

Geotechnical Technical Note June 2022

Project Name: Land at Worcester Lane, Stourbridge
Project No: 220903
Revision: P01
Reference: WLS-BWB-ZZ-XX-RP-CE-0001_GTN
Prepared by: N Gorst
Reviewed by: H Rehman

Introduction

Report purpose

BWB Consulting Ltd (BWB) was instructed by The Feoffees of Old Swinford Hospital (the Client) to prepare this document in order to provide an assessment as to whether a railway cutting to the west of a site proposed for residential development will represent a constraint to development of the site. The site, which has a National Grid Reference of SO 9054 8142 and an approximate post code of DY9 0XY, is an agricultural field located on land at Worcester Lane, Stourbridge and the site location is shown outlined in red in **Figure 1** below.

Figure 1: Site Location



Review of Publicly Available Information

History and Setting

A review of historical maps (starting from 1888 up to the present) seems to indicate that there has been no development on the site. On the six-inch OS County Series map dated 1888, a footpath is shown crossing the subject site from the north-east corner to the south-west corner, where a footbridge crosses the railway line. However, **Figure 1** indicates the presence of a pipeline crossing the railway line at the north-west corner of the site. The purpose of the pipeline and its alignment through or adjacent to the subject site are unknown.

The site is bounded by agricultural land to the north and south, a highway (Worcester Lane) to the east and the Worcester to Birmingham railway line (OWW) to the west.

An aerial photograph (see **Figure 2**) confirms the presence of the pipeline and footpath. It is also readily discernible that further to the north of the subject site residential development has occurred adjacent to the railway line.

Figure 2: Aerial Photograph of Site and Surrounding Area



(Bing aerial mapping, acquired through BWB's Holebase licence.)

A review of freely available online mapping indicates that the site is located in an area at potentially low risk of unexploded Ordnance (UXO) based on bombing during WWII.

Geology

A preliminary review of geological mapping indicates that Superficial deposits are absent across the site. Bedrock geology comprises the Helsby Sandstone Formation, which is classified as being a Principal Aquifer. The Helsby Sandstone Formation is a sedimentary rock of fluvial origin. It is detrital, ranging from coarse- to fine-grained material and forms beds and lenses of deposits reflecting the channels, floodplains and levees of a river

Inspection of four historical exploratory hole records (see **Appendix 1**) obtained from the British Geological Survey (BGS) and located just to the south of the subject site record the presence of topsoil, weathered sandstone and then un-weathered sandstone (described as Bromsgrove

Sandstone in the logs), confirming the published BGS geology. The information contained in Appendix 1 is delivered under the Open Government Licence and contains British Geological Survey materials © UKRI 2022.

The ground conditions encountered to the immediate south of the site are summarised in the following **Table 1**.

Table 1: Summary of Ground Conditions

| Lithology | Top Depth (m) | | Base Depth (m) (Proved) | | Thickness (m) | |
|--|---------------|---------|----------------------------|---------|---------------|---------|
| | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum |
| Topsoil | 0.0 | 0.0 | 0.23 | 0.50 | 0.23 | 0.50 |
| Helsby Sandstone Formation (weathered) | 0.23 | 0.50 | 1.00 | 2.00 | 0.65 | 1.70 |
| Helsby Sandstone Formation (un-weathered) | 1.00 | 2.00 | 3.10 * | 10.69 * | >2.00 | >8.79 |

Note: * Base of lithology not proven.

Groundwater Conditions

Groundwater was not encountered in any of the historical exploratory holes. It is not anticipated that groundwater will be problematic to slope stability, unless further ground investigation works prove otherwise.

Topography

A crude inspection of the topography of the subject site using Google Earth indicates that the western boundary, i.e., the crest of the OWW railway cutting, is approximately 10m above the toe of the railway cutting. It is estimated that the plan distance from crest to toe is approximately 12m. However, the exact geometry of the cutting slope is unclear, although it is anticipated, from inspection of the historical exploratory hole records, that the majority of the cutting comprises unweathered Helsby Sandstone Formation.

