

## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>Waterunderbridge – Dry Bridge</b>		
Other names used for site			
<b>IGH THEME</b>	<b>IGH1 Karst</b>		
<b>TOWNLAND(S)</b>	<b>Mell, Tullyallen</b>		
<b>NEAREST TOWN/VILLAGE</b>	<b>Drogheda</b>		
<b>SIX INCH MAP NUMBER</b>	<b>24</b>		
<b>ITM CO-ORDINATES</b>	<b>706225E 776585N</b>		
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>43</b>	<b>GS1 BEDROCK 1:100,000 SHEET NO.</b>	<b>13</b>

### **Outline Site Description**

A karstic sinking river starts at Waterunderbridge and continues downstream southwards as far as Dry Bridge. The site is mostly in a narrow, shallow gorge with the sometimes-dry streambed in it.

### **Geological System/Age and Primary Rock Type**

The rock is Carboniferous limestone of the Tullyallen Formation, and possibly also the Platin Formation, but the karstification is entirely post-glacial in age, formed during the last 10,000 years or less.

### **Main Geological or Geomorphological Interest**

Evidence from numerous sources shows that the limestones around Dry Bridge are karstified, including those in the nearby Mell Quarry (see Mell Quarry site report). Borehole logs from the area also show well-developed karstification with cavities accounting for approximately 10% of the original rock volume.

Numerous swallow holes were mapped in May 2008 and April 2010 in the bed of the stream which flows past Dry Bridge. Most of these were observed at Waterunder Bridge, approximately 800m northeast of the public supply borehole (seen today in the roadside block building at Dry Bridge). In drought conditions, the entire flow in the stream disappears into these swallow holes. During site visits in relatively dry conditions (19/05/2008 and 30/04/2010) this water was seen to resurface in the dry bed of the stream, some 200m downstream of where it sank. The flow in the stream was of greater magnitude during the 2008 visit. The exact locations of the final sinking of the stream and its subsequent resurgence downstream varied slightly between the two visits showing that the karst system is dynamic and that different karst pathways can be followed depending on the magnitude of flow through the system. The gully hosting the stream at Waterunderbridge, shows well developed epikarst, with frequent, large solutional openings in the rock.

### **Site Importance – County Geological Site**

Karst in County Louth is rare and this is a small but good example of classical karstic drainage, with sinks and risings.

### **Management/promotion issues**

The karst drainage is a near surface feature, and is presumed to be separate from the aquifer which provides a public supply at Dry Bridge. As it is possible to see parts of this feature from the roadside, it has the potential to be promoted in a modest way with a signboard or in other ways.



The public supply borehole at Drybridge, with the bridge beneath the two people.



The dry river bed is in the trees to the left of the grassy field, immediately north of Drybridge.

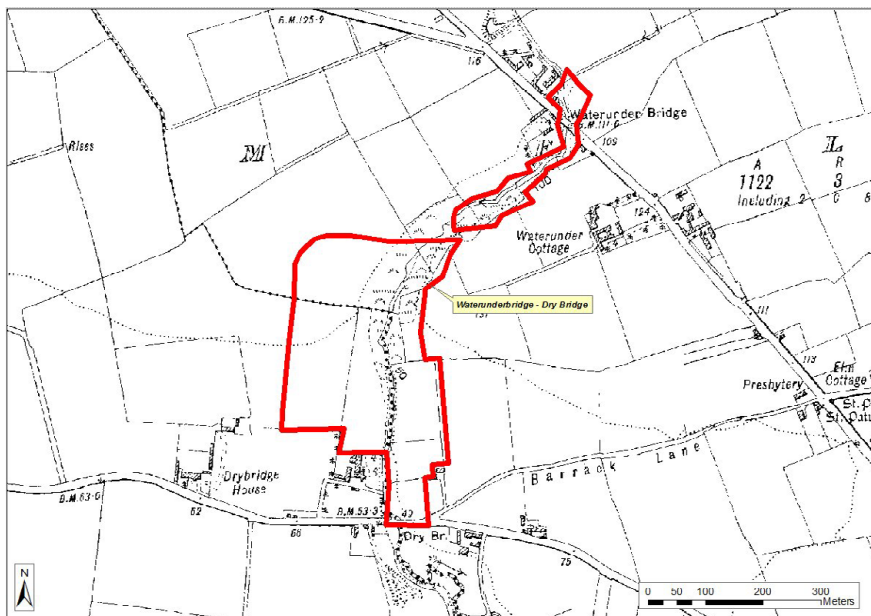
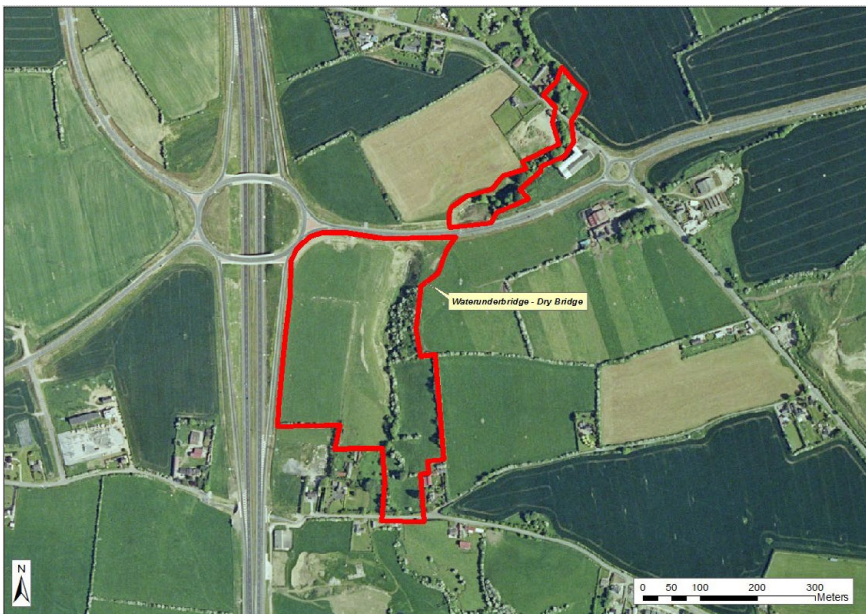
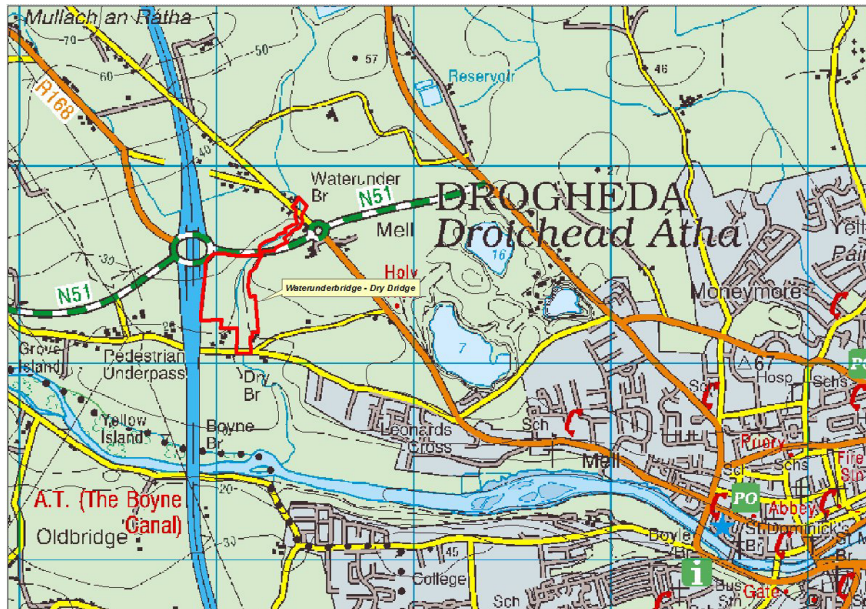


Limestone exposures in the channel.



The roadbridge at Drybridge is inconspicuous.









## LOUTH - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	Mell Quarry
Other names used for site	Tullyallen Quarry
IGH THEME	IGH1 Karst, IGH8 Lower Carboniferous, IGH7 Quaternary
TOWNLAND(S)	Mell
NEAREST TOWN/VILLAGE	Drogheda
SIX INCH MAP NUMBER	24
ITM CO-ORDINATES	707440E 776260N (centre of quarry area)
1:50,000 O.S. SHEET NUMBER	43 GSI BEDROCK 1:100,000 SHEET NO. 13

### Outline Site Description

This complex of disused quarries, which produced limestone for cement manufacture, is adjacent to and northwest of the town of Drogheda. In much geological literature the site has been referred to as Tullyallen Quarry, as opposed to the local name of Mell Quarry.

### Geological System/Age and Primary Rock Type

The rock quarried at Mell is Carboniferous limestone, from about 340 million years ago. It is classified as the Tullyallen Formation on the Geological Survey of Ireland's 1:100,000 bedrock map. Some glaciomarine sediments were also described from the site.

### Main Geological or Geomorphological Interest

The limestone at Mell Quarry is the best exposure of the Tullyallen Formation in the district. It also shows a high degree of karstification throughout the different parts of the quarry. Virtually all accessible faces show cavities in a range of sizes. Most are small tubes and expanded joints, but there are larger infilled tubes and some open voids. Much of the solution that produced the cavities was probably post-glacial, occurring over the course of the last 10,000 years. However, others are definitely much older and have fillings that look like glacial till squeezed into the cavities under high pressure from overlying ice sheets. Although it is unclear from presently accessible faces, it is quite likely that more significant pipes, which could have been interglacial or preglacial in age, were exposed during quarrying. There are published records of an important glaciomarine deposit, including *foraminifera* protozoa, from between two glacial tills overlying the limestone, but this has all been removed as overburden during quarrying. A supposed Palaeolithic tool was found here, thought to have been brought in by natural agents, such as ice or water, rather than having been deposited by a user in situ.

### Site Importance – County Geological Site

The karstification of the limestone is well displayed and this is an important CGS, but the absence of any significant Quaternary tills or associated glaciomarine sediments other than those in solution pipes, mean that research potential is now much diminished.

### Management/promotion issues

The ownership here is mostly Drogheda Council or Louth County Council, but sections of the quarry remain in other hands, including an area of buildings and plant on the east side. There are three flooded pits, probably very deep in places, which constitute a hazard to consider, along with high unfenced cliff edges. Part of the site has been backfilled with domestic waste as the local tip, but this is now grassed over and vented for gas, presenting a largely sanitary aspect. Some parts appear to have suffered a degree of illegal dumping but overall it is relatively clear of debris. Whilst the entire site is fenced, vandalism and trespass remain as concerns. The geological heritage could be made accessible and interpreted fairly easily as part of a community park or similar, but would have to be addressed in the context of an integrated plan for the entire complex. Isolation from human interference means that many animal species have made the site their home, and biodiversity must also be considered.



Karstified face at southern end, upper bench.



Glacial till infilling a tube.



Pothole shaft in limestone.

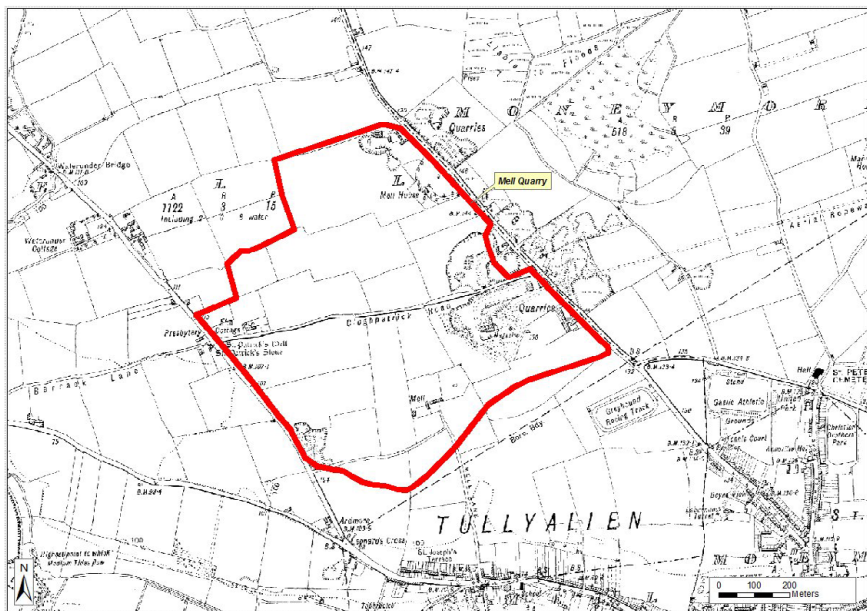


A marked cavity in the face, NE corner.



A panorama of northern quarry lake, with many karstic features in the upper bench facing, viewed from the top of the landfill in the centre of the quarry complex.









## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	Oriel Brook
Other names used for site	
<b>IGH THEME</b>	IGH2 Precambrian to Devonian Palaeontology
<b>TOWNLAND(S)</b>	Oriel
<b>NEAREST TOWN/VILLAGE</b>	Collon
<b>SIX INCH MAP NUMBER</b>	20
<b>ITM CO-ORDINATES</b>	700782E 784278N (centre of section)
<b>1:50,000 O.S. SHEET NUMBER</b>	36                      GSI BEDROCK 1:100,000 SHEET NO. 13

### Outline Site Description

This site is a stream section, with small exposures along the banks, within dense rhododendron plantations in the demesne of Mellifont Abbey.

### Geological System/Age and Primary Rock Type

The stream cuts through Upper Ordovician rocks. They are very poorly exposed mudstones of the Oriel Brook Formation and shales of the Broomfield Formation.

### Main Geological or Geomorphological Interest

The stream section has yielded a fossil assemblage of very small brachiopods and trilobites. The trilobites are classed as a cyclopygid fauna, and the brachiopods have been described as a *Foliomena* fauna. Both associations of small species indicate that the sediments were deposited in deep water outer shelf settings. They are also one of the youngest known faunas within the region, and are part of the Grangegeeth Terrane in the lapetus Suture Zone of Ireland.

### Site Importance – County Geological Site

The site is of County Geological Site importance. Despite poor exposure and overgrown rhododendron vegetation, the site is recommended as a CGS as there is much potential geological heritage interest especially if vegetation was removed in clear felling of the demesne forest.

### Management/promotion issues

The site is exceedingly overgrown with vegetation and almost no rock is visible in the darkness of rhododendron trees. However a diligent fossil collector could potentially add to the small known collections housed in the National Museum of Ireland, the Geological Survey of Ireland, the Natural History Museum in London and other institutions.



One of the main exposures.

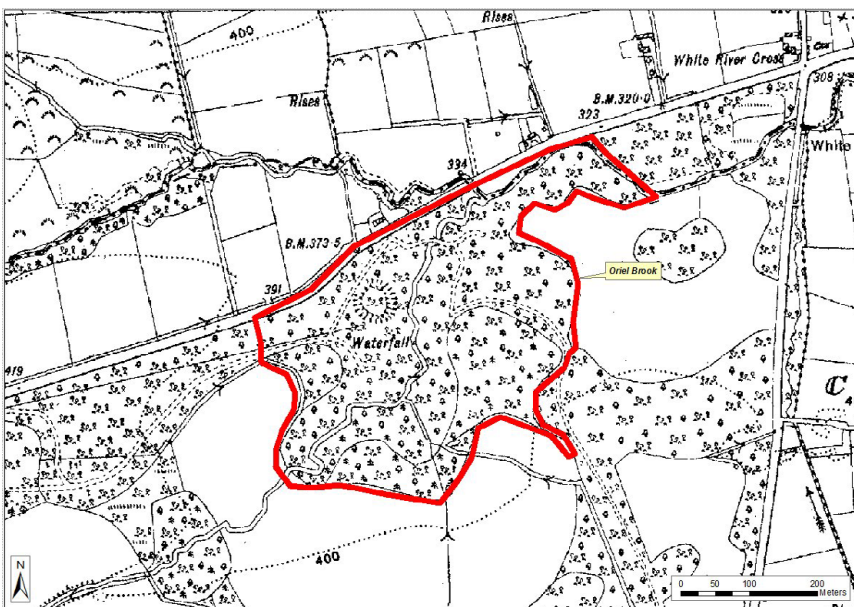
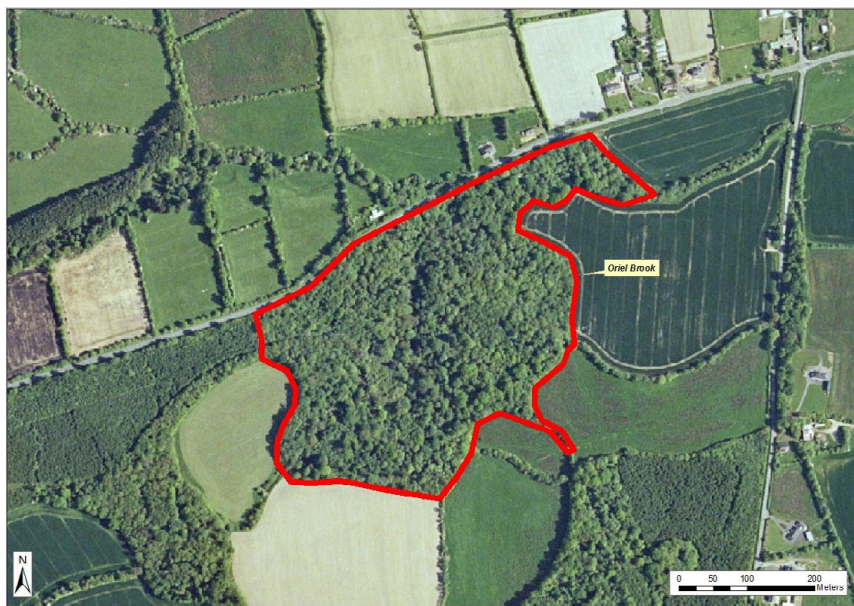


The stream is heavily overgrown.



A better exposure in the main fossil locality, in daytime daylight, made very dark by dense rhododendron cover.









# LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Clogher Head</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH 4 Cambrian to Silurian</b> <b>IGH 11 Igneous Intrusions</b>
<b>TOWNLAND(S)</b>	<b>Clogher</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Clogherhead</b>
<b>SIX INCH MAP NUMBER</b>	<b>22</b>
<b>ITM CO-ORDINATES</b>	<b>717110E 784095N</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 13</b>

## Outline Site Description

This is an approximately 750-long coastal section, between Port Oriel in the north and Red Man's Cove in the south, comprising extensive foreshore outcrops backed in places by steep cliffs.

## Geological System/Age and Primary Rock Type

Most of the rocks in the section are Silurian (Llandovery–Wenlock) in age, comprising coarse–fine-grained calcareous greywackes of the Clogher Head Formation that pass in the south into mudstones of the overlying Red Man's Cove Formation. Both formations are intruded by Caledonian lamprophyre dykes.

## Main Geological or Geomorphological Interest

Clogher Head lies south of the Tinure Fault, the local surface expression of the Iapetus suture, the line along which the Iapetus Ocean closed at the end of the Silurian. The coastal sections in this part of Ireland provide some of the best opportunities to study the different rock formations and structural features associated with this major episode.

The structural evolution of the area was complex during and following closure of the Iapetus but is most obviously manifested in the large-scale Clogher Head Anticline and associated cleavage, both of which strike broadly northeast-southwest, parallel to the regional Caledonian trend. Spectacular folding is a feature of the cliff exposures. The rocks are cut by a near-vertical cleavage that is refracted where it transects beds of differing competence. Some surfaces show tectonic rippling, an effect produced by intersection of cleavage and bedding.

Lamprophyres are relatively uncommon basic or ultrabasic igneous rocks typically found as small intrusions and have been linked to deep melting in subduction zones. They are calc-alkaline, have a high content of mafic minerals and lack quartz. The dykes at Clogher Head were emplaced late in the deformation history: some are cleaved and some post-date cleavage formation. They are generally aligned parallel to the main cleavage but are locally discordant, cutting across the cleavage.

## Site Importance – County Geological Site; may be recommended for Geological NHA

The entire site is within the Clogher Head SAC and proposed NHA. Its importance in the context of structural studies relating to closure of the Iapetus Ocean, the spectacular examples of folding and the presence of numerous lamprophyre dykes provide support for the proposed NHA designation.

## Management/promotion issues

Clogher Head is popular with walkers. Cliff erosion has led to renewal of fencing and erection of warning signs discouraging access to much of the foreshore between the head and Red Man's Cove. There is ample scope for erection of signage, especially at the northern end of the site where folding, cleavage and lamprophyres are all well displayed.



Large-scale asymmetrical fold in Clogher Head Formation greywackes (A4-size clipboard left) for scale), on Clogher Head.

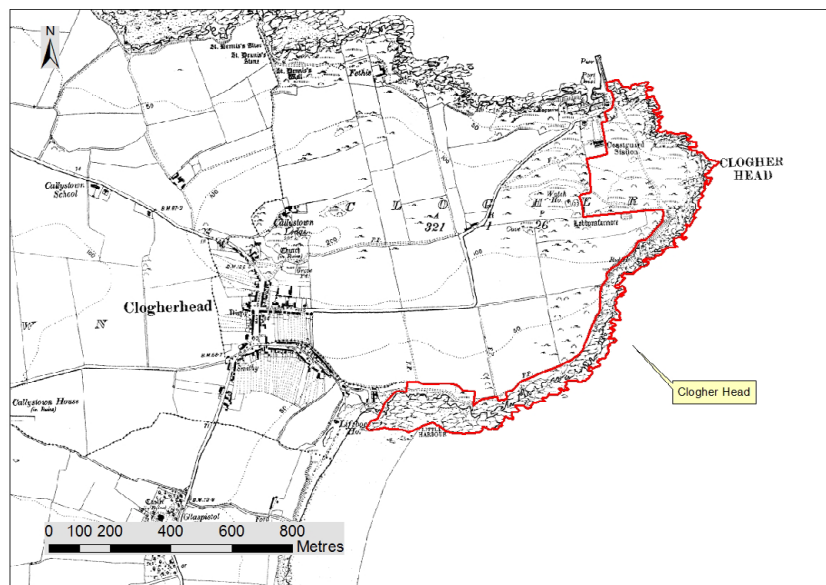


Cleavage refracted as it crosses beds of different competence (yellow line shows trace) (left); tight symmetrical fold in greywacke (right).



Lamprophyre dyke (left of line) emplaced into vertically cleaved greywacke (left); symmetrical fold plunging to east, Red Man's Cove (right)









## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>Collon Quarry</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH4 Cambrian to Silurian</b>
<b>TOWNLAND(S)</b>	<b>Collon</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Collon</b>
<b>SIX INCH MAP NUMBER</b>	<b>13</b>
<b>ITM CO-ORDINATES</b>	<b>699853E 781425N</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b> <b>GSI 1:100,000 BEDROCK Sheet NO. 13</b>

### **Outline Site Description**

This site is a disused quarry.

### **Geological System/Age and Primary Rock Type**

The rocks that were quarried here are Ordovician volcanic lavas of the Collon Formation. In modern stratigraphical terminology they are of probable Sandbian age, formerly of early Caradoc age.

### **Main Geological or Geomorphological Interest**

The volcanic lavas, described as autobrecciated keratophyres in 1952, are essentially andesitic lavas that were fragmented internally as they erupted so they have a broken-up or breccia texture. They were also altered chemically during or shortly after eruption so there are few primary features visible. They appear massive, although some separate lava flows may be distinguished.

On top of the lava flows, in some parts of the quarry, are some thin sedimentary rocks containing fossils of brachiopods, trilobites, crinoids, bryozoans, corals and others. These are from the base of the overlying Knockerk House Formation.

### **Site Importance – County Geological Site**

This is a site of County Geological Site importance as a representative section of the rock succession within the Grangegeeth Terrane in the Iapetus Suture zone of Ireland.

### **Management/promotion issues**

Future exploitation of the rocks here seems unlikely and the faces are beginning to become vegetated. The volcanic rocks are of interest to geologists but do not present much of visible interest to a non-specialist. Promotion of the site would only be an option if ownership and access were fully known and secured.



A panorama view of the southern side of the quarry from the northern side.

