

REPORT ON THE CONSERVATION
OF IRISH COASTAL SITES

MACHAIR IN IRELAND

BY

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PERSONAL PROPERTY
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REPORT ON THE CONSERVATION VALUE OF IRISH COASTAL SITES:

MACHAIR IN IRELAND

By

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Anne Bassett

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TABLE OF CONTENTS

| | | |
|-------|---|---------------|
| I | INTRODUCTION: REVIEW OF THE CHARACTERISTICS OF MACHAIR IN SCOTLAND. | |
| 1.1 | Definition of Machair | Page No. 5 |
| 1.2 | General Physical background | |
| 1.2.1 | Distribution | 6 |
| 1.2.2 | Soils | 7 |
| 1.2.3 | Climate | 7 |
| 1.2.4 | Morphology | 9 |
| 1.2.5 | Vegetation | 10 |
| | | 12 |
| 1.3 | Human Background | |
| 1.3.1 | History | 13 |
| 1.3.2 | Present Day Use - Cultivation, Pasturage, Management | 13 |
| | | 14 |
| II | METHODS: SURVEY OF IRISH MACHAIR SITES | 15 |
| 2.1 | General Methods | 15 |
| 2.2 | Soils | 16 |
| 2.3 | Climate | 16 |
| 2.4 | Morphology | 16 |
| 2.5 | Vegetation | 16 |
| 2.6 | Human Influence | 17 |
| 2.7 | Conservation Value Assessment | 17 |
| III | RESULTS: SURVEY OF IRISH MACHAIR SITES | |
| 3.1 | Soils | 17 |
| 3.2 | Climate | 18 |
| 3.3 | Morphology | 20 |
| 3.4 | Vegetation | 21 |
| 3.5 | Human Influence | 23 |
| 3.6 | Discussion of Results | 24 |
| IV | DESCRIPTIONS AND CONSERVATION ASSESSMENTS OF SITES VISITED | 26 |
| | General Conclusions | 54 |
| | Bibliography | 55 |
| | Acknowledgements | 58 |
| | Tables 1-5 | 59 |
| | Appendices 1-4 | 69 |

TABLES, FIGURES, PLATES, APPENDICES

TABLES

1. Summary of occurrence of the common species found on machair.
2. pH values, percentage organic matter, depth of humus and percentage CaCO_3 from 15 machair sites in western Ireland, consisting of 34 samples, and from 4 Scottish sites.
3. Morphological features noted from Irish machair sites.
4. Vegetation table based on 47 relevés from 17 machair sites in Western Ireland.
5. Archeological features noted from machair sites, in the field and from $\frac{1}{4}$ " and 6" Ordnance Survey Maps.

FIGURES

1. Locational map of Scotland.
2. Climatic data from Stilligary South List.
3. Typical dune-machair morphological sequence in the Hebrides.
4. Climatic data from a) Belmullet and b) Malin Head.
5. Distribution of machair sites in Ireland.

SUMMARY

Machair is a landform-vegetation complex described extensively from Scotland where it has a north-western, Atlantic distribution. It may also be expected to occur in Ireland as physically and climatically much of western and north-western Ireland closely resembles those parts of Scotland in which machair is found. As it is a unique landscape in the European context it deserves priority in research and conservation. This report embodies the results of a survey conducted to locate, describe and assess, from a conservation viewpoint, machair sites in Ireland.

The characteristics of machair in Scotland are first reviewed and the general physical background of its distribution, soils, climate, morphology and vegetation are given. This is followed by a short account of the human use of the complex. The methods chosen to survey Irish sites are outlined. Data on soils, climate, morphology, vegetation, human influence and conservation potential were collected from 25 sites. The analyses of these data showed that machair occurs extensively in Ireland and that it is very similar to that described from Scotland in terms of climate, soils, morphology and vegetation. The main difference lies in the land-use; in Ireland all machair is heavily grazed and utilised as an amenity.

Descriptions of individual sites and evaluation of their conservation value complete the report and the general conclusions confirm that two sites in Co. Mayo - Dooaghty and Annagh-Termoncarragh - contain the most extensive areas of machair in Ireland and which are consequently of most value for conservation.

I INTRODUCTION: REVIEW OF THE CHARACTERISTICS OF MACHAIR IN SCOTLAND

1.1 Definition of Machair

The physical form of Ireland allows for an exceptional length of coastline in relation to its surface area. Thus, a surprising variety of coastline types occur, including many diverse landform and vegetation types, compared with most other European countries. It is with this in mind, and Ireland's Atlantic location that the question of the occurrence of machair in Ireland is approached.

Machair is a unique coastal landform-vegetation complex which has been extensively described from Scotland from places of extreme oceanic climate with high winds. Typically a flat sandy coastal plain, morphologically mature and stable, it arises from deposition of windblown sand which is normally rich in calcium carbonate due to the presence of shell fragments. Machair plains contain a characteristic type of grassland vegetation with a herb rich sward from which sand-binding species are virtually absent, and a landscape quality which is almost "indefinable". (Ritchie 1975).

The complex is maintained by a traditional system of grazing on commonage strongly associated with Gaelic speaking areas, and in fact, the word "machair" is a Gaelic word meaning "plain". Dickinson (1977) regards machair as a "socio-ecosystem", a result of the interaction of a physical environment with the flora, fauna and human culture creating a distinctive landscape or "landschaft".

In short, the following suite of attributes can be used in practice to define machair (after Ritchie, 1975).

1. Mature coastal sandy plain with more or less level surface.

2. Lime rich soil with high ph values containing shell fragments.
3. Grassland vegetation with a low percentage of sand-binding species.
4. A history of grazing and human interference.
5. An extreme oceanic climate with high winds.

Machair is commonly thought of as occurring only in the north and west of Scotland, and in particular in the Outer Hebrides. Ritchie (1975) notes that this is only an indication of an overriding climatic control and that similar areas in Norway, west of Ireland and parts of the coastline of England and Wales have vegetation-landform complexes which could be equally regarded as "machairs". With regard to Ireland, Akeroyd and Curtis (1980) have already studied a site on the Mullet Peninsula, Mayo which they concluded was machair and indicated that other sites of this type occur in western Ireland notably in Donegal and Connemara.

As is noted by Dickinson (1977), machair is an unusual and ecologically interesting landscape in the European context and it therefore has a high claim to priority in conservation. Thus, if Ireland holds large areas of machair it is essential that sites should be identified and surveyed and their conservation potential assessed. The purpose of this report, within the time limits and resources available, is to identify, survey and assess from a conservation viewpoint the machair, sites of Ireland.

1.2 General Physical Background

To make a full assessment of Irish machair sites, it is necessary that the characteristics of Scottish machair be first described against which Irish sites can ultimately be compared.

1.2.1 Distribution

Machair occurs, within the limits of our definition, in north and north-west Scotland, with an exclusively Atlantic distribution. It occurs extensively in the Outer and Inner Hebrides (notably on North and South Uist and on the nearby smaller islands such as the Monach Isles) where it covers approximately 10% of their total area (Ritchie 1971). Lewis and Harris have a small extent of machair. It occurs also in the Shetlands and the Orkney Islands as well as on other Highland Islands such as Islay, Jura, Mull, Coll, Colonsay and Tiree (Ritchie 1975).

On the mainland, machair is found at various sites in Sutherland Caithness, Inverness and Wigtown (Fig. 1). Machair, however cannot be considered unique to the Hebrides or even to north and west Scotland - the term having a wider application and can be synonymous with "links" and "burrows" (Ritchie, 1975) in other parts of these islands.

1.2.2 Soils

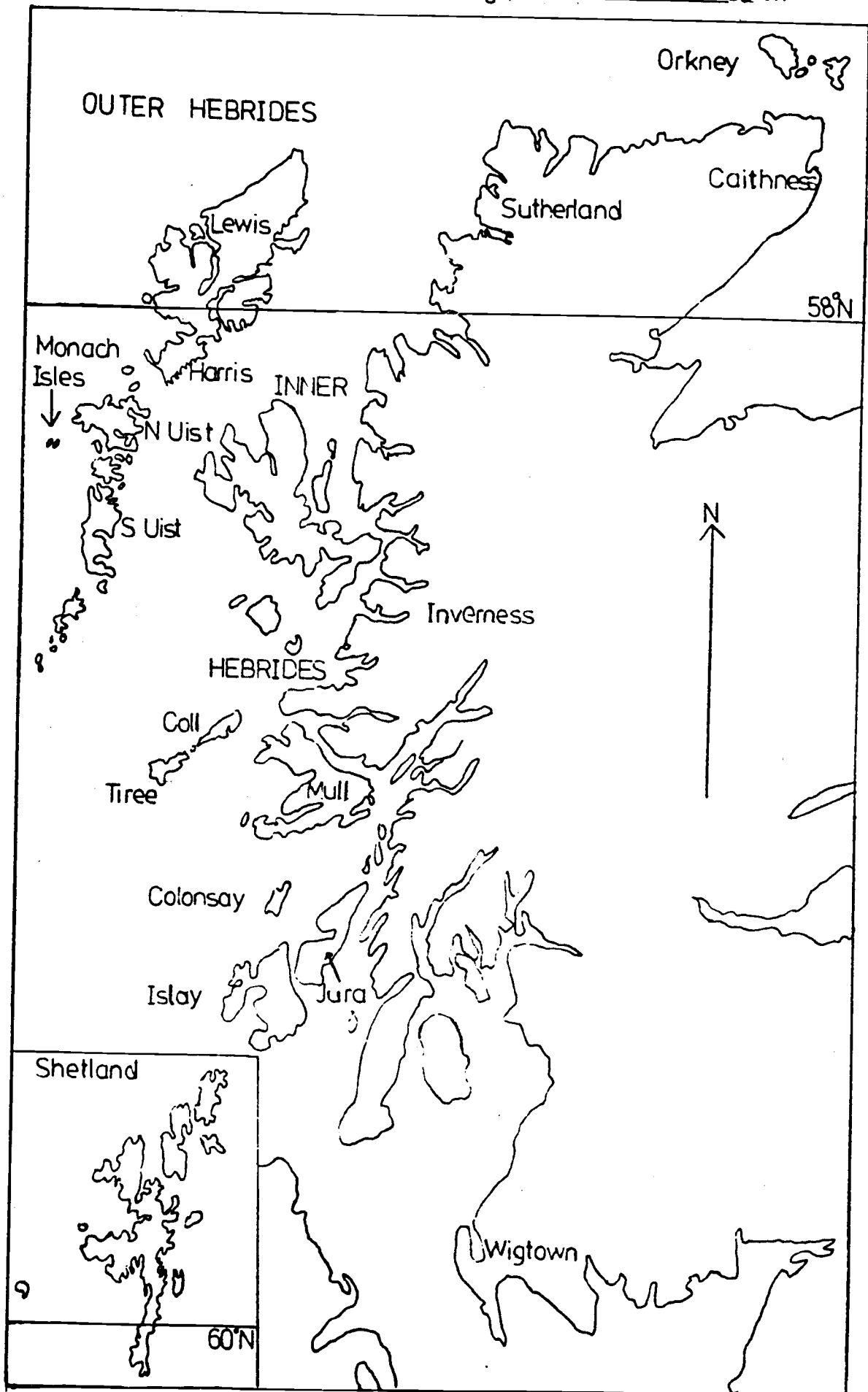
The soils of the machair are probably its most distinctive ecological characteristic, the substrate normally being highly calcareous (Dickinson and Randall, 1979). Generally they are composed of shelly sand, the quantity of which can be more or less equated with percentage calcium carbonate (Ritchie 1967). Single grained in texture, the soils have a high pH, a low percentage of organic matter and have a low fertility with most major and minor elements deficient (Dunn 1981). They are fragile and present difficulties in utilisation and conservation (Dickinson, 1977).

Recorded calcium carbonate levels in the soils of the machair of Scotland are in the range 0-80% (Ritchie, 1971) while the mean value is 41.1% (Randall, 1974). Typically, there is a decrease in calcium carbonate from the shore inland with the build-up of organic matter (Dickinson and

LOCATIONAL MAP OF SCOTLAND

FIG. 1

0 1:200 000 80km



Randall, 1979), giving rise to a purer and purer quartz fraction (Ritchie, 1972).

Trends in the reduction of calcium carbonate inland are often difficult to detect. Firstly, the rate at which calcium carbonate is leached, in the dune-machair system, is not known. It appears that it relates to the build-up of organic material, 9% of which requires 300 years in coastal dunes (Salisbury, 1925). Secondly, the nature and source of the parent material (sand) and its distribution within the machair system varies leading to complex spatial patterns (Dickinson, 1977). Thirdly, the chemical composition of the sand at any one time appears ultimately to be related to the morphology and drainage conditions of the area (Ritchie 1972).

Some machair soils still have a high calcium carbonate content even though they are part of a mature morphological surface. This is accounted for by deposition of wind blown calcareous sand (Randall, 1974). The wind borne nature of the sand is betrayed by the size of the grains, their unpolished surface and their well sorted nature (Ritchie, 1972).

The calcareous nature of machair soils leads to high pH values (usually above 7.0). Randall (1974) recorded a pH range from over 8.0 on the coast to 7.2 inland for the machair on the Monach Isles, the mean value being 7.61. The pH values tended to decrease inland with increasing organic matter.

The percentage organic matter in machair soils is always low, usually less than 10% going as low as 2% and below (Dickinson, 1977). Randall (1974) recorded a mean value of 11.54% on the Monach Isles. The upper humified layer of soil which supports plant life is usually thin - from 7-20 cm (Ritchie, 1971).

Finally, soil characteristics, namely the reduction in carbonate compared with the build-up of organic matter could be significant in the definition of machair (Ritchie, 1975).

1.2.3 Climate

Machair occurs in areas which have an extreme, moist oceanic climate with the occurrence of strong winds as is found on the north-west Atlantic coasts of Europe.

Wind

Randall (1974) says that wind is the most notable feature of the climate of the machair with 44% of the days with recorded gale force gusts mainly from the south with lesser winds blowing from other points of the compass. Dickinson and Randall (1979) state that the predominant direction of high winds is from the S-W quarter but storms, which have the most profound ecological significance, may occur from any direction at any one time of the year. Wind frequency (1970) is shown for Stilligarry, South Uist on Fig. 2 (Ritchie, 1971).

Precipitation

Precipitation averages 1100 mm over 250 raindays per annum on the Monach Isles. Thus, water deficit is rare in theory (Randall, 1974). The monthly precipitation for Stilligarry, S. Uist is shown on Fig. 2 (Ritchie 1971). The rainfall maximum occurs in October and the minimum occurs in June in a relatively evenly distributed rainfall regime for the year represented (1970).

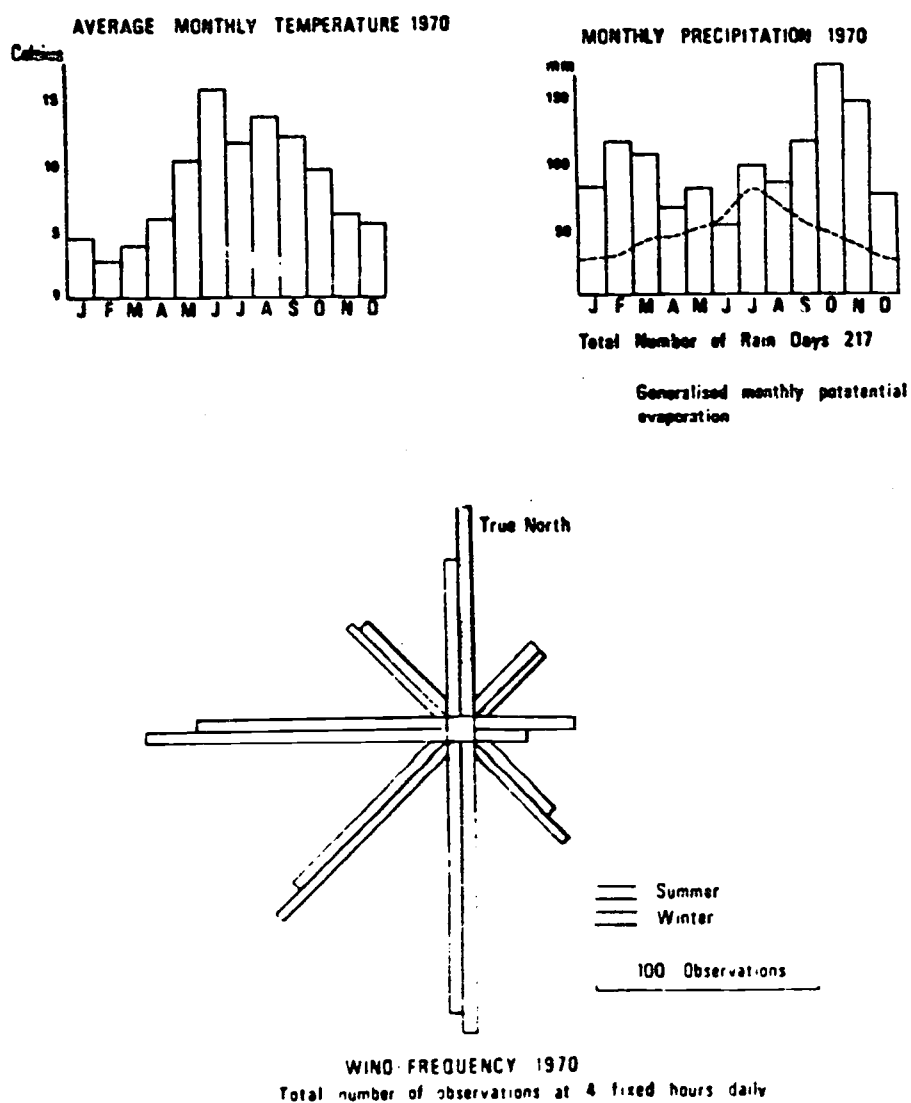
Temperature

The average monthly temperature (1970) is shown from Stilligarry, South Uist on Fig. 2 (Ritchie, 1971). The maximum occurs in June while the minimum occurs in

CLIMATIC DATA

SCOTLAND

STILLIGARRY, SOUTH UIST



(RITCHIE, 1971)

February. There is an absence of harsh winters (Dickinson and Randall, 1979) and while air frost is rare the average daily maximum is only 11°C for the Monach Isles (Randall, 1974). Sunshine figures are low (Dickinson and Randall 1979).

Clearly, the machair experiences an equitable climate though somewhat windy. However, because of the nature of the substrate, drought can be experienced in late May and June and flooding can occur in winter caused by the occurrence of rainfall maxima in late autumn/winter and the concurrent fall in temperature (Ritchie 1971).

1.2.4 Morphology

Type machair is morphologically a stable sandy plain which forms part of a mature coastal sand dune system (Ritchie and Mather, 1974). Slope angles are normally less than 5°, geomorphological activity is low and the landform is mature (100 years). Localised areas of erosion and redeposition, residual landforms and higher areas occur occasionally in a generally level topography (Ritchie and Mather, 1974). In its full development, machair is a deflation plain adjusted down to the water table level (Ritchie and Mather, 1974).

The history and morphology of the machair in the Hebrides has been studied by Ritchie (1967, 1971, 1972, 1974, 1979). Machair can develop only where there is a pre-existing level surface (Ritchie and Mather, 1974). In the Uists, the continental shelf extends from the foot of the east coast mountain range offshore and provides a gentle sloping platform ideal for deposition. Given the fact that no obvious large supply of sediment exists today in this area machair in the Uists is thought to be the result of the deposition on this platform of an excess supply of sand both siliceous and calcareous, brought about by a rise in sea level in post-glacial times (Ritchie, 1971). There is evidence from submerged organic deposits for the last major rise in sea level about 5,700 B.P., when the initiation of the machair plains took place. After

this, it is difficult to prove a rise in sea level but at least 60% of the machair coastlines in the Outer Hebrides is thought to be in retreat due to coastal erosion (Ritchie, 1979).

The typical sequence from the shore inland in the Hebrides is shown in Fig. 3 although many variations occur (Ritchie, 1971). The line of dunes if present forms the coastal edge. Blow outs normally occur in the dunes in response to wind which moves material inland or laterally. The machair plain is flat by comparison due to centuries of rainfall, strong winds, soil creep, grazing and cultivation. The water-table controls the level of the machair plain, the latter being slightly above the level of the dry season water-table and sloping seawards. The plain usually floods in winter the difference between the summer and winter levels being in the region of three feet (Ritchie, 1967).

