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# Soils around Glasgow and the Firth of Clyde

MACAULAY LAND USE RESEARCH INSTITUTE

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# Soils around Glasgow and the Firth of Clyde

by

# J A Hipkin

The Macaulay Land Use Research Institute Craigiebuckler Aberdeen AB9 2QJ The Macaulay Land Use Research Institute Craigiebuckler, Aberdeen AB9 2QJ Telephone: (0224) 318611 Fax: (0224) 311556

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Figure 1. Physical Features

# Description of the Area

# Location and extent

This account deals with the soils of the oneinch-to-one-mile soil map Sheet 30 (Glasgow).

Most of the land lies in the Strathclyde Region to the north and west of Glasgow and around the Firth of Clyde, occupying 1100 square kilometres.

Built-up area accounts for approximately one quarter of the total land area. Glasgow and its satellite towns such as Paisley, Johnstone and Milngavie, dominate the south-east of the area. Other important conurbations are Gourock, Greenock and Port Glasgow on the south bank, and Helensburgh on the north bank of the Firth of Clyde, and Alexandria and Dumbarton between the southern end of Loch Lomond and the Firth of Clyde.

The towns of Strathblane and Killearn lie in Strath Blane, bordered by the Campsie Fells to the north-east. In the north-west the Rosneath peninsula is bounded by Loch Long and Gare Loch, the town of Kilcreggan lying at its southern tip. The seaside towns of Largs, Skelmorlie, Wemyss Bay and Inverkip lie on the Clyde coast in the south-west, and are bounded to the east by the Renfrew Hills.

# Geology

The area north of the Firth of Clyde is traversed by the Highland Boundary Fault zone, a prominent geological feature which extends north-eastwards from Kilcreggan to the southwest shore of Loch Lomond.

Land to the south of the Highland Boundary Fault, the Midland Valley, is dominated by sedimentary and igneous rocks of Devonian (=Old Red Sandstone) and Carboniferous ages. The Devonian rocks consist mainly of sandstones with some conglomerates and usually exhibit strong red colours. Strata of Lower Old Red Sandstone age occur mainly around Cardross and in Kilmaronock Parish; Upper Old Red Sandstone age strata occur between Alexandria and Croftamie, and along the Firth of Clyde coast between Largs and Inverkip, east to Noddsdale Water.

The Carboniferous sediments comprise shales and sandstones with some coals and occasional limestones and calciferous sandstones, ranging in age from the earliest Carboniferous rocks in the Calciferous Sandstone Measures through the Limestone Group and Millstone Grit to the Coal Measures, and occurring mainly in the lowland areas of the Midland Valley. The predominant igneous rocks are basaltic lavas, which being more resistant to erosion than the sediments, usually form the higher, more rocky ground such as the Renfrew and Kilpatrick Hills.

Land to the north of the Highland Boundary Fault comprises rocks of the Upper Dalradian Assemblage, consisting mainly of quartz-micaschists and mica-schists, with grits, slates, phyllites and calc-silicate rocks. During the Pleistocene Epoch the area was affected by glaciation, with the Highlands being the centre of a massive ice-sheet, and the ice moving in a generally southerly direction, tending to southeasterly towards Glasgow. Evidence for the direction of ice movement exists in the orientation of crag-and-tail features, drumlins and drumlin-like ridges, together with glacial striae on rock surfaces. Much of the lowland is covered with a thick mantle of till, whereas the hills have a thin cover of stony drift, especially on the north-facing slopes where the erosive effect of the ice was strongest.

At the end of the glacial period deposits of

silts and clays were laid down in ice-dammed lakes, and glacial meltwaters deposited sands and gravels, indicating successive positions occupied by the ice-margin during its 'retreat'.

Raised beach sands, silts and gravels fringe most of the coastline and deposits of alluvium occur alongside rivers and streams and sometimes in depressions in undulating lowland.

### Landforms

In the Midland Valley area there is a close relationship between rock type, structural pattern and landform. Most of the hill areas, including the Kilpatrick Hills, the Campsie Fells and the Renfrew Hills, are underlain by igneous rocks which are generally harder and more resistant to erosion than are the surrounding sedimentary rocks.

Differential erosion occurs within those areas of igneous rocks that are composed of alternate layers of hard compact lavas and lighter porous lava, and results in a characteristic stepped landscape. Prominent, steep, often precipitous cliffs such as the Kilpatrick Braes, Gleniffer Braes and those on the north and west flanks of the Campsie Fells, occur locally.

The areas underlain by the sedimentary rocks are mantled by thick deposits of glacial till which have produced a smooth landscape with gentle and strong rolling slopes and drumlins and drumlin-like ridges. Much of Glasgow is built on such features as evidenced by names such as Priesthill, Govanhill and Maryhill.

The region to the north of the Highland Boundary Fault is represented by the rounded and locally rocky hills which form the Rosneath peninsula and the area north of Helensburgh.

