WEST DONEGAL RESOURCE SURVEY

Part 1—Soils and other Physical Resources

An Foras Talúntais

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FOREWORD

The continuing decline in population and the various physical, economic and social problems that beset many of our western counties have concerned people at all levels for more than a century. Various studies of the problems have been conducted from time to time, remedies have been proposed and solutions sought and different approaches have been tried. Considerable national effort and finances are being devoted in various ways in an attempt to overcome the problems but these areas are still largely under-developed. The economic, social and cultural well-being of the people of these areas and of the entire nation stands to benefit from any development that can be achieved. Some of the most adverse conditions obtaining in the whole western region of Ireland are those to be found in West Donegal—an area poorly endowed in physical resources and reflecting all the ills of a high rate of emigration, an adverse population structure, an underdeveloped agriculture, low income levels and several other rural problems.

Against this background, the Council of An Foras Taluntais decided that the complex situation prevailing in West Donegal should be examined and appraised in a systematic, scientific manner and, having thoroughly analysed the findings and within the context of modern knowledge and techniques, some models for the agricultural development of the area should be established.

While there was a certain background of experience and information on such problems as emigration and farm resources and income this knowledge was of a general nature, the position in this respect being akin to that for many other areas of the country. There was no precise or coordinated information on such matters as the nature, distribution and the best use of different types of land, on present and potential levels of productivity, on norms for grassland output and animal production, on farm incomes, on educational levels or on the social background in the local farming community.

It was felt then that the way in which we, as an agricultural research organisation, could best contribute would be through a comprehensive survey of the agricultural resources of the area. Of course, agricultural improvement is only one of the means of improving living standards in the area. No matter how well developed, agriculture can only support a proportion of the population. Development in agriculture must go along with expansion in tourism, fishing, industry and other enterprises. The findings of the survey, then, will be used not only as a basis for agricultural development but will also be correlated wtih those of surveys by other organisations in an effort to create an integrated programme of community and general area development.

The carrying out of a sufficiently comprehensive resource survey presented a formidable task demanding the collective efforts of people in a wide variety of disciplines covering the physical, economic and human behavioural aspects. The experience gained on methodology and organisation in the course of a previous resource survey of West Cork was of great value. The report of the present survey will go further than that of West Cork by preparing working plans or operational models, within current economic considerations which would form the basis of future agricultural development of West Donegal and of areas with similar problems in the West of Ireland. Surveys such as this are a prerequisite for optimum use of land resources within a framework of economic and social development. While we appreciate that the knowledge provided in the Survey Report is in certain respects incomplete, the primary objectives of the survey in providing a blueprint for the development of the land and the betterment of the people using the land have been largely achieved. It is hoped that the information provided will serve its purpose as a basis for guiding developments towards the future well-being of the entire community.

It is a pleasure to be associated with the highly merited acknowledgement given below to those within An Foras Taluntais and the many outside who cooperated with us in this project. Finally, may I commend the efforts of the Working Party who embarked on and completed this task with such dedication and enthusiasm.

T. Walsh,

Director.

PREFACE

The findings of the West Donegal Resource Survey are published in four parts covering broadly different aspects of the survey findings:

Part I —Soils and Other Physical Resources.

Part II —Some Aspects of Production—Crops, Animals and Fisheries.

Part III—Economic, Demographic and Sociological Aspects.

Part IV—Summary, Conclusions and Some Development Proposals for Agriculture.

In the Introduction to Part I the background and objectives of the resource survey and the methods adopted are described. The area covered by the survey—the Glenties Rural District—is defined. This report, apart from being Part I of the West Donegal Resource Survey, also constitutes Soil Survey Bulletin No. 20 of the National Soil Survey Series. Unfortunately the entire detail mapped on the field sheets in the course of the soil survey could not be shown on the published soil map due to scale limitation but the field maps are available in the Soil Survey Office at Johnstown Castle, Wexford. Place names throughout this bulletin and on the maps are not in all cases in accord with local spelling as it was deemed desirable to adhere to the official place-name spelling used in the Ordnance Survey.

For their cooperation and assistance in the work reported here the West Donegal Resource Survey Working Party is grateful to: the County Agricultural and Horticultural Advisory Officers and in particular Mr. D. O'Donnell, C.A.O.; Rev. Fr. J. McDyer, *C.C.*, Glencolumbkille; the officers of the Land Project (especially Messrs. L. Drury and J. Griffin) and the Parish Agricultural Advi>ory Agents (especially Mr. T. O'Connell) of the Department of Agriculture and Fisheries in the area: the personnel of Errigal Co-Op. and especially Mr. V. Foley, and the local officers of the Forestry Division, Department of Lands.

Special thanks are due to the local people and particularly to the farmers who facilitated the general soil survey of the area and without whose co-operation the Resource Survey would not have been possible. Here also the excellent support of the various non-statutory rural organisations in the area is acknowledged.

Grateful acknowledgement is also due to the Department of Agriculture and Fisheries (particularly to Dr. H. Spain, Chief Inspector, and personnel of the Land Project and the Farm Buildings and Congested Districts Offices); to the Department of Lands (both Forestry and Land Commission); to the Directors of the Meteorological Service and the Central Statistics Office for various data made available; to the Ordnance Survey for permission to use base maps of the area and for assistance in the printing of the soil maps; to the Geological Survey Office and to the Department of Geology. Liverpool University for providing information on the geology of the area.

The Working Party appreciates the continued interest, stimulation and guidance of the Director, Dr. T. Walsh, and the excellent collaboration of fellow research workers in An Foras Taliintais, not only those making direct contributions but also Mr. T. Shanley and the staff of the Soil Survey Laoratory, the staffs of the other research laboratories and the members of the Cartographic Section, Johnstown Castle. The contribution of Mr. S. van der Schaaf (on a student fellowship from Wageningen University) and that of Mr. M. Bulfin on the field mapping is acknowledged. Finally, thanks are due to those who assisted in the preparation of the report and especially Mr. B. Gilsenan for his editorial work, Miss A. Davin for typing facilities, Mr. C. Godson for photographs, and Miss O. Daly and Mr. E. Culleton for general help.

Grateful acknowledgment is made to all those mentioned here and to others who helped.

Pierce Ryan
Chairman, Working Party

An Foras Taluntais,
January 1969.

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INTRODUCTION

Background

The more pronounced rural problems in Ireland are to be found in the western counties and considerable national effort and finances are being devoted in various ways in an attempt to overcome these problems. However, the western region is far from homogeneous in the quality of its resources and far from uniform in its rural problems. West Donegal is amongst the most poorly endowed areas in physical resources and one of the most extreme in rural problems.

In order to make a thorough, scientific and systematic appraisal of the situation in West Donegal a comprehensive resource survey was undertaken by An Foras Taluntais (The Agricultural Institute). The survey commenced in 1965 and the field investigations were generally completed by the end of 1967. A Working Party drawn from research staff of the Soils, Plant Sciences, Horticulture and Forestry, Animal Sciences, Animal Husbandry and Dairying and Rural Economy Divisions of the Institute was primarily responsible for the survey. Co-operating agencies at State and local level included: Department of Agriculture and Fisheries, Department of Lands (Forestry Division and Land Commission), Central Statistics Office, Meteorological Office, Geological Survey, Bord-Iascaigh Mhara, Gaeltarra Eireann, Co. Donegal Agricultural Advisory Services, Irish Sugar Company (Errigal Co-Op.) and Muintir na Tire and other non-statutory bodies. The Geology Department, Liverpool University also co-operated. The Working Party was under the Chairmanship of the Head of the National Soil Survey. While the main onus for the operation of the resource survey has rested on this working party they in turn have been able to draw on the research resources of the Institute as a whole and to consult local and State bodies and personnel engaged in the area and other outside specialists. The Working Party met at intervals to plan and co-ordinate the survey programme.

Methodology

The procedure followed in conducting this survey was based largely on experience with a similar type survey of West Cork some years previously. Most of the findings were derived by five methods:

(a) complete surveys in the field, *e.g.*, soils, ecology, animal diseases;
(b) farm suryeys on a random selection of different-sized farms in the area:
(c) field experiments, *e.g.*, crop productivity—grassland, horticulture;
(d) questionnaires to farmers, local groups and others;
(e) use of existing knowledge on the area, *e.g.*, climatic records, population and other statistics.

With the emphasis on compiling *factual* information on the physical, economic and social factors of production as a basis for decision-making and planning and with the lack or inadequacy of such information on many facets, the survey and experimental projects were necessary. These research procedures were aimed at getting the answers to local problems in their local environment. During the survey the need for further research, mostly of a long-term nature, into certain aspects was brought to light.

Objectives

The principal aims of the survey were:

1. to provide basic, factual information in a systematic manner on the physical, human and economic resources of this underdeveloped area;
2. to ascertain to what extent and by what means the area can provide a good living for a more stable population through agricultural development.

Of course, agricultural development is only one of the means of improving living standards in the area; no matter how well developed, agriculture can only support a proportion of the population. Development in agriculture must go along with expansion in tourism, fishing, industry and other enterprises. With this in mind it is hoped to integrate the findings of this survey with other studies embracing the area.

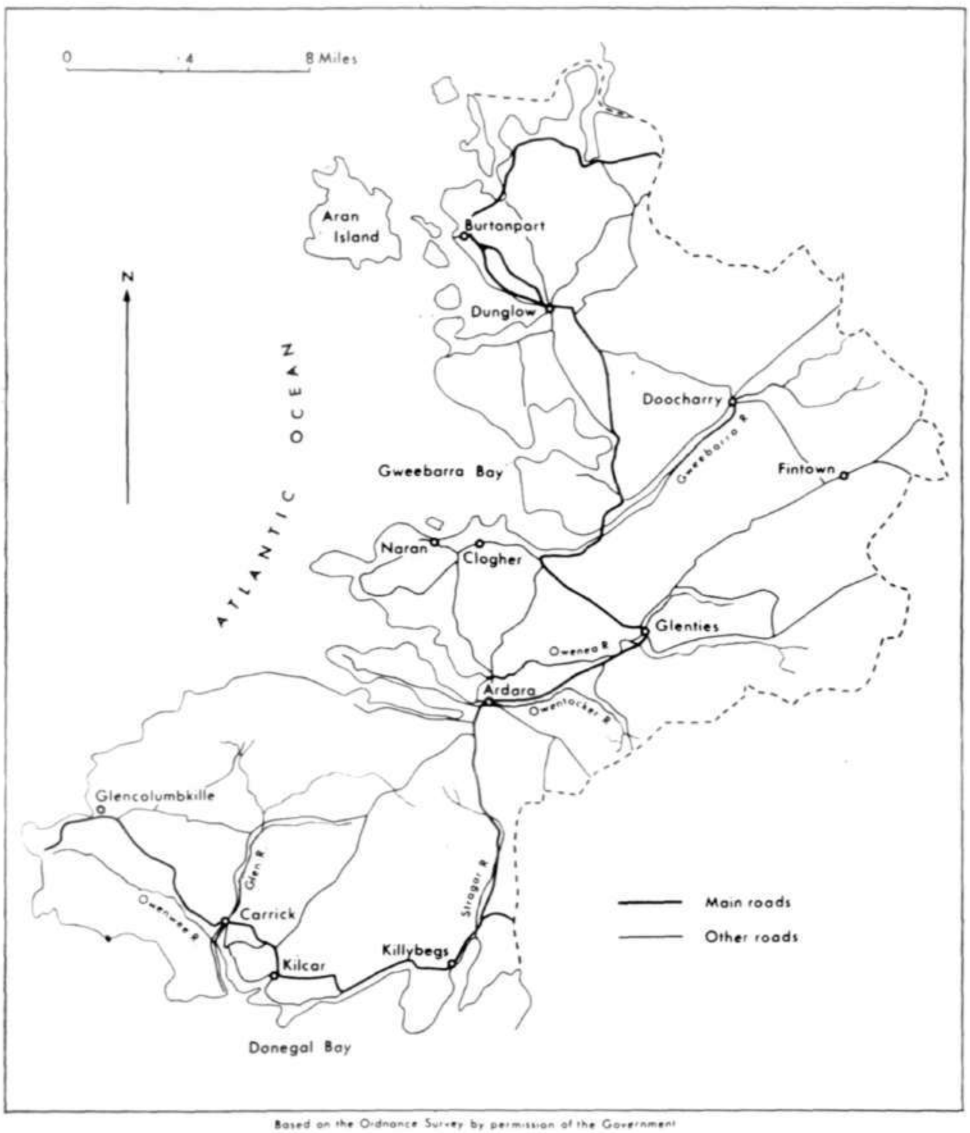
Although this resource survey was designed to find the answers to some of the rural problems of West Donegal and to provide a basis for long-term development of agriculture in the region, the significance of the survey extends far beyond the limits of that area. The findings of such a comprehensive, scientific investigation would have effective application to several areas of the country where conditions are closely akin to those in West Donegal.

The Survey Area

The Resource Survey was confined to the Glenties Rural District of West Donegal. The area comprises approximate!) 411 square miles (263,000 acres) and is shown in outline on the accompanying map (Fig. 1).

The physiographical features show considerable variation within the area providing frequent and significant changes in a complex landscape. Strongly rolling and hilly terrain gives way to mountainous chains with deeply-cut valleys. Very little flat land occurs apart from the alluvial areas, and on the elevated peat-covered plateaux the topography is undulating. The elevation varies considerably throughout the area rising from sea-level to 2,000 feet over a short distance. In the northern part of the area in particular, the continuity of the land form is constantly broken by local patches of rock outcrop giving a very broken landscape. Vast expanses of blanket peat interspersed with mineral soils and rock outcrops are the most commonly occurring pattern.

The Atlantic Ocean forms the southern and western boundaries of the region The coastline is rugged and deeply indented in places. Some islands occur off the coast; of these Aran Island is by far the biggest. The area has a number of small towns and villages, the most important being Killybegs, Glenties, Ardara and Dunglow.



Based on the Ordnance Survey by permission of the Government

Fig. 1 - Glenties Rural District - geographical location and principal towns and villages

CLIMATE*

The climatic details presented here are based on the records of the Meteorological Office and are discussed under the following headings: rainfall; air temperature; wind force ;sunshine; relative humidity; ground frost.

The rainfall figures relate to 12 meteorological stations for the 14-year period 1951-1964; however, the rainfall map (Fig. 2) is based on records of these stations from 1916 to 1950 inclusive. The air temperature figures were recorded at Malin Head over a 15-year period, 1950-1964 and at Glenties over a seven-year period, 1958-1964. Sunshine records are available only for Malin Head (1950-1964). Ground frost records for Milford, Glenties and Malin Head relate to the 1958-1964 period.

Rainfall

In general, rainfall in the survey area is above the national average; however, the variation in mean annual rainfall throughout the area is quite considearble, due mainly to the abrupt changes in topography. The area north of a line from Fintown to Ardara has at least 140 mm less rainfall (5.5 inches) in any year than the area south of this line. The average annual rainfall figures recorded at 12 stations in the area over the period 1951-1964 are given in Table 1. Clogher, near the southern coast of Gweebarra Bay, has the lowest average recorded at 1,140[2] mm; Carrick, on the southern coast of the Slieve League peninsula, and Frosses show recorded averages in the region of 1,800 mm over the same period. There are no recording stations in the elevated regions such as Slieve League but estimating from figures for the adjacent lowland stations the annual rainfall must average between 2,250 and 2,500 mm or even more in places.

The highest recorded annual rainfall was in 1954, when Carrick had 2,480 mm (98 in.) of rain. In the same year Clogher had 1,420 mm (56 in.) and Frosses 2,350 mm (92 in.); these figures represent differences of 280 mm (11 in.) and 530 mm (21 in.) respectively above the average annual rainfall. The following year, 1955, had the lowest recorded rainfall: Clogher had 1,020 mm (40 in.) and Frosses had 1,530 mm (60 in.) of rain.

The minimum average monthly rainfall occurs in the April-May period (Table 1) and the maximum in December. The average difference in rainfall, however, between May and December is only about 115 mm (4 to 5 in.); it is obvious that the area has a high proportion of rain days over the year. The lowest recorded rainfall was 31 mm (1.2 in.) at Clogher during April, 1954, and the highest was 336 mm (13.2 in.) at Frossess during July, 1953.

[1] This section was prepared by M. Ryan and P. Feeney, Soils Division, An Foras Taliintais
* All rainfall figures in millimetres are corrected to the nearest decade

TABLE 1—Mean monthly rainfall (1951-1964) for 12 stations (millimetres, 25*4 = 1 inch)

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly total
Ardara	168	109	115	88	85	99	128	135	156	160	158	201	1,602
Bunbeg	145	107	77	71	58	93	115	127	147	130	118	168	1,356
Carrick	161	118	114	92	91	123	156	164	179	185	184	231	1.798
Clogher	115	82	72	61	56	73	93	101	114	112	117	142	1,138
Doocharry.	149	113	91	90	86	110	147	157	152	162	172	194	1,623
Dunlewy	165	125	109	105	95	121	145	167	156	165	180	214	1,747
Fintown	169	122	100	102	94	119	166	167	167	173	178	206	1,763
Glenties	151	105	98	85	83	95	124	128	146	142	153	187	1,497
Glencolumbkille ...	143	102	109	76	84	96	124	127	140	154	149	197	1,501
Frosses	150	135	104	100	99	133	174	166	185	188	185	205	1,824
Gweedore.	146	115	98	96	75	115	145	154	167	145	173	202	1,631
Killybegs	135	95	91	79	73	98	135	133	143	149	143	178	1,452

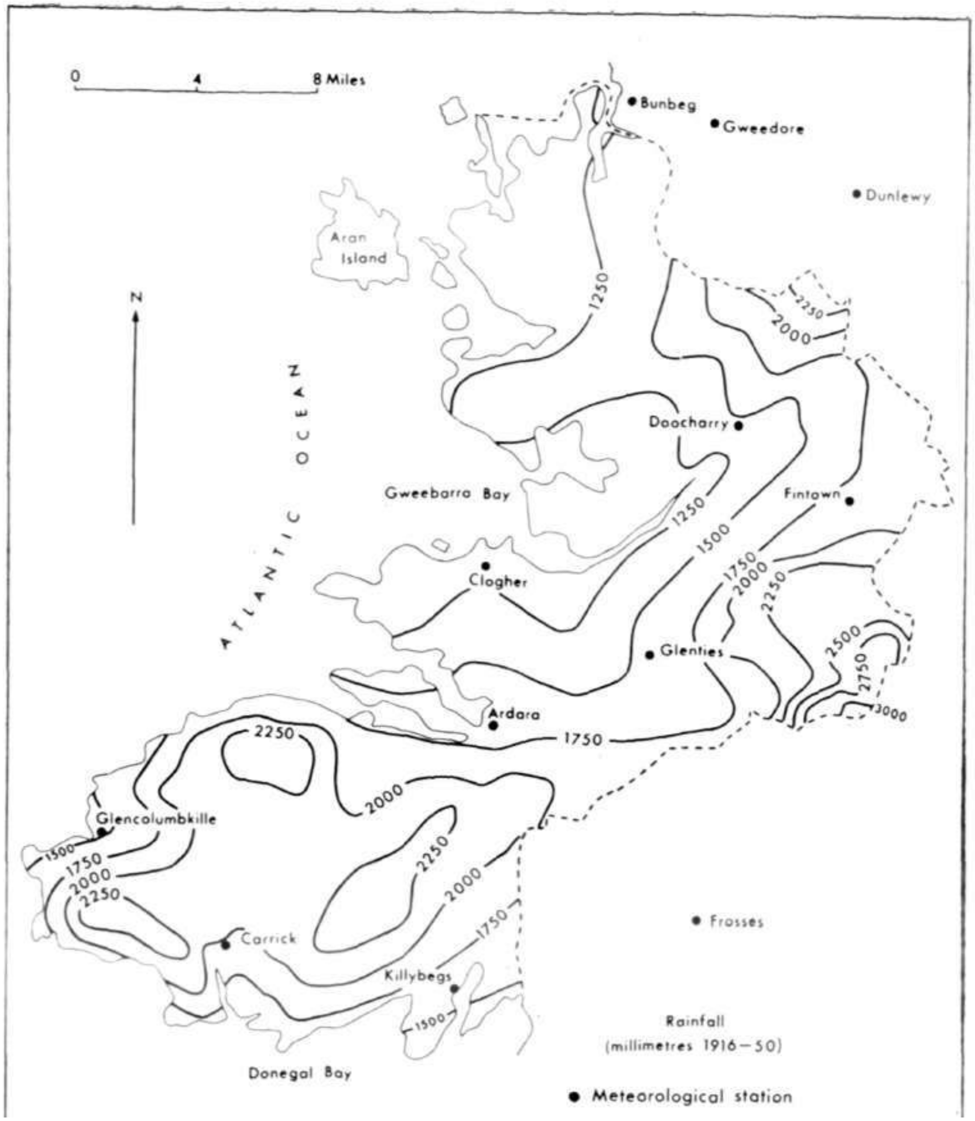


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Fig. 2 - Rainfall distribution pattern throughout the area (average annual rainfall, 1916-50)

Air temperature

The average annual temperature for the area is approximately 9°C which is the same as that for Dublin, and about 1°C less than for West Cork. The average temperature at the coast is 0.2°C higher than inland (Table 2); from November to March it averages 0.8 °C higher at the coast while for the remaining seven months the inland area is warmer by less than 0.6 °C. January is the coldest month in both cases (3.7 and 5.1 °C) and July-August the warmest (13.9^{6}C) period. The lowest average annual temperature recorded was 8.5°C at Glenties in 1963 while the highest was 10.3°C at Malin Head in 1959; the range in annual average temperatures within the area is only 1.8°C. At Glenties the lowest air temperature recorded was 0.4°C in January 1963 and the highest was 15.1 °C in August 1959.