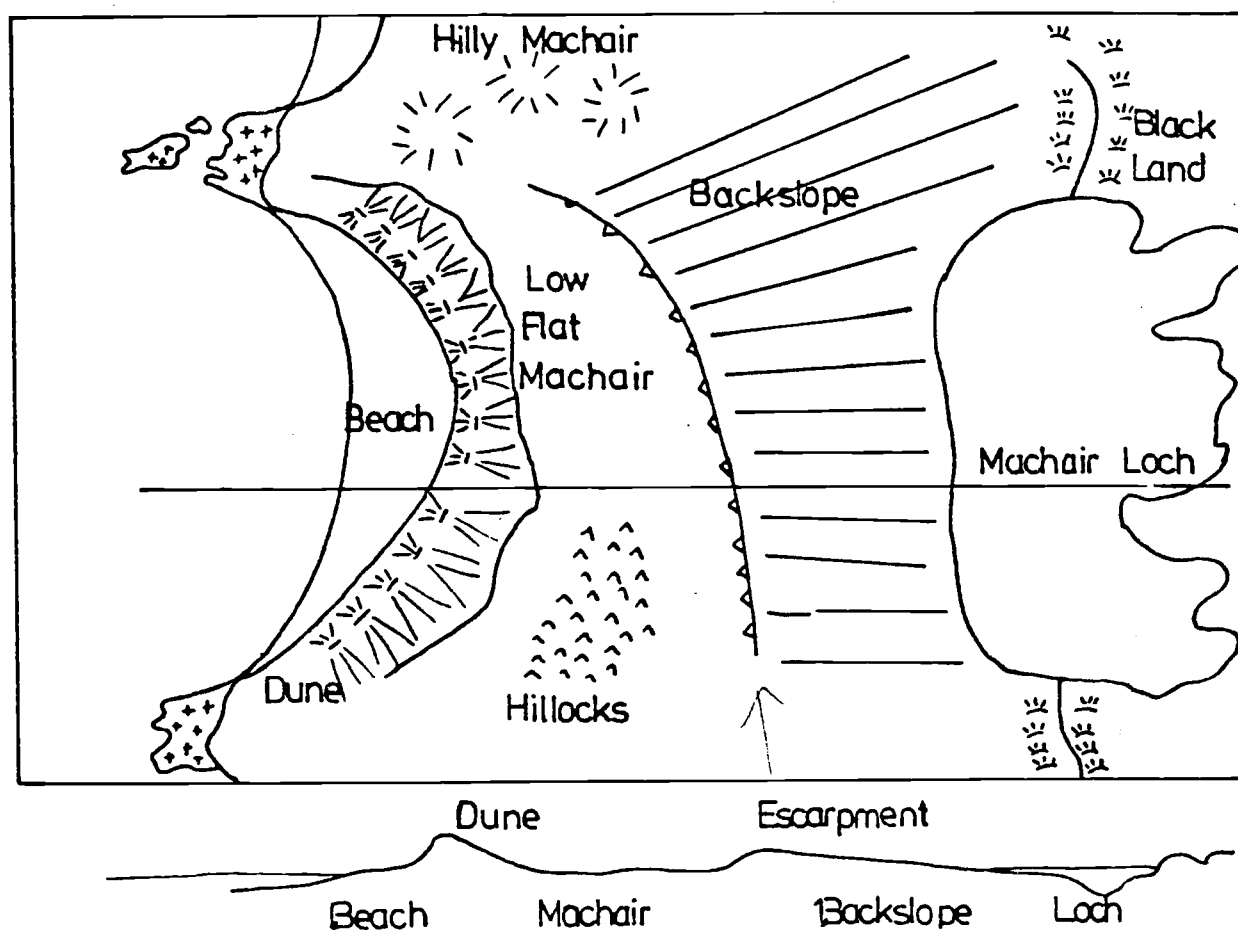
In some cases sand from blowouts accumulates against pre-existing features such as rocks and archeological sites to form fields of hillocks in the machair plain and which are separated by flat surfaces or shallow depressions. Hillocks near the coast often have Ammophila (Marram grass) showing their recent origin and the reworking of the substrate of the machair. Large hills can also be formed and are usually near the erosion feature which produced the sediment supply. The exact evolution of these features is not known (Ritchie, 1967).

The escarpment represents an erosional feature; it being undercut, retreating as a whole, and at a final stage, is completely removed. The landward edge then becomes depositional in origin with the infilling of machair lochs or marsh (Ritchie, 1967).

A variety of landforms can be identified in the field as part or parts of this typical dune-machair sequence. Ritchie (1979) identified three types of machair surfaces. Firstly, nilly or hillocky machair which is under

TYPICAL DUNE - MACHAIR MORPOLOGICAL

SEQUENCE IN THE HEBRIDES



(RITCHIE, 1971)

subsurface control. Secondly, two types of plain surfaces, one sloping seawards with an escarpment and the other sloping landwards terminating in a marsh or loch. Given that the sea level stopped changing dramatically around 5,700 B.P. and that there was a fixed supply of sediment, he puts forward a theory on the morphological evolution of the machair. This is seen as firstly a build up of high dune ridges followed by a sequence of erosion in the dune system extending out a deflation plain forming an escarpment which slopes landwards, and deposition of the sand inland. Alternately the sand is deposited into a pre-existing basin. There is evidence for both types of formation and a combination of the two could occur.

1.2.5 Vegetation

The vegetation of the machair has been studied less extensively than either the morphology or the soils. The typical vegetation type of the machair is a coastal, calcareous grassland with a herb rich sward. It consists of a relatively pure flora of 100-150 species (Randall, 1974), which has floristic links with both dune communities and with calcareous grassland (Gimingham, 1974). Floristic richness distinguishes machair vegetation from more siliceous dune systems (Dickinson and Randall, 1979), and although there is little in the basic composition of machair communities to distinguish it from other fixed dune pasture there is a wealth of interesting plants which in June presents a display of colourful flowers with a notable profusion of orchids (Gimingham in Ritchie 1975). Ritchie (1975) considers the coastal location, the occurrence of lime rich soils and the elimination of long psammophilous grasses as the three main elements in the botanical definition of machair. Dickinson and Randall (1979) state that man has been essential in shaping present day vegetation patterns and without agricultural use, machair would not exist in its present form.

Floristically speaking, Gimingham (1974) notes that in machair the characteristic dune species are reduced such as Ammophila arenaria, Agropyron junceiforme, Carex arenaria and Tortula ruraliformis while there is a great consistency of nine species, Festuca rubra, Trifolium repens, Lotus corniculatus, Achillea millefolium, Galium verum, Plantago lanceolata, Euphrasia spp., Bellis perennis, Rhytidiadelphus squarrosus. Randall (1974) on the Monach Isles noted the frequency on the machair of Fesutca rubra, Plantago lanceolata, Achillea millefolium, Carex arenaria, Euphrasia nemorosa, Galium verum and the consistency of Bellis perennis. This author considers the machair to be biotic in origin due to grazing, the geomorphic conversion being ultimately agricultural. Dickinson and Randall (1979) for the Uists show Festuca rubra, Poa pratensis, Trifolium repens, Plantago lanceolata, Bellis perennis, Rhytidiadelphus squarrosus and Lotus corniculatus as being frequent on the machair. Together these authors proposed a model of machair vegetation, where dune and pasture grassland elements are recognised. Dune types are characterised by the presence of Ammophila and areas of bare ground and grassland types by a frequency of over 80% for Festuca rubra, a floristically rich assemblage and Ammophila absent or nearly so. This floristic information, together with data from the Mullet Peninsula, Mayo (Akeroyd and Curtis, 1980) are summarised on Table 1. Five species are mentioned by all authors as having high frequencies on machair. These are Festuca rubra, Bellis perennis, Plantago lanceolata, Trifolium repens and Lotus corniculatus. All the authors note the low frequency of Ammophila arenaria.

1.3 Human Background

1.3.1 History

Man and machair have for centuries been inextricably linked. Scottish studies have shown the antiquity of man's use of the machair surfaces by the numerous archeological

sites recorded and subsequently covered by sand drift. Ritchie (1971) cites 2000 years of human use of machair sites in the Uists firstly by a seasonal hunting and gathering economy which was later followed by pastoral and arable activity.

Throughout the human history of the machair there have been periods of stability and instability. Five main occupational phases have been recorded - Neolithic, Beaker, Iron Age, Viking/Medieval and Historical (Ritchie, 1979). Evidence of Neolithic, Beaker and Iron Age activity (wheel-houses) is found on several archeological sites in the Uists. The presence of the Vikings from the ninth to the thirteenth centuries is revealed in placenames and Viking houses (Ritchie, 1979). Between this period and the well documented eighteenth and nineteenth centuries the history of the use of the machair by man is not well known.

During the eighteenth century, there was a rise in population on the machair with increasing emphasis on arable farming and stockrearing. The kelp industry grew, the traces of which can still be seen in the ruts left on the machair by the carts collecting seaweeds. The beginning of the nineteenth century saw the collapse of the kelp industry and the start of a series of major socio-economic and land tenure changes. By the end of the nineteenth century the present day pattern of long "street villages" was established. These changes do not seem to have altered the traditional system of common grazing and run-rig cultivation (Ritchie 1971; Mather, 1981).

1.3.2 Present day use - Cultivation, pasturage, management

Machair, as an important grazing and arable unit, has maintained a relatively dense pattern of settlement on the west side of the Uists (Ritchie, 1971). The main use of the machair here is for wintering cattle and for the production of winter keep mostly in the form of small oats

(Avena strigosa) - 65% and Rye (Secale cereale) - 35% (Dunn, 1981 and Knox, 1974). Thus more cattle can be wintered than in other areas of the Highlands (Knox, 1974). Machair, particularly if dunes are present offers a dry and sheltered environment in winter which saves expense on housing (Dunn, 1981).

The rotation consists of 2-3 years cultivation of cereals, and 2-3 years fallow when the area is repopulated with fescues, legumes etc. Ploughing takes place in late March to avoid erosion, seeds and fertilisers are broadcast by hand and the area is then harrowed and rolled. Potato is the only other crop of note and is grown for home consumption (Dunn, 1981). Both Knox (1974) and Dunn (1981) agree that the only way to increase the agricultural productivity of the machair is to increase grass production which would necessitate increased fencing to allow the grass to become established.

Machair is often fenced into strip fields perpendicular to the sea. Large areas form open commonages for grazing.

II METHODS: SURVEY OF IRISH MACHAIR SITES

2.1 General

Having surveyed and studied the available literature on the subject of machair in Scotland, sand-dune areas along the western coast of Ireland were provisionally identified on Ordnance Survey $\frac{1}{2}$ " and 6" maps, by personal communication and by aerial photographs. These sites were subsequently visited in September and October, 1983. A field data card was designed covering locational data, the five relevant characteristics of machair (see Introduction), including the physical aspects such as soils, climate, morphology and vegetation and the human aspects such as pasturage, cultivation and management. (Appendix 1).

2.2 Soil

Soil samples were taken using a soil corer from most of the machair sites visited either as a single sample or as samples along a transect. These soils were analysed for pH, organic matter and calcium carbonate content using methods detailed in Appendix 2. They were checked microscopically for the presence of shell fragments and the depth of humus was also noted where applicable.

2.3 Climate

The meteorological stations of Belmullet, Mayo and Malin Head, Donegal were chosen to represent the prevailing climatic conditions of the machair areas of Ireland (Fig. 5). This was because these two stations are situated in the area where most of the machair sites visited occur, are coastal stations, and are the only stations in these areas for which a variety of meteorological data is available from the Meteorological Office, Dublin. Wind-speed and directional data, temperature and rainfall data as well as humidity and sunshine figures were used to represent the climate of the machair areas.

2.4 Morphology

The topography and landscape of the site and surrounding landscape was noted on the field data card and any unusual morphological features described.

2.5 Vegetation

With the aid of a coastal species list prepared by Dr. Tom Curtis reléves were taken at the sites visited using one or two metre² quadrats. The Braun-Blanquet scale of cover-abundance estimation was used to estimate the frequency and cover values for the species listed. Total vegetation cover and vegetation height was also recorded. Quadrats were chosen to represent visibly different

vegetation units. A relvé table was constructed and the consistent and differential species extracted.

2.6 Human Interference

The presence of present and former cultivation, archeological remains, grazing, fencing and general management of the machair sites and the surrounding countryside was noted.

2.7 Conservation Value

A conservation evaluation card was devised covering the scientific appraisal of the machair characteristics and a management appraisal. Sites were scored against these criteria and graded according to the conservation value. (Appendix 3).

III RESULTS: SURVEY OF IRISH MACHAIR SITES

3.1 Soil

Results of the soil analysis of the Irish machair soils are shown in Table 2. Without exception shell fragments were found to be present, but they varied enormously in quantity. Those soils showing a large quantity of shell fragments give high results in the calcium carbonate determination and visa versa.

Calcium carbonate levels show a great variability and are in the range 0-61% with a mean value of 23%. Results from Annagh/Termoncarragh, Mayo show decreasing calcium carbonate levels from the shore inland although the decline is weak. At Rosmurrevagh, Mayo there is a marked decrease inland of calcium carbonate levels, the most inland sample having been taken in an area of former cultivation. Leaching is probably taking place at a high level here. At Tranarossan, Donegal no trend is observable, but this site is in a very exposed area without a high dune ridge, so

wind-blown sand is likely to reach far inland. At Mannin Bay, Galway, calcium carbonate levels are high all over the system and no trend in reduction of calcium carbonate levels was discernible. The transect was taken over a relatively short distance and obviously wind-borne shell sand is abundantly deposited here on this extremely exposed site. In more sheltered conditions as at Lettermacaward, Donegal there is a small decrease in calcium carbonate levels inland but levels are so low here that the decrease is unremarkable. The wetter site of Doogort, Mayo has a higher level of calcium carbonate which could be caused by being nearer the supply of windborne shell sand since calcium carbonate is normally found at low levels in waterlogged conditions.

All the pH levels recorded are high (usually > 7.0) with a tendency to decrease inland - e.g. Tranarossan and Lettermacaward, Donegal, Annagh and Rosmurrevagh, Mayo.

Coupled with a decrease in pH the percentage organic matter rises with increasing distance from the sea notably at Annagh, Mayo and Tranarossan, Donegal. The highest percentage of organic matter recorded was 12.5% at Tranarossan, approximately 300 metres from the sea. In general, the percentage organic matter is below 10% going as low as almost 1% at Gartar Hill, Mayo. The organic horizon which supports plant life is in the range 0-10 cm from the Irish soils sampled.

Finally, where there is an increase in organic matter, there is a slight tendency for calcium carbonate levels to decrease, e.g. Annagh, Mayo and Tranarossan, Donegal.

3.2 Climate

Wind

The most distinctive climatic feature of the machair is the presence of strong winds throughout the year. Only in

these areas of Ireland where machair is found does the annual average windspeed reach 7 metres per second (1951-1970) and the maximum windspeeds are over 50 metres per second [Fig. 4 (a) and (b)]. The mean number of gales at Malin Head, per annum, is 67 (1967-1980) and at Belmullet 29 (1957-1980) compared with Valentia Island (1951-1980) which has 10 and Claremorris (1961-1970) which has 4.8 which are south-western and western stations respectively. At Malin Head 43% of the hourly recordings show a windspeed of more than Force 4 (5.5-7.9 M/S) while the equivalent figure for Belmullet is 29.8%. As regards the wind direction at Malin Head, the maximum number of hours of wind recorded came from the 190° angle - i.e. south while at Belmullet 220° - i.e. south-west was the predominant direction noted. However, about 40% of the recorded wind directions occur in the south-west quarter both at Belmullet and Malin Head, although strong winds occasionally come from all directions.

Precipitation

The mean annual rainfall for Belmullet is 1100 mm per annum (1957-1980) while at Malin Head the equivalent figure is 1041 mm per annum (1951-1980) with 248 and 238 raindays (0.2 mm) respectively. These stations do not occur in the wettest part of Ireland as rainfall in some mountainous districts in the west exceeds 2000 mm. However, though not extremely wet, machair areas have a rainfall evenly distributed throughout the year [Fig 4 (a) and (b)]. Rainfall maxima occur in late autumn. Both Belmullet and Malin Head record maxima in November and minima in April.

Temperature

The temperature regime shows a small annual range with cool summers and mild winters [Fig. 4 (a) and (b)]. The mean annual daily temperature for Belmullet is 9.8°C, January being the coldest month at 5.6°C and August being the warmest at 14.2°C (1957-1980). Malin Head shows a mean daily temperature of 9.4°C with February the coldest month

CLIMATIC DATA

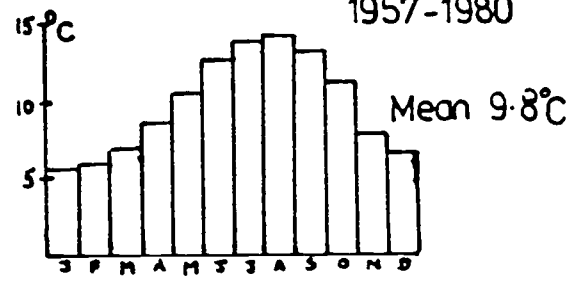
IRELAND

BELMULLET

MAYO

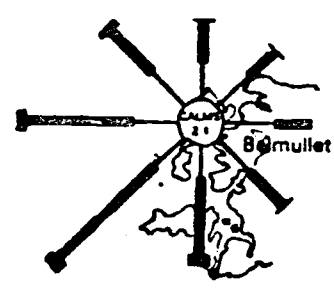
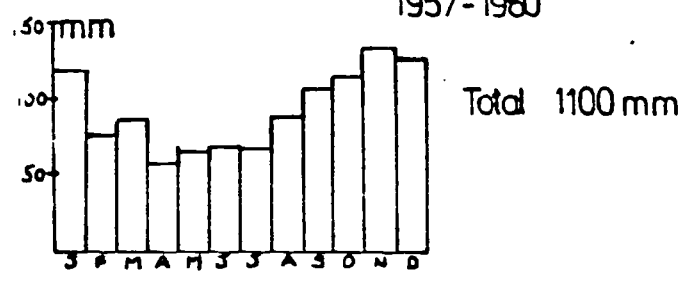
Mean Monthly Temperature

1957-1980



Mean Monthly Precipitation

1957-1980

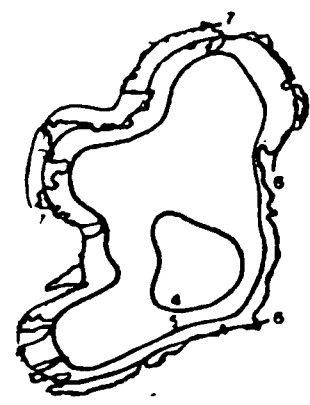


Scale of frequency 0 5 10 15 20 25%

Scale of speed 0.3 to 5.4 5.5 to 13.8 13.9 or more metres sec
Beaufort force 1 to 3 4 to 6 7 or more

Wind Speed and Direction

MEAN ANNUAL
WIND SPEED
(metres per second)
1951 - 1970

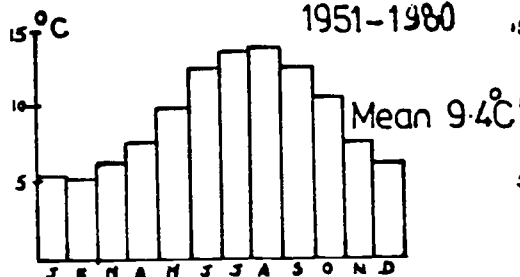


Metres per second 0 1 2 3 4 5 6 7 8 9 10
Miles per hour 0 5 10 15 20

MALIN HEAD DONEGAL

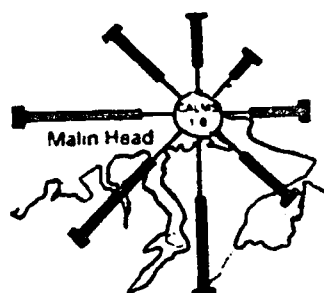
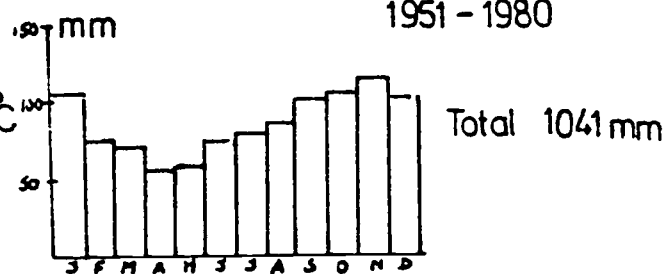
Mean Monthly Temperature

1951-1980



Mean Monthly Precipitation

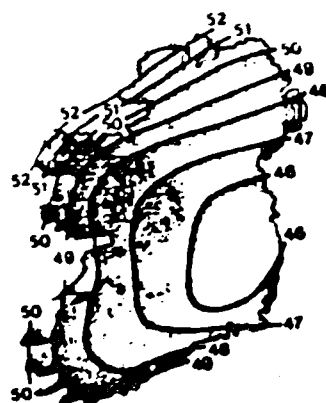
1951-1980



Scale of frequency 0 5 10 15 20 25%

Scale of speed 0.3 to 5.4 5.5 to 13.8 13.9 or more metres/sec
 Beaufort force 1 to 3 4 to 6 7 or more

Wind Speed and Direction



Maximum Wind Speed

Metres per second 0 10 20 30 40 50 60
 Miles per hour 0 20 40 60 80 100 120 140

Maximum wind speed in a gust (metres per second) which is likely to occur once in 50 years

at 5.2°C and August the warmest at 14°C (1951-1980). The mean daily range of air temperature is only 5°C in west Mayo and in north and north-west Donegal, making them the smallest ranges in the whole country (1931-1960). Frost is rare occurring only on 16 days per annum at Belmullet (1957-1980) and on 10.2 days at Malin Head (1951-1980). The frost season is also the shortest in the country, the first frost occurring on average in mid-December and the last frost in mid-March in north and north-west Donegal, west Mayo and Connemara (1944-1968).

Relative Humidity and Sunshine

Relative humidity varies little throughout the year (C.80%) Belmullet being slightly more humid than Malin Head. There are 61 days on average with no sun at Belmullet (1957-1980) with 65 on average at Malin Head (1956-1980).