In some areas glacial till is lodged in hollows between rock outcrops producing a generally craggy landscape with smooth, gently sloping intervening hollows.

Fluvioglacial sands and gravels occur locally in some valleys and often have a terraced or moundy landform, which may also be dissected by river erosion.

Terraces of raised beach deposits are common around the coasts of the Firth of Clyde, and are generally level or gently sloping and often dissected by streams and rivers. A large area occurs around Renfrew, Houston, Linwood and Bishopton, and smaller areas occur for example around the southern tip of the Rosneath peninsula, between Helensburgh and Geilston, and around Inverkip.

## **Parent Materials**

Most of the soil parent materials owe their origin to glacial influences and comprise tills, fluvioglacial sands, silts and gravels, and raised beach deposits. Alluvial and organic parent materials are also represented.

The area to the north-west of the Highland Boundary Fault was subjected to extreme erosion during the glacial period and there is a strong relationship between the drift types and the rock types from which they are derived, both in texture and stoniness. The phyllites, slates and mica-schists were weathered to give soil parent materials with silty or fine sandy textures, and the soils developed on these materials are grouped into the Foudland Association.

The igneous rocks have given rise to various parent materials ranging in texture from clay loam or sandy clay loam till in depressions, to shallow sandy loam deposits in the rockier areas, and are represented by the Darleith Association.

In the lowland areas parent materials derived from Lower and Upper Old Red Sandstone strata consist mainly of reddish brown sandy clay loam tills of the Kippen Association, although widespread water-modification has resulted in a sandy loam, or in extreme cases, a gravelly loamy sand texture. Parent materials derived from Carboniferous sediments consist of yellowish brown and greyish brown tills of clay loam or sandy clay loam texture which, in places, have coarser-textured partially water-sorted upper layers. Hollows tend to be partially colluvium-filled and the soils are deeper with 'loamier' textures. Soils developed on these materials are grouped in the Giffnock and Rowanhill Associations.

Tills of mixed lithology occur where rocks have been overridden by ice containing material from another area. For example, the soils of the Lanfine Association are developed on till derived from sediments of Old Red Sandstone age, mainly sandstones, together with basic igneous rocks, mainly basaltic lavas. The till has a sandy clay loam texture and occurs in an area of drumlin topography around Netherton, near Langbank on the south of the Firth of Clyde. The Old Red Sandstone sandstone component of the till originates from rock outcrops north of the Clyde, and this together with the orientation of the drumlins and till ridges substantiates the theory that ice moved in a north-west to south-easterly direction.

North of Dumbarton, Calciferous Sandstone shales of Carboniferous age have been overridden by, and incorporated with, till derived from Old Red Sandstone sediments to produce a red clay loam till of the Sorn Association.

Fluvioglacial sands and gravels occur locally in the broader valleys. Raised beach sands and gravels, and some fine sands and silts occur mainly along the Firth of Clyde coasts, notably at the southern tip of the Rosneath peninsula and between Helensburgh and Dumbarton. The level, low-lying land between Renfrew and Houston, south to Linwood and north towards Bishopton, is dominated by raised beach fine sands and silts derived mainly from Carboniferous sediments, forming the parent material of the Dreghorn Association.

Alluvial deposits, of various textures, occur along the main river courses, such as the River Clyde, River Kelvin and in Strath Blane, and also in basin sites around Kilmacolm.

Organic parent materials, notably the tracts of blanket peat, occupy large areas of the hill ground, particularly on Stockie and Dumbarton Muirs north of the Firth of Clyde and Duchal Moor, Queenside Muir and Ferret of Keith Muir to the south. The deposits are greater than 50 centimetres deep but rarely exceed 120 centimetres. Small hollows containing basin peat occur throughout the low ground.

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### Climate

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Rainfall in the Clyde valley is less than 1000 millimetres per annum, but a range of 1000 to 1500 millimetres per annum is general in the lowland areas. The intensity and duration of rainfall increases with altitude and the upland areas receive an average annual rainfall of about 2500 millimetres.

Autumn and early winter are the wetter periods of the year with about 45 per cent of the annual total precipitation falling during the months October to January.

The lowlands are relatively warm, having

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an accumulated temperature greater than 1375 day-degrees C, and a growing season of about 300 days. Temperatures decrease with altitude and the cooler upland areas have a lower accumulated temperature in the range 825-1100 day-degrees C, and a shorter growing season of about 200-250 days. More severe conditions occur on the exposed hilltops.

The winters are very mild and the incidence of frost is low in the coastal areas due to the ameliorating effect of the North Atlantic Drift on the local climate. The incidence of frost increases away from the coast and with increasing altitude, but is modified by local topography.