A second crude inspection of topography to the north of the subject site, where residential development has occurred adjacent to the OWW railway line, indicates that the height of the railway cutting is approximately 6m over a plan distance of approximately 12m.

Preliminary Slope Stability Assessment

Without a ground investigation along the western boundary of the subject site, a visual inspection of the railway cutting slope and a topographical survey it is not possible to give a definitive assessment of the likely impact of the railway cutting on the proposed residential development.

Access to the railway line will likely not be available, i.e., without a possession, to inspect the eastern cutting slope and carry out a topographical survey. However, a remote visual inspection could be carried out from the footbridge which crosses the railway, situated at the south-west corner of the subject site. In addition, it might be possible to obtain Network Rail asset management data for the slope, i.e., the results of soil and/or rock slope inspections

carried out by Network Rail or its contractors, which may supply a combination of geological and topographical information.

Currently, there is no readily available evidence of slope failures on the cutting slopes on the OWW railway line in the vicinity of the subject site. Taking into account the proximity of a residential development to the north of the subject site, where the railway cutting is estimated to be 7m deep in similar geology to that of the subject site, and that the foundations for the pipeline and footbridge on the western boundary of the subject site are at crest level, it is considered that, unless the foundations for the pipeline and footbridge needed to be piled, it is unlikely that the presence of the OWW railway cutting will impact on the proposed residential development negatively.

Network Rail will request a stand-off distance to structures, which is a minimum of least 2m (3m for overhead lines and third rail) from Network Rail's boundary. Additionally, structures should not place additional load on cuttings. This might pose a constraint to the layout of the proposed development layout but could be circumvented easily if back gardens are adjacent to the cutting slope.

Global stability analyses will need to be undertaken for the existing cutting slope(s) once the detailed designs have been developed for the residential development.

Appendix 1: Historical Exploratory Hole Records

Norwest Holst Soil Engineering Ltd.

Trial Pit No.
1/105

Trial Pit No.
1/106

Contract No. F8656
 Location: WOL. GL. Contract No. 1. KBH Bypass
 Dept. of Transport
 Construction Plant 428. CAT. 4. X. 4.
 Dimensions (l x b x h)

TRIAL PIT LOG

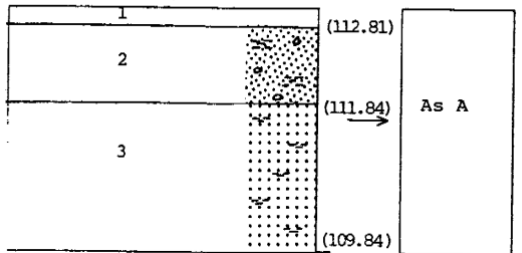
Co-ords
 E 390695.5
 N 281395.0

Ground Level 113.04 m.A.O.D.
 Date 2/12/89

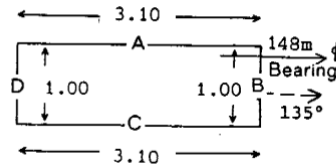
0 m.A.O.D.
 9

5099SW/503
 90.00/100

ELEVATIONS:— (Reduced level)
 (Not to scale)

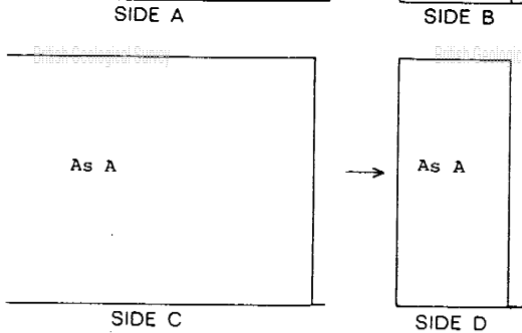


PLAN (Not to scale)