3.3 Morphology

A variety of morphological features occur on Irish machair sites the evolution of which are difficult to assess. Also, there seems to be no correlation between individual features. At all sites the typical stable sandy plain is present but varies in degree of flatness of the surface. At some sites, an extremely flat extensive plain occurs while at other sites the plain is markedly undulating to slightly uneven.

A common feature encountered on Irish machair is the presence of hillocks intermingled with flat areas forming a "hillocky machair". Some of these hillocks have Ammophila present - a dune sandbinding species e.g. Tranarossan, while others have an established and separate flora in comparison to the flat areas, e.g. Rosmurrevagh. The presence of these hillocks indicates reworking of the substrate - i.e. erosion and re-deposition.

Further evidence for geomorphological activity is provided by the foredune or dune system which is often heavily

eroded. Good foredune systems were noted at Sheskinmore and Dooaghtry among others while low poorly formed or badly eroded foredune systems were noted at Srah, Kinrovar and Keel, Mayo, and Mannin Eay, Galway. At Annagh, the foredune is behind the machair the sand having been carried far inland while a fossil dune system occurs nearer the shore. At Gartar Hill, windblown sand is encroaching on agricultural land and reaches as high as 517 feet on the summit of Gartar Hill. Windblown sand was sometimes noticed, freshly deposited on machair e.g. Keel, Achill.

At no site were all recorded morphological features, or the complete dune-machair-escarpment-machair-marsh sequence found. Gartar Hill showed the greatest variety of features with a dune system, flat machair, wet machair, hilly and hillocky machair present.

At Doogort, Achill, an escarpment was noted, with two levels of machair, the furthest one inland terminating in bog. Other morphological features noted on Irish machair were the presence of rock outcrops at Bunlack, Kincaslough and Dooagh Isle and shingle beaches at Rosmurrevagh and Tranarossan, Dooagh Isle and Keel. At Tranarossan, the shingle beach is encroaching on the foredune. A salt marsh was noticed at Carnboy.

3.4 Vegetation

The results of the vegetation survey of Irish machair is summarised in Table 4. They show that the communities present are of the grassland type rather than of the sand-dune type. A flora of 94 species was recorded.

A suite of nine core species occurs consistently throughout the Table. These are Festuca rubra, Plantago lanceolata, Bellis perennis, Lotus corniculatus, Galium verum, Carex arenaria, Trifolium repens, Poa subcaerulea and Brachythecium allicans. Six of these species are universally noted to have high frequencies on machair in

Scotland and in Ireland (Table 1). There is also a very low occurrence of sandbinding species, excepting Carex arenaria.

Some of the distinguishing features of Irish machair vegetation are of note. Firstly, in Ireland Brachythecium albicans is the commonest moss as opposed to Rhytidiadelphus squarrosus in Scotland, which, as can be seen from the Table is restricted in its occurrence in Ireland to the damper parts of the machair. Secondly, of note is the presence of Tortula ruraliformis, a typical dune species, which on Scottish machair was noted by Gimingham (1974) as being low in frequency. Thirdly, the common occurrence of Luzula campestris is interesting as normally it is an indicator of dry acid soils poor in nitrogen. Finally, Achillea millefolium and Euphrasia spp. are less common on Irish machair than on Scottish machair.

Having regrouped and reordered species and relevés to produce a differential table a number of phenomena emerge: the absence of "wet" species such as Agrostis stolonifera, Juncus articulatus, Carex panicea and Calliergon cuspidatum in relevés 37-47 and the presence in relevés 1-10 and 37-47 of pioneers such as Cerastium diffusum, Elymus farctus, Sedum acre and Asperula cynanchica indicating more open sandy conditions. This is probably where windblown sand is being currently deposited. In relevés 11-30 the absence of pioneer sand species and the presence of the species usually found in wet habitats indicate possibly, the absence of the input of sand and comparative "wetness". Some sites seem to contain wet areas being inundated by sand i.e. relevés 1-8 which have a mixture of both "wet" and "dry" species.

In conclusion, Irish machair bears vegetation of grassland affinities rather than that of the dune type. It contains dry and wet components but the differences between these, in terms of community content, are not sharp enough to

merit reorganising them as anything other than "wet" and "dry" facies. Each type contains a central core of species which is common to both.

3.5 Human Influence

History

It seems that the history of human use of the Irish machair is not as well known as that of Scotland where it has, for some historical periods, been well documented. That there is a history of human use of the machair in Ireland is shown by the presence of archeological remains, and evidence of former cultivation on the machair sites visited (Table 5).

Former human settlement is shown by the presence of "kitchen middens" at Tranarossan and Rosapenna, Donegal and Keel, Mayo. Gartar Hill, Mayo had a "sandhill settlement" which has since been covered by sand. Disused graveyards and ruined churches are features commonly encountered on machair as well as the occasional castle, tower and well. Some graveyards such as that of Derrybeg are still in use today. Other features present include a celtic cross.

Evidence of former cultivation, in the form of cultivation ridges or "lazybeds" was found at Kinrovar, Rosmurrevagh and Annagh, Mayo and at Magheradrumman, Donegal very large old cultivation ridges are present. The date of these ridges is not known, but they possibly date from the eighteenth century when population levels were higher than today and the pressure on land greater.

Present Day Use

At the present time machair in Ireland is universally heavily grazed and sometimes markedly overgrazed. Sheep and cattle are the main pasture animals, and large populations of rabbits were noted at several sites

particularly at Dooaghtry and Rosmurrevagh Mayo. In general, Irish machair sites are not fenced, the land is held in commonage, and the cattle or sheep allowed to wander freely. Fencing is at present being carried out at Annagh, Mayo while at Lettermacaward, Donegal the land is more intensively managed with strip fields parallel to the dunes. Strip fields were also noted at Dooagh Isle, Donegal. Machair meadow is rare on Irish sites but it was noted at Lettermacaward, Annagh, Kincaslough and Mannin Bay. Otherwise there is little or no cultivation carried out.

Machair in Ireland is often used for amenity purposes, the beach-dune system being used for recreation while the machair itself is used as a caravan park or sites for holiday homes - Kincaslough, Carnboy, Derrybeg, Rosapenna, Tranarossan, Donegal. The grazed flat machair plain provides an ideal football pitch for the local community and such features were noted from Tranarossan, Donegal to Mannin Bay, Galway on practically all the sites visited. Golf links are frequently present on machair, e.g. Rosmurrevagh, Keel, Derrybeg and Rosapenna. The machair at Carnboy is used as an airstrip while a factory is sited on the machair at Derrybeg.

3.6 Discussion of Results

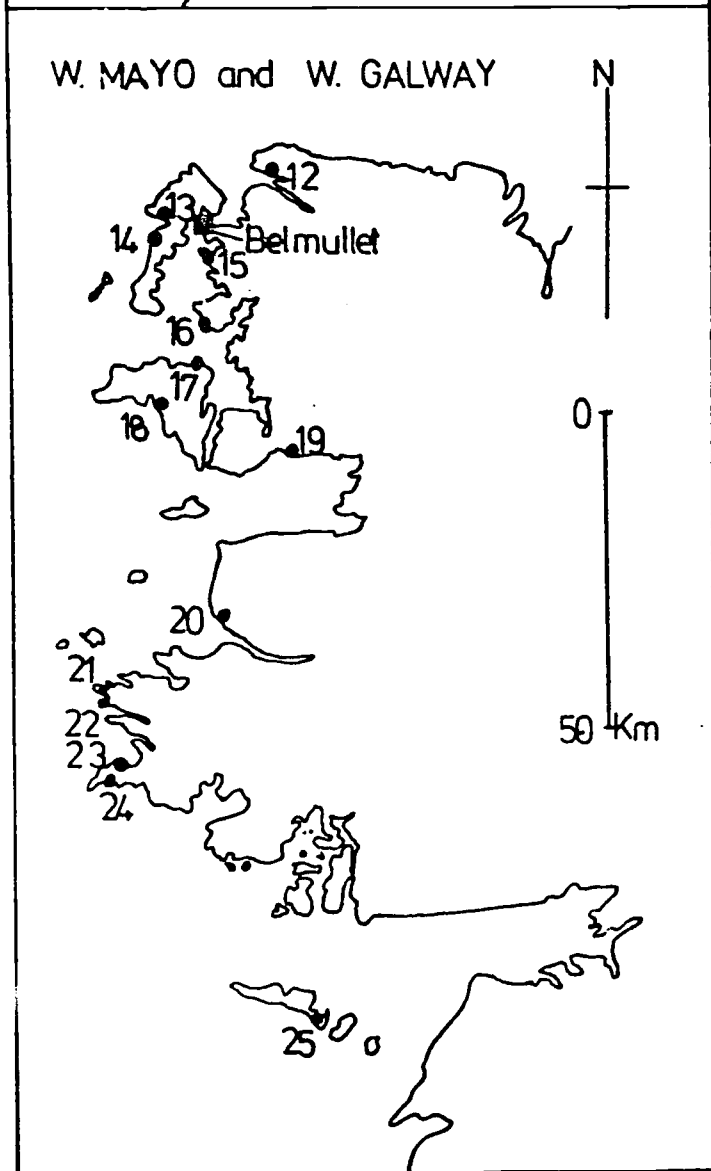
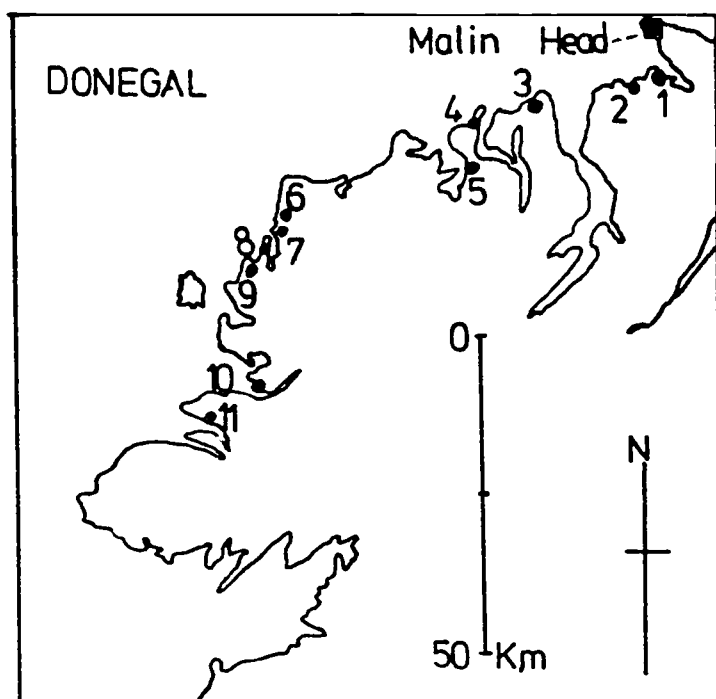
With respect to climate, vegetation, morphology and human use Irish machair is comparable and very similar to Scottish machair.

Minor differences occur. Climatically, the Irish machair enjoys a somewhat more equitable regime (Fig. 2 and Figs. 4(a) and (b)). While the wind factor seems to be more or less the same, temperature and precipitation show less oscillation in Ireland from month to month than is the case in Scotland. The pedology of Scottish and Irish machair seems to be very similar in pH values and percentage organic matter while calcium carbonate levels tend to be on

average lower and less varied in Ireland than in Scotland with fewer, very high values encountered in Ireland.

Morphologically, the Irish dune-machair systems show all the features found in Scotland although the complete dune-machair-escarpment - machair loch sequence was not encountered. Unlike Scottish machair sites, lakes and marshes do not as frequently adjoin machair in Ireland and usually the inland portion of the landform terminates in poor heath or bog. The vegetation, by and large, is very similar to that found in Scotland with the most frequent species identical in both cases. The Irish machair flora does have a high frequency of Carex arenaria, Ranunculus bulbosus, Brachythecium albicans and Luzula campestris, which distinguishes it from the Scottish flora. The main differences between the two systems lies in human use, the Scottish machair being agriculturally much more intensely used, is cultivated and is used for meadow and pasture. In Ireland, the machair is universally grazed and more utilised for amenity purposes.

There can be little doubt that given the evidence available in this study that machair exists as a landform-vegetation complex in Ireland and thus it remains to list, study and assess individual sites as to their conservation value.



KEY: • Machair Sites

■ Meteorological Stations

2. Tullagh Bay
3. Magheradrumman/Ballyniernan Bay
4. Trunacrossan
5. Rosapenna/Carrickart
6. Bunlack
7. Derrybeg
8. Carnboy
9. Kincaslough
10. Letternacaward
11. Sneskinore
12. Gattar Hill
13. Annagh/Ternoncarraigh
14. Cross Lough
15. Sran
16. Kinrovar
17. Doogort, Achill
18. Keel, Achill
19. Rossmurrevagh
20. Dooaghtry
21. Aughrusbeg
22. Omey Island
23. Mannin Bay
24. Aillebrack
25. Aran Islands

IV DESCRIPTIONS AND CONSERVATION ASSESSMENTS OF SITES VISITED

Gartar Hill/Rinroe Point

Grid Reference: F8141

O.S. $\frac{1}{2}$ " sheet: 6

O.S. 6" sheet: Mayo 4

Townland(s): Carrowteige, Gartar Hill, Curraunboy

Approximate Area: 320 hectares.

This is an extensive sandy area stretching from Rinroe Point in the west, covering the area south of Gartar Hill to the coast, and extending to Curraunboy in the east. The area is undergoing severe erosion and large-scale reworking of the substrate with large quantities of sand being blown inland up to 517 feet on Gartar Hill. Sand is encroaching onto agricultural land and being incorporated into the soil.

Dunes are intermingled with machair and in some parts there is no definite boundary between the dunes and the machair. Of note, is the presence of low dunes of the grey type up to 1.5 metres in height. Four types of vegetation-landforms were identified:-

1. Small foredunes with Ammophila.
2. Further inland, small hummocks covered with vegetation, mostly annuals, intermingled with the machair plain.
3. Areas of typical flat machair heavily grazed by sheep.
4. Wet machair grassland.

The soils corresponding to the last three types showed typical machair features with high pH and low levels of organic matter. The level of calcium carbonate is low throughout the system with the windblown sand collected at the site giving the highest level of 11%.

The site has a history of human use as shown by the remains of a "sandhill settlement" and a chapel in ruins. Presently, it is very heavily grazed, especially by sheep. The area is not fenced and is used for amenity purposes with a football pitch on the site.

The site is located in a remote area, is very varied morphologically, and has a good variety of machair vegetation types. It would not present major management problems and as such has conservation possibilities.

Rating: Grade II.

Annagh/Termoncarragh

Grid Reference: F65 34

O.S. $\frac{1}{4}$ " sheet : 6

O.S. 6" sheet : Mayo 9

Townland(s) : Termoncarragh, Annagh, Tonamace, Macecrump,
Ardowen, Carn, Emlycass, Emlybeg North.

Approximate Area: 444 hectares.

This is a very extensive area of machair occurring to the west of Termoncarragh Lake, and to the south and east of Annagh Head. An extensive flat plain occurs between the high dunes and the sea with a fossil dune system near the shore.

The vegetation contains the typical suite of machair species with Carex arenaria very rare and Koeleria macrantha abundant. The soils have high levels of calcium carbonate - up to 50% - decreasing inland with increasing organic matter and decreasing pH and are thus typical of machair soils in general.

The site has a long history of human use with several archeolgocial remains including four burial grounds, a church in ruins and a celtic cross. Old cultivation ridges are present also. Today the area is heavily grazed by cattle, horses and rabbits. Fencing is at present being carried out. Some machair meadows were noted.

Adjacent to the machair area is a lake and marsh area which is of scientific interest from the ornithological viewpoint, being the nesting site of wading birds such as dunlin, lapwing and snipe. It is also a wintering area for wildfowl such as mallard, swans, white fronted barnacle geese and golden plover. It is the only Irish station for the nesting of the rednecked phalarope.

This area contains the finest and largest example of machair in Ireland. At present it is under threat due to a recent change in management whereby fencing of the machair commonage is being carried out. The nature and extent of the fencing is at present

being investigated but it is feared that the traditional common-land grazing system which gives rise to machair will be destroyed, possibly with the result of changing the whole nature of the vegetation. This site or at least in part, is highly recommended for conservation.

Rating: Grade II.

Cross Lough

Grid Reference: F64 29

O.S. $\frac{1}{2}$ " sheet : 6

O.S. 6" sheet : Mayo 16

Townland(s) : Cross, Cross Common, Drumreag

Approximate area: 280 hectares.

This is a fairly extensive area of machair occurring to the west of Cross Lough. The surface is undulating, is extremely heavily grazed and is used for amenity purposes, a golf links being present on the site. A graveyard and an abbey in ruins are the archeological remains which occur here. Cross Lough itself is a very shallow sandy lough with a number of interesting aquatic plants. Neither the vegetation nor the soils were sampled here, the machair site itself not being of great conservation interest being under too great human pressure. However, the loss of the machair at Termoncarragh Lake (Annagh) could enhance the value of this site in the future.

Not Graded.

Srah

Grid Reference: F72 27

O.S. $\frac{1}{2}$ " sheet : 6

O.S. 6" sheet : Mayo 17

Townland(s) : Srah

Approximate area: 40 hectares.

This small area of machair occurs on the north side of the tombola joining Claggan with the mainland, between the dunes and the road. The foredunes are eroded behind which the machair plain is not very extensive.

The vegetation is a typical machair type vegetation with all the usual species present. The soil shows high pH, low organic matter and a relatively low level of calcium carbonate (13.5%). It appears that at Srah the machair is morphologically very mature.

The area is extremely heavily grazed and is used for amenity purposes especially football. It is not fenced. The area would be very difficult to manage from a conservation viewpoint being very open and ~~accessible~~, is very small and of limited quality. Thus it is not recommended for conservation.

Rating: Grade IV.

Kinrovar

Grid Reference: F72 15

O.S. $\frac{1}{4}$ " sheet : 6

O.S. 6" sheet : Mayo 34

Townland(s) : Dooooma

Approximate area: 121 hectares.

This medium sized area of machair occurs to the west of Roy Lough and to the north of Kinrovar Point. There is a large area of nillocky machair with low hummocks alternating with flat areas, especially to the north of the burial ground. The small foredune system is badly eroded. Two types of vegetation were noted: a "dry" area at about 500 metres from the sea and a wet area about 1000 metres from the sea.

The vegetation is a typical machair type vegetation with many of the typical machair species present. All the nine character species of Gimingham (1974) were noted. The abundance of Hypochoeris radicata and Hieracium pilosella is a feature. Near the sea there was a close sward of Rhytidiadelphus squarrosus, Thymus popraecox, Poa subcaerulea and Festuca rubra. The soils show high pH levels, low organic matter percentages and very low calcium carbonate levels, the substrate being mostly composed of siliceous sand.

Old cultivation ridges and a burial ground provide historical evidence for the human use of the machair at Kinrovar. The site is heavily grazed by cattle and is not fenced. Not only is the site in a remote area and difficult of access, it forms a discreet unit with very manageable boundaries. Coupled with this is the fact that the machair is of good quality and is situated in a distinctive western Gaeltacht landscape, making it of definite conservation value.

Rating: Grade II.

Rosmurrevagh

Grid Reference: L85 96

O.S. $\frac{1}{4}$ " sheet : 6

O.S. 6" sheet : Mayo 66

Townland(s) : Murrevagh, Mallaranny

Approximate area: 90 hectares.

This area of machair occurs on the Rosmurrevagh Peninsula on the northern shore of Clew Bay. The surface is undulating between a shingle beach and some low hills, the frontal area being more or less level with characteristic hummock topography. A small lake being infilled by scraw vegetation occurs behind the machair.

The vegetation is typical of machair with all character species occurring. The soils sampled along a transect showed decreasing pH and calcium carbonate levels, and increasing organic matter percentage from the shore inland typical of a machair transect. The highest level of calcium carbonate recorded was 13.8%.

Disused cultivation ridges were noted on the site. The area is not fenced and is heavily grazed today. The western side is used as a golf course, thus only the eastern side would be worth considering for conservation purposes.

The conservation value of the site is raised due to the presence of some interesting species of plants occurring in the bog nearby. These are Vaccinium oxycoccus, Carex limosa and several species of dactylorchids.

Rating: Grade III.

Trawmore/Keel, Achill

Grid Reference: F64 05

O.S. $\frac{1}{4}$ " sheet : 6

O.S. 6" sheet : Mayo 54

Townland(s) : Keel East

Approximate area: 61 hectares.

This area of machair occurs to the east of Keel, Achill, behind Trawmore Strand and stretching between Keel Lough and the sea. To the east it stretches about halfway along the beach. The foreshore consists of very badly eroded foredunes behind a single beach. The machair itself is a flat plain with very low hummocks intermingled with low, wet, flat areas. Sand is being deposited on the plain.

The vegetation was sampled on the top of a hummock where typical machair species were found as well as a few annuals such as Anagallis tenella and Gentianella campestris. The vegetation of the low wet flat areas was the dominant type, with a sparse covering of vascular plants and a high cover of bryophytes, no doubt reflecting the severe trampling that the area undergoes. The corresponding soils showed high pH levels, low organic matter percentages and calcium carbonate levels around 10%.