# Soil Formation and Distribution

Soils in the lowland areas are generally mineral soils and are utilised for arable farming systems. The thick mantle of glacial till provides a fairly homogenous parent material and a smooth undulating landform - relatively uniform conditions for soil development. Owing to a predominance of parent materials with relatively fine textures, such as clay loams, the soils commonly exhibit gley features and have low hydraulic conductivities and impeded natural drainage. The major soil subgroups of brown forest soils with gleying and noncalcareous gleys are the most common. The topsoils are of sufficient depth for cultivation and the growth of most crops.

Although the climate in the lowland areas is less wet than in the hills and upland, the rainfall is still high and exceeds loss of moisture by evapo-transpiration, so those soils which are fine-textured and slowly permeable to water become waterlogged for much of the year unless artificially drained. The climate is sufficiently warm and moist to allow good vegetative growth and a high level of biotic activity in the soil.

Brown forest soils with free natural drainage occur locally in the lowland areas and are developed on coarse-textured parent materials or in areas where slopes are sufficient to allow free drainage by run-off.

Thin stony drifts derived locally from basaltic lavas also carry brown forest soils and these map units are characterised by moderate amounts of outcropping rock and deeper soils in depressions, an example being the Kilmacolm Complex of the Darleith Association.

Soils in the upland and hill areas experience a cool, wet climate and show a strong tendency to form organic surface horizons, the major soil subgroups of peaty gleys and peat being prevalent, with some peaty podzols and peaty rankers. The soils are often shallow over bedrock. the landscape being rock-controlled, that is, taking its form from the underlying rocks rather than a superficial deposit such as glacial till or sands and gravels. There is a strong relationship between the soils, topography and slope, and a consequent short-range variation in soil properties. Deep wet peat or peaty alluvial soils tend to accumulate in depressions, with peaty gleys, peaty podzols and peaty rankers on rocky ridge crests and slopes. Peat also blankets large areas of gently or moderately sloping upland, the cold, wet conditions promoting the accumulation of organic matter by slowing down the rate of decomposition.

# The Soil Associations

A soil association is a grouping of soil map units (soil series and complexes) in which the soils are developed on similar parent materials.

Forty-three soil series, twenty-one soil complexes and nineteen other map units have been mapped in the area under review. The soil series and soil complexes are grouped into the following nineteen soil associations:

Association	Parent Material
Balrownie	Drifts derived from Lower Old Red Sandstone sediments, mainly sandstones, with some Dalradian schist erratics
Bargour	Till derived mainly from sand- stones of Carboniferous (Bar- ren Red) age
Bemersyde	Drifts derived from trachytes
Carbrook	Glacio-lacustrine red silts and clays
Carpow	Upper terrace deposits, mainly fine sands and silts
Corby	Fluvioglacial and raised beach sands and gravels derived mainly from acid rocks
Darleith	Drifts derived from basalts and allied igneous rocks of Carbon- iferous age
Darvel	Fluvioglacial sands and gravels derived mainly from rocks of Carboniferous age
Deecastle	Drifts derived from calc-silicate rocks
Dreghorn	Raised beach sands and gravels derived mainly from rocks of Carboniferous age Raised beach fine sands and silts

	Foudland	Drifts derived from Dalradian slates and argillaceous schists
	Giffnock	Till derived mainly from Car- boniferous sandstones with some shales, coals and lime- stones Residual weathering sandstones and shallow drifts
	Gleneagles	Fluvioglacial sands and gravels derived mainly from Lower Old Red Sandstone sediments and lavas with some Dalradian schists
	Kilmarnock	Till derived mainly from sedi- ments of Carboniferous age and igneous rocks The above till with partially water-sorted upper layers
	Kippen	Drifts derived from sandstones of Upper Old Red Sandstone age with some Dalradian schist erratics Till derived from rocks as above, with partially water- sorted upper layers
	Lanfine	Till derived from sandstones and marls of Old Red Sandstone age and basic lavas
	Panbride	Raised beach sands and gravels derived mainly from rocks of Old Red Sandstone age
	Rowanhill	Till derived from Carbonifer- ous shales and sandstones with some coals and limestones The above till with partially water- sorted upper layers
	Sorn	Till derived from sediments of Old Red Sandstone and Car- boniferous age
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#### The Balrownie Association

The soils of the Balrownie Association occupy about 47 square kilometres around the southern part of Loch Lomond. They occur between Croftamie, Gartocharn and Balloch; in the area from Alexandria to Goukhill Farm; along a narrow ridge extending from Gouk Hill to Killoeter; and around Darleith House as a belt broadening southwards towards Cardross.

