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Godre'r Graig Village Land Stability Summary

Prepared for:

Neath Port Talbot County Borough Council

The Quays, Baglan Energy Park,
Brunel Way, Briton Ferry,
SA11 2GG



Report Reference: **ESP.7234e.7372e.3451.Rev1**

1 Introduction

Neath Port Talbot County Borough Council (NPTCBC) instructed ESP to develop this Land Stability Summary based on previous detailed landslide hazard and risk assessments for the village of Godre'r Graig, located in the Tawe Valley.

The final reports should be read for context: ESP.7234e.3221 (August 2019), 7234e.02.3302 (February 2020) and 7372e.3337 (June 2020) along with each relevant executive summary. The general study area is shown on Figure 1.

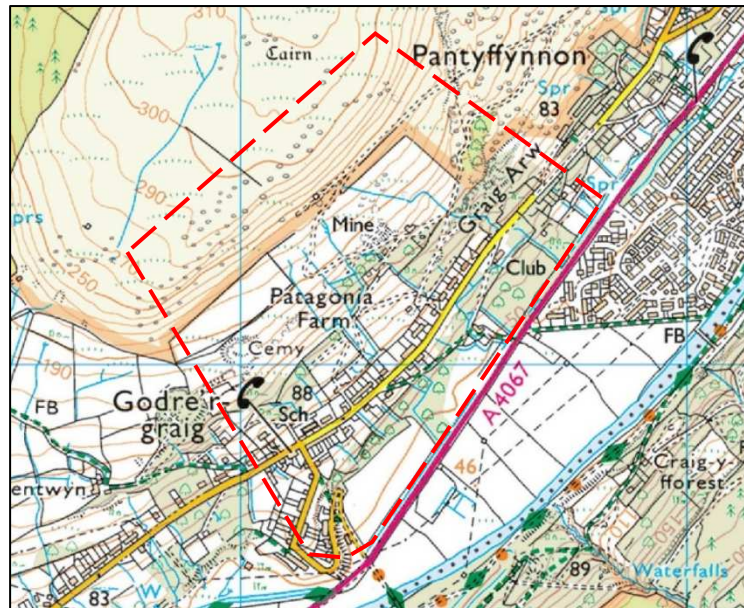


Figure 1: General Study Area 1:10,000 (Ordnance Survey License No.: AL100015788).

2 Important findings from each study area

2.1 Primary School Area

Our preliminary assessment, August 2019 (Ref: ESP.7234e.3221), considered a 'possible' likelihood and a consequence of 'moderate' of a landslide hitting the school; the qualitative risk assessment was 'medium risk'. We noted that a medium risk may be tolerated in certain circumstances but requires investigation, planning and implementation of treatment options to reduce the risk to low.

This summary provides a brief overview of the outcomes of further investigation and assessment work (Ref: ESP.7234e.02.3302, February 2020). Site investigation allowed the Ground Model to be developed. The Quarry Spoil Tip was found to comprise two separate strata, both classed as Coarse Discard, i.e., generally cobbles and gravel of sandstone. There is a lower unit with a higher fine-grained component (clay, silts). Below the Quarry Spoil, Glacial Diamicton has been found which overlies weathered and intact bedrock.

Groundwater has been observed in the Quarry Spoil Tip and monitoring has shown a variable head of water. The Investigation Point Plan is included here as Figure 2.

2.2 Wider Godre'r Graig Village

A study of the wider Godre'r Graig village has been carried out in relation to landslide hazards (Ref: 7372e.3337 (June 2020)). A large amount of mining has been carried out in the surrounding area, with tips and spoils mounds from rock quarries and coal mines. The No. 2 Rhondda and Upper Pinchin seams are located above the village and were worked. There are several springs and streams in the area, which flow downhill toward the east or southeast. Water has been noted issuing out of adits.

There is evidence of small landslides, instability associated with former adit locations. Shallow depressions associated with springs may be the 'shallow slips' noted on the geological map.

3 Primary School Area; Preliminary Investigation and Additional Assessment

3.1 Preliminary Slope Stability Assessment

Initial slope stability assessment has been undertaken to assess the Factor of Safety (FoS) within the Quarry Spoil Tip. The FoS is simply the ratio of disturbing forces against restoring forces and gives a simple indication to stability.

After some careful selection and refinement of appropriate material parameters, the Slope Stability modelling has shown that the slope is 'marginally stable', which is likely to represent the current condition, as the material would have been 'end tipped' and reached a state of stability on the hillside. This assessment broadly aligns with the medium risk assigned to the Quarry Spoil Tip in our previous report (ESP 2019).

