Re: Planning Application Ref. 2560019 – Proposed Biogas / Anaerobic Digestion Facility

Dear Sir / Madam,

On behalf of Killough Biogas Concern Group, we hereby lodge a formal community objection to the above-referenced planning application.

This objection is made on the grounds that the proposed development, by reason of its scale, intensity, traffic generation, emissions profile, and land-use implications, would constitute an inappropriate form of industrial development in a rural area, contrary to the principles of proper planning and sustainable development, and in material contravention of national, regional, and local planning policy.

The proposed development constitutes an industrial energy facility, involving large-scale processing infrastructure, continuous operational activity, and significant vehicular movements.

Such development is fundamentally incompatible with the receiving rural environment and conflicts with:

- Section 2(1) of the Planning and Development Act 2000 (as amended), which requires development to be consistent with the proper planning and sustainable development of the area;
- The Tipperary County Development Plan, which seeks to protect rural residential amenity, landscape character, and the viability of rural communities.

The proposal would result in the permanent industrialisation of a rural landscape, undermining its environmental, residential, and agricultural function.

The development would generate regular Heavy Goods Vehicle (HGV) movements associated with:

- Feedstock delivery
- Digestate removal
- Operational servicing

These movements would take place on local and regional rural roads that are:

- Narrow
- Lacking footpaths and cycle infrastructure
- Unsuitable for sustained industrial traffic volumes

This raises serious concerns regarding:

- Road safety
- Traffic hazard
- Noise and vibration impacts
- Accelerated road degradation

The proposal fails to adequately demonstrate compliance with:

- DMURS (Design Manual for Urban Roads and Streets) principles where vulnerable road users are present;
- The requirement under the County Development Plan that new development shall not give rise to unacceptable traffic or infrastructural impacts.

Anaerobic digestion facilities are associated with odour emissions, fugitive methane releases, ammonia, and hydrogen sulphide (H_2S), even where operated in accordance with regulatory standards.

The proposed development gives rise to a high risk **of adverse impact on residential amenity**, contrary to:

- The **EPA's recognition of odour as a material environmental impact**;
- Established planning principles that protect residential amenity from noise, odour, and air pollution.

The reliance on operational management plans and post-hoc enforcement does not provide adequate certainty at the planning stage, contrary to established planning and environmental assessment standards. Other than knowing that the landowner is Roadstone and the investors are Utopia Mother X, with registered offices in Canada, the operator of the AD plant is still undisclosed.

The proposal would introduce:

- Large digesters and tanks
- Flaring infrastructure
- Security fencing and artificial lighting

These elements would have a **significant adverse visual and landscape impact**, contrary to:

- The **landscape protection objectives of the Tipperary County Development Plan**;
- **National Planning Framework (NPF) National Strategic Outcomes**, which require the protection of rural landscape character and amenity. Considering the borough of Cashel's plans to achieve Unesco heritage status, it is unclear why a medieval settlement and Early Christian Irish church can be detrimentally effected in its environs.

Mitigation by screening does not negate the **fundamental incompatibility of the development's scale and form** with the rural setting.

The development risks incentivising the **diversion of agricultural land from food production to energy feedstock supply**, with implications for:

- Land availability and affordability
- Long-term agricultural sustainability
- Rural socio-economic balance

This is inconsistent with:

- **NPF objectives on sustainable rural development**;
- The requirement to support viable rural communities rather than impose externally driven industrial uses.

Granting permission would also establish an **undesirable precedent** for further industrial energy developments in similar rural locations.

Digestate storage and land-spreading activities present a **material risk to surface and groundwater**, including:

- Nutrient run-off
- Nitrate pollution
- Cumulative impacts on water bodies

Reports sent to the Council indicate the already high concentration of nitrates in local water courses.

These risks engage:

- The **Water Framework Directive**
- The **Nitrates Regulations**
- Local development plan objectives for water protection

The applicant has failed to demonstrate, to the requisite planning standard, that such risks can be fully avoided over the lifetime of the development.

Local opposition arises not from objection to renewable energy in principle, but from:

- Inadequate pre-planning consultation
- Technical documentation inaccessible to non-specialist communities
- A failure to meaningfully address social and community impacts, fully disclose information and only have box ticking exercises at the end of the application process to demonstrate to the council ‘engagement’ was attempted.

This is contrary to the participatory principles underpinning:

- The **Planning and Development Act**
- The **Aarhus Convention**, to which Ireland is a party

Conclusion

For the foregoing reasons, **Killough Biogas Concern Group submits that the proposed development is inappropriate at this location**, would give rise to **significant adverse environmental, infrastructural, and residential impacts**, and would materially contravene national, regional, and local planning policy.

Accordingly, we respectfully request that **Tipperary County Council refuse planning permission** for Planning Application Ref. **2560019**.

Yours faithfully,

Pat Shanahan, on behalf of

Killough Biogas Concern Group
County Tipperary

Please find attached:

Report from Roger Goodwillie on woodlands

Water report on river adjacent to Killough

Slides from Community meeting on Water in Killough and surrounding areas.

List of community concerns from community collaboration at workshops on 3rd and 10th of January 2026

Re: Formal Objection to Planning Application 2560019 by Roadstone Ltd – Killough Renewable Energy Development (Anaerobic Digestion, Biomethane, Gas Upgrading, & LBG Facility)

Reasons for our (Killough Community Group's) objections:

1. **Major accident hazard risk, Major Accident To The Environment (MATTE) Not Assessed**
2. **COMAH/Seveso III non-compliance, inadequate traffic and road safety assessment, material alterations not re-advertised, and insufficient environmental protection, Material Alteration: Switch from CBG to LBG (Cryogenic Liquid Bio-Gas) increases the dangers onsite**.
3. **COMAH/Seveso III Land-Use Constraints Not Addressed**
   The proposed anaerobic digestion and LBG facility would be located inside an **active blasting quarry,** which fundamentally conflicts with Seveso III land-use planning principles. HSA technical guidance emphasises the importance of site layout, domino-effect prevention, vibration impacts, and maintaining public safety buffers. None of these are addressed.
4. Road infrastructure is inadequate for the increased traffic, in conjunction with other local projects.
5. **Karst Aquifer & Groundwater Risks Remain Unaddressed**
   The Killough area overlies a karstified limestone aquifer, highly vulnerable to contamination. Peer-reviewed Irish research shows digestate can contain: pathogens (Cryptosporidium, Salmonella, Listeria, Campylobacter), antibiotic-resistant genes (ARGs), microplastics and heavy metals.
   The EIAR fails to assess spill scenarios, containment failure, biogas reactor rupture, or LBG spill interactions with karst pathways. **There is a potential threat of pollution to water courses and Suir SAC, and local wells.**
6. **This substantially threatens the unique biodiversity of area in a proposed National Heritage Area.**
7. **Over-Intensification & Domino-Effect Risk**: The site squeezes multiple high-hazard units into a confined quarry:

- anaerobic digesters
- biogas upgrading
- CO_2 storage
- methane storage
- cryogenic LBG facility
- flare
- lagoons
- transformers

8. Air quality will be affected. Biomethane plants release hazardous gases such as hydrogen sulphide (H_2S), which can cause rapid unconsciousness or death at high concentrations, and methane and carbon dioxide, which can displace oxygen and lead to asphyxiation if leaked in sufficient quantities in the production process or through flaring.
9. Visual amenities in the area will be adversely effected.
10. Local property prices will plummet.

List of community concerns from community collaboration at workshops on 3rd and 10th of January 2026

11. Re: Formal Objection to Planning Application 2560019
    Roadstone Ltd – Killough Renewable Energy Development
    Anaerobic Digestion, Biomethane, Gas Upgrading and Liquid BioGas (LBG) Facility
12. On behalf of Killough Community Group, we object to this application on the following planning, safety, and environmental grounds:
13. • Major accident and environmental risks are not adequately assessed. The EIAR does not properly evaluate credible accident scenarios, including fire, explosion, containment failure, or Major Accident to the Environment (MATTE).
14. • The development does not demonstrate compliance with COMAH and Seveso III regulations. Traffic risks, public safety, environmental protection, and emergency planning are inadequately addressed.
15. • A material alteration from Compressed BioGas (CBG) to Liquid BioGas (LBG) significantly increases risk due to cryogenic storage and higher energy density, yet this change was not re-advertised or fully reassessed.
16. • The proposed location within an active blasting quarry conflicts with Seveso III land-use planning principles. Risks relating to vibration, blast impacts, safety distances, and domino effects are not addressed.
17. • Local road infrastructure is unsuitable for the scale and type of traffic proposed, particularly when assessed cumulatively with other existing and proposed developments.
18. • The site overlies a highly vulnerable karst limestone aquifer. The EIAR fails to assess spill scenarios, lagoon leakage, reactor failure, or LBG releases and their rapid movement through karst groundwater systems.
19. • Anaerobic digestion by-products may contain pathogens, antibiotic-resistant genes, microplastics, and heavy metals, posing risks to local wells, watercourses, and the River Suir SAC.
20. • The development represents over-intensification, clustering multiple high-hazard installations in a confined quarry, increasing the likelihood of cascading or domino-type accidents.
21. • Air quality and public health risks are insufficiently assessed. Potential emissions include hydrogen sulphide, methane, and carbon dioxide, which present toxicity and asphyxiation hazards.
22. • The scale and industrial nature of the development threaten local biodiversity within a proposed National Heritage Area.
23. • The development would significantly harm rural visual amenity and negatively affect residential amenity and property values.

(Killough Hill & Craig viewed from the East GSI 2019)

Environmental Report on: Proposed Biogas & LNG Facility by Roadstone at Killough Quarry, Gaile Townland, Holy Cross, Co. Tipperary. Planning Application No:2560019

Author: Aine McCann

Date: 17/01/2026

Contact: cillinenvironmental@gmail.com

Cillín Environmental cillinenvironmental.com

Phone: 087-9562037

Statement of authority

Áine McCann is an environmental scientist and consultant specialising in environmental science, EIAR, ecology, and hydrology/hydrogeology, with experience advising on major energy projects and representing clients at An Bord Pleanála oral hearings. A former waste-management practitioner who established Galway City and County's first recycling facility in the early 1990s, she has published research on Charophycean algae, leading a paper identifying arabinogalactan proteins (AGPs) in algal cell walls—structures once thought confined to vascular plants. Áine has presented at Irish plant science conferences, exhibited research at the Environmental Scientific Research Institute in Galway, and recently addressed a government committee on the Renewable Heating Directive and anaerobic digestion. She regularly speaks to local groups on environmental topics and has longstanding field expertise in bat ecology, including participation in Ireland's first Daubenton's bat survey (2006) and ongoing professional and educational bat survey work.

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Purpose of this report

This report has been commissioned by Killough Community Group in response to planning application No 2560019 to Tipperary Coco by Roadstone for permission to build and operate a Biogas facility with an attached LNG facility in the townland of Gaile, Co. Tipperary, where active quarrying (including rock blasting) takes place.

We will examine the proposed site and its uniqueness within the region.

We will evaluate the EIAR's site selection process (Chapter 7) to ensure that the process applied has met EU & Irish environmental standards and has provided adequate justification for the proposed location.

This report will then seek to discern the reasons for choosing to locate a Biogas and LNG facility on a working quarry that lies within a proposed natural heritage site.

By examining hydrology & hydrogeology, we will assess the potential environmental impacts, health risks, and social implications of siting large volumes of nutrient- and microbial-dense fluids on bare karst above a diffuse, regionally important aquifer and in Co Tipperary, where Nitrate levels in ground and surface waters are already under pressure. We will also look at associated risks to human health.

We will compare the justification for development at this location with the nature of the applicant's business, citing an example of good environmental & sustainable practice in a similar industry.

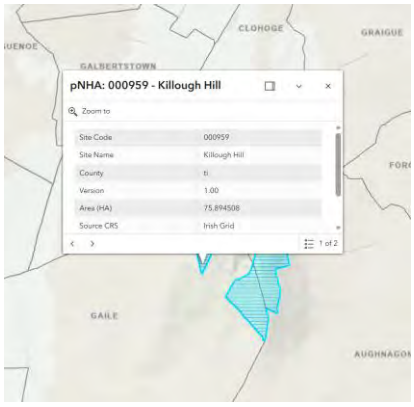
We will also examine the lack of and misapplication of regulations regarding the certification of anaerobic digestate, the LUP report, and the traffic section of the EIAR.

1. Proposed site

1.1 Killough Hill Proposed National Heritage Area (pNHA) 000959

There are currently 630 pNHA's in the Republic of Ireland, of which Killough Hill is one. (Figure 1.1 & 1.2)

These areas receive this designation based on expert evidence related to specialised habitats, geology, and their significant importance to wildlife. It is part of a broader effort to bring such areas under the umbrella and protection of the NHA framework and safeguard areas important to species and habitat conservation.



Killough Hill as per NPWS. Fig. 1.1

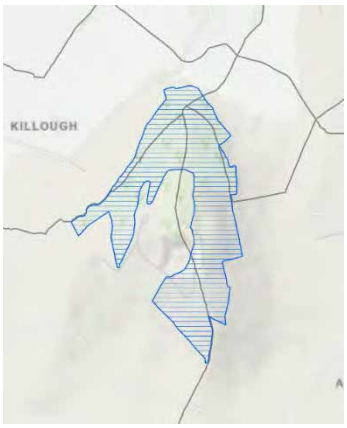


Fig.1.2

The species diversity and richness at Killough Hill are recognised and documented in a 1973 research report by Fahy & Goodwillie, who surveyed Co Tipperary for The National Institute of Physical Planning & Construction. The sites selected were to be preserved from development. Killough Hill was such a site.

Sites of scientific interest are valuable as places of education, research and for amenity and recreation. In terms of the first two, South Tipperary is fortunate: some of its wetlands and woods are deserving of intensive study, having been largely overlooked to date. The exposure of limestone pavement, is one of only five examples in the country and is the most southerly.

Page 2 Fahey & Goodwillie

Quarrying is a threat whose effects are generally only seen in areas of geological importance and South Tipperary is probably unique in Ireland in having a woodland which is at risk by the removal of the limestone hill in which it is growing. Killough hill woodland has already been largely removed and will disappear completely if efforts are not made to ameliorate the effects of quarrying there.

Page 4 Fahey & Goodwillie

The effects of damage already occurring to this recognised special area were highlighted in this 1973 report.

1.2 Why is this area so special?

Killough Hill is a limestone hill of National and Regional importance. It is part of the Ballyadams Formation, which comprises fossil-rich Lower Carboniferous Dinantian limestone. Described as a craig-and-tail feature, the hill slopes downward from North to South and exhibits streamlined bedrock features along the top and flanks, resulting from glacial movement and abrasion during the Quaternary period. It is a well-moulded shape with glacial till remaining at the tail end.

Killough Hill is one of the very few regions in Ireland where we see the formation of true karst features, clints & grikes, outside the Burren in Co Clare. Limestone pavement has formed, and the resulting subterranean features, such as pipes, are also evident. (Figure 1.3) The limestone beds, which subsequently form limestone pavement, are described on the first Ordinance Survey maps of 1830 and commented on by Fahey and Goodwillie.

Description of the area

The site is shown on the accompanying 6" O.S. map. It was described by the original geological survey as a typical limestone escarpment having an abrupt north slope "formed by the .... termination of its beds while the other side is a gentle slope conforming more or less perfectly with the inclination of the beds." Rock is now exposed on top and on the north slope where it has been eroded into limestone pavement.

Page 30 Fahey & Goodwillie

Epikarst in the uppermost portion of the exposed limestone, and a clay-filled 'pipe' within the rock.

GSI. Tipperary Geological Site Report: Killough Hill (Fig 1.3)

There is a complex underlying geomorphology of North-West-trending thrusts of Variscan deposits (320-280 Ma Yr), a fault line, and strike-slip faults formed by Palaeogene & Neogene (65-2 Ma Yr) deposits.

This would require a specialist engineering survey for any building in this area, as construction in karst areas is not straightforward due to subterranean weathering, which can create an unstable foundation. This is particularly concerning for large volumes of nutrient- and microbial-dense liquids, given their potential to leach into groundwater bodies. There are also implications for the movement of foundations for seals of gas and liquid pipes.

Ecology surveys of Killough Hill are still extant from 1973 (Fahey & Goodwillie). We can clearly see from the survey carried out the level of species richness in the area. This corroborates Killough Hills' inclusion on the pNHA list in 1995.

The southern side of the hill is partly under grass, and drift soil normally overlies the limestone. Ash is well established here with some elder and scattered oak trees but only small patches of closed canopy are found.

Higher up and to the north side a hazel wood becomes dominant with some ash and rowan (Sobus aucuparia) and shrubs such as Euonymus europaeus (spindle-tree), Viburnum opulus (guelder rose) and Rosa canina and R. arvensis (roses). The woodland floor has a characteristic assemblage of herbs and mosses, including:-

Oxalis acetosella	wood sorrel	a
Endymion non-scriptus	bluebell	a
Circaea lutetiana	enchanter's nightshade	c
Primula vulgaris	primrose	c
Geranium robertianum	herb robert	c
Galium odoratum	woodruff	f
Fragaria vesca	strawberry	f
Glechoma hederacea	ground ivy	f
Veronica chamedrys	germander speedwell	f
Lysimachia nemorum	yellow pimpernel	f
Arum maculatum	arum lily	o
Ranunculus ficaria	wild celandine	o
Epipactis helleborine	broad-leaved helleborine	o
Dryopteris filix-mas	male fern	o
Athyrium filix-femina	lady fern	o

Fahey & Goodwillie

The plants of the limestone pavement included:-

Festuca ovina	sheep's fescue
Galium verum	lady's bedstraw
Carex flacca	a sedge
Carlina vulgaris	carline thistle
Camptothecium lutescens	a moss
Phyllitis scolopendrium	hart's tongue
Asplenium ruta-muraria	spleenwort
Neckera crispa	moss
Ctenidium molluscum	moss
Sedum acre	wall pepper

Fahey & Goodwillie

Evaluation

The woodland on Killough Hill is of relatively recent origin but is developing well with a very good ground flora. It also houses a large bird population and varied mammals. The open areas of pavement and limestone grassland are perhaps more important since they are a rare feature in the country. To date only four exposures of pavement are known outside the western Clare-Galway area (see map). These have the same interest which oceanic islands have, being isolated from each other. A comparison of the invertebrate fauna with an area of the Burren (Richards, Proc. R.I.A. 62, 1) brings out some similarities especially the prevalence of scavengers, but the presence of a spider family (Dysderidae) suggests a different food chain at Killough.

Fahey & Goodwillie

The site evaluation above, as stated by Fahey & Goodwillie, is still relevant. At the time of writing the above evaluation, the site would not have had the benefit of the Habitats Directive. No plant species recorded in the provided 1973 lists are currently assessed as threatened on Ireland's Red Lists; however, the assemblage is characteristic of calcareous habitats and the conservation concern at Killough Hill arises primarily from the scarcity and vulnerability of *limestone pavement (EU Habitat 8240, priority)* *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora - consolidated version*

01/01/2007 (EU Habitats Directive) and associated semi-natural calcareous communities, rather than from the presence of individually protected flora.

This area is also rare and isolated outside the Clare/Galway area, and it is already under pressure from quarrying, which, according to the Geological Survey Ireland, has caused structural damage to the underlying karst.

NPWS notes that, although a pNHA lacks statutory standing, it should be accorded due recognition and consideration in environmental assessments and planning policy.

2 Examining the site evaluation process

2.1 Section 3 of the submitted EIAR deals with site selection.

Reasonable Alternatives and Site Selection: Legal Test and Deficiencies in the EIAR "Alternatives"

Legal Requirement and Irish Law.

1.1. The EIAR must contain a description of the reasonable alternatives studied (including location and layout/design) and the main reasons for the option chosen, considering **environmental effects**, including a **comparison of the environmental effects of the chosen and alternative sites**.

This duty arises under the EIA Directive 2011/92/EU (as amended) (Annex IV / "reasonable alternatives") and is mirrored in Irish planning law through the Planning & Development Regulations 2001 (as amended), which set out the EIAR content requirements. EPA EIAR guidance further clarifies that the alternatives chapter must show how **environmental considerations** were considered in selecting the preferred option (a "mini-EIA" is not required, but the comparison must be real and environmentally grounded).

1.3. Where groundwater is potentially at risk, decision-makers must also apply binding water-protection objectives, including preventing deterioration and preventing/limiting pollutant inputs to groundwater, implemented in Ireland through the Environmental Objectives (Groundwater) Regulations 2010.

2.2 Assessment of the proposed Alternative Sites

The EIAR acknowledges the legal duty for "reasonable alternatives" and cites Annex IV and Schedule 6, but the substance of the chapter primarily **justifies the chosen quarry site** rather than evidencing a genuine **location alternatives assessment**.

Under "Alternative Locations", the EIAR identifies the National Bioeconomy Campus at Lisheen (approx. 20 km away) but rejects it chiefly on corporate/operational preference ("on-site… best use of resources… rather than… off-site") rather than by comparing **environmental constraints/capacity** between locations.

The EIAR quotes the Tipperary Renewable Energy Strategy (CDP Volume 3, Appendix 2, Section 6.6), stating that mixed biomass processing facilities should typically be located on industrial-zoned land/brownfield sites and on rural sites with a **proven capacity (environmental and infrastructural)** to accommodate development.

No matrix is provided for scoring environmental, traffic, social, and other impact criteria, as is the norm for site comparisons. Only one site has been offered as an alternative.

The "Alternative Designs and Layouts" section confirms that the design iterations (Plates 3-2 to 3-5) were primarily about **sizing** and **reconfiguring the layout** "to ensure the best flow for site operations" and "fit in with the surrounding quarry site," with the "preferred design" chosen for operational reasons (odour/noise positioning; ponds at lowest point "to assist with drainage flow"; ring road, etc.).

This is acceptable only when there is no alternative site for a fire station or a hospital.

. Core weakness: no genuine "location alternatives" methodology or environmental comparison.

The EIAR does **not** define a **search area**, selection criteria, or a constraints-led screening exercise (e.g., groundwater vulnerability/karst sensitivity, flood risk, designated sites, sensitive receptors), nor does it provide any structured **environmental comparison** of candidate sites. Instead, the only identified alternative location (Lisheen) is rejected largely for business/operational reasons.

This is a material deficiency against the legal test: the EIAR must show the **reasonable alternatives studied** and the **main reasons for choosing the selected option, taking environmental effects into account**, with an adequate comparison. DIRECTIVE 2011/92/EU

Misapplication of County policy: "brownfield" is treated as sufficient, while "proven environmental capacity" is not demonstrated.

The EIAR relies on the Renewable Energy Strategy policy wording (industrial/brownfield preference; rural sites only where there is **proven environmental capacity**), but the subsequent "suitability" reasons focus on screening, traffic, proximity to quarry energy use, and

feedstock/market logic, rather than demonstrating that the quarry site has **environmental capacity**, particularly for **groundwater protection**.

In an active quarry/karst setting, "capacity" is not a planning slogan: it requires evidence that credible accident scenarios (spills, contaminated surface water, contaminated firewater) can be contained without unacceptable pathway risk—especially where natural attenuation may be minimal. The alternatives chapter does not perform that capacity test at the stage where it is legally intended to influence site choice.

Why "Option 2" (internal layout alternative) cannot cure the location defect in a karst, active-quarry receiving environment.

The EIAR's "alternatives" are largely internal layout revisions (Plates 3-2 to 3-5) selected for operational/logistical reasons (noise/odour stand-offs; "ponds at the lowest part of the site to assist with drainage flow"; firewater at the highest point, etc.).

On a karst-sensitive quarry floor with little/no soil cover, relocating plant elements within the same footprint does **not** address the determinative risk: **rapid pollutant pathway potential** due to lack of soil attenuation and the likelihood of direct infiltration to fissured limestone. In other words, "Option 2" (a layout tweak) is not a reasonable alternative to avoid significant effects where the key constraint is site sensitivity. The legally relevant alternative in such circumstances is **location avoidance** (i.e., sitting on a demonstrably lower-vulnerability site), not rearrangement within the same high-risk setting.

The EIAR's own preference to place ponds at the "lowest part of the site to assist with drainage flow" reinforces this concern: in a karst quarry context, concentrating flows and storage in low points can increase consequences if containment fails, and the alternatives chapter does not demonstrate how such risks are fundamentally different between the presented layouts.

2.3 Conclusion

The EIAR alternatives chapter (3) is materially weak because it does not provide evidence of a genuine location-alternatives assessment or an environmentally led comparison of alternatives, and it effectively treats "existing quarry/brownfield" as determinative while failing to demonstrate "proven environmental capacity" as required by County policy.

In a karst-sensitive, active quarry setting with no soil attenuation, reliance on internal layout "Option 2" type revisions cannot satisfy the legal purpose of alternatives assessment (avoidance of significant effects where reasonable). The deficiencies undermine the EIAR's compliance with Annex IV / Schedule 6 obligations and the binding groundwater protection objectives relevant to the competent authority's decision. European Communities Environmental Objectives (Groundwater) Regulations **2010 (S.I. No. 9/2010)**. Water Framework Directive **2000/60/EC** (no deterioration/protection objectives).

2.4 Site Selection Matrices

Several matrices for environmental, health & safety, and roads, among others, should be used alongside other criteria to assign a value to each proposed alternative site for comparison. When a value is generated, it provides the basis for correct site selection. (Figure 2.1 2.2)

This should have been applied to this planning application, but it was not.

Site/ Development Selection Criteria

Evaluation Matrix Table	Environmental and Physical Factors					
	RATING					
Site Evaluation Parameteres	%	1	2	3	4	5
Evaluation of Land Area	10%	Insufficient area	Quite bigger than insufficient	Area is exactly fit no excess, no less	Area is more than from the exact	Enough and huge area
Evaluation of Land Accessibility	10%	Accessed by private cars	Accessed by the UV and private cars	Accessed by the jeepneys, UV, and private cars	Accessed by the tricycles, bus, jeepneys, UV, and private cars	Near and accessible with all types of transportation s (land, sea, air)
Site Soil Criteria	10%	Site soil is not suitable for building structure	Site soil is partly good for building structure	Site soil is suitable for building structure	Site soil has better soil characteristic s for building structure	Site soil is best for building structure
Utilities and Services	10%	No existing utilities and services	No existing utilities and services within the area but far away from the site	No existing utilities and services within the area but near from the site	Adjacent services and utilities	Utilities and services are present within the lot
Pedestrians	10%	No pedestrians	There is a pedestrian but only one access	There is a pedestrian but only two access	The is a pedestrian but only three access	Many pedestrian access
Natural Hazards	10%	Highly susceptibilit y and hazardous area to flood; very	High susceptibility to flood; near from fault line	Moderate to high susceptibility to flood; far from fault line	Moderate to high susceptibility to flood; far from fault line	Low susceptibility to flood; far from fault line

Figure 2.1

Site Suitability

STRUCTURAL CONTROL CATEGORY	STRUCTURAL CONTROL	STORMWATER TREATMENT SUITABILITY				WATER QUALITY PERFORMANCE*			
		Water Quality	Channel Protection	Overbank Flood Protection	Extreme Flood Protection	TSS / Sediment Removal Rate	Nutrient Removal Rate (TP/TN)	Bacteria Removal Rate	Hotspot Application
Stormwater Ponds	Wet Pond	✓	✓	✓	✓	80%	50%/30%	70%	✓
	Wet ED Pond	✓	✓	✓	✓				✓
	Micropool ED Pond	✓	✓	✓	✓				✓
	Multiple Ponds	✓	✓	✓	✓				✓
Stormwater Wetlands	Shallow Wetland	✓	✓	✓	✓	80%	40%/30%	70%	✓
	Shallow ED Wetland	✓	✓	✓	✓				✓
	Pond/Wetland	✓	✓	✓	✓				✓
	Pocket Wetland	✓	✓						✓
Bioretention	Bioretention Areas	✓	✪			80%	60%/50%	*Insuff. data*	✓
Sand Filters	Surface Sand Filter	✓	✪			80%	50%/25%	40%	✓
	Perimeter Sand Filter	✓	✪						✓
Infiltration	Infiltration Trench	✓	✪			80%	80%/60%	90%	
Enhanced Swales	Dry Swale	✓	✪			80%	50%/50%	*Insuff. data*	✓
	Wet Swale	✓	✪			80%	25%/40%	*Insuff. data*	✓

Figure 2.2

3. Motivation for building at an active quarry

This note summarises plausible commercial and strategic drivers for Roadstone (a CRH company), proposing an anaerobic digestion (AD) and biomethane facility within the footprint of an existing, active quarry at Killough Hill. The assessment is grounded in the project's Environmental Impact Assessment Report (EIAR) descriptions of what the plant will do, what it will produce, and how those outputs are intended to be used, together with the wider policy direction for decarbonising heat, transport fuels, and energy-intensive industrial activity in Ireland and the EU.

The EIAR frames the facility as a multi-output, circular-economy installation designed to accept large volumes of organic materials (including bovine slurry and poultry wastes) and convert them into energy carriers and products. The stated outputs include upgraded biomethane (compressed for use as bio-CNG), electricity generation, a captured carbon dioxide stream from biogas upgrading, and digestate processed into a fertiliser product. The EIAR also describes a 'closed loop' water concept, where rainwater and process waters are collected, stored, and treated on site, then reused on the quarry and associated concrete/asphalt operations (for example, dust suppression and concrete production), with a stated intention of avoiding routine off-site discharge.

Against that technical description, Roadstone's motivations can be understood as a blend of operational decarbonisation, energy cost and security benefits, new revenue opportunities, and strategic positioning in anticipation of tightening renewable energy and climate obligations. Importantly, the active quarry setting is not incidental: it provides an existing industrial land use, hardstanding and access infrastructure, and immediate internal demand

for energy and water outputs, all of which can materially improve the economics and deliverability of a project of this type.

First, the most direct motivation is likely the decarbonisation of quarry and related manufacturing operations. Quarrying, asphalt production, and concrete operations can be energy-intensive and often rely on diesel, gas, or other fossil fuels for mobile plant, on-site equipment, and process heat. The EIAR's emphasis on using biomethane and electricity for 'adjacent quarry operations' suggests a deliberate aim to substitute fossil fuels with a renewable gas and on-site generation, reducing both direct operational emissions and exposure to fuel price volatility. Where electricity is used on-site 'behind the meter' (without passing through the grid), the project also offers the prospect of lowering energy bills and improving security of supply for a high-demand industrial site. However, they do not provide evidence, by way of contracts, that they have purchased vehicles capable of operating on Bio-LNG. Currently, some of their road fleets have switched to using biodiesel.

Second, the facility appears to be designed to create an additional profit centre beyond the quarry itself. The EIAR indicates that surplus biomethane can be transported, sold, or traded, and that compressed bio-LNG is intended as a transport fuel for a range of vehicles. In parallel, the biogas upgrading process yields a concentrated carbon dioxide stream that is compressed and stored for off-site reuse, and the digestate is described as processed into a 'certified' pelleted fertiliser product. These multiple offtake pathways point to a business model that seeks to monetise several output streams rather than relying solely on one revenue line.

However, a glaring discrepancy of the AD process is that there is no certification process for digestate in Ireland.

Third, the project's timing and design align with strong policy tailwinds for renewable gases and renewable heat. Irish and EU policy is increasingly focused on decarbonising hard-to-abate sectors through renewable heat measures, higher renewable shares in heating and cooling, and increased deployment of biomethane. Ireland has also been developing obligations and supports that increase the value of renewable heat and renewable fuels. In this context, a large AD facility can help a company demonstrate measurable emissions reductions, reduce compliance risk, and potentially benefit from support schemes or market mechanisms that reward renewable heat and gas.

Fourth, transport decarbonisation provides another plausible driver. The EIAR's inclusion of a bio-filling station and bio-CNG storage infrastructure indicates an intention to supply renewable transport fuel. This can support decarbonisation of Roadstone's own logistics fleet and site vehicles and may also position the operator to supply external markets as obligations on transport fuel suppliers tighten and demand for renewable gaseous fuels grows. In practice, this creates a pathway to reduce Scope 1 emissions from road transport and potentially earn value from fuel offtake and related certification frameworks.

Fifth, the active quarry location offers practical advantages that can be viewed as motivations. A quarry is already an established industrial site, typically with controlled access, heavy-duty roads and hardstanding, suitable separation distances, and an operational environment accustomed to HGV movements, storage, and environmental controls. Co-location also creates immediate internal 'sinks' for outputs: water reused for dust suppression and concrete production; electricity used on-site; and potentially bio-LNG used for plant and transport. This can reduce waste, reduce transport requirements for some outputs, and improve overall project integration compared with a greenfield agricultural site.

Sixth, group strategy and corporate reporting considerations are likely relevant. Roadstone is part of a larger corporate group with publicly stated decarbonisation commitments and a

growing focus on circular economy approaches. A flagship AD project can provide a tangible, reportable pathway to emissions reduction, demonstrate innovation in industrial decarbonisation, and strengthen the 'circularity' narrative by turning waste streams into fuels and products. Such projects can also serve as replicable templates for other industrial sites in the company's portfolio, especially where there is existing demand for heat, power, fuel, or water.

Finally, while the motivations above are commercially and strategically coherent, their delivery depends on high-integrity environmental risk management, especially in a sensitive limestone/karst setting such as Killough Hill. The EIAR's emphasis on on-site containment, lined ponds, sealed drainage, process water treatment, and 'no off-site discharge' should be read as a recognition that the environmental consequence of failure could be significant. For stakeholders and decision-makers, the practical question becomes whether the proposed controls are sufficiently redundant, independently verifiable, and enforceable to match the sensitivity of the receiving environment and the scale of the operation.

In summary, Roadstone's likely motivations for proposing an anaerobic digester at an active quarry include (i) substituting fossil fuels with biomethane and on-site power to decarbonise quarry, concrete and asphalt operations; (ii) hedging against energy price and carbon compliance risks; (iii) monetising multiple co-products, including bio-CNG, captured CO2 and fertiliser; and (iv) positioning strategically within an evolving policy environment that increasingly values renewable heat and renewable transport fuels. The quarry setting strengthens these motivations by providing an industrial platform with existing infrastructure and immediate internal demand for the project's outputs.

3.1 Example of sustainable practice in a hard-to-decarbonise industry: MANNOK Cement

Mannok "Energy Valley"

Description of the Mannok "Energy Valley" project

Mannok's "Energy Valley" is best understood as a long-horizon, multi-phase industrial energy transformation programme designed around a simple organising principle: build clean-energy assets that have an immediate, stable, local user ("the adjacent industrial load") and then progressively substitute fossil fuels across the whole integrated operation—from quarrying to cement manufacture to deliveries. The "Energy Valley" concept is repeatedly described publicly as a 15-year, multi-phase programme that is intended to "close the loop" on energy use and move the business toward net-zero by 2050, supported by the company's "Mannok 2030 Vision" sustainability strategy.

The industrial context around which the programme is built

Mannok is a long-established producer of building products with a major cement operation located at the border area around Derrylin (Co. Fermanagh) / Ballyconnell (Co. Cavan). Public documentation and award citations describe Mannok as a significant regional employer with a large logistics footprint and a heavy-energy industrial base.

This matters because the Energy Valley is not framed as "a renewable project in isolation." It is framed as a system redesign for a hard-to-abate industrial campus: changing what fuels are burned in the kiln/calciner, how electricity is sourced, and how the fleet is powered—while keeping the resulting energy vectors (electricity, hydrogen, alternative fuels) tied to a real, permanent local demand rather than exporting them into an uncertain market.

The "Energy Valley" logic: direct use, not speculative export

A central theme in the public record is that Mannok's clean energy projects are designed so

that the energy produced is consumed internally—either directly in the cement works, or in the transport fleet, or in associated site operations—reducing exposure to grid constraints and improving the economics of decarbonisation in a sector with high, continuous energy demand. The "direct-wire" concept is explicitly mentioned in the UK Government's summary of Mannok's hydrogen project: green hydrogen production is proposed using a direct-wire connection from local wind assets to an electrolyser.

This "adjacent load / direct-use" model is also clearly visible in Mannok's solar project at Ballyconnell: local reporting on the planning decision states that Cavan County Council granted approval for a 9.3-hectare solar PV development consisting of approximately 12,609 panels, explicitly described as intended to directly power the adjacent cement factory. The same report notes that the permission is for a 35-year operational lifespan and includes typical supporting infrastructure (transformer station, underground cabling, access track, biodiversity measures), as well as a Construction Environmental Management Plan.

The importance of this design choice (directly powering the adjacent cement works) is that it anchors the Energy Valley in industrial practicality: electricity produced on land owned/controlled by the company is matched to an existing energy user, limiting "stranded energy" and making the decarbonisation narrative more credible in planning and policy terms.

Pillar 1: fuel substitution and process decarbonisation inside the cement plant

Alongside renewables, Mannok's Energy Valley is strongly linked to fuel switching within the cement process, because a cement plant's largest controllable emissions lever in the near-

to-medium term is often substituting coal/petcoke with alternative fuels, while maintaining kiln stability and meeting air-emissions limits.

Multiple industrial sources describe Mannok as an early and aggressive adopter of solid recovered fuel (SRF) and related technologies. The cement press reports that Mannok installed a FLSmidth FUELFLEX® Pyrolyzer—described as a world-first installation—operational since July 2022, enabling higher alternative fuel utilisation and improved NOx control.

The EPA's own licensing/reporting portal includes an Annual Environmental Report excerpt describing Mannok's commissioning of the FUELFLEX Pyrolyzer and characterising it as a significant "beyond compliance" initiative, tied to major reductions in fossil fuel use in the most carbon-intensive stage of cement production and associated NOx reductions.

In 2025, industry reporting also states that Mannok completed Phase 1 of a kiln-system upgrade by installing a satellite burner, enabling SRF substitution for coal in the kiln, and setting up Phase 2 (main burner upgrade) to target much higher substitution rates across the pyroprocessing system.

Taken together, these projects show an Energy Valley pathway that is not only "green energy supply," but a systematic attempt to decarbonise the cement process through: increasing alternative fuel substitution (SRF replacing coal), improving combustion/pyroprocessing stability, reducing NOx control inputs (reported as reducing reliance on ammonia water in some accounts), and lowering carbon intensity of clinker production while maintaining output.

Pillar 2: green hydrogen to decarbonise the heavy fleet (and potentially support industrial processes)

The other flagship pillar is green hydrogen, primarily aimed at heavy transport. The UK Government's Net Zero Hydrogen Fund summary describes "Mannok Green Hydrogen Valley" as a project to generate green hydrogen using a direct wire connection from local wind assets (54 MW wind farm) to a 5 MW electrolyser, including a hydrogen refuelling station, storage, and necessary pipelines. The stated purpose is to reduce emissions and air pollution by displacing diesel.

Trade reporting and company-facing coverage expand on this by framing hydrogen as the first major step in the Energy Valley programme, with the stated intention to replace diesel in a substantial portion of Mannok's heavy goods fleet—Agg-Net reports the first phase aims to replace diesel in over 70% of the company's 150 heavy-goods truck fleet, and it also repeats a claim that the hydrogen phase could reduce diesel usage by around 4 million litres per year.

This hydrogen strand is also presented as an "industrial cluster" style initiative—engineering firms describe feasibility and basic engineering work assessing hydrogen demand, energy potential from curtailed wind, and integration options for cement and fleet uses, showing that the programme is structured as a portfolio of projects rather than a single installation.

Pillar 3: renewable electricity assets integrated with industrial demand (solar now, wind-linked hydrogen)

The Energy Valley story repeatedly returns to the concept of building renewable assets (solar PV and wind) that map onto a large, existing demand curve. In Ireland, the most concrete

public example is the Ballyconnell solar farm decision: a 9.3 ha PV site directly supplying the cement facility, permitted for a long operational life and designed with landscaping, biodiversity measures, and standard environmental management requirements.

In Northern Ireland, the hydrogen project is explicitly "wind-linked," with a direct wire from a 54 MW wind farm to the electrolyzer. The important point here is not only the technology choice, but the "Energy Valley" pattern: build generation, connect it directly to the industrial user, displace diesel/coal, and keep the energy value inside the industrial ecosystem.

The programme's governance framing: targets, awards, and staged implementation

Mannok's Energy Valley is often presented alongside quantified goals in its "2030 Vision" narrative. Award citations from SEAI's Energy Awards coverage describe Mannok's stated aim to reduce Scope 1 and 2 emissions by around 35% by 2030, and they explicitly frame the "Energy Valley Concept" as a 15-year plan to develop renewable assets, including green hydrogen, solar PV, and wind.

Older regional reporting on the publication of Mannok's "2030 Vision" similarly describes targets (including a reduction by 2030 and net zero by 2050) and explicitly references large, planned investments and fleet decarbonisation through green hydrogen, as well as the intention to develop wind and solar assets.

Across sources, a consistent structure appears: (1) Immediate abatement actions inside the cement plant (alternative fuels, pyroprocessing upgrades). (2) Fleet decarbonisation through hydrogen production and refuelling. (3) Renewable electricity build-out matched to the cement works demand, with long-life infrastructure (solar approved; wind assets referenced).

What makes it a useful comparator case in planning and environmental arguments

As a case study, "Energy Valley" is valuable because it demonstrates a decarbonisation approach for a hard-to-abate sector that is largely anchored in: energy substitution (renewable electricity + hydrogen), fuel substitution and process optimisation (SRF replacing coal; kiln/pyro upgrades), and direct-use integration where the energy produced is consumed on or near the industrial campus (reducing the need to justify new, unrelated high-risk industrial processes on sensitive ground).

In other words, Mannok's "Energy Valley" is publicly described as a programme that decarbonises cement by changing the energy system around the cement plant, while retaining a relatively clear line of sight between each new asset (PV, hydrogen system, burners/pyrolyzer) and the industrial demand it serves.

3.2 Using Mannok's "Energy Valley" as a comparator for assessing Roadstone's proposed AD facility at Killough Quarry (Co. Tipperary)

Purpose and context

This brief uses Mannok's "Energy Valley" programme as a comparator to evaluate the siting logic and environmental risk profile of Roadstone's proposed anaerobic digestion (AD) facility on an active limestone quarry at Killough Hill, County Tipperary. The central point of comparison is not whether decarbonisation is necessary—it is—but whether the chosen decarbonisation pathway is being pursued in a location where it introduces a materially higher risk of environmental harm, particularly to groundwater and associated sensitive habitats.

The comparator value of Mannok's approach

Mannok's "Energy Valley" is publicly framed as a demand-led decarbonisation pathway: renewable energy generation (solar PV and wind-linked hydrogen) is designed around direct, adjacent industrial use, while internal process improvements and alternative fuel substitution reduce reliance on fossil fuels in the cement kiln system. The programme therefore demonstrates a pathway for hard-to-abate industry where the main new environmental impacts are those typical of renewable infrastructure (construction management, biodiversity/landscape integration, traffic, and safety controls) rather than the continuous reception and storage of high-strength organic wastes and nutrient-rich liquids.

Roadstone's Killough proposal is a different class of project

Roadstone's proposed development at Killough is not merely an on-site renewable energy installation. The EIAR describes a large-scale waste reception and processing facility designed to accept up to 105,000 tonnes per annum of organic materials, including chicken waste and cattle slurry, as well as silage and brewery residues. The project is described as a multi-output bio factory producing biomethane/bio-CNG, electricity, captured CO2, and a pelletised fertiliser product, supported by extensive storage and water-management infrastructure (including surface water and firewater ponds, wastewater treatment processes, and multiple tanks/silos). The EIAR also describes the intention to use biomethane and electricity directly within quarry operations and to distribute surplus fuels to other Roadstone facilities or to external markets.

Site suitability and vulnerability: why Killough is not analogous to "Energy Valley" siting

The decisive difference between the two cases is site vulnerability. In Roadstone's EIAR baseline, the receiving environment is described as a regionally important karstified diffuse

aquifer (Rkd) with groundwater vulnerability classified as Extreme (X), meaning rock is at or very near the ground surface. This is the setting in which attenuation of pollution is limited and where fractures/epikarst features can allow rapid and unpredictable movement of contaminants to groundwater. The EIAR also confirms proximity to the Killough Hill pNHA and a limestone pavement context.

In such a setting, the environmental risk profile of an AD facility is dominated by high-consequence scenarios: spills during reception and transfer, tank or pipe failures, interceptor failure, contaminated yard runoff, overtopping or liner failures in ponds, and mobilisation of pollutants in firewater following an incident. The EIAR describes a "closed loop" water management approach with a stated intention of no off-site discharge, relying on lined ponds, sealed drainage, pumping and transfer systems, wastewater treatment, and internal reuse (including reuse within quarry and concrete operations). While such systems can reduce routine emissions, they do not eliminate risk; they convert the risk into reliance on engineered containment and operational discipline. In an Extreme (X) vulnerability karst setting, a single containment failure can have disproportionately large consequences, including rapid groundwater impact that is difficult to remediate.

Solving one environmental problem while creating another

In this context, the proposal can be framed as an attempt to solve one environmental problem (industrial decarbonisation) while potentially creating another (heightened risk of groundwater and surface-water contamination in an extremely vulnerable karst setting). The Mannok comparator case is important because it shows that hard-to-abate industries can pursue decarbonisation through direct-use renewables, hydrogen for transport, and kiln-fuel

substitution—strategies that do not require co-locating high-volume waste reception and nutrient-rich liquid handling on sensitive karst ground.

3.3 Concentration of industrial activity at a vulnerable location

Roadstone's proposal also represents a concentration of industrial activities and a hazard inventory at a location that is already an active quarry with sensitive limestone geoheritage features and proximity to pNHA. The argument is not that industry cannot operate in karst landscapes; it is that adding a new waste-processing and bulk liquid handling industry on Extreme vulnerability ground raises the probability-weighted environmental burden unless the proponent can demonstrate, with a robust alternatives assessment, that (a) the location is necessary, and (b) environmental risk is reduced to a level consistent with groundwater protection obligations and the sensitivity of nearby designated features.

3.4 Alternatives are available and should be explicitly evaluated

A major planning weakness in many such proposals is the absence of a meaningful alternatives assessment. If the key objective is low-carbon energy for quarry and manufacturing operations, alternatives exist that mirror the Energy Valley model: on-site solar PV and electrification where feasible, renewable power procurement, efficiency upgrades, and low-carbon fuels supplied via a distributed model where the high-risk digestion and reception elements are located on a less vulnerable industrial site with lower groundwater sensitivity. Even within a biomethane pathway, there are plausible "split-site" configurations in which gas upgrading, compression, and refuelling could serve the quarry's decarbonisation needs without locating the highest-risk reception and digestate-handling elements on the most vulnerable ground. Roadstone's own framing that fuels may be distributed to other facilities

underscores that the project is not inherently site-locked in the way that a directly wired solar farm serving an adjacent cement plant is.

3.5 Conclusion

Mannok's Energy Valley illustrates a decarbonisation pathway that is strongly anchored in direct-use renewables and fuel substitution within a hard-to-abate industrial system. Roadstone's proposed Killough AD facility pursues decarbonisation through a materially different route: adding a high-throughput waste reception and processing installation, with extensive hazardous liquid handling and storage, to an active quarry in an Extreme vulnerability karst setting. The environmental planning question, therefore, becomes one of site suitability and alternatives: whether decarbonisation goals could be met through lower-risk measures and/or alternative locations, rather than concentrating a new pollution hazard at a hydrogeologically sensitive site where failure consequences would be severe.

4. Hydrology & Hydrogeology

4.1 Geology

As we saw in section 1, the proposed site comprises pure early Carboniferous limestone that exhibits karst features only observed in the Burren in Co Clare and the Burren lowlands of Co Galway. (Figure 4.1)

It is part of the Ballyadams formation.

Lithology description: Medium to dark grey. Thick bed.

Lithology: Crinoidal wrack stone, Pack stone. (359-323Ma)

Rock type: Limestone

System: Carboniferous

Series: Dinantian

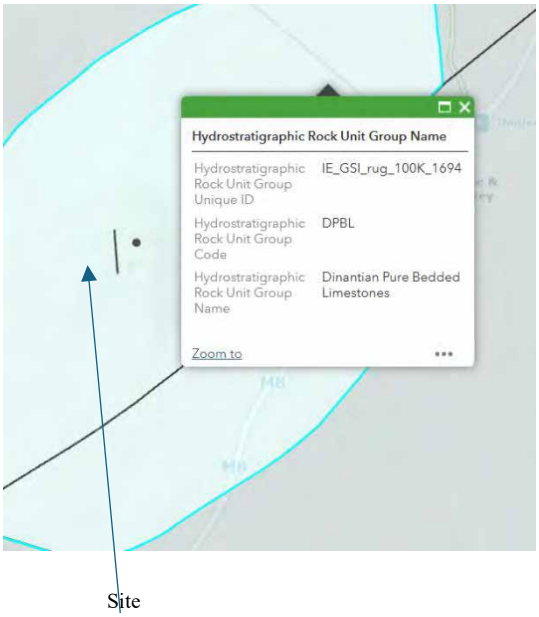
Stage: Asbian

Thickness of rock: 400-700m

Soil type at proposed site: none exposed rock

Soil depth at proposed site: 0mm

Contains veins of Variscan orogeny (320-280Ma) N-W trending. Palaeogene & Neogene (65-2Ma) form strike-slip faults.



GSI Maps

Map demonstrating Limestone bedrock with a fault line on the southwest side of the hill.

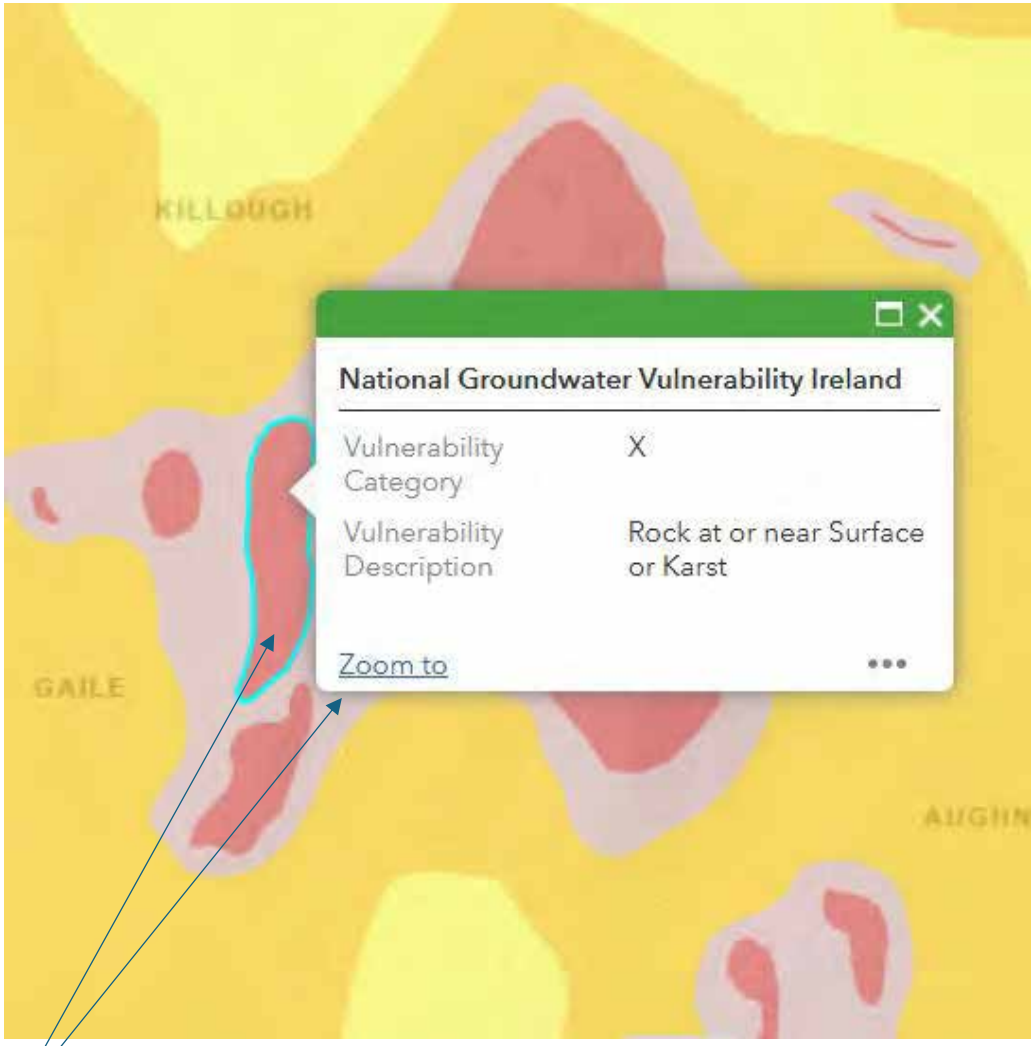
Figure 4.1

4.2 Hydrology & Hydrogeology

The groundwater vulnerability index for the proposed site is 'X' karst rock. GSI's definition of Extreme "X" vulnerability is bedrock at or within ~1 m of the surface, which inherently poses a high risk of rapid contaminant entry when containment fails. And 'E' extreme vulnerability rating. (Figure 4.2 & 4.3)

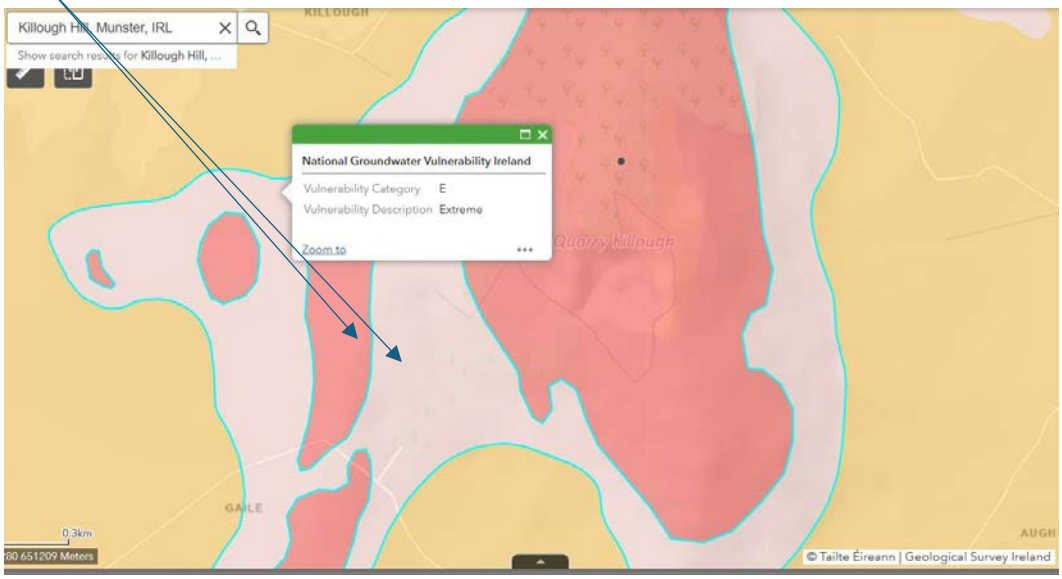
There is no soil at this site to offer any attenuation if leakage, spillage, or accident were to occur.

Figure 4.2



Proposed site

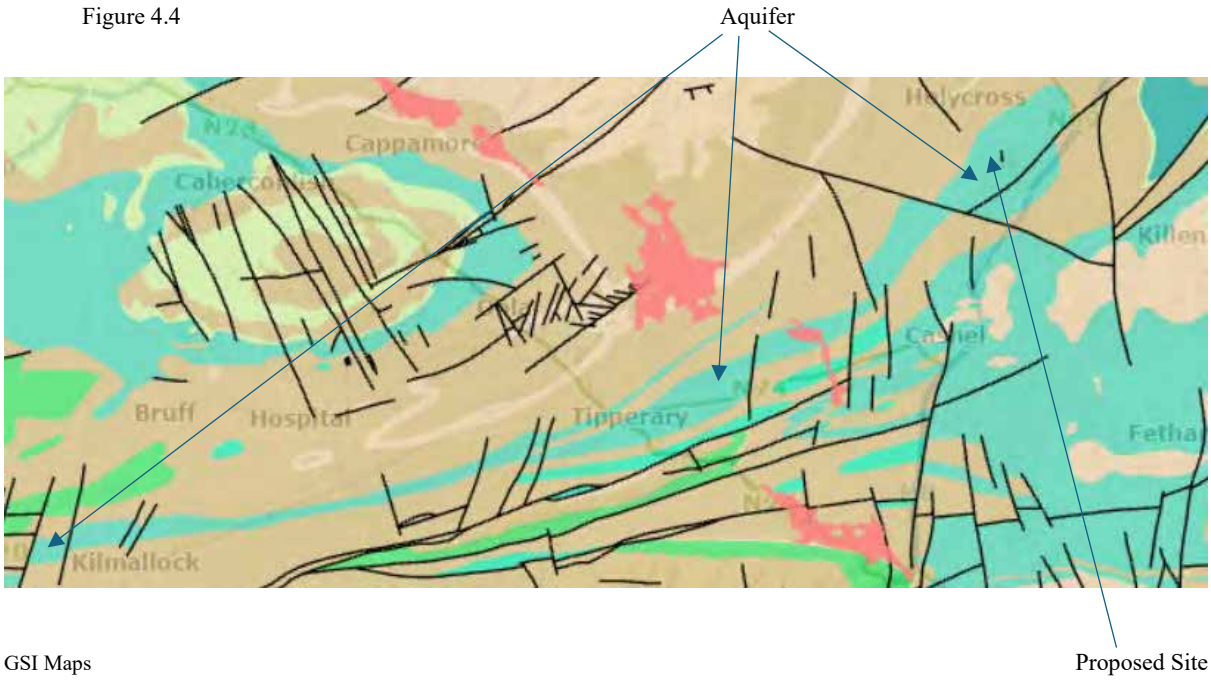
Figure 4.3



GSI Maps

Recharge and contaminant transport to the water table and the underlying aquifer can occur rapidly in this setting because the groundwater vulnerability is mapped as Extreme (X) and the protective subsoil has been removed across much of the active quarry footprint. In karstified limestone, flow occurs through a complex network of fractures, fissures, and solutionally enlarged conduits (epikarst), meaning that where containment fails, pollutants can bypass attenuation and reach groundwater quickly. The underlying aquifer is classified by GSI as Rkd (a regionally important karstified aquifer).

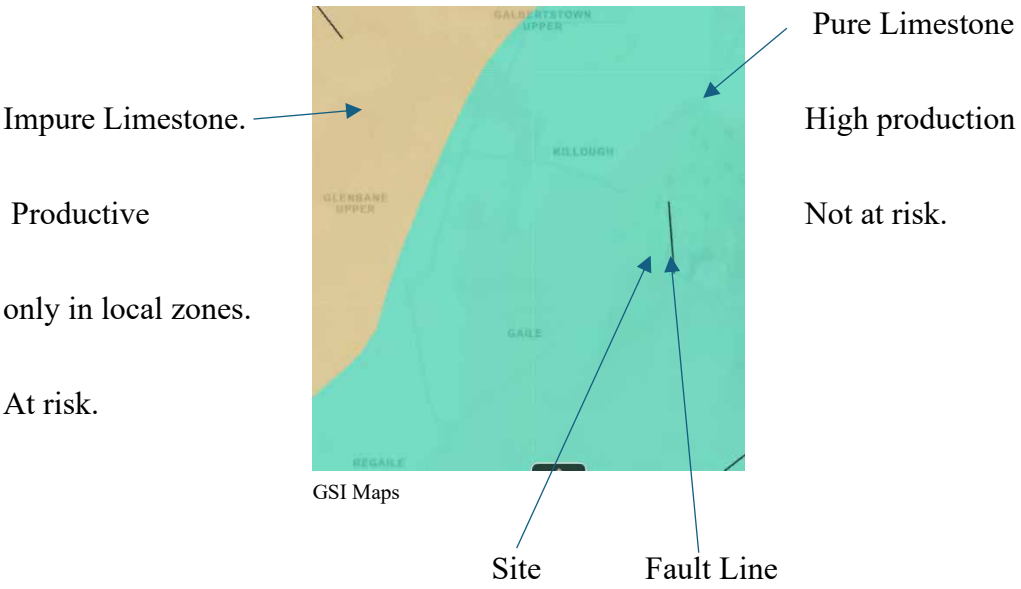
Figure 4.4



GSI Maps

Rkd aquifers can provide significant yields to wells and groundwater supplies. However, the same karst characteristics can also permit rapid and unpredictable contaminant transport over long distances (Figure 4.4), as demonstrated by Irish tracer studies in comparable limestone settings (e.g., Drew, 2008; Drew, 2018; Naughton et al., 2018). (Figure 4.4)

Figure 4.5



GSI Maps

Karst aquifers are difficult and costly to remediate because contaminants can enter quickly, move along preferential pathways, and persist within fissures and voids. International experience in karst regions shows that once karst groundwater is contaminated, restoration is challenging and may require long-term restrictions and monitoring.

Although this is not a high-rainfall area, any precipitation reaching this site is discharged directly into the aquifer without filtration, as all soil cover has been removed by extensive quarrying.

Quarrying exposes the water table and, in karst areas, diverts and alters flow patterns. Drew (2018) warns that planners should be aware of the implications of altering a karst landscape.

The recharge area is also reduced, which affects recharge to the aquifer, well productivity, and summer flow in river systems that rely on it, Drew. (2018, 2008).

Drew (2008, 2018) and Naughton et al. (2018) have conducted extensive flow tracings in the Burren Lowlands, Co. Galway, and the Burren, Co. Clare. The distance and direction that water can travel within the karst system cannot be determined from above-ground observations

because it does not follow predicted pathways. It has been demonstrated that water can travel over long distances. Tracings are necessary to understand and establish the flow patterns.

Rivers rely on groundwater recharge, particularly in the summer months, when it can account for up to 90% of their flow. Drew addresses this with respect to this area in his 2018 publication, which again also highlights how special this area is (Figure 4.6)

The southern limestone outcrop more closely resembles a &uviokarst than any other karst in Ireland. There is a well-developed river and valley network, controlled, in part, by the geological structures and an association between major rivers and karst springs, which is largely absent elsewhere in Ireland, where glacial derangement of surface drainage is the dominant feature. This is particularly true of the north-south oriented segments of rivers rather than the west-east flowing reaches (of the Blackwater and Suir rivers in particular; Figure 7.23). For example, the Clashawley River, south of Fethard, is fed by major

Figure 7.25 The large karst spring of Roaring Well on the west bank of the River Suir north of Ard&nnan. (A) The River Suir looking south (downstream) towards the Knockmealdown Mountains – the spring is located on the right bank just beyond the bend. *(Photograph by Aerial Eye for David Drew.)*. (B) Close-up of Roaring Well which is presumed to be fed in part from a swallow hole to the northwest. *(Photograph by David Drew.)*

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Figure 4.6

Killough Hill acts as a recharge area for the underlying aquifer and the tributaries, which then feed into the River Suir. There are numerous karst features in the immediate vicinity of the proposed development that clearly demonstrate the extent of fluvial karst development, the

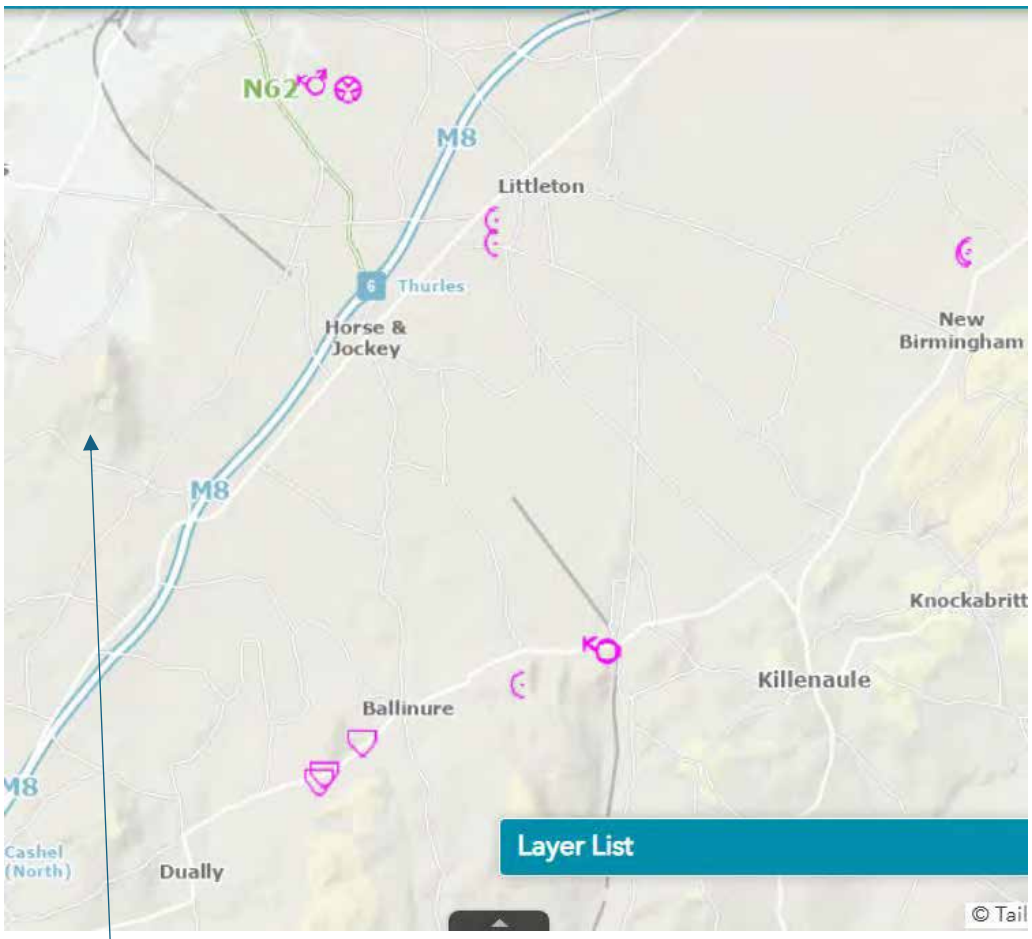
proximity of the water table to the surface, and the importance of proper testing and tracing to understand flow patterns and protect human health. (Figures 4.7 & 4.8)

Several karst features are in close proximity to the proposed development.

To the north of Killough Hill (2.88km), there is an estavelle/swallow hole situated on a farm (Durrow Farm just below Holy Cross), which is monitored as part of the groundwater protection scheme (IE_GSI_KARST_40K_753). Northeast (8.87km) is a spring well, Kylenagross well (IE_GSI_KARST_757). Further to the west and to the east, there are caves, sink holes, and more spring wells.

There are several group water schemes in the area, including Ash Hill (3.28km) and Graigue Pouldine (3.62km) from Killough Hill.

Karst features in pink. Proposed Site Figure 4.7



Proposed Site Karst features in pink Figure 4.8

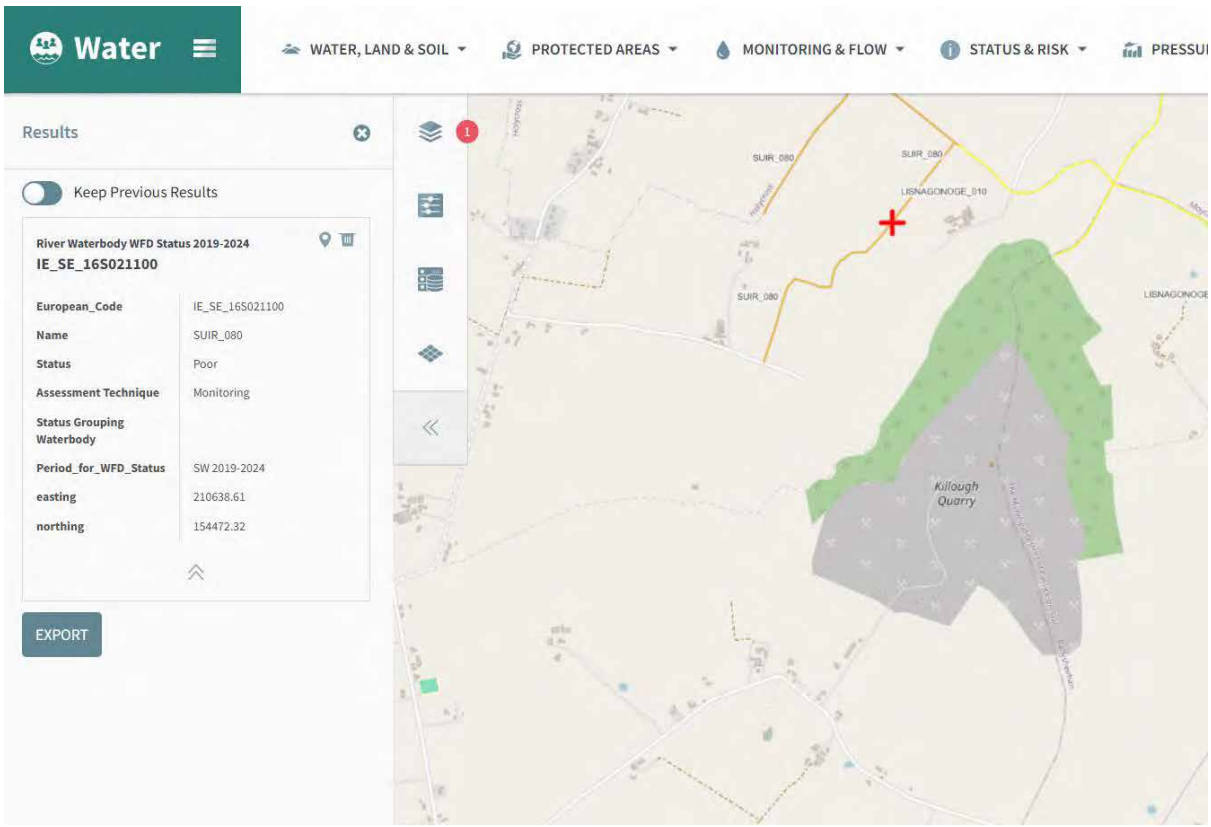


Figure 4.9 River Suir _080 under pressure from farming activities

The EIAR notes that the proposed development site is split between the SUIR_080 and SUIR_090 River Suir sub-basin catchments. Downstream receptors include local rivers and streams (including a local stream (Lisnagonoge) with eventual confluence to the Lower River Suir SAC). The EIAR also reports that the closest EPA biological monitoring station is Holycross Bridge (c. 3.8 km northwest of the site), where the most recent reported Q value is 3 (poor/unsatisfactory), representing a decline since 2020 (Q 3-4). This baseline condition reduces the margin for error and strengthens the Water Framework Directive no-deterioration obligation for any new high-risk activity in the catchment (EIAR Chapter 7, paras. 7.125-7.135 and 7.127-7.129; Table 7-12).

The EIAR does not report any site-specific dye tracing or tracer testing to establish groundwater pathways from the proposed development area to nearby karst features, wells or

surface waters. In an Extreme (X) vulnerability karst setting, tracer testing is a recognised method to reduce uncertainty about travel times and receptor connectivity. Its absence means that the proposed monitoring regime cannot be demonstrated to be adequate, and the risk assessment remains under-informed.

The water tests carried out for the EIAR have also demonstrated raised Nitrate levels for this area.

Importantly, the EIAR records that North Tipperary has a substantial dependence on groundwater supplies: 26 public groundwater supplies were identified as being supplied by groundwater, abstracting up to 11,000 m3/day and contributing an estimated 35% to 40% of the total public water supply for the area (excluding private or group schemes, meaning the true proportion may be higher). The EIAR further records human-caused groundwater quality issues, including high nitrate and bacteriological pollution (faecal coliforms), and reports that 38.5% of the 26 groundwater public water supplies were contaminated with faecal coliforms at least once in the 12 years prior to the Groundwater Protection Scheme. This documented dependence and contamination history strengthens the precautionary case against concentrating additional waste-processing risk on an exposed karst aquifer (EIAR Chapter 7, paras. 7.80-7.82).

4.3 Risk to human health

The aquifer is a local water source. Elevated nitrate in drinking water is a recognised public health concern, particularly for infants (methemoglobinemia / "blue baby syndrome"), and drinking water standards set a parametric value of 50 mg/L as NO3. Baseline data presented in the EIAR show that on-site borehole GW01 recorded nitrate of 25.1 mg/L as NO3 in May 2023

(EIAR Table 7-10), with other monitoring rounds showing nitrate in the same order of magnitude at GW01 (e.g., 28.9 mg/L as NO3 in August 2024). These results indicate the receiving environment already carries nutrient pressure and therefore has reduced assimilative capacity for any additional loss-of-containment scenario.

7.77 There are several other wells within 2km of the site which are of domestic use or of unknown use that range from having a yield class of poor to moderate.

Roadstone Limited
Killough Quarry, Holycross, Co. Tipperary
Proposed Bio-Renewables Facility

7-11
December 2024

SLR

The EIAR recognises there are several private wells within a 2km radius of the proposed site. This is less than the 5km radius of impact recommended by the Irish Geologists' Institute (IGI). The yield range is classed from poor to moderate. No evidence has been presented that the flow in these unidentified wells has been tested. Water samples were not collected to establish a baseline before construction. These water supplies are protected under the EU Drinking Water Directive 2020/2184.

Digestate and process liquors can pose risks to human health. Pasteurisation and the AD process reduce pathogen loads but do not guarantee sterility, and the risk of recontamination or regrowth during storage and handling remains a management issue. In an exposed karst setting, the key planning question is therefore whether containment, monitoring and emergency response are designed to prevent any release to ground or water under credible failure modes (including spills during reception and transfer, pipe or tank failures, interceptor failure, contaminated stormwater and contaminated firewater).

What is highlighted but not quantified or discussed in any detail in peer-reviewed research is the fate of antibiotics, buffers, flocculants, and other additives used in the AD process.

A 2020 NUI Galway-Teagasc research paper ranked the biohazards associated with land spreading of post-pasteurised waste via multiple pathways (Figure 4.10), including water. Nag et al., (2020).

This paper presents a graph showing pathogenic disease outbreaks by country across Europe over the last 20 years. (Figure 4.11) Stars were applied to the bacteria remaining after AD processing (Irish or EU pasteurisation), and the scoring system was applied.

Final bacteria risk results after all scoring was applied are in Figure 4.12

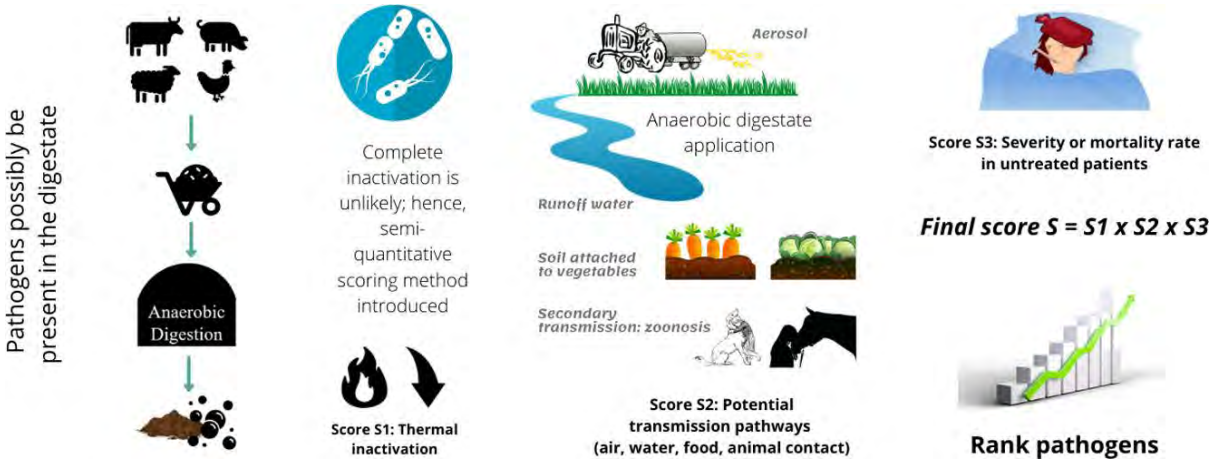


Figure 4.10

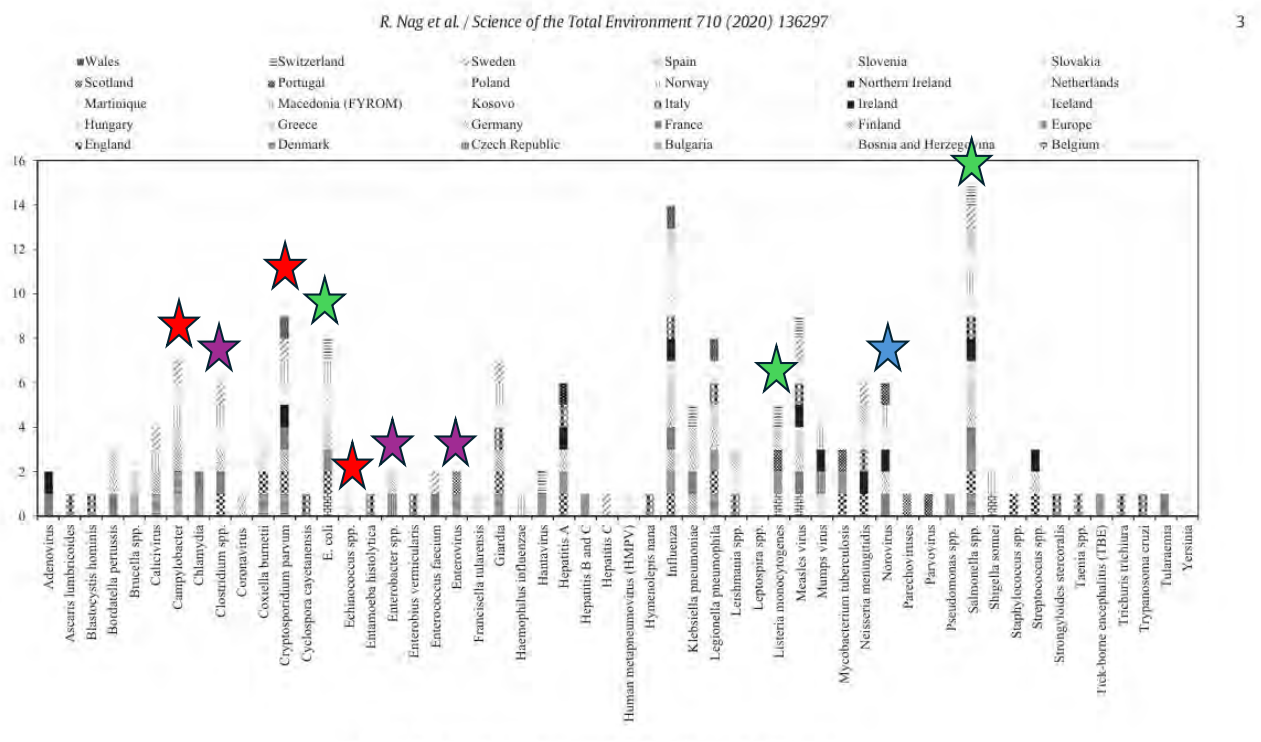


Figure 4.11 Disease outbreaks caused by pathogenic bacteria in Europe, by country. Stars are bacteria that remain in the digestate after processing.

Number	Pathogens	BM	Scenario A FOODIRE or Scenario B FOODEU	Scenario C RAWFYM&S	SUM
1	*Cryptosporidium parvum*	1	1	1	3
2	*Salmonella enterica spp.*	1	1	1	3
3	Norovirus	1	1	1	3
4	*Streptococcus pyogenes*	1		1	2
5	*Entamoeba histolytica*	1		1	2
6	*E. coli* enteropathogenic (EPEC)	1	1		2
7	*Mycobacterium spp.*	1	1		2
8	*Salmonella typhi* followed by *S. paratyphi*	1		1	2
9	*Clostridium* spp.	1	1		2
10	*Listeria monocytogenes*	1	1		2
11	*Campylobacter coli*		1	1	2
12	*Ascaris spp.*	1			1
13	*Giardia lamblia, Giardia intestinalis*	1			1
14	*Shigella* spp.	1			1
15	*Enterobacter* spp.	1			1
16	*Toxoplasma gondi*		1		1
17	*Brucella* spp.		1		1
18	*Coxiella burnetti*		1		1
19	*Echinococcus* spp.		1		1
20	*Yersinia enterocolitica*		1		1
21	*Campylobacter jejuni*			1	1
22	*Vibrio* spp.			1	1
23	Hepatitis A-virus			1	1
24	*E-coli* O157:H7			1	1
25	*E-coli* invasive & toxigenic			1	1
26	*Streptococcus pneumoniae*			1	1
27	Rotavirus			1	1

Note: Highlighted pathogens are present in municipal wastewater only (Table 13) and therefore not considered.

Figure 4.12

4.4 Hydrology risk and assumptions within the EIAR

The Nag et al., (2020) NUIG/Teagasc paper sets out in clear scientific terms that risk is associated with the AD process.

While this proposed project seeks not to land-spread but to create pellets and proposes a closed-loop water management system, it includes an underground tank in a karst area with no

secondary lining, monitoring, or defined limits to detect leakage across its piping system in an area of extreme vulnerability.

This illustrates that the proposed mitigation measures are inadequate for this type of activity at this site.

EIAR also notes a data-gap risk: some high-vulnerability areas may be missing from maps due to limited karst feature data locally (Ch 3 EIAR)

As mentioned, water management is "closed loop," and while this sounds impressive, it depends on engineered containment control and multiple transfers, which are vulnerable to human error, pump failure, power loss, mechanical failure, and recording errors, among other possibilities.

EIAR states no discharge off-site: all waters managed on site; process waters treated; some "excess clean water" reused in the adjacent quarry for concrete production and dust suppression. If used for dust suppression, it will end up in the groundwater system.

The EIAR quantifies large water volumes and capacities (including treatment capacity ~1,129 m^3/day, storm runoff design 4,564 m^3/day, and firewater retention 9,702 m^3, including a factor of safety).

Risk implication: "No discharge" does *not* equal "no impact" in a karst X-vulnerability setting; it shifts risk onto pond liners, sealed drainage, pumping/transfer reliability, storage freeboard management, and emergency shut-off controls.

EIAR proposes quarterly groundwater level monitoring in GW01–GW03 (with continuous loggers), annual groundwater quality monitoring, and surface water testing, and states that quarry supply wells will be decommissioned.

The mitigation schedule confirms no refuelling onsite, use of bunded trays, spill kits, paved roads/wheel wash, audits/ISO14001, etc.

Mitigation and monitoring 17

It should be noted: in karst X, extreme vulnerability settings, monitoring needs **clear trigger levels + mandatory responses**, not just "testing" and general EMS language.

What is also required:

- Leak alarms and secondary sumps,
- a mapped pathway for contaminated water in case of fire, secondary lining,
- Demonstration of combined storm + operational + firewater scenarios due to high vulnerability karst status.
- Karst-proofing and data gaps: require targeted investigations (and/or tracer testing) because EIAR acknowledges limited karst feature data may under-represent risk.
- Redundancy over single barriers: in Extreme X vulnerability, liners/"sealed drainage" should be treated as single points of failure unless independently verified and backed by secondary containment and leak detection.
- Stress-test "no discharge": the system relies on capture → storage → treatment → transfer → reuse (multiple failure nodes). Require an engineering "failure modes" schedule and enforceable operating rules (freeboard, pump failure, power loss).
- Tight monitoring triggers: EIAR proposes monitoring, but you should request **numeric** trigger levels (e.g., conductivity, NH_4-N, NO_3-N, PO_4-P, COD proxy) with mandatory actions and reporting.
- WFD context: baseline indicates poor Suir ecological quality at Holycross Bridge (Q=3 in 2023); this reduces margin for error and strengthens "no deterioration" obligations for this project, as other sites were not correctly considered.

4.5 Building on karst

Drew (2018) has warned planners to be informed before granting consent when building in a karst area. In America, they have seen whole highways and structural collapses due to ignoring this factor. In Ireland, we are only beginning to encroach on our pristine limestone areas.

Implications for building in proximity to an active quarry have not been addressed at any level in the EIAR. They have been actively ignored, creating an inherent danger to employees, the public, and the environment.

An example of a karst protocol for construction phase controls is that used for building the N6 in Galway

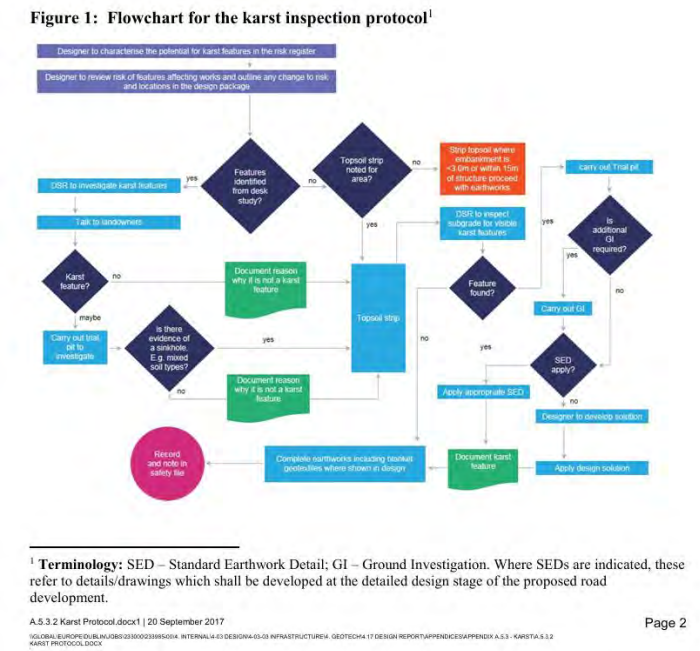


Figure 4.13 Example of a karst protocol for the construction phase of a development.