The parent materials of the Balrownie Association are reddish brown drifts derived from Lower Old Red Sandstone sediments. mainly sandstones, with some erratics of Dalradian schist. The drifts have reddish brown with a sandy clay loam texture but widespread water sorting has resulted in upper layers, usually less than 60 centimetres thick, of sandy loam and sometimes gravelly loamy sand texture. The Balrownie Series, occupying about 24 square kilometres, occurs mainly around Cardross and in the parish of Kilmarnock and comprises brown forest soils with gleying. The fine texture of the underlying parent material results in moderate or slow permeability and imperfect natural drainage. The potential rooting depth depends on the depth of the coarser-textured, partially water-sorted material and is usually in the range 35-60 centimetres. These soils are found in undulating lowlands and foothills with gentle or moderate slopes, suitable for a moderate range of crops, including high yields of grass.

Small areas of soils of the Lour Series, poorly drained noncalcareous gleys, occur in depressions in undulating topography, often in association with soils of the Balrownie Series.

Poorly and very poorly draining peaty gleys of the Sheriffmuir Series occur very locally at higher altitudes.

Three soil complex units were mapped.

The Boturich Complex is the most extensive, occupying about 12 square kilometres around Darleith House and Goukhill Farm, and a large area extending north from Balloch to Loch Lomond. It comprises brown forest soils and noncalcareous gleys with brown rankers in an undulating landscape which has gentle and strong slopes and is locally slightly rocky, the principal land use being grass for livestockrearing and dairying.

The Auchendennan Complex occupies 7 square kilometres on the hills west of Alexandria, and comprises peaty gleys, peaty podzols and peat in a sometimes slightly rocky, undulating and ridged topography with gentle and strong slopes. Being generally wet and peaty, and in a high rainfall area, the soils are used for rough grazing although some areas may be marginally suitable for improvement by limited mechanical means, open ditches, reseeding and liming.

The Killoeter Complex is confined to the slightly to moderately rocky, steep slopes of Gouk Hill and Killoeter, about 2 square kilometres in extent. It comprises brown forest soils and humus-iron podzols with humic gleys, and carries a mixed grass and heathland vegetation suitable for rough grazing.

## The Bargour Association

The soils in this association are developed on clay loam drifts derived from Barren Red Measures sandstones and some Carboniferous and Old Red Sandstone sandstones, in an undulating landform with drumlin ridges and gentle and strong slopes. It occupies less than 1 square kilometre.

Imperfectly draining noncalcareous gleys belonging to the Bargour Series occur very locally at South Bardowie, east of Bearsden.

#### The Bemersyde Association

Small areas of soils developed on shallow drifts derived from intrusive trachytes and rhyolites occur near Inverkip. These soils are freely draining brown forest soils of the Bemersyde Series occupying about 1 square kilometre.

#### The Carbrook Association

Poorly draining noncalcareous gleys of the Carbrook Series developed on glacio-lacustrine red silts and clays occupy about 3 square kilometres in Strath Blane. Being fine-textured, slowly permeable to water and difficult to drain, they are normally under permanent pasture.

#### The Carpow Association

This association is represented by imperfectly draining brown forest soils of the Carey Series. The soils are developed on upper terrace deposits, mainly fine sands and silts, derived from Lower Old Red Sandstone rocks. They occupy about 3 square kilometres mainly in the valley of the Endrick Water, and are utilised in arable farming systems including grass leys.

#### The Corby Association

Soils of the Corby Association are developed on fluvioglacial sands and gravels derived mainly from acid rocks, such as sandstones and schists, occurring mostly between Arden and Helensburgh, and on the Rosneath peninsula. Freely draining cultivated humus-iron podzols of the Corby Series occupy about 3 square kilometres of level and gently sloping land, and a combination of humus-iron podzols, humic gleys and peat, comprising the Kildrummie Complex, occupies about 6 square kilometres of moundy, ridged and terraced topography with gentle and strong slopes. The pattern of soils and slopes in the latter reduces its flexibility for agriculture, but the Corby Series provides reasonable yields of cereals and good yields of roots and grass, with the possibility of grass conservation.

#### The Darleith Association

The soils of the Darleith Association occupy 296 square kilometres, of which 272 square kilometres are mapped as soil complex units and the remaining 24 square kilometres as soil series. These soils occur over a large part of Renfrew District south of the Firth of Clyde, and also north of the Clyde in the Kilpatrick Hills and around Milngavie and Strathblane.

The parent material comprises drifts derived from micro- and macro-porphyritic olivine-basalts and allied igneous rocks such as mugearite, all of Carboniferous age. 7

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A range of textures was encountered varying from clay loam and sandy clay loam in those soils developed on compact glacial till, to sandy loam in those soils developed on locally derived shallow drifts and colluvium.

The principal soils of the Darleith Association are the imperfectly draining noncalcareous gley, Dunlop Series, and the freely draining brown forest soil, Darleith Series, which occupy 7 and 10 square kilometres respectively, mainly around Houston, Howwood and Dykefoot. These soils can produce good yields of cereals and grass, with lower yields of crops such as potatoes, vegetables and forage crops. Grass leys are common and are utilised for grazing by dairy herds and livestock.

