British Geological Survey

Eddleston groundwater and soil moisture monitoring

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Contents

FIGURES

1 Project scope

This report describes work undertaken to continue monitoring at two experimental sites on the Eddleston Water, a tributary of the River Tweed. These experimental sites were set up as part of the wider Eddleston Water Project, which aims to reduce the impact of flooding in and downstream of the village of Eddleston. For a full description of the project, including how and why the monitoring network was established, please see Spray et al. (2016).

The first experimental site is part of Darnhall Mains Farm, adjacent to the village of Eddleston (Ó Dochartaigh et al. 2019). It is approximately 0.2 km^2 (approximately 400 m by 500 m) and covers most of the width of the Eddleston Water floodplain on both sides of the river (Figure 1). The site is farmland predominately comprising mixed livestock farming on improved grassland, but part of the floodplain has been fenced off, which has allowed trees to be planted and vegetation to recover. The monitoring at this site comprises eight boreholes in which groundwater level is recorded. The data are stored with the National Geoscience Data Centre (https://www.bgs.ac.uk/geological-data/national-geoscience-data-centre/, ID 128585). A key objective of the experimental site is to improve understanding of the role of groundwater in floodplain environments and during flooding. In particular, we want to understand the role of antecedent conditions in controlling the ability of the floodplain to act as a buffer between hillslope and river.

The second experimental site is the Cringletie hillslope observatory (Figure 1, Peskett et al. 2020). The site is approximately 2500 m^2 (approximately 50 m by 50 m) and comprises two transects parallel to the slope: one through a narrow forest strip and one on improved grassland used for mixed livestock farming (see Peskett et al. 2020). The installed monitoring equipment comprises soil moisture sensors, rain gauges and piezometers fitted with pressure transducers. The site was set up by Dr Leo Peskett as part of his PhD and was handed over to the BGS in 2020. The aim of the experimental site is to determine whether forest strips planted perpendicular to a hillslope can reduce surface runoff during flood events.

In 2020, the BGS received funding from the Scottish Government to check the monitoring equipment; download all data and reset the loggers; replace broken equipment; and collate, process and quality check the data. In 2020/21, fieldwork was affected by the Covid-19 restrictions with colleagues travelling separately to the sites and maintaining social distancing, among other precautions.

