Appendix 8-1 Ambient Air Quality Standards

National standards for ambient air pollutants in Ireland have generally ensued from Council Directives enacted in the EU (& previously the EC & EEC). The initial interest in ambient air pollution legislation in the EU dates from the early 1980s and was in response to the most serious pollutant problems at that time which was the issue of acid rain. As a result of this Sulphur dioxide, and later nitrogen dioxide, were both the focus of EU legislation. Linked to the acid rain problem was urban smog associated with fuel burning for space heating purposes. Also apparent at this time were the problems caused by leaded petrol and EU legislation was introduced to deal with this problem in the early 1980s.

In recent years the EU has focused on defining a basis strategy across the EU in relation to ambient air quality. In 1996, a Framework Directive, Council Directive 96/62/EC, on ambient air quality assessment and management was enacted. The aims of the Directive are fourfold. Firstly, the Directive's aim is to establish objectives for ambient air quality designed to avoid harmful effects to health. Secondly, the Directive aims to assess ambient air quality on the basis of common methods and criteria throughout the EU. Additionally, it is aimed to make information on air quality available to the public via alert thresholds and fourthly, it aims to maintain air quality where it is good and improve it in other cases.

As part of these measures to improve air quality, the European Commission has adopted proposals for daughter legislation under Directive 96/62/EC. The first of these directives to be enacted, Council Directive 1999/30/EC, has been passed into Irish Law as S.I. No 271 of 2002 (Air Quality Standards Regulations 2002) and has set limit values which came into operation on 17th June 2002. Council Directive 1999/30/EC, relates to limit values for Sulphur dioxide, nitrogen dioxide, lead and particulate matter. The Air Quality Standards Regulations 2002 detail margins of tolerance, which are trigger levels for certain types of action in the period leading to the attainment date. The margin of tolerance varies from 60% for lead, to 30% for 24-hour limit value for PM_{10}, 40% for the hourly and annual limit value for NO_2 and 26% for hourly SO_2 limit values. The margin of tolerance commenced from June 2002 and started to reduce from 1 January 2003 and every 12 months thereafter by equal annual percentages to reach 0% by the attainment date. A second daughter directive, EU Council Directive 2000/69/EC, has published limit values for both carbon monoxide and benzene in ambient air. This has also been passed into Irish Law under the Air Quality Standards Regulations 2002.

The most recent EU Council Directive on ambient air quality was published on the 11/06/08 which has been transposed into Irish Law as S.I. 180 of 2011. Council Directive 2008/50/EC combines the previous Air Quality Framework Directive and its subsequent daughter directives. Provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$. The margins of tolerance specific to each pollutant were also slightly adjusted from previous directives. In regards to existing ambient air quality standards, it is not proposed to modify the standards but to strengthen existing provisions to ensure that non-compliances are removed. In addition, new ambient standards for $PM_{2.5}$ are included in Directive 2008/50/EC. The approach for $PM_{2.5}$ was to establish a target value of 25 µg/m^3, as an annual average (to be attained everywhere by 2010) and a limit value of 25 µg/m^3, as an annual average (to be attained everywhere by 2015), coupled with a target to reduce human exposure generally to $PM_{2.5}$ between 2010 and 2020. This exposure reduction target will range from 0% (for $PM_{2.5}$ concentrations of less than 8.5 µg/m^3 to 20% of the average exposure indicator (AEI) for concentrations of between 18 - 22 µg/m^3). Where the AEI is currently greater than 22 µg/m^3 all appropriate measures should be employed to reduce this level to 18 µg/m^3 by 2020. The AEI is based on measurements taken in urban background locations averaged over a three-year period from 2008 - 2010 and again from 2018-2020.

Additionally, an exposure concentration obligation of 20 µg/m^3 was set to be complied with by 2015 again based on the AEI.

Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions. The Alert Threshold is defined in Council Directive 96/62/EC as "a level beyond which there is a risk to human health from brief exposure and at which immediate steps shall be taken as laid down in Directive 96/62/EC". These steps include undertaking to ensure that the necessary steps are taken to inform the public (e.g. by means of radio, television and the press).

The Margin of Tolerance is defined in Council Directive 96/62/EC as a concentration which is higher than the limit value when legislation comes into force. It decreases to meet the limit value by the attainment date. The Upper Assessment Threshold is defined in Council Directive 96/62/EC as a concentration above which high quality measurement is mandatory. Data from measurement may be supplemented by information from other sources, including air quality modelling.

An annual average limit for both NO_X (NO and NO_2) is applicable for the protection of vegetation in highly rural areas away from major sources of NO_X such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Annex VI of EU Directive 1999/30/EC identifies that monitoring to demonstrate compliance with the NO_X limit for the protection of vegetation should be carried out distances greater than:

- 5 km from the nearest motorway or dual carriageway;
- 5 km from the nearest major industrial installation;
- 20 km from a major urban conurbation.

As a guideline, a monitoring station should be indicative of approximately 1000 km^2 of surrounding area.

Under the terms of EU Framework Directive on Ambient Air Quality (96/62/EC), geographical areas within member states have been classified in terms of zones. The zones have been defined in order to meet the criteria for air quality monitoring, assessment and management as described in the Framework Directive and Daughter Directives. Zone A is defined as Dublin and its environs, Zone B is defined as Cork City, Zone C is defined as 23 urban areas with a population greater than 15,000 and Zone D is defined as the remainder of the country. The Zones were defined based on among other things, population and existing ambient air quality.

EU Council Directive 96/62/EC on ambient air quality and assessment has been adopted into Irish Legislation (S.I. No. 33 of 1999). The act has designated the Environmental Protection Agency (EPA) as the competent authority responsible for the implementation of the Directive and for assessing ambient air quality in the State. Other commonly referenced ambient air quality standards include the World Health Organisation. The WHO guidelines differ from air quality standards in that they are primarily set to protect public health from the effects of air pollution. Air quality standards, however, are air quality guidelines recommended by governments, for which additional factors, such as socio-economic factors, may be considered.

Air Dispersion Modelling

The inputs to the DMRB model consist of information on road layouts, receptor locations, annual average daily traffic movements, annual average traffic speeds and background concentrations (UK Highways Agency, 2007). Using this input data the model predicts ambient ground level concentrations at the worst-case sensitive receptor using generic meteorological data.

The DMRB has recently undergone an extensive validation exercise (UK DEFRA, 2001) as part of the UK's Review and Assessment Process to designate areas as Air Quality Management Areas (AQMAs). The validation exercise was carried out at 12 monitoring sites within the UK DEFRAs national air quality monitoring network. The validation exercise was carried out for NO_X, NO_2 and PM_{10}, and included urban background and kerbside/roadside locations, "open" and "confined" settings and a variety of geographical locations (UK DEFRA 2001).

In relation to NO_2, the model generally over-predicts concentrations, with a greater degree of over-prediction at "open" site locations. The performance of the model with respect to NO_2 mirrors that of NO_X showing that the over-prediction is due to NO_X calculations rather than the NO_X:NO_2 conversion. Within most urban situations, the model overestimates annual mean NO_2 concentrations by between 0 to 40% at confined locations and by 20 to 60% at open locations. The performance is considered comparable with that of sophisticated dispersion models when applied to situations where specific local validation corrections have not been carried out.

The model also tends to over-predict PM_{10}. Within most urban situations, the model will over-estimate annual mean PM_{10} concentrations by between 20 to 40%. The performance is comparable to more sophisticated models, which, if not validated locally, can be expected to predict concentrations within the range of ±50%.

Thus, the validation exercise has confirmed that the model is a useful screening tool for the Second Stage Review and Assessment, for which a conservative approach is applicable (UK DEFRA, 2001).

Appendix 8-2 Transport Infrastructure Ireland Significance Criteria

Table A.8.2.1 Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. days with PM_{10} concentration > 50 µg/m³	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥4 µg/m³	Increase / decrease >4 days	Increase / decrease ≥2.5 µg/m³
Medium	Increase / decrease 2 - <4 µg/m³	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 µg/m³
Small	Increase / decrease 0.4 - <2 µg/m³	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 µg/m³
Imperceptible	Increase / decrease <0.4 µg/m³	Increase / decrease <1 day	Increase / decrease <0.25 µg/m³

Table A.8.2.2 Air Quality Impact Significance Criteria For Annual Mean Nitrogen Dioxide and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration Note 1		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m³ of NO_2 or PM_{10}) (≥25 µg/m³ of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m³ of NO_2 or PM_{10}) (22.5 - <25 µg/m³ of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (30 - <36 µg/m³ of NO_2 or PM_{10}) (18.75 - <22.5 µg/m³ of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<30 µg/m³ of NO_2 or PM_{10}) (<18.75 µg/m³ of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m³ of NO_2 or PM_{10}) (≥25 µg/m³ of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m³ of NO_2 or PM_{10}) (22.5 - <25 µg/m³ of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (30 - <36 µg/m³ of NO_2 or PM_{10}) (18.75 - <22.5 µg/m³ of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<30 µg/m³ of NO_2 or PM_{10}) (<18.75 µg/m³ of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

Note 1 Well Below Standard = <75% of limit value.

Table A.8.2.3: Air Quality Impact Significance Criteria For Changes to Number of Days with PM_{10} Concentration Greater than 50 µg/m^3 at a Receptor

Absolute Concentration in Relation to Objective / Limit Value	**Change in Concentration** Note 1		
	Small	**Medium**	**Large**
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

Note 1 Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible

Appendix 8-3 Dust Minimisation Plan

The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the following management plan has been formulated by drawing on best practice guidance from Ireland, the UK (IAQM (2014), The Scottish Office (1996), UK Office of Deputy Prime Minister (2002) and BRE (2003)) and the USA (USEPA (1997)).

Site Management

The aim is to ensure good site management by avoiding dust becoming airborne at source. This will be done through good design and effective control strategies.

At the construction planning stage, the siting of activities and storage piles will take note of the location of sensitive receptors and prevailing wind directions in order to minimise the potential for significant dust nuisance (see Figure 1 for the windrose for Dublin Airport). As the prevailing wind is predominantly westerly to south-westerly, locating construction compounds and storage piles downwind (to the east) of sensitive receptors will minimise the potential for dust nuisance to occur at sensitive receptors.

Good site management will include the ability to respond to adverse weather conditions by either restricting operations on-site or quickly implementing effective control measures before the potential for nuisance occurs. When rainfall is greater than 0.2mm/day, dust generation is generally suppressed (UK Office of Deputy Prime Minister (2002), BRE (2003)). The potential for significant dust generation is also reliant on threshold wind speeds of greater than 10 m/s (19.4 knots) (at 7m above ground) to release loose material from storage piles and other exposed materials (USEPA, 1986). Particular care should be taken during periods of high winds (gales) as these are periods where the potential for significant dust emissions are highest. The prevailing meteorological conditions in the vicinity of the site are favourable in general for the suppression of dust for a significant period of the year. Nevertheless, there will be infrequent periods were care will be needed to ensure that dust nuisance does not occur. The following measures shall be taken in order to avoid dust nuisance occurring under unfavourable meteorological conditions:

- The Principal Contractor or equivalent must monitor the contractors' performance to ensure that the proposed mitigation measures are implemented and that dust impacts and nuisance are minimised;
- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions;
- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details;
- It is recommended that community engagement be undertaken before works commence on site explaining the nature and duration of the works to local residents and businesses;
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out;

- It is the responsibility of the contractor at all times to demonstrate full compliance with the dust control conditions herein; and
- At all times, the procedures put in place will be strictly monitored and assessed.

The dust minimisation measures shall be reviewed at regular intervals during the works to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures. In the event of dust nuisance occurring outside the site boundary, site activities will be reviewed and satisfactory procedures implemented to rectify the problem. Specific dust control measures to be employed are described below.