TABLE 2—Monthly average of mean air temperature in °C (Malin Head, 1950-1964; Glenties, 1958-1964)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
Malin Head (coastal station)	51	51	66	7-9	10.3	12-6	13-8	13-9	12-9	10-7	7-7	60	9-4
Glenties (inland station)	3-7	50	6-3	81	10-8	130	141	13-7	130	10-7	6-9	4-6	9-2

In the period March to October the temperature is about 1°C lower than for most other parts of the country and as this will be reflected in the temperature of the soils and to an exaggerated degree in the great expanses of wet peat, early spring growth is very exceptional. The slightly higher than average temperatures in the November to February period do not sufficiently raise soil temperature to promote growth. Therefore, the region has a somewhat restricted growth season which is an important factor in the agricultural production pattern.

Wind

A serious climatic factor in the area is the velocity and frequency of winds. Treeless coastal areas, stunted and warped trees and shrubs inland, wind-swept heaths and the manner in which roof-thatch is tied down all testify to the power of the winds in the area. Wind records are available only for Malin Head and due to the nature of the terrain these would not be locally representative.

The Malin Head records, however, indicate that the majority of winds affecting the area fall between 1 and 5 on the Beaufort scale, with velocities ranging from 1 to 24 miles per hour (mph); frequencies vary from 24 days of the month in December and February, to 29 days in July. Winds of the higher velocities (25 mph and over) are more prevalent from September to March with December and January having on average at least 1 day when the wind force (Beaufort scale) is 8 or more, *i.e.,* greater than 42 mph.

The prevailing winds are from the south and west. From November to March the winds are dominantly from the south but approximately 35% are from the north; for the period April to October the winds are mainly from the west with some north-west and north. It is obvious that the area is wind-swept, with wind direction very variable; calm days are seldom experienced.

Sunshine

The months of least rainfall usually have the greatest number of sunshine hours. Since the records in Table 3 are from the coastal station at Malin Head the sunshine figures are higher than those obtaining inland.

The average duration of bright sunshine recorded at Malin Head for the period January to June is fairly comparable with that recorded both in West Cork and at Rosslare in Co. Wexford, but for the remaining 6 months it averages approximately 35 minutes per day less than in these areas. Recently estimated figures for the period 1931-60 show that for March, June, September and December, Malin Head had amongst the lowest values of mean daily duration of bright sunshine in the country; inland areas of the region would have even less sunshine.

TABLE 3—Monthly average of mean daily sunshine (hours) (1950-1964)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Malin Head ...	1-50	2-35	3-60	5-60	6-80	610	4 60	4-70	3-90	2-40	1-70	100
West Cork ...	1 50	2-50	3-50	500	5-50	600	5-50	500	4-50	300	200	1-50
Rosslare ...	1-75	2-50	3-75	5-50	5-75	6-50	7-75	500	4-50	3-25	250	150

Relative humidity

Monthly average relative humidity, based on records taken at Malin Head at mid-day over the period 1950-64, ranges from 77% in April and May to 82% in November and December; variation from month to month never exceeds 5%. By contrast, in West Cork which has the same annual average of 79.8%, variation between months can be up to 8%. Relative humidity in West Donegal, in general, is 5 to 10% higher than that for the midland region of Ireland.

Ground frost

The records of average monthly ground frost for the period 1958-64 (Table 4) show that no frost occurs in the Malin Head area from June to October inclusive, and that frost in May is infrequent. Milford was frost-free in July in the 7 years recorded and from June to September, inclusive, for 4 years out of the 7. Glenties had no frost during August for 6 years and in 4 years out of 7 it had no frost

TABLE 4—Average monthly occurrence of ground frost (days) (1958-1964)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
Malin Head	9-4	8-6	7-9	1-8	0 4	00	00	00	00	00	1-6	60	35-7
Milford	221	16-3	14-3	9-8	4-4	0-4	0 0	0-6	0-8	3 0	10-6	20-3	1026
Glenties	191	14-3	11-9	12-9	5-7	3-3	0-4	0-3	11	4-3	11-7	18-4	103-4

from July to September, inclusive. The average number of frost days per year is variable especially between inland and coastal districts: Milford 102.6, Glenties 103.4, Malin Head (coastal) 35.7. From year to year there is considerable variability also; in 1961, the year with least frost, Milford had 78, Glenties 72 and Malin Head 24 frost days.

January has the most frost (Table 4) with an average of 22 frost days at Milford and 19 at Glenties. In 1963, Milford had as high as 31, Glenties 29 and Malin Head 17 frost days in January.

The frost pattern in West Donegal compares rather unfavourably with most other western coastal areas and especially those in the south-west, and with the country in general. For instance the average annual number of frost days in West Cork is 25 diminishing to 10 at the coast, and in the mid-region of Ireland, *e.g.*, Tullamore, is 50. In West Cork the length of the annual frost-free period is at least 200 days (up to 300 at the coast); it extends from about early April to early November in the inland region, and from early March to near the end of December along the coast.

Summary

The climate of West Donegal has many disadvantages: rainfall is high and frequent by national standards, winds are constant and of considerable force at times, the general mildness is marred by a restricted frost-free period, and the duration of bright sunshine is less favourable generally than elsewhere in the country.

GEOLOGY

by

MRS. M. O. SPENCER[1] and PROFESSOR W. S. PITCHER[1]

Solid Geology

Glenties Rural District consists of very varied rocks with a long and complex history. A low coastal platform in the central and northern parts of the area is bounded by more mountainous areas. The wild and impressive coastal scenery reflects the geology, with marine erosion active along joints, faults and bedding planes producing sea-arches, stacks, blow-holes and skerries. Particularly spectacular are the cliffs of Slieve League rising to 2,000 feet and formed of massive quartzite. The main river valleys reflect erosion along major structural lines

Granitic rocks form a large part of the region and have been emplaced by various means into a series of folded and metamorphosed sedimentary rocks and basic sills of Dalradian (Upper pre-Cambrian) age. These Dalradian rocks have been separated into two major stratigraphic successions, the Creeslough to the north and north-west and the Kilmacrenan to the south and south-east. Along the southern coast of the Slieve League peninsula, Dalradian rocks are unconformably overlain by Carboniferous rocks.

Creeslough Succession

The rocks of the Creeslough Succession have a comparatively small outcrop area in the Glenties Rural District: they merely form the envelope rocks of the large granitic intrusions. The Creeslough Succession outcrops (see map—Fig. 3) on Aranmore, in the Crohy Hills district, the Maas and Lettermacaward areas, the Rosbeg peninsula, in the strip of country which forms the south-east margin of the granites and, finally, where some members of the succession have been preserved as inclusions in the Thorr Granodiorite and the Main Donegal Granite.

The general succession of the Creeslough Group can be seen in the key to Fig. 3. The formation names come from the standard succession in the Creeslough area, which has a suggested total thickness of 16,000 feet. All the rocks of this succession have suffered deformation and metamorphism.

Ards Pelites-

These are the oldest rocks in this region, although in other parts of Donegal the\ are underlain by the very thick Creeslough Formation. The Ards Pelites outcrop in the Crohy Hills area and consist of black graphitic pelites with occasional limestones and quartzitic beds.

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Fig. 3 - Solid geological formations in Glenties Rural District

Ards Quartzite

The Ards Quartzite forms the major part of Aranmore; it outcrops extensively in the Crohy Hills; and it is exposed in the core of an anticline west of Maas and at Cor Point. The quartzite is a white, crystalline, glassy-looking rock of great thickness (approximately 1,000 to 1,500 feet) and uniformity.

* Pelite, semi-pelite, psammite and calc-silicate rock are the terms used in metamorphic rocks for shale, sandy shale, sandstone and sandy limestone which are their unmetamorphosed sedimentary equivalents

Sessiagh-Clonmass Formation

This formation rests conformably on the Ards Quartzite and outcrops largely in the folded rocks of the Maas-Lettermacaward area, from whence it can be traced through 'rafts' in the main Donegal Granite to a synclinal outcrop in the Gubbin Hill area. The formation is characterised by rapid alternations of a wide variety of rock types which give to the formation a banded or striped appearance. The rock types include quartzitic flags, semi-pelites, calc-silicate flags, limestones and dolomites.

Lower Falcarragh Pelites

This formation overlies the Sessiagh-Clonmass Formation conformably and both have a similar distribution in the area. The pelites are best developed in the Maas area where they form a thick homogeneous group of purplish semi-pelites with an occasional thin impure calcareous horizon. The Lower Falcarragh Pelites have been greatly affected by the deformation and the intrusion of the granites.

Falcarragh Limestone

This thick limestone outcrops extensively along the coast between Portnoo and Maas, and in the Derkmore Valley; the latter outcrop continues northwards across the Gweebarra estuary to Lettermacaward. The limestone also outcrops in a valley near Glenaboghil with a NE-SW strike, but is much thinner there. It is the thickest limestone (approx. 500 ft) in the Creeslough Succession and consists of massive grey marble, mostly striped or banded and containing some thick pelitic intercalations.

Upper Falcarragh Pelites

The boundary between the Falcarragh Limestone and the Upper Falcarragh Pelites is transitional, the limestone becoming more pelitic upwards. The Pelites outcrop over a wide area in the Rosbeg and Loughros peninsulas. This outcrop is continuous around the southern margin of the Ardara 'granite' and northeastwards along the strike to Fintown. They also have a small outcrop at Cleengort Hill in the Maas area. The lower part of this formation comprises dark grey pelites, which pass in the upper part into semi-pelites with calcareous horizons. These pelites are often hornfelsed.

Loughros Formation

This formation is the highest in the Creeslough Succession. The main outcrop is in the Loughros peninsula, but it is also poorly exposed around the southern margin of the Ardara 'granite' and continues northeastwards along the strike to Fintown. The formation consists of a massive white quartzite at Loughros, whereas at Glenties and in the Fintown area it consists of 'quartzitic flags'; this flagginess appears, however, to be essentially due to intensive deformation. Indistinct current bedding can be seen in the quartzite. The top of the Loughros Formation is never seen as it is bounded on its uppermost surface by a low angle thrust.

Kilmacrenun Successii >n

The Kilmacrenan Succession outcrops to the south and southeast of the Creeslough Succession and the junction between the two is the low angle thrust.

The general succession can be seen in the key to Fig. 3. The scattered outcrop pattern of certain members of the Kilmacrenan Succession indicates the structural complexity of the area.

Glencolumbkille Pelites

This is the lowest exposed formation in the Kilmacrenan Succession but its base is not actually seen. The outcrops of the formation are everywhere very broken and fragmented. Small outcrops occur in the Slieve League peninsula, around Monargan Glebe and in a NE-SW strip of country to the northwest of Owenea Lough. From the Owentocker River northeastwards small fault slices occur along the tectonic break between the two major successions, until at Lough Finn a thick belt of pelites outcrops on the north-east shore and extends northeastwards. The Glencolumbkille Pelites are mainly dark graphitic schists with an occasional limestone horizon, but in Central Donegal they consist mainly of calc-silicate rocks and limestones.

Glencolumbkille Limestone

This horizon is not well developed over the whole area and occurs mainly in the Slieve League peninsula and also around Monargan Glebe. The characteristic rock type is a grey-blue limestone, but dolomites and graphitic schists are also present. It is probably partially equivalent to some of the calc-silicate rocks and limestones of Central Donegal.

Port Askaig Tillite (Boulder Bed)

The Port Askaig Tillite is a very distinctive marker horizon within the Kilmacrenan Succession. There are a series of small but widespread outcrops of it in the Slieve League peninsula, along the south coast of Loughros Beg Bay, Monargan Glebe, and at Scraigs, south-east of Fintown. The lower part of the tillite has a fine-grained dolomitic matrix in which are embedded boulders of dolomites and granites The upper part of the tillite has a psammitic matrix with granite boulders. The boulders exhibit a wide range of size, but many are between 6 inches and 1 foot in length. This deposit is characterised by lack of bedding and the irregular and often sparse distribution of boulders. These rocks represent the glacial deposits formed during an ancient ice age.

Slieve Tooey Quartzite

This formation has a large, almost continuous outcrop from the north of the Slieve League peninsula swinging round north-eastwards to Aghla Mountain and on towards Tievedeevan Hill. It also outcrops in folds around Leahan and Slieve League, as small fault wedges along the Leannan Fault, south-east of the Magrath Loughs and in the tight fold south of Croveenanta. The Slieve Tooey Quartzite is a massive white quartzite with current and ripple bedding and is remarkably thick, over 7,000 feet at Aghla Mountain.

Slieve League Formation

This formation was probably not deposited over a large part of this region and is now preserved only in the Slieve League area and in Central Donegal around Croaghhubbrid and Croveenanta. In the south-west, around Slieve League, black and grey pelites and gritty psammites occur, whilst in Central Donegal, near Croveenanta, a thick series of dark pelites passes upwards into coarse grits through an interbanded transition series.

Termon Formation

This formation forms a large part of the Slieve League Peninsula and then swings northeastwards towards Tievereagh. Tts base is marked by a limestone, the Cranford Limestone, which is only occasionally present—its absence being due to non-deposition or tectonic thinning. The limestone occurs south of Aghla Mountain, near Lough Shivnagh in the Glen of Glenties and in the Slieve League area. The Cranford Limestone is a grey marble with some orange-yellow dolomites. The limestone is followed by a series of schists, mainly greenish striped pelitic schists which in their upper part have a development of calc-schists and calcareous psammites. In the north-east of the Kilmacrenan Succession outcrop, a well-marked bed of gritty quartzites, known as the Knockletteragh Grits, is developed in the Termon Schists. In central Donegal the whole formation is represented by "granulites" (highly metamorphosed grits and quartzites) particularly in the Silver Hill area.

Crana Quartzite

Only the Lower Crana (Boheolan) Quartzite is present in this area It outcrops in a narrow, north-south belt west of the Oily River and is limited by faulting in the north and overstep of the Carboniferous in the east. The Quartzite is also preserved in a fault wedge which runs NE-SW through Lough Ea along the Leannan Fault complex. The Lower Crana Quartzite is mainly a fine-grained flaggy quartzite with some semi-pelitic and gritty horizons. In the fault zone it is very brecciated and recrystallised. This is the highest member of the Kilmacrenan Succession exposed in this area.

Metadolerites

The sediments of both the Creeslough and Kilmacrenan Successions were intruded by sills of basic material prior to the deformation and metamorphism. These intrusions are generally concordant with the bedding, although they have frequently been dismembered during the deformation and form tectonic lenticles. In the Glenties Rural District these sills are not as widespread as in other parts of Donegal.

Mineralogically the basic sills are fairly uniform over the area and consisted originally of quartz-dolerite, now oligoclase-amphibole-chlorite-quartz rocks. The dolerite sills have been affected by the regional metamorphism and have also suffered contact metamorphism in the granite aureoles.

Structure and Metamorphism

During the Caledonian orogeny[3] the area has suffered a complex sequence of structural events as well as a regional metamorphism. There were six successive episodes of deformation within the Caledonian orogeny. The folds produced by

• An orogeny spans a long period of geological time and can consist of several phases of movement. Each of the phases may produce different kinds of structures. The earlier structures are often affected by thejlater movements the third and fourth episodes are important since they determine the present strike of the rocks. During the last stage of the structural history, a large number of tear faults, parallel to the strike were developed. The most significant of these is the Leannan Fault. The whole of the sequence of structural events, metamorphism and granitic emplacement was prior to the deposition of the Carboniferous rocks.

Granitic Complexes

After the regional metamorphism and deformation, several high-level granites were emplaced into the rocks of the Creeslough Succession. This resulted in a thermal metamorphism being super-imposed on the regionally metamorphosed country rocks The thermal effects are shown by zoned aureoles with mineral assemblages characterised by sillimanite, garnet, staurolite and andalusite. The main granitic complexes are the Thorr Granodiorite, the Ardara granite, the Rosses Ring Complex and the Main Donegal Granite.

Thorr Granodiorite

The Thorr Granodiorite occupies much of the ground in the north of the Glenties Rural District. This is a variable body of a highly reactive quartz diorite and granodiorite. Over a considerable area it contains numerous orientated rafts of metasediments and metadolerite by means of which original sedimentary horizons can be traced through the complex and correlated with members of the Creeslough Succession. This phenomenon has been referred to as the preservation of a ghost stratigraphy.

Ardara 'Granite[7]

This intrusion outcrops in the flat boggy area lying between Ardara, Maas and Narin. It is a circular body with a rim of foliated tonalite and a core of structureless granodiorite, and was emplaced by forceful injection. The Dalradian metasediments around the granite are contact-metamorphosed to sillimanite and andalusite hornfelses.

Rosses Ring Complex

This complex outcrops in another flat-lying area, the Rosses to the north of Dungloe. It consists of four homogeneous granites emplaced into the Thorr Granodiorite as a consequence of successive subsidences on outward dipping polygonal fractures—a process known as cauldron subsidence. The Thorr Granodiorite with its rafts appears to have suffered no contact metamorphism. Associated with the Rosses Complex is a swarm of porphyritic dykes.

Main Donegal Granite

Part of the Main Granite and the lobe of it known as the Trawenagh Bay Granite outcrop in the central part of Glenties Rural District, around Trawenagh Bay and the Gweebarra Estuary, and extends northeastwards into the Derryveagh Mountains. The Main Granite is the largest and the latest of the granites of north-west Donegal. It is elongated parallel to the trend of the regional structures and stratigraphy and is cross-cutting on a large scale only in the south-west, in the Maas area. It is characterised by a marked heterogeneity, a vertical banding and long trains of rafts.

Its aureole rocks are contact schists similar in mineral composition and structure to regionally metamorphosed rocks. The main rock type shows a broad variation from medium-grained biotite-granodiorite on the south-east side to a coarser-grained granodiorite with variable biotite content and more potash felspar on the north-west side. The granite is perfectly banded parallel to the steep country-rock walls and contains very long trains of country-rock rafts that are aligned with the banding.

The Trawenagh Bay Granite forms a lobe of the Main Granite, yet in its cross-cutting nature and structural and petrographic homogeneity, it contrasts so strongly with the latter that it must have been emplaced in a different way. The Trawenagh Bay Granite is virtually structureless and made up of a simple homogeneous, medium to coarse-grained, biotite adamellite.

At a late stage in the history of the granite, pegmatites, aplites and felsites were intruded. Aplites and felsites are commonly found in the surrounding country rocks.

Appinitic Rocks

These are a suite of minor intrusions characterised by abundant heterogeneous amphibole-rich rocks and the widespread occurrence of associated brecciated metasediments. These intrusions mainly cut the aureole rocks of the Ardara 'Granite' and are thought to be petrogenetically related to the 'granite'. The intrusions include appinitic bosses, a swarm of lamprophyres and several intrusive breccia pipes.

Carboniferous

The western margin of the thick and extensive Donegal syncline outcrops along the valley of the Oily River. Remnants of the Carboniferous rocks also outcrop along the south coast of the Slieve League peninsula. The Lower Carboniferous rocks rest upon the underlying metamorphic rocks with strong unconformity. The rocks consist mainly of thick and coarse basal conglomerates, succeeded by sandstones which pass upwards into arenaceous limestones and calcareous sandstones. The whole sequence, from the base to the outcrops in Bruckless harbour, has a thickness of about 1,200 to 1,300 feet. The coarse and arenaceous aspect of the sediments is indicative of proximity to the Carboniferous shoreline. Such sediments probably represent beach conglomerates and deltaic sands which pass laterally southwards or upwards into shallow-water reef limestones.

Tertiary Dykes

Basaltic dykes of Tertiary age cross-cut all the rocks in Donegal. They belong to a north-west swarm of dykes which appears to be centred on the Barnesmore Granite Complex.

