposes ground raising in this area at the proposed pitch; therefore, mitigation measures must be put in place.

The 0.1% AEP MRFS flood line was overlaid over the site layout and the additional volume occupied by the proposed development within the flood zone has been calculated. The design, particularly in terms of levels, is driven by the need to fit the extensive scale of the main pitch into the available space to the west of the stream. The proposed location of the pitch results in a total volume loss of 18m^3. Ground levels for a section of elevated ground between the flood zone and the pitch embankment have been reduced to levels below the floodwaters, creating approximately 50m^3 of compensation storage, see Figure 4-4.

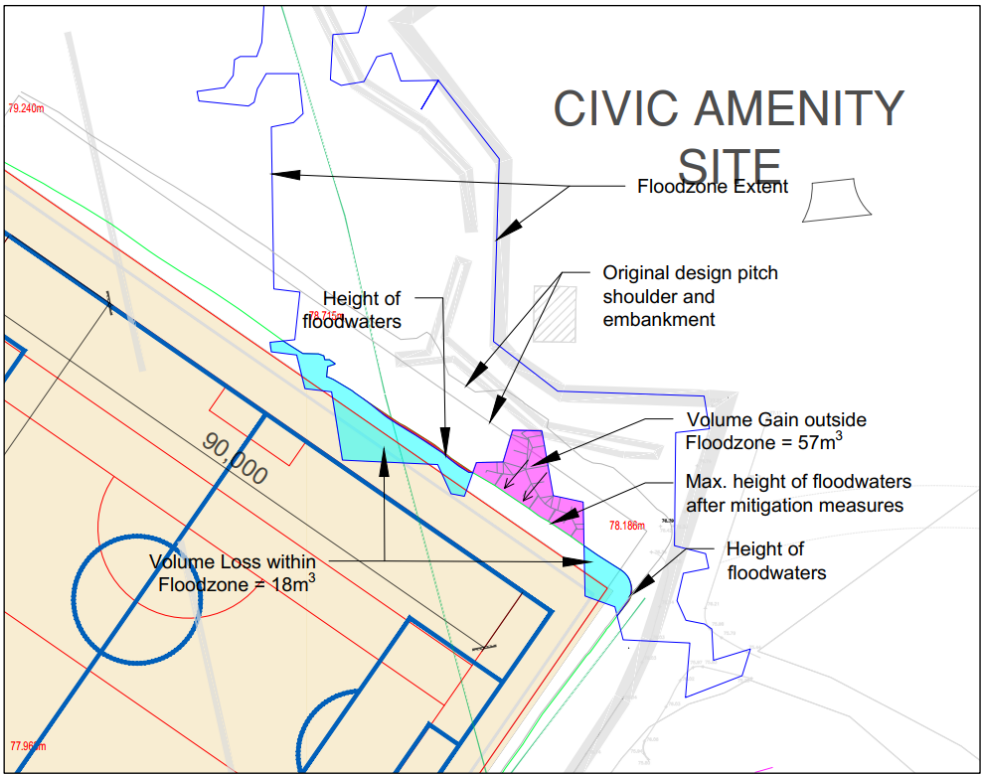


Figure 4-4 Compensation storage along WC2

4.4 Watercourse Crossings

2 No. crossings are proposed to cross WC 3 (Figure 4-5), with another crossing being proposed at the Knocknamona Stream (WC 4) to facilitate the proposed N56 / Crescent Junction (Figure 4-6).All proposed culverts must be appropriately designed through the Section 50 application process ensuring appropriate sizing and that there will be no impact to flood risk elsewhere.

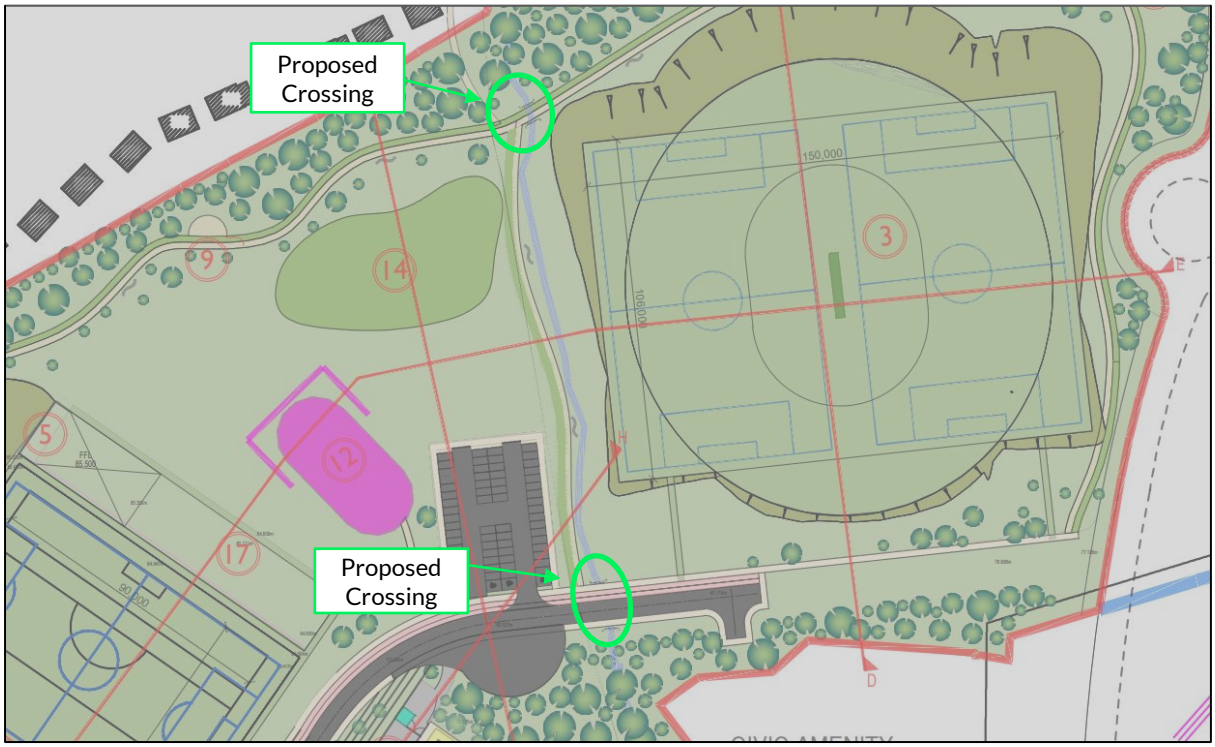


Figure 4-5 2 No. crossings along WC 2

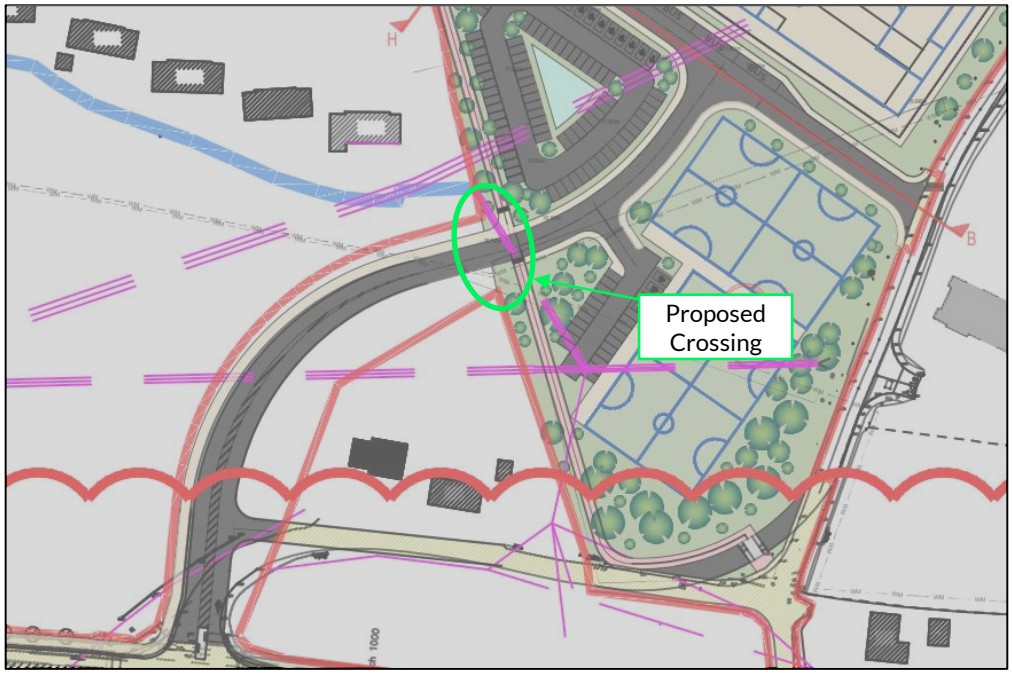


Figure 4-6 Crossing at the Proposed Signalised N56 / Knocknamona Crescent Junction

5.0 DETAILED FLOOD RISK ASESSMENT

The PSFRM Guidelines classify playing pitches as "water-compatible" in terms of sensitivity to flooding. As such, the proposed development can be constructed in any flood zone. The majority of the subject site is located in Flood Zone C with a small portion of the subject site located in Flood Zone B.

5.1 Fluvial Flooding

CFRAM mapping of existing fluvial flood extents, presented in Figure 3-5, indicates portions of the subject site may be at risk of flooding during a 0.1% AEP fluvial flood event. Accordingly, portions of the subject site are located within Flood Zones B, while the majority is within Flood Zone C.

CFRAM mapping suggests that the exit culvert of WC2 is under capacity during the 0.1% AEP event, leading to flood waters propagating upstream. To mitigate this risk, ground levels for a section of elevated ground between the flood zone and the pitch embankment have been reduced to levels below the floodwaters, creating a 39m^3 net gain of compensatory storage.

To assess the risk of fluvial flooding from the watercourses located on the subject site that have not been modelled as part of the CFRAM study, a channel capacity calculation was undertaken. Based on the geometry of the channel and estimated flow rates, the Knocknamona stream and the unnamed tributary have sufficient capacity to convey the 1 in 1,000-year flood event without bursting their banks.

There are no statutory records of any past flood events within the subject site. In addition to this, anecdotal evidence collected by TOBIN during the site survey does not suggest a history of flooding in the vicinity of the subject site.

Therefore, it is estimated that risk of fluvial flooding associated with the proposed development is minimal.

5.2 Pluvial Flooding

Based on the indicative pluvial flood mapping presented in the OPW Preliminary Flood Risk Assessment, it is estimated that the subject site is not at risk from pluvial flooding during an extreme 0.1% AEP pluvial flood event (see Figure 3-2).

Surface water arising at the site will be managed by a dedicated stormwater drainage system designed in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates.

The landscaping and topography of the developed site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the stormwater drainage system becomes blocked.

Therefore, it is estimated that risk of pluvial flooding associated with the proposed development is minimal.

5.3 Groundwater Flooding

Based on a review of the PFRA study (Figure 3-2), and Geological Survey Ireland (GSI) subsurface mapping of karst features and groundwater flooding extents in the area (Figure 3-7 and Figure 3-8), there is no evidence to suggest groundwater flooding at the proposed development site.

Therefore, it is estimated that the proposed development is not at risk of groundwater flooding.

5.4 Coastal Flooding

The subject site is located approximately 3km inland from the sea. The River Swilly, which is located approximately 2km south-east of the subject site is susceptible to tidal influenced flood events. However, these events do not impact on the subject site. Coastal CFRAM mapping of Letterkenny states that tidally influenced flooding does not extent upstream of map tile N01LKY_EXCCD_F0_12, which is located 1.6km southeast of the subject site.

The ICWWS 2018 Phase 1 outputs were reviewed as part of this FRA also. The highest estimated water level from the study is 6.03mOD. This is significantly lower than the ground levels of the subject site. They range from approximately 71.25mOD at the southern site entrance bordering the N56, up to approximately 102.67mOD near the north-western site corner.

The NCFHM in the vicinity of the subject site was reviewed. The closest coastal flood extents to the subject site were located 1.5km away.

It is therefore estimated that the risk of coastal flooding associated with the development is minimal.

6.0 CONCLUSIONS

TOBIN Consulting Engineers were appointed by ATU Donegal to undertake a Flood Risk Assessment (FRA) for their proposed regional sports hub development in Letterkenny, Co. Donegal.

The Planning System and Flood Risk Management (PSFRM) Guidelines (OPW/DoEHLG, 2009) classify playing pitches as "water-compatible" in terms of sensitivity to flooding. As such, the proposed development is appropriate in any flood zone. The majority of the subject site is located in Flood Zone C with a small portion of the subject site located in Flood Zone B.

Pluvial Flooding:

Based on the indicative pluvial flood mapping presented in the OPW Preliminary Flood Risk Assessment, it is estimated that the subject site is not at risk from pluvial flooding during an extreme 0.1% AEP pluvial flood event (see Figure 3-2).

Surface water arising at the site will be managed by a dedicated stormwater drainage system designed in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates.

The landscaping and topography of the developed site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the stormwater drainage system becomes blocked.

Groundwater Flooding:

There is no evidence to suggest groundwater as a potential source of flood risk to the proposed development site.

Coastal/Tidal Flooding:

Based on previous flood studies in the area by the OPW (CFRAM, PFRA, ICWWS), and the location of the subject site, the proposed development is not at risk of coastal flooding.

Fluvial Flooding:

CFRAM mapping of existing fluvial flood extents, presented in Figure 3-5, indicates portions of the subject site may be at risk of flooding during a 0.1% AEP fluvial flood event. Accordingly, vulnerable portions of the subject site are located within Flood Zones B, while the majority is within Flood Zone C.

CFRAM mapping suggests that the exit culvert of WC2 is under capacity during the 0.1% AEP event, leading to flood waters propagating upstream. To mitigate this risk, ground levels for a section of elevated ground between the flood zone and the pitch embankment have been reduced to levels below the floodwaters, creating a 39m^3 net gain of flood storage.

To assess the risk of fluvial flooding from the watercourses located on the subject site that weren't modelled as part of the CFRAM study a channel capacity calculation was undertaken. Based on the geometry of the channel and estimated flow rates, the

Knocknamona stream (WC 4) and WC 3 have sufficient capacity to convey the 1 in 1,000-year flood event without bursting their banks. Both watercourses had wide beds with steep side slopes. The banks are well defined. There was very little vegetation within the watercourse. They are both steep and fast flowing. This suggests there may have been channel maintenance in the past.

3 No. proposed crossing will be appropriately designed through the Section 50 application process ensuring appropriate sizing and that there will be no impact to flood risk elsewhere.

There are no statutory records of any past flood events within the subject site. In addition to this, from the anecdotal evidence collect by TOBIN during the site survey, there is no anecdotal evidence of any flooding in the vicinity of the subject site.

Therefore, it is estimated that risk of fluvial flooding associated with the proposed development is minimal.

Flood Risk Elsewhere

Existing culverts and channels will not be modified, to maintain the capacity of the watercourses within the subject site and minimise the risk of flooding downstream of the subject site. 3 No. proposed watercourse crossing will be appropriately designed through the Section 50 application process ensuring appropriate sizing and that there will be no impact to flood risk elsewhere. Proposed ground levels for a section of elevated ground between the flood zone and the pitch embankment have been reduced to levels below the floodwaters, creating a 39m^3 net gain of flood storage.

Based on the results of this Flood Risk Assessment, it is estimated that the risk of flooding to the proposed development will be minimal, and that the development will not increase the risk of flooding elsewhere.

www.tobin.ie

TOBIN Consulting Engineers

@tobinengineers

Galway
Fairgreen House,
Fairgreen Road,
Galway,
H91 AXK8,
Ireland.
Tel: +353 (0)91 565 211

Dublin
Block 10-4,
Blanchardstown Corporate Park,
Dublin 15,
D15 X98N,
Ireland.
Tel: +353 (0)1 803 0406

Castlebar
Market Square,
Castlebar,
Mayo,
F23 Y427,
Ireland.
Tel: +353 (0)94 902 1401

TOBIN
CONSULTING ENGINEERS
BUILT ON KNOWLEDGE

Atlantic Technological University Donegal

LETTERKENNY REGIONAL SPORTS ACTIVITY HUB

Drainage Assessment

LETTERKENNY REGIONAL SPORTS ACTIVITY HUB

DRAINAGE ASSESSMENT

Document Control Sheet	
Document Reference	11438
Report Status	Planning
Report Date	April 2023
Current Revision	P02
Client:	ATU Donegal
Client Address:	Port Road, Letterkenny, Co. Donegal
Project Number	11438

Galway Office Fairgreen House, Fairgreen Road, Galway, H91 AXK8, Ireland. Tel: +353 (0)91 565 211	Dublin Office Block 10-4, Blanchardstown Corporate Park, Dublin 15, D15 X98N, Ireland. Tel: +353 (0)1 803 0406	Castlebar Office Market Square, Castlebar, Mayo, F23 Y427, Ireland. Tel: +353 (0)94 902 1401

Revision	Description	Author:	Date	Reviewed By:	Date	Authorised by:	Date
P01	First Issue	RB	19/04/2023	MN	19/04/2023	BH	20/04/2023
P02	First Issue	RB	19/05/2023	MN	17/05/2023	BH	17/05/2023

TOBIN Consulting Engineers

Table of Contents

1.0 INTRODUCTION 1
1.1 REPORT BRIEF 1
1.2 SCOPE OF WORKS 1
2.0 SITE DESCRIPTION AND PROPOSAL 2
2.1 SITE DESCRIPTION 2
2.2 SITE DEVELOPMENT PLANS 4
2.3 HYDROLOGY 4
3.0 SITE RUNOFF 5
3.1 CURRENT RUNOFF 5
3.2 POST-DEVELOPMENT RUNOFF 6
3.2.1 SITE DRAINAGE PROPOSALS 6
3.2.2 ATTENUATION CALCULATIONS 9
3.2.3 DISCHARGE OPTIONS 10
4.0 CONCLUSION 10

APPENDIX A - Site Development Plan

APPENDIX B – Greenfields Runoff Calculations

APPENDIX C – Innovyze MicroDrainage Calculation Sheets

APPENDIX D – Attenuation Tank Design Calculation Sheets

Table of Figures

FIGURE 1. PROPOSED SITE LOCATION.....PAGE 2

FIGURE 2. WATERCOURSES WITHIN THE SUBJECT SITE .....PAGE 3

FIGURE 3. CFRAM MRFS FLUVIAL FLOOD EXTENTS .....PAGE 4

FIGURE 4. TYPICAL SYNTHETIC PITCH BUILD-UP .....PAGE 6

FIGURE 5. TYPICAL NATURAL TURF BUILD-UP .....PAGE 6

FIGURE 6. PITCH HYDRAULIC MODEL .....PAGE 7

1.0 INTRODUCTION

1.1 REPORT BRIEF

TOBIN Consulting Engineers has been instructed by ATU Donegal to undertake a Drainage Assessment of the proposed works to take place on the LRSAH site at Carnamoggagh Lower /Knocknamona in Letterkenny.

The proposed development will consist of the provision of a regional sports complex consisting of the following components:

a) Outdoor sports pitches as follows:
    i. 1 no. artificial grass GAA pitch (Pitch 1). Line markings permit rugby and 2 x cross-play soccer pitches;
    ii. 1 Grass / Sand GAA competition pitch (Pitch 2). Line markings permit rugby and 2 cross-play soccer pitches;
    iii. 2 natural grass soccer pitches with Cricket Creases (Pitch 3, 4, 5);
    iv. 4 synthetic 5-a-side soccer pitches (Pitches 6,7 8, 9);
b) 1,000m^2 Indoor Sports Dome [Height = 10.8m] suitable for warm up, a range of sports and activities;
c) Additional outdoor sports and recreation areas to include Training/Practice Area (25x80m), 4m high Hurling/Handball Wall, 6 Lane Athletic Sprint Track (50x7.5m) with PV panels to roof, walking / running trails / children's playpark and community garden;
d) 1,340m2 pavilion building [Height = 11.2m] to accommodate changing facilities, office / reception, self-serve catering facility, storage and flexible space for community programmes;
e) Equipment Store and service compound;
f) Hard and soft landscaping to include biodiversity garden;
g) Vehicular and pedestrian access to include new junction from N56, internal access roads / footpath / cycleway and provision of 196 onsite vehicle parking spaces, 4 coach parking spaces and 100 cycle parking spaces. Additional pedestrian access point from Ashfield;
h) Closure of existing vehicular access from N56 to Knocknamona Crescent;
i) Ancillary infrastructure to include drainage, ESB substation, fencing and entrance gates, signage, retaining walls, floodlighting, netting and culverting watercourse at two locations to accommodate vehicle / pedestrian / cycle crossing.

This report outlines the design approach taken in dealing with surface water drainage and is to be read in conjunction with the Flood Risk Assessment also produced by TOBIN Consulting Engineers.

