# The Geological Heritage of County Fingal

**By Aaron Clarke, Matthew Parkes and Sarah Gatley**

**December 2007**

An Chomhairle Oidhreachta
The Heritage Council

Fingal County Council
Comhairle Contae Fhine Gall

GSI
Geological Survey of Ireland
Suirbhéireacht Gheolaíochta Éireann

# The Geological Heritage of Fingal

## An audit of County Geological Sites in Fingal

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**This report is an action of the Fingal Heritage Plan 2005 – 2010**

# Contents

**Site Name**
Bottle Quay [see IGH 4]
Portraine Shore [see IGH 1,2,4,12]

**IGH 8 Lower Carboniferous**
**Site Name**
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Claremont Strand
Curkeen Hill Quarry [see IGH3]
Feltrim Quarry [see IGH3]
Malahide Coast [see IGH3]
Milverton Quarry
Nags Head Quarry
Skerries to Rush [see IGH3]

**IGH 9 Upper Carboniferous and Permian**
**Site Name**
Balrickard Quarry
Walshestown Stream Section

**IGH 10 Devonian**
**Site Name** - none

**IGH 11 Igneous intrusions**
**Site Name**
Rockabill

**IGH 12 Mesozoic and Cenozoic**
**Site Name**
Hill of Howth [see IGH 4]
Portraine Shore [see IGH 1,2,4,7]

**IGH 13 Coastal Geomorphology**
**Site Name**
Malahide Point

**IGH 14 Fluvial and Lacustrine Geomorphology** - none

**IGH 15 Economic Geology** - none

**IGH 16 Hydrogeology**
**Site Name**
Mulhuddart Holy Well

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**Appendix 1**
Detailed geological map of Fingal
**Appendix 2**
Full bibliography of Fingal geology

## Report Summary
## (County Geological Sites in the Planning Process)

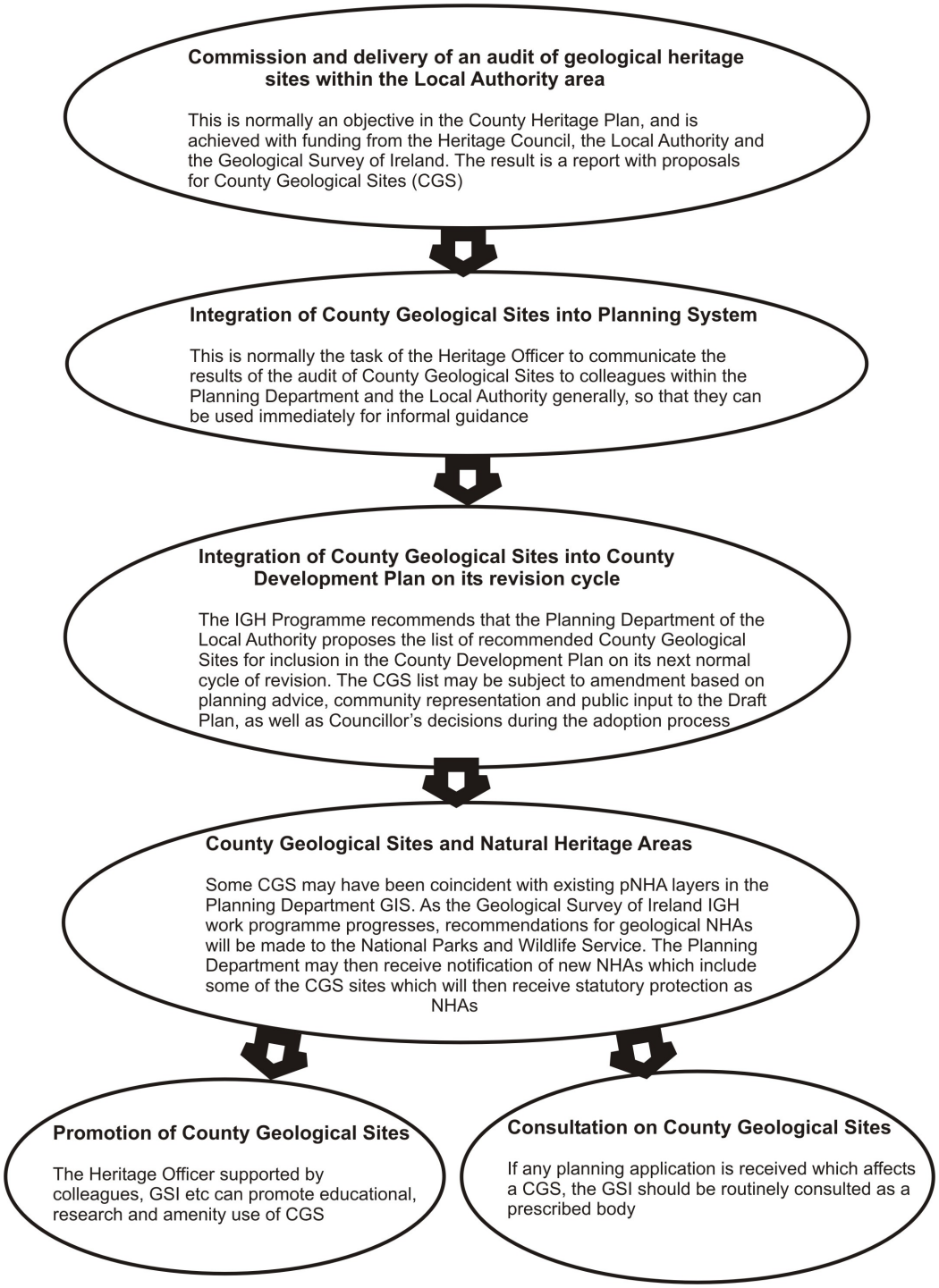
Fingal is a place with a subtle but distinctive landscape compared to other parts of Ireland. The bedrock foundation, with hundreds of millions of years in the formation and shaping, and the more recent history of geomorphological processes involving river channels and glaciers are what have created the underlying geological diversity, or geodiversity. Geological understanding and interpretation is best achieved on the ground at sites where rocks and land-forms are displayed. Fingal has a range of such natural and man-made sites.

**This report documents what are currently understood to be the most important geological sites within Fingal by the Irish Geological Heritage Programme of the Geological Survey of Ireland. It proposes them as County Geological Sites (CGS), recommended for inclusion within the Fingal County Development Plan**. County Geological Sites do not receive statutory protection like Natural Heritage Areas (NHA) but receive an effective protection through their inclusion in the planning system. **The flow chart below summarises the process. Not every Local Authority will perceive the process exactly the same, but this chart represents the Irish Geological Heritage Programme view of how it should operate**. In brief, the sites listed in the report can be used for immediate guidance by the Planning Department, and incorporated as a layer in planning GIS systems. When the next County Development Plan is formulated, the IGH programme recommends that these sites be formally adopted as County Geological Sites and that they receive appropriate protection in the planning process.

However, a selection 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 either have been, or will be, formally proposed by the Geological Survey of Ireland, for designation as NHAs by the National Parks and Wildlife Service after due survey and consultation with landowners. However, some of these sites fall within existing proposed NHAs (pNHAs) and SACs where the ecological interest is founded upon the underlying geodiversity.

The report also documents a wide variety of geological data sources providing information about Fingal. It includes a simple geological history of the county, with maps, charts and a glossary that make the information accessible to those who have not had any formal geological training. This report is written in non-technical language (with a glossary for unavoidable geological terminology) and structured as a working document for use by the Heritage Officer and the Planning Department of Fingal County Council. It is not primarily intended for publication for the people of Fingal in its existing form. A chapter of the report includes recommendations on how to best present and promote the geological heritage of Fingal for the public. However the preliminary sections, summary geological history and accompanying map, timescale and stratigraphical column may be used as they stand to preface a booklet or as website information in the development of this work or for information.

# County Geological Sites - a step by step guide



## Fingal in the context of Irish Geological Heritage

To date, Fingal is one of only a handful of counties which has commissioned an audit of geological heritage sites within the scope of the County Heritage Plan. It will hopefully act as a model and an inspiration for other counties to follow. It 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 Planning and Development Act 2000, Planning and Development Regulations 2001, Wildlife (Amendment) Act 2000, Heritage Act 1995 and the National Heritage Plan (2002). The Geological Survey of Ireland views partnerships with the local authorities, such as through this report, as a very important element of its strategy on geological heritage.

### *Geology in Local Authority planning*

*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: Planning and Development Act 2000 [e.g. Sections 212 (1)f; Part IV, 6; First Schedule Condition 21], Planning and Development Regulations 2001, Wildlife (Amendment) Act 2000 (enabling Natural Heritage Areas) and the Heritage Act 1995. The Planning and Development Act 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 Irish Geological Heritage Programme (IGH) in the Geological Survey of Ireland (GSI) complements other nature conservation efforts of the last two decades, by assessing Ireland's geodiversity. This geodiversity is the foundation of the biodiversity addressed under European Directives on habitats and species by the designation of Special Areas of Conservation (SAC), and more recently on a national scale by the designation of Natural Heritage Areas (NHA). This national nature conservation process is enacted through the Wildlife (Amendment) Act 2000. As a targeted conservation measure to protect the very best of Irish geology and geomorphology, NHA designation fills a void which has existed since the abandonment of the Areas of Scientific Interest (ASI) scheme, listed by An Foras Forbartha in 1981.

The IGH Programme does this by identifying and selecting the most important geological sites nationally, for designation as NHAs. It looks at the whole of Irish geology and geomorphology under 16 different themes. The fundamental

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

**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**

Designation of geological NHAs is undertaken by our partners in the Programme, the National Parks and Wildlife Service (NPWS) in the Department of Environment, Heritage and Local Government. Once designated, any geological NHAs will be subject to normal statutory process within the Fingal Planning Department and other relevant divisions. However, management issues for geological sites are generally fewer, and are different from many ecological designations. A later chapter considers these issues.

As a result of extensive comparison of similar sites to establish which is the best example nationally, many of the non-selected sites may still be of national importance. Others may be of local importance or of particular value as an educational site or as a public amenity. These other sites are proposed here for County Geological Site (CGS) listing in the County Development Plan, along with the clear NHA selections.

At the time of writing this report, candidate sites for Ireland have been established by Expert Panels for all the 16 themes, and the indicative site lists have been finalised. For three themes, the entire process has been essentially completed and detailed site reports and boundary surveys have been included along with a Theme Report. A small number of the sites documented here are already selected and proposed for NHA designation, but due to various factors, they have not been formally designated yet. Members of the Expert Panels for each theme are too numerous to list here but the information is available in GSI's Annual Report for 2003 and on the Heritage Programme's pages on the website (www.gsi.ie).

The procedure for identifying and assessing sites has developed as the whole Irish Geological Heritage Programme has become established. Early thematic reports on Karst, Precambrian to Devonian Palaeontology and Carboniferous to Pliocene Palaeontology (IGH1, IGH2 and IGH3) were done in their entirety, by contractors or by Matthew Parkes. The Expert Panels met to decide which sites should be assessed and prioritised, followed by site reports and fieldwork to allow a basis for selection of the most important for NHA designation.

However, due to lessons learnt in establishing the methodology, and because of urgent demands for information on sites from many quarters, a different approach has evolved. All Expert Panels have concluded their preliminary selection of candidate sites so that we now have a picture of the full range of sites to be examined nationally as candidate NHAs or as County Geological Sites. This is also valuable because sites which have scientific importance under more than one theme can be properly defined in an integrated way. It is hoped that these indicative site lists and location maps will be publicly available on the GSI website in the near future.

Commissioned desk study site reports from members of the Expert Panels for a particular Theme are then followed by field site reporting by IGH Programme staff, including boundary surveys if the sites are suitable. After this stage the Expert Panels review sites to make the final selection for NHA status. Any suitable site may be promoted with a local authority as a County Geological Site, whether or not it goes forward as an NHA at a later stage after full assessment.

**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 as the work of the IGH Programme progresses. The project also does not exclude sites which may be directly promoted by Fingal Council itself, or by local communities wishing to draw attention to important sites with an intrinsic geological interest for amenity or educational purposes.

## Geological conservation issues and site management

The Earth sustains all human society. Soils provide the food we grow and all our material goods are derived from Earth resources, extracted from the ground. The Earth also offers hazards and risks with earthquakes, volcanic eruptions, landslides, flooding, tsunami and storms. Understanding the Earth System and our impact upon it is vital to the sustainability of human culture, let alone the viability of all the rest of the enormous biodiversity sharing our planet. Geological heritage is a significant component of understanding the Earth, in that it identifies key places which demonstrate important earth science information. Identification of such places allows strategies to safeguard and promote them for future education and interpretation.

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 the same areas. In these areas, the geological case enhances and cements the value of these sites for nature conservation, but requires no additional designation of actual land areas. In Fingal, Lambay Island is a good example of this.

**There tend to be two broad types of site identified by the IGH Programme. Most geological sites tend to be small and discrete**. They may be old quarries, natural exposures on hilly ground, river sections, or other natural exposures. They usually have a specific interest such as fossils, minerals or are a representative section of a particular stratigraphical sequence of rocks. **The other type of site tends to encompass larger areas that represent a geomorphological interest – landscapes that illustrate processes which formed them**. In Fingal, much of the landscape is subdued by glacial deposition but large areas like Howth have a strong geomorphological component.

It is also important from a geological conservation perspective that Planning Authorities 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 Fingal. A lack of awareness in the past, has led to the loss of important geological sites and local character, throughout the country. Coastal geomorphology in particular can be drastically modified by small coastal protection works. The existence of Bull Island in Dublin Bay is a good example of such change. It was only created due to the building of port channel walls.

Any proposed coastal protection works may have extensive unforeseen impacts. Whilst they may be totally separated from any coastal geological heritage sites, they may result in accelerated erosion of a site along the coast. Alternatively accretion of sediment may start or increase putting sites at risk. The integrity of coastal geological heritage sites should be considered in the assessment of any proposed developments on the coast, including coastal protection works, harbour/port construction, channel works for shipping, marine aggregate extraction or other projects. However, most hard rock sites

are fairly robust, but geomorphological landforms, often made of unconsolidated sediments, are more vulnerable to change. Any assessment of proposed developments must also acknowledge that coastal systems are naturally dynamic.

There are big contrasts in the management requirements for geological sites compared to biological sites. Most geological sites are actually 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 awareness of the sites in the planning department means they are considered in the planning process, and that consultation takes place with GSI if some development or change in land use is proposed for a site**. In this way, geologists may also get the opportunity to learn more about a site or area. They can record and sample temporary exposures. Early geological consultation may influence the design of a development so that access to exposures of rock is maintained for the future. Equally, a strong geological heritage case might occasionally prevent completely inappropriate developments being permitted.

In Fingal, as in some other counties, working quarries may be considered as CGS or NHAs simply because they are the best representative sections available of entire geological sequences, in areas where exposure is otherwise poor. No restriction would be sought by GSI on the legitimate operation of these quarries. However, in such cases, for hard rock quarries, maintenance of exposure after quarry closure would be sought with the operator and planning authority by GSI. In sand and gravel pits, faces tend to degrade and vegetate once abandoned, but active management of a site can maintain access to the scientific interest once the pit has stopped working, if the site merits it.

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 general opportunity for collecting may need to be stopped. However, Fingal's palaeontological sites are not likely to require such an approach, being slow to yield their fauna without very hard work by a palaeontologist.

**The previous paragraphs provide some discussion of generic management issues but it is important to note that any proposed development affecting a CGS should lead to early consultation with the IGH Programme of GSI on a case-by-case basis. Different developments may generate different issues relating to the geological heritage interest.**

**In terms of landowner interests, the inclusion of their land within a County Geological Site does not automatically imply restrictions on development, but indicates the geological importance of the site and the opportunity for consultation if needed. As noted before, some developments may be positively beneficial in exposing more of the geological character of a site.**

**New exposures in development**

One less obvious area where the Local Authority or the National Roads Authority can play a key role in the promotion and protection of geology is in the case of new roadways. **Wherever new carriageways are built**, or in the case of other major infrastructural work, GSI recommends adoption of a council policy that **newly created rock exposures are left open and exposed** unless geotechnical safety issues occur (such as bedding dips prone to rock failure). The grading and grassing over of slopes in cuttings is largely a civil engineering convenience and a mindset which is hard to change. However, it leads to sterile and uninteresting roads which look the same throughout the country. By leaving the rock exposures intersected along the routeway, there is an improvement in character and interest, reflecting the geology and landscape of an area. Sympathetic tree or shrub planting can still be carried out, 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. It can also potentially save money on the construction.

**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. From an initial European Geoparks Network, there is now a Global Geoparks programme, fully endorsed by UNESCO. A **Geopark is a territory** with a well defined management structure in place (such as Local Authority support), **where the geological heritage is used to develop sustainable tourism opportunities**. A fundamental 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. It therefore provides protection of the geological heritage resource so that the community can benefit from it.

In Ireland there are already two members of the European Geopark Network (the Copper Coast in Waterford and Cuilcagh-Marble Arch in Fermanagh), but there are several active proposals in development from Kerry, to the Burren, through the esker landscapes of Offaly and Westmeath to Carlingford in County Louth and the Mourne Mountains. Applications usually need to demonstrate some existing promotion of geological heritage. **It is the opinion of the authors that Fingal does not have any areas likely to conform to the quite stringent requirements of an application to the Geoparks Network.**

**World Heritage Site status**

Previous UNESCO criteria for defining a World Heritage Site allowed only two classifications: either a natural site or a cultural site. This meant that globally, the majority of sites were designated because of their cultural heritage importance. In Ireland, Newgrange and the Boyne Valley archaeological sites (Brú na Bóinne), and the monastic site of Skellig Michael in Kerry are our only World Heritage Sites. In Northern Ireland, the Giants' Causeway is a World Heritage Site of prime geological importance as a natural site.

However, the criteria have been modified recently to reflect a more holistic approach, and to realise that many sites have a natural component and a history of cultural modification which results in unique landscapes. The Burren in County Clare is perhaps the strongest case Ireland has for another World Heritage Site. **It is the opinion of the authors that Fingal does not possess any geological sites likely to be suitable as candidate World Heritage Sites.**

## Proposals and ideas for promotion of geological heritage in Fingal

The clear and significant inclusion of geological heritage in the Heritage Plan for County Fingal is a most welcome and positive step, for a topic that is often undervalued and poorly known in the wider community. Listed below are the actions in the plan, to which this report contributes, either wholly or in relation to the geology as a part of the spectrum of heritage.

**Action 04** - Create multimedia promotional pack on Local Heritage in Fingal.
**Action 12** - Develop and implement a policy in relation to directional and interpretive heritage signage in Fingal to achieve consistent approach and easy recognition.
**Action 21** - Create a heritage website, which will be a one stop shop for sources of natural heritage information relating to Fingal.
**Action 30** - Conduct an audit of existing natural heritage databases and sources of information and make the information widely and easily available.
**Action 36** - ***Conduct and publish an audit of geological heritage sites.***
**Action 59** - Identify opportunities for co-operation with surrounding counties in relation to the implementation of the Heritage Plan.
**Action 62** - Ensure that the development of the Fingal Coastal Way takes full account of the natural heritage issues involved.
**Action 65 -** Support local historical societies and other local groups in managing and promoting collections of documents and objects in their care.
**Action 73 -** Use the opportunities provided by local area plans to audit and protect important heritage resources in local areas in association with local communities.

Of course, aside from the specific objective and actions relating to geological heritage, there are many other actions in the Heritage Plan, where geological heritage may feature as an integrated facet of the topic. More obvious areas include:

- Geodiversity provides the habitats for much of the biodiversity which it is hoped to conserve.
- Archaeological and architectural monuments, vernacular buildings and features are often influenced by geodiversity, and this should be kept in mind in achieving any of the specific actions related to these parts of Fingal's heritage.
- If the Council do own any of the geological heritage sites included here it will be easier to achieve positive results for both protection and promotion of those sites, and this may provide a basis for prioritising future actions.
- As a repository of the National Archives, the GSI holds various records relating to County Fingal's geology. Efforts to publicise archives in Fingal may need to report such external archives too.

Landscape Character Assessment is a tool which fundamentally defines differences in geology as the basis for land-use and cultural modifications, and the resultant landscapes. However it is clear from the County Development Plan, that this underlying basis is recognised.

## Specific ideas for projects

### Guides

There are very few existing guidebooks to the geology or Quaternary geomorphology of Fingal, of which none are aimed at a general audience. There is certainly scope for other books and products, and especially for guides at different levels of detail and accessibility to non-specialists. A 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 relevant experience, and adequate resources. **However, with modest resources, a simple, highly illustrated booklet on the geological heritage of Fingal could be compiled for a wide general audience, based on the substance of this report.**

### Signboards

Simple explanatory or interpretive signboards may be advisable at some geological heritage locations, but if these are considered, their location and individual siting should be very selective, since a proliferation of different interest groups may provoke a 'rash' of panels. Panels, with their text and graphics require a particular expertise to produce successfully, and the IGH Programme can offer input if signs are desired and planned for key visitor localities. However, given the nature of the majority of sites described in this report, which are either on private land, or have no suitable parking there are few suitable sites that would benefit from a panel. Portraine Shore car park would make a good candidate along with many of the other coastal sites. Ardgillan House Boulder is in urgent need of some interpretation.

### 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 resources an interesting exhibition can be put together for display in the Council offices, Libraries etc. A good model is that produced for the local authorities of Carlow, Kildare and for Dun Laoghaire Rathdown [see www.gsi.ie/Programmes/Heritage/Exhibitions].

### Geoparks

As stated above, it is not considered that any areas are suitable candidates for Geopark status, based on the European and Global Geoparks Network criteria.