The Tertiary dykes are thus the youngest rocks of the Glenties Rural District, but since then the area has suffered a long geomorphological history including the effects of the Quaternary glaciation.

Geomorphology

The sculpturing of the Irish topography was essentially a Tertiary event which was to be modified by the Quaternary glaciation.

The trend of the Dalradian metasediniients and the main mass of granite produces a marked grain in the topography. This influences the direction of many important streams, although their detail in granitic terrains is often controlled by the regional joint pattern. In contrast to this, many of the chief river systems drain eastwards or westwards right across the geological grain and the main watershed runs roughly north to south not far inland from the west coast (Dury, 1959). Superposition of drainage has undoubtedly occurred and Dury (1959) has discussed the possibility of a former Cretaceous or Tertiary cover which was upwarped during Tertiary times. On this were initiated the major consequents (including the Finn River).

High summit surfaces just above 1,000 feet may represent remnants of old land surface which was worn down by the consequents and cut through during the rejuvenation brought about by the warping. There are more distinct remnants of another level at about 800 feet. But the most obvious peneplain is that developed along the coast as in the Rosses where there are wide areas at a height of about 200 feet. The rivers are graded to this level and exhibit marked knick-points below which there are entrenchments, as for example on the Gweedore and Clady rivers. This 200 feet surface rises inland to a very distinct break of slope at approximately 450 feet. All these pre-glacial erosion surfaces are well known in Ireland; the two lower are thought to be of mid-Tertiary and Pliocene ages respectively.

Within the Glenties District the highly indented coastline with its steep cliffs and headlands is still undergoing active erosion and there is, therefore, little trace of the low-lying raised beaches which are so common elsewhere in the north of Ireland and in Scotland. What can occasionally be seen is the evidence of recent submergence shown by the occurrence of submerged peats at the head of some inlets.

Many obvious features of the landscape are due to the glaciation. From the extremely clear evidence of ice-movement provided by striae, roches moutonees, drumlins and erratic trains and from the distribution of corries, U-valleys and moraines, Charlesworth (1924 and 1963) has compiled a picture of ice moving radially from a source situated high on the main part of the watershed in the Blue Stack Mountains. This centre of accumulation was perhaps the most powerful of the gathering grounds for the local ice-sheet which covered Ireland and prevented the Scottish ice-cap from advancing further than north-east Ireland. At the glacial maximum the Slieve League peninsula formed a second centre of dispersal developing a local ice-cap thick enough to remain independent of the Central Donegal ice, except in the east where some over-riding by the main mass occurred (Dury, 1964).

As Dury has shown, one result of this main phase of glaciation was the breaching of the old watershed by the backward erosion of corrie heads. Another result was the scouring of deep U-valleys along the fault zones *(e.g.,* Glengesh). The mountains which occupied the focal position in this ice centre were scraped bare of overburden, but the valleys were filled with debris. In these the withdrawal of the glacier front can be traced back into the corries through a succession of crescent-shaped moraines as in the Glen of Glenties. Yet another result was the local diversion of drainage leading to some rivers cutting new post-glacial gorges such as that occupied by the Shallogan River at Glenties.

Within the area of the Glenties Rural District the drift deposits seldom assume the character of a true boulder clay since the argillaceous material necessary for the formation of a clayey matrix is not available in any quantity: any such matrix has, to a very great extent, to be formed by the breaking down of the softer schists, the only large area of which occupies the plateau of Glencolumbkille. Thus throughout much of the District the stony element predominates and, indeed, on hill-slopes the drift is a mere boulder accumulation forming a characteristically hummocky surface as is obvious between Doochary and Dungloe. Such stony drifts, if not providing good soils, have at least the advantage of increasing the surface drainage.

The thickness of these deposits is very variable as might be expected of a veneer covering an irregular rocky surface. For this reason the boundaries against solid rock are very difficult to define on maps though in the held the best indication of the junction between a valley-fill and the solid rock is a marked change of slope. All in all the drift boundaries shown on the original 1-inch geological maps of the area very fairly represent the distribution of the main drift spreads.

Sometimes the drift is locally moulded into drumlins as between Glenties and Ardara, also in the valley above Killybegs and in Glencolumbkille. Such drumlins often form isolated hills supporting good farm land as, for example, on Loughros, at Tullymore and Tullybeg near Ardara, and at Dungloe. Occasionally the drift takes the form of water-sorted gravels representing the outwash deposits associated with terminal moraines. Such gravels are well displayed at the head of Lough Finn where they have been extensively worked for road metal and building material: other examples are the several terminal moraines located in the Glen of Glenties.

In the shallow hollows peats have formed; here underneath the peat it is sometimes possible to find a thin brown mineral soil layer with roots of *Firms sylvestris.* On the hill slopes the peats are obviously suffering erosion whilst on the lower rock platforms man has all but removed them for fuel, especially in the Rosses.

The sandy morainic material largely derived from the granitic rocks has provided the wind-blown material forming the extensive areas of dunes as around the bays of Loughros Beg, Loughros More and Gweebarra.

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The 1-inch O.S. geology sheets (No. 9, 15, 16, 23 and 24) of the 1890s are useful drift sheets. Although the geology has been greatly revised since then, the drift and peat distributions are still accurate

SOILS

by
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Introduction

A detailed reconnaissance survey of the soils was begun in May, 1965, and completed in August, 1966. Soil boundaries were mapped in the field at a scale of 6 inches to 1 mile (1 :10,560): a reduction to a scale of 1 inch to 1 mile (1:63,360) is made for the published map with this report.

The area covers 411 square miles. Organic soils (mostly unreclaimed peats) occupy roughly 63% of the area, mineral soils 13% and organic-mineral soil complexes 22%. Lakes occupy 2% of the area. These figures are calculated from the mapping units as delineated on the 6 inch to 1 mile O.S base sheets used in the field. Bedrock outcrop is a distinct feature of the region limiting the use-range even of the better soils.

In terms of soil suitability for agriculture including forestry, some 3% of the soils have a moderately wide use-range; these are moderately to poorly suitable for tillage and meadowing, moderately suitable for intensive pasturing and generally suitable for forestry. Ninety per cent of the soils have a limited to extremely limited use-range; these are very poorly suitable or mostly unsuitable for tillage and meadowing, mostly poorly suitable to unsuitable for intensive pasturing and largely of poor suitability for general grazing or forestry. A further 3 to 4% are of intermediate quality. The remainder of the area comprises sand dunes (1%) and lakes (2%).

The Soil Map Legend

The paucity and localised occurrence of mineral soils necessitated a different legend from that normally used in similar surveys.

The nature of the area suggested broad topographic units as primary divisions. These were defined as; lowlands, which included drumlins and coastal sands as subdivisions; highlands; and valley floors. The 400 feet O.D. contour was accepted as the division between the lowland and the highland areas. Only 1.8% of the mineral soils (consisting of humic gleys and peaty podzols) occur above this level. Furthermore, habitation, except in isolated pockets, does not normally occur above this level. The valley floor soils are dealt with separately as they occur both above and below the 400 feet contour.

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The soils of each topographic unit, were, as far as possible, divided into three major categories—mineral soils, organic soils and organic-mineral complexes. Three further subdivisions were necessary because of the extent of bedrock exposure and were based on the relative proportion of exposure: (i) less than 2% rock, (ii) 2 to 10% rock and (Hi) over 10% rock. Any further subdivision on this basis was found to be meaningless as very little soil was present in usable form when bedrock occupied more than 10% of a soil unit. The proportions of the survey area which are occupied by each category of bedrock exposure are (i) 71.8%, (ii) 23.5% and (iii) 4.7% respectively.

Soil Formation

Soil formation is the process by which geological parent materials, subjected to the action of natural forces and living organisms, are transformed over time into soils. The rate at which this process takes place and the character of the resultant soil depend largely on the nature of the parent materials and the environmental conditioning factors involved. In the course of this transformation various chemical, physical and biological changes take place so that the resultant soil, as an end-product, is a distinctly different natural body from the parent material. Primary minerals are decomposed with weathering and secondary minerals formed. Some of the decomposition products are translocated to lower depths or lost entirely, principally by drainage waters. The accumulation of organic matter follows the advent of life in the form of soil flora and fauna. Thus a living body is added to the mineral skeletal mass and a true soil is formed. When mature the soil possesses both inherited and acquired characteristics. Therefore, the nature of the parent material is an important factor governing the character of the resulting soil, but of major significance also are the factors of climate, vegetation, relief and time which determine the nature and intensity of the processes by which the inert parent material is developed into a dynamic soil.

Mapping the Soils

In mapping the distribution of soils in any area, they can be classified, on a broad scale, into Great Soil Groups. Each Great Soil Group is comprised of soils having a number of important profile characteristics in common. A certain latitude in profile variation is allowable at this level of classification, but the degree of similarity, nevertheless, is of quite a high order, especially with regard to land-use possibilities. A single Great Soil Group may not be confined to a particular geological parent material, as the basic criteria for classifying the soils at this level are the characteristics of the profile.

Practically all the mineral soils in the area are classified on the basis of Great Soil Groups and the following were identified—Brown Earths, Brown Podzolics, Podzols, Gleys, Regosols and Lithosols. Vast areas of organic soils or peats were also mapped. A description of each mapped category is contained in the following pages. One complex of mineral soils—the Killybegs Complex—was recognised and mapped; here the pattern of distribution was too intricate to separate the individual soils on the scale of mapping employed.

Profiles were examined and sampled for analyses to help identify the various soils and to assess their use-suitability. However, limited time and manpower prevented the examination in detail for minor variations in soil character related to differences in parent materials and other factors, so the results described in the following pages must be treated in this light.

Depth phases, cultivated areas and areas of severe erosion were mapped in the organic soil regions.

The Lowland Soils

These soils occur between sea-level and 400 feet O.D. and excluding lakes they occupy 49.32% (129,755 acres) of the Glenties Rural District. Soils associated with drumlins are included with the mineral soils in this broad division, but are described and discussed separately because of the distinct topography of the drumlins. The coastal sands are treated separately also because of their particular character. Table 5 summarises the acreage and proportion of the three major soil categories occupying the 'Lowland' and the acreage of bedrock exposure associated with the soil categories.

TABLE 5—Acreage and proportion of each major soil category and the acreage of associated rock outcrop.

Major soil category	Total acreage	Percentage of Glenties Rural District	Percentage of Lowland area	Rock outcrop (acres) <2% rock	Rock outcrop (acres) 2-10% rock	Rock outcrop (acres) >io% rock
Mineral	29,241	11.12	22-5	22,671	5,174	1,396
Organic	69,799	26-53	53-8	51,871	17,316	612
Organic-mineral complex	30,715	11-67	23-7	8,237	13,960	8,518

Provided other soil and land-form conditions are favourable, tillage operations are feasible on these mineral soil areas where bedrock exposure is less than 2%. Bedrock exposures in the organic soils and in the organic-mineral complexes are generally too closely spaced to permit extensive mechanised cultivation. However, tracts of the organic soils, especially, could be used for improved pasture and to a lesser extent for meadowing since rock outcrop of 2% or less is common over a high proportion of the category (Table 5).

Apart from rock outcrops the broken nature of the topography and the many, short, steep slopes, the shallow soils and the adverse climatic factors—especially high precipitation and exposure to severe winds—are further natural obstacles to the agricultural development of these soils.

A breakdown of the three major soil categories—mineral soils, organic soils and organic-mineral complex soils follows.

Mineral Soils

Brown Earth Group (Soil I on Map)

The Brown Earths are relatively mature, well-drained, mineral soils possessing a rather uniform profile, with little differentiation into horizons. It follows, therefore, that these soils have not been too extensively leached or degraded, with the result that there are no obvious signs in the profile of removal and deposition of components such as iron oxides, humus or clay. However, in many cases, some leaching has occurred, resulting in the translocation of soluble constituents notably carbonates of calcium and magnesium.

Some Brown Earths are derived from parent materials poor in lime (or other base-rich components) and are, therefore, inherently acid; these are called Acid Brown Earths or Brown Earths of low base status. Others have developed on lime-rich parent materials, are less acid or may even be alkaline, and are distinguished as Brown Earths of high base status. An intermediate sub-group classified as Brown Earths of medium base status can also be distinguished. These and the Brown Earths of low base status can develop also on lime-rich parent materials under conditions conducive to excessive depletion of bases.

Brown Earths normally possess medium textures (sandy loam, loam, sandy clay loam), and desirable structure and drainage characteristics, and a high degree of friability. They are generally good arable soils. Although normally of rather low nutrient status in their natural state, they respond well to manurial amendments. With good management, they constitute high-quality tillage and grassland soils and are also ideally suitable for a wide range of forest tree species.

Occurrence and character: These soils occupy 1,031 acres or 0.39% of the survey area. Bedrock exposure of 2 to 10% is common to almost half of this soil area and soil depth between the rock outcrops rarely exceeds 20 cm. The soils occur mainly in the vicinity of Portnoo and on the hill immediately west of it. They also occur south of Portnoo on the northern and eastern shores of Kiltooris Lough and again in Glencolumbkille. Areas too small to be mapped on the scale employed occur on the south-facing slopes of Glencolumbkille valley. Limestone, schist and basalt bedrocks and shallow glacial drift derived from these sources form the soil parent materials.

These soils are well drained, of sandy loam texture, and of low base status. The profile consists of a dark-brown to dark, yellowish-brown, friable surface or A horizon over a dark-brown sub-surface (B) horizon. The surface horizon contains 9% clay, 3% organic matter and has a strong, medium granular structure. The depth of this horizon varies considerably due to the broken topography and bedrock exposures but it is an average of 10 cm deep on flattish areas and often twice that depth on sloping areas. The (B) horizon is normally twice as thick as the A horizon but its thickness is subject to the same variations as the A horizon.

Root development is good throughout the profile. Some of these soils, especially those developed over limestone bedrock, have a darker profile and are somewhat higher in organic matter content.

A detailed description and some analytical data for a representative soil profile are given in Appendix 1, Table 1.

Suitability; The broken landscape, with many slopes ranging from 10° to 15° restricts the use-range of these soils. The sloping areas, where soil collects due to colluvial processes, are fragmented by bedrock exposures and seldom permit mechanised cultivation. The flatter areas are also largely unsuited to mechanised operations because of shallow soils and proximity of bedrock to the surface in many places.

Being medium-textured, free draining, friable and well structured, these soils are, however, well suited to grassland farming, with limited areas suitable for arable farming The natural nutrient status is low and regular applications of fertilisers are required for optimum returns. Frequent liming is also necessary to maintain satisfactory pH values except in the vicinity of Portnoo where the soils are affected by aeolian (wind-blown) calcareous sands. With adequate attention to manuring and good management, these can be highly productive grassland soils capable of being grazed over a long season.

Brown Podzolic Group (Soil 2 on Map)

The Brown Podzolics are a more intensely leached version of the Brown Earths and as such, the upper horizons of the soil are more depleted of bases and other constituents. A characteristic feature of these soils is a sub-surface horizon of strong red-brown or yellowish-brown colour due to enrichment, principally by iron oxides leached from the upper horizons. They are more degraded generally and of a more acid nature than the Brown Earths.

Although the Brown Podzolics are more leached and of lower natural nutrient status than the Brown Earths, they are still fairly similar in behaviour and productive capacity. On account of their desirable texture, structure, drainage and friability, the Brown Podzolics are considered highly suitable for cultivated cropping except where they are too shallow or occur on excessively steep slopes. Although poor in natural nutrient and lime status, they respond well to manurial amendments. Highly productive short-term leys can be obtained within the crop rotation, when manuring and management are satisfactory. Like the Brown Earths, they are ideal forest soils under Irish climatic conditions.

Occurrence and character: These soils occupy 4,413 acres or 1.68% of the survey area. Areas with 2 to 10% bedrock exposure occupy 1,020 acres and areas with over 10% occupy 350 acres.

The soils of this group occur on the valley-sides of the Gweebarra River and also on both banks of its estuary in the vicinity of Lettermacaward and Maas. Other localities which contain limited areas of these soils—often too small to be indicated on the soil map)—are the valley sides of the River Owenea Upper, near the mouth of Glencolumbkille valley; immediately south of the Ardara drumlins; the eastern shores of Teelin Bay; the head of Tawny Bay; in the vicinity of Croaghmuckros and Fintragh and north and west of Killybegs.

Parent materials in the Gweebarra River area consist of compact glacial drift of mixed quartzite. diorite and granite origin and in the extreme south the drift is of mixed mica-schist, gneiss and carboniferous conglomerate and limestone origin.

These soils are well drained, have a slightly gravelly, sandy loam texture and are of low base status. The profile consists of a dark-brown to dark-yellowish brown, firm surface or A horizon overlying a brown to dark-brown, friable sub-surface or Bs horizon[4]. The latter horizon shows an increase in iron and aluminium

* Bs=Sesquioxide B. Significant accumulation of either iron or aluminium oxides or both

Plate 1 – Brown Podzolics and organic-mineral soil complexes with 2 to 10% bedrock exposure – typical of south coast of West Donegal.

oxides over the A horizon. The A horizon contains 8% clay, 6% organic matter and has a strong, medium granular structure. Gleying occurs beneath the Bs horizon as evidenced by the many, distinct, yellowish-red mottles. Solum depth—A and B horizons together—averages 60 cm but, as in the Brown Earths, compound slopes, many ranging from 10 to 15° and some as steep as 20°, cause a wide variation in soil depth. Root development is good throughout the profile.

A detailed description and some analytical data for a representative soil profile are given in Appendix 1, Table 2.

Suitability: These soils have a moderately wide use-range. Because of their desirable texture, structure, friability and drainage conditions they are easily tilled but in many cases factors such as slope and rock outcrop are major deterrents. More extensive areas of these soils than of the previous brown earth group are cultivable, mainly in the Lettermacaward area and in the Gweebarra river valley. Although these soils could produce a wide variety of root and cereal crops exposure is prohibitive in many cases and the greater part of the area occupied by these soils is unsuited topographically to mechanised cultivation.

In their natural state, these soils have a low pH and nutrient status, but they respond well to regular application of lime and fertilisers. High levels of aluminium, 220 parts per million in the surface horizon, and 420 in the subsurface horizon, were recorded in the profile in Lettermacaward. These high levels, unless lime is applied, nullify the beneficial effects of phosphorous fertilisers. The soils have a good potential for pasture production and in parts for meadowing. Unless adequately manured and managed, however, the more valuable sown species in the sward are rapidly displaced by indigenous grasses and weeds.

Podzol Group {Soil 3 on Map)

These soils are more intensely leached than the Brown Podzolics. They display well-defined horizons of depletion and accumulation within the profile and are considered to be degraded soils. They develop from parent materials of very low base reserves or under conditions which deplete the base reserves to a low level. The mountains of granite or other "acid" formations for instance provide a situation in which both of these factors operate; with the acid nature of the geological parent materials together with the high rainfall, considerable leaching of soil constituents, principally bases, iron and aluminium oxides, and humus takes place. In more advanced deterioration, the surface becomes very acid, the environment for decomposition by micro-organisms becomes unfavourable, and a peat-like layer accumulates on the surface, on which heath-t\pe vegetation develops.

Podzols are generally poor soils with high lime and fertiliser requirements. In their unreclaimed state they usually have a cover of semi-natural vegetation. In lowland areas, they have been successfully reclaimed for cultivated cropping and other purposes, but unless management is good they revert easily. The more extreme forms, which occupy hill and mountain areas throughout the county, have not been ameliorated to any extent. In most cases the nature of the terrain associated with these soils is such that mechanical reclamation and cultivation are not feasible. Here they are devoted mostly to rough grazing or forestry. Considerable improvement in stock-carrying capacity is possible by surface regeneration of the rough grazing, through manuring and improved management.

Where an ironpan occurs within the profile, it hinders root penetration (an important factor in forestry and in the agricultural use of these soils) and water percolation. For the latter reason drainage in the surface horizons may be ver\ poor—a further unfavourable feature of many of the Podzols. Besides having a low level of major nutrients, these soils are usually very deficient in trace elements.

Podzols are the most widely available mineral soils for afforestation in the country and are usually planted with pines *{Finns* spp.). However, with deep ploughing and the application of phosphorous fertiliser in particular, they can support other species, such as sitka spruce *(Picea sitchensis)* with relative success.

Occurrence and character: These soils occupy 2,951 acres or 1.12% of the survey area. Areas with 2 to 10% bedrock exposure occupy 760 acres and areas with over 10% occupy 34 acres. These soils occur mainly in Dooey (north-west of Lettermacaward), in the Gweebarra river valley, in the vicinity of Maas, on the southern valley side of the River Owenea Upper and on the Loughros peninsula. Parent materials consist of bedrock, mainly schist, and of glacial drift mainly of mixed granite, quartzite. schist and gneiss origin.

