

**Hastings Borough Council**  
**Undercliff West of St Leonards Parish Church**  
Geotechnical Slope Inspection Report  
March 2021



Results emerge  
when local knowledge  
intersects with  
global expertise

**Document Verification**

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Figure 1: Site Plan

## **Undercliff West of St Leonards Parish Church**

### Geotechnical Slope Inspection Report

## **1 INTRODUCTION**

Coffey Geotechnics (Coffey) have been requested by Hastings Borough Council (HBC) to undertake an inspection of the slope to the west of St Leonards Parish Church. A designated public right of way (DPROW) runs through the land connecting Undercliff at the toe of the slopes and West Hill Road at the crest.

This report should be read in conjunction with the Geotechnical Slope Inspection Report issued in May 2016 entitled "02594AA\_R\_001A MH inspection reportv3" (Coffey 2016). The 2016 report details information about the history of the site, history of instability, geology of the site and previous geotechnical assessments.

As reported previously the site comprises an area of sloping, densely vegetated land bounded to the north mainly by 18 and 19 West Hill Road. To the south of the site are residential flats (Victoria Court) and 69 to 71 Marina. Site levels fall from north to south and at the toe of the slope there are retaining walls belonging to the properties on the Marina. To the east is land that is maintained by St Leonards Parish Church and to the west is unkempt common land which is not owned by HBC.

The boundary and retaining walls at the site have in previous studies been defined as Walls A and to D. This nomenclature has been adopted for this study and two additional walls incorporated into this study have been defined as walls E and F. The locations of the walls are defined in Figure 1.

## **2 GEOLOGY**

A review of the 1:10,560 geology plan 'TQ70NE' indicates that the site is underlain by Wadhurst Clay which mainly comprises shaly clay with mudstone, thin ironstone layers and occasional sandstone bands (██████████, 2002). One of these sandstone bands is mapped to be present across the site and around the back of the church.

The Campbell Reith Hill ground investigation reported a thin veneer of made ground in some locations overlying soliflucted Wadhurst Clay. Below a depth of 2m to 3m below ground level the Wadhurst Clay was generally weathered mudstone with the degree of weathering decreasing with depth. The sandstone band was encountered in some of the exploratory holes.

## **3 HISTORY OF THE SITE AND SLOPE INSTABILITY**

The Coffey 2016 report provided a summary of the movements associated with the site since the church was constructed in 181. This summary was put together based on reports, correspondence and monitoring records provided by HBC and is presented below:

- 1831 - The church foundation was laid. It is likely that Wall D was constructed at the same time as the church.
- 1837 - Landslides occurred in the northern slopes behind the church.
- 1928 - The footpath and retaining walls were constructed.
- 1944 – The church destroyed by a flying bomb. It was reconstructed by 1953. Wall D was apparently not replaced at this time.
- Prior to 1981 a slip occurred which reportedly 'nearly buried the church vestry'. A section of retaining wall replaced at the back of the church. Distress was noted in all the retaining walls associated with the path.

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- 1982 - Wall A was reconstructed with a cantilevered reinforced retaining wall. Wall B was also reconstructed. Wall C was not replaced but was monitored.
- 1984 - 20 inches of movement recorded in the slope to the west of the church (slope retained by Wall D).
- October 1987 – Wall D failed. Shoring was put in place between the wall and the church to restrict further movement. The Clayton 1998 report postulates that inside the church there was a complimentary system of walings and shoring which occupied a considerable part of the floor area on the western side of the nave, The method of transferring load through the cavity of the west exterior wall of the church was not apparent. Tension cracks were noted in the adjacent south east facing slope.

## 4 SITE INSPECTION

On the 23<sup>rd</sup> November 2020, [REDACTED] and [REDACTED] of Coffey undertook an inspection to the west of St Leonards Parish Church. The slopes were observed to be heavily vegetated with areas of fly tipping present.

During the site inspection the weather was dry and cold. The Centre for Ecology and Hydrology (CEH) Hydrological Summary for November 2020 (CEH 2020) indicates that the reported rainfall from June 2020 to November 2020 in the Hastings area has been at a level of 90% to 110% of the 1981 to 2010 average. Thus, the area can be considered to have had an average rainfall period prior to the inspection.

Figure 1 presents an aerial photograph of the site with site observations.

### 4.1 Walls

#### 4.1.1 Wall A

Wall A is located on the south and eastern side of the footpath towards the top of the slopes. This wall retains the footpath and the land to the north and west. Construction joints between the individual sections of wall appeared to be displaced both laterally and longitudinally.