SAMPLES

| No. & Type | Depth m. |
|------------|----------|
| B | 0.50 |
| B | 1.50 |
| B | 2.70 |
| | |
| | |
| | |
| | |
| | |
| | |



| Depth m. | STRATA DESCRIPTION | Cv/Cp kN/m ² | Cv/Cp kN/m ² |
|----------|---|-------------------------|-------------------------|
| 0.00 | | | |
| 0.23 | TOPSOIL | | |
| 0.23 | Red brown clayey medium to coarse SAND with occasional weakly cemented gravel and cobble size sandstone fragments and occasional cobble size clay fragments. (Weathered BROMSGROVE SANDSTONE) | | |
| 1.20 | | | |
| 1.20 | Light red brown moderately weathered clayey medium to coarse SANDSTONE, weak, with occasional cobble size mudstone fragments and some fine to coarse gravel size clay pockets. (BROMSGROVE SANDSTONE) | | |
| 3.20 | 2.60m - becoming light brown with many fine to medium gravel size clay pockets and occasional subrounded coarse quartz gravel. | | |

Note: E = Centreline
 () = m.A.O.D.

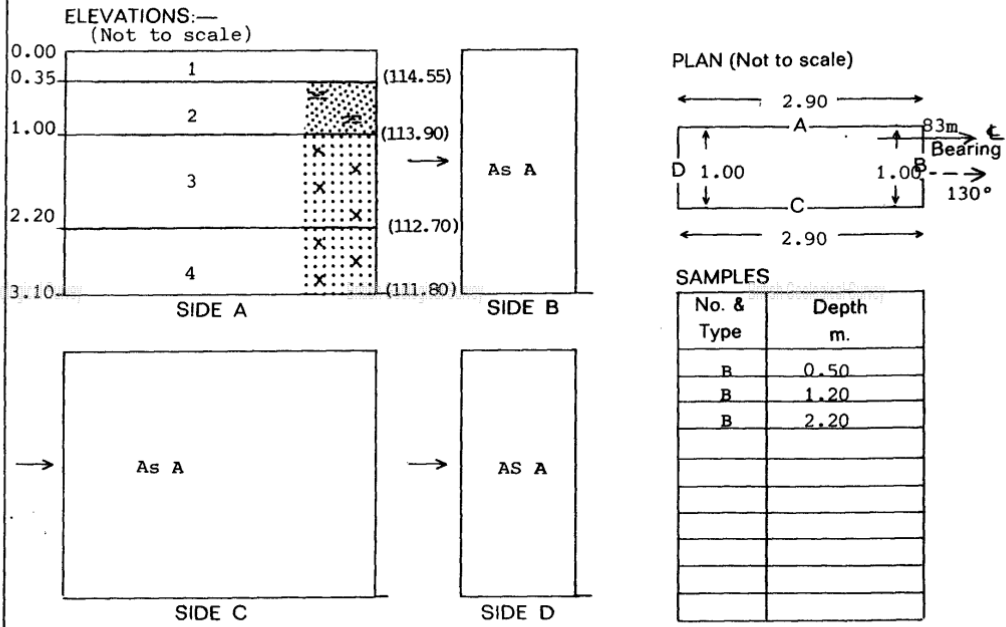
S Cv/Cp: Approximate value of undrained shear strength from hand vane/penetrometer
 Groundwater: Dry
 Pumping:
 Supports/Stability: Sides stable

Norwest Holst Soil Engineering Ltd.

Trial Pit No.
1/106

Contract No. F8656
TRIAL PIT LOG
 Location WOR. GI. Contract No. 1 KBH Bypass
 Client Dept. of Transport
 Excavation Plant CAT 428
 Dimensions (l x b x h) 2.90 x 1.00 x 3.10m

Co-ords
 E 39073 9.0
 N 281348 5
 Ground Level 114.90 m.A.O.D.
 Date 2/12/89



| No. | Depth m. | STRATA DESCRIPTION | Cv/Cp kN/m ² |
|-----|--------------|---|-------------------------|
| 1 | 0.00 0.35 | TOPSOIL | |
| 2 | 0.35 1.00 | Dark red brown clayey fine to medium SAND, (Weathered BROMSGROVE SANDSTONE) | |
| 3 | 1.00 2.20 | Yellow brown mottled red brown moderately weathered silty medium to coarse SANDSTONE with occasional mudstone cobbles. (BROMSGROVE SANDSTONE) | |
| 4 | 2.20 3.10 | Red brown mottled black moderately weathered silty medium to coarse micaceous SANDSTONE, very weak, with many fine to coarse gravel size clay pockets. (BROMSGROVE SANDSTONE) | |

Note: E = Centreline
() = m.A.O.D.