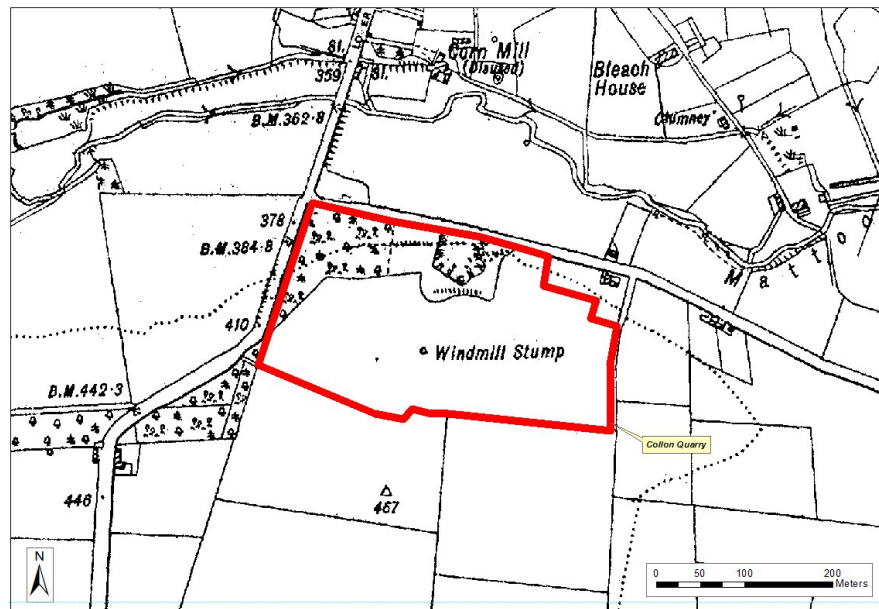
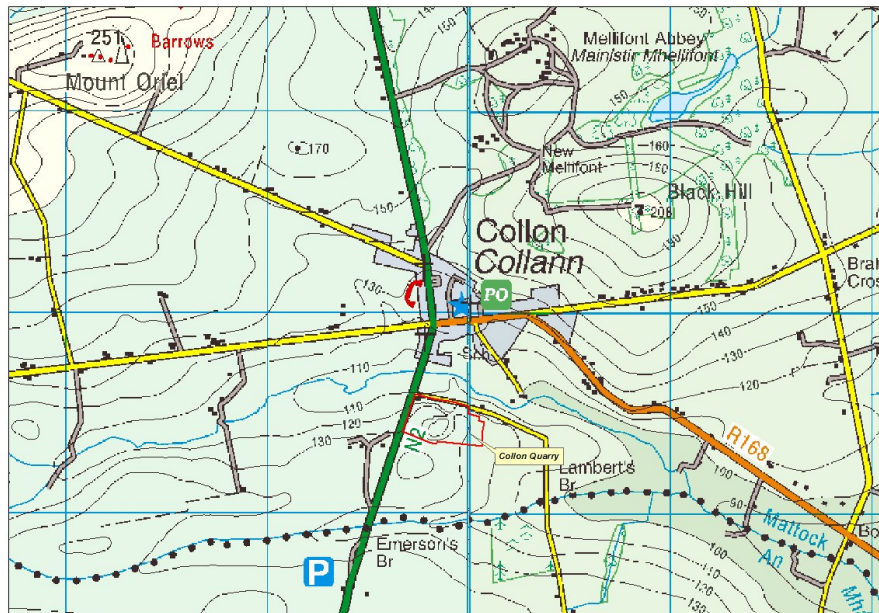


An upper bench on the southern side of Collon Quarry.



A view of a section on the southern margin of Collon Quarry where fossiliferous sediments overlie the volcanic lavas.









## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE:</b>	<b>Carlingford (OVERVIEW)</b>
<b>IGH THEMES:</b>	<b>IGH 6 Mineralogy; IGH 8 Lower Carboniferous IGH 11 Igneous Intrusions</b>
<b>TOWNLAND(S)</b>	<b>Liberties of Carlingford</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>
<b>SIX INCH MAP NUMBER</b>	<b>5</b>
<b>ITM CO-ORDINATES</b>	<b>713679E 811367N (centre of area)</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 8/9</b>

### **Outline Site Description**

The Carlingford geological heritage area embraces much of the Cooley Peninsula and most of the sites described here are found in the foothills and on the flanks of the mountains that form the core of the peninsula.

### **Geological System/Age and Primary Rock Type**

The Carlingford area is principally underlain by the Palaeogene (formerly called Tertiary) Carlingford Igneous Complex, a 59 million-year-old (Ma) complex comprising basalt, gabbro, dolerite and granite. The igneous rocks were emplaced into both Silurian metasediments (445 Ma) and Lower Carboniferous limestones and associated clastic rocks (330 Ma).

### **Main Geological or Geomorphological Interest**

Palaeogene volcanic and intrusive igneous rocks, emplaced during crustal rifting that accompanied the opening of the Atlantic, form the North Atlantic Thulean Volcanic Province that includes the Carlingford Complex, much of the bedrock in Northern Ireland (the Antrim Basalts, Mourne Mountain granites and the Slieve Gullion complex) as well as large igneous complexes in the Hebrides of western Scotland. Minor Palaeogene intrusions, principally dolerite dykes, are known to occur elsewhere in Ireland, e.g. in Donegal and Galway, but the Carlingford Igneous Complex, is the only example of large-scale Palaeogene magmatism in the country and, as such, is of national importance.

Research in the 20<sup>th</sup> century led to numerous publications on the geology of the Carlingford complex. As well as providing accounts of the timing and development of the complex, detailed descriptions of the mineralogy and petrology of the igneous rock types that comprise the complex and the complex interrelationship between gabbro, dolerite and granite, they also describe the effect of igneous intrusion and accompanying thermal metamorphism on the surrounding country rocks. In addition, several comparatively rare minerals that were previously unknown in Ireland were first reported from Carlingford.

### **Site Importance – County Geological Site; may be recommended for Geological NHA**

As the only example of large-scale Palaeogene magmatic activity in the country the Carlingford Igneous Complex is of national importance and should, in its entirety, be designated as a NHA. Within the area, numerous individual sites display specific features of the complex and these are described in the following pages. Some sites are, as far as is known, unique; others offer particularly good or interesting examples of features that are present throughout the area. Most should be designated as CGS.

### **Management/promotion issues**

A significant proportion of the Carlingford Igneous Complex and many of the various individual sites described here are within the proposed Carlingford Mountain and Carlingford Lough NHAs. Both are already SACs. The Cooley Peninsula is also part of the proposed Cooley-Mournes-Gullion Geopark. There is considerable scope for developing new signage and information packs as guides to this unique geological landscape.



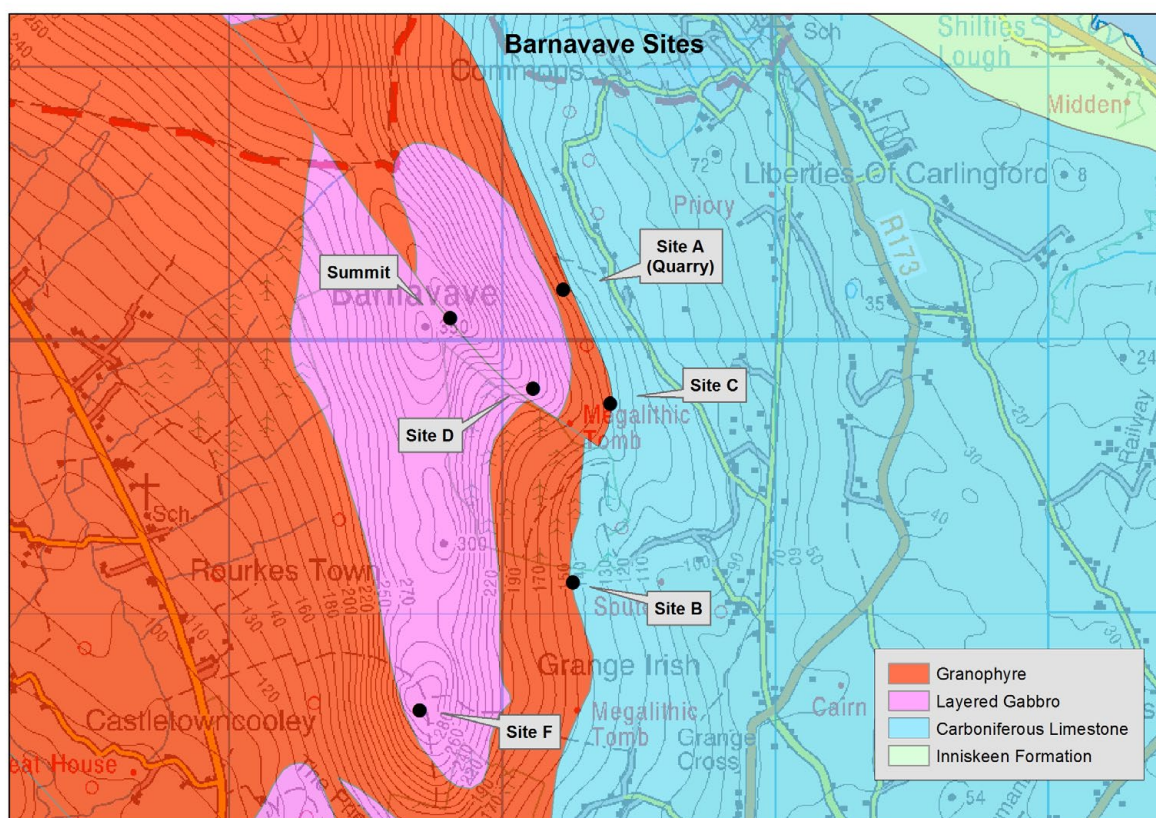


## Louth - Barnavave Area

<b>NAME OF SITE</b>	<b>Barnavave Area (OVERVIEW)</b>
<b>IGH THEMES</b>	<b>IGH 6 Mineralogy</b>
	<b>IGH 8 Lower Carboniferous</b>
	<b>IGH11 Igneous Intrusions</b>
<b>TOWNLAND(S)</b>	<b>Castletowncooley, Commons, Grange Irish</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>
<b>SIX INCH MAP NUMBER</b>	<b>8</b>
<b>ITM CO-ORDINATES</b>	<b>718155E 810190N (north), 717630E, 808654N (south)</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 8/9</b>

The Barnavave area comprises the southeastern end of the Carlingford Mountain uplands, including Barnavave Hill and the ridge to the south. The geology of the area was subject to detailed study in the first half of the 20<sup>th</sup> century. These studies included the petrology, mineralogy and chemistry of the granite-gabbro associations (Nockolds 1935, Osbourne 1932), and the petrology and mineralogy of thermally metamorphosed limestones (skarns) intruded by the granite and gabbro (Nockolds 1947, 1950). Baxter (2011), in her field guide to Cooley Peninsula, refers to two of the sites, Site A (Barnavave Quarry) and Site B, which she calls Grange Irish.

In the original papers, the various sites studied were plotted on sketch maps as “Site A”, “Site B”, etc. Emeleus and Preston (1970), in their field guide to the area, reproduced this site terminology on their map. As these sites have been subject to detailed scientific study they are considered to be important locations for observing and understanding the geology of the Carlingford Igneous Complex. Not all sites have been included in this guide, either because the original outcrop is no longer visible or accessible, but where they are the original site names are retained to ensure conformity with the original research papers. The location and geological setting of the Barnavave sites are shown in the sketch map below.







## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Barnavave Site C</b>		
Other names used for site			
<b>IGH THEME</b>	<b>IGH6 Mineralogy</b>		
<b>TOWNLAND(S)</b>	<b>Commons</b>		
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>		
<b>SIX INCH MAP NUMBER</b>	<b>8</b>		
<b>ITM CO-ORDINATES</b>	<b>718327E 809778N</b>		
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>	<b>GSI BEDROCK 1:100,000 Sheet NO.</b>	<b>8/9</b>

### Outline Site Description

The site consists of a series of small hillside outcrops on the eastern flank of Barnavave ridge, at an elevation of approximately 150m OD.

### Geological System/Age and Primary Rock Type

Lower Palaeozoic limestone, thermally metamorphosed to skarn, is here cut by thin veins of syenite that contains eudialyte and neptunite.

### Main Geological or Geomorphological Interest

The outcrops occur long the contact zone between the granophyric microgranite of the Carlingford Complex and the Lower Palaeozoic limestone country rock. The limestone along the contact zone has been thermally metamorphosed by the granophyre to skarn. Nockolds described the occurrence of syenite at several localities in the Barnavave area and he identified eudialyte and neptunite in thin sections of samples from a location in this area. The exact location is uncertain and the field visit for this audit made use of published small-scale sketch maps.

The area containing the outcrop of interest was largely overgrown when visited for this audit. One large outcrop (photo) of flat-bedded skarn was found, along with some smaller outcrops. Thin quartzo-feldspathic veins, corresponding to Nockold's description of syenite found at Barnavave, cut the skarn in places. None of the minerals described by him, in thin section, as occurring here were observed in the field and it is not clear if they can be identified without the aid of high magnification. Large relict fossils are here and there visible in the skarn.

### Site Importance – County Geological Site

The mineralogy of the rocks of the Barnavave area was the subject of detailed studies in the first half of the 20<sup>th</sup> century, leading to the publication of numerous papers by Nockolds, Osbourne and others which contained the first reported occurrence in Ireland of a number of minerals. The importance of the site lies in the fact that it yielded the first described examples of eudialyte and neptunite. However, the minerals cannot be readily discerned in the field and this site, like most other IGH6 sites in Carlingford, is likely to be of interest mainly to the scientific community.

### Management/promotion issues

The site is on open mountainside and there are no evident threats. It lies completely within the Carlingford Mountain SAC and proposed NHA. Promotion is not an important issue for this site.



View north on east flank of Barnavave Hill along contact between microgranite of Carlingford Complex and metamorphosed Carboniferous limestone (skarn)

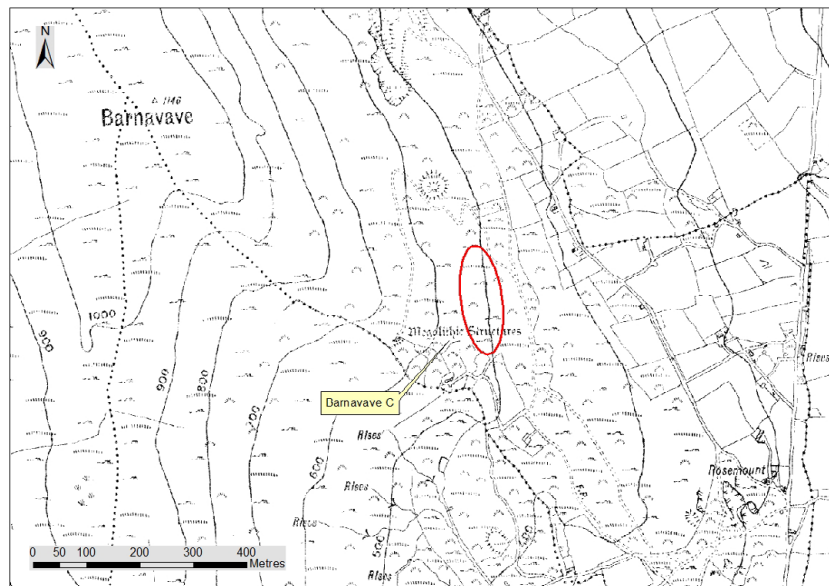
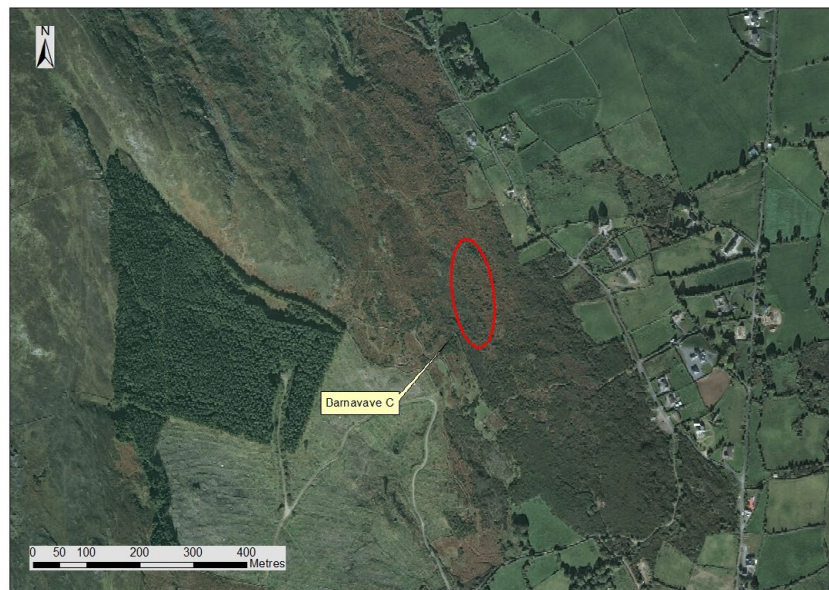
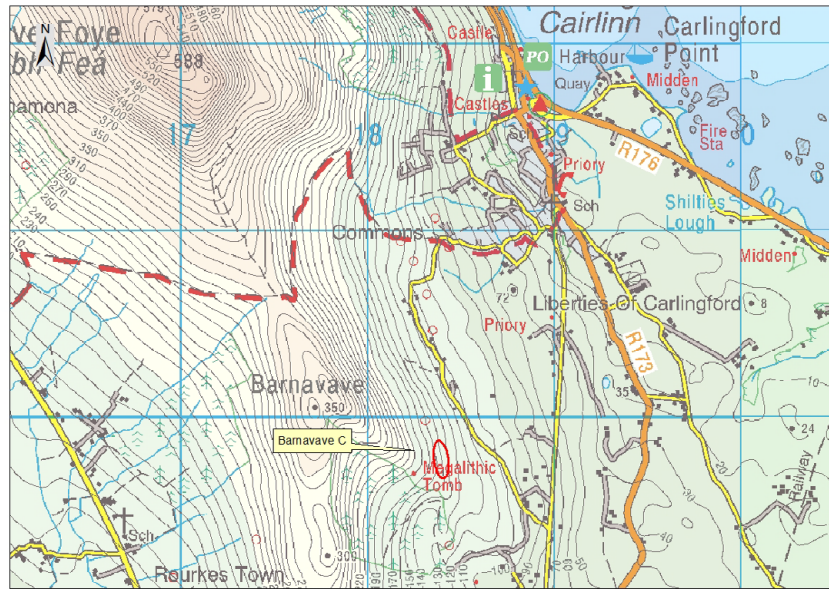


Outcrop of skarn showing near horizontal bedding



Skarn containing remnants of *Lithostrotion* coral (below hammer)









# LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Barnavave Site F</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH6 Mineralogy</b>
<b>TOWNLAND(S)</b>	<b>Castletowncooley</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>
<b>SIX INCH MAP NUMBER</b>	<b>8</b>
<b>ITM CO-ORDINATES</b>	<b>717630E 808654N</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 8/9</b>

## Outline Site Description

The site consists of a large crag on the summit of the unnamed hill that forms the southern end of the ridge extending south from Barnavave Hill.

## Geological System/Age and Primary Rock Type

The outcrop consists of gabbro of the Palaeogene Carlingford Igneous Complex enclosing a lens of thermally metamorphosed Lower Carboniferous limestone.

## Main Geological or Geomorphological Interest

The outcrop is one of a number in Carlingford where the first occurrence in Ireland of specific minerals was recognized. Nockolds described tilleyite ( $\text{Ca}_5(\text{Si}_2\text{O}_7)\text{CO}_3)_2$ ), spurrite ( $\text{Ca}_5(\text{SiO}_4)_2(\text{CO}_3)$ ), wollastonite ( $\text{CaSiO}_3$ ) and subordinate melilite ( $(\text{Ca},\text{Na})_2(\text{Fe},\text{Mg},\text{Al})(\text{AlSiO}_7)$ ) and idocrase or vesuvianite ( $(\text{Ca},\text{Na})_{19}(\text{Al}, \text{Mg}, \text{Fe})_{13}(\text{B},\text{Al},\text{Fe})_5(\text{Si}_2\text{O}_7)\text{SiO}_4)_{10}(\text{OH},\text{F},\text{O})_{10}$ ) from this outcrop. Tilleyite, first described in 1933 from metamorphosed limestone in California, and spurrite had not previously been recognized in Irish rocks.

The descriptions in the literature are apparently based on examination of thin-section samples. In outcrop, the altered limestone comprises a small, 1x1m lens of cream-white saccharoidal rock in which diffuse pink-, green- and grey-coloured zones can be observed. Nockolds provides a detailed account of these high-temperature assemblages observed in thin section, as well as lower-temperature assemblages arising from retrograde alteration of the original minerals during cooling.

## Site Importance – County Geological Site

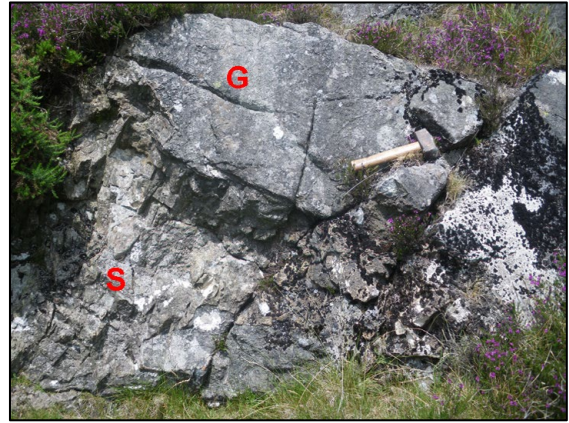
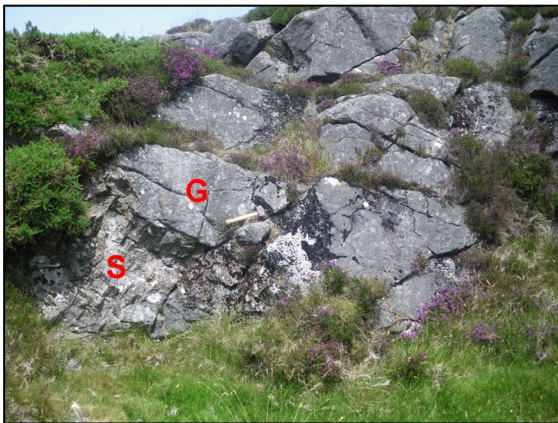
The site deserves recognition as the first recorded location in Ireland where tilleyite and spurrite were recognized. The two minerals were also recognized by Nockolds 300m north in an outcrop of limestone that was also thermally metamorphosed by intruding gabbro but this outcrop was not located during this audit. The two minerals have not been reported from thermally metamorphosed limestone elsewhere in the region.

## Management/promotion issues

The site is on the summit at the southern end of the Barnavave ridge and is within the Carlingford Mountain SAC and proposed NHA. It can be reached only on foot. The area is wholly unspoiled and there are no obvious threats to the outcrop. As the minerals of interest are to be observed primarily in thin section, the site is likely to be of interest mainly to scientists, although interest from mineral collectors cannot be discounted.



The outcrop immediately south of the summit trig point (upper right), looking north.

