The Geological Heritage of Wicklow

An audit of County Geological Sites in Wicklow

by Robert Meehan, Matthew Parkes, Vincent Gallagher, Ronan Hennessy and Sarah Gatley

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For the:
Irish Geological Heritage Programme
Geological Survey of Ireland
Beggars Bush
Haddington Road
Dublin 4
01-6782837

and

Deirdre Burns
Heritage Officer
Wicklow County Council
County Buildings
Wicklow
tel. 0404 20100 / 20191 fax. 0404 67792
email. dburns@wicklowcoco.ie

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Report Summary

County Wicklow is widely known for its geological heritage, mainly in the context of iconic landscapes such as the Wicklow Mountains and glacial valleys such as Glendalough, yet it also has some very fine but underappreciated geological sites. The historic mining landscape at Avoca, for example, is rich part of the county's geological heritage, but is not always readily appreciated as such. The County Council's support for this audit is critical in raising the profile of geological heritage in Wicklow. The geology of the county is not representative of all the time periods but the geological heritage interest extends widely throughout the county.

This report documents what are currently understood by the Irish Geological Heritage Programme (IGH) of the Geological Survey of Ireland (GSI) to be the most important geological sites within Wicklow. It proposes them as County Geological Sites (CGS), for inclusion within the Wicklow County Development Plan (CDP). The audit provides a reliable study of sites to replace a provisional listing based on desk study which was adopted in a previous CDP.

County Geological Sites do not receive statutory protection like Natural Heritage Areas (NHA) but receive an effective protection from their recognition in the planning system by inclusion in the CDP. Some of the sites described in this report are considered to be of national importance as best representative examples of particular geological formations or features. They have been provisionally notified to the National Parks and Wildlife Service (NPWS) by the GSI and recommended for designation as Natural Heritage Areas (NHAs) once due survey and consultation with landowners is complete. Many of the other sites fall within existing pNHAs and SACs where the ecological interest is actually founded upon the underlying geodiversity. The commission of this audit and inclusion of the geological sites within the CDP ensures that County Wicklow follows a now established and effective methodology for ensuring that geological heritage is not overlooked in the general absence of allocated resources for progress at national level. It ensures that Wicklow remains at the forefront of geological conservation in Ireland.

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This report is written in non-technical language (with a glossary for unavoidable geological terminology) as a working document for use by officials of Wicklow County Council. It will also be made available to the wider public via the local authority website and the Wicklow online community heritage archive. A chapter of the report includes recommendations on how to best present and promote the geological heritage of Wicklow to the people of the county. It will also inform the work of the IGH Programme and be made available through the GSI website.

The preliminary sections, summary geological history and accompanying map, timescale and stratigraphical column particularly may be used as they stand to preface a booklet or as website information in the development of this work, and for information, as seen fit by the Heritage Officer. The contents also provide the essential ingredients for a public-oriented book or other publications on the geological heritage of Wicklow, if the funding can be sourced to produce them.

Wicklow in the context of Irish Geological Heritage

This report ensures Wicklow remains active at the forefront of geological heritage within Ireland, as more than half of the counties have now commissioned such an audit within the scope of the county-based Heritage Plan. It will hopefully encourage the remaining local authorities to follow what is now a tried and trusted methodology. In the absence of significant political and economic resources available at a national level to the relevant bodies for conservation of geological heritage as Natural Heritage Areas (NHA), it represents a significant level of progress in defining and safeguarding Ireland's geological heritage.

This audit also represents a significant commitment on the part of the Local Authority to fulfil its obligations to incorporate geology into the spectrum of responsibilities under the Heritage Act 1995, the Planning and Development Act 2000, Planning and Development Regulations 2001, and the Wildlife (Amendment) Act 2000 and the National Heritage Plan (2002). GSI views partnerships with the local authorities, exemplified by this report, as a very important element of its strategy on geological heritage (see Appendix 1).

The Irish Geological Heritage Programme (IGH) in GSI complements other nature conservation efforts of the last decade, by assessing the geodiversity of Ireland. Geodiversity is the foundation of the biodiversity addressed under European Directives on habitats and species by the designations of Special Areas of Conservation (SAC) and more recently on a national scale by the introduction of Natural Heritage Areas (NHA) as the national nature conservation method. As a targeted conservation measure to protect the very best of Irish geology and geomorphology the IGH Programme fills a void which has existed since the abandonment of the Areas of Scientific Interest scheme, listed by An Foras Forbartha in 1981.

The IGH Programme fulfils this by identifying and selecting the most important geological sites nationally for designation as NHAs. It looks at the entire spectrum within Irish geology and geomorphology under 16 different themes:

IGH THEMES

1. Karst
2. Precambrian to Devonian Palaeontology
3. Carboniferous to Pliocene Palaeontology
4. Cambrian-Silurian
5. Precambrian
6. Mineralogy
7. Quaternary
8. Lower Carboniferous
9. Upper Carboniferous and Permian
10. Devonian
11. Igneous intrusions
12. Mesozoic and Cenozoic
13. Coastal geomorphology
14. Fluvial and lacustrine geomorphology
15. Economic geology
16. Hydrogeology

A fundamental approach is that only the minimum number of sites necessary to demonstrate the particular geological theme is selected. This means that the first criterion is to identify the best national representative example of each feature or major sequence, and the second is to identify any unique or exceptional sites. The third criterion, identifying any sites of International importance, is nearly always covered by the other two.

Designation of geological NHAs will be by the GSI's partners in the Programme, the National Parks and Wildlife Service (NPWS). Once designated, any geological NHAs will be subject to normal statutory process within the Wicklow Planning Department and other relevant divisions. **However, compared to many ecological sites, management issues for geological sites are generally fewer and somewhat different in nature. The subsequent section considers these issues**.

From a national perspective, as a result of extensive comparison of similar sites to establish the best among them, there is now a good knowledge of many other sites, which are not the chosen best example, but which may still be of national importance. Others may be of more local importance or of particular value as educational sites or as a public amenity. All these various important sites are proposed for County Geological Site (CGS) listing in the County Development Plan, along with any clear NHA selections.

Currently, in 2014, a Master List of candidate CGS and NHA sites is in use, having been established in GSI with the help of Expert Panels for all the 16 IGH themes. For several themes, the entire process has been largely completed and detailed site reports and boundary surveys have been done along with a Theme Report. Due to various factors, none have yet been formally designated. However, some sites in Wicklow were considered to be of national importance and have been put forward as Natural Heritage Areas (NHA) for those few themes. These include Bray Head, Slieveroe and Rocky Valley, below the Sugarloaf, all within the IGH2 Theme. No progress has yet been made with their designation as geological NHAs although Rocky Valley and Bray Head are already pNHAs for the ecological importance. Therefore, inclusion of all sites as County Geological Sites (CGS) in Wicklow's CDP will ensure that they are not inadvertently damaged or destroyed through lack of awareness of them outside of the IGH Programme in GSI.

The sites proposed here as County Geological Sites (CGS) have been visited and assessed specifically for this project, and represent our current state of knowledge. It does not exclude other sites being identified later, or directly promoted by the Council itself, or by local communities wishing to draw attention to important sites for amenity or education with an intrinsic geological interest. New excavations, such as major road cuttings or new quarries, can themselves be significant and potential additions to this selection.

It was not possible within the scope of this study to identify landowners except in a few sites, but it is emphasised that CGS listing here is not a statutory designation, and carries no specific implications or responsibilities for landowners. It is primarily a planning tool, designed to record the scientific importance of specific features, and to provide awareness of them in any decision on any proposed development that might affect them. It thus also has an educational role for the wider public in raising awareness of this often undervalued component of our shared natural heritage.

Geological conservation issues and site management

Since **geodiversity is the often forgotten foundation for much of the biodiversity** which has been identified for conservation through SAC or NHA designation, it is unsurprising that many of the most important geological sites are actually in the same areas as SAC and NHA sites. In these areas, the geological heritage enhances and cements the value of these sites for nature conservation, and requires no additional designation of actual land areas, other than citation of the geological interest.

Broadly speaking, there are two types of site identified by the IGH Programme. The first, and most common, includes small and discrete sites. These may be old quarries, natural exposures on hilly ground, coastal cliff sections, or other natural cuttings into the subsurface, such as stream sections. They typically have a feature or features of specific interest such as fossils or minerals or they are a representative section of a particular stratigraphical sequence of rocks. **The second type of site is a larger area of geomorphological interest, *i.e*. a landscape that incorporates features that illustrates the processes that formed it**. The Quaternary theme and the Karst theme often include such sites. In Wicklow, the glaciated terrain, riddled with channels cut by glacial meltwater, that dominates the county is characteristic of the larger sites encompassed under the IGH 7 Quaternary theme. Large areas of Wicklow's landscape could present a problem for definition of geoheritage as, although impressive, they can be too extensive to consider as 'sites'.

It is also important from a geological conservation perspective that planners understand the landscape importance of geomorphological features which may not in themselves warrant any formal site designation, but which are an integral part of the character of Wicklow. A lack of awareness in the past, has led to the loss of important geological sites and local character throughout the country. In Wicklow, if a full Landscape Characterisation Assessment was completed it would provide a tool for planners to help maintain the character of the County. The Strategic Environmental Assessment within the County Development Plan also provides tools. In addition, the now routine pattern of consultations with GSI, either by the planning department or by consultants carrying out Environmental Impact Assessment, plus strategic environmental assessment (SEA), has greatly improved the situation.

There are large differences in the management requirements for geological sites in comparison to biological sites. Geological features are typically quite robust and generally few restrictions are required in order to protect the scientific interest. In some cases, paradoxically, the geological interest may even be served better by a development exposing more rock. **The important thing is that the relevant planning department is aware of the sites and, more generally, that consultation can take place if some development is proposed for a site**. In this way, geologists may get the opportunity to learn more about a site or area by recording and sample collection of temporary exposures, or to influence the design so that access to exposures of rock is maintained for the future, or occasionally to prevent a completely inappropriate development through presentation of a strong scientific case.

In many counties, working quarries may have been listed because they are the best representative sections available of specific rock sequences, in areas where exposure is otherwise poor. No restriction is sought on the legitimate operation of these quarries.

However, maintenance of exposure after quarry closure is generally sought in agreement with the operator and planning authority in such a case. At present, working quarries like those at Blessington are now included as County Geological Sites in Wicklow. These issues are briefly explored in a set of Geological Heritage Guidelines for the Extractive Industry, published jointly by the GSI and the Irish Concrete Federation in 2008.

A new quarry may open up a window into the rocks below and reveal significant or particularly interesting features such as pockets of fossils or minerals, or perhaps a karstic depression or cave. Equally a quarry that has finished working may become more relevant as a geological heritage site at that stage in its life. It may need occasional maintenance to prevent overgrowth of vegetation obscuring the scientific interest, or may be promoted to the public by means of a viewing platform and information panel.

Nationally, specific sites may require restrictions and a typical case might be at an important fossil locality or a rare mineral locality, where a permit system may be required for genuine research, but the opportunity for general collecting may need to be controlled. Although, Wicklow's sites are not likely to require such an approach, visitors should always be reminded to take home photos, not specimens.

Waste dumping

An occasional problem throughout the country, including in County Wicklow, is the dumping of rubbish in the countryside. The dumping of waste is not only unsightly and messy, but when waste materials are dumped in areas where rock is exposed, such as in quarries, they may leach into the groundwater table as they degrade. This can cause groundwater pollution and can affect nearby drinking water supplies in wells or springs. Groundwater Protection Schemes (DELG 1999) help to combat pollution risks to groundwater by zoning the entire land surface within counties into different levels of groundwater vulnerability. Such a scheme was previously completed for Wicklow County Council by the GSI and was incorporated into a full national scheme in 2012, thus ranking the county land surface into vulnerability categories of 'Extreme', 'High', 'Moderate' and 'Low', and helping planners to assess which developments are suitable or not in some areas of Wicklow. Without any Carboniferous Limestone in the geology of the county, groundwater is less important as a public supply, but many shallow wells in glacial gravels are highly vulnerable to pollution.
http://spatial.dcenr.gov.ie/GeologicalSurvey/Groundwater/index.html

New exposures in development

One less obvious area where the Local Authority can play a key role in the promotion and protection of geology is in the case of new roads. **Wherever major new carriageways are to be built,** or in other major infrastructural work, it should be a policy within the Planning Department, that **where new rock exposures are created, they be left open and exposed** unless geotechnical safety issues arise (such as where bedding dips are prone to rock failure). The grading and grassing over of slopes in cuttings is largely a civil engineering convenience and a mindset which is difficult to change. However, it leads to sterile and uninteresting roads that look the same throughout the country. Leaving rock outcrops exposed where they are intersected along the road, improves the character and interest of the route, by reflecting the geology and landscape of the locality. Sympathetic tree or shrub planting can still be done, but leaving bare rocks, especially where they show interesting features, not only assists the geological profession, but creates new local landmarks to replace those removed in the construction of the roadway. This can also potentially save money on the construction costs.

In the case of the N11 through the stretch between the Glen of the Downs and Ashford, there were new exposures created during road improvements in the last decade. However none of these were selected as sites because even in a few years they have become very degraded and vegetated. The combination of rock types and the angles of slope created in the cuttings mean that there is little chance of maintaining good accessible rock exposures without a regular routine of cleaning and vegetation removal. An alternative site at the new Wicklow Service Area has been selected which is similar to the N11 road cuttings but is much steeper and liable to retain faces for much longer.

Geoparks

An extremely interesting development in geological heritage, not just in Europe but internationally, has been the rapid recent growth and adoption of the Geopark concept. A **Geopark is a territory** with a well-defined management structure in place (such as Local Authority support), **where the geological heritage is of outstanding significance and is used to develop sustainable tourism opportunities**. Initially it was largely a European Geoparks Network (EGN) but since 2004 has expanded worldwide as the Global Geoparks Network (GGN) and is fully assisted by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) [see www.globalgeopark.org and www.europeangeoparks.org]. A fundamental theoretical basis of the Geopark is that it is driven from the bottom up – the communities in the Geopark are the drivers of the project and are the main beneficiaries. The Geopark branding therefore helps promote the geological heritage resource so that the community can benefit from it.

In Ireland there are three members of the Geoparks Network. One is the cross-border Marble Arch Caves Global Geopark in Fermanagh and Cavan [see www.marblearchcaves.net and www.cavancoco.ie/marble-arch-caves-global-geopark]. The Copper Coast Geopark in Waterford also joined the Network in 2001 [see www.coppercoastgeopark.com]. A now well established addition has been the Burren and Cliffs of Moher in County Clare [see www.burrenconnect.ie/geopark]. In addition there are aspirant groups exploring the work and infrastructure required for applications in other areas such as Joyce Country in Mayo and Galway, and the cross-border Mourne-Cooley-Gullion area.

At present, despite very interesting geological heritage in the county, it is not likely that any area would meet the criteria for a Geopark application, without extensive community development and the proactive support of Wicklow County Council. A ‘Wicklow Mountains Geopark’ is a conceivable approach, but would require major commitment to consider taking that path. With consensus partnership approaches like those of the Wicklow Uplands Council (and the adjoining Dublin Mountains Partnership) and the existing National Park structures, the Geopark approach might be a superfluous vision. However, the experience of the Burren and Cliffs of Moher Geopark, where there is a multiplicity of agencies, organisations and umbrella bodies, may provide valuable guidance as to the viability or otherwise of a Wicklow Mountains Geopark. If considered, it should extend to include the Dublin local authorities of South Dublin County and Dun Laoghaire-Rathdown, for geological contiguity. It should be noted that the County Development Plan (2010-2016) includes a policy of supporting the promotion of geological heritage in the county through a Rocktrail, Geopark or other geo-tourism initiatives (SG5 in Chapter 17).

Proposals and ideas for promotion of geological heritage in Wicklow

The clear and significant inclusion of geological heritage in the County Wicklow Heritage Plan 2009-2014 is a most welcome and positive step, for a topic that is often undervalued and poorly known in the wider community. This section examines the existing points in the plan relating to geological heritage and provides specific suggestions as to how these may be implemented, supported or enhanced by the audit of geological heritage sites in the county.

Objectives

1. To raise awareness and promote appreciation and enjoyment of heritage by all.

2. To develop and encourage best practice in order to deliver practical actions to enhance the protection of heritage in County Wicklow.
Audit Action: The audit may contribute to this action, providing easily understood data in a GIS format and a comprehensible report that may be used in many ways.

3. To compile information on County Wicklow's heritage resource in order to better understand it and to ensure the effective use of heritage data in policy formulation and decision making in the county.
Audit Action: The audit may contribute to this action, providing easily understood data in a GIS format, with a comprehensible report which will make geological heritage more accessible.

4. To encourage partnership and active participation among all for the benefit of heritage in County Wicklow.

Actions

1. Raise awareness and promote appreciation and enjoyment of heritage in County Wicklow.
1.1 Enhance public awareness of heritage in County Wicklow through circulating a Heritage Office newsletter, holding public events and training courses, optimising heritage content of Wicklow Local Authorities website, and utilising local media.
Audit Action: The auditors may contribute to this action by providing news/summary reports for the newsletter or website.

1.3 Work in partnership with Wicklow County Tourism to produce and disseminate in various formats, promotional material on the heritage of County Wicklow and on specific sites to visit. Look at erecting plaques/interpretation panels at selected buildings/houses of heritage interest in the county where appropriate.
Audit Action: The audit may contribute to this action, by providing easily understood material for panels

1.4 Organise Heritage Open Days whereby selected buildings, normally not publicly accessible are opened to the public for a specified time.
Audit Action: The audit may contribute to this action, through suggestions or arrangement of open days for normally inaccessible stone yard, quarry or mine sites.

1.5 Support efforts to promote heritage related tourism, in particular 'ecotourism' and genealogical based tourism, World Heritage Site status for Glendalough, and initiatives to highlight the heritage significance of the county's "Garden of Ireland" tourism.

Audit Action: The audit may broadly contribute to this action, through provision of quality information on the geological foundation of these aspirations.

1.6 Work with the Library Service to make relevant heritage collections (e.g. historic postcards, photographs, travel journals etc) accessible to the public online, and at new facilities such as the upcoming extension of Greystones library.
Audit Action: The audit may contribute to this action, since historical imagery will be accumulated in the research on geological heritage sites and can be provided for use where copyright is not an issue.

1.9 Explore the possibilities for developing a "Virtual Wicklow" web based project to provide a single repository for heritage information in the county, thereby promoting greater heritage awareness and appreciation, and encouraging heritage based tourism.
Audit Action: It is suggested that the audit report would provide an important element of such a repository.

1.10 Investigate the development of a "Heritage Village" initiative scheme for County Wicklow. Use this scheme as a means to complement existing Architectural Conservation Areas (ACA's) in the county, acknowledge and reward local community efforts, and to increase local awareness, appreciation and tourist potential.
Audit Action: It is suggested that Ballyknockan is a prime candidate for special treatment as a Heritage Village for the stone industry.

1.11 Develop with relevant partner organisations, an annual themed school education project/competition in the area of heritage in County Wicklow.
Audit Action: It is suggested that the Geological Survey of Ireland could be a partner in promoting the rich geological heritage of County Wicklow.

1.12 Explore the feasibility of developing a 'folk park' visitor facility in the county to promote a greater appreciation and awareness of vernacular buildings and styles in County Wicklow.
Audit Action: It is suggested that if this action is achieved or developed the topic of granite quarrying will be a very significant component, and the audit will provide a start point for developing the theme.

1.14 Encourage the publication of all national road scheme excavations carried out in County Wicklow, and hold a public event to highlight the significance of these archaeological discoveries.
Audit Action: The geological heritage element of the new road cuttings should not be overlooked.

2. Develop and encourage best practice in order to deliver practical actions to enhance the protection of heritage.

2.1 Produce information on the placenames of County Wicklow, and develop advice and guidance on naming new developments to reflect local heritage and culture.
Audit Action: The importance of the physical landscape, Earth resources and geomorphological features in place names should not be overlooked in this action.

2.2 Support the employment, as resources permit, of heritage related expertise in Wicklow Local Authorities, namely an Architectural Conservation Officer, Biodiversity Officer and Field Monument Advisor.

Audit Action: The option of a County Geologist can also be considered, with the potential to advise on engineering, groundwater, heritage, quarrying, planning and many other issues.

2.3 Produce guidance for the public on the protection afforded to various aspects of heritage in County Wicklow, include in this, procedures to follow and relevant contact details regarding reporting suspected unauthorised works or damage to protected structures, archaeological features, trees or other aspects of heritage.
Audit Action: The County Geological Site listing has no statutory protection, and is primarily a planning tool, but can also provide for wider public participation in the promotion and protection of any sites, especially as public awareness increases. However it is important to note that there is still a responsibility to consult with GSI over any proposed development that may impact on a CGS.

2.4 Develop guidance, possibly a dedicated website to promote best practice for new buildings in the landscape – appropriate materials, siting, design, planting, etc.
Audit Action: The audit may contribute to this action, through raising awareness of the importance of stone as a building material, and how Earth resources available in different places have developed local character.

2.8 Support the identification of Architectural Conservation Areas (ACAs) in towns and villages of County Wicklow to protect their special character.
Audit Action: The audit may contribute to this action, through raising awareness of the importance of stone as a building material, and how Earth resources available in different places have developed local character.

3. Compile information on County Wicklow's heritage in order to better understand it.

3.1 Support the production of an index of historical sources for County Wicklow to support historical research efforts. Include in this index, local journals, research projects, publications and other archival sources and relevant contacts.
Audit Action: The audit may contribute to this action, through research on geological heritage sites which can be provided to the Heritage Officer for inclusion in any index.

3.3 Carry out an audit of heritage sites in County Wicklow for tourism potential. The audit should look at issues such as site vulnerability, environmental sensitivities, car parking, visitor access, interpretation, links to public transport, and an assessment of the overall capacity of the site to operate as a tourist attraction.
Audit Action: The audit provides significant data on the geological heritage sites that could offer tourism potential.

3.5 Carry out an audit and interpretation of significance, of local heritage collections in County Wicklow, and national collections containing material of Wicklow interest. Seek and support the development of suitable facilities in the county for the public display of this material.
Audit Action: The audit may contribute to this action, through provision of data on geological collections, known to the authors, compiled in the course of the audit.

3.9 Carry out an audit of geological heritage sites in County Wicklow in partnership with the GSI.
Audit Action: The audit fully achieves this action.

3.11 Carry out a survey of the coastline and intertidal zone in County Wicklow to identify cultural heritage features, habitats, and recreational amenities sensitive to the effects of climate change (such as increased storms, erosion and rising sea levels). Use this information to plan and prioritise actions in relation the protection of heritage and recreational amenity resources.
Audit Action: It is suggested that the proposed survey should not overlook geological heritage issues on coastal sites, and the importance of the role of geology in a dynamic environment that can be quickly affected by measures such as protection of property or construction of marinas, harbours and other facilities.

4. Encourage partnership and active participation.
4.3 Support existing and new initiatives to enhance physical and intellectual access to, and interpretation of, heritage in County Wicklow, with an emphasis on the development of sustainable trails and walking routes as a means of achieving this.
Audit Action: The audit report includes site-specific suggestions where trails and walking routes are seen as positive options.

4.8 Work in partnership with local groups in the county to pursue suitable opportunities for developing visitor and interpretation potential of County Wicklow's Mining Heritage.
Audit Action: The audit report provides objective data on the mining heritage of County Wicklow, to underpin the efforts of the local groups and the Mining Heritage Trust of Ireland.

4.14 Support a "Ballyknockan Granite Park" initiative and seek to develop this proposed pilot project along with relevant partners, in order to promote and increase appreciation of the local stone cutting tradition.
Audit Action: It is suggested that the Geological Survey of Ireland could be a partner in promoting the rich stone cutting heritage of County Wicklow, and the Mining Heritage Trust of Ireland also.

The County Development Plan (2010-2016) also has important objectives regarding geological heritage integrated into the Section 17.6 Soils and Geology, but deals with wider issues relating to geology also.

Some of the topics or themes that recur in Wicklow's geological heritage are briefly discussed in the following sections before looking at specific ideas for raising awareness of them.

Geological heritage themes: Mining in Wicklow

Wicklow has probably the most extensive range of mining heritage in the whole country. From early iron mining adjacent to Croghan Kinsella and at Ballard, to the Wicklow Gold Rush of 1798 in the Goldmines River, through to the relatively recent cessation of copper mining at Avoca, the geology has provided society with a wide range of minerals extracted from the ground.

The main interest in mining heritage in Wicklow lies in the 19th century working of vein deposits of lead ores in the margins of the Leinster Granite. Three main localities are found in the valleys of Glendasan, Glendalough and Glenmalure. These each had many mine workings, both shafts and adits driven into the hill, until at one time a traverse could be made from Glendasan to Glendalough through many levels underground in the mountain. Connecting the two sets of workings also allowed drainage to the lower side in Glendalough without the need for as much pumping out of water, using water wheels. The shortlived mine at Ballycorus in Dublin had a leadworks built, and the mining Company of Ireland who operated most of the 19th century lead mines kept it supplied with ore from their Wicklow mines.

At Glendalough, a phase of mining in the 1950s was the last occasion, and some ex-miners still live in the area and are working to promote their local mining heritage through the Glens of Lead Project. See www.glensoflead.com

The Avoca Mines on either side of the Avoca River have a long history over many centuries, probably including Bronze Age working. However the latest phases of mining usually destroy evidence of earlier phases, and large opencast pits at Avoca are clear proof of that. Avoca copper mines had several phases with the last one only ending in the early 1980s. The later mining of this volcanic massive sulphide deposit was primarily whole rock extraction to process large volumes of low percentage ore. Big open pits resulted at East Avoca, Cronebane and at West Avoca. The engine houses of 19th century steam power remain dotted amongst them.

As with many former mining areas, today's environmental standards are much stricter than in the past and efforts are being made to 'clean up' the site and stabilise problems of acid mine drainage in the Avoca River and other environmental concerns. Whilst this raises some conflicts of interest between different views on the site and its value to the area, the authors have aimed to report on the geological and mining heritage of the sites in as independent and impartial way as possible, to aid assessments of works and their impacts.

A recommended introduction to the mining heritage of County Wicklow has been published as an action of the County Wicklow Heritage Plan. It is available in print and as a downloadable pdf. http://www.heritagecouncil.ie/landscape/publications/article/exploring-the-mining-heritage-of-county-wicklow/?L=uxwpqerospk&tx_ttnews%5BbackPid%5D=1159

Geological heritage themes: Stone Cutting Traditions

Wicklow granite has been used as a building stone of choice for many centuries, especially in Dublin City, but also in innumerable buildings local to the outcrop of the rock. Whilst the Wicklow Granite outcrops over a very large area, it is actually composed of many different granite bodies that were intruded into the country, or host, rocks, and into itself in different phases. Consequently there are subtle differences in the mineralogy and especially in the crystal grain size (reflecting the rate of cooling of the bodies). These can be mapped geologically, but early stone cutters probably found by experience which bodies were best. This knowledge, combined with accessibility for transport and the practical choice of avoiding high mountainous areas with harsh weather, has meant that stone cutting has focused itself in certain areas.

In his book on the granite industry, Michael Conry has made it clear than a large part of the early working of stone involved simply cutting the large glacial erratic boulders which were prolific in many places. This had the advantage of clearing fields of the boulders and providing walling stone from the offcuts. However the constraints of transport, low altitude and rock quality meant that Golden Hill, near Manor Kilbride north of Blessington, was the early centre of cutting granite for buildings in Dublin.

Ó Maítiu and O'Reilly's (1997) history of stone quarrying at Ballyknockan, a village on the east side of the modern reservoir of Blessington Lake, records the shift of activity to around 1824, perhaps aided by the one landlord, the Cobbe family, owning both areas. From then on, quarrying developed strongly with several different families working different sections. There are a few subsidiary quarries but today, what appears to be only one large quarry in the centre of the southern part of Ballyknockan is actually comprised of many separate sections worked by and named after different families of stonecutters.

At its height some 200 men were employed in stonecutting and the rock was used to build very many of Dublin's finest buildings such as the railway stations, Glasnevin Cemetery Chapel, gateway and mortuary, St. Paul's on Arran Quay, the RDS entrance and many more. It was also used in buildings across Ireland such as Kylemore Castle, and even exported to Liverpool, France and for the Cathedral of St. John's in Newfoundland. The pride of the stonecutters in their work extended to their homes too, and the whole village of Ballyknockan is replete with quirky details of interest in the stonework of homes and even on barns and sheds, fenceposts, walls and pathways. There is considerable local pride and enthusiasm for promoting the stonecutting heritage of Ballyknockan, which probably needs a commitment from the County Council to sustain in the long run.

The view from above Creedon's Quarry over the main area.

Geological heritage themes: The Ice Age

The Ice Age, and glaciations, in County Wicklow

When it is considered that the Earth is 4.6 billion years old it is obvious that the Irish landscape has undergone huge changes within that time. The geological processes which have operated on the Irish landscape over these billions of years are extremely varied and complex, hence the records of these processes that are left in the surface form of the landscape and their underlying rocks are extremely complicated and fragmentary and difficult to decipher. To understand the landscape in its current form we must realise that various large scale, global events have been more important than others, and though geological processes (*e.g.* the action of rivers and the sea, peat formation) are still operating today in Ireland these have only a minor effect on the overall landscape. The last mega-geological event to have affected the Irish landscape is the last **ice age**, or **glaciation**. This occurred between 73,000 and 10,000 years ago and had a huge effect on our landscape and geology, being the final shaping action over the majority of our countryside.

Why did we have an ice age?

Since the beginning of the Earth's History the surface temperatures of the Earth have undergone huge variations, varying from intensely hot conditions to intense cold. These alternating hot and cold periods lasted for hundreds of millions of years. For example, we know that at the time of the dinosaurs the Earth's surface temperatures were high and the Earth's climate as a whole was essentially a tropical one. At present, and for the last 50 million years or so, we have been in a time when the temperatures are quite cold as a whole, therefore we are in a kind of global ice age. 50 million years ago Western European climate was sub-tropical. Temperatures have cooled gradually since then and about 2 million years ago the configuration of ice at the poles was pretty much as it is today. Within the last two million years the extent of ice at the poles has fluctuated greatly, extending at some times into the mid latitudes and beyond. It was during these time periods that ice engulfed Ireland bringing with it ice age effects and processes to this country.

Why does the ice at the poles 'grow' and engulf Ireland every now and then?

There are three factors which contribute to the development of glacial conditions in Ireland every few thousand years. These are all related to the Earth's position and geometry as an orbiting planet in the Solar System.

The **first factor** is known as the '**eccentricity**' effect. As the Earth orbits the sun, its orbit is not perfectly circular but resembles that of an ellipse, or stretched out circle. This means that over a cycle of 100,000 years the orbit brings the Earth further away from the sun when the elliptical orbit is at its most 'eccentric'. Being further away from the sun at these times obviously means we don't get as much heat from the sun. This has huge effects on Earth surface temperatures as a whole.

The **second attribute** is known as the '**tilt**' effect. The Earth's axis is tilted and the northern hemisphere leans towards the sun in June and away from it in December. The angle of tilt is not stable either meaning the Earth 'leans' towards the sun more at some times than it does on others. This means that if the tilt angle is higher the temperature range may be greater. Approximately every 41,000 years, the tilt is closest to vertical. Sunlight then strikes the poles at a sharper angle, and seasonal variations in temperature are reduced.

The **third factor** is the '**wobble**' effect. The Earth's axis wobbles like a spinning top, wobbling along a circular path every 23,000 years. This means that in the case of the northern hemisphere its summer occurs either when the Earth is furthest from the sun on its elliptical orbit, or when it is closest.

These three cycles combined means that the Earth goes through predictable sequences of temperature variations which, when combined and leading to a reduced global temperature, mean that snow and ice do not melt in the mid-to-high latitudes causing glacial conditions. The greatest and longest lasting ice ages occur when all three cycles coincide.

How does the ice collect and flow?

When snow falls it collects on the landscape but in today's climate it usually melts in a matter of hours. Not so during glacial conditions in Ireland. Every few thousand years conditions cause the Earth's temperature to fall as a whole which means that snow may not melt in all localities: if snow begins to accumulate it forms a compact, icy substance called **firn** or **neve**. This can further compact as accumulation increases and when this material attains a depth of 50m or so it begins to flow as blue glacier ice. This ice flows similar to the manner wet concrete flows. As the ice flows over its substrate small pieces of rock and soil over which it flows become stuck to the base by freezing on and are therefore 'plucked' from their resting place and incorporated into the base of the glacier. This makes the base of the glacier more grating and it can further erode the underlying material, just as coarse sandpaper will on wood. Therefore by **'plucking'** and **'abrasion'** processes the glacier ice continues to erode everything it passes over, smoothing and polishing underlying rock and picking up material in its basal layers.

In this way rock and soil debris get incorporated into the glacier and can be carried far from their source. Rock material carried in this way is known as erratic material and the individual rocks are known as **erratics**. The erratics may be small pebbles or sand grains forming soil or subsoil or may be large cobbles or boulders strewn across the landscape. Many erratic are seen throughout Wicklow, including the large granite blocks scattered haphazardly along valleys like Glendalough and Glenmacnass, and the limestones within the gravels in the Blessington District.

What was the geometry of the last ice sheet in Ireland?

During the last glaciation ice covered the entire country. The ice was moving all the time in the manner outlined above, and was up to 900m thick in places. Obviously, the erosive power of an ice sheet nearly one kilometre deep on the underlying landscape was phenomenal. Only our highest mountains peaks stuck up above the ice as **nunataks** so everything under this level was scoured, planed, smoothed or bulldozed, and in most cases then covered by the massive amount of debris that was left by the ice after it retreated. In Wicklow, only Luggala, Mullaghcleevaun, Lugnaquilla, Camenabologue and Tonelegee poked up above the ice.

The Irish ice sheet was not one great mass of ice but contained a number of independent domes and small ice caps which coalesced to form one overall ice sheet. These domes had ice which radiated out from their centres and moulded the countryside under them. As the ice domes started to melt they retreated in on themselves and huge amounts of glacial meltwater was released. Wicklow had its own ice dome, covering most of the mountains and merging with ice from the lowlands around it, within a huge ice mass across the Leinster landscape.

The centres themselves moulded the landscape in such a way that we can reconstruct their geometry by looking at certain ice flow indicators in the landscape.

Ice flow indicator 1: Striae.

Striae are scratches into bedrock which are formed by small pieces of rock or soil protruding from the base of the ice scratching the rock underneath them and leaving a groove mimicking ice flow. They are usually found on smooth outcrop surfaces where the rock has been polished by the abrasive ice. They are remarkably consistent features and many striae may be seen side by side on one small outcrop. They are also found on bedrock under subsoil and if you dig a hole deep enough to hit bedrock not only may the striae be seen, but the very rocks at the base of the subsoil which caused them as this subsoil was emplaced by the glacier all those thousands of year ago!!

Striae are very common in East Wicklow, on the fine-grained shales and greywackes, but are rarely found on the granites of the central mountain area, as the granites are too coarse to hold the etchings.

Ice flow indicator 2: Roche moutonnees.

Roche moutonnees are asymmetric bedrock bumps or hills with polished up-ice faces and jagged down-ice faces. The polished face is a result of ice abrasion on a bedrock obstruction at the base of the ice and the jagged face a result of plucking. They occur at a variety of scales and may be less than 1m to several hundred metres across. Many bedrock outcrops in Ireland look polished and on close inspection it is seen that they have jagged faces too, therefore with some detective work we can infer ice flow direction by simply examining bedrock outcrop at most localities. Roche moutonnees are common on the granite of Wicklow, as outcrops often have polished, smooth surfaces moulded by the ice. They are well expressed particularly along the sides of glacial valleys such as Glenmalure and Glendasan.

At the glacial maximum most of Wicklow was covered by ice, and in the early stages of glaciation preceding this, local mountain ice probably covered most of the county. As the large ice sheet covering the country (which was composed of domes with sources in the Irish Midlands and the Irish Sea Basin) expanded, the local mountain ice became confined to the central mountain area. The mountain ice merged with the general ice and flowed with it towards the south.

More detail on how the ice sheets melted at the end of glaciations is given in the overview report on 'Glacial Meltwater Landforms in East and West Wicklow' within the Site Reports.

Geological heritage themes: Wicklow's Gold Rush 1795

A painting by Thomas Sautell Roberts (c. 1760-1826) of searching for gold in Wicklow. Image by permission of the National Library of Ireland.

The Gold Mines River, flowing off Croghan Kinshelagh to join the Aughrim River, near Woodenbridge, was the site of a remarkable piece of Irish history, when there was a gold rush here from 1795. Forestry work in the river banks provided a gold nugget. There followed a rush of 'peasants' to the area and then to some adjacent rivers, to search for gold in the river bed and banks. Centred on the head of the valley at Ballinagore Bridge, it would seem that frantic digging activity transformed the area, with thousands of people either working or spectating or trading on the needs of so many others.

The thing that made this gold rush so distinctive was the prospect of finding a large nugget that could make a person's fortune in one go. The reputed largest nugget was of 22 oz and was given to King George III in 1796. It is rumoured that he had it made into a snuff box, but there is no certainty about this or many other gold stories originating in the Gold Mines River gold rush.

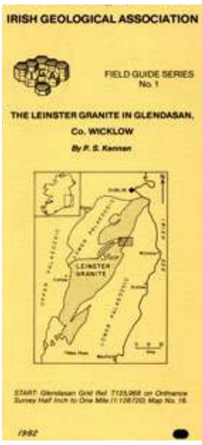
The original few weeks of gold rush were quickly brought under official control with bureaucratic controls backed up by a militia force. Government working of the area yielded more gold intermittently with pauses during rebellion, with a much more structured approach and the geologist Thomas Weaver overseeing operations. Geological and commercial studies ever since have tried to find a possible bedrock source for the alluvial gold, but it seems likely that the Ice Age gathered up residual gold from the weathering of an iron deposit on the Ballycoog-Moneyteige ridge and redeposited it in the Gold Mines River valley.

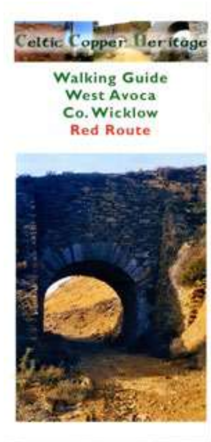
A book 'Gold Frenzy' by Peadar McArdle, former Director of the Geological Survey of Ireland, published by Science Spin tells all the stories in this remarkable lost history.

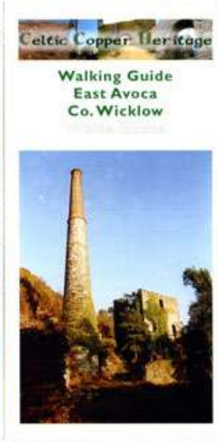
Specific Ideas for Raising Public Awareness of Geological Heritage in Wicklow

Leaflets

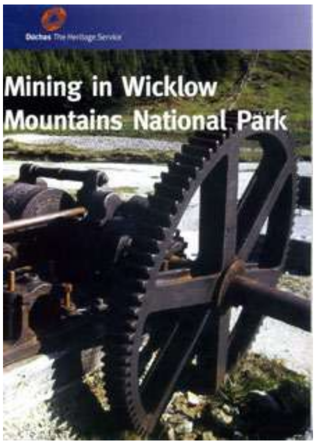
A few existing leaflets are known. The NPWS have an excellent simple leaflet on the mining heritage of Glendalough. Two walking trail leaflets have been produced for mining areas at Avoca, under an INTERREG project. The GSI produced the Wicklow Way walking guide set, but which is now out of print. The Irish Geological Association have older leaflets on areas of Wicklow and Dublin.







There is plenty of scope for other and different leaflets. For example, an NPWS leaflet on the topography, geology and minerals of the Wicklow Mountains National Park would be useful. Any leaflets produced could simply be made available as pdf downloads on the Council's website to avoid large costs of printing.



Guides

There are few existing guides to the geology of County Wicklow, apart from some GSI literature produced some time ago. The 1:100,000 map report for Sheet 16 covers Wicklow and is an essential resource. For general interest, *Wicklow in the Ice Age* is a useful resource. Although out of print, it is available digitally from the GSI. A more modern, excellent guide, *Wicklow in the grip of an ice age* is available from the Irish Quaternary Association. An excellent practical field guide to Leinster's Geology by Chris Stillman and George Sevastopulo is still in print through Dunedin Academic Press.

There is scope for guides at different levels of detail and accessibility to non-specialists. A wide range of leaflets, booklets, books and other media are all feasible, but the research and production of appropriate text and images is a difficult task to do well without appropriate experience, and adequate time and resources. **It is suggested that with only modest editing and reorganisation the main content of this report would distil into a good general guide to the geological heritage of County Wicklow, in a broadly similar style to those books produced for Sligo, Meath, Fingal, Waterford, Roscommon and Clare following audits in those counties.**

Signboards
Simple explanatory or interpretive signboards may be advisable at key geological heritage locations, but if these are considered, their locations and individual siting should be very selective, since a proliferation of different interest groups may provoke a 'rash' of panels all over the county. The Planning Section should clearly have a controlling input, in conjunction with the Heritage Office. It is most likely that a panel combining various heritage interests at a place is preferred to single interest panels. It is important to consult with potential partners in the planning stage so that duplication does not occur.

The successful integration of text and graphics on information panels is a fine art, and the IGH Programme can offer input if signs are planned for key visitor localities. The authors of this report are also able to write, review or provide content on geological heritage for any proposed panels.

It is believed that there will soon be some explanatory signs installed at both Glendasan and Glendalough through co-operation between the National Parks and Wildlife Service (NPWS) and the Glens of Lead Project, representing the local mining heritage community. Both sites are in areas that require some simple explanation for visitors, who currently are left no wiser in passing the ruins and spoil heaps.

Museum exhibitions
As a result of the work to produce this report, the material for a panel based exhibition has been largely compiled. With some extra research covering human dependence on geology and resources, an interesting exhibition can be put together for display in the Wicklow County Council Offices, County Library branches or other venues. The model followed was that used for Carlow, Dun Laoghaire-Rathdown and Waterford. Images of those and other similar ones can be seen on the Geological Heritage/Exhibitions section of the GSI website http://www.gsi.ie/Programmes/Heritage+and+Planning/Public+Outreach+and+Education/

New media
There are increasing numbers of examples of new methods of promoting Earth Sciences, via mobile phone applications and other electronic media. Self-guiding apps on specific sites would be one of these, such as those produced by Ingenious Ireland for Dublin city geology and the recently launched app for tourists in the Burren and Cliffs of Moher Geopark. Plans for such products would require some considerable effort to produce and imagination to link sites across the county in coherent ways.

Earth Science Ireland Group and magazine [www.earthscienceireland.org]
The group Earth Science Ireland is an all-Ireland group promoting awareness of Earth sciences and supporting educational provision in the subject. A main vehicle for the efforts is the twice a year magazine *Earth Science Ireland* and this is distributed free to thousands

of individuals, schools, museums, centres and organisations. The editors would welcome more material from the Republic of Ireland and on Wicklow's geological heritage. It is anticipated by the authors of this report that they will contribute a summary article distilled from the audit report.

Geoschol website [www.geoschol.com]
Geoschol is an educational project, now essentially represented by a website, which was largely aimed at producing educational materials on geology for primary schools. A four page pdf summarising the geology and some highlights of Wicklow is already part of the available material (see Appendix 6). Working links to the *Our Wicklow Heritage* website and the Wicklow Heritage Forum's Facebook page, as well as to other heritage websites, should be established.

Geological Heritage Research Archive
If the Heritage Officer wanted to do something similar to that produced in the Burren and Cliffs of Moher Geopark, with downloadable (or links to) free access papers, then a lot of groundwork is already provided by the reference lists in this audit. Making available technical references of direct relevance to Wicklow geology and geomorphology will assist many users and researchers into the future.

Maps
A series of popular maps of the Wicklow Mountains produced by East West Mapping at a scale of 1:30,000 have been very innovative in taking the geological heritage site data from GSI and including it on the maps. This has been as point data. The completion of the audit will allow future editions of these maps to have more accurate data, with rejected sites removed, new sites added and area definitions if desired. It is hopefully a data layer that might also be adopted by the Ordnance Survey of Ireland in their future map editions of the 1:50,000 Discovery Series, for all counties where an audit has been completed. Similarly a Dublin Mountains Partnership map of the Dublin-Wicklow hills could also be improved in future editions by adding geological heritage site data.

A summary of the Geology of Wicklow

AGE *(Million Years Ago)*	***ERA***	***PERIOD***	***EVENTS IN WICKLOW***	***IF THIS TIMESCALE WERE A DAY LONG …***
2.6	Cenozoic	Quaternary	Several ice ages smothering Wicklow, followed in the last 10,000 years by the spread of vegetation, growth of bogs and arrival of humans. Sculpting of corries and U-shaped valleys in the Wicklow mountains. Meltwater sculpts deep channels and deposits sands and gravels during deglaciation.	The ice ages would begin 38 seconds before midnight
66		*Tertiary*	*Erosion, weathering of rocks and denudation of land surface.* *No record of rocks of this age in Wicklow.*	The Tertiary period begins at 11.40 pm
145	Mezozoic	*Cretaceous*	*Erosion.* *No record of rocks of this age in Wicklow.*	11.15 pm
201		*Jurassic*	*Uplift and erosion.* *No record of rocks of this age in Wicklow.*	The age of the dinosaurs, starting at 10.55 pm
252		*Triassic*	*Desert conditions on land.* *No record of rocks of this age in Wicklow.*	10.42 pm
298	Palaeozoic	*Permian*		10.30 pm
359		*Carboniferous*	*Land became submerged, limestones with some shales and sandstones deposited in tropical seas across much of Ireland.* *No record of rocks of this age in Wicklow.*	Inundation of land by sea around 10.10 pm
419		Devonian	Caledonian mountain building. Leinster Batholith Granite intruded, forming Wicklow Mountains.	Granite intruded into Wicklow, at 9.52 pm
443		Silurian	Shallow seas, following closure of the Iapetus Ocean. Slates, greywacke and shales deposited along eastern extreme of Wicklow.	Starts at 9.42 pm
485		Ordovician	Slates, siltstones and volcanic rocks form across much of southern and eastern Wicklow, as well as portions along the Glen of Imaal.	Begins at 9.28 pm
541		Cambrian	Opening of the Iapetus Ocean. Greywackes and quartzites formed between Bray Head and Roundwood.	Starts at 9.11 pm
2500	Proterozoic	*Precambrian*	*Some of Irelands oldest rocks deposited in Mayo and Sligo.*	Beginning 11.00 am
4000	Archaean		*Oldest known rocks on Earth.*	Beginning 3.00 am
4600			*Age of the Earth.*	Beginning 1 second after midnight

The Geological Timescale and County Wicklow

Simple summary

The bedrock geology of Wicklow can be broadly subdivided into five units. The most distinctive unit in the county is the **Leinster Granite**, a large granite batholith intruded around 405 million years ago into a succession of Lower Palaeozoic sedimentary and volcanic rocks. The granite underlies much of the Wicklow Mountains. The oldest rocks in Wicklow, of Cambrian age, 541 to 485 million years old (Ma), comprise the **Bray Group**, a thick sequence of greywackes and quartzites that crop out between Bray Head and Ashford. The quartzites are hard rocks, resistant to weathering, and form prominent hills including the Great Sugarloaf and Little Sugarloaf. Ordovician (443—485 Ma) slates, mudstones and siltstones form the succeeding **Ribband Group**, so-called because of the distinctive colour-banded or striped appearance of many of these fine-grained lithologies. The Ribband Group underlies much of the eastern part of the county but also crops out in west and northwest Wicklow. The **Duncannon Group** comprises a northeast—southwest-trending belt of volcanic rocks in east Wicklow, 2—4 km wide and 15 km long, centred on Avoca. The Silurian (419—443 Ma) **Kilcullen Group**, a sequence of greywackes, siltstones and shales, crops out only in west Wicklow, between Brittas and Baltinglass.

These Lower Palaeozoic sedimentary rocks of Wicklow were deposited on the seafloor of the ancient Iapetus Ocean. The Iapetus, a deep ocean, lay between two continents, one to the north comprising rocks that today underlie Scotland, north America and the north of Ireland, the other, to the south, incorporating the rest of Ireland, England, Wales and Europe. The Iapetus Ocean filled with clastic sediments derived from the weathering of the continental landmass that lay to the northwest and southeast. The Bray Group rocks are proximal turbidites, deposited close to the margin of the ocean. The finer-grained Ribband Group rocks were deposited as muds and silts in the deeper part of the ocean. The Iapetus Ocean began to close during the Ordovician as a consequence of plate tectonic movements that led to subduction of the ocean floor beneath the continents. This led in turn to the development of volcanic arcs along the continental margins and within the ocean. Volcanic rocks that comprise most of the Duncannon Group around Avoca are the remnants in Wicklow of these volcanic arcs. The youngest sediments in the county, the Kilcullen Group, are also turbidites, deposited on the margin of the closing ocean.

As the ocean gradually closed between the Ordovician and the end of the Silurian, the opposing continents eventually collided, leading to the Caledonian orogeny, an event that had a profound effect on the geology of Ireland. The orogeny was an extended period of mountain building that involved intrusion of granite into the continental crust as well as widespread, intense deformation and metamorphism of the existing Lower Palaeozoic rocks. In Wicklow, the Leinster Granite, the largest granite batholith in Ireland or Britain, is the most obvious product of this orogenic event. Deformation gave rise to compression of the Lower Palaeozoic sedimentary and volcanic rocks, evident today in the intense cleavage present in most of these rocks and in the small- and large-scale folding visible throughout the county.

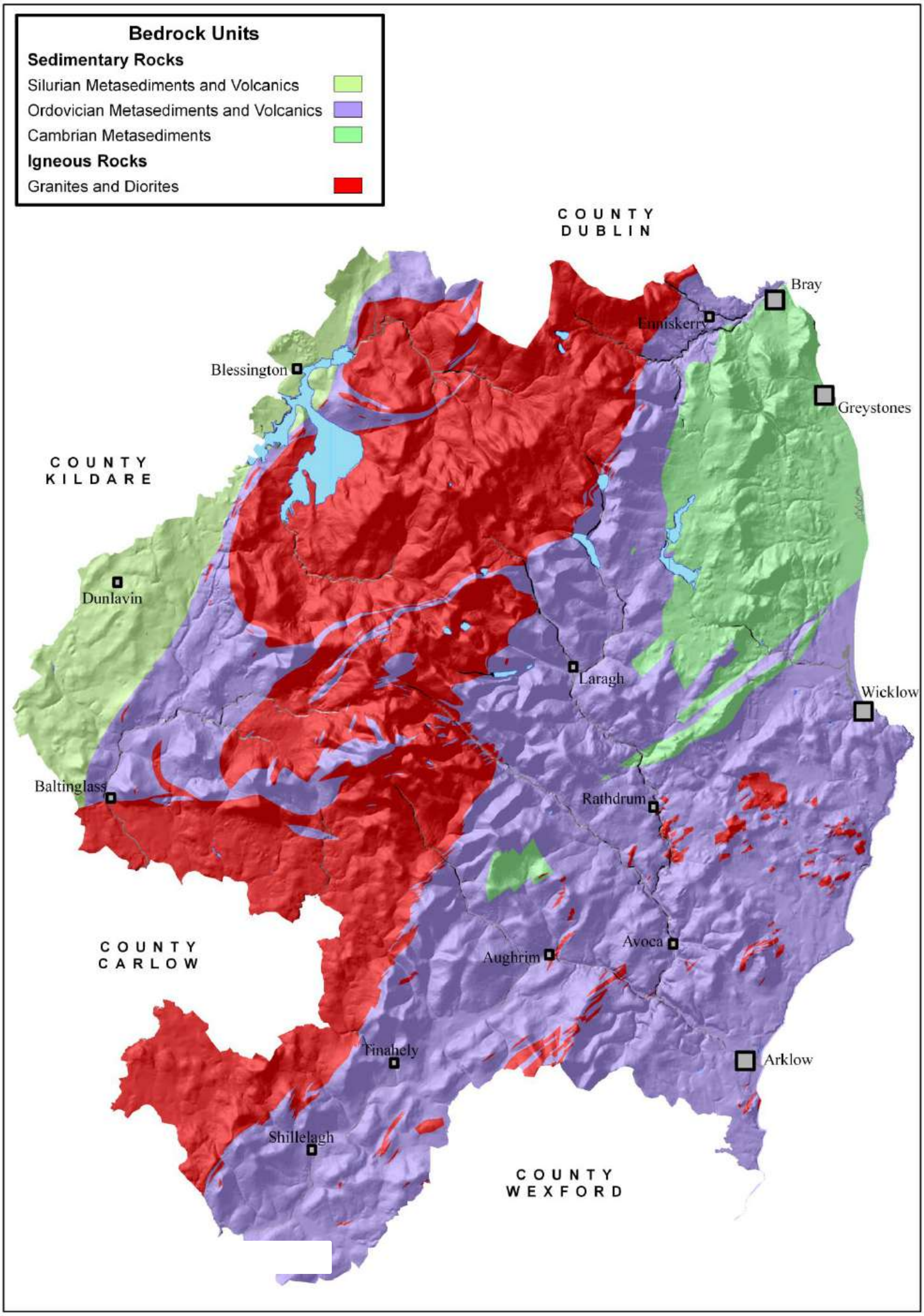
Apart from the Leinster Granite, Wicklow is notable for the variety and abundance of its igneous intrusions. These include a suite of minor granites intruded contemporaneously with and along the margin of the Leinster Granite. There is also a suite of diorites (410 Ma), centred on Carrigmore east of Rathdrum. Some ultrabasic rocks called appinites are intruded into the Lower Palaeozoic rocks around the margin of the Leinster Granite. In addition significant thicknesses of intermediate (50-70% SiO_2) volcanic rocks called andesite, are notable in west Wicklow around Slieve Donard and Dowery Hill, produced by volcanism contemporaneous with Leinster Granite intrusion. There also dolerites, intruded as dykes or large sills into the Lower Palaeozoic succession, e.g. Arklow Rock; and the Croghan Kinshelagh granite (454 Ma), an Ordovician granite intruded at the end of the Avoca volcanic belt with which it shares a similar chemistry and likely origin.

The 400 million year period following the Caledonian orogeny (Carboniferous through to the Tertiary) is not represented in the bedrock of Wicklow due to erosion.

The Pleistocene Period or Ice Age began 2 million years ago and several cold periods interspersed with warm periods saw glaciers form in the Wicklow Mountains and sculpt out superb features like Glendalough, Glenmalure and Glenmacnass, as well as corries like Lough Ouler and Lough Bray. The rock they ground down was deposited as till in thick blankets over much lower ground on the flanks of the mountains.

The ice sheet which covered Wicklow had a complex flow pattern which radiated out from the centre of the mountains in general. Only the highest peaks stuck up above the ice, such as Mullaghcleevaun and Lugnaquilla, since the ice was about 1km thick.

Since the Ice Age, during the Holocene, the modern drainage pattern was superimposed on the deglacial channel network, meaning there are some areas of haphazard drainage among the boulder clay and these are best developed along the Kings River. At this time peat also formed across much of the Wicklow Mountains. During this time along the coast, headlands, bays and cliffs, have been eroded by the sea, while beaches, bars, spits, lagoons and windblown sand dunes have formed.



A simplified geology map of Wicklow outlining the main geological units.

Geological heritage versus geological hazards

Ireland is generally considered to be a country with very low risk of major geological hazards: there are no active volcanoes, Ireland's location on stable tectonic plates mean earthquakes are relatively rare and its recorded human history is not peppered with disastrous landslides, mudflows or other geological catastrophes. There are of course risks of one-off events, and this section briefly looks at the specific record and nature of geological hazards in Wicklow and the relationship of the County Geological Sites to those hazards.

The difference between human timescales and geological timescales can be difficult to comprehend but, for many geological processes, there are periods of sudden activity encompassing major events, and then quiet periods in between. The sites in this audit represent evidence of past geological environments and processes, such as the building of high mountain chains, deep intrusion of massive granite bodies, volcanic eruption, glacier erosion of the land surface and so on. However, a few sites represent the active geomorphological or land-forming processes of today. These sites are generally coastal in or riverine in Wicklow. They are dynamic environments and can be subject to constant or intermittent, sometimes sudden, change.

Landslides and bog flows
The Geological Survey of Ireland has been compiling national data on landslides in the past decade. There are some 429 for Wicklow.
http://spatial.dcenr.gov.ie/GeologicalSurvey/LandslidesViewer/index.html

Flooding
There are two types of flooding which need consideration.

River flooding occurs inland when the rainfall exceeds the capacity of the ground to absorb moisture, and the river channels cannot adequately discharge it to the sea. The OPW website, www.floods.ie, can be consulted for details of individual flood events in County Wicklow. Some 117 events are recorded across the entire county. Some of these are recurring events in urban settings where rainfall exceeds the capacity of the local drains. Karstic flooding can occur when underground passages are unable to absorb high rainfall events. There is no Carboniferous limestone bedrock in County Wicklow, and hence there is no karstification, and none of these type of flood occurrences.

Groundwater pollution
Whilst not such an obvious hazard as physical collapses, flooding and landslides, the pollution of groundwater supplies carries a serious risk to human health. Large groundwater supplies require Source Protection Plans, which are delineated for them by the GSI and the EPA.

Sea level rise, coastal erosion and sedimentation
Geological heritage sites in coastal areas may be particularly vulnerable to wave erosion. The joint hazards of gradual sea level rise and high waves caused by increasing storminess need to be considered in any promotion of coastal geological heritage sites and in future planning. It should be remembered that coasts are dynamic geological environments, with changes to be expected in both erosion and deposition as normal features. Certainly, small changes to coastal situations, like building cliff defences for railway tracks or groynes for

sedimentation traps can have very rapid effects, with impacts further along a coast when such changes are made.

Radon

Radioactive minerals and gases at higher concentrations can be carcinogenic. Radon can seep into homes and workplaces and can be carried in water supplies. A map showing the areas predicted to be at particular risk from radon in Ireland, called High Radon Areas, can be seen on the EPA website at http://www.epa.ie/radiation/#.VRu9OVROPcs. The Radiological Protection Institute of Ireland was formerly responsible for this but has been merged with the EPA.

Glossary of geological terms

Geological term	Definition
Actinolite	a common rock forming silicate mineral in metamorphic rocks, asbestos is a fibrous form of the mineral
Adit	a horizontal or only gently inclined mine tunnel dug to access coal or mineral ore, or to drain, ventilate or further develop a mine.
Alluvial Deposit	unconsolidated clay, silt, sand and gravel, deposited by a body of running water.
Alluvial Fan	a fan-shaped deposit formed where a fast flowing river levels out and slows, typically from the mountain foot onto the plain.
Alluvium	a term for unconsolidated clay, silt, sand and gravel, deposited by a body of running water.
Aplite	a fine to medium-grained igneous rock found as veins within coarser-grained plutonic igneous rocks.
Appinite	plutonic igneous rock formed from hydrous magma of mantle origin, dioritic in composition, i.e. rich in hornblende, also containing plagioclase feldspar and/or alkali feldspar, with or without quartz; typically associated with breccia pipes in Donegal
Batholith	large igneous intrusion (100 km² or more)
Beach	a landform along the coast of an ocean, sea, lake, or river which consists of loose particles, often composed of rock, such as sand, gravel, shingle, pebbles, or cobbles.
Bedrock	a general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material.
Blanket Bogs	bog covering a large, fairly horizontal area, which depends on high rainfall or high humidity, rather than local water sources for its supply of moisture.
Bluff	a steep cliff or escarpment
Borehole	a narrow shaft bored in the ground, usually vertically, which is used for the extraction of water, gas or hydrocarbon.
Boulder Clay	unconsolidated, unsorted glacial deposits consisting of boulders and cobbles mixed with very finely ground-up rock or silt. Also known as till.
Braided River	a river that consists of a network of small channels separated by small and often temporary islands called braid bars.
Calcareous	containing significant calcium carbonate.
Caledonian	relates to Caledonian orogeny that took place towards the end of the Lower Palaeozoic era, affecting Ireland, Scotland, Scandinavia and Greenland
Carbonate	a rock (or mineral), most commonly limestone (calcite) and dolomite.
Cave	a natural underground space large enough for a human to enter, which is usually formed in either soluble limestone by karstic processes, or in exposed rock along the coastline, where the sea erodes natural rock fractures
Channel	a landform consisting of the outline of a path of relatively shallow and narrow body of fluid, most commonly the confine of a river,river delta or strait.
Clast	an individual constituent, grain or fragment of a sediment or rock, usually produced by mechanical weathering (disintegration) of a larger rock mass.
Cleavage	a flat plane of breakage caused by compressive deformation of rocks. e.g. the splitting of slate.
Corrie	a horseshoe-shaped, steep-walled valley formed by glacial erosion.
Crag and tail	a steep resistant rock mass (crag), with sloping softer sediments (tail) protected from glacial erosion or deposited as glacial debris on the crag's 'downstream' side.
Cross-bedding	layering in sedimentary rocks at an inclined angle to bedding formed by current-ripples.
Crust	the outermost, solid, layer of the Earth.

Delta	a low, nearly flat alluvial tract of land at or near the mouth of a river, commonly forming a fan or triangular shaped plain of considerable area, which is crossed by many smaller channels of the main river. Glacial deltas are formed by meltwater in a similar fashion, at the edge of glacial lakes.
Dimension stone	stone that is quarried and cut to specific shapes and sizes
Dip/dipping	when sedimentary strata are not horizontal they are dipping in a direction and the angle between horizontal and the inclined plane is measured as the dip of the strata or beds
Diorite	a grey to dark-grey intrusive igneous rock composed principally of plagioclase
Dune	a mound or ridge of drifted sand, occurring along the sea coast or in deserts.
Dyke	a sub-vertical sheet-like igneous intrusion, typically in-filling a fracture in the earth's crust
Erratic	a rock fragment carried far from its source area by glacial ice.
Erratic	a large rock fragment that has been transported, usually by ice, and deposited some distance from its source. It therefore generally differs from the underlying bedrock, the name "erratic" referring to the errant location of such boulders. Tracing their source can yield important information about glacial movements.
Esker	an elongated ridge of stratified sand and gravel which was deposited in a subglacial channel by meltwaters. Eskers are frequently several kilometres in length.
Extrusive	an igneous body emplaced (erupted) at the Earth's surface as lava.
Fan	a usually triangular deposit of sand and gravel deposited by a glacial stream, either under a lake or under air.
Fault	planar fracture in rocks across which there has been some displacement or movement
Fault Zone	a tabular volume containing many faults and fault rocks (rocks broken up by fault movement).
Floodplain	a flat or nearly flat land area adjacent to a stream or river that experiences occasional or periodic flooding.
Fluvial	pertaining to a river or stream.
Fold(ing)	flexure in layered rocks caused by compression.
Formation	a formal term for a sequence of related rock types differing significantly from adjacent sequences
Fossiliferous	rich in fossils.
Fossils	any remains, trace or imprint of a plant or animal that has been preserved in the Earth's crust since some past geological or prehistorical time.
Glacial	of or relating to the presence and activities of ice or glaciers.
Glacial striae	markings left on the surface of pebbles / boulders / bedrock by moving ice sheets.
Glaciofluvial	pertaining to the meltwater streams flowing from wasting glacier ice and especially to the deposits and landforms produced by such streams.
Glaciomarine	sediment, which originated in glaciated land areas and has been transported to the oceans by glaciers or icebergs.
Grading	a sorting effect with the coarsest material at the base of the bed and finest grained material at the top.
Granite	a coarsely crystalline intrusive igneous rock composed mostly of quartz and feldspar.
Graptolite	extinct colonial pelagic organism, particularly important in dating Ordovician and Silurian rocks.
Greywacke	dark grey, poorly sorted sandstone with more than 15% clay content.
Greywacke	an impure sandstone, characterised by poorly-sorted, angular grains in a muddy matrix, that was deposited rapidly by turbidity currents (submarine avalanches).
Grike	a solutionally widened vertical fracture separating clints on a limestone pavement.
Grus	crumbled granite sand formed by weathering
Gully	a deep valley created by running water eroding sharply into bedrock or subsoil
Haematite (Hematite)	a mineral form of iron oxide, which is the main ore mined as iron

Hornblende	hydrous (OH-bearing) silicate mineral containing Ca, Fe and Mg as major components
Hornfels/hornfelsed	contact metamorphosed rock, i.e. baked by heat of an igneous intrusion; hard and sometimes splintery, depending on original rock type
Hummock	a small hill or knoll in the landscape, which may be formed by many different processes.
Ice margin	the edge of an ice sheet or glacier
Igneous	a rock or mineral that solidified from molten or partially molten material i.e. from a magma.
Interglacial	the time interval between glacial stages, or pertaining to this time
Irish Sea Till	clay-rich till found along the eastern seaboard of Ireland, and occurring as much as 12km inland, which was deposited by an ice stream which occupied the Irish Sea Basin during the last glaciation.
Laminated	extremely fine stratification or bedding, typically exhibited by shales and fine-grained sandstones.
Lamprophyre	uncommon, basic or ultrabasic potassium-rich igneous rocks occurring typically as dykes and small intrusions
Limestone	a sedimentary rock consisting chiefly of calcium carbonate ($CaCO_3$), primarily in the form of the mineral calcite.
Lithology	the description of rocks on the basis of such characteristics as colour, composition and grain size.
Lodgement	process by which debris is released from the sliding base of a moving glacier/ice sheet and plastered or 'lodged' onto the glacier bed; also describes tills emplaced by this process (i.e. lodgement till).
Magma	molten rock, which cools to form igneous rocks.
Meander	a bend in a sinuous watercourse or river which forms when moving water in a stream erodes the outer banks and widens its valley, and the inner part of the river has less energy and deposits fine sediment.
Melt-out	process by which glacial debris is very slowly released from ice that is not sliding or deforming internally; also describes tills emplaced by this process (i.e. melt-out till).
Meltwater	water from melted snow or ice.
Meltwater channel	a channel cut by glacial meltwater, either under, along or in front of an ice margin.
Metamorphic	referring to the process of metamorphism or to the resulting metamorphic rock, transformed by heat and pressure from an originally igneous or sedimentary rock.
Metamorphic aureole	zone of country rock, in contact with an igneous intrusion, which has undergone metamorphism due to the heat of the intruding magma.
Metasediments	metamorphosed sediments.
Micaceous	rich in mica (shiny, flaky silicate minerals).
Microgranite	Medium-grained granite in which crystals are somewhat smaller than those typical of granite, indicating more rapid cooling of the magma
Misfit stream	a stream which is too small to have eroded the valley in which it flows, as is often the case with streams now flowing in meltwater channels.
Moraine	any glacially formed accumulation of unconsolidated debris, in glaciated regions, such as during an ice age.
Nunatak	an exposed, often rocky element of a ridge, mountain, or peak not covered with ice or snow poking up above an ice sheet or glacier.
Olivine	a green, magnesium iron silicate mineral, commonly found in mafic and ultramafic rocks from the Mantle or deep crust of the Earth
Ore	a mineral which is concentrated enough to be exploited by mining
Orogeny	the creation of a mountain belt as a result of tectonic activity.
Outcrop	part of a geologic formation or structure that appears at the surface of the Earth.
Outlier	area of younger bedrock completely surrounded by older bedrock
Oxbow lake	a U-shaped body of water that forms when a wide meander from the main stem of a river is cut off, creating a free-standing body of water

Peat hag	solitary banks of peat standing proud of surrounding areas of eroded and removed peat
Pegmatite	a very coarse-grained igneous rock of granitic composition.
Peridotite	dominant igneous rock type of the Earth's Mantle, composed of olivine and pyroxene
Periglacial	very cold but non-glacial climatic conditions
Phyllite	a foliated pelite.
Pingo	a landform formed when ground ice which developed during the freezing winter months as temperatures fall, following glaciation, was raised up as a circular mound of earth.
Plagioclase	a very common rock forming silicate mineral in many igneous and metamorphic rocks
Plate Tectonics	a theory that states that the crust is divided up into a number of plates, whose pattern of horizontal movement is controlled by the interaction of these plates at their boundaries with one another.
Plutonic	originating at great depth.
Pseudomorph	a mineral that replaces another but retains the form (morphology) of the original
Pyroxene	a group of minerals, of common rock forming occurrence in igneous and metamorphic rock types, especially mafic and ultramafic types
Quartz	the second most abundant mineral in the earth's crust, composed of silicon and oxygen (SiO_2).
Quartzite	a hard, metamorphosed sandstone, composed mostly of recrystallised quartz grains that are tightly interlocking. Quartzite is formed through heat and pressure usually related to tectonic compression.
Raft	large body of country rock entrained in an igneous body, such as a granite, during intrusion of the igneous rock, now visible as an isolated body separated from its original surroundings
Ravine	a steep-sided, deep gorge
Raised Bogs	an area of acid, peaty soil, in which the centre is relatively higher than the margins.
Regression	a recession of the sea from a land area.
Ribbon lake	a long, narrow and deep, lake occupying the floor of a U-shaped glacial valley
Sandstone	a fine to coarse sedimentary rock, deposited by water or wind, and composed of fragments of sand (quartz grains), cemented together by quartz or other minerals.
Sandur	a plain formed of glacial sediments deposited by meltwater outwash at the terminus of a glacier
Schist	a metamorphic rock exhibiting a foliation defined by the preferred alignment of tabular minerals.
Schistosity	planar alignment of platy minerals in metamorphic rocks in response to pressure, giving rise to a strong planar fabric throughout the rock
Scree	loose debris or talus deposits comprising angular stones and boulders
Semipelite	metamorphosed siltstone
Shaft	a vertical or inclined hole dug in a mine for access, ventilation, for hauling ore out or for pumping water out.
Shale	A fine-grained sedimentary rock, formed by the compaction and lithification of clay, silt, or mud. It has a finely laminated (composed of layers) structure that gives it a fissility, or tendency to split along bedding planes.
Shelf	part of the continental rising that is between the shoreline and the continental slope.
Siltstone	is similar to mudstone but with a predominance of silt sized (slightly coarser) particles.
Slate	is a fine-grained metamorphic rock produced from a sedimentary mudstone by pressure, imposing a cleavage along which the slate easily splits.
Spinel	non-silicate mineral consisting typically of various elements, including Mg, Fe, Mn, Cr, etc., in combination with Al and O; the spinel series includes magnetite and chromite
Spring	the point where an underground stream reaches the surface.

Stratiform	occurring as a bed or beds, arranged in strata
Stromatolites	an algal deposit usually found in shallow water.
Subduction	the sinking of one crustal plate beneath the edge of another through the process of plate tectonics.
Talc	Mg-rich platy or sheet-like mineral (phyllosilicate), with the lowest hardness (1) on the standard Mohs scale (1-10) of hardness.
Terrace	terraces are remnants of the former floodplain of a stream of river, formed by the downcutting of a river or stream channel into and the abandonment and lateral erosion of its former floodplain
Terrigenous	something derived from the land or continent.
Till	unconsolidated, unsorted glacial deposits consisting of boulders and cobbles mixed with very finely ground-up rock as sand, silt or clay.
Tor	a large, free-standing rock outcrop that rises abruptly from the surrounding smooth and gentle slopes of a rounded hill summit or ridge crest
Trilobites	extinct arthropods.
U-shaped valley	also known as a glacial trough, this is formed by the process of glaciation and has a characteristic *U* shape, with steep, straight sides and a flat bottom. Glaciated valleys are formed when a glacier travels across and down a slope, carving the valley by the action of scouring.
Vein quartz	white thin veins of quartz injected in rock fractures during episodes of stress. Also found as durable beach pebbles, once it has been eroded.
Volcanic Rock	any rock produced from volcanic material, e.g. ash, lava.
Waterfall	a place where water flows over a vertical drop in the course of a stream or river

Data sources on the geology of County Wicklow

This section is a brief summary of relevant GSI datasets, to assist any enquiry concerning geology and to target possible information easily. The GSI has very many datasets, accumulated since it began mapping Ireland's geology in 1845. A Document Management System (DMS) is freely available to any person at the GSI Customer Centre, into which about half a million documents and maps have been scanned. This means that any user can visit the GSI Customer Centre themselves and search on screen for data of relevance to them. High quality colour and black and white print-outs can be made or data supplied on CD, or via USB keys etc. **Data is available free of charge**. It is planned to make this resource available online within the next few years, although many subsets are already available within existing online data sets.

Key datasets include:

1:100,000 Map Report Series
All historical, modern and other mapping has been compiled into very useful maps and reports that describe the geology of the entire country. Sheets 16 and 19 cover Wicklow.

19th century 6 inch to the mile fieldsheets
These provide an important historical and current resource, with very detailed observations of the geology of the entire country.

19th century one inch maps and Memoirs
Information from the detailed 19th century mapping was distilled into one inch to the mile maps, of which parts of Sheets 120, 121, 129, 130, 138, 139 and 148 cover County Wicklow. Each sheet or several sheets were accompanied by a Memoir which described the geology of that area in some detail. These still provide valuable records of observations even though interpretations may have changed with better geological understanding. Memoirs are in the Customer Centre library and scanned on the DMS.

Historical geological mapping is now available via a website:
http://www.geologicalmaps.net/irishhistmaps/history.cfm

Open File Data
Each Mineral Prospecting Licence issued by the Exploration and Mining Division (EMD), currently of the Department of Communications, Energy and Natural Resources, carries an obligation on the exploration company to lodge records of the work undertaken, for the common good. These records are held by the Geological Survey and are available as Open File Data, once a period of time has expired. They may include geological interpretations, borehole logs, geophysical and geochemical surveys and so on. Licences relate to numbered prospecting areas, and these are available on a map from EMD. See also www.mineralsireland.ie

MinLocs Data
The MinLocs Database records all known mineral occurrences, however small, from GSI records, such as 19th century fieldsheets and Open File data.

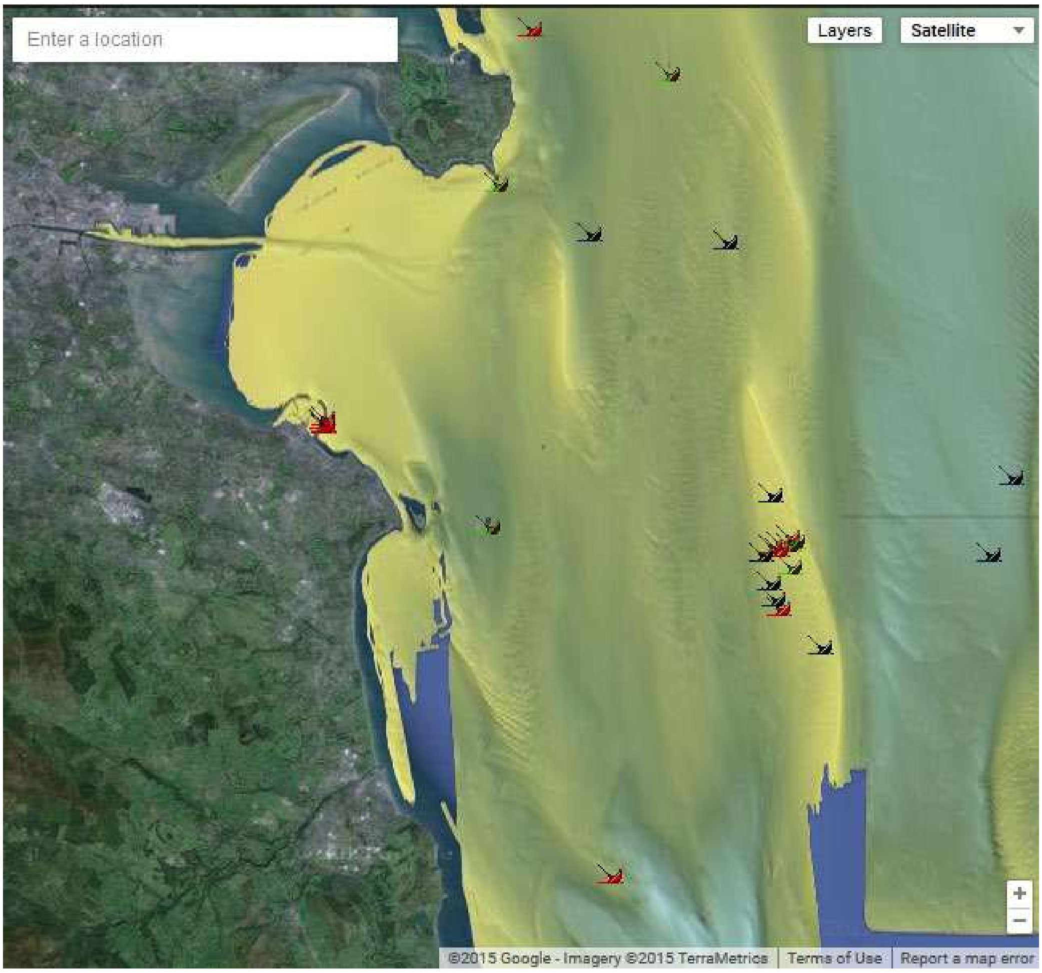
Historic Mine Records
Abandonment plans and varied other material exists for the various mining ventures in the county, including those 19th century lead mines in the Glendalough, Glendasan and

Glenmalure valleys as well as the more modern phases of copper mining at Avoca. Some lesser mining enterprises such as Cloghleagh have very little in the official GSI record.

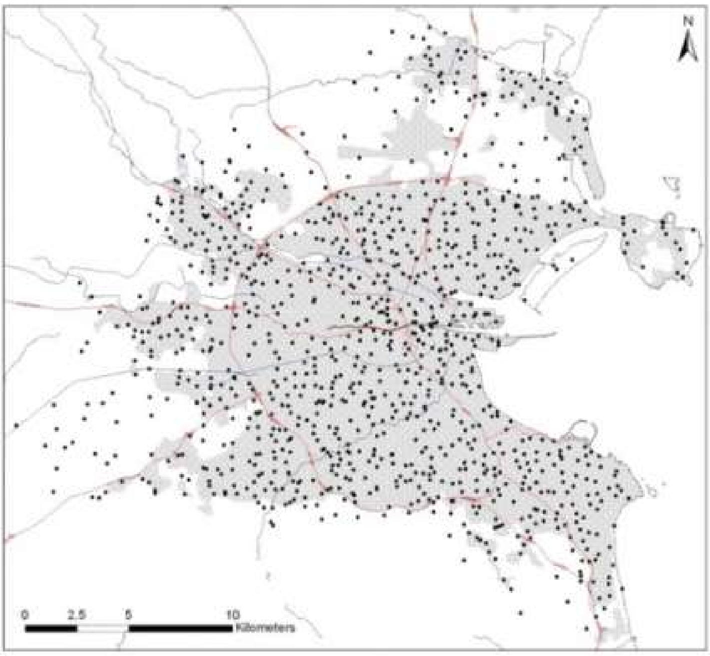
Subsoils Mapping
Since a Groundwater Protection Scheme has been completed by GSI (2012) for the entire country, a modern map of the subsoil types and depths across Wicklow exists, as well as the previously completed bedrock mapping. This provides a significant resource in general terms as well as for groundwater protection. Customised output is possible. Furthermore, detailed compilation of glacial geology datasets will provide more data from late 2014 onwards.

Digital mapping of many different datasets is now available via an easy to use public viewer on the GSI website: www.gsi.ie

Infomar data
The Infomar Programme in the GSI is mapping the seabed in targeted areas of the inshore coast of Ireland. The graphic below shows offshore in Dublin Bay, with some of the many wrecks identified by the survey. Infomar data is freely available for analysis and further processing from the Infomar data via the GSI website.
http://www.gsi.ie/Programmes/INFOMAR+Marine+Survey/
See also www.informar.ie



Dublin SURGE Project (Soil Urban Geochemistry)
GSI has carried out a chemical survey of the topsoil around Dublin city and county in 2012. It involved taking and analysing samples of soil from areas that are publicly accessible (e.g. public parks and school grounds). The aim of the survey was to acquire important information about Dublin soils that will help to better manage the environment.
See https://www.gsi.ie/Surge.htm



Shortlist of Key Geological References

This reference list includes a few **key** papers, books and articles on the geology and geomorphology of Wicklow that are recommended as access points to Wicklow's fabulous geological heritage.

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Full Geological references

See Appendix 2 for the full reference list of all papers, books, articles and some unpublished reports etc relating to the geology and geomorphology of Wicklow that could be traced.

Mining heritage references

Appendix 2 includes some references specifically pertaining to the mining heritage of County Wicklow. Assistance with locating these references may be provided by the Mining Heritage Trust of Ireland if required.

Quaternary References

The references in Appendix 3 all cover the Quaternary, or Ice Age, geology of Wicklow. They are split into references specifically covering sites or features in Wicklow, and a section of national or regional papers which have some data from or on Wicklow included.

Further sources of information and contacts

Sarah Gatley of the Geological Survey of Ireland, who is the Head of the Geological Heritage and Planning Programme, can be contacted in relation to any aspect of this report. Deirdre Burns, the Heritage Officer of Wicklow County Council is the primary local contact for further information in relation to this report. Other contacts include the Conservation Rangers of the National Parks and Wildlife Service, currently in the Department of Arts, Heritage and the Gaeltacht. The names and phone numbers of current staff may be found in the phone book, or at www.npws.ie.

Web sites of interest

www.gsi.ie - for general geological resources
www.geology.ie – the website of the Irish Geological Association who run fieldtrips and lectures for members, including many amateur enthusiasts
www.earthscienceireland.org - for general geological information of wide interest
http://www.iqua.ie - for information, fieldtrips, lectures etc in relation to Ireland's Ice Age history
http://www.progeo.se/ - for information about ProGEO the European Association for the Conservation of Geological Heritage

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Appendix 1 – Geological heritage audits and the planning process

This appendix contains more detail on the legal framework behind geological heritage audits conducted by County Councils, and the process which operates as a partnership between the Geological Heritage and Planning Programme of the GSI and the local authority Heritage Officer.

Geology is now recognised as an intrinsic component of natural heritage in three separate pieces of legislation or regulations, which empower and require various branches of Government, and statutory agencies, to consult and take due regard for conservation of geological heritage features: the Planning and Development Act 2000 [*e.g*. Sections 212 (1)f; Part IV, 6; First Schedule Condition 21], the Planning and Development Regulations 2001, the Wildlife (Amendment) Act 2000 (enabling Natural Heritage Areas) and the Heritage Act 1995. The Planning and Development Act 2000 and the Planning Regulations, in particular, place responsibility upon Local Authorities to ensure that geological heritage is protected. Implementation of the Heritage Act 1995, through Heritage Officers and Heritage Plans, and the National Heritage Plan 2002, allow County Geological Sites to be integrated into County Development Plans.

The chart below illustrates the essential process, established by the Irish Geological Heritage Programme in GSI, over the course of numerous county audits since 2004.

County Geological Sites - a step by step guide

Commission and delivery of an audit of geological heritage sites within the Local Authority area

This is normally an objective in the County Heritage Plan, and is achieved with funding from the Heritage Council, the Local Authority and the Geological Survey of Ireland. The result is a report with proposals for County Geological Sites (CGS)

Integration of County Geological Sites into Planning System

This is normally the task of the Heritage Officer to communicate the results of the audit of County Geological Sites to colleagues within the Planning Department and the Local Authority generally, so that they can be used immediately for informal guidance

Integration of County Geological Sites into County Development Plan on its revision cycle

The IGH Programme recommends that the Planning Department of the Local Authority proposes the list of recommended County Geological Sites for inclusion in the County Development Plan on its next normal cycle of revision. The CGS list may be subject to amendment based on planning advice, community representation and public input to the Draft Plan, as well as Councillor's decisions during the adoption process

County Geological Sites and Natural Heritage Areas

Some CGS may have been coincident with existing pNHA layers in the Planning Department GIS. As the Geological Survey of Ireland IGH work programme progresses, recommendations for geological NHAs will be made to the National Parks and Wildlife Service. The Planning Department may then receive notification of new NHAs which include some of the CGS sites which will then receive statutory protection as NHAs

Promotion of County Geological Sites

The Heritage Officer supported by colleagues, GSI etc can promote educational, research and amenity use of CGS

Consultation on County Geological Sites

If any planning application is received which affects a CGS, the GSI should be routinely consulted as a prescribed body

Appendix 2 - Bibliography – Geology of County Wicklow

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Appendix 3 - Bibliography – County Wicklow Quaternary References

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Appendix 4 – Rejected sites

A range of sites had been previously flagged for consideration in the IGH Master site list, and some were assessed as unsuitable for County Geological Site status in this audit. Similarly a range of additional sites were assessed in the audit, based on the authors' expert knowledge of County Wicklow's geology and mining heritage, and especially in the main mountain area. It was known, for example, that some quarry localities had not been adequately considered in the preparation of the IGH Master site list. Other sites were visited on spec during fieldwork. The rejected sites are listed below with brief notes as to why they were assessed as unsuitable for inclusion.

Rathdangan End Moraine
The Rathdangan End Moraine site was listed in the An Forás Forbartha report 'Areas of Scientific Interest in County Wicklow' in 1976, as being an important moraine site. A broad 'moraine' zone covering a wide area was indicated on the map, but no moraine can been seen on the ground in this area and, though some gravel pits cut into small fan features do exist at nearby Kiltegan, these were not deemed worthy of County Geological Site status.

The locality of the 'Rathdangan End Moraine', which is just rolling countryside with no discernable, impressive glacial features.