Site Roads/Haulage Routes

Movement of construction trucks along site roads (particularly unpaved roads) can be a significant source of fugitive dust if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25 to 80% (UK Office of Deputy Prime Minister, 2002).

- A speed restriction of 20 km/hr will be applied as an effective control measure for dust for on-site vehicles using unpaved site roads;
- Access gates to the site shall be located at least 10m from sensitive receptors where possible;
- Bowsers or suitable watering equipment will be available during periods of dry weather throughout the construction period. Research has found that watering can reduce dust emissions by 50% (USEPA, 1997). Watering shall be conducted during sustained dry periods to ensure that unpaved areas are kept moist. The required application frequency will vary according to soil type, weather conditions and vehicular use;
- Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.

Land Clearing/Earth Moving

Land clearing/earth-moving works during periods of high winds and dry weather conditions can be a significant source of dust.

- During dry and windy periods, and when there is a likelihood of dust nuisance, watering shall be conducted to ensure moisture content of materials being moved is high enough to increase the stability of the soil and thus suppress dust;
- During periods of very high winds (gales), activities likely to generate significant dust emissions should be postponed until the gale has subsided.

Storage Piles

The location and moisture content of storage piles are important factors which determine their potential for dust emissions.

- Overburden material will be protected from exposure to wind by storing the material in sheltered regions of the site. Where possible storage piles should be located downwind of sensitive receptors;

- Regular watering will take place to ensure the moisture content is high enough to increase the stability of the soil and thus suppress dust. The regular watering of stockpiles has been found to have an 80% control efficiency (UK Office of Deputy Prime Minister, 2002);

- Where feasible, hoarding will be erected around site boundaries to reduce visual impact. This will also have an added benefit of preventing larger particles from impacting on nearby sensitive receptors.

Site Traffic on Public Roads

Spillage and blow-off of debris, aggregates and fine material onto public roads should be reduced to a minimum by employing the following measures:

- Vehicles delivering or collecting material with potential for dust emissions shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust;

- At the main site traffic exits, a wheel wash facility shall be installed if feasible. All trucks leaving the site must pass through the wheel wash. In addition, public roads outside the site shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary.

Summary of Dust Mitigation Measures

The pro-active control of fugitive dust will ensure that the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released, will contribute towards the satisfactory performance of the contractor. The key features with respect to control of dust will be:

- The specification of a site policy on dust and the identification of the site management responsibilities for dust issues;

- The development of a documented system for managing site practices with regard to dust control;

- The development of a means by which the performance of the dust minimisation plan can be regularly monitored and assessed; and

- The specification of effective measures to deal with any complaints received.

Appendix 9-1 Glossary of Acoustic Terminology

ambient noise	The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.
background noise	The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).
dB Decibel	The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 μPa).
dB L_{pA}	An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'–weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq,T}$	This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The closer the L_{Aeq} value is to either the L_{AF10} or L_{AF90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.
L_{AFN}	The A-weighted noise level exceeded for N% of the sampling interval. Measured using the "Fast" time weighting.
L_{AFmax}	is the instantaneous slow time weighted maximum sound level measured during the sample period (usually referred to in relation to construction noise levels).
L_{AF90}	Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the "Fast" time weighting.
noise	Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.
sound pressure level	The sound pressure level at a point is defined as:

$$Lp = 20Log\frac{P}{P_0}$$

Appendix 9-2 Results of unattended Baseline Noise Monitoring

Table A1: Results of unattended noise monitoring at Location UN1.

Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)		
		L_{Aeq}	L_{AF10}	L_{AF90}
19 April 2018	09:00	59	61	57
	10:00	57	59	55
	11:00	58	59	56
	12:00	57	59	55
	13:00	58	59	56
	14:00	58	59	56
	15:00	59	60	57
	16:00	59	62	57
	17:00	58	60	56
	18:00	58	60	57
	19:00	58	59	57
	20:00	58	58	56
	21:00	56	58	53
	22:00	54	56	51
	23:00	49	51	45
20 April 2018	00:00	48	51	42
	01:00	46	50	33
	02:00	44	49	33
	03:00	43	46	31
	04:00	51	52	49
	05:00	55	57	51
	06:00	55	57	52
	07:00	59	60	57
	08:00	61	63	59
L_{den}	60			

Table A2: Results of unattended noise monitoring at Location UN2.

Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)		
		L_{Aeq}	L_{AF10}	L_{AF90}
19 April 2018	10:00	46	48	44
	11:00	46	47	45
	12:00	45	47	44
	13:00	45	47	44
	14:00	48	49	46
	15:00	48	51	46
	16:00	51	54	48
	17:00	55	57	53
	18:00	52	54	47
	19:00	48	50	46
	20:00	47	48	45
	21:00	47	48	44
	22:00	45	47	41
	23:00	41	42	37
20 April 2018	00:00	39	41	34
	01:00	36	39	30
	02:00	34	38	29
	03:00	33	36	27
	04:00	36	39	28
	05:00	46	48	34
	06:00	48	49	45
	07:00	50	50	49
	08:00	48	49	47
	09:00	47	49	45
L_{den}	51			

Appendix 10-1 Species List

Improved Agricultural Grassland - GA1		DAFOR
Agrostis stolonifera	Creeping Bent	F
Arrhenatherum elatius	False Oat-grass	F
Cynosurus cristatus	Crested Dog's-tail	O
Dactylis glomerata	Cock's-foot	F
Heracleum sphondylium	Hogweed	O
Holcus lanatus	Yorkshire-fog	F
Lolium perenne	Perennial Rye-grass	F
Plantago lanceolata	Ribwort Plantain	F
Ranunculus repens	Creeping Buttercup	F
Senecio jacobaea	Common Ragwort	O

Treeline - WL2		DAFOR
*Acer pseudoplatanus**	Sycamore	O
Angelica sylvestris	Wild Angelica	O
Anthriscus sylvestris	Cow Parsley	O
Asplenium adiantum-nigrum	Black Spleenwort	R
Asplenium scolopendrium	Hart's-tongue	R
Betula sp.	Birch	R
Calystegia sepium	Hedge Bindweed	O
Carex pendula	Pendulus Sedge	R
Corylus avellana	Hazel	O
Crataegus monogyna	Hawthorn	F
Digitalis purpurea	Foxglove	O
*Fagus sylvatica**	Beech	O
Ficaria verna	Lesser Celandine	O
Fraxinus excelsior	Ash	F
Geum urbanum	Wood Avens	O
Glechoma hederacea	Ground-ivy	O
Hedera helix	Common Ivy	A
Ilex aquifolium	Holly	F
*Petasites fragrans**	Winter Heliotrope	O
*Picea sitchensis**	Sitka Spruce	R
Pinus sylvestris	Scots Pine	R
Polystichum setiferum	Soft Shield-fern	O
Primula vulgaris	Primrose	O
*Prunus laurocerasus**	Cherry Laurel	O
Prunus spinosa	Blackthorn	F
Quercus sp.	Oak	R
Rosa arvensis	Field-rose	O
Rosa canina	Dog-rose	O

Rubus fruticosus agg.	Brambles	A
Sambucus nigra	Elder	F
Scrophularia nodosa	Common Figwort	O
*Smyrnium olusatrum**	Alexanders	O
*Symphoricarpos albus**	Snowberry	O
Teucrium scorodonia	Wood Sage	R
*Tilia sp.**	Lime	R
Ulex europaeus	Gorse	O
Umbilicus rupestris	Navelwort	O
Urtica dioica	Common Nettle	F
Vicia cracca	Tufted Vetch	F

Hedgerow - WL1		**DAFOR**
*Acer pseudoplatanus**	Sycamore	O
*Allium triquetrum**	Three-cornered Garlic	O
Anthriscus sylvestris	Cow Parsley	F
Arum maculatum	Lords-and-Ladies	O
Bellis perennis	Daisy	O
Betula sp.	Birch	O
Brachypodium sylvaticum	False Brome	O
Calystegia sepium	Hedge Bindweed	F
*Calystegia sylvatica**	Large Bindweed	F
*Cuprocyparis leylandii**	Leyland Cypress	R
Epilobium hirsutum	Great Willowherb	O
Fraxinus excelsior	Ash	F
Galium aparine	Cleavers	F
Geranium robertianum	Herb-Robert	O
Glechoma hederacea	Ground-ivy	O
Hedera helix	Common Ivy	A
Heracleum sphondylium	Hogweed	O
Lonicera periclymenum	Honeysuckle	R
*Petasites fragrans**	Winter Heliotrope	O
Pinus sylvestris	Scots Pine	O
Poa annua	Annual Meadow-grass	O
Pteridium aquilinum	Bracken	O
Rubus fruticosus agg.	Brambles	F
Salix cinerea	Grey Willow	F
*Salix fragilis**	Crack-willow	R
Sambucus nigra	Elder	F
Solanum dulcamara	Bittersweet	R
Trifolium repens	White Clover	O
Ulex europaeus	Gorse	O
Urtica dioica	Common Nettle	F

Dry Meadow - GS2		DAFOR
Agrostis stolonifera	Creeping Bent	A
Arrhenatherum elatius	False Oat-grass	A
*Buddleja davidii**	Butterfly-bush	O
Carex flacca	Glaucous Sedge	O
Carex hirta	Hairy Sedge	R
Carex pendula	Pendulus Sedge	O
Centaurea nigra	Common Knapweed	O
Cirsium dissectum	Meadow Thistle	F
Cirsium palustre	Marsh Thistle	O
Dactylis glomerata	Cock's-foot	A
Equisetum arvense	Field Horsetail	O
Filipendula ulmaria	Meadowsweet	O
Juncus inflexus	Hard Rush	O
Lathyrus pratensis	Meadow Vetchling	O
Lythrum salicaria	Purple-loosestrife	R
Plantago lanceolata	Ribwort Plantain	F
Potentilla reptans	Creeping Cinquefoil	O
Rhytidiadelphus squarrosus	Springy Turf-moss	F
Rumex crispus	Curled Dock	F
Senecio jacobaea	Common Ragwort	O
Senecio vulgaris	Groundsel	O
Stachys sylvatica	Hedge Woundwort	R
Stellaria graminae	Lesser Stitchwort	R
Stellaria media	Common Chickweed	R
Trifolium pratense	Red Clover	F
Trifolium repens	White Clover	F
Urtica dioica	Common Nettle	F
Vicia cracca	Tufted Vetch	F
Dactylorhiza fuchsii	Common Spotted-orchid	R

Scrub - WS1		DAFOR
*Buddleja davidii**	Butterfly-bush	F
Calliergonella cuspidata	Pointed Spear-moss	F
Chamerion angustifolium	Rosebay Willowherb	F
Juncus effusus	Soft-Rush	O
Pteridium aquilinum	Bracken	O
Quercus sp.	Oak (sapling)	O
Rhytidiadelphus squarrosus	Springy Turf-moss	F
Rubus fruticosus agg.	Brambles	A
Salix cinerea	Grey Willow	F
Sambucus nigra	Elder	O
Ulex europaeus	Gorse	O

Immature Woodland - WS2		DAFOR
Fraxinus excelsior	Ash	A
Rubus fruticosus agg.	Brambles	O
Ulex europaeus	Gorse	O