1.2 SCOPE OF WORKS

The following scope of works has been undertaken as part of this assessment:

- Review of site development proposal;
- Site walkover / inspection by a Civil Engineer;

- Review of online CFRAM strategic flood maps published on the national flood information portal of the Office of Public Works, in order to identify any potential areas of flooding;
- Calculation of storm flows using Modified Rational Method under pre- and post-development scenarios, which will be used to aid drainage design of the site;
- Limitation of flows with mitigation measures and attenuation volumes if required;
- Assess the site in relation to the applicability of Sustainable Urban Drainage (SuDS), including attenuation, with recommendations for suitable mitigation measures;
- Preparation of Drainage Assessment (DA), based upon the proposed land use and in accordance with relevant planning policy and applicable regulations.

2.0 SITE DESCRIPTION AND PROPOSAL

2.1 SITE DESCRIPTION

The assessment site location is located on 42-acres of a total 66-acre greenfield site at Knocknamona/Carnamoggagh immediately north of the N56 National Road and 2 km to the north of Letterkenny town centre (refer to Figure 1).

The Irish Grid Reference for the centre of the site is 217790 (Easting), 413266 (Northing). The site is currently being used for agricultural purposes. The assessment site is located on the periphery of Letterkenny in a partly residential and partly agricultural setting.

The site falls moderately to gently from the north-west to the south-east in a planar fashion. The higher and steeper reaches of the site have approximately a 1:14 fall from north-west to the south-east with elevations ranging from ~105mOD to ~77mOD, while the elevations of the lower reaches of the site vary from ~80mOD to ~71mOD with approximate falls of 1:32 from north to south.

Figure 1. Proposed Site Location
(Orange highlighted area)

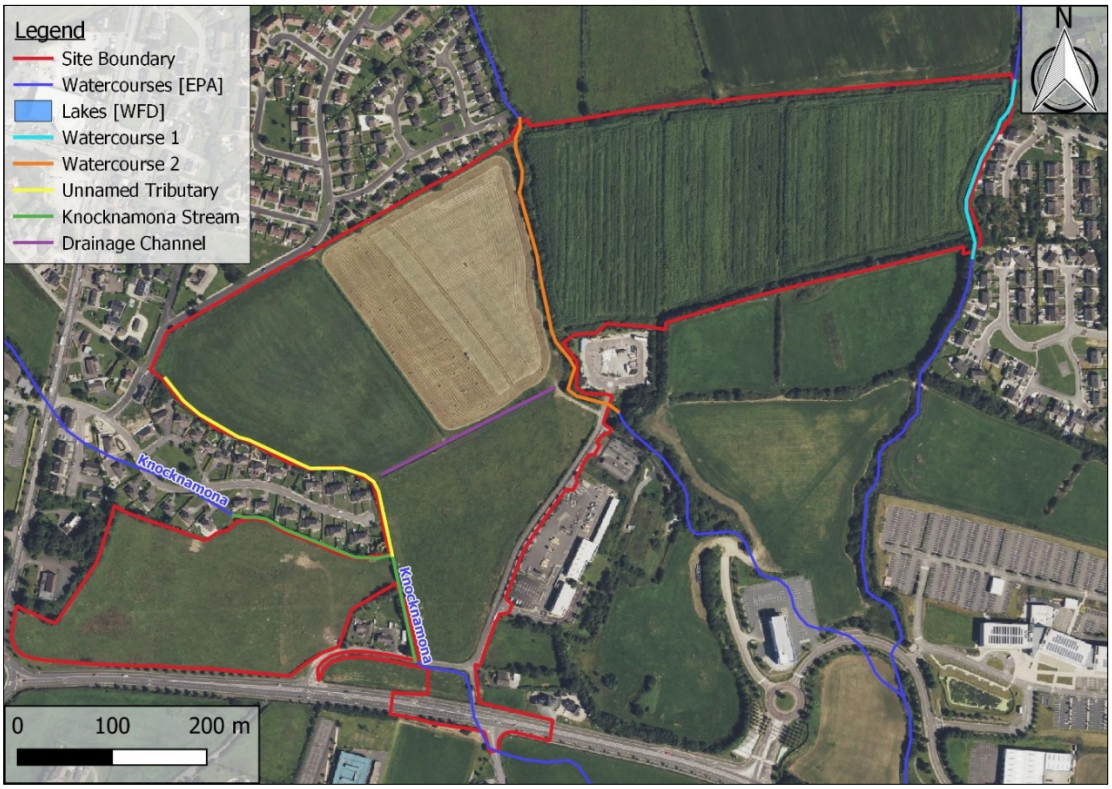


Figure 2. Watercourses within the subject site

Two distinct drainage lines occur within the development footprint. Referencing Figure 2, the Unnamed Tributary (yellow) skirts the west of the site and ties into Knocknamona Stream while Watercourse 2 (orange) traverses the site towards the east, both flowing north to south.

2.2 SITE DEVELOPMENT PLANS

The proposed development will consist of the construction of:

a) Outdoor sports pitches as follows:
    i. 1 no. artificial grass GAA pitch (Pitch 1). Line markings permit rugby and 2 x cross-play soccer pitches;
    ii. 1 Grass / Sand GAA competition pitch (Pitch 2). Line markings permit rugby and 2 cross-play soccer pitches;
    iii. 2 natural grass soccer pitches with Cricket Creases (Pitch 3, 4, 5);
    iv. 4 synthetic 5-a-side soccer pitches (Pitches 6,7 8, 9);
b) 1,000m^2 Indoor Sports Dome [Height = 10.8m] suitable for warm up, a range of sports and activities;
c) Additional outdoor sports and recreation areas to include Training/Practice Area (25x80m), 4m high Hurling/Handball Wall, 6 Lane Athletic Sprint Track (50x7.5m) with PV panels to roof, walking / running trails / children's playpark and community garden;
d) 1,340m2 pavilion building [Height = 11.2m] to accommodate changing facilities, office / reception, self-serve catering facility, storage and flexible space for community programmes;
e) Equipment Store and service compound;
f) Hard and soft landscaping to include biodiversity garden;
g) Vehicular and pedestrian access to include new junction from N56, internal access roads / footpath / cycleway and provision of 196 onsite vehicle parking spaces, 4 coach parking spaces and 100 cycle parking spaces. Additional pedestrian access point from Ashfield;
h) Closure of existing vehicular access from N56 to Knocknamona Crescent;
i) Ancillary infrastructure to include drainage, ESB substation, fencing and entrance gates, signage, retaining walls, floodlighting, netting and culverting watercourse at two locations to accommodate vehicle / pedestrian / cycle crossing.

A Site Development Plan is presented in Appendix A, demonstrating the location and layout of each of these elements in relation to the site boundary area.

2.3 HYDROLOGY

The nearest watercourses to the proposed site are listing in Figure 2 as Knocknamona Stream, Unnamed Tributary and Watercourse 2. Of these three, all of which are mapped on the CFRAM study, only Watercourse 2 features on the CFRAM strategic flood maps as having potential to exceed its channel capacity under 1 in 1,000-year flood events.

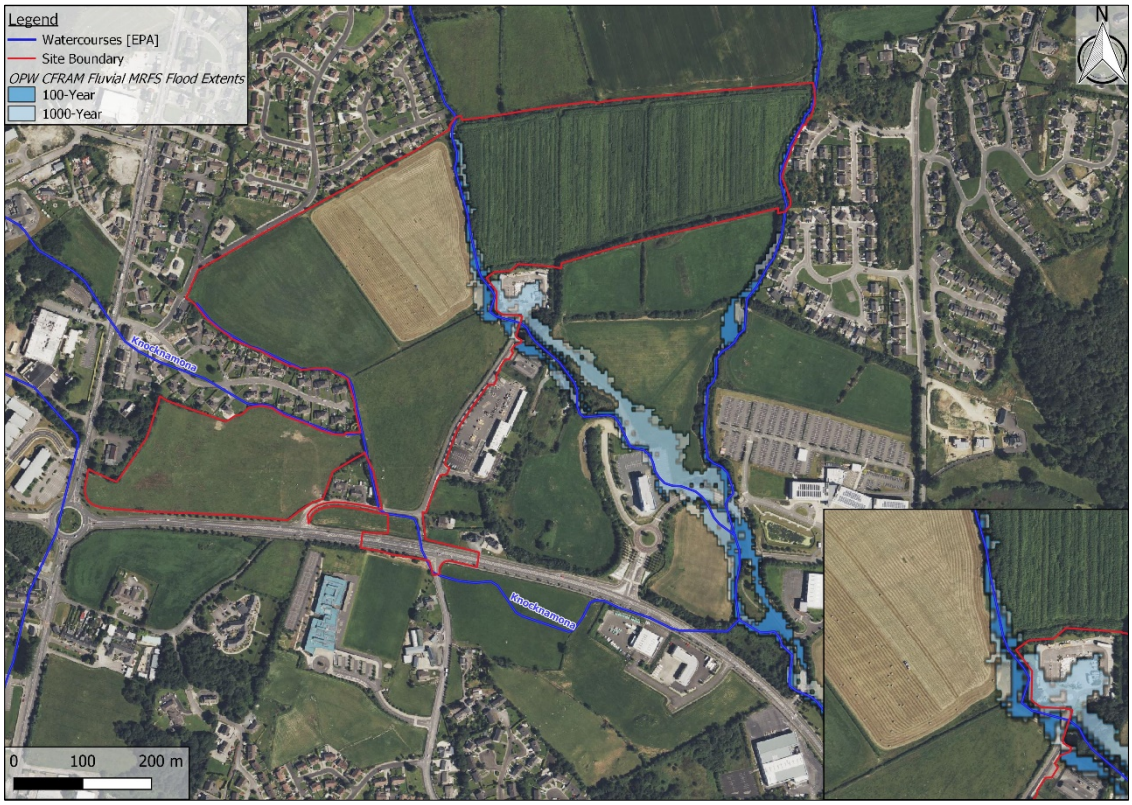


Figure 3. CFRAM MRFS Fluvial Flood Extents

According to this study, the site in the location of Watercourse 2 is affected by surface water fluvial flooding on the south-east side of the main pitch for 10% AEP Flood (1 in 10 or greater chance in any given year), 1% AEP Flood (1 in 100 or greater chance in any given year) and 0.1% AEP Flood (1 in 1000 or greater chance in any given year).

However, it is noteworthy that the extent of floodwaters is limited to the immediate vicinity of the channel and increases in width in inverse proportion to the gradient of the streambed.

In addition, this mapping is expressly for use in identifying '*general areas prone to flooding as opposed to the hazard to individual properties*'.

3.0 SITE RUNOFF

3.1 CURRENT RUNOFF

On-site percolation tests yielded extremely low permeability rates which is characteristic of the clay subsoil. It is surmised that greenfields runoff rates are achieved by virtue of the vegetation coverage on the site, in that interception storage is provided in the surface area of pasturage with run-off making its way to the lower lying ground to the south-east of the site where it enters the existing water courses.

In order to determine the existing site run-off, IoH124 has been used from the HR Wallingford/www.uksuds.com online Greenfields Runoff Tool to calculate the green field runoff (Appendix B), and the Modified Rational Method has been used to calculate run-off from the entire site.

Analysis of the current site runoff is presented in Table 1 below as extracted from the online Greenfields Runoff Tool.

Table 1. Greenfields Runoff Rate Printout

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	58.78	58.78
1 in 1 year (l/s):	49.96	49.96
1 in 30 years (l/s):	96.98	96.98
1 in 100 year (l/s):	114.61	114.61
1 in 200 years (l/s):	126.37	126.37

Based on the above information, the predicted existing site run-off during a Q100 rainfall event is 114.61 l/s for the catchment area of 17ha. (which equates to a run-off rate of 6.74 l/s/ha.) However, for the sake of the design, a more conservative hypothetical greenfields runoff threshold rate of 2 l/s/ha. has been chosen which will ensure that flood risk generated from the proposed development will be lower than that of the 'do nothing' option.

3.2 POST-DEVELOPMENT RUNOFF

3.2.1 SITE DRAINAGE PROPOSALS

The drainage design has been segregated into distinct networks to accommodate both phased development of the site and integration of the entire design. To this end, each pitch is to be drained and attenuated to ensure both playability of the pitch surface and controlled discharge of its runoff. The design approach is similar for both the artificial pitches and the natural turf pitches, with the build-up of the latter being sensitive to the need for permeability.

While the design of the synthetic pitch remains to be finalised, it is expected that the proposed synthetic pitch build-up will comprise of a 60mm synthetic carpet atop a permeable shock pad (12 – 20mm), followed by 40mm porous macadam (optional) over a 150mm clean crushed stone base. There is a possibility that the porous macadam layer may be omitted from the final design. However, it is included here to demonstrate how drainage is achieved in the event that it is deemed necessary or desirable in the final design. The subbase, making up varying depths between the base and the existing subgrade also comprises clean crushed stone separated from the in-situ material by means of a geotextile separation membrane.

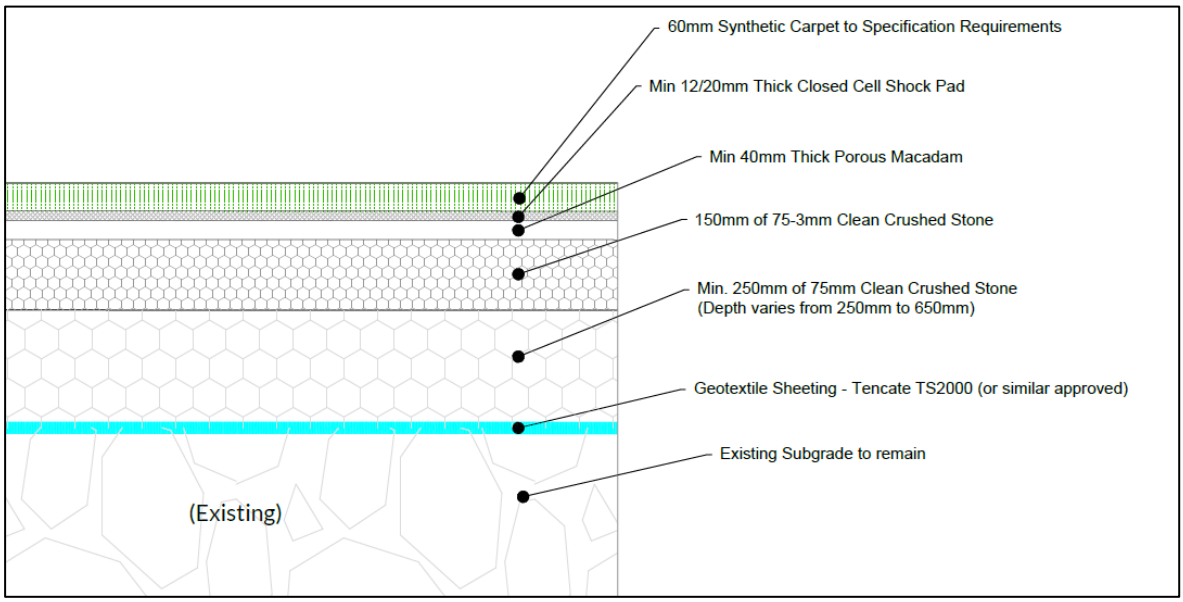


Figure 4. Typical Synthetic Pitch Build-up

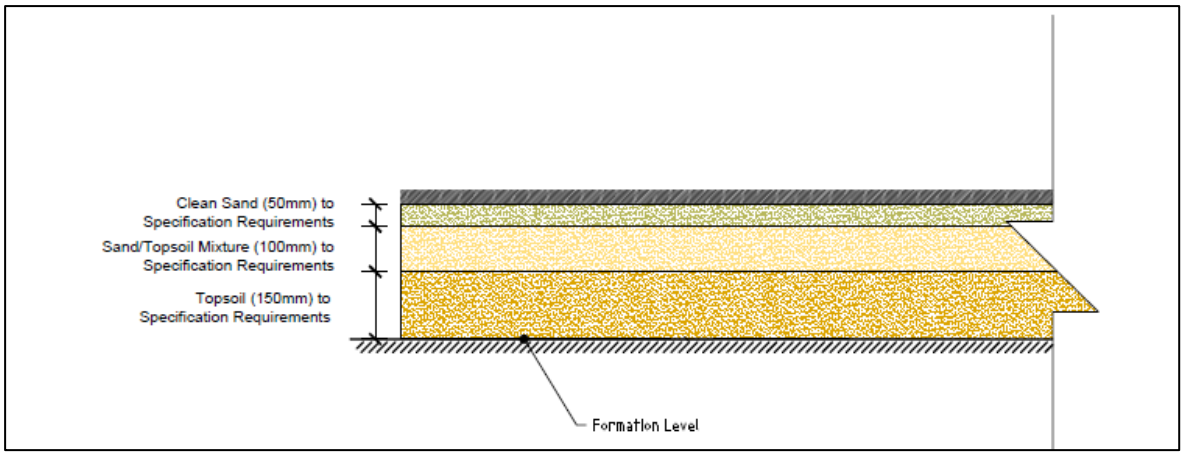


Figure 5. Typical Natural Turf Pitch Build-up

The proposed development will produce not increase in impermeable area over the area of the pitches (both synthetic and natural turf). Indeed, the proposal will improve the permeability of the pitch surfaces such that surface water will not accumulate on the pitch for either 30-year or the 100-year return period storm events. Instead, stormwater will penetrate the surface to be collected in underground French drains.

The storm drainage for the project has been designed using the Innovyze MicroDrainage Design Software. It is noted that this software considers both a 10% and 20% increase in flows to account for climate change for the 30-year and 100-year return periods, respectively.

The pitch build-up is drained by means of transverse 150mm diameter French drains laid at 1:200 (or greater depending on the gradient of the pitch surfaces) gradient at 10m centres in the case of the synthetic pitch and 5m centres in the case of the natural pitches, falling to a collector drain laid along one length of the pitch at falls.

The French drains are modelled as receiving infiltration along their lengths with a notional attenuation tank attached to the node comprising the junction of the French drain and the collector drain. This 'attenuation tank' is equivalent to the holding capacity of the French

drain surround/bedding beneath the carpet and, in the case of the natural turf pitches, the underside of the topsoil. In this way, attenuation occurs at source rather than at a centralised tank, which is consistent with the SuDS design philosophy. The holding capacity/porosity of these 'tanks' is conservatively set at 30%. However, in each case, additional attenuation capacity in the form of stone-fill 'tanks' is provided between the French drain collectors and the outfall, to supplement the French drain holding capacity, to achieve the required greenfields runoff rate.

The accumulated flow from each tank is then discharged at a controlled rate to each water course at a rate equal to or lower than the greenfields rate.

The outlet from the synthetic pitch is to pass through a granulate trap to contain any granulate infill that may have made its way along the flow path, before being discharged. The outlet from each natural pitch passes through a silt trap to contain any sediment that may have made its way along the flow path, before being discharged.

Runoff from the main road will, where possible, pass through point-of-entry SuDS features before being picked up by the main drainage system. Where SuDS measures are employed at point-of-entry, exceedance measures are also provided to allow for seasonal variations in capacity or outright failure of individual SuDS features. Roads will be serviced by gulleys at a rate of no more than 200 sqm per gulley, with double gullies at critical points.

Runoff generated at the pavilion building, sprint track and surrounding hardstand areas will be directed to the synthetic pitch attenuated network.

Collected surface water from these hardened areas will pass through petrol interceptors to remove hydrocarbons lifted from the carparks and roads before passing into attenuation tanks located upstream of discharge points. The attenuation tanks will be sized to achieve the desired 2 l/s/ha. greenfields runoff rate with the rate of discharge being controlled using hydrobrake manholes.

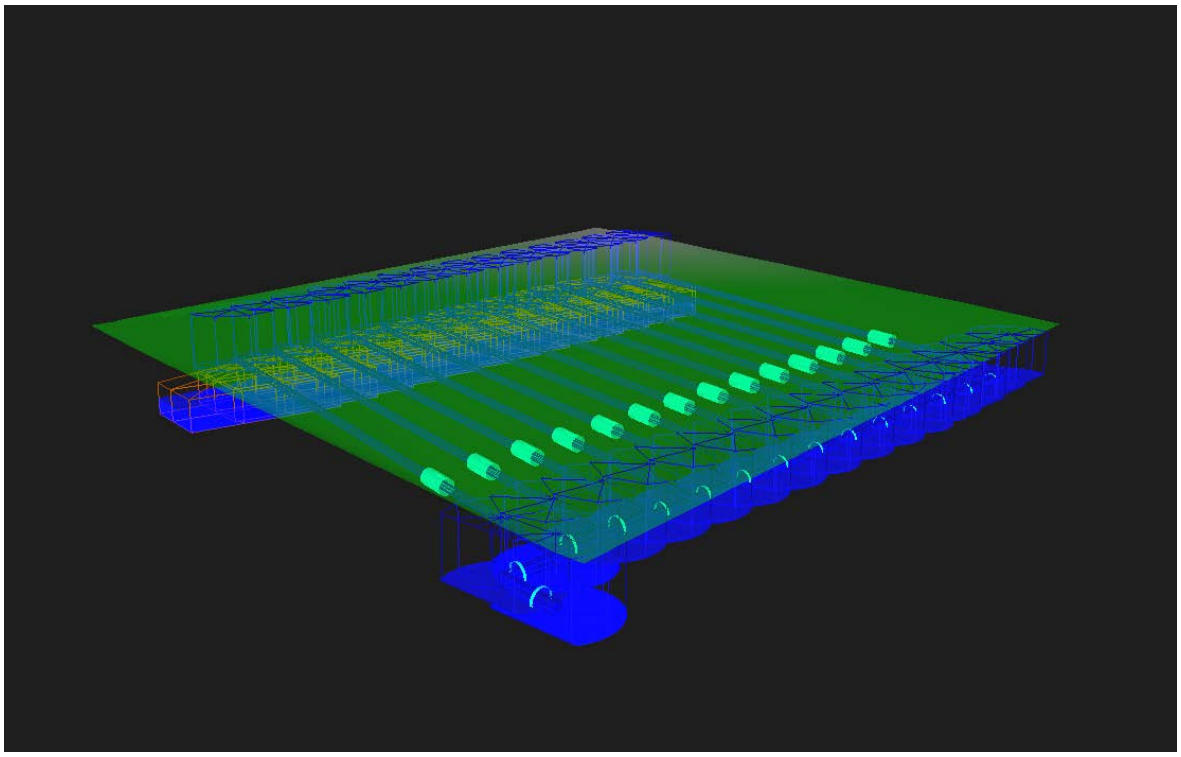


Figure 6. Pitch Hydraulic Model (Microdrainage)

The main pavilion parking area is served by a single SuDS detention pond which receives direct run-off from the hardened area. The base of the pond is drained by means of a sub-soil agricultural drain which discharges at a hydrobrake-controlled rate to the adjacent water course along the boundary. The filtration process through the drainage medium lining the base of the pond provides a nature-based means of isolating hydrocarbons, thereby foregoing the need for a petrol interceptor.