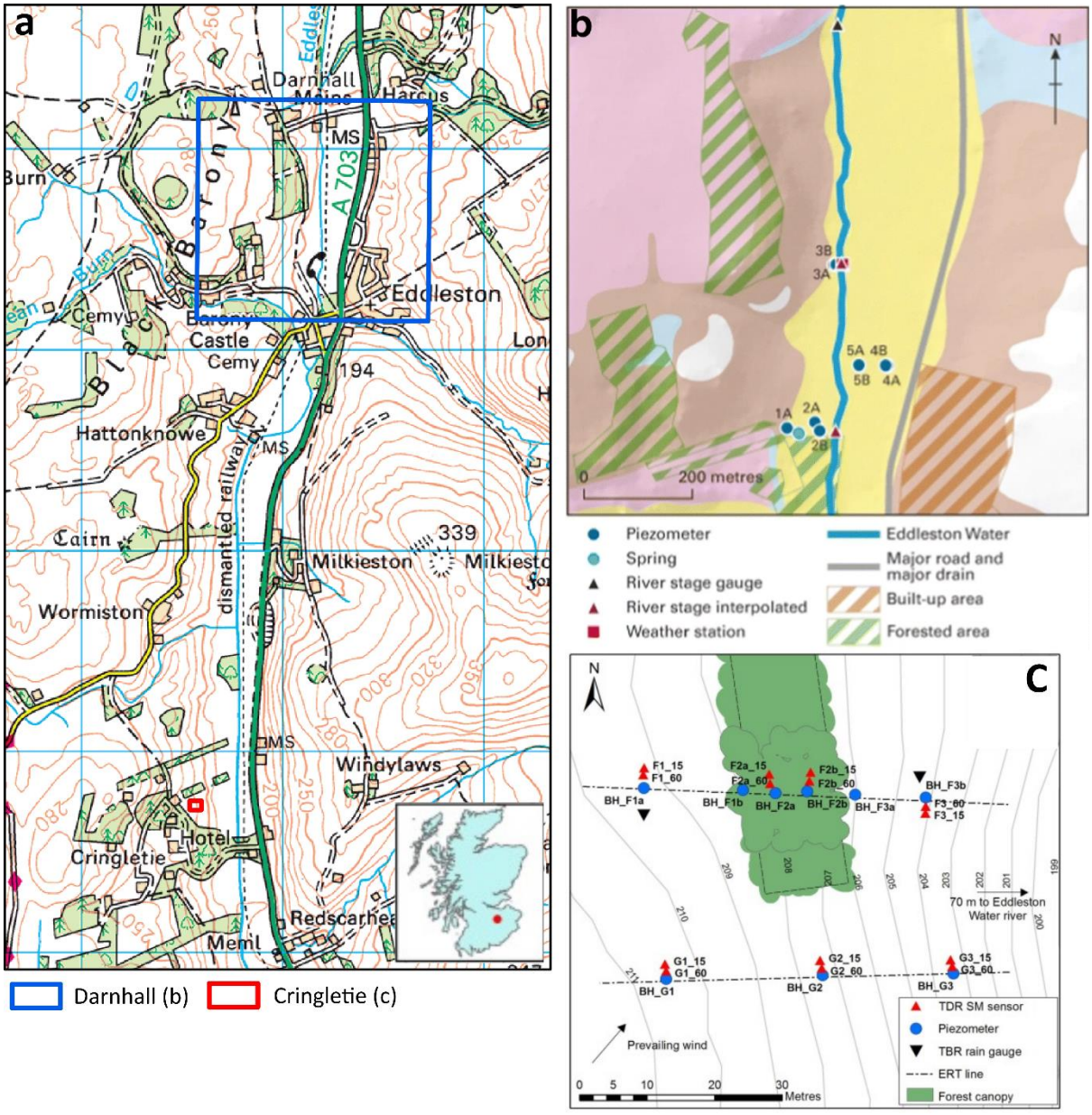

Figure 1 (a) Map of Eddleston experimental sites. (b) Monitoring boreholes at Darnhall (reproduced from Ó Dochartaigh et al. 2019). (c) Soil moisture sensors and piezometers at Cringletie hillslop observatory (reproduced from Peskett et al. 2020). Contains Ordnance Data © Crown Copyright and database rights 2021. Ordnance Survey Licence no. 100021290.

2 Darnhall floodplain monitoring

There are eight monitored boreholes at the Darnhall floodplain site (Ó Dochartaigh et al. 2019; Figure 1b). In November and December 2020, data from pressure transducers in six of the eight boreholes were successfully downloaded. Data from an additional pressure transducer at the same site that measures atmospheric pressure were also downloaded. One borehole, 4B, was inaccessible due to flooding. The pressure transducer in 2A was found to have malfunctioned and no data could be recovered from it. Three new pressure transducers were installed in 1A, 2A and 3B. The remaining transducers were reset.

The groundwater level data were compensated for atmospheric pressure and quality checked. The processed groundwater level data can be found in Figure 2.