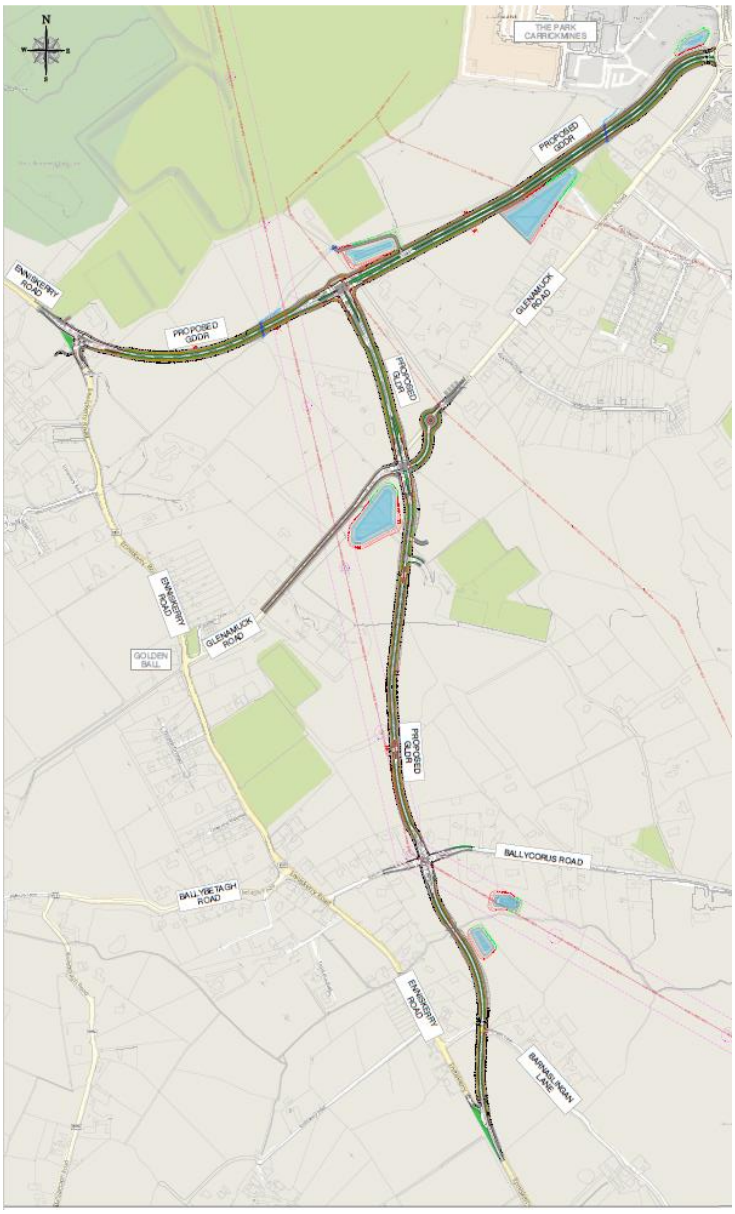
Broadleaved Woodland - WD2		DAFOR
*Acer pseudoplatanus**	Sycamore	O
Alnus glutinosa	Alder	O
Betula sp.	Birch	O
*Buddleja davidii**	Butterfly-bush	R
Dryopteris filix-mas	Male-fern	O
*Fagus sylvatica**	Beech	O
Fraxinus excelsior	Ash	F
Hedera helix	Common Ivy	A
Heracleum sphondylium	Hogweed	O
Ilex aquifolium	Holly	F
Pinus sylvestris	Scots Pine	O
Polystichum setiferum	Soft Shield-fern	O
Quercus sp.	Oak	R
Rubus fruticosus agg.	Brambles	F
Sambucus nigra	Elder	O
*Symphoricarpos albus**	Snowberry	O
Ulex europaeus	Gorse	O
Urtica dioica	Common Nettle	O

Eroding River - FW1/Drainage Ditch - FW4		DAFOR
Alnus glutinosa	Alder	O
Angelica sylvestris	Wild Angelica	O
Carex pendula	Pendulous Sedge	O

*Heracleum mantegazzianum**	Giant Hogweed	R
Nasturtium officinale	Water-cress	O
Phalaris arundinacea	Reed Canary-grass	O

Appendix 10-2 Bat Survey

A Bat Survey of the Glenamuck District Roads Scheme and An Evaluation of The Potential Impacts of The Route on The Resident Bat Fauna



Brian Keeley B.Sc. (Hons) in Zool. MCIEEM September 2018

Executive Summary

The proposed route of the Glenamuck District Road was examined for roosting, commuting and foraging bats in July and September 2018. There were 8 species of bat noted within the area with evidence of roosts of no less than 3 species in close proximity to the route. No roosts were noted within the land-take. There will be a loss of mature trees that may serve as roost sites. There will be severance of commuting corridors and feeding areas by the new road that will affect most if not all bat species. The new road creates a risk of roadkill in addition to habitat loss.

It is proposed that all trees within the land take shall be examined by a bat specialist in advance of felling to determine whether there are any roosts within these trees.

Measures to prevent injury or death to bats must be put in place if roosts are noted and a derogation for roost removal shall be acquired from NPWS.

12 bats boxes of four designs are proposed for the remaining trees. These must be sited in areas that will not be illuminated, exposed to traffic or in dense cover that would prevent bat entry. Most boxes shall be installed in a southerly direction.

Lighting will be designed to avoid illuminating tree canopies in the surrounding areas.

Planting should encourage bats to fly towards the culverts to pass under the road in addition to providing feeding. The road will reduce the availability of feeding and commuting for bats while not altering the overall favourable status of any bat species nationally or within Dublin.

Introduction

Most of Ireland's mammals enjoy protection under the Wildlife Act (1976) and the more recent updating of this legislation (Wildlife (Amendment) Act 2000, S.I. No. 94 of 1997, S.I. No. 378 of 2005, European Communities (Natural Habitats) (Amendment) Regulations, 2005). In conjunction with the enactment of the Habitats Directive into Irish legislation, all native mustelid species and bat species are protected with further protection given to otters and lesser horseshoe bats. Lesser horseshoe bats are not found in County Dublin.

Bats account for nine of Ireland's terrestrial mammal species, approximately one quarter of the species of the Irish land mass. All of the species found to date and indeed all bat species that may remain undetected up to the present are afforded legal protection under Irish and EU legislation and agreements (Wildlife Act (1976), Wildlife (Amendment) Act (2000), S.I. No. 94 of 1997 and S.I. No. 378 OF 2005 implementing the EU Habitats Directive, Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animal) and the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats).

A speedy and productive means of determining the mammal fauna along a road alignment is to walk the entire route concerned, paying particular attention to all hedgerow, woodland, watercourses, fence lines, paths etc. to locate mammal signs. However, this does not provide complete knowledge on the bat fauna as they are nocturnal and do not inhabit ground-level burrows but instead may be found in buildings, bridges, sheds, trees and many other shelters.

The survey undertaken along the current route allows a targeting of mitigation measures to the appropriate or most efficient sites with the aim of preventing accidental death or injury and to allow safe passage across long-established routes under or over the new road. Fieldwork for the current report on bat distribution along the proposed road route was carried out by Brian Keeley. This report addresses the main issues affecting the bat fauna considered in this assessment.

Road realignment and construction activities and subsequent operation of the completed road create a number of significant short-term and long-term risks for the resident Irish mammal fauna, in addition to impacts upon other vertebrates and invertebrates.

The construction of the road itself may involve the removal of key features of the surrounding environment and of the habitats of bat species, such as trees, hedgerow lines, streams. The most damaging operation is the destruction of bat dwellings during the vegetation clearance and early earthworks, through the felling of trees or demolition of houses or outbuildings or alterations to bridges or other structures.

Methodology

Equipment
Pettersson D240X heterodyne and time expansion bat detector and Echometer 3 recording monitor
Peersonic and Songmeter2 Bat+ monitor for static recording – ultrasonic receivers storing signals as sound files to SD cards for later analysis
Kaleidoscope 3.1.1and Batsound 4.2.1 software
Head torch

The survey was undertaken in two seasons to provide a more long-term consideration of the bat fauna and its utilisation of the landscape in the Glenamuck and Kilternan area. The site was initially examined on July 5th, 2018 and with a second summer date of July 15th, 2018 . The route was again examined on 4th- 5th and 6th – 7th September 2018.

The assessment commenced with an examination of the buildings and trees close to the route between the former Wayside Celtic grounds and up north as far as the De La Salle Palmerston Rugby grounds and Dun Laoghaire County Council (DLR) lands running towards Carrickmines on 5th July.

The areas of survey were lands reaching east from the Enniskerry Road and north and south of the Glenamuck Road.

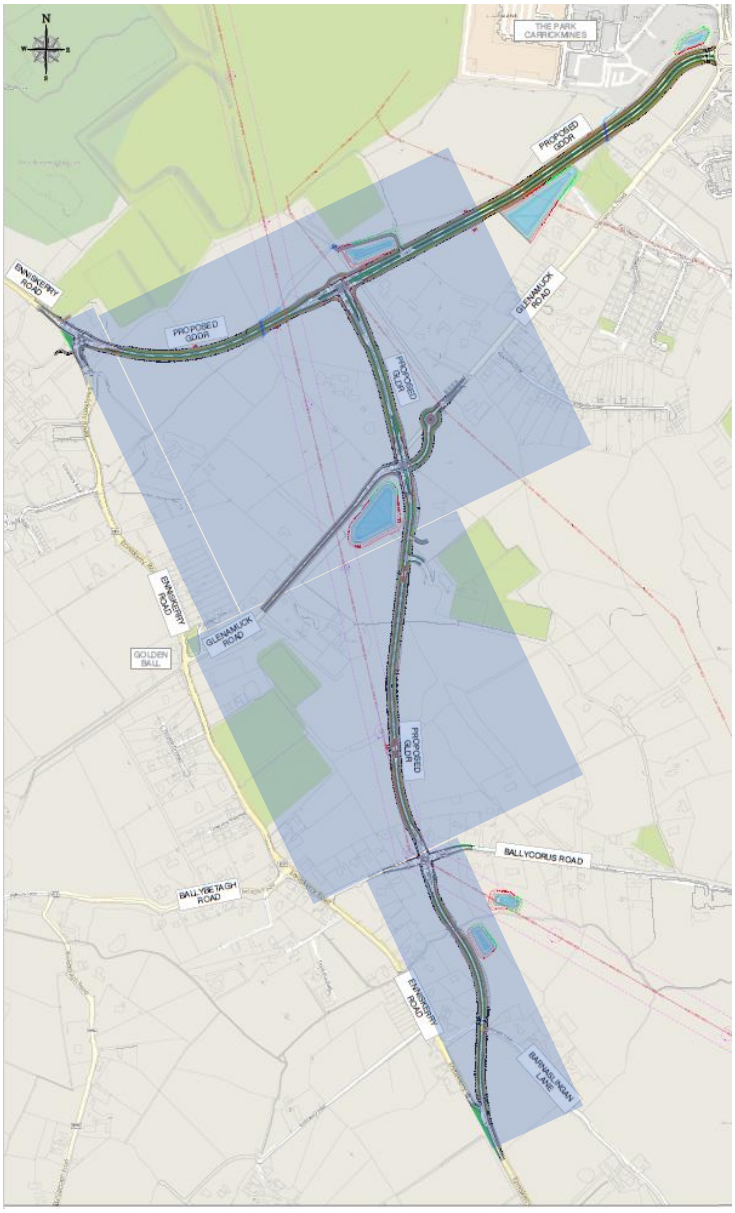
The survey aimed to determine which species commuted through the route or fed or travelled along hedgerow that was likely to bring them into the road alignment. A Peersonic ultrasonic receiver was placed in the land take on the northern side of the Ballycorus Road.

The second date in July (15th) was concentrated on the southern section of the route from south of Ballycorus Road down on to Barnaslingan Lane and back to the most southern section on the Enniskerry Road south of Kilternan village. The main area of examination was the field north of Barnaslingan Lane. This was only undertaken south of the Loughlinstown River as access was denied to lands to the north. From the first observations prior to dusk in this field and along the stream, surveying moved south into the fields between Barnaslingan Lane and Enniskerry Road. After this, the field north of Ballycorus Road was examined for bat activity.