No such protocol exists for this proposal, and no flow tracing has been conducted to determine groundwater flow patterns.

In this instance, it is unacceptable to merely monitor the site. Strict limits would have to be set and adhered to, as the water in this area is already of poor quality and fails to meet targets.

Leakage is possible in any system, and none of these systems is doubly lined.

Building on an active quarry in a karst area adds an extra layer of risk. This would have to be factored into the engineering, much as earthquake-proofing the proposed AD plant and associated LNG plant would require them to withstand blast shocks on a karst foundation.

This would significantly increase the cost of building safely at this location.

Movement within the plant could damage seals, which may not be detected until a pollution event has occurred.

The developer must demonstrate how the system will operate, using engineering and science, in such extreme circumstances and, more to the point, why this is necessary at this location rather than at a safer site with deep loamy soils that provide high attenuation and an absence of danger from explosives.

Also, the fact that Killough Hill pNHA is 5m from the site boundary is irrelevant, as they are one and the same system and business.

Building in Ireland is regulated by:

Statutory basis

- **Building Regulations 1997 (S.I. No. 497/1997) (as amended)** – the legal functional requirements (Parts A–M).
- **Technical Guidance Documents (TGDs)** – government guidance; following a TGD is treated as evidence of compliance.
- **TGD A – Structure** (and Part A itself) requires:
    - **A1 (Loading):** loads must be safely transmitted to the ground; ground movement must not impair nearby stability.

- **A2 (Ground movement):** the building must be designed so **subsoil movement caused by subsidence** (etc.) will not impair stability.

- TGD A also states structural safety depends on **hazard identification + risk assessment** and references the **Eurocodes**, including **Eurocode 7 (geotechnical design)** and Irish National Annexes.

Why karst matters: The Geological Survey Ireland (GSI) explicitly notes that karst voids can cause gradual subsidence or sudden collapse and create "significant problems for engineering."

Part C (Site preparation) — *dangerous substances/gas migration(LNG spill/Digestate leak)*

- **TGD C – Site Preparation and Resistance to Moisture** includes **C3 Dangerous substances**:
  - Requires precautions to avoid danger from substances/contaminants in the ground.
  - Defines contaminant to include substances that are or could become **flammable or explosive**.
- TGD C also flags **gas accumulation risk** and says measures should be designed/constructed with **expert advice** where gas risk exists (it also contains radon/landfill gas protection approaches like membranes/sumps/venting).

Part B (Fire Safety) — *industrial buildings/plant rooms*

- **TGD B 2024 (Volume 1: Buildings other than dwelling houses)** is the main fire-safety guidance for industrial-type buildings associated with a plant.
- Fire Safety Certificate process is under **Building Control Regulations 1997 (S.I. No. 496/1997)**.

Building Control/certification regime

- **BCAR 2014: Building Control (Amendment) Regulations 2014 (S.I. No. 9/2014)** (Assigned Certifier, inspection plan, compliance documentation) for many project categories.

HSA requirements for AD/biogas on karst

1) Construction phase safety (groundworks/excavations on karst)

- **Construction Regulations 2013: S.I. No. 291/2013** – duties on clients/designers/contractors and site safety provisions.
- **HSA Excavations guidance** – stresses collapse prevention and notes that a **professional engineer may be required** to determine excavation safety. On karst (voids/unpredictable ground), that's especially relevant.
- General Application Regulations 2007: S.I. No. 299/2007, Part 8 (Dangerous substances & explosive atmospheres)

Confined spaces (digesters, tanks, pits, valve chambers)

- **Confined Spaces Regulations 2001: S.I. No. 218/2001**.
- **HSA Code of Practice for Working in Confined Spaces** (safe system of work, gas testing/monitoring, rescue arrangements, etc.).

5. Misappropriation of S.I. regulation

An overarching issue with anaerobic digestion of organic materials in Ireland at present is the lack of specific regulations.

This is demonstrated in the current application, which describes the production of a "certified pelleted fertiliser". However, in the Project Description section, it does **not clearly identify a specific Irish fertiliser product certification S.I.** for the pellet itself—whereas it *does* clearly point to **S.I. 113/2022** for *land application controls* by recipients.

The Project Description further asserts that the works will be designed, constructed and operated with BAT and that "products will be certified before storage for removal from the facility," and that unit operations will convert digestate to a "certified pelleted fertiliser" (Project Description, December 2024, paras. 2.19–2.20 and 2.100). However, no certifying body, Irish statutory instrument, product standard or quality assurance scheme is identified for these claims.

The application documentation, as presented, does not identify a clear Irish product certification pathway (or NSAI product standard / national end-of-waste criteria) for AD-derived pellets or digestate. Instead, it relies on land-application controls (e.g., S.I. 113/2022) and general waste/biowaste regulation. This is material because the planning authority cannot rely on a claimed "certified" status without an enforceable specification and quality assurance framework.

EPA Research 375 (2021) set out updated quality standards for compost and digestate. It recommended:

- Updating Irish Standard I.S. 441 (compost)
- Creating a new NSAI digestate standard.
- Adopting national end-of-waste criteria for compost & digestate
- Establishing a contamination-reduction and QA framework

However, to date, this has not occurred.

I.S. 441:2011 is still the principal Irish Standard referenced for compost. The application does not cite a dedicated NSAI digestate standard or national end-of-waste criteria that would demonstrate digestate/pellets are a regulated product (rather than a waste) with enforceable quality controls.

No digestate-specific Quality Assurance Scheme like CQAS 441.

As a result, the applicant's claims that digestate is a high-quality product, not a waste, and is certified, must be treated with caution in this regulatory vacuum.

The applicant's regulatory framing appears to treat the proposal through a "compost/biowaste" lens; however anaerobic digestion is explicitly regulated as a waste biological treatment activity, requiring authorisation under the Waste Management permitting/licensing system (local authority Waste Facility Permit or EPA licensing, depending on scale), and this regime addresses not only biowaste intake but also digestate storage and management.

Furthermore, the proposal's outputs (digestate) cannot be treated as benign "compost-like" material by default. Ireland has been noted to lack national end-of-waste criteria for compost and digestate derived from source-separated materials, meaning the status of digestate as a "product" versus "waste" requires robust regulatory substantiation (including by-product/end-of-waste considerations) and enforceable quality controls.

The receiving environment is karstic and vulnerable. The nitrates/GAP framework recognises the acute pollution sensitivity of karstified limestone features (including swallow holes and collapse features) through explicit setback distances and additional

controls in areas of extreme karst vulnerability. This underscores that any loss of containment at the site (feedstock, leachate, process liquors, digestate, fuels/chemicals) could rapidly bypass attenuation and directly impact groundwater and connected surface waters; therefore, the planning authority must require a precautionary design, containment, and monitoring approach appropriate to karst risk rather than relying on generic "compost" controls.

6. Inadequate consideration of quarry blasting as an external initiating event/interaction risk under COMAH land-use planning and EIA requirements

The proposed Bio-Renewables Facility is expressly located within an existing permitted rock quarry at Killough and will utilise the existing permitted quarry entrance, across approximately 6.3 hectares of the existing permitted quarry. (Chapter 15)

The EIAR also acknowledges that existing health and safety measures at the existing quarry site will continue to be followed. (Chapter 15)

In that context, the failure of the application documentation to explicitly assess active quarry operations—particularly blasting/shotfiring—as an external initiating event and interaction risk is a material deficiency for both (i) technical land-use planning assessment under COMAH and (ii) the EIAR's "major accidents and disasters" assessment.

1) The land-use planning risk assessment is not credible unless it evaluates blasting as a credible initiating event

The Byrne Ó Cléirigh "Land Use Planning Risk Assessment" is presented as a COMAH technical land-use planning assessment using the HSA's TLUP guidance and a limited set of

representative loss-of-containment scenarios for LNG/biogas assets (tanks, balloon, pipelines, loading bay, etc.).

It then aggregates these scenarios to produce the Inner/Middle/Outer risk contours and a societal risk "Expectation Value (EV)".

However, the same report acknowledges (by quoting the HSA TLUP guidance approach) that societal risk sometimes requires more explicit consideration, including where risk is emanating from more than one establishment/source.

In this case, the facility is not being sited beside a passive land use; it is being co-located with an active quarry with explosives/shotfiring, which is a well-recognised high-hazard activity with distinct initiating mechanisms that can plausibly affect major-hazard infrastructure (e.g., vibration/air overpressure/flyrock/face instability leading to loss of containment or impaired emergency response).

The Byrne Ó Cléirigh assessment does include a "Quarry Site" as a population receptor in the EV table, but it treats the quarry only as an occupancy value, not as a hazard generator that can change accident likelihoods and escalation pathways.

The omission of blasting as an initiating event calls into question the reliability of (a) the calculated frequencies used in the risk contours, and

(b) The EV concludes that societal risk is "not significant" because those outputs depend critically on scenario likelihood assumptions.

2) HSA quarry blasting guidance requires defined danger zones and blast specifications that may extend beyond the quarry boundary—yet no interface analysis is provided

HSA quarry shotfiring guidance states that all blasting operations must have a declared danger zone, that it must extend beyond the expected spread of the blast with a margin of safety, be shown on a quarry plan, and be included in the Blast Specification; critically, the

danger zone may extend outside the quarry boundary. (Danger Zones HSA Danger Zones - Health and Safety Authority)

HSA guidance on blast specifications emphasises that the written blast specification must identify the danger zone and be designed to minimise risks, including flyrock and misfires. Danger Zones - Health and Safety Authority

HSA guidance on the duties of the shotfirer likewise emphasises clearing/controlling the danger zone, warning systems, safe firing positions, and post-blast inspection before the "all clear". Duties of Shotfirer - Health and Safety Authority

Given the proposed development includes LNG storage/transfer and other COMAH-relevant infrastructure (e.g., storage tank, ISO tanks, loading area), the planning documentation should demonstrate—using site-specific evidence—that quarry danger zones, flyrock envelopes, and vibration/air overpressure are not capable of impacting:

- LNG/biogas storage vessels and pipework.
- the truck loading bay and transfer operations.
- Truck parking areas, including truck sick bay areas.
- staff occupancy areas and emergency response routes; and
- any off-site receptors along or beyond the danger zone, where relevant.

No such overlay mapping or blast-interface risk assessment is provided in the Byrne Ó Cléirigh LUP report (which does not discuss blasting), nor is it set out in the EIAR major accidents chapter. (Chapter 15)

This is a significant omission because HSA quarry requirements are explicitly built around site-specific blast design and site-specific danger zone control—exactly the type of information needed to establish whether simultaneous quarry operations are compatible with hazardous substance storage and transfer.

3) The EIAR "Major Accidents and Natural Disasters" chapter 15 reaches a "no significant effects" conclusion without addressing the most obvious site-specific hazard interaction

The EIAR acknowledges that the project will be a Lower Tier Seveso establishment and will be regulated under COMAH (S.I. 209/2015), and it notes that a land-use planning risk assessment has been submitted.

The EIAR also states that the facility is situated within the existing permitted quarry.

Despite this, the EIAR concludes that: risks identified are "low"; no likely significant effects arise from major accidents; a review within 5 km did not identify proposals with potential to conflict; and design/management plus "strict EPA and HSA regulation" will ensure no impacts in association with other development.

That "cumulative/conflict" reasoning is weak because the most relevant "conflict" is not a nearby proposed development; it is the existing quarry operations, including blasting, occurring on/adjacent to the footprint of a COMAH establishment.

The EIAR states that it considered vulnerability to major accidents/disasters as required under the EIA Directive framework.

Yet it does not meaningfully assess a major, obvious "baseline condition/surrounding use" (active blasting) as either (i) a trigger for a major accident or (ii) a constraint on safe operation (e.g., restrictions on loading/unloading during blasting). This undermines the robustness of the EIAR's conclusion regarding vulnerability and cumulative interaction.

4) A changed regulatory context applies to blasting: Quarries Regulations 2025 (commencing 1 January 2026)

The Safety, Health and Welfare at Work (Quarries) Regulations 2025 (S.I. No. 283 of 2025) were signed in September 2025 and are stated to come into effect on 1 January 2026,

improving safeguards in relation to explosives and compliance. SI No 283 of 2025 Safety, Health and Welfare at Work (Quarries) Regulations 2025

Because the proposed facility would operate long-term alongside an active quarry, the planning documentation should demonstrate compliance with the regulatory framework governing shotfiring/explosives control—particularly where hazardous substance storage and transfer occur on the same site.

The absence of any explicit blasting interface assessment means the competent authority cannot readily verify that the project design and operational controls are adequate in the real operating environment.

5) What is missing and what should be required (Further Information/conditions)

Given the above, it is submitted that the application is incomplete in respect of site-specific major accident vulnerability and land-use planning interaction. The competent authority should seek Further Information addressing the following:

1. Baseline quarry operations: clear description of the quarry's operational status, presence of blasting, blast frequency/times, blast locations through the life of quarrying, and any planned changes.
2. Blast interface risk assessment: a specific initiating-event assessment for ground vibration, air overpressure, flyrock, misfire, and face instability as triggers for loss-of-containment or escalation affecting LNG/biogas infrastructure.
3. Danger zone/exclusion zone overlay mapping: a plan showing the blast danger zone(s) and how they relate to COMAH assets, loading bays, staff locations, and emergency access; this should reflect HSA requirements that danger zones may extend beyond the quarry boundary and must be controllable. Danger Zones - Health and Safety Authority

4. Structural and layout confirmation: design criteria demonstrating that tanks, pipework, supports, valves, and critical systems are designed and sited to withstand credible quarry vibration/overpressure conditions (with conservative assumptions and monitoring commitments).
5. SIMOPS controls: a written "simultaneous operations" procedure that prohibits LNG/biogas transfers during blasting windows; defines evacuation/communications; and integrates quarry shotfiring rules with COMAH emergency procedures.
6. Updated COMAH/TLUP position: confirmation from the operator that the COMAH safety management system and Major Accident Prevention Policy explicitly include quarry blasting as an external hazard, and that the TLUP risk contours/EV remain valid once that initiating mechanism is accounted for (or else provide revised modelling).

6) Is the omission a "breach of planning law"?

The documentation gap is best characterised as a potential material deficiency in the EIAR and associated risk submissions, rather than something that can be asserted (without adjudication) as a definitive "breach" in itself. The EIAR must address the project's vulnerability to major accidents/disasters relevant to the project, and it expressly frames itself as doing so. (Chapter 15)

Where a project is located within an active blasting quarry, blasting is plainly a relevant hazard interaction; failing to assess it can render conclusions about "low vulnerability" and "no conflict/cumulative effects" inadequately supported. (Chapter 15)

This is an appropriate basis for the planning authority / An Coimisiún Pleanála to (i) request Further Information, (ii) require a revised assessment, or (iii) attach conditions that meaningfully control blasting/transfer interfaces.

Requested outcome (submission wording)

In light of the project's co-location with an active blasting quarry, and the absence of a transparent blast-interface initiating-event analysis in the COMAH land-use planning risk assessment and EIAR major accidents assessment, it is requested that the competent authority not rely on the present risk conclusions. The authority should seek Further Information and/or require a revised major accident vulnerability assessment that explicitly addresses quarry blasting and simultaneous operations, including mapped danger zones, vibration/overpressure assessments at COMAH assets, and enforceable operational controls (including prohibiting hazardous transfers during blasting windows). Alternatively, if such information cannot demonstrate compatibility to a high standard, the authority should refuse permission on grounds of inadequate assessment of major accident vulnerability and interaction risk at an extremely sensitive industrial setting.

> *On 16/01/2026, the Health and Safety Authority (Central Competent Authority under the COMAH Regulations, S.I. 209/2015) advised Tipperary County Council that, following the change from compressed biogas to liquefied biogas, it has insufficient information to provide technical land-use planning advice and has requested the Planning Authority to seek Further Information under Regulation 24(10). The HSA identifies multiple deficiencies in the submitted Byrne Ó Cléirigh LUP Risk Assessment, including the absence of COMAH threshold calculations for the revised inventory, unclear modelling inputs/assumptions and risk contour basis, lack of adequate MATTE assessment, and—critically—no satisfactory assessment of current/future quarry operations (including blasting, projectiles/flyrock, vibration) as external initiating events affecting COMAH equipment. In these circumstances, the application is not decision-ready, and Further Information is required at a minimum; alternatively, permission should be refused pending resolution of these defects.*

7. Traffic and Transport

This section addresses deficiencies in the Traffic and Transport assessment for the proposed anaerobic digestion and bio-renewables facility at Killough Hill, with reference to Transport Infrastructure Ireland (TII) standards and guidance, Health and Safety Authority (HSA) requirements, Irish and EU planning law, and the applicant's own Land Use Planning (LUP) Risk Assessment. It is submitted that the EIAR Traffic Chapter materially underestimates risk and fails to demonstrate compliance with applicable guidance for development on narrow rural local roads with sensitive receptors, including schools.

The proposed development is served primarily by local tertiary roads (L-roads), which are narrow, lack hard shoulders, and contain constrained junctions. The EIAR acknowledges that the L1309 is approximately 6 metres wide with no hard shoulders yet proceeds to assess impacts largely through a capacity-based approach derived from TII DN-GEO-03031. This approach is inappropriate in a rural safety context where theoretical capacity is not the limiting factor. On such roads, collision risk, HGV meeting conflicts, vulnerable road user safety, junction geometry, visibility, and road edge deterioration are the dominant planning considerations.

The Traffic Chapter relies on a single weekday traffic survey extrapolated to AADT using short-period expansion factors. This methodology is inadequate for an industrial and quarry-dominated corridor where traffic volumes and HGV proportions vary seasonally, operationally, and outside standard survey windows. The proposed facility is capable of continuous operation, yet traffic assessment is limited to a 07:00–19:00 period, with no analysis of early morning, evening, night-time, or holiday-period movements, despite other application documents referencing tanker staging and continuous industrial activity.

Operational traffic is stated to comprise approximately 76 HGV movements per day, in addition to staff and light vehicle movements. However, this figure is not reconciled with the Land Use Planning Risk Assessment, which refers to approximately 857 LNG or bio-LNG ISO tank fills per annum and specific tanker staging arrangements. The Traffic Chapter collapses all product outputs into a generic "10 HGVs in / 10 HGVs out per day" assumption without disaggregating vehicle types, hazardous-goods tankers, or timing of movements. This internal inconsistency undermines the completeness and reliability of the EIAR and fails to provide a transparent account of the development's true traffic and risk profile.

The EIAR records exceptionally high HGV proportions at the site access, with HGVs comprising up to approximately 70% of traffic on one arm of the L1309. Despite this, no swept-path analysis is provided for articulated vehicles, tankers, or tractor-trailer combinations at the site access or at constrained junctions along the L-road network. There is no demonstration that junction geometry, entry widths, turning radii, or available visibility are adequate for the actual vehicle types proposed, nor that HGV meeting conflicts can be safely accommodated.

The Traffic Chapter fails to identify or assess sensitive receptors, including schools, school bus stops, pedestrian routes, and community facilities, despite their presence in the wider area and their reliance on the same local road network. There is no analysis of school peak periods, no proposed HGV delivery curfews, and no routing strategy to minimise interaction between industrial traffic and vulnerable road users. This omission is particularly serious given the narrow road widths, lack of footpaths, and limited refuge available to pedestrians and cyclists.

Cumulative effects are inadequately addressed. While the EIAR states that permitted quarry traffic has been included in the baseline as a "worst-case scenario," it also concludes that cumulative impacts are imperceptible and that no monitoring is required. This position is internally contradictory. The proposal represents an intensification of industrial and hazardous-

goods traffic within an already heavily trafficked quarry corridor, and the cumulative road safety implications have not been robustly assessed.

From a regulatory perspective, the Traffic Chapter does not adequately demonstrate compliance with:

- TII guidance, which requires assessment of safety, junction suitability, and appropriateness of the receiving road network rather than reliance on theoretical capacity alone.
- Safety, Health and Welfare at Work legislation in respect of safe access, workplace transport interfaces, and interaction between industrial traffic and the public road network.
- Irish and EU regulations governing the carriage of dangerous goods by road, which heighten the need for suitable routes, safe junctions, and effective emergency access where tanker movements are proposed; and
- The COMAH land-use planning context, which requires that transport movements associated with hazardous substances are fully understood and risk-managed.

The EIAR's conclusion that no traffic monitoring is required is not credible, given the already high HGV dominance, constrained rural road geometry, and proximity to sensitive receptors. At a minimum, a road condition baseline survey, reinstatement bond, enforceable routing and timing restrictions, and ongoing monitoring would be expected.

In summary, the EIAR Traffic and Transport assessment is materially deficient. It relies on inappropriate capacity-based assumptions for narrow rural L-roads, fails to provide a transparent and consistent account of HGV and tanker movements, omits assessment of schools and vulnerable road users, and does not demonstrate that the local road network is suitable for

the proposed development. These deficiencies constitute grounds for Further Information at a minimum and undermine the ability of the Planning Authority or An Coimisiún Pleanála to lawfully conclude that the development would not give rise to significant adverse traffic and road safety effects.

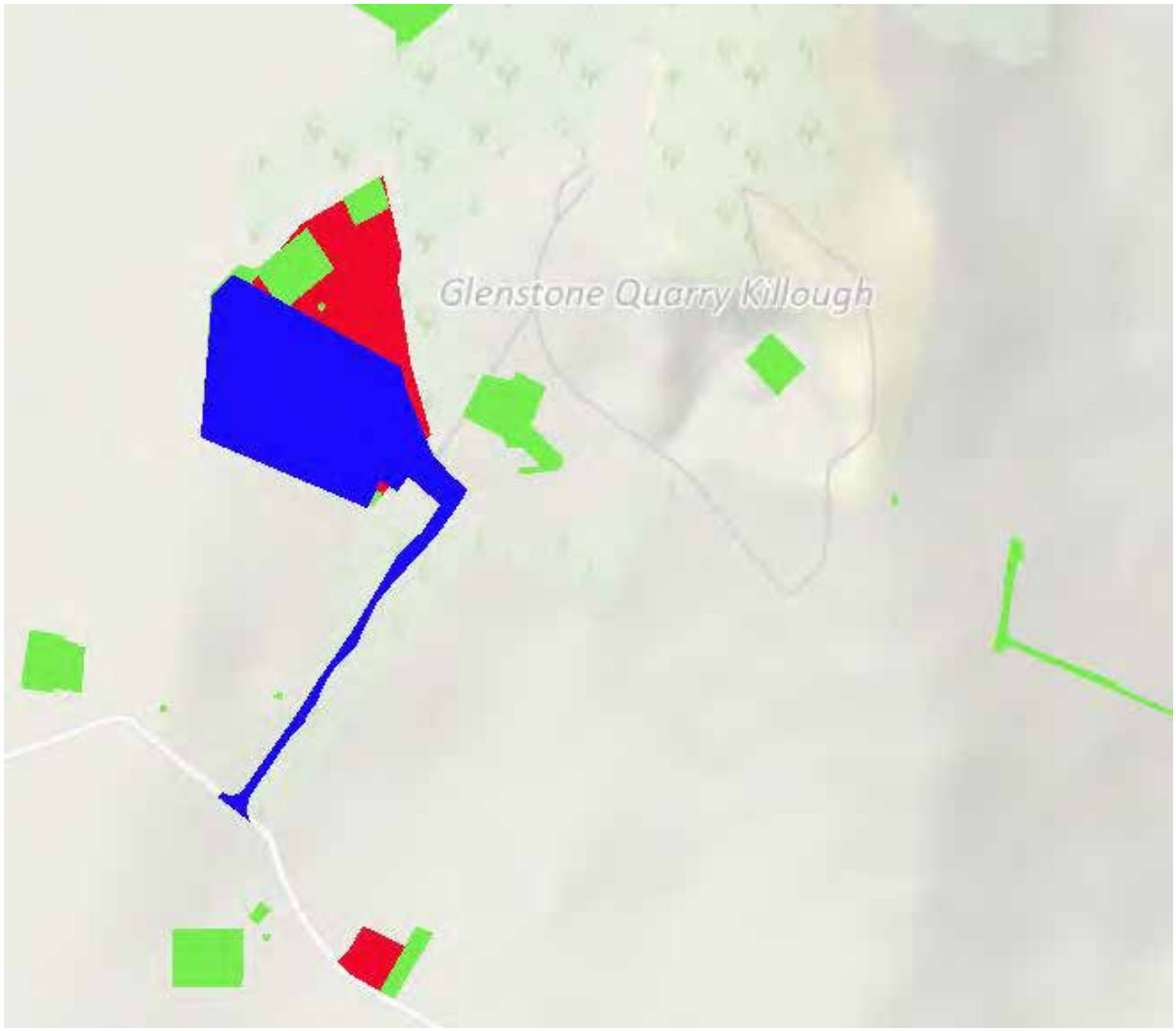


Figure 8. Current planning permission for all extraction and associated works at Killough Hill.

Proposed Planning Area in Blue. Tipperary CoCo,

Permitted planning areas at Killough Hill, pNHA by Tipperary CoCo

Figure 9. The extraction area does not match the area granted in the planning. See figure 8.

Killough Hill pNHA Aerial Photo Taken 2020

Demonstrating the effects of over-quarrying on the pNHA beyond its permitted planning limits.

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- Planning and Development Regulations 2001 (S.I. No. 600/2001, as amended), including EIAR content requirements (Schedule 6) (see consolidation).
- Co. Tipperary Development Plan documents

  Tipperary County Development Plan 2022–2028 (statutory plan).
- Volume 3: Renewable Energy Strategy (includes the Section 6.6 policy wording relied upon in the EIAR).
- SI No 283 of 2025 Safety, Health and Welfare at Work (Quarries) Regulations 2025
- Tipperary - County Geological Site Report
- Water Framework Directive **2000/60/EC**

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Killough Renewable Energy Development Response
Planning Reference: 2560019
Date for Submission: 17th January 2026
[Note: Comments in black are Non Technical summary. Comments in Blue are RFI queries from TCC, Comments in green are RFI Applicant responses, Comments in red with yellow highlights are from Martin Lavelle]

Summary of issues

Issue 1: The issues raised in the RFI in relation to Roads & Transportation & compliance with the Tipperary County Development Plan 2022-2028 have not been complied with:

1) A 12-hour traffic count was seemingly conducted on the 28th May 2024, but not included in submission. A summary was included, but that does not comply with EU Caselaw in relation to Lacunae. The CDP requirement is for a 3-day count.

2) No effective assessment was provided by the applicant, but the submission refers to a site visit on the 2nd October 2024, where 85% speed was assessed as 64.3km/hr & 52.7km/hr. No details of the assessment are provided. The CDP at Clause 6.1.1 requires measurement over 3 days, which was not provided.

3) CDP Vol3 Development Management Standards:

6.1.1 Measuring 'Operational' Speed
The operational speed shall be determined by measurement of actual speeds between 07:00 am 07:00 pm **over a period of three days**, excluding weekends or public holidays. It represents the 85th percentile speed of the traffic travelling on that section of road during that period. The 85th percentile speed is the speed at or below which 85% of the traffic is travelling.

4) The Community Group engaged Cllr. Seamus Walshe, BE to conduct an automated traffic count using road tubes and speed assessment on the 29th & 30th October 2025. On their behalf.
   a) The results outlined below indicate an 85% speed on the 29th October at 77.4km/hr, maximum speed at 139.8km/hr, mean speed at 61.5km/hr with 52.8% exceeding the speedlimit of 60kph.
   b) Similarly on the 30th October the 85% speed was recorded at 73.8km/hr, maximum speed at 112km/hr, mean speed at 58.9km/hr with 48.35% exceeding the speedlimit of 60kph.

5) The proposed development is a 24/7 development and a 12-hour traffic count over 1 day is inappropriate.

6) The Applicant indicates a supply system covering a 20km radius. This supply system involves traffic intensification. No location map indicating suppliers was included. The existing Regional & Local Roads do not have widths greater than 4metres, which cannot accommodate HGV passing movements. The significant additional heavy vehicle traffic movements that will be necessary to both feed into the AD Plant and remove product in itself increases the risk to road users in a very rural environment and already well used category of road. A twoway-sweptpath analysis for HGV's should have been included with farmyard accesses and excluding setdown areas in front of existing houses. It should also be noted that the grass verge is not part of the public road as per Dromada Windfarm (ROI) V Denis Cremins, HC. (2023)IEHC 417. Similarly TCC have to comply with the adopted policies adopted by the cdp. Crofton Buildings Management CLG & Anor v An Bord Pleanála and Fitzwilliam DL Limited, High Court [2022] IEHC 704

7) Wheelwash facilities at farmyards are not indicated. Sight-Distance-Triangles for farmyard entrances were not included.

8) CDP Vol3 Development Management Standards:

6.2 Traffic and Transport Assessments

The Council in accordance with the Traffic and Transport Assessment Guidelines (TII, 2014) and any amendment thereof, will require the submission of a Traffic and Transport Impact Assessment (TTIA) for large scale developments or developments that may impact on the carrying capacity or public safety of the road network. For Industrial Developments over 5000 sqm. The proposed bio-renewables production facility (incorporating anaerobic digestion) compound will cover an area of c. 4 hectares with c. 16,821.5m² of new buildings

9) CDP Vol3 Development Management Standards:

5.3 Road Safety Audits

A Road Safety Audit is an evaluation of the road's element of a development proposal from preliminary design to post-construction stage with a view to promoting the highest standard of, safety for all road users, but especially vulnerable road users such as pedestrians, cyclists and children, to identify potential road safety issues, and to suggest measures to eliminate or mitigate concerns.

The Council will require a Road Safety Audit where a development is likely to have a significant impact on road safety

10) CDP Vol3 Development Management Standards:

6.3 Mobility Management Plans/Workplace Travel Plans

Mobility management plans are required for larger sized developments and for all new schools or for existing schools where 20% or greater expansion in classrooms is proposed. Table 6.3 demonstrates the thresholds for the submission of a mobility management plan in line with Achieving Effective Workplace Travel Plans – Guidance for Local Authorities (NTA) and Workplace Travel Plans, A Guide for Implementors, (NTA) and any review thereof.

Table 6.3: Mobility Management Plans

Land Use	Mobility Management Plan Statement	Indicative number of jobs	Standard Mobility Management Plan	Indicative number of jobs
Offices/Financial	>500sqm	25-100	2,000sqm	>100
Retail/Shops	>600sqm	25-100	2,500sqm	>100
Industrial	>2,500sqm	25-100	6,000sqm	>100

The proposed bio-renewables production facility (incorporating anaerobic digestion) compound will cover an area of c. 4 hectares with c. 16,821.5m² of new buildings

Traffic Signs Manual Chapter 5 – Regulatory Signs Contents

5.2.5 The Stop Sign should ideally be sited 1.5m in advance of the associated Stop Line, but in circumstances where this would lead to impaired visibility of the sign this may be increased to a distance not exceeding 6m.

5.3.2 The provision of a Yield Sign in preference to a Stop Sign requires that drivers have sufficient visibility of conflicting traffic to judge that it is safe to continue to join or cross that traffic without stopping. The minimum sight line criteria for the provision of Yield Signs at a priority junction for new or improved layouts are specified in approved design standards and guidelines.

5.3.6 The Yield Sign should ideally be sited 1.5m in advance of the associated Yield Line but, in circumstances where this would lead to impaired visibility, this may be increased to a distance not exceeding 6m.

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Issue 2: Installing a Comah development in an active quarry where explosives are used is negligent. These explosives have the potential to create vibration with methane leaks, which could create an explosion. It is suggested that it would be fatal for all humans in a 66m radius. The proposal has the potential to create a domino effect between the live quarry, proposed Biogas unit & the surrounding residents. Methane is heavier than air & the ground contours fall towards the existing houses at about 150m distance. This project is similar to the placing of a bull in a china shop, except for the fatalities. This application should be refused on the basis of the Precautionary Principle in relation to overriding public safety. This application is not Proper Planning or Sustainable Development.

Risk Assessment of Biogas Production from Sugarcane Vinasse: Does the Anaerobic Bioreactor Configuration Affect the Hazards? Rogeri, R.C.; Stolecka-Antczak, K.; Maradini, P.d.S.; Camiloti, P.R.; Rusin, A.; Fuess, L.T. Biomass 2025, 5, 79. https://doi.org/10.3390/ biomass5040079

Anaerobic digestion of sugarcane vinasse is integral to enhancing ethanol distilleries' environmental and energy performance by converting organic waste into biogas; however, the flammable and toxic nature of biogas has led to significant safety concerns, particularly in anaerobic bioreactors where biogas is produced and stored. This study provides a comparative risk assessment of different anaerobic reactor configurations–a covered lagoon biodigester (CLB), a continuous stirred-tank reactor (CSTR), an upflow anaerobic sludge blanket reactor (UASB), and an anaerobic structured-bed reactor (AnSTBR)–processing vinasse, focusing on fire, explosion, and hydrogen sulfide (H2S) toxicity hazards. Jet fire scenarios posed the most severe threat, with fatal outcomes extending up to 66 m, while the fireball scenario exhibited no lethal range. The risks to human life from explosions were minimal (1.2%). H2S toxicity was identified as the most critical consequence, with particularly severe impacts in CLB systems, where the hazardous zone was up to 20 times larger than in AnSTBR. Therefore, the design of anaerobic bioreactors for vinasse treatment must primarily address the risks associated with H2S-rich biogas, as reactor configuration plays a key role in mitigating or amplifying these hazards–high-rate systems such as AnSTBR and UASB demonstrating safer profiles due to their compact design and lower gas storage volumes.

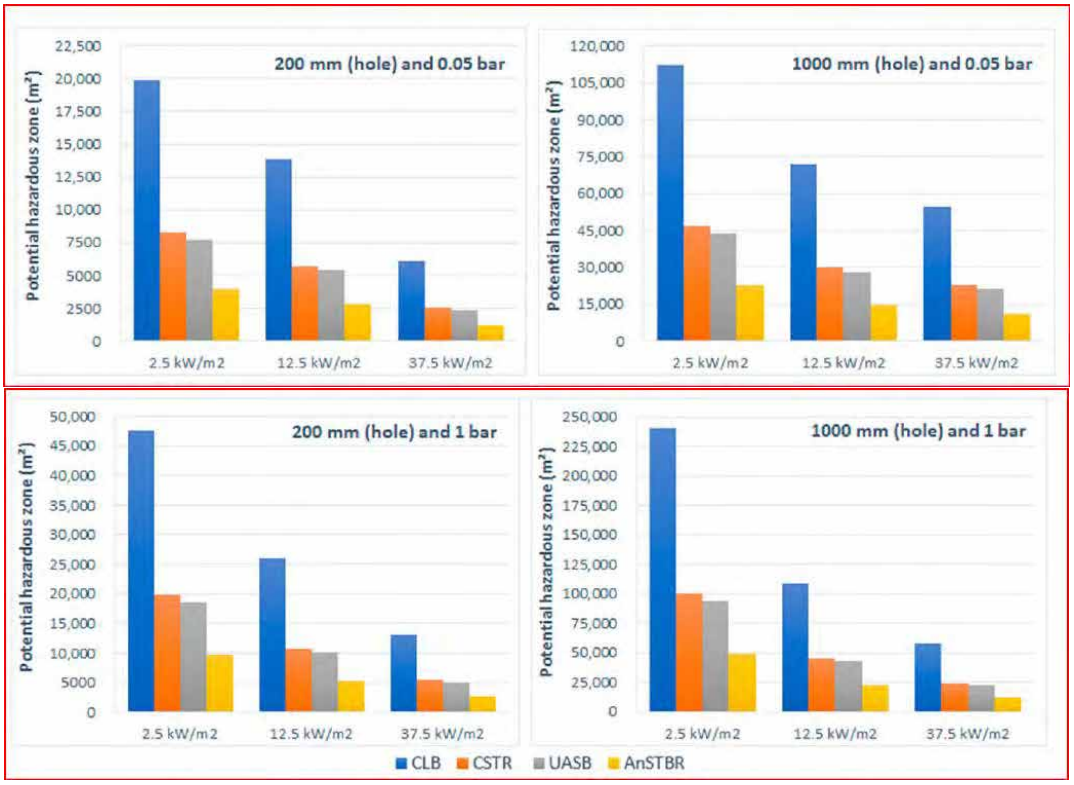
Beyond technological implications, the composition of biogas poses critical safety risks. The bioenergy sector (i.e., ethanol, biodiesel, biomass, and biogas) records the highest number of accidents resulting in severe injuries and fatalities in biogas facilities.

Quantitative analyses reveal that accident rates in Europe have grown faster than the sector itself In these risk assessments, the "critical event" are biogas leakages, which may lead to explosive mixtures when CH4 is released into the atmosphere in the presence of air and potential ignition sources. For biogas composed of 60% CH4 and 40% CO2, explosive atmospheres may form at concentrations between 8.5% and 20.7% of the mixture in air.

In turn, H2S poses severe risks to human health, even at relatively low concentrations. High-level exposure can lead to olfactory paralysis, respiratory failure, and death. H2S is the second leading cause of inhalation-related fatalities after carbon monoxide, and lethal concentrations are reported at approximately 300 ppm. Quantitative studies confirm that intoxication by H2S is one of the main causes of death in accidents in biogas plants. Even moderate exposures can trigger acute symptoms such as headaches, dizziness, and eye irritation, underscoring the need for strict monitoring. The critical unit in biogas plants is the anaerobic reactor due to the high concentration of biogas produced and stored. Moreover, in a quantitative study almost all accidents occurred in anaerobic reactors integrated with or without gasholders.

The safety assessment of anaerobic digestion systems involves analyzing two main accident scenarios to evaluate the consequences of uncontrolled biogas releases. The first scenario focuses on the partial rupture of the bioreactor, leading to biogas leakage through openings of different sizes and pressures, and subsequent hazardous events such as fire, explosion, or toxic exposure. The second scenario represents a more critical condition characterized by the total structural failure of the bioreactor and the complete release of stored biogas to the atmosphere. By comparing both scenarios, the analysis aims to identify how variations in leak size and operating pressure influence the magnitude of hazardous zones and potential risks to workers, providing key insights for preventive design and emergency planning. The identification of hazardous event scenarios was based on previous research that applied event tree analysis (ETA) and identified the uncontrolled biogas leak as a critical event. Figure 2 summarizes all hazardous events that follow the biogas leakage from a partial rupture condition, like immediate ignition (jet fire), delayed ignition (explosion), or no ignition (H2S intoxication). In this study, a 200 mm rupture was selected as a conventional reference diameter widely used in risk assessment methodologies, whereas a 1000 mm tear was included to represent more severe, yet realistic membrane failures reported by operators of covered lagoons. Similarly, the pressures of 0.05 bar and 1 bar correspond to typical operating conditions and an abnormal overpressure scenario, enabling a broader evaluation of potential accident consequences.

Hazards in biogas plants are significantly related to the geometry of the plant, the parameters of its operation, and the composition of the biogas produced, i.e., the content of flammable and/or toxic compounds. Fires caused by biogas ignition can occur in the form of a jet fire in the case of partial rupture. A jet fire occurs when biogas released from a pressurized source is ignited close to the source of the release. This type of fire is characterized by a long and stable flame. Each of the fires has negative effects on humans and the environment related to the direct impact of the flame and the generated heat flux. For example, the lower values of this heat flux at 2.5 kW m−2 cause human pain and the breaking of glass after a sufficiently long period of exposure. Higher values at 12.5-15 kW m−2 cause first-degree burns and melting of plastics. In turn, values at 25 kW m−2 cause significant injuries, and values above 37.5 kW m−2 can result in human deaths.



The probability of death resulting from various types of fires is shown in Figure 5 in the case of partial rupture (i.e., jet fire), because the fireball did not generate a level of heat flux capable of causing human death. A 100 probability of human death was noted for both analyzed levels of biogas pressure and the larger hole size (1000 mm) in the event of a biogas jet fire. The range of areas associated with 100% human deaths will be approximately 32 and 65 m for 0.5 and 1 bar, respectively. In the case of lower pressure and a smaller diameter of damage (200 mm), the probability of human death will be no more than approximately 55% and will extend to a range of about 5 m. In the case of higher pressure, the probability will be about 90% and will extend to a range of about 16 m.

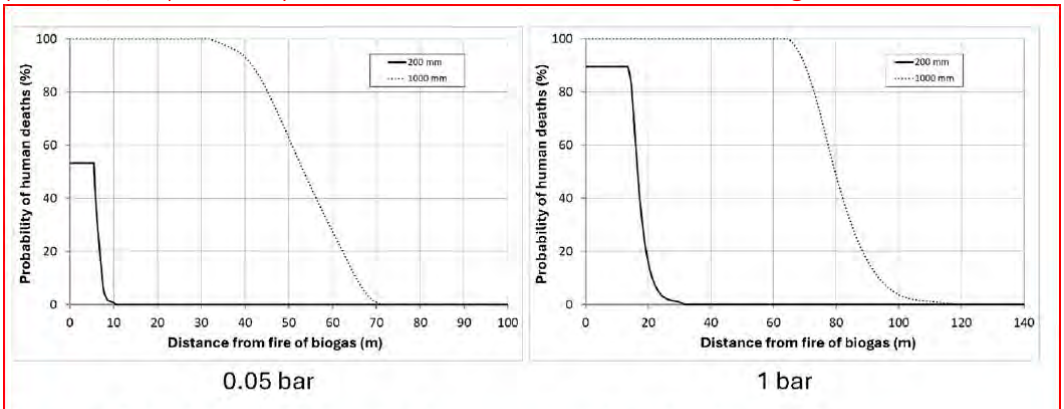


Figure 5. Probability of human deaths caused by a heat flux from jet fire.

An explosion is another type of hazard associated with the flammable properties of biogas components. Under favorable conditions, it may be a consequence of the biogas installation's partial or complete failure. The negative effects of this phenomenon are generated overpressure and flying debris from the ruptured installation. For example, overpressure of 0.21 kPa causes large glass windows to crack, 4.8 kPa damages building construction, and 20.7 kPa causes minor damage to heavy machinery and equipment. Higher values of the overpressure generated by the explosion, i.e., at 99.9 kPa, 137.8 kPa, and 199.8 kPa, result in 1%, 50%, and 99% human fatalities from lung damage, respectively.

Similarly to the fireball scenario, no Hazardous Zone or Hazardous Range were associated with a pressure wave causing the death of humans in the complete rupture explosion simulations. Nonetheless, the range covered by the pressure wave of 4.8 kPa (damage to building construction) and 20.7 kPa (damage to heavy machinery and equipment) was considerably greater than the consequences caused by the partial rupture pressure wave or even the consequences of the fireball. In this case, considerable monetary loss and impact on buildings in the vicinity can occur as a consequence of a complete rupture and the following explosion. In this scenario, the Hazardous Zone and Hazardous Range were also affected by the reactor size and resulting biogas stored in the headspace. The 4.8 kPa pressure wave covered an area of up to 2.4 million m2 and 877 m range under 1 bar of pressure and 1.57 million m2 and a 708 m range under 0.05 bar of pressure for CLB technology. Conversely, for the high-rate AD bioreactors (UASB and AnSTBR), the consequences of the pressure wave were 11- and 3.5-fold lower for Hazardous Zone and Hazardous Range, respectively.

The probability of death as a consequence of partial or complete rupture followed by an explosion and pressure wave was very low for all conditions (1.2%). However, the distance from the bioreactor associated with this death risk increased, along with the hole size (partial rupture) and the volume of biogas stored in the different technologies (complete rupture). The overpressure scenario (from 0.05 to 1 bar) did not significantly impact these distances, unlike in the jet fire scenarios. On the other hand, unlike a fireball, despite the low probability, a complete rupture explosion can result in human death.

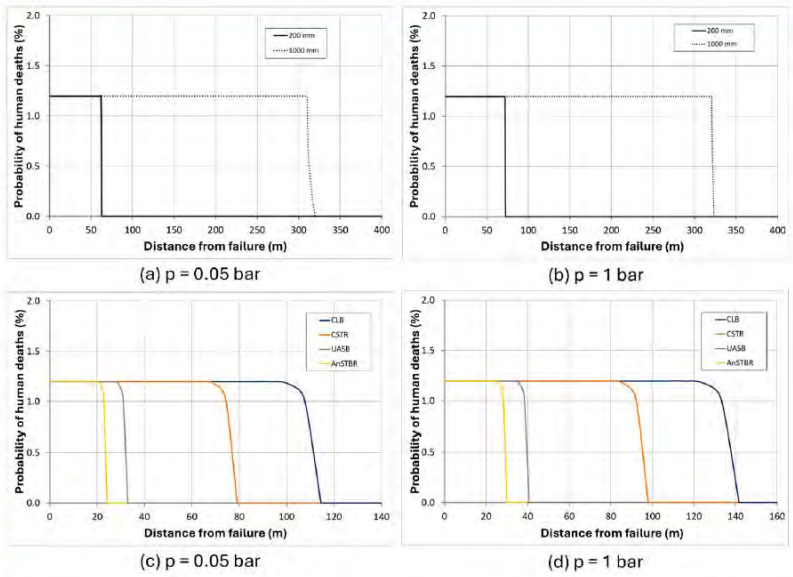


Figure 8. Probability of human deaths resulting from an explosion of biogas. Partial rupture (**a**,**b**), complete rupture (**c**,**d**).

Intoxication by H2S is one of the main causes of death in accidents in biogas plants. There is no report in the literature that evaluates the impacts of the high H2S concentration usually found in the biogas evolved from vinasse on the health and safety of workers and operators of sugarcane vinasse biogas plants. H2S is extremely toxic: concentrations of 20–50 ppm can cause eye irritation (conjunctivitis) and lung irritation; concentrations of 150–200 ppm can affect one's sense of smell and severely irritate the eyes and lungs; 500 ppm may cause sudden loss of consciousness ('syncope'); and concentrations above 1000 ppm are fatal. Among the potential hazards presented in biogas plants in the partial rupture scenarios, H2S intoxication presented a higher Hazardous Range (Table 4) and Hazardous Zone (Figure 9) with risk of death.

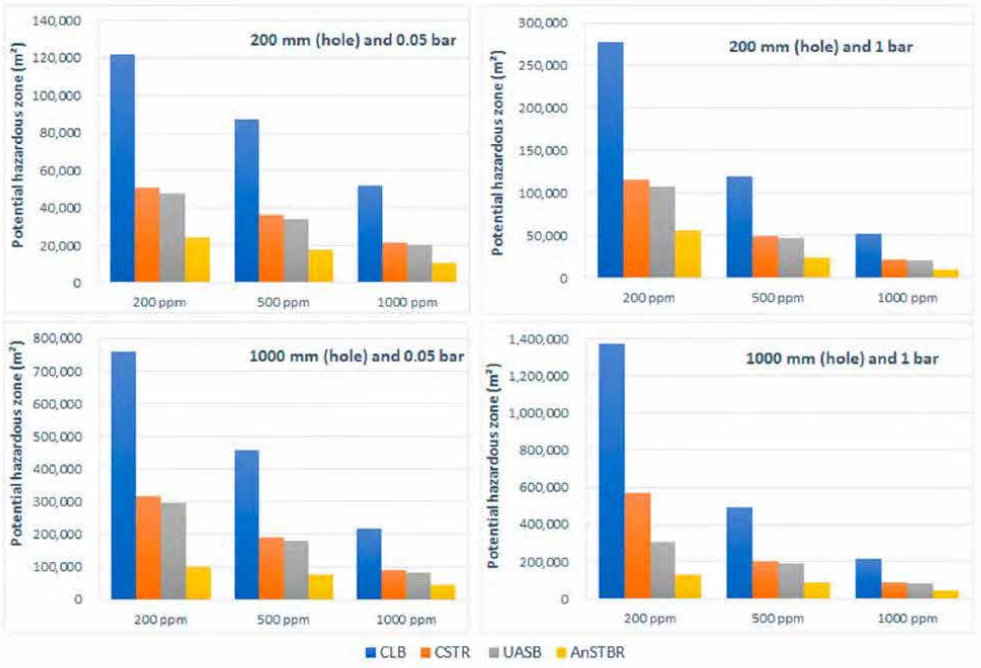


Figure 9. Potential hazardous zones for H_2S intoxication (partial rupture).

H2S intoxication was also associated with a larger hazardous zone, with a risk of death reported to be among the consequences of a complete rupture scenario, according to the evaluation performed in this study..... The 'death Hazardous Range'(1000 ppm) increased up to 20-fold from the smaller (AnSTBR) to the bigger (CLB) reactor at both pressures tested. The death Hazardous Zone was up to 753 and 14,963 m2 for the AnSTBR and CLB reactors, respectively, under 0.05 bar of pressure. Meanwhile, the death Hazardous Zone increased to 2420 and 51,336 m2 for the AnSTBR and CLB reactors, respectively, along with the increased pressure (1.0 bar). It is worth highlighting the impact that the H2S concentration could have on the vicinity of the biogas plant in the case of a complete rupture. The lower concentrations considered in the simulations (200-500 ppm) can still be significantly hazardous to human life. A range of up to 1.7 km was achieved in the case of a complete rupture of a CLB under 1 bar of pressure. Meanwhile, the range of the high-rate AD reactors in the same condition was between 148 and 248 m for UASB and AnSTBR.

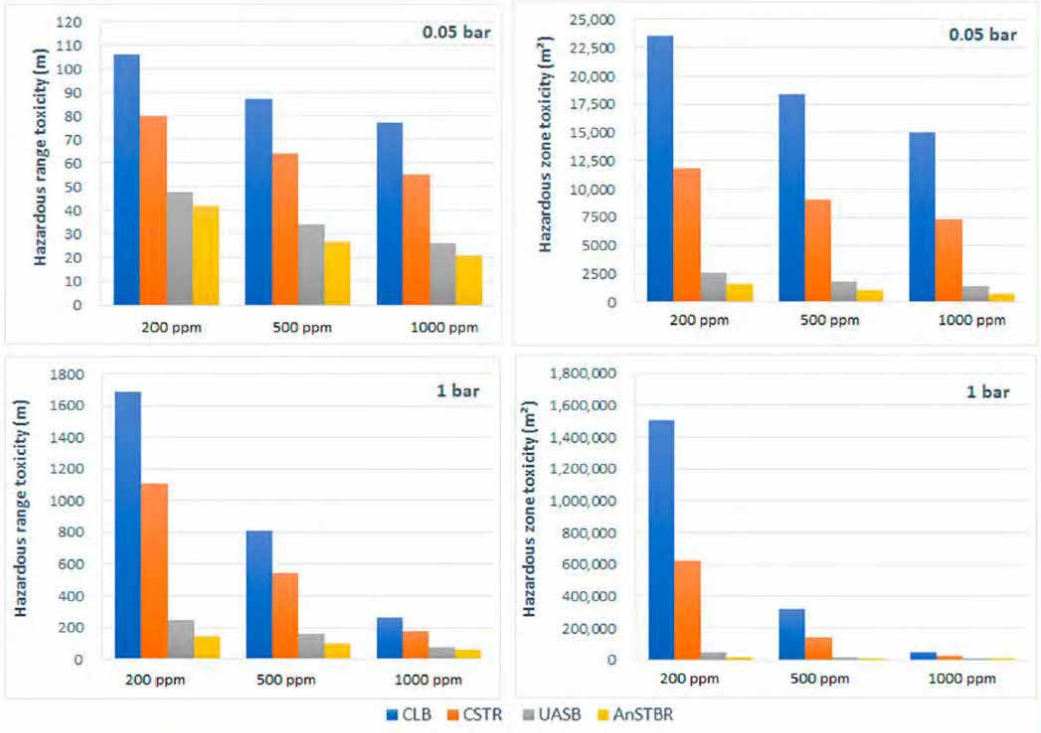


Figure 10. Hazardous zone and range for H_2S intoxication (complete rupture).

The probability of human death as a consequence of a partial and complete rupture followed by a toxic cloud of H2S at the sugarcane vinasse biogas site is extremely high and is impacted by the hole size (Figure 11a,b) and reactor configuration (Figure 11b,c), respectively. For the partial rupture scenarios, the overpressure scenario tested (from 0.05 to 1 bar) did not impact the probability of death as a function of the distance from the reactor either, but the hole size increased significantly. The range of the hazard zone related to a 100% probability of human deaths increased from 20 to 80malong with the hole sizes (200 to 1000 mm; Figure 11a,b). Though no differences in the death zone ranges among the reactor technologies are presented for partial rupture scenarios (Table 4; 1000 ppm), the specific construction of the equipment can make each reactor configuration more susceptible to smaller or larger holes in the case of an uncontrolled biogas leak. In CLB technology, a plastic or HDPE covering is fixed on the sides of the lagoon, which is often inadequate and results in uncontrolled biogas leakage resulting in greater susceptibility to larger holes in the cover fixation areas. For the complete rupture simulations, the high-rate AD. bioreactors, i.e., UASB and AnSTBR, presented a 100% probability of human death within the 15-20 m range (0.05-1.0 bar; Figure 11c,d). Therefore, the complete rupture scenario of a high-rate AD bioreactor resulted in a death zone similar to a biogas leakage from a 200 mm hole size (Figure 9). On the other hand, the bigger bioreactor and biogas volume stored (CLB) showed a 100% probability of human deaths within the 60-80 m range (0.05-1.0 bar; Figure 11c,d) or 4-fold higher than the UASB and AnSTBR.

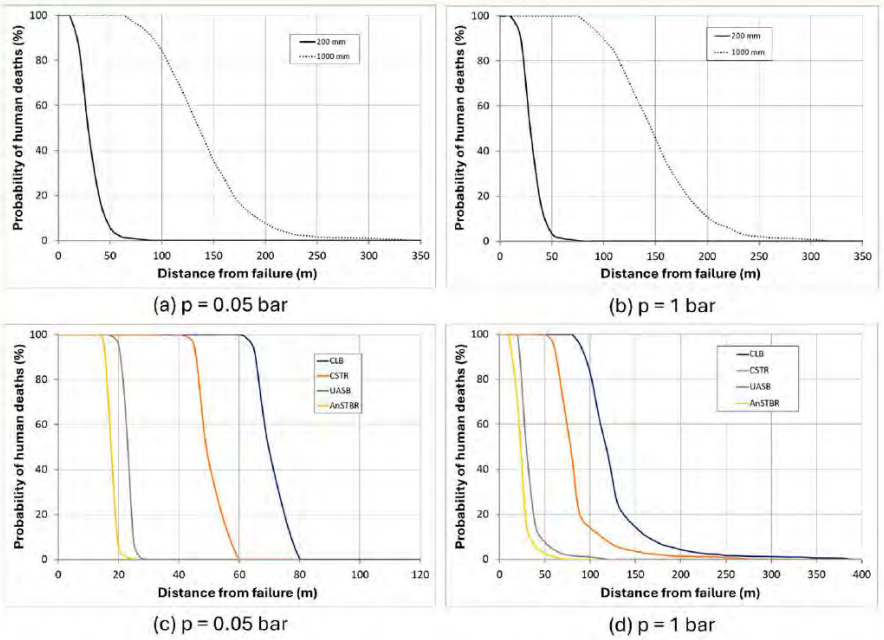


Figure 11. Probability of human deaths from a toxic concentration of biogas. Partial rupture (**a**,**b**), complete rupture (**c**,**d**).

Safety in biogas plants: An analysis based on international standards and best practices. Hala Hegazy, Noori M. Cata Saady, Sohrab Zendehboudi, Process Safety and Environmental Protection200(2025)107390 www.journals.elsevier.com/process-safety-and-environmental-protection.

The operation of biogas plants is fraught with various hazards that can pose significant risks to personnel and the surrounding environment. These hazards stem from the complex interactions among the plant's components, including inputs, processes, and outputs. For instance, the anaerobic digestion process can produce explosive gases such as methane (CH4), hydrogen (H2), and hydrogen sulfide (H2S), necessitating stringent safety measures to prevent fire and explosion incidents (Marjolaine, 2020; Yu et al., 2021). Recent statistics indicate that incidents related to biogas plants are not uncommon. For instance, between 2015 and 2020, over 30 reported explosions and fires in the UK's biogas plants caused injuries and property damage (Hegazy et al., 2024; HSE, 2024b). Similarly, in Germany, the Federal Institute for Occupational Safety and Health reported 18 serious accidents involving biogas plants in 2019 alone, highlighting the need for stringent safety protocols (BAUA, 2022).

A comprehensive understanding of biogas plant components is essential for identifying potential hazards. Typical biogas plant components include feedstock reception areas, anaerobic digesters, biogas storage tanks, combined heat and power generation units (CHP), and digestate treatment units. Each component presents unique risks; for example, digesters operate under anaerobic conditions and produce toxic, flammable, and explosive gases such as CH4, H2, and H2S that can lead to pressure buildup, while biogas storage tanks require careful monitoring to prevent overpressure and leaks (Eric, 2024; Tamburini et al., 2023; Wei et al., 2025). Furthermore, electrical systems integral to the operation of biogas plants can introduce electrical hazards if not properly managed. A study found that electrical failures were responsible for approximately 25 % of industrial accidents in biogas plants in the United States of America (USA) (EPA, 2014b).

Mechanical hazards are predominantly associated with the plant system's feeder, CHP unit, and other machinery (GAOHSA, 2008). Explosion and fire hazards can arise in several key areas, including the feeder, the space between the return valve and shut-off valve, and the access.

Additional risk zones include the connections between overpressure and under-pressure protection systems and the blow-off pipe, as well as the segments between the shut-off valve and the condensate trap, the shut-off valve on the CHP unit, the gas flare, and the gas fine filter/ activated carbon filter within the CHP unit. Hazards may also occur in the conditioning unit used for biogas upgrading to the natural grid system (GAOHSA, 2008; Marjolaine, 2020). Biogas hazards are similar in the conditioning unit for biogas upgrading, the oil tray in the CHP unit, the gas fine filter/activated carbon filter within the CHP unit, and the dosing station for processing aids at the beginning of the process. Finally, the potential for electrical hazards exists in the digester, all electrical equipment, the CHP unit, and the injection unit within the biogas upgrading system to the natural grid. This underscores the across all operational areas of the biogas plant (GAOHSA, 2008; Marjolaine, 2020). Fig. 3 identifies the main hazards associated with the seven primary components from our dataset, highlighting where these hazards are mostly occurring. In addition, Natech, being a natural disaster that cannot be controlled, will be eliminated from our analysis

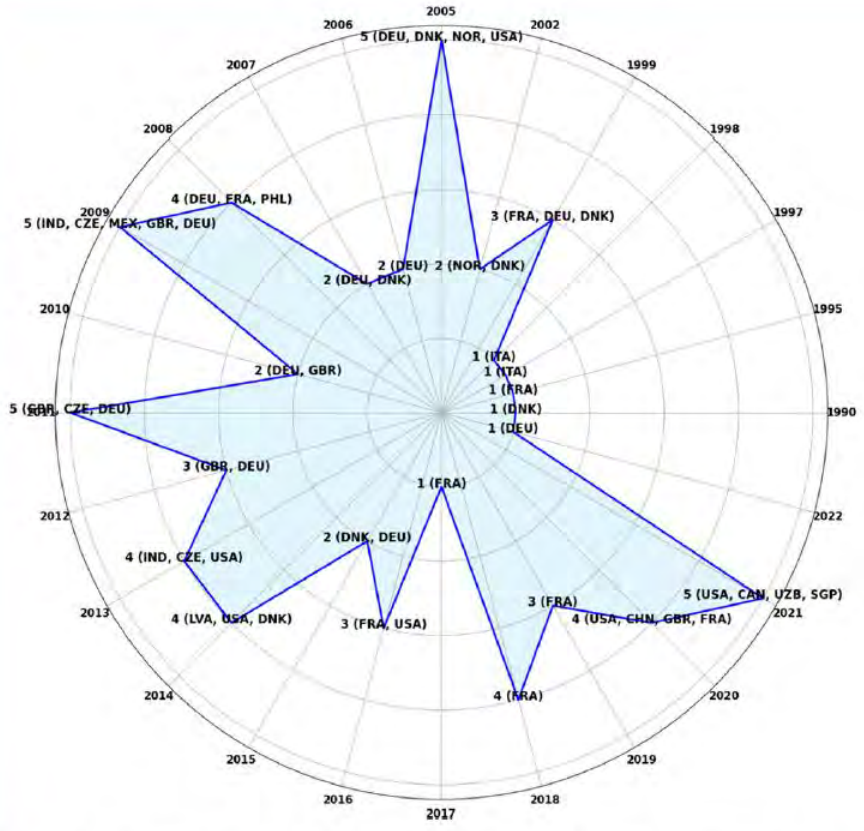


Fig. 4. Yearly distribution of biogas plant accidents. Keycode: Denmark - DNK, France - FRA, Italy - ITA, Germany - DEU, Norway - NOR, USA - USA, Philippines - PHL, India - IND, Czech Republic - CZE, Mexico - MEX, United Kingdom - GBR, Latvia - LVA, China - CHN, and Canada – CAN.

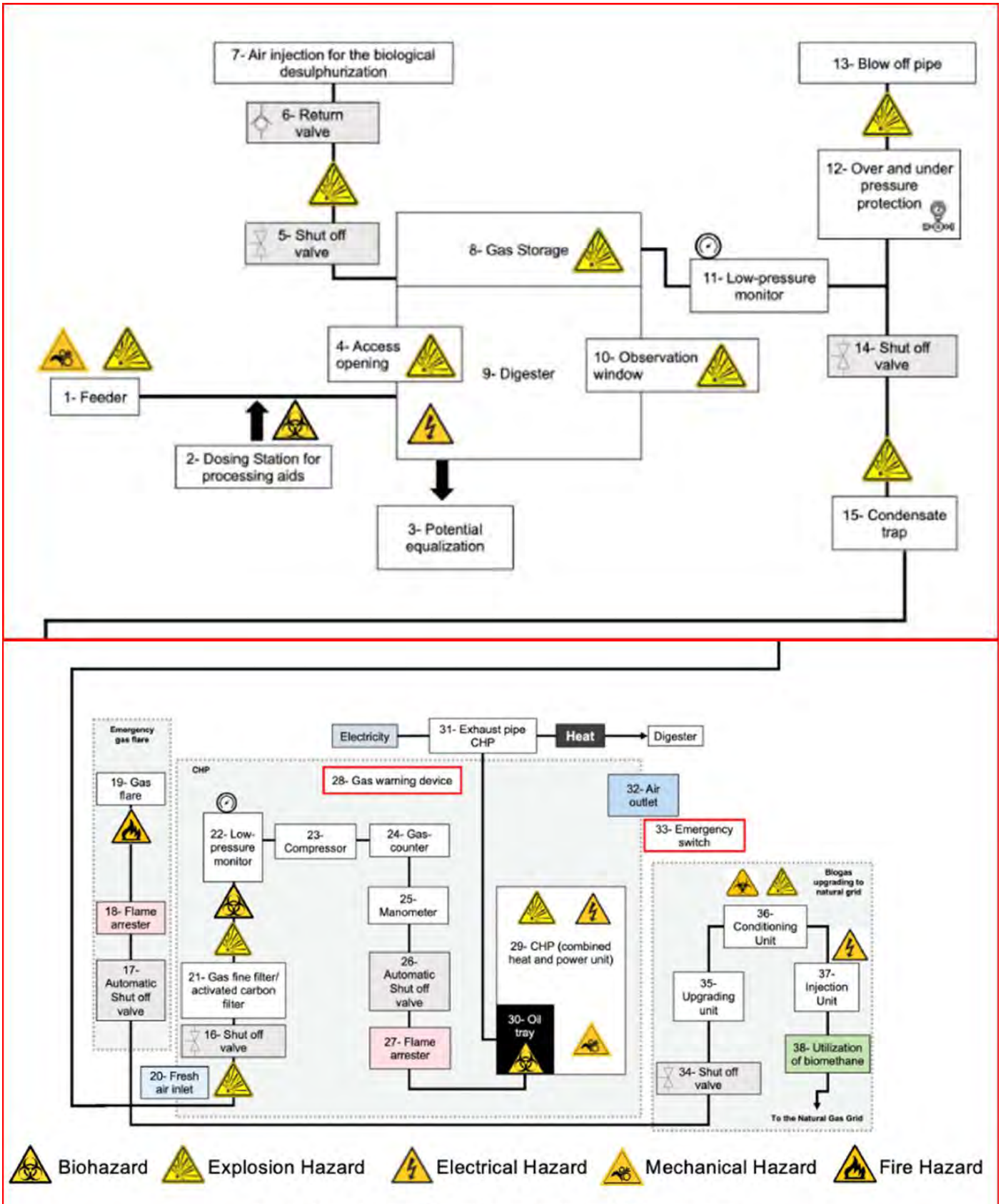


Fig. 2. Possible hazard identification in the typical biogas plant.

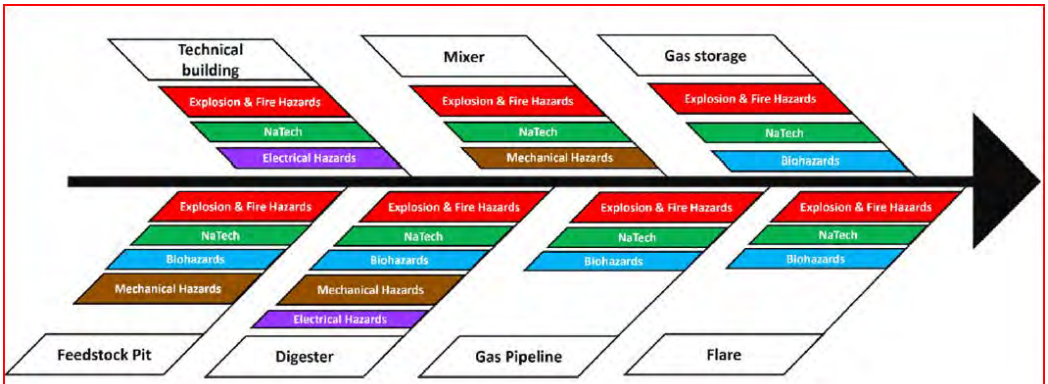


Fig. 3. Fishbone hazards analysis for the seven main biogas components.

Biohazard accidents in biogas plants are primarily associated with releasing toxic or harmful gases, such as H2S, during anaerobic digestion. Exposure to high H2S concentrations poses serious health risks to workers, including respiratory problems and even fatalities (Sawaya and Menezes, 2024). Studies indicate that biohazard-related incidents account for approximately 10 % of accidents in biogas plants (Rao et al., 2010). A fishbone diagram (Fig. 5) depicts several main causes that might lead to biohazards in biogas plants, such as inadequate handling practice, organic overload, improper use or disposal of PPE, accidental spills, poor air quality, inadequate labeling of hazardous material, and the generation of hazardous byproducts (Angelidaki and Ellegaard, 2003).

Explosion and fire hazards are significant risks in biogas plants due to the flammable nature of biogas, which is primarily composed of methane (Wu et al., 2025). Accidental gas leaks, improper ventilation, or ignition sources can lead to explosive mixtures and fires (Schmitz et al., 2021; Weiland, 2010). Statistics reveal that explosion and fire-related accidents contribute to around 15 % of incidents in biogas plants (Rao et al., 2010). These accidents can cause property damage, injuries, and loss of life. Fig. 5 represents some leading causes, such as open flames, electrostatic discharges, mechanically generated sparks, exothermic reactions, inadequate ventilation, combustible material, and improper use of electrical equipment (Demirel, 2008).

Electrical hazards are present in biogas plants due to using electrical equipment for processes such as pumping, mixing, heating, and power generation. Improper wiring, equipment malfunctions, or inadequate grounding can result in electrical shocks, fires, or equipment damage (Gupta et al., 2004). Research suggests that electrical accidents account for approximately 12 % of incidents in biogas plants (Rao et al., 2010). Some of the notable causes of electrical hazards represented in Fig. 5 include faulty grounding, high voltages, inadequate insulation, overloaded circuits, electric shock from exposed wiring or equipment, short circuits, improper use of extension cords, and electric shocks from wet conditions (Gupta et al., 2004).

Mechanical hazards in biogas plants can arise from operating various equipment, including pumps, valves, compressors, and agitators. Malfunctions, failures, or improper maintenance of these components can lead to injuries, entanglement, or equipment damage (Weiland, 2010). Statistics show that mechanical accidents contribute to around 18 % of incidents in biogas plants (Rao et al., 2010). As indicated in Fig. 5, entanglement, hydraulic overload, temperature stress, inadequate guarding, failure of safety interlocks, inadequate maintenance, malfunctioning pumps or valves, and inadequate training are some of the potential causes of mechanical hazards in biogas plants (Angelidaki and Ellegaard, 2003).

Natech accidents refer to incidents where natural hazards, such as earthquakes, floods, or storms, trigger technological failures or accidents. In biogas plants, natural hazards can compromise the integrity of structures, pipelines, or storage tanks, resulting in leaks, spills, or even collapses (Jensen and Hylland, 2019). Although the specific percentage may vary, it is vital to consider the potential consequences of such events and implement appropriate risk assessment and prevention measures (Weiland, 2010). These accidents can have severe consequences for both human safety and the environment. Potential causes include tornadoes, tsunamis, floods, hurricanes, rupture of biogas storage tanks, aging and deterioration of equipment, and power outages (Angelidaki and Ellegaard, 2003), as shown in Fig. 5.

Other accidents in biogas plants can include falls from heights, chemical spills, or process deviations. Falls from elevated platforms or ladders can cause injuries and account for approximately 8 % of incidents (Rao et al., 2010). Chemical spills can lead to environmental contamination and health risks, contributing to around 7 % of accidents in biogas plants (Rao et al., 2010). Process deviations, such as improper mixing or temperature control, can affect the efficiency of biogas production and may result in suboptimal plant performance (Gupta et al., 2004).

Accidents in biogas plants stem from various hazards, including biohazards, explosion and fire risks, electrical and mechanical failures, and natech events. Biohazards, linked to toxic gas releases like H2S, account for 10 % of incidents, while explosion and fire hazards have a contribution of 15 %, often due to gas leaks. Electrical hazards make up 12 % of accidents from equipment malfunctions, and mechanical failures account for 18 %. Natech events further complicate safety risks, underscoring the need for robust risk assessments and safety measures in biogas facilities.

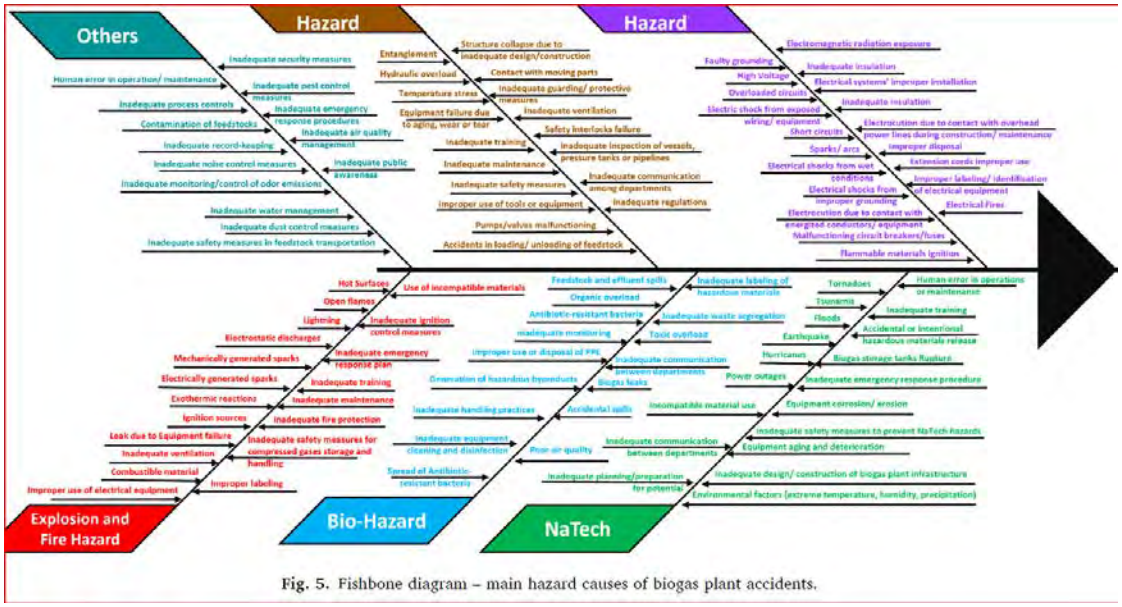


Fig. 5. Fishbone diagram – main hazard causes of biogas plant accidents.

Biogas plants – Safe handling of biogas 002:

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Section on Prevention in the Chemical Industry
Section on Machine and System Safety

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Hazard

The main hazard when handling biogas are the combustibility of methane and the explosiveness of methane/air mixtures.
The explosion range of methane lies between 4 % and 17 % by volume in air.
Further hazardous components of biogas are the asphyxiant carbon dioxide and the toxic hydrogen sulfide, which can be lethal even at low concentrations. The density of biogas is influenced by its carbon dioxide content, the atmospheric pressure and temperature. The higher the concentration of carbon dioxide, the higher the density of biogas. If the composition of biogas is unknown, it has to be assumed that biogas can accumulate at the ceiling as well as in basements, pits, shafts and other cavities.

Explosion prevention

In places where biogas plants or parts thereof are installed one must consider the hazard of an explosion. These areas should be classified into Ex-Zones 0, 1 or 2 in accordance with national guidelines.
In places where explosive atmospheres may occur, ignition sources must be avoided, or other protective measures have to be taken to eliminate the risk of ignition. Effective ignition sources include flames, hot surfaces, electrical sparks, static electricity, mechanically created sparks and lightning strikes.
In explosion zones the following equipment categories must be used respectively:

- in zone 0: equipment category 1G
- in zone 1: at least equipment category 2G
- in zone 2: at least equipment category 3G

Explosion safety in anaerobic digestion sites; where it can go wrong and guidance to avoid that happening
Sarah Bergin, Graham Atkinson, Alan Beswick, Brian Crook, Tim Small, Lee Schilling, SYMPOSIUM SERIES No.170
HAZARDS 33 © 2023 Crown copyright

Anaerobic digestion (AD) is a series of biological processes in which micro-organisms digest plant and/or animal material in sealed containers, producing biogas, which is a mixture of methane, carbon dioxide and other gases.
AD is a complex, living, biological process that is affected by numerous interdependent factors such as temperature, retention time and agitation.
Methane, the main gas of interest in biogas, has an explosive range of between 5 % and 15 % vol. in air. Within biogas, methane accounts for between 50 % and 70 % of the overall gas mixture. Thus, the generated methane has the potential to be within its explosive range at various times during the process, not only during intentional gas generation activities such as the digestion process but also at times when presence of methane is not essential e.g., in the feedstock reception area/holding tanks, or when storage tanks are being accessed for maintenance purposes.
Over the time period from 2010-2020, using search criteria that included biogas/anaerobic digestion as keywords, 68 incidents were recorded. In terms of incident occurrence by industry, 40 of these incidents occurred on industrial sites, 9 were logged as agricultural sites and 19 incidents did not specify industry. It is thought that this seemingly larger incident occurrence in industrial sites is more likely as a result of underreporting in the agricultural sector, rather than the industrial sector being inherently more incident prone. This supposition appears to be corroborated by anecdotal observation and material breaches identified as part of the inspection scheme, which is discussed further in the "Findings from HSE programme of inspections" section below.
Figure 2 shows the breakdown of incident type over the ten-year period; categorised as fire and explosion risk, asphyxiation/toxic gas release, physical injury, and environmental pollution due to biogas release to atmosphere or slurry (solids) release. From these reports, environmental pollution accounted for the most frequent occurrences. This is again possibly down to level of reporting (or underreporting) of human safety issues. Environmental permitting of most AD sites tends to be routinely inspected against the environmental criteria of the license rather than health and safety regulations. Where physical injuries resulted (7 incidents), reasons included equipment failure due to corrosion, use of incorrect tools/PPE or operative not anticipating the hazard and thus not implementing a safe system of work. In the case of asphyxiation/toxic gas releases (7 incidents), where operatives were in close proximity, this tended to be during maintenance activities, for example breaking of a crust in the digester. Where toxic gas releases occurred (not necessarily causing an asphyxiation risk), this tended to be due to failure/absence of an odour abatement system, such as an H2S scrubbing. In terms of fire and explosion risks (15 incidents), these tended to occur as a result of a deviation from normal operating conditions, including foaming causing blockage of PRVs leading to over pressurisation, or power cuts causing safety critical equipment such as flares to stop. The most serious incidents involved hot works on storage tanks that contained accumulations of flammable gas that had not been properly identified during Hazardous Area Classification (HAC).

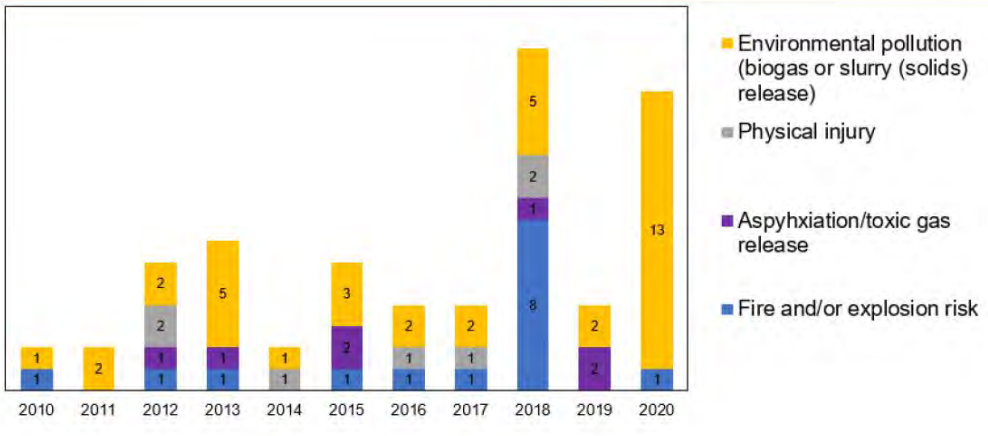

Figure 2: Breakdown of incident from 2010-2020 by nature of risk that occurred i.e. environmental pollution, physical injury, asphyxiation/toxic gas release and fire/explosion risk. The number of incidents for each incident type is overlayed on the relevant section of the bar.

Twenty-two inspections at AD sites were carried out by HSE's Field Operations Division in 2021/22. These were large sites dealing with sewage, food, and industrial wastes. In 2022/23, forty-nine inspections were carried out at agricultural sites. Note: these were routine inspections and not in response to an unsafe occurrence or concern being reported. The outcome of this campaign was that material breaches were found in 50% of cases for industrial sites and 40% of cases in agricultural sites.

Process safety at anaerobic digestion sites and its workplace impact: A rapid review. Alan Beswick, Gareth Evans, Brian Crook, Becky Gosling, Claire Bailey, Iwona Rosa, Helena Senior, Jodi Brookes, Owen Butler, Paul Johnson, Penny Barker, Sarah Bergin, Lee Schilling, Tim Small. Process Saf Prog. 2025;44:359–367. wileyonlinelibrary.com/journal/prs. Crown Copyright.

For this review, the potential for worker exposure to hazards at AD sites is the focus, including exposures to toxic substances, injuries, and fatalities from failures in mechanical and process control.
AD hazards can be broadly categorized as follows:

1. Explosive Atmospheres: These can occur with the uncontrolled release, inappropriate storage, or improper handling of flammable biogas, which poses serious fire, explosion, toxic, and asphyxiant risks. The release of large quantities of fugitive biogas from the AD plant has been widely described, and for methane (CH4) this is often in relation to the environmental impact or economic loss of biogas. However, if not monitored, biogas leaks also present a risk of explosion or flash fire.

2. Harmful Chemicals: Exposure to toxic compounds from the feedstock or AD processes may cause ill health, asphyxiation, and death. For example, hydrogen sulfide gas (H2S) is a potent respiratory and neurological toxicant acting as a pulmonary irritant and asphyxiant. Volatile organic compounds (VOCs) can also cause irritation in the respiratory tract, throat, nose, and eyes, as well as headaches, dizziness, and nausea.
Long-term exposure to VOCs can disrupt the functions of the central nervous system, cause organ damage, and some VOCs may cause cancer. Most of the studies on AD units have focused on the role of H2S as an inhibitor of the methanogenic process or its corrosive effects on metal pipework and CHP engines. Microbial VOCs are often linked to odor concerns rather than respiratory ill health impact.

3. Pressure Accumulation: Biogas components, including CH4, H2, carbon dioxide (CO2), H2S, or a mixture of these, can accumulate and over-pressurize digester vessels, pipework, and other gas containment structures. This may result in containment failure with leakage, fire, and explosion. Pressure build-up may be exacerbated by precursor events or engineering failures, such as pressure release valve or pipework blockage. Poor control of the AD process causing foaming events contributes to these risks.

4. Other Engineering Failures: Mechanical breakdown or deterioration in pumps, valves, mixing mechanisms, and other critical components requires frequent maintenance interventions. Examples of such failures include corrosion of metal equipment caused by H2S, malfunctions of equipment caused by foaming residues, or siloxane combustion products deposited inside CHP machinery, increasing wear and tear. When these failures occur, maintenance tasks may expose employees to chemical or microbiological hazards. Such failures are also linked to poor levels of process reliability and control.

5. Harmful Microorganisms: Exposure to various microorganisms within feedstocks prior to processing (storage and handling), or during the AD process itself, can be hazardous to human health.
Some of these microorganisms are pathogenic, causing infections, inflammation, or toxicity. Exposure may be due to direct contact or inhalation. Some microorganisms cause allergic disease, particularly airborne fungal or bacterial spores. These are often present in large numbers when decomposing organic feedstocks are handled.
In recent years, serious incidents have occurred at AD facilities in parts of the United Kingdom and elsewhere, some causing injury or fatality. These have arisen at different types of AD facilities and include established sites where robust systems and process understanding might reasonably be assumed. These events may reflect the complexity of the microbiological and engineering processes being managed and, among employees, a potential lack of knowledge about the correct preventive and mitigating actions to take. AD plant designs vary, but the associated hazards remain largely consistent and must be controlled.
Multiple reported hazards associated with AD site incidents

A range of hazards and defects has been described across multiple peer-reviewed papers, where common events act as precursors to dangerous occurrences that have the potential to injure or kill AD site personnel, or can affect those attending the site to assist in an emergency response. Examples of these are summarized in Table 1.

TABLE 1 AD-related hazards and outcomes from major incident studies.

Main hazard(s) identified/exposure risks	Study outcomes/conclusions
Between 2003 and 2010, most deaths or injuries involved biogas explosions, or toxic inhalation of H2S, particularly in confined spaces	Five plants exploded during commissioning or during maintenance work. Thirteen deaths: four following gas explosions; four from H2S exposures after safety devices were disabled. Eleven serious injuries were due to burns, explosions, or H2S exposure. Firefighters' injuries from H2S exposures. Conclusion: AD industry lacked formal safety culture; rigorous procedures needed for hazardous materials
In 10 years, 800 incidents in 13,171 European biogas sites. Included: biogas leakage from storage tanks, distribution networks; release of H2S; valves freezing; high pressure inside digester; overflowing sewage systems; dangerous raw feedstock	Three fatal incidents. Risk analysis concluded risk not as high as in chemical plants but still have serious localized consequences. Risk assessments are critical to reduce the frequency of incidents.
Of 169 reported incidents in the biogas supply chain, 66% involved release of biogas; fires for 23%; explosions for 19%. Also, incidents due to exposures to gases such as H2S.	Causes of biogas release: equipment failure, operational error, and explosions, from maintenance errors and system design errors. Learning from previous accidents and developing risk-awareness skills are needed but are limited by insufficient recording and/or in the published literature. Safety procedures of other industries should be adopted; specific safety standards for biogas production facilities could avoid future design and operational errors.
Fires occurred in 52 of 132 incidents where energy generation units (ICE-CHP) were located. Flash fires in 22 of 45 incidents in digester vessels or in gas storage vessels. Biogas leaks occurred from damaged piping, defective gas burners, and damaged gas storage vessels	In 28 of the 52 fires: a technical defect; for example, electrical problems, leakage of operational fluids and ignition, or ignition of other flammable materials from hot surfaces. Flash fires caused by maintenance errors; for example, welding inside poorly ventilated areas; also from lightning (2 incidents). Technical defects included defective shut-off valves due to low temperatures. Biogas leaks from compressors were often linked to defective seals or failure of materials.