NOTES Cv/Cp: Approximate value of undrained shear strength from hand vane/penetrometer
 Groundwater: Dry
 Pumping:
 Supports/Stability: Sides stable

Norwest Holst Soil Engineering Ltd.

Borehole No.
1/110

Contract No. F8656
 Location WOR GI Contract No.1 KBH Bypass
 Client Dept. of Transport
 Method of Boring Cable Percussion Rotary Coring
 Diameter of Borehole 150/121mm

Co-ords: E390433.5 N281338.0
 Sheet 1 of 2
 Chainage
 Ground Level 112.80 m.A.O.D.
 Date 5/6/12/09 & 11/1/09

| Description of Strata | Legend | Depth Below G.L. (m) | O.D. Level (m) | Casing Depth at Sampling | Sampling and Coring | "N"/R.Q.D.% | Daily Progress |
|---|--------|----------------------|----------------|--------------------------|------------------------------------|--------------|----------------|
| TOPSOIL | | 0.30 | 112.50 | | | | |
| Mixed brown and red brown fine and medium SAND | | 1.00 | 111.80 | 150mm to 1.50m | 0.50-1.00 | | |
| Very dense red brown silty fine and medium SAND locally very weakly cemented. | | 2.00 | 110.80 | 5/12 150mm to 2.20m 11/1 | 1.00-1.25 1.00-2.00 s | 85 for 150mm | 5/12 |
| Red brown occasionally mottled pale green fine to medium grained completely weathered locally silty SANDSTONE, recovered as slightly silty fine to medium sand. (BROMSGROVE SANDSTONE) Discontinuities: (1) 0-15° smooth to slightly rough planar closely spaced. (2) 20° slightly rough, irregular (3) 80-85° smooth to rough irregular, locally closely spaced. ...2.90 becoming thinly laminated, highly weathered very weak to strong ...3.25 becoming slightly weathered, moderately weak to moderately strong ...4.00-4.12 soft to firm red brown gravelly silty clay. ...4.75 locally medium and coarse, strong. ...4.77-4.80 soft red brown gravelly silty clay. | | 6.00 | 106.80 | F.I. (£/m) NI | TCR SCR RQD (%) (%) (%) 72 15 0 | | 6/12 |
| Red brown fissured completely weathered silty MUDSTONE, recovered as firm red brown gravelly silty clay (BROMSGROVE SANDSTONE) | | 6.25 | 106.60 | 15 | 3.25 | | |
| Red brown medium to coarse grained thinly laminated slightly weathered SANDSTONE, strong with some thin bands of coarse slightly weathered calcareous sandstone, very strong. (BROMSGROVE SANDSTONE) Discontinuities: (1) 10-35° smooth, stepped planar to curved, closely spaced. (2) 0-10° smooth planar, very closely to medium spaced. (3) 55° smooth undulating ...7.95 occasional fine gravel size mudstone clasts. | | 6.25 | 106.60 | 11 | 68 46 0 | | |
| Red brown light grey and white mottled coarse grained thickly laminated, slightly weathered conglomeratic calcareous SANDSTONE, strong to very strong. (BROMSGROVE SANDSTONE) Discontinuities: (1) 0-5° smooth planar very closely to medium spaced. (2) 20-25° smooth, stepped planar, widely spaced. | | 6.25 | 106.60 | 11 | 100 78 63 | | |
| | | 9.80 | 103.00 | 12 | 84 75 37 | | |
| | | | | 10 | 7.77 | | |
| | | | | 10 | 100 79 66 | | |
| | | | | | 9.25 | | |
| | | | | 12 | 88 88 60 | | |