In autumn, the survey commenced within the field north of Barnaslingan Lane and then moved to the fields between this lane and Enniskerry Road before moving to lands north of Ballycorus Road. On the second night surveying, moved to the northern section of the route. Based on the autumn evaluation, a house along the Glenamuck Road was chosen as a site to commence the survey. The residents of the house were questioned regarding bats and based on their response decided the start point of the survey as the garden of this house. Surveying moved from here into the fields and lanes to the north of the Glenamuck Road .

A SM2 was placed within the field north of Barnaslingan Lane on 4th September and was placed along the Ballycorus Road within the land take on 6th September. A second SM2 was placed on a wall on Barnaslingan Lane within the land take on 4th September.

An examination of available information from Bat Conservation Ireland, personal data and other known survey results was undertaken to compile a list of most likely species in addition to the evaluation of the habitat and known distributions of Irish species.



Proposed route with approximate area of bat survey marked in blue

Results

Bats roosting within the land take of the Glenamuck District Road

None noted

There were three bat roosts noted during the assessment but none of these were within the land take. A bat roost was reported from a house along Glenamuck Road to the west of the proposed road. Here, a single bat was believed to be present between the two floors of a two-storey house. There may be more than one bat present here as observations by untrained bat specialists may cease once one bat has emerged or returned to a building.

The identity of the species concerned was not determined but, on the night, and morning of survey, both soprano and common pipistrelle were noted within the garden.

Soprano pipistrelles were noted returning towards Rockville House prior to dawn on 6th July 2018. This house is known to be a roost to more than one bat species. However, as there is considerable construction work around it, it is possible that the bat fauna is currently reduced.

A Leisler's bat was seen to return to a house on Barnaslingan Lane at 04.54 hours on 16th July 2018 (sunrise 05.17 hours). This building lies within 120 metres of the proposed route.

Another probable roost location is the buildings or trees in the area south of the stream and west of Enniskerry Road, north of Barnaslingan Lane. Here, a soprano pipistrelle was noted feeding early in the night of 4th September and late into the morning of 5th September within the garden and later along the stream. The bat was last seen at mature trees in the northernmost garden (south of the stream) but it was unclear whether the bat had entered the tree. This is outside of the road land-take.

A house to the west of the route on the Glenamuck Road and closest to the road has high roost potential but this building was not accessed. Bat species noted within this area included pipistrelles, Leisler's and *Myotis* species as well as brown long-eared bat and this property is a potential roost site for these species.

Bat species feeding and commuting through the land take

Leisler's bat	*Nyctalus leisleri*
Soprano pipistrelle	*Pipistrellus pygmaeus*
Common pipistrelle	*Pipistrellus pipistrellus*
Nathusius' pipistrelle	*Pipistrellus nathusii*
Natterer's bat	*Myotis nattereri*
Whiskered bat	*Myotis mystacinus*
Brown long-eared bat	*Plecotus auritus*

Bat activity 5th July 2018 at Kilternan

First bat signals between 22.08 hours and 22.20 hours

Legend

Green paddle / circle	*Common pipistrelle*	*Yellow paddle*	*Leisler's bat*
Blue paddle / circle	*Soprano pipistrelle*	*White paddle*	*Two pipistrelle species*
(common and soprano)		*Red circle*	*Myotis* (probably whiskered bat)

White box *Static monitor* *(common and soprano pipistrelle, Leisler's and Natterer's bats recorded)*

Leisler's bat activity was noted throughout the proposed route. This species was seen and heard feeding in lands north and south of Barnaslingan Lane, within the lands adjacent to Wayside Celtic and around the perimeter of the Rugby grounds. On July 5th, the bat was recorded at Derryclare on Ballycorus Road and was not heard for the remainder of the active survey but was noted at 02.49 hours on the passive monitor.

Soprano pipistrelles were relatively widespread within the area and given that there is a long-established roost at Rockville House, this is not surprising. Soprano pipistrelle bats fed along the double hedge to the west of the route and Wayside Celtic and along woodland behind the sports centre. This species was found in all areas and on all dates of survey.

Common pipistrelles were present throughout the survey area and were the most commonly encountered bat in the lands around the Wayside Celtic grounds. There is high common pipistrelle activity here along Glenamuck Road. Common pipistrelles were noted along Enniskerry Road shortly after emergence time on July 5th, 2018.

Leisler's bats and both common and soprano pipistrelles were noted feeding along the edge of the De La Salle Rugby grounds.

Nathusius' pipistrelle was noted on 7th September by the remote monitor at 02.17 hours. This species was noted only once, and it is possible that it travels over a distance to reach this area. The species was noted in previous surveys in neighbouring lands and south towards the ski slope several years ago.

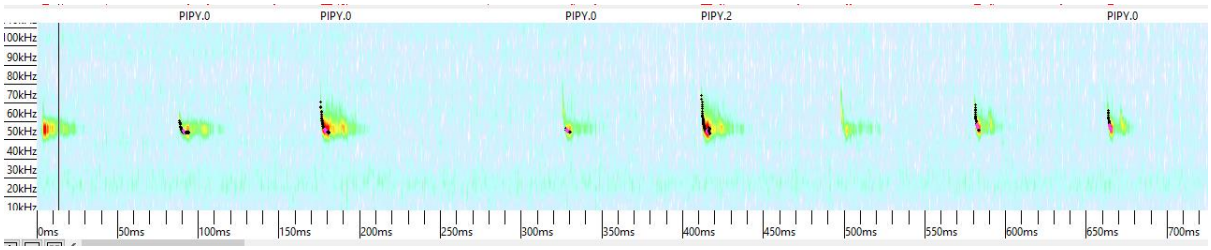
Two species of the genus *Myotis* were present in the area: whiskered Natterer's and bats. Natterer's bats were noted on the active survey prior to dawn on 6th July on Barnaslingan Lane and again close to the route southern section at Enniskerry Road on July 15th. Static monitors recorded them at Ballycorus Road within the land take in July and September and along Barnaslingan Lane in September.

Signals around the Rockville House area on Glenamuck Road on July 5th at approximately 22.45 hours were closest to whiskered bat in characteristics.

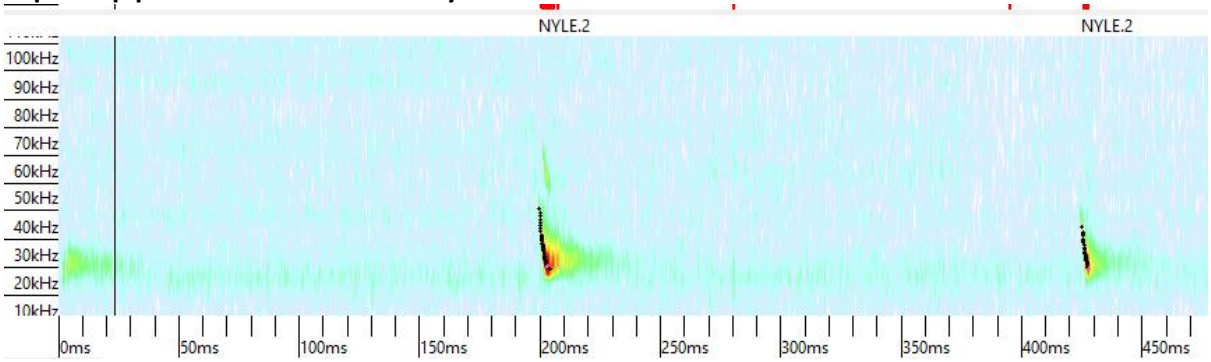
Brown long-eared bats were noted by remote monitors at Barnaslingan Lane on 4th September 2018 as well as on Ballycorus Road on 6th September. This species was also present at 02.00 hours on 5th September at Barnaslingan and at 05.32 hours on 7th September at Ballycorus. This species has previously roosted at Rockville House and may still be here or in nearby buildings.

Peersonic July 5th on Ballycorus Road indicating the presence of 4 bat species

Time	Auto Id	Pulses	Matching	Manual Id
22:29:00	Noid	2	0	Common Pipistrelle
22:33:00	Common Pipistrelle	3	3	Common Pipistrelle
00:29:00	Soprano Pipistrelle	9	9	Soprano Pipistrelle
02:49:00	Leisler's Bat	2	2	Leisler's Bat
03:17:00	Common Pipistrelle	6	6	Common Pipistrelle
03:24:00	Common Pipistrelle	8	8	Common Pipistrelle
03:47:00	Common Pipistrelle	7	5	Common Pipistrelle
03:56:00	Natterer's Bat	13	7	Natterer's Bat
04:10:00	Common Pipistrelle	5	3	Common Pipistrelle