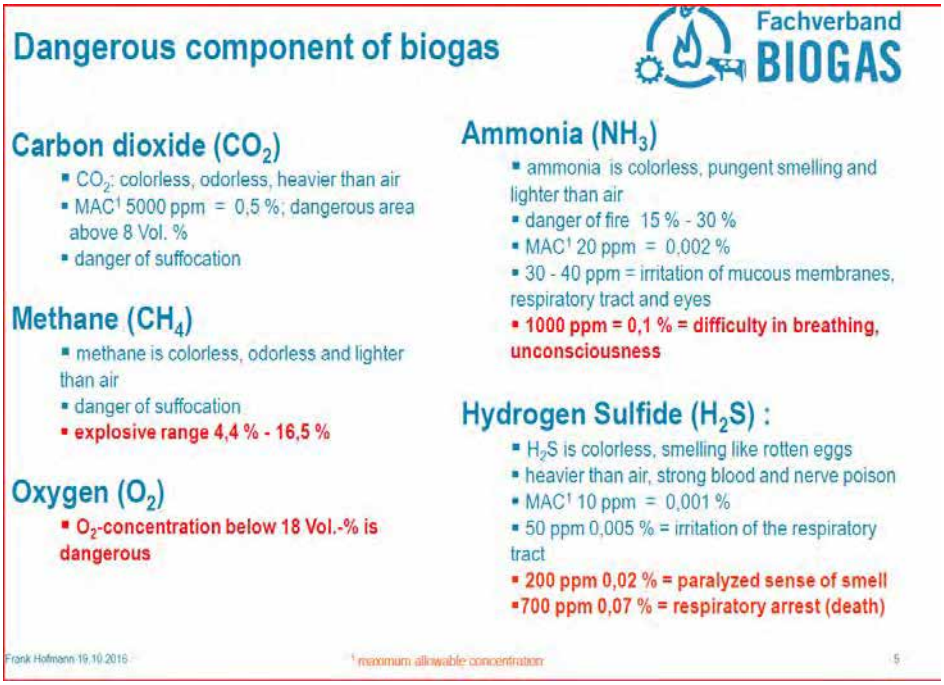

Table 4: Risk analysis

Likelihood			Potential Consequences				
			Minor injuries or discomfort. No medical treatment or measurable physical effects	Injuries or illness requiring medical treatment. Temporary impairment.	Injuries or illness requiring hospital admission.	Injury or illness resulting in permanent impairment.	Fatality
			Not Significant	Minor	Moderate	Major	Severe
	Expected to occur regularly under normal circumstances	Almost Certain	Medium	High	Very High	Very High	Very High
	Expected to occur at some point	Likely	Medium	High	High	Very High	Very High
	May occur at some point	Possible	Low	Medium	High	High	Very High
	Not likely to occur in normal circumstances	Unlikely	Low	Low	Medium	Medium	High
	Could happen, but probably never will	Rare	Low	Low	Low	Low	Medium

Cases, Causes, and Impacts of Safety Incidents at AD Systems

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Workshop of Manure Management and Utilization Technologies (6)
– Anaerobic Digestion Topics Part 3
Bio Town Ag. Reynolds, IN 47980, USA
March 10, 2023

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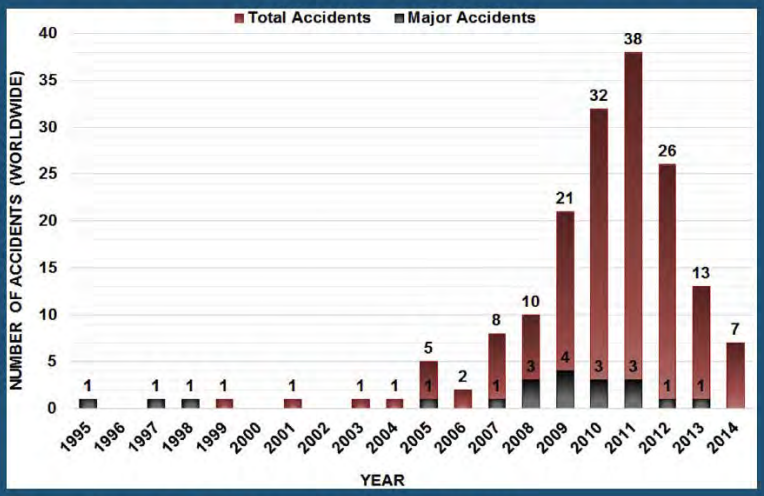
169 Cases in Europe (1995–2014)

12% (20 cases) of the 169 were major accidents (*major emission, fire, or explosion leading to serious danger to human health or the environment*).



Casson Moreno et al. 2016. Renewable Energy. 96, 1127-1134.

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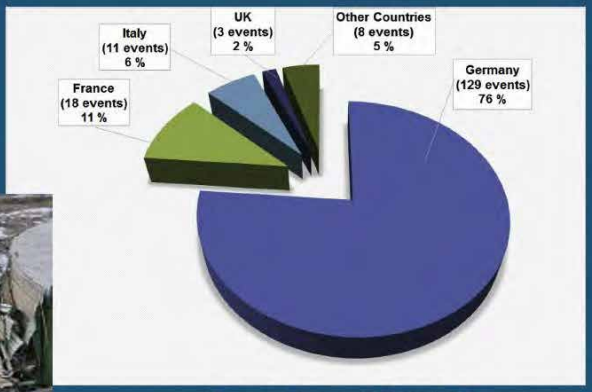
169 Cases in Different Countries



Countries of the 169 cases

Casson Moreno et al. 2016. Renewable Energy. 96, 1127-1134.

Damage in an AD incident

Jenkins et al., 2013. Loss Prevention Bulletin (229), 19-24.

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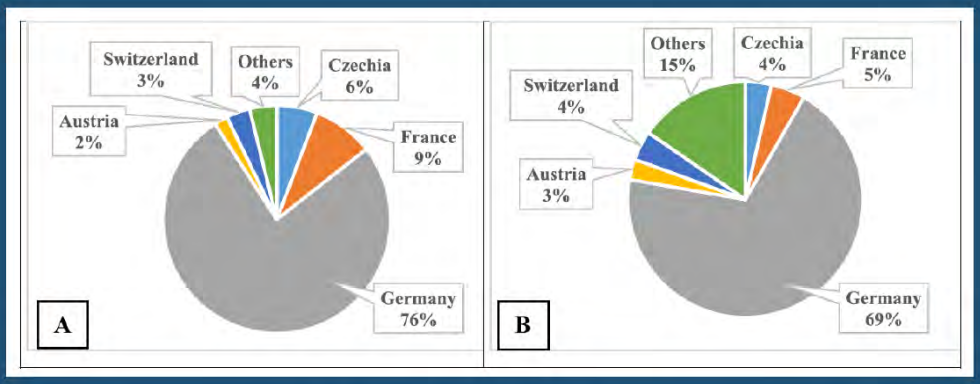
208 Cases in Europe (2006–2016)



Share of accidents in individual countries of 208 events (A). Share of individual countries in the total number of biogas stations in 2015 (B).

Travnicek et al. 2018. Renewable Energy. 122, 89-97

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2 Cases in England and Hungary

Dec. 3, 2020, Avonmouth, Bristol, England. Wesset Water's anaerobic digester explosion killed four people.

https://www.industrytap.com/what-may-have-caused-the-avonmouth-anaerobic-digester-explosion/55634

2021, Hungary: Explosion in the Nyírbátor Biogas Plant - three people died.

Daily News Hungary · Bátor Média · Oct 14, 2021

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4 Cases in USA (2011–2016)

1. April 17, 2011, Linwood, New York. Noblehurst Farms lost its digester, in an early morning fire.
   https://www.manuremanager.com/noblehurst-farms-loses-digester-in-fire-3731/

2. July 2012, Oakley Farm in Aumsville, Oregon. An explosion at the anaerobic manure digester.
   https://www.oregonlive.com/pacific-northwest-news/2012/07/methane_fueled_explosion_at_au.html

3. Aug. 6, 2014, Town of Vienna, Wisconsin. An explosion destroyed the roof of a 1.25-million-gallon manure digester.
   https://www.manuremanager.com/manure-digester-explosion-in-wisconsin-sparks-fire-15850/

4. Nov. 2016, Lowell, Michigan. Lowell Energy AD digester exploded due to a buildup of methane gas, resulted in a ruptured tank cover, a lingering odor and spilled waste.
   https://www.waste360.com/safety/michigan-biodigester-explodes-methane-gas-buildup

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3 Cases in USA in 2017 & 2018

5. Jan. 22, 2017, International Paper in Cantonment, Florida. An explosion caused significant structural damage to the largest pulp digester as well as the power house at the mill.
   http://www.northescambia.com/2017/01/my-heart-sank-mill-manager-speaks-out-about-explosion-future-of-ip

6. Jan. 2018, Missouri. Gas build-up leads to explosion at Blue River Wastewater Treatment Plant, Part of the building collapsed.
   https://www.kshb.com/news/local-news/gas-build-up-leads-to-explosion-at-blue-river-wastewater-treatment-plant

7. Aug. 30, 2018, Chicago. An explosion at a water reclamation plant in appears to have been caused by methane gas ignited by a worker's welding torch.
   https://www.wateronline.com/doc/explosion-at-chicago-water-reclamation-plant-injures-0001

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2 Cases in USA in 2020 & 2021

- April 2020. Jay, Maine. A paper mill disabled by a dramatic explosion.
  No one was injured but 230 workers were left without jobs.
  The mill will close in the first quarter of 2023.
  https://apnews.com/article/explosions-maine-susan-collins-angus-king-4dfd183575a0f364a4545bec0e1132e6

Photo from AP News.
https://apnews.com/article/391dfff9b3768186d3ad318fa30f11fb/gallery/8139f20f69904163b8ebe9756ecea959

- June 8, 2021, Stockton, Iowa. Bob Baenziger Jr., 54, died while performing a dive to repair a broken cable at the bottom of a million-gallon anaerobic digester tank at Sievers Family. *(From multiple source, including https://www.desmoinesregister.com/story/news/2021/07/30/diver-robert-baenziger-jr-drowns-iowa-farm-accident/5427513001/)*

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143 Cases in Asia (1958–2022)

Cases and losses
- Total cases: 143 (all "major accidents")
- Fatalities: 266
- Injuries: 219
- Total property damages: unknown, but huge

Victims
- Male : female = 5.5 : 1
- Minimum age: 3-year-old
- Maximum age: 75-year-old

Cases in two digester types:
- ~73.2% at household digesters
- ~26.8% at industrial digesters

Household digester
https://www.sohu.com/a/323140642_120034261

Industrial digesters

Ni, Unpublished data. Do not cite.

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Acute Poisoning and Explosion

- Poisoning by inhaling hydrogen sulfide (H_2S), 80.6% of all cases.
- Explosions by welding or other work at digesters, and fires by inappropriate use of biogas for cooking, and a lightning strike, 19.4% of all cases.

Poisoning in 2018, China.
https://www.sohu.com/a/233521492_420076

Incidents occurred while:

- Maintaining and repairing digester systems.
- Rescuing other victims in digesters.
- Rescuing animals fallen into digesters.
- Recovering lost items (such as cell phones) from digesters.

Explosion in 2013, India.
https://www.indiatvnews.com/news/india/

Ni, Unpublished data.

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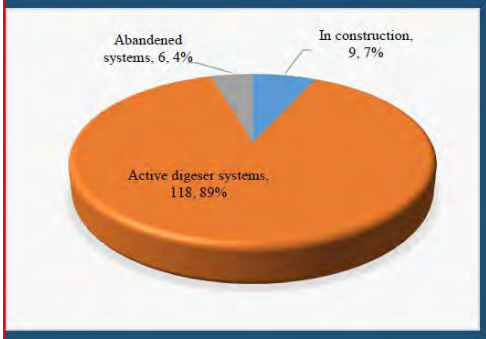
Status of Digesters at Incidents



Ni, Unpublished data.

Incidents occurred:

- 89% at active digester systems.
- 7% at digesters in construction.
- 4% at abandoned digesters.

An abandoned household digester in China that claimed 3 lives

Chen, 2015. Deyang Evening News.

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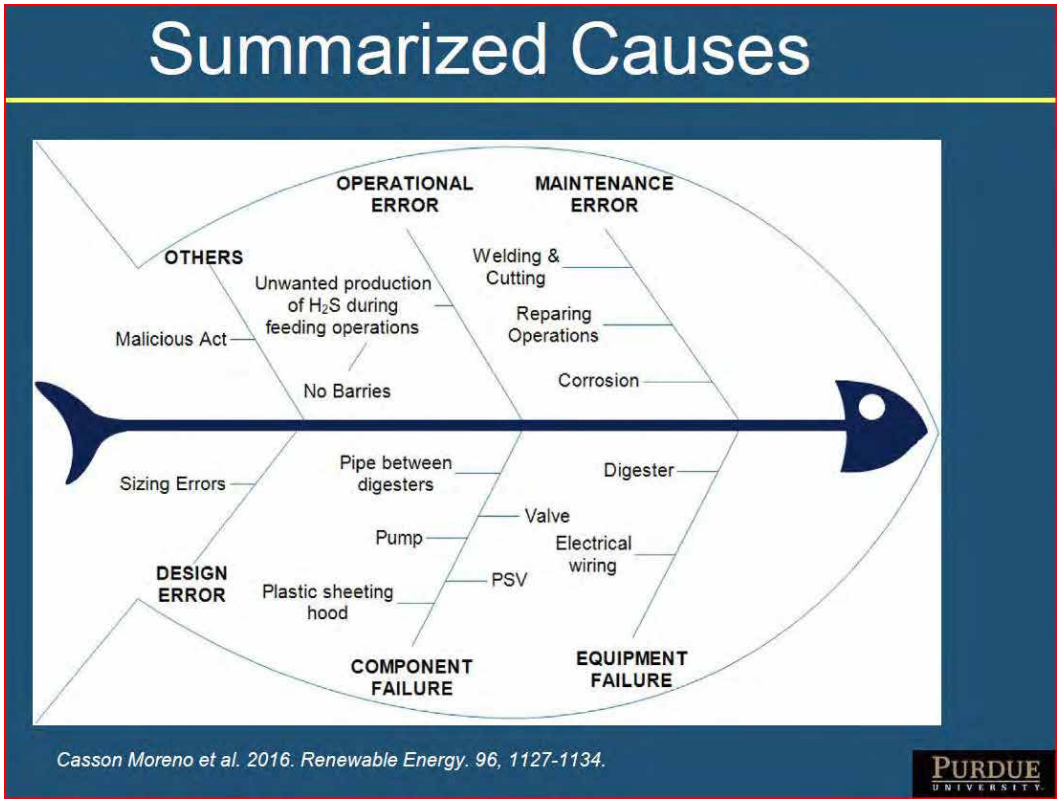

BIOEXELL-European Biogas Centre of Excellence

MANAGEMENT OF BIOLOGICAL CONTAMINATION

The main biologic contaminants in AD substrates are various types of bacteria, viruses, intestinal parasites, prions and other contaminants. The modern technologies of manure and biogenic waste treatment should not result in new routes of pathogens and diseases transmission between animals, humans and the environment. Some main measures would contribute to ensuring a veterinary safe recycling of digestate:

- Livestock health control. No animal manure and slurries will be supplied from any livestock with health problems.
- Feedstock selection and control. Hazardous biomass types are excluded from anaerobic digestion and canalised towards suitable, safe disposal methods (table 3).
- Pre-treatment/sanitation of feedstock
- Pressure sterilisation: 1330C, 3 bar, for 20 minutes.
- Pasteurisation: 700C, for 1 hour.
- Regularly control of the efficiency of pathogen reduction measures in digestate.

Table 3: Health rules concerning animal by-products not intended for human consumption

Category and description	Rules for utilisation
1. Animals suspected to be infected with TSE, specific risk material. - Animals, other than farm and wild animals, spec. pets, zoo and circus animals. - Catering waste from means of transport operating internationally	Always destruction incineration
2. Manure from all species and digestive tract content from mammalians. - All animal materials collected when treating wastewater from slaughterhouses or from category 2 processing plants, except from cat.1 slaughterhouse wastewater treatment plants. - Products of animal origin, containing residues of veterinary drugs. Dead animals, others than ruminants.	For AD must be pressure sterilised, for 20 minutes at 133^{0}C and 3 bars. NB: Manure and digestive tract content can be used for AD without pre-treatment.
3. All parts of slaughtered animals, declared fit for human consumption, or not affected by any signs of diseases. - Hides, skins,	For AD must be sanitised in separate tanks for 1hour at 70 ^{0}C.

THE PLANNING TASK

Feasibility studies

The potentials of a biogas plant can be established in a geographically defined area. The biogas plan may typically consist of the following items:

· mapping of manure resources
· mapping of waste products
· energy production and application/sales of energy
· supply scenarios (alternatives)
· estimate of consequences for the plant
· utilization of the digested product as manure

As an alternative the potentials can be studied based on a specific project. The contents will more or less be identical but be adapted to specific conditions at the site and the required plant concept. Table 1 shows the average biogas potential of the most common AD substrates in Denmark.

Location of the plant

The projects can be established in connection with a biogas plan or based on knowledge about local conditions. The following conditions must be observed:

- Accessibility to biomass – manure and/or various type of waste
- Possibilities of selling power and possibly heat (either directly or as cooling through absorption coolers)
- Political readiness to establish the project
- Possibilities of financing.

High-rate conversion requires available resources of a minimum of 40 t of biomass/day and a part of the biomass must be procured as high-grade waste products, etc. Transport of biomass is one of the important operation costs for the biogas plant. Aiming to have a sustainable economy for the plant, a thumb rule must be considered: the nutrient value of the digested biomass unit must be at least the same or bigger that the total costs of treatment, storage and transport of the same digested biomass unit. This aspect must be considered when planning the emplacement of the plant in the area as well as the location of the post storage tanks for digested biomass.

NB: When deciding upon the location of a biogas plant, a suitable distance between the plant and the residential areas must be considered as well as the direction of the main winds, in order to minimise traffic and odour nuisances.

Mapping of resources and energy sale

The resources are mapped either directly or indirectly. By direct mapping the specific qualities and quantities are examined. It is often possible in industries or other enterprises, which have already established a more or less organized handling of the biomass. Indirect mapping indicates that quantity etc. is estimated from standard figures such as e.g. manure production per cow, waste production per inhabitant, waste quantity per slaughtered animal. The method is particularly suited for mapping of manure and organic household waste. In practice the methods are combined.

The following information about the biomass is obligatory:

- Quantity
- quality (content of dry matter and a rough identification of type)
- possible seasonal variations
- present use/disposal (possibly including price of disposal).

Organisation

Besides the technical assessments the feasibility study should also contain an assessment of the organisation of the project under establishment and under operating conditions. As biogas projects aim at meeting requirements and solving problems for individuals, companies, groups, etc. it is essential that all interested parties are involved from the first steps of the planning phase.

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Issue 3: The Retail Property Value of surrounding houses will be seriously affected.

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Issue 4: The presence of a geological fault line under the quarry site creates the potential for gross contamination of public water supplies.

The reports below indicate that land spreading of digestate requires compliance with the Precautionary Principle in relation to human health & that this Application be refused.

Understanding risks and optimising anaerobic digestion to minimise pathogen and antimicrobial resistance genes entering the environment. Devendra Saroj, Lisa M Avery, Rupert L Hough,

Material that originates from the human or animal gut can contain pathogens and other organisms, any of which may be carrying genes that make them resistant to antibiotics. If we apply those to land, and allow them to enter the environment, they can remain in the soil or be washed into water bodies which may be used for irrigation of food crops, water supplies, recreation or shellfish production. From here, humans and animals can potentially consume pathogens/resistant organisms or come into direct contact with them in the environment. Given that earlier this year, the UK's outgoing chief medical officer said that "we are in an arms race against microbes" and that if no action is taken on antimicrobial resistance, 10 million people worldwide could die each year by 2050; we ought to understand exactly what is in the organic amendments we apply to land.

Anaerobic digestion (AD) utilises organic materials to produce energy *via* biogas while also producing nutrient-rich digestate ideal for application to land as a fertiliser. However, there may be a risk to human (and livestock) health if pathogens originating in the feedstock are transferred to land and potentially taken up into the food chain This is compounded by concerns over antibiotic-resistant bacteria (ARBs) entering the environment. Resistance genes (ARGs) can be transferred widely within the soil microbiome, including to and from pathogens, and we do not know their fate during and post-anaerobic digestion. Organisms of particular concern include Clostridia, which, being anaerobes, can proliferate under the digester conditions and isn't always removed by pasteurisation. With little data on pathogen and ARB/ARG prevalence in feedstocks, persistence/proliferation through the AD process, we cannot determine risks associated with application of AD to land or how it compares to traditional organic amendments.

These results indicate that land spreading of digestate requires compliance with the Precautionary Principle in relation to human health & that this Application be refused.

Liu, H.; Yuan, X.; Yao, Y.; Yao, L.; Zhang, J.; Maurer, C. Microplastics, Antibiotics, and Heavy Metals in Anaerobic Digestion Systems: A Critical Review of Sources, Impacts, and Mitigation Strategies. Recycling 2025, 10, 116. https://doi.org/10.3390/recycling10030116

The widespread implementation of anaerobic digestion (AD) systems for organic waste treatment is increasingly challenged by emerging contaminants, including microplastics (MPs), antibiotics, and heavy metals (HMs), which exhibit environmental persistence and pose risks to ecological and human health. This review critically examines the sources, transformation pathways, and advanced mitigation strategies for these contaminants within AD systems. MPs, primarily derived from fragmented plastics and personal care products, accumulate in digestates and act as vectors for adsorbing toxic additives and pathogens. Antibiotics, introduced via livestock manure and wastewater, exert selective pressures that propagate antibiotic resistance genes (ARGs) while disrupting methanogenic consortia. HMs, originating from industrial and agricultural activities, impair microbial activity through bioaccumulation and enzymatic interference, with their bioavailability modulated by speciation shifts during digestion. To combat these challenges, promising mitigation approaches include the following:

- bioaugmentation with specialized microbial consortia to enhance contaminant degradation and stabilize HMs;
- thermal hydrolysis pretreatment to break down MPs and antibiotic residues;
- chemical passivation using biochar or sulfides to immobilize HMs.

Co-digestion practices inadvertently concentrate these contaminants, with MPs and HMs predominantly partitioning into solid phases, while antibiotics persist in both liquid and solid fractions. These findings highlight the urgency of optimizing mitigation strategies to minimize contaminant mobility and toxicity. However, critical knowledge gaps persist regarding the long-term impacts of biodegradable MPs, antibiotic transformation byproducts, and standardized regulatory thresholds for contaminant residues in digestate. This synthesis underscores the necessity for integrated engineering solutions and policy frameworks to ensure the safe resource recovery from AD systems, balancing energy production with environmental sustainability.

Microplastics is the subject of the contamination studies of the 14 papers we consider for this critical review. The pervasive use of plastics—global production reached 360 million metric tons in 2018—has led to irreversible environmental fragmentation, with an estimated 12 billion tons of plastic waste projected to accumulate in landfills and ecosystems by 2050. Secondary microplastics (MPs, 1 μm–5 mm) predominantly originate from the degradation of microplastics through mechanical abrasion, UV weathering, and microbial action, while primary MPs are intentionally manufactured for industrial applications (e.g., electronics coatings, personal care products). China alone discharges approximately 306.9 million tons of plastic microbeads annually into aquatic environments, exemplifying the scale of anthropogenic MP emissions.
Wastewater treatment plants (WWTPs) act as critical interception points, retaining >90% of influent microplastics (MPs) in sewage sludge through sedimentation and filtration processes. However, this retention inadvertently transforms sludge into a concentrated MP reservoir, with digestates containing 5-fold higher MP concentrations than raw waste-activated sludge (WAS) [24]. Globally, PS, PVC, PP, PET, and PE dominate sludge-associated MPs, exhibiting morphological diversity (spheres, fibers, fragments) and size heterogeneity (0.1–5 mm). Regional studies reveal substantial variations: Italian WWTPs report PA and PET concentrations of 29.3–1470 μg/g in sludge, while Canadian facilities detect 50–150 μg/L polystyrene nanoplastics (PsNPs) in anaerobically digested sludge.
Notably, MPs' high surface-area-to-volume ratio and hydrophobicity enable them to act as vectors for heavy metals, antibiotics, and pathogens through adsorption–desorption dynamics, amplifying contaminant mobility in AD systems. Land application of MP-laden digestates introduces these composites into agricultural soils, posing long-term risks to food security—a critical nexus requiring regulatory intervention.

Antibiotics is the subject of the contamination studies of 18 papers we consider for this critical review. Antibiotics, widely used as growth promoters in livestock and additives in personal care products, have experienced escalating environmental release due to surging global consumption. Between 2000 and 2015, global antibiotic usage increased by 65%, with 30% allocated to livestock farming, while medical and aquaculture sectors accounted for 55% and 15%, respectively. Approximately 17–90% of veterinary antibiotics are excreted as parent compounds or active metabolites, resulting in concentrations ranging from 100 μg/L to 500 mg/L in livestock manure. To the best of our knowledge, there are four types of antibiotics including tetracyclines, sulfonamides, quinolones, and macrolides that were reportedly detected in the FW and related AD systems, as shown in Table 1. In China's intensive farming systems, tetracyclines (TCs), sulfonamides (SAs), and fluoroquinolones (QNs) constitute >75% of the antibiotic load in swine manure, while enrofloxacin concentrations in poultry manure exceed those in swine/cattle manure by three orders of magnitude.

Table 1. Antibiotic contents found in manure and digestates.

Country	Matrix	CTC	DC	OTC	TC	SDZ	SMZ
China	Dairy cow feces	1	-	5.1	1.1	-	0.46
China	Cattle manure	-	-	21.4	12	4.6	9.4
China	Cow dung	2.2	0.68	1.2	-	-	-
China	Cow feces	1.5	-	-	0.02	-	-
The Netherlands	Swine feces	-	1.9	0.16	-	0.13	-
Belgium	Swine manure	-	22.8	2	-	3	-
Germany	Swine manure	6.2	-	21.5	9.7	4.9	-
Austria	Pig manure	46	-	29	23	-	-
Germany	Pig manure	37.4	27.4	13.6	152	7.3	-

Antibiotics enter anaerobic digestion systems via two primary pathways:

- codigestion of livestock manure (e.g., TCs (tetracyclines): 21.4–152.0 μg/g dry weight) with municipal waste-activated sludge (WAS), directly suppressing methanogen metabolic activity;
- WAS-retained antibiotics (e.g., sulfamethoxazole: 3–9.4 μg/g) influencing microbial community function through extracellular polymeric substance-mediated adsorption–desorption dynamics [46]. Antibiotics with low MIC50 values (e.g., enrofloxacin MIC50 <0.06 μg/mL) inhibit key enzymatic activities via ribosomal targeting, reducing CH4 yield by 30–50%. Concurrently, antibiotic-induced selective pressure drives horizontal transfer of antibiotic resistance genes (ARGs, e.g., sulfonamide resistance genes sul1 and sul2), increasing multidrug-resistant bacteria abundance by 2–3 orders of magnitude in AD sludge.

Despite the predominance of TCs and SAs (>75% detection rate in Chinese swine manure), global thresholds for antibiotic residues in agricultural digestate remain undefined. Drawing from Germany's regulatory model, integrated strategies should include source reduction (e.g., restricting high-risk antibiotics with MIC50 <1 μg/mL), process intervention (10% biochar addition achieves >90% sulfonamide adsorption), and legislative controls (ecotoxicology-based MRLs) to mitigate risks.

Heavy metals (HM) is the subject of the contamination studies of the 17 papers we consider for this critical review. The valorization of municipal sludge and livestock manure as organic fertilizers is hindered by heavy metal (HM) contamination, despite their rich nutrient content. China generates over 60 million tons of sludge annually, with notable HM concentrations (e.g., Cu, Zn, Cd, Cr), where Fe, Mn, Cu, and Zn constitute >80% of total HMs in swine manure. Table 2 shows the content of HMs in slurry. Total HM concentrations alone inadequately reflect ecological risks, as bioavailability and toxicity depend critically on chemical speciation—acid-soluble (F1) and reducible fractions (F2) exhibit high mobility, while oxidizable (F3) and residual fractions (F4) remain stable

Table 2. HMs contents in the slurry (mg/L).

Animal Manure	Treatment Condition	Cu	Zn	Cd	As	Pb	Cr	Ni	Mn
PM	Mesophilic digestion	16.34	20.66	-	0.26	-	-	-	-
PM	Mesophilic digestion	4.17	8.92	-	-	0.02	-	-	0.26
PM	Mesophilic digestion	1.32	3	-	-	0.04	0.05	3.62–22.1	-
PM	Mesophilic digestion Mixed with corn silage	14.78	9.71	1.59	-	13.9	-	-	1.88
CHM	Mesophilic digestion	1.79	12.67	-	-	0.05	0.11	6.91–31.4	-
CHM	Thermophilic digestion	15.17	124.51	0.17	27.15	1.94	39.75	-	-
DCM	Mesophilic digestion	3.29	17.45	-	0.06	-	-	1.51–4.96	-
China		0.5	2	0.01	0.05	0.2	0.1	0.2	-

Note. Limit values according to standard for irrigation water quality in China (GB 5084-2021) ; PM: pig manure; CHM: chicken manure; DCM: dairy cattle manure;-: It was not mentioned in the references.

Within anaerobic digestion (AD) systems, HMs undergo dynamic speciation transformations. During initial hydrolysis-acidogenesis, organic acids lower pH to 5.5–6.0, enhancing dissolution of HM ions (e.g., Cu^{2+}, Zn^{2+}). As methanogenesis consumes volatile fatty acids, pH 7.5–8.5, establishing a reductive environment that facilitates HM stabilization through:

- sulfide precipitation (e.g., CuS/ZnS) mediated by sulfate-reducing bacteria;
- humic acid (HA) complexation, with HA-Cu/HA-Zn exhibiting 2–3× higher stability than fulvic acid-bound forms;
- extracellular polymeric substance (EPS) adsorption, achieving 60–85% binding efficiency. Ultimately, >90% of HMs accumulate in digestate solids, with 3–25 μm particles carrying >70% of the HM load.

Toxicity rankings follow Hg > Cd > Cr(III), where Cd poses the highest risk due to its bioaccumulation factor (BCF > 5). Although passivation strategies (e.g., composite additives) reduce Cu bioavailability by 40–60%, global standards for HM thresholds in agricultural digestate remain absent. Future efforts must establish speciation-based risk assessment frameworks and develop microbial enhancement technologies targeting EPS synthesis or sulfur metabolism to achieve controlled HM risks in AD systems.

These results indicate that land spreading of digestate requires compliance with the Precautionary Principle in relation to human health & that this Application be refused.

Ranking hazards pertaining to human health concerns from land application of anaerobic digestate. Rajat Nag, Paul Whyte, Bryan K. Markey, Vincent O'Flaherty, Declan Bolton, Owen Fentone, Karl G. Richards , Enda Cummins. Science of the Total Environment 710 (2020) 136297. https://doi.org/10.1016/j.scitotenv.2019.136297

Farm yard manure and slurry (FYM&S) are important AD feedstock and are typically mixed with agricultural waste, grass and/or food wastes. The feedstock may contain many different pathogens which can survive the AD process and hence also possibly be present in the final digestate.

A scoring system was used to categorise likely inactivation during AD, hazard pathways and finally, severity as determined from reported human mortality rates, number of global human-deaths and infections per 100,000 populations. Five different conditions including mesophilic and thermophilic AD and three different pasteurisation conditions were assessed in terms of specific pathogen inactivation. In addition, a number of scenarios were assessed to consider foodborne incidence data from Ireland and Europe and to investigate the impact of raw FYM&S application (without AD and pasteurisation). A sensitivity analysis revealed that the score for the mortality rate (S3)was themost sensitive parameter (rank coefficient 0.49) to influence the final score S; followed by thermal inactivation score (S1, 0.25) and potential contamination pathways (S2, 0.16). Across all the scenarios considered, the screening tool prioritised Cryptosporidium parvum, Salmonella spp., norovirus, Streptococcus pyogenes, enteropathogenic E. coli (EPEC), Mycobacterium spp., Salmonella typhi (followed by S. paratyphi), Clostridium spp., Listeria monocytogenes and Campylobacter coli as the highest-ranking pathogens of human health concern resulting from AD digestate in Ireland. This tool prioritises potentially harmful pathogens which can emerge from AD digestate and highlights where regulation and intervention may be required.

Harmful pathogens can be present in higher concentrations in animal FYM&S (Jones and Martin, 2003; Avery et al., 2004; Nicholson et al., 2005) compared to food waste (Jones and Martin, 2003), grass and agricultural residues (Seadi and Lukehurst, 2012). Hutchison et al. (2004) reported high numbers of zoonotic pathogens (E. coli O157, Salmonella, Listeria monocytogenes, Campylobacter, Cryptosporidium parvum, Giardia intestinalis) in both fresh and stored animal waste (cattle, pig, poultry and sheep). The application of rawmanure and slurry is standard practice on farms to utilise animal waste while also replenishing nutrients to the soil (Szogi et al., 2015). AD is a process which can also use FYM&S as a feedstock and, by the action of microorganisms, break down biodegradable organic compounds into simpler molecules in the absence of oxygen to produce methane (Abbasi et al., 2012; Manyi-Loh et al., 2013, 2016).

Foodborne illness (gastroenteritis) is a particular global health concern (WHO, 2008; Thomas et al., 2013; Torgerson et al., 2015). Nag et al. (2019)mentioned that the application of raw FYM&S and anaerobic digestate could possibly play a role in pathogen transportation from agricultural land to humans through the food chain (mainly ready to eat RTE crops). According to TIME Health (2017), 351,000 people die of food-poisoning globally every year. Foodborne disease means, according to WHO (2008), any disease of an infectious or toxic nature caused by consumption of food and a foodborne disease outbreak can be defined in the following ways,

a) The observed number of cases of disease exceeds the expected number

b) The occurrence of two or more cases of a similar foodborne disease resulting from the ingestion of a common food.

The Health Protection Surveillance Centre (HSE, 2019) cited by Nag et al. (2019) suggests that Clostridium, Cryptosporidium, E. coli, Salmonella are the main pathogens of human health concern in Ireland. This highlights the importance of considering the severity (fatality/mortality rate) rather than simply the number of confirmed cases in an outbreak.

Tropical diseases; mostly parasites (helminths) and some viral diseases such as yellowfever virus,West Nile virus, dengue virus, tick-borne encephalitis virus, zika virus, ebola virus, lassa virus,marburg virus (Hotez et al., 2007) are not common in Ireland and there is no historical evidence of such outbreaks in Europe.

In some countries such as Denmark, animal manure is treated with mixed municipal sewage (Hartmann et al., 2002). Therefore, pathogens which are present both in animal manure, slurry and human effluent need to be considered in the European context. In contrast, grass, agriculture residues, animal manure and slurry, the organic fraction of municipal solid waste (comprises food and garden waste only) are considered the only feedstock used in AD plants in Ireland (Singh et al., 2010). The pathogenswhich have possible transmission pathways such as air, soil or food, water, and animal contact/zoonotic were considered for this study, while diseases which can be spread only by person-to-person contact (HPSC, 2005) or insect bites were excluded.

Animal diseases found in Ireland and typical symptoms.
(Source: DAFM).

Diseases	Pathogens	Relative frequency of population deaths (%) in 2016
Cattle		
Gastrointestinal infection (Enteritis and Parasitic)	Bovine Diarrhoeal Virus, *Salmonella*, Liver fluke, Rumen fluke, gut worms (stomach and intestinal)	12
Respiratory infections (pneumonia, pleuropneumonia and parasitic bronchitis)	Mycobacterium, Bovine respiratory syncytial virus (RSV), Trueperella pyogenes, Mannheimia haemolytica, Dictyocaulus spp., Mycoplasma bovis, Pasteurella multocida, bovine herpesvirus, Histophilus somni	17
Systemic infection	Escherichia coli	5
Clostridial infection	Clostridium novyi, Cl. Chauvoei, Cl. Sordellii, Cl. perfringens, Cl. septicum, Cl. perfringens, Cl. Botulinum	4
Cardiac infection	Trueperella pyogenes	9.5
Liver disease	Listeria monocytogenes, Liver fluke	3.5
Bovine abortion	Trueperella pyogenes, Salmonella Dublin, Bacillus licheniformis, Listeria moncytogenes, Aspergillus spp.	7.1, 4.8, 4.1, 2.9, 0.6
Bovine mastitis	E. coli, Staphylococcus aureus, Streptococcus uberis	8, 26.8, 12
Sheep		
Parasitic disease	Teladorsagia (Ostertagia) circumcincta, Haemonchus contortus, Trichostrongylus spp., Nematodirus battus	13
Respiratory infections	Mannheimia haemolytica, Less commonly (Pasteurella multocida, Trueperella pyogenes, Bibersteinia trehalosi and Mycoplasma ovipneumonae)	12
Septicaemia	Bibersteinia trehalosi	15
Clostridial and Kidney disease	Clostridium perfringens, Clostridium difficile	7
Enteric disease	rotavirus and coronavirus	7
Ovine abortion	Toxoplasma gondii, Chlamydophila abortus, E. coli, Salmonella Dublin, Trueperella pyogenes, Listeria spp., Streptococcus spp.	40.2, 26.1, 16.5, 0.8, 4.4, 4.0, 2.0
Pig		
Pneumonia	Pasteurella multocida, Mycoplasma hyopneumoniae, Actinobacillus pleuropeumoniae, Trueperella pyogenes, Swine influenza virus	29
Colibacillosis and Enteric infection	E. coli, Salmonella, Clostridium perfringens, Clostridium difficile	22
Septicaemia	Klebsiella pneumoniae, Streptococcus suis, Listeria monocytogenes, E. coli	12
Nervous disease	Streptococcus suis	5
Poultry		
Septicaemia	Escherichia coli, Erysipelothrix rhusiopathiae	26
Digestive	Erysipelothrix rhusiopathiae, Brachyspira spp., adenovirus	6.5
Musculoskeletal	NA	8
Respiratory	Adenovirus	9
Parasitic disease	Dermanyssus gallinae	15

Pathogens considered for Scenario A $_{FOODIRE}$.

Number	Pathogens	Number of confirmed human cases in Ireland[b]										Total number of confirmed cases/100,000 population (notification rates)[b,d]										Avg. value	Score $S3^{a}_{IRE}$
		2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007		
1	*Campylobacter* spp.	2511	2453	2593	2288	2391	2433	1660	1810	1752	1885	53.1	53	56.3	49.8	52.17	54.3	37.15	40.67	39.8	43.7	47.999	0.9
2	*Salmonella* spp.	299	270	259	326	309	311	349	335	447	440	6.3	5.8	5.6	7.1	6.7	6.9	7.8	7.5	10.2	10.2	7.41	0.8
3	*Yersinia* spp.	3	13	5	4	2	6	3	3	3	6	0.06	0.28	0.11	0.09	0.04	0.13	0.07	0.07	0.1	0.1	0.105	0.7
4	*E. coli*	737	598	572	564	412	275	197	237	213	115	15.6	12.92	12.42	12.29	8.99	6.14	4.41	5.33	4.8	2.7	8.56	0.8
5	*Listeria monocytogenes*	13	19	15	8	11	7	10	10	13	21	0.28	0.41	0.33	0.17	0.24	0.16	0.22	0.22	0.3	0.5	0.283	0.7
6	*Coxiella burnetii*	6	4	0	0	5		9	17			0.13	0.09	0	0	0.11		0.2	0.4			0.132	0.7
7	*Echinococcus* spp.	2	0	0	1	1	0	1	1	2	0	0.04	0	0	0.02	0.02	0	0.02	0.02	0	0	0.012	0.6
8	*Brucella* spp.	2	0	3	1	2	1	1	0	2	7	0.04	0	0.07	0.02	0.04	0.02	0.02	0	<0.1	0.2	0.045	0.6
9	*Trichinella* spp.	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	<0.1	0.09	0.6
10	*Mycobacterium* spp.	3	5	3	6	4	6	7	11	5	5	0.06	0.11	0.07	0.13	0.08	0.13	0.16	0.25	0.11	<0.1	0.122	0.7
11	*Toxoplasma gondii*	0	1	0	1	1		1	37			0	1.5	0	1.5	1.4		1.36	0.83			0.941	0.7
12	*Vibrio* spp.																					0.001	0.5
13	*Clostridium* spp.																					0.001	0.5
14	Norovirus							50	28									1.1	0.616			0.858	0.7
15	*Hepatitis A*																					0.001	0.5
16	*Cryptosporidium*[c]		439	394	514	556	428	294	445	416	609		10.38	9.31	12.15	13.14	10.12	6.95	10.52	9.83	14.4	10.755	0.9

[a] Scale for selecting score $S3_{IRE}$ based on the total number of confirmed cases/100,000 population (notification rates).
[b] Blank cells represent unavailability of data in the report.
[c] Only Cryptosporidium data has been collected from The Health Protection Surveillance Centre (HPSC) (2018).

[d]

* Number of confirmed cases/100,000 population range		Score $S3_{IRE}$
100	10	0.9
9.9	1	0.8
0.99	0.1	0.7
0.099	0.01	0.6
0.0099	0.001	0.5
0.00099	0.0001	0.4

Pathogens considered for Scenario B $_{FOODEU}$.

Number	Pathogens	Number of confirmed human cases in the EU[b,c]										Total number of confirmed cases/100,000 population (notification rates)[b,c,d]										Avg. value	Score $S3^{a}_{EU}$
		2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007		
1	*Campylobacter* spp.	246,307	232,134	236,818	214,710	214,300	220,209	215,397	198,725	190,579	200,980	66.3	62.9	66.5	61.4	61.7	50.28	48.56	45.57	40.7	45.2	54.911	0.9
2	*Salmonella* spp.	94,530	94,597	92,012	87,753	94,278	95,548	101,037	110,181	134,580	153,852	20.4	20.9	20.7	20.3	21.9	20.7	21.5	24	26.4	31.1	22.79	0.9
3	*Yersinia* spp.	6861	6928	6435	6352	6215	7017	6780	7578	8356	8803	1.82	1.91	1.83	1.92	1.93	1.63	1.58	1.65	1.8	2.8	1.887	0.8
4	*E. coli*	6378	5929	5900	6042	5680	9485	3656	3583	3159	3271	1.82	1.68	1.75	1.8	1.7	1.93	0.83	0.75	0.7	0.6	1.356	0.8
5	*Listeria monocytogenes*	2536	2206	2242	1883	1720	1476	1601	1654	1425	1581	0.47	0.43	0.46	0.39	0.36	0.32	0.35	0.36	0.3	0.3	0.374	0.7
6	*Coxiella burnetii*	1057	822	780	647	518		1414	1988	1660	605	0.16	0.18	0.18	0.15	0.12		0.36	0.51	0.5		0.27	0.7
7	*Echinococcus* spp.	772	883	820	805	865	781	756	775	909	972	0.2	0.2	0.19	0.18	0.2	0.18	0.16	0.18	0.2	0.2	0.189	0.7
8	*Brucella* spp.	516	437	462	498	503	330	356	404	735	639	0.12	0.09	0.09	0.1	0.1	0.07	0.07	0.08	0.1	0.1	0.092	0.6
9	*Trichinella* spp.	101	156	324	217	301	268	223	750	670	787	0.02	0.03	0.06	0.04	0.06	0.05	0.05	0.16	0.1	0.2	0.077	0.6
10	*Mycobacterium* spp.	170	181	167	144	132	132	165	134	123	113	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02	<0.1	0.031	0.6
11	*Toxoplasma gondii*	47	288	258	213	144		21	289	11	16	1.57	8.27	7.4	6.2	4.2		0.56	0.65			4.121	0.8
12	*Vibrio* spp.	76	29						17			<0.01	<0.01									0.009	0.5
13	*Clostridium* spp.	49	60	1727	2009	1729	1050	795	1704	857		0.01	0.01	0.04	0.06	0.03	0.03	0.02	0.03	0.03		0.028	0.6
14	Norovirus	11,993	13,536	3580	2023	13,987	2529	6533	2670	3617		0.08	0.06		0.23							0.123	0.7
15	*Hepatitis A*	155	78	48	1444	116	7	13	2	104		<0.01	<0.01	<0.01								0.009	0.5
16	*Cryptosporidium*	62	120	24	65	11	20,000	12,700		87		<0.01	<0.01	<0.01								0.009	0.5

[a] Scale for selecting score $S3_{EU}$ based on the total number of confirmed cases/100,000 population (notification rates).
[b] Iceland, Norway, Switzerland are excluded; no special agreement for data.
[c] Blank cells represent unavailability of data in the report.

[d]

* Number of confirmed cases/100,000 population range		Score $S3_{EU}$
100	10	0.9
9.9	1	0.8
0.99	0.1	0.7
0.099	0.01	0.6
0.0099	0.001	0.5
0.00099	0.0001	0.4

It can be concluded that pathogens such as Mycobacterium spp., Salmonella enterica spp., Listeria monocytogenes, Enterobacter spp., Clostridium spp. And E. coli are common both in human and animals. The common top ranked pathogens which appeared in the BM(Fig. 5), Scenario A FOODIRE (Fig. 7a), Scenario B FOODEU (Fig. 7b), and Scenario C RAWFYM&S (Fig. 7c) models are Cryptosporidiumparvum, Salmonella enterica spp., norovirus, Streptococcus pyogenes, Entamoeba histolytica, enteropathogenic E. coli (EPEC), Mycobacterium spp., Salmonella typhi followed by S. paratyphi, Clostridium spp., Listeria monocytogenes and Campylobacter coli. A comparison between results of A FOODIRE (Fig. 7a) and Scenario B FOODEU (Fig. 7b) highlights the difference between foodborne pathogens in Ireland and those found in the EU, with Cryptosporidium being noted as a greater issue in Ireland. According to the Health Protection Surveillance Centre (HPSC) (2018), there have been 400 to 600 cases (yearly) of cryptosporidiosis in Ireland since 2004. In the last scenario (Scenario C RAWFYM&S), no heat treatment was applied in terms of AD or pasteurisation; the additional pathogens of concern were Campylobacter jejuni, Vibrio spp., hepatitis A-virus, E. coli O157:H7, E. coli invasive & toxigenic, Streptococcus pneumoniae and rotavirus. A comparison of Fig. 5 and 7c highlights the effect of M-AD in reducing the final risk score for Salmonella typhi (and S. paratyphi) and norovirus. Other pathogens remained unchanged in terms of the ranking score; such as Cryptosporidium parvum, Streptococcus pyogenes, Entamoeba histolytica and Salmonella enterica spp. highlighting their heat resistance.

Likely levels and sources of parasites can be found in urban wastewater and hospital waste.

Pathogen name	Likely levels	Unit	Source	Reference
Ascaris	0.7 to 13.33	eggs l^{-1}	Wastewater	(Amahmid et al., 1999)
	10.08 to 24.36		Urban raw wastewater	(Maya et al., 2006;
	1344 to 4116		Animal wastewater	Hatam-Nahavandi et al., 2015)
Ancylostoma duodenale	100–150	eggs g^{-1}	Affected human stool	(Anderson and Schad, 1985)
	Mean intensity of infection was 250.1 ± 64.4		Affected human stool	(Reynoldson et al., 1997)
Toxocara spp.	0–4.35	eggs g^{-1}	Sand sample contaminated with faeces	(Uga, 1993)
	mean 4.24 ± 4.62 and median 2.17 ± 5.92		Hair sample of contaminated dogs	(Devoy Keegan and Holland, 2010)
Trichinella spp.	2 to 295	larvae g^{-1}	Contaminated meat	(Teunis et al., 2012)
Entamoeba histolytica	2.5 × 10^2 to 5.0 × 10^2	cysts l^{-1}	Wastewater treatment plant influent	(Sabbahi et al., 2018)
	39–308	cysts g^{-1}	Faecal sample collected from infected patients in hospitals	(Voupawoe, 2016)
Echinococcus multilocularis	20–140	eggs g^{-1}	Faecal sample of infected dog; mostly red fox and racoon dogs; very rare disease in Europe	(Allan et al., 1992; Conraths and Deplazes, 2015)
Echinococcus granulosus				

This lists the pathogens (parasites) such as Ascaris, Ancylostoma duodenale, Toxocara spp., Trichinella spp., Entamoeba histolytica, Echinococcus multilocularis, and Echinococcus granulosus and the likely levels in urban wastewater and hospital waste; the presence of these pathogens in FYM&S is rare. It is not recommended to mix urban wastewater with FYM&S in an AD plant, hence limiting the likely presence of these parasites.

These results indicate that land spreading of digestate requires compliance with the Precautionary Principle in relation to human health & that this Application be refused.

Understanding the extent of emerging contaminants in english soils: Environmental implications of differing organic waste applications John Nightingale, Felicity C.T. Elder, Andrea-Lorena Garduno-Jimenez, Laura J. Carter. Journal of Hazardous Materials 500 (2025) 140433. https://doi.org/10.1016/j.jhazmat.2025.140433

The application of differing organic fertilisers to agricultural land is a long-standing practice that supports sustainable nutrient recycling. Despite the widespread use of organic amendments, the occurrence, distribution and fate of Emerging Contaminants (ECs), within agricultural soils remains poorly understood. To address this knowledge-gap, this study presents a comprehensive assessment of ECs across 22 English farms with diverse amendment histories and soil types. We evaluated and developed both a harmonised in-field sampling strategy alongside targeted and non-targeted mass spectrometry approaches, to reveal the presence of a wide range of ECs in soils. The antiparasitic ivermectin had the highest reported concentrations (21.8 ± 7.3–105.9 ± 86.7 ng/g (dw)), followed by the antibiotics oxytetracycline, ofloxacin, enrofloxacin, and plant protection products atrazine, and diazinon. Non-target screening identified 524 chemical entities, 194 were singular occurrences. Prevalent contaminant classes included pharmaceuticals, plasticisers, polymers, fungicides and surfactants; > 40 % of these had not been previously detected in English soils. Dominant pharmaceuticals included antibiotics (n = 9), steroids (n = 4), anticancer (n = 3), and antipsychotic metabolites (n = 3). Here we present a feasible, and accurate approach to soil sampling – analyses which reflects accurate concentrations in field, in addition to the wide-spread occurrence of ECs in English agricultural soils receiving an array of organic fertilisers.

Soil quality underpins agricultural productivity, ecosystem resilience, and ultimately human wellbeing. Historically, agricultural soils have been monitored for legacy contaminants such as heavy metals, nutrients, and persistent organic pollutants (POPs). These substances have relatively well-established analytical methods, known persistence in the environment and well characterised toxicology profiles. As such traditional pollutants, including lead, cadmium, arsenic, mercury, as well as poly aromatic hydrocarbons (PAHs), and polychlorinated biphenyl (PCBs), have been the focus of regulatory frameworks and environmental risk assessments. However, the intensification of agricultural practices and evolving environmental pressures (e.g., the need to reduce synthetic fertiliser production and use), has led to an increase in the use of organic waste amendments (e.g., farm yard manures, biosolids, digestates), that have the potential to introduce a new suite of chemical stressors, emerging contaminants (ECs), into the soil environment. These amendments, while beneficial for soil fertility and structure, can introduce a wide range of chemical residues, including pharmaceuticals, personal care products, pesticides, and industrial chemicals. ECs are not routinely monitored meaning there is a marked deficiency in data on the presence and distribution of ECs in agricultural soils, despite the significant environmental and human health risk they may pose.

Where monitoring data does exist, this has largely focused on the presence of ECs in the United States and Australia. Occurrence and concentrations of ECs in UK soils remain poorly characterised despite the fact that a diverse spectrum of organic waste amendments are routinely applied across the UK's agricultural landscape, ranging from livestock manures, treated sewage sludge (biosolids), wastewater treatment residuals and green waste composts. This

knowledge gap is concerning given that farming systems, amendment types, amendment treatments/practices and environmental conditions differ between regions, which can influence contaminant fate and bioavailability. The UK's Circular Economy Package set the aim to achieve a 65 % reduction in municipal waste by 2035. As part of this initiative, wastewater treatment companies are incentivised to reuse biosolids, aligning with the principles of a circular economy. This lack of knowledge is critical, as persistent contaminants can accumulate over time, potentially affecting soil microbial communities, crop health, and food safety, while also posing risks to groundwater and wider ecosystems. Whilst our understanding of chemical presence and fate is evolving; our evaluations of risk are consistently behind that of chemical production and use. Furthermore, there is a clear need to understand how ECs, in particular, can persist in natural systems following repeated applications of organic waste amendment. The importance of addressing this knowledge gap is underscored by technological advances in analytical chemistry, particularly mass spectrometry (MS), techniques. Modern MS methods, including high- resolution and tandem mass spectrometry, enable the detection and quantification of a much broader array of chemical compounds at trace levels than was previously possible. These advances facilitate comprehensive chemical profiling of soils and amendments, providing new insights into the chemical landscape shaped by contemporary agricultural practices. Currently, regulation surrounding ECs in agricultural soils is non-existent in the UK. The introduction of regulatory frameworks to safeguard soil quality and food safety will require robust, validated analytical methods and monitoring strategies. Without baseline data and standardised approaches, risk evaluations will be obsolete thus hindering policymaking. Leading to the potential risks associated with ECs to go unrecognised or unmanaged. Moreover, monitoring studies consistently overlook key analytical components such as sampling strategy and effects of sample transport which ultimately result in a poor understanding of absolute concentrations in the field. A comprehensive evaluation of the persistence of ECs with known ecological and human health concerns under real crop production conditions is urgently needed. This study aimed to;

1) critically assess and devise a harmonised approach of soil monitoring through to analysis (targeted and untargeted), in soils; and

2) determine the presence of ECs in English agricultural soils with diverse organic amendment histories.

To achieve this a multi-residue extraction method was developed targeting 18 analytes that consisted of a wide range of physicochemical properties and optimised for their extraction from soils with varying properties. Liquid chromatography-tandem mass spectrometry (LC-MS/ MS), and liquid chromatography-tandem high-resolution mass spectrometry (HRMS), techniques were employed to capture a broad spectrum of contaminants, enabling a comprehensive assessment of EC presence in soils. To the best of our knowledge, this is the first study to report a wide analysis of ECs in English agricultural soils. Ascertaining representative soils across farming landscapes remains a challenge for environmental scientists; controversial goals between production/farming and environmental research (i.e., farming, academia, and regulatory bodies), continuously stunts our abilities to assess chemical risks towards soils in the environment. To address this, the study adopted a citizen science approach, engaging directly with farmers to raise awareness of the issue associated with chemical contamination in soils. This approach underscores the importance of such studies for improving soil health and advancing our current evaluation of chemical risks. Our approach fosters stakeholder engagement, raising awareness of soil contamination issues and promoting a shared responsibility for environmental stewardship.

Twenty-three farms with contrasting farming practices and application histories were sampled across England; SI Table 1 contains the application histories for the selected farms. In brief, the farm application histories were comprised of, FYM/slurry (n = 9), biosolids (n = 8), food digestate (n = 3), Wastewater Treatment Residuals (n = 2), and unknown (n = 2). Fourteen farms were sampled using a W- transect sampling method following site visits (as described below), and samples from eight farms were shipped to the University of Leeds (1 sample per field). Soil samples were sampled to 0–10 cm depth using a trowel and stored in zip-lock bags and cool boxes containing ice packs (≤ 8 h), before storage at 20 ◦ C.

Table 1
Physicochemical properties and fate parameters of selected target analytes for monitoring and quantification.

Chemical	Pharmaceutical Class	pKa_a	pKa_b	log K_{OW}	K_{OC} (L/kg)	Soil DT_{50} (days)	Biodegradation rate (1/h)
Atrazine	Herbicide	1.6(A)		2.61(A)	37–121(C)	101(D)	NA
Carbamazepine	Pharmaceutical – anticonvulsant	13.9(A)		2.77(A)	158.48(E)	533.2(F)	0.26(F)
Clotrimazole	Antifungal	4.1(A)		6.1(A)	57544(G)	68(H)	0.0213(I)
Cyclophosphamide	Pharmaceutical – Immunosuppressant	0.02(B)		0.63(A)	38(J)		0.0372(K)
Diazinon	Insecticide – Organophosphate	2.6(A)		3.81(A)	1493–1589(L)	26.6–78.1(M)	0–0.056(N)
Diclofenac	Pharmaceutical – NSAID	3.99(A)		4.51(A)	479–956(O)	< 5(P)	11.79(F)
Enrofloxacin	Pharmaceutical – Antibiotic	6.09(A)	8.74(A)	−0.2(A)	987.12(Q)	280(R)	0.012(S)
Ivermectin	Veterinary medicine – Anthelmintic				25800(T)	16–67(U)	
Lamotrigine	Pharmaceutical – Anticonvulsant	5.7(A)		2.5(A)	93.13–702.88(V)	129–264(W)	0.048(F)
Lincomycin	Pharmaceutical – Antibiotic	7.6(A)		0.2(A)	288.3(X)	31.35(Y)	NA
Metformin	Pharmaceutical – Diuretic	12.4(A)		−1.3(A)	12–19(Z)	5(Z)	7.23(F)
Ofloxacin	Pharmaceutical – Antibiotic	5.97(A)	9.28(A)	0.39(A)	1657.8(AA)	1.1–2.01 years(AB)	0(AC)
Oxytetracycline	Pharmaceutical – Antibiotic	3.27(A)	9.5(A)	−0.9(A)	4102.59(AD)	18–28(R)	0.00463(AE)
Robenidine HCl	Veterinary medicine – Coccodiciostat	3.3(AF)		3.8(AF)	> 426,580 (AG)		
Sulfamethoxazole	Pharmaceutical – Antibiotic	1.6(A)	5.7(A)	0.89(A)	94.9(AH)	10.81–33.24(AI)	0.0289(AJ)
Triclosan	Personal care product	7.9(A)		4.76(A)	12981.75(AK)	~ 9 months(AL)	0.0578(H)
Trimethoprim	Pharmaceutical – Antibiotic	7.12(A)		0.91(A)	623.8(AM)	64.6(D)	0.02(F)
Tylosin	Pharmaceutical – Antibiotic	7.73(A)		1.63(A)	623.80(AN)	4.5(AO)	0.00214(AP)

Footnote citation key: A =PubChem; B =DrugBank (NA); C =Martins et al.; D =Blume et al.;E=Shao et al.; F =Lautz et al.; G =Chen et al.; H =Sabourin et al.; I =Kahle et al.; J =Mansouri et al.; (Opera prediction); K =˘ Cesen et al.; L =Nemeth-Konda et al.; M =Aggarwal et al.;N=Campo et al.; O =Yu and Bi;P=Al-Rajab et al.; Q =Wu et al.]; R =Li et al.; S =Frade et al.;T=Krogh et al.; U =Krogh et al.; V =Li et al.; W =Menacherry et al.;X=Wang et al.; Y =;Z=Mrozik and Stefa´ nska,]; AA =Straub et al.; AB =Yang et al.; AC =Kümmerer et al.; AD =Jones et al.; AE =Li et al.; AF =Hansen et al.; AG =EFSA; AH =Stoob et al.; AI =Srinivasan and Sarmah; AJ =Gao et al.; AK =Karnjanapiboonwong et al.; AL =Wu et al.; AM =Zhang et al.; AN =Rabølle and Spliid,; AO =Carlson and Mabury, ; AP =Prado et al..

Over 520 chemicals were identified to a high confidence level (Level 1–2), representing 194 unique entities. The contaminant classes most frequently detected were human pharmaceuticals (n = 52, Rank 1) > plasticisers (n = 51, Rank 2) > surfactants (n = 44, Rank 3) > fungicides (n = 40, Rank 4) > polymers (n = 35, Rank 5) > veterinary medicines (n = 23, Rank 6) > herbicides (n = 20, Rank 7) > human or veterinary use pharmaceuticals (n = 16, Rank 8) > disinfectant (n = 14, Rank 9) >pharmaceutical derivative/research chemical (n = 11, Rank 10).
These dominant classes differ from those reported in previous studies, highlighting the importance of context-specific chemical classification when assessing risks to soil, plant and human health. Notably, 46.4 % of the identified pharmaceutical compounds—both veterinary and human—had no prior documentation in the scientific literature, regardless of environmental matrix. This underscores the limitations of current monitoring frameworks and the need for expanded EC surveillance. Quantified concentrations of pharmaceuticals in soils were found to range between 0.06 ± 0.07 (sulphamethoxazole) ng/g (dw)- 105.9 ±86.7 (ivermectin) ng/g (dw), and positive correlations were identified between concentration and K OC. This demonstrates that fate processes play a fundamental role in the presence and concentration of ECs in agricultural soils, and thus their risk towards terrestrial biota (i.e., microbial populations, earthworms). The potential risks associated with this exposure require further investigation. Although elevated concentrations of ivermectin, oxytetracycline, and ofloxacin raise immediate concerns for soil health, the primary contaminant classes posing leaching risks were plasticisers (35 %), herbicides (26.1 %), plasticisers (21.7 %), fungicides (8.7 %), plant growth regulators (4.4 %), and flame retardants (4.4 %). Overall, our understanding of the risks posed by ECs identified in this monitoring campaign are limited. This underscores the urgent need for a more harmonised approach to contaminant identification in agricultural soils and more comprehensive evaluations of the risks they pose to ecological receptors and connected environmental compartments. The engagement of farmers within this study through citizen science approach not only improved sampling reach but also fostered awareness and stewardship among key stakeholders. This will be critical in maintaining soil health as the UK moves towards a circular economy with increased organic waste reuse within agriculture. This study underscores the urgent need for a more harmonised approach to contaminant identification in agricultural soils and more comprehensive evaluations of the risks they pose to ecological receptors and connected environmental compartments.

Environmental implications

The presented study demonstrates that the reuse of contaminated organic fertilisers contributes to the widespread occurrence, and accumulation of emerging contaminants in agricultural soils. Over 520 contaminants were identified, some reported for the first time in England, with concentrations ranging from 0.06 ± 0.07–105.9 ± 86.7 ng/ g (dw). Notably, 46.4 % of pharmaceuticals had not been detected in previous monitoring campaigns, underscoring the

unknown risks these chemicals pose in arable soils. There is a clear need to accurately assess the risks associated with different organic fertiliser applications to protect both environmental and consumer health.
These results indicate that land spreading of digestate requires compliance with the Precautionary Principle in relation to human health & that this Application be refused.

Issue 5: Effects of RED III on the biomethane market: What impact will the sustainability requirements from Article 29 of RED III have on the biomethane market?
The analysis answers the question of what impact the increased sustainability requirements from Article 29 of RED III will have on the biomethane market. As a result, a large proportion of the biomethane currently used in biomethane CHP plants would very likely not fulfil the greenhouse gas reduction requirements set out in Article 29 of RED III. This could affect around two-thirds of the biomethane used under the German Renewable Energy Sources Act, meaning that around 2.3 TWh of renewable heat and 1.9 TWh of renewable electricity could then no longer be generated.

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EIAR Non-Technical Summary: Killough Bio-Renewables Plant. Proposed Bio-Renewables Plant (incorporating Anaerobic Digestion) at Killough Quarry, Holycross, Co. Tipperary Roadstone Ltd. SLR Project No.: 501.00180.065577 December 2024
4.11 Traffic

A traffic assessment was undertaken to examine the traffic implications associated with the proposed development in terms of its integration with existing traffic in the area. The extent of additional trips generated by the development was estimated and the resulting impact on operational performance of such trips on the local road network was assessed based on traffic counts undertaken on the local road network and modelling of the additional trips using standard industry programmes.

Response: No traffic count provided with application.

The Traffic and Transport Assessment makes the following conclusions:

- Link capacity analysis was carried out on L1309, and it was determined that all roads will continue to operate within capacity for each of the assessment years: 2025, 2026, 2027, 2032, and 2042;
- The results of the junction capacity analysis indicates that all junctions will operate within capacity for each of the assessment years: 2025, 2026, 2027, 2032, and 2042;
- The assessment therefore indicates that the development will have a negligible impact on traffic flows on the existing road network due to the low volumes of traffic being generated by the development;
- Visibility to the north and south of the quarry access is limited by the vertical alignment, the horizontal alignment of the local road, and vegetation. However, the geometric constraints, coupled with low traffic volumes on the local road, have passively controlled vehicle speeds at the access. There are no accident records indicating that there are existing incident patterns at the site entrance and the site operator has confirmed that no issues or concerns have been reported by staff. Traffic on the L1309 will largely be associated with the application site, or vehicles generated by local development. Therefore they will be aware of the site operation and existing access junction. All vehicles will access/egress the application site using a forward gear. Operational vehicles also benefit from a raised driver viewpoint and are positioned closer to the junction as HGVs tend not to have a bonnet. Adjacent hedgerows and vegetation are all under the control of the site operator and will continue to be maintained to ensure that visibility is maximised at the site access junction. Therefore, junction visibility at the site access junction is considered appropriate and fit for purpose; and

Response MLavelle: Visibility imitations of vertical alignment, horizontal alignment & vegetation are not matters that can be overcome. The community automated traffic counts indicate speeds up to 139.8km/hr on the L1309.

- The parking spaces within the site is considered sufficient for the number of staff working on site, and also for any miscellaneous trips that may occur.

Response MLavelle: Compliance with the current County Development Plan requirements is required.

RFI Request

5. (a) The applicant is advised that having reviewed the details submitted, the Planning Authority is not satisfied that the sightlines proposed from the site entrance to the public roadway are in accordance with the standards as set out in the Tipperary County Development Plan 2022-2028. ***The applicant is therefore, requested to submit the following: A revised site layout plan clearly indicating the required sightlines at each of the site entrances onto the public roadways serving the development proposed in accordance with the provisions of Section 6.1 and Tables 6.1 and 6.2 of Volume 3, Appendix 6 of the Tipperary County Development Plan 2022-2028.*** *The response should include a Site Layout Plan, accurately illustrating:*

i. The existing public road carriageway,

ii. ***The existing public carriageway-verge,***

Response MLavelle: This item was not provided.

The existing roadside boundary,

iii. ***Unobstructed sightlines of 120 metres to the nearside road edge in both directions from a setback of 4.5*** *metres at the centre of the entrance,*

Response MLavelle: The Community would query the 120m requirement in the context of an operational 85% speed of 77.4km/hr. Such a speed indicates a sight distance triangle Y-distance of c160m. The setback of 4.5m is not shown on the Sight Distance Map supplied.

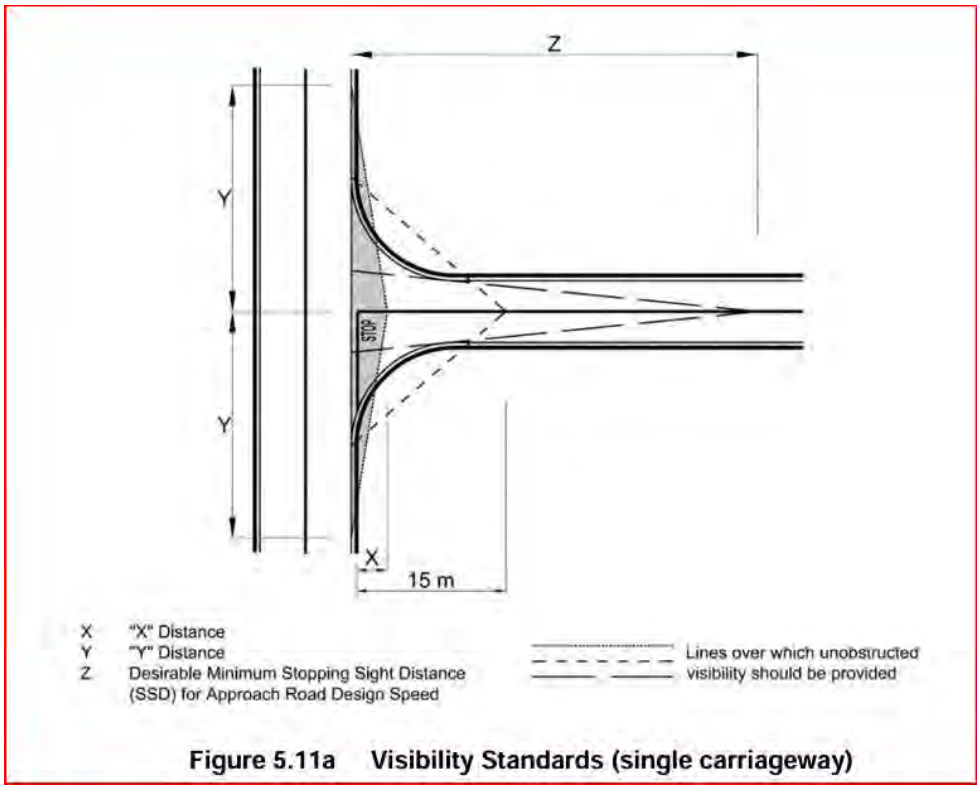


Figure 5.11a Visibility Standards (single carriageway)

iv. The full extent of the modifications required to the existing roadside boundary and proposals for a replacement boundary treatment, where applicable,

Response MLavelle: No response provided.

v. Consent of any third parties affected,

Response MLavelle: No response provided. Yet the Sight Distance Triangle to the North traverses private property.

vi. Surface water management arrangement at the entrance that will prevent surface water from discharging from the site onto the public road.

Response MLavelle: No response provided.

The requirement for 120 metre sight lines is based on a mandatory speed limit of 60km/hr that applies to this road. The use of a lower operational speed (as set out in Table 6.2 of the Tipperary County Development Plan) and lesser sight lines may be accepted by the Council provided that it can be demonstrated to the satisfaction of the Council that the operational speed of the road is less than the mandatory speed.

Response MLavelle: No response provided except statement for 23rd May 2025. The operational 85% speed is higher than the mandatory speed limit. Road Safety requires compliance with the operational 85% speed.

In this regard please find Sight Line Check Form contained within Part B of the Planning Application Form that sets out a method to measure the operational speed of the road. This form must be fully completed, and speed measurement undertaken in order for proposals for reduced sightlines to be considered. Sight lines shall be demonstrated on a revised plan to a scale of 1:500 in accordance with the measured operational speed of the road. The site layout plan shall contain the information required under item (i) to (vii) above. Where hedgerow removal and set back is proposed, the red line site boundary shall be revised to ensure all works that are required to achieve the sight lines are contained within the application site boundary.

Response MLavelle: No response to speed measurement undertaken except for statement in completion of Planning Application Form

Appendix C: Completed Sight Line Assessment Form

Sightlines

Y-Distance Sightline Check for Direct Accesses to Non-National Rural Public Roads

Table 6.2: Design Speeds and associated Y-Distances

Mandatory Speed Limit	Design Speed (operational Speed)	Rural Non-National Road	Urban Non-National Road
km/h	**km/h**	**Y-Distance (m)**	**Y-Distance (m)**
30	40	N\A	33
40	50	70	45
50	60	90	59
60	70	120	72
80	85	160	N\A
100	100	215	N\A

Road Number: L1309

Check box for road type:

National Road ☐ Regional Road ☐ Local Road ☑

Mandatory Speed limit for road: 60kph. As of 7/2/2025, the default speed limit on rural road s has reduced from 80 to 60kph, as set out in the Road Traffic Act 2024.

Y- Distance required in Table 4 based on ***Mandatory Speed*** limit: 120 (m)

Y- Distance available at proposed entrance (as measured): Left 120(m) Right 120(m)

The visibility standards can be achieved by the implementation of proposed measures incl uding vegetation trimmed/removed/maintained and embankment reprofile at the high dem and bend south of the site and relocation of stop line with hatching at the site access.

	Approach From Left Direction (secs)	Approach From Right Direction 2 (secs)
Run 1	N/A	N/A
Run 2	N/A	N/A
Run 3	N/A	N/A
Average Time for runs	N/A	N/A
Speed (m/s)	N/A	N/A
Operational Speed (km/h) (to convert m/s to km/h multiply by 3.6)	64.3 (85th Percentile) 53.1 (Mean)	52.7(85th Percentile) 45.6 (Mean)

Date of Survey: 23/05/2025-29/05/2025

Time of Survey: 00:00-23:59

Y- Distance corresponding to Operational Speed (taken from Table 4 above): Left-120(m) Right-120(m)

Note: The minimum Y-Distance on a Rural Non-National Road shall be 70m, corres ponding to an *Operational Speed* of 50km/h.

Justification for use of a lower speed:
A site visit was undertaken on the 2nd of October 2024.During the site visit the posted speed limit of the L1309 was 80kph. However, as of the 7th February 2025, the default speed limit on rural roads in Ireland has reduced from 80kph to 60kph, as set out in the Road Traffic Act 2024.This speed limit reduction will, in effect, lower the sightline requirements near the access. The 85th percentile speed for northbound traffic on the L1309 in the vicinity of the access is 64.3kph and southbound traffic is 52.7kph. Therefore, the sight line assessment considered a design speed of 60 kph.
Survey completed by : Traffinomics Limited

Guidance Note:
The Y-Distance will, by default, be that corresponding to the Mandatory Seed limit for that road, ie National Roads generally have a speed limit of 100km/h, Regional and Local Roads generally have a speed limit of 80km/h. Only in exceptional circumstances may a lower speed be proposed to determine the Y-Distance. The use of a lower speed must be justified by the Applicant in the Planning Application. The sightlines should always be indicated on the drawings accompanying the Application. This should include the sightline corresponding to the Mandatory Speed limit as well as any proposed sightline, if different. These should be indicated in different colours for clarity, with the distances indicated on the drawing.
When carrying out a speed survey, the driver should drive normally within the traffic flow or at a comfortable speed for the road geometry. Driving at an inappropriately slow speed for the purpose of reducing the Y-Distance will not be accepted.
Tipperary County Council shall determine whether the appropriate speed and sight distance has been used for each planning application.

MetroCount Traffic Executive
Speed Statistics

SpeedStat-244 -- English (ENI)

Datasets:

Site:	**[Killough, Community Assoc.] Gaile, Thurles, Co. Tipperary.**
Attribute:	[+0.000000 +0.000000]
Direction:	7 - North bound A>B, South bound B>A. **Lane:** 0
Survey Duration:	09:47 Tuesday 28 October 2025 => 11:15 Sunday 9 November 2025,
Zone:	
File:	Killough, Community Assoc. 0 2025-11-09 1116.EC0 (Plus.)
Identifier:	WX3273VB MC5900-X13 (c)MetroCount 09Nov16
Algorithm:	Factory default axle (v5.08)
Data type:	Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time:	**00:00 Wednesday 29 October 2025 => 00:00 Thursday 30 October 2025 (1)**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15
Speed range:	10 - 160 km/h.
Direction:	North, East, South, West (bound), P = North, Lane = 0-16
Separation:	Headway > 0 sec, Span 0 - 100 metre
Name:	Default Profile
Scheme:	Vehicle classification (VRX)
Units:	Metric (metre, kilometre, m/s, km/h, kg, tonne)
In profile:	Vehicles = 479 / 4374 (10.95%)

Speed Statistics

SpeedStat-244

Site:	Killough, Community Assoc..0.1NS
Description:	**Gaile, Thurles, Co. Tipperary.**
Filter time:	**00:00 Wednesday 29 October 2025 => 00:00 Thursday 30 October 2025**
Scheme:	Vehicle classification (VRX)
Filter:	Cls(1-12, 14-15) Dir(NESW) Sp(10,160) Headway(>0) Span(0 - 100) Lane(0-16)

Vehicles = 479
Posted speed limit = 60 km/h, Exceeding = 253 (52.82%), Mean Exceeding = 72.84 km/h
Maximum = 139.8 km/h, **Minimum** = 18.2 km/h, **Mean** = 61.5 km/h
85% Speed = 77.40 km/h, **95% Speed** = 88.02 km/h, **Median** = 60.66 km/h
10 km/h Pace = 51 - 71, **Number in Pace** = 253 (52.82%)
Variance = 256.50, **Standard Deviation** = 16.02 km/h

MetroCount Traffic Executive
Individual Report

Individual-252 -- English (ENI)

Datasets:

Site:	**[Killough, Community Assoc.] Gaile, Thurles, Co. Tipperary.**
Attribute:	[+0.000000 +0.000000]
Direction:	7 - North bound A>B, South bound B>A. **Lane:** 0
Survey Duration:	09:47 Tuesday 28 October 2025 => 11:15 Sunday 9 November 2025,
Zone:	
File:	Killough, Community Assoc. 0 2025-11-09 1116.EC0 (Plus)
Identifier:	WX3273VB MC5900-X13 (c)MetroCount 09Nov16
Algorithm:	Factory default axle (v5.08)
Data type:	Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time:	**00:00 Thursday 30 October 2025 => 00:00 Friday 31 October 2025 (1)**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15
Speed range:	10 - 160 km/h.
Direction:	North, East, South, West (bound), P = North, Lane = 0-16
Separation:	Headway > 0 sec, Span 0 - 100 metre
Name:	Default Profile
Scheme:	Vehicle classification (VRX)
Units:	Metric (metre, kilometre, m/s, km/h, kg, tonne)

Speed Statistics

SpeedStat-245

Site:	Killough, Community Assoc..0.1NS
Description:	**Gaile, Thurles, Co. Tipperary.**
Filter time:	**00:00 Thursday 30 October 2025 => 00:00 Friday 31 October 2025**
Scheme:	Vehicle classification (VRX)
Filter:	Cls(1-12, 14-15) Dir(NESW) Sp(10,160) Headway(>0) Span(0 - 100) Lane(0-16)

Vehicles = 395
Posted speed limit = 60 km/h, Exceeding = 191 (48.35%), Mean Exceeding = 71.41 km/h
Maximum = 112.0 km/h, **Minimum** = 10.2 km/h, **Mean** = 58.9 km/h
85% Speed = 73.80 km/h, **15% Speed** = 83.05 km/h, **Median** = 59.22 km/h
20 km/h Pace = 48 - 68, **Number in Pace** = 211 (53.42%)
Variance = 247.94, **Standard Deviation** = 15.75 km/h

YYYY-MM-DD	hh:mm:ss	Speed	YYYY-MM-DD	hh:mm:ss	Speed
29/10/2025	00:26:59	46.41	30/10/2025	00:28:59	78.6
29/10/2025	02:28:49	70.52	30/10/2025	00:36:43	50.18
29/10/2025	03:22:45	68.97	30/10/2025	01:36:33	43.74
29/10/2025	03:49:49	60.81	30/10/2025	04:02:55	**81.33**
29/10/2025	04:22:11	76.3	30/10/2025	04:36:40	63.86
29/10/2025	04:29:16	55.87	30/10/2025	04:49:11	74.04
29/10/2025	04:40:57	67.95	30/10/2025	05:46:28	78.47
29/10/2025	04:49:39	59.05	30/10/2025	05:57:25	**82.43**
29/10/2025	04:51:58	75.45	30/10/2025	06:01:07	58.15
29/10/2025	05:03:49	50.37	30/10/2025	06:03:37	62.84
29/10/2025	05:32:42	53.53	30/10/2025	06:19:38	68.46
29/10/2025	05:51:31	77.5	30/10/2025	06:21:49	73.84
29/10/2025	06:12:48	59.8	30/10/2025	06:24:52	75.64
29/10/2025	06:20:35	58.16	30/10/2025	06:29:48	62.74
29/10/2025	06:20:40	60.68	30/10/2025	06:42:41	75.06
29/10/2025	06:20:41	27.27	30/10/2025	06:45:44	61.16
29/10/2025	06:33:16	75.27	30/10/2025	06:47:00	48.2
29/10/2025	06:34:36	42.09	30/10/2025	06:47:41	**88.06**

29/10/2025	06:34:37	53.9	30/10/2025	06:48:56	70.98
29/10/2025	06:39:55	71.43	30/10/2025	06:51:13	**81.47**
29/10/2025	06:42:34	23.96	30/10/2025	06:53:19	47.62
29/10/2025	06:48:13	77.7	30/10/2025	07:03:20	54.42
29/10/2025	06:49:20	**83.84**	30/10/2025	07:04:25	51.61
29/10/2025	06:49:51	**92.68**	30/10/2025	07:06:39	**90.53**
29/10/2025	06:56:56	64.56	30/10/2025	07:15:39	61.33
29/10/2025	07:07:27	64.44	30/10/2025	07:17:13	44.01
29/10/2025	07:14:47	43.21	30/10/2025	07:23:55	51.94
29/10/2025	07:19:25	62.74	30/10/2025	07:25:07	69.88
29/10/2025	07:20:02	**84.9**	30/10/2025	07:27:23	**96.23**
29/10/2025	07:26:41	64.27	30/10/2025	07:28:23	55.05
29/10/2025	07:29:42	48.39	30/10/2025	07:31:32	**90.4**
29/10/2025	07:40:26	74.41	30/10/2025	07:31:49	59.52
29/10/2025	07:41:42	42.34	30/10/2025	07:38:13	62.42
29/10/2025	07:50:11	54.31	30/10/2025	07:41:18	58.82
29/10/2025	07:56:48	47.18	30/10/2025	07:45:18	69.77
29/10/2025	07:58:11	56.31	30/10/2025	07:45:49	61.52
29/10/2025	08:00:32	66.56	30/10/2025	07:55:21	48.32
29/10/2025	08:01:08	77.34	30/10/2025	07:57:27	47.95
29/10/2025	08:03:03	**92.02**	30/10/2025	07:59:18	55.54
29/10/2025	08:06:32	70.79	30/10/2025	08:00:15	71.29
29/10/2025	08:06:36	57.85	30/10/2025	08:03:03	56.8
29/10/2025	08:07:13	60.24	30/10/2025	08:06:34	64.99
29/10/2025	08:08:55	54.17	30/10/2025	08:08:48	**87.07**
29/10/2025	08:10:04	67.81	30/10/2025	08:10:18	66.5
29/10/2025	08:12:59	55.31	30/10/2025	08:10:27	**90.7**
29/10/2025	08:13:16	59.28	30/10/2025	08:10:54	54.1
29/10/2025	08:16:56	44.17	30/10/2025	08:13:01	79.88
29/10/2025	08:17:00	69.66	30/10/2025	08:16:32	63.91
29/10/2025	08:18:01	57.03	30/10/2025	08:17:11	67.02
29/10/2025	08:18:26	35.83	30/10/2025	08:19:24	58.64
29/10/2025	08:18:29	41.57	30/10/2025	08:20:59	70.27
29/10/2025	08:21:14	60.32	30/10/2025	08:22:10	49.31
29/10/2025	08:25:09	68.68	30/10/2025	08:24:46	53.65
29/10/2025	08:26:06	42.93	30/10/2025	08:26:10	72.93
29/10/2025	08:26:42	53.04	30/10/2025	08:28:58	66.61
29/10/2025	08:28:06	31.66	30/10/2025	08:29:13	41.76
29/10/2025	08:29:06	28.37	30/10/2025	08:31:34	27.53
29/10/2025	08:29:06	28.37	30/10/2025	08:33:33	44.61
29/10/2025	08:29:16	54.95	30/10/2025	08:34:16	71.4
29/10/2025	08:30:26	76.32	30/10/2025	08:36:10	52.27
29/10/2025	08:30:45	**106.02**	30/10/2025	08:36:55	50.06
29/10/2025	08:32:39	61.87	30/10/2025	08:37:02	10.22
29/10/2025	08:33:40	67.92	30/10/2025	08:37:02	10.22
29/10/2025	08:35:35	64.06	30/10/2025	08:39:19	39.64
29/10/2025	08:37:00	46.48	30/10/2025	08:39:49	39.86
29/10/2025	08:37:19	57.13	30/10/2025	08:41:43	72.61
29/10/2025	08:38:01	52.9	30/10/2025	08:41:57	60.78

29/10/2025	08:39:22	48.25	30/10/2025	08:44:14	56.62
29/10/2025	08:39:44	71.06	30/10/2025	08:44:25	43.34
29/10/2025	08:40:45	62.15	30/10/2025	08:45:10	68.91
29/10/2025	08:41:50	63.2	30/10/2025	08:45:57	41.62
29/10/2025	08:42:20	70.49	30/10/2025	08:45:58	65.71
29/10/2025	08:43:19	73.99	30/10/2025	08:48:14	**90.36**
29/10/2025	08:44:12	74.43	30/10/2025	08:49:06	58.81
29/10/2025	08:45:38	79.13	30/10/2025	08:55:42	44.74
29/10/2025	08:46:20	51.57	30/10/2025	08:55:46	43.11
29/10/2025	08:47:38	78.67	30/10/2025	08:58:55	43.35
29/10/2025	08:47:43	71.47	30/10/2025	09:01:38	61.17
29/10/2025	08:48:53	46.15	30/10/2025	09:01:38	46.07
29/10/2025	08:49:19	73.77	30/10/2025	09:01:43	61.17
29/10/2025	08:49:37	79.33	30/10/2025	09:01:43	46.07
29/10/2025	08:51:37	**80.56**	30/10/2025	09:01:48	21.53
29/10/2025	08:52:37	78.74	30/10/2025	09:01:54	27.48
29/10/2025	08:53:44	74.73	30/10/2025	09:01:57	22.36
29/10/2025	08:54:17	76.16	30/10/2025	09:02:00	22.24
29/10/2025	08:54:31	**80.4**	30/10/2025	09:02:04	36.24
29/10/2025	08:54:46	74.2	30/10/2025	09:02:07	32.2
29/10/2025	08:56:04	53.84	30/10/2025	09:02:09	12.89
29/10/2025	08:56:06	54.74	30/10/2025	09:02:26	43.08
29/10/2025	08:57:45	44.78	30/10/2025	09:04:01	47.37
29/10/2025	09:00:57	68.31	30/10/2025	09:04:04	39.36
29/10/2025	09:01:42	56.62	30/10/2025	09:04:20	36.28
29/10/2025	09:04:01	47.73	30/10/2025	09:04:20	39.36
29/10/2025	09:06:28	62.46	30/10/2025	09:04:23	12.95
29/10/2025	09:06:53	68.91	30/10/2025	09:05:01	44.84
29/10/2025	09:07:46	62.19	30/10/2025	09:05:35	76.6
29/10/2025	09:09:45	58.91	30/10/2025	09:06:26	73.77
29/10/2025	09:11:28	67.82	30/10/2025	09:08:27	65.05
29/10/2025	09:11:54	56.38	30/10/2025	09:09:09	70.89
29/10/2025	09:13:03	72.16	30/10/2025	09:16:52	42.57
29/10/2025	09:13:28	68.06	30/10/2025	09:17:00	77.59
29/10/2025	09:13:58	70.45	30/10/2025	09:20:20	71.3
29/10/2025	09:15:19	48.11	30/10/2025	09:23:42	47.51
29/10/2025	09:20:31	58.32	30/10/2025	09:23:46	45.46
29/10/2025	09:23:47	56.22	30/10/2025	09:23:49	47.02
29/10/2025	09:26:02	38.12	30/10/2025	09:27:32	63.87
29/10/2025	09:27:11	54.34	30/10/2025	09:28:14	55.8
29/10/2025	09:28:40	**85.77**	30/10/2025	09:28:52	41.87
29/10/2025	09:30:23	68.22	30/10/2025	09:32:11	61.95
29/10/2025	09:30:23	60.1	30/10/2025	09:33:32	72.18
29/10/2025	09:30:43	60.1	30/10/2025	09:34:42	71.95
29/10/2025	09:30:43	68.22	30/10/2025	09:37:24	57.99
29/10/2025	09:30:44	26.56	30/10/2025	09:38:25	78.42
29/10/2025	09:30:44	26.56	30/10/2025	09:39:48	41.72
29/10/2025	09:30:44	26.56	30/10/2025	09:39:51	40.92
29/10/2025	09:33:37	62.74	30/10/2025	09:40:21	61.21