### World Heritage Site bid

It is not considered that any areas are suitable from a geological or geomorphological perspective as candidate World Heritage Sites. It is understood that the National Parks and Wildlife Service and the Department of Environment, Heritage and Local Government are the recognised body for such a bid from Ireland. There is however, no site in Fingal on the 'tentative list' of candidate sites for Ireland on the World Heritage Site Organisation website. If there were any sites under consideration in future from a wider heritage perspective, then the GSI should be consulted in relation to including

a geological assessment in the work even if this only constitutes a small element, such as sources of building stone etc.

## Summary stories of the Geology of Fingal

## 1) Simple summary:

The varied landscapes of Fingal formed over hundreds of millions of years by various geological processes. The oldest underlying bedrock of Fingal comprises Cambrian quartzite formed as sand deposits over 500 million years ago, now seen at Howth and Ireland's Eye. The most complex rocks stem from a time when Ireland was made up of two main halves. Lambay Island, Portraine and Balbriggan have volcanic rocks that erupted in an ocean as two plates of the Earth's crust came together, 500 to 400 million years ago. The majority of the bedrock underlying the county consists of Lower Carboniferous aged rocks, mainly limestone. These formed on the continental shelf of a tropical sea around 340 million years ago. There was a deep marine basin in the southern part of Fingal and shallow water in the northern part. Some of the last sediments to be deposited in Fingal accumulated during the Quaternary period (1.6 million years ago to present) when a series of large ice sheets moved over Ireland, and down the Irish Sea area, depositing glacial till (clay, sand and gravel) and scouring the underlying bedrock giving Fingal much of its present day geomorphological characteristics.

## 2) Main summary

The varied landscapes of Fingal formed over hundreds of millions of years by various geological processes, each one leaving its mark in the rock record. Careful examination of the rocks in the region can help unravel the story of their formation and thus shed light on the evolution of the Fingal terrain.

Rocks can be divided into three main groups, **sedimentary**, **igneous** and **metamorphic**. Sedimentary rocks are laid down as particles of material such as sand or mud and then hardened by compaction and **lithification** into **sandstones**, **siltstones**, **mudstones** and **limestones**. **Fossils**, often preserved in these rocks, can give us an idea of when the rock formed and what the climate and environment were like at that time. Igneous rocks crystallise from **magma** originating deep beneath the Earth's surface and may be **extrusive** (i.e. **volcanic lava** flows at the Earth's surface) or **intrusive** (emplaced within the Earth's **crust**, below the surface). Metamorphic rocks are sedimentary or igneous rocks that have been altered by changes in temperature and/or pressure. New minerals grow in response to these changes and their composition depends on the composition of the original rock, and the temperatures and pressures that affect it.

The predominant rock types in Fingal are sedimentary rocks, limestone of Carboniferous age in particular. These sedimentary rocks have only been mildly affected by **folding** and retain many of their original sedimentary and depositional structures. There are volcanic rocks at Lambay Island, Portraine, Balbriggan and Bellewstown.

At any one locality there is usually more than one rock type, or **lithology** and they are generally inter-layered. Ranges of lithologies over a small area are largely consistent and sequences of rock often share common characteristics allowing them to be grouped together as packages or geological units. The most important of these 'units' is the Formation, which is defined as a sequence of related rock types differing significantly from adjacent sequences.

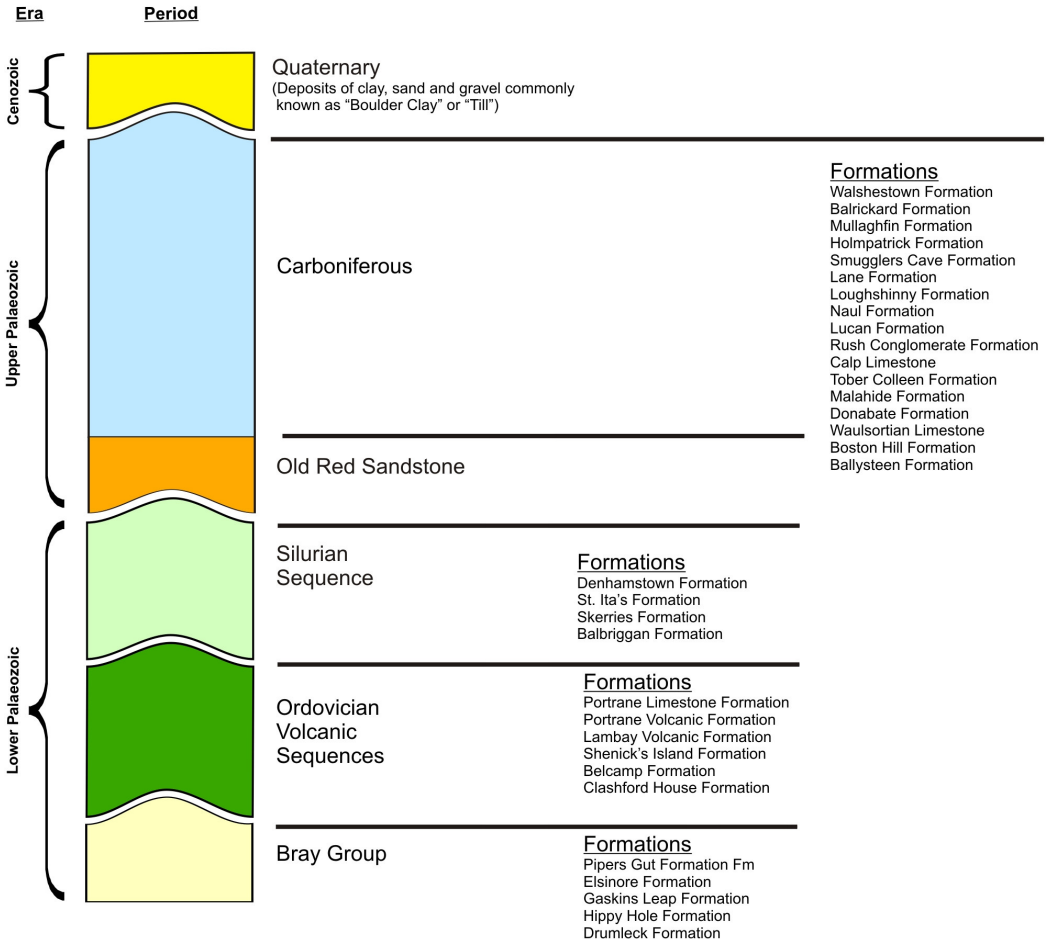
These formations are mapped as a sequence or succession of units in a stratigraphical order, with younger rocks overlying older rocks unless they have been strongly **faulted** or folded. By compiling the formations into a column with oldest at the bottom and youngest at the top we can represent the geological history of an area, with international names for the time periods. The following description of the main events and the rocks they formed in Fingal should be read with reference to the map, stratigraphical column and geological timescale. The simplified map of Fingal's geology outlines the main units by age. For more detail of the individual formations described it would be necessary to examine the GSI's 1:100,000 scale [sheets 13 and 16 – available from GSI] and 1:500,000 scale maps of the area.

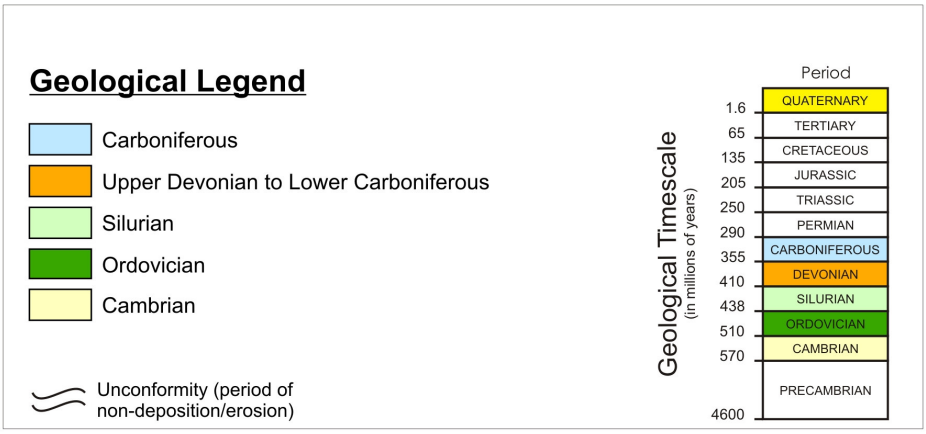
# Geological Timescale for Fingal

(Age in millions of years)

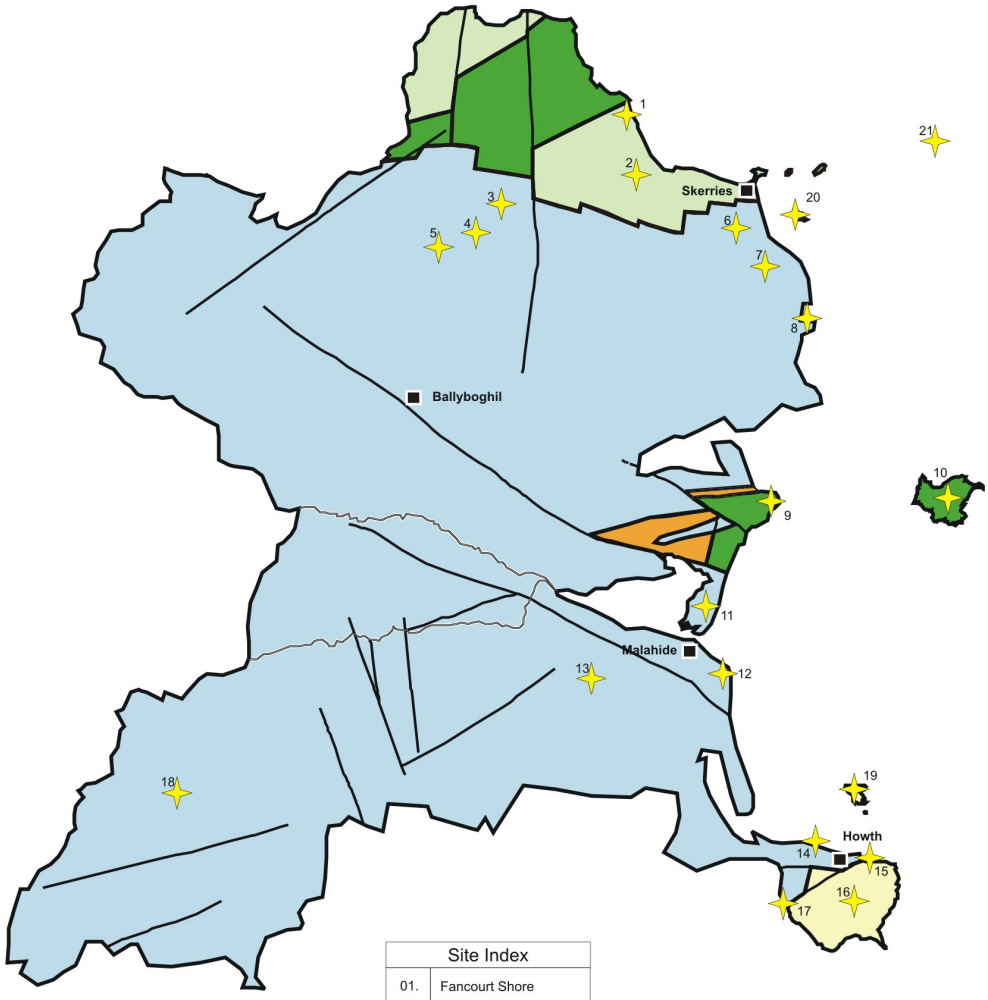
| AGE (Million Years) | ERA | PERIOD | | Events Relating to Ireland and Fingal (in italics) |
|---|---|---|---|---|
| 1.6 | Cenozoic | Quaternary | | ***A series of ice ages leaving plains of sand and gravel followed by spread of vegetation, growth of bogs and the arrival of man.*** |
| 65 | | Tertiary | | Erosion. Opening of the North Atlantic ocean. Volcanoes in NE Ireland. |
| 135 | Mesozoic | Cretaceous | | Erosion. Probable incursion of the sea. Chalk deposition preserved today in northern Ireland. |
| 205 | | Jurassic | | Uplift and erosion. Sediments deposited offshore. |
| 250 | | Triassic | | Erosion and deposition under desert conditions. |
| 290 | Palaeozoic | Upper | Permian | |
| 355 | | | Carboniferous | ***Land progressively submerged. Coastal plain and nearshore deposits followed by limestone deposition in shallow tropical seas. Subsequent building out of the land, deltaic sands and muds deposited often under swampy conditions.*** Variscan mountain building event (affecting southwest Ireland) towards the end of the Carboniferous. |
| 410 | | | Devonian | ***Continued mountain building, rapid erosion and deposition under semi-desert conditions. Intrusion of granites and metamorphism during early Devonian.*** |
| 438 | | Lower | Silurian | ***Closure of Iapetus Ocean, continental collision and initiation of Caledonian mountain building.*** |
| 510 | | | Ordovician | ***Deep-sea mudstone deposition on the floor of the Iapetus Ocean. Volcanism along the southeast margin of Iapetus as the ocean contracts.*** |
| 570 | | | Cambrian | ***Opening of the Iapetus Ocean between northwest and southeast Ireland.*** |
| 2500 | Pre-cambrian | Proterozoic | | Oldest rocks in Ireland. |
| 4000 | | Archaean | | Oldest known rocks on Earth. |
| Formation of the Solar System approximately 4600 million years ago | | | | |

# Schematic Stratigraphic Column Summarising the Rock Sequence in Fingal



# Summary Geological Map of Fingal
## (Including Site Locations)




**Geological Legend**

- Carboniferous
- Upper Devonian to Lower Carboniferous
- Silurian
- Ordovician
- Cambrian

**Symbol Key**

- Town
- Site Location
- Rivers
- Fault Line

| Site Index | |
|---|---|
| 01. | Fancourt Shore |
| 02. | Ardgillan House Boulder |
| 03. | Balrickard Quarry |
| 04. | Walshestown Stream |
| 05. | Nags Head Quarry |
| 06. | Milverton Quarry |
| 07. | Curkeen Hill Quarry |
| 08. | Skerries to Rush |
| 09. | Portraine Shore |
| 10. | Lambay Island |
| 11. | Malahide Point |
| 12. | Malahide Coast |
| 13. | Feltrim Quarry |
| 14. | Claremont Strand |
| 15. | Balscadden Bay |
| 16. | Hill of Howth |
| 17. | Bottle Quay |
| 18. | Mulhuddart Well |
| 19. | Ireland's Eye |
| 20. | Shenick's Island |
| 21. | Rockabill |

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Kilometers

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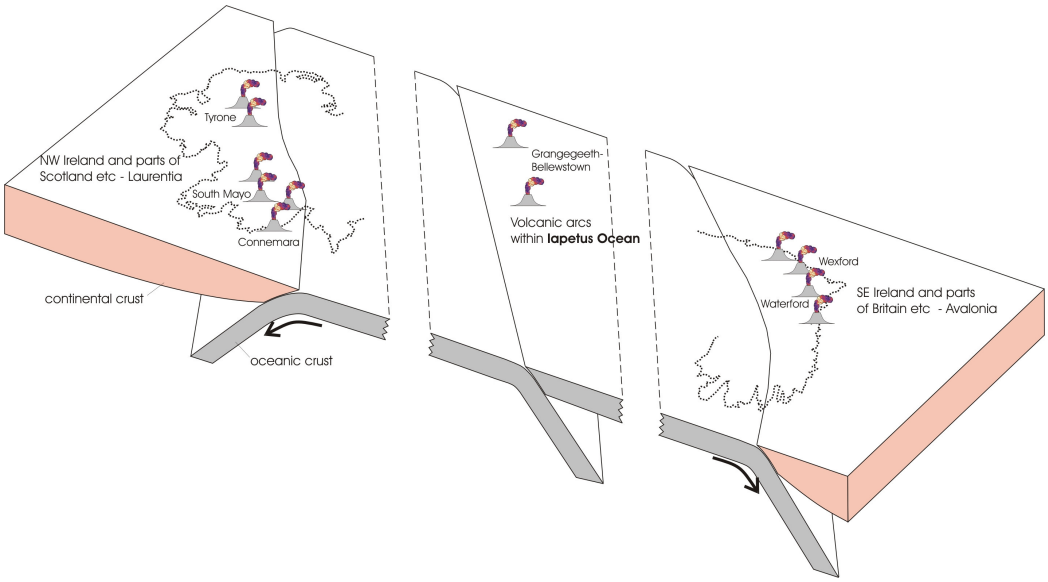
GSI
Geological Survey of Ireland
Suirbhéireacht Gheolaíochta Éireann

## Lower Palaeozoic

It is now well understood that Ireland is made up of two 'halves', which were originally separated by an ocean that geologists call Iapetus. The northwestern half was on the margins of a North American continent, whilst the southeastern half was on the margins of the European continent. **Plate tectonic** movement throughout the Ordovician period saw this Iapetus Ocean close and the two halves converge and eventually combine in Silurian times. Fingal's rocks tell part of this story, and need to be understood in the wider context.




### The Cambrian

The Cambrian saw the generation of **oceanic crust**, which would later underlie the Iapetus Ocean. Although the **basalts** and other igneous rocks associated with oceanic crust formation are not observed in Fingal, a number of sedimentary formations are exposed along the coast and inland areas of Howth Head. These represent the oldest rocks found in Fingal and are indicative of deposition in a marine environment. They are composed of sedimentary deposits of **greywacke**, **quartzite** and a chaotic **mélange** of several different sedimentary rocks, formed by **slumping**. Sedimentary structures in the greywackes indicate that they were deposited by **turbidity currents**. These rocks are fault bound and are found alongside much younger Carboniferous limestones. Evidence of this faulting can be seen at Balscadden Bay, where fault breccia and other fault associated structures can be observed within the rocks.

### The Ordovician

As Iapetus gradually closed during the Ordovician, by **subduction** of the ocean floor, volcanic rocks were erupted and intruded into the marine sedimentary sequences building **volcanic arcs** along the margins and within the ocean. **Andesite** lavas and intrusions are well exposed along the shore at Portraine (Portrane) and Balbriggan. Lambay Island and Balbriggan both had volcanic islands centred on them. The Ardgillan House Boulder is an example of **pillow lavas** produced by underwater eruption of lavas. Palaeomagnetic

studies indicate that the Portraine—Balbriggan volcanic arc formed on the southern margin of the Iapetus Ocean (around 50° south). As northward subduction of the oceanic plate continued, the late Ordovician and early Silurian sediments deposited on the ocean floor were scraped off and accreted against the northern margin as a series of fault-bound slivers. Volcanism appears to have ceased by the end of the Ordovician, suggesting that subduction had stopped. The latest Ordovician Portrane Limestone Formation was deposited over the southern volcanic arc sequence, suggesting relatively shallow water.

**Silurian**

By mid-Silurian times, the ocean had narrowed enough that it was no longer a barrier to **benthic** migration, and deposition of greywackes by turbidity currents could span both sides. Silurian rocks are widespread in the north of Fingal, though generally not well exposed. Following deposition of the Lower Palaeozoic sequences, the continents on opposite sides of the Iapetus Ocean were brought together, squeezing the oceanic sediments and volcanic arcs in between. The collision crumpled the rocks and uplifted them to produce a range of mountains, in an event known as the Caledonian **Orogeny**. The axes of the folds, and the associated cleavage, are aligned generally northeast—southwest throughout Ireland and give an idea of the orientation of the mountain range and the continental margins during collision. The base of the crust was pushed down under the weight of the mountains and the heat at depth caused it to partially melt, producing a large volume of magma. This rose into the upper crust and cooled slowly to form coarse-grained **granite**. There are no visible occurrences of this granite in mainland Fingal but it occurs in Rockabill.

**Devonian**

The Caledonian mountain belt was an area of erosion rather than deposition during most of the Devonian period. Conditions at this time were semi-arid, with Ireland lying near the equator in a semi-desert environment. Few sedimentary rocks of this age are present in Fingal. The prolonged erosion wore down the mountains, right down to the granite, so that the next stage of deposition produced a major unconformity in the rock succession.

## The Upper Palaeozoic

**The Carboniferous**

The eroded Caledonian mountains were patchily veneered by the earliest Carboniferous “Old Red Sandstone” arid-climate river deposits. In the Navan area there may have been remnant hills, formed of resistant Lower Palaeozoic rocks, the continued erosion of which produced coarse **alluvial fans**. The red beds are overlain by estuarine and then marginal marine sedimentary deposits, representing a marine transgression across the area. As the transgression advanced northwards, during the early Carboniferous, a thick succession of progressively deeper water limestone sediments accumulated in slowly subsiding basins. Richly **fossiliferous** mounds of **carbonate** mud (“Waulsortian Limestones”) are a particular feature of this

phase. Tectonic stretching then accentuated the earlier subsidence patterns, and introduced new ones, and resulted in the formation of a "block and **basin**" topography. The blocks, bounded by faults, moved upwards relative to the basins, and became areas of mainly shallow-water limestone sedimentation ("**platforms**"). The basins, meanwhile, accumulated fine-grained deep-water sediments, plus debris shed off the adjacent platforms, including boulders and large blocks from partial collapse of the "platform" margins. A general subsidence followed and the shallow "platforms" were buried by calcareous muds and sands. In the mid-Carboniferous, a southerly advancing delta complex deposited sands and muds in progressively shallower environments overlying the limestone-dominant sequence.

**(Permian, Triassic, Jurassic, Cretaceous and Tertiary)**
The subsequent periods have largely left no trace as rocks on the land. It is inferred that Ireland was mostly land, subject to weathering and erosion, which supplied the offshore basins with sediment. During the Tertiary period Ireland probably suffered karstic weathering with a landscape similar to the famous tower karst of Guilin in China.