The slope stability assessment showed that the tip stability was variable with a variable head of water. Typically, higher the water level the stability decreased, and vice versa. To put the stability assessment into context, broad definitions to describe a stability condition are described below:

- **Stable** – the margin of stability is sufficiently high to withstand all destabilising forces;
- **Marginally Stable** – likely to fail at some time in response to destabilising forces reaching a certain level of activity; and
- **Actively unstable** – slopes where destabilising forces produce continuous or intermittent movements.

The initial slope stability assessment based on ground investigation has shown that the Quarry Spoil Tip is marginally stable. This is below what would be expected for modern engineering standards given the high risk to life if failure were to occur. Monitoring of the in-ground instrumentation in 2020 suggests that the Quarry Waste (Hazard Type 2a), may be, or has become, actively unstable; downward continuous and/or intermittent movements have been recorded via inclinometers.

3.2 Discussion of Remedial Options

Risk management or mitigation options were considered and followed an assessment using a semi-quantitative scoring system. Mitigation options were scored for effectiveness, durability, practicability, sustainability and cost. The scoring system was given +1, for a positive impact, 0 (or zero) for a neither negative or positive impact and a -1 for a negative impact, all relative to the other options.

The risk management or mitigation options that scored the highest were:

- Stop using the current school property such that the tip no longer represents a risk to users, 1 point; or
- A combined approach of incorporating drainage to create betterment only, install monitoring points and produce warning system, 2 points.

The assessment showed that removing the tip to landfill or some combination of hard engineered structure(s) are unlikely to be favourable.

4 Wider Godre'r Graig Village; Preliminary Landslide Hazard and Risk Assessment

4.1 Hazard Types and Risk Assessment

Hazard types occur in different areas, and they do not represent a hazard to each individual house in the village; for example, Hazard Type 2a and 2b will not impact all of the village, only the school or houses near the school as they are proximal to those hazards.

The risk assessment information is included in our main reports; however, the findings of the assessment are presented in Table 1 below, and the Risk Map is presented as Figure 3.

Table 1: Summary of Estimated Level of Risk to Property

Hazard Type	Likelihood Designation	Consequence Descriptor	Risk
Hazard Type 1 - Rock fall Rock fall initiating from outcrops of the Rhondda Sandstone	Unlikely	Minor	Low
Hazard Type 2a – Quarry spoil landslide Impact from debris avalanche initiating from <i>quarry</i> spoil	Unlikely to barely credible*	Medium	Low to Very Low*
Hazard Type 2b - Colliery spoil landslide Impact from debris avalanche initiating from <i>colliery</i> spoil	Unlikely to barely credible*	Medium	Low to Very Low*
Hazard Type 3 - Landslides associated with the working of the Upper Pinchin seam Impacts from debris avalanches originating from over steep slopes associated with the coal workings	Unlikely (likely for a single property)	Insignificant	Very low (low for a single/specific property)
Hazard Type 4 - Shallow earth slides	N/A	N/A	N/A
Notes: 1. Based on AGS qualitative risk analysis matrix. *Depending on travel angle to element at risk.			

Based on the above it has been assumed that the risk to residential properties to the south of Graig Road is very low.

No specific assessment has been carried out to assess the risk to members of the public using/visiting the cemetery. However, the cemetery will have a lower usage than the surrounding residential houses. Given that the shallow earth landslides are very slow to slow moving and appear to be limited in depth, risks to cemetery users is likely to be lower.

5 Conclusions

5.1 Primary School Area

Risk management or mitigation options were considered and following an assessment using a semi-quantitative scoring system. Each mitigation option was scored for effectiveness, durability, practicability, sustainability, and cost. The scoring system was given +1, for a positive impact, 0 (or zero) for a neither negative or positive impact and a -1 for a negative impact, all relative to the other options. The risk management or mitigation options that scored the highest were:

1. Stop using the current school property such that the tip no longer represents a risk to users, 1 point; or
2. A combined approach of incorporating drainage to create betterment only, install monitoring points and produce warning system, 2 points.