29/10/2025	09:37:05	66.18	30/10/2025	09:46:02	67.11
29/10/2025	09:38:19	78.21	30/10/2025	09:46:59	27.95
29/10/2025	09:39:02	75.68	30/10/2025	09:53:33	66.71
29/10/2025	09:41:02	67.28	30/10/2025	09:53:41	40.35
29/10/2025	09:42:37	67.16	30/10/2025	09:53:54	72.64
29/10/2025	09:43:27	57.5	30/10/2025	09:55:38	59.58
29/10/2025	09:43:44	18.16	30/10/2025	09:58:53	71.85
29/10/2025	09:49:29	60.35	30/10/2025	10:00:11	50.68
29/10/2025	09:52:04	62.47	30/10/2025	10:07:59	56.14
29/10/2025	09:53:08	54.6	30/10/2025	10:09:41	55.05
29/10/2025	09:53:41	51.21	30/10/2025	10:12:21	34.82
29/10/2025	09:56:08	**89.7**	30/10/2025	10:14:26	56.21
29/10/2025	09:58:41	40.3	30/10/2025	10:17:24	40.2
29/10/2025	09:59:39	76.5	30/10/2025	10:24:52	43.09
29/10/2025	10:01:28	54.04	30/10/2025	10:25:11	52
29/10/2025	10:05:26	54.28	30/10/2025	10:27:12	30.51
29/10/2025	10:07:11	**80.54**	30/10/2025	10:31:17	55.9
29/10/2025	10:08:31	56.36	30/10/2025	10:31:46	74.97
29/10/2025	10:14:59	55.77	30/10/2025	10:35:33	70.26
29/10/2025	10:15:50	58.69	30/10/2025	10:39:25	51.79
29/10/2025	10:17:48	77.08	30/10/2025	10:40:09	51.54
29/10/2025	10:18:15	42.02	30/10/2025	10:45:08	68.52
29/10/2025	10:19:56	63.87	30/10/2025	10:45:14	74.83
29/10/2025	10:20:33	34.02	30/10/2025	10:46:30	52.17
29/10/2025	10:20:36	32.29	30/10/2025	10:52:35	62.32
29/10/2025	10:20:42	41.43	30/10/2025	10:57:26	54.03
29/10/2025	10:20:46	39.98	30/10/2025	11:01:22	74.31
29/10/2025	10:21:31	58.93	30/10/2025	11:03:41	44.73
29/10/2025	10:22:42	60.9	30/10/2025	11:04:22	51.83
29/10/2025	10:23:54	46.66	30/10/2025	11:04:53	**82.48**
29/10/2025	10:25:26	**84.37**	30/10/2025	11:07:05	63.59
29/10/2025	10:27:40	68.92	30/10/2025	11:08:55	35.53
29/10/2025	10:28:16	60.66	30/10/2025	11:13:32	68.58
29/10/2025	10:37:15	58.48	30/10/2025	11:15:43	42.93
29/10/2025	10:38:20	21.98	30/10/2025	11:17:10	**96.65**
29/10/2025	10:38:37	52.44	30/10/2025	11:17:37	53.59
29/10/2025	10:40:55	60.88	30/10/2025	11:21:02	**92.06**
29/10/2025	10:42:42	50.94	30/10/2025	11:23:10	60.62
29/10/2025	10:45:34	66.39	30/10/2025	11:23:24	76.02
29/10/2025	10:45:57	61	30/10/2025	11:23:42	61.44
29/10/2025	10:48:04	59.3	30/10/2025	11:24:01	**88.47**
29/10/2025	10:53:33	**83.17**	30/10/2025	11:24:22	52.58
29/10/2025	10:54:46	71.08	30/10/2025	11:32:05	46.8
29/10/2025	10:54:50	59.86	30/10/2025	11:34:14	56.2
29/10/2025	10:59:23	72.47	30/10/2025	11:37:43	65.85
29/10/2025	11:01:18	65.21	30/10/2025	11:38:21	45.57
29/10/2025	11:03:05	68.52	30/10/2025	11:38:39	55.32
29/10/2025	11:03:14	63.24	30/10/2025	11:39:07	48.51
29/10/2025	11:03:31	47.65	30/10/2025	11:39:28	48.92

29/10/2025	11:05:56	88.7	30/10/2025	11:39:34	74.17
29/10/2025	11:08:18	54.87	30/10/2025	11:40:43	59.21
29/10/2025	11:10:59	79.74	30/10/2025	11:45:57	54.45
29/10/2025	11:12:37	64.68	30/10/2025	11:47:16	69.49
29/10/2025	11:13:07	**80.91**	30/10/2025	11:52:07	66
29/10/2025	11:13:21	**81.66**	30/10/2025	11:52:22	66
29/10/2025	11:14:42	47.75	30/10/2025	11:52:22	53.02
29/10/2025	11:15:18	22.12	30/10/2025	11:52:22	66
29/10/2025	11:15:35	76.28	30/10/2025	11:52:25	31.49
29/10/2025	11:16:34	**130.76**	30/10/2025	11:52:47	59.28
29/10/2025	11:17:09	56.61	30/10/2025	11:54:51	50.36
29/10/2025	11:22:24	48.29	30/10/2025	11:55:40	77.86
29/10/2025	11:23:57	47.95	30/10/2025	11:58:05	48.72
29/10/2025	11:26:16	54.86	30/10/2025	12:01:40	61.93
29/10/2025	11:27:17	39.6	30/10/2025	12:03:57	64.55
29/10/2025	11:31:04	40.91	30/10/2025	12:05:11	58.16
29/10/2025	11:31:27	**92.01**	30/10/2025	12:05:16	66.37
29/10/2025	11:32:01	**94.55**	30/10/2025	12:07:46	71.88
29/10/2025	11:32:52	**139.79**	30/10/2025	12:08:46	55.65
29/10/2025	11:36:58	40.86	30/10/2025	12:11:33	48.9
29/10/2025	11:41:16	71.29	30/10/2025	12:13:41	40.45
29/10/2025	11:41:26	67.69	30/10/2025	12:14:40	12.89
29/10/2025	11:43:47	49.15	30/10/2025	12:15:00	70.24
29/10/2025	11:45:29	56.87	30/10/2025	12:16:16	67.33
29/10/2025	11:47:22	62.32	30/10/2025	12:19:59	59.3
29/10/2025	11:49:34	59.81	30/10/2025	12:21:03	33.39
29/10/2025	11:51:31	49.32	30/10/2025	12:22:14	71.75
29/10/2025	11:57:10	37.69	30/10/2025	12:25:30	55.41
29/10/2025	12:01:41	63.26	30/10/2025	12:27:40	49.7
29/10/2025	12:03:04	53.15	30/10/2025	12:27:56	67.03
29/10/2025	12:04:29	35.17	30/10/2025	12:33:07	60.11
29/10/2025	12:08:45	57.38	30/10/2025	12:33:53	53.08
29/10/2025	12:08:54	60.02	30/10/2025	12:34:34	58.15
29/10/2025	12:10:22	58.19	30/10/2025	12:35:54	52.56
29/10/2025	12:10:41	48.55	30/10/2025	12:36:03	**112.01**
29/10/2025	12:15:00	63.62	30/10/2025	12:37:31	66.87
29/10/2025	12:15:52	49.83	30/10/2025	12:37:50	62.32
29/10/2025	12:18:49	57.48	30/10/2025	12:42:47	55.92
29/10/2025	12:20:52	50.86	30/10/2025	12:45:11	**92.58**
29/10/2025	12:25:01	55.67	30/10/2025	12:46:21	59.16
29/10/2025	12:31:45	44.66	30/10/2025	12:56:19	48.87
29/10/2025	12:31:53	40.03	30/10/2025	12:57:04	65.71
29/10/2025	12:33:30	67.59	30/10/2025	13:05:58	55.41
29/10/2025	12:33:53	65.67	30/10/2025	13:06:51	69.59
29/10/2025	12:41:04	**80.49**	30/10/2025	13:09:24	66.56
29/10/2025	12:43:15	62.14	30/10/2025	13:09:41	14.36
29/10/2025	12:46:14	55.61	30/10/2025	13:10:01	68.21
29/10/2025	12:46:16	68.15	30/10/2025	13:11:30	74.58
29/10/2025	12:46:50	76.24	30/10/2025	13:12:50	67.34

29/10/2025	12:48:18	58.87	30/10/2025	13:12:50	54.22
29/10/2025	12:49:42	27.16	30/10/2025	13:12:50	67.34
29/10/2025	12:50:27	**85.52**	30/10/2025	13:12:50	54.22
29/10/2025	12:52:41	**85.66**	30/10/2025	13:12:50	67.34
29/10/2025	12:54:11	60.92	30/10/2025	13:14:44	83
29/10/2025	12:54:41	58.28	30/10/2025	13:15:52	77.94
29/10/2025	12:54:43	58.14	30/10/2025	13:20:21	69.66
29/10/2025	12:58:14	78.07	30/10/2025	13:22:05	54.37
29/10/2025	13:00:28	43.64	30/10/2025	13:22:41	59.72
29/10/2025	13:02:43	75.39	30/10/2025	13:24:50	67.6
29/10/2025	13:04:01	54.88	30/10/2025	13:28:47	**100.89**
29/10/2025	13:06:56	53.08	30/10/2025	13:31:58	55.59
29/10/2025	13:06:59	53.09	30/10/2025	13:34:23	60
29/10/2025	13:07:21	48.05	30/10/2025	13:37:23	44.67
29/10/2025	13:08:22	41.73	30/10/2025	13:40:53	45.18
29/10/2025	13:08:58	65.19	30/10/2025	13:41:40	63.16
29/10/2025	13:09:01	**83.78**	30/10/2025	13:44:37	69.94
29/10/2025	13:10:06	61.55	30/10/2025	13:45:53	74.49
29/10/2025	13:17:38	47.37	30/10/2025	13:47:19	59.37
29/10/2025	13:19:23	30.94	30/10/2025	13:48:51	47.42
29/10/2025	13:19:26	68.86	30/10/2025	13:51:21	56.96
29/10/2025	13:20:10	54.97	30/10/2025	13:51:59	76.92
29/10/2025	13:21:26	62.06	30/10/2025	13:53:18	48.2
29/10/2025	13:21:48	50.13	30/10/2025	13:55:03	67.77
29/10/2025	13:22:10	25.53	30/10/2025	13:55:07	66.94
29/10/2025	13:22:11	28.41	30/10/2025	13:57:33	59.72
29/10/2025	13:24:27	77.52	30/10/2025	13:57:58	66.46
29/10/2025	13:24:54	72.44	30/10/2025	13:59:22	36.94
29/10/2025	13:25:40	59.1	30/10/2025	13:59:38	30.57
29/10/2025	13:28:22	66.9	30/10/2025	14:00:21	73.95
29/10/2025	13:30:26	36.47	30/10/2025	14:02:06	74.22
29/10/2025	13:31:46	62.57	30/10/2025	14:04:13	56.91
29/10/2025	13:32:09	48.85	30/10/2025	14:06:56	64.98
29/10/2025	13:33:09	55.98	30/10/2025	14:11:00	55.78
29/10/2025	13:33:35	74.65	30/10/2025	14:11:28	56.85
29/10/2025	13:34:23	59.55	30/10/2025	14:14:13	59.03
29/10/2025	13:40:43	72.93	30/10/2025	14:14:13	59.21
29/10/2025	13:41:08	33.89	30/10/2025	14:14:13	59.03
29/10/2025	13:44:17	62.51	30/10/2025	14:14:21	35.06
29/10/2025	13:48:26	78.19	30/10/2025	14:14:25	39.19
29/10/2025	13:48:42	70.19	30/10/2025	14:18:04	36.03
29/10/2025	13:49:33	60.2	30/10/2025	14:22:56	46.52
29/10/2025	13:53:12	50.99	30/10/2025	14:30:12	61.69
29/10/2025	13:53:47	39	30/10/2025	14:33:34	67.68
29/10/2025	13:54:58	36.27	30/10/2025	14:37:17	45.8
29/10/2025	13:55:58	49.38	30/10/2025	14:37:56	**82.47**
29/10/2025	13:56:29	55.76	30/10/2025	14:38:43	55.08
29/10/2025	13:57:41	41.5	30/10/2025	14:42:18	**93.67**
29/10/2025	13:58:25	62.05	30/10/2025	14:43:39	63.44

29/10/2025	13:59:05	55.98	30/10/2025	14:44:36	61.28
29/10/2025	13:59:40	**95.18**	30/10/2025	14:44:59	55.21
29/10/2025	14:01:58	75	30/10/2025	14:45:33	41.45
29/10/2025	14:02:50	62.98	30/10/2025	14:48:29	54.97
29/10/2025	14:02:55	71.8	30/10/2025	14:50:16	52.62
29/10/2025	14:03:20	**83.99**	30/10/2025	14:50:21	46.52
29/10/2025	14:04:25	58.54	30/10/2025	14:51:46	48.22
29/10/2025	14:05:28	68.24	30/10/2025	14:52:01	49.72
29/10/2025	14:05:40	78.81	30/10/2025	14:55:45	46.17
29/10/2025	14:10:16	46.11	30/10/2025	15:06:44	55.01
29/10/2025	14:10:17	41.66	30/10/2025	15:08:18	**82.2**
29/10/2025	14:10:21	41.48	30/10/2025	15:08:55	65.78
29/10/2025	14:13:58	50.23	30/10/2025	15:10:58	63.53
29/10/2025	14:13:58	56.55	30/10/2025	15:14:49	53.53
29/10/2025	14:17:52	**88.16**	30/10/2025	15:16:38	16.07
29/10/2025	14:21:03	75.07	30/10/2025	15:17:22	51.19
29/10/2025	14:21:59	56.27	30/10/2025	15:19:50	61.1
29/10/2025	14:26:16	50.96	30/10/2025	15:21:59	74.9
29/10/2025	14:27:54	59.28	30/10/2025	15:22:09	67.74
29/10/2025	14:29:33	55.52	30/10/2025	15:24:42	72.09
29/10/2025	14:29:58	66.97	30/10/2025	15:30:42	49.67
29/10/2025	14:31:15	41.64	30/10/2025	15:33:37	28.6
29/10/2025	14:31:41	65.15	30/10/2025	15:34:31	63.43
29/10/2025	14:34:22	55.84	30/10/2025	15:39:48	57.62
29/10/2025	14:37:45	69.83	30/10/2025	15:39:50	62.07
29/10/2025	14:38:11	**98.75**	30/10/2025	15:42:44	39.46
29/10/2025	14:40:24	59.51	30/10/2025	15:43:40	65.56
29/10/2025	14:44:39	52.71	30/10/2025	15:44:36	33.65
29/10/2025	14:47:16	41.67	30/10/2025	15:48:07	56.57
29/10/2025	14:50:07	55.46	30/10/2025	15:51:53	63.54
29/10/2025	14:50:12	50.47	30/10/2025	15:52:41	48.71
29/10/2025	14:50:48	52.29	30/10/2025	15:52:45	50.62
29/10/2025	14:52:59	45.01	30/10/2025	15:55:03	65.36
29/10/2025	14:53:41	59.26	30/10/2025	15:55:13	55.59
29/10/2025	14:59:48	67.28	30/10/2025	15:56:07	61.5
29/10/2025	15:07:28	**82.61**	30/10/2025	16:00:59	32.5
29/10/2025	15:08:01	62.49	30/10/2025	16:02:00	63.94
29/10/2025	15:08:56	74.87	30/10/2025	16:02:45	50.19
29/10/2025	15:09:49	42.2	30/10/2025	16:09:01	50.53
29/10/2025	15:11:05	60.93	30/10/2025	16:10:55	63.93
29/10/2025	15:11:45	48.29	30/10/2025	16:11:31	83.26
29/10/2025	15:12:31	37.56	30/10/2025	16:13:11	55.33
29/10/2025	15:12:33	64.57	30/10/2025	16:20:36	66.86
29/10/2025	15:12:33	44.59	30/10/2025	16:21:44	48.54
29/10/2025	15:13:33	68.3	30/10/2025	16:23:01	50.21
29/10/2025	15:13:38	63.13	30/10/2025	16:25:14	56.66
29/10/2025	15:14:56	53.18	30/10/2025	16:31:21	54.18
29/10/2025	15:15:00	58.18	30/10/2025	16:35:07	71.98
29/10/2025	15:17:40	41.91	30/10/2025	16:36:35	56.12

29/10/2025	15:18:49	65.08	30/10/2025	16:38:52	68.96
29/10/2025	15:19:10	72.76	30/10/2025	16:39:53	64.51
29/10/2025	15:20:50	47.3	30/10/2025	16:39:53	54.84
29/10/2025	15:21:40	39.97	30/10/2025	16:39:53	64.51
29/10/2025	15:24:41	59.54	30/10/2025	16:41:27	**80.51**
29/10/2025	15:25:44	42.62	30/10/2025	16:42:50	54.56
29/10/2025	15:28:07	62.65	30/10/2025	16:43:53	51.74
29/10/2025	15:29:16	63.03	30/10/2025	16:45:00	64.35
29/10/2025	15:30:07	75.41	30/10/2025	16:47:42	42.22
29/10/2025	15:30:41	52.89	30/10/2025	16:47:55	22.55
29/10/2025	15:31:23	54.36	30/10/2025	16:49:13	51.73
29/10/2025	15:32:30	72.61	30/10/2025	16:51:29	72.05
29/10/2025	15:34:21	56.82	30/10/2025	16:52:13	66.68
29/10/2025	15:40:25	77.35	30/10/2025	16:53:07	59.35
29/10/2025	15:40:55	61.96	30/10/2025	16:53:50	65.51
29/10/2025	15:42:28	**100.32**	30/10/2025	16:54:43	54.84
29/10/2025	15:45:33	74.4	30/10/2025	16:54:54	68.51
29/10/2025	15:47:07	63.79	30/10/2025	16:55:28	64.13
29/10/2025	15:47:25	67.96	30/10/2025	16:55:37	71.28
29/10/2025	15:47:59	55.2	30/10/2025	16:57:40	48.17
29/10/2025	15:50:25	78.4	30/10/2025	16:58:13	41.67
29/10/2025	15:50:56	55.03	30/10/2025	17:00:55	74.2
29/10/2025	15:51:25	37.74	30/10/2025	17:11:04	16.02
29/10/2025	15:52:25	53.16	30/10/2025	17:12:02	66.3
29/10/2025	15:53:43	**82.93**	30/10/2025	17:12:06	67.72
29/10/2025	15:54:08	33.25	30/10/2025	17:14:29	50.53
29/10/2025	15:54:53	51.43	30/10/2025	17:19:57	**82.84**
29/10/2025	15:57:00	48.12	30/10/2025	17:27:26	58.9
29/10/2025	15:57:31	45.67	30/10/2025	17:27:44	51.64
29/10/2025	15:57:42	69.39	30/10/2025	17:35:31	28.78
29/10/2025	15:58:52	58.94	30/10/2025	17:50:33	52.99
29/10/2025	16:03:52	47.49	30/10/2025	17:51:41	68.7
29/10/2025	16:04:01	72.62	30/10/2025	17:54:33	**87.37**
29/10/2025	16:06:01	78.52	30/10/2025	17:56:09	62.22
29/10/2025	16:06:17	**80.7**	30/10/2025	17:56:36	66.77
29/10/2025	16:06:48	41.72	30/10/2025	17:56:45	69.91
29/10/2025	16:07:33	59.39	30/10/2025	17:58:34	68.65
29/10/2025	16:08:40	**87.62**	30/10/2025	17:59:13	71.56
29/10/2025	16:09:33	71.03	30/10/2025	18:00:42	70.2
29/10/2025	16:12:18	47.92	30/10/2025	18:06:20	73.7
29/10/2025	16:13:48	57.33	30/10/2025	18:06:55	71.72
29/10/2025	16:14:18	49.28	30/10/2025	18:14:27	74.45
29/10/2025	16:15:40	62.74	30/10/2025	18:14:45	60.19
29/10/2025	16:16:11	61.24	30/10/2025	18:14:54	67.66
29/10/2025	16:21:56	78.11	30/10/2025	18:17:14	50.27
29/10/2025	16:22:34	66.36	30/10/2025	18:17:35	60.88
29/10/2025	16:25:17	49.37	30/10/2025	18:19:51	78.17
29/10/2025	16:25:42	46.96	30/10/2025	18:20:59	**82.55**
29/10/2025	16:25:59	28.09	30/10/2025	18:21:32	47.73

29/10/2025	16:26:27	57.98	30/10/2025	18:23:09	63.29
29/10/2025	16:27:25	37.11	30/10/2025	18:24:59	58.04
29/10/2025	16:27:38	60.72	30/10/2025	18:27:11	77.97
29/10/2025	16:28:13	60.54	30/10/2025	18:27:40	78
29/10/2025	16:28:42	**90.06**	30/10/2025	18:31:12	**88.82**
29/10/2025	16:30:18	52.57	30/10/2025	18:35:39	54.04
29/10/2025	16:31:01	65.93	30/10/2025	18:42:09	56.74
29/10/2025	16:34:28	61.54	30/10/2025	18:42:11	49.84
29/10/2025	16:34:30	67.37	30/10/2025	18:42:20	57.88
29/10/2025	16:39:09	79.86	30/10/2025	18:42:26	71.01
29/10/2025	16:42:15	66.91	30/10/2025	18:44:03	72.32
29/10/2025	16:42:32	20.92	30/10/2025	19:01:24	60.14
29/10/2025	16:44:04	62.24	30/10/2025	19:09:43	55.4
29/10/2025	16:48:37	69.52	30/10/2025	19:18:18	40.56
29/10/2025	16:49:56	69.46	30/10/2025	19:18:49	50.2
29/10/2025	16:50:59	66.81	30/10/2025	19:43:30	57.54
29/10/2025	16:51:29	61.98	30/10/2025	19:51:14	65.95
29/10/2025	16:52:07	45.89	30/10/2025	19:59:18	78.96
29/10/2025	16:52:35	76.84	30/10/2025	20:00:22	66.56
29/10/2025	16:53:20	75.41	30/10/2025	20:05:18	41.28
29/10/2025	16:57:00	55.61	30/10/2025	20:15:26	48.97
29/10/2025	16:57:48	62.21	30/10/2025	20:43:27	55.37
29/10/2025	16:59:45	53.57	30/10/2025	20:58:16	65.3
29/10/2025	16:59:46	58.51	30/10/2025	21:17:48	66.11
29/10/2025	17:00:12	57.73	30/10/2025	21:17:54	48.39
29/10/2025	17:01:57	74.98	30/10/2025	21:20:52	76.65
29/10/2025	17:02:36	**89.83**	30/10/2025	21:21:21	53.99
29/10/2025	17:02:57	46.31	30/10/2025	21:36:03	51.47
29/10/2025	17:04:08	62.43	30/10/2025	21:42:31	**94.45**
29/10/2025	17:04:10	68.32	30/10/2025	21:48:18	71.92
29/10/2025	17:07:44	79.58	30/10/2025	21:56:02	60.35
29/10/2025	17:09:05	61.35	30/10/2025	22:58:30	72.4
29/10/2025	17:09:29	66.96	30/10/2025	23:23:15	58.55
29/10/2025	17:12:34	62.82	30/10/2025	23:38:39	**85.43**
29/10/2025	17:12:57	68.4			
29/10/2025	17:14:14	**80.06**			
29/10/2025	17:16:19	68.23			
29/10/2025	17:16:40	71.05			
29/10/2025	17:17:44	58.33			
29/10/2025	17:17:47	60.28			
29/10/2025	17:18:46	68.56			
29/10/2025	17:21:32	52.5			
29/10/2025	17:22:17	52.56			
29/10/2025	17:22:20	60.57			
29/10/2025	17:23:26	**98.89**			
29/10/2025	17:23:40	68.68			
29/10/2025	17:24:39	48.04			
29/10/2025	17:27:01	58.32			
29/10/2025	17:28:41	58.8			

29/10/2025	17:29:46	58.73			
29/10/2025	17:29:50	55.52			
29/10/2025	17:38:29	53.64			
29/10/2025	17:40:12	67.36			
29/10/2025	17:40:35	38.06			
29/10/2025	17:41:23	**81.04**			
29/10/2025	17:43:03	58.06			
29/10/2025	17:43:35	74.81			
29/10/2025	17:47:13	43.6			
29/10/2025	17:47:27	49.52			
29/10/2025	17:49:56	**104.24**			
29/10/2025	17:51:03	64.28			
29/10/2025	17:54:41	63.92			
29/10/2025	17:55:39	56.85			
29/10/2025	17:56:13	43.55			
29/10/2025	17:57:23	52.94			
29/10/2025	17:58:23	68.95			
29/10/2025	18:01:25	69.53			
29/10/2025	18:02:42	70.91			
29/10/2025	18:03:11	65.38			
29/10/2025	18:04:04	49.16			
29/10/2025	18:07:29	**82.02**			
29/10/2025	18:07:45	53.05			
29/10/2025	18:15:12	61.23			
29/10/2025	18:17:24	58.56			
29/10/2025	18:19:11	**102.63**			
29/10/2025	18:21:38	43.36			
29/10/2025	18:22:12	68.11			
29/10/2025	18:34:30	58.17			
29/10/2025	18:37:53	**82.61**			
29/10/2025	18:38:25	61.6			
29/10/2025	18:38:34	29.47			
29/10/2025	18:39:12	**87.42**			
29/10/2025	18:44:06	59.52			
29/10/2025	18:47:17	77.63			
29/10/2025	18:47:39	64.73			
29/10/2025	18:48:41	**90.86**			
29/10/2025	18:54:10	59.79			
29/10/2025	18:54:29	66.63			
29/10/2025	19:01:06	73.13			
29/10/2025	19:05:20	50.47			
29/10/2025	19:05:42	69.84			
29/10/2025	19:09:05	74.7			
29/10/2025	19:10:48	45.69			
29/10/2025	19:24:15	78.4			
29/10/2025	19:30:28	66.76			
29/10/2025	19:35:53	**87.97**			
29/10/2025	19:59:50	**80.48**			
29/10/2025	20:03:23	69.94			

29/10/2025	20:08:28	**81.83**			
29/10/2025	20:13:40	70.27			
29/10/2025	20:15:32	62.11			
29/10/2025	20:27:32	61.15			
29/10/2025	20:27:55	67.91			
29/10/2025	20:32:43	60.58			
29/10/2025	20:47:01	51.41			
29/10/2025	21:08:23	56.58			
29/10/2025	21:24:35	52.58			
29/10/2025	21:29:49	**94.52**			
29/10/2025	21:31:03	**80.52**			
29/10/2025	21:33:09	62.76			
29/10/2025	21:35:25	57.93			
29/10/2025	21:45:40	51.75			
29/10/2025	22:09:13	**88.11**			
29/10/2025	22:28:21	**96.6**			
29/10/2025	22:49:14	**111.15**			
29/10/2025	23:17:25	**82.92**			
29/10/2025	23:22:17	50.4			
29/10/2025	23:40:40	62.41			

RFI Response

PMCE Consulting Engineers have provided and updated Traffic & Transport Impact Assessment as a stand-alone report that accompanies this Further Information response (refer to paragraphs 14.76 – 14.80).

Procurement of a Traffic Speed Survey on the L3109 in the vicinity of the site access was carried out as part of the Further Information response.

Response MLavelle: No traffic speed survey response provided.

PMCE Consulting Engineers produced a sightline drawing, to assess sightlines on the L1309 against the prevailing traffic speeds and have completed the Sight Line Assessment form.

Response MLavelle: No response provided in relation to 85% speeds.

The sightline drawing (Ref No P24109-PMCE-ZZZ-XX-DG-CR-5_0002 Sightlines) illustrating the above details is attached to this Further Information Response along with the completed Sight Line Assessment form provided in Appendix C.

The proposed bio-renewables plant will be located within the existing Killough Quarry. The proposed facility will use the existing access and a new internal road will be provided off the current main internal access road for the site Sightlines have been assessed against Section 6.1 and Tables 6.1 and 6.2 of Volume 3, Appendix 6 of the Tipperary County Development Plan 2022-2028, which requires 120m of unobstructed visibility (for a design speed of 60kph on the L1309 in accordance with the Road Traffic Act 2024) at a point 4.5m back from the edge of the carriageway.

Response MLavelle: The Sight Distance Triangle Map does not indicate any X-distance.

Visibility splays looking south are currently restricted due to the embankment, overgrown trees and vegetation at the high demand bend to the south of the site. The vegetation will be trimmed/removed, and maintained regularly, and the embankment will be reprofiled in order to ensure that the sightlines at the access are kept clear at all times.

Response MLavelle: Is this area under the control of the applicant?

Visibility splays looking north are currently restricted due to the adjacent building boundary and the vertical alignment. To address the restricted visibility splays to the north, it is proposed to amend the existing road markings at the site access including relocating the stop line further south, and provide hatching at the site access. These measures are proposed to position exiting vehicles such that the required visibility standards can be achieved.

Response MLavelle: These proposed measures are not documented in planning application. This response does not include a sweptpath analysis to indicate that vehicles can access the site. The kerb radii requirement of >13m is not shown.

In addition, the geometric constraints, coupled with low traffic volumes on the local road, have passively controlled vehicle speeds at the access.

Response MLavelle: Vehicle speeds up to 139.8km per hour are not passively controlled.

There are no accident records indicating that there are existing incident patterns at the site entrance and the site operator has confirmed that no issues or concerns have been reported by staff. Traffic on the L1309 will largely be associated with the application site, or vehicles generated by local development. Therefore they will be aware of the site operation and existing access junction.

Response MLavelle: Many road users are not "local development" traffic. This paragraph is nonsense.

All vehicles will access/egress the application site using a forward gear. Operational vehicles also benefit from a raised driver viewpoint and are positioned closer to the junction as HGVs tend not to have a bonnet. Adjacent hedgerows and vegetation are all under the control of the site operator and will continue to be maintained to ensure that visibility is maximised at the site access junction.

Response MLavelle: Adjacent hedgerows to the north are not under the control of the site operator & without consent cannot be maintained to maximise visibility at the junction.

There is currently no discharge of surface water at the existing site entrance onto the public road. If any further road improvements (associated with the sightlines at the entrance) are required by the Roads Department of Tipperary County Council, Roadstone are agreeable to these being conditioned and agreed prior to commencement of the development.

Response

An updated Traffic and Transport Assessment Report is provided under separate cover to accompany this Further Information Response.

The updated assessment has been revised to reflect the following:

· Update the 'Traffic Assignments' section to reflect traffic assignment corresponding to each development operation in accordance with information provided by Roadstone [Item 6(9) a];

· Update the 'Trip Generation [Construction]' section to provide further information regarding abnormal loads, and excavation/groundworks processes [Item 6(9) b and c], and detailed information regarding the construction stages, the type of traffic, and the construction traffic haul routes in accordance with information provided by Roadstone [item 6(9) d];

· Update the 'Trip Generation [Operations]' section to account for a worst-case scenario that will be assessed in accordance with information provided by Roadstone [item 6(9) e];

· Update the 'Scope of Assessment' section to clarify that for the purpose of a robust assessment, for the scoping assessment, PMCE did use the background traffic volumes based on the traffic counts survey as should they have included the maximum permitted quarry traffic volumes in the background traffic as part of the scoping assessment,

the percentage of the traffic generated by the proposed bio-renewable plant as a percentage of the background traffic would decrease which would lead us to exclude junctions and link roads from the capacity assessment.

· A review and revision of the existing Traffic and Transport Assessment report to reflect changes in the construction and operational development traffic volumes and assignments;

· Updated Link Capacity Assessment to be undertaken on the L1309; and

· Updated Junction capacity analysis at all junctions assessed.

Note:

Regarding tractor movements, it should be noted that tractors will only operate for ~17 days over a 5-month period to haul silage from the R639/M8 (75%) and L1309 (25%) direction (15 loads a day max.) These tractor loads were included within the miscellaneous loads as part of the original assessment.

The permitted HGV traffic trips associated with the existing permitted quarry and ancillary operations are 235 in/out per day (470 total). Recent traffic surveys have demonstrated that quarry production and associated HGV movements over the last decade are well below this permitted figure and are likely to remain below this figure.

On this basis, Roadstone give a commitment that the maximum HGV movements of 235 in/out per day will not be exceeded by the existing quarry/ancillary operations in combination with the propose new AD facility.

RFI Chapter 10: Traffic

(a) EIAR states that 66% of additional road traffic generated will comprise HGVs, however it is not stated how this figure has been derived. The Planning Authority note that the feedstocks comprise maize and grass silage which may be transported by tractor/trailer rather than HGV, although the report references increases in HGV movement. It is considered this may result in more significant noise level.

(b) The EIAR has considered cumulative noise impacts and states that the predicted specific noise levels owing to the proposed development taken together with the ambient noise levels will have a negligible to minor long term impact with a maximum increase in sound pressure levels at any receptor not exceeding 4dB during daytime hours (7am to 7pm). It is noted no data has been provided in relation to cumulative impacts for night time (7pm – 7am), noting that the proposed development will operate 24/7.

(c) Cumulative noise from increased road traffic, blasting and AD operational noise should be modelled and included in the EIAR

(d) The siting of the development within an existing quarry where there is constant movement of heavy machinery, extraction of rock and where basting occurs raises concerns regarding impacts of vibration on the development arising from its interaction with adjoining uses. This matter has not been addressed in the EIAR.

Chapter 14. Noise and Vibration

(a) The EIAR provides estimates on traffic distribution. However, no explanation is given in relation to the prediction on traffic distribution, noting that a large quantity of the feedstock e.g. maize, grass may be transported to the site via the local road network. The Planning Authority consider that the predictions do not accurately reflect the diverse nature of inputs and their origins. Similar concerns relate to the traffic distribution associated with movement of by products from the site.

(b) The EIAR has made no provision for abnormal loads, which are anticipated given the nature of the proposed development i.e. large silos/tanks etc.

(c) While it is assumed that all necessary plant is available on site in relation to groundworks, excavations etc same is not addressed in the EIAR.

(d) The EIAR is lacking in detailed data relating to construction traffic, e.g. types of vehicles and in particular in relation to different stages of construction e.g. during groundworks, abnormal loads, peak construction periods, etc. Furthermore, it is noted that the haul route for the construction period has not been specifically identified.

(e) The EIAR details an average no. of vehicles per day which is considered unrealistic, with no cognisance of peak traffic movements during construction.

Response MLavelle: The TRICS data provided relates to Quarries in the UK & is not relevant to Ireland. No TRICS information was provided for an Anaerobic Digester or for a Quarry & Anaerobic Digester.

(f) The figures provided in the EIAR show the percentage of traffic increase that will arise from the development against the maximum permitted traffic levels from the Killough Quarry site. In order to allow a detailed assessment of traffic impacts the traffic increases should be assessed against data for existing traffic movements based on surveys of current actual movements.

Response MLavelle: Current traffic count over a one-day period is totally inadequate for an industrial development of this size. There is a suggestion locally that the quarry traffic was switched to alternative quarries for the day of the traffic count.

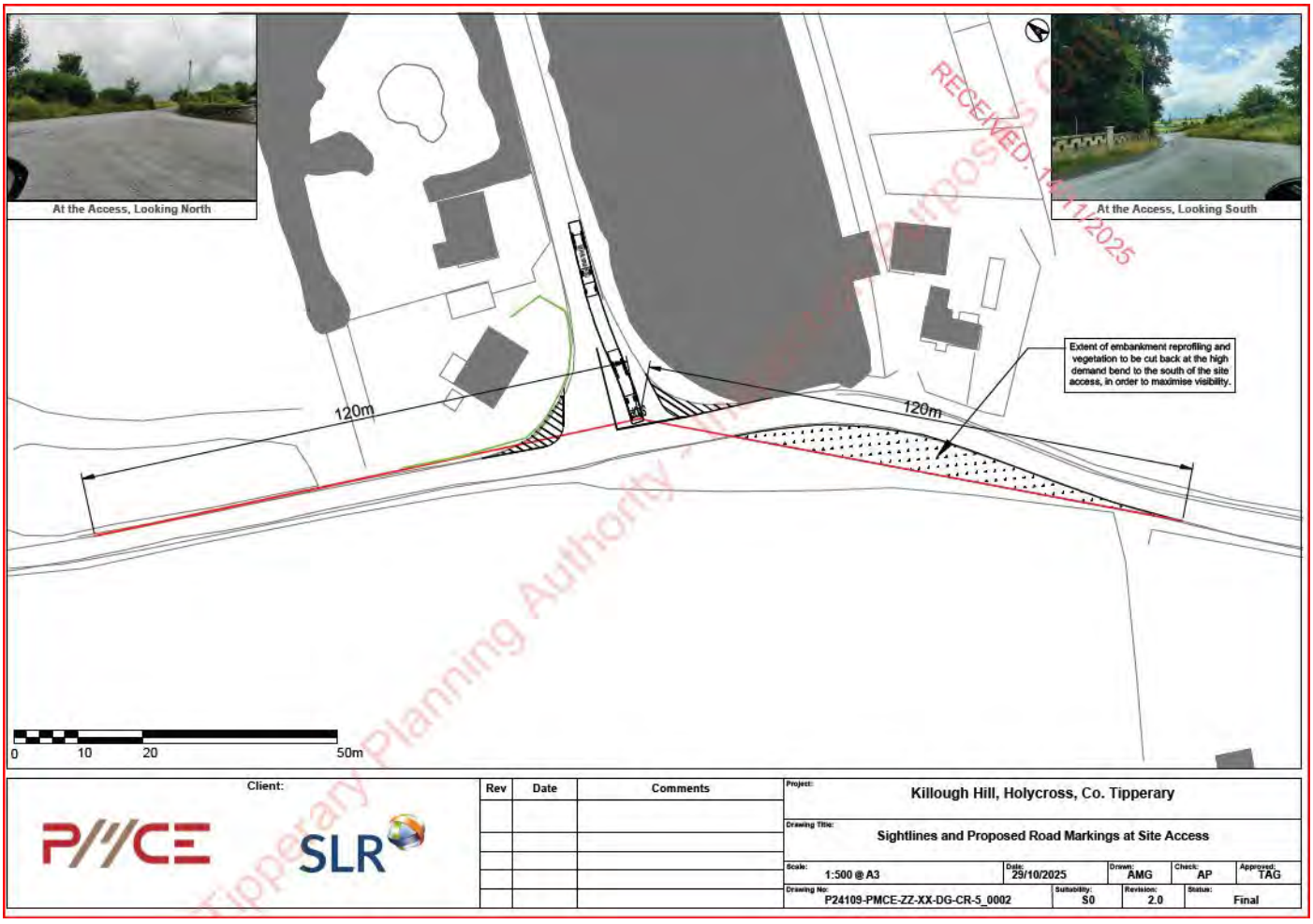
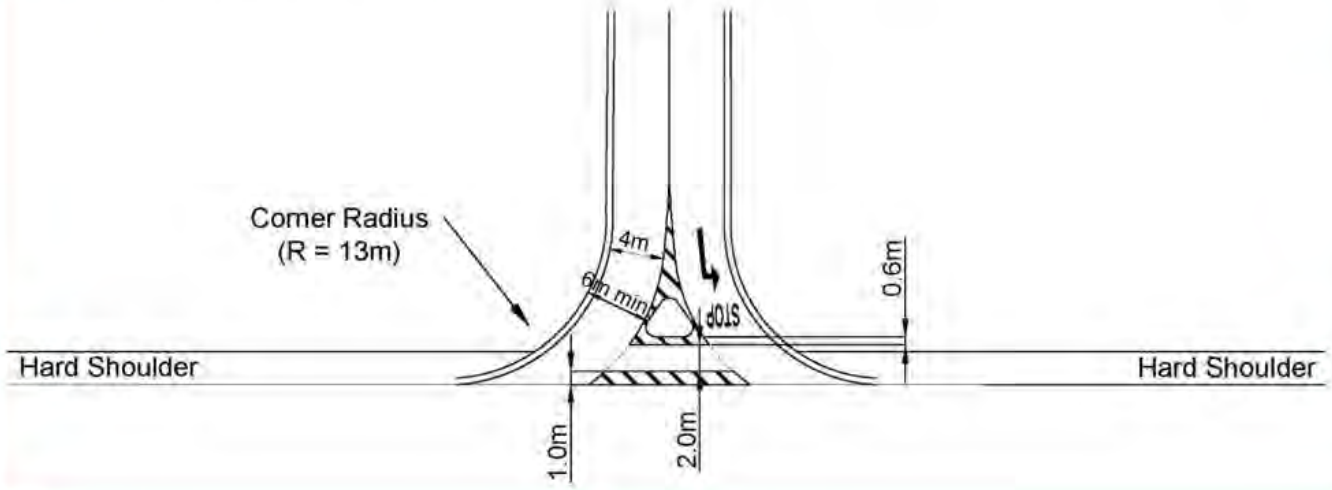
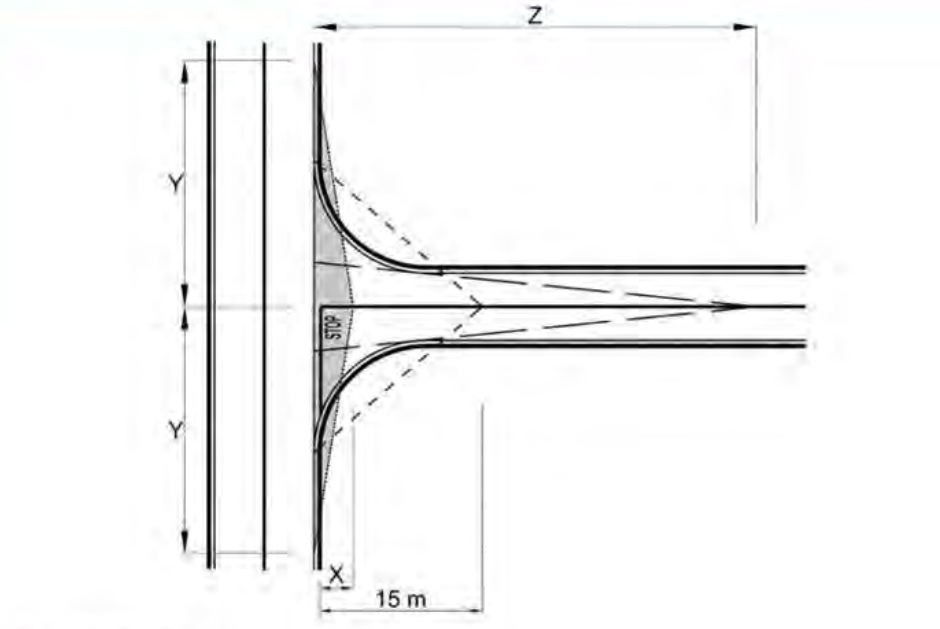


Figure 1: Sight Distance Triangle X-distance of 4.5m not shown. Sight Distance Triangle to North traverses the from garden of house. Consent to this has not been provided.





X "X" Distance
Y "Y" Distance
Z Desirable Minimum Stopping Sight Distance (SSD) for Approach Road Design Speed

Lines over which unobstructed visibility should be provided

Figure 5.11a Visibility Standards (single carriageway)

Figure 2: Google Map photo 2025 showing no grass verge in front of house

Figure 3: Google Map photo 2025 to south showing existing STOP sign

Figure No. 4: Google Map photo 2025 from centre of road to North. Note STOP sign not visible. Note nearside view would be worse.

Figure No. 5: Google Map photo 2025 from centre of road to South. Note STOP sign not visible. Note nearside view would be worse.

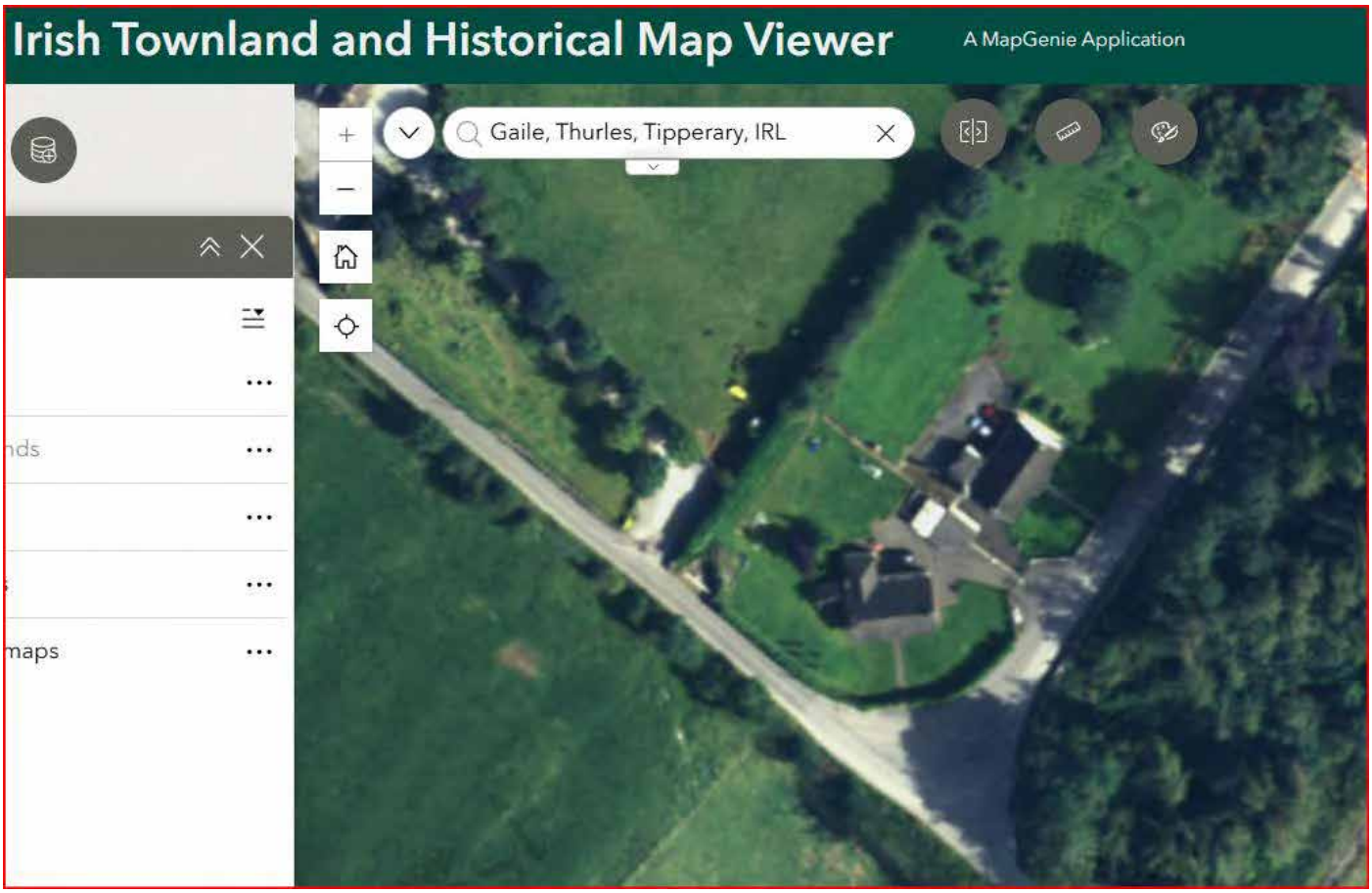
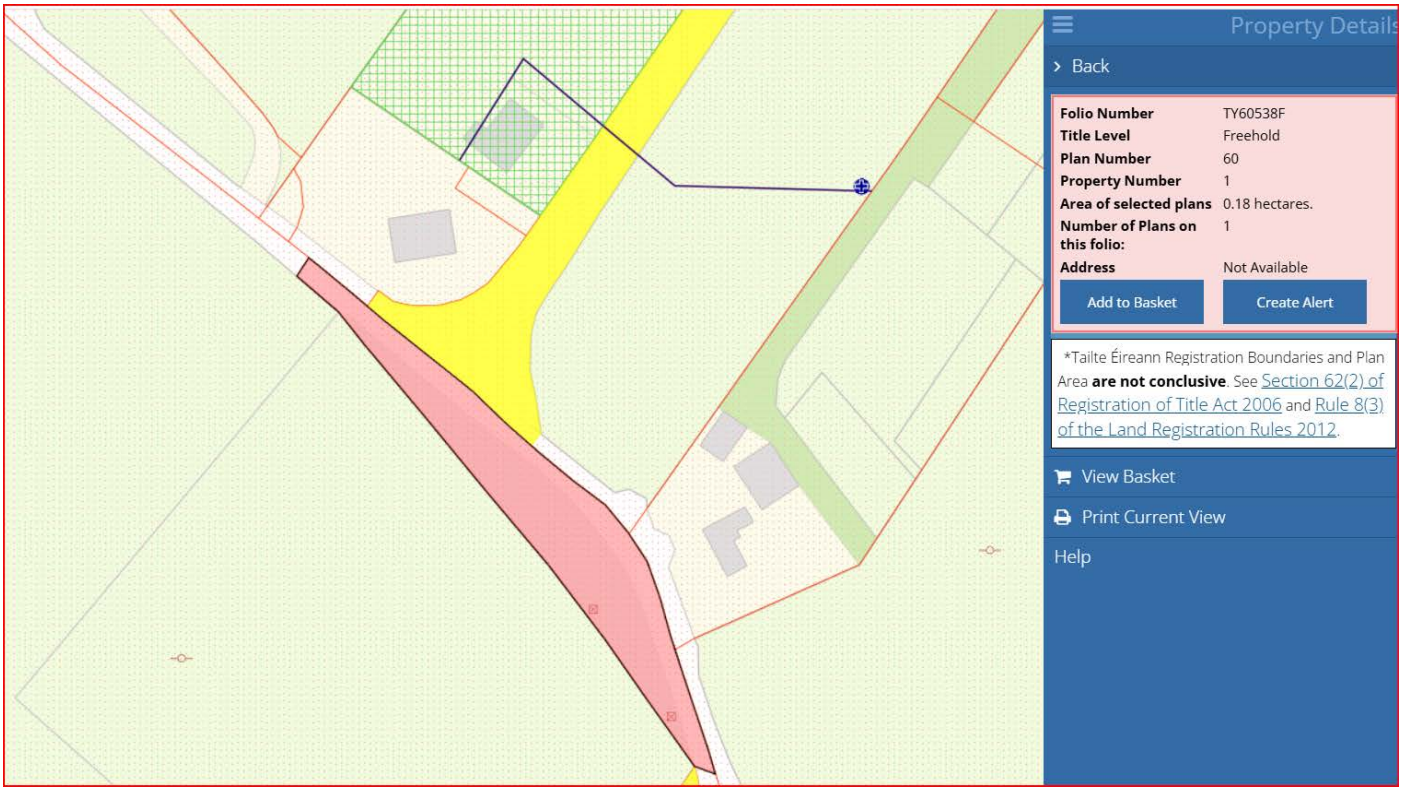
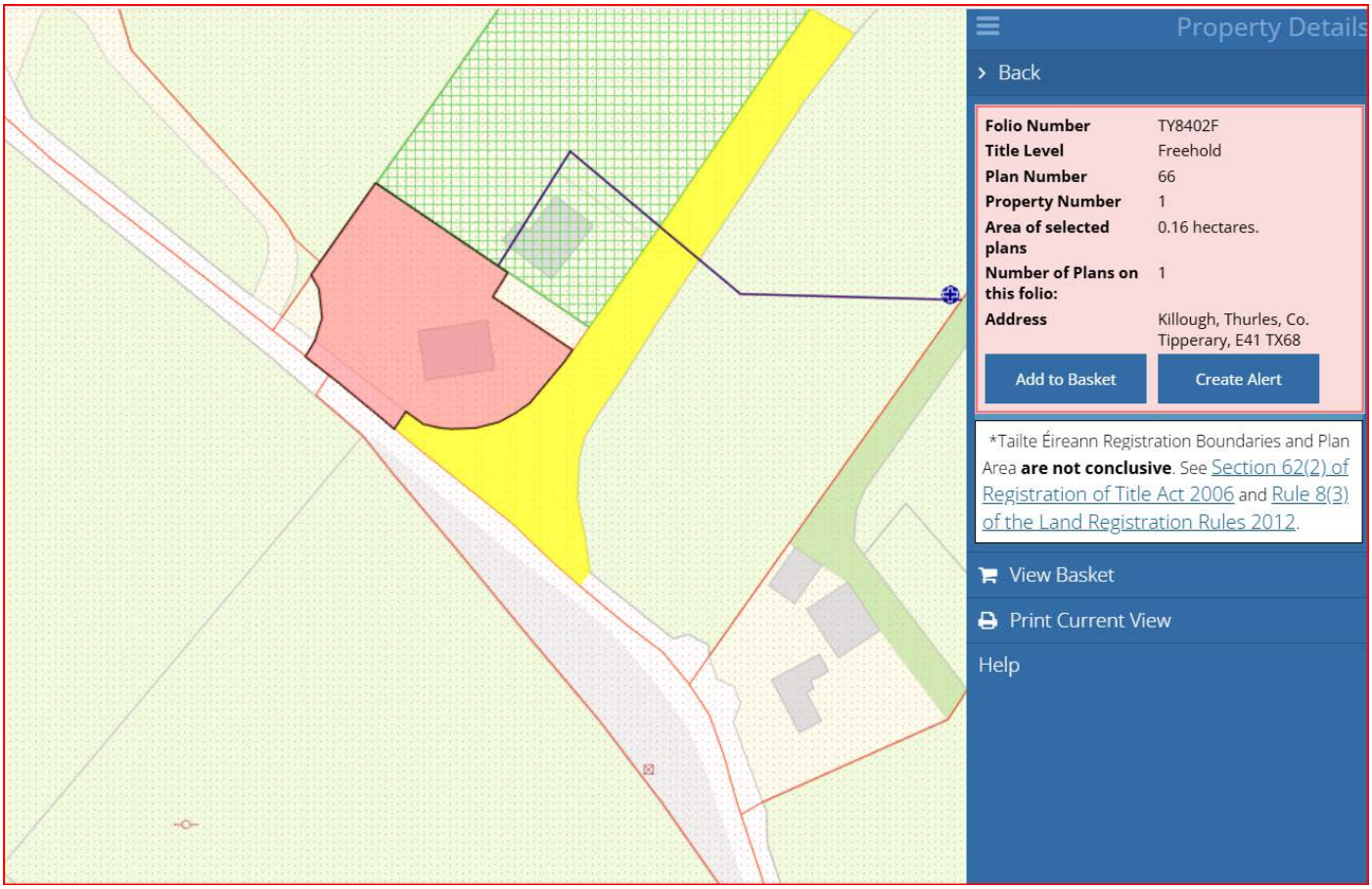


Figure Number 6: Site boundary coloured red with total landholding in blue


Residence (R1)
0.40
Residence (R2)
Site Entrance
Residence (R5)
9.13
Gael
Gaile
SLR


Property Details
Back
Folio Number TY60538F
Title Level Freehold
Plan Number 60
Property Number 1
Area of selected plans 0.18 hectares.
Number of Plans on this folio: 1
Address Not Available
Add to Basket
Create Alert
*Tailte Éireann Registration Boundaries and Plan Area are not conclusive. See Section 62(2) of Registration of Title Act 2006 and Rule 8(3) of the Land Registration Rules 2012.
View Basket
Print Current View
Help



TIPPERARY COUNTY DEVELOPMENT PLAN 2022 – 2028 VOLUME 3

5.7 Industrial Development

The standards set out in Table 5.1 shall apply for industrial developments;

Table 5.1: Minimum Standards for Industrial Developments

Access	Multi-unit developments shall have a single access. Access roads shall have a minimum carriageway width of 7.5m with 1.3m wide grass strip and 2m wide footpath(s). Cyclists should be accommodated in proposed multi-unit developments either through the provision of appropriate traffic calming measures or dedicated cycling lanes.

6.0 Parking, Traffic and Road Safety

6.1 Road Design & Visibility at a Direct Access

Any direct access to a rural national primary or rural national secondary road shall comply with the visibility parameters contained in Section 5.6.3 of TII Publication DN-GEO-03060, Geometric Design of Junctions, which is available for download from the TII Publications website (https://www.tiipublications.ie/).

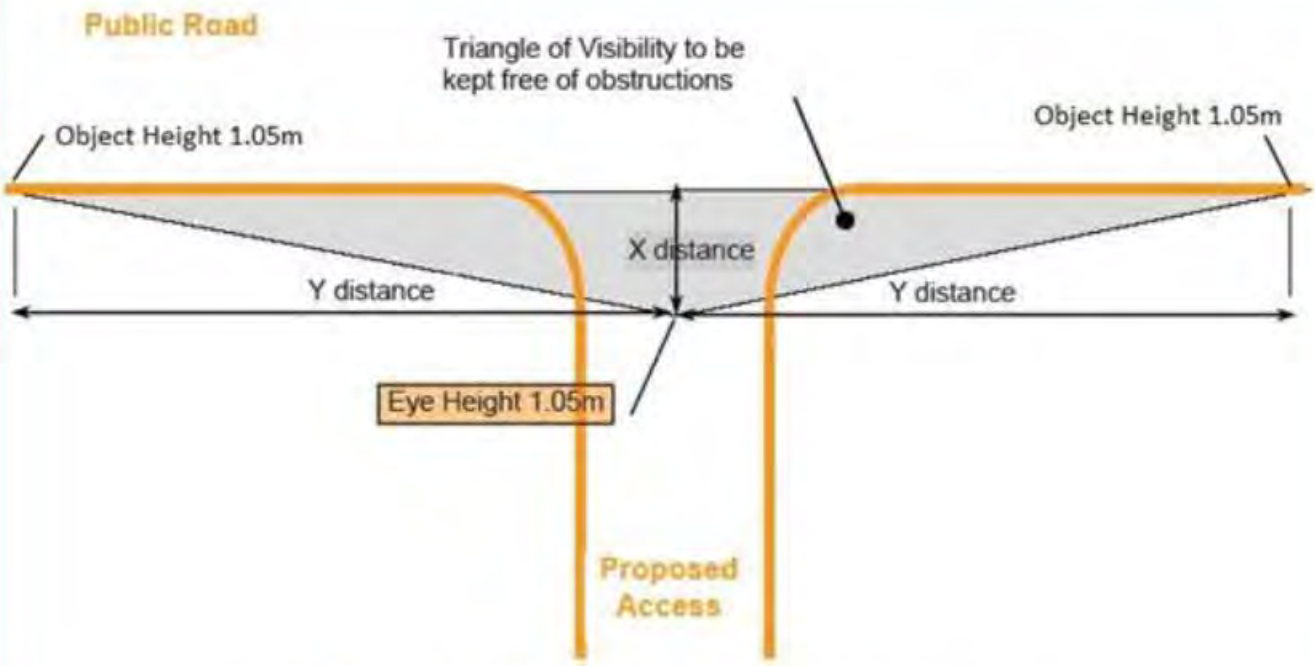


Figure 6.2: Forward Visibility Requirements

On all national and non-national roads, the full 'Y – Distance' shall be to an object height of 1.05m above the road surface level measured at the near edge of the travelling lane (the yellow line, or if none exists, the edge of the paved surface). Forward visibility equal to the Y-Distance shall also be provided along the public road on the approaches from each side of an access.

The distance back along the minor road or direct access from which the full visibility is measured is known as the 'X-Distance'. It is measured back along the centreline of the minor road or direct access from the continuation of the line of the nearside edge of the paved surface (including hardstrip or hard shoulder) of the major road. The 'X-Distance' on the minor road for visibility measurements shall be as defined in Table 6.1 below.

Table 6.1: X-Distance Requirements

Major Road Use	Minor Road use/Direct Access	X-Distance
National Roads	Simple Junctions, Stop control	2.4m
Regional & Local Roads	All junctions and accesses, Stop control	2.4m
Regional & Local Roads	All junctions and accesses, Yield control	3.0m
National Roads, Regional & Local Roads	Multiple residential, Commercial, Agricultural or other	4.5m
Regional & Local Roads	Accesses lightly trafficked (single residence)	2.0m

For direct access to a non-national road, the same principles apply as for national roads. Where posted mandatory speed limits are provided the design speeds and associated Y-Distances in Table 6.2 shall apply:

Table 6.2: Design Speeds and associated Y-Distances

Mandatory Speed Limit	Design Speed (operational Speed)	Rural Non-National Road	Urban Non-National Road
km/h	km/h	Y-Distance (m)	Y-Distance (m)
30	40	N\A	33
40	50	70	45
50	60	90	59
60	70	120	72
80	85	160	N\A
100	100	215	N\A

On non-national roads, in cases of particular difficulty, the use of a lower design speed for a given mandatory speed limit (as set out in Table 6.2) may be accepted by the Council. In such a case, the applicant must demonstrate to the satisfaction of the Council that the 'operational speed' of the road is less than the specified design speed. In such cases, the Council may accept the use of the lower speed than identified in column 2 of Table 6.2 above.

6.1.1 Measuring 'Operational' Speed

The operational speed shall be determined by measurement of actual speeds between 07:00 am 07:00 pm over a period of three days, excluding weekends or public holidays. It represents the 85th percentile speed of the traffic travelling on that section of road during that period. The 85th percentile speed is the speed at or below which 85% of the traffic is travelling.

As an alternative, the applicant may use the methodology described in Section 10.2 of DN GEO 03031: Rural Road Link Design (TII, April 2017) to determine a design speed based on the physical characteristics of the road section.

The minimum design or operating speed that will be allowable under any circumstances for a rural non national road shall be 50kph, and for an urban non-national road it shall be 40kph. The Council's decision on the appropriate design or operating speed shall be final.

6.2 Traffic and Transport Assessments

The Council in accordance with the Traffic and Transport Assessment Guidelines (TII, 2014) and any amendment thereof, will require the submission of a Traffic and Transport Impact Assessment (TTIA) for large scale developments or developments that may impact on the carrying capacity or public safety of the road network. The following are the minimum thresholds of developments which will require a TTIA:

- Industrial Developments over 5000 sqm.

TTIAs will also be required where there is a 10% increase in traffic (or a 5% increase in congested areas). Where the Council considers that a development may have an impact on the carrying capacity of the surrounding network, a TTIA may also be required for sub threshold development.

Such a decision will be based on an evaluation of the proposal against Table 2.2 and 2.3 of the Traffic and Transport Assessment Guidelines (TII, 2014), and any amendment thereof.

6.3 Road Safety Audits

A Road Safety Audit is an evaluation of the road's element of a development proposal from preliminary design to post-construction stage with a view to promoting the highest standard of, safety for all road users, but especially vulnerable road users such as pedestrians, cyclists and children, to identify potential road safety issues, and to suggest measures to eliminate or mitigate concerns.

The Council will require a Road Safety Audit where a development is likely to have a significant impact on road safety

6.4 Mobility Management Plans/Workplace Travel Plans

A 'Mobility Management Plan/Workplace Travel Plan' is a package of measures aimed at supporting sustainable travel for work-related journeys. It comprises actions to promote walking, cycling, public transport, car-sharing, the use of technology instead of travel, and flexible working practices. There are two distinct levels of plan which may be required for differing types and size of development. These are the 'Standard Workplace Travel Plan' and the 'Workplace Travel Plan Statement'. In general Workplace Travel Plan 'Statements' may be requested for smaller developments.

Mobility management plans are required for larger sized developments and for all new schools or for existing schools where 20% or greater expansion in classrooms is proposed. Table 6.3 demonstrates the thresholds for the submission of a mobility management plan in line with Achieving Effective Workplace Travel Plans – Guidance for Local Authorities (NTA) and Workplace Travel Plans, A Guide for Implementors, (NTA) and any review thereof.

Table 6.3: Mobility Management Plans

Land Use	Mobility Management Plan Statement	Indicative number of jobs	Standard Mobility Management Plan	Indicative number of jobs
Offices/Financial	>500sqm	25-100	2,000sqm	>100
Retail/Shops	>600sqm	25-100	2,500sqm	>100
Industrial	>2,500sqm	25-100	6,000sqm	>100
Leisure		25-100		>100 or >100,000 visitors/annum
Hospitals/Medical Centres		25-100		>100 or >100,000 visitors/annum
Warehousing	>2,500sqm	25-100	10,000sqm	>100

The Council will require mobility management plans and statements as the case may be, to be prepared in accordance with the NTA's Workplace Travel Plans, A Guide for Implementors. An updated mobility management plan shall be submitted to the Planning Authority on the first, third and fifth anniversaries of the first occupation of the development.

Traffic Volumes

14.15 Classified 12-hour Junction Turning Counts (JTCs) were carried out on Tuesday 28th May 2024, by Traffinomics Ltd., at a total of 3 no. junctions.

14.16 The counts were carried out between 7:00am and 7:00pm, with this time period encompassing the peak hours on the adjacent national and local roads network. Surveyed vehicles were broken down into five categories as follows:

· Cars;
· LGV's (Light Goods Vehicles);
· OGV1 (Two and three axle goods vehicles);
· OGV2 (Four and five axle goods vehicles);
· Buses.

14.17 The detailed results of the traffic survey are summarised in **Appendix 14-B**. The morning and evening peak hours have been established as:

· **3-Arm T-Junction of the Site Access and L1309 (referred to as the 'L1309 Site Access' in this report) –** 08:30 to 09:30 (AM Peak) and 16:45 to 17:45 (PM Peak)
· **4-Arm Crossroads Junction of the L5310 and L1309 (referred to as the 'Aughnagamun Cross' in this report) –** 08:15 to 09:15 (AM Peak) and 16:45 to 17:45 (PM Peak)
· **3-Arm T-Junction of the R639 and L1309 (referred to as the 'R639 Junction' in this report) –** 08:30 to 09:30 (AM Peak) and 16:45 to 17:45 (PM Peak)

14.18 The count data for each site has been converted to Annual Average Daily Traffic (AADT) values using the methodology described in "Expansion Factors for Short Period Traffic Counts" (Unit 16.1 NRA Project Appraisal

Guidelines, October 2016). Appendices A to C of the above document were used in the expansion of traffic counts to AADT's.

14.19 A combined factor of 0.851 was arrived at by combining the individual hourly factors for the count duration. This factor was then used to determine the 24-hour traffic flow. This was then converted to a Weekly Average Daily Traffic (WADT) using an index of 0.98 for the Tuesday traffic count. Finally, this was converted to AADT using an index of 0.97 for the month of May. These factors were used to calculate the AADT for the four junctions.

14.20 The resulting AADT figures at each junction are provided in Appendix 14-C.

Traffic 14: Table 1: Estimated AADTs at Site 1- (L1309 Site Access)

Hour Ending	L1309 North	Site Access	L1309 South
08:00	16	19	27
09:00	28	21	43
10:00	26	18	42
11:00	14	22	32
12:00	13	22	27
13:00	25	14	37
14:00	16	16	30
15:00	28	18	42
16:00	31	22	45
17:00	23	17	34
18:00	45	14	51
19:00	18	2	20
Period Total	283	205	430
Period Total HGVs	37	144	151
% HGVs	13%	70%	35%
Total AADT	316	229	480

Proposed Development Operations

14.23 The proposed development operations will include feedstock intake which is estimated to be c. 105,000 tonnes per annum and total methane gas production of approximately 12,700,000m3 per year.

14.24 The majority of feedstocks (c. 81%) will be supplied locally, and consideration will be given to supply within a radius of less than 20kms approximately.

1.0 Introduction

An Environmental Impact Assessment Report (EIAR) has been prepared in support of a planning application on behalf of Roadstone Ltd in support of a planning application under Section 34 of the Planning and Development, Act, 2000 (as amended) to Tipperary County Council which provides for a Bio-Renewable Plant (including anaerobic digester) to be located at the existing Killough Quarry facility, in Gaile townland, Holycross, Co. Tipperary.

An Appropriate Assessment Screening and Natura Impact Statement (NIS) has also been prepared in support of the planning application and is provided as a separate document.

1.1 The Applicant

The applicant, Roadstone Limited is an operating company within CRH plc and is Ireland's leading supplier of aggregates, construction, and road building materials. The company currently employs several hundred people at 65 locations throughout the country. Roadstone Limited originally developed from aggregate supply companies founded by the Roche Brothers in the 1930s. After steady growth through the 1930s and 1940s, it was floated on the Irish Stock Exchange in 1949. After further significant growth through the 1960s, Roadstone merged with Cement Ltd. in 1970 to

become Cement Roadstone Holdings (CRH) plc. Today, CRH plc is one of the leading suppliers of construction materials in the world, operating from over 3,500 locations and employing over 76,000 people in 35 countries.
Although Roadstone's principal business interest in Ireland is aggregate extraction and manufacture of building materials and products, it is also currently restoring a small number of its former pits and quarries under EPA licence using imported inert soil and stone waste.
In addition to these facilities, Roadstone also operates construction and demolition (C&D) waste recycling facilities at several of its locations across the State. These recovery facilities are principally engaged in the recycling / re-use of concrete and bituminous wastes and are regulated by way of Local Authority waste facility permits. Operations at all Roadstone's locations adhere to the environmental guidelines of the Irish Concrete Federation (ICF) and current best practice for the quarrying industry, as set out in the publication Guidelines on Environmental Management in the Extractive Industries published by the Environmental Protection Agency (EPA, 2006).
Roadstone is committed to achieving and maintaining industry leading environmental standards. To this end, the company has established, and actively implements, an in-house Environmental Management System (EMS) at all its locations include Killough quarry.

1.2 Site Location

The application site is located wholly within the townland of Gaile, Holycross, Co. Tipperary, and within the existing footprint of the Killough quarry development, owned and operated by Roadstone Limited. The site is approximately 3.5km and 6.5km south of Holycross and Thurles respectively, refer to Figure NTS-1.
The main transport route within the area is the M8 motorway, approximately 2.5km to the southeast of the site. There are also a number of regional routes in the area, the R659 and R660, east and south of Holycross respectively; and the R639, the former N8, just east of the M8). Access from the site to the primary road network is via c. 2.5 km of local road onto the M8 Motorway between Urlingford and Cashel.

1.3 Surrounding Land-Use

The overall Roadstone landholding (c. 108.3 hectares) encompasses a large portion of Killough Hill and is located over the three townlands of Gaile, Aughnagormaun and Sallsquarter in Co. Tipperary.
Killough Hill is a limestone escarpment which lies within the otherwise flat plain stretching several kilometres to the east and west of the river Suir. The north slope of the hill is steep whilst the southern side, and application area is a gentle slope.
The land immediately surrounding Killough Hill lies at levels of between 110 and 120m AOD.
Over a distance of 3.5km to the west of the hill the land falls very gently towards the River Suir to levels just under 80m AOD. Killough Hill which reaches a maximum height of approximately 215m is the only noticeable highpoint within the general area.
The existing main extraction void of the quarry at Killough Hill covers approximately the southern three quarters of the hill. To the immediate northwest, north and east of the void, the land slopes fairly steeply towards the surrounding plain, covering a height difference of between 50-80m over a distance of less than 200m. These steep slopes are covered by conifer and mixed woodland. To the immediate southeast and south of the void the land slopes slightly less steeply and is made up from pasture as well as some woodland scrub areas. To the immediate southwest of the void the quarry processing facilities are located at levels between 140m AOD and 170m AOD.
The flat landscape surrounding Killough Hill is almost exclusively made up from agricultural land (mostly pasture interspersed with some arable fields). The fields, which are usually enclosed by hedgerows, are also variable in size.
Residential development within the general area consists of isolated private residential property and agriculture farms located throughout the surrounding rural landscape, predominantly along the local road network. There are c. 22 residences located within c. 1km of the red line application boundary, of which 12 residences are located within 500m. Gaile national school is located c. 1.4km west of the site.

1.4 Site Access

The proposed development will use the existing permitted access to the existing quarry with direct access to and from the L1309 local road.
All HGV traffic associated with the bio-renewables facility will access and egresses the site via a dedicated weighbridge and wheelwash within the application boundary.
The public site notice is located at the site entrance as indicated on Figures NTS-2 and NTS-3.

1.5 Existing Site Description

The existing quarry has been in operation since the 1950's. Material extracted from the quarry area is processed within the quarry void using mobile processing plant. The materials are then stockpiled, pending further use on site for value added asphalt and concrete production or for transport off-site to market.
Manufacturing facilities at the quarry site include a concrete manufacturing facility, asphalt plant, a limestone production facility and an agricultural lime facility. Ancillary quarry facilities include offices, weighbridge & weighbridge office, canteen, toilets, wheelwash with overhead spray bar, bunded fuel storage areas and a garage / workshop. The extraction of the limestone rock is carried out using blasting techniques; processing (crushing and screening) of the fragmented rock to produce lime and aggregates for the concrete production (readymix and blocks), asphalt, road construction and site development works.
The proposed bio-renewables production facility compound will cover an area of c. 4 hectares within the southwest corner of the existing quarry (as indicated on **Plate 1** below) adjacent to the existing asphalt and concrete batching plants in an area currently used for aggregate stockpiling, refer to **Figure NTS-4**. The proposed facility will utilise the existing quarry entrance and access road, and along with some peripheral buffer areas and the compound site itself, the overall application area for the proposed development is 6.3 hectares.

Plate 1: Proposed Development Location within the existing Killough Quarry site

2.0 Description of the Proposed Development

2.1 Development Overview

The overall planning application site area of c. 6.3 hectares comprises the proposed biorenewables production facility, buffer screening, ancillary facilities and site access via the existing permitted quarry entrance.
The proposed bio-renewables production facility (incorporating anaerobic digestion) compound will cover an area of c. 4 hectares with c. 16,821.5m² of new buildings consisting of an administration building; a dry matter reception building; a workshop; a bio-conversion building; a pre-treatment, equalisation and gas upgrading building; a digestate handling building; a warehouse storage building; a bio-filling station building; an odour abatement and pumping station building; a linear generator building; and an ESB sub-station building.
Ancillary facilities to be provided will include, a wheelwash; a weighbridge; surface water and fire water storage ponds; storage tanks for water, silage feed, cattle manure, pot ale and spent grain, maize, chicken litter and gas; effluent collection and storage tanks; staff and visitor car parking and bicycle storage; HGV parking; roof mounted solar panels; hydrocarbon interceptors; wastewater treatment equipment; bunding and surface treatments; boundary treatments and fencing; lighting; services; drainage; landscaping; and all associated ancillary works.
Details of the proposed site layout are shown on **Figure NTS-5** and on **Plate 2** below. Key aspects of the proposed development include:

- Proposed development situated within the footprint of the existing permitted rock quarry at Killough which is owned and operated by Roadstone (i.e. not a greenfield site);
- A maximum tank height of c. 16 metres (gas storage balloon structure) and a maximum stack height of c. 17.5m (associated with the linear generator building);
- Facility will operate 24 hours a day / 7 days a week;

- Delivery of feedstock will be between the hours of 8am to 6pm Monday – Saturday /no deliveries Sundays or bank holidays;
- Feedstock importation will be c. 105,000 tonnes per annum consisting of:
- Chicken Waste c. 15,000 tpa
- Cattle Slurry c. 20,000 tpa
- Grass Silage c. 60,000 tpa
- Maize Silage c. 5,000 tpa
- Pot ale and Spent Grain c. 5,000 tpa
- Outputs will consist of:
- bio-methane (gas);
- compressed bio-methane (bio-CNG);
- carbon dioxide (CO2);
- electricity (green);
- organic fertilisers (pelleted); and
- water.

The adjacent Roadstone Killough Quarry plant will utilise the electricity, bio-methane and water generated by the proposed development. Pelletised fertiliser will be available for supply to local agriculture and traders off-site. CNG and CO2 will be pressurised and stored for ongoing draw-off by tankers to points of re-use off-site.

Plate 2: 3D Indicative Image of Proposed Development

It is proposed that the permission for the Proposed Development is open ended with no time limit attached, and therefore the EIAR provided a detailed assessment of the construction and operational stages only.
Should decommissioning be required at a later stage, it would require to be considered in the context of the overriding conditions and trends at that time, and these will be assessed as part of the future planning process and EPA licencing. It is considered likely that any decommissioning activities would involve similar works and time-frame as the construction stage.
As with any development, it is acknowledged that the various plant, equipment and structures will have varying lifespans and replacement of these will be carried out as required on an ongoing basis (examples: windows are assumed will be replaced on a 15 year cycle and doors on a 30 year cycle. Solar panels have also been assumed to have a service life of 25 years.)

2.2 Bio-Renewables Concept

The bio-renewables concept will include conversion of feedstock carbon to biofuels, CO2 to methane, digestate for further processing on site to capture nutrients for conversion to solid organic fertiliser (N,P,K). All products resulting will be co-products for reuse. There will be no by-products requiring disposal.
The silage, maize and slurry feedstocks required for the manufacturing programme will be supplied from local farms in the region. The total feedstock capacity anticipated from the works will be c.105,000 tonnes per annum.

The concept is based on the breakdown of organic volatiles using the anaerobic digestion process with offtake of biogas and digestate for further processing. CO2 will be captured and converted to methane for reuse. Digestate will be processed to produce solid fertilisers.

2.3 Best Available Technology (BAT) & Process Design

The works will be designed constructed and operated with BAT (Best Available Techniques) and products will be certified before storage for removal from the facility.

The following points are highlighted with respect to the design:

- Feedstock capacity will be contained at c. 105,000 tonnes per annum including grass, maize, silage, pot ale, spent grain, cattle slurry and chicken waste;
- Pretreatment will include special conditioning to maximise nutrient separation and conversion of volatiles, thereby maximising process performance;
- The digestion process put forward comprises of plug flow reactors running in series with biogas production significantly exceeding that of conventional digesters;
- Biogas will be separated into biomethane and CO2 with further processing of both products to produce finished fuel, for internal use by Roadstone;
- Digestate will be separated and further processed to provide solid organic fertilisers. All products will be certified;
- The thermal energy resulting from the various in-house unit operations will be captured for reuse at the fertiliser drying stage. The conversion of excess energy to electricity will be executed using state of the art CHP;
- The short-term storage of feedstock, gases, solids and liquids produced on site will be accommodated within the design with BAT environmental management measures;
- There will be no fugitive emissions, so that air quality standards can be maximised ensuring 100% methane and CO2 capture across the mass balance of the process.

2.4 Contribution to Local & Regional Sustainability

The proposed development will provide a significant contribution to local and regional sustainability. This will include the following:

- The silage, maize and slurry feedstocks will be supplied locally, and consideration will be given to supply within a radius of less than 20 km.
- This feedstock approach increases the potential output of farming in the region and individual contracts will be concluded on the basis of unit feedstock values.
- The fertiliser produced will further increase the potential of agriculture with introduction of regenerative farming and carbon sequestration.
- The energy related products will provide major reduction in carbon footprint (CF) and GHG, specifically:
- Total methane gas production is estimated to be c. 12,170,000m^3
- Roadstone will utilise some of the finished fuel to power their machinery at Killough and other centres.
- The balance of the finished fuel will be sold / traded to third parties.

2.5 Plant / Facility Overview

The facility will consist of the following elements to be constructed as detailed in **Table 1** below.

Detailed drawings showing the design, layout, finish and dimensions of each plant component are provided in the accompanying planning application drawings prepared by WEW Engineering Limited.

Table 1: Key Plant / Facility Components and Process

Drawing No.	Plant / Facility
WEW 1905-DG-**0001** **2**	Two-storey **administration building with** (gross floor area **664m²** and **8.15m** in height) to accommodate reception and storage areas, canteen, laboratory, first aid room, control room/electrical switch room, storage room, toilets, offices, conference room, training room and kitchenette, and roof solar panels **315m²**
WEW 1905-DG-**0002**	**Dry matter reception building** (gross floor area **5,215m²** and **12.7m** in height) with roof solar panels **4,000m²**

WEW 1905-DG-**0003**	**Workshop building** (gross floor area **122.1m²** and **8.9m** in height) to accommodate workshop and internal gantry crane, store and office at ground leveland office at mezzanine level
WEW 1905-DG-**0004**	**Bio-conversion building** (gross floor area **3,257m²** and **12.5m** in height) with roof solar panels **2,400m²**
WEW 1905-DG-**0005**	**Pre-treatment, equalisation and gas upgrading building** (gross floor area **5,685m²** and **12m** in height) to accommodate pre-treatment & equalisation area (3,527m²), utilities area (376m²), heat recovery plant area (361m²), water treatment recovery area (316m²), and gas upgrading facility (1,105m²) with roof solar panels 3,850m²
WEW 1905-DG-**0006**	**Digestate handling building** (gross floor area **692m²** and **8.6m** in height)
WEW 1905-DG-**0007**	**Warehouse storage building** (gross floor area **158m²** and **11.2m** in height)
WEW 1905-DG-**0008**	**Bio-filling station building** (gross floor area **300m²** and **9.75m** in height) with canopy overhang area of 134m², and externally located bio-methane (CH4) storage tank (**Ø 3m** x **11.5m** height) and bio-carbon dioxide (CO2) storage tank (**Ø 2.4m** x **9.75m** height) to southern elevation
WEW 1905-DG-**0009**	**Odour abatement and pumping station building** (gross floor area **448m²** and **11.25m** in height) to accommodate odour abatement system area (412m²) and pumping station (36m²) with emissions stack (**Ø 2.6m** x **17.5m** height)
WEW 1905-DG-**0010**	**Linear generator building (gross floor area 233m² and 5.82m in height) with emissions stack (Ø 1m x 17.5m height)**
WEW 1905-DG-**0011**	**ESB sub-station building (gross floor area 47.4m² and 3.2m in height)**
WEW 1905-DG-**0012**	**(18m x 4.5m) with associated water top-up sump (6m x 1.25m)**
WEW 1905-DG-**0013**	**Weighbridge (16.4m x 4.6m)**
WEW 1905-DG-**0014**	**Surface water storage pond (1,900m² x 6m depth) and fire water storage pond (2,800m² x 6m depth)**
WEW 1905-DG-**0015**	**External boundary paladin fencing (2.28m in height)**
WEW 1905-DG-**0016**	**1 no. water storage tank (internal size Ø 9.4m x 11.23m height and volume 800m³)** **3 no. silage feed soil/mixing tanks (internal size Ø 8.54m x 12.63m height and volume 770m³)** **2 no. fire water supply tanks (internal size Ø 21.35m x 14m height and volume 5,020m³)** **2 no. treated water storage tanks (internal size Ø 27.32m x 14m height and volume 8,230m³)**
WEW 1905-DG-**0017**	**3 no. bio-rest tanks (internal size Ø 17.1m x 14m height and volume 3,220m³)**
WEW 1905-DG-**0018**	**1 no. cattle manure/slurry silo (internal size Ø 7.5m x 10m height)** **1 no. pot ale / spent grain material tank/silo (internal size Ø 5.5m x 3m height)** **1 no. maize silo (internal size Ø 5.5m x 7m height)** **1 no. chicken litter silo (internal size Ø 5.5m x 10m height)** **2 no. precast concrete units (below ground) for surface water and effluent tanks (internal size Ø 5.5m x 7m height)** **1 no. below ground precast elliptical concrete sewage collection tank (3.2m x 6m height and 8,000 gallon capacity);** **1 no. gas storage balloon facility (Ø 30.6m x 16m height)** **1 no. flare (10m height)**
WEW 1905-DG-**0014** WEW 1905-DG-**0019**	**Associated and ancillary works including 22 no. staff and visitor parking spaces (16 no. standard, 4 no. EV charging and 2 no. disabled parking spaces with EV charging points); bike storage for 10 no. bikes); HGV parking area adjacent to workshop; 2 no. hydrocarbon interceptors; wastewater treatment equipment; bunding and surface treatments; boundary treatments; lighting; services; drainage; landscaping; and all associated ancillary works**

2.5.1 Administration Building

A two-storey administration building with (gross floor area 664m² and 8.15m in height) as shown on planning drawing WEW 1905-DG-**0001** to accommodate reception and storage areas, canteen, laboratory, first aid room, control room/electrical switch room, storage room, toilets, offices, conference room, training room and kitchenette. The

building will be a steel portal frame with blockwork and externally finished with Kingspan architectural wall panels (goosewing grey colour). There will be c. 315m² of solar panels attached to the roof.
The Administration Block will include facilities for ongoing laboratory assessment of feedstocks, gas and fertilisers and water. Wastewaters from the laboratories will be drained to a separate chamber for collection and off-site removal by a licensed contractor.
Certification of bio-methane and organic fertilizer will be carried out with necessary on-site attendances in compliance with the associated regulations, namely:

- Regulation (EU) 2023 / 1640 of 5 June 2023.
- S.I. No. 693/2023

The certificates of origin for the biomethane will be obtained via GNI and will confirm the product as green gas for use across European markets as anticipated on the Ergar market concept.

2.5.2 Dry Matter Reception Building

The dry matter reception building will be a fully enclosed building (gross floor area 5,215m² and 12.7m in height) with roof solar panels covering c. 4,000m² as shown on planning drawing WEW 1905-DG-0002. The building will be a steel portal frame with concrete precast walls to the lower 4m section with the upper section and roof consisting of Kingspan twin skinned insulated sheeting (goosewing grey colour). All dry feedstock arriving on site will be delivered by either truck or tractor & trailer into the reception building where the material will be offloaded into divided storage areas.