Table Mountain
Table Mountain was included in the IGH Master site list for 'peat hag' features. However, peat hags are common all over the blanket peatlands of Wicklow and are transient features; where occurring in other sites they have been mentioned but no site or area is deemed worthy of inclusion as a County Geological Site on the basis of having peat hags alone. On this premise, Table Mountain was rejected as a site.

River Slaney, Baltinglass

The River Slaney at Baltinglass was included as it was described as ‘gorge-like’. However, in the field the river at Baltinglass comprises a wide floodplain with relatively gentle backslopes on the bounding hills; from this there is no gorge feature at the locality. The river in the area has no notable features and from this, it is not included as a County Geological Site.

The River Slaney just north of Baltinglass, where no gorge exists.

Church Mountain

Located roughly between Hollywood and Donard, (ITM GR 694800 701290) Church Mountain is on the western margin of the Wicklow Mountains. At 544m, the summit affords wonderful views of the Kildare lowlands to the west and the Wicklow Mountains plateau to the east. A granite mountain on the very western fringe of the Leinster Granite, the lower western and southwestern slopes of Church Mountain comprise Ordovician schist, slate and volcanics. The IGH Master Site List records Church Mountain as a *Fluvial and Lacustrine Geomorphology (IGH14)* theme site for chemical weathering, rotted granite, screes and mass wasting. Whilst rotted granite and granitic quartz sands are exposed where peat has been eroded on the mountain, these features are not of significant merit to be recognised as a County Geological Site. Most of the granite summits in the Wicklow Mountains exhibit varying degrees of rotted granite, and as such Church Mountain is not specifically unique. The summit hosts a circular cairn of granite stones, which has been described as the remains of a passage tomb, and the centre of the cairn is hollowed out in which the remains of a church and a well have been reported.


Left: View north from Church Mountain towards Pollaphuca Reservoir.
Right: Granite rocks and sand on path to Church Mountain summit and cairn.

Cummer
Cummer is in County Wexford, immediately east of the county boundary with Wicklow. A serpentinite body with minor chromite minerlization occurs here and was drilled by GSI in the 1980s and again in 2013. Early GSI maps suggested an outcrop further west, in County Wicklow, based on the distribution of boulders. However, serpentinite has not been confirmed to occur there. The bedrock occurrence at Cummer in Wexford is the only confirmed occurrence of this rock in the region. Hence, Cummer is rejected as a Wicklow CGS but may well in future be designated a CGS for Wexford.

Baltinglass
Baltinglass is listed in the expert panel list as a site where tourmaline occurs with garnet schist. This is presumably a reference to the hypothesis that held that tourmaline-rich rocks (tourmalinites) found in the Lower Palaeozoic rocks on either side of the Leinster Granite were formed from hydrothermal fluid in a submarine-exhalative environment and could thus be linked to mineralization both in in the Lower Palaeozoic rocks themselves and in the Leinster Granite and other igneous bodies. Tourmalinites were seen as companion rocks to coticules, also linked to submarine exhalative environments. However, there is no consensus as to the significance of tourmaline in the context of the origin of particular mineral deposits in southeast Ireland. The exact location of the Baltinglass site is unknown and efforts to establish it for this audit failed. For this reason and because the significance of this particular occurrence of tourmaline has not been defined, this site is rejected as a CGS.

Crone Forest
Crone Forest is another tourmaline site where the mineral has been reported to occur associated with pegmatites at the margin of the Leinster Granite. There is no information about the nature of the tourmaline that is the basis for the suggestion to designate this site a CGS. A site visit failed to identify tourmaline in any of the numerous pegmatites observed, although this may be partly owing to the thick vegetation (ferns) that obscured much of the site during the audit. Nevertheless, the lack of detailed information about the site and the significance that is attached to tourmaline at this location (e.g. whether it is simply a good example of tourmaline as a mineral or whether it is linked to theories regarding mineralisation, etc.) do not allow any judgement to be made regarding its importance and this site is therefore rejected as a CGS.

Kilmacoo
Kilmacoo is the site of sub-economic gold mineralization, hosted by the Avoca Formation. The site is immediately adjacent the northeastern end of Avoca mine site (Connary). The gold is contained within sulphide-rich volcanic rocks similar to those that host the base metal mineralization at Avoca. The deposit has been defined entirely by drilling and appears to have no surface expression, i.e. there is no site as such. Those interested in the mineralisation must rely on examination of drill core. For this reason Kilmacoo is rejected as a CGS.

Derrywater and Derry River, Tinahely
The Derry River rises to the northwest of Tinahely, proximal to the Carlow-Wicklow border and flows southeast from a stream confluence to Tinahely, before turning south, and then southwest through Shillelagh before entering the River Slaney at Killdavin. The Derrywater rises to the northeast of Tinahely, and flows northeastward joining the Ow River near Aughrim, and then proceeding as the Aughrim River, joins the Avoca River near Woodenbridge. The IGH Master Site List records Derrywater and Derry River as a *Fluvial and Lacustrine Geomorphology (IGH14)* theme site for palaeo-channels that predate the fluvial captures and diversions. The palaeo-channels are not especially apparent at ground level and are best appreciated on aerial photography. Whilst the macro-features are of interest in fluvial geomorphology, they are not deemed of significant interest as a County Geological Site or in terms of public promotion or tourism.


Left: Derry River - looking upstream, N, from Railway Walk bridge at Tinahely
Right: Derry Water – view downstream, NE, from bridge at Drummin, NE of Tinahely

Ballybrew Quarries
This site was a large centre of stone quarrying for granite for many decades. It was most latterly run by Stone Developments who had their base there and did much work processing other rock types from around the world, when the extraction of Irish granite could not be cost effective compared to Chinese and others. However, today there is very little of interest at the site and not enough to merit CGS status. Almost no exposure of the Leinster Granite is available as the main quarry workings have either been backfiilled with demolition and other quarry waste rock, or are flooded and inaccessible. The buildings and sheds have all been demolished for safety reasons and only concrete footprints remain.


Ballybrew concrete footprint

Ballybrew main quarry, now flooded.

Callow Hill Upper
According to the paper by Oppenheim that originally described the occurrence of the chromium mineral eskolalite, the till in which the mineral coated pebbles occurred was subsequently removed, so there is no site to examine.

Lacken
This site was listed under IGH 14 for chemical weathering of granite. No site was located in the area displaying any rotted granite, and it is supposed that when originally suggested for the IGH list there was a transient exposure available in connection with a development. The site is therefore rejected. In any case, such chemical weathering of the granite is encompassed in other sites.

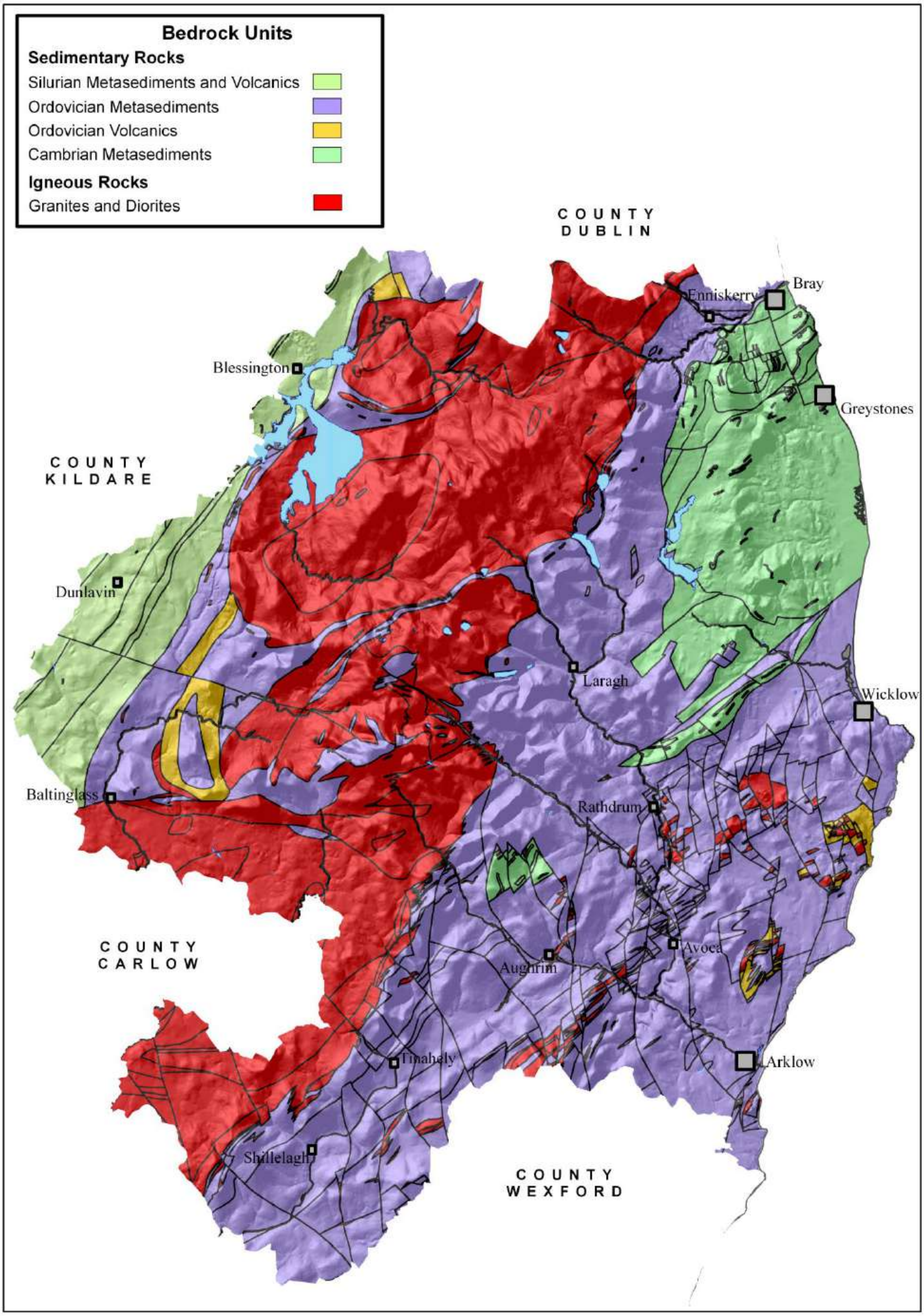
Lugduff
This site was originally listed for pseudokarstic pipes in peat deposits. Our investigations and consultation with expert panel members involved in the original proposal of them has determined that there is no meaningful site where they exist that could be assessed. They are very transitory features that are of some research interest across the Wicklow and other uplands, but no physical site is defined for this.

Wicklow Gap
This site when originally proposed was described as a small roadside quarry with granite pillars developing towards tors. Field investigation indicated that this site no longer exists and may have been affected by road works or lost through slumping and vegetation.

Ballycoog
Ballycoog is listed for "magnetite-siderite deposits in Avoca Volcanic Formation" and is described as the best example of this type of mineralization. The mineralization is minor and there are few remains either of the workings or of mineralization. A similar situation is found southwest along the ridge at Moneyteige, in a clearing in the forest, where no clear trace exists of the shafts that were sunk on the iron mineralization. The mineralization at these localities includes stratiform concentrations of magnetite that can be described as "banded iron formation" but, while of interest as mineral localities, the sites do not contain sufficient of interest to define a CGS here.

Ballard
Although there was a significant iron mine at Ballard south west of Wicklow Town, there is very little now visible of the workings. There are some areas of depressions and disturbed ground in two woodland areas that probably result from mining, and an adit stream outlet is present beside the road, but overall there is insufficient interest to define any site here. It is largely a mine that is defined by historical maps and reports rather than by physical evidence on the ground, despite relatively modern reports of open adits.

Appendix 5



A detailed geological map of County Wicklow

Appendix 6 - Geoschol leaflet on the geology of County Wicklow

WICKLOW

AREA OF COUNTY: 2,024 square kilometres or 781 square miles

COUNTY TOWN: Wicklow

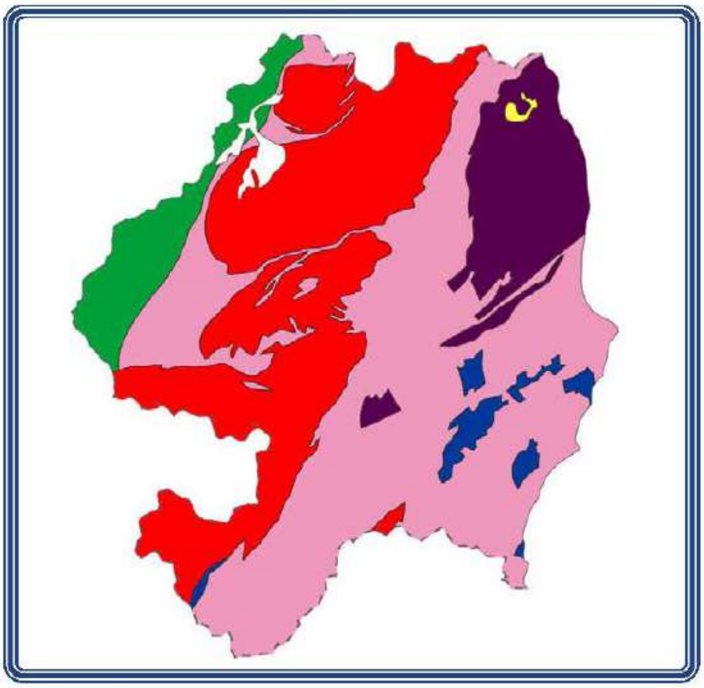
OTHER TOWNS: Arklow, Avoca, Baltinglass, Blessington, Bray, Dunlavin, Greystones, Rathdrum, Tinahely

GEOLOGY HIGHLIGHTS: Cambrian trace fossils, Glendalough mining activity, Avoca copper mines, Leinster granite mountains, Glacial deposits.

AGE OF ROCKS: Cambrian to Silurian; Pleistocene

View towards Bray Head along the prominade at Bray

Bray Head is composed of Cambrian red and green shales and greywackes together with quartzite which makes up the resistant ridges at the summit



Geological Map of County Wicklow

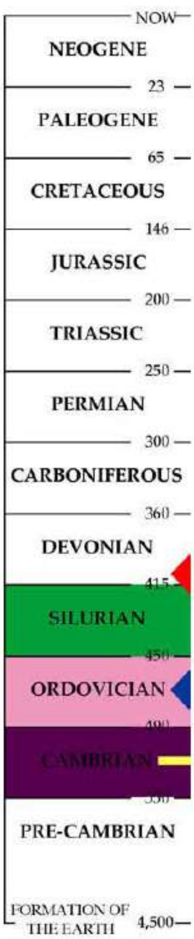
Purple: Cambrian shales and grewyackes; **Pale yellow:** Quartzite; **Pink:** Ordovician; **Green:** Silurian; **Red:** Granite; **Dark blue:** Ordovician volcanic rocks.

Geological history

The oldest rocks in Wicklow are those of the Cambrian period (550-490 million years ago [Ma]) that occur near Bray. These are a mixture of shales and greywackes that were deposited in deep water in an ocean called the Iapetus Ocean that divided Ireland in two. Sandstones deposited in this ocean were later metamorphosed into quartzite, and now make up the hard ridges of Bray Head and the distinctive Sugar Loaf mountains [these are **not** volcanoes but owe their shape to the weathering characteristics of quartzite].

During the Ordovician period (490-450 Ma) Ireland was south of the equator, and the Iapetus Ocean had begun to close. Sediments continued to be deposited off the land into this ocean and volcanic rocks were also produced in this tectonically active region. At the start of the Devonian (405 Ma) molten granite magma was injected into the overlying rocks which were baked around the granite margins. At this time veins containing lead, zinc and silver formed in the granite. The granite was injected in several batches

Oldhamia radiatia, a Cambrian trace fossil from Bray Head (left) named after Thomas Oldham a Dublin geologist (right)



to form large masses called batholiths. As these cooled slowly below the surface they solidified into a coarsely crystalline rock. Eventually 100 million years later the overlying rocks had been eroded away so that by the Carboniferous period the granite was at the surface.

In the last million years Ireland was affected by the Ice Age. Glaciers flowed down mountain valleys forming icesheets and eroded rocks and deepened valleys. When the ice finally melted, large lakes at Enniskerry and Blessington formed into which sands and gravels were dumped. These are now useful resources for building. Sometimes the melt water rushed through valleys like the Glen of the Downs and widened them.

Glendalough situated in a U-shaped glaciated valley. This was deepened by a glacier that moved through it during the Ice Age. Since the Ice Age sediments have accumulated in the lake.

Geological timescale showing age of rocks in Wicklow.

Lead Mining, Gold & Building Stones

Glendalough and Glendasan were important mining centres in the 18th century when lead was the prime ore extracted from the veins that ran through the granite. The ore was moved to Ballycorus in Co. Dublin for smelting. At Avoca copper was extracted from the 1800s until very recently.

Glendalough showing some old mining buildings and the waste tips from mining,

Gold was found in the Gold Mines River near Woodenbridge in the 1790s and this resulted in a 'goldrush' where prospectors would use a goldpan and wash river sands looking for traces of gold. While some nuggets were discovered there was not enough gold recovered to allow long-term working.

Model of a Gold nugget 12 cm wide found in 1790s in the Gold Mines River.

Leinster Granite is a hard-wearing stone that can be cut into blocks and polished or left rough. Stone from Blessington and Ballyknockan was an important building and facing stone used in many buildings in Dublin from Georgian times.

Leinster Granite (polished) from Ballyknockan with interlocking crystals of glassy quartz, white felspar and black mica.

Map adapted with permission from Geological Survey of Ireland 1:1,000,000 map 2003.
Image credits: Patrick Wyse Jackson 1, 4 (bottom); Geological Museum, Trinity College, Dublin 3 (top left and right), 4 (centre); Matthew Parkes 3 (bottom), 4 (top).

www.geoschol.com

Text by Patrick Wyse Jackson & Mike Simms

Section 2 - Site Reports

Site reports – general points
The following site reports are brief non-technical summaries of the proposed County Geological Sites for County Wicklow. These have been specially prepared for this Report in order to make the information accessible to planners and others without geological training. For most sites more detailed reports and information files are held in the IGH Programme in the Geological Survey of Ireland. These are available for consultation if required. Further sites may become relevant as IGH Programme work develops.

Each site report has primary location information, a mention of the main rock types and their age, and a short description of the key aspects of scientific interest. A section outlining any particular management or other issues specific to the site is included, along with one or two low resolution photographs exemplifying the site. **A CD accompanying this report will include further pictures of most sites at higher resolution, should they be required for a glossy booklet or leaflet for the general public**. Grid references are given for a central point in the site generated from the GIS mapping (a shapefile) of the site boundary. They are only indicative of the location, but the site extent is best shown on the included maps.

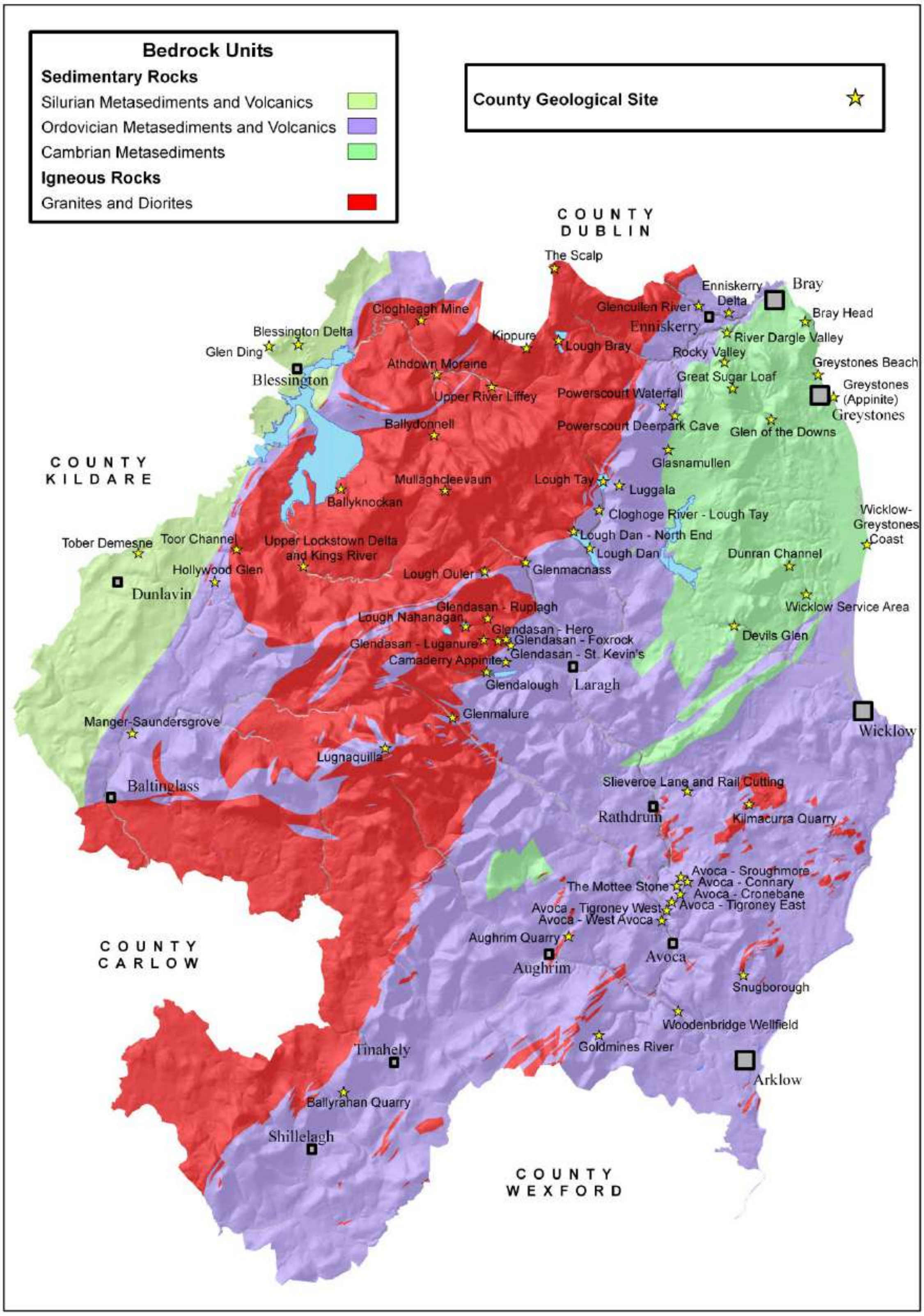
Irish Transverse Mercator (ITM) is the geographic projection co-ordinate system now in use for Ireland, and has been applied to all site localities in the site reports. It is the standard co-ordinate system for OSi maps, including the new Discovery map series, but a coordinate conversion tool is available on the OSi website at:
http://www.osi.ie/calculators/converter_index.asp?alias=/services/gps-services/co-ordinate-converter#results.

A series of maps are provided with an outline of the site boundary. It is important to note that these boundaries have no legal or definitive basis. They are indicative only of the limits of exposure or of geological interest, and not based on detailed field and boundary surveys, which were outside the scope of this contract. Boundaries are drawn to include the geological or geomorphological interest of the site, but are extended to the nearest mappable boundary, such as a field boundary, stream, road or edge of forestry. On a few sites, such as in open mountain terrain, it is impractical to find a boundary within a reasonable distance and an arbitrary line may be defined. County Geological Sites are non-statutory and so this is not problematic. If any such site is fully assessed for NHA status in the future, such a boundary may require small revisions.

For sites that have been recommended or which will be recommended for NHA designation detailed site boundary maps will become available to the Local Authority, through NPWS as the designation process is undertaken. Some areas may already be available if they are proposed NHAs (pNHA), under the Wildlife (Amendment) Act 2000. Areas which have been designated as Special Areas of Conservation (SAC) under European Habitats Directives will also have statutory boundaries already determined. The geological interest may be included within these wider areas of nature conservation.

In terms of any geological heritage site designation as NHA, due process of site reporting, boundary survey and very importantly, consultation with landowners where they can be readily identified, will take place before GSI finalises

recommendations with NPWS on the most important sites to be designated. Any landowner within areas or sites identified in this report with concerns over any aspect of this project is encouraged to contact Sarah Gatley, Head of the Heritage and Planning Programme, in the Geological Survey of Ireland, Beggars Bush, Haddington Road, Dublin 4. Phone 01-6782837. Email: sarah.gatley@gsi.ie



Simplified Geological Map of Wicklow with site locations indicated.

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Bray Head**
Other names used for site	
IGH THEME	**IGH 2 Precambrian to Devonian Palaeontology**
TOWNLAND(S)	**Newcourt, Ballynamuddagh, Rathdown Upper**
NEAREST TOWN/VILLAGE	**Bray**
SIX INCH MAP NUMBER	**8**
ITM CO-ORDINATES	**728020E 717060N (summit of headland)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
Coastal headland with extensive natural exposure and sea cliffs, plus railway cuttings.

Geological System/Age and Primary Rock Type
Bray Head is composed of Cambrian rocks classified as the Bray Group. Most of the rock is greywacke slate, but the best exposed rocks are large sections of quartzite. These thick sandy units were formed as channels during original deposition. They are now more resistant to erosion and form the summit ridges.

Main Geological Interest
Bray Head is a prominent landmark, an important public amenity area and a designated conservation area for its heathland. The scientific and other characteristics result from the geological foundation of hard Cambrian slates and quartzite rocks, for which this is the best place to see them in eastern Ireland. The site is interesting because of a variety of trace fossils found and described first from Bray Head. Although the animals that made them are not known, these traces left behind are now recognised throughout the world. The most notable is *Oldhamia*, a probable feeding trace, which has a radial pattern or a fan shaped pattern. The site is very important for the Irish fossil record it provides from Cambrian rocks, at a time when common invertebrate life forms were just beginning to proliferate.

Site Importance - County Geological Site; recommended for Geological NHA
In terms of Cambrian palaeontology, the Irish record is very sparse. The numerous trace fossils found on Bray Head, which is the type locality for some species, are an important element of Cambrian faunas, best represented on Bray Head. The site should receive protection as a Natural Heritage Area for the palaeontological interest.

Management/promotion issues
The site is relatively robust against most operations. Commercial fossil collecting should not be allowed, but in any case most museum specimens collected were probably found when fresh rock exposure was available in rail cuttings, as it is very difficult to find any fossils today. Any rock operations which compromise the railway line cuttings should be strictly forbidden. Any work on footpaths or other development which is permitted for any reason and **which** provides new exposures of fresh rock should be notified to GSI or the National Museum by NPWS. The walking path along the coast is very popular and surface upgrades make the site more accessible to all. The summit and paths on the top are well managed by the Council for amenity and recreation.


From the summit area looking south.


Bray Head from the seafront in Bray.

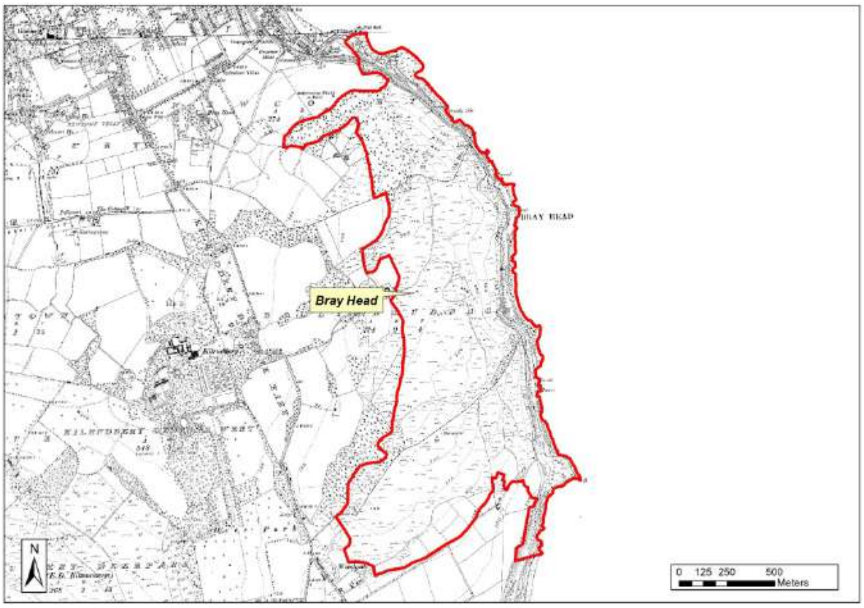

Looking north along the cliff path, with footpath above the railway line.


On the cliff path.


Looking north towards the summit.


BRAY
Bré
Bray Head
Ceann Bhré
Bray Head
Muir
Bhreata
Crab Rock
Periwinkle Rocks
Brandy Hole
Cable Rock
Newcourt
Ballyman
Old
Connaught
Fassaroe
Glenfield
Kilbride
Oldcourt
Ballywaltrim
Irishtown
Wingfield
Hollybrook
Giltspur
Glencormick
Ravenswell
Little
Bray
Martello
Tower
National
Aquarium
Holy
Well
Megalithic
Tomb
Kilcroney
Church
Fire
Stn
Industrial
Park
M11
R117
R761
R768
R762
R766
240


Bray Head
N
0 125 250 500
Meters


Bray Head
BRAY HEAD
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0 125 250 500
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Rocky Valley**
Other names used for site	
IGH THEME	**IGH 2 Precambrian to Devonian Palaeontology, IGH7 Quaternary**
TOWNLAND(S)	**Carrigoona Commons West**
NEAREST TOWN/VILLAGE:	**Kilmacanogue**
SIX INCH MAP NUMBER	**7**
ITM CO-ORDINATES	**723232E 714666N (centre of valley)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
This site comprises very small, disused quarries on side of the Rocky Valley.

Geological System/Age and Primary Rock Type
Cambrian age Bray Group slates.

Main Geological Interest
Small shallow roadside quarries in the Rocky Valley have yielded samples, which when processed have a range of microfossils in them. These microfossils are planktonic acritarchs and are very useful for dating older rock sequences and provide the best evidence to confirm the Cambrian age for the Bray Group rocks found at Bray Head, Sugar Loaf, Rocky Valley and throughout much of eastern Wicklow. A few trace fossils, called *Oldhamia*, have also been found, correlating with the Bray Head site where these are best known from.

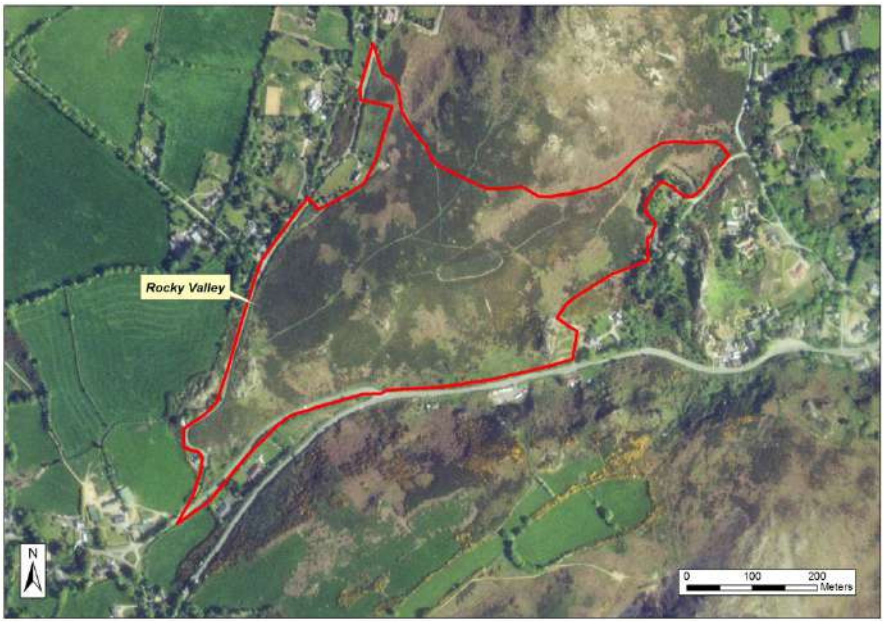
The valley was a meltwater channel at the end of the last ice Age, and is dry today.

Site Importance - County Geological Site; recommended for Geological NHA
These microfossil data provide the most reliable and biostratigraphically precise age so far obtained for the Bray Group in southeast Ireland.

Management/promotion issues
The site is entirely within pNHA 001769 The Great Sugar Loaf. It is rough grazing and vegetated with scrub and gorse.

The Rocky Valley, looking towards the Little Sugar Loaf.

One of the two small quarries in the Rocky Valley which yielded Cambrian microfossils.


ENNISKERRY
Áth na Sceire
Cookstown
R117
Kilcroney
Church
Powerscourt Estate and Gardens
Tinnehinch
Tinnehinch Br.
Newtown
Wingfield
Bushy Park
Church
Charleville Demesne
Stilebawn
Glencormick
Hollybrook
N11
Carrigoona Commons
R760
Rocky Valley
Coolakay
Ballyorney
R755
Rocky Valley
Sch
PO
Cairn
Ballybawn
Ballinagee
Ballinagee Br.
Glencap Commons North
Well
Motte
Kilbride
PO
Sch
15
16
17
14
18

Rocky Valley
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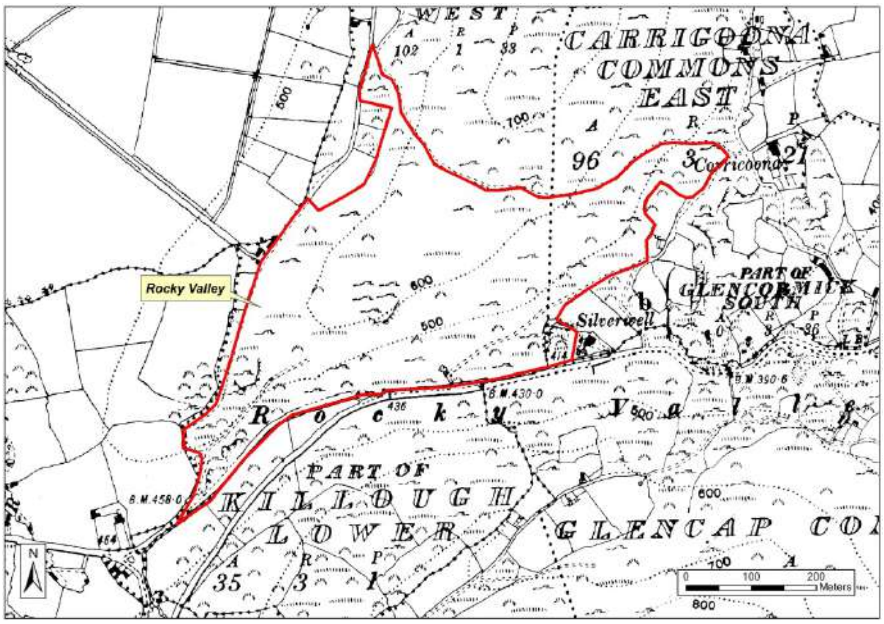
WEST
CARRIGOONA COMMONS EAST
96
Carricoona
Rocky Valley
PART OF GLENCORMICK SOUTH
Silverwell
Rocky Valley
PART OF KILLOUGH LOWER
GLENCAP
600
500
700
N
0
100
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Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Slieveroe lane and rail cutting**
Other names used for site	Slieveroe
IGH THEME	**IGH 2 Precambrian to Devonian Palaeontology**
TOWNLAND(S)	**Slieveroe**
NEAREST TOWN/VILLAGE	**Rathdrum**
SIX INCH MAP NUMBER	**30**
ITM CO-ORDINATES	**721040E 689250N (centre of exposures)**
1:50,000 O.S. SHEET NUMBER	**62 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
A lane and a short section of railway cutting.

Geological System/Age and Primary Rock Type
The rocks are of Ordovician age, and are composed of fossiliferous mudstones in the lane and black slates with graptolite fossils in the railway cutting.

Main Geological Interest
Slieveroe Townland has a railway cutting which has yielded graptolite fossils from black slates and a laneway which has yielded a rich assemblage of brachiopods and trilobites and other shelly invertebrates. It is important because the association of the faunas allows correlation of two different biozonal schemes which are widely used internationally in correlation of Ordovician rocks. The site also provides the only real constraint on the age of the economically important volcanic rocks of the Avoca district. These have been mined for copper over centuries, but understanding the age and formation of the rocks is important for any future exploitation.

The shelly fossils from the lane include many trilobite and brachiopod species, as well as many other invertebrate groups. It is the type locality for several species, i.e. the locality from which they were originally described.

Site Importance - County Geological Site; recommended for Geological NHA
The importance of the site is both historical and present, since Avoca is still an exploration target for minerals. However, there is scope for further examination and refinement of the knowledge of the site and its faunas, and this is an important reason for protection of the site. It should receive NHA designation to ensure continued accessibility to palaeontologists and others.

Management/promotion issues
Any excavations required, such as for agricultural or developmental purposes, would be beneficial in providing new sections for examination, but any major changes in land use should require permission before commencement. If the boreen was tarmacadamed over it would destroy the accessibility to bedrock, which effectively has to be reached by digging. The black slates in the railway cutting are now considerably overgrown, but could be cleared relatively simply. Access to the railway was formerly through a farmyard and a level crossing gate, but it is now not possible from any immediately local point.

The lane is heavily vegetated and little used, and fossiliferous rock is found mainly by digging a trench.

Left: The railway cutting at Slieveroe looking east, c. 1998.
Right: The lane looking south, with person at site of trenches c. 1998.

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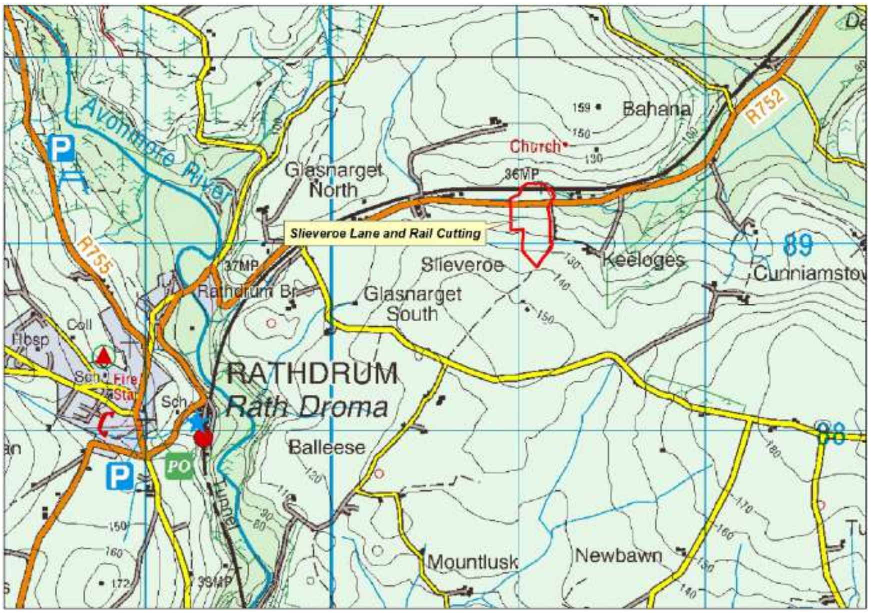
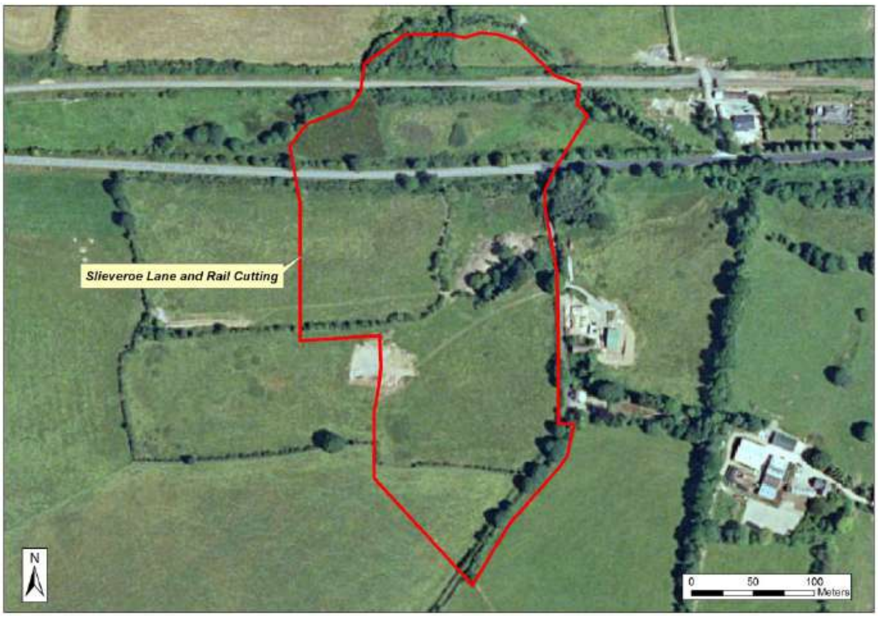
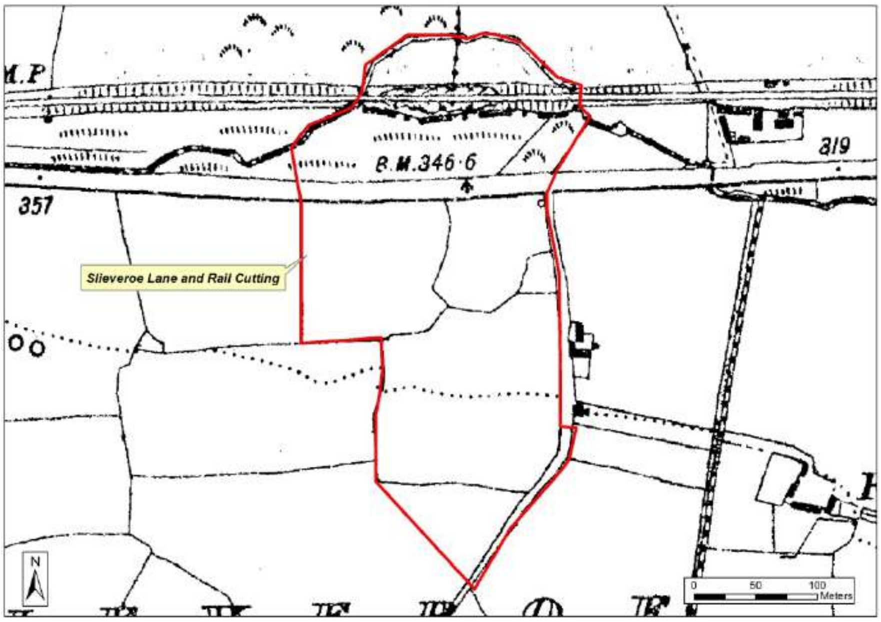

Slieveroe Lane and Rail Cutting
Avonmore River
Glasnarget North
Glasnarget South
Slieveroe
Keeloges
Bahana
Church
Cunniamstow
RATHDRUM
Rath Droma
Balleese
Mountlusk
Newbawn
Rathdrum Br
R752
R755
36MP
37MP
39MP
PO
89
88


Slieveroe Lane and Rail Cutting
N
0 50 100 Meters


Slieveroe Lane and Rail Cutting
M.P
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357
319
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0 50 100 Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Great Sugar Loaf**
Other names used for site	Big Sugar Loaf, Little Sugar Loaf, *Ó Cualann*
IGH THEME	**IGH4 Cambrian-Silurian, IGH7 Quaternary**
TOWNLAND(S)	**Glencap Commons South, Glencap Commons Upper, Glencap Commons North**
NEAREST TOWN/VILLAGE	**Kilmacanoge**
SIX INCH MAP NUMBER	**7, 8**
ITM CO-ORDINATES	**723710E 713110N (summit)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
A prominent, scree covered, quartzite conical mountain peak standing out on the north Wicklow and Dublin skyline.

Geological System/Age and Primary Rock Type
Cambrian quartzite (Bray Head Formation) bedrock with greywacke/quartzite bedrock on the south/southwest slopes. The scree deposits (of quartzite) are Quaternary in age, having formed from freeze-thaw activity during the last glaciation.

Main Geological or Geomorphological Interest
Great Sugar Loaf (501m) is a prominent conical peak of pale-pink Cambrian quartzite, around 7km southwest of Bray. The conical shape contrasts with the rounded summits of the granite mountains to the west. The elevated terrain comprising Great Sugar Loaf, Little Sugar Loaf and Bray Head marks the northern margin of a tectonic slide (roughly along the course of the River Dargle) where Cambrian rocks were thrust up onto Ordovician rocks (found between Bray Head and Killiney Hill and southwest beyond Rathdrum). This NW directed thrusting occurred during a great mountain building event (Caledonian Orogeny), 475-400 million years ago, also during which the Late Caledonian Leinster granites were formed.

Great Sugar Loaf and Little Sugar Loaf (341m), 3km to the northeast, are separated by Kilmacanoge valley. This valley was part of a regional north-south subglacial meltwater drainage route that included the Scalp (north) and Glen of the Downs (southeast). The mountain summit affords wonderful views of these spectacular meltwater channels, which are incised into high topography of solid bedrock. The steep upper slopes of Great Sugar Loaf are blanketed with extensive patches of loose angular quartzite boulders (scree) that have physically weathered out, by freeze-thaw action, from the upper summit and rolled downwards to their present locations. Screes occur in virtually all upland areas throughout Ireland, particularly on quartzite mountains such as Great Sugar Loaf, Errigal (Co. Donegal) and the Twelve Bens (Co. Galway). Views even as far as Snowdonia, Wales are possible from the summit of Great Sugar Loaf on a clear day.

Site Importance - County Geological Site
Great Sugar Loaf is a prominent landmark on the Dublin and north Wicklow skyline. Great Sugar Loaf is a proposed NHA (001769). A Landscape Survey of the Great and Little Sugar Loaf Mountains conducted in 2010 considered the site to be of 'high amenity, cultural and natural heritage significance in a local and regional context'.

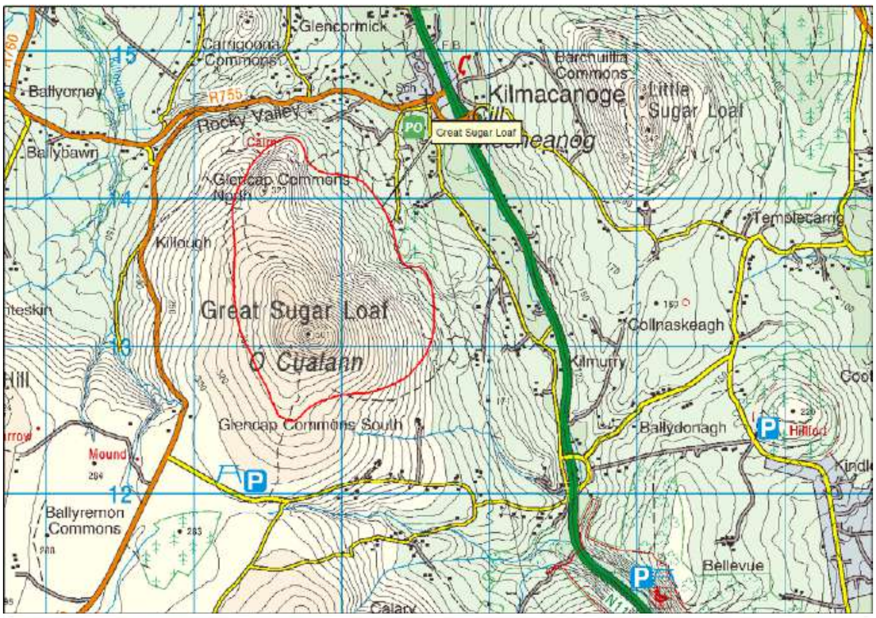
Management/promotion issues
A popular site for hiking, the southern 1km-long route to the summit is severely eroded down to the bedrock. Litter is a common problem along the well-trodden track and summit. A public information panel at the car park would help to inform visitors of the sensitive nature of the site, how to minimise damage, and promote the geological heritage of the mountain.

Great Sugar Loaf, viewed from the southern hiking route to the summit.

Hiking track through a scree slope-failure scar on the southern slopes of Great Sugar Loaf.

View of the north side of Great Sugar Loaf from Glencullen, looking southeast.

Scree on the southeast slopes of Great Sugar Loaf.



Glencormick
Carrigoona Commons
Barchuillia Commons
Kilmacanoge
Little Sugar Loaf
Ballyorney
R755
Rocky Valley
Great Sugar Loaf
Ballybawn
Glencap Commons North
Templecarrig
Killough
Great Sugar Loaf
Ó Cualann
Collnaskeagh
Kilmurry
Glencap Commons South
Ballydonagh
Hilltop
Mound
Ballyremon Commons
Bellevue
Calary

Great Sugar Loaf
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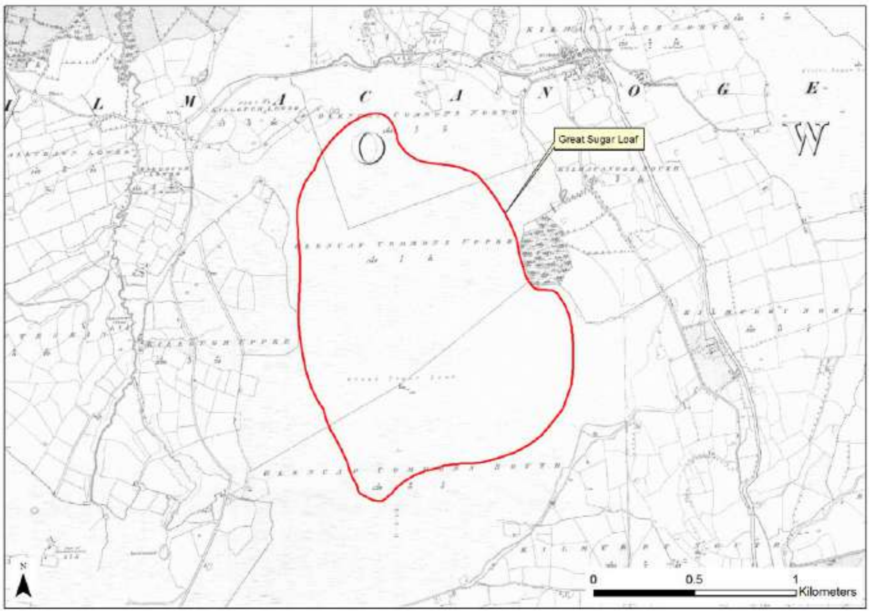
Kilometers



Great Sugar Loaf
N
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0.5
1
Kilometers

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Luggala**		
Other names used for site			
IGH THEME	**IGH4 Cambrian – Silurian, IGH6 Mineralogy**		
TOWNLAND(S)	**Ballinastoe**		
NEAREST TOWN/VILLAGE	**Roundwood**		
SIX INCH MAP NUMBER	**12**		
NATIONAL GRID REFERENCE	**716996E 707363N**		
1:50,000 O.S. SHEET NUMBER	**56**	**GSI 1:100,000 Bedrock Sheet No.**	**16**

Outline Site Description
The site consists of several large outcrops flanking the public road above Lough Tay.

Geological System/Age and Primary Rock Type
The bedrock consists of schists and quartzites of the Lower Palaeozoic (Ordovician) Maulin Formation, about 300 m from their contact with the Leinster Granite.

Main Geological or Geomorphological Interest
The site is listed because of the occurrence of *coticule*, an unusual lithology that has received considerable attention both for its complex structure and its mineralogical composition. Coticules were originally described in the 19th century from Belgium where they have been mined and quarried for use as sharpening stones. The name is a derivative of the latin word for whetstone. The principal characteristic of coticule is the presence of abundant equidimensional crystals of garnet, typically a manganese (Mn)-rich type called spessartine. Garnet is a hard mineral that can act as an abrasive. Garnets within coticules are typically fine-grained, generally much less than 1 mm in diameter.

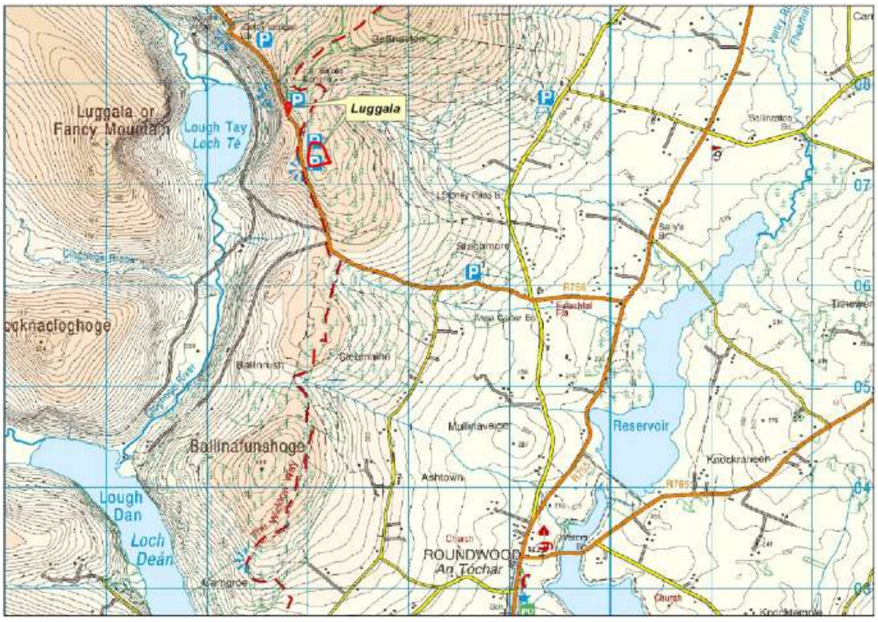
In Wicklow, the coticule comprises thin quartzite or psammite beds with abundant spessartine. The coticule layers display complex folding suggesting slumping or deformation prior to final lithification. The enrichment of coticules in Mn has been linked to their possible formation within a seafloor hydrothermal system, and it has been speculated that they may be evidence for possible metal enrichment in Lower Palaeozoic rocks in southeast Ireland. Other origins, including diagenesis, have also been suggested.

Site Importance – County Geological Site
Coticule is an unusual rock, easily overlooked in the field, particularly since the garnets are so fine-grained. The occurrences at Luggala are relatively abundant and accessible.

Management/promotion issues
The outcrops of coticule-bearing schist are mainly along the eastern side of the narrow, often heavily trafficked road. The site is within the Wicklow Mountains National Park and is not under any threat. Coticule is likely to be of interest mainly to geologists and further promotion is not recommended.

Complexly folded coticule layers within schist.

Close-up of folded coticule layer. The pink colour is typical, reflecting
the red colour of the spessartine garnet.


Luggala
Luggala or Fancy Mountain
Lough Tay
Loch Té
Ballinafunshoge
Reservoir
Lough Dan
Loch Deán
ROUNDWOOD
An Tóchar
Mullinaveige
Ashtown
Knockraheen
R755
R765


Luggala
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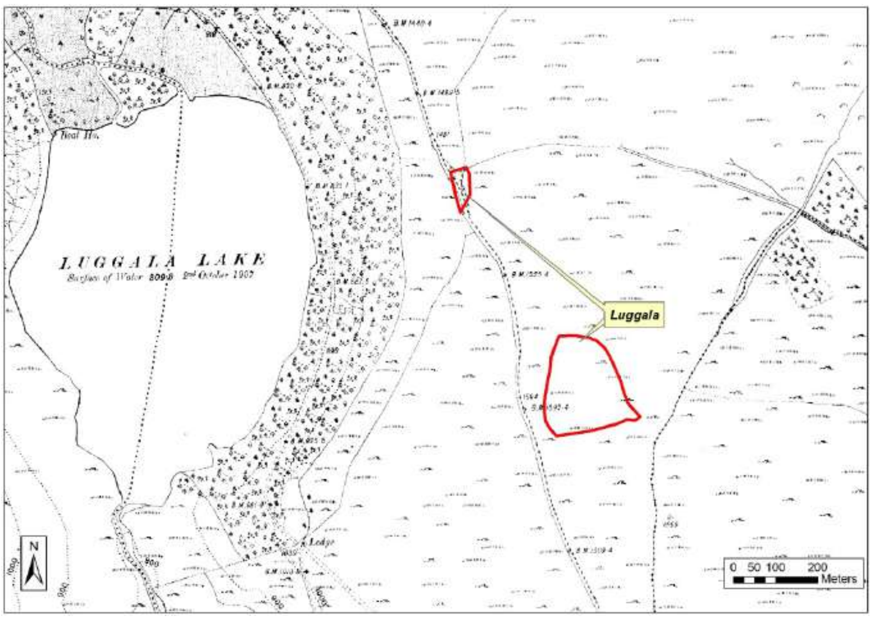
Meters


LUGGALA LAKE
Luggala
Lodge
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WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Wicklow Service Area**
Other names used for site	Coyne's Cross
IGH THEME	**IGH 4 Cambrian-Silurian**
TOWNLAND(S)	**Cullenmore, Kilmartin**
NEAREST TOWN/VILLAGE:	**Ashford**
SIX INCH MAP NUMBER	**19**
ITM CO-ORDINATES	**728075E 700910N (centre of section)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
This is a long cutting behind a new Motorway Service Station.

Geological System/Age and Primary Rock Type
The rocks are part of the Bray Group, of Cambrian age. They are composed of quartzite, greywacke and slate.

Main Geological Interest
This fresh and large exposure of Bray Group rocks gives a more detailed picture of the primary rock lithologies and structure than is apparent in Bray Head or Rocky Valley, as they are only partially exposed sections with mostly thick quartzite units that get left as resistant outcrop.

Site Importance - County Geological Site
This is a useful new site, better than the degraded road cuttings on the N11 in the district, which have become very overgrown and weathered.

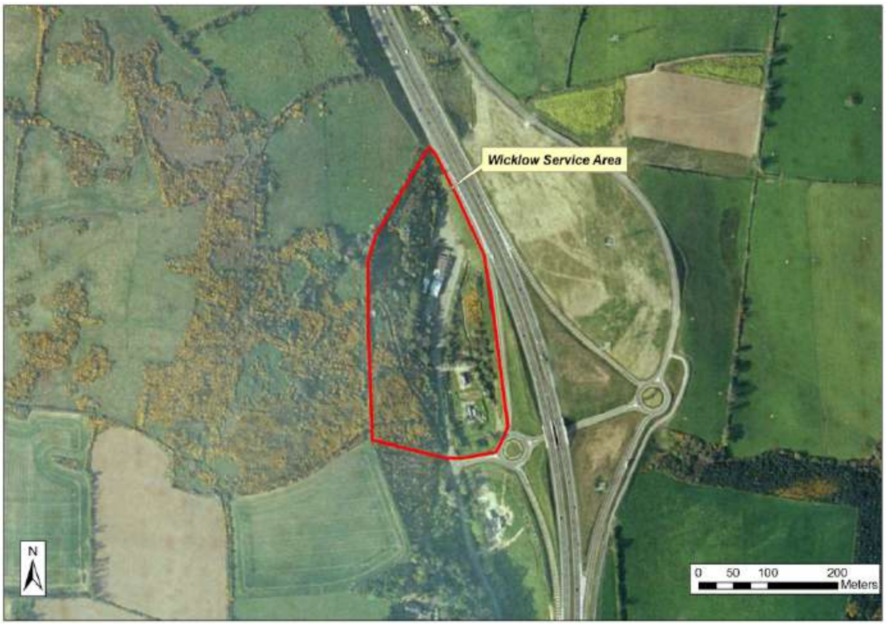
Management/promotion issues
As it is on the private land of the service station it is not freely accessible, but there is a very good view of the strata from the public areas. The Management could be approached to provide a sign explaining the rocks that are so readily visible here. As the slopes are quite steep the colonisation by vegetation will be much slower than on the road cuttings in the same rocks to the north of here on the N11 road.

An overview of the Wicklow Service Area with the large new cutting behind it.

Left: Wicklow Service Area, new cutting behind it.
Right: Some vertical beds of the Bray Group.

Wicklow Service Area, new cutting behind it.


Wicklow Service Area
ASHFORD
Áth na Fuinseoige
Muir Bhreatan


Wicklow Service Area
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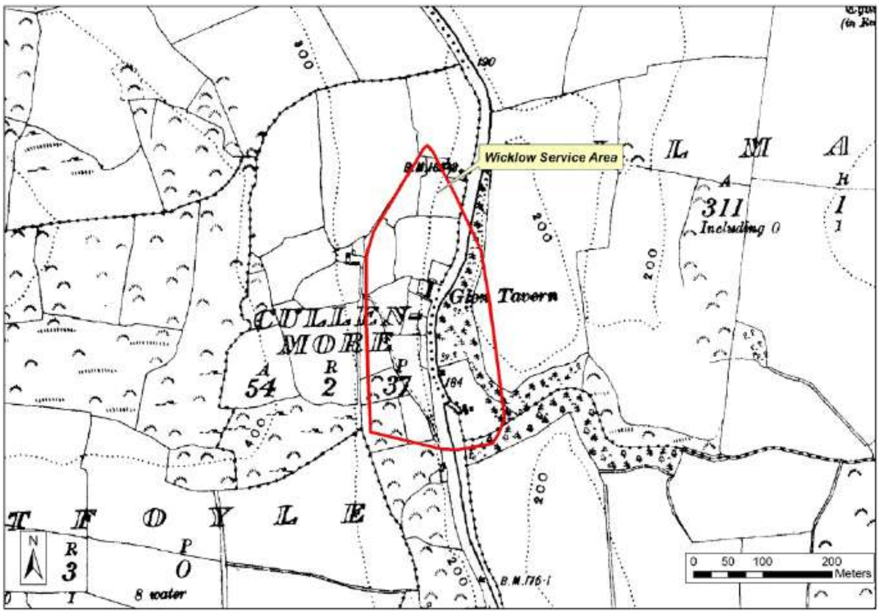

Wicklow Service Area
Glen Tavern
CULLEN-MORE
T F O Y L E
0 50 100 200
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Cloghleagh Mine**
Other names used for site	Cloghlea Mine, Cloughleagh Mine
IGH THEME	**IGH 6 Mineralogy, IGH 15 Economic Geology**
TOWNLAND(S)	**Cloghleagh**
NEAREST TOWN/VILLAGE	**Blessington**
SIX INCH MAP NUMBER	**5, 6**
ITM CO-ORDINATES	**705270E 717160N (centre of feature)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
A small, probably quarried, escarpment of rock includes a small mine adit, with some remnant crushing equipment on the flat terrace.

Geological System/Age and Primary Rock Type
The iron and manganese minerals are within a brecciated (broken up) fault zone within the Leinster granite and are found within a vein quartz breccia. The age of mineralisation of the fault zone is unknown, but is thought to be associated with faulting from around 12 million years ago, and possibly connected to that at Deerpark cave and Glasnamullen near Powerscourt in east Wicklow.

Main Geological Interest
The site contains a fault zone with minerals which can be seen close up in the buttress of rock on the escarpment. These are the manganese oxide ores hollandite and cryptomelane, part of a mineral series, with variable compositions of the elements potassium and barium. The fault zone is possibly tens of metres wide, with extensive explosive brecciation of quartz veins, and banded quartz fragments in a broken matrix are seen in the rock buttress and in the minor mine working. It is believed that this fault structure is related to faulting around 12 million years ago, also seen at the Deerpark Cave and at Glasnamullen near Powerscourt.

Two large cut stones are seen on the site and these are remnants of a large cone crushing device installed when the mine was worked in 1862-1868, but possibly never assembled. A third piece of this device was previously seen on site, but is reported as having been removed by the Army to a nearby military base. There was also formerly a substantial building ruin on the opposite side of the track, built by Reverend William Ogle Moore, an original promoter of the mine.

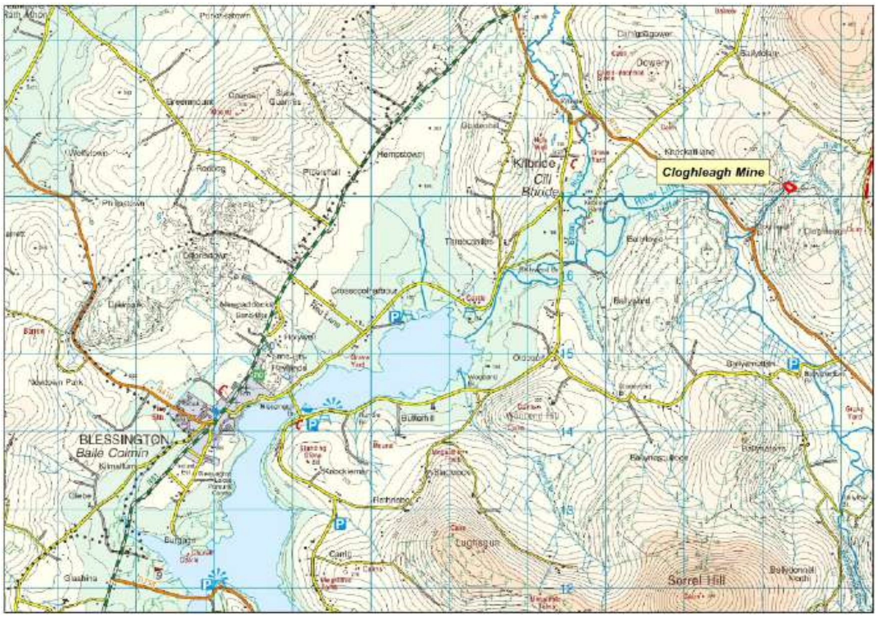
Site Importance - County Geological Site
The occurrence of manganese minerals in Ireland is poorly understood since few modern analyses have been done on the different minerals, most of which were identified simply as one of them - psilomelane. The geological study and analysis done here makes this a site of some importance, worthy of CGS recognition.

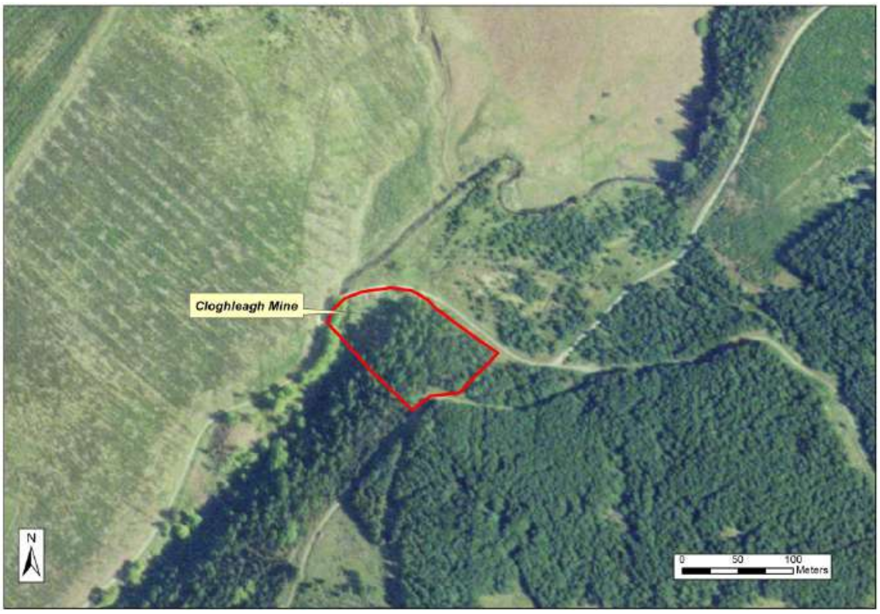
Management/promotion issues
Unfortunately the mining heritage interest of the site has been diminished by the demolition and removal of the former mine owner's house. Similarly, the reported removal of part of the cone crushing machine grinding stone is regrettable and it would be best to see it reinstated on site. Despite these issues, there is interest in the site and it could be promoted on site by an explanatory signboard. It might be better treated as part of a wider trail, with apps or guidebooks available elsewhere which would provide a visitor with explanation. Perhaps a simple Q code sign attached to the grinding stones would lead a visitor to a website with historical pictures. A minor adit is clearly visited, despite being well hidden, but it is in stable rock and is not a safety hazard.

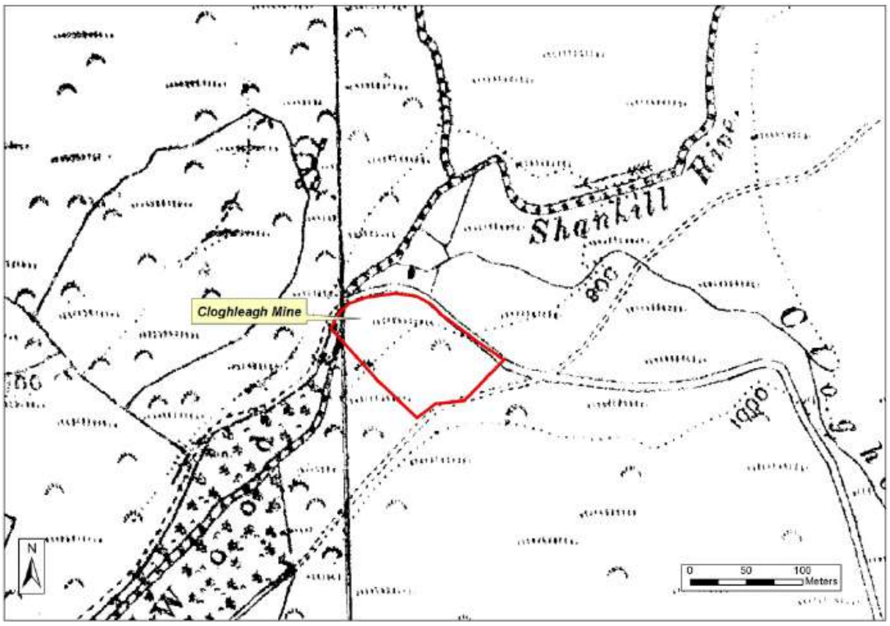
Group examining the quartz breccia on the fault plane, dipping steeply from right to left.

The former mine owner's house, presumably demolished by Coillte in recent decades.
Right: some fragments of the mineralisation lying around near the crusher stones.

Group examining the two remaining stones of a cone crusher.


Cloghleagh Mine
BLESSINGTON
Baile Coimín
Kilbride
Sorrel Hill


Cloghleagh Mine
N
0 50 100
Meters


Cloghleagh Mine
Shankill Rive
800
1000
N
0 50 100
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Goldmines River**
Other names used for site	Goldmine River
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Ballinasilloge, Ballinagore, Ballinvally Lower, Ballinvally Upper**
NEAREST TOWN/VILLAGE	**Woodenbridge**
SIX INCH MAP NUMBER	**39, 40**
NATIONAL GRID REFERENCE	**715791E 674799N (centre of area)**
1:50,000 O.S. SHEET NUMBER	**62 GSI 1:100,000 Bedrock Sheet No. 19**

Outline Site Description
The site consists of a c. 1.5km-long section of river, typically 2-3 m wide. Both banks have a thick cover of trees and shrubs.

Geological System/Age and Primary Rock Type
The bedrock consists of slates, siltstones and felsic volcanic rocks of the Ordovician Kilmacrea Formation.

Main Geological or Geomorphological Interest
Goldmines River was the site of Wicklow's gold rush of 1795 following the discovery of placer gold in the river gravels below Ballinagore Bridge. The source of the gold has never been satisfactorily established but it has been suggested to have been within the volcanic and sedimentary rocks underlying the Ballinasilloge – Ballycoog ridge to the west. Minor bedrock was detected in the 1980s in arsenopyrite-rich quartz veins east of the river.

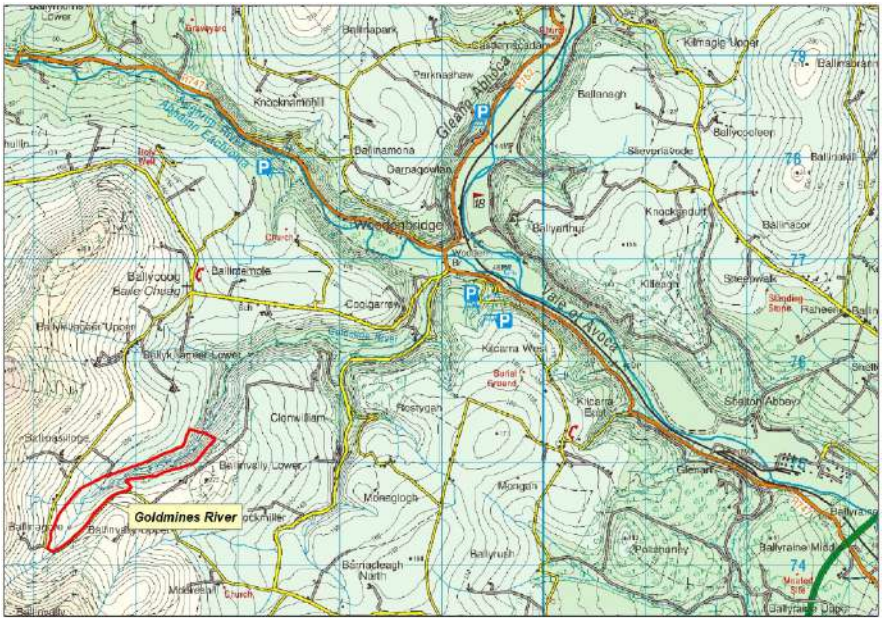
The site today retains no obvious features linking it to the era of the gold rush, unsurprising after over 200 years. It is included here largely because of its historic importance. While there have been reports of individuals finding small amounts of panned gold, sufficient in one instance for a wedding ring, and the National Museum has some nuggets in its possession, as a geological site, the Goldmines River is essentially of historic interest.

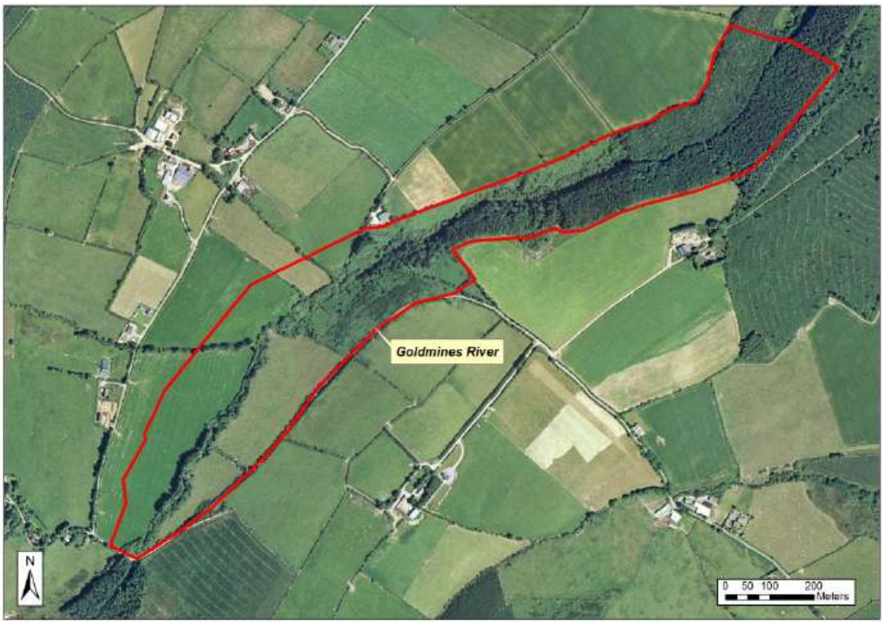
Site Importance – County Geological Site
This is the site of Wicklow's gold rush of 1795 when placer gold was discovered in the gravels and is of historic interest.

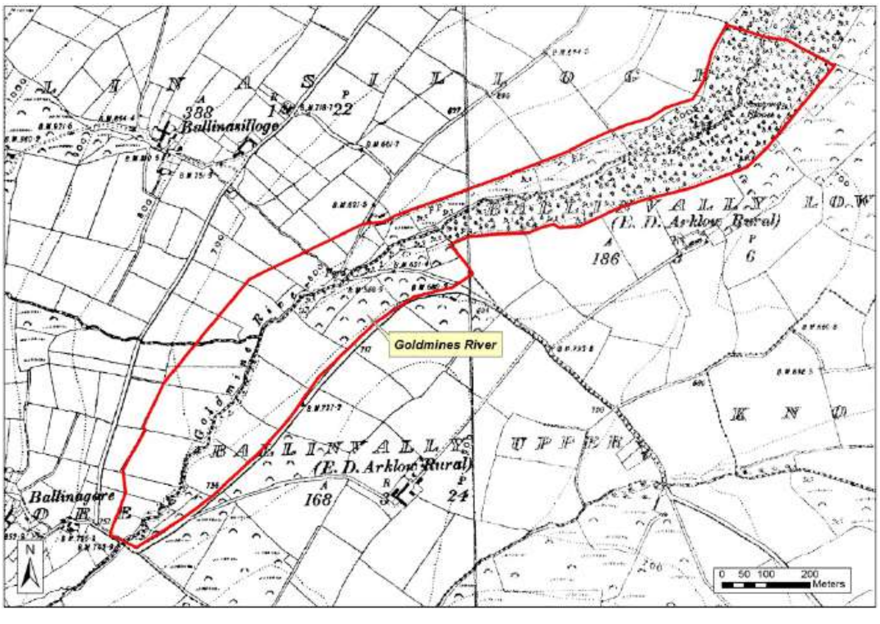
Management/promotion issues
The possibility of promoting this site as a themed, activity-based site centred on gold panning was considered, but is not recommended. The site is in a remote location, surrounded by pasture. Consideration could be given to developing such a site downriver, closer to Woodenbridge. However, the site could be included in any geological or historical heritage trails and in this context a signboard located at Ballinagore Bridge should be considered.

View westwards upstream along Goldmines River towards Ballinagore Bridge. Ballinagore is in background, with Croghan Kinshelagh beyond the summit of the ridge.

Ballinagore Bridge view from upstream. The main area of historic gold workings commences just downstream of the bridge.


Goldmines River
Woodenbridge
Ballinapark
Ballinamona
Ballyarthur
Ballinacor
Coolgarrow
Clonwilliam
Kilcarra West
Ballinvally Lower
Ballinvally Upper
Ballyraine Middle
Standing Stone
Church
Burial Ground


Goldmines River
N
0 50 100 200
Meters


Goldmines River
388
Ballinasilloge
Ballinagore
BALLINVALLY
(E. D. Arklow Rural)
168
24
186
6
UPPER
N
0 50 100 200
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glaciofluvial Meltwater Landforms – East and West Wicklow - Overview**
Other names used for site	East and West Wicklow Meltwater Channels, Glacial Lake Deltas
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Many townlands throughout East and West Wicklow**
NEAREST TOWN/VILLAGE	**Blessington, Hollywood, Donard, Stratford, Baltinglass, Bray, Enniskerry, Delgany, Newtown Mount Kennedy, Ashford**
SIX INCH MAP NUMBER	**3, 5, 6, 7, 8, 9, 10, 13, 15, 16, 18, 19, 21, 24**
NATIONAL GRID REFERENCE	**centred on 701300E 706000N**
1:50,000 O.S. SHEET NUMBER	**56, 62 GSI Bedrock 1:100,000 Sheet No. 16**

Introduction
The glacial and glaciofluvial deposits in County Wicklow are very variable. Although Wicklow is only one of thirty-two counties on the Irish landmass not to have any underlying limestone bedrock, the glacial and glaciofluvial deposits over large areas of both east and west Wicklow are composed of limestone debris. In west Wicklow, most of the direct glacial deposits were carried by, and deposited from, ice that spread in from the Midlands of Ireland, as were the meltwater deposits. The result of this is that much of the area of west Wicklow underlain by Lower Palaeozoic shale, slate and greywacke rocks is covered by glacial and meltwater sediments derived from the Carboniferous limestone of the Irish Midlands. Only occasionally are Lower Palaeozoic shale, greywacke and slate rocks, or granite, dominant in these sediments. With limestone and chert derived from limestone common well into the Liffey and Kings River valley (both underlain by granite in their upper reaches) this suggests that there was a general ice movement from the Midlands pushing up into the foothills of the mountains.

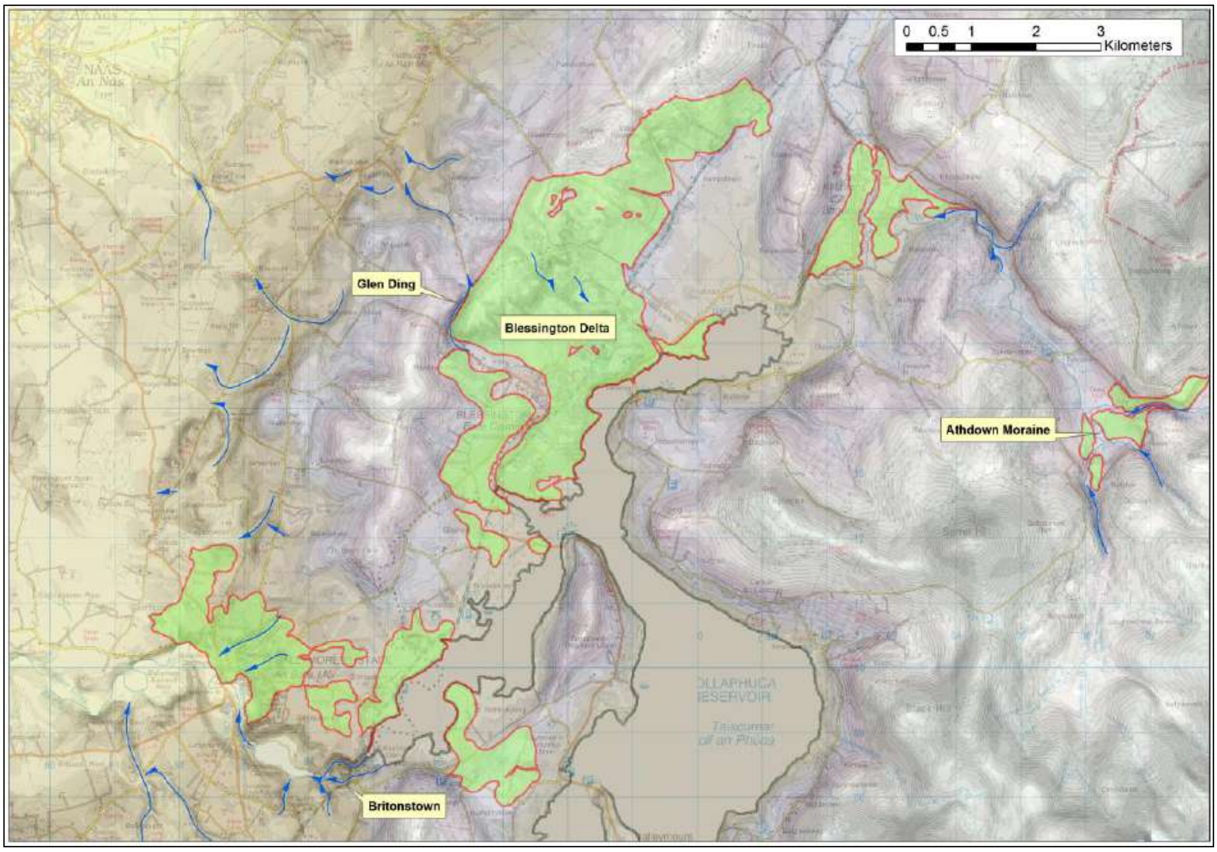
Limestone dominated tills and glaciofluvial sand and gravel deposits are also seen along the northern foothills of the mountains resting on Lower Palaeozoic and granite rock along the boundary with south County Dublin. These too have their ultimate source in the Midlands. In east Wicklow, limestone dominated till extends as far south as Kilcoole, while meltwater gravels containing large amounts of limestone continue southwards to south of Newtown Mount Kennedy. Patches of limestone dominated gravels extend as far south as just south of Wicklow town. All of this limestone ultimately had its source in the Midlands and the Irish Sea Basin. The most striking glacial deposit of the coastal strip of east Wicklow is, however, a clayey till usually containing marine shell fragments and flints as well as other erratics from the northern Irish Sea basin. These are the deposits that were laid down by the ice sheet that filled the Irish Sea Basin flowing southwards from southwestern Scotland and northeastern Ireland. They are termed ‘Irish Sea Tills’.

Main Geological or Geomorphological Interest - ice flow patterns, meltwater channels and glacial lakes
At the glacial maximum most of Wicklow was covered by ice, and in the early stages of glaciation preceding this, local mountain ice probably covered most of the county. As the large ice sheet covering the country (which was composed of domes with sources in the Irish Midlands and the Irish Sea Basin) expanded, the local mountain ice became confined to the central mountain area. The mountain ice merged with the general ice and flowed with it towards the south.