Soprano pipistrelle 00.29 hours 6 July 2018

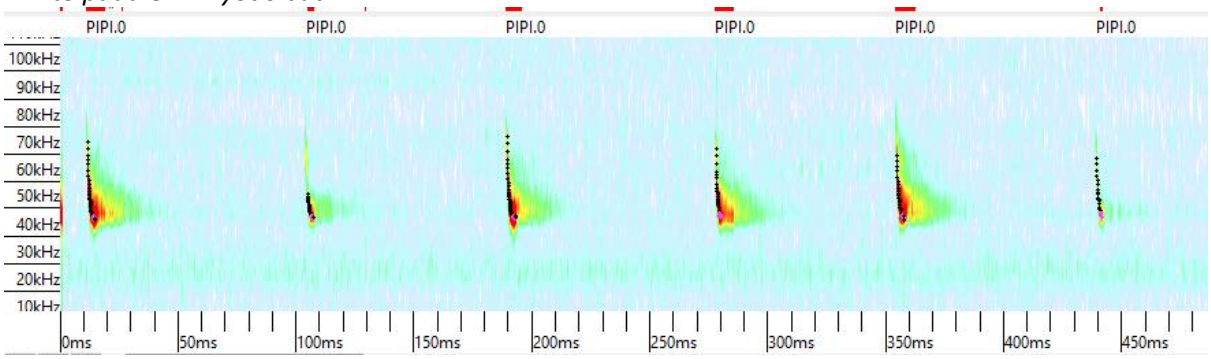


Leisler's bat 02.49 hours 6 July 2018

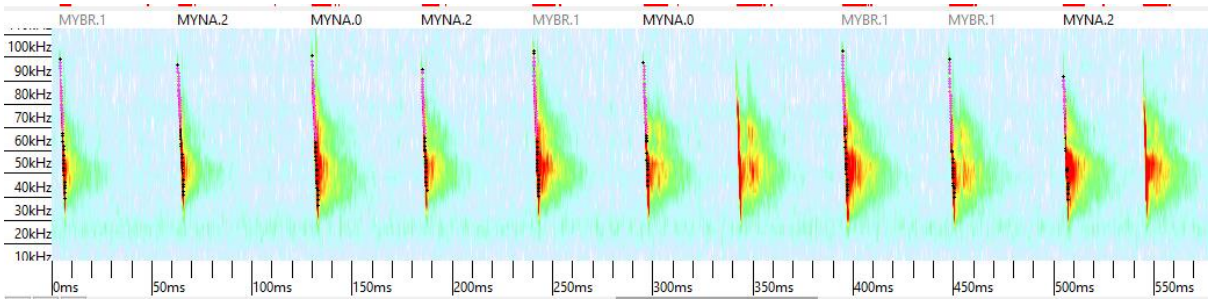
Bat activity 15th July 2018

Legend

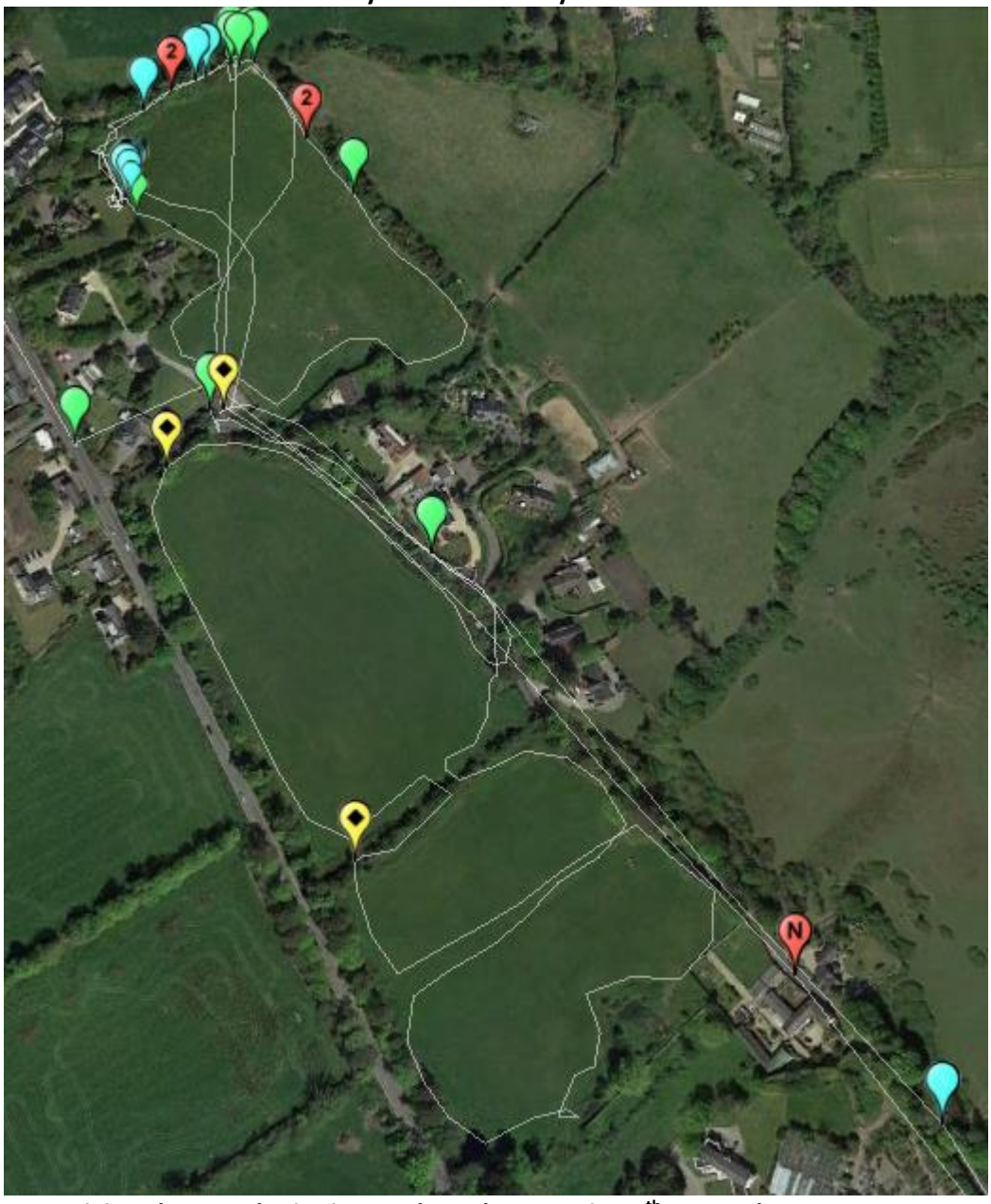
Green paddle *Common pipistrelle* *Blue paddle* *Soprano pipistrelle*
White paddle *Myotis bat*



Common pipistrelle 03.17 hours 6 July also recorded 22.29, 22.33, 03.24, 03.47 and 04.10 hours



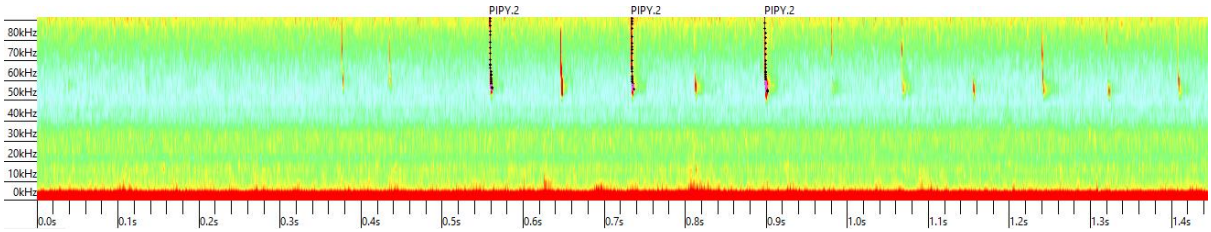
Natterer's bat 03.56 hours 6 July 2018 near Derryclare



Bat activity Glenamuck District Road Southern section 4th September 2018

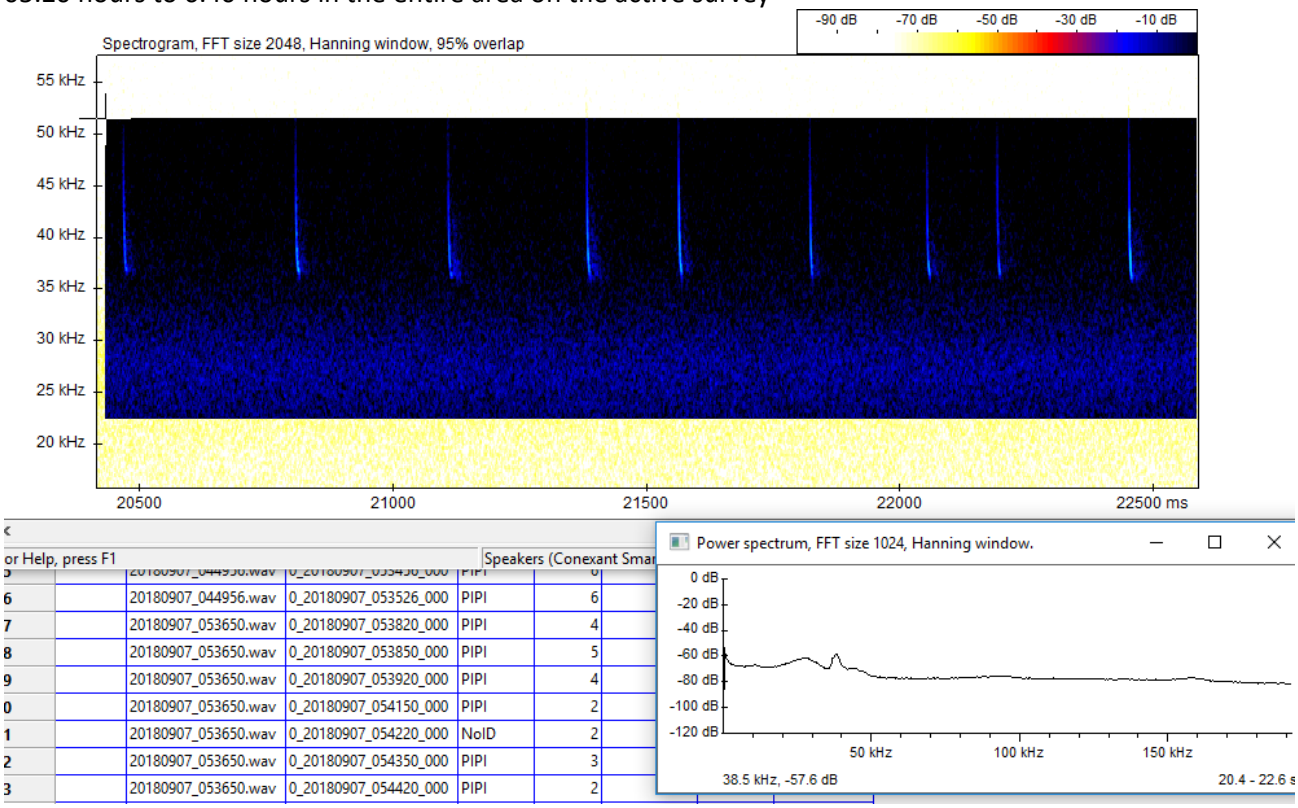
Legend

Blue paddle	*Soprano pipistrelle*	*Green paddle*	*Common pipistrelle*
"2" paddle	*Soprano and common pipistrelle*	*Yellow paddle*	*Leisler's bat*
"N" paddle	*Natterer's bat and common pipistrelle*		



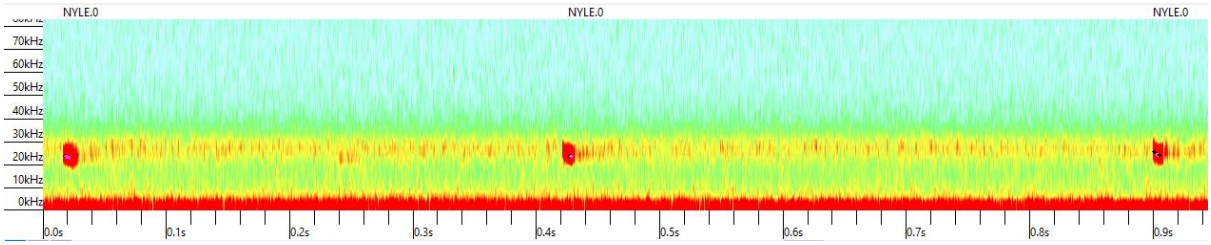
Bat activity prior to sunrise on 7th September 2018 at Glenamuck

Soprano pipistrelle in a garden off the Glenamuck Road South at 06.20 hours; the only signal from 05.20 hours to 6.40 hours in the entire area on the active survey

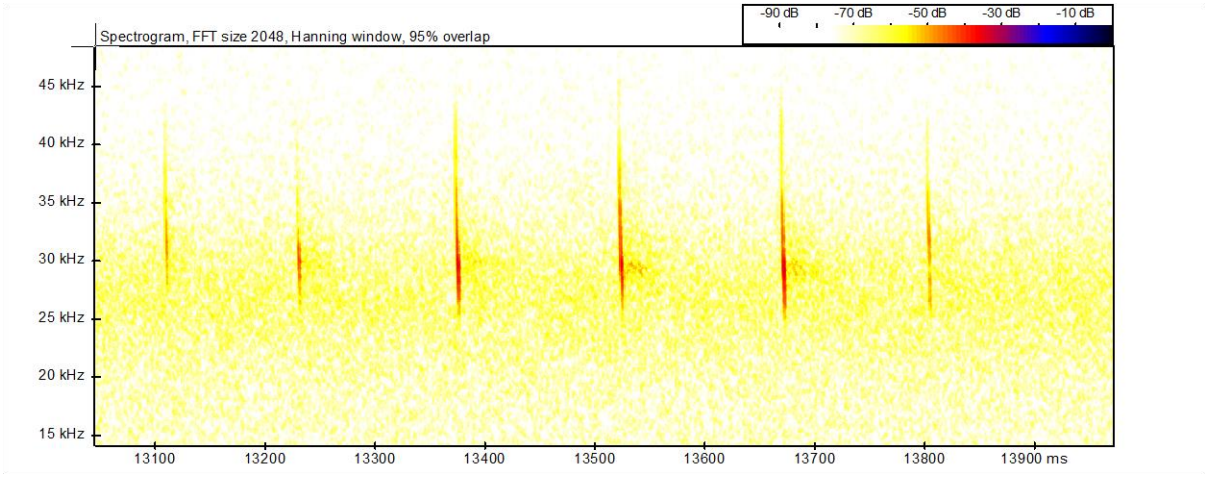


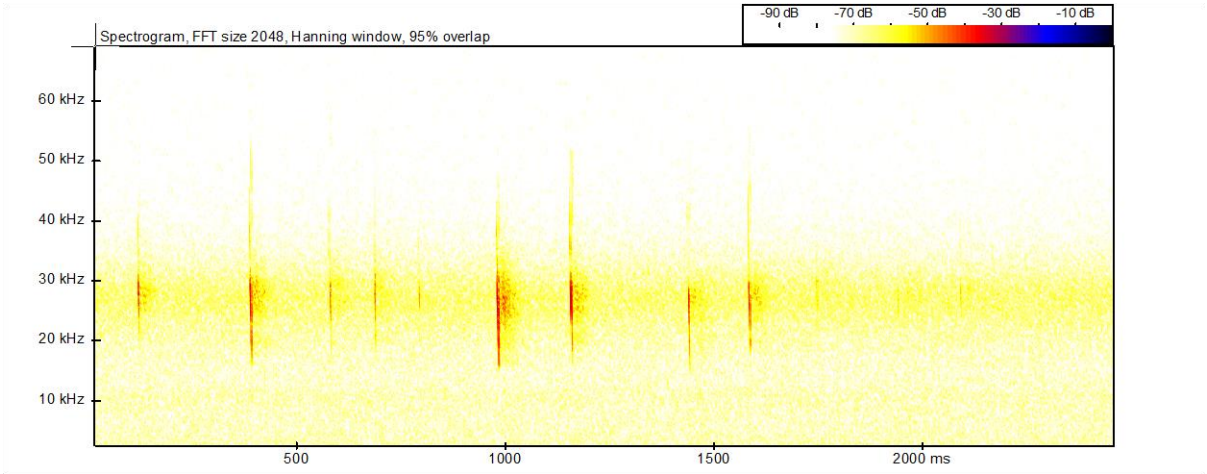
Nathusius' pipistrelle signal on 7th September 2018 at 02.17 hours.