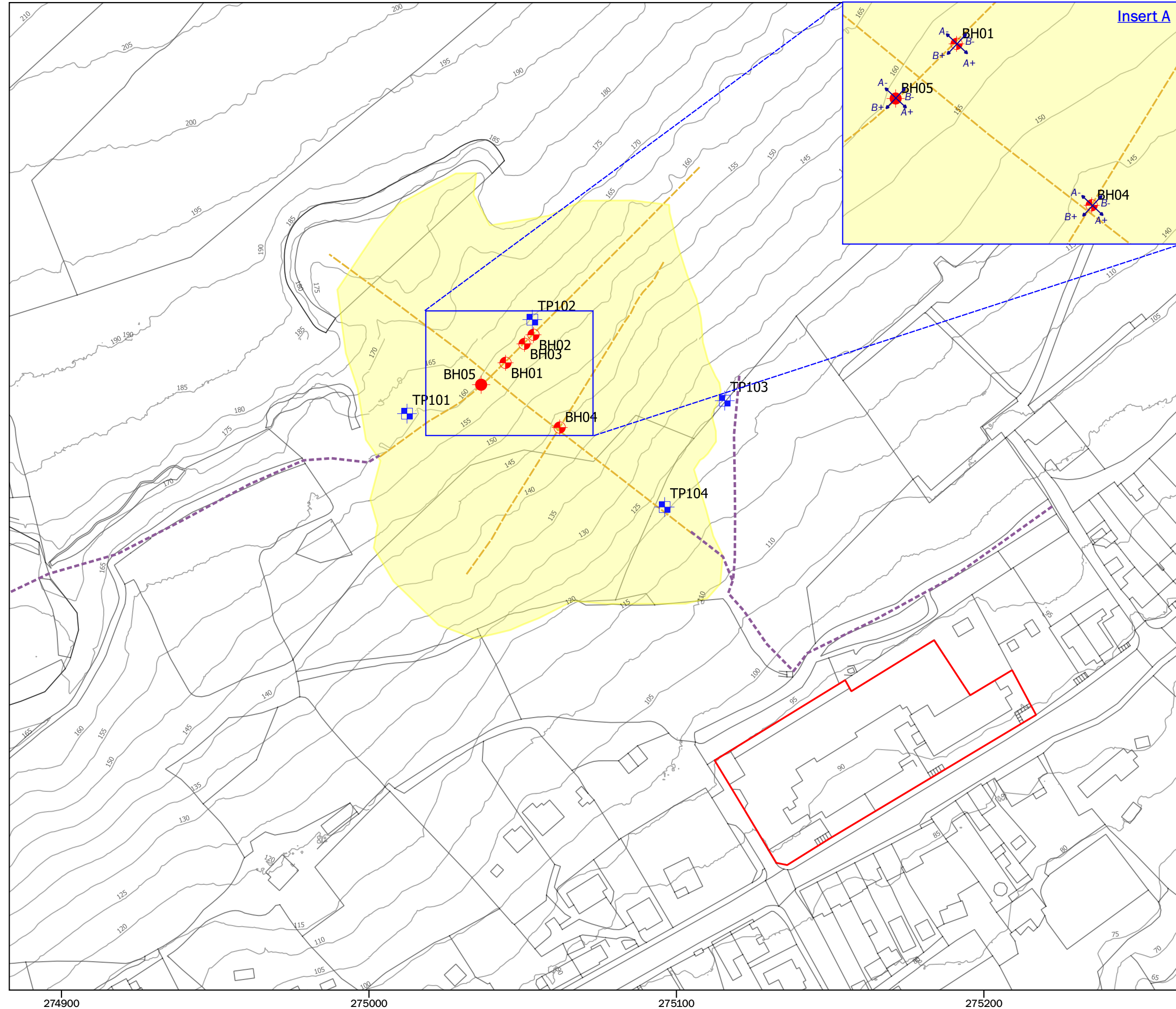
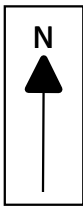
The assessment showed that physically removing the tip or some combination of hard engineered structure(s) are unlikely to be favourable.

The initial slope stability assessment based on ground investigation has shown that the Quarry Spoil Tip is marginally stable. This assessment broadly aligns with the medium risk assigned to the Quarry Spoil Tip in our previous report (ESP 2019).







Monitoring of the in-ground instrumentation in 2020 suggests that the Quarry Waste (Hazard Type 2a), may be, or has become, actively unstable; downward continuous and/or intermittent movements have been recorded via inclinometers. This would need to be considered in point 2 above.

5.2 Wider Godre'r Graig Village

The assessment has shown that there is a very low to low risk to residential properties in Godre'r Graig, which is "usually acceptable to regulators" (AGS, 2007). No specific remedial or mitigation recommendations are considered necessary. Risks to cemetery users is likely to be lower than the risks to residential properties surrounding the cemetery. The risk to residential properties to the south of Graig Road is very low.