Archaeological remains occur in the form of "kitchen middens" showing ancient use of the machair here. Today, the machair area is not fenced, is very overgrazed by cattle and sheep, and is heavily trampled being used as a golf course and amenity area for the holiday centre of Keel. Thus the conservation value is limited.

Rating: Grade III.

Doogort, Achill

Grid Reference: F71 10

O.S. $\frac{1}{2}$ " sheet : 6

O.S. 6" sheet : Mayo 43

Townland(s) : Tonatanvally

Approximate area: 80 hectares.

This area of machair occurs on the north side of Achill Island to the west of Lough Doo and to the north of Lough Nambrack. The foredune system has been eroded and the machair itself occurs on two plains separated by an escarpment. Firstly, there is a low wet hummocky plain near the sea and secondly a higher, drier, flat plain further inland, terminating in bog.

The vegetation on the upper surface is that of typical machair as it is on the lower surface, which in addition has Carex arenaria and Juncus articulatus present. The soils show high pH levels, low organic matter percentages and calcium carbonate at 25%.

An ancient well -"teher"- occurs on the site. The machair area is fenced off from the surrounding area and is used for grazing. Because of the poor quality, morphologically, of the machair, the small area involved, and the fact that it seems to be interfered with, the machair at this site is of limited conservation value.

Rating: Grade III.

Dooaghtry

Grid Reference: L74 71

O.S. $\frac{1}{4}$ " sheet : 10

O.S. 6" sheet : Mayo 105

Townland(s) : Kinnadoohy, Corragaun, Carrigskeewaun, Dooaghtry,
Lackakeely, Dadreen.

Approximate area: 208 hectares.

Two distinct areas of machair occur here forming part of an extensive "natural" complex of lakes, streams, marsh, wet grassland and dune and rocky pasture, stretching between the Mweelrea Mountains and the sea. This interesting and varied area has been the subject of a detailed scientific study (Beckers, Brock and Klerkx, 1976).

On the southern end at Lackakeely, an area of 55 hectares occurs where there is heavy erosion of the dunes with large quantities of sand being blown inland. There is a machair plain occurring in the dunes and there seems to be no strict division between the machair and the dunes. The machair here has a high proportion of bare sand and is obviously undergoing disturbance. Low hummocks with Ammophila are interspersed with flat areas where a "wet" machair community occurs with Juncus articulatus and Potentilla anserina present. This area is grazed by sheep.

The largest area of machair (135 hectares) occurs in the area north-west of Corragaun Lough and west of Dooaghtry Lough. An extensive very flat plain occurs here behind a large dune system. The dune-machair system is in part cut off from the mainland by a tidal channel. On the machair plain the vegetation cover is 100% and forms a very close sward. A typical machair flora was noted. Also typical of machair were the soils at Dooaghtry, with high pH levels, low organic matter results, and calcium carbonate levels at over 20%.

Evidence of former use of the machair occurs, as evidenced by the presence of Templedoomore disused graveyard. The area is not

fenced and does not seem to be as heavily grazed as other areas. However, rabbits are abundant.

The "intangible" quality of the machair landscape and the surrounding landscape, the intrinsic good quality of the machair itself, and in conjunction with the scientific value of the whole area, makes this a site of considerable importance and so it is recommended for conservation. Also, from a management viewpoint, the area is remote, and the machair area of difficult access making easier management possible through absence of human pressures.

Rating: Grade I.

Mannin Bay/knock

Grid Reference: L60 46

O.S. $\frac{1}{4}$ " sheet : 10

O.S. 6" sheet : Galway 34, 35, 48, 49

Townland(s) : Mannin More, Mannin Beg

Approximate area: 70 hectares.

This area of machair occurs on the northern end of the Slyne Head Peninsula, north-west of Ballyconeely, north of Truska Lough, and stretching as far as Knock. The foredune is eroded, and the topography of the machair plain itself is undulating with some flatter areas.

The vegetation survey showed a typical machair suite of species. The soils however have the unique feature of having the highest levels of calcium carbonate recorded for Irish machair at 60%. A very large proportion of the soil is made up of shell fragments. Consequently, organic matter is low (5%) and pH levels are high (8.0).

The area is very heavily grazed and some meadow was noted on the machair. The presence of a football pitch indicated that the site is used for amenity purposes. The site is fairly accessible and open and is under pressure which would make conservation difficult from the management viewpoint. However, given the fact that the site is unique in terms of its pedology, that there is an interesting fen and marsh attached, and that part of the machair here is used as meadow which is unusual in Ireland, the conservation value of the area must be considerable.

Rating:

Grade II.

The following machair sites in Galway, were visited in June 1983, by Curtis, Douglas, Lockhart and Wymer (U.C.D.) engaged on a coastal survey for the Forest and Wildlife Service. Data from this survey was used in the compilation of the relvé table.

Na Muirbhig, Inishmore, Aran Islands

Grid Refence: L 89 07

O.S. $\frac{1}{2}$ " sheet : 14

O.S. 6" sheet : 111 and 119

This area of machair occurs on the south eastern end of Inishmore, near Killeany Bay. The area is fairly extensive with limestone outcropping in parts. The vegetation recorded showed typical machair features with Rhyddiadelphus squarrosus showing a high frequency inland. The area is used for grazing by cattle. Rabbits are abundant and an airstrip is located near the site.

Rating: Not Rated (see Appendix 4).

Aillebrack

Grid Refence: L 57 43

O.S. $\frac{1}{2}$ " sheet : 10

O.S. 6" sheet : 48 and 49

This fairly extensive area of machair occurs south-west of Ballyconneely near Slyne Head. The dune system is small and badly eroded. Nearby large sandhills occur on the machair plain which ranges from being even to undulating. Hummocky areas occur. Large blowouts occur inland. The vegetation shows typical machair features. Aerial photographs show patterns of old cultivation ridges stretching out from a circular mound in the centre of the machair plain. The machair today is used for grazing, a caravan park and a golf links.

Rating: Not Rated. (See Appendix 4).

Omey Island

Grid Refence: L 56 56

O.S. $\frac{1}{4}$ " sheet : 10

O.S. 6" sheet : 21

Omey Island is a tidal island north-west of Clifden on the Connemara coast. Much of the island is covered with machair. On the southern end of the island strip fields occur while the north-west contains areas of eroded unfenced dune-machair behind a badly eroded foredune system. Much of the machair is undulating. The vegetation shows typical machair features on a transect between the foredune and Fahy Lough in the centre of the island. Of note is the presence of communities dominated by Achillea millefolium an unusual feature in Irish machair. The area is heavily grazed by cattle and rabbits.

Rating: Not rated (see Appendix 4).

Aughrusbeg

Grid Refence: L 55 58

O.S. $\frac{1}{2}$ " sheet : 10

O.S. 6" sheet : 21

This small area of machair occurs to the south-west of Aughrusbeg Lough. The dune system has been completely eroded and there is an eroding face to the machair. The topography is undulating. The vegetation shows typical machair features.

Rating: Not rated (See Appendix 4).

Dooagh Isle

Grid Refence: C 40 50

O.S. $\frac{1}{4}$ " sheet : 1

O.S. 6" sheet : Donegal 3

Townland(s) : Carrickabraghy, Carrowreagh, Ballymacmoriarty, Lagacurry

Approximate area: 440 hectares

This is a very extensive dune-machair system covering the western half of the peninsula of Dooagh Isle, part of the Inishowen Peninsula. The area needs more investigation. At the northern end shingle beaches occur while a variety of other morphological features such as sand beaches, sand over rock, sand hills and machair occur in other parts of the complex. The south western end of the complex contains some machair occurring behind sand hills and is found about 30 metres from the shore at Cloghorna. Here the topography is undulating.

Vegetation and soils were sampled at two sites. Firstly on higher sloping areas with a closely grazed Festuca turf and secondly, on a lower lying area which has been much poached. Carex arenaria is a major feature of the latter type of community. The vegetation in general is typical of machair as are the soils. Organic matter percentage is below 10% while pH levels are above 7.0. Calcium carbonate occurs at about 25% for both samples.

The area contains the ruins of a castle and a tower. At present the system is used for grazing and amenity purposes with a golf links occurring on the site. Also, strip fields were noted. The machair site occurs in a remote area but it is difficult to assess its conservation value as both the machair site and the whole area needs further study.

Rating: Grade II.

Magheradrumman/Ballyhiernan Bay

Grid Refence: C 21 45

O.S. $\frac{1}{2}$ " sheet : 1

O.S. 6" sheet : Donegal 8

Townland(s) : Rinmore, Ballyhiernan, Rinboy.

Approximate area: 280 hectares

This is an area of degraded machair on the Fanad Peninsula, skirting Ballyhiernan Bay. On the western side the system is heavily used for amenity purposes with numerous holiday homes occurring on the site. On the eastern side, of note are the very high, disused cultivation ridges with lower ones to the west. As is seen from the aerial photographs of the area these form a definite pattern with large areas of ridges both parallel and perpendicular to the coast. Also of note here is the abundance of Campanula rotundifolia on the turf. The western end is partially fenced and heavily grazed. A football pitch was noted.

The area, although with some unusual features, would not be of conservation interest as it is too degraded and would present too many management problems.

Rating: Not Rated.

Grid Refence: C 12 43
O.S. $\frac{1}{2}$ " sheet : 1
O.S. 6" sheet : Donegal 7
Townland(s) : Dundooan lower
Approximate area: 135 hectares

This fairly extensive area of machair on the Rosguill Peninsula covers the low-lying area between Tranarossan Bay and Gortnalughoge Bay. An extensive flat plain occurs between two higher areas to the north and to the south forming an intact unit.

Aerial photographs show a hilly area at the northern end of the site while east of the road traversing the area, strip fields perpendicular to the shore are present. To the west, a shingle beach is encroaching on the dunes which are very low or practically non-existent. Some small hillocks occur just inland and have Annopnila growing on them. Further inland the plain is extremely flat. The topography suggests the frequent, very strong winds to which the area is subjected.

The vegetation and soil were sampled at approximately 20, 150 and 300 metres from the sea. Cynosurus cristatus is dominant. The plant species and communities are typical of machair, as are the soils. The pH levels are high, as are the calcium carbonate levels which reach 42%. Organic matter reached 12.5% inland which is high for machair.

The history of human use of the machair here is shown by the presence of archaeological remains in the form of 'kitchen middens'. The area is not fenced and forms an open landscape which is striking in its flatness. It is extremely heavily grazed, mostly by sheep and is used for amenity purposes, especially football.

Tranarossan contains a good quality machair site forming a striking landscape. The machair site here forms a distinct unit and also has some unusual features making it of definite conservation interest.

Rating: Grade II.

Rosapenna/Carrickart

Grid Refence: C 12 38

O.S. $\frac{1}{4}$ " sheet : 1

O.S. 6" sheet : Donegal 16

Townland(s) : Rosapenna, Ballyoghagan, Finver,
Magheramagorgan.

Approximate area: 300 hectares

This is an extensive sandy area south-east of Rosapenna. Near Rosapenna a fossil dune system occurs with machair-like characteristics. Very little actual machair occurs in relation to dune. Large hillocks occur to the west of the road linking Carrickart with Rosapenna.

Historically, the area has been used by man as 'kitchen middens' and a chapel-in-ruins are present on the site as well as a standing stone and a mound nearby. Now the area is heavily used as a holiday and recreation centre. Golf links occur on the site. Grazing is carried out and the area is partially fenced.

The site is not judged to be of conservation interest from the viewpoint of machair.

Rating: Not rated.

Bunlack

Grid Refence: B 81 27

O.S. $\frac{1}{2}$ " sheet : 1

O.S. 6" sheet : Donegal 32

Townland(s) : Carrick, Lunniagh.

Approximate area: 135 hectares

This is a fairly extensive dune-machair complex south-west of Lough Aniver. The machair occurs behind low dunes alternating with lower wetter marshy areas. There is some outcropping rock on the site. At the northern end the topography is more undulating.

The vegetation and soil was sampled in a machair meadow dominated by Rhinanthus minor, Centurea nigra, Cynosurus cristatus and Festuca rubra. Orchids are a feature here and Dactylorhiza fuchsii and Coeloglossum viride were noted. The soil showed high pH levels, low organic matter and about 20% calcium carbonate content.

The area does not seem to be as heavily grazed as the other sites visited and is apparently ungrazed in the machair meadow. However, aerial photography shows the site to be extremely criss-crossed with tracks.

The presence of machair meadow and machair marsh make the site of some conservation interest.

Rating: Grade III.

Derrybeg

Grid Refence: B 80 26

O.S. $\frac{1}{4}$ " sheet : 1

O.S. 6" sheet : Donegal 32

Townland(s) : Magheragallan, Magheraclogher, Ardnagappary.

Approximate area: 135 hectares

This fairly extensive area of machair occurs to the west of Derrybeg. The topography varies from flat to undulating. The site has a distinctive landscape quality being located in a very densely populated Gaeltacht area. As such the machair is under heavy pressure from the local community being used for grazing, golf, football and as a general amenity area. There is a church in ruins on the site and a graveyard still in use. A factory building is located on the machair.

The area is not interesting from a conservation viewpoint as there are too many human pressures on it and is too open and accessible to be managed effectively.

Rating: Not rated.

Kincaslough

Grid Refence: B 76 21

O.S. $\frac{1}{2}$ " sheet : 1

O.S. 6" sheet : Donegal 41

Townland(s) : Mullaghderg, Mullaghdoon Irish, Drumnacart.

Approximate area: 100 hectares

This area of machair occurring near Kincaslough is not very extensive and is now fairly disturbed. A road goes through the site and new bungalows have been built. Of note is the presence of machair meadow. The area is not interesting from a conservation point of view.

Rating: Not rated.

Carnboy

Grid Refence: B 78 24

O.S. $\frac{1}{2}$ " sheet : 1

O.S. 6" sheet : Donegal 32 and 41

Townland(s) : Braade, Boylagh, Carnboy, and Carrickfin.

Approximate area: 100 hectares

This area of machair occupies the central area of the tombolo/spit joining Carnboy with the mainland. To the west of the spit a rich flora occurs on higher areas corresponding to broad Ammophila hummocks with a curious assemblage of plant species - Arabis cf brownii, Armeria maritima, Silene maritima, and Rumex acetosa. The flat areas between the hillocks holds a typical flora with the addition of Glaux maritima. To the east of the spit there is a lowlying area with salt marsh on sand open to erosion. Small hummocks of Ammophila occur alongside these. The soil sample showed a high pH, low organic matter and over 40% calcium carbonate.

The area contains an old burial ground and is used for recreation purposes. A football pitch and a air strip occur on the site.

This site, although with some unusual features, would be difficult to conserve as it is under too much pressure from the local heavily populated area and would be too difficult to manage.

Rating: Grade III.

Lettermacaward/Dooey Point

Grid Refence: B 75 12

O.S. $\frac{1}{4}$ " sheet : 3

O.S. 6" sheet : Donegal 65

Townland(s) : Dooey.

Approximate area: 165 hectares

This is a fairly extensive area of very flat machair occurring behind well developed dunes to the south of Dooey Point and to the west of Lettermacaward. The vegetation sampled is of machair type with typical machair species. Soils show a high pH, low organic matter percentage and a very low percentage of calcium carbonate.

This machair site is much more intensively managed than is normally the case in Ireland, being fenced into strip fields, parallel to the dunes. Phragmites australis occurs in the ditches between fields. Machair meadow was noted in the area. There are also areas of the machair which are not fenced.

The area forms a compact unit and is unique in Ireland from the management viewpoint. It is also fairly remote. It is thus of some conservation interest.

Rating: Grade III.

Sheskinmore

Grid Refence: G 69 95

O.S. $\frac{1}{4}$ " sheet : 3

O.S. 6" sheet : Donegal 73

Townland(s) : Magheramore, Mullyvea, Sandfield.

Approximate area: 490 hectares

This extensive area of machair occurs to the south and west of Sheskinmore Lake. There is a good dune system behind a beach to the west of the site and some undulating areas to the south. There are considerable bare areas on the machair.

Typical machair vegetation is present on the site. Areas of Schoenus nigricans occur. The soil showed typical machair features with high pH levels and low organic matter percentages. The calcium carbonate content of the soil is low at 12%.

Aerial photographs show strip fields in the machair area. The area is grazed by cattle and rabbits. A caravan site occurs in the area and the machair is somewhat degraded. However, because of the presence of the lake and a small salt/brackish marsh by its ~~north~~-eastern channel with Blysmus rufus, Carex panicea/nigra and Bellis perennis the conservation interest of the area is increased. There is also a little open water with Scirpus tabernaemontani and Potamogeton pectinatus.

Rating: Grade III.

General Conclusions

Machair, the landform-vegetation complex extensively described from Scotland is well represented in north, north-west and western Ireland in the counties of Donegal, Mayo and Galway and thus has a north-west Atlantic distribution as has been described from Scotland. Mayo contains the finest examples and the greatest number of machair sites, from a conservation viewpoint.

Soils, climate, vegetation and morphology of Irish machair are comparable to Scottish machair although minor differences occur as is outlined in 3.6. The greatest difference between Scottish and Irish machair occurs in human use. The Scottish machair is much more intensively managed for pasturage and cultivation use and is often fenced. The Irish machair is mostly used for open common grazing and amenity purposes.

Machair is a unique landscape in the European context and thus deserves priority in conservation and research. At present in Ireland the machair is under great pressure due to extremely heavy grazing and in some cases due to trampling from indiscriminate and unmanaged amenity use.

The two top quality machair sites in the country occur in areas or adjacent to areas which are of themselves of great scientific interest. The machair at Dooaghtry, Mayo is of intrinsic quality, forms part of a varied landform-vegetation complex of scientific interest and does not present management difficulties. It is highly recommended for conservation, being of international importance and urgent measures are required to ensure that this site will be conserved. Annagh-Termoncarragh, Mayo contains the finest and most extensive area of machair visited during this survey. This site is undergoing a change in management whereby fencing of the machair commonage is being carried out, the consequences of which will lead to a change in the whole nature of the vegetation. Urgent measures are thus required in order that at least part of the machair at Annagh-Termoncarragh is conserved.

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TABLE 1: OCCURRENCE OF THE COMMON SPECIES FOUND ON MACHAIR

| | % Frequency | | | |
|----------------------------------|---------------------|-------------------|----------------------------------|-------------------------------|
| | Gimingham (1974) | Randall (1974) | Dickinson & Randall (1979) | Akeroyd & Curtis (1980) |
| <i>Festuca rubra</i> | + | 96 | 91 | + |
| <i>Bellis perennis</i> | + | 100 | 69 | + |
| <i>Plantago lanceolata</i> | + | 93 | 77 | + |
| <i>Trifolium repens</i> | + | 67 | 83 | + |
| <i>Lotus corniculatus</i> | + | 76 | 58 | + |
| <i>Galium verum</i> | + | 83 | A | + |
| <i>Achillea millefolium</i> | + | 91 | A | A |
| <i>Rhytidadelphus squarrosus</i> | + | A | 63 | A |
| <i>Euphasia</i> spp. | + | 83 | A | A |
| <i>Poa pratensis</i> | A | A | 88 | + |
| | | | | (<i>Poa subcaerulea</i>) |
| <i>Senecio jacobea</i> | A | 61 | A | + |
| <i>Carex arenaria</i> | A | 85 | A | A |
| <i>Ranunculus aeris</i> | A | 78 | A | A |
| <i>Ranunculus bulbosus</i> | A | A | A | + |
| <i>Prunella vulgaris</i> | A | 71 | A | A |
| <i>Rumex acetosa</i> | A | A | A | + |
| | | | | (<i>hibernicus</i>) |
| <i>Koeleria macrantha</i> | A | A | A | + |
| <i>Ammophila arenaria</i> | A | 4 | 6 | + |
| A = Not mentioned | | | | |