Pockets of poorly draining noncalcareous gleys of the Amlaird Series occur in depressions, and are developed on slowly permeable, fine-textured tills. They are difficult to drain

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and manage and are predominantly under long ley pastures. Poaching by livestock is often a problem.

Poorly and very poorly draining peaty gleys of the Myres Series occur on the footslopes of Cairncurran Hill and around Rottenburn Bridge. Being either marginally suitable for reclamation as grassland or suitable only for rough grazing, they carry a poor grass vegetation used for stock-rearing.

Over much of the area there is a close correlation between the soil types and the rockcontrolled topography. The resulting intricate patterns of soils have been delineated as complex mapping units which may include small areas of brown rankers, humic gleys, organic soils and rock, as well as the above mentioned soil series.

Seven soil complex units were mapped.

The Kilmacolm Complex occurs on gently undulating rock-controlled lowland areas with brown rankers and occasional small rock outcrops on the tops of knolls, freely draining brown forest soils on the slopes, and imperfectly draining noncalcareous gleys with some peaty and humic gleys in the intervening hollows. This unit occupies about 92 square kilometres, much of it in Renfrew District, with substantial areas on the lower slopes of the Kilpatrick Hills and Campsie Fells. In areas where rock is at or near the surface the use of cultivation equipment is limited, although the rock is sometimes sufficiently weathered to allow the passage of ploughs and harrows. Farming systems are predominantly based on grassland utilised for dairy herds or the fattening of livestock, with limited areas of cereals and root crops grown for feed. Some knolls and bluffs are too steep or shallow for cultivation and carry a vegetation of rough grass, scrub or trees.

The Tourgill Complex occupies 26 square kilometres of steeply sloping, often stepped, slightly rocky to rocky land forming the flanks of the Kilpatrick Hills and Campsie Fells, and the western edge of the Renfrew Hills east of the Noddsdale Water. This complex of soils comprises brown forest soils and brown rankers, with some humic gleys in flushes and stream gullies. Being too steep and irregular for agriculture this complex has a semi-natural grassland vegetation with a high grazing value.

The Balglass Complex comprises brown rankers and brown forest soils with areas of scree and crags, and occurs on moderately to extremely rocky, steep and very steep slopes. It occupies only 3 square kilometres and is limited to features such as Lang Craigs and the prominent cliffs on the north side of the Campsie Fells. Those parts of the complex which are not too steep or rocky provide rough grazing for sheep.

The Gleddoch Complex comprises humusiron podzols, brown forest soils and noncalcareous gleys with ranker soils, peaty soils and some peat. It occurs in ridged and stepped topography with a wide range of moderately rocky slopes. This unit occupies about 61 square kilometres, in the area north of Milngavie and west of Strathblane, and extensively south of the Firth of Clyde on the footslopes of the Renfrew Hills, west of Bridge of Weir. The semi-natural vegetation is very variable, ranging from heather-dominated vegetation of low grazing value on the peaty soils, to improved grass swards of high grazing value on the areas of mineral soils. Although not generally suitable for arable farming this unit provides good grazing for livestock.

The Whitelees Complex comprises peaty podzols, brown forest soils and peaty gleys with some peat in a strongly undulating and stepped topography with a wide range of slopes, and is slightly to moderately rocky. This unit occupies 32 square kilometres in the Inverclyde District to the north of Loch Thom and around Whitelees Moor, and north of the Firth of Clyde in the Kilpatrick Hills. The vegetation is dominated by heather, coarse grasses and rushes on the wet and peaty soils, with some fine grasses and bracken on the dry soils, the unit being suitable for rough grazing mainly by sheep.

The Mistylaw Complex comprises peaty gleys and peat with peaty podzols; it occurs in undulating topography with gentle and strong slopes and is often slightly rocky. It is generally at elevations greater than 200 metres above sea level and occurs extensively on the hills around Misty Law extending north to Loch Thom, and on the Kilpatrick Hills and the flanks of the Campsie Fells, 54 square kilometres in all. The vegetation is dominated by heather and is of low grazing value.

The Muirshiel Complex occupies only 4 square kilometres and comprises peaty podzols and brown forest soils with humic gleys and peaty gleys, developed on locally slightly bouldery moundy moraine. This unit was mapped on the eastern slopes of Queenside Muir above the River Calder, and in the eastern Kilpatrick Hills, and is of low grazing value.

# The Darvel Association

The soils of the Darvel Association occupy about 3 square kilometres in Strath Blane and around the River Kelvin; they are developed on fluvioglacial sands and gravels, often interbedded, derived mainly from rocks of Carboniferous age. Freely draining brown forest soils of the Darvel Series are the only mapped soils, and vary in texture from sandy loam to loamy sand and sand with varying amounts of gravel. Being coarse-textured they are easily cultivated and utilised in arable farming systems although stones in some areas may hamper potato harvesting.