2.5.3 Workshop

The workshop building will be a fully enclosed building (gross floor area 122.1m² and 8.9m in height) as shown on planning drawing WEW 1905-DG-0003. The building will be a steel portal frame with the walls and roof consisting of Kingspan twin skinned insulated sheeting (goosewing grey colour). It will accommodate the workshop area with an internal gantry crane a store and 2 no. offices, one at ground level and one at mezzanine level.

2.5.4 Bio-Conversion Building

The bio-conversion building will be a fully enclosed building (gross floor area 3,257m² and 12.5m in height) and will contain roof solar panels covering c. 2,400m² as shown on planning drawing WEW 1905-DG-0004. The building will be a steel portal frame with the walls and roof consisting of Kingspan twin skinned insulated sheeting (goosewing grey colour).

2.5.5 Pre-Treatment, Equalisation & Gas Upgrading Building

The pre-treatment, equalisation and gas upgrading building will be a fully enclosed building (gross floor area 5,685m² and 12m in height) to accommodate pre-treatment & equalisation area (3,527m²), utilities area (376m²), heat recovery plant area (361m²), water treatment recovery area (316m²), and gas upgrading facility (1,105m²) with roof solar panels 3,850m² as shown on planning drawing WEW 1905-DG-0005. The building will be a steel portal frame with the walls and roof consisting of Kingspan twin skinned insulated sheeting (goosewing grey colour).

2.5.6 Digestate Handling Building

The digestate handling building will be fully enclosed (gross floor area 692m² and 8.6m in height) as shown on planning drawing WEW 1905-DG-0006 to accommodate palletiser station/packing station area (150m²), solid dryer/vacuum evaporator area (392m²) and nutrient adjustment facility (150m²). The building will be a steel portal frame with the walls and roof consisting of Kingspan twin skinned insulated sheeting (goosewing grey colour).

2.5.7 Warehouse Storage Building

The warehouse storage building will be fully enclosed (gross floor area 158m² and 11.2m in height) as shown on planning drawing WEW 1905-DG-0007. The building will be a steel portal frame with the walls and roof consisting of Kingspan twin skinned insulated sheeting (goosewing grey colour).

2.5.8 Bio-Filling Station Building

The bio-filling station building will be fully enclosed (gross floor area 300m² and 9.75m in height) with a canopy overhang area of 134m², and externally located bio-methane (CH4) storage tank (Ø 3m x 11.5m height) and bio-carbon dioxide (CO2) storage tank (Ø 2.4m x 9.75m height) to southern elevation as shown on planning drawing WEW 1905-DG-0008. The building will be a steel portal frame with the walls and roof consisting of Kingspan twin skinned insulated sheeting (goosewing grey colour).

2.5.9 Odour Abatement & Pumping Station Building

The odour abatement and pumping station building will be fully enclosed (gross floor area 448m² and 11.25m in height) as shown on planning drawing WEW 1905-DG-0009 to accommodate an odour abatement system area (412m²) and pumping station (36m²) with an emissions stack (Ø 2.6m x 17.5m height). The building will be a steel portal frame with the walls and roof consisting of Kingspan twin skinned insulated sheeting (goosewing grey colour).
The eradication of odorous emissions is necessary to achieve BAT design. During preliminary design stage works the sources of odorous emissions were identified and the constituents requiring specific removal from the diluted gaseous emissions comprise sulphides, ammonia, methane and related volatiles and micro solids. These will be removed and the gaseous emissions will comply with EU EN13725.2022.
Gaseous emissions from buildings will be evacuated and ducted via a ducting network to a modular air purification system using biofiltration and/or adsorption in the odour removal building. Air quality will comply with the guidance recommendations of the EPA Air Guidance Note AG 9, 2019.

2.5.10 Linear Generator Building

The linear generator building will be fully enclosed (gross floor area 233m² and 5.82m in height) as shown on planning drawing WEW 1905-DG-0010 with emissions stack (Ø 1m x 17.5m height). The building will be a steel portal frame with the walls and roof consisting of Kingspan twin skinned insulated sheeting (goosewing grey colour).
The biomethane diverted to provide an electrical supply to Killough Quarry will be split to a series of linear electricity generators which can provide electrical supply without waste gas emission. The units come as integrated assemblies and may be installed on a modular basis in the Linear Generator Building shown.

2.5.11 ESB Sub-Station Building

The ESB sub-station building will be fully enclosed (gross floor area 47.4m² and 3.2m in height) with a render finish as shown on planning drawing WEW 1905-DG-0011. The substation will be constructed in accordance with ESB specifications. Green electricity will be produced by on-site solar power generation, utilizing the building complex with battery storage and supply forward via the new sub-station.

2.5.12 Wheelwash / Weighbridge

The wheelwash (18m x 4.5m) with associated water top-up sump (6m x 1.25m) as shown on planning drawing WEW 1905-DG-0012 and the weighbridge (16.4m x 4.6m) as shown on planning drawing WEW 1905-DG-0013 will be located in line along the entry/exit route and located to the south of the administrative building and carpark area.
All vehicles entering the facility to deliver feedstock or export digestate will enter and depart via the weighbridge. Weighbridge information will be recorded automatically by a weighbridge data management system. The weighbridge will be of steel construction, mounted on load cells within a reinforced concrete pit chamber while the wheelwash will be a concrete 'bath type' wheelwash through which the trucks drive through.

2.5.13 Storage Tanks & Silos

There are several storage tanks and silos located throughout the site as shown on planning drawing WEW 1905-DG-0016, 0017 and 0018, consisting of:

- 1 no. water storage tank (internal size Ø 9.4m x 11.23m height and volume 800m³);
- 3 no. silage feed soil/mixing tanks (internal size Ø 8.54m x 12.63m height and volume 770m³);
- 2 no. fire water supply tanks (internal size Ø 21.35m x 14m height and volume 5,020m³);
- 2 no. treated water storage tanks (internal size Ø 27.32m x 14m height and volume 8,230m³);
- 3 no. bio-rest tanks (internal size Ø 17.1m x 14m height and volume 3,220m³);
- 1 no. cattle manure/slurry silo (internal size Ø 7.5m x 10m height);
- 1 no. pot ale / spent grain material tank/silo (internal size Ø 5.5m x 3m height);
- 1 no. maize silo (internal size Ø 5.5m x 7m height);
- 1 no. chicken litter silo (internal size Ø 5.5m x 10m height); and
- 1 no. gas storage balloon facility (Ø 30.6m x 16m height).

2.5.14 Flare

An enclosed biogas flare is proposed for installation on the site, serving as an additional safety measure. The flare will be located within the water storage ponds area as shown on planning drawing WEW 1905-DG-0018 and will only operate under distinct scenarios to ensure safety and compliance. The flare is incorporated for emergency use only and is not anticipated to function during normal operating procedures.

2.5.15 Piping System

All feedstock / digestate pipes will be located above ground so that any leakages in the piping system cannot lead to pollution of the receiving environment. The pipework for the transmission of biogas will be fabricated mostly in stainless steel above the ground. For any biogas pipework located underground, polyethylene will be used. After pipework construction is completed, a tightness test will be carried out with all pipes being pressure tested.

2.5.16 Compound Security

The perimeter of the site will be secured by a paladin fencing and security gates (2.28m in height) as shown on planning drawing WEW 1905-DG-0015.

2.5.17 Lighting

Down lighting will be provided at approximately 20m spacing and mounted on buildings, tanks and other suitable structures as shown on planning drawing WEW 1905-DG-0020. The lighting will be directed downwards and all lights will be located internally within the site and directed inwards with the buildings and tanks themselves blocking light from being directed externally. Such lighting will be sufficient to permit safe operation of plant and machinery during early morning and late evening periods over winter months.

2.5.18 Landscaping

The overall development plan is shown in Figure NTS-5, and entirely within the existing operational quarry site. There is no requirement to remove topsoil or overburden off site.

There is no requirement to remove any trees or hedgerows from the application site.

Existing screening berms (c. 4-6m in height) and hedge/tree vegetation bound the southern and western boundaries of the application site.

2.5.19 Operational Hours and Employment

The facility will operate 24 hours per day, 7 days a week, as anaerobic digestion is a continuous biological process. However, transport of feedstock to the site and any products exported from the site will only be carried out between the hours of 0800 and 1800 Monday to Saturday. There will be no feedstock or product transport on Sundays or Bank Holidays.

The proposed development will provide direct employment for 15 to 20 people.

2.5.20 Water Management

Process water and precipitation will be typically reused and not discharged to outfall. On site water will be captured, pumped to storage with in-line quality monitoring, for use on the application site and for use in the adjacent quarry site. Drainage networks are shown on planning drawing WEW 1905-DG-0014.

The application site drainage will comprise of:

- run-off from the building roofs in the facility will be collected in a sealed pipe network for onsite storage in the surface water pond and reused in the adjacent quarry site as required;
- drainage of hard standing / trafficked areas will be collected in a separate sealed pipe network for onsite storage in the surface water pond and reused in the adjacent quarry site as required.

2.5.20.1 Water Supply

When the site is operational, process water will be recovered from the digestate and recirculated through the process to dilute incoming feedstock. The feedstock will be on average 70% water (30% DM) and requires dilution to 94% water (6% DM) for processing so process water will be added. Excess water will be treated and stored for use in the concrete plant on the adjacent quarry site.

There is no requirement for a groundwater supply to the plant. There is no requirement for a connection to any Irish Water infrastructure.

Potable water supply to the offices will be bottled water brought to site.

2.5.20.2 Water Storage

There are surface water ponds and tanks as noted in the project description above for the use of storing fire water, water for reuse in the anaerobic digestion process and water for use in the adjacent concrete batching plant.

2.5.20.3 Foul Wastewater Management

It is estimated that sewage generated by staff, visitors and canteen will vary between 2m3/d and 4m3/d. This will gravitate to a collection tank, roofed and with an adsorption roof filter, submersible mixer and sealed tanker connection to prevent any odour emission. It will be drawn off site once every two weeks for treatment at an existing sewage works by agreement with the STW operator.

Similarly, the laboratory facility will be plumbed separately to a holding tank for collection and removal off site by a licensed contractor. Storage tanks on site will consist of:

- 2 no. precast concrete units (below ground) for surface water and effluent tanks (internal size Ø 5.5m x 7m height); and
- 1 no. below ground precast elliptical concrete sewage collection tank (3.2m x 6m height and 8,000 gallon capacity).

2.5.20.4 Surface Water Management

Surface water runoff and roof water will gravitate to the surface water pond for use as dust suppression water by the adjacent quarry site. Further details of the proposed water management system are provided in EIAR Chapter 7 Water.

2.5.21 Construction Phase

2.5.21.1 Construction & Commissioning Programme

It is envisaged that construction and commissioning of the proposed development will be undertaken over c. 18 months with works expected to commence in 2025.

2.5.21.2 Construction Environmental Management Plan

During the construction phase, the methods of working will comply with all relevant legislation and best practice in reducing the environmental impacts of the project. Construction stage impacts are a short-term localised impact. However, the impacts will be reduced as far as practicable through compliance with the mitigation measures as stated in the EIAR topic chapters and current construction industry guidelines.

As part of the preconstruction preparation a comprehensive Construction Environmental Management Plan (CEMP) will be developed. To ensure the CEMP is tailored to the project and the current environment at the time of construction, it will be prepared by the appointed contractor in advance of any construction works commencing and in accordance with any conditions imposed by the Planning Authority.

The CEMP, in a single document, will outline the procedures and practices for monitoring the effectiveness of the proposed environmental protection measures, and will include at the very least:

- List of all relevant environmental legislation requirements;
- State methods by which the construction works will be managed to avoid, reduce or remedy potential adverse environmental impacts;
- Incorporate environmental mitigation measures and controls in the construction contract documents which will incorporate the mitigation measures as outline in the following chapters of this EIAR; in any conditions attached to a grant of planning permission or any further requirements of statutory bodies;
- Provide a method statement outlining how compliance with the environmental commitments / mitigation measures will be carried out.
- Take account of best practice guidance such as CIRIA C741 Environmental Good Practice on Site (4th edition) and CIRIA C532 Control of Water Pollution for Construction Sites.

In general, disturbance arising from construction works may result from various activities including preparatory works, diversion of services, noise and vibration, excavation operations earthworks, construction traffic and delivery of materials. Details of the predicted impacts and mitigation measures associated with the construction of the proposed development are included in the relevant chapters (e.g. Air Quality in Chapter 8, and Noise & Vibration in Chapter 10) with a summary of all mitigation and monitoring proposals provided in Chapter 17.

2.6 Construction Employment

It is expected that c. 20 direct jobs will be created during the construction phase. In addition, many more indirect jobs will be generated.

2.7 Temporary Facilities

A temporary contractors compound will be required for the duration of the construction phase works. This will include temporary staff welfare facilities, temporary car parking and will be located within the red line boundary application area.

2.8 Operational Phase (AD Life-Cycle Processes)

2.8.1 Feedstock

The proposed development has been designed to accept and treat up to 105,000 tonnes per annum of predominantly locally sourced cattle manures, slurries, and crop-based feedstocks along with a small quantity of brewery residues (pot ale and spent grain). The estimated feedstock composition and annual tonnages accepted are outlined in Table 2

below. These tonnages are indicative and subject to change based on market and season conditions and availability and quality of feedstocks. Overall tonnages will not exceed 105,000 tonnes.
AD can process a broad spectrum of feedstock from various sources. In principle, any biodegradable organic matter can be anaerobically digested to produce biogas.
Cattle manure is one of the most common feedstocks employed in AD because it is readily available in agricultural farms. Despite containing many characteristics favourable for AD (neutral pH, different microbes, a wide variety of nutrients, etc.), they produce a lower amount of biogas than other feedstocks because they are already predigested by the animal intestine.
However, manure is often added as a base substrate and co-digested with other feedstock because of its desirable characteristics. Combination of feedstocks, commonly known as codigestion process, offers the opportunity to add energy-rich organic waste materials, for example, sustainable co-products from brewing /distilling etc. Typically, these high-energy materials can produce significantly higher levels of biogas than conventional agricultural feedstocks.

Table 2: Estimated Feedstock Composition and Intake

Feedstock	Estimated Quantity (tonnes / annum)
Chicken Waste	15,000 tpa
Cattle Slurry	20,000 tpa
Grass Silage	60,000 tpa
Maize Silage	5,000 tpa
Pot ale and Spent Grain	5,000 tpa

The silage, maize and slurry feedstocks which make up approximate 80% of the feedstock will be supplied locally, and consideration will be given to supply within a radius of less than 20km.

2.8.2 Feedstock Acceptance and Storage Procedures

Feedstocks will be transported to the proposed development using heavy goods vehicles (HGV's / HDV's) and tractor/trailer, and sealed vacuum tankers. Only feedstocks meeting strict feedstock acceptance procedures and complying with Environmental Protection Agency (EPA) and Department of Agriculture, Food & Marine (DAFM) license conditions will be accepted.
All vehicles entering the facility to deliver feedstock or export compressed bio-methane (bio- CNG), carbon dioxide (CO_2) or organic fertilisers (pelleted) will enter and depart via a weighbridge located along the site access road. Weighbridge information will be recorded automatically by a weighbridge data management system.
All suppliers must complete a Feedstock Acceptance Agreement (FAA). Upon arrival at the site, incoming feedstock deliveries will be weighed and logged at the dedicate weighbridge in accordance with regulatory requirements set by the EPA and DAFM. Visual inspection of feedstocks will ensure conformity with the FAA. Once delivery and documentation are confirmed, delivery vehicles will be directed to the Reception Hall for further processing.
Solid materials will be unloaded into designated feedstock bays within the reception hall which has a storage capacity of c. 10,000 tonnes, to allow for continuous operation of the plant on days where no feedstock deliveries are made. Liquid manure will arrive onsite in sealed tankers and be pumped directly into the sealed storage tanks.

2.8.3 Odour Abatement System

An odour abatement system will recover and treat all odours arising from the processes and activities occurring on site. All major odour sources, inclusive of the reception hall, digestate storage tanks, liquid feed tanks and pasteurisation tanks are connected to the odour abatement system. The odour treatment will be a proprietary system designed and supplied by a specialist contractor with experience of treating odour from biogas and other organic waste facilities.

2.8.4 Feedstock Conditioning

This is carried out in the pretreatment and equalization building which is connected to the odour abatement system via ducting to remove odours.
The respective feedstocks will be conditioned to maximise the efficiency of the biochemical methane potential (BMP). Incoming feedstocks from grasses, maize and manure origins need to undergo size reduction.
Breaking down cell walls directly through physical force using mechanical methods are less likely to contaminate the final product than other methods. The Killough project will utilise proven technology to ensure particle size of <5mm

through high-pressure grinding, maceration, pulping and on-line transfer to the mixing plant. The Killough plant will include leading feedstock maceration technology.
The feedstocks from other sources will be added in parallel to the premix chamber to create a standardised feedstock that is easily pumped and mixed into the reactor to ensure close culture contact will result as required for efficient AD reactions.

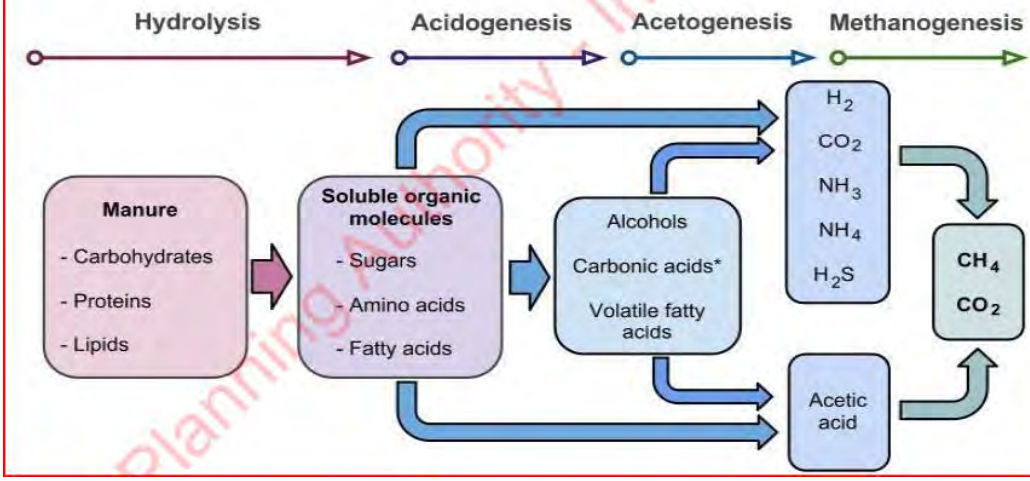
2.8.5 Anaerobic Digestion Process

Anaerobic digestion (AD) is a natural biochemical process that converts organic materials into combustible biogas. AD has been long practiced for agricultural and urban waste management. The process consists of a series of biochemical reactions where bacteria break down the organic matters of any substrate into a gaseous mixture (CH4, CO2, H2, H2S, etc.) in the absence of free oxygen. Some groups of bacteria involved in the digestion process cannot survive in the presence of oxygen. Therefore, an anaerobic (oxygen-free) environment is necessary for the process.
The AD process typically occurs in a closed vessel such as that shown in Plate 1. Produced biogas flows out to temporary storage and later on to the end-use applications. The main commercial applications of biogas are typically fuel, heat and electricity generation. After AD, the vessel will contain residual solids and organic matter known as digestate. Digestate can be separated into liquid and solid streams. Both streams contain valuable plant nutrients and can substitute as fertilizer in agricultural applications.
The AD process occurs through multiple steps with complex interactions between different types of microorganisms. Diverse microbial communities collaborate to break down the complex biomass polymers at different stages and turn them into a gaseous mixture. The biochemical AD reactions can be divided into four distinct stages as outlined below and shown in Plate 2:

- Hydrolysis: this is essentially the first stage of the digestion process. Water and extracellular enzymes break down the complex polymeric structure of cellulose, starch, proteins and convert them into their respective simple units (monomers or oligomers) such as glucose, fatty acids, and amino acids. Some compounds in this stage are ready to be converted into biogas, but most compounds need further breakdown through other stages.
- Acidogenesis: the products of hydrolysis are further broken down in the acidogenesis stage by acidogenic (acid-forming) bacteria.
- Acetogenesis: is the third step of anaerobic digestion. Products from fermentation (organic acids, alcohols) are converted into hydrogen (H2), carbon dioxide (CO2) and acetic acid (CH3COOH). To produce acetic acid, acetogenic bacteria need oxygen and carbon. For this, they use the oxygen solved in the solution or bound-oxygen. Hereby, the acid-producing bacteria create an anaerobic condition, which is essential for the methane-producing microorganisms responsible for the final step of anaerobic digestion which is methanogenesis.
- Methanogenesis: This is the final stage where methane is produced from all intermediate products of the previous stages. This stage is strictly anaerobic as the methanogenic bacteria cannot survive in the presence of oxygen. CH3COOH (acetic acid) and H2 are converted into CO2 and CH4 by two different groups of bacteria, such as acetophilic and hydrogenophilic. Acetophilic bacteria convert acetate into CH4 and CO2, while hydrogenophilic bacteria convert H2 and CO2 into CH_4.

Plate 1: Typical Reactor Bank

Plate 2: Stages of the Anaerobic Digestion Process



The AD technology chosen for the site utilises plug flow AD technology and also incorporates internal high rates of reaction due to high intimate contact area. This maximises series performance of the hydrolytic, acidification and methanogenic bacterial groupings.

The plug flow reactor type technology has been researched, patented and proven over years by Antec Biogas. It allows the development of an AD plant that offers a small footprint versus biogas yield with a tight control of the hydrolysed feedstock to the anaerobic bioreactors. The system will also include ammonia stripping to allow for increased processing of high-energy by-products. Please refer to the accompanying technical report prepared by the design engineers WEW Engineering Ltd.

2.8.6 Bio-Renewables & Anaerobic Digestion Outputs

The anaerobic digestion process at the site will generate a number of end-products also referenced as co-products as outlined below.

2.8.7 Bio-methane (gas) / Compressed bio-methane (bio-CNG)

Biogas is the product of the complex biological decomposition (anaerobic digestion) of organic materials, mainly consisting of 55-70% by volume methane (CH4), 30-45% carbon dioxide (CO2), together with traces of other gases, i.e., nitrogen, hydrogen, hydrogen sulphide and ammonia, as well as water vapour. The exact composition of biogas is dependent on the type of feedstock being digested.

Biogas can be 'upgraded' to pure methane, often called bio-methane, by removing CO2, H2S, moisture and other trace gases. The biogas upgrading process produces a purified stream of biomethane. The upgrading process also produces a CO2 rich gas stream which can be recovered for treatment within a CO2 recovery system for use off site.

The gas will also be processed further to generate compressed natural gas (CNG) / compressed bio-methane (bio-CNG) which is commonly used by passenger cars, vans, buses, and trucks. The compressed gas will be used as a fuel source for the Killough Quarry operations and any surplus will be tankered off-site for use at other Roadstone facilities or sold on the open market.

2.8.8 Carbon Dioxide (CO2)

As noted above, upgrade of the biogas requires the removing of the CO2 which would contribute to GHG concentration in the atmosphere if not captured.

The proposed development will provide a biogas upgrading facility which will allow the desulphurised biogas to be separated into biomethane and CO2 while using membrane technology. The separated CO2 will be compressed and stored on the site for removal on an ongoing basis. By utilising this process, the biogenic CO2 from biomethane production which would have been emitted to the atmosphere is now captured, purified, and reused, thereby creating a circular economy.

In the EU, the specification for CO2 for use as a food or beverage additive is defined in Commission Regulation No 231/2012. The regulation gives recommendations on establishing levels of such impurities, taking account of variability in naturally sourced CO2 or in source processes using natural feedstocks, and on the quality assurance procedures that should be applied to compressed-CO2 storage and supply operations. The CO2 may then be upgraded to a standard where it can used in various industries, for example food, pharmaceutical, chemical etc.

2.8.9 Electricity from bio-methane

As noted above, upgrade of the biogas requires the removing of the CO2 which would contribute to GHG concentration in the atmosphere if not captured.

The proposed development will convert a proportion of the biomethane produced directly to electricity for use by the adjacent Roadstone quarry operations without passage through the mains grid.

In addition to the above electricity generation, solar photovoltaic (PV) modules are included upon the roof structures of the administration, dry reception, bio-conversion and pre-treatment buildings, covering a total surface area of c. 10,565m2 with anticipated electricity generation of between 1.5 to 1.8 GWh per annum.

2.8.10 Organic Fertilisers

The other by-product of the anaerobic digestion is digestate, which consists of undigested inert material and water. The digestate is composed of liquid and solid components and the system carries the nutrients carried into the system via the feedstock to the end co-product as organic fertiliser. Unit operations will be installed which will convert the digestate produced to a certified pelleted fertiliser for use by farmers in place of synthetic fertilisers.

It is anticipated that pelletised digestate and fibre will, on the whole, be returned to lands associated with feedstock supplies of crop and/or slurry, thereby promoting a local circular bioeconomy. Digestate receivers will manage the storage and application of bio-based fertiliser on their lands and will be subject to controls set out in S.I. No. 113 of 2022 European Union (Good Agricultural Practice for Protection of Waters) Regulations 2022.

2.8.11 Water

When the site is operational, process water will be recovered from the digestate and recirculated through the process to dilute incoming feedstock. The feedstock will be on average 70% water (30% DM) and requires dilution to 94% water (6% DM) for processing so process water will be added.

The system design is based on reuse of excess waters locally by Roadstone at the Quarry and concrete plant. Water from processing will be treated to potable standards, S.I. No. 99/2023 and will be stored on site for export to the quarry site after servicing firewater storage requirements.

Roof waters and clean rainwater will pass via a drainage network to the collection and storage tanks and will be pumped in a programmed manner to the Roadstone Quarry site for re-use.

2.9 Environmental Controls

2.9.1 General

Site operations and activities at the application site will require a number of environmental controls to eliminate or minimise the potential disturbance to the public arising from the onsite processing operations. The environmental control measures to be put in place at the site are outlined in the relevant EIAR Chapters that follow.

2.9.2 Pest Control

Anaerobic digestion (AD) is a natural process involving the conversion of feedstock (any organic non-woody material) by micro-organisms in the absence of oxygen into biogas and digestate. Given the nature of organic material being used as feedstock, there is potential for the site to be attractive to flies, birds, vermin and other feral animals.
If these potential pests were not controlled there could be a risk to public health and surrounding agriculture because of the potential for spread of disease they can represent.
However, effective pest control procedures are a mandatory requirement for all waste management facilities and a specialist pest control agency will be engaged for monitoring and management (where required) during all stages of the proposed development.

2.9.3 Bird Control

As the feedstock materials will be transported in covered or sealed vehicles, and stored within fully enclosed buildings, site activities are not anticipated to attract scavenging birds such as gulls and crows for the duration of works. Accordingly, it is not intended to implement any specific bird control measures at the site as is the case at present at the quarry site.

2.9.4 Traffic Control

As the planning application relates to development within the existing quarry site, the proposed development will utilise the existing site entrance.

2.9.5 Litter Control

As the proposed development will be largely free of litter, the daily operational activities are unlikely to give rise to problems with windblown litter. Accordingly, there is no requirement to implement any specific litter control measures at the site.

2.9.6 Odour Control

As noted previously, an odour abatement system will be implemented to eradicate odours arising from the processes and activities occurring on site. All major odour sources, inclusive of the reception hall, digestate storage tanks, liquid feed tanks and pasteurisation tanks are all connected to the odour abatement system. The odour treatment will be a proprietary system designed and supplied by a specialist contractor with experience of treating odour from biogas and other organic waste facilities.

2.9.7 Fire Control

In the unlikely event that a fire does occur, the local fire station will be contacted and emergency response procedures will be implemented. A range of fire extinguishers (water, foam and CO2) will be kept at the site office to deal with any localised small-scale fires which might occur.
Additional fire-fighting capacity will be provided by storing water in a dedicated firewater pond (9,800 m3).

2.9.8 Environmental Management System (EMS)

An Environmental Management System (EMS) will be put in place for the facility, as will be required by the IE Licence. The operator shall develop the EMS in accordance with ISO14001:2015, applying for accreditation when operational. This EMS will include but not be limited to the following:

- Measures to comply with the IE licence and other relevant environmental legislation;
- Materials Acceptance Procedures;
- Standard Operating Procedures;
- Measures to comply with the corporate sustainability goals (e.g., reducing water and energy consumption);
- Accident prevention and emergency response procedures; and
- Complaints Register.

2.9.9 Airborne Emission Control

The eradication of odorous emissions is necessary to achieve BAT design. During the preliminary design the sources of odorous emissions were identified. The constituents requiring specific removal from the diluted gaseous emissions comprise sulphides, ammonia, methane and related volatiles and micro solids. These will be removed and the gaseous emissions will comply with EU EN13725.2022 with a design odour number not greater than C 98 5 OUE/m3.
Gaseous emissions from buildings will be evacuated and ducted via a ducting network to a modular air purification system using biofiltration and/or adsorption in the odour removal building. Air quality will comply with the guidance recommendations of the EPA Air Guidance Note AG 9, 2019. Gaseous emissions from each operations building will be monitored for flow, ammonia, sulfides and methane (specific to the gas production and gas handling areas). The system will be automated with emergency alarms.

2.9.10 Noise Generation and Control

Prior to commencement of works, the Applicant (and any appointed Contractors) will compile and submit to Tipperary County Council a Construction Noise and Vibration Management Plan (NVMP). The plan shall:

- Outline management processes and mitigation measures to be utilised to remove or reduce significant noise impacts from the intended construction works;
- Define noise and vibration monitoring and reporting;
- Include method statements for each phase of the works including associated specific measures to minimise noise and vibration in so far as is reasonably practicable for the specific works covered by the plan and a detailed appraisal of the resultant construction noise and vibration generated.

The Applicant will also proactively engage with the local community and notify the public and potential noise / vibration sensitive premises before the commencement of any works which would be likely to generate any appreciable levels of noise or vibration, explaining the nature and duration of the works.

The Applicant will also distribute information circulars informing the local community of the progress of site-based construction works which will also highlight any likely periods of significant noise and vibration.

The Applicant also intends to implement best practice noise and vibration management techniques throughout the operational phase of the proposed development to control, and where possible, further reduce the noise impact to nearby noise sensitive receptors.

- All noise generating mechanical plant will be reviewed for potential tonal and impulsive properties or characteristics and ensure that appropriate noise reduction is fitted at source, where practicable.
- Based on the noise emissions of the selected mechanical plant items, the sound insulation performance of all building elements making up the façades, roofs, louvres, roller doors and personnel doors of all process buildings will be designed, specified and constructed in a manner that ensures that applicable noise thresholds can be achieved offsite.
- The CHP exhaust stacks will be fitted with suitable acoustics attenuators as standard.
- In order to minimise noise breakout, doors to all buildings with potentially elevated levels of noise will be installed with auto rollers or segmented personnel and vehicle access doors.
- Loader operators will be required to restrict heavy impact of the loader bucket against concrete hardstand or material bunkers.
- Access / internal haul roads will be kept clean and maintained in a good state of repair, specifically any uneven surfaces will be repaired, potholes filled, and large bumps removed to avoid unwanted rattle and “body-slap” from heavy goods vehicles.
- All vehicles delivering and operating on the site will have white noise reversing alarms fitted.
- Vehicles waiting within the application site will be prohibited from leaving their engines running and there will be no unnecessary revving of engines.
- Care will be taken when unloading vehicles to reduce or minimise potential for noise disturbance to nearby residents.
- HGVs / trucks accessing and egressing the proposed development should adhere a 60 kmph speed limit travelling along on the L1309 to ensure road traffic noise impacts at the nearest noise sensitive receptors are minimised.
- Any deliveries to the proposed development site will be programmed to arrive during daytime hours only. Licensing Requirements

2.10 Environmental Protection Agency

The EPA was consulted during the pre-planning consultation period to seek feedback on the proposed development. No response was received by the time of the submission of the application. Having regard to waste authorisation requirements as defined by the classes of waste activity listed in the Third Schedule of the Waste Management (Facility Permit and Registration) Regulations, 2007 (S.I. No. 821 of 2007), as amended and to current law and practice, it is considered that the proposed development will require an application for an Industrial Emissions (IE) licence to the EPA in accordance with Class 11.4 of the First Schedule of the EPA Act 1992 as amended, outlined in Table 3 below.

Table 3: Class 11.4 of the First Schedule of the EPA Act 1992 (as amended)

11.4 (a)	Disposal of non-hazardous waste with a capacity exceeding 50 tonnes per day involving one or more of the following activities (other than activities to which the Urban Wastewater Treatment Regulations 2001 (S.I. 254 of 2001) apply):
1	biological treatment;
2	physico-chemical treatment;
3	pre-treatment of waste for incineration or co-incineration;
4	treatment of slags and ashes;
5	treatment in shredders of metal waste, including waste electrical and electronic equipment and end-of-life vehicles and their components.

11.4 (b)	Recovery, or a mix of recovery and disposal, of non-hazardous waste with a capacity exceeding 75 tonnes per day involving one or more of the following activities, (other than activities to which the Urban Wastewater Treatment Regulations 2001 (S.I. No. 254 of 2001) apply):
1	biological treatment;
2	pre-treatment of waste for incineration or co-incineration;
3	treatment of slags and ashes;
4	treatment in shredders of metal waste, including waste electrical and electronic equipment and end-of-life vehicles and their components

11.4 (c)	Notwithstanding clause (b), when the only waste treatment activity carried out is anaerobic digestion, the capacity threshold for that activity shall be 100 tonnes per day.

The IE licence will set conditions under which the following will be controlled:

- Emission Limit Values (ELV's) for emissions to air and stormwater;
- Monitoring requirements for emissions;
- Resource use and energy efficiency;
- Waste management control documentation;
- Waste acceptance procedures and records;
- Storage and transfer of substances;
- Changes to operations and the physical fabric of the facility;
- Facility management including the requirement for an environmental management system (EMS);
- Accident prevention and emergency response including fire water retention; and
- Operational controls.

2.11 Department of Agriculture, Food, and Marine (DAFM)

The Anaerobic Digestion Facility will be a 'Type 1' plant under the European Union (Animal By-Products (ABP)) Regulations (S.I. No. 187 of 2014). The facility will process Category 2 animal by-products, specifically cattle manures i.e., cattle slurry, and poultry manure (chicken litter). Approval will be required from the Department of Agriculture, Food, and the Marine (DAFM) in accordance with Article 24 of Regulation (EC) No. 1069/2009, for the acceptance and/or treatment of animal by-products. DAFM was consulted during the pre-planning consultation period to seek feedback on the proposed development. No response was received by the time of the submission of the application.

The proposed development has been designed with consideration to the DAFM guidance CN11: *Conditions for approval and operation of biogas plants transforming animal by-products and derived products in Ireland*.

The application process for approval and operation of the proposed facility by the DAFM occurs in three stages as follows:

1. Application for approval in principle.
2. Application for conditional approval to operate which allows an operating period of three months to test and demonstrate ABP compliance. This stage commences following the construction and handover of the facility.
3. Full approval. This application process will commence upon receipt of planning consent.

2.12 SEVESO III Directive / Control of Major Accidents Hazards Regulations (COMAH)

The Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015 (S. L No. 209 of 2015) transposes Directive 2012/18/EU of the European Parliament and of the Council of 4th July 2012 on the control of major accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC ("the SEVESO III Directive").
The purpose of the COMAH Regulations is to lay down rules for the prevention of major accidents involving dangerous substances, and to seek to limit as far as possible the consequences for human health and the environment of such accidents when they occur, with
the overall objective of providing a high level of protection in a consistent and effective manner.
There are two tiers of establishment, which are related to the quantities of dangerous substances present. Depending on quantity, an establishment may be upper-tier or lower-tier.
Upper-tier establishments have greater quantities of dangerous substances present and therefore are obliged to comply with additional requirements specified in the Regulations.
The COMAH Regulations place an obligation on operators of establishments that store, handle, or process dangerous substances above certain thresholds to take all necessary measures to prevent major accidents and to limit the consequences for human health and the environment.

2.12.1 SEVESO/COMAH Assessment of the Proposed Development

Methane, the combustible component of biogas is classified as a P2 flammable gas in accordance with Regulation (EC) No. 1272/2008 on the classification, labelling and packaging of substances and mixtures.
Under COMAH, P2 flammable gases are subject to a threshold quantity of 10 tonnes meaning that any biogas facility storing less than 10 tonnes of methane will fall outside of the COMAH Regulations.

- Biogas will be stored at less than 100 mbar with a density of 1.15- 1.2 kg/m3.
  - The storage volume is approximately 11,000 m3.
  - Therefore 13.2 tonnes of Biogas.
- Biomethane will be stored at up to 250 bar with a density of up to 215 kg/m3.
  - The storage volume is approximately 81.25 m3.
  - Therefore 17.5 tonnes of Biomethane.
- Biogas would be subject to the 10 tonne Lower Tier Threshold (P2 Gas), the Biomethane would be subject to the 50 tonne Lower Tier Threshold *(Named substances 18, Note 19),*
  - (13.2 ÷ 10) + (17.5 ÷ 50) = 1.67
- Biogas would be subject to the 50 tonne Upper Tier Threshold (P2 Gas), the Biomethane would be subject to the 200 tonne Upper Tier Threshold *(Named substances 18, Note 19),*
  - (13.2 ÷ 50) + (17.5 ÷ 200) = 0.35
- Also just to note that on a long weekend there is the potential for 2No MECG biomethane trucks to be onsite waiting to be moved to another site. This is up to another 50 tonnes.
  - (13.2 ÷ 50) + (67.5 ÷ 200) = 0.6

The assessment set out above confirms the site will exceed the threshold by storing more than 10 tonnes of flammable gas and will therefore be considered a Lower Tier COMAH regulated site.
A detailed Safety Risk Assessment (SRA) has been carried out for the development and is detailed in EIAR Chapter 15.
As noted previously, part of this facility will include an anaerobic digestion (AD) plant. The plant is expected to convert organic feedstock into carbon dioxide and methane, with further processing to produce synthetic biofuel, which will be stored and exported at high pressure.
Carbon dioxide is an asphyxiant whilst methane is a highly flammable gas, with the latter especially raising concerns at a public consultation meeting for land-use planning (LUP). Roadstone has therefore appointed the SLR Consulting Safety Advisory team (SLR-SA) to conduct a semi-quantitative risk assessment (sQRA) in line with the Health and Safety Authority guidance on land-use planning decisions.

2.13 Consultations

2.13.1 Pre-Planning Consultation

A Section 247 pre-planning meeting was held with Tipperary County Council on the 20th of November 2023 (Pre-planning Ref. PP10095) to discuss the proposed development. In attendance were representatives for the client and the design team, with representatives from TCC planning, environmental and engineering departments. Matters

discussed included the development proposals, planning considerations and advice from TCC to the applicant. A copy of the pre-planning minutes is provided in Chapter 1 of the EIAR.
In addition, a pre-planning consultation document was issued to statutory consultees. The list of consultees and any responses received are noted in **Table 4** below, and full details provided in Chapter 1 of the EIAR and relevant technical chapters of the EIAR.

Table 4: Statutory Consultees

	Consultee	Response (Y/N)
1	Development Applications Unit (DAU)	Y
2	Transport Infrastructure Ireland (TII)	Y
3	Geological Survey of Ireland (GSI)	Y
4	Uisce Éireann (formerly Irish Water)	Y
5	Inland Fisheries Ireland (IFI)	N
6	Health and Safety Authority (HSA)	Y
7	An Taisce	N
8	Fáilte Ireland	
9	National Parks & Wildlife Services (NPWS)	N
10	Heritage Council	N
11	Environmental Protection Agency (EPA)	N
12	Dept of the Environment, Climate and Communications	N
13	Dept of Agriculture, Food and the Marine (DAFM)	N
14	Sustainability Energy Authority of Ireland	N
15	Health and Safety Executive (HSE	N

A summary of the feedback received consists of the following:

- The Department of Housing, Local Government and Heritage referred to the wider area of known archaeological settlement and activity and emphasised the importance of the study area for the archaeological and cultural heritage assessment being of sufficient size and extent to reflect that. It also advised that the assessment must be carried out by a suitably qualified Consultant Archaeologist.
- Transport Infrastructure Ireland (TII) provided general advice on the methodology and guidance to be followed in assessing the impact on the road network and the importance of considering cumulative projects in the area in terms of road impacts. TII also highlighted that any improvements required to facilitate development, haul routes and requirements for abnormal loads should be clearly identified and assessed.
- Geological Survey Ireland (GSI) requested consideration of measures by the quarry operator to assist in achieving their geological heritage goals, such as allowing access to quarry faces and facilitating means of allowing wider appreciation of geological heritage with the wider public.
- · Uisce Éireann provided advice on ensuring that water resources and infrastructure are safeguarded during all stages of development, and that any new requirements for connection to existing infrastructure are clearly identified.
- The Health and Safety Authority (HSA) highlighted the need to consider whether the project would come within the scope of the Control of Major Accident Hazard Regulations 2015 and requested that the body be notified once a planning application has been submitted.

2.13.2 Public Consultations

Roadstone elected to organise a public consultation event in the form of a 'Public Information Drop-In Event' at a local hotel (the Horse & Jockey), on the evening of Tuesday 25th June 2024. A local residence letter drops, and a newspaper public notice advertisement were carried out in the two-week period prior to the scheduled information drop-in event. The public were invited to submit observations and feedback either in person at the public information session or via email to info@roadstone.ie.

The event was intended to provide an opportunity for potentially impacted local residents and any interested third parties to meet with Roadstone personnel and its advisors to discuss the development and ask any relevant questions.

To facilitate public engagement and discussion, Roadstone set up display's information boards around the meeting room. The display boards provided some background information, proposed layout scheme, brief description of the proposed development along with some 3-D concept views.

Attendees were also invited to submit any further comments or questions to an email (info@roadstone.ie) provided by Roadstone on or before the 26th July 2024. This date was later extended to 23rd August 2024 by Roadstone Limited as requested by a local Councillor.

3.0 Need for Development and Consideration of Alternatives

To align themselves with well publicised International and European requirements in relation to moving to a zero-carbon economy, Roadstone have decided to initiate a full-scale bio renewables plant at its Killough Quarry outside Thurles, Co. Tipperary where there is capacity for such infrastructure to be installed within the existing quarry site. Ireland is now legally committed to reducing greenhouse gases to net-zero emissions no later than 2050, the DECC has published a target of up to 10% of national gas demand to come from biomethane by 2030 as part of the Sectoral Emissions Ceilings.

The proposed development will support this target by providing a facility which will provide renewable energy production from biomethane, whilst also supporting the rural circular economy and the effective management of agricultural waste.

These opportunities would be missed should the proposed development not proceed and local agricultural wastes would continue to be applied directly with chemical fertiliser to the land at current volumes. CH4 would not be captured for renewable energy production, and it would continue to be a source of greenhouse gas emissions. The economic opportunity and jobs provision associated with the proposed development would also be lost.

The application site at Killough Quarry is considered a suitable location due to:

- its location within the existing and long established quarry site, i.e. a brown field site in a rural area;
- within an appropriate topographic setting i.e. well screened from surrounding areas;
- rural location, but with good access to the regional and national roads network with long established HGV traffic movements on the local road network;
- located directly where the energy and by-products generated will be used, i.e. the asphalt and concrete plants at the existing quarry;
- over 80% of the feedstock (cattle slurry and silage) can be sourced locally, i.e. within a c. 20km radius of the proposed development;
- similarly, there is a local market for use of the organic fertilisers which will be a byproduct of the anaerobic digestion process, pelleted fertiliser for use by farmers in place of synthetic fertilisers;
- best practice industry standard methodology and standards can be used; and
- the proposed development will provide renewable energy production, support the circular economy and the effective management of waste in line with EU, National, Regional and Local Policy which all highlight urgent need to diversify Irelands energy sources to provide a carbon neutral and sustainable energy sector in Ireland.

The overall design process has been an iterative process between the design team and Roadstone with inputs from engineering, planning, environmental, hydrological and traffic specialists. This process was implemented to design out any potential significant environmental impacts. Alternative design revisions were considered in relation to sizing of plant and equipment, and reconfiguring of the layout to ensure the best flow for site operations and in order to be proportionate and fit in with the surrounding quarry site. The most environmentally efficient technological configurations incorporated to the process design were selected following extensive feasibility work and review of Best Available Technology as mandated by European and Irish legislation to reduce environmental pollution.

4.0 Existing Environment, Effects and Mitigation

4.1 Population & Human Health

The review of population is based predominantly on a review of settlement and land use patterns to identify existing residential housing and sensitive receptors in the vicinity of the application site. Ordnance Survey maps and aerial photography were also examined.

Demographic information from the Electoral Division (ED) of Gaile, in which the application site is located, from the census years of 2016 and 2022 were used in order to identify broad trends in the area.

The census results indicate that the population has increased in the Gaile ED area, albeit at a lower rate than that observed at the county and (in particular) the national level. The census data in relation to economic activity suggests that employment opportunities offered by the proposed development are in line with the requirements of the local workforce and their current industry experience. Long-term employment is envisaged for 15 to 20 direct employees plus a number of indirect sub-contractors, hauliers and service providers for the lifetime of the facility.

The proposed development supports the Tipperary County Development Plan objectives of sustaining the importance of the agricultural economy and supporting the diversification of it, while at the same time developing renewable energy capacity. It will stimulate local employment and boost the bio-energy sector experience and opportunities in the area.

Measures to prevent and control industry specific emissions such as the potential for malodour and the safe handling of gas are identified and proposed based on technical environmental investigations. Therefore, it is anticipated that the potential emissions / disturbance to amenity will be managed and minimised so as not to conflict with tourism, agriculture or any other economic assets in the surrounding area. It is considered likely that the potential diversification that the proposed development can provide for local agricultural enterprises will assist in supporting the viability of existing community services.

4.2 Biodiversity

An ecological field survey was conducted in August 2024 to determine the biodiversity value of the application site and surrounds. The dominant plant species present in each habitat type were recorded and sightings or evidence of any invasive species, birds, mammals or amphibians were also noted. The habitats within the study area were evaluated for their potential to support protected species and trees or structures suitable for bat roosts / foraging were noted. Findings from the field survey have been supplemented by publicly available biodiversity records for the area.

All designated sites for biodiversity within 15 km and with ecological and/or hydrological connectivity were considered as part of the assessment. The site is adjacent to the Killough Hill proposed Natural Heritage Area (pNHA), which is designated due to the presence of nationally rare limestone pavement and associated grassland habitats. The pNHA covers parts of the wider quarry site.

Most of the application site and surrounding area is comprised of active quarry works. Some floral species have grown along the side of tracks but the habitat has negligible value for biodiversity. The existing structures, grounds and earth banks within the application site were also assessed but considered to be of negligible value for biodiversity.

The quarry faces within the existing quarry may provide suitable nesting habitat for peregrine and kestrel, although no nests were identified on the quarry faces during the field survey.

There is no potential nesting habitat for these species within the application site itself.

The Site is considered to be of low value to foraging and commuting bats due to the presence of surrounding suitable habitats (i.e. woodland edge) that will be retained and have good connectivity with the surrounding hedgerow network and woodland along the northern boundary of the existing quarry.

The woodland habitats to the north and west of the Site have potential to support local fauna but these do not extend into the proposed project area and the Project will not result in the removal of any of the woodland. The 6 semi-mature trees (beech and pine), 5 young pine and c. 50 young willow trees that will need to be removed in the aggregate stockpile storage area are self-seeded species which are not part of any ecologically valuable woodland or treeline in the area. The clearance of the trees within the Site must be carried out outside of the bird nesting season

(1st March – 31st August inclusive) will avoid any potential loss of breeding and foraging habitats for birds. There is sufficient and more suitable bird nesting habitat also available in the surrounding area.

The trees that are to be removed are of negligible roosting suitability as they are not of sufficient size or maturity to be used on a regular basis by bats. The storage building that is due to be removed for the proposed development has entrances that may be accessed by roosting bats. However, the corrugated roof of this building renders it of negligible suitability for roosting bats.

The potential for negative impacts on plant growth from potential nitrogen arising from the emissions from the AD plant was assessed, and it was found that appropriate built-in anaerobic digestion (AD) plant design mitigation measures will prevent any nitrogen deposition.

Best practice operational measures and implementation of a site Environmental Management System (EMS) will be put in place for the facility to ensure the safeguarding of habitats within the Killough Hill pNHA.

4.3 Land, Soils & Geology

The proposed development site is set to be located within the Roadstone Killough Quarry (area c. 108.3 hectares), specifically, in the southeast of the quarry.

It is located within 'Killough Hill' which is a designated County Geological Site in recognition of its intrinsic limestone escarpment value for natural heritage. As such, Killough Hill should be protected and promoted for its heritage value and for recreational and geo-tourism initiatives. These actions are deemed to be more appropriately focused on the quarry site rather than the proposed bio-renewables application site.

The land immediately surrounding Killough Hill lies at levels of between 110 and 120m AOD.

The land gently slopes down towards the River Suir (c. 3.5km west of Killough Hill) to just under 80m AOD. Killough Hill is the only noticeable high point in the local area at a maximum heigh of c. 215m.

To the immediate northwest of the site, the land slopes steeply towards the surrounding plainlands, resulting in a height difference of between 50-80m over a distance of roughly 200m. These steep slopes are covered by conifer and mixed woodland. To the immediate southeast and south of the void the land slopes slightly less steeply and is made up from pasture as well as some woodland scrub areas. To the immediate southwest of the void the quarry processing facilities are located at levels between 140m AOD and 170m AOD.

Site investigation data from drilling of groundwater wells in 2020 and a Geotechnical Assessment undertaken in 2016 were to inform the assessment of local soil and geology conditions. The soil association at the application site has been classified as the Elton Series (ISIS Code 1000x). The soil combination is considered to be well draining and widespread within the study area. The Elton Series is especially productive for agricultural uses.

The application site currently consists of rock at the surface and former luvisol type of soils which were previously stripped from the application area as part of the quarrying operations.

The bedrock is derived from mainly calcareous parent materials (IFS code BminSW). The bedrock is classified as shallow well drained mineral (Mainly basic). Therefore, soils across the proposed development site are absent.

Distribution of subsoils in the study area is presented as principally Till type occurring in form of Limestone till. Additionally, minor deposits of alluvium (sand and gravel), cutover peat, manmade materials, limestone sands and gravels and lake sediments are present in varying small proportions within the 5 km study area examined.

The boreholes drilled in 2020 (GW1, GW2, and GW3) reached a depth of up to 101 m bgl, primarily encountering strong, medium-grey limestone with occasional minor zones of weak, weathered, and clay-rich sections. The dominant lithology across all boreholes is consistent with the Ballyadams Formation—a fossil-rich, clean limestone commonly quarried.

Bedrock geology underlying the site has high potential economic value, however, this will be minimally disturbed as a result of the proposed development. The status of the site as a proposed Natural Heritage Area (pNHA, site code

000959) due to the presence of unique limestone pavement and calcareous grassland in these areas will not be impacted and no existing geological exposures will be lost.

The nature of the development will entail the change in land use from mineral extraction to renewable energy production.

A direct impact will occur from the removal of a small volume of limestone bedrock at the site to facilitate the construction of the development, including building foundations and water ponds at the site, however, it is considered unlikely that development will have an indirect impact on the broader geological aspects of the environment outside the footprint of the application site.

Standard best practice construction and drainage management mitigation measures will be implemented at the site to manage any accidental fuel or oil leaks that could cause interactive impacts between ground and other environmental features.

4.4 Water (Hydrology and Hydrogeology)

In addition to a desk study of publicly available data, extensive data gathering has been undertaken at the site as follows:

- Drilling of three groundwater monitoring boreholes (GW1 – GW3) was undertaken in August 2020 and all three boreholes were drilled to 101m depth.
- A borehole survey was undertaken in November 2020 to determine which of the existing boreholes could be used for groundwater level monitoring. PW06 was identified as a borehole where groundwater level monitoring could be undertaken. PW05 was monitored until Q2 2022. Pumps are installed in PW01 – PW03, and so the groundwater levels (GWLS) are not monitored at these locations.
- Installation of groundwater level data loggers in November 2022 at groundwater monitoring boreholes GW01 – GW03 and PW06 to facilitate continuous groundwater level monitoring;
- Quarterly manual dipping of groundwater wells and groundwater level logger downloads since November 2020;
- Annual groundwater quality monitoring results at GW01 – GW03 from 2022 to 2024.

The site is underlain by crinoidal wackestone/packstone limestone of the Ballyadams Formation and that a small section in the middle of the site is underlain by cherty, muddy, coarse grained, calcarentic limestone of the Clogrenan Formation. The soils surrounding the overall quarry landholding are fine loamy drift with limestone stones known as the Elton (1000ET) Soil Association.

Surface water features at the proposed development area include two small streams located close to the boundary of the site. The first stream, SUIR_080 is located along the northwestern border and the second stream, LISNAGONOGE_010 is located along the northern boundary and flows into the north of the quarry.

The SUIR_080 stream, located northwest of the proposed development site, flows into the Lower River Suir SAC which is located c. 3.5km north of the proposed development site. The Lower River Suir SAC is also located c. 4km west of the proposed site. The site is within the Water Framework Directive (WFD) Suir_SC_050 Sub Catchment (ID 16_10) and is split between three River Sub-Basin catchments, LISNAGONOGE_010, SUIR_090 and SUIR_080. The proposed development site is split between the SUIR_080 and SUIR_090 River Sub-Basin catchments. Under the WFD classification, the River Suir is ‘At Risk’ status and the Lisnagonoge stream is classified as being of ‘Moderate’ status.

There are no recorded flood events at or near the site, nor is there any risk of potential flooding.

The GSI online map viewer shows the site is underlain by a regionally important karstic aquifer (Rkd). This aquifer is defined as being a good aquifer capable of supplying regionally important supplies e.g. large public water supplies. The groundwater vulnerability at the site is classed as Extreme and as X (Rock at or Near Surface). The closest karst features are two swallow holes located just over 2km northwest of the proposed development.

The proposed development is located within the Tipperary Groundwater Body (GWB). The groundwater flow in this aquifer is expected to be close to the surface through karstic conduits and enlarged fissures, mainly along fault zones. This GWB is classified as being not at risk status under the WFD classification. This groundwater body is bordered by the Templemore GWB, Clonmel GWB and the North Kilmallock GWB. All of these GWBs, including Tipperary GWB, received a Good WFD status during the 2016-2021 period. However, these same GWBs, are considered At Risk of deteriorating in quality.

There is the Ash Hill Group Scheme Source Protection Area located c. 2.5km east of the site.

The closest Group Water Scheme (GWS) is located c. 2km northeast of the site, the Graigue- Moycarkey GWS. The Graigue-Moycarkey GWS well has a depth of 76.2m with no info on the depth of rock. The yield class is noted as good (327.30 m^3/day) and has a productivity class of III. There is no public supply source protection area within the vicinity of the proposed site, the closest is Tobernaloo Public Water Supply (PWS) c. 7km north of the site.

There are ten groundwater well locations within the overall quarry landholding, 4 of which are monitored for groundwater levels and for data loggers and 3 of which are monitored for groundwater quality. Each of these wells have pumps installed and groundwater is regularly abstracted from them.

Between 2020 and 2024, large variations have been observed in all four monitoring wells. It is likely that nearby groundwater pumping is the main cause of these large-scale fluctuations in groundwater levels. Groundwater level data indicates a general groundwater flow direction of south-east to north/north-west, towards the Lisnagonoge stream.

Groundwater quality monitoring was carried out on 7th August 2024, 22nd May 2023 and 3rd February 2022. The results were compared against several legislation and EPA specified limits. Across the three monitoring rounds, no exceedances were reported for Volatile Organic Compounds (VOCs), Total petroleum hydrocarbons (TPHs) and Extractable Petroleum Hydrocarbons (EPHs).

All waters will be managed on site, including clean rainwater, process water and foul waters.

Process waters will be treated in the onsite treatment plant. All water will be reused on site where possible but some excess clean water will go to Killough Quarry for use there in concrete production and dust suppression, replacing the current abstraction requirements.

There will be no discharge of waters off site.

The water streams at the site are as follows:

- Process waters;
- Roof water;
- Site surface water:
- Firewater; and
- Foul waters.

Water is stored in a number of tanks at the site for use in the process activities and also for emergency purposes.

There will be no discharge of water from the Killough Quarry site associated with the proposed development.

Examination of the identified potential impacts on the receiving environment show that with the inherent design mitigation measures and best practice management in place, there are no significant residual impacts with respect to groundwater and surface water during the construction or operation of the proposed bio-renewables facility development. A monitoring programme is proposed to demonstrate that the development is not having an adverse impact on the surrounding environment and will document any improvements in water quality.

4.5 Air Quality

A full technical Air Quality Assessment was undertaken in order to predict the following:

- Road traffic trip generation and dust emissions associated with the construction phase;
- Road traffic trip generation associated with the site operations;
- Odour and dust emissions associated with the site operations;
- Emissions to air associated with the on-site combustion of bio-methane; and
- Ammonia emissions associated with the site operations.

With respect to the potential for air quality impacts, the key objective at the application site is to manage activities to ensure that air emissions are prevented where possible, and the effects of any residual releases are minimised.

The Ambient Air Quality Standards Regulations 2022 in Ireland set out the framework for monitoring and managing air quality in accordance with European Ambient Air Quality Directive (2008/50/EC) and its daughter directives, which aim to protect human health and the environment. Within these, standards and objectives for ten priority pollutants are identified, and this provides a framework for quantifying the potential for human health impacts. UK Environmental Protection Agency Guidance are used to provide the framework for assessment of potential ecological impacts.

A review of Irish Environmental Protection Agency monitoring data suggests that NO2, SO2 and PM10 concentrations monitored are below specified limits.

A wind rose was developed to show the frequency of wind speed and direction in order to determine the broad direction and spread of modelled air and odour emissions.

Air from the areas within which potentially odorous processes will be undertaken will be extracted to and treated by an onsite odour abatement system (which will be in operation 24 hours per day, 7 days a week), or captured by the gas capture system.

The odour exposures predicted as a result of emissions from the proposed development at the identified sensitive receptors are below the relevant impact criterion and deemed not to be significant in line with the relevant guidance thresholds.

A wide range of mitigation and management measures are recommended for implementation during the construction phase of the proposals, and the following operational/containment measures are proposed:

- the chicken litter and brewery residue siloes, cattle slurry tanks, pretreatment and equalization building, bio rest tanks and digestate handling building would be enclosed structures, with air extracted to the odour abatement system;
- the odour abatement system would treat the air extracted from these areas prior to discharge to atmosphere via a dispersion stack at a height of 17.5m;
- the anaerobic digestion process would be undertaken within sealed reactors located within the bioconversion building. These sealed reactors would be connected to the gas capture system, ensuring complete containment;
- a site management system would be in place to ensure routine cleaning measures are undertaken;
- implementation of a speed restriction (25 km/hr) within and around the quarry;
- the existing road surfaces will be maintained;
- water-assisted dust sweeper(s) will be utilised on the access road and local roads, as necessary, to remove material tracked out of the site; and
- vehicles leaving the site will use the existing wheel wash.

With these measures in place, there are no significant effects predicted to human or ecological receptors.
Ongoing dust deposition monitoring is carried out by Roadstone at the existing quarry site at selected locations along the extent of the site boundary. Review of the dust monitoring results from these locations will be used to ensure the mitigation measures are effective for the duration of the construction phase.
Once operational, the proposed development will be a licenced facility under the Industrial Emissions Directive and will therefore be required to conduct “sniff surveys” in accordance with AG5 at regular intervals to demonstrate that mitigation measures are sufficient to prevent odour nuisance at sensitive off-site locations. Stack monitoring of the odour abatement system exhaust may also be required at regular intervals under the conditions of the IE Licence.

Emissions monitoring of selected point sources will also be carried out in accordance with conditions of a future licence.

4.6 Climate

The proposed development is a bio renewable facility for the generation of renewable fuels from agricultural and animal organic matter. The facility includes several buildings of which will be powered by the bio-methane and solar energy generation.
On completion of the proposed development, it is expected to support in the reduction of emissions through the avoided use of fossil fuels for the customers of this facility. A whole life cycle assessment of the potential greenhouse gas emissions associated with the proposed development shows a significant beneficial impact as a result of the project.
There are no expected significant impacts from future climate change on the proposed development however it is recommended the operators of the facility consider supply chain impacts from climate and take this into account when agreeing contracts.

4.7 Noise & Vibration

The noise impact assessment describes and assesses the existing noise characteristics of the local area. The anticipated effects of the proposed development have been applied to these baseline conditions, using worst case assumptions, and the resulting noise impacts assessed. Mitigation measures are identified where necessary to eliminate or minimise adverse impacts, insofar as practical.
The existing topography of the site boundary berms provide some inherent acoustic screening.
The predicted construction noise levels show that construction noise levels will fall below the standard thresholds and impacts are predicted to be temporary.
Notwithstanding the findings of the construction phase noise impact assessment, best practice construction noise and vibration management practice will be adhered to and implemented as a matter of course.
The predicted operational noise levels indicate that under typical operational conditions, the relevant operational noise thresholds during the day, evening and night time periods would be achievable subject to the adherence to best practice noise management practices.
The road traffic noise level arising from hourly HGV movements when the proposed development is operating at maximum capacity have been predicted on assessment as being a negligible to minor potential impact on receptors located along the L1309.
The Applicant will undertake an annual compliance noise survey to establish operational noise emissions arising at the application site and demonstrate compliance with noise emission thresholds set by any grant of planning permission or licence issued by the EPA.

4.8 Material Assets

The material assets assessment comprises the consideration of existing resources pertinent to the proposed development and the application site that are not addressed elsewhere in the EIAR and the likely development impacts on those resources. On this basis, it primarily includes a review of utilities such as electricity, telecommunications, gas, water supply infrastructure and sewerage, as well as waste management arrangements.
Pre-planning consultation feedback of most relevance to the assessment of material assets was received from Uisce Éireann (formerly Irish Water), which stipulated required measures to ensure the protection of supply and protection of public water supplies. This was addressed in EIAR Chapter 7 – Water.
Public consultation feedback in relation to material assets was received in relation to road capacity, water management, safety risks to buildings (from potential explosion of gas or blasting from the quarry) and the management of feedstock to the proposed development.
The water assessment set out in Chapter 7 confirms that the proposed development will not have any adverse impacts on local residents in terms of quality or supply. Monitoring arrangements will be put in place to provide further reassurance. Consultation with Irish Water as part of the material asset assessment confirmed there is no local mains supply in the area.
The electricity infrastructure will be enhanced at the application site by way of a new substation to be introduced, and potential enhanced connectivity to renewable energy from solar power and biogas.
All agricultural wastes entering the facility will be required to meet strict feedstock acceptance procedures and complying with Environmental Protection Agency (EPA) and Department of Agriculture, Food & Marine (DAFM) licence conditions.

In developing proposals for the site, technical investigations have been carried out in relation to the application site's suitability and feasibility of the AD plant in this location and the available capacity for the scale of agricultural wastes required to feed it was confirmed.
The 20km radius of the proposed development was estimated to include 133,477 hectares of agricultural land with average farm size of 45 hectares. The estimated requirements of the proposed AD plant would utilise 1.7%, 0.25% and 48% of the present indicative potential production grass silage, maize and bovine slurry annually respectively.

4.9 Cultural Heritage

Chapter 12 of the EIAR provides an assessment of the effects on the archaeological, architectural and cultural heritage of the application site and the surrounding area of a proposal to develop a Bio-Renewables Plant on a brownfield site in the townland of Gaile, Co. Tipperary, within the existing Killough Quarry.
The following sources were examined and a list of sites and areas of archaeological, cultural heritage and architectural potential compiled:

- Record of Monuments and Places (RMP) for County Tipperary SR
- The Sites and Monuments Record that is maintained by the Dept of Housing, Local Government and Heritage · The County Tipperary County Development Plan 2022-2028
- The National Inventory of Architectural Heritage
- Aerial photography
- Cartography

The application site has also been the subject of several site visits by the author.

The application area is situated in southern Tipperary County, c. 4 km to the west of Horse and Jockey and 2.2km km north-west of the R639. It is situated on Killough Hill which rises to 220m OD.

The application area has already been assessed for developments on two previous occasions and no effects on archaeology, cultural heritage or buildings of special architectural significance have been identified. The entire application area has been completely stripped of topsoil down to subsoil levels and there will be no direct or indirect effects by the proposal on any known items of archaeology, cultural heritage, or buildings of special architectural significance in the application area or the vicinity.

There are no effects on any items of archaeology, cultural heritage, or buildings of special architectural significance in the application area or vicinity and no mitigation is required.

4.10 Landscape & Visual

The Landscape and Visual Impact Assessment (LVIA) was undertaken based on a desk top assessment of relevant plans, guidance and landscape character assessments, as well as a thorough site assessment carried out in April 2024. The desktop study and field work were informed by the following:

- Tipperary County Development Plan 2022-2028
- digital and paper (Ordnance Survey Ireland) mapping at different scales; and
- information available on the internet (such as satellite images and information on recreational facilities and nature conservation sites).

A study area of 1 km surrounding the application area and extending up to 3 km to the northwest, west, southwest, south and southeast was identified during the desktop study, based on the Zone of Theoretical Visibility Map. While the ZTV indicates further areas of visibility beyond this area, the level of visibility is very low and considering the local agricultural landscape with many screening hedgerows, a larger study area is not considered necessary.

Seven representative viewpoints were selected and were provided as annotated panoramic images showing the existing view with software additions to illustrate the visibility of the proposed development, i.e. how much of the proposed structures will become visible above the existing boundary screening berms and vegetation.

The proposed development will result in limited landscape and visual effects during the construction stage, owing partly to the short-term construction stage. Due to the height of the individual buildings it is not feasible to screen all

the works and therefore no landscape / visual mitigation measures are considered necessary during the construction stage associated with the proposed development.

No significant landscape or visual effects were identified during the operational stage of the development. Large parts of this development will be screened by the existing boundary berms and vegetation, even more so, when the recently carried out planting on top of the western boundary berm matures. Apart from this planting, which is already in place, no further landscape or visual mitigation measures are considered feasible / necessary during the operational stage of the proposed development.

4.11 Traffic

A traffic assessment was undertaken to examine the traffic implications associated with the proposed development in terms of its integration with existing traffic in the area. The extent of additional trips generated by the development was estimated and the resulting impact on operational performance of such trips on the local road network was assessed based on traffic counts undertaken on the local road network and modelling of the additional trips using standard industry programmes.

The Traffic and Transport Assessment makes the following conclusions:

- Link capacity analysis was carried out on L1309, and it was determined that all roads will continue to operate within capacity for each of the assessment years: 2025, 2026, 2027, 2032, and 2042;
- The results of the junction capacity analysis indicates that all junctions will operate within capacity for each of the assessment years: 2025, 2026, 2027, 2032, and 2042;
- The assessment therefore indicates that the development will have a negligible impact on traffic flows on the existing road network due to the low volumes of traffic being generated by the development;
- Visibility to the north and south of the quarry access is limited by the vertical alignment, the horizontal alignment of the local road, and vegetation. However, the geometric constraints, coupled with low traffic volumes on the local road, have passively controlled vehicle speeds at the access. There are no accident records indicating that there are existing incident patterns at the site entrance and the site operator has confirmed that no issues or concerns have been reported by staff. Traffic on the L1309 will largely be associated with the application site, or vehicles generated by local development. Therefore they will be aware of the site operation and existing access junction. All vehicles will access/egress the application site using a forward gear. Operational vehicles also benefit from a raised driver viewpoint and are positioned closer to the junction as HGVs tend not to have a bonnet. Adjacent hedgerows and vegetation are all under the control of the site operator and will continue to be maintained to ensure that visibility is maximised at the site access junction. Therefore, junction visibility at the site access junction is considered appropriate and fit for purpose; and
- The parking spaces within the site is considered sufficient for the number of staff working on site, and also for any miscellaneous trips that may occur.

4.12 Major Accidents and Disasters

A review was undertaken to establish both the vulnerability of the application site to major accidents and disasters (such as through flooding risk) and the potential for the proposed development to cause an increased risk of major accidents and disasters at the site.

A matrix analysis was used to identify the potential risks, their likelihood of occurrence and an evaluation of their consequences. The matrix approach was used to indicate the potential risks/vulnerabilities with greatest potential to occur at the project site. The potential risks identified in construction and operation related to severe weather/flooding incidents, collapse/damage of structures or industrial style accident / accidental spillage causing water contamination. The risk of introducing the potential for spread of infectious disease was identified during the operational stage due to the handling of biological animal waste.

For all potential risks, an assessment was made as either unlikely or very unlikely. The design and construction of the proposed development adheres to the best practices outlined in the planning application details and will be subject to internal Environmental Management Systems as well as rigorous licencing procedures by the EPA and DAFM. Therefore, all risks were ultimately assessed as being a low risk scenario.

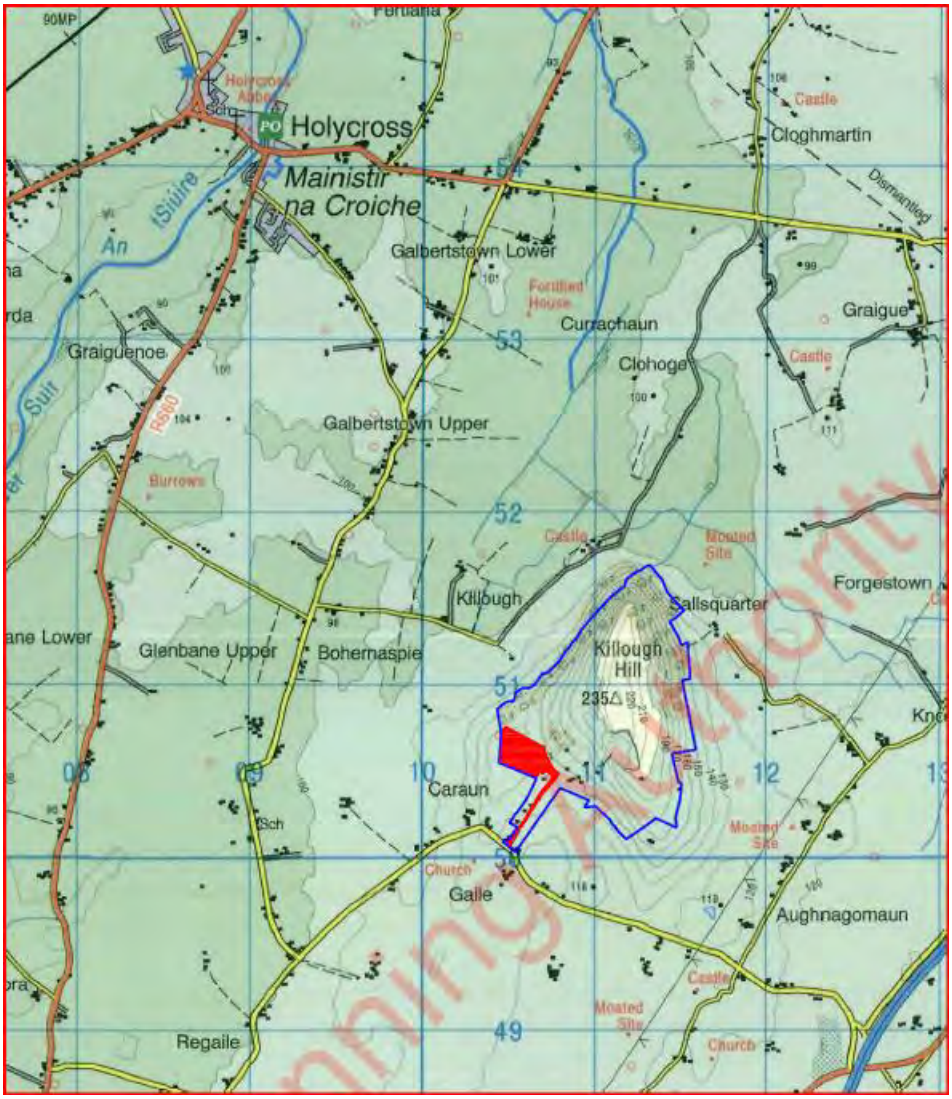
The proposed project does not introduce a significant risk of major accidents or disasters, nor is it vulnerable to potential disasters or accidents, including both natural and man-made incidents.

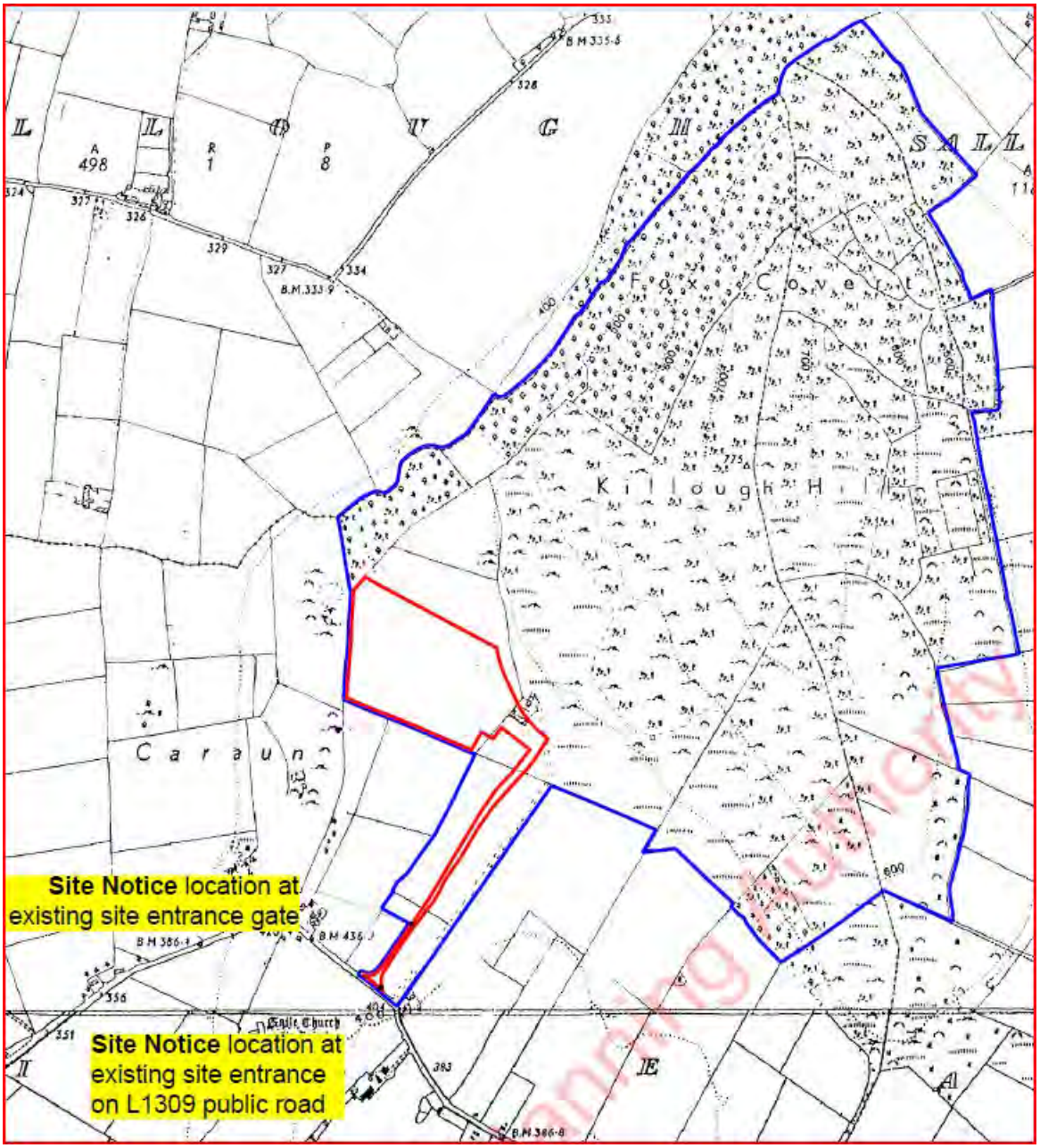
4.13 Interactions

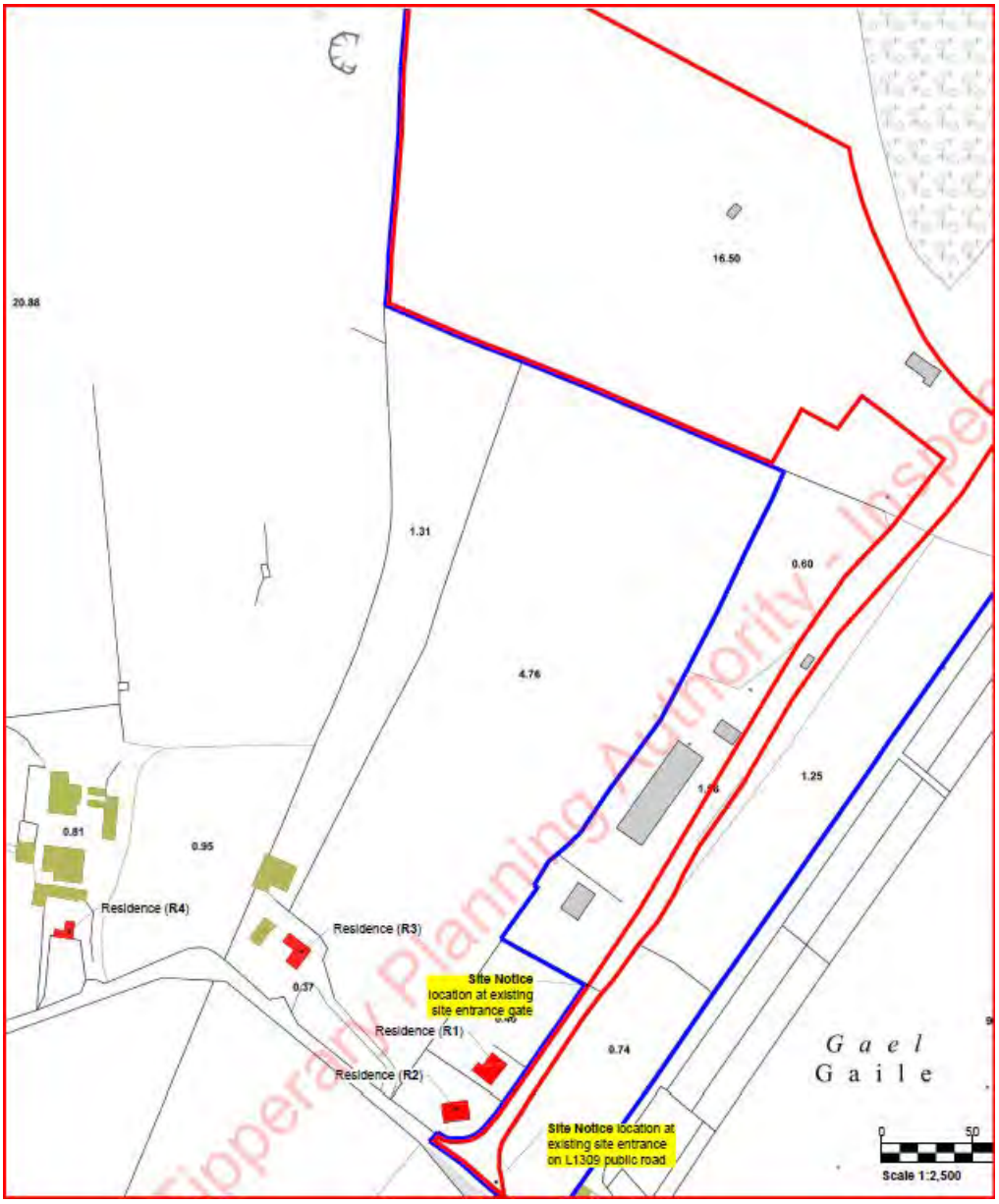
A matrix and associated commentary is provided in Chapter 16 of the EIAR, which acts as a checking mechanism to ensure that there are no potential additional impacts from the interactions of impacts that are dealt with within the individual assessment chapters of the EIAR.

4.14 Mitigation and Monitoring

Chapter 17 of the EIAR provides a summary of mitigation and monitoring commitments set out within the technical chapters. This is intended to assist Tipperary County Council in determining the planning application and identifying any planning conditions that it may wish to impose on any future planning permission.