TABLE 2: pH values, % organic matter, depth of humus and % CaCO₃ from 15 machair sites in western Ireland, consisting of 34 samples and from 4 Scottish sites

| | Shell | pH | % organic matter | Depth of humus (cm) | % CaCO ₃ |
|---------------------------------------|-------|-------|------------------|---------------------|---------------------|
| <u>DONEGAL</u> | | | | | |
| Looagh Isle 1 | + | 7.35 | 6.97 | 8 | 26.77 |
| Looagh Isle 2 (further inland) | + | 7.45 | 9.5 | 9 | 24.27 |
| Tranarossan 1 (20m from sea) | + | (7.45 | (3.17 | (2 | (33.49 |
| Tranarossan 2 (150m from sea) | + | (7.40 | (9.0 | (9 | (41.99 |
| Tranarossan 3 (300m from sea) | + | (7.35 | (12.5 | (9.5 | (27.76 |
| Bunlack | + | 7.25 | 7.53 | 6 | 18.4 |
| Carnboy | + | 7.60 | 5.00 | | 41.18 |
| Lettermacaward 1 (sand dune) | + | (7.35 | (5.46 | | (3.42 |
| Lettermacaward 2 (inland) | + | (7.15 | (9.93 | | (1.72 |
| Sheskinmore | + | 7.85 | 3.05 | | 12.12 |
| <u>MAYO</u> | | | | | |
| Gartar Hill 1 (wind blown sand) | + | 8.25 | 2.52 | 0 | 10.88 |
| Gartar Hill 2 (hummock top) | + | 8.55 | 1.1 | 0 | 6.10 |
| Gartar Hill 3 (wet grassland) | + | 7.85 | 4.6 | 3 | 0.17 |
| Gartar Hill 4 (machair) | + | 7.55 | 5.28 | 8 | 6.06 |
| Annagh 1 (start of transect) | + | (8.55 | (1.7 | | (49.25) |
| Annagh 2 (open fore dune) | + | (8.00 | (2.42 | | (38.67 |
| Annagh 3 | + | (8.40 | (3.33 | | (34.96 |
| Annagh 4 (machair) | + | (7.75 | (6.19 | | (34.49 |
| Srah | + | 7.85 | 7.5 | 10 | 13.46 |
| Kinrovar 1 (500m from sea) | + | (6.65 | (3.0 | (5 | (0.72 |
| Kinrovar 2 (1000m from sea) | + | (7.25 | (7.08 | (6 | (1.38 |
| Doogart 1 (lower, wetter, nearer sea) | + | (8.35 | (2.7 | .5 | (24.91 |
| Doogart 2 (higher, drier) | + | (7.95 | (2.9 | | (13.66 |
| Keel 1 (hummock top) | + | 7.95 | 2.0 | 8 | 7.49 |
| Keel 2 (golf course) | + | 7.95 | 2.7 | Banded | 10.70 |
| Rossmurrevagh ₁ (machair) | + | 8.35 | 2.86 | 1 | 12.91 |
| Rossmurrevagh ₂ | + | 7.85 | 5.4 | 1 | 13.81 |
| Rossmurrevagh ₃ | + | 6.85 | 9.73 | 8 | 00.82 |
| Dooaghtry (dune/machair interface) | + | (7.95 | (6.69 | (5 | (20.76 |
| Dooaghtry (machair) | + | (7.95 | (8.5 | (5 | (23.31 |

TABLE 2: (contd)

| | Shell | pH | % organic matter | Depth of humus (cm) | % CaCO ₃ |
|--|-------|-------|------------------|---------------------|---------------------|
| <u>GALWAY</u> | | | | | |
| Mannin Bay (foredunes) | + | (8.35 | (3.38 | | (61.41 |
| Mannin Bay (machair) | + | (8.30 | (3.96 | | (58.64 |
| Mannin Bay (machair) | + | (8.00 | (4.01 | | (56.54 |
| Mannin Bay (machair meadow) | + | (8.30 | (3.23 | | (61.36 |
| <u>SCOTLAND</u> (Ritchie 1967 and 1972) | | | | | |
| Stilligarry (South Uist) (machair plain) | | | | | 53.9 |
| Borve (South Uist) (machair plain) | | | | | 1.6 |
| Clerkhill (Sutherland) (high machair) | | | | | 12.9 |
| Achmelvich (Sutherland) (machair) | | | | | 74.5 |

TABLE 3: Morphological Features noted from Irish Machair Sites

| SITE | FEATURE | | | | | | | | | | | | | | |
|-------------------|----------------------|----------------|------------|---------------|------------------|--------------------------------|--|------------|---------------------|--------------|---------------|----------------|------------|-----------------|----------------------|
| | Extensive Flat plain | Flat-ish Plain | With Hills | Hilly Macnair | Good Dune System | Dune System Degraded or Eroded | Complete Sequence Beach-dune Machair/ Escarp/ Loch | Escarpment | Undulating mach-air | Wet Mach-air | Shingle beach | Rock Out-Crops | Salt Marsh | Lakes Adjoining | Marsh, fen adjoining |
| DOUGAL | | | | | | | | | | | | | | | |
| Dooagh Isle | / | / | / | / | / | / | | / | / | / | / | / | | | / |
| Tranarossan | | / | / | / | / | | | | / | / | / | / | | | / |
| Kosapenna | | / | / | / | / | | | | / | / | | / | | | / |
| Bunlack | / | / | / | | | | | | / | / | | | | | |
| Derrybeg | | / | / | / | / | | | | / | | | / | | / | / |
| Carnboy | | / | / | / | / | | | | / | | | | | / | / |
| Kincashlough | / | / | / | / | / | | | | / | | | / | | / | / |
| Latternacaward | | | | / | / | | | | / | | | | | / | / |
| Sheskinnore | | / | / | | / | | | | / | | | | | | |
| MAVO | | | | | | | | | | | | | | | |
| Gartar Hill | | / | / | / | / | | | | / | / | | | | / | / |
| Throncarraig | / | | | | / | | | | | | | | | | |
| Srah | | / | / | / | | / | | | / | | | | | / | |
| Kinrovar | | / | / | / | | / | | | | / | / | | | / | |
| Keel, Achill | | / | / | | | / | | | | / | / | | | | |
| Loogart, Achill | | | | | | | | / | | | | | | | |
| Kosmurevagh | | / | / | / | / | | | | / | / | / | | | / | |
| Loogahtry | / | / | | / | / | | | | / | | | | | / | |
| GALWAY | | / | | / | | | | | / | | | | | / | |
| Nannin Bay | | / | | / | | / | | | / | | | | | / | |

63

[illegible]

TABLE 4 (contd)

RELEVE NO.

LIST OF EXTRA SPECIES

- 1 ANN 14: *Ammophila* +, *Rumex acetosa* +, *Daucus carota* +,
Homalothecium lutescens +, *Eurhynchium praelongum* +,
Minium undulatum +.
- 2 GAHI 5: *Peltigera canina* +, *Daucus carota* +, *Aira caryophyllea*
1, *Barbula* sp. 3, *Lophocolea* sp. +, *Cladonia* sp. +.
- 3 OMEY 7: *Polygala vulgaris* +.
- 4 OMEY1: *Senecio jacobaea* +.
- 5 GAHI 2: *Daucus carota*
- 6 MAN 5: *Desmazeria marina* +, *Peltigera canina* +, *Holcus*
lanatus 1, *Dactylorhiza fuchsii* ssp *herbridensis* +,
Gymnadenia conopsea 1.
- 7 ANN 3: *D^uaucus carota* +, *Rumex acetosa* +, *Senecio jacobaea* +,
Campanula rotundifolia 2.
- 8 LEFT 2: *Salix repens* 3, *Viola canina* +.
- 9 AILL 9: *Polygala vulgaris* 1.
- 10 GAHI 3: *Aira praecox* +, *Ammophila arenaria* +, *Anthyllis*
vulneraria +, *Phleum arenarium* 1, *Saxifraga*
tridactylites +, *Veronica arvensis* +.
- 11 DOO1 2: *Cirsium arvense* +, *Senecio jacobaea* 1.
- 12 DOOY 2: -
- 13 ROS 1: -
- 14 BUNL 1: *Peltigera canina* +, *Plantago maritima* 1, *Minium*
undulatum +, *Daucus carota* 1, *Cynosurus cristatus* 1,
Hieracium pilosella 2, *Rhinanthus minor* +, *Trifolium*
pratense 1, *Selaginella selaginoides* +, *Dicranella*
sp. 2.

- 15 GANI 4: *Cynosurus cristatus* 1, *Anagallis tenella* 2, *Holcus lanatus* 1.
- 16 DOO1 1: -
- 17 SRAH 1: *Danthonia decumbens* + *Eurhynchium praelongum* 2.
- 18 MAN 6: *Salix repens* +
- 19 TRA 2: *Mnium undulatum* +, *Cardamine pratensis* 1, *Eleocharis quinqueflora* +, *Mentha aquatica* +, *Ranunculus repens* 1.
- 20 KEEL 2: *Plantago maritima* 3, *Anagallis tenella* +, *Cardamine pratensis* 1, *Glaux maritima* +, *Marchantia polymorpha* 3, *Carex demissa* 2.
- 21 TRA 3: *Minium undulatum* +, *Cynosurus cristatus* 3, *Selaginella selaginoides* +, *Anagallis tenella* +, *Cardamine pratensis* +, *Cirsium palustre* +.
- 22 KIN 1: *Sagina procumbens* +, *Eurhynchium praelongum* 4.
- 23 DOOY 1: *Ammophila arenaria* +.
- 24 ROS 3: *Trifolium pratense* +, *Gentianella campestris* +
- 25 KIN 2: *Agrostis canina* 2, *Rumex acetosa* 1, *Hieracium pilosella* 2, *Danthonia decumbens* +, *Sagina procumbens* +, *Polytricum* sp. 2, *Dicranum* sp. +.
- 26 POOG 2: *Peltigera canina* +, *Minium undulatum* +, *Senecio jacobaea* 1, *Lophocolea* sp. 2.
- 27 ARAN 5: *Ammophila arenaria* 3, *Anthyllis vulneraria* 2, *Daucus carota* 2, *Senecio jacobaea* +, *Dactylis glomerata* +
- 28 ANN 6: *Ammophila arenaria* 1, *Rumex acetosa* +.
- 29 LETT 1: *Salix repens* 4, *Viola canina* +, *Agrostis canina* +, *Polygala vulgaris* +, *Senecio jacobaea* +, *Hieracium pilosella* +, *Trifolium pratense* +, *Homalothecium lutescens* +, *Hylocomium splendens* +.

- 30 AUGH 1: *Polygala vulgaris* +, *Eurhynchium praelongum* +
- 31 KEEL 1: *Plantago maritima* +, *Anagallis tenella* +, *Trifolium dubium* +, *Gentianella campestris* +.
- 32 TRA 1: *Peltigera canina* +, *Plantago maritima* 1, *Agrostis canina* 3, *Mnium undulatum* +
- 33 GAHI 1: *Aira praecox* +, *Plantago maritima* 1.
- 34 ROS 2:
- 35 ARAN 3: *Anthyllis vulneraria* 3, *Daucus carota* +, *Rumex acetosa* 2, *Cuscuta epithymum* 1.
- 36 DOOI 1: *Cirsium arvense* +, *Senecio jacobaea* 1.
- 37 MAN 3: *Desmazeria marina* +, *Trifolium dubium* +
- 38 AILL 6: *Arenaria serpyllifolia* 1.
- 39 OMEY 3:
- 40 AILL 4: *Desmazeria marina* 1, *Senecio vulgaris* +, *Veronica arvensis* +.
- 41 OMEY 2:
- 42 MAN 4: *Aira praecox* +, *Desmazeria marina* +, *Erophila verna* +.
- 43 OMEY 4:
- 44 OMEY 5: *Veronica arvensis* +
- 45 AILL: 3
- 46 AILL: 5 *Veronica arvensis* +
- 47 MAN: 7 *Anthyllis vulneraria* +, *Polygala vulgaris* +, *Rhinanthus minor* +

CODES

ANN = ANNAGH
GAHI = GARTAR HILL
OMEY = OMEY ISLAND
MAN = MANNIN BAY
LETT = LETTERMACAWARD
AILL = AILLEBRACK
DOOI = DOOAGH ISLE
DOCY = DOOAGHTRY

AUGH = AUGHRUSBEG
ROS = ROSMURREVAGH
BUNL = BUNLACK
SRAH = SRAH
TRA = TRANAROSSAN
KEEL = KEEL, ACHILL
KIN = KINROVAR
DOOG = DOOGORT
ARAN = NA MUIRBHIGH, ARAN

TABLE 5

ARCHEOLOGICAL FEATURES NOTED FROM MACHAIR SITES IN THE FIELD AND
FROM $\frac{1}{2}$ " AND 6" ORDNANCE SURVEY MAPS

| Site | 6" Map | Feature |
|----------------|--------|---|
| <u>Donegal</u> | | |
| Dooagh Isle | 3 | Carrickabragho Castle/Tower (in runis) |
| Tranarossan | 7 | Kitchen middens |
| Rosapenna | 16 | Chapel in ruins, kitchen middens |
| Derrybeg | 32 | Church in ruins, graveyard |
| Carnboy | 32 | Old burial ground |
| <u>Mayo</u> | | |
| Gartar Hill | 4 | Sandhill settlement, chapel in ruins |
| Termoncarragh | 9 | Church in ruins, graveyard, celtic cross. Kilmore burial ground (disused). Childrens burial ground (disused) |
| Cross Lough | 16 | Graveyard Cross Abbey in ruins with graveyard |
| Kinrovar | 34 | Burial ground |
| Keel, Achill | 54 | Middens |
| Doogort | 42 | Taher - well |
| Dooaghtry | 105 | Templedoomore graveyard (disused) |

APPENDIX 1 - FIELD CARD

MACHAIR CARD

| | | | |
|---------------|------------------|--------------------------|------------|
| 1 General | 2 | 3 Sample Area | 4 Rel. No. |
| 5 Recorder(s) | 6 Date | 7 Mapped $\frac{1}{2}$ " | 8" |
| 8 Location | 9 Grid Ref. | 10 Townland | |
| 11 County | 12 Weather: fine | bad | |
| 13 Slope | 14 Aspect | Altitude | 16 Exposed |

| | | |
|---|---|--|
| 17 Landscape | 18 Topography | 19 Surrounding landscape |
| <input type="checkbox"/> Distance of Dunes from sea <input type="checkbox"/> Position of Machair Re: dunes <input type="checkbox"/> Extent of Machair | a <input type="checkbox"/> Lake b <input type="checkbox"/> Streams c <input type="checkbox"/> Brackish marsh d <input type="checkbox"/> Freshwater Marsh e <input type="checkbox"/> Wet grassland f <input type="checkbox"/> Rocky | a <input type="checkbox"/> Cultivated b <input type="checkbox"/> Meadow c <input type="checkbox"/> Pasture d <input type="checkbox"/> Rough Grazing e <input type="checkbox"/> Woodland f <input type="checkbox"/> Residential g <input type="checkbox"/> Industrial h <input type="checkbox"/> Other |

| | | |
|---|---|---|
| 20 Site Management Activity | 21 % Cover/Height | 24 Soil Analysis |
| a <input type="checkbox"/> Drainage b <input type="checkbox"/> Fenced c <input type="checkbox"/> Fertilisation d <input type="checkbox"/> Grazing n Sheep o Cattle p Goats q Deer f <input type="checkbox"/> Recreation Shooting Other | Total Dwarf shrubs Herbs Bryophytes Litter Rock Soil | Organic Matter CaCO ₃ pH CM 4 8 12 |
| | 22 Soil Type (Map) 23 Geology (Map) | |

26 % occurrence of 9 character species

| | |
|--------------------------|----------------------|
| <input type="checkbox"/> | Festuca Rubra |
| <input type="checkbox"/> | Trifolium repens |
| <input type="checkbox"/> | Bellis perennis |
| <input type="checkbox"/> | Galium verum |
| <input type="checkbox"/> | Plantago lanceolata |
| <input type="checkbox"/> | Lotus corniculatus |
| <input type="checkbox"/> | Achillea millefolium |
| <input type="checkbox"/> | Euphrasia nemorosa |
| <input type="checkbox"/> | Rhytidiaadelphus |

27 Comments

25 Attributes of Machair

| | |
|--------------------------|----------------------------------|
| <input type="checkbox"/> | Level surface/mature dune system |
| <input type="checkbox"/> | Shell fragments in soil |
| <input type="checkbox"/> | Few sand-binding species |
| <input type="checkbox"/> | Human interference |
| <input type="checkbox"/> | Cool moist climate |

28 Climatological Data

APPENDIX 2 - METHODS OF SOIL ANALYSIS

- A. Determination of percentage calcium carbonate in soil samples:
Calcium carbonate was determined by Titration using the Total Neutralising Value (TVY) method.

Method:

1. Weight out 1 gram of sample
2. Put sample in a 250 ml. conical flask
3. Pipette 50 mls of .5N HCl into the flask
4. Heat the flask - boil gently until all the effervescence ceases
5. Allow to cool
6. Titrate sample using .25N NaOH and 3-4 drops of phenolphthalein indicator
7. note titre = x mls.

Control

1. Weight out 1 gram of pure calcium carbonate (98-99%) and run through the same procedure.

Calculation

$$\frac{5.004 \times N \text{ HCl} \times [50 - X \times (\text{NaOH})]}{[(\text{N HCl})]}$$

Sample weight

Note

To test the normality of HCl and NaOH used

HCl:

1. Weight out 1 gram NaCO_3 and put in flask
2. Add 20 mls of distilled water
3. Titrate with the HCL used using 3-4 drops of methyl orange as indicator.

Calculation

$$\frac{\text{weight of NaCO}_3 \times 1000}{x = \text{titre}} = 53$$

NaOH:

1. Take 20 mls of Hcl (already tested for normality) into a flask
2. Titrate NaOH against Hcl using phenolphthalein as indicator
 $x = \text{titre}.$

Calculation

$$X \times N = .5 \times 20 \text{ mls}$$

Normality of Hcl

B. Determination of organic matter in soil samples:

Loss of ignition

Method

1. Air dry soil samples
2. Oven dry the air dried soil samples at 60°C overnight
3. Weight out 1 gram of sample
4. Burn in a Muffle furnace for 6 hours at 600°C.
5. Calculate percentage weight loss.

C. Determination of pH

The pH soils was measured on a 2:1 water-soil slurry on an Orior Research digital pH meter (Model 201).

APPENDIX 3 - CONSERVATION EVALUATION SCHEME FOR MACHAIR SITES

Scientific Appraisal

1. Presence or absence of machair features -

a) Morphology

| | |
|---|---|
| Extensive flat plain | 2 |
| Flat plain with hillocks | 2 |
| Hilly machair | 1 |
| Good foredune system | 1 |
| Complete sequence-beach-dune-machair-escarpment | |
| etc. | 3 |
| Escarpment | 1 |
| Undulating machair | 1 |
| Wet machair | 1 |

(12)

b) Soils

i) Calcium carbonate ii) Organic matter iii) pH

| | | |
|------------|-----------|---------|
| 0-25% - 1 | 0- 5% - 4 | 7.0 - 3 |
| 25-50% - 3 | 5.10% - 3 | 7.0 - 1 |
| 50% + - 5 | 10% - 2 | |

(12)

c) Vegetation

i) Present

ii) Absent

Festuca rubra - 2
Bellis perennis - 2
Plantago lanceolata - 2
Trifolium repens - 2
Lotus corniculatus - 2

Ammophila arenaria - 2

(12)

d) Human Influence

Archeological remains - 3

Evidence of former cultivation - 3

Grazing - 3

Management - fencing etc - 3

(12)

2. Extent/Area

- a) Large - 3 ()
- b) Medium - 2 ()
- c) Small - 1 ()

3. Representatives of ecosystem

- a) Other sites of this type in the county - 1
- b) Only site of its type in the county - 2
- c) Only site of its type in the province - 3
- d) Only site of its type in the country - 4

4. Habitat diversity

- a) 1-3 habitats on site - 1
- b) 4-6 habitats on site - 2
- c) 7 or more habitats on site - 3

5. Community diversity

- a) 1-3 communities present - 1
- b) 4-6 communities present - 2
- c) 7 or more communities present - 3

6. Plant species diversity

- a) 40 species or less - 1
- b) 41-120 species present - 2
- c) 120 species present - 3

7. Species rarity

- | | | | |
|----|---|---|---|
| a) | No very local, rare or very rare species on site | - | 1 |
| b) | 1-5 very local, rare or very rare species on site | - | 2 |
| c) | 6 or more very local, rare or very rare species on site | - | 3 |

Management Appraisal

1. Access to site

- | | | | |
|----|--|---|---|
| a) | Site in remote area or vehicular access difficult | - | 3 |
| b) | Public transport some distance from site, or vehicular access possible | - | 2 |
| c) | Public transport near site or vehicular access easy | - | 1 |

2. Boundaries

- | | | | |
|----|--|---|---|
| a) | Insecure, long difficult to maintain | - | 1 |
| b) | Fairly secure, some maintenance required | - | 2 |
| c) | Good security, natural boundaries, minimal maintenance | - | 3 |

3. Surrounding landscape

- | | | | |
|----|--|---|---|
| a) | Surrounding landscape degraded ecologically and agriculturally | - | 1 |
| b) | Surrounding landscape with typical western farming pattern | - | 2 |
| c) | Surrounding landscape with area of scientific interest | - | 3 |

4. Ownership

- | | | | |
|----|--------------------------|---|---|
| a) | Private | - | 1 |
| b) | Private and state bodies | - | 2 |
| c) | Public ownership | - | 3 |

5. Security of tenure

- | | | | |
|----|-------------------------------|---|---|
| a) | Management agreement possible | - | 1 |
| b) | Lease agreement possible | - | 2 |
| c) | Ownership possible | - | 3 |

6. Liabilities

- | | | | |
|----|---|---|---|
| a) | Possible future development or disturbance or already started | - | 1 |
| b) | Possible long term development. | | |
| | No immediate threats | - | 2 |
| c) | No known liabilities | - | 3 |

7. Sensitivity to disturbance

- | | | | |
|----|---|---|---|
| a) | Some disturbance will affect site little if at all | - | 3 |
| b) | Some disturbance will modify site but not alter value | - | 2 |
| c) | Some disturbance will totally alter or destroy site | - | 1 |

8. Potential amenity use

- | | | | |
|----|------------------------------|---|---|
| a) | Very limited amenity use | - | 1 |
| b) | Can withstand limited access | - | 2 |
| c) | Can withstand heavy pressure | - | 3 |

9. Special features

- | | | | |
|----|--|---|---|
| a) | Special features which lower conservation interest | - | 1 |
|----|--|---|---|

- | | | | |
|----|--|---|---|
| b) | Special feature of some interest | - | 2 |
| c) | Special feature of overriding interest | - | 3 |

