Natural Environment Research Council

BRITISH GEOLOGICAL SURVEY

GEOLOGICAL REPORT ON

THE A68 PATHHEAD TO SOUTRA

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INTRODUCTION

The report was prepared using information held by the Survey, from published geological surveys (maps and memoirs) of the area, from records of boreholes and also from more recent unpublished surveys and data.

GENERAL CONCLUSIONS

Two potential problem areas on the route of the A68 can be recognised as follows:

(1) The area of abandoned limestone quarries and mine-workings at Hope and Magazine at the northern end of the route. The workings are shallow and extend beneath the road at one point,

(2) The area of very thick and landslipped superficial deposits, mainly boulder clay, in the valley of the Fala Dam Burn to the north and south of Fala Tunnel. The areas of landslip are unstable and if disturbed by extra loading or undercutting they or adjacent areas are likely to undergo further movement.

MINERAL WORKINGS

Limestone

At Hope and Magazine, at the northern end of the route, the Skateraw Limestone of the Lower Limestone Group has been worked extensively in the past by both quarrying and mining. The quarries are overgrown and partially filled in with spoil from the mines and some refuse. The known extent of the mine workings, taken from plans held by the BGS (Plan Nos LSP 60, 956 and 1660) is shown on the accompanying plan. The workings are "stoop and room" and extend up to both sides of the A68 and a little way under it in one place. The plans of the mines are working, not abandonment, plans so that it is possible the workings are more extensive than shown. Borehole NT 46 SW/3 adjacent to the A68 encountered old workings at a depth of 12.7 metres below the surface.
The Upper Longcraig Limestone was quarried to a smaller extent at Magazine Wood but there are no records of mining in the limestone at this locality. The limestone quarried in Marl Law Wood is thought to be part of a large glacial erratic in the boulder clay.

Coal

Coal seams near the surface have been worked in the past on the east bank of Fala Dam Burn. In 1965 a small drift (adit) mine was driven into the east bank of Fala Dam Burn, c200 metres north of Fala Tunnel, where a 1.20 thick coal seam outcrops and where there was evidence of older openings. The mine encountered older workings in the coal seam c6 metres from the mine mouth. The extent of the older workings is not known. The mine was continued in a north-easterly direction in the coal seam for a distance of c15 metres from the entrance. In the mine the strata were found to dip towards the north-west at an angle of 2 to 3 degrees. The mine was dry.
A borehole, Fala Dam No 1 (NT 46 SW/7), sited c110 metres NE of the coal outcrop and at a ground level c24 metres higher (bore at c225 metres above OD), proved that a short distance ahead of the mine superficial deposits lie to a depth more than 40 metres below the level of the coal. The bore penetrated over 56 metres of boulder clay containing sand beds beneath a 7 metre thick bed of sand containing blocks of coal. Also boulder clay overlying sand and gravel is exposed in the valley below the level of the coal outcrop. On this evidence it seems almost certain that the coal and associated strata at Fala Dam are not in situ but exist as a large ice-transported mass (glacial erratic) within the boulder clay.

Lower Limestone Group

These strata occur beneath the route from the northern end to Magazine. They consist of interbedded limestones, the thickest and most important being the Skateraw Limestone and Upper Longcraig Limestone, calcareous mudstones, siltstones, sandstones and occasional thin coal seams. The strata dip towards the north-west at angles of around 5 degrees or less.

Calciferous Sandstone Measures

These strata occur beneath the site from Magazine to Fala. From Magazine to the Dunbar-Gifford Fault at Crichton Dean the strata belong to the higher parts of the Calciferous Sandstone Measures and consist largely of sandstones with subordinate siltstones, mudstones and thin limestones. The beds are thought to dip towards the north-west. From the Dunbar-Gifford Fault to the Lammermuir Fault at Fala the strata are thought to belong to the lower parts of the Calciferous Sandstone Measures consisting of mainly sandstones with subordinate siltstones and mudstones. These strata are believed to dip generally towards the west or south-west.

Devono-Carboniferous (Upper Old Red Sandstone)

These strata from Fala to Soutra Mains consist of red and brown sandstones, siltstones and mudstones with a few thin beds of conglomerate. The strata dip generally towards the north at low angles.

SOLID ROCKS

Introduction

The distribution of the solid rocks underlying the route of the A68 is shown on the accompanying plan. The information is based on the published geological maps. The rocks over much of the route are largely obscured by the thick drift deposits and the only exposures are confined to the disused limestone quarries at Hope and Magazine and to a few stream sections in the deeply incised valley of the Dean Burn.

Stratigraphy

The stratigraphic sequence of the major sedimentary rock formations to be found beneath the route is as follows:

Carboniferous

Lower Limestone Group

Calciferous Sandstone Measures

Devono-Carboniferous

Upper Old Red Sandstone

Structure

All the strata formations beneath the route dip generally towards the north-west or west at angles of mainly between 5 and 10 degrees. The route crosses two major north-east trending faults, the Dunbar-Gifford Fault at Crichton Dean and the Lammermuir Fault at Fala. Both faults have large downthrows to the north-west. The Dunbar-Gifford Fault separates higher Calciferous Sandstone Measures strata to the north-west from lower Calciferous Sandstone Measures strata to the south-east. The Lammermuir Fault separates lower Calciferous Sandstone Measures strata to the north-west from Devono-Carboniferous strata to the south-east. The faults are not exposed in the area and their positions are conjectural. The position of the Lammermuir Fault in the Fala area is based on unpublished geophysical data that show a well developed gravity change thought to be associated with the fault. Each of the faults may be represented by a band or zone of broken and disturbed strata with locally steep dips. Some minor faulting is conjectured in the Lower Limestone Group south of Hope and other minor faults parallel to the two major ones described above may also be present elsewhere along the route.