Site Notice location at existing site entrance gate
Site Notice location at existing site entrance on L1309 public road
Fox Covert
Killough Hill
Caraun
Eagle Church


16.50
20.88
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0.60
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Residence (R4)
Residence (R3)
Site Notice
location at existing
site entrance gate
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Residence (R1)
Residence (R2)
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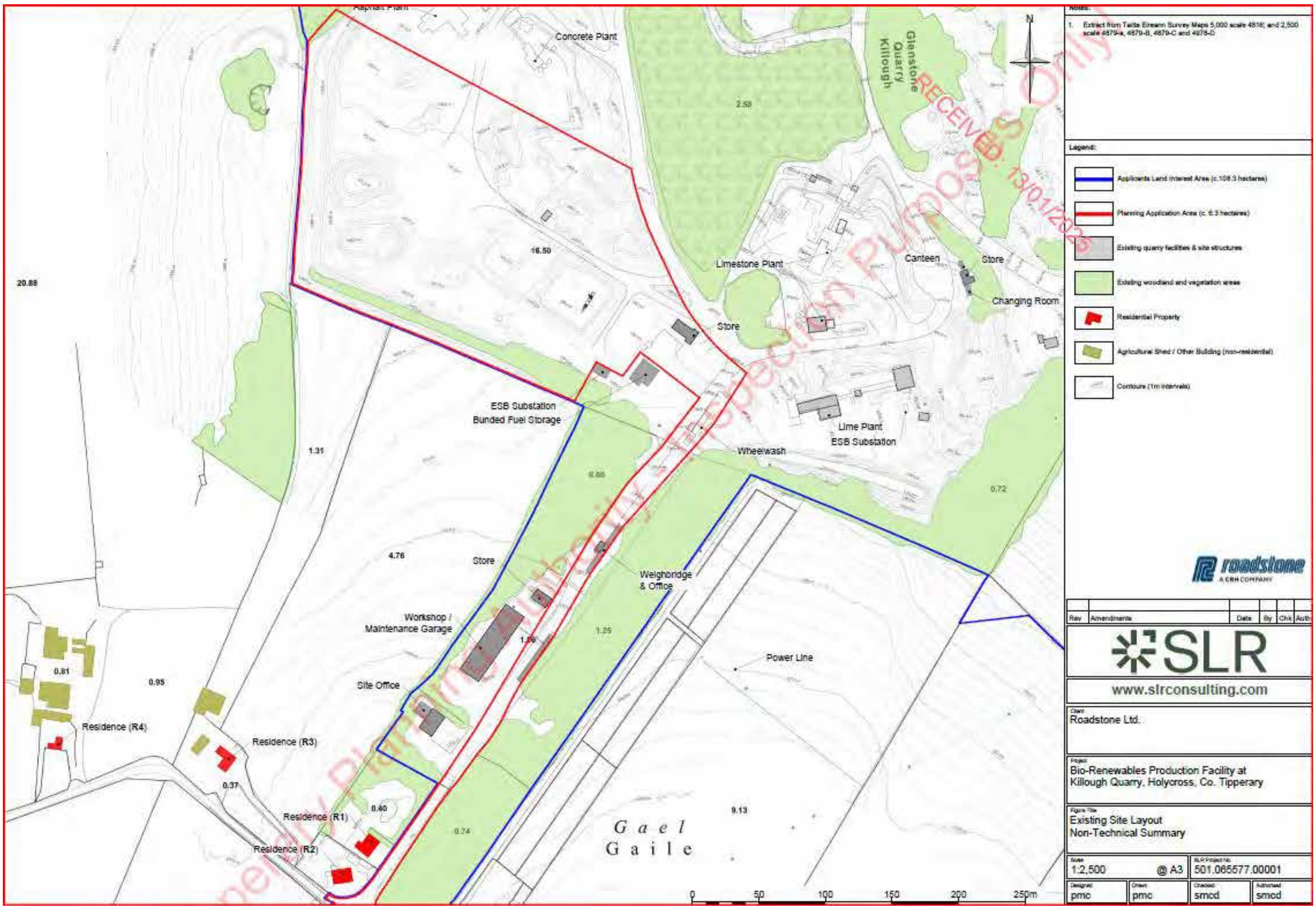
Gael
Gaile
Site Notice location at
existing site entrance
on L1309 public road
0
50
Scale 1:2,500


Concrete Plant
Glenstone Quarry Killough
RECEIVED: 13/01/2025
Limestone Plant
Canteen
Store
Changing Room
Store
ESB Substation
Bunded Fuel Storage
Lime Plant
ESB Substation
Wheelwash
Store
Weighbridge & Office
Workshop / Maintenance Garage
Site Office
Power Line
Residence (R4)
Residence (R3)
Residence (R1)
Residence (R2)
Gael Gaile
Notes:
1. Extract from Tailte Eireann Survey Maps 5,000 scale 4816; and 2,500 scale 4879-a, 4879-B, 4879-C and 4878-D
Legend:
Applicants Land Interest Area (c.108.3 hectares)
Planning Application Area (c. 6.3 hectares)
Existing quarry facilities & site structures
Existing woodland and vegetation areas
Residential Property
Agricultural Shed / Other Building (non-residential)
Contours (1m intervals)
roadstone
SLR
www.slrconsulting.com
Roadstone Ltd.
Bio-Renewables Production Facility at Killough Quarry, Holycross, Co. Tipperary
Existing Site Layout
Non-Technical Summary
1:2,500 @ A3
501.065577.00001
pmc
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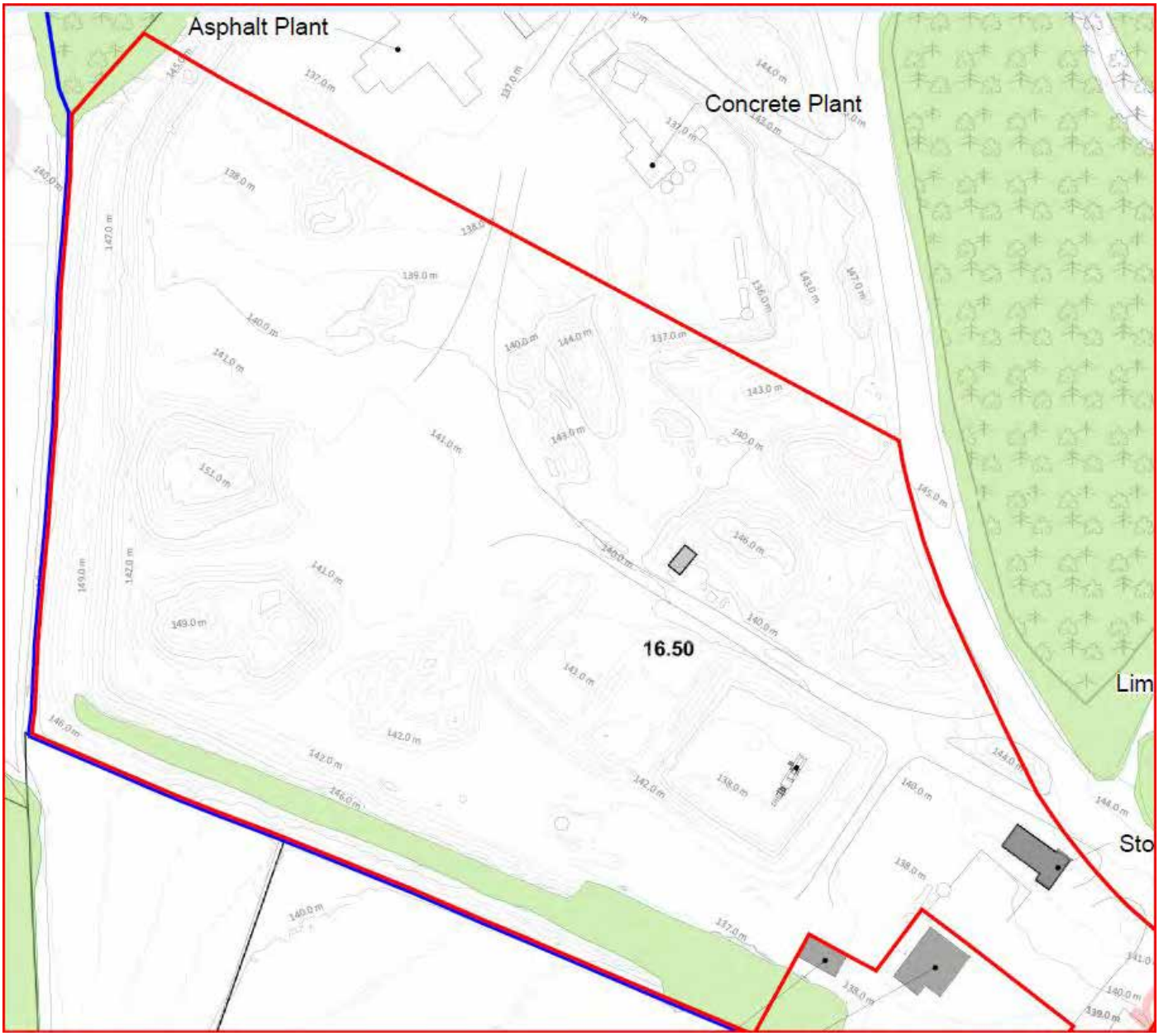
Asphalt Plant
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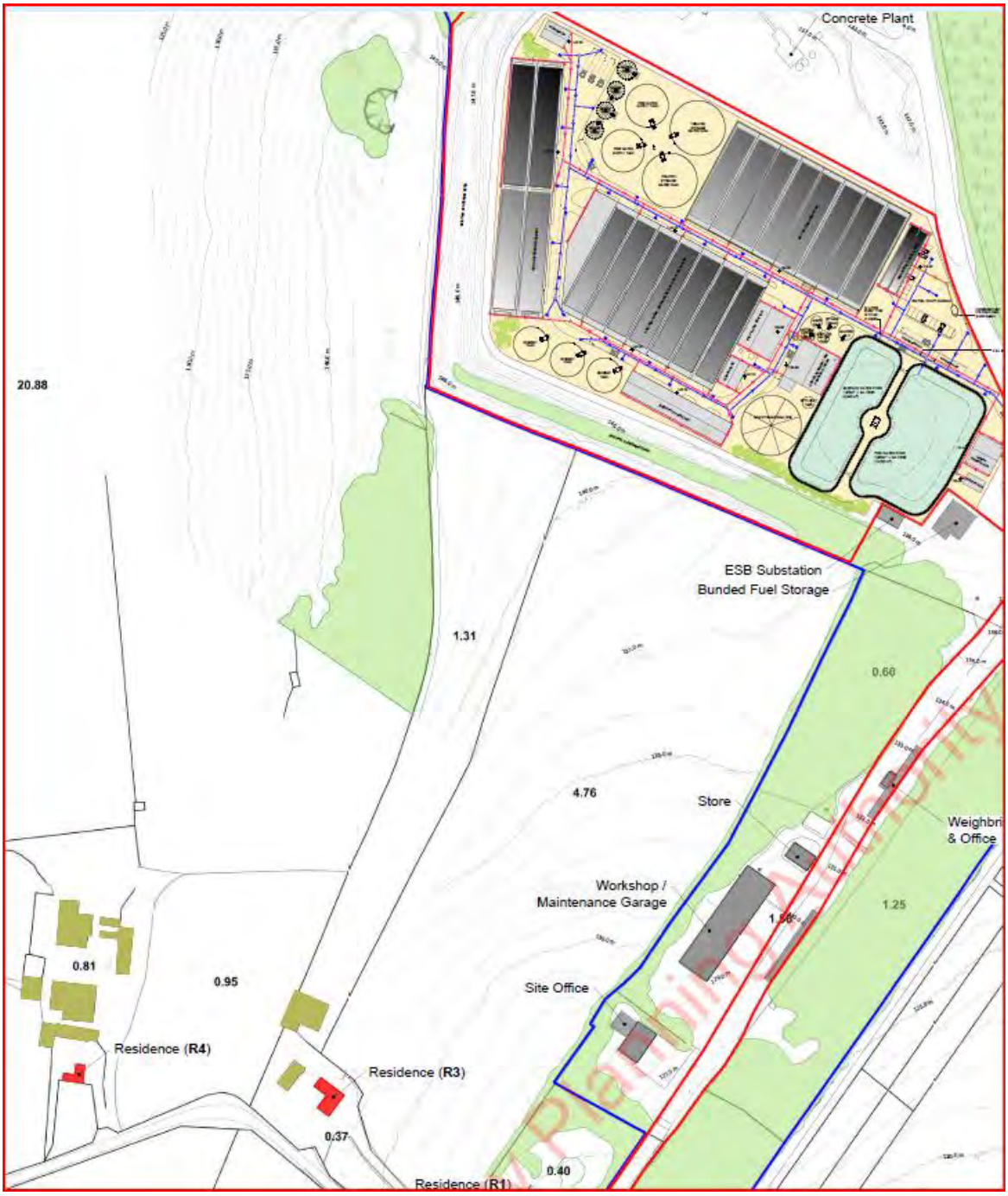
Concrete Plant
20.88
ESB Substation
Bunded Fuel Storage
1.31
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Store
Weighbri
& Office
Workshop /
Maintenance Garage
1.25
1.50
0.81
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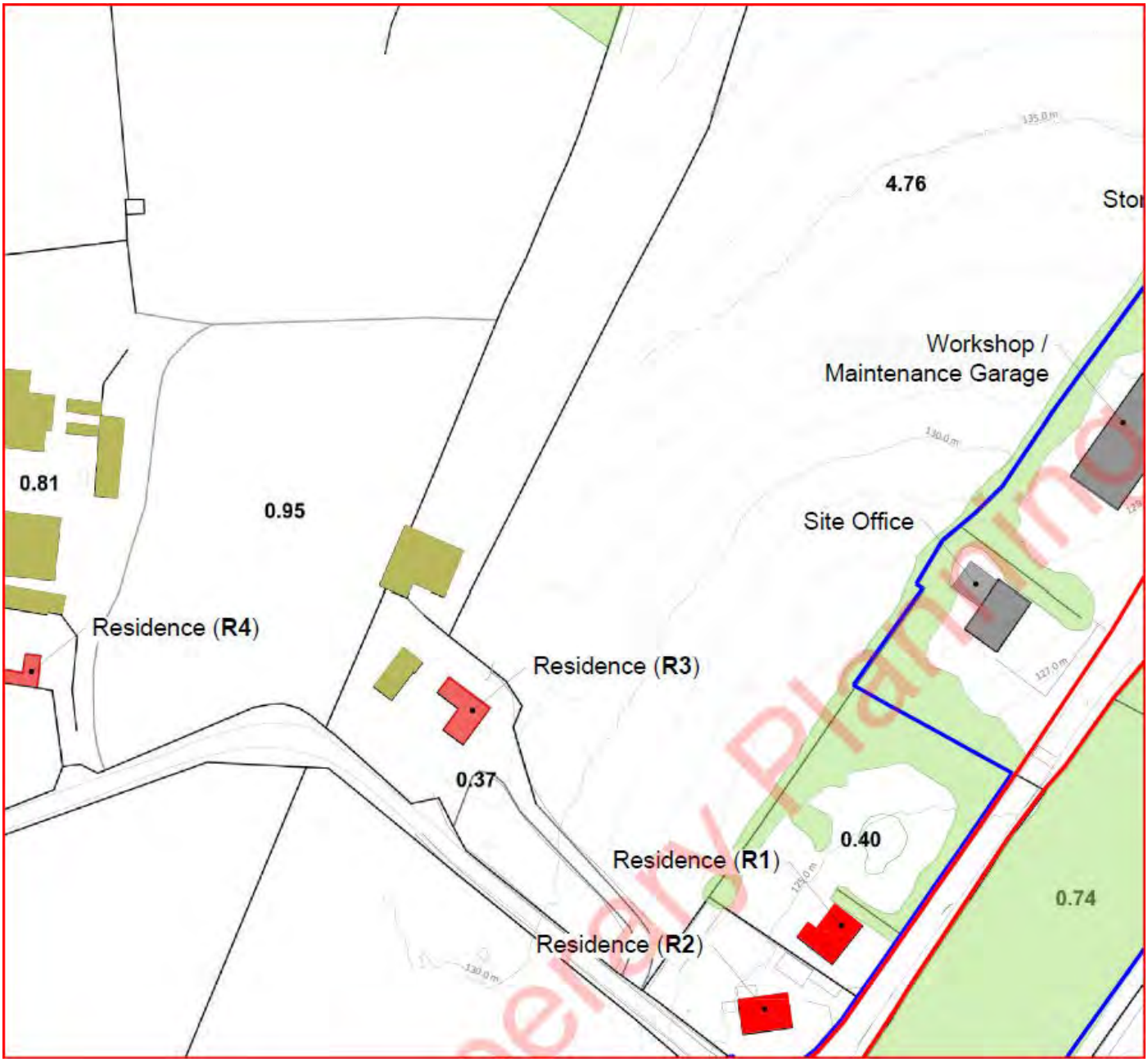
Site Office
Residence (R4)
Residence (R3)
0.37
0.40
Residence (R1)


Asphalt Plant
1.31
4.76
Workshop /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Site Office
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0.37
0.40
Residence (R1)
0.74
Residence (R2)

Killough Hill Woods

Co Tipperary

Ecology

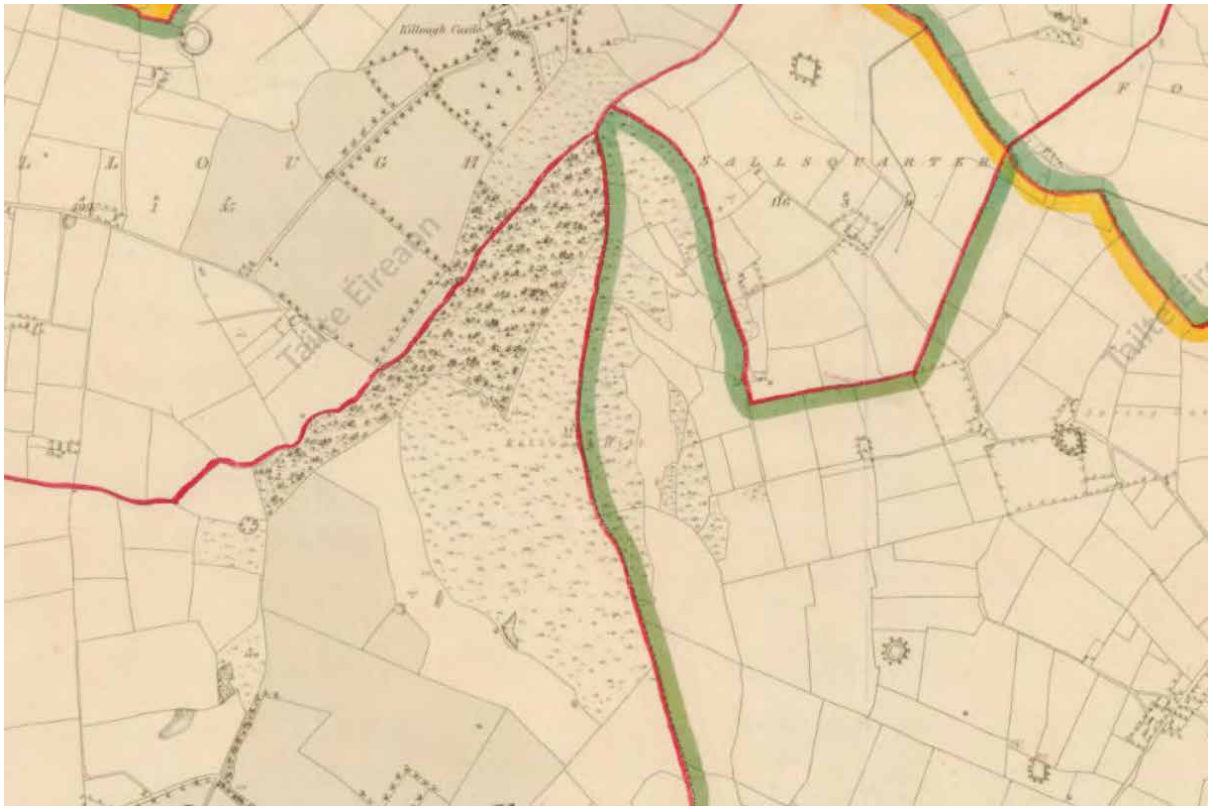
Report prepared for Alice Coman

October 2025

Roger Goodwillie & Associates, Lavistown House, Kilkenny. Tel. 087-2443024

1. INTRODUCTION

Killough Hill is divided into three townlands, Killough to the west, Gaile to the south and Aughnagomaun to the east (see below). In the field, townlands are usually separated by a bank which in agricultural country is often planted with a hedge but can be a simple bank and ditch in woodland. The first (1840's) map shows that the woodland established at that time was a plantation on the NW side of the hill and mostly in Gaile. The SW tail of this remains as a beechwood today but much of the rest has been planted with spruce. North and south of the wood outcropping rock is shown with a trace of 'brushwood' or hazel scrub at the northern end, behind the walled garden of Killough Castle.

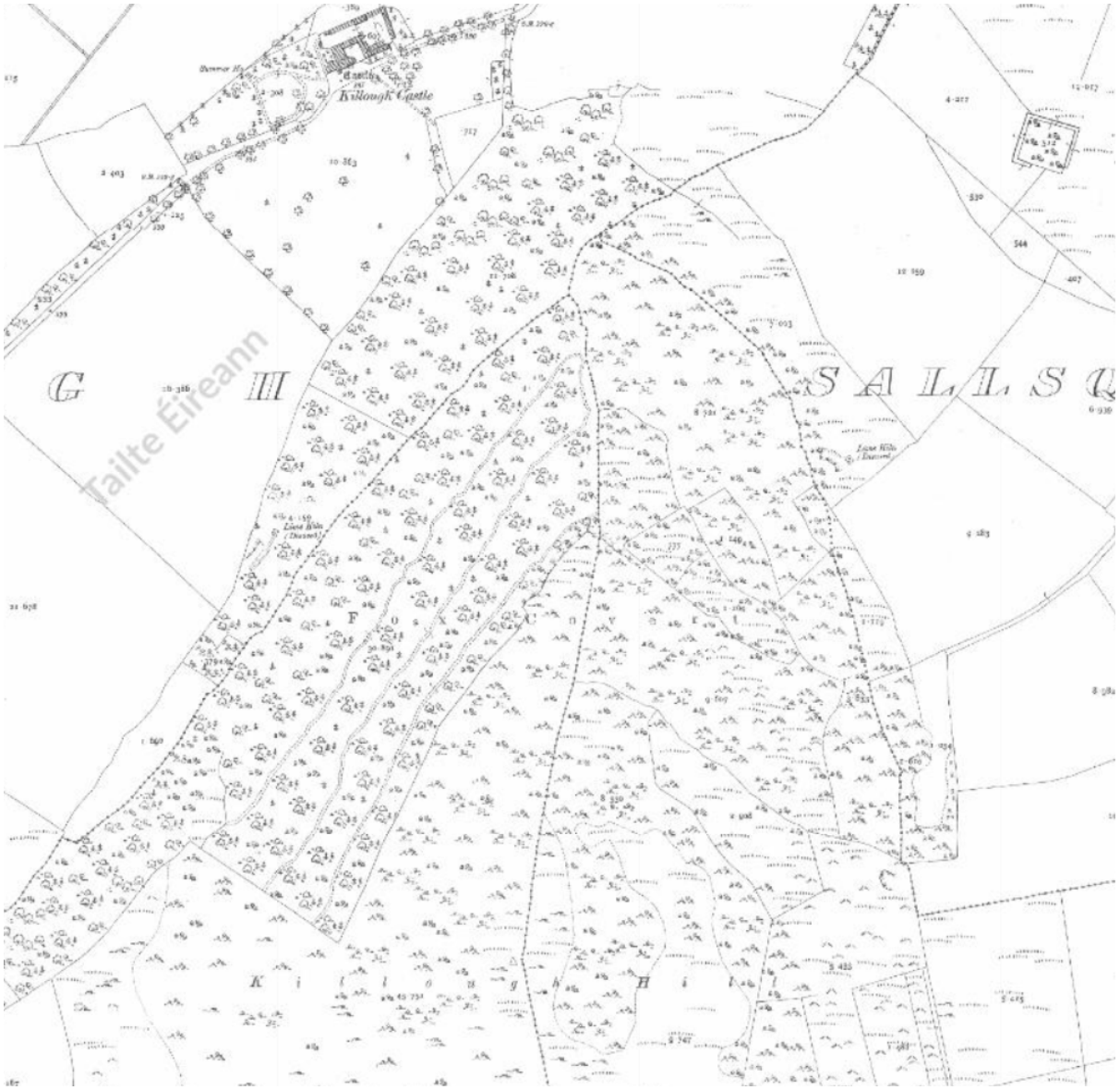


First O.S. sheet of Killough Hill, pre-Famine in the 1840's. Townland boundaries coloured

Substantial changes had taken place by the second survey reflecting the huge decline in local population and, consequently, the natural spread of scrub and trees to land that was formerly open. Also some additional planting was done, of sycamore, oak, ash and

elm with occasional Scot's pine and other conifers. Many estates put in silver firs, which today overtop other trees.

As seen below in the early 1900's woodland now covered a swathe of land on the western side of the hill including new trees to the east of Killough Castle. The wood is represented as mixed, i.e with some conifers, and a series of parallel rides or paths existed along the contours of the upper part, probably for management.



Killough Hill as it was in the second OS survey (1910)

Scrub (brushwood) and rough pasture covered the rest of the hill at this stage, most likely a mix of hazel and hawthorn as would be found in many parts of the Burren today. A small cliff is noted at the northern point of the hill – a reflection of ice movement from the north during one of the ice advances – and outcropping limestone occurs just south

of the highest point. Later changes have seen a consolidation of the conifers into a block on the middle part of the SW wood, a continuation of the re-wilding of the upper ground as a stand dominated by hazel, ash and goat willow *Salix caprea*. Latterly (starting in the 1950's) a quarry has removed most of the central hill and woodland.

An aerial photo of the current situation is shown at the end of this account.

Flora

Above the boundary bank, the Gaile part of the wood supports this community, categorised as FH (Ash-ivy) in Cross *et al* (2010) and most likely FH3 (hazel-wood sorrel) though the latter species is not everywhere abundant. The trees mentioned are augmented by a little wych elm *Ulmus glabra* and rowan *Sorbus aucuparia*, while guelder rose *Viburnum opulus* and spindle *Euonymus europaeus* are also scattered. Ivy is abundant on the ground and brambles form large patches because of treefall and ash dieback. The full list of herbs and ferns is extensive, including

Bluebell	*Hyacinthoides non-scriptus*
Wood sedge	*Carex sylvatica*
Common violet	*Viola riviniana*
Herb Robert	*Geranium robertianum*
Lesser celandine	*Ficaria verna*
Yellow pimpernel	*Lysimachia nemorum*
Wood dock	*Rumex sanguineus*
Enchanter's nightshade	*Circaea lutetiana*
Wild strawberry	*Fragaria vesca*
Barren strawberry	*Potentilla sterilis*
Wood false-brome	*Brachypodium sylvaticum*
Wood sorrel	*Oxalis acetosella*
Primrose	*Primula vulgaris*
Germander speedwell	*Veronica chamaedrys*
Woodruff	*Galium odoratum*
Hedge woundwort	*Stachys sylvatica*
Ground ivy	*Glechoma hederacea*
Broad-leaved willowherb	*Epilobium montanum*
Short-fruited willowherb	*Epilobium obscurum*
Lords-and-ladies	*Arum maculatum*
Tutsan	*Hypericum androsaemum*
Slender St John's wort	*Hypericum pulchrum*
Glaucous sedge	*Carex flacca*
Broad-leaved helleborine	*Epipactis helleborine*
Male fern	*Dryopteris filix-mas*
Soft shield-fern	*Polystichum setiferum*

Lady fern	*Athyrium filix-femina*
Hartstongue	*Asplenium scolopendrium*

West of the bank, in Killough townland, the wood is distinctly different with a smaller variety of herbs and different trees. Probably based on deeper soil, sycamore *Acer pseudoplatanus* becomes abundant and is spreading, there are isolated oaks *Quercus robur*, some small-leaved elm *Ulmus* ?*minor* and holly *Ilex aquifolium* and a few conifers – Scot's pine *Pinus sylvestris*, larch *Larix decidua* and spruce *Picea sitchensis*. These join the prevailing ash (many with disease) and goat willow, some of large size, and they create an open stand with more brambles, blackthorn *Prunus spinosa*, hawthorn *Crataegus monogyna* and frequent spindle in the understorey. At the southern end there is a band of bracken *Pteridium aquilinum*, with some wild raspberry *Rubus idaeus*, field rose *Rosa arvensis* and figwort *Scrophularia nodosa* nearby Damp ground also features in a few places with remote sedge *Carex remota*, soft rush *Juncus effusus*, compact rush *J. conglomeratus* and square-stemmed St John's wort *Hypericum terapterum*.

This part of the wood is poorer in small herbs than the upper wood; they are shaded out by the vigorous growth of brambles and ivy (and sycamore). Apart from the ferns and bluebells, and woodruff in one place, one looks in vain for many of those on the list above. This seems likely to be the result of the more recent establishment of trees on this lower ground and their historic management for timber by Killough Castle. It is also caused by the richer soils and the lack of a stable tree canopy.

Fauna

Coming to the wood in late summer makes an assessment of its birdlife impossible as most species have stopped singing by then. However a full range of species is very likely to occur including blackcap and chiffchaff, treecreeper, goldcrest, long-tailed tit and all the more common 'garden' species. Raven, magpie, hooded crow, sparrowhawk, kestrel, buzzard, woodpigeon and stock dove, represent the larger species while the great spotted woodpecker is likely also.

In terms of mammals, all expected species are also found in some part of the woodland, not necessarily in Killough townland. Records of badger, fox, pine marten, stoat, red and grey squirrel and hare are in the NBDC database as well as hedgehog and wood mouse. There are no bat records as yet but seven of the main Irish species were recorded on adjacent ground during a study for a contiguous solar farm (soprano pipistrelle, common pipistrelle, Leisler's, brown long-eared, Natterer's, whiskered and Daubenton's bats). It is likely that most of these use the woodland as the size and

structure of the wood and the possibilities of roosting in Killough Castle buildings make the habitat very favourable.

Aerial photo taken in 2020

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The National Institute for Physical Planning and Construction Research

CONSERVATION AND AMENITY ADVISORY SERVICE

A Preliminary Report on Areas of Scientific Interest in Co. Tipperary S.R.

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CONTENTS

ACKNOWLEDGEMENTS

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The maps presented in this report are based on the Ordnance Survey by permission of the Government (Licence number 221/73).

SECTION A

PREFACE

In the pages which follow less than 4,000 acres are described as worthy of conservation. This area represents approximately o·7% of the total surface of the South Riding; over half of it is high mountain terrain without any prospect of development in the foreseeable future. Some of the remainder is under trees and is already being suitably managed and only a small number of sites are under adverse pressure.

The areas which have been selected for preservation are in most cases clearly limited and outside the immediate area of interest development of various kinds could proceed. Some of the aquatic sites are however more susceptible - particularly to the adverse effects of eutrophication (water enrichment) and even toxic pollution. As development progresses in the county special attention should be paid to the likely effects of aerial and water contamination. Another kind of pollution, by noise or human disturbance, could be detrimental to the few potential wild-fowl haunts and attention should be paid to this factor when permission to develop in their immediate vicinity is sought.

Sites of scientific interest are valuable as places of education, research and for amenity and recreation. In terms of the first two, South Tipperary is fortunate: some of its wetlands and woods are deserving of intensive study, having been largely overlooked to date. The exposure of limestone pavement, is one of only five examples in the country and is the most southerly.

The animal and plant diversity in areas of scientific interest is an important factor in recreation. This applies particularly to deciduous trees which are being replaced on a wide scale by conifers. The woods which are identified here are generally distributed throughout the county and, if managed correctly provide essential reservoirs for typical fauna and flora which will at a later date, come to occupy coniferous woods, at present too young to contain it.

trees should include small block clearance rather than large scale timber removal at any time. As high a proportion of deciduous trees as possible should be planted with coniferous species. Trees should not be planted too close to the wildfowl habitat. The land is likely to be suitable for oak growth and regeneration and this species should be set as a high proportion of deciduous species planted. Deer are numerous in the forest and should be controlled.

It is stressed that this report is preliminary based on the best information to hand at the time of writing. Now that attention has been focussed on this rather neglected county is it likely that further exploration could be well rewarded. Quarrying and mining for example will expose rock formations, some of which could be useful to research and education. The progressive increase in diversity as a coniferous wood grows up has been referred to above.

The best use of any interesting feature, particularly biological entities, by the public will however, involve management. A forest path can support only so many people before the vegetation is killed off and wetlands are especially vulnerable in this respect. Eventually, in order to protect the resource and permit maximum public access paths will have to be designed and perhaps entry limited etc. Continual vigilance in order to monitor the condition of areas of interest is the best means of ensuring their survival and their best use by the public.

SECTION B

VULNERABILITY OF VARIOUS HABITATS

Areas of scientific interest can be gradually or quickly destroyed. Their value may be eroded by overgrazing or a gradual build-up of deletrious matter, whether toxic or organic. Alternatively they may be more dramatically destroyed by drainage, tree clearance or quarrying. All of these influences could be operative on a wide scale in South Tipperary and, as will be seen from the text, some are already influencing the sites which are described in the following pages.

Quarrying is a threat whose effects are generally only seen in areas of geological importance and South Tipperary is probably unique in Ireland in having a woodland which is at risk by the removal of the limestone hill in which it is growing. Killough hill woodland has already been largely removed and will disappear completely if efforts are not made to ameliorate the effects of quarrying there.

Drainage can also have a sudden and catastrophic effect on aquatic communities and could have serious effects in Tipperary. Some of the aquatic sites are however fortunate in being topographically difficult to drain.

A more likely threat is contamination of freshwater by organic matter. Both sewage plants and intensive livestock units are likely sources and possible contamination from both should be taken into account upstream of areas of scientific interest.

Woodlands are most generally at risk from clearance for building or replanting purposes. When a slow growing deciduous wood is replaced by a faster developing coniferous species the woodland community is drastically altered although in time some diversity may be restored. Initially however, the coniferous trees are planted closely together and the result is exclusion of light on which the ground flora and fauna depend. Where

replanting does occur some attempt can be made to lessen its deleterious effects by judiciously spacing the trees and harvesting the coniferous tree crop. Recommendations to this effect will be made where relevant in the ensuing text.

Once man enters any habitat he affects it in some way. Even by simply allowing his livestock to graze a woodland floor its flora will gradually change in composition as will the form and size of individual plants. In recreation it may be paradoxical that interest in a biological community can bring deleterious effects to it. Trampling sand dunes for example results, if carried to extremes, in the elimination of flora and may even end with the disintegration of the sand hills. While public pressures on areas of importance is to be welcomed as an expression of interest it is a force which must be controlled if the features of importance are to be maintained. At present in South Tipperary no site is at risk from over-use. A careful watch must be kept however to ensure this situation persists.

SECTION C

INTRODUCTION TO THE SCIENTIFIC HERITAGE OF CO. TIPPERARY (S.R.)

The bedrock of South Tipperary is composed of Palaeozoic Rocks. The lowest or Old Red Sandstone Series (Devonian) forms three inliers to the south of the county the Galtee, Knockmealdown and Slievnamon Mountains. The north-west of the county coincides with the Keeper Hill inlier. The centre of the county is saucer like, comprising upper Carboniferous limestones.

Few features of the solid geology are noteworthy but the Pleistocene period las left remains which deserve preservation. The Glen of Aherlow which was temporarily dammed to form a glacial resevoir is one of these. Deltas formed by incoming meltwaters and a glacial "plug" which walled up the lake remain. The Weichsel end moraine which stretches across southern Ireland is well exposed at two points in the county and at a third river terraces cut in ice-deposited gravels occur. The corries on the Galtee Mountains are important glacial remains and Lough Diheen has a most unusual structure.

Although fossil bearing rock sites are confined to one exposure at Hollyford, micro fossil remains occur at Ballymacadam, south of Cahir. in the lignite deposits.

Rainfall over the country is moderate varying from 35 inches/year in the north of the South Riding to as much as 60 inches/year in the south. The cumulative annual temperature is not markedly high, though it could accomodat many of the animals and plants which normally occur in the warmer conditions of the south coast.

The low lying countryside of the central part of the country is covered with mineral soils, grey-podzolics and gleys. In the west of the county the drift forms hummocks and hollows which enclose small waterbodies. A group of these fens occurs to the north of Tipperary town. They display

a succession from open water through various stages of dominance by plants to alder woodland. The fens are noteworthy because they contain various rare plants like Typha angustifolia, Oenanthe fistulosa and Equisetum variegatum all of which now occur irregularly in the central limestone areas of Ireland.

Most of the fens seen in this grouping were safe from drainage which would be costly. Infill on a small scale was occurring at one however and could, if practised on a wider scale, be a means of destroying the habitat.

At least one other place of potential interest, Castlelake Marsh (not included in site descriptions, grid reference S. 041, 405) has been burned and drained. The network of drains which have lowered the water table are separated by small intervals and slotted pipes have been inserted into the dividing soil banks. In the vicinity of Turreen Spring (marked on O.S. 6" Map) a marshland flora still survives consisting of Filipendula ulmaria (meadowsweet), Succisa pratensis (devil's bit scabious), Angelica sylvestris (angelica) and Cladium mariscus (saw toothed sedge). Although a partial recovery to previous diversity may occur in time if the scheme becomes uneconomic to maintain a complete disappearance of marshland characteristics seems to be more likely. However, the Castlelake Marsh should be kept under review.

Woodlands on these lowland mineral soils are represented by ash and hazel and some good examples remain. One which has developed from open grassland in recent historic time is Killough Hill. Here there are few rarities but the limestone at the top of the hill is unusual, being in the form of a limestone pavement. The site has a selection of native invertebrates on the trees and the interstices of the rock. Killough is significant as one of the four exposures of limestone pavement in the country, isolated from the main region, the Burren in Cos. Clare/Galway. It is the most southern occurrence of this kind of habitat and as such deserves intensive study.

The Devonian hills are covered with a shallow mountain soil, consisting of podzols. The natural climax tree species in these areas are oak and birch but the lower slopes have been largley replanted with commercial timber, mostly spruce and pines.

South Tipperary is unusual in having no large area of open water and is, with the exception of the fens referred to above, without a still water-body. The River Suir which drains South Tipperary has no outstanding biological features meriting protection, except for its bankside marshes below Carrick. However, it has considerable commercial potential and should be carefully managed. The National Report on Water Quality (An Foras Forbartha, 1972) demonstrates that north of Holycross the condition of the river is not good but south of this point it improves considerably. A check on the inflows should be exercised in an effort to maintain this valuable resource.

At some sites listed in the following pages, it appears coniferous plantations will eventually replace the deciduous trees entirely; at others there is a danger that they may obscure interesting landforms. In both these cases contact should be made with the Forestry Division at the earliest opportunity while advance plans are still being made, in order to preserve a mixed type of woodland with large blocks of deciduous trees, and to prevent unsuitable afforestation. Belts and lines of deciduous trees can in no way maintain an intact community and only contribute an amenity function to a wood whereas even quite small blocks preserve a good deal of the scientific interest.

In some woods the surviving oaks have been over-run by rhododendron which occasionally reaches epidemic proportions. (e.g. considerably more harmful than weeds of pasture like thistles and ragwort. Its eradication should be given priority and the Forestry Division should be encouraged and possibly assisted to this end.

SECTION D

List of Sites of Scientific Interest

Name of Area	Page No.	Grid Reference	Rating	Priority	Interest
Ballymacadam	14	S.060,121	International	C	Geological and botanical : A deposit of lignite of Tertiary age containing pollen of extinct plants.
Weichsel end Moraine and associated features	17	S.363,349 S.286,232 S.085, 180	National	C	Geological : Some large topographical features resulting from ice deposition of sands and gravels.
Galtee Mountains	21	R.90, 24	National	C	Botanical and ecological : The only inland mountain range having such a diverse and interesting flora.
Hollyford Quarry	24	R.935,562	National	C	Geological : An exposure of rocks of Wenlockian (Silurian) age which are rare in Ireland
Knockastakeen Forest	27	R.930, 275	National	C	Zoological : A coniferous forest containing a rare insect species.
Killough Hill	30	S.110,508	National/Regional	A	Ecological, botanical and zoological : A limestone hill with a natural tree cover and typical invertebrates and ground flora.
Glacial features in the Glen of Aherlow	34	R.90, 30	National/Regional	A-C	Geological : Features associated with the glacial Lake of Aherlow.

Name of Area	Page No.	Grid Reference	Rating	Priority	Interest
Inchinsquillib Wood	39	R.912,502	Regional	A	Ecological : A semi-natural wood with an unusual plant species.
Grove Wood	42	S.218, 333	Regional	A	Ecological, botanical and zoological : A young wood with a rich flora and fauna.
Marshes and ponds near Annacarty	45	R.93, 44	Regional	B	Ecological, botanical and zoological : A series of richly vegetated waterbodies with a diverse fauna,displaying various stages of succession.
Suir below Carrick-on-Suir	51	S.422,214	Regional	C	Botanical, ecological : An interesting marsh with unusual plant species.
Mitchelstown Caves	54	R.925,163	Regional	C	Geological, zoological and botanical Limestone Caves displaying dripstone formations and having a well described fauna.
Dundrum Sanctuary	57	R.957,442	Regional/local	C	Ecological, zoological and botanical: Alder marsh and pond containing typical fauna and flora.
Scaragh Wood	60	S.020,250	Local	A	Ecological, botanical and zoological: Some stands of oak displaying good regeneration.
Cahir Park Woodland	63	S.052, 234	Local	B	Ecological and ornithological : A planted wood with typical fauna and flora

Name of Area	Page No.	Grid Reference	Rating	Priority	Interest
Knockanavar Wood	66	R.863, 503	Local	B	Ecological, botanical and zoological : A semi-natural wood in a steep-sided valley, likely to survive with the minimum of protection.
Shanbally Wood	69	R.971, 150	Local	B	Ecological, botanical and zoological a small wet woodland in an other-wise cultivated area.
Carrowkeale Woods	72	R.965,510	Local	B	Ecological, botanical, zoological and ornithological : Semi natural acidic woodland, potentially rich in fauna and flora.
Glenboy Wood	75	S.12, 09	Local	B	Ecological : A birch wood community of plants and animals.
Knockroe Fox Covert	78	S.032, 385	Local	C	Ecological, botanical and zoological : a hazel wood with typical fauna and ground flora.
Power's Wood	81	S.177,380	Local	C	Ecological, botanical, zoological and ornithological : A small, neglecte deciduous wood containing typical fauna and flora.
Ardmayle Lily Pond	83	S.053, 453	Local	C	Ecological : A small waterbody containing animals and plants of still waters, a rare phenomenon in the county..
Kilcooly Abbey Lake	86	S.298, 581	Local	C	Ornithological, botanical and ecological : An artificial lake managed as a wildfowl Sanctuary.

SECTION E

RATING OF AREAS OF SCIENTIFIC IMPORTANCE AND EXPLANATION OF BOTANICAL TERMINOLOGY

This is a measure of the relative importance of areas of scientific importance

The importance of each area is indicated in terms of the following categories:

International Importance

1. Only area of its type in Europe
2. One of a few such localities in Europe
3. One of a natural series in Europe
4. Recognised international importance
5. Specialised educational importance

National Importance

1. Only area of its type in Ireland
2. One of a few such localities in Ireland
3. One of a natural series in Ireland
4. Recognised national importance
5. General or specialised educational importance

Regional Importance

1. Only area of its type in province
2. One of a few localities in Ireland
3. One of a natural series in region
4. Fine example of its kind
5. General or specialised educational importance

Local Importance

1. Only area of its type in county
2. One of a few localities in province
3. Fine example of its kind
4. General educational importance

PRIORITY OF AREAS OF SCIENTIFIC INTEREST

This is a measure of the relative urgency necessary for protection of the areas of scientific importance.

Each site is given a priority rating of A, B or C.

The rating of any area is based on a combination of the following criteria:-

a) the importance of the area
b) the vulnerability of the area
c) the nature and imminence of any threats to the area

BOTANICAL TERMINOLOGY

The following terms are used to indicate the occurrence of plants at biological sites:

c	common
a	abundant
r	rare
l	used as a prefix, locally

The latin names of plants are those found in the standard work, Flora Europaea, of which the first three volumes have appeared. The english names are taken mostly from the Concise British Flora in Colour by W. Keble Martin. (Michael Joseph, 1965)

SECTION F DETAILED SITE DESCRIPTIONS

Name of Area	BALLYMACADAM
Acreage	1 acre
Grid reference	S. 060, 232
Scientific Interest	Geological and botanical
Rating	International importance
Priority	C

Description of the area and its evaluation

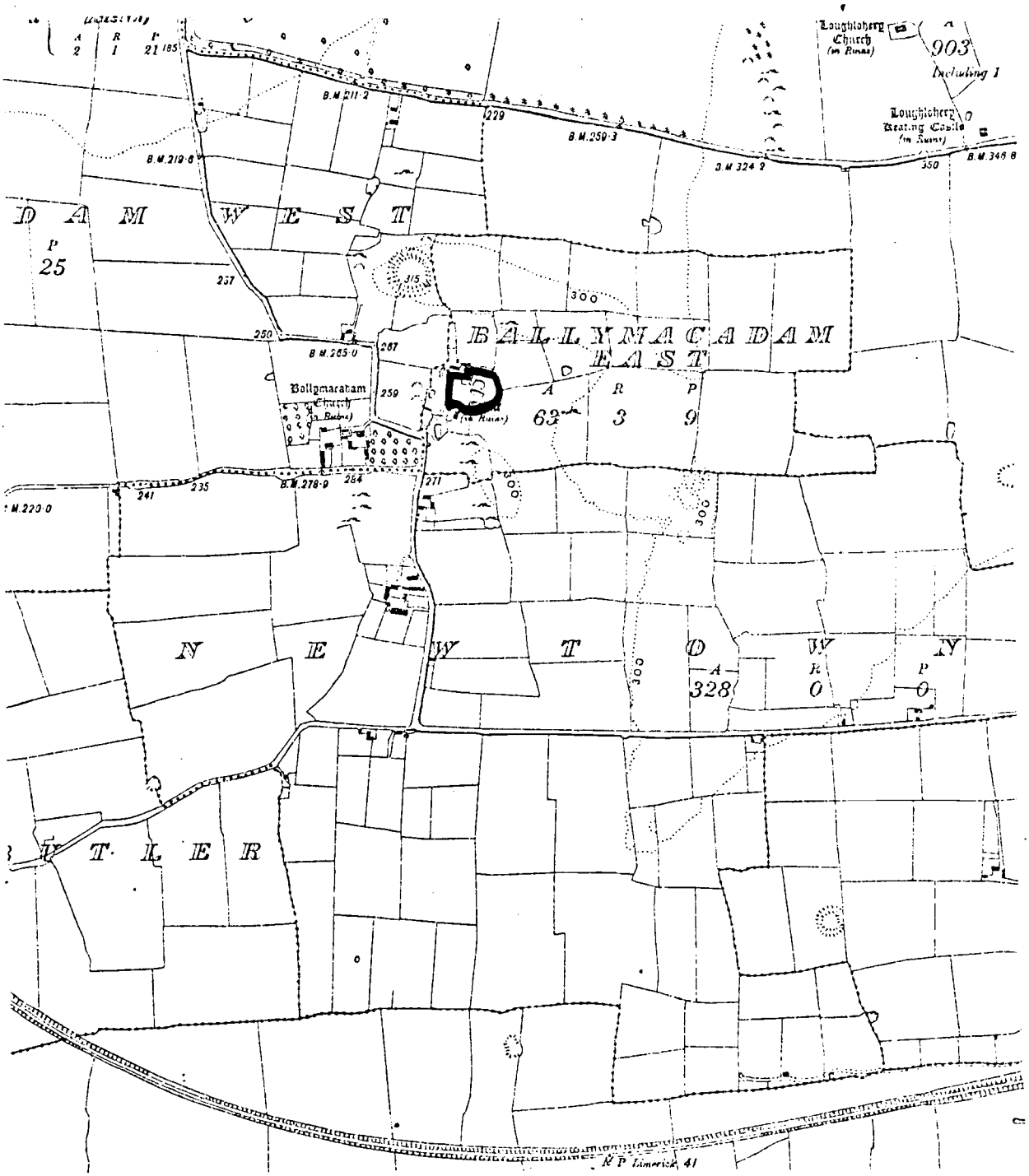
The site is shown on the accompanying 6" map. It occurs on the boundary between the townlands of Ballymacadam east and west. The feature of interest is a deposit of clay which occurs in a hollow of the bluish-grey limestones. The deposit represents the insoluble residue of dissolved limestone beds which contain a high concentration of chert (silica) in the vicinity of Cahir. The siliceous clay is unfossiliferous except for the presence of lignite which occurs in lenticels (lens shaped deposits) 7 feet thick. The whole deposit is circular in shape and 300 feet in diameter and at maximum 90 feet deep, a more general depth being 20 feet. Lignite occurs at the surface in one place but more generally at a depth of 15 feet.

The lignite is rich in pollen of a small number of plants which have been determined to genus, but not to species. Pollen of oaks makes up the greater part of the deposit but the majority of the plants occurring there now occur mainly in the tropics. The deposit which is thought to be of middle or early Tertiary age can be regarded as a "museum store" of pollen which could be used to elucidate Ireland's botanical history.

Similar deposits occur at Loughlohery, $\frac{1}{2}$ mile to the north and at Knockgraffon, 3 miles north of Cahir but the Ballymacadam site is regarded as the best of its kind for research purposes.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Publications

Bishopp (1948) Sources of industrial silica in Ireland. Geological Survey of Ireland Emergency paper number 3.

Watts, W.A. (1957) A tertiary deposit in Co. Tipperary Sci. Proc. R.D.S. 27 (N.S.): 309-311

Watts, W.A. (1962) Early tertiary deposits in Ireland Nature 193: 600-601

Threats to the area

The china-clay deposit was used in the manufacture of clay pipes and to provide a whitener for military uniforms in the early 1900's. In the 1940's Carrigaline Potteries used the clay and it is still mined, though on a smaller scale. The greatest potential threat, therefore is the removal of large quantities of clay without an evaluation of plant material contained in the lignite.

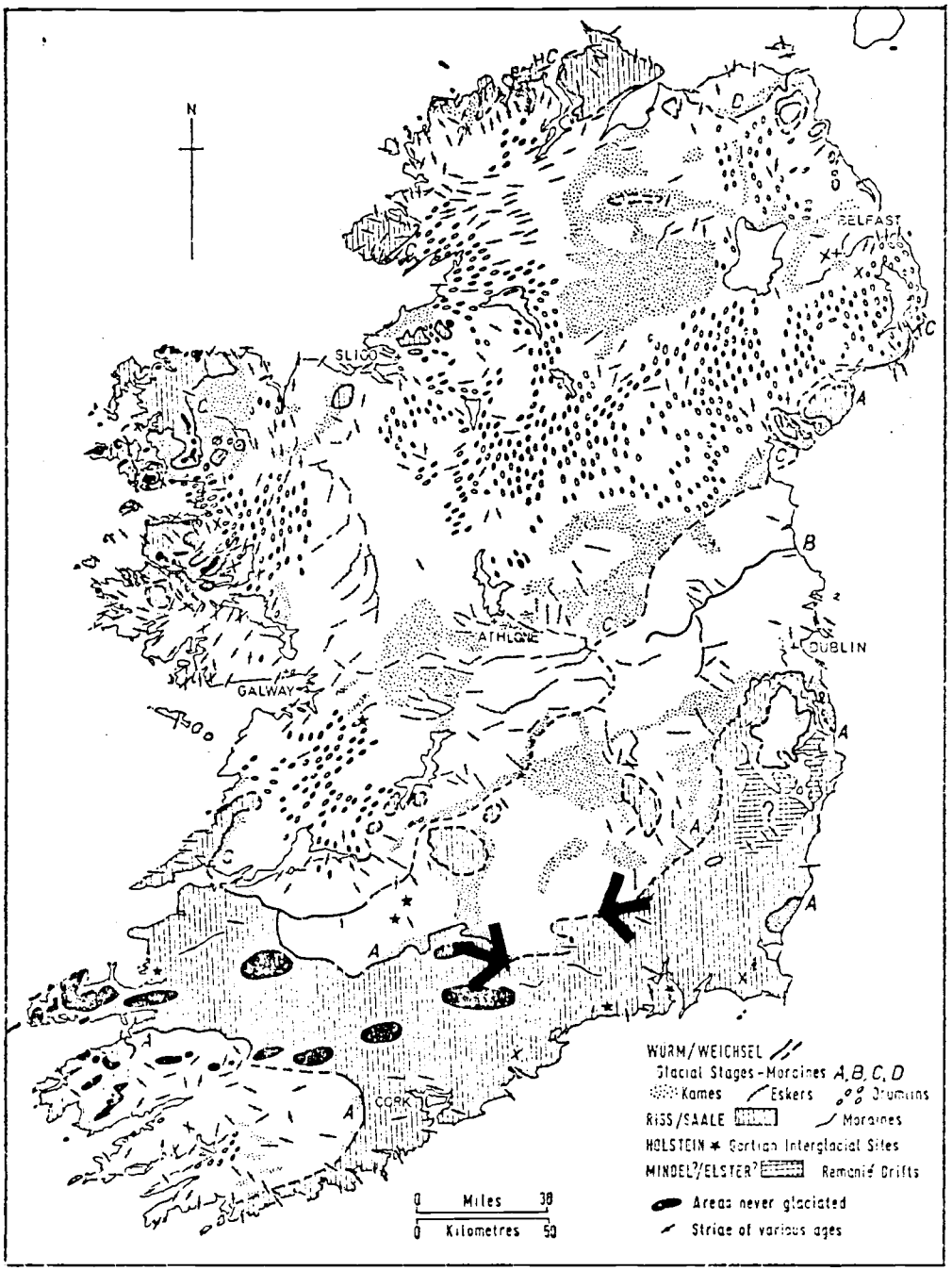
Recommendations

No major action is required to preserve the remains occurring at Ballymacadam. However, a notice on-site stressing the need to obtain planning permission before excavation should be put up. In the event of a major mining operation the Geological Survey and An Foras Forbartha should be informed so that samples can be taken before the deposit is completely removed.

Name of Area	EXPOSURES OF THE WEICHSEL END MORAINE AND ASSOCIATED FEATURES
Acreages	14; not calculated; 9 acres
Grid References	S.363, 349 Ninemilehouse S.286, 232 Kilsheelan S.085, 180 Ardfinnan
Scientific interest	Geological
Rating	National importance
Priority	C

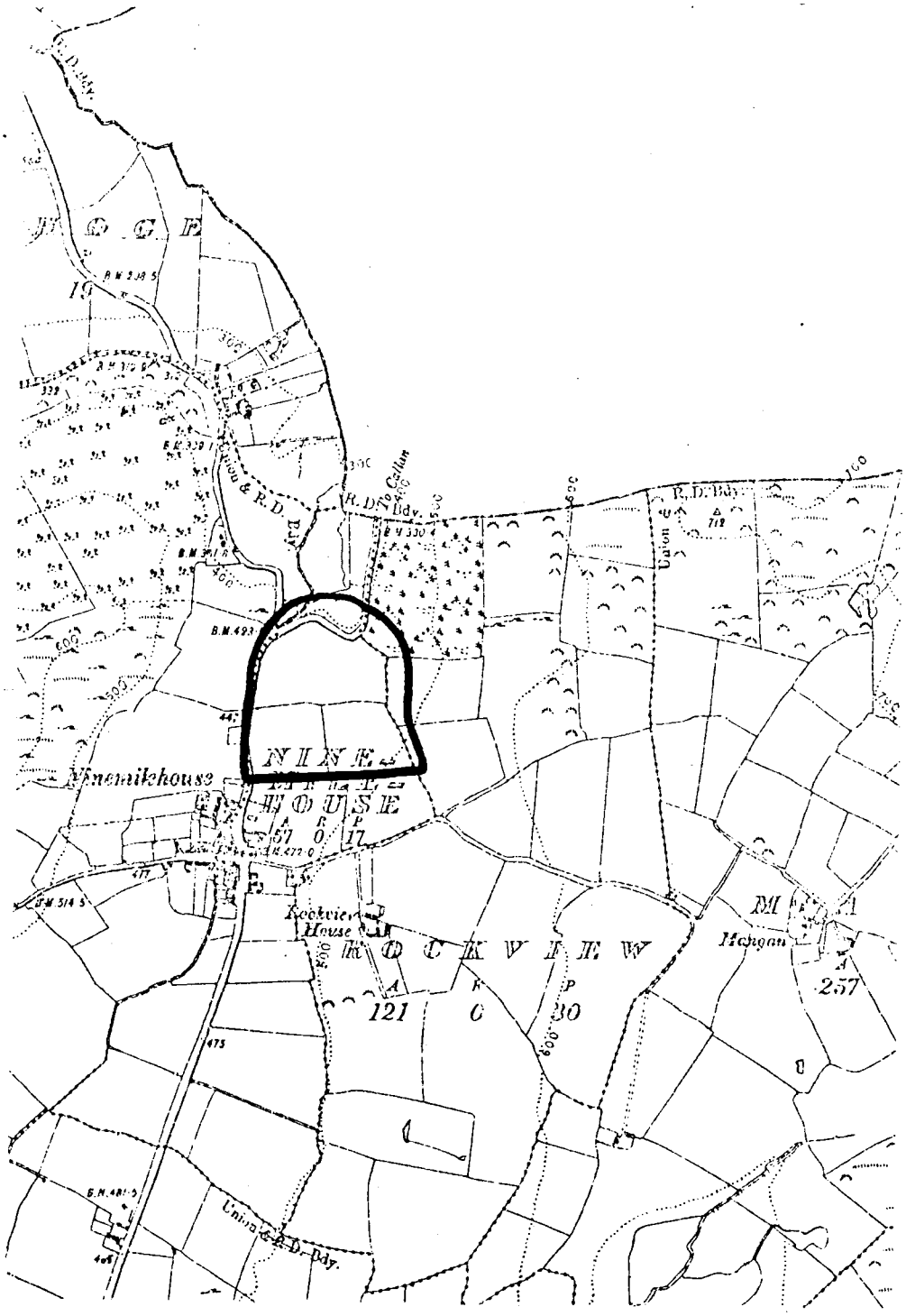
Description and evaluation of the areas

The Weichsel end moraine marks the most southern advance of the northern ice sheet during the Pleistocene period. The moraine is a hill composed of sand, gravel and boulders and running in a roughly east-west direction (see below)



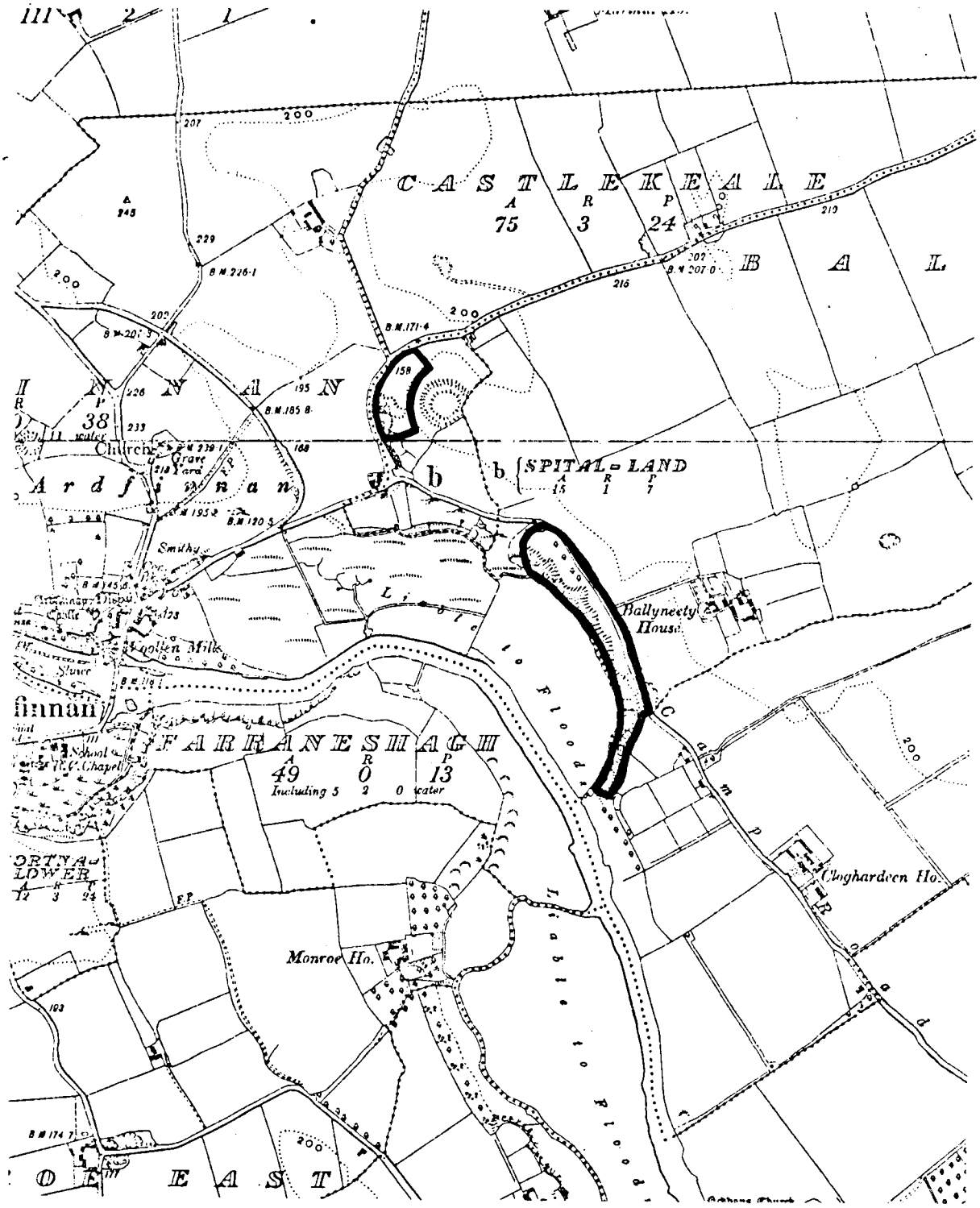
MAP SHOWING AREA OF SCIENTIFIC INTEREST — 1

Scale: 6 Inches to 1 Mile



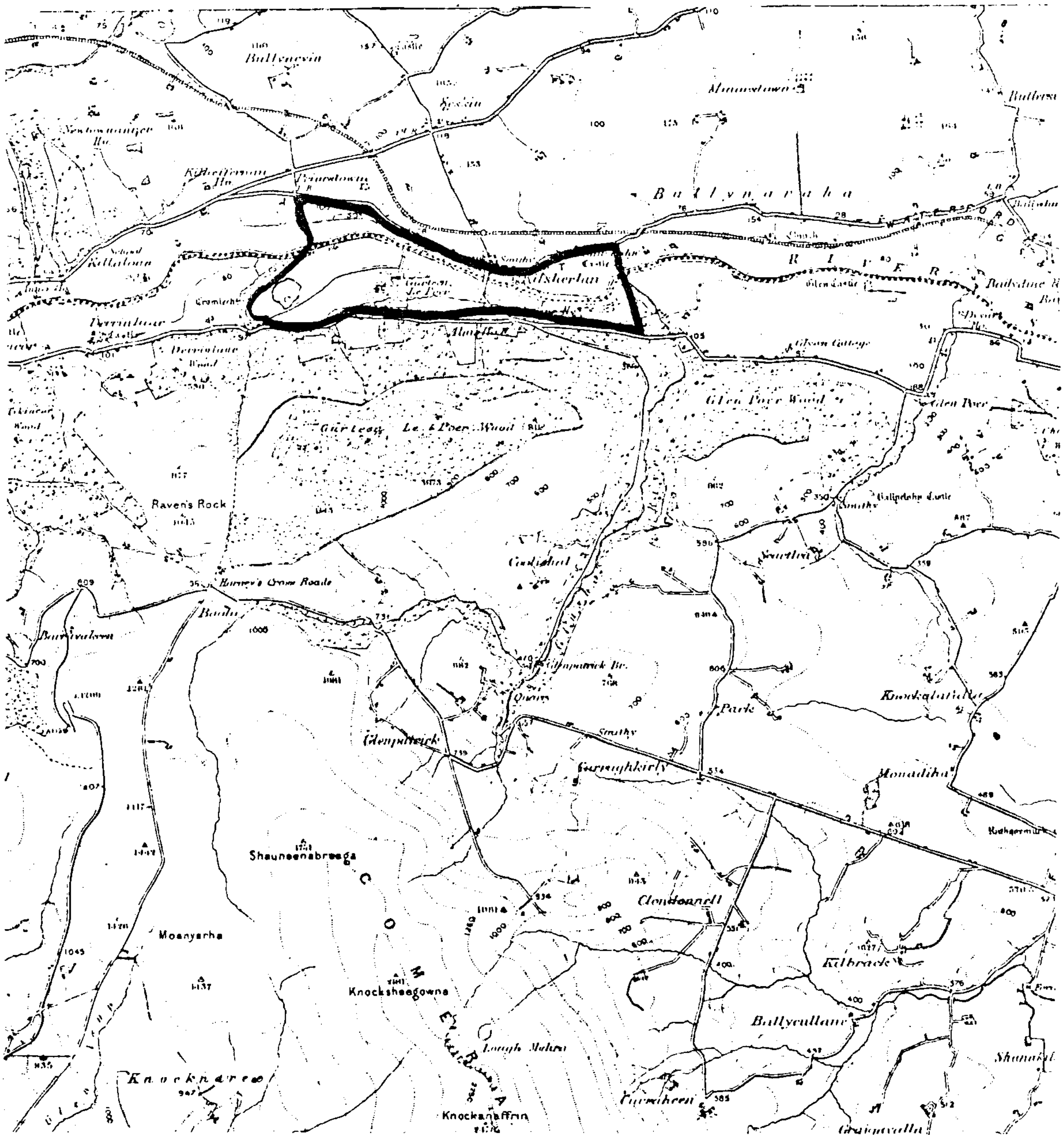
MAP SHOWING AREA OF SCIENTIFIC INTEREST — 2

Scale: 6 Inches to 1 Mile



MAP SHOWING AREA OF SCIENTIFIC INTEREST — 3

Scale: 1 Inch to 1 Mile



Features of interest are the following:
at Ninemilehouse the Weichsel end moraine is visible. The exposure is a low grassy bank on the western side of the North-South road. A map of the exposure is shown (1).
Ardfinnan Another part of the moraine is exposed at the town in some sand-pits which appear to be out of use at present. The materials contained are intermixed, as is the case for sands and gravels carried in ice. A map of this exposure is attached (2).
Kilsheelan. Here the River Suir valley is wide and flat. At the Southern side (in Co. Cork) it is bounded by the moraine while, to the north, the valley rises through a number of low hills.

The flat valley floor at Kilsheelan is a result of ice planing. The resulting terraces which are formed of ice-deposited gravels are more extensive on the Southern side of the river but also occur as a narrow strip on the north bank. This is shown on the 1 inch scale in map 3 (attached).

Threats to the Areas

These glacial phenomena are large topographical features which are under no immediate threat. Further quarrying at Ardfinnan would expose a large deposit and this would contribute to a knowledge of the structure. At Ninemilehouse and Kilsheelan there is no obvious threat to the survival of the features of interest although these might become obscured by road-building, infill or afforestation.

Recommendations

No immediate action is recommended for the three glacial features and no action at all is required at Ardfinnan. At Kilsheelan infill from the road to the glacial river terrace should be avoided by exercising of planning control.

Name of area	GALTEE MOUNTAINS
Acreage	2,000 acres
Grid reference	R 90, 24
Scientific interest	Botanical, ecological
Rating	National
Priority	C

Description of area

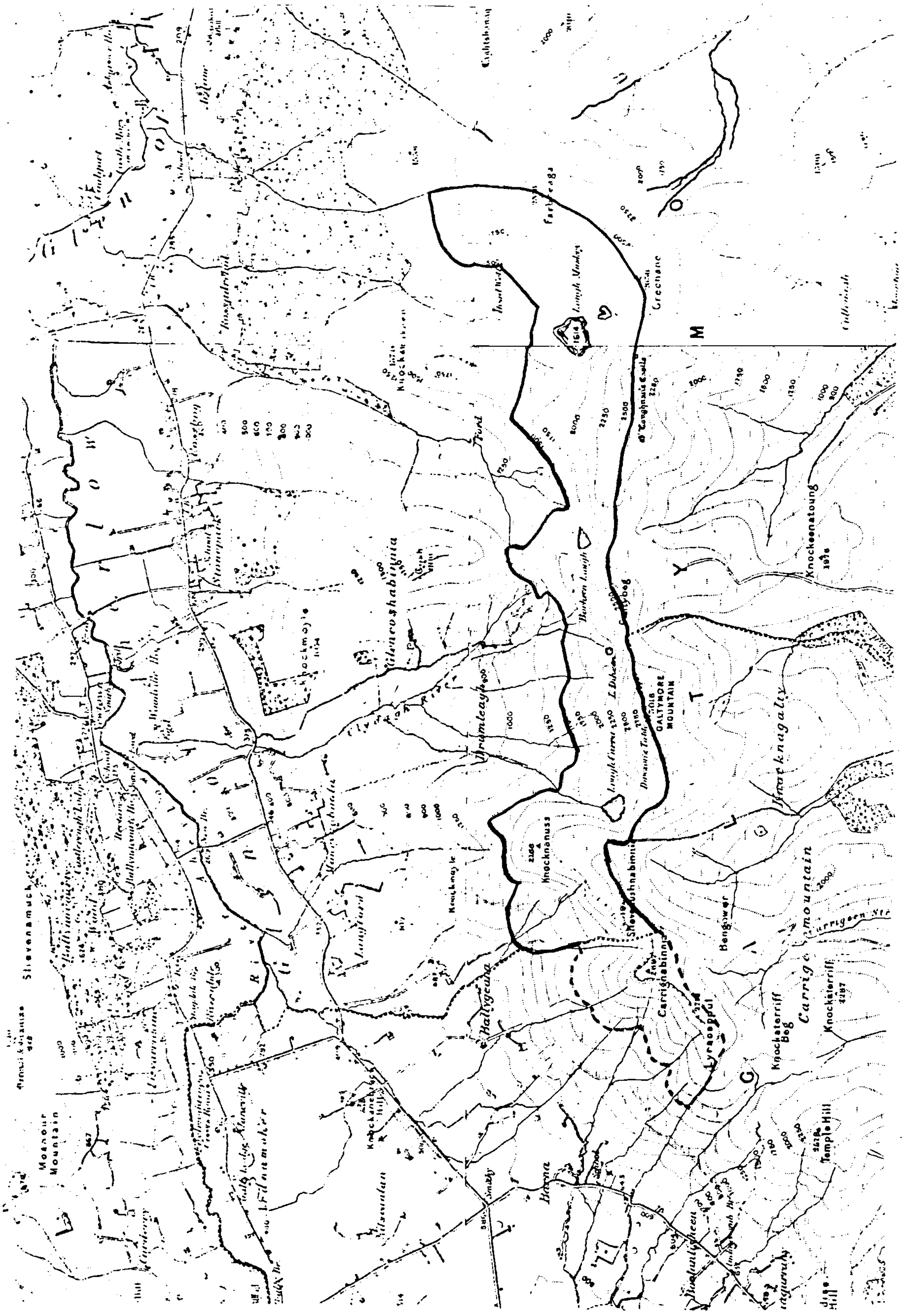
This range of mountains extends for about fifteen miles in an E.W. direction, but a quarter of this lies in Co. Limerick. The rocks are either sandstones or shales and it is on this latter formation, which overhangs most of the corries on the north side, that most of the interesting vegetation is found.

The community contains many plants and probably some invertebrates of arctic character and these are found on the cliffs above Lough Curra, L. Diheen, L. Borheen and L. Muskry. The waters of the lakes are acidic and peat-stained and very poor in vegetation but their form and origin is of some geomorphological interest. (See Lough Diheen p.35)

Typical mountain plants such as Calluna vulgaris (heather), Eriophorum vaginatum (bog cotton), Rhacomitrium lanuginosum (a moss) and Sphagnum spp. are abundant while Empetrum nigrum (crowberry) and Carex bigelowii (a sedge) occur on the flat summits. The cliffs contain scattered trees of Betula pubescens (birch), Salix aurita (a willow) and Sorbus aucuparia (rowan) with good patches of Luzula sylvatica (woodrush), Vaccinium myrtillus (frochan) and Hymenophyllum wilsonii (filmy fern). Many other fern species occur also, such as Dryopteris dilatata, D. aemula (buckler ferns), Polystichum setiferum (shield fern) and Cystopteris fragilis (brittle bladder fern). Among the more interesting species which grow in a few places are:

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 1 Inch to 1 Mile



Asplenium viride	mountain spleenwort
Thalictrum minus	meadow rue
Rhodiola rosea	roseroot
Saxifraga stellaris	starry saxifrage
S. hypnoides	mossy saxifrage
S. rosacea	mossy saxifrage
S. spathularis	St. Patrick's cabbage
Cardaminopsis petraea	mountain rock-cress
Meconopsis cambrica	welsh poppy
Epilobium angustifolium	rose-bay willowherb
E. brunnescens	creeping willowherb
Geum rivale	water avens
Rubus saxatilis	stone bramble
Oxyria digyna	mountain sorrel
Campanula rotundifolia	harebell
Saussurea alpina	alpine saw-wort
Hieracium spp.	hawkweed
Salix herbacea	least willow

Evaluation

This is a nationally important site in view of the occurrance of a diverse and interesting flora. For one species the Galtees form one of two sites in Ireland. Several lowland species reach high altitudes in this range while its inland position makes it unique among Irish mountain groups. None of the other inland ranges has a flora approaching the Galtees in variety or interest.

Vulnerability

The interesting species occur in general on cliffs out of the range of grazing sheep and on ground too steep or too high for afforestation. Thus collection would appear to be the only threat to them.

Recommendations

Land use in the area should continue in its present form and if any sort of development is contemplated that will bring more people to the mountains, a Conservation Order should be placed on the south of the area outlined.

Name of Area	HOLLYFORD QUARRY
Area	Less than 1 acre
Grid Reference	R. 935,562
Scientific Interest	Geological
Rating	National importance
Priority	C

Description of the area

The site is a small roadside quarry located by the main Tipperary to Nenagh Road. The location is shown on the accompanying 6" map.

Evaluation

The quarry is of an outcrop of Silurian rock. The Silurian period is a part of the Palaeozoic era and its remains are widespread in Ireland. The quarry in this case is an exposure of Wenlockian age (a sub-division of the Silurian), examples of which are rare.

The rocks are of stratigraphic (position in vertical series), palaeontological (fossil-wise) sedimentological (due to grain sizes represented) and structural (fracturing etc. of strata) importance. The fossils are graptolites and retiolitids.

Publications

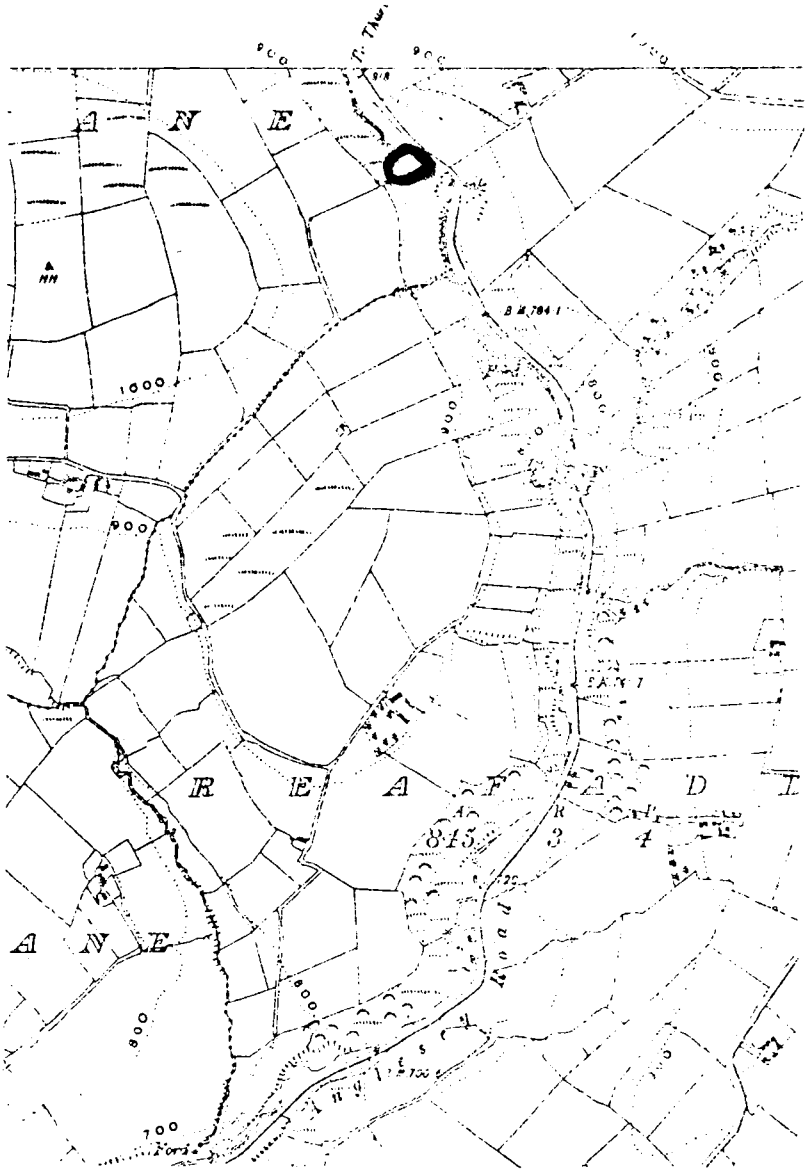
Doran, R.J.P., The Palaeozoic rocks between Tipperary town and Milestone, County Tipperary (Ph.D. thesis - T.C.D. - in prep.)

Cope, R.N. (1934), Cytrograptids and Retiolitids from Co. Tipperary, Geol. Mag. 91: 319-324.

Cope, R.N. (1959), The Silurian Rocks of the Devilsbit mountain district, County Tipperary, Proc. R.Ir.Acad. 60: 217-242.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Threats to the area

None is obvious. The site is too small to be used as a location for a dwelling house and reopening of the quarry for commercial purposes is not thought likely. Casual rubbish tipping is however a possibility.

Recommendations

This site is used at present by geological field parties for educational and research purposes. Basic planning protection will serve to maintain the site.

Name of Area	KNOCKASTAKEEN FOREST
Acreage	790 acres
Grid reference	R. 930,275
Scientific Interest	Zoological
Rating	National importance
Priority	C

Description and Evaluation of the Area

The site which is a coniferous forest is situated on the northern face of the Galtee Mountains.

The forest is made up of Pinus sylvestris (scot's pine), P. contorta (contorted pine) and Picea abies (spruce) and the ground flora comprises the usual woodland herbs among which Calluna vulgaris (ling) is common, indicating the acidic nature of the soil.

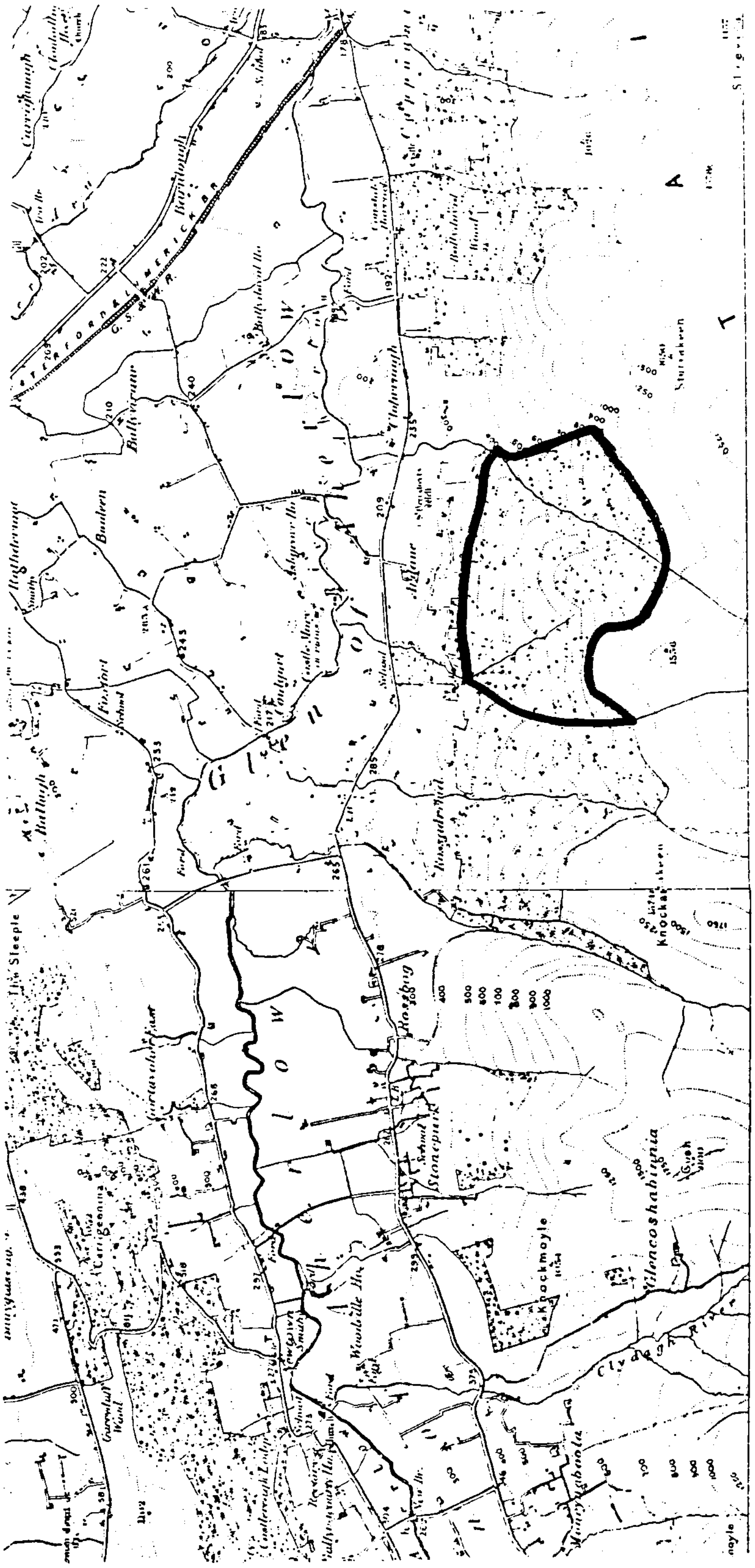
Wood ants of the genus Formica were reported in the wood during the 1950's. They are widely scattered throughout the forest but are concentrated in largest numbers in the area surrounded by a black line on the accompanying one inch map. During a recent census forty-five nests were reported and though it is thought that this figure is a minimum estimate it is thought there are not more than fifty in all. The ants are of commercial value as a pest control as well as being of considerable scientific interest. From Knockastakeen wood colonies have been distributed to other parts of Ireland and some colonies are known to occur at other places (see C.A. Collingwood, A Survey of Irish Formicidae Proc. R. Ir. Acad. 59 (B) 11:213 - 219). This site in South Tipperary is possibly the largest concentration of nests in the country.

Threats to the Area

The ants in Aherlow do not occur in such vigorous colonies as are generally encountered in alpine conditions and this is thought to be a result of climate which is mild in Southern Ireland. There is no other threat to the survival

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 1 Inch to 1 Mile



of the colonies on the Galtees. The Forestry Division of the Department of Lands is anxious to conserve existing nests and encourage their spread for pest control.

Recommendations

Land use should remain in its present form.

Name of area	KILLOUGH HILL
Acreage	105 acres
Grid reference	S. 110, 508
Scientific interest	Ecological, botanical, zoological
Rating	National/Regional
Priority	A

Description of the area

The site is shown on the accompanying 6" O.S. map. It was described by the original geological survey as a typical limestone escarpment having an abrupt north slope "formed by the .... termination of its beds while the other side is a gentle slope conforming more or less perfectly with the inclination of the beds." Rock is now exposed on top and on the north slope where it has been eroded into limestone pavement.

The southern side of the hill is partly under grass, and drift soil normally overlies the limestone. Ash is well established here with some elder and scattered oak trees but only small patches of closed canopy are found.

Higher up and to the north side a hazel wood becomes dominant with some ash and rowan (Sobus aucuparia) and shrubs such as Euonymus europaeus (spindle-tree), Viburnum opulus (guelder rose) and Rosa canina and R. arvensis (roses). The woodland floor has a characteristic assemblage of herbs and mosses, including:-

Oxalis acetosella	wood sorrel	a
Endymion non-scriptus	bluebell	a
Circaea lutetiana	enchanter's nightshade	c
Primula vulgaris	primrose	c
Geranium robertianum	herb robert	c
Galium odoratum	woodruff	f
Fragaria vesca	strawberry	f
Glechoma hederacea	ground ivy	f
Veronica chamedrys	germander speedwell	f
Lysimachia nemorum	yellow pimpernel	f
Arum maculatum	arum lily	o
Ranunculus ficaria	wild celandine	o
Epipactis helleborine	broad-leaved helleborine	o
Dryopteris filix-mas	male fern	o
Athyrium filix-femina	lady fern	o

Invertebrates when sampled in July consisted of typical bark-dwellers, seven species of Psocoptera, three Neuroptera and a number of small beetles. The accumulated leaflitter held mites and springtails which were also found in the debris in the limestone pavement. Here leaf litter could be up to a foot in depth and with a high humidity many of the more primitive groups of insects with thin skins were well-represented. These included springtails (Tomocerus sp.), bristle-tails (Petrobius maritimus), centipedes (Lithobius spp.), millipedes (Cylindroiulus latestriatus and Ophiulus pilosus), spiders (Megalumus sp.) and wood lice (Oniscus asellus). These were the most numerous occupants of the crevices though false scorpions, beetles and worms were also taken.

The plants of the limestone pavement included:-

Festuca ovina	sheep's fescue	f
Galium verum	lady's bedstraw	f
Carex flacca	a sedge	f
Carlina vulgaris	carline thistle	o
Camptothecium lutescens	a moss	f
Phyllitis scolopendrium	hart's tongue	f
Asplenium ruta-muraria	spleenwort	o
Neckera crispa	moss	c
Ctenidium molluscum	moss	c
Sedum acre	wall pepper	o

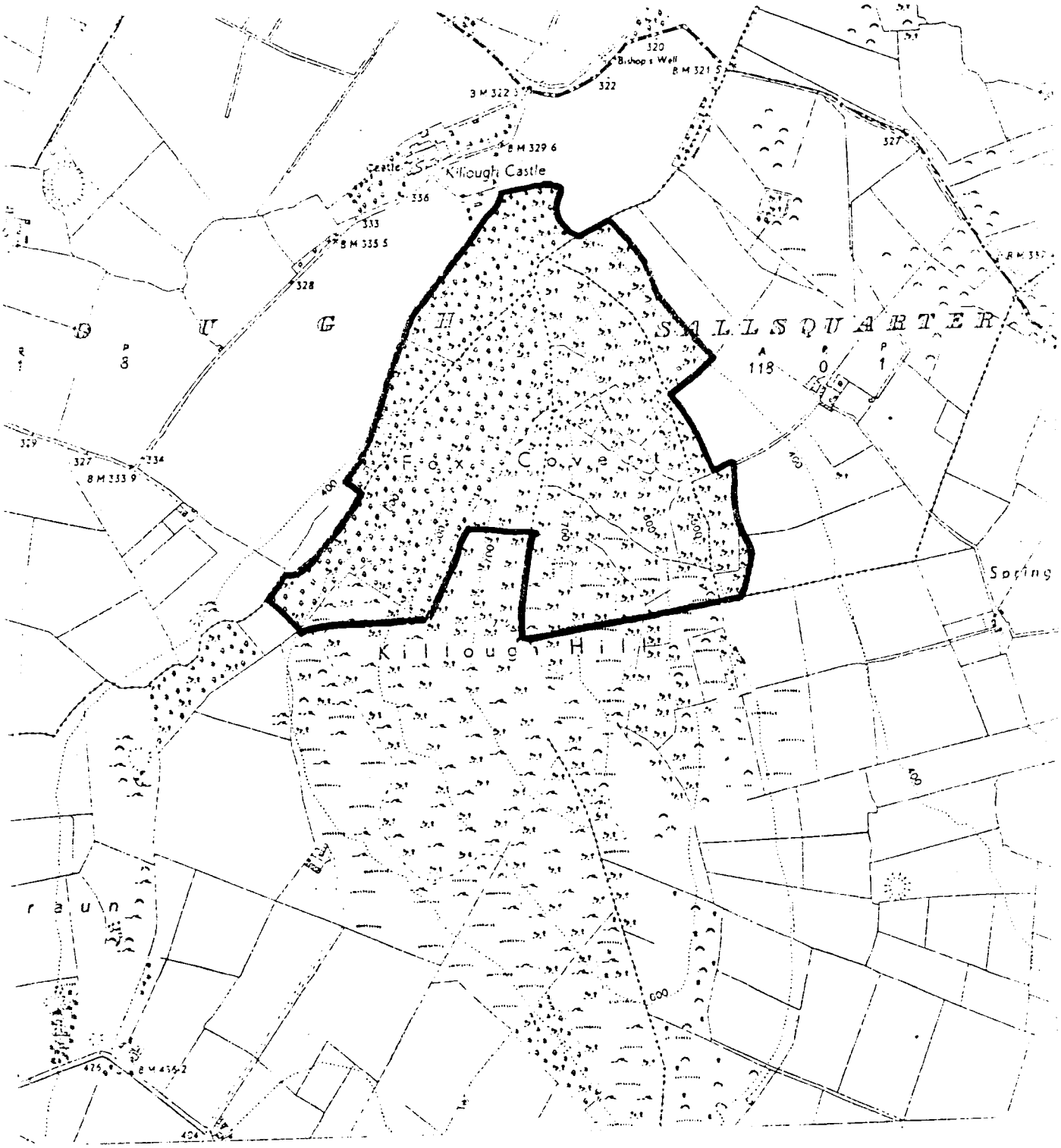
Evaluation

The woodland on Killough Hill is of relatively recent origin but is developing well with a very good ground flora. It also houses a large bird population and varied mammals. The open areas of pavement and limestone grassland are perhaps more important since they are a rare feature in the country. To date only four exposures of pavement are known outside the western Clare-Galway area (see map). These have the same interest which oceanic islands have, being isolated from each other. A comparison of the invertebrate fauna with an area of the Burren (Richards, Proc. R.I.A. 62, 1) brings out some similarities especially the prevalence of scavengers, but the presence of a spider family (Dysderidae) suggests a different food chain at Killough.

