British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Analysis of the Hollin Hill Landslide, Low Mowthorpe, North Yorkshire; Field reconnaissance survey and proposed survey recommendations

Physical Hazards Programme

Internal Report IR/06/110

BRITISH GEOLOGICAL SURVEY

PHYSICAL HAZARDS PROGRAMME

INTERNAL REPORT IR/06/110

Analysis of the Hollin Hill Landslide, Low Mowthorpe, North Yorkshire; Field reconnaissance survey and proposed survey recommendations

G. O. Jenkins, L. D. Jones & A. D. Gibson

Keywords

Landslide, Lias, Hollin Hill, Low Mowthorpe, Laser Scanning, GPS.

Front cover

Upper section of the Hollin Hill landslide complex, March 2005.

Bibliographical reference

JENKINS, G. O., JONES, L. D. & GIBSON, A. D. 2006. Analysis of the Hollin Hill Landslide, Low Mowthorpe, North Yorkshire; Field reconnaissance survey and proposed survey recommendations. *British Geological Survey Internal Report*, IR/06/110. 12pp.

Keyworth, Nottingham British Geological Survey 2005

BRITISH GEOLOGICAL SURVEY

The full range of Survey publications is available from the BGS Sales Desks at Nottingham, Edinburgh and London; see contact details below or shop online at www.geologyshop.com

The London Information Office also maintains a reference collection of BGS publications including maps for consultation.

The Survey publishes an annual catalogue of its maps and other publications; this catalogue is available from any of the BGS Sales Desks.

The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as its basic research projects. It also undertakes programmes of British technical aid in geology in developing countries as arranged by the Department for International Development and other agencies.

The British Geological Survey is a component body of the Natural Environment Research Council.

British Geological Survey offices

Keyworth, Nottingham NG12 5GG

☎ 0115-936 3241 Fax 0115-936 3488
e-mail: sales@bgs.ac.uk
www.bgs.ac.uk
Shop online at: www.geologyshop.com

Murchison House, West Mains Road, Edinburgh EH9 3LA

☎ 0131-667 1000 Fax 0131-668 2683
e-mail: scotsales@bgs.ac.uk

London Information Office at the Natural History Museum (Earth Galleries), Exhibition Road, South Kensington, London SW7 2DE

☎ 020-7589 4090 Fax 020-7584 8270
☎ 020-7942 5344/45 email: bgslondon@bgs.ac.uk

Forde House, Park Five Business Centre, Harrier Way, Sowton, Exeter, Devon EX2 7HU

☎ 01392-445271 Fax 01392-445371

Geological Survey of Northern Ireland, Colby House, Stranmillis Court, Belfast BT9 5BF

☎ 028-9038 8462 Fax 028-9038 8461

Maclean Building, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB

☎ 01491-838800 Fax 01491-692345

Columbus House, Greenmeadow Springs, Tongwynlais, Cardiff, CF15 7NE

☎ 029–2052 1962 Fax 029–2052 1963

Parent Body

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon, Wiltshire SN2 1EU

☎ 01793-411500 Fax 01793-411501
www.nerc.ac.uk

Foreword

This report describes a field reconnaissance survey carried out by the BGS in October 2005 and March 2006, in advance of detailed surveys to monitor slope instability at Hollin Hill Farm, Low Mowthorpe, North Yorkshire.

Acknowledgements

The authors would like to thank Anthony Cooper and Simon Price for their assistance during the survey, and Jon Ford for his help and advice regarding access to the site. Extended thanks also go to Mr & Mrs Stephen Gibson of Birkdale Farm, Low Mowthorpe, for their kind hospitality in granting BGS access to their land in order to survey in detail an active landslide complex.

Contents

FIGURES

Summary

This report is a result of a study by the British Geological Survey (BGS) investigating a landslide complex at Hollin Hill, Low Mowthorpe in North Yorkshire. The report provides an initial appraisal of a slope, and the proposed survey to be carried out in the autumn of 2006.

1 Introduction

BGS was alerted to the presence of a landslide at Birkdale Farm by the landowner, Mr Stephen Gibson, who approached field survey geologist Jon Ford at a meeting of the Ryedale Vernacular Building Materials Research Group.