| | |
|---|--|
| <p>Type of Sample</p> <p>Is S.P.T. <input type="checkbox"/> Undisturbed</p> <p>Ic C.P.T. <input checked="" type="checkbox"/> Vane</p> <p>O Jar <input type="checkbox"/> Water</p> <p>● Bulk <input type="checkbox"/> Piezometer</p> | <p>Remarks (Observations of Ground Water etc.) * Seating blows only NP - No Penetration</p> <p>PWF barrel with mylar, air and water flush, full returns. No groundwater observed Water added to assist boring from 0.50m Chiselling Hard Strata from 2.10 to 2.20m for 1 hour. Slotted standpipe installed to base of hole on completion.</p> <p>! see preliminary data sheet 1 and report text, re classification and logging system ! Log to be read in conjunction with the relevant core photograph</p> <p>Water levels are subject to seasonal or tidal variations and should not be taken as constant</p> |
|---|--|

Norwest Holst Soil Engineering Ltd.

Borehole No.
1/110

BOREHOLE LOG

Contract No. F8656
 Location H08, GI, Contract, No. 1, KBL, Bypass
 Client Dept. of Transport
 Method of Boring Cable Percussion/Rotary Coring
 Diameter of Borehole 150/121mm
 Co-ords: E390433.5 N281338.0
 Sheet 2 of 2
 Chainage
 Ground Level 122.80 m.A.O.D.
 Date 5-6/12/89 & 11/1/90

| Description of Strata | Legend | Depth Below G.L. (m) | O.D. Level (m) | Casing Depth at Sampling | Sampling and Coring | "N"/R.Q.D.% | Daily Progress |
|---|--------|----------------------|----------------|--------------------------|---------------------|-------------|----------------|
| Red brown light grey and white mottled coarse grained thickly laminated, slightly weathered conglomeratic calcareous SANDSTONE, strong to very strong. (BROMSGROVE SANDSTONE) Discontinuities: (1) 0-5° smooth planar very closely to medium spaced. (2) 20-25° smooth, stepped planar, widely spaced. Borehole complete at 10.17m | | 10.17 | 102.70 | | 10.17 | | 11/1 |

| Type of Sample | Remarks (Observations of Ground Water etc.) |
|--|--|
| Is S.P.T. <input type="checkbox"/> Undisturbed Ic C.P.T. <input checked="" type="checkbox"/> Vane 0 Jar <input type="checkbox"/> Water ● Bulk <input type="checkbox"/> Piezometer | # see preliminary data sheet 1 and report text, re classification and logging system. # Log to be read in conjunction with relevant core photograph Water levels are subject to seasonal or tidal variations and should not be taken as constant |

Norwest Holst Soil Engineering Ltd.

Borehole No.
1/111

Contract No. F8656

BOREHOLE LOG

Location... WOR GI Contract No.1 KBH Bypass

Co-ords:
E390430.5
N281308.5

Sheet... 1 ... of ... 2

Client... Dept... of Transport

Chainage.....

Method of Boring... Cable Percussion/Rotary Coring

Ground Level... 111.70 m.A.O.D.