These soils are imperfectly drained. They are moderately well structured and have a loamy fine sand texture in the surface or A horizon, grading to a gravelly sandy loam texture, with many schist fragments, in the sub-surface B horizon.

The profile consists of a very dark-grey, friable A1[5] horizon over a slightly greyer firm A2[5] horizon. Iron and aluminium oxides have been leached from the latter and deposited in the underlying Bs horizon. There is also evidence of clay movement in that there is an obvious increase from 4% clay in the A2 to 9% in the Bs. The surface horizon contains 6% clay, 7% organic matter and has a moderate, fine, sub-angular blocky structure. Solum depth averages 60 cm and root development is good throughout.

A detailed description and some analytical data for a representative soil profile are given in Appendix 1, Table 3.

Suitability: These soils have a somewhat limited use-range. As a result of podzolisation, the\ are degraded soils with very low native lime and nutrient status. Where influenced by wind-blown calcareous sands, as in Ballincrick, pH values of 6.0 and over have been recorded. Manganese levels are low so that crops on these soils are predisposed to manganese deficiency whilst low cobalt levels will adversely affect the thrift and health of sheep and to a lesser extent of cattle.

With the addition of lime and fertilisers and with good management, satisfactory yields of oats and barley and of most root crops are possible, other factors, *e.g.,* exposure, permitting. However, with many slopes averaging 20° and with rock outcrop in places, the cultivable areas are severely restricted. Worthwhile pasture production is possible on these soils, but a high management level is required to maintain a productive sward against strong reversion tendencies.

Gley Group (Soil 4 on Map)

Gleys are soils in which the effects of drainage impedance dominate and which have developed under conditions of permanent or intermittent water-logging. The impeded condition may be caused by a high water-table or by a 'perched' water-table due to the relatively impervious nature of the soils and their parent materials and, in many cases, by both of these factors, together with excess run-off from higher slopes. For this reason, gley soils can occur both in depressions and on elevated sites.

Where the gley condition results from a high water-table, the soils are referred to as ground-water Gleys. Where it is due to the impermeable nature of the soils or of their parent material, or to run-off from higher slopes, the soils are usually referred to as surface-water Gle\s.

The mineral horizons of Gleys are usually grey (or bluish-grey, in more extreme cases), with distinct ochreous mottling much in evidence. Relative to the podzolied soil groups, depletion of bases and other constituents is not so pronounced. However, rooting area is limited, aeration poor, rate of decomposition of organic matter slow, and many other unfavourable features prevail.

Podzolised Gleys are soils in which there is evidence of a soil formation process similar to that described for Brown Podzolics or Podzols associated with the Gleys, whilst Podzolic Gleys refer to soils displaying evidence of grey-brown podzolic characteristics associated with the Gley.

The majority of gle\ soils have weak structure, are not very friable and, in the wet state, tend to become very sticky. Due to their poor physical properties, these soils, except in very favourable seasons, present difficulties in cultivation, especially

[5] Subdivisions of the surface or A horizon based mainly on degree of leaching

in the development of a desirable tilth. The poor drainage conditions retard growth in the spring. Even for pasture production, this is a decided disadvantage. Besides poor drainage, the characteristic weak structure renders these soils susceptible to poaching damage by grazing stock, a factor which curtails the length of grazing season and the proportion of fodder utilised. Despite their physical shortcomings, however, the potential of these soils for pasture production is high in many cases, provided management and manuring are satisfactory.

Gleys are generally considered to be relatively productive forest soils. However, windthrow caused by poor root penetration is a common hazard.

Occurrence and character: These soils occupy 5,400 acres or 2.05",, of the survey area. Areas with 2 to 10% bedrock exposure occupy 384 acres and areas with over 10% occupy 86 acres. These soils occur mainly on the northern and southern sides of Glencolumbkille valley, along the coast between Largymore and Fintragh, immediately west of Killybegs, in the lower Stragar valley and south of Ardara near the mouth of the Glengesh valley. Parent materials consist of glacial drift, mainly of schist and gneiss origin, but also of mixed igneous and metamorphic rock composition as in the vicinity of Ardara. Most slopes occupied by these soils are under 12°.

These are poorly-drained, badly-aerated soils with a high surface organic matter content. The profile consists of a loam textured, very dark greyish-brown, firm to slightly plastic surface A horizon over subsurface horizons that are more coarse-textured but compact. The depth of the surface horizon averages 50 cm but rooting is confined mainly to the upper 25 cm. Many prominent yellowish-red, iron mottles are present throughout the profile and the structure varies from moderate, medium sub-angular blocky in the surface horizon to massive lower down. The clay content of the surface horizon is 12% and the organic matter content 13%.

A detailed description and some analytical data for a representative soil profile are given in Appendix 1, Table 4.

Suitability: These soils have a somewhat limited use-range. They are largely unsuited to tillage. Dense rush infestation is a constant problem in pastures. When drained and adequately manured, however, high outputs of grass can be obtained, but a very high standard of management is required, to prevent poaching and to ensure optimum utilisation of the sward.

Reclaimed Peat Sub-Soils (Soil 5 on Map)

In some places throughout the Glenties Rural District peat cutting for domestic consumption has been sufficiently intensive to expose the underlying glacial drift. This drift is now being cultivated but in most cases a shallow layer of peat has been intermixed with the uppermost mineral layers.

Occurrence and character: These soils occupy 4,635 acres or 1.76% of the survey area. Areas with 2 to 10% bedrock exposure occupy 392 acres and areas with over 10% occupy 209 acres. The soils are found mainly in the vicinity of Glenties, in the Owentocker valley, at the eastern end of Glencolumbkille valley, at Malin More and Malin Beg and in the Glen and Ballaghdoo river valleys. The drift materials are mainly of granite, quartzite and schist composition around Glenties and Ardara and of schist, gneiss and quartzite composition further south. Most slopes occupied by these soils are under 10°. The profile consists of a black, firm surface Ap horizon overlying a greyish-brown, firm B horizon. Texture varies from turfy[6], sandy loam in the Ap horizon to sandy loam in the B horizon and structure from moderate fine, sub-angular blocky to structureless and massive. The surface horizon has 9% organic matter. The average depth of the solum is 40 cm. Rooting is good throughout.

A detailed description and some analytical data for a representative soil profile are given in Appendix 1, Table 5.

Suitability: Poor natural drainage conditions limit the use-range of these soils in some places, but with proper management they are moderate to good grassland soils. Cultivation is more feasible where the underlying drift is of a less compact nature. Properly manured and well-managed, these soils can produce satisfactory-yields of oats and barley and of most root crops and vegetables, especially potatoes and celery. A feature of these soils is the high aluminium level, 325 to 360 parts per million, which adversely influences the uptake of phosphorus from the soil. Therefore, frequent dressings of phosphorus are a prerequisite to sustained production.

Mineral Soils—modified by man (Arranmore Island—Soil 6 on Map)

Occurrence and character: These soils occupy 1,313 acres or 0.5% of the entire survey area. Areas with 2 to 10% bedrock exposure occupy 677 acres and areas with over 10% occupy 38 acres. The soils occur on the eastern and southern shores of Arranmore Island and are developed on compact glacial drift of granite, mica-schist and quartzite composition. Many slopes range from 15 to 20°.

Inherent drainage conditions are moderately good and the natural profile character is that of a humus podzol (see Podzol Group p. 26). The surface Al horizon, which has been very much influenced by man, consists of a black, friable, loamy coarse sand overlying a friable dark-brown A2 horizon of similar texture. The Al horizon has 3% clay, and 8.5% organic matter. The structure is moderate fine to medium sub-angular blocky. Beneath the A2 lies a B horizon of accumulation of humus and of iron and aluminium oxides. The profile is gravelly throughout and roots penetrate to an average depth of 50 cm. The A horizon attains an average depth of 40 cm.

A detailed description and some analytical data for a representative soil profile are given in Appendix 1, Table 6.

Suitability: These soils have a limited use-range mainly because of their occurrence on moderately steep slopes. A ridge system of cultivation is practised on the island. Sea-weed, sea-sand and sea-shells have been added as manurial amendments to these soils. Peat-dust, which is widely used as bedding for cows, has also been added in the form of farmyard manure.

With adequate manuring and proper management, good pasture production and an extended grazing season are possible on these soils. Mechanised cultivation is possible only on very restricted areas and here good yields of grass, potatoes and vegetables are possible.

Killybegs Complex (Soil 7 on Map)

Occurrence and character: The Killybegs complex is the only mineral soil complex mapped within the survey area. It occupies 1,804 acres or 0.69% of the entire

• The word 'turfy' is used as an adjective on the textural class name for horizons of mineral soils that contain 15 % or more of partially decomposed organic matter area. Areas with 2 to 10% bedrock exposure occupy 686 acres. The soils of this complex consist of Brown Earths, Brown Podzolics and Gleys (each of these soils is described earlier) and they occur mainly on the peninsulas which flank Killybegs Harbour on the east and west. Parent materials consist mainly of schist and gneiss bedrock.

Natural drainage is variable and surface textures are mostly sandy loams. Soil depth is greatly influenced by topograph)—in some places it is no more than skeletal whereas in more favourable situations depth varies from 10 to 20 cm. Many slopes, especially in the areas of fairly extensive rock outcrop, vary between 18 and 30° while in other areas they are mostly under 12°.

Suitability: These soils are generally unsuited to mechanised farming. Liming, manuring and good management can greatly increase pasture production on these soils but manurial application, except by hand or by air transport, would be very difficult.

Podzols of the Drumlins {Soils 8 on Map)

Occurrence and character: These soils occupy 554 acres or 0.21 '•'„ of the entire survey area. They occur mainly on the Ardara drumlins and on some drumlins in the vicinity of Killybegs. Parent material consists of gravelly glacial drift of quartzite, granite, diorite and schist composition.

The general nature of the Podzol Group is described on page 26. The profile in this case consists of a dark-brown, friable, surface horizon (subdivided into an All and an A12) over a light brownish-grey friable A2 horizon. Underlying the latter horizon and at an average depth of 50 cm is a brittle, wavy iron-pan about 1 cm thick and under this a yellowish-red Bs horizon enriched in aluminium and iron oxides and organic matter. The soil has a gravelly, sandy loam texture throughout and a structure varying from strong, fine sub-angular blocky in the Al to massive in the A2, and to moderate, fine sub-angular blocky in the Bs horizon. The surface horizon contains 12 cla\ and 7.4% organic matter.

A detailed description and some analytical data for a representative soil profile are given in Appendix 1, Table 7.

Suitability: These soils have a somewhat limited use-range. The degree of podzolisation is not extreme and the discontinuous iron-pan allows root penetration into the lower B horizon. Much of the area occupied by these soils lends itself readily to mechanised cultivation. These soils have a high cation exchange capacity and respond well to fertilisers. With manuring and good management, which involves deep ploughing to prevent the iron-pan from intensifying, satisfactory yields of oats and root crops can be obtained. These are also good grassland soils and with proper management can provide high yields of grass over a long grazing season.

Gleys of the Drumlins (Soil 9 on Map)

Occurrence and character: These soils occupy 1.069 acres or 0.41% of the survey area. They occur mainly on the drumlins in the vicinity of Killybegs and in the lower Stragar valley and, to a lesser extent, near Ardara. The parent material is glacial drift of predominantly mica-schist origin but with some quartzite, gneiss and granite admixture.

The general nature of the Gleys is described on page 27. The profile in this case consists of a firm, dark-brown surface A horizon overlying a firm, dark greyish-brown ACg horizon. Both horizons show signs of gleying. The structure varies from moderate, medium sub-angular blocky in the A horizon to weak, medium angular blocky in the ACg horizon. Underlying these horizons is the strongly gleyed parent material. The A horizon has a gravelly loam texture and an average depth of 10 cm. The percentage clay and organic matter of the A horizon are 7 and 12.5 respectively. Rooting is confined mainly to the surface 15 cm. Low levels of copper were recorded in the soil profile examined; this ma\ be important in crop and animal nutrition.

A detailed description and some analytical data for a representative soil profile are given in Appendix 1, Table 8.

Suitability: These soils have a limited use-range due mainly to poor drainage and structure. They are generally not suited to arable cropping. With adequate manuring, they can be highly productive for grazing and hay, but careful management is required to ensure maximum utilisation of the grass and to prevent poaching and rush infestation

Organic Soils or Peats

Peats are soils of a highly organic nature and are usually separated on the basis of characteristics related to their mode of formation. When successfully ameliorated they can become highly productive.

Deep Blanket Peat (Soil 10 on Map)

Occurrence and character: Peat of this nature covers 60,666 acres or 23.06% of the survey area. Areas with 2 to 10% bedrock exposure occupy 14,330 of these acres and areas with over 10% occupy 333 acres. The largest expanse occurs from the Gweebarra River north to the Rosses; here bedrock exposure is a particular feature (Plate 2). A large expanse of peat also exists west of Glenties; Bord na Mona are harvesting turf on the latter bog.

Some vegetation differences were observed on the lowland peats; these would be important in surface regeneration of the sward. A wider range of species was found on peat formed over glacial drift of mixed igneous-metamorphic composition or over mica-schist bedrock than on that formed over granite. In the former case, *Molinia, Tricophorum, Eriophorutn* spp., *Rhyncospera, Drosera* spp., *Erica* spp., *Cladonia* spp., *Calluna. Narthecium, Polygala, Potentilla* and *Sphagnum* spp. are very common, while in the latter case, the vegetation is markedly dominated by *Molinia* with some *Narthecium, Tricophorum* and *Eriophorutn* spp. Besides, the peat developed over glacial drift of the mixed geological composition or over mica-schist bedrock is in general wetter than that over granite.

Suitability: These organic soils are mainh suited to rough pasture for sheep grazing. Manuring and surface-seeding would improve the grazing generally and render the limited amount of drier, flat, rock-free peat suitable for meadowing. Particular attention to grazing management would be necessary to prevent erosion on the steeper slopes as peat decomposes more rapidly under such improvement measures.

Plate 2 - Soils in the Rosses. Deep blanket peat (soil 10) in foreground, organic-mineral soil complexs (soil 14) in background.

Cultivated Peats (Soil 11 on Map)

Occurrence and character: Cultivated peats occupy 8,783 acres or 3.34% of the survey area. Areas with 2 to 10% bedrock exposure occupy 2,986 acres and those with over 10% occupy 279 acres. These areas occur on the periphery of the peat expanses, especially around Dungloe and on the peninsula which terminates in Crohy Head. They have been ameliorated for agricultural purposes by various methods over the years; the surface horizon is now partly mineralised.

The profile consists of a black, friable surface horizon with a moderate, medium crumb structure, overlying a very dark-brown to black horizon containing fragments of undecomposed wood. Fibres form about 5% of the total mass of the modified surface horizon and about 75% of the total mass of the underlying horizon. The surface horizon, which has an average depth of 12 cm and to which rooting is confined, showed a loss of 59.2% on ignition (indicating a high organic content).

Suitability: Where successfully ameliorated and under good management, high yields of potatoes and vegetables can be produced on these soils. Although copper deficiency would normally be expected in these soils, a level of 41.25 ppm (probably due to contamination, *e.g.,* use of copper-base potato sprays) was recorded in the surface horizon of the profile examined. The underlying horizons have levels of only 2.5 ppm. A very low cobalt level (0.2 ppm) was also recorded and this is

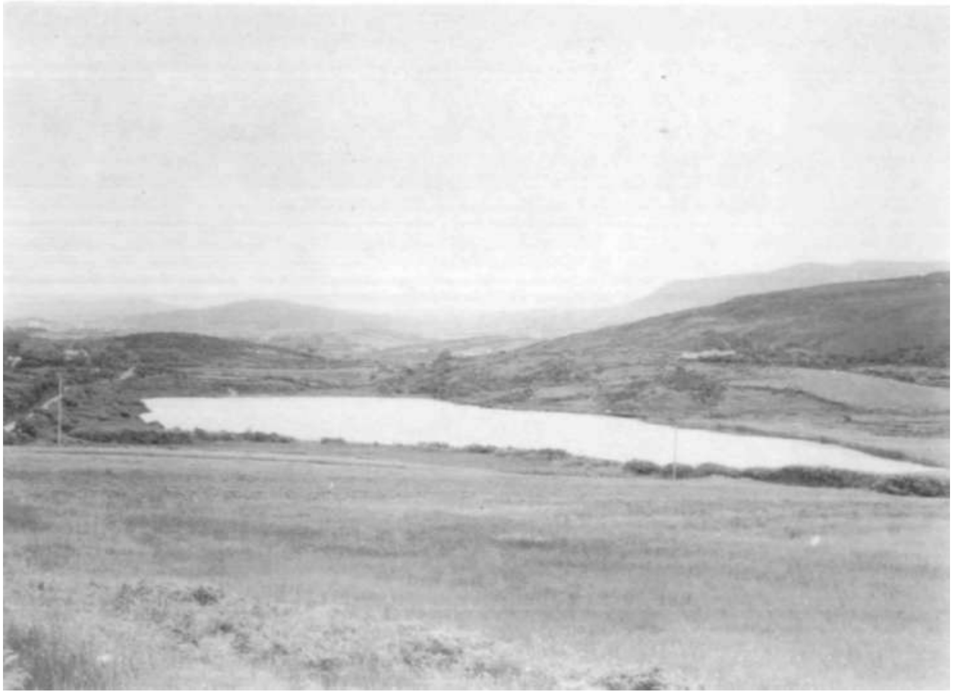

Plate 3 - Cultivated peat in near foreground with Ardara drumlin 'swarm' in middle distance.

a highly important factor in the health of ruminants, particularly sheep which suffer from pine disease where cobalt intake from the grazing is inadequate. Productive grassland can be developed on these soils but a high level of management is required to utilise the sward fully and to prevent poaching and rush infestation.

Eroding Peat (Soil 12 on Map)

Occurrence and character: Much of the lowland peat has been affected by some surface erosion but onl\ a ver> small area—\9 acres in the upper Glen river valley—has undergone severe erosion. The erosion here was probably initiated by uncontrolled grazing of sheep and cattle and subsequently intensified by gully erosion conditioned by the impact of the high rainfall. Erosion is always a hazard on these peats unless precautions are taken to prevent it; it is much more extensive on the upland peats.

Suitability: It is possible to reclaim these areas by levelling the remaining peat hummocks and by installing a drainage system. Pasture could be established by surface seeding and manuring. These soils would be suitable mainly for low to moderate intensity grazing and careful management would be necessary to prevent reversion.

Derrydruel Complex (Soil 13 on Map)

Occurrence and character: The Derrydruel Complex occupies 301 acres or

0.11% of the survey area. It occurs in the Derrydruel locality only and consists of pockets of hand-cultivated peat, with some organic and mineral skeletal soils, among large expanses of granite rock outcrop.

Suitability: The suitability of the peats here is similar to that described for the cultivated peats (Soil No. 11) but these are so limited in extent that the production capacity of the whole complex is very restricted.

Organic-Mineral Soils

Organic and Mineral Soil Complexes (Soil 14 on Map)

Occurrence and character: These soils occupy 27,784 acres or 10.56% of the entire survey area. Areas with 2 to 10°,, bedrock exposure occupy 13,960 acres and those with over 10% occupy 8,598 acres. The soils occur mainly in the Rosses, in Dooey, on the valley-sides of the Gweebarra River, west of the Glenties Bog between Portnoo and Rossbeg, in the Loughros peninsula and in small areas in the western and southern parts of the Slieve League peninsula (Plate 4). The soils comprising the complex include lithosols, mostly organic, some peaty podzols and some gleys and peaty gleys. The intricate pattern of distribution precluded the separation of the individual soils on the map.

Plate 4 - Organic-mineral soil complex with over 10% bedrock exposure, near Annagarx

Suitability: These soils have a very limited use-range principally on account of the rugged nature of the topography where many slopes vary between 18 and 30° and rock exposure is frequent. The soils are unsuited to arable cropping but where it is possible to broadcast seeds and fertilisers, certain areas, especially those west of the Glenties Bog, are capable of improved grazing. However, good management is required as the sward on these soils tends to revert easily to the native vegetation.

Lithosols {Soil 15 on Map)

This group consists of skeletal. stonj soils, usually of an organic nature, overling, in most cases, solid or shattered bedrock. Generally, such soil areas have frequent rock outcrops. Lithosols are most often associated with Podzols and climatic Peats at the higher elevations. Their use range is limited to rough grazing or, occasionally, to forestry.

Occurrence and character. These soils occupy 2,931 acres or 1.11% of the survey area. Areas with over 30% bedrock are very common in this soil unit. The soils are mainly of a skeletal organic nature and they occur on Trusklieve and immediately south-east of Lough Waskel in the Rosses.

Suitability: The use-range of these soils is extremely limited because of their shallowness and patchwork nature between the expanses of exposed rock. They are mostly suited only to rough grazing.