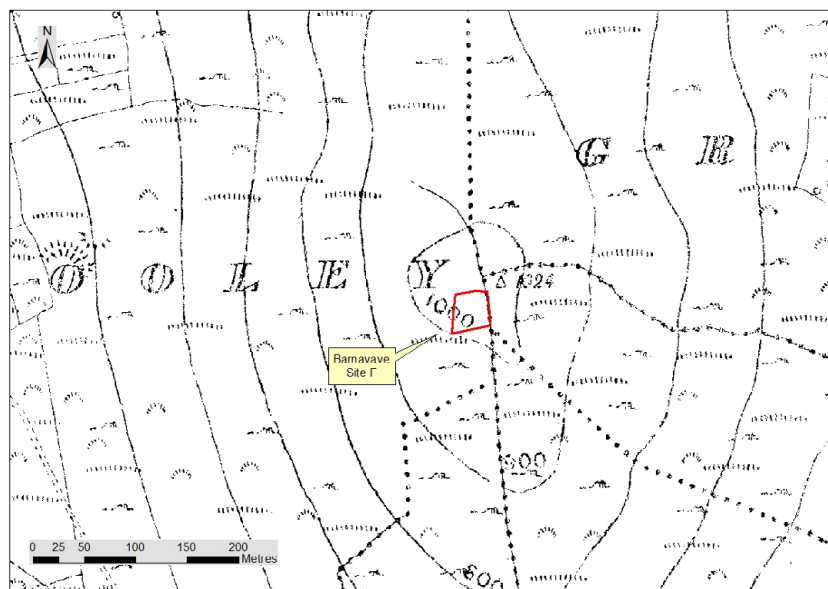
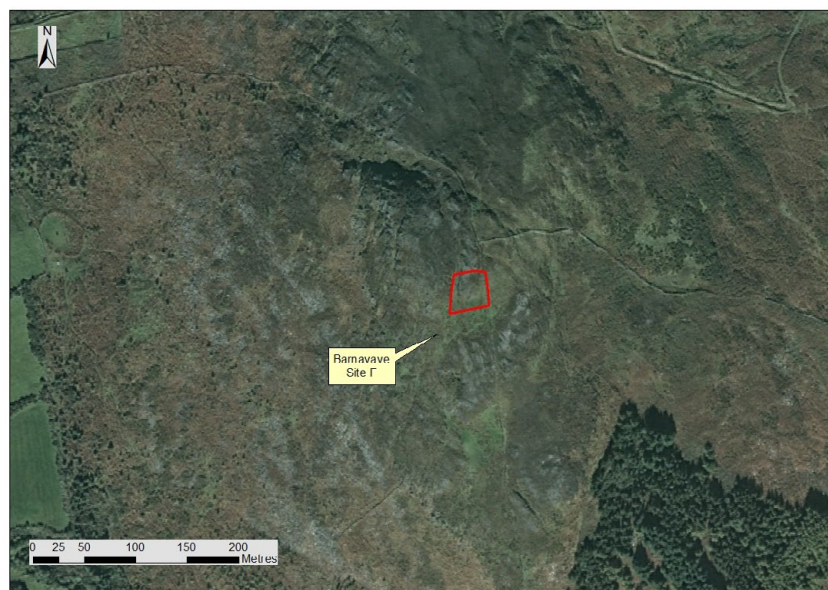
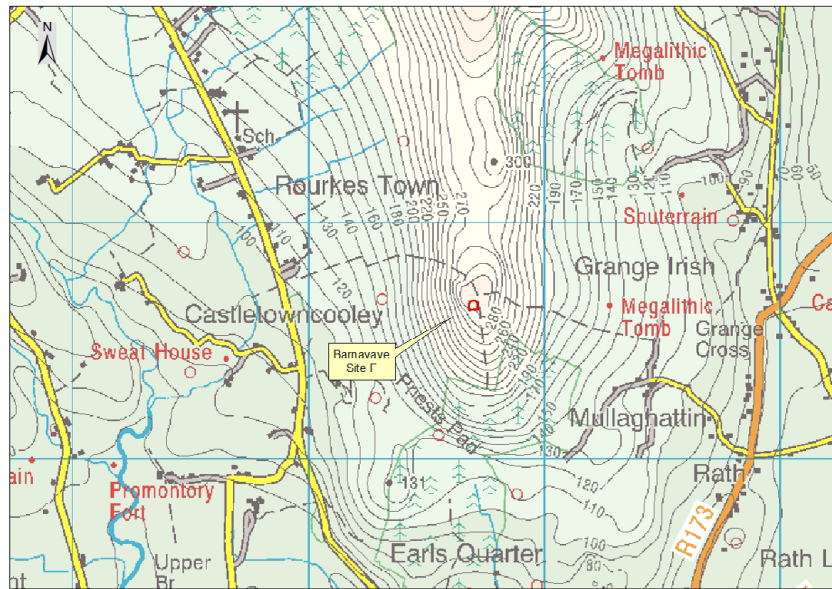


General (left) and close-up (right) view of skarn body (S) enclosed by massive gabbro (G).



Sharp contact between massive, darker-coloured gabbro and paler, thinly bedded skarn. The minerals tilleyite and spurrite, described in thin sections of samples from this locality, are not visible to the naked eye in outcrop.









## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>Ardee-Newtown Bedform Field</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH7 Quaternary</b>
<b>TOWNLAND(S)</b>	<b>Screedoge, Hurlstown, Bigisland, Smarmore</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Ardee</b>
<b>SIX INCH MAP NUMBER</b>	<b>17, 20</b>
<b>ITM CO-ORDINATE</b>	<b>695000E 788000N (centre of features)</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 13</b>

### **Outline Site Description**

This field of subglacial bedforms, which are features formed under the bed of an ice sheet, includes drumlins, crag-and-tails and ribbed moraines, and forms part of a small, discrete field of these features south and southwest of Ardee town. The field covers an area of 8 by 6 kilometres, and includes approx. 50 features. Some of the drumlins are superimposed on ribbed moraine features.

### **Geological System/Age and Primary Rock Type**

The bedforms are formed, in the majority of cases, on Lower Carboniferous limestone, but the higher crag-and-tails have formed on Silurian metasediments and volcanic rocks. The features themselves are Quaternary in age, having been deposited at the base of the ice sheet moving eastwards during the maximum period of the last Ice Age.

### **Main Geological or Geomorphological Interest**

The drumlin field forms the southeastern edge of the extensive 'Drumlin Belt' of north central Ireland, and was historically thought to include a wide, bounding end-moraine feature at the edge of the drumlin field. Research in the late 1990s and early 2000s, using analysis of Digital Elevation Models of the area, have shown that this is not the case, and that the 'wide band' of what was previously-considered end moraine actually includes a number of individual ribbed moraine and drumlin features.

The field is also unusual in a county context in that, in such a small area, a huge variety and range of sizes of subglacial bedform features are found. These range from small, individual drumlins around 200m in length and 30m in height, to high, composite crag-and-tails up to 3 km long and 80m high.

### **Site Importance – County Geological Site**

This is the southeastern edge of the traditionally-termed 'Drumlin Belt' and is important in its internal diversity and form with respect to subglacial bedform features.

### **Management/promotion issues**

This is an excellent site in terms of macro-scale Quaternary subglacial geomorphology. The features as a whole are too large to define as a single site with a specific boundary, as would be required for NHA status. However the landscape itself is particularly noteworthy and should be mentioned as unique in landscape elements within the Louth County Development Plan, and in Landscape Characterisation. A colour leaflet on 'The Drumlins of County Louth' could be produced.



A view of one of the drumlins just south of Ardee.



The complex bedform landscape just south of Ardee.









## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Bush Delta</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH7 Quaternary</b>
<b>TOWNLAND(S)</b>	<b>Ballaverty, Mullaghatten, Rath, Rath Lower</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>
<b>SIX INCH MAP NUMBER</b>	<b>8</b>
<b>ITM CO-ORDINATES</b>	<b>718260E 807400N (centre of feature)</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 8/9</b>

### Outline Site Description

The Bush 'delta' includes a large accumulation of sands and gravels deposited between two ice lobes centred on Carlingford Lough and Dundalk Bay, and records a topographically-induced parting of the ice sheet in the lee of the mountains.

### Geological System/Age and Primary Rock Type

The 'delta' is formed along the boundary between the granites and gabbros of the Carlingford Igneous Complex and the Lower Carboniferous limestone of the lowlands, on the southern side of the Carlingford peninsula. The 'delta' is Quaternary in age, having been deposited at the edge of the northward-retreating ice sheet during deglaciation after the last Ice Age.

### Main Geological or Geomorphological Interest

The 'delta' is a striking feature, standing proud of the bedrock-cored Mullaghatten ridge upon which it was deposited. It is comprised of a raised, elevated area of sands and gravels which looks upon first inspection to be a delta surface, but actually has a steeply-sloping face and many incised channels thereon. The sediments are up to 50m thick, and seem to have been deposited subaerially, comprising mainly cross beds. The lack of topsets and a purely flat surface on the feature suggests the subaerial origin.

Previously, the glacial literature recorded the delta as having been built out from ice margins into what is assumed to be a freshwater lake, as no shells were recovered from the feature. However, sedimentological assessment of the feature suggests that the likelihood is that the feature is actually a one-cone sandur formed in fresh water while the 'Irish Sea' glacier was uncoupling from the Mourne Mountains, yet before incursion of the saline sea water. It should be noted that no recorded and detailed, empirical sedimentological research has ever been conducted on the feature.

The delta feature is consequently important in unravelling the sequence of terrestrial to marine deposition in the northern Irish Sea Basin during deglaciation. The sands and gravels within the feature are comprised chiefly of granite clasts.

### Site Importance – County Geological Site

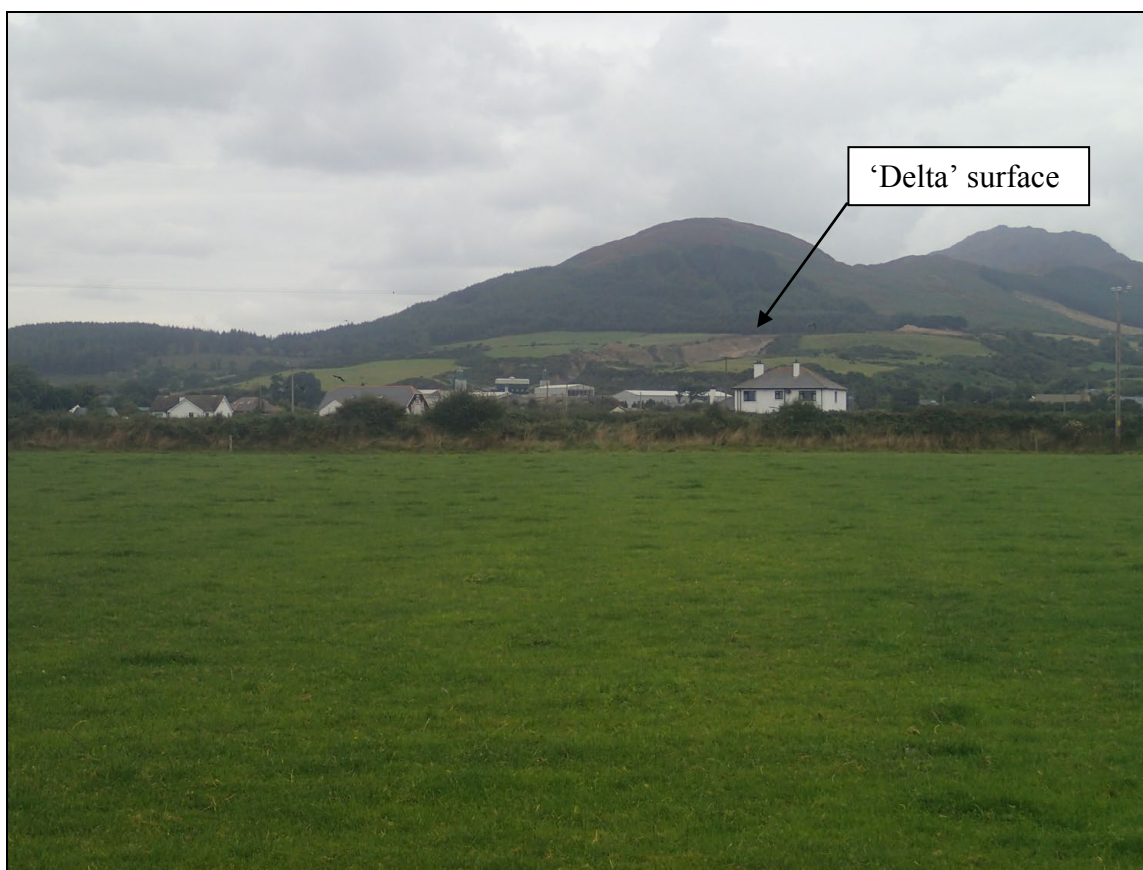
The feature is a high, striking example of a dry sand and gravel ridge, and stands proud of the surrounding landscape. This seems to be an excellent example of a deglacial, ice marginal, meltwater-deposited feature.

### Management/promotion issues

This system comprises a superb landform sequence and should be listed as a County Geological Site. A signboard at the stone monument at Riverstown, where the feature can be well seen, might help promote the feature.

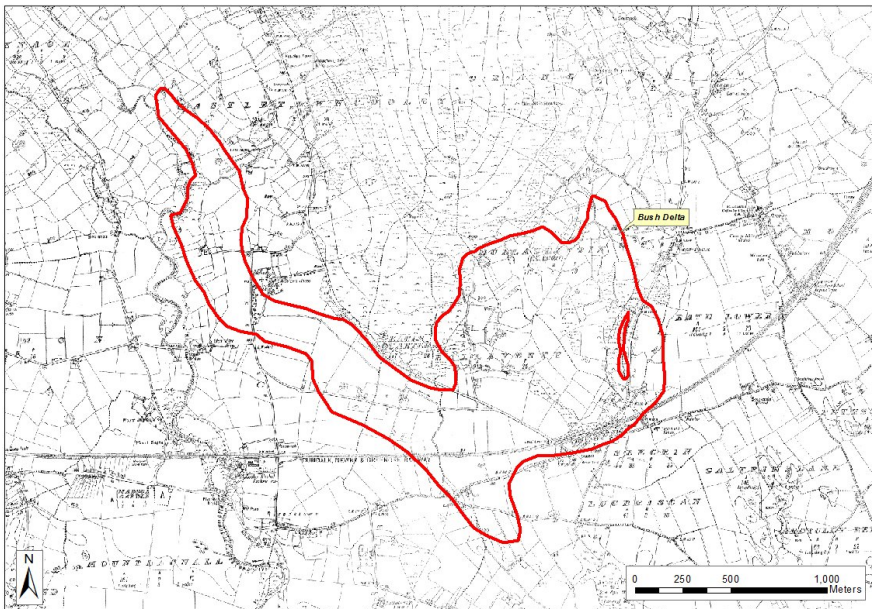
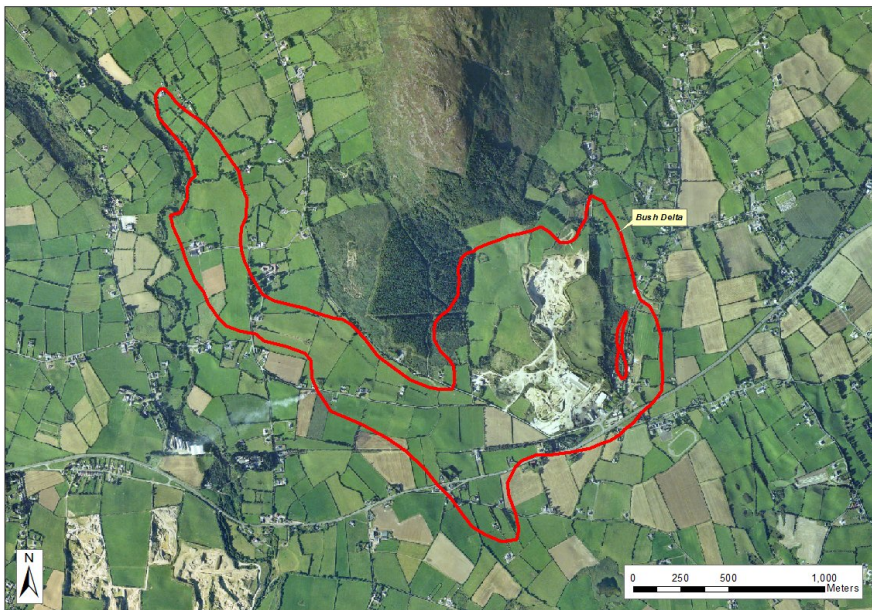


Gravel pit in the main 'delta' feature at The Bush.



See the flat-topped nature of the 'delta' feature, viewed from the south.









## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>Castlebellingham Morainic Complex</b>		
Other names used for site			
<b>IGH THEME</b>	<b>IGH7 Quaternary</b>		
<b>TOWNLAND(S)</b>	<b>Kilsaran, Milestown, Greenmount, Williamstown, Bolies</b>		
<b>NEAREST TOWN/VILLAGE</b>	<b>Castlebellingham</b>		
<b>SIX INCH MAP NUMBER</b>	<b>15</b>		
<b>ITM CO-ORDINATE</b>	<b>705300E 793300N (centre of feature)</b>		
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>	<b>GSI BEDROCK 1:100,000 SHEET NO.</b>	<b>13</b>

### **Outline Site Description**

The Castlebellingham Morainic Complex includes a large accumulation of sands and gravels deposited at the edge of the northward-retreating ice margin at the end of the last Ice Age.

### **Geological System/Age and Primary Rock Type**

The morainic complex formed on bedrock of Silurian metasediments and volcanic rocks, but the features comprising the complex itself are Quaternary in age.

### **Main Geological or Geomorphological Interest**

The morainic complex includes a distinctive hummocky topography just south of Castlebellingham where the land surface is formed of many small hummocks and marked hollows.

The feature is poorly exposed today but in the early 1970s Marshall McCabe logged many gravel pits from the area in detail. The topography reflects a wide range of depositional settings that resulted in ice-pushed ridges, hummocks and diamict ridges. McCabe has suggested that the morainic complex is part of the well-documented Killard Point Readvance System from north central Ireland, which can be correlated with the Heinrich 1 Event in the North Atlantic. During such events, armadas of icebergs broke off from glaciers and traversed the North Atlantic. The melting of the icebergs caused prodigious amounts of fresh water to be added to the North Atlantic Ocean.

The morainic complex is consequently important in unravelling the sequence of terrestrial to marine deposition in the northern Irish Sea Basin during deglaciation. The sands and gravels within the feature are comprised chiefly of sandstones and shales of Silurian-age.

### **Site Importance – County Geological Site**

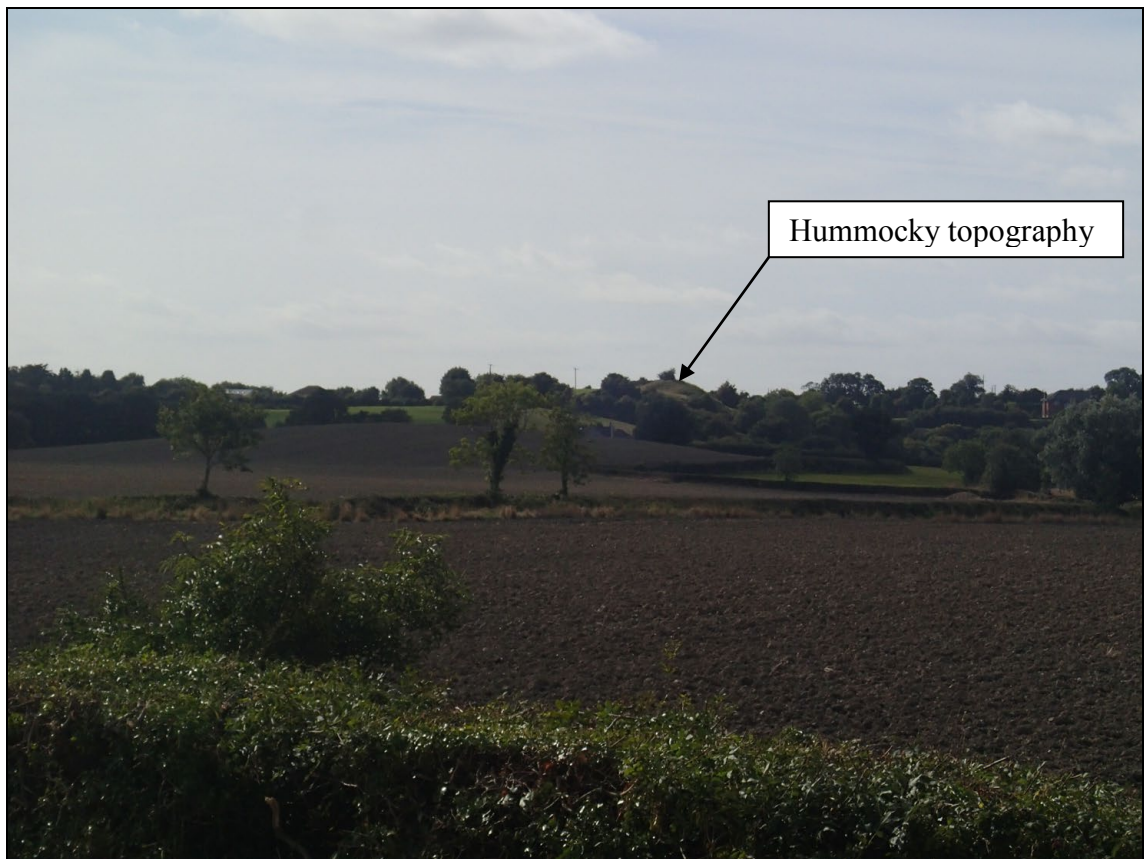
The feature is a good example of the haphazard, hummocky topography which forms at the retreating margin of a melting ice sheet.

### **Management/promotion issues**

This system comprises a fine landform sequence and should be listed as a County Geological Site. The hummocks are readily visible from the R132 between Mullincross and Greenmount.

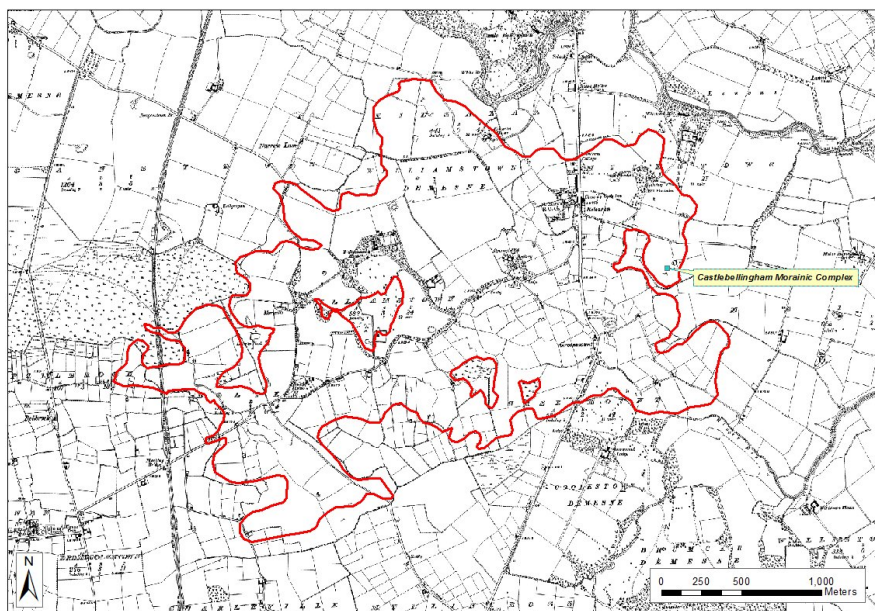
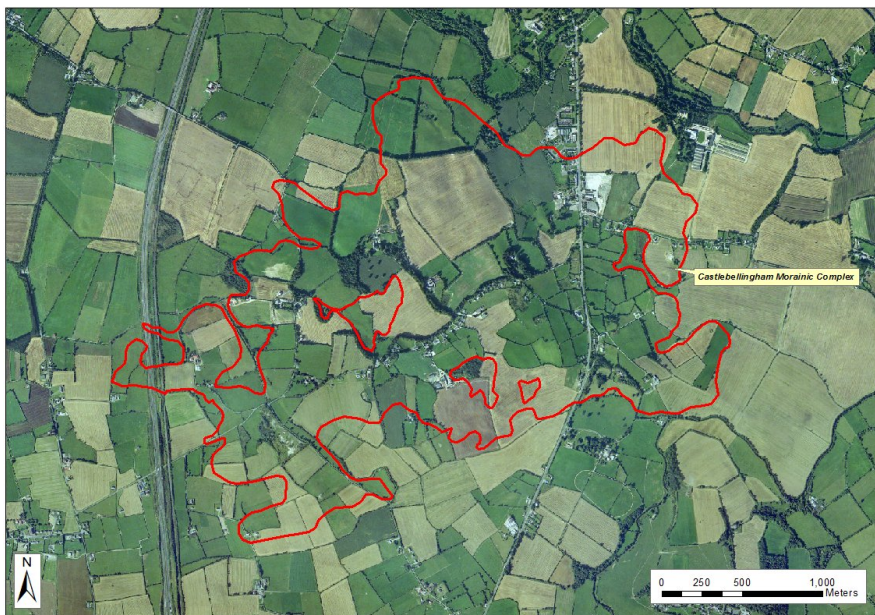


Well drained sand and gravel hummocks forming part of the morainic complex, at Milestown.



View of the edge of the hummocky morainic complex, at Greenmount, viewed from the northeast.







## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>Clogherhead Wave Cut Platform</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH7 Quaternary</b>
<b>TOWNLAND(S)</b>	<b>Clogher</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Clogherhead</b>
<b>SIX INCH MAP NUMBER</b>	<b>22</b>
<b>ITM CO-ORDINATES</b>	<b>717090E 784545N</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 13</b>

### **Outline Site Description**

This site includes an important erosional feature which was cut by high relative sea levels around the headland at Clogherhead.

### **Geological System/Age and Primary Rock Type**

The erosional features at Clogherhead were cut by marine action at the end of the last Ice Age, and are therefore Quaternary in age, but are cut into rocks which are of Silurian age.

### **Main Geological or Geomorphological Interest**

On the northern portion of the headland at Clogherhead a number of flat notches have been cut into the bedrock outcrops, giving the side of the hill there a staircase-like appearance. On the southern side of the headland, one wave-cut notch can be seen.

These notches are wave-cut platforms, which are also termed coastal benches, wave-cut benches or shore platforms. These are the narrow flat area often found at the base of a sea cliff or along the shoreline of a lake, bay, or sea that was created by the erosion of waves. Wave-cut platforms are usually most obvious at low tide when they become visible as huge areas of flat rock

Where sea level has fallen the wave cut platforms may be raised well above current sea level, and the fact that several can be seen along the northern side of the headland at Clogherhead means that the locality records the height of several post-glacial sea levels.