10. Subjective assessment

- | | | | |
|----|--|---|---|
| a) | Low priority site. Low scientific value. Major management problems | - | 1 |
| b) | Medium priority site. Good scientific value. Few management problems | - | 2 |
| c) | Top priority site. High scientific value. No management problems | - | 3 |

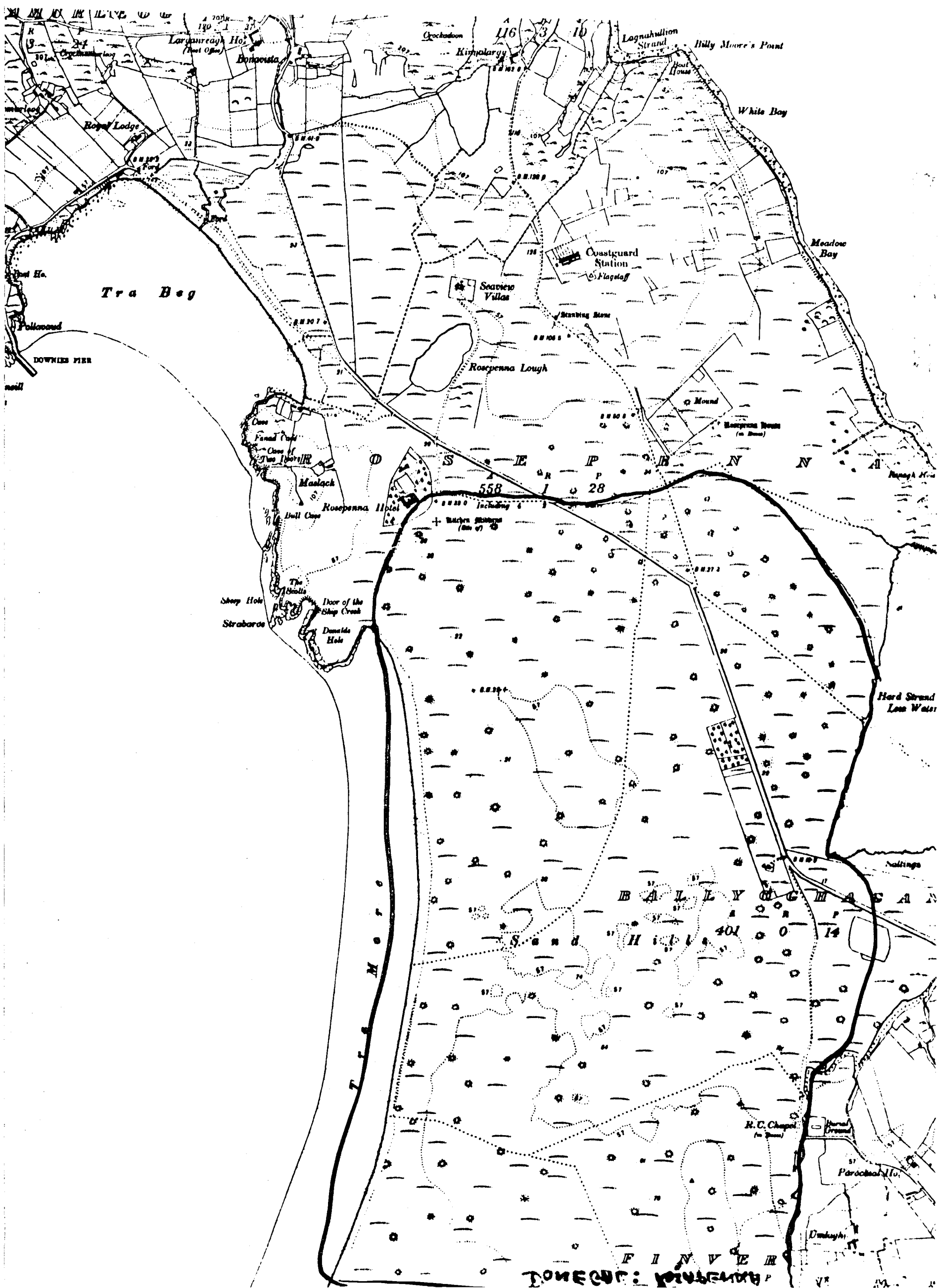
11. Action:

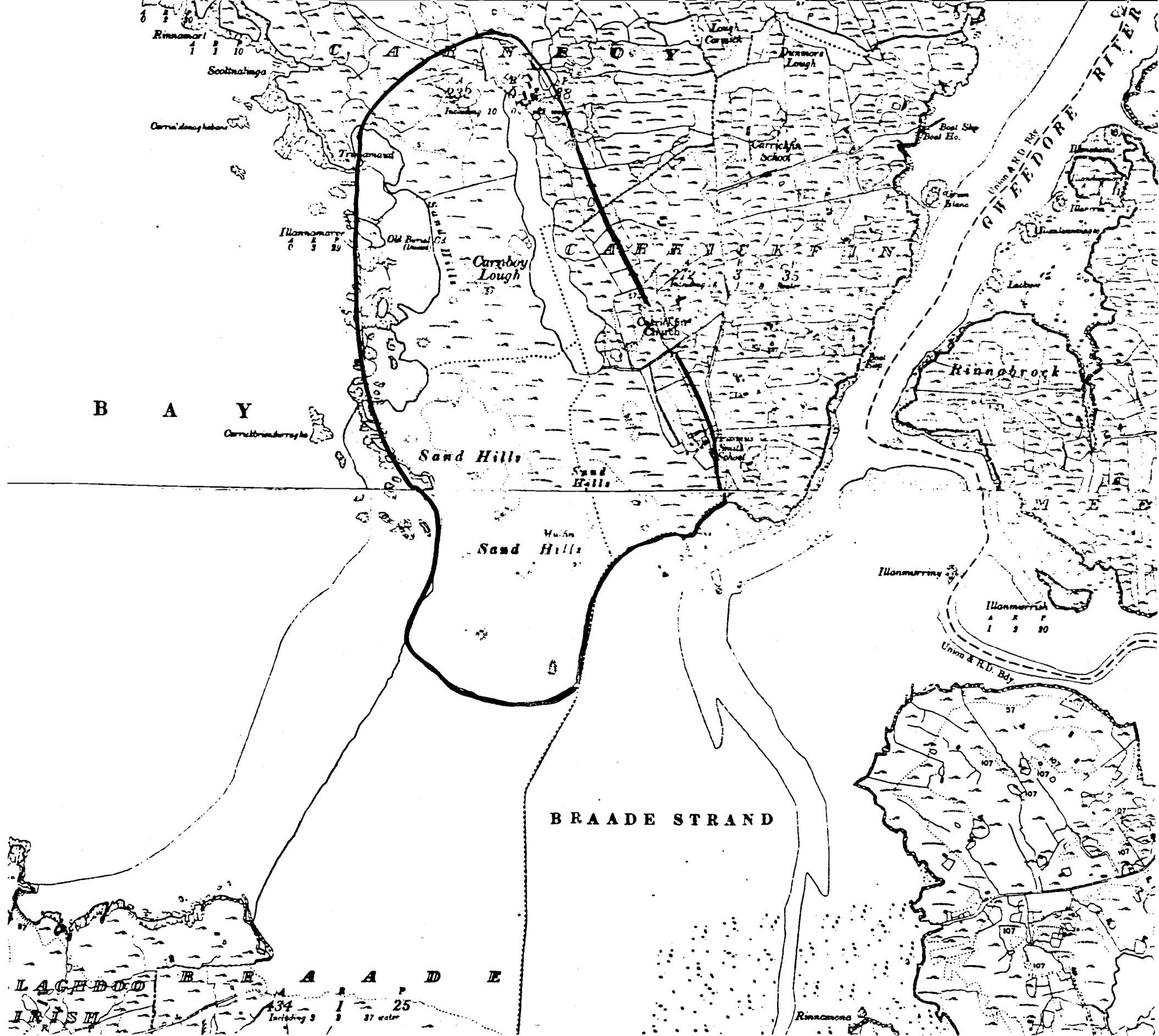
- | | | | |
|----|--|---|---|
| a) | No action needed | - | 3 |
| b) | Some action may be necessary at a later date | - | 2 |
| c) | Immediate action required | - | 1 |

APPENDIX 4 - GRADING OF MACHAIR SITES

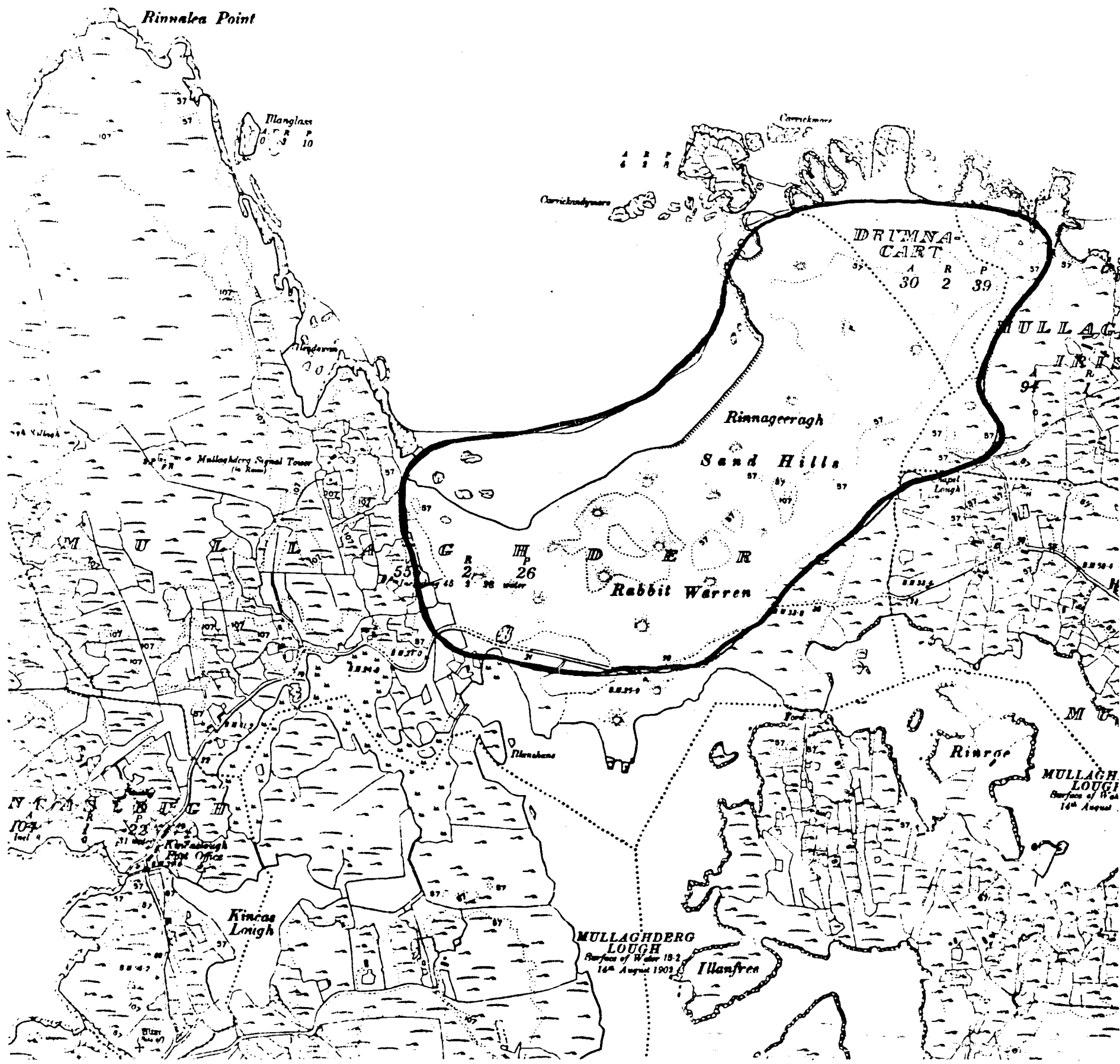
| Site | County | Scientific Appraisal (67) | Management Appraisal (33) | Total (100) | Subjective Grade |
|-----------------------|---------|---|---------------------------------|----------------|---------------------|
| Dooaghtry | Mayo | 45 | 26 | 71 | I |
| Annagn, Ternoncarragh | Mayo | 48 | 20 | 68 | II |
| Kinrovar | Mayo | 41 | 23 | 64 | II |
| Mannin Bay | Galway | 42 | 21 | 63 | II |
| Dooagh Isle | Donegal | 43 | 18 | 61 | II |
| Tranarossan | Donegal | 37 | 23 | 60 | II |
| Gartar Hill | Mayo | 41 | 19 | 60 | II |
| Lettermacaward | Donegal | 38 | 20 | 58 | III |
| Rosmurrevagh | Mayo | 40 | 18 | 58 | III |
| Sheskinmore | Donegal | 37 | 19 | 56 | III |
| Carnboy | Donegal | 39 | 16 | 55 | III |
| Keel, Achill | Mayo | 37 | 14 | 51 | III |
| Doogort, Achill | Mayo | 36 | 15 | 51 | III |
| Bunlack | Donegal | 33 | 17 | 50 | III |
| Grab | Mayo | 34 | 13 | 47 | IV |
| 1. Cross Lough | Mayo |] NOT RATED BECAUSE NOT FULLY INVESTIGATED] These non-rated sites fall into two categories] a) 1-7 when visited were found to be very degraded] and of little conservation value] b) 8-10 hold some conservation value but more] detailed investigation would be necessary] to assess their full conservation value | | | |
| 2. Tullagh Bay | Donegal | | | | |
| 3. Magheradrumman | Donegal | | | | |
| 4. Rosapenna | Donegal | | | | |
| 5. Derrybeg | Donegal | | | | |
| 6. Kincaslough | Donegal | | | | |
| 7. Oney Island | Galway | | | | |
| 8. Aran | Galway | | | | |
| 9. Aughrusbeg | Galway | | | | |
| 10. Aillebruck | Galway | | | | |