Coastal Sand Soils

These soils include the fairly stable, flat sand areas immediately inland from sand dunes, the dunes themselves, the salt marshes and the areas which have been markedly influenced by wind-borne sands. They occupy 2.31%, (6,071 acres) of the Glenties Rural District. The soils of the flat, stabilised sand areas are divided into free-draining and poorly-drained categories. All samples examined were calcareous.

Free-draining stabilised sands (Soil 16 on Map)

Occurrence and character: These soils occupy 2.526 acres or 0.96% of the survey area. They occur mainly between Ardara and Rossbeg, in Dooey and north of Annagary. The soil profile near the sand dunes consists of a loose, very dark-brown A horizon having an average depth of 15 cm overlying aeolian sand—C horizon—which so far is not influenced by soil-forming processes. The A horizon has a fine sand texture and a loose, single grain structure. It has an organic matter content of 1.5% and contains no clay. Further inland from the dunes the profile has similar A and C horizons, but here these overlie a buried podzol which in turn overlies a peat seam.

A detailed description and analyses of a representative soil profile are given in Appendix 1, Table 9.

Included in this group are soils which are markedly influenced by blown sand. These occupy 1,721 acres or 0.66% of the survey area mainly in coastal positions north of Burtonport. Areas with 2 to 10% bedrock exposure occupy 789 acres and those with over 10% occupy 677 acres. The profile here shows an arrangement of A and C horizons similar to those described earlier. The A horizon has no clay and only 1.4% organic matter.

Suitability: 'Lightness' of texture, absence of structure, frequent soil moisture deficit and recurring surface deposits of freshly-blown sand limit the use-range of these soils. The absence of clay and the low organic matter content means that these soils can retain very little moisture. For the same reasons the cation exchange capacity is very low. This together with the very poor native nutrient supply means that if worthwhile crop yields, including grass, are to be achieved frequent applications of fertilisers, including organic manures are necessarx.

Grazing is probably the most suitable use for these soils but production will be very seasonal, due mainly to the poor soil moisture supply. Under grazing conditions also careful management is essential to prevent surface exposure and subsequent wind erosion. In places, these soils may be devoted to cultivated cropping, perhaps horticulture, but drought and wind erosion are major problems apart from sea-spray damage to crops. Trace element deficiencies are widespread here and very low levels of cobalt and copper were recorded in the profiles examined. Manganese levels, however, were relatively high compared with those recorded for the other mineral soils.

Imperfectly to poorly drained stabilised sands {Soil 17 on Map)

Occurrence and character: These soils occupy 428 acres or 0.16% of the survey area. A peat mantle covers 311 of these acres. The soils occur mainly in the vicinity of Dooey and Lettermacaward and are the furthest inland of the stabilised sands (Plate 5).

Disregarding the peat cover, the profile consists of a friable, black horizon, on average 30 cm deep, overlying a sticky, black peaty horizon which on average is 20 cm thick. The upper horizon contains a mere 2% clay but has 5.7% organic matter. Underneath these layers the sand is lighter in colour but yet relatively high in organic matter. The water-table is encountered at 80 cm from the surface.

Structure is moderate, coarse granular. Fine sand dominates the mineral fraction of the soil throughout the profile.

A detailed description and analyses for a representative soil profile are given in Appendix 1, Table 10.

Suitability: These soils have a somewhat limited use-range because of their coarse texture, their uncertain moisture regime and poor drainage conditions. Their natural nutrient status is low. They have a high cation exchange capacity, however, and therefore can retain fertilisers better than the other sands. Low levels of copper, cobalt, iron and manganese were recorded in the profile examined. With manuring and good management these soils can support fairly intensive grassland farming and can give satisfactory yields of oats and root crops in more favourable seasons. Limited areas here would be suitable for horticultural cropping.

Sand Dunes and Salt Marshes (Soils 18 and 19 on Map)

These areas, although of very little agricultural value, were also mapped. Together they occupy 3,117 acres or 1.19% of the area. These units occur along the seashore, chiefly north of Portnoo. The salt marshes (495 acres) which are normally covered by incoming tidal waters provide some grazing for cattle during the ebb periods. The sand dunes (2, 622 acres) can provide dry and sheltered out-wintering sites for cattle but have little further agricultural use.

Plate 5 - Soils in Dooey area, Lettermacaward. Podzols (soil 3) in foreground, stabilised sands (soils 16 and I7)and sand dunes (soil 18)in middle distance.

The Highland Soils

These soils occur above 400 feet O.D. and. excluding lakes, they occupy 46.9% (123,250 acres) of the Glenties Rural District.

Table 6 summarises the acreage and the proportion of the three major soil categories occupying the 'Highland' and the acreage of bedrock exposure associated with each of the three major soil categories.

In addition to the natural difficulties outlined for the 'Lowland Soils', more prevalent steep rocky slopes, higher precipitation, greater exposure and general inaccessibility are associated with these soils. The limited mineral soils, which are either intensely leached or strongly gleyed, are mainly suitable only for grassland farming. The extensive organic and organic-mineral soils are also suited only to grazing and mainly for sheep.

Mineral Soils

Soil Developed on Scree Slopes (Soil 20 on Map)

Occurrence and character: These soils occupy 341 acres or 0.13% of the survey area. Areas with 2 to 10% bedrock exposure occupy 192 acres. Scree slopes are

TABLE 6—Acreage and proportion of each major soil category and the acreage of associated rock outcrop

Major soil category	Total acreage	Percentage of Glenties Rural District	Percentage of Highland area	Rock outcrop (acres) < 2% rock	Rock outcrop (acres) 2-10% rock	Rock outcrop (acres) >io% rock
Mineral	736	0-28	0-6	**417**	319	—
Organic	94,395	35-89	76-6	81,159	12,967	269
Organic-mineral	28,119	10-69	22-8	17,371	9,591	1,157

most extensive at the eastern end of Glencolumbkille valley and in the valley of Glengesh.

These comprise mainly shallow, stony brown podzolic soils (see page 24) developed on slopes often averaging 30°. Water run-off is strong on these slopes and the moisture holding capacity of the soils is very low on account of their extreme stoniness.

Suitability: These soils are mainly suited only to low intensity grazing.

Other Mineral Soils {Soil 21 on Map)

Occurrence and character: These soils occupy 395 acres or 0.15% of the survey area. Areas with 2 to 10% bedrock exposure occupy 127 acres. The soils are found mainly in the Glengesh valley and on the north-western slopes of Aghla mountain. They consist of shallow, very degraded podzols and some gley podzols and are developed both from glacial drift of mixed composition but mainly of metamorphic rock materials and from local solifluction deposits

Suitability: Because of profile shallowness, steep slopes and inaccessibility these soils are best suited to low intensity grazing.

Organic Soils or Peats

The highland organic soils (peats) were divided into four units: (i) Reclaimed peat, (ii) Peat generally over 1 metre deep, (iii) Peat generally less than 1 metre deep and (iv) Eroding peat.

Reclaimed Peat (Soil 22 on Map)

Occurrence and character: These soils occupy 5,284 acres or 2.01% of the survey area. Areas with 2 to 10% bedrock exposure occupy 252 acres. These reclaimed soils occur in small isolated patches near roads and farmsteads and generally on gently sloping topography. The soils are mainly peats interspersed with peaty gleys and peaty podzols.

Suitability: These soils are mainly best suited to grassland farming They require a high standard of manuring and management without which the sward tends to revert to the native vegetation.

Peat generally over I metre deep (Soil 23 on Map)

Occurrence and character: This deeper peat occupies 42,680 acres or 16.23% of the survey area. Areas with 2 to 10% bedrock exposure occupy 1,598 acres and those with over 10% occupy 174 acres. The peat occurs on the Glengesh plateau and occupies a large portion of the highlands northeast of the Slieve League peninsula. Slopes in these areas are generally 5° or less.

The peat is extremely wet and poorly decomposed. Fibres form about 50% of the surface 80 cm and about 20% of the total mass below this. Loss on ignition is extremely high (up to 98%). The vegetation consists mainly of *Molinia, Tricophorum, Hedera, Erica cinerea, E. tetrali.x* and *Sphagnum* species.

A detailed description and analyses of a representative profile are given in Appendix 1, Table 11.

Suitability: These soils are suited only to low intensity grazing. Trampling by animals induces surface erosion which affects large expanses. After reclamation by an effective drainage system, improved grass swards can be established in many places by manuring and surface seeding. Fertiliser application is difficult, however, because of the nature of the terrain; aerial top dressing may be the most effective means where extensive areas are involved. Good grazing management is required to utilise the sward fully and to avoid poaching and erosion.

Peat generally less than 1 metre deep (Soil 24 on Map)

Occurrence and character: This unit occupies 35,012 acres or 13.31% of the survey area. Areas with 2 to 10% bedrock exposure occupy 11,117 acres and those with over 10% occupy 95 acres. This shallower peat often occurs adjacent to the previous deeper peat but on somewhat steeper slopes (generally greater than 8°).

1 ibres form about 40% of the surface 18 cm and about 15% of the underlying peat. The native vegetation consists mainh of *J uncus squarrosus, Carex, Nardus, Tricophorum, Rhacomitrium. Polytrichum* and *Sphagnum* species.

Suitability: The use-range for this peat is similar to that described for the deeper peat. However, it can withstand more intensive stocking due to better natural drainage which is conditioned b\ shallower depth of peat and steeper slopes.

Eroding Peat (Soil 25 on Map)

This unit occupies 11,419 acres or 434% of the survey area. It is found chiefh on the Glengesh plateau but also in scattered localities elsewhere. The phenomenon of more widespread peat erosion above 400 feet O.D. seems to be more closely associated with the increase in rainfall than with surface disturbance by grazing animals. These areas often coincide with watershed areas and in their present state are generally unsuited to agriculture.

Organic-Mineral Soils

Organic-mineral soil complexes (Soil 26 on Map)

Occurrence and character: These soil complexes occupy 18,174 acres or 6.^1 of the survey area Areas with 2 to 10% bedrock exposure occupy 9,591 acres and

Plate 6 - Shallow peat over drift, Slieve League.

those with over 10% occupy 1,157 acres. They occur mainly between Killybegs and Kilcar, on the north-facing slopes of the Glengesh plateau and on the south-facing slopes of Aghla Mountain. The soils consist mostly of peats (with inter-mixed mineral matter) and peaty podzols.

Suitability: These complexes have a very limited use-range not only because of the poor quality of the soils but more so on account of the very steep slopes—often between 18 and 30°—which they occupy. Where it is possible to broadcast fertiliser and to enact other improvements, moderately good grazing can be established. Proper management is required, however, as established swards on these soils revert easily to the indigenous cover.

Lithosoh (Soil 27 on Map)

Occurrence and character: These soils occupy 9,945 acres or 3.78% of the survey area. Areas with over 30% bedrock exposure dominate. The soils are mainly organic and occur on and near the summits of Slieve League, Slieve Tooey, Crownarad ridge. Aghla Mountain, Croeknasharragh and Croaghleheen.

Suitability: The use-range of these soils is extremely limited because of their shallowness, exposure and inaccessibility. They are suited only to low intensiu grazing.

Plate 7 - Peat erosion above Glengesh valley.

The Valley Floor Soils

These soils occur in both the 'Lowland' and 'Highland' regions and occupy 1.67% (4,379 acres) of the Glenties Rural District. They consist of moderately well to imperfectly drained regosols[7]. poorly drained regosols and peats.

The major natural difficulties affecting the agricultural development of these soils are their poor soil structure, their imperfect to poor natural drainage and frequent flooding hazards. Grassland farming is the most suitable land-use but limited cropping is also possible.

Mineral Soils

Regosols—imperfectly drained (Soil 28 on Map)

Occurrence and character: These soils occupy 1,150 acres or 0.44% of the survey area. They occur as narrow strips along the banks of many rivers in the area;

[7] Regosols are mineral soils derived from unconsolidated materials, *e.g.*, alluvium and that show little or no signs of profile development (horizons) due to immaturity

scale limitations prevent many of these from appearing on the published map. The parent materials consist of alluvium derived from mica-schist, quartzite, granite and diorite.

The soils are mainly imperfectly drained with mottles occurring to within 15 cm of the surface. The profile consists of a firm, very dark greyish-brown surface A horizon which varies in texture from silt to fine sandy loam. The lower horizons are coarser textured and more friable. The All horizon has 7% clay, 9.9% organic matter and has a weak, medium sub-angular blocky structure. Organic matter content decreases to 4.0 in the A12 and structure deteriorates. The average depth of the A horizon is 15 cm.

Suitability: The soils of this unit have a somewhat limited use-range due to impeded natural drainage and poor structure and because of the risk of frequent flooding. Natural lime and nutrient status is very low but these soils respond well to the appropriate amendments. They are generally unsuited to arable cropping because of factors already explained and also because they occur in long, winding, narrow strips. Where cropping is possible, however, good yields of tillage crops can be achieved. They are moderately well suited to grassland farming

In the profile examined levels of trace elements such as cobalt, copper and manganese are satisfactory.

Regosols—poorly drained (Soil 29 on Map)

Occurrence and character: These soils occupy 2,206 acres or 0.84% of the survey area. They occur principally in the valleys of the following rivers, the Stracashel, the Owenea Upper, the Gweebarra and the Owenwee north-east of Doochary. The parent material consists of alluvium of mica-schist, quartzite and diorite composition.

The soils here are mainly peaty gleys. The profile consists of a 7-cm thick organic horizon of undecomposed moss peat overlying a sticky, dark to very dark-grey Ag horizon of loam texture. The latter horizon has an average depth of 15 cm and a weak, fine sub-angular blocky structure; it has 16% clay, 8.7% organic matter and displays mottles due to gleying. The underlying horizons are of similar texture but are very strongly gleyed.

A detailed description and analyses of a representative soil profile are given in Appendix 1. Table 12.

Suitability: These soils have a limited use-range due to their peaty surface layers, poor drainage conditions, weak structure and liability to frequent flooding. Besides, the nutrient status and pH are low. They are unsuited to arable cropping and at present are used for meadowing and pasture. Drainage, followed by manuring and liming are prerequisites to improved production, and management must be of sufficient standard to prevent poaching and rush infestation.

Organic Soils

Peats—{Soil 30 on Map)

Valley floor peats occupy 1,023 acres or 0.39% of the survey area. They occur in the valleys of the Ballaghdoo and Gweebarra (near Doochary) rivers. These peats consist mainly of a weak-structured, loamy sedge peat in the surface, gradualh changing to a slightly loamy reed peat lower down the profile. The transition between the different peat types occurs at a depth of about 40 cm. The mineral component of the peats consists of alluvium deposited mainly from flood waters. The present vegetation consists mainly of *Carex* species with *Jimcus acutiflorus, Ranunculus tiammiilu* and *Myrica gale.*

Suitability: The agricultural value of these soils is severely restricted not only because of the nature of the soils themselves but also because of the difficulty of establishing an effective drainage system and because of frequent flood hazards. Where reclaimed, these soils are best suited to pasture and perhaps limited meadowing.

Summary Outline of Soils

A summary breakdown of the various soils mapped in the survey area is shown in Table 7 which also includes the acreage and percentage of the region occupied by each soil unit.

TABLE 7—Soils and their extent in West Donegal

		No.	Soils	Natural drainage	Percentage of total area	Acres
Lowland soils (0-400 ft O.D.)	Mineral	1	Acid Brown Earths	Good	0.39	1,031
		2	Brown Podzolics	Moderate	1-68	4,413
		3	Podzols	Imperfect	112	2,951
		4	Gleys	Poor	2 05	5,400
		5	Reclaimed peat sub-soils	Imperfect to poor	1*76	4,635
		6	Soils with man-made surface horizons	Imperfect	0-50	1,313
		7	Killybegs Complex of Gleys, Brown Earths and Brown Podzolics	Variable	0-69	1,804
		8	Podzols of the Drumlins	Good to moderate	0-21	554
		9	Gleys of the Drumlins	Poor	0-41	1,069
	Organic	10	Peat	Poor	23 06	60,666
		11	Cultivated peat	Poor	3-34	8,783
		12	Eroding peat	Poor	002	49
		13	Derrydruel Complex (Extensive rock outcrop with small patches of peat)	Poor	011	301
	Organic-mineral	14	Organic and mineral soil complexes	Imperfect to poor	10-56	27,784
		15	Lithosols	Excessive	111	2,931
		16	Stabilised sea-sand and sea-sand influenced soils	Good to moderate	0-96	2,526

TABLE *I* (contd.)

		No.	Soils	Natural drainage	Percentage of total area	Acres
	Coastal sand soils	17	Stabilised sea-sand soils	Imperfect to poor	016	428
		18	Sand dunes	Excessive	1 00	2,622
		19	Salt marshes	Tidal	019	495
	Mineral	20	Scree slope soils mainly podzolised	Good to moderate	0 13	341
		21	Podzols with some Gleys	Moderate to poor	015	395
Highland soils (above 400 ft O.D.)	Organic	22	Reclaimed peat	Poor	201	5,284
		23	Peat > 1 m deep	Poor	16-23	42,680
		24	Peat <1 m deep	Poor	13-31	35,012
		25	Eroding peat	Poor	4-34	11,419
	Organic-mineral	26	Organic and mineral soil complexes	Imperfect to poor	691	18,174
		27	Lithosols	Excessive	3-78	9,945
Valley	Mineral	28	Regosols on alluvium	Moderate to imperfect	0-44	1,150
		29	Regosols on alluvium	Poor	0-84	2,206
	Organic	30	Peats	Poor	0-39	1,023
Lakes					215	5,666

On the soil map:
suffix 'a' to a Soil No. = bedrock exposure occupying 2 to 10% of the soil unit
suffix 'b' to a Soil No. ^bedrock exposure occupying over 10% of area

SOIL SUITABILITY

by

M. WALSH and M. RYAN

Introduction

Soil suitability classification is essentially a grouping of soils according to the use or uses to which they are most adaptable, and is based principally on the significance of the more permanent characteristics of the soil. A further step in the suitability classification consists of an assessment of the production potential of each soil, for the normal range of farm and forest crops, under defined management standards. This provides the essential link between the physical and economic aspects of the use of soils. However, for this purpose reliable quantitative data on the productive capacity of each soil are required; these can only be provided by detailed field experimentation and yield observations, over a number of years, on sample areas representative of the particular soil. Sufficient information of this nature for the Glenties Rural District is not so far available[8]. Therefore, the present system of soil suitability evaluation and classification is largely a qualitative, rather than a quantitative appraisal of the potentialities of the different soils in the area.

Although the physical, chemical and biological properties of the soil merit foremost consideration in assessing soil suitability, environmental factors such as elevation, aspect, local climate, distance from the sea and factors such as accessibility, proximity to markets and consumer demands must also be taken into account. For instance, local features such as exposure to strong winds and late spring frosts can limit forest tree growth no matter how deep and fertile the soils may be. In general statements concerning soil suitability one must bear in mind, therefore, that environmental and other factors can influence considerably the economics of production and hence can modify the use-range to which the soils are otherwise ideally suited.

Furthermore, the concept of land quality has changed radically in recent years. With modern fertiliser technology, natural nutrient fertility problems in soils have become subordinate to physical ones such as defective natural drainage, "heavy" texture and poor structure, which are more difficult and more costly to rectify. Besides, an abundant farm labour supply no longer obtains, and its replacement by mechanisation has drastically altered the feasible cultural and management practices on many soils.

[8] Productivity ratings for forestry for a number of the soils in the Glenties Rural District are given in Part 2 of the Survey Report

Technological innovations and socio-economic changes can alter the suitability rating of different soils.

Soils—Their General Suitability, Use-range and Major Limitations

The general suitability, use-range and major limitations of the soils of West Donegal are summarised in Table 8. A number of the mapped soil units is included in each suitability class. Even with optimum manurial and management practices, certain differences in overall productive capacity persist between the soil units included in each class, as a result of inherent differences in the nature of the soils themselves. Nevertheless, the soils in any one class have sufficient characteristics in common to warrant their inclusion in the same suitability class.

In drawing up the suitability classification, only the normal or dominant phase of each soil has been considered. For instance, in Class A, Units 1 and 2 contain fairly extensive areas of soils which are too shallow and too rocky for successful cultivation and management. Conversely, small enclaves of Units 5, 6, 8, and 9 deserve higher ratings than the units in general, in terms of suitability for tillage and grassland farming. These enclaves, however, constitute only a very small proportion of the entire units. Separate considerations of such local exceptions is beyond the scope of this account.