**The Quaternary**
The Quaternary Period covers the last 1.6 million years and includes the Pleistocene and Holocene Epochs. During the Pleistocene, which lasted from 1.6 million years to 10,000 years ago, alternating cold and warm stages (termed glacial and interglacial periods) led to the growth and decay of ice sheets which covered the country on a number of occasions. The Holocene, which is the current interglacial or postglacial period, dates from 10,000 years ago to the present day.

As ice moves over its substrate, pieces of rock are incorporated into its basal layers, making the ice very abrasive. It subsequently scours and erodes the **bedrock** over which it flows. The ice also carried boulders (**erratics**) far from their source. The rock material eroded by and incorporated into the ice was eventually deposited, either directly by the ice as **till** (commonly called boulder clay) or by meltwater as sorted gravel, sand, silt or clay. The glacial deposits are thin or absent on the upland areas, but on the lowlands till thicknesses of over 30m are common and can be seen within a number of working quarries in the county as an overburden above the underlying bedrock.

Towards the end of the last glacial period, as the great ice sheets melted, returning the vast amounts of water they contained to the oceans, sea-level began to rise from 100 metres below that of today. As it did so, areas that had been depressed by the weight of ice were inundated by the sea. As the land surface began to rise in response to the removal of the ice sheets, beaches that had been deposited in the inundated areas rose with the land and were left high and dry as 'raised beaches'.

The modern coastline began to develop after the postglacial sea-level stabilised more than 5,000 years ago. Fingal's beaches and spits at Portmarnock, Malahide and Donabate were formed and blown sand collected

in the form of sand dunes. The peninsula at Skerries is really a **tombolo,** that is, an island connected to the mainland by a sand spit which is covered by blown sand. The accumulation of these sediments is balanced by the erosion of other parts of the coast line, most spectacularly along the cliffs at Skerries. The Hill of Howth is also joined by a tombolo at Sutton, but rising sea levels could easily make it an island once again in the future!

## Glossary

| | |
|---|---|
| **Andesite** | a volcanic rock of intermediate composition (between rhyolite and basalt). |
| **Alluvial Fan** | a fan-shaped deposit formed where a fast flowing river levels out and slows, typically from the mountain foot onto the plain. |
| **Basalt** | a dark grey to black extrusive volcanic rock. It is fine-grained due to rapid cooling of the extruded lava (preventing large crystal growth) at the Earth's surface. |
| **Basin** | low areas in the Earth's crust, of tectonic origin, in which sediments have accumulated. |
| **Bedrock** | a general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material. |
| **Benthic** | referring to marine and/or fresh water animals that live on or are attached to the sea or lake floor. |
| **Carbonate** | a rock (or mineral), most commonly limestone (calcite) and dolomite. |
| **Crust** | the outermost, solid, layer of the Earth. |
| **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. |
| **Extrusive** | an igneous body emplaced (erupted) at the Earth's surface as lava. |
| **Fault** | planar fracture in rocks across which there has been some displacement. |
| **Fluvial** | of or pertaining to rivers. |
| **Fold(ing)** | flexure in layered rocks caused by compression. |
| **Formation** | a sequence of related rock types differing significantly from adjacent sequences. |
| **Fossiliferous** | pertaining to a rock with a high concentration of 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. |
| **Granite** | a coarsely crystalline intrusive igneous rock composed mostly of quartz and feldspar. |
| **Greywacke** | is an impure sandstone, characterised by poorly-sorted, angular grains in a muddy matrix, that was deposited rapidly by turbidity currents (submarine avalanches). |
| **Igneous** | a rock or mineral that solidified from molten or partially molten material i.e. from a magma. |
| **Intrusive** | an igneous rock emplaced within the Earth's crust, not extruded like lava. |
| **Lava** | magma extruded onto the Earth's surface, or the rock solidified from it. |

| | |
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| **Limestone** | a sedimentary rock consisting chiefly of calcium carbonate ($CaCO_3$), primarily in the form of the mineral calcite. It is mostly formed by the accumulation of calcareous shells, cemented by calcium carbonate precipitated from solution. |
| **Lithification** | the process of rock formation from unconsolidated sediment. |
| **Lithology** | the description of rocks on the basis of such characteristics as colour, composition and grain size. |
| **Magma** | molten rock, which cools to form igneous rocks. |
| **Mélange** | a chaotic jumble of large blocks of varied rock types, deposited by large-scale slumping of unconsolidated sediments. |
| **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. |
| **Mudstone** | a very fine grained sedimentary rock, containing quartz and clay minerals. Similar to shale, but not as easily split along the plane of bedding. |
| **Oceanic Crust** | part of the Earth's outermost rock layer that is generated at mid oceanic ridges. Thinner than continental crust, it is predominantly composed of basalts and a thin skin of sedimentary rocks. |
| **Orogeny** | the creation of a mountain belt by tectonic activity. |
| **Pillow Lava** | a lava that forms from an underwater eruption and is characterized by pillow-shaped masses. |
| **Plate Tectonics** | a dynamic process driving the interaction between a series of interlocking crustal plates along their plate boundaries, e.g. by subduction. |
| **Platform** | a continental area of relatively flat or gently sloping, mostly sedimentary strata, overlying a basement of consolidated igneous or metamorphic rocks. |
| **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. |
| **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. |
| **Sedimentary** | a rock formed by the deposition of sediment, or pertaining to the process of sedimentation. |
| **Siltstone** | is similar to mudstone but with a predominance of silt-sized (slightly coarser) particles. |
| **Slumping** | the movement of a mass of unconsolidated sediment or rock layers down a slope, or pertaining to contorted sedimentary bedding features. |
| **Subduction** | the sinking of one crustal plate beneath the edge of another through the process of plate tectonics. |

| | |
|---|---|
| **Till** | unconsolidated, unsorted glacial deposits consisting of boulders and cobbles mixed with very finely ground-up rock as sand, silt or clay. |
| **Tombolo** | a narrow depositional landform such as a sand spit or bar that connects an island to the mainland or to another island (it has a beach on each of its sides). |
| **Turbidity Current** | underwater density current carrying suspended sediment at high speed down a subaqueous slope. The resulting deposit is called a turbidite. |
| **Volcanic Arc** | a linear belt of volcanoes formed on the overlying plate at a subduction zone, resulting from subduction of the underlying plate. |
| **Volcanism** | the process by which magma and its associated gasses rise into the crust and are extruded onto the Earth's surface and into the atmosphere. |
| **Volcano** | a vent in the surface of the Earth through which magma and associated gasses and ash erupt. |

## Data sources on the geology of Fingal

This section is a brief summary of relevant GSI datasets, to assist any enquiry concerning geology to target possible information easily. The GSI has very many datasets, accumulated since it began mapping Ireland's geology in 1845. A recent project has established a Document Management System 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 prints can be made or data supplied on CD. Data is now provided free but a small service charge may apply.
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. Sheet 13 and 16 cover Fingal. In addition digital mapping from the 1:100,000 series is now available on a seamless national basis and customised output can be produced for specific areas.

**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. These are also now available seamlessly on line through the GSI website www.gsi.ie. The Archives of the GSI also include a set of first edition Ordnance Survey six inch to the mile maps, which generally predate the geologically coloured fieldsheets. For historical study they can be useful in showing changes through time.

**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 Sheets 92, 101 and 102 cover Fingal. Each sheet or several sheets were accompanied by a Memoir which described the geology in some detail. These still provide valuable records of observations even though interpretations may have changed with better geological understanding.

**MinLocs Data**
The MinLocs Database records all known mineral occurrences, however small, from GSI records, such as 19th century fieldsheets and Open File data. These include economic rock deposits such as sand and gravel pits, brick clays, aggregate and dimension (building) stones as well as metallic and non-metallic minerals.

**Historic Mine Records**
Abandonment plans and varied other material exists for the various mining and exploratory ventures in the county, including the copper mine at Loughshinny and other minor workings.

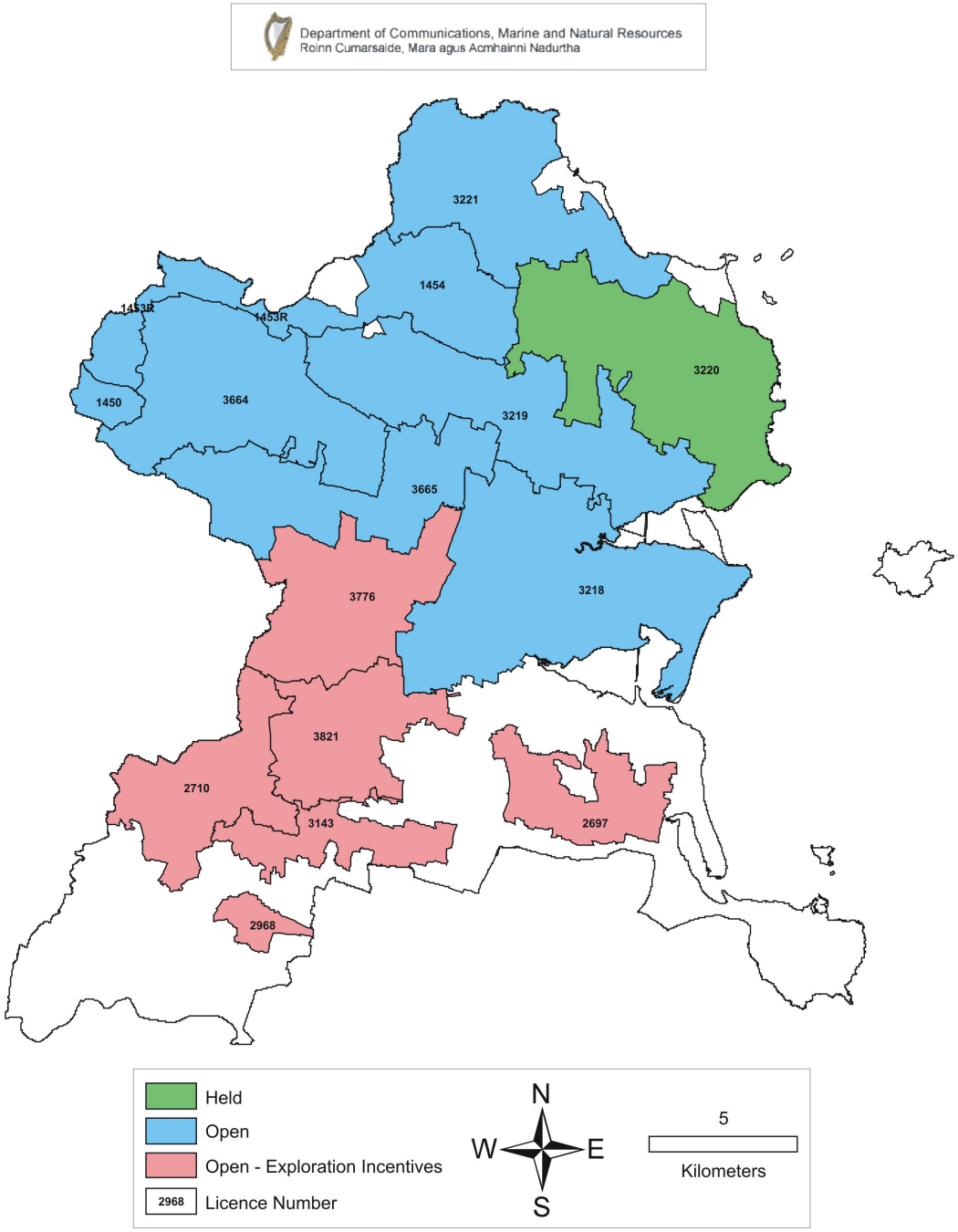
**Quaternary Mapping**
Since a Groundwater Protection Scheme has been completed for Fingal by GSI, a modern mapping of the Quaternary sediments exists as well as bedrock mapping. This provides a significant resource in general terms as well as for groundwater protection. Customised output is possible.

**Aerial Photography**
The GSI has almost full coverage of the country in 1973 black and white Air Corps vertical aerial photography, which together with a stereoscope can be very useful in interpreting geological and geomorphological features. Partial coverage of 1954 photography is also available. All are available for public consultation, with a stereoscope in the Customer Centre of GSI.

In addition the GSI network has more recent digital ortho photography and colour aerial photography from about 2000 and 2004 which can be consulted for particular purposes on request, but OSi copyright applies.

**Open File Data**
Each Mineral Prospecting Licence issued by the Exploration and Mining Division of the Department of Communications, Energy and Natural Resources (currently, but formerly the Department of Communications, Marine 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 5 year period of time has expired. They may include geological interpretations, borehole logs, geophysical and geochemical surveys and so on. Exploration is based on defined areas known as Prospecting Licences (PL) which allow someone the right to search and investigate for minerals on or under under the ground within the PL or a block of PLs. The PLs covering Fingal, and their current status are shown below.

# Prospecting Licence Designation
# Exploration and Mining Division (EMD)



## Shortlist of Key Geological References

This reference list includes seleted papers, books and articles that are recommended as access points to Fingal's geological heritage. A full reference list of papers relating to the geology of Fingal is contained in Appendix 2, including all references cited in the individual site reports.

**********

### Introduction to geology in general


DUNNING, F.W., ADAMS, P.J., THACKRAY, J.C., van ROSE, S., MERCER, I.F. and ROBERTS, R.H. 1981. *The story of the Earth*. (2nd edition). Geological Museum, H.M.S.O., 36pp.

EDMONDS, E. 1983. *The geological map: an anatomy of the landscape*. Geological Museum, H.M.S.O., 36pp.

HOLMES, A. 1978. *Principles of Physical Geology*. (3rd edition revised by D. Holmes), Thomas Nelson, 730pp.

THACKRAY, J. 1980. *The age of the Earth.* Geological Museum, H.M.S.O., 36pp.


### Introduction to the geology of Ireland


AALEN, F.H.A., WHELAN, K. and STOUT, M. (eds) 1997. *Atlas of the Irish rural landscape.* Cork University Press, Cork.

FEEHAN, J. and O'DONOVAN, G. 1996. *The Bogs of Ireland. An Introduction to the Natural, Cultural and Industrial Heritage of Irish Peatlands*. *University College Dublin. The Environmental Institute.*

HOLLAND, C.H. (ed.). 2001. *The Geology of Ireland*. Dunedin Academic Press, Edinburgh.

HOLLAND, C.H. 2003. The Irish Landscape. A scenery to celebrate. Dunedin Academic Press, Edinburgh. 180 pp.

KENNAN, P. *Written in Stone*. Geological Survey of Ireland, 50pp. [*Also DVD/VCR of TV Series*]

MITCHELL, F. and RYAN, M. 1997. *Reading the Irish Landscape*. Town House. Dublin. 392 pages.

SLEEMAN, A.G., McCONNELL, B. and GATLEY, S. 2004. *Understanding Earth Processes, Rocks and the Geological History of Ireland*. Geological Survey of Ireland, Dublin. 120 pp, including map and CD.

STILLMAN, C. and SEVASTOPULO, G. 2005. Leinster. Classic Geology in Europe 6, Terra Publishing, Harpenden, Herts. 192 pp.

WHITTOW, J.B. 1974. *Geology and Scenery in Ireland.* Pelican Books, 301pp.

WILLIAMS, D.M. and HARPER, D. 1999. *The Making of Ireland*. Landscapes in Geology. Immel Publishing, London. 98 pp.

**Introduction to geology of Fingal (and adjoining areas) in particular**

McCONNELL, B., PHILCOX, M, E. and GERAGHTY, M. 2001. *Geology Of Meath. A Geological Description To Accompany The Bedrock Geology 1:100,000 Scale Map Sheet 13, Meath.* Geological Survey of Ireland.

MEEHAN, R.T. and WARREN, W.P. 1999. *The Boyne Valley in the Ice Age: A field guide to some of the valley's most important glacial geological features*. Meath County Council and the Geological Survey of Ireland. 84 pages.

WYSE JACKSON, P., STONE, J., PARKES, M. and SANDERS, I. 1993. *Field Guide to the Geology of some localities in County Dublin*. Department of Geology, Trinity College Dublin and ENFO, Dublin.

**Further sources of information and contacts**
The Geological Survey of Ireland, and the Head of the Irish Geological Heritage Programme, Sarah Gatley can be contacted in relation to any aspect of this report. Gerry Clabby, the Heritage Officer of Fingal County Council, is the primary local contact for further information in relation to this report. Other contacts are the Conservation Rangers of the National Parks and Wildlife Service (NPWS), of the Department of Environment, Heritage and Local Government. The names and phone numbers of current staff may be found in the phone book, or on the NPWS website.

**Web sites of interest**
www.gsi.ie - for general geological resources
http://www.habitas.org.uk/es2k/index.html - for general geological information of wide interest
http://www.tcd.ie/Geography/IQUA/Index.htm - for information, fieldtrips, lectures etc in relation to Ireland's Ice Age history
http://www.sgu.se/hotell/progeo/index.html - for information about ProGEO, the European Association for the Conservation of Geological Heritage

**Acknowledgements**
The authors would like to gratefully acknowledge the assistance of Gerry Clabby Heritage Officer for Fingal County Council in the development of this project. The members of Fingal Heritage Forum are kindly thanked for their support and input. We also acknowledge the many members of the IGH Programme Expert Panels who helped define the sites which were considered for County Geological Site status. Colleagues in the GSI are thanked, particularly Robbie Meehan, Sean Cullen, Koen Verbruggen and Brian McConnell. The quarries and quarry managers are especially thanked for their help and cooperation during this audit.

## County Geological Site Reports – General Points

The following site reports are brief non-technical summaries of the proposed County Geological Sites for Fingal. These have been specially prepared for this Report in order to make the information accessible to local authority planners and other staff without geological training. For most sites more detailed reports and information files are held in the IGH Section 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. CDs accompanying this report include further pictures of most sites at higher resolution. Grid references are given normally for a central point in the site, or two extreme points at opposite ends of the site.

**GIS shapefiles with associated attribute tables have been provided with an outline of the site boundaries. It is important to note that there is no legal or definitive basis for these boundaries. They are indicative only of the limits of exposure or of geological interest, and not based on detailed field surveys, which were outside the scope of this contract.**

For sites that have been proposed (pNHA) or will be proposed for NHA designation, detailed site boundary maps will become available to the Local Authority, through NPWS as the designation process is undertaken. **In terms of any geological heritage site designation as an 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 makes recommendations to NPWS on the 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 at the Irish Geological Heritage Programme, in the Geological Survey of Ireland, Beggars Bush, Haddington Road, Dublin 4. Phone 01-6782837. Email: sarah.gatley@gsi.ie**

### Map/Photo Scales

**In the following section each site has a segment of 1:50,000 Ordnance Survey of Ireland map, and/or a segment of 1:10,560 (six inch to the mile) OSi map and/or a colour aerial photograph (year 2000; 2004 for Nags Quarry). The displayed scale is variable, i.e. they have been zoomed in or out to best show the limits of the site in the page space available. They are therefore indicative only and should not be used with assumption that they are all at the same or standard scale. Dates of publication on maps vary considerably.**

# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | |
|---|---|
| **NAME OF SITE** | **Portraine Shore** |
| Other names used for site | Portrane |
| **IGH THEME:** | IGH 1, 2, 4, 7, 12 (Karst, Precambrian to Devonian Palaeontology, Cambrian-Silurian, Quaternary, Mesozoic and Cenozoic) |
| **TOWNLAND(S)** | Quay |
| **NEAREST TOWN** | Portrane, Donabate |
| **SIX INCH MAP NUMBER** | 8, 12 |
| **NATIONAL GRID REFERENCE** | 325960 249990 = O 2596 4999 |
| **1:50,000 O.S. SHEET NUMBER** | 43, 50 **1/2 inch Sheet No.** 13 |

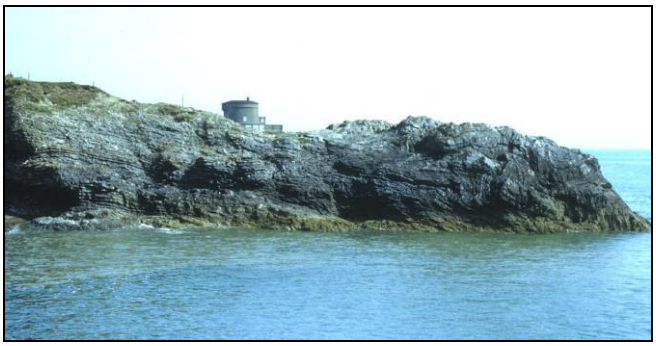
## Outline Site Description
Coastal cliffs and foreshore.

## Geological System/Age and Primary Rock Type
Ordovician volcanic lavas and associated debris flows, slumped limestones, palaeokarstic doline and Silurian sandstones. There is a very small exposure of earliest Carboniferous conglomerate.

## Main Geological or Geomorphological Interest
This headland displays a great geodiversity and complex geological history in the cliffs and foreshore exposures. Most rocks are distal equivalents of the volcanic Lambay Island succession which provide an easier opportunity to interpret the geological development. Eruption of andesite lavas was accompanied by instability and numerous submarine debris flows, which include some black slates. After these events limestone reefs developed around the volcanic island, again with instability as the sediments are often slumped and disturbed. These limestones supported a rich fauna which is now preserved as fossils in the rocks. At the end of the Ordovician Period, the sea level dropped dramatically due to a global glaciation event and these limestones were exposed, and a karstic doline formed which is now visible in the cliffs, infilled with younger sediment. A series of unfossiliferous sandstones were deposited on top of part of the limestones during the Silurian Period. The more recent events seen in the record of the rocks include karstification including two caves, and glaciation which planed off the top of the cliffs.

