

17 March 2021

Head of Highways and Construction  
Pembrokeshire County Council  
County Hall  
Haverfordwest  
Pembrokeshire  
SA61 1TP

For the attention of Mr P Morgan

Project Name: St Dogmaels Landslide  
Project Number: 202089CH

**Subject: Consultancy Services - Inspection and monitoring 2021**

Dear Sirs

We are pleased to report the results of the inspection of the St Dogmaels Landslide and of the monitoring of the piezometers and wells at the site undertaken on 11 and 12 March 2021. The work was undertaken in accordance with the inspection and monitoring activities set out in Section 3.1 of the St Dogmaels Landslide: Site condition and future requirements report dated April 2017.

A copy of the landslide inspection checklist is enclosed together with a copy of figures presenting the current observations of water levels in piezometers and wells, together with previous observations made at the site for comparison. An electronic copy of the monitoring data files will be issued by email for Pembrokeshire County Council (PCC) records.

### **Landslide inspection (ref Landslide Inspection Checklist)**

The inspection of the landslide revealed no evidence of active landslide ground movements throughout the main body of the landslide area. As previously observed, the backscar and side scarps of the landslide show the effects of ongoing soil creep, however this is not considered significant. The ground immediately in front of the landslide backscar was saturated as were most of the fields at Pencnwc Farm. These observations are similar to those made in March 2020 and are considered to reflect the significantly higher than average rainfall experienced at the site during the 2020/2021 autumn and winter period, discussed further below.

In 2012 the landslide lateral shear located in the field south-east of Pencnwc Farm showed signs of instability in the form of development of a step feature. The step feature coincided with the fissure that developed at this location during the 1994 landslide event and which re-opened post the 1997/1998 landslide stabilisation measures. This area of slope is beyond the expected influence of the well drainage system installed in 1997/1998 to stabilise the landslide. PCC installed additional shallow sub-surface drainage in parts of the slope circa 2001 to improve its stability. Over subsequent years including the current inspection, the step feature has become

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increasingly degraded and less prominent consistent with the area having remained stable with no significant further movement having taken place since.

During the 2021 inspection, the properties both sides of the upper part of Cwmins Hill (coinciding with location of the former landslide lateral shear) appeared in good condition with only occasional localised cracking noted in some boundary walls. The observed cracking was old and was little changed from previous inspections, as can be seen by comparing the photographs presented in the 2021 landslide inspection checklist with those included in the 2020 and earlier checklists. It is considered that the cracking in the boundary walls represents local ground movements rather than the effects of any landslide displacement. The former landslide lateral shears crossed the ends of Ffordd y Cwm. The road at those locations was found to be in good condition, as were the properties in the area. Localised cracking was noted to some property boundary walls, but this was old and reflects construction or localised ground problems and is not related to landslide movement.

## **Rainfall**

Total rainfall of 1163mm was recorded at Aberporth weather station in 2020, which is about 31% above the long term (1981-2010) average. Monthly rainfall over the autumn and winter period months September 2020 to November 2020 was about average, but in subsequent months December to February it was consistently well above normal, between 165% and 207% of average. The total rainfall in the autumn and winter period was 722mm, 36% above of the long-term average. Owing to reduced evapotranspiration in late autumn and winter months, rainfall tends to have a greater effect on ground water levels compared to other times of the year.

## **Water level observations (ref Figures P2 to P5, P7, P8 and W1 to W4 inclusive)**

### Upper and central areas of landslide – zones with well installations

#### *Introduction information*

As described in the St Dogmaels Landslide Report on Efficacy of Landslide Remedial Measures dated November 1999, artesian and high sub-artesian groundwater levels existed throughout the landslipped soils in the upper and central areas of the St Dogmaels landslide prior to the installation of the gravity wells drainage remedial measures in 1997/1998. The wells were successful in lowering the piezometric levels by typically 4 to 4.5m in the upper area of the landslide and by up to 2m in the central area, thereby stabilising the landslide with adequate factors of safety.

The piezometer installations for monitoring water levels within the landslide deposits in the upper and central areas of site are in general located centrally within the grid on which the wells were installed. At the wells, the groundwater levels are drawn down to the well tapping off point at around 3m below ground surface. Consequently, the water levels at the centrally located piezometers can be expected to represent peak piezometric levels within the landslide deposits, with average piezometric levels within the landslide deposits being between the piezometer water level and the well drawdown level.

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## *2021 observations*

In the upper area of the landslide, the groundwater levels recorded within all piezometer installations (SDL2b, SDL2Aa, SDL3a, SDL3b, SDL4a, SDL4b, SDL4Aa, SDL4Ab, SDSDL5Aa and SDL5Ab) were within about 0.5m of ground surface, ref Figures P2, P3, P4 and P5. This is comparable with levels recorded in recent years, post landslide remediation. As seen on the figures, in general the groundwater levels in March 2021 were similar to those observed in March 2020. This is consistent with the similar rainfall experienced in the corresponding autumn/winter periods which was significantly higher than the long-term average. The observed groundwater levels were, however, within the range experienced post landslide remediation and remain typically 1 to 4m below the levels that existed prior to the installation of the wells drainage landslide stabilisation works.

Within most of the wells in upper area of the landslide, water levels were similar to previously recorded values (as seen on Figures W1, W2 and W3), at around the tapping-off level of the individual well. This is consistent with their continued satisfactory function. Historically, groundwater levels at a few of the wells, notably SDL41 and SDL65, have been lower than the well tapping-off point. Consequently, the observations have shown fluctuations in water level reflecting the piezometric levels in the surrounding ground. In March 2021, the water levels in well SDL41 and SDL65 were slightly lower than recorded in March 2020.

In the central area of the landslide the recorded water levels (piezometers SDL7a, SDL7b, SDL7Aa, SDL7Ab, SDL8a, SDL8b, and SDL8Ab) were within the range of previous post landslide remediation observations, ref Figure P7 and P8. Generally, the groundwater levels were similar to those observed in March 2020, most likely reflecting the similar rainfall.

Similar to the wells in the upper area, most wells in the central area (as seen on Figure W4) show constant water levels at around the well tapping-off point, consistent with their continued satisfactory function. Historically the water level in well SDL72 has been below the well tapping-off point and the observations have shown fluctuations. The water level in well SDL72 in March 2021 was marginally lower than the previous observation in March 2020, but within the range of previously recorded water levels.

## **Conclusions and Recommendations**

The groundwater levels observed across the site in March 2021 were in general similar to those recorded in March 2020. This is consistent with the similar rainfall experience in the corresponding autumn/winter periods, which was significantly higher than the long-term average.

The observations show that the wells continue to regulate groundwater levels within the landslide to levels well below those that existed prior to the 1997/1998 landslide remediation works. With reference to our report entitled St Dogmaels Landslide Report on Efficacy of Landslide Remedial Measures dated November 1999, and letters covering previous annual inspections and monitoring of the site, we confirm that the landslide remains secure.



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We trust the above meets with your requirements. If, however, there are any matters you wish to discuss please do not hesitate to contact us.

Yours faithfully

**J D Maddison**

Director of Ground Engineering

dean.maddison@jacobs.com

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