3.2.2 ATTENUATION CALCULATIONS

The storm events and coefficients applied to the MicroDrainage calculations are indicated in the Appendix. Critical storm events are identified and simulated. It is noted that where surcharge/flood risk conditions are noted at critical nodes within the network, this refers to the elevation of water levels within the notional structures as opposed to surface flooding; an acceptable condition. No surface flooding is generated under the simulated critical rainfall events. However, it is worth pointing out that temporary flooding of playing surfaces and even car parks is considered a legitimate SuDS approach, since these conditions would occur under extreme storm events at locations that are not considered critical to human safety and in a manner which would prevent damage to infrastructure.

The critical storm event differs per network so unattenuated flow exiting the site would vary considerably according to the choice of storm event. However, it is proposed that the site is limited by attenuation measures with outflow controls to a maximum surface water discharge of 36l/s under all storm events which equates to the threshold run-off rate of 2l/s/ha.

In order to achieve this discharge rate during a Q_{100} storm event, attenuation will be required to ensure the proposed discharge rate (36l/s) is not exceeded and, ideally, surface water flooding does not occur.

In order to achieve the proposed runoff rate (36l/s) during a Q_{100} rainfall event for the application area, a 'chain' of SuDS techniques will be employed, including holding capacity in the French drain bedding, optimally-sized piping and manhole junctions, a 30% void stone attenuation tank (within the subbase of the artificial pitches only), 43% void stone attenuation tanks downstream of all pitches and hardstand areas, and a hydrobrake outlet before the outfall.

It must be appreciated that while the greenfields runoff rate will be achieved by employing an attenuation-only design, the attenuation 'beds' in the build-up of the pitches and the attenuation tank(s) used in the main drainage upstream of discharge points will not be lined so as to prevent infiltration into subsoils. Indeed, every opportunity for infiltration will be taken by ensuring that the tanks are permeably lined. However, the design will no depend on any infiltration capacity of the existing subsoils.

3.2.3 DISCHARGE OPTIONS

Discharge from the tanks passes through hydrobrake manholes to control discharge to 36 litres/second over the entire site. The outfall of the main drainage system is to the existing water courses along the lower reaches of the site.

In addition, a factor of safety of 2.0 is applied to all elements of this design, thereby providing a high level of service even under the conditions of localised failure within the network.

4.0 CONCLUSION

The proposed development consists of a number of expansive surfaces, some permeable and others impermeable, some natural and others synthetic or hardened.

Reference is drawn to the Drainage Layouts (Drawings 11438-2003 to 2006).

The works involves the addition of some new impermeable areas to the site. The design requires new outfalls to the existing water courses skirting the site.

The proposed design improves upon the current calculated greenfield runoff rate of 58.78 litres/second by some 61% and provides measures to filter out contaminants within the flow path.

As the site development continues, the approved drainage design will be installed in accordance with local Building Control Regulations, and all other required standards.

Given the above information, it is considered that this development will not increase surface water flood risk at, or downstream of, the site.

APPENDIX A

Site Development Plan

Notes:
1. Do not scale
2. Contractor to check all dimensions and report omissions and errors to the Architect
3. Hamilton Architects LLP accepts no liability for use of this drawing by parties other than the party for whom it was prepared or for purposes other than those for which it was prepared.
4. If this drawing is issued in dwg/dwf format as an uncontrolled version to enable the recipient to prepare their own documents/drawings/models for which they are solely responsible. This drawing is based on project information current at the time of issue.
5. Hamilton Architects LLP accepts no liability for any alterations or additions to or discrepancies arising out of any change to such project information that occurs after it is issued by Hamilton Architects LLP.
This drawing does not contain shared coordinates and is not issued for coordination purposes.

Existing Site - 275,309m2 / 27,5 Hectares

KEY:

1. 1x 4G Synthetic Pitch (Pitch 1)
2. 1x Grass/Sand Competition Pitch (Pitch 2)
3. 2x Natural Grass Pitches with Cricket Crease (Pitch 3,4,5)
4. 4x Synthetic 5 Aside Soccer (Pitch 6,7,8,9)
5. 1x Hurling Wall
7. 1x Athletics Sprint Track
8. Walking Track Loop with Bollard Lighting
9. Outdoor Gym Equipment
10. Playpark
11. Pavilion Building
12. Pavilion Building Air-Dome Annex
13. Site Compound
14. Biodiversity Garden
15. Amphitheatre
16. Community Garden
17. Training Area
18. Site access to be agreed with DCC

LEGEND:

- Public Landscaped Area
- Community Benefit Area (Park/ Outdoor Gym)
- Hard Surface
- 4m Public Footpath & Cycle Lane
- Public Road
- Public Spaces
- Slope to be graded
- Existing Trees
- Proposed New Trees
- Secure Bike Shelter
- Site Boundary (Site Area)
- Adjoining land owned by client
- Retaining Wall
- Existing Houses
- Existing Sewer
- Existing Waterway
- Proposed Bridge
- Existing overhead power cables
- Lands owned by third parties
- Paved Area
- External Furniture

Rev	Description	Ckd	Apr	Date
P14	Site Plan coordinated with landscape drawing	RK	MP	03.05.23
P13	site plan general amendments	RK	WT	28.04.23
P12	Site compound amended. Ramp added.	RK	MP	20.04.23
P11	Drawing updated for following public consultation event.	WT	MP	03.04.23
P10	Drawing amended to clients comments.	AM	MP	06.02.23
P9	Shared cycle/pedestrian path layout amended to follow road. Carpark numbers amended. clients comments included	AM	MP	19.01.23
P8	N56 junction updated. Floodlighting and street lighting indicated. Bicycle shelters shown.	MP	MP	20.12.22
P7	Road layout and pavilion updated. Car park omitted to playground	MP	MP	23.11.22
P6	Pitches 1&2 relocated away from open stream. Roads & site adjusted accordingly.	RK	MP	31.10.22
P5	Cricket pitch rotated & road layout updated	JH	MP	02.08.22
P4	Key amended to show third party lands	WT	MP	21.06.22
P3	Boundary line amended	WT	MP	16.06.22
P2	Boundary line amended	WT	MP	14.06.22
P1	First Issue	WT	MP	30.05.22

Project Title
ATU Regional Sports Activity Hub

Drawing Title
Proposed Planning Master Plan

Scale: A1 @As indicated
Date: 04/24/23

Status Code
S4 - Suitable for stage approval

Drawing Number: 22018-HAM-01-XX-DR-A-1001
Rev: P14

hamilton ARCHITECTS
W: www.hamiltonarchitects.co.uk E: design@hamiltonarchitects.co.uk

APPENDIX B

Greenfields Runoff Rate Calculations

Print | Close Report

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Ryan Bragge
Site name:	LRSAH
Site location:	Knocknamona

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	54.96495° N
Longitude:	7.7045° W
Reference:	2319672861
Date:	Apr 19 2023 10:21

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 17

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics	Default	Edited
SAAR (mm):	1210	1210
Hydrological region:	13	13
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.65	1.65
Growth curve factor 100 years:	1.95	1.95
Growth curve factor 200 years:	2.15	2.15

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	58.78	58.78
1 in 1 year (l/s):	49.96	49.96
1 in 30 years (l/s):	96.98	96.98
1 in 100 year (l/s):	114.61	114.61
1 in 200 years (l/s):	126.37	126.37

APPENDIX C

Innovyze MicroDrainage Calculation Sheets

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	1	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	15.900	Volumetric Runoff Coeff.	0.900	Min Design Depth for Optimisation (m)	0.900
Ratio R	0.265	PIMP (%)	100	Min Vel for Auto Design only (m/s)	0.75
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.005		

Designed with Level Inverts

Time Area Diagram for Surface Network 1

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.189	4-8	0.288	8-12	0.003

Total Area Contributing (ha) = 0.479

Total Pipe Volume (m^3) = 17.252

Network Design Table for Surface Network 1

« - Indicates pipe capacity < flow

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	40.444	0.404	100.1	0.062	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	19.743	0.197	100.2	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	34.379	0.491	70.0	0.055	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	9.205	0.061	150.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	11.438	0.076	150.5	0.009	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	26.348	0.932	28.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	36.58	5.67	84.198	0.062	0.0	0.0	0.0	1.00	17.7	7.4
1.001	35.81	6.00	83.793	0.069	0.0	0.0	0.0	1.00	17.7	8.0
2.000	37.05	5.48	84.391	0.055	0.0	0.0	0.0	1.20	21.3	6.6
2.001	36.59	5.66	83.638	0.055	0.0	0.0	0.0	0.82	14.4	6.6
2.002	36.04	5.90	83.576	0.064	0.0	0.0	0.0	0.82	14.4	7.5
1.002	35.41	6.18	83.200	0.133	0.0	0.0	0.0	2.47	98.2	15.3

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
3.000	27.953	0.559	50.0	0.065	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	13.462	0.269	50.0	0.017	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	15.072	0.377	40.0	0.045	5.00	0.0	0.600	o	225	Pipe/Conduit	
4.001	14.435	0.361	40.0	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.002	9.112	0.061	149.4	0.011	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	13.827	0.092	150.3	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	21.931	0.274	80.0	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.000	37.64	5.25	84.139	0.065	0.0	0.0	0.0	1.85	73.7	8.0
3.001	37.32	5.37	83.171	0.082	0.0	0.0	0.0	1.85	73.7	9.9
4.000	37.98	5.12	83.577	0.045	0.0	0.0	0.0	2.08	82.5	5.6
4.001	37.67	5.24	82.861	0.066	0.0	0.0	0.0	2.07	82.5	8.1
4.002	37.30	5.38	82.350	0.077	0.0	0.0	0.0	1.07	42.4	9.3
3.002	36.76	5.60	82.289	0.178	0.0	0.0	0.0	1.06	42.3	21.3
1.003	34.87	6.43	82.000	0.340	0.0	0.0	0.0	1.46	58.2	38.5

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	20.136	0.336	59.9	0.054	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	26.659	0.174	153.2	0.031	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	32.508	0.246	132.1	0.054	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	10.724	0.054	200.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	28.070	0.286	98.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	18.184	0.070	259.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	34.45	6.62	81.336	0.394	0.0	0.0	0.0	1.69	67.3	44.1
1.005	33.75	6.98	80.374	0.425	0.0	0.0	0.0	1.27	89.6	46.6
1.006	32.99	7.37	79.930	0.479	0.0	0.0	0.0	1.37	96.6	51.4
1.007	32.70	7.53	79.684	0.479	0.0	0.0	0.0	1.11	78.3	51.4
1.008	32.25	7.79	79.216	0.479	0.0	0.0	0.0	1.83	202.1	51.4
1.009	31.61	8.16	78.930	0.479	0.0	0.0	0.0	0.81	32.1«	51.4

Manhole Schedules for Surface Network 1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SA 4.2	85.548	1.350	Open Manhole	1350	1.000	84.198	150				
SA 4.1	85.154	1.361	Open Manhole	1350	1.001	83.793	150	1.000	83.794	150	1
SA 1	86.295	1.904	Open Manhole	1200	2.000	84.391	150				
SA 2	84.916	1.278	Open Manhole	1350	2.001	83.638	150	2.000	83.900	150	262
SA 3	85.202	1.626	Open Manhole	1350	2.002	83.576	150	2.001	83.577	150	1
SA 4	85.086	1.886	Open Manhole	1200	1.002	83.200	225	1.001	83.596	150	321
								2.002	83.500	150	225
S6	86.104	1.965	Open Manhole	1200	3.000	84.139	225				
S7	85.003	1.832	Open Manhole	1200	3.001	83.171	225	3.000	83.580	225	409
S8	85.354	1.777	Open Manhole	1200	4.000	83.577	225				
S18	84.635	1.774	Open Manhole	1200	4.001	82.861	225	4.000	83.200	225	339
S9	83.939	1.589	Open Manhole	1350	4.002	82.350	225	4.001	82.500	225	150
S10	84.331	2.042	Open Manhole	1200	3.002	82.289	225	3.001	82.902	225	613
								4.002	82.289	225	
SA 5	83.695	1.695	Open Manhole	1350	1.003	82.000	225	1.002	82.268	225	268
								3.002	82.197	225	197
SA 6	83.253	1.917	Open Manhole	1200	1.004	81.336	225	1.003	81.726	225	390
SA 7	82.514	2.140	Open Manhole	1200	1.005	80.374	300	1.004	81.000	225	551
SA 8	81.381	1.451	Open Manhole	1350	1.006	79.930	300	1.005	80.200	300	270

Manhole Schedules for Surface Network 1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SA 9	80.920	1.237	Open Manhole	1350	1.007	79.684	300	1.006	79.684	300	
SA 10	80.991	1.775	Open Manhole	1350	1.008	79.216	375	1.007	79.630	300	339
SA 11	81.513	2.583	Open Manhole	1350	1.009	78.930	225	1.008	78.930	375	
SA 12	82.198	3.338	Open Manhole	0		OUTFALL		1.009	78.860	225	

PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	SA 4.2	85.548	84.198	1.200	Open Manhole	1350
1.001	o	150	SA 4.1	85.154	83.793	1.211	Open Manhole	1350
2.000	o	150	SA 1	86.295	84.391	1.754	Open Manhole	1200
2.001	o	150	SA 2	84.916	83.638	1.128	Open Manhole	1350
2.002	o	150	SA 3	85.202	83.576	1.476	Open Manhole	1350
1.002	o	225	SA 4	85.086	83.200	1.661	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	40.444	100.1	SA 4.1	85.154	83.794	1.210	Open Manhole	1350
1.001	19.743	100.2	SA 4	85.086	83.596	1.340	Open Manhole	1200
2.000	34.379	70.0	SA 2	84.916	83.900	0.866	Open Manhole	1350
2.001	9.205	150.9	SA 3	85.202	83.577	1.475	Open Manhole	1350
2.002	11.438	150.5	SA 4	85.086	83.500	1.436	Open Manhole	1200
1.002	26.348	28.3	SA 5	83.695	82.268	1.202	Open Manhole	1350

PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
3.000	o	225	S6	86.104	84.139	1.740	Open Manhole	1200
3.001	o	225	S7	85.003	83.171	1.607	Open Manhole	1200
4.000	o	225	S8	85.354	83.577	1.552	Open Manhole	1200
4.001	o	225	S18	84.635	82.861	1.549	Open Manhole	1200
4.002	o	225	S9	83.939	82.350	1.364	Open Manhole	1350
3.002	o	225	S10	84.331	82.289	1.817	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
3.000	27.953	50.0	S7	85.003	83.580	1.198	Open Manhole	1200
3.001	13.462	50.0	S10	84.331	82.902	1.204	Open Manhole	1200
4.000	15.072	40.0	S18	84.635	83.200	1.210	Open Manhole	1200
4.001	14.435	40.0	S9	83.939	82.500	1.214	Open Manhole	1350
4.002	9.112	149.4	S10	84.331	82.289	1.817	Open Manhole	1200
3.002	13.827	150.3	SA 5	83.695	82.197	1.273	Open Manhole	1350

PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.003	o	225	SA 5	83.695	82.000	1.470	Open Manhole	1350
1.004	o	225	SA 6	83.253	81.336	1.692	Open Manhole	1200
1.005	o	300	SA 7	82.514	80.374	1.840	Open Manhole	1200
1.006	o	300	SA 8	81.381	79.930	1.151	Open Manhole	1350
1.007	o	300	SA 9	80.920	79.684	0.937	Open Manhole	1350
1.008	o	375	SA 10	80.991	79.216	1.400	Open Manhole	1350
1.009	o	225	SA 11	81.513	78.930	2.358	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.003	21.931	80.0	SA 6	83.253	81.726	1.302	Open Manhole	1200
1.004	20.136	59.9	SA 7	82.514	81.000	1.289	Open Manhole	1200
1.005	26.659	153.2	SA 8	81.381	80.200	0.881	Open Manhole	1350
1.006	32.508	132.1	SA 9	80.920	79.684	0.936	Open Manhole	1350
1.007	10.724	200.0	SA 10	80.991	79.630	1.061	Open Manhole	1350
1.008	28.070	98.0	SA 11	81.513	78.930	2.208	Open Manhole	1350
1.009	18.184	259.8	SA 12	82.198	78.860	3.113	Open Manhole	0

Area Summary for Surface Network 1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.062	0.062	0.062
1.001	-	-	100	0.007	0.007	0.007
2.000	-	-	100	0.055	0.055	0.055
2.001	-	-	100	0.000	0.000	0.000
2.002	-	-	100	0.009	0.009	0.009
1.002	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.065	0.065	0.065
3.001	-	-	100	0.017	0.017	0.017
4.000	-	-	100	0.045	0.045	0.045
4.001	-	-	100	0.021	0.021	0.021
4.002	-	-	100	0.011	0.011	0.011
3.002	-	-	100	0.019	0.019	0.019
1.003	-	-	100	0.029	0.029	0.029
1.004	-	-	100	0.054	0.054	0.054
1.005	-	-	100	0.031	0.031	0.031
1.006	-	-	100	0.054	0.054	0.054
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.479	0.479	0.479

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.009	SA 12	82.198	78.860	0.000	0	0

Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.900	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	15.900	Cv (Summer)	0.900
Return Period (years)	1	Ratio R	0.265	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Surface Network 1

Hydro-Brake® Optimum Manhole: SA 11, DS/PN: 1.009, Volume (m³): 6.6

Unit Reference	MD-SHE-0135-8500-1000-8500	Sump Available	Yes
Design Head (m)	1.000	Diameter (mm)	135
Design Flow (l/s)	8.5	Invert Level (m)	78.930
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	8.5	Kick-Flo®	0.667	7.0
Flush-Flo™	0.302	8.5	Mean Flow over Head Range	-	7.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.9	0.600	7.7	1.600	10.6	2.600	13.3	5.000	18.2	7.500	22.1
0.200	8.3	0.800	7.7	1.800	11.2	3.000	14.3	5.500	19.1	8.000	22.8
0.300	8.5	1.000	8.5	2.000	11.8	3.500	15.4	6.000	19.9	8.500	23.5
0.400	8.4	1.200	9.3	2.200	12.3	4.000	16.4	6.500	20.7	9.000	24.2
0.500	8.2	1.400	10.0	2.400	12.8	4.500	17.3	7.000	21.4	9.500	24.8

Storage Structures for Surface Network 1

Cellular Storage Manhole: SA 10, DS/PN: 1.008

Invert Level (m) 78.930 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.43
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	920.0	920.0	1.000	920.0	1166.0	1.001	0.0	1166.0

Manhole Headloss for Surface Network 1

PN	US/MH Name	US/MH Headloss
1.000	SA 4.2	0.500
1.001	SA 4.1	0.500
2.000	SA 1	0.500
2.001	SA 2	0.500
2.002	SA 3	0.500
1.002	SA 4	0.500
3.000	S6	0.500
3.001	S7	0.500
4.000	S8	0.500
4.001	S18	0.500
4.002	S9	0.500
3.002	S10	0.500
1.003	SA 5	0.500
1.004	SA 6	0.500
1.005	SA 7	0.500
1.006	SA 8	0.500
1.007	SA 9	0.500
1.008	SA 10	0.500
1.009	SA 11	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.900 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.265 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 10, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	SA 4.2	15 Winter	100	+20%	100/15 Summer				84.570	0.222	0.000	1.13		19.5
1.001	SA 4.1	15 Winter	100	+20%	100/15 Summer				84.045	0.102	0.000	1.24		20.7