Rockiness (see Tables 5, 6 and 9) and rugged micro-topography occur to a greater or lesser extent in practically all the units mapped. These present major obstacles in the management and utilization of soils otherwise suited to tillage and grassland farming. Less than 2% bedrock exposure presents relatively little interference to mechanised mowing or tillage, provided other conditions are favourable. In many areas with 2 to 10°,, bedrock exposure, exposed rocks are often within 100 feet of each other Such areas are generally unsuited to mechanised cultivation or mowing but use of machinery is possible when exposed rocks are further apart. Areas with over 10% bedrock exposure are only suitable for grazing. For instance, certain areas in Units 1 and 2 in suitability Class A have a limited use-range. However, in any classification system involving multiple variables, it is not possible to fully accommodate all exceptions without impairing the purpose of the classification[9]. It must also be accepted that certain units placed in one general suitability class may be borderline to a neighbouring class.

The present suitability classification is based largely on the relative quality of the soils within the survey area. Therefore, some of the suitability classes established for the West Donegal soil units may lose (or gain) status by reference to a national scale of suitability values.

Suitability Class A

The soils in this class (Table 8) have a moderate to a somewhat limited use-range and are generally of moderate to poor suitability for tillage crops and meadow and of moderate suitability for pasture.

[9] Local climate may also have an overriding effect on soil suitability in the area. The generally exposed nature of the landscape, the high precipitation and frequent strong winds limit the possible tillage crops to the hardier cereals, *e.g.*, oats and rye, and to some root crops. These factors drastically affect the potential for forestry and horticulture and have a deleterious effect on pasture production and utilisation even where the soils *per se* are suitable for these enterprises

Plate 8 - Pockets of brown podzolic soils on rugged microtopography near Kilcar.

The major physical limitations to the more intensive use of these soils include: rugged micro-topography, shallow soil depth and rockiness (Soils 1 and 2) and moisture deficit and wind erosion (Soil 16). Trace element deficiencies are a further problem in 16. The general character of the soils has been described earlier.

All the soils in this Class have a moderately high potential for grass production which can be attained by proper management including appropriate manurial treatments. Although only a small area of Unit 2, near the Gweebarra estuary, is devoted to forestry, the majority of the soils in this class should be well suited to this enterprise where exposure is not a limiting factor.

The soils of Class A occupy 3.03 % (7,970 acres) of the survey area. Areas with 2 to 10% bedrock exposure occupy 2,275 acres and those with over 10% occupy 1,029 acres.

Suitability Class B

The soils in this class (Table 8) have a somewhat limited use-range. They are mainly of poor suitability for tillage crops and meadow and of moderate suitability for pasture and forestrx

The major physical limitations to the more intensive use of these soils include: rugged micro-topography with steep slopes, shallow soil depth and rockiness (Soils

TABLE 8—Soil suitability classification[10]

Suitability class[11]	Use-range	Type of limitation[12]	Soil unit no.	Percentage of total area
A Moderately to poorly suitable for tillage and meadow; moderately suitable for pasture; suitable for forestry	Moderately wide to somewhat limited	Rugged micro-topography : shallow soils; rockiness	1,2	207
7,970 acres (3 03%)		Moisture deficit; wind erosion; copper and cobalt deficiencies	16	096
B Poorly suitable for tillage; mixed suitability for meadowing; moderately suitable for pasture and forestry	Somewhat limited	Rugged micro-topography or steep slopes; rockiness; shallow soils; cobalt deficiency	3,8	1-33
10,483 acres (3-98%)		Adverse soil moisture regime; liable to poaching; copper, cobalt and manganese deficiencies	4, 17	2-21
		Periodic flooding, weak structure	28	044
C Very poorly suitable for tillage and meadowing: moderately to poorly suitable for pasture and forestry	Limited	Rugged hilly topography; many shallow soils	7	0-69
		Adverse soil physical conditions; 6 occupies steep slopes in places	5,6,9	2-67
25,830 acres (9-83%)		Steep slopes; many shallow soils; high elevations	20,21	0-28

[10] In making this classification a high standard of management (including lime and fertiliser amendments, as required) is assumed.

[11] Limited areas within series may more exactly fit into one of the other suitability classes.

" Limitations noted here refer mainly to physical soil problems under *existing conditions.* Inadequate nutrient status is a major limitation in most of the soils and many need liming

TABLE 8 (contd.)

Suitability class	Use-range	Type of limitation	Soil unit no.	Percentage of total area
		Organic nature and poor drainage; liable to severe poaching; cobalt deficiency	11,22	5-35
		Serious drainage problem; adverse soil physical conditions; liable to severe poaching; periodic flooding	29	0-84
D Unsuitable for tillage or for intensive grazing or meadowing; moderately to poorly suitable for extensive grazing and forestry	Very limited	Steep slopes; adverse soil physical conditions; liable to severe poaching	14	10-56
45,958 acres (17-47%)		Steep slopes; adverse soil physical conditions; liable to poaching; high elevations	26	6 91
E Unsuitable for tillage or for intensive grazing or meadowing; mainly poorly suitable for extensive grazing and forestry	Extremely limited	Steep slopes; rockiness; very shallow soils; cobalt deficiency	15	1-11
		Steep slopes; rockiness; high elevations; very shallow soils; cobalt deficiency	27	3-78
164,521 acres (62-54%)		Frequent tidal flooding	19	0 19
		Extreme rockiness; shallow soils; organic nature; cobalt deficiency	13	Oil
		Raw organic nature; extreme wetness; cobalt and copper deficiencies	10	23 06
		Raw organic nature; extreme wetness; High elevations; cobalt and copper deficiencies	23	16-23

TABLE 8 (contd.)

Suitability class	Use-range	Type of limitation	Soil unit no.	Percentage of total area
		Steep slopes; raw organic nature; high elevations; cobalt and copper deficiencies	24	13-31
		Severe erosion; raw organic nature; extreme wetness; cobalt and copper deficiencies	12,25	4-36
		Periodic flooding; raw organic nature; extreme wetness; cobalt and copper deficiencies	30	0 39
Unclassified 2,622 acres (1 00%)		Sand dunes	18	1-00

3 and 8); adverse soil moisture regime, very weak structure (Soils 4 and 17) and the hazard of periodic flooding (Soil 28). Trace element deficiencies are a further problem in most of the class. The general character of the soils has been described earlier.

The soils in this class occupy 3.98% (10,483 acres) of the survey area. Areas with 2 to 10% bedrock exposure occup) 1,249 acres and those with over 10% occupy 265 acres.

Suitability Class C

The soils included in this class (Table 8) have a limited use-range. In general these soils are poorly suitable for tillage and of only poor to moderate suitability for pasture or forestry.

The major physical limitations to the more intensive use of these soils include: rugged topography with steep slopes and shallow soil depth in places (Soil 7) together with high elevation (Soils 20 and 21); adverse soil physical conditions (texture/structure/consistence/permeability) and drainage problems (Soils 5, 6, 9, 11, 22) together with the hazard of periodic flooding (Soil 29). Cobalt deficiency is a further problem especially on Soils 11 and 22. The general character of the soils has been described earlier.

The soils in this class occupy 9.83% (25,830 acres) of the survey area. Areas with 2 to 10% bedrock exposure occupy 5,149 acres and those with over 10% occupy 391 acres.

Suitability Class D

The soils of this class (Table 8) have a very limited use-range. The class contains two units—numbers 14 and 26. Soil suitability is limited by the inherent nature of the soils (mostly uet. rau organic soils) and by rockiness and steep slopes High elevation is an additional limitation in Unit 26. Trace element deficiencies, especially of cobalt, are to be expected.

The soils are generally unsuitable for tillage cropping or even for intensive pasturing or meadowing and are only of moderate to poor suitability for extensive grazing. However, where the terrain permits, stock-carrying capacity (principally sheep) could be greatly increased by applying modern hill-grazing improvement techniques, in the form of manuring and surface seeding, with due attention to cobalt supply. The range of suitable forest trees is restricted by soil and environmental conditions.

This class occupies 17.47 <4^58 acres) of the survey area. Areas with 2 to 10°(1 bedrock exposure occupy 23.551 acres and those with 10% occupy 9,675 acres.

Plate 9 - Soils on northern slopes of Slieve League. Deep blanket peat (soil 10) in foreground, cultivated peat (soil 11) and somewhat shallower peat (soil 24) in middle distance with lilhosols (soil 27) in background.

Suitability Class E

The soils in this class (Table 8) have an extremely limited use-range. They are mainly unsuitable for cultivation or intensive grazing or meadowing and are only poorly suitable for forestry. They are moderately to poorly suitable for hill-grazing but have potential for increased output using modern improvement techniques. More intensive use is limited principalis by the raw organic nature of the soils and by rockiness, steep slopes and high elevations, by shallow soil depth (Soils 15 and 27), severe erosion (Soils 12 and 25) and periodic flooding (Soils 19 and 30). Cobalt deficiency is a further problem where livestock health is concerned.

The soils in this class occup) 62.54 (164.521 acres) of the survey area. Areas with 2 to 10% bedrock exposure occupy 27,045 acres and those with over 10% occupy 602 acres.

Unclassified

This group consists of the Sand Dunes (Soil 18 on Map) and constitutes 1.00% (2,622 acres) of the survey area

Bedrock Exposure

The proportion of each Suitability Class occupied by rock exposure is shown in Table 9. Rock exposure is a key factor in the use possibilities of the soils.

TABLE 9—Acreage of each suitability class occupied by different concentrations of rock exposure

itability class	Percentage of West Donegal	Total acreage	< 2 % rock (acres)	2-10% rock (acres)	> 10% rock (acres)
A	3 03	7,970	4,666	2,275	1,029
B	3-98	10,483	8,979	1,249	265
C	9-83	25,830	20,280	5,149	391
D	17-47	45,958	12,732	23,551	9,675
E	62-54	164,521	136,874	27,045	602
assified	100	2,622			

Land Use Possibilities

It is important to know the quality potential of land and the alternative uses for which particular soils are suitable in order to cope with changing economic and social circumstances and market demands. On soils where the possible use-range is wide, the particular enterprise to be followed may depend largely on economic circumstances. Whereas none of the soils in the Survey Area have a really wide use-range, those in Suitability Class A (Table 8) offer most scope for diversified use in agriculture including forestry. Unfortunately this class represents only 3% of the entire area. On the other hand, for soils of limited to extremely limited use-range (Classes C, D and E—Table 8) the use cannot be so easily adopted to economic circumstances since the very nature of the soils or the associated terrain restricts their use possibilities. Such soils occupy 90% of the

Survey Area. Class B soils (Table 8) are intermediate in most of these respects; these represent roughly 4% of the entire area. The remainder of the Survey Area comprises the unclassified sand dunes (1%) and the lakes.

Classification of Soils according to Natural Drainage Condition

The soils have been grouped (Table 10) into six drainage classes: (a) excessively drained, (b) well drained, (c) imperfectly drained, (d) poorly drained, (e) very poorlv drained, (f) variable drainage. The peats have been classified on the basis of degree of run-off. All drainage classes refer to the natural drainage condition

TABLE 10—Classification of soils according to natural drainage

Natural drainage class	Conditioning factors	Soil unit no.	Percentage of total area
(a) Excessively drained	Rapid run-off; very shallow soils; rapid permeability	15, 27 18	5-89
(b) Well drained	Moderate permeability; deep water-table	1, 2, 8 16,20	3-37
(c) Imperfectly drained	Moderate to slow permeability; water seepage	3, 5, 6	3-38
	Moderate to slow permeability; seasonal high water-table	17,28	0 60
(d) Poorly drained	Very slow permeability; water seepage; deep water-table	4, 9, 11 14,21,22 26	25-43
(e) Very poorly drained	Slow permeability; water seepage; high water-table	29	0 S4
(f) Variable drainage	Rapid to slow permeability; seasonal high water-table in places	7	069
Peats:			
Better drained	Rapid run-off due to steeper slopes	12,24,25	17-67
Poorer drained	Less rapid run-off due to gentler slopes	10,23, 30	39-68
Unclassified		13, 19	0-30

of the soil; artificial drainage would up-grade some of the soils in the lower classes.

The soils in Class A carry a heath (15 and 27) and a Marram grass (18) vegetation and have a moisture deficit for long periods of the year due to excessive run-off (and the shallow nature of the soils) and to very rapid permeability respectively. The soils in Class B can hold sufficient moisture for the normal growth of a wide range of crops throughout the average growing season; in very prolonged dry periods, however, they are liable to a temporary moisture deficit. Drainage must be improved to attain the full potential of the soils in Class C, whilst for the !>oils in Classes D and E artificial drainage is a basic pre-requisite to any form of sustained improvement and higher output. The soils in Class F have variable drainage characteristics ranging from excessively to poorly drained.

The unreclaimed peats have been divided according to their natural drainage condition into two broad groups on the basis of degree of surface water run-off.

For each drainage class the main factors conditioning the drainage regime of the soils have been outlined. For example, in soils with defective drainage, contributing factors may be water-table height, or slow permeability, or both. Methods of artificial drainage must be adapted to the factors responsible, if the best results are to be attained.

The extent of occurrence of each drainage class is also given in Table 10. About 13", of the soils of the Glenties Rural District have free to moderately free internal drainage; of these, 25% are well-drained, 45% excessively drained and 30% imperfectly drained. Approximately 26% of the soils of the area have defective natural drainage. The remaining 61% of the area comprises the wet, unreclaimed peats, the soils of variable drainage, those which have not been classified, *i.e.*, the Derrydruel Complex and the Salt Marshes and lake areas. In all then, only 13% of the soils in the Glenties Rural District are naturally free draining and slightly more than 3% have ideal drainage conditions.

LIME AND NUTRIENT STATUS OF SOILS

by

J. LEEI and M. RYAN*

The survey of the soils of West Donegal included an appraisal of their lime and nutrient status. The procedure consisted in examining (a) soil analyses records of samples submitted to the Soil Testing Service at Johnstown Castle, Wexford, by agricultural advisors in the area and (b) analyses of representative soil samples taken specially for this purpose as part of the Resource Survey. There are possible limitations in using advisors' samples in that there is a tendency for samples taken by request to come from the better farms and these may not be representative of the range of soils occurring throughout the area. It is unlikely that an equitable proportion of the advisor's samples, for instance, were taken from the extensive areas of unimproved peat To check this possibliity the special random sampling was done. The mineral soils and the ameliorated peats of the area are considered first; the unimproved, raw peats are discussed separately because of their peculiar physical and chemical characteristics.

Soil analyses on advisory samples ***(other than raw peat)***

Analytical results for soil samples received from advisors in the area during 1965 were reviewed. The analytical results were categorised on the basis of lime, phosphorus and potassium levels into three groups, namely low", 'medium' and "high'.

These groupings represent soils which are likely to require high, moderate and low amendments respectively, of lime and fertiliser to sustain worthwhile crop yields.

Lime status of advisory soil samples

The distribution of these samples according to lime status is shown in Table 11.

[1] National Soil Survey, Soils Division, An Foras Taliintais
[2] Grassland Nutrition and Ecology Dept., Soils Division, An Foras Taliintais

TABLE ll—Lime status of advisory soil samples

Category	Percentage of samples	
	Non-tillage	Tillage fields
Low	48	52
Medium ...	45	24
High ...	7	24

The three categories roughly correspond to lime requirements per acre of 6 tons or more, 2 to 6 tons and less than 2 tons. It is obvious that the lime status of the non-tillage soils sampled is highly unsatisfactory with only 7% of all samples approaching an adequate level. The situation is considerably less favourable than that for the entire country,[3] which in itself is far from satisfactory. Roughly 8% of the advisors' samples in 1965 were taken from tillage fields. Although lime status of tillage fields is somewhat better than for non-tillage fields still three-quarters of the samples have inadequate lime levels and these tillage samples are representative of only an extremely low proportion of the survey area.

Phosphorus stains of advisory soil samples

The distribution of these samples by phosphorus status is shown in Table 12.

TABLE 12—Phosphorus status of advisory soil samples

Category	Percentage of samples	
	Non-tillage	Tillage fields
Low	70	38
Medium ...	23	37
High ...	7	25

The 'low' category corresponds to less than 3 ppm (parts per million): the medium category to 3 to 6 ppm and the high category to greater than 6 ppm of 'available' soil phosphorus. It may be concluded that at least 70% of the non-tillage soils of the area require high phosphate dressings whilst only 7% are reasonably well supplied for sustained crop yields. Although the soil phosphorus position is less critical in the tillage fields, nevertheless, it is far from satisfactory. It may be concluded that, in general, phosphorus deficiency is a major limiting factor in crop production.

Potassium status oj advisory soil samples

The distribution of these samples by potassium status is shown in Table 13.

[3] Soil analyses records (1965), Soil Laboratory, Johnstown Castle. Wexford

TABLE 13—Potassium status of advisory soil samples

Category	Percentage of samples: Non-tillage	Tillage fields
Low	22	14
Medium ...	54	29
High	23	57

The 'low' category corresponds to less than 50 ppm; the 'medium' to 50-100 ppm and the 'high' to greater than 100 ppm of 'available' soil potassium. Potassium levels are more favourable than those of phosphorus. Nevertheless, from a crop productivity viewpoint, it may be concluded that potassium is limiting in at least 75% of the non-tillage soils. The potassium status of the tillage soils has been improved to a fairly satisfactory level. However, over 40% of the fields sampled should still give a response to applied potassium and especially for the potato crop; otherwise, the present levels merely need to be maintained.

Analyses of special survey samples

Because of the possible bias towards the better managed soils in advisory officers' samples, a special sampling based on the soil map was carried out. A total of 300 samples representative of the more extensive soil types, was taken and subjected to laboratory analyses. The results for samples from untilled mineral soils and ameliorated peat and from similar soils under tillage are compared in Table 14.

TABLE 14—Lime, phosphorus and potassium status of untilled and tillage soils

Category[4]	Percentage of samples: Non-tillage	Tillage fields
Lime		
Low	61	33
Medium	32	40
High	7	27
Phosphorus		
Low	70	53
Medium	22	20
High	8	27
Potassium		
Low	10	17
Medium ...	45	33
High ...	45	50

* These are similar to the categories outlined earlier

The figures in Table 14 agree substantially with those presented in the earlier tables. The most obvious contrast between the tillage and non-tillage soils (Table 14) is in lime and phosphorus status; the difference in potassium status is less pronounced. It is apparent that tillage land receives preferential treatment within the limited usage of lime and phosphorus in the area. It can be concluded that 73 to 92% of the soils (Table 14) apart altogether from the unimproved, raw peats, should give considerable response to both lime and phosphates. Good responses to potassium can be expected in 50 to 55% of cases.

Lime, phosphorus and potassium status of the unimproved peats

Due to the fundamental difference in the interpretation of soil test values for calcium, phosphorus and potassium in raw peats, these soils were considered apart from the mineral soils and ameliorated peats. Peat contains 90% water and only 10% solids so on analysis the phosphorus content may appear to be comparable with that of mineral soils Besides, even the solids of the peat contain very little reserves of available phosphorus compared with mineral soils[5]. Experience at the Peatland Experimental Stations at Glenamoy and Lullymore and general experience in the reclamation of peat suggest that all raw peats are very deficient in phosphorus and potassium.

Peat samples analysed for advisors in 1965 showed that 85% were strongly acid, with pH values mostly in the range 4.3 to 4.8 and 15% were moderately acid (pH approx. 5.5). These results were substantiated by the analytical results of the special survey samples.

The sand-dune soils

The small area of soils associated with the coastal sand dunes was exceptional in that it was slightly alkaline (pH 7.2) in reaction and had high phosphorus levels (15 ppm). The potassium status of these soils, however, was extremely low (22 ppm).

Copper and cobalt levels

Copper analyses on a number of samples indicated that the extensive virgin peats were deficient in this element. More satisfactory copper levels were recorded in the mineral soils. Ill-thrift in livestock due to copper deficiency, may be a problem therefore in the virgin peats and possibly also in some of the organic/mineral skeletal soils of the highland areas.

The most satisfactory levels of cobalt were recorded in the lowland mineral and ameliorated peat soils. Normally, soils of 'greenland* areas around houses have a fairly satisfactory cobalt status. However, the extensive highland a»-eas and virgin peats are generally deficient in cobalt and ill-thrift, especially in sheep, may be expected as a result.

Summary

The soils of the Glenties Rural District are very infertile by nature. Apart from their physical shortcomings, gross shortages of lime and of both major

[5] McDonnell, P. M. and Walsh, T. (1956). P. values (Morgan's Solution) as an index of the phosphorus status of organic soils. Proc. 6th Int. Congr. Soil Sci. 11, 787-796

and minor nutrient elements are widespread. This situation is a reflection of soil type and local climate. Over most of the area, 90% or more of the soils have medium to very low levels of lime and phosphorus and even on the limited tillage areas only 25% of the soils have satisfactory levels. The potassium position is not so bad but still far from satisfactory with only some 50%, even of tillage soils, having adequate levels. Nitrogen is low throughout and is a particular problem on the peats. Trace element deficiencies are widespread: these include boron, cobalt, copper, manganese and molybdenum which are important in agriculture.