The site has good educational potential as well as its considerable scientific interest.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile

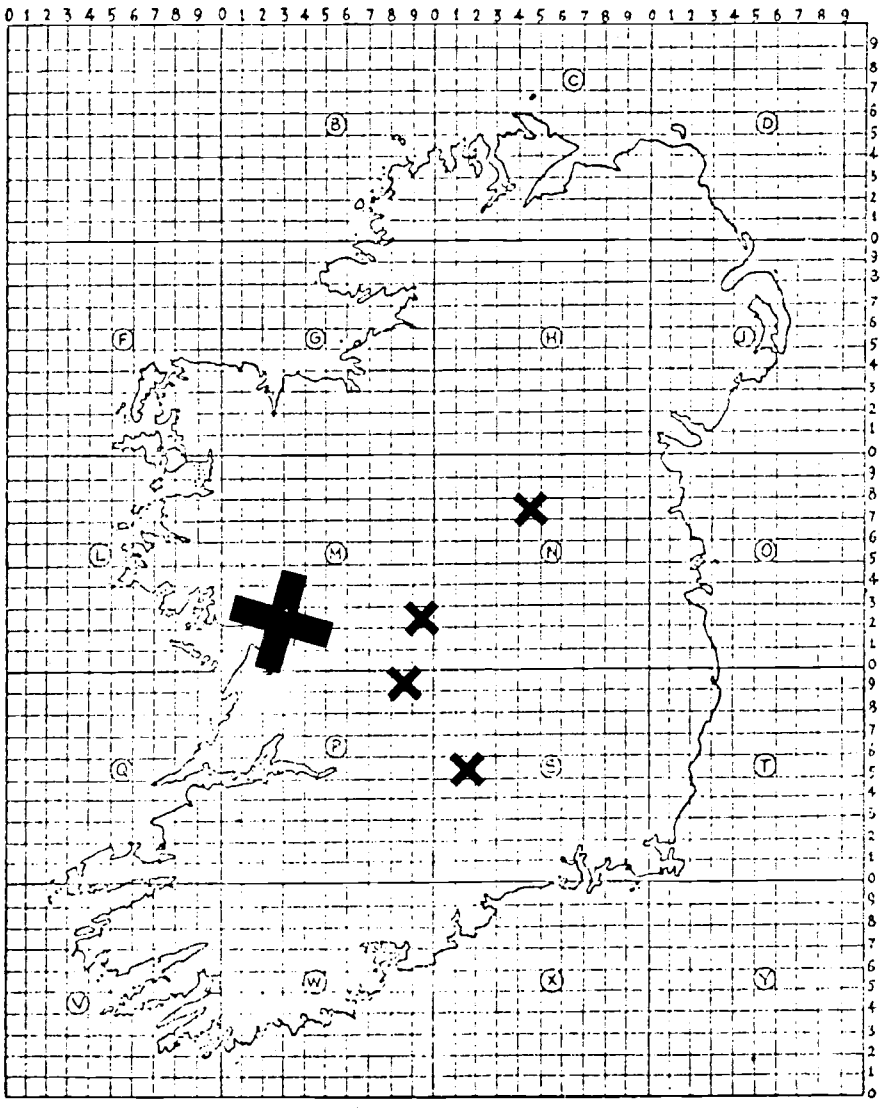


Threats to the area

The main threat comes from the large quarry which is cutting into the central part of the hill. The hazel woods have been bulldozed in places and limestone dust is widely scattered.

Recommendations

From a biological viewpoint this site is one of the most valuable in South Tipperary so as much as possible of the pavement and hazel wood should be preserved. The outlined area on the 6" sheet should be protected by a Conservation Order and the quarry should be allowed to spread in other directions, especially to the east.



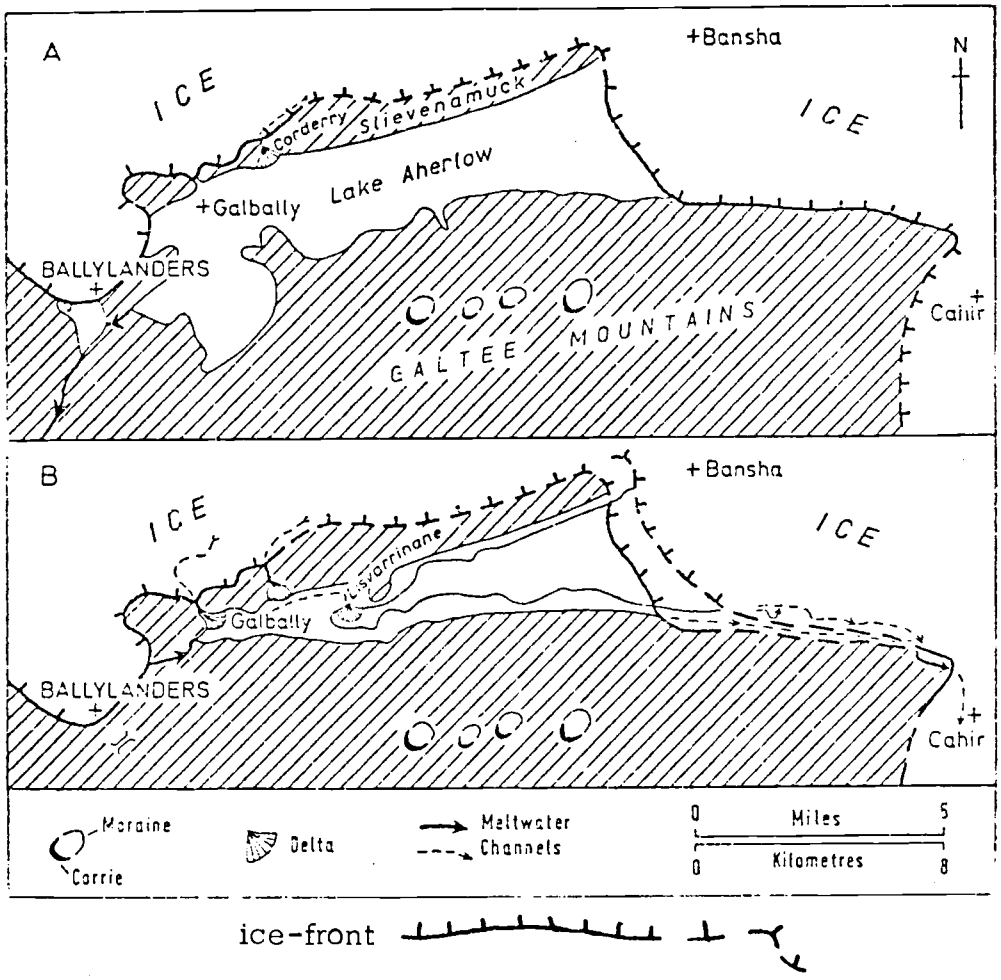
Known exposures of limestone pavement in Ireland

Name of Area	GLACIAL FEATURES IN THE GLEN OF AHERLOW (See also botanical sites in the Galtee Mountains)
Acreage	166 + 5 = 171 acres
Grid Reference	R.90,30 (centre of valley)
Scientific interest	Geological
Rating	Regional - possibly national importance
Priority	Varies from A (Corderry) - C (Lough Diheen); see threats to the area .

Description and evaluation of the areas.

The Glen of Aherlow (shown on accompanying maps) is surrounded in either side by the Galtee Mountains which are a Palaeozoic inlier. The inlier breaks into two fingers which enclose the Glen in an east-west direction. The floor of the valley is formed of limestone.

On the two figures below the glacial history of the valley is illustrated.



During the Weichsel (2nd phase) glaciation ice built up to the south of Slievenamuck and melt-water entered the valley at Corderry and west of Bansha. The glacial lake which formed in the valley drained out by an overflow channel near Ballylanders. This sequence is shown in Fig. A. The second Figure (B) illustrates a later stage of the process in which there was a slight retreat of the ice-front. The drop in water-level was accompanied by the formation of two more inflow deltas at Galbally and Lisvarrinane and the Ballylanders outflow was replaced by an inflow channel from the ice front. At this stage melt-water was released from the lake at the eastern end of the Galtees where it passed into the Suir valley at Cahir.

Meanwhile successive snowfalls accumulated on the Galtees where the resulting ice formed a series of corries.

Interesting features which deserve conservation are the following: Ballylanders outflow channel (in Co. Limerick). The Galbally delta has been quarried and, on the eastern side, the Lisvarrinane delta might be quarried but for the regional water table which is too high there. The Corderry delta is a good example of a glacial delta and deserves protection.

There are four corries on the Galtee mountains, facing north. Lough Diheen is the smallest and the most visually impressive. Set in front of a steep enclosure wall it contains a shallow lake. A moraine which was clearly deposited in two phases closes the mouth of the structure.

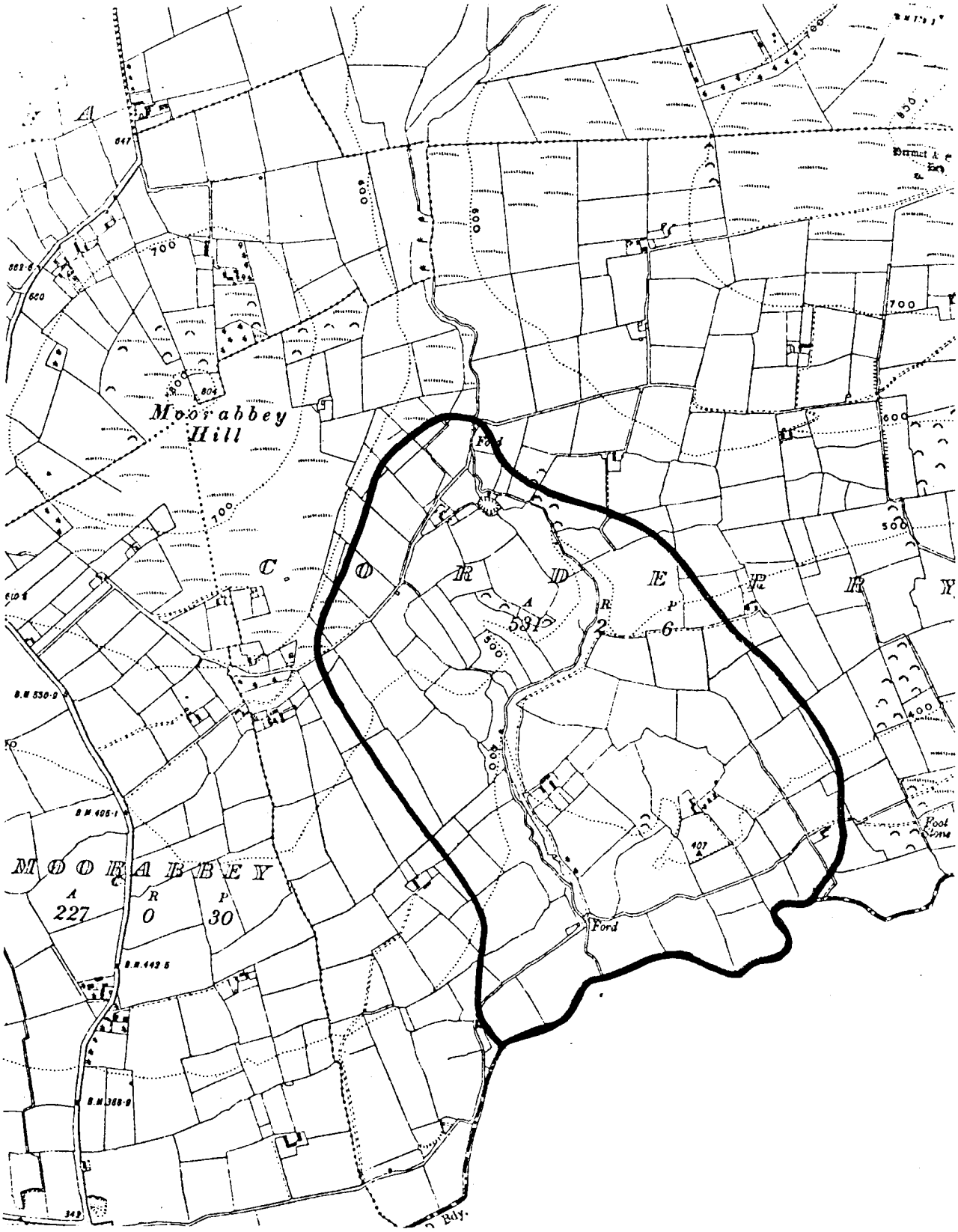
Threats to the Area

The Corderry delta is likely to be exploited if conservation measures are not adopted. Delta gravels are very pure (well sorted) and hence are valued highly for road metalling etc.

There is no likely threat to the survival of Lough Diheen but coniferous afforestation could obscure the outlines of this and the other site. At Diheen afforestation is unlikely (the corrie is at 1800 feet O.D.) At Corderry it is a possibility although the high agricultural values of the land probably make forestry an unlikely development.

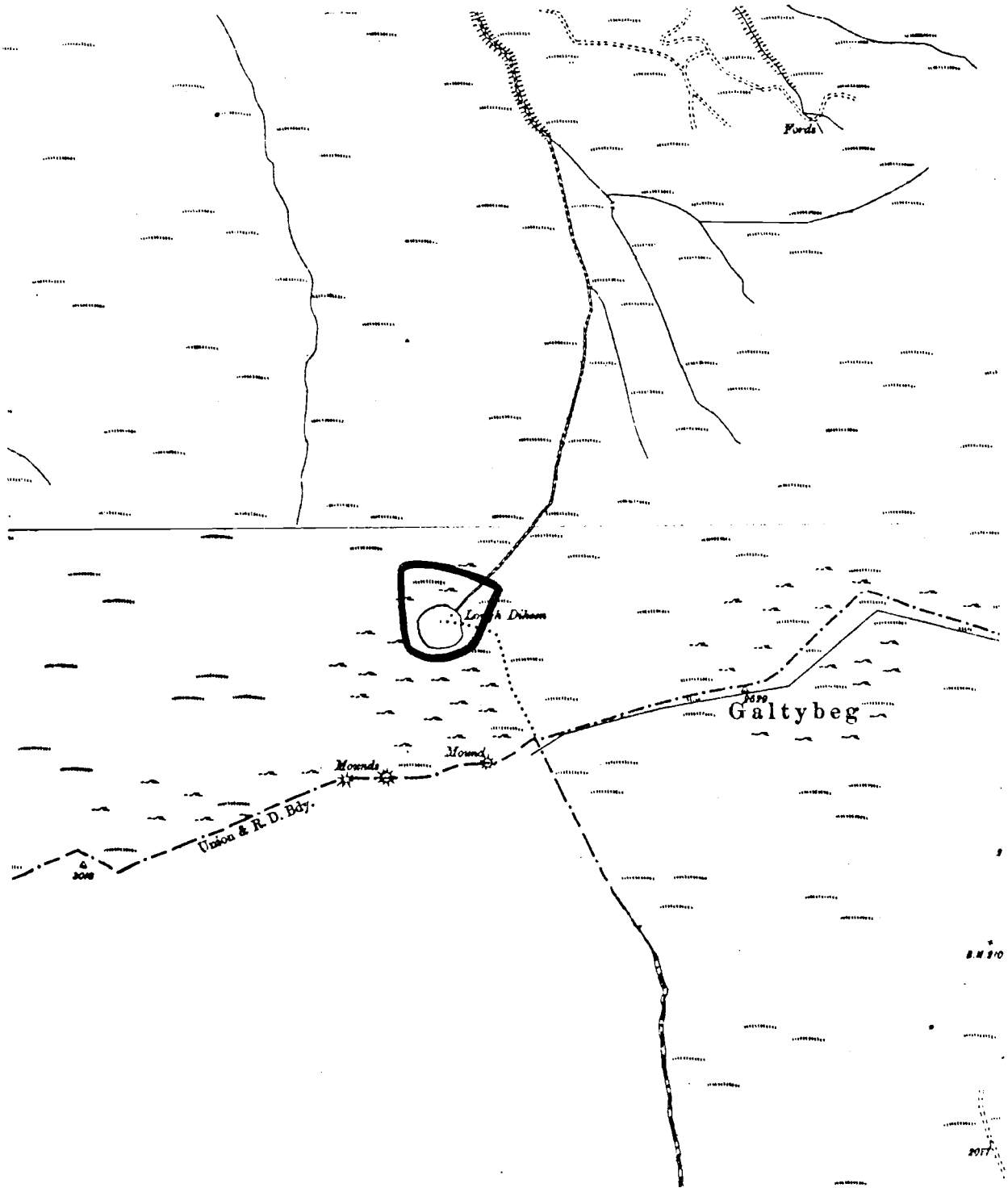
MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Recommendations

The Corderry delta could be protected by a refusal of permission to mine gravels at the site. In addition, afforestation should not take place on this site although it would only affect the area visually. The Department of Lands could well be notified of the County Council's concern to preserve the Corderry delta in its present form, before any land acquisition takes place.

No action is recommended for Lough Diheen, except for a similar notification to the Department. As stated above afforestation is unlikely to occur here.

Name of area	INCHINSQUILLIB WOOD
Acreage	22 acres
Grid reference	R. 912, 502
Scientific interest	Ecological
Rating	Regional
Priority	A

Description of area

On these acid rocks several naturally developed woods are found, the best one being west of the road from Cappagh White to Hollyford. It is predominantly of hazel at the moment but natural succession is transforming it into an oakwood. The hazel canopy is overtopped in places by strong growing (8") oak trees (Quercus petraea). Birch (Betula pubescens) and ash (Fraxinus excelsior) are other species that occur commonly as large trees while there is a limited amount of Ilex aquifolium (holly) below the main canopy.

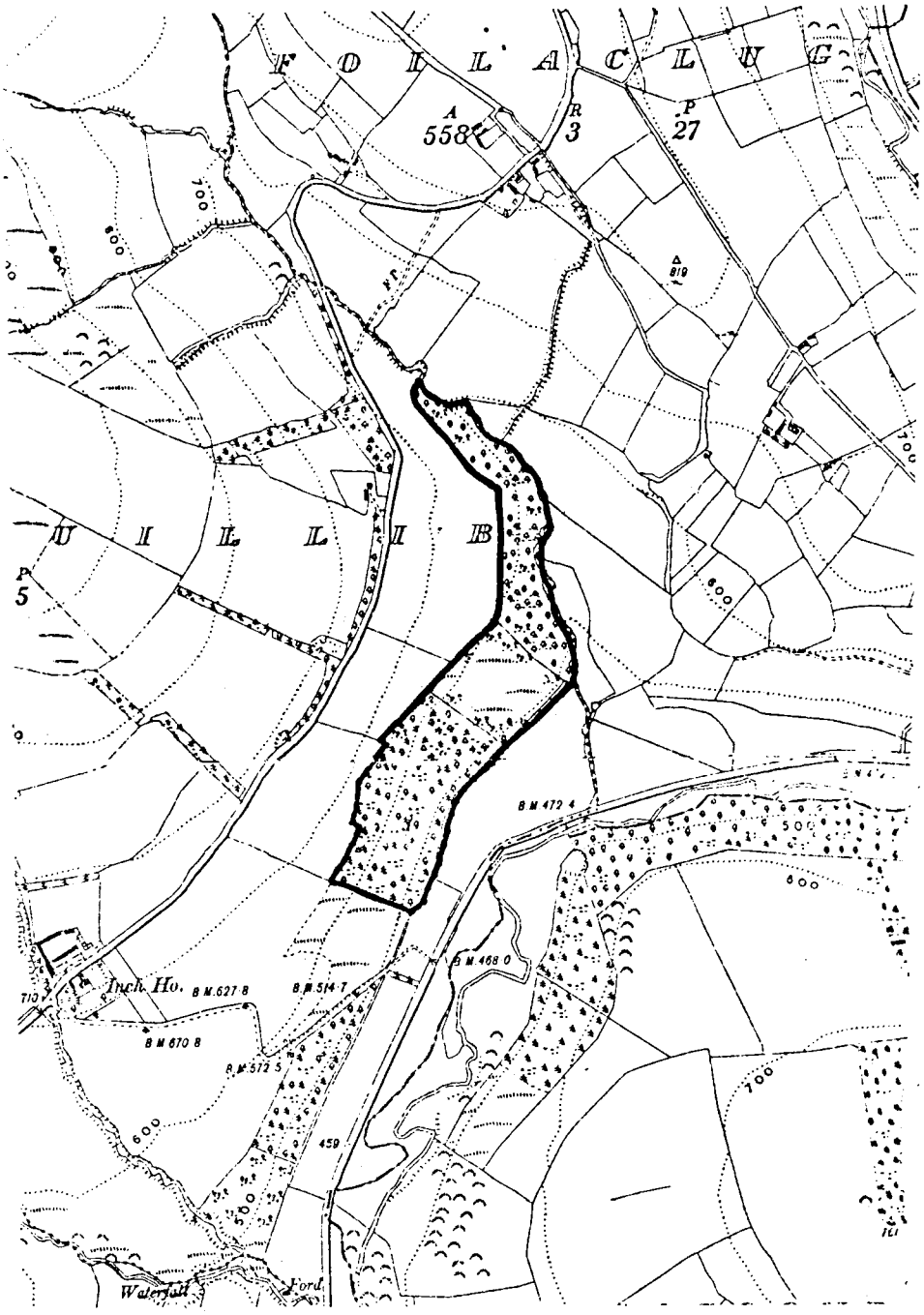
The ground floor is well developed but fairly poor in species which is characteristic of this sort of woodland. It includes:

Carex sylvatica	wood sedge	c
Primula vulgaris	primrose	c
Endymion non-scriptus	blue bell	f
Oxalis acetosella	wood sorrel	f
Conopodium majus	pignut	f
Blechnum spicant	hard fern	f
Veronica chamaedrys	germander speedwell	f
Sanicula europaea	wood sanicle	o
Circaea lutetiana	enchanter's nightshade	o
Carex remota	a sedge	o
Luzula sylvatica	great woodrush	l.f.
L. pilosa	spring woodrush	o
Athyrium filix-femina	lady fern	o
Veronica montana	wood speedwell	o
Arrhenatherum elatius	false oat	o

Bird life is moderately rich including some of the larger, less common species.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Evaluation

Though there is no indication of continuity with the ancient natural forest, this site has been left alone to develop naturally without introduced species or much management. It thus has considerable ecological interest and is probably the best woodland site now in the county. It is ungrazed and a certain amount of regeneration is taking place.

The occurance of Arrhenatherum in woodland is of interest in the ecology of this species.

Threats to the area

Substantial clearance is now affecting the middle section of this wood for agricultural purposes. This must be regarded as the major threat as it may extend further in area, but indescriminate felling of the trees before they reach maturity, or underplanting with conifers should not be overlooked.

Recommendations

An immediate Tree Preservation Order under Section 44 Local Government (Planning and Development) Act, 1963, should be put on the remainder of this wood especially the northern section.

Name of area	GROVE WOOD, FETHARD
Acreage	77 acres
Grid reference	S. 218, 333
Scientific interest	Ecological, botanical, zoological
Rating	Regional
Priority	A

Description of area

Grove Wood is situated on a sandstone hill just south of Fethard. The canopy is formed by ash, hazel and birch (Betula pendula) in the lower part and oak above where the trees are older but moderately small due to exposure. The clayey soils in the lower part have a typical flora for this woodland type, e.g.

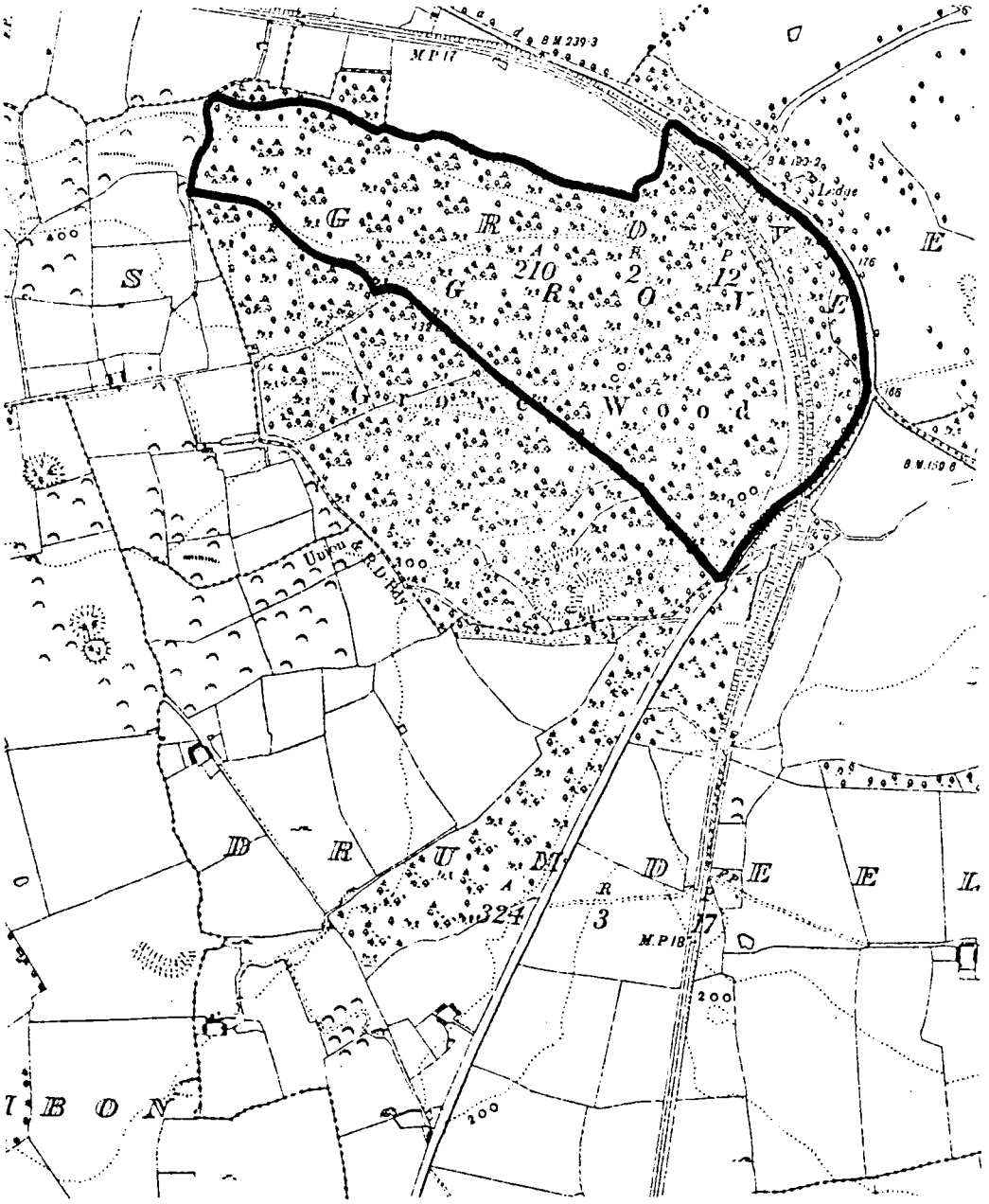
Hedera helix	ivy	a
Carex sylvatica	wood sedge	c
Circaea lutetiana	enchanter's nightshade	c
Anemone nemorosa	wood anemone	l.c.
Oxalis acetosella	wood sorrel	c
Ajuga reptans	bugle	f
Endymion non-scriptus	bluebell	f
Glechoma hederacea	ground ivy	f
Conopodium majus	pignut	f
Dryopteris dilatata	buckler fern	f
D. filix-mas	male-fern	f
Ranunculus auricomus	goldilocks	o
Carex remota	a sedge	o
C. nigra	a sedge	o
C. lævigata	a sedge	r
Phyllitis scolopendrium	hart's tongue	r
Epipactis helleborine	helleborine	r
Veronica montana	wood speedwell	r
Bromus ramosus	wood brome	o

Other shrubs that occur include Viburnum opulus (guelder rose), Euonymus europaeus (spindle-tree) and Ilex aquifolium (holly) while Salix caprea (goat willow) is quite common as a tree.

The older part of the stand, the oak trees towards the top of the hill occur in a more heathy community with Teucrium scorodonia (wood sage), Rubus fruticosus (bramble), Holcus mollis (creeping soft-grass),

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Stellaria holostea (greater stitchwort) and Moehringia trinerva (a sandwort). Oxalis and Endymion are again common with much Lonicera periclymenum (honeysuckle) and some Luzula sylvatica (greater woodrush), L. pilosa (spring woodrush) and Blechnum spicant (hard fern). Betula pubescens is the usual birch in among the oak.

There is quite a rich fauna is the wood both of mammals(including squirrels) and birds.

Evaluation

This is a wood of considerable amenity value as it is visible from a distance. It also has a rich flora though it is relatively young, and would be of considerable use in education.

The oak canopy is ecologically interesting and it is one of the only stands on relatively base rich soil (derived from glacial drift) in the county.

Threats to the area

Widespread felling of all species is occurring on the south side of the hill and the ground in being replanted with larch. Already at least half of the oak stand has disappeared and there is no indication that any will be left.

Recommendations

Grove Wood to the limits shown should be covered as soon as possible by a Tree Preservation Order under Section 45 Local Government (Planning and Development) Act, 1963. In this way half of it would remain as a productive coniferous unit and the other half as an amenity and educational (deciduous) area. This latter would benefit from the laying out of walks including a nature trail and a picnic site.

Name of area	MARSHES AND PONDS NEAR ANNACARTY
Acreage	57 acres
Grid reference	R. 93, 44 (Greenane R.914 395)
Scientific interest	Ecological, botanical, zoological
Rating	Regional
Priority	B

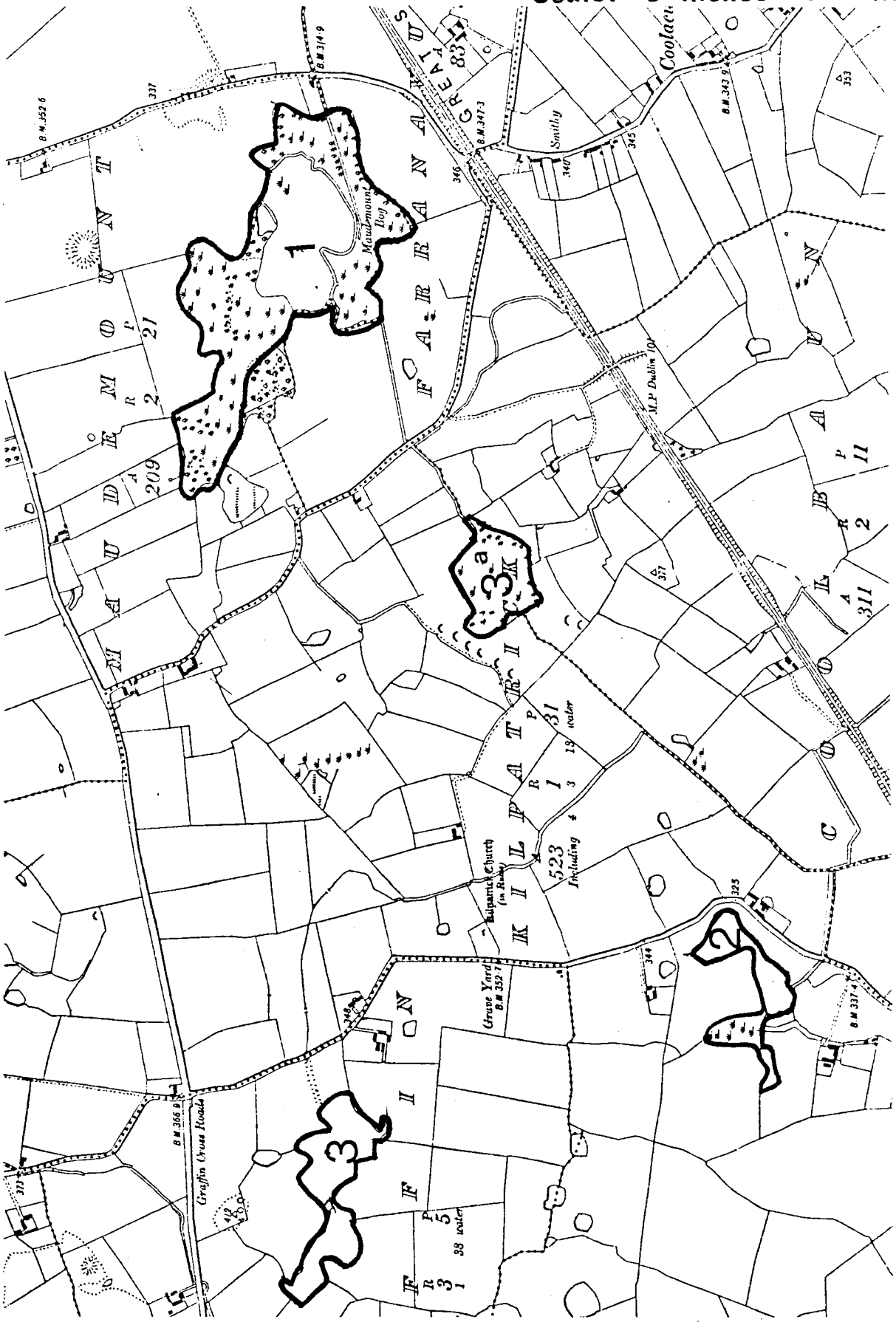
Description of area

The drift cover of all this area, from Tipperary to Cappagh White and Dundrum, is undulating with frequent hollows and ridges. Some of the former are very regular and of small size and so can be called kettle-holes while others are larger with surface water. Drainage from these areas is very slight so the streams leading from them are small. This means that there is little communication between sites and they each have developed peculiar features, though this is also related to their depth at formation and the consequently speed of vegetation infill.

Of the open water examples one is highly calcareous with marl deposits and calcareous fen vegetation at its edge (1). Juncus obtusiflorus (blunt-flowered rush) and Carex lepidocarpa (a sedge) are perhaps the commonest species here with small amounts of Molinia carulea (purple moor grass) and Eriophorum angustifoliam (bog cotton). The more interesting species include Potamogeton coloratus (pondweed) in the very clear water, and Galium uliginosum (fen bedstraw), Epipactis palustris (marsh helleborine), Equisetum variegatum (a horsetail) and Cladium mariscus (saw sedge) at the margins. Many other marsh species occur at the edges of this waterbody and in the kettleholes that were completely grown over, they formed a floating mat of vegetation. Menyanthes trifoliata (bog bean) is especially important in this situation with Potentilla palustris (marsh cinquefoil), Lychnis flos-cuculi (ragged robin), Ranunculus flammula (lesser spearwort), Mentha aquatica (water mint), Veronica scutellata (marsh speed well), Carex rostrata, C. diandra and C. disticha (sedges).

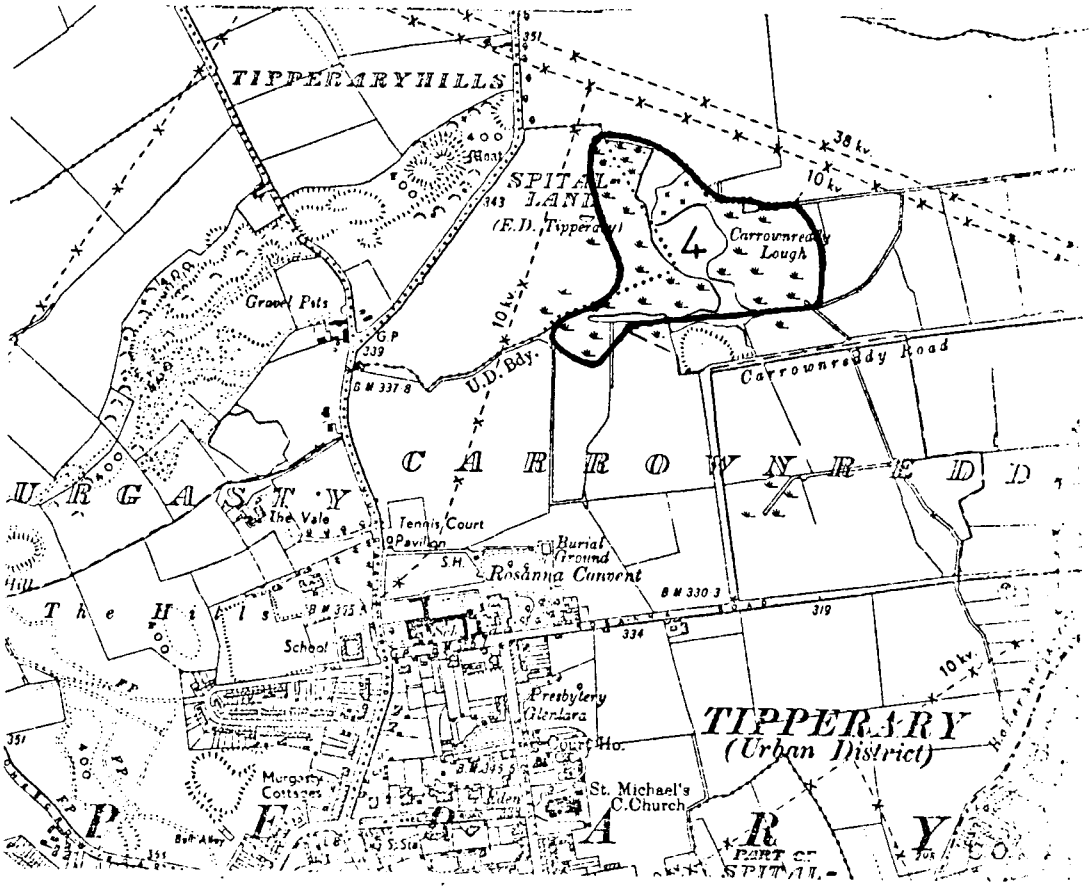
MAP SHOWING AREA OF SCIENTIFIC INTEREST — 1-3

Scale: 6 Inches to 1 Mile



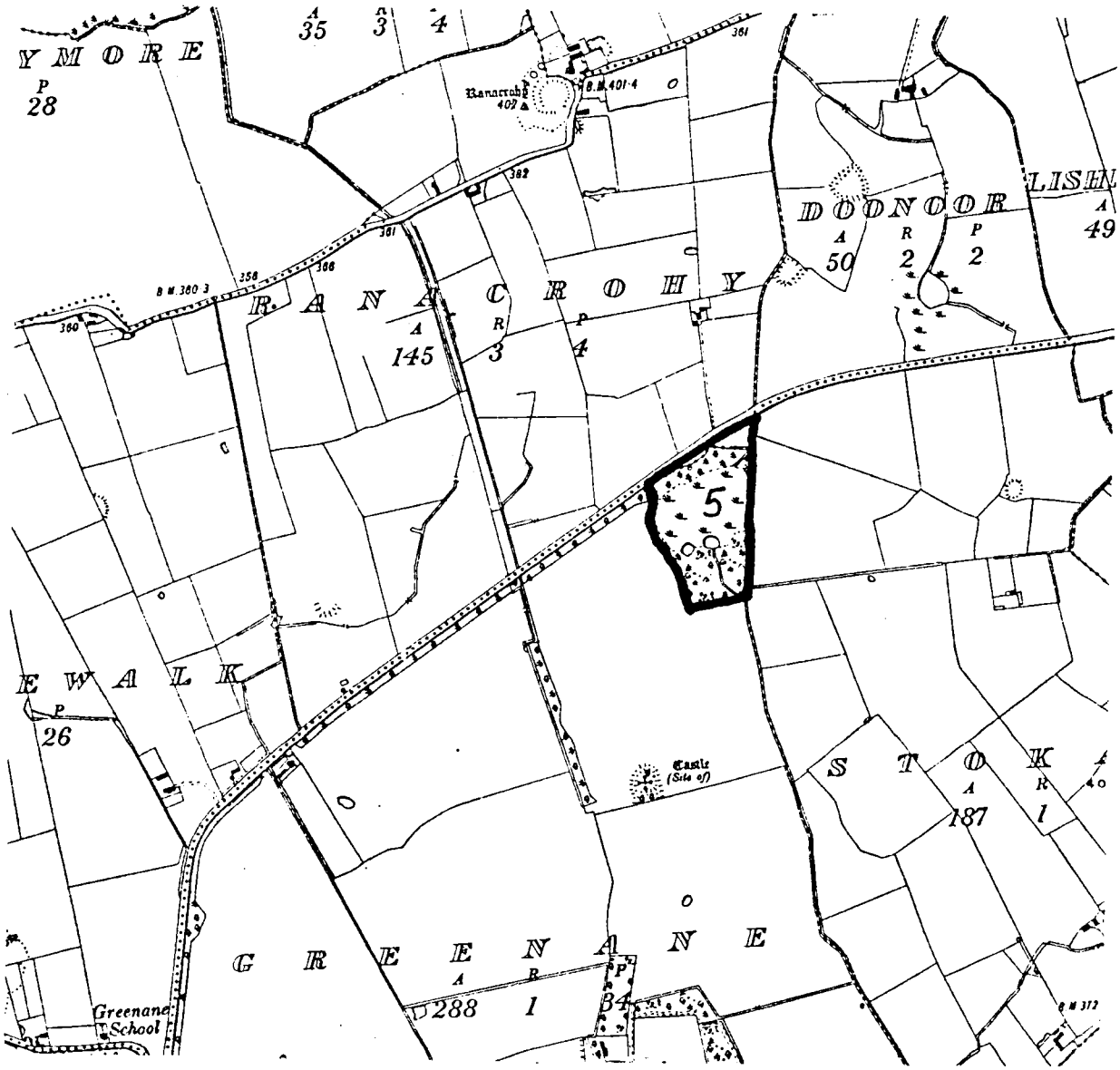
MAP SHOWING AREA OF SCIENTIFIC INTEREST —4

Scale: 6 Inches to 1 Mile



MAP SHOWING AREA OF SCIENTIFIC INTEREST — 5

Scale: 6 Inches to 1 Mile



Site (2) is also calcareous with Chara spp (stonewort) in the water but (3) is a larger pond, muddier in appearance and probably about neutral. The species content is different here with both species of Typha (bulrush), Iris pseudacorus (yellow flag), Alisma plantago-aquatica (water plantain), Lycopus europaeus (gipsy wort), Scutellaria galericulata (skull-cap), Oenanthe fisulosa (water dropwort), Ranunculus sceleratus (crowfoot) and much Riccia fluitans (a liverwort) and Lemna minor (duckweed) in the water.

Site (4) just north of Tipperary is almost grown over and some alder colonisation is taking place, associated with tussocks of the sedge Carex paniculata. Ranunculus lingua (greater spearwort) is common here with Menyanthes and much Agrostis stolonifera (creeping bent), Galium palustre (marsh bedstraw) and Equisetum fluviatile (water horsetail). Berula erecta (water parsnip), Epilobium palustre (marsh willowherb), Caltha palustris (marsh marigold), Sparganium erectum (bur-reed) and Valeriana officinalis (marsh valerian), make up the complement of the larger species of herbs. Sites 3a and 5 represent the end of the vegetational successions, being largely overgrown and containing some trees.

Zoologically the sites are rich and a generalised account of the insect fauna follows. Abundant mosquitoes (Culicidae) were found at all the areas but Chironomidae (non-biting midges) were taken only where open water occured. Of these the dominant forms were carnivores (Tanypodinae, especially Anatopynia and Dentaneura). These feed on a large biomass of small crustaceans, Cladocera and Copepoda, secondary carnivores included Argiopid (orb spinning) spiders and coccinellid beetles. Other aquatic insects taken included Limnephilus sp. (a small caddis fly) found even where vegetation completely covered the water surface. Mayflies of the genus Baetis (olives) on the other hand occurred only in two sites containing visible springs.

Small Tortricid moths were numerous while Zygoptera (dragonflies etc.) were represented by Lestes sponsa, Pyrrhosoma nymphula and Coenagrion pulchellum and puella. Other orders of insect whose larvae live in water were well represented, included seven species of hoverfly. Smaller species of Hymenoptera (wasps and sawflies) were some of the most numerous organisms present (especially Sphecoidea) while bugs

(Hemiptera - Velia) and beetles (Gyrinus natator) were also frequent. The alder fly Sialis was taken at one fen.

Evaluation

This is an exceptionally interesting series of marshes in which many facets of ecology such as succession, alkalinity and migration are all well shown and invite study, together with a richness and diversity of plant and animal species.

Vulnerability

These sites are difficult to drain but possibly easier to fill in using modern equipment. At Tipperary the marsh in question adjoins the town refuse tip and this is a source of pollution, and infill for it.

Recommendations

The landowners should be approached to keep these marshes in their present state. They all could be used for educational purposes but No. 4 at Tipperary is pre-eminent in this respect. It should be retained in some form and though there is room beside (E. of) the present tipping area for additional dumping, it should be an objective to find a new site at the earliest opportunity.

Marsh 1 would be best protected by a Conservation Order as it is the most unusual and interesting wetland in the county.

Name of area	SUIR BELOW CARRICK-ON-SUIR
Acreage	53 acres
Grid reference	S. 422, 214
Scientific interest	Botanical, ecological
Rating	Regional
Priority	C

Description of area

The low marshes and fields below Carrick-on-Suir are flooded both by the river and the tide and though the pasture fields have been protected by newly formed banks, they retain wet patches, and their ditches hold a continuation of the riverbank community. This is dominated by willows (eg. Salix viminalis, S. alba, S. triandra) while sedges and grasses occur below, especially Carex riparia (greater pond sedge), Phalaris arundinacea (reed canary grass), and Glyceria maxima (reed grass). The herb flora is rich but its arrangement has been confounded by the recent earthworks which have also introduced many weed species. The following plants occur:

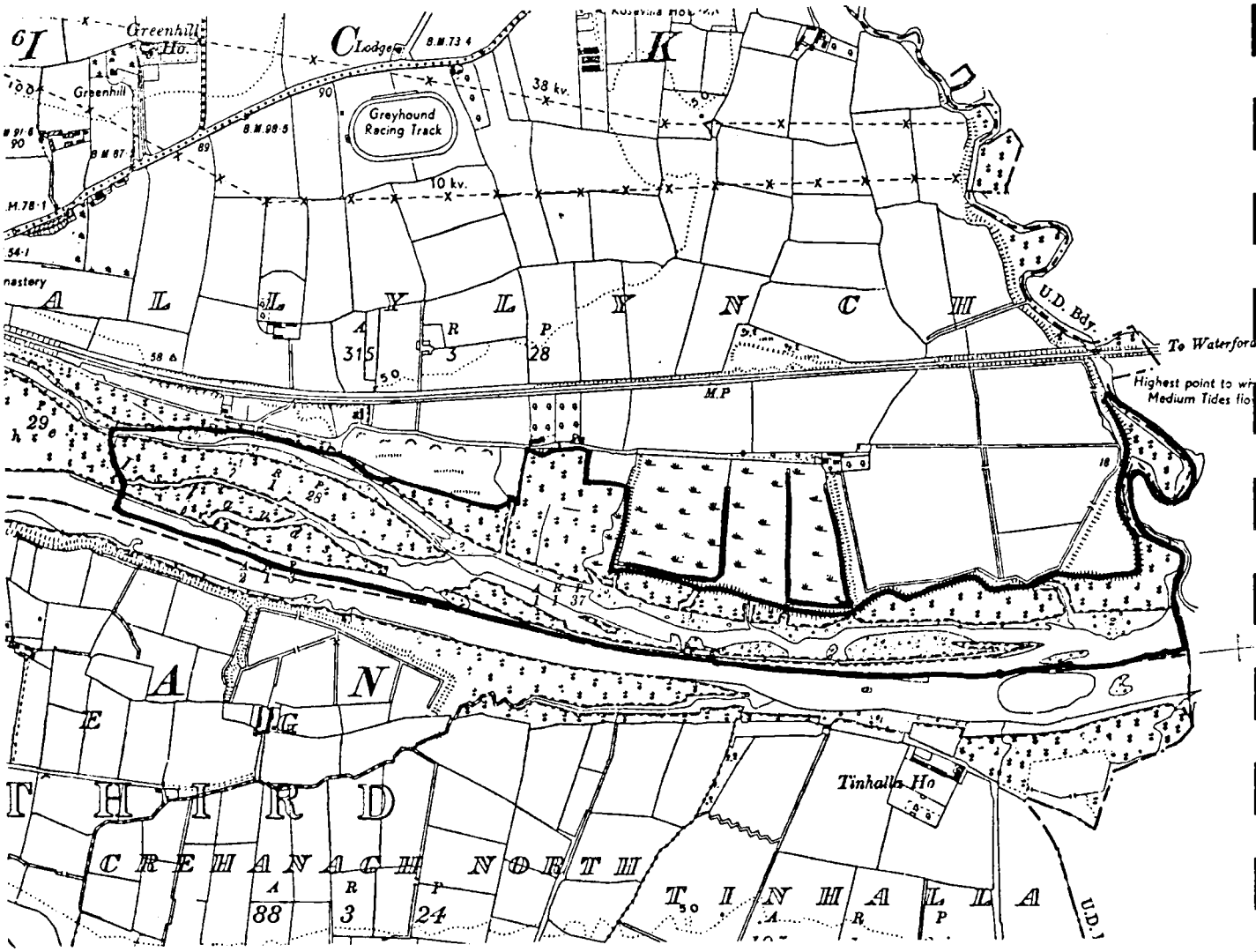
Epilolium hirsutum	great willow herb	l.a.
Iris pseudacorus	yellow flag	c
Valeriana officinalis	marsh valerian	c
Mimulus guttatus	monkey flower	c
Oenanthe crocata	water dropwort	f
Berula erecta	water parsnip	f
Veronica anagallis-aquatica	marsh speedwell	f
V. catenata	marsh speedwell	o
Scrophularia aquatica	water figwort	o
Carex otrubae	a sedge	o
Myosotis scorpioides	forget-me-not	l.f.
Catabrosa aquatica	water whorl grass	r
Rorippa palustris	marsh yellow cress	f
R. amphibia	water radish	r
Pulicaria dysenterica	fleabane	r

Animal life is also rich in this area especially in insects, eg. hoverflies and the brackish conditions so far inland are an interesting factor. However, as recorded in the National Report on Water Quality*, pollution by both organic wastes and toxic materials takes place at Carrick so aquatic life is somewhat reduced. The presence of the town refuse dump, now disused, may add to any toxic effect.

*An Foras Forbartha, 1972.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Evaluation

This is an interesting stretch of marshland which has many unusual species, but in places a somewhat upset community structure. Being so close to the town it is of great significance for environmental studies in education.

Vulnerability

Aquatic river life is adversely affected by pollution at the moment though most plant species are resistant to it.

Riverbank development including infill, further drainage by sluices etc. would damage the scientific value of the site.

Recommendations

Any riverside developments should leave the marshland as intact as possible.

Access for a walk way along the north bank could well be provided to encourage educational use of the area.

Name of Area	MITCHELSTOWN CAVES
Acreage	Not calculated, an underground site
Grid reference	R.925,163
Scientific Interest	Geological and zoological
Rating	Regional importance
Priority	C

Description and evaluation of the area

The site which is shown on the accompanying 6" map is an extensive limestone cave system. The caves are situated in the limestone syncline between the Galtee and Knockmealdown mountains. This dips at 35-40° and it is at this angle that the major caverns are formed. The entrance of the new cave has been formed by quarrying but the old cave was opened by collapse of a joint fissure. In all the caves are $1\frac{1}{2}$ miles in length. A description of them appears in J. C. Coleman, The Caves of Ireland (Anvil Books, Tralee (1965)).

The caverns internally display many fine dripstone formations and their present owner has carried out consdierable work on the "new cave", installing electric light and improving access.

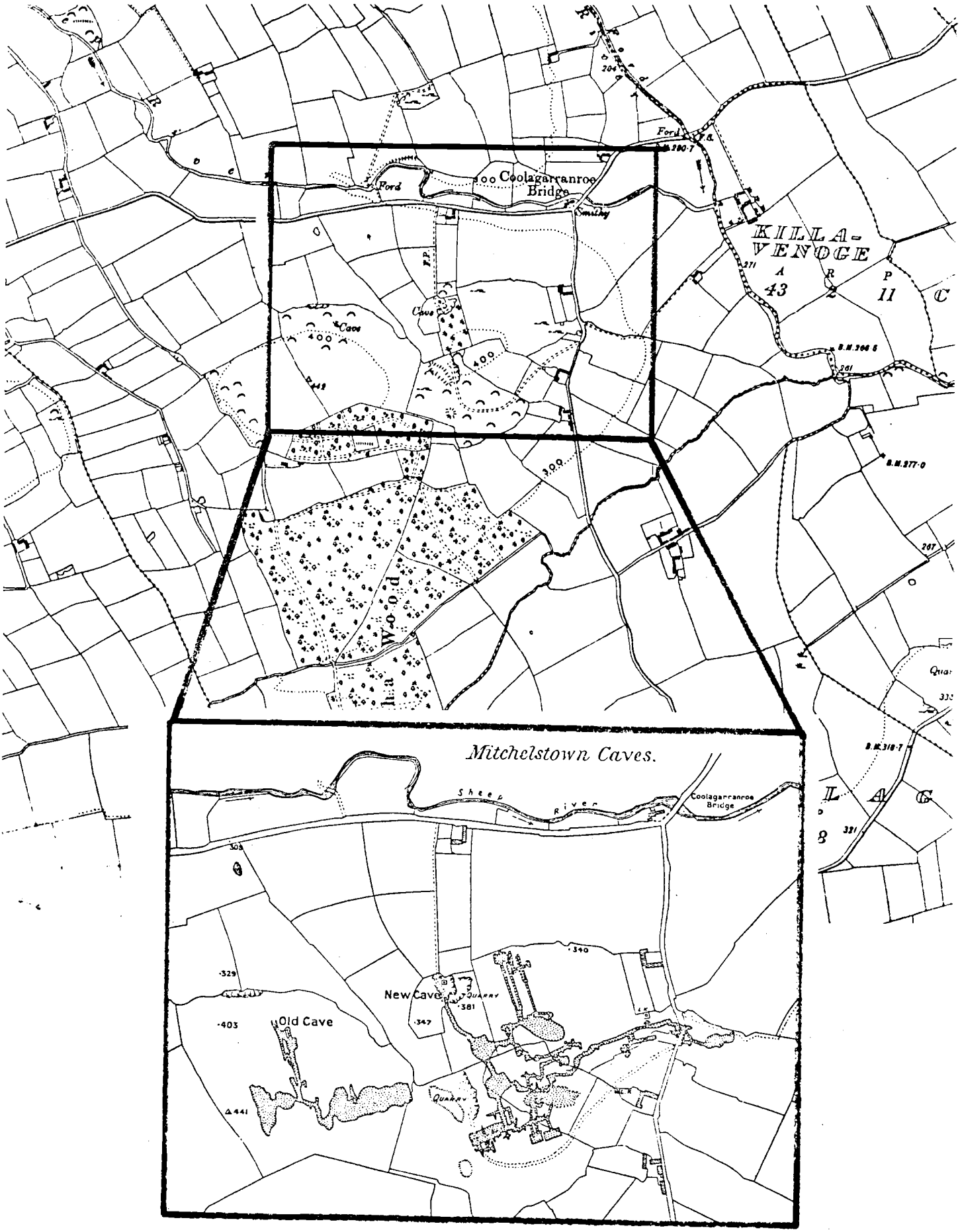
An important feature of the caves is their fauna which was originally described by G.H. Carpenter in 1895 (Ir. Nat. 4). It must be stressed that this description overlooked flora which should also be investigated. A number of fungi are known to live in subterranean conditions. A pale spider with reduced sight of the genus Porhomma was described from the new caves along with an annelid and a springtail, both of which should be re-examined. The fauna of Mitchelstown is the best known cave-life in the country.

Threats to the area

The Mitchelstown caves are well known as a tourist attraction which is visited by hundreds of people every year. Present indications are that access to visitors will be further improved. Inevitably there has

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



been a certain amount of damage to dripstone features; visitors have broken stalactites and removed cave pearls while smoke from tilly camps and candles has blackened the cave roof. The door on the new cave has also cut off contact with the outside world on which cave fauna depends to survive and there was no sign of the spider Porhomma when the caves were recently inspected. The owner is however anxious to enhance the cave by maintaining fauna and he invites suggestions as to how best this should be done.

Recommendations

No action is required to preserve these caves. Applications to quarry limestone in the vicinity of the system should however be referred to An Foras Forbartha or the Geological Survey before permission is granted.

Name of Area	DUNDRUM SANCTUARY
Acreage	38 acres
Grid Reference	R.957, 442
Scientific interest	Ecological, zoological and botanical
Rating	Local - Regional importance
Priority	C

Description of the area and evaluation

This site, whose location is shown on the accompanying map, is mostly a coniferous plantation under the management of the Department of Lands - Forestry Division. Labelled "Sanctuary" it contains a wide range of mammals and birds including deer, fox, waterfowl in small numbers, sparrow hawks etc.

There are two main places of interest from the scientific point of view: an aldermarsh to the north of the site and an artificial and shallow pond further to the south. The flora here is that of a calcicole water-body and Chara (stonewort) is abundant. Carex aquatilis (a sedge) is an interesting species. Both aquatic habitats contain a typical invertebrate fauna and a typical flora. Otherwise trees are mainly conifers especially spruce. The forest contains some small experimental plots.

Threats to the area

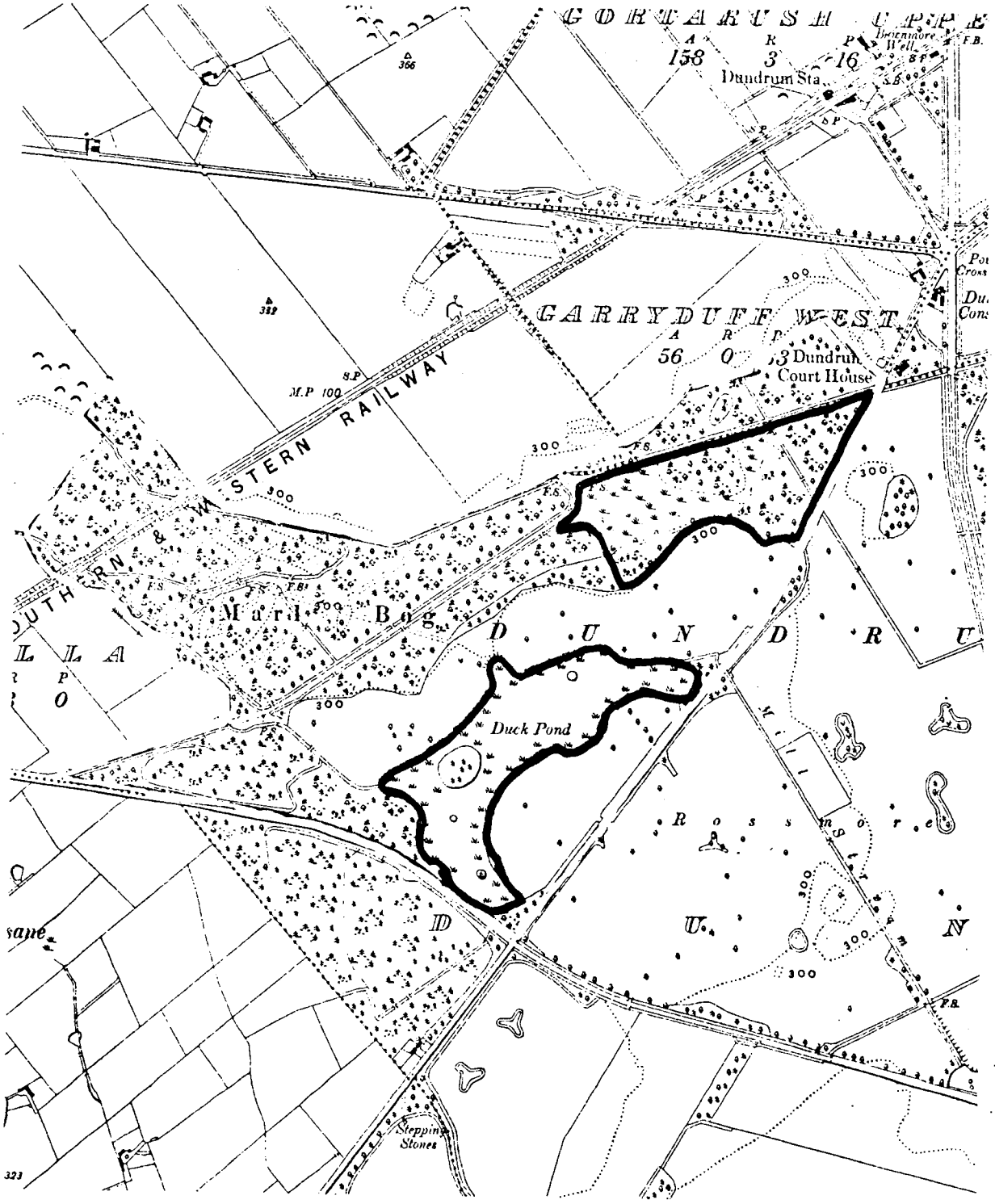
While the fate of this area as a forest seems to be assured there are aspects of its development which could be improved. A universal plantation of similarly aged trees which are closely packed could adversely affect existing values at the area. The long term effects of drainage could also prove unfavourable to the plants and animals already occurring in the forest.

Recommendations

No representations by the Local Authority need be made to the Department of Lands but some suggestions might be usefully passed on. Some major points are as follows: The planting regimen for coniferous

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



trees should include small block clearance rather than large scale timber removal at any time. As high a proportion of deciduous trees as possible should be planted with coniferous species. Trees should not be planted too close to the wildfowl habitat. The land is likely to be suitable for oak growth and regeneration and this species should be set as a high proportion of deciduous species planted. Deer are numerous in the forest and should be controlled.

Name of Area	SCARAGH WOOD
Acreage	26 acres
Grid Reference	S.020,250
Scientific interest	Ecological, botanical and zooligical
Rating	Local importance
Priority	A

Description of the area and its evaluation

The site which is shown on the accompanying 6" map is a large area of coniferous afforestation which replaces an earlier oak wood. The remnants of ground and shrub flora indicate that this forest was at one time a very good example of oak woodland. Sarothamnus scoparius (broom) and holly survive in small amounts with a depleted but still representative ground flora. Vaccinium myrtillus (bilberry) and Luzula sylvatica (greater wood rush) are common with such calcifuge species as Melampyrum sylvaticum (cow wheat) and Lathyrus montanus (bitter vetch).

The forest is a large one and the best remaining oaks are in the area outlined on the accompanying map. Oak regeneration was examined and found to be good except where inhibited by Rhododendron.

Threats to the Area

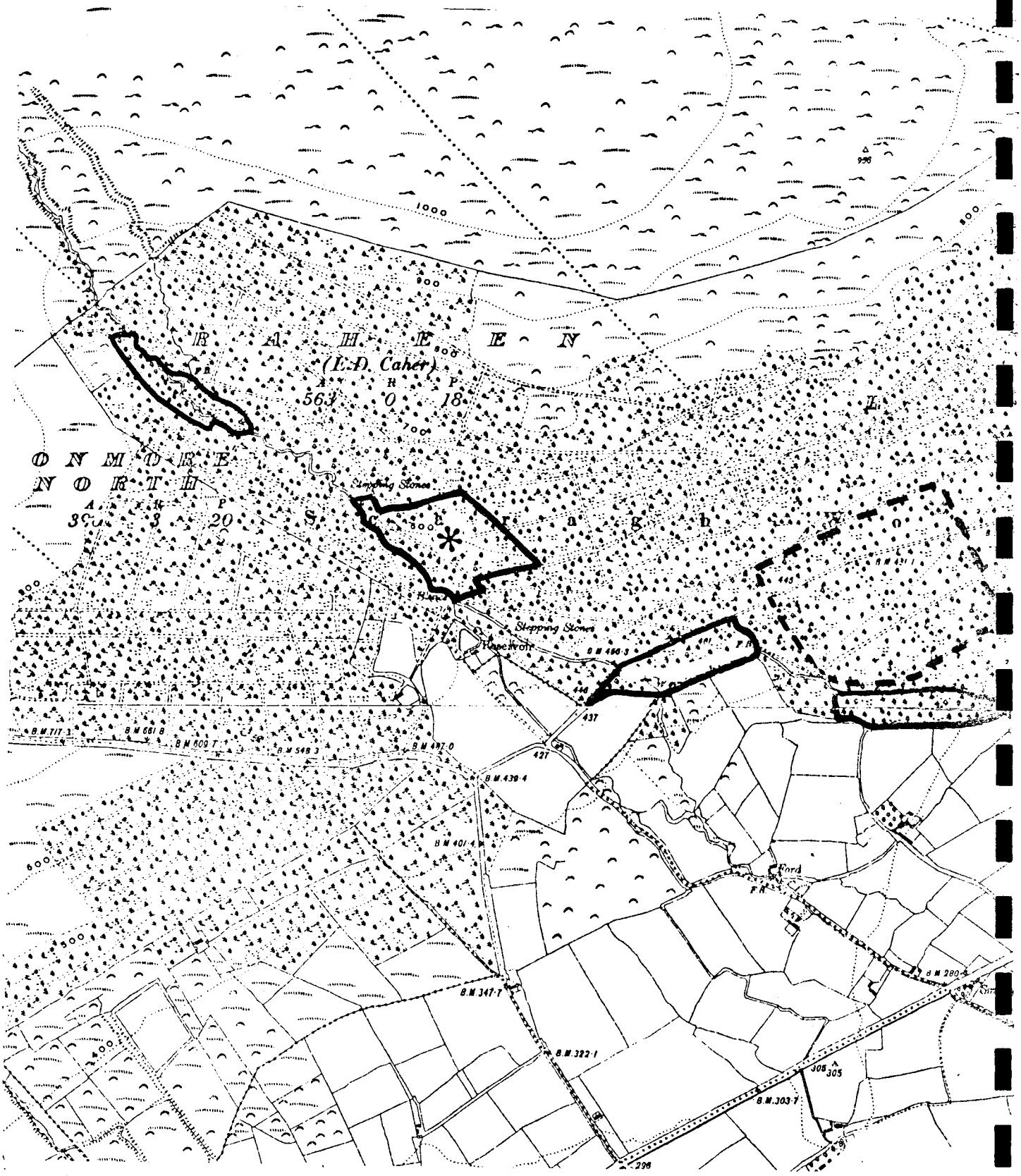
The most obvious is the progressive replacement of deciduous trees with conifers. Rhododendron is well established especially where asterisked and may yet over-run the wood completely to the detriment of the remaining scientific interest.

Recommendations

This site is under the control of the Department of Lands, but it is a large one and close to a centre of population.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Thus the local authority will have an interest in it and should see that it is utilised for as many purposes as possible (education, recreation, amenity). Deciduous planting would enhance visual aspects of the woods as well as its scientific interest and oak would be a suitable species for use here - especially in view of its regenerative status. The area outlined (broken line) on the accompanying map should be considered as a likely place for concentrating oak seedlings or permitting regeneration to proceed naturally without the inhibitive effects of coniferous plantings. Representations to this effect could be made to the Forest and Wildlife Service by the Local Authority.

Name of area	CAHIR PARK WOODLAND
Acreage	52 acres
Grid reference	S. o52, 234
Scientific interest	Ecological, ornithological
Rating	Local importance
Priority	B

Description of the area

Several small woods occur in Cahir Park, some of the best being on the valley sides overlooking the River Suir. Here they are composed mainly of planted deciduous trees, oak, beech and elm being common. These are well grown and reach a large size while some individual trees of lime (Tilia europaea) and chestnut (Hippocastaneum) are present also. The shrub layer consists of holly, (Ilex aquifolium), laurel (Prunus laurocerasus), snowberry (Symphoricarpos rivularis), privet (Ligustrum spp.), rhododendron, and some Viburnum opulus (guelder rose), almost all of introduced origin. However, native species of herbs have immigrated into this foreign assemblage; they include:-

Glechoma hederacea	ground ivy	c
Veronica chamedrys	germander speedwell	c
V. montana	wood speedwell	o
Alliaria petiolata	garlic mustard	l.c.
Endymion non-scriptus	bluebell	f
Brachypodium sylvaticum	false brome-grass	f
Sanicula europaea	wood sanicle	f
Dryopteris filix-mas	male fern	f
Moehringia trinerva	three-veined sandwort	o

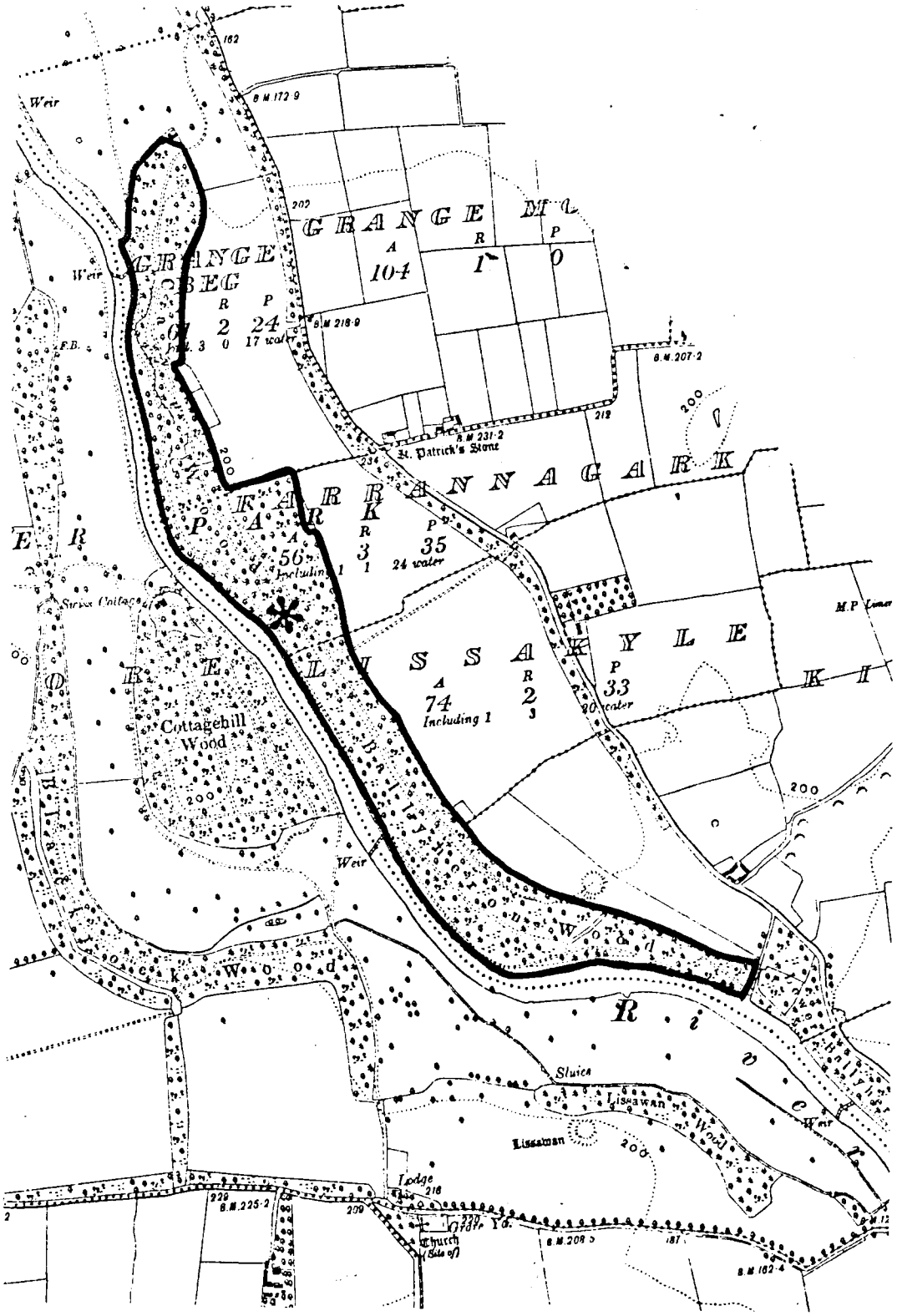
Herb cover is in general scanty but this may partly be due to intensive grazing by rabbits.

Evaluation

Like woods on the Waterford border the Cahir Park trees are of greater significance for amenity rather than of purely scientific interest. The fact that part of the site (how much is not certain) is an established recreation centre is relevent to the amenity values of the area.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



In scientific terms neither the parent trees, shrubs or herbs are of great interest because of their obviously artificial origin. Even the oak wood comprises trees of one bole size, suggesting a planted origin. However, the bird fauna is interesting and includes blackcaps. The proximity of a large waterbody contributes an admixture of habitats which is reflected in the bird fauna (herons, for example, occur). Red squirrels are common in the woods and other large mammals (fox and badger) are likely. The insect fauna includes typical bark and foliage frequenting species, large Diptera (two-winged flies) and Coleoptera (beetles). Again, the proximity of water contributes diversity to the invertebrates which are present.

Threats to the Area

None is obvious here at present. Deciduous trees are being planted and it is hoped that replacement of existing stock by the same species as they reach maturity and are renewed will continue.

Recommendations

The proximity of these woods to a town and the use of part of the area concerned for recreation purposes underlines the value of the site for amenity purposes. It would be useful to consider the likely pattern of recreation here further and, if necessary, to devise a plan to offset pressures. The scientific aspects of the area should be developed, at least in places. A nature trail would be a good idea - possibly in the small forest park. Here rhododendron should be eradicated immediately anyway and, indeed, any likely source of infection of the plant from seed should be combatted at once anywhere in the area outlined.

Name of Area	KNOCKANAVAR WOOD
Acreage	40 acres
Grid Reference	R.863,503
Scientific Interest	Ecological, botanical and zoological
Rating	Local importance
Priority	B

Description of the area and evaluation

This site, shown on the accompanying map, is a steep sided river valley containing deciduous woods which consist of hazel, birch, rowan and some oak. Most of these species are regenerating well although the development of new timber varies somewhat with the presence of grazing animals at different points along the valley.

Where the tree canopy is best developed there is profuse growth of woodland ground flora, dominated by Luzula sylvatica (greater wood rush) and Vaccinuim myrtillus (bilberry). The usual range of woodland herbs occur with these and the invertebrate fauna includes some spectacular insect species, notably Longicorn beetles. The usual mammal species are likely to occur and the presence of foxes, rabbits and red squirrels was confirmed. Passerine birds are likely to consist of the usual range of species.

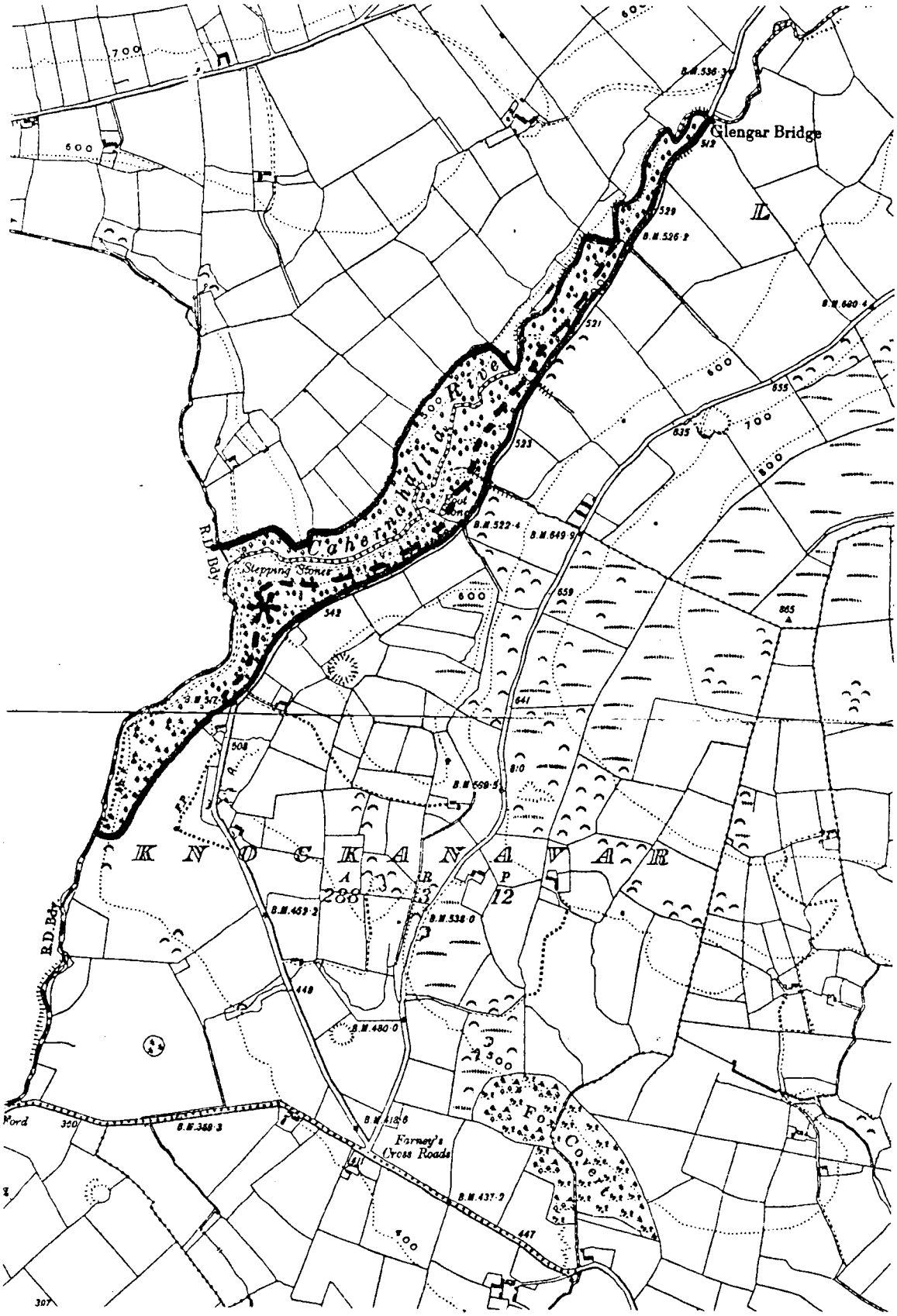
Because of its steep sides most of this valley is likely to remain untouched (but see below). It is thus a reservoir of typical plant and animal life which will survive with the minimum of protection.

Threats to the Area

The only likely development in this valley is replanting with coniferous trees and this would be difficult in most of the area because of the steep sides. Part of the flatter land (marked with an asterisk)

MAP SHOWING AREA OF SCIENTIFIC INTEREST

Scale: 6 Inches to 1 Mile



however appears to be in the course of clearance and it is likely that coniferous trees might be set here.

Recommendations

It is desirable that as much as possible of this valley should remain in its present state because of its occurrence in cultivated land, and its relatively undisturbed state. Whenever action to secure this is initiated the precise extent of coniferous woods (*) should be determined. Should these extend far in a north-south direction, it might be as well to remove some of the coniferous plantings. If it is not possible to maintain the entire valley in its present state then the 500 foot contour on the eastern side should be agreed as the limit of any development encroaching on the trees. A Tree Preservation Order under the Local Government Planning Act (1963) should be used only as a last resort to achieve this end and a management agreement with the owner(s) should instead be sought. Most important, if a T.P.O. is to be used, other areas of equal rating and priority but of larger size elsewhere in the county should be dealt with first.

Name of Area	SHANBALLY WOOD
Acreage	42 acres
Grid reference	R. 971, 150
Scientific Interest	Ecological, botanical, zoological
Rating	Local importance
Priority	B

Description of the Area

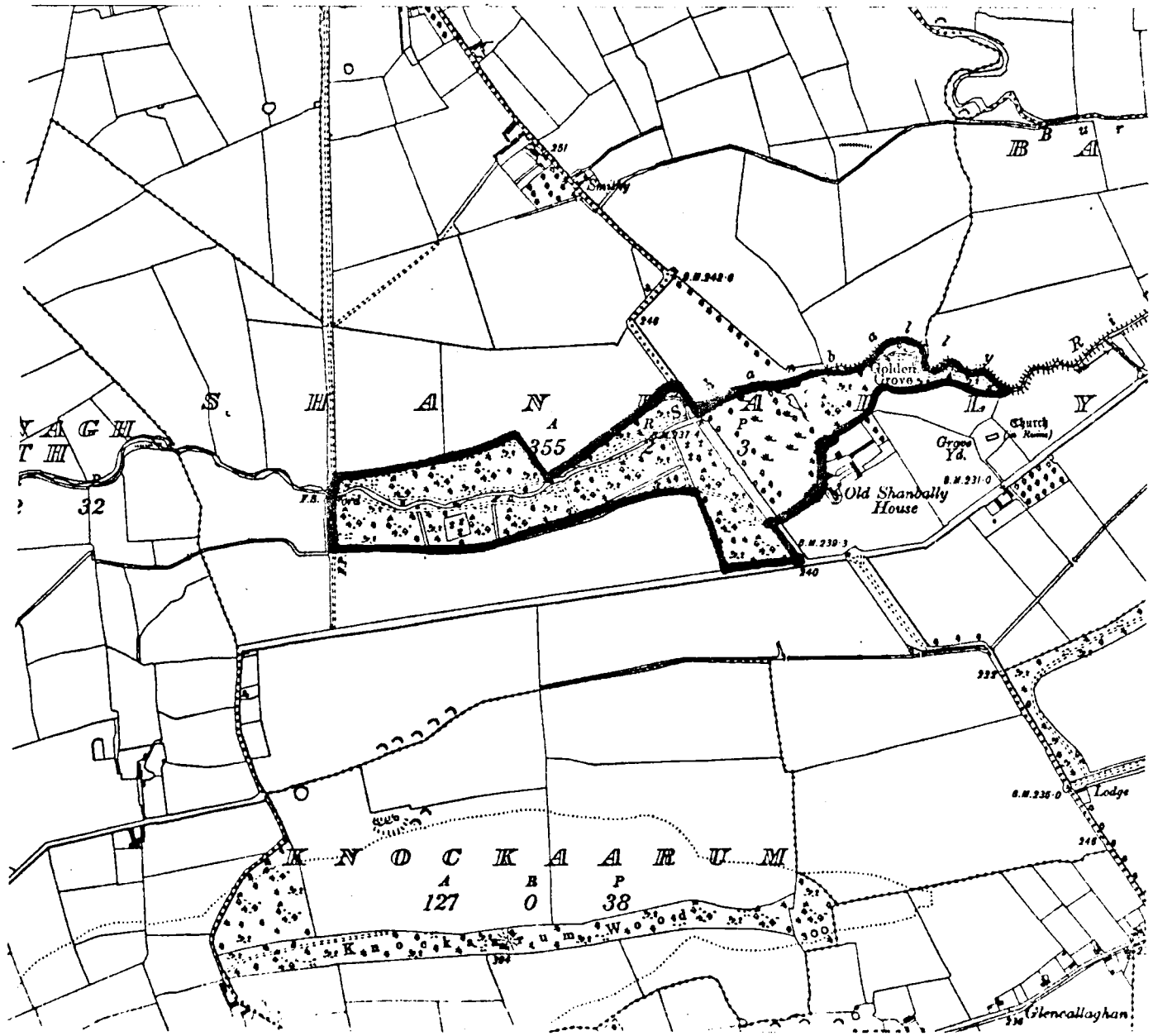
This site is a small planted wood consisting of beech, ash, sycamore and some oak. The shrub layer contains hawthorn, elder, holly, box and rhododendrom which, so far, is limited in extent. The eastern side of the site is predominantly of beech and there are some wet patches occupied by Iris pseudacorus (yellow flag). On the other side of the road which subdivides the area into two parts shallow drainage channels concentrate the water. However the land is low lying and the flora is characteristic of wet woodland, the range of species including Iris, Ajuga reptans (bugle) and Filipendula ulmaria (meadowsweet) in addition to the usual herbs:

Orchis mascula	early purple orchid	l.c.
Sanicula europaea	wood sanicle	r.
Geranium robertianum	herb robert	c.
Arum maculatum	arum lily	c.
Rumex sp.	dock	c.
Primula vulgaris	primrose	c.
Conopodium majus	pignut	c.
Viola riviniana	dog violet	c.
Equisetum spp.	horsetail	l.c.
Endymion non-scriptus	bluebell	l.a.
Ranunculus	buttercup	c.

The passerine bird fauna comprises some common species which were present in moderate numbers but rarities were not in evidence. Invertebrates present were the usual range of generally distributed insects and molluscs. Bark frequenting insect species were briefly examined and found to include species normally found in woodlands of this kind; there was no sign of representatives of the Southern element of Neuroptera and Psocoptera which might be expected at this latitude.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Evaluation

This small woodland is one of a few patches of trees in a predominantly cultivated area.

Threats to the Area

Being wet probably throughout the year this land is not likely to be used for agricultural purposes. It is possible however that "commercial" forestry might replace the trees already existing here.

Fly tipping of domestic rubbish is occurring in the western side of the site and is likely, if not checked, to continue on a more extensive scale. At worst this could obliterate part of the ground flora or, at least, make the site an unpleasant place to visit or in which to work.

Recommendations

This site should remain in its present state although, ideally, it could be improved by addition of more beech or even oak. Conifers, if planted at all, should be set judiciously with consideration for the existing scientific values of the site. The spread of rhododendron which is occurring should be checked by eradicating this shrub altogether and casual dumping of refuse should be stopped. It would be desirable to discontinue any enlargement of the drainage channels on the western side of the site.

It may be necessary to impose a Tree Preservation Order under the Local Government Planning Act (1963) to maintain the scientific values of this area. Otherwise general planning control should suffice.

Name of Area	CARROWKEALE WOODS
Acreage	34 acres
Grid reference	R.965,510
Scientific interest	Ecological, botanical, zoological and ornithological
Rating	Local importance
Priority	B

Description of the Area

The site which is outlined on the accompanying map is a steep-sided river valley. The northern end of the wood which occupies most of the site was visited (where marked with an asterisk) but it was not feasible to verify all the scrub boundaries on the O.S. 6" map. Some small patches of marshland occur on the eastern bank and here the flora consists of:

Equisetum sylvaticum	horsetail	l.c.
Filipendula ulmaria	meadowsweet	a.
Carex paniculata	panicle sedge	l.a.
Holcus lanatus	yorkshire fog grass	c.
Rubus fruticosus agg.	bramble	c.