# The Deecastle Association

The soils of this association are limited to a small area of less than 1 square kilometre east of Helensburgh, and comprise brown forest soils and peaty podzols with brown rankers developed on drifts derived from calc-silicate rocks, and mapped together as the Goukhill Complex. The land use is restricted to rough grazing for sheep by the strongly to steeply sloping ridged topography.

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# The Dreghorn Association

The soils of the Dreghorn Association occupy about 14 square kilometres of level low-lying land in the area between Renfrew and Houston, extending south to Linwood and north towards Bishopton. The parent material consists of raised beach deposits developed mainly from rocks of Carboniferous age. Freely draining brown forest soils of the Dreghorn Series have developed on deposits of sands and gravels. Poorly draining noncalcareous gleys of the Yonderton Series have been developed on fine sands and silts. The Dreghorn Series is the least extensive, occurring on upper terraces at higher elevation than the Yonderton Series. Peat once covered much of the area now mapped as Yonderton Series. Most of it was removed by man in an effort to improve agricultural capability, although remnants occur, as at Barochan Moss where the peat surface lies about one metre above the surrounding land and the boundaries of which are often along straight fence lines. Most of the association is utilised by arable farming systems, based on cereals and grass and a limited range of other crops.

#### The Foudland Association

The soils of the Foudland Association occupy 12 square kilometres to the north-west of the Highland Boundary Fault. The parent material comprises fine-textured drifts derived from slates and argillaceous schists, mainly of Dalradian age. Poorly draining noncalcareous gleys of the Fisherford Series occupy about 7 square kilometres of low-ground and need artificial drainage and careful management to realise their potential in arable and grass ley rotations.

The Drumardoch Series of shallow, stony, poorly and very poorly draining peaty gleys are prevalent on the hills, and occupy about 5 square kilometres mainly north of Helensburgh. The vegetation associated with these soils is mainly coarse grasses and rush pastures, although some areas are dominated by heather. The soils are difficult to manage; drainage usually by open ditches to intercept surface water, reseeding, liming and application of fertilisers are often the only possible means of improvement.

In the hilly areas the pattern of soils is intricate, related to the varied and rock-controlled topography; there are three soil complexes.

The Knockderry Complex comprises noncalcareous gleys and brown forest soils with humic gleys and occurs in undulating, non- to slightly rocky topography with gentle and strong slopes. This unit occupies about 14 square kilometres of the lower hill slopes of the Rosneath peninsula, and the slopes north of Helensburgh.

The Clynder Complex comprises brown forest soils and humic gleys with humus-iron podzols on non- to moderately rocky, strongly to steeply sloping land. This complex occurs on the flanks of the Rosneath peninsula and on the south side of Glen Fruin, occupying about 4 square kilometres.

The Mamore Complex of peaty gleys with peaty podzols and peat occurs in undulating, non- to slightly rocky land with gentle and strong slopes. It occupies 17 square kilometres on the upper hill slopes of the Rosneath peninsula and on the hill slopes between Glen Fruin and Gareloch north of Helensburgh.

The vegetation of these soil complexes varies from grassland and rush pastures in the Knockderry Complex and Clynder Complex to heather-dominated moorland in the Mamore Complex. Some improvement and reclamation is possible.

### The Giffnock Association

The soils of the Giffnock Association occupy about 12 square kilometres in an area surrounding Craigmaddie Muir to the southeast of Strathblane. The parent material is a brown till of sandy clay loam texture derived mainly from Carboniferous sandstones with some shales, coals and limestones. The principal soils suitable for arable agriculture are the imperfectly and poorly draining noncalcareous gleys of the Aberdona and Giffnock Series respectively, in all about 5 square kilometres of land. Small areas of very poorly draining peaty gleys of the Scaurs Series occur in depressions. Owing to the 'heavy' nature and slow permeability to rainwater of these soils, drainage and careful management are needed, and grass leys are a common feature of the crop rotation.

A small area of residual weathering sandstone and shallow drift gives rise to the freely draining brown forest soils of the Forestmill Series. An area of about 6 square kilometres confined to Craigmaddie, Craigend, Muirhouse and Blairskaith Muirs is delineated as one mapping unit - the Craigmaddie Complex. The unit comprises humus-iron podzols, peaty rankers, peaty podzols, peaty gleys and peat in an undulating and stepped, slightly rocky landscape which has a wide range of slopes. The soil pattern is too variable and the soils are mostly too poorly draining to make improvement a viable proposition and the land is left in a semi-natural heathy and scrub vegetation.

# The Gleneagles Association

The soils of the Gleneagles Association occupy about 1 square kilometre near Croftamie and at Largs and are represented by the freely draining humus-iron podzols of the Gleneagles Series. The soils are coarse textured, being developed on fluvioglacial sands and gravels derived mainly from Lower Old Red Sandstone sediments and lavas with some Dalradian schists, and are utilised mainly for grass and cereal production.