Boulder Clay

This deposit, otherwise known as glacial till, is present at the surface over most of the southern part of the route from Fala to Soutra Mains. It probably also lies beneath most of the sand and gravel deposits to the north of Fala. In places, particularly in the district around Fala, the boulder clay is interbedded with sands and gravels. The deposit generally rests directly on bedrock and is normally a well-consolidated, stiff to very stiff, impervious, silty or sandy clay containing pebbles, cobbles and boulders of various rock types. The upper one to three metres of the clay are commonly weathered, more sandy and less stiff than the rest of the deposit.

The thickness of the boulder clay varies greatly along the route from less than 5 metres at Hope and an estimated 5 to 10 metres towards Soutra Mains to more than 56 metres in the vicinity of the Fala Dam Burn where a buried channel is thought to occur.

Glacial Erratics

The boulder clay in places contains numerous large ice-transported blocks of limestone and coal. Evidence exists for a large erratic containing coal seams near Fala Dam where the coal has been mined on a small scale in the past. At Marl Law Wood a large mass of shattered and folded limestone and calcareous mudstone, which was once quarried, is regarded as a very large glacial erratic.

Landslip

Several fairly extensive areas of landslip have been mapped on the steep valley sides above the Fala Dam Burn, both to the north and south of the A68. The landslips are an unstable jumble of superficial deposits, mainly boulder clay and sands and gravels, that have slumped down the valley sides.

SUPERFICIAL DEPOSITS

Introduction

Much of the route of the A68 is underlain by thick superficial deposits, otherwise known as drift or drift deposits. The distribution of these deposits, based on the published 1:10 560 scale geological maps (NT 45 NW and NT 46 SW) modified in places by more recent information, are shown on the accompanying plan. Details of borehole sections in the superficial deposits are given at the end of the report.

Drift Thickness

Over much of the route there is very little information on the total drift thickness as only a few borehole records are available. At the northern end of the route around Hope the drift is generally about 5 metres or less thick. South of Hope the drift is thought to increase in thickness fairly rapidly, reaching a maximum in the vicinity of the valley of the Fala Dam Burn where a borehole (NT 46 SW/7) proved over 64 metres of superficial deposits infilling a deep buried channel. From Fala to Soutra Mains at the southern end of the route the drift thickness is thought to decrease to an estimated 5 to 10 metres.

Alluvium

Small areas of alluvium occur as flat spreads or terraces adjacent to the Salters Burn, from Magazine to Old Crichton Dean, around Bleak Law and in the valley bottoms of the Fala Dam Burn and Dean Burn. These deposits are likely to consist of soft, unconsolidated sands, gravels, silts and clays in varying amounts. They may also contain local lenses or pockets of peat. The deposits lying alongside the rivers and streams are liable to be partly waterlogged. The alluvium is thought to generally lie on boulder clay but in the valley bottom of the Dean Burn the deposits may rest directly on bedrock in places.

Glacial Sand and Gravel

These deposits occur fairly extensively at the surface over the route from around Magazine to Fala. They lie mostly on boulder clay although in places, especially around Fala, sand and gravel is interbedded with boulder clay. The surface deposits of sand and gravel are largely moundy and of variable thickness. For the most part they are thought to be no more than 5 metres thick with locally thicker deposits of between 5 and 10 metres. Very little sand and gravel has been mapped at the surface over the route from Fala to Soutra Mains.

BOREHOLE SECTIONS

The following are abstracted details from records of boreholes in the area of the route held by the BGS. The boreholes are referred to by their BGS National Grid Sheet record number. The depths and thicknesses are in metres.

NT 46 SW		Thickness	Depth
3.	Clay, sand and gravel	3.0	3.0
	Sandy clay with gravel and fragments of weathered limestone	2.2	5.2
	SKATERAW LIMESTONE	7.5	12.7
	OLD WORKINGS (VOID)	3.9	16.6
	SKATERAW LIMESTONE	1.3	17.9
	Calcareous mudstone	0.5	18.4
	COAL	0.1	18.5
	Fireclay	0.8	19.3
	Sandstone and mudstone	7.7	27.0
	LOWER SKATERAW LIMESTONE	1.6	28.6
	Sandstone	6.5	35.1
	UPPER LONGCRAIG LIMESTONE	10.2	45.3
	Mudstone	0.3	45.6
	COAL	0.1	45.7
6.	Sand and gravel (pebbles of sandstone and limestone)	18.3+	18.3+
7.	Soil and subsoil	0.9	0.9
	Sand with blocks of coal	7.0	7.9
	Boulder clay with boulders	7.5	15.4
	Boulder clay with much sand	5.7	21.1
	Boulder clay	10.9	32.0
	Sand	0.6	32.6
	Boulder clay with boulders	5.4	38.0
	Fireclay and mudstone (glacial erratic)	2.6	40.6
	Boulder clay	23.4+	64.0+
24.	Sandy boulder clay with boulders	4.5	4.5
	Calcareous mudstone (?boulder)	0.5	5.0
29.	Solifluction till	3.0	3.0
	Sand and gravel	4.4	7.4
	Silty clay	2.5	9.9
	Boulder clay	4.4	14.3
	Sand, silt and gravel	5.7	20.0
	Boulder clay	1.1+	21.1+
32.	Sandy boulder clay	8.6	8.6
	Sand	4.9	13.5
	Silty clay and sand	5.5	19.0
	Boulder clay and gravel	2.4+	21.4+