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Status	Level Exceeded
1.000	SA 4.2	SURCHARGED	
1.001	SA 4.1	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
2.000	SA 1	15 Winter	100	+20%					84.512	-0.029	0.000	0.97		19.9
2.001	SA 2	15 Winter	100	+20%	30/15 Summer				83.999	0.211	0.000	1.50		19.1
2.002	SA 3	15 Winter	100	+20%	30/15 Summer				83.860	0.134	0.000	1.67		21.8
1.002	SA 4	15 Winter	100	+20%					83.308	-0.117	0.000	0.46		42.2
3.000	S6	15 Winter	100	+20%					84.231	-0.133	0.000	0.35		24.0
3.001	S7	15 Winter	100	+20%					83.281	-0.115	0.000	0.48		30.4
4.000	S8	15 Winter	100	+20%					83.650	-0.152	0.000	0.23		16.6
4.001	S18	15 Winter	100	+20%	100/15 Summer				83.295	0.209	0.000	0.32		22.7
4.002	S9	15 Winter	100	+20%	30/15 Summer				83.264	0.689	0.000	0.65		22.6
3.002	S10	15 Winter	100	+20%	30/15 Summer				83.240	0.726	0.000	1.33		48.9
1.003	SA 5	15 Winter	100	+20%	30/15 Summer				83.101	0.876	0.000	1.78		94.5
1.004	SA 6	15 Winter	100	+20%	30/15 Summer				82.237	0.676	0.000	1.73		105.7
1.005	SA 7	15 Winter	100	+20%	30/15 Summer				80.966	0.292	0.000	1.39		111.8
1.006	SA 8	15 Winter	100	+20%	30/15 Summer				80.625	0.395	0.000	1.38		121.9
1.007	SA 9	15 Winter	100	+20%	30/15 Summer				80.151	0.168	0.000	1.98		121.6
1.008	SA 10	480 Winter	100	+20%					79.431	-0.161	0.000	0.06		11.3
1.009	SA 11	480 Winter	100	+20%	30/240 Winter				79.535	0.380	0.000	0.29		8.5

PN	US/MH Name	Status	Level Exceeded
2.000	SA 1	OK	
2.001	SA 2	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Status	Level Exceeded
2.002	SA 3	SURCHARGED	
1.002	SA 4	OK	
3.000	S6	OK	
3.001	S7	OK	
4.000	S8	OK	
4.001	S18	SURCHARGED	
4.002	S9	SURCHARGED	
3.002	S10	SURCHARGED	
1.003	SA 5	SURCHARGED	
1.004	SA 6	SURCHARGED	
1.005	SA 7	SURCHARGED	
1.006	SA 8	SURCHARGED	
1.007	SA 9	SURCHARGED	
1.008	SA 10	OK	
1.009	SA 11	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 3

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	1	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	15.900	Volumetric Runoff Coeff.	0.900	Min Design Depth for Optimisation (m)	0.900
Ratio R	0.265	PIMP (%)	100	Min Vel for Auto Design only (m/s)	0.75
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.005		

Designed with Level Inverts

Time Area Diagram for Surface Network 3

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.220	4-8	0.325	8-12	0.027

Total Area Contributing (ha) = 0.572

Total Pipe Volume (m^3) = 19.327

Network Design Table for Surface Network 3

« - Indicates pipe capacity < flow

Network Design Table for Surface Network 3

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	18.749	0.125	150.0	0.089	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	42.644	0.499	85.5	0.056	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	39.423	0.820	48.1	0.053	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	65.872	0.402	163.9	0.078	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	12.373	0.206	60.1	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	16.919	0.282	60.0	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	16.835	0.281	59.9	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.007	49.814	1.245	40.0	0.075	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.008	12.946	0.086	150.5	0.017	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	37.52	5.29	81.929	0.089	0.0	0.0	0.0	1.07	42.4	10.9
1.001	36.28	5.80	81.804	0.145	0.0	0.0	0.0	1.42	56.3	17.1
1.002	35.49	6.14	81.305	0.198	0.0	0.0	0.0	1.89	75.2	22.8
1.003	33.28	7.22	80.485	0.276	0.0	0.0	0.0	1.02	40.5	29.8
1.004	33.05	7.34	80.083	0.292	0.0	0.0	0.0	1.69	67.2	31.4
1.005	32.74	7.51	79.600	0.313	0.0	0.0	0.0	1.69	67.3	33.3
1.006	32.45	7.68	79.052	0.333	0.0	0.0	0.0	1.69	67.3	35.1
1.007	31.76	8.08	77.805	0.408	0.0	0.0	0.0	2.07	82.5	42.1
1.008	31.48	8.24	76.000	0.425	0.0	0.0	0.0	1.28	90.4	43.5

Network Design Table for Surface Network 3

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.009	22.881	0.153	149.5	0.025	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.010	30.274	0.572	52.9	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.011	19.192	0.229	83.8	0.023	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.012	33.774	0.700	48.2	0.051	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.013	11.779	0.059	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.009	31.00	8.54	75.914	0.450	0.0	0.0	0.0	1.28	90.7	45.3
1.010	30.64	8.77	75.761	0.498	0.0	0.0	0.0	2.17	153.1	49.6
1.011	30.36	8.96	75.189	0.521	0.0	0.0	0.0	1.72	121.5	51.4
1.012	30.00	9.21	74.960	0.572	0.0	0.0	0.0	2.27	160.4	55.8
1.013	29.69	9.42	74.259	0.572	0.0	0.0	0.0	0.92	36.6«	55.8

Manhole Schedules for Surface Network 3

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SB 1	83.843	1.914	Open Manhole	1200	1.000	81.929	225				
SB 2	83.737	1.933	Open Manhole	1200	1.001	81.804	225	1.000	81.804	225	
SB 3	82.800	1.495	Open Manhole	1350	1.002	81.305	225	1.001	81.305	225	
SB 4	81.977	1.492	Open Manhole	1350	1.003	80.485	225	1.002	80.485	225	
SB 5	81.725	1.642	Open Manhole	1350	1.004	80.083	225	1.003	80.083	225	
SB 6	81.302	1.702	Open Manhole	1350	1.005	79.600	225	1.004	79.877	225	277
SB 7	80.743	1.691	Open Manhole	1350	1.006	79.052	225	1.005	79.318	225	266
SB 8	80.197	2.392	Open Manhole	1200	1.007	77.805	225	1.006	78.771	225	966
SB 9	78.008	2.008	Open Manhole	1200	1.008	76.000	300	1.007	76.560	225	485
SB 10	77.522	1.608	Open Manhole	1350	1.009	75.914	300	1.008	75.914	300	
SB 11	77.186	1.425	Open Manhole	1350	1.010	75.761	300	1.009	75.761	300	
SB 12	76.723	1.534	Open Manhole	1350	1.011	75.189	300	1.010	75.189	300	
SB 13	76.229	1.269	Open Manhole	1350	1.012	74.960	300	1.011	74.960	300	
SB 14	75.685	1.426	Open Manhole	1350	1.013	74.259	225	1.012	74.260	300	76
SB 15	75.491	1.291	Open Manhole	0		OUTFALL		1.013	74.200	225	

PIPELINE SCHEDULES for Surface Network 3

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	SB 1	83.843	81.929	1.689	Open Manhole	1200
1.001	o	225	SB 2	83.737	81.804	1.708	Open Manhole	1200
1.002	o	225	SB 3	82.800	81.305	1.270	Open Manhole	1350
1.003	o	225	SB 4	81.977	80.485	1.267	Open Manhole	1350
1.004	o	225	SB 5	81.725	80.083	1.417	Open Manhole	1350
1.005	o	225	SB 6	81.302	79.600	1.477	Open Manhole	1350
1.006	o	225	SB 7	80.743	79.052	1.466	Open Manhole	1350
1.007	o	225	SB 8	80.197	77.805	2.167	Open Manhole	1200
1.008	o	300	SB 9	78.008	76.000	1.708	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	18.749	150.0	SB 2	83.737	81.804	1.708	Open Manhole	1200
1.001	42.644	85.5	SB 3	82.800	81.305	1.270	Open Manhole	1350
1.002	39.423	48.1	SB 4	81.977	80.485	1.267	Open Manhole	1350
1.003	65.872	163.9	SB 5	81.725	80.083	1.417	Open Manhole	1350
1.004	12.373	60.1	SB 6	81.302	79.877	1.200	Open Manhole	1350
1.005	16.919	60.0	SB 7	80.743	79.318	1.200	Open Manhole	1350
1.006	16.835	59.9	SB 8	80.197	78.771	1.201	Open Manhole	1200
1.007	49.814	40.0	SB 9	78.008	76.560	1.223	Open Manhole	1200
1.008	12.946	150.5	SB 10	77.522	75.914	1.308	Open Manhole	1350

PIPELINE SCHEDULES for Surface Network 3

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.009	o	300	SB 10	77.522	75.914	1.308	Open Manhole	1350
1.010	o	300	SB 11	77.186	75.761	1.125	Open Manhole	1350
1.011	o	300	SB 12	76.723	75.189	1.234	Open Manhole	1350
1.012	o	300	SB 13	76.229	74.960	0.969	Open Manhole	1350
1.013	o	225	SB 14	75.685	74.259	1.201	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.009	22.881	149.5	SB 11	77.186	75.761	1.125	Open Manhole	1350
1.010	30.274	52.9	SB 12	76.723	75.189	1.234	Open Manhole	1350
1.011	19.192	83.8	SB 13	76.229	74.960	0.969	Open Manhole	1350
1.012	33.774	48.2	SB 14	75.685	74.260	1.125	Open Manhole	1350
1.013	11.779	200.0	SB 15	75.491	74.200	1.066	Open Manhole	0

Area Summary for Surface Network 3

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.089	0.089	0.089
1.001	-	-	100	0.056	0.056	0.056
1.002	-	-	100	0.053	0.053	0.053
1.003	-	-	100	0.078	0.078	0.078
1.004	-	-	100	0.016	0.016	0.016
1.005	-	-	100	0.021	0.021	0.021
1.006	-	-	100	0.020	0.020	0.020
1.007	-	-	100	0.075	0.075	0.075
1.008	-	-	100	0.017	0.017	0.017
1.009	-	-	100	0.025	0.025	0.025
1.010	-	-	100	0.048	0.048	0.048
1.011	-	-	100	0.023	0.023	0.023
1.012	-	-	100	0.051	0.051	0.051
1.013	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.572	0.572	0.572

Free Flowing Outfall Details for Surface Network 3

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.013	SB 15	75.491	74.200	0.000	0	0

Simulation Criteria for Surface Network 3

Volumetric Runoff Coeff	0.900	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 1	Number of Storage Structures 1	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	15.900	Cv (Summer)	0.900
Return Period (years)	1	Ratio R	0.265	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Surface Network 3

Hydro-Brake® Optimum Manhole: SB 14, DS/PN: 1.013, Volume (m³): 4.3

Unit Reference	MD-SHE-0132-8100-1000-8100	Sump Available	Yes
Design Head (m)	1.000	Diameter (mm)	132
Design Flow (l/s)	8.1	Invert Level (m)	74.259
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	8.1	Kick-Flo®	0.664	6.7
Flush-Flo™	0.300	8.1	Mean Flow over Head Range	-	7.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	7.3	1.600	10.1	2.600	12.7	5.000	17.4	7.500	21.1
0.200	7.9	0.800	7.3	1.800	10.7	3.000	13.6	5.500	18.2	8.000	21.8
0.300	8.1	1.000	8.1	2.000	11.2	3.500	14.6	6.000	18.9	8.500	22.4
0.400	8.0	1.200	8.8	2.200	11.7	4.000	15.6	6.500	19.7	9.000	23.0
0.500	7.8	1.400	9.5	2.400	12.2	4.500	16.5	7.000	20.4	9.500	23.6

Storage Structures for Surface Network 3

Cellular Storage Manhole: SB 14, DS/PN: 1.013

Invert Level (m) 74.259 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.43
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	450.0	450.0	1.000	450.0	540.0	1.001	0.0	540.0

Manhole Headloss for Surface Network 3

PN	US/MH Name	US/MH Headloss
1.000	SB 1	0.500
1.001	SB 2	0.500
1.002	SB 3	0.500
1.003	SB 4	0.500
1.004	SB 5	0.500
1.005	SB 6	0.500
1.006	SB 7	0.500
1.007	SB 8	0.500
1.008	SB 9	0.500
1.009	SB 10	0.500
1.010	SB 11	0.500
1.011	SB 12	0.500
1.012	SB 13	0.500
1.013	SB 14	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.900 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.265 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 10, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	SB 1	15 Winter	100	+20%	100/15 Summer				82.387	0.233	0.000	0.77		29.2	SURCHARGED
1.001	SB 2	15 Winter	100	+20%	100/15 Summer				82.332	0.303	0.000	0.82		43.8	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

PN	US/MH Name	Level Exceeded
1.000	SB 1	
1.001	SB 2	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.002	SB 3	15 Winter	100	+20%	30/15 Winter				82.071	0.541	0.000	0.72		51.3
1.003	SB 4	15 Winter	100	+20%	30/15 Summer				81.646	0.936	0.000	1.74		68.2
1.004	SB 5	15 Winter	100	+20%	30/15 Winter				80.396	0.088	0.000	1.21		70.0
1.005	SB 6	15 Winter	100	+20%	30/15 Winter				79.953	0.128	0.000	1.22		72.9
1.006	SB 7	30 Winter	100	+20%	30/15 Summer				79.441	0.164	0.000	1.27		76.1
1.007	SB 8	15 Winter	100	+20%	100/15 Summer				78.593	0.563	0.000	1.20		95.0
1.008	SB 9	15 Winter	100	+20%	30/15 Summer				76.475	0.175	0.000	1.35		99.4
1.009	SB 10	15 Winter	100	+20%	30/15 Summer				76.317	0.103	0.000	1.32		105.8
1.010	SB 11	15 Winter	100	+20%					75.983	-0.078	0.000	0.85		118.4
1.011	SB 12	15 Winter	100	+20%	100/15 Summer				75.570	0.081	0.000	1.18		124.7
1.012	SB 13	360 Winter	100	+20%	100/240 Winter				75.324	0.064	0.000	0.26		37.9
1.013	SB 14	360 Winter	100	+20%	30/15 Summer				75.329	0.845	0.000	0.27		8.3

PN	US/MH Name	Status	Level Exceeded
1.002	SB 3	SURCHARGED	
1.003	SB 4	SURCHARGED	
1.004	SB 5	SURCHARGED	
1.005	SB 6	SURCHARGED	
1.006	SB 7	SURCHARGED	
1.007	SB 8	SURCHARGED	
1.008	SB 9	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

PN	US/MH Name	Status	Level Exceeded
1.009	SB 10	SURCHARGED	
1.010	SB 11	OK	
1.011	SB 12	SURCHARGED	
1.012	SB 13	SURCHARGED	
1.013	SB 14	SURCHARGED	

Fairgreen House
Fairgreen Road
Galway

Date 18/05/2023 10:15
File 11438 - NETWORK D.MDX

Designed by michael.naughton
Checked by

Micro Drainage | Network 2018.1.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 4

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	1	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	15.900	Volumetric Runoff Coeff.	0.900	Min Design Depth for Optimisation (m)	0.900
Ratio R	0.265	PIMP (%)	100	Min Vel for Auto Design only (m/s)	0.75
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.005		

Designed with Level Inverts

Time Area Diagram for Surface Network 4

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.029	4-8	0.070

Total Area Contributing (ha) = 0.099

Total Pipe Volume (m^3) = 14.612

Network Design Table for Surface Network 4

Network Design Table for Surface Network 4

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Surface Network 4

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	23.235	0.465	50.0	0.053	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	26.615	0.133	200.1	0.046	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	21.711	0.109	200.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	88.227	0.425	207.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.004	33.988	0.170	199.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	37.75	5.21	74.765	0.053	0.0	0.0	0.0	1.85	73.7	6.5
1.001	36.53	5.69	73.533	0.099	0.0	0.0	0.0	0.92	36.6	11.8
1.002	35.77	6.02	73.325	0.099	0.0	0.0	0.0	1.11	78.3	11.8
1.003	33.33	7.19	72.995	0.099	0.0	0.0	0.0	1.25	138.5	11.8
1.004	32.22	7.81	72.570	0.099	0.0	0.0	0.0	0.92	36.6	11.8

Manhole Schedules for Surface Network 4

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SD 1	76.867	2.102	Open Manhole	1200	1.000	74.765	225				
SD 2	75.753	2.220	Open Manhole	1200	1.001	73.533	225	1.000	74.300	225	767
SD 3	74.729	1.404	Open Manhole	1350	1.002	73.325	300	1.001	73.400	225	
SD 4	75.579	2.584	Open Manhole	1350	1.003	72.995	375	1.002	73.216	300	146
SD 5	74.851	2.281	Open Manhole	1350	1.004	72.570	225	1.003	72.570	375	
SD 6	73.151	0.751	Open Manhole	0		OUTFALL		1.004	72.400	225	

PIPELINE SCHEDULES for Surface Network 4

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	SD 1	76.867	74.765	1.877	Open Manhole	1200
1.001	o	225	SD 2	75.753	73.533	1.995	Open Manhole	1200
1.002	o	300	SD 3	74.729	73.325	1.104	Open Manhole	1350
1.003	o	375	SD 4	75.579	72.995	2.209	Open Manhole	1350
1.004	o	225	SD 5	74.851	72.570	2.056	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	23.235	50.0	SD 2	75.753	74.300	1.228	Open Manhole	1200
1.001	26.615	200.1	SD 3	74.729	73.400	1.104	Open Manhole	1350
1.002	21.711	200.0	SD 4	75.579	73.216	2.063	Open Manhole	1350
1.003	88.227	207.6	SD 5	74.851	72.570	1.906	Open Manhole	1350
1.004	33.988	199.9	SD 6	73.151	72.400	0.526	Open Manhole	0

Area Summary for Surface Network 4

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.053	0.053	0.053
1.001	-	-	100	0.046	0.046	0.046
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.099	0.099	0.099

Free Flowing Outfall Details for Surface Network 4

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004	SD 6	73.151	72.400	0.000	0	0

Simulation Criteria for Surface Network 4

Volumetric Runoff Coeff	0.900	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 1	Number of Storage Structures 1	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	15.900	Cv (Summer)	0.900
Return Period (years)	1	Ratio R	0.265	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Surface Network 4

Hydro-Brake® Optimum Manhole: SD 5, DS/PN: 1.004, Volume (m³): 12.9

Unit Reference	MD-SHE-0019-2000-1200-2000	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	19
Design Flow (l/s)	0.2	Invert Level (m)	72.570
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	0.2	Kick-Flo®	0.168	0.1
Flush-Flo™	0.081	0.1	Mean Flow over Head Range	-	0.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.1	0.600	0.1	1.600	0.2	2.600	0.3	5.000	0.4	7.500	0.4
0.200	0.1	0.800	0.2	1.800	0.2	3.000	0.3	5.500	0.4	8.000	0.5
0.300	0.1	1.000	0.2	2.000	0.2	3.500	0.3	6.000	0.4	8.500	0.5
0.400	0.1	1.200	0.2	2.200	0.3	4.000	0.3	6.500	0.4	9.000	0.5
0.500	0.1	1.400	0.2	2.400	0.3	4.500	0.4	7.000	0.4	9.500	0.5

Storage Structures for Surface Network 4

Cellular Storage Manhole: SD 5, DS/PN: 1.004

Invert Level (m) 72.570 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.43
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	176.0	176.0	1.200	176.0	392.0	1.201	0.0	392.0

Manhole Headloss for Surface Network 4

PN	US/MH Name	US/MH Headloss
1.000	SD 1	0.500
1.001	SD 2	0.500
1.002	SD 3	0.500
1.003	SD 4	0.500
1.004	SD 5	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.900 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.265 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 10, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	SD 1	15 Winter	100	+20%					74.848	-0.142	0.000	0.29		19.5	OK
1.001	SD 2	15 Winter	100	+20%	100/15 Summer				73.780	0.022	0.000	1.07		36.2	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

PN	US/MH Name	Level Exceeded
1.000	SD 1	
1.001	SD 2	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.002	SD 3	5760 Winter	100	+20%					73.527	-0.098	0.000	0.01		0.9
1.003	SD 4	5760 Winter	100	+20%	100/1440 Winter				73.527	0.157	0.000	0.01		0.9
1.004	SD 5	5760 Winter	100	+20%	1/600 Winter				73.527	0.732	0.000	0.01		0.2

PN	US/MH Name	Status	Level Exceeded
1.002	SD 3	OK	
1.003	SD 4	SURCHARGED	
1.004	SD 5	SURCHARGED	

APPENDIX D

Attenuation Tank Design Calculation Sheets

Project No.	11438	Client :	Letterkenny ATU	Project:	LRSAH

Soakaway/Attenuation Tank Design to BRE 365

Design Procedure I - O = S
where;
I = Inflow from impermeable area to be drained
O = Outflow infiltrating into the soil during rainfall
S = Storage required

I = A x R
where;
A = the impermeable area drained to the soakaway;
R = the total rainfall in a 30 yrdesign storm

$O = a_{s50} \times f \times D$
where;

a_{s50} = the internal surface area of the soakaway to 50% effective depth
f = the soil infiltration rate determined in trial pit at the site of the proposed soakaway
D = the storm Duration

	m2	(%) Permeability Factor	m2
Pitch 1	2550.00	0.9	2295.00
		Total	**2295.00**

Drained Area = **2295** m2

Proposed Soakaway				Proposed Hydrobrake	
Length (m)	**Width (m)**	**Depth (m)**		**Maximum outflow rate (l/s)**	2
19	**10**	**2**	**380 m³**		
a_{s50}	58 m^2				
Void Ratio	43 %				
Infiltration Rate (f)		0.0000E+00 m/s			