Diameter of Borehole... 150/121mm

Date... 8/12/89 & 9-10/1/90

50985W/431


| Description of Strata | Legend | Depth Below G.L.(m) | O.D. Level (m) | Casing Depth at Sampling | Sampling and Coring | "N"/R.Q.D.% | Daily Progress |
|---|--------|---------------------|----------------|--------------------------|-------------------------------------|---------------------------|----------------|
| TOPSOIL | | 0.50 | 111.20 | | | | |
| Mixed brown and red brown fine to medium SAND with occasional grey silty bands. | * * * | 1.10 | 110.60 | 150mm to 1.50m 6/12 | 0.50-1.00 1.00-1.45 1.00-1.90 | "100" | |
| Very dense red brown fine and medium SAND, locally very weakly cemented. | ••••• | 1.90 | 109.80 | 125mm to 2.60m 10/1 | 1.90-1.95 2.00 | 50* for 75mm 50 for NP | 6/12 |
| Interbedded reddish brown, medium and coarse slightly weathered SANDSTONE, strong slightly calcareous below 2.30 and light reddish brown coarse slightly weathered calcareous, slightly conglomeratic SANDSTONE, strong to very strong locally moderately strong, poorly cemented (BRMSGROVE SANDSTONE) | ••••• | | | F.I. (£/m) 9 | TCR (%) 90 | SCR (%) 90 | RQD (%) 56 |
| Discontinuities: (1) 0-5° smooth to slightly rough planar to irregular, very closely to medium spaced, occasionally associated with fragmented core. (2) 10°-15°, slightly rough planar to undulose, locally closely spaced. (3) 30°, smooth undulose (4) 90°, very closely spaced. | | | | 4 | 3.19 | 100 | 100 |
| | | | | 2 | 4.56 | 94 | 93 |
| | | | | 6 | 6.19 | 99 | 95 |
| | | | | 9 | 7.67 | 98 | 98 |
| Light red brown coarse slightly weathered calcareous slightly conglomeratic SANDSTONE, strong to very strong with occasional grey white bands and some thin beds of medium and coarse sandstone poorly cemented. (BRMSGROVE SANDSTONE) | ••••• | 7.50 | 104.20 | | | | |
| Discontinuities: (1) 0°-10°, slightly rough irregular occasional coarse sand in fill, closely to medium spaced. (2) 20°-25°, smooth stepped irregular to undulating medium spaced. | | | | 7 | 9.19 | 99 | 98 |

| Type of Sample | Remarks (Observations of Ground Water etc.) |
|-------------------------|--|
| Is S.P.T. ■ Undisturbed | PWF barrel with mylar, air flush, full returns No groundwater observed Chiselling Hard Strata 1.95-2.00m, 1 hour Borehole grouted on completion * see preliminary data sheet 1 and report text, re classification and logging system. * Log to be read in conjunction with the relevant core photograph Water levels are subject to seasonal or tidal variations and should not be taken as constant |
| Ic C.P.T. x Vane | |
| 0 Jar △ Water | |
| ● Bulk ■ Piezometer | |

Norwest Holst Soil Engineering Ltd.

Borehole No.
1/111

Contract No. F8656 **BOREHOLE LOG** Sheet...2...of...2...
 Location...WOB.GI.Contract.No.1.KBU.Bypass, Co-ords: E390430.5 Chainage.....
 Client...Dept...of Transport..... N281308.5 Ground Level...111.70 m.A.O.D.
 Method of Boring Cable Percussion/Rotary Coring Date...5/12/99 & 9-10/1/99
 Diameter of Borehole...150/121mm *2005 S0785/143*

| Description of Strata | Legend | Depth Below G.L.(m) | O.D. Level (m) | Casing Depth at Sampling | Sampling and Coring | "N"/R.O.D.% | Daily Progress |
|--|---|---------------------|----------------|--------------------------|---------------------|-------------|----------------|
| Red brown coarse slightly weathered calcaceous slightly conglomeratic SANDSTONE, strong to very strong with occasional grey white bands and some thin beds of medium and coarse sandstone poorly cemented. (BROMSGROVE SANDSTONE) |  | 10.69 | 101.00 | | 10.69 | | 10/1 |
| Borehole complete at 10.69m | | | | | | | |

| Type of Sample | Remarks (Observations of Ground Water etc.) |
|--|--|
| Is S.P.T. <input type="checkbox"/> Undisturbed Ic C.P.T. <input checked="" type="checkbox"/> Vane O Jar <input checked="" type="checkbox"/> Water ● Bulk <input checked="" type="checkbox"/> Piezometer | ■ see preliminary data sheet 1 and report text, re classification and logging system. ■ Log to be read in conjunction with relevant core photograph Water levels are subject to seasonal or tidal variations and should not be taken as constant |