The most common tree species in the woods is Sorbus aucuparia (rowan): birch and Salix spp. (willows) come next in frequency and there is some oak. Crataegus (hawthorn) and holly form a shrub layer and the ground surface is bare in places. The usual woodland herbs are represented.

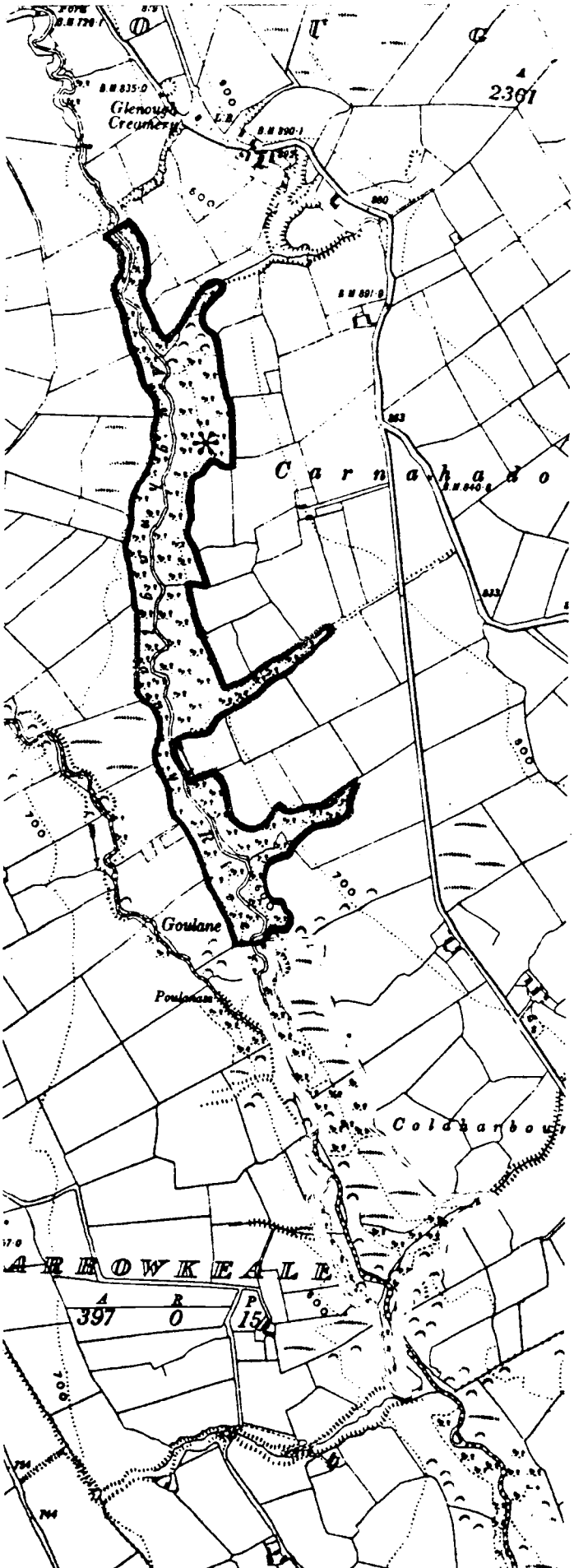
The valley is, from its topography and vegetation, a potentially rich area for birds, invertebrates and medium sized and small mammals. Signs of fox and squirrels were both seen.

Evaluation

The site is a reservoir of typical plants and animals in this vicinity. In composition it is similar to Knockanavar Wood and both are the more valuable for being in largely cultivated areas and for having a topographical configuration which does not lend itself to agricultural practises. Basic protection would therefore serve to maintain the

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



scientific interests here (but see below) and the fauna and flora should be maintained with the minimum of effort.

Threats to the Area

The only likely development in Carrowkeale Valley is confferous afforestation which would displace existing deciduous woods.

Recommendations

Every effort should be made to maintain the existing diversity of these woods. Particularly important will be the percentage of deciduous trees and, even if these are reduced, a sizeable proportion would, in the event of partial replanting with conifers, suffice to maintain the floral and faunal variety of the site.

General planning control should be exercised in this valley to maintain existing values there.

Name of area	GLENBOY WOOD
Acreage	31 acres
Grid reference	S. 12, 09
Scientific interest	Ecological
Rating	Local
Priority	B

Description and evaluation of the area

The outlined area contains a small area of mature oakwood and a much larger one of birchwood. This was more widespread before it was mostly cleared for afforestation: it persists especially by the upper tributaries of the Glenboy River. The oak stands are on wet shaley soil and include such characteristic species as:-

Luzula sylvatica	greater woodrush	l.a.
Stellaria holostea	greater stitchwort	c
Anthoxanthum odoratum	sweet vernal grass	c
Athyrium filix-femina	lady fern	c
Vaccinium myrtillus	bilberry	c
Lonicera periclymenum	honeysuckle	c
Blechnum spicant	hard fern	f
Oxalis acetosella	wood sorrel	f
Deschampsia flexuosa	wavy hair-grass	f
Digitalis purpurea	foxglove	f
Dryopteris filix-mas	male fern	o
Dicranum majus	a moss	o
Luzula pilosa	spring woodrush	o

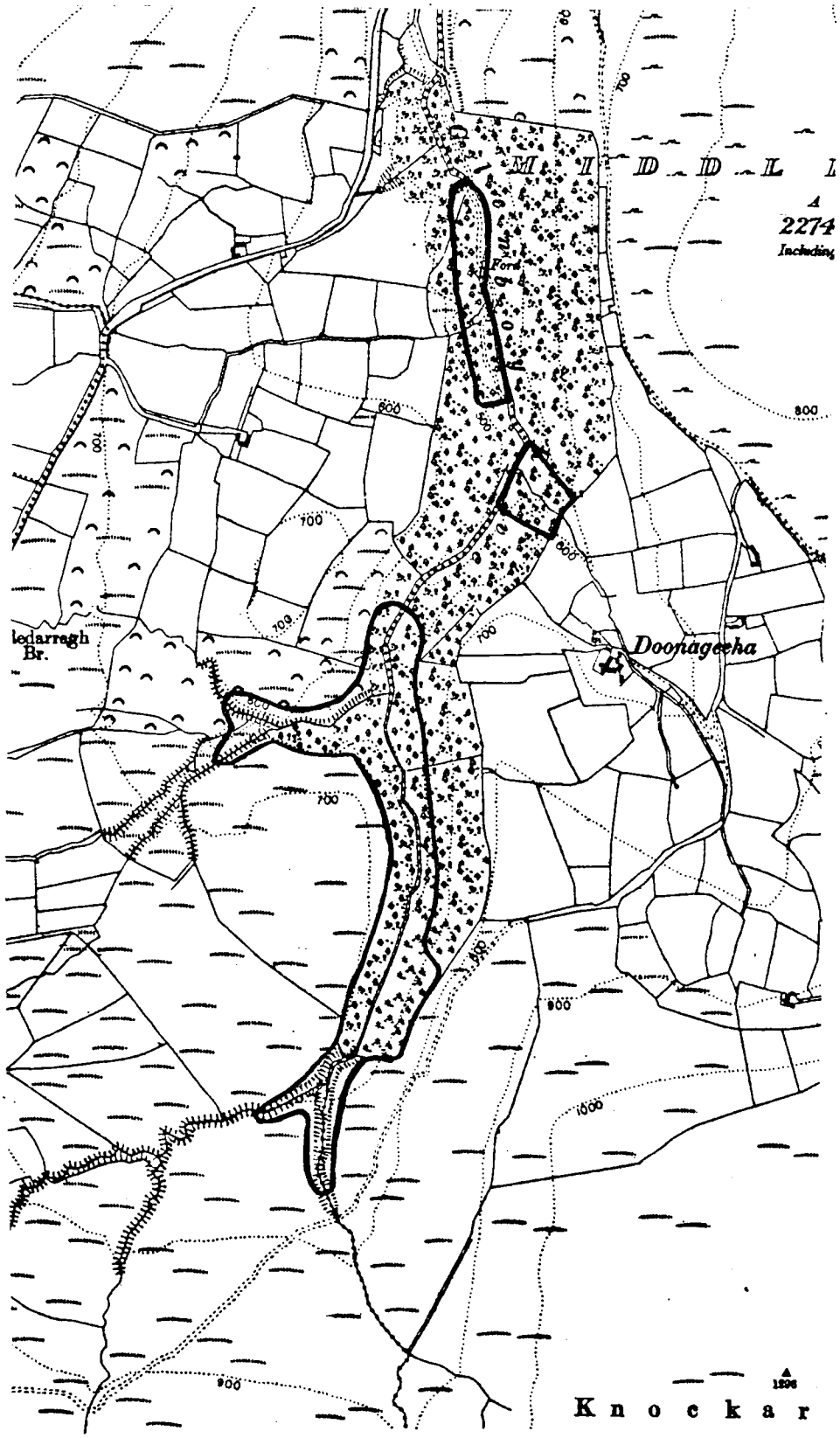
A number of ash trees occur by the river and reach 60 feet in sheltered situations. Rowan (Sorbus aucuparia) and birch (Betula pubescens) with holly (Ilex aquifolium) make up the complement of tree species.

The parts of the area dominated by birch were not examined closely but can be expected to have a similar flora including more light-demanding species such as bracken (Pteridium aquilinum) and brambles (Rubus fruticosus).

In a region where deciduous woodland is rare, this area houses a concentration of the mammals and birds that depend on it for their way

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



of life. It is far from schools but has considerable amenity value when seen from the overlooking roads. One of these seems to be developing as a scenic route on the Knockmealdowns. The birch wood community is rare in the county and this is one of only two sites listed. It usually shows a tendancy to develop naturally into oakwood and so is of some ecological interest.

Vulnerability

Coniferous afforestation has been encroaching on the present area for several years and may continue to spread.

Recommendations

An agreement with the Forestry Division should be sought to preserve intact the stands of trees shown overleaf. This should be initiated by the County Council in their role as preservers of woods and trees of amenity value or special interest.

Name of Area	KNOCKROE FOX COVERT
Acreage	28 acres
Grid reference	S.032,385
Scientific Interest	Ecological, botanical and zoological
Rating	Local importance
Priority	C

Description of the area and evaluation

The site which is shown on the accompanying map is a small hazel wood in an undisturbed state. The southern boundary is formed of a thick Prunus spinosa "hedge" and the northern side is fairly steep hill. The ground flora consists of the following plants.

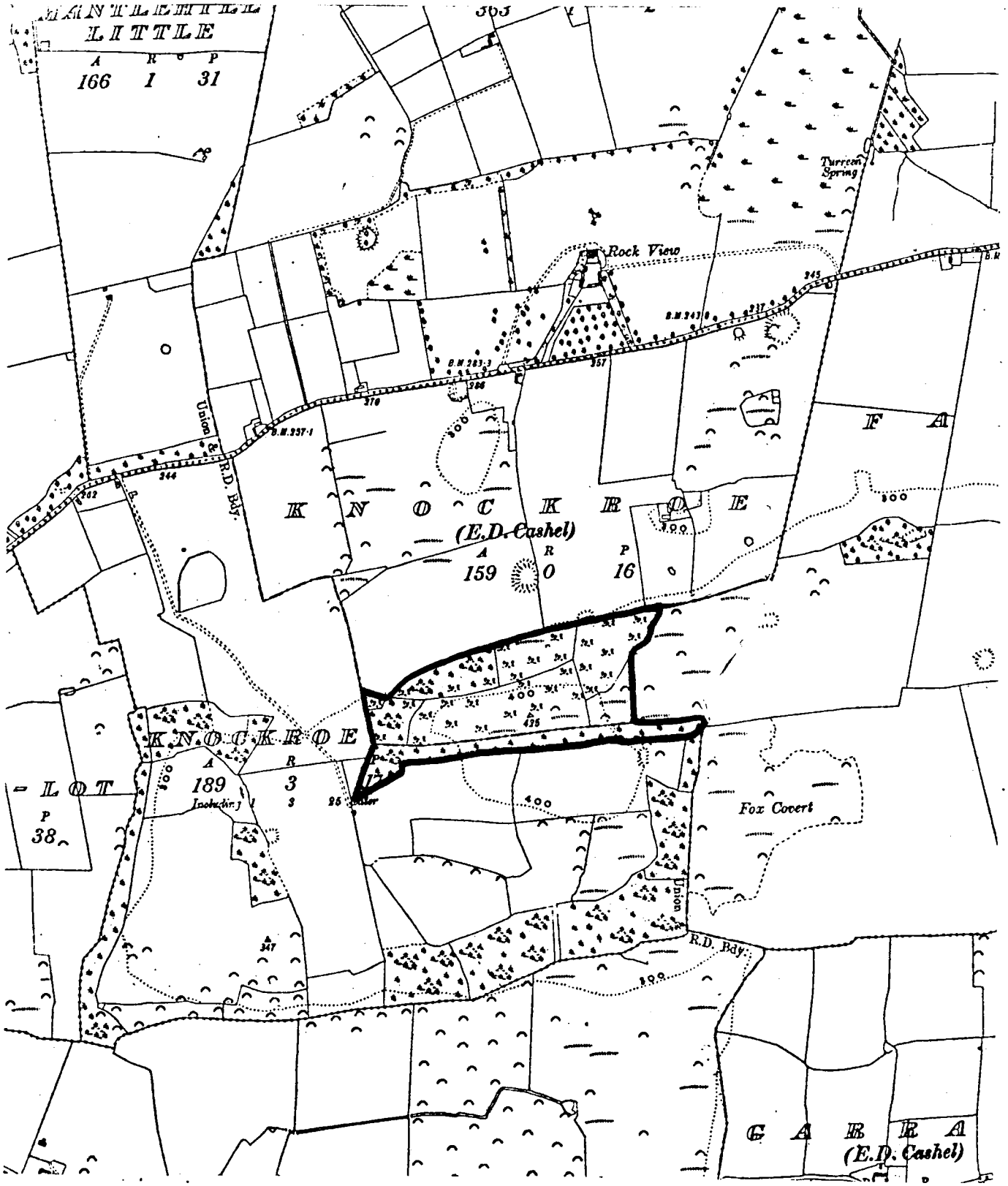
Lysimachia nemorum	yellow pimpernel	c
Endymion non-scriptus	bluebell	l.a.
Lonicera periclymenum	honeysuckle	c
Arum maculatum	arum lily	c
Primula vulgaris	primrose	c
Fragaria vesca	wild strawberry	c
Orchis mascula	early purple orchid	r
Sanicula europaea	wood sanicle	c
Conopodium majus	pignut	c
Circaea lutetiana	enchanter's nightshade	c
Allium ursinum	wild garlic	l.a.
Glechoma hederacaea	ground ivy	r

Shrubs and trees include box, hawthorn and apple.

From the list of ground flora and trees presented above this wood clearly has a typical flora. There were no signs of cattle when the site was examined and a well marked path runs down the southern edge of the woods leaving the herb flora undisturbed.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Foxes and squirrels are present together with a moderate number of passerine birds. The site is some distance away from likely disturbance which is an additional point in its favour.

Threats to the area

None seems likely at present and the area has the appearance of being purposely maintained in its present condition. The surrounding land is however productive and the possibility of clearing the A.S.I. and putting it under grass will always be there.

Recommendations

The site should be kept under review and, if threatened, steps should be taken to preserve it, possibly by use of a Tree Preservation Order under the Local Government Planning Act, 1963. This action is not recommended in the foreseeable future however.

Name of Area	POWER'S WOOD
Acreage	13 acres
Grid Reference	S.177, 380
Scientific Interest	Ecological, botanical, zoological and ornithological
Rating	Local importance
Priority	C(?)

Description and evaluation of the area

This small wood (shown on the accompanying map) consists of ash and hazel, as do the majority of South Tipperary's woods. There is some oak, beech and holly here also. The ground flora contains a range of typical species among which honeysuckle, bramble and bluebell are dominant. The wood is in an undisturbed condition, old trees which have fallen are rotting and there has apparently been no attempt to harvest them. The wood has an aspect of neglect, a feature which contributes to the diversity of the animal life which occurs there. Passerine birds are numerous although the species represented are widespread. Although the site is small and not very close to a centre of population for purely scientific reasons it would be desirable to maintain it.

Threats to the area

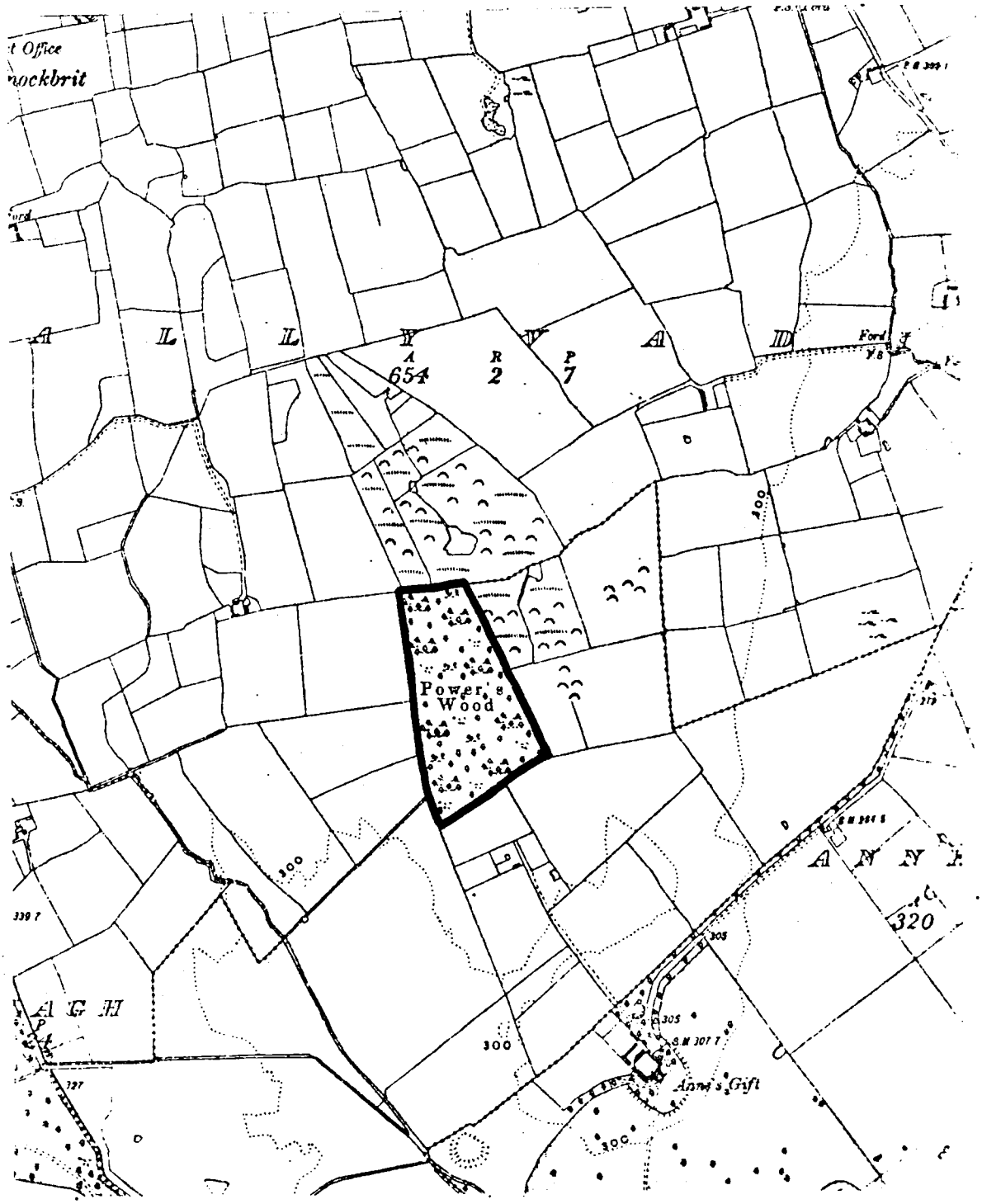
It would be unrealistic to suppose that this site will remain as it is indefinitely and steps should be taken by the Local Authority to discover what plans, if any, exist for it.

Recommendations

It would not be desirable to place either a Conservation Order or a Tree Preservation Order under the Local Government Planning and Development Act (1963) until other sites of greater importance have been dealt with. In the meantime a management agreement with the owner should be sought. If a T.P.O. and C.O. are used in the future, beech should be excluded from its protection.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Name of area	ARDMAYLE LILY POND
Acreage	4 acres
Grid reference	S. 053, 453
Scientific interest	Ecological
Rating	Local importance
Priority	C

Description of the area and its evaluation

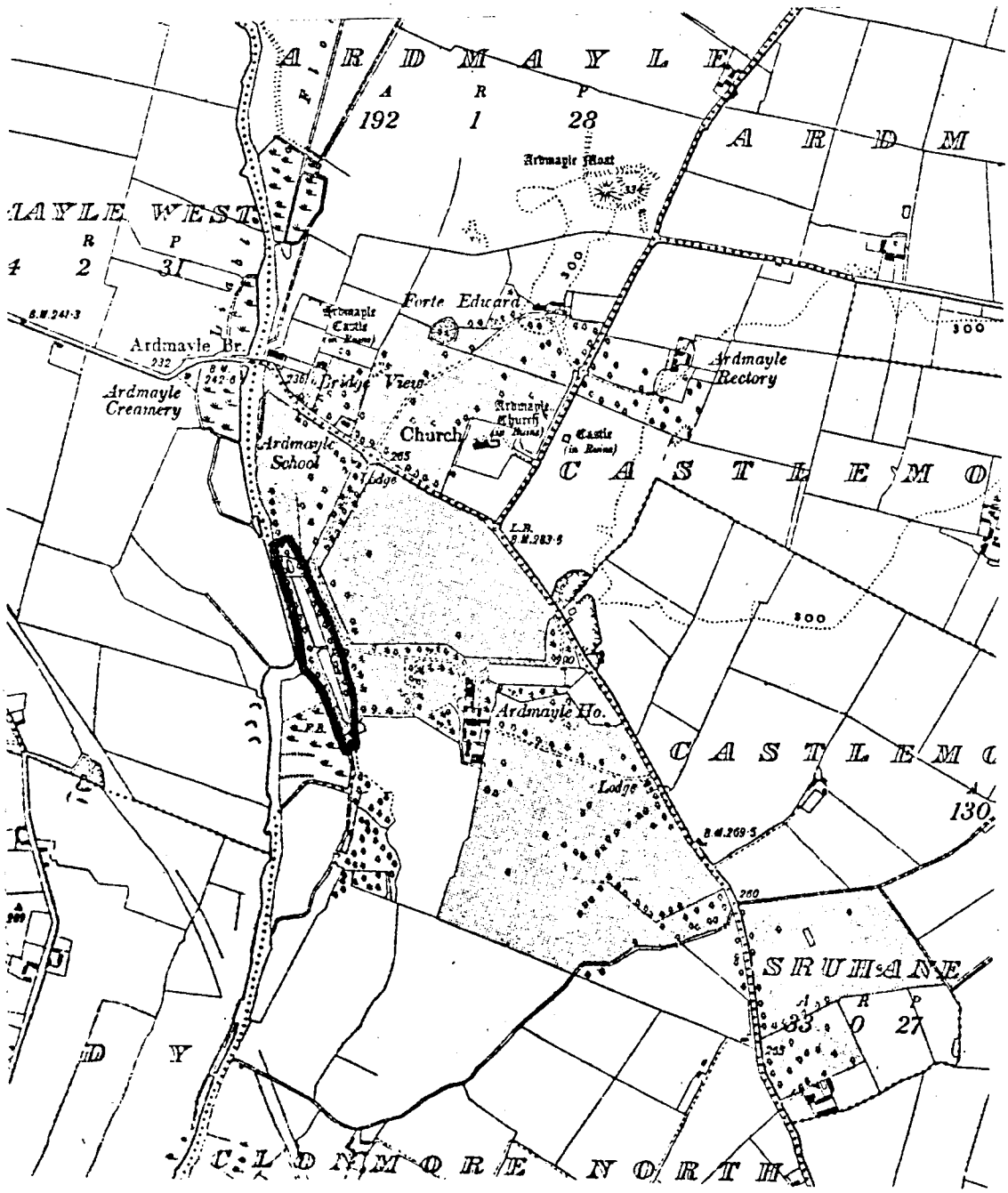
The site is shown on the accompanying 6" map. It is a long, narrow, possibly artificially excavated pond, parallel with the River Suir. Each side is bordered with lime, sycamore and alder trees while the shallow water is occupied by Iris pseudacorus (yellow flag), Sparganium erectum (bur reed) and Carex remota (remote sedge). The surface of the pond supports Nuphar lutea (yellow water lily) and Nymphaea alba (white water lily) with Elodea canadensis (Canadian pond weed) and Utricularia vulgaris (bladder wort) submerged. Around the waterbody the mud is vegetated by Lycopus europaeus (Gipsywort), Equisetum fluviatile (water horsetail) and some Phalaris (canary grass).

Into the still water of the pond have moved invertebrates from the nearby river. Those which would normally dwell in sluggish or still waters are established and, although this fauna could not be said to be profuse, still waters with a fairly open surface are rare in the county, thus contributing a scarcity value to this site. Gyrinus (Coleoptera), Asellus (Crustacea), Corixidae (Hemiptera), cased caddis and the snail Lymnaea peregra are the most obvious forms of life and small Cladocera (water fleas) and Copepoda (small crustacea) are also common.

The main value of this pond is its close approximation to a small centre of population to which it may be of educational value. The pond might support small numbers of wild-fowl in winter.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



Threats to the area

None is obvious although eutrophication by animal waste is a possibility.

Recommendations

The low values of the site do not warrant any action on it.

Name of area	KILCOOLY ABBEY LAKE
Acreage	10 acres
Grid reference	S. 298, 581
Scientific interest	Ornithological, botanical and ecological
Rating	Local importance
Priority	C

Description of the area and its evaluation

The small lake shown on the accompanying map displays signs of being man-made although it probably originated as wet, low lying ground which was later shaped to its present form by a previous occupant of the estate. Some modification of the shoreline is still continuing. The lake is managed as a wildfowl sanctuary, possibly for shooting purposes and nest boxes are distributed around the margin. The summer population of wildfowl and waterbirds was very small when the site was visited and winter counts are not available. However, the lake surface is one of the largest areas of open water in the south Riding and as such is the only feeding place in a large area for waterbirds.

The lake water supports a varied flora including a species of Utricularia (bladderwort), Chara (stonewort) and Typha (bulrush), the latter forming a marginal band. Typha angustifolia (narrow leaved bulrush), which is rare in Ireland, occurs there.

Threats to the area

As long as the estate remains intact it is likely that the present use of the lake will continue. No threat seems likely although the present situation could be improved (see below).

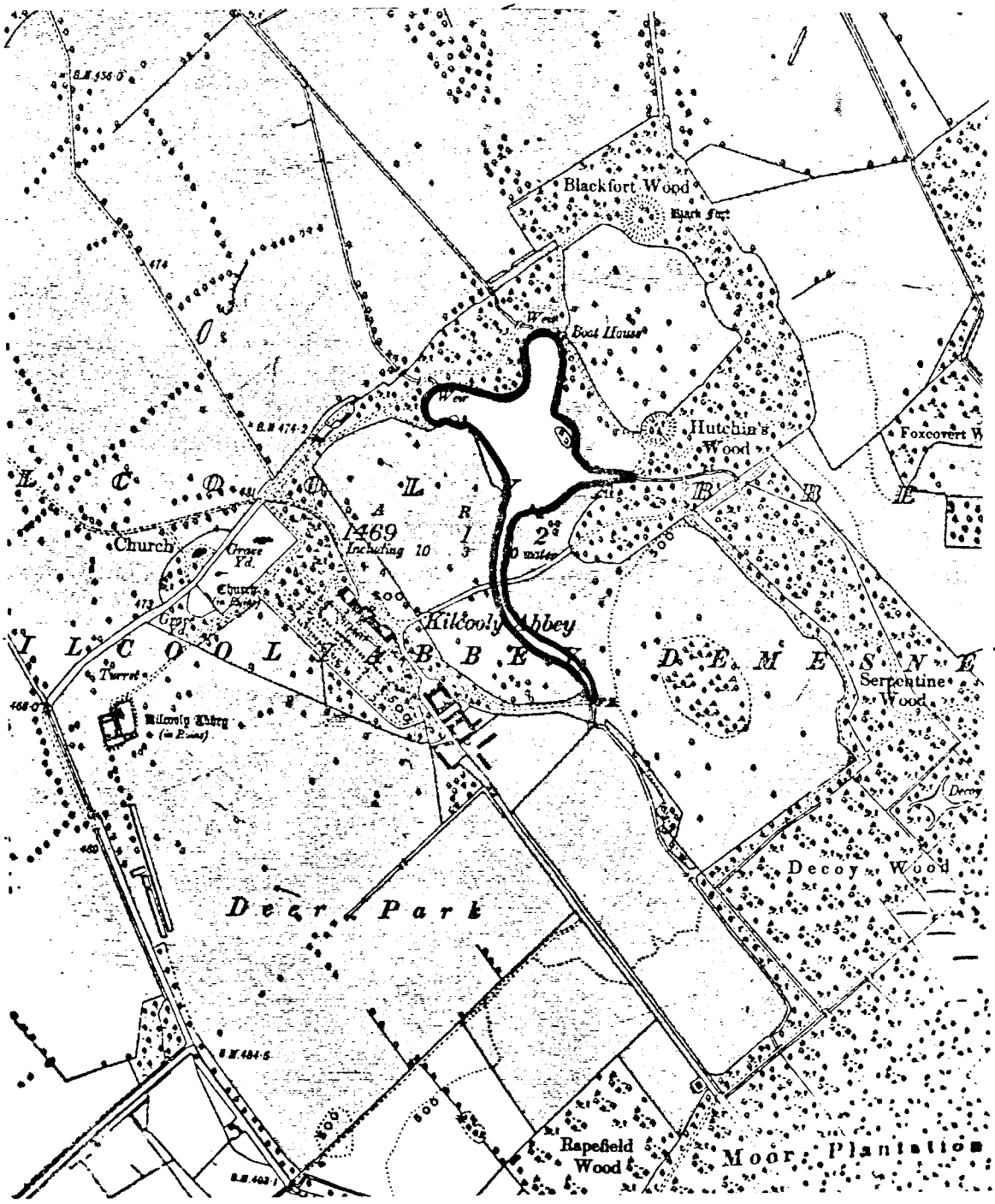
Recommendations

In view of the scarcity of open water in the south Riding every effort should be made to continue the present form of land use on the Abbey grounds. General recommendations which could be made in passing

but on which no specific action is at present required are: a partial clearance of trees from the immediate lake side would give greater visibility to wildfowl and possibly encourage them in larger numbers. The estate grounds have other features of scientific interest (the woods contain deer for example) which might be used as an attraction and for educational purposes in the future. Survey work to discover the full range of fauna and flora should be encouraged. The future of the wildfowl reserve will depend largely on the form of land use in the vicinity. The only specific recommendation made here therefore is that any development within the estate boundaries should be referred to An Foras before planning permission is granted so that its implications might be considered.

MAP SHOWING AREA OF SCIENTIFIC INTEREST —

Scale: 6 Inches to 1 Mile



SECTION G

SUMMARY OF RECOMMENDATIONS FOR SITES OF SCIENTIFIC INTEREST IN CO. TIPPERARY (S.R.)

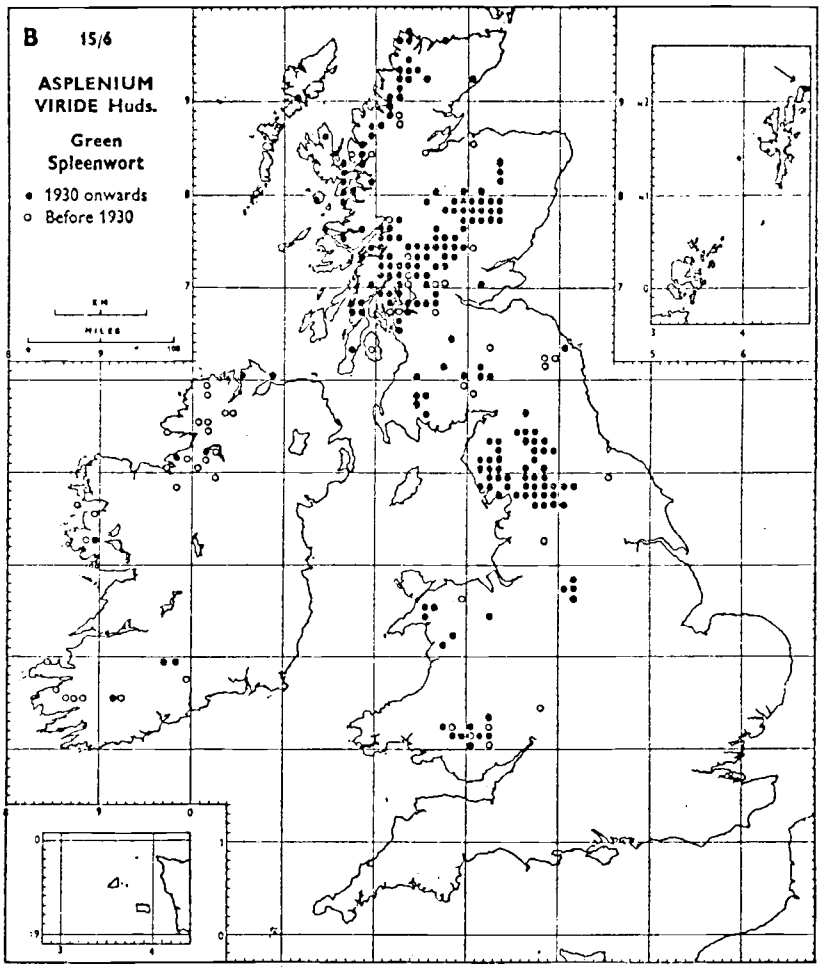
	No Action Required	General Planning Control	Conservation Order	Tree Preservation Order	Action Other, Refer to Site Description
Ballymacadam	*				
Exposures of Weichsel End Moraine (3 Sites)		*			
Galtee Mountains			*		
Hollyford Quarry		*			
Knockastakeen Forest	*				
Killough Hill			*		
Glen of Aherlow (2 Sites)	*				
Inchinsquillib Wood				*	
Grove Wood, Fethard				*	
Marshes and Ponds near Annacarty (6 Sites)			*		

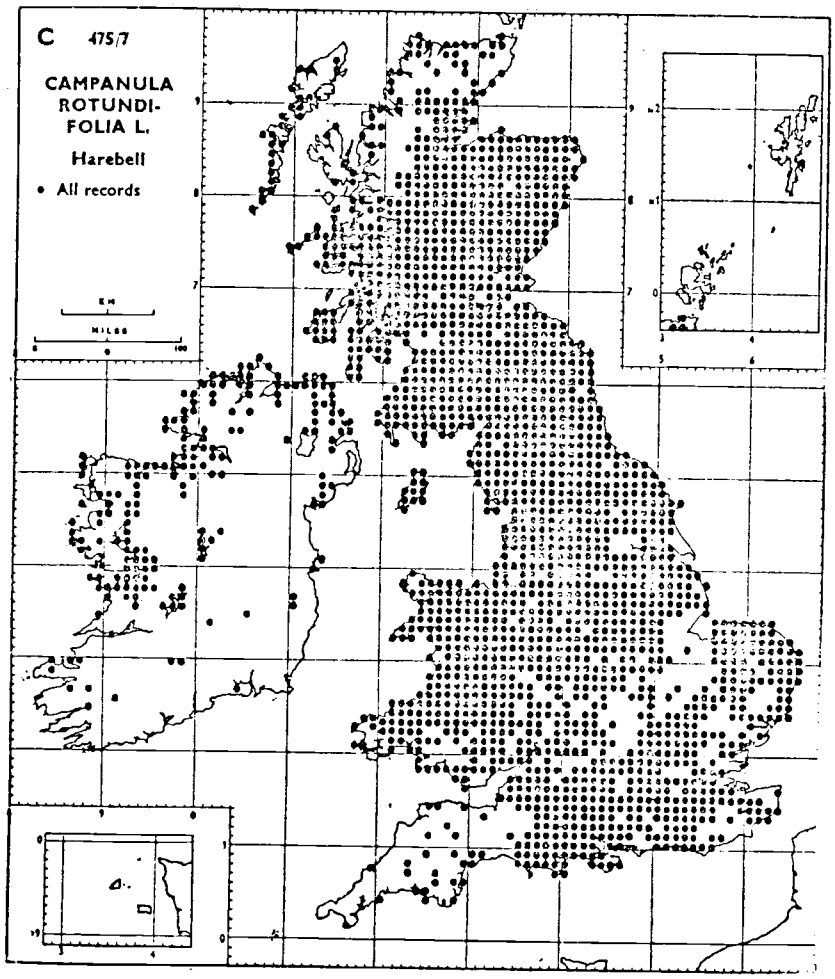
	No action Required.	General Planning Control	Conservation Order	Tree Preservation Order	Action Other, Refer to Site Description
Suir below Carrick-on-Suir					*
Mitchelstown Caves	*				
Dundrum Sanctuary	*				
Scaragh Wood					*
Cahir Park Woodland					*
Knockanavar Wood				*	
Shanbally Wood				*	
Carrowkeale Woods		*			
Glenboy Wood					*
Knockroe Fox Covert				*	
Power's Wood				*	
Ardmayle Lily Pond	*				
Kilcooly Abbey Lake					*

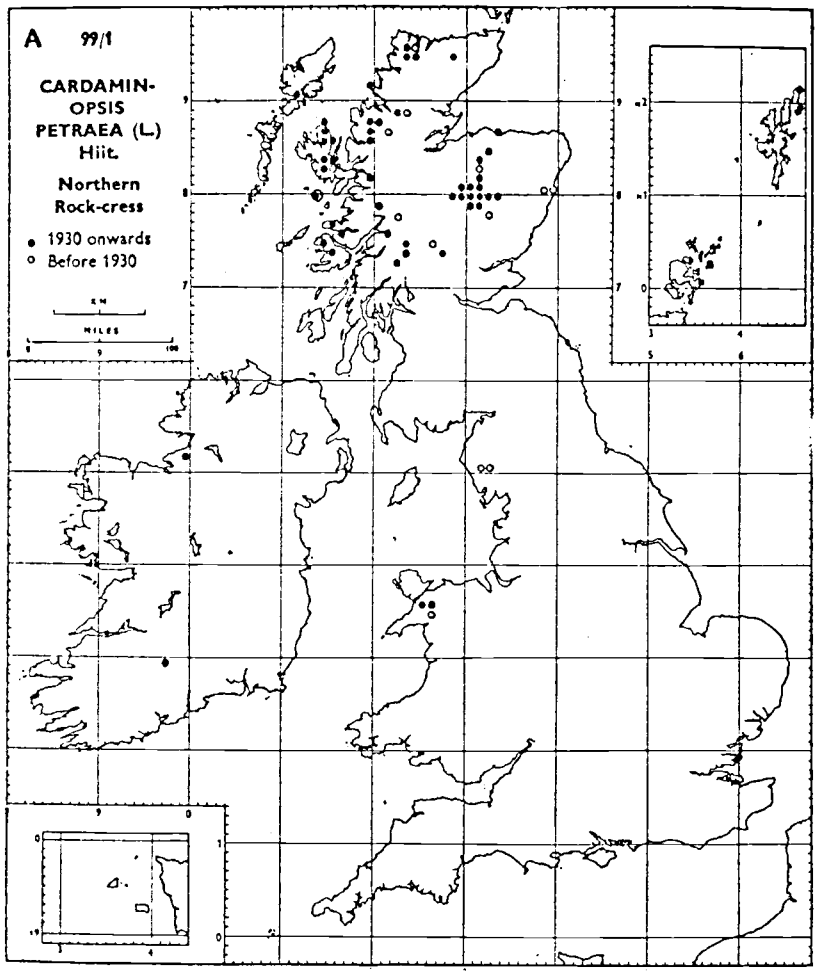
SECTION H

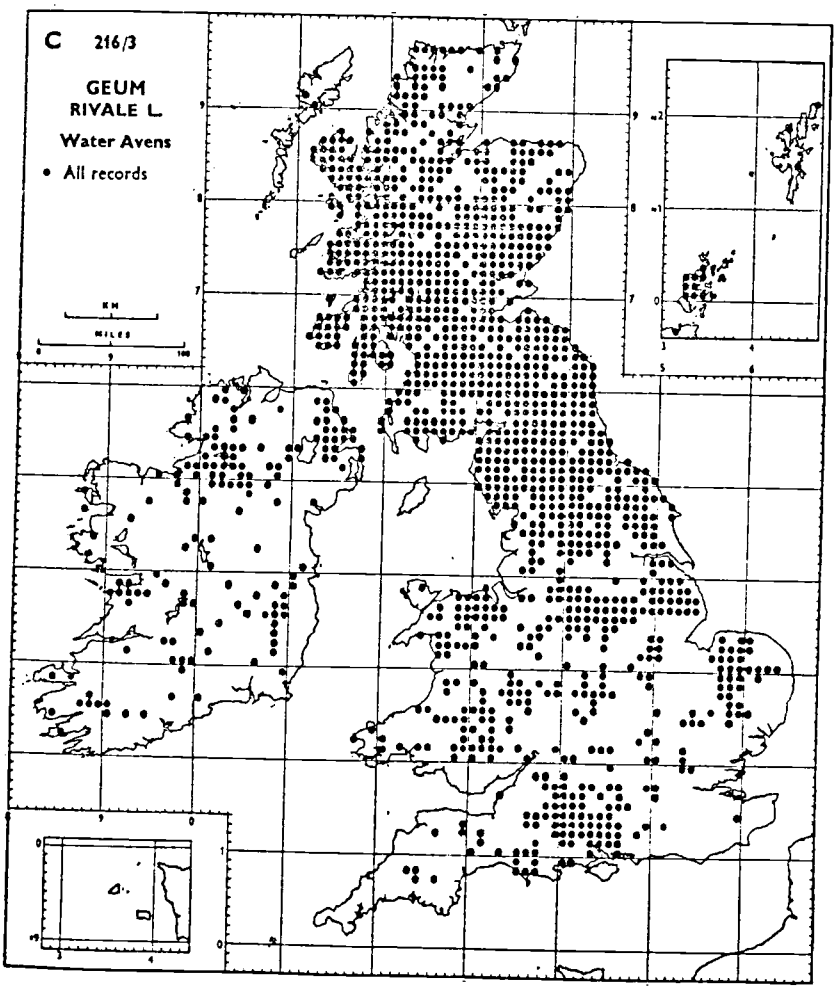
The distribution in Ireland and Britain of some of the rarer plant species mentioned in this report (From: Atlas of the British Flora by F.H. Perring & S.M. Walters B.S.B.I. 1962).

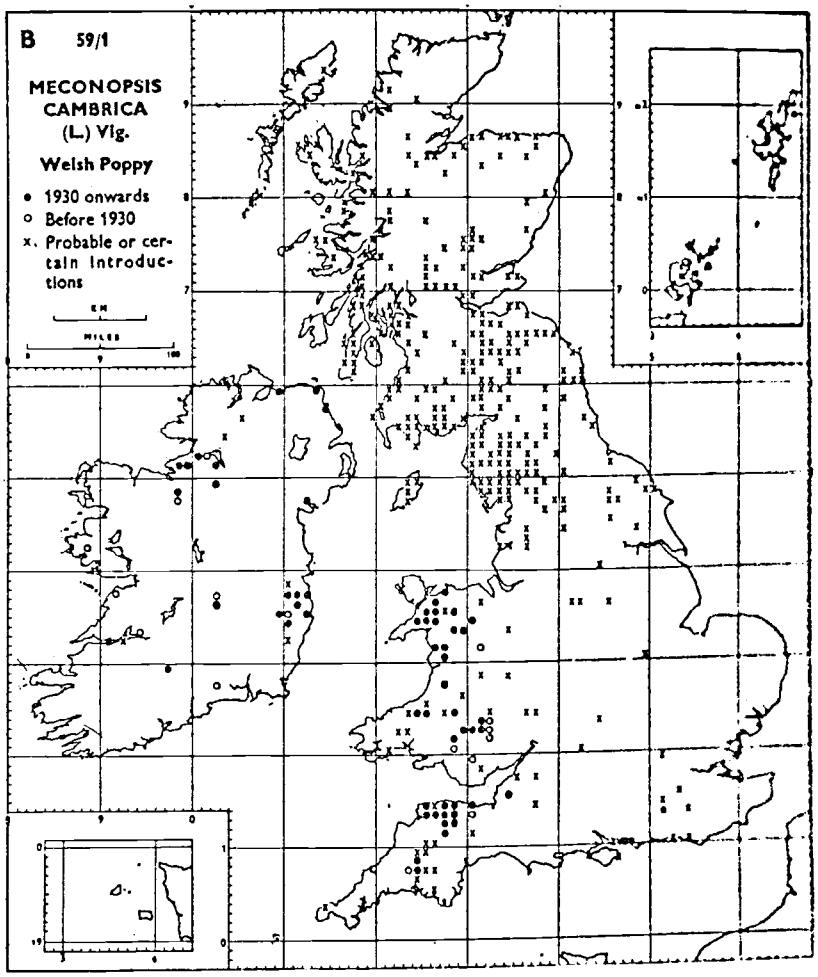
Plant names are arranged in alphabetical order.

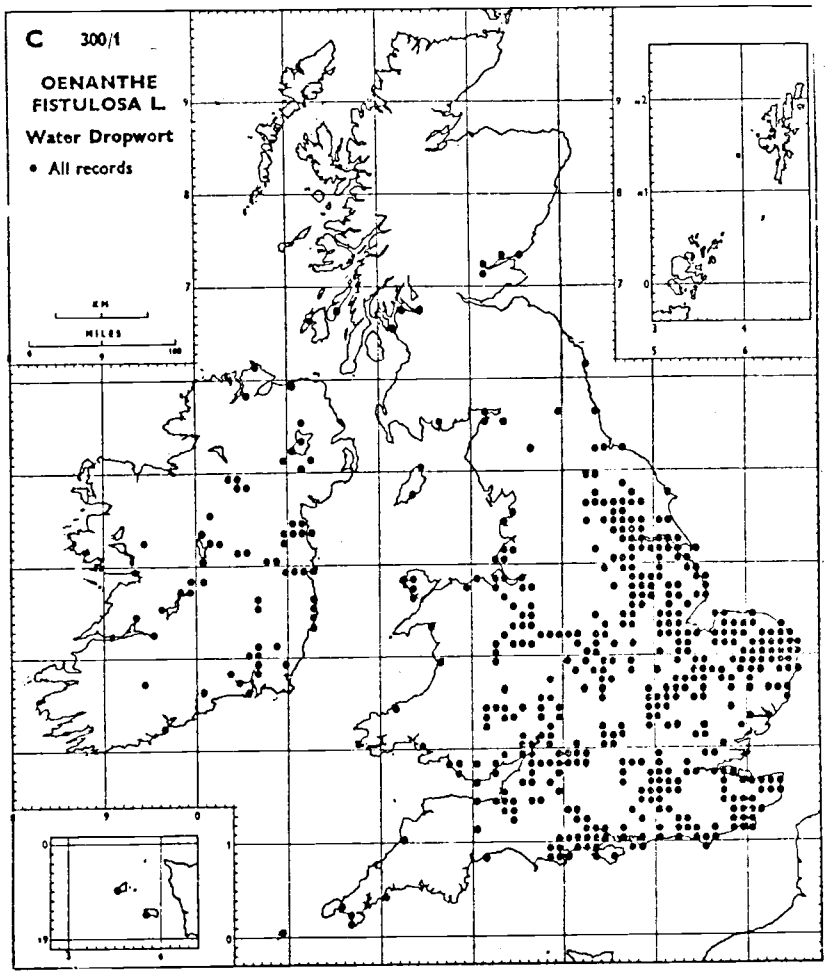

B 15/6
ASPLENIUM VIRIDE Huds.
Green Spleenwort
• 1930 onwards
○ Before 1930
KM
MILES

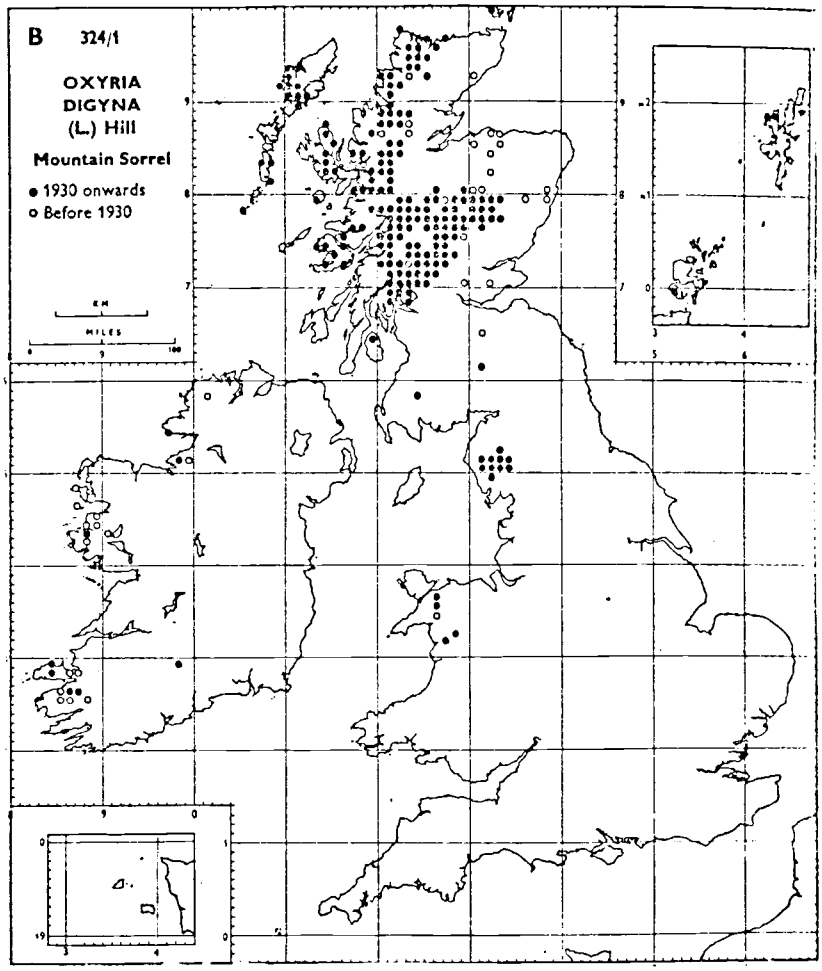

C 475/7
CAMPANULA ROTUNDI-FOLIA L.
Harebell
• All records
KM
MILES

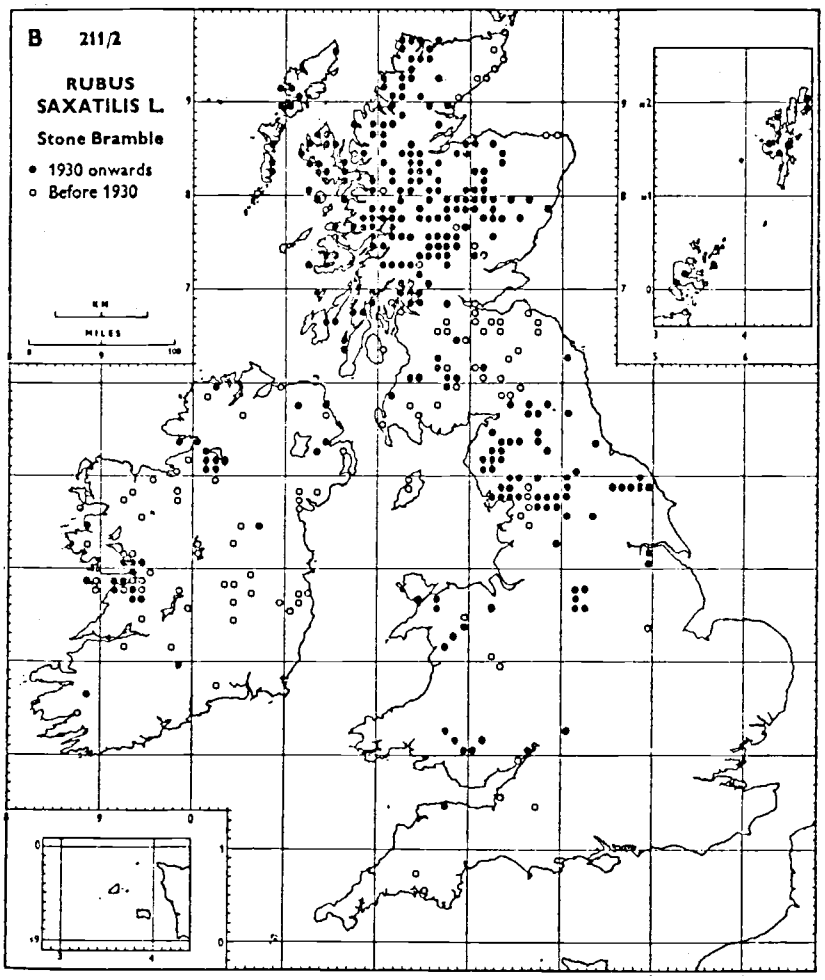

A 99/1
CARDAMIN-
OPSIS
PETRAEA (L.)
Hiit.
Northern
Rock-cress
• 1930 onwards
○ Before 1930
KM
MILES

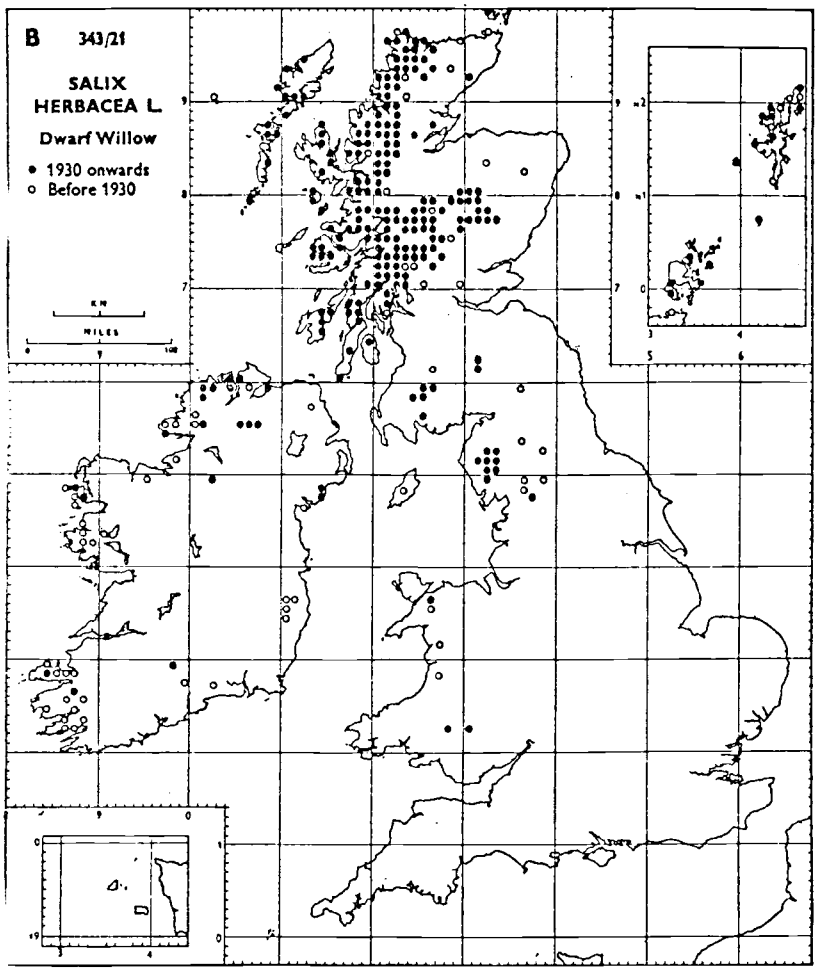

C 216/3
GEUM
RIVALE L.
Water Avens
• All records
KM
MILES

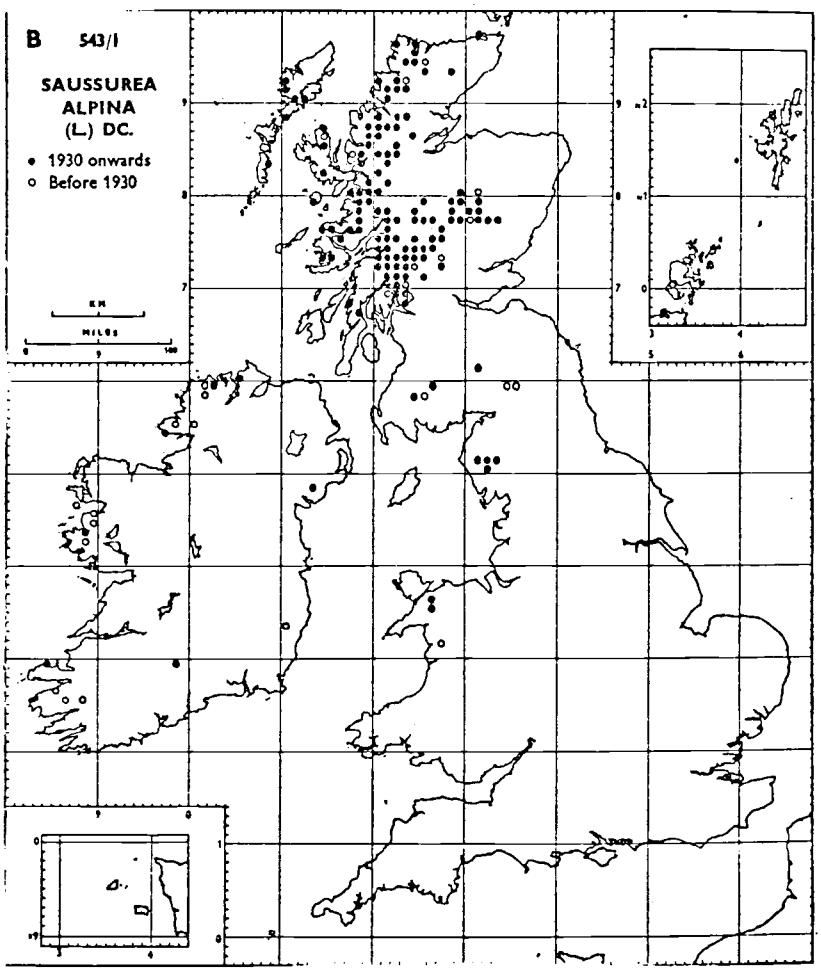

B 59/1
MECONOPSIS CAMBRICA (L.) Vig.
Welsh Poppy
• 1930 onwards
○ Before 1930
× Probable or certain introductions
KM
MILES

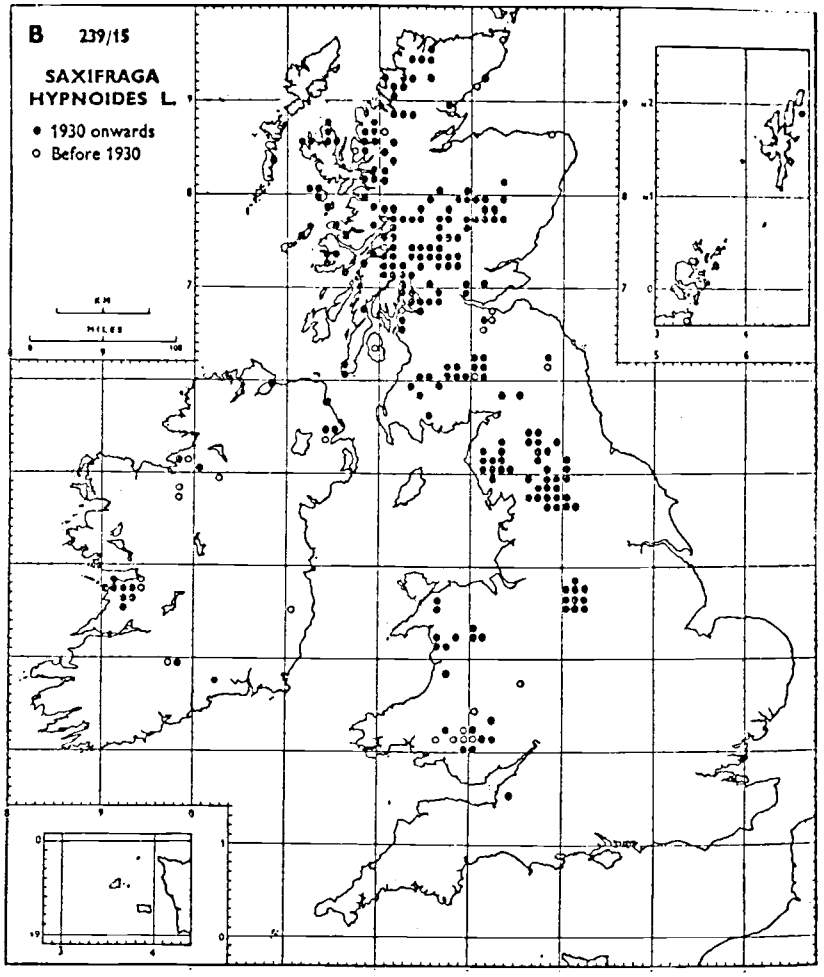

C 300/1
OENANTHE FISTULOSA L.
Water Dropwort
• All records
KM
MILES

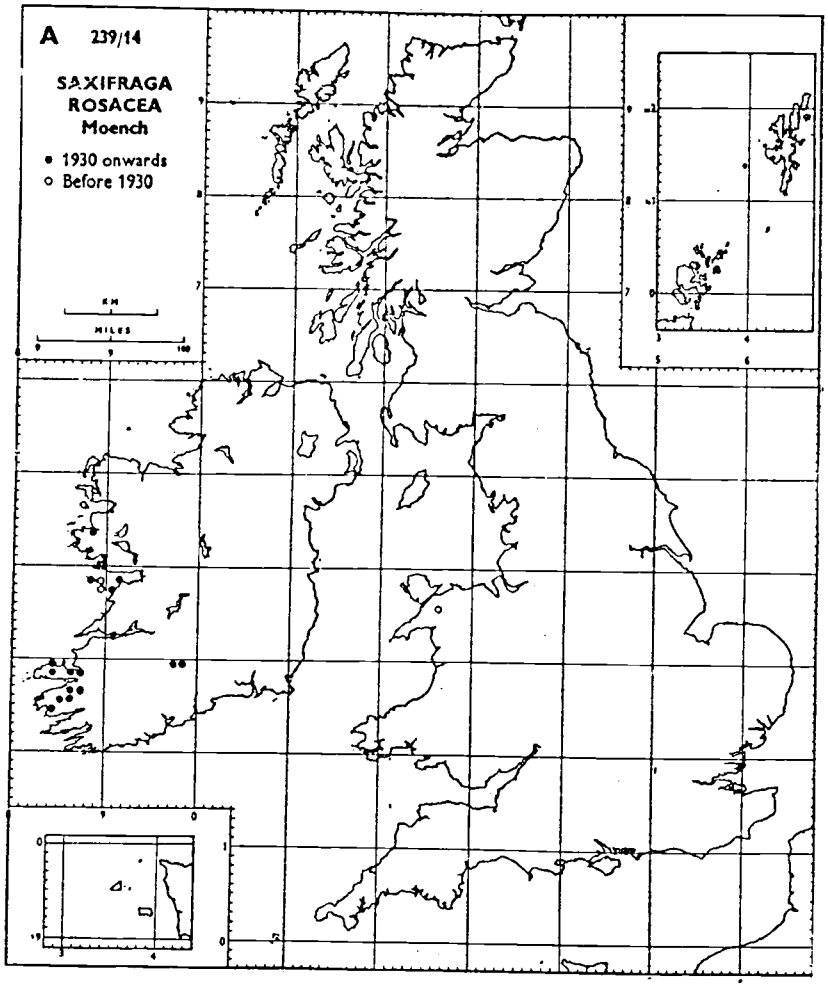

B 324/1
OXYRIA
DIGYNA
(L.) Hill
Mountain Sorrel
● 1930 onwards
○ Before 1930
KM
MILES

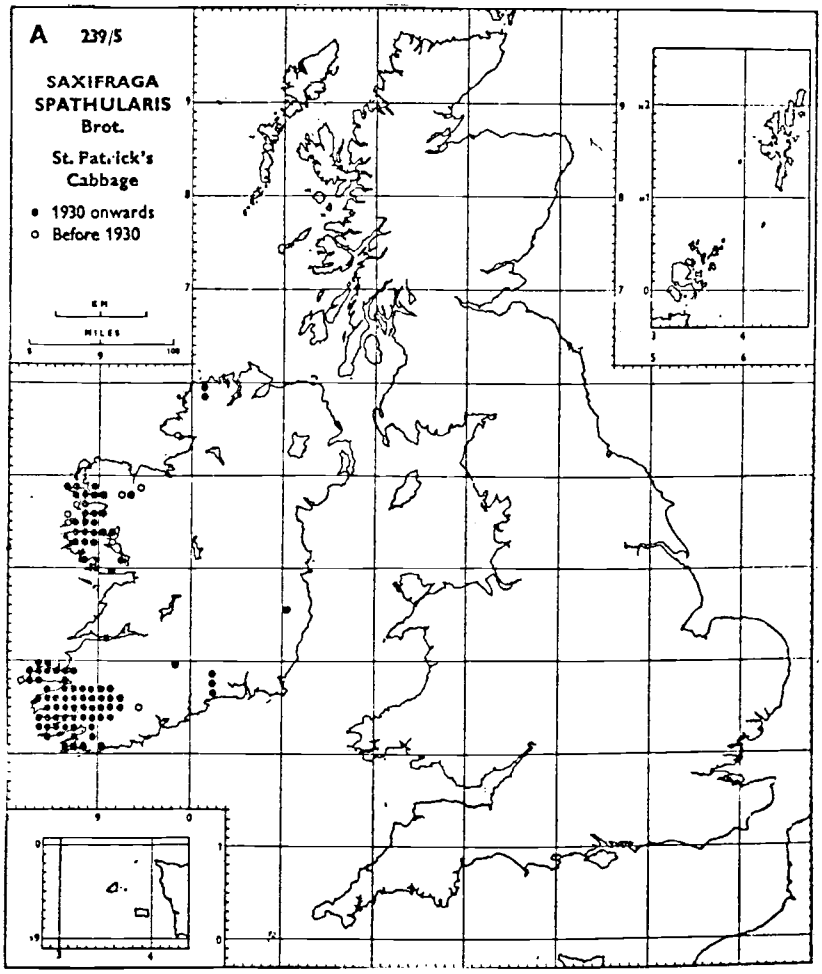

B 211/2
RUBUS
SAXATILIS L.
Stone Bramble
● 1930 onwards
○ Before 1930
KM
MILES

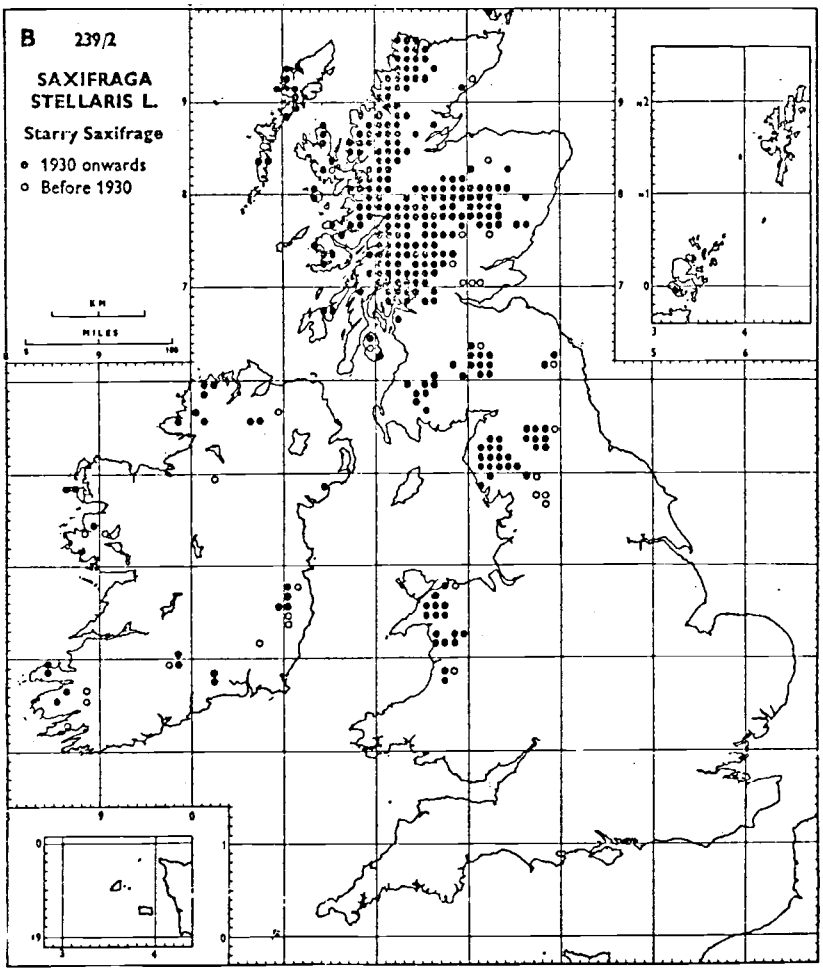

B 343/21
SALIX HERBACEA L.
Dwarf Willow
• 1930 onwards
○ Before 1930
KM
MILES

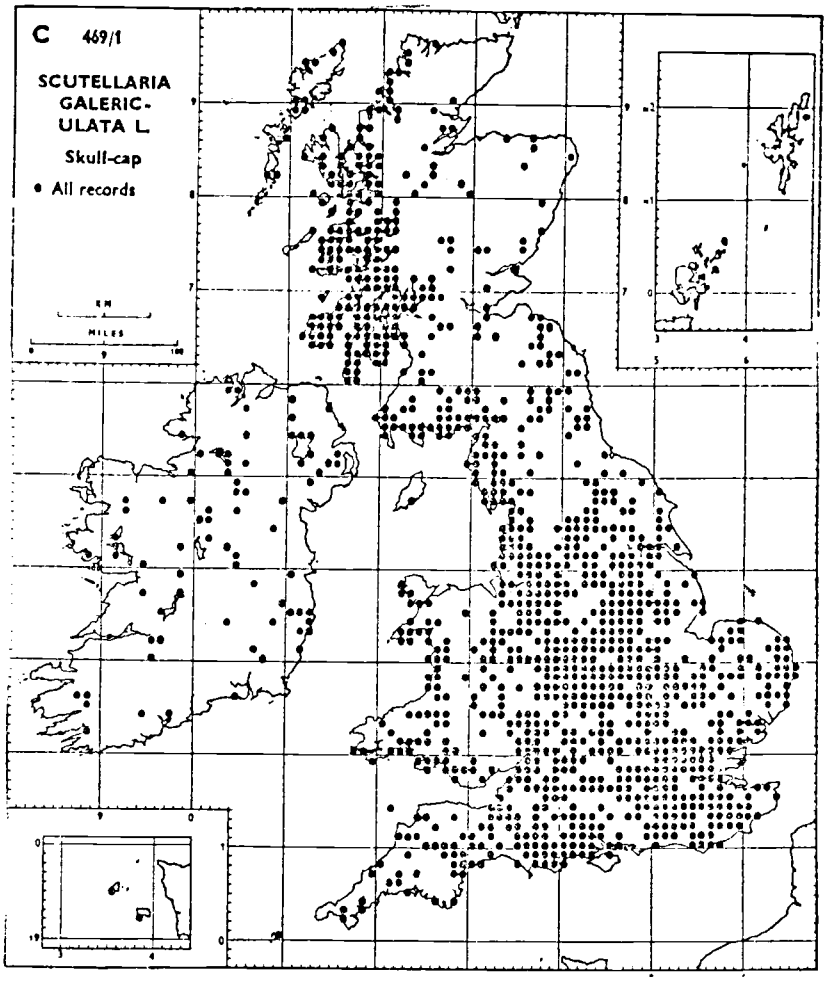

B 543/1
SAUSSUREA ALPINA (L.) DC.
• 1930 onwards
○ Before 1930
KM
MILES

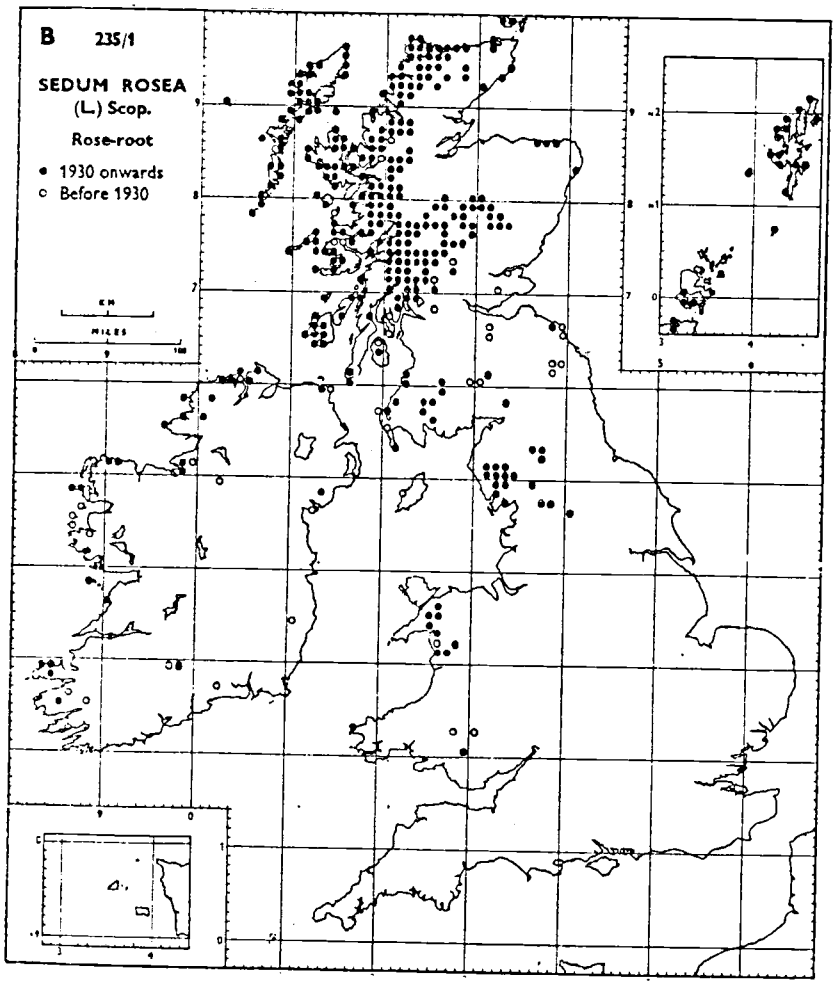

B 239/15
SAXIFRAGA
HYPNOIDES L.
• 1930 onwards
○ Before 1930
KM
MILES

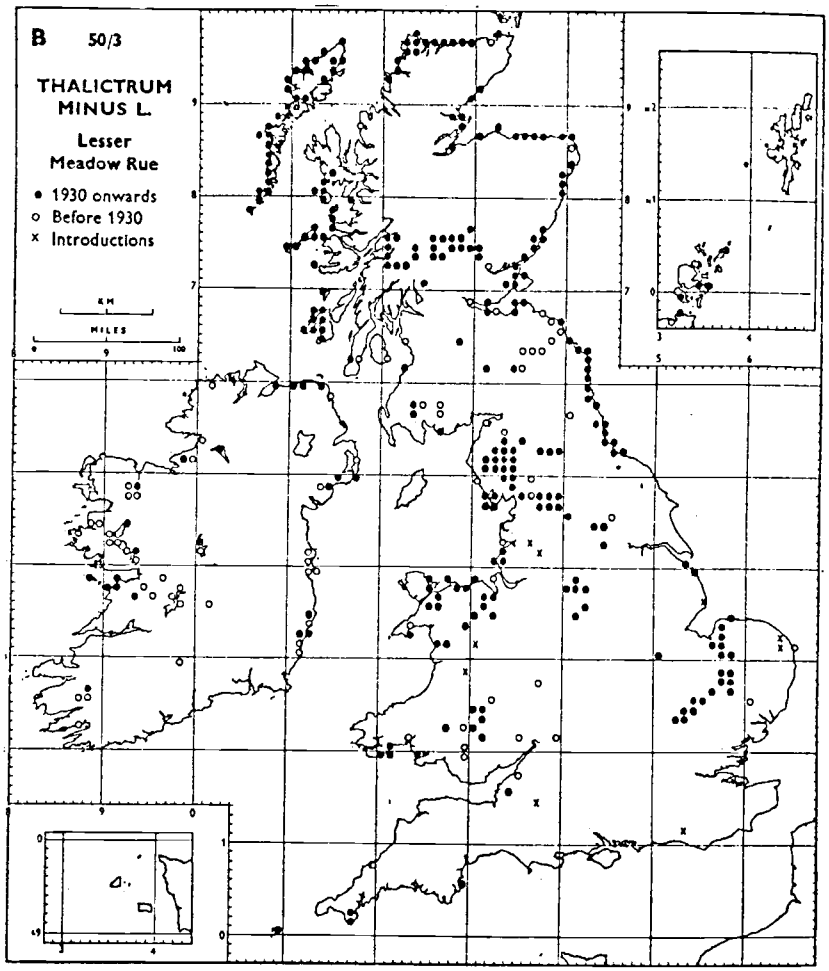

A 239/14
SAXIFRAGA
ROSACEA
Moench
• 1930 onwards
○ Before 1930
KM
MILES

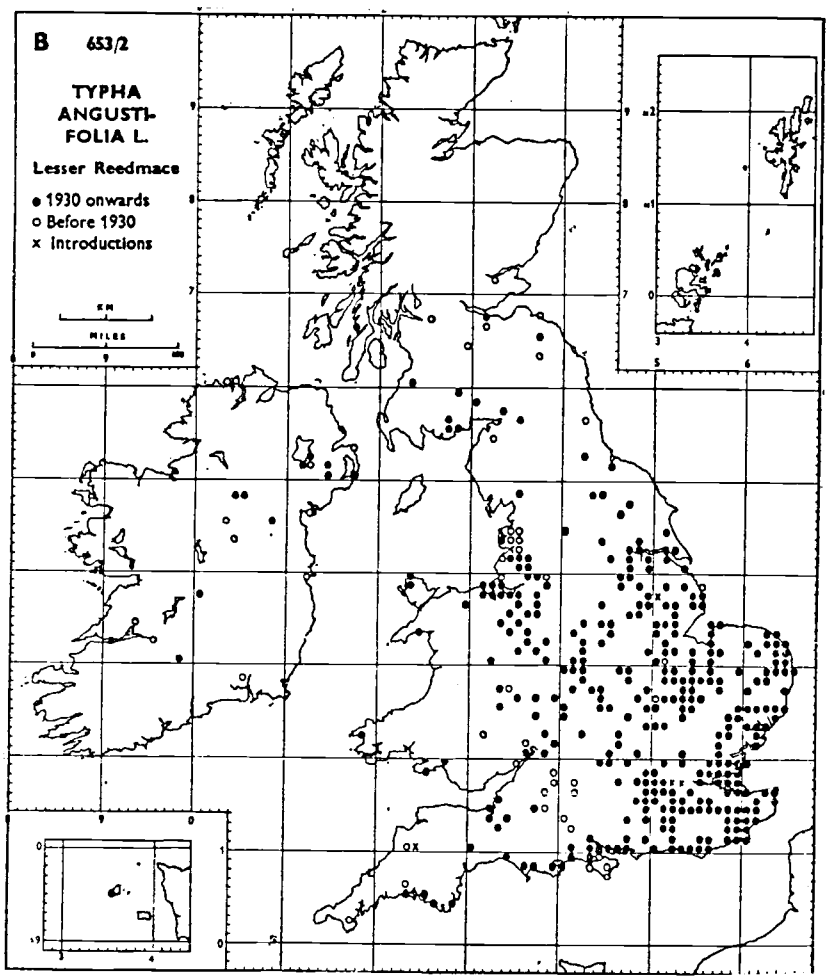

A 239/5
SAXIFRAGA SPATHULARIS Brot.
St. Patrick's Cabbage
• 1930 onwards
○ Before 1930
KM
MILES


B 239/2
SAXIFRAGA STELLARIS L.
Starry Saxifrage
• 1930 onwards
○ Before 1930
KM
MILES


C 469/1
SCUTELLARIA GALERIC-ULATA L.
Skull-cap
• All records
KM
MILES


B 235/1
SEDUM ROSEA (L.) Scop.
Rose-root
• 1930 onwards
○ Before 1930
KM
MILES

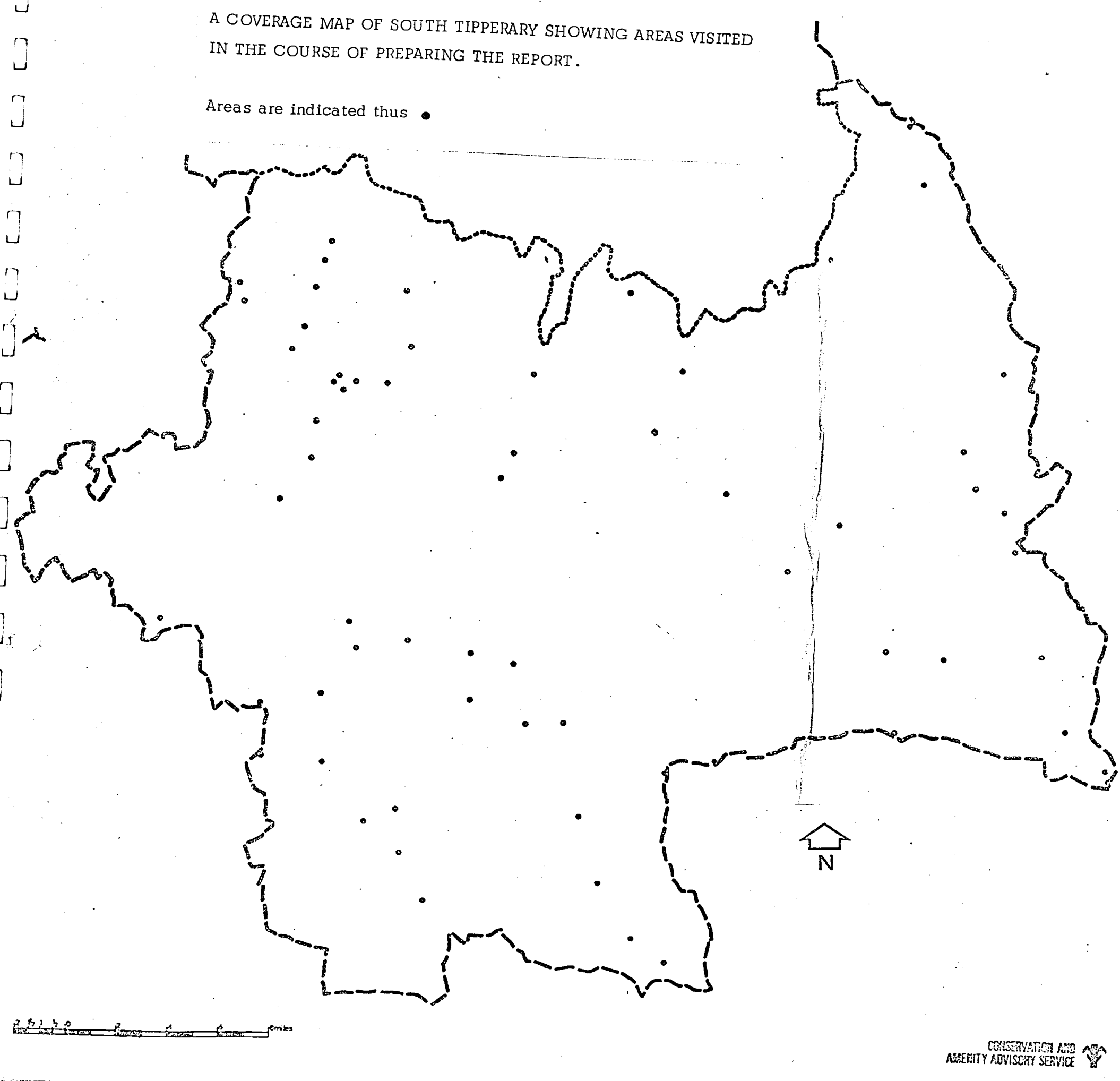

B 50/3
THALICTRUM MINUS L.
Lesser Meadow Rue
• 1930 onwards
o Before 1930
x Introductions
KM
MILES


B 653/2
TYPHA ANGUSTI-FOLIA L.
Lesser Reedmace
• 1930 onwards
o Before 1930
x Introductions
KM
MILES

	General Planning Control	Special Amenity Area Order	Conservation Order	Tree Preservation Order
Derinch Island	X			
Ardtermon Fen	X			
Doonee Rock	X			
Dunneill R.	X			
Rinn	X			
L. Arrow (parts)	X			
Horse Island	X			
(Raghly) Yellow Strand	X			
Wood nr.Five Mile Bourne				X

A COVERAGE MAP OF SOUTH TIPPERARY SHOWING AREAS VISITED IN THE COURSE OF PREPARING THE REPORT.

Areas are indicated thus ●



CONSERVATION AND AMENITY ADVISORY SERVICE