### **Site Importance – County Geological Site**

The wave-cut features at Clogherhead are important in terms the information their elevations provide in terms of relative sea levels during regional deglaciation episodes in this portion of the Irish Sea Basin.

### **Management/promotion issues**

The portion of the site on the southern side of the headland is accessible through public beach access and is therefore easily visited. On the northern side, visiting the features is tricky and will involve clambering along rocks.

The site is not at any great risk, although dumping of exotic rock boulders in any kind of coastal protection measure should be avoided. Given that it has safe access and the number of visitors to this area anyway, the wave-cut features at Clogherhead could be promoted more as an interesting geological locality. However, the geological stories that it displays are quite complex and not easily presented in a straightforward way and would need expert interpretive geologist input.

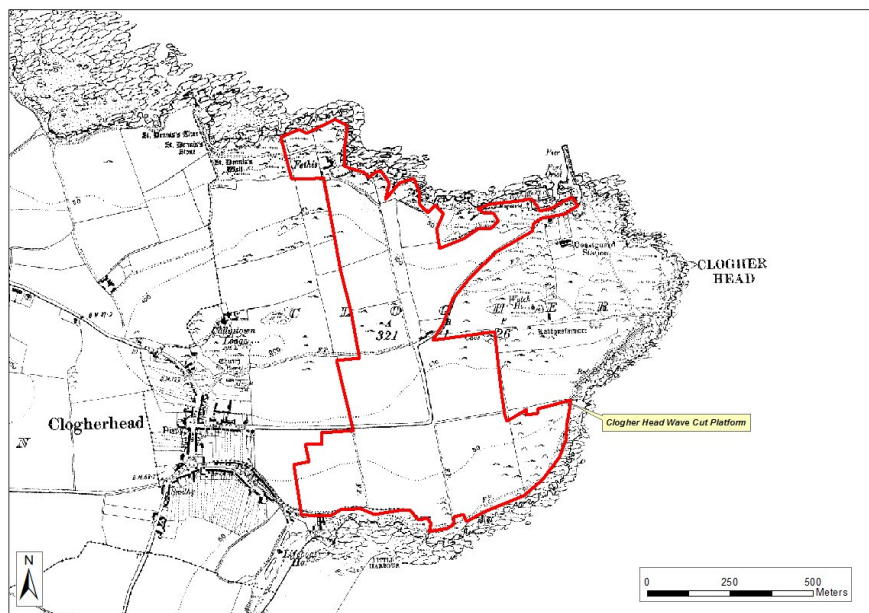




View along the north side of the headland at Clogherhead. See the 'staircase-like' form of the bedrock outcrops, recording wave washing and cutting.



View northeastwards from Glaspistol, towards Clogherhead. See the wave cut platform on the southern side of the headland.







## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	Cooley Point
Other names used for site	
<b>IGH THEME</b>	IGH7 Quaternary
<b>TOWNLAND(S)</b>	Templetown
<b>NEAREST TOWN/VILLAGE</b>	Greenore
<b>SIX INCH MAP NUMBER</b>	9
<b>ITM CO-ORDINATES</b>	721733E 805180N (centre of section)
<b>1:50,000 O.S. SHEET NUMBER</b>	36
<b>GSI BEDROCK 1:100,000 SHEET NO.</b>	8/9

### Outline Site Description

This site includes a low coastal cliff section that extends for several hundred metres and is c. 6m-8m high over most of its extent.

### Geological System/Age and Primary Rock Type

The cliff section at Cooley Point is comprised of Quaternary Age glacial sediments, deposited during deglaciation at the end of the last Ice Age.

### Main Geological or Geomorphological Interest

The cliff exposes sediments that are important to an understanding of relative sea levels in this part of Ireland during the end of the last Ice Age.

The exposure contains four main facies, or units, of sediment:

- (1) Massive and laminated muds are exposed at beach level over a length of about 200m. These yield samples of *Elphidium clavatum*, a genus of foraminiferan protozoa, which yielded an AMS <sup>14</sup>C age of 15,000 and 15,400 years BP.
- (2) The mud is overlain by a boulder pavement which is pressed into the marine muds. The pavement contains boulders which have bevelled upper surfaces, and most of the boulders are flat-lying.
- (3) The boulder pavement is in turn overlain by approximately 2m of laminated silty clay.
- (4) These then pass into a 2m thickness of laminated sand. These form part of a raised beach sequence.

The pavement is interpreted to have been deposited during a fall in high relative sea level in the area, and seems to have been deposited in the intertidal zone.

### Site Importance – County Geological Site

The section at Cooley Point is important as its stratigraphy provides information on regional deglaciation and the section shows an excellent example of a boulder pavement.

### Management/promotion issues

The site is accessible via the public beach and is therefore easily visited. The cliffs are prone to slumping, however, and care must be taken when close to the faces. The importance of the section could be highlighted in promotional material for the Carlingford Lough proposed NHA.

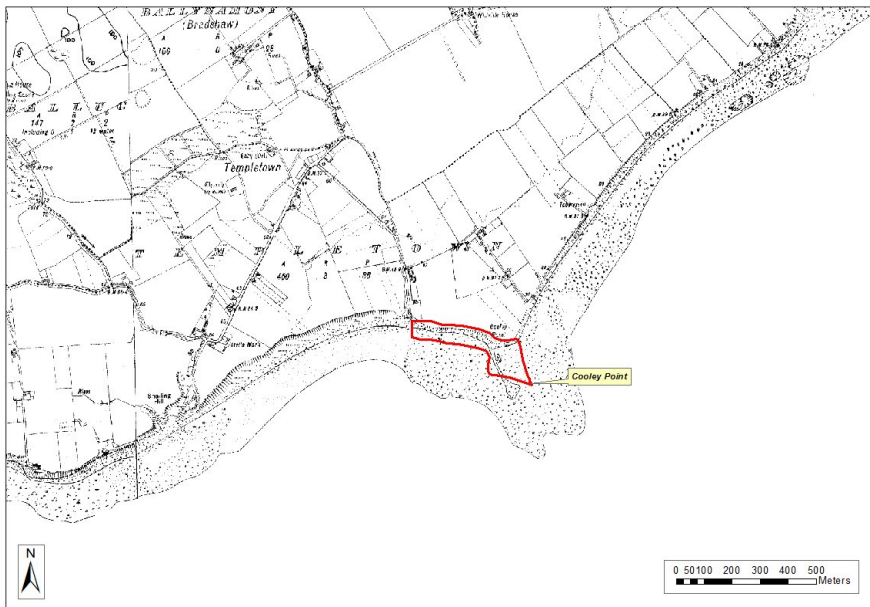


Boulder pavement overlying deformed muds, Cooley Point.



View northwards along the Cooley Point section, towards Cooley Point itself.









## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Dunany Point</b>
Other names used for site	Dunany Ridge, also Site of the Mad Chair of Dunany
<b>IGH THEME</b>	<b>IGH7 Quaternary</b>
<b>TOWNLAND(S)</b>	<b>Dunany</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Castlebellingham</b>
<b>SIX INCH MAP NUMBER</b>	<b>16, 19</b>
<b>ITM CO-ORDINATES</b>	<b>715915E 791400N (centre of section)</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 13</b>

### Outline Site Description

This site includes a coastal cliff section that extends for several hundred metres and is c. 8m-10m high over most of its extent.

### Geological System/Age and Primary Rock Type

The cliff section at Dunany Point is comprised of Quaternary Age glacial sediments, deposited during deglaciation at the end of the last Ice Age.

### Main Geological or Geomorphological Interest

The coastal section at Dunany Point is cut into a marked, west-east-trending ridge which is up to 25m high.

The cliff section exposes sediments important to an understanding of relative sea levels in this part of Ireland during the end of the last Ice Age. The sediments in the ridge consist mainly of muddy sediments that contrast starkly with the stratified deposits exposed along the north side of Dundalk Bay, at Rathcor and Cooley Point.

The Dunany Ridge is one of the highest and most continuous moraines in Ireland that has been interpreted to have been deposited in glaciomarine conditions (*i.e.* by a glacier into the sea). It is also the southernmost section showing definitively glaciomarine sediments along the east coast of Ireland, and was therefore at the southernmost extent of glaciomarine conditions in the Irish Sea Basin during the last deglaciation.

Dunany Point (*Dunany* being the anglicisation of *Dún Áine* -the fort of Áine) is said to be the place where the beautiful mythical Queen Áine sat in her chair of stone and looked across the sea, towards her love who never returned. Local folklore says that the black rocks at the base of the cliff were Áine's attempt to build a causeway, so she could see her love one day. They are in fact glacial erratics, which have fallen from the cliff as it has been eroded inland over the millennia.

### Site Importance – County Geological Site

The section at Dunany Point is important for the information its stratigraphy provides about the regional deglaciation in the Irish Sea Basin, and the section shows excellent examples of unsorted, heterogeneous glaciomarine sediment.

### Management/promotion issues

The site is accessible via the public beach and is therefore easily visited. The cliffs are prone to slumping, however, and care must be taken when close to the faces.

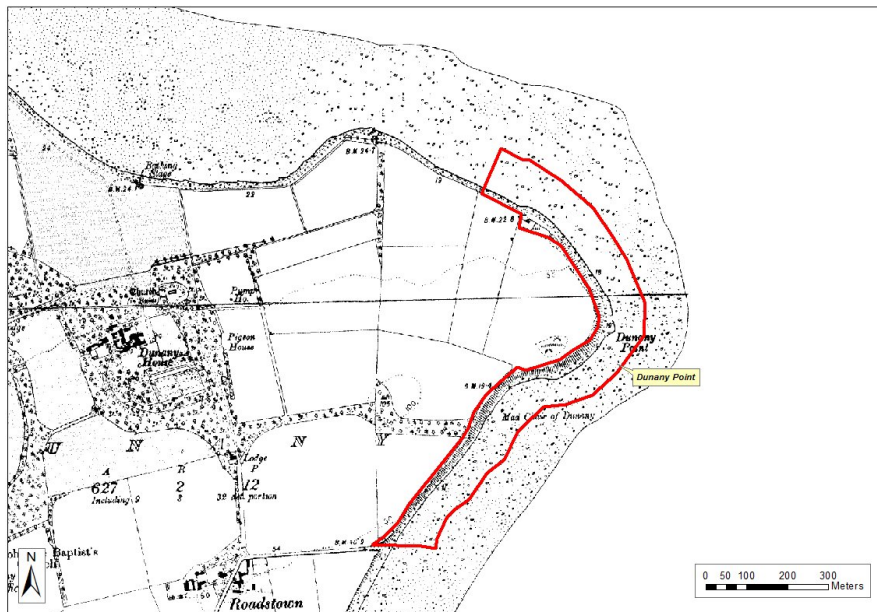
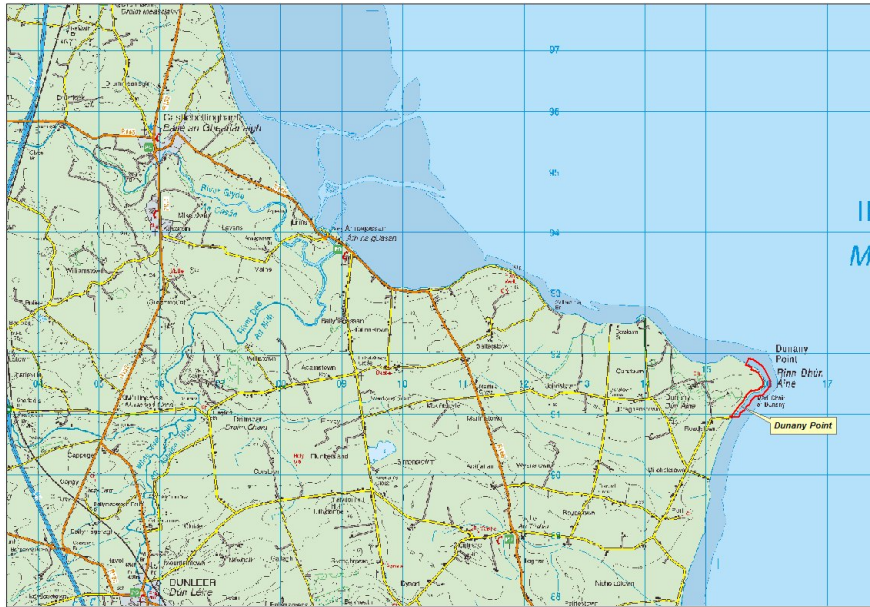


View northwards along the beach cliff sections at Dunany Point.



View northwards from Port, along the Dunany Point section, where the marked east-west ridge is also seen.







## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>King William's Glen</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH7 Quaternary, IGH8 Lower Carboniferous</b>
<b>TOWNLAND(S)</b>	<b>Tullyallen, Townley Hall</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Drogheda</b>
<b>SIX INCH MAP NUMBER</b>	<b>24</b>
<b>ITM CO-ORDINATES</b>	<b>704575E 776550N (centre of channel)</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>43 GSI BEDROCK 1:100,000 SHEET NO. 13</b>

### **Outline Site Description**

King William's Glen comprises a deep channel oriented generally northwest-southeast, and stretches for a distance of almost 2 km. A small stream flows along the base of the channel into the River Boyne.

### **Geological System/Age and Primary Rock Type**

The channel is formed in an area of glacial till of varying depths, with portions of bedrock outcrop or subcrop along its stretch. The till was deposited at the maximum of the last Ice Age. The channels themselves were formed during deglaciation at the end of the last Ice Age, by meltwater erosion along the northern edge of the Boyne Meltwater Complex.

The bedrock in the locality is varied, with Silurian shales underlying most of the channel stretch, and bedded, karstified limestone at the southernmost extent adjacent to the River Boyne.

### **Main Geological or Geomorphological Interest**

The channel is up to 20m deep and has a particularly well-developed U-shaped profile, typical of meltwater channels. The channel hosts a misfit stream, which is much smaller than the channel hosting the watercourse.

Though no dating or detailed study has been completed on the feature, it is considered to have formed completely in the late-glacial period. King William's Glen may have been formed subglacially initially, before it operated as a proglacial channel, something that is suggested by its unusual depth and size.

The crags of limestone across the road to the south, and adjacent to the River Boyne, are included in the site extent, as exposure of this limestone is extremely rare in County Louth.

### **Site Importance – County Geological Site**

This is a location with good potential as a teaching site on glacial meltwater erosion, as the feature is accessible and easily viewed from both the car park at its southern end, and the Battle of the Boyne site across the road to the south.

### **Management/promotion issues**

The roadside location of the feature means it is easily accessible, although the majority of the land within the channel itself is presumably either privately owned or in commonage. Parking is available and a signboard in the car park outlining the formation of the channel itself, as well as the bedrock geology of the locality, may help promote the feature.



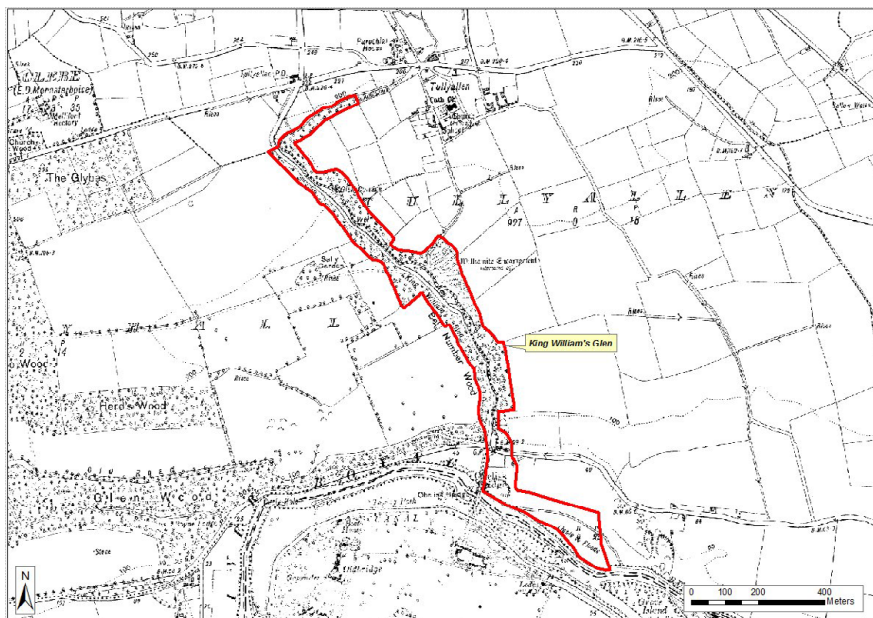
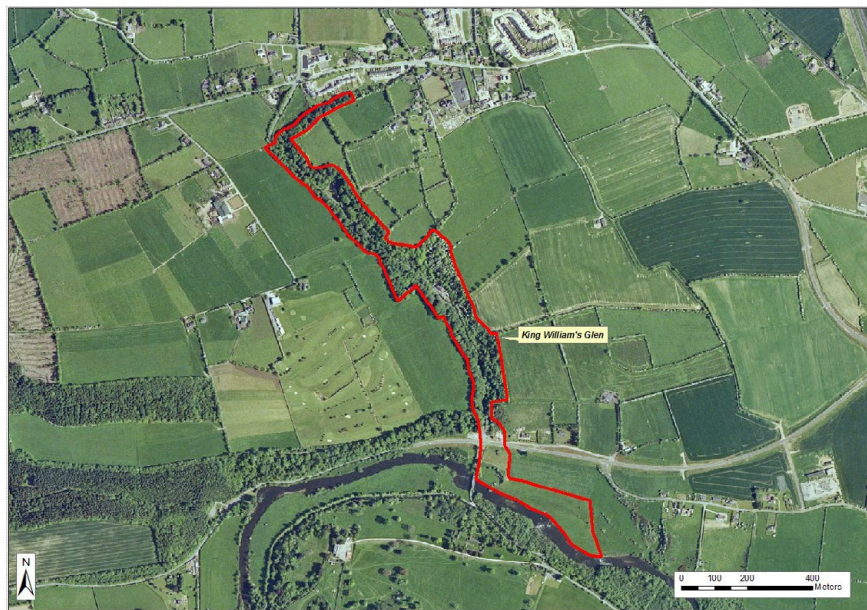
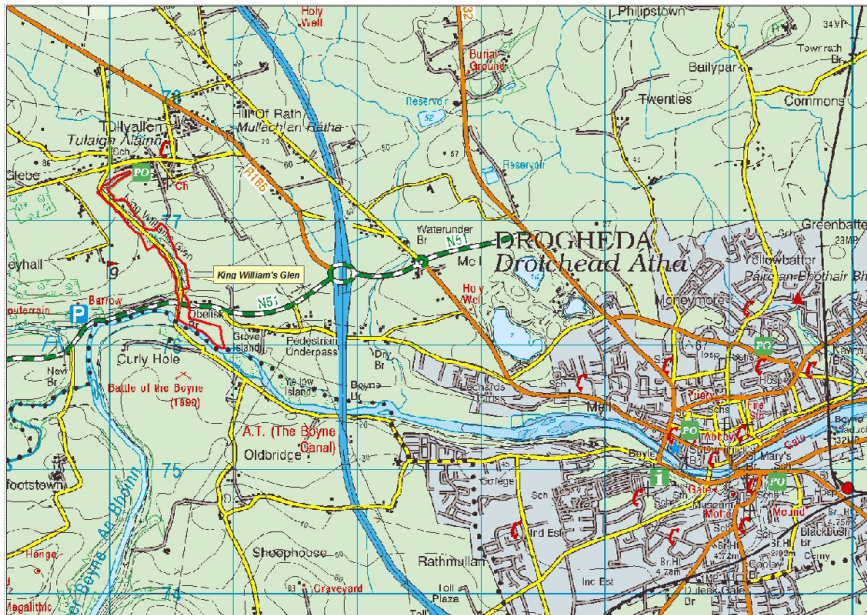


Steep 'U' shaped profile in King William's Glen, etched into bedrock along this portion.



The car park at the southern end of the Glen, on the Slane-Drogheda road.









## LOUTH - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	Linns Moraine
Other names used for site	
IGH THEME	IGH7 Quaternary
TOWNLAND(S)	Linns, Castlebellingham
NEAREST TOWN/VILLAGE	Castlebellingham
SIX INCH MAP NUMBER	15
ITM CO-ORDINATES	708330E 794120N (centre of feature)
1:50,000 O.S. SHEET NUMBER	36
GSI BEDROCK 1:100,000 SHEET NO.	13

### Outline Site Description

This site comprises a distinctive moraine ridge that extends for approximately 2 kilometres and is c. 10m-15m high over most of its extent.

### Geological System/Age and Primary Rock Type

The moraine ridge at Linns and Castlebellingham is comprised of Quaternary glacial sediments, deposited during deglaciation at the end of the last Ice Age. The moraine feature overlies bedrock of Silurian age.

### Main Geological or Geomorphological Interest

The Linns Moraine is a marked, northwest-southeast-trending ridge up to 15m high, located just northwest of Annagassan village.

The ridge records ice-marginal dynamics after the ice withdrew a short distance from the large moraine at Dunany Point. The ridge structure is different to that at Dunany Point as it records an ice advance over fossiliferous marine muds, something demonstrated by the orientation and structure of shears within the muds.

The muds yield samples of *Elphidium clavatum*, which is a genus of foraminiferan protozoa, a sample of which, when dated, provided an AMS <sup>14</sup>C age of 14,200 years BP. This constrains the date of the readvance, and the site provides a critical index point for dating readvances of the ice margin in Dundalk Bay. The date is contiguous with Heinrich Event 1, when icebergs broke off from glaciers and traversed the North Atlantic, causing the ocean to become inundated with freshwater and cooling global temperatures..

The muds within the ridge contains the greatest concentration of marine microfauna yet found in glaciomarine sediments anywhere in Ireland.

### Site Importance – County Geological Site

The sections cut within the Linns Moraine are important in terms of the information its stratigraphy provides about regional deglaciation in the Irish Sea Basin, and the section shows excellent examples of unsorted, heterogeneous glaciomarine sediment.

### Management/promotion issues

The ridge can be seen east of the R166 road northwest of Annagassan, and is also a prominent feature visible from the village itself. The moraine is on private farmland and permission must be sought to walk across the feature. A signboard in Annagassan, at the pier, could highlight the importance of the feature.

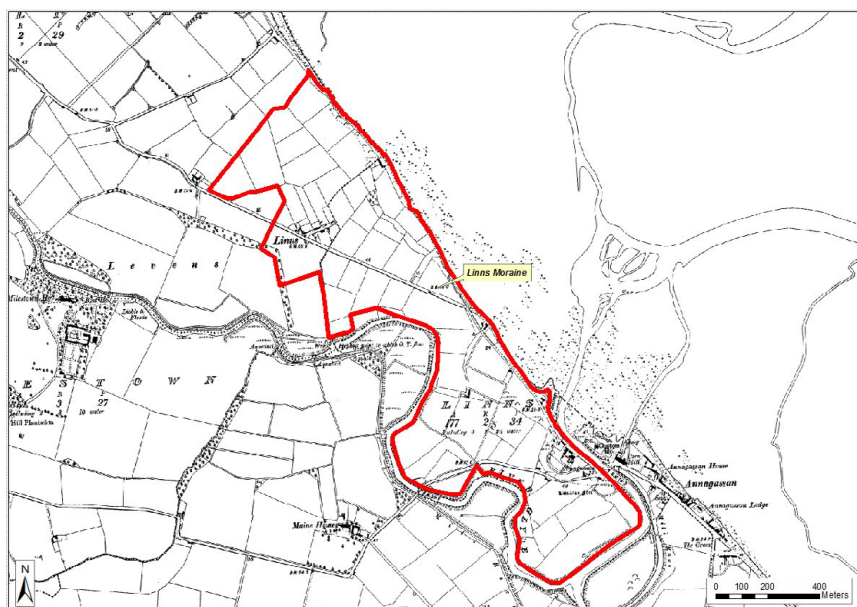


View northwards to the Linns Moraine ridge, from Annagassan Pier.



View eastwards from the R166 road just north of Annagassan, with the Linns Moraine ridge clearly seen.









# LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Rathcor Complex</b>
Other names used for site	Rathcor Moraine
<b>IGH THEME</b>	<b>IGH7 Quaternary</b>
<b>TOWNLAND(S)</b>	<b>Rathcor, Castlecarragh, Galtrim Island, Ardtully Beg, Balymaghery, Rockmarshall, Annaloughan, Rampark, Loughanmor, Maddoxland, Mountbagnall Greenore, Jenkinstown</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>8</b>
<b>SIX INCH MAP NUMBER</b>	<b>718000E 805500N (centre of feature)</b>
<b>ITM CO-ORDINATES</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 8/9</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	

## Outline Site Description

The Rathcor Complex includes a large accumulation of hummocky sands and gravels along the southern edge of the Cooley Peninsula.