This bat passed the passive monitor on Ballycorus Road.

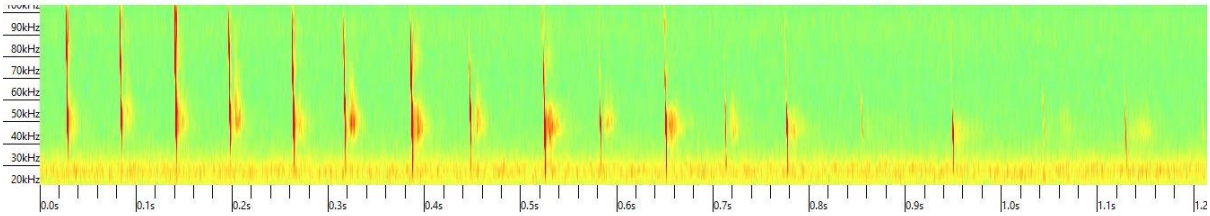


Leisler's bat at 20.52 hours on Ballycorus Road section





Brown long-eared bat at 23.05 hours and at 23.13 hours at Ballycorus Road 6th September



Natterer's bat at 21.02 hours at Ballycorus Road 6th September 2018

Bat activity at the northern section of the route 6th September 2018

Legend

Blue paddle	*Soprano pipistrelle*	*Green paddle*	*Common pipistrelle*
Yellow paddle	*Leisler's bat*	*"L" paddle*	*Leisler's bat and soprano pipistrelle*

Bat activity recorded by a SM2 monitor at Ballycorus Road on 6th September 2018

TIME	AUTO ID	MANUAL ID
20:38:56	Common pipistrelle	Common pipistrelle
20:39:56	Common pipistrelle	Common pipistrelle
20:44:56	Common pipistrelle	Common pipistrelle
20:45:56	Common pipistrelle	Common pipistrelle
20:48:56	Common pipistrelle	Common pipistrelle
20:52:26	Leisler's bat	Leisler's bat
20:52:56	Common pipistrelle	Common pipistrelle
20:55:26	Common pipistrelle	Common pipistrelle
20:55:56	Common pipistrelle	Common pipistrelle
20:56:26	Leisler's bat	Leisler's bat
20:58:26	Common pipistrelle	Common pipistrelle
20:58:56	Common pipistrelle	Common pipistrelle
21:02:56	MYBR	Natterer's bat
21:03:26	MYNA	Natterer’s bat
21:05:26	Leisler's bat	Leisler's bat
21:08:56	Common pipistrelle	Common pipistrelle
21:10:26	Leisler's bat	Leisler's bat
21:10:56	Leisler's bat	Leisler's bat
21:16:50	MYBR	MYOTIS
21:17:50	Leisler's bat	Leisler's bat
21:22:20	Leisler's bat	Leisler's bat
21:24:50	Leisler's bat	Leisler's bat
21:27:50	Common pipistrelle	Common pipistrelle
21:36:50	Soprano pipistrelle	Soprano pipistrelle
21:46:50	Common pipistrelle	Common pipistrelle
21:49:20	Leisler's bat	Leisler's bat
22:01:30	Common pipistrelle	Common pipistrelle
22:03:30	NoID	Leisler's bat
22:07:00	Common pipistrelle	Common pipistrelle
22:07:30	Common pipistrelle	Common pipistrelle
22:09:30	Common pipistrelle	Common pipistrelle
22:10:30	Common pipistrelle	Common pipistrelle
22:30:00	Leisler's bat	Leisler's bat
22:32:00	Leisler's bat	Leisler's bat
22:32:30	Leisler's bat	Leisler's bat
22:40:23	Leisler's bat	Leisler's bat
23:03:23	Leisler's bat	Leisler's bat
23:03:53	Leisler's bat	Leisler's bat
23:05:53	Brown long-eared bat	Brown long-eared bat
23:13:53	NoID	Brown long-eared bat
02:17:22	Nathusius' pipistrelle	Nathusius' pipistrelle
05:13:56	Common pipistrelle	Common pipistrelle
05:22:26	Common pipistrelle	Common pipistrelle

05:22:56	Common pipistrelle	Common pipistrelle
05:26:26	Common pipistrelle	Common pipistrelle
05:27:26	Common pipistrelle	Common pipistrelle
05:27:56	Common pipistrelle	Common pipistrelle
05:29:26	Common pipistrelle	Common pipistrelle
05:29:56	Common pipistrelle	Common pipistrelle
05:30:26	Common pipistrelle	Common pipistrelle
05:32:56	Brown long-eared bat	Brown long-eared bat Common pipistrelle
05:33:26	Common pipistrelle	Common pipistrelle
05:33:56	Common pipistrelle	Common pipistrelle
05:34:26	Common pipistrelle	Common pipistrelle
05:34:56	Common pipistrelle	Common pipistrelle
05:35:26	Common pipistrelle	Common pipistrelle
05:38:20	Common pipistrelle	Common pipistrelle
05:38:50	Common pipistrelle	Common pipistrelle
05:39:20	Common pipistrelle	Common pipistrelle
05:41:50	Common pipistrelle	Common pipistrelle
05:42:20	NoID	Common pipistrelle
05:43:50	Common pipistrelle	Common pipistrelle
05:44:20	Common pipistrelle	Common pipistrelle
05:46:20	Common pipistrelle	Common pipistrelle
05:49:20	Common pipistrelle	Common pipistrelle
05:50:50	Common pipistrelle	Common pipistrelle
05:53:50	Common pipistrelle	Common pipistrelle
05:56:20	Common pipistrelle	Common pipistrelle
05:56:50	Common pipistrelle	Common pipistrelle
06:08:20	Leisler's bat	Leisler's bat

Bat activity noted at Barnaslingan Lane 4th September 2018 by SM2 monitor

TIME	AUTO ID	MANUAL ID
20:24:30	Common pipistrelle	Common pipistrelle
20:25:00	Common pipistrelle	Common pipistrelle
20:33:30	Leisler's bat	Leisler's bat
20:35:30	Soprano pipistrelle	Soprano pipistrelle
20:36:00	Common pipistrelle	Common pipistrelle
20:37:55	Leisler's bat	Leisler's bat
20:39:25	Common pipistrelle	Common pipistrelle
20:47:25	MYBR	MYOTIS
20:51:25	Common pipistrelle	Common pipistrelle
20:55:25	Common pipistrelle	Common pipistrelle
20:59:25	Common pipistrelle	Common pipistrelle
20:59:55	Common pipistrelle	Common pipistrelle
21:00:25	Common pipistrelle	Common pipistrelle
21:05:25	Common pipistrelle	Common pipistrelle
21:06:55	Common pipistrelle	Common pipistrelle

21:09:25	Soprano pipistrelle	Soprano pipistrelle
21:09:55	Soprano pipistrelle	Soprano pipistrelle
21:11:25	Leisler's bat	Leisler's bat
21:11:55	Leisler's bat	Leisler's bat
21:23:49	Common pipistrelle	Common pipistrelle
21:24:19	Common pipistrelle	Common pipistrelle
21:24:49	Common pipistrelle	Common pipistrelle
21:25:19	Leisler's bat	Leisler's bat
21:30:49	Leisler's bat	Leisler's bat
21:31:49	MYBR	MYOTIS
21:34:19	Common pipistrelle	Common pipistrelle
21:48:49	Common pipistrelle	Common pipistrelle
21:49:19	Soprano pipistrelle	Soprano pipistrelle
21:54:00	Brown long-eared bat	Brown long-eared bat
21:58:30	Soprano pipistrelle	Soprano pipistrelle
21:59:00	Common pipistrelle	Common pipistrelle
21:59:30	Common pipistrelle	Common pipistrelle
22:05:30	Soprano pipistrelle	Common pipistrelle Soprano pipistrelle
22:08:00	Common pipistrelle	Common pipistrelle
22:13:30	Common pipistrelle	Common pipistrelle
22:14:00	Common pipistrelle	Common pipistrelle
22:18:30	Soprano pipistrelle	Soprano pipistrelle
22:20:30	Common pipistrelle	Common pipistrelle
22:42:21	Brown long-eared bat	Brown long-eared bat
22:54:51	Common pipistrelle	Common pipistrelle
22:55:21	Common pipistrelle	Common pipistrelle
23:04:51	Common pipistrelle	Common pipistrelle
23:10:21	Leisler's bat	Leisler's bat
23:11:51	Common pipistrelle	Common pipistrelle
23:19:51	Common pipistrelle	Common pipistrelle
23:20:21	Common pipistrelle	Common pipistrelle
23:28:45	Leisler's bat	Leisler's bat
23:37:15	Common pipistrelle	Common pipistrelle
23:38:15	NoID	Common pipistrelle
23:38:45	Common pipistrelle	Common pipistrelle
23:42:45	Common pipistrelle	Common pipistrelle
23:47:45	Brown long-eared bat	Common pipistrelle
23:48:15	Common pipistrelle	Common pipistrelle
23:58:15	MYBR	MYOTIS
00:23:39	Common pipistrelle	Common pipistrelle
00:24:39	Common pipistrelle	Common pipistrelle
01:03:00	Common pipistrelle	Common pipistrelle
01:06:30	Common pipistrelle	Common pipistrelle
01:15:00	MYBR	MYOTIS

01:16:00	Common pipistrelle	Common pipistrelle
01:59:24	Common pipistrelle	Common pipistrelle
01:59:54	Common pipistrelle	Common pipistrelle
02:00:24	Brown long-eared bat	Brown long-eared bat
02:38:49	Common pipistrelle	Common pipistrelle
02:39:49	Common pipistrelle	Common pipistrelle
02:43:19	Common pipistrelle	Common pipistrelle
02:46:19	Common pipistrelle	Common pipistrelle
02:47:49	Common pipistrelle	Common pipistrelle
02:48:19	Common pipistrelle	Common pipistrelle
02:48:49	Common pipistrelle	Common pipistrelle
02:49:19	Common pipistrelle	Common pipistrelle

Potential Impacts of Glenamuck District Road on Bats

Construction Phase

Loss of roosts

There will be a removal of mature trees to facilitate construction of the road. Bats may avail of trees as roost sites during any season and are known to breed in suitable trees (uncommon or relatively rare), mate (more common and widespread), roost or perch (widespread). Roosts may be used for several days or weeks uninterrupted or more often, may be short-term resting places.
Tree roosts are very difficult to pinpoint without considerable effort including bat detector assessments and / or visual inspection.