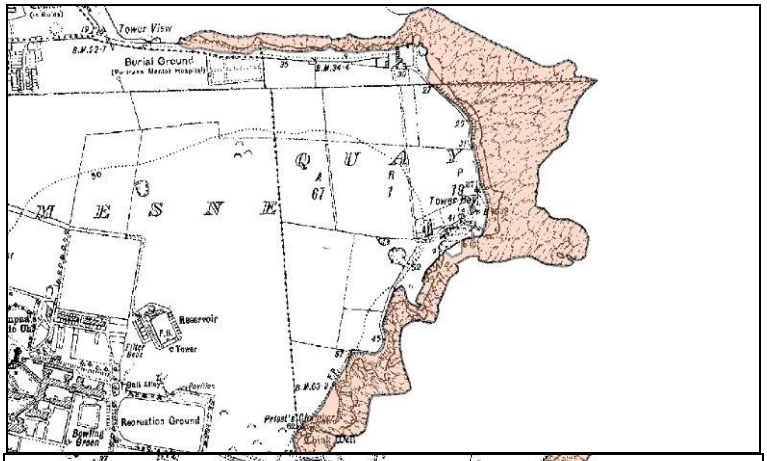
## Site Importance
The section at Portraine is one of the finest in Ireland and has interest under several different geological themes. It has already been proposed as a biodiversity pNHA (Portraine Shore - 1215).

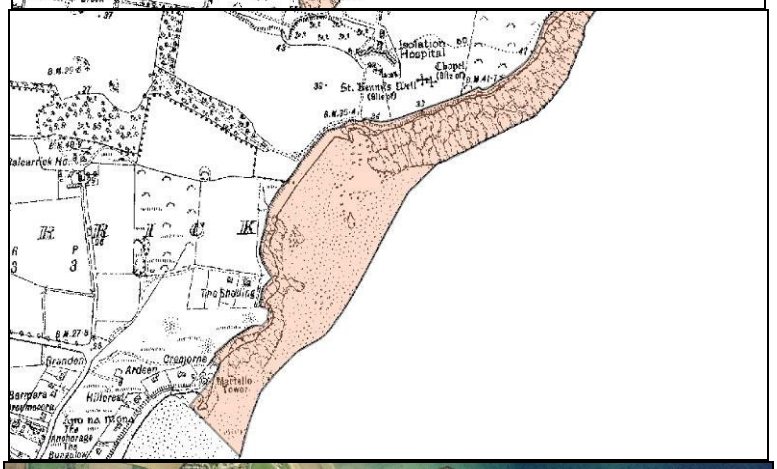
## Management/promotion issues
This site is publicly accessible from the Council car park on the headland and from the beaches and is a popular amenity area for walking. An explanatory signboard in the car park may enhance people's enjoyment by making the geology accessible. Alternatively a leaflet/guidebook available in local outlets could be produced.



Left: The Portrane Limestone Formation to the east of the bay south of the car park, showing the widespread soft sediment deformation.
Right: The black slates in Tower Bay from the east side.

# Portraine Shore


# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | |
|---|---|
| **NAME OF SITE** | **Fancourt Shore** |
| Other names used for site | Balbriggan |
| **IGH THEME:** | IGH 2, 4 (Precambrian to Devonian Palaeontology, Cambrian - Silurian) |
| **TOWNLAND(S)** | Kilsough North |
| **NEAREST TOWN** | Balbriggan |
| **SIX INCH MAP NUMBER** | Dublin 5 |
| **NATIONAL GRID REFERENCE** | 321700 262750 = O21700 62750 |
| **1:50,000 O.S. SHEET NUMBER** | 43 **1/2 inch Sheet No.** 13 |

## Outline Site Description
Coastal cliffs and foreshore.

## Geological System/Age and Primary Rock Type
Silurian slates and greywacke sandstones.

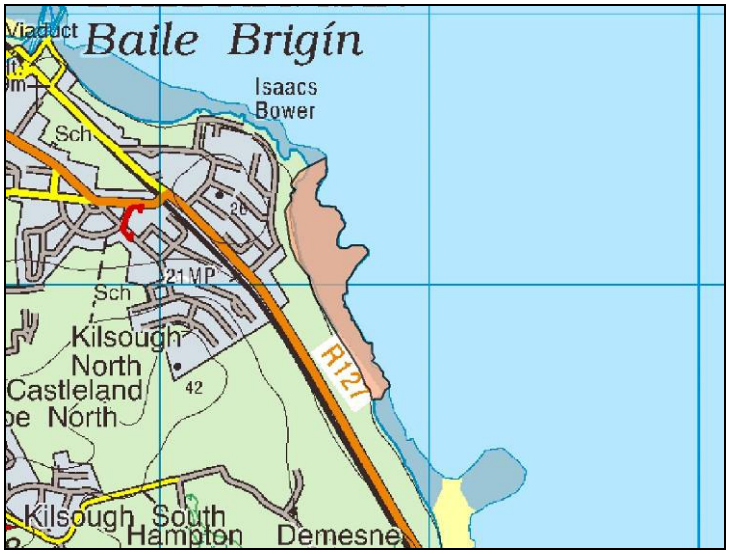
## Main Geological or Geomorphological Interest
A coastal section of rocks at Fancourt, south of Balbriggan town, has yielded the most complete succession of Irish Silurian rocks dated by the graptolite fossils within them. This makes it an important reference section against which other fossiliferous sites and sections can be compared. The sequence includes upper Ordovician *anceps* Biozone graptolitic black shales, in faulted contact with the Silurian succession. Whilst not every single Silurian graptolite biozone is recognisable, due to local faulting, a nearly complete succession from the basal Llandovery *acuminatus* Biozone to the Wenlock *lundgreni* Biozone has been established.

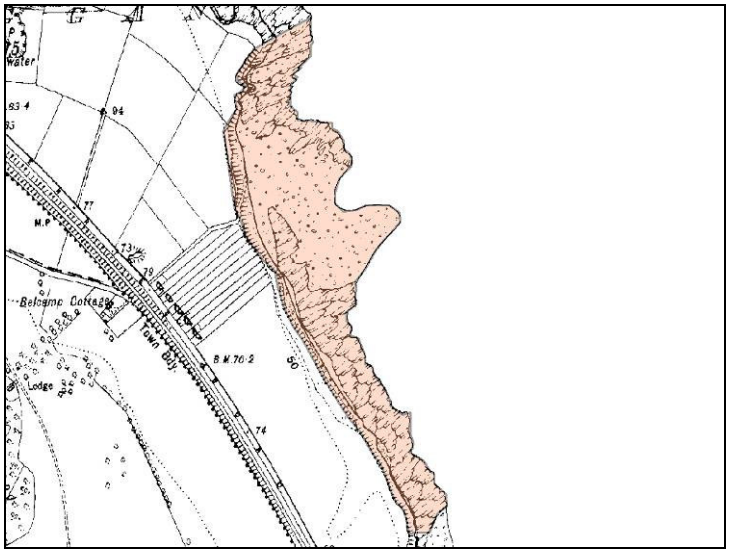
## Site Importance
The site is promoted here as a County Geological Site but it has also been put forward for NHA designation by NPWS on account of the completeness of the graptolite fossil succession. Most localities with graptolites in Ireland tend to represent snapshots of one particular time and graptolite zone.

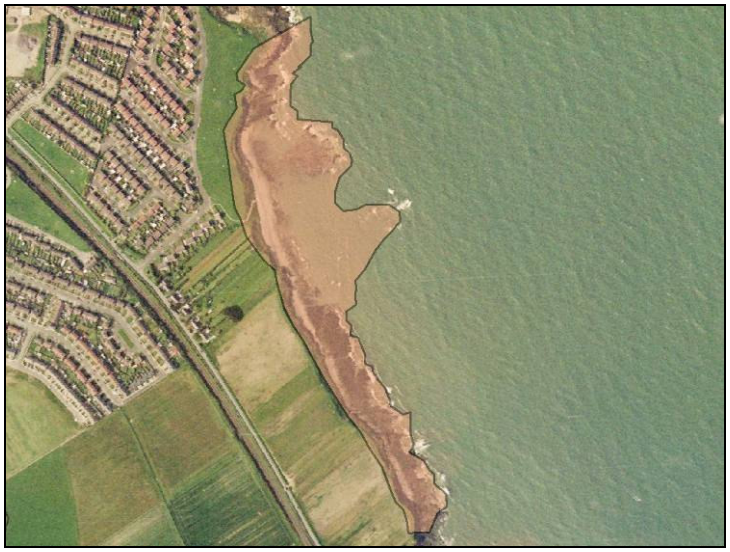
## Management/promotion issues
This site is publicly accessible as it is nearly all foreshore, although it is only safely reached when the tide is out. Due to the arduous work required to extract graptolites, and their relatively unexciting appearance except to the specialist, this site is unlikely to raise general public interest and should probably remain as a scientific reference site.

Left: A view from the northern margin of the site to the south.
Right: A view from the southern margin of the site looking north.

# Fancourt Shore





# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | |
|---|---|
| **NAME OF SITE** | **Lambay Island** |
| Other names used for site | Kiln Point, Seal Hole, Heath Hill |
| **IGH THEME:** | IGH 2, 4 (Precambrian to Devonian Palaeontology, Cambrian-Silurian) |
| **TOWNLAND(S)** | Lambay Island |
| **NEAREST TOWN** | Portraine, Rush |
| **SIX INCH MAP NUMBER** | Dublin 9 |
| **NATIONAL GRID REFERENCE** | 332400 250200 = O32400 50200 |
| **1:50,000 O.S. SHEET NUMBER** | 43 **1/2 inch Sheet No.** 13 |

## Outline Site Description
Entire island with extensive coastal cliffs and inland natural exposures of rock.

## Geological System/Age and Primary Rock Type
Upper Ordovician andesite and associated volcanic rocks, with fossiliferous limestones at Kiln Point and shales at Heath Hill.

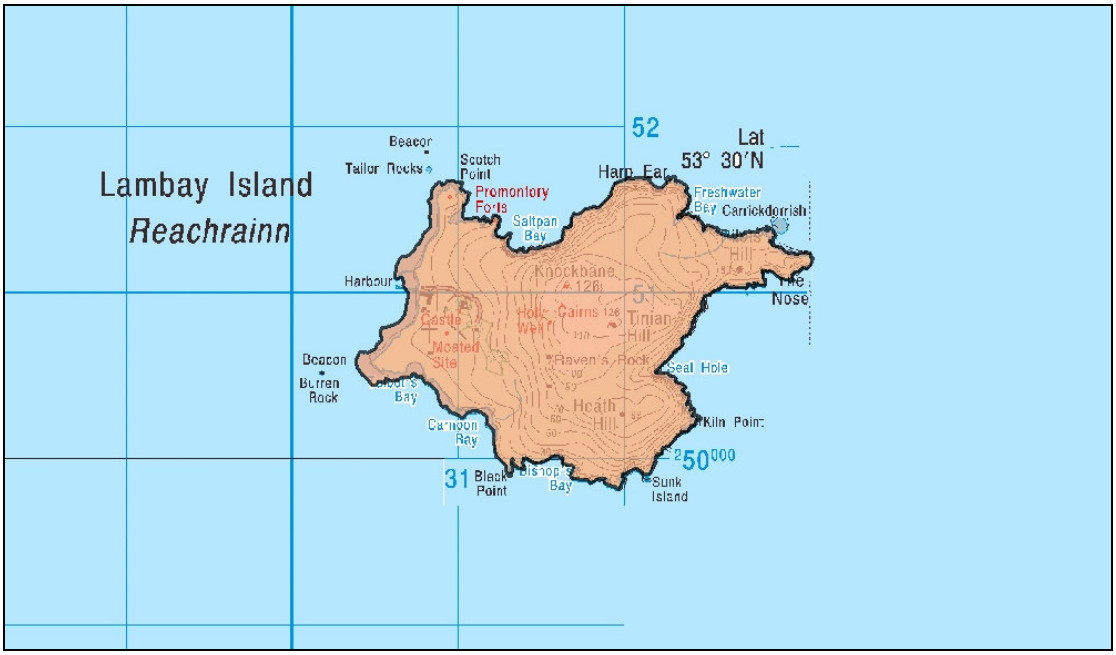
## Main Geological or Geomorphological Interest
The island itself is important as an Ordovician volcanic complex. It forms one of several such complexes which resulted from the closure of the Iapetus Ocean and subduction of one tectonic plate beneath another. This took place around 450 million years ago, resulting in the two 'halves' of Ireland joining together. The diversity of rock types include the well known Lambay porphyry – an attractive stone when polished for ornamental use. Of particular importance is the area around Kiln Point and Heath Hill, where a variety of fossils have been collected which provide evidence of the age of the rocks and of the environment at the time. Corals and other shells indicate a warm tropical sea around the extinct volcanic island.

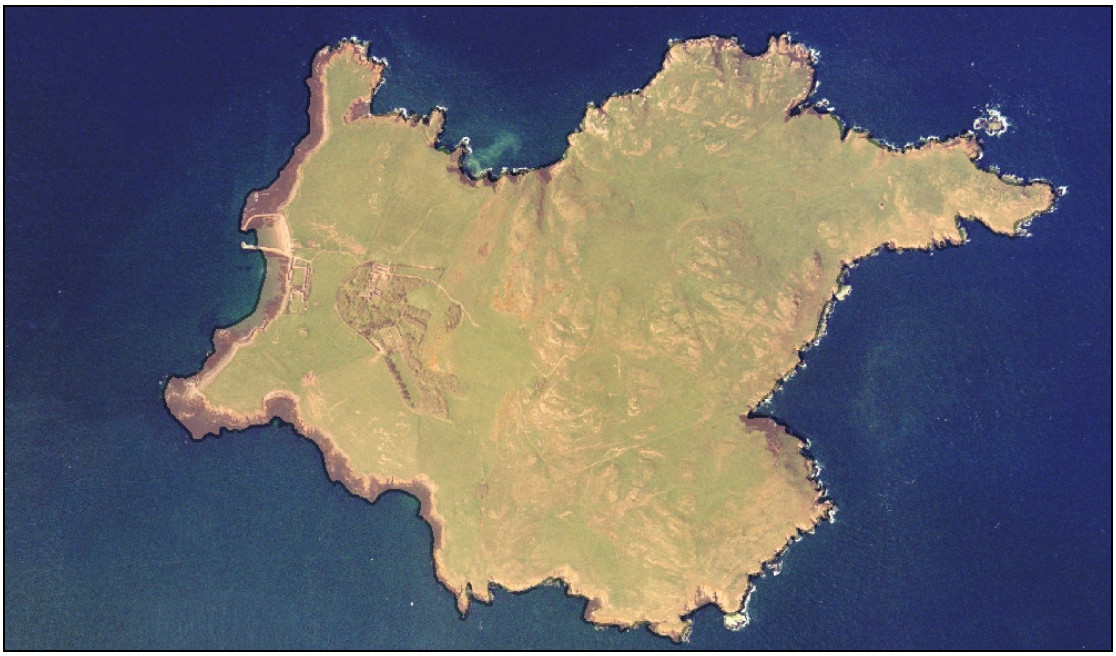
## Site Importance
Lambay's palaeontological record which documents the volcanic events in the construction of Ireland as we know it, makes this an important site. The island is already recognised and protected as an SAC, partly because of the isolation which reduces threats to nature conservation. The geological heritage is equally significant.

## Management/promotion issues
This island is privately owned and well managed, with a conservation programme in place since it is already a pNHA, SAC (204) and SPA (4069). Public access is restricted and therefore this site is not suitable for any public promotion. The geological story on Lambay is mirrored by Portrane and this can be used to illustrate Lambay's geology to the public.

Above: Kiln Point, on extreme left, Heath Hill (centre) and Seal Hole (right), with graptolite locality at top right of picture, at left end of shadowed bank. This view is from the northern margin of the site looking south.

# Lambay Island



# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | |
|---|---|
| **NAME OF SITE** | **Curkeen Hill Quarry** |
| Other names used for site | |
| **IGH THEME:** | IGH 3, 8 (Carboniferous to Pliocene Palaeontology, Lower Carboniferous) |
| **TOWNLAND(S)** | Dellabrown |
| **NEAREST TOWN** | Skerries |
| **SIX INCH MAP NUMBER** | 5 |
| **NATIONAL GRID REFERENCE** | 325800 257800 = O 258 578 |
| **1:50,000 O.S. SHEET NUMBER** | 43 **1/2 inch Sheet No.** 13 |

## Outline Site Description
Disused quarry used as a landfill site.

## Geological System/Age and Primary Rock Type
Lower Carboniferous (Late Tournaisian to Lower Viséan) mudbank limestone.

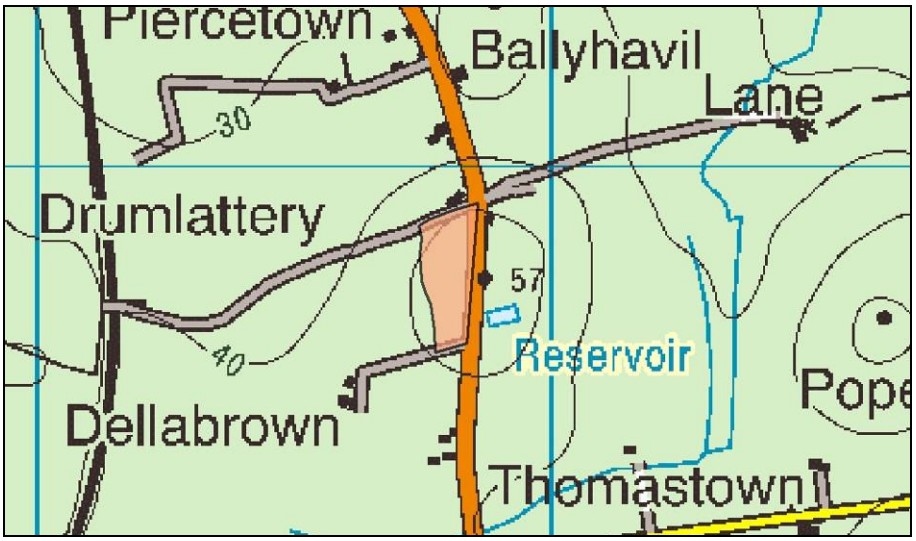
## Main Geological or Geomorphological Interest
The small open face of a disused quarry lies 2.5km south of Skerries. The rocks exposed within this quarry represent Lower Carboniferous carbonate mudbank rocks.

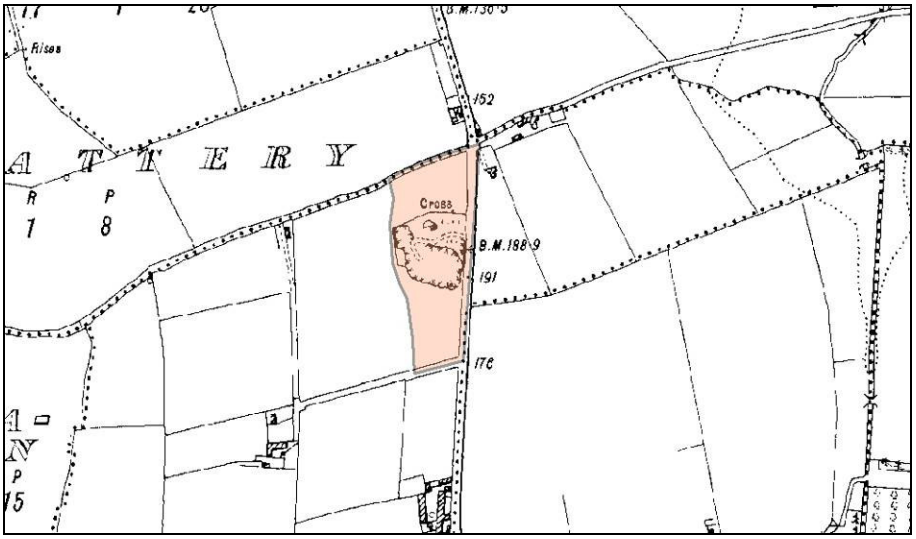
## Site Importance
Curkeen Hill Quarry represents a diverse fossil locality with many recorded species. These are comparable to fossils found on the coastline at Loughshinny. This is an important Lower Carboniferous exposure, which has been studied in the past and is therefore recommended as a County Geological Site.

## Management/promotion issues
The only access to the site is through a locked gate, which leads on to a disused quarry and landfill site. The area has been back filled with the exception of a small open face to the north (left by previous negotiation with GSI). Although left open the exposed quarry face is difficult and potentially hazardous to access and therefore is not suitable for general promotion. Removal of vegetation and waste on the slope leading down to the exposed limestone would make this section a lot safer to access for geological groups.

Left: Exposed section of limestone at Curkeen Hill Quarry.
Right: Some of the waste that is scattered round this site, creating a potentially dangerous environment.

# Curkeen Hill Quarry




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Feltrim Quarry** | | |
| Other names used for site | Feltrim Hill | | |
| **IGH THEME:** | IGH 8, 3 (Lower Carboniferous, Carboniferous to Pliocene Palaeontology) | | |
| **TOWNLAND(S)** | Feltrim | | |
| **NEAREST TOWN** | Swords | | |
| **SIX INCH MAP NUMBER** | 12 & 15 | | |
| **NATIONAL GRID REFERENCE** | 320300 244400 = O 203 444 | | |
| **1:50,000 O.S. SHEET NUMBER** | 50 | **1/2 inch Sheet No.** | 13 |

## Outline Site Description
A working quarry on Feltrim Hill.

## Geological System/Age and Primary Rock Type
Lower Carboniferous (Waulsortian) limestone with shale from the Tober Colleen Formation.