The displacement of the first joint downslope from West Hill Road was measured to have an offset of 30mm (with the northerly section offset to the east). During the 2016 inspection this joint did not show any signs of movement. Moving down the path multiple joint displacements were identified and these were between 10mm and 180mm with the largest offsets along the section of wall facing south (Photo 1). The south facing section of Wall A was typically offset to the south and the corner segment of the wall appeared to be displaced in a south-easterly direction.

During the 2016 inspection the wall foundations of Wall A were visible within the scarp of a landslide (see Figure 1). This could not be observed during the 2020 inspection due to the amount of vegetation cover on the slope.



**Photo 1. Wall A. Joint opening and rotating with a displacement of 100mm to the south.**

#### **4.1.2 Wall B**

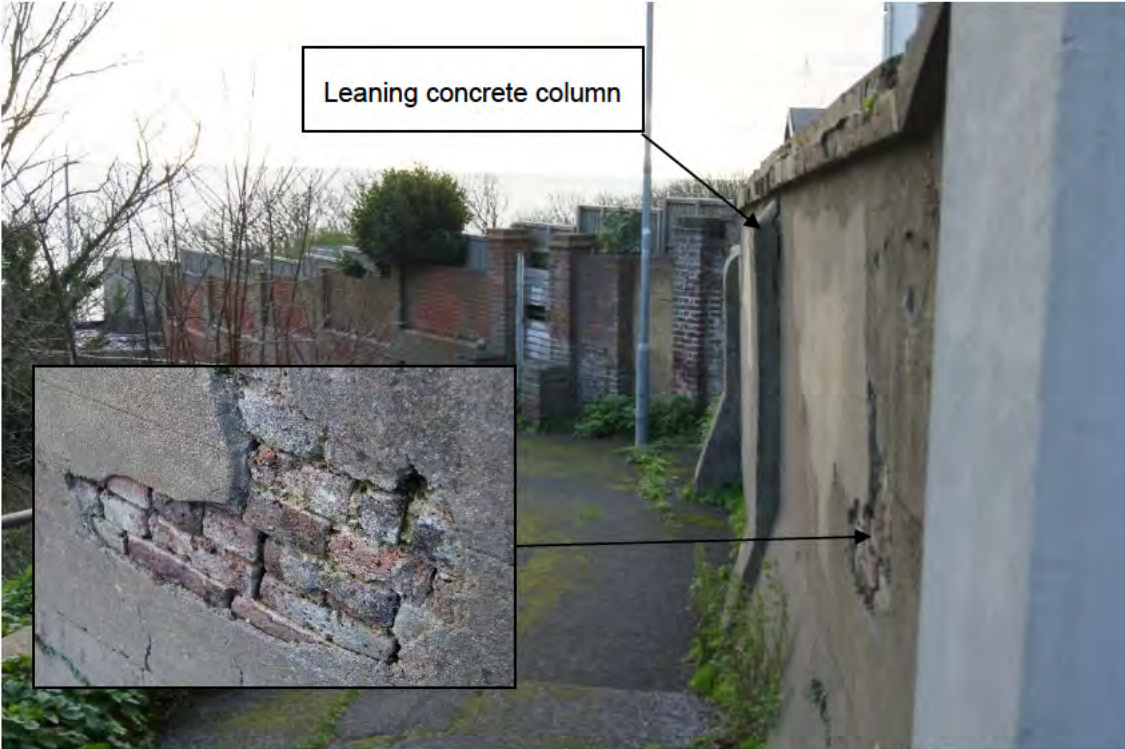
Wall B is located to the north and west of the footpath towards the top of the slopes and runs parallel to Wall A. Wall B is the boundary wall to the residential properties on West Hill Road to the west of the footpath. During the site visit it was unclear if the wall retained land to the north and west or if it was a free-standing boundary wall.

On the first section of Wall B (downslope from West Hill Road), which runs NE-SW, the wall appears to be constructed of bricks and faced with concrete which is supported by concrete columns (Photo 2). There are many visible cracks and the concrete facing appears to have broken off in some areas leaving exposed brickwork. The wall is also leaning outwards with one of the columns measuring 5° from vertical.

The southern face of Wall B is a brick wall which is leaning outwards at an angle of approximately 10° and appears to be buckling in the central section. The wall has an extensive network of cracks with some areas of brick being horizontally offset by at least 60mm (Photo 3). The displacement of the bricks at this location has extended to the far east corner of the wall since the inspection by Coffey in 2016 and the wall has deteriorated. The section of Wall B showed lateral displacement to the west and south plus rotation of the middle and upper parts of the wall to the south east.