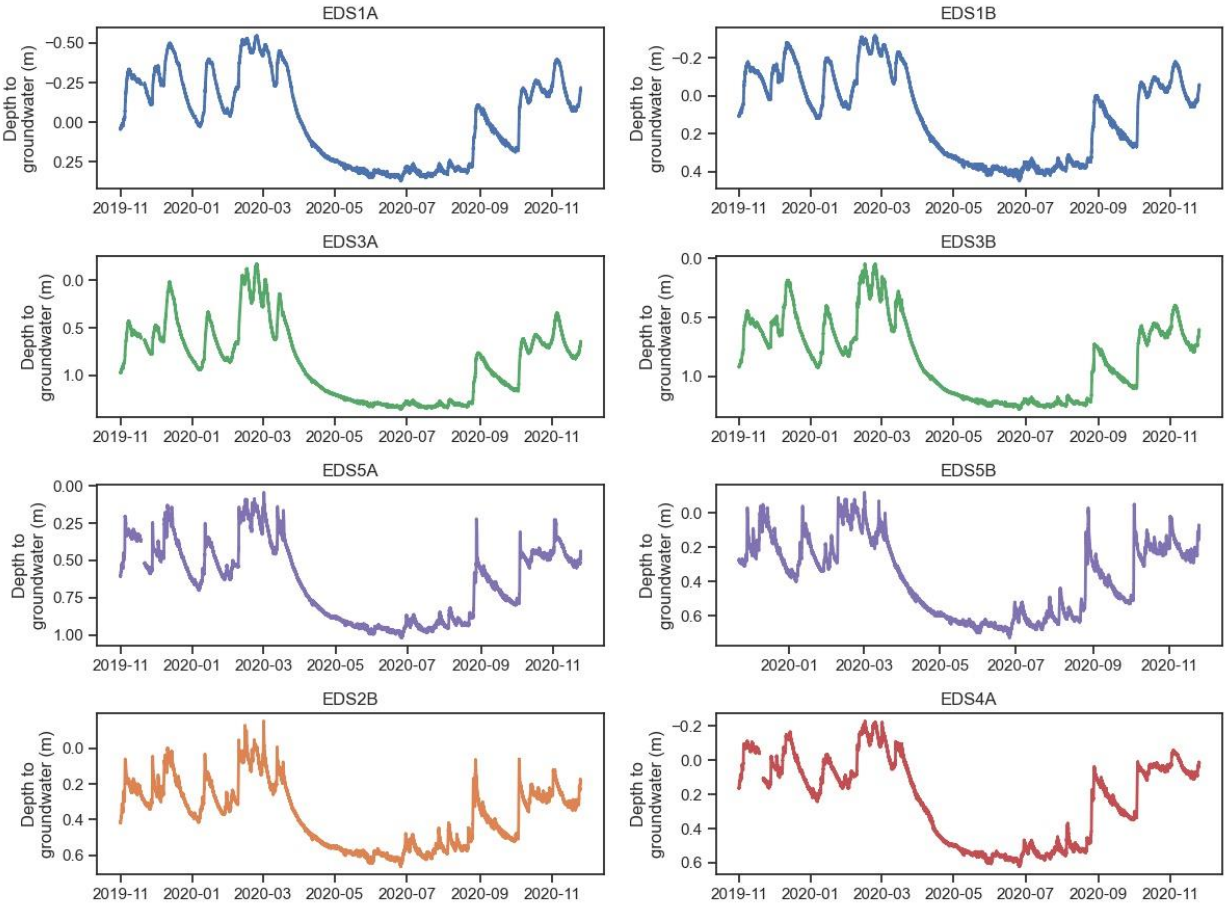

Figure 2 Groundwater levels at floodplain boreholes for period November 2019 to November 2020. Locations in Figure 1b.

3 Cringletie hillslope monitoring

In 2020, BGS took over the maintenance of the Cringletie hillslope observatory installed by Dr Leo Peskett as part of his PhD (Peskett et al. 2020). The site consists of 14 soil moisture sensors, 2 rain gauges and 7 piezometers fitted with pressure transducers (Figure 1c).

3.1 Soil Moisture

Most of the soil moisture loggers stopped due to a loss of battery power in June/July 2020, although two of the loggers – G1_15 and G1_60 – continued until late September 2020. The data were downloaded and the loggers reset. All batteries were replaced. The soil moisture data are plotted in Figure 3.