Key

-  GrG Primary School Boundary
-  CP Borehole Locations
-  RC Boreholes
-  Trial Pit Locations
-  Geophysics Profiles
-  Access Tracks

Details of inclinometer installations are shown on Insert A

Notes:
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SCALE: 1:1,250 (approx. @ A3)

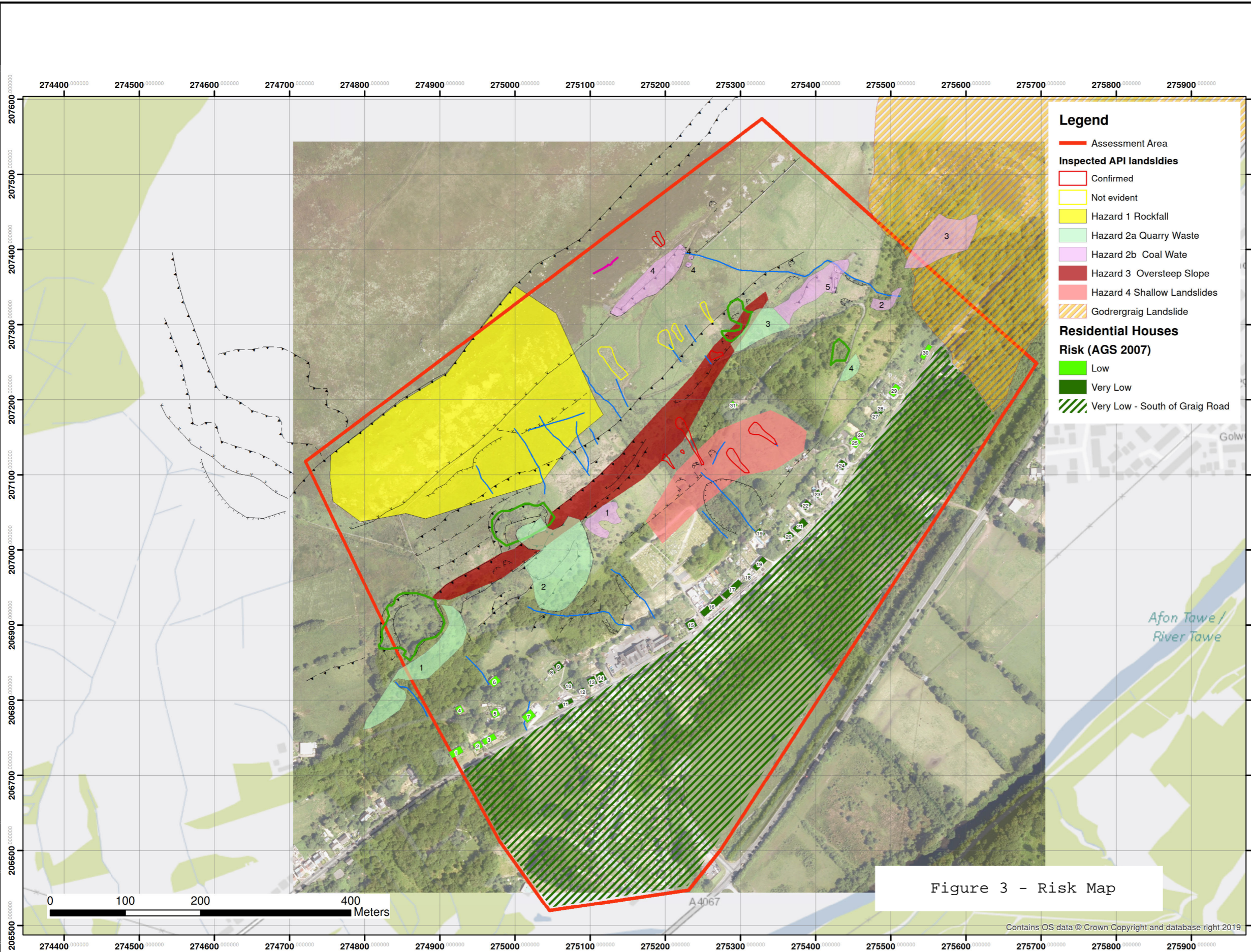
PROJECT:
Godre'r Graig Primary School
Godre'r Graig

FIGURE 2:
Investigation Point Plan

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Notes:

Risks to Cemetery visitors considered to be low. See report for details.



Legend

- Assessment Area
- Inspected API landslides**
- Confirmed
- Not evident
- Hazard 1 Rockfall
- Hazard 2a Quarry Waste
- Hazard 2b Coal Waste
- Hazard 3 Oversteep Slope
- Hazard 4 Shallow Landslides
- Godrergraig Landslide
- Residential Houses**
- Risk (AGS 2007)**
- Low
- Very Low
- Very Low - South of Graig Road

Figure 3 - Risk Map

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PROJECT:
 GODRE'R GRAIG VILLAGE, TAW
 VALLEY

Scale: AS SHOWN

FIGURE 3:
 INITIAL RISK MAP

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