After the ice sheets began to melt they began to separate. The Midland ice front retreated to the ridge running northeast-southwest from Saggart Hill to Ballymore Eustace, and from Ballymore Eustace ran southwards close to Hollywood, Church mountain and Donard. Mountain ice had by then retreated into the Upper Liffey Valley, Kings River Valley and the

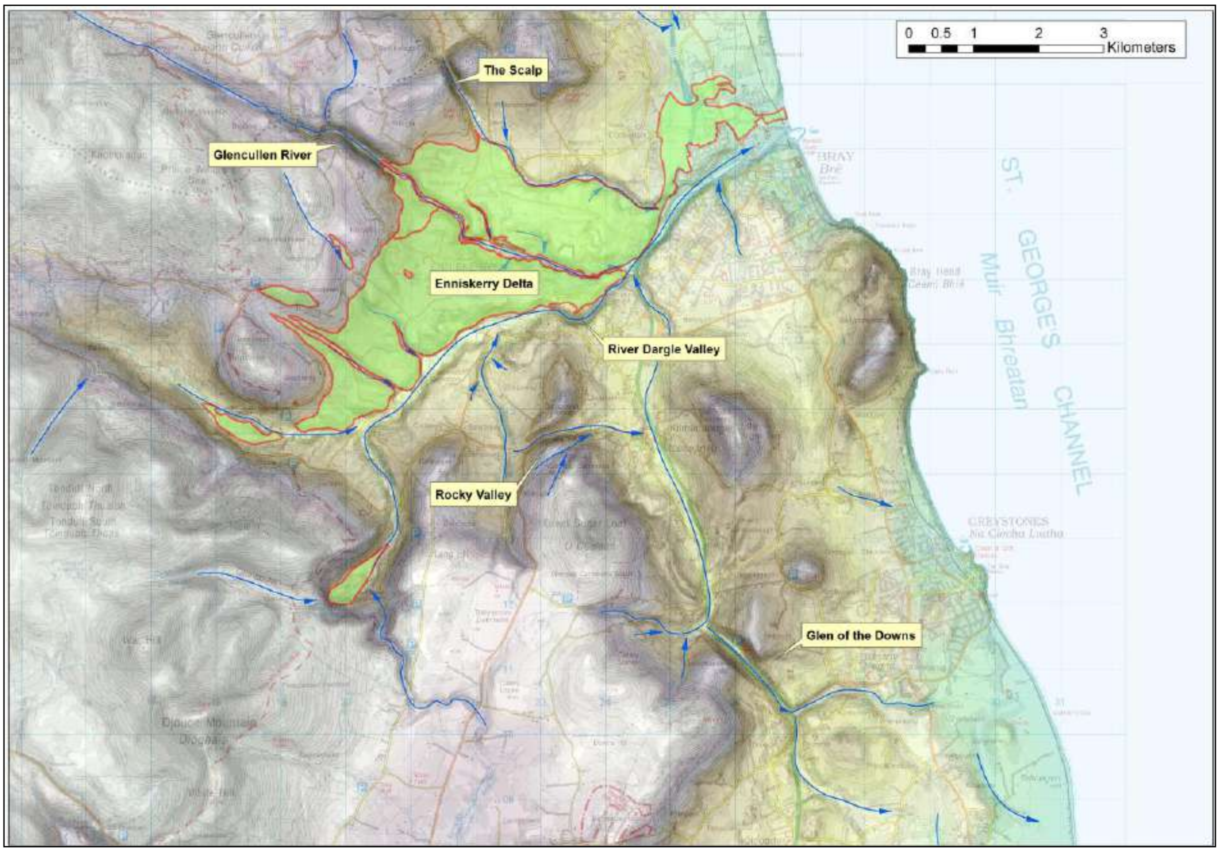
Glen of Imaal. The terminus of the Irish Sea glacier may have retreated north of the Wicklow district by this time.

Just as the hydroelectric dam at Pollaphuca now creates the Pollaphuca Reservoir, the margin of the Midland ice dome created a large, temporary ice dammed lake. And, as the ice was thicker than the present dam, it created a much bigger and deeper lake. The present 270m (900 feet) contour marks the approximate extent of the ice dammed lake. The lake was called Glacial Lake Blessington and the level was controlled by the lowest col which allowed the lake water to spill out and flow southwards along the ice margin. The lake water tumbled over the col at Toor to form the Toor Channel and then along, and under, the ice margin to form the Hollywood Glen meltwater complex. Meltwaters also deposited massive amounts of limestone debris into the lake around this time, in the form of the Blessington Delta. The Upper Lockstown Delta and Athdown Moraine record later, lower delta inflows to the lake.



The Blessington Delta and the suite of associated meltwater channels around Blessington.

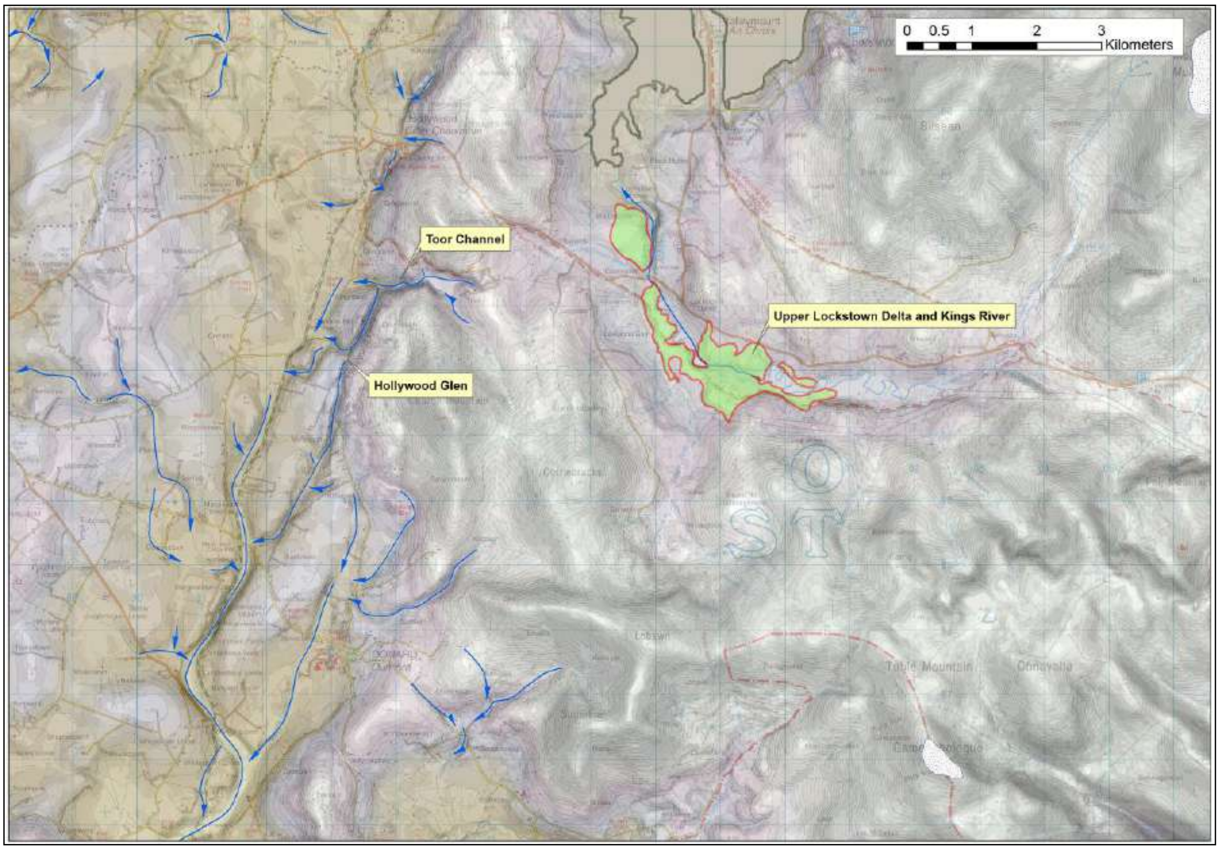
Glacial events in east Wicklow mirrored somewhat those of west Wicklow. Here the extraneous ice was from the Irish Sea Basin, and the major lake which dammed between the mountain ice and the Irish Sea ice was called Glacial Lake Enniskerry. The Enniskerry Delta was deposited into this, and deep channels at The Scalp, in the Dargle River Valley and at the Glen of the Downs were cut by meltwater along the lake margin. Other impressive channels in east Wicklow occur at Dunran and the Devil's Glen. Most of the channels were formed subglacially, but close to the ice margin, and subsequently used as glacial lake outlet channels. Thus the channels and deltas form an integrated suite through which the marginal drainage of the Irish Sea and Midlands ice sheets passed, as the meltwater flowed generally southwards during ice retreat.



The Enniskerry Delta and the suite of associated meltwater channels in east Wicklow.

Site Importance – County Geological Site
Depending on the importance of the individual features, the sites vary from those recommended as Geological NHAs and some which may be recommended, to those recognised simply as County Geological Sites. The exact importance of each site is assessed within each separate, individual site report.

Management/promotion issues
Much of this district is within the Wicklow Mountains SAC, SPA, pNHA and National Park, and is very popular with visitors and walkers. Many of the features have a long-studied history, and the sequence of events is well understood. Signboards at some of the features, such as the Devil's Glen and Hollywood Glen, where good walking trails are established, would prove useful. Promotional leaflets or a booklet on the glacial history of the Wicklow Mountains area would be useful additions to the overall experience of the area for the tourist.



The Upper Lockstown Delta and the suite of associated meltwater channels in west Wicklow.

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Athdown Moraine**		
Other names used for site	Athdown Delta Moraine		
IGH THEME	**IGH7 Quaternary**		
TOWNLAND(S)	**Athdown, Ballynabrocky, Ballynatona, Ballylow**		
NEAREST TOWN/VILLAGE	**Blessington**		
SIX INCH MAP NUMBER	**6**		
ITM CO-ORDINATE	**706490E 731780N (centre of feature)**		
1:50,000 O.S. SHEET NUMBER	**56**	**GSI BEDROCK 1:100,000 SHEET NO.**	**16**

Outline Site Description
The Athdown Moraine includes a large accumulation of sands and gravels deposited at the edge of an ice margin and into a proglacial lake, at the end of the last Ice Age.

Geological System/Age and Primary Rock Type
The 'moraine' rests on bedrock of granite, but the features comprising the moraine itself are Quaternary in age.

Main Geological or Geomorphological Interest
The Athdown Moraine includes a distinctive hummocky topography at Athdown, where the River Liffey, Srahoe Brook and Ballydonnell Brook now meet.

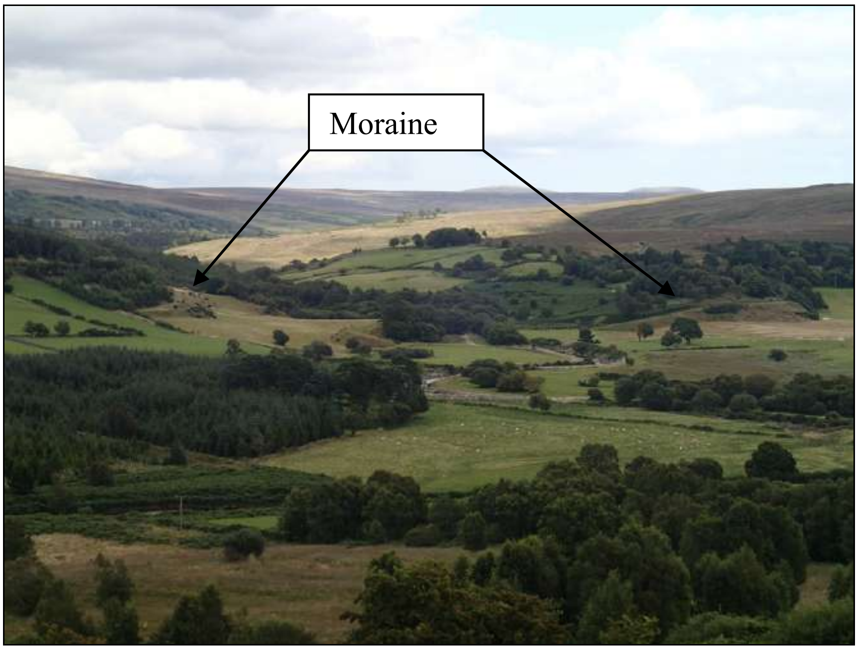
The feature is poorly exposed today as most of it has been quarried away, but in the 1950s Anthony Farrington of the Geological Survey of Ireland logged many gravel pits from the area in detail, as well as mapping the topography of the area. The sediments and topography reflect the deposition of the feature by meltwater flowing from the mountain ice cap whose margin lay immediately to the east. The feature itself actually comprises a small delta built in front of an earlier-deposited moraine.

The surface of the feature (before it was removed by quarrying) was close to the level of the main deltas at Blessington, and the two deltas clearly formed in the same lake at around the same time. The surface of this lake was at about 275m above modern day sea level.

The sediments forming the delta are all derived from granite, and this is not surprising as the ice cap to the east lay on granite bedrock also. In the remaining pit exposures, delta topsets and foresets are visible, which are well bedded sands and fine gravels.

Site Importance – County Geological Site
The feature is a good example of the type of topography which forms at the retreating margin of a melting ice sheet at the edge of an upland area. Though most of the feature has been removed, this is an important site in terms of our understanding of the glaciation of the Wicklow Mountains and still warrants inclusion as a CGS.

Management/promotion issues
This system comprises a fine landform sequence and should be listed as a County Geological Site. The hummocks and related features are best seen on a drive from Sally Gap to Kilbride, along the R759 road, about 1 kilometre southeast of the junction for Ballysmuttan Bridge and Blessington. Access to the pits themselves is by arrangement with the owner/operator.

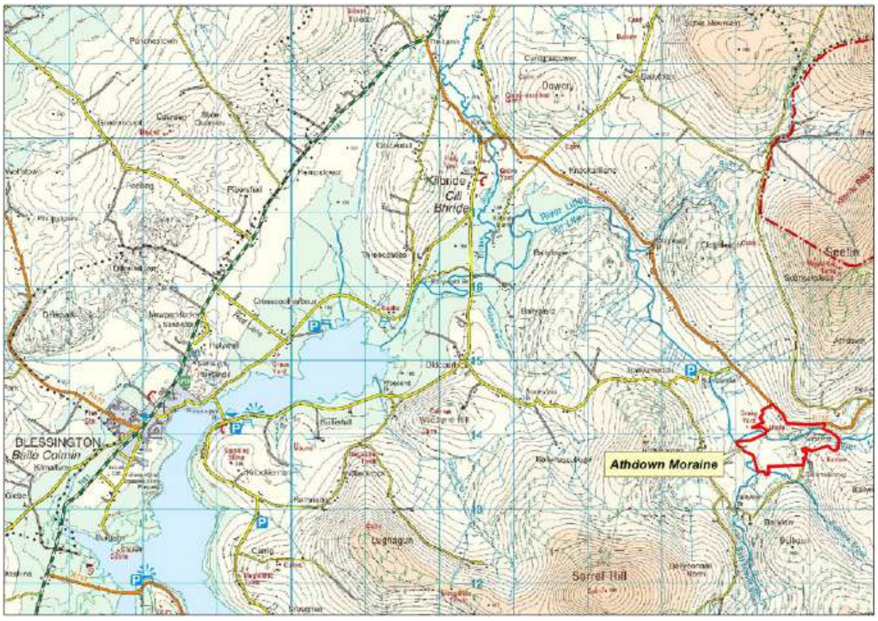


The Athdown Moraine, viewed from the west at Ballynatona.


Part of the remaining moraine hummocks, among a reclaimed gravel pit at Ballynabrocky.

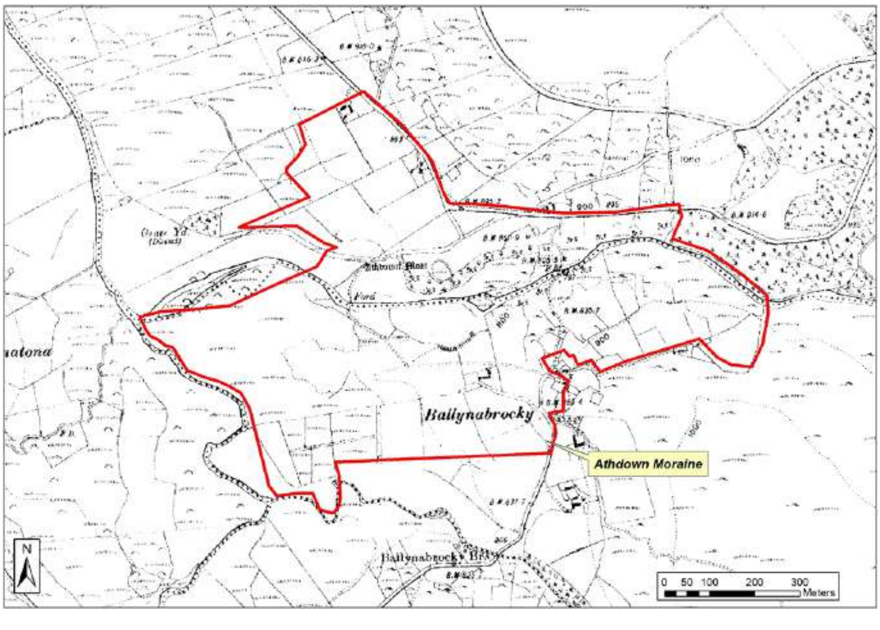

A view of the pits in the moraine, active from 1995.


Reworked gravels in the modern Ballydonnell Brook at Ballynabrocky.



BLESSINGTON
Baile Coimín
Kilbride
Cill Bhríde
Seefin
Lugnagun
Sorrel Hill
Athdown Moraine

Athdown Moraine
N
0 50 100 200 300
Meters



Ballynabrocky
Athdown Moraine
N
0 50 100 200 300
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Blessington Delta**
Other names used for site	Blessington Lake Delta Complex
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Deerpark, Dillonsdown, Newpaddocks, Blessington, Oldpaddocks, Santryhill, Edmondstown, Hoyvalley, Crosscoolharbour, Haylands**
NEAREST TOWN/VILLAGE	**Blessington**
SIX INCH MAP NUMBER	**5**
ITM CO-ORDINATES	**698000E 715700N (centre of feature)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
The Blessington Delta includes a large accumulation of sands and gravels which has been quarried extensively, just outside Blessington town.

Geological System/Age and Primary Rock Type
The 'delta' is comprised of deep glaciofluvial and glaciolacustrine sediments and bedrock is at great depths throughout the area of the feature. This bedrock is of Silurian age, and consists of greywackes and slates. The 'delta' is Quaternary in age, having been deposited at the edge of the northward-retreating ice sheet during deglaciation after the last Ice Age.

Main Geological or Geomorphological Interest
The delta is a striking feature, a large sand and gravel accumulation deposited into Glacial Lake Blessington by meltwaters flowing from the large ice dome covering the Irish Midlands at the end of the last ice age, while its margin lay along the northeast-southwest oriented ridge between Saggart and Ballymore Eustace. The delta was built out from this ridge into the lake, the surface of which was at about 275m above present sea level. The delta surface at this level can be viewed from the road from Blessington to Rathmore *via* Cross Chapel on the N81.

The delta is about 5 kilometres long and up to 1.5 kilometres wide. The sands and gravels are comprised largely of limestone from the Irish Midlands (no limestone bedrock occurs in Wicklow). The sediments are arranged in the typical delta sequence: topset gravels composed of up to 2m depth of horizontally bedded gravels on top; foreset gravels which are steeply dipping and well bedded, deposited at the front of the delta; and bottomset, finer sediments of sands and silts, usually underlying the foresets and representing sediment that was originally deposited beyond the steep delta front on the lake floor.

The sediments in the Blessington Delta are up to 90m deep, and the locality therefore represents some of the deepest glacially-derived sediments in the country. The delta feature is extremely important in unravelling the sequence of terrestrial deglaciation in the northern Irish Midlands at the end of the last ice Age.

Site Importance – County Geological Site; recommended for Geological NHA
The feature is a high, striking example of a dry sand and gravel ridge, and stands proud of the surrounding landscape. This is an excellent example of a deglacial, ice marginal, meltwater-deposited feature. The depth of sediment is extraordinary and the fact that the sediments are so well exposed and have been so well researched historically makes this one of the most important glacial sites in Ireland.

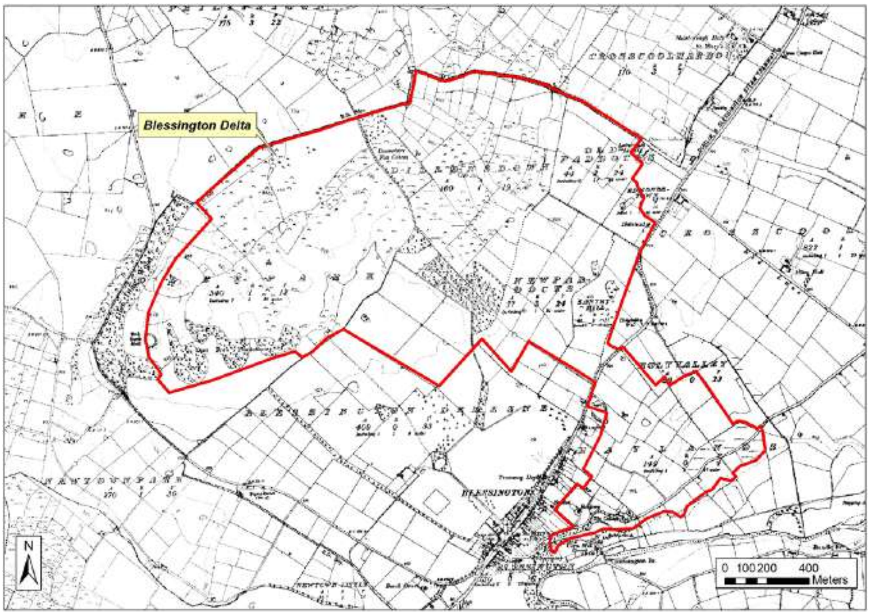
Management/promotion issues
Much of the delta has been removed by quarrying, and access to pits is by permission of the owners or operators and safety protocols must be followed.

Ripple structures and cross beds in fine sand, in one of the faces in the Blessington Pits.

Left: View over one of the large gravel pits in the Blessington Delta. Right: Calcreted gravels at the top of a face.


Philipstown
Sand Pits
Athgarrett
Blessington Delta
Dillonsdown
Threecastles
Crosscoolharbour
Castle
Deerpark
Newpaddocks
Sand Pits
Great
Barrow
Red Lane
Holywell
Sand Pits
Haylands
Grave Yard
Newtown Park
R410
Fire Stn.
Blessington Br.
Butterhill
332
BLESSINGTON
Baile Coimín
Standing Stone
Mound
Megalithic Tomb
Kilmalum
Knockiernan
Blackrock
N81
Indust Est
Blessington Lakes Pursuits Centre
Glebe
Glenmore
Rathnabo
Cairn
Burgage
Church
Castle
Carrig
Lughagu


Blessington Delta
N
0 100 200 400
Meters


Blessington Delta
BLESSINGTON
N
0 100 200 400
Meters

WICKLOW – COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Britonstown**
Other names used for site	Main channel also called 'The Glen'
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Bishopsland (Kildare), Britonstown (Wicklow)**
NEAREST TOWN/VILLAGE	**Ballymore Eustace (Kildare), Hollywood (Wicklow)**
SIX INCH MAP NUMBER	**9**
ITM CO-ORDINATES	**694596E 708490N (centre of channel)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
The Britonstown site comprises two interlocking glacial meltwater channels that were formed by meltwater erosion as water escaped from Glacial Lake Blessington at the end of the last Ice Age. The channels are oriented generally northeast–southwest or west-east, and extend for a distance of approx. 950m.

Geological System/Age and Primary Rock Type,
The feature is formed in an area of deep glacial sediments which have a 'scalped' appearance. The feature was etched out by meltwater during deglaciation at the end of the last Ice Age, about 12,000 years ago.

The bedrock in the locality is Silurian metasediments and volcanics, which are generally slates and schists.

Main Geological or Geomorphological Interest
The Britonstown channels are up to 30m deep and have a U-shaped profile, typical of meltwater channels. The base of the channels are dry.

The channels are considered to have formed completely in the late-glacial Period. Initially the channels may have been subglacial channels, formed under the ice, but later carried surface glacial outwash from Glacial Lake Blessington to the lowlands to the west. The channels carried large volumes of subglacial meltwater draining the lake which covered the area now inundated by the Pollaphuca Reservoir. This very high energy meltwater flow developed the channels' unusual depth and size.

Much of the sides of the channels are very steep, and are covered in scrub along most of their lengths. Only half of the southern channel is located in Wicklow; therefore the site extent only covers half of the feature.

Site Importance – County Geological Site
This is a site with good teaching potential on glacial meltwater erosion, as the feature is fairly accessible and easily viewed from roads. The feature lies within a proposed SPA (SPA 004063, Pollaphuca Reservoir), and NHA (NHA 000731), and the bridges over the channels are protected as they contain high arches and refuges from ca. 1830, designed by Alexander Nimmo.

Management/promotion issues
The roadside location of the channels means they are fairly accessible. However, there is no parking nearby and it is difficult to stop safely on the road. Promotion of the features along these roads is therefore not recommended.

The channels themselves and their origins should however be highlighted in any promotion of the above SPA, NHA or Protected Structure elements of the locality.

The Kildare element of the site needs to be incorporated into the audit for Kildare and a revision made to the County Development Plan in Kildare

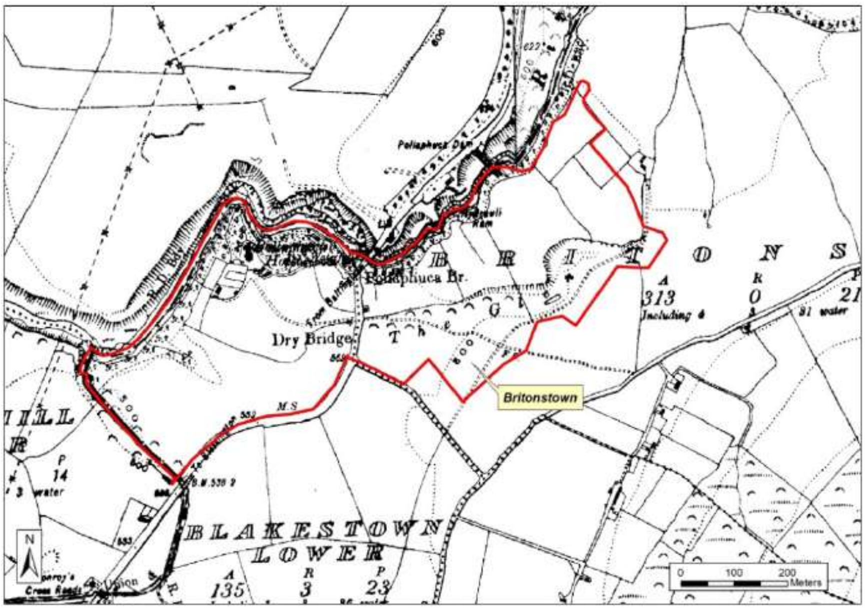

The main Britonstown channel, ‘The Glen’, looking northeast towards Pollaphuca Reservoir.


The adjacent channel, southwest of Pollaphuca Bridge.


The upper reaches of the main channel near the reservoir.


View south along the main channel, looking into Silverhill Townland in County Kildare.


BLESSINGTON
Baile Coimín
BALLYMORE EUSTACE
An Baile Mór
Britonstown
Pollaphuca Dam
Bishopslane
Russelstown
Rathballylong
Longstone
Boystown or Baltyboys Lower
Boystown or Baltyboys Upper
Lugnagroagh
Humphrystown
Blakestown
Carrigeen
Barretstown
Eadestown
Glebe
Glebe West
Greenhall
Broadleas Commons
Ballymore Eustace West
Dowdenstown
Tinnycross
Seasons
94
95
97
98
99

Britonstown
N
0
100
200
Meters

Pollaphuca Dam
Pollaphuca Br.
Dry Bridge
Britonstown
B R I T O N S T O W N
BLAKESTOWN LOWER
313
135
N
0
100
200
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Devil's Glen**
Other names used for site	Devil's Glen Forest, Devil's Punchbowl, Glanmore
IGH THEME	**IGH4 Cambrian-Silurian, IGH7 Quaternary, IGH14 Fluvial and Lacustrine Geomorphology**
TOWNLAND(S)	**Ballymoneen, Birchwood, Ballymaghroe, Tiglin, Boleynass, Boleynass Upper**
NEAREST TOWN/VILLAGE	**Ashford**
SIX INCH MAP NUMBER	**18, 19, 24, 25**
ITM CO-ORDINATES	**723800E 699050N (centre of feature)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
Devil's Glen comprises a deep ravine, oriented east-west, bounded by woodland, and stretches a distance of almost 3km. The Vartry River flows eastwards along the floor of the channel emptying into the Irish Sea near Wicklow town.

Geological System/Age and Primary Rock Type
The gorge is cut through Early Cambrian (c. 520 million years ago) bedrock consisting of greywackes and shales (Bray Group). The gorge is a glacial meltwater channel (Quaternary) and formed around the time of deglaciation at the end of the last Ice Age.

Main Geological or Geomorphological Interest
Devil's Glen is a steep-sided ravine c. 1km southeast of Vartry Reservoir. In less than 3km, the glen carries the Vartry River across the eastern rim of the Vartry basin and down to the Wicklow coastal plain at Nun's Cross, c. 100m below the level of the Vartry basin floor. An impressive waterfall drops into a pool (the Devil's Punchbowl) at the west end of the gorge from where it flows gently eastwards through the glen. The sides of the gorge rise steeply c. 100m above the river bed to heights of 166m OD at View Rock, on the north bank of the river, c. 500m north of the parking area. View Rock (GR 724650 699100) is the type locality (the locality where the rock formation was originally described) for the Devil's Glen Formation (Cambrian-age Bray Group). This formation of green and red greywacke and shale is the older of the two Cambrian formations in Wicklow (the other is the Bray Head Formation). Rising near Great Sugar Loaf, the Vartry River flows south through Vartry Reservoir, veering southeast and east through Devil's Glen, and on to the sea at Broad Lough, north of Wicklow town. The lower reservoir was completed in 1863 (max. depth c. 18m), and the upper reservoir completed in 1923 (max. depth c.15m). Construction of the reservoir greatly regulated and reduced the discharge of water through Devil's Glen. (It has been suggested that were it not for Devil's Glen, the Vartry Basin would be occupied by a large lake.) No specific dates or detailed studies have been carried on the gorge feature. However, it is considered to have formed completely in the late-glacial period.

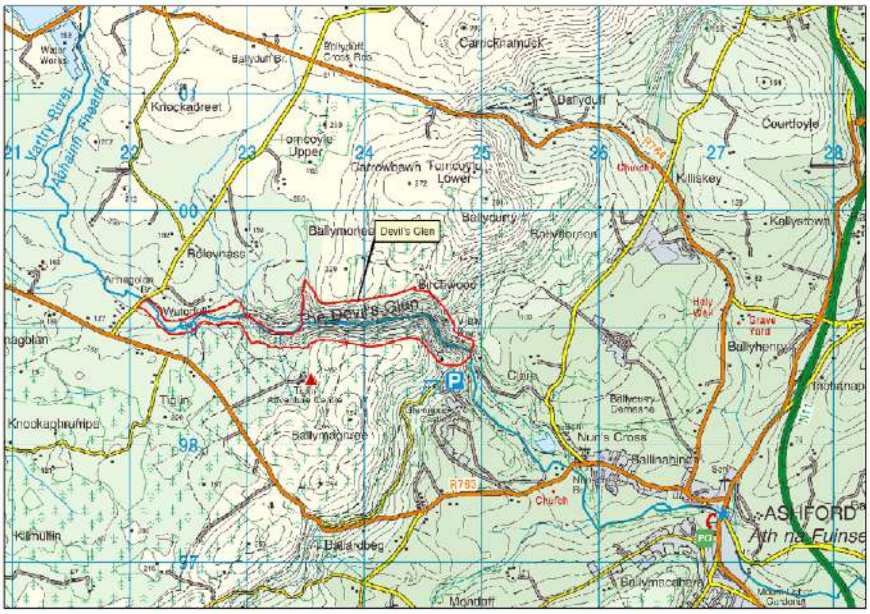
Site Importance - County Geological Site
The site is within a proposed NHA (Devil's Glen, 000178). Devil's Glen Forest is owned by Coillte. The location has good potential as a teaching site on glacial meltwater erosion, and whilst it is a macro-landform, the scale of the ravine can be appreciated by observing the ravine-sides towering over the mature broadleaf woodland growing along the river bank.

Management/promotion issues
The site is accessible via the trails developed by Coillte in the woods along the south bank. The Waterfall Walk follows a route alongside the Vartry River in the ravine floor. A sculpture trail, *Sculpture in Woodland* (1994), also follows a route along the ravine floor. (The Seamus Heaney walk follows a route through the woods). The erection of a geology/landform information panel at the forest entrance, alongside the existing visitor information panel, would be a valuable inclusion at this recreational forest.

Devil's Glen (just east, downstream from waterfall). Waterfall Walk and Coillte woods on right (south) bank.

Cascades over Cambrian greywackes just upstream from the river bend to south (east end of Devil's Glen).

View downstream along the Woodland Walk on the south bank of the Vartry River.


Devil's Glen
The Devil's Glen
Ballymoneen
Roundwood
Knockadreet
Tomcoyle Upper
Tomcoyle Lower
Carrowbawn
Ballycurry
Ballyhenny
Killiskey
Courtoyle
Kellystown
Nun's Cross
ASHFORD
Áth na Fuinse
Ballinahinch
Ballymagruge
Ballardbeg
Knockaghruhipe
Kilmullin
Church
Holy Well
Grave Yard
R763
Carrickramuck
Ballyduff
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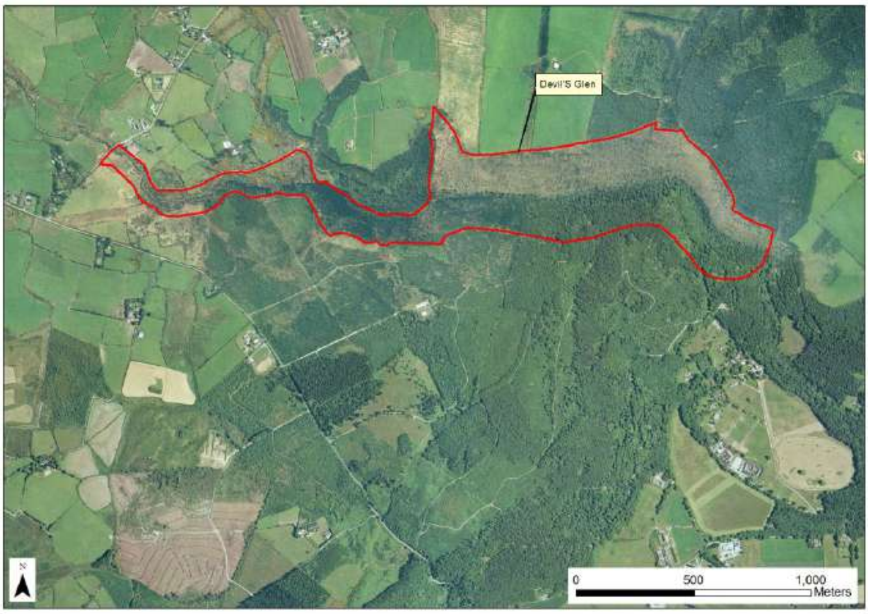
Devil'S Glen
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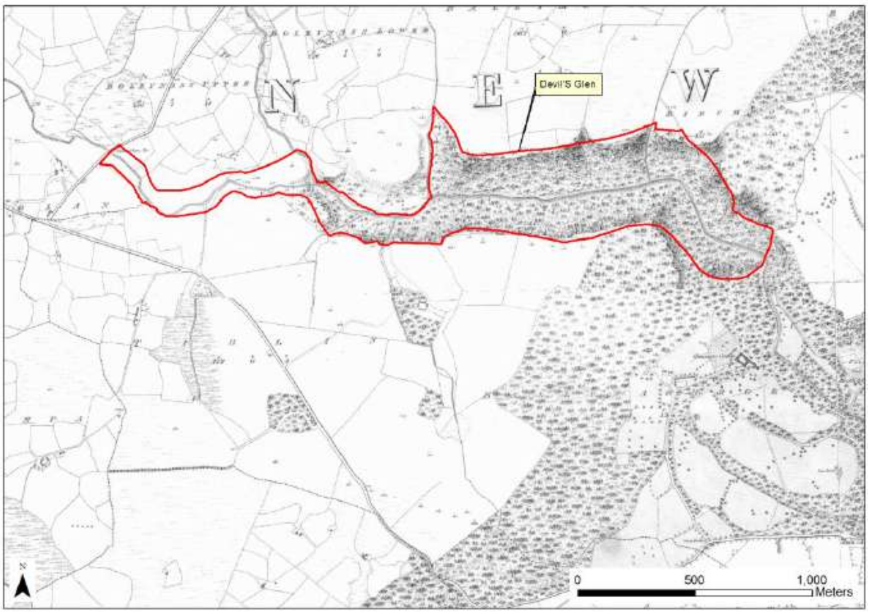
Devil'S Glen
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Meters

WICKLOW – COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Dunran Channel**
Other names used for site	
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Dunran, Moorstown, Carrignamuck, Killiskey, Ballyduff**
NEAREST TOWN/VILLAGE	**Newcastle**
SIX INCH MAP NUMBER	**19**
ITM CO-ORDINATES	**727080E 702590N (centre of channel)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
The Dunran comprises a deep channel that was formed by meltwater erosion on the eastern flank of the Wicklow Mountains. The channel is oriented generally north–south, and extends for a distance of approx. 3 kilometres.

Geological System/Age and Primary Rock Type,
The feature is formed in an area of bedrock outcrop and subcrop, and bedrock outcrops along the majority of the channel sides, giving the feature its 'carved out' appearance. The feature was etched out by meltwater during deglaciation at the end of the last Ice Age, about 12,000 years ago.

The bedrock in the locality is dominated by greywacke and quartzite of Cambrian age.

Main Geological or Geomorphological Interest
The Dunran channel is up to 80m deep and has a U-shaped profile, typical of meltwater channels. The base of the northern portion of the channel is dry, but springs emerge in the grounds of Dunran Castle and form a stream that flows along the base of the channel and exits to the south.

The Dunran Channel is considered to have formed completely in the late-glacial Period. Initially the Dunran Channel was a subglacial channel, formed under the ice, but later carried surface glacial outwash southwards from an ice margin just to the north. The channel carried huge amounts of subglacial meltwater draining the ice sheet which extended into Wicklow from the Irish Sea Basin. This very high energy meltwater flow resulted in the Dunran Channel's unusual depth and size.

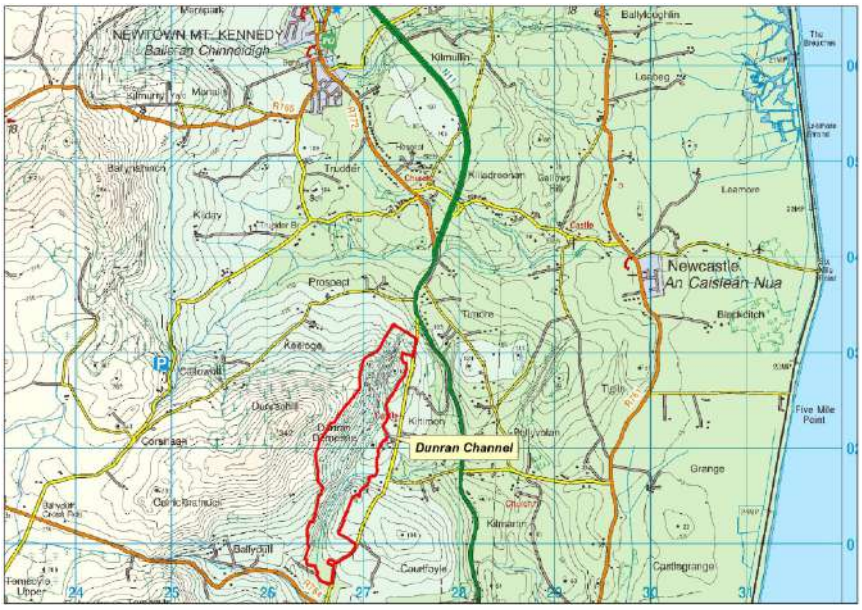
Much of the sides of the channel are very steep, and are covered with coniferous forestry today. The glen has an irregular long profile, which means that meltwater was under huge pressure from ice above, thus proving that the channel was initially subglacial in origin. The channel probably extended further southwards but its southern portion was blocked by ice marginal sediments which forced drainage later in deglaciation to flow southeastwards towards Ashford.

Site Importance – County Geological Site
This is a site with good teaching potential on glacial meltwater erosion, as the feature is accessible, quite spectacular, and easily viewed from roads.

Management/promotion issues
The location of the channel just off the N11 means it is easily accessible, although the flanks are located presumably in private ownership or in commonage. However, there is no parking nearby and it is difficult to stop safely on the road. A good impression of the feature can be had by looking south from the highpoint of the N11 as it passes by Newtown Mount Kennedy. The road then passes below the Dunran channel through the Kiltimon channel which was formed later by meltwater flowing southwards, marginal to the ice.

The Dunran Channel, viewed from the N11 to the north.

The southern end of the Dunran channel, where the feature is cutting through till sediment.
See the outcropping rock along the shoulder of the channel in the distance.


NEWTOWN MT. KENNEDY
Baile an Chinnéidigh
Kilmullin
Ballyloughlin
Trudder
Killadreenan
Kiddy
Castle
Newcastle
An Caisleán Nua
Prospect
Kealoge
Leamore
Blackditch
Dunranhill
Tiglin
Five Mile Point
Dunran Channel
Ballyvolan
Grange
Kilmurry
Cottfoyle
Castlegrange
Ballydull
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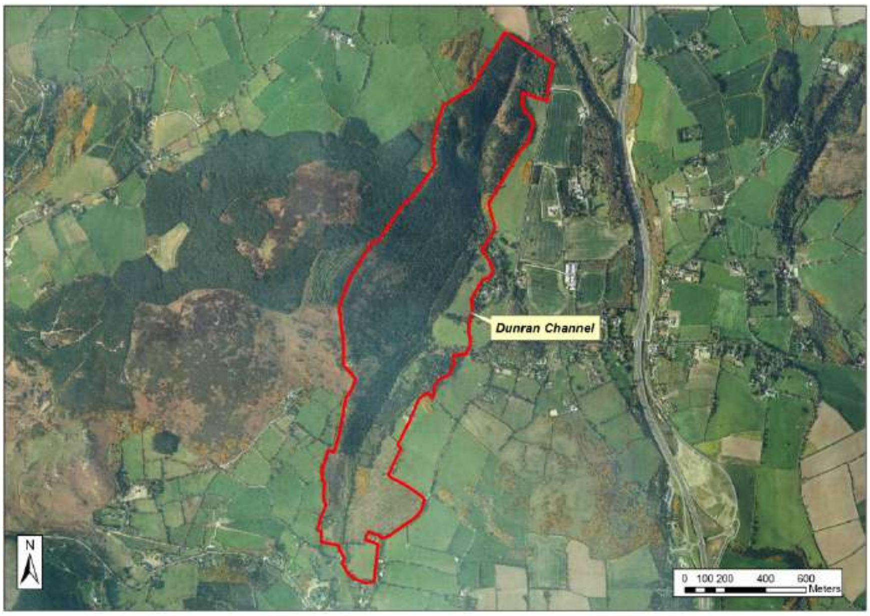
Dunran Channel
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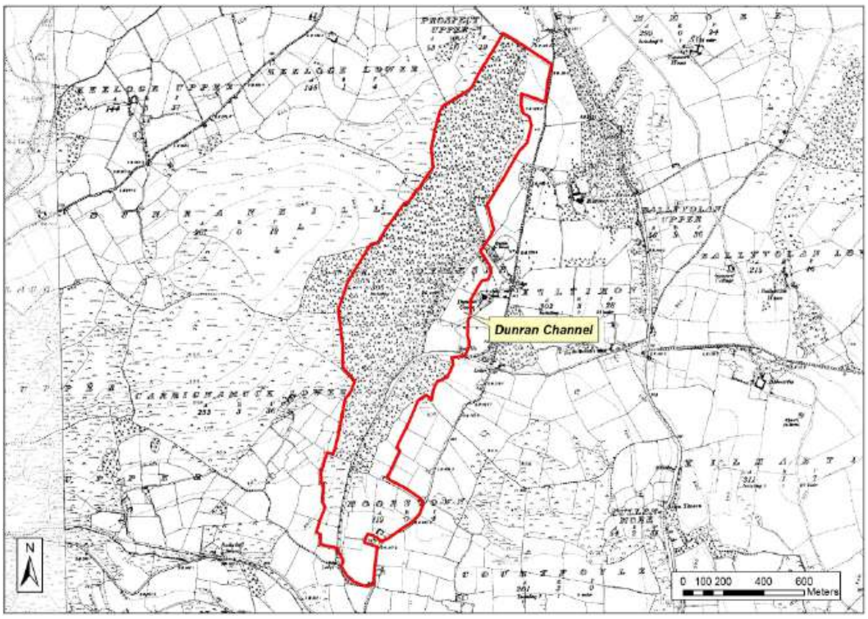

Dunran Channel
N
0 100 200 400 600
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Enniskerry Delta**
Other names used for site	Fassaroe Delta
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Fassaroe**
NEAREST TOWN/VILLAGE	**Enniskerry**
SIX INCH MAP NUMBER	**3, 4, 7, 8**
ITM CO-ORDINATES	**723500E 717600N (centre of feature)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
The Enniskerry Delta includes a large accumulation of sands and gravels which has been quarried extensively historically, just outside Enniskerry town.

Geological System/Age and Primary Rock Type
The 'delta' is comprised of deep glaciofluvial and glaciolacustrine sediments and bedrock is at great depths throughout the area of the feature. This bedrock is of Ordovician age, and consists of greywackes, schists and slates. The 'delta' is Quaternary in age, having been deposited at the edge of the northward-retreating ice sheet during deglaciation after the last Ice Age.

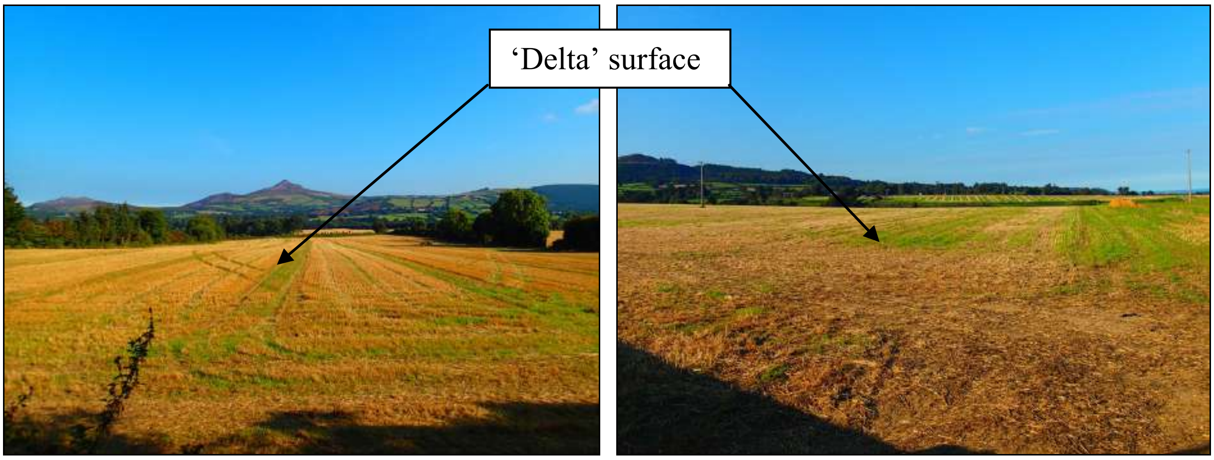
Main Geological or Geomorphological Interest
The delta is a striking feature, a large sand and gravel accumulation deposited into Glacial Lake Enniskerry by meltwaters flowing from ice of the large glacier which occupied the Irish Sea and encroached inland into Wicklow, as it stood between Carrickgollogan and Bray Head. The delta was built out from this ridge into the lake, the surface of which was at about 100m above present sea level. The delta surface at this level can be viewed from the road from Old Connaught to Enniskerry, where one gets an impression of this large, level surface dissected by the small stream that flows from the mouth of The Scalp.

The delta is just under 3 kilometres long and up to 2.5 kilometres wide, covering an area of approximately 6 square kilometres. The 'sands and gravels' are comprised largely of limestone from the Irish Midlands (no limestone bedrock occurs in Wicklow). The sediments are arranged in the typical delta sequence: topset gravels composed of up to 2m depth of horizontally bedded gravels on top; foreset gravels which are steeply dipping and well bedded deposited at the front of the delta; and bottomset, finer sediments of sands and silts, usually underlying the foresets and representing sediment that was originally deposited beyond the steep delta front on the lake floor. There are many old gravel pits in the area around Fassaroe itself, but exposure is poor today.

The delta also affords a very fine view of the Scalp to the northwest, through which much of the sediment making up the delta feature passed. To the south, the low point on the skyline between the two Sugar Loaves indicates the position of the Glen of the Downs.

Site Importance – County Geological Site
The feature is a high, striking example of a dry sand and gravel ridge, and stands proud of the surrounding landscape. This is an excellent example of a deglacial, ice marginal, meltwater-deposited feature.

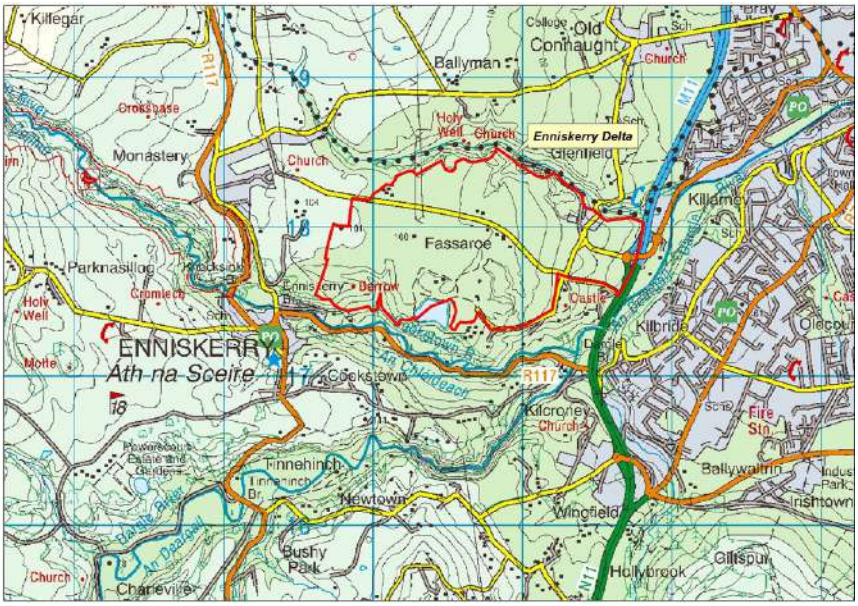
Management/promotion issues
Much of the delta has been removed by quarrying, and access to pits is by permission of the owners or operators and subject to safety protocols. Viewing from the Old Connaught to Enniskerry road, as detailed above, is the best means of viewing the delta surface.

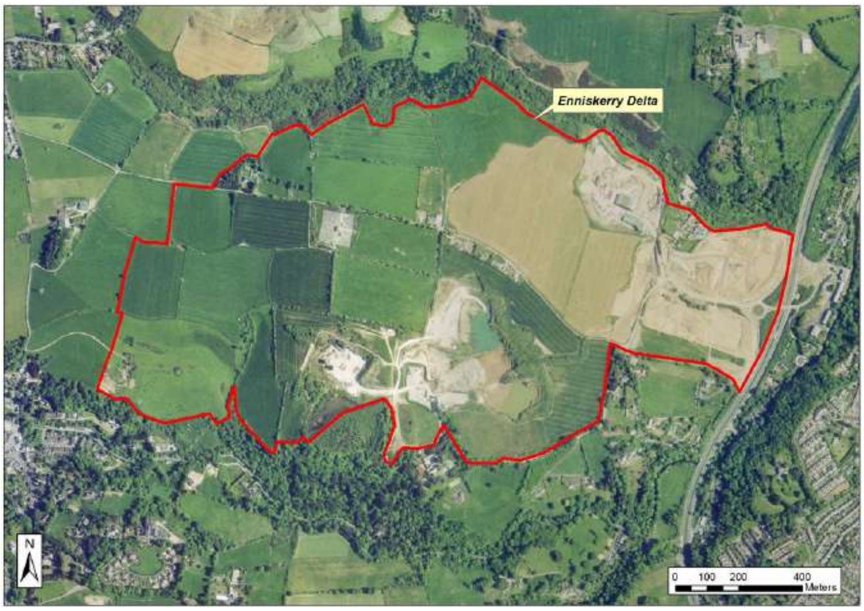


Two views across the flat surface of the Enniskerry Delta at Fassaroe.

View southwest towards Powerscourt Estate, across the delta feature.

Small channel at the edge of the southern edge of the delta near Fassaroe House.


Killegar
Old Connaught
Ballyman
Holy Well
Church
Enniskerry Delta
Glenfield
Monastery
Fassaroe
Parknasillog
Cromlech
Holy Well
Barrow
Castle
ENNISKERRY
Áth na Sceire
Cookstown
R117
M11
Kilbride
Kilcroney
Church
Fire Stn
Motte
Finnehinch
Newtown
Ballywaltrin
Irishtown
Wingfield
Bushy Park
Hollybrook
Giltspur
Church
Charleville
Dargle River
N11


Enniskerry Delta
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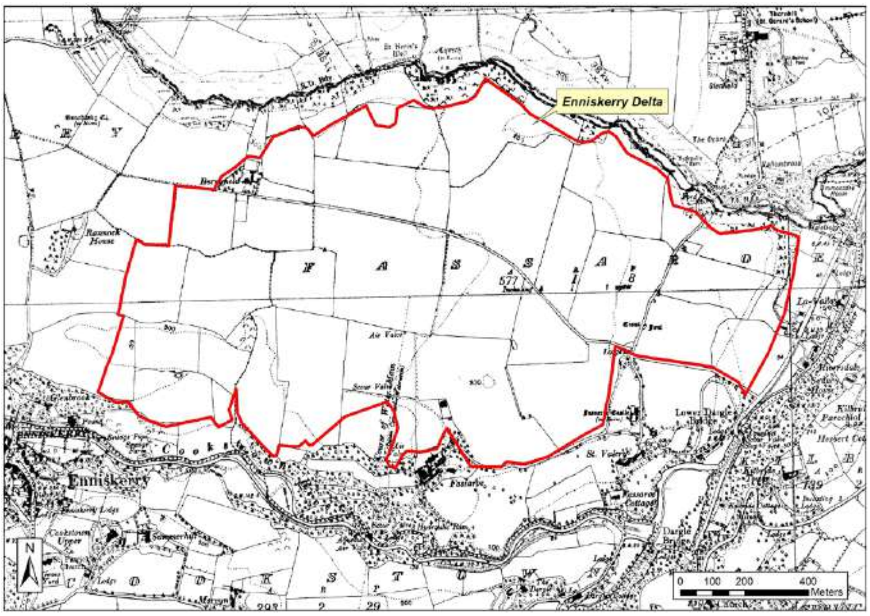

Enniskerry Delta
F A S S A R O E
Enniskerry
N
0 100 200 400
Meters

WICKLOW – COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glen Ding**
Other names used for site	
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Deerpark (Wicklow)** **Athgarret, Newtownpark (Kildare)**
NEAREST TOWN/VILLAGE	**Blessington**
SIX INCH MAP NUMBER	**5**
ITM CO-ORDINATES	**696260E 715600N (centre of channel)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
Glen Ding comprises a deep channel that was formed by meltwater erosion on the northwestern flank of the Wicklow Mountains. The channel is oriented generally northeast–southwest, and extends for a distance of just over 1 kilometre.

Geological System/Age and Primary Rock Type,
The feature is formed in an area of bedrock outcrop and subcrop and bedrock outcrops along the channel side at the northwest. The feature was etched out by meltwater during deglaciation at the end of the last Ice Age, about 12,000 years ago.

The bedrock in the locality is dominated by greywacke of Silurian age.

Main Geological or Geomorphological Interest
Glen Ding is up to 50m deep and has a U-shaped profile, typical of meltwater channels. The base of the channel is dry, although a shallow drainage ditch has been dug along much of the southern portion to channel excess surface water during heavy rainfall. The channel is curved at the southern end, opening up into an area of deep glacial sediments.

Glen Ding probably formed following the deposition of the majority of the Blessington Delta Complex into Glacial Lake Blessington, prior to full withdrawal of glacial ice from the area. The highest point of the channel is at the northern end, which suggests that it was an overflow channel rather than a tunnel valley, at least in its final stages of development. The channel seems to have been the final one opened up while the Blessington Delta was deposited, just before ice finally retreated from the area. However, its exact position in the sequence in the development of the Blessington Delta is still uncertain.

Sands and gravels a few metres thick cover the southeastern shoulder of the channel. As well as this, roche moutonnees are present where the ground rises beyond the glen to the west.

Site Importance – County Geological Site
This is a site with some teaching potential on glacial meltwater erosion, as the feature is accessible, quite spectacular, and can be viewed from the road running through it.

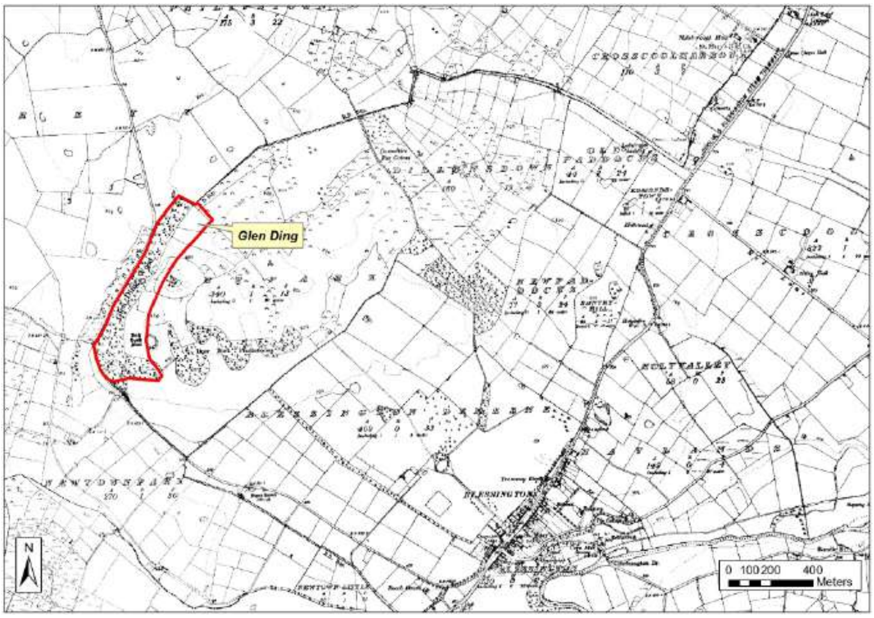
Management/promotion issues
The location of the channel with the R410 road passing through it means it is easily accessible, although the flanks are located presumably in private ownership. However, there is no parking in the centre of the channel and it is difficult to stop safely on the road. Much of the site is also very steep and heavily wooded making access difficult. Not suitable for general promotion without permission from the landowner and a safe access point.

Glen Ding, viewed from the central portion and looking southeast.

Looking northeast into Glen Ding; see the lorry passing through the channel for scale.

Philipstown
Sand Pits
Athgarrett
Dillonsdown
Threecastles
Crosscoolharbour
Castle
Deerpark
Newpaddocks
Great
Barrow
Glen Ding
Holywell
Red Lane
Sand Pits
Haylands
Grave Yard
PO
Newtown Park
R410
Coll
Fire Stn
Sch
Blessington Br.
Butterhill
BLESSINGTON
Baile Coimín
Standing Stone
Mound
Megalithic Tomb
Kilmalum
Indust Est.
Knockiernan
Blackrock
Blessington Lakes Pursuits Centre
N81
Glebe
Glenmore
Rathnabo
Burgage
Cairn
Church
Castle
Carrig

Glen Ding
N
0 100200 400
Meters



Glen Ding
BLESSINGTON
N
0 100200 400
Meters

WICKLOW – COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glen of the Downs**
Other names used for site	*Gleann da Ghrua*, The Valley of the Two Brows
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Bellevue Demesne, Woodlands**
NEAREST TOWN/VILLAGE	**Delgany**
SIX INCH MAP NUMBER	**8, 13**
ITM CO-ORDINATES	**725990E 711250N (centre of channel)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
The Glen of the Downs comprises a deep channel that was formed by meltwater erosion on the northeastern flank of the Wicklow Mountains. The channel is oriented generally northwest–southeast, and extends for a distance of approximately 2 kilometres.

Geological System/Age and Primary Rock Type,
The feature is formed in an area of bedrock outcrop and subcrop and bedrock outcrops along the majority of the channel sides, giving the feature its' 'scalped' appearance. The feature was etched out by meltwater during deglaciation at the end of the last Ice Age, about 12,000 years ago.

The bedrock in the locality is dominated by greywackes and quartzites of Cambrian age.

Main Geological or Geomorphological Interest
The Glen of the Downs is up to 100m deep and has a V-shaped profile. The base of the channel hosts a small stream, which seems tiny given the depth of the channel itself. Such streams, flowing through deep, relict glacial meltwater channels, are thus called 'misfit' streams.

The Glen of the Downs is considered to have formed completely in the Late-Glacial Period. Initially the glen was a subglacial channel, formed under the ice, but later carried surface glacial outwash from Glacial Lake Enniskerry southwards. As well as this, the channel carried huge amounts of subglacial meltwater draining the ice sheet which extended into Wicklow from the Irish Sea Basin. This very high energy meltwater flow resulted in the Glen of the Downs' unusual depth and size.

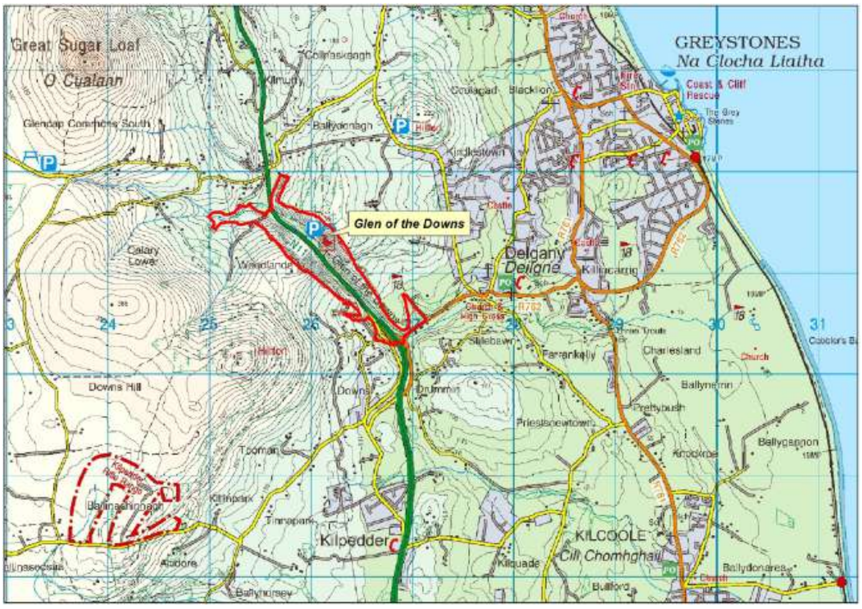
Much of the sides of the channel are very steep, and are nowadays covered in broadleaf forestry. The glen has an irregular long profile, which means that meltwater was under huge pressure from ice above, thus proving that the channel was initially subglacial in origin. The channel probably extended further southwards but its southern portion was blocked by ice marginal sediments which forced drainage from the later glacial lake to flow eastwards towards Delgany.

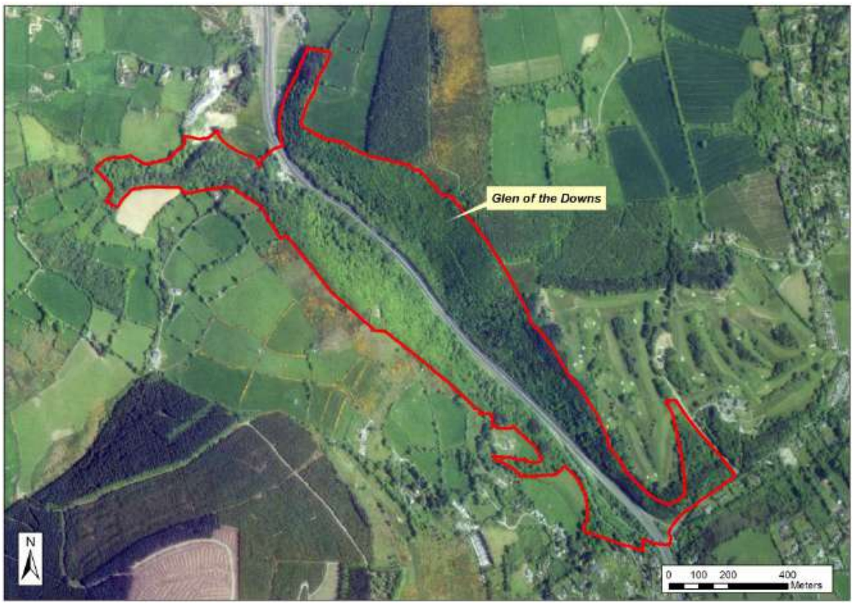
Site Importance – County Geological Site; recommended for Geological NHA
This is a site with excellent teaching potential on glacial meltwater erosion, as the feature is accessible, spectacular, and easily viewed from roads. The N11 passes through the feature and the glen is already an SAC and proposed NHA (Site Code 000719).

Management/promotion issues
The location of the channel with a road passing through it means it is easily accessible, although the flanks are located presumably in private ownership or in commonage. However, there is no parking in the centre of the channel and it is inadvisable to stop on the N11 road. There is a car park in the glen off the N11 from which its northeast slopes can be accessed, but its size and context can probably be better appreciated viewing it from the narrow road which climbs from Delgany to cross the hill immediately southeast of the glen. This is best approached on foot from Delgany as it is narrow and there are no convenient parking spaces.

The Glen of the Downs, viewed from the south.

The Glen of the Downs, viewed from the northeast.


Great Sugar Loaf
O Cualann
GREYSTONES
Na Clocha Liatha
Glen of the Downs
Delgany
Deilgne
Kilpedder
KILCOOLE
Cill Chomhghaill
Downs Hill
Charlesland
Ballygannon


Glen of the Downs
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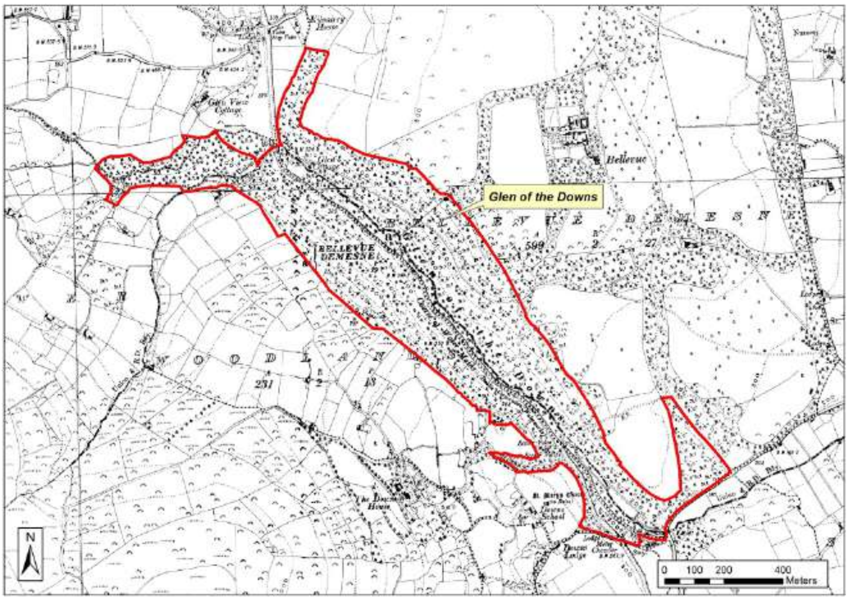

Glen of the Downs
N
0 100 200 400
Meters

The Glen of the Downs, from ‘The Scenery and Antiquities of Ireland, 1841, by J. Stirling Coyne and N. P. Willis.

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glendalough Valley**
Other names used for site	*Gleann Dá Loch* (glen of the two lakes), Van Diemen's Land (mining locality at head of valley)
IGH THEME	**IGH7 Quaternary, IGH 14 Fluvial and Lacustrine Geomorphology, IGH15 Economic Geology**
TOWNLAND(S)	**Sevenchurches, Lugduff, Derrybawn, Brockagh**
NEAREST TOWN/VILLAGE	**Laragh**
SIX INCH MAP NUMBER	**23**
NATIONAL GRID REFERENCE	**709154E 696318N (centre of valley)**
1:50,000 O.S. SHEET NUMBER	**56 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description

The Glendalough Valley is a deep glacial valley in the central Wicklow Mountains. The mine site within it sits at the head of the Upper Lake, where siltation has led to development of a wetland. 'Van Diemen's' Land is an isolated mine site further up the valley, on high ground.

Geological System/Age and Primary Rock Type

The bedrock is Lugnaquillia Granodiorite, part of the Lugnaquillia Pluton which is one of the five plutons that comprise the late-Caledonian (405 Ma) Leinster Granite batholith. The granite is cut by slightly younger quartz veins containing lead and zinc mineralization. The contact between the granite and schists of the Lower Palaeozoic Maulin Formation runs through the site immediately east of the mine area. The valley itself and the glacial features within it date from the last Ice Age.

Main Geological or Geomorphological Interest

Glendalough is a marvellous example of a glaciated U-shaped valley, with oversteepened cliff sides and a flat floor. At the mouth of the glen where it meets Glendasan is a delta, which formed at the end of the last Ice Age in a lake that reached a higher level than either of the present lakes. Above the delta, to the north, is a fine medial moraine deposited between the ice of the Glendalough and Glendasan glaciers as they decayed during deglaciation. The two lakes at Glendalough are separated by a broad, low alluvial fan deposited by water from the high level valley to the south of Glendalough. At the upper end of the Upper Lake, at the so-called "Miners Village", is a modern delta building out into the lake, which is in turn gradually shrinking in size.

The "Miners Village" was in fact a processing area for ore mined from the Luganure lode that runs northwards through Camaderry mountain to Luganure in Glendasan. Adits were driven northwards along the lode in the 1850s to connect with those driven earlier southwards from Luganure. A crusher plant was built and ore produced in Luganure was then brought to the Glendalough site for processing. Between 1913 and 1925 a small operation was run to recover Pb (lead) from the waste rock in the valley. Mine features include several adits, the ruins of the Roll Mill house, forge and offices as well as a stone hopper (ore bin/chute) and cobbled dressing floor. A small 20th-century roll crusher presumably dates from the period between 1913 and 1925 when waste was reworked to extract Pb. The Van Diemen's site, which was linked to Glendalough by a tramway, contains numerous small waste heaps, the remains of a crusher house and office, several flooded shafts and a collapsed adit. The rare mineral Pyromorphite has been found in the dumps here. The contact between the granite and its wallrocks is well exposed at the eastern end of the site.

Site Importance – County Geological Site; recommended for Geological NHA

The Glendalough site is a superb example of a glacial valley. Its abundant, accessible mine features add considerable interest to the site. It merits consideration as a Geological NHA.

Management/promotion issues

The site is within the Wicklow Mountains SAC, SPA and proposed NHA, as well as the National Park. Some signboards have been erected but further information could be provided. The crusher house may require conservation.

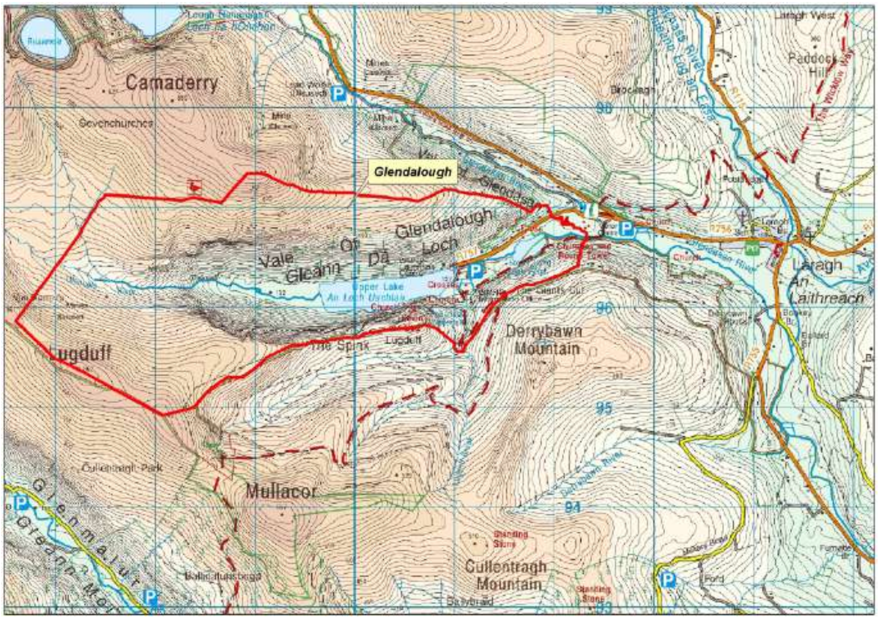

The Glendalough Valley, including the Upper Lake.


Spoil heaps below adits above the “Miners Village”.


Boulder scree along the northern flank of the valley.


Spoil heaps at van Diemens Land.


Panorama of Glendalough, from the west.


Glendalough
Camaderry
Sevenchurches
Vale Of Glendalough
Gleann Dá Loch
Upper Lake
The Spink
Lugduff
Derrybawn Mountain
Mullacor
Cullentragh Mountain
Cullentragh Park
Laragh
An Láithreach
Paddock Hill

Glendalough
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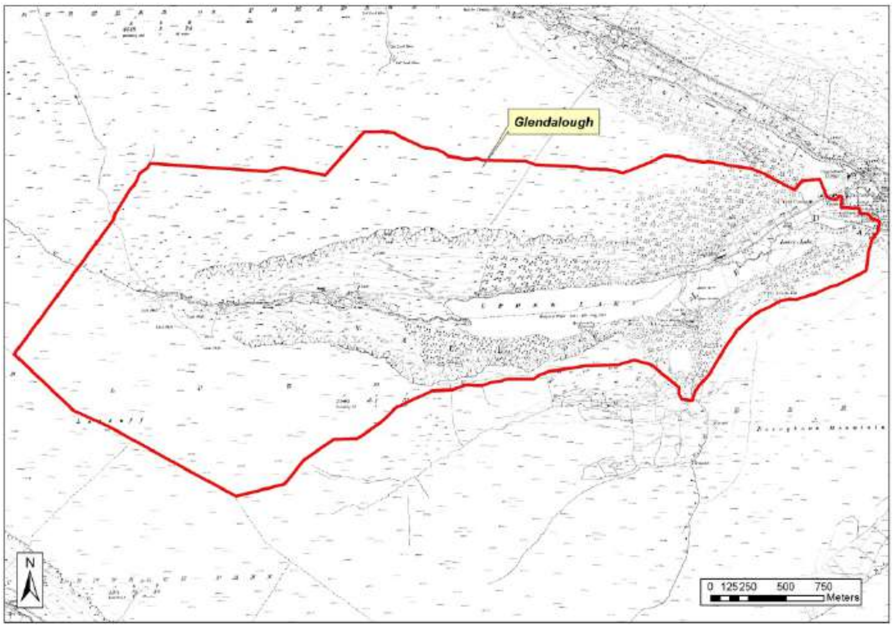
Meters

Glendalough
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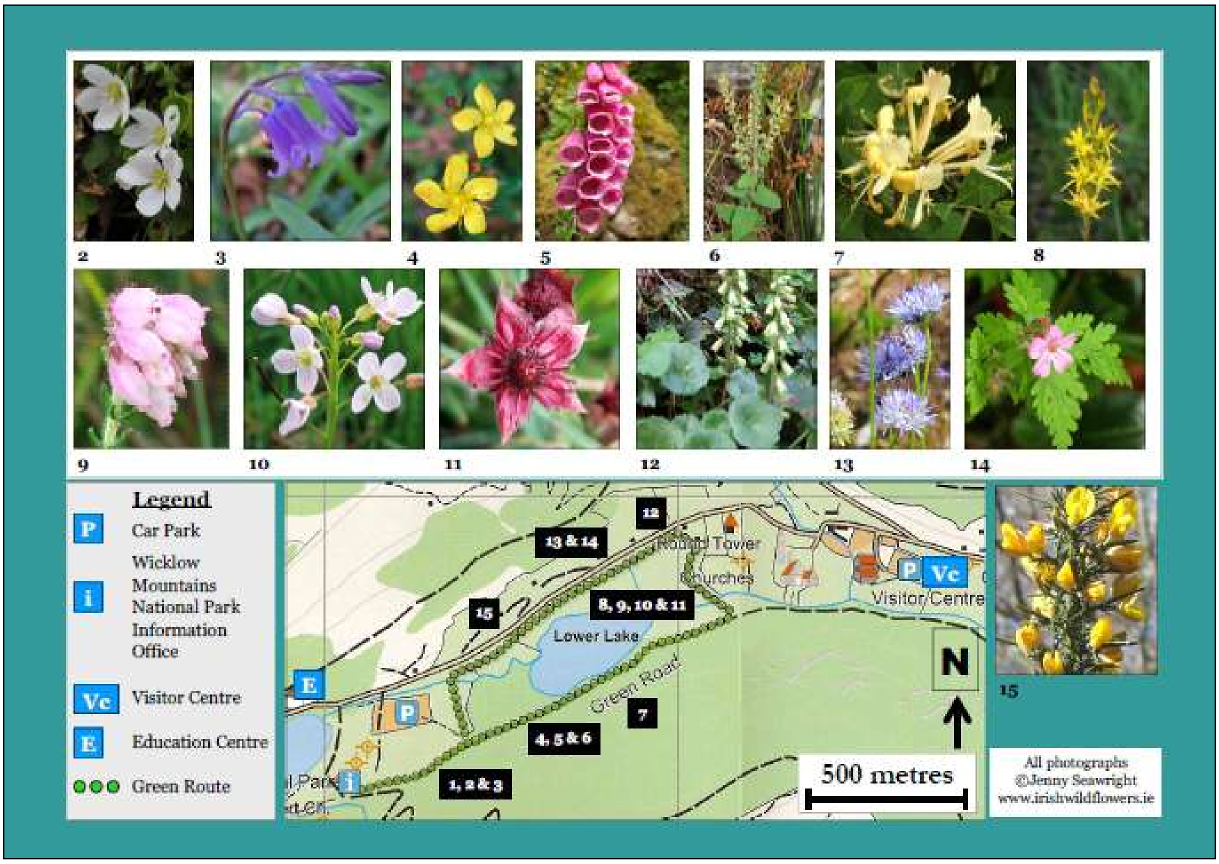


Walking tour of the Glendalough Valley, following flowers. Several themes have been produced (birds, trees, bugs). Such or similar material could potentially include a geological element.

George Victor du Noyer's painting of Glendalough from the nineteenth century, viewed from the north slope of Derrybawn Mountain and looking west.

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glenmacnass Valley**
Other names used for site	*Gleann Log an Easa*, meaning "The glen of the hollow of the waterfall"
IGH THEME	**IGH7 Quaternary, IGH11 Igneous Intrusions, IGH 14 Fluvial and Lacustrine Geomorphology**
TOWNLAND(S)	**Laragh, Drummin, Brockagh**
NEAREST TOWN/VILLAGE	**Laragh**
SIX INCH MAP NUMBER	**17**
NATIONAL GRID REFERENCE	**711450E 702808N (at waterfall)**
1:50,000 O.S. SHEET NUMBER	**56 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description
The Glenmacnass Valley is a deep glacial valley in the central Wicklow Mountains. It separate Tonelagee and Brockagh mountain from Scarr Mountain.

Geological System/Age and Primary Rock Type
The bedrock in the upper portion of the valley is porphyritic granite, part of the Lugnaquillia Pluton which is one of the five plutons that comprise the late-Caledonian (405 Ma) Leinster Granite batholith. The contact between the granite and slate and schists of the Lower Palaeozoic Maulin Formation runs through the site, picked out by the waterfall locality. The valley itself and the glacial features within it date from the last Ice Age.

Main Geological or Geomorphological Interest
Glenmacnass is a stunning example of a glaciated U-shaped valley, with oversteepened cliff sides and a flat floor. The valley contains a number of moraines marking positions of the ice front as it retreated back towards the source area of the ice in the centre of the mountains. An especially impressive moraine occurs about half way between the waterfall and Laragh and can be seen as a boulder-strewn mound running right across the valley.

From the viewing point just east of the waterfall, a number of smaller moraines are seen to the east of the river. These are elongate with the valley and face towards the cliff face west of the river. They were deposited at the front of a small glacier that remained here in the shelter of Tonelagee, after ice in the rest of the lower part of the valley had melted. Linear accumulations of boulders close to the waterfall but following the trend of these moraines were deposited either at the margin of this small glacier or snow patch. They probably accumulated by funnelling and sliding down the glacier/snow patch.

The waterfall on the Glenmacnass River has three staggered drops along a vertical distance of about 80m, and falls across whitish to grey-coloured, smooth granite bedrock. On each side of the waterfall further down-valley, dark grey to black, jagged schist rock can be seen cropping out. The waterfall has therefore formed at the boundary between these two rock types.

The river flowing down the valley has beautiful meander bends and small islands within it, typical of a river depositing much of its load within and across its floodplain.

Site Importance – County Geological Site; recommended for Geological NHA
The Glenmacnass site is a superb example of a glacial valley, also with a waterfall at the junction of two rock types. Its abundant and unusual moraine features add considerable interest to the site, and it merits consideration as a Geological NHA.

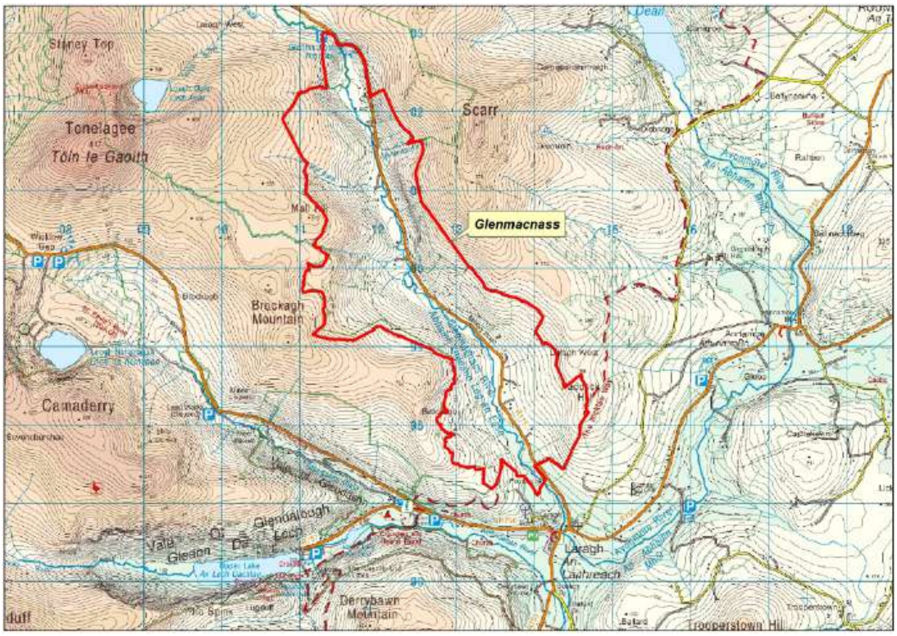
Management/promotion issues
The site is currently outside the Wicklow Mountains SAC, SPA and proposed NHA, but is within the National Park. A car-park exists just north of the waterfall locality, and a signboard at the waterfall itself would prove useful in terms of explaining various geological aspects of the valley.

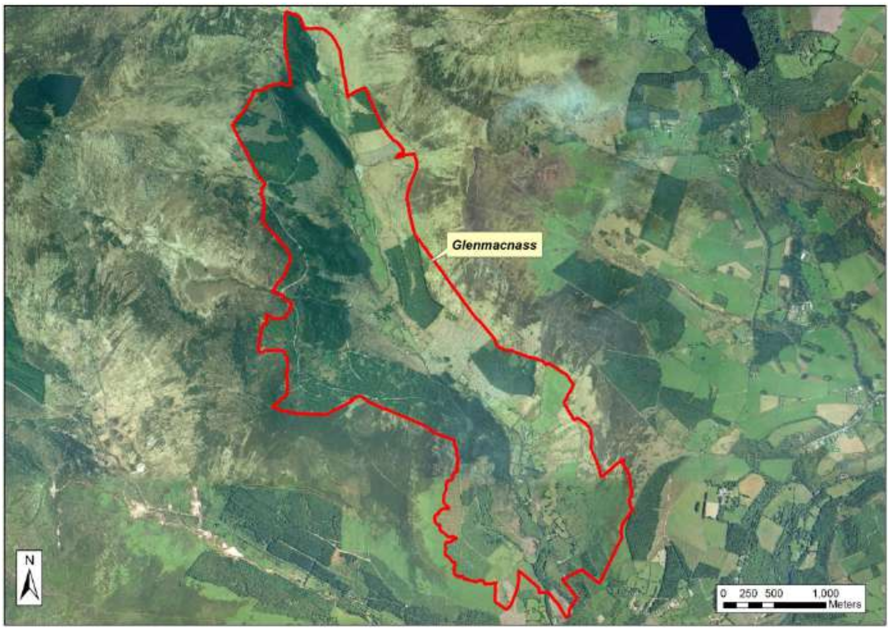
The Glenmacnass Waterfall, falling across smooth granite bedrock.