## The Kilmarnock Association

The soils of the Kilmarnock Association occupy about 6 square kilometres near Strathblane and around Milngavie at Easter Blairskaith. The parent material is a reddish brown sandy clay loam till derived mainly from sediments of Carboniferous age, and igneous rocks. The landscape is gently undulating with some steep-sided drumlin-like ridges. The principal soils are the imperfectly draining noncalcareous gleys of the Kilmarnock Series which are slowly permeable and require careful management in arable systems to avoid structural damage. A small area of imperfectly draining brown forest soils of the Brownrigg Series occurs to the east of Strathblane. These soils are developed on till with partially water-sorted upper layers and are coarser-textured and 'more easily worked' than those of the Kilmarnock Series, but drainage is still impeded by the finetextured till below.

# The Kippen Association

The soils of the Kippen Association occupy 117 square kilometres, occurring in three main areas: between Dumbarton and Dumbarton Muir, extending north-east towards Killearn and Ballikinrain Muir; in an area east and north-east of Helensburgh; along the Clyde coast between Inverkip and Largs, east to Noddsdale Water. The parent material comprises reddish brown, sandy clay loam drifts derived from sandstone of Upper Old Red Sandstone age with some Dalradian schist erratics. The drift is sometimes hard and compact as a result of induration.

The mineral soils are all suitable for arable farming systems. The imperfectly draining brown forest soils of the Kippen Series which occupy 34 square kilometres are dominant. Freely draining brown forest soils of the Fourmerk Series and freely draining humus-iron podzols of the Redbrae Series occupy 5 and 3 square kilometres respectively. Poorly draining noncalcareous gleys of the Arnmore Series occur in depressions and on lower hillslopes, occupying about 14 square kilometres. a.

The poorly and very poorly draining peaty gleys of the Limpithill Series occupy about 46 square kilometres of hill land. Small areas of the imperfectly draining peaty podzol (Garrique Series) occur in association with peaty gleys, often where weathered rock is near the surface. The hill land vegetation associated with the peaty soils is dominated by heather with some areas of coarse grass. Improvements are limited by the wetness of the soils and rough grazing is the dominant land use. Small areas of soils developed on drift with partially water-sorted upper layers occur in the lowland, notably the imperfectly draining brown forest soils of the Butterwell Series which occupy about 2 square kilometres of arable land near Killearn and Strathblane.

Three soil complex units, each occupying about 2 square kilometres were also mapped.

The Portkil Complex comprises humusiron podzols and brown forest soils with peaty podzols in a non- to slightly rocky, knolly landscape with gentle and strong slopes.

The Caldarvan Complex comprises brown forest soils, humus-iron podzols and noncal-, careous gleys developed on moundy moraine.

The Gallangad Complex comprises peaty podzols, peaty gleys and peat developed on moundy moraine.

# The Lanfine Association

The soils of the Lanfine Association occupy about 15 square kilometres between Dumbarton and Milngavie, and around Langbank on the south side of the Clyde. The parent material is a reddish brown till of sandy clay loam or sandy loam texture, derived from sandstones and marls of Old Red Sandstone age, and basic lavas. The dominant mineral soils are the imperfectly draining noncalcareous gleys of the Lanfine Series which occupy 10 square kilometres of undulating lowland with drumlin-like ridges, and are in arable rotations including grass leys. Being finetextured and slowly permeable they need artificial drainage and good management to realise their potential. At higher elevations poorly and very poorly drained peaty gleys of the Distinkhorn Series become dominant, with a vegetation of coarse grasses and rushes, and heather, used for grazing.

## The Panbride Association

The Panbride Association occupies 5 square kilometres of land along the coast between Helensburgh, Cardross and Dumbarton, and between Inverkip and Largs. The soils are developed on raised beach sands and gravels derived mainly from rocks of Old Red Sandstone age.

The Geilston Complex occurs on gently undulating raised beach terraces and comprises noncalcareous and humic gleys with peaty gleys and humus-iron podzols. The soils are variable but are generally wet and stony and the vegetation consists of grasses, rushes, and scrub. In more uniform areas of raised beach with deeper, sandy deposits, freely draining humus-iron podzols of the Panbride Series have developed, which are suitable for arable farming and often carry an improved grass sward.

# The Rowanhill Association

The soils of the Rowanhill Association occupy 40 square kilometres mainly in the Glasgow area near Paisley, Johnstone, Lochwinnoch, Milngavie and Bearsden. The parent material is a brown, sandy clay loam or clay loam till derived from Carboniferous shales and sandstones with some coals and limestones. The landscape consists of undulating ridges and drumlins with gentle to strong slopes. In some areas, notably at low elevations, the till has partially water-sorted upper layers with textures coarser than those of the unmodified till.