A visit was made to the farm by the landslide and mapping team during the October 2005 field reconnaissance survey. A walkover survey of the slope proved that the landslide was very active, with common slumping and arcuate backscarps. It was evident, due to the morphology and immaturity of the landslide features that movement on the slope has occurred relatively recently. The landslide at Hollin Hill provides BGS with a unique opportunity to monitor an active terrestrial landslide.

A second visit was made to the site in March 2006 by BGS staff Lee Jones, Gareth Jenkins and Mike Raines. The purpose of this visit was to conduct a second walkover survey in order to assess the best strategy for surveying and monitoring of the slope.

2 Geological Background

The slope at Hollin Hill consists of Redcar Mudstone (Lower Lias) at the base, with an outcrop of the Staithes Sandstone Formation (Middle Lias) running across the middle section of the slope (evidenced from sandy soil excavated by badger setts). The Whitby Mudstone Formation (Upper Lias) overlies this, with the upper part of the slope composed of the Dogger Formation. Both the Redcar Mudstone and the Whitby Mudstone are highly susceptible to landsliding, and movement across the entire slope is facilitated by these two Formations.

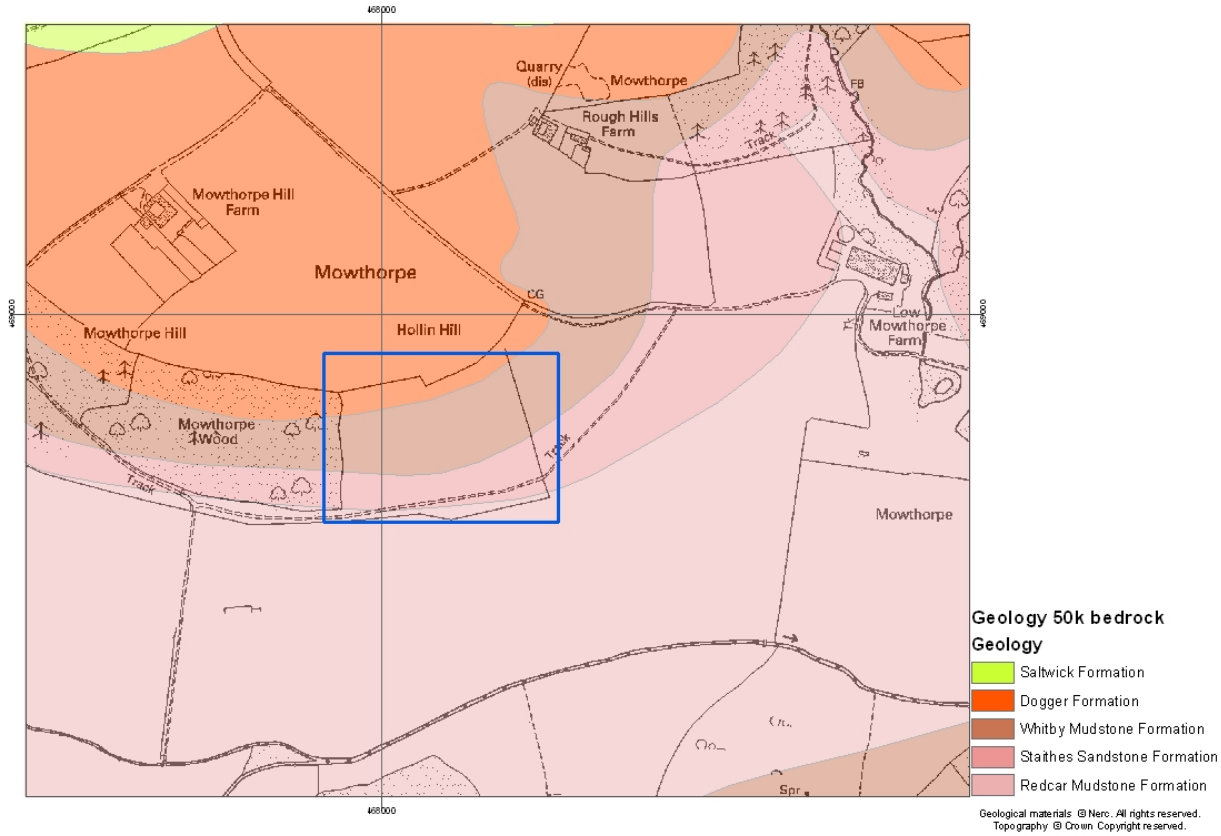

Figure 1. Geology of the Hollin Hill landslide (study area in blue).