## Geological System/Age and Primary Rock Type

The morainic complex overlies bedrock of Lower Carboniferous age, comprising sandstones, shales and limestones, but the features comprising the complex itself are Quaternary in age, having been deposited at the edge of the northward-retreating ice sheet during deglaciation at the end of the last Ice Age.

## Main Geological or Geomorphological Interest

The morainic complex includes an area of hummocky topography between Rockmarshall House and Ballug Point, approximately 8 km x 1 km in extent. Most of the complex comprises west-northwest to east-southeast trending sinuous ridges, which can attain heights of 25m. Single, round-crested ridges are the general rule although pitted, hummocky and flat-to-gently undulating gravelly spreads frequently form an integral part of individual ridges.

The ridges comprise planar cross-bedded gravels interbedded with massive diamicts and fine muds. They record deposition off the glacier into a fan-delta sequence in a restricted shallow water body, which lay south of the Cooley Peninsula during deglaciation. Some interpretations suggest that the eastern end of the system was open to the Irish Sea, and that the water body thus shared the high relative sea level prevailing at the time.

A sample of *Elphidium clavatum*, which is a genus of foraminiferan protozoa, taken from the fine muds within the coastal section at Rathcor provided an AMS  $^{14}\text{C}$  age of  $14,250 \pm 130$  years, which means the sediments in the Rathcor Complex were deposited around 14,000 years ago. This is an important date in constraining the timing of deglaciation across the Irish landmass. The Rathcor Complex therefore contains extremely important evidence for unravelling the interplay of terrestrial and marine deposition in the northern Irish Sea Basin during deglaciation.

## Site Importance – County Geological Site

The feature is a good example of the haphazard, hummocky topography which forms at the end of a melting ice sheet.

## Management/promotion issues

This system comprises a fine landform sequence and should be listed as a County Geological Site. The sediments are especially well exposed along the beach at Rathcor and in the harbour at Giles Quay. The importance of the section at Rathcor could be highlighted in promotional material for the Dundalk Bay proposed NHA.

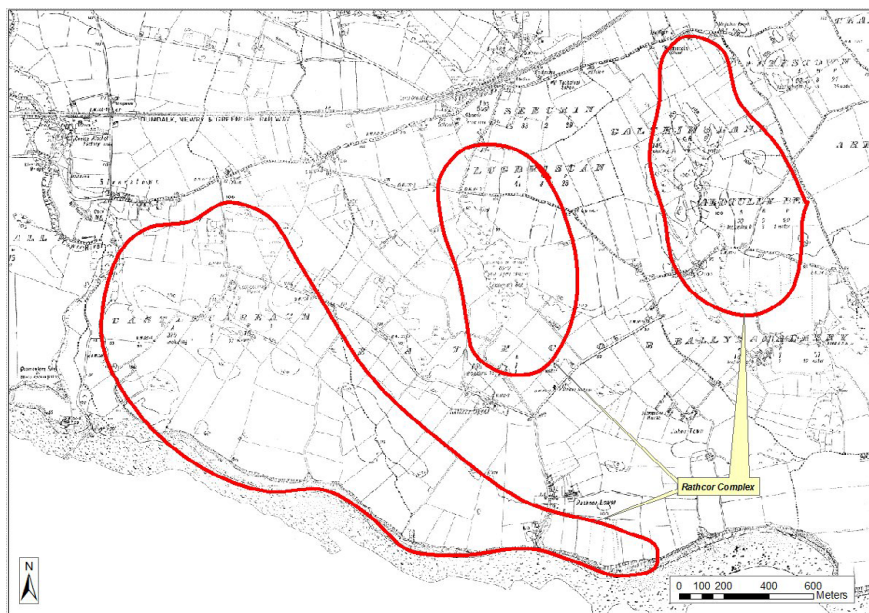


Well drained sand and gravel hummocks forming part of the Rathcor complex, at Ardtully Beg.



Interbedded sands and gravels, and muddy diamicts, exposed along the beach at Rathcor.







## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Slieve Foy Slate Rock</b>		
Other names used for site			
<b>IGH THEME</b>	<b>IGH8 Lower Carboniferous; IGH11 Igneous Intrusions</b>		
<b>TOWNLAND(S)</b>	<b>Commons</b>		
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>		
<b>SIX INCH MAP NUMBER</b>	<b>8</b>		
<b>ITM CO-ORDINATES</b>	<b>717823E 811555N</b>		
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>	<b>GSi BEDROCK 1:100,000 SHEET NO.</b>	<b>8/9</b>

### Outline Site Description

The Slate Rock is a large, prominent sloping exposure at 220m O.D. on the southeastern flank of Slieve Foy, immediately beside the Táin Way path. Nearby are a small quarry as well as several small outcrops and boulders of interest.

### Geological System/Age and Primary Rock Type

The Slate Rock was originally considered to comprise volcanic agglomerate of the Palaeogene Carlingford Igneous Complex but is now regarded as metamorphosed Lower Carboniferous basal conglomerate. Other rocks in the vicinity include a porphyry of the Carlingford Igneous Complex and Silurian metasediments.

### Main Geological or Geomorphological Interest

The Slate Rock crops out near the contact between the Lower Carboniferous basal conglomerate and, to the north, the older Silurian metasediments of the Inniskeen Formation. Uphill to the west are the gabbro and microgranite of the Carlingford Igneous Complex. The Carboniferous–Silurian contact is not exposed but is an unconformity, i.e. the Carboniferous rocks were deposited on the older metasediments that had already undergone uplift and erosion. The sloping face of the outcrop is an inclined bedding plane, indicating up-doming of the Carboniferous strata in this area following igneous intrusion which was also responsible for thermal metamorphism of the conglomerate. The conglomerate comprises clasts of various lithologies in a fine-grained matrix. The clasts range up to 15cm in length and may have rounded or irregular shapes. A 0.5m-thick vertical dolerite dyke intrudes the conglomerate.

On top of the Slate Rock, immediately south of the path, several boulders of Silurian metasediments display complex deformation, including intense cleavage and folding. The path that runs north from the Táin Way leads to a small quarry 100m north of Slate Rock. The quarry is in cone sheet of medium-grained feldspar porphyry.

### Site Importance – County Geological Site; may be recommended for Geological NHA

Slate Rock is a large, well-exposed example of Lower Carboniferous conglomerate in a readily accessible location along the Táin Way walking route. Exposures of Carboniferous rocks elsewhere along the contact with the Carlingford Igneous Complex are typically of metamorphosed limestone (skarn) rather than basal conglomerate so this site represents an interesting variation. The dolerite dyke, porphyry cone sheet and boulders of Silurian metasediments displaying complex deformation give the site an unusual breadth of interest.

### Management/promotion issues

The site is on a popular walking route and would be a candidate for an information panel that could both describe the immediate geology but also place the site in the context of the Carlingford Igneous Complex and, given the views across the Lough to the Mourne, the other Palaeogene igneous centres in northeast Ireland.





View of Slate Rock, looking northeast towards Carlingford Lough.

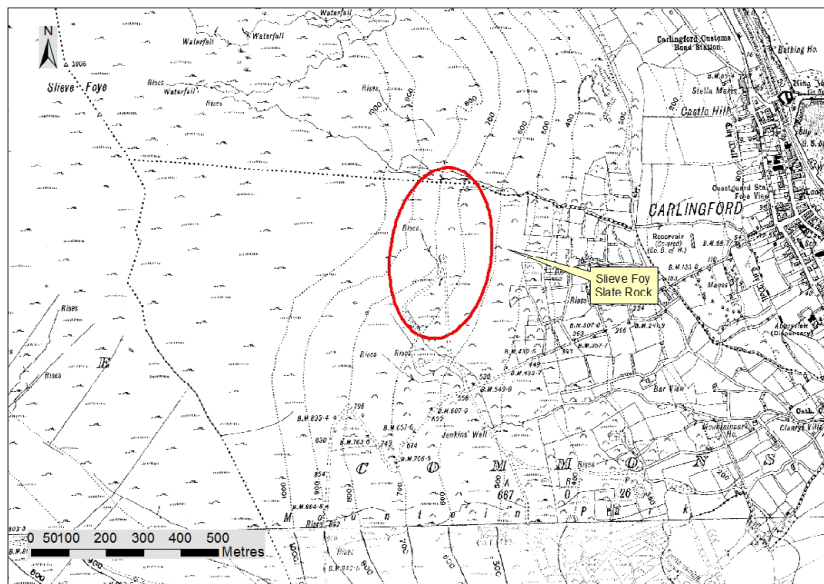
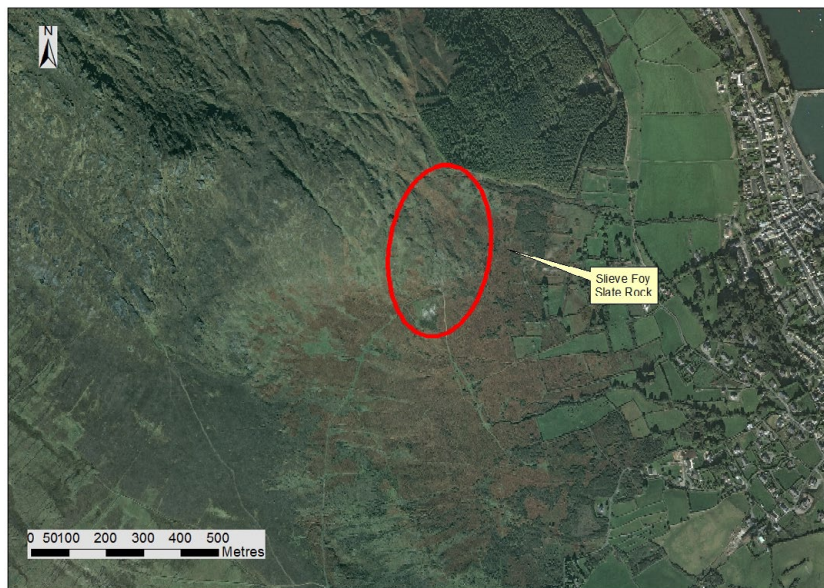
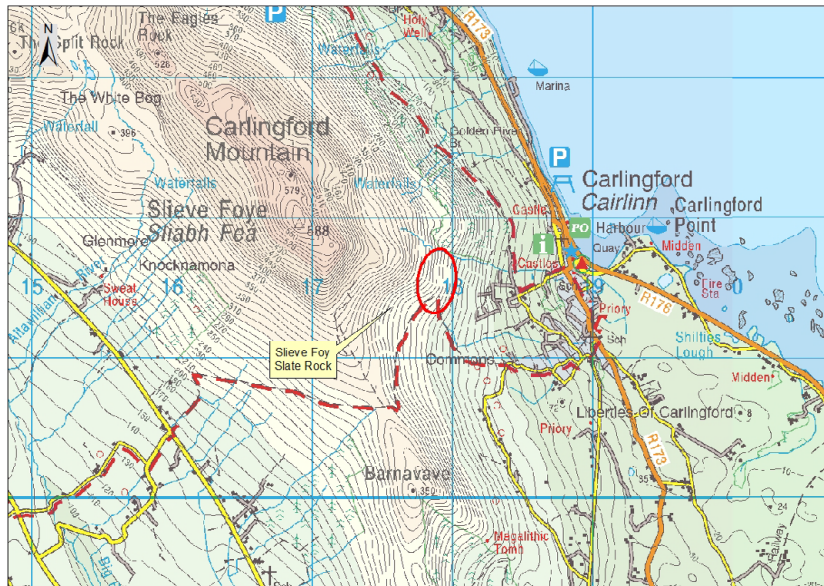


Rounded and angular pebbles in metamorphosed basal conglomerate (left); dolerite dyke intruded into Slate Rock (right). Coin is 24mm in diameter.



Boulder of cleaved and folded Silurian metasediment atop Slate Rock (left); feldspar porphyry cone sheet exposed in small quarry, 100m north of Slate Rock (right).









## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Barnavave Summit</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH11 Igneous Intrusions</b>
<b>TOWNLAND(S)</b>	<b>Commons</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>
<b>SIX INCH MAP NUMBER</b>	<b>8</b>
<b>ITM CO-ORDINATES</b>	<b>717737E 810087N</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>
<b>GSi BEDROCK 1:100,000 SHEET NO.</b>	<b>8/9</b>

### Outline Site Description

The site occupies the summit of Barnavave Hill where two elongate crags are separated by a c. 50m-wide flat, northwest-southeast-trending area covered by blanket bog. The latter is Maeve's Gap, or *Bearna Mhedhbh* in Irish.

### Geological System/Age and Primary Rock Type

The two crags consist chiefly of gabbro veined by granite that intruded the gabbro as it cooled. Both are part of the Palaeogene Carlingford Igneous Complex.

### Main Geological or Geomorphological Interest

The exposed summit location hosts abundant, clean outcrops that allow detailed observation of the relationship between the gabbro and granite. The thickness of granite intrusions ranges from several mm to > 1m. Contacts between the two rocks are typically sharp but in many cases curved or lobate, indicating that while the gabbro had hardened sufficiently to fracture it was not completely solidified when the granite was intruded. The cross-cutting of some granite veins by others indicates a protracted sequence of intrusion during cooling of the gabbro.

Maeve's Gap marks the line of a fault that can be traced northwestwards to Slieve Foy. Preferential erosion along the line of the fault is responsible for the observed break in the outcrop pattern of the otherwise massive gabbro intrusion.

### Site Importance – County Geological Site

There are several sites in the Carlingford area displaying gabbro intruded by granite, e.g. Barnavave Quarry and Cooley Castle Quarry, but the outcrops on Barnavave Summit are particularly large and clean, allowing more extensive examination of the contact relationships than at other sites. The northwest-southeast-trending fault is very clearly delineated, an additional feature that adds to the site's importance.

### Management/promotion issues

The site is within the proposed Carlingford Mountain NHA. It overlooks the village of Carlingford in an area very popular with hill-walkers. The Táin Way walking route passes over the col 600m to the northwest and a rough track leads from it to Barnavave Summit. The area is unspoilt and there are no obvious threats to the integrity of the site.



Maeve's Gap on the summit of Barnavave, looking southeast along the line of the fault.

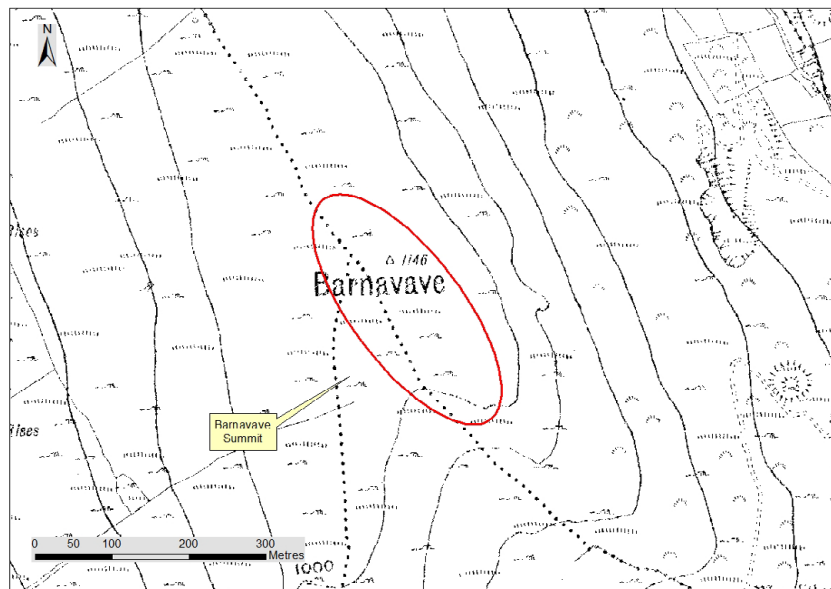
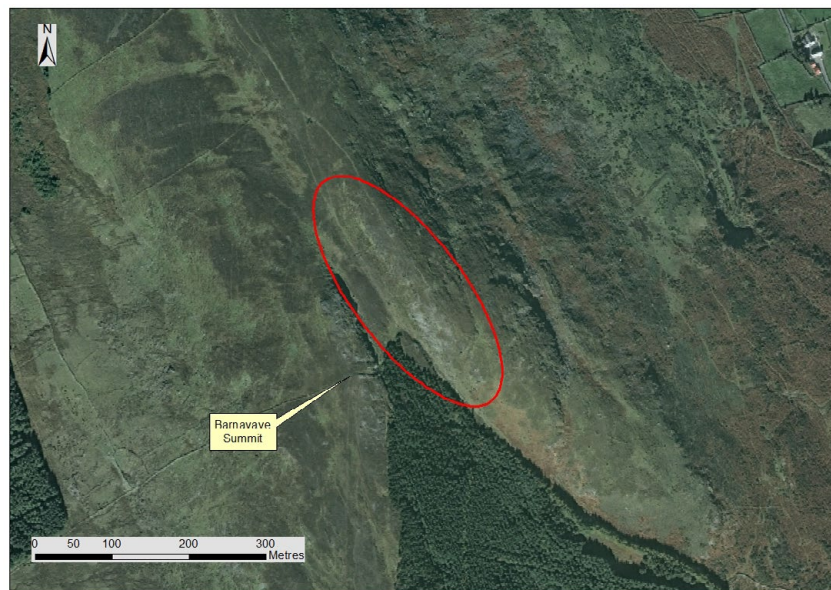
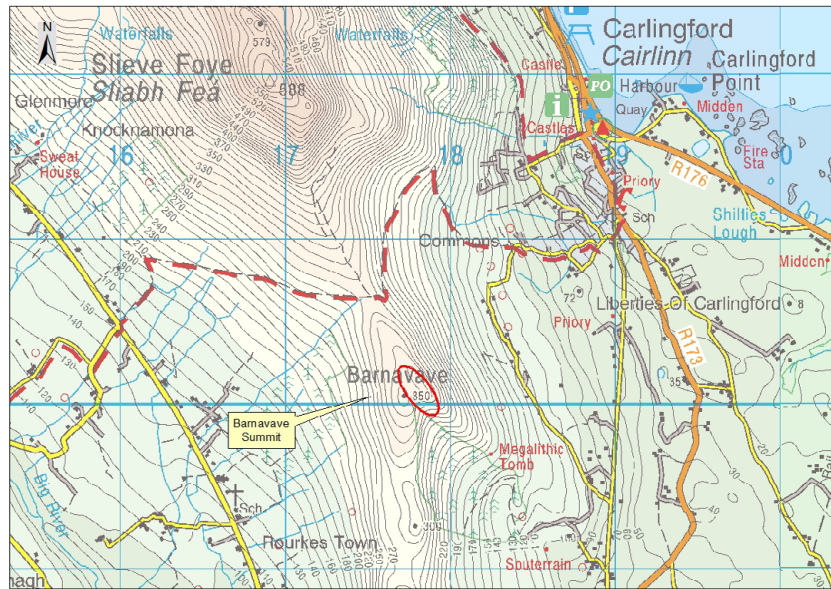


Light-coloured granite veins in dark gabbro. Several generations of veins are apparent, later veins cross-cutting earlier ones (left). Contacts are generally sharp but can be irregular (right) or curved (left).



Granite veins are typically less than 100mm thick but can exceed 1m (left). Lobate contacts between granite and gabbro (right) suggest that gabbro had not fully solidified before intrusion of the granite.









## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>Barnavave Quarry</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH11 Igneous Intrusions</b>
<b>TOWNLAND(S)</b>	<b>Commons</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>
<b>SIX INCH MAP NUMBER</b>	<b>8</b>
<b>ITM CO-ORDINATE</b>	<b>718151E 810204N</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 8/9</b>

### **Outline Site Description**

The site is a small disused quarry on the eastern flank of Barnavave Hill, 200m above the upper road between Carlingford and Grange Irish.

### **Geological System/Age and Primary Rock Type**

The quarry was excavated in the early 20<sup>th</sup> century along the contact between gabbro of the Palaeogene Carlingford Igneous Complex and the Lower Carboniferous limestone country rock.

### **Main Geological or Geomorphological Interest**

In the upland area of Barnavave and Slieve Foy, at the eastern end of the Cooley peninsula, the Carlingford Complex comprises a series of layered gabbros cut by slightly younger intrusions of dolerite and granite. The rock exposures along the summit and eastern flank of Barnavave display a range of textures and compositions that reflect physical mixing of the different rock types as well as chemical reaction between them. Reaction between gabbro and granite has given rise to “hybrid” rock types, with a composition intermediate between the basic and acid rocks. Nockolds first described these rocks in detail, basing his work mainly on the exposures in Barnavave Quarry.

At the northern end of the quarry, the western wall consists of massive, medium-grained gabbro interleaved with finer-grained material (dolerite) of similar composition. At the southern end, the basic rocks are veined by granite. Reaction between the granite and gabbro is apparent in the gradational contact observed between them in places and the alteration of both to rock of intermediate composition (see photos). Other features observed in the quarry include a dolerite cone sheet at its southern end and, in the southeastern corner, boulders of calc-silicate skarn, products of contact metamorphism of the country rock limestone when intruded by the hot magma that formed the gabbro.

### **Site Importance – County Geological Site; may be recommended for Geological NHA**

The quarry represents a convenient, readily accessible exposure of gabbro and associated lithologies of the Palaeogene Carlingford Complex, particularly hybrid rocks formed by reaction between gabbro and granite. Such rocks are exposed elsewhere in the complex but the comprehensive lithological and mineralogical description of the rocks in the literature provides a strong scientific underpinning to the site.

### **Management/promotion issues**

The site is part of the Carlingford Mountain SAC and proposed NHA. It is in an unspoilt upland area overlooking Carlingford village, popular with walkers and occasionally used by grazing animals. It is well preserved, contains excellent exposure and is easily accessible from the road, making it ideal for educational purposes.



View of the quarry, looking south.

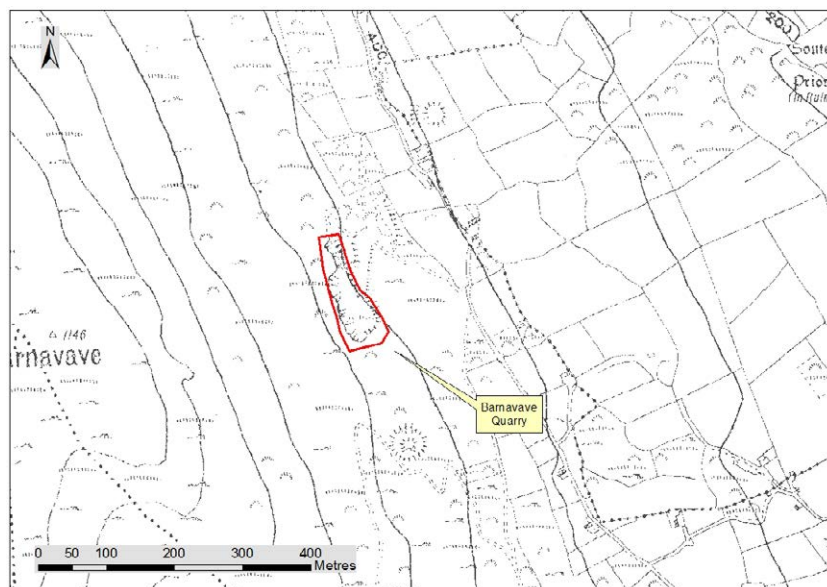
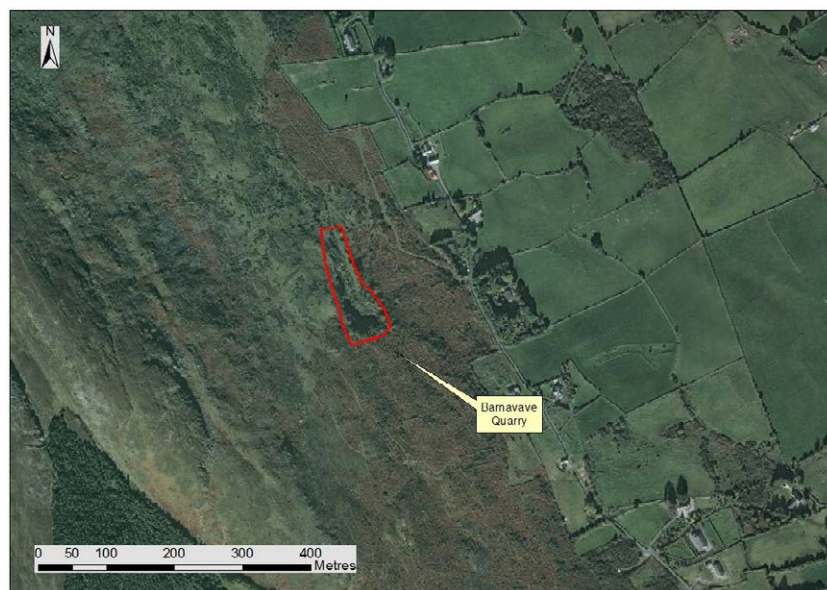
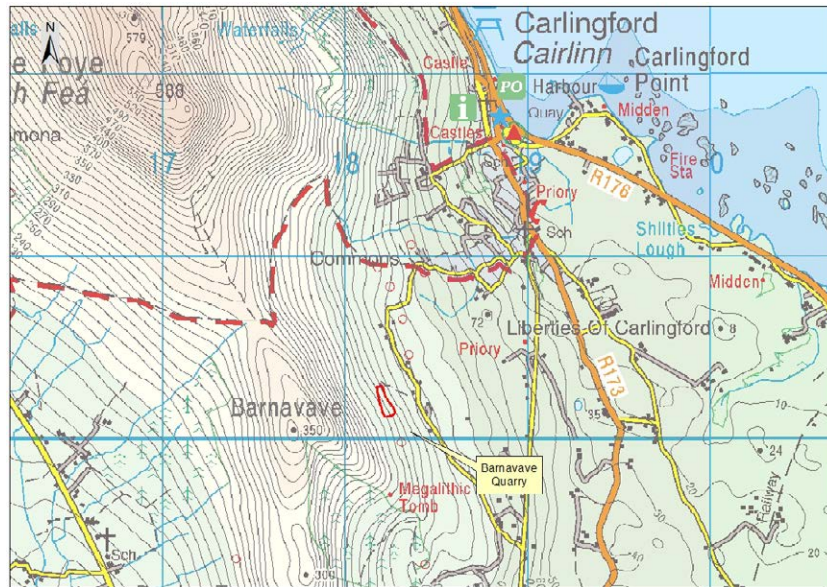


Gabbro xenolith surrounded by zone of hybridization (left) and hybridization within granite vein cutting unaltered gabbro (right), both in southwestern corner of quarry.