The footpath in between Wall A and Wall B is showing significant signs of distress, particularly on the southern section (upslope of Wall C). Photo 7 shows what appears to be a tension crack running parallel to the slope.

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**Photo 2. Upper section of Wall B showing wall cracking and leaning outwards.**



**Photo 3. Southern face of Wall B showing extensive cracking and significant horizontal displacement of bricks.**

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#### 4.1.3 Wall C

Wall C is located on the north side of the footpath in the lower-mid section of the slope and is aligned in an east to west orientation. It appears to be formed of concrete and retains the sloping ground to the north.

The wall was observed to be leaning towards the south at a typical angle of 10° from vertical. There were several significant cracks observed which were up to 300mm wide. In some areas the handrail has become detached due to the movements exhibited by the wall (Photo 4). This area has not deteriorated significantly since the 2016 inspection.



**Photo 4. Large crack on Wall C. Broken railing can be seen on the right side of the photograph.**

#### 4.1.4 Wall D

Wall D is located adjacent to the west side of St Leonards Parish Church. The wall is leaning towards the church (to the east) and has broken up into 2 sections with a large opening in between up to 600mm wide (Photo 5). The wall is currently supported by timber walings and props off the west side of the church wall. The Clayton 1998 report postulates that inside the church there was a complimentary system of walings and shoring which occupied a considerable part of the floor area on the western side of the nave, The method of transferring load through the cavity of the west exterior wall of the church was not apparent.

No significant deterioration of this wall has occurred since the 2016 inspection.

It is obvious that this area is being inhabited as there were clothes and belongings found above the wall.



**Photo 5. Wall D leaning towards the church.**

#### **4.1.5 Wall E – Brick Facing / Retaining Wall below Wall A**

A 5m to 6m high retaining wall / brick facing was observed on the slopes between Wall A and the back of the church (Photo 5) during the 2016 inspection. Details of this retaining wall are unknown; however, based on Lidar provided for this area Wall E appears to comprise a series of arcuate retaining walls. Due to the vegetation cover these have only been partially viewed but it is expected that it extends all the way behind the church. It was inferred in the Clayton 1998 report (Clayton, 1998) that the slopes around St Leonards Church appear to be the degraded remnants of quarry slopes which may have been quarried for sandstone. This ties in with a mapped sandstone band shown on the 1:10,560 geology plan so it is considered likely the retaining walls may be related to the historic quarry. A previous failure occurred here in 1834 (Clayton 1998) and part of the retaining wall was replaced at the back of the church.

To the north west of the church some sections of a retaining wall were visible, and this may have formed the western extent of Wall E. This wall was showing signs of distress (Photo 6).



**Photo 6. Wall E exhibiting some cracking.**

#### **4.1.6 Wall F – Brick Facing / Retaining Wall Behind Garden**

This wall was not inspected due to access issues and heavy vegetation.

### **4.2 Footpath**

The footpath was visibly showing signs of distress through the whole site. This was the most visible on the east to west orientated section between Wall A and B (Photo 7) and the north west to south east orientated section below Wall C (Photo 8) where tension cracks were visible through the paving. Between the 2016 and 2020 inspections, the condition of the footpath has deteriorated with the tension cracks and differential settlement of the paving becoming more distinct.

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**Photo 7. Footpath located between Wall A and B orientated east to west.**



**Photo 8. Footpath adjacent to Wall C.**

## **4.3 Slopes**

### **4.3.1 Between Wall A and Wall D**

The slopes between Wall A and D were heavily vegetated therefore a detailed slope inspection could not be carried out. It was observed that the slopes are approximately south east facing and 40° near the crest, 30° mid-slope and shallowing to 5° immediately above Wall D.

In the previous inspection report (Coffey 2016) a scarp was identified on this slope measuring approximately 1.2m in height at the top of the slope. It was previously suggested that the foundations of Wall A had been undermined and were visible in the scarp. This was not observed in the 2020 inspection due to the increase in density of vegetation.

### **4.3.2 Between Wall A and Wall C**

The slopes between Wall A and Wall C are south facing and typically 40° shallowing to 25° above Wall C. The slopes are heavily vegetated with trees, ivy and brambles.

The ground was observed to be slightly hummocky which was reported previously in the 2016 inspection and was suggested to be associated with potential instability and/or soil creep within the Wadhurst Clays.