For a 100 Year return period from table below

Duration Minutes	M100 - D (mm)	I (m^3)	$O_{infiltration}$ (m^3)	$O_{hydrobrake}$ (m^3)	S (m^3)	S required @ 43% voids	Check
10.00	18.5	50.949	0.000	1.200	50	116	OK
15.00	21.8	60.037	0.000	1.800	58	135	OK
30.00	26.9	74.083	0.000	3.600	70	164	OK
60.00	33.3	91.708	0.000	7.200	85	197	OK
120.00	41.2	113.465	0.000	14.400	99	230	OK
360.00	57.6	158.630	0.000	43.200	115	268	OK
720.00	71.3	196.360	0.000	86.400	110	256	OK
1440.00	88.1	242.627	0.000	172.800	70	162	OK

Rainfall Data obtained from Met Eireann for Grid co-ords 217739E, 413394N (Irish Grid) with 20% added for climate change
Highlighted cell is volume required for critcal storm duration

Project No.	11438	Client :	Letterkenny ATU	Project:	LRSAH

Soakaway/Attenuation Tank Design to BRE 365

Design Procedure I - O = S
where;
I = Inflow from impermeable area to be drained
O = Outflow infiltrating into the soil during rainfall
S = Storage required

I = A x R
where;
A = the impermeable area drained to the soakaway;
R = the total rainfall in a 30 yrdesign storm

$O = a_{s50} \times f \times D$
where;

a_{s50} = the internal surface area of the soakaway to 50% effective depth
f = the soil infiltration rate determined in trial pit at the site of the proposed soakaway
D = the storm Duration

	m2	(%) Permeability Factor	m2
Pitch 4	4550.00	0.15	682.50
		Total	**682.50**

Drained Area = **683** m2

Proposed Soakaway				Proposed Hydrobrake	
Length (m)	**Width (m)**	**Depth (m)**		**Maximum outflow rate (l/s)**	0.2
88	**1.5**	**1**	**132 m³**		
a_{s50}	89.5	m^2			
Void Ratio	43	%			
Infiltration Rate (f)			0.0000E+00 m/s		

For a 100 Year return period from table below

Duration Minutes	M100 - D (mm)	I (m^3)	$O_{infiltration}$ (m^3)	$O_{hydrobrake}$ (m^3)	S (m^3)	S required @ 43% voids	Check
10.00	18.5	15.152	0.000	0.120	15	35	OK
15.00	21.8	17.854	0.000	0.180	18	41	OK
30.00	26.9	22.031	0.000	0.360	22	50	OK
60.00	33.3	27.273	0.000	0.720	27	62	OK
120.00	41.2	33.743	0.000	1.440	32	75	OK
360.00	57.6	47.174	0.000	4.320	43	100	OK
720.00	71.3	58.395	0.000	8.640	50	116	OK
1440.00	88.1	72.154	0.000	17.280	55	128	OK

Rainfall Data obtained from Met Eireann for Grid co-ords 217739E, 413394N (Irish Grid) with 20% added for climate change
Highlighted cell is volume required for critcal storm duration

Project No.	11438	Client :	Letterkenny ATU	Project:	LRSAH

Soakaway/Attenuation Tank Design to BRE 365

Design Procedure I - O = S
where;
I = Inflow from impermeable area to be drained
O = Outflow infiltrating into the soil during rainfall
S = Storage required

I = A x R
where;
A = the impermeable area drained to the soakaway;
R = the total rainfall in a 30 yrdesign storm

$O = a_{s50} \times f \times D$
where;

a_{s50} = the internal surface area of the soakaway to 50% effective depth
f = the soil infiltration rate determined in trial pit at the site of the proposed soakaway
D = the storm Duration

	m2	(%) Permeability Factor	m2
Pitch 1	20700.00	0.3	6210.00
		Total	**6210.00**

Drained Area = **6210** m2

Proposed Soakaway				Proposed Hydrobrake	
Length (m)	**Width (m)**	**Depth (m)**		**Maximum outflow rate (l/s)**	2
45	**25**	**1**	**1125 m³**		
a_{s50}	70 m^2				
Void Ratio	43 %				
Infiltration Rate (f)		0.0000E+00 m/s			

For a 100 Year return period from table below

Duration Minutes	M100 - D (mm)	I (m^3)	$O_{infiltration}$ (m^3)	$O_{hydrobrake}$ (m^3)	S (m^3)	S required @ 43% voids	Check
10.00	18.5	137.862	0.000	1.200	137	318	OK
15.00	21.8	162.454	0.000	1.800	161	374	OK
30.00	26.9	200.459	0.000	3.600	197	458	OK
60.00	33.3	248.152	0.000	7.200	241	560	OK
120.00	41.2	307.022	0.000	14.400	293	681	OK
360.00	57.6	429.235	0.000	43.200	386	898	OK
720.00	71.3	531.328	0.000	86.400	445	1035	OK
1440.00	88.1	656.521	0.000	172.800	484	1125	OK

Rainfall Data obtained from Met Eireann for Grid co-ords 217739E, 413394N (Irish Grid) with 20% added for climate change
Highlighted cell is volume required for critcal storm duration

Project No.	11438	Client :	Letterkenny ATU	Project:	LRSAH

Soakaway/Attenuation Tank Design to BRE 365

Design Procedure I - O = S
where;
I = Inflow from impermeable area to be drained
O = Outflow infiltrating into the soil during rainfall
S = Storage required

I = A x R
where;
A = the impermeable area drained to the soakaway;
R = the total rainfall in a 30 yrdesign storm

$O = a_{s50} \times f \times D$
where;

a_{s50} = the internal surface area of the soakaway to 50% effective depth
f = the soil infiltration rate determined in trial pit at the site of the proposed soakaway
D = the storm Duration

	m2	(%) Permeability Factor	m2
Pitch 2	17300.00	0.15	2595.00
		Total	**2595.00**

Drained Area = **2595** m2

Proposed Soakaway				Proposed Hydrobrake	
Length (m)	**Width (m)**	**Depth (m)**		**Maximum outflow rate (l/s)**	2
22	**15**	**1**	**330 m³**		
a_{s50}	37 m^2				
Void Ratio	43 %				
Infiltration Rate (f)		0.0000E+00 m/s			

For a 100 Year return period from table below

Duration Minutes	M100 - D (mm)	I (m^3)	$O_{infiltration}$ (m^3)	$O_{hydrobrake}$ (m^3)	S (m^3)	S required @ 43% voids	Check
10.00	18.5	57.609	0.000	1.200	56	131	OK
15.00	21.8	67.885	0.000	1.800	66	154	OK
30.00	26.9	83.767	0.000	3.600	80	186	OK
60.00	33.3	103.696	0.000	7.200	96	224	OK
120.00	41.2	128.297	0.000	14.400	114	265	OK
360.00	57.6	179.366	0.000	43.200	136	317	OK
720.00	71.3	222.028	0.000	86.400	136	315	OK
1440.00	88.1	274.343	0.000	172.800	102	236	OK

Rainfall Data obtained from Met Eireann for Grid co-ords 217739E, 413394N (Irish Grid) with 20% added for climate change
Highlighted cell is volume required for critcal storm duration

Project No.	11438	Client :	Letterkenny ATU	Project:	LRSAH

Soakaway/Attenuation Tank Design to BRE 365

Design Procedure I - O = S
where;
I = Inflow from impermeable area to be drained
O = Outflow infiltrating into the soil during rainfall
S = Storage required

I = A x R
where;
A = the impermeable area drained to the soakaway;
R = the total rainfall in a 30 yrdesign storm

$O = a_{s50} \times f \times D$
where;

a_{s50} = the internal surface area of the soakaway to 50% effective depth
f = the soil infiltration rate determined in trial pit at the site of the proposed soakaway
D = the storm Duration

	m2	(%) Permeability Factor	m2
Pitch 3	18000.00	0.15	2700.00
		Total	**2700.00**

Drained Area = **2700** m2

Proposed Soakaway				Proposed Hydrobrake	
Length (m)	**Width (m)**	**Depth (m)**		**Maximum outflow rate (l/s)**	2
22	**16**	**1**	**352 m³**		
a_{s50}	38 m^2				
Void Ratio	43 %				
Infiltration Rate (f)			0.0000E+00 m/s		

For a 100 Year return period from table below

Duration Minutes	M100 - D (mm)	I (m^3)	$O_{infiltration}$ (m^3)	$O_{hydrobrake}$ (m^3)	S (m^3)	S required @ 43% voids	Check
10.00	18.5	59.940	0.000	1.200	59	137	OK
15.00	21.8	70.632	0.000	1.800	69	160	OK
30.00	26.9	87.156	0.000	3.600	84	194	OK
60.00	33.3	107.892	0.000	7.200	101	234	OK
120.00	41.2	133.488	0.000	14.400	119	277	OK
360.00	57.6	186.624	0.000	43.200	143	334	OK
720.00	71.3	231.012	0.000	86.400	145	336	OK
1440.00	88.1	285.444	0.000	172.800	113	262	OK
2880.00	100.3	324.972	0.000	324.972	0	0	OK

Rainfall Data obtained from Met Eireann for Grid co-ords 217739E, 413394N (Irish Grid) with 20% added for climate change
Highlighted cell is volume required for critcal storm duration

www.tobin.ie

TOBIN Consulting Engineers

@tobinengineers

Galway
Fairgreen House,
Fairgreen Road,
Galway,
H91 AXK8,
Ireland.
Tel: +353 (0)91 565 211

Dublin
Block 10-4,
Blanchardstown Corporate Park,
Dublin 15,
D15 X98N,
Ireland.
Tel: +353 (0)1 803 0406

Castlebar
Market Square,
Castlebar,
Mayo,
F23 Y427,
Ireland.
Tel: +353 (0)94 902 1401

Feature name	Species group	Species name	Record count	Date of last record	Title of dataset	Designation
Custom	alga	Dictyota dichotoma	1	31/12/1853	Seaweeds of Ireland	
Custom	alga	Laminariocolax tomentosoides	1	31/12/1853	Seaweeds of Ireland	
Custom	amphibian	Common Frog (Rana temporaria)	6	20/05/2020	Amphibians and reptiles of Ireland	Protected Species: EU Habitats Directive || Protected Species: EU Habitats Directive >> Annex V || Protected Species: Wildlife Acts
Custom	annelid	Chestnut Worm (Lumbricus castaneus)	1	31/12/1893	Earthworms of Ireland	
Custom	annelid	Common Earthworm (Lumbricus terrestris)	1	31/12/1893	Earthworms of Ireland	
Custom	annelid	Red Worm (Lumbricus rubellus)	1	31/12/1893	Earthworms of Ireland	
Custom	bird	Anthus spinoletta/petrosus agg.	1	29/02/1984	The First Atlas of Wintering Birds in Britain and Ireland: 1981/82-1983/84.	
Custom	bird	Barn Owl (Tyto alba)	6	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	bird	Barn Swallow (Hirundo rustica)	14	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Barnacle Goose (Branta leucopsis)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Bar-tailed Godwit (Limosa lapponica)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Bean Goose (Anser fabalis)	1	29/02/1984	The First Atlas of Wintering Birds in Britain and Ireland: 1981/82-1983/84.	
Custom	bird	Black-billed Magpie (Pica pica)	21	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Blackcap (Sylvia atricapilla)	7	27/04/2021	Birds of Ireland	
Custom	bird	Black-crowned Night Heron (Nycticorax nycticorax)	1	31/12/1834	Rare birds of Ireland	
Custom	bird	Black-headed Gull (Larus ridibundus)	11	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	bird	Black-tailed Godwit (Limosa limosa)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Black-throated Diver (Gavia arctica)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Blue Tit (Cyanistes caeruleus)	19	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Bohemian Waxwing (Bombycilla garrulus)	1	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Brambling (Fringilla montifringilla)	1	29/02/1984	The First Atlas of Wintering Birds in Britain and Ireland: 1981/82-1983/84.	
Custom	bird	Branta bernicla subsp. hrota	1	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Brent Goose (Branta bernicla)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Carrion Crow (Corvus corone)	1	31/07/1991	The Second Atlas of Breeding Birds in Britain and Ireland: 1988-1991	
Custom	bird	Chaffinch (Fringilla coelebs)	20	12/05/2016	Birds of Ireland	
Custom	bird	Coal Tit (Periparus ater)	14	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Common Blackbird (Turdus merula)	21	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Common Bullfinch (Pyrrhula pyrrhula)	16	31/12/2011	Bird Atlas 2007 - 2011	

Custom	bird	Common Buzzard (Buteo buteo)	12	25/01/2023	Birds of Ireland	
Custom	bird	Common Chiffchaff (Phylloscopus collybita)	13	27/04/2021	Birds of Ireland	
Custom	bird	Common Coot (Fulica atra)	2	31/07/1972	The First Atlas of Breeding Birds in Britain and Ireland: 1968-1972.	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Common Cuckoo (Cuculus canorus)	6	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Common Goldeneye (Bucephala clangula)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation
Custom	bird	Common Grasshopper Warbler (Locustella naevia)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation
Custom	bird	Common Greenshank (Tringa nebularia)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation
Custom	bird	Common Guillemot (Uria aalge)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation
Custom	bird	Common Kestrel (Falco tinnunculus)	10	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation
Custom	bird	Common Linnet (Carduelis cannabina)	7	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation
Custom	bird	Common Moorhen (Gallinula chloropus)	5	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Common Pheasant (Phasianus colchicus)	9	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section I Bird Species
Custom	bird	Common Raven (Corvus corax)	7	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Common Redshank (Tringa totanus)	8	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation
Custom	bird	Common Sandpiper (Actitis hypoleucos)	2	31/07/1991	The Second Atlas of Breeding Birds in Britain and Ireland: 1988-1991	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation
Custom	bird	Common Shelduck (Tadorna tadorna)	11	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation

Custom	bird	Common Snipe (Gallinago gallinago)	9	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Common Starling (Sturnus vulgaris)	19	27/04/2021	Birds of Ireland	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Common Swift (Apus apus)	7	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Common Tern (Sterna hirundo)	1	31/07/1972	The First Atlas of Breeding Birds in Britain and Ireland: 1968-1972.	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Common Whitethroat (Sylvia communis)	4	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Common Wood Pigeon (Columba palumbus)	20	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section I Bird Species
Custom	bird	Corn Crake (Crex crex)	5	31/07/1991	The Second Atlas of Breeding Birds in Britain and Ireland: 1988-1991	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	bird	Dunlin (Calidris alpina)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Eurasian Collared Dove (Streptopelia decaocto)	12	02/02/2021	Birds of Ireland	
Custom	bird	Eurasian Curlew (Numenius arquata)	15	08/12/2020	Birds of Ireland	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation
Custom	bird	Eurasian Jackdaw (Corvus monedula)	22	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Eurasian Jay (Garrulus glandarius)	6	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Eurasian Oystercatcher (Haematopus ostralegus)	8	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation
Custom	bird	Eurasian Siskin (Carduelis spinus)	9	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Eurasian Sparrowhawk (Accipiter nisus)	14	31/12/2011	Bird Atlas 2007 - 2011	

Custom	bird	Eurasian Teal (Anas crecca)	5	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Eurasian Tree Sparrow (Passer montanus)	3	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Eurasian Treecreeper (Certhia familiaris)	9	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Eurasian Wigeon (Anas penelope)	3	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Eurasian Woodcock (Scolopax rusticola)	6	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	European Golden Plover (Pluvialis apricaria)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	bird	European Goldfinch (Carduelis carduelis)	13	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	European Greenfinch (Carduelis chloris)	16	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	European Robin (Erithacus rubecula)	22	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Fieldfare (Turdus pilaris)	3	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Glaucous Gull (Larus hyperboreus)	1	29/02/1984	The First Atlas of Wintering Birds in Britain and Ireland: 1981/82-1983/84.	
Custom	bird	Goldcrest (Regulus regulus)	15	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Great Black-backed Gull (Larus marinus)	4	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Great Cormorant (Phalacrocorax carbo)	5	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Great Crested Grebe (Podiceps cristatus)	4	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List

Custom	bird	Great Northern Diver (Gavia immer)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species
Custom	bird	Great Tit (Parus major)	16	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Greater Scaup (Aythya marila)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Greater White-fronted Goose (Anser albifrons)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Greenland White-fronted Goose (Anser albifrons subsp. flavirostris)	1	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Green-winged Teal (Anas carolinensis)	2	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Grey Heron (Ardea cinerea)	17	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Grey Partridge (Perdix perdix)	1	31/07/1972	The First Atlas of Breeding Birds in Britain and Ireland: 1968-1972.	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	bird	Grey Plover (Pluvialis squatarola)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Grey Wagtail (Motacilla cinerea)	12	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Greylag Goose (Anser anser)	3	31/12/2011	Bird Atlas 2007 - 2011	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland) || Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Gyr Falcon (Falco rusticolus)	1	13/01/1884	Rare birds of Ireland	
Custom	bird	Hedge Accentor (Prunella modularis)	16	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Herring Gull (Larus argentatus)	5	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	bird	Hooded Crow (Corvus cornix)	16	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	House Martin (Delichon urbicum)	8	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List

Custom	bird	House Sparrow (Passer domesticus)	18	25/01/2021	Birds of Ireland	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Iceland Gull (Larus glaucoides)	2	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Lesser Black-backed Gull (Larus fuscus)	3	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Lesser Redpoll (Carduelis cabaret)	13	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Little Egret (Egretta garzetta)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species
Custom	bird	Little Grebe (Tachybaptus ruficollis)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Long-eared Owl (Asio otus)	2	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Long-tailed Duck (Clangula hyemalis)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species
Custom	bird	Long-tailed Tit (Aegithalos caudatus)	14	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Mallard (Anas platyrhynchos)	15	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section I Bird Species
Custom	bird	Meadow Pipit (Anthus pratensis)	11	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Merlin (Falco columbarius)	2	29/02/1984	The First Atlas of Wintering Birds in Britain and Ireland: 1981/82-1983/84.	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Mew Gull (Larus canus)	4	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Mistle Thrush (Turdus viscivorus)	18	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Mute Swan (Cygnus olor)	7	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Northern Lapwing (Vanellus vanellus)	11	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	bird	Northern Pintail (Anas acuta)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List

Custom	bird	Northern Shoveler (Anas clypeata)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	bird	Northern Wheatear (Oenanthe oenanthe)	1	31/07/1972	The First Atlas of Breeding Birds in Britain and Ireland: 1968-1972.	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Peregrine Falcon (Falco peregrinus)	1	29/02/1984	The First Atlas of Wintering Birds in Britain and Ireland: 1981/82-1983/84.	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species
Custom	bird	Pink-footed Goose (Anser brachyrhynchus)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species
Custom	bird	Razorbill (Alca torda)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Red Grouse (Lagopus lagopus)	1	31/07/1972	The First Atlas of Breeding Birds in Britain and Ireland: 1968-1972.	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	bird	Red Knot (Calidris canutus)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	bird	Red-breasted Merganser (Mergus serrator)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species
Custom	bird	Red-throated Diver (Gavia stellata)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Redwing (Turdus iliacus)	4	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Reed Bunting (Emberiza schoeniclus)	11	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Ringed Plover (Charadrius hiaticula)	4	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Rock Pigeon (Columba livia)	11	27/04/2021	Birds of Ireland	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species
Custom	bird	Rook (Corvus frugilegus)	20	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Ruddy Turnstone (Arenaria interpres)	2	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Sand Martin (Riparia riparia)	4	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Sanderling (Calidris alba)	2	31/12/2011	Bird Atlas 2007 - 2011	

Custom	bird	Sandwich Tern (Sterna sandvicensis)	2	31/07/1991	The Second Atlas of Breeding Birds in Britain and Ireland: 1988-1991	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Sedge Warbler (Acrocephalus schoenobaenus)	6	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Sky Lark (Alauda arvensis)	13	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Slavonian Grebe (Podiceps auritus)	1	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Snow Goose (Anser caerulescens)	1	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Song Thrush (Turdus philomelos)	18	02/02/2021	Birds of Ireland	
Custom	bird	Spotted Flycatcher (Muscicapa striata)	7	31/07/1991	The Second Atlas of Breeding Birds in Britain and Ireland: 1988-1991	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Stock Pigeon (Columba oenas)	2	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Stonechat (Saxicola torquata)	4	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Tree Pipit (Anthus trivialis)	1	31/07/1991	The Second Atlas of Breeding Birds in Britain and Ireland: 1988-1991	
Custom	bird	Tufted Duck (Aythya fuligula)	4	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Tundra Swan (Cygnus columbianus)	1	29/02/1984	The First Atlas of Wintering Birds in Britain and Ireland: 1981/82-1983/84.	
Custom	bird	Whinchat (Saxicola rubetra)	1	31/07/1972	The First Atlas of Breeding Birds in Britain and Ireland: 1968-1972.	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	White Wagtail (Motacilla alba)	16	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	White-throated Dipper (Cinclus cinclus)	3	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Whooper Swan (Cygnus cygnus)	5	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
Custom	bird	Willow Warbler (Phylloscopus trochilus)	12	07/04/2016	Birds of Ireland	
Custom	bird	Winter Wren (Troglodytes troglodytes)	18	31/12/2011	Bird Atlas 2007 - 2011	
Custom	bird	Wood Warbler (Phylloscopus sibilatrix)	1	31/07/1991	The Second Atlas of Breeding Birds in Britain and Ireland: 1988-1991	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List