APPENDIX

PROFILE DESCRIPTIONS AND ANALYSES

Soil Unit No. 1—Modal Profile

Location!	Drumboy Hill TD
Slope:	10°
Altitude:	190 feet O.D.
Vegetation:	Pasture—*Cynosurus cristatus, Holcus lanatus, Festuca rubra, Plant ago lanceolata, Agrostis tenuis, Dactylis glomerata* and *Pteridium aquilinum*
Drainage:	Well-drained
Parent Material:	Basalt bedrock and shallow glacial drift of basalt composition

Horizon	*Depth (cm)*	*Description*
A	0-30	Sandy loam; dark-brown to dark yellowish-brown (10 YR 3-5/4); medium granular to fine sub-angular blocky structure; friable; many worm-holes: abundant roots; gradual, smooth boundary to:
(B)	30-77	Sandy loam; dark-brown (7-5 YR 3-5/3); moderate, medium sub-angular blocky structure; friable; weakly developed dark-brown (7-5 YR 3/2) clay skins on peds; many roots and worm holes; gradual, smooth boundary to:
	77-110	Similar to above except for a moderate to coarse sub-angular blocky structure; irregular boundary to:
	Below 110	Weathered basalt bedrock

Soil Unit No. 2—Modal Profile

Location:	Cullion TD
Slope:	15°
Altitude:	110 feet O.D.
Vegetation:	Rough pasture-£//e* *europaeus, Erica cinerea, Holcus lanatus, Anthoxanthum odoratum, Bellis perennis* and *Ranunculus repens*
Drainage:	Moderately-well to well drained
Parent Material:	Compact, gravelly, glacial drift of quartzite, diorite and granite composition

Horizon	*Depth (cm)*	*Description*
A	0-22	Slightly gravelly sandy loam; dark-brown to dark yellowish-brown (10 YR 3-5/3-5); strong, medium granular structure; firm, abundant roots: clear, wavy boundary to:

TABLE 1—Soil Unit No. 1

Horizon	Mechanical analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	pH	Cation Exchange: C.E.C. meq/lOOg	Available Nutrients (ppm): P	K	Mg	Organic Fraction: C %	N %	C/N	Loss on ignition %	Free iron %	T.N.V. %
A	24	34	33	9	5-7	200	1	69	190	1-6	019	8-4	8-2	2-4	nd
(B)	18	37	35	10	5-7	20-6	I	47	140	1-4	014	10-0	8-2	3-2	ml
C	28	36	34	2	56	160	I	80	85	10	0-70	14-3	6-2	2-5	nd

Coarse Sand 20-0-2 mm; Fine Sand 0-2-0-05 mm; Silt 005-0002 mm; Clay ^002 mm diameter size
C.E.C. Cation Exchange Capacity; P- Phosphorous; K Potassium; Mg^ Magnesium; C Carbon
N = Nitrogen; C/N Ratio Carbon/Nitrogen Ratio; T.N.V.— Total Neutralising Value; nd -not determined

Trace Elements—extractable content (ppm)

Horizon	Co (total)	Al	Cu	Mn
A	17-6	175	110	1
(B)	17-6	140	10-25	1
C	24-6	200	110	1

Co Cobalt; Al Aluminium; Cu=^Copper; Mn -Manganese

TABLE 2—Soil Unit No. 2

	Mechanical analysis of mineral fraction					Cation Exchange	Available Nutrients (ppm)			Organic Fraction					
Horizon	Coarse sand %	Fine sand %	Silt %	I	pH	C.E.C. meq/lOOg	P	K	Mg	c%	N %	C/N	Loss on ignition %	Free iron %	T.N.V. %
A	35	32	25	8	5-8	24-2	2	60	100	3-2	0-28	11-4	120	2-8	nd
Bs	36	29	30	5	61	160	1	47	85	1-2	006	200	7-8	3-1	nd
CI	41	30	26	3	6-3	5-4	1	55	85	0-6			4 0	2-6	nd
C2	51	29	18	2	6-4	2-4	1	55	50	0-3			2-8	2-7	nd

Trace Elements—extractable content (ppm)

Horizon	*Co* (total)	Al	Cu	Mn
A	10-5	220	9-50	1
Bs	22 0	420	4-75	1
CI	27-2	290	2-50	1
C2	16-6	140	1-75	1

Soil Unit No. 2—Modal Profile {continued)

Horizon	*Depth (cm)*	*Description*
*B_S	22-52	Gravelly sandy loam; brown to dark-brown (7-5 YR 4-5/5); strong, fine sub-angular blocky structure; friable; many roots, abrupt, wavy boundary to:
CI	52-61	Very gravelly, sandy loam; yellowish-brown (10 YR 5/4); common, fine, distinct, yellowish-red (5 YR 5/8) mottles; structureless; massive; very firm; few roots; clear wavy boundary to:
C2	Below 61	Gravelly, loamy sand; yellowish-brown (10 YR 5/4); few, distinct, fine, reddish-brown to dark reddish-brown (5 YR 3-5/4) mottles; structureless, massive; firm; no roots

*B_s=sesquioxide B, B horizon contains illuvial Fe or Al sesquioxldes or both

Soil Unit No. 3—Modal Profile

Location:	Dooey TD
Slope:	15°
Altitude:	70 feet O.D.
Vegetation:	Poor pasture—*Cirsium palustre, Carex spp., Euphrasia* and *Anthyllis vulneraria*
Drainage:	Imperfectly to poorly drained
Parent Material:	Mica-schist bedrock and shallow glacial drift of mica-schist composition

Horizon	*Depth {cm)*	*Description*
Al	0-23	Loamy fine sand; very dark grey (5 Y 3/1); common, distinct, fine, dark-brown (7-5 YR 3/2) mottles; moderate, fine sub-angular blocky structure; friable, abundant roots; gradual, smooth boundary to:
A2	23-35	Loamy, fine sand; very dark grey (5 Y 3/1) slightly greyer than above; few distinct, fine, brown to dark-brown (7-5 YR 4/4) mottles; medium angular blocky structure; firm; many roots; clear, wavy boundary to:
B,	35-63	Gravelly, sandy loam; dark greyish-brown to very dark-greyish-brown (10 YR 3-5/2); weak, coarse, sub-angular blocky structure; slightly sticky, non-plastic; many roots; abrupt, smooth boundary to:
	Below 63	Mica-schist bedrock

Soil Unit No. 4—Modal Profile

Location:	Fintragh TD
Slope:	5°
Altitude:	60 feet O.D.
Vegetation:	Pasture—*J uncus spp., Holcus lanatus, Trifolium repens, Potentilla erecta, Lychnis flos-cuculi, Orchis* and *Hypnum cupressiforme*
Drainage:	Poorly-drained
Parent Material:	Glacial drift of schist composition

TABLE 3—Soil Unit No. 3

Horizon	Mechanical analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	pH	Cation Exchange: C.E.C. meq/lOOg	Available Nutrients (ppm): P	K	Mg	Organic Fraction: C %	N %	C/N	Loss on ignition %	Free iron %	T.N.V. %
Al	**4**	**74**	**16**	**6**	**61**	**20-7**	**1**	**41**	**120**	**3-9**	**0 31**	**12-6**	**10-8**	**10**	**nd**
A2	**16**	**58**	**22**	**4**	**6-1**	**14-8**	**3**	**33**	**110**	**3-4**	**0-26**	**131**	**8-2**	**0-5**	**nd**
Bs	**28**	**38**	**25**	**9**	**6-5**	**100**	**1**	**29**	**70**	**10**	**010**	**100**	**5-8**	**2-8**	**nd**

Trace Elements—extractable content (ppm)

Horizon	**Co (total)**	**Al**	**Cu**	**Mn**
Al	1-9	49-5	3-25	1
A2	1-5	37-5	400	2
Bs	1-9	76-5	400	1

Horizon	*Depth (cm)*	*Description*
A	0-25	Sandy loam; very dark greyish-brown (10 YR 3/2); common, distinct, fine, dark reddish-brown (5 YR 3/2) mottles; moderate to medium sub-angular blocky structure; firm; abundant roots; abrupt, wavy boundary to:
C1g	25-51	Stony sandy loam; greyish-brown to dark greyish-brown (2-5 Y 4-5/2) many, prominent, coarse, yellowish-red (5 YR 4/8) mottles; structureless, massive; non-sticky, slightly plastic; many roots; clear, irregular boundary to:
C2g	51-75	Stony sandy loam; dark greyish-brown (2-5 Y 4/2); common, distinct, coarse, brown to dark-brown (7-5 YR 4-5/4) mottles; structureless, massive; slightly sticky, non-plastic; few roots; clear, wavy boundary to:
C3g	75-92	Gravelly, sandy loam; dark greyish-brown (10 YR 4/2); many, distinct, coarse, yellowish-brown to dark yellowish-brown (10 YR 2-5/5) mottles; structureless; massive; slightly sticky, non-plastic; no roots; clear, smooth boundary to:
C4	Below 92	Gravelly, sandy loam; greyish-brown (2-5 Y 5/2); compact, massive; very sticky, non-plastic; no roots

Soil Unit No. 5~Modal Profile

Location:	Straleel North TD
Slope:	10-15°
Altitude:	180 feet O.D.
Vegetation:	Pasture—*Cynosurus cristatus, Anthoxanthum odoratum, Agrostis tenuis, Trifolium spp., Prunella vulgaris, Plant ago lanceolata, Hieracium pilosella* and *Euphrasia*
Drainage:	Poorly-drained
Parent Material	Glacial drift of quartzite, schist, granite and diorite composition

Horizon	*Depth (cm)*	*Description*
	0-22	Mucky, sandy loam; black (10 YR 2/1); strong, fine sub-angular blocky structure; firm; abundant roots; abrupt, smooth boundary to:
	22-41	Sandy loam; greyish-brown (2-5 Y 5/2) layers alternating with dark-brown (7-5 YR 3/2) layers; structureless, massive; firm; many roots; gradual, smooth boundary to:
	Below 41	Gravelly, gritty sandy loam; greyish-brown to dark greyish brown (2-5 Y 4-5/2); structureless, massive; friable; no roots

TABLE 4—Soil Unit No. 4

Horizon	Mechanical analysis of mineral fraction				pH	Cation Exchange	Available Nutrients (ppm)			Organic Fraction			Loss on ignition %	Free iron %;	T.N.V. %
	Coarse sand %	Fine sand %	Silt %	Clay %		C.E.C. meq/lOOg	P	K	Mg	C %	N %	C/N			
A	23	29	36	12	5 0	320	2	34	95	7-1	0-4	17-8	15-6	1-3	nd
CI,	25	40	31	4	5-3	8-6	1	12	50	1 0	0 04	25 0	2-8	0-9	nd
C2,	25	37	33	5	5-4	8-4	1	10	30	0-9	nd		3-4	0-6	nd
$C3_g$	28	31	38	3	5-5	7-2	2	10	20	0-6	nd		2-4	1 1	nd
C4	27	32	37	4	5-8	5 0	3	20	10	0-4	nd		1-8	1-4	nd

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Trace Elements—extractable content (ppm)

Horizon	Co (total)	Al	Cu	Mn
A	1 1	95	2-50	2
CI,	7 0	75	0-50	1
C2,	1-9	200	3-25	1
C3,	7 0	200	4-00	1
C4	7-8	115	4-75	1

TABLE 5—Soil Unit No. 5

Horizon	Mechanical analysis of mineral fraction				PH	Cation Exchange	Available Nutrients (ppm)			Organic Fraction			Loss on ignition %	Free iron%	T.N.V. %
	Coarse sand %	Fine sand %	Silt %	Clay %		C.E.C. meq/lOOg	P	K	Mg	C%	N %	C/N			
A_p	26	31	34	9	5-2	53-4	2	30	40	11-6	0-5	23-2	24-8	0-3	nd
B	33	38	26	3	5-2	11-6	2	10	20	0-9	nd		4 0	0 1	nd
C	35	36	25	4	5-2	4 0	4	10	10	0-3	nd		1-6	0-2	nd

Trace Elements—extractable content (ppm)

Horizon	Co (total)	Al	Cu	Mn
A_p	2-8	325	22-00	1
B	4-2	360	4-75	1
C	6 0	64	1-25	1

Soil Unit No. 6—Modal Profile

Location:	Leabgarrow TD
Slope:	8°
Altitude:	40 feet O.D.
Vegetation:	Pasture—*Cynosurus cristatus, Agrostis tenuis, Trifolium repens, Plantago lanceolata, Juncus* and *Centaurea nigra*
Drainage:	Moderately-well drained
Parent Material:	Tenacious glacial drift of granite, mica-schist and quartzite composition

Horizon	*Depth (cm)*	*Description*
A(an)*	0-27	Gravelly, loamy coarse sand; black (7-5 YR 2/0) moderate, fine, to medium sub-angular blocky structure; friable; abundant roots; clear, smooth boundary to:
A2	27-41	Gravelly, loamy coarse sand; dark-brown (7-5 Y 3/2); weak, fine to medium angular blocky structure; friable; many roots; clear, wavy boundary to:
B_h,	41-62	Gravelly, humose, loamy, coarse sand; black (10 YR 2/1); strong, medium angular blocky structure; firm, illuvial humus skins on peds; some roots—between peds only; clear, wavy boundary to:
B3	62-95	Gravelly, coarse sand; brown to dark-brown (10 YR 4/3); few, faint, medium, dark-brown (7-5 YR 3/2) mottles; weak, medium, angular blocky structure; very friable; few roots; clear, wavy boundary formed by illuvial, reddish-brown (5 YR 4/4) iron to:
Cg	Below 95	Gravelly, coarse sandy loam; olive-grey (5 Y 5/2); structureless; extremely firm and impermeable; no roots

* (an)=Anthrophic horizon

Soil Unit No. 8—Modal Profile

Location:	Edergole TD
Slope:	10°
Altitude:	55 feet O.D.
Vegetation:	Pasture—*Cynosurus cristatus, Trifolium spp., Holcus lanatus, Anthoxanthum odoratum, Plantago lanceolata, Centaurea nigra, Hieracium pilosella,* and *Potentilla erecta*
Drainage:	Well-drained
Parent Material:	Glacial drift of quartzite, granite, diorite and schist composition

Horizon	*Depth (cm)*	*Description*
A11	0-13	Gravelly sandy loam; dark-brown (10 YR 3/3); strong, fine sub-angular blocky structure; friable; abundant roots and wormholes; gradual, smooth boundary to:
A12	13-44	Gravelly loam; dark-brown (10 YR 3-5/3); moderate, medium sub-angular blocky structure; friable; plentiful roots and wormholes; clear, wavy boundary to:

TABLE 6—Soil Unit No. 6

Horizon	Coarse sand %	Fine sand %	Silt %	(las %	pH	C.E.C. meq/lOOg	P	K	Mg	$C^0/$ ',	N %	C/N	Loss on ignition %	Free iron %	T.N.V. %
	Mechanical analysis of mineral fraction					Cation Exchange	Available Nutrients (ppm)			Organic Fraction					
A(an)	59	23	15	3	5-9	31 0	2	51	190	4-7	0-24	19-6	12-4	0-4	nd
A2	65	18	14	3	5-8	160	1	18	140	1-3	006	21-7	60	0-2	nd
Bhs	71	13	13	3	5-8	27-8	1	30	200	21	008	26-3	9-6	0-2	nd
B3	76	12	10	2	60	4-6	1	43	85	0-4	nd		1-6	0-6	nd
C,	46	23	28	3	5 0	3-2	1	57	50	0-3	nd		1 0	0-3	nd

Trace Elements—extractable content (ppm)

Horizon	Co (total)	Al	Cu	Mn
A(.n)	11	97-5	1-25	1
A2	0-6	255	1-25	1
Bhs	3-3	465	410	1
B3	1-5	115	1-75	1
C,	4-2	595	2-50	1

TABLE 7—Soil Unit No. 8

Horizon	Mechanical analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	PH	Cation Exchange: C.E.C. meq/lOOg	Available Nutrients (ppm): P	K	Mg	Organic Fraction: C%	N°/„	C/N	Loss on ignition %	Free iron %;	T.N.V. %
All	27	29	32	12	5-4	29-2	1	37	120	41	0-31	13-2	13-2	2-6	nd
A12	24	28	35	13	5-6	190	1	10	50	1-5	014	10-7	8-8	31	nd
A2	35	25	33	7	5-5	11-6	1	10	50	0-8	nd		4-6	2-7	nd
B,	39	25	33	3	5-7	25-8	1	10	60	1-2	0-8	150	9-4	5-2	nd

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Trace Elements—extractable content (ppm)

Horizon	Co (total)	Al	Cu	Mn
All	13-2	160	22-75	1
A12	110	220	11 00	1
A2	1-5	140	3-25	2
B,	9-6	405	2-50	1

Soil Unit No. 8—Modal Profile (continued)

Horizon	*Depth (cm)*	*Description*
A2	44-49	Gravelly sandy loam; light brownish-grey (2-5 Y 6/2); structureless, massive; friable; many roots; abrupt, wavy boundary to:
	49-50	Brittle, yellowish-red to reddish-brown (5 YR 5/7) iron-pan; abrupt, wavy boundary to:
B,	Below 50	Gravelly sandy loam; yellowish-red (6-25 YR 4/8); moderate, fine sub-angular blocky structure; friable; peds porous with slight, yellowish-red (5 YR 4/6) clay-skins; common roots

Soil Unit No. 9—Modal Profile

Location	Aghayeevoge TD
Slope:	7-10°
Altitude:	130 feet O.D.
Vegetation:	Pasture—*Cynosurus cristatus, Anthoxanthum odoratum, Ulex europaeus, J uncus spp.,* and *Rubus spp.*
Drainage:	Poorly-drained
Parent Material:	Glacial drift predominantly of mica-schist composition with some quartzite, gneiss and granite admixture

Horizon	*Depth (cm)*	*Description*
A	0-10	Gravelly loam; dark-brown (10 YR 3/3); few, distinct, medium, brown to dark-brown (7-5 YR 4/4) mottles; moderate, medium sub-angular blocky structure; firm; abundant roots; abrupt, wavy boundary to:
AC	10-18	Gravelly loam; dark greyish-brown (2-5 Y 4/2); many, prominent, coarse, dark reddish-brown (2-5 YR 3/4) mottles: weak, medium, angular blocky structure; firm; many roots; clear, wavy boundary to:
Cg	Below 18	Very gravelly loam; light brownish-grey to greyish-brown (2-5 Y 5-5/2); many faint, coarse, brown to dark-brown (10 YR 4/3)~mottles; structureless, massive; firm; few roots

Soil Unit No. 16—Modal Profile

Location:	Dooey TD
Slope:	0°
Altitude:	40 feet O.D.
Vegetation:	Pasture—mainly *Trifolium repens* and *Lolium perenne*
Drainage:	Well-drained
Parent Material:	Blown sand

TABLE 8—Soil Unit No. 9

	Mechanical analysis of mineral fraction					Cation Exchange	Available Notrients (ppm)			Organic Fraction					
Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	C.E.C. meq/lOOg	P	K	Mg	C %	N %	C/N	Loss on ignition %	Free iron %	T.N.V. %
A	17	34	42	7	5-0	29-6	3	107	120	6-5	0-43	151	150	1-3	nd
AC_f	16	32	41	11	5-3	23-2	2	49	40	2-8	0-16	17-5	8-6	2-6	nd
	15	25	46	14	5-4	100	2	57	20	0-7	nd		3-4	1-1	nd

Trace Elements—extractable content (ppm)

Horizon	Co (total)	Al	Co	Mn
A	4-2	115	2-50	1
AC,	8-3	310	2-50	1
C,	14-5	375	1-75	1

Horizon	Depth (cm)	Description
A	0-14	Fine sand; very dark brown (10 YR 2/2) with slightly leached sand grains; loose, single grain structure; plentiful roots; clear, smooth boundary to:
C	14-30	Fine sand; brown to dark brown (10 YR 4/3); few fine to medium, black (5 Y 2/1) mottles; single grain structure; few roots; abrupt, smooth boundary to:
Alb	30-51	Fine sand, very dark greyish-brown to black (2-5 Y 3-5/2); few, fine to medium, black (5 Y 2/1) mottles; single grain structure; very few shell fragments; few roots; clear, smooth boundary to:
A2b	51-73	Fine sand; greyish-brown (2-5 Y 5/2); single grain structure; few roots; clear to gradual, smooth boundary to:
Bib	73-90	Fine sand; olive brown (2-5 Y 4/4); few, faint, dark brown (7-5 YR 3/2) mottles; loose, single grain structure; no roots; gradual, irregular boundary to:
B2b	90-117	Fine sand; olive to pale olive (5 Y 5-5/3); common, prominent, coarse reddish-brown (5 YR 4/4) mottles; single grain structure; no roots; gradual, smooth boundary to:
B3b	117-128	Very fine sand; dark greyish-brown (2-5 Y 4/2); common fine to medium, distinct, reddish-brown (5 YR 4/4) mottles; single grain structure; no roots; abrupt, smooth boundary to:
	128-132	Peat layer