The Redcar Mudstone forms the base of the Lias Group and comprises (at maximum) up to 200m of mainly dark grey mudstones and siltstones; subsidiary thin limestones (concentrated in the lower third), very fine grained sandstones, and sideritic and 'chamositic' ironstone beds and nodules are also present (Powell, 1984).

The Staithes Sandstone Formation comprises approximately 20m (at maximum) of fossiliferous, micaceous, calcareous, very fine- to fine-grained sandstone. It is yellow-brown at outcrop but grey when fresh with interbedded grey siltstone and silty mudstone.

The Whitby Mudstone Formation, which forms the upper part of the Lias Group, typically consists of bluish grey to dark grey, sparsely fossilifereous, fissile, locally bituminous mudstones and siltstones. Bands of calcareous concretions are common at some horizons. At its thickest it reaches about 25-30m thickness in the study area.

The Dogger Formation is composed of a massive, fine to medium-grained sandstone, up to 2.7 metres in thickness. The matrix is calcareous and in places poikilitic, and the basal part is almost a sandy limestone. Scattered to locally abundant ooliths are present except near the top of the formation (Gaunt *et al.*, 1980).

3 Nature of slope

Observation of the Hollin Hill landslide during the walkover survey showed it to be approximately 150 metres in length (downslope) with a width of at least 260 metres (across slope). These dimensions refer to the area of unstable ground that will be covered during the monitoring of the slope. The unstable ground was observed to continue into the wooded area to the west of the study area (Figure 2), but due to the dense cover of mixed woodland, it is not

possible to monitor this area. The slope faces south to south-south-east and the gradient shallows to form a wide, flat field to the south of the landslide. The morphology of the slope is complex with numerous isolated shallow failures and slumping (Figures 3 and 4). Locally the slope becomes very steep where slipped material has accumulated to form lobes (Figure 5).

The Dogger Formation is believed to be present in the fields immediately above the landslide (the area is currently being re-mapped by the BGS), and conversation with the landowner suggests that water drains from the Dogger Formation into the Lias sediments that underlie the slope. This causes the sediments to become saturated, leading to increased pore water pressure, which causes the slope to fail.

Figure 2. SW corner of the Hollin Hill landslide. Photograph taken from ^{4}68046 ^{4}68799, orientation 250° (ESE).

Figure 3. Shallow rotational failures in the Hollin Hill landslide. Photograph taken from ^{4}68107 ^{4}68858, orientation 045° (NE).

Figure 4. Small scale rotational failures in the Hollin Hill landslide. Photograph taken from ^{4}68082 ^{4}68822, orientation 065° (ENE).

Figure 5. Localised steepening of the slope from lobe accumulation. Photograph taken from ^{4}67954 ^{4}68735, orientation 015° (NNE).

4 Survey Plan

From the walkover survey, it is evident that the slope at Hollin Hill was, at the time of survey, an active site. The landowner is very interested in the site and it provides BGS with a unique opportunity to monitor an active terrestrial landslide.

A BGS team of Lee Jones and Gareth Jenkins will undertake an initial baseline survey of the site, using the Riegl LPM880HA laser scanner, coupled with a Leica SR530 differential global positioning system (dGPS). The survey will involve 15 scans, orientated in a 5x3 grid across the slope (Figure. 6). (Additional scans may be necessary in order to capture areas of shadowing). This will enable a 3-dimensional, geo-rectified model of the slope to be produced, from which any future slope movement can be compared, thus providing an insight into the mechanisms and volumes of movement. Repeat surveys will initially be undertaken every 6 months. This may potentially be extended to 12 months depending on the level of activity. It is also anticipated that responsive surveys may also be undertaken if significant movement occurs at the site in the intervening periods.