Custom	bird	Yellowhammer (Emberiza citrinella)	9	31/12/2011	Bird Atlas 2007 - 2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
Custom	conifer	Sitka Spruce (Picea sitchensis)	1	22/07/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	fern	Hart's-tongue (Phyllitis scolopendrium)	2	25/09/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	fern	Lady-fern (Athyrium filix-femina)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	fern	Male-fern (Dryopteris filix-mas)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	fern	Polypodium vulgare Sensu lato	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	fern	Polypody (Polypodium vulgare)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	fern	Soft Shield-fern (Polystichum setiferum)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Alder (Alnus glutinosa)	2	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Annual Meadow-grass (Poa annua)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Ash (Fraxinus excelsior)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Aspen (Populus tremula)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Bearded Couch (Elymus caninus)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Bell Heather (Erica cinerea)	2	06/05/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Bilberry (Vaccinium myrtillus)	1	05/04/2008	Species Data from the National Vegetation Database	
Custom	flowering plant	Biting Stonecrop (Sedum acre)	1	01/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Blackthorn (Prunus spinosa)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Bluebell (Hyacinthoides non-scripta)	4	13/05/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Bramble (Rubus fruticosus agg.)	2	04/08/2017	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Branched Bur-reed (Sparganium erectum)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Broad-leaved Dock (Rumex obtusifolius)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Broad-leaved Willowherb (Epilobium montanum)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Broom (Cytisus scoparius)	1	11/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Bush Vetch (Vicia sepium)	2	28/05/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Calystegia sepium subsp. sepium	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Cat's-ear (Hypochaeris radicata)	1	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Celery-leaved Buttercup (Ranunculus sceleratus)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Chives (Allium schoenoprasum)	2	14/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Threatened Species: Vulnerable
Custom	flowering plant	Cleavers (Galium aparine)	2	08/04/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Cochlearia officinalis sens.lat.	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Cock's-foot (Dactylis glomerata)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Coltsfoot (Tussilago farfara)	2	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Common Bent (Agrostis capillaris)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Common Centaury (Centaurium erythraea)	2	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Common Chickweed (Stellaria media)	2	14/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Common Cottongrass (Eriophorum angustifolium)	1	05/04/2008	Species Data from the National Vegetation Database	
Custom	flowering plant	Common Couch (Elytrigia repens)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Common Dog-violet (Viola riviniana)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Common Figwort (Scrophularia nodosa)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Common Knapweed (Centaurea nigra)	2	22/07/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Common Mouse-ear (Cerastium fontanum)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Common Nettle (Urtica dioica)	3	09/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Common Ragwort (Senecio jacobaea)	4	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Common Saltmarsh-grass (Puccinellia maritima)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Common Sorrel (Rumex acetosa)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Common Spotted-orchid (Dactylorhiza fuchsii)	4	18/06/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Common Whitebeam (Sorbus aria)	1	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Corn Spurrey (Spergula arvensis)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Cow Parsley (Anthriscus sylvestris)	2	28/05/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Cowslip (Primula veris)	1	11/04/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Crack-willow (Salix fragilis)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Creeping Bent (Agrostis stolonifera)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Creeping Buttercup (Ranunculus repens)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Creeping Thistle (Cirsium arvense)	2	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Crested Dog's-tail (Cynosurus cristatus)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Cross-leaved Heath (Erica tetralix)	1	05/04/2008	Species Data from the National Vegetation Database	
Custom	flowering plant	Cuckooflower (Cardamine pratensis)	9	20/08/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Curled Dock (Rumex crispus)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Cut-leaved Crane's-bill (Geranium dissectum)	1	28/05/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Daisy (Bellis perennis)	2	11/03/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Dame's-violet (Hesperis matronalis)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Devil's-bit Scabious (Succisa pratensis)	1	22/07/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	

Custom	flowering plant	Downy Birch (Betula pubescens)	1	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Elder (Sambucus nigra)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	False Oat-grass (Arrhenatherum elatius)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Field Bindweed (Convolvulus arvensis)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Floating Sweet-grass (Glyceria fluitans)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Foxglove (Digitalis purpurea)	2	22/07/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Galeopsis tetrahit agg. sensu lato	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Germander Speedwell (Veronica chamaedrys)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Giant Hogweed (Heracleum mantegazzianum)	1	04/07/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Custom	flowering plant	Giant-rhubarb (Gunnera tinctoria)	2	18/09/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Custom	flowering plant	Gooseberry (Ribes uva-crispa)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Gorse (Ulex europaeus)	4	06/05/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Great Willowherb (Epilobium hirsutum)	2	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Greater Bird's-foot-trefoil (Lotus pedunculatus)	3	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Greater Plantain (Plantago major)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Greater Sea-spurrey (Spergularia media)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Greater Stitchwort (Stellaria holostea)	2	19/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Green Alkanet (Pentaglottis sempervirens)	1	13/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Ground-elder (Aegopodium podagraria)	2	14/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Groundsel (Senecio vulgaris)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Hawthorn (Crataegus monogyna)	2	20/08/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Hazel (Corylus avellana)	1	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Heath Rush (Juncus squarrosus)	1	05/04/2008	Species Data from the National Vegetation Database	
Custom	flowering plant	Heath Speedwell (Veronica officinalis)	1	10/06/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Heather (Calluna vulgaris)	2	22/07/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Hedge Bindweed (Calystegia sepium)	2	04/08/2017	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Herb-Robert (Geranium robertianum)	4	20/08/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Himalayan Clematis (Clematis montana)	1	20/08/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Hogweed (Heracleum sphondylium)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Holly (Ilex aquifolium)	2	09/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Hornbeam (Carpinus betulus)	1	25/06/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Horse-chestnut (Aesculus hippocastanum)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Indian Balsam (Impatiens glandulifera)	1	05/05/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Custom	flowering plant	Ivy (Hedera helix)	2	09/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Japanese Knotweed (Fallopia japonica)	2	05/05/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Custom	flowering plant	Lamiastrum galeobdolon subsp. argentatum	1	20/04/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Lesser Burdock (Arctium minus)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Lesser Celandine (Ranunculus ficaria)	6	08/04/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Lesser Sea-spurrey (Spergularia marina)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Lesser Trefoil (Trifolium dubium)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Lords-and-Ladies (Arum maculatum)	1	20/04/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Marsh Cudweed (Gnaphalium uliginosum)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Marsh Foxtail (Alopecurus geniculatus)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Marsh Ragwort (Senecio aquaticus)	1	22/07/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Marsh Thistle (Cirsium palustre)	2	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Marsh Woundwort (Stachys palustris)	2	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Marsh-bedstraw (Galium palustre)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Meadow Vetchling (Lathyrus pratensis)	1	31/12/1999	BSBI tetrad data for Ireland	

Custom	flowering plant	Meadowsweet (Filipendula ulmaria)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Navelwort (Umbilicus rupestris)	1	20/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Nipplewort (Lapsana communis)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Northern Marsh-orchid (Dactylorhiza purpurella)	1	13/06/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Opposite-leaved Golden-saxifrage (Chrysosplenium oppositifolium)	5	17/04/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Oxeye Daisy (Leucanthemum vulgare)	1	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Perennial Rye-grass (Lolium perenne)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Phleum pratense sens.lat.	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Pineappleweed (Matricaria discoidea)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Polygonum aviculare agg. sensu lato	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Portugal Laurel (Prunus lusitanica)	1	18/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Prickly Sow-thistle (Sonchus asper)	2	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Primrose (Primula vulgaris)	5	11/03/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Procumbent Pearlwort (Sagina procumbens)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Red Bartsia (Odontites vernus)	2	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Red Clover (Trifolium pratense)	2	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Red Dead-nettle (Lamium purpureum)	1	21/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Redshank (Persicaria maculosa)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Rhododendron ponticum	3	20/08/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Custom	flowering plant	Ribwort Plantain (Plantago lanceolata)	3	08/04/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Rosebay Willowherb (Chamerion angustifolium)	2	22/07/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Rough Meadow-grass (Poa trivialis)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Salicornia aggregate	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Salix cinerea	1	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Salmonberry (Rubus spectabilis)	1	02/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Medium Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Custom	flowering plant	Saltmarsh Rush (Juncus gerardii)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Sea Arrowgrass (Triglochin maritimum)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Sea Aster (Aster tripolium)	3	25/09/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Sea Club-rush (Bolboschoenus maritimus)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Sea Plantain (Plantago maritima)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Sea-milkwort (Glaux maritima)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Selfheal (Prunella vulgaris)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Shepherd's-purse (Capsella bursa-pastoris)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Silverweed (Potentilla anserina)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Slender St John's-wort (Hypericum pulchrum)	2	22/07/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Smooth Hawk's-beard (Crepis capillaris)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Smooth Sow-thistle (Sonchus oleraceus)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Sneezewort (Achillea ptarmica)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Snowberry (Symphoricarpos albus)	1	25/09/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Spear Thistle (Cirsium vulgare)	3	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Square-stalked St John's-wort (Hypericum tetrapterum)	2	14/08/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Stinking Hellebore (Helleborus foetidus)	1	20/03/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Sweet Vernal-grass (Anthoxanthum odoratum)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Sycamore (Acer pseudoplatanus)	1	31/12/1999	BSBI tetrad data for Ireland	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Medium Impact Invasive Species
Custom	flowering plant	Taraxacum aggregate	5	20/08/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Three-cornered Garlic (Allium triquetrum)	1	20/04/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Medium Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Custom	flowering plant	Thrift (Armeria maritima)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Toad Rush (Juncus bufonius)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Tormentil (Potentilla erecta)	3	20/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Trichophorum cespitosum subsp. germanicum	1	05/04/2008	Species Data from the National Vegetation Database	
Custom	flowering plant	Tufted Vetch (Vicia cracca)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Upright Hedge-parsley (Torilis japonica)	1	31/12/1999	BSBI tetrad data for Ireland	

Custom	flowering plant	Wavy Bitter-cress (Cardamine flexuosa)	2	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	White Clover (Trifolium repens)	1	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Wild Angelica (Angelica sylvestris)	2	22/07/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Wild Cherry (Prunus avium)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Wild Strawberry (Fragaria vesca)	1	14/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Wood Avens (Geum urbanum)	1	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Wood Speedwell (Veronica montana)	1	27/05/2020	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Wood-sorrel (Oxalis acetosella)	3	09/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Wych Elm (Ulmus glabra)	1	25/09/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Yarrow (Achillea millefolium)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Yellow Loosestrife (Lysimachia vulgaris)	1	22/07/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	
Custom	flowering plant	Yorkshire-fog (Holcus lanatus)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	flowering plant	Zigzag Clover (Trifolium medium)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	harvestman (Opiliones)	Leiobunum blackwalli	1	12/10/1995	Harvestmen (Opiliones) of Ireland	
Custom	harvestman (Opiliones)	Nelima gothica	1	04/07/1995	Harvestmen (Opiliones) of Ireland	
Custom	harvestman (Opiliones)	Nemastoma bimaculatum	1	04/07/1995	Harvestmen (Opiliones) of Ireland	
Custom	harvestman (Opiliones)	Opilio parietinus	1	12/10/1995	Harvestmen (Opiliones) of Ireland	
Custom	harvestman (Opiliones)	Paroligolophus agrestis	1	12/10/1995	Harvestmen (Opiliones) of Ireland	
Custom	harvestman (Opiliones)	Phalangium opilio	1	12/10/1995	Harvestmen (Opiliones) of Ireland	
Custom	horsetail	Field Horsetail (Equisetum arvense)	1	31/12/1999	BSBI tetrad data for Ireland	
Custom	insect - beetle (Coleoptera)	14-spot Ladybird (Propylea quattuordecimpunctata)	1	15/05/2019	Ladybirds of Ireland	
Custom	insect - beetle (Coleoptera)	2-spot Ladybird (Adalia bipunctata)	1	26/07/2013	Ladybirds of Ireland	
Custom	insect - beetle (Coleoptera)	7-spot Ladybird (Coccinella septempunctata)	6	06/06/2022	Ladybirds of Ireland	
Custom	insect - beetle (Coleoptera)	Cream-spot Ladybird (Calvia quattuordecimguttata)	1	31/05/2019	Ladybirds of Ireland	
Custom	insect - beetle (Coleoptera)	Hygrotus (Hygrotus) quinquelineatus	1	29/09/1906	Water Beetles of Ireland	
Custom	insect - beetle (Coleoptera)	Larger Noterus (Noterus clavicornis)	1	29/09/1906	Water Beetles of Ireland	
Custom	insect - beetle (Coleoptera)	Nebrioporus (Nebrioporus) assimilis	1	29/09/1906	Water Beetles of Ireland	
Custom	insect - beetle (Coleoptera)	Nicrophorus vespilloides	1	10/06/2019	Carrion Beetles of Ireland	
Custom	insect - beetle (Coleoptera)	Orange Ladybird (Halyzia sedecimguttata)	2	01/07/2020	Ladybirds of Ireland	
Custom	insect - butterfly	Common Blue (Polyommatus icarus)	1	31/12/1969	Distribution Atlas of Butterflies in Ireland 1979 (An Foras Forbartha)	
Custom	insect - butterfly	Green-veined White (Pieris napi)	28	02/06/2021	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Holly Blue (Celastrina argiolus)	4	26/04/2020	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Large White (Pieris brassicae)	13	14/06/2020	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Marsh Fritillary (Euphydryas aurinia)	4	31/12/2010	All Ireland Marsh Fritillary Database	Protected Species: EU Habitats Directive || Protected Species: EU Habitats Directive >> Annex II || Threatened Species: Vulnerable
Custom	insect - butterfly	Meadow Brown (Maniola jurtina)	15	01/07/2020	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Orange-tip (Anthocharis cardamines)	25	02/06/2021	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Painted Lady (Vanessa cardui)	20	21/04/2021	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Peacock (Inachis io)	27	02/06/2021	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Red Admiral (Vanessa atalanta)	13	29/04/2021	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Ringlet (Aphantopus hyperantus)	15	01/07/2020	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Small Copper (Lycaena phlaeas)	3	10/06/2019	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Small Heath (Coenonympha pamphilus)	8	02/06/2021	Atlas of Butterflies in Ireland 2021	Threatened Species: Near threatened
Custom	insect - butterfly	Small Tortoiseshell (Aglais urticae)	15	28/09/2020	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Small White (Pieris rapae)	3	29/04/2021	Atlas of Butterflies in Ireland 2021	
Custom	insect - butterfly	Speckled Wood (Pararge aegeria)	18	01/07/2020	Atlas of Butterflies in Ireland 2021	
Custom	Insect - butterfly	Wood White (Leptidea sp.)	1	08/04/2017	Atlas of Butterflies in Ireland 2021	
Custom	insect - dragonfly (Odonata)	Common Darter (Sympetrum striolatum)	1	03/07/2019	Dragonfly Ireland 2019 to 2024	
Custom	insect - dragonfly (Odonata)	Emerald Damselfly (Lestes sponsa)	1	20/07/1937	Dragonfly Ireland	
Custom	insect - dragonfly (Odonata)	Large Red Damselfly (Pyrrhosoma nymphula)	1	20/05/2019	Dragonfly Ireland 2019 to 2024	
Custom	insect - hymenopteran	Andrena (Andrena) clarkella	5	25/04/2021	Bees of Ireland	
Custom	insect - hymenopteran	Bombus (Bombus) lucorum	1	21/03/2021	Bees of Ireland	
Custom	insect - hymenopteran	Bombus (Bombus) terrestris	1	25/04/2021	Bees of Ireland	
Custom	insect - hymenopteran	Bombus lucorum agg.	5	21/05/2020	Bees of Ireland	
Custom	insect - hymenopteran	Common Carder Bee (Bombus (Thoracombus) pascuorum)	5	20/05/2020	Bees of Ireland	
Custom	insect - hymenopteran	Early Bumble Bee (Bombus (Pyrobombus) pratorum)	3	26/05/2020	Bees of Ireland	
Custom	insect - hymenopteran	Grey Mining Bee (Andrena (Melandrena) cineraria)	5	25/04/2021	Bees of Ireland	
Custom	insect - hymenopteran	Heath Bumble Bee (Bombus (Pyrobombus) jonellus)	1	01/06/2020	Bees of Ireland	
Custom	insect - hymenopteran	Honey Bee (Apis mellifera)	1	20/08/2022	Bees of Ireland	

Custom	insect - hymenopteran	Nomada leucophthalma	1	17/04/2021	Bees of Ireland	
Custom	insect - hymenopteran	Small Garden Bumble Bee (Bombus (Megabombus) hortorum)	1	15/06/2019	Bees of Ireland	
Custom	insect - moth	Angle Shades (Phlogophora meticulosa)	3	06/05/2022	Moths Ireland	
Custom	insect - moth	Argyresthia brockeella	2	22/06/2018	Moths Ireland	
Custom	insect - moth	August Thorn (Ennomos quercinaria)	1	14/08/2003	Moths Ireland	
Custom	insect - moth	Bee Moth (Aphomia sociella)	1	31/12/1891	Moths Ireland	
Custom	insect - moth	Bilberry Tortrix (Aphelia viburnana)	2	31/12/2009	Microlepidoptera collections (National Museum of Ireland)	
Custom	insect - moth	Blue-bordered Carpet (Plemyria rubiginata)	1	23/06/2017	Moths Ireland	
Custom	insect - moth	Buff-tip (Phalera bucephala)	1	28/08/2019	Moths Ireland	
Custom	insect - moth	Caloptilia syringella	2	23/06/2022	Moths Ireland	
Custom	insect - moth	Cinnabar (Tyria jacobaeae)	1	28/05/2018	Moths Ireland	
Custom	insect - moth	Clouded Border (Lomaspilis marginata)	2	23/06/2017	Moths Ireland	
Custom	insect - moth	Coleophora serratella	1	23/06/2022	Moths Ireland	
Custom	insect - moth	Common Marbled Carpet (Chloroclysta truncata)	2	03/09/2005	Moths Ireland	
Custom	insect - moth	Coxcomb Prominent (Ptilodon capucina)	1	26/08/2019	Moths Ireland	
Custom	insect - moth	Crescent (Celaena leucostigma)	1	03/09/2005	Moths Ireland	
Custom	insect - moth	Dark Marbled Carpet (Chloroclysta citrata)	1	14/08/2003	Moths Ireland	
Custom	insect - moth	Drinker (Euthrix potatoria)	4	27/04/2021	Moths Ireland	
Custom	insect - moth	Ear Moth agg. (Amphipoea oculea agg.)	1	03/09/2005	Moths Ireland	
Custom	insect - moth	Epermenia chaerophyllella	1	23/06/2022	Moths Ireland	
Custom	insect - moth	Flame Carpet (Xanthorhoe designata)	2	03/09/2005	Moths Ireland	
Custom	insect - moth	Garden Carpet (Xanthorhoe fluctuata)	1	01/07/2019	Moths Ireland	
Custom	insect - moth	Haworth's Minor (Celaena haworthii)	1	03/09/2005	Moths Ireland	
Custom	insect - moth	Heath Rustic (Xestia agathina)	1	03/09/2005	Moths Ireland	
Custom	insect - moth	Herald (Scoliopteryx libatrix)	6	15/11/2019	Moths Ireland	
Custom	insect - moth	Iron Prominent (Notodonta dromedarius)	1	26/08/2019	Moths Ireland	
Custom	insect - moth	July Highflyer (Hydriomena furcata)	2	03/09/2005	Moths Ireland	
Custom	insect - moth	Large Yellow Underwing (Noctua pronuba)	3	01/07/2020	Moths Ireland	
Custom	insect - moth	Lesser Broad-bordered Yellow Underwing (Noctua janthe)	2	03/09/2005	Moths Ireland	
Custom	insect - moth	Lesser Swallow Prominent (Pheosia gnoma)	1	14/08/2003	Moths Ireland	
Custom	insect - moth	Lesser Yellow Underwing (Noctua comes)	2	03/09/2005	Moths Ireland	
Custom	insect - moth	Light Knot Grass (Acronicta menyanthidis)	2	15/06/1900	Moths Ireland	
Custom	insect - moth	Magpie (Abraxas grossulariata)	1	10/07/2021	Moths Ireland	
Custom	insect - moth	Micropterix aruncella	2	07/06/2019	Moths Ireland	
Custom	insect - moth	Miller (Acronicta leporina)	1	31/12/1960	Moths Ireland	
Custom	insect - moth	Mompha langiella	1	23/06/2022	Moths Ireland	
Custom	insect - moth	Mottled Umber (Erannis defoliaria)	1	05/06/2019	Moths Ireland	
Custom	insect - moth	Narrow-bordered Bee Hawk-moth (Hemaris tityus)	1	20/06/2017	Moths Ireland	
Custom	insect - moth	Neglected Rustic (Xestia castanea)	1	03/09/2005	Moths Ireland	
Custom	insect - moth	Notch Wing Tortix (Acleris emargana)	1	24/08/2018	Moths Ireland	
Custom	insect - moth	Peppered Moth (Biston betularia)	1	06/09/2019	Moths Ireland	
Custom	insect - moth	Phyllonorycter maestingella	1	23/06/2022	Moths Ireland	
Custom	insect - moth	Poplar Hawk-moth (Laothoe populi)	2	13/07/2020	Moths Ireland	
Custom	insect - moth	Riband Wave (Idaea aversata)	1	14/08/2003	Moths Ireland	
Custom	insect - moth	Ruby Tiger (Phragmatobia fuliginosa)	1	20/05/2019	Moths Ireland	
Custom	insect - moth	Setaceous Hebrew Character (Xestia c-nigrum)	1	31/12/1960	Moths Ireland	
Custom	insect - moth	Shaded Broad-bar (Scotopteryx chenopodiata)	3	26/07/2019	Moths Ireland	
Custom	insect - moth	Silver Y (Autographa gamma)	7	01/07/2020	Moths Ireland	
Custom	insect - moth	Six-spot Burnet (Zygaena filipendulae)	1	14/08/2015	Moths Ireland	
Custom	insect - moth	Small Square-spot (Diarsia rubi)	1	03/09/2005	Moths Ireland	
Custom	insect - moth	Small Wainscot (Chortodes pygmina)	1	03/09/2005	Moths Ireland	
Custom	insect - moth	Spindle Ermine (Yponomeuta cagnagella)	2	27/07/2020	Moths Ireland	
Custom	insect - moth	Square-spot Rustic (Xestia xanthographa)	1	03/09/2005	Moths Ireland	
Custom	insect - moth	Stigmella aurella	1	23/06/2022	Moths Ireland	
Custom	insect - moth	Stigmella hemargyrella	1	23/06/2022	Moths Ireland	
Custom	insect - moth	Timothy Tortrix (Aphelia paleana)	1	02/06/2021	Moths Ireland	
Custom	insect - moth	Vapourer (Orgyia antiqua)	2	21/07/2017	Moths Ireland	
Custom	insect - moth	Willow Beauty (Peribatodes rhomboidaria)	1	14/08/2009	Moths Ireland	
Custom	insect - true bug (Hemiptera)	Birch Shieldbug (Elasmostethus interstinctus)	4	23/06/2020	True Bugs (Heteroptera) of Ireland	
Custom	insect - true bug (Hemiptera)	Bronze Shieldbug (Troilus luridus)	2	20/07/2018	True Bugs (Heteroptera) of Ireland	
Custom	insect - true bug (Hemiptera)	Forest Bug (Pentatoma rufipes)	6	23/06/2020	True Bugs (Heteroptera) of Ireland	
Custom	insect - true bug (Hemiptera)	Gorse Shieldbug (Piezodorus lituratus)	3	22/03/2019	True Bugs (Heteroptera) of Ireland	
Custom	insect - true bug (Hemiptera)	Green Shieldbug (Palomena prasina)	1	27/09/2019	True Bugs (Heteroptera) of Ireland	
Custom	insect - true bug (Hemiptera)	Hawthorn Shieldbug (Acanthosoma haemorrhoidale)	2	27/04/2021	True Bugs (Heteroptera) of Ireland	
Custom	insect - true bug (Hemiptera)	Parent Bug (Elasmucha grisea)	3	15/05/2019	True Bugs (Heteroptera) of Ireland	
Custom	insect - true fly (Diptera)	Helophilus pendulus	1	19/06/2013	Hoverflies (Syrphidae) of Ireland	
Custom	insect - true fly (Diptera)	Phytomyza ranunculi	1	20/04/2016	Leafminers of Ireland	
Custom	insect - true fly (Diptera)	Rhingia campestris	1	05/06/2019	Hoverflies (Syrphidae) of Ireland	