### **4.3.3 Below Wall C**

The slopes below Wall C are south facing and typically 40° shallowing to 10° above the flats below. This slope was heavily vegetated therefore difficult to fully inspect; however, there were no obvious signs of slope movement. As reported previously, given the instability on the adjacent areas of the site it is considered slope instability may have occurred.

At the base of this slope are retaining walls approximately 6m high which are at the rear of residential properties (apartment blocks). These were viewed from above and no signs of instability were observed.

## **4.4 West Hill Road**

Numerous signs of instability were identified on West Hill Road which is situated above the site. These included multiple cracks in the road itself (Photo 9) and within the wall forming the West corner of the junction with Archery Road (Photo 10). The cracks in the road surface were not observed during the inspection in 2016 and the cracks in the walls appear to be more pronounced.

It is possible that these are associated with the overall movement occurring on the slopes at St Leonards

Photo 9 shows that the grid at the junction is silted up and indicates that the drainage above the site is not functioning adequately. It is recommended that a drainage survey in this area and through the site is undertaken with all drainage inspected and cleared out where it is observed to be functioning inadequately.

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**Photo 9. Cracks and silted up drain visible in the road forming the junction between West Hill and Archery Road.**



**Photo 10. Cracks visible in the wall forming the junction between West Hill and Archery Road.**

## 5 ONGOING MONITORING

From communication with HBC (G Thorp 2021, personal communication, 13<sup>th</sup> January) it is understood that monitoring has been undertaken of some of the walls in this area; however, we have not seen the results with the exception of Table 1.

On 15<sup>th</sup> December 2020, Andy Brown of Hastings council took readings of all the crack monitors installed at the site. The readings recorded of the brick boundary wall (Wall B) monitors (Table 1) showed significant movement of the crack over a seven-month period between May and December 2020. It is understood Andy Brown contacted East Sussex Highways Structures and advised they should make a site visit and take the appropriate action, if necessary, for Health and Safety reasons. Building Control was also contacted with regards to the wall being a dangerous structure.

**Table 1. Reading of monitors across one of the cracks on Wall B**

Date	6/07/18	18/12/18	23/04/19	16/09/19	15/05/20	15/12/20
Upper Monitor	109.62	112.11	111.55	112.53	113.50	121.47
Lower Monitor	104.08	107.00	106.30	107.23	107.40	110.75

\* It is assumed that the readings are in mm.

On the 17<sup>th</sup> December 2020 the footpath was closed by East Sussex Highways due to the deterioration of Wall B. Discussions between them and the property owner indicate that remedial works will be undertaken on the wall in early 2021. It should be noted that whilst the replacement of the wall will remove the immediate risk to persons accessing the footpath, the instability present at the site will continue to adversely affect the walls and slopes in this area.

## 6 CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Conclusions

Comparing the findings of this site inspection and our previous site inspection there are signs of significant movement within the upper slopes (Walls A and B, the upper part of the footpath, the slopes between Wall A, West Hill Road and the church). The lower slopes (lower part of the footpath, slopes below Wall C and the residential apartment blocks at the toe of the slope) have not changed significantly since the 2016 inspection; however, it is observed that movement is still ongoing.

During the 2020 inspection the majority of the slope was heavily vegetated obscuring access and inspection; therefore, there could be other features of instability present that were not visible.

Following on from what has been reported previously it would appear that there are two main mechanisms of failure. On the south east facing slope the landsliding is likely to be relatively deep seated and potentially circular and could be potentially extending as far as West Hill Road (based on the 2020 observations of the cracks developing in the wall and on the road surface). As the retaining walls behind the church (Wall E) have not been inspected during 2016 or 2020, it is not possible to say if these walls supporting West Hill Road are functioning adequately. It is recommended that vegetation be cleared off

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these walls to allow a structural inspection. The south facing slope is considered to be undergoing shallower more translational failure (likely within the soliflucted Wadhurst Clay), but this would need to be confirmed with further investigation.