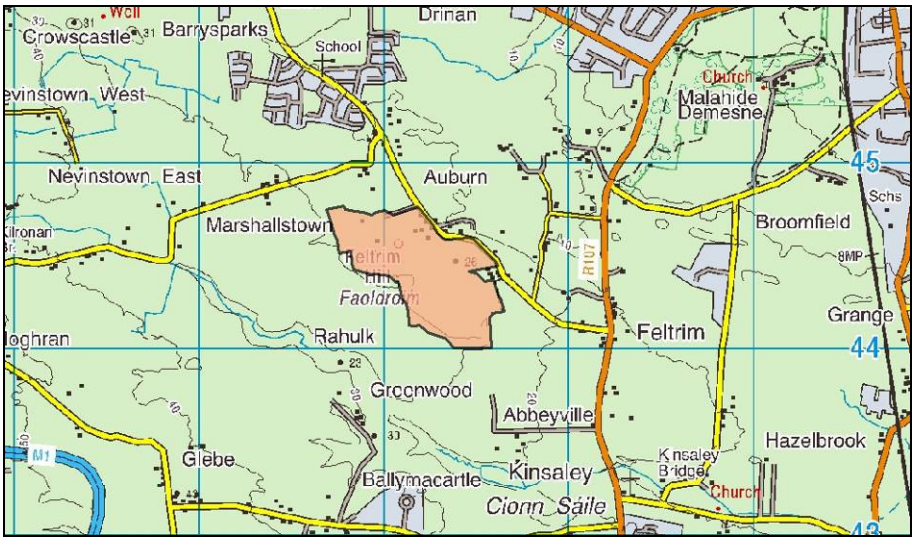
## Main Geological or Geomorphological Interest
Feltrim Hill quarry is contained within a Waulsortian mudmound complex where quarrying has been active since the eighteenth century. Due to the quarry's constant activity through the years it has provided excellent exposure of the Dublin Basin Waulsortian rocks and Viséan shale. This site has a diverse range of macro- and microfauna and is the type locality for some fossil species.

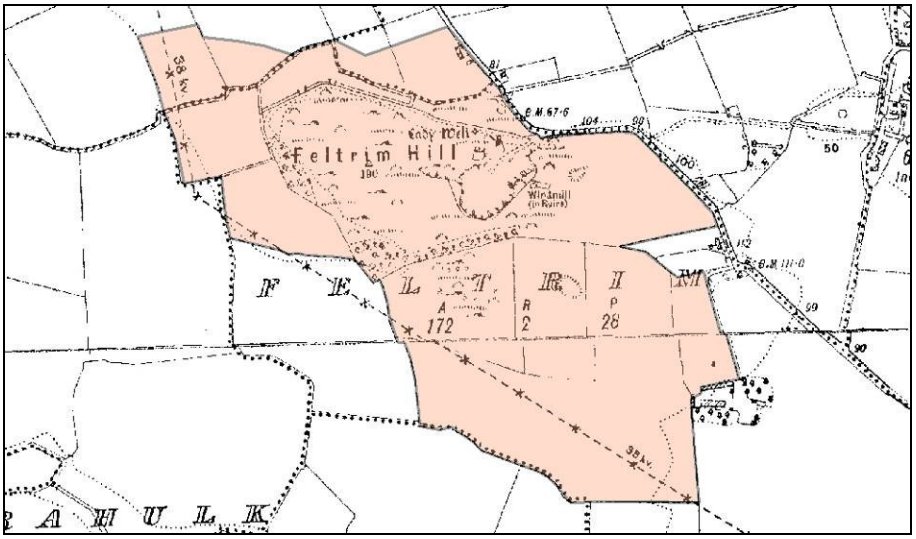
## Site Importance
The extensive exposures of Feltrim Quarry, showing Lower Carboniferous stratigraphy with its diverse fauna make this site nationally important. According to the quarry manager, many of the faces that contained fossils are now gone but during this audit many faunal species were still observed. This site lies within the existing Feltrim Hill pNHA (1208).

## Management/promotion issues
This is a large working quarry and is therefore a hazardous environment. This site is not suitable for general promotion without appropriate arrangements being made with Roadstone.

Left: Eastern section of Feltrim Quarry showing exposed faces of Waulsortian Limestone and the darker Viséan Shale (top right corner) of the Tober Colleen Formation.
Right: Fossilised fauna within the Waulsortian Limestone. This delicate fossil is known as a bryozoan.

# Feltrim Quarry




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | |
|---|---|
| **NAME OF SITE** | **Malahide Coast** |
| Other names used for site | |
| **IGH THEME:** | IGH 3, 8 (Carboniferous to Pliocene Palaeontology, Lower Carboniferous) |
| **TOWNLAND(S)** | Robswalls |
| **NEAREST TOWN** | Malahide, Portmarnock |
| **SIX INCH MAP NUMBER** | 12, 15 |
| **NATIONAL GRID REFERENCE** | 324830 245030 = O 2483 4503 |
| **1:50,000 O.S. SHEET NUMBER** | 50 **1/2 inch Sheet No.** 13 |

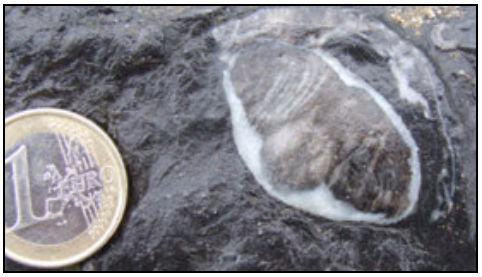
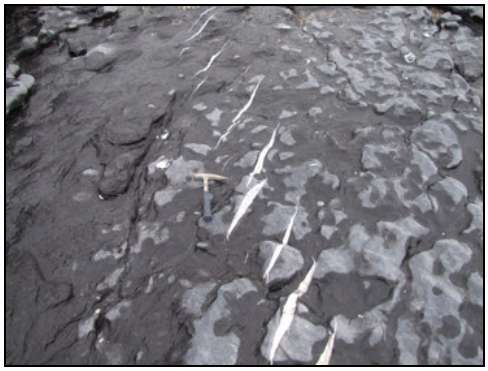
## Outline Site Description
Coastal Section.

## Geological System/Age and Primary Rock Type
Lower Carboniferous limestone and shale of the Malahide Formation and Tober Colleen Formation.

## Main Geological or Geomorphological Interest
This coastal exposure, just south of Malahide, shows a diverse range of fauna within the Lower Carboniferous rocks. Three fault lines run through this coastal section, which have created breaks in the stratigraphic succession. The rocks have been solely dated on the basis of their microfaunal assemblages.

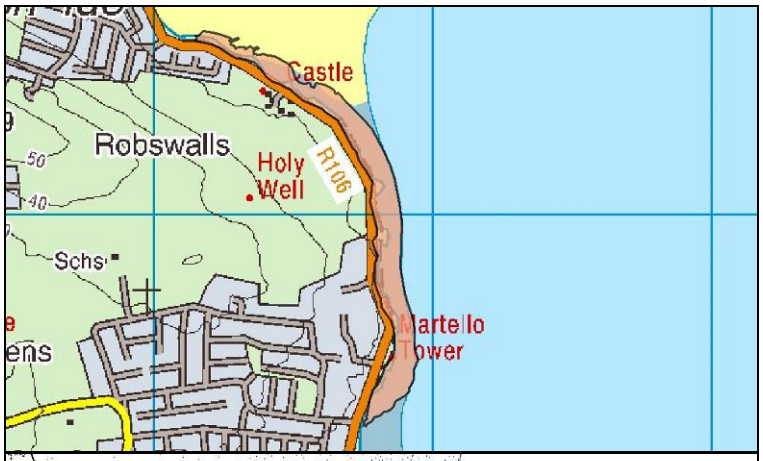
## Site Importance
The Malahide coast shows the only near-continuous section through the fossiliferous Lower Carboniferous rocks in the Dublin basin and as such should be recognised for its national importance. As well as its geological significance the large quantity and variety of fossils makes this a very interesting location, even for someone without any knowledge of geology.

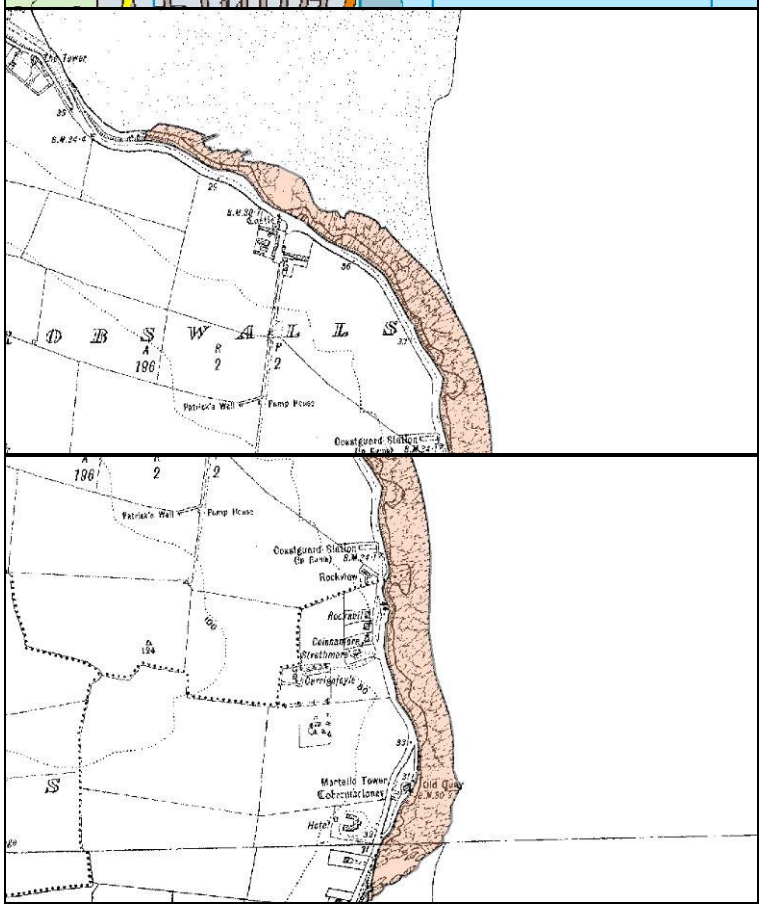
## Management/promotion issues
This site lies within an already existing pNHA and SAC (Malahide Estuary - 205). It can be easily accessed from anywhere along the R106 between Malahide and Portmarnock. This is a well walked stretch of coastline with no foreseeable management problems. No building or disturbance should be permitted.


Above left: Colonial Coral found within the Lower Carboniferous limestone along the Malahide Coastline.
Above right: Brachiopod fossil.
Bottom Left: En Echelon quartz veins occurring near fault lines. These are small scale indicators of tectonic activity.
Bottom Right: A view of the Lower Carboniferous flaggy limestone along the Malahide coastline.

# Malahide Coast




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | |
|---|---|
| **NAME OF SITE** | **Skerries to Rush** |
| Other names used for site | |
| **IGH THEME:** | IGH 3, 8 (Carboniferous to Pliocene Palaeontology, Lower Carboniferous) |
| **TOWNLAND(S)** | Numerous Townlands |
| **NEAREST TOWN** | Skerries, Loughshinny, Rush |
| **SIX INCH MAP NUMBER** | 5, 8 |
| **NATIONAL GRID REFERENCE** | 326700 258600 to 326600 253700 = O 267 586 to O 266 537 |
| **1:50,000 O.S. SHEET NUMBER** | 43 **1/2 inch Sheet No.** 13 |

## Outline Site Description
Coastal cliff and foreshore section.

## Geological System/Age and Primary Rock Type
Lower Carboniferous (Visean) limestone, shale and conglomerate.

## Main Geological or Geomorphological Interest
Six geological formations make up this impressive Lower Carboniferous succession between Skerries and Rush. They are seen in chronological order from the youngest, the Holmpatrick Formation, in the north to the oldest, the Tober Colleen Formation, in the south. Most of these formations are structurally deformed; at Loughshinny they have a severe zigzag appearance known as chevron folding. The section includes an important conglomerate turbidite sequence and a fossil locality.

## Site Importance
The foreshore and cliff sections along the Rush-Loughshinny-Skerries area represents one of the best continuous successions of Lower Carboniferous rocks in Ireland and Britain, illustrating many sedimentary structures, tectonic structures and fauna. Of national and potentially international importance, this site is promoted here as a County Geological Site, but will be proposed as an NHA.

## Management/promotion issues
A small part of this site (northern end) is an existing pNHA (Loughshinny Coast 2000). Much of this coastal section is backed by high cliffs and not easily accessible. The most accessible areas which are suitable for general promotion are located around the towns of Rush, Loughshinny and just south of Skerries where there are walkable beaches.

Top left: En echelon quartz veins within the Loughshinny Formation (an indicator of structural deformation).
Middle: Conglomerate outcrop within the Rush Conglomerate Formation.
Right: Typical view of Skerries to Rush coastal cliff section.
Left: Impressive large scale chevron folds at Loughshinny (just south of the pier).

# Skerries to Rush


# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Ardgillan House Boulder** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 4 (Cambrian – Silurian) | | |
| **TOWNLAND(S)** | Ardgillan Demesne, Kilmainham | | |
| **NEAREST TOWN** | Skerries | | |
| **SIX INCH MAP NUMBER** | 5 | | |
| **NATIONAL GRID REFERENCE** | 321984 261143 = O 21984 61143 | | |
| **1:50,000 O.S. SHEET NUMBER** | 43 | **1/2 inch Sheet No.** | 13 |

## Outline Site Description
Single large boulder placed beside path from public car park to Ardgillan House.

## Geological System/Age and Primary Rock Type
Ordovician pillow lavas, weathered to show concentric patterns within pillows.

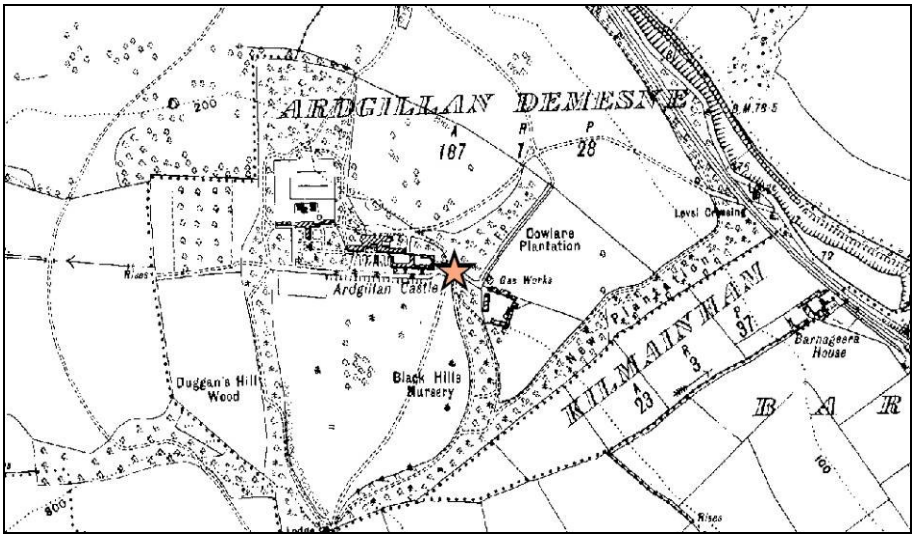
## Main Geological or Geomorphological Interest
This single large boulder is composed of Ordovician pillow lavas. It formed when volcanic eruptions occurred underwater about 470 million years ago, forming globular 'pillow' shapes as a result of interaction with seawater. The water quenched the outside of the lava forming a crust but hot molten lava under pressure continued to flow out, creating these classic structures. Subsequent weathering has picked out concentric rings of cooling structures and trapped gas bubbles within the lava. This boulder also has an interesting recent history. It was first found on the shore near Ardgillan, and was thought to be an archaeological artefact showing prehistoric stone carvings, like those of Newgrange. Following storage in OPW premises in Trim, it was only later saved from disposal and moved to Ardgillan by the Senior Parks Superintendant of Fingal County Council.

## Site Importance
The boulder merits listing as a CGS because it tells several fascinating stories in a publicly and accessible, eye catching spot, where many visitors can see it. It reveals not only its geological origin as volcanic lava erupted underwater, as evidence of the amalgamation of the two 'halves' of Ireland millions of years ago, but also a more recent history of movement at the hands of people.

## Management/promotion issues
This site is owned by Fingal County Council and should be promoted and presented in the best possible way. This should be addressed as a priority arising from this report and the further assistance of one author (M. Parkes) sought in the interpretation of the boulder for the public.

Above: Two images of Ardgillan House Boulder. The concentric rings represent cooling structures from a time when this oddly shaped boulder was once hot molten lava, erupting underwater.

# Ardgillan House Boulder


# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Bottle Quay** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 4, 7 (Cambrian-Silurian, Quaternary) | | |
| **TOWNLAND(S)** | Sutton South | | |
| **NEAREST TOWN** | Sutton | | |
| **SIX INCH MAP NUMBER** | 19 | | |
| **NATIONAL GRID REFERENCE** | 326600 237470 = O 2660 3747 | | |
| **1:50,000 O.S. SHEET NUMBER** | 50 | **1/2 inch Sheet No.** | 16 |

## Outline Site Description
Coastal cliffs and foreshore section.

## Geological System/Age and Primary Rock Type
Cambrian quartzite and mudstone of the Drumleck Formation with overlying Quaternary sediments.

## Main Geological or Geomorphological Interest
Along the southern shores of Howth Head at Bottle Quay are excellent exposures of both Cambrian rocks and Quaternary sediments. The Cambrian Drumleck Formation is made up of quartzite and mudstone and displays tectonic structures along with soft sediment deformation. To the north of the site there is a fault, which displaces the Cambrian rocks alongside much younger Lower Carboniferous Waulsortian Limestone.

The southern section of this site is dominated by 10m high cliffs composed of Quaternary material. These cliffs represent deposits of glacial till, mainly sand, gravel and clay overlying glacially sheared beds of the Cambrian Drumleck Formation. These sheared quartzite and mudstone beds illustrate the extent to which glacial ice can dramatically mould the landscape beneath them.

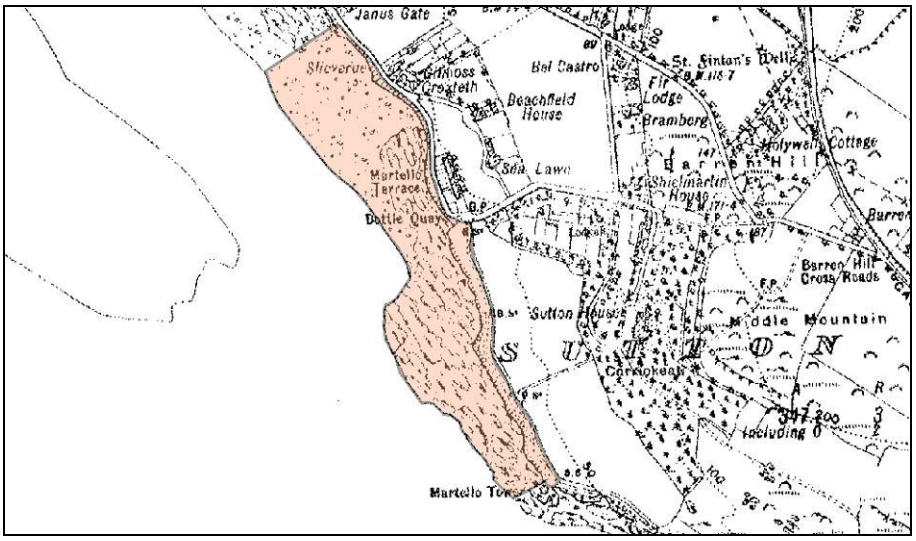
## Site Importance
This is an excellent example of both Cambrian and Quaternary features along the same short stretch of shoreline. This site is a fine teaching locality and is proposed as a County Geological Site.

## Management/promotion issues
As an existing pNHA (Howth Head 202) this site should not have any foreseeable management issues. This area is well used for recreation by local people. Most of the site can be accessed from the cliff walk although most if not all of the features are better observed from the rocky beach below.

Left: Glacial material composed of clay, sand, gravel and boulders from the Quaternary Period deposited on top of older Cambrian rocks.
Right: Unconformable contact between glacially sheared Cambrian mudstone of the Drumleck Formation and much younger Quaternary sediments.

# Bottle Quay


Megalithic Tomb
Bloody
Sch
Cemetery
Church
Muck Rock
Reservoir
Holy Well
18
Cairn
Ben of Howth
Martello Tower
Cliff
R105
Walk


Janus Gate
Bel Castro
St. Sinian's Well
Beachfield House
Fir Lodge
Bramberg
Howth
Martello Terrace
Bottle Quay
Sutton House
Middle Mountain
Barren Hill
Cross Roads
Martello Tower

# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Hill of Howth** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 4, 12 (Cambrian-Silurian, Mesozoic and Cenozoic) | | |
| **TOWNLAND(S)** | Sutton North | | |
| **NEAREST TOWN** | Howth | | |
| **SIX INCH MAP NUMBER** | 15, 19 | | |
| **NATIONAL GRID REFERENCE** | 328180 237840 = O 2818 3784 | | |
| **1:50,000 O.S. SHEET NUMBER** | 50 | **1/2 inch Sheet No.** | 16 |

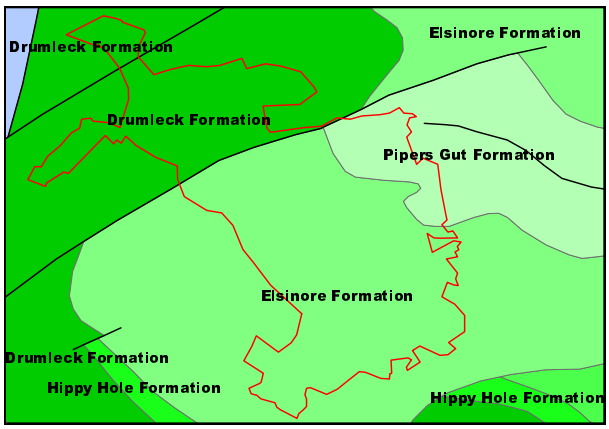
## Outline Site Description
Valleys and rock outcrops on the Hill of Howth.