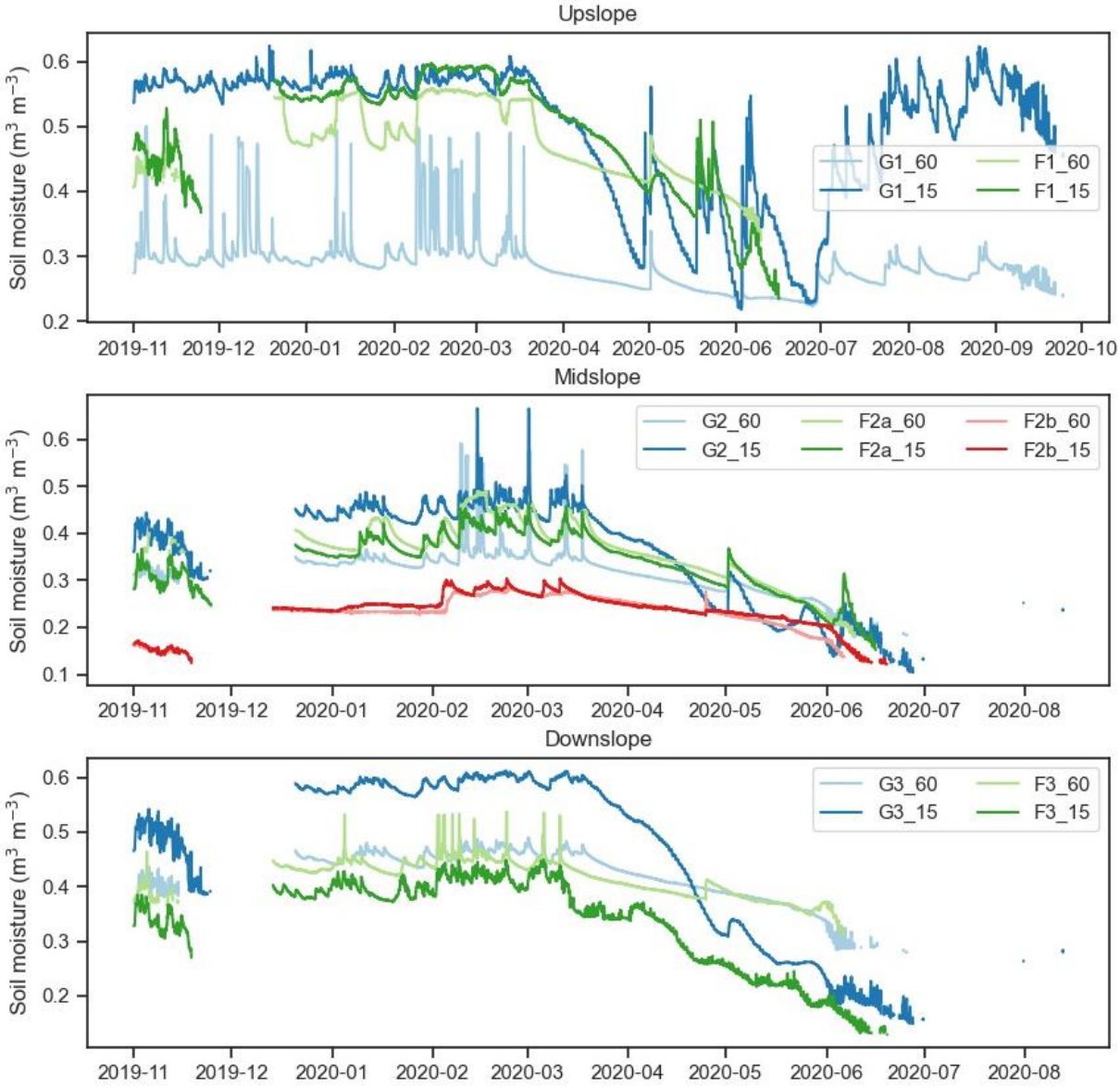

Figure 3 Measured soil moisture from November 2019 to November 2020.

3.2 RAINFALL

The two rain gauges – one is located above the forest strip and the other below (Figure 1c) – were found to be in good working order. They stopped logging in July 2020 due to a loss of battery power. The batteries were replaced and the loggers reset. The rainfall data are plotted in Figure 4.

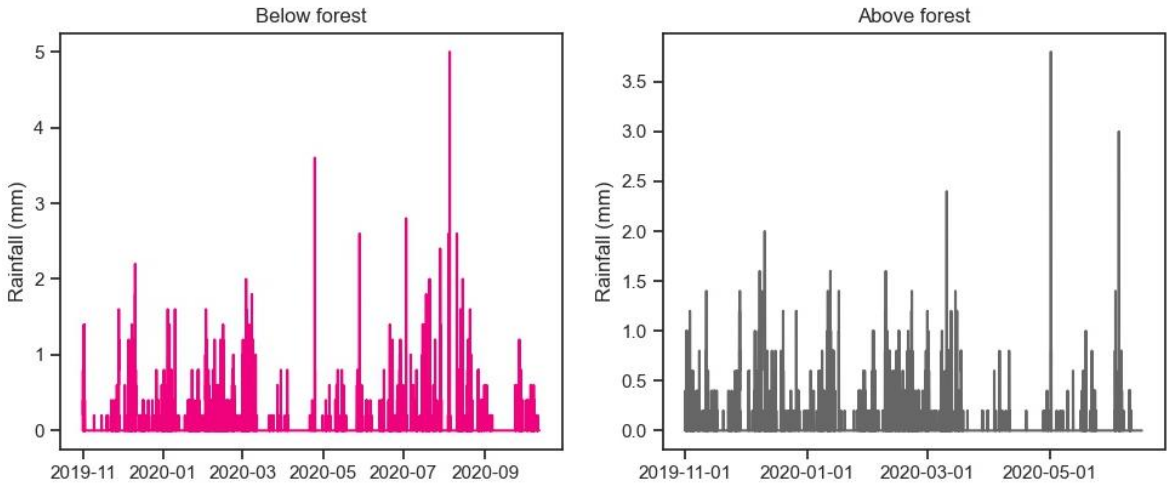

Figure 4 Measured rainfall above and below forest strip.