GRADE I - 70+
 GRADE II - 60+
 GRADE III - 50+
 GRADE IV - 50

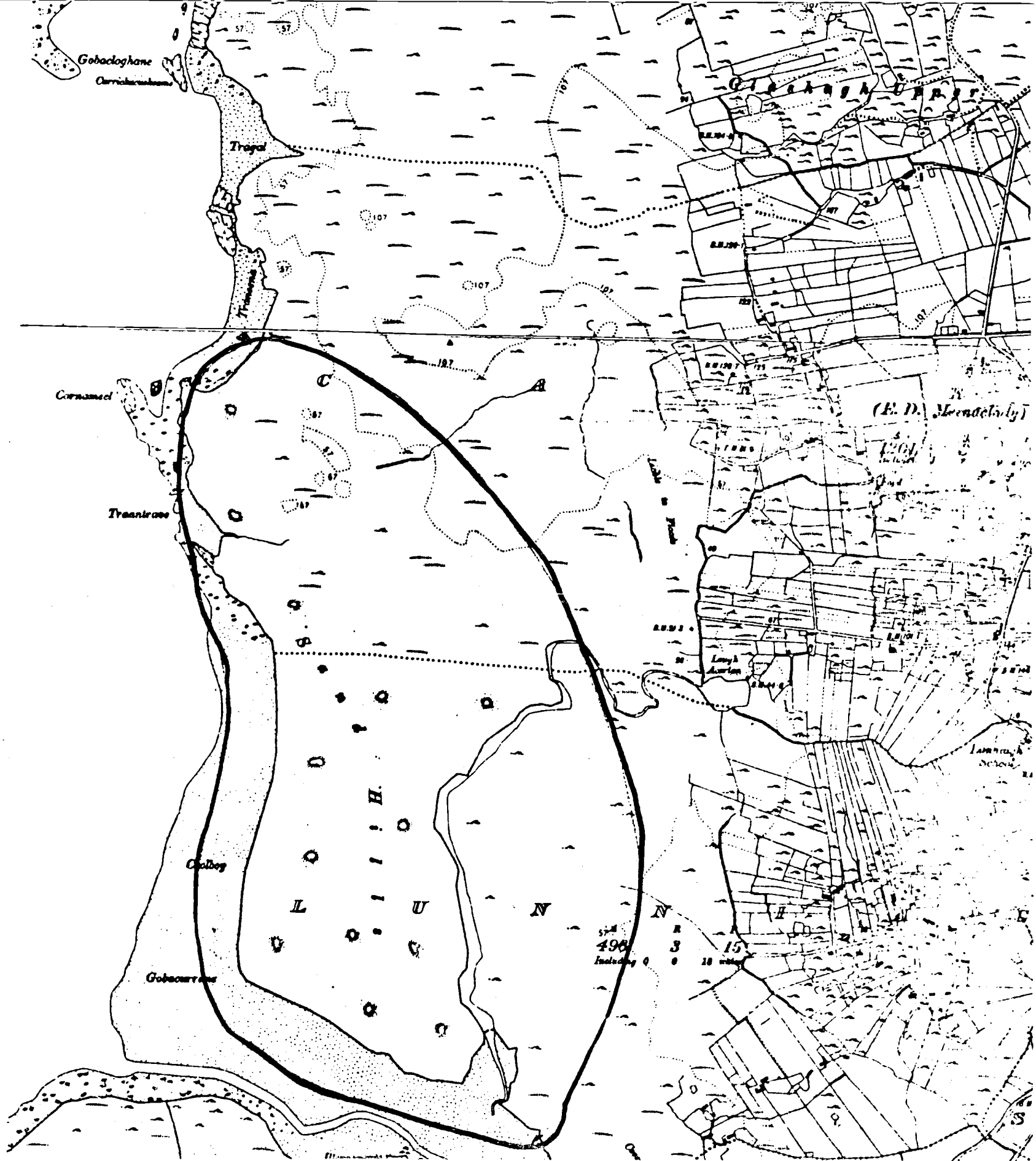


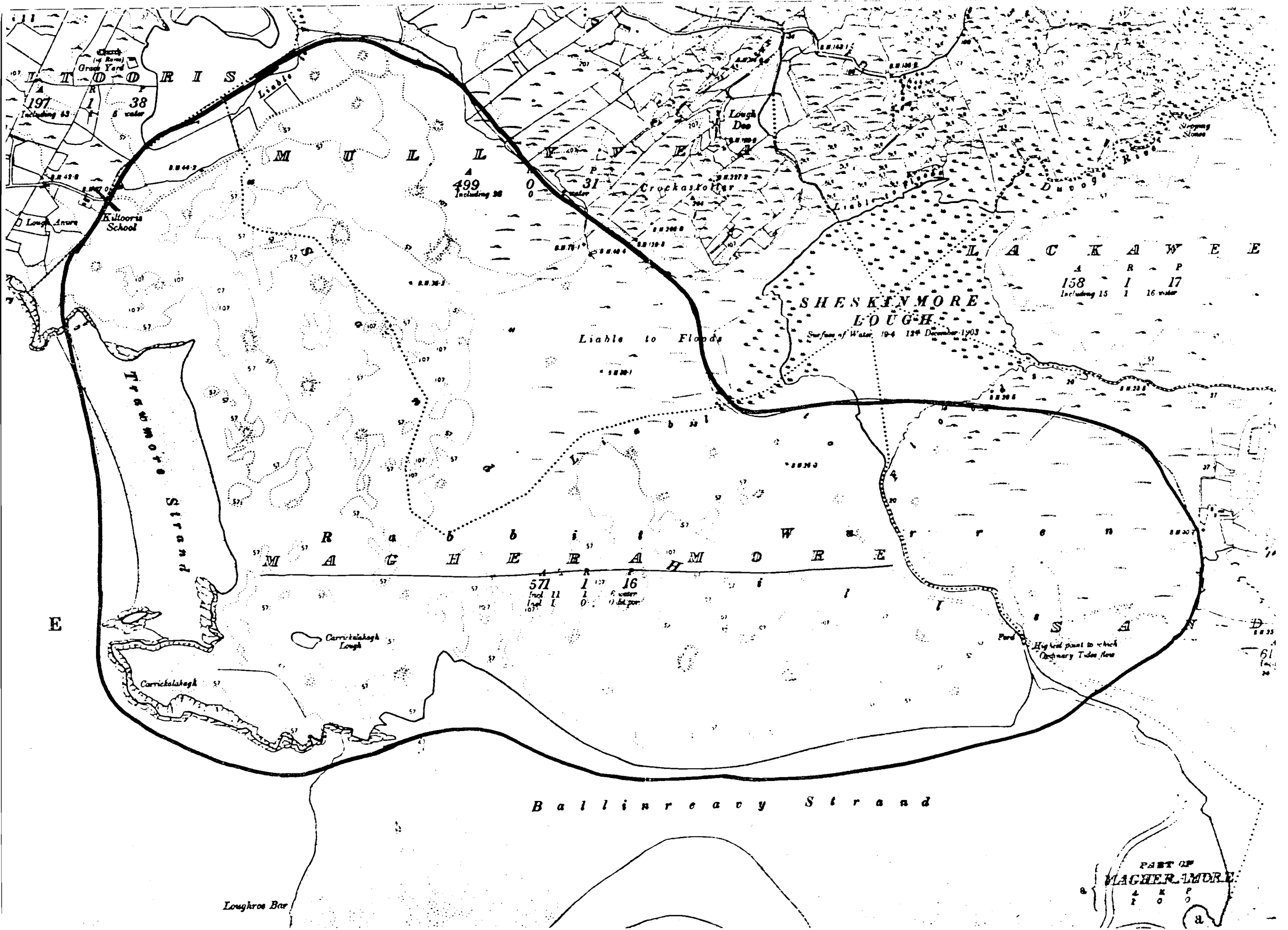


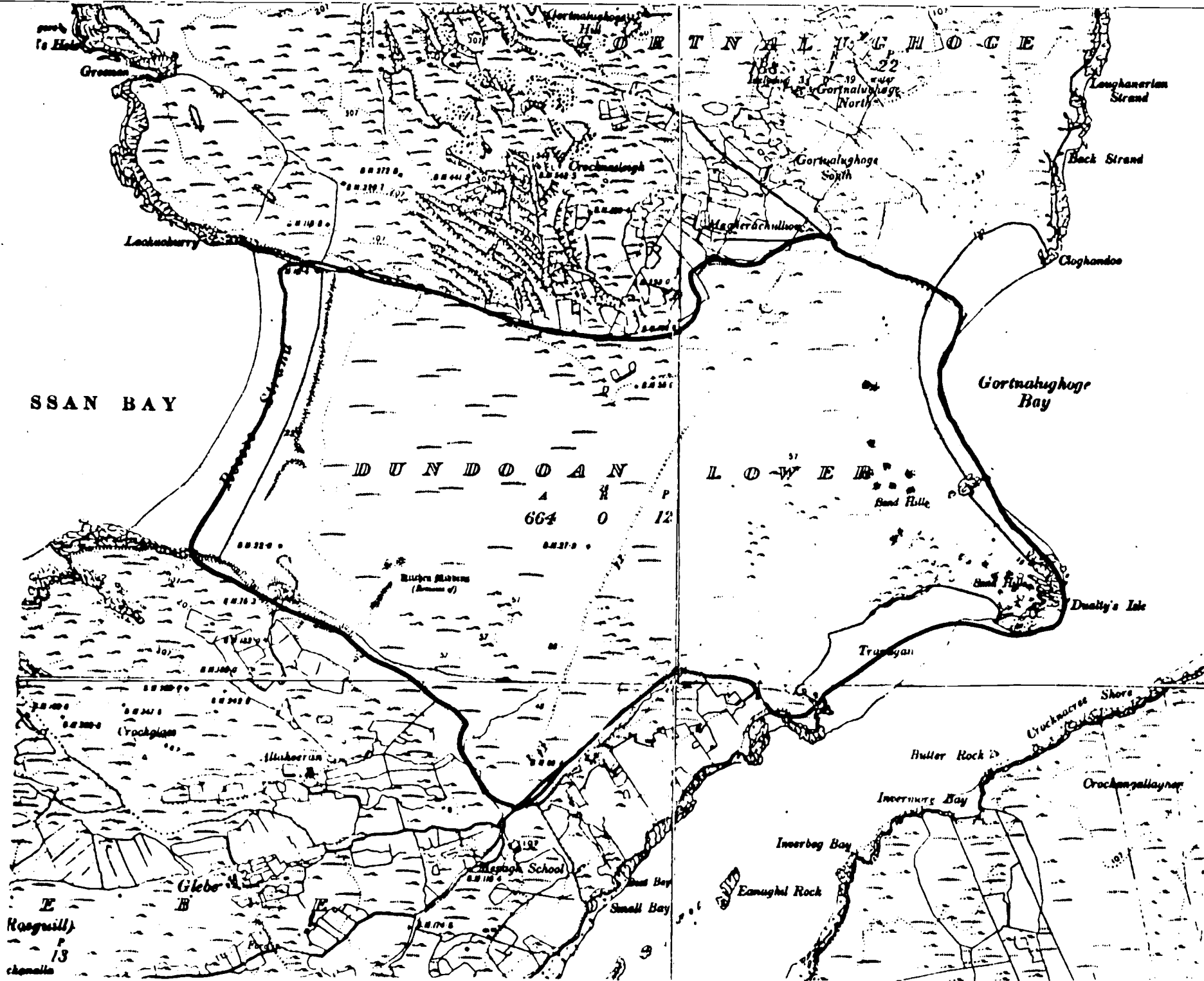
Rinnaka Point



[illegible]





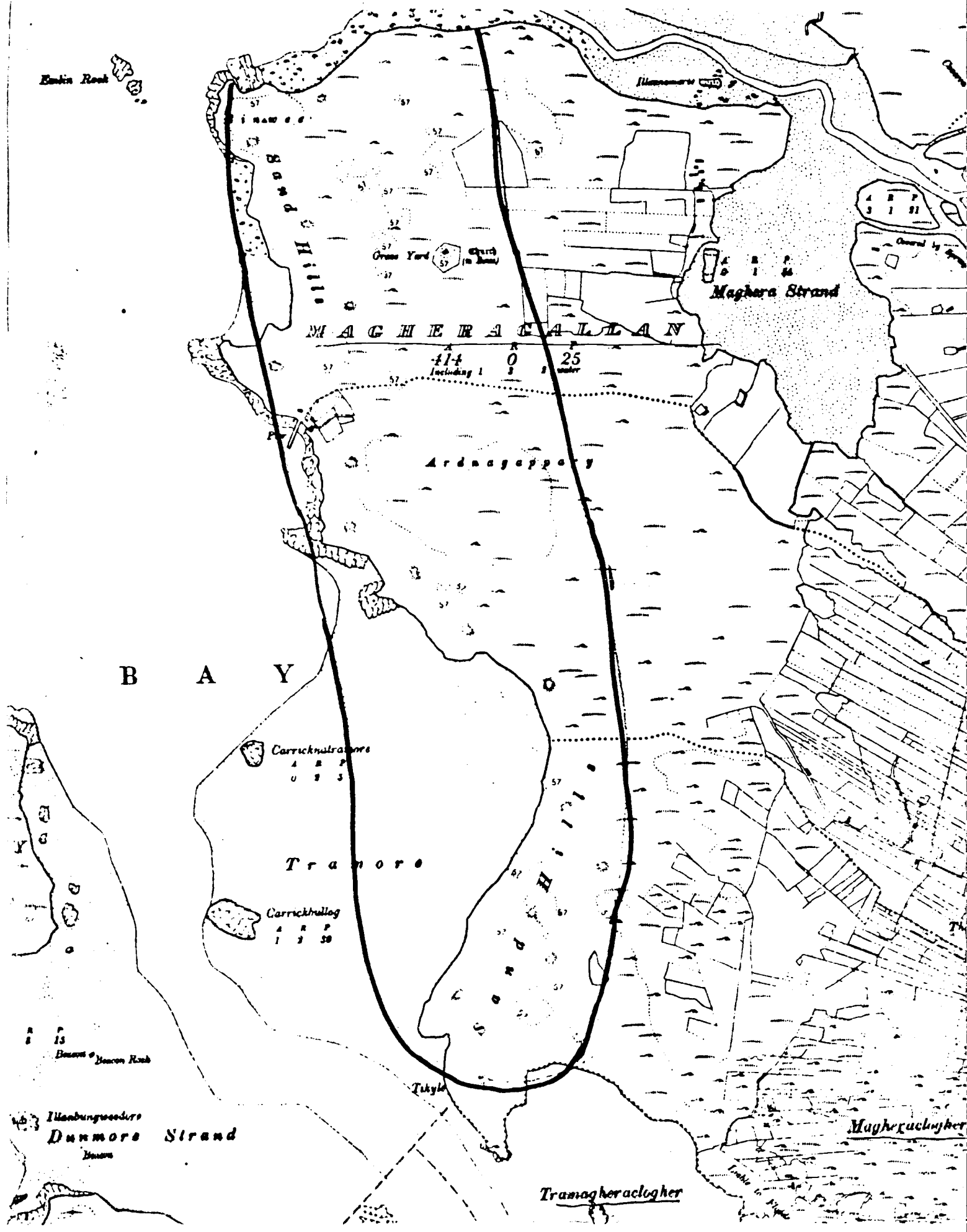


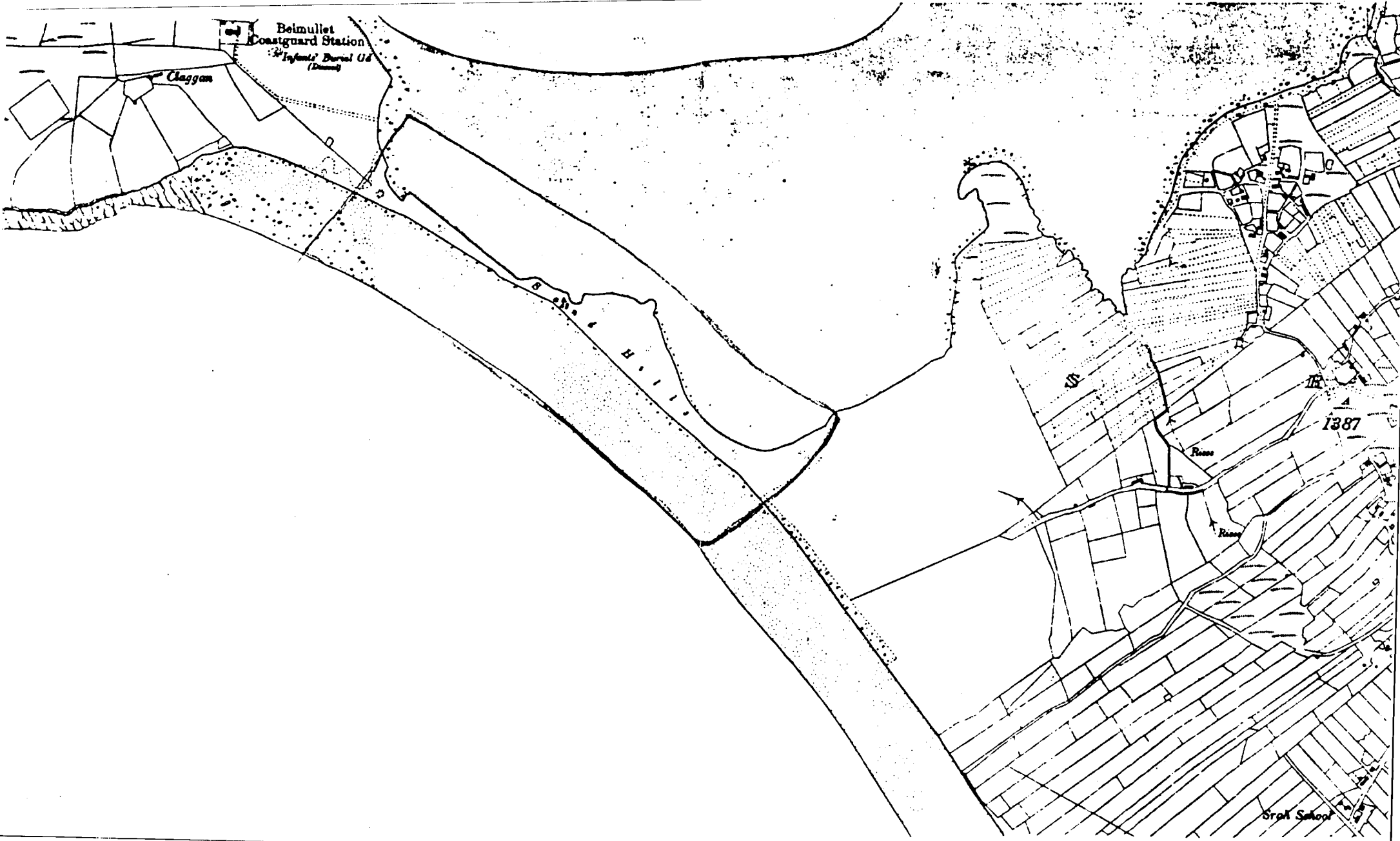


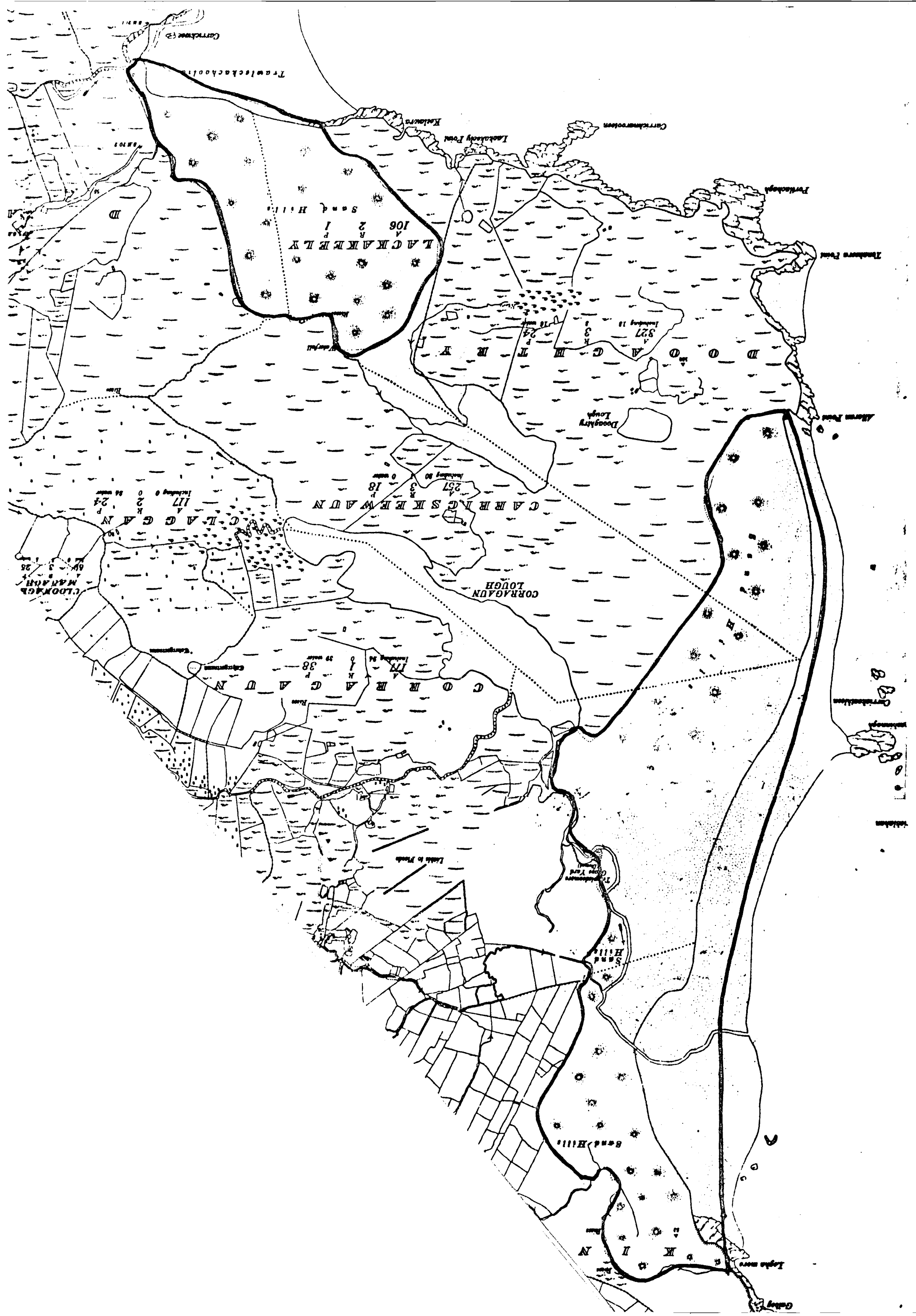
Sand Hills

Rabbit

Warren







LIVER

Q

Carmen Poley

Porto

Surface of Water 31.9 18th August 1911.