Dolerite cone sheet intruding gabbro in western wall of quarry (left) and loose boulder of calc-silicate skarn (right) near contact with limestone countryrock at southeastern end of quarry.







# LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Barnavave Site B</b>		
Other names used for site			
<b>IGH THEME</b>	<b>IGH11 Igneous Intrusions</b>		
<b>TOWNLAND(S)</b>	<b>Grange Irish</b>		
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>		
<b>SIX INCH MAP NUMBER</b>	<b>8</b>		
<b>ITM CO-ORDINATES</b>	<b>718229E 809081N</b>		
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>	<b>GSi BEDROCK 1:100,000 SHEET NO.</b>	<b>8/9</b>

## Outline Site Description

The site comprises an outcrop on the lower eastern slope of Barnavave ridge immediately beside a Coillte forest and an adjacent small quarry.

## Geological System/Age and Primary Rock Type

The outcrop comprises skarn, produced by thermal alteration of Lower Carboniferous limestone, and thin veins of syenite of the Palaeogene Carlingford Igneous Complex.

## Main Geological or Geomorphological Interest

The outcrop consists mainly of grey, saccharoidal (sugar-like texture) skarn produced by thermal metamorphism of the Lower Carboniferous country rock after intrusion of granophyric microgranite of the Carlingford Complex. The skarn displays near vertical bedding in places, indicating up-doming of the country rock during granite emplacement. The skarn is also intruded by very thin veins of grey fine—medium-grained syenite, an alkali-rich intrusive rock. Nockolds has described the petrology of this rock. The syenite, present in the area only in small volumes, is considered to be a late-stage fractionate of the magma that produced the main granophyric microgranite at Carlingford. The syenite includes rounded xenoliths of dolerite.

30m southeast, across a low stone wall, a near-vertical dolerite dyke forms the northern boundary of a small quarry cut into the Carboniferous Limestone. The overhanging roof of the quarry is another dolerite intrusion, a sill emplaced along the east-dipping bedding plane in the limestone. The quarry was excavated to provide limestone for the now ruined lime kiln immediately south of the quarry.

## Site Importance – County Geological Site; may be recommended for Geological NHA

This site probably has the best exposure of the thermally metamorphosed Carboniferous Limestone at its contact with the eastern side of the Carlingford Igneous Complex microgranite. The presence of relatively rare syenite veinlets within it add to the interest. The limestone quarry affords an opportunity to observe two different kinds of dolerite intrusion, a dyke cross-cutting the limestone beds and a sill emplaced parallel to them. The adjacent ruined lime kiln is a reminder of the role played by limestone in local economies in previous centuries.

## Management/promotion issues

The site is readily accessible from the entrance to the Coillte forest, much of which in the vicinity had been felled at the time of this audit. The area is part of the Carlingford uplands and is popular with walkers. The skarn outcrop is within the Carlingford Mountain SAC and proposed NHA. There are no apparent threats to the site and consideration could be given to erection of a signboard, perhaps in the vicinity of the forest gate, outlining the geology of the site.





Barnavave B, outcrop of thermally metamorphosed limestone skarn (foreground).

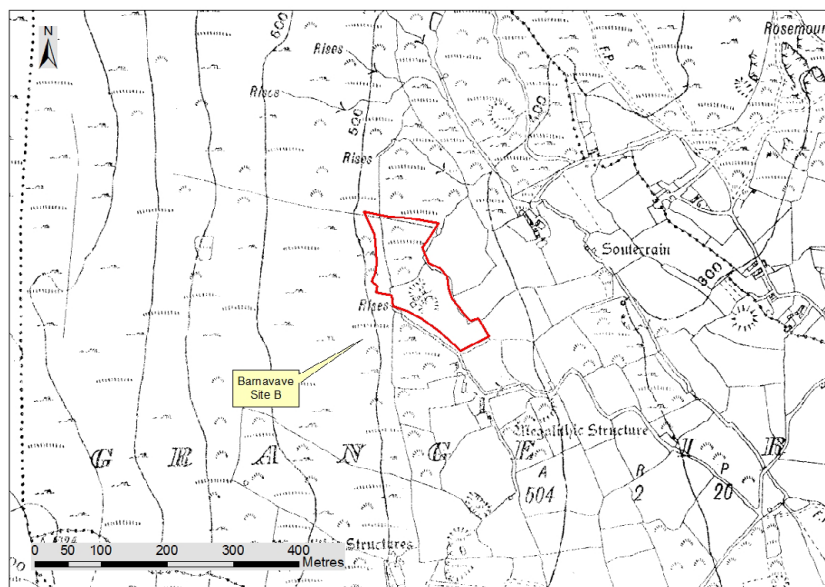
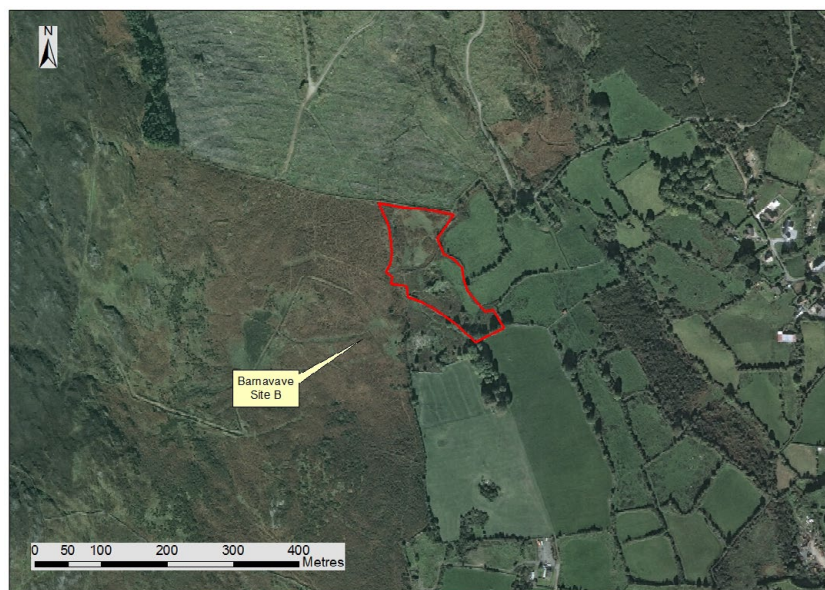
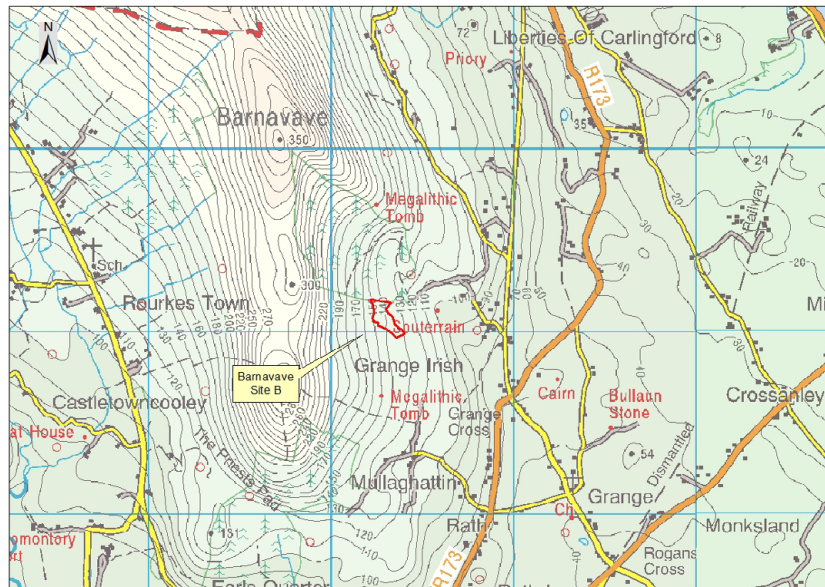


Barnavave B: skarn showing folding, cleavage (left) and near-vertical bedding (right)



Barnavave B, limestone quarry with dolerite sill (top, right) and dyke (left, centre).









## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>Barnavave Site D</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH11 Igneous Intrusions</b>
<b>TOWNLAND(S)</b>	<b>Commons</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>
<b>SIX INCH MAP NUMBER</b>	<b>8</b>
<b>ITM CO-ORDINATES</b>	<b>718047E 809827N</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>
	<b>GS1 BEDROCK 1:100,000 SHEET NO. 8/9</b>

### **Outline Site Description**

This is a steep hillside site, approximately 500m southeast of the summit of Barnavave Hill, at a height of 220-240m OD, 30m north of the boundary of a Coillte Forest.

### **Geological System/Age and Primary Rock Type**

The rocks are part of the Palaeogene Carlingford Igneous Complex. Gabbro is cut by narrow veins of acidic material and reaction between the two has produced zones of hybrid composition within the gabbro.

### **Main Geological or Geomorphological Interest**

This is one of the sites subject in the first half of the 20<sup>th</sup> century to detailed research by Nockolds who considered it to provide the best examples of hybrid rock produced by reaction between gabbro and acid veins cutting it. The hybrid rock has a black and white speckled appearance. The acid veins are mainly granitic in composition but also include very thin, off-shoot veins of alkaline material composed mainly of alkali feldspar with minor components including calcite.

The dark, massive gabbro is criss-crossed by abundant thin veins of granite. Brecciation of the gabbro is common. Contacts between the granite and gabbro are typically sharp. Lobate or curved contacts indicate the gabbro was not fully solidified when the net-veining took place. Similar features are found at other sites, such as Barnavave Summit and Cooley Castle Quarry. Of particular interest here are the diffuse zones of hybridization found in gabbro adjacent to veins. In these zones the gabbro is altered by the addition of alkali (Na-K) feldspar and by alteration of the chemistry of plagioclase feldspar by addition of sodium (Na) in place of calcium (Ca). Hybridized gabbro is coarser-grained and much lighter in colour than the original.

### **Site Importance – County Geological Site**

The site is one of a number in the Carlingford Complex that display brecciation of gabbro and net-veining of the gabbro by granite. The principal interest here is the well-exposed examples of hybridized rock and the presence of alkali-rich veinlets as off-shoots of granite, both of which have been described in detail in the literature, giving this site a well-founded scientific base.

### **Management/promotion issues**

The site is within the Carlingford Mountain SAC and proposed NHA. It is in an upland area and there are no evident development threats to the site. The area is popular with walkers – the Carlingford Loop walk passes along the forest boundary to the south – but is likely to be of interest mainly to scientists and further promotion is not required.



General view of the site, looking west.



Gabbro net-veined by granite (left). Closer view (right) shows thin veinlets and diffuse areas of altered gabbro (coin is 24mm in diameter).



Brecciation of gabbro, net-veins of granite and an area of hybridized gabbro (H) appearing to merge with an acid vein on its left (coin 24mm in diameter) (left). Black and white, relatively coarse-grained "speckled" gabbro hybrid (right)









## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Cooley Castle Quarry</b>		
Other names used for site			
<b>IGH THEME</b>	<b>IGH11 Igneous Intrusions</b>		
<b>TOWNLAND(S)</b>	<b>Castletowncooley</b>		
<b>NEAREST TOWN/VILLAGE</b>	<b>Carlingford</b>		
<b>SIX INCH MAP NUMBER</b>	<b>8</b>		
<b>ITM CO-ORDINATES</b>	<b>717138E 807886N</b>		
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>	<b>GSi BEDROCK 1:100,000 SHEET NO.</b>	<b>8/9</b>

### Outline Site Description

The site is an abandoned, partly overgrown but unfenced hill-side quarry on the southwestern flank of the Barnavave ridge, accessible via an unpaved roadway.

### Geological System/Age and Primary Rock Type

The rocks are part of the Palaeogene Carlingford Igneous Complex, mainly dolerite that is net-veined by granite. Intrusion of the granite has caused alteration and even assimilation of the dolerite.

### Main Geological or Geomorphological Interest

Cooley Castle Quarry contains very good exposures of dolerite intruded by granite, similar to but cleaner than the exposures in Barnavave Quarry. The best exposure is the most recently worked face near the entrance at the eastern end of the quarry. The dolerite is veined by granite, or granophyre, similar in composition to that found elsewhere in the complex. Veins range from millimetres to more than 1m in thickness. Granite-dolerite contacts are typically smooth but the upper contacts of flat-lying sheets, in particular, can be highly irregular, with tongues and veinlets of granite extending into the dolerite. Brecciation of dolerite is also displayed at this site. The brecciated dolerite has been intruded by granite and some dolerite fragments display rounded edges suggestive of assimilation. Reaction between the granite and dolerite has given rise to rocks with compositions intermediate between the two. At the contact with granite, dolerite typically has a thin fine-grained recrystallized dark margin interpreted as a consequence of hornfelsing under influence of intruding granite.

The dolerite-granite relationship at Cooley Castle Quarry was the subject of a detailed study by De and Poole which included chemical analysis of different rock types. They concluded that the granite intruded the dolerite along contraction fractures that developed as the dolerite cooled. Volatiles associated with the granite feldspathized and amphibolitized the dolerite and also gave rise to narrow hornfelsed contact zones.

### Site Importance – County Geological Site

This is a particularly good site for studying the relationships between dolerite and granite in the Carlingford Igneous Complex, particularly brecciation and veining. Detailed contact relationships are visible in relatively fresh exposures and mineralogical and lithological variations within and between the different rocks can be readily seen. It is thus worthy on its own of CGS status and might be considered as a component part of a wider, Carlingford NHA designation.

### Management/promotion issues

The site is an abandoned quarry on private land, largely overgrown by gorse, heather, etc., and grazed by sheep. The most recent quarrying activity, possibly following planning permission granted in the early 1970s, focused on the southern end of the quarry. Efforts should be made to protect the well-exposed southeastern faces.



General view of quarry faces at southern end of Cooley Castle Quarry (view to east).

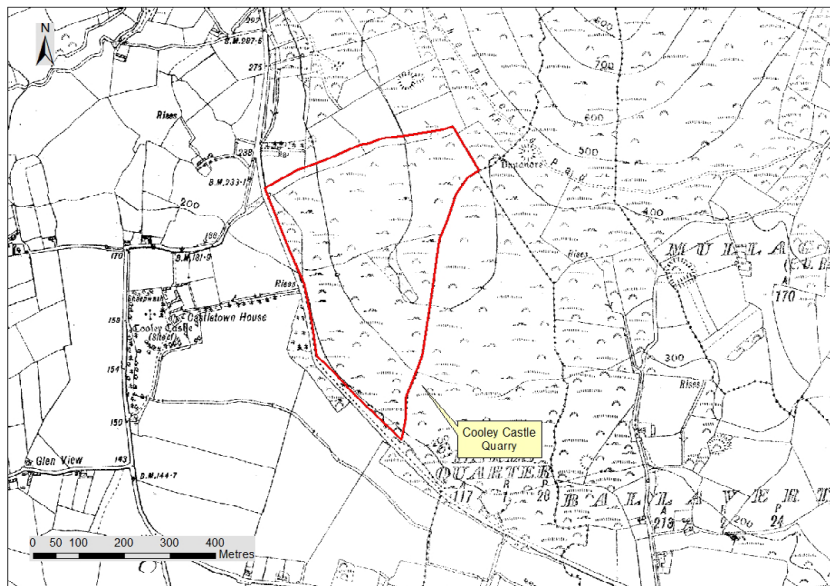
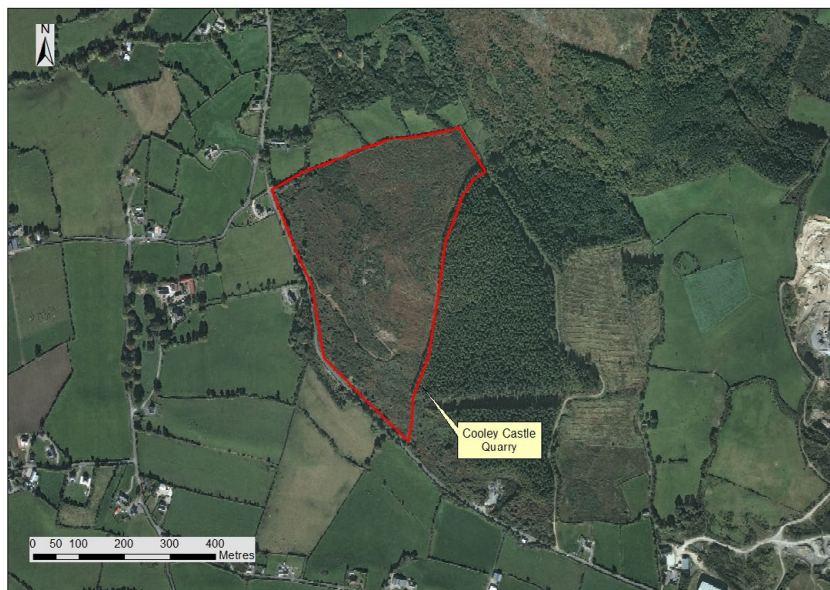
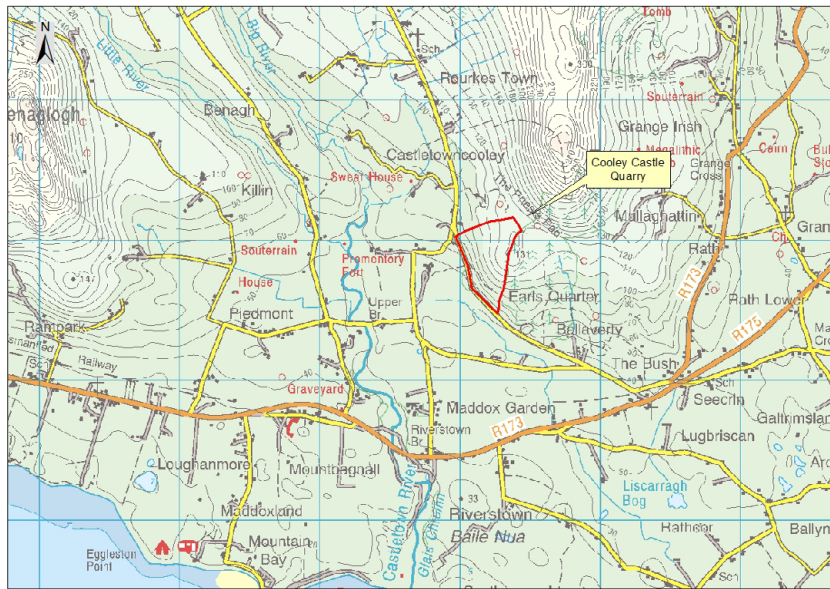


Vertical granite vein (left, G) in dolerite (D) acting as feeder for thicker, near-horizontal vein above. Near-vertical spurs extend from horizontal vein into enclosing dolerite (right).



Brecciated dolerite fragments within granite vein (left). Dark, fine-grained hornfelsed zone at margin of dolerite intruded by granite (right). Granite has undulating contact surface.







## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Drumenagh Quarry</b>		
Other names used for site	Dromeena Quarry		
<b>IGH THEME</b>	<b>IGH11 Igneous Intrusions</b>		
<b>TOWNLAND(S)</b>	<b>Ballymakellet</b>		
<b>NEAREST TOWN/VILLAGE</b>	<b>Jeninstown</b>		
<b>SIX INCH MAP NUMBER</b>	<b>7</b>		
<b>ITM CO-ORDINATES</b>	<b>710123E 810523N</b>		
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>	<b>GSi BEDROCK 1:100,000 SHEET NO.</b>	<b>8/9</b>

### Outline Site Description

The site is an old quarry marked that is marked on the 1910 6-inch map. It is believed to have been last worked around 1960. It has recently been used as a paddock for horses.

### Geological System/Age and Primary Rock Type

The rocks exposed in the quarry are gabbros emplaced during the early stages of the formation of the Tertiary Carlingford Igneous Complex.

### Main Geological or Geomorphological Interest

The quarry is one of two main locations where the early-stage gabbros of the Carlingford Igneous Complex are exposed. The other is Trumpet Hill, which lies 400m southwest of the quarry. The broad sequence of events in the formation of the Carlingford Complex began with the alkaline basalt flows preserved near Rampark, east of Jeninstown (see Rampark site report). These were followed by intrusion into the Lower Palaeozoic and Lower Carboniferous succession of the gabbros and dolerites in the Drumenagh Hill – Trumpet Hill area, northwest of Jeninstown. Emplacement of the main rock types of the complex, the layered gabbros and the granophyre, followed.

The gabbro in the quarry is massive but is jointed, cut by faults and intruded by thin (typically  $\leq 0.2$ m thick) dolerite sheets or veins. Some of these veins have chilled margins, indicating intrusion into already-cooled gabbro. Some of the dolerite is in places reduced to a soft, friable rock by shearing. This is well exposed in the southeast corner of the quarry. Also on the southeastern face of the quarry is a 30mm-wide vein of glassy material displaying conchoidal texture typical of obsidian.

### Site Importance – County Geological Site; may be recommended for Geological NHA

This is the best exposure of the early-stage gabbro in the Carlingford Igneous Complex and as such warrants designation as a CGS. It is immediately northeast of Trumpet Hill and consideration should be given to extending the boundaries of the proposed Trumpet Hill NHA to include this site.

### Management/promotion issues

There appear to be no major threats to the integrity of the site. The quarry is private property and secured by a 3m-high metal gate. It has recently been used as a paddock for horses. Aerial photographs suggest it has not undergone any significant material change in the last 20 years. A limited amount of fly-tipping of household waste (bicycles, a metal sink, etc.) has taken place but the gates should prevent future dumping. As the site is privately owned and gated, permission should be sought if access is required. For this reason, promotion of the site should be limited to those seeking access for scientific purposes.





Drummenagh Quarry, view south from entrance.