Given the possibility of short-term use, there is also the likelihood that there are tree roosts within the area that have not been identified. Some of the mature trees within the land-take have potential as roosts.

Operational Phase

Roadkill

Bats may be killed while feeding along roads or flying across them to feeding areas or roosts. This is most significant close to major roosts. All Irish bat species have been noted as road fatalities within their European range, but lower-flying bats are more at risk.

Loss of feeding

Vegetation removal to construct the road will interrupt hedgerow continuity and lead to loss of mature trees and scrub. This will lead to loss of feeding for bats.

Increased Lighting

There will be a requirement for lighting of the new road in addition to the increased lights from cars, buses, trucks, bicycles and access for pedestrians along the roadside.

Increased Noise

There will be an increase of traffic noise through all the lands that the road traverses. This may affect the ability of species such as brown long-eared bat to use audible sound for hunting and will affect the ability of bats to hear lower frequency social calls with interference from car brakes etc.

Mitigation Measures

Construction

Checking of all mature trees for bats prior to felling

All mature trees shall be examined in advance of felling by a bat specialist and where potential as a roost is considered moderate to high, the tree shall be further inspected either by means of a fibrescope and access or by a bat detector assessment at a time of year when bats are active and such as survey is likely to identify their exit or return to a tree roost.

Provision of bat boxes

14 bat boxes are proposed in neighbouring trees to compensate for roost loss through tree removal and severance of the habitat. The boxes proposed are the following:

Schwegler:	2F x 4	Improved Cavity Bat box x 2	Eco Bat box x 2
	2FN x 4	Improved Crevice Bat box x 2	

These boxes shall be erected away from direct light and from traffic and from any clutter that would obstruct entry or exit for bats. Boxes shall be primarily erected in a southerly direction with a number of boxes facing away from this direction (for example, east). Boxes may be erected singly or in groups of no greater than 3 to any one tree or other structure (wall, building, culvert etc.).

Operational

Culvert access for bats

There will be three culverts to carry the road over the Glenamuck Stream and its minor tributaries in the north of scheme (WX01-WX03). There will be a bridge to carry the road over the Loughlinstown River in the south of the scheme (WX4). The culverts are approximately 1 to 2 metres in height and provide only a narrow channel by which bats might pass under the road. The bridge has over 2 metres clearance over the stream invert and a cross-sectional area of over 10 metres ^{2}. Culvert cross-sectional area of no less than 47m^2 is considered adequate to allow pipistrelles to avail of culverts while smaller sizes such as 7m^2 can facilitate Daubenton's bats (based on a probability of 95% that a culvert is used). Low culverts may be used by bats to pass under roads but the taller the culvert the more beneficial to bats.

Lighting

Road lighting must not overspill on to the surrounding vegetation . Lighting must not increase the level of illumination of tree canopy level by greater than 3 lux to ensure that bats do not lose feeding and commuting areas. This has greatest impacts on species such as brown long-eared bat, Natterer's and whiskered bats.

Planting

Planting along the road leading to each culvert should be sufficiently dense to encourage bats to commute to the culverts and cross the road at these points (e.g. leading to the Loughlinstown River. Planting would also provide feeding areas for bats.

Impacts After Mitigation

There will be a loss of feeding from the construction of the road. There will be an increase in lighting from the road. There will be a replacement of tree roost potential with bat boxes. This may create more suitable roost sites than currently available. There is a reduction in safe movement through the lands crossed while there will be facilitation of future development of the lands crossed by the provision of the road. While bat species will not move from a favourable to an unfavourable conservation status, there will be a reduction in suitability of the area for bats.

Appendix 11-1 Classification of Archaeological Monuments

NOTE: The monument classification below comprises an update of the RMP classifications undertaken by the Archaeological Survey of Ireland and published in www.archaeology.ie.

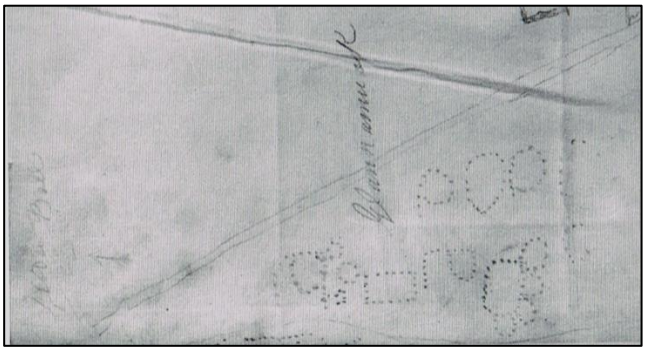
CLASSIFICATION	SCOPE NOTE
Burnt Mound/Spread	A circular or irregularly shaped mound of material consisting of burnt stones, ash and charcoal with no surface evidence of a trough or depression. Levelled examples can appear as a spread containing burnt stones. These can be of any date from the Bronze Age (c. 2400-500 BC) to the early medieval period (5th - 12th century AD). See also Fulacht fiadh
Cist	A rectangular or polygonal structure used for burial purposes, constructed from stone slabs set on edge and covered by one or more horizontal slabs or capstones. Cists may be built on the surface or sunk into the ground or set within a cemetery cairn or cemetery mound. They date to the Bronze/Iron Ages (c. 2400 BC - AD 400).
Cross	A free-standing structure, in the form of a cross (+), symbolising the structure on which Jesus Christ was crucified. These can be of any date from c. 400 AD onwards.
Enclosure	An area defined by an enclosing element and occurring in a variety of shapes and sizes, possessing no diagnostic features which would allow classification within another monument category. These may date to any period from prehistory onwards.
Fulacht Fiadh	A horseshoe or kidney-shaped mound consisting of fire-cracked stone and charcoal-enriched soil built up around a sunken trough located near or adjacent to a water supply, such as a stream or spring, or in wet, marshy areas. The first recorded use of the term 'fulacht fiadh/fia' (cooking pit of the deer or of the wild) as relating to ancient cooking sites was in the 17th century. The monuments are generally interpreted as to have been associated with cooking and date primarily to the Bronze Age (*c.* 2400-500 BC) – see also Burnt Mound.

Appendix 11-2 Classification of Archaeological Monuments

SITE CH-5

SMR No:
DU026-021
TOWNLANDS:
Glenamuck South
Kingston
CLASSIFICATION:
Enclosure(s)
ITM:
720925 722064
PROTECTION:
RMP; DLRCDP

A sketch accompanying the *Ordnance Survey Letters (1837)* shows a cluster of enclosures at Glenamuck (Herity, 2001, p.20, Fig. 12), as illustrated below.



There are no indications of these features on any O.S. historic maps and that of 1837 indicates some possible outcropping rock at this location. The files of the Archaeological Survey of Ireland (ASI) note that the site was visited in 1996 at which time no visible traces of these features was evident. Likewise, there are no visible indications for such features on aerial photographs. A Geophysical Survey in the area of these features (Appendix 4) failed to detect any related subsurface anomalies.

SITE CH-6

SMR No:
N/A
TOWNLAND:
Carrickmines Great
CLASSIFICATION:
Burnt Spread/Fulacht Fiadh
ITM:
721102 723525
PROTECTION:
DLRCDP

This feature was uncovered by Teresa Bolger, Margaret Gowen & Co (Licence No: 05E0756; Bolger, 2007) during a programme of Archaeological Monitoring of topsoil stripping associated with the Glenamuck – Kiltiernan Main Drainage Project, and on the western edge of a wayleave area.

The feature initially presented as a spread of dark, charcoal-stained, gravelly clays with frequent heat-affected stones. The surface was truncated by parallel agricultural furrows. Subsequent archaeological testing indicated that the extent of the feature within the wayleave area measured 12.5m (N-S) x 7m (E-W) and extended under/into the western baulk (i.e. limit of development); consequently the exposed area only represent an unknown portion of the feature. The exposed remains were subsequently covered with soil and the feature was preserved *in situ*.

SITE CH-7

SMR No:
DU026-018
TOWNLAND:
Carrickmines Great
CLASSIFICATION:
Cross

A cross base is located in the front garden of a modern house, on the lands of Springfield farm. It comprises a flat granite boulder, the surface of which is level with the ground (L: 0.76m; W:0.35m; D:0.23m) and contains a socket for a cross in the centre (L:0.35m; W:0.2m; D:0.02m)

ITM:
721623 723306
PROTECTION:
RMP; DLRCDP

SITE CH-8

SMR No:
DU026-015
TOWNLAND:
Jamestown
CLASSIFICATION:
Cist
ITM:
720118 723467
PROTECTION:
RMP; DLRCDP

Several burials found from a sand quarry discovered *c.* 1908 may represent the remains of a flat cemetery; an encrusted urn, a vase and an anomalous bowl are preserved, the latter of which may have been found in a cist. Human bones were reportedly strewn on the paved floor of the grave – NMI 1908:158; NMI SA 1927:45 (Ó Ríordáin & Waddell, 1993, 108)

Appendix 11-3 Summary of Geophysical Investigations (after Harrison, 2006)

As noted above in Section 11.3.4.2.B, a limited Geophysical Survey was undertaken by David Harrison, Margaret Gowen & Co (Licence No: 06R0064) in 2006 with respect to the previous proposed Glenamuck Distributor Road proposals. An initial gradiometer scan of an area totalling 14ha was undertaken at two locations – within the extent, and south of, DU026-021 (Site CH-6) and at a location to the north, where there was potential for subsurface remains of a former road which is marked on Rocque's Map of 1760 following more detailed gradiometer survey was undertaken in nine separate areas at these locations, totalling 3.2ha – Figure A below.

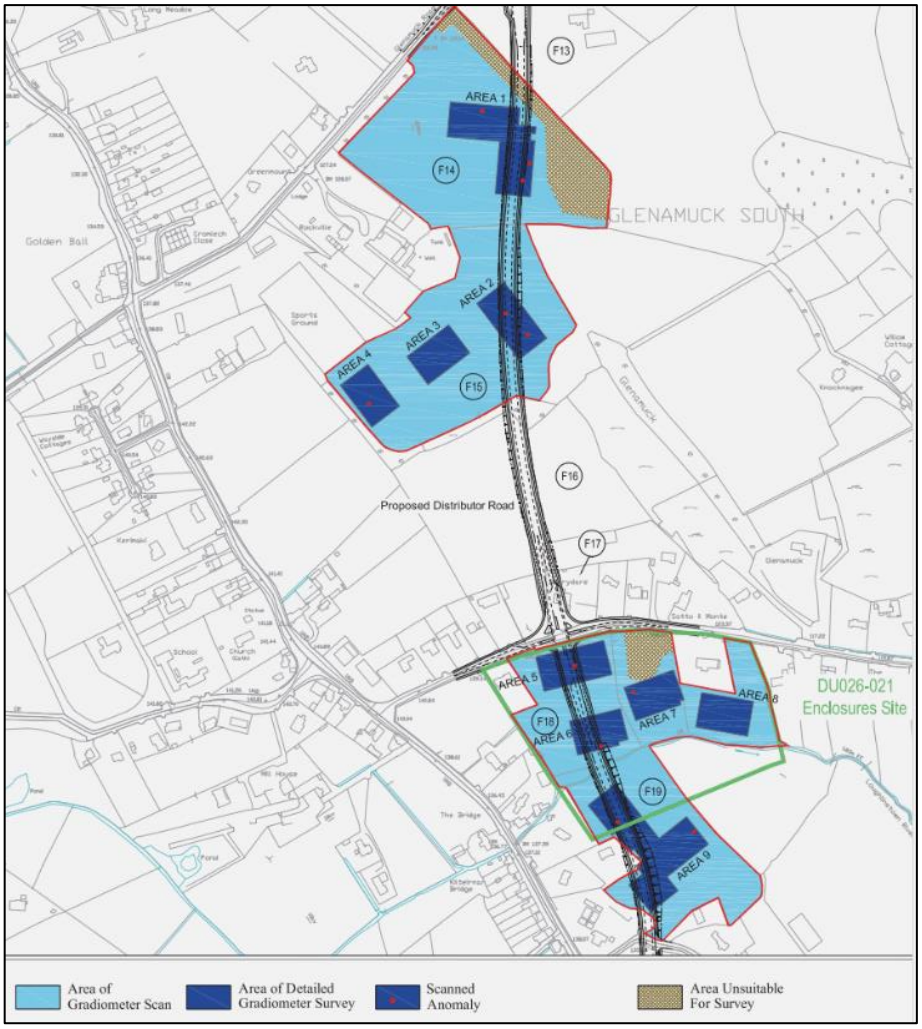


Figure A Locations & Extents of Geophysical Survey

The Interpretative Maps relating to the nine individual areas of more detailed gradiometer survey are illustrated below in Figures B and C.