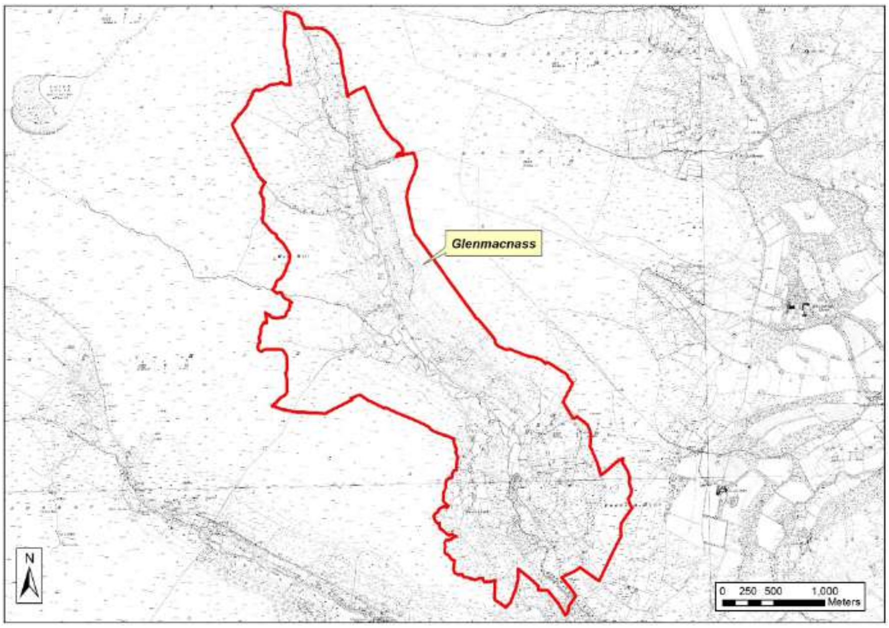
Some of the moraines in the middle portion of the valley.

The boulder accumulations below the waterfall, and the adjacent meandering river.

View down-valley from the waterfall.


Stoney Top
Tonelagee
Tóin le Gaoith
Scarr
Glenmacnass
Brockagh
Mountain
Camaderry
Derrybawn
Mountain
Laragh
Trooperstown Hill


Glenmacnass
N
0 250 500 1,000
Meters


Glenmacnass
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0 250 500 1,000
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glenmalure**
Other names used for site	*Gleann Molúra*
IGH THEME	**IGH7 Quaternary, IGH15 Economic Geology**
TOWNLAND(S)	Camenabologue, Conavalla, Baravore, Ballinagoneen, Ballinaskea, Cullentragh, Clonkeen, Ballinafunshoge, Corrasillagh, Carrawaystick, Clohernagh, Ballyboy, Drumgoff, Carriglinneen, Fananierin, Kirikee, Ballinabarny, Ballinacor
NEAREST TOWN/VILLAGE	**Rathdrum**
SIX INCH MAP NUMBER	**22, 23, 29**
NATIONAL GRID REFERENCE	**707130E 693610N (centre of valley)**
1:50,000 O.S. SHEET NUMBER	**56 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description
The Glenmalure valley is a deep 20km-long glacial valley in the central Wicklow Mountains, one of the longest glacial valleys in the country. The site extent includes a number of hanging valleys along each side of Glenmalure (*e.g*. Fraughan Rock, or Baravore, Glen), which were formed by feeder glaciers into the main valley during the last Ice Age.

Geological System/Age and Primary Rock Type
The valley covers a large area underlain by the late-Caledonian (405 Ma) Leinster Granite bedrock and its wallrocks. The granite is part of the Lugnaquillia Pluton, one of the five plutons that comprise the Leinster Granite and various granite varieties occur along the valley. The wallrocks consist of various metasedimentary lithologies of the Ordovician Maulin Formation. The granite is cut by slightly younger quartz veins containing lead and zinc mineralization. The valley itself and the glacial features within it date from the last Ice Age.

Main Geological or Geomorphological Interest
Glenmalure is a spectacular example of a glaciated U-shaped valley, with oversteepened cliff sides and a flat floor. Glenmalure is straight, steep-sided, and rocky, just under 20 kilometres long, 800m wide and up to 350m deep.

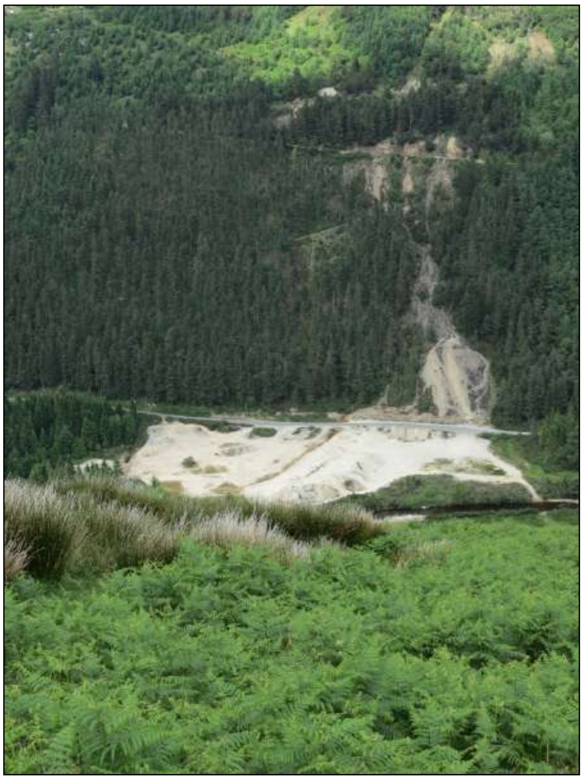
The base of the valley hosts a number of cross-valley moraines, as well as particularly fine lateral moraines along the southwestern side of the valley. Outwash deposits floor the lower end of the valley, from Greenan as far as Avoca.

There are abandoned mine sites at Ballinafunshoge, half-way along the valley, and at Baravore and Ballinagoneen near the head of the valley. The Ballinafunshoge site, which contains two adits, a shaft and large areas of mine, was in operation by 1800, one of the first sites to operate in the Glendalough-Glenmalure district. At Baravore, five well-defined adits, the remains of two crusher houses and a reservoir can be observed. The Ballinagoneen site contains three spoil heaps below two adits with a third adit apparently hidden beneath spoil. These adits appear to have been exploration rather than production adits, as there is no record of any ore output from Ballinagoneen.

Site Importance – County Geological Site; recommended for Geological NHA
The Glenmalure mine workings are of interest as the oldest of the lead mines along the margin of the Leinster Granite. The valley itself is a spectacular example of a glacial valley containing fine examples of glacial features throughout.

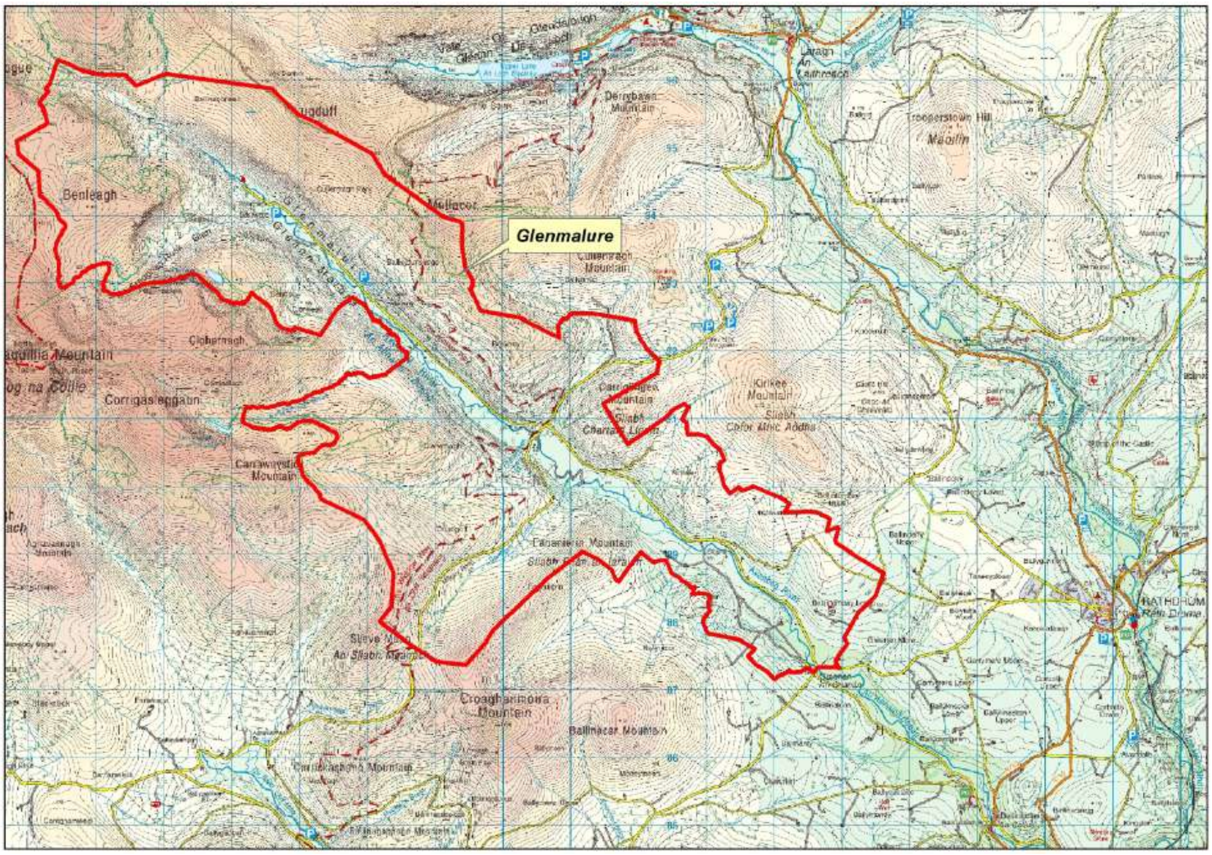
Management/promotion issues
Much of the site is within the Wicklow Mountains SAC, SPA and proposed NHA, as well as the National Park. This is a popular walking route. Few signboards have been erected and much more information could be provided to describe the mine features and host rock geology and to illustrate the glacial processes that led to formation of the valley.

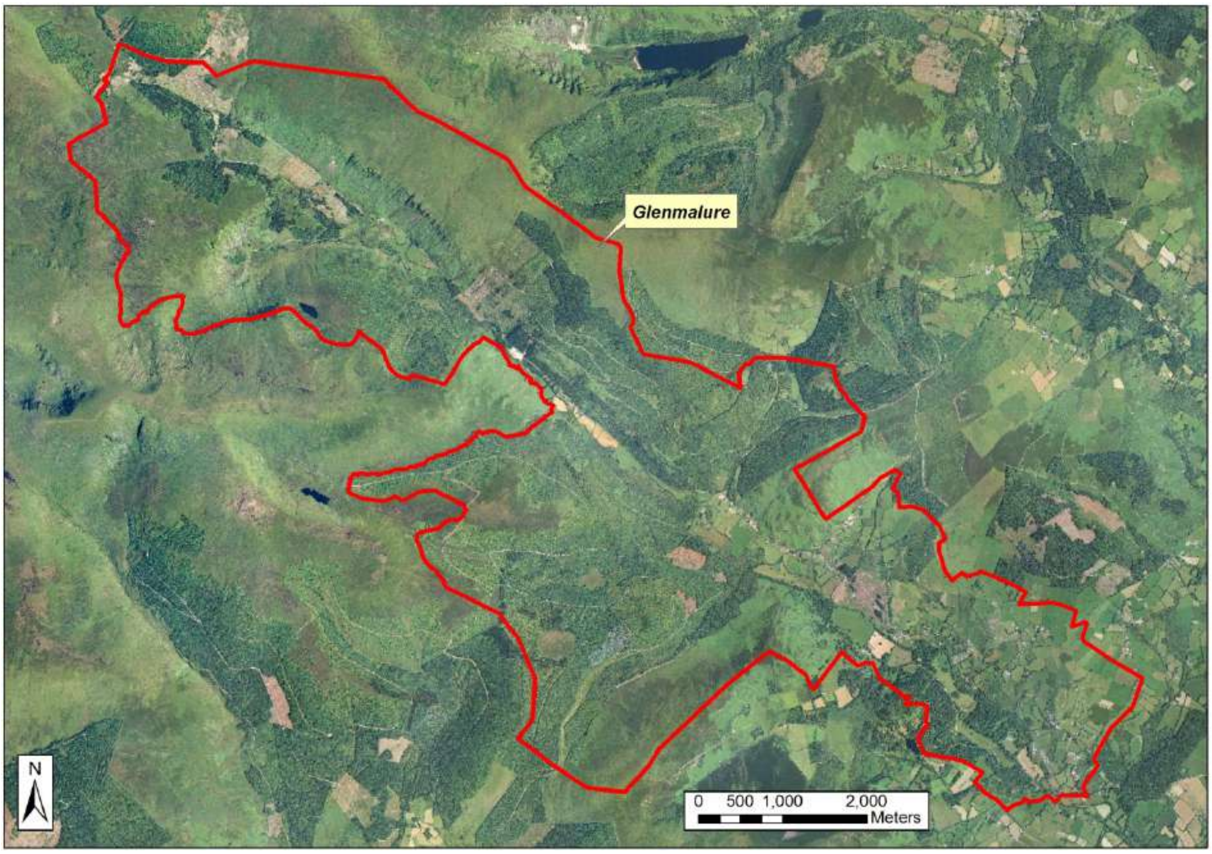
The Glenmalure Valley, looking northwest.



Ballinafunshoge mine site in the central portion of the valley, looking northeast.

Spoil heaps below the Ballinagoneen adit on the north side of the valley near the Youth Hostel.


Glenmalure
Benleagh
Mullacor
Cullentragh Mountain
Derrybawn Mountain
Trooperstown Hill
Carrickashane Mountain
Kirikee Mountain
Clohernagh
Corrigasleggaun
Carrawaystick Mountain
Fananierin Mountain
Slieve Maan
Croaghanmoira Mountain
Ballinacor Mountain
Rathdrum


Glenmalure
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Meters

Baravore Glen, viewed from the west, as painted by George Victor du Noyer in the nineteenth century.

WICKLOW – COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Greystones beach**
Other names used for site	Greystones
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Rathdown**
NEAREST TOWN/VILLAGE	**Greystones**
SIX INCH MAP NUMBER	**8**
ITM CO-ORDINATES	**728770E 713920N (centre of section)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
Along the beach just north of Greystones, a 2 kilometre-long coastal section exposes a succession of several units of glacial till, separated in places by sand and gravel.

Geological System/Age and Primary Rock Type,
The till itself was deposited at the base of the last ice sheet to cover the area, during the late Quaternary Period, approximately 20,000 years ago. This till is deep in the locality but the sediments overlie greywacke, slate and quartzite bedrock of Cambrian age.

Main Geological or Geomorphological Interest
This sequence of sediments is one of the most renowned in Irish Quaternary literature and has been controversially interpreted as ‘glaciomarine’ in origin (*i.e.* deposited under a floating ice sheet in the sea) by some academics. However, the general consensus is that the sediments are the product of a terrestrial ice sheet, interpreted as ‘subglacial’ tills deposited at the base of an ice sheet on land. They now form part of a prominent moraine ridge in the cliff.

Examining the sedimentology of the cliff shows that there are a number of till units stacked on top of each other. The tills include gravel beds, sand pockets and clay lenses, and are dominated by erratic limestone rocks. Large boulders of Leinster granite and small pebble erratics of Ailsa Craig microgranite (from Scotland), and Cretaceous chalk, flint and Tertiary basalt (all from Antrim) can also be seen both in the section and on the beach.

The southern portion of the section, just north of the new marina at Greystones, is dominated by bedded sands and gravels.

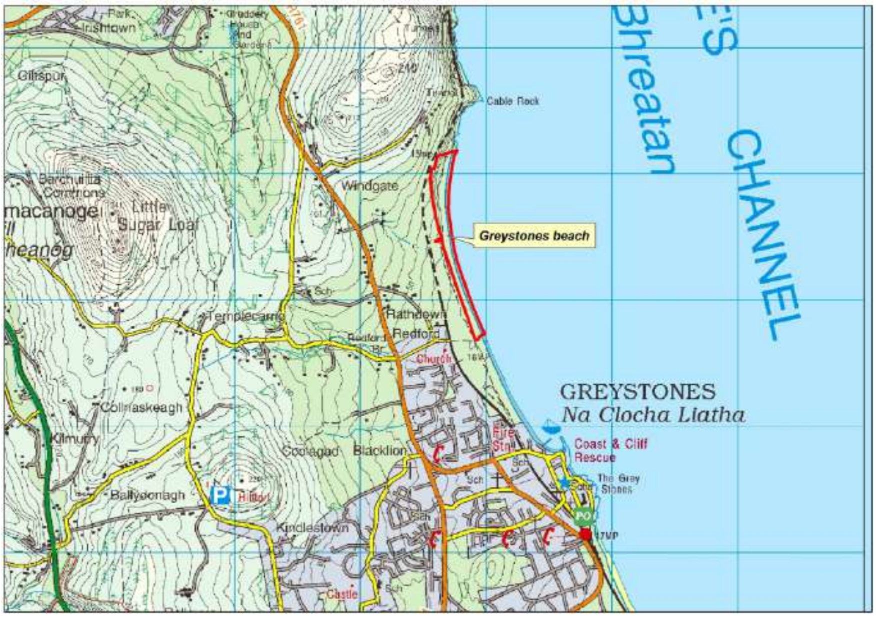
Coastal erosion is a continued threat at Greystones, despite attempted human control of this, which involves erection of baffles and mesh-wire structures to stop recession of the cliffs. This means many portions of the exposure at Greystones are heavily slumped.

Site Importance – County Geological Site; recommended for Geological NHA
This is a particularly impressive exposure into deep glacial tills, with several sedimentological characteristics well exposed. The site is effectively included within the existing Bray Head SAC and proposed NHA (Site Code 000714).

Management/promotion issues
The site is accessible through public beach access and is therefore easily visited. The cliffs are prone to slumping, however, and care must be taken when close to the faces. The importance of the section could be highlighted in promotional material for the Bray Head SAC and proposed NHA.

The section at Greystones, looking south from the beach area just south of Cable Rock.

Left: Gravel beds resting on top of stiff, muddy glacial till sediment in the section. Note the slumping at the base of the cliff.
Right: Looking north along the section towards Cable Rock and Bray Head. The large boulders emplaced to stop erosion are clearly seen.


Greystones beach
GREYSTONES
Na Clocha Liatha
CHANNEL
Bhreatan
Cable Rock
Windgate
Little Sugar Loaf
Rathdown
Redford
Church
Coast & Cliff Rescue
The Grey Stones
Blacklion
Kindlestown
Ballydonagh
Castle


Greystones beach
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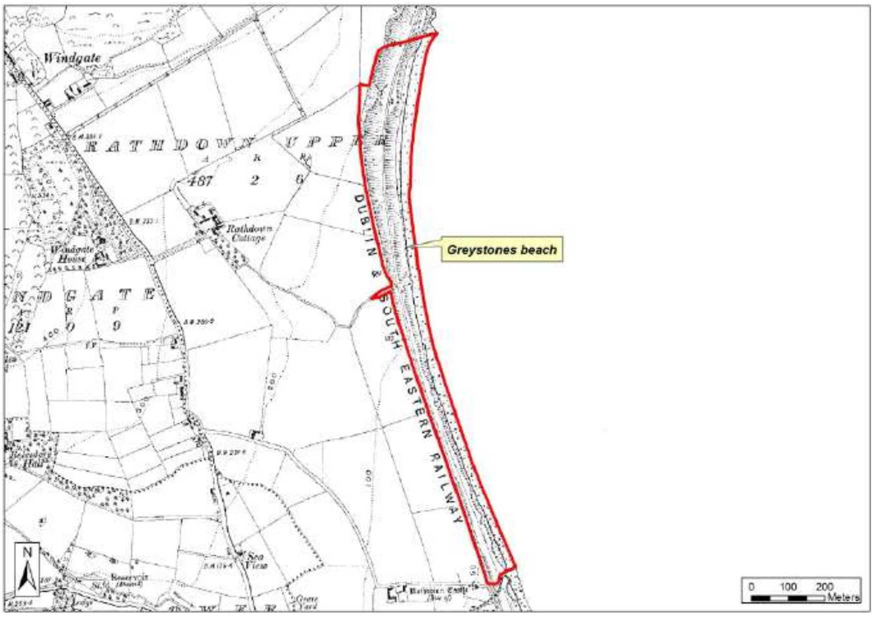
0 100 200 Meters


Windgate
Greystones beach
DUBLIN & SOUTH EASTERN RAILWAY
N
0 100 200 Meters

WICKLOW – COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Hollywood Glen**
Other names used for site	
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Athgreany, Drumreagh, Conlans, Woodenboley, Mullycagh, Kilbaylet**
NEAREST TOWN/VILLAGE	**Hollywood**
SIX INCH MAP NUMBER	**15**
ITM CO-ORDINATES	**693060E 701650N (centre of channel)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
Hollywood Glen comprises a deep channel that was formed by meltwater erosion on the northwestern flank of the Wicklow Mountains. The channel is oriented generally north–south, and extends for a distance of approximately 2.5 kilometres.

Geological System/Age and Primary Rock Type,
The feature is formed in an area of bedrock outcrop and subcrop and bedrock outcrops along the majority of the channel sides, giving the feature its ‘carved out’ appearance. The feature was etched out by meltwater during deglaciation at the end of the last Ice Age, about 12,000 years ago.

The bedrock in the locality is dominated by schists and quartzites of Ordovician age.

Main Geological or Geomorphological Interest
Hollywood Glen is up to 60m deep and has a U-shaped profile, typical of meltwater channels. The base of the channel is dry, although a shallow drainage ditch has been dug along much of the southern portion to channel excess surface water during heavy rainfall.

Hollywood Glen is considered to have formed completely in the late-glacial Period. Initially the glen was a subglacial channel, formed under the ice, but later carried surface glacial outwash from Glacial Lake Enniskerry southwards. As well as this, the channel carried huge amounts of subglacial meltwater draining the ice sheet which also covered the Irish Midlands. This very high energy meltwater flow resulted in Hollywood Glen’s unusual depth and size.

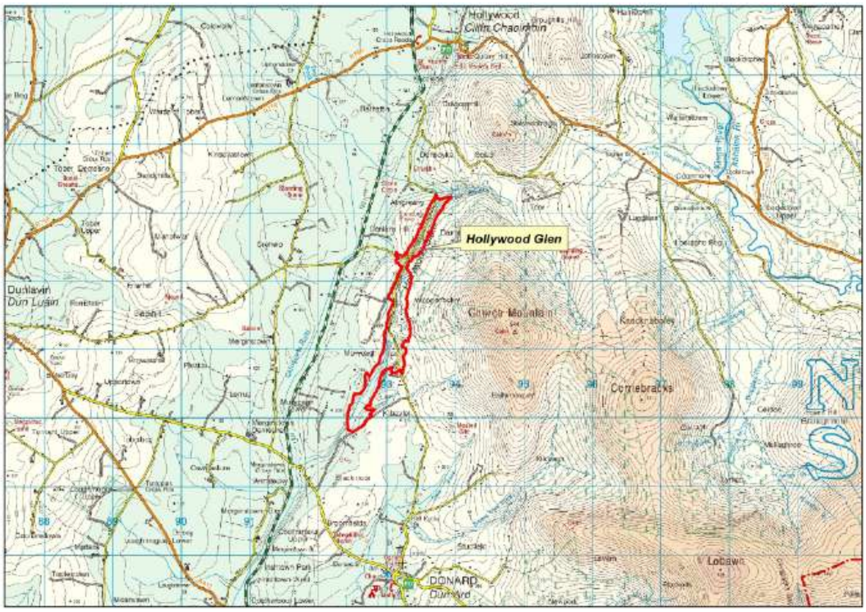
Much of the sides of the channel are very steep, and littered with (sometime huge) boulders, some in quite precarious positions above the third class road which passes through the feature. The glen is very narrow and has an irregular long profile, which means that meltwater was under huge pressure from ice above, thus proving that the channel was initially subglacial in origin.

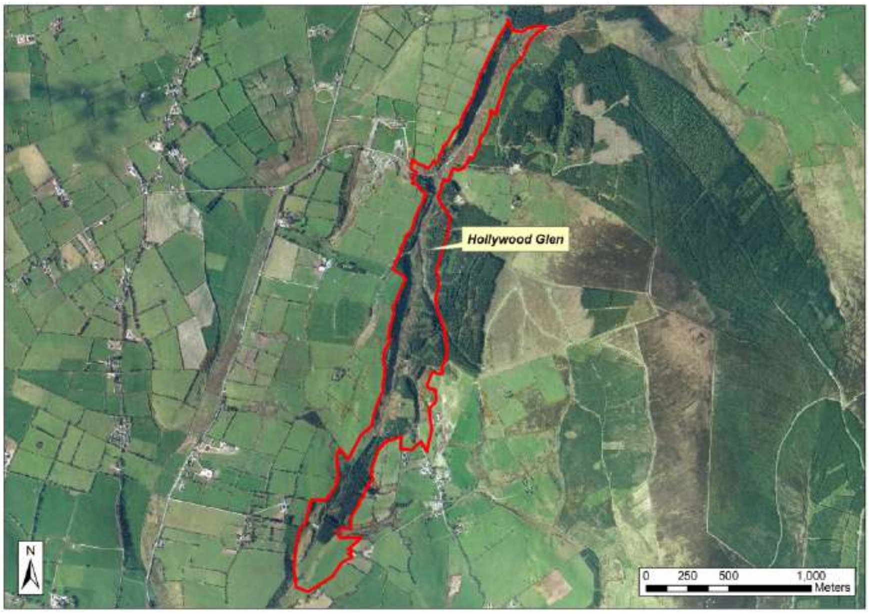
Site Importance – County Geological Site; may be recommended for Geological NHA
This is a site with good teaching potential on glacial meltwater erosion, as the feature is accessible, quite spectacular, and easily viewed from roads. The northern portion of the channel forms the Hollywood Glen proposed NHA (Site Code 002053).

Management/promotion issues
The location of the channel with a road passing through it means it is easily accessible, although the flanks are located presumably in private ownership or in commonage. However, there is no parking in the centre of the channel and it is difficult to stop safely on the road; the only parking is near the southern end at the entrance to a Coillte forest walk. Good views can be had from the western slopes of Church Mountain and the western slopes of Slievecorragh.

Hollywood Glen, viewed from the north.

Two views of Hollywood Glen from the northern side, looking south.


Hollywood Glen
Hollywood
Dunlavin
DONARD
Corriebracks
Lobawn


Hollywood Glen
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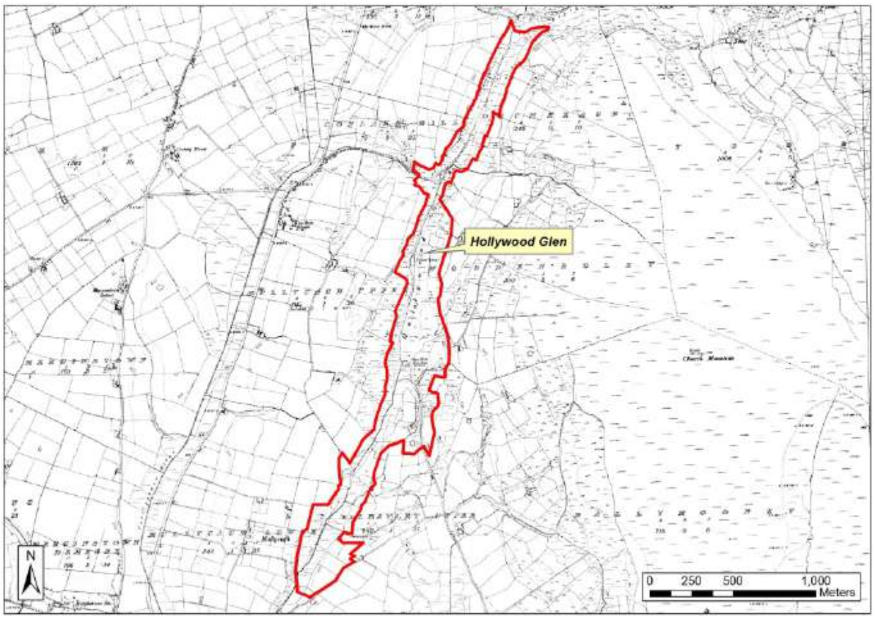
Meters


Hollywood Glen
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WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Kippure**
Other names used for site	*Cipiúr*
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Powerscourt Mountain, Kippure, Castlekelly**
NEAREST TOWN/VILLAGE	**Enniskerry**
SIX INCH MAP NUMBER	**2, 6**
ITM CO-ORDINATES	**711500E 715490N (summit)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
A landmark mountain on the South Dublin-Wicklow county boundary, capped with a prominent transmission tower. The upper mountain hosts extensively eroded peat, exposed granite sands, and granite blocks.

Geological System/Age and Primary Rock Type
Erosion of the peat has been ongoing for the past 3,000 years on this granite mountain. The granites (fine to coarse-grained, with microcline phenocrysts) are part of the Late Caledonian Leinster granites that were emplaced around 405 million years ago (Devonian).

Main Geological or Geomorphological Interest
Above heights of *c*. 740m, the near-flat summit of Kippure is devoid of significant peat accumulations. The summit hosts a blockfield of rounded granite boulders that lie embedded in grus (crumbled sandy granite). Below the 740m contour, areas of blanket peat are extensively eroded. Deep peat gullies, sub-peat pipes, solitary peat hags (haggs), and collapsing peat banks characterize much of the upper mountain slopes. Where peat has eroded fully, granite bedrock is exposed, with thick accumulations of grus, or granite sand (quartz, feldspar, mica) overlying the bedrock

Peat erosion has been a continual process in Wicklow for over 3,000 years, and is not considered to be attributed solely to recent human disturbance. Peat erosion is considered to be a natural consequence of the accumulation of peat on sloping ground. Climate is also considered to be an influencing factor, as are natural blog flows. Clearance of woodlands in the region pre-dates the onset of peat erosion by too significant a period of time to have had any direct influence on the onset of erosion. Human and biotic factors (grazing animals, vegetation burning, drainage, trampling) are both considered contributory factors to peat erosion, although studies indicate that erosion began before most human and biotic factors began.

Site Importance - County Geological Site
This site is an excellent CGS for observing the effects of long-term (millennial scale) peat erosion. Kippure is a landmark mountain, and is the most northerly of the nunataks. The site is located in the Wicklow Mountains SAC (02122) and on the Wicklow-Dublin county boundary, and should be considered along with the adjacent part of Kippure CGS in South Dublin County.

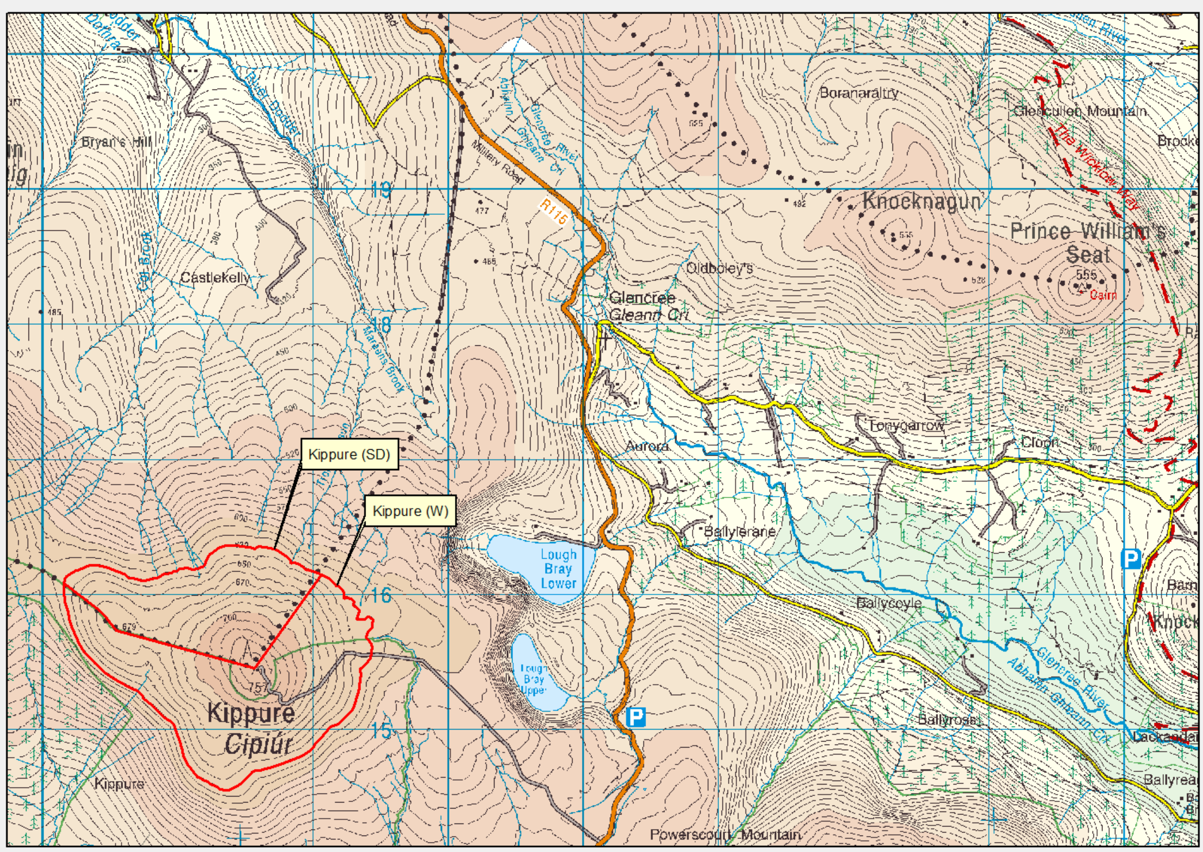
Management/promotion issues
Access to the site by foot is afforded along a 3.5km tarmacadam service road. The summit is capped by a 127m high TV and radio transmitter mast. It has been suggested that management of the peatland resources may decrease current erosion rates in some areas of high-level blanket peat. The processes of peat erosion that are evident on Kippure and elsewhere in Wicklow are an integral part of the upland blanket peatland system.

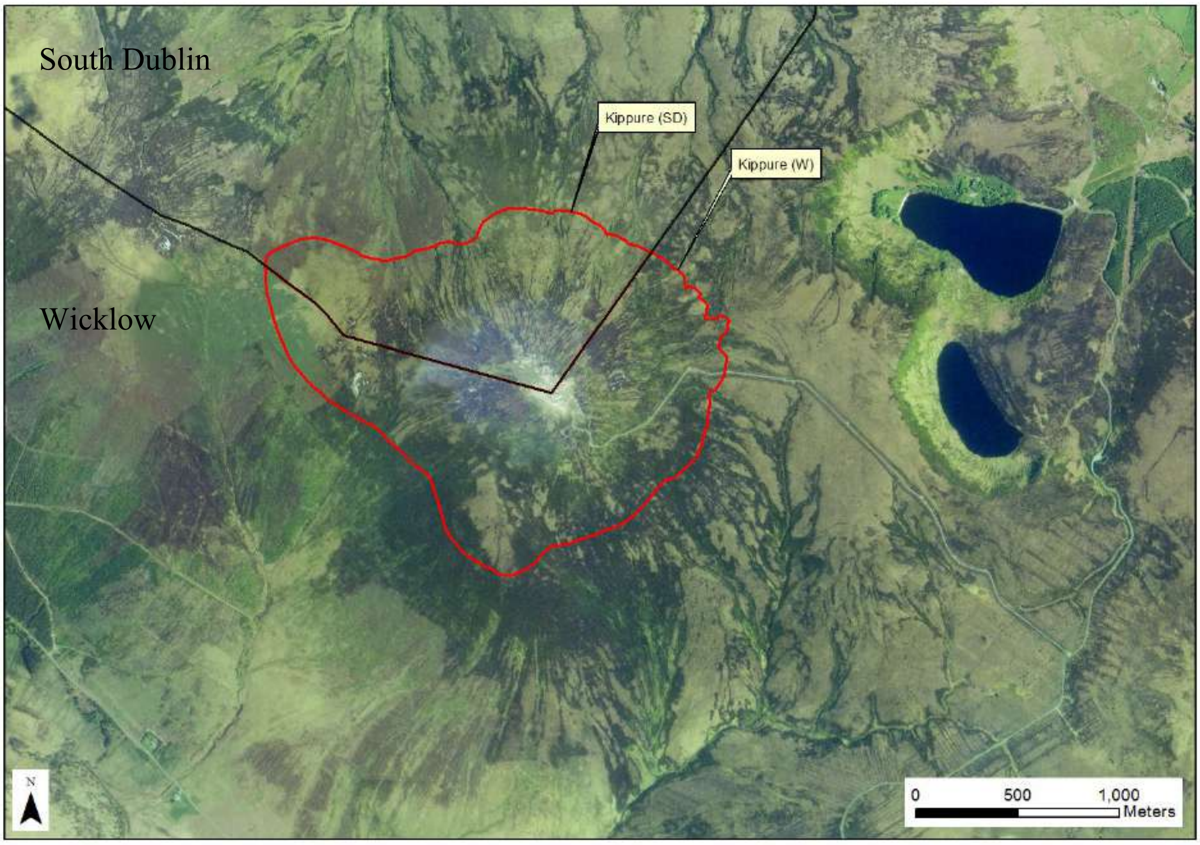
Upper limit of peat erosion on east side of Kippure summit. Main erosion occurs below this altitude (~740m).

Peat banks, peat hags, granite sands and granite blockfields on Kippure summit looking north towards Tallaght.

Sub-peat pipes and gullies on upper east slopes.

RTÉ radio/TV transmitter station on summit.


Kippure (SD)
Kippure (W)
Kippure
Cipiúr
Lough Bray Lower
Lough Bray Upper
Glencree
Gleann Cri
Knocknagun
Prince William's Seat
Boranaraltry
Glencullen Mountain
Bryan's Hill
Castlekelly
Oldboley's
Aurora
Tonygarrow
Cloon
Ballycoyle
Ballyross
Powerscourt Mountain
Military Road
R115
The Wicklow Way
Glencree River
Cairn


South Dublin
Wicklow
Kippure (SD)
Kippure (W)
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500
1,000
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Lough Bray**		
Other names used for site			
IGH THEME	**IGH7 Quaternary**		
TOWNLAND(S)	**Powerscourt**		
NEAREST TOWN/VILLAGE	**Glencree, Enniskerry**		
SIX INCH MAP NUMBER	**6**		
NATIONAL GRID REFERENCE	**713405E 715950N (arête between corries)**		
1:50,000 O.S. SHEET NUMBER	**56**	**GSI Bedrock 1:100,000 Sheet No.**	**16**

Outline Site Description
The Lough Bray site consists of two lakes; Lough Bray Upper and Lough Bray Lower, which occupy two of the most accessible corries in Ireland, 2 kilometres south of Glencree Village and just off the Military Road.

Geological System/Age and Primary Rock Type
The features were formed during the Quaternary (Ice Age), by glacier ice scouring out two deep, armchair-shaped hollows at the northeastern edge of the Wicklow Mountains. The majority of the features therefore comprise ice-scoured bedrock, which is coarse-grained granite. The granite is part of the Lugnaquillia Pluton which is one of the five plutons that comprise the late-Caledonian (405 Ma) Leinster Granite batholith.

Main Geological or Geomorphological Interest
These corries have almost-vertical backwalls up to 200m in height. Two tarns (glacial lakes) floor the features and the corries and lakes are bounded on their eastern sides by a series of impressive moraines. These have been dissected by Holocene (post-glacial) streams draining the lakes.

The moraines comprise well-drained, bouldery material, and the area around and east of Lough Bray is littered with large erratic boulders up to 10m across. Many of these erratics weigh several hundred tonnes and bear testament to the power of the ice sheet which transported them. Small moraines sit on top of a very large and impressive moraine feature, which dams the upper lake. A walk along the crest of one of the smaller moraines will provide an excellent overview of similar moraines ascending, like a staircase, the larger moraine.

Both corries are separated by an arête feature, which is a thin, almost knife-like, ridge of rock formed when two glaciers erode adjacent depressions. Here the arête is called Eagle’s Nest or Eagle’s Crag. Owing to the way the granite joints erode here, there are some unusual rock formations.

On the plateau on top of the corries, much of the covering blanket peat is eroding, and distinct peat hags are seen in places. Fine views can be had from here of the Glencree Valley to the east, Kippure to the west, and the central portion of the Wicklow Mountains to the south.

Site Importance – County Geological Site; may be recommended for Geological NHA
This is a fine example of two corries and an arête, with bounding moraine features. The site is already part of the Wicklow Mountains SAC and proposed NHA (Site Number 002122), as well as being within the National Park. The Upper Lake is part of the Wicklow Mountains SPA.

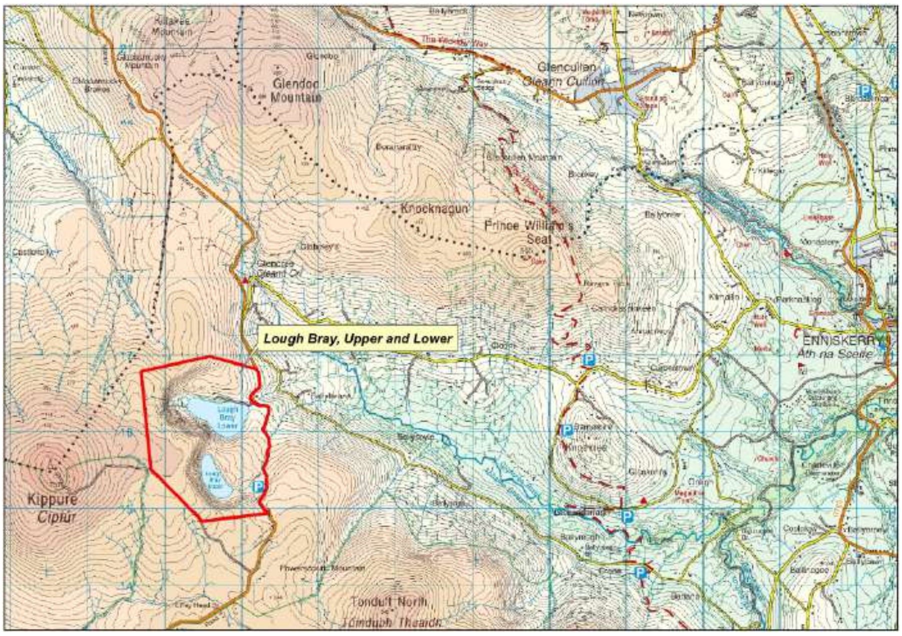
Management/promotion issues
A small car park in an old quarry above Lough Bray Upper provides a good view of the large outer moraine to the north, and the smaller moraines right at the lakeside to the west. There is a well-defined path across the moraine and up the arête, and rough trails across the top of the Upper Lake also. A promotional signboard at the roadside quarry might prove useful.

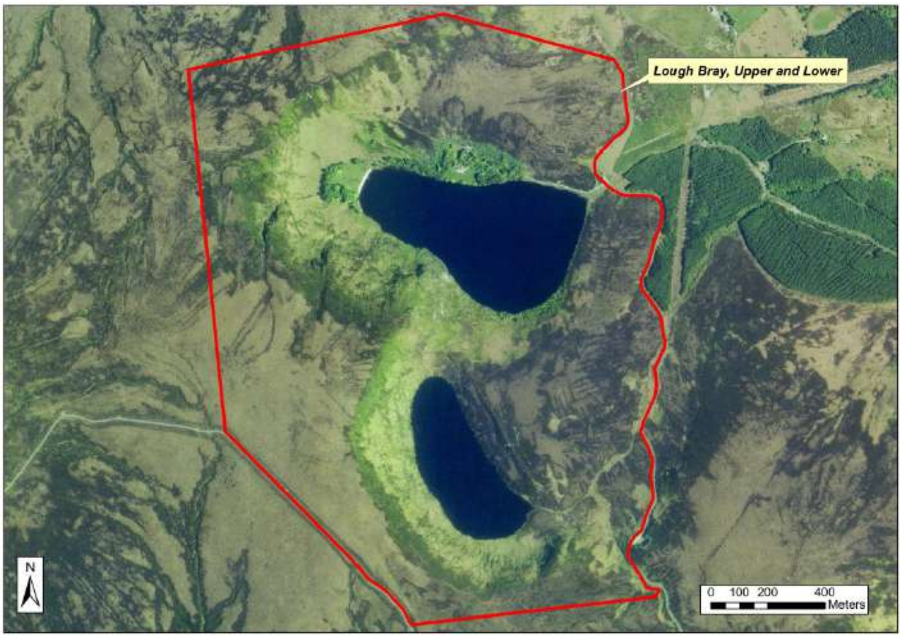
The corrie at Upper Lough Bray, viewed from the north.

The main moraine ridge, with smaller moraines thereon, viewed from Eagle's Crag.

The corrie at Lower Lough Bray, viewed from the south.

View north across Upper Lough Bray, and into the Glencree Valley.


Lough Bray, Upper and Lower
Glendoo Mountain
Knocknagun
Prince William's Seat
Glencullen
ENNISKERRY
Áth na Sceire
Kippure
Cipiúr
Tonduff North


Lough Bray, Upper and Lower
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0 100 200 400
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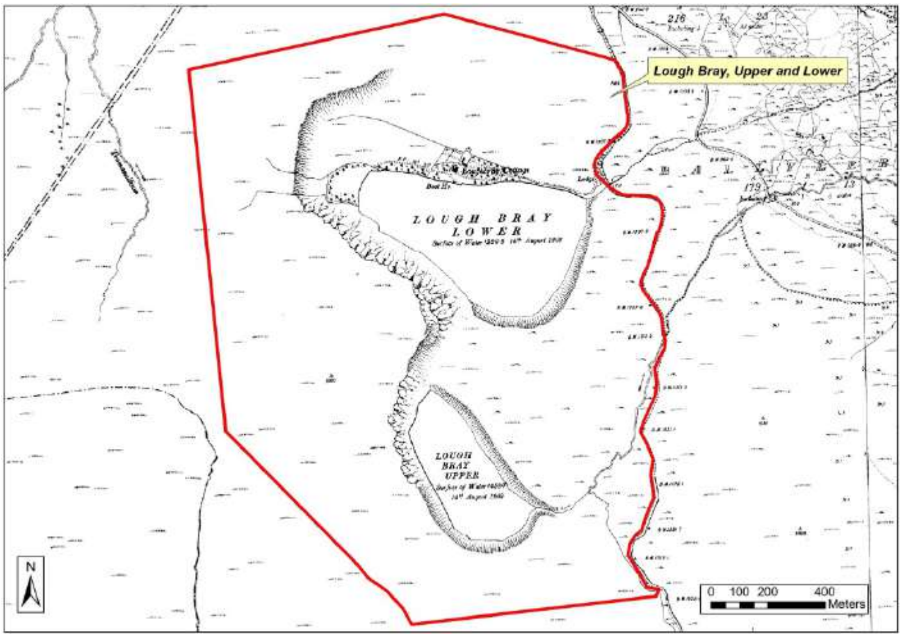
Lough Bray, Upper and Lower
LOUGH BRAY LOWER
LOUGH BRAY UPPER
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Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Lough Dan, Lough Tay and Cloghoge River**
Other names used for site	*Loch Déan, Loch Té*, Guinness Lake, Luggala Estate
IGH THEME	**IGH7 Quaternary; IGH14 Fluvial and Lacustrine Geomorphology**
TOWNLAND(S)	**Cloghogue, Carrigeenshinnagh, Carrigeenduff, Ballinrush, Carrigroe, Ballinastoe**
NEAREST TOWN/VILLAGE	**Roundwood**
SIX INCH MAP NUMBER	**11, 12, 17, 18**
ITM CO-ORDINATES	**715250E 703650N (centre of Lough Dan)** **716050E 707600N (centre of Lough Tay)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
Situated in the central Wicklow Mountains, the Cloghoge River drains Lough Tay and flows south through the north-south oriented U-shaped Cloghoge valley, draining into Lough Dan.

Geological System/Age and Primary Rock Type
The valleys hosting the Lough Dan and Lough Tay ribbon lakes are Quaternary in age, shaped by glaciers during and prior to the Late Glacial Maximum (c. 25,000-22,000 years ago) of the last ice age. Bedrock is predominantly Ordovician schist with Devonian granite at the northwest end of Lough Dan, and on the west and north side of Lough Tay.

Main Geological or Geomorphological Interest
Wicklow's mountainous terrain was covered by the vast Wicklow Ice Dome (area c. 1000km^2) during the Late Glacial Maximum (c. 25,000 to 22,000 years ago). From the ice dome, a large glacier flowed through the Lough Dan valley. This glacier was joined by another glacier moving south from above Lough Tay through the Cloghoge Valley. When the two glaciers merged, they continued as one into the southern reaches of the Lough Dan valley. When the ice sheets retreated and melted, meltwaters remained on the valley floors, forming Lough Dan and Lough Tay. 3km long and 0.5km wide, Lough Dan (mean depth 13.5m; area 106ha) is a classic ribbon lake occupying the floor of a U-shaped glacial valley, c. 200m above sea-level. Two rivers feed Lough Dan: the Cloghoge River and the Inchavore. Both rivers feature sandy river deltas where they enter Lough Dan. The Avonmore River drains Lough Dan to the south. The Cloghoge River valley was carved out of schist bedrock whilst the mountainous terrain north and west of Lough Tay is mostly granitic. Traces of the metamorphic aureole are inter-fingered with the granite terrain overlooking Lough Tay. At Luggala Lodge, the Cloghoge River meanders across flat 'delta' draining into Lough Tay. Mass wasting (boulder debris) is abundant at the foot of the eastern slopes of Luggala (595m). Large debris slumps are visible at the western side of the valley where landslides occurred when ice retreated from this over-deepened glacial valley.

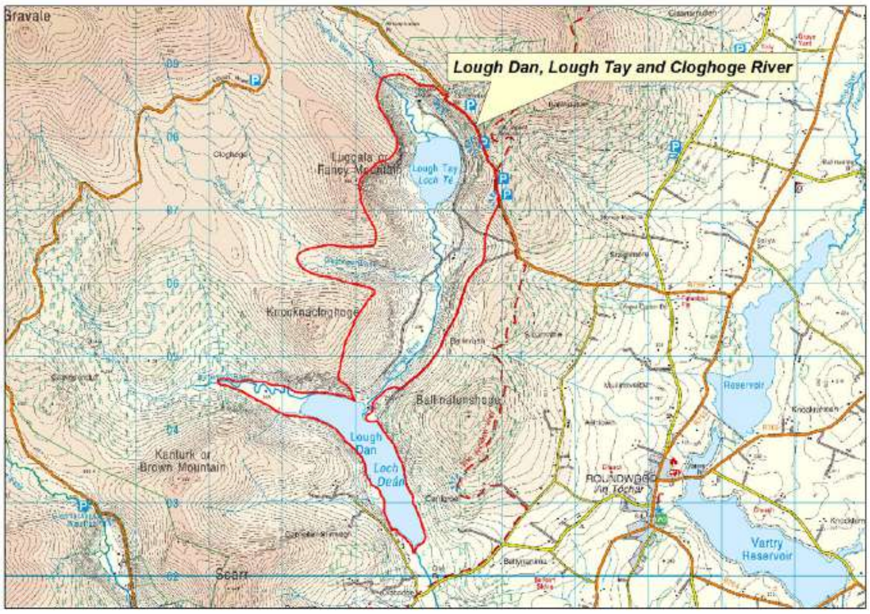
Site Importance - County Geological Site
This County Geological Site encompasses one of Wicklow's classic and most scenic glacial landscapes. Most of the site is within the Wicklow Mountains SAC (002122) and it is imperative that the influence of the site's geological heritage on the landscape and biodiversity is promoted in any future promotion of the area.

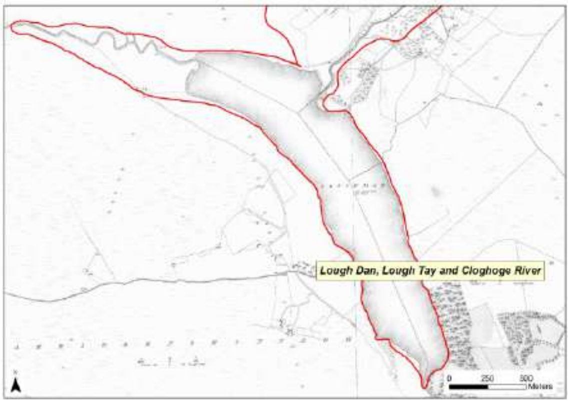
Management/promotion issues
This is a hugely important site in terms of the variety of classic glacial landform features (ribbon lake, collapsed valley sides, river deltas). Roadside (R759) viewpoints overlooking Lough Tay and the walking route along the Cloghoge valley to Lough Dan allow for wonderful views of the landscape. A public information board at a roadside stop would be an ideal means of communicating the wonderful heritage of this scenic glacial landscape.

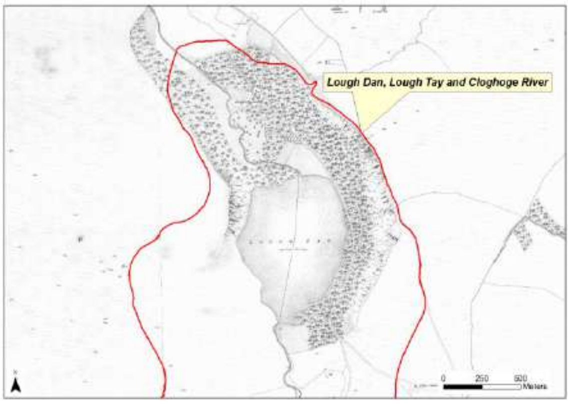
North end of Lough Dan, viewed looking west from Cloghoge River delta.

Lough Tay viewed from roadside viewing area overlooking Lough Tay – looking south down Cloghoge Valley.

Cloghoge Valley - view northwards from track at east foot of Knocknacloghoge hill (left). Stone wall built of local Ordovican schist and some Devonian granite. Debris slumps right of track in middle-distance near woodland.







Lough Dan

Lough Tay

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Lough Nahanagan**
Other names used for site	Lake forms part of 'Turlough Hill'
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Sevenchurches, Brockagh**
NEAREST TOWN/VILLAGE	**Laragh**
SIX INCH MAP NUMBER	**17**
NATIONAL GRID REFERENCE	**707900E 699000N (centre of lake)**
1:50,000 O.S. SHEET NUMBER	**56 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description
Lough Nahanagan rests within a deep glacial corrie, situated in the central portion of the Wicklow Mountains, 6.3 kilometres west-northwest of Laragh and just south of the Wicklow Gap.

Geological System/Age and Primary Rock Type
The feature was formed during the Quaternary (Ice Age), by glacier ice scouring out a deep, armchair-shaped hollow at the northern edge of Camaderry Mountain.

The majority of the feature therefore comprises ice-scoured bedrock, which is adamellite granite. The granite is part of the Lugnaquillia Pluton which is one of the five plutons that comprise the late-Caledonian (405 Ma) Leinster Granite batholith.

Main Geological or Geomorphological Interest
This corrie has an almost-vertical backwall up to 240m in height. A tarn (glacial lake) floors the feature and the corrie and lake are bounded on their northeastern side by a series of moraines, which have been dissected by a Holocene (post-glacial) river draining the lake.

The moraines comprise well-drained, bouldery material, and the area around and northeast of Lough Nahanagan is littered with large erratic boulders up to 10m across. Many of these erratics weigh several hundred tonnes and bear testament to the power of the ice sheet which transported them. Small moraines sit on top of a very large and impressive moraine feature, which dams the lake. Many of the smallest moraines are drowned by the lake water.

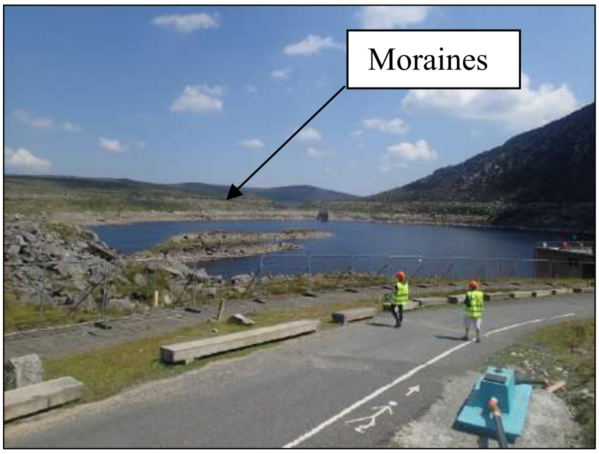
The smallest, underwater moraines were dated to the 'Younger Dryas', which was a cold snap at the end of the last glacial period. This period is therefore termed the Nahanagan Stadial in Ireland. They can be seen when the water levels in the lake are low following pumping to the upper reservoir of the Turlough Hill electricity pumped-storage system which the lake now forms part of.

Much of the granite bedrock around the lake has been moulded by glacier ice, and shows striations, chattermarks, roche moutonnées and whaleback forms.

Site Importance – County Geological Site; recommended for Geological NHA
This is a fine example of a corrie, with a bounding moraine feature. The site is already part of the Wicklow Mountains SPA, SAC and proposed NHA (Site Number 002122), as well as being within the National Park. The fact that the post-glacial period in Ireland is called the Nahanagan Stadial, following dating of the moraines at the base of the lake, demonstrates that the feature is significant within many scientific disciplines.

Management/promotion issues
The corrie is now the site of an electricity pumped storage scheme and has an access road leading up to it. Tours were offered of the facility in 2014, when 'Turlough Hill' had its 40th Anniversary; if this tour is continued, even occasionally, some glacial aspects could be incorporated. The site is already part of the Wicklow Mountains SPA, SAC and proposed NHA (Site Number 002122), as well as being within the National Park.

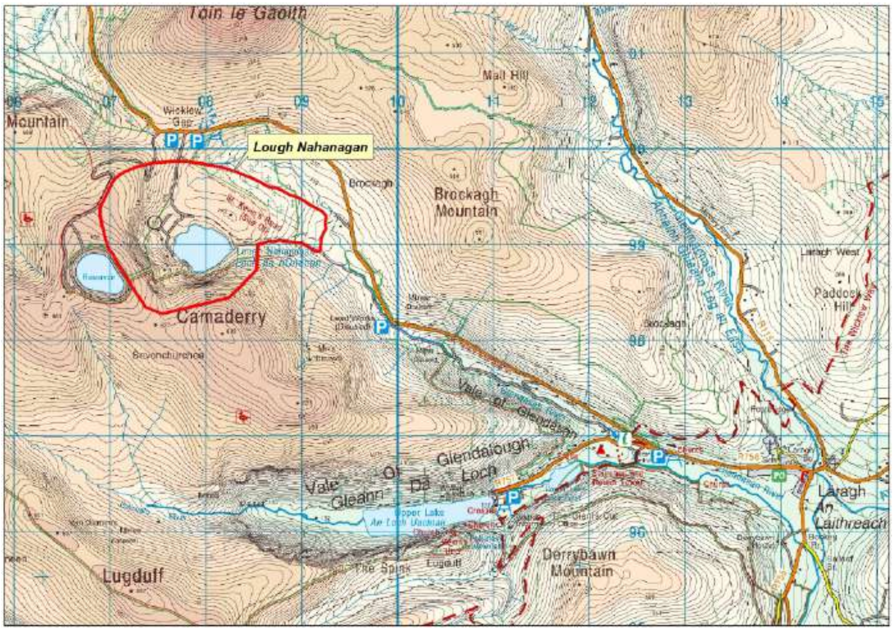
The corrie at Lough Nahanagan, viewed from the Wicklow Gap to the north.



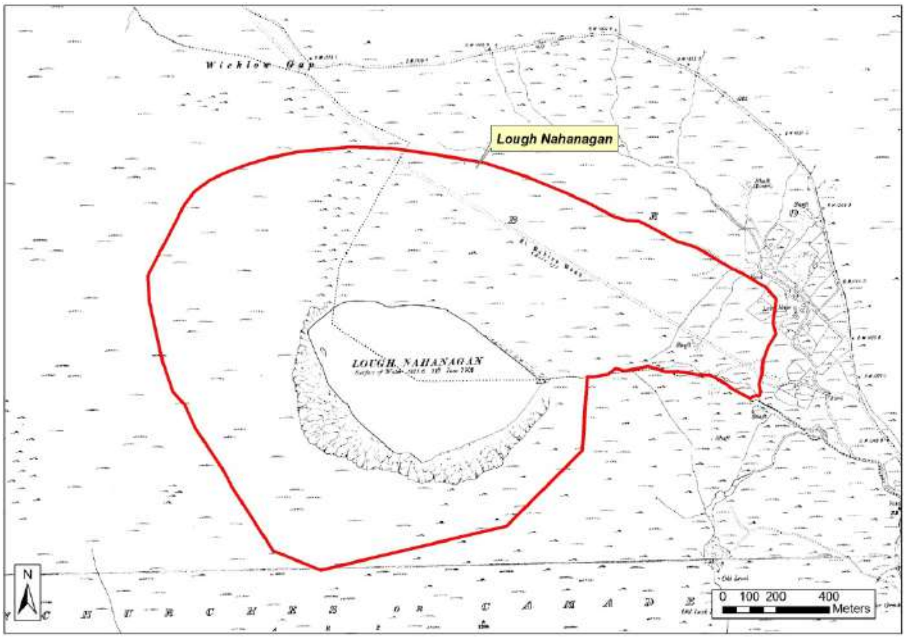
Lough Nahanagan, with the enclosing moraines seen at the far shore.

The 'underwater' bouldery moraine material exposed at the edge of the lake.

Ice-moulded bedrock along the shore of Lough Nahanagan.


Lough Nahanagan
Camaderry
Brockagh Mountain
Vale of Glendalough
Glendalough
Derrybawn Mountain
Lugduff
Laragh


Lough Nahanagan
N
0 100 200 400 Meters


Lough Nahanagan
LOUGH NAHANAGAN
Wicklow Gap
N
0 100 200 400 Meters

Inside the visitor centre display area at Lough Nahanagan, July 2014.

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Lough Ouler**		
Other names used for site			
IGH THEME	**IGH7 Quaternary**		
TOWNLAND(S)	**Laragh**		
NEAREST TOWN/VILLAGE	**Laragh**		
SIX INCH MAP NUMBER	**17**		
NATIONAL GRID REFERENCE	**709030E 702270N (centre of lake)**		
1:50,000 O.S. SHEET NUMBER	**56**	**GSI Bedrock 1:100,000 Sheet No.**	**16**

Outline Site Description
Lough Ouler rests within a deep glacial corrie, situated in the central portion of the Wicklow Mountains, 7.5 kilometres northwest of Laragh and west of the Military Road.

Geological System/Age and Primary Rock Type
The feature was formed during the Quaternary (Ice Age), by glacier ice scouring out a deep, armchair-shaped hollow at the edge of Tonelagee and Stoney Top Mountains.

The majority of the feature therefore comprises ice-scoured bedrock, which is porphyritic granite at the northern edge of the corrie, and slate and schists of the Lower Palaeozoic Maulin Formation along the southern edge. The granite is part of the Lugnaquillia Pluton which is one of the five plutons that comprise the late-Caledonian (405 Ma) Leinster Granite batholith. The contact between the granite and schist/slate runs through the site, evident as a vertical divide between dark coloured rocks on the left of the cliff and light coloured granite on the right, with vegetational colour differences also.

Main Geological or Geomorphological Interest
This corrie has an almost-vertical backwall up to 210m in height. A tarn (glacial lake) floors the feature and the corrie and lake are bounded on their eastern side by a moraine, which has been dissected by a Holocene (post-glacial) river draining the lake. The moraine comprises well-drained, bouldery material, and the area around and east of Lough Ouler is littered with large erratic boulders up to 15m across. Many of these erratics weigh several hundred tonnes and bear testament to the power of the ice sheet which transported them.

On the connecting ridge between Tonelagee and Stoney Top, much of the covering blanket peat has been eroded, and distinct peat hags are strewn across the ridge. Fine views can be had from here of the Upper Reservoir at Turlough Hill, to the southwest, as well as the central portion of the Wicklow Mountains.

Site Importance – County Geological Site
This is a fine example of a corrie, with bounding moraine feature.

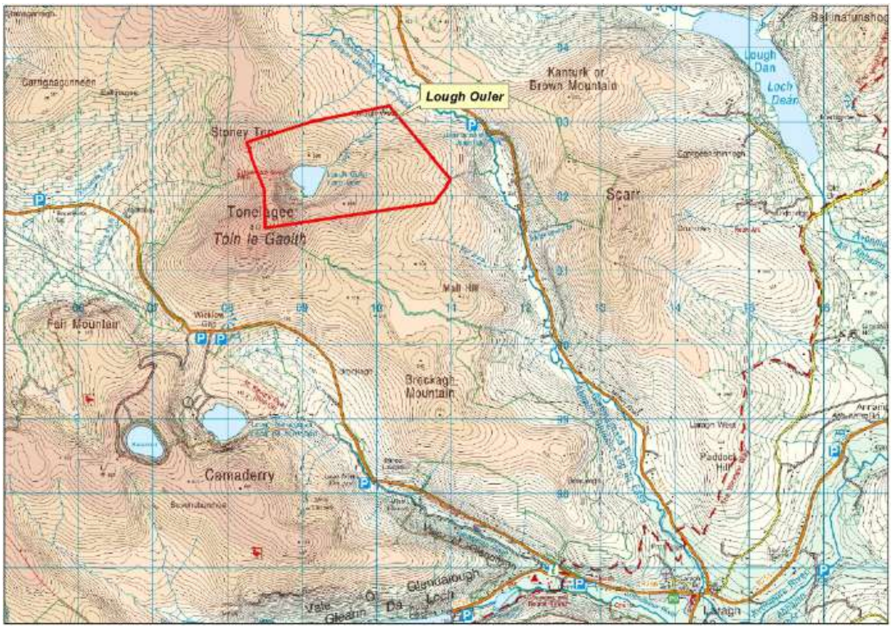
Management/promotion issues
The corrie has no real pathway up to it, and little promotional signage in the general area. Though the feature is potentially under-promoted, the absence of a cut/built path and signs, in fact helps to protect the locality as a pristine portion of montane terrain. The site is already part of the Wicklow Mountains SAC and proposed NHA (Site Number 002122), as well as being within the National Park.

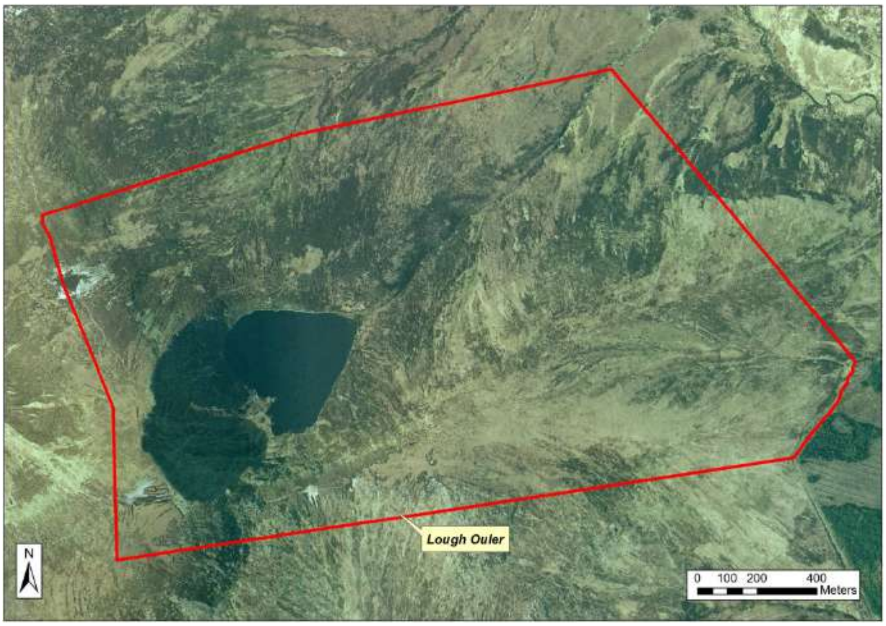
The corrie at Lough Ouler, viewed from the south on the flanks of Tonelagee.

Some of the peat hags on the ridge between Tonelagee and Stoney Top.

The moraine at the eastern end of the lake.

View east across Scarr and Kanturk from the southern side of the corrie.


Lough Ouler
Stoney Top
Tonelagee
Toin le Gaoith
Kanturk or
Brown Mountain
Lough
Dan
Loch
Dean
Scarr
Fair Mountain
Brockagh
Mountain
Camaderry
Glendalough
Vale
Gleann Dá Loch
Paddock
Hill
Ballinafunshoge


Lough Ouler
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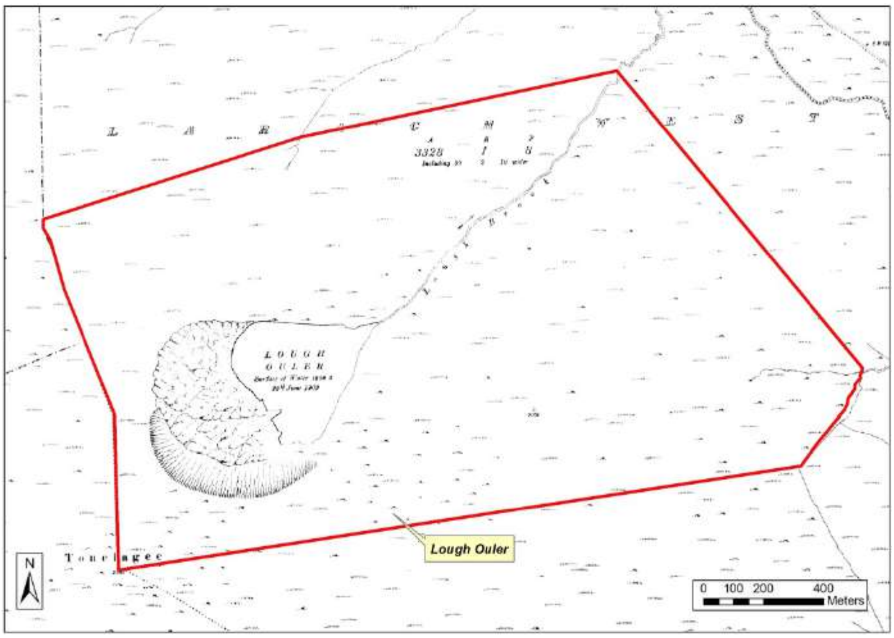
Meters


Lough Ouler
Tonelagee
N
0 100 200 400
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Lugnaquilla**
Other names used for site	Lug, *Log na Coille*, Percy's Table (summit)
IGH THEME	**IGH7 Quatenary**
TOWNLAND(S)	**Ballinaskea, Cloonkeen, Corrasillagh, Carrowaystick, Aghavannagh, Aghavannagh Mountain, Lugnaquilla, Cannow Mountain**
NEAREST TOWN/VILLAGE	**Donard**
SIX INCH MAP NUMBER	**22, 23**
ITM CO-ORDINATES	**703140E 691810N (summit)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
Lugnaquilla is the highest mountain in County Wicklow, and Leinster.

Geological System/Age and Primary Rock Type
The slatey schist (Ribband Group) capping the mountain is Ordovician in age. Late Caledonian granites intruded the pre-existing Ordovician country rock, or host rock, approximately 405 million years ago (Devonian). Rocky crags (nunataks) of schist have been free of ice and exposed for between 46,000 and 96,000 years.

Main Geological or Geomorphological Interest
Lugnaquilla (925m) is a slate capped, granite rooted, relatively flat-topped mountain. The summit drops west into North Prison corrie, south into South Prison corrie, and north into Fraughan Rock Glen (a hanging valley that opens into the U-shaped valley of Glenmalure). Viewed from the summit, crags of dark-grey schist protrude from the upper cliff walls of the corries. In 1894, G.H. Kinahan first described accumulations of loose rocks on the floor of the North and South Prisons called '*snowstones'* or '*cloghsnatty'*, today internationally called 'protalus ramparts' (these form at the foot of ice/snow banks). The summit forms the southern extent of an axis of high ground (>600m) that stretches almost continuously for 27km north to Kippure. The summit is marked by a stone cairn and 'Trig' pillar. The granites underlying the mountain are part of the Lugnaquilla pluton (part of the Leinster Granite Batholith), a 200km^2 body of granite. The cap of schist overlying the granite is the remnant roof of the magma chamber into which the Lugnaquilla granites were emplaced. The schists are part of a metamorphic aureole (a zone of country rock surrounding an igneous intrusion which has undergone metamorphism due to the heat of the intruding magma). Cosmogenic (^{10}Be) dating on exposed bedrock at the summit reveals that the schists were not covered by ice during the last glacial maximum (LGM, 25,000-22,000 years ago), and have been exposed to the elements for between 46,000 years and 96,000 years. This type of mountain top feature is called a nunatak. During the Last Glacial Maximum, only a small number of summits above 725m in the Wicklow Mountains escaped glacial erosion, while most of the region lay under a cover of ice. Cosmogenic dating and pollen analysis indicate that ice persisted on the southern side of Lugnaquilla around Kelly's Lough until 11,800 years ago.

Site Importance - County Geological Site; recommended for Geological NHA
This landmark site is of special geological and geomorphological interest, hosting excellent glacial landscape features and the Leinster Batholith 'slate cap'. It is located in Wicklow Mountains SAC (002122).

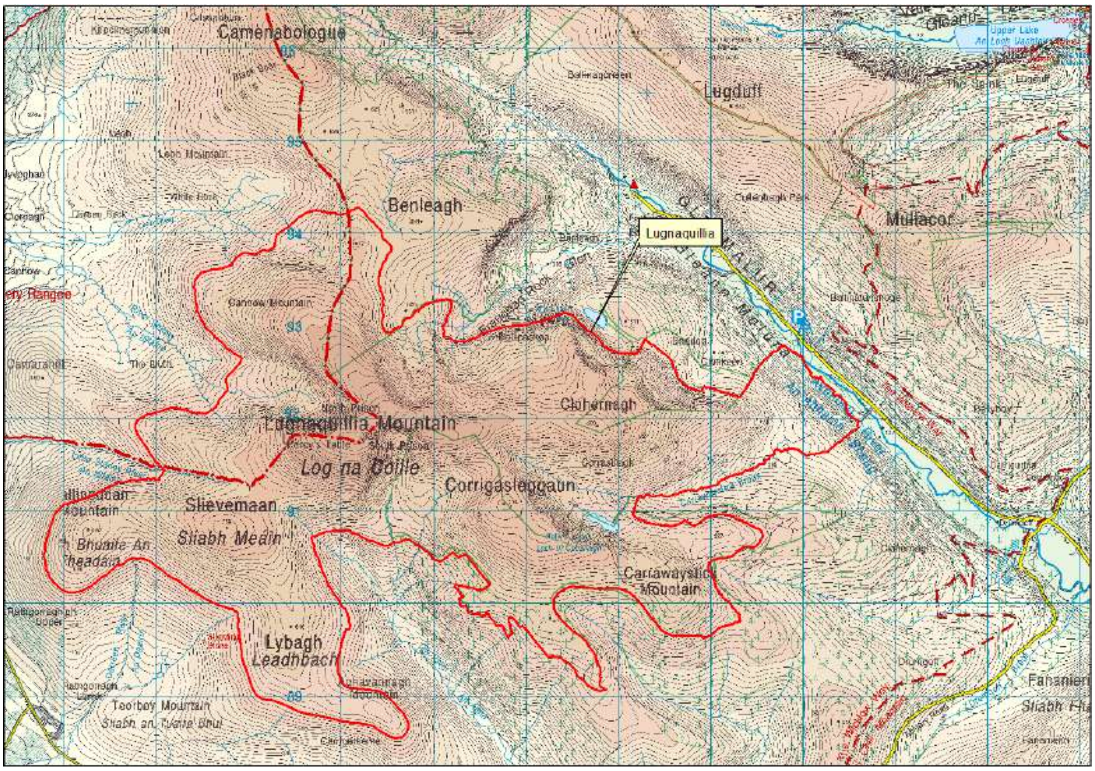
Management/promotion issues
This is a popular hillwalking site. Initiatives such as those led by Mountain Meitheal signage are important in highlighting the sensitivity of the tracks to erosion by walkers. The geological and geomorphological characteristics should be promoted in any literature or media content pertaining to the highest mountain in Leinster.

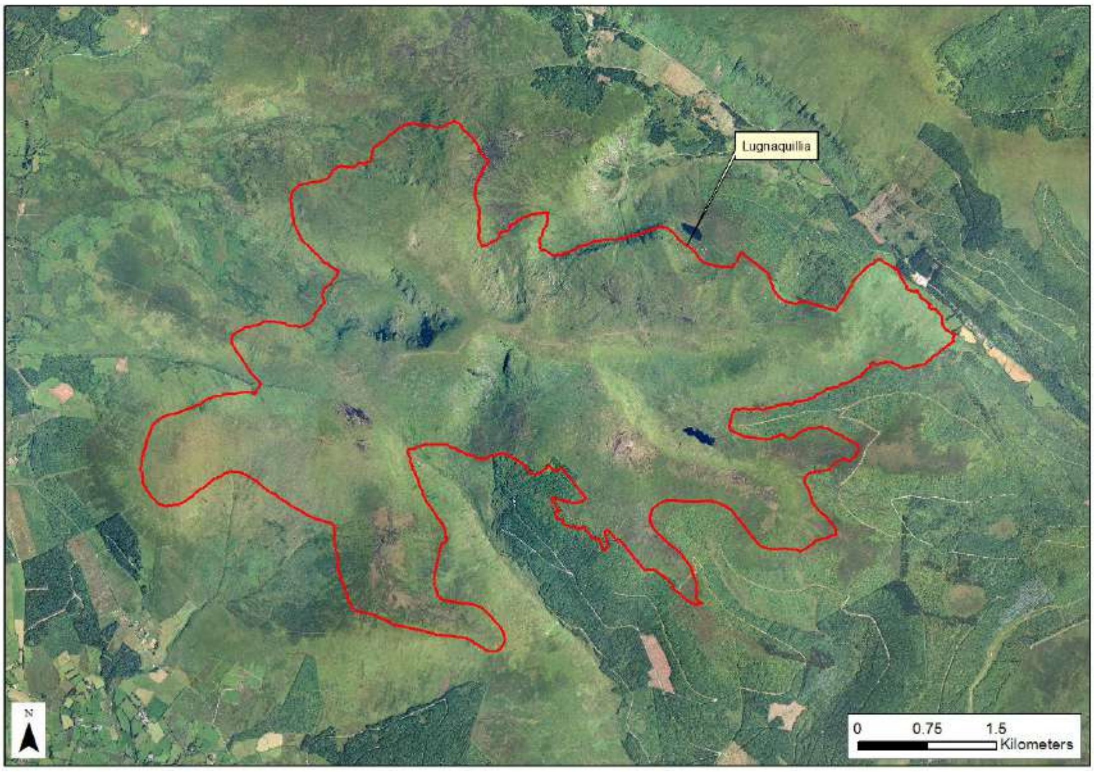
Summit of Lugnaquilla, looking west. Schist crags outcrop on upper walls of South Prison corrie. Ow valley to left.

Schist (dark-grey) and granite (white) on east walls of South Prison corrie - viewed from summit.

Kelly's Lough, viewed from ridge to Lugnaquilla summit. Moraine to left (north) of lake.

Granite crag (Jim's High rock) on walking route at Cloghernagh, looking east to Glenmalure.


Camenabologue
Lugduff
Benleagh
Mullacor
Lugnaquillia
Lugnaquillia Mountain
Log na Coille
Cloghernagh
Corrigasleggaun
Slievemaan
Sliabh Meáin
Carrawaystick Mountain
Lybagh
Leadhbach
Toorboy Mountain
Upper Lake


Lugnaquillia
N
0
0.75
1.5
Kilometers

Kelly's Lough, on the southeastern flank of Lugnaquilla, as painted by George Victor du Noyer in the nineteenth century.

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Manger - Saundersgrove**
Other names used for site	
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Manger, Stratford, Saundersgrove**
NEAREST TOWN/VILLAGE	**Stratford, Baltinglass**
SIX INCH MAP NUMBER	**21**
ITM CO-ORDINATES	**688170E 692680N (centre of southernmost feature)**
1:50,000 O.S. SHEET NUMBER	**62 GSI BEDROCK 1:100,000 SHEET NO. 19**

Outline Site Description
The Manger-Saundersgrove site includes a number of elevated fields under pasture, on the northwestern side of the N81 road, just north of Baltinglass town.

Geological System/Age and Primary Rock Type
The fields comprise a 'delta' feature, which is composed of deep glaciofluvial and glaciolacustrine sediments. Bedrock is at depth throughout the area of the features. The bedrock is of Ordovician age, and comprises greywackes and schists.

The 'delta' is Quaternary in age, having been deposited at the edge of the northward-retreating ice sheet during deglaciation after the last Ice Age.

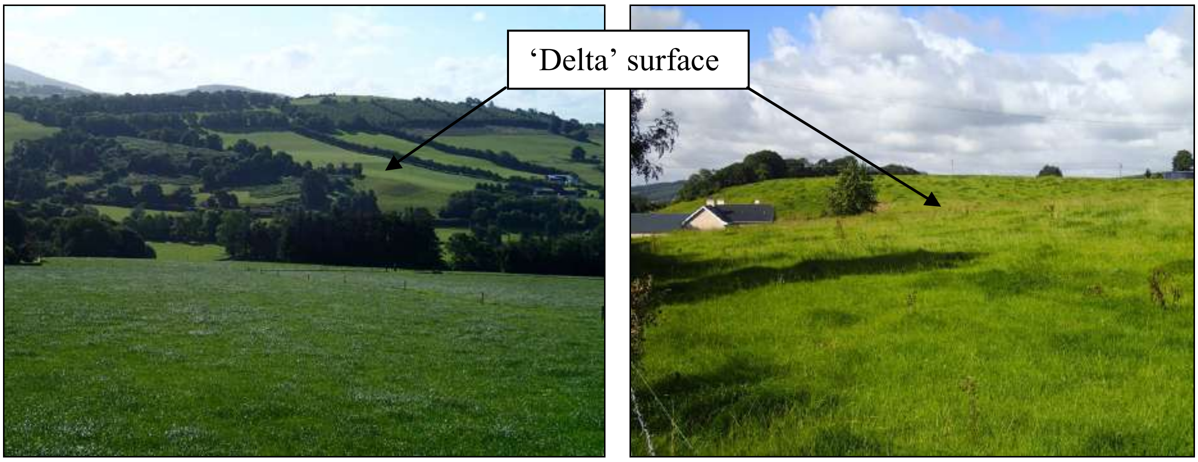
Main Geological or Geomorphological Interest
The delta is a striking feature, a large sand and gravel accumulation deposited into a lake in the locality by meltwaters flowing from glacier ice on the western side of the Wicklow Mountains, at the end of the last ice age. The delta was built out into a lake, the surface of which was at about 170m above present sea level. The delta surface at this level can be clearly viewed from the N81 road just north of Manger Bridge.

The delta is about 2 kilometres long and up to 0.5 kilometres wide. The sands and gravels are comprised largely of granite from the Wicklow Mountains to the east (deposited on top of a different type of bedrock at the site). The sediments are arranged in the typical delta sequence: topset gravels composed of up to 2m depth of horizontally bedded gravels on top; foreset gravels which are steeply dipping and well bedded, deposited at the front of the delta; and bottomset, finer sediments of sands and silts, usually underlying the foresets and representing sediment that was originally deposited beyond the steep delta front on the lake floor.

The delta feature has been dissected by the River Slaney, and is hence seen on both sides of the valley.

Site Importance – County Geological Site
The feature is a high, striking example of dry sand and gravel ridges, and stands proud of the surrounding landscape. This is an excellent example of a deglacial, ice marginal, meltwater-deposited feature.

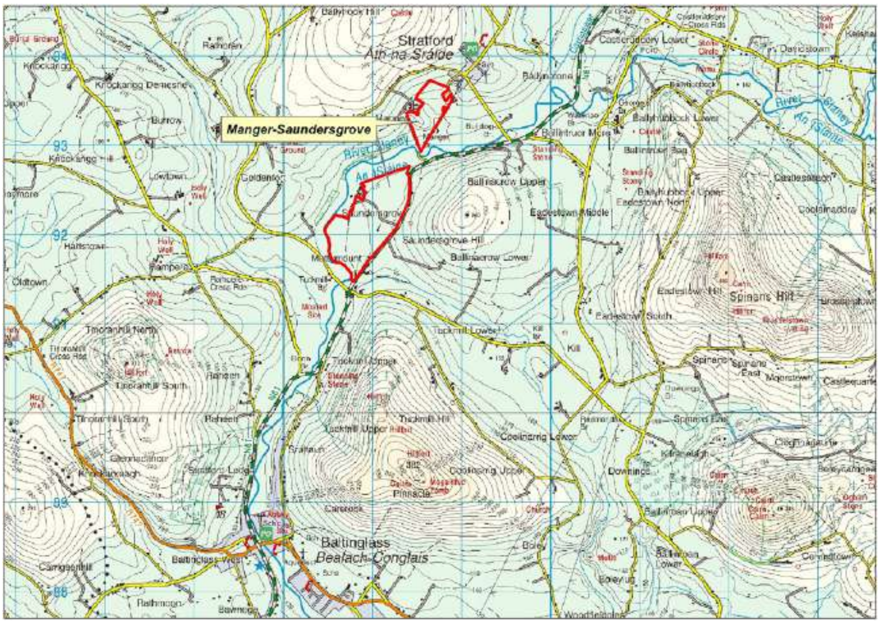
Management/promotion issues
Some of the delta has been removed by quarrying, and access to any pits is by permission of the owners or operators and safety protocols must be followed. As it is difficult to stop on the N81 road, and as the delta is on private farmland, it is not suitable for general promotion.