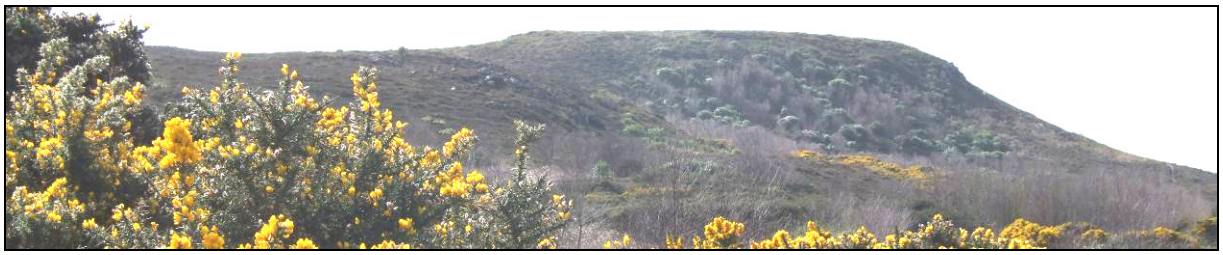
## Geological System/Age and Primary Rock Type
Cambrian quartzite and mudstone mélange of the Drumleck Formation and polymict mélange of the Elsinore Formation.

## Main Geological or Geomorphological Interest
Near the summit of Howth Hill, lying between Muck Rock and the Ben of Howth is a heavily vegetated, steep sided valley. This valley represents a large fault plane that creates a contact between the Drumleck Formation to the north and the Elsinore Formation to the south. A large number of outcrop exposures from both formations are found across this site, showing structures associated with faulting.

## Site Importance
This is an important site, recommended for County Geological Site status. It clearly demonstrates both small and large scale structural deformation within Cambrian rocks, making this an excellent teaching locality. It also has specialist research potential for Tertiary landscape evolution.

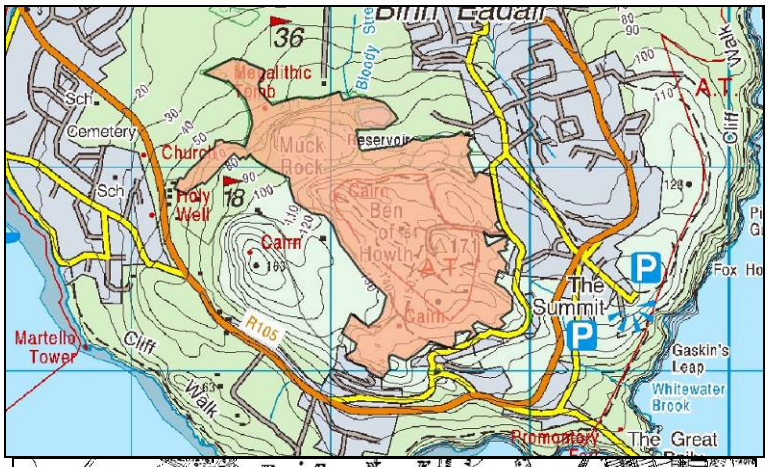
## Management/promotion issues
This site lies within the existing pNHA and SAC of Howth Head (202) and is well used by locals as a walking route. Access to the site is by numerous public footpaths that criss-cross the area.

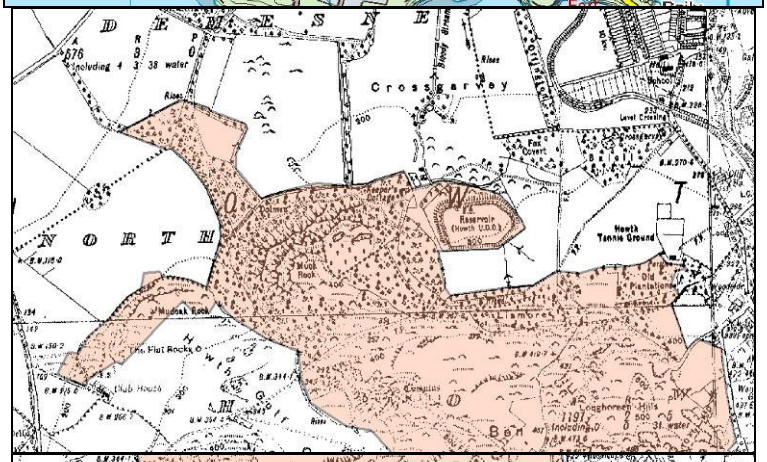


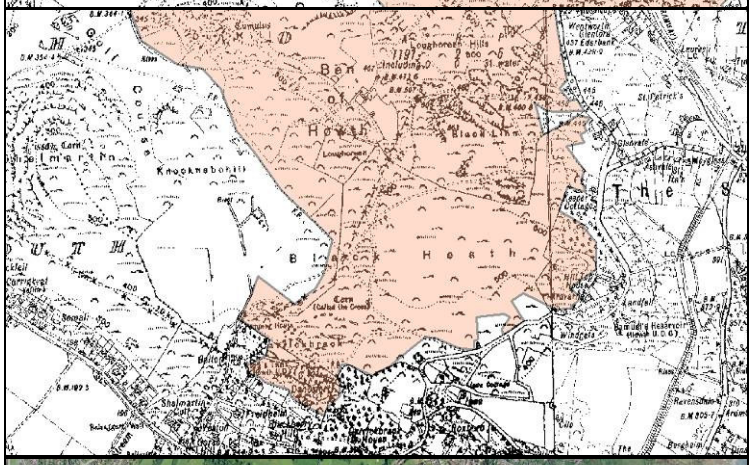



Top Left: Geological map of the Hill of Howth. The north east - south west trending fault can be seen here creating a contact between the Drumleck and Elsinore Formations (Site boundary marked with red line).
Top Right: Aerial photography showing the variation in vegetation across the fault line.
Bottom: View of Muck Rock, which is composed of Cambrian rocks of the Drumleck Formation

# Hill of Howth




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Ireland's Eye** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 4 (Cambrian-Silurian) | | |
| **TOWNLAND(S)** | Ireland's Eye | | |
| **NEAREST TOWN** | Howth | | |
| **SIX INCH MAP NUMBER** | 15, 16 | | |
| **NATIONAL GRID REFERENCE** | 329000 241000 = O 29 41 | | |
| **1:50,000 O.S. SHEET NUMBER** | 50 | **1/2 inch Sheet No.** | 16 |

## Outline Site Description
Entire island with cliff sections and inland outcrop exposures.

## Geological System/Age and Primary Rock Type
Cambrian greywacke, sandstone and quartzite of the Bray Group.

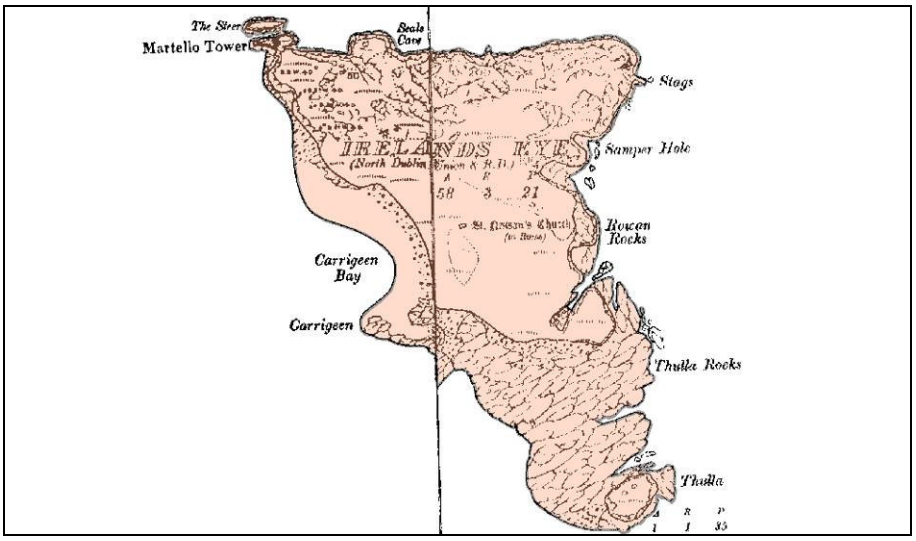
## Main Geological or Geomorphological Interest
Ireland's Eye displays some of the best exposed cliff sections and inland exposures of Cambrian rocks in Fingal. They complement and are closely related to those on Howth Head. These rocks consist of greywacke, sandstone and quartzite, and were deposited in a marine environment during the initial opening stages of the Iapetus Ocean (over 510 million years ago). On the north-east side of the island are a number of large sea stacks. These impressive coastal geomorphology features were carved out of the surrounding cliffs by the constant erosive power of the sea. These stacks of sandstone and quartzite help give Ireland's Eye its distinctive appearance from the mainland. They are also home to many of the island's nesting sea birds.

## Site Importance
Ireland's Eye, which is an existing pNHA (203), SAC (2193) and SPA for birds (4117), displays some of the best exposures of Cambrian rocks on the east coast of Ireland and is therefore recommended as a County Geological Site.

## Management/promotion issues
This is a popular tourist attraction during the summer, with large numbers of visitors reaching the island by ferry. This leaves from Howth Harbour - frequency and availability are dependent on the season. The island is home to many species of nesting sea birds from late April to mid August. The birds and their nests should be left undisturbed as much as possible, during any visit.

Left: Coastal cliff sections made up of Cambrian rocks.
Right: An inland exposure of greywacke, sandstone and quartzite.

# Ireland's Eye


# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Shenick's Island** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 4 (Cambrian - Silurian) | | |
| **TOWNLAND(S)** | | | |
| **NEAREST TOWN** | Skerries | | |
| **SIX INCH MAP NUMBER** | 5 | | |
| **NATIONAL GRID REFERENCE** | 326971 259738 = O269 5973 | | |
| **1:50,000 O.S. SHEET NUMBER** | 43 | **1/2 inch Sheet No.** | 13 |

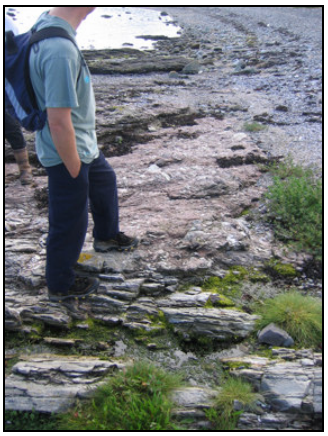
## Outline Site Description
Coastal exposures around an island.

## Geological System/Age and Primary Rock Type
Ordovician andesite, tuffs, shales with an undated red breccia.

## Main Geological or Geomorphological Interest
This island displays an inverted (upside-down) succession of volcanic rocks and sediments which are inferred to be Ordovician in age. Although no fossils have yet been found in them to provide confirmation, the tuffs (volcanic ash fall material) and andesite with shales are closely related to similar rocks north of Balbriggan. There is an unconformable breccia of local tuff clasts in a red matrix at the south-eastern end of the island, termed the Smuggler's Cave Formation. This is probably of early Carboniferous age, by comparison with similar deposits on the east coast. Ice Age boulder clay covers the centre of the island with a good section exposed below the Martello Tower on the west side.

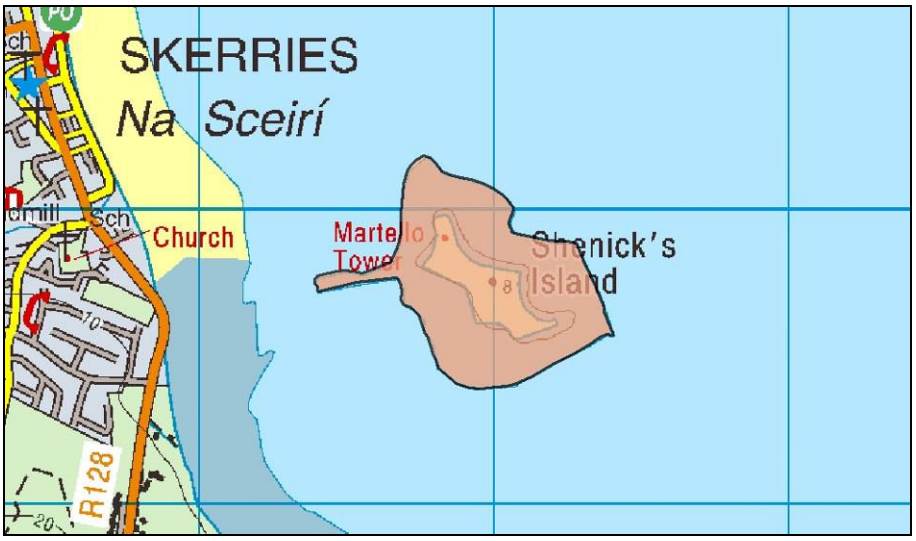
## Site Importance
This island is a good example within Fingal of the late Ordovician volcanic successions of Leinster. Easily observed from beach access, the locality should be recognised as a County Geological Site.

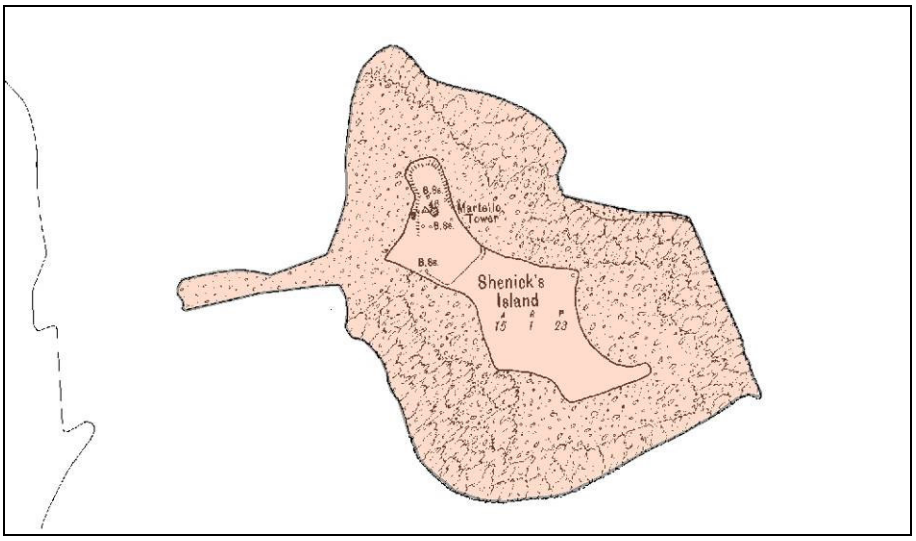
## Management/promotion issues
The island is part of the Skerries Islands pNHA (1218) and SPA (4122) and is a robust site. Although the geology is interesting, it is not particularly visually exciting for the general public and no special promotion is recommended. Geology should be included if any signboards or local guides are to be created, but as a component of the total natural and cultural heritage. For the general public, the unconformity between the red breccia and the older rocks representing a time gap of over 200 million years is the most obvious feature of interest.


Left: A view of the island from the sand bar connection to Skerries, at low tide.
Middle: The unconformable red breccia at the south-eastern end of the island.
Right: A view of the typical shoreline exposures of Ordovician volcanics and shales of Shenick's Island.

# Shenick's Island




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Balscadden Bay** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 8 (Lower Carboniferous) | | |
| **TOWNLAND(S)** | Howth | | |
| **NEAREST TOWN** | Howth | | |
| **SIX INCH MAP NUMBER** | 15, 16 | | |
| **NATIONAL GRID REFERENCE** | 328920 239110 = O 2892 3911 | | |
| **1:50,000 O.S. SHEET NUMBER** | 50 | **1/2 inch Sheet No.** | 16 |

## Outline Site Description
Coastal cliffs within a small bay area.

## Geological System/Age and Primary Rock Type
Lower Carboniferous limestone and Cambrian polymict mélange (an ill-assorted mixture of various fragmented rock types).

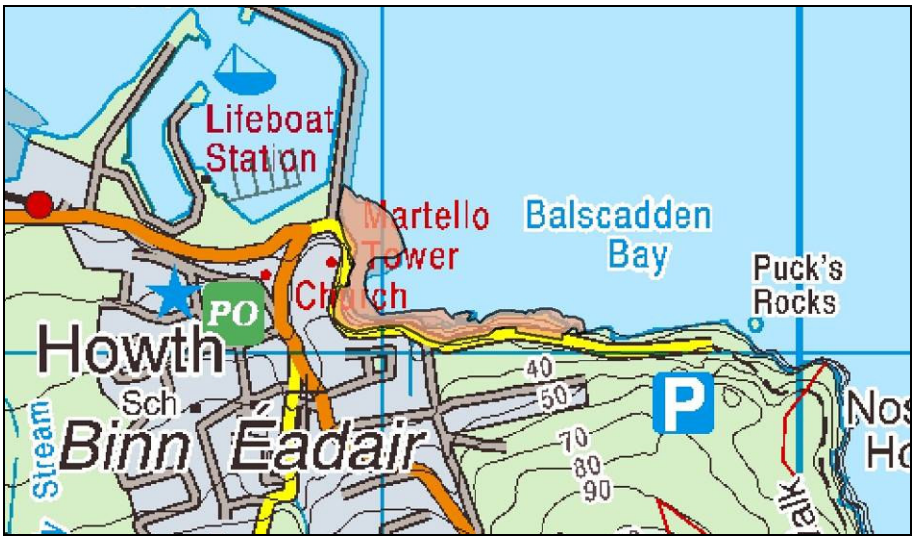
## Main Geological or Geomorphological Interest
The coastal exposure along Balscadden Bay shows a faulted contact between the Lower Carboniferous dark muddy limestone of the Ballysteen Formation and the Cambrian polymict mélange of the Elsinore Formation. The contact between these two rock formations is a large fault zone, which juxtaposes older Cambrian rocks with much younger Lower Carboniferous rocks. This contact can be seen as fault breccia along the beach at Balscadden Bay.

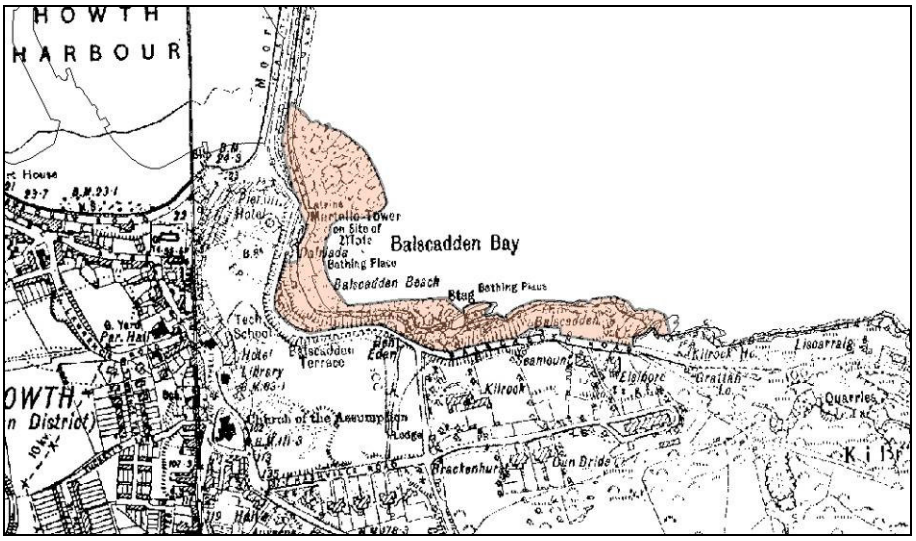
## Site Importance
This is a good example of a faulted contact between Lower Carboniferous and Cambrian rocks making this site a good teaching locality and it is therefore is recommended as a County Geological Site.

## Management/promotion issues
This site already lies within the existing pNHA and SAC of Howth Head (202). Access is by means of a public footpath and steps, which lead down to a small shingle beach. Care should be taken during periods of high tide and rough seas as nearly all the geological interest is along the waterline.

Right: A section along Balscadden Bay displaying fault breccia (a type of altered and fractured rock that is produced along a fault line).
Right: View of the Cambrian coastal exposure of the Elsinore Formation along Balscadden Bay.

# Balscadden Bay




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Claremont Strand** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 8 (Lower Carboniferous) | | |
| **TOWNLAND(S)** | Burrow | | |
| **NEAREST TOWN** | Howth, Sutton | | |
| **SIX INCH MAP NUMBER** | 15 | | |
| **NATIONAL GRID REFERENCE** | 327310 239750 = O 2731 3975 | | |
| **1:50,000 O.S. SHEET NUMBER** | 50 | **1/2 inch Sheet No.** | 16 |

## Outline Site Description
Coastal and foreshore section.

## Geological System/Age and Primary Rock Type
Lower Carboniferous (Waulsortian) limestone.

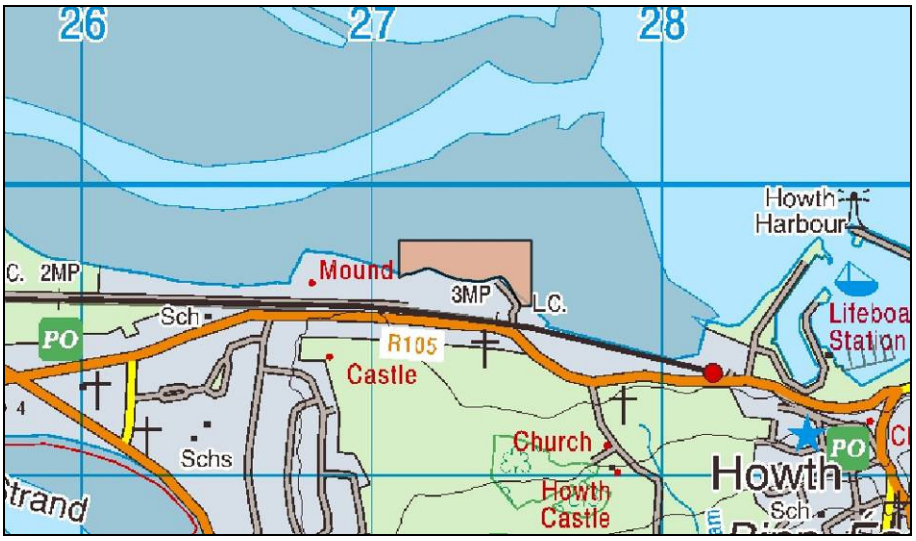
## Main Geological or Geomorphological Interest
This is a 500m long section of fossiliferous Waulsortian limestone. It is found along Claremont strand halfway between Cush Point and Howth Harbour. As well as the Lower Carboniferous geology, good Quaternary sections, which make up a 5m high cliff, can also be observed east of the exposed limestone.