Custom	marine mammal	Bottle-nosed Dolphin (Tursiops truncatus)	1	24/07/2001	IWDG Cetacean Strandings Database	Protected Species: EU Habitats Directive || Protected Species: EU Habitats Directive >> Annex II || Protected Species: EU Habitats Directive >> Annex IV || Protected Species: Wildlife Acts
Custom	marine mammal	Common Seal (Phoca vitulina)	3	03/02/2020	Explore Your Shore	Protected Species: EU Habitats Directive || Protected Species: EU Habitats Directive >> Annex II || Protected Species: EU Habitats Directive >> Annex V || Protected Species: Wildlife Acts
Custom	millipede	Blunt-tailed Snake Millipede (Cylindroiulus punctatus)	1	31/08/1994	Millipedes of Ireland	
Custom	millipede	Common Flat-backed Millipede (Polydesmus angustus)	1	31/08/1994	Millipedes of Ireland	
Custom	millipede	Eyed Flat-backed Millipede (Nanogona polydesmoides)	1	31/08/1994	Millipedes of Ireland	
Custom	mollusc	Arion (Arion)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Brown Snail (Zenobiella subrufescens)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	Threatened Species: Vulnerable
Custom	mollusc	Cellar Snail (Oxychilus (Oxychilus) cellarius)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Dusky Slug (Arion (Mesarion) subfuscus)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Freshwater Pearl Mussel (Margaritifera (Margaritifera) margaritifera)	3	31/12/1994	All Ireland Non-Marine Molluscan Database	Protected Species: EU Habitats Directive || Protected Species: EU Habitats Directive >> Annex II || Protected Species: EU Habitats Directive >> Annex V || Protected Species: Wildlife Acts
Custom	mollusc	Great Grey Slug (Limax maximus)	1	31/07/1977	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Jenkins' Spire Snail (Potamopyrgus antipodarum)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Medium Impact Invasive Species
Custom	mollusc	Large Amber Snail (Succinea putris)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Lymnaea (Stagnicola)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Netted Slug (Deroceras (Deroceras) reticulatum)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Pfeiffer's Amber Snail (Oxyloma (Oxyloma) elegans)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Porous Pea Mussel (Pisidium obtusale)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Red-crusted Pea Mussel (Pisidium personatum)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Tree Slug (Lehmannia marginata)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	Wandering Snail (Radix balthica)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	mollusc	White-lipped Ramshorn (Anisus (Anisus) leucostoma)	1	31/10/1905	All Ireland Non-Marine Molluscan Database	
Custom	moss	Archangelic Thread-moss (Bryum archangelicum)	1	31/12/1891	Bryophytes of Ireland	Threatened Species: Least concern
Custom	moss	Bank Haircap (Polytrichum formosum)	1	31/12/1969	Bryophytes of Ireland	
Custom	moss	Common Striated Feather-moss (Eurhynchium striatum)	1	31/12/1969	Bryophytes of Ireland	Threatened Species: Least concern
Custom	moss	Common Tamarisk-moss (Thuidium tamariscinum)	1	31/12/1969	Bryophytes of Ireland	Threatened Species: Least concern
Custom	moss	Great Plait-moss (Hypnum lacunosum var. lacunosum)	1	31/12/1969	Bryophytes of Ireland	Threatened Species: Least concern
Custom	moss	Springy Turf-moss (Rhytidiadelphus squarrosus)	1	31/12/1969	Bryophytes of Ireland	Threatened Species: Least concern
Custom	moss	Supine Plait-moss (Hypnum cupressiforme var. resupinatum)	1	31/12/1969	Bryophytes of Ireland	Threatened Species: Least concern
Custom	moss	Wall Screw-moss (Tortula muralis)	1	31/12/1969	Bryophytes of Ireland	Threatened Species: Least concern
Custom	terrestrial mammal	Eastern Grey Squirrel (Sciurus carolinensis)	3	05/03/2019	National Invasive Species Database	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> EU Regulation No. 1143/2014 || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Custom	terrestrial mammal	Eurasian Badger (Meles meles)	1	06/06/2018	Mammals of Ireland 2016-2025	Protected Species: Wildlife Acts
Custom	terrestrial mammal	European Otter (Lutra lutra)	3	01/02/2015	Atlas of Mammals in Ireland 2010-2015	Protected Species: EU Habitats Directive || Protected Species: EU Habitats Directive >> Annex II || Protected Species: EU Habitats Directive >> Annex IV || Protected Species: Wildlife Acts
Custom	terrestrial mammal	European Rabbit (Oryctolagus cuniculus)	1	06/06/2018	Mammals of Ireland 2016-2025	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Medium Impact Invasive Species
Custom	terrestrial mammal	Red Deer (Cervus elaphus)	2	31/12/2008	Deer of Ireland Database	Protected Species: Wildlife Acts
Custom	terrestrial mammal	Red Fox (Vulpes vulpes)	2	20/04/2018	Mammals of Ireland 2016-2025	

Custom	terrestrial mammal	West European Hedgehog (Erinaceus europaeus)	7	17/05/2021	Hedgehogs of Ireland	Protected Species: Wildlife Acts

OUTLINE INVASIVE SPECIES MANAGEMENT PLAN

ATU Regional Sports Activity Hub

NI 2553 ATU Regional Sports
Activity HUb
Ecology
OISMP
F01
April 2023

www.rpsgroup.com

Document Status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
F01	OISMP	S. O'Hara	J.McCrory	J.McCrory	21/04/23

Approval for issue

James McCrory CEcol CEnv MCIEEM CBiol MRSB		21/04/23

Prepared by:

RPS Ireland Ltd (NI)

Samuel O'Hara
Associate - Ecology

Elmwood House, 74 Boucher Road
Belfast, Co. Antrim, BT12 6RZ

T 028 9066 7914
E samuel.ohara@rpsgroup.com

Prepared for:

Hamilton Architects

Mark Priestley
Senior Architect

Hamilton House, 3 Joy Street, The Linen Quarter, Belfast, BT2 8LE

T +44 (0)28 9033 4250
E mark.priestley@hamiltonarchitects.co.uk

Contents

1 INTRODUCTION 3
1.1 Introduction 3
1.2 Statement of Authority 3
1.3 Proposed Project 3
1.4 Site Description 4
1.5 Invasive Species 4
2 LEGISLATION & PLANNING POLICY 6
2.1 European Communities (Birds and Natural Habitats) Regulations 2011 [SI. 477] 6
2.2 European Regulations 6
3 INVASIVE SPECIES SURVEY RESULTS 7
3.1 Himalayan Balsam 7
3.2 Salmonberry 7
4 OUTLINE MANAGEMENT PLAN 8
4.1 Responsibility 8
4.2 Site Management Objectives 8
4.3 Himalayan Balsam 8
4.4 Salmonberry 10
5 REFERENCES 15

Figures

Figure 1.1: Survey Area
Figure 3.1: Invasive Species Plan

Appendices

Appendix I: Herbicide Records
Appendix II: Waste Records
Appendix III: Monitoring Records

1 INTRODUCTION

1.1 Introduction

RPS was commissioned by Hamilton Architects, on behalf of Letterkenny Institute of Technology to produce an Outline Invasive Species Management Plan (OISMP) for lands north of the N56 Road, Letterkenny in association with the proposed Regional Sports Activity Hub.

1.2 Statement of Authority

The author and surveyor, Samuel O'Hara, is an Associate Ecologist with RPS and holds a BSc (Hons) in Ecology and has over eight years of experience in the field of ecology. Samuel has extensive experience of ecological field survey including habitat, mammal and bird survey and is a protected species license holder. Samuel is an Associate member of the CIEEM.

The reviewer, James McCrory, is a Senior Associate of Ecology within RPS and holds a BA (Hons) in Natural Sciences (Mod) Botany and a MSc in Habitat Creation and Management. James is a Chartered Environmentalist (CEnv), a Chartered Ecologist (CEcol) and a Chartered Biologist (CBiol). James is part of the CIEEM Policy Review Group in Ireland and is a member of the CIEEM technical committee updating the seminal Guidelines for Ecological Impact Assessment in the United Kingdom (IEEM, 2006).

We confirm that the professional judgement expressed herein is the true and bona fide opinion of our professional ecologists. The information prepared and provided is accurate at the time of issue of this report and has been prepared and provided in accordance with the CIEEM Code of Professional Conduct (CIEEM 2019).

1.3 Proposed Project

The scope of the project includes but not limited to the construction of a sports hub incorporating the following elements:

- Pitch 1: Full GAA sized 4G artificial grass pitch – split into 2 x 4G AGP soccer pitches when required.
- Pitch 2: Full sized grass GAA sized match pitch
- Pitch 3: Full size grass soccer pitch
- Pitch 4: Full size grass soccer pitch
- Pitch 5: Non-turf pitch cricket wicket and grass outfield over pitches 3 and 4
- Pitches 6 –7: 2 x small sided 4G artificial grass pitches 'caged' with 1.2m high rebound boards and 2.4m fencing over
- c.990 sqm Indoor dome covered sports courts and ancillary accommodation suitable for warm-up and a range of sports
- Training/Practice Area (25x80m)
- Hurling/Handball Wall
- 6 Lane Athletic Sprint Track (50x7.5m)
- Pavilion building (c.1,325m^2) with:

  - Booking office/reception
  - changing and meeting facilities
  - self-serve catering facility
  - stores
  - flexible space for group exercise and community programmes
- Grounds Equipment Store and service compound
- Walking Trail Loop
- Informal cross-country route
- Children's playpark, with amphitheatre and Community Garden
- Landscaping to include biodiversity garden

The scope of the project also includes:

- Drainage
- Floodlighting to Pitches 1, 2, 6 & 7
- Fencing and netting to pitches 1, 2, 6 & 7
- Goal posts and ball stop netting.
- Tiered spectator viewing facilities to Pitches 1 and 2
- Site lighting
- Access roads, footpaths and cycleways
- Coach Parking
- Parking including disabled parking
- Electricity line that needs to be realigned
- Improved access arrangements from the N56
- Realignment of part of the site boundary with the adjoining local road to improve visibility
- Site preparation including:
  - cut and fill and soil importation to prepare sloping areas of site
  - ducting for undergrounding of overhead electrical services

1.4 Site Description

The study area surveyed for invasive species and subject to the recommendations within this document consist of large areas of agricultural fields and adjacent areas of short-rotation willow coppice, in addition to associated hedgerows. The site is semi-urban, being largely surrounded by existing development.

The area subject to survey are illustrated on the accompanying Figures 1.0, invasive species outside of the proposed development boundaries were also noted, where these were recorded during survey works within the study area.

1.5 Invasive Species

Invasive non-native species are defined as those that have been introduced, either intentionally or unintentionally, outside of their natural range and that present a threat to biodiversity. They can have a

wide range of impacts on ecology, the environment and the economy. Once established they can be extremely difficult to control and costly to eradicate. It is also an offence to plant or otherwise cause to grow in the wild any plant listed on Part 1 of SI. No. 477 of 2011, European Communities (Birds and Natural Habitats) Regulations 2011.

Invasive non-native species listed on Part 1 of SI. No. 477 of 2011, European Communities (Birds and Natural Habitats) Regulations 2011 and recorded within the survey sites include Himalayan balsam *Impatiens glandulifera* and salmonberry *Rubus spectabilis*.

2 LEGISLATION & PLANNING POLICY

The principal legislation in Ireland relating to invasive non-native species and relevant to the proposed development are set out below.

2.1 European Communities (Birds and Natural Habitats) Regulations 2011 [SI. 477]

It is an offence under Article 49 (2) of the European Communities (Birds and Natural Habitats) Regulations 2011 for any person to plant, disperse, allow to grow or cause to disperse, spread or otherwise cause to grow throughout the state any plant included in Part 1 of the Third Schedule. Giant hogweed, Himalayan balsam, Himalayan knotweed, Japanese knotweed and rhododendron are included on the Third Schedule of the Regulations.

2.2 European Regulations

Regulation (EU) 1143/2014 on invasive alien species (the IAS Regulation) entered into force on 1 January 2015, fulfilling Action 16 of Target 5 of the EU 2020 Biodiversity Strategy, as well as Aichi Target 9 of the Strategic Plan for Biodiversity 2011-2020 under the Convention of Biological Diversity.

The core of the IAS Regulation is the list of Invasive Alien Species of Union concern ("the Union list").

The IAS Regulation provides for a set of measures to be taken across the EU in relation to invasive alien species included on the Union list. Three distinct types of measures are envisaged, which follow an internationally agreed hierarchical approach to combatting IAS:

Prevention: a number of robust measures aimed at preventing the intentional or unintentional introduction of IAS of Union concern into the EU.

Early detection and rapid eradication: Member States must put in place a surveillance system to detect the presence of IAS of Union concern as early as possible and take rapid eradication measures to prevent them from establishing.

Management: some IAS of Union concern are already established in certain Member States. Concerted management action is needed to prevent them from spreading any further and to minimize the harm they cause.

3 INVASIVE SPECIES SURVEY RESULTS

Invasive species survey at the site was undertaken by RPS in May 2022.

Invasive species survey findings are described below for the site are illustrated on the accompanying Figures 3.1.

3.1 Himalayan Balsam

The locations of these species within the survey area are illustrated on the accompanying Figure 3.1.

Himalayan balsam was recorded in two separate scattered stands within the study area, including a long and narrow stand (c.150m2) within the margins of short rotation coppice to the east of the central watercourse and a smaller stand (c.40m2) of recently colonised plants on an area of dumped spoil adjacent to the access track leading to the short rotation coppice in the central area of the site.

3.2 Salmonberry

Salmonberry was recorded scattered throughout the vast majority of the hedgerows within the study area in addition to scattered throughout areas of short-rotation coppice.

The locations of these species within the survey area are illustrated on the accompanying Figure 3.1.

4 OUTLINE MANAGEMENT PLAN

4.1 Responsibility

The OISMP has been drafted prior to procurement of a Contractor by Letterkenny Institute of Technology. The person responsible for the management of invasive non-native species on site and the implementation of the ISMP has therefore yet to be appointed. Once procured the Contractor will appoint an Environmental Manager (EM) and Ecological Clerk of Works (ECoW).

The EM will be responsible for the implementation and sign-off of the ISMP, liaison with the ECoW, ensuring that all contractors, sub-contractors and site personnel are aware of the plan and that provisions are made for avoiding any further contamination of the site. The EM will also be responsible for ensuring that the ISMP is updated and revised in light of any emerging civil engineering design and in advance of management works.

The ECoW will be a person with the qualifications, training, skills and relevant experience to undertake appropriate survey and monitoring and to provide specialist advice in relation to invasive non-native species to site personnel on the necessary working practices required to safeguard the site and to aid compliance with relevant legislation. The ECoW will be responsible for survey and identification of invasive non-native species; supervising management works where necessary and monitoring.

The ISMP is a working document, its appendices and any revisions will be kept for future site owners.

4.2 Site Management Objectives

The main management objective is to manage and/or eradicate invasive non-native species including Himalayan balsam and salmonberry located within the site boundary prior to commencement of initial site preparation works and any resulting construction contract.

Where proposed development will involve excavation or other works within areas supporting invasive non-native species it is envisaged that more rapid techniques for eradication will likely be required to ensure the future integrity of any constructed features and to prevent spread of the species during construction.

Where stands of invasive species will not be directly affected by the proposals it is considered that a more long-term approach may be more appropriate, involving management rather than eradication, to reduce expenses associated with large and unnecessary excavations, as may be required.

4.3 Himalayan Balsam

Himalayan balsam is an invasive non-native species in Ireland originating from the Himalayas. It is an annual plant that completes its life cycle in one growing season and reproduces from seed. Each plant can produce over 800 seeds which remain viable in the soil for up to two years. The mature seed capsules explode at the slightest touch and can scatter seeds up to 7 m from the parent plant. It can be spread by the movement of contaminated soil containing seeds and by transport of seed by water when located next to watercourses.

4.3.1 Management Options

There are a number management options for the control of balsam these include:

- Excavation & Removal of the Seed Bank Off Site
- Excavation of the Seed Bank, Cell Formation & Burial On Site
- In-situ Herbicide Treatment (folia application)
- Manual removal (pulling or cutting)
- Combined Method (combined treatment of cutting & herbicide)

It is not an acceptable option to consider doing nothing.

Given the timescales involved in the project it is proposed that feasible management options are limited to in-situ herbicide treatment or combined methods of cutting, removal and herbicide treatment. Such treatment can proceed as early as possible and in advance of the proposed development.

Stands of Himalayan balsam located outside of the site boundary or within areas not subject to direct disturbance, should be managed via in-situ herbicide treatment. This treatment will result in the eradication of the treated plants however treatment is likely to be required on a repeated basis over a number of years to exhaust the seed bank.

4.3.2 Preventing Further Spread

- At construction stage, all contractors, sub-contractors and site personnel should be briefed on the presence and location of invasive non-native species; the site practices put in place to avoid further spread and contamination; and receive training in the identification of Himalayan balsam. A poster or leaflet highlighting the key features of the plant will be displayed in all communal areas. Signs should be erected in relevant areas including those proposed for works in associated with the proposals, where the species is present. These measures will help to avoid the potential spread of invasive non-native species either around the site or off site.