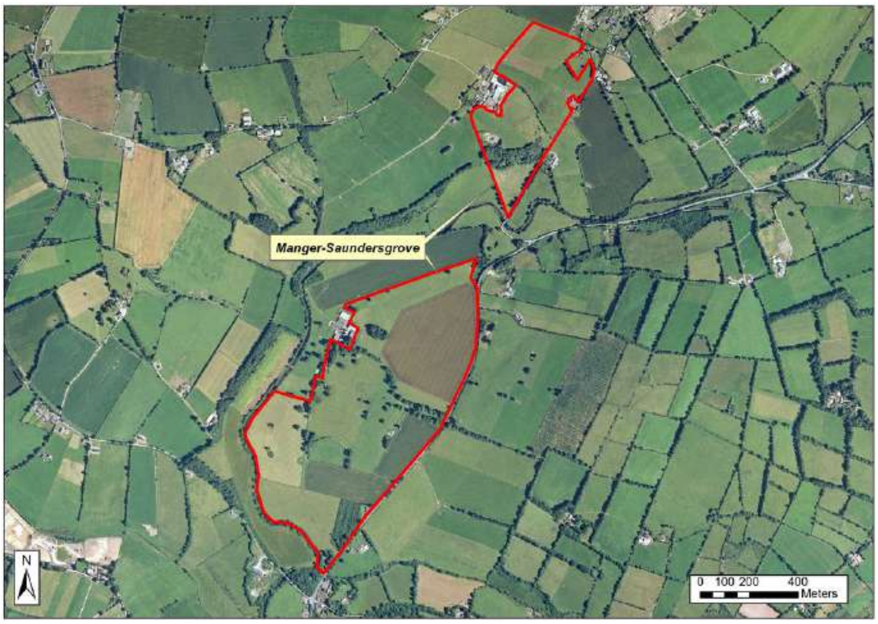


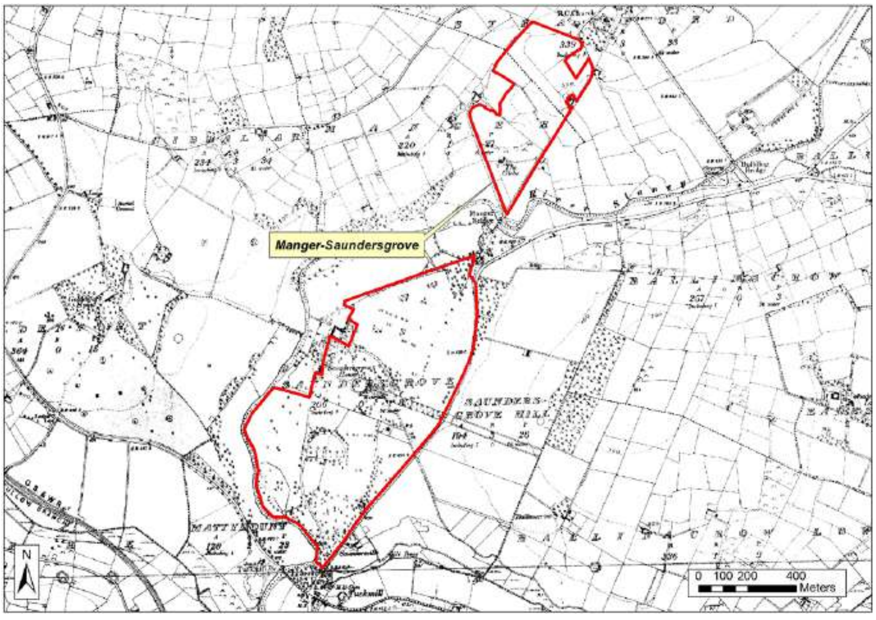
Two views over the Manger – Saundersgrove delta; the first shows the southernmost feature, east of the Slaney; the second the northern feature, to the west of the river.

Foreset beds in a sand pit in the northern feature.

The northern delta feature at Manger; photo at left shows a view looking across the surface from the top of a sand pit; the right photo shows the flat-topped feature in the distance, across the River Slaney.


Manger-Saundersgrove
Stratford
Áth na Sráide
Baltinglass
Bealach Conglais


Manger-Saundersgrove
N
0 100 200 400
Meters


Manger-Saundersgrove
SAUNDERS-GROVE HILL
N
0 100 200 400
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Mottee Stone**
Other names used for site	Motto Stone
IGH THEME	**IGH 7 Quaternary**
TOWNLAND(S)	**Cronebane**
NEAREST TOWN/VILLAGE	**Rathdrum**
SIX INCH MAP NUMBER	**35**
ITM CO-ORDINATES	**72082E 683289N**
1:50,000 O.S. SHEET NUMBER	**62 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
The Mottee Stone is a large erratic boulder, perched at approximately 250m above sea level on a prominent hill.

Geological System/Age and Primary Rock Type
An erratic from the Ice Age, of Devonian-age granite, sitting on Ordovician volcanic rocks.

Main Geological or Geomorphological Interest
The bedrock in the site comprises Ordovician volcanic rocks and associated sediments, which host the adjacent volcanic massive sulphide minerals mined in the immediate vicinity and district.

The Mottee Stone itself is made of granite, and is 13 km away from the nearest likely source around Glenmalure. Striae in the locality indicate that ice passed from northwest to southeast from the mountain ice cap, down Glenmalure and the Avonbeg Valley, and swept out into the Irish Sea Basin. The Mottee Stone was deposited in this fashion by glacier ice.

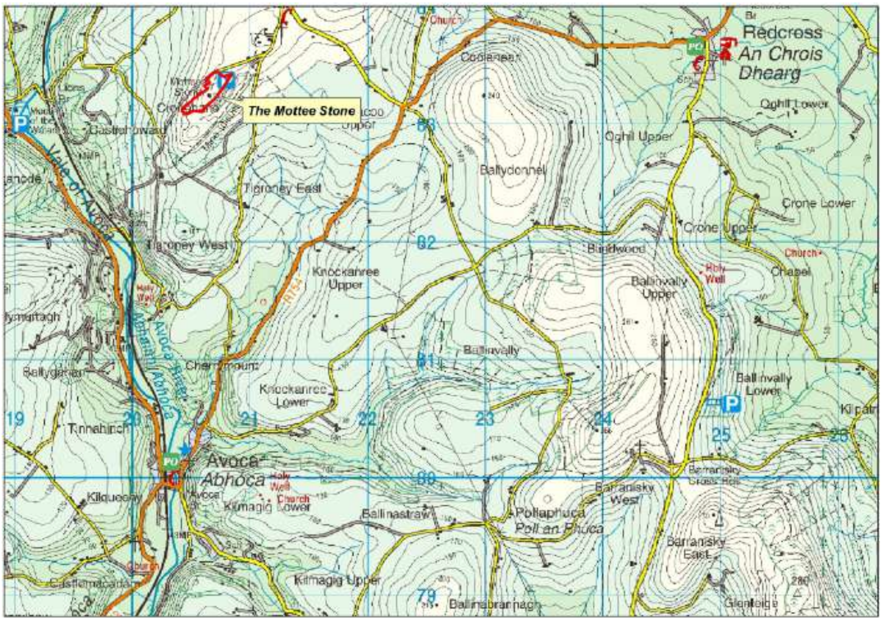
There are spectacular views from Cronebane Hill; views can be had up the Avonbeg Valley into Glenmalure, and Lugnaquilla is seen west of this. Croghan Mountain is visible to the southwest, with the Vale of Avoca and Goldmines River valley in between. From this site, while looking around the panorama of the landscape, the magnitude of ice cover during the ice Age can be well understood. Within the view, only the top of Lugnaquilla poked up above the ice sheet.

Site Importance - County Geological Site
It is an important site in terms of imagining the power of glaciation, and for the elegant and obvious demonstration of the power of ice to carry large rocks for considerable distances.

Management/promotion issues
The Mottee Stone is easily accessible by paths across the heath, and was a tourist attraction. There are superb views from here in most directions. Signage to the Mottee Stone has disappeared in recent years from the nearby roads. The car park that once existed for visitors has had to be blocked off in response to anti-social behaviour and abuse. What could be a really good landmark and a tourist attraction has a very shabby surrounding. It seems to be an opportunity wasted, but is part of a spectrum of issues in the area, and so is not easy to improve without a more integrated approach.


The Mottee Stone. Note the ladder stapled into the side to allow visitors to climb it.

The blocked off car park for visitors to the Mottee Stone.


Redcross
An Chrois
Dhearg
The Mottee Stone
Oghil Lower
Oghil Upper
Ballydonnell
Crone Lower
Crone Upper
Tigroney East
Tigroney West
Knockanree
Upper
Knockanree
Lower
Ballinvally
Ballinvally
Upper
Ballinvally
Lower
Holy
Well
Church
Chapel
Cherrymount
Tinnahinch
Avoca
Abhóca
Kilqueeny
Kilmagig Lower
Kilmagig Upper
Ballinastraw
Pollaphuca
Poll an Phúca
Barranisky
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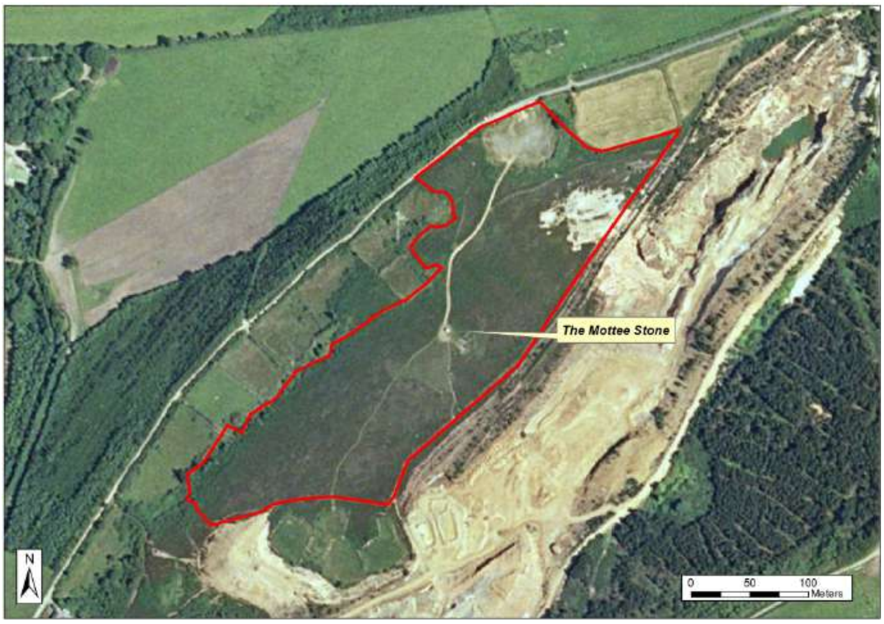
80
81
82
83


The Mottee Stone
N
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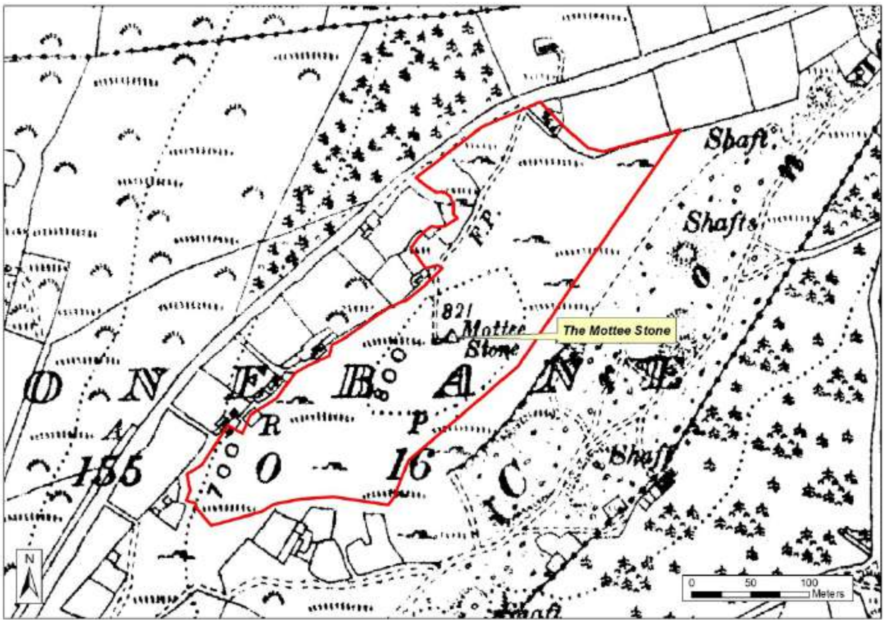
100
Meters


Shaft
Shafts
821
Mottee
Stone
The Mottee Stone
F.P.
Shaft
N
0
50
100
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Mullaghcleevaun**
Other names used for site	*Mullach Cliabh*áin, Mullaghcleevaun East Top, Ballacullian
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Ballynultagh, Glenbride, Ballinagee, Laragh West, Drummin, Carrigeenduff,**
NEAREST TOWN/VILLAGE	**Laragh**
SIX INCH MAP NUMBER	**11, 17**
ITM CO-ORDINATES	**706690E 707060N (summit)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
A predominantly granite mountain, this site comprises upland mountain areas of extensively eroded peatland, exposed granite blockfields, perched boulders and granite sand.

Geological System/Age and Primary Rock Type
Peat erosion has been ongoing for the past 3,000 years (Holocene). The Late Caledonian granites were emplaced approximately 405 million years ago during the Devonian Period.

Main Geological or Geomorphological Interest
Areas of high-level blanket peat on Mullaghcleevaun (849m), Mullaghcleevaun East Top (795m) and Ballacullian (715m) show extensive erosional damage. Isolated peat hags and peat banks are found throughout the site, as are deep gullies in peat, and sub-peat pipes. Where peat has eroded severely, the underlying granite is exposed, in most places as granite sand (quartz, feldspar, mica). Peat erosion has been ongoing in Wicklow for over 3000 years, and is therefore not solely attributed to recent human disturbance. Tree clearance in the Wicklow Mountains pre-dates the onset of peat erosion by too significant a period of time to have had any direct influence on the onset of erosion. Other human and biotic factors (grazing animals, burning, drainage, trampling, industrial pollution) are recognised as contributory factors to the acceleration of erosion. However, studies have revealed that erosion began before most human and biotic factors began. On Mullaghcleevaun (849m) and Mullaghcleevaun East (795m), ice-scoured granite slabs are found at heights of up to 670m, and perched boulders up to 735m. This implies that the former ice surface lay at least as high as 735m. Both summits support small tors with occasional large cantilevered slabs, and in situ blockfields descend to 780m, implying that the maximum altitude of glacial action on these mountains reached heights of 735m-780 m. Peat erosion is considered to be a natural consequence of the accumulation of peat on sloping ground. Climate is also considered to be an influencing factor, as are natural bog flows.

Site Importance: County Geological Site
This County Geological Site is an excellent site for observing the results of long-term (millennial scale) peat erosion. The site is located in the Wicklow Mountains SAC (02122).

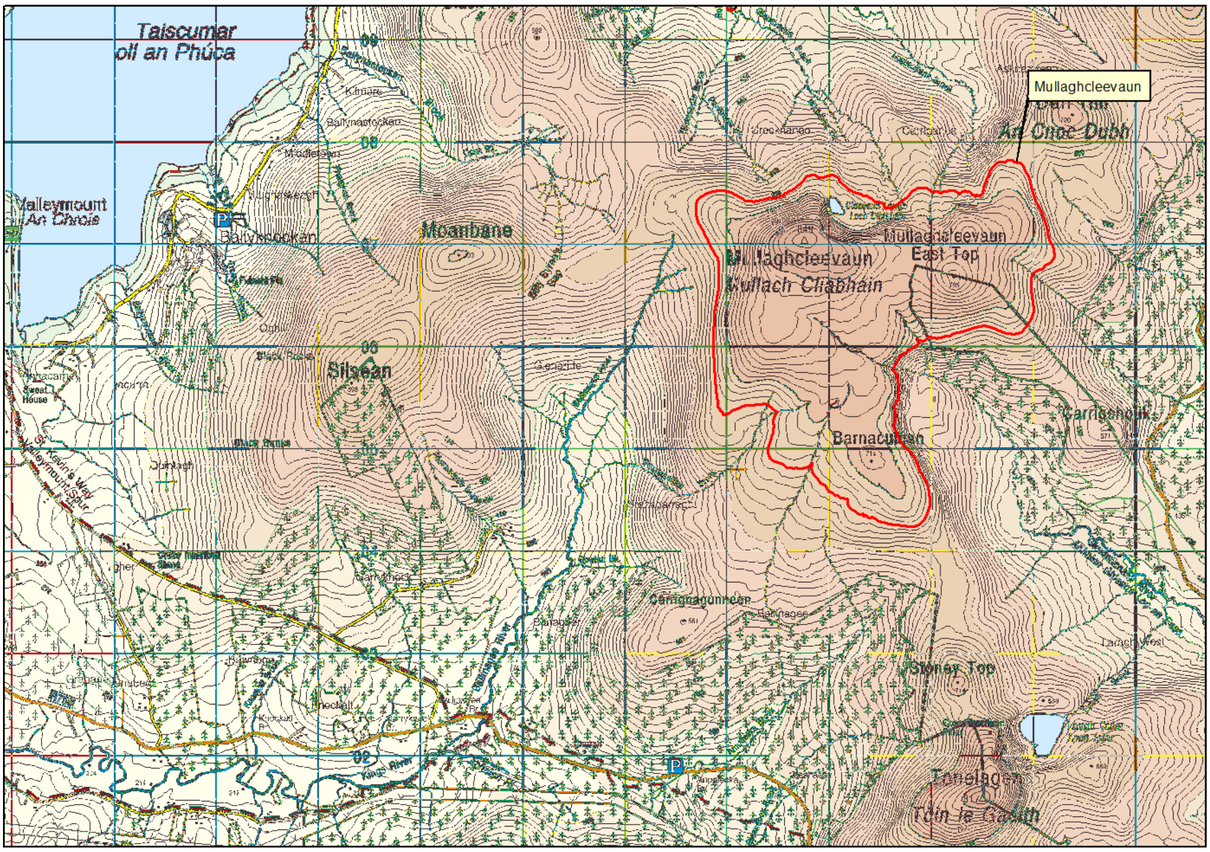
Management/promotion issues
It has been suggested that management of the peatland resources may decrease current erosion rates in some areas of high-level blanket peat. However, the processes of peat erosion evident on Mullaghcleevaun and elsewhere in Wicklow are an integral part of the upland blanket peatland system. Mullaghcleevaun is a popular destination for hill walking and trekking in the Wicklow Mountains, providing remarkable views of the surrounding mountain/valley terrain. There is no defined path to the summit. Whilst most walkers are respectful of the natural environment, literature for Wicklow Mountains walkers should include guidelines on avoiding damage to fragile peat hags and banks.

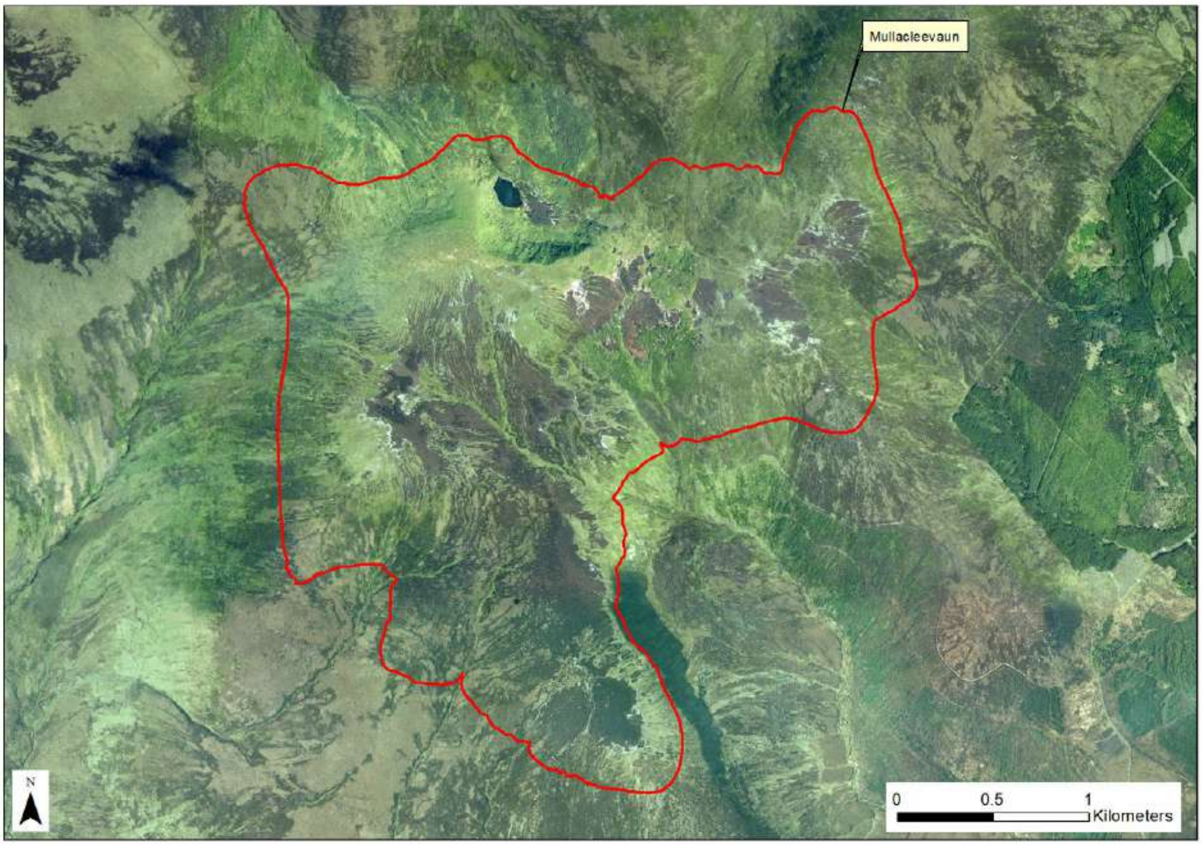
Peat erosion on east slopes of Mullaghcleevaun (849m) looking west from Mullaghcleevaun East Top (790m).

Peat banks, peat hags and granite sands on Mullaghcleevaun looking east towards Lough Dan\Knocknacloghoge.

Collapsed peat hag. Looking east towards Lough Dan.

Extensive peat erosion on Barnacullian ridge, viewed from Mullaghcleevaun East Top looking southwest.


Taiscumar
Mullaghcleevaun
An Cnoc Dubh
Valleymount
An Chróis
Ballyknockan
Moanbane
Mullaghcleevaun
Mullach Cliabhain
Mullaghcleevaun
East Top
Silsean
Barnacullian
Carrigshouk
Stoney Top
Tonelagee
Tóin le Gaoith


Mullacleevaun
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0.5
1
Kilometers

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Powerscourt Waterfall**
Other names used for site	Powerscourt Corrie, Powerscourt
IGH THEME	**IGH 7 Quaternary, IGH 14 Fluvial and lacustrine**
TOWNLAND(S)	**Deerpark**
NEAREST TOWN/VILLAGE	**Enniskerry**
SIX INCH MAP NUMBER	**7**
ITM CO-ORDINATES	**719573E 712093N (at waterfall)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
A large corrie with a notable waterfall in the corrie backwall.

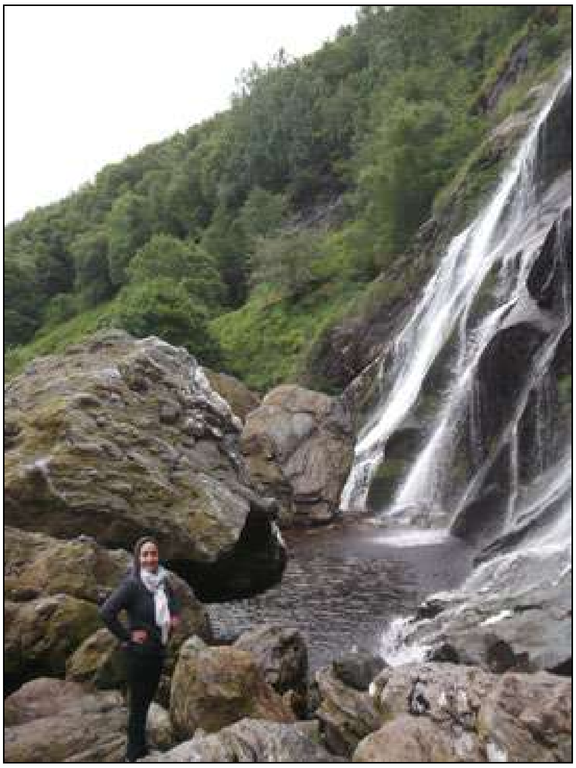
Geological System/Age and Primary Rock Type
The bedrock in the site is the Ordovician Maulin Formation but the corrie is of Quaternary age.

Main Geological Interest
The Powerscourt corrie is a fine example of glacial erosion, where accumulated ice has scoured out a deep basin, with a steep backwall. The waterfall in the back of the corrie flows over Ribband Group schists in the metamorphic aureole of the Leinster Granite. The cleavage (or schistosity) dips steeply outwards, paralleling the sides of the granite pluton. This forms the surface over which the water cascades. The contact between schist and granite is some distance upstream of the waterfall.

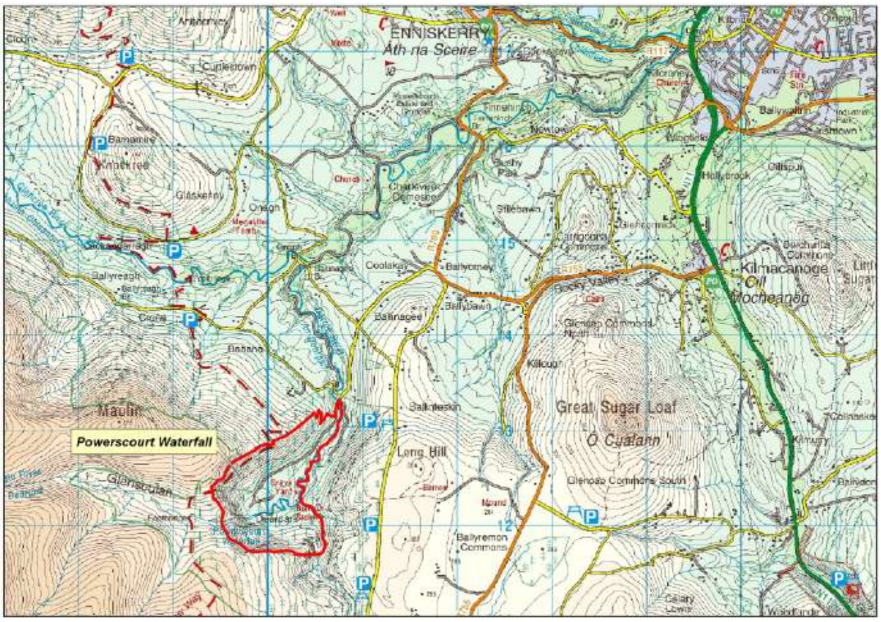
Site Importance - County Geological Site
It is an important site for both the glacial feature and for the geological influence of the rocks themselves on the formation of the waterfall.

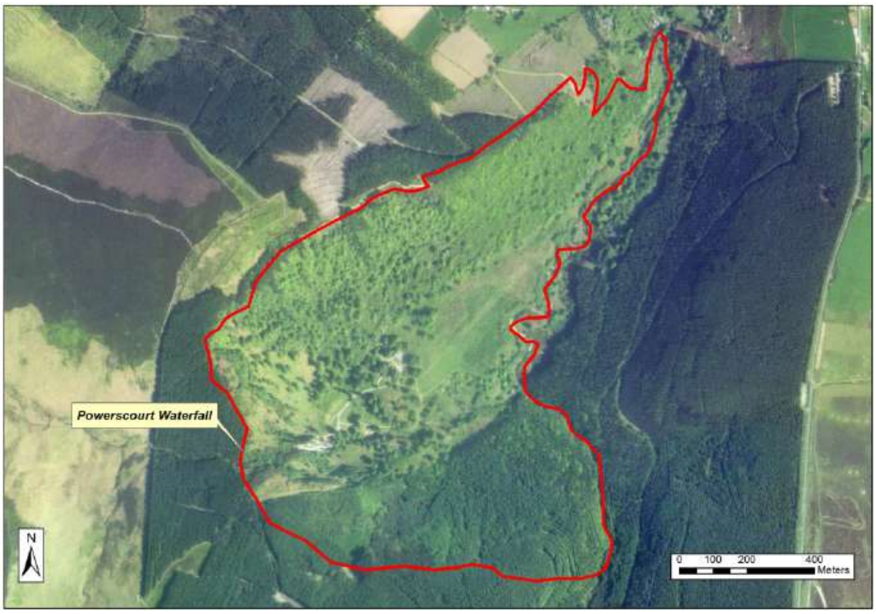
Management/promotion issues
The Powerscourt Estate controls access to the base of the corrie and the waterfall and charge a significant fee for visitors to get to the site by road. It can be seen from very few vantage points, without walking on forest paths in the Djouce Woods or Crone Woods.

Powerscourt corrie from the southern side in Djouce woods.



Left: Powerscourt waterfall at the base
Right: Powerscourt waterfall viewed from the east, by the roadside in Djouce woods.


ENNISKERRY
Áth na Sceire
Kilmacanoge
Great Sugar Loaf
Ó Cualann
Maulin
Long Hill
Powerscourt Waterfall


Powerscourt Waterfall
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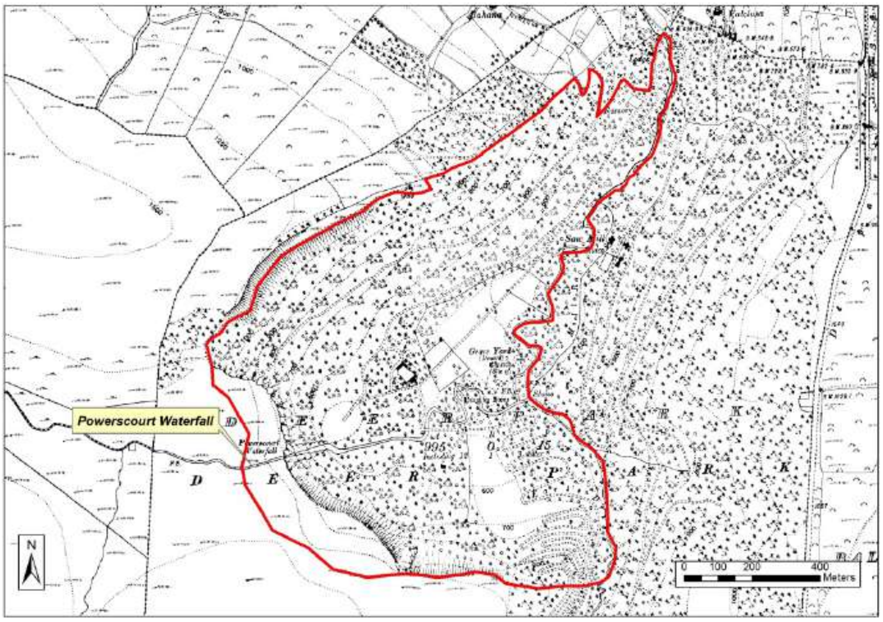
Meters


Powerscourt Waterfall
N
0 100 200 400
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**River Dargle Valley**
Other names used for site	Dargle Gorge, Lover's Leap
IGH THEME	**IGH7 Quaternary, IGH14 Fluvial\Lacustrine Geomorphology**
TOWNLAND(S)	**Tinnehinch, Cookstown, Kilcroney, Newtown**
NEAREST TOWN/VILLAGE	**Enniskerry**
SIX INCH MAP NUMBER	**7**
ITM CO-ORDINATES	**723380E 716400N (centre of feature)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
A stretch of the River Dargle meandering from a wide and flat valley into cascades in a deep, steep-sided rocky gorge.

Geological System/Age and Primary Rock Type
The River Dargle gorge is a Quaternary feature, formed during deglaciation towards the end of the last glaciation (after 22,000 years ago). The river course flows over glaciofluvial drift, underlain by Ordovician slates (from Tinnehinch Bridge to gorge) into a rocky gorge cut into Cambrian quartzite and greywacke bedrock (from the gorge to Dargle Bridge near the N11).

Main Geological or Geomorphological Interest
The River Dargle gorge is one of several spectacular subglacial meltwater channels cut into solid bedrock in north Wicklow (see also Glen of the Downs, the Scalp, Glencullen River). This deeply incised landscape feature was formed when high pressure waters, flowing at the base of the overlying ice sheet, cut into and eroded solid bedrock. The gorge is up to 60m deep below Lovers Leap.

The Dargle River rises in granite uplands between War Hill (686m) and Tonduff North (642m) and flows 3km eastwards to Powerscourt Waterfall (120m high), where it descends to the floor of a wide and flat valley (between Maulin and Great Sugar Loaf). The river course meanders northeastwards, meeting the waters of the Glencree River at Onagh Bridge.

Much of the Dargle valley, like that of the Cookstown River to the north, is drift-filled. After it passes 1km east of Tinnehinch Bridge, the river cuts into a ridge of quartzite and becomes constricted into a wooded rocky gorge. At the floor of the gorge, the riverbed steepens, cascading over greywacke and quartzite bedrock, and continues on to Dargle Bridge where it is joined by the waters of the Cookstown (Glencullen) River, and henceforth to the sea at Bray.

Site Importance - County Geological Site
This is an important County Geological site partly because of its dramatic gorge landform, and also because it is one of several meltwater channels in Wicklow that are essential to understanding deglaciation processes, and the recent formation of the Wicklow landscape.

Management/promotion issues
The River Dargle gorge is less widely known or seen than the meltwater channels of the Scalp and the Glen of the Downs on the N11. The northern ridge overlooking the gorge (e.g. at Lover's Leap) is accessed via a wooded path. It is a steep scramble to the riverbank, and obvious caution should be exercised. Public signboards are not recommended in this relatively unspoilt and secluded site, however its value in terms of geological education and as a local natural amenity is ideally suitable for promotion in any relevant literature.

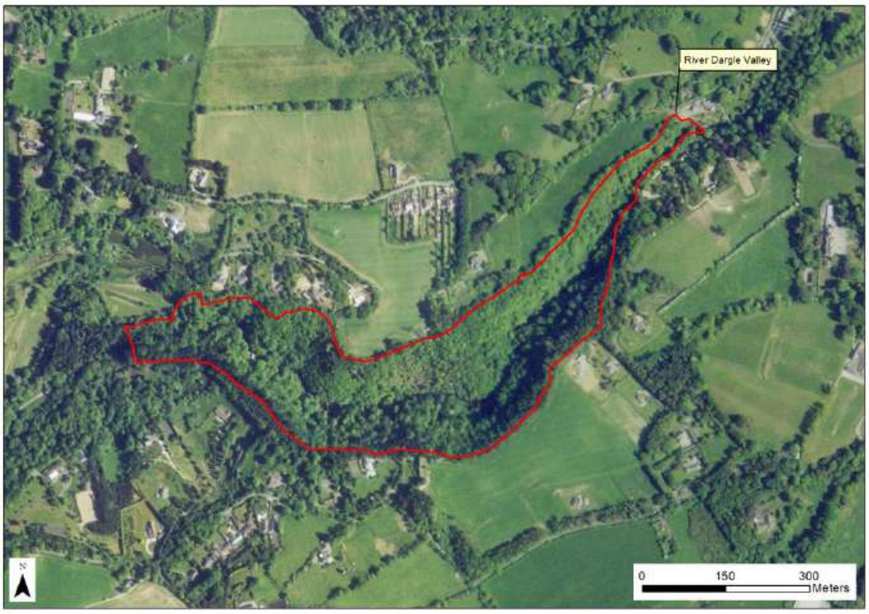
Cascades over Cambrian greywackes below The View\Lover’s Leap looking upstream (west).

View downstream from north bank below The Lodge (ruin) towards The View\Lover’s Leap.

Wasting on south bank viewed from north bank below Lover’s Leap.

Cascades on gorge floor viewed from The View and Lover’s Leap looking upstream.


ENNISKERRY
Ath na Sceire
River Dargle Valley
R117
Cookstown
Kilcroney
Church
Kilbride
Powerscourt Estate and Gardens
Tinnehinch
Tinnehinch Br.
Newtown
Wingfield
Dargle River
An Deargail
Bushy Park
Hollybrook
N11
Charleville Demesne
Stilebawn
Glencormick
R760
Carrigoona Commons
Coolakay
Ballyorney
R755
Rocky Valley
PO
Kilma
Cill


River Dargle Valley
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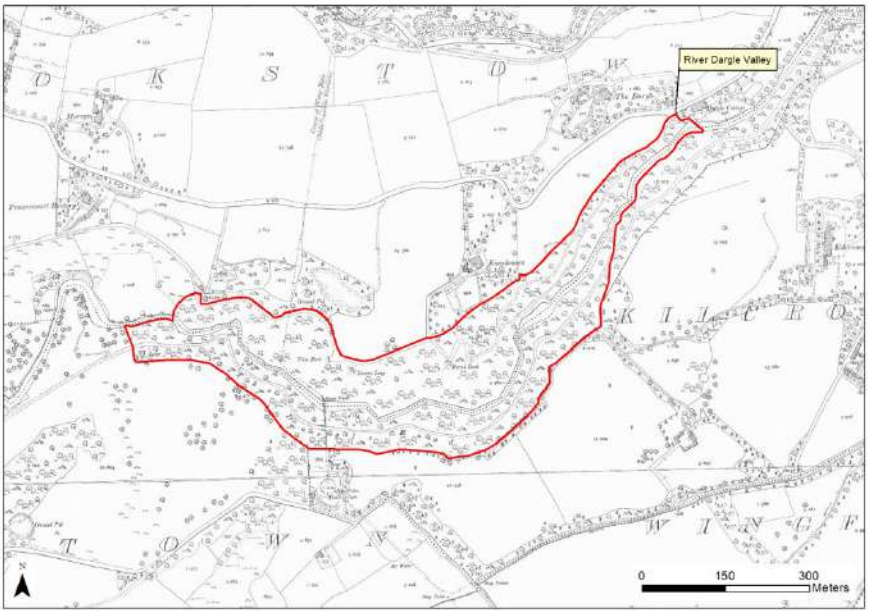
300
Meters


River Dargle Valley
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Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Snugborough**
Other names used for site	Snugborough Pingo Rampart, Snugborough Pingo
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Snugborough**
NEAREST TOWN/VILLAGE	**Avoca**
SIX INCH MAP NUMBER	**40**
ITM CO-ORDINATE	**724348E 678350N (centre of feature)**
1:50,000 O.S. SHEET NUMBER	**62 GSI BEDROCK 1:100,000 SHEET NO. 19**

Outline Site Description
The site comprises a deep hollow along a hedgerow, which separate two fields under pasture. This hollow is a 'pingo rampart' feature.

Geological System/Age and Primary Rock Type
The pingo rampart rests on bedrock of Ordovician volcanics, but the feature itself is Quaternary in age.

Main Geological or Geomorphological Interest
The pingo rampart at Snugborough comprises a raised, circular feature which looks like a man-made rampart, but the embankment is actually a natural feature.

The pingo rampart is evidence of the very cold conditions following deglaciation of the locality at the end of the last Ice Age. The feature indicates that permafrost conditions occurred here, meaning the ground was frozen throughout the year. The pingo was formed when upwelling groundwater froze underground in the permafrost zone, accumulating to form a small, ice-cored hill which grew like a pimple, pushing up the glacial sediments as its outer skin. In melting, the sediments slumped to the side to form the rampart, and a deep hollow was left where the ice core once was.

Site Importance – County Geological Site
The feature is an excellent example of a periglacial feature; one formed by ice within the permafrost zone, after the glacier ice itself has vacated the area. Pingoes are unusual in Ireland, with notable examples in Cork and Wexford, and this one at Snugborough, being the best examples.

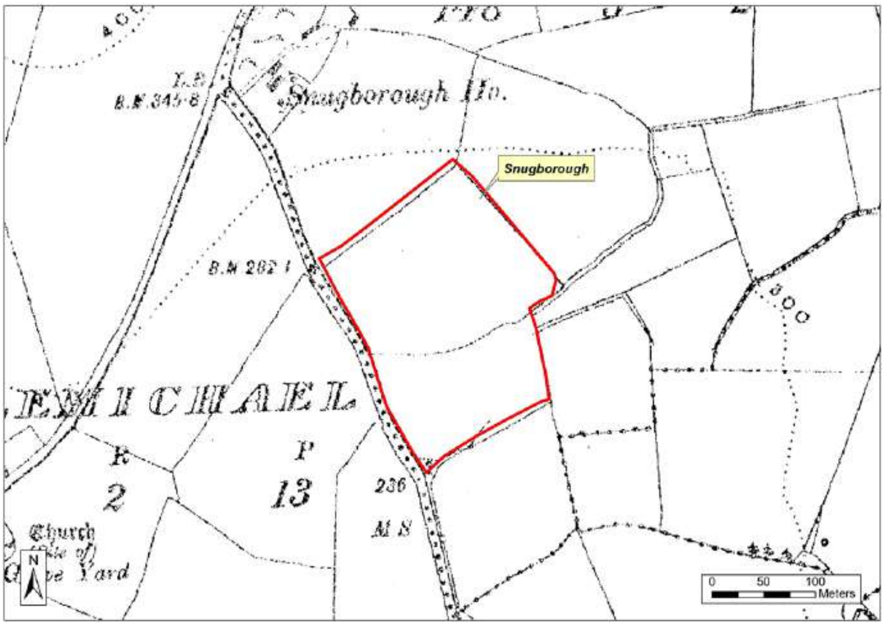
Management/promotion issues
The pingo rampart is best seen from the field itself, but access is across private land and the landowner should be consulted for permission to enter and view.

The pingo rampart at Snugborough, viewed from the west.


View outwards from the base of the pingo at Snugborough.


Avoca
Abhóca
Snugborough
ARKLOW
An tInbhear


Snugborough
N
0 50 100
Meters


Snugborough Ho.
Snugborough
MICHAEL
P
13
R
2
N
0 50 100
Meters

WICKLOW – COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**The Scalp**
Other names used for site	*An Scailp*, which means 'the chasm' or 'the cleft'
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Barnaslingan (Dun Laoghaire-Rathdown)** **Killegar (Wicklow)**
NEAREST TOWN/VILLAGE	**Kiltiernan (Dun Laoghaire-Rathdown)** **Enniskerry (Wicklow)**
SIX INCH MAP NUMBER	**3**
ITM CO-ORDINATES	**712552E 720214N (centre of channel)**
1:50,000 O.S. SHEET NUMBER	**50, 56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
The Scalp comprises a deep channel that was formed by meltwater erosion on the northeastern flank of the Wicklow Mountains. The channel is oriented generally north–south, and extends for a distance of approx. 700m.

Geological System/Age and Primary Rock Type,
The feature is formed in an area of bedrock outcrop and subcrop, and bedrock crops out along the majority of the channel sides, giving the feature its 'scalped' or 'carved out' appearance. The feature was etched out by meltwater during deglaciation at the end of the last Ice Age, about 12,000 years ago.

The bedrock in the locality is dominated by granite, but the southernmost portion of the channel is etched into mica-schist.

Main Geological or Geomorphological Interest
The Scalp channel is up to 70m deep and has a U-shaped profile, typical of meltwater channels. The base of the channel is dry, although a drainage ditch has been dug along most of its length to channel excess surface water during heavy rainfall.

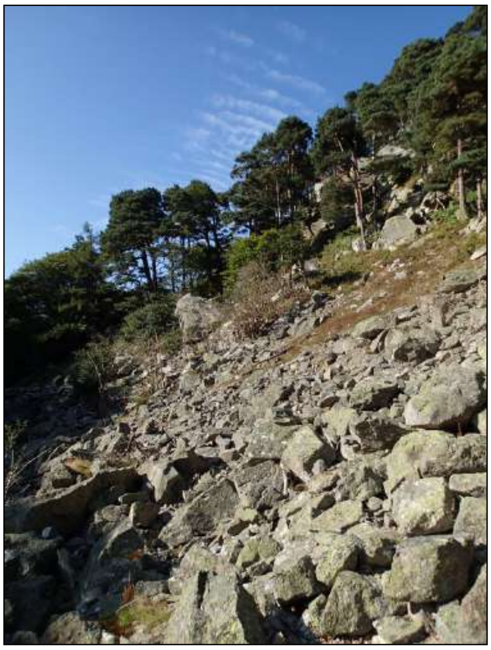
The Scalp is considered to have formed completely in the late-glacial Period. Initially the Scalp was a subglacial channel, formed under the ice, but later carried surface glacial outwash into Glacial Lake Enniskerry from an ice margin just to the north. The channel carried huge amounts of subglacial meltwater draining the ice sheet which covered the Irish Midlands close to its zone of convergence with Irish Sea Basin ice. This very high energy meltwater flow resulted in the Scalp's unusual depth and size.

Much of the sides of the channels are very steep, and littered with (often huge) boulders, some in quite precarious positions above the R117 road, which passes through the feature. This makes the site a popular rock climbing destination. This also means many of the huge boulders have interesting names, such as 'Quartz Crag', 'Eugene's Pinnacle' and 'Rothery's Rocks'.

Site Importance – County Geological Site; may be recommended for Geological NHA
This is a site with good teaching potential on glacial meltwater erosion, as the feature is accessible, quite spectacular, and easily viewed from roads.

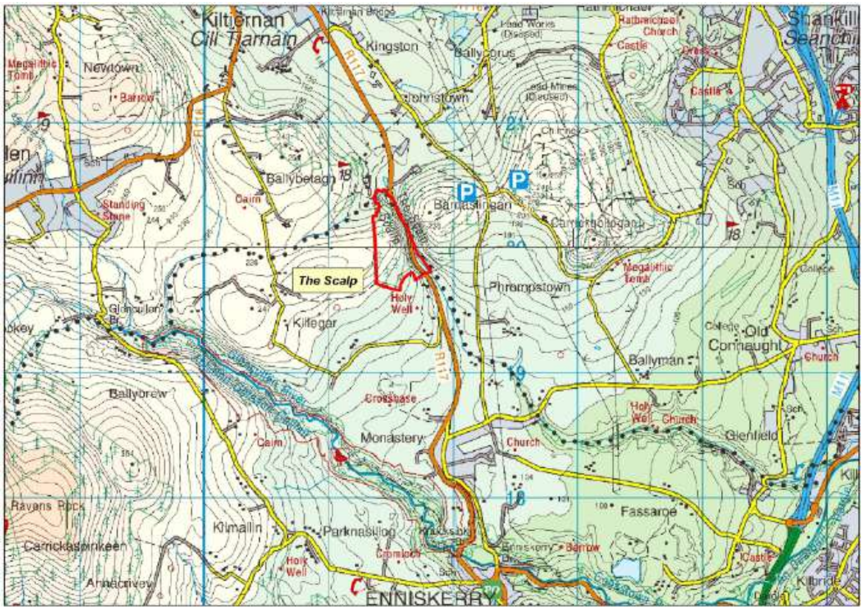
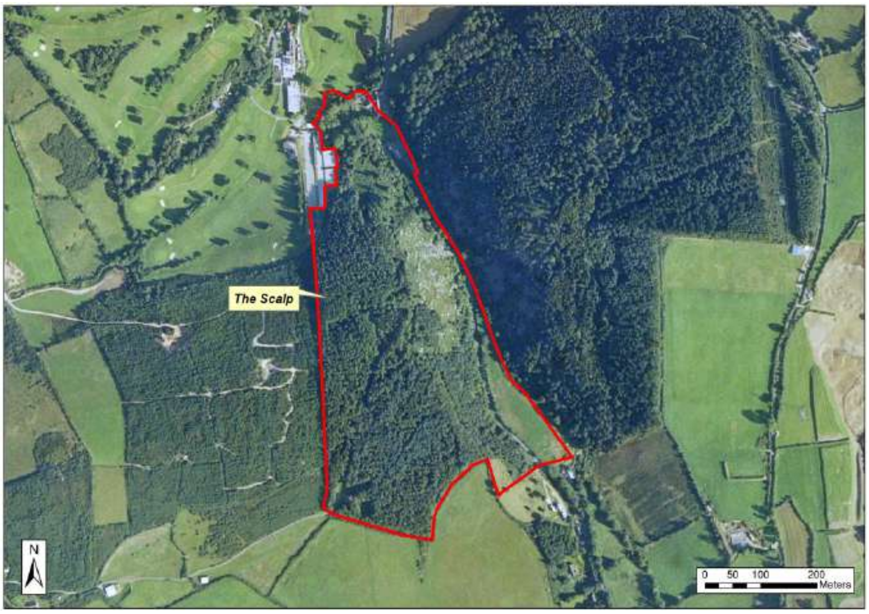
Management/promotion issues
The roadside location of the channel means it is easily accessible, although the flanks are located presumably in private ownership or in commonage. However, there is no parking nearby and it is difficult to stop safely on the road. A good impression of the feature can be had by driving through it on the R117 road, but the view from the Old Connaught to Enniskerry road, to the south, is better.

The Scalp, viewed from the south.



Left: Large boulders along the eastern flank of the Scalp. Right: One of the huge boulders along the R117 road.

The Scalp, viewed from the north.


Kiltiernan
Cill Tiarnáin
Kingston
Ballycorus
Johnstown
Shankill
Newtown
Barrow
Ballybetagh
Cairn
Barnaslingan
Standing Stone
The Scalp
Holy Well
Phrompstown
Megalithic Tomb
Kilfegar
Old Connaught
Ballyman
Ballybrew
Crossbase
Monastery
Church
Glenfield
Ravens Rock
Fassaroe
Kilmalin
Parknasillog
Cromlech
Barrow
Castle
Kilbride
ENNISKERRY

The Scalp
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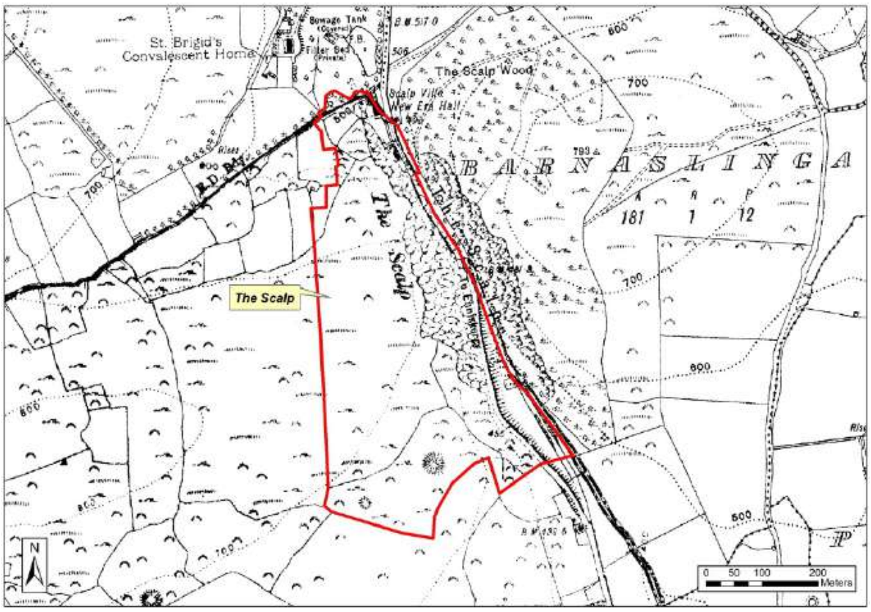
Meters

St. Brigid's
Convalescent Home
Sewage Tank
Filter Bed
The Scalp Wood
Scalp Villa
New Era Hall
B A R N A S L I N G A
The Scalp
700
600
The Scalp
N
0 50 100 200
Meters

An old photograph of The Scalp from the late nineteenth century, which was used as a postcard from the locality (David Cotter Postcard Collection).

George Victor du Noyer's sketch of The Scalp, viewed from "near the Dargle".

WICKLOW – COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Toor Channel**
Other names used for site	Parts of the feature are called ‘Toor Glen’ and ‘Toor Brook’
IGH THEME	**IGH7 Quaternary**
TOWNLAND(S)	**Scalp, Toor, Drumreagh, Dunboyke**
NEAREST TOWN/VILLAGE	**Hollywood**
SIX INCH MAP NUMBER	**33**
ITM CO-ORDINATES	**694340E 703585N (centre of channel)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
The Toor Channel comprises a deep channel that was formed by meltwater erosion on the northwestern flank of the Wicklow Mountains. The channel is oriented generally north–south, before turning east-west, and extends for a distance of just over 1 kilometre.

Geological System/Age and Primary Rock Type,
The feature is formed in an area of bedrock outcrop and subcrop and bedrock crops out along the majority of the channel sides, giving the feature its ‘scalped’ appearance. The feature was etched out by meltwater during deglaciation at the end of the last Ice Age, about 12,000 years ago.

The bedrock in the locality is dominated by schists and quartzites of Ordovician age, with granite also outcropping at the head of the channel.

Main Geological or Geomorphological Interest
The Toor Channel is up to 40m deep and has a U-shaped profile, typical of meltwater channels. The base of the north-south portion of the channel is dry, but the Toor Brook flows westward along the east-west stretch south of this.

The Toor Channel is considered to have formed completely in the late-glacial Period. Initially the glen was a subglacial channel, formed under the ice, but later carried surface glacial outwash from Glacial Lake Enniskerry south and westwards. As well as this, the channel carried huge amounts of subglacial meltwater draining the ice sheet which also covered the Irish Midlands. This very high energy meltwater flow resulted in the Toor Channel’s unusual depth and size.

The intake point for the Toor Channel, which acted as the outlet to Glacial Lake Blessington, lies at approximately 270m above sea level, which means the channel acted as a lake outlet at the time of the formation of the Blessington Delta. The channel is very narrow and has an irregular long profile, which means that meltwater was under huge pressure from ice above, thus proving that the channel was initially subglacial in origin.

Site Importance – County Geological Site; may be recommended for Geological NHA
This is a site with good teaching potential on glacial meltwater erosion, as the feature is accessible, quite spectacular, and easily viewed from roads.

Management/promotion issues
The location of the channel with a road passing alongside it means it is easily accessible, although the flanks are located presumably in private ownership or in commonage. However, there is no parking and it is difficult to stop safely on the road. The channel can be viewed from the road that leaves the N81 about 2 kilometres south of Blessington, and skirts the southeast flank of Slievecorragh.

The north-south portion of the Toor Channel, looking south.

Left: The portion of the channel where flow orientation changes, with bedrock outcrop at either side.

Right: Steep, cliff sides in the channel mid-portion.


BALLYMORE EUSTACE
An Baile Mór
Valleymount
An Chrois
Hollywood
Cillín Chaoimhín
Toor Channel


Toor Channel
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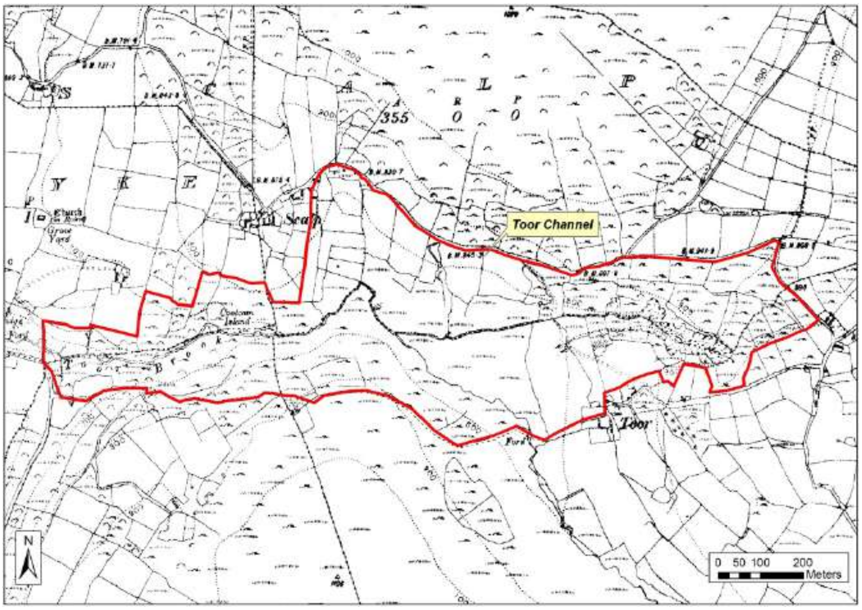
Meters


Toor Channel
355
Toor
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Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Upper Lockstown Delta and Kings River**
Other names used for site	Lockstown Delta, Kings River Delta
IGH THEME	**IGH7 Quaternary, IGH14 Fluvial and Lacustrine Geomorphology**
TOWNLAND(S)	**Lockstown Upper, Granmore**
NEAREST TOWN/VILLAGE	**Hollywood, Donard**
SIX INCH MAP NUMBER	**16**
ITM CO-ORDINATES	**6983300E 702570N (centre of feature)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
The Upper Lockstown Delta includes a large accumulation of sands and gravels, which has been quarried extensively, in the Kings River valley.

Geological System/Age and Primary Rock Type
The 'delta' is comprised of deep glaciofluvial and glaciolacustrine sediments and bedrock is at depth throughout the area of the feature. This bedrock is of fine to coarse-grained granite. The 'delta' is Quaternary in age, having been deposited at the edge of the westward-retreating ice sheet during deglaciation after the last Ice Age. The river features in the valley are of Holocene age, formed within the last 10,000 years.

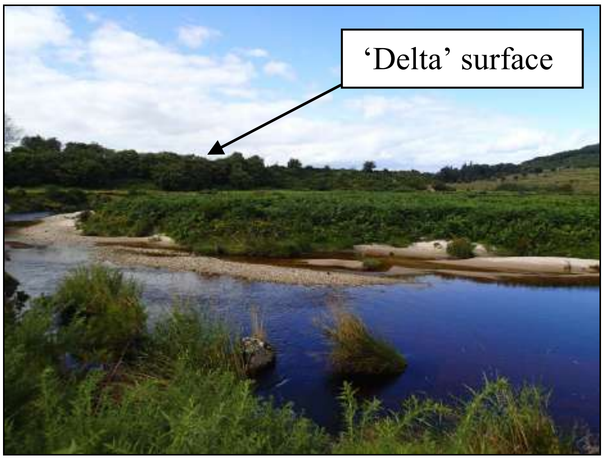
Main Geological or Geomorphological Interest
The delta is a striking feature, a large sand and gravel accumulation deposited into Glacial Lake Blessington by meltwaters flowing from ice of the large ice dome covering the Irish Midlands at the end of the last ice age, while its margin lay to the west of the valley between Slievecorragh and Corriebracks Mountain. The delta was built out from this location into the lake, the surface of which was at about 211m above present sea level at that time. The delta surface here is therefore much lower than at Blessington and Athdown, and relates to a lowering of the lake level following a shift in the location of the ice margin (probably related to the downcutting of Hollywood Glen). The delta at this level can be viewed superbly from the R756 road at Lockstown Upper, in the lay-by at the junction with the R758.

The delta is about 2.5 kilometres long and up to 1 kilometre wide. The sands and gravels are comprised largely of granite from the Wicklow Mountains. The sediments are arranged in the typical delta sequence: topset gravels composed of up to 2m depth of horizontally bedded gravels on top; foreset gravels which are steeply dipping and well bedded, deposited at the front of the delta; and bottomset, finer sediments of sands and silts, usually underlying the foresets and representing sediment that was originally deposited beyond the steep delta front on the lake floor.

The modern day Kings River is eroding the delta feature, resulting in some prominent scarps on the side of the feature, as well as superb meanders, ox-bow lakes, point bars, freshly-cut banks, and a perfect example of a Holocene floodplain.

Site Importance – County Geological Site; recommended for Geological NHA
The feature is a high, striking example of a dry sand and gravel ridge, and stands proud of the surrounding landscape. This is an excellent example of a deglacial, ice marginal, meltwater-deposited feature. The glacial history coupled with the superb alluvial depositional features makes this a marvellous teaching site for second or third level students of geography and geology.

Management/promotion issues
A sizeable portion of the delta has been removed by quarrying, and access to surrounding fields is by permission of the owners or operators, and safety protocols must be followed.



Left: View across the Kings River towards the delta surface. Right: Scarp along the delta edge caused by erosion of the Kings River.

Point bar of coarse sand at a meander edge within the Kings River.


Left: Delta topsets exposed in sand pit. Right: View across sand pit, on northern edge of delta feature.


BALLYMORE EUSTACE
POLLAPHUCA RESERVOIR
Upper Lockstown Delta and King's River


Upper Lockstown Delta and King's River
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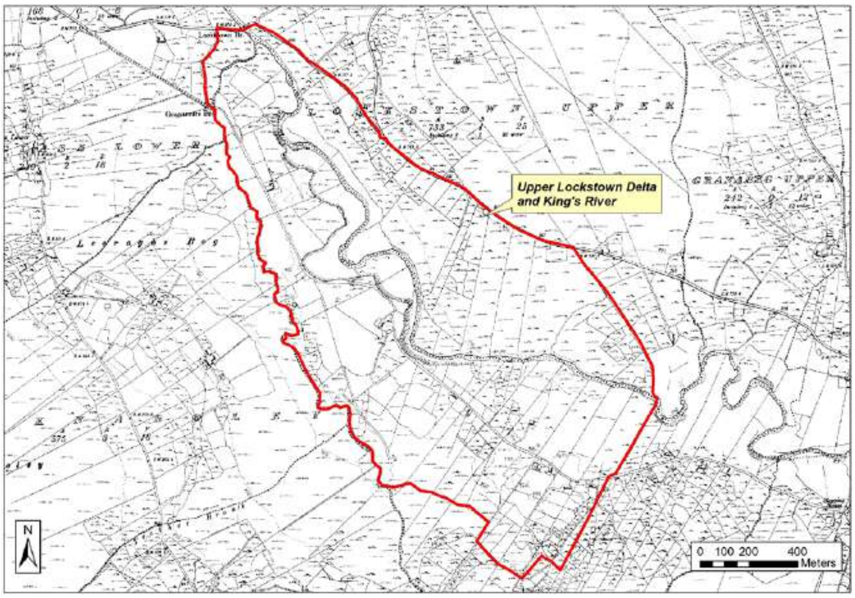
Upper Lockstown Delta and King's River
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WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Aughrim Quarry**		
Other names used for site			
IGH THEME	**IGH11 Igneous Intrusions**		
TOWNLAND(S)	**Tinnakilly**		
NEAREST TOWN/VILLAGE	**Aughrim**		
SIX INCH MAP NUMBER	**34**		
NATIONAL GRID REFERENCE	**713998E 680662N**		
1:50,000 O.S. SHEET NUMBER	**62**	**GSI 1:100,000 Bedrock Sheet No.**	**19**

Outline Site Description
The site consists of two abandoned quarries cut into the western side of a hill - a large upper quarry with an extensive quarry face and a smaller, lower quarry that is partly flooded and extensively vegetated.

Geological System/Age and Primary Rock Type
The rock is a fine-grained granodiorite of the Aughrim Granite, a 400 Ma-old intrusion that is part of the late Caledonian suite of minor granitoid intrusions emplaced along the margin of the Leinster Granite in southeast Ireland.

Main Geological or Geomorphological Interest
The Aughrim Granite is a sheet-like intrusion, up to 400 m wide and almost 3 km long, striking northeast-southwest just east of the town of Aughrim between the townlands of Killacloran and Tinnakilly Upper. It was emplaced under static conditions after the main phase of late-Caledonian deformation, unlike the slightly older Leinster Granite batholith which was emplaced at least partly during deformation. The granite is one of a number of granodiorite intrusions of similar composition between Aughrim and Ballinaclash and is considered to be part of a more extensive suite of contemporaneous minor intrusions in the region.

The quarries ceased operating in 1952. The granodiorite's fine grain (typically 1 mm), lack of textural variation, lack of deformation and limited alteration give it a very even, massive quality with a low porosity that make it very suitable as a building stone. The quarries supplied stone for, among other projects, the construction of the Ardnacrusha hydroelectric scheme.

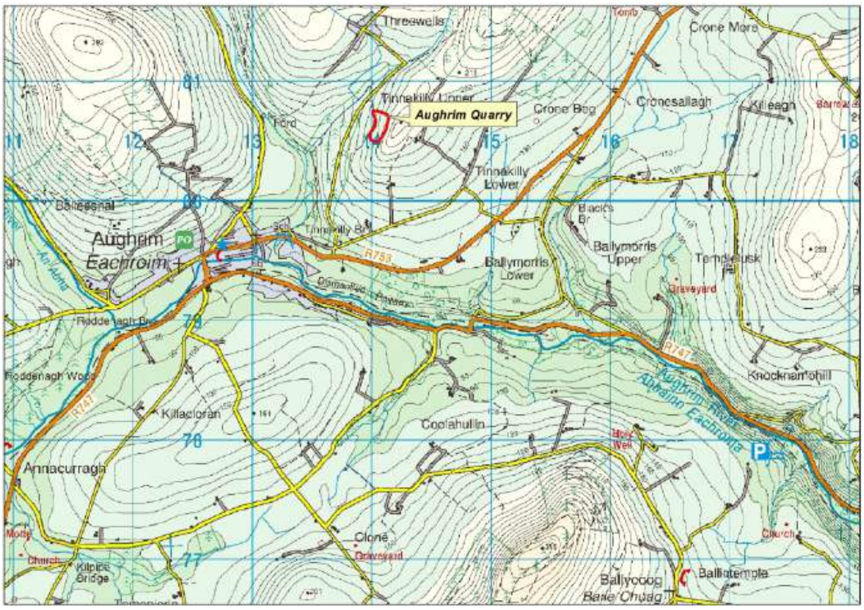
Site Importance – County Geological Site
The quarries at Tinnakilly are among the best exposures of this suite of minor granitoids. The extensive faces of the upper quarry, in particular, provide ample opportunity to examine the composition and texture of the granodiorite.

Management/promotion issues
The site is on private land and appears to be used for grazing horses, although none were observed during this audit. Padlocked gates at the roadside mark the entrance to the site. The quarries have been abandoned for over 60 years, yet appear to be largely intact. The site does not appear to be under any threat. The site is likely to be of interest mainly to professional geologists and researchers. In any case, the presence of high, unfenced quarry faces and partly flooded floor mean that it is not suitable for promotion to the general public.

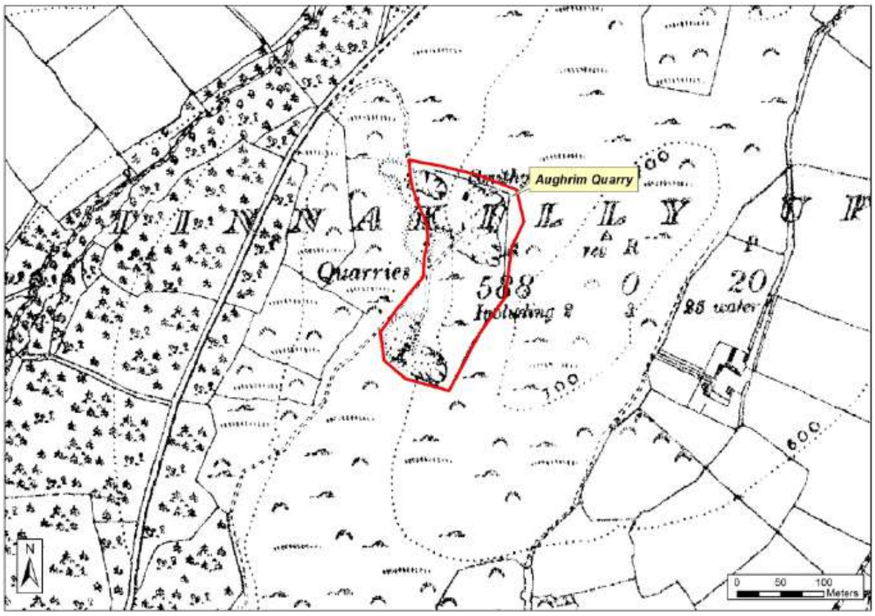
Aughrim Quarry: Lower quarry, view from west.

Aughrim Quarry: Upper quarry, view northwards along eastern face.

Aughrim Quarry: Fine-grained Type 1 granodiorite.


Aughrim Quarry
Threewells
Crone More
Tinnakilly Upper
Crone Beg
Cronesallagh
Killeagh
Tinnakilly Lower
Aughrim
Eachroim
Ballymorris Upper
Ballymorris Lower
Killacloran
Coolahullin
Knocknamohill
Annacurragh
Clone
Graveyard
Ballycoog
Baile Chuag
Ballintemple
Aughrim River
Abhainn Eachroma
Church


Aughrim Quarry
N
0 50 100 Meters


Aughrim Quarry
Quarries
588
N
0 50 100 Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Camaderry Appinite**
Other names used for site	
IGH THEME	**IGH11 Igneous Intrusions**
TOWNLAND(S)	**Seven Churches or Camaderry**
NEAREST TOWN/VILLAGE	**Laragh**
SIX INCH MAP NUMBER	**23**
NATIONAL GRID REFERENCE	**710281E 696895N (centre of outcrops)**
1:50,000 O.S. SHEET NUMBER	**56 GSI 1:100,000 Bedrock Sheet No. 16**

Outline Site Description
The site consists of extensive, large-scale outcrops on the upper part of the southern face of Camaderry Mountain. The mountainside supports thick moorland vegetation.

Geological System/Age and Primary Rock Type
The rock is a coarse-grained hornblende-rich appinite, part of a suite of Late Caledonian appinite intrusions associated with the 405 Ma Leinster Granite.

Main Geological or Geomorphological Interest
Almost 20 Caledonian appinite bodies have been described from southeast Ireland and the Camaderry Appinite is the best known and best exposed example in the region. Appinites are ultrabasic rocks, possible fragments of the mantle that have been emplaced in the upper crust during the Caledonian orogeny. Most appinites in southeast Ireland are within the metamorphic aureole of the Leinster Granite. They post-date folding associated with the regional late-Caledonian deformation but have been affected by late-stage thermal metamorphism associated with the Leinster Granite. They are thus broadly contemporaneous with the Leinster Granite and represent a coeval basic magma. The association of appinites and granitic intrusions is common throughout the Caledonides of Ireland and Scotland.

The Camaderry appinite is a stock-like body with apparently steep contacts to north and south and moderately-dipping, conformable contact with enclosing rocks to the east. Its composition varies from northeast to southwest, ranging from coarse-grained hornblendite or hornblendite-peridotite, composed of large hornblende crystal with embedded olivine and pyroxene, to hornblende-diorite (hornblende, plagioclase) in the southwest. Pegmatitic variants occur and an actinolite-rich rock is developed along the northern and eastern margins. The massive outcrops on the hillside are characterized by pock-marks that have developed where weathering of pyroxene has led to pitting of the rock face. Large outcrops display fine examples of spherical weathering. On the eastern margin of the appinite body, contact metamorphism is apparent in the strongly hornfelsed country rock phyllites.

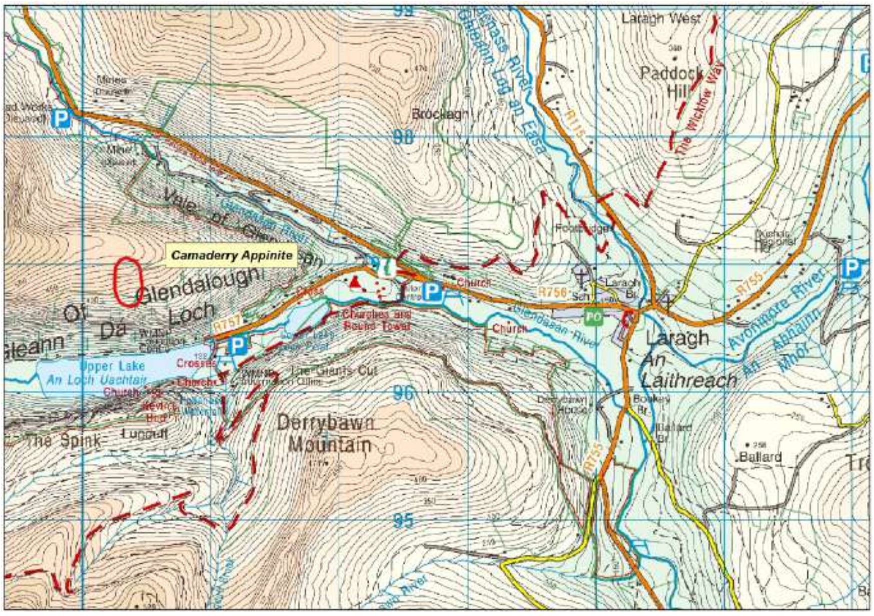
Site Importance – County Geological Site
Appinites comprise a well-known sub-group of Caledonian igneous intrusions, with those around the Ardara pluton in Donegal being particularly well studied. The Camaderry site provides excellent exposure of the most significant appinite intrusion in southeast Ireland and, as such, is an important County Geological Site.

Management/promotion issues
The site is within the Wicklow Mountains National Park, close to a hillwalking route on Camaderry Mountain. There are no threats to the site. Signage would be inappropriate but the site merits inclusion in heritage literature for the National Park and the Glendalough area in particular.

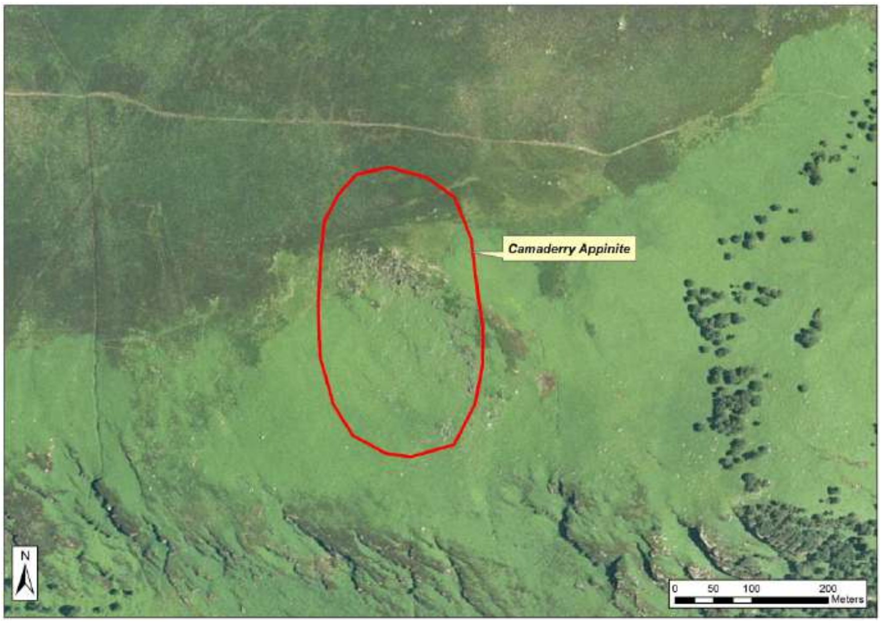
Camaderry Appinite: view from south of main outcrop area.

Camaderry Appinite: massive outcrop showing spherical weathering.

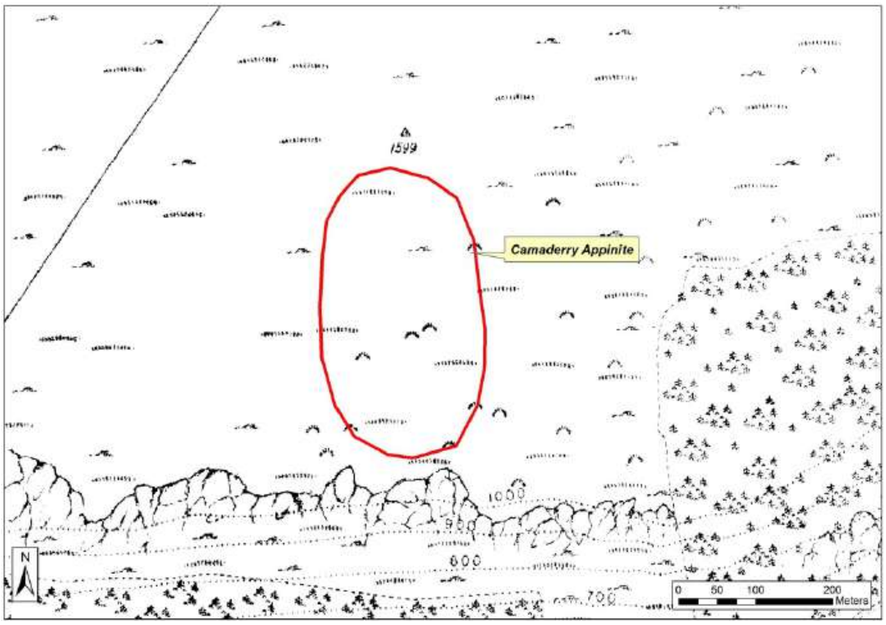
Camaderry Appinite: pitting on surface owing to weathering of crystals.



Camaderry Appinite
Glendalough
Vale of Glendasan
Brockagh
Laragh West
Paddock Hill
The Wicklow Way
Laragh
An Laithreach
Avonmore River
Glendasan River
Upper Lake
An Loch Uachtair
Derrybawn Mountain
The Spink
Lugduff
Gleann Da Loch
Churches and Round Tower
Ballard
R756
R755
R757
99
98
96
95



Camaderry Appinite
N
0 50 100 200
Meters



1599
Camaderry Appinite
1000
900
800
700
N
0 50 100 200
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Greystones (Appinite)**
Other names used for site	Greystones Harbour
IGH THEME	**IGH11 – Igneous Intrusions**
TOWNLAND(S)	**Rathdown Lower**
NEAREST TOWN/VILLAGE	**Greystones**
SIX INCH MAP NUMBER	**8**
ITM CO-ORDINATES	**729690E 712610N (appinite outcrop)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
A section of rocky coastline on the scenic and popular Greystones waterfront.

Geological System/Age and Primary Rock Type
The predominant rock type at Greystones are the Cambrian age meta-sedimentary Bray Group greywackes. The coarse-grained hornblende-rich appinite rocks were emplaced into the Cambrian rocks either at the same time as, or just before, the emplacement of the main Leinster Granite, 405 million years ago (Devonian). The Greystones appinites are described as hornblende lamprophyre dykes in some geological literature.

Main Geological or Geomorphological Interest
Part of a suite of Late Caledonian appinite intrusions associated with the Leinster Granite, the Greystones appinites are dark-grey coloured igneous rocks that occur (for about 50m, east-west) within the rocky Greystones waterfront, to the south of the harbour. The location of the appinite dykes is marked by a conspicuous eroded gully cut into the rocky coastline at the north end of the 'grey stones'. The appinites were intruded (squeezed into bedrock or crust) into the greywackes around 405 million years ago. Appinites are ultrabasic igneous rocks that crystalise from molten magma that is rich is water. The intrusion appears as two sills that are separated by a U-bend fold (syncline) in the greywackes, and roughly follows the same bedding patterns of the greywackes.

The appinitic rocks comprise dark medium-to-coarse textured rock composed of the minerals hornblende and biotite, set in a groundmass of the minerals plagioclase, orthoclase, and quartz. Contact (thermal) metamorphism (when hot rocks are squeezed into and alter or 'bake' the cooler rocks) is evident in the greywacke rocks alongside and in contact with the appinites. The appinite dykes occur around five kilometres east of, and quite remote from, the eastern margin of the Leinster Granites. Xenoliths (large rock fragments torn from the walls of the magma chamber) up to a metre in length are present in the Greystones appinites. The Cambrian greywackes are understood to be the origin of the town's name.

Site Importance – County Geological Site
Easy to access at low tide, the appinites at Greystones are fine examples of igneous rocks intruded into older (immediately adjacent) meta-sedimentary rocks. The appinites exhibit very well-developed hornblende crystals which are clearly visible with the naked-eye. One of at least 18 appinites bodies that comprise a sub-group of Caledonian igneous intrusions in the region, Greystones represents one of the best sites for appinite rocks in Wicklow.

Management/promotion issues
The site is on the rocky section of the Greystones waterfront, alongside a scenic and popular amenity area. The features are not deemed to be of significant public interest, as access to the appinite outcrops requires a shoreline scramble. There are no apparent threats to this site. However, a smaller appinitic body previously exposed near the harbour to the north has been obscured by harbour developments.

Appinite outcrops (dark) in the gully below road level.

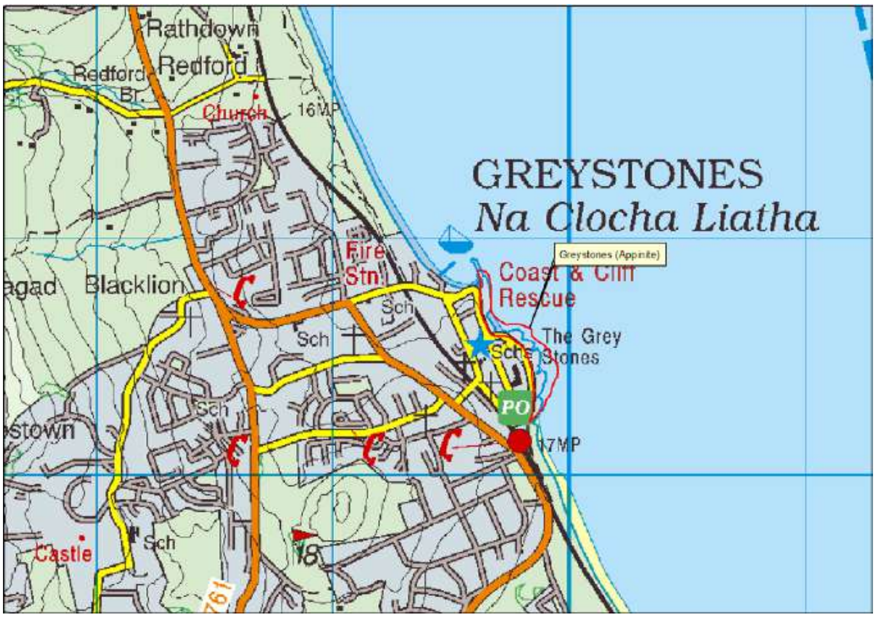
Appinite – close-up.

View eastwards from the head of gully where appinites are exposed on both sides.

View westwards at gully (left) where appinites are exposed. Strata folded into syncline to right (north).

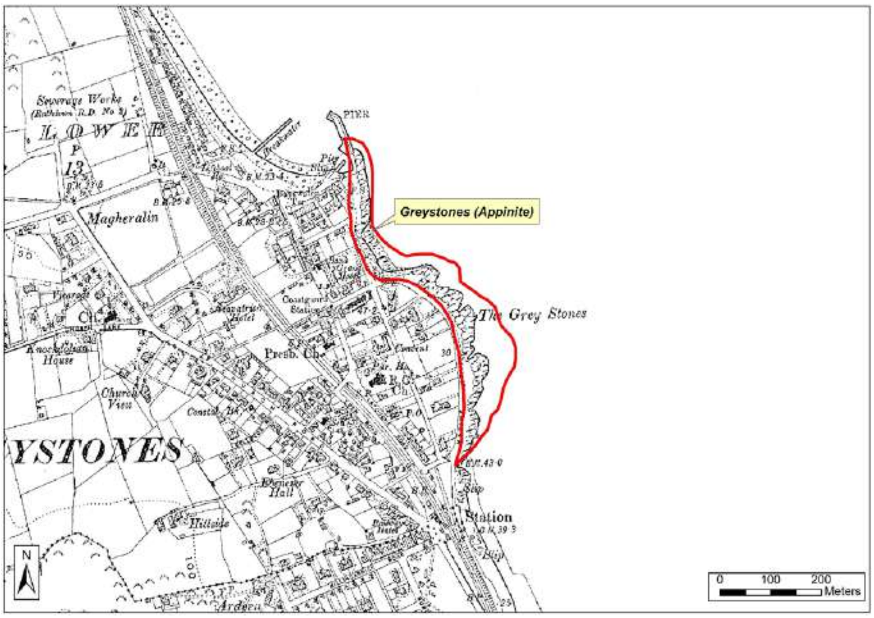
The “Grey Stones” – looking south along coast towards Cobbler Bulk.

Bray Head, viewed looking north along coast from near location of appinite outcrop.