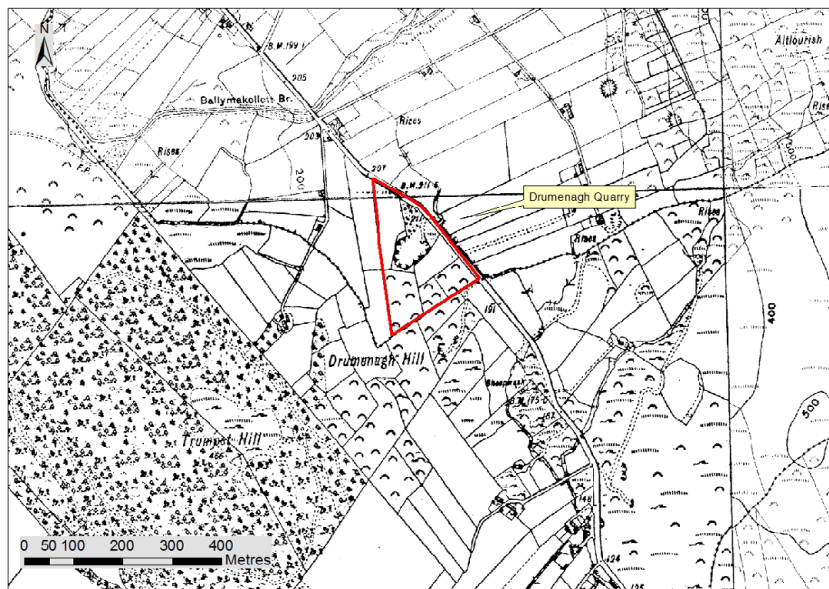
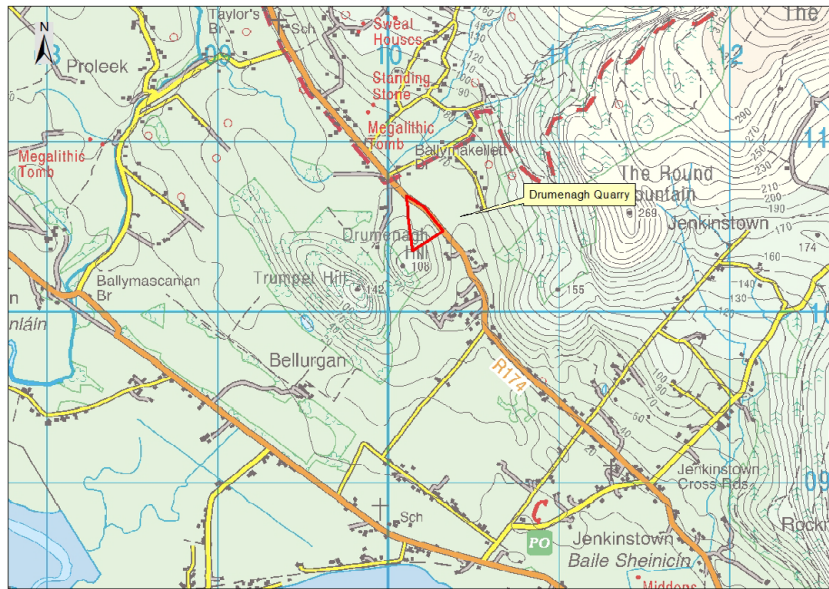


Gabbro in southwest face of quarry (left); dolerite vein (D) cutting gabbro in southeast face (right).



Sheared dolerite (above hammer) in southeast face of quarry (left); conchoidal texture in thin, glassy vein cutting gabbro in southeast face of quarry (right).









# LOUTH - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	King John's Castle
Other names used for site	
IGH THEME	IGH11 Igneous Intrusions IGH 4 Cambrian–Silurian
TOWNLAND(S)	Liberties of Carlingford
NEAREST TOWN/VILLAGE	Carlingford
SIX INCH MAP NUMBER	5
ITM CO-ORDINATES	718736E 812005N
1:50,000 O.S. SHEET NUMBER	36 GSI BEDROCK 1:100,000 SHEET NO. 8/9

## Outline Site Description

The site includes several exposures of the large outcrop at the northern end of Carlingford town on which King John's Castle is built: a rock cutting in a lay-by, a cliff exposure on the foreshore and the base of the castle itself.

## Geological System/Age and Primary Rock Type

The outcrop consists mainly of Silurian (440–445 Ma) siltstones and coarser greywackes of the Longford-Down Inlier. Several dolerite cone sheets, part of the Palaeogene Carlingford Igneous Complex (60 Ma), were subsequently intruded into the sediments.

## Main Geological or Geomorphological Interest

As well as being among the most accessible, the exposures of cone sheets at King John's Castle are among the best seen in the Carlingford Igneous Complex, illustrating not only aspects of their mineralogical composition but also their emplacement history and disposition. The complex deformation history of the Longford-Down Inlier, interpreted as an accretionary prism formed above a subduction zone, can be glimpsed in the strong deformation, including cleavage and spectacular folding, displayed by the metasediments.

Cone sheets form when radial fractures develop outwards in cooling igneous intrusions. These fractures dip inward toward the centre of the intrusion and can be intruded by later-stage magma. When this happens, the resulting relatively thin intrusion has the shape of an inverted cone. The cone sheets exposed at this site all dip 30–50° west, toward the centre of the Carlingford Complex. All are composed of fine-grained dolerite, in places with large crystals (*phenocrysts*) of white plagioclase feldspar typically clustered in the centre of the cone sheets, an example of flow sorting within an igneous intrusion, where the faster-flowing magma in the centre of the intrusion has entrained the phenocrysts.

The metasediments have a near-vertical dip and display tight, upright folding, the latter best seen in the lay-by. Thin siltstone beds alternate with thicker, more massive greywackes that are less strongly cleaved than the siltstones as a consequence of their greater hardness and strength.

## Site Importance – County Geological Site

Cone sheets are a characteristic feature of the Carlingford Igneous Complex and they are especially well displayed at King John's Castle site. The site is within the Carlingford Lough SAC and proposed NHA.

## Management/promotion issues

The site is already a popular stop for guided geological field trips. An information panel should be considered for the lay-by, which is a popular picnic stop. However, the rock cutting at the lay-by needs regular maintenance to keep the face clear of vegetation.



Rock face at lay-by, King John's Castle (left); dolerite cone sheet (below yellow line) cutting vertically-dipping sediments (same outcrop) (right).

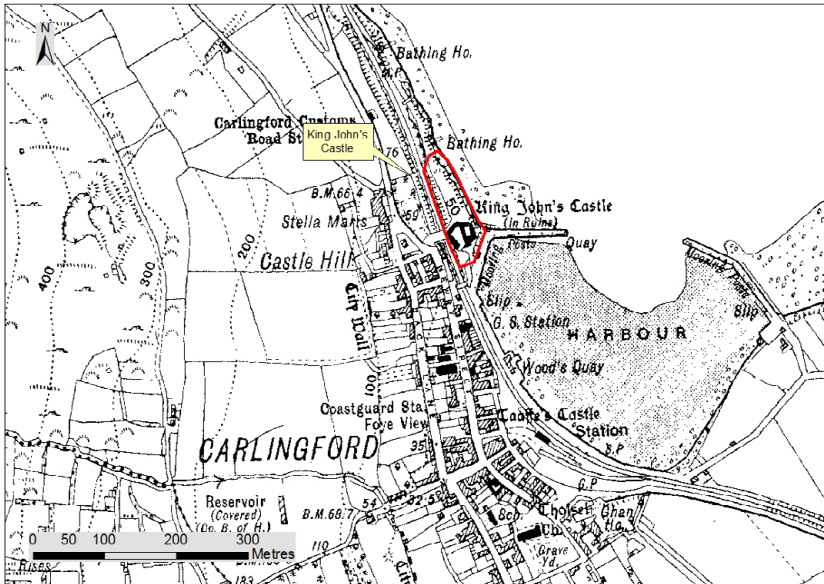
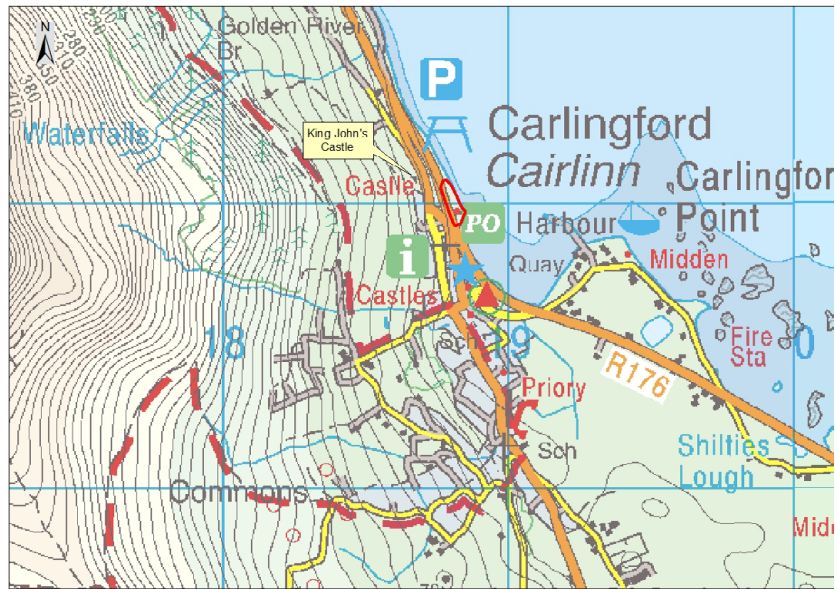


Coarse plagioclase crystals in centre of dolerite cone sheet at lay-by (above); tightly folded metasediment layers above cone sheet at lay-by (right).



Dolerite cone sheet (1m thick) cutting vertically-dipping metasediments in cliff-face above beach (left); dolerite cone sheet (> 1m thick) in base of King John's Castle (right).









# LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Rampark</b>		
Other names used for site			
<b>IGH THEME</b>	<b>IGH11 Igneous Intrusions</b>		
<b>TOWNLAND(S)</b>	<b>Rampark</b>		
<b>NEAREST TOWN/VILLAGE</b>	<b>Jenkinstown</b>		
<b>SIX INCH MAP NUMBER</b>	<b>8</b>		
<b>ITM CO-ORDINATES</b>	<b>713695E 807648N</b>		
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>	<b>GSi BEDROCK 1:100,000 SHEET NO.</b>	<b>8/9</b>

## Outline Site Description

The main site consists of a series of outcrops bordering a private unpaved road on the southern slopes of Slievenagloagh, about 400m northwest of the village of Rampark.

## Geological System/Age and Primary Rock Type

The rocks are similar to hawaiite lavas, considered to represent the earliest phase of igneous activity in the Palaeogene (c. 59 Ma) Carlingford Igneous Complex.

## Main Geological or Geomorphological Interest

The earliest examples of igneous activity in the Carlingford Complex are lavas that form a synclinal structure on the southern slopes of Slievenagloagh, between the granophyric microgranite on the hill to the north and the limestone of the coastal lowland to the south. The core of the synclinal structure is formed by a distinctive hawaiite lava. Hawaiite is an alkali basalt first described from Hawaii. It typically contains olivine phenocrysts and its plagioclase is andesine rather than more Ca-rich plagioclase typical of basalts.

The hawaiites are exposed in a series of outcrops on the northern side of the unpaved private road (see map), and are also observed as boulders on the hillside, notably in an overgrown pit or quarry near the Y-junction (see map). The hawaiite is a medium grey rock with a fine-grained matrix, containing phenocrysts of pale green olivine up to 10mm across. Plagioclase may or may not be present as white prismatic crystals. ....

## Site Importance – County Geological Site

The southern slopes of Slievenagloagh are the only known location of these distinctive lavas in the county. Apart from their unusual composition, the lavas are significant because they represent the earliest known phase of magmatism in the Carlingford Complex. On both these counts, the exposures above Rampark should be designated as a CGS.

## Management/promotion issues

The outcrops are on the side of a private road that leads from the public road west of Rampark to a private house. The entrance to the private road is marked by a gate and cattle grid. The main risks arise from any future possible road-widening or resurfacing scheme. Consultation with the landowner would be required to ensure protection of outcrops.



View of hawaiite lava outcrop, looking east along track

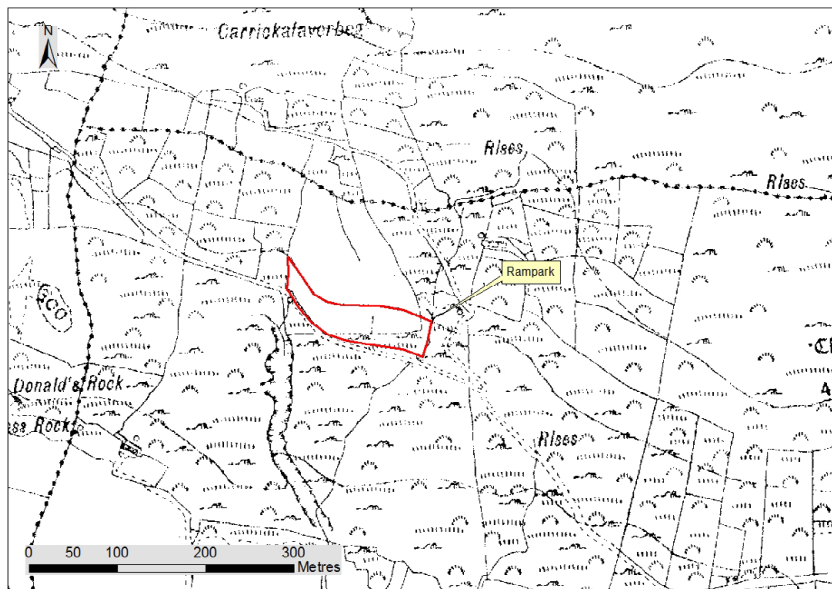


Massive hawaiite lava outcrop (left); view of overgrown quarry with hawaiite boulders (right).



Pale green olivine phenocrysts (O) in hawaiite lava (left); phenocrysts of plagioclase in hawaiite (right).







# LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Slievenaglogh</b>		
Other names used for site			
<b>IGH THEME</b>	<b>IGH11 Igneous Intrusions</b>		
<b>TOWNLAND(S)</b>	<b>Slievenaglogh, Annaloughan</b>		
<b>NEAREST TOWN/VILLAGE</b>	<b>Jeninstown</b>		
<b>SIX INCH MAP NUMBER</b>	<b>8</b>		
<b>ITM CO-ORDINATES</b>	<b>713314E 809336N</b>		
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>	<b>GS1 BEDROCK 1:100,000 SHEET NO.</b>	<b>8/9</b>

## Outline Site Description

This is a mountain-top site, an area of commonage with large outcrops surrounded by blanket bog.

## Geological System/Age and Primary Rock Type

The outcrops contain a variety of igneous rocks, all part of the Palaeogene Carlingford Igneous Complex (59Ma).

## Main Geological or Geomorphological Interest

The area between the summits of Slievenaglogh and Annaloughan Mountain contains one of two large mapped outcrop zones of vent agglomerate in the Carlingford Complex. Vent agglomerates typically form in and around volcanic vents when explosive eruption shatters solidified lava within the vent. The fragments are deposited around the vent as angular clasts that can reach 10s of cm in diameter. Agglomerates can also include rounded fragments of volcanic bombs. The matrix is generally a fine-grained tuff. At Slievenaglogh the agglomerate is visible in several large outcrops. Rounded and angular lithic clasts range up to 10cm in diameter / length.

Most of Annaloughan Mountain and Slievenaglogh is underlain by granophyric microgranite which is exposed in numerous outcrops. Layered gabbro is also present between the vent agglomerate outcrops on the eastern part of the site. Basalt, with irregularly-shaped pyroxene phenocrysts, can also be observed on the western side of the site. The basalt has a distinctive pitted weathering surface where phenocrysts have been recessed by weathering. It is presumably one of the early basalts whose main outcrop is on the southern slopes of Slievenaglogh (see Rampark report).

## Site Importance – County Geological Site

Vent agglomerate is a minor lithology within the Carlingford Igneous Complex, with very restricted occurrence, and this site contains perhaps the best and most easily accessible exposures. It also contains good exposure of the lithologies that make up the bulk of the Carlingford Complex, layered gabbro and granophyric microgranite, as well less common basalt.

## Management/promotion issues

The site is unspoilt upland commonage, used for grazing sheep. The Annaloughan Loop walk runs through the forestry plantation that lies to the west of the site and there are two small areas for parking cars beside the road that forms its northern boundary. A stile allows easy access to the site from the road. Unlike other upland sites in the Carlingford area, Slievenaglogh is not part of an existing SAC or proposed NHA. There is scope for placing a signboard in the car-park area. Apart from its geological significance, the site affords excellent views southwards over Dundalk Bay and northwards over Carlingford Mountain area and the Mourne Mountains.





View southeastwards across Slievenaglogh (summit on left) and Annaloughan.

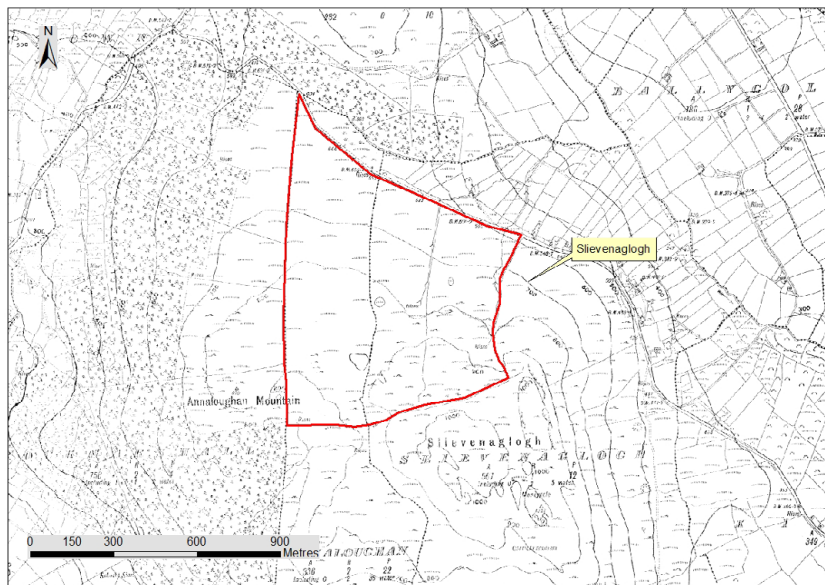
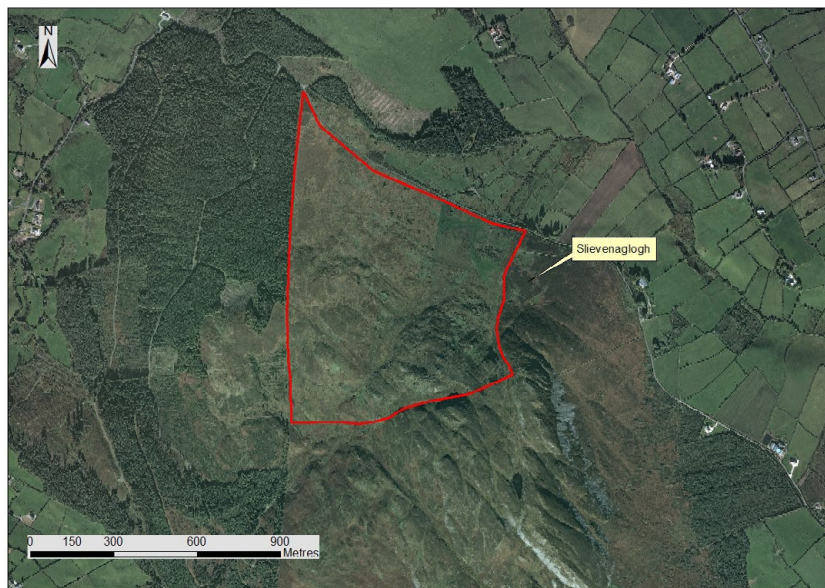


Vent agglomerate (left) and in close-up (right, coin 24mm diameter) displaying irregularly shaped, unsorted clasts in fine matrix.



Porphyritic basalt on west side of site showing dissolution pits on weathered surface (left) and irregularly-shaped phenocrysts (right) (coin 24mm in diameter).









# LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Windy Gap</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH11 Igneous Intrusions</b>
<b>TOWNLAND(S)</b>	<b>Corrakit</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Omeath</b>
<b>SIX INCH MAP NUMBER</b>	<b>5</b>
<b>ITM CO-ORDINATES</b>	<b>713042E 813809N</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 8/9</b>

## Outline Site Description

Windy Gap is a 200m-high mountain pass between the Slieve Foy (east) and Black Mountain (west) massifs. The site comprises a 200m-long road-side cutting on the west side of the road as well as the lower slopes of The Foxes Rock to the east.

## Geological System/Age and Primary Rock Type

The rocks are all part of the Palaeogene Carlingford Igneous Complex. East of the road are layered gabbros of the Later Gabbro series; west of the road is granophyric microgranite, the youngest intrusion of the complex.

## Main Geological or Geomorphological Interest

Windy Gap marks the line of a northnorthwest-southsoutheast-trending fault that has brought the microgranite into contact with the gabbro. East of the fault the Silurian sedimentary rocks have been moved almost 1km south and north of the gap are in contact with gabbro. Faulting has caused intense fracturing of the microgranite that is well displayed in south-facing exposures at the southwestern end of the gap. The fractures dip steeply west. At least four dolerite cone sheets intrude the microgranite, their thickness varying from less than 0.1 to more than 0.3m. One is cut by a steep fault. All dip 40–50° southwest.

Around 100m east of the road, a stile leads to the base of The Foxes Rock, the northwestern end of the Slieve Foy massif. The hillside exposes two of the five layered gabbro intrusions that comprise the Later Gabbros of the Carlingford Igneous Complex. Layering within the intrusions is subtle and not apparent in outcrop but pyroxene, plagioclase and weathered olivine can be readily seen in the dark-coloured crags on the hillside.

## Site Importance – County Geological Site; may be recommended for Geological NHA

Windy Gap is an important, easily accessible site for observing aspects of Carlingford Igneous Complex geology, specifically good exposure of layered gabbro intrusions, faulted and fractured microgranite and fault-related juxtaposition of microgranite, gabbro and the Silurian metasediments. The presence of numerous dolerite cone sheets, themselves affected by late faulting, adds to the interest of the site.

## Management/promotion issues

The site is on a well-trafficked scenic upland route. A recently expanded car-park on the east side of the gap is popular for short stops and picnics and as a starting point for hill-walking on the Slieve Foy massif. Beside the car-park is the Long Woman's Grave and a sign-board recounts her legend. The car-park would also be an excellent location for a sign-board describing the geology of the area. The site is within the Carlingford Mountain SAC and proposed NHA.



Windy Gap (south side), view to northwest: granophyre intruded by dolerite cone sheets.

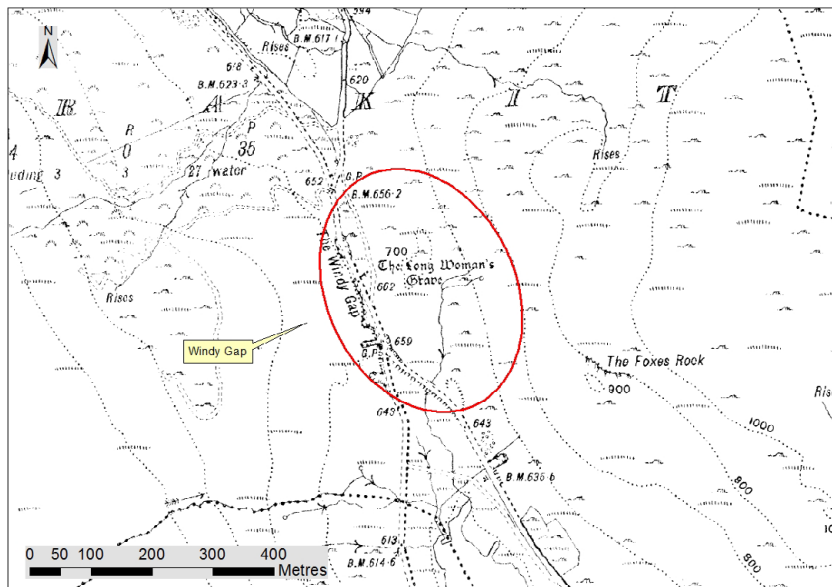


Fractured and jointed granophyre (left); dolerite cone sheet (between lines) in granophyre, dipping west.



Dolerite cone sheet in granophyre, offset by fault (F) (left); view east from road of layered gabbro on western side of Slieve Foy (right).







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## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	Dundalk Bay
Other names used for site	
<b>IGH THEME</b>	IGH13 Coastal geomorphology
<b>TOWNLAND(S)</b>	Loughanmore, Rampark, Annaloughan, Rockmarshall, Bellurgan, Aghaboys, Marsh North, Point, Townparks, Marsh South, Haggardstown, Mooretown, Dromiskin, Castlebellingham, Linns, Dillonstown
<b>NEAREST TOWN/VILLAGE</b>	Dundalk
<b>SIX INCH MAP NUMBER</b>	7, 8, 12, 15
<b>ITM CO-ORDINATES</b>	710300E 806500N (centre of Bay)
<b>1:50,000 O.S. SHEET NUMBER</b>	36
<b>GSi BEDROCK 1:100,000 SHEET NO.</b>	8/9, 13

### Outline Site Description

Dundalk Bay is a wide coastal embayment, flanked on either side by bedrock headlands and incorporating wide expanses of coastal flats.

### Geological System/Age and Primary Rock Type

The feature has been forming in the Holocene Period following the last glaciation, and the bay itself hosts soft mud, silt and sand sediment washed into it during that time.

It is likely that the macro-structure of the Bay dates back beyond the Quaternary (Ice Age) to the Palaeogene Period.