The principal soils are the imperfectly draining noncalcareous gleys of the Caprington Series which occupy 21 square kilometres. Poorly draining noncalcareous gleys of the Rowanhill Series occupy about 5 square kilometres in depressions and in more subdued topography, where lack of slope hinders site drainage. In low-lying areas and on the lower slopes of ridges and drumlins, the till has been modified by glacial meltwater and imperfectly draining brown forest soils of the Macmerry Series have developed with deeper, more coarse-textured upper layers, overlying the unmodified till. The Macmerry Series is easier to cultivate, provides greater rooting depth, is more responsive to drainage and more resistant to structural damage than the finer-textured 'heavy' soils developed on unmodified till. The mineral soils are all utilised for arable farming systems which include grass leys of varying duration in the rotation. Good management and artificial drainage schemes with backfill are essential requirements on this 'heavy' land.

Small areas of poorly and very poorly draining peaty gleys of the Glaisnock Series occur in hollows and adjacent to areas of peat.

The Fulton Complex occupies about 8 square kilometres near Linwood and Bishopton and comprises imperfectly draining noncalcareous gleys of the Caprington Series together with poorly draining noncalcareous gleys of the Yonderton Series developed on fine sands and silts of the Dreghorn Association. In this area the raised beach fine sands and silts appear to occupy the lower elevations, occurring between the mounds and drumlins of glacial till. Stream channels and some glacial meltwater channels have dissected the raised beach deposits, in places down to the underlying till. The soils occur in undulating topography with gentle and steep slopes and are generally under arable farming systems including rhubarb growing at West Fulton, near Johnstone.

### The Sorn Association

The soils of the Sorn Association occupy 22 square kilometres in two main areas around Inverkip and Loch Thom, and around Dumbarton. The soils are developed on red to reddish brown clay loarn till derived from sediments of Old Red Sandstone and Carboniferous age, in a gently undulating landscape with gentle or moderate slopes.

The dominant mineral soils are the poorly draining noncalcareous gleys of the Sorn Series, which occupy 9 square kilometres and are usually under long ley pastures.

The imperfectly draining noncalcareous gleys of the Glenpark Series occupy 4 square kilometres to the east and north of Inverkip, and are utilised for arable farming systems.

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With increasing altitude and rainfall an organic surface horizon becomes prevalent and the poorly and very poorly draining peaty gleys of the Weitshaw Series occupy about 9 square kilometres of land at Leap Moor, Auchenreoch Muir and also at Ballikinrain Muir north of the Campsie Fells. This moorland has a heather-dominated vegetation suitable only for rough grazing or use as grouse-moor.

### **Alluvial Soils**

Mineral alluvial soils with varying textures and drainage characteristics, and some undifferentiated alluvial deposits have been mapped, notably along the River Kelvin, the River Clyde, and the Blane Water, and locally elsewhere.

Some low-lying hollows of alluvium interstratified with peat have been delineated as peaty alluvial soils.

The larger, more homogeneous areas of

alluvium are utilised by arable farming systems, but the smaller areas, especially those with a high water-table, fine textures and poor accessibility, have a semi-natural vegetation of grasses and rushes, and occasionally scrub or trees such as willow and birch.

#### **Organic Soils**

Deposits of basin and valley peat greater than 50 centimetres deep occupy about 10 square kilometres, mainly in depressions which occur through much of the low ground. Barrochan Moss near Houston, and Linwood Moss are the most extensive. Being difficult to reclaim and drain, and manage, most of these soils carry a semi-natural vegetation of birch scrub or rush pasture. A small area of Linwood Moss at Blackstoun has been successfully reclaimed and is used as part of a market gardening enterprise.

Blanket peat greater than 50 centimetres deep occupies about 91 square kilometres and is extensive on the Renfrew Hills at Ferret of Keith Moor, Duchal Moor and Waterhead Moor, on the Campsie Fells, and on the Dumbarton and Stockie Moors. The vegetation of these areas is dominated by heather and is suitable for rough grazing by sheep, and for use as grouse-moors.

Although not mapped as a separate unit large areas of blanket peat have been eroded.

# Land Use

Arable farming is practised principally on the mineral soils of the low-ground, for example around Glasgow, Kilmacolm, Gartocharn and Killearn, and along the Clyde coasts, where good yields of a narrow range of crops are obtained, notably cereals, potatoes and root crops, and more recently oilseed rape. Small areas are utilised for market gardening and rhubarb growing.

As many of the mineral soils are finetextured and slowly permeable to water, drainage and timeliness of machine operations are necessary to maintain yield levels and avoid structural damage to the soils. Grass leys are an important part of arable rotations.

In higher rainfall areas long grass ley rotations or permanent pastures become prevalent and the land is utilised for stock-rearing or dairying, with cereal or roots grown as stock feed.

The foothills and hills are utilised for rough grazing and forestry, with some grouse-moors. Around Glasgow and some of the outlying towns land is used for amenity purposes such as parkland, nature reserves and golf-courses.