Rathdown
Redford
Church
16MP
GREYSTONES
Na Clocha Liatha
Greystones (Appinite)
Fire Stn
Coast & Cliff Rescue
Blacklion
Sch
The Grey Stones
PO
17MP
Castle
18

Greystones (Appinite)
N
0 100 200 Meters



PIER
Magheralin
Greystones (Appinite)
The Grey Stones
Presb. Ch.
YSTONES
Station
N
0 100 200 Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Kilmacurra Quarry**
Other names used for site	
IGH THEME	**IGH11 Igneous Intrusions**
TOWNLAND(S)	**Kilmacurra West**
NEAREST TOWN/VILLAGE	**Rathdrum**
SIX INCH MAP NUMBER	**30**
NATIONAL GRID REFERENCE	**724682E 688471N (centre of quarry)**
1:50,000 O.S. SHEET NUMBER	**62 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description
Kilmacurra Quarry is a large, partly flooded quarry developed in a diorite intrusion. It is now abandoned.

Geological System/Age and Primary Rock Type
The bedrock is diorite, part of the Caledonian Carrigmore Diorite suite of intrusions in east Wicklow. The suite has been dated at 410 Ma, slightly older than the Leinster Granite. Wallrocks are slates of the Ordovician Kilmacrea Formation.

Main Geological or Geomorphological Interest
The Carrigmore Diorite suite comprises a series of igneous intrusions of intermediate composition, i.e. a chemical and mineralogical composition intermediate between granite and gabbro. Diorite intrusions occur widely in Ireland but the Carrigmore suite is unusual for the size and internal complexity of the intrusions. Diorite is a relatively hard rock, suitable for aggregate and concrete manufacture, and several quarries have been developed in the Carrigmore suite, including those at nearby Ballinclare and Parnell Quarry near Rathdrum.

Site Importance – County Geological Site
Diorite is an important minor igneous rock type in Wicklow. The Kilmacurra Quarry provides good exposure on quarry faces and in loose blocks. The other quarries developed in the Carrigmore suite are apparently still operational so this site provides an opportunity to examine the diorite in situ.

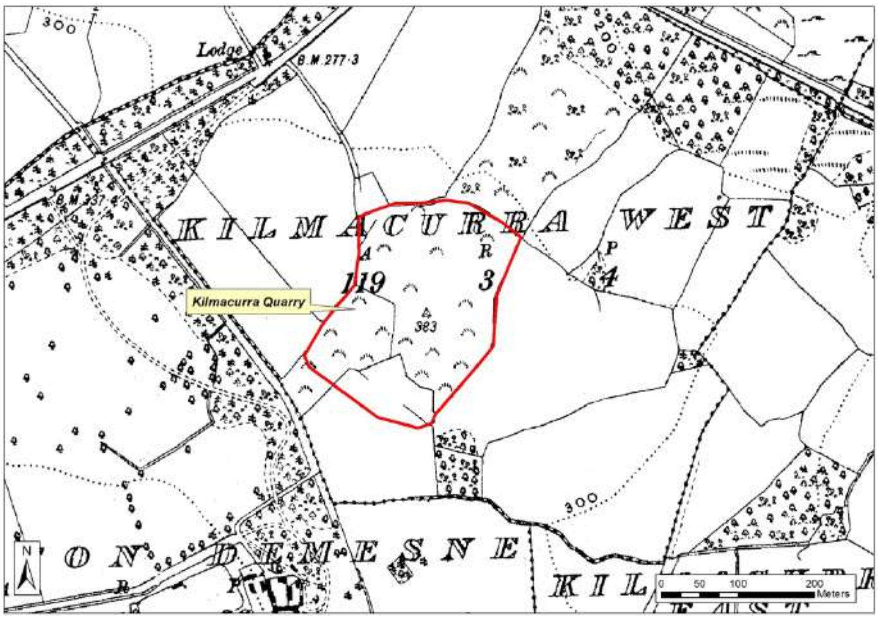
Management/promotion issues
The quarry is abandoned and partly flooded, with deep water and high vertical quarry faces. It is of interest mainly to geologists and is not suitable for promotion to the general public.

View southwards of western side of quarry, showing vertical faces and flooded quarry floor. Upper faces to right are readily accessible.

Medium-grained grey-green diorite, typical of rock exposed in the quarry.


Kilmacurra Quarry
RATHDRUM
Rath Droma
Glenealy
Gleann Fhaidhle


Kilmacurra Quarry
N
0 50 100 200
Meters


Kilmacurra Quarry
KILMACURRA WEST
Lodge
B.M. 277·3
119
3
4
383
300
DEMESNE
N
0 50 100 200
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Lough Dan Granite Contact**
Other names used for site	
IGH THEME	**IGH11 Igneous Intrusions**
TOWNLAND(S)	**Cloghogue, Carrigeenduff**
NEAREST TOWN/VILLAGE	**Roundwood**
SIX INCH MAP NUMBER	**17, 18**
ITM CO-ORDINATES	**714300E 704650N (centre of feature)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
Glacial valley terrain at the NW end of Lough Dan, where the granite-schist contact zone is clearly visible on the mountain slopes flanking the valley.

Geological System/Age and Primary Rock Type
Late Caledonian Leinster granites were intruded into pre-existing Ordovician slate country rock 405 million years ago (Devonian). The slates were thermally altered and metamorphosed to silver-coloured mica-schists along a zone of thermal contact (aureole). The valley is Quaternary in age, its current shape formed by glaciers during the last glaciation.

Main Geological or Geomorphological Interest
At the northwestern end of Lough Dan, where the Inchavore River flows into the lake, the contact of the Devonian granites (to the west) with the Ordovician schist (to the east) is easy to recognise on the mountain sides. The contact, where two very different rock types (igneous and metamorphic) of different ages are found side-by-side, marks the eastern margin of the Leinster Granite in this part of the Wicklow Mountains. This contact zone is called a metamorphic aureole, which formed when heat and pressure of the rising granite 'baked' and altered the mineralogy of the slate bedrock into which it was intruded. Elsewhere in the general proximity of Lough Dan, such as at Glenmacnass Waterfall and Luggala, the granite-schist contact is marked by a severe drop in topographic elevation. The contact at Lough Dan however is demarcated by a change in vegetation and terrain on the mountain sides, particularly on the flanks of Knocknacloghoge (534m). At ground-level, the contact is buried beneath marsh and the alluvial sediments of the Inchavore River delta. The steeper sides of Knocknacloghoge on the north side of the lake are footed by massive granite boulders, the result of mass wasting (slope failure), similar to that seen on the shores of nearby Lough Tay. In contrast to the granite, the Ordovician schist on Knocknacloghoge weathers and erodes on a less severe scale, such that large boulders are absent on the schist slopes. A small lead-zinc lode occurs within a short distance of the granite/schist contact on the hillsides flanking the southern side of northwest Lough Dan, near the abandoned village of Inchavore. This mine was the site of small-scale mining activities in the eighteenth century and the ore deposits were reportedly exhausted by the turn of the nineteenth century.

Site Importance - County Geological Site
This is an excellent educational site, used by third level student groups, and is accessible along a lengthy track leading from the Cloghoge Valley and from the southeast.

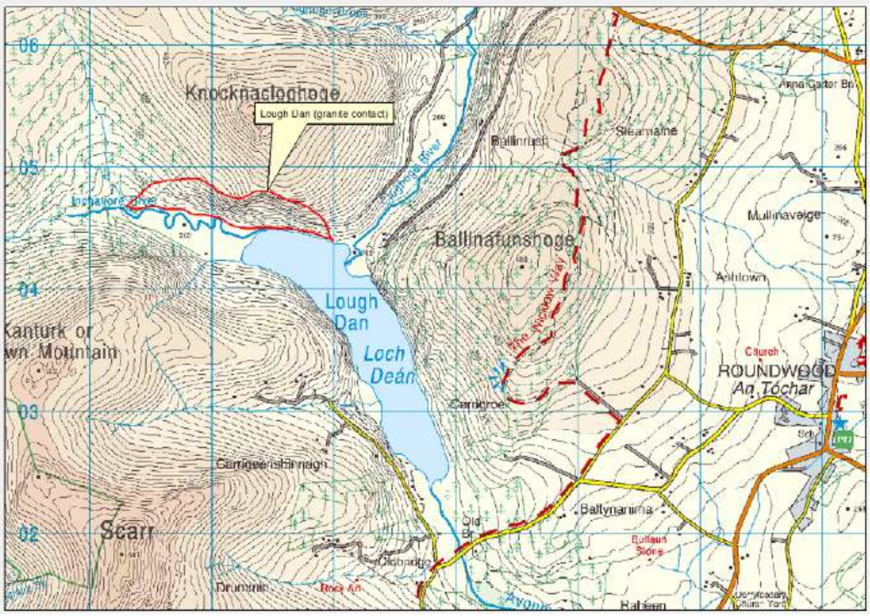
Management/promotion issues
Access to this scenic and remote site requires a trek. The significance of the site as a granite-schist contact zone should be highlighted in any literature or media content pertaining to Lough Dan, particularly as the feature is recognisable even from a distance.

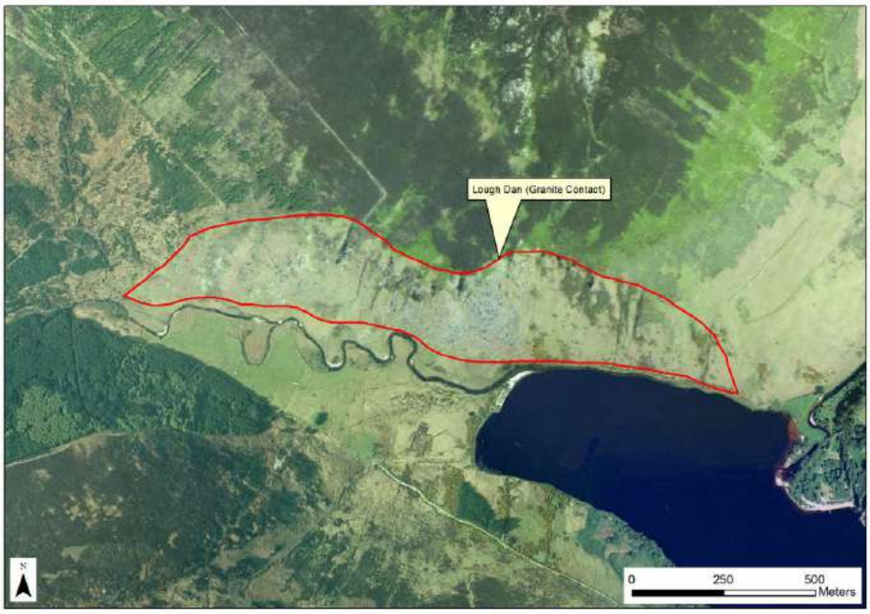
Contact zone (dashed line) at north part of Lough Dan - looking west from Cloghoge River delta.

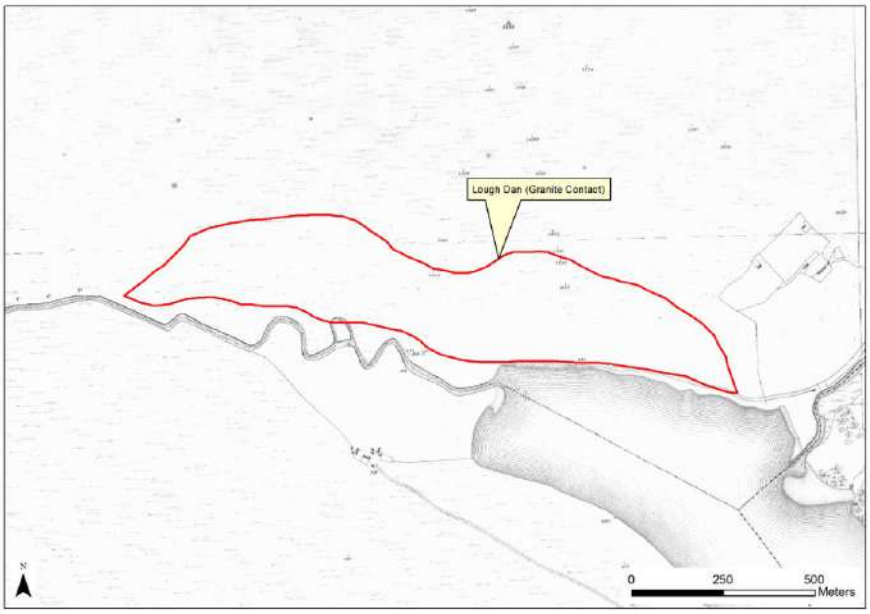
Ordovician (green hillslopes on left)-Leinster Granite (dark coloured patchy terrain) contact at north end of Lough Dan (Kanturk Mountain side).

Leinster Granite (left)-Ordovician (right) contact zone – on the slopes of Knocknacloghoge Hill (northwest end of Lough Dan).

Granite boulders at the foot of the south-facing granite slopes of Knocknacloghoge Hill looking west.


Lough Dan (granite contact)
Knocknacloghoge
Ballinafunshoge
Lough
Dan
Loch
Deán
ROUNDWOOD
An Tóchar
Scarr


Lough Dan (Granite Contact)
0
250
500
Meters


Lough Dan (Granite Contact)
0
250
500
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glasnamullen**
Other names used for site	
IGH THEME	**IGH 12 Mesozoic-Cenozoic**
TOWNLAND(S)	**Glasnamullen**
NEAREST TOWN/VILLAGE	**Roundwood**
SIX INCH MAP NUMBER	**12**
ITM CO-ORDINATES	**719900E 709480N (centre of outcrop)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
A long stream section with rock exposures in the bed and banks.

Geological System/Age and Primary Rock Type
Tertiary (Miocene) fault breccia exposed in the bed and banks of the stream.

Main Geological Interest
The site comprises the exposures of a breccia deposit created by a major fault which moved in the Tertiary Period, approximately 12.1 million years ago. Evidence of such faulting is rarely seen, except through interpretation of outcrop patterns. This site and the Powerscourt Deerpark cave site are both surface outcrops providing direct faulting evidence.

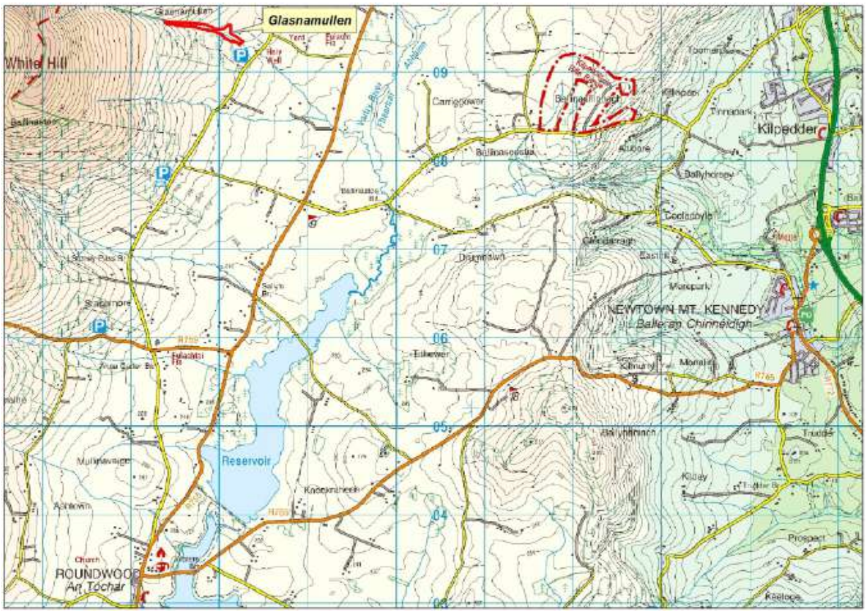
The movement on this Shankhill Fault Zone has been dated elsewhere, at Cloghleagh Mine, by radiometric method, using the isotopes of ^{40}Argon/^{39}Argon. The argon isotopes were contained within the potassium-bearing manganese oxide, cryptomelane. The mineralisation was generated as a hydrothermal breccia. The breccia at Glasnamullen is a part of the same fault zone.

Site Importance - County Geological Site
The site represents a rare example of evidence of faulting in eastern Ireland from the Miocene, and complements both Cloghleagh Mine and Powerscourt Deerpark Cave sites.

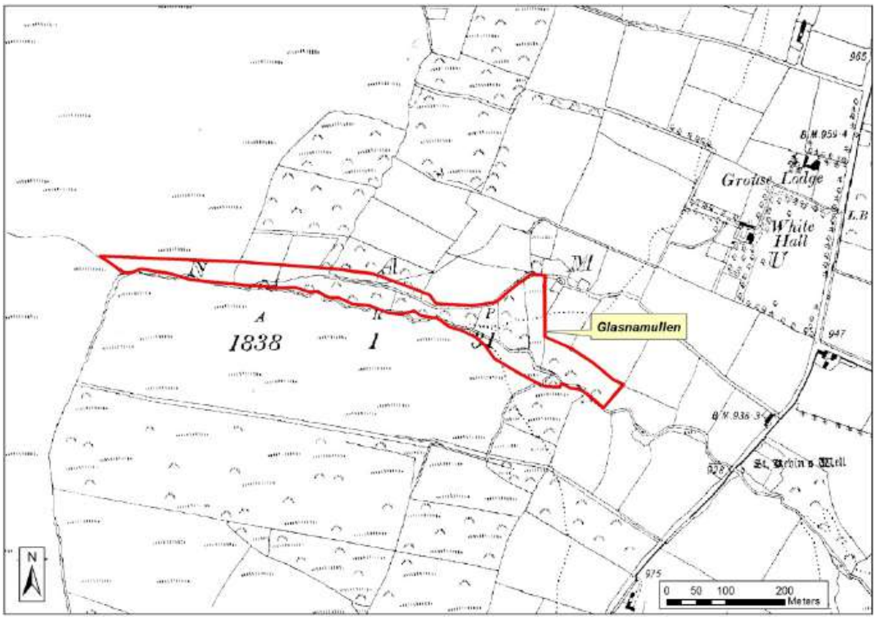
Management/promotion issues
The stream is in wild hillside, dividing farmland from forestry and is in a small gorge in places. It would appear to be under little threat, but if the landuse were to change in the vicinity, it could. Any forestry or farming operation such as drainage would have the potential to create new exposures.

Some of the breccia exposed in the stream bed, in the upper part of the site.

Left: Some of the breccia exposed in the stream bank.
Right: The stream is in a gorge in the lower part of the site.


Glasnamullen
White Hill
Kilpedder
NEWTOWN MT. KENNEDY
Baile an Chinnéidigh
Reservoir
ROUNDWOOD
An Tóchar


Glasnamullen
N
0 50 100 200 Meters


Glasnamullen
1838
Grouse Lodge
White Hall
N
0 50 100 200 Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Powerscourt Deerpark Cave**
Other names used for site	
IGH THEME	**IGH 12 Mesozoic-Cenozoic**
TOWNLAND(S)	**Deerpark**
NEAREST TOWN/VILLAGE	**Enniskerry**
SIX INCH MAP NUMBER	**7**
ITM CO-ORDINATES	**720285E 711500N (cave entrance)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
A small cave, which may have been enlarged by excavation, within a stream bed.

Geological System/Age and Primary Rock Type
The cave is hosted in a fault breccia deposit that is about 12 million years old.

Main Geological Interest
This cave is the only known natural cave in Wicklow, though it has been modified by channelling the downstream end into a conduit underneath the forest road. It is rare to find caves in Ireland formed in geological settings other than karstic limestone, and this cave is part water-eroded and possibly part tectonic fissure. It is formed within a breccia deposit created by a major fault which moved in the Tertiary Period, approximately 12 million years ago, and evidence of such faulting is rarely seen, except through interpretation of outcrop patterns. This site and the Glasnamullen site both show surface outcrops that provide direct evidence of faulting.

The fault deposit is iron rich and it is apparently a source of ochre, probably worked in the past, with some indication of excavation around the cave entrance. It is also possible that small amounts are collected by local artists today. The waterfall at the downstream mouth of the cave shows a curtain of ochreous precipitate.

Site Importance - County Geological Site; recommended for Geological NHA
It is a small but significant site, which with the companion Glasnamullen, provides direct evidence of Irish geological history in Wicklow during relatively recent geological periods. This is very rare as such evidence is not normally preserved because this was during periods of erosion of the land.

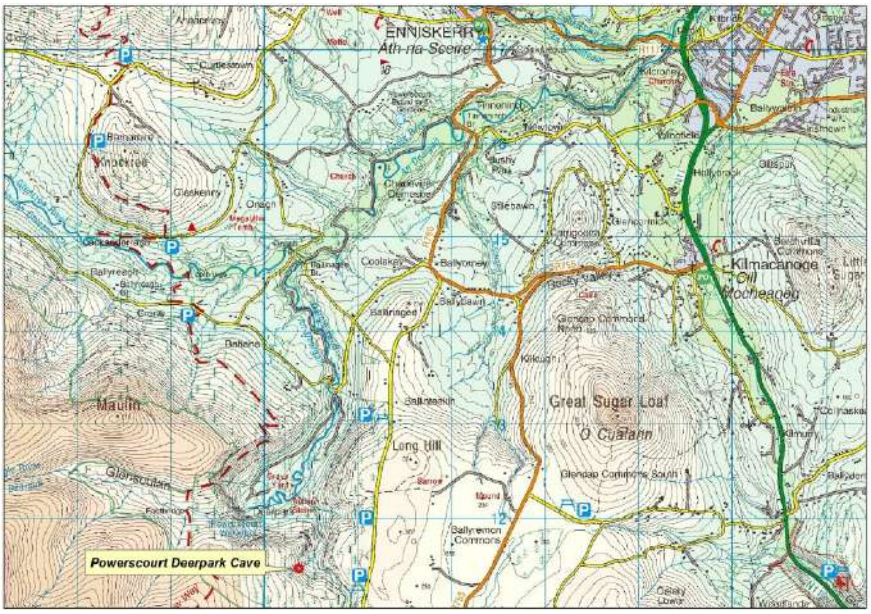
Management/promotion issues
The site is beside a forest road that is widely used by walkers, but is unlikely to be at risk from recreational users. It is not regarded as a risk to walkers, as anyone investigating the cave from the track would not penetrate further than the entrance as they would get a shower from the waterfall- which is picturesque but hard to photograph. It is such a short cave that sport cavers would not visit. Forestry operations may affect it, either by tree removal in the immediate vicinity or by windfall of adjacent trees. Also upstream felling may affect the stream flow into the cave, and change the sediment regime.

It could be promoted with a signboard, a Q-code symbol or other means, but is possibly best left to those who wish to investigate and identify it as of interest on their hillwalks. It appears on East-West mapping, and could be added to Ordnance Survey mapping if they adopted County Geological Sites as a layer in their data.

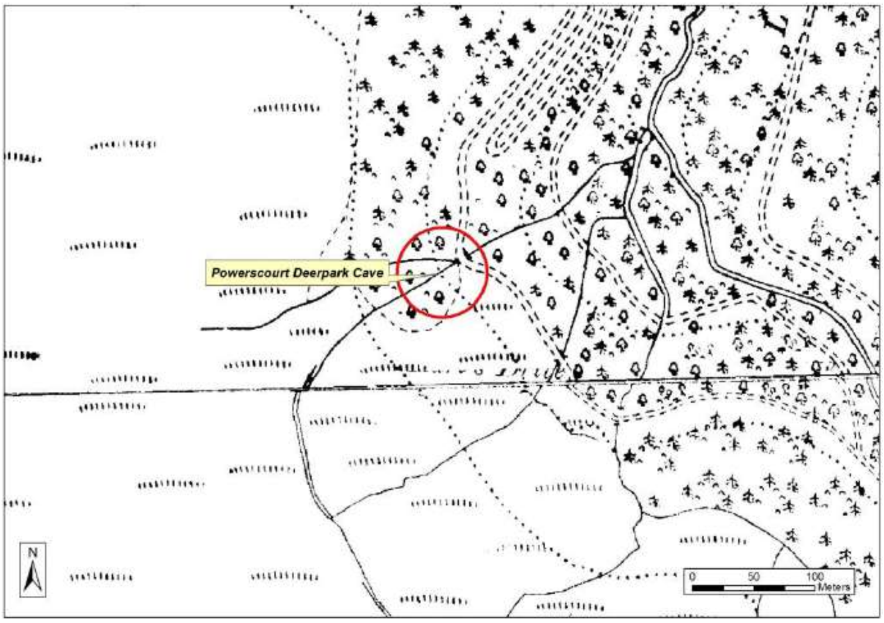

Left: The waterfall of iron minerals from the cave's exit.
Right: The location of the cave just off a bend in the forest track.


Left: Matthew Parkes within the cave.
Right: The view into the overhang and waterfall of the cave entrance.


Left: a small section of abandoned cave or an excavated area, adjacent to the waterfall.
Right: The bend in the forest road, with the cave off to the right.


ENNISKERRY
Áth na Sceire
Kilmacanoge
Cill Mocheanóg
Great Sugar Loaf
Ó Cualann
Long Hill
Maulin
Powerscourt Deerpark Cave


Powerscourt Deerpark Cave
N
0
50
100
Meters


Powerscourt Deerpark Cave
N
0
50
100
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Wicklow - Greystones Coast**
Other names used for site	Wicklow Coast, The Murrough, The Breaches
IGH THEME	**IGH13 – Coastal Geomorphology**
TOWNLAND(S)	***Numerous townlands border this coastline***
NEAREST TOWN/VILLAGE	**Wicklow, Greystones**
SIX INCH MAP NUMBER	**11**
ITM CO-ORDINATES	**731670E 703870N (at Six Mile Point)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
An uninterrupted shingle beach extending for over 17km between Greystones and Wicklow.

Geological System/Age and Primary Rock Type
The shingle ridge (beach) is a Quaternary (Holocene) feature, and is understood to have formed around 5,000 years ago. At this time, a rise in sea-level carried eroded sea-floor glacigenic deposits into a shingle ridge.

Main Geological or Geomorphological Interest
The low and flat terrain coastal landscape between Greystones and Wicklow town is underlain by Cambrian bedrock, which is not widely exposed between the two towns. Wicklow Head is a bold headland of slopes descending to rocky cliffs of grey schist. At Greystones, Cambrian greywacke rocks outcrop along the esplanade coastline.

Between the two towns is ‘the Murrough’. This 15km long coastal wetland area borders the Irish Sea with an uninterrupted shingle ridge consisting of smooth rounded pebbles interspersed with sand particles. Sediment size increases from north to south, being dominated by sand along its northern stretch near Greystones, and by larger pebbles nearer Wicklow. The variation is understood to be a result of wave-induced grading of the ridge deposits by longshore drift.

At Six Mile point, a salient point (land jutting seaward) on the shingle coast has been armoured with a rampart of large boulders dumped to protect the railway. The shingle ridge carries the Dublin-Rosslare railway line. To the north, the Breaches are small inlets where the Kilcoole Marshes drain to the sea. Saltmarsh is present at the Breaches and further south at the brackish, partly tidal Broad Lough near Wicklow.

Site Importance – County Geological Site; may be recommended for Geological NHA
This is an important County Geological Site that could be considered for a geological NHA status under the IGH13 Coastal Geomorphology theme. The site is located within the Murrough Wetlands SAC (002249), the largest coastal wetland complex on the east coast of Ireland and supports a number of habitats listed on Annex I of the EU Habitats Directive.

Management/promotion issues
The site is publicly accessible from access points at e.g. Kilcoole Railway Station, Six Mile Point and Five Mile Point. Coastal protection works have been carried out by Iarnród Éireann to protect the railway line, with the installation of rock armour on the seaward side of the line such as at Six Mile Point. Any future promotion of the Murrough Wetlands SAC should make reference to the natural processes of coastal erosion affecting this coastline, and also to the extensive shingle shoreline and greywacke boulders (defence walls).

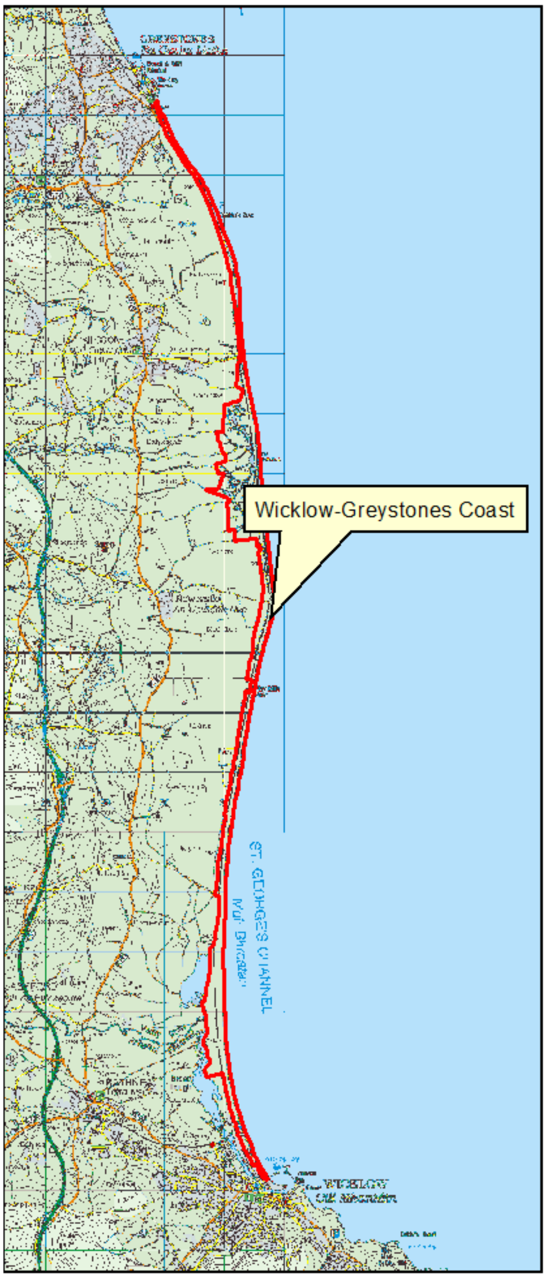
Shingle beach and coastal defences (greywacke boulders) at Six Mile Point, looking north.

Railway bridge and shingle accumulations at the Breaches, looking north.

Coastal Defence Works sign at Six Mile Point.

Proximity of railway line to shore at Six Mile Point.

Coastal defences at Kilcoole Railway Station, looking north.


Wicklow-Greystones Coast
ST. GEORGES CHANNEL


Greystones
Wicklow-Greystones Coast
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2
4
Kilometers
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WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Ballydonnell**
Other names used for site	Ballydonnell Brook
IGH THEME	**IGH14 Fluvial and Lacustrine Geomorphology**
TOWNLAND(S)	**Ballynultagh, Ballydonnell South**
NEAREST TOWN/VILLAGE	**Blessington**
SIX INCH MAP NUMBER	**11**
ITM CO-ORDINATES	**706030E 710330N (Ballydonnell Brook and Luqaculleen Brook confluence)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
The Ballydonnell floodplain occupies the floor of one of three sub-basins that make up the Upper Liffey catchment. Ballydonnell Brook and its tributaries drain a large valley and flow north to join the main course of the upper River Liffey in County Wicklow.

Geological System/Age and Primary Rock Type
During the past 8,000 years, the streams and rivers in the upper Liffey catchment have formed floodplains and terraces by the deposition of alluvial sediments. Three periods of erosion and river incision have also been recorded in the catchment: Mid-Holocene (8,000-3,000 BP), Late Holocene (2,000-500 BP) and modern (post-500 BP). Ballydonnell valley and floodplain are situated in mountainous terrain underlain by 405 million year old (Devonian) granite.

Main Geological or Geomorphological Interest
The 100km^2 River Liffey catchment is located on the west side of the Wicklow Mountains, and is the location of the source of the River Liffey. The upper River Liffey catchment comprises three sub basins that contain alluvial floodplains, of which Ballydonnell is one (the other two at Coronation Plantation and Athdown-Ballysmutton). A tributary of the upper River Liffey, Ballydonnell Brook flows north to join the River Liffey between Ballysmuttan Bridge and Ballylow Bridge. The Ballydonnell floodplain is at an elevation of 300m OD.

Ballydonnell Brook comprises a 2m-5m deep channel cut into the valley floor glacial tills and moraines (composed of granite boulders, gravel and sandy grus). This channel contains Holocene (post-glacial) alluvial sediments inherited from erosion of weathered granite and glaciofluvial deposits further upstream and on the mountain slopes. The stream bed comprises an assortment of granite boulders, cobble/gravel bars, and coarse/fine sand bars. The surrounding valley is underlain by granite bedrock, which in places has been deeply weathered into sandy grus (crumbled granite). Blanket peat (2m-4m thick) is extensive in the valley above 350 m OD, where large swathes have been planted with conifers.

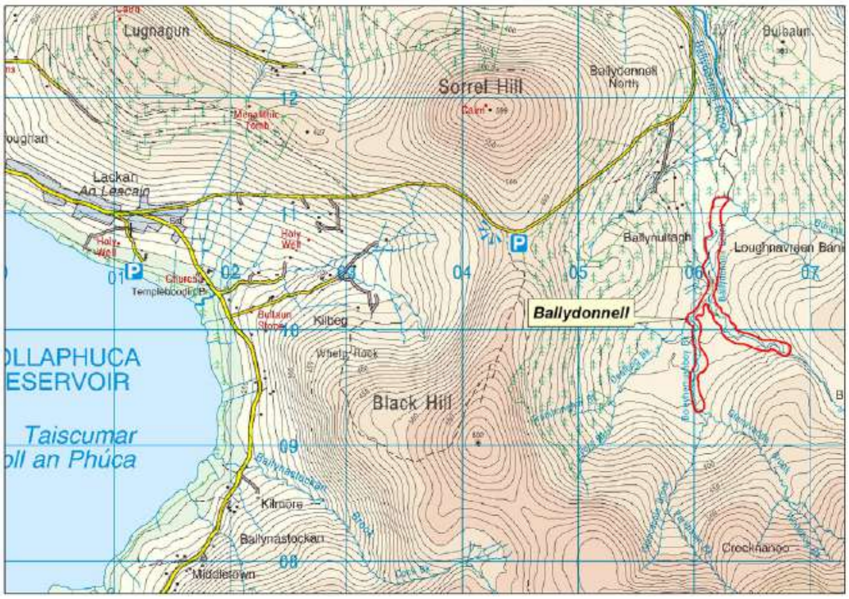
Site Importance - County Geological Site
Ballydonnell is one of the best sites in Wicklow for looking into environmental changes since the end of the last ice (i.e. the last 15,000 years). This County Geological Site is important in assisting in the understanding of post-glacial environmental change, and river system development and change in the past 15,000 years. Most of the site is located in the Wicklow Mountains SAC (002122).

Management/promotion issues
This is an excellent site in terms of post-glacial fluvial geomorphology. The site is remote, but accessible via well-maintained forest tracks. It is important that future conifer plantations do not limit access to the site. The site is not suitable for public promotion.

Granite boulders and cobble gravel bars in Ballydonnell Brook, looking north, downstream.

Ballydonnell Brook (left) - Luqaculleen Brook (right) confluence - looking downstream along Ballydonnell Brook channel, northward to eroded moraine on east bank.

Ballydonnell Brook (right) - Luqaculleen Brook (left) confluence - looking upstream, south. Mullaghcleevaun in the left-background.


Lugnagun
Sorrel Hill
Ballydonnell North
Bulbaun
Lackan
An Leacain
Ballynultagh
Ballydonnell
LLAPHUCA
ESERVOIR
Taiscumar
oll an Phúca
Black Hill
Kilbeg
Whelp Rock
Kilmore
Ballynastockan
Middletown
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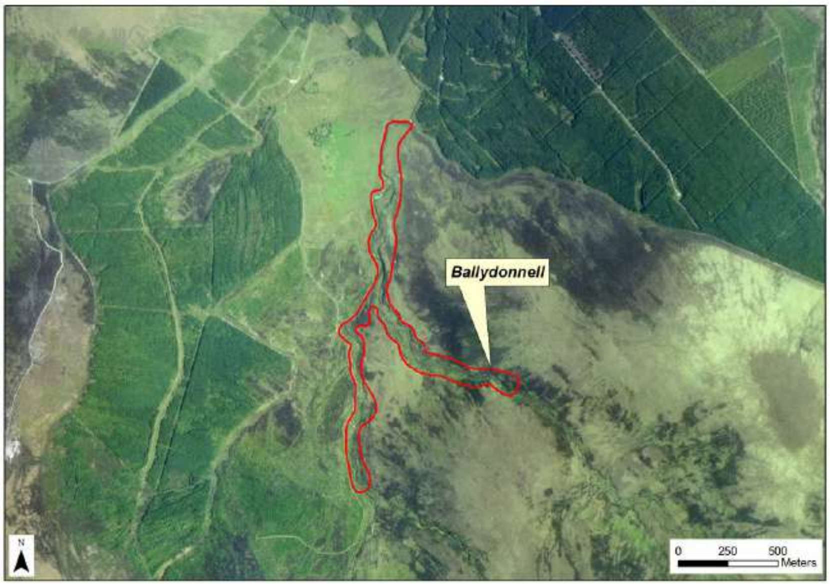
Ballydonnell
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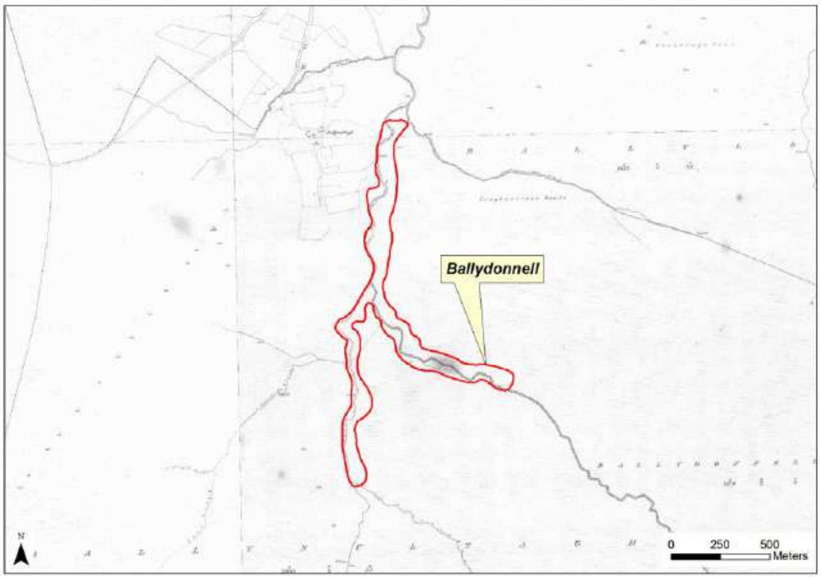
Ballydonnell
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Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glencullen River**
Other names used for site	*Abhainn Ghleann Cuilinn*, Glendoo, Knocksink Wood
IGH THEME	**IGH14 Fluvial and Lacustrine Geomorphology**
TOWNLAND(S)	**Knocksink, Monastery, Killegar, Ballybrew, Parknasilloge**
NEAREST TOWN/VILLAGE	**Enniskerry**
SIX INCH MAP NUMBER	**7**
ITM CO-ORDINATES	**721699E 718000N (Knocksink Woods Car Park)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
A narrow, steep-sided wooded valley in the northeast Wicklow Mountains through which the fast flowing Glencullen River flows south-eastwards towards Enniskerry.

Geological System/Age and Primary Rock Type
The northwest-southeast oriented glacial meltwater valley is cut through bedrock (Devonian granite in the northwest section; Ordovician schist in the southeast section) and glacial drift. The valley was formed by glacial meltwaters flowing south-eastwards during the deglaciation at the end of the last Ice Age.

Main Geological or Geomorphological Interest
Glencullen is the most northerly of the eastern Wicklow Mountains' glens. The valley runs for a distance of 9.5km in a northwesterly direction from Enniskerry, crossing the county boundary to Tibradden, Co. Dublin (valley called Glendoo). The valley floor is partially filled with glacial till and glaciofluvial gravels. Slope instability and mass movement (mass wasting) is confined to the glacial drift materials and several different styles of slope failure occur along the valley, which themselves are controlled by drift topography and the bedrock surface underlying the drift. The greater extent of the valley sides is vegetated (gorse, bramble, broadleaf deciduous woods). Nearer the riverbank, the terrain vegetated with wet woodland, heath and a number of tufa (springs and seepage areas) can be seen, such as the path-side seepage area near Knocksink Wood car park.

Slope instabilities have resulted from the excavation by the post-glacial (in the last c. 12,000 years) Glencullen River of a new valley in the drift, and slope failures occur on the steep slopes of this 'new' valley. The different types of failure vary from shallow to deep landslips, to steep bluff (cliff) failures where bluffs are undercut by the river (Knocksink Wood area), to earthflows (Ballybrew area).

Bedrock is sporadic and best seen in the stream channel where the river has eroded through drift down to bedrock. The valley formed along a geological fault, in a similar way to the Glencree and Dodder valleys 4km to the south, which also have NW-SW orientations.

Site Importance - County Geological Site
This important County Geological Site is located within the Knocksink Wood SAC and proposed NHA (000725). This site includes petrifying springs with tufa formation (Cratoneurion) [7220], an Annex 1 Priority Habitat protected under the EU Habitats Directive.

Management/promotion issues
Knocksink Wood is a popular amenity area, and has great potential as a glacial landform field teaching site. A public information sign (beside the existing NPWS sign at Knocksink Wood car park) would be useful in communicating the heritage aspects of this landscape feature. Slope collapse and river erosion of the valley-sides is an ongoing, if irregular, natural process, so future development of e.g. paths should take this into consideration.

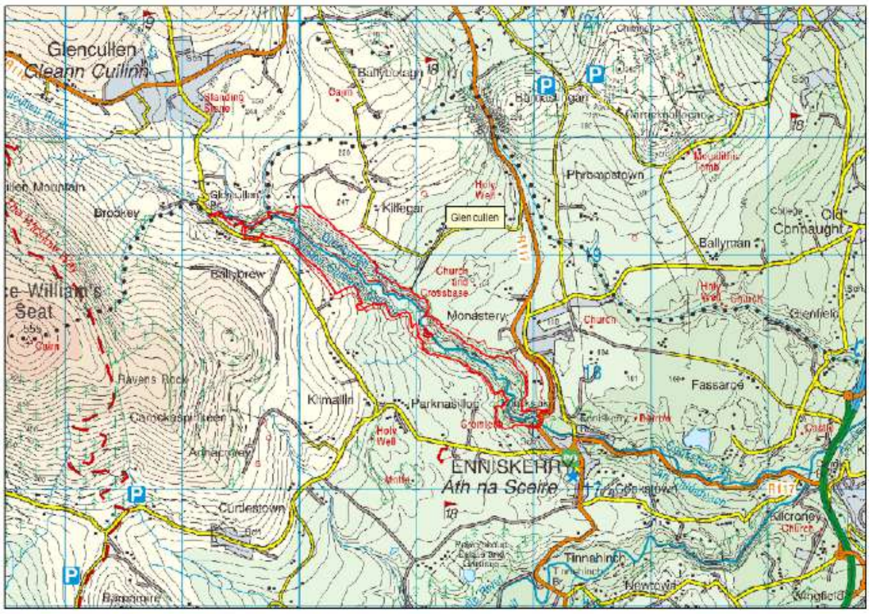
Cobble/boulder bar on northeast bank looking upstream (between the two wooden bridges in Knocksink Wood).

Slope failure (mass movement) on NE bank of river (north of second bridge in Knocksink Wood). Low river flow conditions.

Stone reinforcements on NE riverbank river (between two wooden bridges in Knocksink Wood).

Seepage beside path near first (south) wooden bridge in Knocksink Wood.

First (south) wooden bridge over Glencullen river, Knocksink Wood.


Glencullen
Gleann Cuilinn
Ballybrack
Kilgegar
Glencullen
Brockey
Ballybrew
Seat
Ravens Rock
Monastery
Phrompstown
Ballyman
Old Connaught
Fassaroe
Kilmalin
Parknasilloge
ENNISKERRY
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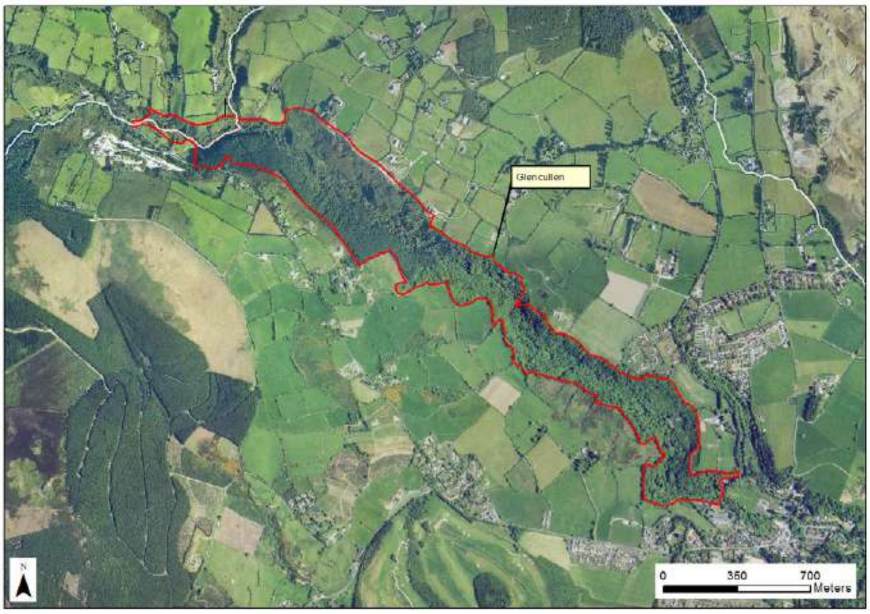
Curtlestown
Tinnehinch
Kilcroney
Holy Well
Church
Cromlech


Glencullen
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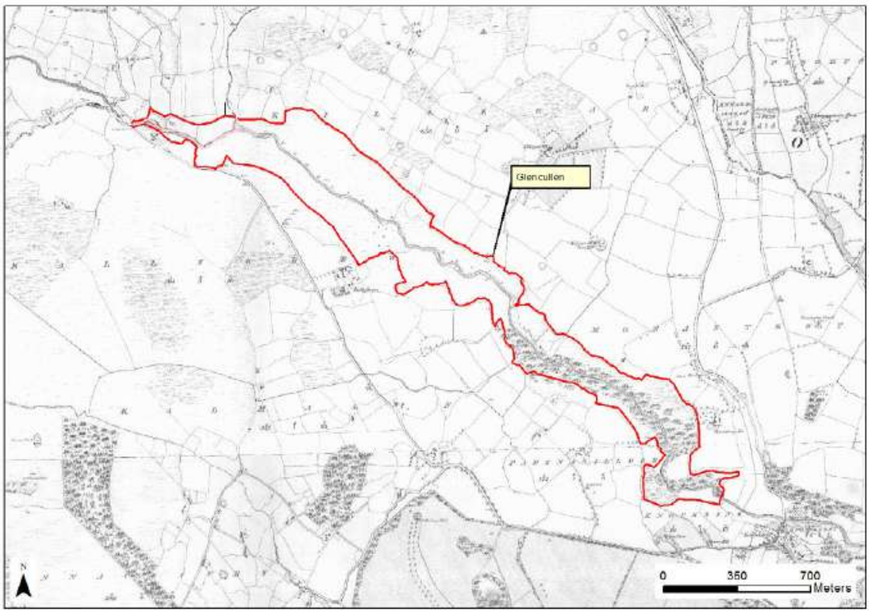
Glencullen
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Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Upper River Liffey**
Other names used for site	Coronation Plantation
IGH THEME	**IGH7 Quaternary, IGH14 Fluvial/Lacustrine Geomorphology**
TOWNLAND(S)	**Ballynabrocky, Powerscourt Mountain, Ballinastoe, Kippure**
NEAREST TOWN/VILLAGE	**Blessington**
SIX INCH MAP NUMBER	**6**
ITM CO-ORDINATES	**709450E 713210N (bridge at Coronation Plantation)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
A wide river floodplain in the upper Liffey catchment, northwest Wicklow Mountains, where the young stages of the River Liffey flow northwest through a series of older alluvial terraces.

Geological System/Age and Primary Rock Type
Radiocarbon dating, dendrochronology (tree-ring dating), and pollen analysis have all contributed to give ages for the river terraces (repeated layers of sandy alluvium with layers of soil) in the upper Liffey floodplains. The oldest floodplain terrace (mid-Holocene) formed between 8000 and 3000 years ago. The younger Holocene terrace accumulated between 2000 and 500 years ago. Modern floodplain sediments accumulated between 1650 AD and 1850 AD.

Main Geological or Geomorphological Interest
Three sub-basins in the upper River Liffey catchment (100km^2) have been described in literature pertaining to this area, one of which is known as the Coronation Plantation basin, in which this site is located. The other two are the Ballydonnell and the Athdown-Ballysmutton basins. In the Coronation Plantation reach, the river has formed a sequence of alluvial floodplain terraces. Two Holocene (post-glacial) river terraces flank the modern floodplain. River landforms and sediments in the upper Liffey catchment reveal past river behaviour (erosion, incision, migration, sediment deposition) over the last 8000 years. In addition, pollen analysis of the peats and soils on the terraces provide insights into past vegetation cover in the valley (forest, 9000-4000 years ago; blanket peat, 4000 years ago; blanket peat, less than 4000 years ago; vegetation similar to today without conifer plantations, less than 2500). Today, blanket peat covers the ridges and valley sides, with farmland and coniferous forests in the lower, gentler sloped valley. In the valley floor, two Holocene alluvial terraces have been identified flanking the current floodplain. The river channel contains Holocene (post-glacial) alluvial sediments inherited from erosion of weathered granite and glaciofluvial deposits further upstream and on the mountain slopes. The stream bed comprises granite boulders, cobble/gravel bars, and coarse/fine sand bars.

Site Importance – County Geological Site
This area of the upper Liffey catchment is very important to the understanding of the past environmental changes in Wicklow since the end of the last ice (i.e. the last 15,000 years). This site is located in Wicklow Mountains National Park, and in the Wicklow Mountains SAC (002122) and SPA (004040).

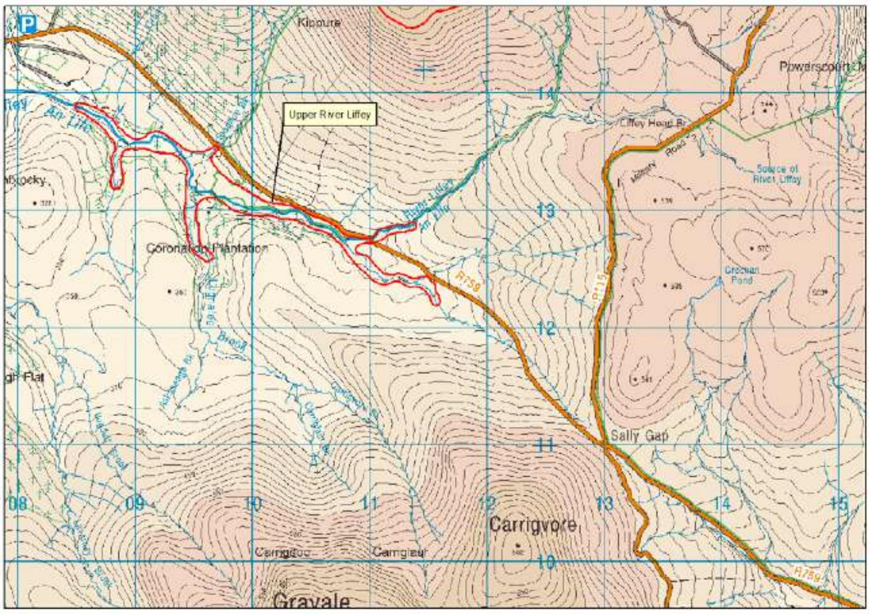
Management/promotion issues
This site is easily accessed and is an excellent teaching site. The Coronation Plantation was named to mark the coronation of King William IV in 1831. Scots Pine was reintroduced here in the 19th century (after it had died out around 2000 years ago).

View of site looking W from R759 between of Sraghoe Brook bridge and Liffey bridge. Sorrel Hill in distance.

View upstream (SE) towards terraces from bridge to Gamekeeper's Lodge, Coronation Plantation.

Upper River Liffey – looking SE upstream towards Game Keeper's Lodge bridge.

Boulder/cobble bar on east bank. Wasting on west bank. Looking SE upstream from beside National Park track.


Kippure
Upper River Liffey
Liffey Head Br.
Source of River Liffey
Coronation Plantation
Sally Gap
Carrigvore
Gravale
R759
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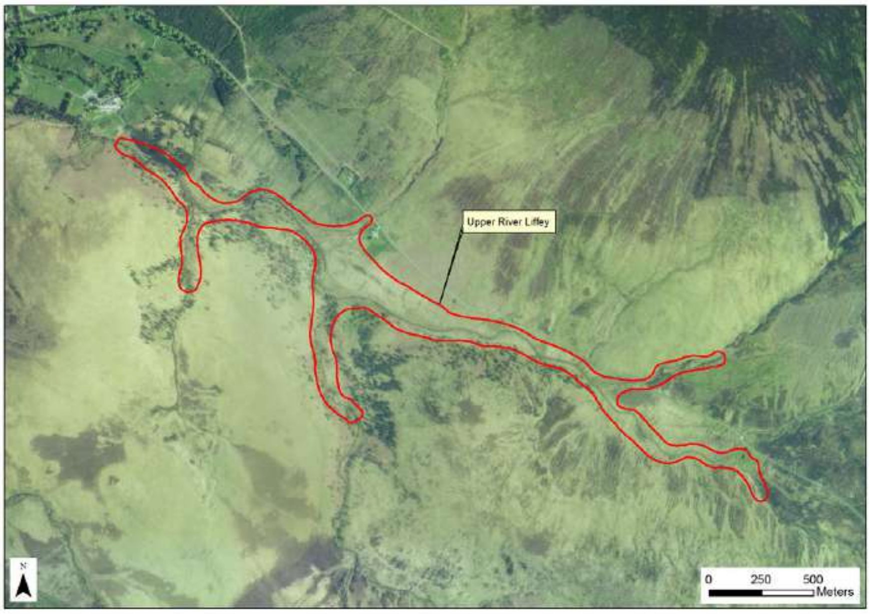
Upper River Liffey
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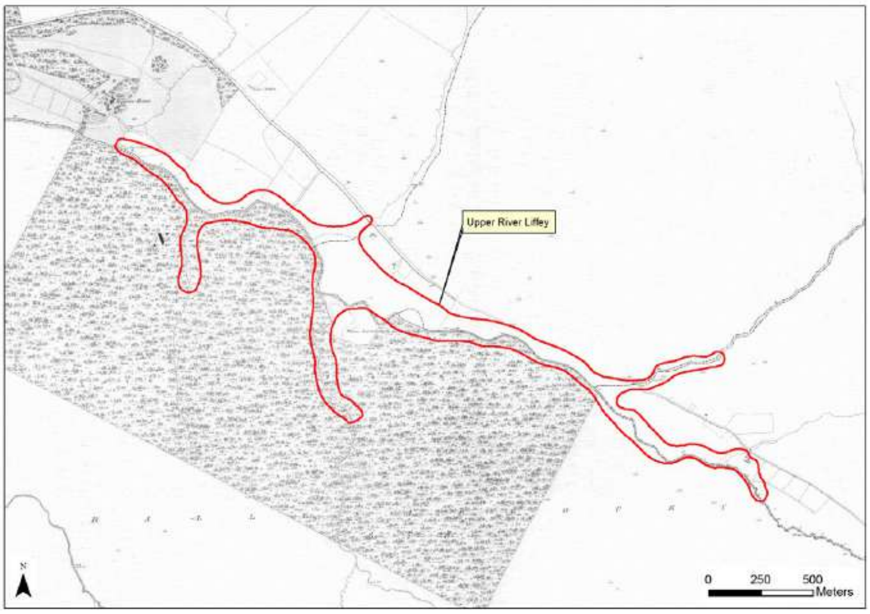
Upper River Liffey
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WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Avoca District - Overview**
Other names used for site	
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Connary, Cronebane, Ballygahan, Ballymurtagh, Sroughmore, Tigroney West**
NEAREST TOWN/VILLAGE	**Avoca**
SIX INCH MAP NUMBER	**35**
NATIONAL GRID REFERENCE	**720200E 682700N**
1:50,000 O.S. SHEET NUMBER	**62 GSI Bedrock 1:100,000 Sheet No. 16, 19**

Introduction
Copper mining began in Avoca around 1720 and continued episodically for the next 260 years. The selective hand-tool mining of high-grade seams of the 18th and 19th Centuries gave way to mechanized mining of relatively low-grade ore (0.6% Cu) in the second half of the 20th century. Historically the mine was subdivided into a series of small properties, or setts, and these form the basis for the individual sites defined in this audit, although, in modern times, the site has generally been seen as comprising East and West Avoca.

Between 1822 and 1888, up to 200,000 tons of copper ore and 2,400,000 million tons of pyrite were mined in Avoca, while from 1958 to 1982 almost 12 Mt of ore were mined, most of it underground in West Avoca. The mine underlies the ground that rises to the east and west of the Avoca River and, throughout the mine's history, acidic, metal-rich mine water has drained directly to the river, causing severe contamination and disruption of the aquatic ecosystem. The site today is surrounded by farmland, mainly used as pasture for cattle and sheep. There is a relatively high density of houses, chiefly detached single houses, in the area, and some are in very close proximity to the mine site.

Geology and Mineralization
The Avoca deposit is hosted by the Avoca Formation, a northeast-southwest-trending sequence of 455 million-year-old Ordovician volcanic and sedimentary rocks. The formation is 2-4 km thick and dips steeply to the southeast. A series of north-south faults offset the mineralized zones and they have been interpreted as possible feeder zones for mineralizing fluids. The mineralization is found mainly within distinctive chloritic tuffs, interpreted as having formed by alteration of rhyolitic and intermediate tuffs on the seafloor during the hydrothermal activity that gave rise to the mineralization. Shearing is a distinctive element of the mineralization and may have played an important role in the formation of vein-disseminated mineralization.

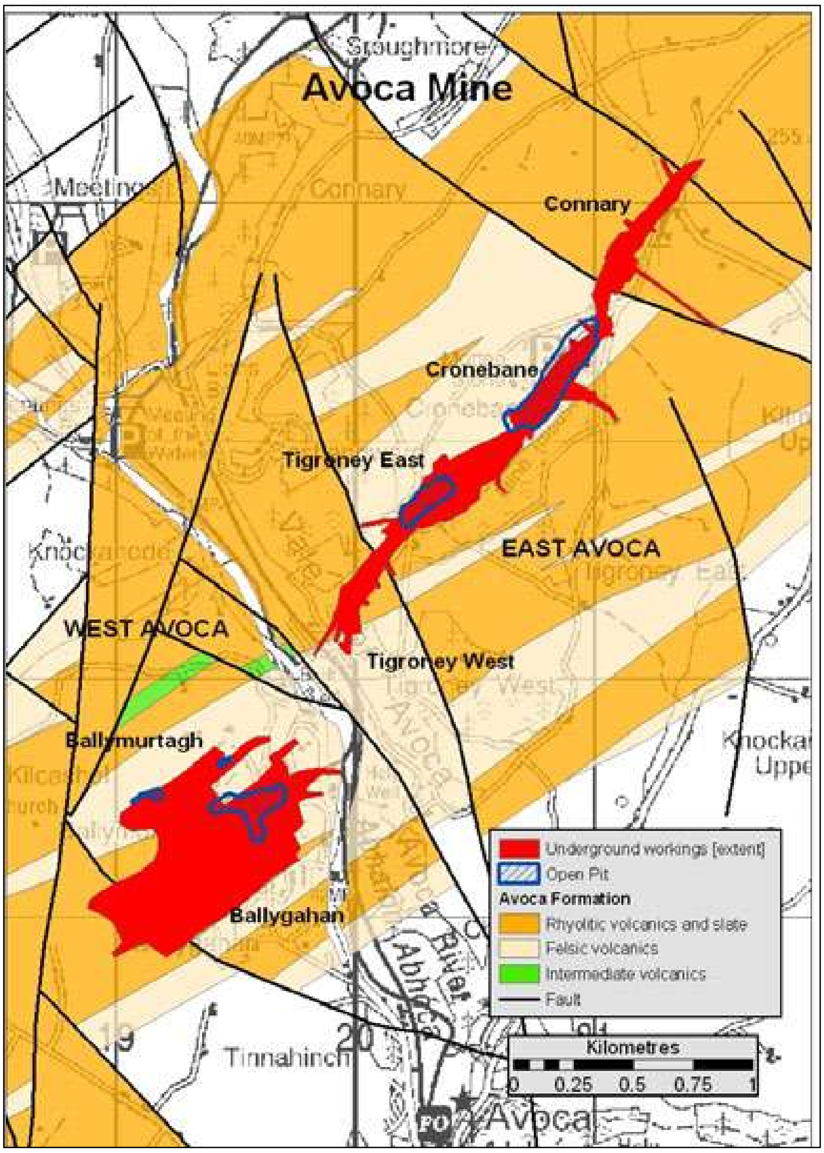
Mineralization types include (1) banded or massive ore where bands of pyritic ore alternate with bands of sphalerite-rich ore and bands of chlorite and sericite; (2) disseminated ore or stringer ore containing major pyrite, chalcopyrite, sphalerite and lesser galena within a siliceous matrix; (3) Lead-Zinc ore containing banded sphalerite, galena, pyrite, arsenopyrite and chalcopyrite in a chlorite matrix and (4) supergene mineralization formed by weathering of bedrock ore within 60 m of the surface.

Main Geological or Geomorphological Interest
Avoca has a long history amongst mine sites in Ireland. Numerous 18th- and 19th-century mine features remain on the site, including engine houses, adits, and shafts, including some that appear to be unique in Ireland, such as the tramway arch, flatrod tunnels and ochre pits. These pre-20th century features are more numerous and varied at Avoca than at any other mine in Ireland. The large-scale mechanized mining of the 20th century, especially excavation of open pits, has altered the site significantly, creating potential hazards for visitors, but has also helped create an interesting and varied landscape. Avoca is the best example of

volcanic massive sulphide (VMS) copper deposits in Ireland and the remaining examples of mineralisation on the site are of significant scientific interest. Avoca is also the only mine site in Ireland with significant acid mine drainage (AMD). This AMD is generated by the reaction between rainfall and the pyritic ore within the workings and the spoil areas, and contributes to the Avoca River. It thus affords a unique opportunity for studying the negative environmental impacts of AMD and the success or otherwise of approaches to mitigating its effects.

Site Importance – County Geological Site; may be recommended for Geological NHA
Avoca is the largest and best example of a VMS deposit in Ireland. Its mine heritage is extensive and varied, with some unique elements in an Irish context.

Management/promotion issues
Much of the site is accessible on foot from public roads. Works are ongoing to make safe various parts of the site, including open shafts and adits, and to reduce environmental impacts from AMD. Thus, in the short term, promotion of the site is not warranted. In the longer term, Avoca provides a unique opportunity to develop a mine heritage site that encompasses many aspects of mining, including its environmental impacts and measures developed to ameliorate them. However, the site in its present state is unsafe and access by the public should not be encouraged.



Map from Stanley *et al.* 2010

Avoca - Sroughmore
Avoca - Connary
Avoca - Cronebane
Avoca - Tigroney East
Avoca - Tigroney West
Avoca - West Avoca
255
Kilmacoo Upper
Mottee Stone
Cronebane
Castlehoward
Mine (disused)
Lions Br
Meeting of the Waters
Vale of Avoca
Tigroney West
Knockanree Upper
R754
Cherrymount
Ballygahan
Knockanree Lower
Avoca River
Abhainn Abhóca
19
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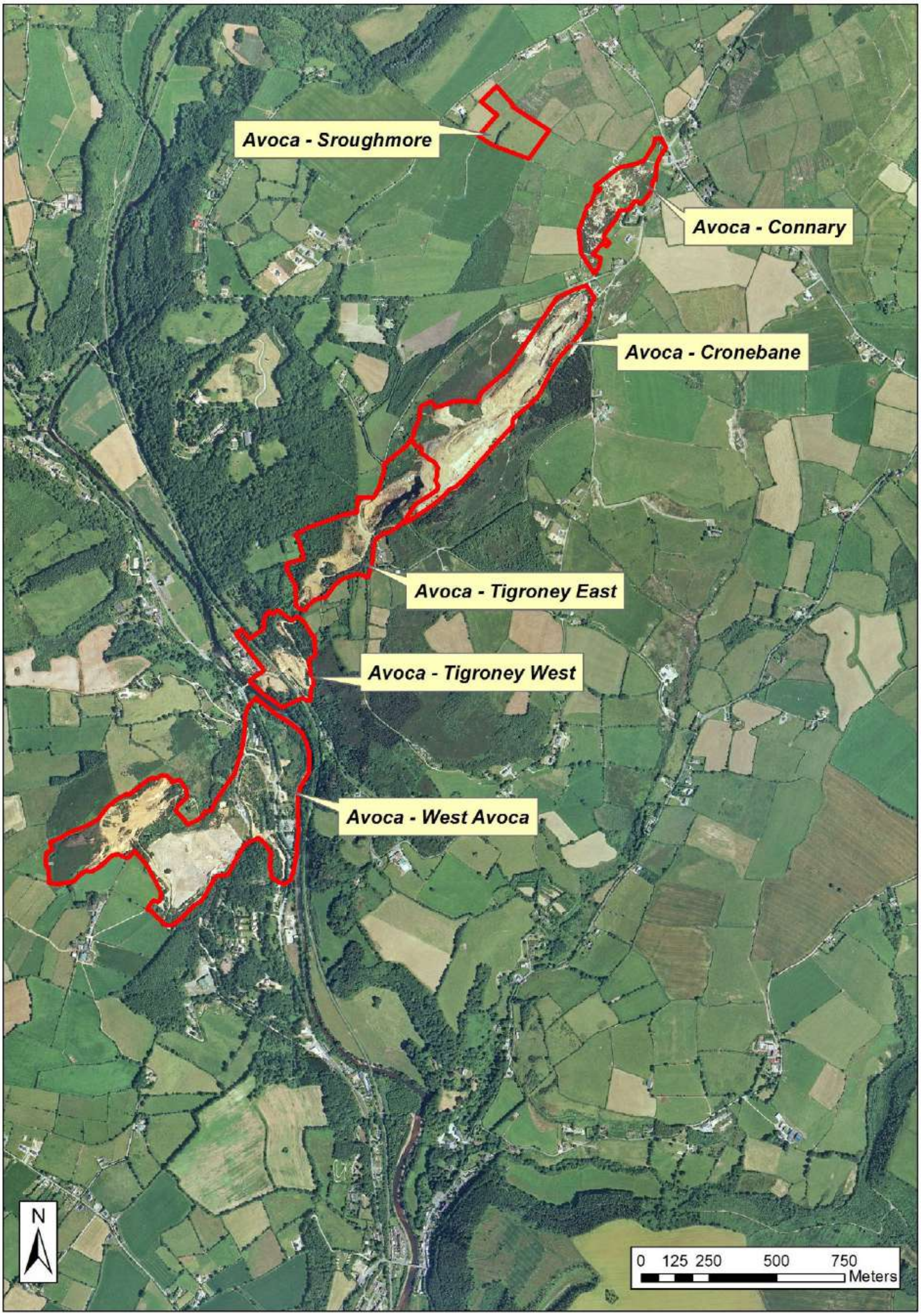
PO
Holy Well
Church
Kilqueeny


Avoca - Sroughmore
Avoca - Connary
Avoca - Cronebane
Avoca - Tigroney East
Avoca - Tigroney West
Avoca - West Avoca
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Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Avoca - Connary**		
Other names used for site			
IGH THEME	**IGH15 Economic Geology**		
TOWNLAND(S)	**Connary Upper, Sroughmore**		
NEAREST TOWN/VILLAGE	**Avoca**		
SIX INCH MAP NUMBER	**35**		
NATIONAL GRID REFERENCE	**721046E 683885N**		
1:50,000 O.S. SHEET NUMBER	**62**	**GSI Bedrock 1:100,000 Sheet No.**	**16**

Outline Site Description
Connary mine site is on high ground surrounded by rolling farmland and private dwellings, located immediately beside Connary village. The site comprises a number of distinct areas each surrounded by a chain-link fence. The ground is covered by hummocky spoil heaps that are typically around 1m thick.

Geological System/Age and Primary Rock Type
The bedrock is part of the c. 455 Ma Ordovician Avoca Volcanic Formation which comprises an interbedded sequence of strongly deformed and altered volcanic and sedimentary rocks. Massive, disseminated and vein-hosted sulphide mineralization (chalcopyrite, pyrite, galena and sphalerite) is found mainly within distinctive chloritic tuffs.

Main Geological or Geomorphological Interest
Mining last took place in Connary in the 19th Century; subsequently, open shafts were capped, possibly in the 1940s by Mianraí Teoranta. Two engine houses, Connary and Waggon Shaft, operated on the site but the only remains of these are the Waggon Shaft Engine House chimney and part of the furnace house belonging to Connary Engine House. The chimney is in some disrepair and lacks a lightening conductor. The walls of the furnace house have been raised in modern time and a roof has been added – it is now in use as a barn. A concrete support base for the aerial ropeway that ran northwest from the site lies within the site (see Sroughmore site report). The low walls of a small concrete water tank beside Connary Engine House shaft and trace remains of a reservoir near the site of Waggon shaft are the only other remains of mine buildings at Connary.

Numerous shafts are marked on old maps and various depressions in the ground may mark the site of many of these. However, only six shafts have been identified with certainty: Connary Engine (concrete cap), Barry's (concrete cap), Vale's (collapsed), Reed's (concrete cap) and two unnamed shafts (collapsed) within the fenced areas at the crossroads. One of these is the vent shaft for Kilmacoo North adit.

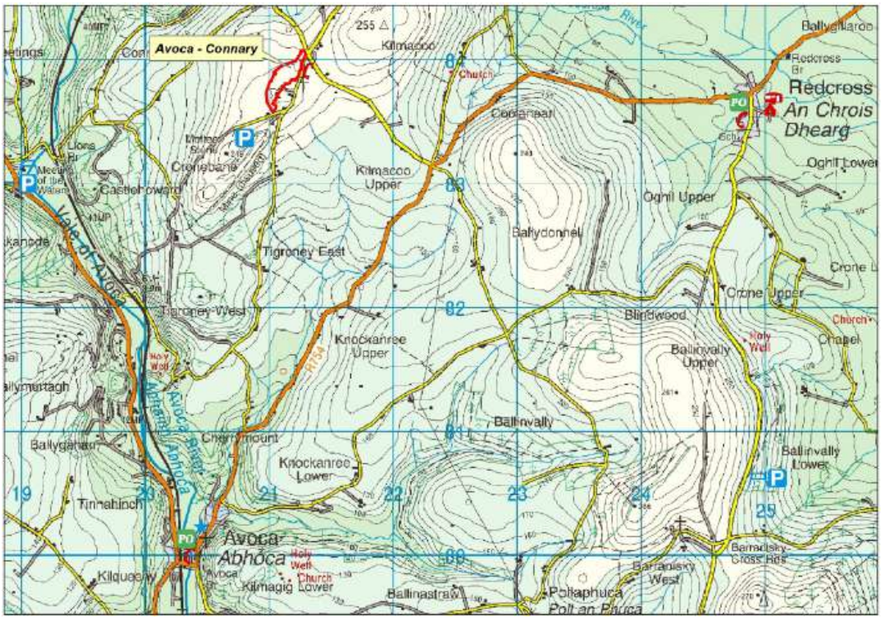
Site Importance – County Geological Site
The Connary site is, unusually among the various sites at Avoca, largely unaffected by modern, i.e. 20th century, mining and is notable for the number of shafts present on site, surface expressions of an apparently largely intact 19th-century underground mine. The chimney is a prominent local landmark.

Management/promotion issues
The site's owner, DCENR, is in the process of recapping several shafts. The Waggon Shaft Engine House chimney is in urgent need of attention - alone among the engine-house chimneys at Avoca it has not benefited from conservation efforts in recent years.

Waggon Engine House chimney on Connary mine site,
surrounded by extensive waste heaps.

Furnace house for Connary Engine House, now used as a barn.

Reservoir, used for storing water used in Connary Engine House.


Avoca - Connary
Kilmacoo
Church
Redcross
An Chrois
Dhearg
Ognil Upper
Ballydonnell
Kilmacoo
Upper
Tigroney East
Tigroney West
Knockanree
Upper
Castlehoward
Cronebane
Blindwood
Ballinvally
Upper
Ballinvally
Ballinvally
Lower
Knockanree
Lower
Cherrymount
Ballygahan
Tinnahinch
Avoca
Abhóca
Kilmagig Lower
Ballinastraw
Pollaphuca
Poll an Phúca
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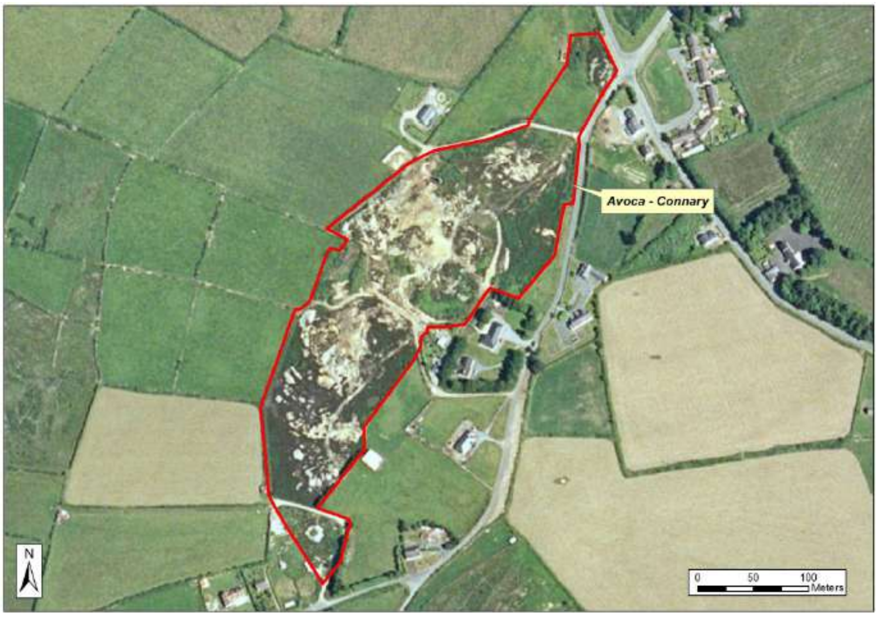
Avoca - Connary
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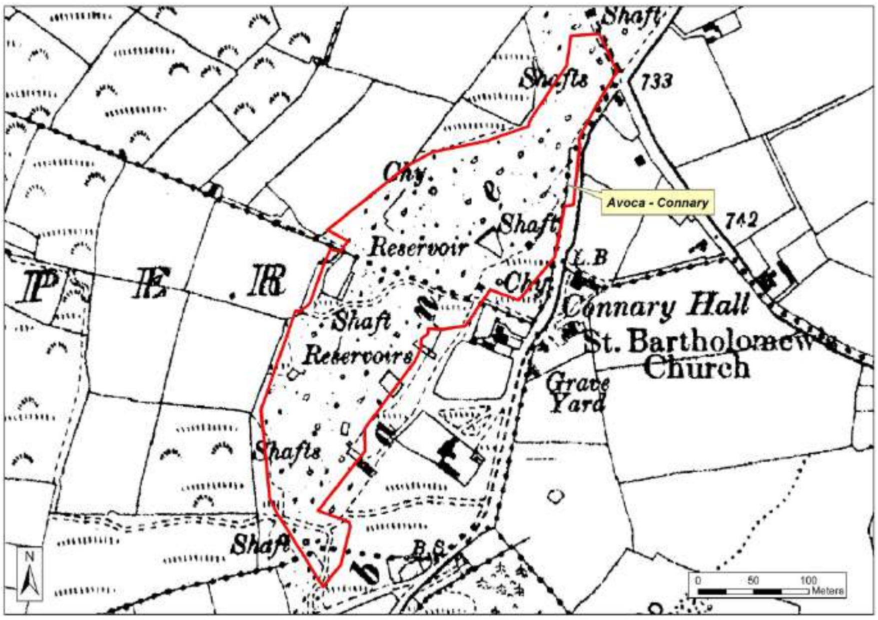
Shaft
Shafts
733
Chy.
Avoca - Connary
Shaft
Reservoir
742
L.B
Chy.
Connary Hall
St. Bartholomew
Church
Shaft
Reservoirs
Grave
Yard
Shafts
Shaft
B.S.
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0
50
100
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Avoca - Cronebane**
Other names used for site	
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Cronebane**
NEAREST TOWN/VILLAGE	**Avoca**
SIX INCH MAP NUMBER	**35**
NATIONAL GRID REFERENCE	**720604E 683153N**
1:50,000 O.S. SHEET NUMBER	**62 GSI Bedrock 1:100,000 Sheet No. 19**

Outline Site Description
The Cronebane site is centred on Cronebane open pit, running southwestwards from Connary, between the high moorland of the Mottee Stone site to the northeast and mixed evergreen plantations on the southeast. The southwestern end of the site is dominated by Mount Platt, a landmark spoil heap created from the waste rock produced during excavation of the open pit.

Geological System/Age and Primary Rock Type
The bedrock is part of the c. 455 Ma Ordovician Avoca Volcanic Formation which comprises an interbedded sequence of strongly deformed and altered volcanic and sedimentary rocks. Massive, disseminated and vein-hosted sulphide mineralization (chalcopyrite, pyrite, galena and sphalerite) is found mainly within distinctive chloritic tuffs.

Main Geological or Geomorphological Interest
The site covers the area of the 19th-century Cronebane mine but little of this remains since excavation of the open pit in the early 1970s. Several 19th-century adits and levels are exposed in the floor and northwestern or hanging wall of the pit. In addition, apparently in situ timbers, partially covered by spoil in the floor of the pit, mark the trace of other levels. Another adit, Madam Butler's, runs beneath the plantation to the southeast of the pit. It has partly collapsed to form an open trench. The open pit was originally almost 600m long and 120m wide. The southwestern end was backfilled with waste rock so that the exposed pit is now 350m long and 40m deep. A pond at the northeastern end of the pit was constructed in the 1980s as a reservoir for a gold-leach project.

The northeastern end of the pit contains significant bedrock exposure, including rhyolite, tuffs and a narrow zone of massive sulphide mineralization that includes lead-zinc-rich ore called kilmacooite.

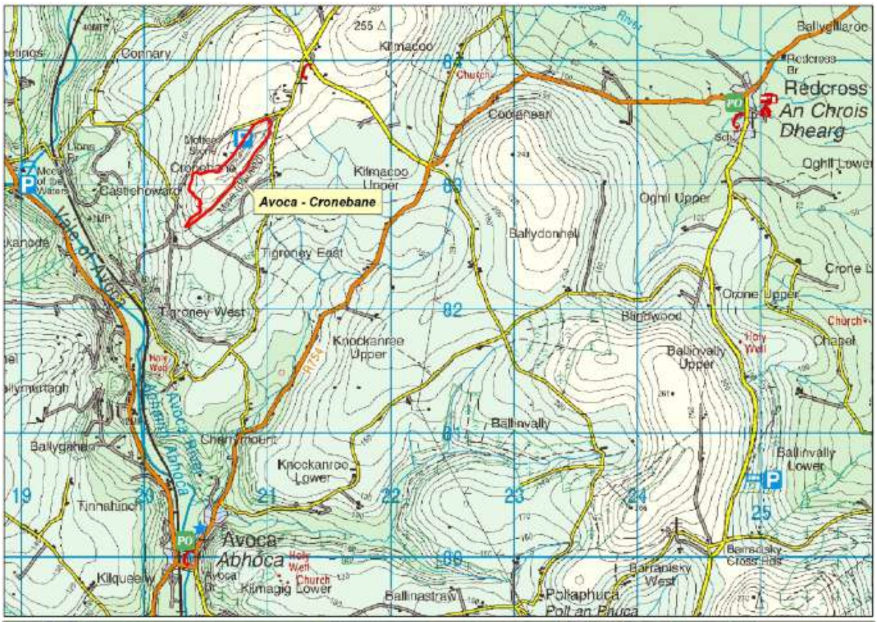
Site Importance – County Geological Site
Cronebane open pit is an important remnant of 20th century surface mining at Avoca and the large spoil heap built from waste rock has been a significant local landmark for 40 years. The pit contains a unique cross-section through a zone of massive sulphide mineralization and interbedded volcanic rocks. Numerous, poorly-preserved 19th-century mine features can be observed throughout the site.

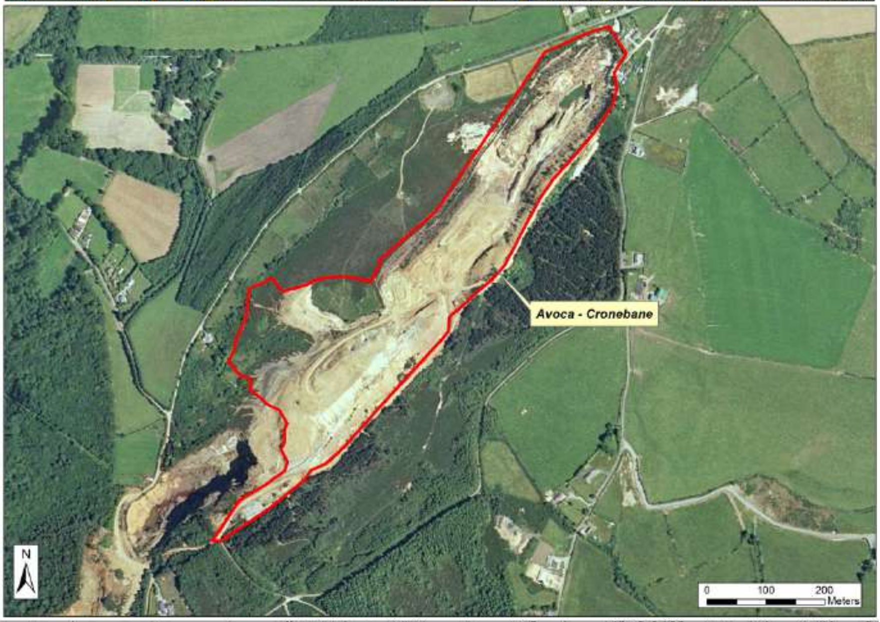
Management/promotion issues
The northeastern, hanging wall of the open pit is unstable and has partly collapsed. The site is surrounded by a 2m-high chain-link fence that is frequently breached. While the bedrock exposure, including its massive sulphide mineralization, is considered to be of significant scientific interest, the site is unsuitable for general public access and these benefits must be weighed up against the need to address the hazards. The Feasibility Study undertaken by DCENR in 2008 contains proposals to use some of the waste rock on Mount Platt to backfill part of East Avoca open pit to address the stability issue.

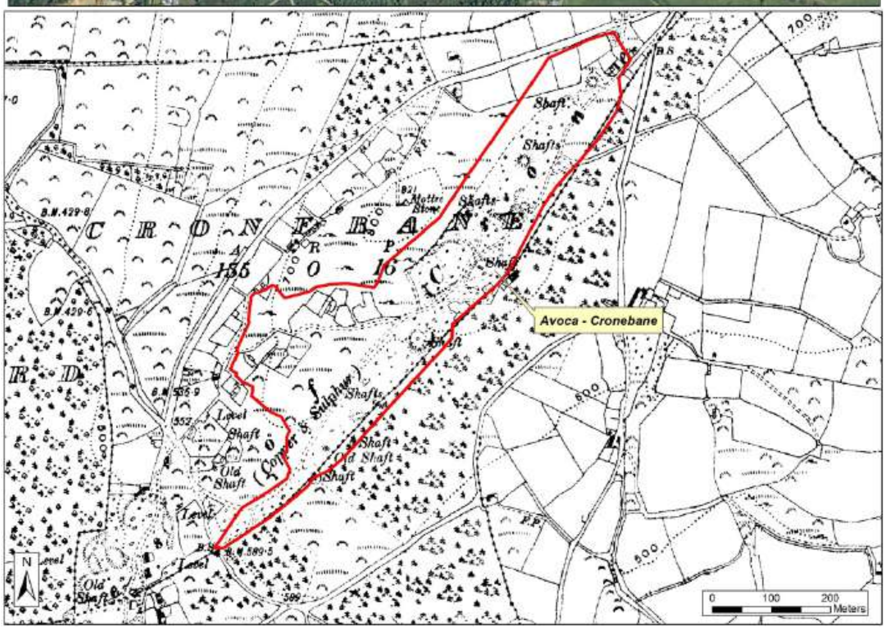
View northeastwards from Mount Platt of Cronebane open pit. Area in foreground was originally excavated but was backfilled with waste rock.

Exposure of massive sulphide mineralization at northeastern end of Cronebane open pit.

Remains of timbering outline former adit, now blocked,
driven at northeast end of Cronebane open pit.


Avoca - Cronebane
Redcross
An Chrois
Dhearg
Avoca
Abhoca
Kilmacoo
Kilmacoo
Upper
Tigroney East
Tigroney West
Knockanree
Upper
Knockanree
Lower
Ballinvally
Ballydonnell
Ogull Upper
Ballinastraw
Kilmagig Lower
Pollaphuca
Poll an Phúca
19
20
21
22
23
24
25


Avoca - Cronebane
N
0
100
200
Meters


C R O N E B A N E
Avoca - Cronebane
Shaft
Shafts
Old Shaft
Level
(Copper & Sulphur)
N
0
100
200
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Sroughmore**
Other names used for site	
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Sroughmore**
NEAREST TOWN/VILLAGE	**Avoca**
SIX INCH MAP NUMBER	**35**
NATIONAL GRID REFERENCE	**720658E 684158N**
1:50,000 O.S. SHEET NUMBER	**62 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description
The Sroughmore site is a hillside pasture field on the northwestern side of the Connary mine site.