### Main Geological or Geomorphological Interest

The bay is almost perfectly symmetrical and is bordered on the northeast by the Castletown River Estuary and to the south by the Glyde Estuary at Annagassan. Freshwater feeds into the bay *via* the Glyde, Fane and Castletown Rivers, which flow through Annagassan, Blackrock and Dundalk respectively. The central portion of the bay comprises mud, silt and sand flats, which dry out at low tide. Extensive salt marshes and intertidal sand/mudflats also occur in pockets around the edge of the bay and there is a narrow sand or gravel beach in places also.

Shingle beaches are particularly well represented in Dundalk Bay, occurring more or less continuously from Salterstown to Lurgan White House in the south, and from Jenkinstown to east of Giles Quay in the north. The shingle is mostly stable, occurring on post-glacial raised beaches. The shingle often occurs in association with intertidal shingle, salt marsh and or shingle-based grassland.

### Site Importance - County Geological Site

The extensive flats and the associated beach, dune and slack features, as well as the surrounding beaches, salt marshes and headlands, make Dundalk Bay a textbook locality for the recognition of coastal erosion and deposition features. The Harbour is already a proposed NHA (pNHA 00455, Dundalk Bay), SPA and SAC for biodiversity reasons and the geodiversity of an active sedimentation system should be highlighted in any promotion of this.

### Management/promotion issues

The location of the features of interest makes them easily accessible, and Dundalk Bay is a popular recreational area given the number of fine beaches around its perimeter. Information boards at Port and Blackrock are worthy additions to the site, and explain the features associated habitats, flora and fauna. The geological formation of the feature could be highlighted in future on literature produced on the bay.

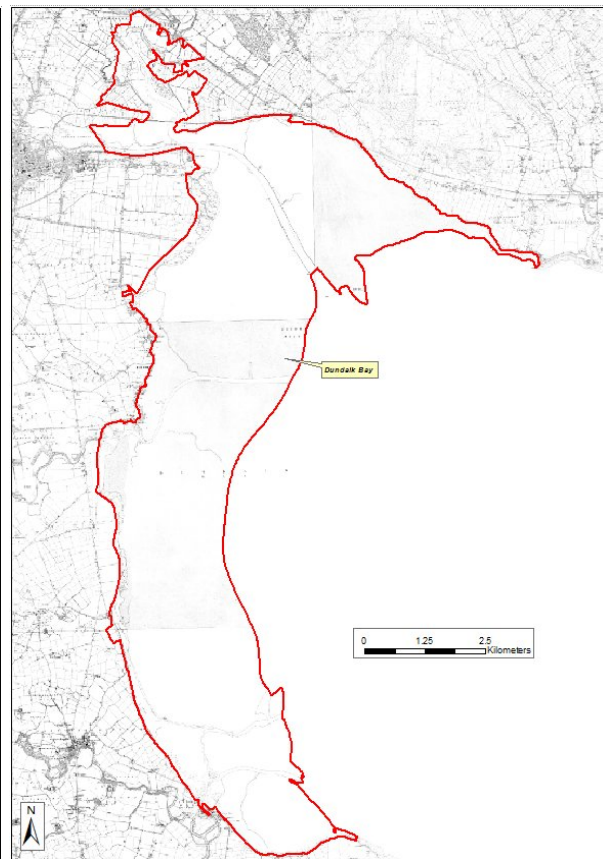
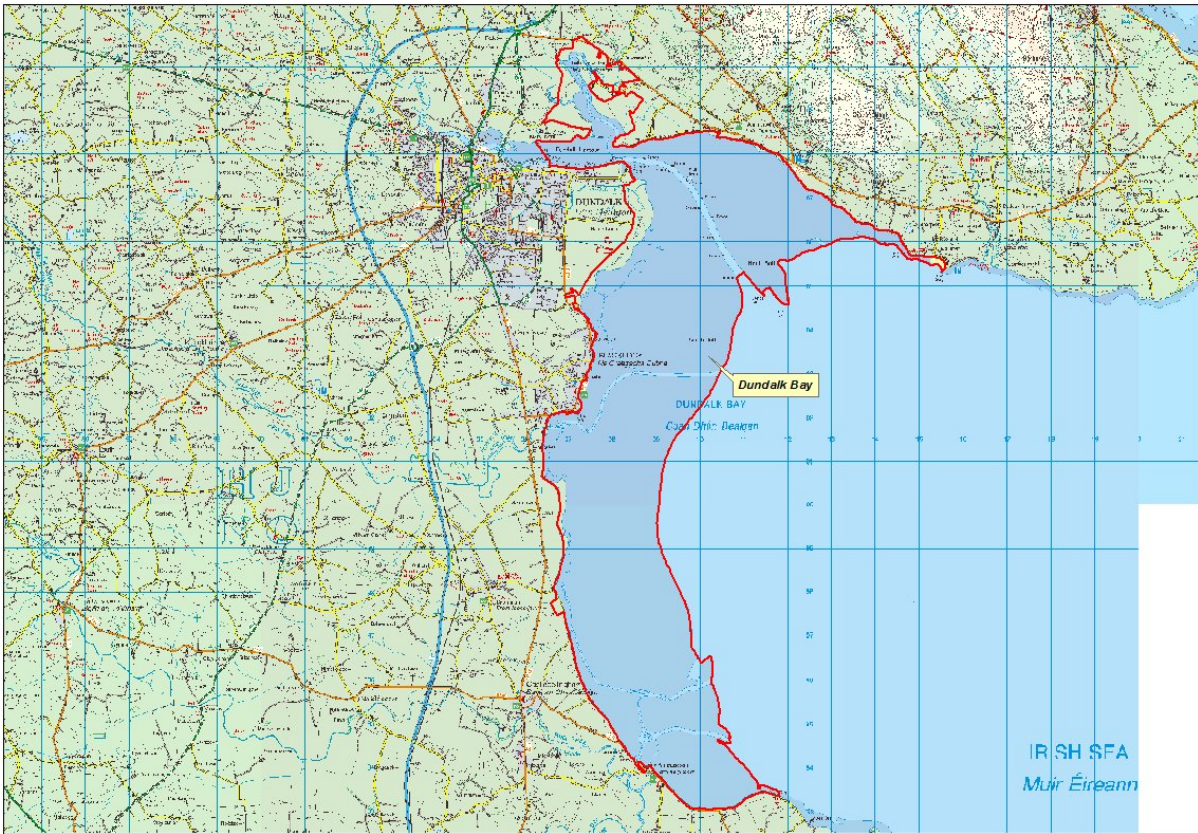


A panorama view of Dundalk Bay, across the mud, silt and sand flats, near Castlebellingham.



Shingle beach at the edge of Dundalk Bay, near Castlebellingham.







## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>Greenore Raised Beach</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH13 Coastal geomorphology</b>
<b>TOWNLAND(S)</b>	<b>Greenore, Mullatee, Millgrange, Muchgrange</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Greenore</b>
<b>SIX INCH MAP NUMBER</b>	<b>9</b>
<b>ITM CO-ORDINATES</b>	<b>722500E 810530N (centre of feature)</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 8/9</b>

### **Outline Site Description**

The Greenore Raised Beach is a wide, flat-topped feature adjacent to the shoreline around Greenore. It is the remains of a beach deposited in the locality when sea level was 3m-5m higher than it is today.

### **Geological System/Age and Primary Rock Type**

The feature has been formed since the last glaciation ended 10,000 years ago and is therefore Holocene in age.

### **Main Geological or Geomorphological Interest**

The raised beach is exceptionally flat-topped and has no real relief, excepting the artificial hummocks created at Greenore Golf Club, which lies within the centre of the feature.

Exposure into the raised beach, in low cliffs along the modern beach, shows that the feature is comprised of exceptionally well bedded and sorted sands and gravels, which are unconsolidated and easily eroded.

Raised beaches such as this have been elevated above the modern shoreline by a relative fall in sea level. This fall in sea level is a consequence of elastic rebounding of the land that occurred after the ice had retreated, thereby removing a huge weight that had depressed the land surface. The beach is thought to date from the post-Mesolithic period and contains some stones that are thought to be rolled flint implements dating from the same time.

### **Site Importance - County Geological Site**

The beach is a textbook locality for the recognition of coastal emergence and a fall in relative sea level. The beach lies at the edge of Carlingford Lough which is already a proposed NHA (pNHA 000452) as well as an SPA and SAC for biodiversity reasons. The geodiversity of the raised beach should be highlighted in any promotion of this.

### **Management/promotion issues**

The location of the feature means it is easily accessible and the modern beach at Greenore is a popular recreational feature. Information on the feature could be provided on some of the information boards at Greenore, which already explain the associated habitats, flora and fauna of the area. The geological formation of the feature could be highlighted in future in literature covering the Cooley Peninsula.



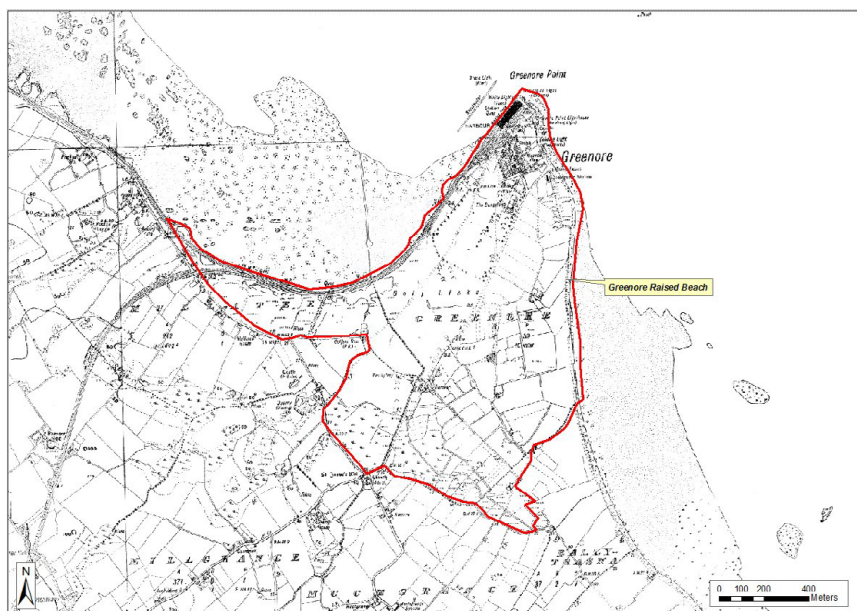
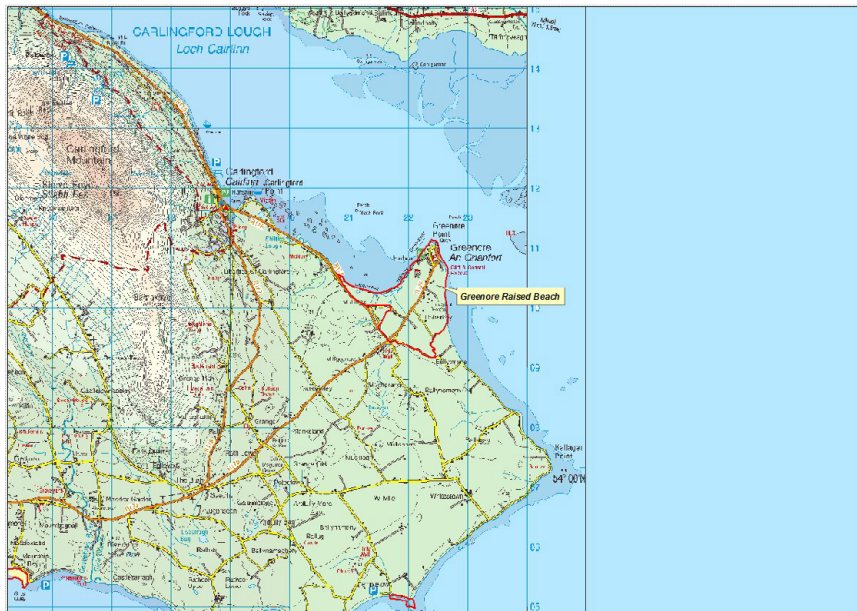


A view of the flat-topped form of the Greenore Raised Beach, just south of the town itself.



Exposure into raised beach sands and gravels along the modern day beach, at Greenore.









# **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>Port Raised Beach</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH13 Coastal geomorphology</b>
<b>TOWNLAND(S)</b>	<b>Dunany, Mitchelstown, Draghanstown, Corstown, Port, Lurganboy, Nicholastown, Painestown, Labanstown, Cruisetown, Reynoldstown</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Clogherhead</b>
<b>SIX INCH MAP NUMBER</b>	<b>19</b>
<b>ITM CO-ORDINATES</b>	<b>713850E 787500N (centre of feature)</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 13</b>

## **Outline Site Description**

The Port Raised Beach is a wide, flat-topped feature adjacent to the shoreline between Clogherhead and Dunany Point, which extends inland up to two kilometres. The feature is a beach deposited in the locality when sea level was higher than it is today.

## **Geological System/Age and Primary Rock Type**

The feature was formed at the end of the last glaciation and is therefore Quaternary in age.

## **Main Geological or Geomorphological Interest**

The beach is exceptionally flat-topped and has no real relief, excepting occasional low swales which are themselves probably individual beach features. The beach has been cut into till which was deposited earlier in glaciation.

Exposure of the raised beach, in low cliffs along the modern beach, shows that the feature is comprised of exceptionally well bedded and sorted sands and gravels, which are unconsolidated and easily eroded.

Raised beaches such as this have been raised above the modern shoreline by a relative fall in sea level.

The raised beach at Port contains some ice-wedge casts, where sediment has in-filled deformation structures (involutions) in the gravels caused by intense freezing just after glaciation, when an ice mass still lay further to the north in Ireland.

## **Site Importance - County Geological Site**

The beach is a textbook locality for the recognition of coastal emergence and a fall in relative sea level. The feature is probably the widest raised beach in Ireland.

## **Management/promotion issues**

The location of the feature means it is easily accessible, and the modern beaches at Port, Lurganboy and Cruisetown are popular recreational features. Information on the feature could be provided on some of the information boards at Port, which already explain the associated habitats, flora and fauna. The geological formation of the feature could be highlighted in future in literature produced on the area around Port and Clogherhead.

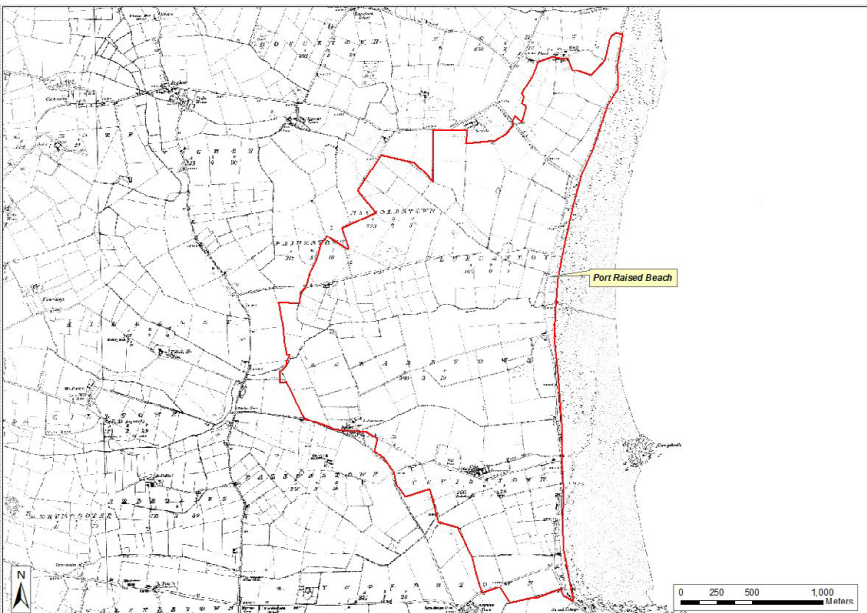
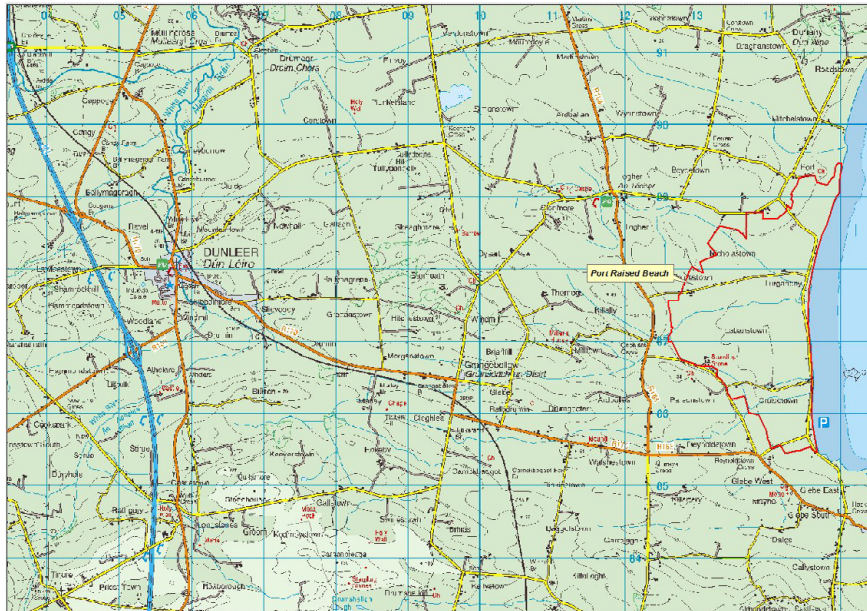


A view of the flat-topped form of the Port Raised Beach, looking north towards Dunany Point.



The widest part of the Port Raised Beach, between Port and Clogherhead.









## **LOUTH - COUNTY GEOLOGICAL SITE REPORT**

<b>NAME OF SITE</b>	<b>Templetown Raised Beach</b>
Other names used for site	
<b>IGH THEME</b>	<b>IGH13 Coastal geomorphology</b>
<b>TOWNLAND(S)</b>	<b>Templetown</b>
<b>NEAREST TOWN/VILLAGE</b>	<b>Greenore</b>
<b>SIX INCH MAP NUMBER</b>	<b>9</b>
<b>ITM CO-ORDINATES</b>	<b>721530E 805319N (centre of feature)</b>
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36 GSI BEDROCK 1:100,000 SHEET NO. 8/9</b>

### **Outline Site Description**

The Templetown Raised Beach is a wide, flat-topped feature adjacent to the shoreline west of Cooley Point, which extends inland up to 500m. The feature is a beach deposited in the locality when sea level was approximately 20m higher than it is today.

### **Geological System/Age and Primary Rock Type**

The feature was formed at the end of the last glaciation and is therefore Quaternary in age.

### **Main Geological or Geomorphological Interest**

The beach is exceptionally flat-topped and has no real relief. The beach has been cut into till which was deposited earlier during the glaciation.

Exposure of the raised beach, in low cliffs along the modern beach, shows that the feature is comprised of exceptionally well bedded and sorted sands and gravels, which are unconsolidated and easily eroded.

Raised beaches such as this have been raised above the modern shoreline by a relative fall in sea level. This feature is probably the best example of a late-glacial shingle beach closely related to readvance of ice sheet limits in Ireland.

### **Site Importance - County Geological Site**

The beach is a textbook locality for the recognition of coastal emergence and a fall in relative sea level, and as it is such a good example of a late-glacial shingle beach related to a readvance, it is of County Geological Status merit.

### **Management/promotion issues**

The location of the feature means it is easily accessible, and the modern beach at Templetown is a popular recreational site. Information on the feature could be provided on some of the information boards at the car park at Templetown, which already explain the associated habitats, flora and fauna. The geological formation of the feature could be highlighted in future in literature produced about the Cooley Peninsula.

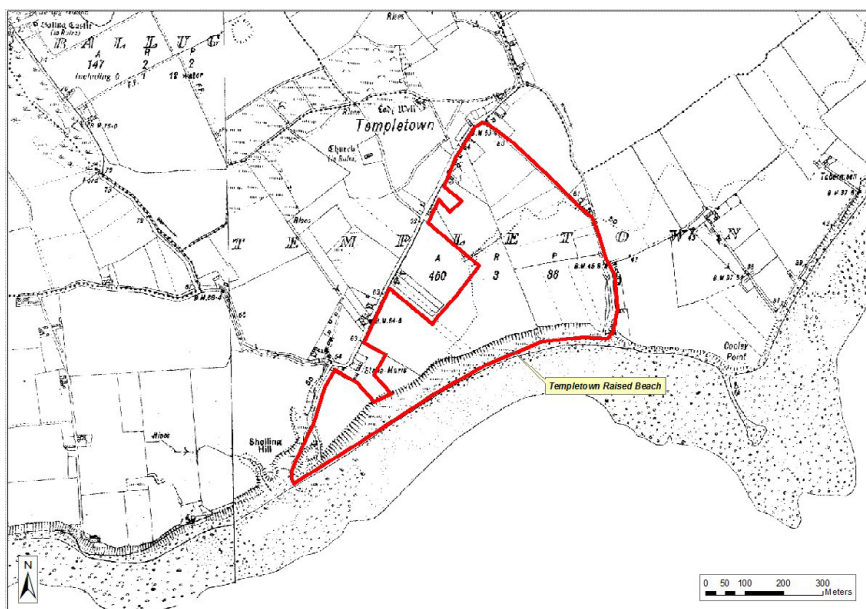


A view of the flat-topped Templetown Raised Beach, looking south from the car park.



The widest part of the Templetown Raised Beach, inland from Cooley Point.







## LOUTH - COUNTY GEOLOGICAL SITE REPORT

<b>NAME OF SITE</b>	<b>Salterstown</b>		
Other names used for site			
<b>IGH THEME</b>	<b>IGH15 Economic Geology</b>		
<b>TOWNLAND(S)</b>	<b>Salterstown</b>		
<b>NEAREST TOWN/VILLAGE</b>	<b>Annagassan</b>		
<b>SIX INCH MAP NUMBER</b>	<b>16</b>		
<b>ITM CO-ORDINATES</b>	<b>711840E 793358N (foreshore)</b>		
<b>1:50,000 O.S. SHEET NUMBER</b>	<b>36</b>	<b>GSI BEDROCK 1:100,000 SHEET NO.</b>	<b>13</b>

### Outline Site Description

The main site is a small coastal section on southern shore of Dundalk Bay; a ruined church less than 400m southwest is adjacent to the site of 19<sup>th</sup> century excavations.

### Geological System/Age and Primary Rock Type

The coastal section comprises greywackes and siltstones of the Silurian Salterstown Formation, part of the Lower Palaeozoic Longford-Down inlier. The area around the church is also underlain by the Salterstown Formation, not here exposed but present in boulders that make up the boundary wall of the church.

### Main Geological or Geomorphological Interest

The greywackes and siltstones exposed to the east of the slipway on the foreshore at Salterstown are intensely deformed: kinking, brecciation and quartz-carbonate veins are abundant. A sinuous, pinching and swelling fault-breccia zone is well exposed immediately north of the small lay-by 200m southeast of the slipway. The fault-breccia zone is up to 0.7m wide and strikes c.114°, dipping south. It comprises greywacke, siltstone and quartz fragments in a siliceous matrix. Abundant brown-yellow sphalerite (zinc sulphide) is present in quartz-carbonate veins and in the breccia matrix within this fault zone. Lesser amounts of galena (lead sulphide), chalcopyrite (copper-iron sulphide) and pyrite (iron sulphide) can also be observed. Mineralized veins, up to several cm thick, are also abundant in the footwall (northern) part of the outcrop.

In the area of the church, a lead deposit and a copper deposit were apparently mined in the early years of the 19<sup>th</sup> century. The Hibernian Mining Company subsequently sank shafts and drove an underground level in the mid-1820s but operations had ceased by 1827. There is no trace of these operations today. The stone wall that surrounds the ruined church and its graveyard contains greywacke and siltstone boulders with abundant examples of quartz-carbonate veining and brecciation. One boulder was observed with chalcopyrite, pyrite and sphalerite in veined and brecciated greywacke.

### Site Importance – County Geological Site; may be recommended for Geological NHA

This is the only significant example of exposed sulphide mineralization in county Louth and as such warrants CGS status. It also has some national significance as an excellent exposure of mineralization within a fault-breccia zone in the Lower Palaeozoic Longford-Down tract.

### Management/promotion issues

The site on the foreshore is unprotected but has not been a target for mineral collectors. It is immediately adjacent to the Dundalk Bay SAC and proposed NHA. The area is very popular with swimmers and holiday-makers. The church site contains mineralization only within boulders making up its boundary wall – promotion of this site is not recommended given the risk of damage to the wall.





Salterstown mineralized zone, view to northeast along foreshore.



Mineralized zone on foreshore bounded by faults (yellow lines) (left); zone of brecciation with yellow sphalerite within foreshore mineralized zone (right).



Yellow sphalerite in cross-cutting veins and fractures on foreshore (left); sphalerite and chalcopyrite in quartz veins in boulder from church wall (right).