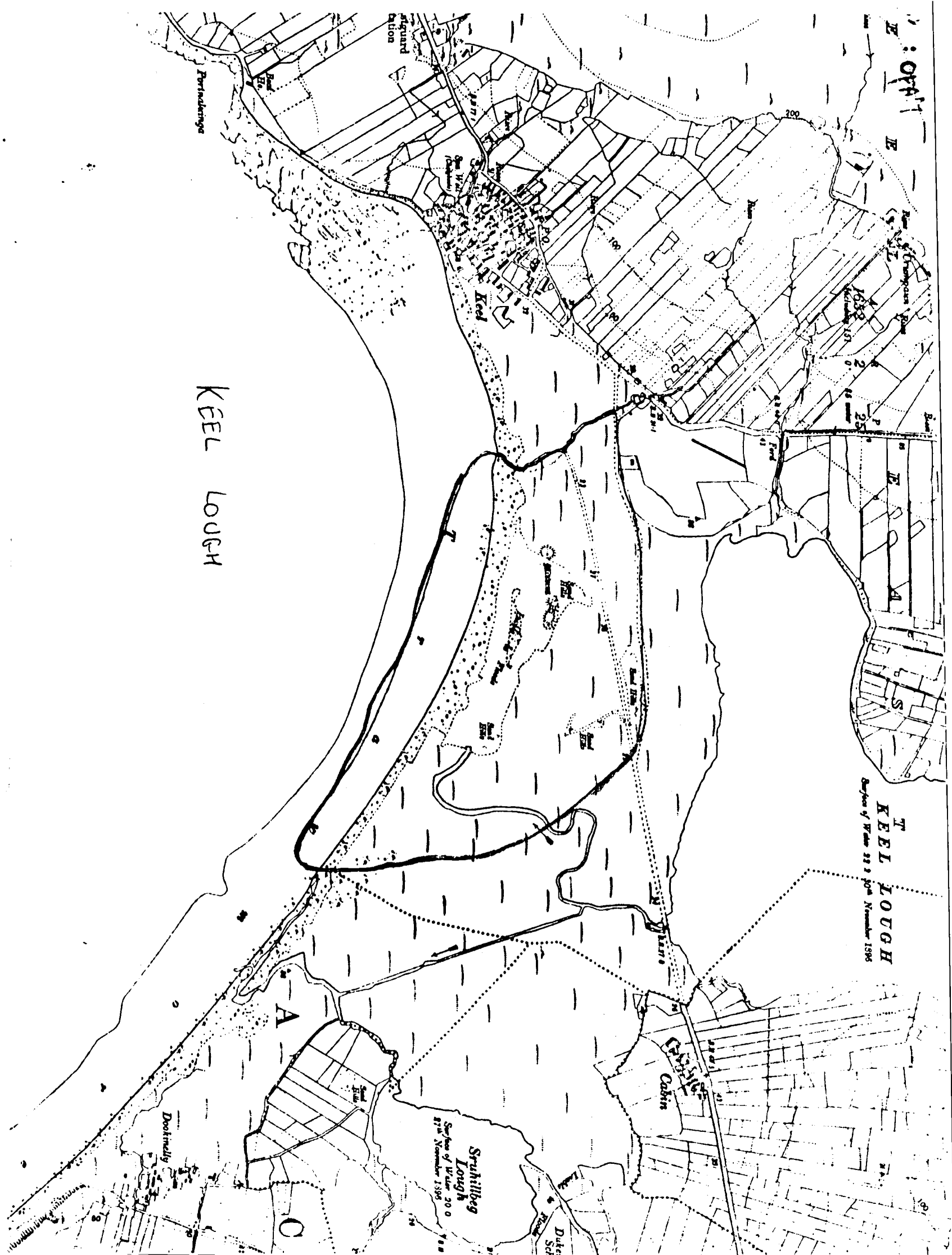
Surface of Water 193 15th August 1911

Long memory

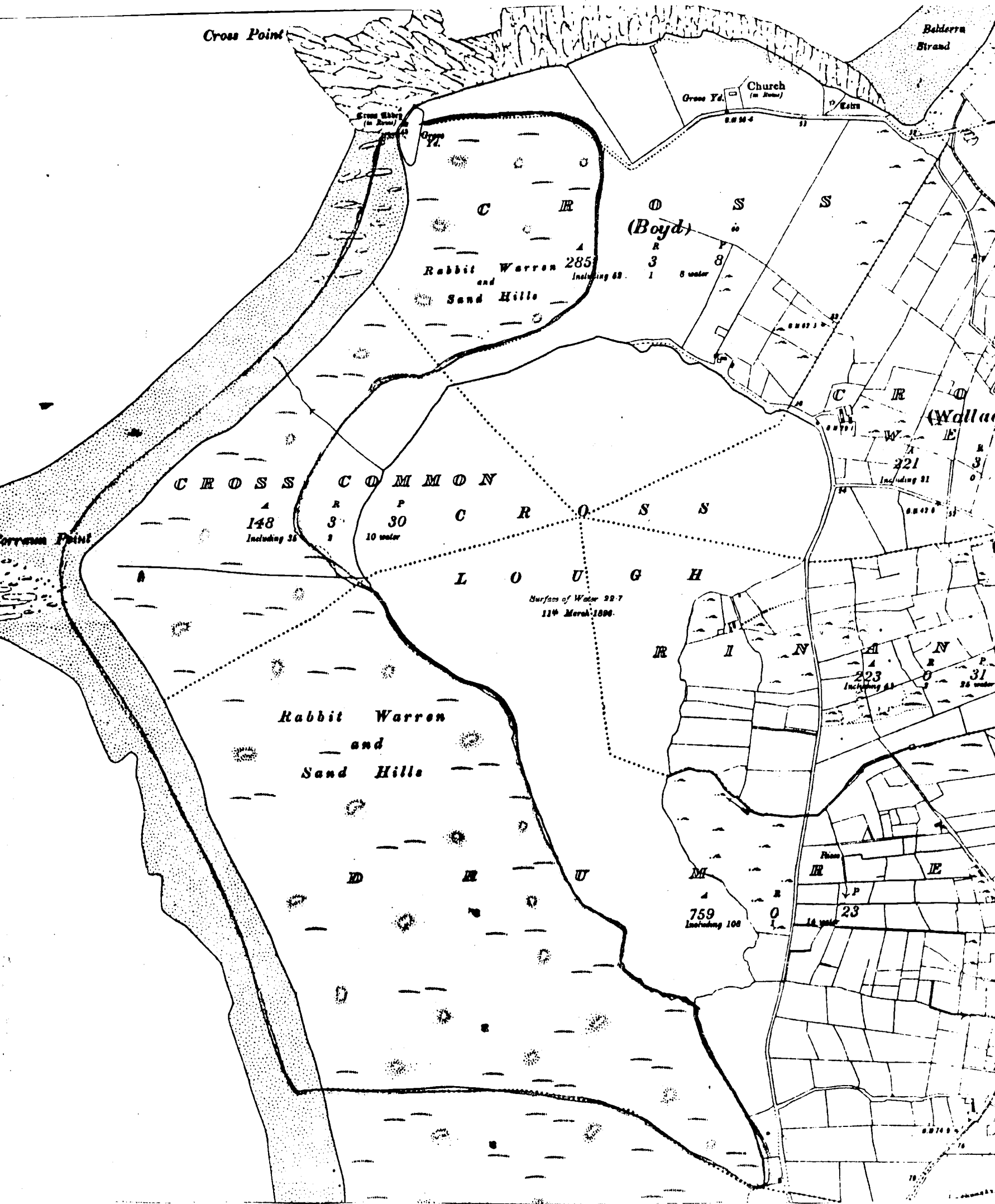
Surface of Water 36.8
154 August 1911

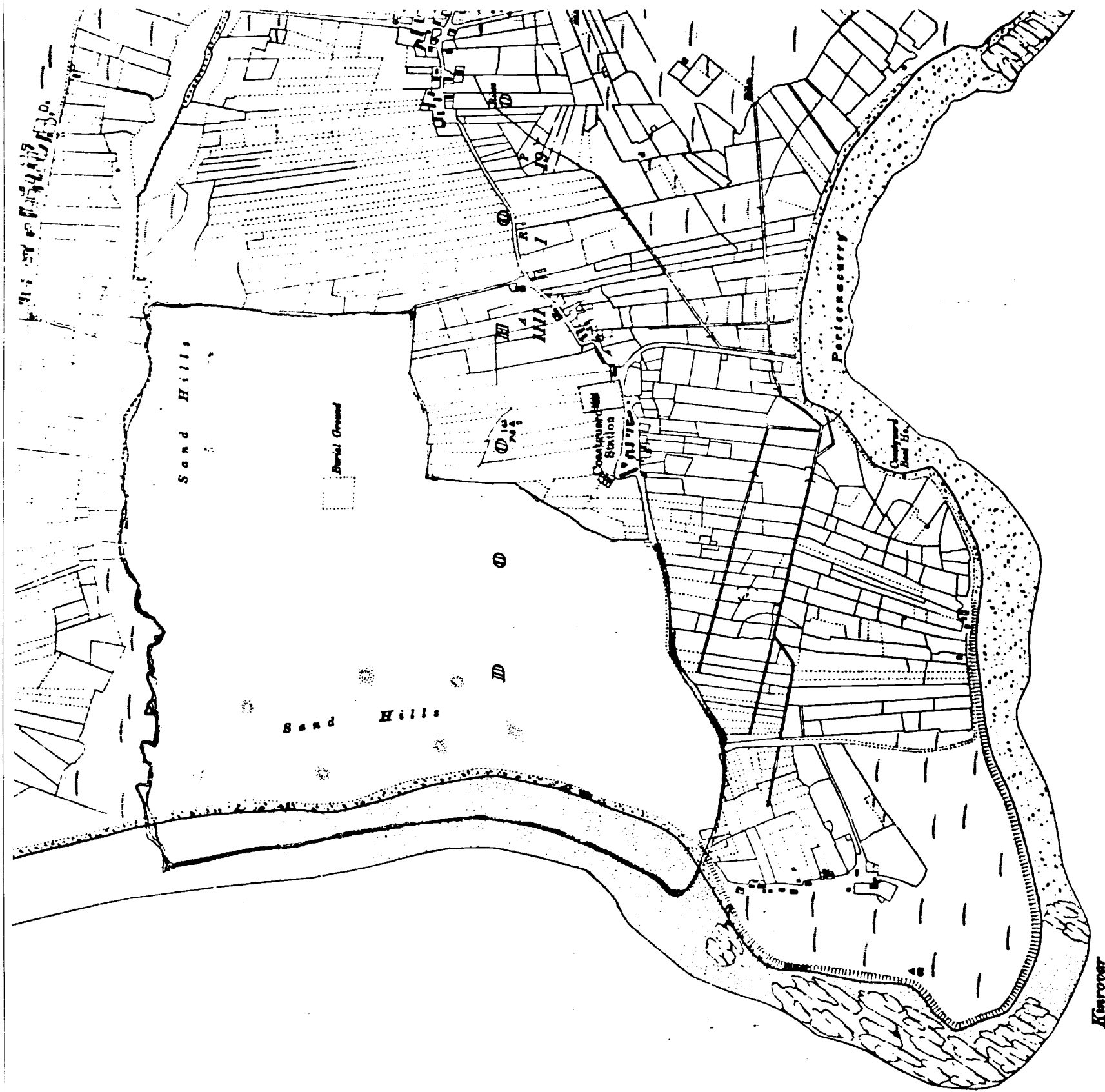
Valley School

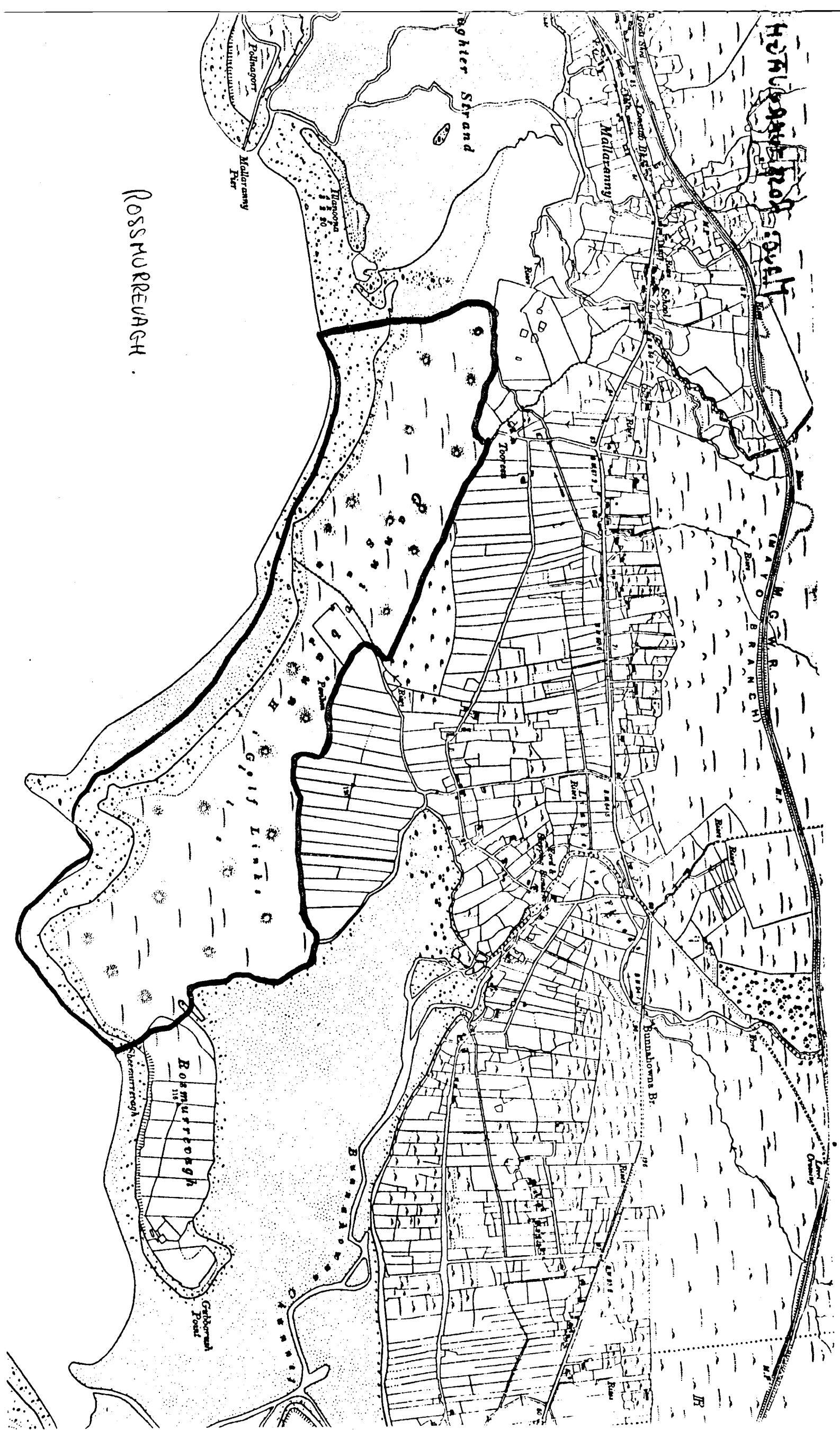
21-6

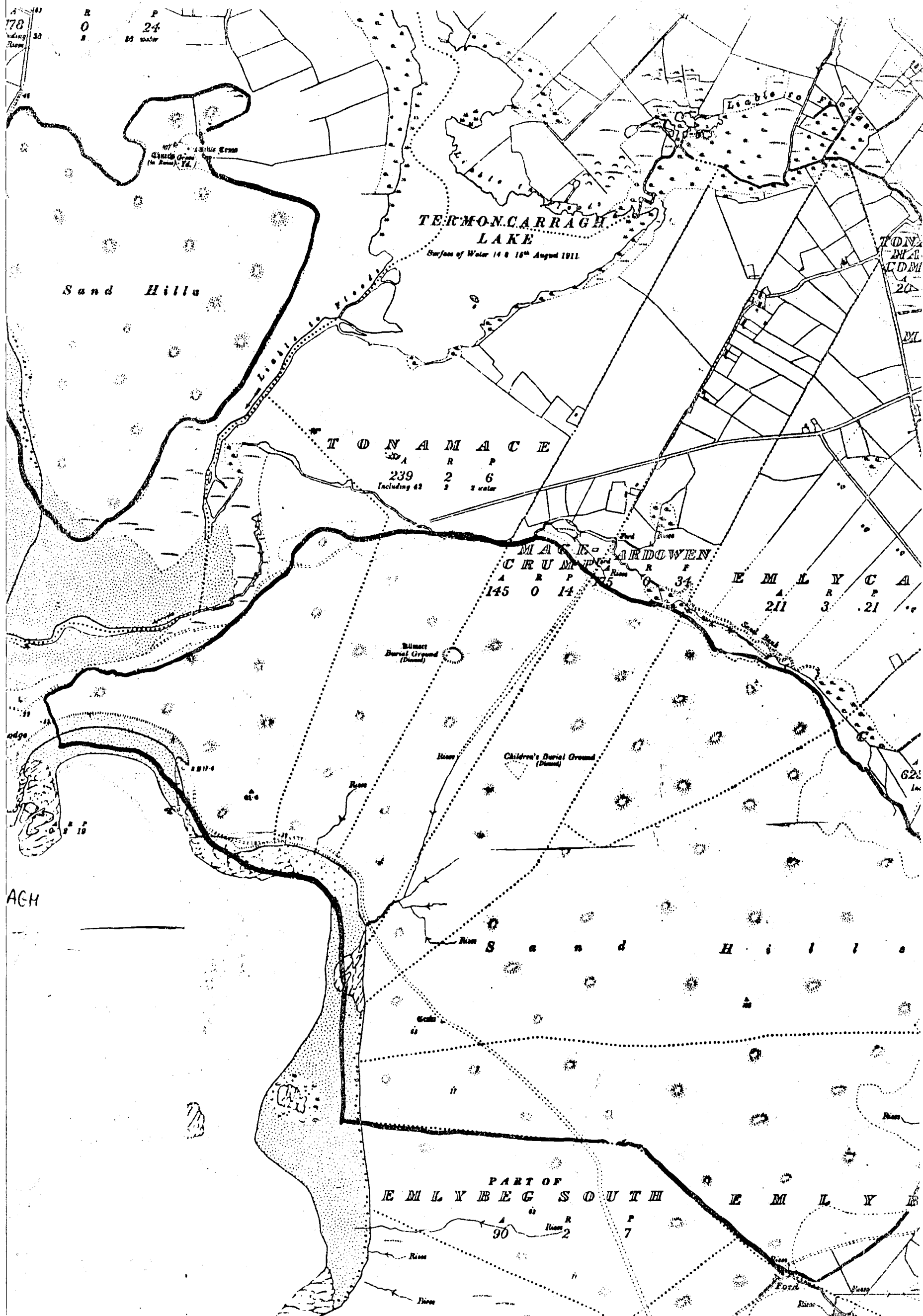


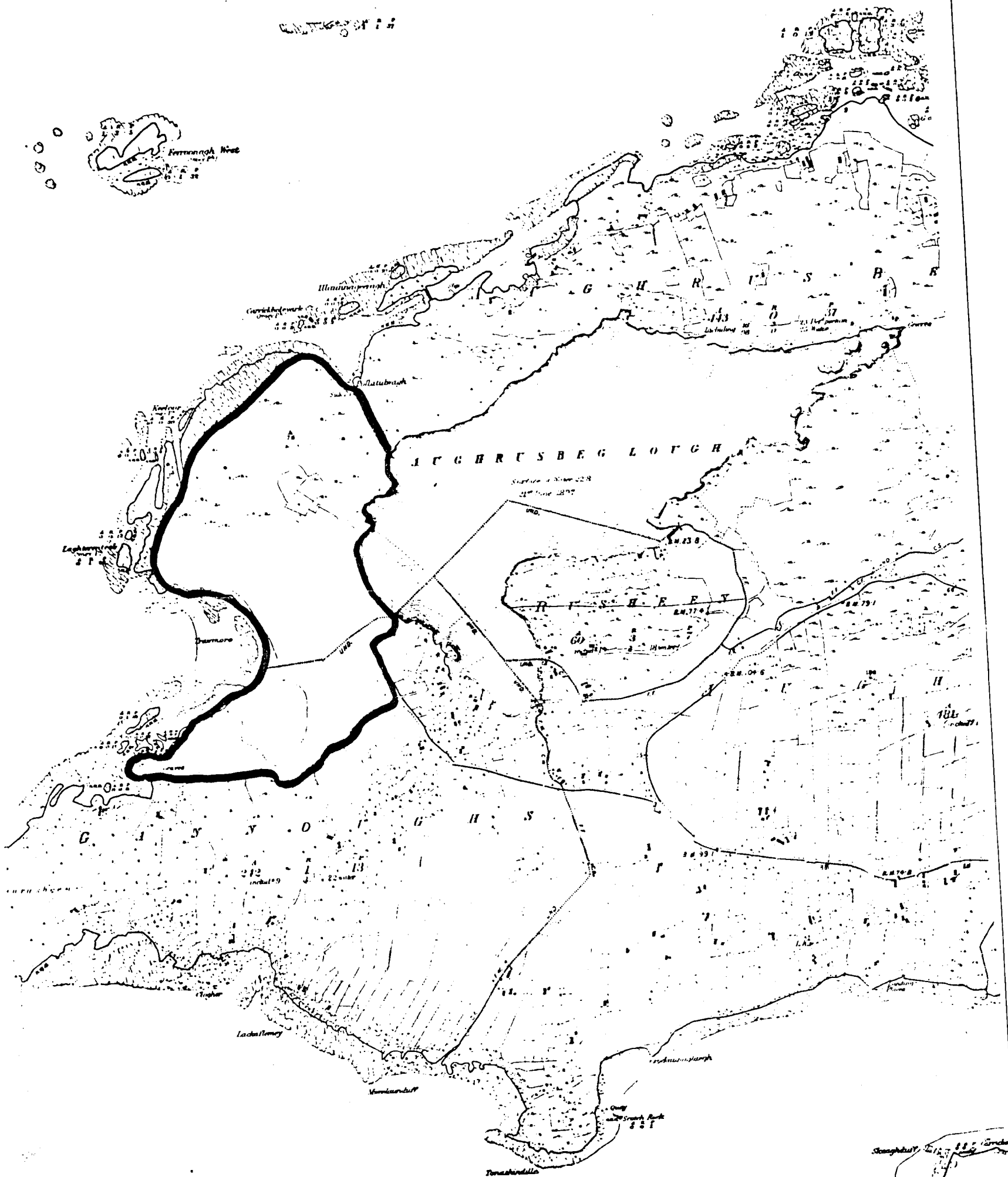




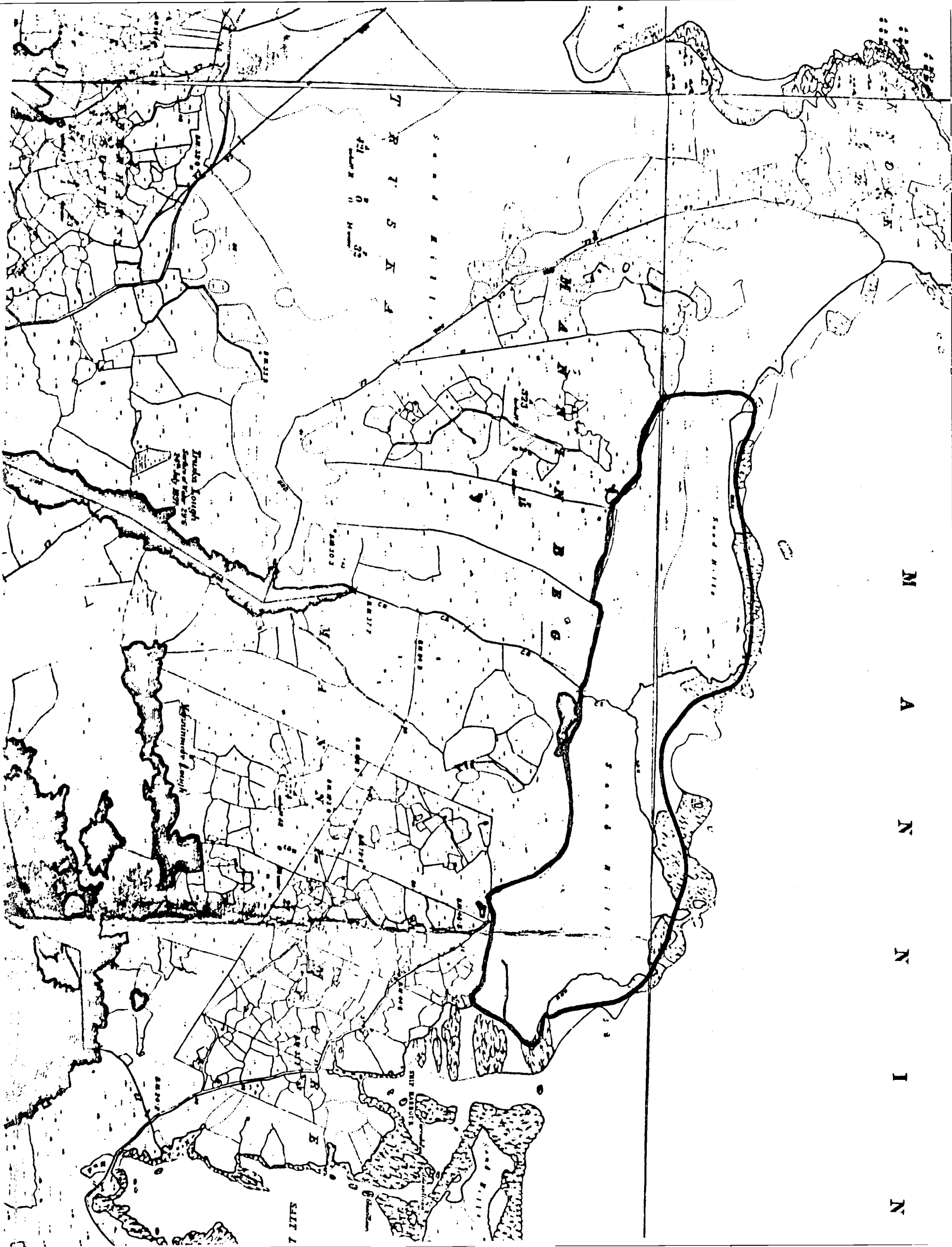








M A N N I N



A map of Straw Island, showing the lighthouse, sand dunes, and surrounding water. The map is oriented with the lighthouse on the left side. The island is irregularly shaped, with a large, rounded central area labeled 'Sand Dunes'. To the left of the dunes is a small, rectangular area labeled 'Straw Island Lighthouse'. The island is surrounded by water, with a small inlet at the bottom labeled 'Cush'. The map is drawn with simple lines and shading to represent the terrain.