4.3.3 Option 1: In-Situ Herbicide Treatment (Folia Application)

- Himalayan balsam stands managed using in-situ herbicide treatment. Herbicide must be applied by a '*Suitable Qualified and Fully Trained Operative'*. It is recommended that glyphosate is used to treat balsam growth. It should be noted however that glyphosate is a non-selective broad-spectrum systemic herbicide. Care should therefore be taken when using it around mature trees and desirable vegetation.
- Herbicide should be applied in late-spring in dry weather conditions (no rain for 24 hours). Spraying should not be carried out in wind speeds above Force 2 on the Beaufort scale to avoid spray drift.
- Details of all herbicide applications should be recorded and documented in Appendix I. Details should include the name of personnel, date, balsam stands treated, herbicide brand name, active ingredient, amount used and weather conditions.
- The treated stand should be monitored to check for new growth throughout the growing season and herbicide treatment carried out once a year in late-spring, prior to the plant setting seed.
- Herbicide treatment will kill each individual plant, however repeated treatment over a number of years will be required given the presence of a seed bank within the areas in which the plant is supported, as new growth from the seed bank arises.

4.3.4 Option 2: Manual Removal

- Himalayan balsam stands managed using manual removal. This methodology will involve the cutting of plants in the growing season before the plant has set seed. It is therefore recommended that such works would not take place when pods are visible on plants.
- Plants should be cut manually and cleanly using a cutter, hook or scythe. Plants should be cut below the lowest node of the plant to prevent regenerative growth. Cutting should be undertaken in late-spring before the plant sets seed.
- Plants should not be cut, strimmed or flailed during the active seeding period (June-September) to prevent dispersal of seeds.
- Where cutting is undertaken prior to the plant setting seed the cut material can be left in-situ or removed from site.
- Where cutting is required within the late-summer and autumn, when the plant has set seed, it will be necessary for plants to be individually bagged and subsequently cut. Bags will be of appropriate size and care taken to prevent the accidental spread of seed during the process. It is recommended however that cutting or other treatment of the species during the late-summer and autumn is avoided where possible.
- Where small areas are to be cleared manual control can be achieved through the pulling up of plants. Again such plants can be left in-situ or removed from site and it is recommended that such works take place in the late-spring to avoid the potential for inadvertent spreading of seeds.
- Manual removal will eradicate individual plants, however repeated treatment over a number of years will be required given the presence of a seed bank within the areas in which the plant is supported, as new growth from the seed bank arises.

4.3.5 Option 3: Combined Methodology

- A combined methodology can be utilised as required, including both the application of herbicide or cutting, where such solutions may complement each other and where one treatment option is not feasible.
- The methodology for such an approach is likely to be subject to tailoring by the contractor on the ground, but should be undertaken in line with the relevant information above in respect of the treatment options.

4.4 Salmonberry

R. spectabilis is a deciduous shrub from western North America. It is a deciduous, vigorous, suckering shrub, naturalising in woods and hedges, often forming extensive thickets. It is common throughout Ireland having naturalised in many areas. Forming dense thickets, it can inhibit the regeneration of native plant species, such as native trees in woodland. It can fully occupy a site through vegetative regeneration (suckering as well as layering of above-ground stems) and can spread through seed dispersal.

Rhizomes typically grow within several feet of the soil surface, but may be deeper. Often they form dense, interwoven mats. Each rhizome has the potential to produce buds every 0.5 to 1.0 inch. As such, a single network can therefore contain hundreds of thousands of buds per acre. Rhizomes grow rapidly, often several feet per year, particularly following disturbance (O'Rourke, E. & Lysaght, L., 2014).

In the Republic of Ireland it has been assessed as having a risk of Medium Impact.

4.4.1.1 Preventing Further Spread

- Immediate priority should be given to setting up a Contamination Zone around an individual plant or large thicket or stand. The Contamination Zone should extend 2m laterally from visible plant growth and hi-visibility hazard tape or barrier fencing mesh and signs should be erected warning of the presence of invasive non-native species. The Contamination Zone will demarcate the area of soil likely to be contaminated by the underground rhizome system of salmonberry. No access should be allowed within the Contamination Zones.
- Eradication works should avoid the use of machinery and vehicles with caterpillar tracks. Contractors should ensure that all machinery and vehicles used on site will be brushed down on root barrier membrane and cleaned immediately prior to leaving the Contamination Zone. Care must be taken to clean off all infective plant and soil material. The discarded material will not be allowed to contaminate drains, ditches or watercourses. The machinery and vehicles will be inspected before being taken off site and used for other work. All other equipment used on site including clothes and boots that have come into contact with contaminated material must also be cleaned and the discarded material must be disposed of appropriately with all other contaminated material. Materials leaving or brought onto site should be checked to ensure that invasive non-native species do not leave or enter the site via this route.
- All contractors, sub-contractors and site personnel should be briefed on the presence and location of invasive non-native species; the site practices put in place to avoid further spread and contamination; and receive training in the identification of Salmonberry. A poster or leaflet highlighting the key features of the plant will be displayed in all communal areas. Signs should be erected in Contamination Zones. These measures will help to avoid the potential spread of invasive non-native species either around the site or off site.

4.4.1.2 Herbicide Treatment

- Herbicide must be applied by a ‘suitable qualified and fully trained operative’. It is recommended that glyphosate is used to treat Salmonberry. It should be noted however that glyphosate is a non-selective broad-spectrum systemic herbicide. Care should therefore be taken when using it around mature trees and desirable vegetation.
- Herbicide should be applied in dry weather conditions (no rain for 24 hours). Spraying should not be carried out in wind speeds above Force 2 on the Beaufort scale to avoid spray drift.
- Details of all herbicide applications should be recorded and documented in Appendix I. Details should include the name of personnel, date, plant location(s), herbicide brand name, active ingredient (if not glyphosate), amount used and weather conditions.
- The stand(s) of salmonberry should be monitored to check for re-growth every 6 weeks throughout the growing season and herbicide treatment before Excavation, Cell Formation & Burial on Site can take place prior to the commencement of initial site preparation works and the main construction contract.

4.4.1.3 Removal Options

4.4.1.3.1 Option 1 – Excavation and Stockpiling and Treatment

It may be feasible to excavate plants and deposit this material and contaminated soil within a specific area of the site which is not proposed for development for ongoing herbicide treatment.

- The designed Spread Ground Location Area will be identified and prepared prior to the excavation.
- A haulage route and decontamination area, protected with a root barrier membrane, will be set up and isolated by exclusion fencing and signs erected to indicate Salmonberry contamination. The route barrier membrane will be protected from damage by a 100mm layer of sand above and below the membrane, topped with a layer of hardcore or other suitable material. All of this material will be removed off-site along with the last load of contaminated soil. The haulage route will be limited to machinery and vehicles involved in the transport of contaminated soil only. The location of the haulage route and decontamination area will be sited in consultation with the ECoW.
- Where ground conditions allow Salmonberry stands should be excavated to the recommended minimum depth of 2m below ground level and within 2m from the plant growth area. It is possible that the volume may be reduced by the presence of the ECoW who would identify the rhizome during excavation. A single excavator with the sole purpose of excavating contaminated soil will be used throughout the entire excavation to reduce the risk of further contamination.
- All machinery used in the excavation and transport of contaminated material must be brushed down in the decontamination area and then pressure washed immediately prior to leaving the site. Care must be taken to clean off all infective plant and soil material. All other equipment used on site including clothes and boots must also be cleaned. All machinery and vehicles will be inspected by the ECoW before being used for other work or taken off site. The decontamination area must be designed to collect and contain all contaminated material including soil, water and silt left behind after machinery and vehicles have been pressure washed. The discarded contaminated material should be disposed of in the Spread Ground Location Area.
- Care must be taken to ensure that all equipment used on site is cleaned and free from Salmonberry material before leaving the site to avoid committing an offence.
- The appointed Contractor should provide a site plan indicating the location of the cell formation area, haulage routes & decontamination areas; a technical specification drawing for cell formation taking into account existing site conditions and underground services; and method statements detailing the procedures for removal.
- The Contractor should provide method statements detailing the procedures for Salmonberry eradication including:
  - Method Statement for Application of Herbicide to Salmonberry
  - Method Statement for Spread Ground Location Area
  - Method Statement for Excavation of Salmonberry
  - Method Statement for Loading & Transporting Salmonberry
- Full details of the ISMP and the Spread Ground Location Area should be kept for future site owners.

- Following completion of all works with potential to give rise to disturbance to salmonberry, heribbicide treatment of the spread ground area should be undertaken in line with the prescription above.

4.4.1.3.2 Option 2 - Standard Excavation, Cell Formation & Burial on Site Method

- Plants will be treated with herbicide immediately prior to excavation using foliar application and left in-situ for a period of two weeks. Herbicide must be applied by a 'S*uitable Qualified and Fully Trained Operative'*. It is recommended that glyphosate is used. Note however that glyphosate is a non-selective broad-spectrum systemic herbicide. Care should therefore be taken when using it around mature trees and desirable vegetation. Herbicide Records including details of herbicides used, dose rate, application rates and dates applied should be kept in Appendix I.
- All contractors, sub-contractors and site personnel working on site should first be briefed on the presence and location of Salmonberry on site. They should receive a tool box talk in the identification of this invasive non-native species and the site practices put in place to avoid committing an offence under relevant legislation. A poster or leaflet illustrating and highlighting the key features of the plant will be given to all contractors, sub-contractors and site personnel. These measures will help avoid the unintentional spread of invasive species either within the site or off site.
- A Cell Formation Area will be identified and prepared prior to the excavation of all stands of Salmonberry. Cell formation will involve excavation of a pit to the require dimensions; installation of root barrier membrane to completely encapsulate the contaminated Salmonberry material; layering of sand to protect the membrane; insertion of contaminated Salmonberry material and all other contaminated material; adequate sealing of the root barrier membrane in accordance with manufacturer's instructions and finally capping off of the cell formation area to at least 2m deep.
- A haulage route and decontamination area, protected with a root barrier membrane, will be set up and isolated by exclusion fencing and signs erected to indicate Salmonberry contamination. The route barrier membrane will be protected from damage by a 100mm layer of sand above and below the membrane, topped with a layer of hardcore or other suitable material. All of this material will be removed off-site along with the last load of contaminated soil. The haulage route will be limited to machinery and vehicles involved in the transport of contaminated soil only. The location of the haulage route and decontamination area will be sited in consultation with the ECoW.
- Where ground conditions allow Salmonberry stands should be excavated to the recommended minimum depth of 2m below ground level and within 2m from the plant growth area. It is possible that the volume may be reduced by the presence of the ECoW who would identify the rhizome during excavation. A single excavator with the sole purpose of excavating contaminated soil will be used throughout the entire excavation to reduce the risk of further contamination.
- All machinery used in the excavation and transport of contaminated material must be brushed down in the decontamination area and then pressure washed immediately prior to leaving the site. Care must be taken to clean off all infective plant and soil material. All other equipment used on site including clothes and boots must also be cleaned. All machinery and vehicles will be inspected by the ECoW before being used for other work or taken off site. The decontamination area must be designed to collect and contain all contaminated material including soil, water and silt left behind after machinery and vehicles have been pressure washed. The discarded contaminated material should be disposed of in the Cell Formation Area.

- Care must be taken to ensure that all equipment used on site is cleaned and free from Salmonberry material before leaving the site to avoid committing an offence.
- The appointed Contractor should provide a site plan indicating the location of the cell formation area, haulage routes & decontamination areas; a technical specification drawing for cell formation taking into account existing site conditions and underground services; and method statements detailing the procedures for Salmonberry eradication.
- The Contractor should provide method statements detailing the procedures for Salmonberry eradication including:
  - Method Statement for Application of Herbicide to Salmonberry
  - Method Statement for Cell Formation
  - Method Statement for Excavation of Salmonberry
  - Method Statement for Loading & Transporting Salmonberry
- Full details of the ISMP and the location of the cell formation area should be kept for future site owners.
- The following risks remain with Excavation, Cell Formation & Burial On Site; limitations to future construction works within the location of the cell formation area; limitations to construction of new services or maintenance of existing services; risk of re-establishment of Salmonberry if the root barrier membranes is incorrectly sealed or if the integrity of the membrane is breeched.

4.4.1.4 Ongoing Management

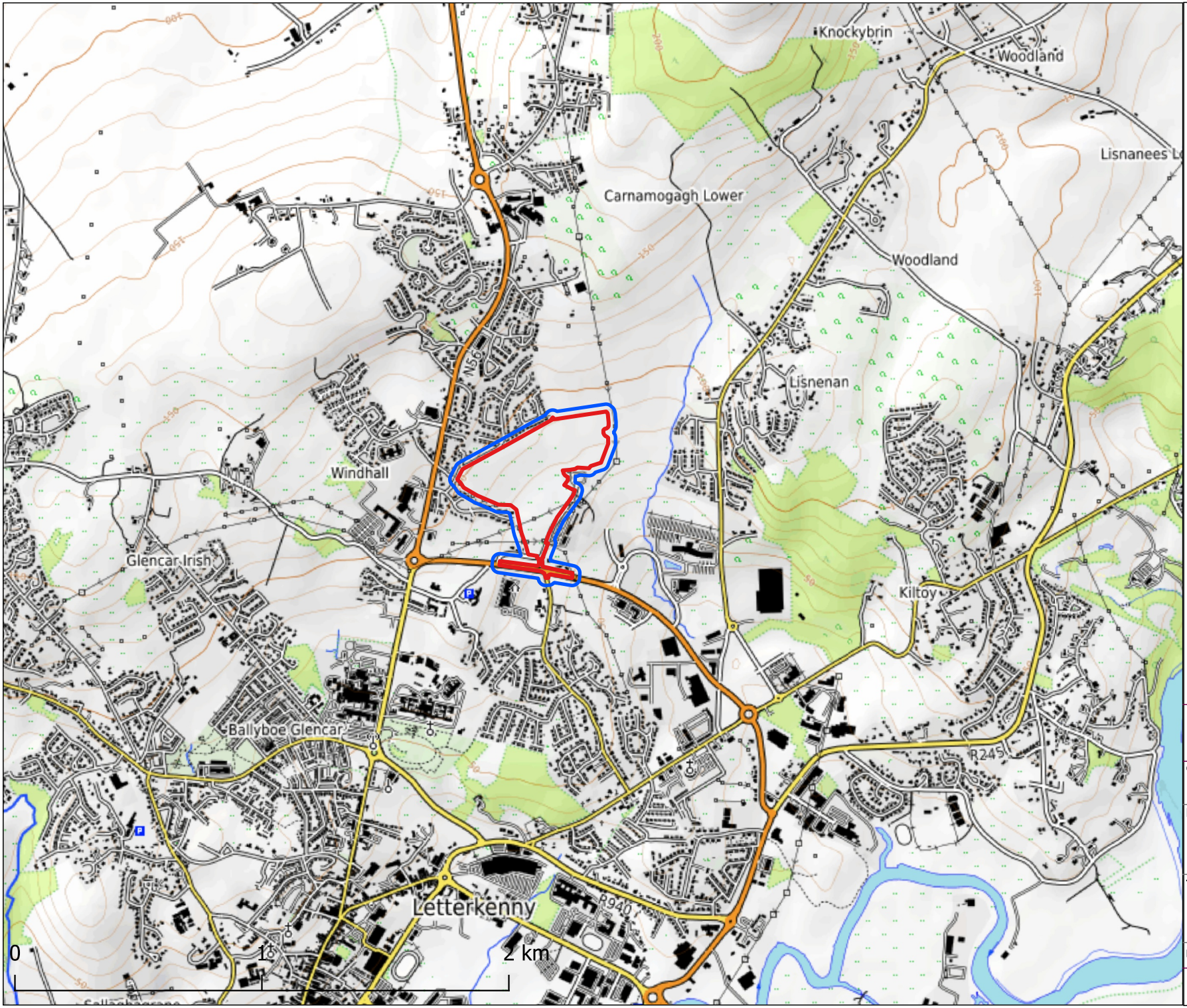
Maintenance of the proposed development at the operational phase should include for periodic inspection of the site for Salmonberry.

5 REFERENCES

CIEEM (2019) *Code of Professional Conduct*, Chartered Institute of Ecology and Environmental Management, Winchester

Figures

Figure 1.1: Survey Area



Legend

- Site Boundary
- Ecological Study Area

rps
Elmwood House T +44(0) 28 90 667914
74 Boucher Road F +44(0) 28 90 668286
Belfast W www.rpsgroup.com/ireland
BT12 6RZ E ireland@rpsgroup.com

Client: Hamilton Architects

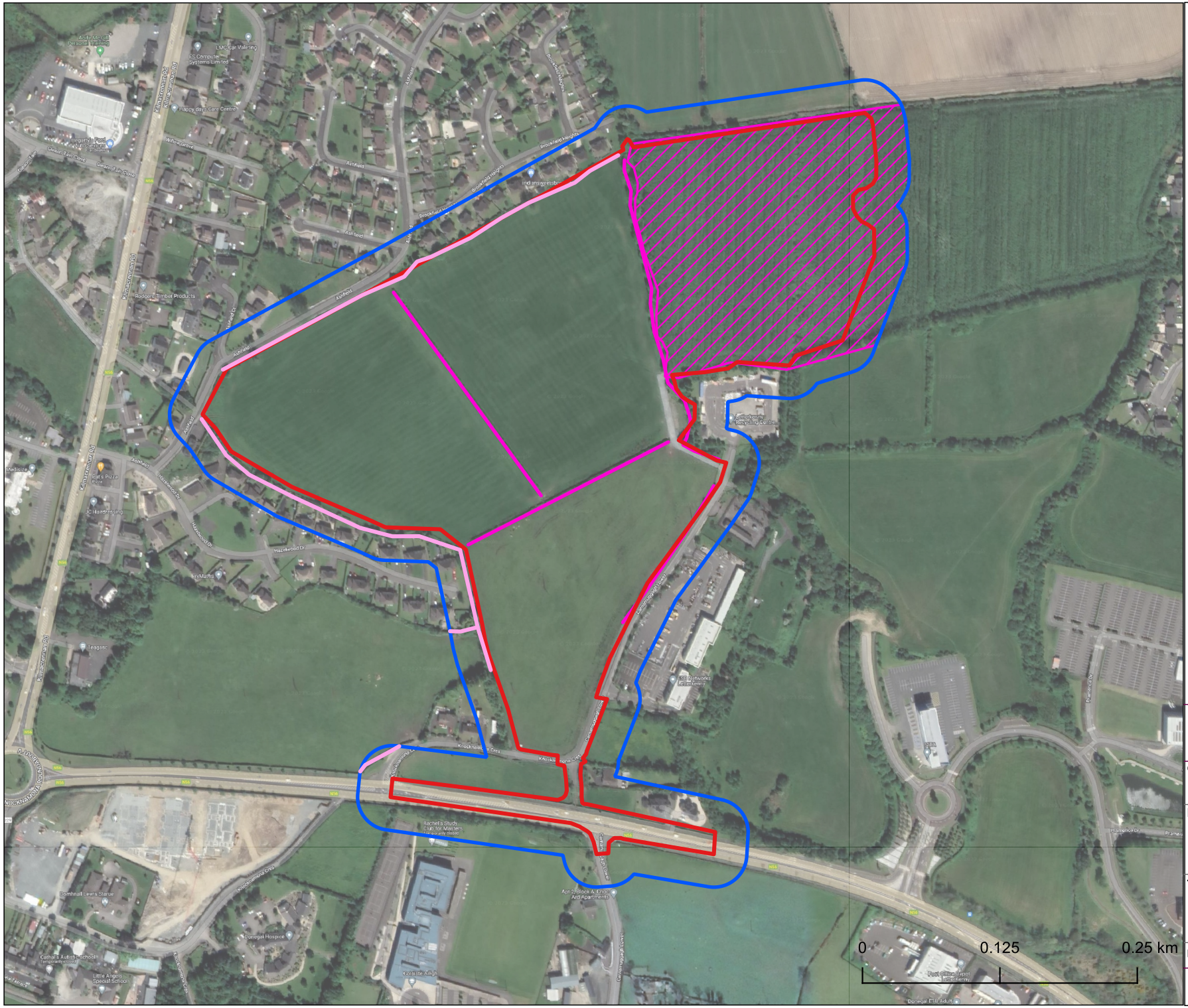
Project: Letterkenny Sports Hub

Title: Site Location

Figure No. 1.0

Project No.	Date	Revision
NI2553	07.06.2022	D01

Figure 3.1: Invasive Species Plan



Legend

- Site Boundary
- Ecological Study Area
- Salmonberry (Scattered)
- Salmonberry (Linear): (For Treatment)
- SalmonberryLinear: (Treatment TBC)

rps
Elmwood House
74 Boucher Road
Belfast
BT12 6RZ
T +44(0) 28 90 667914
F +44(0) 28 90 668286
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

Client: Hamilton Architects

Project: ATU Regional Sports Hub

Title: Invasive Species

Figure No. 3.1

Project No.	Date	Revision
NI2553	07.06.2022	D01

Appendix I

Herbicide Records

Attach details of herbicides used, dose rate and application rates and dates applied.

Appendix II

Waste Records

Attach details of waste records for any material containing invasive non-native species taken off site.

Appendix III

Monitoring Records

Attach copies of data collection sheets.