3.3 GROUNDWATER LEVELS

The groundwater level loggers were found to be logging and in good working order. The data were downloaded from all loggers and they were reset. The groundwater data were compensated for atmospheric pressure and quality checked. Most piezometers were dry at the time of the visit (November 2020) and, as can be seen from the data (Figure 5), all piezometers were dry throughout the summer.

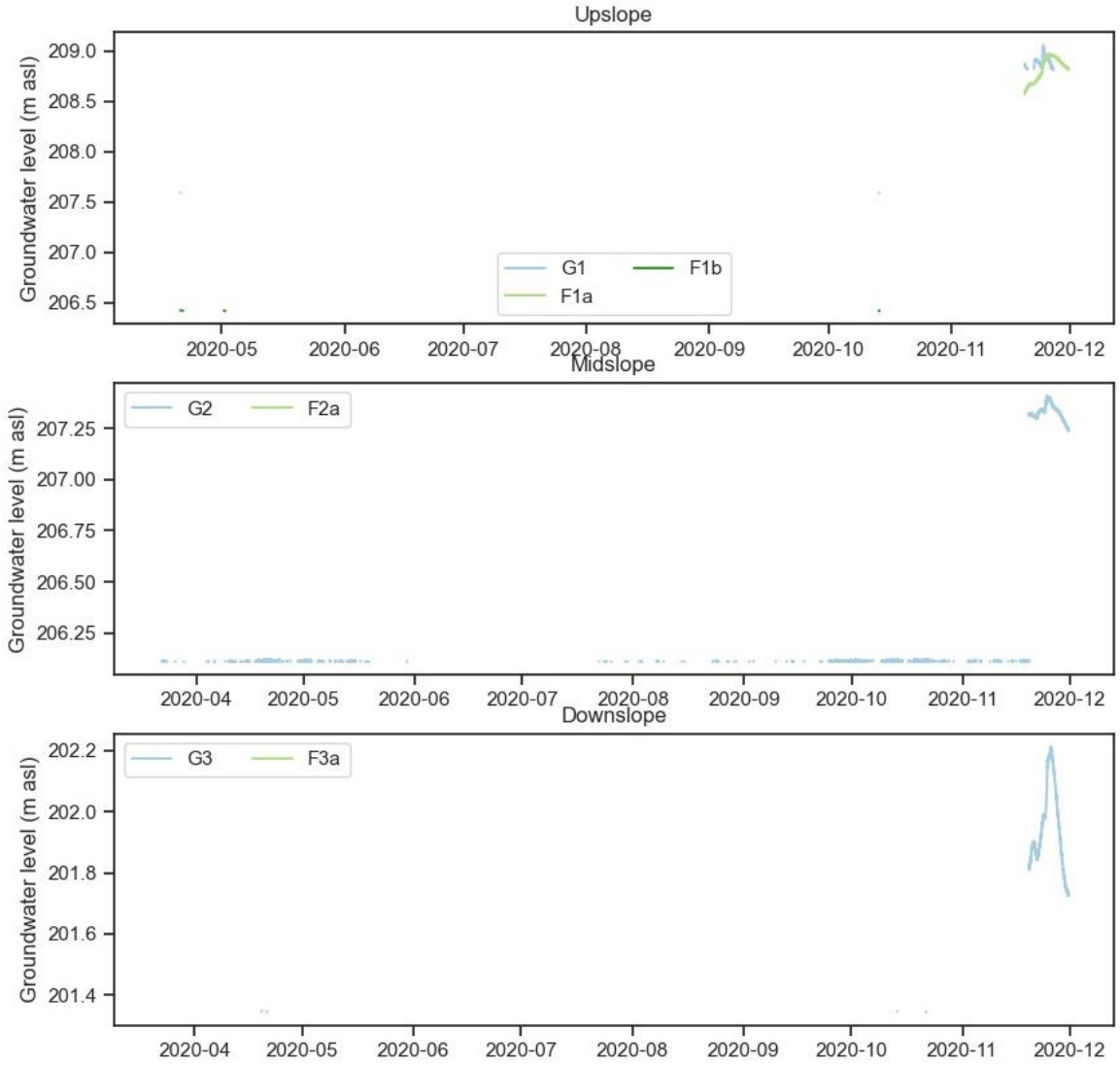

Figure 5 Groundwater levels after compensating for atmospheric pressure in 2020.

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