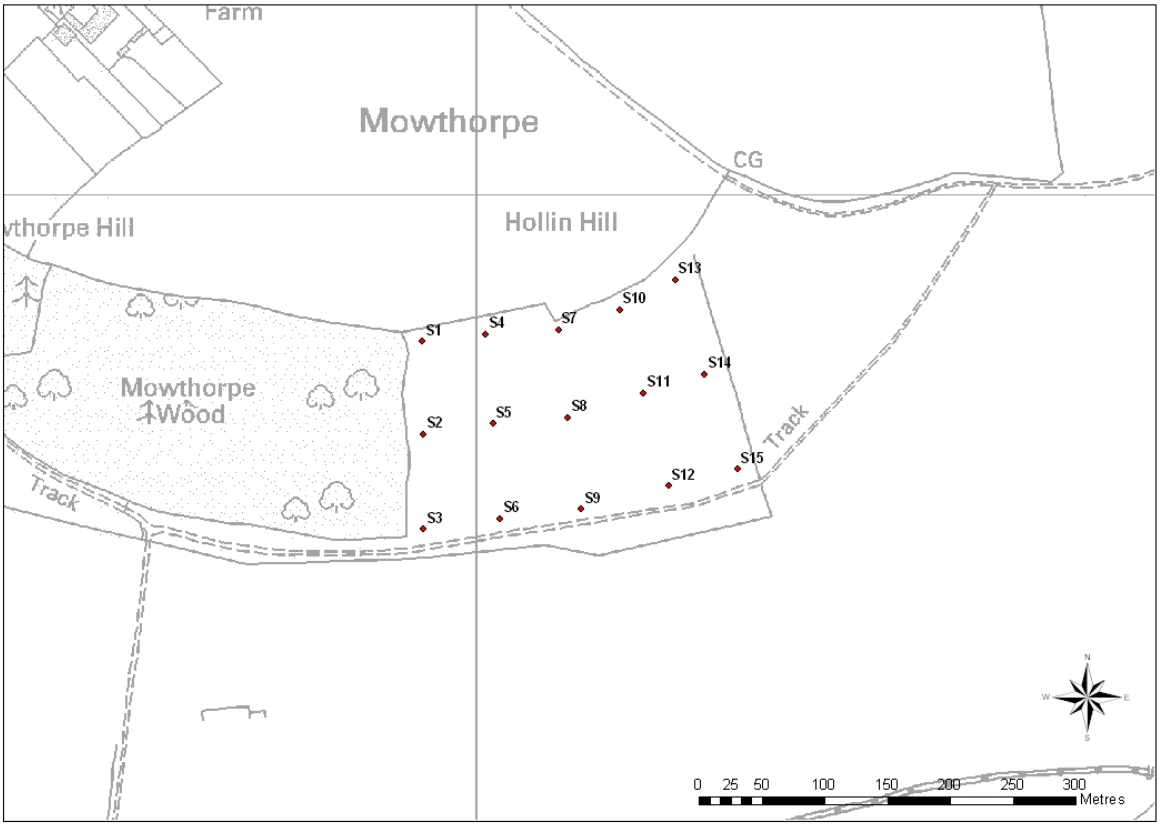

Figure 6. Proposed Hollin Hill survey station locations.

References

Most of the references listed below are held in the Library of the British Geological Survey at Keyworth, Nottingham. Copies of the references may be purchased from the Library subject to the current copyright legislation.

GAUNT, G. D., IVEMY-COOK, H. C., PENN, I. E. & COX, B. M. 1980. Mesozoic rocks proved by IGS boreholes in the Humber and Acklam areas. *Report of the Institute of Geological Sciences*, No 79/13.

POWELL, J. H. 1984. Lithostratigraphic nomenclature of the Lias Group in the Yorkshire basin. *Proceedings of the Yorkshire Geological Society*. **45**, (1-2). P 51-57.