The potential significant risks associated with the site are given below:

- The ground movement could lead to failure of the walls, with the south east corner of Wall B appearing to be in the worst condition at the time of the inspection. It is considered that failure of Wall B poses a high risk to users of the path. It is understood that the footpath has been closed due to the risk posed by this wall.
- The slope below Wall C is likely to be marginally stable. Significant instability of this slope would pose a moderate to high risk to the properties below.
- Wall A is of marginal stability and it is considered that currently the wall poses a low to moderate risk to users of the path. However, it is likely that the wall will continue to deteriorate as the slope continues to move below it and the consequential risk will be greater as it becomes undermined.
- Wall C is of marginal stability and it is considered that currently the wall poses a low to moderate risk to users of the path. However, it is likely that the wall will continue to deteriorate and the consequential risk will be greater.
- Wall D and the slope above are marginally stable and are being supported by a system of braces onto and through the church wall. The long-term effectiveness of this system and its influence on the structure of the church needs to be investigated and assessed. It is considered that the wall currently poses a low risk to users of the path and a high risk to the church and persons accessing the slope in this area (noted that homeless appeared to be using the top of the wall as a resting place).
- Failure of the Wall D buttressing is likely to result in further instability in the slope above. This may result in undermining, and ultimately, failure of the Walls A and B. This is currently considered to pose a low risk to the users of the path; however, if the Wall D buttresses deteriorate or fail the risk to users of the path and the properties above is likely to be high.
- The condition of Walls E and F could not be determined. Nevertheless, from site observations it is considered that failure of these walls is likely to pose a high risk to the users of the path, the church, West Hill Road and the residents in the properties to the south of the site.

In addition to the above it should be appreciated that features / hazards may be present which have not been observed due to the extent of the vegetation cover. The features that were observed give an indication of the nature of the slope and likely hazards expected to be present on site.

## 6.2 Recommendations

Following the 2020 inspection there are a number of recommendations that should be implemented as soon as practicable, and these are as follows:

- Prevent access to the slopes surrounding Wall D and around the church, where it was observed that people were using it as an area to rest.
- Undertake a drainage inspection of the site and the area to the north (West Hill Road and Archery Road). Clear and maintain all drainage to ensure it is functioning adequately. Given the significant role water plays in landslide activity this is considered of high importance.

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- Do not reopen the footpath until the south east corner of Wall B is replaced. Any reopening should be agreed with HBC and East Sussex Highways and inspected by a structural engineer..
- Remove vegetation from Wall E to allow an inspection of the retaining walls that support West Hill Road above the site.
- Remove vegetation from the top section of the slope between Wall A and Wall D to allow an inspection of the foundations of Wall A as they are becoming exposed by movement of the soil below.

In addition to the recommendations above, it is considered that there are two options for risk reduction; on-going monitoring and management; and remediation of the slopes, as follows.

#### 6.2.1 Option 1: Monitoring and Management

As a minimum it is recommended that monitoring of the slopes and the walls is undertaken. This could be achieved through continued regular measurement of the movement of the walls, visual inspection of the slopes and the installation of inclinometers in the most critical / unstable sections of the site.

It is understood that monitoring using demec studs installed either side of cracks in the retaining walls (Wall A and Wall B), is undertaken twice a year by HBC. It is recommended that in addition to monitoring of the cracks already undertaken by HBC, survey points be installed at set locations on each wall and slope, with an absolute survey point installed off-site on stable ground. This will allow the slope movements to be mapped and determine the rate and direction of movement for each part of the site. This survey should be undertaken annually.

Visual inspections of the slopes and walls should be undertaken annually; however, given the density of the vegetation, features that are indicative of slope failure may be masked. It is recommended that vegetation clearance be undertaken prior to visual inspection of the slopes and retaining walls.

As discussed in our 2016 report (Coffey 2016), borehole inclinometers would provide data on the depth and rate of movement of the slopes. We would recommend these are installed on the slope between Wall A and Wall D, the slope between Wall A and C, and below Wall C.

As discussed above access to the footpath should be restricted until Wall B has been repaired, and access to the area around Wall D and the church should be prevented.

#### 6.2.2 Option 2: Remediation

In the Coffey 2016 inspection report a review was undertaken of the 2002 [REDACTED] slope stability report and we were in general agreement with most of the proposed remedial measures.

Given the amount of time since the design was undertaken in 2002 and the continued deterioration of the walls it is recommended that a review of the [REDACTED] proposals is undertaken. This should incorporate the following actions:

- A review of the ground investigation to ensure that the ground conditions are sufficiently understood.
- An assessment of the impact of the proposals, in particularly the soil nailing, on the vegetation on site.
- Investigation and assessment of the drainage on site and within local vicinity that may affect the stability of the slopes.
- A review of the proposed gabion walls to ensure that the walls comply with current design guidelines.

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- An assessment of the short-term stability during construction and temporary works where the profile of the slope is likely to change e.g. where excavations are required for gabion walls.
- Value engineering of the proposed remedial measures to ensure construction and whole life costs are optimised.

## **REFERENCES**

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## Figures