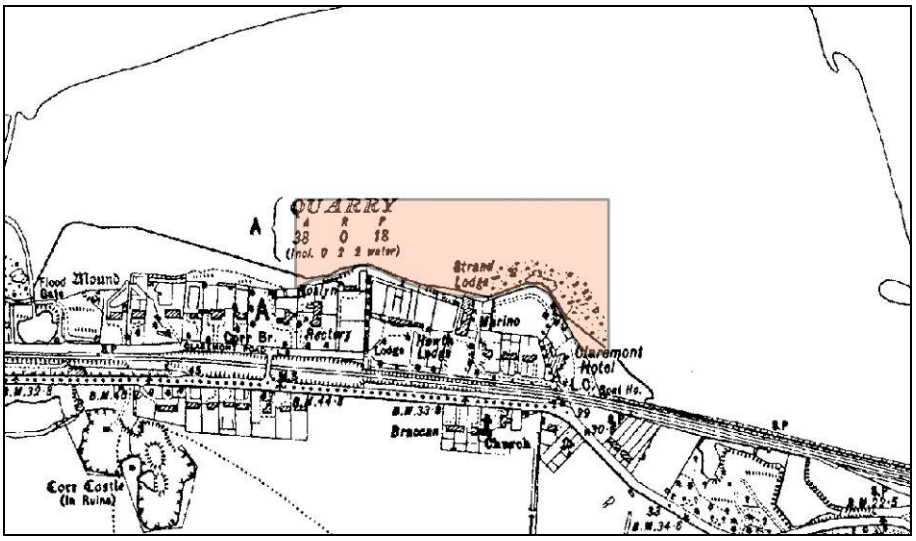
## Site Importance
This site lies within the Baldoyle Bay pNHA and SAC (199). It is an excellent example of easily accessible Lower Carboniferous limestone as well as a good fossil locality and is recommended as a County Geological Site.

## Management/promotion issues
As this site already lies within an existing pNHA there are no major management problems. It should be noted that most of this rocky coastal exposure is only accessible during periods of low tide.

Left: Fossilised crinoid stem found within the Waulsortian limestone at Claremont Strand. A crinoid is a marine animal found in both shallow and deep waters. Living examples of these can be seen in deep modern oceans.
Right: Coastal exposure of Waulsortian limestone found along Claremont Strand.

# Claremont Strand




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Milverton Quarry** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 8 (Lower Carboniferous) | | |
| **TOWNLAND(S)** | Milverton | | |
| **NEAREST TOWN** | Skerries | | |
| **SIX INCH MAP NUMBER** | 5 | | |
| **NATIONAL GRID REFERENCE** | 324671 259032 = O 246 590 | | |
| **1:50,000 O.S. SHEET NUMBER** | 43 | **1/2 inch Sheet No.** | 13 |

## Outline Site Description
Working quarry.

## Geological System/Age and Primary Rock Type
Lower Carboniferous (Viséan) limestone and shale of the Holmpatrick Formation.

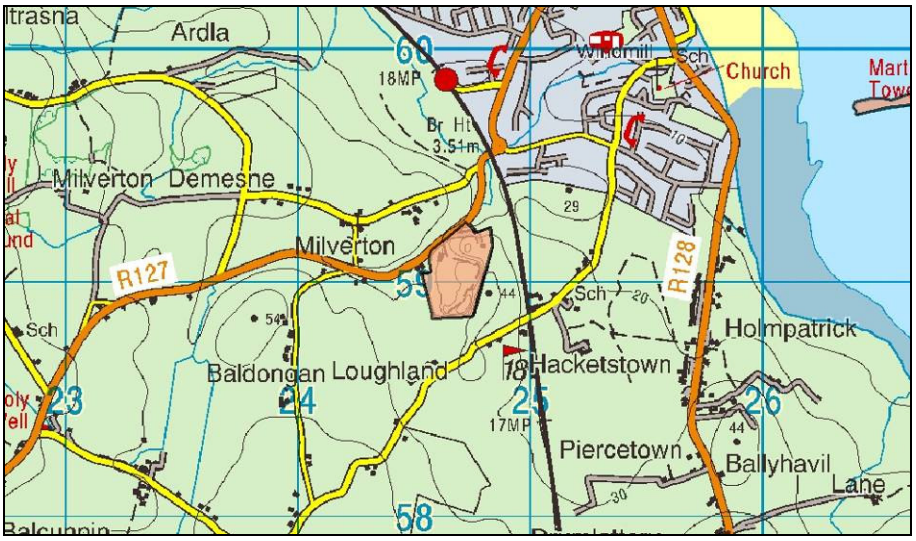
## Main Geological or Geomorphological Interest
This small Roadstone quarry just south of Skerries shows good exposures of predominantly thick bedded to massive Viséan shelf limestone with occasional shale beds. These rocks display sub vertical joints that should not be confused with the bedding, which dips shallowly to the north east. Karst weathering features known as pipes and caves were observed. These features are mostly clay infilled (orange-brown gravelly clay), with some up to 8m high, and are found within the massive limestone in the upper levels of this quarry. The limestone was used in the building of the Rockabill Lighthouse.

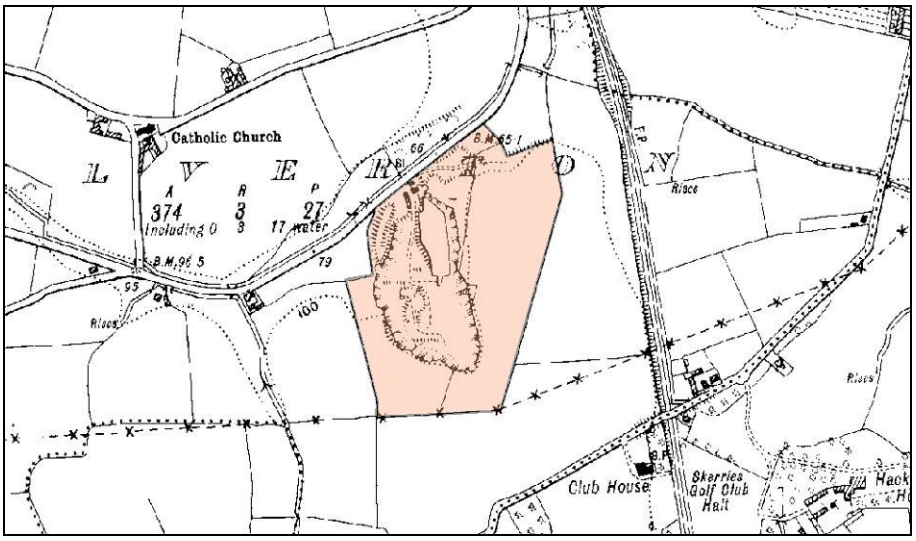
## Site Importance
This is a good example of exposed Lower Carboniferous rocks of the Holmpatrick Formation, which otherwise can only be partially viewed along the Fingal coastline, just south of Skerries. The presence of karst weathering features along some of the quarry walls may make this site a good teaching locality and it is therefore recommended as a County Geological Site.

## Management/promotion issues
Although this is a small, relatively quiet working quarry it is still a potentially hazardous environment and would not be suitable for general promotion without appropriate access arrangements being made with Roadstone. There are potential opportunities here to create safe viewing places associated with the retail display area for quarry products.

Left: This vertical feature, called a pipe, is the product of karst weathering. The pipe seen here is partially infilled with orange-brown clay. These features can only been seen along this particular section of the quarry.
Right: A view from the south west corner of Milverton Quarry.

# Milverton Quarry




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Nags Head Quarry** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 8 (Lower Carboniferous) | | |
| **TOWNLAND(S)** | Nags Head | | |
| **NEAREST TOWN** | Naul | | |
| **SIX INCH MAP NUMBER** | 4 | | |
| **NATIONAL GRID REFERENCE** | 315500 257910 = O 155 579 | | |
| **1:50,000 O.S. SHEET NUMBER** | 43 | **1/2 inch Sheet No.** | 13 |

## Outline Site Description
Large working quarry.

## Geological System/Age and Primary Rock Type
Lower Carboniferous (Viséan) limestone, shale and sandstone.

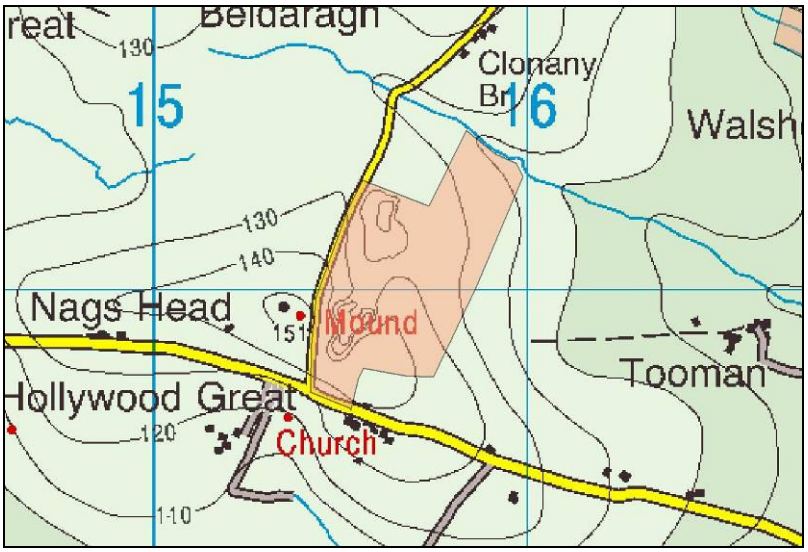
## Main Geological or Geomorphological Interest
This large working quarry 5km south of Naul exposes Lower Carboniferous rocks of the Loughshinny Formation - a mixture of thin to medium bedded limestone and shale. The structural deformation seen here, for example as chevron folds, reflects the geology also visible 12km away on the coast at Loughshinny. The Nags Head structures are bigger and are much better preserved than those on the coast as they have been sheltered from the erosion of the sea. In the northern part of the quarry, one of the very few exposures of Upper Carboniferous sandstones in North County Dublin, was reported to be exposed. The audit revealed that this Upper Carboniferous section has been backfilled, but it is possible that the sandstones may be uncovered in the future in another part of the quarry.

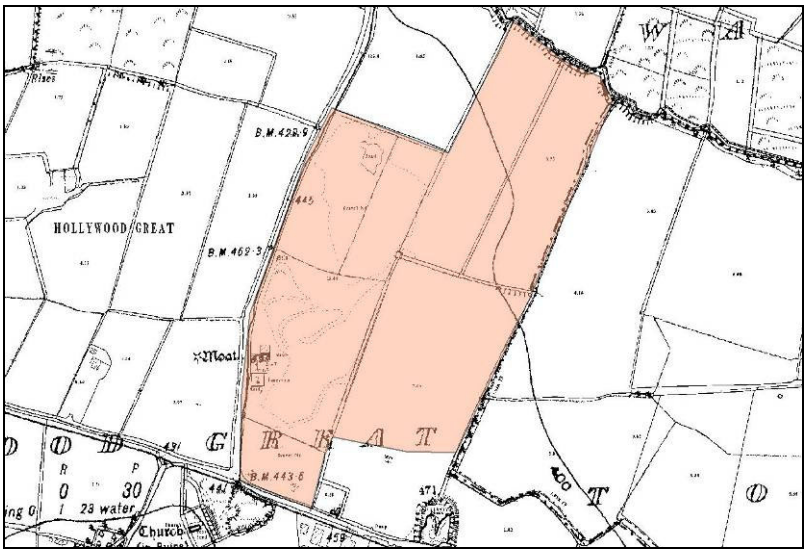
## Site Importance
This site shows impressive large scale structural features within the bedrock, that can only otherwise be observed along the coastal section at Loughshinny. This quarry would make an excellent teaching locality, while the walls are still exposed and it is recommended for County Geological Site status.

## Management/promotion issues
As a large scale working quarry, operated by Murphy Environmental, this is a potentially hazardous environment and is not suitable for general promotion without first contacting the owners. The quarry management may allow supervised educational groups inside the quarry, on request.

Above: Large scale chevron folds within the shale and limestone of the Loughshinny Formation at Nags Head Quarry.

# Nags Head Quarry




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Balrickard Quarry** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 9 (Upper Carboniferous) | | |
| **TOWNLAND(S)** | Balrickard | | |
| **NEAREST TOWN** | Skerries/Naul | | |
| **SIX INCH MAP NUMBER** | 4 | | |
| **NATIONAL GRID REFERENCE** | 317720 259690 = O 1772 5969 | | |
| **1:50,000 O.S. SHEET NUMBER** | 43 | **1/2 inch Sheet No.** | 13 |

## Outline Site Description
A disused quarry.

## Geological System/Age and Primary Rock Type
Upper Carboniferous (Namurian) sandstone and shale of the Balrickard Formation.

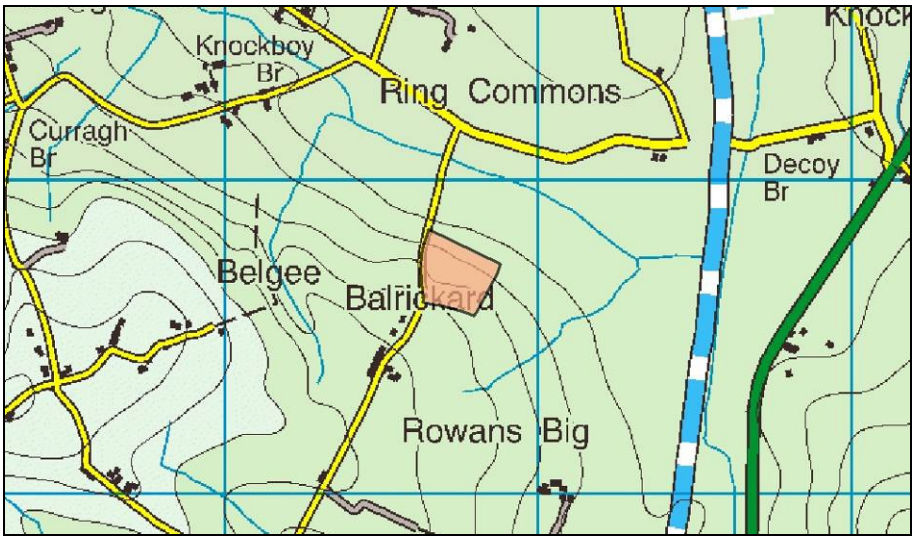
## Main Geological or Geomorphological Interest
This disused quarry, 6km east of Naul displays good exposures of thickly bedded coarse grained sandstone interbedded with dark grey shale, all dipping shallowly to the west.

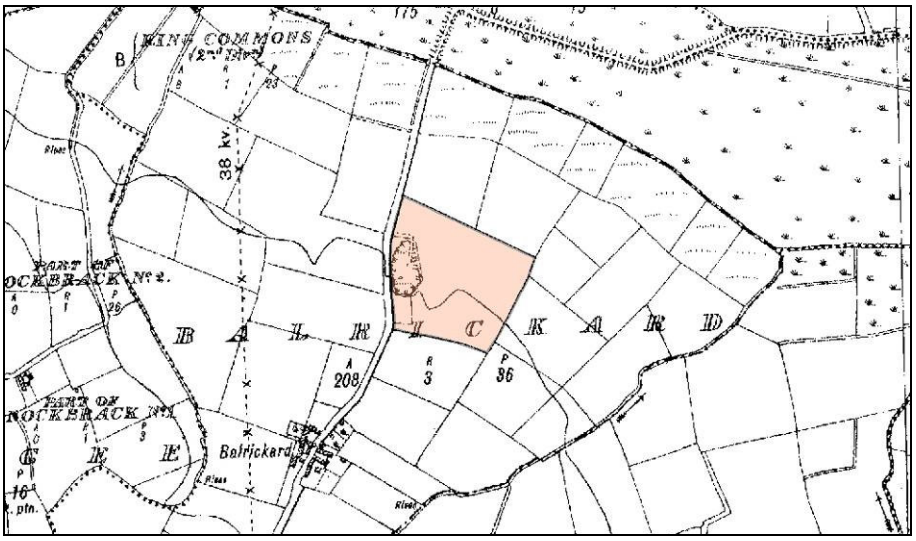
## Site Importance
This old quarry exposes rocks of the Balrickard Formation, which would otherwise not be accessible. This is one of the few examples in Fingal where this rock formation is so easily observed and should be recognised for its importance as a County Geological Site.

## Management/promotion issues
This site is privately owned agricultural land, with the area of interest being used as a shelter for cattle. The exposed rock faces are surrounded by deep mud and cattle effluent, which could pose a potential hazard. General promotion is not advised due to the nature of this site.

Left: A cattle shed constructed up against the walls of the disused quarry at Balrickard.
Right: Interbedded sandstone and shale of the Balrickard Formation. The thicker beds are made up of the coarse sandstones while the darker thinner beds are the shale.

# Balrickard Quarry




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Walshestown Stream Section.** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 9 (Upper Carboniferous and Permian) | | |
| **TOWNLAND(S)** | Walshestown, Rowans Little | | |
| **NEAREST TOWN** | Naul | | |
| **SIX INCH MAP NUMBER** | 4 | | |
| **NATIONAL GRID REFERENCE** | 317300 258300 = O 173 583 | | |
| **1:50,000 O.S. SHEET NUMBER** | 43 | **1/2 inch Sheet No.** | 13 |

## Outline Site Description
Rock exposures in the banks of a stream over a distance of 1.5km.

## Geological System/Age and Primary Rock Type
Upper Carboniferous (Namurian) shale, sandstone and limestone of the Walshestown and Balrickard Formations.

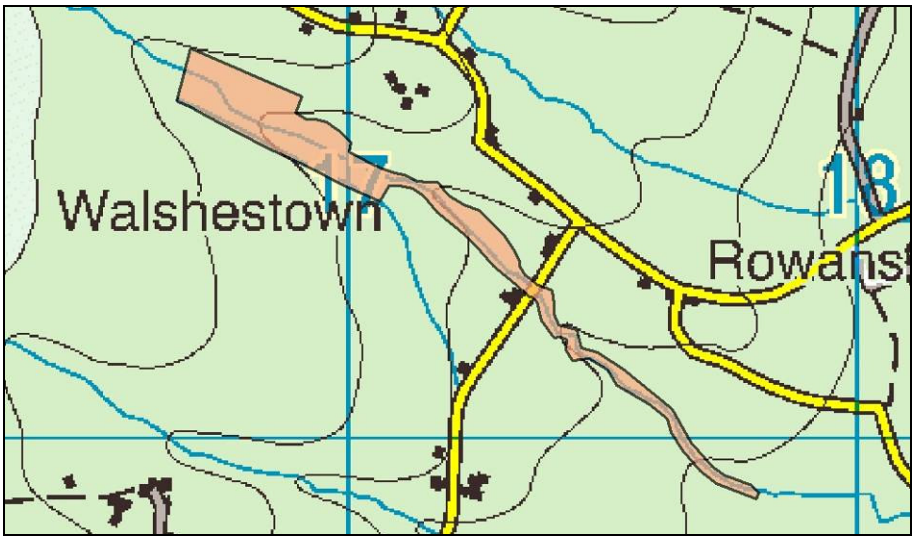
## Main Geological or Geomorphological Interest
A small deeply incised stream at Walshestown has exposed long sections of dark shale, which is occasionally interbedded with limestone and sandstone. This stream section displays excellent bedding, jointing and the occurrence of a fault. The rocks here, although mostly fresh, in places show several stages of mechanical weathering. A number of small waterfalls, with plunge pools occur along the length of this stream. A small tunnel, which allows the stream to flow under a third class road, displays some of the best exposed rocks of this section.

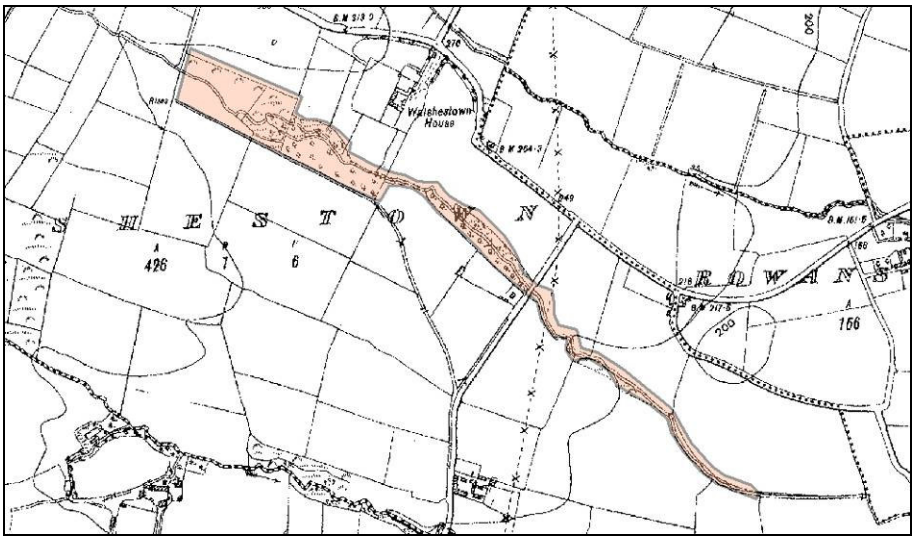
## Site Importance
Natural well exposed outcrops such as this stream section are rare and can be used by earth scientists as teaching localities and for mapping purposes. This stream section is therefore recommended as a County Geological Site.