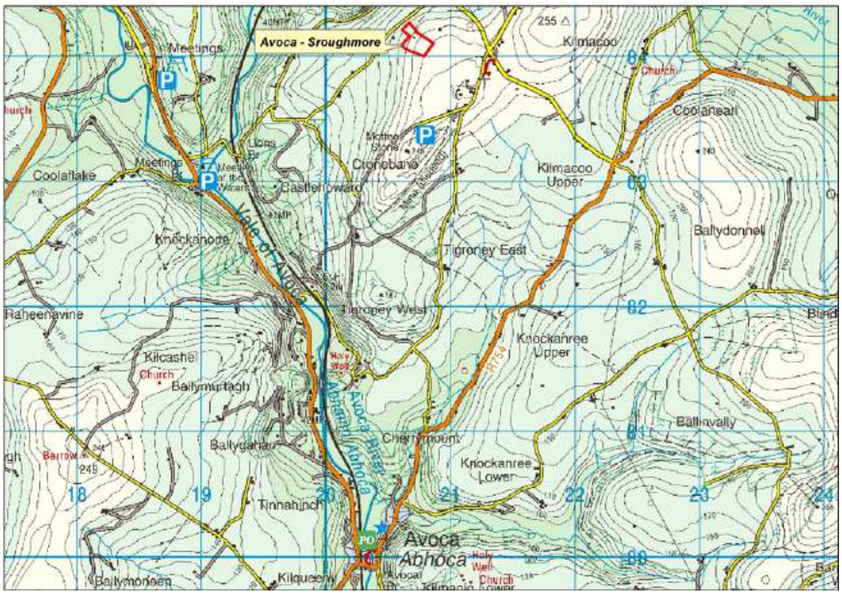
Geological System/Age and Primary Rock Type
The bedrock is part of the c. 455 Ma Ordovician Avoca Volcanic Formation which comprises an interbedded sequence of strongly deformed and altered volcanic and sedimentary rocks. Massive, disseminated and vein-hosted sulphide mineralization (chalcopyrite, pyrite, galena and sphalerite) is found mainly within distinctive chloritic tuffs.

Main Geological or Geomorphological Interest
Sroughmore contains two concrete structures that are the remains of a 19th-century aerial ropeway constructed to pump water from Connary mine. A third structure, overturned and damaged, is located inside the Connary site itself. The ropeway was apparently powered by a turbine at Sroughmore old glebe house and ran c. 1.5 km to Connary engine shaft. As a pumping mechanism however, the ropeway was a failure. Similar pylon-type structures were used in Tigroney to transmit power via cables linked to water wheels on the Avoca River but there are no remains of these. For this reason, the structures at Sroughmore are valuable evidence for various mine engineering approaches in the 18th and 19th centuries.

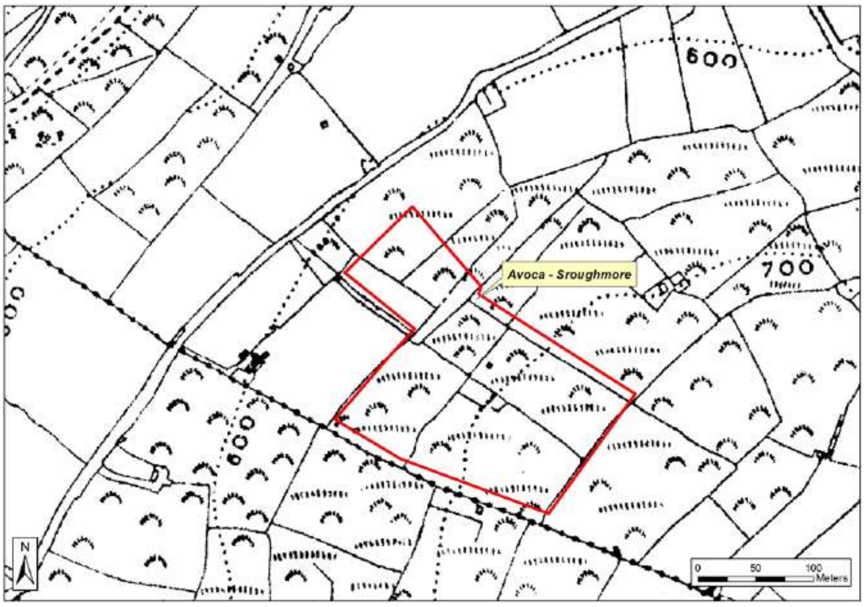
Site Importance – County Geological Site
The ropeway support structures are of interest because they help demonstrate the variety of mine engineering approaches adopted at Avoca.

Management/promotion issues
The structures have stood for over a century without any apparent interference. Their size and robust construction provide some protection against damage or removal. Nevertheless, they are on private land used for pasture and vulnerable to change of land use, e.g. housing development. They can be viewed from the public road immediately downhill of the site and would merit inclusion in any Avoca mine heritage trail.

Ropeway support at Sroughmore. Second structure visible in background. View to east.


Avoca - Sroughmore
Meetings
Coolaflake
Knockanode
Castlehoward
Cronebane
Kilmacoo
Kilmacoo Upper
Coolanearl
Ballydonnell
Tigroney East
Tigroney West
Raheenavine
Kilcashel
Ballymurtagh
Knockanree Upper
Ballinvally
Cherrymount
Knockanree Lower
Ballygahan
Tinnahinch
Avoca
Abhoca
Kilqueeny
Ballymoneen
Vale of Avoca
Avoca River
Church
Holy Well
Barrow
255
245
18
19
20
21
22
23
24
80
81
82
83
84


Avoca - Sroughmore
N
0
50
100
Meters


Avoca - Sroughmore
600
700
N
0
50
100
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Avoca – Tigroney East**
Other names used for site	
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Tigroney West, Cronebane**
NEAREST TOWN/VILLAGE	**Avoca**
SIX INCH MAP NUMBER	**35**
NATIONAL GRID REFERENCE	**720103E 682681N**
1:50,000 O.S. SHEET NUMBER	**62 GSI Bedrock 1:100,000 Sheet No. 19**

Outline Site Description
This is a narrow, 700m-long northeast—southwest-trending hillside site, bounded to north and south by forestry, heathland and pasture, containing a deep open pit at the upper end as well as extensive mine-waste covered ground and numerous 19th-century mine features.

Geological System/Age and Primary Rock Type
The bedrock is part of the c. 455 Ma Ordovician Avoca Volcanic Formation which comprises an interbedded sequence of strongly deformed and altered volcanic and sedimentary rocks. Massive, disseminated and vein-hosted sulphide mineralization (chalcopyrite, pyrite, galena and sphalerite) is found mainly within distinctive chloritic tuffs.

Main Geological or Geomorphological Interest
Tigroney East was the site of intensive mining both in the 18th - 19th centuries and in the 20th century. It includes (1) the fenced, 20th-century East Avoca open pit (1978-1982) where large blocks of ore can be examined, (2) numerous spoil heaps, (3) several shafts and adits, (4) the remains of Baronet's engine house and (5) well-preserved ochre pits. One shaft (Farmer's) formerly provided access to the extensive undergound workings below the site but it is now securely covered. Three adits are open to some degree. Wood Adit was the entrance to the 1.4km-long 53 fathom or Cronebane Deep level - mine water discharging from it was channelled into nearby settling pits where iron hydroxides were separated and dried to provide ochre. Cronebane Shallow Adit, now largely silted up, was the main mining adit in use in Cronebane in the late 18th century. Recent clearance of vegetation around Baronet's Engine House has revealed long-hidden features including a well-preserved flue linking the boiler house and chimney, while removal of mine waste nearby has uncovered a pre-20th century dressing floor.

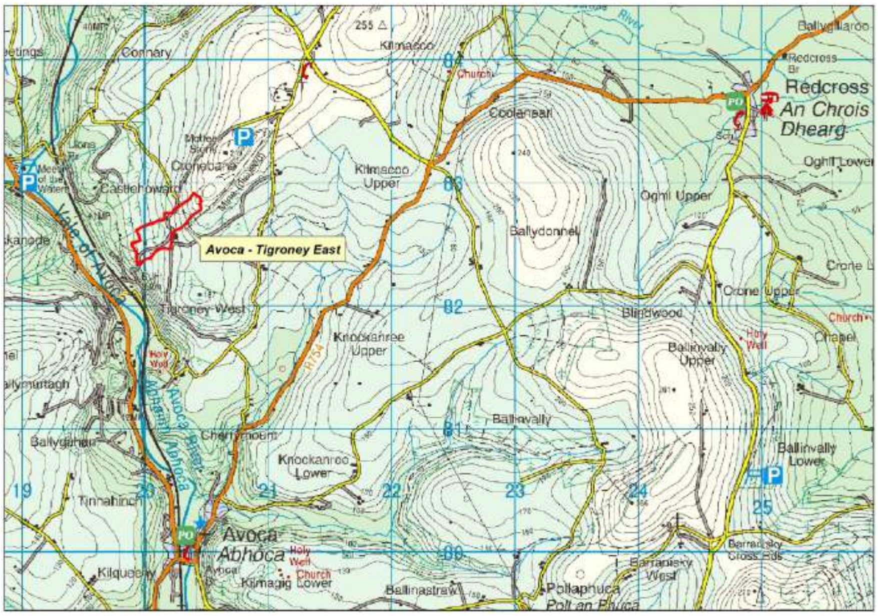
Site Importance – County Geological Site
East Avoca open pit is a significant remnant of 20th century surface mining at Avoca and contains excellent examples of mineralisation not seen elsewhere in the Avoca district. Several 18th and 19th century mine features add to the site's importance.

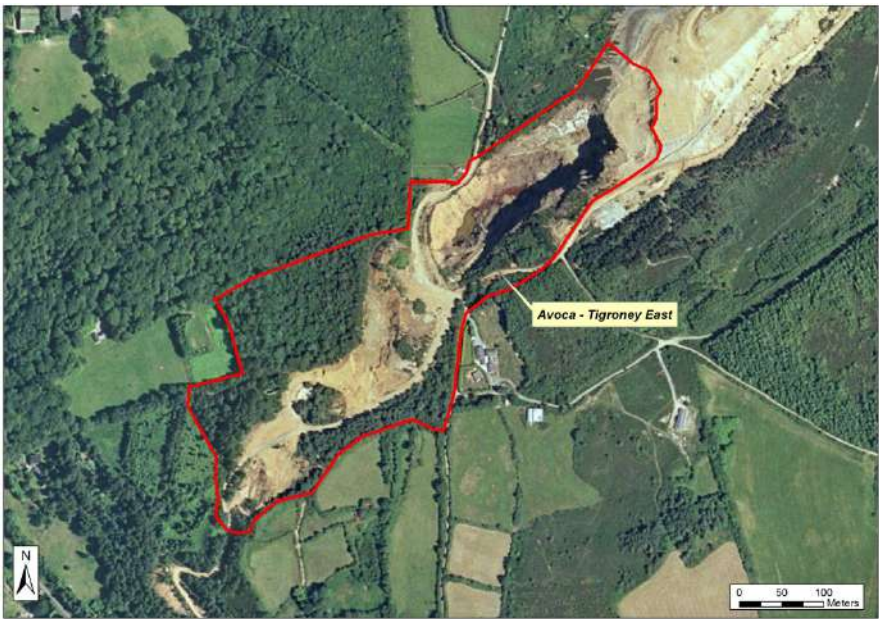
Management/promotion issues
The hanging wall of the open pit at its southwestern end is unstable and there are plans to fill this end of the pit to stabilise it, something that would also block access to the stope that was breached during pit excavation. The remainder of the site contains numerous interesting mine features that could form part of any future mine heritage trail. However, the site in its current state is unsafe and unsuitable for public access. The open pit is reported as having been home to nesting peregrine falcons for many years, and ledges in the pit show active use by some large birds, but the current status of this or other protected species needs review. Several species of bats have been detected at the underground workings (Enda Mullen, NPWS pers. comm.).

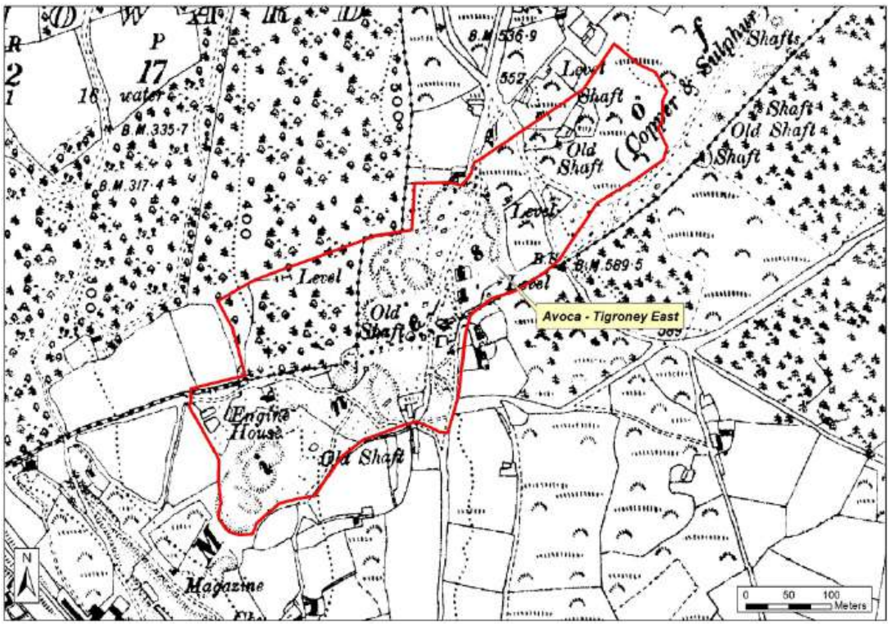
Area of last mine blast in centre of East Avoca open pit.

Sulphide mineralization in centre of East Avoca open pit.

Left: Flue entrance at base of Baronet's Engine House chimney, revealed by recent site clearance
Right: 19th-century ore dressing floor, revealed by recent site works.


Avoca - Tigroney East
Redcross
An Chrois
Dhearg
Avoca
Abhoca
Connary
Kilmacoo
Coolanearl
Kilmacoo
Upper
Ballydonnel
Oghil Upper
Oghil Lower
Crone Upper
Blindwood
Ballinvally
Upper
Tigroney West
Knockanree
Upper
Knockanree
Lower
Ballinvally
Ballinvally
Lower
Ballygahan
Tinnahinch
Kilmagig Lower
Ballinastraw
Pollaphuca
Poll an Phúca
Castlehoward
Church
Holy
Well
19
21
22
23
24
25
82
81
80


Avoca - Tigroney East
N
0 50 100
Meters


Avoca - Tigroney East
Level
Shaft
Old
Shaft
Old Shaft
Engine
House
Magazine
Copper & Sulphur
Shafts
B.M.536·9
B.M.589·5
B.M.335·7
B.M.317·4
N
0 50 100
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Avoca – Tigroney West**
Other names used for site	
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Tigroney West**
NEAREST TOWN/VILLAGE	**Avoca**
SIX INCH MAP NUMBER	**35**
NATIONAL GRID REFERENCE	**719814E 682198N**
1:50,000 O.S. SHEET NUMBER	**62 GSI Bedrock 1:100,000 Sheet No. 19**

Outline Site Description
This site includes a flat section on the Avoca River floodplain separated by a railway track from a steep, partly wooded hillside section that includes large volumes of mine waste as well as Avoca's best-preserved 19th-century engine house. A small housing cluster lies between part of the site and the river.

Geological System/Age and Primary Rock Type
The bedrock is part of the c. 455 Ma Ordovician Avoca Volcanic Formation which comprises an interbedded sequence of strongly deformed and altered volcanic and sedimentary rocks. Massive, disseminated and vein-hosted sulphide mineralization (chalcopyrite, pyrite, galena and sphalerite) is found mainly within distinctive chloritic tuffs.

Main Geological or Geomorphological Interest
Williams engine house and chimney, dating from around 1860, have been conserved in recent years and are structurally sound. The Deep Adit was initially driven in the late 18th century and now extends northwest for over 800m, draining all workings in Tigroney and Cronebane below the level of the Cronebane Shallow Adit. The largely blocked adit discharges acidic, metal-rich mine water that drains via a 150m-long channel into the Avoca River. Two partly blocked flatrod tunnels, one beneath the railway embankment and one beside the ore bins, originally extended eastwards to Williams shaft. The only other remaining 19th century mine features on the site are two poorly preserved ochre pits and an almost entirely obliterated sawmill. The 750 m-long 850 Adit was driven between 1959 and 1962. Ore was brought out on wagons hauled by a diesel locomotive and tipped into the two large ore bins. DCENR has plans to control the water flow from this adit through the construction of a bulkhead or dams. The two steel ore bins, 4.9m high on a 1.9m-high support structure, and wooden crib show signs of severe corrosion and decay. Tigroney West is covered either by spoil heaps or, in between, a thin layer of spoil. Most of the spoil is in the form of three terrace-like areas east of and above the railway line, and as seen in historical photos of the site.

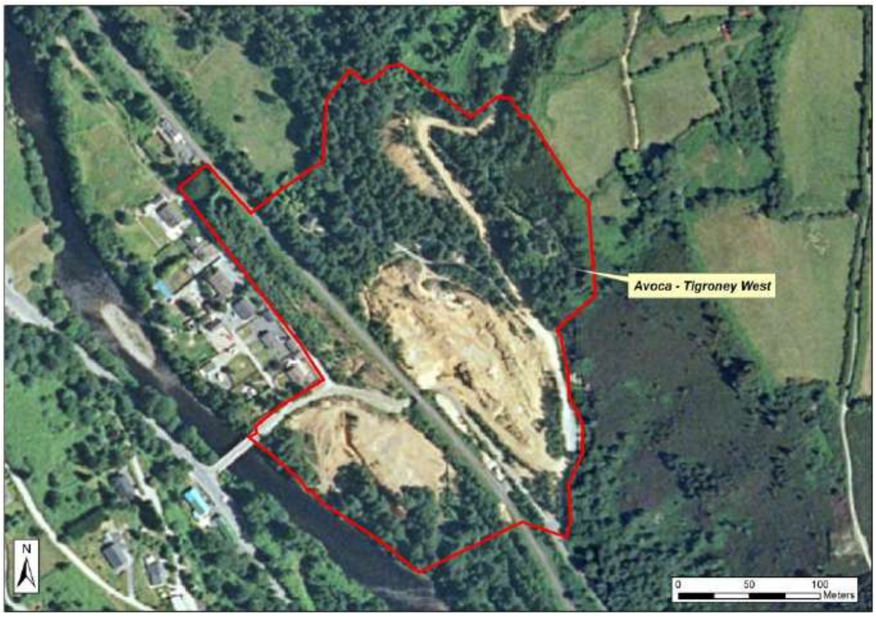
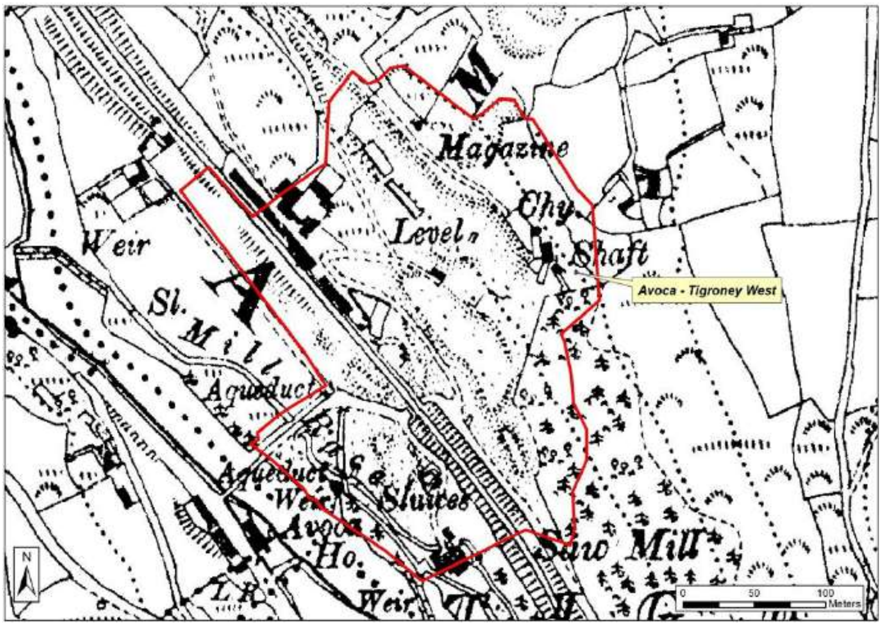
Site Importance – County Geological Site
Tigroney West contains Williams engine house, the largest and best-preserved at Avoca. The Deep Adit and its discharge are highly significant, historically and in the present day, in the context of the environmental impact of mining on the Avoca River.

Management/promotion issues
There are plans to cover or seal a large proportion of the mine waste on the site, potentially affecting the ore bins and flatrod tunnels, in addition to installing a bulkhead or dam in the 850 Adit. There is potential for a 3D Lidar Survey of the 850 Adit before any bulkhead installation, that would serve to document the mining heritage and provide tourism videos for any appropriate visitor centre and website. Williams engine house is fenced off but could be an important part of a mine heritage trail for Avoca. In its current state much of the mine site is unsafe for public access.

Williams Engine House, Tigroney West, viewed from southwest.

Timbered entrance to 850 Level adit partly hidden behind spoil. The channel in front was dug in recent years to accommodate a periodic discharge of water from the adit, a recent development possibly related to blocking of the normal drainage routes within the mine.

Ore bins installed in the late 1950s to hold ore trucked from the
850 adit and destined for the mill in West Avoca. One flatrod tunnel is located just to the right behind the bushes.


Avoca - Tigroney West
Redcross
An Chrois Dhearg
Avoca
Abhoca
Ballinvally
Ballydonnell
Kilmacoo Upper
Knockanree Upper
Knockanroo Lower
Cherrymount
Tigroney East
Tigroney West
Castlehoward
Crone Upper
Ballinvally Upper
Ballinvally Lower
Ballinastraw
Pollaphuca
Poll an Phúca
Kilmagig Lower
Barranisky West
Ogilil Upper
Blindwood
Tinnahinch
Ballygahan
Connary
Kilmacoo
Church
Holy Well

Avoca - Tigroney West
N
0 50 100
Meters

Avoca - Tigroney West
Magazine
Level
Shaft
Weir
Aqueduct
Sluices
Saw Mill
N
0 50 100
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**West Avoca**
Other names used for site	Ballygahan, Ballymurtagh
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Ballygahan, Ballymurtagh**
NEAREST TOWN/VILLAGE	**Avoca**
SIX INCH MAP NUMBER	**35**
NATIONAL GRID REFERENCE	**719512E 681596N**
1:50,000 O.S. SHEET NUMBER	**62 GSI Bedrock 1:100,000 Sheet No. 19**

Outline Site Description
West Avoca occupies a hillside site above the Avoca River and an extensive grassy site on the river bank. The site is surrounded on three sides by pasture and forestry. The Rathdrum–Avoca road runs through the site.

Geological System/Age and Primary Rock Type
The bedrock is part of the c. 455 Ma Ordovician Avoca Volcanic Formation which comprises an interbedded sequence of strongly deformed and altered volcanic and sedimentary rocks. Massive, disseminated and vein-hosted sulphide mineralization (chalcopyrite, pyrite, galena and sphalerite) is found mainly within distinctive chloritic tuffs.

Main Geological or Geomorphological Interest
The West Avoca site incorporates two major 19th-century mine sites, Ballygahan and Ballymurtagh. The former became the locus of the 20th-century underground mine as well as the Pond Lode open pit. At its height between the late 1950s and final closure in 1982, the site contained a large ore mill, workshops, mine offices and dormitories. Houses built in the late 1950s along the Red Road south of the site to accommodate mine managers still exist. Access to the underground mine was via a large portal into the Knight Tunnel. The flat area on the east of the site along the riverbank is the former emergency tailings pond, now covered by a thick layer of grassed soil. There are significant remains of 19th-century mining, especially on the high ground on the western and northern parts of the site. They include several engine houses with intact chimneys, the Tramway Arch, part of the inclined plane railway built in the 1840s to carry ore to Arklow, and various capped shafts. The open pit at Ballymurtagh, described in the 1850s as the then largest in the world, was backfilled with tailings and soil in the 1970s.

Site Importance – County Geological Site
The site was the heart of modern, 20th-century mining at Avoca but little trace of this era remains. The open pit, used as a municipal dump in the 1980s and 1990s, is now infilled and grassed over. Of the modern buildings only the mine offices are intact if derelict. The principal interest on the site is the cluster of conserved 19th-century engine houses and the unique Tramway Arch.

Management/promotion issues
The site of the 20th-century mine is now a recycling centre and access is largely restricted. The engine houses were conserved in the 1990s but in recent years have become almost inaccessible following unchecked growth of trees and shrubs. The western and northern part of the site could be incorporated into a future mine walking trail but the unchecked growth of vegetation around the engine houses would first have to be addressed. The site is unsafe and should not be accessed in its present state by the general public.

View of West Avoca from Mount Platt in Cronebane. The grassed area (middle, left) is the site of the former open pit. The mine spoil of Ballymurtagh can be seen on the right.

The Tramway Arch at Ballymurtagh with the bed of the 1840s railway clearly defined on top.

Former mine offices at West Avoca, proposed as a mine heritage centre in the past, now derelict.

Avoca - West Avoca
Redcross
An Chrois Dhearg
Avoca
Abhoca
Kilmacoo
Kilmacoo Upper
Coolanearl
Ballydonnell
Ogphil Upper
Tigroney East
Tigroney West
Knockanree Upper
Knockanree Lower
Ballinvally
Ballinvally Upper
Ballinvally Lower
Cherrymount
Ballygahan
Tinnahinch
Kilqueeny
Kilmagig Lower
Ballinastraw
Pollaphuca
Poll an Phúca
Vale of Avoca
Connary
Castlehoward
Crone Upper
Blindwood
Church
Holy Well
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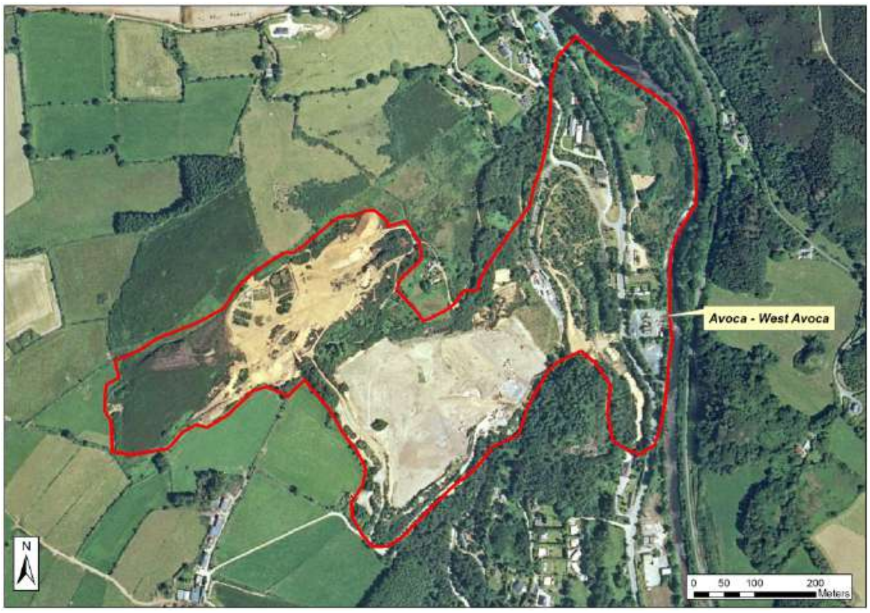
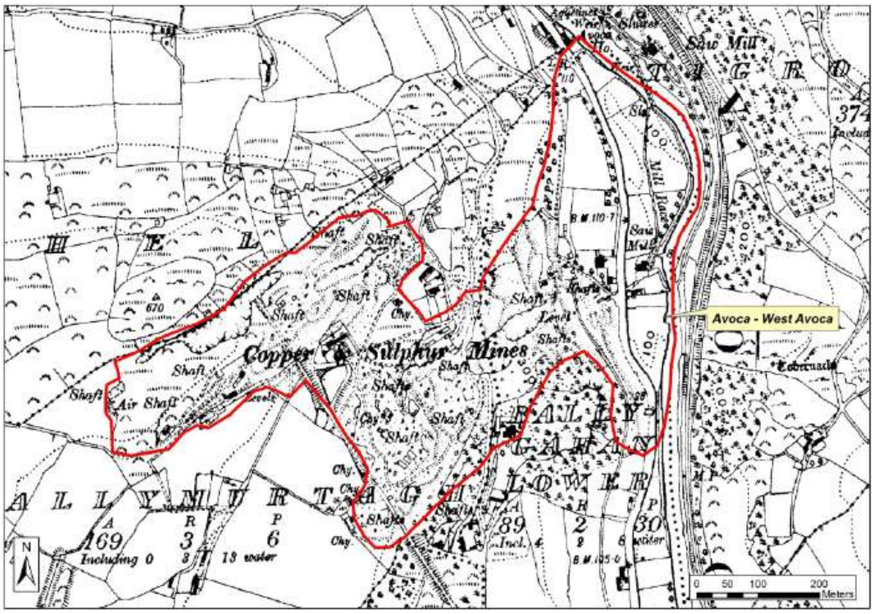


Avoca - West Avoca
N
0 50 100 200 Meters



Avoca - West Avoca
Copper & Sulphur Mines
Shaft
Air Shaft
Saw Mill
Mill Race
N
0 50 100 200 Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Ballyknockan**
Other names used for site	Ballyknockan Quarries
IGH THEME	**IGH 15 Economic Geology**
TOWNLAND(S)	**Ballyknockan**
NEAREST TOWN/VILLAGE	**Blessington**
SIX INCH MAP NUMBER	**10**
ITM CO-ORDINATES	**700520E 707150N (crossroads in village)**
1:50,000 O.S. SHEET NUMBER	**56 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
Inactive granite quarries are surrounded by a dispersed village with many features related to the quarrying of stone and the skills of craftsmen stonemasons in the past.

Geological System/Age and Primary Rock Type
The granite rock is of Devonian age from around 400 million years ago.

Main Geological Interest
The site was probably the most important area for supplying cut stone blocks of granite for the construction of many of Dublin City's major public buildings. The granite is no longer quarried, although a few stonemasons still work on monumental and gravestone orders in the village, mainly using stockpiled stone. The streets, buildings and walls around the village are highly visible reminders of the former industrial past of Ballyknockan. Building construction, field boundary walls and fence posts, partial sculptures and other features scattered around the quarries all exemplify the pride and skill of the stonemasons who worked here since the quarries were opened in 1824.

Site Importance - County Geological Site
The economic importance of the stone quarrying industry to the growth of Dublin City was significant, and the industrial and cultural heritage of Ballyknockan is more important than the pure geology of the granite that was exploited here.

Management/promotion issues
There are many factors to consider here, given that a local committee has made considerable efforts in the past to raise the profile of the stone quarrying heritage, with monuments to the workers, and to individuals placed at strategic points around the village, and signs approaching the village. In addition past efforts have meant that the Heritage Plan includes an action to: Support a "Ballyknockan Granite Park" initiative. However that particular local committee is seemingly defunct in 2014.

There is a definite need to promote the appreciation of the local stone cutting tradition, but it needs to be driven by local, community led, upward efforts, rather than imposed from above by the County Council or any other agency. There are some local individuals with a wish to develop more business in Ballyknockan founded upon the stone cutting tradition, as well as to preserve the heritage of the village and these should be supported, along with relevant partners such as the Geological Survey of Ireland, the Mining Heritage Trust of Ireland and others.

The main quarried area, formerly Creedon's Quarry viewed from the road to the south.

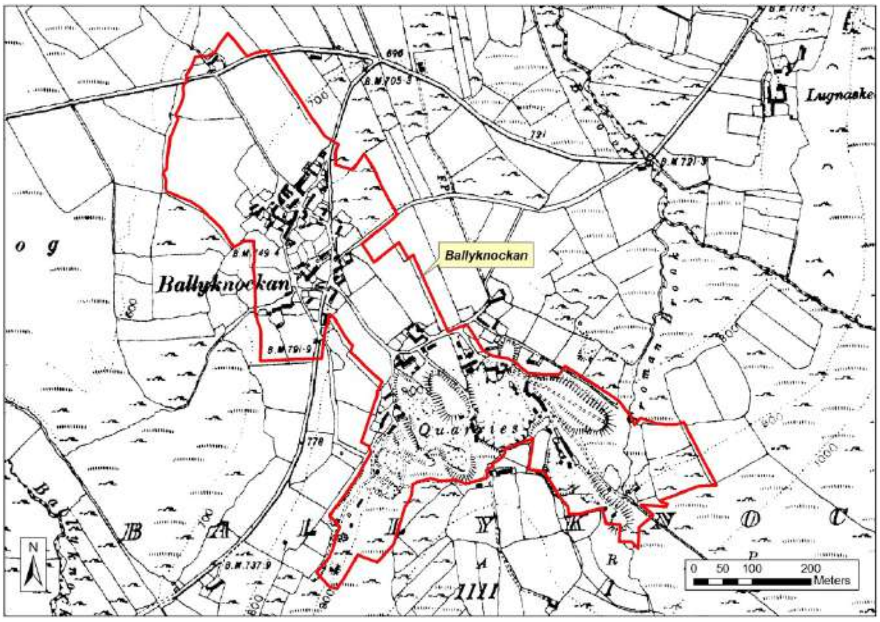
The Ballyknockan Inn, formerly the quarry owner's residence, showing many fine details of stone dressing.

Overgrown old quarry.

Madonna carving, fencepost and view down the Horse Lane, with 2.5m high walls in places.


BLESSINGTON
Baile Coimín
POLLAPHUCA
RESERVOIR
Taiscumar
Pholl an Phúca
Valleymount
An Chrois
Sorrel Hill
Black Hill
Moanbane
Ballyknockan
Ballyknockan


Ballyknockan
N
0 50 100 200
Meters


Ballyknockan
Ballyknockan
Quarries
N
0 50 100 200
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Ballyrahan Quarry**		
Other names used for site	Ballyraheen Quarry		
IGH THEME	**IGH15 Economic Geology**		
TOWNLAND(S)	**Ballyraheen**		
NEAREST TOWN/VILLAGE	**Tinahely**		
SIX INCH MAP NUMBER	**43**		
NATIONAL GRID REFERENCE	**700675E 671416N**		
1:50,000 O.S. SHEET NUMBER	**62**	**GSI Bedrock 1:100,000 Sheet No.**	**19**

Outline Site Description
Ballyrahan Quarry is a small long-abandoned quarry developed in a minor granitoid intrusion, and has been used in recent times for cattle grazing.

Geological System/Age and Primary Rock Type
The bedrock is a fine-grained tonalite (microtonalite), part of a swarm of thin sheet-like intrusions along the eastern margin of the near-contemporaneous Leinster Granite (405 Ma). The microtonalites, centred on Ballinglen, north of Tinahely, were emplaced into pelites and semi-pelites of the Ordovician Maulin Formation.

Main Geological or Geomorphological Interest
The microtonalites are host to a tungsten-tin mineralization that is unique in Ireland. Mineralization comprises scheelite, cassiterite, arsenopyrite, sphalerite and other minerals in thin quartz veins within heavily altered or greisened microtonalite and its immediate wallrocks. The sub-economic mineralization was discovered in the 1970s and was the subject of a major exploration programme. The best known exposure of mineralization was in the now infilled Ballybeg Quarry, north of Ballinglen. Minor exposure occurs throughout the area but the best examples of mineralization are now seen in preserved drill core. Ballyrahan Quarry is near the southern end of the microtonalite swarm and it demonstrates many of the basic features of the style of mineralization, although mineralization itself is at best weak. Contact between the wallrocks and the microtonalite is very well exposed. Observed features that are characteristic of the mineralization include silicification or quartz vein formation, greisenization and development of muscovite margins to barren quartz veins. The microtonalite sheet has been emplaced conformably along the country rock cleavage and a chilled margin, produced by rapid cooling of the hot magma in contact with the cooler country rock, is present.

Site Importance – County Geological Site
The site contains the best exposure of microtonalite that is host to unique tungsten-tin mineralization in Wicklow. It demonstrates the form of the intrusion and its relationship to the host country rocks. Various features that characterize the mineralization can be observed in the microtonalite exposed here, although mineralization itself is very weak.

Management/promotion issues
The quarry has been abandoned for more than 30 years. Numerous examples of one-off housing are present in the area and the site may be vulnerable to development. It is of interest mainly to geologists and researchers and does not warrant promotion.

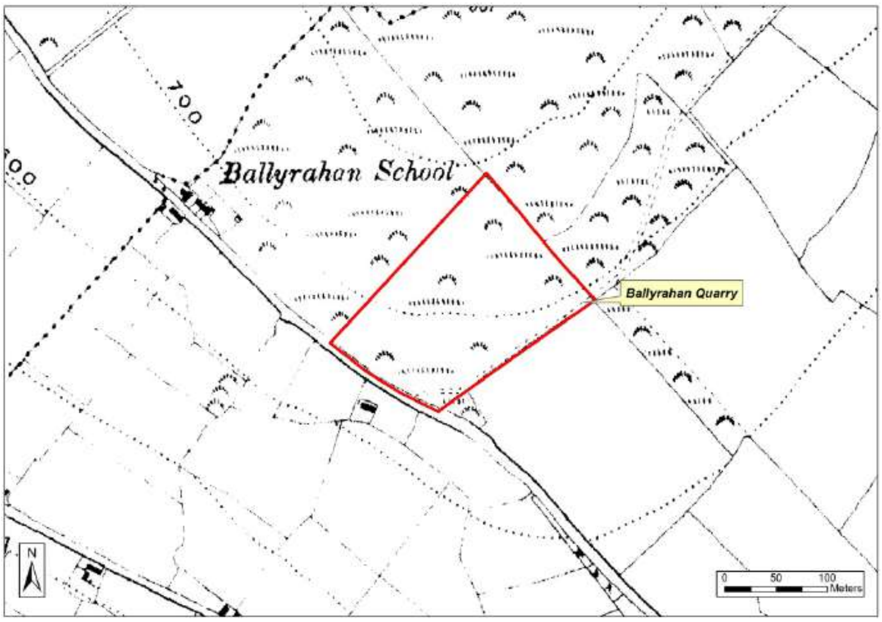
Microtonalite outcrop in Ballyrahan Quarry. Sheeted nature of intrusion is clearly visible. Sheet dips southeastwards and is conformable with its host rocks.

Quartz veinlets cutting microtonalite, surrounded by narrow zones of greisenization that have bleached the microtonlite.

Conformable contact between microtonalite sheet and pelitic wallrocks on eastern side of quarry. The microtonalite has a chilled margin, i.e. It is very fine grained at contact where it cooled very rapidly in contrast to the interior of the sheet where cooling was slower.


Ballyrahan Quarry
Tinahely
Tigh na hÉille
Muskeagh
Newtown
Ballyshonog
Glenphilipeen
Coolross
Churchland
Lugduff
Whitefield
Rosbane
Mountpleasant
Boleybawn
Greenhall
Ballyraheen
Ballyraheen Cross Roads
Strahakelly Cross Roads
Gortean
Coolroe
Tomnafinnoge
Tomnafinnoge Wood
Holy Well
Fire Sta
R747
R749
99
00
01
02
03
04
05
70
71
72
73
74


Ballyrahan Quarry
N
0
50
100
Meters


Ballyrahan School
Ballyrahan Quarry
700
N
0
50
100
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glendalough-Glendasan-Glenmalure District - Overview**
Other names used for site	
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Camaderry, Seven Churches, Brockagh, Lugduff**
NEAREST TOWN/VILLAGE	**Laragh**
SIX INCH MAP NUMBER	**22, 23, 28, 29**
NATIONAL GRID REFERENCE	**708500E 696300N**
1:50,000 O.S. SHEET NUMBER	**56 GSI Bedrock 1:100,000 Sheet No. 16**

Introduction

Small quartz vein-hosted Pb-Zn(-Cu-Ba) deposits along the margin of the Leinster Granite batholith were worked episodically from the late 18th century to the 1950s. Lead ore (Pb) was the main product although limited amounts of copper (Cu) and silver, from argentiferous galena, were also produced. Efforts to produce zinc (Zn), notably in the 1950s, failed, possibly for want of proper processing technology. Most of the deposits were small, producing some ?tens of tonnes of ore, but 45,000 tonnes of Pb, 60% of the total Irish output, was produced in the Glendalough District between 1826 and 1900.

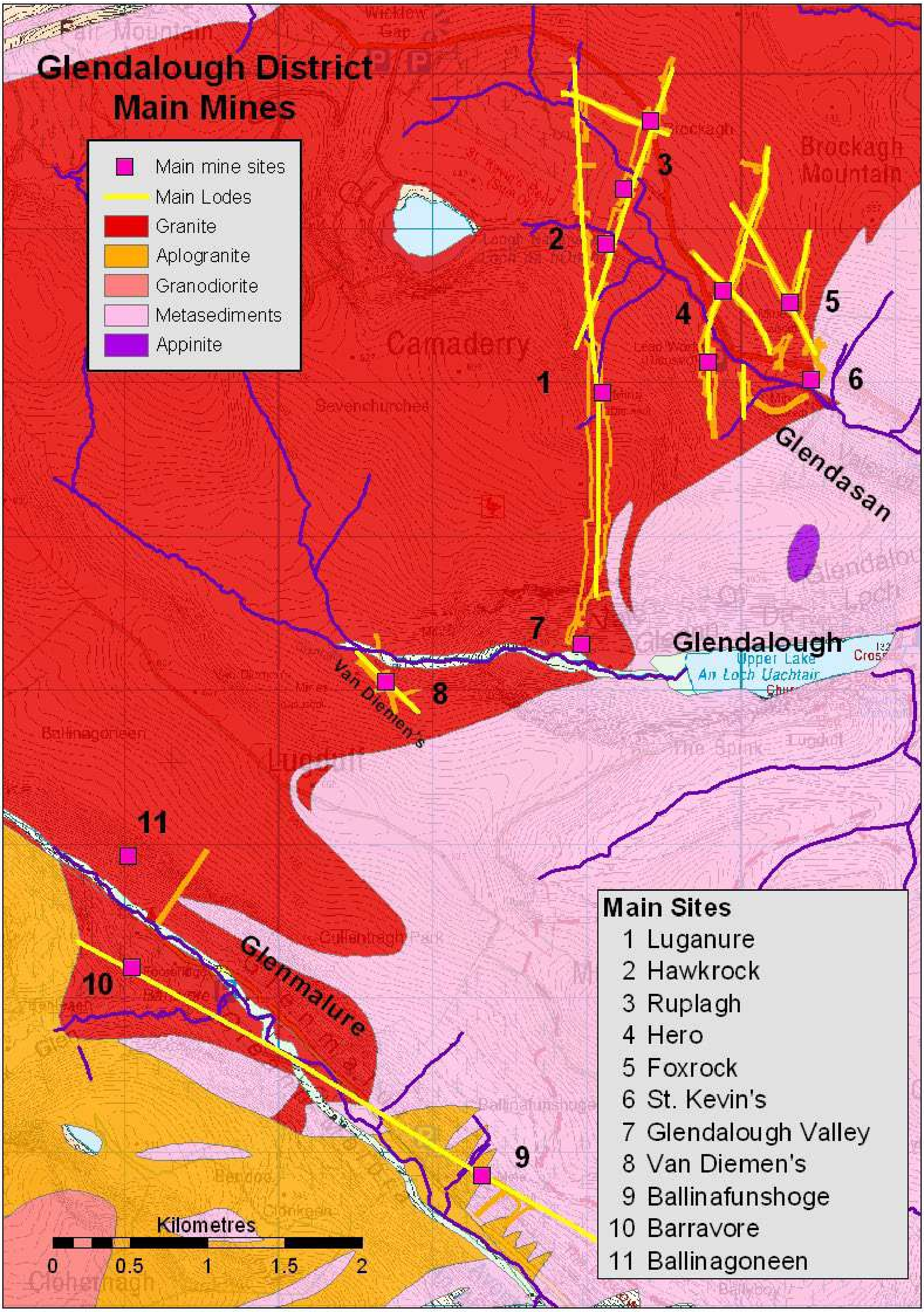
The Glendalough-Glendasan district comprises a number of mine sites in three broadly parallel valleys that run northwest-southeast through the Wicklow mountains. **Glendasan** in the north is separated from **Glendalough** valley by Camaderry mountain. These two valleys host most of the mine sites in the district. The rivers that drain them, the Glendasan and Glenealo rivers, come together at the old monastic site in Glendalough to form the Avonmore River. In the south, the **Glenmalure** valley was the site of earliest mining in the district in the late 18th century.

Geology

The mineralization is hosted mainly by the 405 Ma Leinster Granite in quartz veins that follow the line of faults or previously emplaced pegmatite/aplite veins. Their strike direction varies but most are oriented at a high angle to the granite margin (Fig. 1). The longest vein, the Luganure Lode, was worked over a length of almost 3.5 km but is typically less than 6 m in thickness. In most instances, brecciation preceded and followed the deposition of sulphides. The mineralized veins are largely confined to the granite but a few cross the granite/wallrock contact where particularly rich mineralization has been found. The mineralogy of the veins includes major galena (PbS) and sphalerite (ZnS), subordinate chalcopyrite ($CuFeS_2$) and pyrite (FeS_2) and minor amounts of other minerals including haematite and native silver.

Main Geological or Geomorphological Interest

The underground workings in the district are very extensive considering the narrow courses they were driven on. Maximum depth of workings below ground is approximately 400m though most levels are significantly shallower than this, with the median depth below ground about 80m. In all, over 40km of levels and shafts were driven, most of them in the 19th century. The mines were generally kept dry by drainage from the adits but deeper levels were pumped dry, using waterwheels powered by water from Lough Nahanagan. Waterwheels were also used to raise ore. In 1871, a drought seriously reduced the amount of ore produced by MCI. Most adits have now collapsed or are blocked off and the underground workings are in poor condition and inaccessible to the public. There are extensive surface workings, including processing floors, spoil heaps, tailings ponds, the remains of mine buildings (offices, miners' accommodation, mill, dressing sheds, hoppers, etc.), wheel pits and the traces of plugged shaft openings.

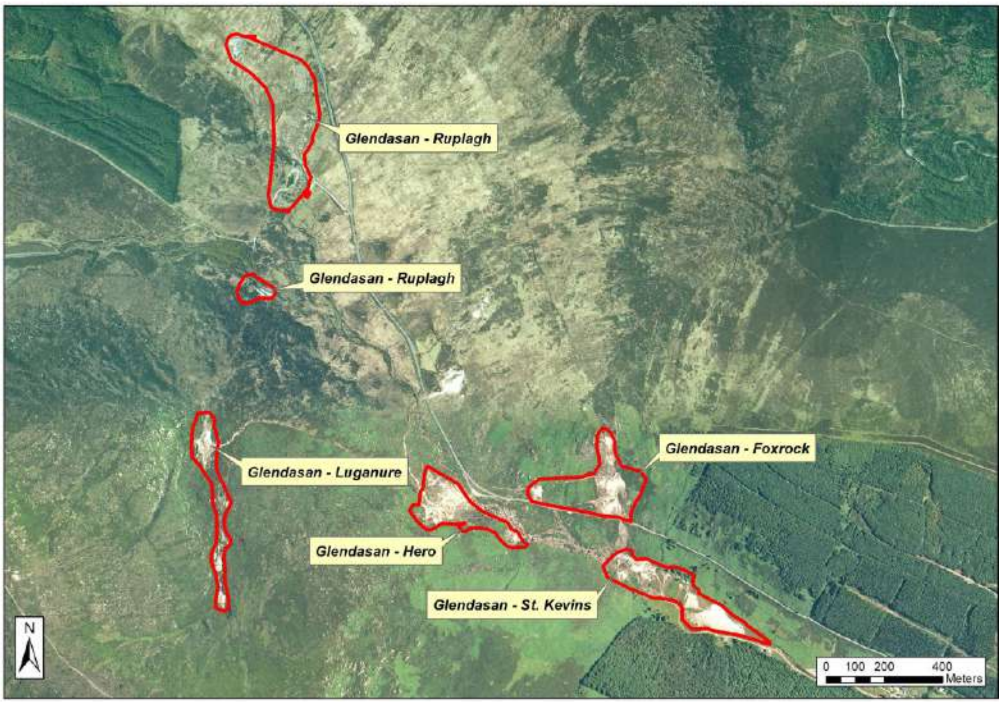


Map from Stanley *et al.* 2010

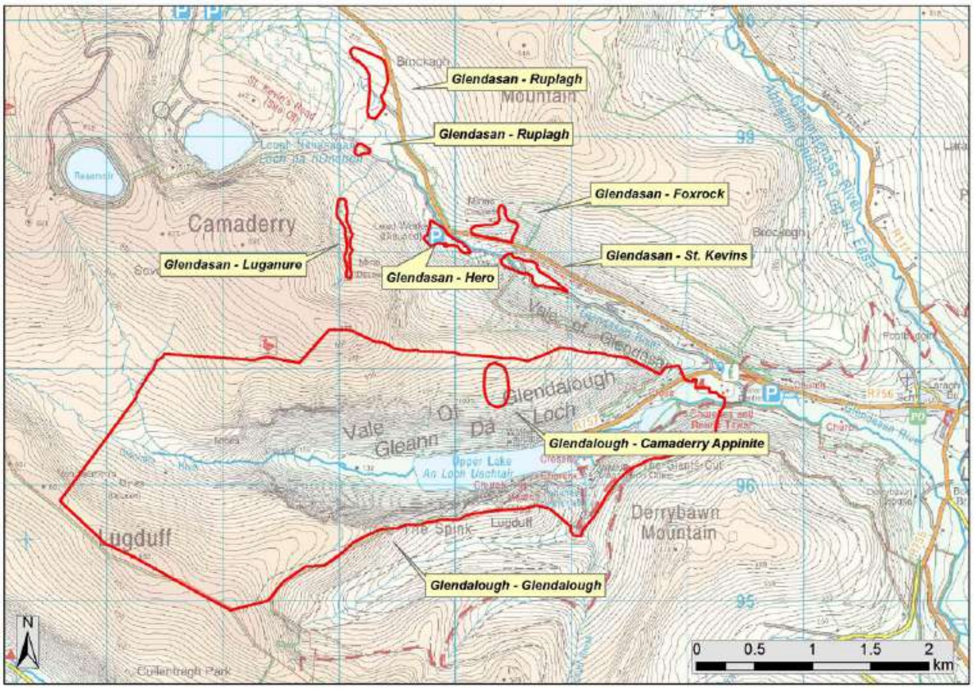
Site Importance – County Geological Site

The Glendalough – Glendasan – Glenmalure district is one of the most significant historical mine sites in Ireland with excellent rock exposures, numerous remains of mine buildings, large, well-documented ore processing sites and very extensive underground workings with abundant surface expression.

Management/promotion issues
The district is within the Wicklow Mountains SAC, SPA, pNHA and National Park, and is very popular with visitors and walkers. Glendasan and Glendalough have both been the subject of detailed mine heritage studies, supported by WCC, and there are plans to erect signboards at Glendalough and Glendasan. Promotional leaflets or a booklet on the mining history of the area would be useful additions to the overall experience of the area for the tourist.



Aerial photograph showing in detail the density and outline of the mine sites in Glendasan.



WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glendasan - Foxrock**
Other names used for site	
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Brockagh**
NEAREST TOWN/VILLAGE	**Laragh**
SIX INCH MAP NUMBER	**17, 23**
NATIONAL GRID REFERENCE	**710294E 698243N**
1:50,000 O.S. SHEET NUMBER	**56 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description
Foxrock mine site is located on the north side of the Glendasan River, on the southern slope of Brockagh Mountain, immediately north of the Wicklow Gap road.

Geological System/Age and Primary Rock Type
The bedrock is Lugnaquillia Granodiorite, part of the Lugnaquillia Pluton which is one of the five plutons that comprise the late-Caledonian (405 Ma) Leinster Granite batholith. The granite is cut by slightly younger quartz veins containing lead and zinc mineralization. Immediately east of the site is the contact between the granite and schists of the Lower Palaeozoic Maulin Formation.

Main Geological or Geomorphological Interest
The eastern part of the site is marked by three prominent spoil heaps, one above the other on the steep hillside, each created from waste rock tipped at the entrance to an adit driven on the Foxrock lode. Further west are spoil heaps related to adits on the Hollyrock lode. Most of the eight extant adits identified on the site have visible openings but all have collapsed to a greater or lesser degree within metres of the entrance. Two ruined mine buildings remain on the site - the main building was a crusher house: thick stone walls define the footprint of the building but much of it has been reduced to a height of one metre or less.

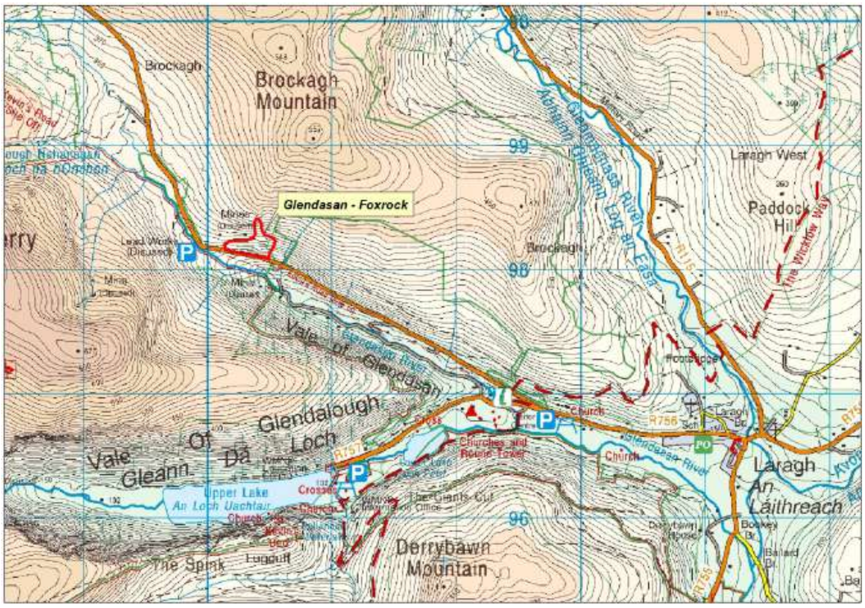
The area was first mined in the 19th century and some of the adits (3rd Adit, Hollyrock Deep Adit) were reopened and explored in the 1940s by Mianrai Teoranta. However, the only mining carried out on the Foxrock lode in the 20th century seems to have been from the underlying 4th Adit at St. Kevin's site, south of the Wicklow Gap road.

Site Importance – County Geological Site
The Foxrock site is one of the most prominent mine sites in the Glendasan valley, readily accessible from the road. The stacked arrangement of the adits and waste heaps illustrate well the geometry of the near vertical lode and the approach adopted to mining it. It is a significant mine site particularly when placed in context with the Old Hero processing site on the other side of the road.

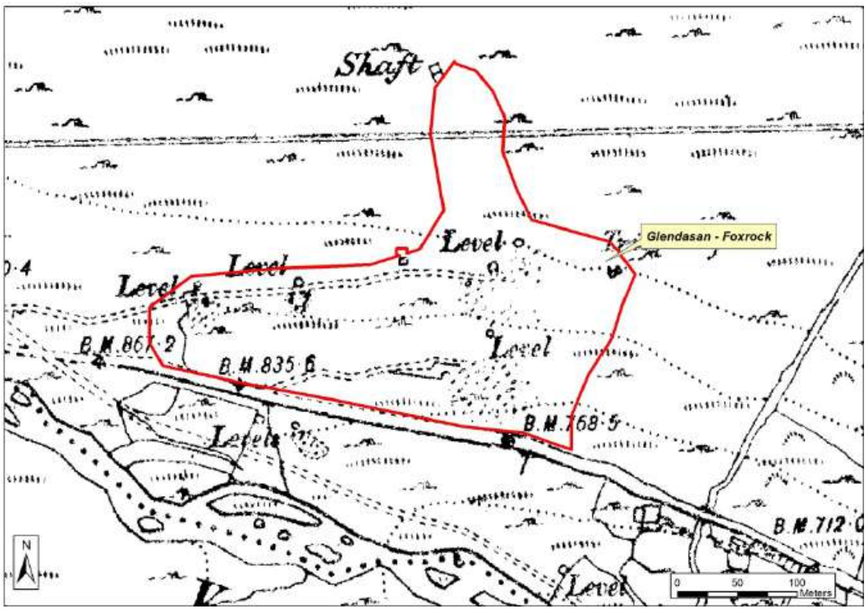
Management/promotion issues
The spoil heap immediately above the road is potentially unstable but otherwise the site merits promotion in tandem with the Old Hero site as an excellent illustration of 19th century mining and processing in Glendasan.

3rd Adit on Foxrock lode, July 2014, showing almost complete closure of entrance by siltation. Photo on right is from 2007.

Ruins of apparent crusher house, Foxrock


Brockagh
Brockagh Mountain
Glendasan - Foxrock
Lead Works (Disused)
Vale of Glendasan
Glendalough
Vale Of Da Loch
Gleann Dá Loch
Upper Lake
An Loch Uachtair
The Spink
Lugduff
Derrybawn Mountain
The Giants Cut
Churches and Round Tower
Laragh West
Paddock Hill
Laragh
An Láithreach
R756
R757
R115
99
98
97
96


Glendasan - Foxrock
N
0 50 100 Meters


Shaft
Level
Level
Level
Level
Levels
Level
Glendasan - Foxrock
B.M.867·2
B.M.835·6
B.M.768·5
B.M.712
N
0 50 100 Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glendasan - Hero**
Other names used for site	
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Sevenchurches or Camaderry**
NEAREST TOWN/VILLAGE	**Laragh**
SIX INCH MAP NUMBER	**23**
NATIONAL GRID REFERENCE	**709819E 698162N**
1:50,000 O.S. SHEET NUMBER	**56 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description
The site, in two parts, is in the centre of the Glendasan Valley, on the south bank of the Glenealo River. Both parts are sloping, spoil-covered areas within moorland largely used for sheep pasture and hill walking.

Geological System/Age and Primary Rock Type
The bedrock is Lugnaquillia Granodiorite, part of the Lugnaquillia Pluton, one of the five plutons that comprise the late-Caledonian (405 Ma) Leinster Granite batholith. The granite is cut by slightly younger quartz veins containing lead and zinc mineralization.

Main Geological or Geomorphological Interest
The larger, northwestern part of the site is the 2.5 ha Old Hero site which acted as a central processing area during the 19th century for various mines in Glendasan. The upper floor of the site contains the ruins of a number of buildings. The most substantial are those of the cobbing house or yard, where waste material was removed from lumps of ore by hand using hammers (“cobbing”). Two buildings beside this were presumably offices or stores. The walls of the crusher house are still standing and, beside them, the wheel pit for the water wheel. An area of gravel waste in front of the crusher house is apparently a residue of the material produced by the crusher. On the lower floor of the site, the iron-oxide coated mortar stones of the stamps (photo, left) are present above the buddle area. The outlines of the buddles are still visible. Buddles were circular tanks in which water was used to separate the lighter impurities from the heavier ore. Immediately beside the river is an accumulation of slimes (finely ground material produced during ore processing) in what was presumably once the location of a slime pit. Vertical wooden poles in the spoil on the southern edge of the site are supports for a former ramp that led down to the Old Hero adit from which ore was raised. The extensive underground workings on Old Hero lode lie mainly below the western part of the site. Several shafts are marked on old maps but none are visible today. There is one opening where a stope has broken through to the surface.

Less than 200 m downslope from Old Hero is the Moll Doyle site, a smaller site comprising an adit on the Moll Doyle lode, a dressing floor and associated mine waste. The adit is one of the most accessible in the district.

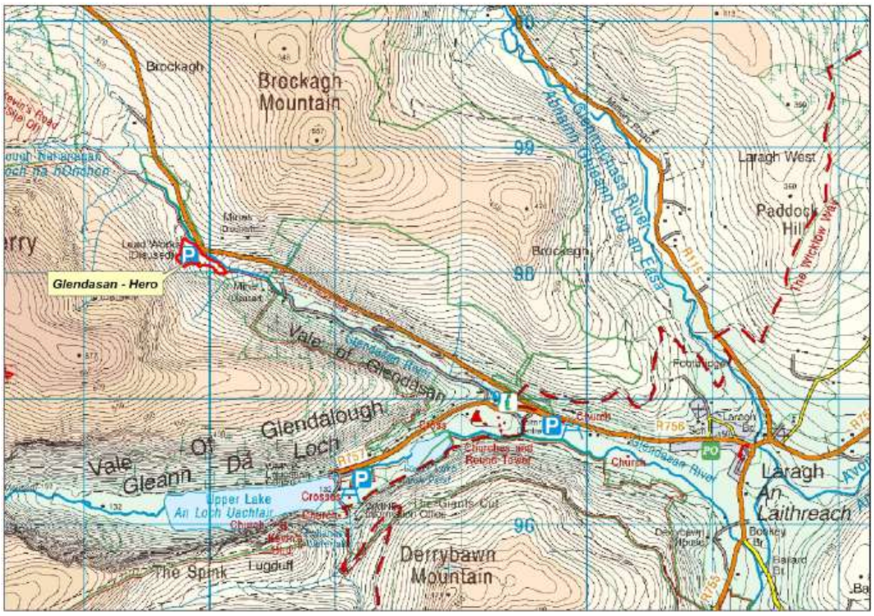
Site Importance – County Geological Site; may be recommended for Geological NHA
The Hero processing site is one of the best preserved and studied 19th-century ore processing sites in the country and warrants consideration as an NHA, perhaps in the wider context of Glendasan mining area.

Management/promotion issues
The processing site is well known and popular with visitors as it is immediately adjacent to a lay-by that is the first stopping area on the Wicklow Gap when travelling west from Laragh. The entire site is within the Wicklow Mountains National Park. Wicklow County Council currently has plans to install an information panel at the site.


View of Old Hero processing site from north.


Dressing floor where ore was ‘cobbed’ prior to crushing by stamps.


Iron base of stamps with exposed timbering of frame.


Brockagh
Brockagh Mountain
Lead Works (Disused)
Glendasan - Hero
Vale of Glendasan
Glendalough
Vale Of Da Loch
Gleann Dá Loch
Upper Lake
An Loch Uachtair
Derrybawn Mountain
The Spink
Lugduff
Laragh West
Paddock Hill
Laragh
An Laithreach
Brockagh
99
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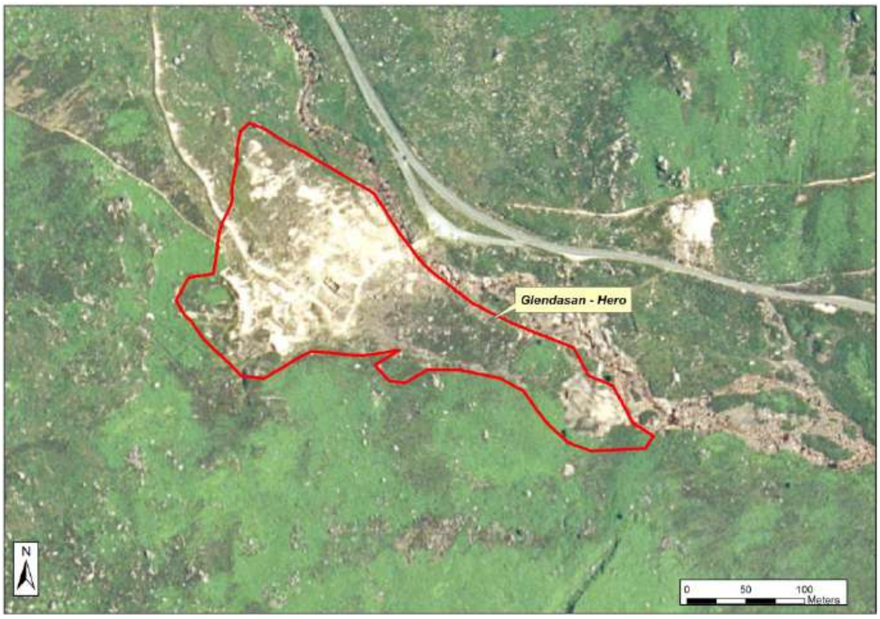
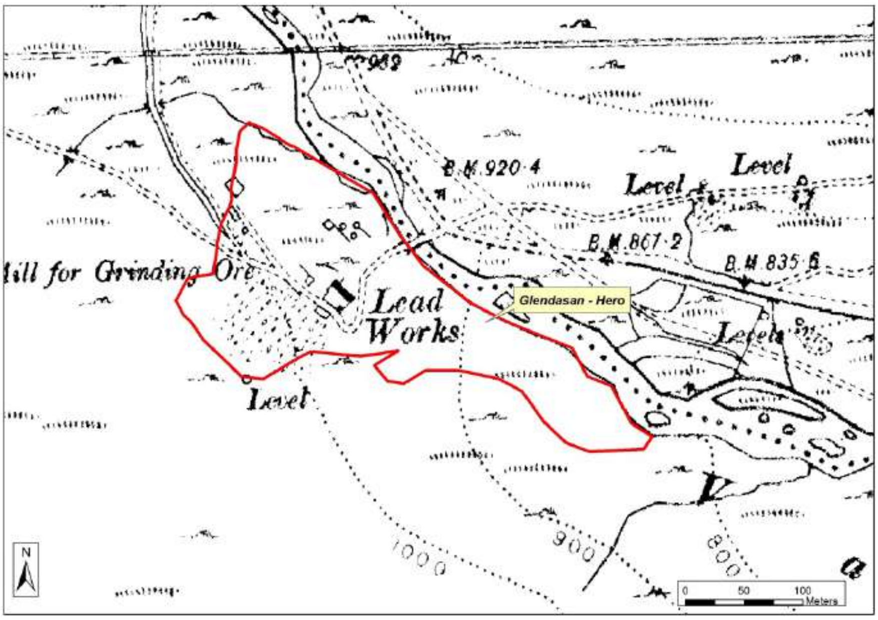

Glendasan - Hero
N
0 50 100 Meters


B.M. 920·4
Level
Level
B.M. 867·2
B.M. 835·6
Mill for Grinding Ore
Lead Works
Glendasan - Hero
Level
1000
900
800
N
0 50 100 Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glendasan - Luganure**
Other names used for site	Luganure – Hawkrock
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Sevenchurches or Camaderry**
NEAREST TOWN/VILLAGE	**Laragh**
SIX INCH MAP NUMBER	**17, 23**
NATIONAL GRID REFERENCE	**708981E 698211N**
1:50,000 O.S. SHEET NUMBER	**56 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description
The site comprises two 19th century mine sites on the northern slopes of Camaderry Mountain, an area of uninhabited moorland within Wicklow Mountains National Park.

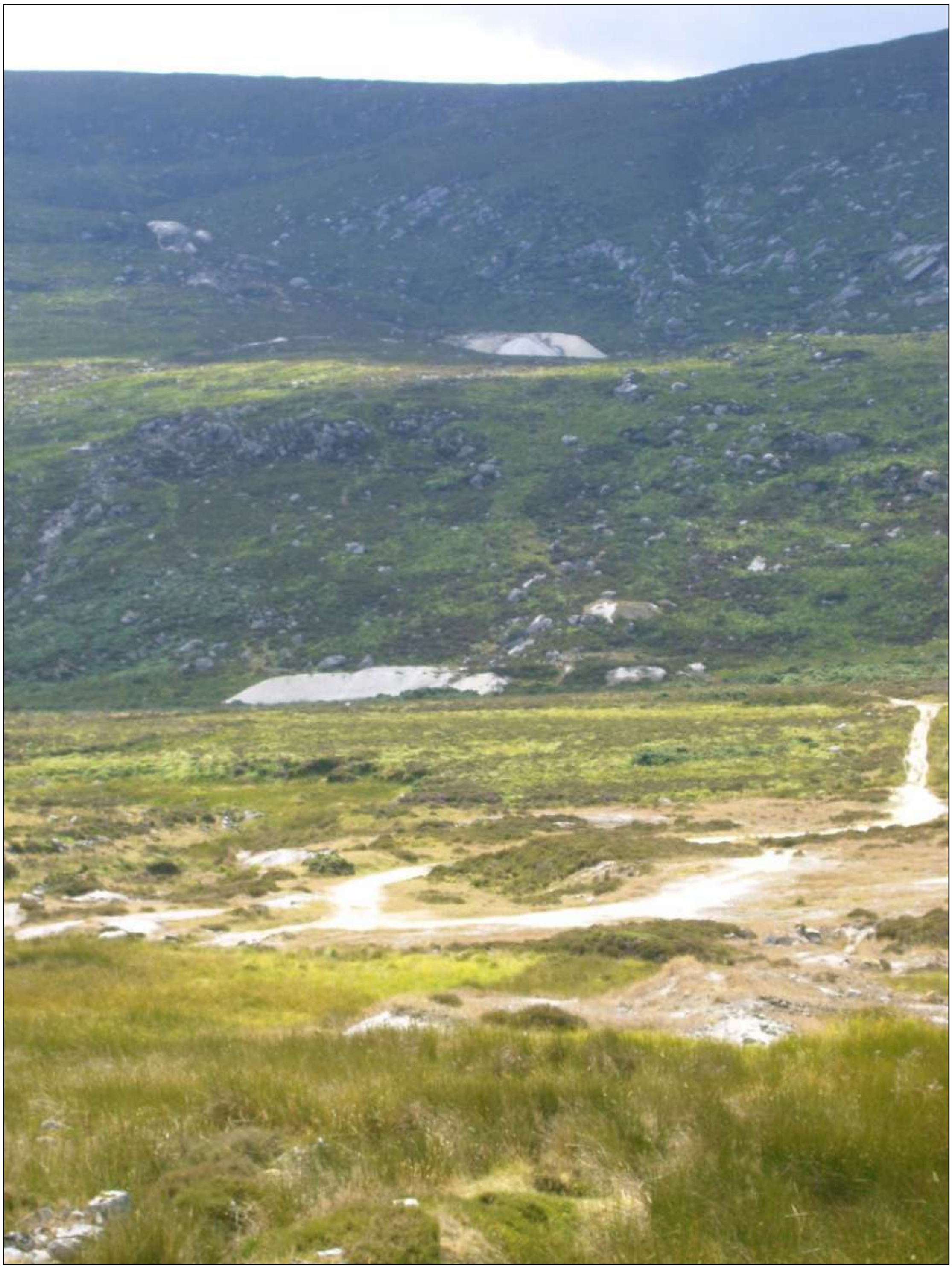
Geological System/Age and Primary Rock Type
The bedrock is Lugnaquillia Granodiorite, part of the Lugnaquillia Pluton which is one of the five plutons that comprise the late-Caledonian (405 Ma) Leinster Granite batholith. The granite is cut by slightly younger quartz veins containing lead and zinc mineralization.

Main Geological or Geomorphological Interest
Luganure and Hawkrock mine sites are among the most remote sites in the Glendalough mining district. Luganure mine was developed along the Luganure Lode while Hawkrock was developed along the southern part of the Ruplagh Lode. The Luganure lode was the first to be exploited in Glendasan, possibly as early as 1800 and large-scale mining in the district in the 1820s and 1830s initially centred on this lode. Around 1859 the workings were driven through the south side of Camaderry Mountain to the Glendalough valley site where a crusher and other processing plant had been established. Access to the underground workings at Luganure was by a series of vertically stacked adits driven into the side of Camaderry Mountain from both the north (Luganure) and south (Glendalough) sides. The total vertical extent of the workings is approximately 270m, between the lowermost 2nd Adit and the uppermost Shallow Adit.

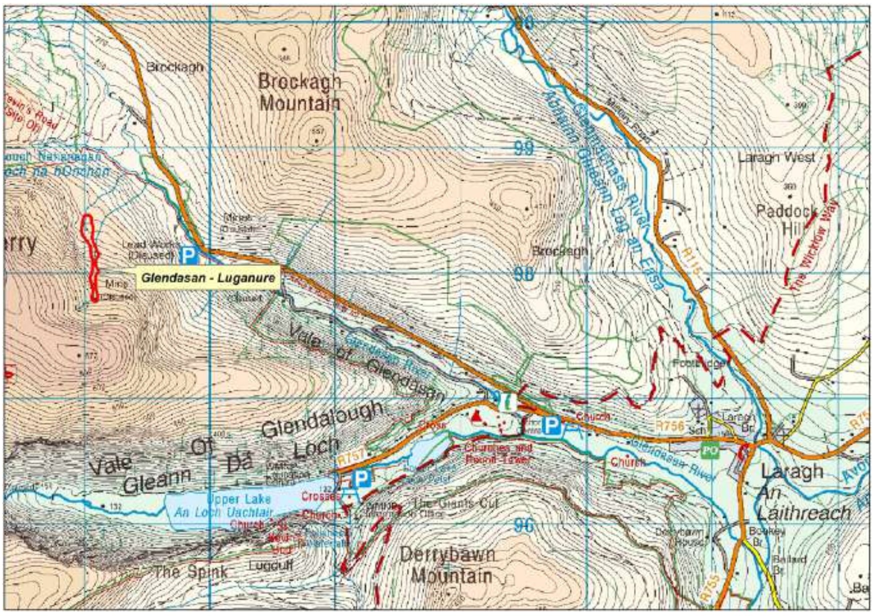
Luganure and Hawkrock are remarkable for an abundance of extant shafts and adits. The adits are in various states of collapse but their entrances are generally well defined. Several ruined mine buildings still stand on the two sites but the most striking features are the substantial waste heaps, especially on Luganure sites – the line of the Luganure Lode can be followed southwards from heap to heap up the side of Camaderry Mountain. The ore mined at Luganure was initially taken by tramway to the Old Hero Processing site via what is now a walking track that links the two sites. In later years, the ore was taken out from the southern side of the mountain and processed at the Glendalough Valley site.

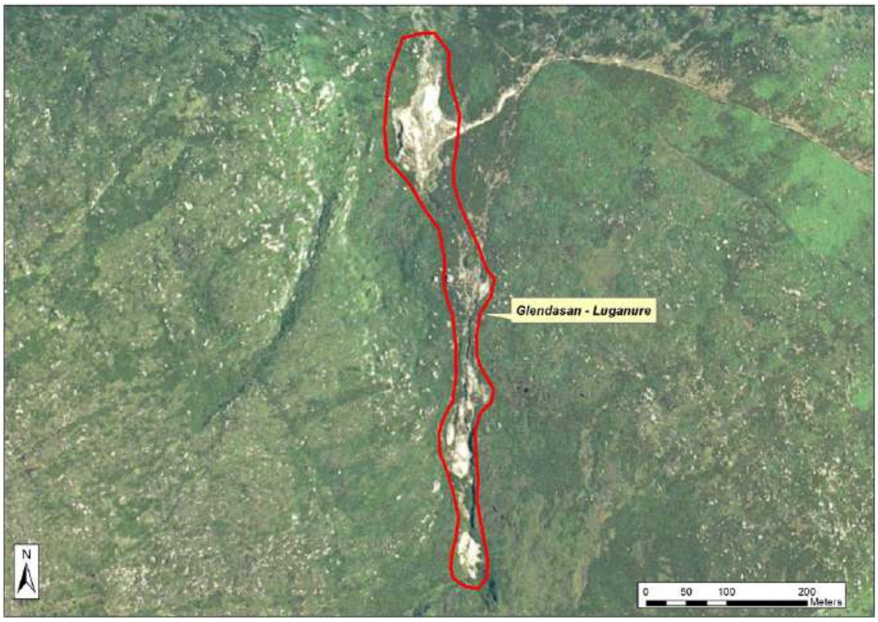
Site Importance – County Geological Site
The Luganure–Hawkrock site is one of the most substantial 19th century mine sites in the valley. Its physical link to the Glendalough valley mine site represents an important aspect of the mining history of Glendasan.

Management/promotion issues
The site is less well known than others in the district owing to its remoteness. The numerous unfenced shafts, adits and steeply sided waste heaps are potential safety issues in the context of promotion of the site to the general public.



Luganure workings, viewed from the north. Spoil heaps are located near mouths of adits driven southwards through Camaderry Mountain, with some emerging on the other side of the mountain at Glendalough (see also the Glendalough site report).


Brockagh
Brockagh Mountain
Glendasan - Luganure
Vale of Glendasan
Glendalough
Vale of Glendalough
Gleann Dá Loch
Upper Lake
An Loch Uachtair
The Spink
Derrybawn Mountain
Laragh West
Paddock Hill
Laragh
An Láithreach
The Giants Cut
Glenmacnass River
Glendasan River
Glenealo River
R756
R757
R115
The Wicklow Way


Glendasan - Luganure
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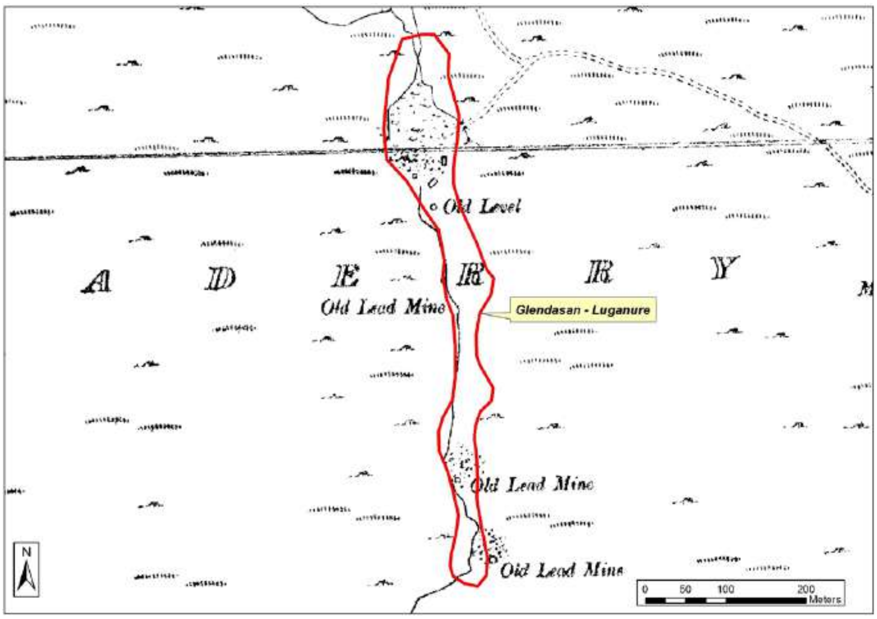
Meters


Old Level
A D E R R Y
Old Lead Mine
Glendasan - Luganure
Old Lead Mine
Old Lead Mine
N
0 50 100 200
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glendasan - Ruplagh**
Other names used for site	
IGH THEME	**IGH15 Economic Geology**
TOWNLAND(S)	**Brockagh, Sevenchurches or Camaderry**
NEAREST TOWN/VILLAGE	**Laragh**
SIX INCH MAP NUMBER	**17**
NATIONAL GRID REFERENCE	**709213E 699473N**
1:50,000 O.S. SHEET NUMBER	**56 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description
The site is spread over an area in excess of 8 hectares in moorland largely used for sheep pasture and hill walking.

Geological System/Age and Primary Rock Type
The bedrock is Lugnaquillia Granodiorite, part of the Lugnaquillia Pluton which is one of the five plutons that comprise the late-Caledonian (405 Ma) Leinster Granite batholith. The granite is cut by slightly younger quartz veins containing lead and zinc mineralization.

Main Geological or Geomorphological Interest
Ruplagh, at the western end of the Glendasan Valley, includes some of the most remote mine sites in the Glendalough district. It incorporates the old mine sites of Old Ruplagh, North Ruplagh and West Ruplagh. The sites were developed along the Ruplagh Lode and the West Ruplagh Lode that runs northwest from it. The Ruplagh Lode is a splay or offshoot of the Luganure Lode. The Mining Company of Ireland opened the original “Old” Ruplagh mine in 1835 but by 1844 it was almost wholly unproductive. In 1845 the North Ruplagh mine was opened as an extension of Old Ruplagh. Mining appears to have continued at Ruplagh through the following three decades until a general decline that would eventually lead to a cessation of mining in the district by 1890. The underground workings at Ruplagh are extensive, reaching a depth of approximately 190m.

The Ruplagh site is most remarkable for an abundance of extant if collapsed shafts and adits. Among several ruined mine buildings the most impressive of them appears to be an engine-house ruin, now consisting of exterior and interior stone walls and a well preserved wheel pit. The highest wall is 2.5 m high. This building is now part of a farm enclosure and is used as a sheep shelter. Solid waste on the site is typical of the district but is not very extensive - in part this reflects the fact that most of the material produced at Ruplagh was processed at the Old Hero Processing site further down the valley.

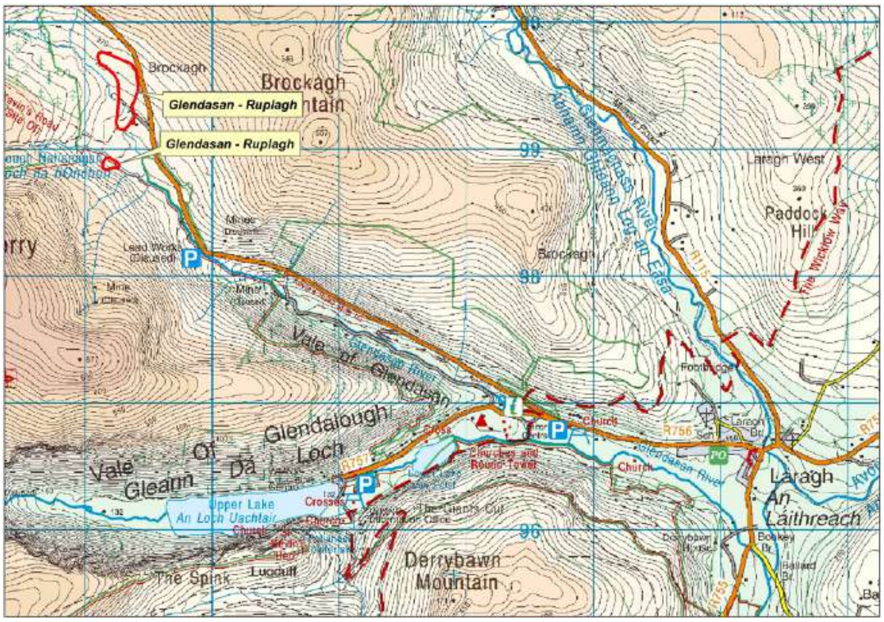
Site Importance – County Geological Site
The Ruplagh site is the western-most mine site in the Glendasan valley. The remains of what appears to be an engine house make the site unique within the valley.

Management/promotion issues
The site is less well known than others in the district owing to its remoteness. Numerous unfenced shafts and adits are potential safety issues in the context of promotion of the site to the general public.

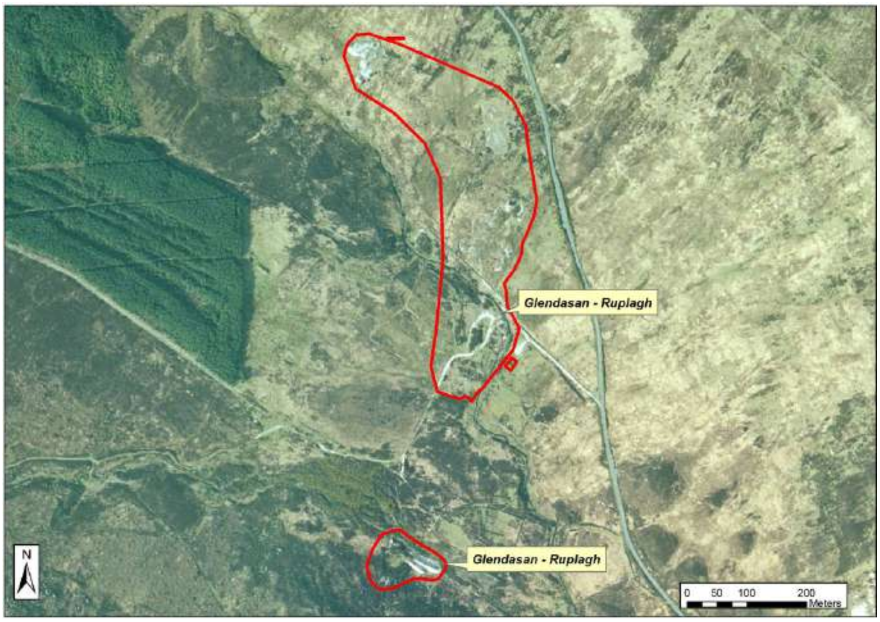
Mine building at Ruplagh.

Wheel pit in mine building at Ruplagh..

New Engine Shaft at Ruplagh.