The results/interpretations are as follows:

Area 1 – Figure B

An isolated positive response may be archaeological in origin; although no clear pattern is discernible an archaeological interpretation should be considered, although it is likely that this related to deeply buried ferrous debris.

A curvilinear negative response corresponds to a dry stream or ditch which was observed during fieldwork and is not considered to be of archaeological interest. In addition, several linear trends within

the dataset are considered to relate to drainage and, likewise are not likely to be of archaeological significance.

Area 2 – Figure B

Two isolated responses were identified; no archaeological pattern is visible and these may relate to buried ferrous debris.

Area 3 – Figure B

No responses of archaeological potential were identified.

Area 4 – Figure B

An isolated response in the centre may be of archaeological interest. However, a large amount of ferrous debris is apparent and the response may be related to this.

Area 5 – Figure C

A number of linear trends are considered to relate to natural subsoil variations and not of archaeological significance.

Area 6 – Figure C

An isolated response within the northern area may be archaeological in origin. However, the response is isolated and may relate to a natural localised soil variation.
Magnetic disturbance within the southern area relates to ferrous material lying close to the banks of the Loughlinstown River.

Area 7 – Figure C

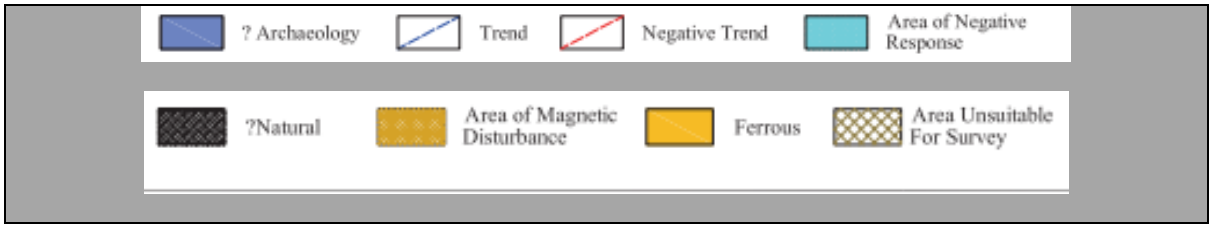
A positive rectilinear response corresponds to an area of waterlogged and disturbed ground adjacent a concrete platform. The response may be of modern origin; however, the strength and clarity of the response is such that an archaeological interpretation should be considered.
A broad area of magnetic disturbance to the north relates to an existing fence.

Area 8 – Figure C

Several isolated responses were identified with no discernible archaeological pattern. Although these may be of archaeological potential the responses could equally relate to buried ferrous objects.
An increased magnetic response in the southern area may be related to disturbed ground associated with the field entrance, although it may be of archaeological potential.
A broad area of magnetic disturbance to the north relates to an existing fence.

Area 9 – Figure C

An isolated response in the northern area may be archaeological origin although it could equally be related to a considerable amount of ferrous debris apparent within the dataset and related to buried ferrous material.
An area of magnetic disturbance in the southern sector corresponds to disturbed aground at the field entrance and is not considered to be of archaeological potential.



Key to Figures B and C

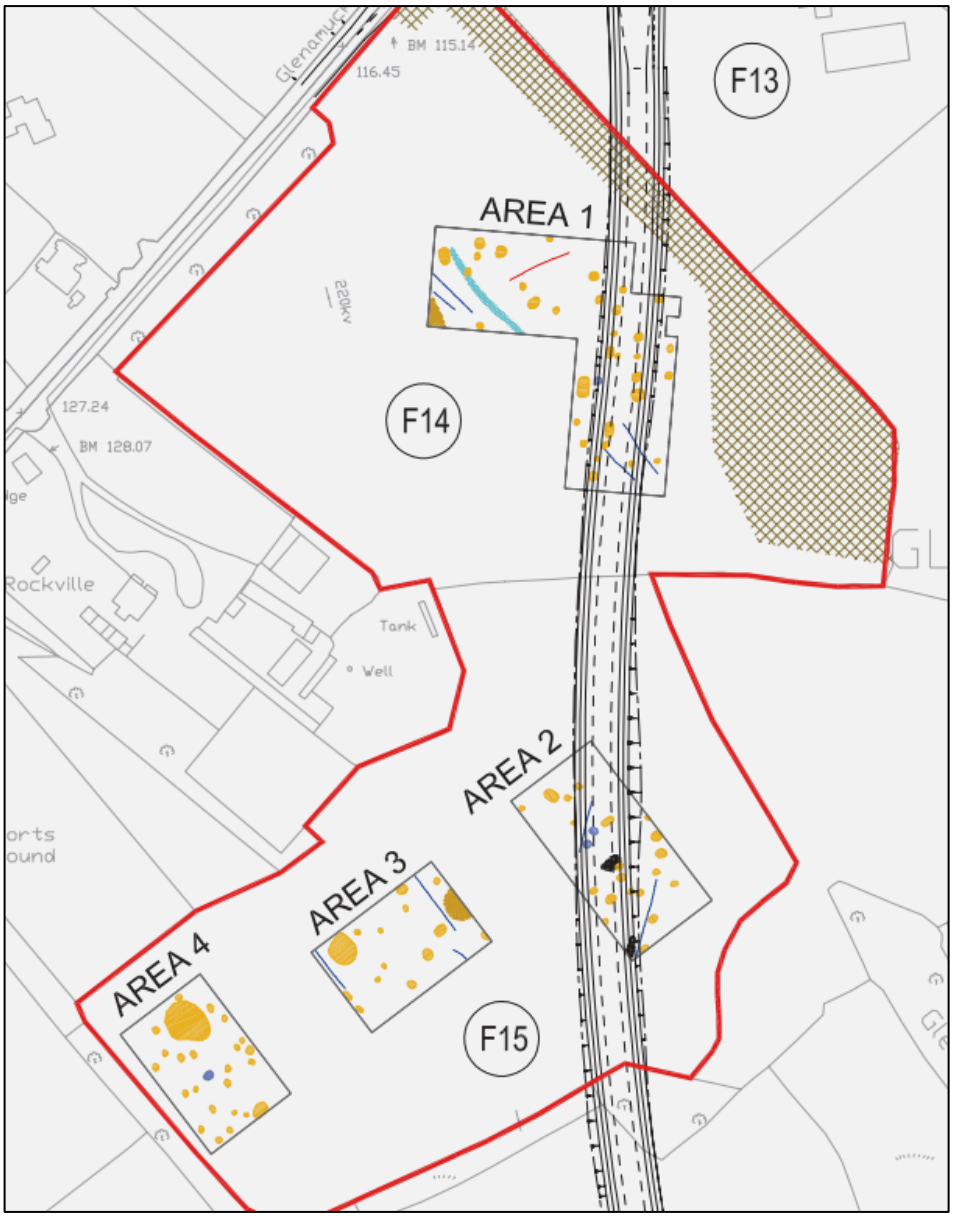


Figure B – Geophysical Interpretation Map – Areas 1 - 4

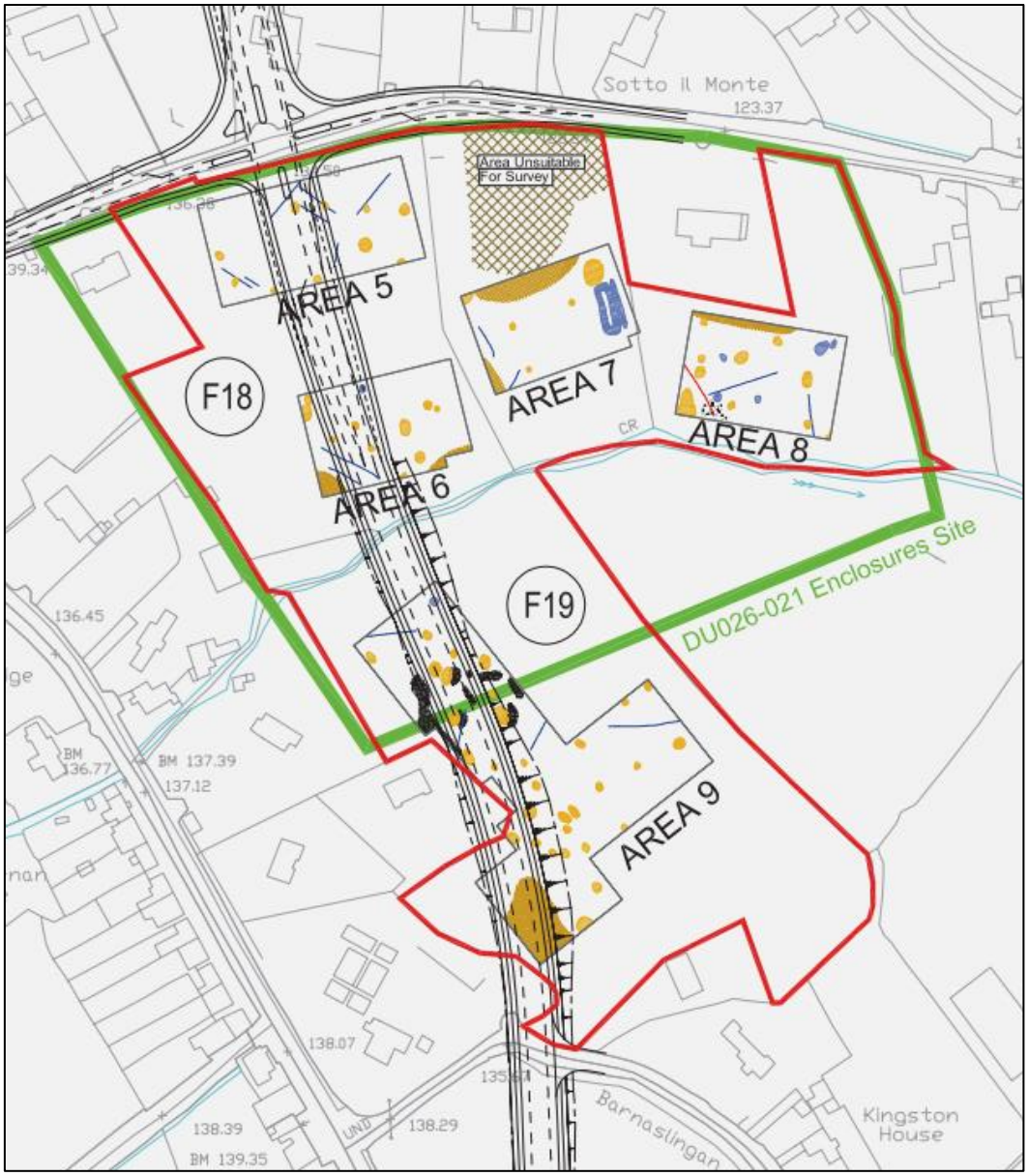


Figure C Geophysical Interpretation Map – Areas 5 – 9