## Management/promotion issues
The land is heavily forested and is private property; it is therefore not suitable for general promotion.

Above: Thinly interbedded shale and limestone (foreground) with a small waterfall and plunge pool (background) cutting into the surrounding bedrock.

# Walshestown Stream Section




# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Rockabill** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 11 (Igneous intrusions) | | |
| **TOWNLAND(S)** | | | |
| **NEAREST TOWN** | Skerries | | |
| **SIX INCH MAP NUMBER** | 5a | | |
| **NATIONAL GRID REFERENCE** | 332213 262623 = O322 626 | | |
| **1:50,000 O.S. SHEET NUMBER** | 43 | **1/2 inch Sheet No.** | 13 |

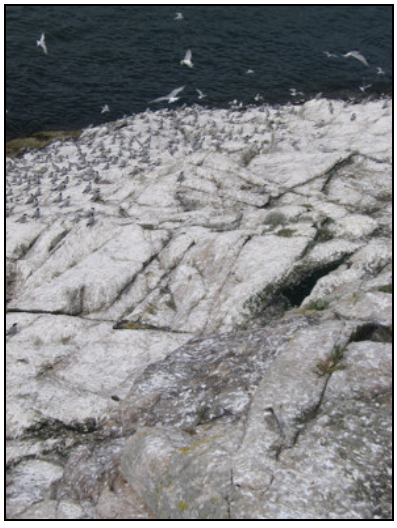
## Outline Site Description
Two entire islands.

## Geological System/Age and Primary Rock Type
Caledonian granite.

## Main Geological or Geomorphological Interest
This site consisting of two islands composed entirely of granite. Analysis of structures within the granite suggests it is of Caledonian age. This means it is closely related to the late Devonian granite plutons of south Dublin and Wicklow, as well as the Kentstown Granite known from gravity surveys to be buried under County Meath, and a minor granite at Drogheda.

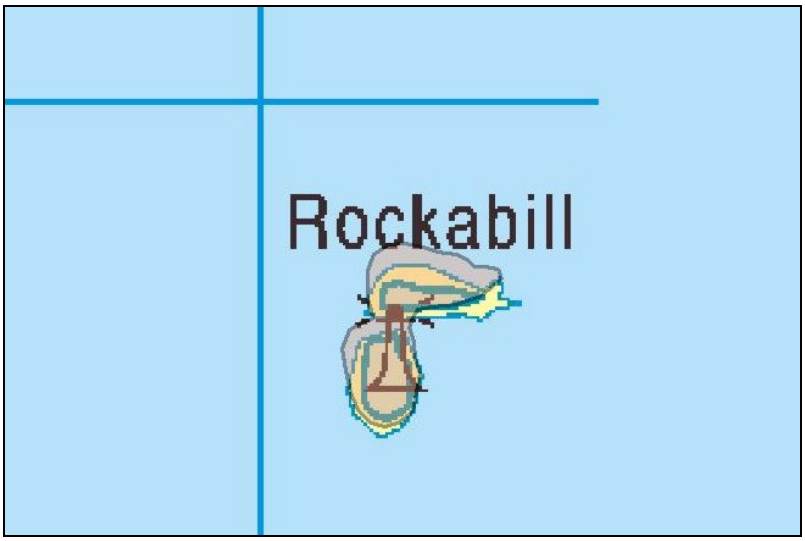
## Site Importance
The site is a significant outlier of granite from the main Leinster granite plutons. It deserves recognition as a County Geological Site in Fingal.

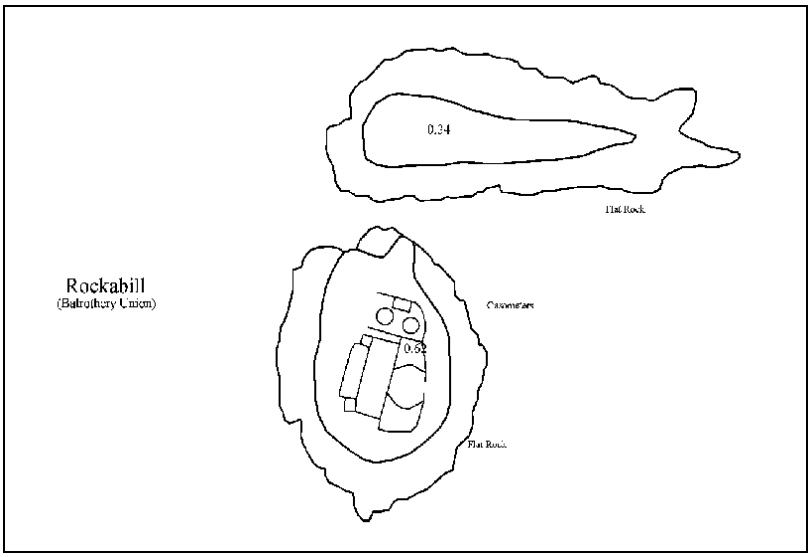
## Management/promotion issues
The site is already a very important nature conservation site for its breeding Roseate Tern population (Rockabill Island pNHA 207 and SPA 4014) and is occupied by Birdwatch Ireland project workers every season. The isolation and existing access restrictions to this nature conservation site are sufficient to protect it. No public promotion of its geology is advised. The guano provides a health risk for fieldwork. No fieldwork is possible during the bird breeding season.

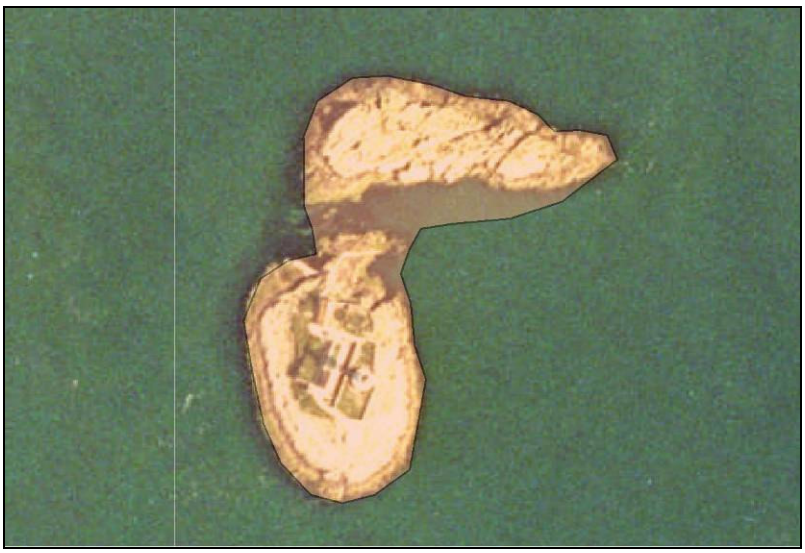




Left: Birdwatch Ireland staff during summer 2007 at the Rockabill Lighthouse.
Middle: Typical exposures of Rockabill granite covered by bird nests and guano during summer 2007.
Right: A view westward to the mainland from Rockabill, with typical rock platform around the lighthouse.

# Rockabill


Rockabill


0.34
Flat Rock
Rockabill
(Bairdfury Union)
Catamaran
0.52
Flat Rock



# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Malahide Point** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 13 (Coastal Geomorphology) | | |
| **TOWNLAND(S)** | Corballis | | |
| **NEAREST TOWN** | Donabate | | |
| **SIX INCH MAP NUMBER** | 12 | | |
| **NATIONAL GRID REFERENCE** | 324000 246000 = O 24 46 | | |
| **1:50,000 O.S. SHEET NUMBER** | 43, 50 | **1/2 inch Sheet No.** | 13 |

## Outline Site Description
Dunes and a sand/shingle spit.

## Geological System/Age and Primary Rock Type
Recent geomorphological landforms.

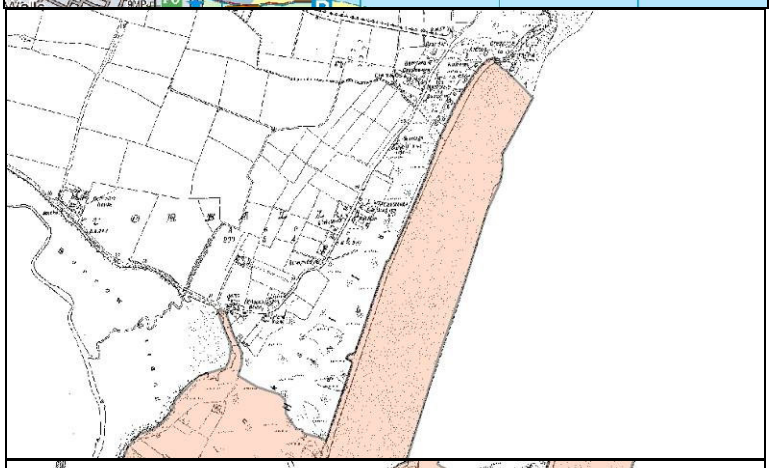
## Main Geological or Geomorphological Interest
This large geomorphological feature composed of a broad dune system and a long beach to its east is formed by the transport of beach material (primarily in this case of sand and shingle) by a process called longshore drift. This occurs when waves approach a shore obliquely and push transported beach deposits along the coast in the direction of the waves. A spit will form when there is a change in the shape of the coastline, such as a bay or small inlet, as seen north of Malahide. This causes the transported material to stretch out across the mouth of the bay to form what is called a spit. The continued flow of the Broadmeadow River prevents the spit from closing off and forming a lagoon.

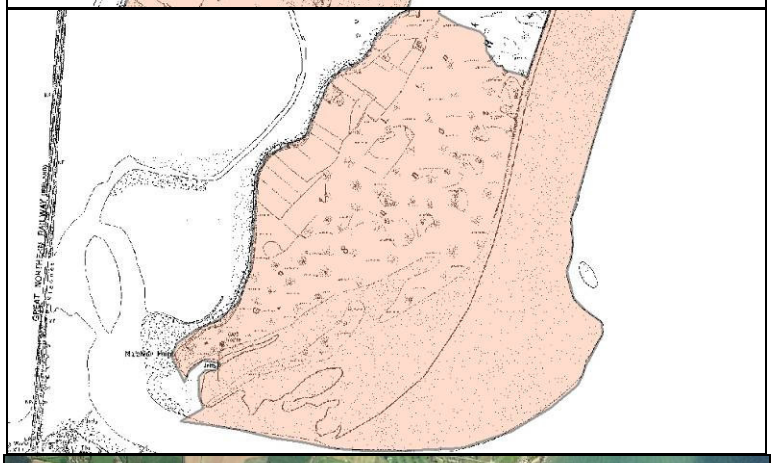
## Site Importance
This dune system is based on a shingle spit and is one of the best-developed and most natural in the country.

## Management/promotion issues
Malahide sand spit is surrounded and partly included in the existing Malahide Estuary pNHA and SAC (205). The beach and sand dunes are generally well maintained. Most of the small peninsula belongs to a local golf club, whereas the beach is public and can be accessed from the main road. Any change of land use of the spit from the existing golf links could be detrimental to the integrity of the spit.

Left: Sand and shingle deposits found along the east and southeast shores of Malahide Point.
Right: An elevated view of Malahide Point from near the summit of the Ben of Howth.

# Malahide Point



# FINGAL - COUNTY GEOLOGICAL SITE REPORT

| | | | |
|---|---|---|---|
| **NAME OF SITE** | **Mulhuddart Well** | | |
| Other names used for site | | | |
| **IGH THEME:** | IGH 16 (Hydrogeology) | | |
| **TOWNLAND(S)** | Buzzardstown | | |
| **NEAREST TOWN** | Mulhuddart | | |
| **SIX INCH MAP NUMBER** | 13 | | |
| **NATIONAL GRID REFERENCE** | 306960 241008 = O 069 410 | | |
| **1:50,000 O.S. SHEET NUMBER** | 50 | **1/2 inch Sheet No.** | 13 |

## Outline Site Description
Cold spring.

## Geological System/Age and Primary Rock Type
The water is presumably derived from either shallow bedrock or Quaternary deposits.

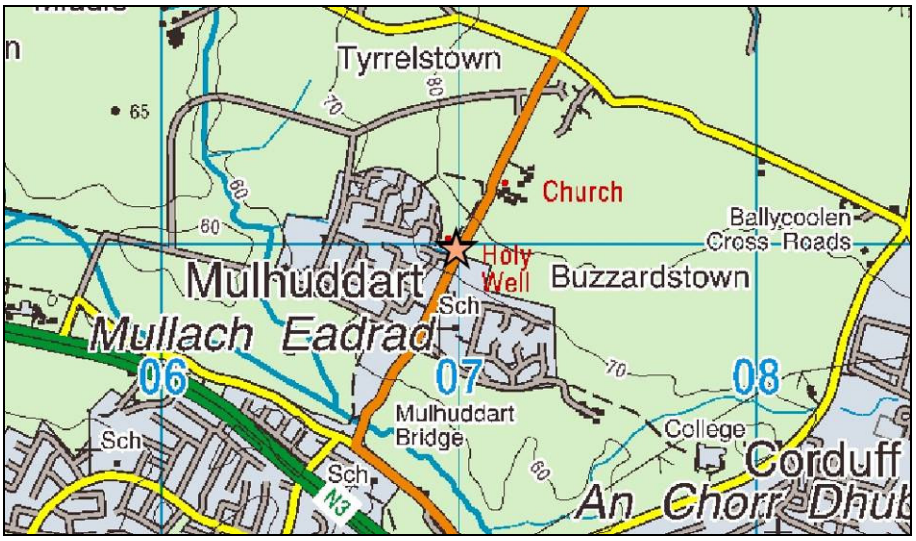
## Main Geological or Geomorphological Interest
This site is located just north of Mulhuddart along the R121. The spring is contained within a man-made white washed stone shrine at the roadside with a small opening on both its front and back walls. The mean depth is approximately 0.2m-0.3m and the substratum is composed of a layer of dark grey silt with some organic debris.

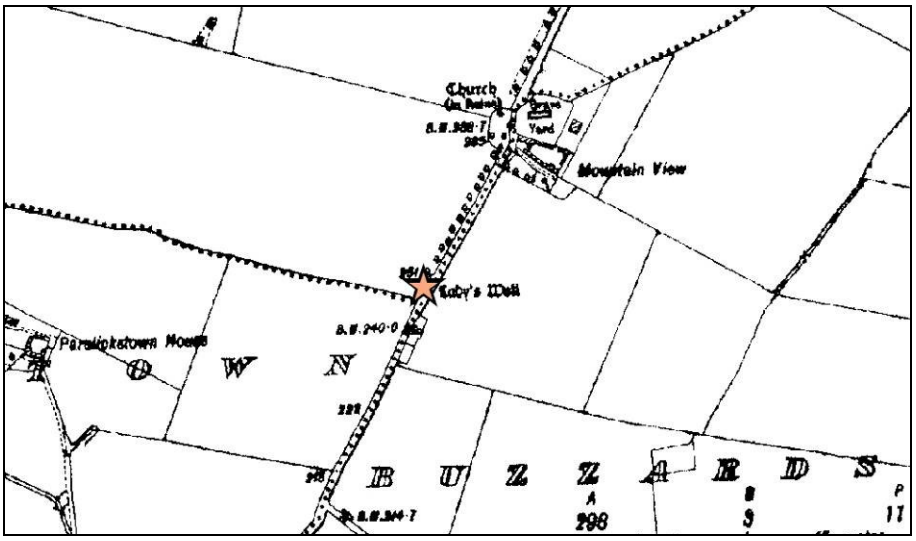
## Site Importance
This is simply a good example of a spring in a publicly accessible place and is considered to be worthy of promotion as a County Geological Site.

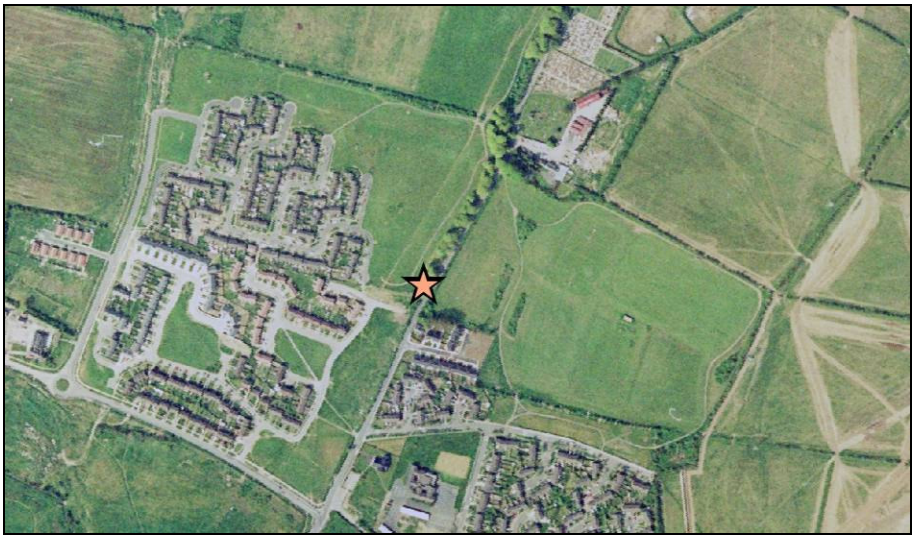
## Management/promotion issues
The site is well maintained but as it is right beside a busy road, care should be taken.

Left: Mulhuddart Holy Well.
Right: Spring water within this stone structure.

# Mulhuddart Well

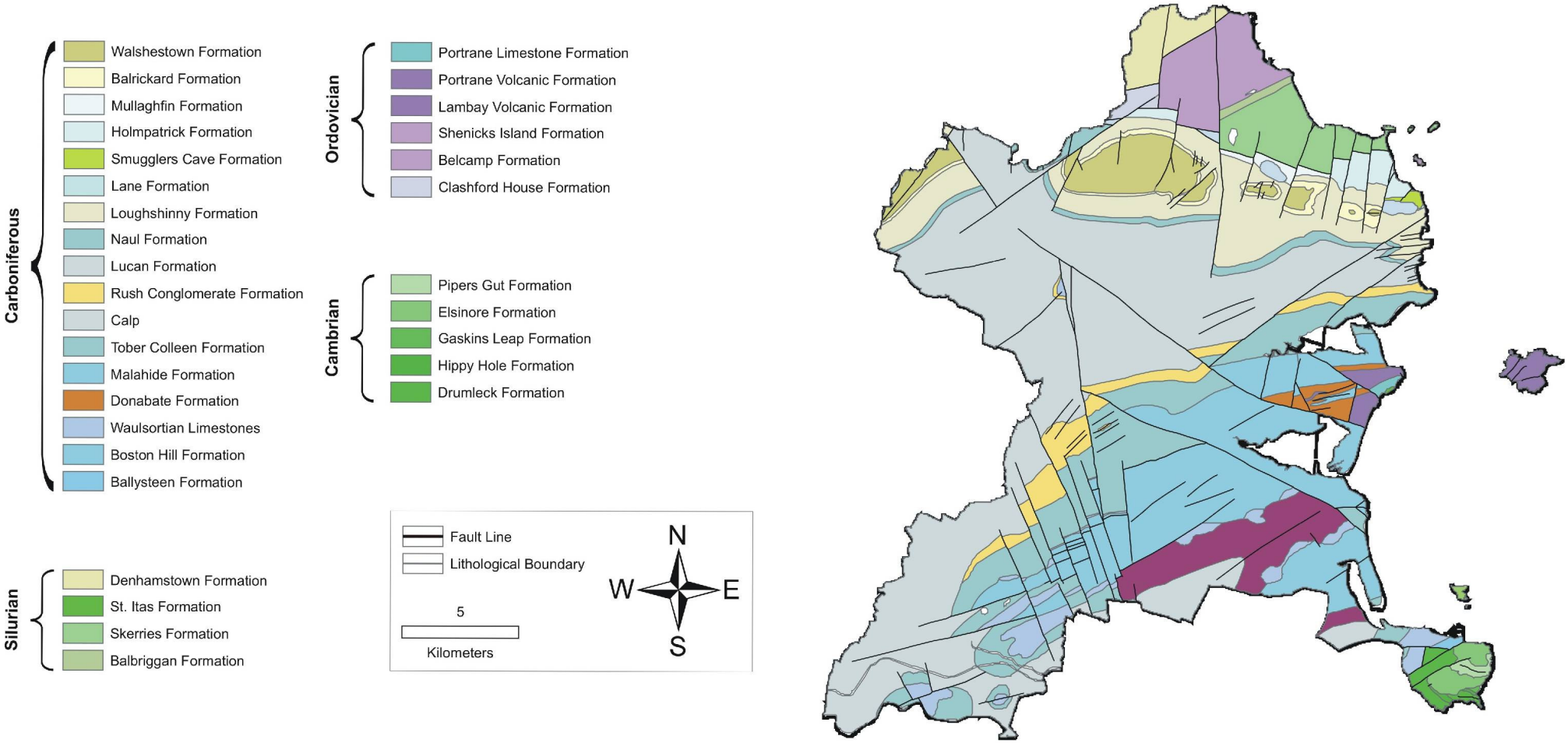


**Appendix 1**

# Detailed Geological Map of County Fingal



# Appendix 2 - Bibliography – Geology of County Fingal

This bibliography is quite comprehensive, but is certainly not claimed to be definitive. Any additional references (and preferably a copy of the publication) relating to the geology, geomorphology or hydrogeology of Fingal County will be welcomed by the Heritage Officer.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