Glendasan - Ruplagh
Glendasan - Ruplagh
Brockagh
Lead Works (Disused)
Vale of Glendasan
Glendalough
Vale of Gleann Dá Loch
Upper Lake
An Loch Uachtair
The Spink
Lugduff
Derrybawn Mountain
Laragh West
Paddock Hill
Laragh
An Laithreach
Footbridge
Church
The Wicklow Way



Glendasan - Ruplagh
Glendasan - Ruplagh
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0 50 100 200
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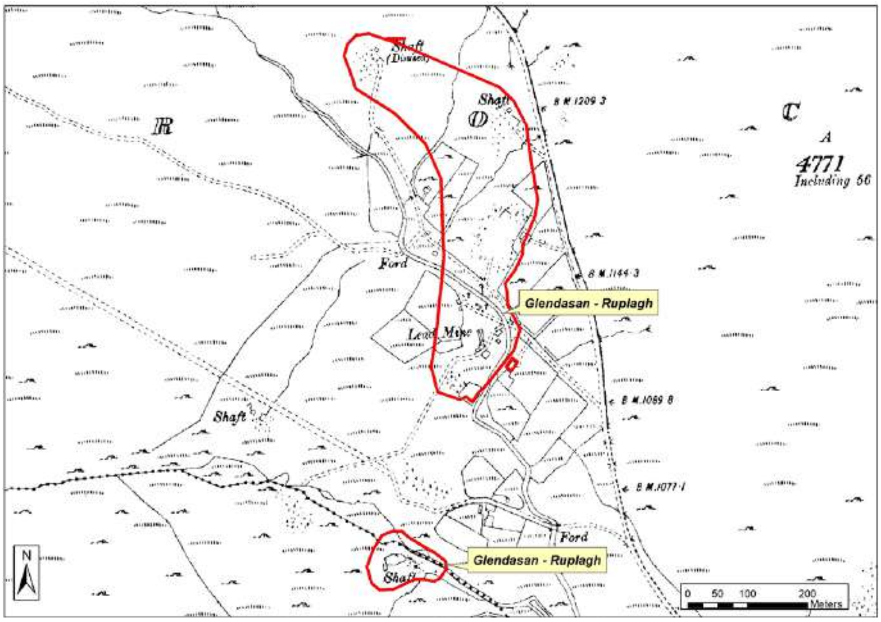


Shaft (Disused)
Shaft
Ford
Lead Mine
Shaft
Ford
4771
Including 66
Glendasan - Ruplagh
Glendasan - Ruplagh
N
0 50 100 200
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glendasan - St. Kevin's**		
Other names used for site			
IGH THEME	**IGH15 Economic Geology**		
TOWNLAND(S)	**Brockagh, Sevenchurches or Camaderry**		
NEAREST TOWN/VILLAGE	**Laragh**		
SIX INCH MAP NUMBER	**23**		
NATIONAL GRID REFERENCE	**710572E 697874N**		
1:50,000 O.S. SHEET NUMBER	**56**	**GSI Bedrock 1:100,000 Sheet No.**	**16**

Outline Site Description
St. Kevin's mine site is on the north bank of the Glendasan River, at the base of a steep section where the valley becomes much flatter and wider. The southern side of the valley is covered by coniferous plantations; the northern side has rough pasture for sheep.

Geological System/Age and Primary Rock Type
The bedrock is Lugnaquillia Granodiorite, part of the Lugnaquillia Pluton which is one of the five plutons that comprise the late-Caledonian (405 Ma) Leinster Granite batholith. The granite is cut by slightly younger quartz veins containing lead and zinc mineralization. The contact between the granite and schists of the Lower Palaeozoic Maulin Formation runs through the site immediately east of the 4th Adit.

Main Geological or Geomorphological Interest
St. Kevin's site covers an area of about 5.5 ha that includes 1.3 ha of fine waste or tailings deposited on the northern bank of the Glendasan River. The area was first mined in the 19th century but was reopened by the Wicklow Mining Company in the 1950s. Mining was chiefly on the Foxrock lodes accessed via the 4th Adit at the northwestern end of the site. The Hayes Adit on the south bank of the river was not worked in the 20th century. The 4th Adit is the deepest adit on the Foxrock lode and the main drain for the extensive underground workings in the Foxrock-Hollyrock-Hawkrock area that underlies the valley side north of the Wicklow gap road. The only building of significance on the site is the old processing shed built in the 1950s that contains the remains of some plant equipment including a roll crusher. A 19th Century mess building and what may have been miners' houses can be seen in the area behind the small tailings cells. The St. Kevin's site includes two of the largest mine waste deposits in the Glendalough District, the main spoil heap in front of the adit and the tailings "pond". There is a memorial to a miner who died in the mine during the 1950s.

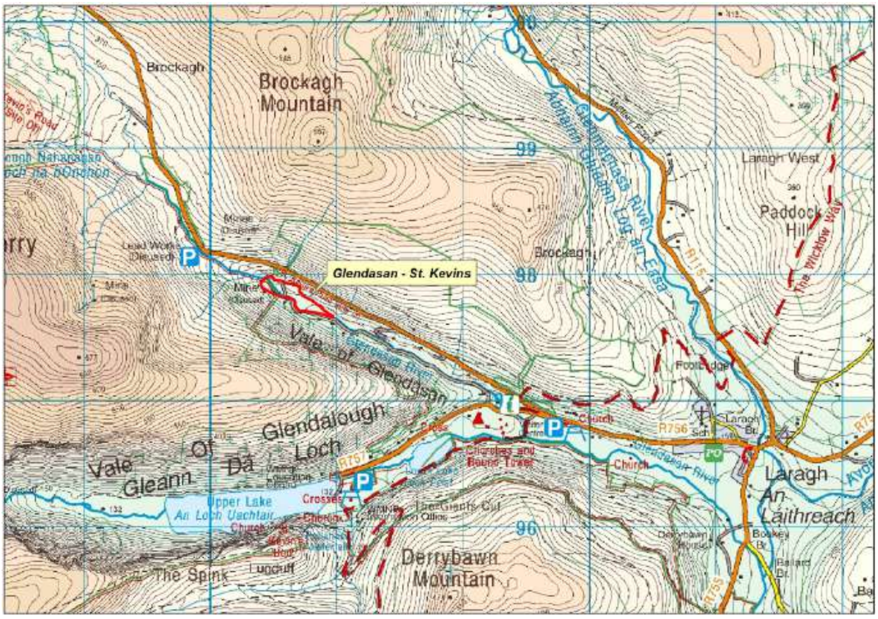
Site Importance – County Geological Site
The St. Kevin's site is unusual in Glendasan because it was the focus of extensive 20th-century mining. It contains significant remains of mine buildings and processing equipment from that era, unlike other sites in the valley. The 4th adit is the main access point for workings on the Foxrock lode.

Management/promotion issues
An unsealed road runs southeast along the river bank from the mine to the monastic site and hotel at Glendalough. The walking route through the valley passes by the site and the site is popular with walkers and sightseers. It is an ideal location for a signboard illustrating aspects of mining on the Foxrock lode in the 19th and 20th centuries.

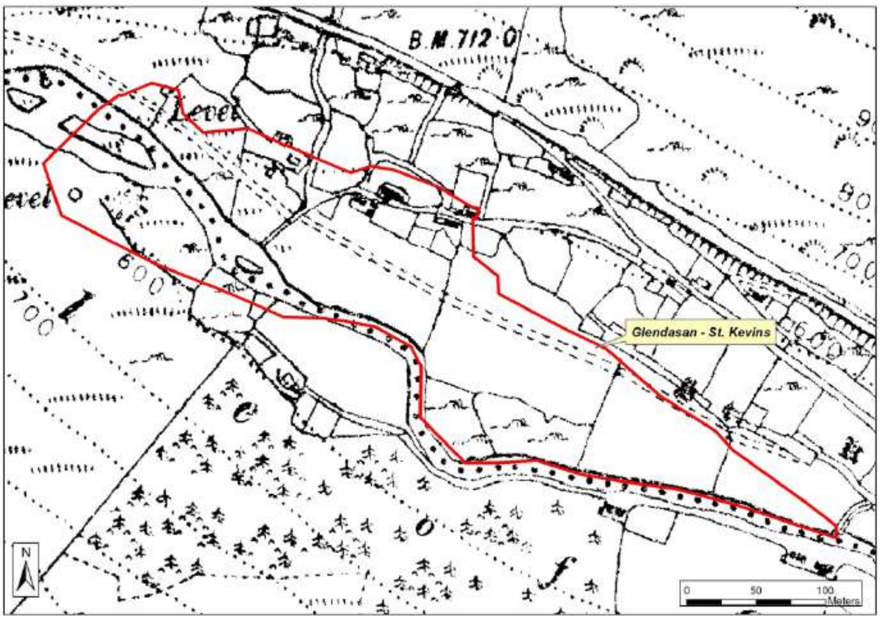
Spoil heaps at St. Kevin's mine site.

Concrete hopper dating from 1950’s mining.

Area of tailings or fine waste material deposited downstream of the mine.


Brockagh
Brockagh Mountain
Glendasan - St. Kevins
Vale of Glendasan
Glendalough
Vale of Gleann Dá Loch
Upper Lake
An Loch Uachtair
The Spink
Derrybawn Mountain
Laragh West
Paddock Hill
Laragh
An Laithreach
The Wicklow Way
R756
Brockagh
Lead Works (Disused)
Crosses
Church
Churches and Round Tower
Footbridge


Glendasan - St. Kevins
N
0
50
100
Meters


B.M. 712.0
Level
600
700
Glendasan - St. Kevins
N
0
50
100
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Tober Demesne**
Other names used for site	The Fish Pond, Gormanstown Group Water Scheme
IGH THEME	**IGH16 Hydrogeology**
TOWNLAND(S)	**Tober Demesne**
NEAREST TOWN/VILLAGE	**Dunlavin**
SIX INCH MAP NUMBER	**15**
NATIONAL GRID REFERENCE	**688527E 703350N (centre of 'fish pond')**
1:50,000 O.S. SHEET NUMBER	**56 GSI Bedrock 1:100,000 Sheet No. 16**

Outline Site Description
At Tober Demesne a spring emerges from deep glaciofluvial gravels and flows into a man-made 'fish pond' feature, before flowing away from the site as a fast-flowing stream. The water supply for much of the area inside the Kildare county boundary to the northwest of the site (the 'Gormanstown Usk' group scheme groundwater supply), is extracted from a shallow borehole at the site, which is adjacent to the spring.

Geological System/Age and Primary Rock Type
The spring emerges from sands and gravels that are of Quaternary age. The depth to bedrock at the spring is greater than 10m, and the bedrock (at depth) is of Silurian age greywacke and shale.

Main Geological or Geomorphological Interest
The Gormanstown Group Water Scheme abstracts 300 m^3 per day (66,000 gallons per day) from a borehole located beside a high yielding spring. The spring (and borehole) is fed by a locally important sand and gravel aquifer. Almost 3,000 m^3 of water per day has been measured to flow out of the spring.

Groundwater levels are close to, or at the ground surface, in the vicinity of the spring and borehole. The topography around the spring forms a horseshoe, which drives groundwater westwards to discharge at the spring which is located at the point where the sand/gravel deposits pinch out.

The groundwater quality at the source is hard to very hard, as the spring extracts from limestone sands and gravels.

Site Importance – County Geological Site
The spring at Tober Demesne is one of the largest springs in County Wicklow, and work completed by the Geological Survey of Ireland has shown that the spring and borehole have a contributing area of several square kilometres. As the site is also a major water supply source, it is also one of the most important hydrogeological sites within the county.

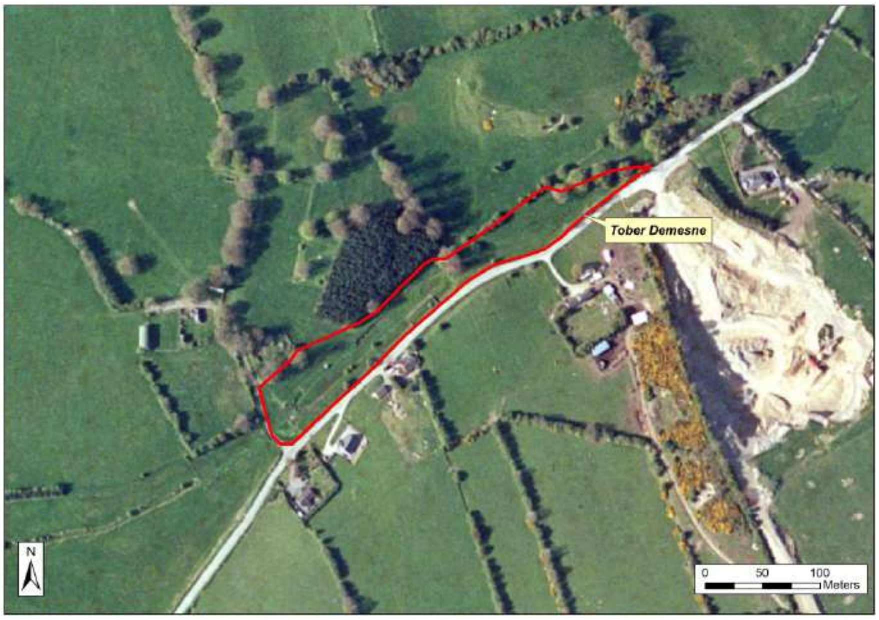
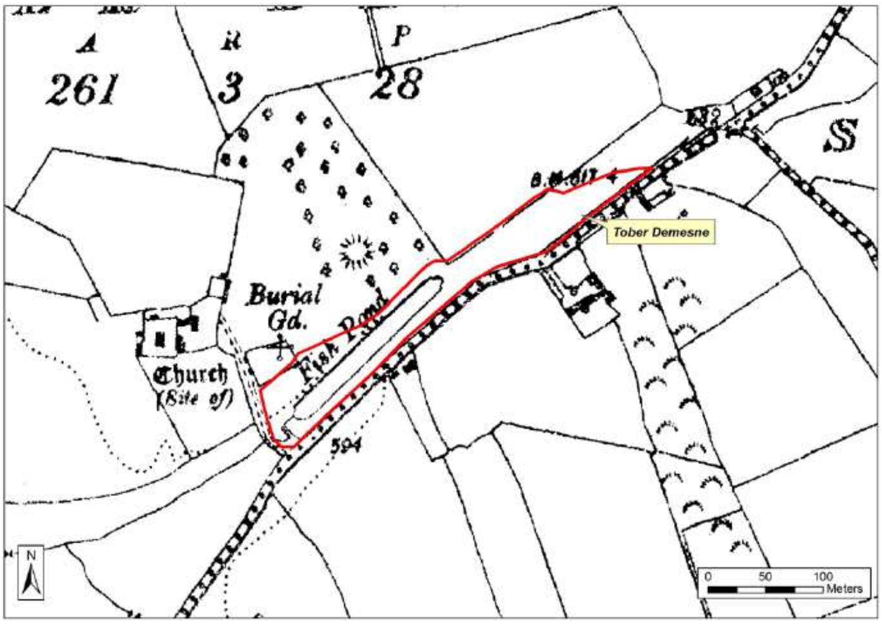
Management/promotion issues
The site is securely fenced off within its own compound, and the 'fish pond' is surrounded by a concrete chamber. Being a secure water supply vulnerable to contamination the general promotion of the locality is not recommended. General education about the vulnerability of 'spring' groundwater supplies to pollution from septic tanks and agricultural slurry spills and bad spreading practices is highly advisable.

The site is easily seen from the roadside and the adjacent ruined church affords good views of the feature, as well as the emergent stream flowing away from it.

The ‘fish pond’, viewed from the road at the northeast.

The water emerging through the fish pond (left), and flowing past the ruined church (right).

Overview of the Gormanstown Usk Group Water Scheme, viewed from the adjacent road.


Gormanstown
Gormanstown Cross Rds
Grange Beg
Wards of Tober
Lemonstown Br.
Lemonstown Cross Rds
Lemonstown
R756
Tober Cross Rds
Tober Demesne
Burial Ground
Sandyhills
Tober Demesne
Kinsellastown
Standing Stone
Barrow
Tober Lower
Lugatryna
R412
R756
Tober Upper
Manofwar
Crehelp
Knockandorr
Railway
Dismantled
Friarhill
Dunlavin
Dún Luáin
PO
Fire Stn
Forristeen
Mound
Blackhill
Barrow
Merginstown
Coll
R412
Milltown
Cross Keys
Grave Yard
Brewershill
Plezica

Tober Demesne
N
0
50
100
Meters

A
261
R
3
P
28
S
Burial
Gd.
Church
(Site of)
Fish Pond
Tober Demesne
N
0
50
100
Meters

WICKLOW - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Woodenbridge Wellfield**
Other names used for site	
IGH THEME	**IGH16 Hydrogeology**
TOWNLAND(S)	**Garnagowlan, Kilcarra**
NEAREST TOWN/VILLAGE	**Woodenbridge**
SIX INCH MAP NUMBER	**40**
NATIONAL GRID REFERENCE	**720480E 676216N (centre of southeastern cluster)**
1:50,000 O.S. SHEET NUMBER	**62 GSI Bedrock 1:100,000 Sheet No. 19**

Outline Site Description
The Woodenbridge Wellfield is the public water supply source for the Arklow area. The source consists of five bored wells which together provide approximately 10,000m^3 of water per day.

Geological System/Age and Primary Rock Type
The wells are between 12.5m and 20.6m deep and are bored into a sequence of alluvial clays, gravels and clays. The alluvial gravels are approx. 10m deep, with the gravels underlain by clay, and the depth to bedrock at the site is greater than 20m.

Main Geological or Geomorphological Interest
Combined, the four boreholes have been proven to be capable of supplying up to 10,000m^3 per day, or 10 million litres of water. Collectively these boreholes are therefore potentially some of the best yielding wells in Ireland.

It is considered that the Arklow River, which is only a few tens of metres from the boreholes laterally, is perched on top of the alluvial clay deposits. Temperature and conductivity readings taken from the well water during a pumping test at Woodenbridge in 2009 suggested that the boreholes were drawing water from the river.

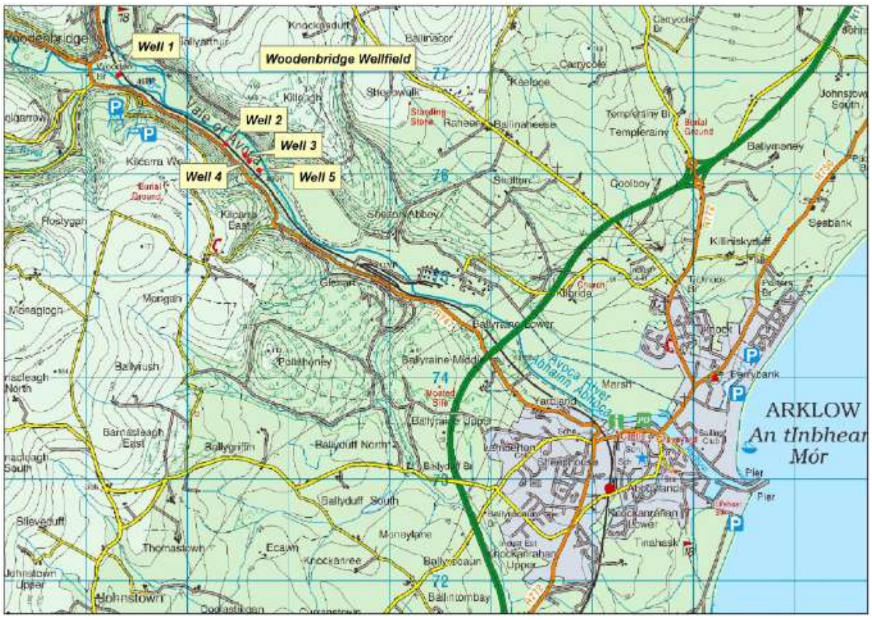
The gravel deposit is therefore acting like a saturated ‘funnel’ of groundwater set in the valley, constrained by high bedrock ridges on either side, and with water levels just below ground level.

Site Importance – County Geological Site
These are exceptionally productive bored wells which are among the top-yielding wells in the country. Four of the boreholes are situated within the Avoca River Valley Proposed NHA (Site Code 001748).

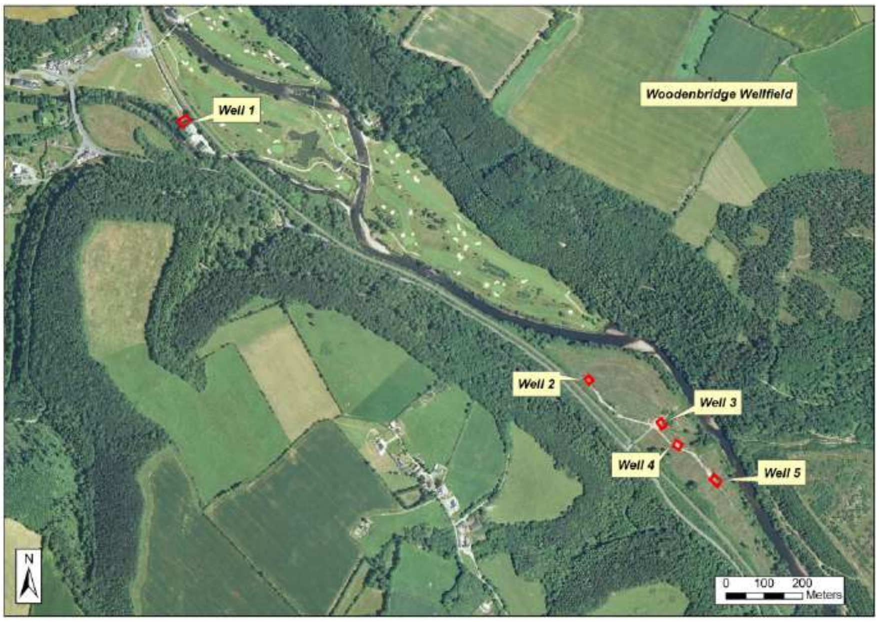
Management/promotion issues
The boreholes are well protected, with secure surrounding fencing and secure concrete, above-ground, chambers containing their caps.

The infrastructure around the northwesternmost borehole, within Woodenbridge Golf Club.

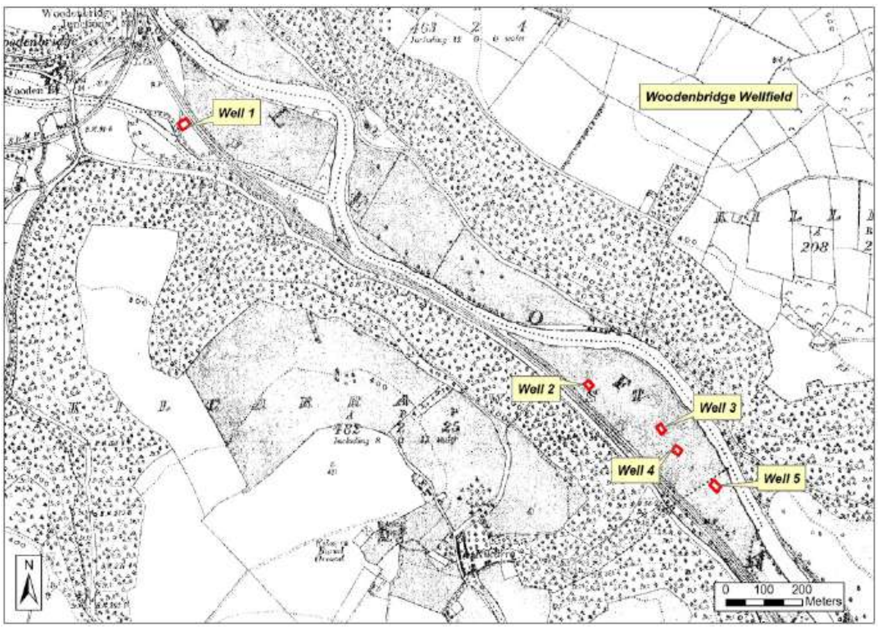
One of the boreholes in the southeastern cluster of four.



Well 1
Woodenbridge Wellfield
Well 2
Well 3
Well 4
Well 5
ARKLOW
An tInbhear Mór



Woodenbridge Wellfield
Well 1
Well 2
Well 3
Well 4
Well 5
N
0 100 200 Meters



Woodenbridge Wellfield
Well 1
Well 2
Well 3
Well 4
Well 5
N
0 100 200 Meters

Theme Site No.	Site Name	County	Sheet No. 6 inch	Sheet No. 1:50,000	ITM Easting	ITM Northing	Principal characteristics Critical feature(s) key words	Townland(s)/district	Ex-ASI site?	Summary description	Definite CGS	NHA?	Definite NHA	Key references	IGH Theme - Primary	IGH Theme - Secondary	IGH Theme- Tertiary
IGH2	Bray Head	Wicklow	8	56	728020E	717060N	Cambrian trace fossils, *Oldhamia* . Type locality of the Cambrian Bray Head Formation.	Newcourt, Ballynamuddagh, Rathdown Upper Tds., Bray	Wicklow #4	*Oldhamia* , Middle Cambrian trace fossil assemblage recorded, including Oldhamia radiata and Oldhamia antiqua. Coastal, cliff path and headland exposures of the type locality of the late Lower - early Middle Cambrian Bray Head Formation. Sedimentary and tectonic structures.	CGS		IGH2-1	Brück. P. M. and Reeves, T. J. 1976. Stratigraphy, Sedimentology and Structure of the Bray Group in County Wicklow and South County Dublin. Proc. R. Ir. Acad., 76B, 53 – 77. McConnell, B. and Philcox, M. E.1994. Geology of Kildare – Wicklow. A Geological Description to accompany the Bedrock Geology 1:100,000 Map Series, Sheet 16, Kildare – Wicklow. Geol. Surv. Ire.	IGH2 Precambrian - Devonian Palaeontology	IGH4 Cambrian - Silurian	
IGH2	Rocky Valley	Wicklow	7	56	723232E	714666N	Cambrian palynology. Microfossils important for the biostratigraphy of the Cambrian Bray Group.	Carrigoona Commons West, Kilmacanogue		Small shallow roadside quarries in the Rocky Valley have yielded a range of planktonic acritarch microfossils, very useful for dating older rock sequences and these provide the best evidence to confirm the Cambrian age for the Bray Group rocks found at Bray Head, Sugar Loaf, Rocky Valley and throughout much of eastern Wicklow. A few trace fossils, called Oldhamia, have also been found, correlating with the Bray Head site where these are best known from. The valley was a meltwater channel at the end of the last ice Age, and is dry today.	CGS		IGH2-3		IGH2 Precambrian - Devonian Palaeontology	IGH7 Quaternary	
IGH2	Slieveroe lane and rail cutting	Wicklow	30	62	721040E	689250N	Ordovician shelly fossils correlating graptolite and shelly fossil zonation schemes.	Slieveroe	Wicklow #2	Mid Caradoc shelly fauna and graptolite fauna in black slates. Slieveroe Townland has a railway cutting which has yielded graptolite fossils from black slates and a laneway which has yielded a rich assemblage of brachiopods and trilobites and other shelly invertebrates. It is important because the association of the faunas allows correlation of two different biozonal schemes which are widely used internationally in correlation of Ordovician rocks. The shelly fossils from the lane include many trilobite and brachiopod species, as well as many other invertebrate groups. It is the type locality for several species.	CGS		IGH2-18		IGH2 Precambrian - Devonian Palaeontology		
IGH4	Great Sugar Loaf	Wicklow	7, 8	56	723710E	713110N	Cambrian quartzites, physical weathering, screes.	Glencap Commons South, Glencap Commons Upper, Glencap Commons North	Wicklow #25	Great Sugar Loaf (501m) is a prominent conical peak of pale-pink Cambrian quartzite, around 7km southwest of Bray. The conical shape contrasts with the rounded summits of the granite mountains to the west. The elevated terrain comprising Great Sugar Loaf, Little Sugar Loaf and Bray Head marks the northern margin of a tectonic slide where Cambrian rocks were thrust up onto Ordovician rocks . This NW directed thrusting occurred during a great mountain building event (Caledonian Orogeny), 475-400 million years ago. The steep upper slopes of Great Sugar Loaf are blanketed with extensive patches of loose angular quartzite boulders (scree) that have physically weathered out, by freeze-thaw action, from the upper summit and rolled downwards to their present locations.	CGS				IGH4 Cambrian-Silurian	IGH7 Quaternary	
IGH4	Luggala	Wicklow	12	56	716996E	707363N	Coticule/ garnetiferous quartzites with intricate folds within the Cambrian Maulin Formation of the Ribband Group.	Ballinastoe		The site is listed because of the occurrence of coticule, an unusual lithology that has received considerable attention both for its complex structure and its mineralogical composition. The principal characteristic of coticule is the presence of abundant equidimensional crystals of garnet, typically a manganese (Mn)-rich type called spessartine. Garnets within coticules are typically fine-grained, generally much less than 1 mm in diameter. In Wicklow, the coticule comprises thin quartzite or psammite beds with abundant spessartine. The coticule layers display complex folding suggesting slumping or deformation prior to final lithification. The enrichment of coticules in Mn has been linked to their possible formation within a seafloor hydrothermal system, and it has been speculated that they may be evidence for possible metal enrichment in Lower Palaeozoic rocks in southeast Ireland. Other origins, including diagenesis, have also been suggested.	CGS			Brindley, J. C. 1954. The garnetiferous beds of the Leinster Granite aureole and their small-scale structures. Scient. Proc. R. Dubl. Soc., 26 (N.S.), 245 – 262. McConnell, B. and Philcox, M. E. 1994. Geology of Kildare – Wicklow. A Geological Description to accompany the Bedrock Geology 1:100,000 Map Series, Sheet 16, Kildare – Wicklow. Geol. Surv. Ireland.	IGH4 Cambrian-Silurian	IGH6 Mineralogy	
IGH4	Wicklow Service Area	Wicklow	19	56	728075E	700910N	Good exposures of the Bray Group rocks.	Cullenmore, Kilmartin Tds, Ashford		This fresh and large exposure of Bray Group rocks gives a more detailed picture of the primary rock lithologies and structure than is apparent in Bray Head or Rocky Valley, as they are only partially exposed sections with mostly thick quartzite units that get left as resistant outcrop.	CGS				IGH4 Cambrian-Silurian		
IGH6	Cloghleagh Mine	Wicklow	5, 6	56	705270E	717160N	Manganese ore in Tertiary fault breccia, worked in 19th century mine.	Cloghleagh, Blessington		The site contains a fault zone with minerals which can be seen close up in the buttress of rock on the escarpment. These are the manganese oxide ores hollandite and cryptomelane. The fault zone is possibly tens of metres wide, with extensive explosive brecciation of quartz veins, in a fault structure is related to faulting around 12 million years ago, also seen at the Deerpark Cave and at Glasnamullen near Powerscourt.	CGS				IGH6 Mineralogy	IGH15 Economic Geology	
IGH7	Glaciofluvial Meltwater Landforms - East and West Wicklow - Overview	Wicklow	3, 5, 6, 7, 8, 9, 10, 13, 15, 16, 18, 19, 21, 24	**56, 62**	701300E	706000N	Overview of glacial drainage in east and west wicklow, from Glacial lakes and a complex system of overflow channels			Just as the hydroelectric dam at Pollaphuca now creates the Pollaphuca Reservoir, the margin of the Midland ice dome created a large, temporary ice dammed lake. And, as the ice was thicker than the present dam, it created a much bigger and deeper lake. The present 270m (900 feet) contour marks the approximate extent of the ice dammed lake. The lake was called Glacial Lake Blessington and the level was controlled by the lowest col which allowed the lake water to spill out and flow southwards along the ice margin. The lake water tumbled over the col at Toor to form the Toor Channel and then along, and under, the ice margin to form the Hollywood Glen meltwater complex. Meltwaters also deposited massive amounts of limestone debris into the lake around this time, in the form of the Blessington Delta. The Upper Lockstown Delta and Athdown Moraine record later, lower delta inflows to the lake. Glacial events in east Wicklow mirrored somewhat those of west Wicklow. Here the extraneous ice was from the Irish Sea Basin, and the major lake which dammed between the mountain ice and the Irish Sea ice was called Glacial Lake Enniskerry. The Enniskerry Delta was deposited into this, and deep channels at The Scalp, in the Dargle River Valley and at the Glen of the Downs were cut by meltwater along the lake margin. Other impressive channels in east Wicklow occur at Dunran and the Devil's Glen. Most of the channels were formed subglacially, but close to the ice margin, and subsequently used as glacial lake outlet channels. Thus the channels and deltas form an integrated suite through which the marginal drainage of the Irish Sea and Midlands ice sheets passed, as the meltwater flowed generally southwards during ice retreat.							
IGH7	Athdown Moraine	Wicklow	6	56	706490E	731780N	Moraine, ice marginal gravels.	Athdown, Ballynabrocky, Ballynatona, Ballylow	Wicklow #3	The sediments and topography reflect the deposition of the feature by meltwater flowing from the mountain ice cap whose margin lay immediately to the east. The feature itself actually comprises a small delta built in front of an earlier-deposited moraine.	CGS				IGH7 Quaternary		

IGH7	Blessington Delta	Wicklow	5	56	698000E	715700N	Glacial palaeo-deltas.	Deerpark, Dillonsdown, Newpaddocks, Blessington, Oldpaddocks, Santryhill, Edmondstown, Hoyvalley, Crosscoolharbour, Haylands Tds, Blessington		The delta is a striking feature, a large sand and gravel accumulation deposited into Glacial Lake Blessington by meltwaters flowing from the large ice dome covering the Irish Midlands at the end of the last ice age. The delta is about 5 kilometres long and up to 1.5 kilometres wide. The sands and gravels are comprised largely of limestone from the Irish Midlands (no limestone bedrock occurs in Wicklow). The sediments in the Blessington Delta are up to 90m deep, some of the thickest glacially-derived sediments in the country. The delta feature is extremely important in unravelling the sequence of terrestrial deglaciation in the northern Irish Midlands at the end of the last ice Age.	CGS		NHA		IGH7 Quaternary		
IGH7	Britonstown	Wicklow	9	56	694596E	708490N	Glacial channel.	Bishopsland (Kildare), Britonstown (Wicklow)		The Britonstown channels are up to 30m deep and have a U-shaped profile, typical of meltwater channels. The base of the channels are dry. The channels are considered to have formed completely in the late-glacial Period. Initially the channels may have been subglacial channels, formed under the ice, but later carried surface glacial outwash from Glacial Lake Blessington to the lowlands to the west. The channels carried large volumes of subglacial meltwater draining the lake which covered the area now inundated by the Pollaphuca Reservoir. This very high energy meltwater flow developed the channels' unusual depth and size. Only half of the southern channel is located in Wicklow; therefore the site extent only covers half of the feature.	CGS				IGH7 Quaternary		
IGH7	Devils Glen	Wicklow	18, 19, 24, 25	56	723800E	699050N	Meltwater channel in bedrock, waterfall, gorge.	Ballymoneen, Birchwood, Ballymaghroe, Tiglin, Boleynass, Boleynass Upper Tds, Ashford	Wicklow #21	The gorge is cut through Early Cambrian (c. 520 million years ago) bedrock consisting of greywackes and shales (Bray Group). The gorge is a glacial meltwater channel (Quaternary) and formed around the time of deglaciation at the end of the last Ice Age	CGS				IGH7 Quaternary	IGH14 Fluvial/Lacustrine Geomorphology	IGH4 Cambrian-Silurian
IGH7	Dunran Channel	Wicklow	19	56	727080E	702590N	Meltwater channel.	Dunran, Moorstown, Carrignamuck, Killiskey, Ballyduff		The Dunran channel is up to 80m deep and has a U-shaped profile, typical of meltwater channels. It is considered to have formed completely in the late-glacial Period. Initially the Dunran Channel was a subglacial channel, formed under the ice, but later carried surface glacial outwash southwards from an ice margin just to the north. The channel carried huge amounts of subglacial meltwater draining the ice sheet which extended into Wicklow from the Irish Sea Basin. This very high energy meltwater flow resulted in the Dunran Channel's unusual depth and size.	CGS				IGH7 Quaternary		
IGH7	Enniskerry Delta	Wicklow	3, 4, 7, 8	56	723500E	717600N	A deglacial, ice marginal, meltwater-deposited delta feature.	Fassaroe, Enniskerry		The delta is a striking feature, a large sand and gravel accumulation deposited into Glacial Lake Enniskerry by meltwaters flowing from ice of the large glacier which occupied the Irish Sea and encroached inland into Wicklow, as it stood between Carrickgollogan and Bray Head. The delta was built out from this ridge into the lake, the surface of which was at about 100m above present sea level. The delta surface at this level can be viewed from the road from Old Connaught to Enniskerry, where one gets an impression of this large, level surface dissected by the small stream that flows from the mouth of The Scalp. The delta is just under 3 kilometres long and up to 2.5 kilometres wide, covering an area of approximately 6 square kilometres. The 'sands and gravels' are comprised largely of limestone from the Irish Midlands (no limestone bedrock occurs in Wicklow).	CGS				IGH7 Quaternary		
IGH7	Glen Ding	Wicklow - Kildare	5	56	696260E	715600N	Glacial valley, overflow channel	Deerpark (Wicklow) Athgarret, Newtownpark (Kildare)	Wicklow #47	Glen Ding is up to 50m deep and has a U-shaped profile, typical of meltwater channels. The base of the channel is dryThe channel is curved at the southern end, opening up into an area of deep glacial sediments. Glen Ding probably formed following the deposition of the majority of the Blessington Delta Complex into Glacial Lake Blessington, prior to full withdrawal of glacial ice from the area. The highest point of the channel is at the northern end, which suggests that it was an overflow channel rather than a tunnel valley, at least in its final stages of development.	CGS				IGH7 Quaternary		
IGH7	Glen of the Downs	Wicklow	8, 13	56	725990E	711250N	Glacial overflow channel	Bellevue Demesne, Woodlands	Wicklow #7	The Glen of the Downs is considered to have formed completely in the Late-Glacial Period. Initially the glen was a subglacial channel, formed under the ice, but later carried surface glacial outwash from Glacial Lake Enniskerry southwards. As well as this, the channel carried huge amounts of subglacial meltwater draining the ice sheet which extended into Wicklow from the Irish Sea Basin. This very high energy meltwater flow resulted in the Glen of the Downs' unusual depth and size.	CGS	NHA?			IGH7 Quaternary		
IGH7	Glendalough Valley	Wicklow	23	56	709154E	696318N	Delta, hanging valley, U-shaped valley. Lead-zinc mineralization in Leinster Granite. Pollanass waterfall, glacial mountain erosional inheritance.	Sevenchurches, Lugduff, Derrybawn, Brockagh Tds, Laragh	Wicklow #6, Wicklow #23	Glendalough is a marvellous example of a glaciated U-shaped valley, with oversteepened cliff sides and a flat floor. At the mouth of the glen where it meets Glendasan is a delta, which formed at the end of the last Ice Age in a lake that reached a higher level than either of the present lakes. Above the delta, to the north, is a fine medial moraine deposited between the ice of the Glendalough and Glendasan glaciers as they decayed during deglaciation. The two lakes at Glendalough are separated by a broad, low alluvial fan deposited by water from the high level valley to the south of Glendalough. At the upper end of the Upper Lake, at the so-called "Miners Village", is a modern delta building out into the lake, which is in turn gradually shrinking in size. The "Miners Village" was in fact a processing area for ore mined from the Luganure lode that runs northwards through Camaderry mountain to Luganure in Glendasan. Adits were driven northwards along the lode in the 1850s to connect with those driven earlier southwards from Luganure. A crusher plant was built and ore produced in Luganure was then brought to the Glendalough site for processing. Between 1913 and 1925 a small operation was run to recover Pb (lead) from the waste rock in the valley. Mine features include several adits, the ruins of the Roll Mill house, forge and offices as well as a stone hopper (ore bin/chute) and cobbled dressing floor. A small 20th-century roll crusher presumably dates from the period between 1913 and 1925 when waste was reworked to extract Pb. The Van Diemen's site, which was linked to Glendalough by a tramway, contains numerous small waste heaps, the remains of a crusher house and office, several flooded shafts and a collapsed adit. The rare mineral Pyromorphite has been found in the dumps here. The contact between the granite and its wallrocks is well exposed at the eastern end of the site.	CGS		NHA		IGH7 Quaternary	IGH14 Fluvial/Lacustrine Geomorphology	IGH15 Economic Geology

IGH7	Glenmacnass Valley	Wicklow	17	56	711450E	702808N	Granite, schists, moraines, U-shaped valley, upland morainic landscape. Meanders, waterfall, boulder beds, bedrock channel. Leinster Granite contact with Ordovician sediments.	Laragh, Drummin, Brockagh	Wicklow #24	Glenmacnass is a stunning example of a glaciated U-shaped valley, with oversteepened cliff sides and a flat floor. The valley contains a number of moraines marking positions of the ice front as it retreated back towards the source area of the ice in the centre of the mountains. An especially impressive moraine occurs about half way between the waterfall and Laragh and can be seen as a boulder-strewn mound running right across the valley. The waterfall on the Glenmacnass River has three staggered drops along a vertical distance of about 80m, and falls across whitish to grey-coloured, smooth granite bedrock. On each side of the waterfall further down-valley, dark grey to black, jagged schist rock can be seen cropping out. The waterfall has therefore formed at the boundary between these two rock types. The river flowing down the valley has beautiful meander bends and small islands within it, typical of a river depositing much of its load within and across its floodplain.	CGS	NHA?			IGH7 Quaternary	IGH14 Fluvial/Lacustrine Geomorphology	IGH11 Igneous intrusions
IGH7	Glenmalure	Wicklow	22, 23, 2	56	707130E	693610N	Glenmalure is a spectacular example of a glaciated U-shaped valley.	Camenabologue, Conavalla, Baravore, Ballinagoneen, Ballinaskea, Cullentragh, Clonkeen, Ballinafunshoge, Corrasillagh, Carrawaystick, Clohernagh, Ballyboy, Drumgoff, Carriglinneen, Fananierin, Kirikee, Ballinabarny, Ballinacor Tds, Rathdrum	Wicklow #10	Glenmalure is a spectacular example of a glaciated U-shaped valley, with oversteepened cliff sides and a flat floor. Glenmalure is straight, steep-sided, and rocky, just under 20 kilometres long, 800m wide and up to 350m deep. The base of the valley hosts a number of cross-valley moraines, as well as particularly fine lateral moraines along the southwestern side of the valley. Outwash deposits floor the lower end of the valley, from Greenan as far as Avoca. There are abandoned mine sites at Ballinafunshoge, half-way along the valley, and at Baravore and Ballinagoneen near the head of the valley. The Ballinafunshoge site, which contains two adits, a shaft and large areas of mine, was in operation by 1800, one of the first sites to operate in the Glendalough-Glenmalure district. At Baravore, five well-defined adits, the remains of two crusher houses and a reservoir can be observed. The Ballinagoneen site contains three spoil heaps below two adits with a third adit apparently hidden beneath spoil. These adits appear to have been exploration rather than production adits, as there is no record of any ore output from Ballinagoneen.	CGS		NHA		IGH7 Quaternary	IGH15 Economic Geology	
IGH7	Greystones Beach	Wicklow	8	56	728770E	713920N	Glacial morainal bank, coarse grained diamict.			This sequence of sediments is one of the most renowned in Irish Quaternary literature and has been controversially interpreted as 'glaciomarine' in origin (i.e. deposited under a floating ice sheet in the sea) by some academics. However, the general consensus is that the sediments are the product of a terrestrial ice sheet, interpreted as 'subglacial' tills deposited at the base of an ice sheet on land. They now form part of a prominent moraine ridge in the cliff.	CGS	NHA?			IGH7 Quaternary		
IGH7	Hollywood Glen	Wicklow	15	56	693060E	701650N	Meltwater, channels, flood tracks.	Athgreany, Drumreagh, Conlans, Woodenboley, Mullycagh, Kilbaylet Tds, Hollywood	Wicklow #27	Hollywood Glen is up to 60m deep and has a U-shaped profile, typical of meltwater channels. Hollywood Glen is considered to have formed completely in the late-glacial Period. Initially the glen was a subglacial channel, formed under the ice, but later carried surface glacial outwash from Glacial Lake Enniskerry southwards. As well as this, the channel carried huge amounts of subglacial meltwater draining the ice sheet which also covered the Irish Midlands. This very high energy meltwater flow resulted in Hollywood Glen's unusual depth and size.	CGS	NHA?			IGH7 Quaternary		
IGH7	Kippure	Wicklow	2, 6	56	711500E	715490N	Peat hags and erosion.	Powerscourt Mountain, Kippure, Castlekelly, Enniskerry		Above heights of c. 740m, the near-flat summit of Kippure is devoid of significant peat accumulations. The summit hosts a blockfield of rounded granite boulders that lie embedded in grus (crumbled sandy granite). Below the 740m contour, areas of blanket peat are extensively eroded. Deep peat gullies, sub-peat pipes, solitary peat hags (haggs), and collapsing peat banks characterize much of the upper mountain slopes. Where peat has eroded fully, granite bedrock is exposed, with thick accumulations of grus, or granite sand (quartz, feldspar, mica) overlying the bedrock. Peat erosion has been a continual process in Wicklow for over 3,000 years, and is not considered to be attributed solely to recent human disturbance. Peat erosion is considered to be a natural consequence of the accumulation of peat on sloping ground.	CGS				IGH7 Quaternary		
IGH7	Lough Bray	Wicklow	6	56	713405E	715950N	Corries.	Powerscourt, Glencree	Wicklow #8	These corries have almost-vertical backwalls up to 200m in height. Two tarns (glacial lakes) floor the features and the corries and lakes are bounded on their eastern sides by a series of impressive moraines. These have been dissected by Holocene (post-glacial) streams draining the lakes.	CGS	NHA?			IGH7 Quaternary		
IGH7	Lough Dan, Lough Tay and Cloghoge River	Wicklow	11, 12, 1	56	715250E	703650N	Ribbon lakes.	Cloghogue, Carrigeenshinnagh, Carrigeenduff, Ballinrush, Carrigroe, Ballinastoe Tds, Roundwood	Wicklow #29	Wicklow's mountainous terrain was covered by the vast Wicklow Ice Dome during the Late Glacial Maximum (c. 25,000 to 22,000 years ago). From the ice dome, a large glacier flowed through the Lough Dan valley. This glacier was joined by another glacier moving south from above Lough Tay through the Cloghoge Valley. When the two glaciers merged, they continued as one into the southern reaches of the Lough Dan valley. When the ice sheets retreated, meltwaters remained on the valley floors, forming Lough Dan and Lough Tay. Lough Dan is a classic ribbon lake occupying the floor of a U-shaped glacial valley. At Luggala Lodge, the Cloghoge River meanders across flat 'delta' draining into Lough Tay. Mass wasting (boulder debris) is abundant at the foot of the eastern slopes of Luggala (595m). Large debris slumps are visible at the western side of the valley where landslides occurred when ice retreated from this over-deepened glacial valley.	CGS				IGH7 Quaternary	IGH14 Fluvial/Lacustrine Geomorphology	
IGH7	Lough Nahanagan	Wicklow	17	56	707900E	699000N	Lake in a steep-sided corrie. A dated moraine - Younger Dryas. Need to see at low water in the lough.		Wicklow #52	This corrie has an almost-vertical backwall up to 240m in height. A tarn (glacial lake) floors the feature and the corrie and lake are bounded on their northeastern side by a series of moraines, which have been dissected by a Holocene (post-glacial) river draining the lake. Small moraines sit on top of a very large and impressive moraine feature, which dams the lake. Many of the smallest moraines are drowned by the lake water. The smallest, underwater moraines were dated to the 'Younger Dryas', which was a cold snap at the end of the last glacial period. This period is therefore termed the Nahanagan Stadial in Ireland. They can be seen when the water levels in the lake are low following pumping to the upper reservoir of the Turlough Hill electricity pumped-storage system which the lake now forms part of. Much of the granite bedrock around the lake has been moulded by glacier ice, and shows striations, chattermarks, roche moutonnées and whaleback forms.	CGS	NHA?			IGH7 Quaternary		
IGH7	Lough Ouler	Wicklow	17	56	709030E	702270N	Corrie.	Laragh	Wicklow #9	This corrie has an almost-vertical backwall up to 210m in height. A tarn (glacial lake) floors the feature and the corrie and lake are bounded on their eastern side by a moraine, which has been dissected by a Holocene (post-glacial) river draining the lake. The moraine comprises well-drained, bouldery material, and the area around and east of Lough Ouler is littered with large erratic boulders up to 15m across.	CGS				IGH7 Quaternary		

IGH7	Lugnaquilla	Wicklow	22, 23	56	703140E	691810N	Glacial features, e.g. Nunataks. Protalus ramparts. Includes Kelly's Lough, southern side of Luqnaquilla, with cosmogenic dates. Kinahan - protalus ramp. "Snowstones" -	Ballinaskea, Cloonkeen, Corrasillagh, Carrowaystick, Aghavannagh, Aghavannagh Mountain, Lugnaquilla, Cannow Mountain Tds, Donard	Wicklow #10	Lugnaquilla (925m) is a slate capped, granite rooted, relatively flat-topped mountain. The summit drops west into North Prison corrie, south into South Prison corrie, and north into Fraughan Rock Glen (a hanging valley that opens into the U-shaped valley of Glenmalure). Viewed from the summit, crags of dark-grey schist protrude from the upper cliff walls of the corries. In 1894, G.H. Kinahan first described accumulations of loose rocks on the floor of the North and South Prisons called 'snowstones' or 'cloghsnatty', today internationally called 'protalus ramparts' (these form at the foot of ice/snow banks). The cap of schist overlying the granite is the remnant roof of the magma chamber into which the Lugnaquilla granites were emplaced. Cosmogenic (10Be) dating on exposed bedrock at the summit reveals that the schists were not covered by ice during the last glacial maximum (LGM, 25,000-22,000 years ago), and have been exposed to the elements for between 46,000 years and 96,000 years. This type of mountain top feature is called a nunatak.	CGS		NHA		IGH7 Quaternary		
IGH7	Manger - Saundersgrove	Wicklow	21	62	688170E	692680N	Palaeo-deltas.	Manger, Stratford, Saundersgrove Tds, Baltinglass		The delta is a striking feature, a large sand and gravel accumulation deposited into a lake in the locality by meltwaters flowing from glacier ice on the western side of the Wicklow Mountains, at the end of the last ice age. The delta was built out into a lake, the surface of which was at about 170m above present sea level. The delta surface at this level can be clearly viewed from the N81 road just north of Manger Bridge. The delta is about 2 kilometres long and up to 0.5 kilometres wide. The delta feature has been dissected by the River Slaney, and is hence seen on both sides of the valley.	CGS				IGH7 Quaternary		
IGH7	Mottee Stone	Wicklow	35	62	720582E	683289N	Large erratic boulder.		Wicklow #31	A large erratic carried from Glenmalure, by the Brittas glaciation, to the Meeting of the Waters. The bedrock in the site comprises Ordovician volcanic rocks and associated sediments, which host the adjacent volcanic massive sulphide minerals mined in the immediate vicinity and district. The Mottee Stone itself is made of granite, and is 13 km away from the nearest likely source around Glenmalure. Striae in the locality indicate that ice passed from northwest to southeast from the mountain ice cap, down Glenmalure and the Avonbeg Valley, and swept out into the Irish Sea Basin. The Mottee Stone was deposited in this fashion by glacier ice.	CGS				IGH7 Quaternary		
IGH7	Mullacleevaun	Wicklow	11, 17	56	706690E	707060N	Peat hags and erosion.	Ballynultagh, Glenbride, Ballinagee, Laragh West, Drummin, Carrigeenduff Tds, Laragh		Areas of high-level blanket peat on Mullaghcleevaun (849m), Mullaghcleevaun East Top (795m) and Ballacullian (715m) show extensive erosional damage. Isolated peat hags and peat banks are found throughout the site, as are deep gullies in peat, and sub-peat pipes. Where peat has eroded severely, the underlying granite is exposed, in most places as granite sand (quartz, feldspar, mica). Peat erosion has been ongoing in Wicklow for over 3000 years, and is therefore not solely attributed to recent human disturbance. Studies have revealed that erosion began before most human and biotic factors began.	CGS				IGH7 Quaternary		
IGH7	Powerscourt Waterfall	Wicklow	7	56	719573E	712093N	Steep 100m waterfall flows over backwall of a corrie.	Deerpark, Enniskerry	Wicklow #12	The Powerscourt corrie is a fine example of glacial erosion, where accumulated ice has scoured out a deep basin, with a steep backwall. The waterfall in the back of the corrie flows over Ribband Group schists in the metamorphic aureole of the Leinster Granite. The cleavage (or schistosity) dips steeply outwards, paralleling the sides of the granite pluton. This forms the surface over which the water cascades. The contact between schist and granite is some distance upstream of the waterfall.	CGS				IGH7 Quaternary	IGH14 Fluvial/Lacustrine Geomorphology	
IGH7	River Dargle Valley	Wicklow	7	56	723380E	716400N	Gorge, formed as subglacial meltwater channel.	Tinnehinch, Cookstown, Kilcroney, Newtown Tds, Enniskerry	?Wicklow #20	The River Dargle gorge is one of several spectacular subglacial meltwater channels cut into solid bedrock in north Wicklow. This deeply incised landscape feature was formed when high pressure waters, flowing at the base of the overlying ice sheet, cut into and eroded solid bedrock. The gorge is up to 60m deep below Lovers Leap. Much of the Dargle valley, like that of the Cookstown River to the north, is drift-filled. After it passes 1km east of Tinnehinch Bridge, the river cuts into a ridge of quartzite and becomes constricted into a wooded rocky gorge. At the floor of the gorge, the riverbed steepens, cascading over greywacke and quartzite bedrock, and continues on to Dargle Bridge where it is joined by the waters of the Cookstown (Glencullen) River, and henceforth to the sea at Bray.	CGS				IGH7 Quaternary	IGH14 Fluvial/Lacustrine Geomorphology	
IGH7	Snugborough	Wicklow	40	62	724348E	678350N	Fossil Pingo	Snugborough, Avoca		The pingo rampart at Snugborough comprises a raised, circular feature which is evidence of the very cold conditions following deglaciation of the locality at the end of the last Ice Age. The feature indicates that permafrost conditions occurred here, meaning the ground was frozen throughout the year. The pingo was formed when upwelling groundwater froze underground in the permafrost zone, accumulating to form a small, ice-cored hill which grew like a pimple, pushing up the glacial sediments as its outer skin. In melting, the sediments slumped to the side to form the rampart, and a deep hollow was left where the ice core once was.	CGS			Mitchell, G. F. (1971) Fossil pingos in the south of Ireland. Nature, Volume 230, 43-44.	IGH7 Quaternary		
IGH7	The Scalp	Wicklow-Dublin (-DLR)	Wicklow 3, Dublin 26	50, 56	712552E	720214N	The best and most accessible glacial outwash channel in the Dublin area.	Barnaslingan (Dun Laoghaire-Rathdown), Killegar (Wicklow)	Wicklow #15	A dry valley with block scree on both sides. The Scalp channel is up to 70m deep and has a U-shaped profile, typical of meltwater channels. The base of the channel is dry. The Scalp is considered to have formed completely in the late-glacial Period. Initially the Scalp was a subglacial channel, formed under the ice, but later carried surface glacial outwash into Glacial Lake Enniskerry from an ice margin just to the north. The channel carried huge amounts of subglacial meltwater draining the ice sheet which covered the Irish Midlands close to its zone of convergence with Irish Sea Basin ice. This very high energy meltwater flow resulted in the Scalp's unusual depth and size.	CGS	NHA?			IGH7 Quaternary		
IGH7	Toor Channel	Wicklow	33	56	694340E	703585N	The site of a glacial spillway which was once the highest outlet of Lake Blessington.	Scalp, Toor, Drumreagh, Dunboyke Tds, Hollywood	Wicklow #37	The Toor Channel is up to 40m deep and has a U-shaped profile, typical of meltwater channels. The base of the north-south portion of the channel is dry, but the Toor Brook flows westward along the east-west stretch south of this. The Toor Channel is considered to have formed completely in the late-glacial Period. Initially the glen was a subglacial channel, formed under the ice, but later carried surface glacial outwash from Glacial Lake Enniskerry south and westwards. As well as this, the channel carried huge amounts of subglacial meltwater draining the ice sheet which also covered the Irish Midlands. This very high energy meltwater flow resulted in the Toor Channel's unusual depth and size. The intake point for the Toor Channel, which acted as the outlet to Glacial Lake Blessington, lies at approximately 270m above sea level, which means the channel acted as a lake outlet at the time of the formation of the Blessington Delta.	CGS	NHA?			IGH7 Quaternary		

IGH7	Upper Lockstown Delta and Kings River	Wicklow	16	56	698330E	702570N	Meanders, oxbows, delta, palaeo-terraces, palaeo-deltas, glacifluvial sedimentary inheritance, glacial mountain erosional inheritance.	Lockstown Upper, Granmore Tds, Hollywood	Wicklow #16	The delta is a striking feature, a large sand and gravel accumulation deposited into Glacial Lake Blessington by meltwaters flowing from ice of the large ice dome covering the Irish Midlands at the end of the last ice age, while its margin lay to the west of the valley between Slievecorragh and Corriebracks Mountain. The delta surface here is much lower than at Blessington and Athdown, and relates to a lowering of the lake level following a shift in the location of the ice margin (probably related to the downcutting of Hollywood Glen). The delta is about 2.5 kilometres long and up to 1 kilometre wide. The sands and gravels are comprised largely of granite from the Wicklow Mountains. The modern day Kings River is eroding the delta feature, resulting in some prominent scarps on the side of the feature, as well as superb meanders, ox-bow lakes, point bars, freshly-cut banks, and a perfect example of a Holocene floodplain.	CGS	NHA?			IGH7 Quaternary	IGH14 Fluvial/Lacustrine Geomorphology	
IGH11	Aughrim Quarry	Wicklow	34	62	713998E	680662N	Microgranites later than Leinster Granite.	Tinnakilly		The Aughrim Granite is a sheet-like intrusion, up to 400 m wide and almost 3 km long, just east of the town of Aughrim. It was emplaced under static conditions after the main phase of late-Caledonian deformation, unlike the slightly older Leinster Granite batholith which was emplaced at least partly during deformation. The granite is one of a number of granodiorite intrusions between Aughrim and Ballinaclash and is considered to be part of a more extensive suite of contemporaneous minor intrusions in the region.	CGS				IGH11 Igneous Intrusions		
IGH11	Camaderry Appinite	Wicklow	23	56	710281E	696895N	Appinite (igneous intrusion).	Seven Churches or Camaderry, Laragh		Almost 20 Caledonian appinite bodies have been described from southeast Ireland and the Camaderry Appinite is the best known and best exposed example in the region. Appinites are ultrabasic rocks, possible fragments of the mantle that have been emplaced in the upper crust during the Caledonian orogeny.	CGS			Thomson, J.A, 1903. QJGS,256, V64, 475-495	IGH11 Igneous Intrusions		
IGH11	Greystones (Appinite)	Wicklow	8	56	729690E	712610N	Appinite suites (igneous intrusions).	Rathdown Lower, Greystones Harbour		Part of a suite of Late Caledonian appinite intrusions associated with the Leinster Granite, the appinites were intruded (squeezed into bedrock or crust) into the greywackes around 405 million years ago. Appinites are ultrabasic igneous rocks that crystalise from molten magma that is rich is water. The intrusion appears as two sills that are separated by a U-bend fold (syncline) in the greywackes, and roughly follows the same bedding patterns of the greywackes. The appinitic rocks comprise dark medium-to-coarse textured rock composed of the minerals hornblende and biotite, set in a groundmass of the minerals plagioclase, orthoclase, and quartz. Contact (thermal) metamorphism is evident in the greywacke rocks alongside and in contact with the appinites.	CGS			Thomson, J.A, 1903. QJGS,256, V64, 475-495	IGH11 Igneous Intrusions		
IGH11	Kilmacurra Quarry	Wicklow	30	62	724682E	688471N	Disused quarry in Carrigmore Diorite suite.	Kilmacurra West, Rathdrum		The Carrigmore Diorite suite comprises a series of igneous intrusions of intermediate composition, i.e. a chemical and mineralogical composition intermediate between granite and gabbro. Diorite intrusions occur widely in Ireland but the Carrigmore suite is unusual for the size and internal complexity of the intrusions. Diorite is a relatively hard rock, suitable for aggregate and concrete manufacture, and several quarries have been developed in the Carrigmore suite, including those at nearby Ballinclare and Parnell Quarry near Rathdrum.	CGS						
IGH11	Lough Dan Granite Contact	Wicklow	17, 18	56	714300E	704650N	Leinster Granite contact with Ordovician sediments.	Cloghogue, Carrigeenduff Tds, Roundwood		At the northwestern end of Lough Dan, where the Inchavore River flows into the lake, the contact of the Devonian granites (to the west) with the Ordovician schist (to the east) is easy to recognise on the mountain sides. The contact, where two very different rock types (igneous and metamorphic) of different ages are found side-by-side, marks the eastern margin of the Leinster Granite in this part of the Wicklow Mountains. This contact zone is called a metamorphic aureole, which formed when heat and pressure of the rising granite 'baked' and altered the mineralogy of the slate bedrock into which it was intruded.	CGS				IGH11 Igneous Intrusions		
IGH12	Glasnamullen	Wicklow	12	56	719900E	709480N	Tertiary fault breccia in 150 m stream section.	Glasnamullen, Roundwood		The site comprises the exposures of a breccia deposit created by a major fault which moved in the Tertiary Period, approximately 12.1 million years ago. Evidence of such faulting is rarely seen, except through interpretation of outcrop patterns. This site and the Powerscourt Deerpark cave site are both surface outcrops providing direct faulting evidence. The movement on this Shankhill Fault Zone has been dated elsewhere, at Cloghleagh Mine, by radiometric method, using the isotopes of 40Argon/39Argon. The breccia at Glasnamullen is a part of the same fault zone.	CGS			Jordan & Jones IJES 2005, 23.	IGH12 Mesozoic/ Cenozoic		
IGH12	Powerscourt Deerpark Cave	Wicklow	7	56	720285E	711500N	Natural cave in Tertiary fault breccia	Deerpark, Enniskerry		This cave is the only known natural cave in Wicklow, though it has been modified by channelling the downstream end into a conduit underneath the forest road. It is rare to find caves in Ireland formed in geological settings other than karstic limestone, and this cave is part water-eroded and possibly part tectonic fissure. It is formed within a breccia deposit created by a major fault which moved in the Tertiary Period, approximately 12 million years ago, and evidence of such faulting is rarely seen, except through interpretation of outcrop patterns. This site and the Glasnamullen site both show surface outcrops that provide direct evidence of faulting.	CGS	NHA?		Jordan & Jones, 2004/5, IJES 23, 47-54.	IGH12 Mesozoic/ Cenozoic		
IGH13	Wicklow - Greystones coast	Wicklow	11	56	731670E	703870N	Shingle coast with overwash features.	Wicklow, Greystones		The low and flat terrain coastal landscape between Greystones and Wicklow town is underlain by Cambrian bedrock, which is not widely exposed between the two towns. Wicklow Head is a bold headland of slopes descending to rocky cliffs of grey schist. At Greystones, Cambrian greywacke rocks outcrop along the esplanade coastline. Between the two towns is 'the Murrough'. This 15km long coastal wetland area borders the Irish Sea with an uninterrupted shingle ridge consisting of smooth rounded pebbles interspersed with sand particles. Sediment size increases from north to south, being dominated by sand along its northern stretch near Greystones, and by larger pebbles nearer Wicklow. The variation is understood to be a result of wave-induced grading of the ridge deposits by longshore drift.	CGS	NHA?			IGH13 Coastal Geomorphology		
IGH14	Ballydonnell	Wicklow	11	56	706030E	710330N	Gravel bars, glacial mountain erosional inheritance.	Ballynultagh, Ballydonnell South Tds, Blessington		Tributary of the River Liffey, floodplains and terraces by the deposition of alluvial sediments	CGS				IGH14 Fluvial/Lacustrine Geomorphology		
IGH14	Glencullen River	Wicklow	7	56	721699E	718000N	Mass wasting: slumps in a river gorge	Knocksink, Monastery, Killegar, Ballybrew, Parknasilloge Tds, Enniskerry		The valley floor is partially filled with glacial till and glaciofluvial gravels. Slope instability and mass movement (mass wasting) is confined to the glacial drift materials and several different styles of slope failure occur along the valley, which themselves are controlled by drift topography and the bedrock surface underlying the drift. Slope instabilities have resulted from the excavation by the post-glacial (in the last c. 12,000 years) Glencullen River of a new valley in the drift, and slope failures occur on the steep slopes of this 'new' valley. The different types of failure vary from shallow to deep landslips, to steep bluff (cliff) failures where bluffs are undercut by the river (Knocksink Wood area), to earthflows (Ballybrew area).	CGS				IGH14 Fluvial/Lacustrine Geomorphology		

IGH14	Upper River Liffey	Wicklow	6	56	709450E	713210N	Gravel bars (Sean's Bar), palaeo-terraces, glacial mountain erosional inheritance, glacial sedimentary inheritance.	Ballynabrocky, Powerscourt Mountain, Ballinastoe, Kippure Tds, Blessington		Radiocarbon dating, dendrochronology (tree-ring dating), and pollen analysis have all contributed to give ages for the river terraces (repeated layers of sandy alluvium with layers of soil) in the upper Liffey floodplains. The oldest floodplain terrace (mid-Holocene) formed between 8000 and 3000 years ago. The younger Holocene terrace accumulated between 2000 and 500 years ago. Modern floodplain sediments accumulated between 1650 AD and 1850 AD.					IGH14 Fluvial/Lacustrine Geomorphology	IGH7 Quaternary	
IGH15	Avoca District - Overview	Wicklow	35	62	720200E	682700N	Avoca is the largest and best example of a VMS deposit in Ireland. Its mine heritage is extensive and varied, with some unique elements in an Irish context.	Connary, Cronebane, Ballygahan, Ballymurtagh, Sroughmore, Tigroney West Tds, Avoca		Avoca has a long history amongst mine sites in Ireland. Numerous 18th- and 19th-century mine features remain on the site, including engine houses, adits, and shafts, including some that appear to be unique in Ireland, such as the tramway arch, flatrod tunnels and ochre pits. These pre-20th century features are more numerous and varied at Avoca than at any other mine in Ireland. The large-scale mechanized mining of the 20th century, especially excavation of open pits, has altered the site significantly, creating potential hazards for visitors, but has also helped create an interesting and varied landscape. Avoca is the best example of volcanic massive sulphide (VMS) copper deposits in Ireland and the remaining examples of mineralisation on the site are of significant scientific interest. Avoca is also the only mine site in Ireland with significant acid mine drainage (AMD). This AMD is generated by the reaction between rainfall and the pyritic ore within the workings and the spoil areas, and contributes to the Avoca River. It thus affords a unique opportunity for studying the negative environmental impacts of AMD and the success or otherwise of approaches to mitigating its effects.	CGS	NHA?			IGH15 Economic Geology		
IGH15	Avoca - Connary	Wicklow	35	62	721046E	683885N	The Connary site is largely unaffected by modern, i.e. 20th century, mining and is notable for the number of shafts present on site, surface expressions of an apparently largely intact 19th-century underground mine.	Connary Upper, Sroughmore Tds, Avoca		The Connary site is, unusually among the various sites at Avoca, largely unaffected by modern, i.e. 20th century, mining and is notable for the number of shafts present on site, surface expressions of an apparently largely intact 19th-century underground mine. The chimney is a prominent local landmark. Mining last took place in Connary in the 19th Century; subsequently, open shafts were capped, possibly in the 1940s by Mianraí Teoranta. Two engine houses, Connary and Waggon Shaft, operated on the site but the only remains of these are the Waggon Shaft Engine House chimney and part of the furnace house belonging to Connary Engine House.	CGS	NHA?		Williams, F.M., Sheppard, W.A. and McArdle, P. (1986). Avoca Mine, County Wicklow: a review of geological and isotopic studies. In Geology and genesis of mineral deposits in Ireland, (eds. Andrew, C.J., Crowe, R.W.A., Finlay, S., Pennell, W.M. and Pyne, J.F.), Irish Association for Economic Geology, 71-82.	IGH15 Economic Geology		
IGH15	Avoca - Cronebane	Wicklow	35	62	720604E	683153N	Cronebane open pit is an important remnant of 20th century surface mining at Avoca and the large spoil heap built from waste rock has been a significant local landmark for 40 years. The pit contains a unique cross-section through a zone of massive sulphide mineralization and interbedded volcanic rocks. Numerous, poorly-preserved 19th-century mine features can be observed throughout the site.	Cronebane, Avoca		The site covers the area of the 19th-century Cronebane mine but little of this remains since excavation of the open pit in the early 1970s. Several 19th-century adits and levels are exposed in the floor and northwestern or hanging wall of the pit. In addition, apparently in situ timbers, partially covered by spoil in the floor of the pit, mark the trace of other levels. Another adit, Madam Butler's, runs beneath the plantation to the southeast of the pit. It has partly collapsed to form an open trench. The open pit was originally almost 600m long and 120m wide. The southwestern end was backfilled with waste rock so that the exposed pit is now 350m long and 40m deep. A pond at the northeastern end of the pit was constructed in the 1980s as a reservoir for a gold-leach project. The northeastern end of the pit contains significant bedrock exposure, including rhyolite, tuffs and a narrow zone of massive sulphide mineralization that includes lead-zinc-rich ore called kilmacooite.	CGS	NHA?		Williams, F.M., Sheppard, W.A. and McArdle, P. (1986). Avoca Mine, County Wicklow: a review of geological and isotopic studies. In Geology and genesis of mineral deposits in Ireland, (eds. Andrew, C.J., Crowe, R.W.A., Finlay, S., Pennell, W.M. and Pyne, J.F.), Irish Association for Economic Geology, 71-82.	IGH15 Economic Geology		
IGH15	Avoca - Sroughmore	Wicklow	35	62	720658E	684158N	Two concrete structures that are the remains of a 19th-century aerial ropeway constructed to pump water from Connary mine	Sroughmore, Avoca		Sroughmore contains two concrete structures that are the remains of a 19th-century aerial ropeway constructed to pump water from Connary mine. A third structure, overturned and damaged, is located inside the Connary site itself. The ropeway was apparently powered by a turbine at Sroughmore old glebe house and ran c. 1.5 km to Connary engine shaft. As a pumping mechanism however, the ropeway was a failure.	CGS	NHA?			IGH15 Economic Geology		
IGH15	Avoca - Tigroney East	Wicklow	35	62	720103E	682681N	Extensive mining remians from 18-20th century. East Avoca Open Pit includes extensive exposure of the mineralised volcanic massive sulphides. Baronets Engine House, ochre pits with Wood Adit.	Tigroney West, Cronebane Tds, Avoca		Tigroney East was the site of intensive mining both in the 18th - 19th centuries and in the 20th century. It includes (1) the fenced, 20th-century East Avoca open pit (1978-1982) where large blocks of ore can be examined, (2) numerous spoil heaps, (3) several shafts and adits, (4) the remains of Baronet's engine house and (5) well-preserved ochre pits. One shaft (Farmer's) formerly provided access to the extensive undergound workings below the site but it is now securely covered. Three adits are open to some degree. Wood Adit was the entrance to the 1.4km-long 53 fathom or Cronebane Deep level - mine water discharging from it was channelled into nearby settling pits where iron hydroxides were separated and dried to provide ochre. Cronebane Shallow Adit, now largely silted up, was the main mining adit in use in Cronebane in the late 18th century. Recent clearance of vegetation around Baronet's Engine House has revealed long-hidden features including a well-preserved flue linking the boiler house and chimney, while removal of mine waste nearby has uncovered a pre-20th century dressing floor.	CGS	NHA?		Williams, F.M., Sheppard, W.A. and McArdle, P. (1986). Avoca Mine, County Wicklow: a review of geological and isotopic studies. In Geology and genesis of mineral deposits in Ireland, (eds. Andrew, C.J., Crowe, R.W.A., Finlay, S., Pennell, W.M. and Pyne, J.F.), Irish Association for Economic Geology, 71-82.	IGH15 Economic Geology		
IGH15	Avoca - Tigroney West	Wicklow	35	62	719814E	682198N	Extensive mining remains from 19-20th century. Williams Engine House, Deep Adit, flatrod tunnels, ochre pits, 850 Level and spoil areas.	Tigroney West, Avoca		Williams engine house dating from around 1860, and its chimney which has been conserved in recent years, is a key feature. The Deep Adit was initially driven in the late 18th century and now extends northwest for over 800m, draining all workings in Tigroney and Cronebane below the level of the Cronebane Shallow Adit. The largely blocked adit discharges acidic, metal-rich mine water that drains via a 150m-long channel into the Avoca River. Two partly blocked flatrod tunnels, one beneath the railway embankment and one beside the ore bins, originally extended eastwards to Williams shaft. The only other remaining 19th century mine features on the site are two poorly preserved ochre pits and an almost entirely obliterated sawmill. The 750 m-long 850 Adit was driven between 1959 and 1962. Ore was brought out on wagons hauled by a diesel locomotive and tipped into the two large ore bins. DCENR has plans to control the water flow from this adit through the construction of a bulkhead or dams. The two steel ore bins, 4.9m high on a 1.9m-high support structure, and wooden crib show signs of severe corrosion and decay. Tigroney West is covered either by spoil heaps or, in between, a thin layer of spoil. Most of the spoil is in the form of three terrace-like areas east of and above the railway line, and as seen in historical photos of the site.	CGS	NHA?		Williams, F.M., Sheppard, W.A. and McArdle, P. (1986). Avoca Mine, County Wicklow: a review of geological and isotopic studies. In Geology and genesis of mineral deposits in Ireland, (eds. Andrew, C.J., Crowe, R.W.A., Finlay, S., Pennell, W.M. and Pyne, J.F.), Irish Association for Economic Geology, 71-82.	IGH15 Economic Geology		

IGH15	Avoca - West Avoca	Wicklow	35	62	719512E	681596N	Extensive mining remains from 19-20th century. Ballygahan and Ballymurtagh engine Houses, Tramway Arch, open pit workings and spoil areas.	Ballygahan, Ballymurtagh Tds, Avoca		The West Avoca site incorporates two major 19th-century mine sites, Ballygahan and Ballymurtagh. The former became the locus of the 20th-century underground mine as well as the Pond Lode open pit. At its height between the late 1950s and final closure in 1982, the site contained a large ore mill, workshops, mine offices and dormitories. Houses built in the late 1950s along the Red Road south of the site to accommodate mine managers still exist. Access to the underground mine was via a large portal into the Knight Tunnel. The flat area on the east of the site along the riverbank is the former emergency tailings pond, now covered by a thick layer of grassed soil. There are significant remains of 19th-century mining, especially on the high ground on the western and northern parts of the site. They include several engine houses with intact chimneys, the Tramway Arch, part of the inclined plane railway built in the 1840s to carry ore to Arklow, and various capped shafts. The open pit at Ballymurtagh, described in the 1850s as the then largest in the world, was backfilled in the 1970s.	CGS	NHA?		Williams, F.M., Sheppard, W.A. and McArdle, P. (1986). Avoca Mine, County Wicklow: a review of geological and isotopic studies. In Geology and genesis of mineral deposits in Ireland, (eds. Andrew, C.J., Crowe, R.W.A., Finlay, S., Pennell, W.M. and Pyne, J.F.), Irish Association for Economic Geology, 71-82.	IGH15 Economic Geology		
IGH15	Ballyknockan	Wicklow	10	56	700520E	707150N	Granite quarries.	Ballyknockan, Blessington		The site was probably the most important area for supplying cut stone blocks of granite for the construction of many of Dublin City's major public buildings. The streets, buildings and walls around the village are highly visible reminders of the former industrial past of Ballyknockan. Building construction, field boundary walls and fence posts, partial sculptures and other features scattered around the quarries all exemplify the pride and skill of the stonemasons who worked here since the quarries were opened in 1824.	CGS				IGH15 Economic Geology		
IGH15	Ballyrahan Quarry	Wicklow	43	62	700675E	671416N	Microtonalites are host to a tungsten-tin mineralization that is unique in Ireland.	Ballyraheen		The bedrock is a fine-grained tonalite (microtonalite), part of a swarm of thin sheet-like intrusions along the eastern margin of the Leinster Granite (405 Ma). The microtonalites are host to a tungsten-tin mineralization that is unique in Ireland. Mineralization comprises scheelite, cassiterite, arsenopyrite, sphalerite and other minerals in thin quartz veins within heavily altered or greisened microtonalite and its immediate wallrocks. The sub-economic mineralization was discovered in the 1970s. The best known exposure of mineralization was in the now infilled Ballybeg Quarry, north of Ballinglen. Ballyrahan Quarry is near the southern end of the microtonalite swarm and it demonstrates many of the basic features of the style of mineralization, although mineralization itself is at best weak.	CGS						
IGH15	Glendalough-Glendasan-Glenmalure District - Overview	Wicklow	17, 22, 23, 28, 29	56	708500E	696300N		Camaderry, Seven Churches, Brockagh, Lugduff Tds, Laragh			CGS	NHA?			IGH15 Economic Geology		
IGH15	Glendasan - Foxrock	Wicklow	17, 23	56	710294E	698243N		Brockagh, Laragh		The eastern part of the site is marked by three prominent spoil heaps, one above the other on the steep hillside, each created from waste rock tipped at the entrance to an adit driven on the Foxrock lode. Further west are spoil heaps related to adits on the Hollyrock lode. Most of the eight extant adits identified on the site have visible openings but all have collapsed to a greater or lesser degree within metres of the entrance. Two ruined mine buildings remain on the site - the main building was a crusher house: thick stone walls define the footprint of the building but much of it has been reduced to a height of one metre or less. The area was first mined in the 19th century and some of the adits (3rd Adit, Hollyrock Deep Adit) were reopened and explored in the 1940s by Mianrai Teoranta. However, the only mining carried out on the Foxrock lode in the 20th century seems to have been from the underlying 4th Adit at St. Kevin's site, south of the Wicklow Gap road.	CGS	NHA?			IGH15 Economic Geology		
IGH15	Glendasan - Hero	Wicklow	23	56	709819E	698162N	The Hero processing site is one of the best preserved and studied 19th-century ore processing sites in the country.	Sevenchurches or Camaderry, Laragh		The larger, northwestern part of the site is the 2.5 ha Old Hero site which acted as a central processing area during the 19th century for various mines in Glendasan. The upper floor of the site contains the ruins of a number of buildings. The most substantial are those of the cobbing house or yard, where waste material was removed from lumps of ore by hand using hammers ("cobbing"). Two buildings beside this were presumably offices or stores. The walls of the crusher house are still standing and, beside them, the wheel pit for the water wheel. An area of gravel waste in front of the crusher house is apparently a residue of the material produced by the crusher. On the lower floor of the site, the iron-oxide coated mortar stones of the stamps are present above the buddle area. The outlines of the buddles (circular tanks) are still visible. Immediately beside the river is an accumulation of slimes. Vertical wooden poles in the spoil on the southern edge of the site are supports for a former ramp that led down to the Old Hero adit from which ore was raised. The extensive underground workings on Old Hero lode lie mainly below the western part of the site. Several shafts are marked on old maps but none are visible today. There is one opening where a stope has broken through to the surface. Less than 200 m downslope from Old Hero is the Moll Doyle site, a smaller site comprising an adit on the Moll Doyle lode, a dressing floor and associated mine waste. The adit is one of the most accessible in the district.	CGS	NHA?			IGH15 Economic Geology		
IGH15	Glendasan - Luganure	Wicklow	17, 23	56	708981E	698211N	The Luganure–Hawkrock site is one of the most substantial 19th century mine sites in the valley. Its physical link to the Glendalough valley mine site represents an important aspect of the mining history of Glendasan.	Sevenchurches or Camaderry, Laragh		Luganure and Hawkrock mine sites are among the most remote sites in the Glendalough mining district. Luganure mine was developed along the Luganure Lode while Hawkrock was developed along the southern part of the Ruplagh Lode. The Luganure lode was the first to be exploited in Glendasan, possibly as early as 1800 and large-scale mining in the district in the 1820s and 1830s initially centred on this lode. Around 1859 the workings were driven through the south side of Camaderry Mountain to the Glendalough valley site where a crusher and other processing plant had been established. Access to the underground workings at Luganure was by a series of vertically stacked adits driven into the side of Camaderry Mountain from both the north (Luganure) and south (Glendalough) sides. The total vertical extent of the workings is approximately 270m, between the lowermost 2nd Adit and the uppermost Shallow Adit. Luganure and Hawkrock are remarkable for an abundance of extant shafts and adits. The adits are in various states of collapse but their entrances are generally well defined. Several ruined mine buildings still stand on the two sites but the most striking features are the substantial waste heaps, especially on Luganure sites – the line of the Luganure Lode can be followed southwards from heap to heap up the side of Camaderry Mountain. The ore mined at Luganure was initially taken by tramway to the Old Hero Processing site via what is now a walking track that links the two sites. In later years, the ore was taken out from the southern side of the mountain and processed at the Glendalough Valley site. Also important for minerals eg wolfenite and pyromorphite.	CGS	NHA?			IGH15 Economic Geology		

IGH15	Glendasan - Ruplagh	Wicklow	17	56	709213E	699473N		Brockagh, Sevenchurches or Camaderry, Laragh		Ruplagh, at the western end of the Glendasan Valley, includes some of the most remote mine sites in the Glendalough district. It incorporates the old mine sites of Old Ruplagh, North Ruplagh and West Ruplagh. The sites were developed along the Ruplagh Lode and the West Ruplagh Lode that runs northwest from it. The Ruplagh Lode is a splay or offshoot of the Luganure Lode. The Mining Company of Ireland opened the original "Old" Ruplagh mine in 1835; a general decline then lead to a cessation of mining in the district by 1890. The underground workings at Ruplagh are extensive, reaching a depth of approximately 190m. The Ruplagh site is most remarkable for an abundance of extant if collapsed shafts and adits. Solid waste on the site is typical of the district but is not very extensive - in part this reflects the fact that most of the material produced at Ruplagh was processed at the Old Hero Processing site further down the valley.	CGS	NHA?			IGH15 Economic Geology		
IGH15	Glendasan - St. Kevins	Wicklow	23	56	710572E	697874	The St. Kevin's site is unusual in Glendasan because it was the focus of extensive 20th-century mining. It contains significant remains of mine buildings and processing equipment from that era, unlike other sites in the valley.	Brockagh, Sevenchurches or Camaderry, Laragh		St. Kevin's site covers an area of about 5.5 ha that includes 1.3 ha of fine waste or tailings deposited on the northern bank of the Glendasan River. The area was first mined in the 19th century but was reopened by the Wicklow Mining Company in the 1950s. Mining was chiefly on the Foxrock lodes accessed via the 4th Adit at the northwestern end of the site. The Hayes Adit on the south bank of the river was not worked in the 20th century. The 4th Adit is the deepest adit on the Foxrock lode and the main drain for the extensive underground workings in the Foxrock-Hollyrock-Hawkrock area that underlies the valley side north of the Wicklow gap road. The only building of significance on the site is the old processing shed built in the 1950s that contains the remains of some plant equipment including a roll crusher. A 19th Century mess building and what may have been miners' houses can be seen in the area behind the small tailings cells. The St. Kevin's site includes two of the largest mine waste deposits in the Glendalough District, the main spoil heap in front of the adit and the tailings "pond". There is a memorial to a miner who died in the mine during the 1950s.	CGS	NHA?			IGH15 Economic Geology		
IGH15	Goldmines River	Wicklow	39, 40	62	715791E	674799N	1790's gold workings.	Ballinasilloge, Ballinagore, Ballinvally Lower, Ballinvally Upper		Goldmines River was the site of Wicklow's gold rush of 1795 following the discovery of placer gold in the river gravels below Ballinagore Bridge. The source of the gold has never been satisfactorily established but it has been suggested to have been within the volcanic and sedimentary rocks underlying the Ballinasilloge – Ballycoog ridge to the west.	CGS				IGH15 Economic Geology		
IGH16	Tober Demesne	Wicklow	15	56	688527E	703350N	Spring in gravels.	Tober Demesne, Dunlavin		The Gormanstown Group Water Scheme abstracts 300 m3 per day (66,000 gallons per day) from a borehole located beside a high yielding spring. The spring (and borehole) is fed by a locally important sand and gravel aquifer. Almost 3,000 m3 of water per day has been measured to flow out of the spring. Groundwater levels are close to, or at the ground surface, in the vicinity of the spring and borehole. The topography around the spring forms a horseshoe, which drives groundwater westwards to discharge at the spring which is located at the point where the sand/gravel deposits pinch out. The groundwater quality at the source is hard to very hard, as the spring extracts from limestone sands and gravels.	CGS				IGH16 Hydrogeology		
IGH16	Woodenbridge Wellfield	Wicklow	40	62	720480E	676216N	The Woodenbridge Wellfield is the public water supply source for the Arklow area. The source consists of five bored wells which together provide approximately 10,000m3 of water per day	Garnagowlan, Kilcarra, Woodenbridge		Combined, the four boreholes have been proven to be capable of supplying up to 10,000m3 per day, or 10 million litres of water. Collectively these boreholes are therefore potentially some of the best yielding wells in Ireland. It is considered that the Arklow River, which is only a few tens of metres from the boreholes laterally, is perched on top of the alluvial clay deposits. Temperature and conductivity readings taken from the well water during a pumping test at Woodenbridge in 2009 suggested that the boreholes were drawing water from the river. The gravel deposit is therefore acting like a saturated 'funnel' of groundwater set in the valley, constrained by high bedrock ridges on either side, and with water levels just below ground level.	CGS						