Soil Unit No. 17—Modal Profile

Location:	Dooey TD
Slope:	0°
Altitude:	40 feet O.D.
Vegetation:	Pasture—*Trifolium repens, J uncus effusus, Cirsium palustre, Cynosurus cristatus, Lolium perenne* and *Hokus lanatus*
Drainage:	Imperfectly to poorly drained
Parent Material:	Blown sand

Horizon	Depth (cm)	Description
All	0-33	Fine sand; black (10 YR 2/1); common, distinct, medium, black (2-5 Y 2/0) and brown to dark brown (7-5 YR 4/4) mottles; moderate, coarse, granular structure; friable; abundant roots; clear, smooth boundary to:
A12b	33-51	Mucky fine sand; black (10 YR 2/1); structureless, massive; sticky, non-plastic; abundant roots; abrupt, smooth boundary to:

TABLE 9—Soil Unit No. 16

Horizon	Mechanical analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	PH	Cation Exchange: C.E.C. meq/100g	Available Nutrients (ppm): P	K	Mg	Organic Fraction: C%	N %	C/N	Loss on ignition %	Free iron%	T.N.V. %
A	5	92	2	1	7-2	100	18	25	125	0-8	nd		2-6	0-2	4-3
C	8	90	2	0	7-5	3-6	10	13	160	0-3	nd		1 0	0-2	4 0
$A1_b$	2	95	3	0	7-8	7-8	3	12	50	0-7	nd		2 0	0-2	0-7
$A2_b$	4	93	3	0	7-7	4-3	3	10	30	0-2	nd		0-2	0 1	0 0
$B1_b$	2	96	2	0	7-6	2-3	5	10	20	0-2	nd		0-2	0 1	0-7
$B2_b$	6	90	3	1	7-5	3-2	3	10	20	0-3	nd		0-2	0-3	1-8
$B3_b$	3	95	2	0	7-5	2-3	3	16	20	0-2	nd		0-2	0-2	0 0

Trace Elements—extractable content (ppm)

Horizon	Co (total)	Al	Cu	Mn
A	0-75	<0-2	1-25	19
C	0-4	1-5	0-50	4
$A1_b$	0-4	<0-2	0-50	2
$A2_b$	0-4	3-2	<0-50	2
$B1_b$	1-5	9-3	<0-50	2
$B2_b$	0-75	15-5	<0-50	2
$B3_b$	1 0	130	<0-50	1

TABLE 10—SoU Unit No. 17

Horizon	Mechanical analysis of mineral fraction				PH	Cation Exchange	Available Nutrients (ppm)			Organic Fraction					
	Coarse sand %	Fine sand %	Silt %	Clay %		C.E.C. meq/lOOg	P	K	Mg	c%	N %	C/N	Loss on ignition %	Free iron %	T.N.V. %
All	2	91	5	2	6-9	22-2	2	16	100	3 0	019	15-8	7-0	0-2	nd
$A12_b$	2	83	7	8	6-2	800	1	10	160	101	0-23	43 -9	160	01	nd
AC_b	1	97	2	0	6-3	24-2	1	10	85	2-5	0-13	19-2	5-8	0-1	nd
$C1_b$	1	97	2	0	6-5	3-2	1	6	20	0-3	nd		0-6	01	nd
$C2_b$	4	71	18	7	6-6	40	3	6	20	0-6	nd		0-8	0-2	nd

Trace Elements—extractable content (ppm)

Horizon	Co (total)

Soil Unit No. 17—Modal Profile (continued)

Horizon	*Depth (cm)*	*Description*
ACb	51-57	Fine sand; very dark brown (10 YR 2/2); structureless; many roots; abrupt, smooth boundary to:
C1b	57-69	Fine sand; light brownish grey to greyish brown (2-5 Y 5-5/2); compact, single grain structure; many, very fine, fossilised roots; abrupt, wavy boundary to:
C2b	Below 69	Very fine sand; dark greyish brown to olive brown (2-5 Y 4/3); compact, single grain structure; many fossilised roots

Soil Unit No. 23—Modal Profile

Location:	Crowbane TD
Slope:	3°
Altitude:	800 feet O.D.
Vegetation:	*Molinia, Trichophorum caespitosum, Ulex europaeus, Erica cinerea, E. tetralix,* and *Spagmtm spp.*
Drainage:	No drainage system
Organic Soil:	Deep, Blanket Peat

Depth (cm)	*Description*
0-80	Peat; very dark-brown (10 YR 2/2); dark reddish-brown (5 YR 2/2) after squeezing; yields turbid water; very little material escapes between fingers; fibres form 50% of total mass; very gradual, smooth boundary to:
80-110	Peaty muck; black (7-5 YR 2/0); same after squeezing; c. 20% material escapes between fingers; fibres form c. 20% of total mass; very gradual, smooth boundary to:
Below 110	Peaty muck; very dark greyish-brown (10 YR 3/2); black (10 YR 2/1) after squeezing; c. 80% of material escapes between fingers; fibres form c. 20% of total mass

Soil Unit No. 29—Modal Profile

Location:	Fintragh TD
Slope:	0°
Altitude:	100 feet O.D.
Vegetation:	Rough grazing-mat of *Sphagnum, Juncus spp., Cirsium palustre, Prunella vulgaris, Dorchis maculata, Potentilla erecta* and *Succisa pratensis*
Drainage:	Poorly-drained
Parent Material:	Alluvium

TABLE 11— Soil Unit No. 23

	Mechanical analysis of mineral fraction					Cation Exchange	Available Nutrients (ppm)			Organic Fraction
(cm)	sand "%	sand %	Silt %	Clay %	pH	mcq/lOOg	P	K	Mg	Loss on ignition %
0- 80		Peat			4-9	96-4	3	60	250	Peat
80-110		Peat			4-8	111-2	2	25	600	98-3
Below 110		Peat			4-5	90-4	1	18	600	Peat

Trace Elements—extractable content (ppm)

Depth (cm)	Al	Cu	Mn
0- 80	<0-2	nd	1
80-110	<0-2	1-25	1
Below 110	<0-2	1-25	1

Soil Unit No. 29—Modal Profile (continued)

Horizon	*Depth (cm)*	*Description*
O	7-0	Undecomposed moss peat; abrupt, smooth boundary to:
Ag	0-16	Loam; dark-grey to very dark-grey (5 Y 3-5/1); few, distinct, fine, strong-brown (7-5 YR 5/6) mottles; weak, fine sub-angular blocky structure; sticky, plastic; abundant roots; gradual, wavy boundary to:
ACg	16-36	Loam; olive grey (5 Y 5/2); common, distinct, fine, brown to dark-brown (7-5 YR 4/4) mottles; few, prominent, fine, black (7-5 YR 2/0) mottles; weak, coarse angular blocky structure; slightly sticky, plastic; many roots; abrupt wavy boundary to:
Clg	36-53	Loam; olive grey (5 Y 5/2); many, prominent, medium, yellowish-red (5 YR 6/6) mottles; few prominent, medium, black (7-5 YR 2/0) mottles; massive structure; sticky, slightly plastic; few roots; gradual smooth boundary to:
C2g	Below 53	Loam; light-grey to grey (5 Y 6/1); few prominent, medium reddish-yellow (7-5 YR 6/8) and black (7-5 YR 2/0) mottles; structureless, massive; non-sticky, plastic; no roots

TABLE 12—Soil Unit No. 29

Horizon	Mechanical analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	PH	Cation Exchange: C.E.C. meq/lOOg	Available Nutrients (ppm): P	K	Mg	Organic Fraction: C%	N %	C/N	Loss on ignition %	Free iron %	T.N.V. %
O	Peat	Peat	Peat	Peat	51	Peat	3	80	140	Peat	Peat	Peat	66 0	Peat	nd
A1	9	35	40	16	5-2	200	2	34	70	4-6	0-28	16-4	12-4	1-3	nd
ACg	6	40	44	10	5-6	130	1	16	70	1-7	014	121	6 0	1-8	nd
C1g	6	35	44	15	5-9	10-6	1	16	70	1-1	008	13-8	5-6	0-9	nd
C2g	9	28	49	14	5-7	8 0	1	14	40	0-9			3-4	0-3	nd

Trace Elements—extractable content (ppm)

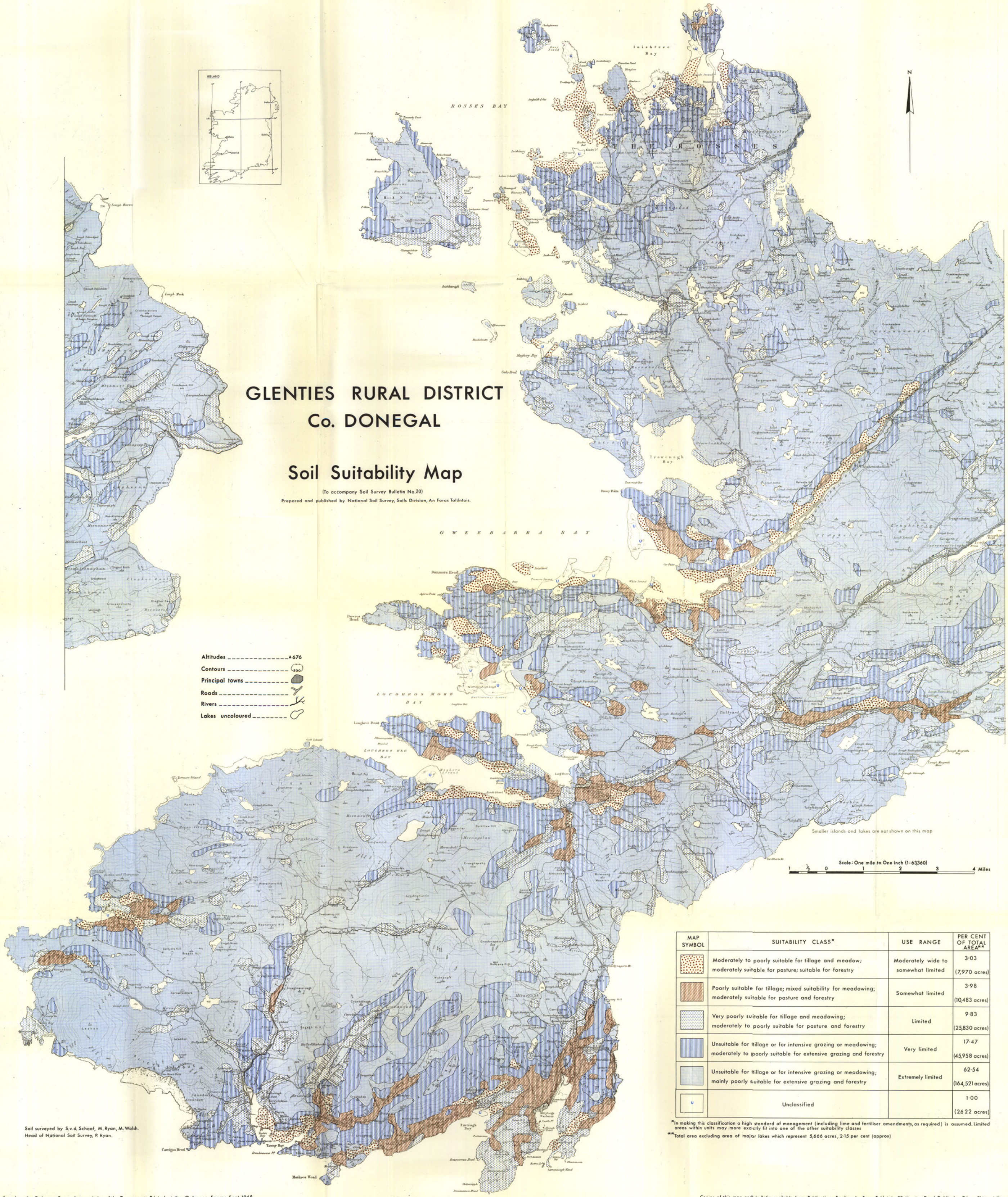
Horizon	Co (total)	Al	Cu	Mn
O	5-5	200	—	10
A1	5-1	97-5	5-50	10
ACg	7-3	81-5	5-50	16
C1g	8-8	61-0	4-75	23
C2g	4-7	67-5	3-25	12

GLENTIES RURAL DISTRICT
Co. DONEGAL

Soil Suitability Map

(To accompany Soil Survey Bulletin No. 20)

Prepared and published by National Soil Survey, Soils Division, An Foras Talúntais.



MAP SYMBOL	SUITABILITY CLASS*	USE RANGE	PER CENT OF TOTAL AREA**
	Moderately to poorly suitable for tillage and meadow; moderately suitable for pasture; suitable for forestry	Moderately wide to somewhat limited	3·03 (7,970 acres)
	Poorly suitable for tillage; mixed suitability for meadowing; moderately suitable for pasture and forestry	Somewhat limited	3·98 (10,483 acres)
	Very poorly suitable for tillage and meadowing; moderately to poorly suitable for pasture and forestry	Limited	9·83 (25,830 acres)
	Unsuitable for tillage or for intensive grazing or meadowing; moderately to poorly suitable for extensive grazing and forestry	Very limited	17·47 (45,958 acres)
	Unsuitable for tillage or for intensive grazing or meadowing; mainly poorly suitable for extensive grazing and forestry	Extremely limited	62·54 (164,521 acres)
U	Unclassified		1·00 (2622 acres)

*In making this classification a high standard of management (including lime and fertiliser amendments, as required) is assumed. Limited areas within units may more exactly fit into one of the other suitability classes

**Total area excluding area of major lakes which represent 5,666 acres, 2·15 per cent (approx)

Soil surveyed by S. v. d. Schaaf, M. Ryan, M. Walsh.
Head of National Soil Survey, P. Ryan.

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GLENTIES RURAL DISTRICT
Co. DONEGAL

Soil Map

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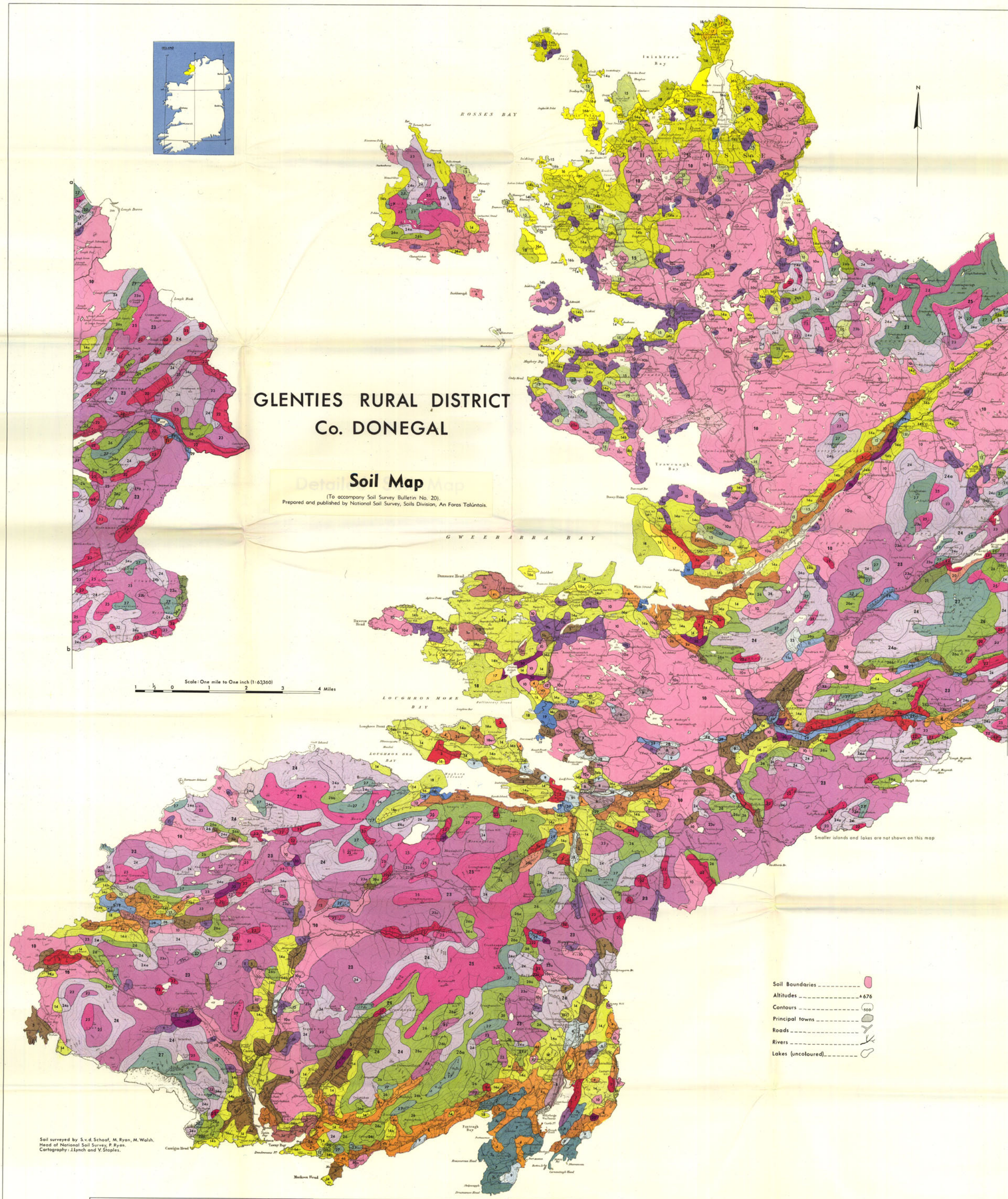

Soil surveyed by S.v.d. Schaaf, M. Ryan, M. Walsh.
Head of National Soil Survey, P. Ryan.
Cartography: J. Lynch and V. Staples.

LOWLAND SOILS 0–400 feet O.D.																			
	MINERAL									ORGANIC				ORGANIC – MINERAL		COASTAL SOILS			
MAP SYMBOL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
SOILS	Acid Brown Earths	Brown Podzolics	Podzols	Gleys	Reclaimed Peat sub-soils	Anthropic Podsols	Killybegs Complex	Podzols of the Drumlins	Gleys of the Drumlins	Peat	Cultivated Peat	Eroding Peat	Derrydruel Complex	Organic and Mineral Soil Complex	Lithosols	Regosols (Aeolian Sands)	Regosols (Aeolian Sands)	Regosols (Sand Dunes)	Salt Marshes
NATURAL DRAINAGE	Good	Moderate	Imperfect	Poor	Imperfect-Poor	Imperfect	Variable	Good-Moderate	Poor	Poor	Poor	Poor	Poor	Imperfect-Poor	Excessive	Good-Moderate	Imperfect-Poor	Excessive	(Tidal)
PER CENT OF TOTAL AREA*	0·39	1·68	1·12	2·05	1·76	0·50	0·69	0·21	0·41	23·06	3·34	0·02	0·11	10·56	1·11	0·96	0·16	1·00	0·19
ACRES	1,031	4,413	2,951	5,400	4,635	1,313	1,804	554	1,069	60,666	8,783	49	301	27,784	2,931	2,526	428	2,622	495

*Total area excluding area of major lakes which represent 5,666 acres, 2·15 per cent (approx)

HIGHLAND SOILS Above 400 feet O.D.								
	MINERAL		ORGANIC				ORGANIC – MINERAL	
MAP SYMBOL	20	21	22	23	24	25	26	27
SOILS	Scree slope soils	Podzols with some Gleys	Reclaimed Peat	Peat > 1m deep	Peat < 1m deep	Eroding Peat	Organic and Mineral Soil Complex	Lithosols
NATURAL DRAINAGE	Good-Moderate	Moderate-poor	Poor	Poor	Poor	Poor	Imperfect-Poor	Excessive
PER CENT OF TOTAL AREA	0·13	0·15	2·01	16·23	13·31	4·34	6·91	3·78
ACRES	341	395	5,284	42,680	35,012	11,419	18,174	9,945

VALLEY SOILS			
	MINERAL		ORGANIC
MAP SYMBOL	28	29	30
SOILS	Regosols on Alluvium	Regosols on Alluvium	Peat
NATURAL DRAINAGE	Moderate	Imperfect-Poor	Poor
PER CENT OF TOTAL AREA	0·44	0·84	0·39
ACRES	1,150	2,206	1,023

Suffix 'a' to a Soil number on Map = outcropping rock occupies 2 to 10 per cent of area
Suffix 'b' to a Soil number on Map = outcropping rock occupies over 10 per cent of area

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